APPLICATION FOR HCAI PREAPPROVAL OF MANUFACTURER'S CERTIFICATION (OPM)

OFFICE USE ONLY

APPLICATION #: OPM-0052

HCAI Preapproval of Manufacturer's Certification (OPM)

Type: ☐ New ☒ Renewal/Update

Manufacturer Information

Manufacturer: Eaton's B-Line Series

Manufacturer's Technical Representative: Bret L. Eilerman

Mailing Address: 509 West Monroe Street, Highland, IL 62249

Telephone: (618) 250-9407 Email: BretEilerman@Eaton.com

Product Information

Product Name: BLine

Product Type: Seismic bracing and hangers

Product Model Number: Various

General Description: Seismic bracing for Mechanical, Electrical, Plumbing and Fire Protection systems, hangers, strut, Cable, structural attachments and various non-structural supports

Applicant Information

Applicant Company Name: Eaton's B-Line Series

Contact Person: Bret L Eilerman

Mailing Address: 509 West Monroe Street, Highland, IL 62249

Telephone: (618) 250-9407 Email: BretEilerman@Eaton.com

Title: Engineering Supervisor

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

Registered Design Professonal Preparing Engineering Recommendations

Company Name: MRH Structural Engineers, Inc.

Name: Mohammad Hariri California License Number: S3545

Mailing Address: 3400 Irvine Ave, Suite 101, Newport Beach, CA 92660

Telephone: (714) 633-6302 Email: mrh@mrhse.com

HCAI Special Seismic Certification Preapproval (OSP)

☐ Special Seismic Certification is preapproved under OSP OSP Number:

Certification Method

Testing in accordance with: ☐ ICC-ES AC156 ☒ FM 1950-16

☒ Other(s) (Please Specify): FM 1950-10

*Use of criteria other than those adopted by the California Building Standards Code, 2022 (CBSC 2022) for component supports and attachments are not permitted. For distribution system, interior partition wall, and suspended ceiling seismic bracings, test criteria other than those adopted in the CBSC 2022 may be used when approved by HCAI prior to testing.

☒ Analysis

☐ Experience Data

☒ Combination of Testing, Analysis, and/or Experience Data (Please Specify): Test Reports, Drawings, Calculations

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HCAI Approval

Date: 4/24/2025

Name: Roy Lobo Title: Principal Structural Engineer

Condition of Approval (if applicable):

TOLCO Seismic Bracing Solutions

HCAI PRE-APPROVAL OF
MANUFACTURERS CERTIFICATION

OPM-0052-22

Seismic Restraint Systems Guidelines

2022 CALIFORNIA BUILDING CODE (2022 CBC)

Features Eaton's TOLCO™ Seismic Bracing Solutions
and B-Line Series Support System Solutions

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REGISTERED PROFESSIONAL ENGINEER
MOHAMMAD R. HARIRI
NO. 3545
STRUCTURAL
STATE OF CALIFORNIA

04/23/2025

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ABBREVIATIONS & NOMENCLATURES

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ABBREVIATIONS

AB	Anchor Bolt
ABV	Above
ACD	Amended Construction Document
ACI	American Concrete Institute
ALT	Alternate
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASD	Allowable Stress Design
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing And Materials
ATR	All Threaded Rod
B	Bottom
BA	Brace Angle
BLK'G	Blocking
BM	Beam
BOTT	Bottom
BTWN	Between
CAC	California Administrative Code
CBC	California Building Code
CD	Construction Document
CJP	Complete Joint Penetration
CL (℄)	Center Line
CLR	Clear
COL	Column
CONC	Concrete
CONN	Connection
CONT'D	Continued
CPC	California Plumbing Code
CS	Carbon Steel
DBL	Double
DIA. (ø)	Diameter
DIAG	Diagonal
DIM	Dimension
DRWGS	Drawings
DWL	Dowel
EA.	Each
ED.	Edge Distance
e.g.	For Example
EMBED	Embedment
EMT	Electrical Metallic Tubing
EQ.	Equal
EQUIP	Equipment
ESR	Evaluation Service Report
ETC	Etcetra
FEMA	Federal Emergency Management Agency
FIG.	Figure
FM	Factory Mutual
FP	Fire Protection
FT.	Foot, Feet

F.S.	Far Side
FW	Fillet Weld
GA	Gage or Gauge
GALV	Galvanized
HCAI	Department of Health Care Access Information
HHCS	Hex Head Cap Screw
HHN	Hex Head Nut
HNGR	Hanger
HORIZ	Horizontal
HSB	Horizontal Seismic Brace
HSS	Hollow Structural Section
HT	Height
ICC	International Code Council
ID	Inside Diameter
IMC	Intermediate Metal Conduit
IN	Inch
INFO	Information
L	Angle or Angle Iron
LBS	Pounds
LLH	Long Leg Horizontal
LLV	Long Leg Vertical
LONGIT	Longitudinal
LS	Lag Screw
LSH	Long Side Horizontal
LSV	Long Side Vertical
LWC	Light-Weight Concrete
MAX.	Maximum
MB	Machine Bolt
MD	Metal Decking
MECH'L	Mechanical
MEP	Mechanical/Electrical/Plumbing
MFR	Manufacturer
MIN.	Minimum
MS	Metal Stud
MSW	Metal Stud Wall
MTL	Metal
NFPA	National Fire Protection Association
NO.	Number
N.S.	Near Side
NTS	Not To Scale
NWC	Normal Weight Concrete
O/	Over
O.C.	On Center
OD	Outside Diameter
OPM	OSHPD Preapproval of Manufacturer's Certification
OSHPD	Office of Statewide Health Planning and Development
PERP	Perpendicular
PJP	Partial Joint Penetration
PL	Plate

PRS	Pipe Riser Support
PSA	Pipe Support And Attachment
PTC	Post-Tensioned Concrete
QTY	Quantity
RDP	Registered Design Professional
REINF	Reinforcing
REQ'D	Required
REQMT'S	Requirements
RMC	Rigid Metal Conduit
SC	Single Hung Cable
SCHED.	Schedule
SDC	Seismic Design Category
SECT	Section
SEOR	Structural Engineer of Record
SHT	Sheet
SIM	Similar
SLTD	Slotted
SMS	Sheet Metal Screw
SPEC	Specification
SQ	Square
SR	Single Hung Rigid
SS	Stainless Steel
SSL	Short-Slotted Holes
ST	Snug Tight / Bolt
STAGG	Stagger
STD	Standard
STIFF	Stiffener
STL	Steel
STR	Structure, or Structural
SYM	Symmetrical
T	Top
TC	Trapeze Cable
THK.	Thick/Thickness
THRD	Thread, or Threaded
THRU	Through
TR	Trapeze Rigid
TRANS	Transverse
TYP	Typical
UL	Under-Righter Laboratory
UNO	Unless Noted Otherwise
VERT	Vertical
VSB	Vertical Seismic Brace
VSC	Vertical Side Clip
W/	With
W/O	Without
WP	Work Point, or Waterproof
ZOI	Zone of Influence

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NOMENCLATURES

Symbols	Description	Code Reference
Ω_o	Over-Strength factor	ASCE 7-16
a_P	Component amplification factor	ASCE 7-16
C_P	ASD Seismic Coefficient	NFPA 2022
F_P	Horizontal seismic design force	ASCE 7-16
F_V	Vertical seismic load effect (E_V as defined by ASCE)	ASCE 7-16
G / G-Factor	ASD seismic force factor used in this manual (G and G-Factor are interchangeable)	-
h	Average roof height of structure with respect to the base	ASCE 7-16
h_{ef}	Effective embedment depth of anchor	ACI 318-19
I_P	Component importance factor	ASCE 7-16
R_P	Component response modification factor	ASCE 7-16
S_{DS}	Design, 5% damped, spectral response acceleration parameter at short periods	ASCE 7-16
W_P	Component operating weight	ASCE 7-16
z	Height in structure of point of attachment of component with respect to the base	ASCE 7-16

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PART A

MECHANICAL ELECTRICAL PLUMBING (MEP)

HCAI PRE-APPROVED TOLCO "MEP" GUIDELINES

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SECTION 1

GENERAL NOTES,
DESIGN GENERAL NOTES,
TYPICAL DESIGN EXAMPLES

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AND

PRE-DESIGNED TABLES
FOR SEISMIC BRACE SPACING

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1.0 PREFACE

This HCAI Pre-approval of Manufacturer's Certification (OPM) is based on the 2022 CBC. The demand (design forces) for use with this OPM shall be based on the 2022 CBC.

1. **Scope and Limitations:**
   This pre-approval is for the seismic bracing of interior mechanical, electrical, plumbing and fire protection systems. It does not address other loads such as, but not limited to, those generated by, pressure, fluid dynamics, pipe rupture, vibration, elevated temperature, or movements of equipment that braced components are attached to. It does not address components that cross seismic separations of buildings or components attached to portions of the structure or equipment that will experience relative seismic drifts other than pipe risers. The maximum S_{DS} utilized for this OPM shall not exceed 2.5g.

2. **The ranges of components sizes and material included in the pre-approval are as follows:**
   A. Pipes:
      - Steel; Schedule 10, 20, 30, 40 - Sizes 1" to 12"
      - Cast Iron Pipe - Sizes 1" to 12"

   B. Ducts:
      - Galvanized Rectangular Duct; 18 - 24 gage - Sizes 12"x12" up to 78"x78"
      - Galvanized Round Duct; 18 - 24 gage - Sizes 12" up to 60"

   C. Conduits:
      - Steel Conduit - Size 1/2" up to 6"
      - EMT, IMC, & RMC Conduit - Sizes 1" up to 4" (Ductile Only)

   D. Fire Sprinklers Steel Pipe Sizes:
      - See Part B, Fire Protection (FP)

   E. Brace Members:
      - Steel (ASTM A53 Type E Grade B) Schedule 40: 1", 1 1/4", 1 1/2", 3", 3 1/2", 4" NPS.
      - Steel (ASTM A53 Type E Grade B) Schedule 10: 2", 2 1/2" 3", 3 1/2", and 4".
      - Strut Channel, B-Line B22.
      - Pre-Stretched galvanized, 7x19, aircraft cable per ASTM A1023, 1/8",3/16", and1/4".
      - EMT, IMC, & RMC Conduit - Sizes 1" up to 4" (Ductile Only)

   F. Calcium Silicate Shield
      - Pipe Size 1" - 4" B-Line B3380 Series, ASTM C533 for 1" Thickness
      - Pipe Size 5" : B-Line B3380 Series, ASTM C533 for 1-1/2" Thickness
      - Pipe Size 6" and larger : B-Line B3380 Series, ASTM C533 for 2" Thickness

3. **The substrates included in this pre-approval are as follows:**
   A. Concrete
   B. Bare Metal Decking
   C. Concrete Filled Metal Deck
   D. Steel
   E. Wood

4. **Construction Tolerances:**
   A. Construction Tolerances shall be as noted on the drawing details and appendices.
   B. Construction Tolerance for angles of all braces shall be limited to ±5°, out of plane as shown on Page 12-21.
   C. The recommended brace angle is 45° for the diagonal brace, or 1 (verttical) to 1 (horizontal) brace ratio. However, the brace can be installed between 0°-60° from horizontal. See Page 12-21.

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1.1 INTRODUCTION AND CONDITIONS FOR USE OF THIS MANUAL

1. Seismic bracing design and layout drawings shall be prepared by current Registered Structural Engineer licensed in California with experience in the design of seismic bracing for mechanical, electrical, plumbing and fire protection systems. This Registered Design Professional (RDP) is responsible for:

   A. Verifying that the nonstructural components or system is seismically qualified in accordance with the 2022 CBC.
   B. Verifying that the B-Line TOLCO brace system selected meets the seismic requirements of this OPM.
   C. Verifying that the structure to which the B-Line bracing system is anchored meets the requirements of the appropriate anchor's approved ICC-ESR Report.
   D. Verifying that anchor edge distance and spacing meets the requirements of the applicable ICC-ESR.
   E. Verifying that the installation is in conformance with the 2022 CBC and with the details shown in this OPM. Testing of post installed anchors shall also be performed in compliance with the 2022 CBC, Section 1910A.5.

2. For seismic bracing design per this design manual, HCAI to verify that the seismic force level used for bracing design for the site specific project matches.

3. Modifications and/or changes to the designs shown in this guideline shall be performed or reviewed by a qualified Registered Structural Engineer and approved by the design engineer of record.

4. When more than one criteria is presented, the more stringent criteria shall be used. The data presented in this manual is subject to change without notice. Refer to the appropriate codes and standards for additional information and requirements.

5. The Structural Engineer of Record (SEOR) shall verify the adequacy of the supporting structure and its components for the loads applied to the supporting structure and its components by the seismic bracing systems, and compliance with the applicable codes and standards.

6. A copy of this manual and copies of all other details, layouts and calculations shall be at the jobsite and readily available prior to installing the seismic bracing system.

7. It is the responsibility of the user of this manual to be familiar with all requirements for seismic bracing and shall be proficient in determining and applying utility loads for their application.

8. The user of this manual shall determine the spacing and layout for the required bracing. The user shall determine the maximum horizontal, vertical and axial force component of the earthquake demand loads. The user's calculations must take into consideration the increases in loads caused by construction tolerances. Construction tolerances for angles of all braces, in plane or out of plane, from horizontal shall be limited to +/- 5 degrees.

9. As with all pre-approved details, systems, etc., plans are still required showing how and where this pre-approved anchorage and bracing system will be applied on a project specific basis. This process is needed to verify that the appropriate detail has been selected and applied for each condition and for the actual substrate to which it will be connected/attached to.

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1.1 INTRODUCTION AND CONDITIONS FOR USE OF THIS MANUAL (CONT'D)

10. The SEOR must review and forward the anchorage and bracing plans for plan check with a notation indicating that the plans have been reviewed and they have been found to be in general conformance with the design of the project. A "shop drawing stamp" is usually acceptable for compliance with this requirement. Anchorage and bracing details and supporting calculations that are not part of this pre-approval, are subject to project specific review and approval by HCAI. Review of anchorage and bracing details of this nature does not constitute a pre-approval that may be used on other projects without the benefit of plan review.

11. Distribution system (HVAC ducts, pipes and electrical raceways) seismic supports and attachments OPMs:

    A. Layout drawings of the supports, attachments, and bracing systems in accordance with approval shall be submitted to the Structural Engineer of Record/Registered Design Professional in responsible charge of the project for review to verify that the details are in conformance with the code requirements. The layout drawings shall as a minimum satisfy the requirements of ASCE 7 Section 13.6 as modified by the 2022 CBC Section 1617A.

        a. The Structural Engineer of Record shall verify that the supporting structure is adequate for the forces imposed on it by the supports, attachments, and braces installed in accordance with the pre-approval addition to all other loads.

        b. The Structural Engineer of Record shall forward the supports, attachments, and bracing drawings (including construction documents for supplementary framing where required) to the Registered Design Professional in responsible charge with a notation indicating that the drawings have been reviewed and are in general conformance with the pre-approval and the design of the project.

        c. A review stamp shall be permitted to be used, by the Structural Engineer of Record, to indicate compliance with this requirement..

        d. The Registered Design Professional other than Structural Engineer of Record, may provide the review stamp for small projects at the discretion of the HCAI.

    B. The layout drawings, with the review stamp, shall be submitted to HCAI, as part of original CDs or as Deferred Submittal Items in accordance with the 2022 CAC Section 7-126 and the 2022 CBC Section 107.3.4.1 for verification that:

        a. Structure supporting the distribution system has adequate capacity;

        b. Seismic design forces (F_P) are in accordance with the ASCE 7 and 2022 CBC;

        c. Submittal is within the scope of the OPM:
            - Size of distribution system components,
            - Spacing of bracing and flexible joints, and
            - Substrate for attachments

    C. The layout drawings with the review stamp, shall be kept on the jobsite to be used for installation of the support and bracing.

        a. The approved agency/inspector of record shall provide inspection in accordance with the 2022 CBC Sections 1704 or 1704A and the 2022 CAC Section 7-145.
        b. HCAI field staff will review/inspect the installation in accordance with the CAC Section 7-147.

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1.1 INTRODUCTION AND CONDITIONS FOR USE OF THIS MANUAL (CONT'D)

D. The structural engineer of record shall design any supplementary framing that is needed to resist the loads, maintain stability and/or is required for installation of pre-approved system.
   a. The supplementary framing shall be submitted to HCAI as part of original construction documents or as a Deferred Submittal Items shall be listed on the cover page of the original construction documents.

E. A copy of the chosen bracing system(s) installation guide/OPM manual shall be on the jobsite prior to starting the installation of hangers and/or braces.
   a. The approval agency/inspector shall maintain an approved copy of the OPM (obtained from HCAI website) in accordance with the CAC Section 7-145 Item # 4.

F. Components of two or more pre-appvoed bracing systems shall not be mixed.
   a. Only one pre-approved bracing system may be used for a run of pipe, duct or raceway.
   b. Any substitution of component of an OPM system shall require HCAI review and approval.

12. Components of two or more pre-approved bracing systems shall not be mixed. Only this pre-approval may be used for the design of seismic bracing. Any substitution of component of this pre-approval shall require HCAI review, approval and testing matching the HCAI requirements.

13. This manual is prepared as a guideline for seismic bracing for piping, ducts, conduits, cable trays, and other systems. Following is an outline of the manual:

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Part A - Mechanical Electrical Plumbing (MEP):

Section 1: General Information. Presents general notes and requirements for seismic bracing of mechanical, electrical, fire protection and plumbing systems. It includes a general step by step procedure for seismic bracing design using this manual. It also include pre-designed tables for seismic brace spacing.

Section 2: Single Hanger Rigid Brace Details. Includes seismic bracing details for individually hung systems using rigid brace members.

Section 3: Single Hanger Rigid Brace Spacing Charts. Presents seismic brace spacing charts for individually hung systems using rigid brace members. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, steel beams, bar joists and wood beams.

Section 4: Trapeze Rigid Brace Details. Includes seismic bracing details for trapeze assemblies for piping, ducts, conduits, cable trays, bus ducts, equipment and others using rigid brace members.

Section 5: Trapeze Rigid Brace Spacing Charts. Presents seismic brace spacing charts for trapeze assemblies for piping, ducts, conduits, cable trays, bus ducts, equipment and others using rigid brace members. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, steel beams, bar joists and wood beams.

1.1 INTRODUCTION AND CONDITIONS FOR USE OF THIS MANUAL (CONT'D)

Part A - Mechanical Electrical Plumbing (MEP) (Cont'd) :

Section 6: **Single Hanger Cable Brace Details.** Includes seismic bracing details for individually hung systems using cable braces.

Section 7: **Single Hanger Cable Brace Spacing Charts**. Presents seismic brace spacing charts for individually hung systems using cable braces. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, steel beams, bar joists and wood beams.

Section 8: **Trapeze Cable Brace Details.** Includes seismic bracing details for trapeze assemblies for piping, ducts, conduits, cable trays, bus ducts, equipment and others using cable braces.

Section 9: **Trapeze Cable Brace Spacing Charts.** Presents seismic brace spacing charts for trapeze assemblies for piping, ducts, conduits, cable trays, bus ducts, equipment and others using cable braces. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, steel beams, bar joists and wood beams.

Section 10: **Component Part Number References.** Includes part number references for all components listed in this manual.

Section 11: **Structural Attachments.** Shows structural attachment details and allowable loads for attaching hanger rod and seismic bracing to supporting structure. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, attachments to steel beams and bar joists, attachments to wood beams, and others.

Section 12: **Seismic Brace Components.** Includes details and allowable loads for seismic bracing components used in the seismic bracing design. Components include brace attachment fitting, rod stiffening requirements, clevis bolt spacer details, and others.

Section 13: **Seismic Hanger Components.** Includes details and allowable loads for seismic hanger components for single hung and trapeze hung assemblies.

Section 14: **Seismic Bracing Maximum Spacing Tables.** Includes maximum seismic bracing spacing for various pipe and conduit types.

Section 15: **Special Seismic Floor Support Details.** Includes details and allowable loads for various seismic floor support configurations.

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1.1 INTRODUCTION AND CONDITIONS FOR USE OF THIS MANUAL (CONT'D)

Part A - Mechanical Electrical Plumbing (MEP) (Cont'd) :

Section 16: **Special Seismic Wall Support Details.** Includes details and allowable loads for various seismic wall support configurations.

Section 17: **Special Seismic Riser Support Details.** Includes details and allowable loads for various seismic riser support configurations.

Section 18: **Special Seismic Support Details.** Includes details and allowable loads for various seismic support configurations.

Appendix A: **2022 California Building Code - Design Force Formulas.**

Appendix B: **Metric Conversion Charts.**

Appendix C: **Pipe Weight Tables, Conduit Weight Tables, Rectangular Duct Weight Tables, Round Duct Weight Tables and Galvanized Sheet Metal Conversion Tables.**

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1.2 BUILDING CODES, STANDARDS AND GUIDELINES

1. The Eaton B-LineTolco Seismic Restraint Guidelines are prepared to meet or exceed the requirements of the following:

- 2022 California Building Code (2022 CBC)
- 2018 National Design Specification for Wood Construction (ANSI / AWC NDS-2018)
- 2022 National Fire Protection Association Pamphlet 13 (NFPA-13-2022)
- 2019 American Concrete Institute Building Code Requirements for Structural Concrete (ACI 318-19)
- 2016 American Society of Civil Engineers (ASCE 7-16) Including Supplements 1, 2 & 3.
- American Society of Mechanical Engineers (ASME B31Ea-2010, B31.1-2016, and B31.3-2020)
- 2016 American Institute of Steel Construction (ANSI/AISC 360-16)
- 2016 Seismic Provisions for Structural Steel Buildings (ANSI/AISC 341-16)

These guidelines are intended to describe seismic restraints for the piping industry's most commonly used single rod pipe hangers for up to 12-inch pipe and mechanical/plumbing/electrical trapeze supports up to 8 feet wide.

Spacing charts provided show pipe sizes and maximum loads based on the following:

- 1" through 4" schedule 40 steel pipe, water filled with 1" maximum thickness insulation
- 5" schedule 40 steel pipe, water filled with 1 1/2" maximum thickness insulation
- 6" through 12" schedule 40 steel pipe, water filled with 2" maximum thickness insulation

For other piping, piping w/ additional weights such as flanges, and other mechanical/plumbing/electrical systems, determine bracing design based on maximum weight per foot equivalent to the total weight including additional weights.

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1.3 SEISMIC BRACING GENERAL REQUIREMENTS - MECHANICAL & PLUMBING PIPING

$a_P = 2.5$; $R_P = 3.0$ (6.0 MAX); $S_{DS} = 2.5$; $\Omega_o = 2.0$; $I_P = 1.5$; $z/h \leq 1$

The above parameters for this Section are worst case and apply to mechanical/plumbing piping and tubing of low (cast iron, glass, and non-ductile plastics), limited, or high deformability materials whether in accordance with ASME B31 or not. Joints can be threaded, bonded, compression coupling, grooved coupling, welded or brazed, per the ASCE/SEI 7-16, Table 13.6-1. For additional factors for different systems see the ASCE/SEI 7-16, Table 13.6-1.

1. Seismic restraints are required for the following piping installations:

   A. All piping weighing more than 5 lbs/ft. or 2 1/2" diameter and larger ($R_P < 4.5$) where Seismic Design Category is C and Ip is equal to 1.5.
   B. All piping weighing more than 5 lbs./ft., or 3 1/2" diameter and larger ($R_P < 4.5$) where Seismic Design Category is D thru F and Ip is equal to 1.0.
   C. All piping weighing more than 5 lbs./ft., or 1 1/4" diameter and larger ($R_P < 4.5$) where Seismic Design Category is D thru F and Ip is equal to 1.5.
   D. Single trapeze supported piping that has a total weight > 100 lbs/ft or more where Seismic Design Category is C thru F and Ip > 1.0.
   E. All trapeze supported piping that has a total weight > 100 lbs/ft or more where Seismic Design Category is D through F and Ip is equal to 1.0.
   F. Trapeze supported piping that would require bracing supported individually.

   Exception #1:
   Seismic restraints are not required where either condition below is met:
   - All piping w/ Ip = 1.0 assigned to SDC D, E, or F, suspended by individual hanger rods (3/8" diameter or 1/2" diameter) where hanger in piping run is 12 inches or less in length from the top of pipe to the bottom of the support structure where hanger is connected (See Page 1-12). Total weight supported by any single hanger is ≤ 50 lbs, and normal pipe size ≤ 3" diameter.
   - All piping w/ Ip = 1.5 assigned to SDC A, B, or C, suspended by individual hanger rods (3/8" diameter or 1/2" diameter) where hanger in piping run is 12 inches or less in length from the top of pipe to the bottom of the support structure where hanger is connected (See Page 1-12). Total weight supported by any single hanger is ≤ 50 lbs, and normal pipe size ≤ 3" diameter.
   - Trapeze supported systems suspended 12 inches or less w/ 3/8" diameter or 1/2" diameter hanger rods from the top of the trapeze to the bottom of the support structure where trapeze is connected, and total weight supported by any single trapeze is ≤ 100 lbs (See Page 1-12).

   Exception #2:
   - All piping suspended by individual hanger rods with total weight of 5 lbs/ft or less.

   In both exceptions above, all of the hangers of a run must comply with the 12-inch rule or bracing is required.

   The 12-inch rod rule exception has additional requirements:

   - Lateral motion of the piping will not cause impact with other systems (e.g. other pipe, duct, or electrical systems, equipment, structural members etc., or fragile appurtenances such as sprinkler heads or lighting fixtures) or loss of system vertical support.
   - Piping must be made of ductile material with ductile connections (e.g. welded steel pipe, etc.)
   - Vertical rod hanger top connections to the building structure cannot develop moments. Moments may be eliminated by using swivel attachments or by other means.

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1.3 SEISMIC BRACING GENERAL REQMT'S - MECHANICAL & PLUMBING PIPING (CONT'D)

SUMMARY FOR PIPING SYSTEMS THAT ARE EXEMPT FROM DESIGN FOR SEISMIC FORCES AND SEISMIC RELATIVE DISPLACEMENTS (SEE FOOTNOTES 1 & 2)

Mechanical, Plumbing, Process Pipe and Similar Systems with $4.5 \le R_P \le 6.0$

Ip		EXEMPTIONS	Material, Steel or Copper
1.0	1.	All pipes ≤ 3" diameter.	Heating Hot and Chilled Water Conderser Water High Temperature Hot Water Steam and Steam Vent Condensate Return Water Boiler Feed Water and Blowdown Domestic Hot and Cold Water Fuel Oil, Gas and Compressed Air Medical Gases and Vacuum Industrial, Irrigation and Soft Water Emergency Cold Water Grease Waste and Vent Sanitary Waste and Vent.
	2.	All pipes exempted for the Ip=1.5 case below.	
1.5	1.	All following pipes (≤ 5 lbs/ft) where a flexible connection is provided between pipes and components, and component is positively attached to the structure. a. ≤ 2" diameter vent, gas or empty Schedule 40 steel pipe w/o insulation. b. ≤ 1-1/2" diameter Schedule 40 steel pipe water-filled w/ insulation). c. ≤ 3" diameter vent, gas or empty copper pipe w/o insulation. d. ≤ 2" diameter copper pipe water-filled w/ insulation. e. Any other piping with an operating weight ≤ 5 lbs/ft. (Note: Refer to system weights in the appendix. Pipes with hazardous contents (e.g. medical gases, fuel oil, natural gas, etc.) shall be braced regardless of weight. Pipe size exemption 2 below still applies. Non-hazardous contents include, but are not limited to, medical vacuum and compressed air.)	
	2.	All other pipes ≤ 1" diameter.	

Plumbing Pipe Gravity, Waste, Vent and Similar System with $R_P < 4.5$

Ip		EXEMPTIONS	Material, Non-Ductile Cast Iron
1.0 or 1.5	1.	The following pipes where a flexible connection is provided between the pipes and components. a. Non-Hub cast iron vent pipes ≤ 3" diameter. b. Non-Hub cast iron pipes ≤ 2" diameter. c. Any other piping with an operating weight ≤ 5 lbs/ft.	Sanitary Waste Vent Storm and Overflow Drain Grease Waste Vent

Footnote:

1. The piping is supported by hangers and each hanger in the piping run is 12 inch or less in length from the top of the pipe to the supporting structure. Where pipes are supported on trapeze, the trapeze shall be supported by hangers having a length of 12 inch or less in length from the pipe support point (e.g., top of strut) to the connection at the supporting structure. Where rod hangers are used with a diameter greater than 1/2 inch, they shall be equipped with swivels, eye nuts or other devices to prevent bending in the rod.

2. Piping that has an Rp in Table 13.6-1 of 4.5 or greater supported by rod hangers and provisions are made to avoid impact with other structural or nonstructural components or to protect the piping in the event of such impact, or pipes with Ip = 1.0 supported by individual rod hangers 3/8 inch or 1/2 inch in diameter, where each hanger in the pipe run is 12 inches (305 mm) or less in length from the pipe support point to the connection at the supporting structure; and the total weight supported by any single hanger is 50 pounds or less. In addition, the following limitations on the size of piping shall be observed:
   a. In structures assigned to Seismic Design Category D, E or F where I_P is greater than 1.0, the nominal pipe size shall be 1 inch or less.
   b. In structures assigned to Seismic Design Categories D, E or F where I_P = 1.0, the nominal pipe size shall be 3 inches or less.

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1.3 SEISMIC BRACING GENERAL REQMT'S - MECHANICAL & PLUMBING PIPING (CONT'D)

2. Transverse bracing shall be provided at 40 ft. maximum spacing (unless reduced spacing is required per Section 3, Section 5,Section 7,Section 9, and Section 14) for welded steel pipe, or grooved piping with UL 213 listed connections. Rigid grooved coupling listed for UL standard 213 shall be permitted in horizontal run of pipe. Flexible grooved coupling listed for UL standard 213 shall be permitted in vertical risers (to accommodate drift) and other locations (e.g. seismic separation, equipment nozzle, etc.) to accommodate small movement and/or rotation. Non-UL listed grooved couplings shall not be used unless approved on project specific basis.

3. Longitudinal bracing shall be provided at 80 ft. maximum spacing (unless reduced spacing is required per Section 3, Section 5,Section 7 and Section 9) for welded steel pipe, or grooved piping with UL 213 listed connections. Rigid grooved coupling listed for UL Standard 213 shall be permitted in horizontal run of pipe. Flexible grooved coupling listed for UL Standard 213 shall be permitted in vertical risers (to accommodate drift) and other locations (e.g. seismic separation, equipment nozzle, etc.) to accommodate small movement and/or rotation. Non-UL listed grooved couplings shall not be used unless approved on project specific basis. Maximum longitudinal brace spacing shall not exceed two times (2x) maximum transverse brace spacing.

4. Cast iron pipe (No-Hub pipe) brace spacings shall not exceed the spacings tabulated in Section 14. No-hub couplings shall be manufactured in accordance with the ASTM C1540, shall be certified in accordance with FM 1680 Class 1 and gravity hangers shall be spaced per the requirements of Table 313.1 of the 2022 California Plumbing Code (CPC) for no-hub cast iron pipe.

5. Exception: Cast iron (No-hub) pipe joined by couplings not satisfying the ASTM C1540 or not certified in accordance with FM 1680 Class 1 shall be designed on a project by project basis, and shall require project specific HCAI approval.

6. Brace No-Hub piping on each side of 90 degree horizontal change in direction, both in transverse and longitudinal directions.

7. When determining horizontal load requirements, consider all pipes full of water unless calculated for other substances.

8. Seismic bracing shall not limit the expansion and contraction of the piping system. When thermal expansion or contraction is involved, longitudinal bracing shall be designed at the anchor point of the piping system. The longitudinal bracing and the connections must be capable of resisting the additional force induced by expansion and contraction designed by a Registered Design Professional (RDP) on a project-specific basis, since it is outside the scope of this OPM.

9. All braces shall be located at or within 6" of the vertical support. Provide rod stiffener for vertical support where required by Page 12-17 or Page 12-18.

10. When bracing trapeze supports, the bracing shall be attached directly to the trapeze with piping secured to the trapeze with approved components. At transverse brace locations, a minimum of one transverse brace is required per trapeze. At longitudinal brace locations, a minimum of two longitudinal braces are required per trapeze, one at each vertical support or rod. At trapeze locations where both transverse & longitudinal seismic bracing is required, both conditions apply.

11. Stacked trapezes supported by the same rods shall be braced independently from one another. The rod supports in each section may require stiffening (See Pages 4-19, 4-20, 4-21, 8-19, 8-20, 8-21, 12-17, 12-18).

12. Bracing installed on smaller piping shall not be used to brace larger piping.

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1.3 SEISMIC BRACING GENERAL REQMT'S - MECHANICAL & PLUMBING PIPING (CONT'D)

13. A piping system shall not be braced to different parts of the building that may respond differently during seismic activity.

14. See Page 12-21 for Maximum Brace Member Lengths.

15. The following Tolco products were engineered with torque indicators to ensure proper installation (See Sections 11 & 12):

    A. Fig. 909 (Page 12-10) No-Thread Swivel Sway Brace Attachments have a connecting bolt head that bottoms out.
    B. Fig. 980 (Page 12-1) & Fig. 981 (Page 12-2) Universal Swivel Sway Brace Attachments have break-off bolt heads.
    C. Fig. 985 (Page 12-4) & Fig. 986 (Page 12-5) Swivel Sway Brace Attachments have break-off bolt heads.
    D. Fig. 990 (Page 12-7) & Fig. 991 (Page 12-8) Cable Sway Brace Attachments have break-off nuts.
    E. Fig. 1000 (Page 12-13) Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement.
    F. Fig. 1001 (Page 12-14) Sway Brace Attachment has bolt heads that bottom out.
    G. Fig. 800 (Pages 11-65, 11-66 & 11-67) , Fig. 825 (Page 11-62) & Fig. 828 (Page 11-64) Adjustable Sway Brace Attachment to Steel and Bar Joist have break-off bolt heads.
    H. Fig. 4L (Page 12-6) Sway Brace Attachments have break-off bolt heads.
    I. Through-bolts shall be torqued by 3/4 turn of the nuts after the snug tight (The snug-tight condition is defined as the tightness required to bring the connected piles into firm contact) condition is achieved. Minimum 3 bolt threads shall pass nuts.

16. Continue with "Seismic Bracing Layout - General Requirements" on Pages 1-21 to 1-25.

17. Rigid grooved coupling listed for UL Standard 213 shall be permitted in horizontal run of pipe. Flexible grooved coupling listed for UL standard 213 shall be permitted in vertical risers (to accommodate drift) and other locations (e.g., seismic separation, equipment nozzle, etc.) to accommodate all movement and/or rotation. Non-UL listed groove couplings shall not be used unless approved on project specific basis. See also Notes 1 to 3 on Pages 1-8 to 1-10.

18. Notes on Vertical Risers:

    A. Vertical piping systems supported at each floor shall be considered seismically braced if the penetration through each floor is tightly packed with approved firestops, satisfying the NFPA 13-2022 Section 18.5.8.5 and the floor to floor spacing does not exceed the maximum brace spacing tabulated in Section 14. Top of risers exceeding 3 feet shall be provided with a 4-way brace. Where the 4-way brace is attached to the horizontal piping, it shall be installed within 2 feet of the centerline of the riser.

    B. Vertical pipe riser in an open shaft must be attached to steel supports with both steel supports and connections sized to accept the combined gravity and seismic loads. Thermal loads shall be considered, where applicable. Lateral seismic restraint spacing shall not exceed the spacings tabulated in Section 14. Supports and connections must be engineered on a job by job basis subject to approval by the enforcement agency. Seismic relative displacement between floors shall be considered in the design.

    C. Vertical pipe risers subject to thermal expansion or contraction may be engineered to allow pipe movement and reduce load transfer between floors. Sliding guides and/or resilient anchors shall be employed to allow or control thermal movement while designed to accept seismic loads at maximum spacings tabulated in Section 14. Pipe penetrating cored holes at floor levels that are lightly packed may be considered as pipe guides. Where insulated pipes penetrate cored holes used as guides. a hard insulation insert that exceeds the floor depth at each end is required. Riser clamps or brackets shall be designed to transfer resultant horizontal and vertical loads from the pipe to the supports. Supports and connections must be engineered on a job by job basis subject to approval by the enforcement agency.

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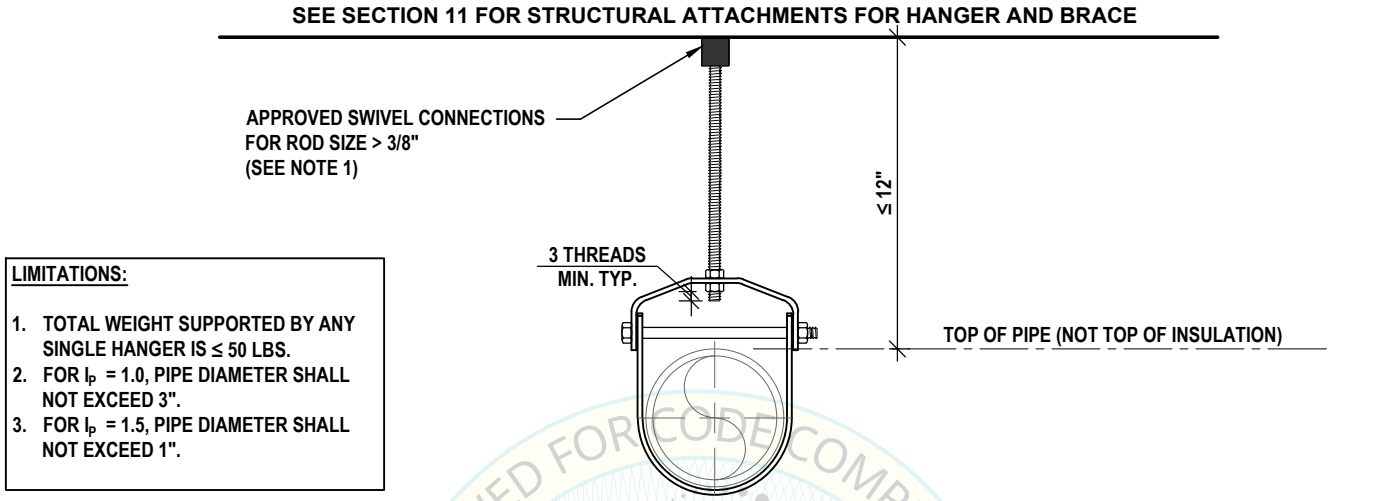
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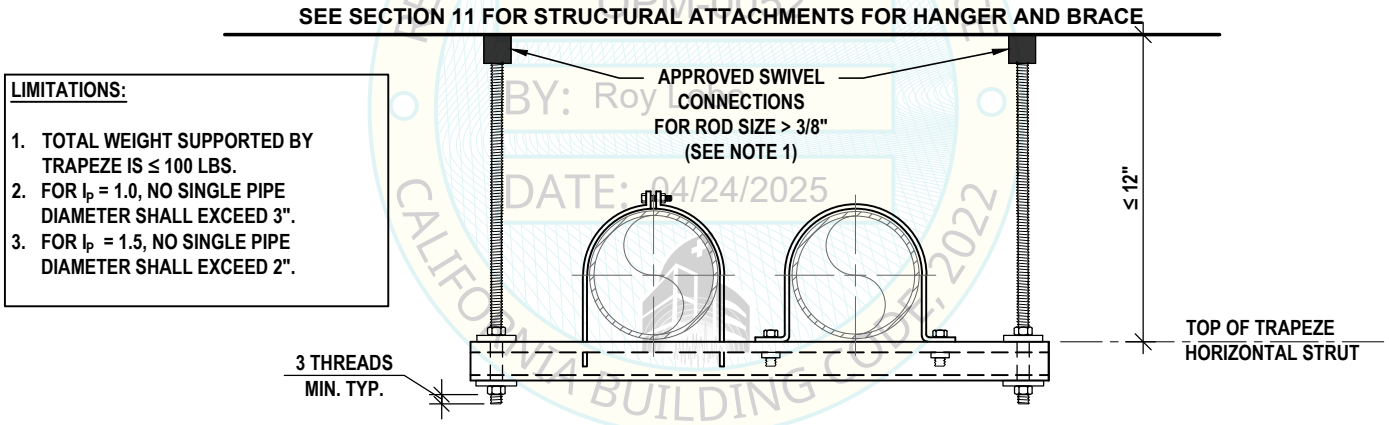
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1.3 SEISMIC BRACING GENERAL REQMT'S - MECHANICAL & PLUMBING PIPING (CONT'D)

1.3.1 12-INCH-RULE EXEMPTION FOR SUSPENDED PIPING



CLEVIS HUNG PIPE



PIPES ON SINGLE-TIER TRAPEZE

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NOTES:

1. CONNECTIONS COMPLYING INCLUDE SWIVEL JOINT, EYE BOLTS, ETC.
2. THE 12-INCH-RULE EXEMPTION HAS ADDITIONAL REQUIREMENTS:
   - LATERAL MOTION OF THE PIPING SHALL NOT CAUSE IMPACT WITH OTHER SYSTEMS (E.G. OTHER PIPE, DUCT, OR ELECTRICAL SYSTEMS, EQUIPMENT, STRUCTURAL MEMBERS ETC., OR FRAGILE APPURTENANCES SUCH AS SPRINKLER HEADS OR LIGHTING FIXTURES) OR LOSS OF SYSTEM VERTICAL SUPPORT.
   - THE FUNCTIONAL AND PHYSICAL INTERRELATIONSHIP OF COMPONENTS, THEIR SUPPORT, AND THEIR EFFECT ON EACH OTHER SHALL BE CONSIDERED SO THAT THE FAILURE OF AN ESSENTIAL OR NONESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT SHALL NOT CAUSE THE FAILURE OF AN ESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT.
   - PIPING MUST BE MADE OF DUCTILE MATERIAL WITH DUCTILE CONNECTIONS (E.G. WELDED STEEL PIPE, ETC.)
   - VERTICAL ROD HANGER TOP CONNECTIONS TO THE BUILDING STRUCTURE CANNOT DEVELOP MOMENTS. MOMENTS MAY BE ELIMINATED BY USING SWIVEL ATTACHMENTS OR BY OTHER MEANS.
   - THE 12-INCH-RULE EXEMPTION IS APPLICABLE TO SINGLE-TIER TRAPEZE ONLY.

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1.4 SEISMIC BRACING GENERAL REQUIREMENTS - FIRE PROTECTION PIPING

$a_P = 2.5$; $R_P = 4.5$; $S_{DS} = 2.5$; $\Omega_o = 2.0$; $I_P = 1.5$; $z/h = 1$

The above parameters for this section are worst case and apply to Fire Protection piping of limited, or high deformability materials whether in accordance with ASME B31 or not. Joints can be threaded, bonded, compression coupling, grooved coupling, welded or brazed, per the ASCE/SEI 7-16, Table 13.6-1. See also Part B this manual for Fire Protection (FP) requirements and information. For additional factors for different systems see the ASCE/SEI 7-16, Table 13.6-1.

1. Lateral (transverse) Seismic Bracing is required for the following fire protection piping:

   A. For Seismic Design Category C, D, E, or F, and Ip is equal to 1.5.
   - All mains.
   - All cross mains.
   - All branch lines 2 1/2" diameter and larger.
   - The last length of pipe at the end of a feed or cross main shall be provided with a lateral brace.

2. Transverse bracing shall be provided at 40 ft. maximum spacing (unless reduced spacing is required per Section 3, Section 5, Section 7, Section 9, and Section 14) for welded steel pipe.

   A. Lateral (transverse) seismic bracing is to protect piping against movement perpendicular to the run of pipe.
   B. Lateral (transverse) seismic bracing shall be spaced at a maximum of 40' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 30' maximum span (piping smaller than 2 1/2" diameter).
   C. A lateral (transverse) seismic brace placed on the pipe run section at the opposite side of an elbow within 24" may act as a longitudinal brace. For an example, see Page FP-1-8.
   D. The minimum required bracing for runs longer than 5' is a transverse brace at each end, and a longitudinal brace at one of those two positions. For an example, see Page FP-1-10.
   E. Rigid grooved couplings listed for UL Standard 213 shall be permitted in horizontal runs of pipe. Flexible grooved couplings listed for UL Standard 213 shall be permitted in vertical risers (to accommodate drift) and at other locations (e.g. seismic separations, equipment nozzles, etc.) to accommodate small movement and/or rotation. Non-UL listed grooved couplings shall not be used unless approved on a project specific basis.

   Exceptions:
   All piping suspended by individual hanger rods 6 inches or less in length from the top of the pipe to the bottom of the support structure where hanger is connected. All of the hangers of a run must comply with the 6 inch rule or bracing is required.

3. Longitudinal bracing shall be at 80 ft. maximum spacing (unless reduced spacing is required per Sections 3, Section 3, Section 5, Section 7and Section 9) for welded steel pipe.

   A. Longitudinal seismic bracing is to protect piping against movement parallel to the run of pipe.
   B. Longitudinal seismic bracing shall be spaced a maximum of 80' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 60' maximum span (piping smaller than 2 1/2" diameter) for an example, see Page FP-1-9.
   C. Each pipe run shall have at least one longitudinal brace, additional longitudinal braces are required when the maximum longitudinal spacing is exceeded. For an example, see Page FP-1-9.

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1.4 SEISMIC BRACING GENERAL REQUIREMENTS - FIRE PROTECTION PIPING (CONT'D)

4. When determining horizontal load requirements, follow the NFPA 13-2022 Zone of Influence requirements.

5. A piping system shall not be braced to different parts of the building that may respond differently during seismic activity.

6. The following Tolco products were engineered with torque indicators to ensure proper installation (See Sections 11 & 12):

   A. Fig. 980 (Page 12-1) Universal Swivel Sway Brace Attachments have a break-off bolt head.
   B. Fig. 1000 (Page 12-13) Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement.
   C. Fig. 1001 (Page 12-14) Sway Brace Attachments have bolt heads that bottom out.
   D. Fig. 800 (Pages 11-65, 11-66 & 11-67), Fig. 825 (Page 11-62) & Fig. 828 (Page 11-64) Adjustable Sway Brace Attachments to Steel and Joist have break-off bolt heads.
   E. Fig. 4L (Page 12-6) Braced Pipe Attachments have break-off bolt heads.
   F. Through-bolts shall be torqued by 3/4 turn of the nuts after the snug tight (The snug-tight condition is defined as the tightness required to bring the connected piles into firm contact) condition is achieved. Minimum 3 bolt threads shall pass nuts.

7. Refer to the appropriate codes and standards for additional information and requirements.

8. See Part B - Fire Protection (FP), Appendix FP-A and Item 1.8 of Section FP-1, Pages FP-1-19 to FP-1-21 for lateral sway bracing tables.

9. Vertical Offsets / Risers:

   A. Top of vertical offsets/risers exceeding 3'-0" in length shall be provided with a four-way brace. Bracing shall be located within 24" of the end of the vertical run. Refer to partial isometric on Page FP-1-10.
   B. Distance between four-way braces for risers shall not exceed 25'-0".

10. Continue with "Seismic Bracing Layout - General Requirements" on Pages 1-21 to 1-25.

Note:

See Part B of this guidelines for HCAI Pre-Approved Fire Protection.

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1.5 SEISMIC BRACING GENERAL REQUIREMENTS - DUCTS

$$a_P = 2.5;\ R_P = 3.0;\ S_{DS} = 2.5;\ \Omega_o = 2.0;\ I_P = 1.5;\ z/h = 1$$

The above parameters for this section are worst case and apply to all ductwork of low (cast iron, glass, and non-ductile plastics), limited, or high deformability materials. Joints can be welded or brazed, or other than welded or brazed, per the ASCE/SEI 7-16, Table 13.6-1. For additional factors for different systems see the ASCE/SEI 7-16, Table 13.6-1.

1. Seismic restraints are required for the following duct installations:

   A. All ducts having a cross-sectional area in excess of 6 sq. ft. or greater than 20 plf., round ducts with diameter equal or larger than 33", and weigh heavier than 20 plf., where Seismic Design Category D thru F and Ip is equal to 1.5.
   B. Equipment installed independently of the duct system or is within a run of duct weighing 75 lbs or more where Seismic Design Category D thru F and Ip is equal to or greater than 1.5.
   C. Duct designed to carry toxic, highly toxic, or explosive gases, or used for smoke control shall be designed and braced without exceptions.

   Exceptions:
   Seismic restraints are not required where either condition i. or ii. below are met:

   - All ducts suspended by hanger straps 12 inches or less in length from the duct support point to the bottom of the support structure where the hanger is connected. The strap hangers must be attached within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws. (See Page 1-17)
   - Trapeze supported systems suspended 12 inches or less from the duct support point to the bottom of the support structure where trapeze is connected. (See Page 1-17)

   In both exceptions above, all of the hangers in a run must comply with the 12-inch rule or bracing is required. The 12-inch rule exception has the following additional requirements:

   a. Lateral motion of duct will not cause impact with other systems (e.g. other duct, pipes or electrical systems, equipment, structural members etc., or fragile appurtenances such as sprinkler heads or lighting fixtures) or loss of system vertical support.
   b. Duct must be made of ductile material with ductile connections.
   c. Vertical rod hanger top connections to the building structure cannot develop moments. Moments may be eliminated by using swivel attachments or other means.

2. Transverse bracing shall be provided at 30 ft. maximum spacing (unless reduced spacing is required per Section 2 through 9).

3. Longitudinal bracing shall be provided at 60 ft. maximum spacing (unless reduced spacing is required per Section 2 through 9).

4. Duct bracing for square, rectangle or oval duct shall consist of a trapeze support with two support rods to carry the gravity dead load. The trapeze must have a support member connected to the top of the duct and to the bottom of duct. Both trapeze members shall be connected to the duct with #10 sheet metal screws spaced at maximum 6" o.c. Support rods shall be stiffened where required by the following Pages: 4-13, 4-14, 4-15, 4-19, 4-20, 4-21, 8-13, 8-14, 8-15, 8-19, 8-20, 8-21, 12-17, 12-18. Transverse and/or longitudinal bracing shall then be attached to the top of the upper trapeze member for Single-Tier Trapeze Supports. Transverse and/or longitudinal bracing shall then be attached to the top of each horizontal trapeze member for Multi-Tier Trapeze Supports.

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1.5 SEISMIC BRACING GENERAL REQUIREMENTS - DUCTS (CONT'D)

5. Wall penetrations may be considered transverse bracing where duct is tightly blocked unless smoke dampers are installed in the wall, subject to approval by SEOR. Penetrations can be through full height partitions or structural walls. Gap between duct and wall shall not exceed 1/8". Solid blocking shall be provided around duct penetrations at all stud wall construction. Walls must be confirmed adequate by the SEOR on a project specific basis.

6. Ducts may be combined on a single support and braced based on their combined weight.

7. Floor penetrations of vertical duct may be considered transverse and longitudinal brace locations where duct is tightly blocked, no smoke dampers are installed, and change in direction does not exceed the maximum allowable offset length (See Note 4, on Page 1-21) as measured from the floor penetration to the inside of a 90 degree turn.

8. See Page 12-21 for Maximum Brace Member Lengths.

9. The following Tolco products were engineered with torque indicators to ensure proper installation (See Sections 11 & 12):

   A. Fig. 909 (Page 12-10) No-Thread Swivel Sway Brace Attachments have a connecting bolt head that bottoms out.
   B. Fig. 980 (Page 12-1) & Fig. 981 (Page 12-2) Universal Swivel Sway Brace Attachments have break-off bolt heads.
   C. Fig. 985 (Page 12-4) & Fig. 986 (Page 12-5) Swivel Sway Brace Attachments have break-off bolt heads.
   D. Fig. 990 (Page 12-7) & Fig. 991 (Page 12-8) Cable Sway Brace Attachments have break-off nuts.
   E. Fig. 1000 (Page 12-13) Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement.
   F. Fig. 1001 (Page 12-14) Sway Brace Attachment has bolt heads that bottom out.
   G. Fig. 800 (Pages 11-65, 11-66 & 11-67) , Fig. 825 (Page 11-62) & Fig. 828 (Page 11-64) Adjustable Sway Brace Attachment to Steel and Bar Joist have break-off bolt heads.
   H. Fig. 4L (Page 12-6) Sway Brace Attachments have break-off bolt heads.
   I. Through-bolts shall be torqued by 3/4 turn of the nuts after the snug tight (The snug-tight condition is defined as the tightness required to bring the connected piles into firm contact) condition is achieved. Minimum 3 bolt threads shall pass nuts.

10. For additional information and requirements refer to the appropriate codes and standards as listed on Page 1-7, Note 1.

11. Continue with "Seismic Bracing Layout - General Requirements" on Pages 1-21 to 1-25.

12. Avoid bracing a system to two (2) different parts of a building which may act differently in response to an earthquake (ie., separated by a seismic joint). In cases where this may occur, the duct run must be designed to accept seismic relative displacements per ASCE 7-16 section 13.3.2.

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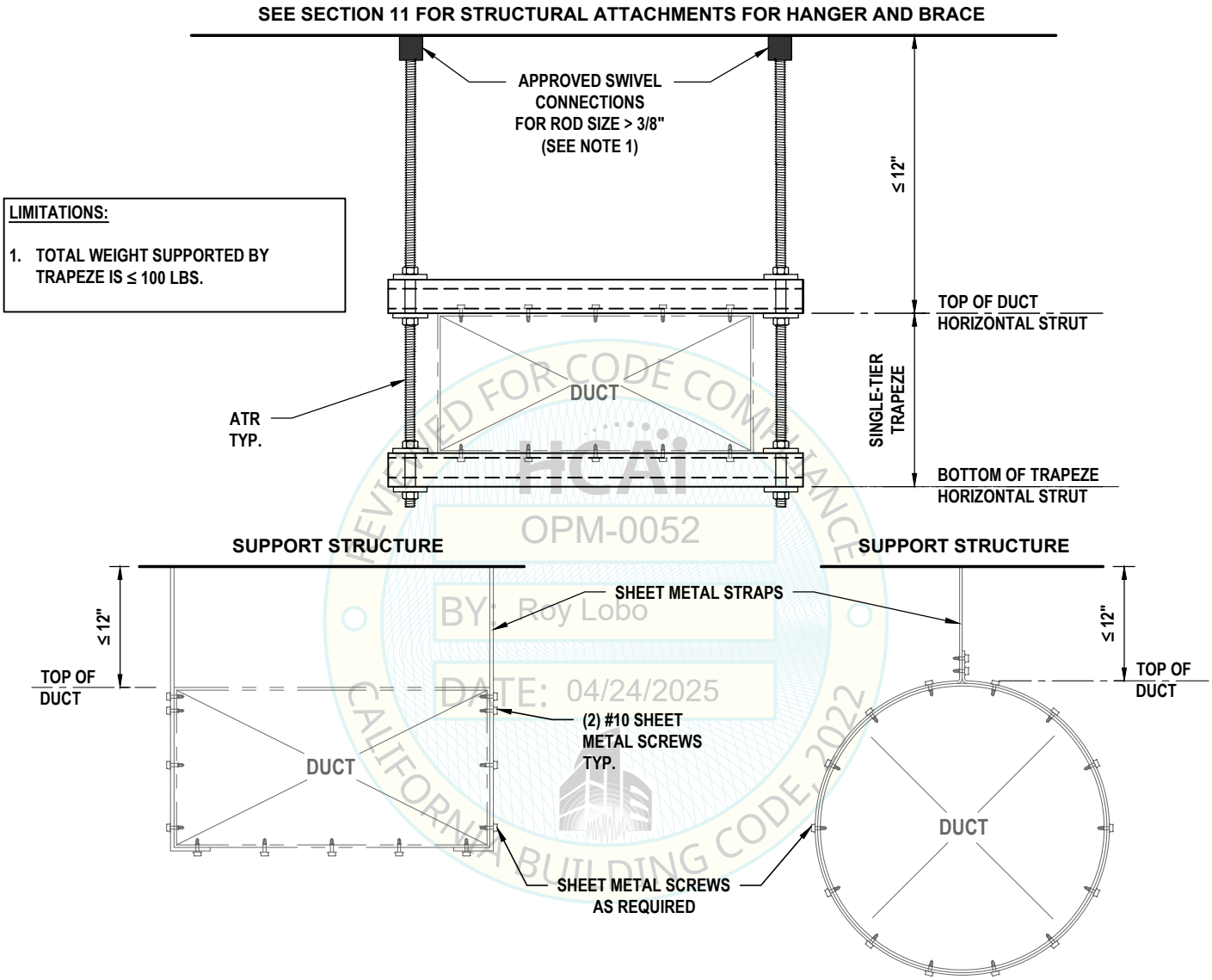
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California SE No. S3545

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DATE: April 23, 2025

1.6 SEISMIC BRACING GENERAL REQUIREMENTS - ELECTRICAL SYSTEMS (CONT'D)

1.6.1 12-INCH-RULE EXEMPTION FOR SUSPENDED DUCTWORK



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NOTES:

1. CONNECTIONS COMPLYING INCLUDE SWIVEL JOINT, EYE BOLTS, ETC.
2. THE 12-INCH-RULE EXEMPTION HAS ADDITIONAL REQUIREMENTS:
   - LATERAL MOTION OF THE PIPING SHALL NOT CAUSE IMPACT WITH OTHER SYSTEMS (E.G. OTHER PIPE, DUCT, OR ELECTRICAL SYSTEMS, EQUIPMENT, STRUCTURAL MEMBERS ETC., OR FRAGILE APPURTENANCES SUCH AS SPRINKLER HEADS OR LIGHTING FIXTURES) OR LOSS OF SYSTEM VERTICAL SUPPORT.
   - THE FUNCTIONAL AND PHYSICAL INTERRELATIONSHIP OF COMPONENTS, THEIR SUPPORT, AND THEIR EFFECT ON EACH OTHER SHALL BE CONSIDERED SO THAT THE FAILURE OF AN ESSENTIAL OR NONESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT SHALL NOT CAUSE THE FAILURE OF AN ESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT.
   - PIPING MUST BE MADE OF DUCTILE MATERIAL WITH DUCTILE CONNECTIONS (E.G. WELDED STEEL PIPE, ETC.)
   - VERTICAL ROD HANGER TOP CONNECTIONS TO THE BUILDING STRUCTURE CANNOT DEVELOP MOMENTS. MOMENTS MAY BE ELIMINATED BY USING SWIVEL ATTACHMENTS OR BY OTHER MEANS.
   - THE 12-INCH-RULE EXEMPTION IS APPLICABLE TO SINGLE-TIER TRAPEZE ONLY.

1.6 SEISMIC BRACING GENERAL REQUIREMENTS - ELECTRICAL SYSTEMS

$$a_P = 2.5;\ R_P = 6.0;\ S_{DS} = 2.5;\ \Omega_o = 2.0;\ I_P = 1.5;\ z/h \leq 1$$

The above parameters for this section are worst case and apply to Electrical Conduit and Cable Trays, per the ASCE/SEI 7-16, Table 13.6-1. For additional factors for different systems see the ASCE/SEI 7-16, Table 13.6-1.

1. Seismic restraints are required for the following electrical installations:

   A. All conduits 2 1/2" diameter and larger where Seismic Design Category is D thru F and Ip is equal to 1.5.
   B. All conduits, cable trays and trapeze assemblies weighing 10 lbs./ft. or more where Seismic Design Category is D thru F and Ip is equal to 1.5.
   C. Trapeze supported conduit that would require seismic bracing if supported individually.

   Exceptions:
   Seismic restraints are not required where either of the following conditions is met:

   - All conduit or cable trays suspended by individual hanger rods 12 inches or less in length from the top of the support point to the bottom of the support structure where hanger is connected. (See Page 1-20).
   - Trapeze supported systems suspended 12 inches or less from the top of the trapeze support point to the bottom of the support structure where trapeze is connected. (See Page 1-20).

   In both exceptions above, all of the hangers of a run must comply with the 12-inch rule or bracing is required.

   The 12-inch rod rule exception has the following additional requirements:

   - Lateral motion of the electrical system will not cause impact with other systems (e.g. other electrical systems, piping, duct, equipment, structural members etc., or fragile appurtenances such as sprinkler heads or lighting fixtures) or loss of system vertical support.
   - Electrical system must be made of ductile material with ductile connections.
   - Vertical rod hanger top connections to the building structure cannot develop moments. Moments may be eliminated by using swivel attachments or by other means.

2. Transverse bracing shall be provided at 40 ft. maximum spacing (unless reduced spacing is required per Sections 2 through 9, and 14).

3. Longitudinal bracing shall be provided at 80 ft. maximum spacing (unless reduced spacing is required per Sections 2 through 9. Maximum longitudinal brace spacing shall not exceed two times maximum transverse brace spacing (S).

4. Conduits constructed of non-ductile materials such as EMT, shall have the maximum brace spacing reduced, if necessary so as not to exceed spacings of either Notes 2 and 3 above, nor Section 14.

5. All braces shall be located at or within 6" of a vertical support. Provide rod stiffener for vertical support where required by Page 12-17 or 12-18.

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1.6 SEISMIC BRACING GENERAL REQUIREMENTS - ELECTRICAL SYSTEMS (CONT'D)

6. When bracing trapeze supports, the bracing shall be attached directly to the trapeze, with conduits or cable trays secured to the trapeze with straps, conduit clamps, or cable tray clips bolted to B-Line strut, as detailed in this OPM. At transverse brace locations, a minimum of one transverse brace is required per trapeze. At longitudinal brace locations, a minimum of two longitudinal brace are required per trapeze, one at each vertical support, or rod. At locations where both transverse and longitudinal seismic bracing is required, both conditions apply.

7. Stacked trapezes supported by the same rods shall be braced independently from one another. The rod supports in each section may require stiffening. (See Pages 4-19, 4-20, 4-21, 8-9, 8-20, 8-21, 12-17, 12-18)

8. See Page 12-21 for Maximum Brace Member Lengths.

9. The following Tolco products were engineered with torque indicators to ensure proper installation (See Sections 11 & 12):

   A. Fig. 909 (Page 12-10) No-Thread Swivel Sway Brace Attachments have a connecting bolt head that bottoms out.
   B. Fig. 980 (Page 12-1) & Fig. 981 (Page 12-2) Universal Swivel Sway Brace Attachments have break-off bolt heads.
   C. Fig. 985 (Page 12-4) & Fig. 986 (Page 12-5) Swivel Sway Brace Attachments have break-off bolt heads.
   D. Fig. 990 (Page 12-7) & Fig. 991 (Page 12-8) Cable Sway Brace Attachments have break-off nuts.
   E. Fig. 1000 (Page 12-13) Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement.
   F. Fig. 1001 (Page 12-14) Sway Brace Attachment has bolt heads that bottom out.
   G. Fig. 800 (Pages 11-65, 11-66 & 11-67) , Fig. 825 (Page 11-62) & Fig. 828 (Page 11-64) Adjustable Sway Brace Attachment to Steel and Bar Joist have break-off bolt heads.
   H. Fig. 4L (Page 12-6) Sway Brace Attachments have break-off bolt heads.
   I. Through-bolts shall be torqued by 3/4 turn of the nuts after the snug tight (The snug-tight condition is defined as the tightness required to bring the connected piles into firm contact) condition is achieved. Minimum 3 bolt threads shall pass nuts.

10. For additional information and requirements refer to the appropriate codes and standards as listed on Page 1-7.

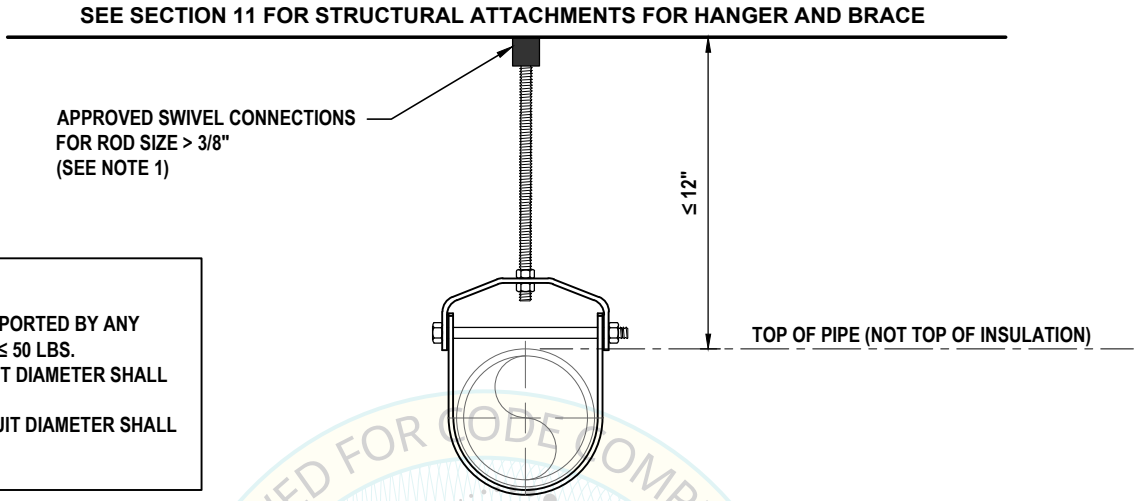
11. Continue with "Seismic Bracing Layout - General Requirements" on Pages 1-21 to 1-25.

12. Cable tray or Raceway transverse and longitudinal brace spacing shall not exceed those specified by the manufacturer. Rigid Metal Conduit (RMC, schedule 40 pipe), Intermediate Metal Conduit (IMC), and Electrical Metallic Tubing (EMT), shall be braced at spacings tabulated in Section 14. Longitudinal brace spacing shall not exceed 3 times the tabulated transverse brace spacings. For cases where multiple conduits with varying brace spacings are supported on trapeze, the smallest brace spacing shall govern. The seismic design engineer may design brace spacings for trapezed conduits based on combined conduits sections and/or by adding steel strengthening sections on a job basis subject to approved by the enforcement agency.

13. Bus duct transverse and longitudinal brace spacing shall not exceed those specified by the manufacturer. Bus duct shall be braced at spacings tabulated in Section 14. Longitudinal brace spacing shall not exceed 3 times the tabulated transverse brace spacings. For cases where multiple conduits with varying brace spacings are supported on trapeze, the smallest brace spacing shall govern. The seismic design engineer may design brace spacings for trapezed conduits based on combined conduits sections and/or by adding steel strengthening sections on a job basis subject to approved by the enforcement agency.

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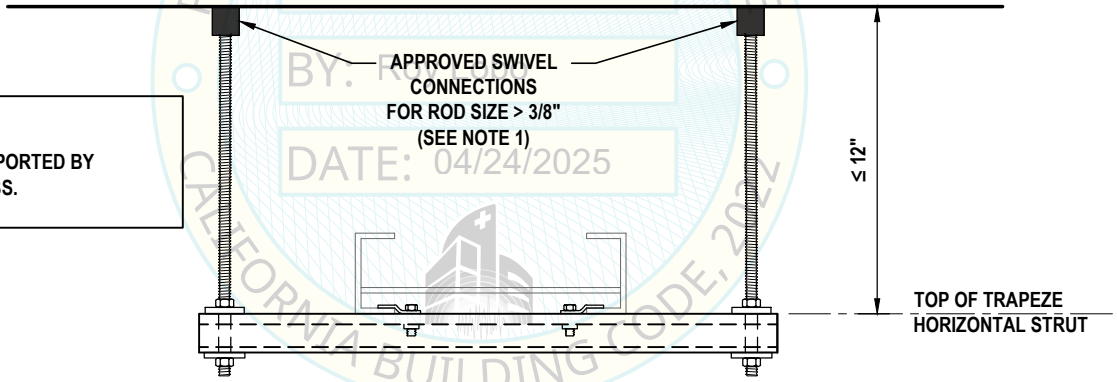
1.3.1 12-INCH-RULE EXEMPTION FOR SUSPENDED RACEWAYS



LIMITATIONS:

1. TOTAL WEIGHT SUPPORTED BY ANY SINGLE HANGER IS ≤ 50 LBS.
2. FOR I_p = 1.0, CONDUIT DIAMETER SHALL NOT EXCEED 3".
3. FOR I_p = 1.50, CONDUIT DIAMETER SHALL NOT EXCEED 1".

CLEVIS HUNG CONDUIT



LIMITATIONS:

1. TOTAL WEIGHT SUPPORTED BY TRAPEZE IS ≤ 100 LBS.

CONDUIT OR CABLE TRAY ON SINGLE-TIER TRAPEZE

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NOTES:

1. CONNECTIONS COMPLYING INCLUDE SWIVEL JOINT, EYE BOLTS, ETC.
2. THE 12-INCH-RULE EXEMPTION HAS ADDITIONAL REQUIREMENTS:
   - LATERAL MOTION OF THE PIPING SHALL NOT CAUSE IMPACT WITH OTHER SYSTEMS (E.G. OTHER PIPE, DUCT, OR ELECTRICAL SYSTEMS, EQUIPMENT, STRUCTURAL MEMBERS ETC., OR FRAGILE APPURTENANCES SUCH AS SPRINKLER HEADS OR LIGHTING FIXTURES) OR LOSS OF SYSTEM VERTICAL SUPPORT.
   - THE FUNCTIONAL AND PHYSICAL INTERRELATIONSHIP OF COMPONENTS, THEIR SUPPORT, AND THEIR EFFECT ON EACH OTHER SHALL BE CONSIDERED SO THAT THE FAILURE OF AN ESSENTIAL OR NONESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT SHALL NOT CAUSE THE FAILURE OF AN ESSENTIAL MECHANICAL OR ELECTRICAL COMPONENT.
   - PIPING MUST BE MADE OF DUCTILE MATERIAL WITH DUCTILE CONNECTIONS (E.G. WELDED STEEL PIPE, ETC.)
   - VERTICAL ROD HANGER TOP CONNECTIONS TO THE BUILDING STRUCTURE CANNOT DEVELOP MOMENTS. MOMENTS MAY BE ELIMINATED BY USING SWIVEL ATTACHMENTS OR BY OTHER MEANS.
   - THE 12-INCH-RULE EXEMPTION IS APPLICABLE TO SINGLE-TIER TRAPEZE ONLY.

1.7 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS

The Eaton B-Line TOLCO Seismic Restraint Guidelines provides for the protection of suspended pipe, ducts and electrical systems and equipment against excessive movement due to seismic forces.

1. The seismic restraint assemblies in this guideline are designed to simultaneously resist vertical loads due to the weight of the component and its contents and both horizontal and vertical seismic loads.

2. Horizontal loads are braced with two types of seismic restraints;

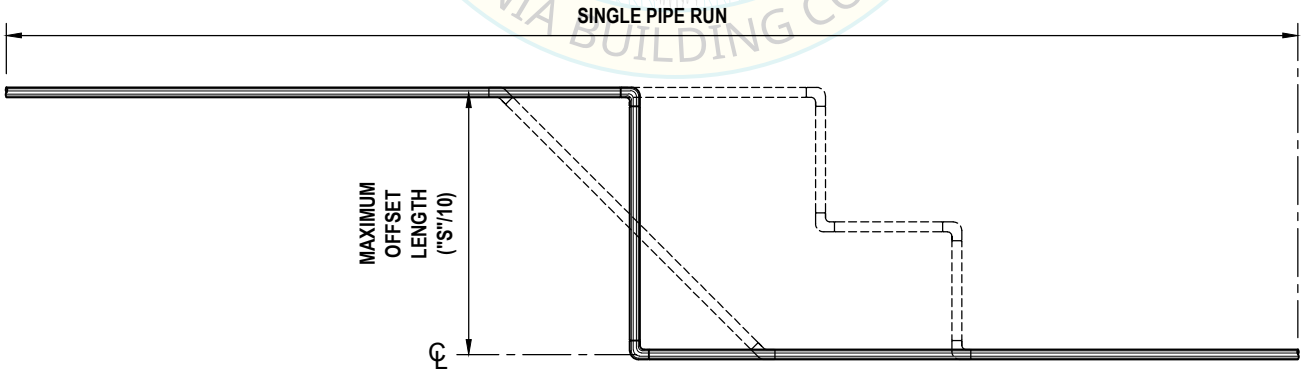
   A. Transverse Brace to protect pipe, duct, or electrical conduit and cable tray against movement perpendicular to its run.
   B. Longitudinal Brace to protect pipe, duct, or electrical conduit and cable tray against movement parallel to its run.

3. For the purpose of these guidelines, refer to the following legend for the parameters shown:

LEGEND	
A	Offset Brace Location
D	Distance to first Longitudinal Brace Around Corner
L	Maximum Longitudinal Brace Spacing
S	Maximum Transverse Brace Spacing
(T)	Transverse Brace Location
(L)	Longitudinal Brace Location
(TL)	Transverse Brace Location also Acting as Longitudinal Brace

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4. A run of pipe, duct or electrical system is defined as a straight length, or one with allowable offsets, that is 10 feet or greater in length that occurs between changes in direction. If there occurs an offset(s) between changes of direction it may be neglected if the distance perpendicular to the run is less than the maximum offset length, S/10, where S is the maximum transverse brace spacing tabulated in Section 14 less any reductions from Sections 2 through Section13. For ductwork the maximum offset length shall be less than 2 feet (inside-to-inside). See detail below.



PLAN VIEW

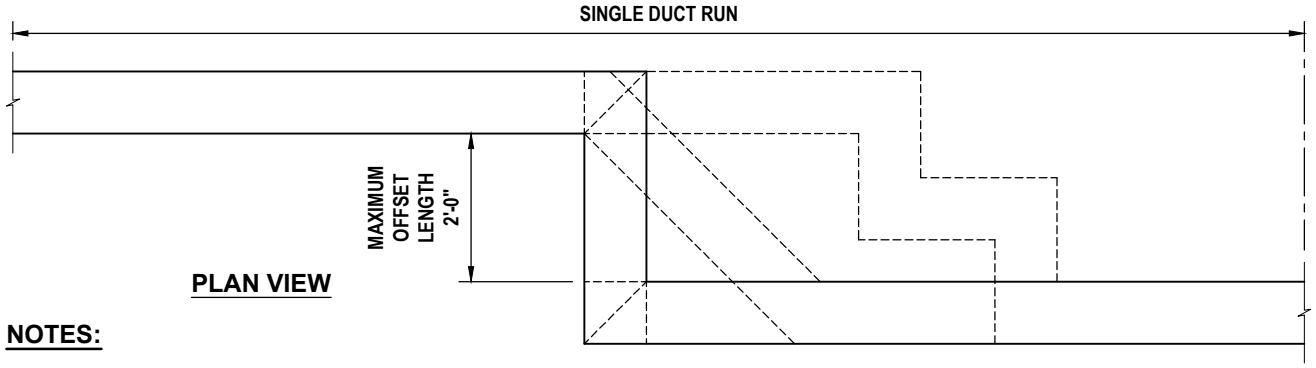
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DATE: April 23, 2025

1.7 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

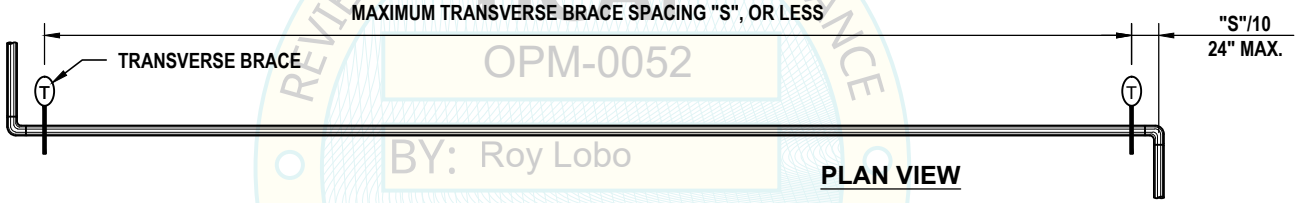


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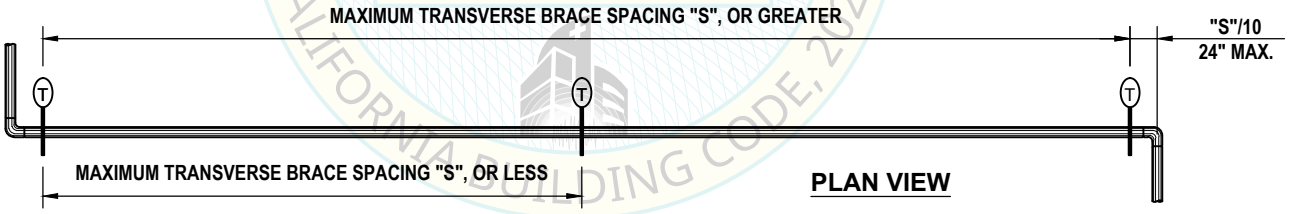
(1) For the purpose of these guidelines a "run" is defined as a suspended, distributed utility having a minimum of 10 feet straight run length. Refer to Page 1-23 for guidance on treating interconnected short runs with multiple off-sets.

(2) When a run of pipe, duct or electrical system that requires bracing transitions down to a size that does not, the point of transition is considered the end of the run and will require a transverse brace.

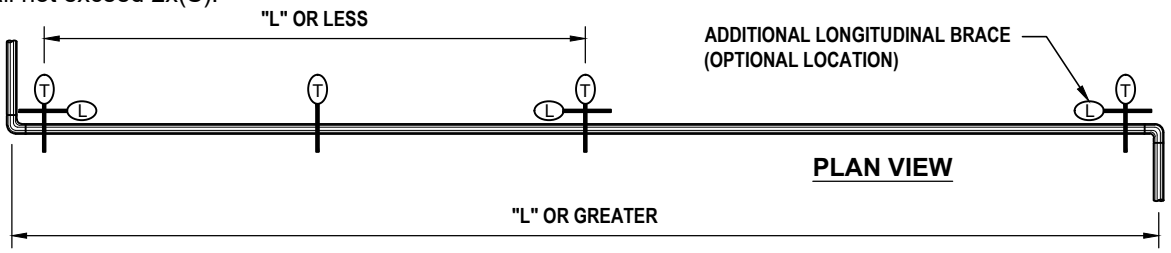
5. Each run of pipe, duct, electrical conduit, cable tray and others requires a minimum of two transverse braces one at each end of the run.



6. If the distance between the two transverse braces exceeds the maximum allowable spacing (S), add transverse braces as needed.



7. Each run of pipe, duct, electrical system, cable tray and others must have at least one longitudinal brace. If the maximum allowable longitudinal spacing (L), is exceeded then add longitudinal braces to meet the spacing requirement. (L) shall not exceed 2x(S).

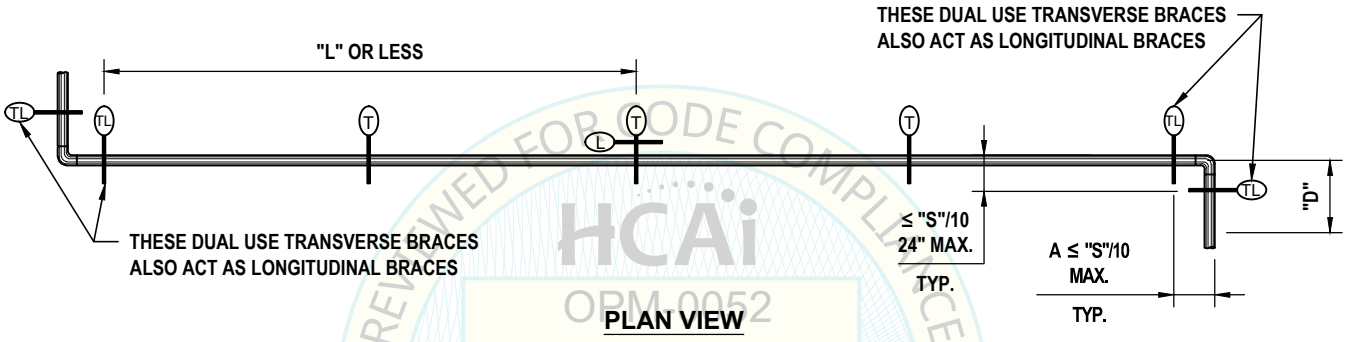


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1.7 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

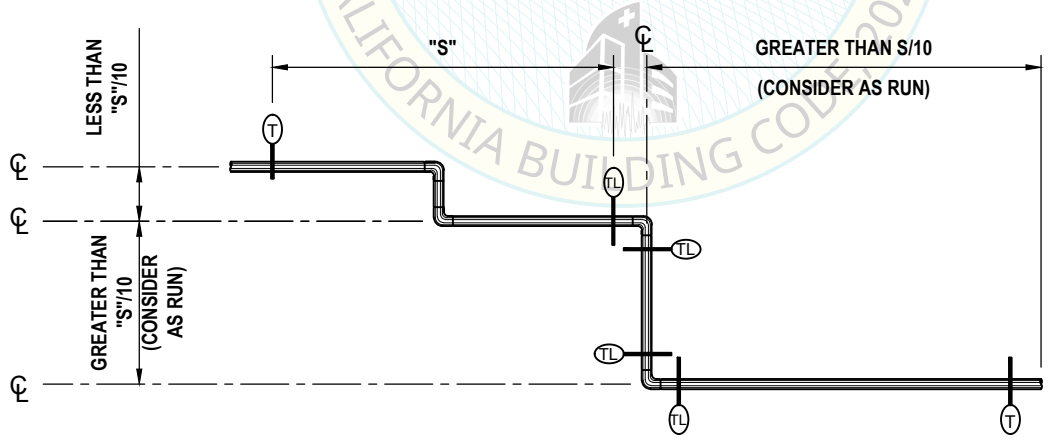
8. Each run of pipe, duct, electrical system, cable tray and others requires a minimum of one longitudinal brace. However, a transverse brace placed on the run section at the opposite side of an elbow or tee within S/10 MAX. may act as a longitudinal brace, and can be referred to as a "DUAL USE" brace. Dual Use Braces are to be designed for worst case of longitudinal or transverse loading. Distance to first longitudinal brace around corner ("D") shall not exceed maximum longitudinal spacing (L), minus S/2, minus A. See layout example below.

   A. Longitudinal and Longitudinal "DUAL USE" braces on single supported pipe or conduit shall be attached directly to the pipe or conduit.
   B. Bracing installed to smaller piping shall not be used to brace larger piping.



PLAN VIEW

9. In some cases several short runs may occur in close proximity. By following the preceding guidelines each run shall have longitudinal and transverse bracing. Transverse bracing may be used as longitudinal bracing and vice versa on runs adjacent to each other as long as the total length of pipe tributary to the brace does not exceed the maximum allowable spacing "S" (See Note 4 on Page 1-21). In cases where it does, additional braces are required.

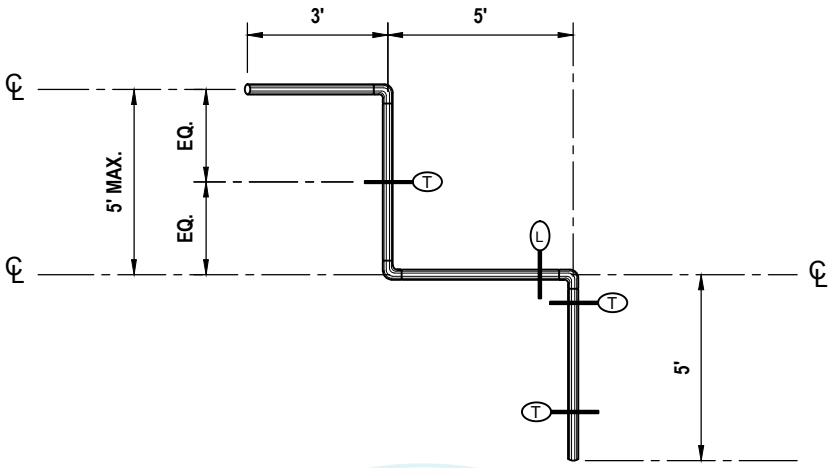


PLAN VIEW

[EXAMPLE FOR THE END OF SHORT OFFSET CONDITION]

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1.7 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)



PLAN VIEW

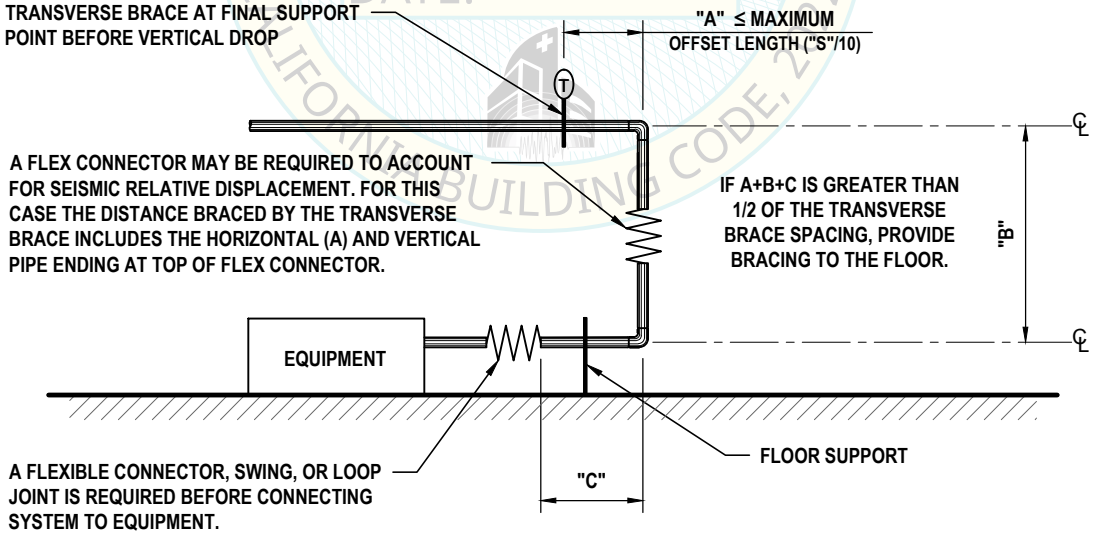
[EXAMPLE FOR THE END OF SHORT OFFSET CONDITION]

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NOTES:

Short offsets shall not exceed 10 feet cumulative length.

10. At vertical pipe or conduit drop to equipment, where pipe or conduit is connected to the equipment using a flexible connection, provide transverse bracing before the vertical drop. The total length from the transverse brace to the vertical drop shall not be more than the allowable offset previously determined ("S"/10). Provide transverse bracing at the floor after the vertical drop if the total length of the pipe from the transverse brace before the vertical drop to the flexible connection is greater than 1/2 of the maximum transverse brace spacing ("S"/10).



ELEVATION

1.7 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

11. When systems cross a building seismic separation or seismic joint they must be capable of accommodating the joint displacements as specified by the engineer of record.

12. When systems cross a building seismic separation or seismic joint they must be capable of accommodating the joint displacements as specified by the engineer of record.

13. A system shall not be braced to dissimilar parts of a building structure or two dissimilar building systems that may move different from one another during an earthquake. Bracing shall be attached to the part of the building structure that is supporting the pipe, duct or electrical system.

14. Transverse and longitudinal braces shall be installed as shown in this guideline up to 60° from horizontal. However, the recommended brace ratio is 45° from horizontal, or 1 (vert.):1 (horiz.) brace ratio.

15. All transverse and longitudinal braces utilizing strut, steel pipe, or steel cable with Tolco Fig. 900 series fittings on both ends have an alignment tolerance of 5° from center without adversely affecting the given loads. This applies to single hanger supports as well as trapeze hanger support. See Page 12-21 for more information.

16. The seismic brace assemblies in this guideline consist of three important components; (a) supports and attachments to building structure; (b) brace member such as strut, pipe, angle iron, or cable; and (c) seismic brace attachments. For details and load information of structural attachments see Section 11, for details of brace assemblies see applicable "Brace Details" section(s).

17. Single Rigid Braces, where required, must be at or within 6 inches of a vertical hanger assembly to protect against vertical movement. When the vertical hanger assembly consists of threaded rods for support rod stiffeners are to be provided when required (See Pages 12-17 & 12-18). An exception to this would be the use of two opposing rigid braces at the same location. The two opposing rigid braces must be at the same angle from horizontal and within 5-degrees of perpendicular to the pipe. In this case no rod stiffeners are necessary for vertical rods.

18. At a brace location, threaded rod and their building attachment components used in a vertical hanger assembly shall be increased in size when capacity is inadequate for loads due to the additional seismic tension loads placed upon them. The vertical hanger assembly is adequate if the maximum allowable load of its components is greater than or equal to the system gravity load plus any additional seismic loads.

19. Steel bolt connections to steel structure or components shall not have a diameter less than 1/16" less than the mounting hole. Steel bolt connections to concrete structure shall not have a diameter less that 1/8" less than the mounting hole.

20. No attachment shall be made in the protection zones for steel beams in moment frames, per Section D1.3 of AISC 341.

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1.8 GENERAL DESIGN PROCEDURE - SINGLE HANGER AND TRAPEZE BRACING

The following presents a general procedure for design of seismic bracing for single rod hangers and trapeze supports. The following assumes that a system design layout has been provided, and that gravity hanger supports have been designed by others. The following also assumes that seismic bracing has been determined to be required. Pre-designed table have been provided starting on Page 1-45, which allow skipping the following calculations for those configurations. For Registered Design Professionals (RDP), use the following design procedures, or the Pre-Designed Tables starting on Page 1-45. The following steps are to be followed, unless designated otherwise.

STEP 1: Seismic Force Coefficient

Determine the total design lateral seismic force coefficient based on the applicable code, project drawings, and specifications. This coefficient is commonly referred to as the "G-factor"; i.e. F_P = 0.5G (ASD). In case of a conflict, use the more stringent criteria. The total design horizontal seismic force coefficient, when multiplied by the weight of the system, represents the total design lateral seismic force.

According to 2022 CBC and its referenced standards as listed on Page 1-7, the total design lateral seismic force, Fp, and the total vertical seismic force, Fv, shall be determined from the following formulas. The final Fp and Fv shall be multiplied by 0.70 to convert the strength based seismic force to the allowable stress based seismic force (ASD) as included in formulas below. This is necessary because the loads and brace spacing in this manual are based on the allowable stress design (ASD).

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Horizontal Seismic Force:

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}} (1+2\frac{z}{h})\, W_P \right] (0.70) \qquad \text{(ASD)(ASCE 7-16, EQ. 13.3-1)}$$

Except that:

F_P need not to be greater than $1.6\, S_{DS}\, I_P\, W_P\, (0.70)$ (ASD)(ASCE 7-16, EQ. 13.3-2)
and shall not be less than $0.3\, S_{DS}\, I_P\, W_P\, (0.70)$ (ASD)(ASCE 7-16, EQ. 13.3-3)

Vertical Seismic Force:

$F_V = 0.2\, S_{DS}\, W_P\, (0.70)$ (ASD)(ASCE 7-16, Section 13.3.1)

Where:

S_{DS} = Design spectral acceleration for short periods
a_P = Component amplification factor
I_P = Component importance factor
W_P = Component operating weight (lbs.)
R_P = Component response modification factor
z = Height of structure at point of attachment of component with respect to the base of building (ft.)
h = Average roof height of structure with respect to the base of building (ft.)

Refer to 2022 CBC codes for additional information & requirements. See also Sub-Sections 1.3, 1.4, 1.5, & 1.6 of this manual for allowable values for these parameters per the ASCE 7-16, Table 13.6-1.

1.8 GENERAL DESIGN PROCEDURE - SINGLE HANGER AND TRAPEZE BRACING (CONT'D)

Step 2: Seismic Bracing Detail

Tentatively select two Seismic Bracing Details; choose one detail for Transverse Bracing and one detail for a Longitudinal Bracing. If using rigid braces select from Section 2 for "Single Hung Pipe" or Section 4 for "Trapeze". If using cable braces select from Section 6 for "Single Hung Pipe" or Section 8 for "Trapeze Supported Pipe". The capacity of these two choices will be confirmed in a subsequent Step.

Step 3: Structural Attachment Detail

Select a Structural Attachment Detail appropriate for the building construction from Sections 3, Section 5, Section 7, or Section 9. This section allows a detail to be selected by utilizing the F_P factor found in step 1 and either the pipe size of the pipe being braced or the weight being applied to the trapeze (see application in examples on Pages 1-24, 1-27, and 1-32) . Select a Structural Attachment Detail appropriate for the building construction from Sections 3, 5, 7, or 9. Selection shall consider Seismic Bracing Detail from Step 2 so as to correspond to the same bracing configuration, rigid or cable brace. Sections that correspond to one another are as follows: Sections 2 and Section 3; Section 4 and Section 5; Sections 6 and Section 7; Sections 8 and Section 9. In any case Section 11 applies. At all tables with the following note, "Max load includes over strength factor Ω_o = 2.0 per ASCE 7-16, Table 13.6-1 to satisfy ACI 318-19", compare values with F_P directly without amplification by Ω_o, since capacities have already been adjusted to consider it.

Step 4: Brace Spacing

Determine the maximum transverse and maximum longitudinal brace spacings from the Section 3 "Single Hanger Rigid Brace Spacing Charts", or Section 5 "Trapeze Rigid Brace Spacing Charts", or Section 7 "Single Hanger Cable Brace Spacing Charts", Section 9 "Trapeze Cable Brace Spacing Charts", or Section 11 "Structural Attachments" and Section 14 "Pipe Stress and Deflections" (where pipe occurs). The maximum spacing chosen shall be the least of the allowable spacings for the specific structural attachment detail previously selected and/or the stresses to the pipe itself per Section 14.

The brace spacings listed in Section 3, Section 5, Section 7, Section 9, and Section 14, are based on the pipe size, maximum pipe weight per ft., and the total design horizontal seismic force coefficients of 0.25G, 0.5G, 0.75G and 1.0G. To determine the maximum allowable spacing for other G-factors, use the spacing charts provided for 1.0G and divide the spacing given for the applicable pipe size or weight per ft. by the project specific G-factor, as previously determined.

Example: If the allowable spacing is 21ft for 1.0g, the allowable spacing for 0.7g will be: 21ft / 0.7g = 30ft.

The brace spacing shall not exceed the maximum allowable brace spacing based on the requirements listed in the general notes section. The transverse brace spacing shall not exceed the maximum allowable spacings tabulated in Section14.

When using single brace rigid bracing, brace spacing may be limited by the gravity hanger support system and its attachment to the structure due to the additional vertical load which is equal to the horizontal seismic load (for brace at 45 degrees; for other angles calculate appropriate vertical component based on the angle) applied by the seismic bracing on the gravity hanger support system. Verify that the hanger support system and its attachment to the structure are adequate for the applied gravity load plus vertical seismic force equal to the maximum horizontal seismic force (for brace at 45 degrees; for other angles calculate appropriate vertical

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1.8 GENERAL DESIGN PROCEDURE - SINGLE HANGER AND TRAPEZE BRACING (CONT'D)

Step 5: **Attachment to Strut** (Trapeze Supported Systems Only)

Verify the adequacy of the pipe, duct or electrical system attachment to the strut. The attachment must be adequate to transfer transverse, longitudinal and vertical seismic loads to strut as per Section 13. See Pages 13-17 through 13-20.

Step 6: **Trapeze Support Member** (Trapeze Supported Systems Only)

Determine the adequacy of the trapeze member to carry the seismic loads in addition to the gravity loads. The trapeze member shall be designed to carry the gravity loads and seismic loads. The gravity load and vertical seismic load will apply bending. The transverse seismic loads will apply an axial load and an additional bending. The longitudinal seismic loads are often much larger than the vertical gravity and seismic loads, and will apply loads about the weak axis causing additional bending. The trapeze support member shall be increased in size if required to satisfy the design criteria described above. Reference Pages 13-17 through 13-20 to determine adequacy of strut.

Step 7: **Determine Demand**

Determine the applied horizontal seismic loads, F_p, (DEMAND) by using the G-Factor from Step 1 and the Brace Spacing from Step 4. The DEMAND is **[(G-Factor) x (Maximum Weight-per-Foot) x (Brace Spacing)]**.

Step 8: **Confirm CAPACITY Exceeds DEMAND**

Confirm the applied horizontal seismic load (DEMAND) calculated in Step 7 is less than the allowable horizontal seismic load (CAPACITY) in the detail load table chosen in Step 2. If not, then redo Step 2 and Step 4 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 9: **Determine Total Vertical Load at Hanger**

Determine total vertical load at the hanger (DEMAND), which is **[(Gravity Vertical) + (Seismic Vertical) + (Brace Induced-Seismic Vertical Loads)]**. Then select a hanger attachment detail from Section 11 with a CAPACITY that exceeds this DEMAND. If the CAPACITY does not exceed the demand, then redo Step 2 and Step 4 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 10: **Bracing Layout**

Layout the seismic bracing as explained in the previous Sub-Section 1.7 "Seismic Bracing Layout Procedure". Pages 1-21 through 1-25.

Step 11: **Brace Member**

Select a brace member and determine its total length. A brace member shall be B-Line strut channel or schedule 10, schedule 40 steel pipe or cable. Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on Page 12-21. The Maximum applied horizontal load (DEMAND) calculated in Step 7, shall be equal to or less than the maximum allowable horizontal seismic load (CAPACITY) of the brace chosen from Page 12-21.

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1.8 GENERAL DESIGN PROCEDURE - SINGLE HANGER AND TRAPEZE BRACING (CONT'D)

Step 12: Rod Stiffener

Determine if rod stiffeners are required. When the vertical hanger assembly consists of threaded rod for support a stiffener is to be provided when required. See Pages 12-17 and 12-18 for maximum lengths allowed for hanger rods without rod stiffeners. An exception to this would be the use of two opposing rigid braces at the same location. The two opposing braces must be at the same angle from horizontal and within 5 degrees of perpendicular to the pipe. In this case no stiffening of vertical rod is necessary.

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1.9 TYPICAL DESIGN EXAMPLES

1.9.1 EXAMPLE 1 - PIPE OR ELECTRICAL CONDUIT

PROCEDURE STEPS:

The General Design Procedure steps are used as follows to determine hanger and brace components and the seismic brace spacings to seismically restrain a single hanger pipe or electrical conduit.

Step 1: Determine the "G" force factors for F_P and F_V using equations on Page 1-26 for each floor of the building.

Step 2: Select Seismic Bracing Details from Section 2 or Section 6.

Step 3: Select Structural Attachment Details from Section 3, Section 7 and/or Section 11, with a "G" force greater than or equal to that determined in Step 1.

Step 4: Determine the maximum Transverse Brace Spacing and the maximum Longitudinal Brace Spacing from the details chosen in Step 3. The transverse brace spacing shall not exceed the maximum allowable spacings tabulated in Section 14. The longitudinal brace spacing shall not exceed two times the allowable transverse brace spacing.

Step 5: Not applicable.

Step 6: Not applicable.

Step 7: Using the Brace Spacing from Step 4 and the seismic "G" factor from Step 1, determine the applied horizontal seismic load F_P (DEMAND), which is **[(G-Factor) x (Maximum Weight-per-Foot) x (Brace Spacing)]**.

Step 8: Confirm the applied horizontal seismic load (DEMAND) calculated in Step 5 is less than the allowable horizontal seismic load (CAPACITY) in the detail load table chosen in Step 2. If not, then redo Step 2 and Step 6 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 9: Determine total vertical load at the hanger, which is **[(Gravity Vertical) + (Seismic Vertical) + (Brace Induced Seismic Vertical Loads)]**. Then select a hanger attachment detail from Section 11 that exceeds this DEMAND. If not, then redo Step 2 and Step 6 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 10: Prepare the seismic brace layout per Sub-Section 1.7, Page 1-21.

Step 11: Select a brace member and determine its total length. A brace member shall be B-Line strut channel sch. 40 steel pipe or cable.

Step 12: Determine if rod stiffeners are required.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.1 EXAMPLE 1 - PIPE OR ELECTRICAL CONDUIT (CONT'D)

NUMERICAL EXAMPLE:

Determine the hanger and seismic brace design for a 4" diameter (schedule 40) insulated, water filled, steel pipe hung on the third floor of a 4-Story building of poured-in-place concrete slab construction. The gravity hanger spacing is S_h = 10 feet maximum. Each floor is 15 feet in height. The contract drawings specify S_{DS} = 1.50 and I_P = 1.5. For this example the brace angle is 45 degrees.

Step 1: Determine the "G" force factors.

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}} (1+2\frac{z}{h})\, W_P \right] (0.70) \qquad \text{(ASD)} \qquad \text{(ASCE 7-16, EQ. 13.3-1)}$$

where:

a_P = 2.5	(component amplification factor)	(ASCE 7-16, Table 13.6-1)
R_P = 4.5	(component response modification factor for piping not in accordance w/ ASME B31)	(ASCE 7-16, Table 13.6-1)
Ω_o = 2.0	(overstregnth factor for concrete anchors)	(ASCE 7-16, Table 13.6-1)
S_{DS} = 1.5	(from contract drawings)	
I_P = 1.5		
z = 45 feet	(height to attachment)	
h = 60 feet	(height of building)	

F_P = [(0.4)(2.5)(1.5)(1.5)/4.5]*(1+2(45/60)(0.70)W_P = 0.875 W_P
F_P need not exceed F_P = 1.6 S_{DS} I_P W_P (0.70) = 2.52 W_P
F_P must be greater than F_P = 0.3 S_{DS} I_P W_P (0.70) = 0.473 W_P

Since 0.473 ≤ 0.875 ≥ 2.52
F_P = 0.875 W_P

"G" Factor = 0.875 (horizontal)
F_V = (0.20) S_{DS} W_P (0.70) = 0.21 W_P (vertical)

Weight of 4"Ø (schedule 40) steel pipe, full of water, with insulation,
(Per Steel Pipe Weight Table, Page C-1, Appendix C)
W_P = 18.1 lb/ft.

Step 2: Tentatively select two Seismic Bracing Details from Section 2, Page 2-2 for Transverse Bracing and Page 2-11 for Longitudinal Bracing. The choices of Page 2-2 and Page 2-11 will be confirmed in Step 8.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.1 EXAMPLE 1 - PIPE OR ELECTRICAL CONDUIT (CONT'D)

Step 3: Select Structural Attachment Details from Section 3, Section 7 and/or Section 11. For this example, the strength of existing poured-in-place concrete is 3,000 psi. Checking Pages 3-1 through 3-4, the one with a "G" factor higher than in Step 1 is Page 3-4. It has a "G" factor of 1.0. So choose Page 3-4. Note that for this example the right hand table for Longitudinal Bracing on Page 3-3 requires two rigid braces. Compare values with F_P without amplification by Ω_o, since capacities have already been adjusted to consider it.

Step 4: Determine maximum Brace Spacings using the two tables on Page 3-4, then convert the 1.0 G spacings from the table to 0.875 G from Step 1. The transverse brace spacing shall not exceed the maximum allowable spacings tabulated in Section 14. The longitudinal brace spacing shall not exceed two times the allowable transverse brace spacing. All values are ASD.

From table on Page 3-4, Maximum Transverse Brace Spacing @1.0 G = 25 ft
Maximum Transverse Brace Spacing @ 0.875 G = 25ft / 0.875 = 28ft
Checking Page 14-1, this Transverse Brace Spacing of 17ft. does not exceed the 1.0g maximum allowable of 42ft. for the 4 inch sch40 pipe of this example.

From table on Page 3-4, Maximum Longitudinal Brace Spacing @1.0 G = 50 ft
Maximum Longitudinal Brace Spacing @ 0.875 G = 50 ft / 0.875 = 57 ft
(See notes for other restrictions.)

Therefore:
Maximum Transverse Brace Spacing @ 0.875 G = 25ft / 0.875 = 28ft (x1 brace).
Maximum Longitudinal Brace Spacing @ 0.875 G = 2 x 28 ft = 56ft (x2 braces).

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Step 5: Not applicable.

Step 6: Not applicable.

Step 7: Determine the applied horizontal seismic loads, F_P (DEMAND) All values are ASD.

(0.875)(18.1 lb/ft)(28 ft) = 443.5 lb. (Transverse Seismic Load)
(0.875)(18.1 lb/ft)(56 ft) = 887.0 lb. (Longitudinal Seismic Load)

Step 8: Confirm the horizontal seismic load calculated in Step 7 (DEMAND) is less than the allowable horizontal seismic load in the detail load table chosen in Step 2 (CAPACITY). If not, then redo Step 2 and Step 4 by reducing the brace spacing until the DEMAND is less than the CAPACITY. For this example the brace angle is 45 degrees. All values are ASD.

A. Checking Page 2-2 for Transverse Bracing, the rigid brace table has an Allowable Load (CAPACITY) of 448 lb. Therefore, the CAPACITY is greater than the Applied Transverse Seismic Load (DEMAND) from Step 7 of 443.5 lb.

B. Checking Page 2-11 for Longitudinal Bracing, the rigid brace table has an Allowable Load of 730 lb. Since two braces are required by the table on Page 3-4 (determined in Step 3), the CAPACITY for this case is (2 x 730 lb = 1460 lb). Therefore, the CAPACITY is greater than the applied longitudinal seismic load (DEMAND) from Step 7 of 887.0 lb.

1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.1 EXAMPLE 1 - PIPE OR ELECTRICAL CONDUIT (CONT'D)

Step 9: Determine the total vertical load (DEMAND) at the critical hanger, P_S, wish equals gravity + seismic vertical + brace-induced seismic vertical loads. Then select a hanger attachment detail from Section 11 with a CAPACITY that exceeds this DEMAND. The induced seismic assumes the case of Longitudinal Seismic Load and brace angle of 45 degrees, and is therefore equal to F_P. All values are ASD.

S_h = 10 feet (Gravity Hanger Spacing)
$P_S = W_P (S_h) + F_V (S_h) + F_P$ [tangent (brace angle from horizontal)]
P_S = (18.1 lb/ft)(10 ft) + (0.21)(18.1 lb/ft)(10 ft) + 887.0 lb./2 braces
P_S = 662.5 lb. vertical at hanger

Checking Page 11-2, and checking 1/2" dia. Hilti KB-TZ2 with 3 ¼" minimum embedment, the CAPACITY is 890 lb., which exceeds the DEMAND.

Step 10: Prepare the seismic brace layout per Page 1-21, Sub-Section 1.7.

Step 11: Select a brace member and determine it's total length. A brace member shall be B-Line strut channel or schedule 40 steel pipe or cable. Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on Page 12-21. The Maximum applied horizontal load (DEMAND) calculated in Step 7, shall be equal to or less than the maximum allowable horizontal seismic load (CAPACITY) of the brace chosen from Page 12-21. For this example, assume a brace length of 7'-0".

A. From Page 12-21 Choose B-Line Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 1097lb. horizontal which exceeds the Transverse Seismic Load (DEMAND) from Step 7 of 443.5 lb., and with a Maximum Length = 9'-6", which exceeds the example brace length of 7'-0".

B. From Page 12-21 choose B-Line B22 Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 1097lb. horizontal which exceeds the Longitudinal Seismic Load (DEMAND) from Step 7 of 887.0 lb., and with a Maximum Length = 9'-6", which exceeds the example brace length of 7'-0"

Step 12: Determine if rod stiffeners are required. See Pages 12-17 or 12-18 for maximum lengths allowable for hanger rods without rod stiffeners. For this example, assume a hanger rod length of 60 inches. Checking the table on Page 12-17, the Maximum Rod Length without rod stiffener for the 1/2" rod of this example = 25". Since the example rod length exceeds this maximum, then rod stiffeners must be installed at a minimum of every 18", as shown on Page 12-18.

FLOOR LEVEL	PIPE SIZE	HANGER SPACING (FT)	HANGER ANCHOR DIA. (IN)	HANGER ANCHOR EMBED (hef)(IN)	TRANSVERSE BRACING			LONGITUDINAL BRACING			BRACE ANGLE FROM HORIZ. (DEG)	BRACE ANCHOR DIA. (IN)	HANGER ANCHOR EMBED (hef)(IN)
					BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACHMENT DETAIL PAGE	BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACHMENT DETAIL PAGE			
3	1 1/4"												
	1 1/2"												
	2"												
	3"												
	4"	10	1/2	3 1/4	28	2-2	11-1	56	2-13	11-1	45	1/2	3 1/4

1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.1 EXAMPLE 1 - PIPE OR ELECTRICAL CONDUIT (CONT'D)

In conclusion, the 4" diameter (Schedule 40) steel pipe in this example, hung at 10 ft. spacing on the third floor of a 4-Story building, can be adequately braced using:

- Page 2-2, Detail SR-2, Transverse Rigid Bracing for Single Hung Pipe or Conduit,
- Page 2-12, Detail SR-12, Longitudinal Rigid Brace for Single Hung Pipe or Conduit, 2 braces per location,
- Page 3-4, Single Pipe Hanger Brace Spacing Chart for Concrete Wedge Anchors,
- Page 11-1, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete, for Brace Attachments,
- Page 11-2, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete, for Hanger Attachments,
- Transverse Brace Spacing is 28 ft o.c.,
- Longitudinal Brace Spacing is 56 ft o.c.
- Transverse and Longitudinal Brace angle is 45°.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.2 EXAMPLE 2 - TRAPEZE SUPPORTS

PROCEDURE STEPS:

The General Design Procedure steps are used as follows to determine trapeze hanger and brace components and the seismic brace spacings to seismically restrain trapeze supports.

Step 1: Determine the "G" force factors for F_P and F_V using equations on Page 1-26 for each floor of the building.

Step 2: Select Seismic Bracing Details from Section 4 or Section 8.

Step 3: Select Structural Attachment Details from Section 5, Section 9 and/or Section 11, with a "G" force factor greater than or equal to that determined in Step 1.

Step 4: Determine the maximum Transverse Brace Spacing and the maximum Longitudinal Brace Spacing from the details chosen in Step 3. The transverse brace spacing shall not exceed the maximum allowable spacings tabulated in Section 14. The longitudinal brace spacing shall not exceed two times the allowable transverse brace spacing.

Step 5: Attachment to Strut (Trapeze Supported Systems Only) - Verify the adequacy of the pipe, duct or electrical system attachment to the strut. The attachment must be adequate to transfer transverse, longitudinal and vertical seismic loads to strut.

Step 6: Trapeze Support Member (Trapeze Supported Systems Only) - Determine the adequacy of the trapeze member to carry the seismic loads in addition to the gravity loads. The trapeze member should be designed to carry the gravity loads and seismic loads. The gravity load and vertical seismic load will apply bending. The transverse seismic loads will apply an axial load and an additional bending. The longitudinal seismic loads are often much larger than the vertical gravity and seismic loads, and will apply loads about the weak axis causing additional bending. The trapeze support member shall be increased in size if required to satisfy the design criteria described above.

Step 7: Using the Brace Spacing from Step 4 and the seismic "G" factor from Step 1, determine the applied horizontal seismic load, F_P (DEMAND), which is **[(G-Factor) x (Maximum Weight-per-Foot) x (Brace Spacing)]**.

Step 8: Confirm the applied horizontal seismic load (DEMAND) calculated in Step 5 is less than the allowable horizontal seismic load (CAPACITY) in the detail load table chosen in Step 2. If the CAPACITY does not exceed the demand, then redo Step 2 and Step 6, by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 9: Determine total vertical load at the hanger, which is **[(Gravity Vertical) + (Seismic Vertical) + (Brace Induced seismic Vertical Loads)]**. Then select a hanger attachment detail from Section 11 that exceeds this DEMAND. If not, then redo Step 2 and Step 6, by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 10: Prepare the seismic brace layout per Page 1-21, Sub-Section 1.7.

Step 11: Select a brace member and determine it's total length. A brace member shall be B-Line strut channel or schedule 40 steel pipe or cable.

Step 12: Determine if rod stiffeners are required.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.2 EXAMPLE 2 - TRAPEZE SUPPORTS (CONT'D)

NUMERICAL EXAMPLE:

Determine the trapeze hanger seismic brace design to support one 4"Ø (schedule 40) insulated, water filled, steel pipe hung on the third floor of a 4-Story building of poured-in-place concrete slab construction. The gravity hanger spacing is S_h = 10 feet maximum. Each floor is 15 feet in height. The contract drawings specify S_{DS} = 1.50 and Ip = 1.5. For this example the brace angle is 45 degrees.

Step 1: Determine the "G" force factors.

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}} (1+2\frac{z}{h})\, W_P \right] (0.70) \qquad \text{(ASD)} \qquad \text{(ASCE 7-16, EQ. 13.3-1)}$$

where:

a_P = 2.5 (component amplification factor) (ASCE 7-16, Table 13.6-1)
R_P = 4.5 (component response modification factor for piping not in accordance w/ ASME B31) (ASCE 7-16, Table 13.6-1)
Ω_o = 2.0 (overstregnth factor for concrete anchors) (ASCE 7-16, Table 13.6-1)
S_{DS} = 1.5 (from contract drawings)
I_P = 1.5
z = 45 feet (height to attachment)
h = 60 feet (height of building)

$F_P = [(0.4)(2.5)(1.5)(1.5)/4.5]*(1+2(45/60)(0.70)W_P = 0.875\ W_P$
F_P need not exceed $F_P = 1.6\ S_{DS}\ I_P\ W_P\ (0.70) = 2.52\ W_P$
F_P must be greater than $F_P = 0.3\ S_{DS}\ I_P\ W_P\ (0.70) = 0.473\ W_P$

Since $0.475 \le 0.875 \ge 2.52$
$F_P = 0.875\ W_P$

"G" Factor = 0.875 (horizontal)
$F_V = (0.20)\ S_{DS}\ W_P\ (0.70) = 0.21\ W_P$ (vertical)

Weight of 4"Ø (schedule 40) steel pipes, full of water, with insulation,
(Per Steel Pipe Weight Table, Page C-1, Appendix C)
W_P = 18.1 lb/ft.

Step 2: Tentatively select two Trapeze Seismic Bracing Details from Section 4, Page 4-1 for Transverse Rigid Bracing, and Page 4-3 for combined Transverse and Longitudinal Rigid Bracing. The choices of Page 4-1 and Page 4-3 will be confirmed in Step 8.

Step 3: Select Structural Attachment Details from Section 5, Section 9 and/or Section 11. For this example the deck is poured-in-place concrete. Checking Pages 5-1 through 5-4, the one with a "G" factor higher than in Step 1 is Page 5-4. It has a "G" factor 1.0. So choose Page 5-4. Compare Values with F_P without amplification by Ω_o, since capacities have already been adjusted to consider it.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.2 EXAMPLE 2 - TRAPEZE SUPPORTS (CONT'D)

Step 4: Determine maximum Brace Spacings for W_P = 18.1 lb/ft (component weight per linear foot) using the two tables on Page 5-4, then convert the 1.0 G spacings from the table to 0.875 G from Step 1. The transverse brace spacing shall not exceed the maximum allowable spacings tabulated in Section 14. The longitudinal brace spacing shall not exceed two times the allowable transverse brace spacing. All values are ASD.

From table on Page 5-4, Maximum Transverse Brace Spacing @1.0 G = 30 ft
Maximum Transverse Brace Spacing @ 0.875 G = 30 ft / 0.875 = 34 ft
Checking Page 14-1, this Transverse Brace Spacing of 34 ft. does not exceed the 1.0g maximum allowable of 42 ft. for the 4 inch sch40 pipe of this example:

From table on Page 5-4, Maximum Longitudinal Brace Spacing @1.0 G = 60 ft
Maximum Longitudinal Brace Spacing @ 0.875 G = 60 ft / 0.875 = 68 ft
(See notes for other restrictions.)
Therefore:
Maximum Transverse Brace Spacing @ 0.875 G = 30 ft / 0.875 = 34 ft, Try 30 ft (x1 braces).
Maximum Longitudinal Brace Spacing @ 0.875 G = 60 ft / 0.875 = 68 ft, Try 60 ft (x2 braces).

Step 5: Attachment to Strut (Trapeze Supported Systems Only) - Verify the adequacy of the pipe, duct or electrical system attachment to the strut. The attachment must be adequate to transfer transverse, longitudinal and vertical seismic loads to strut.

Step 6: Trapeze Support Member (Trapeze Supported Systems Only) - Determine the adequacy of the trapeze member to carry the seismic loads in addition to the gravity loads. For this example assume a trapeze span (rod-to-rod) of 36 inches.

A. Determine the vertical load (DEMAND) as the gravity load (W_P) (S_h) plus the vertical seismic load (F_V)(S_h):
W_P = (18.1 lb/ft)(10ft) = 181 lb.
F_V = (0.21)(18.1 lb/ft)(10 ft) = 38.1 lb.
$P_S = W_P + F_V$ = 219.1 lb.

B. Determine the horizontal load (DEMAND) as the Longitudinal Seismic Load from Step 7, F_P = 950 lb.

C. Determine the minimum allowable Section Modulus, S_{Xmin}, assuming a point load:
$S_{Xmin} = M_X / 25$ ksi
where $M_X = P_S$ (36 in) / 4 = 1,993 in/lb
S_{Xmin} = 1,993 / 25 ksi = 0.080 in^3
From Page 13-17, select B22A with S_X = 0.599 in^3 (CAPACITY), which is greater than S_{Xmin} = 0.080 in^3

D. Determine the minimum allowable Section Modulus, S_{Ymin}, assuming a point load:
$S_{Ymin} = M_Y / 25$ ksi
where $M_Y = F_P$ (36 in) / 4 = 8,550 in/lb.
S_{Ymin} = 8,550 / 25 ksi = 0.342 in^3
From Page 13-17, select B22A with S_Y = 0.591 in^3 (CAPACITY), which is greater than S_{Xmin} = 0.342 in^3

E. Check combined loading, (0.080 / 0.599) + (0.342/ 0.591) = 0.71, which is less than 1.0. Therefore, capacity of B22A double strut exceeds the demand of this example.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.2 EXAMPLE 2 - TRAPEZE SUPPORTS (CONT'D)

Step 7: Determine the applied horizontal seismic loads, F_P (DEMAND). All values are ASD.

(0.875)(18.1 lb/ft)(30 ft) = 475 lb. (Transverse Seismic Load)
(0.875)(18.1 lb/ft)(60 ft) = 950 lb. (Longitudinal Seismic Load)

Step 8: Confirm the horizontal seismic load calculated in Step 7 (DEMAND) is less than the allowable horizontal seismic load in the detail load table chosen in Step 2 (CAPACITY). If not, then redo Step 2 and Step 4 by reducing the brace spacing until the DEMAND is less than the CAPACITY. For this example the brace angle is 45 degrees. All values are ASD.

A. Checking Page 4-3 for Transverse and Longitudinal Combination Bracing, the rigid brace table has an Allowable Load (CAPACITY) of 326 lb. Therefore, the CAPACITY is less than the Applied Transverse Seismic Load (DEMAND) from Step 7 of 475 lb, t, the Transverse spacing must be reduced. The maximum reduced spacing is (326 lb) / ((18.1 lb/ft)(0.875) = 20.6 ft.

B. Checking Page 4-3 for Transverse & Longitudinal Combination Bracing, the rigid brace table has an allowable Load of 326 lb. Since this CAPACITY is less than the Applied Longitudinal Seismic Load (DEMAND) from Step 7 of 950 lb., the Longitudinal spacing must be reduced. The maximum reduced spacing is: (2)(326 lb) / ((18.1 lb/ft)(0.875)) = 41.2 ft.

C. Since Transverse and Longitudinal Brace Spacing should be multiple of hanger spacing (10 ft) use the Transverse spacing 20 ft and Longitudinal spacing 40 ft .

Step 7 (Redo):

If brace spacing is modified , then redo Step 7 and modify the applied horizontal seismic loads, F_P (Demand) to correspond to determined spacing in step 8.

(0.875)(18.1 lb/ft)(20 ft) = 317 lb. (Transverse Seismic Load)
(0.875)(18.1 lb/ft)(40 ft) = 634 lb. (Longitudinal Seismic Load)

Step 9: Determine the total vertical load (Demand) at the critical hanger, P_S, which equals **[(Gravity Vertical) + (Seismic Vertical) + (Brace Induced Seismic Vertical Loads)]**. Select a hanger attachment detail from Section 11 that exceeds this demand. The induced seismic assumes the case of Longitudinal Seismic Load and brace angle of 45 degrees and is therefore equal to F_P. All values are ASD.

S_h = 10 feet (Gravity Hanger Spacing)
$P_S = W_P (S_h) + F_V (S_h) + F_P$ [tangent (brace angle from horizontal)]
P_S = (18.1 lb/ft)(10 ft) + (0.21)(18.1 lb/ft)(10 ft) + 317 lb/2 braces.
P_S = 378 lb vertical at hanger

Select 1/2" Ø ATR (all Threaded Rod) from Page 13-3 which has a capacity of 1350 lbs. which exceeds the DEMAND. Checking Page 11-2, the 1/2" Hilti KB-TZ2 with 2" embed has a CAPACITY of 740 lb., which exceeds the DEMAND.

Step 10: Prepare the seismic brace layout per Page 1-21, Section 1.7.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.2 EXAMPLE 2 - TRAPEZE SUPPORTS (CONT'D)

Step 11: Select a brace member and determine it's total length. A brace member shall be B-Line strut channel or schedule. 40 steel pipe or cable. Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on Page 12-21. The Maximum applied horizontal load (DEMAND) calculated in Step 7, shall be equal to or less than the maximum allowable horizontal seismic load (CAPACITY) of the brace chosen from Page 12-21. For this example, assume a brace length of 7'-0".

A. From Page 12-21 choose B-Line B22 Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 926 lb. horizontal which exceeds the Transverse Seismic Load (DEMAND) from Step 7 of 317 lb., and with a Maximum Length = 9'-6", which exceed the example brace length of 7'-0"

B. From Page 12-21 choose B-Line B22 Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 1097 lb. horizontal which exceeds the Longitudinal Seismic Load (DEMAND) from Step 7 of 634 / 2 braces = 317 lb., and with a Maximum Length = 9'-6", which exceeds the example brace length of 7'-0".

Step 12: Determine if rod stiffeners are required. See Pages 12-17 or 12-18 for maximum lengths allowable for hanger rods without rod stiffeners. For this example, assume a hanger rod length of 60 inches. Checking the table on Page 12-18, the Maximum Rod Length without Rod Stiffener for the 1/2" rod of this example = 25". Since the example rod length exceeds this maximum, then Rod Stiffeners must be installed at a minimum of every 18", as shown on Page 12-18.

FLOOR LEVEL	PIPE SIZE	HANGER SPACING (FT)	HANGER ANCHOR DIA. (IN)	HANGER ANCHOR EMBED (hef)(IN)	TRANSVERSE BRACING			LONGITUDINAL BRACING			BRACE ANGLE FROM HORIZ. (DEG)	BRACE ANCHOR DIA. (IN)	HANGER ANCHOR EMBED (hef)(IN)
					BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACHMENT DETAIL PAGE	BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACHMENT DETAIL PAGE			
3	1 1/4"												
	1 1/2"												
	2"												
	3"												
	4"	10	3/4	2	20	4-3	11-1	40	4-3	11-1	45	5/8	4

In conclusion, the 4" diameter (sch. 40) steel pipe in this example, hung at 10 ft. spacing on the third floor of a 4 story building, can be adequately braced using:

- Page 4-3, Detail TR-3, Combo Transverse / Longitudinal Rigid Brace for Trapeze Support, 2 braces per location,
- Page 5-4, Trapeze Brace Spacing Chart for Concrete Wedge Anchors,
- Page 11-1, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete for Brace Attachment,
- Page 11-4, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete, for Hanger Attachments,
- Transverse Brace Spacing is 20 ft o.c.,
- Longitudinal Brace Spacing is 40 ft o.c.
- Transverse and Longitudinal Brace angle is 45°.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.3 EXAMPLE 3 - DUCT SUPPORTS

PROCEDURE STEPS:

The General Design Procedure steps are used as follows to determine duct hanger and brace components, and the seismic brace spacings to seismically restrain trapeze supported ducts.

Step 1: Determine the "G" force factors for F_P and F_V using equations on Page 1-26 for each floor of the building.

Step 2: Select Seismic Bracing Details from Section 4 or Section 8.

Step 3: Select Structural Attachment Details from Section 5, Section 9 and/or Section 11, with a "G" force factor greater than or equal to that determined in Step 1.

Step 4: Determine the maximum Transverse Brace Spacing and the maximum Longitudinal Brace Spacing from the details chosen in Step 3.

Step 5: Attachment to Strut (Trapeze Supported Systems Only) - Verify the adequacy of the pipe, duct or electrical system attachment to the strut. The attachment must be adequate to transfer transverse, longitudinal and vertical seismic loads to strut.

Step 6: Trapeze Support Member (Trapeze Supported Systems Only) - Determine the adequacy of the trapeze member to carry the seismic loads in addition to the gravity loads. The trapeze member should be designed to carry the gravity loads and seismic loads. The gravity load and vertical seismic load will apply bending. The transverse seismic loads will apply an axial load and an additional bending. The longitudinal seismic loads are often much larger than the vertical gravity and seismic loads, and will apply loads about the weak axis causing additional bending. The trapeze support member shall be increased in size if required to satisfy the design criteria described above.

Step 7: Using the Brace Spacing from Step 4 and the seismic "G" factor from Step 1, determine the applied horizontal seismic load, F_P (DEMAND), which is **[(G-Factor) x (Maximum Weight-per-Foot) x (Brace Spacing)]**.

Step 8: Confirm the applied horizontal seismic load (DEMAND) calculated in Step 5 is less than the allowable horizontal seismic load (CAPACITY) in the detail load table chosen in Step 2. If the CAPACITY does not exceed the demand, then redo Step 2 and Step 6 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 9: Determine total vertical load at the hanger, which is **[(Gravity Vertical) + (Seismic Vertical) + (Brace Induced Seismic Vertical Loads)]**. Then select a hanger attachment detail from Section 11 that exceeds this DEMAND. If not, then redo Step 2 and Step 6 by reducing the brace spacing until the DEMAND is less than the CAPACITY.

Step 10: Prepare the seismic brace layout per Page 1-21, Sub-Section 1.7.

Step 11: Step a brace member and determine it's total length. A brace member shall be B-Line strut channel or schedule 40 steel pipe or cable.

Step 12: Determine if rod stiffeners are required.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.3 EXAMPLE 3 - DUCT SUPPORTS (CONT'D)

NUMERICAL EXAMPLE:

Determine the duct hanger seismic brace design needed to seismically restrain a standard SMACNA, 30" x 40" x 18 gage duct hung by trapeze on the third floor of a 4-Story building of poured-in-place 3,000 psi, 12" thick concrete slab construction. The gravity hanger spacing is S_h = 8 feet maximum. Each floor is 15 feet in elevation. The contract drawings specify S_{DS} = 1.50 and I_p = 1.5. For this example the brace angle is 45 degrees.

Step 1: Determine the "G" force factors.

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}\, W_P}{\frac{R_P}{I_P}} (1+2(\frac{z}{h})) \right] (0.70) \qquad \text{(ASD)} \qquad \text{(ASCE 7-16, EQ. 13.3-1)}$$

where:

a_P = 2.5 (component amplification factor) (ASCE 7-16, Table 13.6-1)
R_P = 6.0 (component response modification factor for piping not in accordance w/ ASME B31) (ASCE 7-16, Table 13.6-1)
Ω_o = 2.0 (overstregnth factor for concrete anchors) (ASCE 7-16, Table 13.6-1)
S_{DS} = 1.5 (from contract drawings)
I_P = 1.5
z = 45 feet (height to attachment)
h = 60 feet (height of building)

F_P = [(0.4)(2.5)(1.5)(1.5)/6.0]*(1+2(45/60)(0.70)W_P = 0.656 W_P
F_P need not exceed F_P = 1.6 S_{DS} I_P W_P (0.70) = 2.52 W_P
F_P must be greater than F_P = 0.3 S_{DS} I_P W_P (0.70) = 0.473 W_P

Since 0.473 ≤ 0.656 ≥ 2.52
F_P = 0.656 W_P

"G" Factor = 0.656 (horizontal)
F_V = (0.20) S_{DS} W_P (0.70) = 0.21 W_P (vertical)

Weight of the 30" x 40" x 18 gage duct (including seams and laps),
(Per Rectangular Duct Weights Table, Page C-3, Appendix C)
W_P = 26.9 lb/ft.

Step 2: Tentatively select two Rectangular Duct Seismic Bracing Details from Section 4, Page 4-13 for Transverse Rigid Bracing and Page 4-15 for combined Transverse and Longitudinal Rigid Bracing. The choices of Page 4-13 and Page 4-15 will be confirmed in Step 8.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.3 EXAMPLE 3 - DUCT SUPPORTS (CONT'D)

Step 3: Select Structural Attachment Details from Section 5 and/or Section 11. For this example the deck is poured-in-place concrete. Checking Pages 5-1 throught 5-4, the one with a "G" factor higher than in Step 1 is Page 5-3. It has a "G" factor 0.75. So choose Page 5-3. Compare values with F_P without the amplification factor of Ω_0, since capacities have already been adjusted to consider it.

Step 4: Determine maximum Brace Spacings for W_P = 26.9 lb/ft (component weight per linear foot) using the two tables on Page 5-3, chosen in Step 3. All values are ASD.

From Table on Page 5-3, Maximum Transverse Brace Spacing @ 0.75 G = 40 ft
From Table on Page 5-3, Maximum Longitudinal Brace Spacing @ 0.75 G = 80 ft
(Do not exceed max of 30'T/60'L for suspended ductwork. See Page 1-15, Sub-Section 1.5, Items 2 & 3.
See notes for other restrictions.) Transverse and Longitudinal Brace Spacing should be multiple of hanger spacing per Page 1-52 (8 ft).

Therefore:
Maximum Transverse Brace Spacing = 24 ft (x1 braces)
Maximum Longitudinal Brace Spacing = 48 ft (x2 braces)

Step 5: Attachment to Strut (Trapeze Supported Systems Only) - Verify the adequacy of the pipe, duct or electrical system attachment to the strut. The attachment must be adequate to transfer transverse, longitudinal and vertical seismic loads to strut.

Step 6: Trapeze Support Member (Trapeze Supported Systems Only) - Determine the adequacy of the trapeze member to carry the seismic loads in addition to the gravity loads. For this example assume a trapeze span (rod-to-rod) of 36 inches.

A. Determine the vertical load (DEMAND) as the gravity load (W_P) (S_h) plus the vertical seismic load (F_V)(S_h):
W_P = (26.9 lb/ft)(8 ft) = 215 lb.
F_V = (0.21)(26.9 lb/ft)(8 ft) = 45.2 lb.
$P_S = W_P + F_V$ = 260.2 lb.

B. Determine the horizontal load (DEMAND) as the Longitudinal Seismic Load from Step 7, F_P = 848 lb.

C. Determine the minimum allowable Section Modulus, S_{Xmin}, assuming a point load:
$S_{Xmin} = M_X / 25$ ksi
where $M_X = P_S$ (36 in) / 4 = 2,342 in-lb
S_{Xmin} = 2,342 / 25 ksi = 0.094 in^3
From Page 13-17, select B22A with S_X = 0.599 in^3 (CAPACITY), which is greater than S_{Xmin} = 0.094 in^3

D. Determine the minimum allowable Section Modulus, S_{Ymin}, assuming a point load:
$S_{Ymin} = M_Y / 25$ ksi
where $M_Y = F_P$ (36 in) / 4 = 7,632 in-lb.
S_{Ymin} = 7,632 / 25 ksi = 0.306 in^3
From Page 13-17, select B22A with S_Y = 0.591 in^3 (CAPACITY), which is greater than S_{Ymin} = 0.306 in^3

E. Check combined loading, (0.094 / 0.599) + (0.306 / 0.591) = 0.68, which is less than 1.0. Therefore, capacity of B22A double strut exceeds the demand of this example.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.3 EXAMPLE 3 - DUCT SUPPORTS (CONT'D)

Step 7: Determine the applied horizontal seismic loads, F_P (DEMAND). All values are ASD.

(0.656)(26.9 lb/ft)(24 ft) = 424 lb. (Transverse Seismic Load)
(0.656)(26.9 lb/ft)(48 ft) = 848 lb. (Longitudinal Seismic Load)

Step 8: Confirm the horizontal seismic loads calculated in Step 7 (DEMAND) are less than the allowable horizontal seismic loads in the detail load table chosen in Step 2 (CAPACITY). If not, then redo Step 2 and Step 4 by reducing the brace spacing until the DEMAND is less than the CAPACITY. For this example the brace angle is 45 degrees. All values are ASD.

A. Checking Page 4-15 for Transverse and Longitudinal Combination Bracing, the rigid brace table has an Allowable Load (CAPACITY) of 326 lb for 3/4"Ø ATR. Therefore, the CAPACITY is less than the Applied Transverse Seismic Load (DEMAND) from Step 7 of 424 lb., the Transverse spacing must be reduced. The maximum reduced spacing is (326 lb) / ((26.9 lb/ft)(0.656)) = 18.4 ft.

B. Checking Page 4-15 for Transverse and Longitudinal Combination Bracing, the rigid brace table has an Allowable Load of 326 lb for 3/4"Ø ATR. Since two braces are required by the table on Page 5-3 (determined in Step 3), the CAPACITY for the two-brace case is 652 lb. Since this CAPACITY is less than the Applied Longitudinal Seismic Load (DEMAND) from Step 7 of 848 lb., the Longitudinal spacing must be reduced.

The maximum reduced spacing is (2)(326 lb) / ((26.9 lb/ft)(0.656)) = 36.9 ft.

C. Since Transverse and Longitudinal Brace Spacing should be multiple of hanger spacing per Page 1-52 (8 ft) use the Transverse spacing 16 ft and Longitudinal spacing 32 ft .

Step 7 (Redo):

If brace spacing is modified , then redo Step 7 and modify the applied horizontal seismic loads, F_P (Demand) to correspond to determined spacing in step 8.

(0.656)(26.9 lb/ft)(16 ft) = 282 lb. (Transverse Seismic Load)
(0.656)(26.9 lb/ft)(32 ft) = 564 lb. (Longitudinal Seismic Load)

Step 9: Determine total vertical load (DEMAND) at the critical hanger, P_S, which equals gravity vertical + seismic vertical + brace-induced seismic vertical loads. The induced seismic assumes the case of Longitudinal Seismic Load and brace angle of 45 degrees, and is therefore equal to F_P. All values are ASD.

S_h = 10 feet (Gravity Hanger Spacing)
$P_S = W_P (S_h) + F_V (S_h) + F_P$ [tangent (brace angle from horizontal)]
P_S = [(26.9 lb/ft)(8 ft) + (0.21)(26.9 lb/ft)(8 ft)] / 2 + (282 lb)
P_S = 412 lb vertical at hanger

Checking Page 11-4, the 3/4" Hilti KB-TZ2 with 3 3/4" embed has a CAPACITY of 1710 lb., which exceeds the DEMAND.

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1.9 TYPICAL DESIGN EXAMPLES (CONT'D)

1.9.3 EXAMPLE 3 - DUCT SUPPORTS (CONT'D)

Step 10: Prepare the seismic brace layout per Page 1-21, Section 1.7.

Step 11: Select a brace member and determine it's total length. A brace member shall be B-Line strut channel or schedule 40 steel pipe. Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on Page 12-21. The Maximum applied horizontal load (DEMAND) calculated in Step 7, shall be equal to or less than the maximum allowable horizontal seismic load (CAPACITY) of the brace chosen from Page 12-21. For this example, assume a brace length of 7'-0".

A. From Page 12-21 choose B-Line B22 Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 609 lb. horizontal which exceeds the Transverse Seismic Load (DEMAND) from Step 7 of 424 lb., and with a Maximum Length = 9'-6", which exceed the example brace length of 7'-0"

B. From Page 12-21 choose B-Line B22 Strut brace with an Allowable Horizontal Seismic Load (CAPACITY) = 609 lb. horizontal which exceeds the Longitudinal Seismic Load (DEMAND) from Step 7 of 848 / 2 braces = 424 lb., and with a Maximum Length = 9'-6", which exceeds the example brace length of 7'-0".

Step 12: Determine if rod stiffeners are required. See Pages 12-17 or 12-18 for maximum lengths allowable for hanger rods without rod stiffeners. For this example, assume a hanger rod length of 60 inches. Checking the table on Page 12-18, the Maximum Rod Length without Rod Stiffener for the 3/4" rod of this example = 37". Since the example rod length exceeds this maximum, then Rod Stiffeners must be installed at a minimum of every 28", as shown on Page 12-18.

FLOOR LEVEL	DUCT WT. (LB/FT)	HANGER SPACING (FT)	HANGER ANCHOR DIA. (IN)	HANGER ANCHOR EMBED (hef)(IN)	TRANSVERSE BRACING			LONGITUDINAL BRACING			BRACE ANGLE FROM HORIZ. (DEG)	BRACE ANCHOR DIA. (IN)	BRACE ANCHOR EMBED (hef)(IN)
					BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACHMENT DETAIL PAGE	BRACE SPACING (FT)	BRACE DETAIL PAGE	ATTACH. DETAIL PAGE			
3	26.9	8	3/4	3 3/4	16	4-15	11-1	32	4-15	11-1	45	5/8	3.25

In conclusion, the 30" x 40" x 18 gage duct in this example, trapeze hung at 8 ft. spacing on the third floor of a 4 story building, can be adequately braced using:

- Page 4-15, Detail TR-15 Combo Transverse / Longitudinal Rigid Bracing for Trapeze Supported Duct,
- Page 5-3, Trapeze Brace Spacing Chart for Concrete Wedge Anchors,
- Page 11-1, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete for Brace Attachment,
- Page 11-4, Hilti KB-TZ2 Wedge Anchors in 3,000 psi NW Concrete, for Hanger Attachments,
- Transverse Brace Spacing is 16 ft o.c.,
- Longitudinal Brace Spacing is 32 ft o.c.
- Transverse and Longitudinal Brace angle is 45°.

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1.10 PRE-DESIGNED TABLES

- **THE FOLLOWING PAGES CONTAIN PRE-DESIGNED TABLES FOR IMMEDIATE USE. USING PIPE, DUCT, OR TRAPEZE SIZE/WEIGHT, AND PROJECT F_P/W_P, THESE TABLES PROVIDE SEISMIC BRACE SPACING AND COMPONENT DESIGN BASED ON OPM 0052-22.**

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CABLE BRACE DUCT (SHEET STEEL)

INSTALLATION DETAILS: 8-13, 8-14, 8-15

F_P/W_P = 0.50 G F_V/W_P = 0.22 G			3/16"Ø[1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
RECTANGULAR DUCT		HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
DUCT SIZE	MAX. WT. (PLF)		TRANS. (FT)[2]	LONGIT. (FT)[3]	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[6] PER 13-17 & 13-18	MIN. ROD SIZE
6 SQ FT[7]	24.80	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
8 SQ FT[7]	27.20	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
10 SQ FT[7]	28.40	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
12 SQ FT[7]	29.60	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
16 SQ FT[7]	32.00	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
20 SQ FT[8]	43.90	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
24 SQ FT[8]	46.90	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
28 SQ FT[8]	50.00	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
32 SQ FT[8]	53.10	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
36 SQ FT[8]	55.40	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 8-13, 8-14 & 8-15.
2. MAXIMUM SPACING IS PER SMACNA REQUIREMENTS.
3. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.
7. DUCT THICKNESS SHALL BE 20 GAUGE MINIMUM.
8. DUCT THICKNESS SHALL BE 18 GAUGE MINIMUM.

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

CABLE BRACE DUCT (SHEET STEEL)

INSTALLATION DETAILS: 8-13, 8-14, 8-15

F_P/W_P = 1.00 G F_V/W_P = 0.44 G			3/16"Ø[1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
RECTANGULAR DUCT		HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
DUCT SIZE	MAX. WT. (PLF)		TRANS. (FT)[2]	LONGIT. (FT)[3]	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[6] PER 13-17 & 13-18	MIN. ROD SIZE
6 SQ FT[7]	24.80	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
8 SQ FT[7]	27.20	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
10 SQ FT[7]	28.40	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
12 SQ FT[7]	29.60	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
16 SQ FT[7]	32.00	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
20 SQ FT[8]	43.90	5	5	10	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
24 SQ FT[8]	46.90	5	5	10	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
28 SQ FT[8]	50.00	5	5	10	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
32 SQ FT[8]	53.10	4	4	8	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
36 SQ FT[8]	55.40	4	4	8	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 8-13, 8-14 & 8-15.
2. MAXIMUM SPACING IS PER SMACNA REQUIREMENTS.
3. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.
7. DUCT THICKNESS SHALL BE 20 GAUGE MINIMUM.
8. DUCT THICKNESS SHALL BE 18 GAUGE MINIMUM.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

EATON
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

CABLE BRACE SINGLE HUNG STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 6-2[6], 6-3, 6-4[6], 6-5, 6-6, 6-7[6], 6-8[6], 6-9

F_P/W_P = 0.50 G F_V/W_P = 0.22 G			3/16"Ø [1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK						
PIPE SIZE DIAMETER (IN)	MAX. PIPE WT. [2] (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		MIN. REQ'D ROD SIZE
			TRANS. (FT)[3]	LONGIT. (FT)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	
1-1/4 [6]	3.8	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
1-1/2 [6]	4.5	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2 [6]	6.2	10	20	40	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2-1/2	9.1	11	22	22	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	1/2"
3	12.1	11	22	22	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	1/2"
4	18.1	12	24	24	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	5/8"
		10	20	40	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.375 x 2.0 (1)	
6	34.8	13	26	26	11-7 (S)	0.50 x 3.25 (1)	11-8 (D)	0.50 x 3.25 (2)	3/4"
8	55.1	9	18	18	11-7 (D)	0.375 x 2.0 (2)	11-8 (D)	0.625 x 2.75 (2)	3/4"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 6-2 THROUGH 6-9.
2. THE MAXIMUM PIPE WEIGHT IS BASED ON SCHEDULE 40 STEEL PIPE FILLED WITH WATER AND WRAPPED WITH INSULATION.
3. BASED ON MAXIMUM SEISMIC BRACE SPACING PER STRESS/DEFLECTION ON PAGE 14-1 FOR SCHEDULE 40 PIPES ONLY. USE THE LOWER OF THE BRACE SPACINGS ON THIS PAGE OR PAGE 14-1.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. INSTALLATION DETAILS 6-2, 6-4, 6-7 & 6-8 SHALL NOT BE USED FOR THESE PIPE DIAMETERS.

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CABLE BRACE SINGLE HUNG STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 6-2[6], 6-3, 6-4[6], 6-5, 6-6, 6-7[6], 6-8[6], 6-9

F_P/W_P = 1.00 G F_V/W_P = 0.44 G			3/16"Ø [1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK						
PIPE SIZE DIAMETER (IN)	MAX. PIPE WT. [2] (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		MIN. REQ'D ROD SIZE
			TRANS. (FT)[3]	LONGIT. (FT)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	
1-1/4 [6]	3.8	6	12	24	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
1-1/2 [6]	4.5	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2 [6]	6.2	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2-1/2	9.1	7	14	14	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	1/2"
3	12.1	12	12	12	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	1/2"
4	18.1	10	10	14	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.50 x 3.25 (1)	5/8"
6	34.8	10	10	14	11-7 (S)	0.625 x 2.75 (1)	11-8 (D)	0.625 x 2.75 (2)	3/4"
8	55.1	9	9	9	11-7 (S)	0.625 x 4.0 (1)	11-8 (D)	0.625 x 2.75 (2)	3/4"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 6-2 THROUGH 6-9.
2. THE MAXIMUM PIPE WEIGHT IS BASED ON SCHEDULE 40 STEEL PIPE FILLED WITH WATER AND WRAPPED WITH INSULATION.
3. BASED ON MAXIMUM SEISMIC BRACE SPACING PER STRESS/DEFLECTION ON PAGE 14-1 FOR SCHEDULE 40 PIPES ONLY. USE THE LOWER OF THE BRACE SPACINGS ON THIS PAGE OR PAGE 14-1.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. INSTALLATION DETAILS 6-2, 6-4, 6-7 & 6-8 SHALL NOT BE USED FOR THESE PIPE DIAMETERS.

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CABLE BRACE TRAPEZE STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 8-1, 8-2, 8-3, 8-4, 8-5, 8-6

F_P/W_P = 0.50 G F_V/W_P = 0.22 G		3/16"Ø [1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
MAX. TRAPEZE WEIGHT (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
		TRANS. (FT)[2]	LONGIT. (FT)[3]	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[6] PER 13-17 & 13-18	MIN. ROD SIZE
TRAPEZE 5 LB/FT	6	36	72	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
TRAPEZE 10 LB/FT	6	36	72	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
TRAPEZE 20 LB/FT	6	24	48	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	12	24	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	6	6	12	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 60 LB/FT	6	6	12	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 5 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B22	3/8"
TRAPEZE 10 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
TRAPEZE 20 LB/FT	10	20	40	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	10	10	20	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	10	10	10	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 60 LB/FT	8	8	8	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 8-1, 8-2, 8-3, 8-4, 8-5 & 8-6.
2. FOR ANY PIPE/CONDUIT ON TRAPEZE, SEISMIC BRACE SPACING MUST NOT EXCEED MAX. TRANSVERSE SPACING GIVEN IN TABLES IN SECTION 14, AND THIS TABLE.
3. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.

REVIEWED FOR CODE COMPLIANCE
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By Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

CABLE BRACE TRAPEZE STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 8-1, 8-2, 8-3, 8-4, 8-5, 8-6

F_P/W_P = 1.00 G F_V/W_P = 0.44 G		3/16"Ø [1] CABLE BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
MAX. TRAPEZE WEIGHT (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
		TRANS. (FT)[2]	LONGIT. (FT)[3]	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	DETAIL (PAGE)[4]	ANCHOR[5] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[6] PER 13-17 & 13-18	MIN. ROD SIZE
TRAPEZE 5 LB/FT	6	36	72	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	3/8"
TRAPEZE 10 LB/FT	6	24	48	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 20 LB/FT	6	12	24	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	5	5	10	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 60 LB/FT	4	4	8	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 5 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	B12	1/2"
TRAPEZE 10 LB/FT	10	20	40	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 20 LB/FT	10	10	20	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	5	5	10	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 60 LB/FT	4	4	8	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"

FOOTNOTES:

1. 3/16"Ø CABLE SHALL BE USED FOR ALL ROD SIZES IN INSTALLATION DETAILS 8-1, 8-2, 8-3, 8-4, 8-5 & 8-6.
2. FOR ANY PIPE/CONDUIT ON TRAPEZE, SEISMIC BRACE SPACING MUST NOT EXCEED MAX. TRANSVERSE SPACING GIVEN IN TABLES IN SECTION 14, AND THIS TABLE.
3. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
4. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
5. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
6. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.

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OPM-0052
By Roy Lobo
DATE: 04/24/2025
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RIGID BRACE DUCT (SHEET STEEL)

INSTALLATION DETAILS: 4-13, 4-14, 4-15

F_P/W_P = 0.50 G F_V/W_P = 0.22 G			RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
RECTANGULAR DUCT		HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
DUCT SIZE	MAX. WT. (PLF)		TRANS. (FT)[1]	LONGIT. (FT)[2]	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[5] PER 13-17 & 13-18	MIN. ROD SIZE
6 SQ FT[6]	24.80	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.50 x 3.25 (1)	B22	3/8"
8 SQ FT[6]	27.20	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B22	3/4"
10 SQ FT[6]	28.40	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
12 SQ FT[6]	29.60	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
16 SQ FT[6]	32.00	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
20 SQ FT[7]	43.90	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
24 SQ FT[7]	46.90	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
28 SQ FT[7]	50.00	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
32 SQ FT[7]	53.10	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
36 SQ FT[7]	55.40	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"

FOOTNOTES:

1. MAXIMUM SPACING IS PER SMACNA REQUIREMENTS.
2. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
3. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
4. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
5. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.
6. DUCT THICKNESS SHALL BE 20 GAUGE MINIMUM.
7. DUCT THICKNESS SHALL BE 18 GAUGE MINIMUM.

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RIGID BRACE DUCT (SHEET STEEL)

INSTALLATION DETAILS: 4-13, 4-14, 4-15

F_P/W_P = 1.00 G F_V/W_P = 0.44 G			RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
RECTANGULAR DUCT		HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
DUCT SIZE	MAX. WT. (PLF)		TRANS. (FT)[1]	LONGIT. (FT)[2]	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[5] PER 13-17 & 13-18	MIN. ROD SIZE
6 SQ FT[6]	24.80	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B22	3/4"
8 SQ FT[6]	27.20	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B22	3/4"
10 SQ FT[6]	28.40	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
12 SQ FT[6]	29.60	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
16 SQ FT[6]	32.00	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
20 SQ FT[7]	43.90	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B12	3/4"
24 SQ FT[7]	46.90	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B12	3/4"
28 SQ FT[7]	50.00	5	5	10	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B12	3/4"
32 SQ FT[7]	53.10	5	5	10	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B12	3/4"
36 SQ FT[7]	55.40	5	5	10	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B12	3/4"

FOOTNOTES:

1. MAXIMUM SPACING IS PER SMACNA REQUIREMENTS.
2. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
3. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
4. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
5. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.
6. DUCT THICKNESS SHALL BE 20 GAUGE MINIMUM.
7. DUCT THICKNESS SHALL BE 18 GAUGE MINIMUM.

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RIGID BRACE SINGLE HUNG STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 2-3, 2-8, 2-13, 2-14

F_P/W_P = 0.50 G F_V/W_P = 0.22 G			RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK						
PIPE SIZE DIAMETER (IN)	MAX. PIPE WT.[4] (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		MIN. REQ'D ROD SIZE
			TRANS. (FT)[1]	LONGIT. (FT)	DETAIL (PAGE)[2]	ANCHOR[3] x EMBED (IN) x (IN)	DETAIL (PAGE)[2]	ANCHOR[3] x EMBED (IN) x (IN)	
1-1/4	3.8	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
1-1/2	4.5	8	16	32	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2	6.2	10	20	40	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2-1/2	9.1	11	22	44	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.50 x 3.25 (1)	1/2"
3	12.1	11	22	44	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	1/2"
4	18.1	12	24	48	11-7 (S)	0.50 x 3.25 (1)	11-8 (D)	0.625 x 4.0 (2)	5/8"
		12	24	24	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 4.0 (1)	
6	40.1	11	22	22	11-7 (S)	0.50 x 3.25 (1)	11-8 (D)	0.625 x 4.0 (2)	3/4"
		17	17	17	11-7 (S)	0.50 x 3.25 (1)	11-8 (D)	0.625 x 4.0 (2)	
8	55.1	15	15	15	11-7 (S)	0.50 x 3.25 (1)	11-8 (D)	0.625 x 4.0 (2)	3/4"

FOOTNOTES:

1. BASED ON MAXIMUM SEISMIC BRACE SPACING PER STRESS/DEFLECTION ON PAGES 14-1, 14-10, 14-11 & 14-12.
2. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
3. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
4. THE MAXIMUM PIPE WEIGHT IS BASED ON SCHEDULE 40 STEEL PIPE FILLED WITH WATER AND WRAPPED WITH INSULATION, OR RIGID METAL CONDUIT (RMC).

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DATE: 04/24/2025
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RIGID BRACE SINGLE HUNG STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 2-3, 2-8, 2-13, 2-14

F_P/W_P = 1.00 G F_V/W_P = 0.44 G			RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK						
PIPE SIZE DIAMETER (IN)	MAX. PIPE WT.[4] (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		MIN. REQ'D ROD SIZE
			TRANS. (FT)[1]	LONGIT. (FT)	DETAIL (PAGE)[2]	ANCHOR[3] x EMBED (IN) x (IN)	DETAIL (PAGE)[2]	ANCHOR[3] x EMBED (IN) x (IN)	
1-1/4	3.8	6	12	24	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
1-1/2	4.5	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2	6.2	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2.0 (1)	3/8"
2-1/2	9.1	7	14	28	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.50 x 3.25 (1)	1/2"
3	12.6	11	11	22	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	1/2"
4	19.7	13	13	26	11-7 (S)	0.625 x 4.0 (1)	11-8 (D)	0.625 x 4.0 (2)	5/8"
6	40.0	11	11	11	11-7 (S)	0.625 x 4.0 (1)	11-8 (D)	0.625 x 4.0 (2)	3/4"
8	55.1	8	8	8	11-7 (S)	0.625 x 4.0 (1)	11-8 (D)	0.625 x 4.0 (2)	3/4"

FOOTNOTES:

1. BASED ON MAXIMUM SEISMIC BRACE SPACING PER STRESS/DEFLECTION ON PAGES 14-1, 14-10, 14-11 & 14-12.
2. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
3. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
4. THE MAXIMUM PIPE WEIGHT IS BASED ON SCHEDULE 40 STEEL PIPE FILLED WITH WATER AND WRAPPED WITH INSULATION, OR RIGID METAL CONDUIT (RMC).

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RIGID BRACE TRAPEZE STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 4-1, 4-2, 4-3, 4-4, 4-5, 4-6

F_P/W_P = 0.50 G F_V/W_P = 0.22 G		RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
MAX. TRAPEZE WEIGHT (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
		TRANS. (FT)[1]	LONGIT. (FT)[2]	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[5] PER 13-17 & 13-18	MIN. ROD SIZE
TRAPEZE 5 LB/FT	6	36	72	11-7 (S)	0.375 x 2 (1)	11-8 (S)	0.375 x 2 (1)	B22	3/8"
TRAPEZE 10 LB/FT	6	36	72	11-7 (S)	0.375 x 2 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
TRAPEZE 20 LB/FT	6	24	48	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	12	24	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	6	12	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"
TRAPEZE 60 LB/FT	6	6	12	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"
TRAPEZE 5 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.375 x 2 (1)	B22	3/8"
TRAPEZE 10 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
TRAPEZE 20 LB/FT	10	20	40	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	10	10	20	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	8	8	16	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 60 LB/FT	8	8	8	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"

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FOOTNOTES:

1. FOR ANY PIPE/CONDUIT ON TRAPEZE, SEISMIC BRACE SPACING MUST NOT EXCEED MAX. TRANSVERSE SPACING GIVEN IN TABLES IN SECTION 14, AND THIS TABLE. ALSO, INDIVIDUAL PIPING/CONDUIT MAY GOVERN GOVERN MAXIMUM GRAVITY SUPPORT.
2. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
3. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
4. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
5. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.

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RIGID BRACE TRAPEZE STEEL PIPE OR CONDUIT

INSTALLATION DETAILS: 4-1, 4-2, 4-3, 4-4, 4-5, 4-6

F_P/W_P = 1.00 G F_V/W_P = 0.44 G		RIGID BRACING AT 45 DEG. BRACE ANGLE 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER METAL DECK							
MAX. TRAPEZE WEIGHT (PLF)	HANGER SPACING (FT.)	SEISMIC BRACE SPACING - MAX		SEISMIC BRACE ATTACHMENT (CARBON STEEL)		HANGER ATTACHMENT (CARBON STEEL)		TRAPEZE REQUIRMENTS	
		TRANS. (FT)[1]	LONGIT. (FT)[2]	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	DETAIL (PAGE)[3]	ANCHOR[4] x EMBED (IN) x (IN)	B-LINE SOLID CHANNEL[5] PER 13-17 & 13-18	MIN. ROD SIZE
TRAPEZE 5 LB/FT	6	36	72	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
TRAPEZE 10 LB/FT	6	24	48	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 20 LB/FT	6	12	24	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	6	6	6	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"
TRAPEZE 60 LB/FT	5	5	5	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"
TRAPEZE 5 LB/FT	10	40	80	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B12	3/4"
TRAPEZE 10 LB/FT	10	20	40	11-7 (S)	0.375 x 2.0 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 20 LB/FT	10	10	20	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 40 LB/FT	6	6	12	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 2.75 (1)	B11	3/4"
TRAPEZE 50 LB/FT	6	6	6	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"
TRAPEZE 60 LB/FT	5	5	5	11-7 (S)	0.50 x 3.25 (1)	11-8 (S)	0.625 x 4.0 (1)	B11	3/4"

FOOTNOTES:

1. FOR ANY PIPE/CONDUIT ON TRAPEZE, SEISMIC BRACE SPACING MUST NOT EXCEED MAX. TRANSVERSE SPACING GIVEN IN TABLES IN SECTION 14, AND THIS TABLE. ALSO, INDIVIDUAL PIPING/CONDUIT MAY GOVERN GOVERN MAXIMUM GRAVITY SUPPORT.
2. THE LONGITUDINAL SPACING IS VALID WHEN THE TRAPEZE IS LOADED CONCENTRICALLY.
3. (S) = SINGLE ANCHOR; (D) = DOUBLE ANCHOR
4. BASED ON HILTI KB-TZ2. SEE PAGE 11-82 FOR TESTING NOTES AND TORQUE VALUES.
5. THIS B-LINE SOLID CHANNEL IS FOR THE TRAPEZE HORIZONTAL MEMBER SPANS BETWEEN RODS.

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SECTION 2

SINGLE HANGER RIGID BRACE DETAILS

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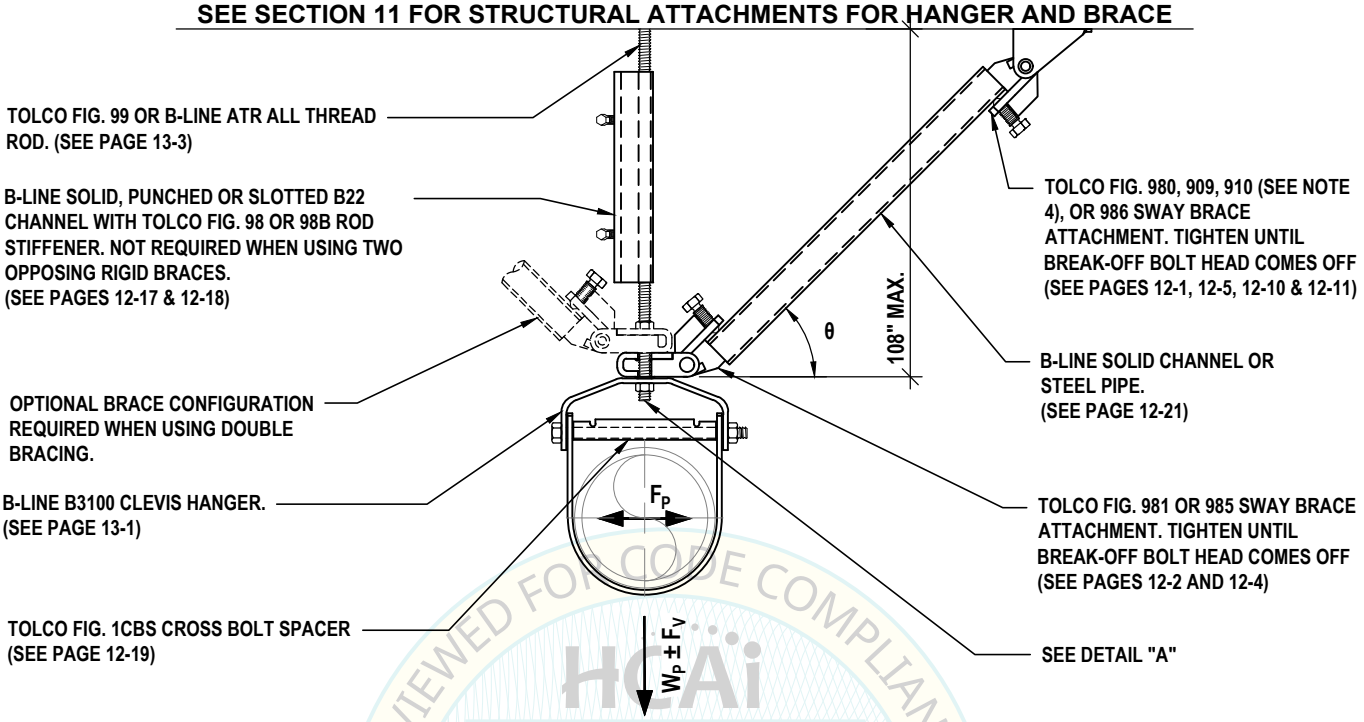
PAGE: 2-0

DATE: April 23, 2025

TRANSVERSE RIGID BRACING FOR SINGLE HUNG PIPE OR CONDUIT WITH CLEVIS HANGER

DETAIL
SR-1

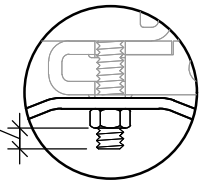
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



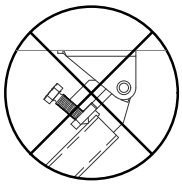
1 1/4" - 3" PIPE

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PIPE DIAMETER	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD) (LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2 1/2"	93	97	96
3"	111	109	107



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. PIPES WITH INSULATION SHALL NOT BE USED.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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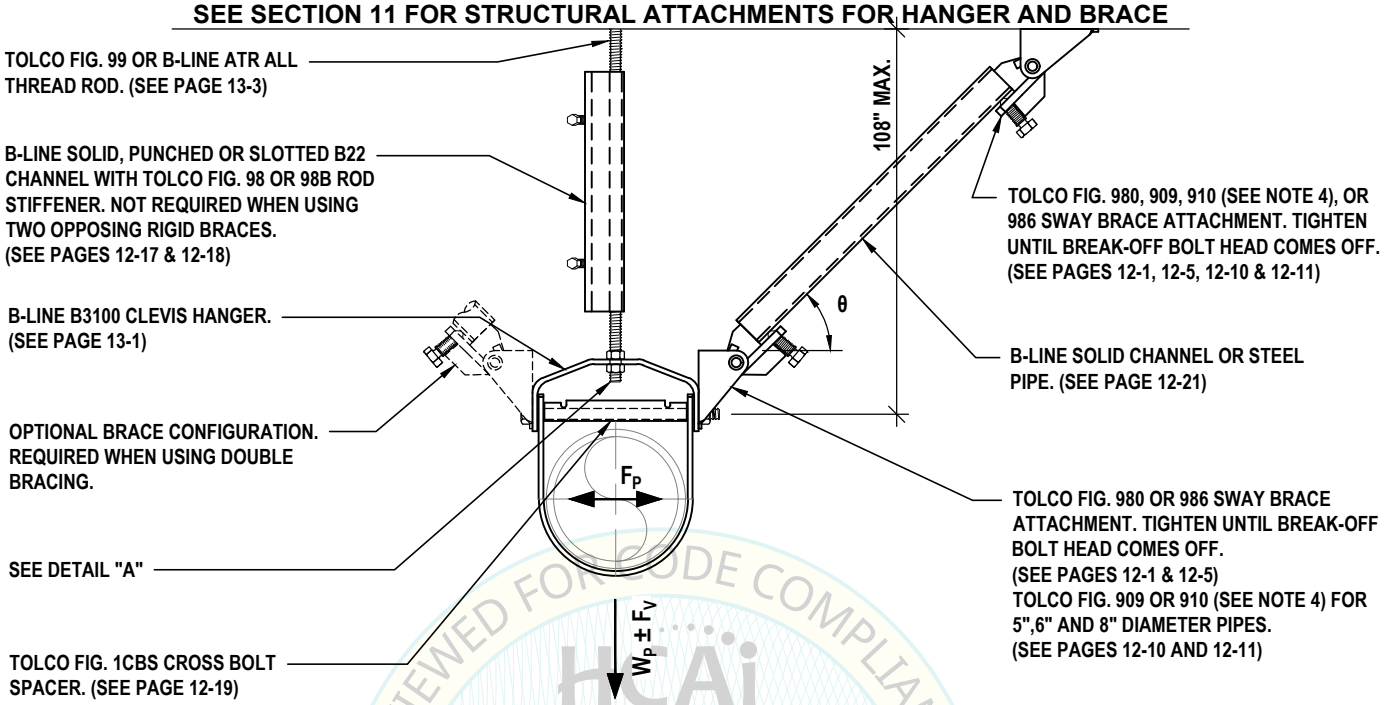
PAGE: **2-1**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACING FOR SINGLE HUNG PIPE OR CONDUIT WITH CLEVIS HANGER

DETAIL
SR-2

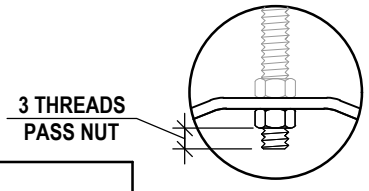
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



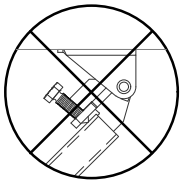
2 1/2" - 8" PIPE

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PIPE DIAMETER	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD) (LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
2 1/2" - 3 1/2"	129	213	110
4" - 5"	236	448	292
6" - 8"	556	593	454



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPE. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. PIPES WITH INSULATION SHALL NOT BE USED.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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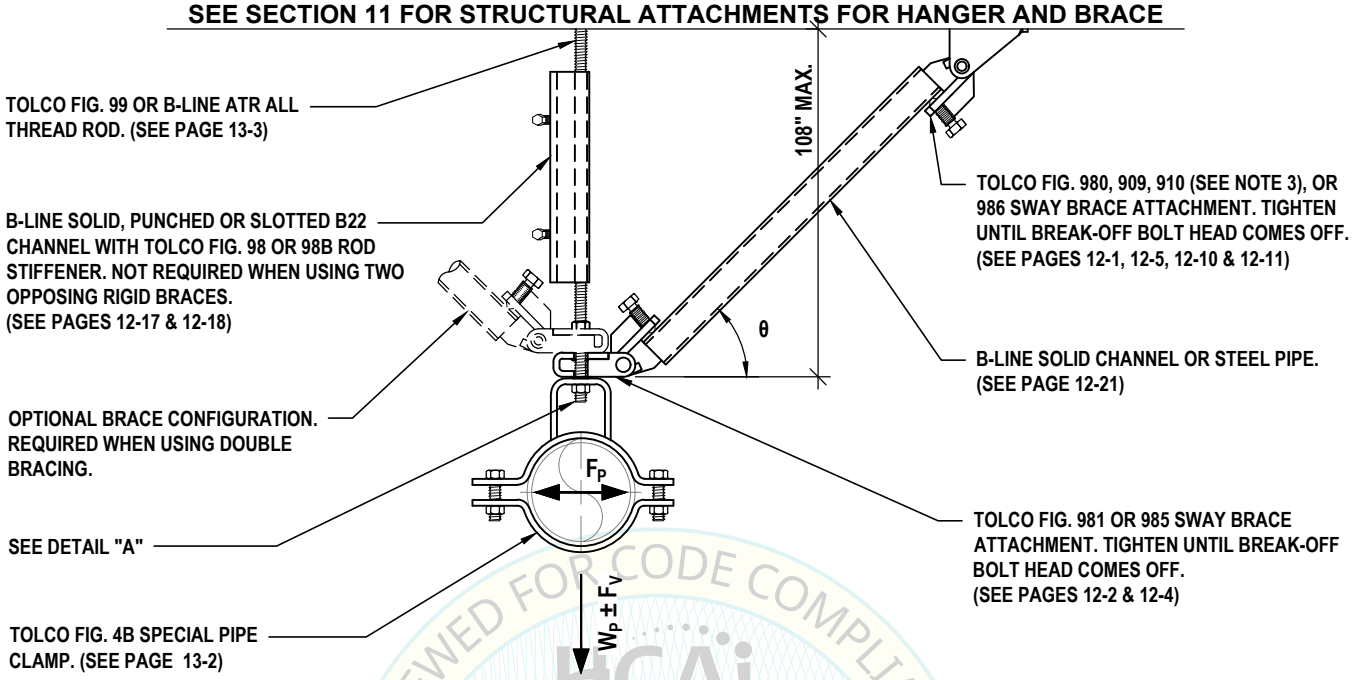
PAGE: **2-2**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

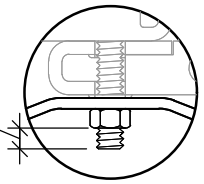
DETAIL
SR-3

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



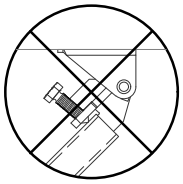
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	272	317	310
2 1/2" - 3 1/2"	272	317	310
4" - 5"	582	724	517
6"	582	724	517
8"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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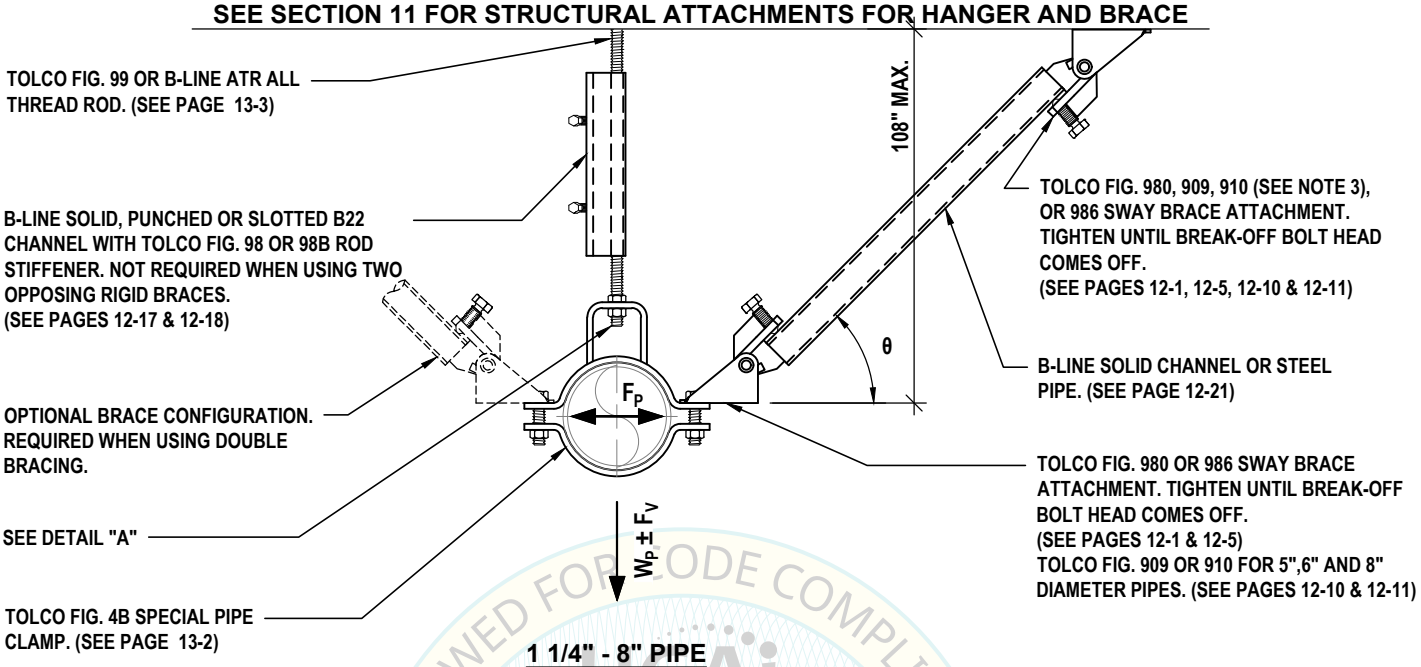
PAGE: 2-3

DATE: April 23, 2025

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SR-4

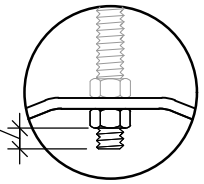
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



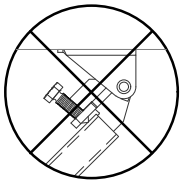
1 1/4" - 8" PIPE

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DATE: 04/24/2025
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PIPE DIAMETER	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	272	317	310
2 1/2" - 3 1/2"	272	317	310
4" - 5"	582	724	517
6" - 8"	920	746	636



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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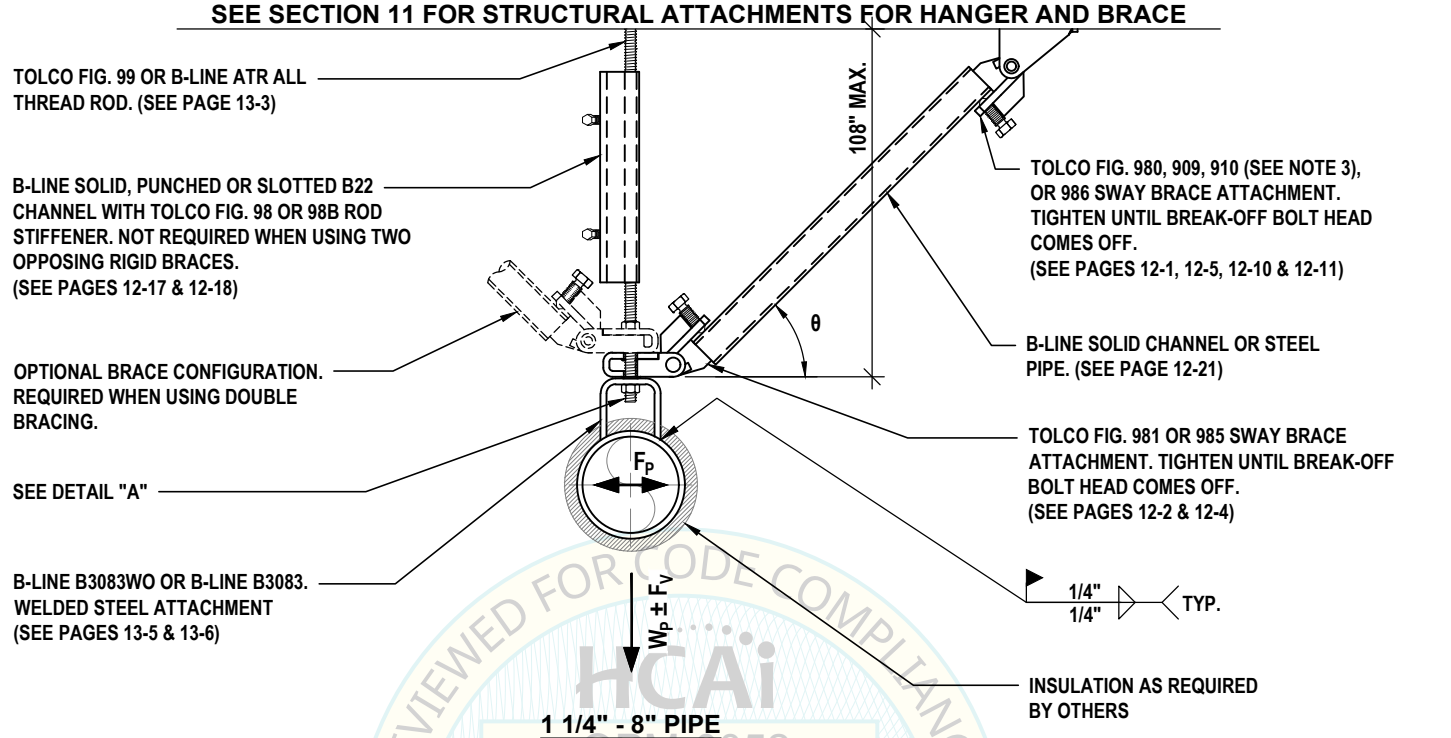
PAGE: **2-4**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

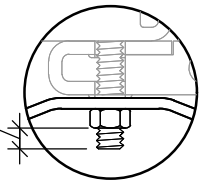
DETAIL SR-5

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



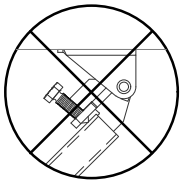
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	272	317	310
2 1/2" - 3 1/2"	1/2"	272	317	310
4" - 5"	5/8"	582	724	517
6"	3/4"	582	724	517
8"	7/8"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND BETTER SUPPORTED PIPING.
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.
4. THE B-LINE B3083 SHALL NOT BE USED WITH EMT.
5. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
6. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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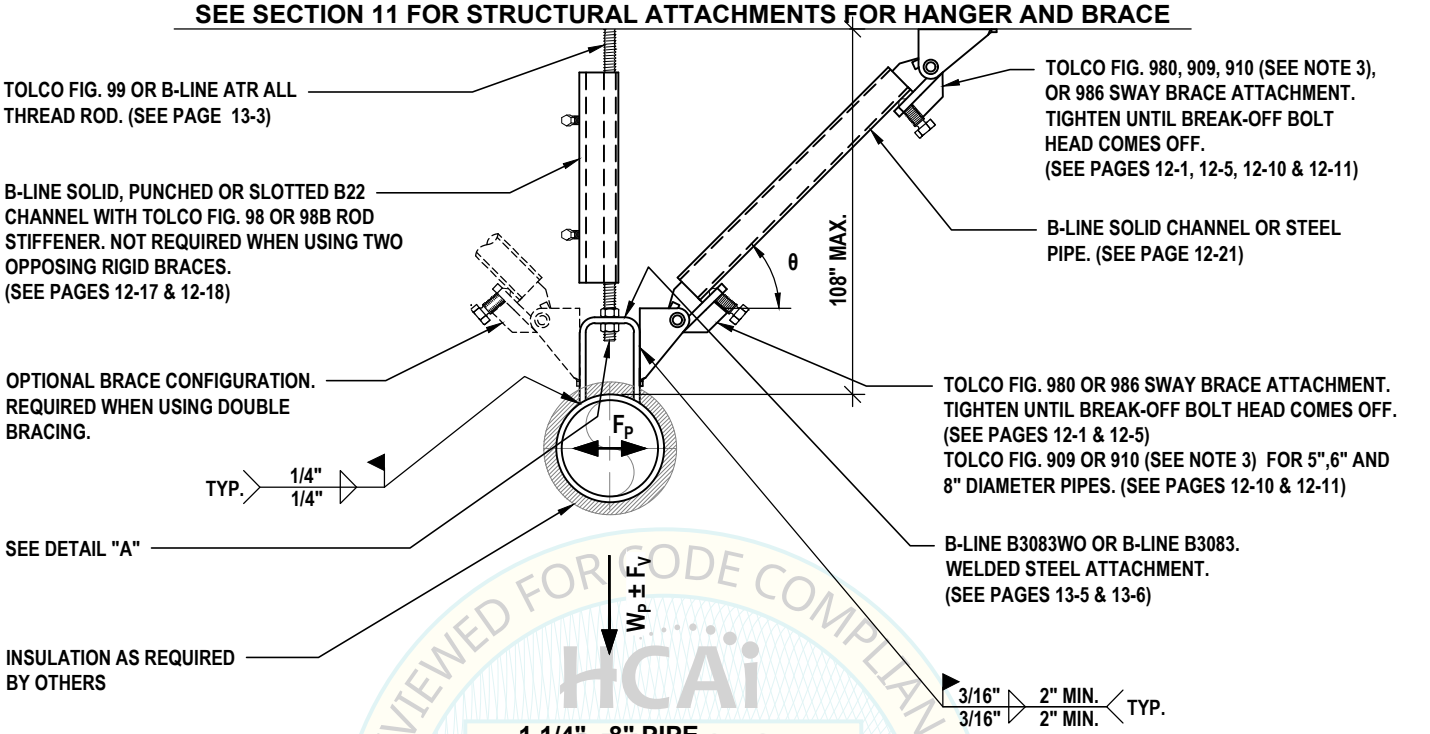
PAGE: 2-5

DATE: April 23, 2025

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

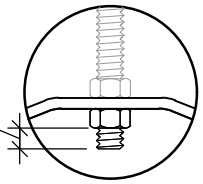
DETAIL
SR-6

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



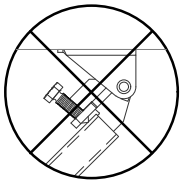
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
		BRACE (θ) ANGLE MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	272	317	310
2 1/2" - 3 1/2"	1/2"	272	317	310
4" - 5"	5/8"	582	724	517
6"	3/4"	920	746	636
8"	7/8"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND BETTER SUPPORTED PIPING.
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.
4. THE B-LINE B3083 SHALL NOT BE USED WITH EMT.
5. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
6. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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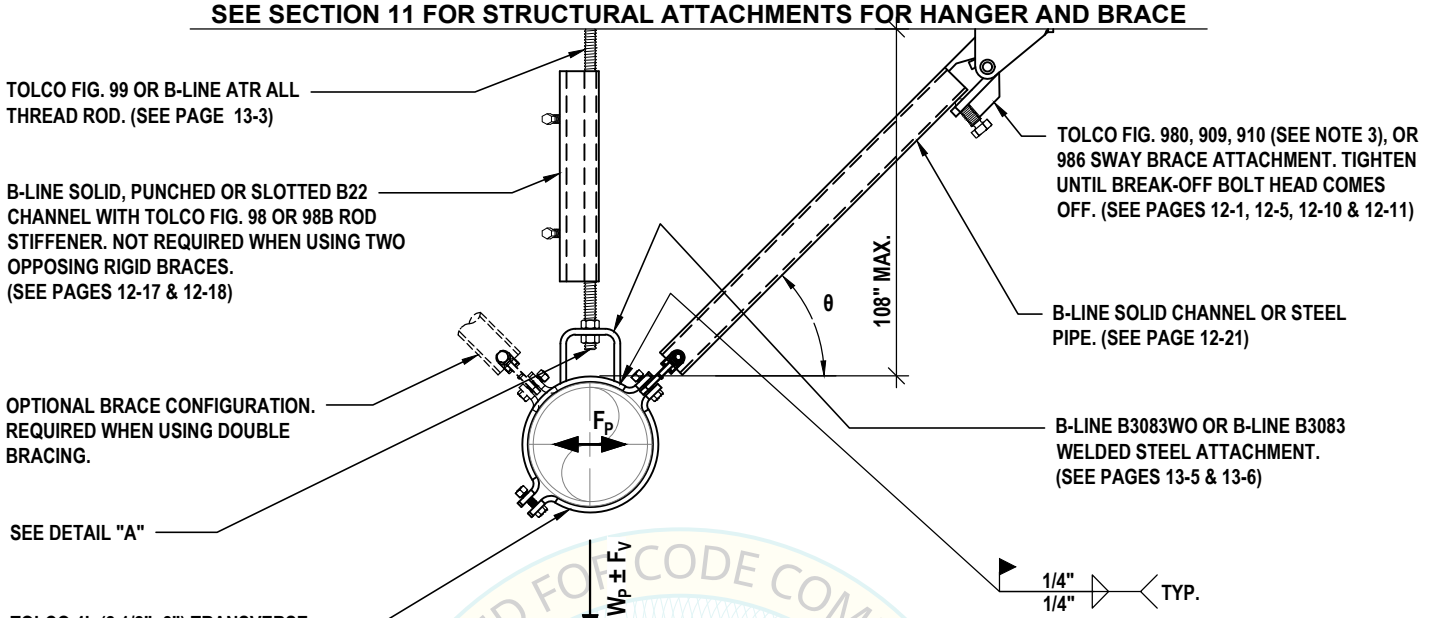
PAGE: **2-6**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE OOR CONDUIT WITH WELDED STEEL ATTACHMENT

DETAIL
SR-7

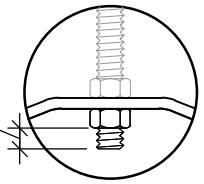
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



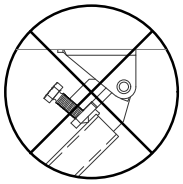
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2 1/2" - 8" PIPE

PIPE DIAMETER	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
2 1/2" - 5"	866	707	500
6" - 8"	1,039	848	600



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND BETTER SUPPORTED PIPING.
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-11 AND 12-12.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.
4. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
5. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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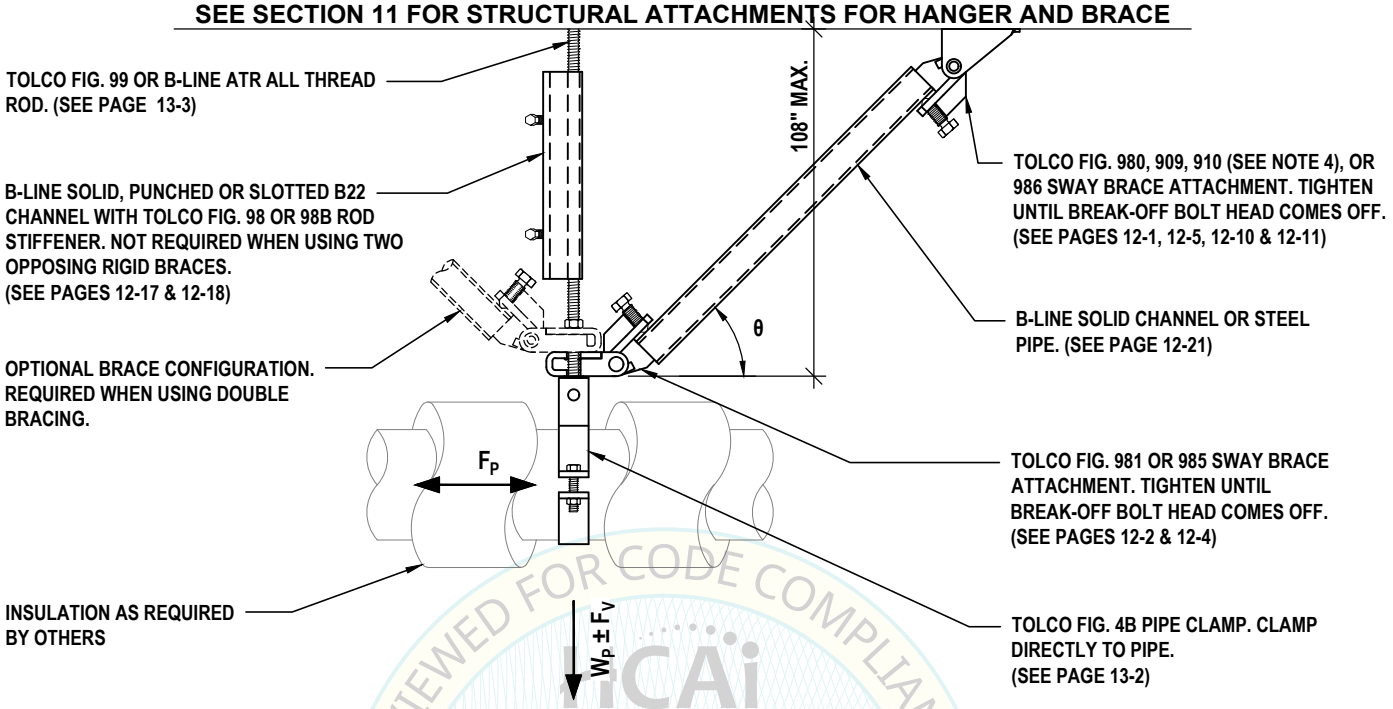
PAGE: **2-7**

DATE: **April 23, 2025**

LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

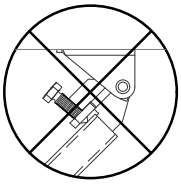
DETAIL
SR-8

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1 1/4" - 8" PIPE

PIPE DIAMETER	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	868	865	407
2 1/2" - 3 1/2"	868	865	407
4"	1,113	990	659
6"	1,089	930	595
8"	1,089	930	595



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. FIG. 986 MUST BE USED WITH 1/2" OR LARGER BOLT OR ALL THREAD ROD
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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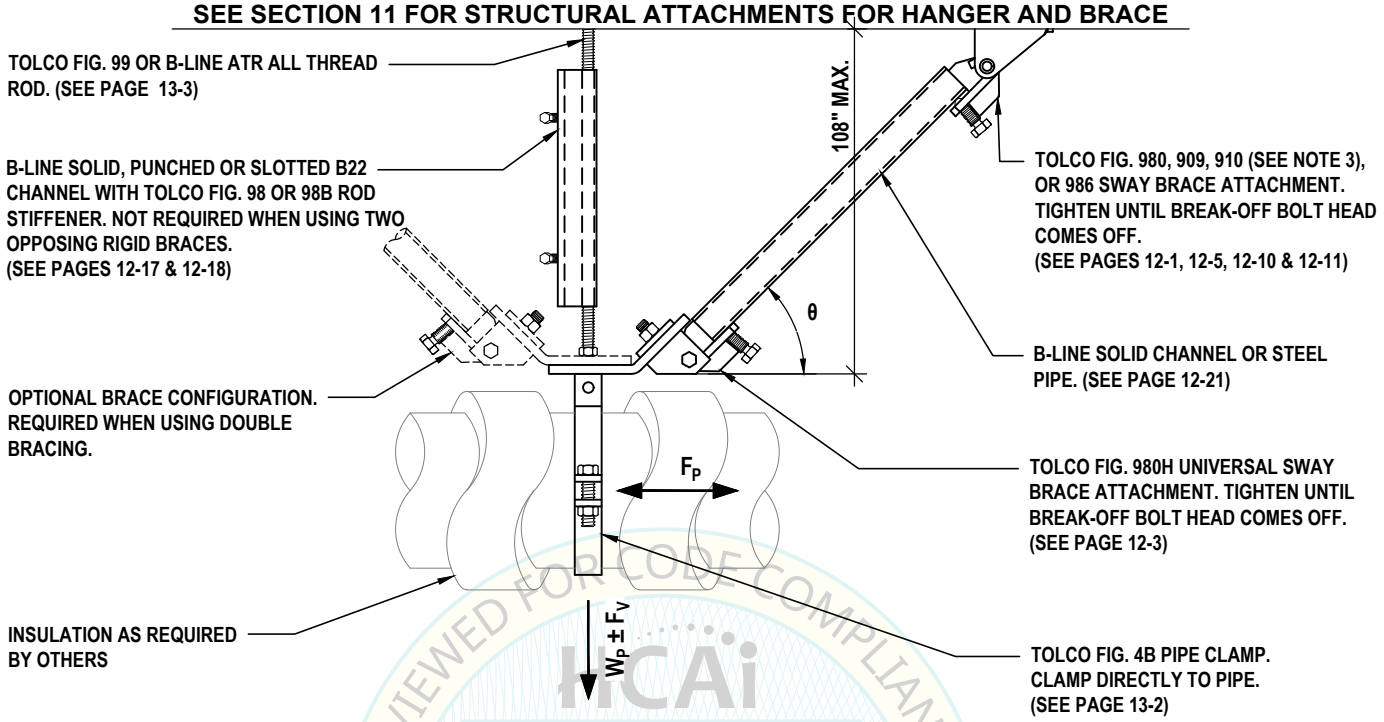
PAGE: **2-8**

DATE: **April 23, 2025**

LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

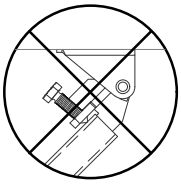
DETAIL
SR-9

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



8" PIPE

PIPE DIAMETER	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
8"	930



DO NOT BEND BRACE PAST 90°

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NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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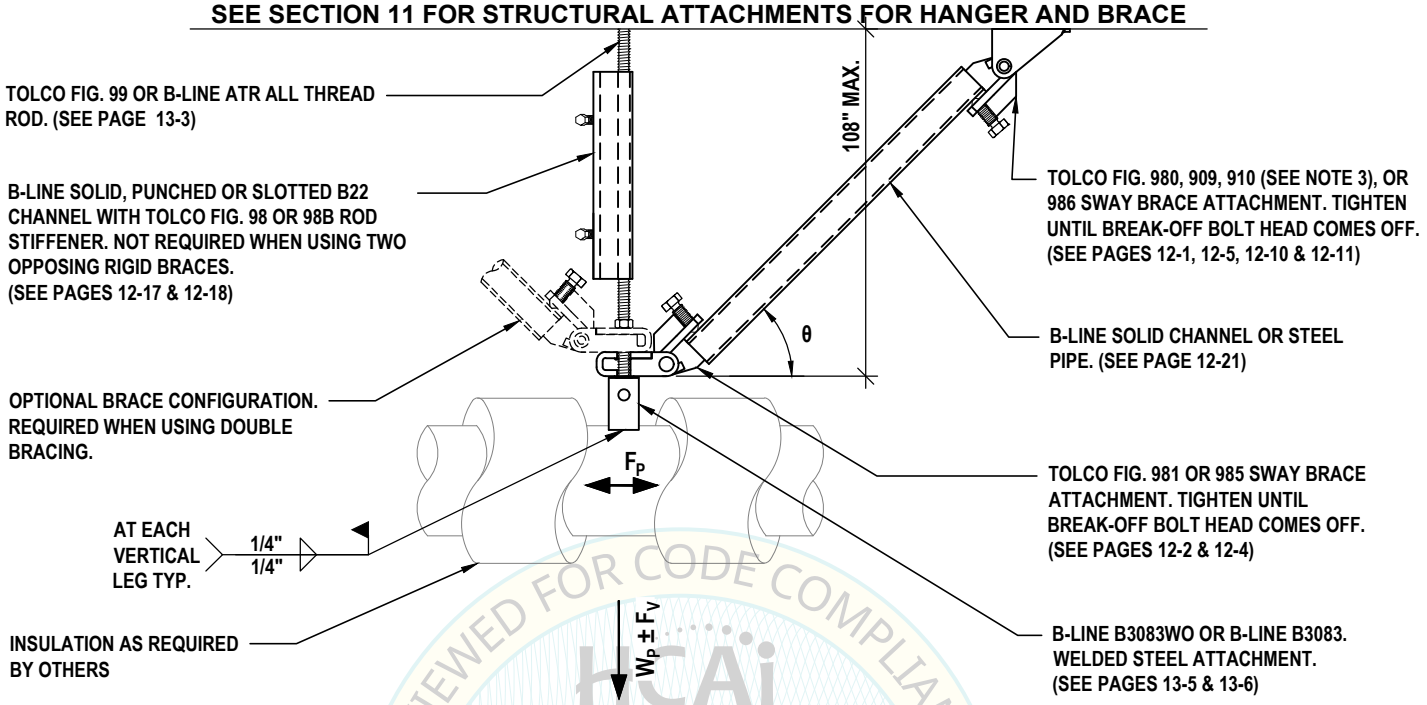
PAGE: **2-9**

DATE: **April 23, 2025**

LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

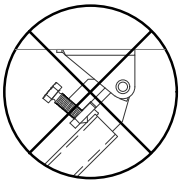
DETAIL
SR-10

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1 1/4" - 8" PIPE

PIPE DIAMETER	ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	868	865	407
2 1/2" - 3 1/2"	1/2"	868	865	407
4" - 5"	5/8"	1,113	990	659
6"	3/4"	1,113	930	595
8"	7/8"	1,307	930	595



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND BETTER SUPPORTED PIPING.
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.
4. THE TOLCO FIG. 304, TOLCO FIG. 305 AND B-LINE B3083 SHALL NOT BE USED WITH EMT.
5. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
6. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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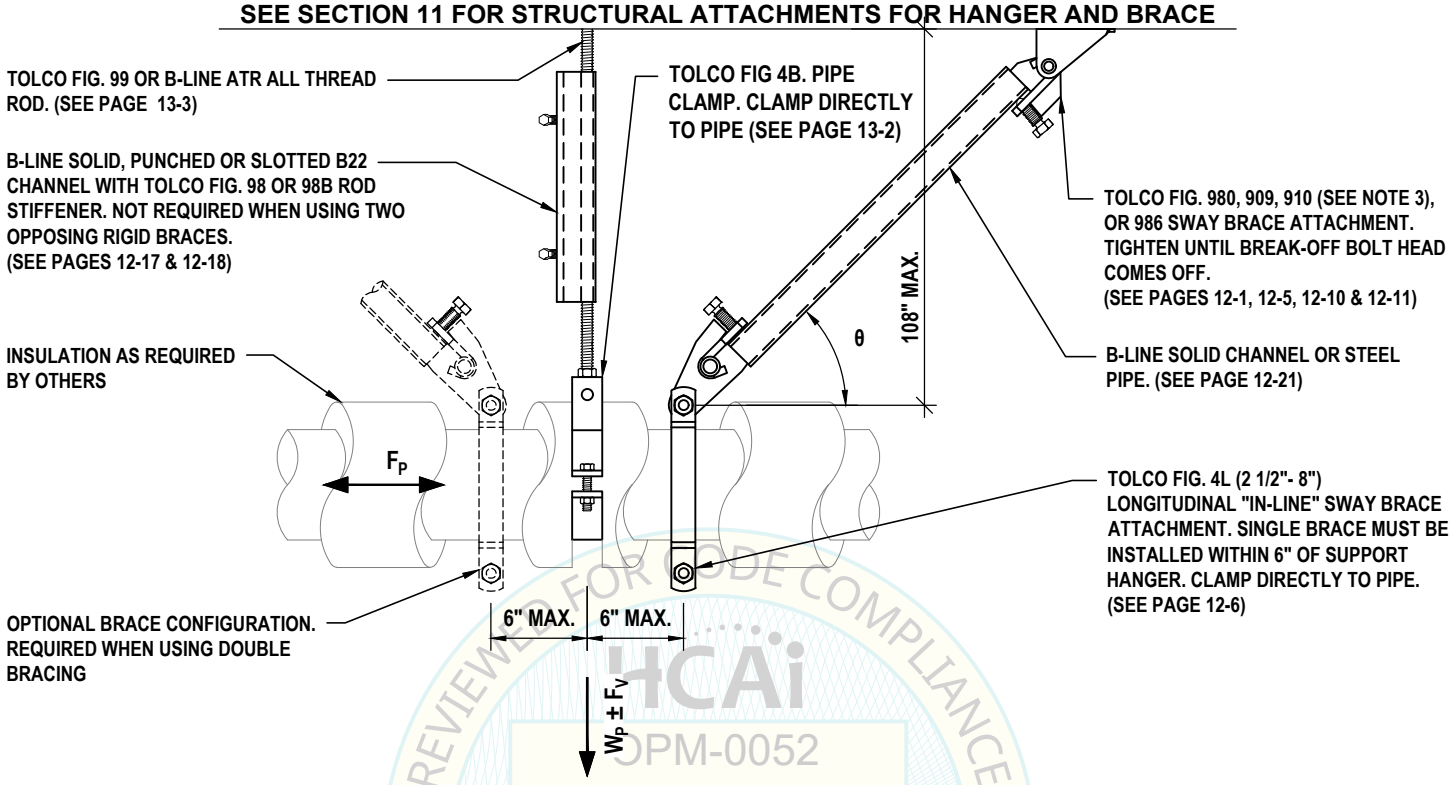
PAGE: **2-10**

DATE: **April 23, 2025**

LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH LONGITUDINAL "IN-LINE" PIPE CLAMP

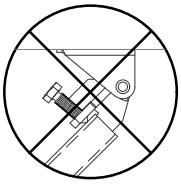
DETAIL
SR-11

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



2 1/2" - 8" PIPE

PIPE DIAMETER	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
2 1/2"	1,420	1,180	1,030
3" - 4"	890	730	530
5" - 8"	830	680	490



DO NOT BEND BRACE PAST 90°

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NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING UNLESS NOTED OTHERWISE ON PAGE 12-6. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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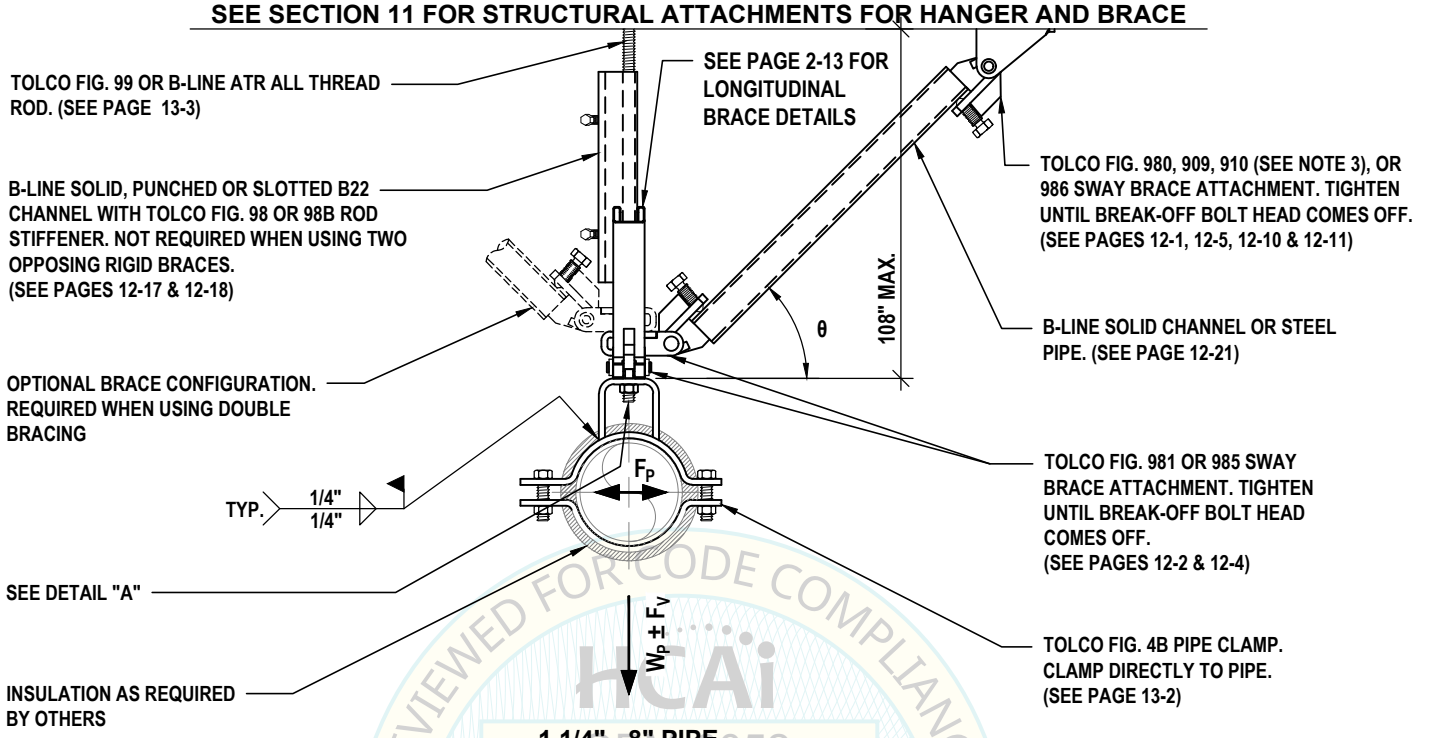
PAGE: **2-11**

DATE: **April 23, 2025**

TRANSVERSE/LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SR-12

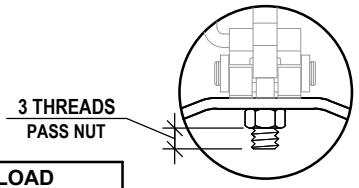
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



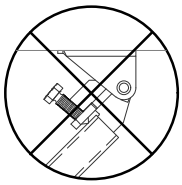
1 1/4" - 8" PIPE

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PIPE DIAMETER	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
1 1/4" - 3 1/2"	326
4"	564
6" - 8"	493



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.
4. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
5. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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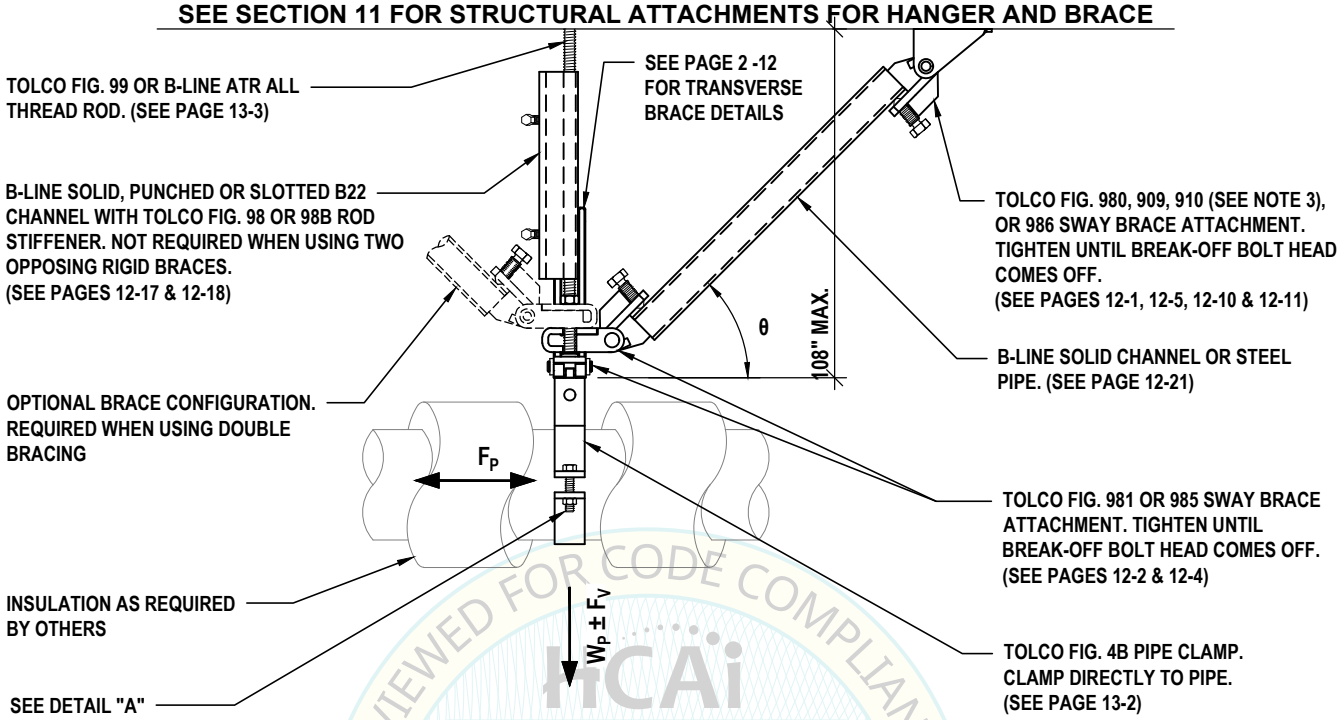
PAGE: **2-12**

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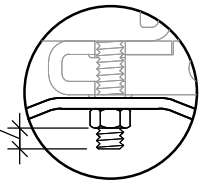
TRANSVERSE/LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SR-13

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE

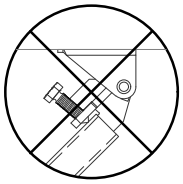


1 1/4" - 8" PIPE



DETAIL A

PIPE DIAMETER	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
1 1/4" - 3 1/2"	326
4"	564
6" - 8"	493



DO NOT BEND BRACE PAST 90°

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NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER SUPPORTED PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
3. FOR FIG 910, BRACE MEMBER SHALL BE THREADED AT UPPER END FOR FITTING.

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SECTION 3

SINGLE HANGER RIGID BRACE SPACING CHARTS

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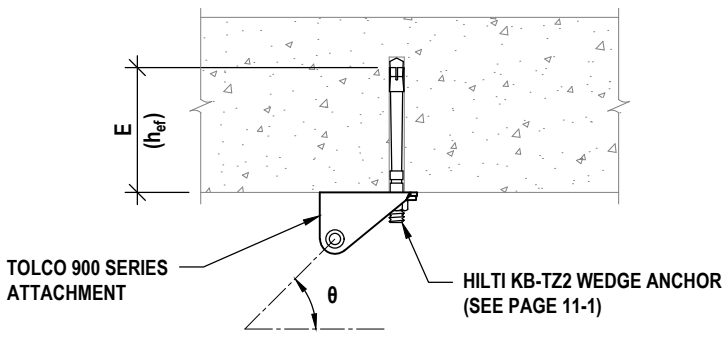
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-0

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	3/8"	2"
5	26.6	40	1	1	3/8"	2"
6	34.8	40	1	1	3/8"	2"
8	55.1	40	1	1	1/2"	3.25"
10	80.2	40	1	1	5/8"	3.25"
12	109.0	39	1	1	3/4"	3.25"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	3/8"	2"
3	12.1	80	1	1	3/8"	2"
4	18.1	80	1	1	3/8"	2"
5	26.6	80	1	1	1/2"	3.25"
6	34.8	80	1	1	1/2"	3.25"
8	55.1	78	1	1	3/4"	3.75"
10	80.2	54	1	1	3/4"	3.75"
12	109.0	78	2[2][3]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 by Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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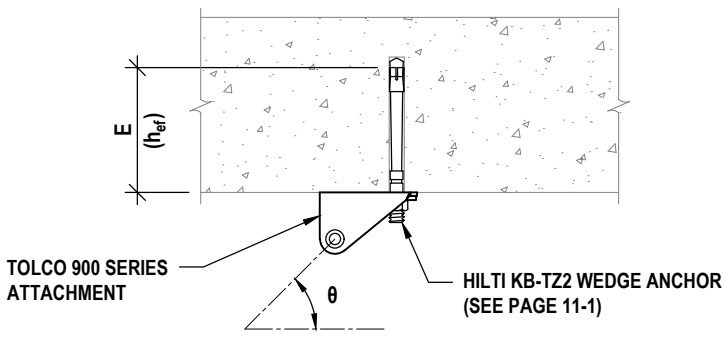
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-1

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	3/8"	2"
5	26.6	40	1	1	1/2"	3.25"
6	34.8	40	1	1	1/2"	3.25"
8	55.1	39	1	1	3/4"	3.75"
10	80.2	27	1	1	3/4"	3.75"
12	109.0	39	2[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	3/8"	2"
3	12.1	80	1	1	1/2"	3.25"
4	18.1	80	1	1	1/2"	3.25"
5	26.6	80	1	1	3/4"	3.75"
6	34.8	42	1	1	1/2"	3.25"
8	55.1	78	2[(2)(3)]	1	3/4"	3.75"
10	80.2	54	2[(2)(3)]	1	3/4"	3.75"
12	109.0	39	2[(2)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 by Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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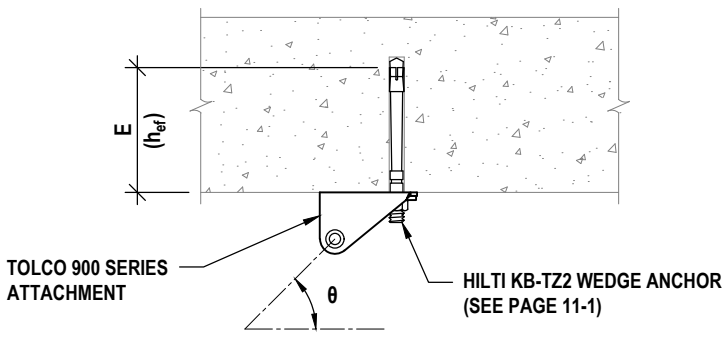
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-2

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	1/2"	3.25"
5	26.6	40	1	1	5/8"	3.25"
6	34.8	40	1	1	3/4"	3.75"
8	55.1	26	1	1	3/4"	3.75"
10	80.2	36	2[(2)(3)]	1	3/4"	3.75"
12	109.0	26	2[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	1/2"	3.25"
3	12.1	80	1	1	1/2"	3.25"
4	18.1	80	1	1	3/4"	3.75"
5	26.6	54	1	1	3/4"	3.75"
6	34.8	80	2[(2)(3)]	1	3/4"	3.75"
8	55.1	52	2[(2)(3)]	1	3/4"	3.75"
10	80.2	36	2[(2)]	1	3/4"	3.75"
12	109.0	26	2[(2)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 by Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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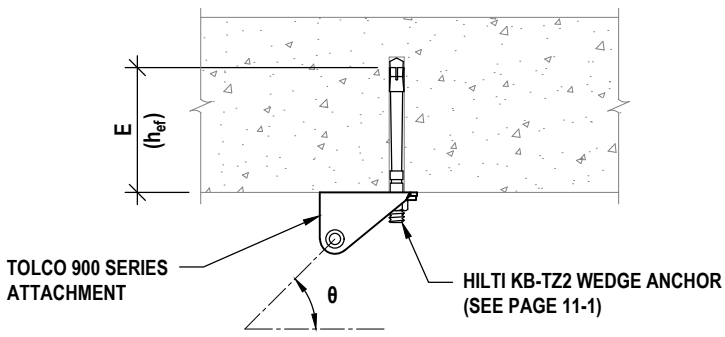
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	1/2"	3.25"
4	18.1	40	1	1	1/2"	3.25"
5	26.6	40	1	1	3/4"	3.75"
6	34.8	31	1	1	3/4"	3.75"
8	55.1	39	2[(2)(3)]	1	3/4"	3.75"
10	80.2	27	2[(2)(3)]	1	3/4"	3.75"
12	109.0	19	2[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:

1. BBRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	1/2"	3.25"
2-1/2	9.1	80	1	1	1/2"	3.25"
3	12.1	80	1	1	5/8"	4"
4	18.1	80	1	1	3/4"	3.75"
5	26.6	80	2[(2)(3)]	1	3/4"	3.75"
6	34.8	62	2[(2)(3)]	1	3/4"	3.75"
8	55.1	39	2[(2)]	1	3/4"	3.75"
10	80.2	27	2[(2)]	1	3/4"	3.75"
12	109.0	19	2[(2)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 by Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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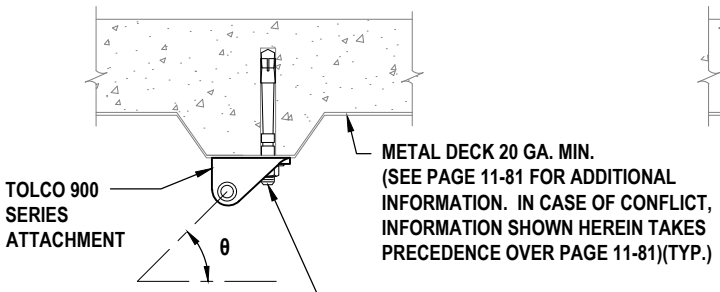
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

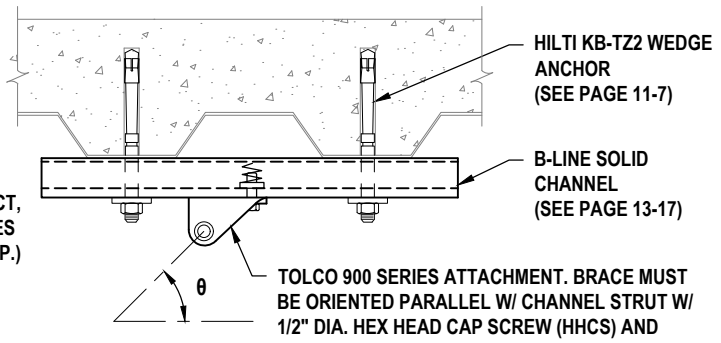
PAGE: 3-4

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	3/8"	2"
5	26.6	40	1	1	3/8"	2"
6	34.8	40	1	1	1/2"	3.25"
8	55.1	40	1	1	5/8"	4"
10	80.2	31	1	1	5/8"	4"
12	109.0	23	1	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	3/8"	2"
3	12.1	80	1	1	3/8"	2"
4	18.1	80	1	1	1/2"	3.25"
5	26.6	80	1	1	5/8"	4"
6	34.8	73	1	1	5/8"	4"
8	55.1	46	1	1	5/8"	4"
10	80.2	62	2[(2)(3)]	1	5/8"	4"
12	109.0	46	2[(2)(3)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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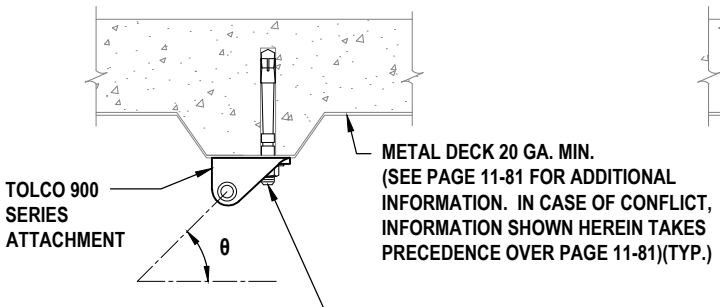
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

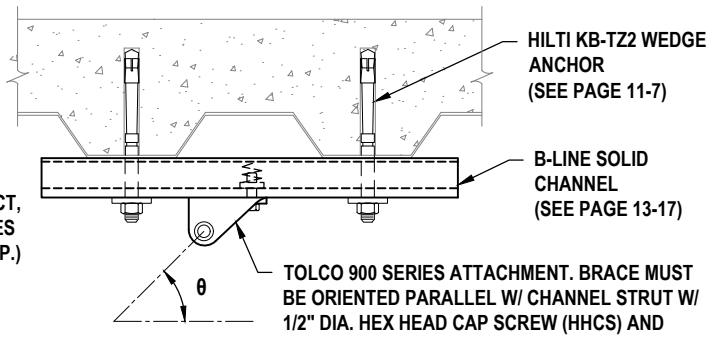
PAGE: 3-5

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.5 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	1/2"	3.25"
5	26.6	40	1	1	5/8"	4"
6	34.8	36	1	1	5/8"	4"
8	55.1	23	1	1	5/8"	4"
10	80.2	31	2[(2)(3)]	1	5/8"	4"
12	109.0	23	2[(2)(3)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.5 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	1/2"	3.25"
3	12.1	80	1	1	5/8"	2.75"
4	18.1	70	1	1	5/8"	4"
5	26.6	47	1	1	5/8"	4"
6	34.8	72	2[(2)(3)]	1	5/8"	4"
8	55.1	46	2[(2)(3)]	1	5/8"	4"
10	80.2	31	2[(2)]	1	5/8"	4"
12	109.0	23	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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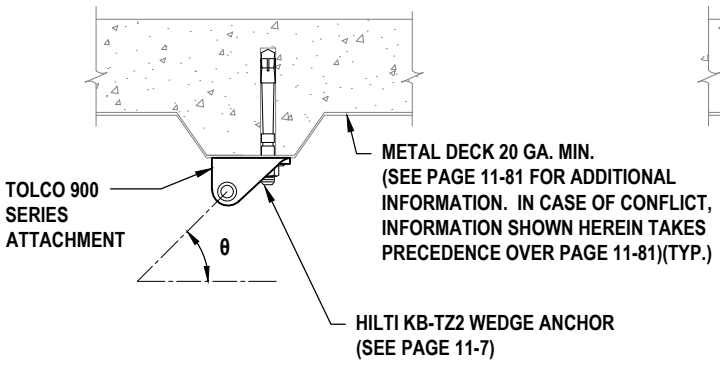
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

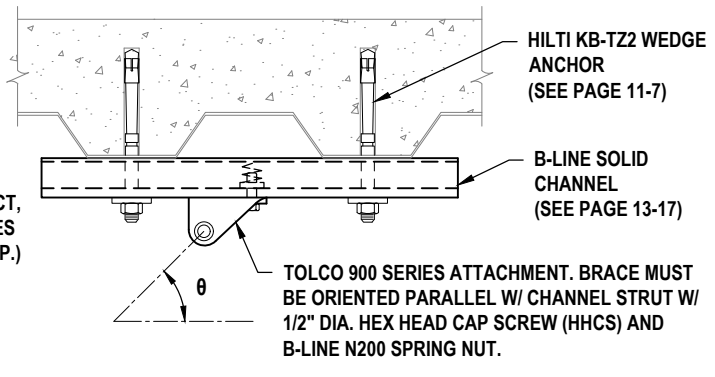
PAGE: 3-6

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	1/2"	3.25"
4	18.1	40	1	1	5/8"	4"
5	26.6	31	1	1	5/8"	4"
6	34.8	24	1	1	5/8"	4"
8	55.1	30	2[(2)(3)]	1	5/8"	4"
10	80.2	21	2[(2)(3)]	1	5/8"	4"
12	109.0	15	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	1/2"	3.25"
2-1/2	9.1	80	1	1	5/8"	4"
3	12.1	70	1	1	5/8"	4"
4	18.1	47	1	1	5/8"	4"
5	26.6	62	2[(2)(3)]	1	5/8"	4"
6	34.8	48	2[(2)(3)]	1	5/8"	4"
8	55.1	30	2[(2)]	1	5/8"	4"
10	80.2	21	2[(2)]	1	5/8"	4"
12	109.0	15	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2025

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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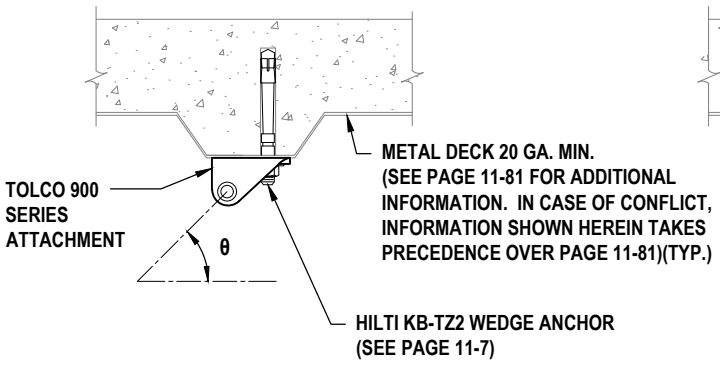
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

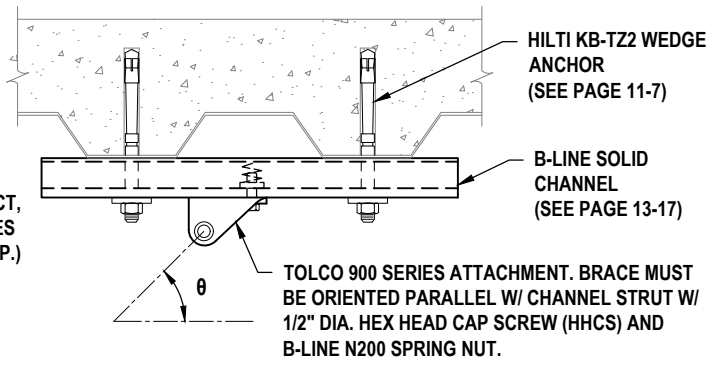
PAGE: 3-7

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	1/2"	3.25"
3	12.1	40	1	1	5/8"	2.75"
4	18.1	35	1	1	5/8"	4"
5	26.6	23	1	1	5/8"	4"
6	34.8	36	2[(2)(3)]	1	5/8"	4"
8	55.1	23	2[(2)(3)]	1	5/8"	4"
10	80.2	15	2[(2)]	1	5/8"	4"
12	109.0	11	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	1/2"	3.25"
1-1/2	4.5	80	1	1	1/2"	3.25"
2	6.2	80	1	1	5/8"	4"
2-1/2	9.1	70	1	1	5/8"	4"
3	12.1	52	1	1	5/8"	4"
4	18.1	70	2[(2)(3)]	1	5/8"	4"
5	26.6	46	2[(2)(3)]	1	5/8"	4"
6	34.8	36	2[(2)]	1	5/8"	4"
8	55.1	23	2[(2)]	1	5/8"	4"
10	80.2	15	2[(2)]	1	5/8"	4"
12	109.0	11	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2025

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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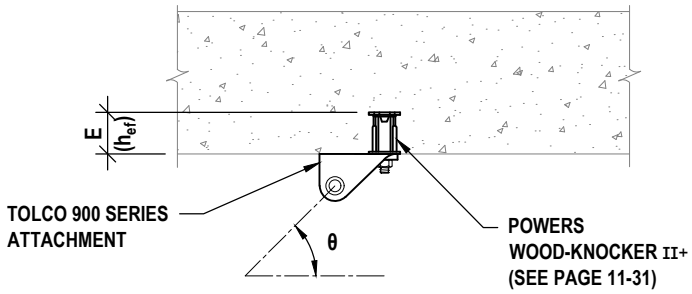
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-8

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	3/8"	2"
5	26.6	40	1	1	3/8"	2"
6	34.8	40	1	1	1/2"	2"
8	55.1	30	1	1	1/2"	2"
10	80.2	40	2[(2)(3)]	1	1/2"	2"
12	109.0	30	2[(2)(3)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	3/8"	2"
3	12.1	80	1	1	3/8"	2"
4	18.1	80	1	1	1/2"	2"
5	26.6	62	1	1	1/2"	2"
6	34.8	47	1	1	1/2"	2"
8	55.1	60	2[(2)(3)]	1	1/2"	2"
10	80.2	40	2[(2)]	1	1/2"	2"
12	109.0	30	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
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REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 by Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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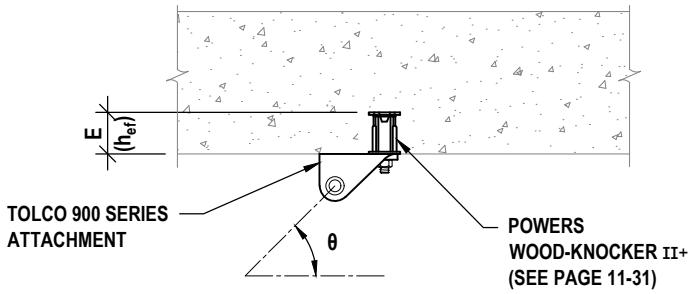
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-9

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.5 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	1/2"	2"
5	26.6	31	1	1	1/2"	2"
6	34.8	23	1	1	1/2"	2"
8	55.1	30	2[(2)(3)]	1	1/2"	2"
10	80.2	20	2[(2)(3)]	1	1/2"	2"
12	109.0	15	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.5 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	1/2"	2"
3	12.1	68	1	1	1/2"	2"
4	18.1	46	1	1	1/2"	2"
5	26.6	62	2[(2)(3)]	1	1/2"	2"
6	34.8	46	2[(2)(3)]	1	1/2"	2"
8	55.1	30	2[(2)]	1	1/2"	2"
10	80.2	20	2[(2)]	1	1/2"	2"
12	109.0	15	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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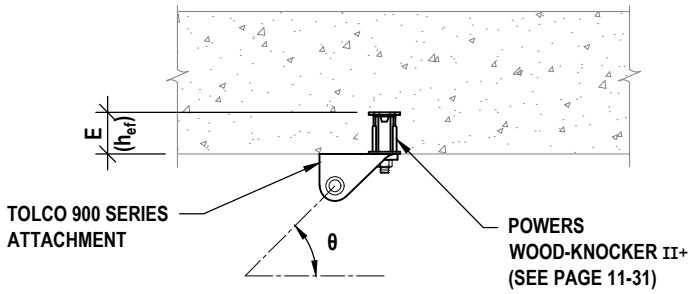
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-10

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	1/2"	2"
4	18.1	30	1	1	1/2"	2"
5	26.6	20	1	1	1/2"	2"
6	34.8	31	2[(2)(3)]	1	1/2"	2"
8	55.1	20	2[(2)(3)]	1	1/2"	2"
10	80.2	13	2[(2)]	1	1/2"	2"
12	109.0	10	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	1/2"	2"
2-1/2	9.1	61	1	1	1/2"	2"
3	12.1	45	1	1	1/2"	2"
4	18.1	60	2[(2)(3)]	1	1/2"	2"
5	26.6	40	2[(2)(3)]	1	1/2"	2"
6	34.8	31	2[(2)]	1	1/2"	2"
8	55.1	20	2[(2)]	1	1/2"	2"
10	80.2	13	2[(2)]	1	1/2"	2"
12	109.0	10	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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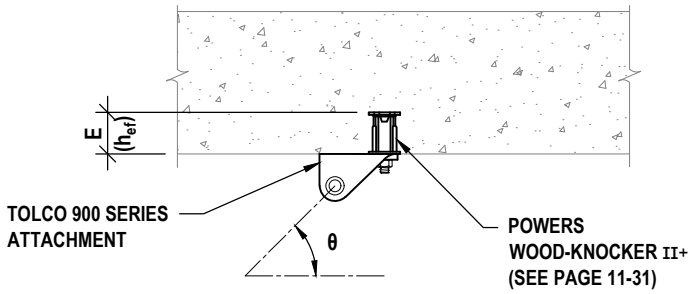
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-11

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	1/2"	2"
3	12.1	34	1	1	1/2"	2"
4	18.1	23	1	1	1/2"	2"
5	26.6	31	2[(2)(3)]	1	1/2"	2"
6	34.8	23	2[(2)(3)]	1	1/2"	2"
8	55.1	15	2[(2)]	1	1/2"	2"
10	80.2	10	2[(2)]	1	1/2"	2"
12	109.0	7	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	1/2"	2"
2	6.2	67	1	1	1/2"	2"
2-1/2	9.1	45	1	1	1/2"	2"
3	12.1	68	1	1	1/2"	2"
4	18.1	46	1	1	1/2"	2"
5	26.6	31	2[(2)(3)]	1	1/2"	2"
6	34.8	23	2[(2)(3)]	1	1/2"	2"
8	55.1	15	2[(2)]	1	1/2"	2"
10	80.2	10	2[(2)]	1	1/2"	2"
12	109.0	7	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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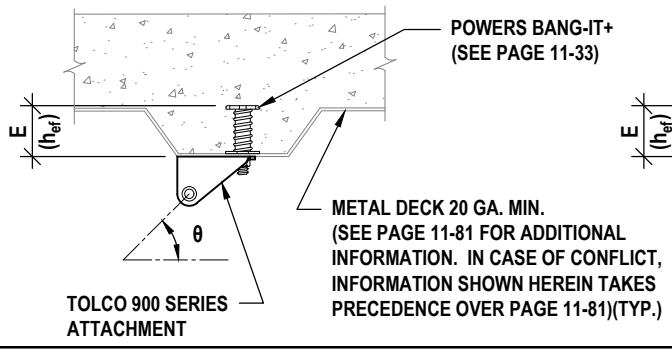
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

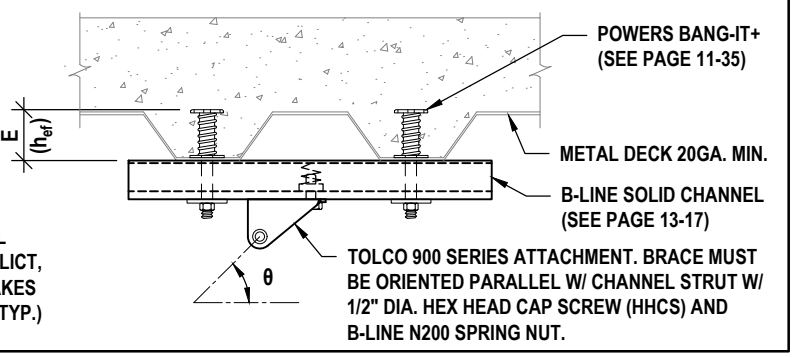
PAGE: 3-12

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	40	1	1	3/8"	2"
4	18.1	40	1	1	3/8"	2"
5	26.6	36	1	1	5/8"	2"
6	34.8	28	1	1	5/8"	2"
8	55.1	35	1	2	5/8"	2"
10	80.2	24	1	2	5/8"	2"
12	109.0	36	2[(2)(3)]	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	80	1	1	3/8"	2"
2-1/2	9.1	80	1	1	3/8"	2"
3	12.1	80	1	1	5/8"	2"
4	18.1	54	1	1	5/8"	2"
5	26.6	72	1	2	5/8"	2"
6	34.8	56	1	2	5/8"	2"
8	55.1	70	2[(2)(3)]	2	5/8"	2"
10	80.2	48	2[(2)(3)]	2	5/8"	2"
12	109.0	36	2[(2)]	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
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REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
by: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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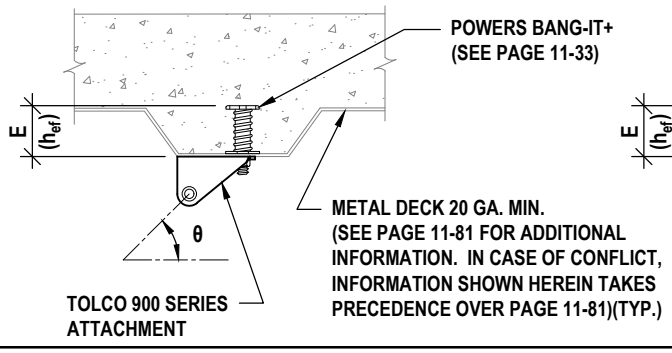
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

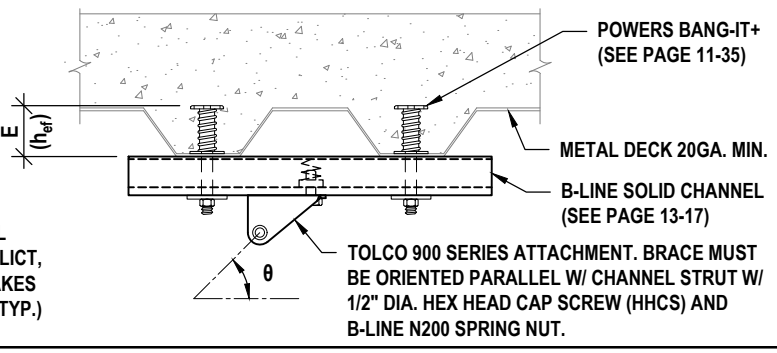
PAGE: 3-13

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	40	1	1	3/8"	2"
3	12.1	38	1	1	1/2"	2"
4	18.1	25	1	1	1/2"	2"
5	26.6	34	1	2	1/2"	2"
6	34.8	26	1	2	1/2"	2"
8	55.1	33	$2^{(2)(3)}$	2	1/2"	2"
10	80.2	23	$2^{(2)(3)}$	2	1/2"	2"
12	109.0	17	$2^{(2)}$	2	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	3/8"	2"
1-1/2	4.5	80	1	1	3/8"	2"
2	6.2	74	1	1	1/2"	2"
2-1/2	9.1	50	1	1	1/2"	2"
3	12.1	76	1	2	1/2"	2"
4	18.1	50	1	2	1/2"	2"
5	26.6	68	$2^{(2)(3)}$	2	1/2"	2"
6	34.8	52	$2^{(2)(3)}$	2	1/2"	2"
8	55.1	33	$2^{(2)}$	2	1/2"	2"
10	80.2	23	$2^{(2)}$	2	1/2"	2"
12	109.0	17	$2^{(2)}$	2	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
Reviewed by: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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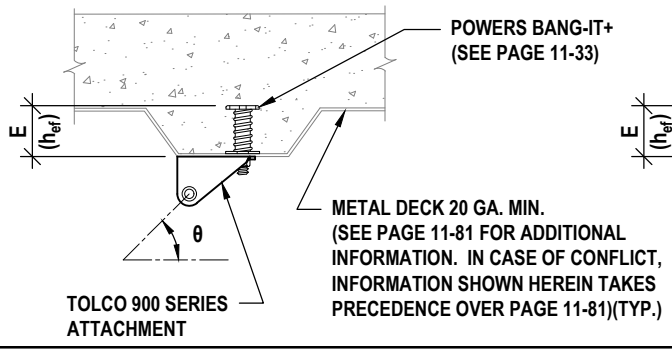
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

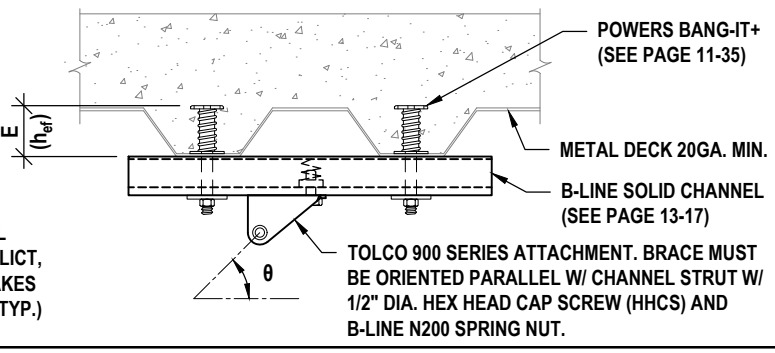
PAGE: 3-14

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	40	1	1	3/8"	2"
2-1/2	9.1	33	1	1	1/2"	2"
3	12.1	25	1	1	1/2"	2"
4	18.1	34	1	2	1/2"	2"
5	26.6	23	1	2	1/2"	2"
6	34.8	35	2[(2)(3)]	2	1/2"	2"
8	55.1	22	2[(2)(3)]	2	1/2"	2"
10	80.2	15	2[(2)]	2	1/2"	2"
12	109.0	11	2[(2)]	2	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	3/8"	2"
1-1/4	3.8	80	1	1	1/2"	2"
1-1/2	4.5	68	1	1	1/2"	2"
2	6.2	49	1	1	1/2"	2"
2-1/2	9.1	66	1	2	1/2"	2"
3	12.1	50	1	2	1/2"	2"
4	18.1	68	2[(2)(3)]	2	1/2"	2"
5	26.6	46	2[(2)(3)]	2	1/2"	2"
6	34.8	35	2[(2)]	2	1/2"	2"
8	55.1	22	2[(2)]	2	1/2"	2"
10	80.2	15	2[(2)]	2	1/2"	2"
12	109.0	11	2[(2)]	2	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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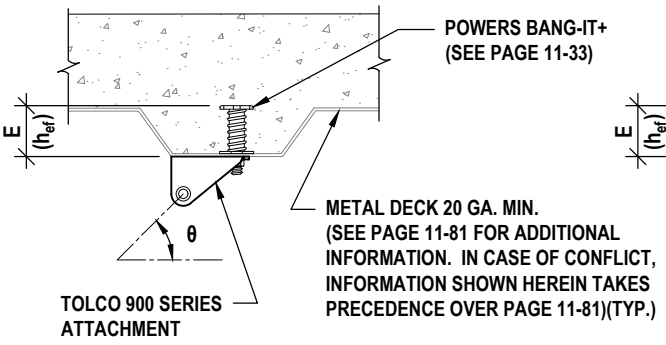
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

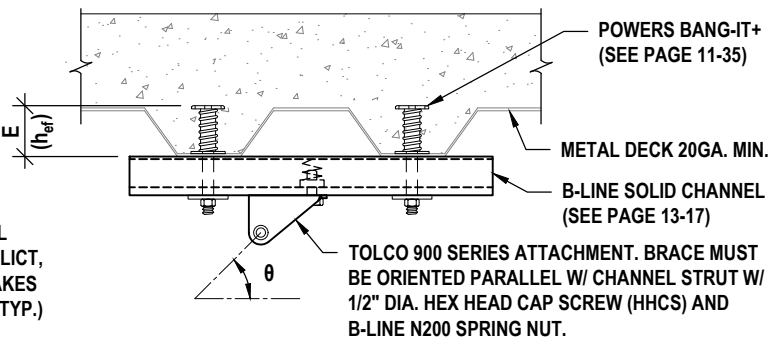
PAGE: 3-15

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1	1	3/8"	2"
1-1/4	3.8	40	1	1	3/8"	2"
1-1/2	4.5	40	1	1	3/8"	2"
2	6.2	37	1	1	1/2"	2"
2-1/2	9.1	40	1	2	1/2"	2"
3	12.1	38	1	2	1/2"	2"
4	18.1	25	1	2	1/2"	2"
5	26.6	34	2[(2)(3)]	2	1/2"	2"
6	34.8	26	2[(2)(3)]	2	1/2"	2"
8	55.1	16	2[(2)]	2	1/2"	2"
10	80.2	11	2[(2)]	2	1/2"	2"
12	109.0	8	2[(2)]	2	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1	1	1/2"	2"
1-1/4	3.8	80	1	2	1/2"	2"
1-1/2	4.5	80	1	2	1/2"	2"
2	6.2	74	1	2	1/2"	2"
2-1/2	9.1	50	1	2	1/2"	2"
3	12.1	76	2[(2)(3)]	2	1/2"	2"
4	18.1	50	2[(2)(3)]	2	1/2"	2"
5	26.6	34	2[(2)]	2	1/2"	2"
6	34.8	26	2[(2)]	2	1/2"	2"
8	55.1	16	2[(2)]	2	1/2"	2"
10	80.2	11	2[(2)]	2	1/2"	2"
12	109.0	8	2[(2)]	2	1/2"	2"

FOOTNOTES:

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REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

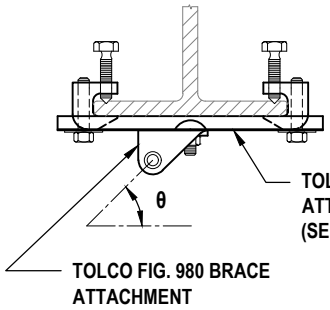
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DATE: April 23, 2025

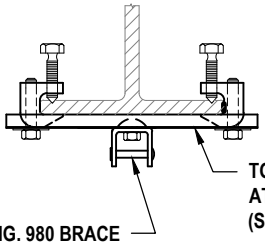
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.25 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G"	
			Perpendicular	Parallel
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	40
6	34.8	1	40	40
8	55.1	1	40	40
10	80.2	1	40	40
12	109.0	1	40	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G"	
			Perpendicular	Parallel
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	80
4	18.1	1	80	80
5	26.6	1	80	80
6	34.8	1	80	80
8	55.1	1	80	80
10	80.2	1	61	59
12	109.0	1	44	43

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

REVIEWED FOR CODE COMPLIANCE
ICAT
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

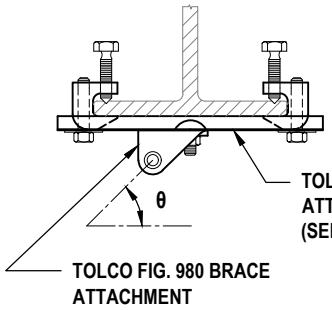
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DATE: April 23, 2025

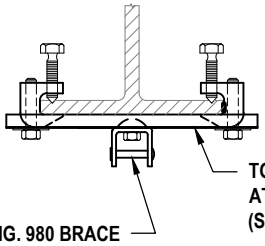
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.50 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G"	
			Perpendicular	Parallel
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	40
6	34.8	1	40	40
8	55.1	1	40	40
10	80.2	2[(2)(3)]	40	40
12	109.0	2[(2)(3)]	40	40

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G"	
			Perpendicular	Parallel
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	80
4	18.1	1	80	80
5	26.6	1	80	80
6	34.8	1	80	68
8	55.1	2[(2)(3)]	80	80
10	80.2	2[(2)(3)]	61	59
12	109.0	2[(2)(3)]	44	43

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
OPM-0053
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

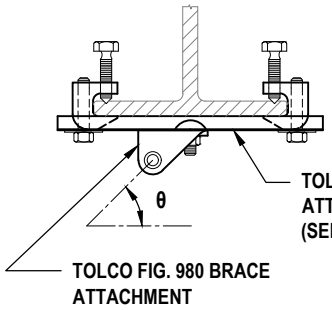
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DATE: April 23, 2025

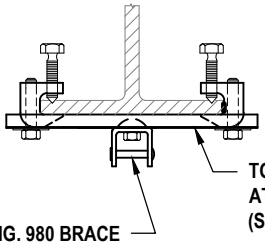
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.75 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G"	
			Perpendicular	Parallel
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	40
6	34.8	1	40	40
8	55.1	2[(2)(3)]	40	40
10	80.2	2[(2)(3)]	40	39
12	109.0	2[(2)(3)]	29	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G"	
			Perpendicular	Parallel
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	80
4	18.1	1	80	80
5	26.6	1	61	59
6	34.8	1	46	45
8	55.1	2[(2)(3)]	59	57
10	80.2	2[(2)(3)]	40	39
12	109.0	2[(2)(3)]	29	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE ICAI OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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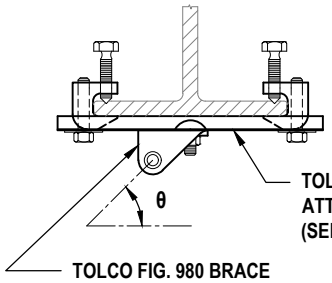
PAGE: 3-19

DATE: April 23, 2025

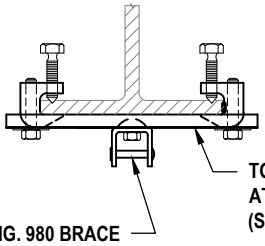
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

1.0 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G"	
			Perpendicular	Parallel
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	40
6	34.8	1	40	34
8	55.1	2[(2)(3)]	40	40
10	80.2	2[(2)(3)]	30	29
12	109.0	2[(2)(3)]	22	21

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G"	
			Perpendicular	Parallel
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	80
4	18.1	1	67	65
5	26.6	1	46	44
6	34.8	1	35	34
8	55.1	2[(2)(3)]	44	43
10	80.2	2[(2)(3)]	30	29
12	109.0	2[(2)(3)]	22	21

FOOTNOTES:

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REVIEWED FOR CODE COMPLIANCE ICAI OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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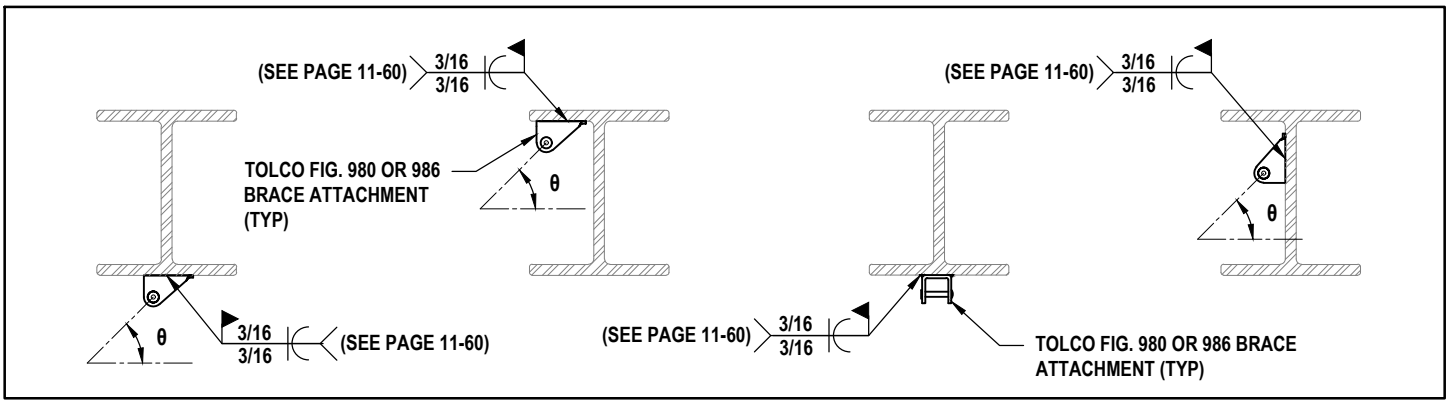
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G"
1	2.8	1	40
1-1/4	3.8	1	40
1-1/2	4.5	1	40
2	6.2	1	40
2-1/2	9.1	1	40
3	12.1	1	40
4	18.1	1	40
5	26.6	1	40
6	34.8	1	40
8	55.1	1	40
10	80.2	1	40
12	109.0	1	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G"
1	2.8	1	80
1-1/4	3.8	1	80
1-1/2	4.5	1	80
2	6.2	1	80
2-1/2	9.1	1	80
3	12.1	1	80
4	18.1	1	80
5	26.6	1	80
6	34.8	1	80
8	55.1	1	80
10	80.2	1	61
12	109.0	1	44

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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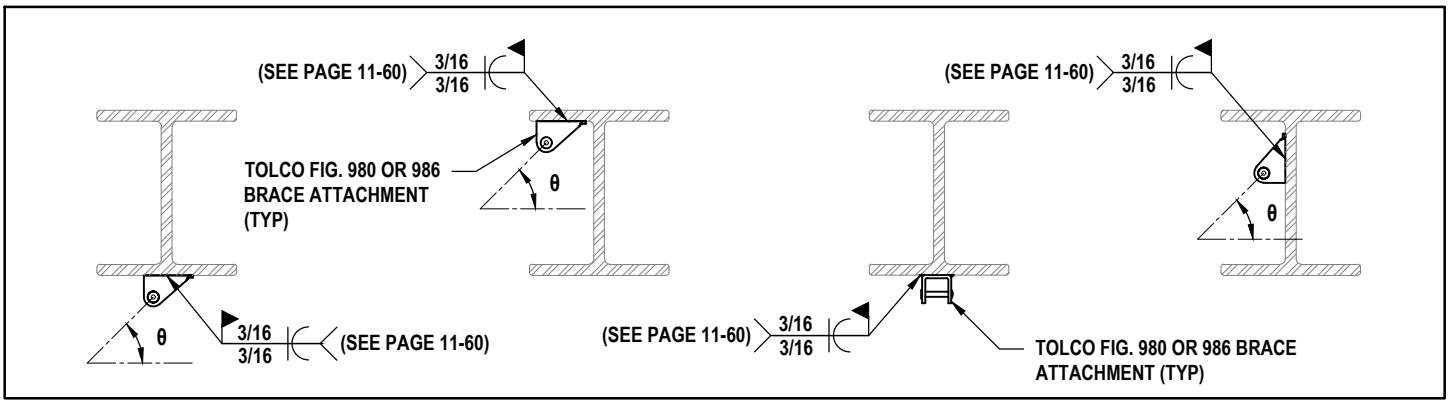
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-21

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G"
1	2.8	1	40
1-1/4	3.8	1	40
1-1/2	4.5	1	40
2	6.2	1	40
2-1/2	9.1	1	40
3	12.1	1	40
4	18.1	1	40
5	26.6	1	40
6	34.8	1	40
8	55.1	1	40
10	80.2	2[(2)(3)]	40
12	109.0	2[(2)(3)]	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G"
1	2.8	1	80
1-1/4	3.8	1	80
1-1/2	4.5	1	80
2	6.2	1	80
2-1/2	9.1	1	80
3	12.1	1	80
4	18.1	1	80
5	26.6	1	80
6	34.8	1	63
8	55.1	2[(2)(3)]	80
10	80.2	2[(2)(3)]	61
12	109.0	2[(2)(3)]	44

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
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REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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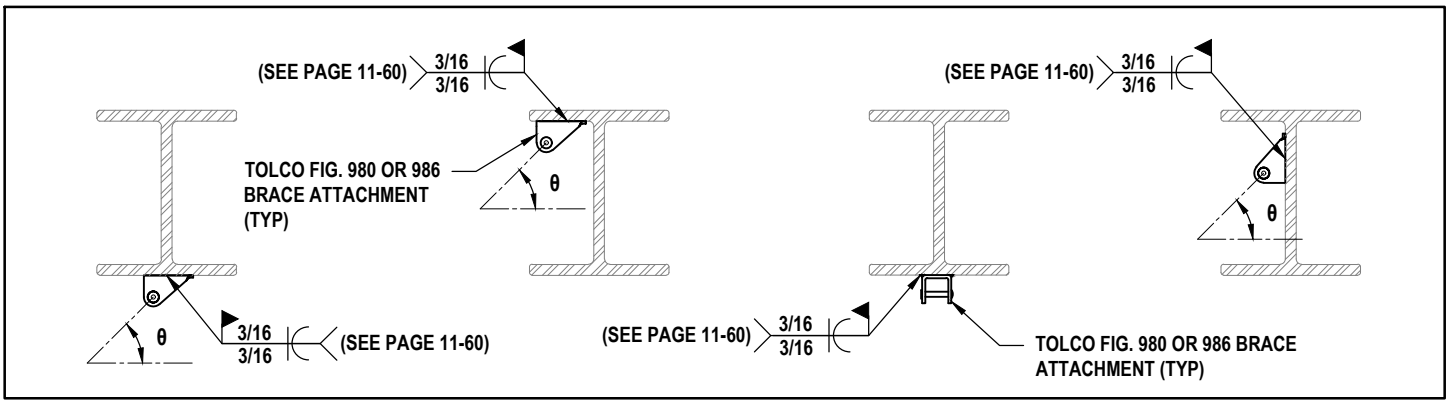
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-22

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G"
1	2.8	1	40
1-1/4	3.8	1	40
1-1/2	4.5	1	40
2	6.2	1	40
2-1/2	9.1	1	40
3	12.1	1	40
4	18.1	1	40
5	26.6	1	40
6	34.8	1	40
8	55.1	2[(2)(3)]	40
10	80.2	2[(2)(3)]	40
12	109.0	2[(2)(3)]	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G"
1	2.8	1	80
1-1/4	3.8	1	80
1-1/2	4.5	1	80
2	6.2	1	80
2-1/2	9.1	1	80
3	12.1	1	80
4	18.1	1	80
5	26.6	2[(2)(3)]	80
6	34.8	2[(2)(3)]	80
8	55.1	2[(2)(3)]	59
10	80.2	2[(2)(3)]	40
12	109.0	2[(2)(3)]	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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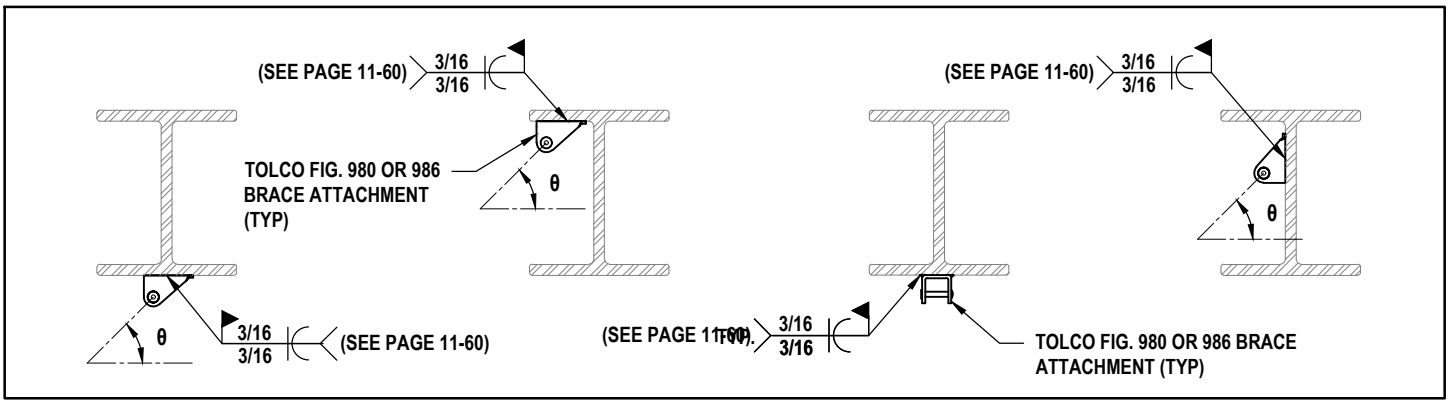
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-23

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G"
1	2.8	1	40
1-1/4	3.8	1	40
1-1/2	4.5	1	40
2	6.2	1	40
2-1/2	9.1	1	40
3	12.1	1	40
4	18.1	1	40
5	26.6	1	40
6	34.8	1	35
8	55.1	2[(2)(3)]	40
10	80.2	2[(2)(3)]	30
12	109.0	2[(2)(3)]	22

FOOTNOTES:

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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G"
1	2.8	1	80
1-1/4	3.8	1	80
1-1/2	4.5	1	80
2	6.2	1	80
2-1/2	9.1	1	80
3	12.1	1	80
4	18.1	1	67
5	26.6	2[(2)(3)]	80
6	34.8	2[(2)(3)]	70
8	55.1	2[(2)(3)]	44
10	80.2	2[(2)(3)]	30
12	109.0	2[(2)(3)]	22

FOOTNOTES:

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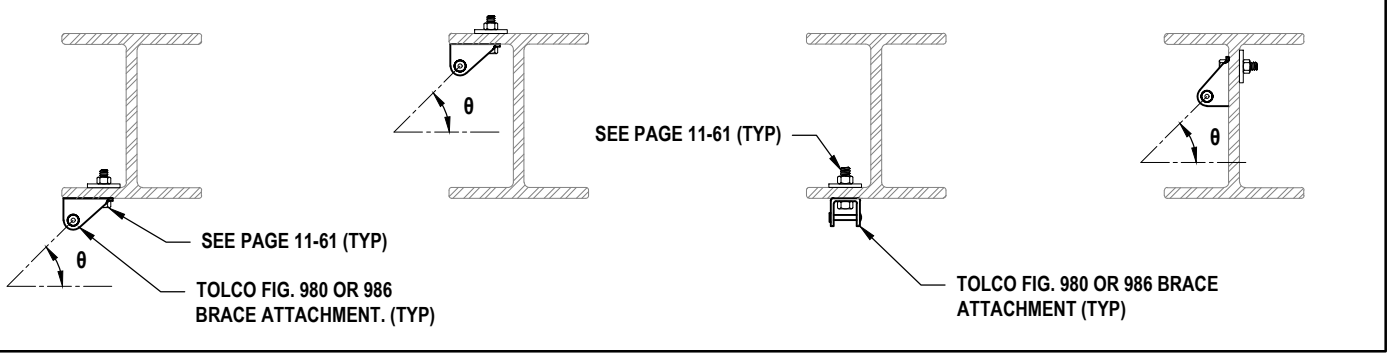
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-24

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.25 "G"
1	2.8	1	3/8"	40
1-1/4	3.8	1	3/8"	40
1-1/2	4.5	1	3/8"	40
2	6.2	1	3/8"	40
2-1/2	9.1	1	3/8"	40
3	12.1	1	3/8"	40
4	18.1	1	3/8"	40
5	26.6	1	3/8"	40
6	34.8	1	3/8"	40
8	55.1	1	1/2"	40
10	80.2	1	5/8"	40
12	109.0	1	5/8"	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"
1	2.8	1	3/8"	80
1-1/4	3.8	1	3/8"	80
1-1/2	4.5	1	3/8"	80
2	6.2	1	3/8"	80
2-1/2	9.1	1	3/8"	80
3	12.1	1	3/8"	80
4	18.1	1	3/8"	80
5	26.6	1	1/2"	80
6	34.8	1	1/2"	80
8	55.1	1	5/8"	80
10	80.2	1	5/8"	61
12	109.0	2	5/8"	80

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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OPM-0053
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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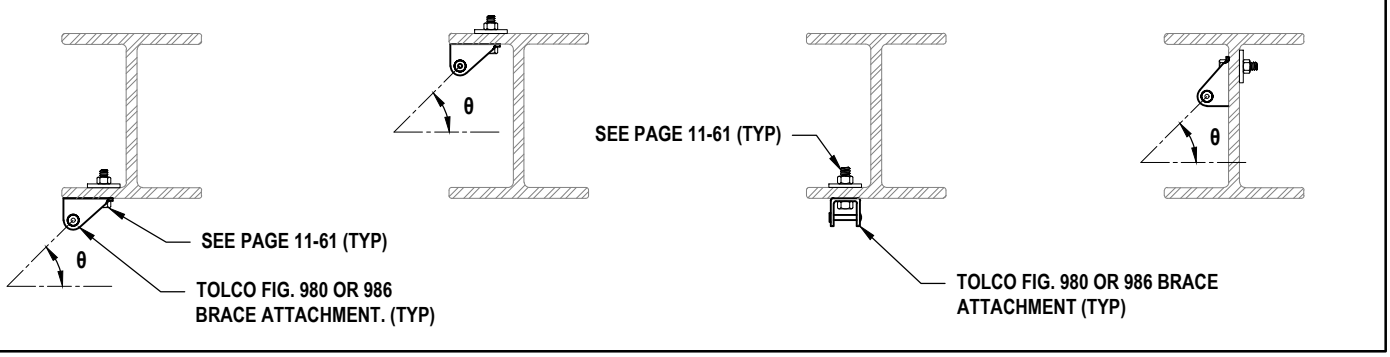
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-25

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.50 "G"
1	2.8	1	3/8"	40
1-1/4	3.8	1	3/8"	40
1-1/2	4.5	1	3/8"	40
2	6.2	1	3/8"	40
2-1/2	9.1	1	3/8"	40
3	12.1	1	3/8"	40
4	18.1	1	3/8"	40
5	26.6	1	1/2"	40
6	34.8	1	1/2"	40
8	55.1	1	5/8"	40
10	80.2	2[(2)(3)]	5/8"	40
12	109.0	2[(2)(3)]	5/8"	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"
1	2.8	1	3/8"	80
1-1/4	3.8	1	3/8"	80
1-1/2	4.5	1	3/8"	80
2	6.2	1	3/8"	80
2-1/2	9.1	1	3/8"	80
3	12.1	1	1/2"	80
4	18.1	1	1/2"	80
5	26.6	1	5/8"	80
6	34.8	1	5/8"	70
8	55.1	2[(2)(3)]	5/8"	80
10	80.2	2[(2)(3)]	5/8"	61
12	109.0	2[(2)(3)]	5/8"	44

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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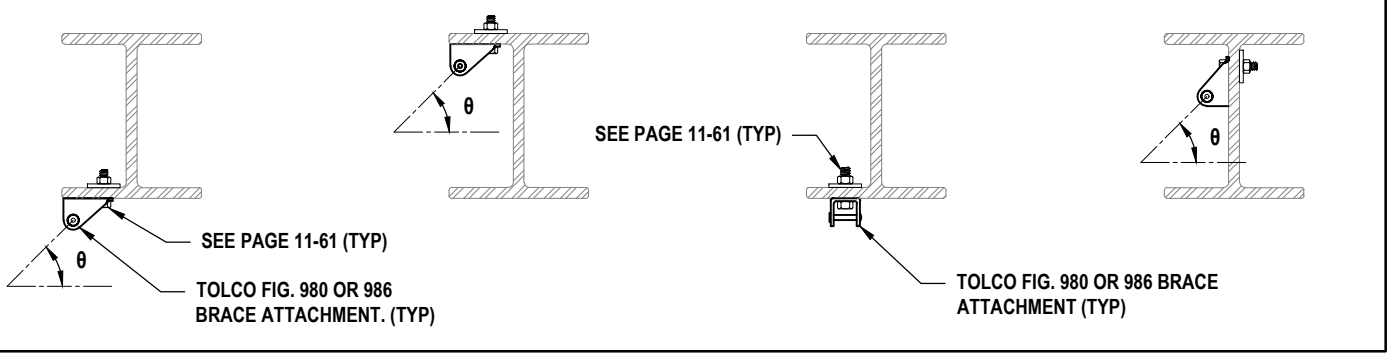
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-26

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.75 "G"
1	2.8	1	3/8"	40
1-1/4	3.8	1	3/8"	40
1-1/2	4.5	1	3/8"	40
2	6.2	1	3/8"	40
2-1/2	9.1	1	3/8"	40
3	12.1	1	3/8"	40
4	18.1	1	1/2"	40
5	26.6	1	5/8"	40
6	34.8	1	5/8"	40
8	55.1	2[(2)(3)]	5/8"	40
10	80.2	2[(2)(3)]	5/8"	40
12	109.0	2[(2)(3)]	5/8"	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"
1	2.8	1	3/8"	80
1-1/4	3.8	1	3/8"	80
1-1/2	4.5	1	3/8"	80
2	6.2	1	3/8"	80
2-1/2	9.1	1	1/2"	80
3	12.1	1	1/2"	80
4	18.1	1	5/8"	80
5	26.6	2[(2)(3)]	5/8"	80
6	34.8	2[(2)(3)]	5/8"	80
8	55.1	2[(2)(3)]	5/8"	59
10	80.2	2[(2)(3)]	5/8"	40
12	109.0	2[(2)(3)]	5/8"	29

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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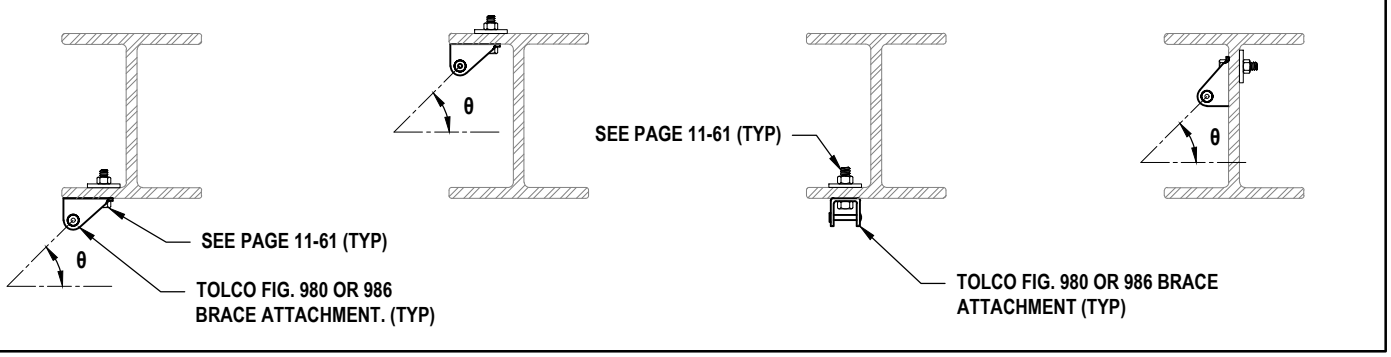
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-27

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 1.0 "G"
1	2.8	1	3/8"	40
1-1/4	3.8	1	3/8"	40
1-1/2	4.5	1	3/8"	40
2	6.2	1	3/8"	40
2-1/2	9.1	1	3/8"	40
3	12.1	1	1/2"	40
4	18.1	1	1/2"	40
5	26.6	1	5/8"	40
6	34.8	1	5/8"	35
8	55.1	2[(2)(3)]	5/8"	40
10	80.2	2[(2)(3)]	5/8"	30
12	109.0	2[(2)(3)]	5/8"	22

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"
1	2.8	1	3/8"	80
1-1/4	3.8	1	3/8"	80
1-1/2	4.5	1	3/8"	80
2	6.2	1	1/2"	80
2-1/2	9.1	1	5/8"	80
3	12.1	1	5/8"	80
4	18.1	1	5/8"	60
5	26.6	2[(2)(3)]	5/8"	80
6	34.8	2[(2)(3)]	5/8"	70
8	55.1	2[(2)(3)]	5/8"	44
10	80.2	2[(2)(3)]	5/8"	30
12	109.0	2[(2)(3)]	5/8"	22

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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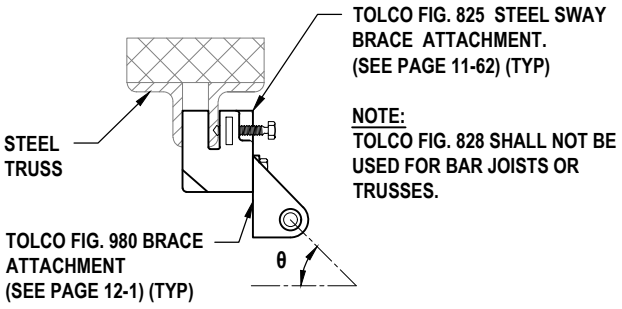
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

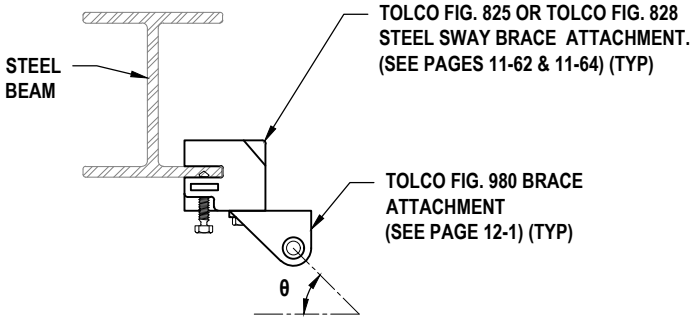
PAGE: 3-28

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	40
6	34.8	1	40	40
8	55.1	1	40	30
10	80.2	1	40	20
12	109.0	1	33	15

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	80
4	18.1	1	80	80
5	26.6	1	80	62
6	34.8	1	80	48
8	55.1	1	65	30
10	80.2	2[3][4]	80	41
12	109.0	2[3][4]	66	30

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G

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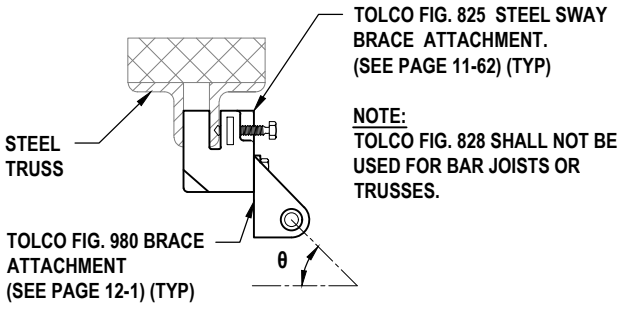
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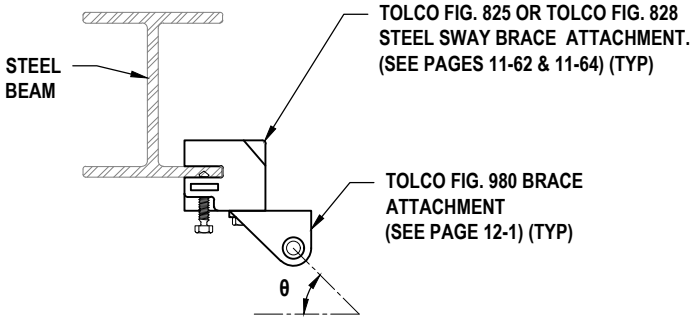
PAGE: **3-29**

DATE: **April 23, 2025**

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	40
5	26.6	1	40	31
6	34.8	1	40	24
8	55.1	1	32	15
10	80.2	2[3][4]	40	20
12	109.0	2[3][4]	33	15

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	80
3	12.1	1	80	69
4	18.1	1	80	46
5	26.6	1	67	31
6	34.8	1	51	24
8	55.1	2[3][4]	65	30
10	80.2	2[3][4]	44	20
12	109.0	2[3][4]	33	15

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G

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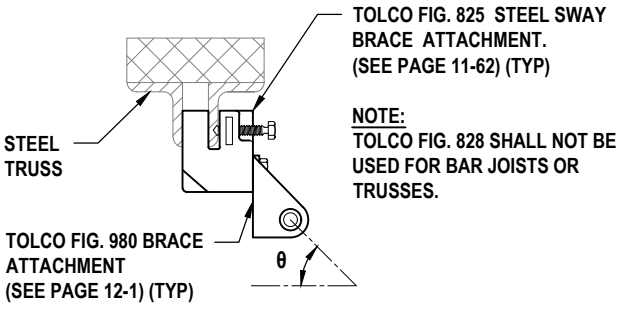
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

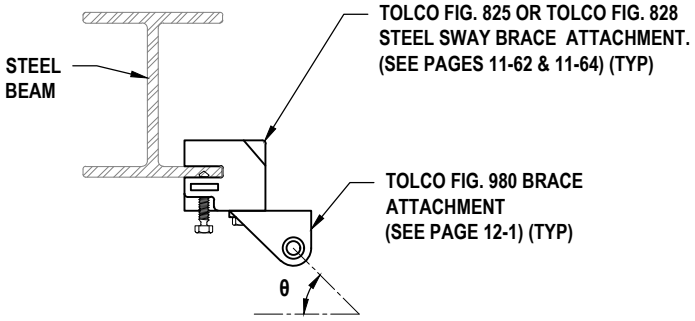
PAGE: 3-30

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	40
4	18.1	1	40	30
5	26.6	1	40	20
6	34.8	1	34	16
8	55.1	2[3][4]	40	20
10	80.2	2[3][4]	29	13
12	109.0	2[3][4]	22	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	80
2-1/2	9.1	1	80	61
3	12.1	1	80	46
4	18.1	1	66	30
5	26.6	2[3][4]	80	41
6	34.8	2[3][4]	68	32
8	55.1	2[3][4]	43	20
10	80.2	2[3][4]	29	13
12	109.0	2[3][4]	22	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
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REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G

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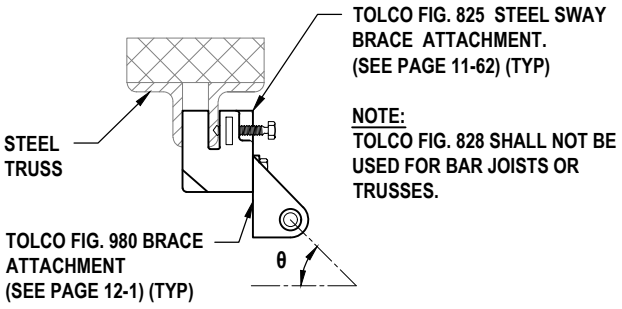
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

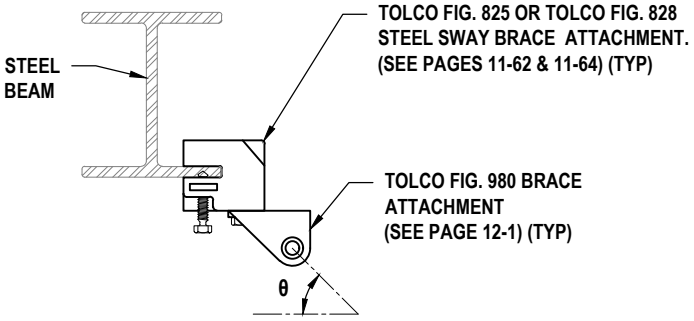
PAGE: 3-31

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	40	40
1-1/4	3.8	1	40	40
1-1/2	4.5	1	40	40
2	6.2	1	40	40
2-1/2	9.1	1	40	40
3	12.1	1	40	34
4	18.1	1	40	23
5	26.6	1	33	15
6	34.8	1	25	12
8	55.1	2[3][4]	32	15
10	80.2	2[3][4]	22	10
12	109.0	2[3]	16	7

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G" Fig. 825 OR 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1	80	80
1-1/4	3.8	1	80	80
1-1/2	4.5	1	80	80
2	6.2	1	80	67
2-1/2	9.1	1	80	45
3	12.1	1	74	34
4	18.1	1	49	23
5	26.6	2[3][4]	67	31
6	34.8	2[3][4]	51	24
8	55.1	2[3][4]	32	15
10	80.2	2[3][4]	22	10
12	109.0	2[3]	16	7

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G

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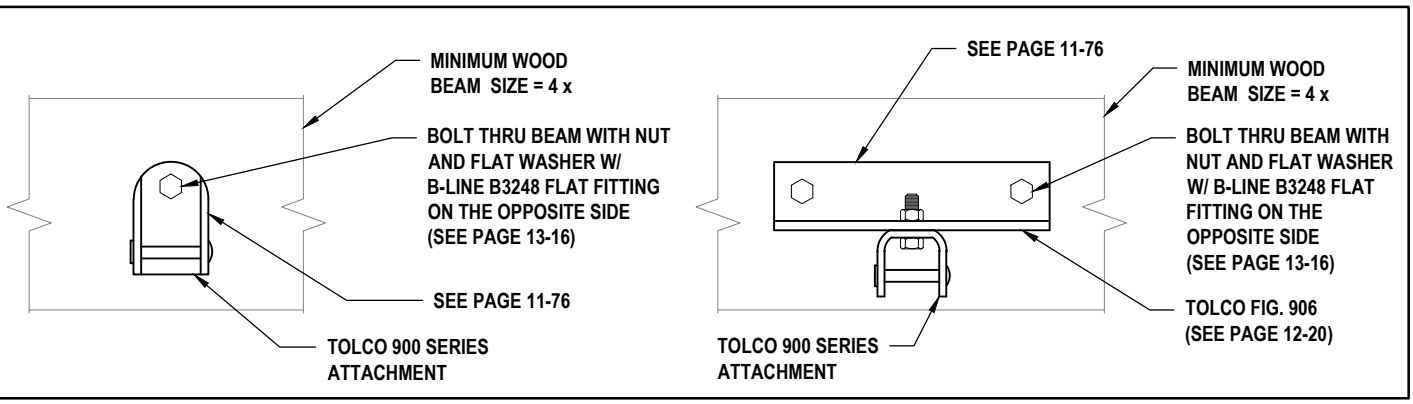
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **3-32**

DATE: **April 23, 2025**

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	1/2"
3	12.1	40	1	1	1/2"
4	18.1	40	1	1	1/2"
5	26.6	40	1	1	1/2"
6	34.8	40	1	1	3/4"
8	55.1	32	1	1	3/4"
10	80.2	38	1	2	3/4"
12	109.0	28	1	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	1/2"
2	6.2	80	1	1	1/2"
2-1/2	9.1	80	1	1	1/2"
3	12.1	80	1	1	1/2"
4	18.1	80	1	1	3/4"
5	26.6	68	1	1	3/4"
6	34.8	52	1	1	3/4"
8	55.1	55	1	2	3/4"
10	80.2	76	2[2][3]	2	3/4"
12	109.0	56	2[2][3]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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NOTES:

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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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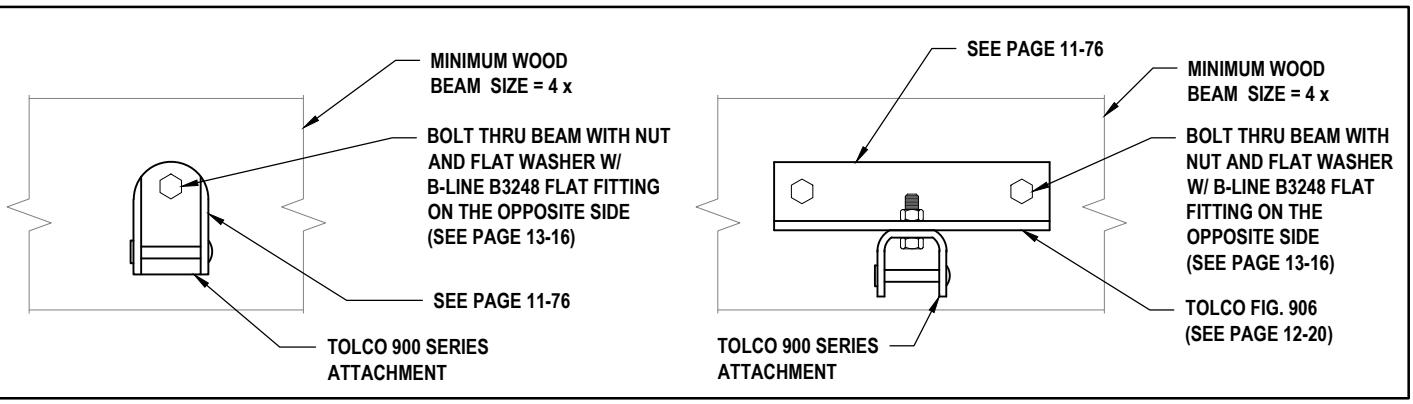
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-33

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	1/2"
3	12.1	40	1	1	1/2"
4	18.1	40	1	1	3/4"
5	26.6	40	1	2	1/2"
6	34.8	40	1	2	3/4"
8	55.1	40	2[(2)(3)]	2	5/8"
10	80.2	38	2[(2)(3)]	2	3/4"
12	109.0	28	2[(2)(3)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	1/2"
2	6.2	80	1	1	1/2"
2-1/2	9.1	80	1	1	3/4"
3	12.1	80	1	2	1/2"
4	18.1	80	1	2	3/4"
5	26.6	80	2[(2)(3)]	2	1/2"
6	34.8	80	2[(2)(3)]	2	3/4"
8	55.1	55	2[(2)(3)]	2	3/4"
10	80.2	38	2[(2)(3)]	2	3/4"
12	109.0	28	2[(2)(3)]	2	3/4"

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DATE: 04/24/2025
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NOTES:

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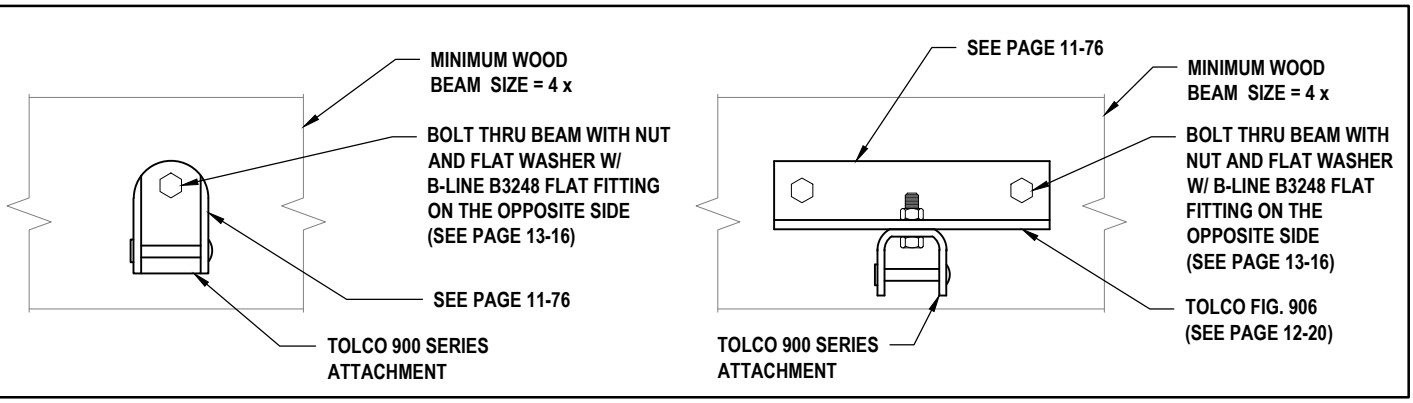
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-34

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	5/8"
3	12.1	40	1	1	3/4"
4	18.1	40	1	2	1/2"
5	26.6	40	2[(2)(3)]	2	1/2"
6	34.8	40	2[(2)(3)]	2	1/2"
8	55.1	37	2[(2)(3)]	2	3/4"
10	80.2	25	2[(2)(3)]	2	3/4"
12	109.0	18	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	1/2"
2	6.2	80	1	2	1/2"
2-1/2	9.1	80	1	2	5/8"
3	12.1	80	1	2	3/4"
4	18.1	80	2[(2)(3)]	2	1/2"
5	26.6	77	2[(2)(3)]	2	3/4"
6	34.8	59	2[(2)(3)]	2	3/4"
8	55.1	37	2[(2)(3)]	2	3/4"
10	80.2	25	2[(2)(3)]	2	3/4"
12	109.0	18	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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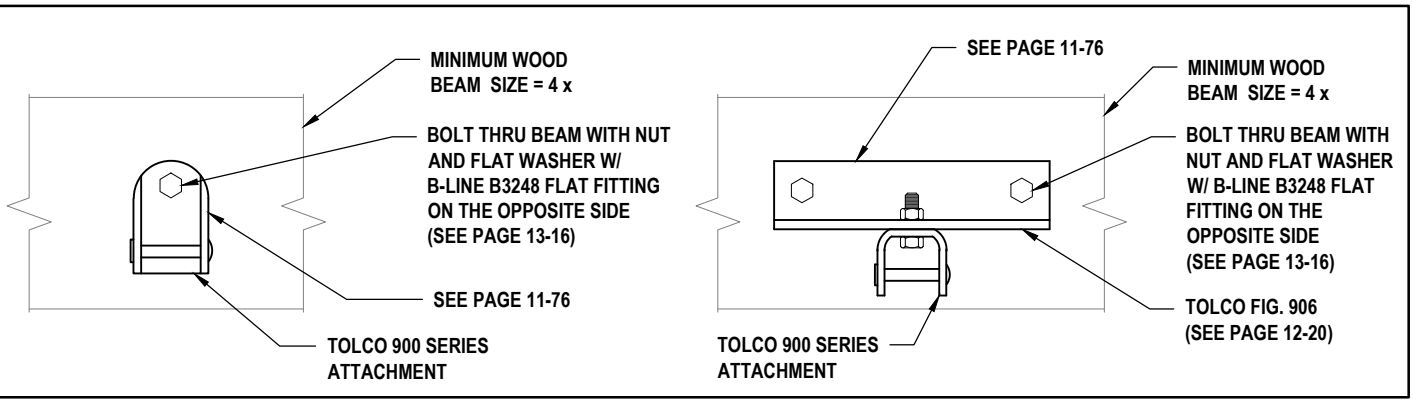
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-35

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	3/4"
3	12.1	40	1	2	1/2"
4	18.1	40	1	2	3/4"
5	26.6	40	2[(2)(3)]	2	1/2"
6	34.8	40	2[(2)(3)]	2	3/4"
8	55.1	27	2[(2)(3)]	2	3/4"
10	80.2	19	2[(2)]	2	3/4"
12	109.0	14	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	5/8"
1-1/2	4.5	80	1	1	3/4"
2	6.2	80	1	2	1/2"
2-1/2	9.1	79	1	2	3/4"
3	12.1	80	2[(2)(3)]	2	1/2"
4	18.1	80	2[(2)(3)]	2	3/4"
5	26.6	57	2[(2)(3)]	2	3/4"
6	34.8	44	2[(2)(3)]	2	3/4"
8	55.1	27	2[(2)(3)]	2	3/4"
10	80.2	19	2[(2)]	2	3/4"
12	109.0	14	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

ICC-ES OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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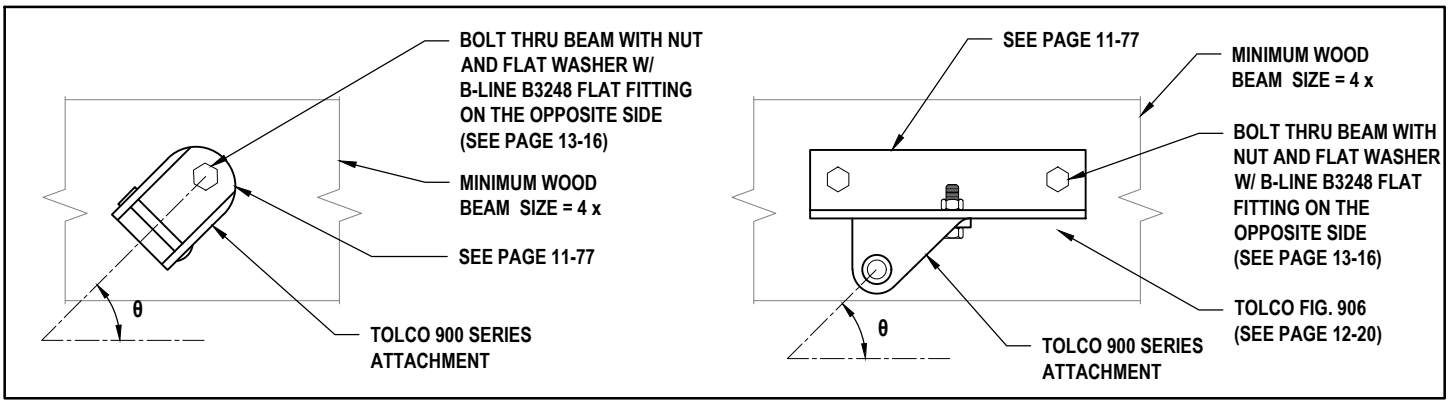
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-36

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	1/2"
3	12.1	40	1	1	1/2"
4	18.1	40	1	1	1/2"
5	26.6	40	1	1	5/8"
6	34.8	40	1	2	1/2"
8	55.1	40	2[(2)(3)]	2	1/2"
10	80.2	40	2[(2)(3)]	2	1/2"
12	109.0	40	2[(2)(3)]	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	1/2"
2	6.2	80	1	1	1/2"
2-1/2	9.1	80	1	1	1/2"
3	12.1	80	1	1	5/8"
4	18.1	80	1	2	1/2"
5	26.6	80	1	2	1/2"
6	34.8	80	2[(2)(3)]	2	1/2"
8	55.1	80	2[(2)(3)]	2	1/2"
10	80.2	75	2[(2)(3)]	2	3/4"
12	109.0	55	2[(2)(3)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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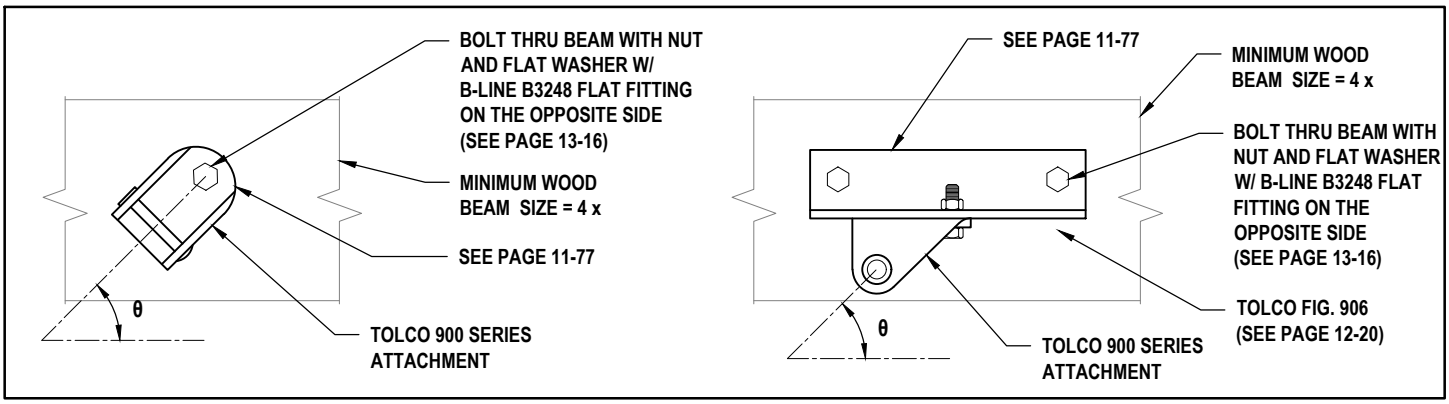
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-37

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	1/2"
3	12.1	40	1	1	1/2"
4	18.1	40	1	2	1/2"
5	26.6	40	1	2	1/2"
6	34.8	40	1	2	5/8"
8	55.1	40	2[(2)(3)]	2	1/2"
10	80.2	37	2[(2)(3)]	2	3/4"
12	109.0	27	2[(2)(3)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	1/2"
2	6.2	80	1	1	1/2"
2-1/2	9.1	80	1	2	1/2"
3	12.1	80	1	2	1/2"
4	18.1	80	1	2	3/4"
5	26.6	80	2[(2)(3)]	2	3/4"
6	34.8	80	2[(2)(3)]	2	3/4"
8	55.1	55	2[(2)(3)]	2	3/4"
10	80.2	37	2[(2)(3)]	2	3/4"
12	109.0	27	2[(2)(3)]	2	3/4"

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE
ICAT
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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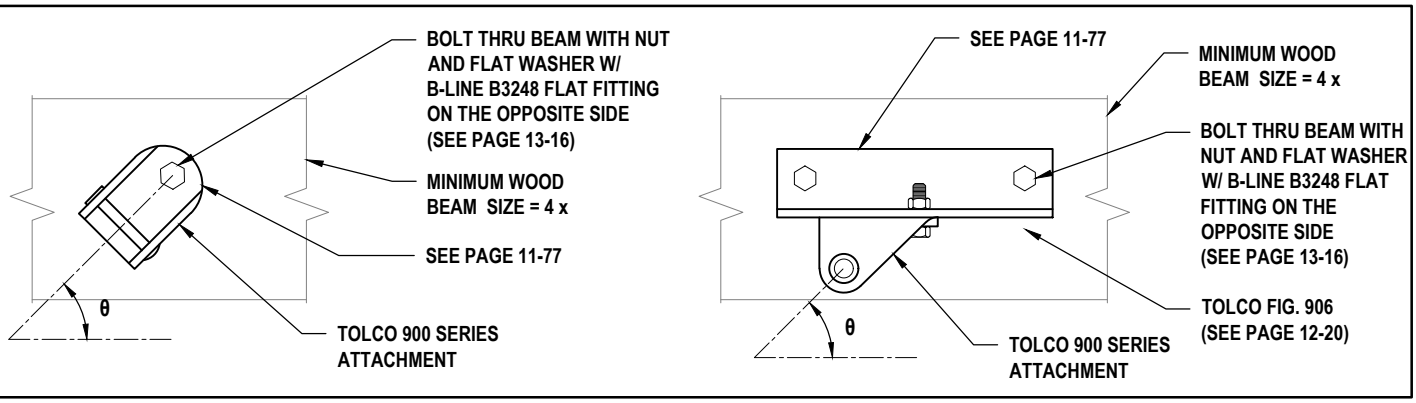
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-38

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	1	5/8"
3	12.1	40	1	2	1/2"
4	18.1	40	1	2	3/4"
5	26.6	40	2(2)(3)	2	1/2"
6	34.8	40	2(2)(3)	2	1/2"
8	55.1	36	2(2)(3)	2	3/4"
10	80.2	25	2(2)(3)	2	3/4"
12	109.0	18	2(2)	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	1/2"
1-1/2	4.5	80	1	1	5/8"
2	6.2	80	1	2	1/2"
2-1/2	9.1	80	1	2	3/4"
3	12.1	80	1	2	3/4"
4	18.1	80	2(2)(3)	2	1/2"
5	26.6	76	2(2)(3)	2	3/4"
6	34.8	58	2(2)(3)	2	3/4"
8	55.1	36	2(2)(3)	2	3/4"
10	80.2	25	2(2)(3)	2	3/4"
12	109.0	18	2(2)	2	3/4"

FOOTNOTES:

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REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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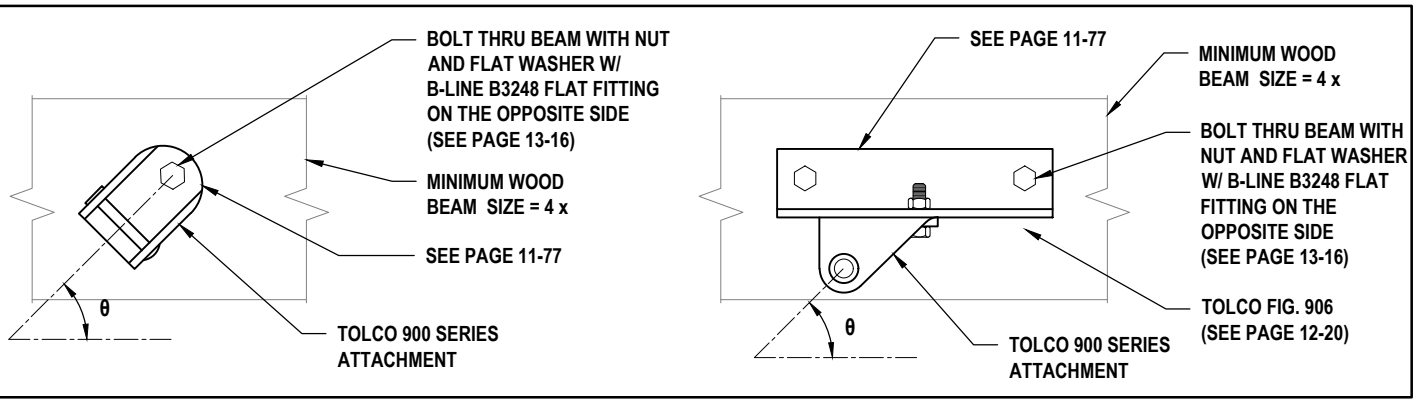
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-39

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1	1	1/2"
1-1/4	3.8	40	1	1	1/2"
1-1/2	4.5	40	1	1	1/2"
2	6.2	40	1	1	1/2"
2-1/2	9.1	40	1	2	1/2"
3	12.1	40	1	2	1/2"
4	18.1	40	1	2	3/4"
5	26.6	40	2[(2)(3)]	2	1/2"
6	34.8	40	2[(2)(3)]	2	5/8"
8	55.1	27	2[(2)(3)]	2	3/4"
10	80.2	18	2[(2)]	2	3/4"
12	109.0	13	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1	1	1/2"
1-1/4	3.8	80	1	1	3/4"
1-1/2	4.5	80	1	2	1/2"
2	6.2	80	1	2	1/2"
2-1/2	9.1	80	1	2	3/4"
3	12.1	80	2[(2)(3)]	2	1/2"
4	18.1	80	2[(2)(3)]	2	3/4"
5	26.6	57	2[(2)(3)]	2	3/4"
6	34.8	43	2[(2)(3)]	2	3/4"
8	55.1	27	2[(2)(3)]	2	3/4"
10	80.2	18	2[(2)]	2	3/4"
12	109.0	13	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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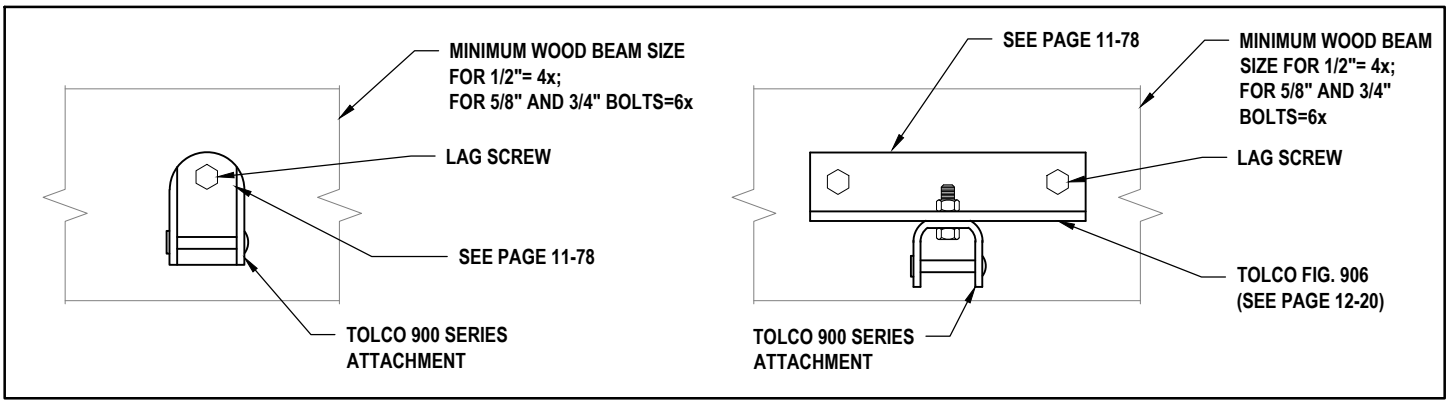
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-40

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	1/2"	3"
2	6.2	40	1	1	1/2"	3"
2-1/2	9.1	40	1	1	1/2"	3"
3	12.1	40	1	1	1/2"	3"
4	18.1	40	1	1	5/8"	4"
5	26.6	40	1	2	1/2"	3"
6	34.8	40	1	2	5/8"	4"
8	55.1	40	2[(2)(3)]	2	1/2"	3"
10	80.2	40	2[(2)(3)]	2	5/8"	4"
12	109.0	30	2[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	1/2"	3"
1-1/4	3.8	80	1	1	1/2"	3"
1-1/2	4.5	80	1	1	1/2"	3"
2	6.2	80	1	1	1/2"	3"
2-1/2	9.1	80	1	1	5/8"	4"
3	12.1	80	1	2	1/2"	3"
4	18.1	80	1	2	5/8"	4"
5	26.6	80	2[(2)(3)]	2	1/2"	3"
6	34.8	80	2[(2)(3)]	2	5/8"	4"
8	55.1	61	2[(2)(3)]	2	3/4"	5"
10	80.2	42	2[(2)(3)]	2	3/4"	5"
12	109.0	30	2[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
IAPMO ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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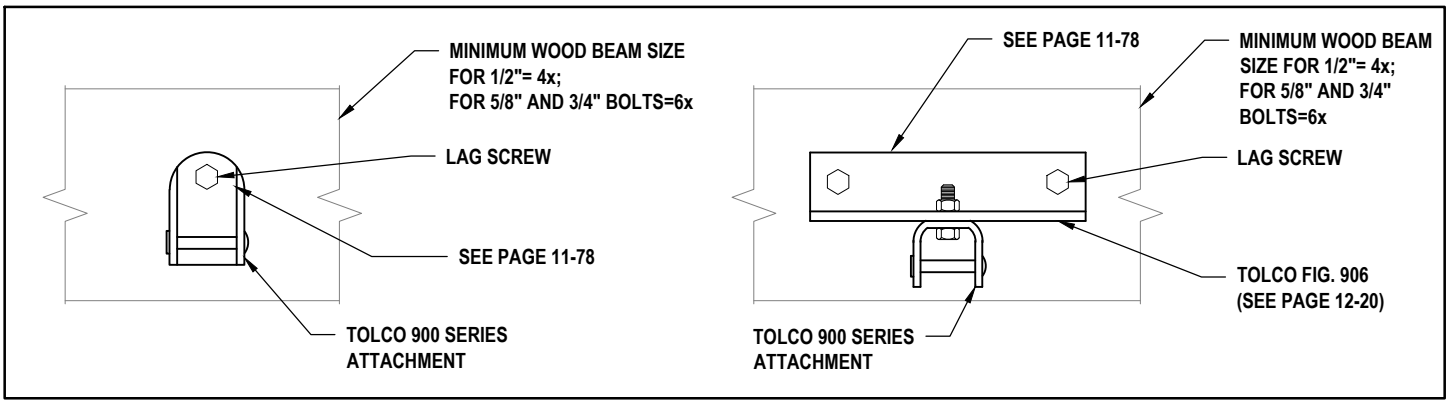
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-41

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	1/2"	3"
2	6.2	40	1	1	1/2"	3"
2-1/2	9.1	40	1	1	5/8"	4"
3	12.1	40	1	2	1/2"	3"
4	18.1	40	1	2	5/8"	4"
5	26.6	40	2[(2)(3)]	2	1/2"	3"
6	34.8	40	2[(2)(3)]	2	5/8"	4"
8	55.1	30	2[(2)(3)]	2	3/4"	5"
10	80.2	21	2[(2)(3)]	2	3/4"	5"
12	109.0	15	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	1/2"	3"
1-1/4	3.8	80	1	1	1/2"	3"
1-1/2	4.5	80	1	1	5/8"	4"
2	6.2	80	1	2	1/2"	3"
2-1/2	9.1	80	1	2	5/8"	4"
3	12.1	80	2[(2)(3)]	2	1/2"	3"
4	18.1	80	2[(2)(3)]	2	5/8"	4"
5	26.6	63	2[(2)(3)]	2	3/4"	5"
6	34.8	48	2[(2)(3)]	2	3/4"	5"
8	55.1	30	2[(2)(3)]	2	3/4"	5"
10	80.2	21	2[(2)(3)]	2	3/4"	5"
12	109.0	15	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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IAPMO ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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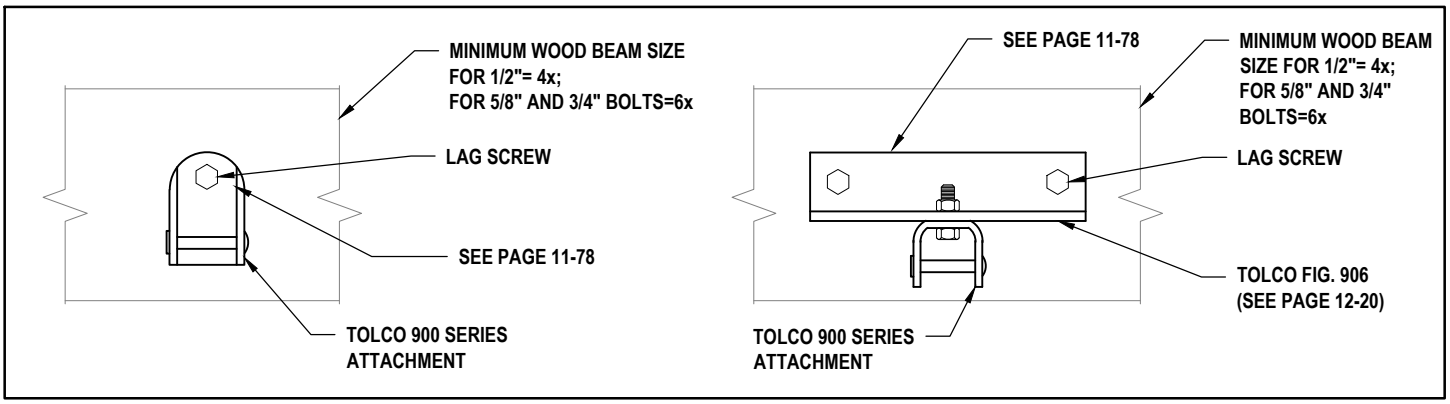
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-42

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	1/2"	3"
2	6.2	40	1	1	5/8"	4"
2-1/2	9.1	40	1	2	1/2"	3"
3	12.1	40	1	2	5/8"	4"
4	18.1	40	$2^{(2)(3)}$	2	1/2"	3"
5	26.6	40	$2^{(2)(3)}$	2	5/8"	4"
6	34.8	32	$2^{(2)(3)}$	2	3/4"	5"
8	55.1	20	$2^{(2)(3)}$	2	3/4"	5"
10	80.2	14	$2^{(2)}$	2	3/4"	5"
12	109.0	10	$2^{(2)}$	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	1/2"	3"
1-1/4	3.8	80	1	2	1/2"	3"
1-1/2	4.5	80	1	2	1/2"	3"
2	6.2	80	1	2	5/8"	4"
2-1/2	9.1	80	$2^{(2)(3)}$	2	1/2"	3"
3	12.1	80	$2^{(2)(3)}$	2	5/8"	4"
4	18.1	62	$2^{(2)(3)}$	2	3/4"	5"
5	26.6	42	$2^{(2)(3)}$	2	3/4"	5"
6	34.8	32	$2^{(2)(3)}$	2	3/4"	5"
8	55.1	20	$2^{(2)(3)}$	2	3/4"	5"
10	80.2	14	$2^{(2)}$	2	3/4"	5"
12	109.0	10	$2^{(2)}$	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
IAPMO ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCH. 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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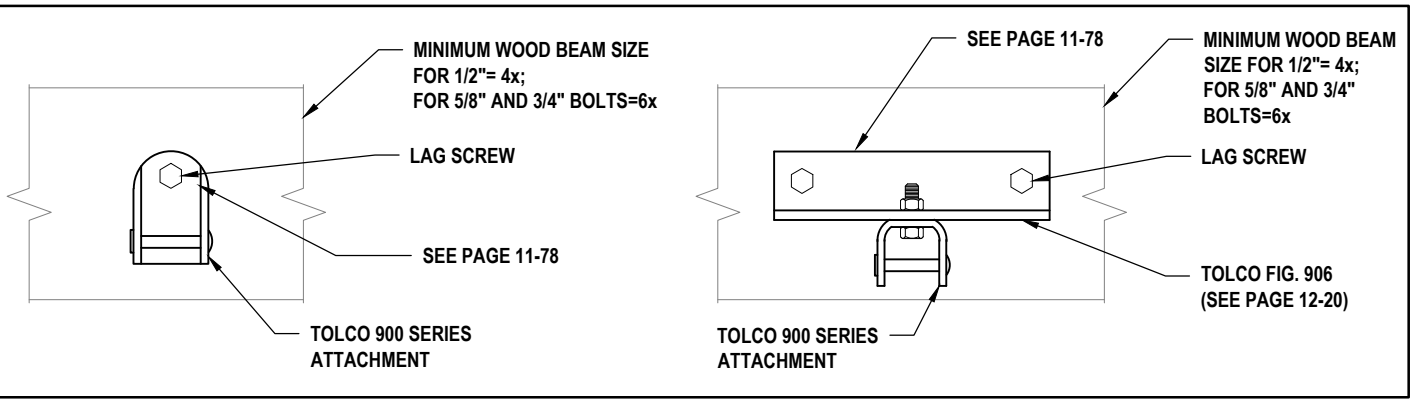
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-43

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	5/8"	4"
2	6.2	40	1	2	1/2"	3"
2-1/2	9.1	40	1	2	5/8"	4"
3	12.1	40	2[(2)(3)]	2	1/2"	3"
4	18.1	40	2[(2)(3)]	2	5/8"	4"
5	26.6	31	2[(2)(3)]	2	3/4"	5"
6	34.8	24	2[(2)(3)]	2	3/4"	5"
8	55.1	15	2[(2)]	2	3/4"	5"
10	80.2	10	2[(2)]	2	3/4"	5"
12	109.0	7	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	2	1/2"	3"
1-1/4	3.8	80	1	2	1/2"	3"
1-1/2	4.5	80	1	2	5/8"	4"
2	6.2	80	2[(2)(3)]	2	1/2"	3"
2-1/2	9.1	80	2[(2)(3)]	2	5/8"	4"
3	12.1	69	2[(2)(3)]	2	3/4"	5"
4	18.1	46	2[(2)(3)]	2	3/4"	5"
5	26.6	31	2[(2)(3)]	2	3/4"	5"
6	34.8	24	2[(2)(3)]	2	3/4"	5"
8	55.1	15	2[(2)]	2	3/4"	5"
10	80.2	10	2[(2)]	2	3/4"	5"
12	109.0	7	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE ICAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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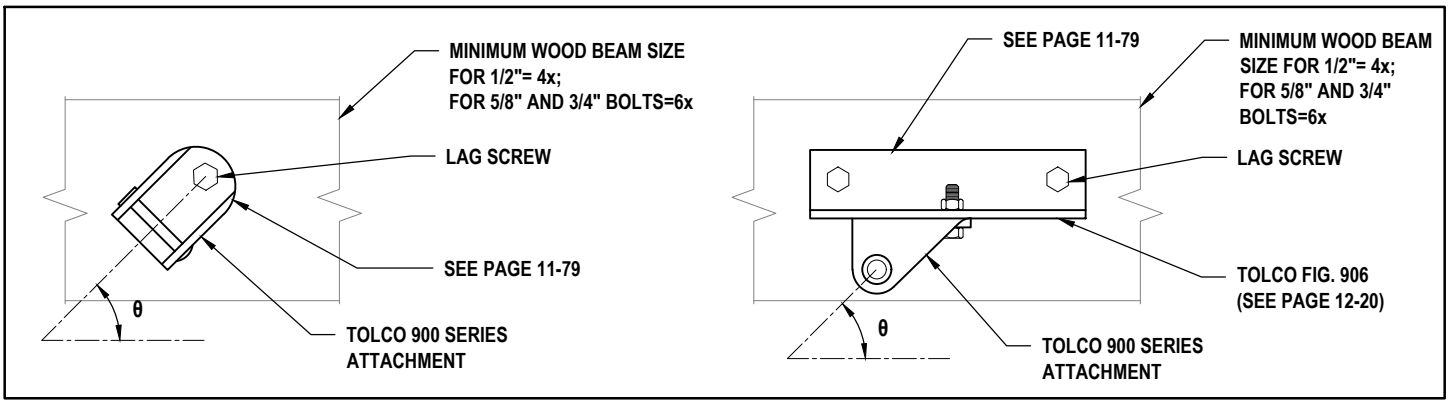
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	1/2"	3"
2	6.2	40	1	1	1/2"	3"
2-1/2	9.1	40	1	1	1/2"	3"
3	12.1	40	1	1	1/2"	3"
4	18.1	40	1	1	5/8"	4"
5	26.6	40	1	2	5/8"	4"
6	34.8	40	1	2	3/4"	5"
8	55.1	40	2[(2)(3)]	2	5/8"	4"
10	80.2	40	2[(2)(3)]	2	3/4"	5"
12	109.0	29	2[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	1/2"	3"
1-1/4	3.8	80	1	1	1/2"	3"
1-1/2	4.5	80	1	1	1/2"	3"
2	6.2	80	1	1	1/2"	3"
2-1/2	9.1	80	1	1	5/8"	4"
3	12.1	80	1	2	1/2"	3"
4	18.1	80	1	2	5/8"	4"
5	26.6	80	2[(2)(3)]	2	5/8"	4"
6	34.8	80	2[(2)(3)]	2	3/4"	5"
8	55.1	59	2[(2)(3)]	2	3/4"	5"
10	80.2	40	2[(2)(3)]	2	3/4"	5"
12	109.0	29	2[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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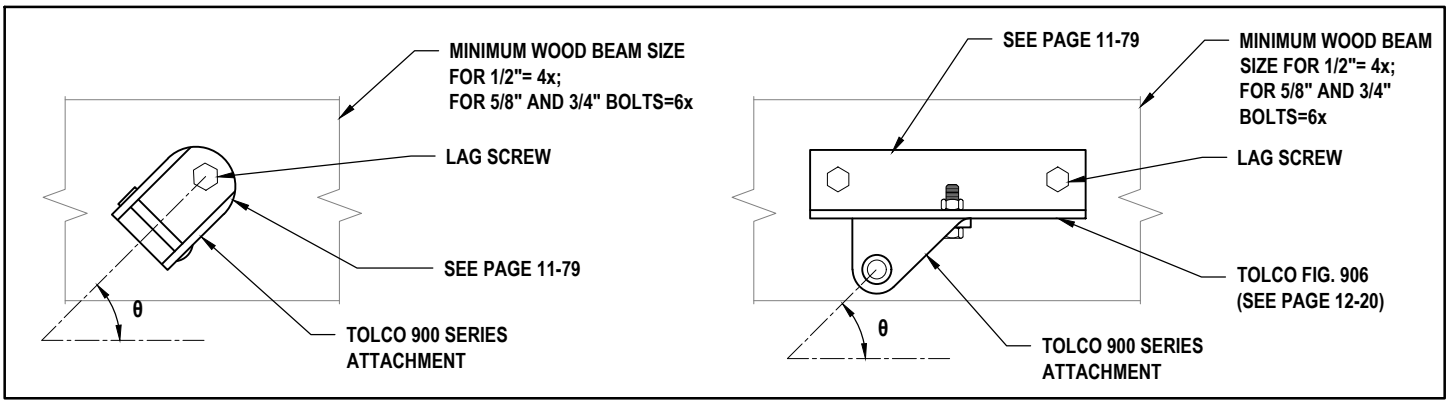
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-45

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	1/2"	3"
2	6.2	40	1	1	1/2"	3"
2-1/2	9.1	40	1	1	5/8"	4"
3	12.1	40	1	2	1/2"	3"
4	18.1	40	1	2	5/8"	4"
5	26.6	40	2[(2)(3)]	2	5/8"	4"
6	34.8	40	2[(2)(3)]	2	5/8"	4"
8	55.1	29	2[(2)(3)]	2	3/4"	5"
10	80.2	20	2[(2)(3)]	2	3/4"	5"
12	109.0	14	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	1/2"	3"
1-1/4	3.8	80	1	1	5/8"	4"
1-1/2	4.5	80	1	1	5/8"	4"
2	6.2	80	1	2	1/2"	3"
2-1/2	9.1	80	1	2	5/8"	4"
3	12.1	80	2[(2)(3)]	2	1/2"	3"
4	18.1	80	2[(2)(3)]	2	5/8"	4"
5	26.6	61	2[(2)(3)]	2	3/4"	5"
6	34.8	46	2[(2)(3)]	2	3/4"	5"
8	55.1	29	2[(2)(3)]	2	3/4"	5"
10	80.2	20	2[(2)(3)]	2	3/4"	5"
12	109.0	14	2[(2)]	2	3/4"	5"

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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3. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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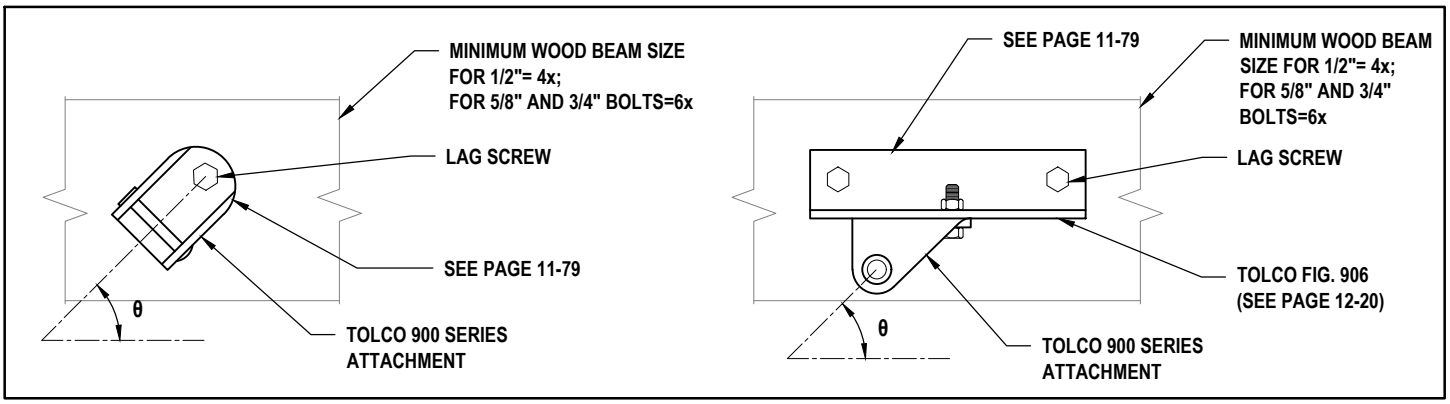
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 3-46

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	1/2"	3"
1-1/2	4.5	40	1	1	5/8"	4"
2	6.2	40	1	1	3/4"	5"
2-1/2	9.1	40	1	2	5/8"	4"
3	12.1	40	1	2	3/4"	5"
4	18.1	40	2[(2)(3)]	2	5/8"	4"
5	26.6	40	2[(2)(3)]	2	3/4"	5"
6	34.8	31	2[(2)(3)]	2	3/4"	5"
8	55.1	19	2[(2)]	2	3/4"	5"
10	80.2	13	2[(2)]	2	3/4"	5"
12	109.0	9	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	1	5/8"	4"
1-1/4	3.8	80	1	2	1/2"	3"
1-1/2	4.5	80	1	2	5/8"	4"
2	6.2	80	1	2	3/4"	5"
2-1/2	9.1	80	2[(2)(3)]	2	5/8"	4"
3	12.1	80	2[(2)(3)]	2	5/8"	4"
4	18.1	60	2[(2)(3)]	2	3/4"	5"
5	26.6	40	2[(2)(3)]	2	3/4"	5"
6	34.8	31	2[(2)(3)]	2	3/4"	5"
8	55.1	19	2[(2)]	2	3/4"	5"
10	80.2	13	2[(2)]	2	3/4"	5"
12	109.0	9	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
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3. DOUBLE BRACING IS REQUIRED.

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OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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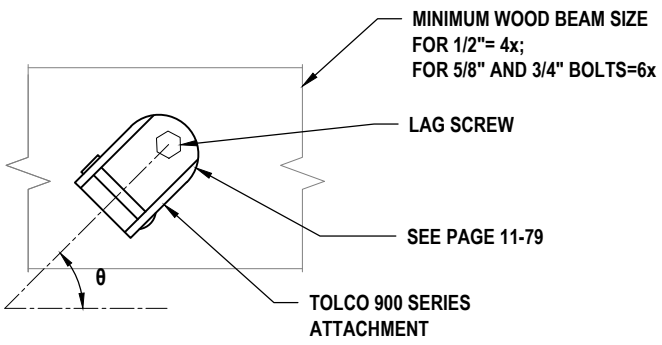
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

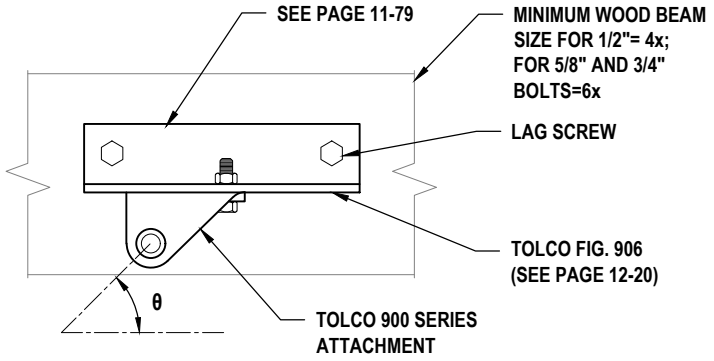
PAGE: **3-47**

DATE: **April 23, 2025**

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1	1	1/2"	3"
1-1/4	3.8	40	1	1	5/8"	4"
1-1/2	4.5	40	1	1	5/8"	4"
2	6.2	40	1	2	1/2"	3"
2-1/2	9.1	40	1	2	5/8"	4"
3	12.1	40	2[(2)(3)]	2	1/2"	3"
4	18.1	40	2[(2)(3)]	2	5/8"	4"
5	26.6	30	2[(2)(3)]	2	3/4"	5"
6	34.8	23	2[(2)(3)]	2	3/4"	5"
8	55.1	14	2[(2)]	2	3/4"	5"
10	80.2	10	2[(2)]	2	3/4"	5"
12	109.0	7	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1	2	1/2"	3"
1-1/4	3.8	80	1	2	5/8"	4"
1-1/2	4.5	80	1	2	5/8"	4"
2	6.2	80	2[(2)(3)]	2	1/2"	3"
2-1/2	9.1	80	2[(2)(3)]	2	5/8"	4"
3	12.1	67	2[(2)(3)]	2	3/4"	5"
4	18.1	45	2[(2)(3)]	2	3/4"	5"
5	26.6	30	2[(2)(3)]	2	3/4"	5"
6	34.8	23	2[(2)(3)]	2	3/4"	5"
8	55.1	14	2[(2)]	2	3/4"	5"
10	80.2	10	2[(2)]	2	3/4"	5"
12	109.0	7	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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3. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE IAPMO OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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5. LAG BOLTS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 2 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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PAGE: 3-48

DATE: April 23, 2025

SECTION 4

TRAPEZE RIGID BRACE DETAILS

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
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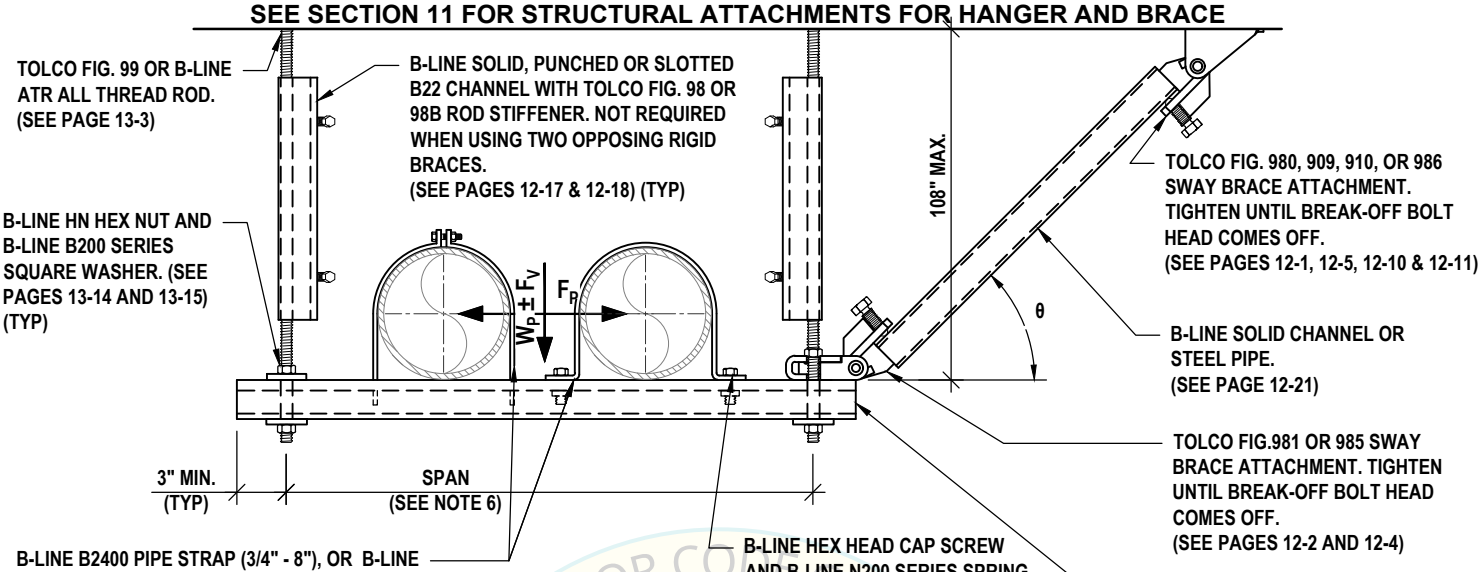
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DATE: **April 23, 2025**

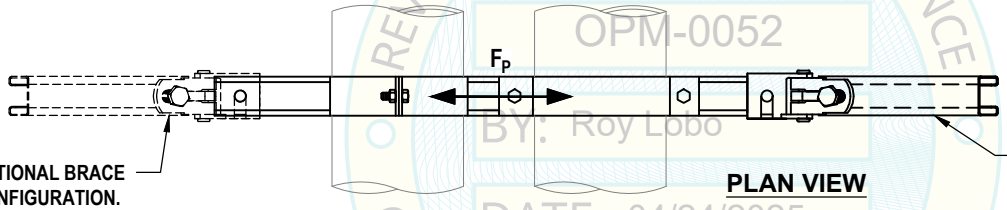
TRANSVERSE RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

DETAIL
TR-1

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE

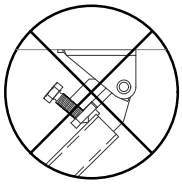


SECTION



PLAN VIEW

ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	1449	1224	774



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
6. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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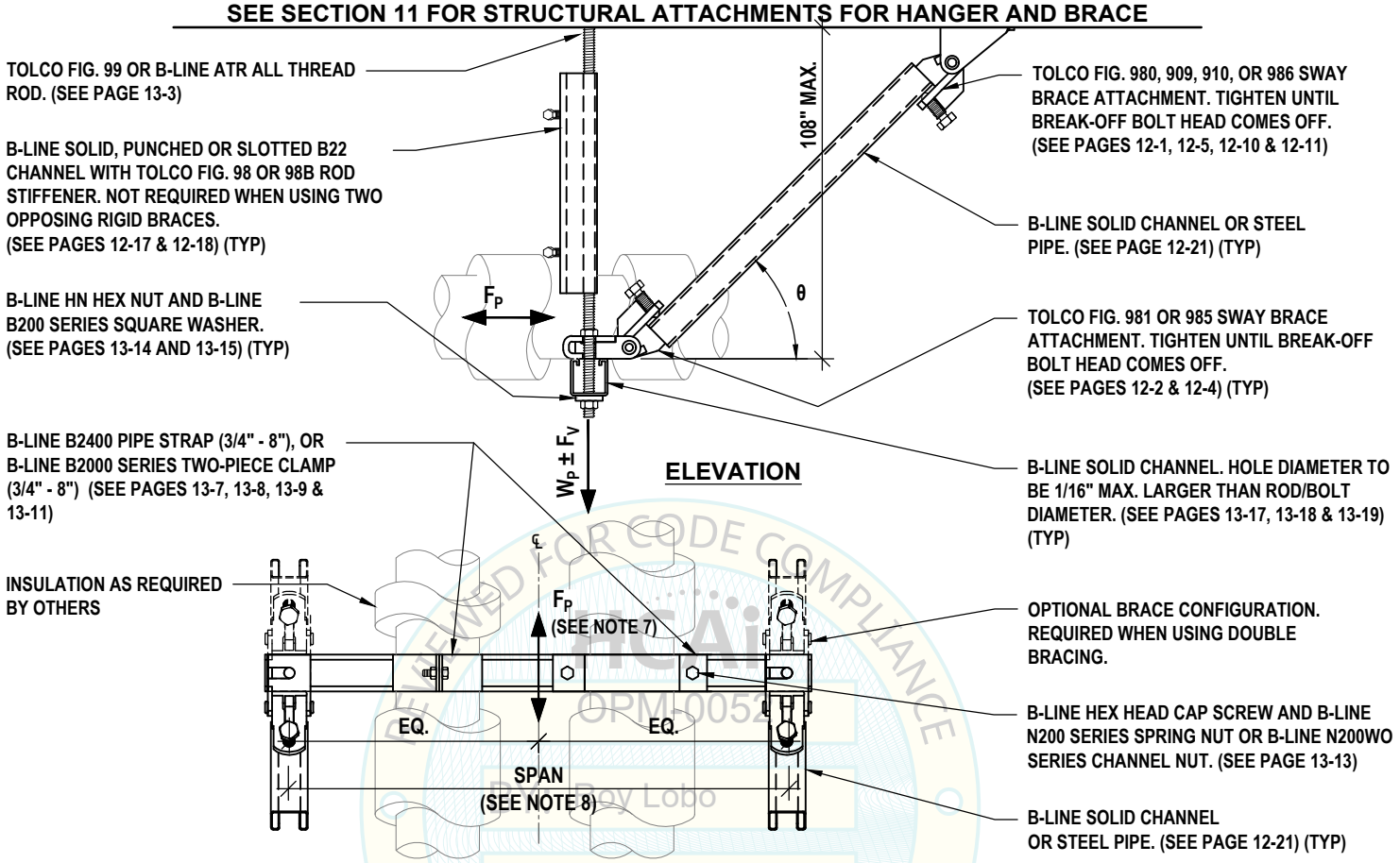
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DATE: **April 23, 2025**

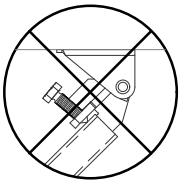
LONGITUDINAL RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT SYSTEMS WITH SINGLE TRAPEZE STRUT

DETAIL
TR-2

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 7) (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	463	492 (7)	440
1/2"	463	492 (7)	440
3/4"	479	494	470



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS INCLUDING EMT - REDUCE LOADS BY 0%
2. SEE PAGE 4-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. LONGITUDINAL BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
6. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
7. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

ICC-ES EVALUATION REPORT FOR CODE COMPLIANCE
ESR-4643
OPM-0052
Reviewed by Roy Lobo
DATE: 04/24/2025
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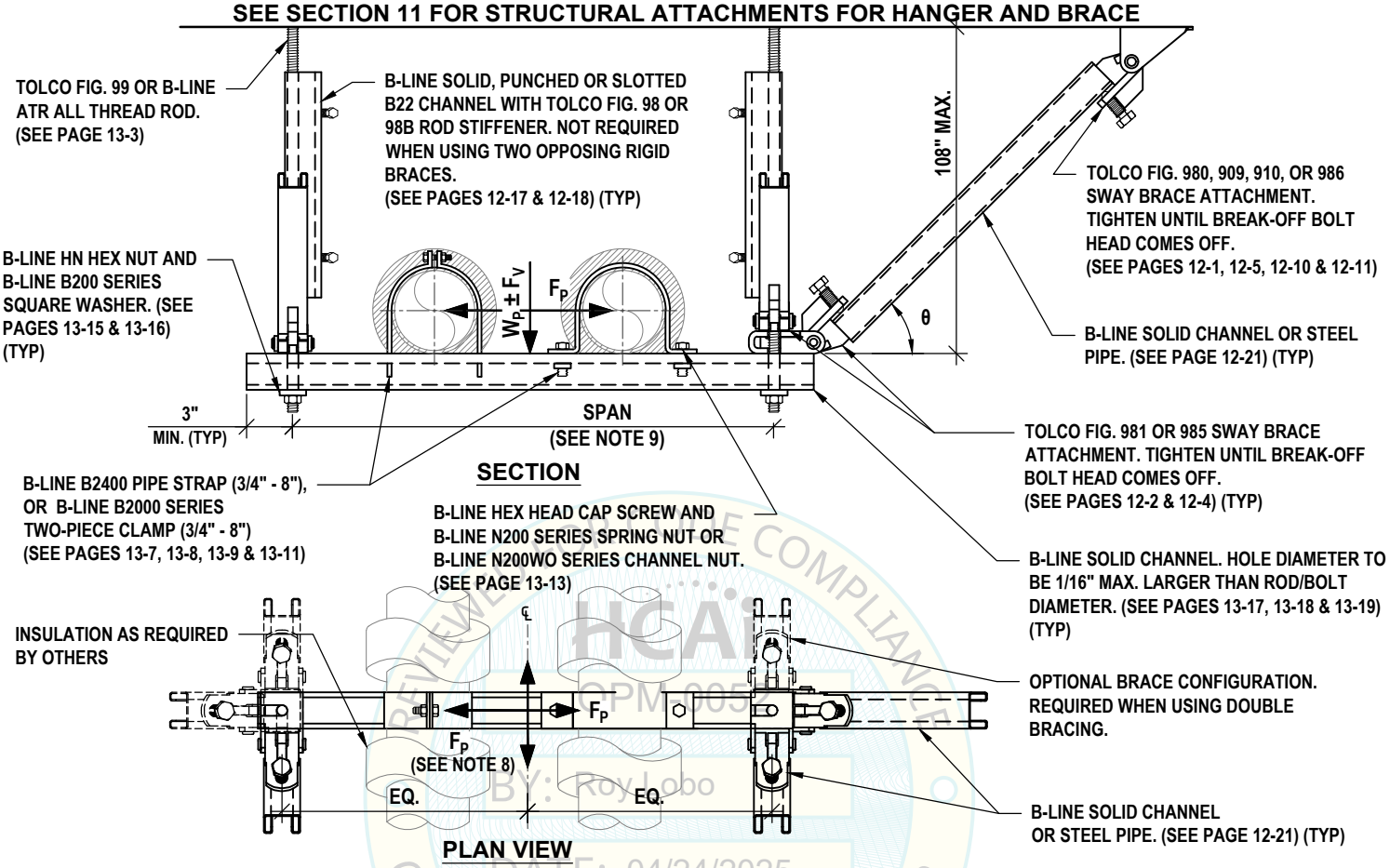
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DATE: **April 23, 2025**

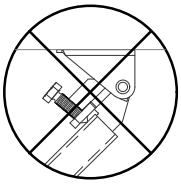
TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

DETAIL
TR-3

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 8) (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS INCLUDING EMT - REDUCE LOADS BY 0%
2. SEE PAGES 4-21, AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. BRACES MAY BE INSTALLED IN OPPOSING DIRECTION.
4. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
9. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

HCAI PREAPPROVED COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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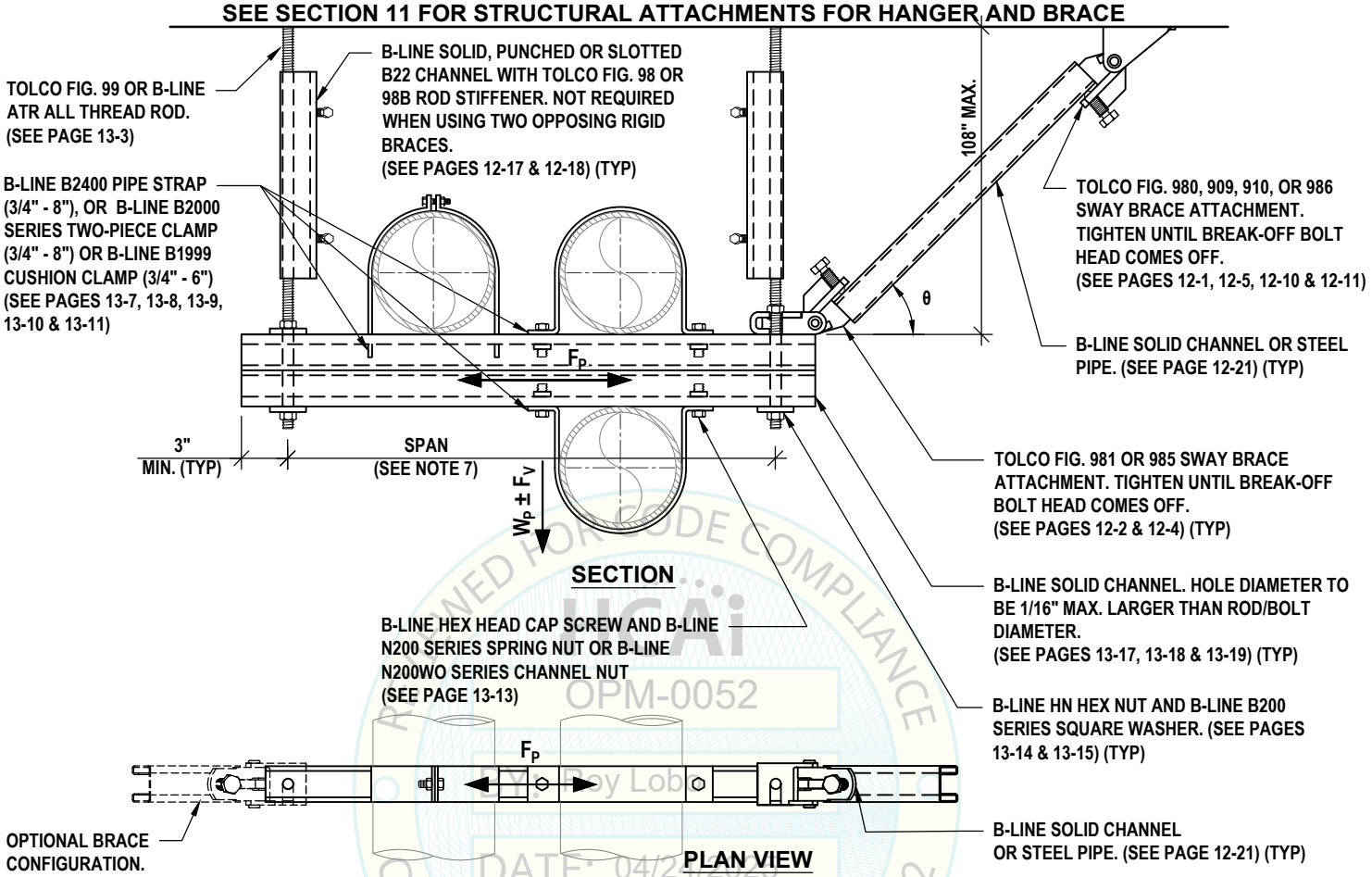
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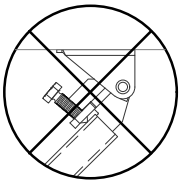
TRANSVERSE RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH DOUBLE TRAPEZE STRUT

DETAIL
TR-4

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	1449	1224	774



DO NOT BEND BRACE PAST 90°

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
4. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF THE TRAPEZE MAY USE B-LINE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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PAGE: **4-4**

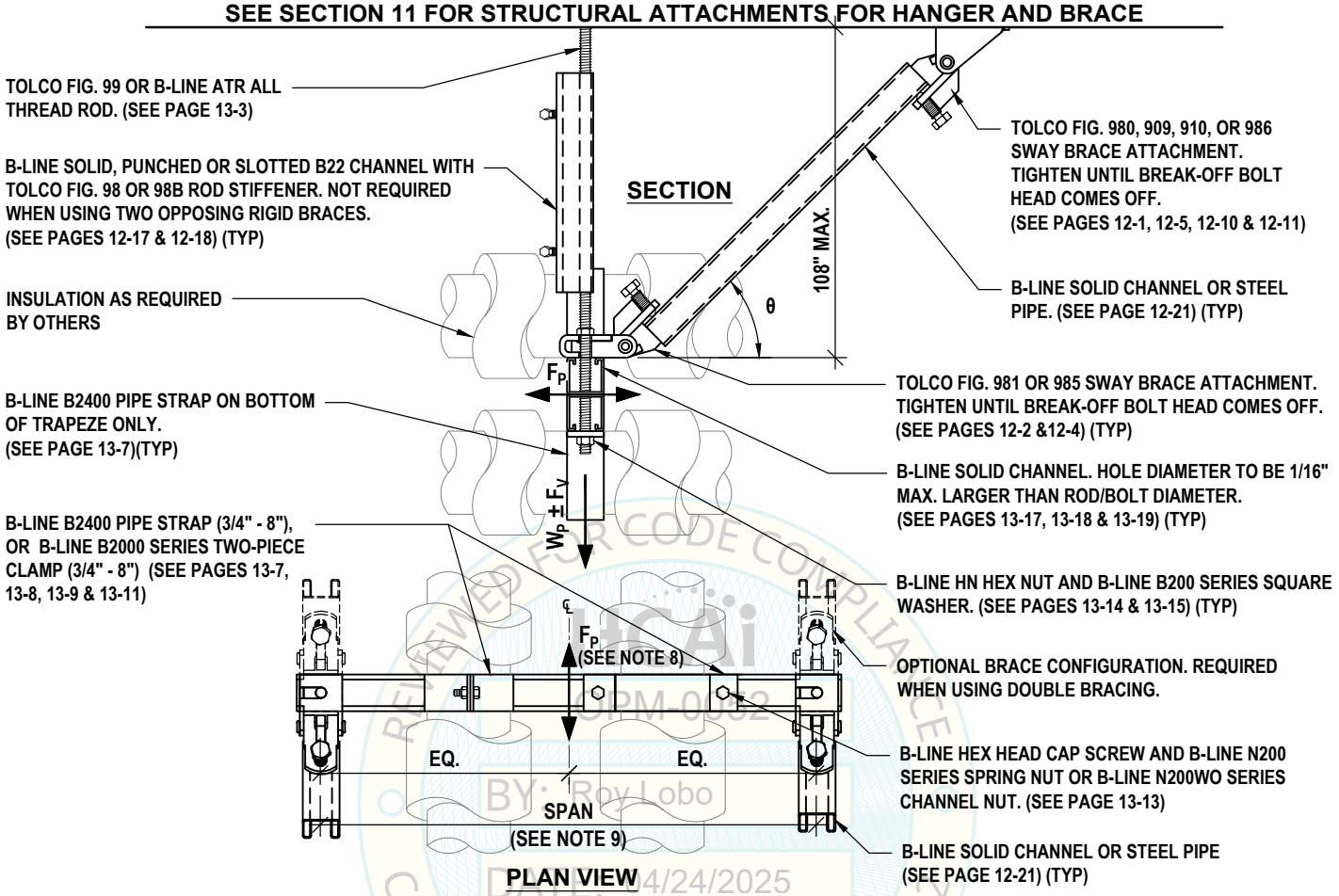
DATE: **April 23, 2025**

OPM-0052 Reviewed for Code Compliance by Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

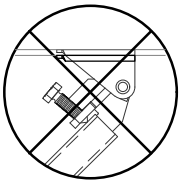
LONGITUDINAL RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH DOUBLE TRAPEZE STRUT

DETAIL TR-5

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 8) (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	463	492	440
1/2"	463	492	440
3/4"	479	494	470



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS INCLUDING EMT - REDUCE LOADS BY 0%
2. SEE PAGE 4-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
4. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF THE TRAPEZE STRUT. MAY USE B-LINE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
9. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

ICC-ES REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 4/24/2025
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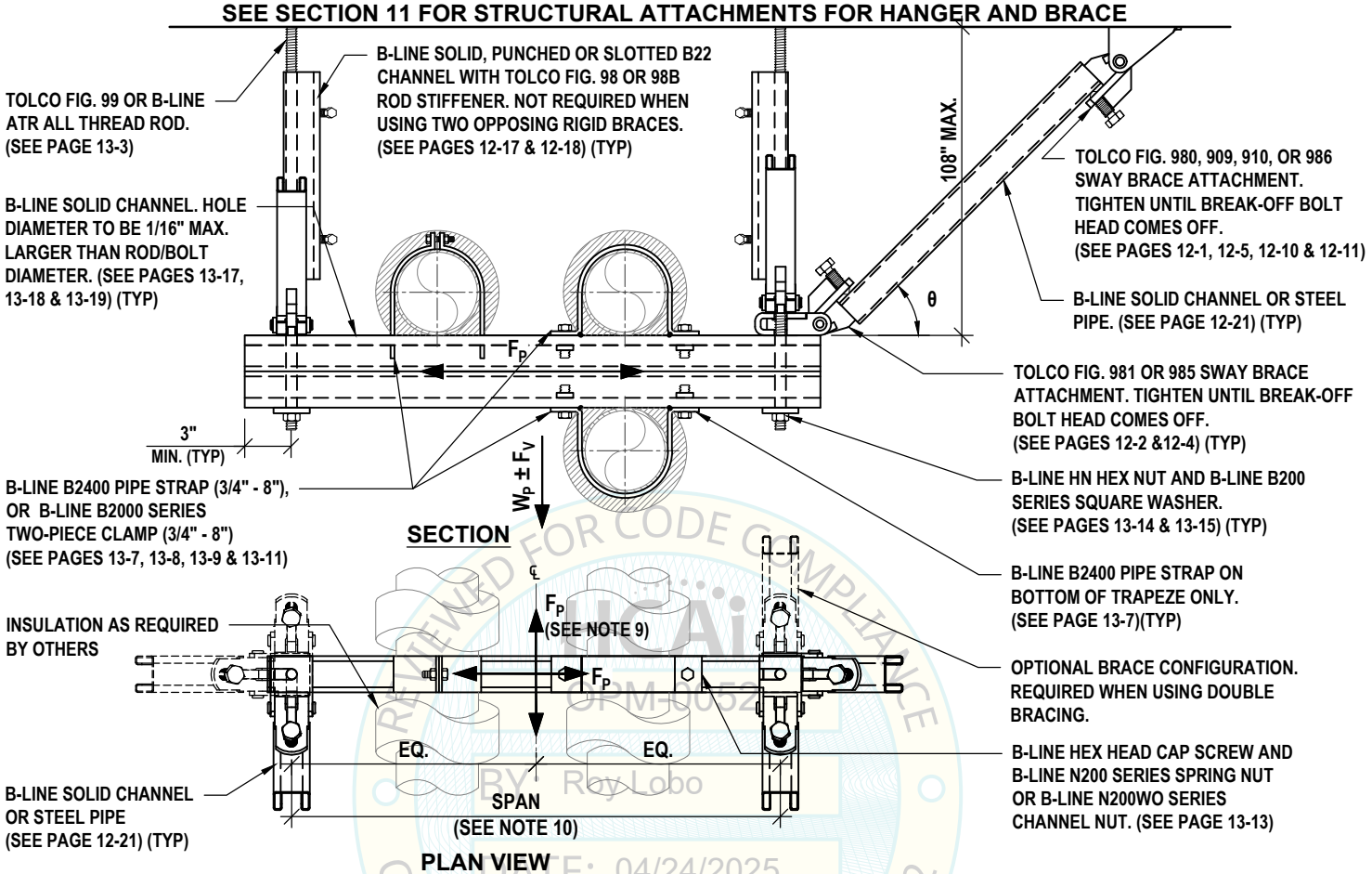
PAGE: 4-5

DATE: April 23, 2025

TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH DOUBLE TRAPEZE STRUT

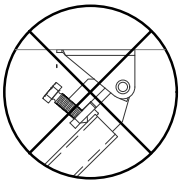
DETAIL **TR-6**

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 9) (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS INCLUDING EMT - REDUCE LOADS BY 0%
2. SEE PAGES 4-21 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
4. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF THE TRAPEZE STRUT. MAY USE B-LINE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
5. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
6. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
7. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
8. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
9. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
10. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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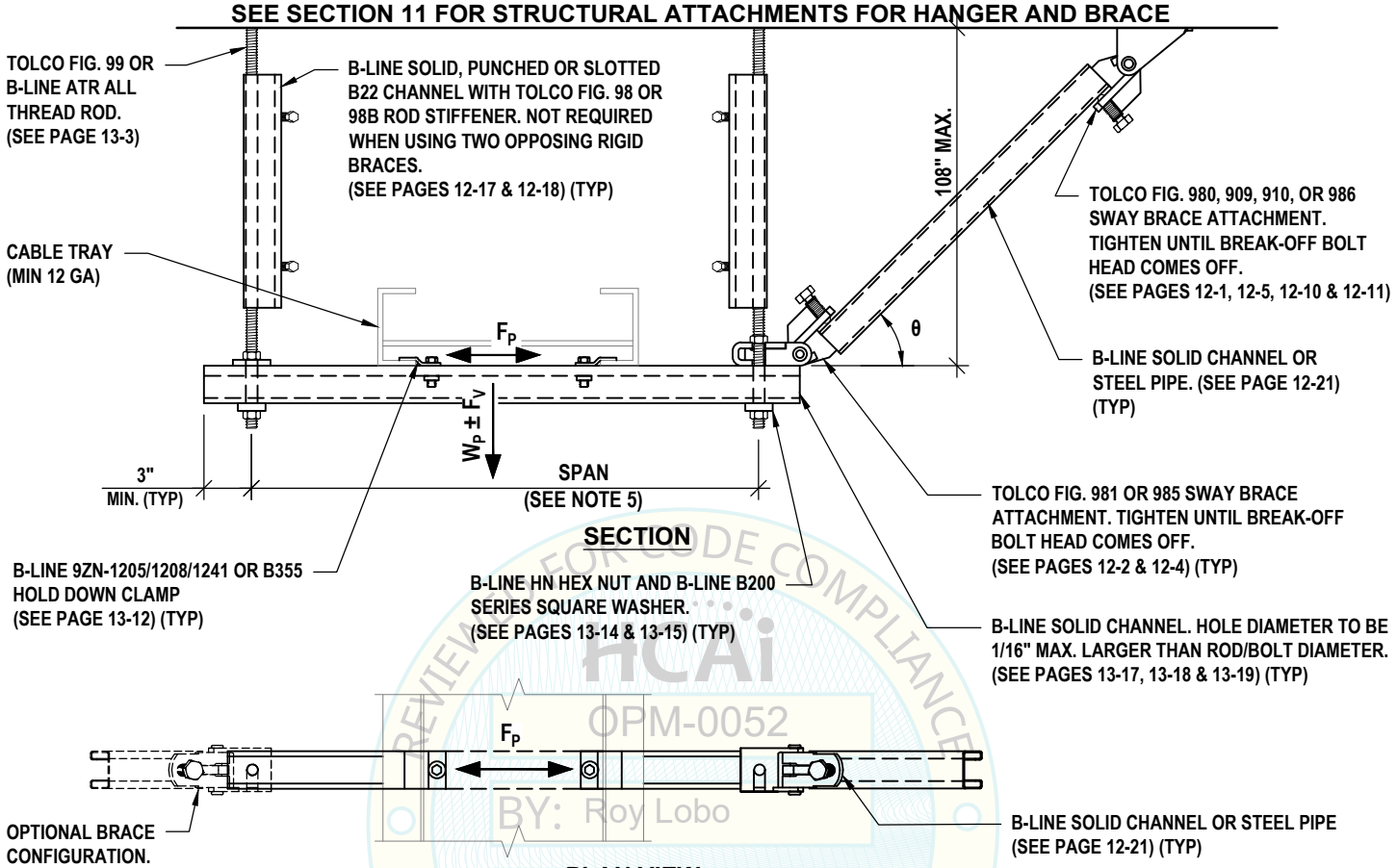
PAGE: **4-6**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACING FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

DETAIL
TR-7

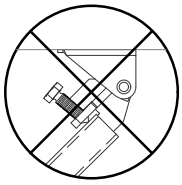
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



SECTION

PLAN VIEW

ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	949	949	774



DO NOT BEND BRACE PAST 90°

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DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-22 FOR MAXIMUM BEAM SPAN.

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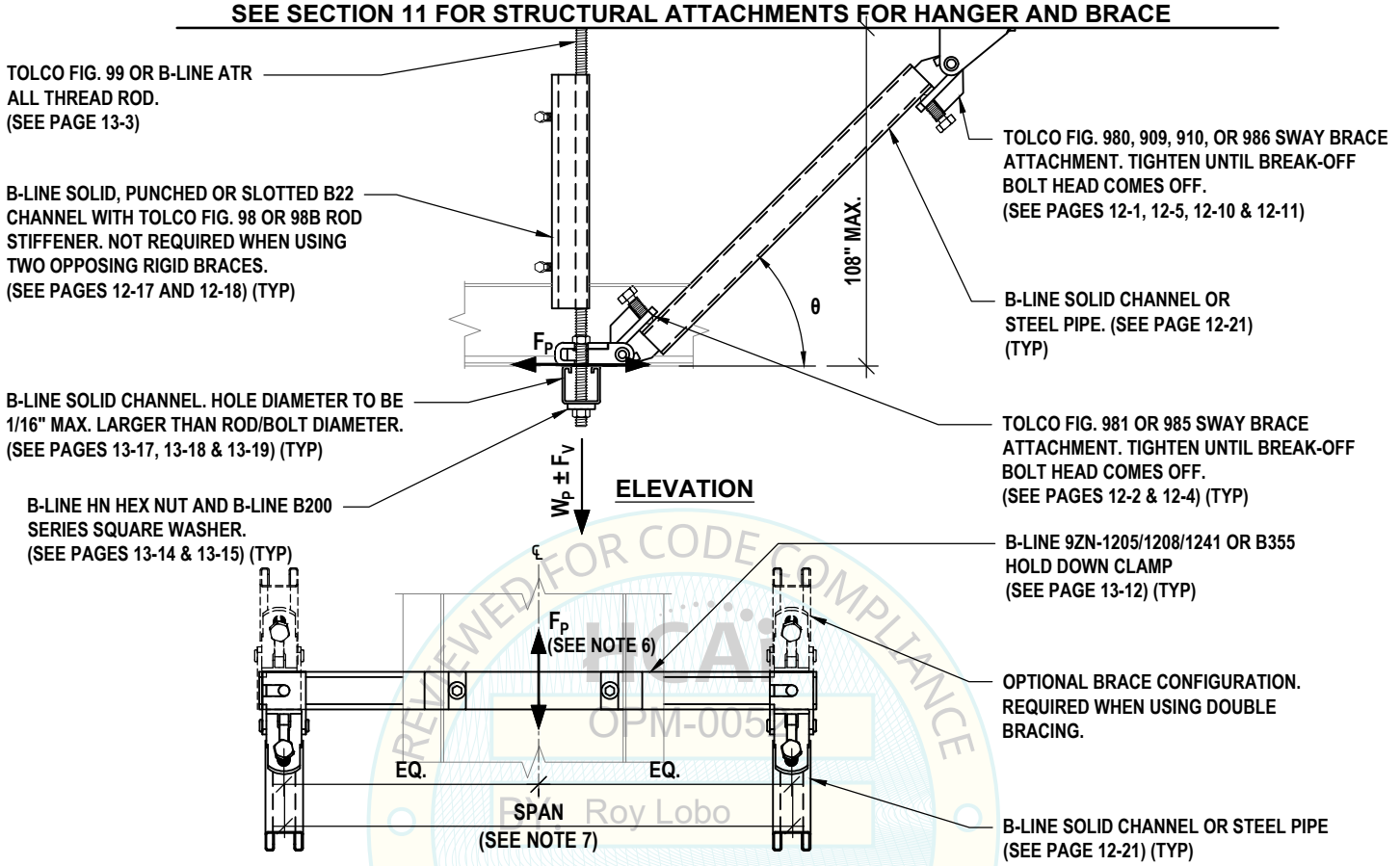
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DATE: **April 23, 2025**

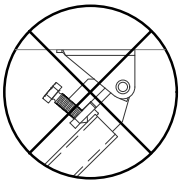
LONGITUDINAL RIGID BRACING
FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

DETAIL
TR-8

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	407	407	407
1/2"	407	407	407
3/4"	407	407	407



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 4-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. LONGITUDINAL BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
Reviewed by Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

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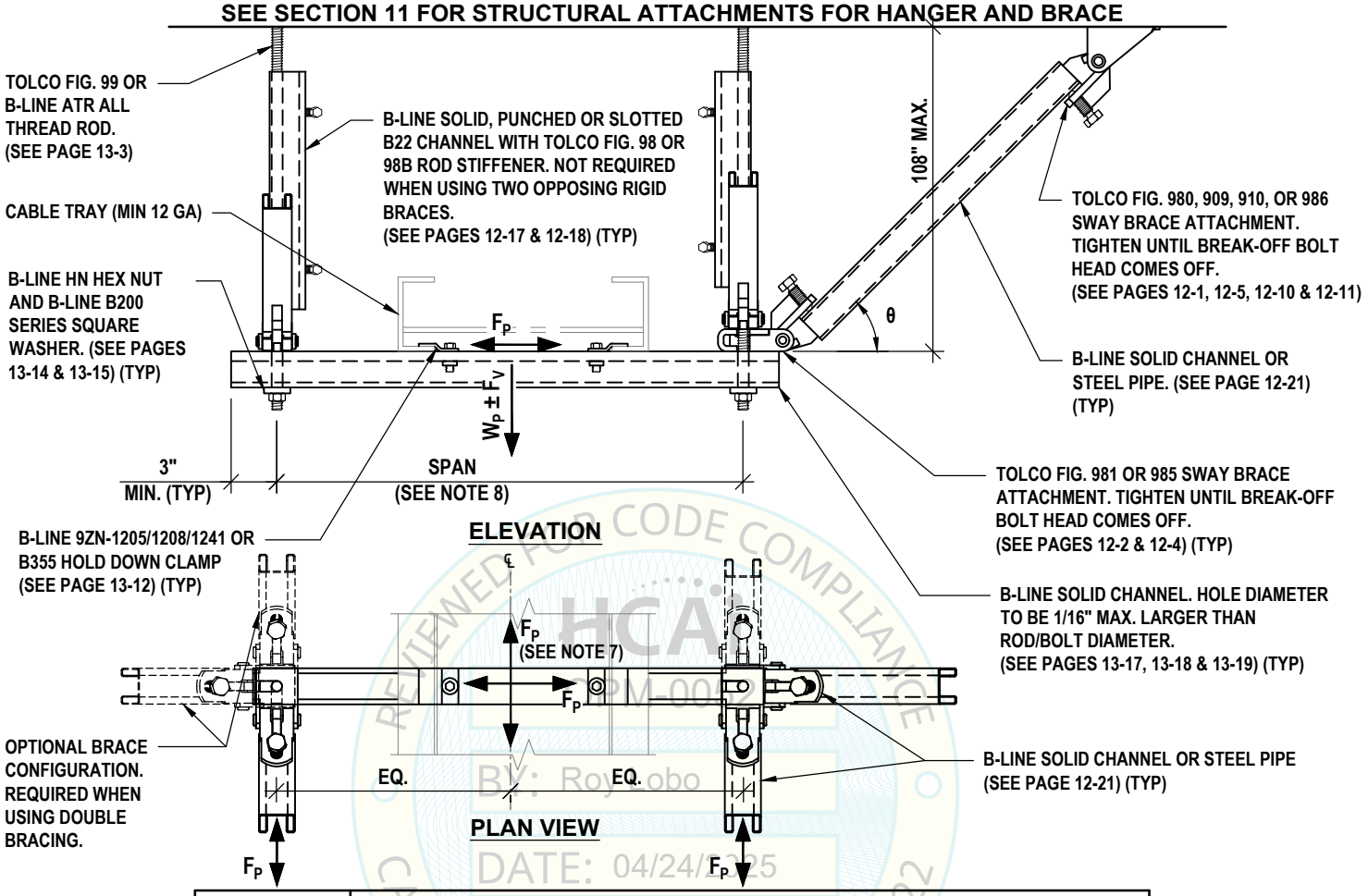
PAGE: 4-8

DATE: April 23, 2025

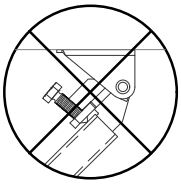
TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

DETAIL
TR-9

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 7) (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE PAGES 4-21 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTIONS.
3. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS CONSIDERING CODE-BASED ORTHOGONAL EFFECTS.
4. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
7. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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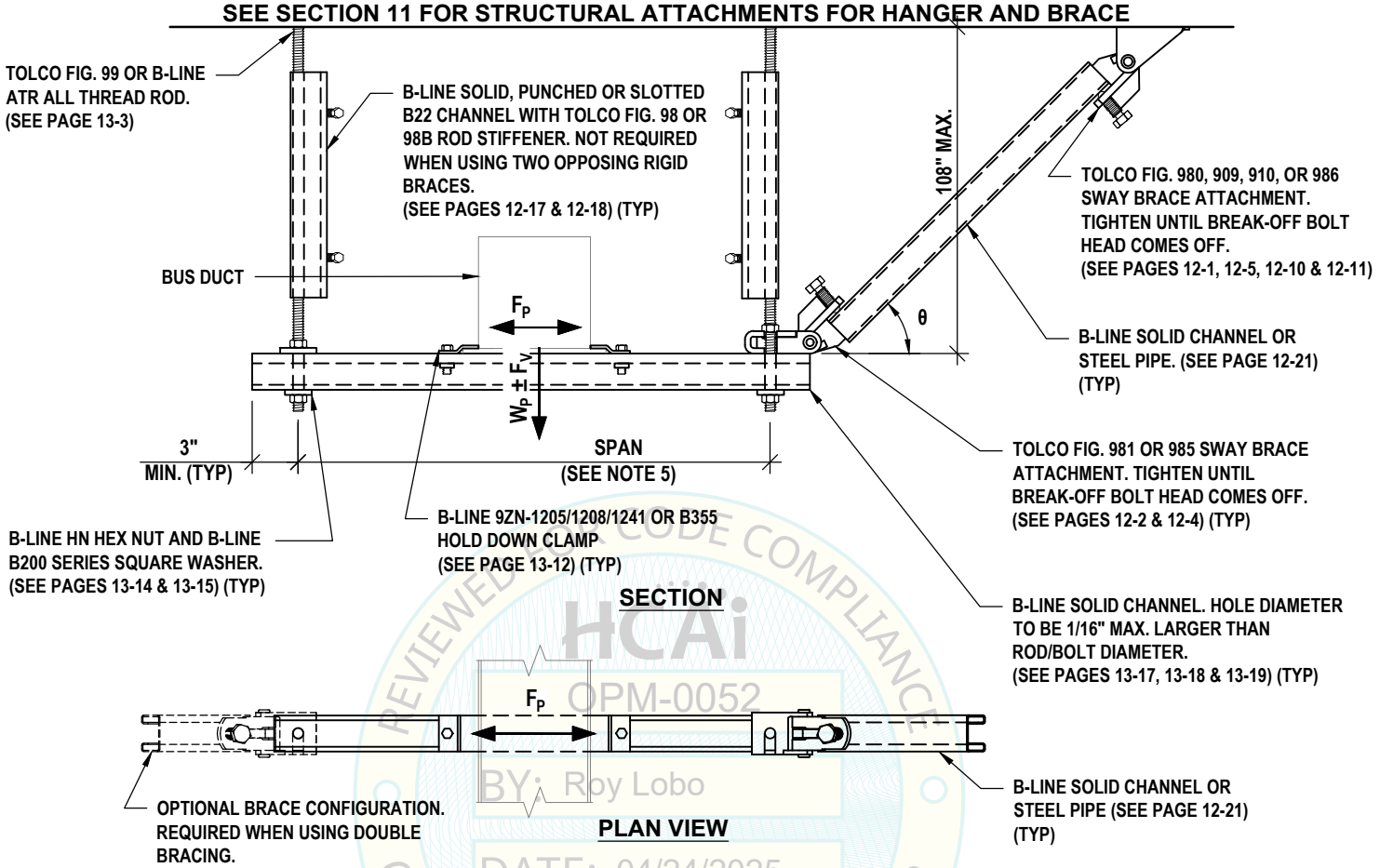
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DATE: **April 23, 2025**

TRANSVERSE RIGID BRACING FOR TRAPEZE SUPPORTED BUS DUCT

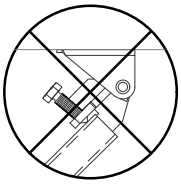
DETAIL TR-10

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	949	949	774



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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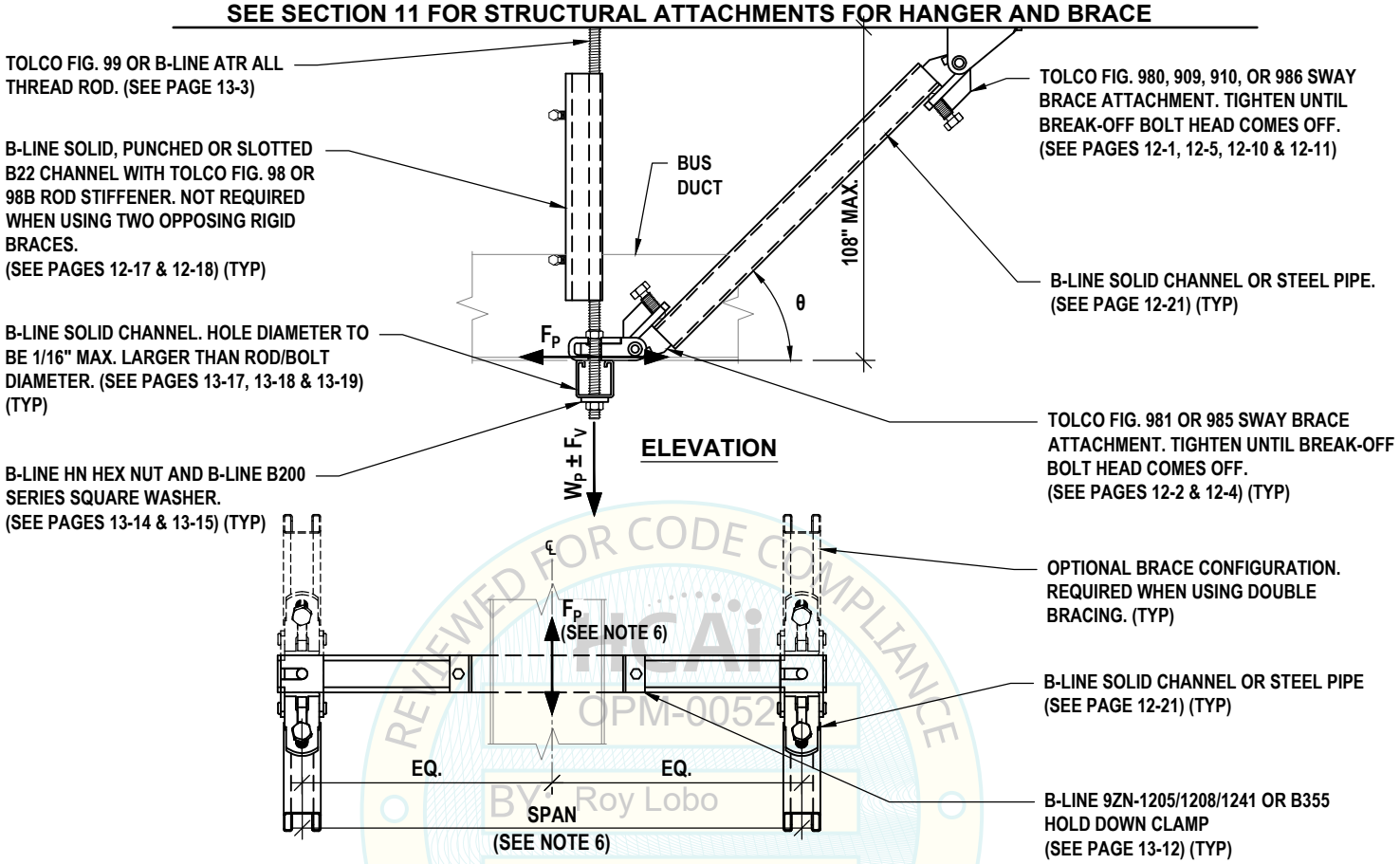
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DATE: April 23, 2025

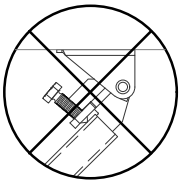
LONGITUDINAL RIGID BRACING FOR TRAPEZE SUPPORTED BUS DUCT

DETAIL TR-11

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	407	407	407
1/2"	407	407	407
3/4"	407	407	407



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-20 OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. LONGITUDINAL BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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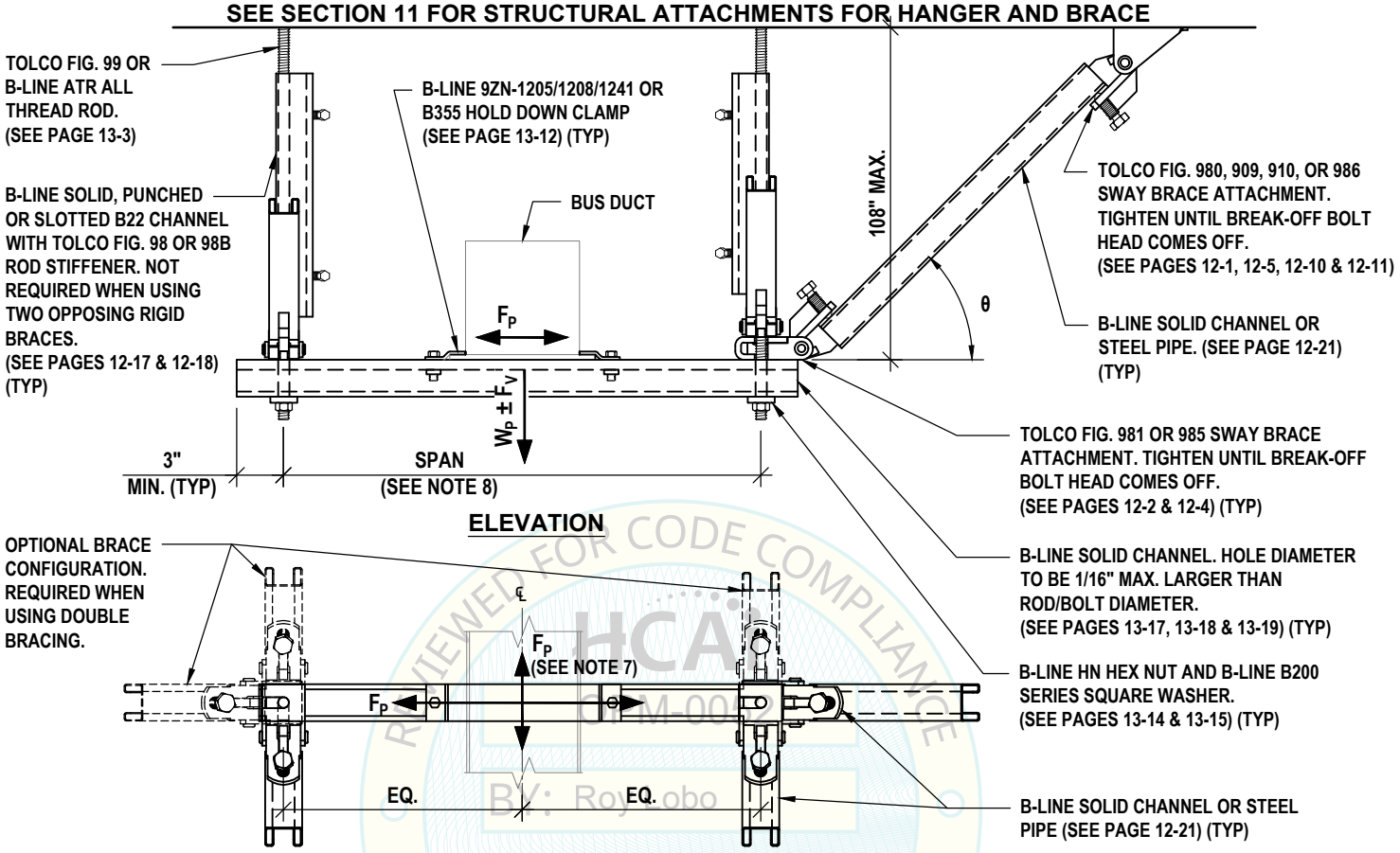
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DATE: April 23, 2025

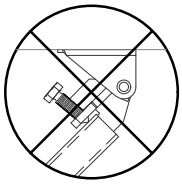
TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR TRAPEZE SUPPORTED BUS DUCT

DETAIL
TR-12

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 7) (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-21 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTIONS.
3. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS CONSIDERING CODE-BASED ORTHOGONAL EFFECTS.
4. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-11 AND 12-12.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
7. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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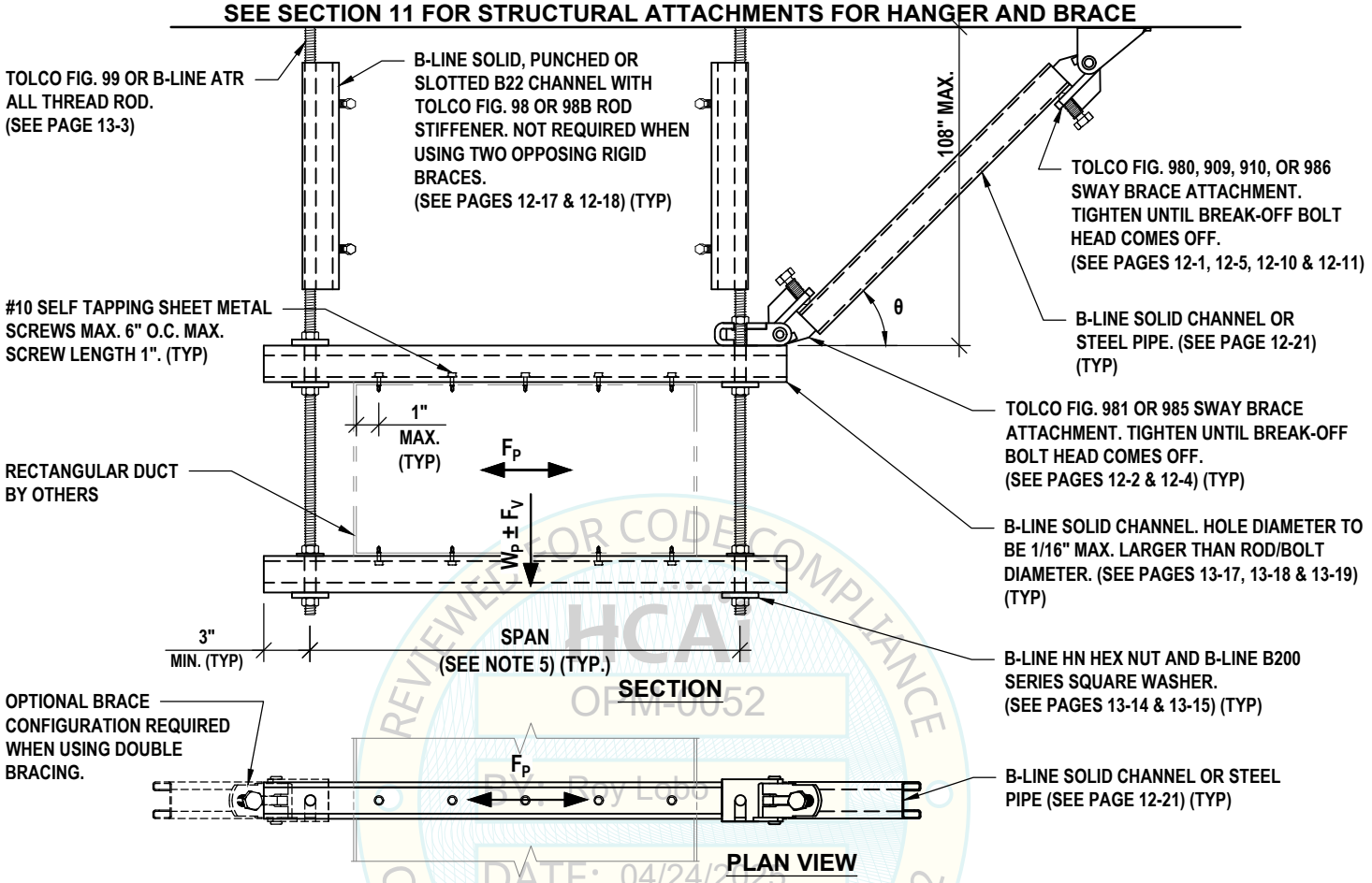
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DATE: **April 23, 2025**

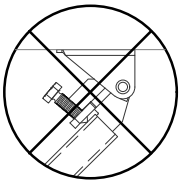
TRANSVERSE RIGID BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL
TR-13

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	1449	1224	774



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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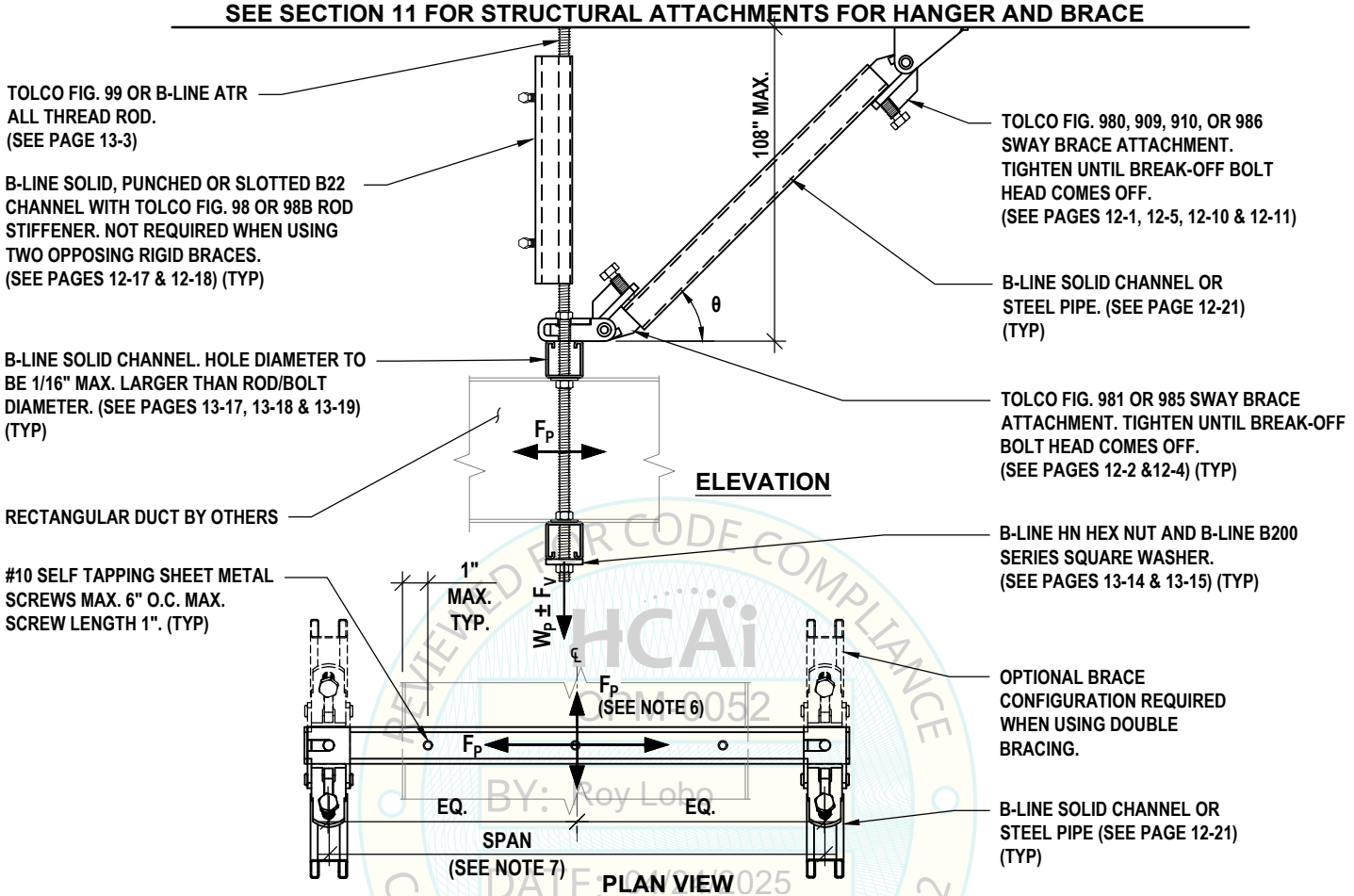
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DATE: **April 23, 2025**

LONGITUDINAL RIGID BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL **TR-14**

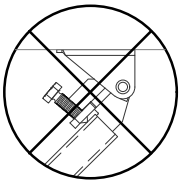
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ELEVATION

PLAN VIEW

ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	463	492	440
1/2"	463	492	440
3/4"	479	494	470



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 4-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. LONGITUDINAL BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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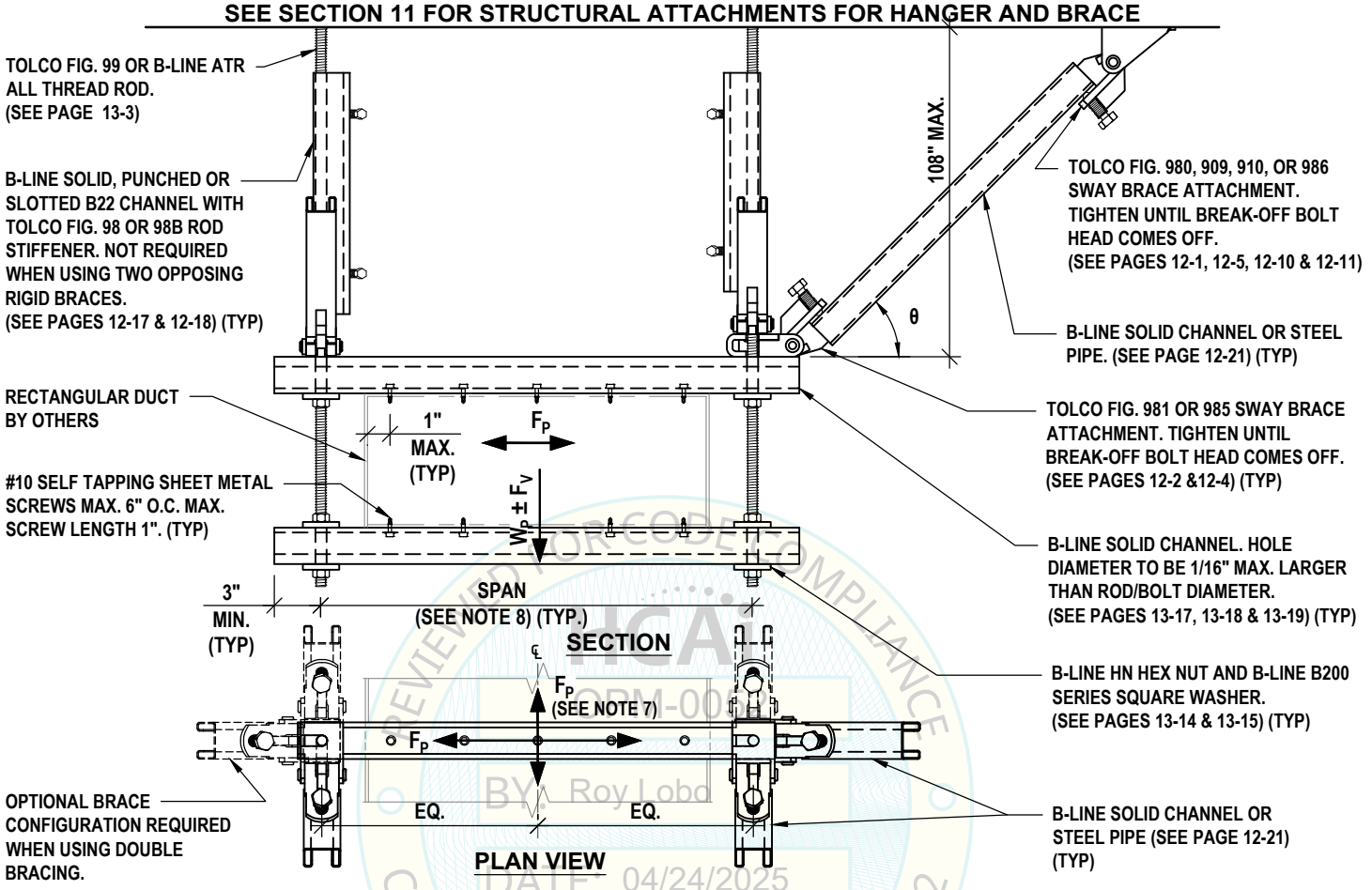
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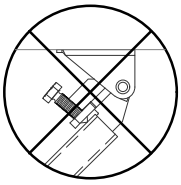
TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL
TR-15

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 7) (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-21 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
4. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
7. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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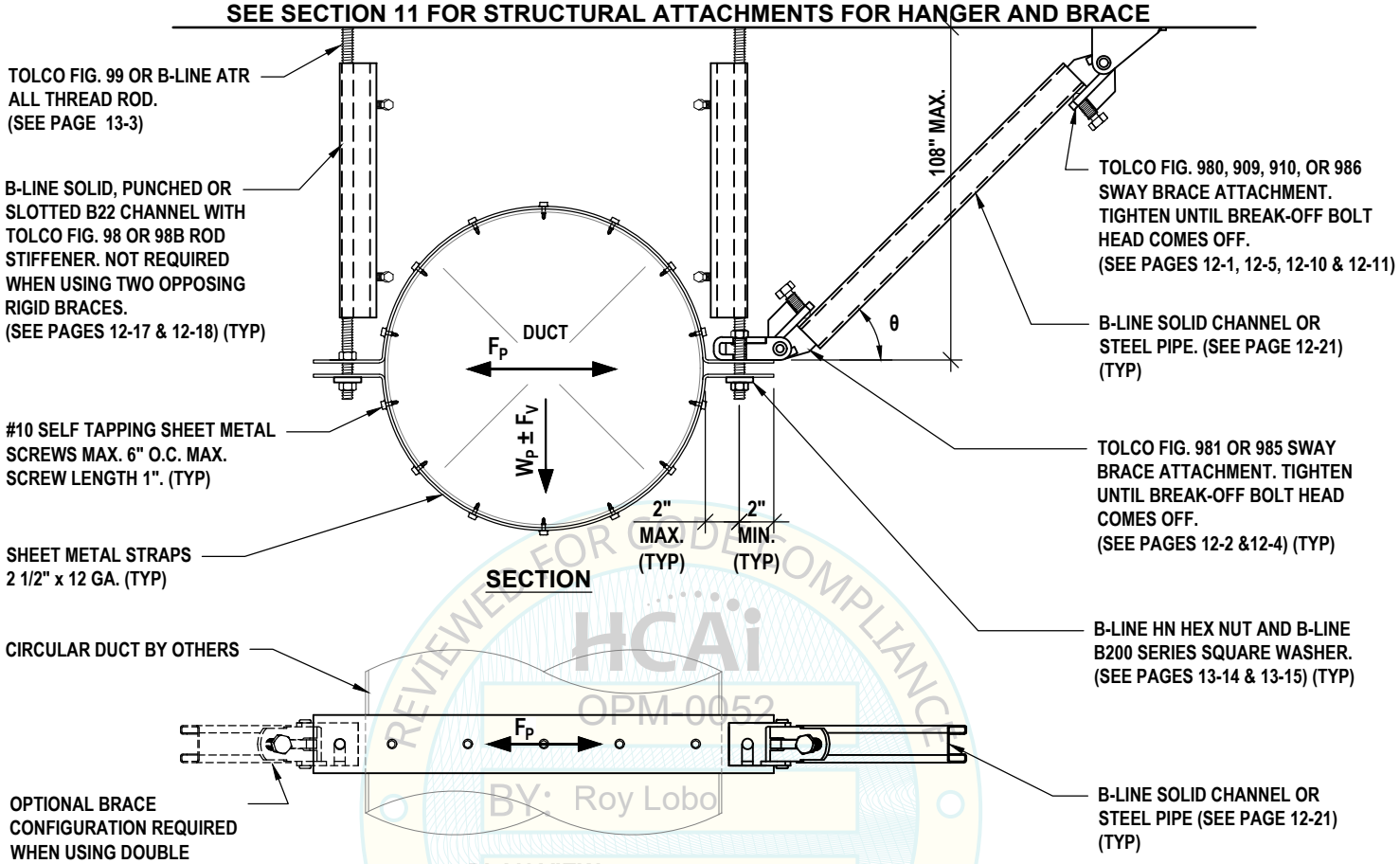
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TRANSVERSE RIGID BRACING FOR STRAP SUPPORTED ROUND DUCT

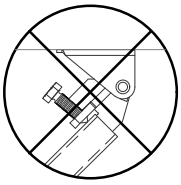
DETAIL
TR-16

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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ALL THREAD ROD SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	549	234	507
1/2"	549	234	507
3/4"	1449	1224	774



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-19 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-11 AND 12-12.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.

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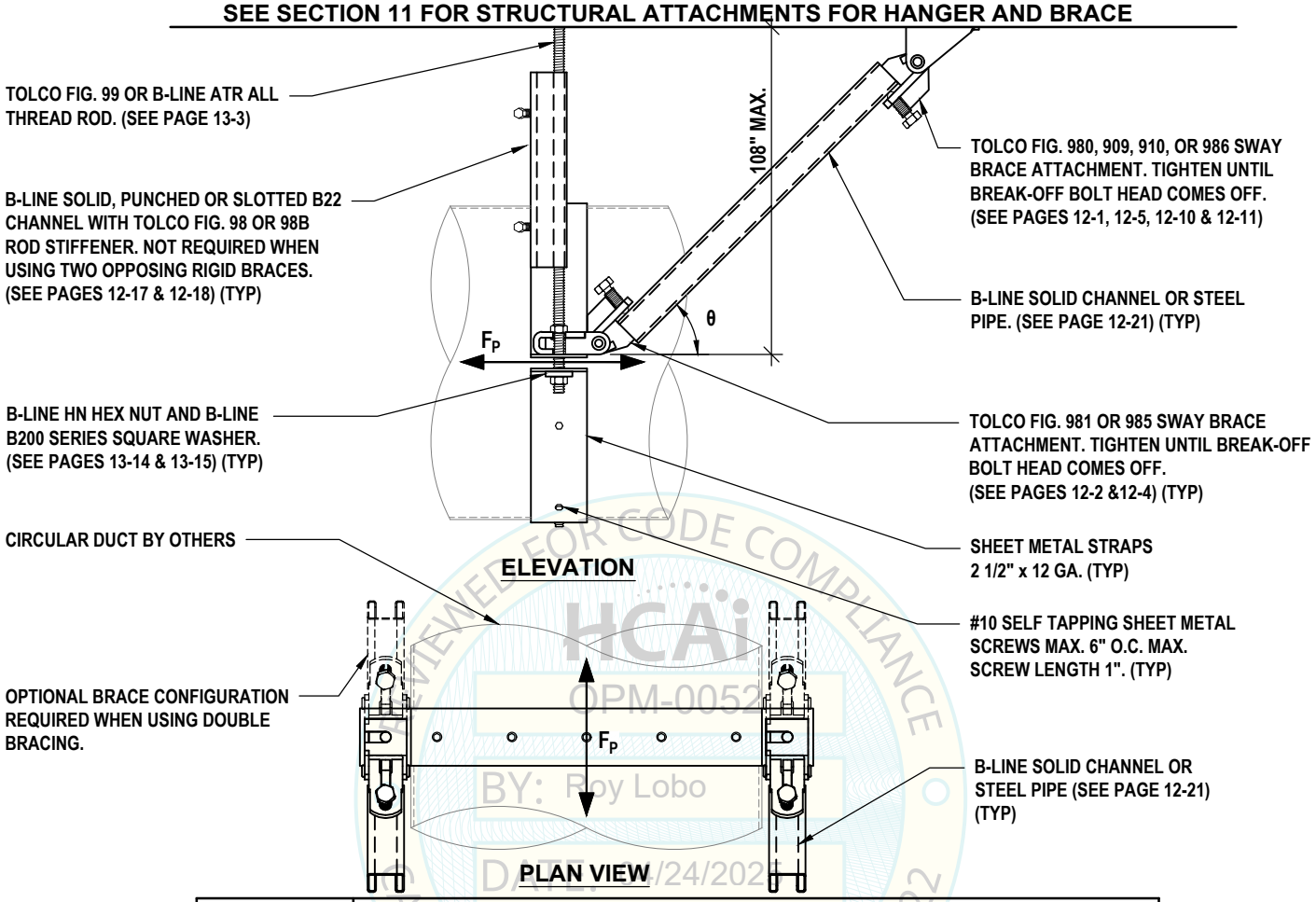
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DATE: **April 23, 2025**

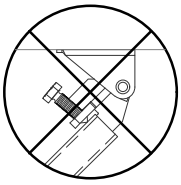
LONGITUDINAL RIGID BRACING FOR STRAP SUPPORTED ROUND DUCT

DETAIL
TR-17

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	463	492	440
1/2"	463	492	440
3/4"	479	494	470



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 4-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. TRANSVERSE BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.

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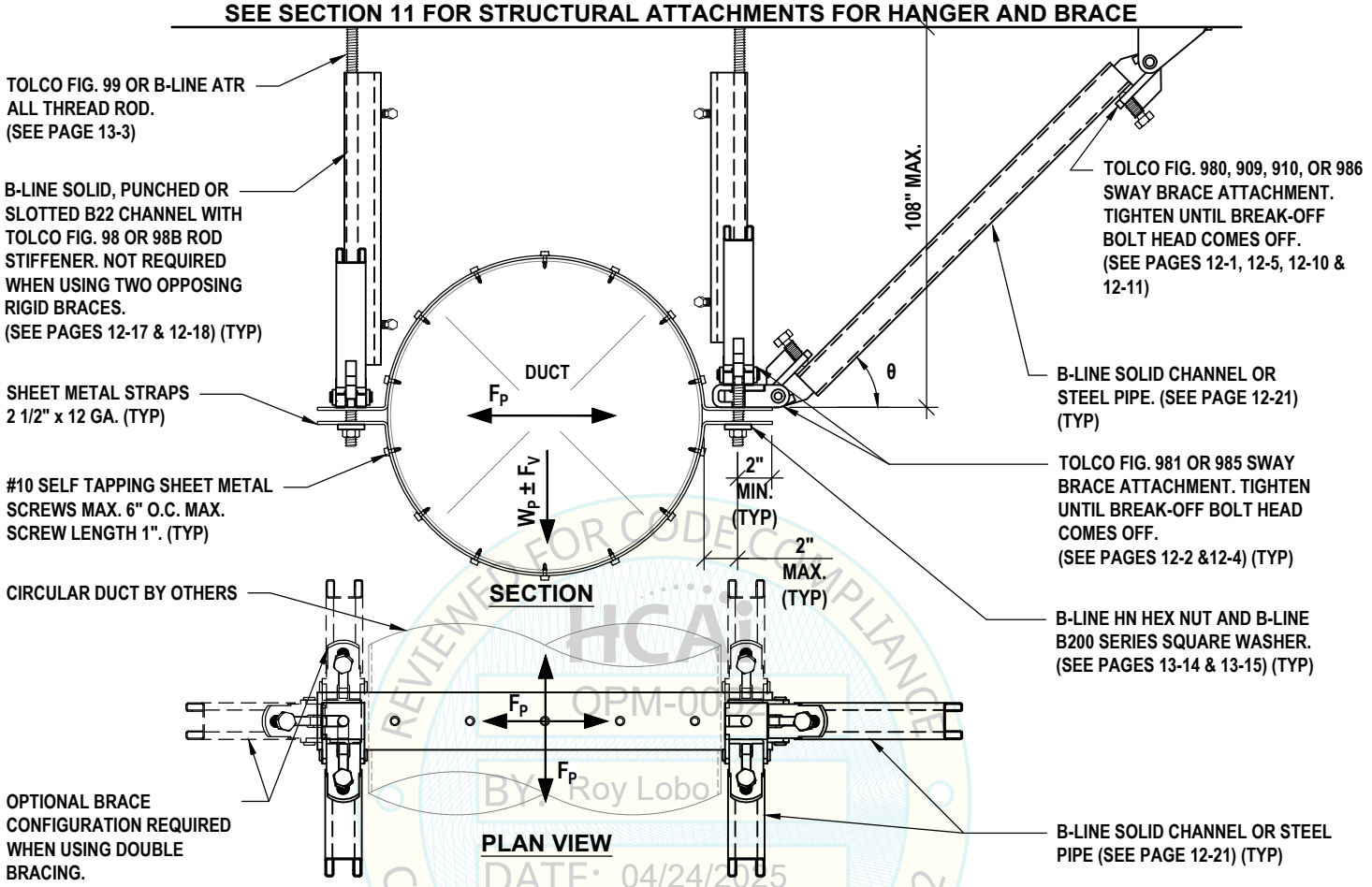
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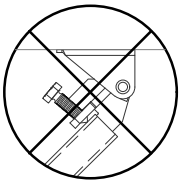
TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR STRAP SUPPORTED ROUND DUCT

DETAIL
TR-18

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ALL THREAD ROD SIZE	TRANSVERSE / LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)
	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 45°
3/8"	320
1/2"	320
3/4"	326



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-21 AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTION.
3. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
4. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.

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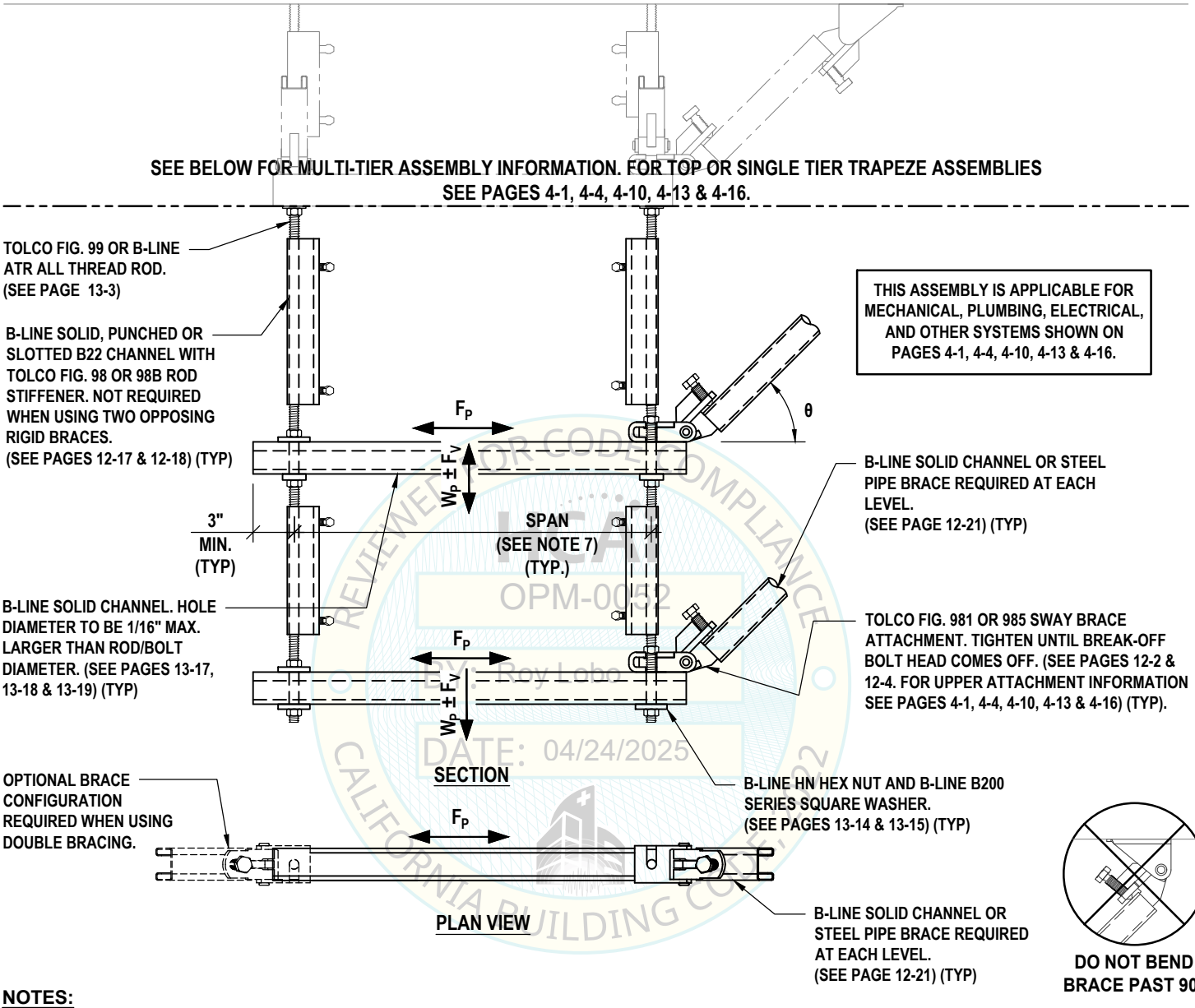
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PAGE: **4-18**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TR-19



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NOTES:

1. SEE PAGES 4-20, 4-21, AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTION.
3. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME TIME. THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 4-1, 4-4, 4-10, 4-13 AND 4-16.
4. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 4-1, 4-4, 4-10, 4-13 AND 4-16 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 4-1, 4-4, 4-10, 4-13 AND 4-16.
5. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
6. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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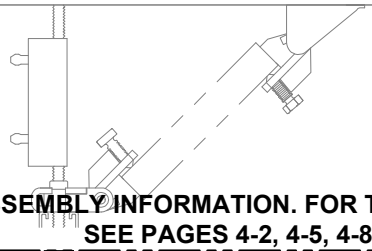
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PAGE: **4-19**

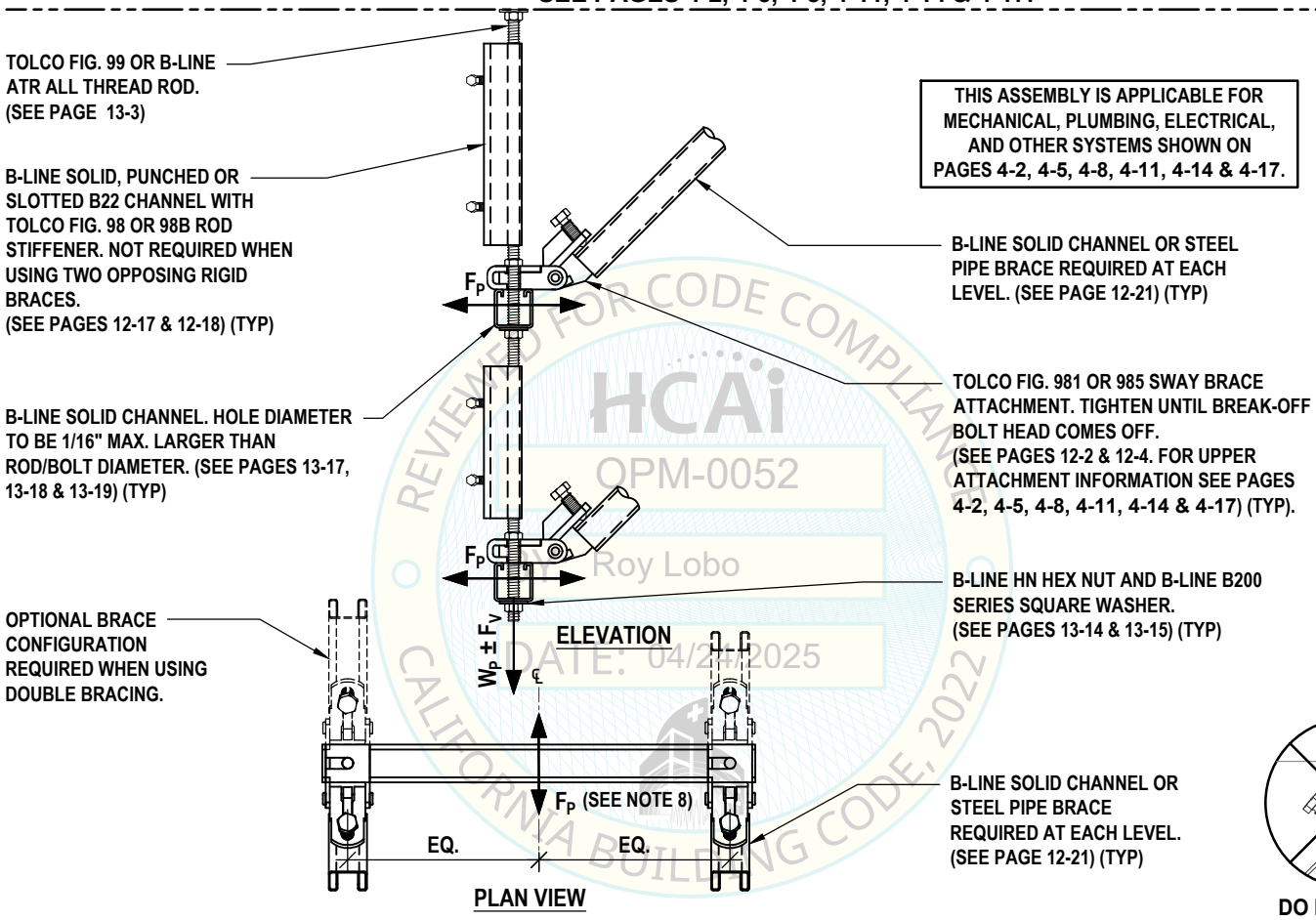
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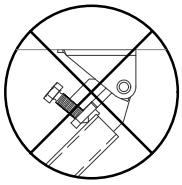
LONGITUDINAL RIGID BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TR-20



SEE BELOW FOR MULTI-TIER ASSEMBLY INFORMATION. FOR TOP OR SINGLE TIER TRAPEZE ASSEMBLIES SEE PAGES 4-2, 4-5, 4-8, 4-11, 4-14 & 4-17.





DO NOT BEND BRACE PAST 90°

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NOTES:

1. SEE PAGE PAGES 4-19, 4-21, AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACE MAY BE INSTALLED IN OPPOSING DIRECTION.
3. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 44-2, 4-5, 4-8, 4-11, 4-14 AND 4-17.
4. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 4-2, 4-5, 4-8, 4-11, 4-14 AND 4-17 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 4-2, 4-5, 4-8, 4-11, 4-14 AND 4-17.
5. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
6. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
9. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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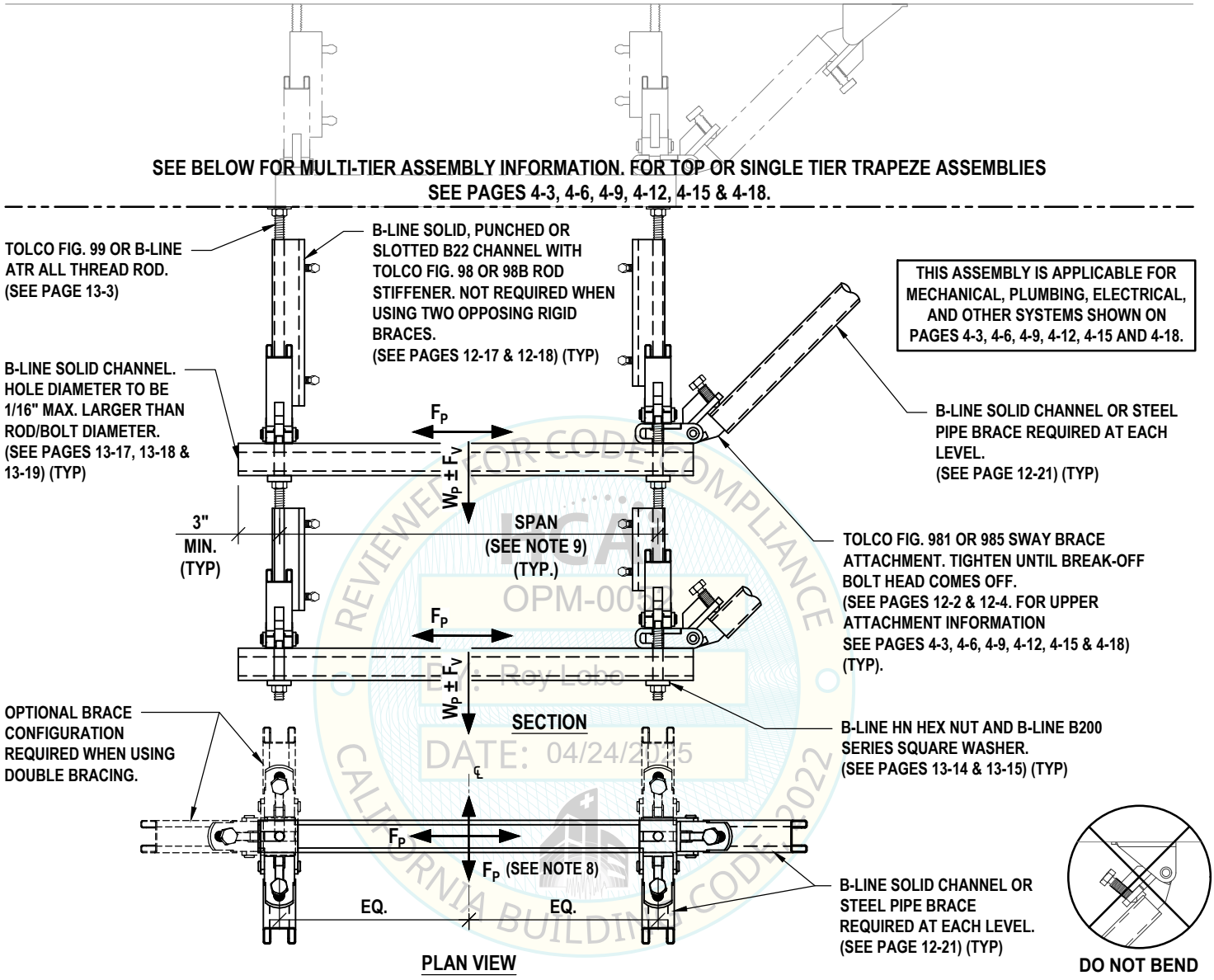
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **4-20**

DATE: **April 23, 2025**

TRANSVERSE AND LONGITUDINAL COMBINATION RIGID BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TR-21



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ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SEE PAGES 4-19, 4-20, AND 4-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE INSTALLED IN OPPOSING DIRECTION.
3. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME TIME. THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 4-3, 4-6, 4-9, 4-12, 4-15 AND 4-18.
4. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 4-3, 4-6, 4-9, 4-12, 4-15 AND 4-18 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 4-1 THRU 4-18.
5. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
6. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
9. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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California SE No. S3545

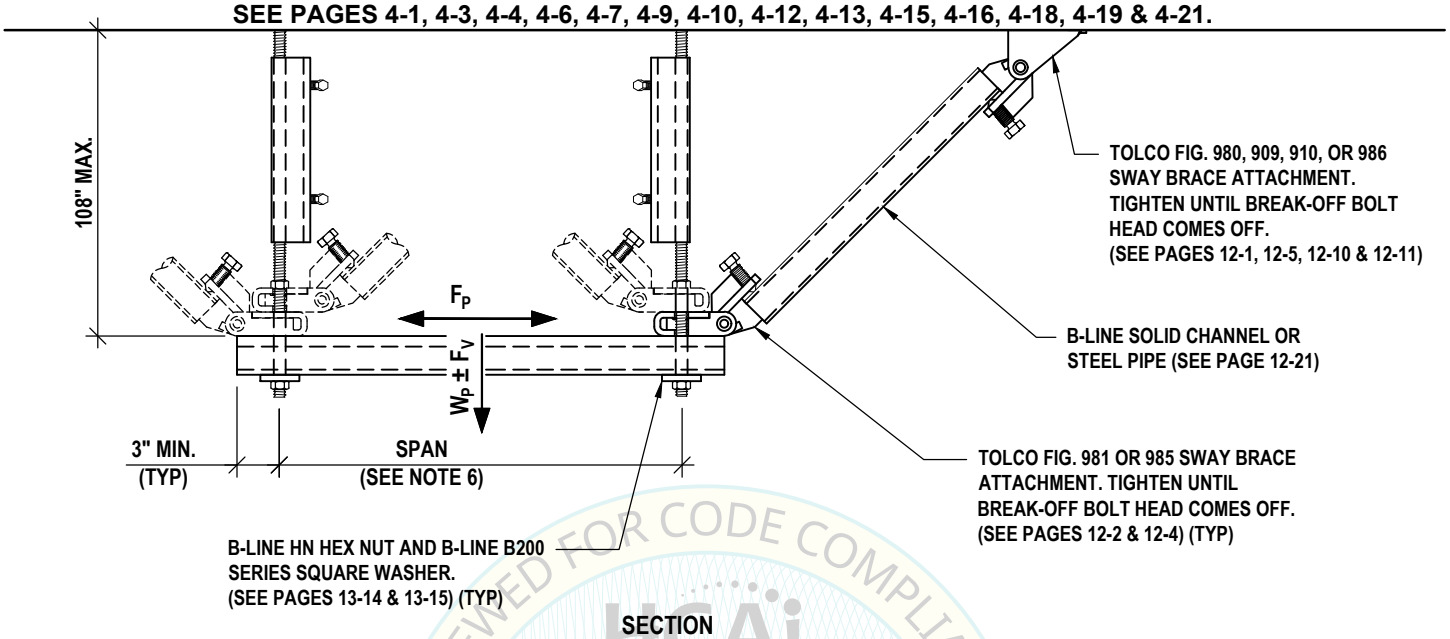
PAGE: **4-21**

DATE: **April 23, 2025**

OPTIONAL RIGID BRACE CONFIGURATIONS

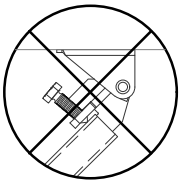
DETAIL
TR-22

SEE BELOW FOR OPTIONAL BRACE CONFIGURATIONS FOR TOP OF TRAPEZE ASSEMBLIES
SEE PAGES 4-1, 4-3, 4-4, 4-6, 4-7, 4-9, 4-10, 4-12, 4-13, 4-15, 4-16, 4-18, 4-19 & 4-21.



SECTION

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DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 4-19, 4-20 AND 4-21 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE POSITIONED IN ANY OF THE ABOVE SHOWN CONFIGURATIONS. QUANTITY OF BRACES MAY VARY BASED ON DESIGN CRITERIA.
3. THE FIG 909 AND FIG 910 ARE FOR USE ONLY WITH STEEL PIPE BRACES, PER PAGES 12-10 AND 12-11.
4. THIS OPTIONAL BRACE CONFIGURATION IS APPLICABLE TO PAGES 4-1, 4-3, 4-4, 4-6, 4-7, 4-9, 4-10, 4-12, 4-13, 4-15, 4-16, 4-18, 4-19 AND 4-21.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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PAGE: **4-22**

DATE: **April 23, 2025**

SECTION 5

TRAPEZE RIGID BRACE SPACING CHARTS

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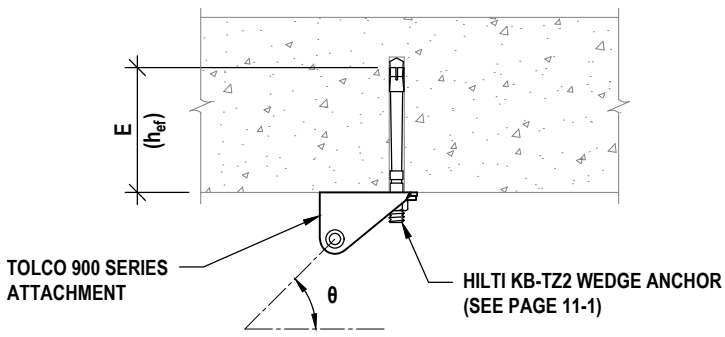
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-0

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	3/8"	2"
30	40	1	1	3/8"	2"
40	40	1	1	3/8"	2"
50	40	1	1	1/2"	3.25"
60	40	1	1	1/2"	3.25"
70	40	1	1	1/2"	3.25"
80	40	1	1	5/8"	3.25"
90	40	1	1	5/8"	3.25"
100	40	1	1	5/8"	4"
125	34	1	1	3/4"	3.75"
150	29	1	1	3/4"	3.75"
175	24	1	1	3/4"	3.75"
200	21	1	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[2]	1	3/8"	2"
20	80	2[2]	1	3/8"	2"
30	80	2[2]	1	3/8"	2"
40	80	2[2]	1	3/8"	2"
50	80	2[2]	1	1/2"	3.25"
60	80	2[2]	1	1/2"	3.25"
70	80	2[2]	1	1/2"	3.25"
80	80	2[2]	1	5/8"	3.25"
90	80	2[2]	1	5/8"	3.25"
100	80	2[2]	1	5/8"	4"
125	68	2[2]	1	3/4"	3.75"
150	58	2[2]	1	3/4"	3.75"
175	48	2[2]	1	3/4"	3.75"
200	42	2[2]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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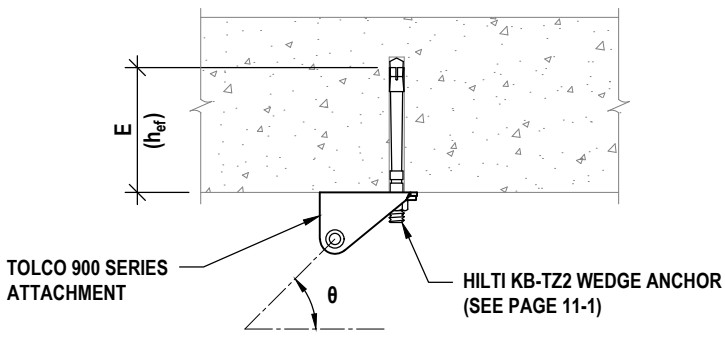
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-1

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	3/8"	2"
30	40	1	1	1/2"	3.25"
40	40	1	1	5/8"	3.25"
50	40	1	1	5/8"	4"
60	36	1	1	3/4"	3.75"
70	31	1	1	3/4"	3.75"
80	27	1	1	3/4"	3.75"
90	24	1	1	3/4"	3.75"
100	21	1	1	3/4"	3.75"
125	34	2[(2)(3)]	1	3/4"	3.75"
150	29	2[(2)(3)]	1	3/4"	3.75"
175	24	2[(2)(3)]	1	3/4"	3.75"
200	21	2[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	3/8"	2"
30	80	2[(2)]	1	1/2"	3.25"
40	80	2[(2)]	1	5/8"	3.25"
50	80	2[(2)]	1	5/8"	4"
60	72	2[(2)]	1	3/4"	3.75"
70	62	2[(2)]	1	3/4"	3.75"
80	54	2[(2)]	1	3/4"	3.75"
90	48	2[(2)]	1	3/4"	3.75"
100	42	2[(2)]	1	3/4"	3.75"
125	68	4[(2)(3)]	1	3/4"	3.75"
150	58	4[(2)(3)]	1	3/4"	3.75"
175	48	4[(2)(3)]	1	3/4"	3.75"
200	42	4[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 4/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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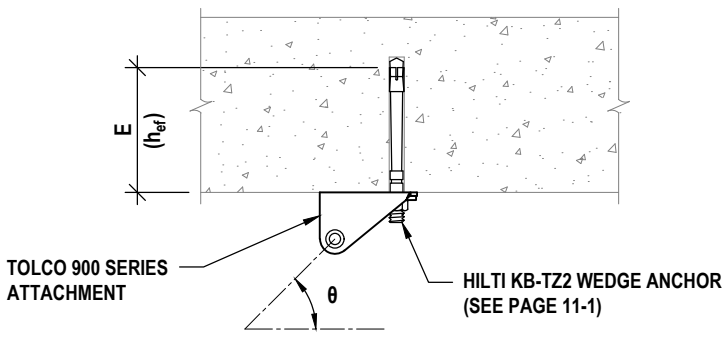
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-2

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	1/2"	3.25"
30	40	1	1	5/8"	3.25"
40	36	1	1	3/4"	3.75"
50	29	1	1	3/4"	3.75"
60	24	1	1	3/4"	3.75"
70	20	1	1	3/4"	3.75"
80	36	2[(2)(3)]	1	3/4"	3.75"
90	32	2[(2)(3)]	1	3/4"	3.75"
100	29	2[(2)(3)]	1	3/4"	3.75"
125	23	2[(2)(3)]	1	3/4"	3.75"
150	19	2[(2)]	1	3/4"	3.75"
175	16	2[(2)]	1	3/4"	3.75"
200	14	2[(2)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	1/2"	3.25"
30	80	2[(2)]	1	5/8"	3.25"
40	72	2[(2)]	1	3/4"	3.75"
50	58	2[(2)]	1	3/4"	3.75"
60	48	2[(2)]	1	3/4"	3.75"
70	40	2[(2)]	1	3/4"	3.75"
80	72	4[(2)(3)]	1	3/4"	3.75"
90	64	4[(2)(3)]	1	3/4"	3.75"
100	58	4[(2)(3)]	1	3/4"	3.75"
125	46	4[(2)(3)]	1	3/4"	3.75"
150	38	4[(2)(3)]	1	3/4"	3.75"
175	32	4[(2)(3)]	1	3/4"	3.75"
200	28	4[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 BY: R.W. Lobo DATE: 4/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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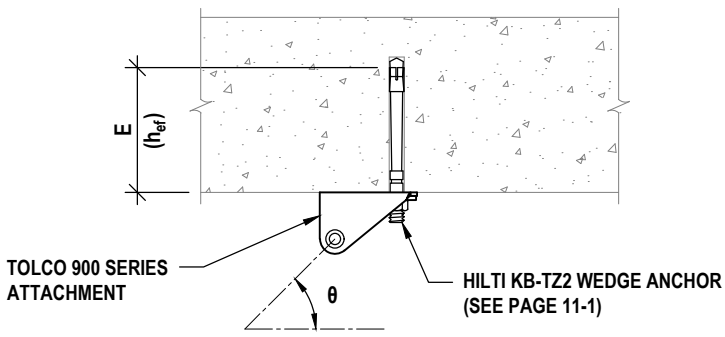
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-3

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	5/8"	3.25"
30	36	1	1	3/4"	3.75"
40	27	1	1	3/4"	3.75"
50	21	1	1	3/4"	3.75"
60	36	2[(2)(3)]	1	3/4"	3.75"
70	31	2[(2)(3)]	1	3/4"	3.75"
80	27	2[(2)(3)]	1	3/4"	3.75"
90	24	2[(2)(3)]	1	3/4"	3.75"
100	21	2[(2)(3)]	1	3/4"	3.75"
125	17	2[(2)]	1	3/4"	3.75"
150	14	2[(2)]	1	3/4"	3.75"
175	12	2[(2)]	1	3/4"	3.75"
200	10	2[(2)]	1	3/4"	3.75"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	5/8"	3.25"
30	72	2[(2)]	1	3/4"	3.75"
40	54	2[(2)]	1	3/4"	3.75"
50	42	2[(2)]	1	3/4"	3.75"
60	72	4[(2)(3)]	1	3/4"	3.75"
70	62	4[(2)(3)]	1	3/4"	3.75"
80	54	4[(2)(3)]	1	3/4"	3.75"
90	48	4[(2)(3)]	1	3/4"	3.75"
100	42	4[(2)(3)]	1	3/4"	3.75"
125	34	4[(2)(3)]	1	3/4"	3.75"
150	28	4[(2)(3)]	1	3/4"	3.75"
175	24	4[(2)(3)]	1	3/4"	3.75"
200	20	4[(2)(3)]	1	3/4"	3.75"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
BY: RW Lobo
DATE: 4/24/2025
CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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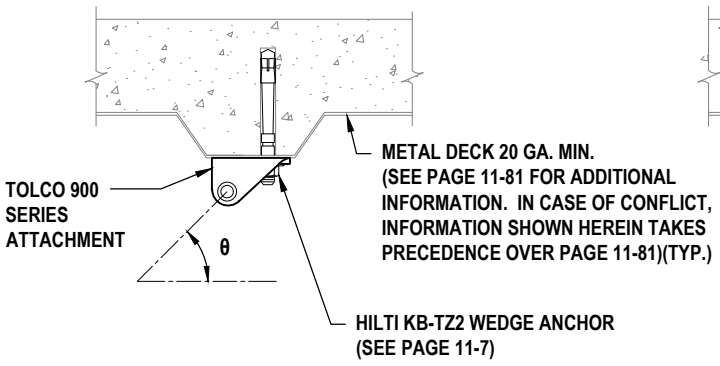
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

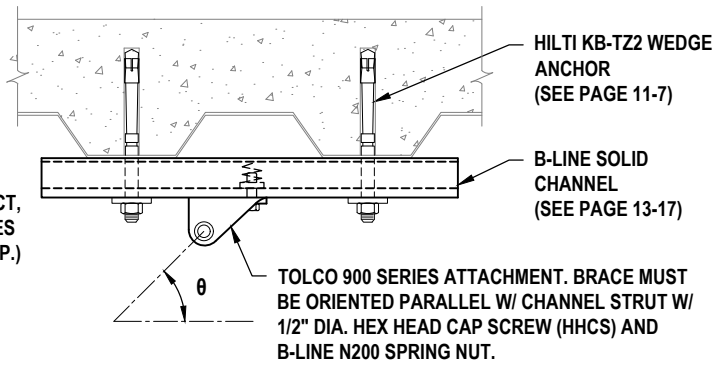
PAGE: 5-4

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	3/8"	2"
30	40	1	1	1/2"	3.25"
40	40	1	1	1/2"	3.25"
50	40	1	1	5/8"	4"
60	40	1	1	5/8"	4"
70	36	1	1	5/8"	4"
80	31	1	1	5/8"	4"
90	28	1	1	5/8"	4"
100	25	1	1	5/8"	4"
125	20	1	1	5/8"	4"
150	34	2[2][3]	1	5/8"	4"
175	28	2[2][3]	1	5/8"	4"
200	24	2[2][3]	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°. FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED. FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	2[2]	1	3/8"	2"
20	80	2[2]	1	3/8"	2"
30	80	2[2]	1	1/2"	3.25"
40	80	2[2]	1	1/2"	3.25"
50	80	2[2]	1	5/8"	4"
60	80	2[2]	1	5/8"	4"
70	72	2[2]	1	5/8"	4"
80	62	2[2]	1	5/8"	4"
90	56	2[2]	1	5/8"	4"
100	50	2[2]	1	5/8"	4"
125	40	2[2]	1	5/8"	4"
150	68	4[2][3]	1	5/8"	4"
175	56	4[2][3]	1	5/8"	4"
200	48	4[2][3]	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°. FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED. FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 Reviewed By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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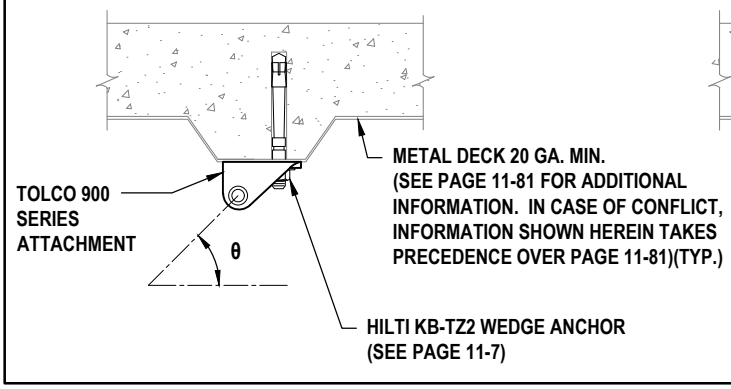
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

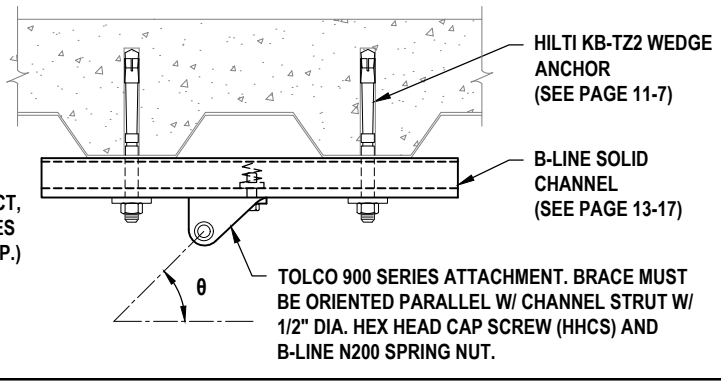
PAGE: 5-5

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	1/2"	3.25"
30	40	1	1	5/8"	4"
40	31	1	1	5/8"	4"
50	25	1	1	5/8"	4"
60	21	1	1	5/8"	4"
70	36	2[(2)(3)]	1	5/8"	4"
80	31	2[(2)(3)]	1	5/8"	4"
90	28	2[(2)(3)]	1	5/8"	4"
100	25	2[(2)(3)]	1	5/8"	4"
125	20	2[(2)(3)]	1	5/8"	4"
150	17	2[(2)]	1	5/8"	4"
175	14	2[(2)]	1	5/8"	4"
200	12	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	1/2"	3.25"
30	80	2[(2)]	1	5/8"	4"
40	62	2[(2)]	1	5/8"	4"
50	50	2[(2)]	1	5/8"	4"
60	42	2[(2)]	1	5/8"	4"
70	72	4[(2)(3)]	1	5/8"	4"
80	62	4[(2)(3)]	1	5/8"	4"
90	56	4[(2)(3)]	1	5/8"	4"
100	50	4[(2)(3)]	1	5/8"	4"
125	40	4[(2)(3)]	1	5/8"	4"
150	34	4[(2)(3)]	1	5/8"	4"
175	28	4[(2)(3)]	1	5/8"	4"
200	24	4[(2)(3)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 CALIFORNIA BUILDING Reviewed By: Roy Lobo DATE: 04/24/2025

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
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4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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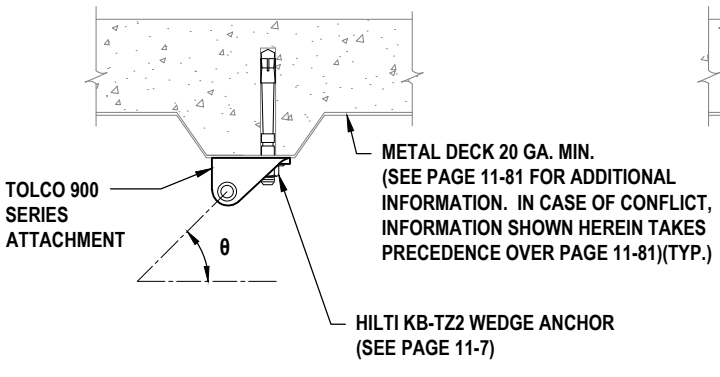
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

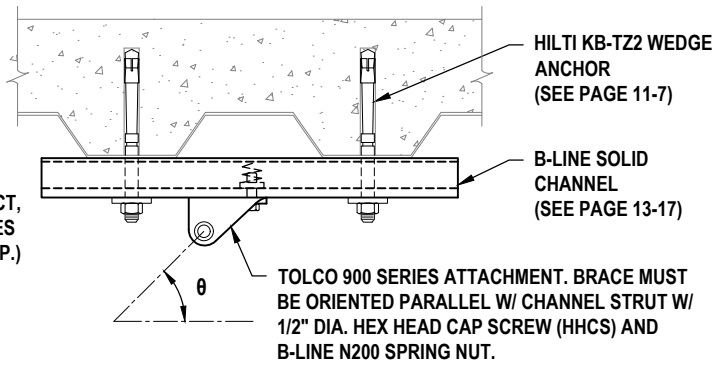
PAGE: 5-6

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	1/2"	3.25"
20	40	1	1	5/8"	4"
30	28	1	1	5/8"	4"
40	21	1	1	5/8"	4"
50	34	2[(2)(3)]	1	5/8"	4"
60	28	2[(2)(3)]	1	5/8"	4"
70	24	2[(2)(3)]	1	5/8"	4"
80	21	2[(2)(3)]	1	5/8"	4"
90	18	2[(2)]	1	5/8"	4"
100	17	2[(2)]	1	5/8"	4"
125	13	2[(2)]	1	5/8"	4"
150	11	2[(2)]	1	5/8"	4"
175	9	2[(2)]	1	5/8"	4"
200	8	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	1/2"	3.25"
20	80	2[(2)]	1	5/8"	4"
30	56	2[(2)]	1	5/8"	4"
40	42	2[(2)]	1	5/8"	4"
50	68	4[(2)(3)]	1	5/8"	4"
60	56	4[(2)(3)]	1	5/8"	4"
70	48	4[(2)(3)]	1	5/8"	4"
80	42	4[(2)(3)]	1	5/8"	4"
90	36	4[(2)(3)]	1	5/8"	4"
100	34	4[(2)(3)]	1	5/8"	4"
125	26	4[(2)(3)]	1	5/8"	4"
150	22	4[(2)(3)]	1	5/8"	4"
175	18	4[(2)]	1	5/8"	4"
200	16	4[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 Reviewed by: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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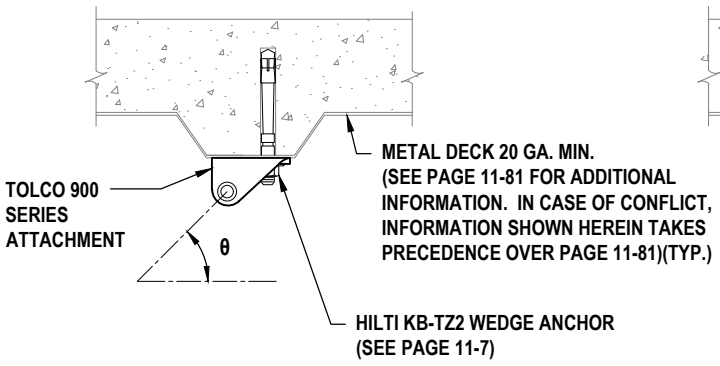
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

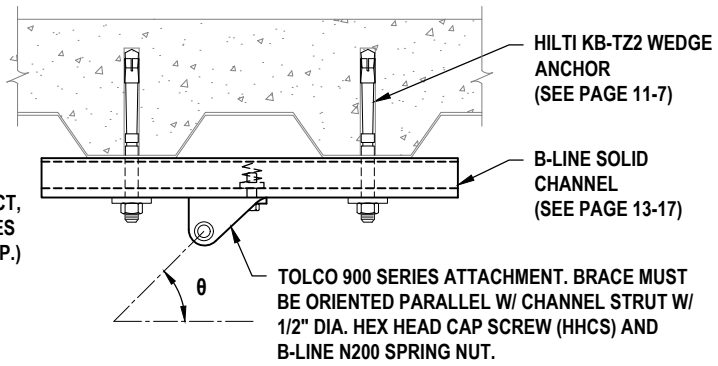
PAGE: 5-7

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	1/2"	3.25"
20	31	1	1	5/8"	4"
30	21	1	1	5/8"	4"
40	31	2[(2)(3)]	1	5/8"	4"
50	25	2[(2)(3)]	1	5/8"	4"
60	21	2[(2)(3)]	1	5/8"	4"
70	18	2[(2)]	1	5/8"	4"
80	15	2[(2)]	1	5/8"	4"
90	14	2[(2)]	1	5/8"	4"
100	12	2[(2)]	1	5/8"	4"
125	10	2[(2)]	1	5/8"	4"
150	8	2[(2)]	1	5/8"	4"
175	7	2[(2)]	1	5/8"	4"
200	6	2[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	1/2"	3.25"
20	62	2[(2)]	1	5/8"	4"
30	42	2[(2)]	1	5/8"	4"
40	62	4[(2)(3)]	1	5/8"	4"
50	50	4[(2)(3)]	1	5/8"	4"
60	42	4[(2)(3)]	1	5/8"	4"
70	36	4[(2)(3)]	1	5/8"	4"
80	30	4[(2)(3)]	1	5/8"	4"
90	28	4[(2)(3)]	1	5/8"	4"
100	24	4[(2)(3)]	1	5/8"	4"
125	20	4[(2)(3)]	1	5/8"	4"
150	16	4[(2)]	1	5/8"	4"
175	14	4[(2)]	1	5/8"	4"
200	12	4[(2)]	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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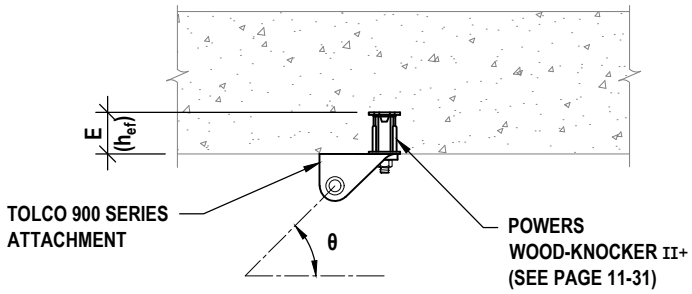
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-8

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	3/8"	2"
30	40	1	1	3/8"	2"
40	40	1	1	1/2"	2"
50	33	1	1	1/2"	2"
60	27	1	1	1/2"	2"
70	23	1	1	1/2"	2"
80	20	1	1	1/2"	2"
90	37	2[(2)(3)]	1	1/2"	2"
100	33	2[(2)(3)]	1	1/2"	2"
125	26	2[(2)(3)]	1	1/2"	2"
150	22	2[(2)(3)]	1	1/2"	2"
175	19	2[(2)]	1	1/2"	2"
200	16	2[(2)]	1	1/2"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	3/8"	2"
30	80	2[(2)]	1	3/8"	2"
40	80	2[(2)]	1	1/2"	2"
50	66	2[(2)]	1	1/2"	2"
60	54	2[(2)]	1	1/2"	2"
70	46	2[(2)]	1	1/2"	2"
80	40	2[(2)]	1	1/2"	2"
90	74	4[(2)(3)]	1	1/2"	2"
100	66	4[(2)(3)]	1	1/2"	2"
125	52	4[(2)(3)]	1	1/2"	2"
150	44	4[(2)(3)]	1	1/2"	2"
175	38	4[(2)(3)]	1	1/2"	2"
200	32	4[(2)(3)]	1	1/2"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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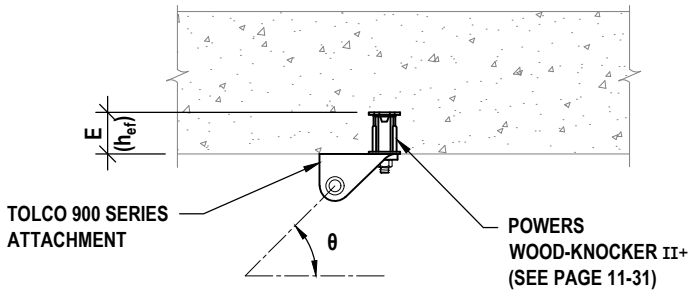
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-9

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	1/2"	2"
30	27	1	1	1/2"	2"
40	20	1	1	1/2"	2"
50	33	2[(2)(3)]	1	1/2"	2"
60	27	2[(2)(3)]	1	1/2"	2"
70	23	2[(2)(3)]	1	1/2"	2"
80	20	2[(2)(3)]	1	1/2"	2"
90	18	2[(2)]	1	1/2"	2"
100	16	2[(2)]	1	1/2"	2"
125	13	2[(2)]	1	1/2"	2"
150	11	2[(2)]	1	1/2"	2"
175	9	2[(2)]	1	1/2"	2"
200	8	2[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	1/2"	2"
30	54	2[(2)]	1	1/2"	2"
40	40	2[(2)]	1	1/2"	2"
50	66	4[(2)(3)]	1	1/2"	2"
60	54	4[(2)(3)]	1	1/2"	2"
70	46	4[(2)(3)]	1	1/2"	2"
80	40	4[(2)(3)]	1	1/2"	2"
90	36	4[(2)(3)]	1	1/2"	2"
100	32	4[(2)(3)]	1	1/2"	2"
125	26	4[(2)(3)]	1	1/2"	2"
150	22	4[(2)(3)]	1	1/2"	2"
175	18	4[(2)]	1	1/2"	2"
200	16	4[(2)]	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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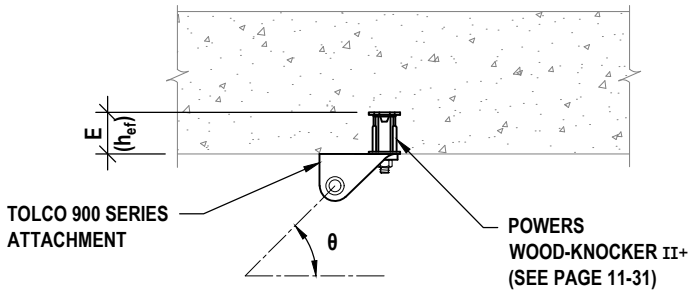
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-10

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	21	1	1	3/8"	2"
30	37	$2^{(2)(3)}$	1	1/2"	2"
40	27	$2^{(2)(3)}$	1	1/2"	2"
50	22	$2^{(2)(3)}$	1	1/2"	2"
60	18	$2^{(2)}$	1	1/2"	2"
70	15	$2^{(2)}$	1	1/2"	2"
80	13	$2^{(2)}$	1	1/2"	2"
90	12	$2^{(2)}$	1	1/2"	2"
100	11	$2^{(2)}$	1	1/2"	2"
125	8	$2^{(2)}$	1	1/2"	2"
150	7	$2^{(2)}$	1	1/2"	2"
175	6	$2^{(2)}$	1	1/2"	2"
200	5	$2^{(2)}$	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	$2^{(2)}$	1	3/8"	2"
20	42	$2^{(2)}$	1	3/8"	2"
30	74	$4^{(2)(3)}$	1	1/2"	2"
40	54	$4^{(2)(3)}$	1	1/2"	2"
50	44	$4^{(2)(3)}$	1	1/2"	2"
60	36	$4^{(2)(3)}$	1	1/2"	2"
70	30	$4^{(2)(3)}$	1	1/2"	2"
80	26	$4^{(2)(3)}$	1	1/2"	2"
90	24	$4^{(2)(3)}$	1	1/2"	2"
100	22	$4^{(2)(3)}$	1	1/2"	2"
125	16	$4^{(2)}$	1	1/2"	2"
150	14	$4^{(2)}$	1	1/2"	2"
175	12	$4^{(2)}$	1	1/2"	2"
200	10	$4^{(2)}$	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

HCAi OPM-0052 Reviewed for Code Compliance by Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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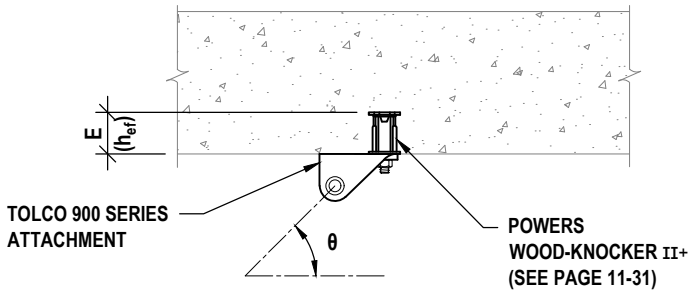
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-11

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	1/2"	2"
20	20	1	1	1/2"	2"
30	27	2(2)(3)	1	1/2"	2"
40	20	2(2)(3)	1	1/2"	2"
50	16	2(2)	1	1/2"	2"
60	13	2(2)	1	1/2"	2"
70	11	2(2)	1	1/2"	2"
80	10	2(2)	1	1/2"	2"
90	9	2(2)	1	1/2"	2"
100	8	2(2)	1	1/2"	2"
125	6	2(2)	1	1/2"	2"
150	5	2(2)	1	1/2"	2"
175	4	2(2)	1	1/2"	2"
200	4	2(2)	1	1/2"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2(2)	1	1/2"	2"
20	40	2(2)	1	1/2"	2"
30	54	4(2)(3)	1	1/2"	2"
40	40	4(2)(3)	1	1/2"	2"
50	32	4(2)(3)	1	1/2"	2"
60	26	4(2)(3)	1	1/2"	2"
70	22	4(2)(3)	1	1/2"	2"
80	20	4(2)(3)	1	1/2"	2"
90	18	4(2)	1	1/2"	2"
100	16	4(2)	1	1/2"	2"
125	12	4(2)	1	1/2"	2"
150	10	4(2)	1	1/2"	2"
175	8	4(2)	1	1/2"	2"
200	8	4(2)	1	1/2"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 CITY OF Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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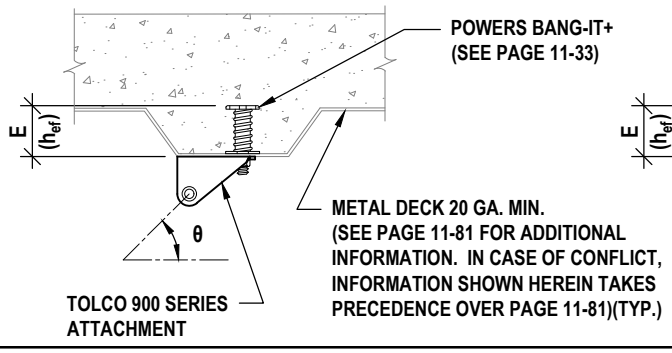
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

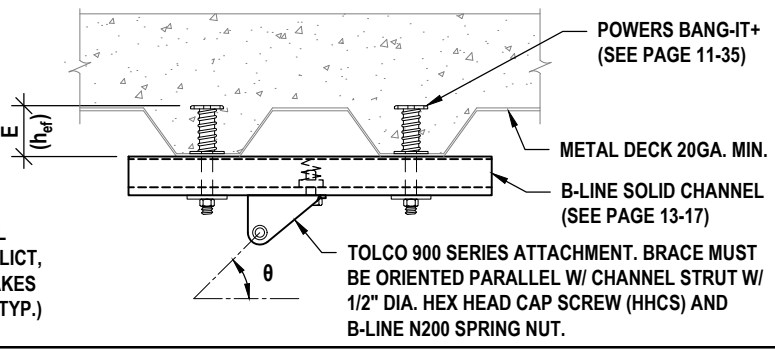
PAGE: 5-12

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1	1	3/8"	2"
20	40	1	1	3/8"	2"
30	32	1	1	5/8"	2"
40	24	1	1	5/8"	2"
50	39	1	2	5/8"	2"
60	32	1	2	5/8"	2"
70	28	1	2	5/8"	2"
80	24	1	2	5/8"	2"
90	40	2[(2)(3)]	2	5/8"	2"
100	39	2[(2)(3)]	2	5/8"	2"
125	31	2[(2)(3)]	2	5/8"	2"
150	26	2[(2)(3)]	2	5/8"	2"
175	22	2[(2)(3)]	2	5/8"	2"
200	19	2[(2)(3)]	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	80	2[(2)]	1	3/8"	2"
30	64	2[(2)]	1	5/8"	2"
40	48	2[(2)]	1	5/8"	2"
50	78	2[(2)]	2	5/8"	2"
60	64	2[(2)]	2	5/8"	2"
70	56	2[(2)]	2	5/8"	2"
80	48	2[(2)]	2	5/8"	2"
90	80	4[(2)(3)]	2	5/8"	2"
100	78	4[(2)(3)]	2	5/8"	2"
125	62	4[(2)(3)]	2	5/8"	2"
150	52	4[(2)(3)]	2	5/8"	2"
175	44	4[(2)(3)]	2	5/8"	2"
200	38	4[(2)(3)]	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 Reviewed By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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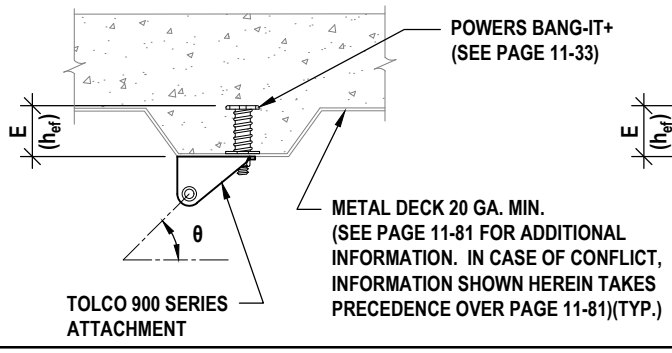
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

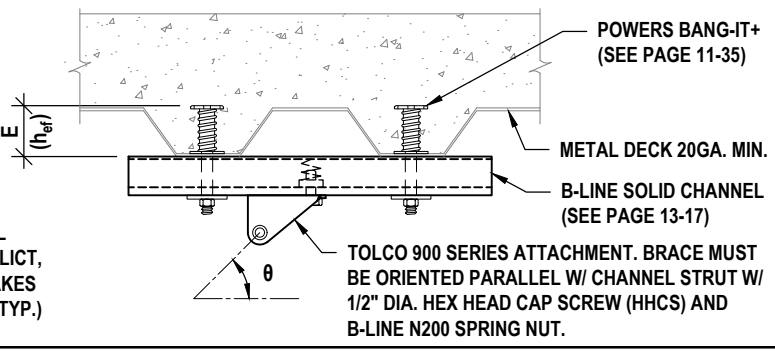
PAGE: 5-13

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Max. Trapeze Weight Per Ft.	Transverse[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1	1	3/8"	2"
20	24	1	1	5/8"	2"
30	32	1	2	5/8"	2"
40	24	1	2	5/8"	2"
50	39	2[(2)(3)]	2	5/8"	2"
60	32	2[(2)(3)]	2	5/8"	2"
70	28	2[(2)(3)]	2	5/8"	2"
80	24	2[(2)(3)]	2	5/8"	2"
90	21	2[(2)(3)]	2	5/8"	2"
100	19	2[(2)(3)]	2	5/8"	2"
125	15	2[(2)(3)]	2	5/8"	2"
150	13	2[(2)(3)]	2	5/8"	2"
175	11	2[(2)(3)]	2	5/8"	2"
200	9	2[(2)(3)]	2	5/8"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1]	Brace Qty.	Concrete Anchorage		
	Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	2[(2)]	1	3/8"	2"
20	48	2[(2)]	1	5/8"	2"
30	64	2[(2)]	2	5/8"	2"
40	48	2[(2)]	2	5/8"	2"
50	78	4[(2)(3)]	2	5/8"	2"
60	64	4[(2)(3)]	2	5/8"	2"
70	56	4[(2)(3)]	2	5/8"	2"
80	48	4[(2)(3)]	2	5/8"	2"
90	42	4[(2)(3)]	2	5/8"	2"
100	38	4[(2)(3)]	2	5/8"	2"
125	30	4[(2)(3)]	2	5/8"	2"
150	26	4[(2)(3)]	2	5/8"	2"
175	22	4[(2)(3)]	2	5/8"	2"
200	18	4[(2)(3)]	2	5/8"	2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 Reviewed By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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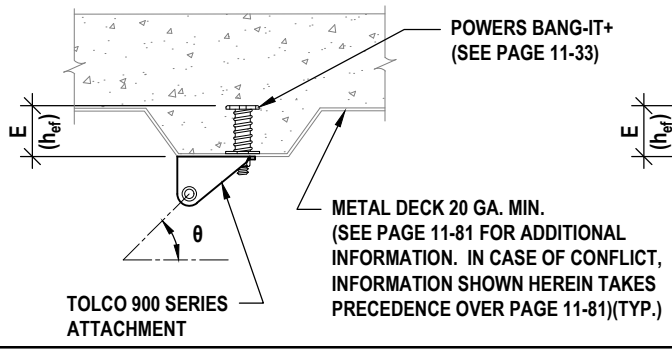
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

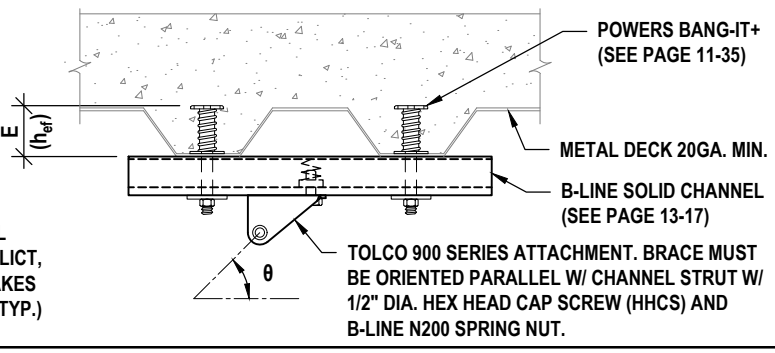
PAGE: 5-14

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	32	1	1	5/8"	2"
20	32	1	2	5/8"	2"
30	40	2(2)(3)	2	5/8"	2"
40	32	2(2)(3)	2	5/8"	2"
50	26	2(2)(3)	2	5/8"	2"
60	21	2(2)(3)	2	5/8"	2"
70	18	2(2)(3)	2	5/8"	2"
80	16	2(2)(3)	2	5/8"	2"
90	14	2(2)(3)	2	5/8"	2"
100	13	2(2)(3)	2	5/8"	2"
125	10	2(2)(3)	2	5/8"	2"
150	8	2(2)(3)	2	5/8"	2"
175	7	2(2)(3)	2	5/8"	2"
200	6	2(2)(3)	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	64	2(2)	1	5/8"	2"
20	64	2(2)	2	5/8"	2"
30	80	4(2)(3)	2	5/8"	2"
40	64	4(2)(3)	2	5/8"	2"
50	52	4(2)(3)	2	5/8"	2"
60	42	4(2)(3)	2	5/8"	2"
70	36	4(2)(3)	2	5/8"	2"
80	32	4(2)(3)	2	5/8"	2"
90	28	4(2)(3)	2	5/8"	2"
100	26	4(2)(3)	2	5/8"	2"
125	20	4(2)(3)	2	5/8"	2"
150	16	4(2)(3)	2	5/8"	2"
175	14	4(2)(3)	2	5/8"	2"
200	12	4(2)(3)	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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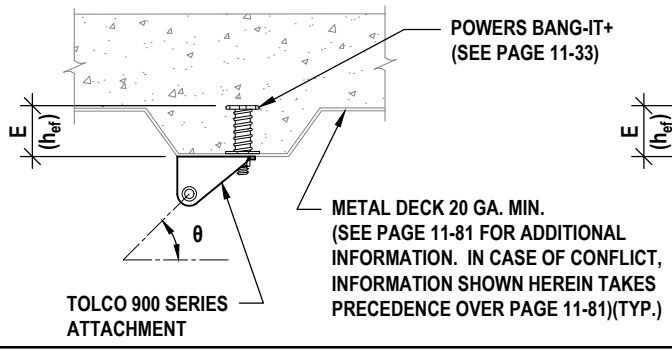
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

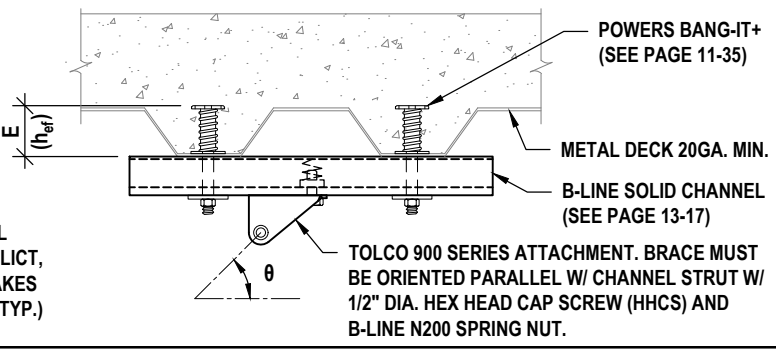
PAGE: 5-15

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	24	1	1	5/8"	2"
20	24	1	2	5/8"	2"
30	32	$2^{(2)(3)}$	2	5/8"	2"
40	24	$2^{(2)(3)}$	2	5/8"	2"
50	19	$2^{(2)(3)}$	2	5/8"	2"
60	16	$2^{(2)(3)}$	2	5/8"	2"
70	14	$2^{(2)(3)}$	2	5/8"	2"
80	12	$2^{(2)(3)}$	2	5/8"	2"
90	10	$2^{(2)(3)}$	2	5/8"	2"
100	9	$2^{(2)(3)}$	2	5/8"	2"
125	7	$2^{(2)(3)}$	2	5/8"	2"
150	6	$2^{(2)(3)}$	2	5/8"	2"
175	5	$2^{(2)(3)}$	2	5/8"	2"
200	4	$2^{(2)(3)}$	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	48	$2^{(2)}$	1	5/8"	2"
20	48	$2^{(2)}$	2	5/8"	2"
30	64	$4^{(2)(3)}$	2	5/8"	2"
40	48	$4^{(2)(3)}$	2	5/8"	2"
50	38	$4^{(2)(3)}$	2	5/8"	2"
60	32	$4^{(2)(3)}$	2	5/8"	2"
70	28	$4^{(2)(3)}$	2	5/8"	2"
80	24	$4^{(2)(3)}$	2	5/8"	2"
90	20	$4^{(2)(3)}$	2	5/8"	2"
100	18	$4^{(2)(3)}$	2	5/8"	2"
125	14	$4^{(2)(3)}$	2	5/8"	2"
150	12	$4^{(2)(3)}$	2	5/8"	2"
175	10	$4^{(2)(3)}$	2	5/8"	2"
200	8	$4^{(2)(3)}$	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

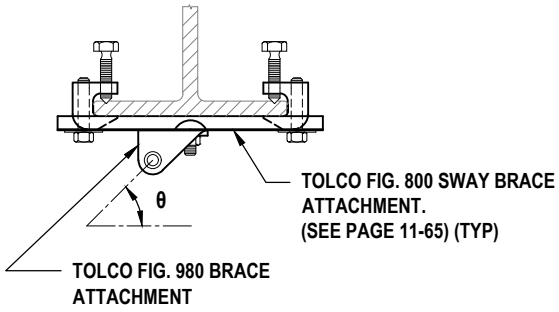
PAGE: 5-16

DATE: April 23, 2025

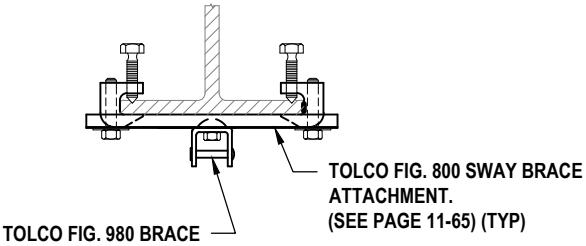
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.25 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G"	
		Perpendicular	Parallel
10	1	40	40
20	1	40	40
30	1	40	40
40	1	40	40
50	1	40	40
60	1	40	40
70	1	40	40
80	1	40	40
90	1	40	40
100	1	40	40
125	1	40	38
150	1	40	31
175	1	40	27
200	1	35	23

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G"	
		Perpendicular	Parallel
10	2[2]	80	80
20	2[2]	80	80
30	2[2]	80	80
40	2[2]	80	80
50	2[2]	80	80
60	2[2]	80	80
70	2[2]	80	80
80	2[2]	80	80
90	2[2]	80	80
100	2[2]	80	80
125	2[2]	80	76
150	2[2]	80	62
175	2[2]	80	54
200	2[2]	70	46

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.
2. DOUBLE BRACING IS REQUIRED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

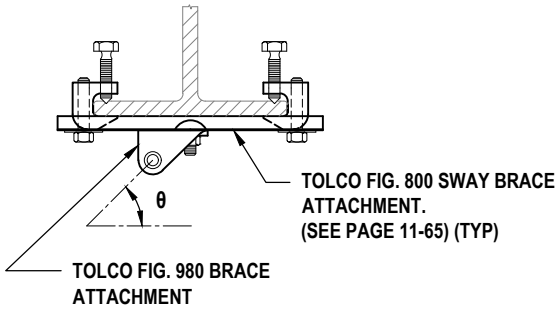
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DATE: April 23, 2025

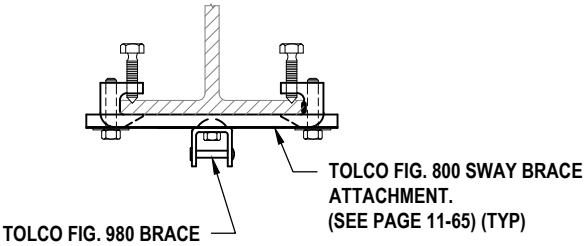
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.50 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G"	
		Perpendicular	Parallel
10	1	40	40
20	1	40	40
30	1	40	40
40	1	40	40
50	1	40	40
60	1	40	39
70	1	40	34
80	1	40	29
90	1	39	26
100	1	35	23
125	2[2]	40	38
150	2[2]	40	31
175	2[2]	40	27
200	2[2]	35	23

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.
2. DOUBLE BRACING IS REQUIRED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G"	
		Perpendicular	Parallel
10	2[2]	80	80
20	2[2]	80	80
30	2[2]	80	80
40	2[2]	80	80
50	2[2]	80	80
60	2[2]	80	78
70	2[2]	80	68
80	2[2]	80	58
90	2[2]	78	52
100	2[2]	70	46
125	4[2][3]	80	76
150	4[2][3]	80	62
175	4[2][3]	80	54
200	4[2][3]	70	46

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

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6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
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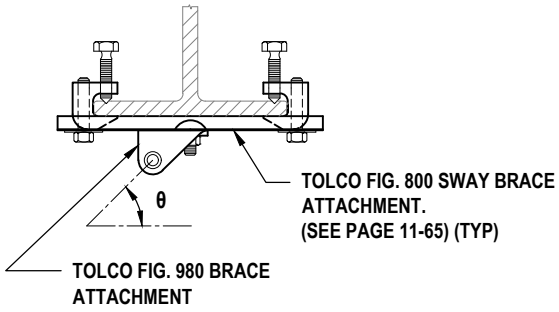
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DATE: April 23, 2025

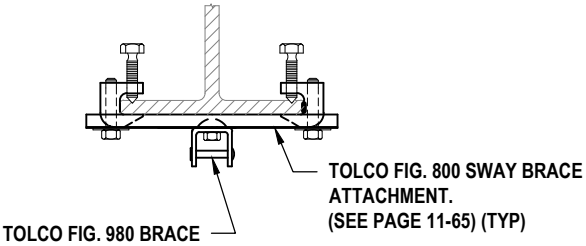
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.75 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G"	
		Perpendicular	Parallel
10	1	40	40
20	1	40	40
30	1	40	40
40	1	40	39
50	1	40	31
60	1	39	26
70	1	34	22
80	2[2][3]	40	39
90	2[2][3]	40	35
100	2[2][3]	40	31
125	2[2][3]	38	25
150	2[2][3]	31	21
175	2[2][3]	27	18
200	2[2][3]	23	15

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G"	
		Perpendicular	Parallel
10	2[2]	80	80
20	2[2]	80	80
30	2[2]	80	80
40	2[2]	80	78
50	2[2]	80	62
60	2[2]	78	52
70	2[2]	68	44
80	4[2][3]	80	78
90	4[2][3]	80	70
100	4[2][3]	80	62
125	4[2][3]	76	50
150	4[2][3]	62	42
175	4[2][3]	54	36
200	4[2][3]	46	30

FOOTNOTES:
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REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
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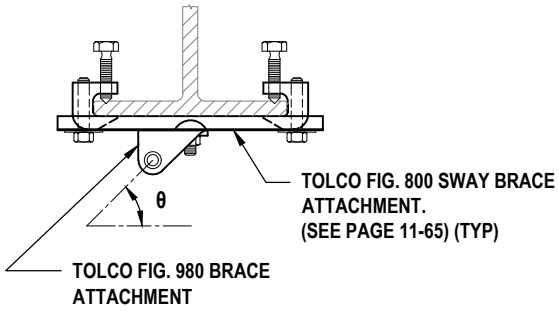
PAGE: 5-19

DATE: April 23, 2025

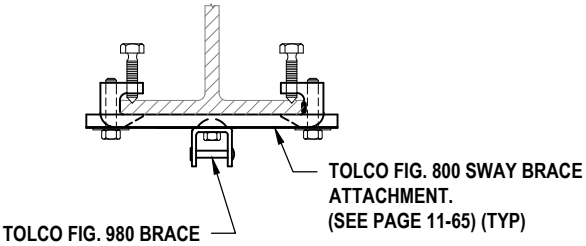
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

1.0 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G"	
		Perpendicular	Parallel
10	1	40	40
20	1	40	40
30	1	40	39
40	1	40	29
50	1	35	23
60	2[(2)(3)]	40	39
70	2[(2)(3)]	40	34
80	2[(2)(3)]	40	29
90	2[(2)(3)]	39	26
100	2[(2)(3)]	35	23
125	2[(2)(3)]	28	19
150	2[(2)(3)]	23	15
175	2[(2)(3)]	20	13
200	2[(2)(3)]	17	11

FOOTNOTES:
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Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G"	
		Perpendicular	Parallel
10	2[(2)]	80	80
20	2[(2)]	80	80
30	2[(2)]	80	78
40	2[(2)]	80	58
50	2[(2)]	70	46
60	4[(2)(3)]	80	78
70	4[(2)(3)]	80	68
80	4[(2)(3)]	80	58
90	4[(2)(3)]	78	52
100	4[(2)(3)]	70	46
125	4[(2)(3)]	56	38
150	4[(2)(3)]	46	30
175	4[(2)(3)]	40	26
200	4[(2)(3)]	34	22

FOOTNOTES:
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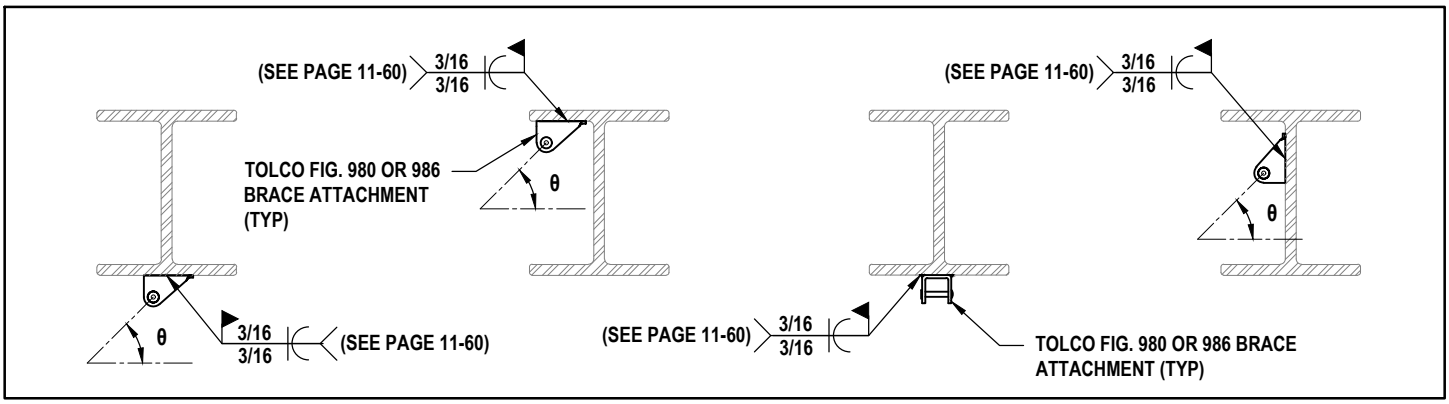
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-20

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.25 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G"
10	1	40
20	1	40
30	1	40
40	1	40
50	1	40
60	1	40
70	1	40
80	1	40
90	1	40
100	1	40
125	1	39
150	1	32
175	1	27
200	1	24

FOOTNOTES:
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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G"
10	2[2]	80
20	2[2]	80
30	2[2]	80
40	2[2]	80
50	2[2]	80
60	2[2]	80
70	2[2]	80
80	2[2]	80
90	2[2]	80
100	2[2]	80
125	2[2]	78
150	2[2]	64
175	2[2]	54
200	2[2]	48

FOOTNOTES:
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.

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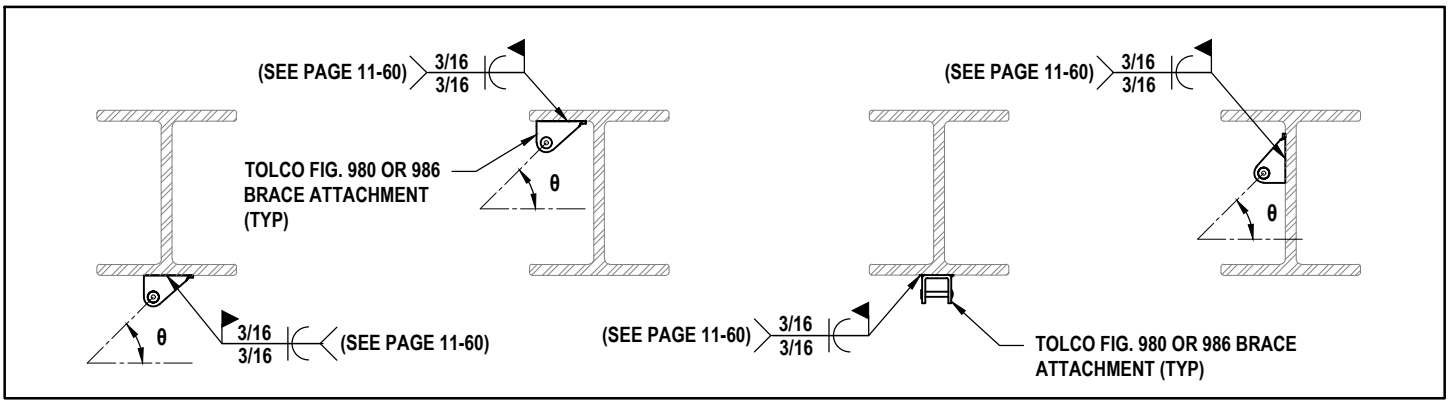
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **5-21**

DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.50 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G"
10	1	40
20	1	40
30	1	40
40	1	40
50	1	40
60	1	40
70	1	34
80	1	30
90	1	27
100	1	24
125	2[(2)(3)]	39
150	2[(2)(3)]	32
175	2[(2)(3)]	27
200	2[(2)(3)]	24

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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G"
10	2[(2)]	80
20	2[(2)]	80
30	2[(2)]	80
40	2[(2)]	80
50	2[(2)]	80
60	2[(2)]	80
70	2[(2)]	68
80	2[(2)]	60
90	2[(2)]	54
100	2[(2)]	48
125	4[(2)(3)]	78
150	4[(2)(3)]	64
175	4[(2)(3)]	54
200	4[(2)(3)]	48

FOOTNOTES:
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BY: Roy Lobo
DATE: 04/24/2025
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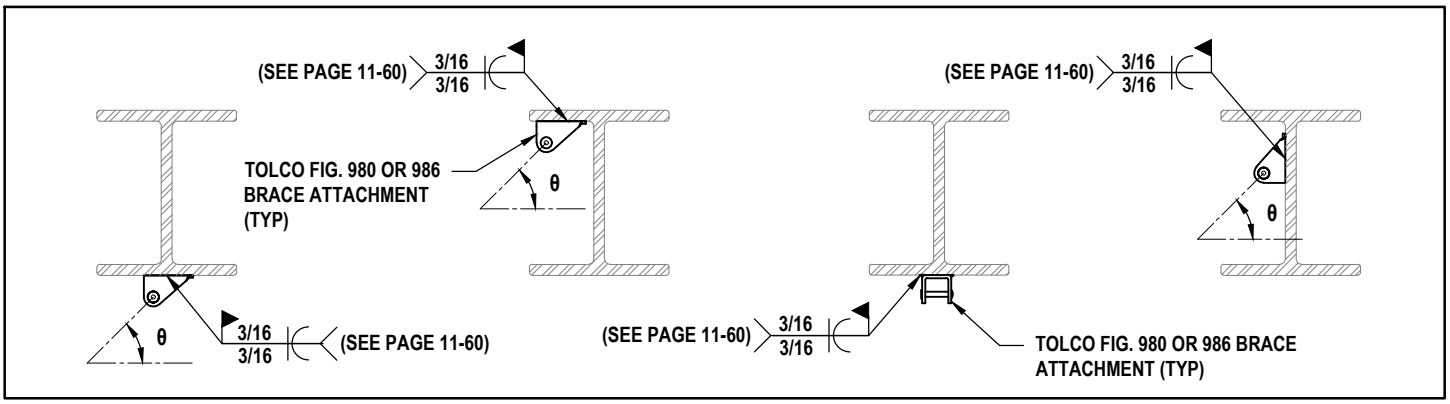
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-22

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.75 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G"
10	1	40
20	1	40
30	1	40
40	1	40
50	1	32
60	1	27
70	1	23
80	1	20
90	2[(2)(3)]	36
100	2[(2)(3)]	32
125	2[(2)(3)]	26
150	2[(2)(3)]	21
175	2[(2)]	18
200	2[(2)]	16

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G"
10	2[(2)]	80
20	2[(2)]	80
30	2[(2)]	80
40	2[(2)]	80
50	2[(2)]	64
60	2[(2)]	54
70	2[(2)]	46
80	2[(2)]	40
90	4[(2)(3)]	72
100	4[(2)(3)]	64
125	4[(2)(3)]	52
150	4[(2)(3)]	42
175	4[(2)(3)]	36
200	4[(2)(3)]	32

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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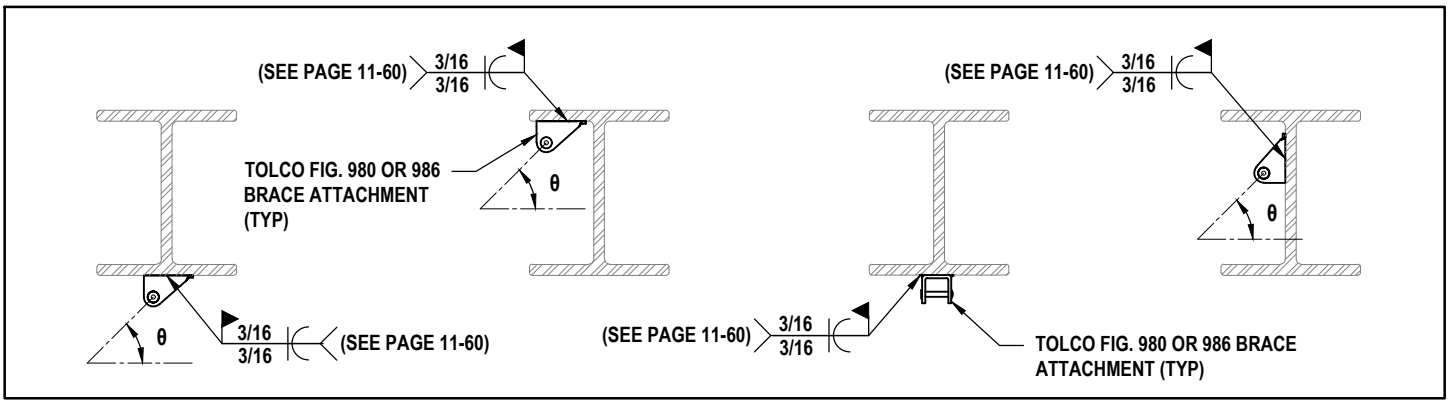
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **5-23**

DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

1.0 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G"
10	1	40
20	1	40
30	1	40
40	1	30
50	1	24
60	1	20
70	2[(2)(3)]	34
80	2[(2)(3)]	30
90	2[(2)(3)]	27
100	2[(2)(3)]	24
125	2[(2)]	19
150	2[(2)]	16
175	2[(2)]	13
200	2[(2)]	12

FOOTNOTES:
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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G"
10	2[(2)]	80
20	2[(2)]	80
30	2[(2)]	80
40	2[(2)]	60
50	2[(2)]	48
60	2[(2)]	40
70	4[(2)(3)]	68
80	4[(2)(3)]	60
90	4[(2)(3)]	54
100	4[(2)(3)]	48
125	4[(2)(3)]	38
150	4[(2)(3)]	32
175	4[(2)(3)]	26
200	4[(2)(3)]	24

FOOTNOTES:
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

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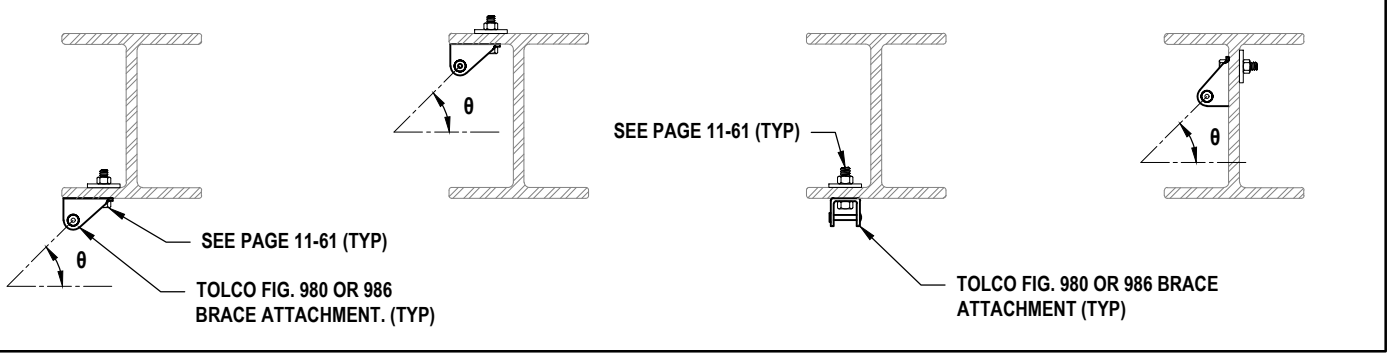
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-24

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.25 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Transverse[1] Max. Spacing @ 0.25 "G"
10	1	3/8"	40
20	1	3/8"	40
30	1	3/8"	40
40	1	3/8"	40
50	1	1/2"	40
60	1	1/2"	40
70	1	1/2"	40
80	1	1/2"	40
90	1	5/8"	40
100	1	5/8"	40
125	1	5/8"	39
150	1	5/8"	32
175	1	5/8"	27
200	1	5/8"	24

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Longitudinal[1] Max. Spacing @ 0.25 "G"
10	2[2]	3/8"	80
20	2[2]	3/8"	80
30	2[2]	3/8"	80
40	2[2]	3/8"	80
50	2[2]	1/2"	80
60	2[2]	1/2"	80
70	2[2]	1/2"	80
80	2[2]	1/2"	80
90	2[2]	5/8"	80
100	2[2]	5/8"	80
125	2[2]	5/8"	78
150	2[2]	5/8"	64
175	2[2]	5/8"	54
200	2[2]	5/8"	48

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.
2. DOUBLE BRACING IS REQUIRED.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

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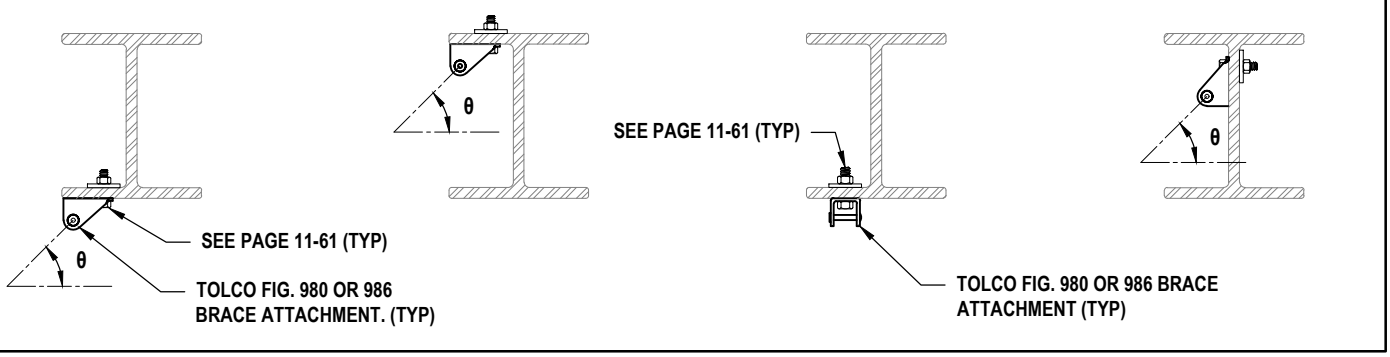
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-25

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.50 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Transverse[1] Max. Spacing @ 0.50 "G"
10	1	3/8"	40
20	1	3/8"	40
30	1	1/2"	40
40	1	1/2"	40
50	1	5/8"	40
60	1	5/8"	40
70	1	5/8"	34
80	1	5/8"	30
90	1	5/8"	27
100	1	5/8"	24
125	2[(2)(3)]	5/8"	39
150	2[(2)(3)]	5/8"	32
175	2[(2)(3)]	5/8"	27
200	2[(2)(3)]	5/8"	24

FOOTNOTES:
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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Longitudinal[1] Max. Spacing @ 0.50 "G"
10	2[(2)]	3/8"	80
20	2[(2)]	3/8"	80
30	2[(2)]	1/2"	80
40	2[(2)]	1/2"	80
50	2[(2)]	5/8"	80
60	2[(2)]	5/8"	80
70	2[(2)]	5/8"	68
80	2[(2)]	5/8"	60
90	2[(2)]	5/8"	54
100	2[(2)]	5/8"	48
125	4[(2)(3)]	5/8"	78
150	4[(2)(3)]	5/8"	64
175	4[(2)(3)]	5/8"	54
200	4[(2)(3)]	5/8"	48

FOOTNOTES:
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

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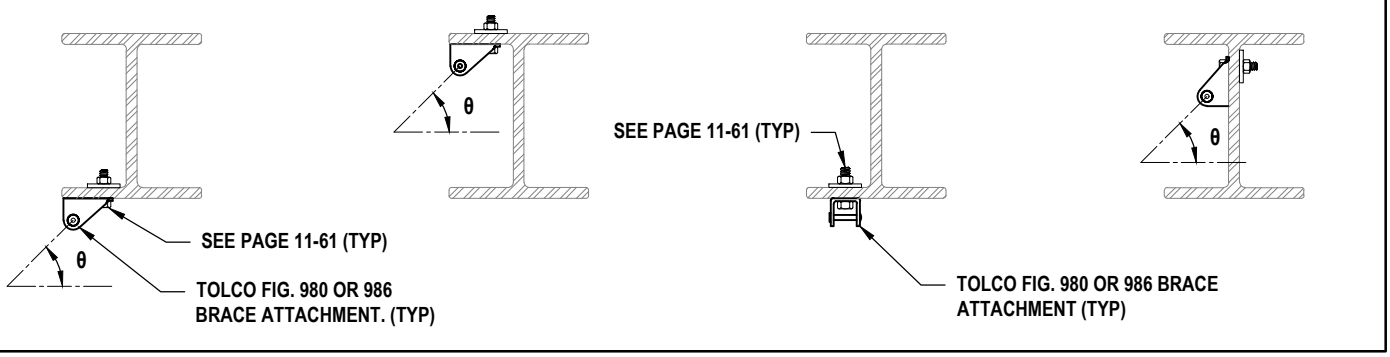
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-26

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.75 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Transverse[1] Max. Spacing @ 0.75 "G"
10	1	3/8"	40
20	1	1/2"	40
30	1	5/8"	40
40	1	5/8"	40
50	1	5/8"	32
60	1	5/8"	27
70	1	5/8"	23
80	2[(2)(3)]	5/8"	40
90	2[(2)(3)]	5/8"	36
100	2[(2)(3)]	5/8"	32
125	2[(2)(3)]	5/8"	26
150	2[(2)(3)]	5/8"	21
175	2[(2)]	5/8"	18
200	2[(2)]	5/8"	16

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Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Longitudinal[1] Max. Spacing @ 0.75 "G"
10	2[(2)]	3/8"	80
20	2[(2)]	1/2"	80
30	2[(2)]	5/8"	80
40	2[(2)]	5/8"	80
50	2[(2)]	5/8"	64
60	2[(2)]	5/8"	54
70	2[(2)]	5/8"	46
80	4[(2)(3)]	5/8"	80
90	4[(2)(3)]	5/8"	72
100	4[(2)(3)]	5/8"	64
125	4[(2)(3)]	5/8"	52
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BY: Roy Lobo
DATE: 04/24/2025
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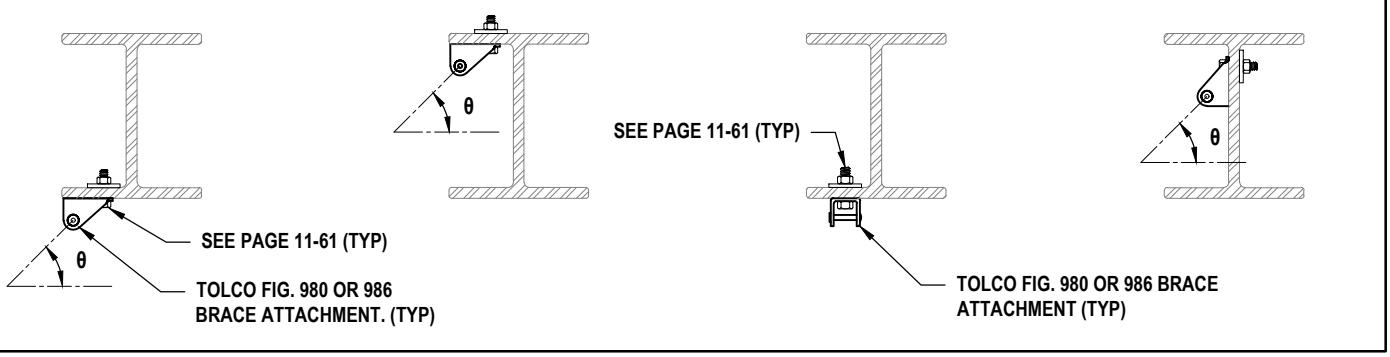
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-27

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

1.0 "G"



Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Transverse[1] Max. Spacing @ 1.0 "G"
10	1	3/8"	40
20	1	5/8"	40
30	1	5/8"	40
40	1	5/8"	30
50	1	5/8"	24
60	1	5/8"	20
70	2[(2)(3)]	5/8"	34
80	2[(2)(3)]	5/8"	30
90	2[(2)(3)]	5/8"	27
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Max. Trapeze Weight Per Ft.	Brace Qty.	Bolt Dia.	Longitudinal[1] Max. Spacing @ 1.0 "G"
10	2[(2)]	3/8"	80
20	2[(2)]	5/8"	80
30	2[(2)]	5/8"	80
40	2[(2)]	5/8"	60
50	2[(2)]	5/8"	48
60	2[(2)]	5/8"	40
70	4[(2)(3)]	5/8"	68
80	4[(2)(3)]	5/8"	60
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100	4[(2)(3)]	5/8"	48
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BY: Roy Lobo
DATE: 04/24/2025
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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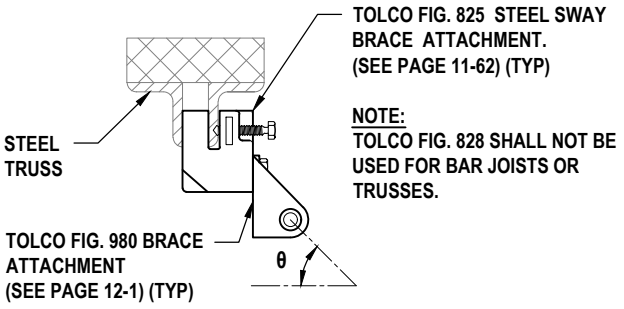
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

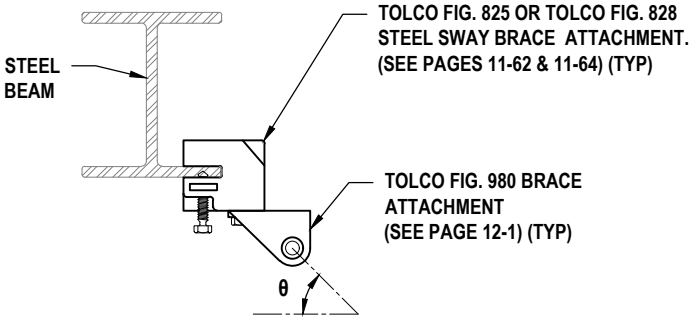
PAGE: 5-28

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.25 "G"





Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1	40	40
20	1	40	40
30	1	40	40
40	1	40	40
50	1	40	33
60	1	40	27
70	1	40	23
80	2[3][4]	40	40
90	2[3][4]	40	37
100	2[3][4]	40	33
125	2[3][4]	40	26
150	2[3][4]	40	22
175	2[3][4]	40	19
200	2[3][4]	36	16

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	2[3]	80	80
20	2[3]	80	80
30	2[3]	80	80
40	2[3]	80	80
50	2[3]	80	66
60	2[3]	80	54
70	2[3]	80	46
80	4[3][4]	80	80
90	4[3][4]	80	74
100	4[3][4]	80	66
125	4[3][4]	80	52
150	4[3][4]	80	44
175	4[3][4]	80	38
200	4[3][4]	72	32

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCH. 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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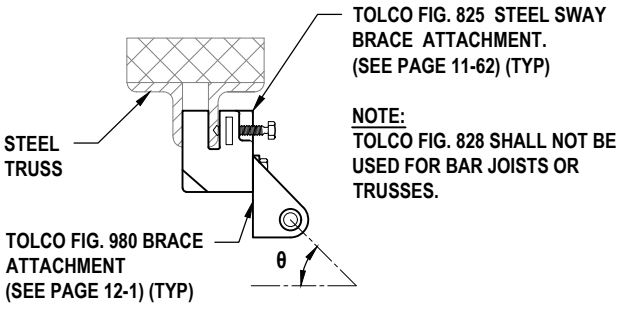
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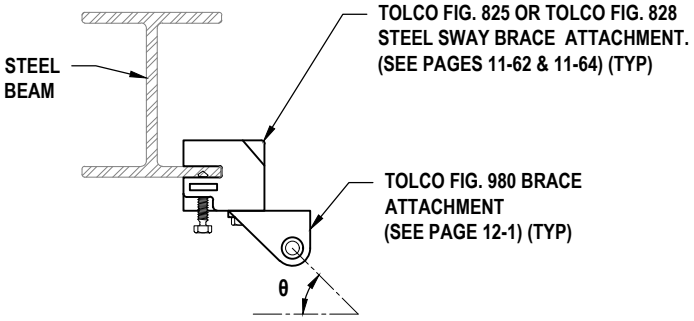
PAGE: 5-29

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.50 "G"





Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1	40	40
20	1	40	40
30	1	40	27
40	1	40	20
50	2[3][4]	40	33
60	2[3][4]	40	27
70	2[3][4]	40	23
80	2[3][4]	40	20
90	2[3][4]	40	18
100	2[3][4]	36	16
125	2[3][4]	28	13
150	2[3][4]	24	11
175	2[3][4]	20	9
200	2[3]	18	8

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	2[3]	80	80
20	2[3]	80	80
30	2[3]	80	54
40	2[3]	80	40
50	4[3][4]	80	66
60	4[3][4]	80	54
70	4[3][4]	80	46
80	4[3][4]	80	40
90	4[3][4]	80	36
100	4[3][4]	72	32
125	4[3][4]	56	26
150	4[3][4]	48	22
175	4[3][4]	40	18
200	4[3][4]	36	16

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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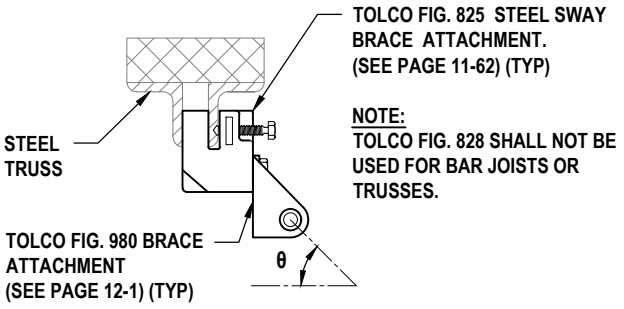
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California SE No. S3545

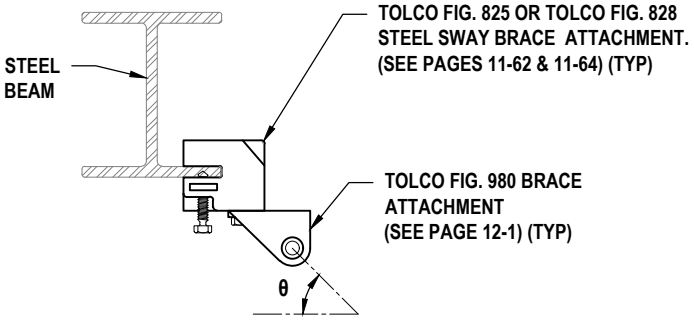
PAGE: 5-30

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.75 "G"





Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1	40	40
20	1	40	27
30	2[3][4]	40	37
40	2[3][4]	40	27
50	2[3][4]	40	22
60	2[3][4]	40	18
70	2[3][4]	34	15
80	2[3][4]	30	13
90	2[3][4]	26	12
100	2[3][4]	24	11
125	2[3]	19	8
150	2[3]	16	7
175	2[3]	13	6
200	2[3]	12	5

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	2[3]	80	80
20	2[3]	80	54
30	4[3][4]	80	74
40	4[3][4]	80	54
50	4[3][4]	80	44
60	4[3][4]	80	36
70	4[3][4]	68	30
80	4[3][4]	60	26
90	4[3][4]	52	24
100	4[3][4]	48	22
125	4[3][4]	38	16
150	4[3][4]	32	14
175	4[3][4]	26	12
200	4[3][4]	24	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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NOTES:

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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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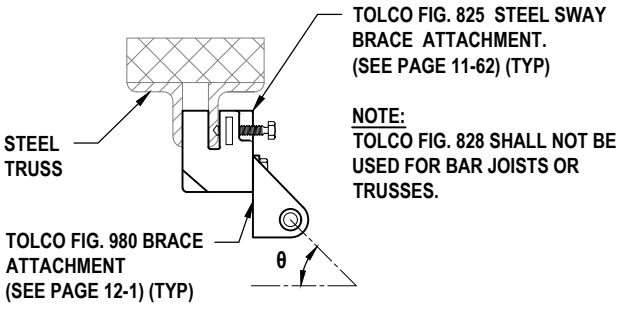
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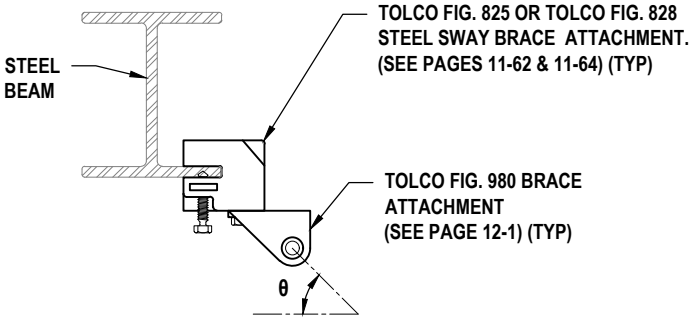
PAGE: **5-31**

DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

1.0 "G"





Max. Trapeze Weight Per Ft.	Brace Qty.	Transverse[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1	40	40
20	1	40	20
30	2[3][4]	40	27
40	2[3][4]	40	20
50	2[3][4]	36	16
60	2[3][4]	30	13
70	2[3][4]	25	11
80	2[3][4]	22	10
90	2[3][4]	20	9
100	2[3]	18	8
125	2[3]	14	6
150	2[3]	12	5
175	2[3]	10	4
200	2[3]	9	4

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.
3. DOUBLE BRACING IS REQUIRED.
4. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Brace Qty.	Longitudinal[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	2[3]	80	80
20	2[3]	80	40
30	4[3][4]	80	54
40	4[3][4]	80	40
50	4[3][4]	72	32
60	4[3][4]	60	26
70	4[3][4]	50	22
80	4[3][4]	44	20
90	4[3][4]	40	18
100	4[3][4]	36	16
125	4[3][4]	28	12
150	4[3][4]	24	10
175	4[3][4]	20	8
200	4[3]	18	8

FOOTNOTES:

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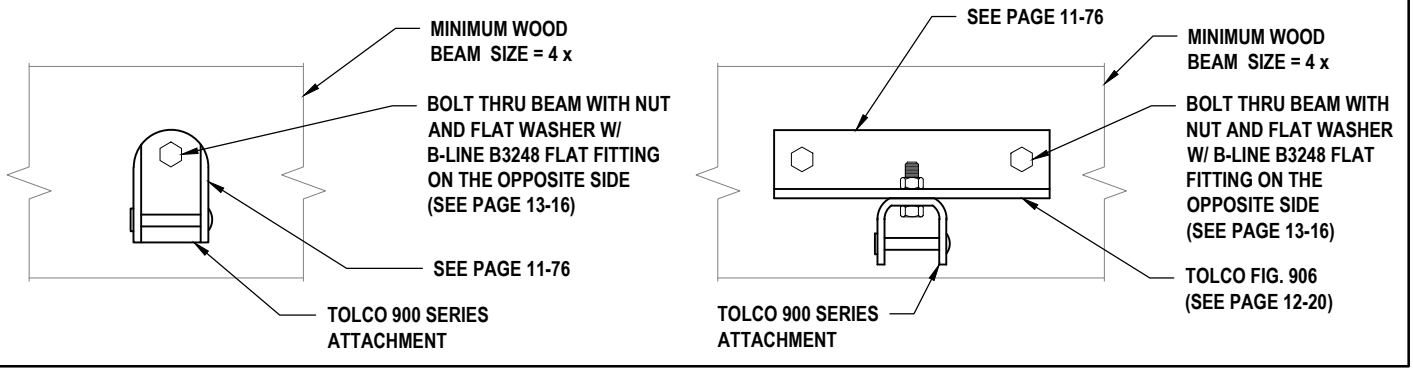
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-32

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	1	1	1/2"
30	40	1	1	1/2"
40	40	1	1	1/2"
50	40	1	2	1/2"
60	40	1	2	1/2"
70	40	1	2	1/2"
80	38	1	2	1/2"
90	34	1	2	1/2"
100	30	1	2	1/2"
125	24	1	2	1/2"
150	40	2[(2)(3)]	2	1/2"
175	35	2[(2)(3)]	2	1/2"
200	30	2[(2)(3)]	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2[(2)]	1	1/2"
20	80	2[(2)]	1	1/2"
30	80	2[(2)]	1	1/2"
40	80	2[(2)]	1	1/2"
50	80	2[(2)]	2	1/2"
60	80	2[(2)]	2	1/2"
70	80	2[(2)]	2	1/2"
80	76	2[(2)]	2	1/2"
90	68	2[(2)]	2	1/2"
100	60	2[(2)]	2	1/2"
125	48	2[(2)]	2	1/2"
150	80	4[(2)(3)]	2	1/2"
175	70	4[(2)(3)]	2	1/2"
200	60	4[(2)(3)]	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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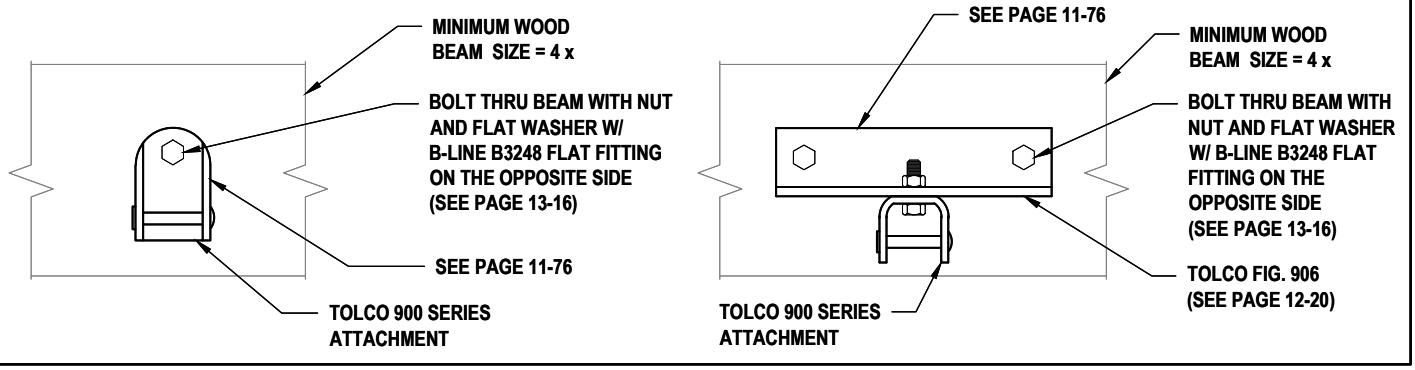
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-33

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	1	1	1/2"
30	40	1	2	1/2"
40	40	2(2)(3)	2	1/2"
50	40	2(2)(3)	2	1/2"
60	40	2(2)(3)	2	1/2"
70	40	2(2)(3)	2	1/2"
80	38	2(2)(3)	2	1/2"
90	34	2(2)(3)	2	1/2"
100	30	2(2)(3)	2	1/2"
125	24	2(2)(3)	2	1/2"
150	20	2(2)(3)	2	1/2"
175	17	2(2)	2	1/2"
200	15	2(2)	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2(2)	1	1/2"
20	80	2(2)	1	1/2"
30	80	2(2)	2	1/2"
40	80	4(2)(3)	2	1/2"
50	80	4(2)(3)	2	1/2"
60	80	4(2)(3)	2	1/2"
70	80	4(2)(3)	2	1/2"
80	76	4(2)(3)	2	1/2"
90	68	4(2)(3)	2	1/2"
100	60	4(2)(3)	2	1/2"
125	48	4(2)(3)	2	1/2"
150	40	4(2)(3)	2	1/2"
175	34	4(2)(3)	2	1/2"
200	30	4(2)(3)	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE
ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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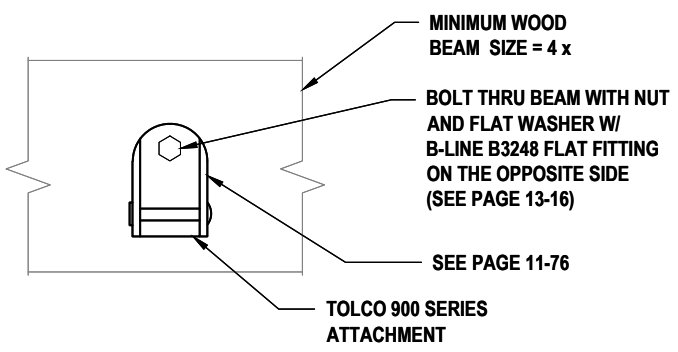
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

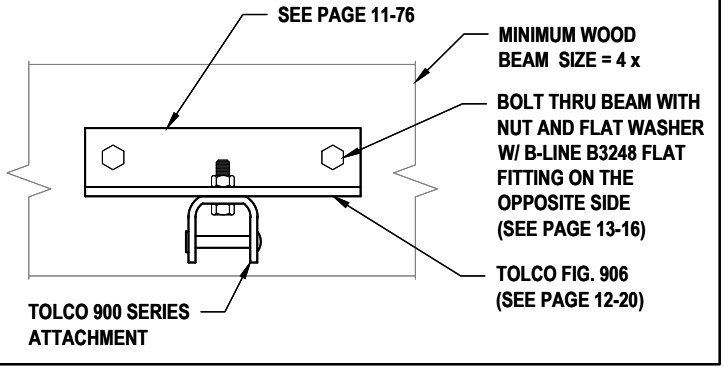
PAGE: 5-34

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	1	2	1/2"
30	40	2(2)(3)	1	3/4"
40	40	2(2)(3)	2	1/2"
50	40	2(2)(3)	2	1/2"
60	34	2(2)(3)	2	1/2"
70	29	2(2)(3)	2	1/2"
80	25	2(2)(3)	2	1/2"
90	22	2(2)(3)	2	1/2"
100	20	2(2)(3)	2	1/2"
125	16	2(2)	2	1/2"
150	13	2(2)	2	1/2"
175	11	2(2)	2	1/2"
200	10	2(2)	2	1/2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2(2)	1	1/2"
20	80	2(2)	2	1/2"
30	80	4(2)(3)	1	3/4"
40	80	4(2)(3)	2	1/2"
50	80	4(2)(3)	2	1/2"
60	68	4(2)(3)	2	1/2"
70	58	4(2)(3)	2	1/2"
80	50	4(2)(3)	2	1/2"
90	44	4(2)(3)	2	1/2"
100	40	4(2)(3)	2	1/2"
125	32	4(2)(3)	2	1/2"
150	26	4(2)(3)	2	1/2"
175	22	4(2)(3)	2	1/2"
200	20	4(2)(3)	2	1/2"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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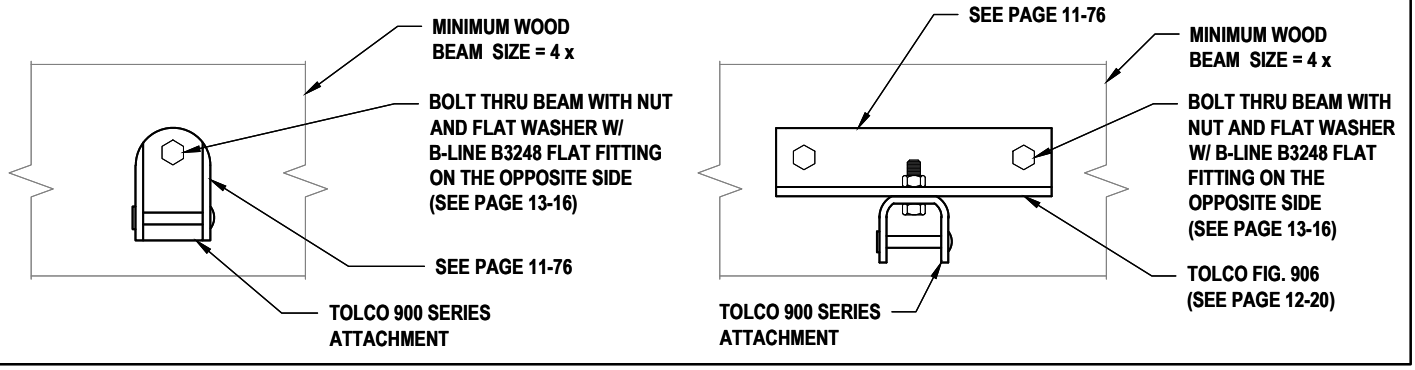
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-35

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	2[2][3]	1	1/2"
30	40	2[2][3]	2	1/2"
40	38	2[2][3]	2	1/2"
50	30	2[2][3]	2	1/2"
60	25	2[2][3]	2	1/2"
70	22	2[2][3]	2	1/2"
80	19	2[2]	2	1/2"
90	17	2[2]	2	1/2"
100	15	2[2]	2	1/2"
125	12	2[2]	2	1/2"
150	10	2[2]	2	1/2"
175	8	2[2]	2	1/2"
200	7	2[2]	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2[2]	1	1/2"
20	80	4[2][3]	1	1/2"
30	80	4[2][3]	2	1/2"
40	76	4[2][3]	2	1/2"
50	60	4[2][3]	2	1/2"
60	50	4[2][3]	2	1/2"
70	44	4[2][3]	2	1/2"
80	38	4[2][3]	2	1/2"
90	34	4[2][3]	2	1/2"
100	30	4[2][3]	2	1/2"
125	24	4[2][3]	2	1/2"
150	20	4[2][3]	2	1/2"
175	16	4[2]	2	1/2"
200	14	4[2]	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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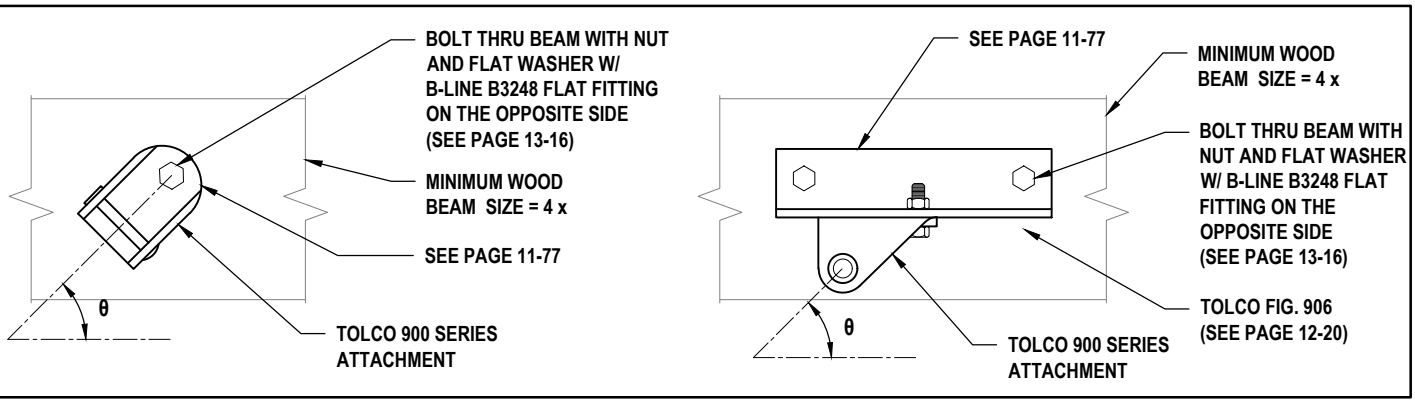
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-36

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	1	1	1/2"
30	40	1	1	3/4"
40	40	1	2	1/2"
50	40	1	2	1/2"
60	40	1	2	1/2"
70	40	1	2	5/8"
80	40	2[(2)(3)]	2	1/2"
90	40	2[(2)(3)]	2	1/2"
100	40	2[(2)(3)]	2	1/2"
125	40	2[(2)(3)]	2	1/2"
150	40	2[(2)(3)]	2	3/4"
175	34	2[(2)(3)]	2	3/4"
200	30	2[(2)(3)]	2	3/4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2[(2)]	1	1/2"
20	80	2[(2)]	1	1/2"
30	80	2[(2)]	1	3/4"
40	80	2[(2)]	2	1/2"
50	80	2[(2)]	2	1/2"
60	80	2[(2)]	2	1/2"
70	80	2[(2)]	2	5/8"
80	80	4[(2)(3)]	2	1/2"
90	80	4[(2)(3)]	2	1/2"
100	80	4[(2)(3)]	2	1/2"
125	80	4[(2)(3)]	2	1/2"
150	80	4[(2)(3)]	2	3/4"
175	68	4[(2)(3)]	2	3/4"
200	60	4[(2)(3)]	2	3/4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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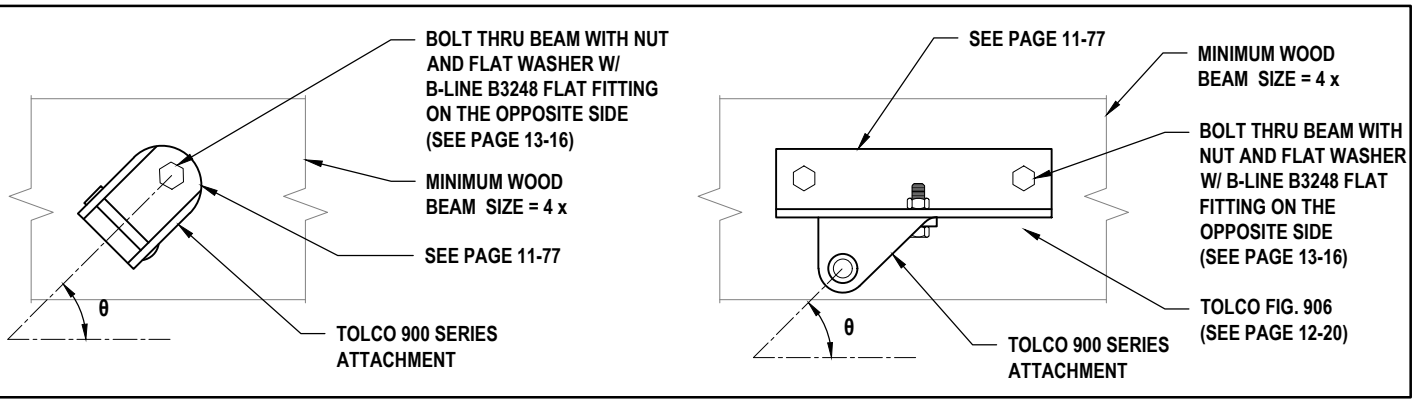
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-37

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	1/2"
20	40	1	2	1/2"
30	40	1	2	1/2"
40	40	2[(2)(3)]	2	1/2"
50	40	2[(2)(3)]	2	1/2"
60	40	2[(2)(3)]	2	1/2"
70	40	2[(2)(3)]	2	5/8"
80	37	2[(2)(3)]	2	3/4"
90	33	2[(2)(3)]	2	3/4"
100	30	2[(2)(3)]	2	3/4"
125	24	2[(2)(3)]	2	3/4"
150	20	2[(2)(3)]	2	3/4"
175	17	2[(2)]	2	3/4"
200	15	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2[(2)]	1	1/2"
20	80	2[(2)]	2	1/2"
30	80	2[(2)]	2	1/2"
40	80	4[(2)(3)]	2	1/2"
50	80	4[(2)(3)]	2	1/2"
60	80	4[(2)(3)]	2	1/2"
70	80	4[(2)(3)]	2	5/8"
80	74	4[(2)(3)]	2	3/4"
90	66	4[(2)(3)]	2	3/4"
100	60	4[(2)(3)]	2	3/4"
125	48	4[(2)(3)]	2	3/4"
150	40	4[(2)(3)]	2	3/4"
175	34	4[(2)(3)]	2	3/4"
200	30	4[(2)(3)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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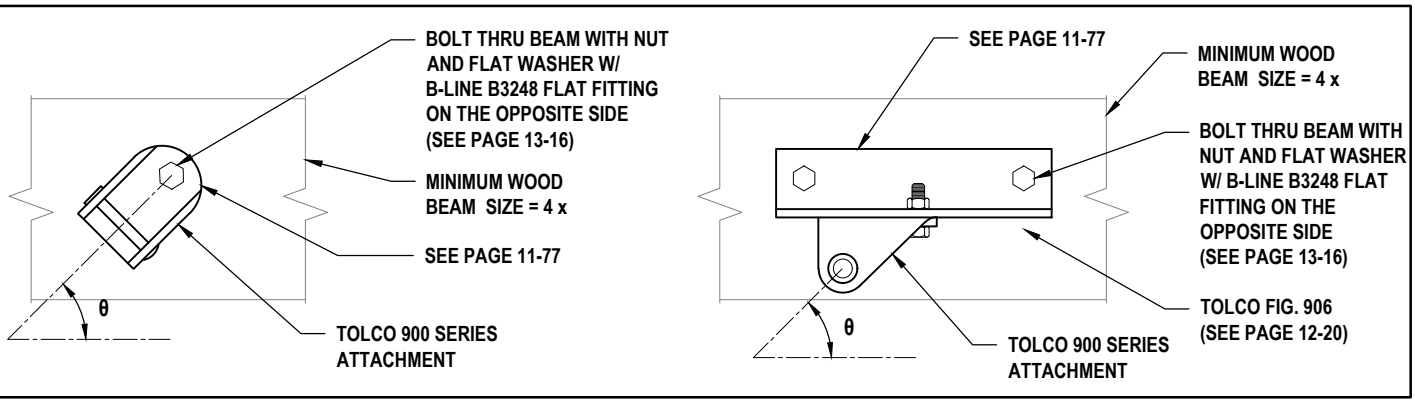
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-38

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	1	3/4"
20	40	1	2	1/2"
30	40	2(2)(3)	2	1/2"
40	40	2(2)(3)	2	1/2"
50	40	2(2)(3)	2	3/4"
60	33	2(2)(3)	2	3/4"
70	28	2(2)(3)	2	3/4"
80	25	2(2)(3)	2	3/4"
90	22	2(2)(3)	2	3/4"
100	20	2(2)(3)	2	3/4"
125	16	2(2)	2	3/4"
150	13	2(2)	2	3/4"
175	11	2(2)	2	3/4"
200	10	2(2)	2	3/4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2(2)	1	3/4"
20	80	2(2)	2	1/2"
30	80	4(2)(3)	2	1/2"
40	80	4(2)(3)	2	1/2"
50	80	4(2)(3)	2	3/4"
60	66	4(2)(3)	2	3/4"
70	56	4(2)(3)	2	3/4"
80	50	4(2)(3)	2	3/4"
90	44	4(2)(3)	2	3/4"
100	40	4(2)(3)	2	3/4"
125	32	4(2)(3)	2	3/4"
150	26	4(2)(3)	2	3/4"
175	22	4(2)(3)	2	3/4"
200	20	4(2)(3)	2	3/4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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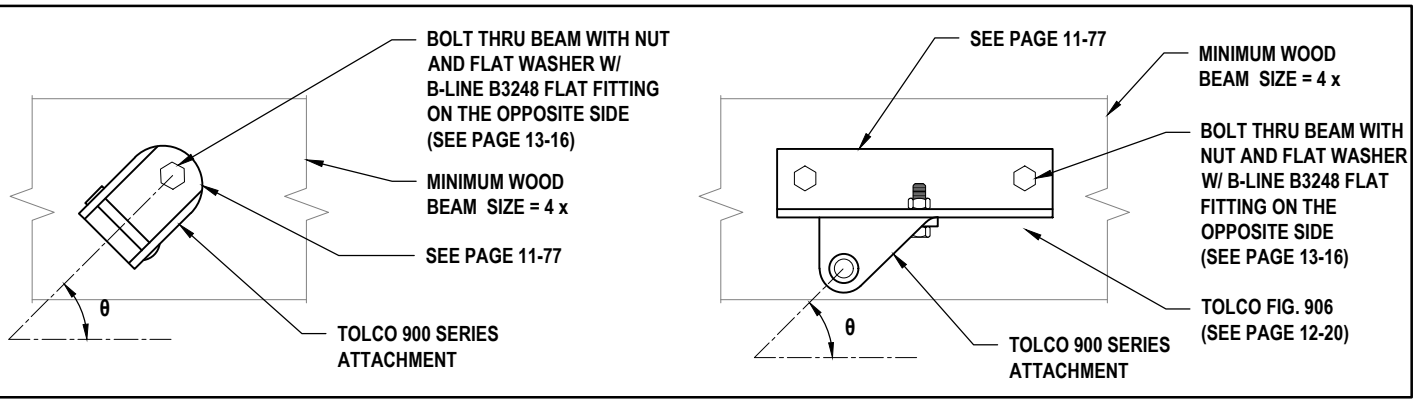
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-39

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1	2	1/2"
20	40	2[(2)(3)]	2	1/2"
30	40	2[(2)(3)]	2	1/2"
40	37	2[(2)(3)]	2	3/4"
50	30	2[(2)(3)]	2	3/4"
60	25	2[(2)(3)]	2	3/4"
70	21	2[(2)(3)]	2	3/4"
80	18	2[(2)]	2	3/4"
90	16	2[(2)]	2	3/4"
100	15	2[(2)]	2	3/4"
125	12	2[(2)]	2	3/4"
150	10	2[(2)]	2	3/4"
175	8	2[(2)]	2	3/4"
200	7	2[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	2[(2)]	2	1/2"
20	80	4[(2)(3)]	2	1/2"
30	80	4[(2)(3)]	2	1/2"
40	74	4[(2)(3)]	2	3/4"
50	60	4[(2)(3)]	2	3/4"
60	50	4[(2)(3)]	2	3/4"
70	42	4[(2)(3)]	2	3/4"
80	36	4[(2)(3)]	2	3/4"
90	32	4[(2)(3)]	2	3/4"
100	30	4[(2)(3)]	2	3/4"
125	24	4[(2)(3)]	2	3/4"
150	20	4[(2)(3)]	2	3/4"
175	16	4[(2)]	2	3/4"
200	14	4[(2)]	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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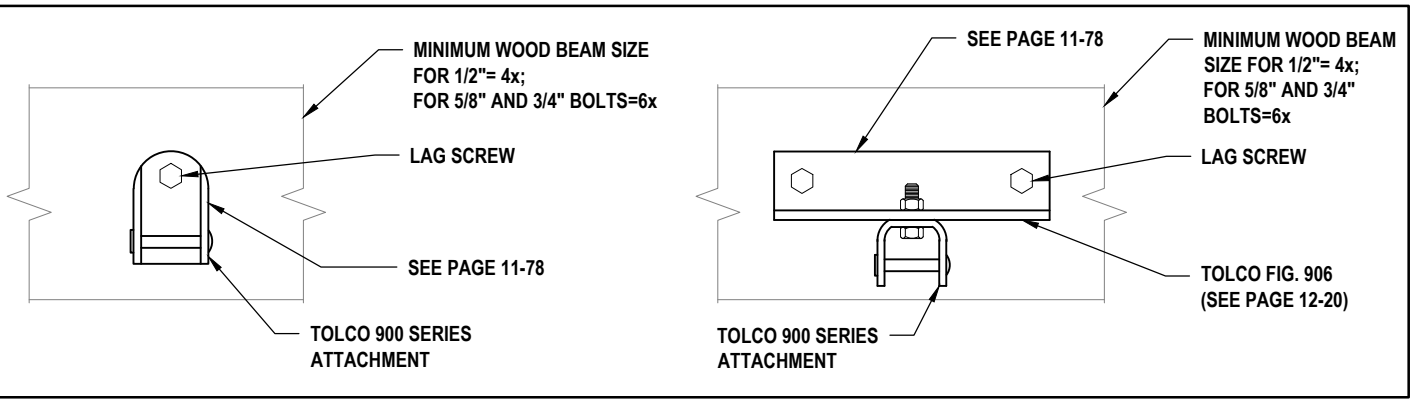
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-40

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	1	1/2"	3"
20	40	1	1	5/8"	4"
30	40	1	2	1/2"	3"
40	40	1	2	5/8"	4"
50	40	2[(2)(3)]	2	1/2"	3"
60	40	2[(2)(3)]	2	1/2"	3"
70	40	2[(2)(3)]	2	5/8"	4"
80	40	2[(2)(3)]	2	5/8"	4"
90	37	2[(2)(3)]	2	3/4"	5"
100	33	2[(2)(3)]	2	3/4"	5"
125	26	2[(2)(3)]	2	3/4"	5"
150	22	2[(2)(3)]	2	3/4"	5"
175	19	2[(2)]	2	3/4"	5"
200	16	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2[(2)]	1	1/2"	3"
20	80	2[(2)]	1	5/8"	4"
30	80	2[(2)]	2	1/2"	3"
40	80	2[(2)]	2	5/8"	4"
50	80	4[(2)(3)]	2	1/2"	3"
60	80	4[(2)(3)]	2	1/2"	3"
70	80	4[(2)(3)]	2	5/8"	4"
80	80	4[(2)(3)]	2	5/8"	4"
90	74	4[(2)(3)]	2	3/4"	5"
100	66	4[(2)(3)]	2	3/4"	5"
125	52	4[(2)(3)]	2	3/4"	5"
150	44	4[(2)(3)]	2	3/4"	5"
175	38	4[(2)(3)]	2	3/4"	5"
200	32	4[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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BY: Roy Lobo
DATE: 04/24/2025
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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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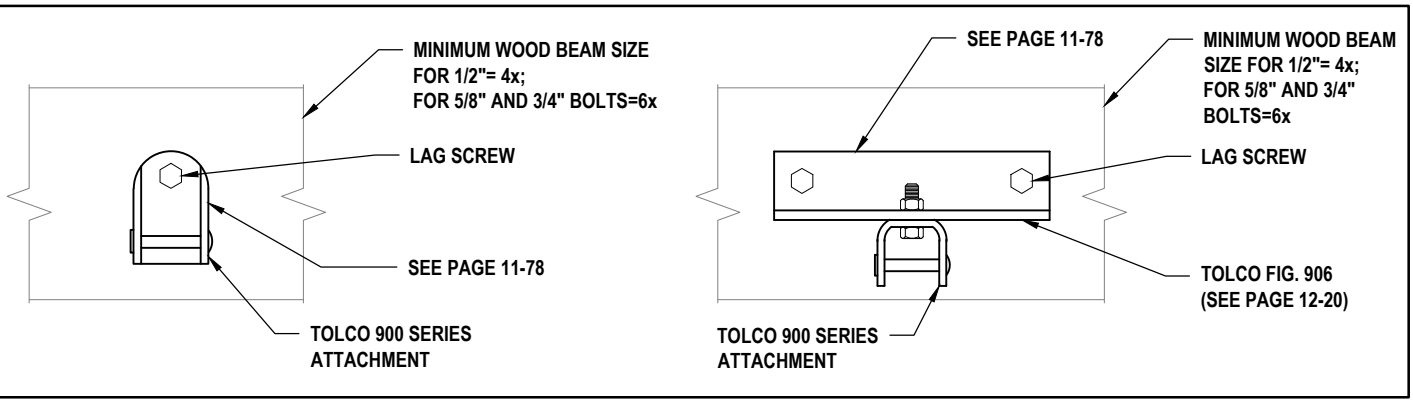
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-41

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	1	5/8"	4"
20	40	1	2	5/8"	4"
30	40	2[(2)(3)]	2	1/2"	3"
40	40	2[(2)(3)]	2	5/8"	4"
50	33	2[(2)(3)]	2	3/4"	5"
60	28	2[(2)(3)]	2	3/4"	5"
70	24	2[(2)(3)]	2	3/4"	5"
80	21	2[(2)(3)]	2	3/4"	5"
90	18	2[(2)]	2	3/4"	5"
100	16	2[(2)]	2	3/4"	5"
125	13	2[(2)]	2	3/4"	5"
150	11	2[(2)]	2	3/4"	5"
175	9	2[(2)]	2	3/4"	5"
200	8	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2[(2)]	1	5/8"	4"
20	80	2[(2)]	2	5/8"	4"
30	80	4[(2)(3)]	2	1/2"	3"
40	80	4[(2)(3)]	2	5/8"	4"
50	66	4[(2)(3)]	2	3/4"	5"
60	56	4[(2)(3)]	2	3/4"	5"
70	48	4[(2)(3)]	2	3/4"	5"
80	42	4[(2)(3)]	2	3/4"	5"
90	36	4[(2)(3)]	2	3/4"	5"
100	32	4[(2)(3)]	2	3/4"	5"
125	26	4[(2)(3)]	2	3/4"	5"
150	22	4[(2)(3)]	2	3/4"	5"
175	19	4[(2)]	2	3/4"	5"
200	16	4[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
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REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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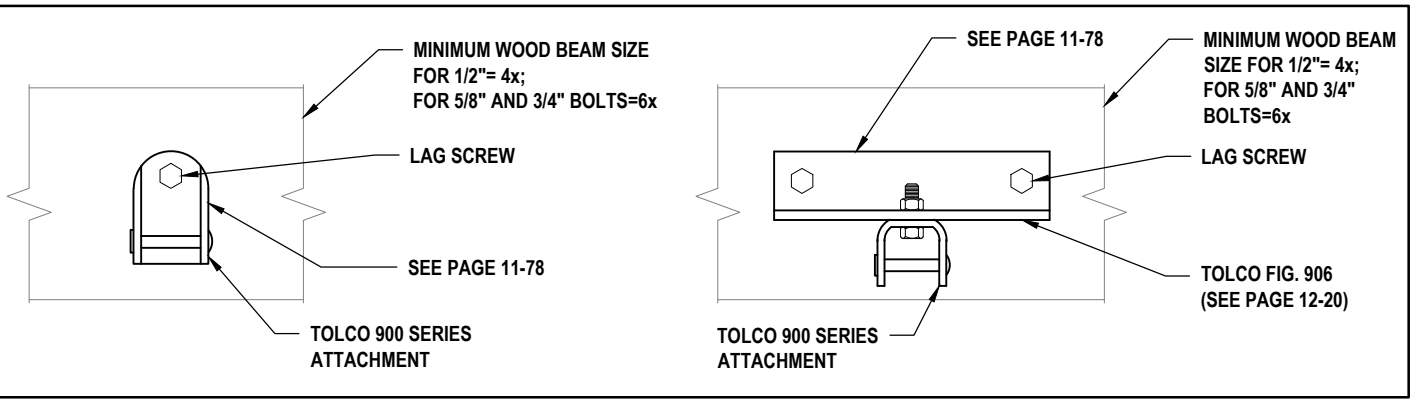
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-42

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	2	1/2"	3"
20	40	2[(2)(3)]	2	1/2"	3"
30	37	2[(2)(3)]	2	3/4"	5"
40	28	2[(2)(3)]	2	3/4"	5"
50	22	2[(2)(3)]	2	3/4"	5"
60	18	2[(2)]	2	3/4"	5"
70	16	2[(2)]	2	3/4"	5"
80	14	2[(2)]	2	3/4"	5"
90	12	2[(2)]	2	3/4"	5"
100	11	2[(2)]	2	3/4"	5"
125	8	2[(2)]	2	3/4"	5"
150	7	2[(2)]	2	3/4"	5"
175	6	2[(2)]	2	3/4"	5"
200	5	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2[(2)]	2	1/2"	3"
20	80	4[(2)(3)]	2	1/2"	3"
30	74	4[(2)(3)]	2	3/4"	5"
40	56	4[(2)(3)]	2	3/4"	5"
50	44	4[(2)(3)]	2	3/4"	5"
60	36	4[(2)(3)]	2	3/4"	5"
70	32	4[(2)(3)]	2	3/4"	5"
80	28	4[(2)(3)]	2	3/4"	5"
90	24	4[(2)(3)]	2	3/4"	5"
100	22	4[(2)(3)]	2	3/4"	5"
125	16	4[(2)]	2	3/4"	5"
150	14	4[(2)]	2	3/4"	5"
175	12	4[(2)]	2	3/4"	5"
200	10	4[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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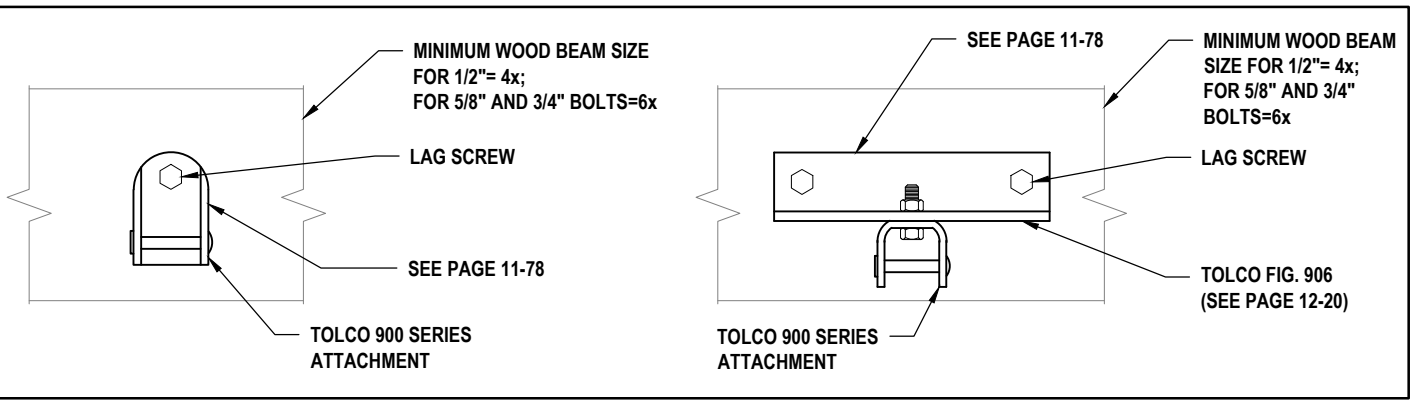
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-43

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1	2	3/4"	5"
20	40	2[(2)(3)]	2	3/4"	5"
30	28	2[(2)(3)]	2	3/4"	5"
40	21	2[(2)(3)]	2	3/4"	5"
50	16	2[(2)]	2	3/4"	5"
60	14	2[(2)]	2	3/4"	5"
70	12	2[(2)]	2	3/4"	5"
80	10	2[(2)]	2	3/4"	5"
90	9	2[(2)]	2	3/4"	5"
100	8	2[(2)]	2	3/4"	5"
125	6	2[(2)]	2	3/4"	5"
150	5	2[(2)]	2	3/4"	5"
175	4	2[(2)]	2	3/4"	5"
200	4	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	2[(2)]	2	3/4"	5"
20	80	4[(2)(3)]	2	3/4"	5"
30	56	4[(2)(3)]	2	3/4"	5"
40	42	4[(2)(3)]	2	3/4"	5"
50	32	4[(2)(3)]	2	3/4"	5"
60	28	4[(2)(3)]	2	3/4"	5"
70	24	4[(2)(3)]	2	3/4"	5"
80	20	4[(2)(3)]	2	3/4"	5"
90	18	4[(2)]	2	3/4"	5"
100	16	4[(2)]	2	3/4"	5"
125	12	4[(2)]	2	3/4"	5"
150	10	4[(2)]	2	3/4"	5"
175	8	4[(2)]	2	3/4"	5"
200	8	4[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

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2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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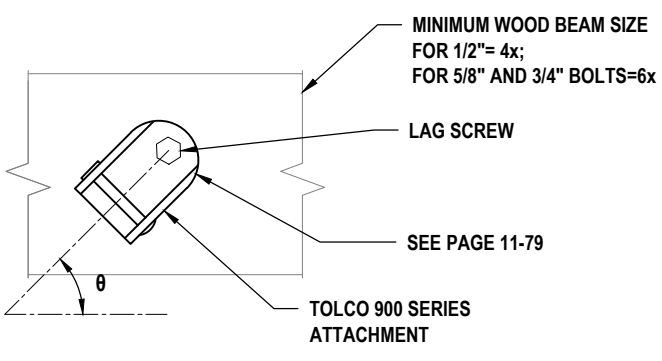
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

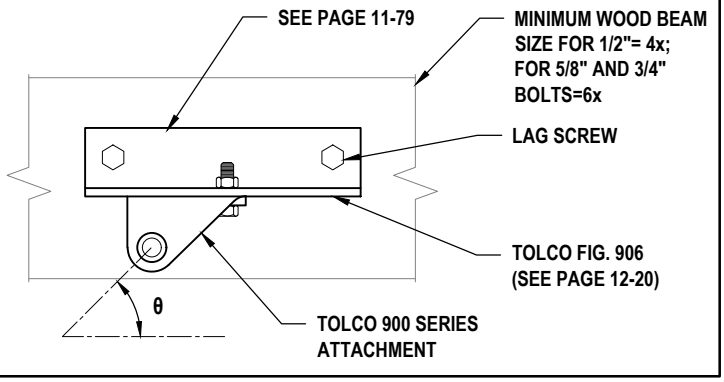
PAGE: 5-44

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	1	1/2"	3"
20	40	1	1	3/4"	5"
30	40	1	2	5/8"	4"
40	40	1	2	3/4"	5"
50	40	2[(2)(3)]	2	1/2"	3"
60	40	2[(2)(3)]	2	5/8"	4"
70	40	2[(2)(3)]	2	5/8"	4"
80	40	2[(2)(3)]	2	3/4"	5"
90	36	2[(2)(3)]	2	3/4"	5"
100	32	2[(2)(3)]	2	3/4"	5"
125	26	2[(2)(3)]	2	3/4"	5"
150	21	2[(2)(3)]	2	3/4"	5"
175	18	2[(2)]	2	3/4"	5"
200	16	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2[(2)]	1	1/2"	3"
20	80	2[(2)]	1	3/4"	5"
30	80	2[(2)]	2	5/8"	4"
40	80	2[(2)]	2	3/4"	5"
50	80	4[(2)(3)]	2	1/2"	3"
60	80	4[(2)(3)]	2	5/8"	4"
70	80	4[(2)(3)]	2	5/8"	4"
80	80	4[(2)(3)]	2	3/4"	5"
90	72	4[(2)(3)]	2	3/4"	5"
100	64	4[(2)(3)]	2	3/4"	5"
125	52	4[(2)(3)]	2	3/4"	5"
150	42	4[(2)(3)]	2	3/4"	5"
175	36	4[(2)(3)]	2	3/4"	5"
200	32	4[(2)(3)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
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3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING STANDARDS

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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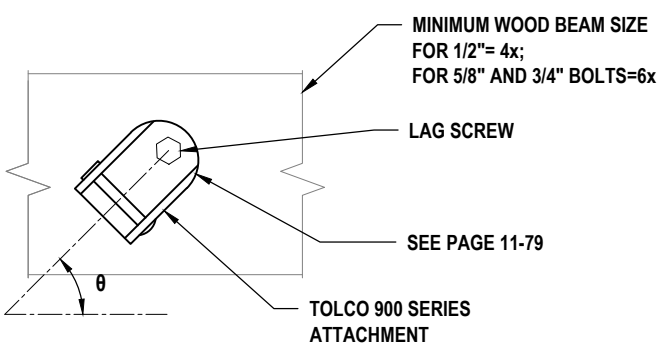
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

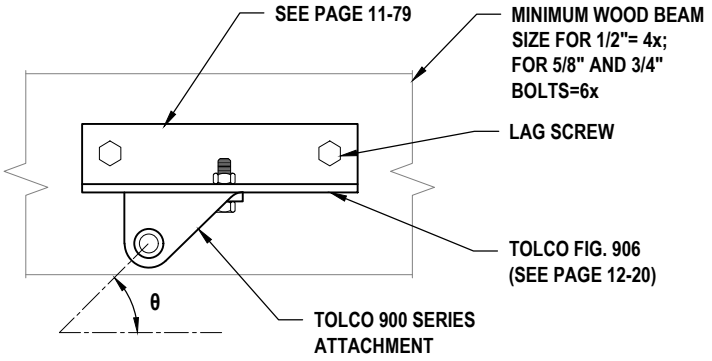
PAGE: 5-45

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	1	3/4"	5"
20	40	1	2	3/4"	5"
30	40	2[(2)(3)]	2	5/8"	4"
40	40	2[(2)(3)]	2	3/4"	5"
50	32	2[(2)(3)]	2	3/4"	5"
60	27	2[(2)(3)]	2	3/4"	5"
70	23	2[(2)(3)]	2	3/4"	5"
80	20	2[(2)(3)]	2	3/4"	5"
90	18	2[(2)]	2	3/4"	5"
100	16	2[(2)]	2	3/4"	5"
125	13	2[(2)]	2	3/4"	5"
150	10	2[(2)]	2	3/4"	5"
175	9	2[(2)]	2	3/4"	5"
200	8	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2[(2)]	1	3/4"	5"
20	80	2[(2)]	2	3/4"	5"
30	80	4[(2)(3)]	2	5/8"	4"
40	80	4[(2)(3)]	2	3/4"	5"
50	64	4[(2)(3)]	2	3/4"	5"
60	54	4[(2)(3)]	2	3/4"	5"
70	46	4[(2)(3)]	2	3/4"	5"
80	40	4[(2)(3)]	2	3/4"	5"
90	36	4[(2)(3)]	2	3/4"	5"
100	32	4[(2)(3)]	2	3/4"	5"
125	26	4[(2)(3)]	2	3/4"	5"
150	20	4[(2)(3)]	2	3/4"	5"
175	18	4[(2)]	2	3/4"	5"
200	16	4[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING STANDARDS

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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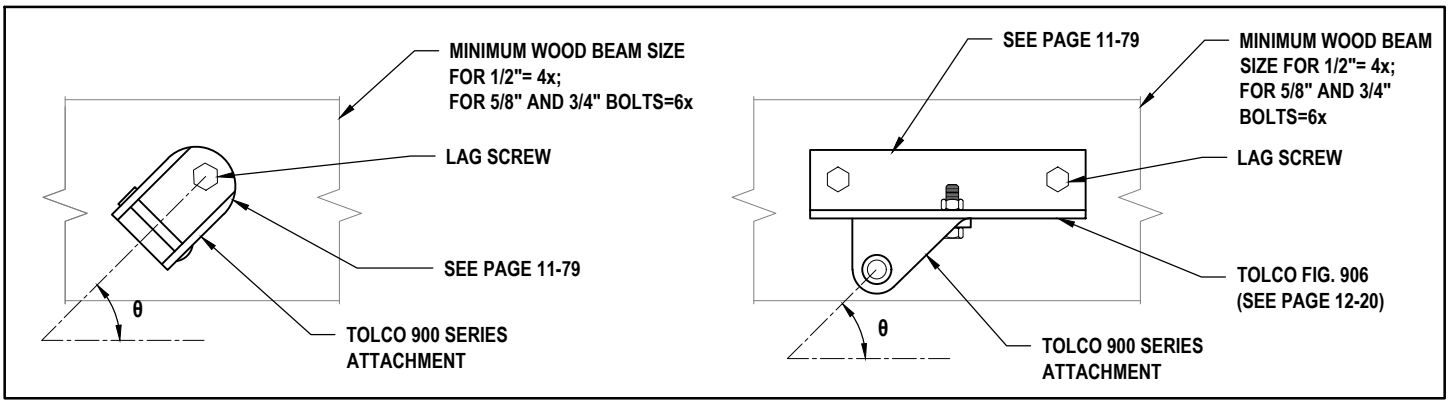
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 5-46

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	40	1	2	5/8"	4"
20	40	2(2)(3)	2	5/8"	4"
30	36	2(2)(3)	2	3/4"	5"
40	27	2(2)(3)	2	3/4"	5"
50	21	2(2)(3)	2	3/4"	5"
60	18	2(2)	2	3/4"	5"
70	15	2(2)	2	3/4"	5"
80	13	2(2)	2	3/4"	5"
90	12	2(2)	2	3/4"	5"
100	10	2(2)	2	3/4"	5"
125	8	2(2)	2	3/4"	5"
150	7	2(2)	2	3/4"	5"
175	6	2(2)	2	3/4"	5"
200	5	2(2)	2	3/4"	5"

FOOTNOTES:

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2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Brace Qty.	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
10	80	2(2)	2	5/8"	4"
20	80	4(2)(3)	2	5/8"	4"
30	72	4(2)(3)	2	3/4"	5"
40	54	4(2)(3)	2	3/4"	5"
50	42	4(2)(3)	2	3/4"	5"
60	36	4(2)(3)	2	3/4"	5"
70	30	4(2)(3)	2	3/4"	5"
80	26	4(2)(3)	2	3/4"	5"
90	24	4(2)(3)	2	3/4"	5"
100	20	4(2)(3)	2	3/4"	5"
125	16	4(2)	2	3/4"	5"
150	14	4(2)	2	3/4"	5"
175	12	4(2)	2	3/4"	5"
200	10	4(2)	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING STANDARDS

NOTES:

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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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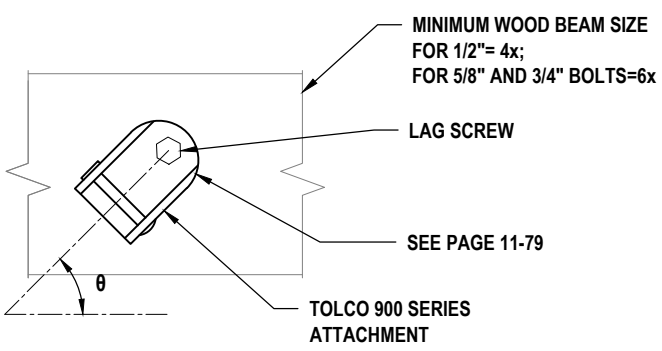
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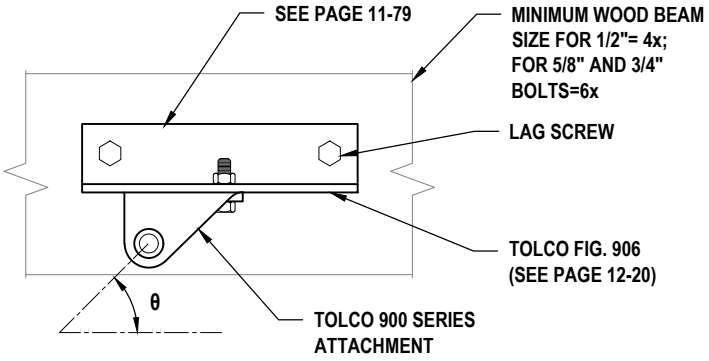
PAGE: 5-47

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1	2	3/4"	5"
20	40	2[(2)(3)]	2	3/4"	5"
30	27	2[(2)(3)]	2	3/4"	5"
40	20	2[(2)(3)]	2	3/4"	5"
50	16	2[(2)]	2	3/4"	5"
60	13	2[(2)]	2	3/4"	5"
70	11	2[(2)]	2	3/4"	5"
80	10	2[(2)]	2	3/4"	5"
90	9	2[(2)]	2	3/4"	5"
100	8	2[(2)]	2	3/4"	5"
125	6	2[(2)]	2	3/4"	5"
150	5	2[(2)]	2	3/4"	5"
175	4	2[(2)]	2	3/4"	5"
200	4	2[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Brace Qty.	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	2[(2)]	2	3/4"	5"
20	80	4[(2)(3)]	2	3/4"	5"
30	54	4[(2)(3)]	2	3/4"	5"
40	40	4[(2)(3)]	2	3/4"	5"
50	32	4[(2)(3)]	2	3/4"	5"
60	26	4[(2)(3)]	2	3/4"	5"
70	22	4[(2)(3)]	2	3/4"	5"
80	20	4[(2)(3)]	2	3/4"	5"
90	18	4[(2)]	2	3/4"	5"
100	16	4[(2)]	2	3/4"	5"
125	12	4[(2)]	2	3/4"	5"
150	10	4[(2)]	2	3/4"	5"
175	8	4[(2)]	2	3/4"	5"
200	8	4[(2)]	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.
2. DOUBLE BRACING IS REQUIRED.
3. HALF THE NUMBER OF BRACES MAY BE USED AT HALF THE SPACING LISTED.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, INTERMEDIATE METAL CONDUIT (IMC), RIGID METAL CONDUIT (RMC), OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 4 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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SECTION 6

SINGLE HANGER CABLE BRACE DETAILS

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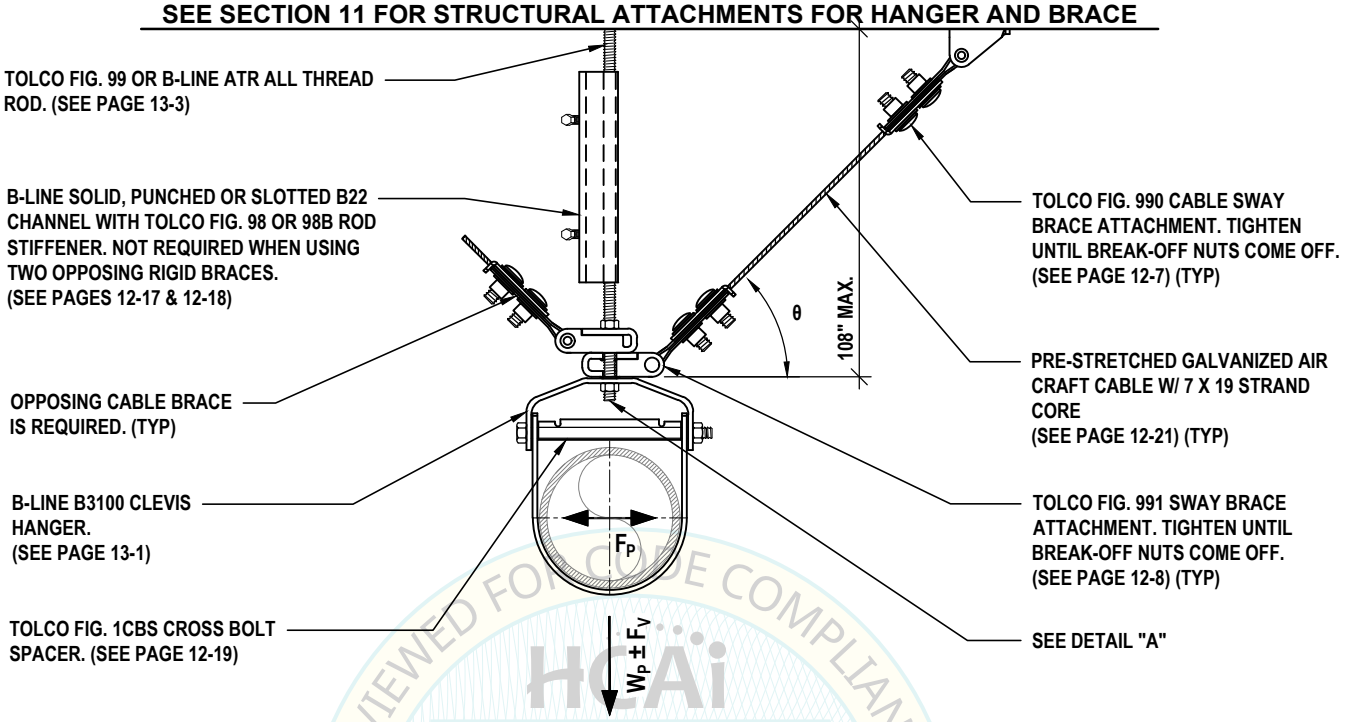
PAGE: 6-0

DATE: April 23, 2025

TRANSVERSE CABLE BRACING FOR SINGLE HUNG PIPE OR CONDUIT WITH CLEVIS HANGER

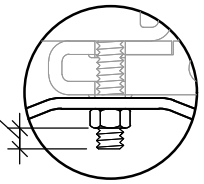
DETAIL
SC-1

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



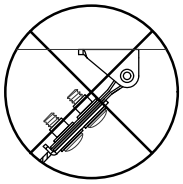
1 1/4" - 3" PIPE

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DETAIL A

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	1/8"	93	97	96
2 1/2" - 3"	1/2"	1/8"	111	109	107



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. PIPES WITH INSULATION SHALL NOT BE USED.

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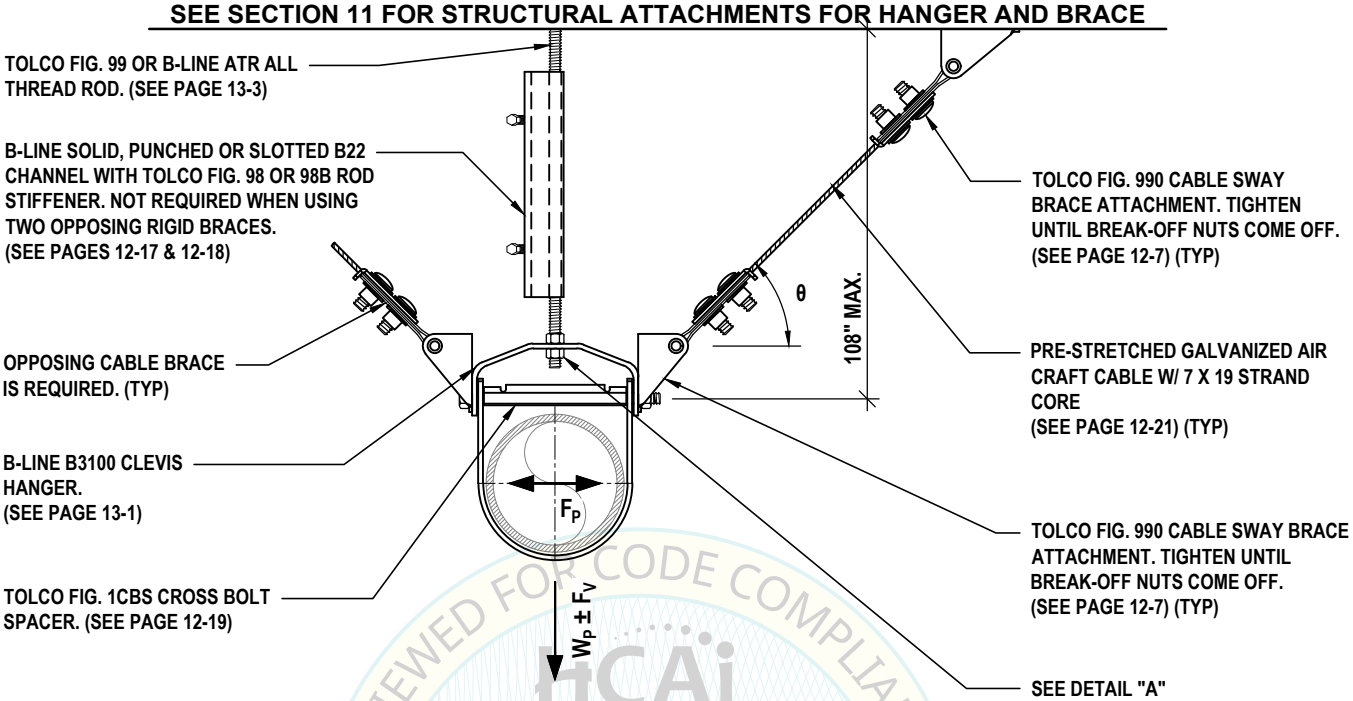
PAGE: **6-1**

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TRANSVERSE CABLE BRACING FOR SINGLE HUNG PIPE OR CONDUIT WITH CLEVIS HANGER

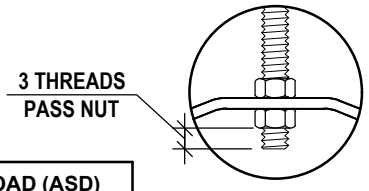
DETAIL
SC-2

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



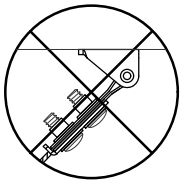
2 1/2" - 8" PIPE

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DETAIL A

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
2 1/2" - 3 1/2"	1/2"	1/8"	129	213	110
4" - 5"	5/8"	3/16"	236	448	292
6" - 8"	3/4"	3/16"	556	593	442



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%
2. PIPES WITH INSULATION SHALL NOT BE USED.

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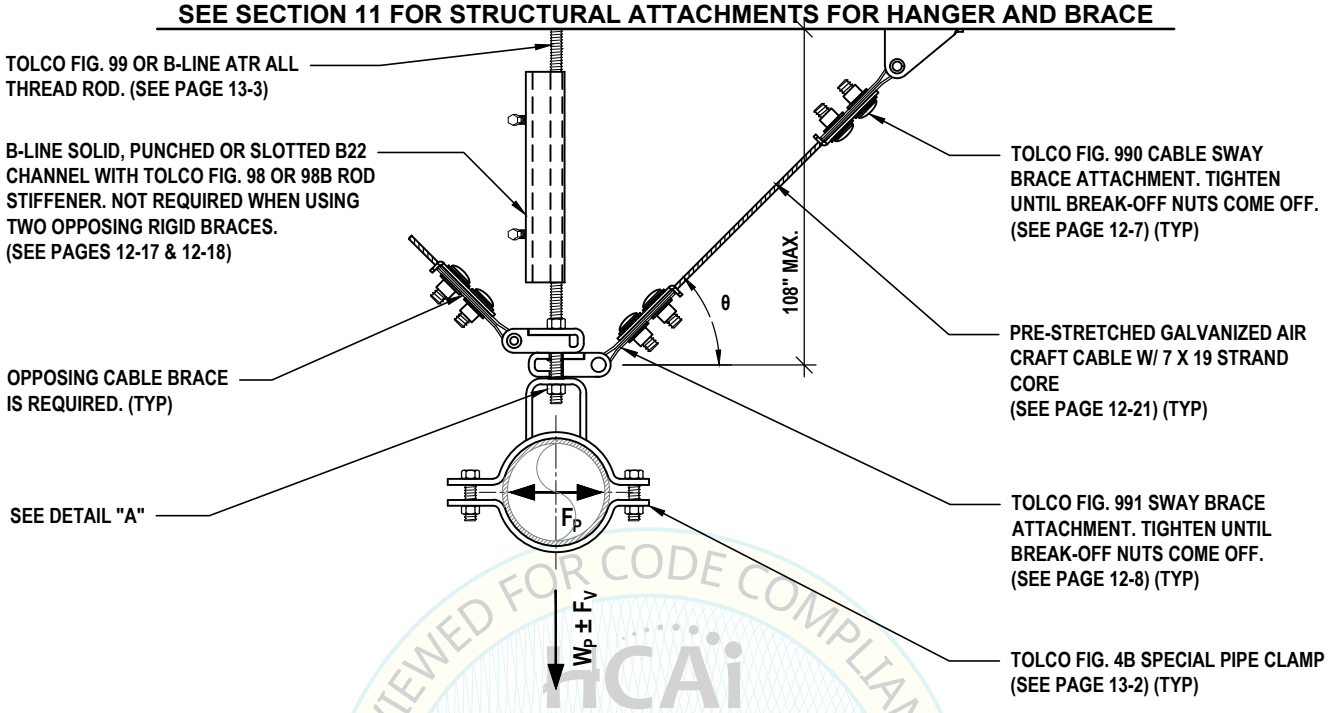
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TRANSVERSE CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

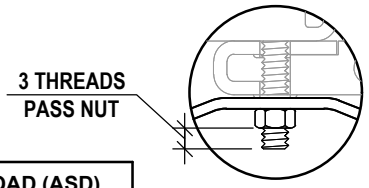
DETAIL
SC-3

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



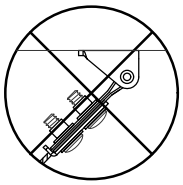
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	1/8"	272	317	310
2 1/2" - 3 1/2"	1/2"	1/8"	272	317	310
4" - 5"	5/8"	3/16"	582	724	517
6"	3/4"	3/16"	582	724	517
8"	7/8"	3/16"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%

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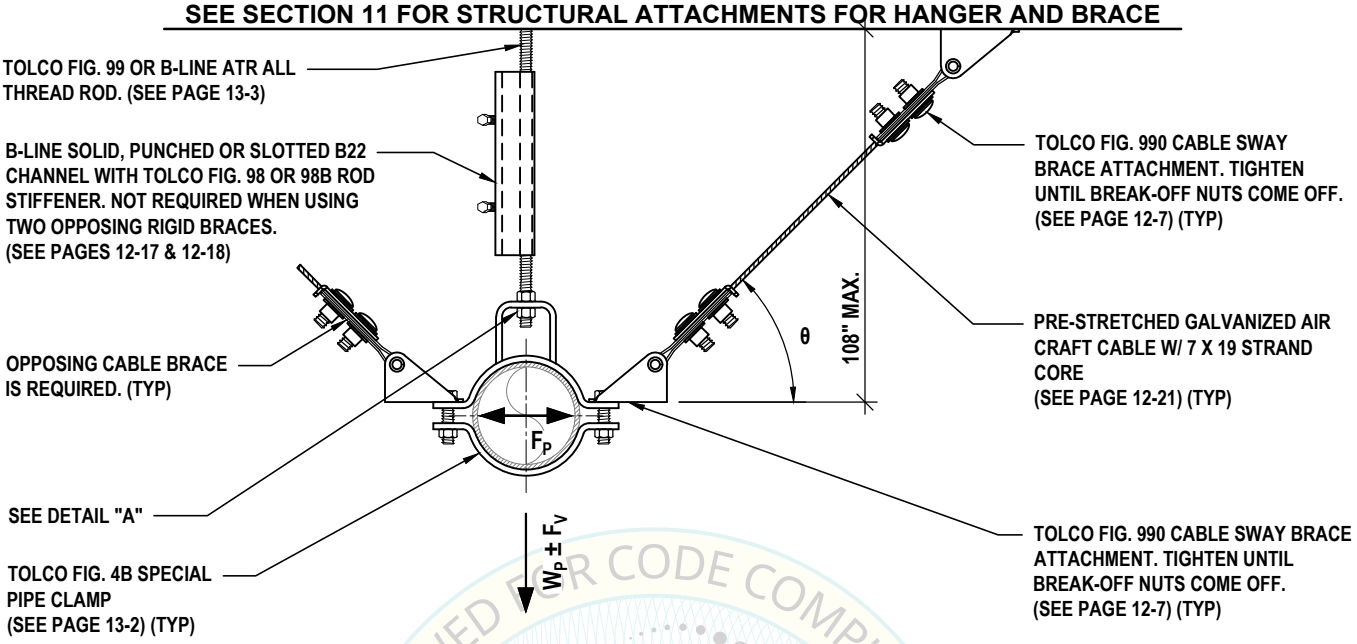
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TRANSVERSE CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SC-4

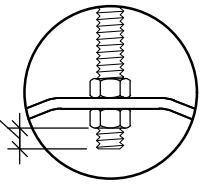
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



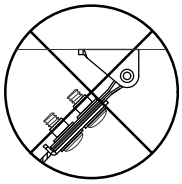
2 1/2" - 8" PIPE

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PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
2 1/2" - 3 1/2"	1/2"	1/8"	272	317	310
4" - 5"	5/8"	3/16"	582	724	517
6"	3/4"	3/16"	582	724	517
8"	7/8"	3/16"	920	746	636



DETAIL A



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%

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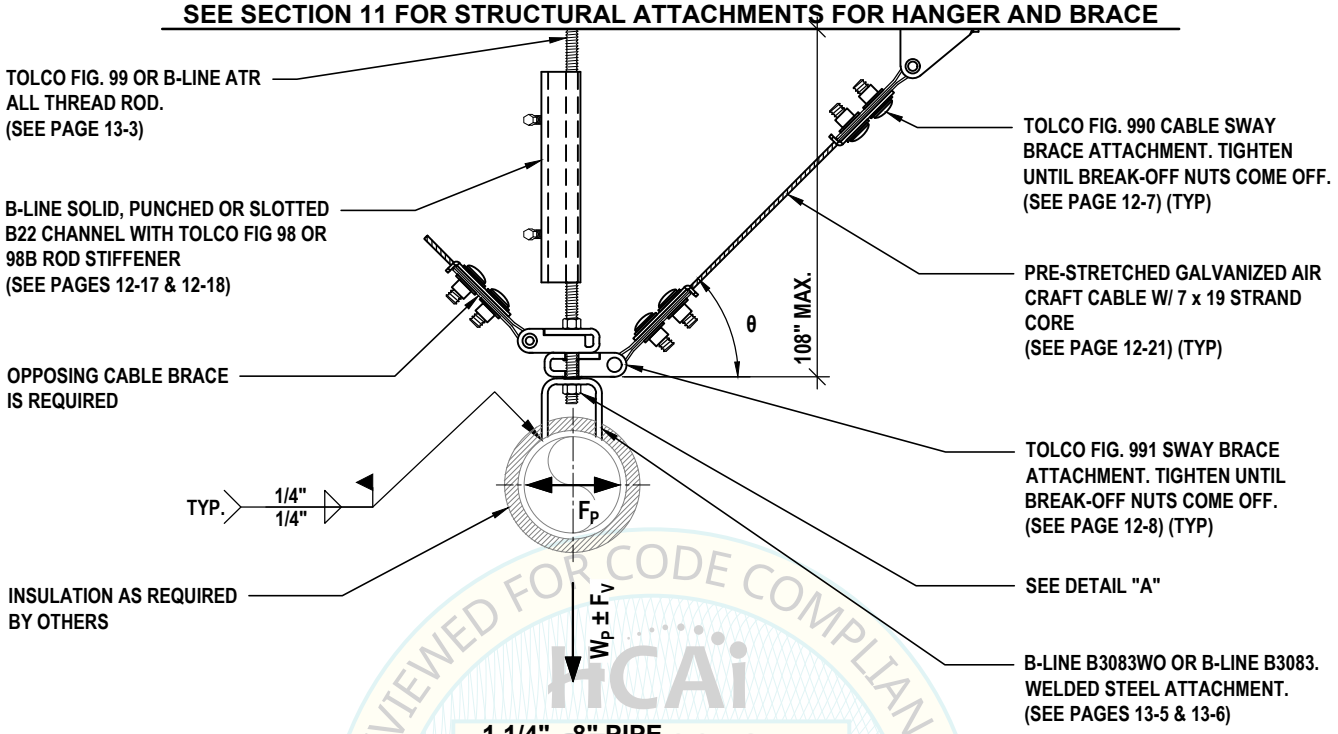
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DATE: **April 23, 2025**

TRANSVERSE CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

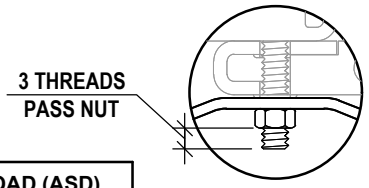
DETAIL
SC-5

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



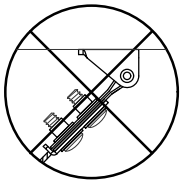
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	1/8"	272	317	310
2 1/2" - 3 1/2"	1/2"	1/8"	272	317	310
4" - 5"	5/8"	3/16"	582	724	517
6"	3/4"	3/16"	582	724	517
8"	7/8"	3/16"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND THICKER WALL THICKNESS PIPING.
2. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
3. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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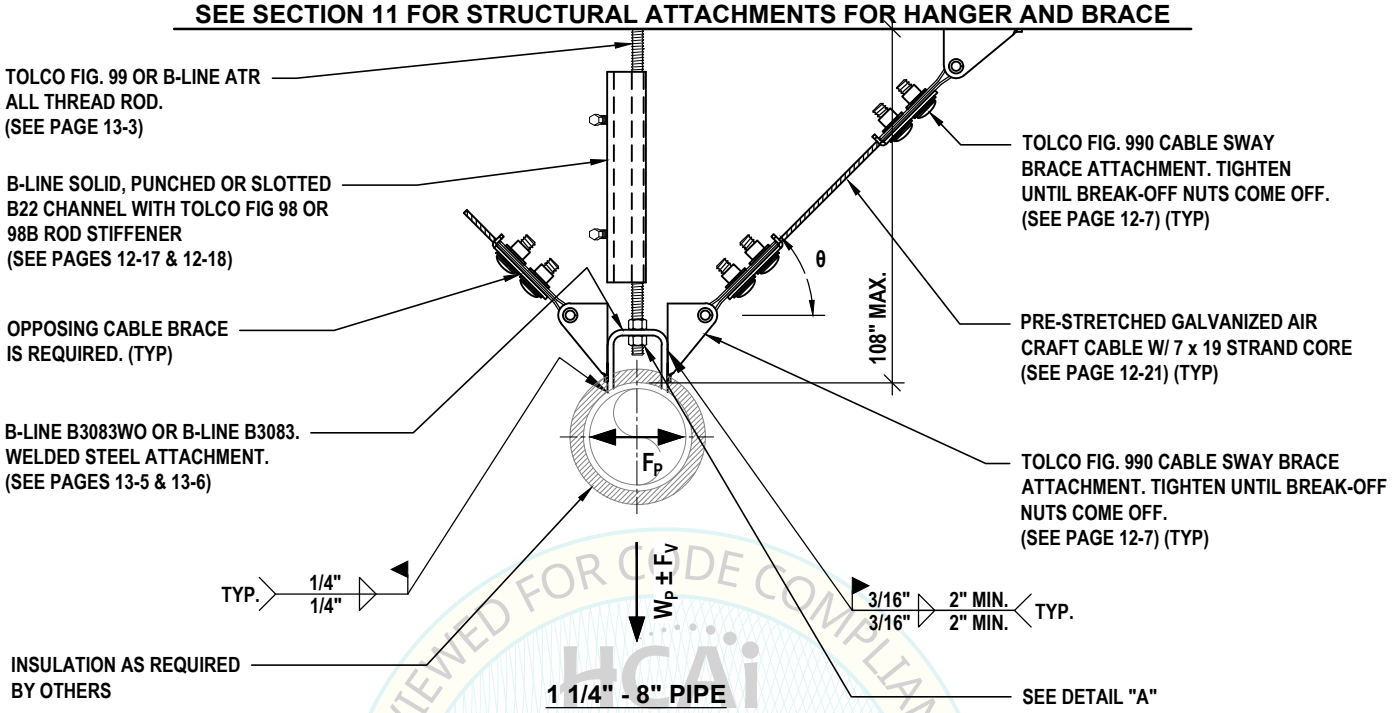
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TRANSVERSE CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

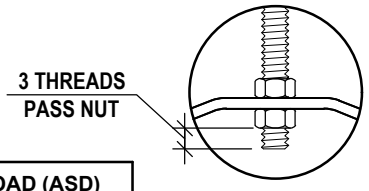
DETAIL
SC-6

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



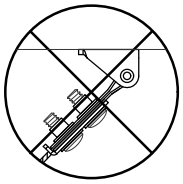
1 1/4" - 8" PIPE

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DETAIL A

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	1/8"	272	317	310
2 1/2" - 3 1/2"	1/2"	1/8"	272	317	310
4" - 5"	5/8"	3/16"	582	724	517
6"	3/4"	3/16"	582	724	517
8"	7/8"	3/16"	920	746	636



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND THICKER WALL THICKNESS PIPING.
2. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
3. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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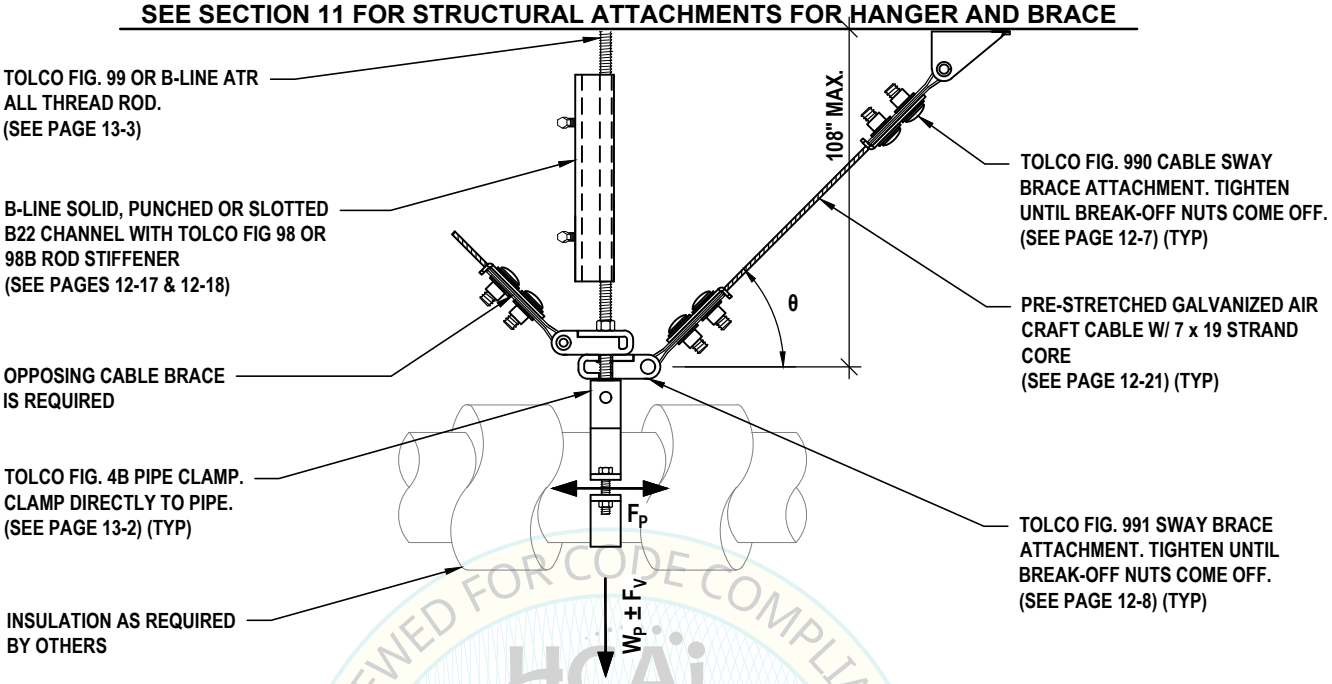
PAGE: **6-6**

DATE: **April 23, 2025**

LONGITUDINAL CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SC-7

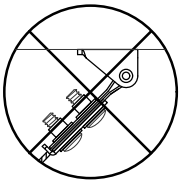
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



4" - 8" PIPE

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PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
4"	5/8"	3/16"	1113	990	659
5"	5/8"	3/16"	1105	930	595
6"	3/4"	3/16"	1089	930	595
8"	7/8"	3/16"	1089	930	595



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%
   b. CONDUITS EXCLUDING EMT - REDUCE LOADS BY 0%

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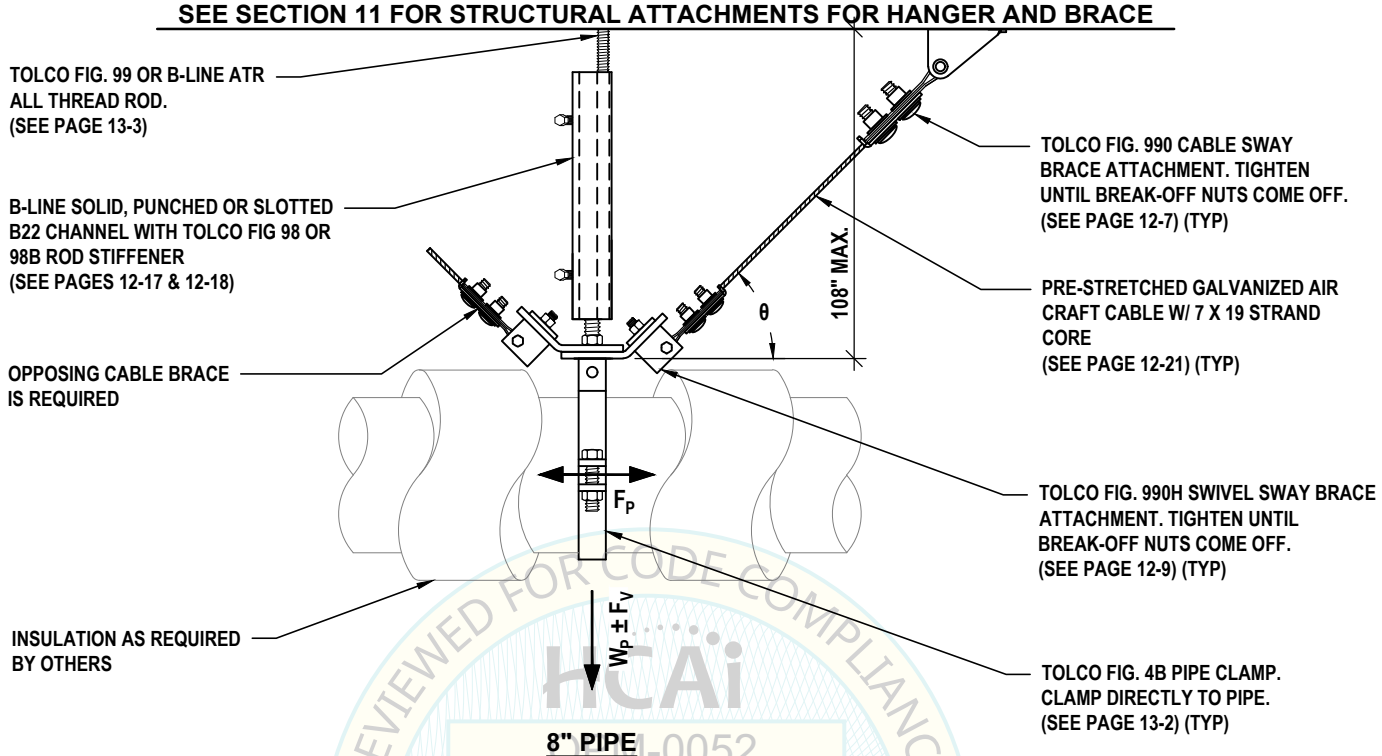
PAGE: 6-7

DATE: April 23, 2025

LONGITUDINAL CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP

DETAIL
SC-8

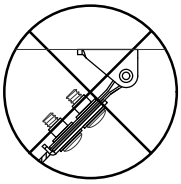
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



8" PIPE

HCAi
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PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
8"	7/8"	3/16"	1089	930	595



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a. THIN WALL PIPING - REDUCE LOADS BY 0%

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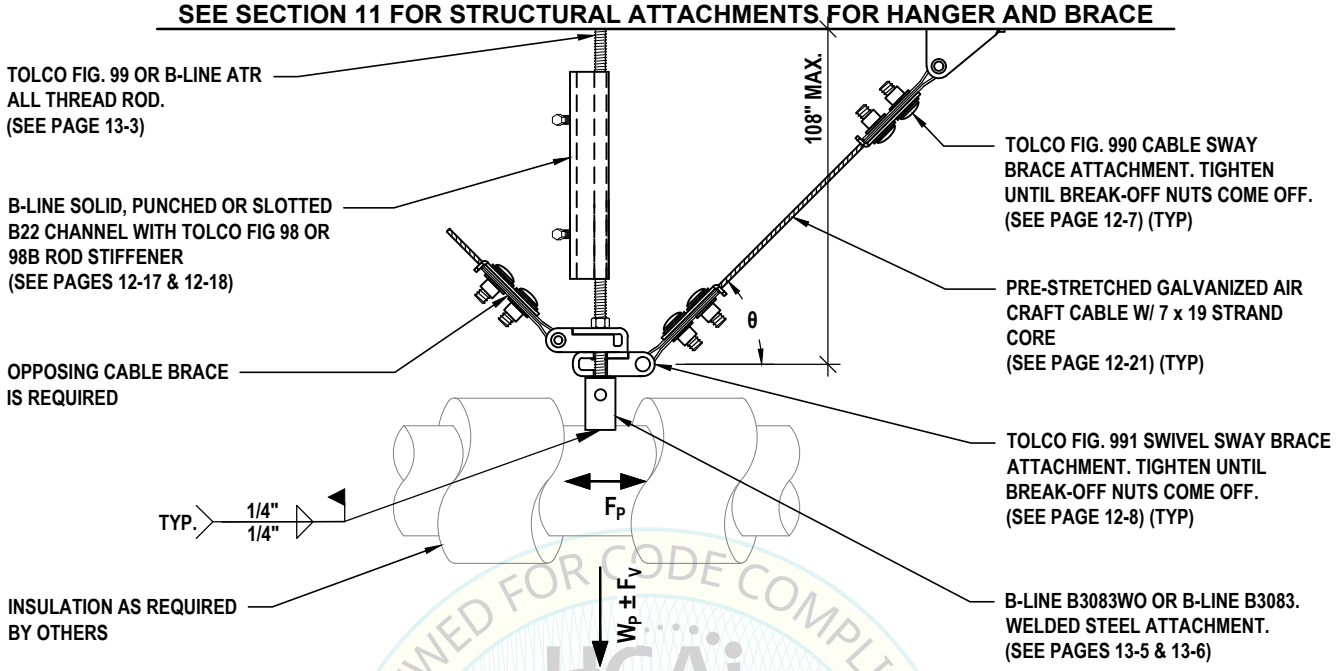
PAGE: **6-8**

DATE: **April 23, 2025**

LONGITUDINAL CABLE BRACE FOR SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT

DETAIL
SC-9

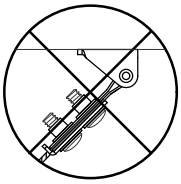
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1 1/4" - 8" PIPE

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DATE: 04/24/2025

PIPE DIAMETER	MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD (ASD)		
			BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
			θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1 1/4" - 2"	3/8"	1/8"	868	865	407
2 1/2" - 3 1/2"	1/2"	1/8"	868	865	407
4" - 5"	5/8"	3/16"	1113	990	659
6"	3/4"	3/16"	1089	930	595
8"	7/8"	3/16"	1089	930	595



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 40 AND THICKER WALL THICKNESS PIPING.
2. E70XX SHALL ELECTRODES SHALL BE USED FOR ALL WELDS.
3. CONTINUOUS INSPECTION REQUIRED FOR ALL FIELD WELDS.

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DATE: **April 23, 2025**

SECTION 7

SINGLE HANGER CABLE BRACE SPACING CHARTS

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BY: Roy Lobo
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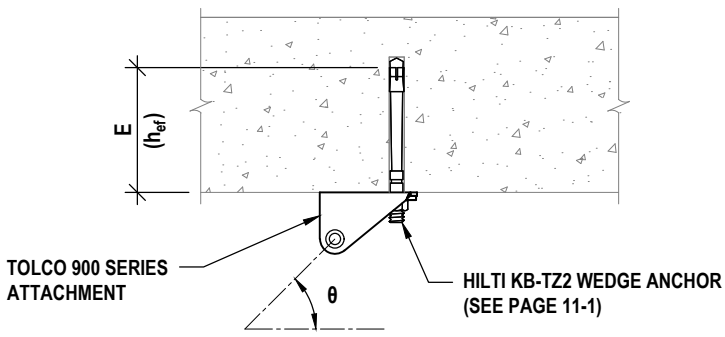
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	3/8"	2"
4	18.1	40	3/16"	1	3/8"	2"
5	26.6	40	3/16"	1	3/8"	2"
6	34.8	40	3/16"	1	3/8"	2"
8	55.1	40	3/16"	1	1/2"	3.25"
10	80.2	40	3/16"	1	5/8"	3.25"
12	109.0	39	3/16"	1	3/4"	3.25"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	3/8"	2"
2-1/2	9.1	80	3/16"	1	3/8"	2"
3	12.1	80	3/16"	1	3/8"	2"
4	18.1	80	3/16"	1	3/8"	2"
5	26.6	80	3/16"	1	1/2"	3.25"
6	34.8	80	3/16"	1	1/2"	3.25"
8	55.1	79	3/16"	1	3/4"	3.75"
10	80.2	54	3/16"	1	3/4"	3.75"
12	109.0	39	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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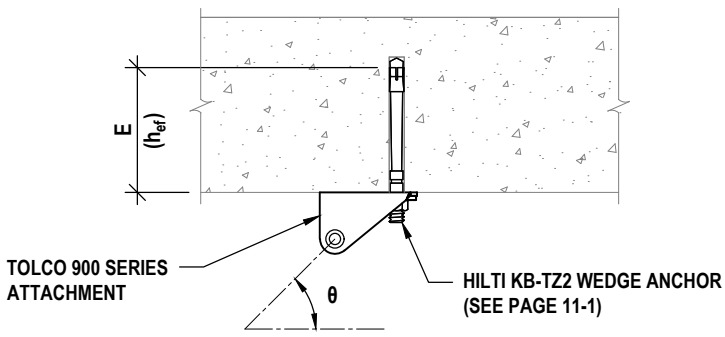
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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	3/8"	2"
4	18.1	40	3/16"	1	3/8"	2"
5	26.6	40	3/16"	1	1/2"	3.25"
6	34.8	40	3/16"	1	1/2"	3.25"
8	55.1	39	3/16"	1	3/4"	3.75"
10	80.2	27	3/16"	1	3/4"	3.75"
12	109.0	19	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	3/8"	2"
2-1/2	9.1	80	3/16"	1	3/8"	2"
3	12.1	80	3/16"	1	1/2"	3.25"
4	18.1	80	3/16"	1	1/2"	3.25"
5	26.6	80	3/16"	1	3/4"	3.75"
6	34.8	62	3/16"	1	3/4"	3.75"
8	55.1	39	3/16"	1	3/4"	3.75"
10	80.2	27	3/16"	1	3/4"	3.75"
12	109.0	19	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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BY: Roy Lobo
DATE: 4/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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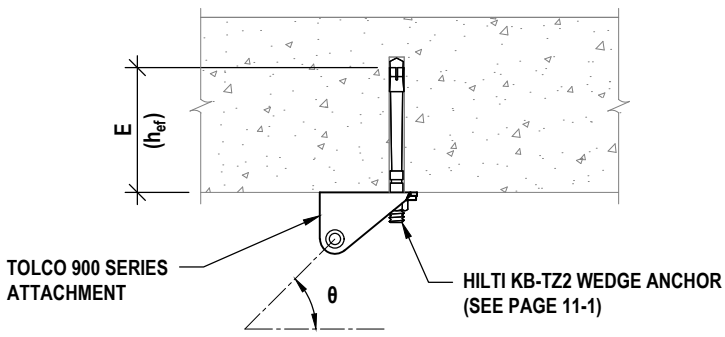
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	3/8"	2"
4	18.1	40	3/16"	1	1/2"	3.25"
5	26.6	40	3/16"	1	5/8"	3.25"
6	34.8	40	3/16"	1	3/4"	3.75"
8	55.1	26	3/16"	1	3/4"	3.75"
10	80.2	18	3/16"	1	3/4"	3.75"
12	109.0	13	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	3/8"	2"
2-1/2	9.1	80	3/16"	1	1/2"	3.25"
3	12.1	80	3/16"	1	1/2"	3.25"
4	18.1	80	3/16"	1	3/4"	3.75"
5	26.6	54	3/16"	1	3/4"	3.75"
6	34.8	41	3/16"	1	3/4"	3.75"
8	55.1	26	3/16"	1	3/4"	3.75"
10	80.2	18	3/16"	1	3/4"	3.75"
12	109.0	13	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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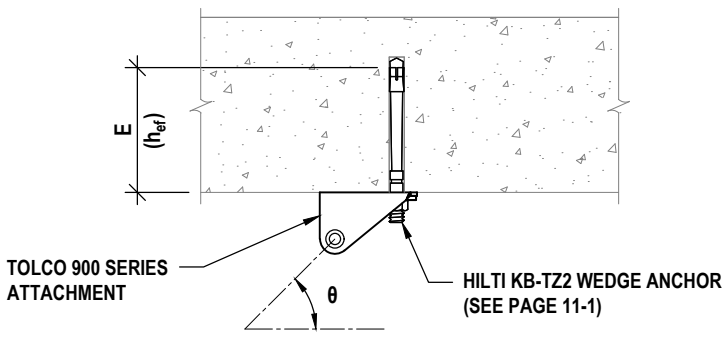
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-3

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	1/2"	3.25"
4	18.1	40	3/16"	1	1/2"	3.25"
5	26.6	40	3/16"	1	3/4"	3.75"
6	34.8	31	3/16"	1	3/4"	3.75"
8	55.1	19	3/16"	1	3/4"	3.75"
10	80.2	13	3/16"	1	3/4"	3.75"
12	109.0	9	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	1/2"	3.25"
2-1/2	9.1	80	3/16"	1	1/2"	3.25"
3	12.1	80	3/16"	1	5/8"	4"
4	18.1	60	3/16"	1	3/4"	3.75"
5	26.6	40	3/16"	1	3/4"	3.75"
6	34.8	31	3/16"	1	3/4"	3.75"
8	55.1	19	3/16"	1	3/4"	3.75"
10	80.2	13	3/16"	1	3/4"	3.75"
12	109.0	9	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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DATE: 4/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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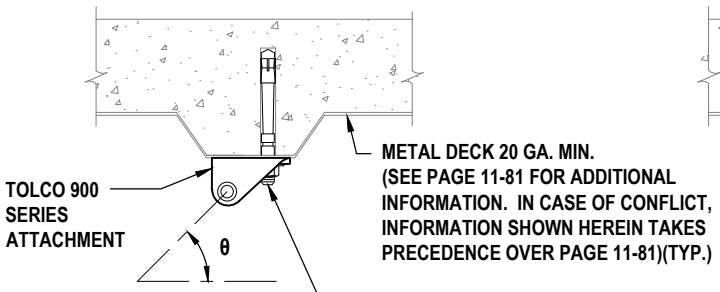
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

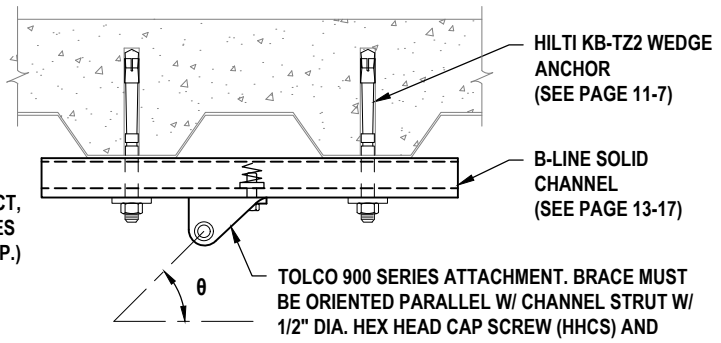
PAGE: 7-4

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	3/8"	2"
4	18.1	40	3/16"	1	3/8"	2"
5	26.6	40	3/16"	1	3/8"	2"
6	34.8	40	3/16"	1	1/2"	3.25"
8	55.1	40	3/16"	1	5/8"	4"
10	80.2	31	3/16"	1	5/8"	4"
12	109.0	23	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	3/8"	2"
2-1/2	9.1	80	3/16"	1	3/8"	2"
3	12.1	80	3/16"	1	3/8"	2"
4	18.1	80	3/16"	1	1/2"	3.25"
5	26.6	80	3/16"	1	5/8"	4"
6	34.8	73	3/16"	1	5/8"	4"
8	55.1	46	3/16"	1	5/8"	4"
10	80.2	31	3/16"	1	5/8"	4"
12	109.0	23	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
IAPMO UMC
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
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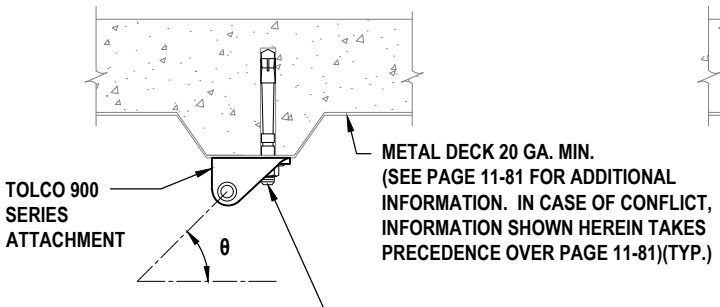
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

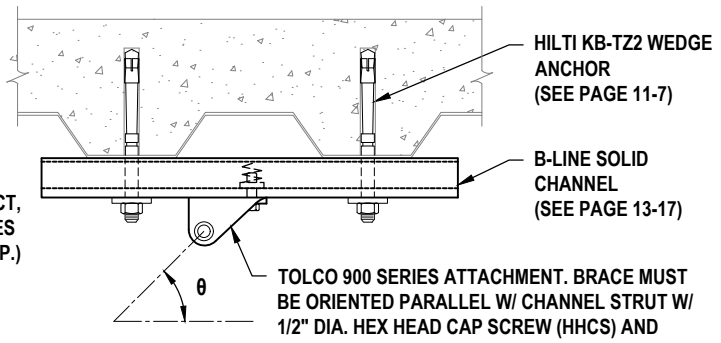
PAGE: 7-5

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.5 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	3/8"	2"
4	18.1	40	3/16"	1	1/2"	3.25"
5	26.6	40	3/16"	1	5/8"	4"
6	34.8	36	3/16"	1	5/8"	4"
8	55.1	23	3/16"	1	5/8"	4"
10	80.2	15	3/16"	1	5/8"	4"
12	109.0	11	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.5 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	3/8"	2"
2-1/2	9.1	80	3/16"	1	1/2"	3.25"
3	12.1	80	3/16"	1	5/8"	2.75"
4	18.1	70	3/16"	1	5/8"	4"
5	26.6	47	3/16"	1	5/8"	4"
6	34.8	36	3/16"	1	5/8"	4"
8	55.1	23	3/16"	1	5/8"	4"
10	80.2	15	3/16"	1	5/8"	4"
12	109.0	11	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
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OPM-0052
By Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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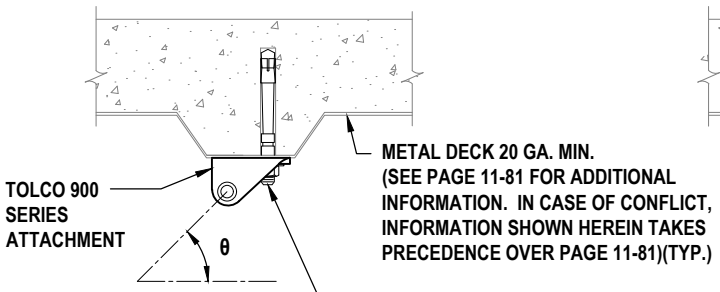
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

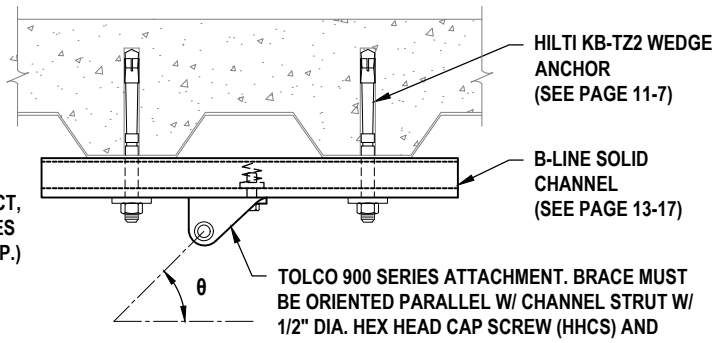
PAGE: 7-6

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	3/8"	2"
3	12.1	40	3/16"	1	1/2"	3.25"
4	18.1	40	3/16"	1	5/8"	4"
5	26.6	31	3/16"	1	5/8"	4"
6	34.8	24	3/16"	1	5/8"	4"
8	55.1	15	3/16"	1	5/8"	4"
10	80.2	10	3/16"	1	5/8"	4"
12	109.0	7	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	3/8"	2"
1-1/2	4.5	80	3/16"	1	3/8"	2"
2	6.2	80	3/16"	1	1/2"	3.25"
2-1/2	9.1	80	3/16"	1	5/8"	4"
3	12.1	70	3/16"	1	5/8"	4"
4	18.1	47	3/16"	1	5/8"	4"
5	26.6	31	3/16"	1	5/8"	4"
6	34.8	24	3/16"	1	5/8"	4"
8	55.1	15	3/16"	1	5/8"	4"
10	80.2	10	3/16"	1	5/8"	4"
12	109.0	7	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
IAPMO UES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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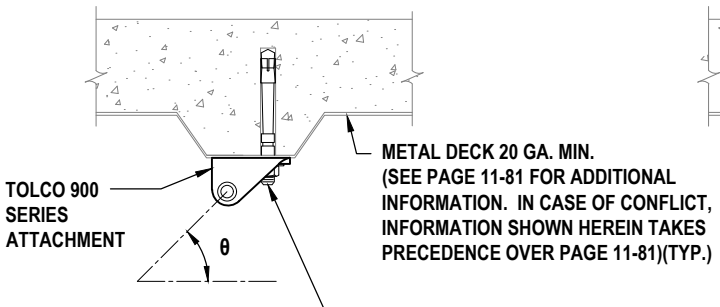
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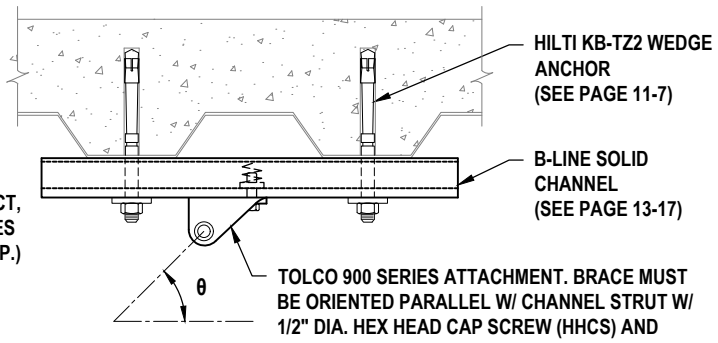
PAGE: 7-7

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	40	3/16"	1	3/8"	2"
1-1/4	3.8	40	3/16"	1	3/8"	2"
1-1/2	4.5	40	3/16"	1	3/8"	2"
2	6.2	40	3/16"	1	3/8"	2"
2-1/2	9.1	40	3/16"	1	1/2"	3.25"
3	12.1	40	3/16"	1	5/8"	2.75"
4	18.1	35	3/16"	1	5/8"	4"
5	26.6	23	3/16"	1	5/8"	4"
6	34.8	18	3/16"	1	5/8"	4"
8	55.1	11	3/16"	1	5/8"	4"
10	80.2	7	3/16"	1	5/8"	4"
12	109.0	5	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Dia.	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
1	2.8	80	3/16"	1	3/8"	2"
1-1/4	3.8	80	3/16"	1	1/2"	3.25"
1-1/2	4.5	80	3/16"	1	1/2"	3.25"
2	6.2	80	3/16"	1	5/8"	4"
2-1/2	9.1	70	3/16"	1	5/8"	4"
3	12.1	52	3/16"	1	5/8"	4"
4	18.1	35	3/16"	1	5/8"	4"
5	26.6	23	3/16"	1	5/8"	4"
6	34.8	18	3/16"	1	5/8"	4"
8	55.1	11	3/16"	1	5/8"	4"
10	80.2	7	3/16"	1	5/8"	4"
12	109.0	5	3/16"	1	5/8"	4"

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REVIEWED FOR CODE COMPLIANCE
IAPMO UES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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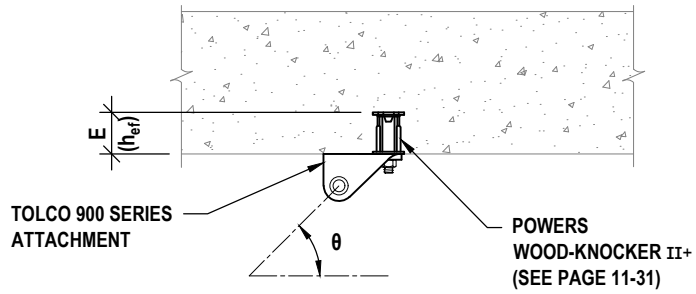
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-8

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	3/8"	2"
3	12.1	40	1/8"	1	3/8"	2"
4	18.1	40	1/8"	1	3/8"	2"
5	26.6	40	1/8"	1	3/8"	2"
6	34.8	40	3/16"	1	1/2"	2"
8	55.1	30	3/16"	1	1/2"	2"
10	80.2	20	3/16"	1	1/2"	2"
12	109.0	15	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	3/8"	2"
2	6.2	80	1/8"	1	3/8"	2"
2-1/2	9.1	80	1/8"	1	3/8"	2"
3	12.1	80	1/8"	1	3/8"	2"
4	18.1	80	3/16"	1	1/2"	2"
5	26.6	62	3/16"	1	1/2"	2"
6	34.8	47	3/16"	1	1/2"	2"
8	55.1	30	3/16"	1	1/2"	2"
10	80.2	20	3/16"	1	1/2"	2"
12	109.0	15	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE
IAPMO UMC
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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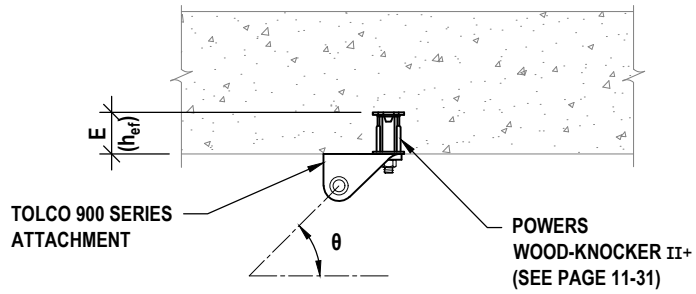
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-9

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.5 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	3/8"	2"
3	12.1	40	1/8"	1	3/8"	2"
4	18.1	40	1/8"	1	1/2"	2"
5	26.6	31	1/8"	1	1/2"	2"
6	34.8	23	3/16"	1	1/2"	2"
8	55.1	15	3/16"	1	1/2"	2"
10	80.2	10	3/16"	1	1/2"	2"
12	109.0	7	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.5 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	3/8"	2"
2	6.2	80	1/8"	1	3/8"	2"
2-1/2	9.1	80	1/8"	1	1/2"	2"
3	12.1	68	1/8"	1	1/2"	2"
4	18.1	46	3/16"	1	1/2"	2"
5	26.6	31	3/16"	1	1/2"	2"
6	34.8	23	3/16"	1	1/2"	2"
8	55.1	15	3/16"	1	1/2"	2"
10	80.2	10	3/16"	1	1/2"	2"
12	109.0	7	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE
IAPMO UMC
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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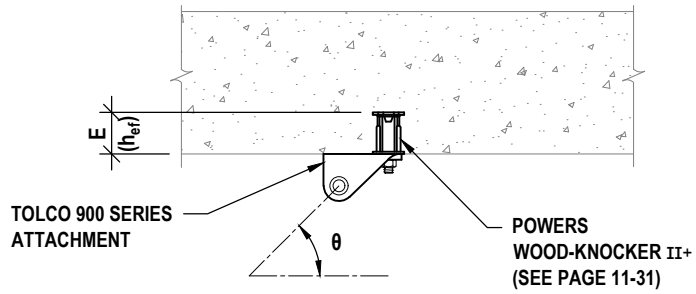
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-10

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	3/8"	2"
3	12.1	40	1/8"	1	1/2"	2"
4	18.1	30	3/16"	1	1/2"	2"
5	26.6	20	3/16"	1	1/2"	2"
6	34.8	15	3/16"	1	1/2"	2"
8	55.1	10	3/16"	1	1/2"	2"
10	80.2	6	3/16"	1	1/2"	2"
12	109.0	5	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	3/8"	2"
2	6.2	80	1/8"	1	1/2"	2"
2-1/2	9.1	61	3/16"	1	1/2"	2"
3	12.1	45	3/16"	1	1/2"	2"
4	18.1	30	3/16"	1	1/2"	2"
5	26.6	20	3/16"	1	1/2"	2"
6	34.8	15	3/16"	1	1/2"	2"
8	55.1	10	3/16"	1	1/2"	2"
10	80.2	6	3/16"	1	1/2"	2"
12	109.0	5	3/16"	1	1/2"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE
IAPMO UMC
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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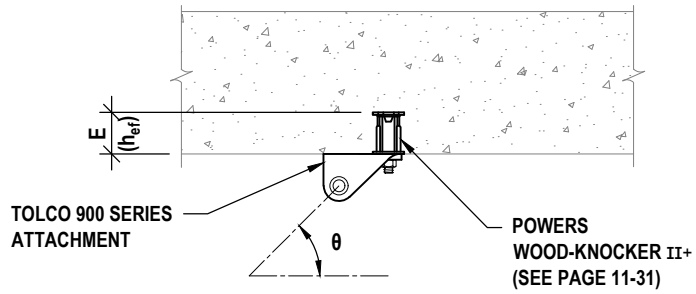
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-11

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	1/2"	2"
3	12.1	34	1/8"	1	1/2"	2"
4	18.1	23	3/16"	1	1/2"	2"
5	26.6	15	3/16"	1	1/2"	2"
6	34.8	11	3/16"	1	1/2"	2"
8	55.1	7	3/16"	1	1/2"	2"
10	80.2	5	3/16"	1	1/2"	2"
12						

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	1/2"	2"
2	6.2	67	1/8"	1	1/2"	2"
2-1/2	9.1	45	3/16"	1	1/2"	2"
3	12.1	34	3/16"	1	1/2"	2"
4	18.1	23	3/16"	1	1/2"	2"
5	26.6	15	3/16"	1	1/2"	2"
6	34.8	11	3/16"	1	1/2"	2"
8	55.1	7	3/16"	1	1/2"	2"
10	80.2	5	3/16"	1	1/2"	2"
12						

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE ICC-ES OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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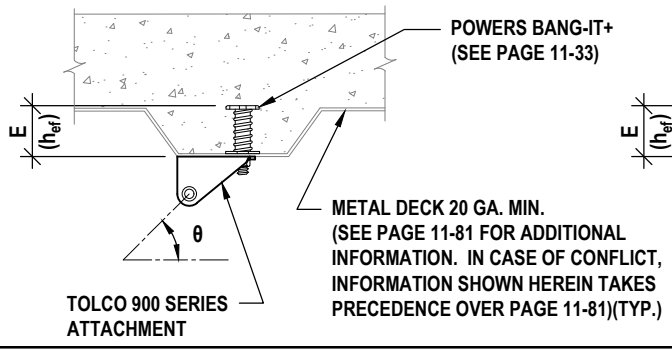
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

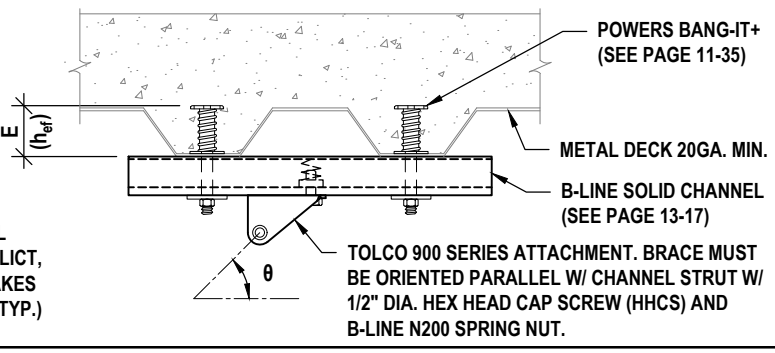
PAGE: 7-12

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	3/8"	2"
3	12.1	40	1/8"	1	3/8"	2"
4	18.1	40	1/8"	1	3/8"	2"
5	26.6	36	1/8"	1	5/8"	2"
6	34.8	28	3/16"	1	5/8"	2"
8	55.1	35	3/16"	2	5/8"	2"
10	80.2	24	3/16"	2	5/8"	2"
12	109.0	18	3/16"	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.25 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	3/8"	2"
2	6.2	80	1/8"	1	3/8"	2"
2-1/2	9.1	80	1/8"	1	3/8"	2"
3	12.1	80	1/8"	1	5/8"	2"
4	18.1	54	3/16"	1	5/8"	2"
5	26.6	36	3/16"	1	5/8"	2"
6	34.8	28	3/16"	1	5/8"	2"
8	55.1	35	3/16"	2	5/8"	2"
10	80.2	24	3/16"	2	5/8"	2"
12	109.0	18	3/16"	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
IAPMO UPC
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. SPACING TABLE IS BASED ON A 1:1 (45°) BRACE ANGLE RATIO.
5. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
6. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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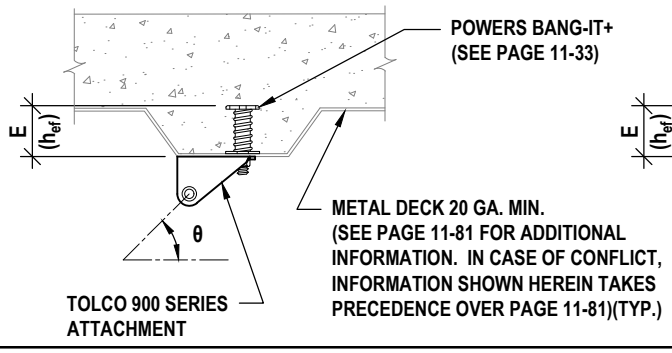
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

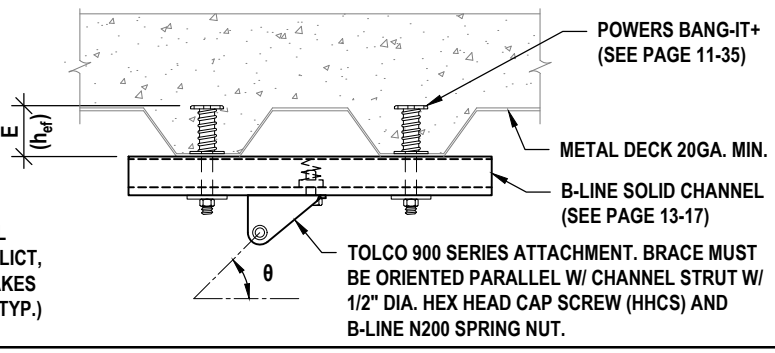
PAGE: 7-13

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	40	1/8"	1	3/8"	2"
3	12.1	40	1/8"	1	5/8"	2"
4	18.1	27	1/8"	1	5/8"	2"
5	26.6	36	1/8"	2	5/8"	2"
6	34.8	28	3/16"	2	5/8"	2"
8	55.1	17	3/16"	2	5/8"	2"
10	80.2	12	3/16"	2	5/8"	2"
12	109.0	9	3/16"	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.50 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	3/8"	2"
1-1/2	4.5	80	1/8"	1	3/8"	2"
2	6.2	79	1/8"	1	5/8"	2"
2-1/2	9.1	53	1/8"	1	5/8"	2"
3	12.1	40	1/8"	1	5/8"	2"
4	18.1	27	3/16"	1	5/8"	2"
5	26.6	36	3/16"	2	5/8"	2"
6	34.8	28	3/16"	2	5/8"	2"
8	55.1	17	3/16"	2	5/8"	2"
10	80.2	12	3/16"	2	5/8"	2"
12	109.0	9	3/16"	2	5/8"	2"

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REVIEWED FOR CODE COMPLIANCE
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OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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7. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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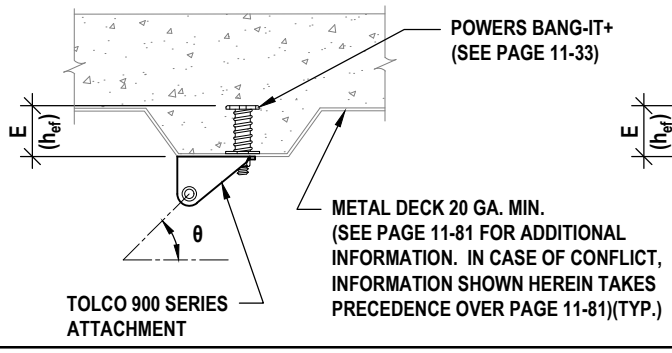
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

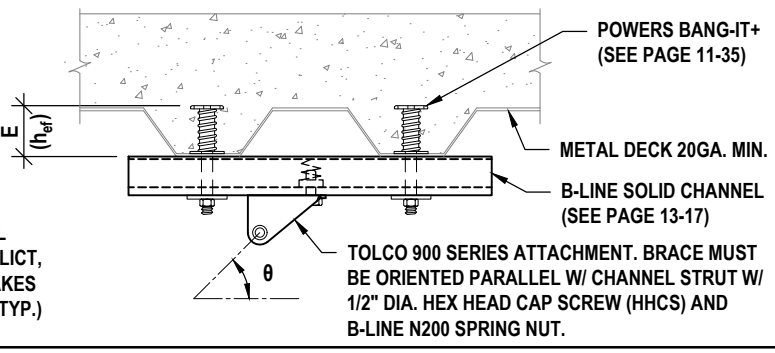
PAGE: 7-14

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	3/8"	2"
1-1/2	4.5	40	1/8"	1	3/8"	2"
2	6.2	40	1/8"	1	3/8"	2"
2-1/2	9.1	35	1/8"	1	5/8"	2"
3	12.1	27	1/8"	1	5/8"	2"
4	18.1	36	1/8"	2	5/8"	2"
5	26.6	24	3/16"	2	5/8"	2"
6	34.8	18	3/16"	2	5/8"	2"
8	55.1	11	3/16"	2	5/8"	2"
10	80.2	8	3/16"	2	5/8"	2"
12	109.0	6	3/16"	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	3/8"	2"
1-1/4	3.8	80	1/8"	1	1/2"	2"
1-1/2	4.5	72	1/8"	1	5/8"	2"
2	6.2	52	1/8"	1	5/8"	2"
2-1/2	9.1	35	3/16"	1	5/8"	2"
3	12.1	27	3/16"	1	5/8"	2"
4	18.1	36	3/16"	2	5/8"	2"
5	26.6	24	3/16"	2	5/8"	2"
6	34.8	18	3/16"	2	5/8"	2"
8	55.1	11	3/16"	2	5/8"	2"
10	80.2	8	3/16"	2	5/8"	2"
12	109.0	6	3/16"	2	5/8"	2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
IAPMO UMC
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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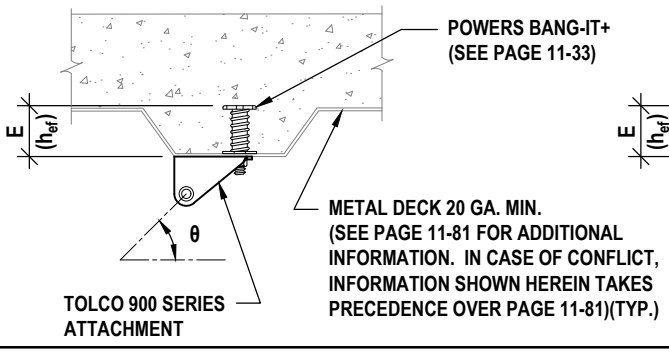
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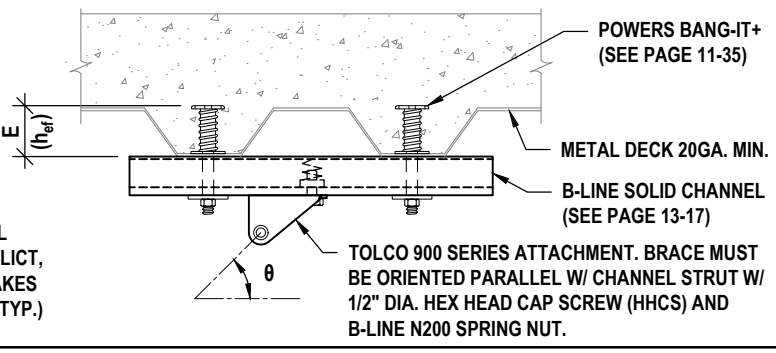
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-15

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK





Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	40	1/8"	1	3/8"	2"
1-1/4	3.8	40	1/8"	1	5/8"	2"
1-1/2	4.5	40	1/8"	1	5/8"	2"
2	6.2	39	1/8"	1	5/8"	2"
2-1/2	9.1	40	1/8"	2	3/8"	2"
3	12.1	40	1/8"	2	5/8"	2"
4	18.1	27	3/16"	2	5/8"	2"
5	26.6	18	3/16"	2	5/8"	2"
6	34.8	14	3/16"	2	5/8"	2"
8	55.1	8	3/16"	2	5/8"	2"
10	80.2	6	3/16"	2	5/8"	2"
12	109.0	4	3/16"	2	5/8"	2"

FOOTNOTES:

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Dia.	Concrete Anchorage		
		Max. Spacing @ 1.0 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
1	2.8	80	1/8"	1	1/2"	2"
1-1/4	3.8	64	1/8"	1	5/8"	2"
1-1/2	4.5	54	1/8"	1	5/8"	2"
2	6.2	39	1/8"	1	5/8"	2"
2-1/2	9.1	26	3/16"	1	5/8"	2"
3	12.1	40	3/16"	2	5/8"	2"
4	18.1	27	3/16"	2	5/8"	2"
5	26.6	18	3/16"	2	5/8"	2"
6	34.8	14	3/16"	2	5/8"	2"
8	55.1	8	3/16"	2	5/8"	2"
10	80.2	6	3/16"	2	5/8"	2"
12	109.0	4	3/16"	2	5/8"	2"

FOOTNOTES:

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
IAPMO UPC
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

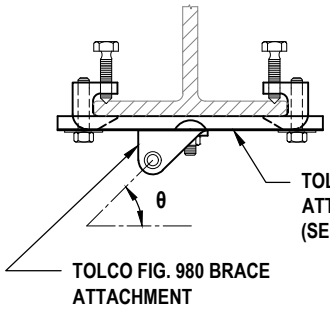
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DATE: April 23, 2025

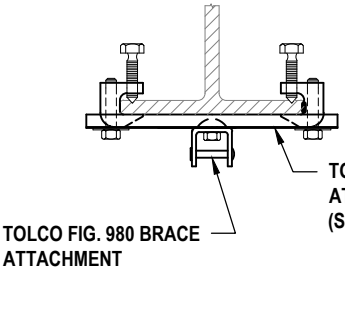
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.25 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	1/8"	40	40
5	26.6	1/8"	40	40
6	34.8	3/16"	40	40
8	55.1	3/16"	40	40
10	80.2	3/16"	40	40
12	109.0	3/16"	40	40

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	1/8"	80	80
3	12.1	1/8"	80	80
4	18.1	3/16"	80	80
5	26.6	3/16"	80	80
6	34.8	3/16"	80	80
8	55.1	3/16"	80	80
10	80.2	3/16"	55	55
12	109.0	3/16"	40	40

FOOTNOTES:

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REVIEWED FOR CODE COMPLIANCE
OPM-0053
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
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Structural Engineer: Mohammad R. Hariri
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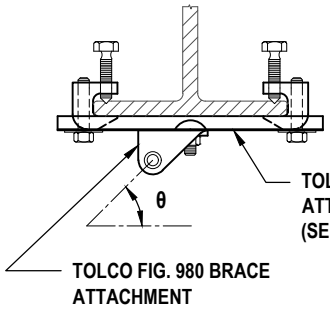
PAGE: 7-17

DATE: April 23, 2025

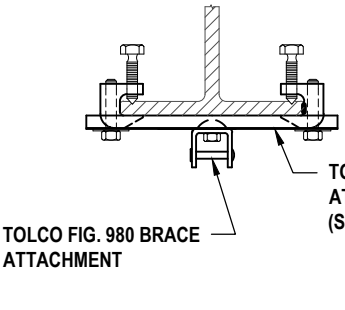
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.50 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	1/8"	40	40
5	26.6	1/8"	39	39
6	34.8	3/16"	40	40
8	55.1	3/16"	40	40
10	80.2	3/16"	27	27
12	109.0	3/16"	20	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	1/8"	80	80
3	12.1	1/8"	80	80
4	18.1	3/16"	80	80
5	26.6	3/16"	80	80
6	34.8	3/16"	63	63
8	55.1	3/16"	40	40
10	80.2	3/16"	27	27
12	109.0	3/16"	20	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
OPM-0053
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

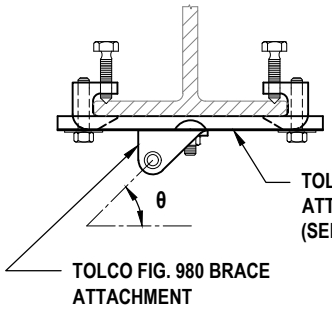
PAGE: **7-18**

DATE: **April 23, 2025**

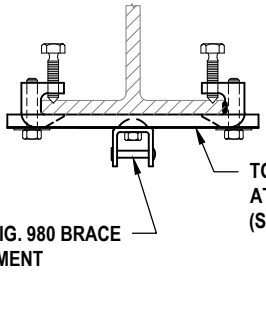
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.75 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	3/16"	40	40
5	26.6	3/16"	40	40
6	34.8	3/16"	40	40
8	55.1	3/16"	26	26
10	80.2	3/16"	18	18
12	109.0	3/16"	13	13

FOOTNOTES:

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	3/16"	80	80
3	12.1	3/16"	80	80
4	18.1	3/16"	80	80
5	26.6	3/16"	55	55
6	34.8	3/16"	42	42
8	55.1	3/16"	26	26
10	80.2	3/16"	18	18
12	109.0	3/16"	13	13

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE
OPM-0053
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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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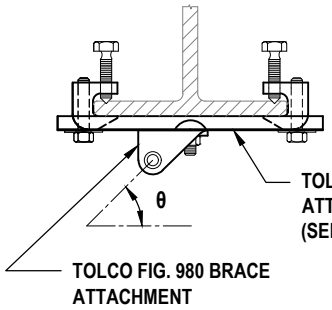
PAGE: 7-19

DATE: April 23, 2025

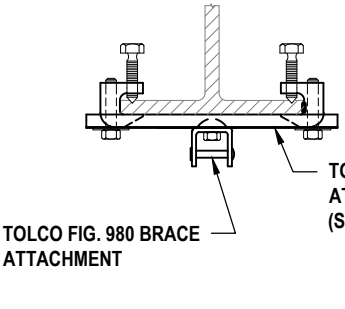
SINGLE PIPE HANGER BRACE SPACING CHART FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

1.0 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	3/16"	40	40
5	26.6	3/16"	40	40
6	34.8	3/16"	31	31
8	55.1	3/16"	20	20
10	80.2	3/16"	13	13
12	109.0	3/16"	10	10

FOOTNOTES:

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"	
			Perpendicular	Parallel
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	3/16"	80	80
3	12.1	3/16"	80	80
4	18.1	3/16"	61	61
5	26.6	3/16"	41	41
6	34.8	3/16"	31	31
8	55.1	3/16"	20	20
10	80.2	3/16"	13	13
12	109.0	3/16"	10	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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OPM-0053
BY: Roy Lobo
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6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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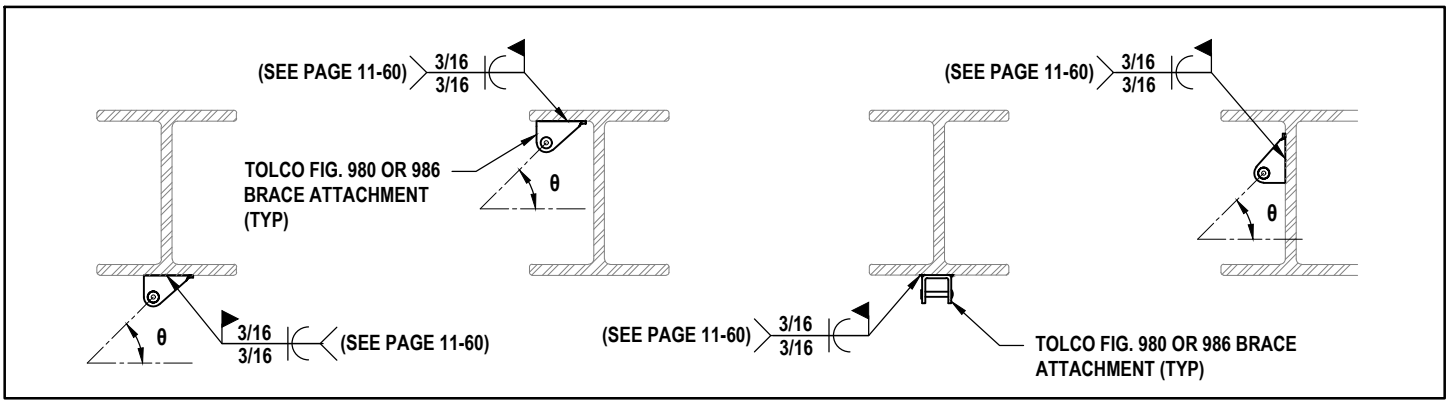
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-20

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G"
1	2.8	1/8"	40
1-1/4	3.8	1/8"	40
1-1/2	4.5	1/8"	40
2	6.2	1/8"	40
2-1/2	9.1	1/8"	40
3	12.1	1/8"	40
4	18.1	1/8"	40
5	26.6	1/8"	40
6	34.8	1/8"	40
8	55.1	3/16"	40
10	80.2	3/16"	40
12	109.0	3/16"	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"
1	2.8	1/8"	80
1-1/4	3.8	1/8"	80
1-1/2	4.5	1/8"	80
2	6.2	1/8"	80
2-1/2	9.1	1/8"	80
3	12.1	1/8"	80
4	18.1	1/8"	80
5	26.6	3/16"	80
6	34.8	3/16"	80
8	55.1	3/16"	80
10	80.2	3/16"	55
12	109.0	3/16"	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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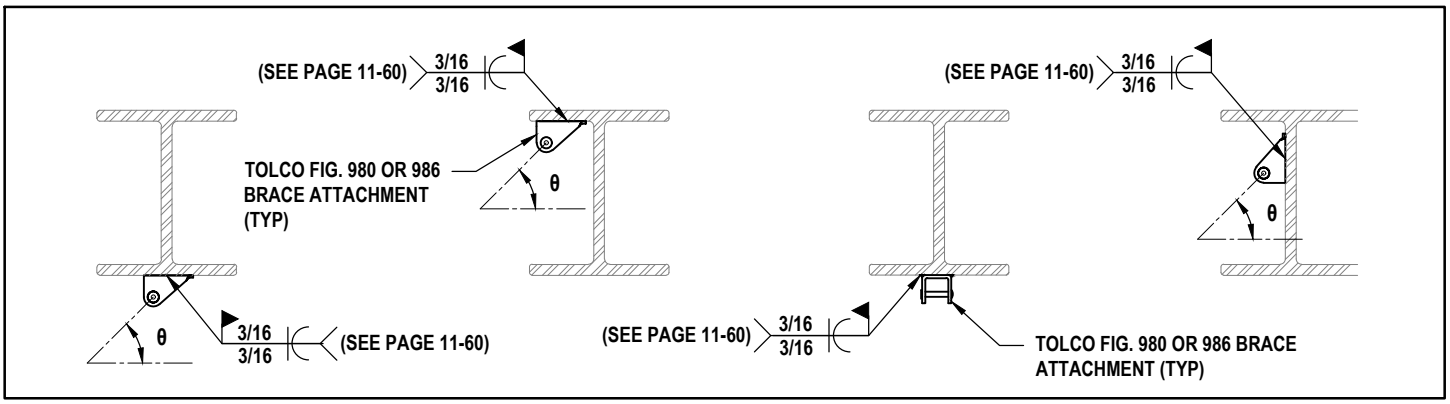
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-21

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G"
1	2.8	1/8"	40
1-1/4	3.8	1/8"	40
1-1/2	4.5	1/8"	40
2	6.2	1/8"	40
2-1/2	9.1	1/8"	40
3	12.1	1/8"	40
4	18.1	1/8"	40
5	26.6	3/16"	40
6	34.8	3/16"	40
8	55.1	3/16"	40
10	80.2	3/16"	27
12	109.0	3/16"	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"
1	2.8	1/8"	80
1-1/4	3.8	1/8"	80
1-1/2	4.5	1/8"	80
2	6.2	1/8"	80
2-1/2	9.1	1/8"	80
3	12.1	1/8"	80
4	18.1	3/16"	80
5	26.6	3/16"	80
6	34.8	3/16"	63
8	55.1	3/16"	40
10	80.2	3/16"	27
12	109.0	3/16"	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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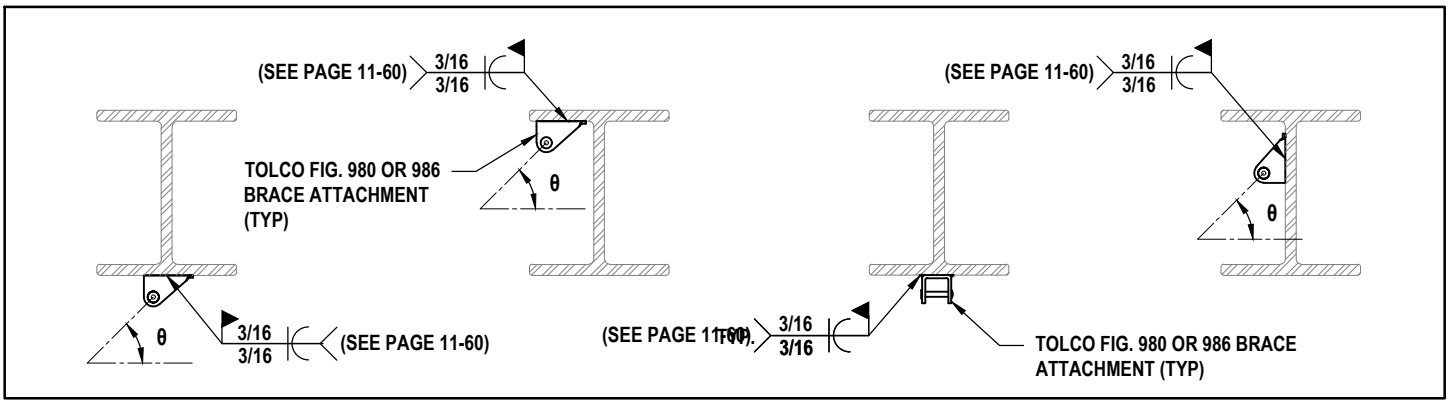
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-22

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G"
1	2.8	1/8"	40
1-1/4	3.8	1/8"	40
1-1/2	4.5	1/8"	40
2	6.2	1/8"	40
2-1/2	9.1	1/8"	40
3	12.1	1/8"	40
4	18.1	3/16"	40
5	26.6	3/16"	40
6	34.8	3/16"	40
8	55.1	3/16"	26
10	80.2	3/16"	18
12	109.0	3/16"	13

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"
1	2.8	1/8"	80
1-1/4	3.8	1/8"	80
1-1/2	4.5	1/8"	80
2	6.2	1/8"	80
2-1/2	9.1	3/16"	80
3	12.1	3/16"	80
4	18.1	3/16"	80
5	26.6	3/16"	55
6	34.8	3/16"	42
8	55.1	3/16"	26
10	80.2	3/16"	18
12	109.0	3/16"	13

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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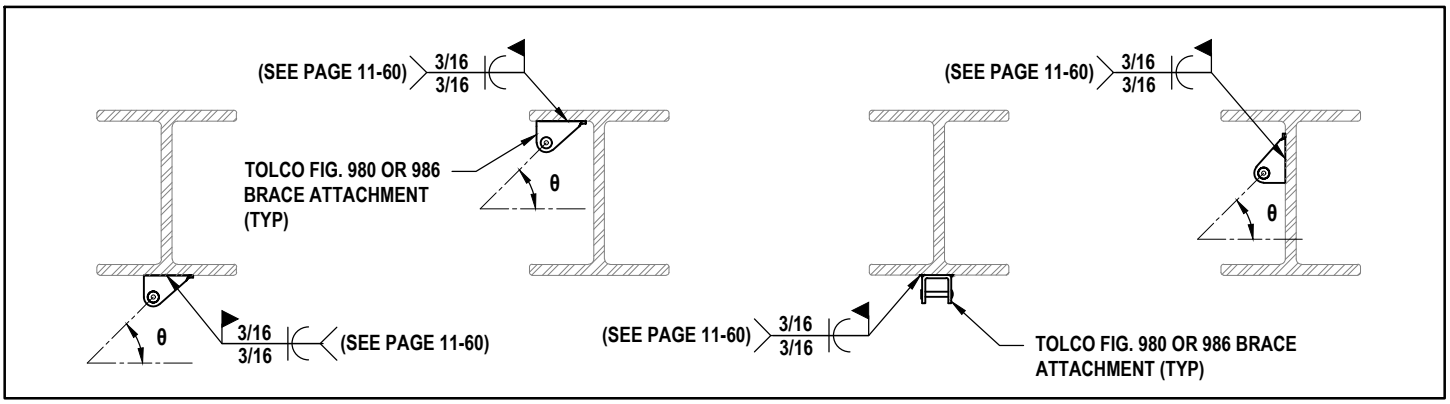
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-23

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR WELDED ATTACHMENT TO STEEL BEAM

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G"
1	2.8	1/8"	40
1-1/4	3.8	1/8"	40
1-1/2	4.5	1/8"	40
2	6.2	1/8"	40
2-1/2	9.1	1/8"	40
3	12.1	1/8"	40
4	18.1	3/16"	40
5	26.6	3/16"	40
6	34.8	3/16"	31
8	55.1	3/16"	20
10	80.2	3/16"	13
12	109.0	3/16"	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"
1	2.8	1/8"	80
1-1/4	3.8	1/8"	80
1-1/2	4.5	1/8"	80
2	6.2	1/8"	80
2-1/2	9.1	3/16"	80
3	12.1	3/16"	80
4	18.1	3/16"	61
5	26.6	3/16"	41
6	34.8	3/16"	31
8	55.1	3/16"	20
10	80.2	3/16"	13
12	109.0	3/16"	10

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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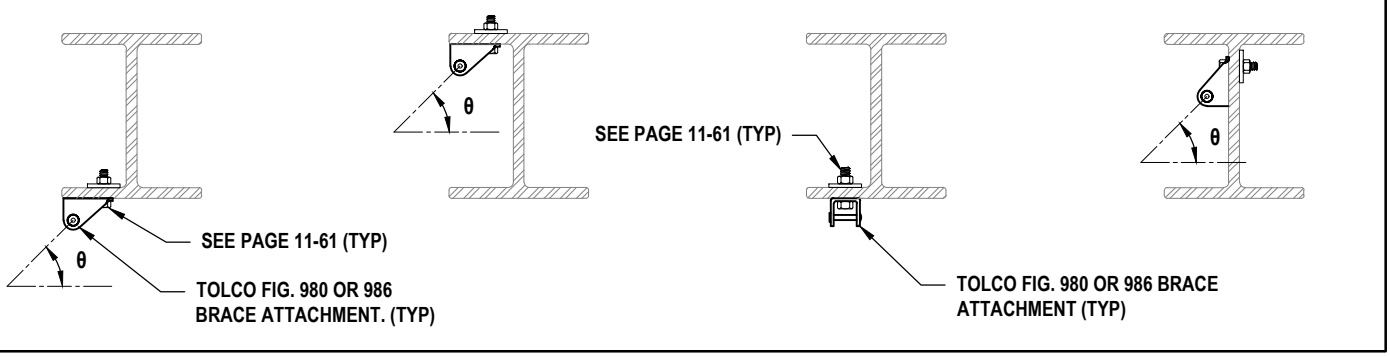
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.25 "G"
1	2.8	1/8"	3/8"	40
1-1/4	3.8	1/8"	3/8"	40
1-1/2	4.5	1/8"	3/8"	40
2	6.2	1/8"	3/8"	40
2-1/2	9.1	1/8"	3/8"	40
3	12.1	1/8"	3/8"	40
4	18.1	1/8"	3/8"	40
5	26.6	1/8"	3/8"	40
6	34.8	1/8"	3/8"	40
8	55.1	3/16"	1/2"	40
10	80.2	3/16"	5/8"	40
12	109.0	3/16"	5/8"	40

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"
1	2.8	1/8"	3/8"	80
1-1/4	3.8	1/8"	3/8"	80
1-1/2	4.5	1/8"	3/8"	80
2	6.2	1/8"	3/8"	80
2-1/2	9.1	1/8"	3/8"	80
3	12.1	1/8"	3/8"	80
4	18.1	1/8"	3/8"	80
5	26.6	3/16"	1/2"	80
6	34.8	3/16"	1/2"	80
8	55.1	3/16"	5/8"	80
10	80.2	3/16"	5/8"	55
12	109.0	3/16"	5/8"	40

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G

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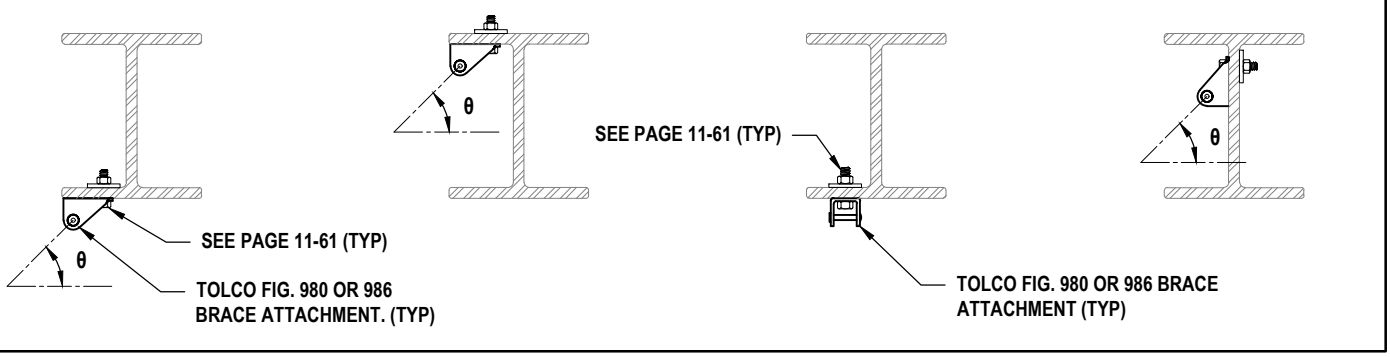
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-25

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.50 "G"
1	2.8	1/8"	3/8"	40
1-1/4	3.8	1/8"	3/8"	40
1-1/2	4.5	1/8"	3/8"	40
2	6.2	1/8"	3/8"	40
2-1/2	9.1	1/8"	3/8"	40
3	12.1	1/8"	3/8"	40
4	18.1	1/8"	3/8"	40
5	26.6	3/16"	1/2"	40
6	34.8	3/16"	1/2"	40
8	55.1	3/16"	5/8"	40
10	80.2	3/16"	5/8"	27
12	109.0	3/16"	5/8"	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"
1	2.8	1/8"	3/8"	80
1-1/4	3.8	1/8"	3/8"	80
1-1/2	4.5	1/8"	3/8"	80
2	6.2	1/8"	3/8"	80
2-1/2	9.1	1/8"	3/8"	80
3	12.1	1/8"	1/2"	80
4	18.1	3/16"	1/2"	80
5	26.6	3/16"	5/8"	80
6	34.8	3/16"	5/8"	63
8	55.1	3/16"	5/8"	40
10	80.2	3/16"	5/8"	27
12	109.0	3/16"	5/8"	20

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
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NOTES:

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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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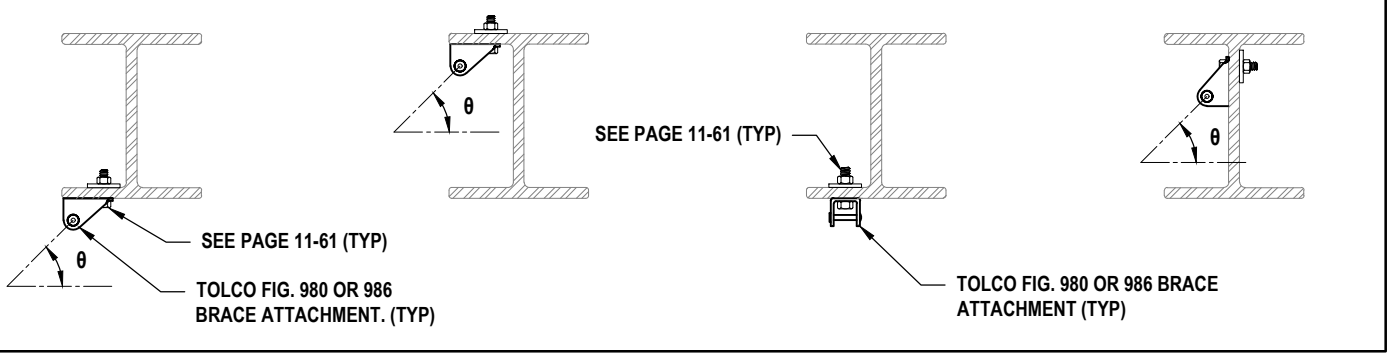
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-26

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 0.75 "G"
1	2.8	1/8"	3/8"	40
1-1/4	3.8	1/8"	3/8"	40
1-1/2	4.5	1/8"	3/8"	40
2	6.2	1/8"	3/8"	40
2-1/2	9.1	1/8"	3/8"	40
3	12.1	1/8"	3/8"	40
4	18.1	3/16"	1/2"	40
5	26.6	3/16"	5/8"	40
6	34.8	3/16"	5/8"	40
8	55.1	3/16"	5/8"	26
10	80.2	3/16"	5/8"	18
12	109.0	3/16"	5/8"	13

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"
1	2.8	1/8"	3/8"	80
1-1/4	3.8	1/8"	3/8"	80
1-1/2	4.5	1/8"	3/8"	80
2	6.2	1/8"	3/8"	80
2-1/2	9.1	3/16"	1/2"	80
3	12.1	3/16"	1/2"	80
4	18.1	3/16"	5/8"	80
5	26.6	3/16"	5/8"	55
6	34.8	3/16"	5/8"	42
8	55.1	3/16"	5/8"	26
10	80.2	3/16"	5/8"	18
12	109.0	3/16"	5/8"	13

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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NOTES:

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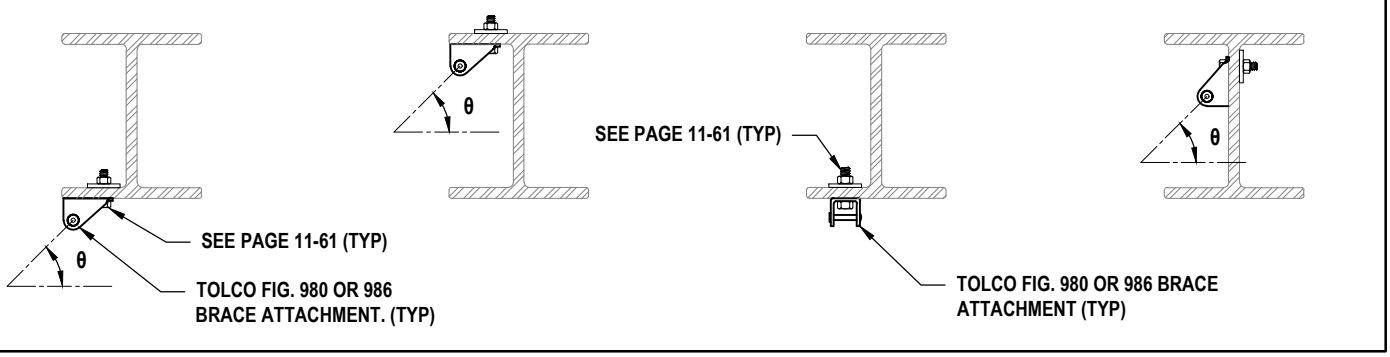
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-27

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR BOLTED ATTACHMENT TO STEEL BEAM

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Transverse[1] Max. Spacing @ 1.0 "G"
1	2.8	1/8"	3/8"	40
1-1/4	3.8	1/8"	3/8"	40
1-1/2	4.5	1/8"	3/8"	40
2	6.2	1/8"	3/8"	40
2-1/2	9.1	1/8"	3/8"	40
3	12.1	1/8"	1/2"	40
4	18.1	3/16"	1/2"	40
5	26.6	3/16"	5/8"	40
6	34.8	3/16"	5/8"	31
8	55.1	3/16"	5/8"	20
10	80.2	3/16"	5/8"	13
12	109.0	3/16"	5/8"	10

FOOTNOTES:

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Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Minimum Bolt Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"
1	2.8	1/8"	3/8"	80
1-1/4	3.8	1/8"	3/8"	80
1-1/2	4.5	1/8"	3/8"	80
2	6.2	1/8"	1/2"	80
2-1/2	9.1	3/16"	5/8"	80
3	12.1	3/16"	5/8"	80
4	18.1	3/16"	5/8"	61
5	26.6	3/16"	5/8"	41
6	34.8	3/16"	5/8"	31
8	55.1	3/16"	5/8"	20
10	80.2	3/16"	5/8"	13
12	109.0	3/16"	5/8"	10

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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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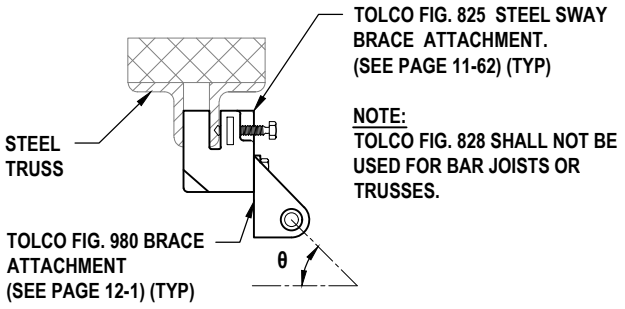
Structural Engineer: Mohammad R. Hariri
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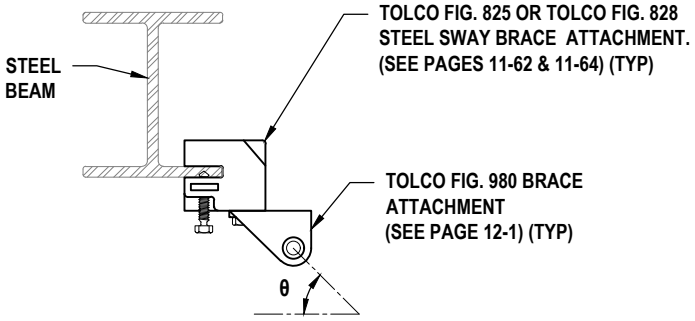
PAGE: 7-28

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.25 "G"





Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	1/8"	40	40
5	26.6	1/8"	40	40
6	34.8	3/16"	40	40
8	55.1	3/16"	40	30
10	80.2	3/16"	40	20
12	109.0	3/16"	33	15

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	1/8"	80	80
3	12.1	1/8"	80	80
4	18.1	3/16"	80	80
5	26.6	3/16"	80	62
6	34.8	3/16"	80	48
8	55.1	3/16"	65	30
10	80.2	3/16"	44	20
12	109.0	3/16"	33	15

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE ICAT OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G

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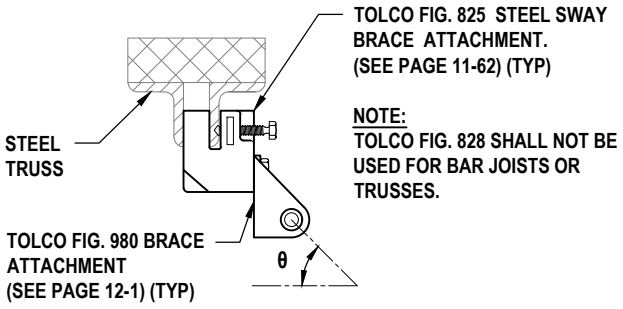
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

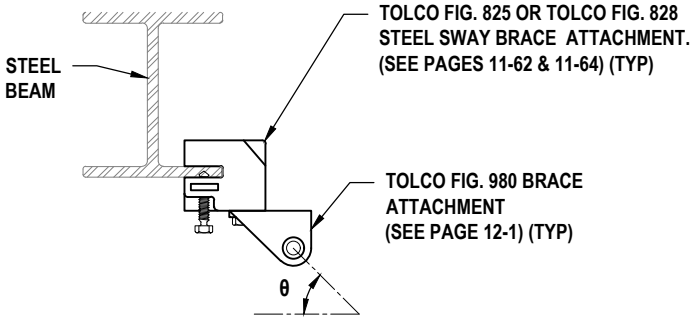
PAGE: 7-29

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.50 "G"





Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	1/8"	40	40
5	26.6	1/8"	40	31
6	34.8	3/16"	40	24
8	55.1	3/16"	32	15
10	80.2	3/16"	22	10
12	109.0	3/16"	16	7

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	1/8"	80	80
3	12.1	1/8"	80	69
4	18.1	3/16"	80	46
5	26.6	3/16"	67	31
6	34.8	3/16"	51	24
8	55.1	3/16"	32	15
10	80.2	3/16"	22	10
12	109.0	3/16"	16	7

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE
OPM-0053
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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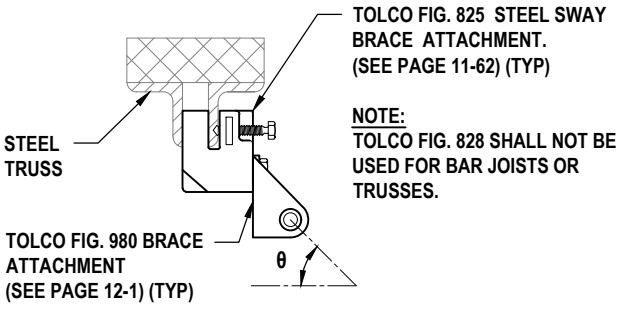
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

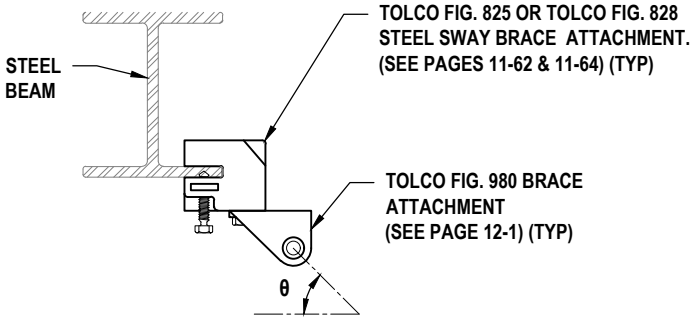
PAGE: 7-30

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.75 "G"





Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	40
4	18.1	3/16"	40	30
5	26.6	3/16"	40	20
6	34.8	3/16"	34	16
8	55.1	3/16"	21	10
10	80.2	3/16"	14	6
12	109.0	3/16"	11	5

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	80
2-1/2	9.1	3/16"	80	61
3	12.1	3/16"	80	46
4	18.1	3/16"	66	30
5	26.6	3/16"	45	20
6	34.8	3/16"	34	16
8	55.1	3/16"	21	10
10	80.2	3/16"	14	6
12	109.0	3/16"	11	5

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE ICAI OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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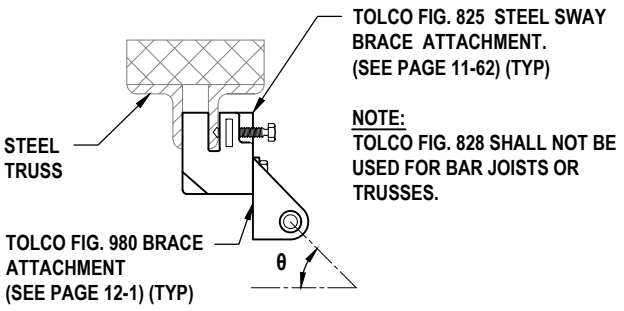
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

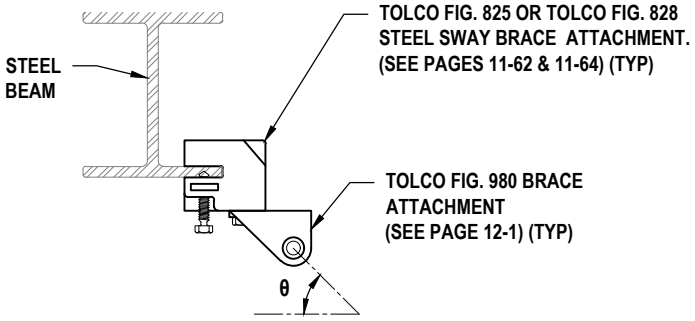
PAGE: 7-31

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	40	40
1-1/4	3.8	1/8"	40	40
1-1/2	4.5	1/8"	40	40
2	6.2	1/8"	40	40
2-1/2	9.1	1/8"	40	40
3	12.1	1/8"	40	34
4	18.1	3/16"	40	23
5	26.6	3/16"	33	15
6	34.8	3/16"	25	12
8	55.1	3/16"	16	7
10	80.2	3/16"	11	5
12				

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Pipe Diameter	Max. Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
			Perpendicular[2]	Parallel[2]
1	2.8	1/8"	80	80
1-1/4	3.8	1/8"	80	80
1-1/2	4.5	1/8"	80	80
2	6.2	1/8"	80	67
2-1/2	9.1	3/16"	80	45
3	12.1	3/16"	74	34
4	18.1	3/16"	49	23
5	26.6	3/16"	33	15
6	34.8	3/16"	25	12
8	55.1	3/16"	16	7
10	80.2	3/16"	11	5
12				

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE OPM-0053 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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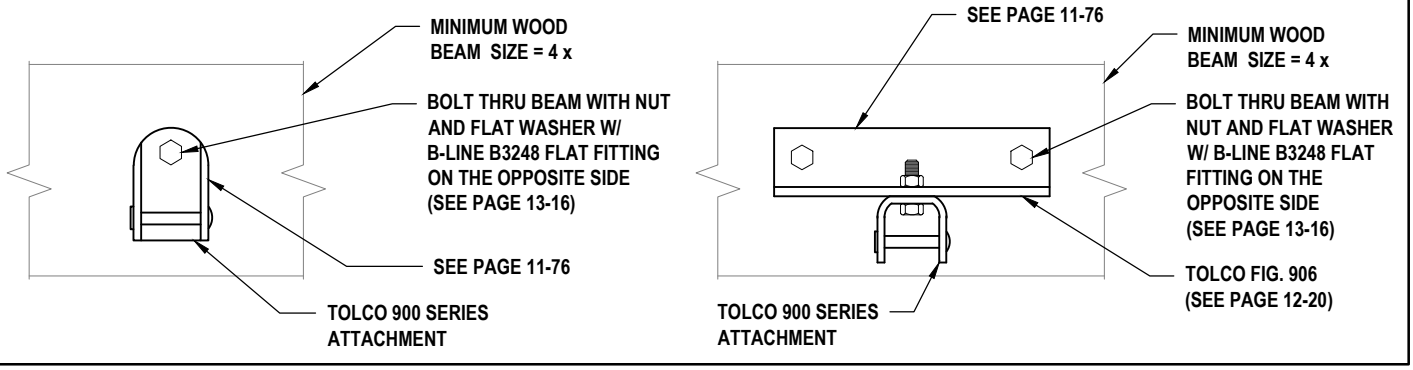
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-32

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	1	1/2"
4	18.1	40	1/8"	1	1/2"
5	26.6	40	1/8"	1	1/2"
6	34.8	40	1/8"	1	1/2"
8	55.1	40	3/16"	2	1/2"
10	80.2	38	3/16"	2	1/2"
12	109.0	28	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	1	1/2"
2-1/2	9.1	80	1/8"	1	1/2"
3	12.1	80	1/8"	1	1/2"
4	18.1	80	1/8"	1	1/2"
5	26.6	80	3/16"	2	1/2"
6	34.8	80	3/16"	2	1/2"
8	55.1	55	3/16"	2	1/2"
10	80.2	38	3/16"	2	1/2"
12	109.0	28	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE ICAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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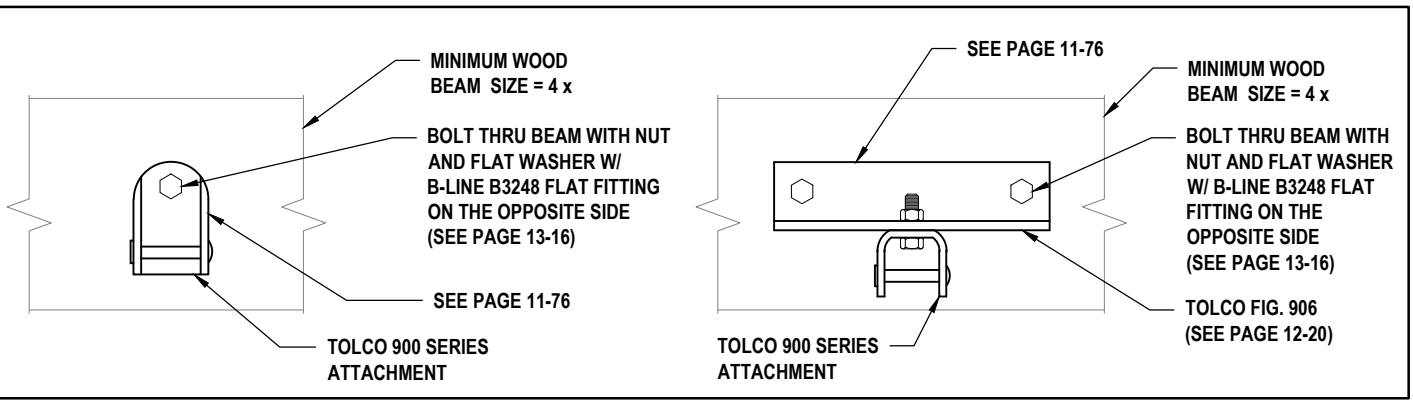
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-33

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	1	1/2"
4	18.1	40	1/8"	1	1/2"
5	26.6	40	3/16"	2	1/2"
6	34.8	40	3/16"	2	1/2"
8	55.1	27	3/16"	2	1/2"
10	80.2	19	3/16"	2	1/2"
12	109.0	14	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	1	1/2"
2-1/2	9.1	80	1/8"	1	1/2"
3	12.1	80	1/8"	2	1/2"
4	18.1	80	3/16"	2	1/2"
5	26.6	57	3/16"	2	1/2"
6	34.8	44	3/16"	2	1/2"
8	55.1	27	3/16"	2	1/2"
10	80.2	19	3/16"	2	1/2"
12	109.0	14	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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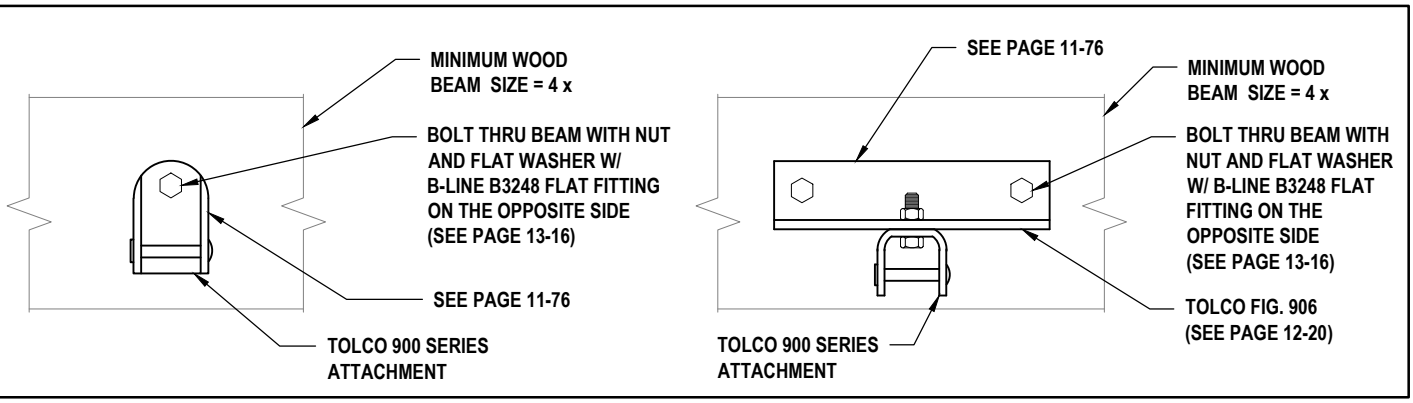
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-34

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1]	Cable Diameter	Thru-Bolts	
		Max. Spacing @ 0.75 "G"		Bolt Qty.	Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	1	1/2"
4	18.1	38	1/8"	2	1/2"
5	26.6	38	3/16"	2	1/2"
6	34.8	29	3/16"	2	1/2"
8	55.1	18	3/16"	2	1/2"
10	80.2	12	3/16"	2	1/2"
12	109.0	9	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1]	Cable Diameter	Thru-Bolts	
		Max. Spacing @ 0.75 "G"		Bolt Qty.	Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	1	1/2"
2-1/2	9.1	77	1/8"	2	1/2"
3	12.1	80	3/16"	2	1/2"
4	18.1	56	3/16"	2	1/2"
5	26.6	38	3/16"	2	1/2"
6	34.8	29	3/16"	2	1/2"
8	55.1	18	3/16"	2	1/2"
10	80.2	12	3/16"	2	1/2"
12	109.0	9	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE ICAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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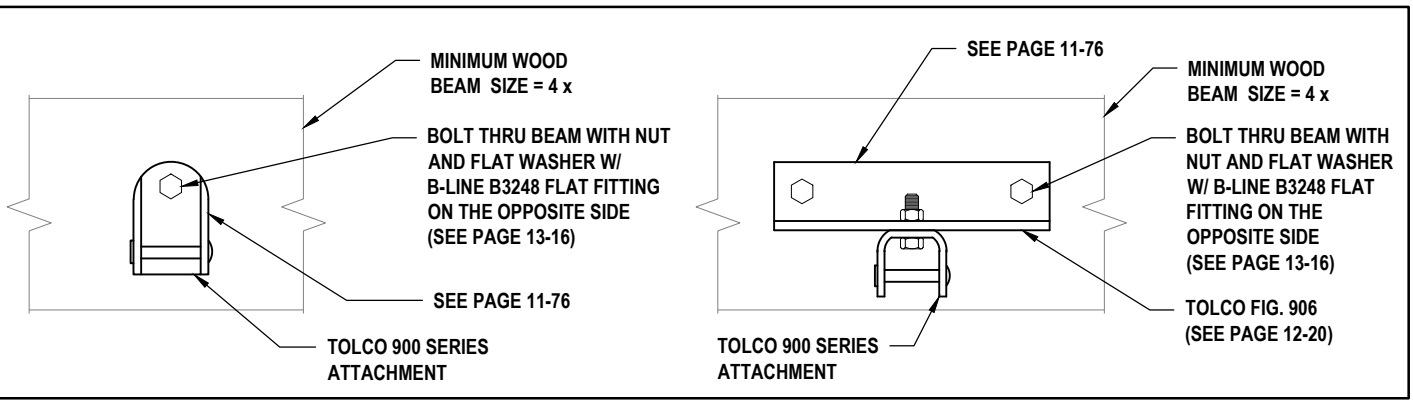
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-35

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	2	1/2"
4	18.1	40	3/16"	2	1/2"
5	26.6	28	3/16"	2	1/2"
6	34.8	22	3/16"	2	1/2"
8	55.1	13	3/16"	2	1/2"
10	80.2	9	3/16"	2	1/2"
12	109.0	7	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	2	1/2"
2-1/2	9.1	80	3/16"	2	1/2"
3	12.1	63	3/16"	2	1/2"
4	18.1	42	3/16"	2	1/2"
5	26.6	28	3/16"	2	1/2"
6	34.8	22	3/16"	2	1/2"
8	55.1	13	3/16"	2	1/2"
10	80.2	9	3/16"	2	1/2"
12	109.0	7	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE ICAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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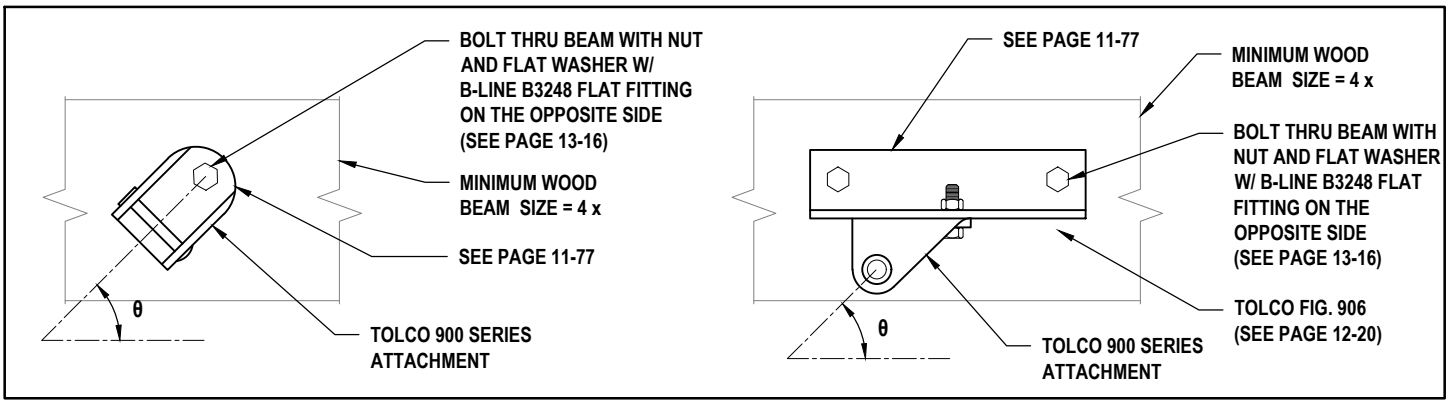
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-36

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	1	1/2"
4	18.1	40	1/8"	1	1/2"
5	26.6	40	1/8"	1	1/2"
6	34.8	40	1/8"	2	1/2"
8	55.1	40	3/16"	2	1/2"
10	80.2	37	3/16"	2	3/4"
12	109.0	27	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	1	1/2"
2-1/2	9.1	80	1/8"	1	1/2"
3	12.1	80	1/8"	1	1/2"
4	18.1	80	1/8"	2	1/2"
5	26.6	80	3/16"	2	1/2"
6	34.8	80	3/16"	2	5/8"
8	55.1	55	3/16"	2	3/4"
10	80.2	37	3/16"	2	3/4"
12	109.0	27	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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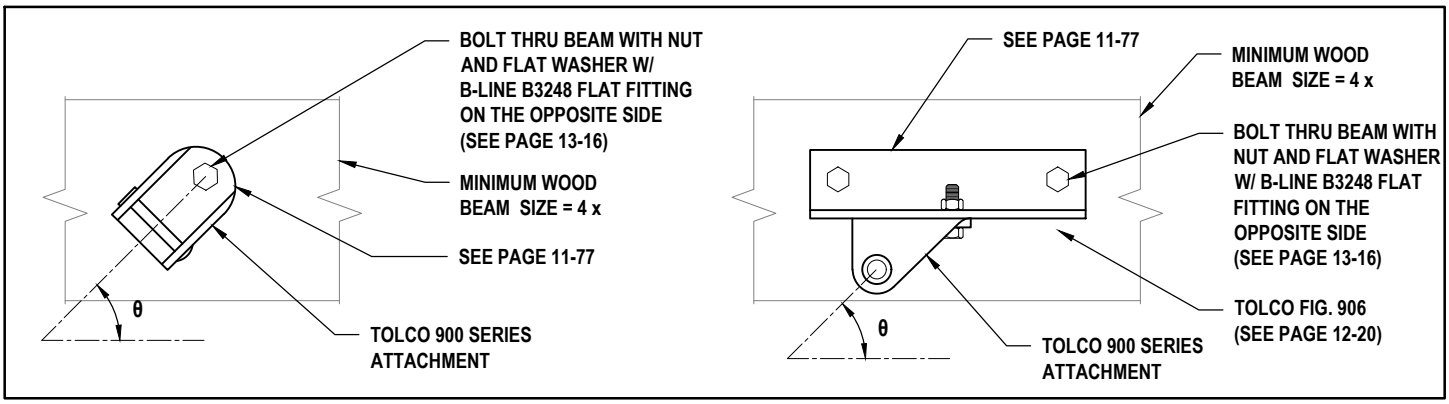
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-37

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	1/2"
3	12.1	40	1/8"	1	1/2"
4	18.1	40	1/8"	2	1/2"
5	26.6	40	3/16"	2	1/2"
6	34.8	40	3/16"	2	5/8"
8	55.1	27	3/16"	2	3/4"
10	80.2	18	3/16"	2	3/4"
12	109.0	13	3/16"	2	3/4"

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	1/2"
2	6.2	80	1/8"	1	1/2"
2-1/2	9.1	80	1/8"	2	1/2"
3	12.1	80	1/8"	2	1/2"
4	18.1	80	3/16"	2	3/4"
5	26.6	57	3/16"	2	3/4"
6	34.8	43	3/16"	2	3/4"
8	55.1	27	3/16"	2	3/4"
10	80.2	18	3/16"	2	3/4"
12	109.0	13	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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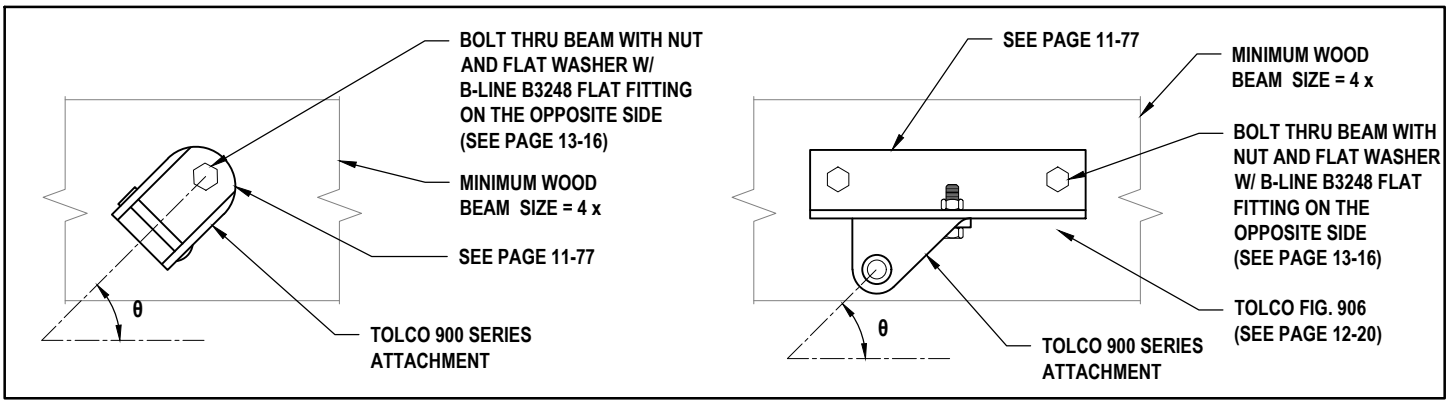
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-38

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	1	5/8"
3	12.1	40	1/8"	2	1/2"
4	18.1	40	3/16"	2	1/2"
5	26.6	38	3/16"	2	3/4"
6	34.8	29	3/16"	2	3/4"
8	55.1	18	3/16"	2	3/4"
10	80.2	12	3/16"	2	3/4"
12	109.0	9	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	1/2"
1-1/2	4.5	80	1/8"	1	5/8"
2	6.2	80	1/8"	2	1/2"
2-1/2	9.1	80	3/16"	2	1/2"
3	12.1	80	3/16"	2	3/4"
4	18.1	55	3/16"	2	3/4"
5	26.6	38	3/16"	2	3/4"
6	34.8	29	3/16"	2	3/4"
8	55.1	18	3/16"	2	3/4"
10	80.2	12	3/16"	2	3/4"
12	109.0	9	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

REVIEWED FOR CODE COMPLIANCE ICAT OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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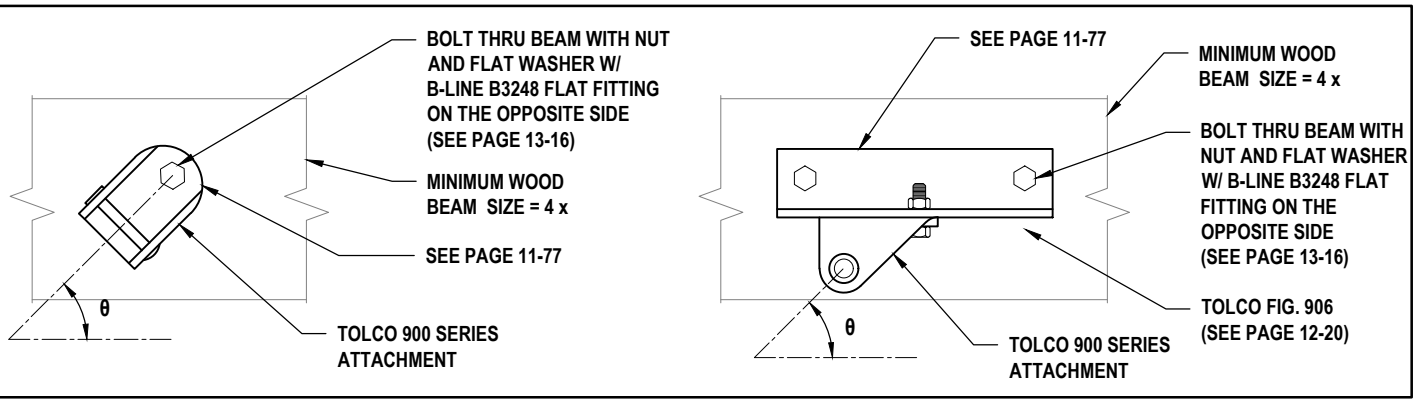
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-39

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	40	1/8"	1	1/2"
1-1/4	3.8	40	1/8"	1	1/2"
1-1/2	4.5	40	1/8"	1	1/2"
2	6.2	40	1/8"	1	1/2"
2-1/2	9.1	40	1/8"	2	1/2"
3	12.1	40	1/8"	2	1/2"
4	18.1	40	3/16"	2	3/4"
5	26.6	28	3/16"	2	3/4"
6	34.8	21	3/16"	2	3/4"
8	55.1	13	3/16"	2	3/4"
10	80.2	9	3/16"	2	3/4"
12	109.0	6	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
1	2.8	80	1/8"	1	1/2"
1-1/4	3.8	80	1/8"	1	3/4"
1-1/2	4.5	80	1/8"	2	1/2"
2	6.2	80	1/8"	2	1/2"
2-1/2	9.1	80	3/16"	2	3/4"
3	12.1	62	3/16"	2	3/4"
4	18.1	41	3/16"	2	3/4"
5	26.6	28	3/16"	2	3/4"
6	34.8	21	3/16"	2	3/4"
8	55.1	13	3/16"	2	3/4"
10	80.2	9	3/16"	2	3/4"
12	109.0	6	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

REVIEWED FOR CODE COMPLIANCE
ICAT
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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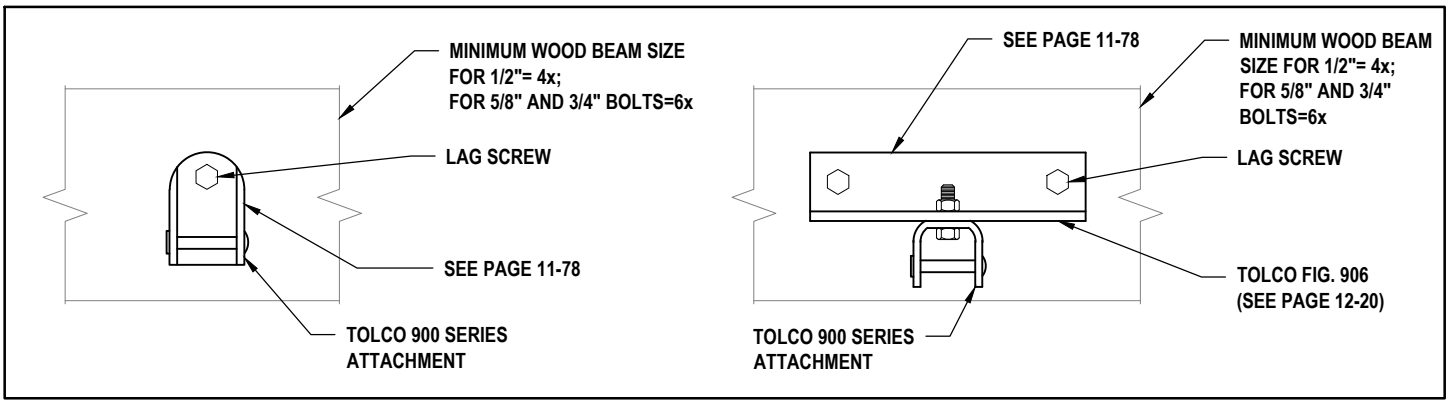
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-40

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	1/2"	3"
2	6.2	40	1/8"	1	1/2"	3"
2-1/2	9.1	40	1/8"	1	1/2"	3"
3	12.1	40	1/8"	1	1/2"	3"
4	18.1	40	1/8"	1	5/8"	5"
5	26.6	40	1/8"	2	1/2"	3"
6	34.8	40	1/8"	2	5/8"	5"
8	55.1	30	1/8"	2	3/4"	5"
10	80.2	21	1/8"	2	3/4"	5"
12	109.0	15	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	1	1/2"	3"
1-1/4	3.8	80	1/8"	1	1/2"	3"
1-1/2	4.5	80	1/8"	1	1/2"	3"
2	6.2	80	1/8"	1	1/2"	3"
2-1/2	9.1	80	1/8"	1	5/8"	5"
3	12.1	80	1/8"	2	1/2"	3"
4	18.1	80	1/8"	2	5/8"	5"
5	26.6	63	1/8"	2	3/4"	5"
6	34.8	48	1/8"	2	3/4"	5"
8	55.1	30	1/8"	2	3/4"	5"
10	80.2	21	1/8"	2	3/4"	5"
12	109.0	15	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE IHCA OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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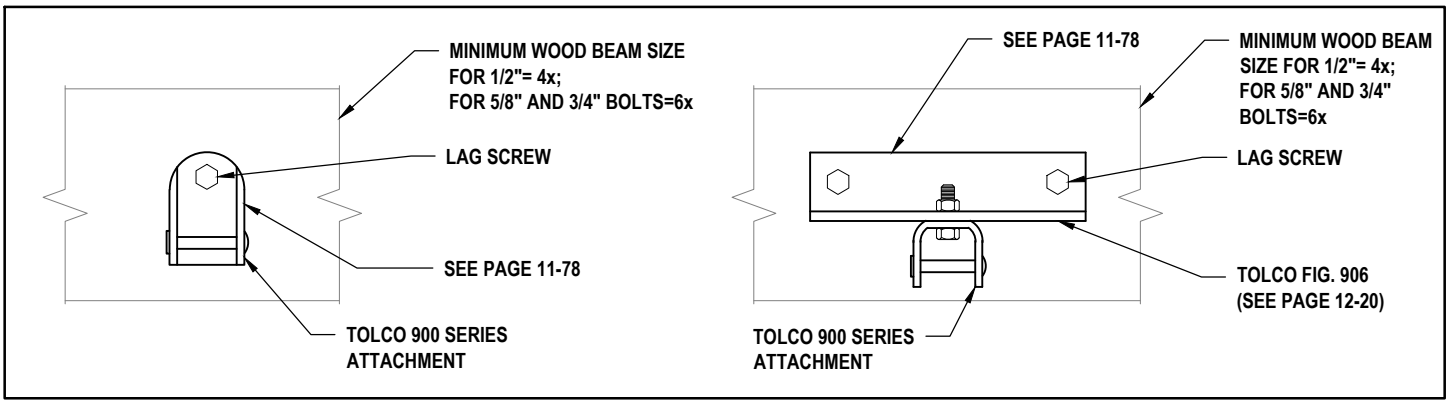
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-41

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	1/2"	3"
2	6.2	40	1/8"	1	1/2"	3"
2-1/2	9.1	40	1/8"	1	5/8"	5"
3	12.1	40	1/8"	2	1/2"	3"
4	18.1	40	1/8"	2	5/8"	5"
5	26.6	31	1/8"	2	3/4"	5"
6	34.8	24	1/8"	2	3/4"	5"
8	55.1	15	1/8"	2	3/4"	5"
10	80.2	10	1/8"	2	3/4"	5"
12	109.0	7	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	1	1/2"	3"
1-1/4	3.8	80	1/8"	1	1/2"	3"
1-1/2	4.5	80	1/8"	1	5/8"	5"
2	6.2	80	1/8"	2	1/2"	3"
2-1/2	9.1	80	1/8"	2	5/8"	5"
3	12.1	69	1/8"	2	3/4"	5"
4	18.1	46	1/8"	2	3/4"	5"
5	26.6	31	1/8"	2	3/4"	5"
6	34.8	24	1/8"	2	3/4"	5"
8	55.1	15	1/8"	2	3/4"	5"
10	80.2	10	1/8"	2	3/4"	5"
12	109.0	7	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE IHCA OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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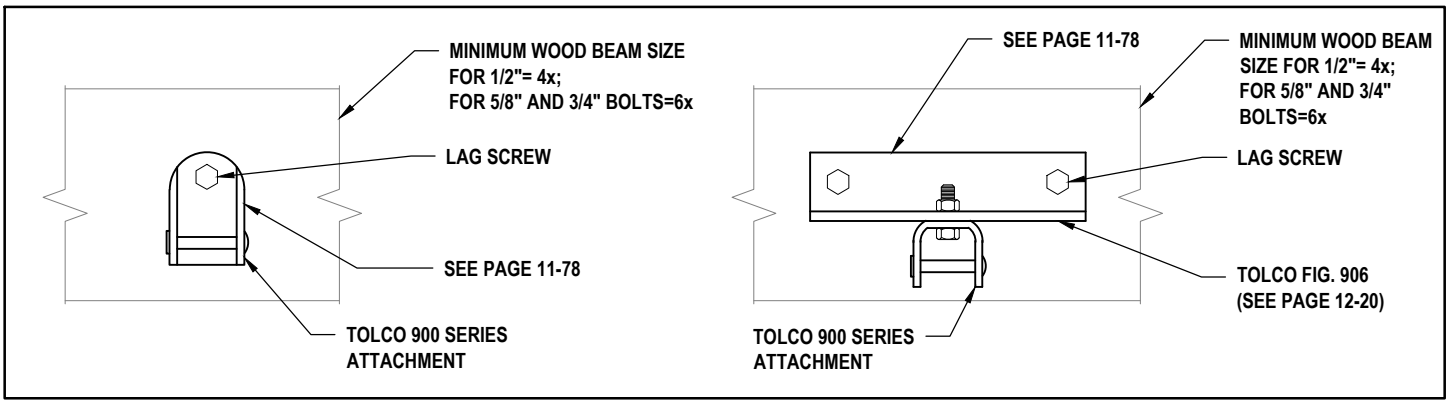
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-42

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	1/2"	3"
2	6.2	40	1/8"	1	5/8"	5"
2-1/2	9.1	40	1/8"	2	1/2"	3"
3	12.1	40	1/8"	2	5/8"	5"
4	18.1	31	1/8"	2	3/4"	5"
5	26.6	21	1/8"	2	3/4"	5"
6	34.8	16	1/8"	2	3/4"	5"
8	55.1	10	1/8"	2	3/4"	5"
10	80.2	7	1/8"	2	3/4"	5"
12	109.0	5	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	1	1/2"	3"
1-1/4	3.8	80	1/8"	2	1/2"	3"
1-1/2	4.5	80	1/8"	2	1/2"	3"
2	6.2	80	1/8"	2	5/8"	5"
2-1/2	9.1	61	1/8"	2	3/4"	5"
3	12.1	46	1/8"	2	3/4"	5"
4	18.1	31	1/8"	2	3/4"	5"
5	26.6	21	1/8"	2	3/4"	5"
6	34.8	16	1/8"	2	3/4"	5"
8	55.1	10	1/8"	2	3/4"	5"
10	80.2	7	1/8"	2	3/4"	5"
12	109.0	5	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE IHCA OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.75G.

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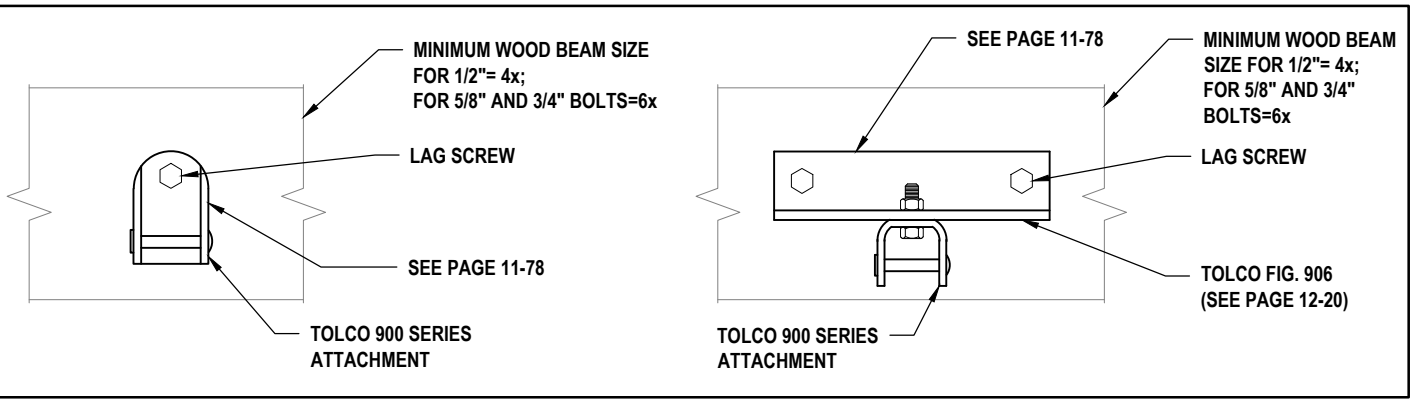
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **7-43**

DATE: **April 23, 2025**

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	5/8"	5"
2	6.2	40	1/8"	2	1/2"	3"
2-1/2	9.1	40	1/8"	2	5/8"	5"
3	12.1	34	1/8"	2	3/4"	5"
4	18.1	23	1/8"	2	3/4"	5"
5	26.6	15	1/8"	2	3/4"	5"
6	34.8	12	1/8"	2	3/4"	5"
8	55.1	7	1/8"	2	3/4"	5"
10	80.2	5	1/8"	2	3/4"	5"
12						

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	2	1/2"	3"
1-1/4	3.8	80	1/8"	2	1/2"	3"
1-1/2	4.5	80	1/8"	2	5/8"	5"
2	6.2	68	1/8"	2	3/4"	5"
2-1/2	9.1	46	1/8"	2	3/4"	5"
3	12.1	34	1/8"	2	3/4"	5"
4	18.1	23	1/8"	2	3/4"	5"
5	26.6	15	1/8"	2	3/4"	5"
6	34.8	12	1/8"	2	3/4"	5"
8	55.1	7	1/8"	2	3/4"	5"
10	80.2	5	1/8"	2	3/4"	5"
12						

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 1.0G.

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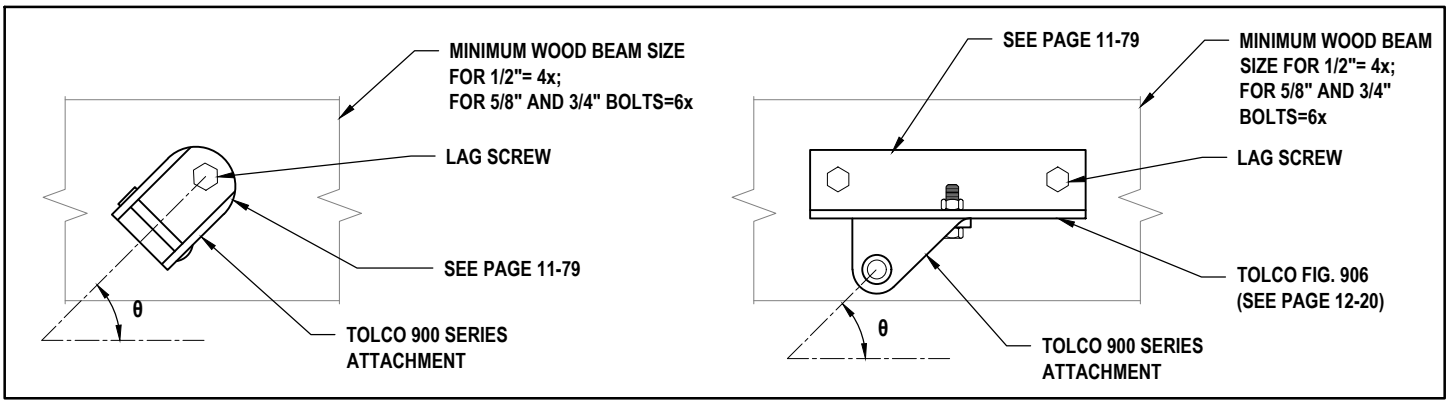
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-44

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	1/2"	3"
2	6.2	40	1/8"	1	1/2"	3"
2-1/2	9.1	40	1/8"	1	1/2"	3"
3	12.1	40	1/8"	1	1/2"	3"
4	18.1	40	1/8"	1	5/8"	5"
5	26.6	40	1/8"	2	5/8"	5"
6	34.8	40	1/8"	2	5/8"	5"
8	55.1	29	1/8"	2	3/4"	5"
10	80.2	20	1/8"	2	3/4"	5"
12	109.0	14	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	1	1/2"	3"
1-1/4	3.8	80	1/8"	1	1/2"	3"
1-1/2	4.5	80	1/8"	1	1/2"	3"
2	6.2	80	1/8"	1	1/2"	3"
2-1/2	9.1	80	1/8"	1	5/8"	5"
3	12.1	80	1/8"	2	1/2"	3"
4	18.1	80	1/8"	2	5/8"	5"
5	26.6	61	1/8"	2	3/4"	5"
6	34.8	46	1/8"	2	3/4"	5"
8	55.1	29	1/8"	2	3/4"	5"
10	80.2	20	1/8"	2	3/4"	5"
12	109.0	14	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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DATE: 04/24/2025
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NOTES:

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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.25G.

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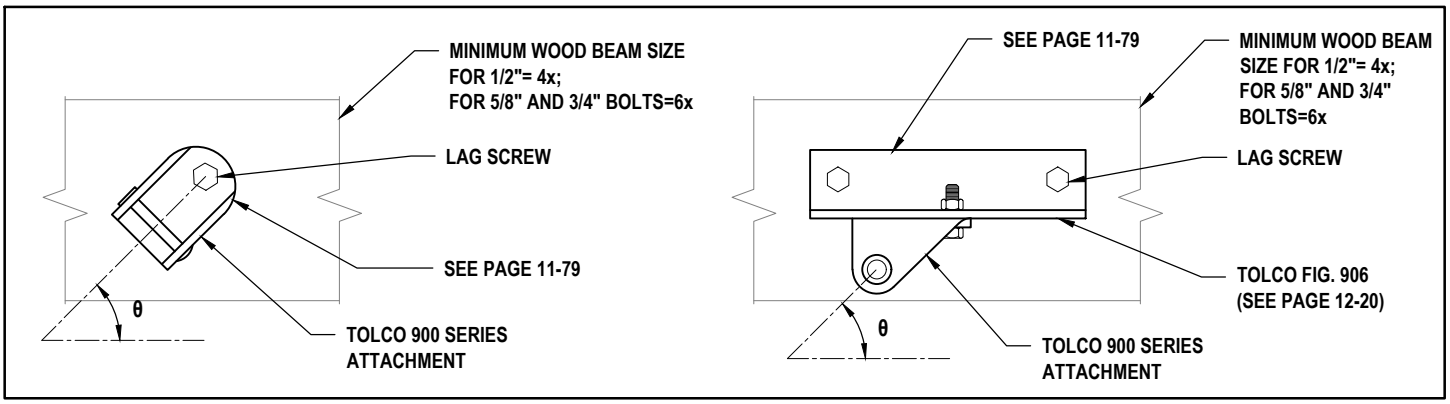
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **7-45**

DATE: **April 23, 2025**

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	1/2"	3"
2	6.2	40	1/8"	1	1/2"	3"
2-1/2	9.1	40	1/8"	1	5/8"	5"
3	12.1	40	1/8"	2	1/2"	3"
4	18.1	40	1/8"	2	5/8"	5"
5	26.6	30	1/8"	2	3/4"	5"
6	34.8	23	1/8"	2	3/4"	5"
8	55.1	14	1/8"	2	3/4"	5"
10	80.2	10	1/8"	2	3/4"	5"
12	109.0	7	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	80	1/8"	1	1/2"	3"
1-1/4	3.8	80	1/8"	1	5/8"	5"
1-1/2	4.5	80	1/8"	1	5/8"	5"
2	6.2	80	1/8"	2	1/2"	3"
2-1/2	9.1	80	1/8"	2	5/8"	5"
3	12.1	67	1/8"	2	3/4"	5"
4	18.1	45	1/8"	2	3/4"	5"
5	26.6	30	1/8"	2	3/4"	5"
6	34.8	23	1/8"	2	3/4"	5"
8	55.1	14	1/8"	2	3/4"	5"
10	80.2	10	1/8"	2	3/4"	5"
12	109.0	7	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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NOTES:

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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF SINGLE HUNG PIPES IN SECTION 6 DIVIDED BY THE PRODUCT OF LISTED PIPE WEIGHT TIMES 0.50G.

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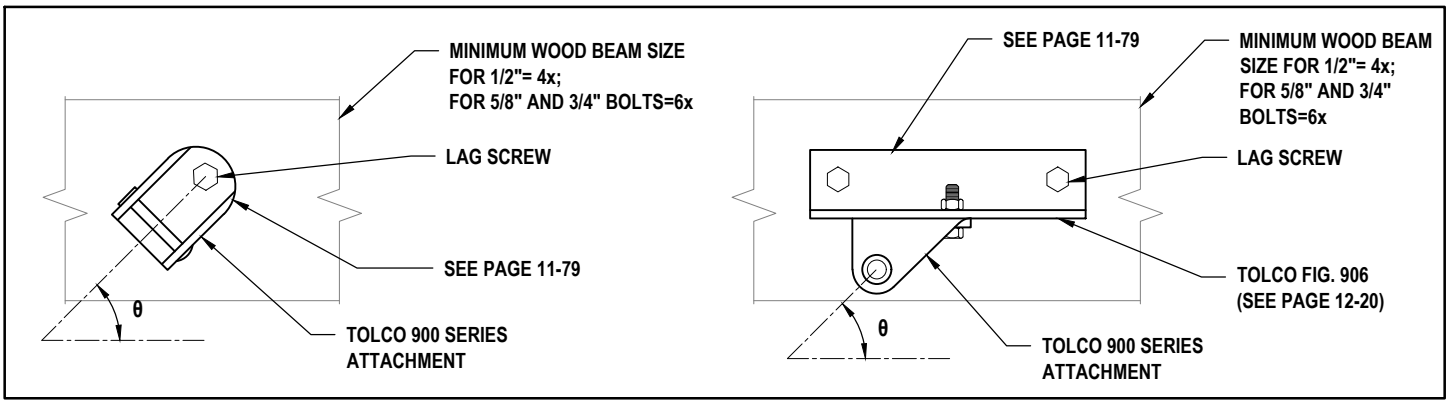
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 7-46

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	1/2"	3"
1-1/2	4.5	40	1/8"	1	5/8"	5"
2	6.2	40	1/8"	1	3/4"	5"
2-1/2	9.1	40	1/8"	2	5/8"	5"
3	12.1	40	1/8"	2	5/8"	5"
4	18.1	30	1/8"	2	3/4"	5"
5	26.6	20	1/8"	2	3/4"	5"
6	34.8	15	1/8"	2	3/4"	5"
8	55.1	9	1/8"	2	3/4"	5"
10	80.2	6	1/8"	2	3/4"	5"
12	109.0	4	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	80	80	1/8"	1	5/8"	5"
1-1/4	61	80	1/8"	2	1/2"	3"
1-1/2	52	80	1/8"	2	5/8"	5"
2	43	80	1/8"	2	3/4"	5"
2-1/2	29	59	1/8"	2	3/4"	5"
3	22	44	1/8"	2	3/4"	5"
4	14	30	1/8"	2	3/4"	5"
5	10	20	1/8"	2	3/4"	5"
6	7	15	1/8"	2	3/4"	5"
8	55.1	9	1/8"	2	3/4"	5"
10	80.2	6	1/8"	2	3/4"	5"
12	109.0	4	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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NOTES:

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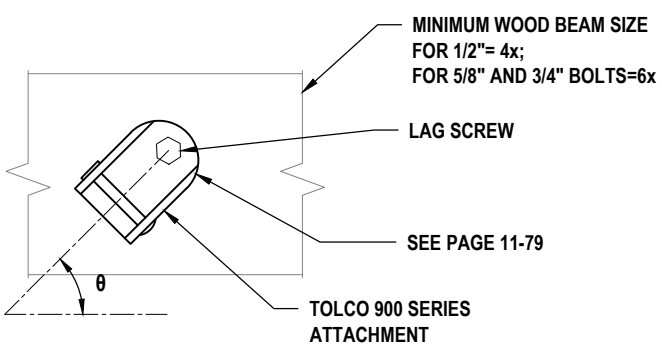
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California SE No. S3545

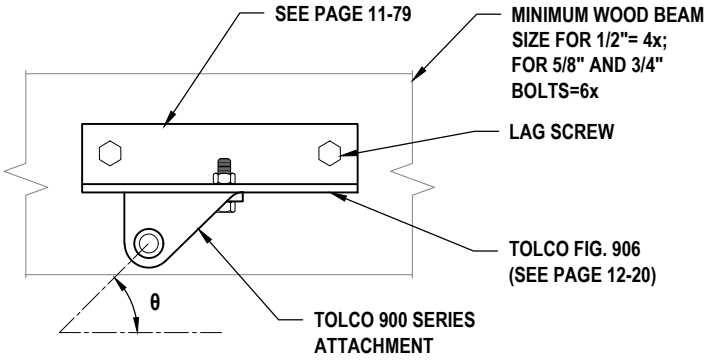
PAGE: 7-47

DATE: April 23, 2025

SINGLE PIPE HANGER BRACE SPACING CHART FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"





Pipe Diameter	Max. Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	2.8	40	1/8"	1	1/2"	3"
1-1/4	3.8	40	1/8"	1	5/8"	5"
1-1/2	4.5	40	1/8"	1	5/8"	5"
2	6.2	40	1/8"	2	1/2"	3"
2-1/2	9.1	40	1/8"	2	5/8"	5"
3	12.1	33	1/8"	2	3/4"	5"
4	18.1	22	1/8"	2	3/4"	5"
5	26.6	15	1/8"	2	3/4"	5"
6	34.8	11	1/8"	2	3/4"	5"
8	55.1	7	1/8"	2	3/4"	5"
10	80.2	5	1/8"	2	3/4"	5"
12						

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Pipe Diameter	Max. Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws Bolt Qty.	Lag Screws Min. Diameter	Lag Screws Min. Length
1	80	80	1/8"	2	1/2"	3"
1-1/4	61	80	1/8"	2	5/8"	5"
1-1/2	52	80	1/8"	2	5/8"	5"
2	43	65	1/8"	2	3/4"	5"
2-1/2	29	44	1/8"	2	3/4"	5"
3	22	33	1/8"	2	3/4"	5"
4	14	22	1/8"	2	3/4"	5"
5	10	15	1/8"	2	3/4"	5"
6	7	11	1/8"	2	3/4"	5"
8	55.1	7	1/8"	2	3/4"	5"
10	80.2	5	1/8"	2	3/4"	5"
12						

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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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BY: Roy Lobo
DATE: 04/24/2025
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California SE No. S3545

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SECTION 8

TRAPEZE CABLE BRACE DETAILS

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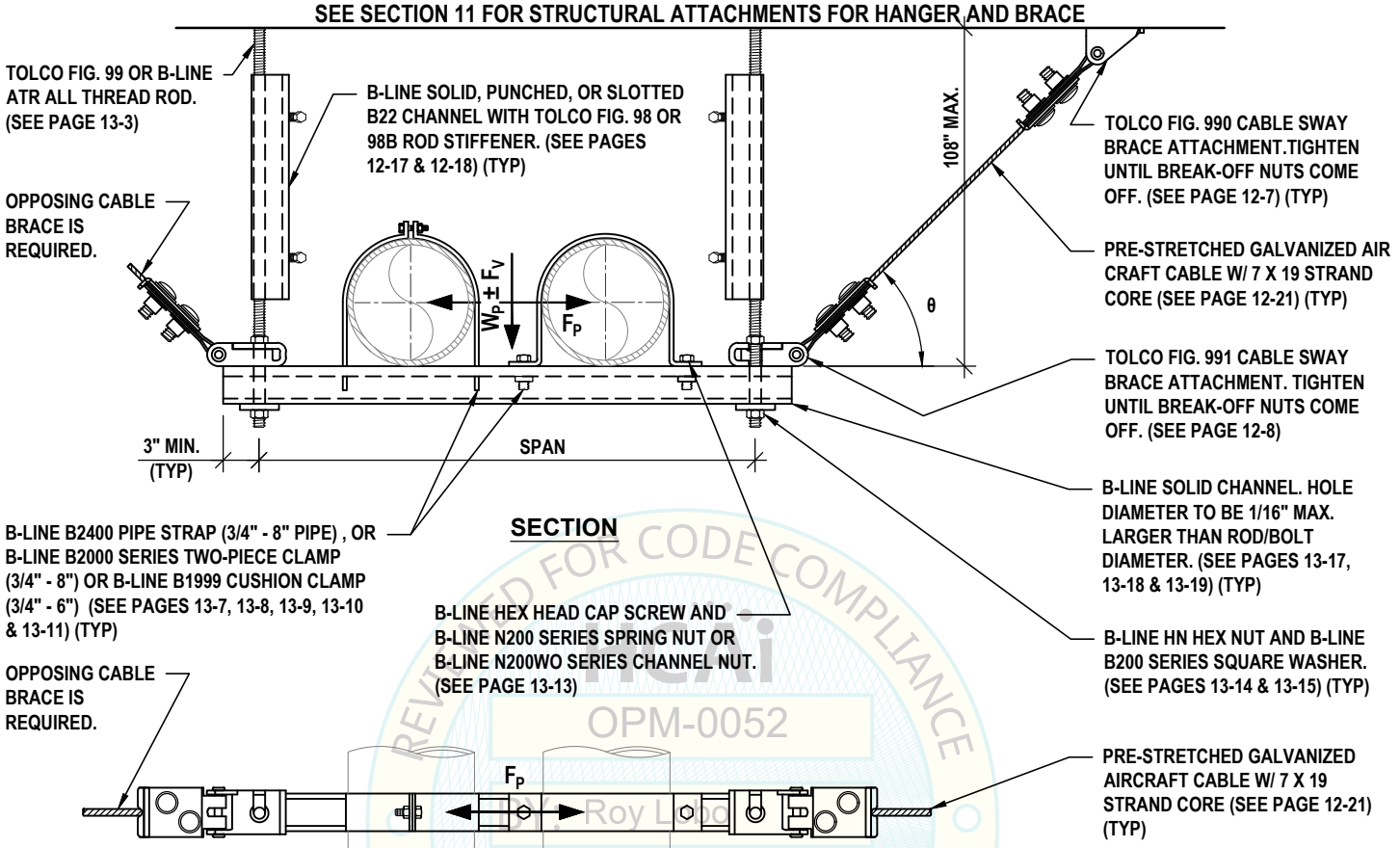
PAGE: 8-0

DATE: April 23, 2025

TRANSVERSE CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

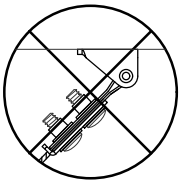
DETAIL
TC-1

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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DATE: 04/24/2025
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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	1263	893	666
3/4"	3/16"	1492	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 8-19 AND 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
4. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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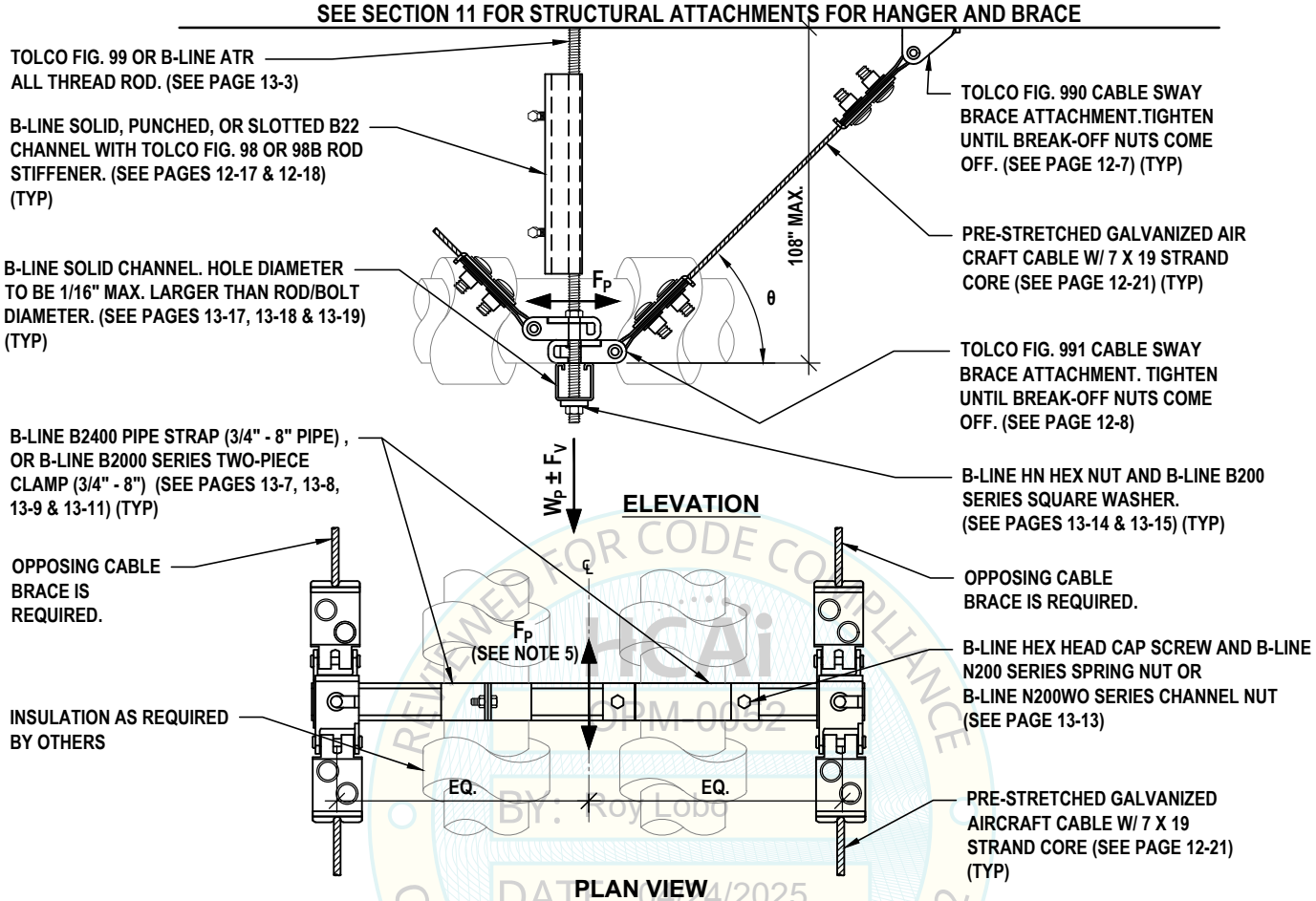
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DATE: **April 23, 2025**

LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

DETAIL
TC-2

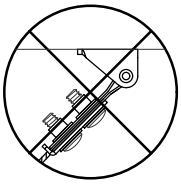
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



ELEVATION

PLAN VIEW

MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 5) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	419	438	408
1/2"	3/16"	422	424	437
3/4"	3/16"	458	470	447



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
4. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
5. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
6. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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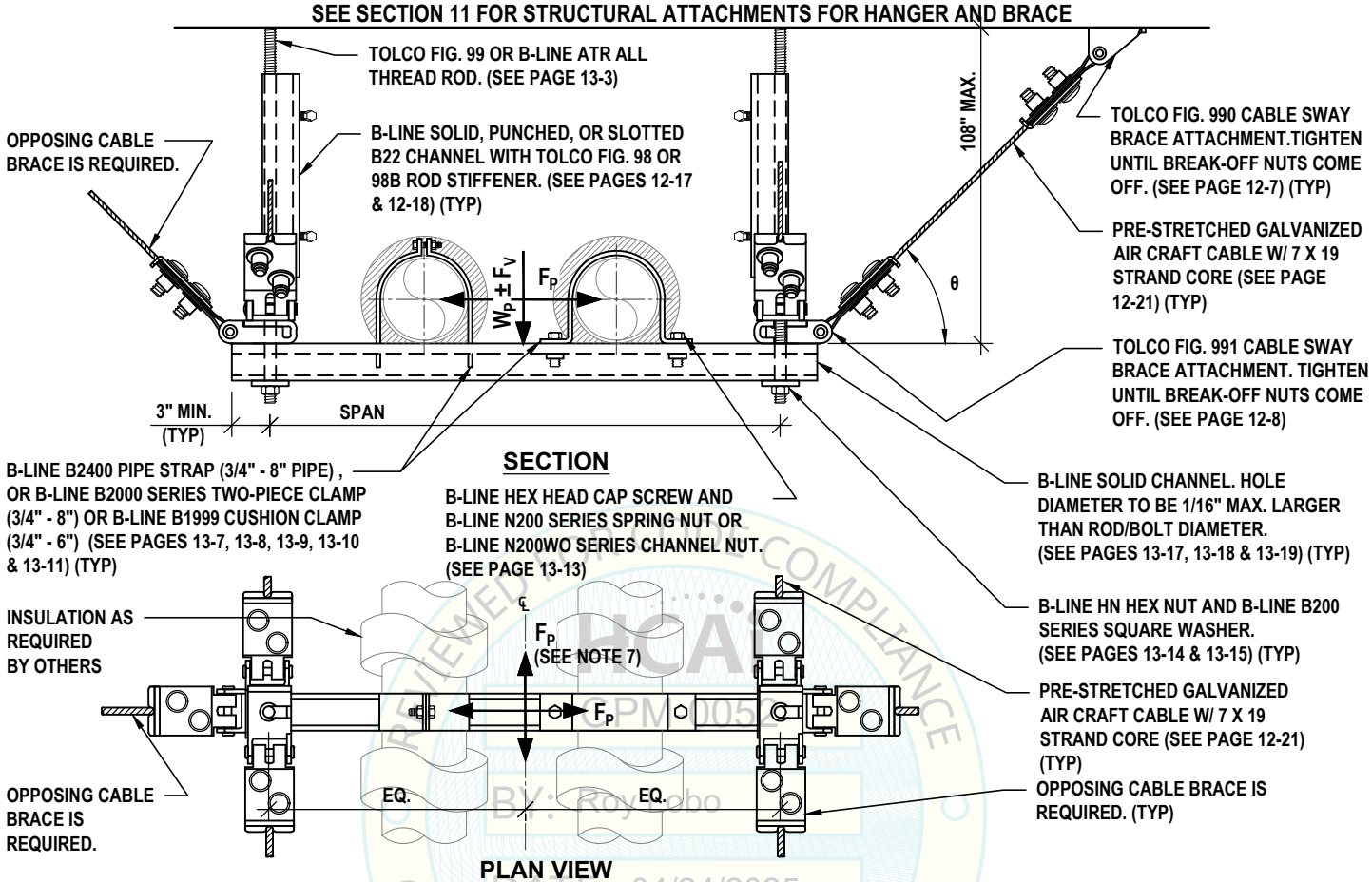
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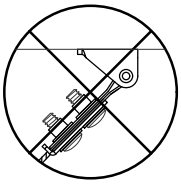
TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

DETAIL
TC-3

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 7) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	301	281	274
3/4"	3/16"	309	319	306



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45 DEGREES.
6. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
7. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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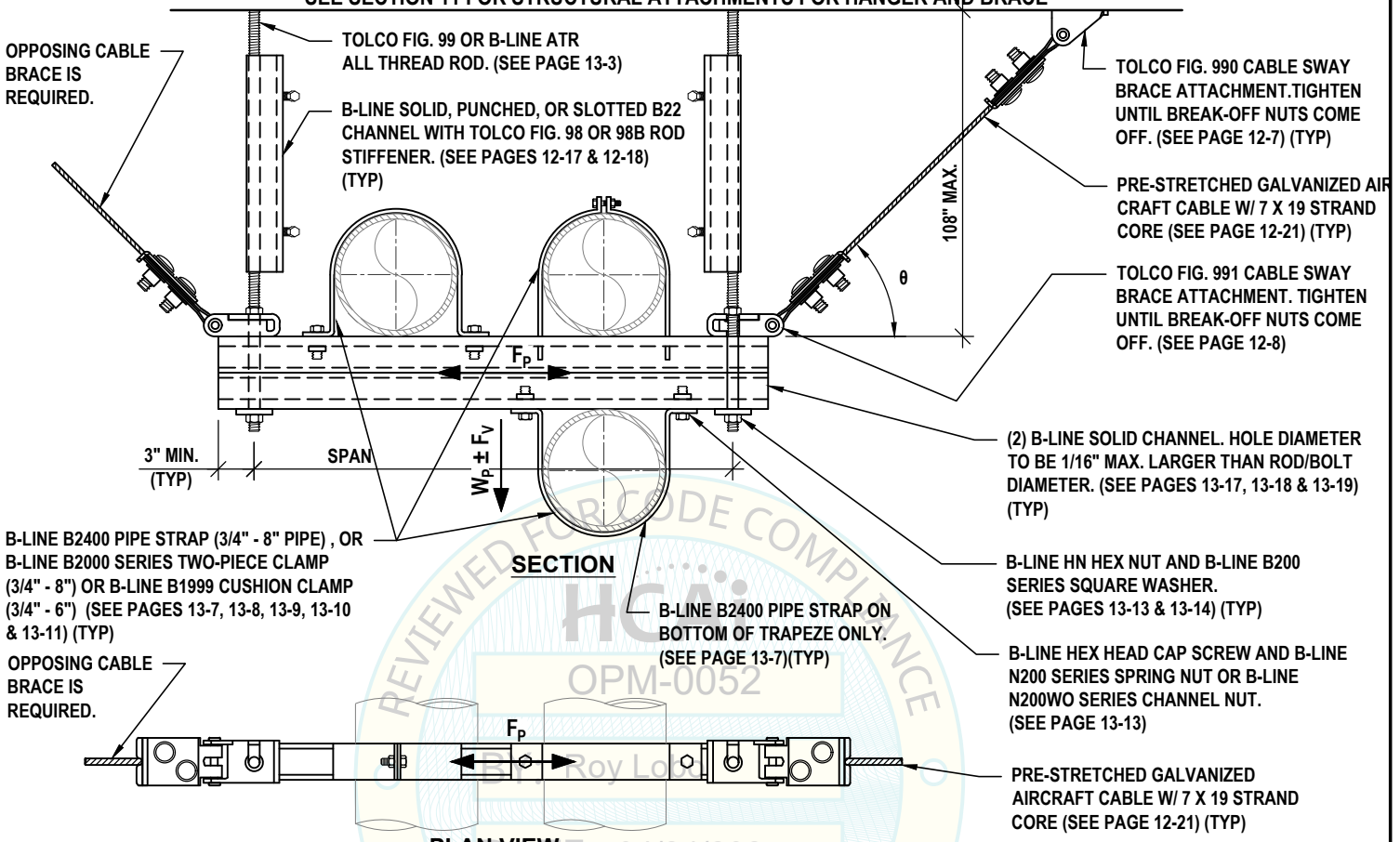
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DATE: **April 23, 2025**

TRANSVERSE CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH DOUBLE TRAPEZE STRUT

DETAIL
TC-4

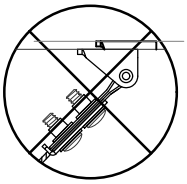
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



SECTION

PLAN VIEW

MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	1263	893	666
3/4"	3/16"	1492	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) PIPING WITH INSULATION - REDUCE LOADS BY 25% FOR 1"-2" PIPES, 32% FOR 2.5"-3.5" PIPES AND 43% FOR 4"-8" PIPES.THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 8-19 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF TRAPEZE STRUT. MAY USE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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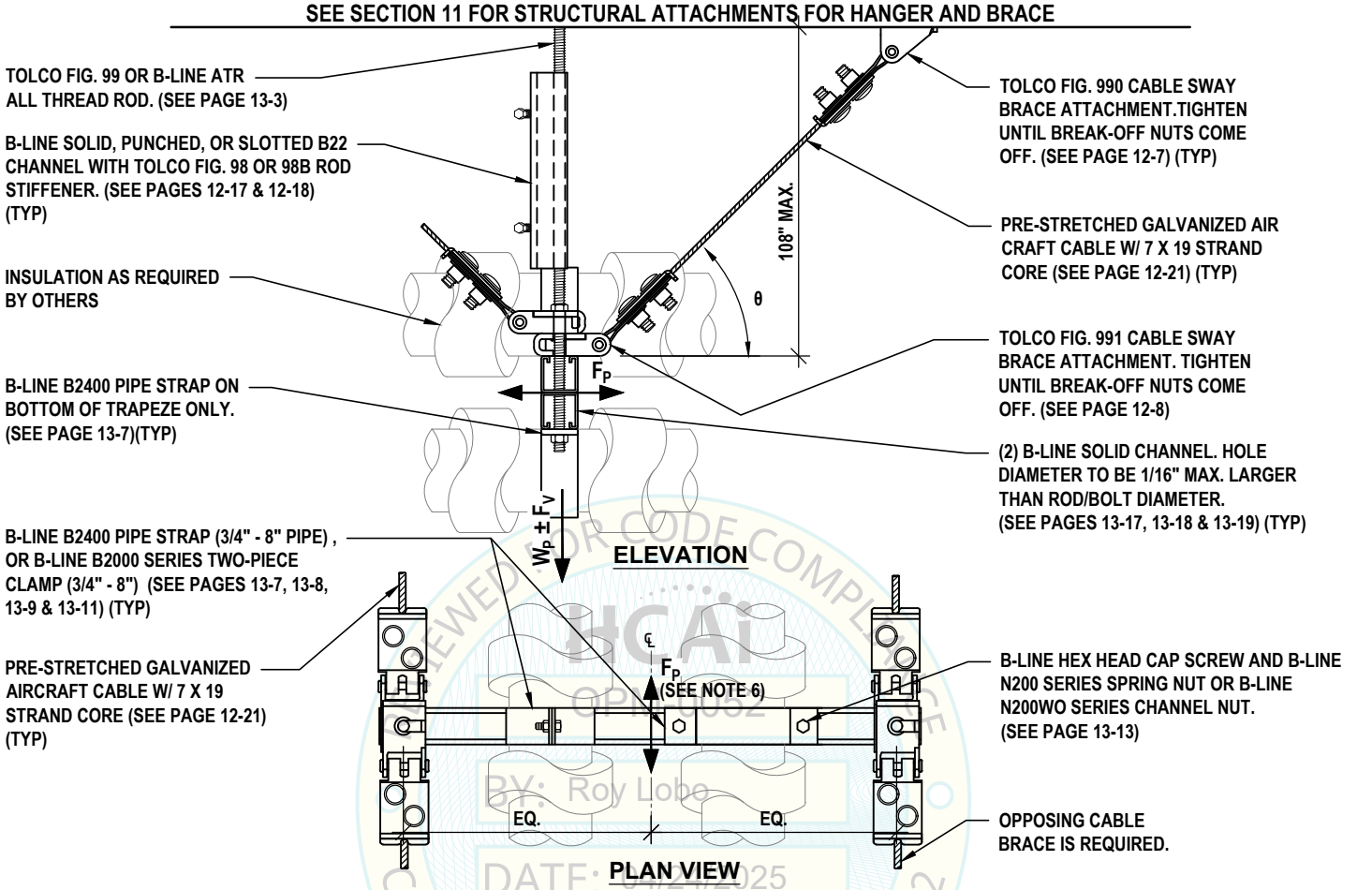
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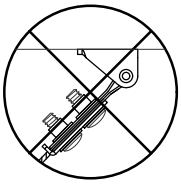
LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH DOUBLE TRAPEZE STRUT

DETAIL TC-5

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	419	438	408
1/2"	3/16"	422	424	437
3/4"	3/16"	458	470	447



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF TRAPEZE STRUT MAY USE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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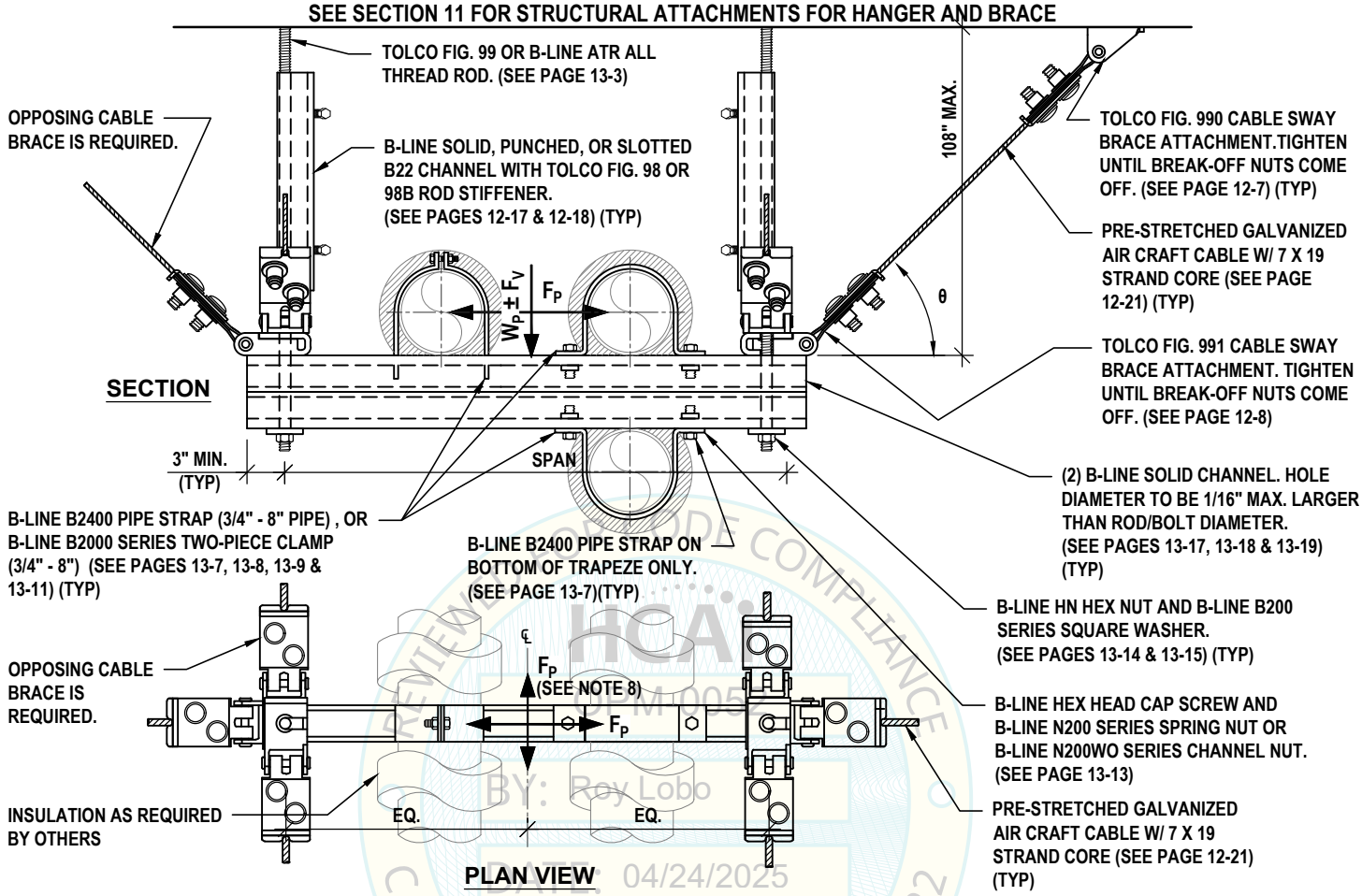
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DATE: April 23, 2025

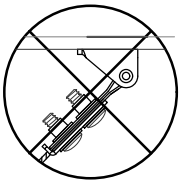
TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR TRAPEZE SUPPORTED PIPE OR CONDUIT WITH SINGLE TRAPEZE STRUT

DETAIL
TC-6

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 8) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	301	281	274
3/4"	3/16"	309	319	306



DO NOT BEND BRACE PAST 90°

NOTES:

1. LOADS LISTED ABOVE ARE FOR SCHEDULE 10 AND BETTER PIPING. THE FOLLOWING REDUCTIONS SHALL APPLY FOR OTHER PIPING AND SYSTEMS:
   a) THIN WALL PIPING - REDUCE LOADS BY 0%
   b) CONDUITS INCLUDING EMT - REDUCE LOADS BY 15%
2. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
3. FOR 2" & SMALLER PIPING 2-PIECE CLAMP MAY BE USED WHEN PIPING IS SUPPORTED-HUNG FROM THE BOTTOM OF TRAPEZE STRUT. MAY USE B2400 FOR UP TO 8" WHEN STRAPPING TO THE BOTTOM OF THE TRAPEZE.
4. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
5. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
6. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
7. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
8. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
9. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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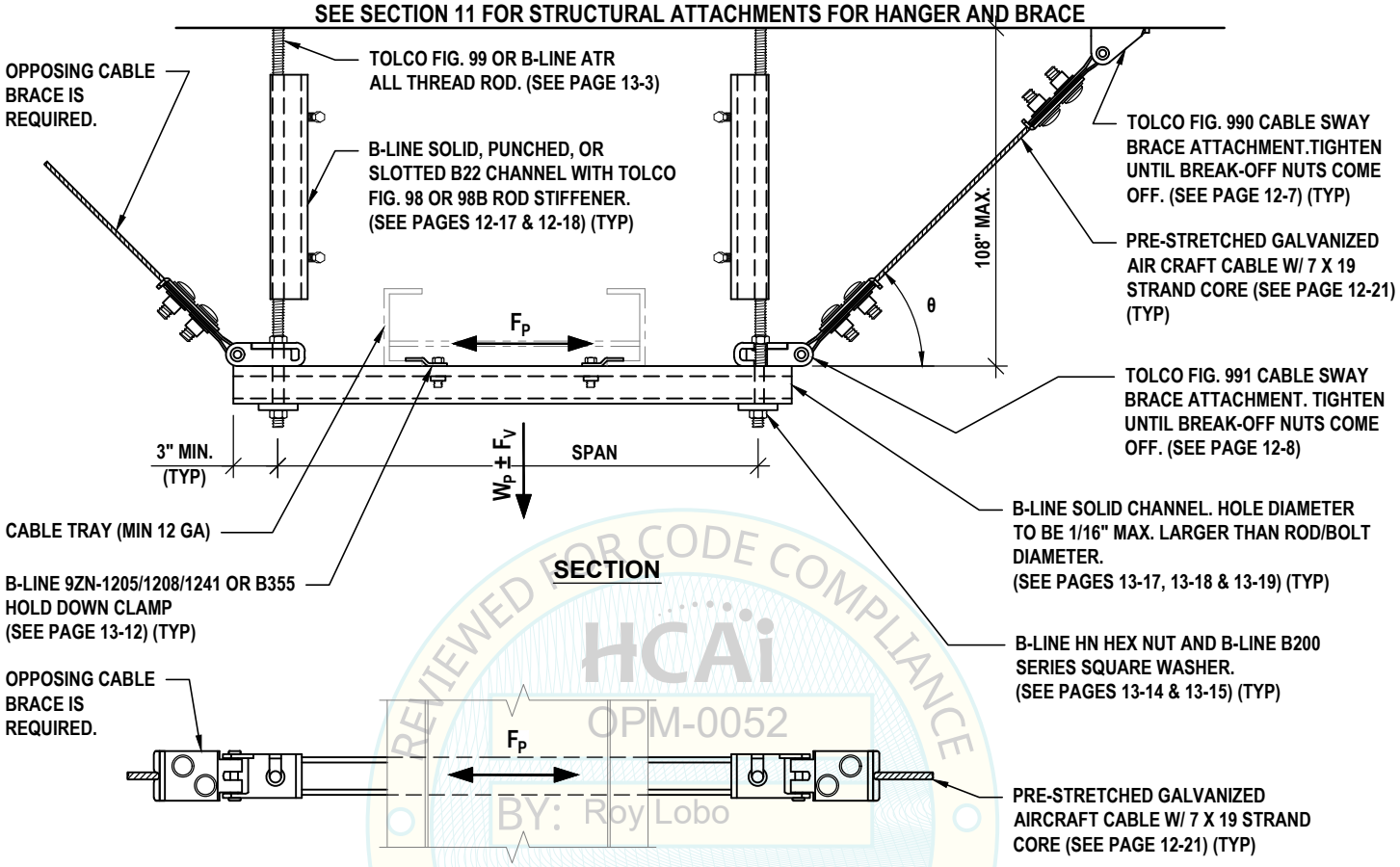
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DATE: **April 23, 2025**

TRANSVERSE CABLE BRACING FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

DETAIL
TC-7

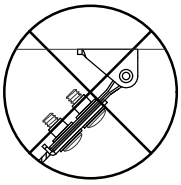
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



SECTION

PLAN VIEW

MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	949	893	666
3/4"	3/16"	949	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-19 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. CABLE TRAY SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. CABLE TRAY BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
4. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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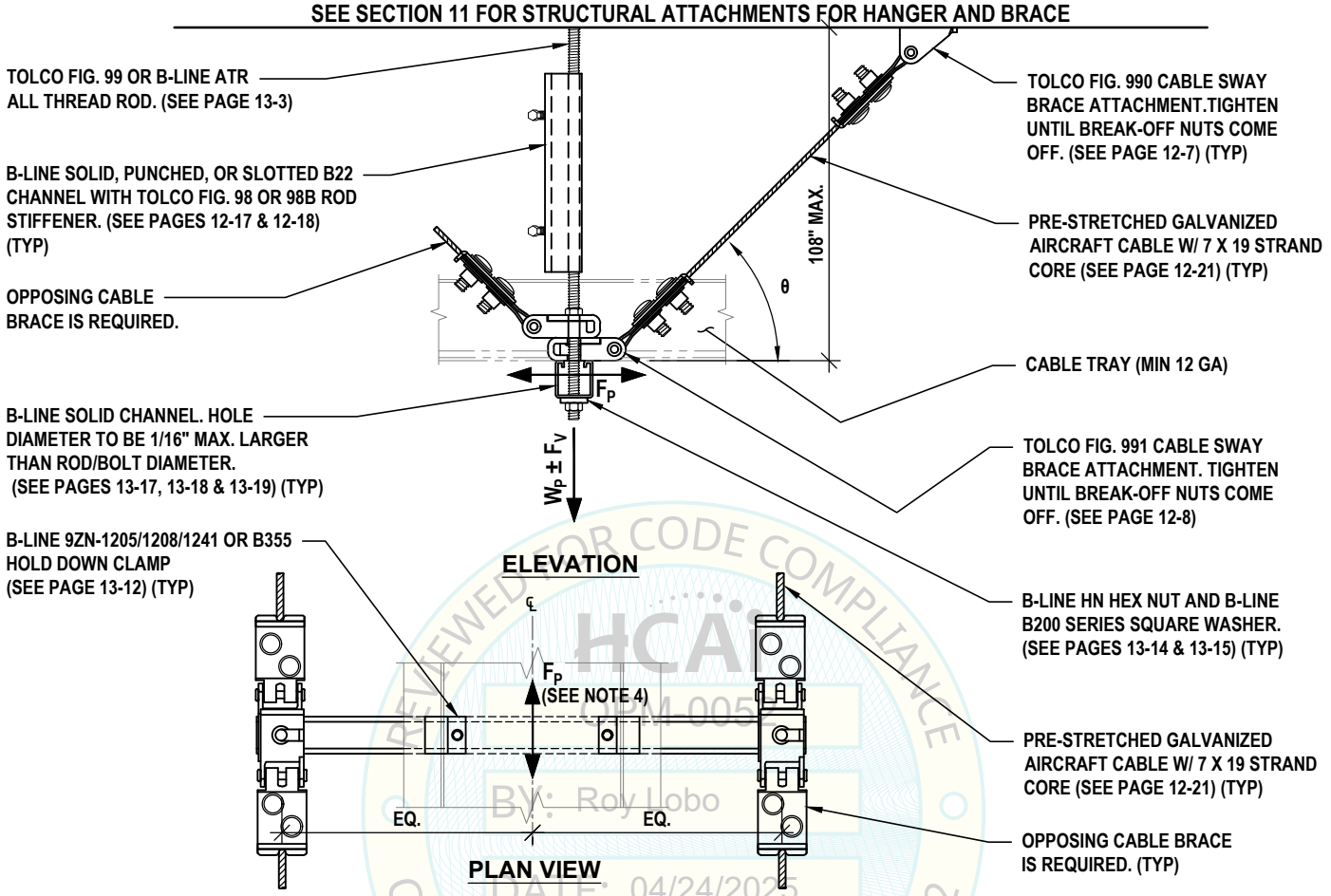
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DATE: **April 23, 2025**

LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

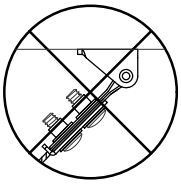
DETAIL
TC-8

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 4) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	407	407	407
1/2"	3/16"	407	407	407
3/4"	3/16"	407	407	407



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
4. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
5. CABLE TRAY SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. CABLE TRAY BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
6. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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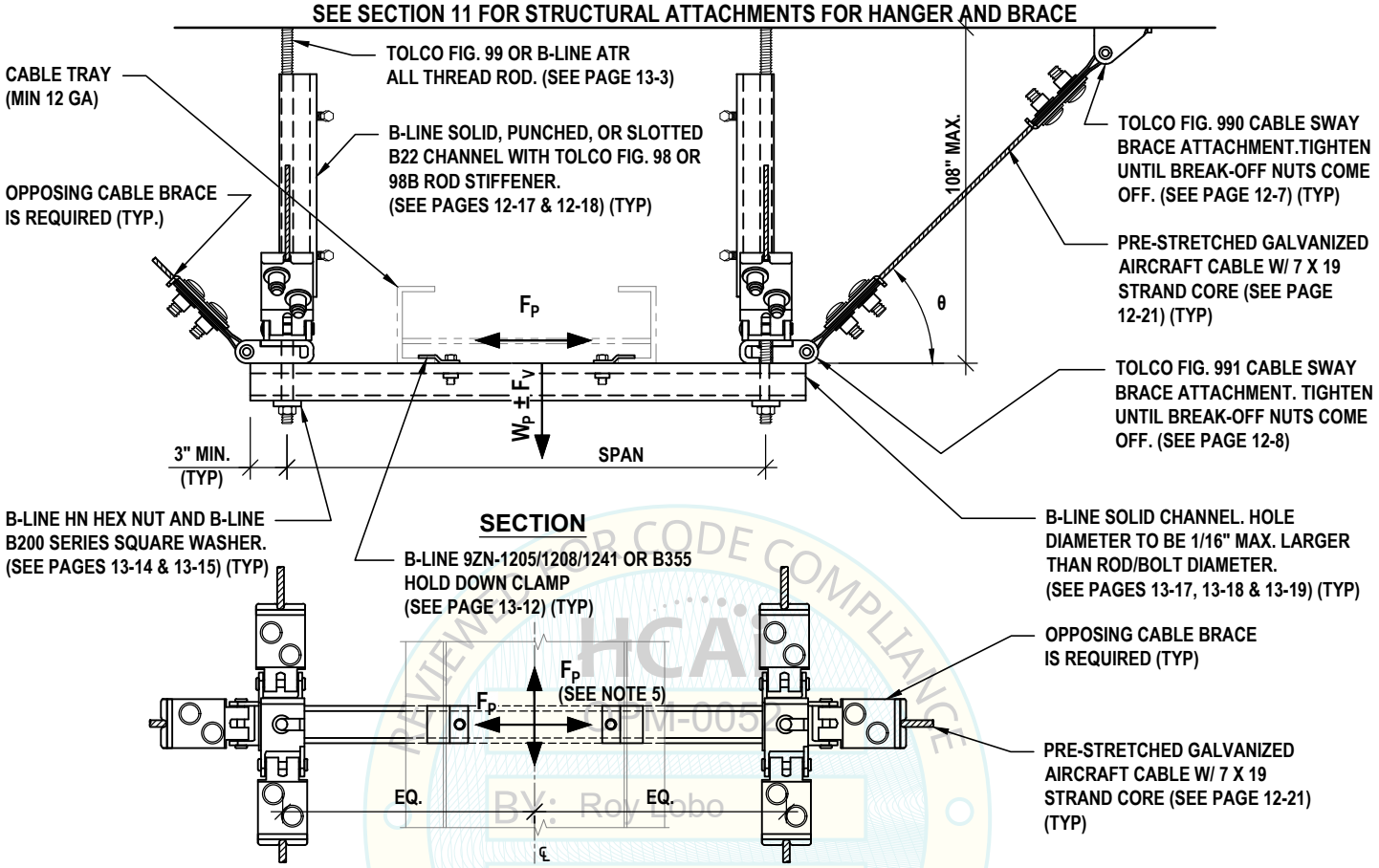
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DATE: **April 23, 2025**

TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAY

DETAIL
TC-9

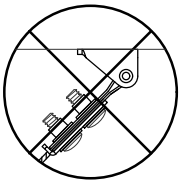
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



SECTION

PLAN VIEW

MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 5) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	296	281	274
3/4"	3/16"	296	296	296



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
3. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
4. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
5. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
6. CABLE TRAY SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. CABLE TRAY BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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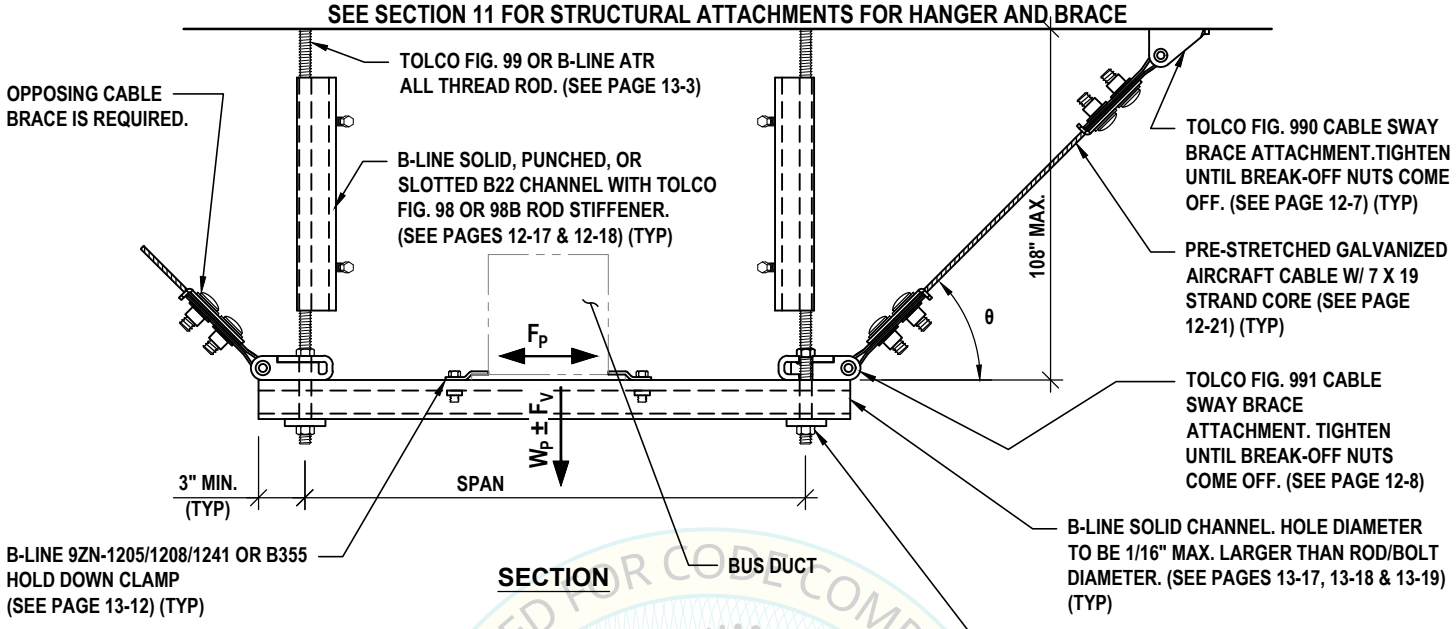
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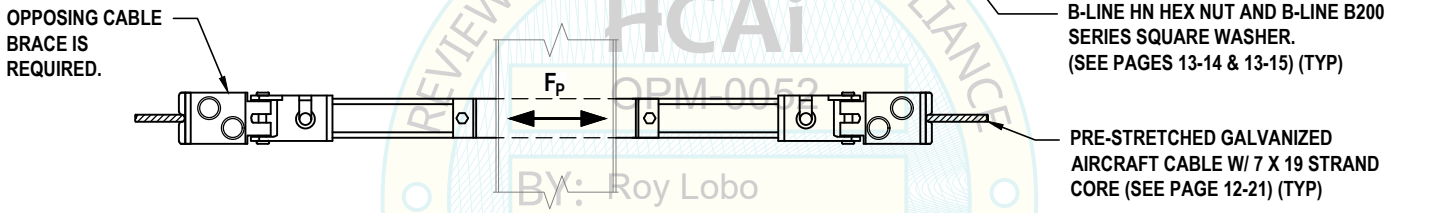
TRANSVERSE CABLE BRACING FOR TRAPEZE SUPPORTED BUS DUCT

DETAIL
TC-10

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



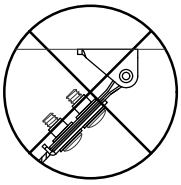
SECTION



PLAN VIEW

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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	949	893	666
3/4"	3/16"	949	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-19 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. BUS DUCT SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. BUS DUCT BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
4. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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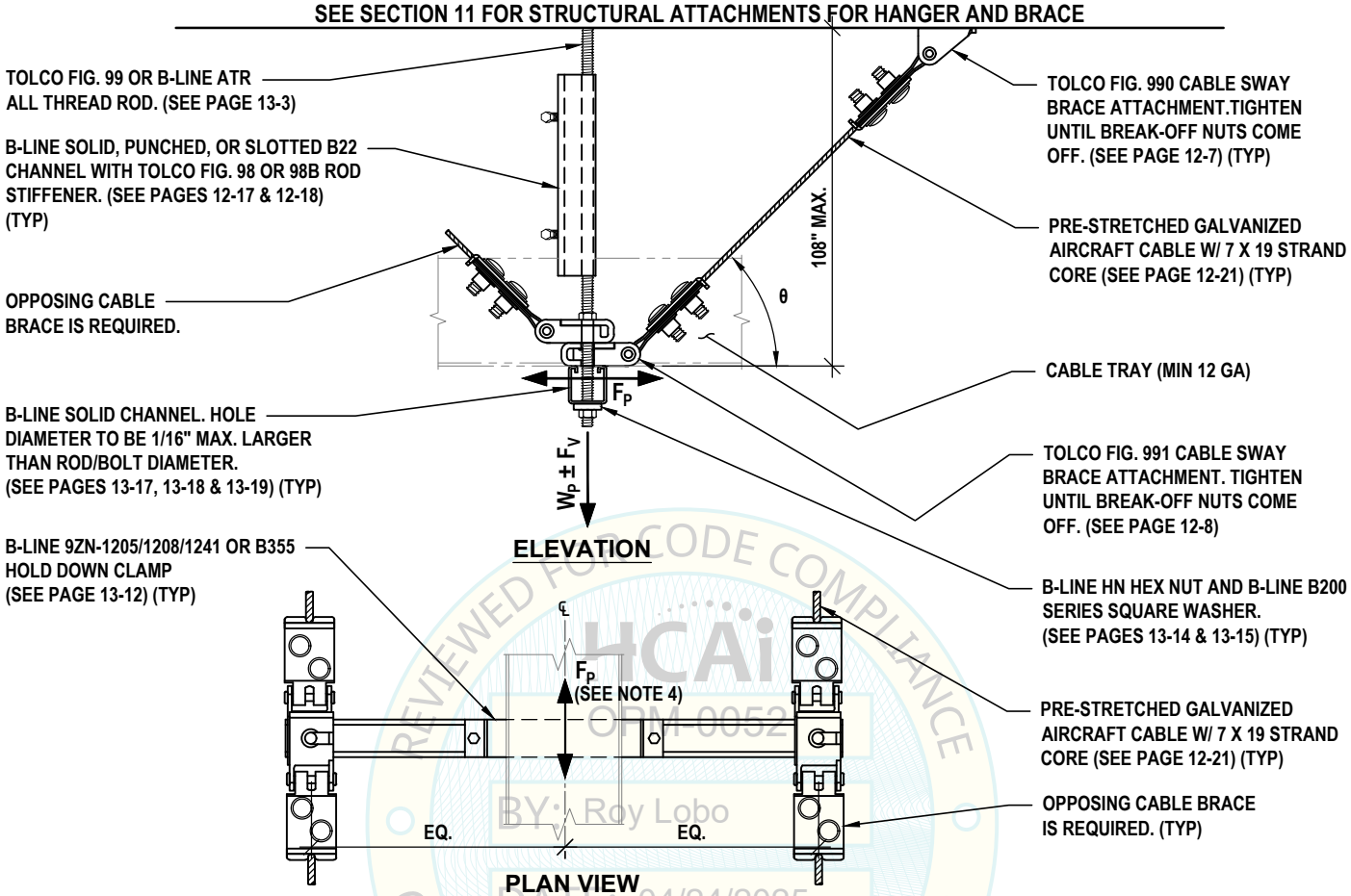
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DATE: **April 23, 2025**

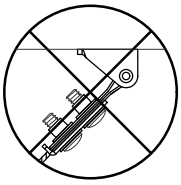
LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED BUS DUCT

DETAIL TC-11

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 4) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	407	407	407
1/2"	3/16"	407	407	407
3/4"	3/16"	407	407	407



DO NOT BEND BRACE PAST 90°

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NOTES:

1. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
4. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
5. BUS DUCT SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. BUS DUCT BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
6. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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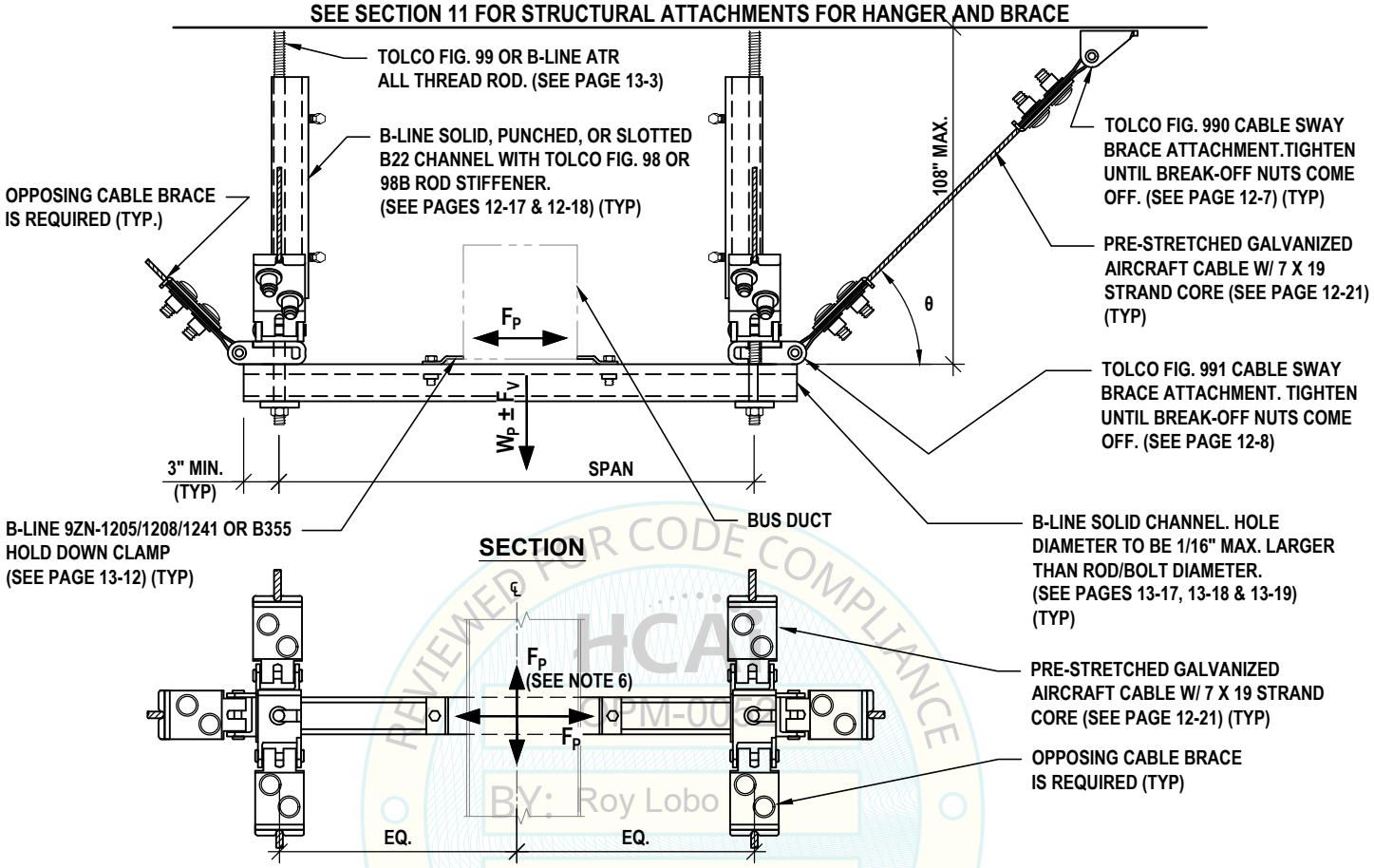
PAGE: 8-11

DATE: April 23, 2025

TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR TRAPEZE SUPPORTED BUS DUCT

DETAIL
TC-12

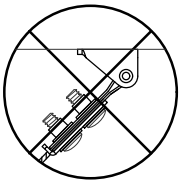
SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



SECTION

PLAN VIEW

MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	296	281	274
3/4"	3/16"	296	296	296



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
3. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 40%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. BUS DUCT SHALL BE APPROVED ON A PROJECT SPECIFIC BASIS OR PRE-APPROVED BY HCAI. SPACING LIMITS SET BY THE MFR SHALL NOT BE EXCEEDED. BUS DUCT BRACE SPACING SHALL BE APPROVED OR PRE-APPROVED BY HCAI.
8. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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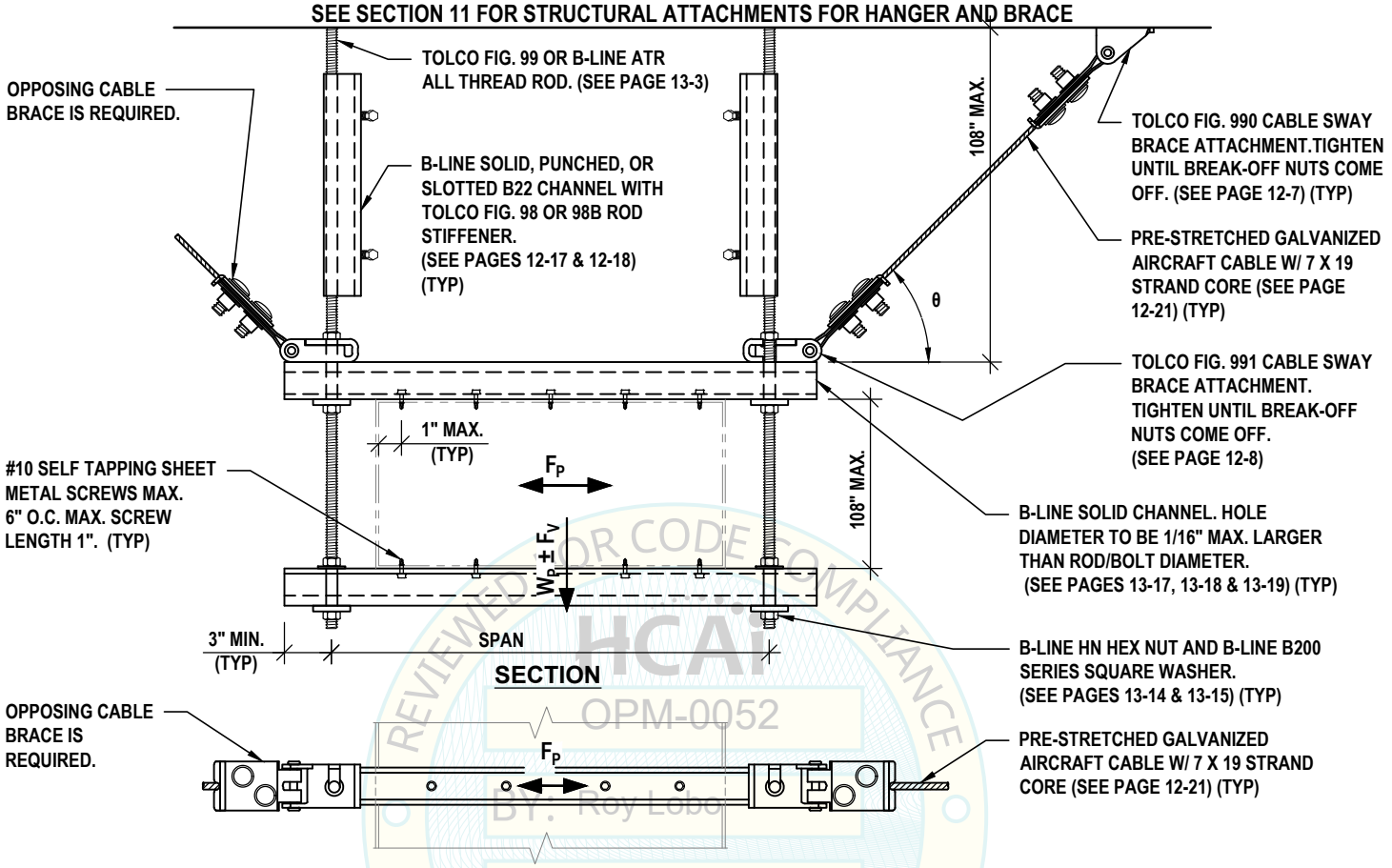
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DATE: **April 23, 2025**

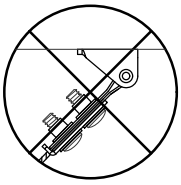
TRANSVERSE CABLE BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL
TC-13

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	1263	893	666
3/4"	3/16"	1492	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-19 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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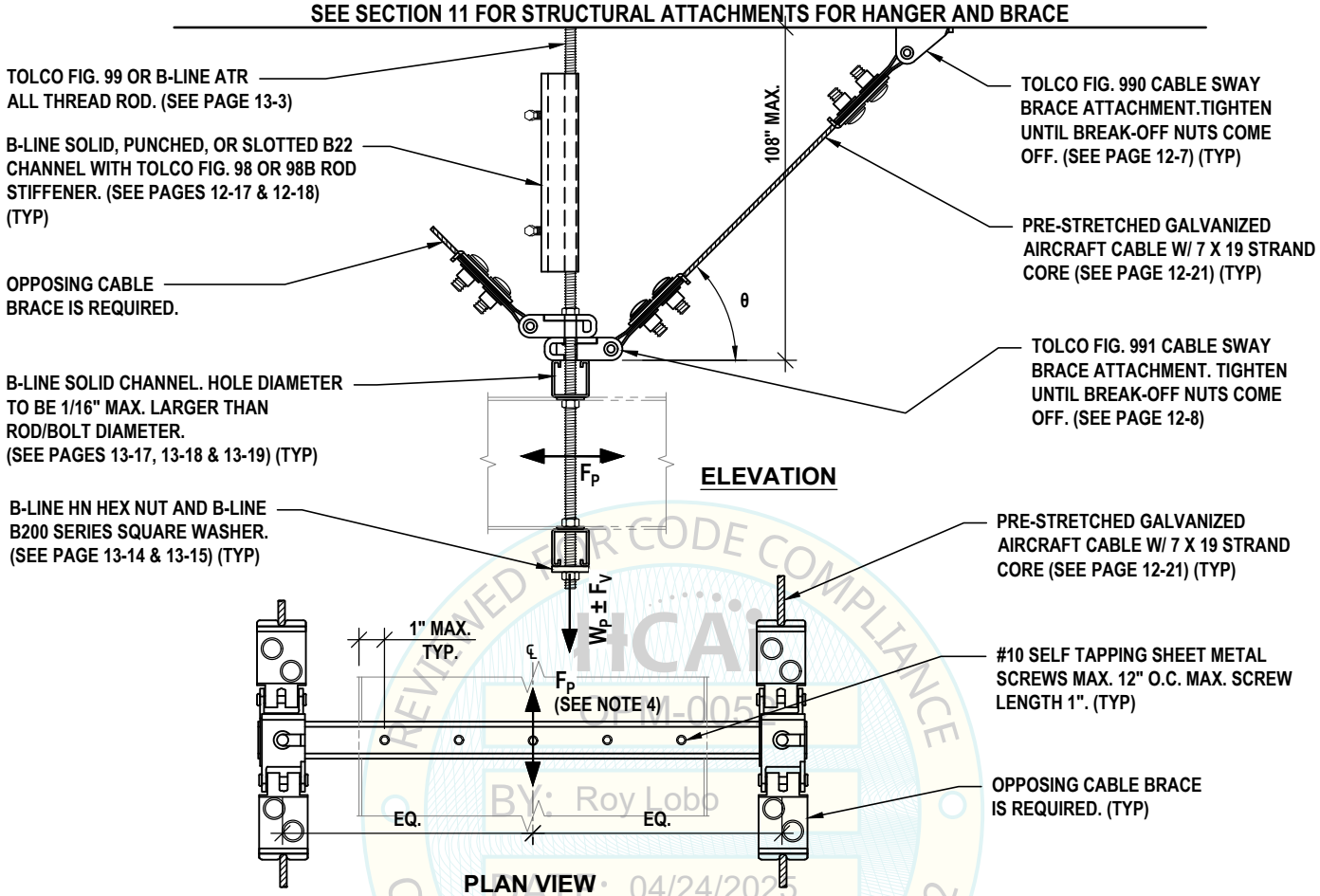
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DATE: **April 23, 2025**

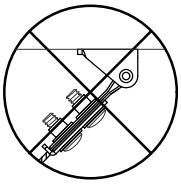
LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL
TC-14

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 4) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	419	438	408
1/2"	3/16"	422	424	437
3/4"	3/16"	458	470	447



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
4. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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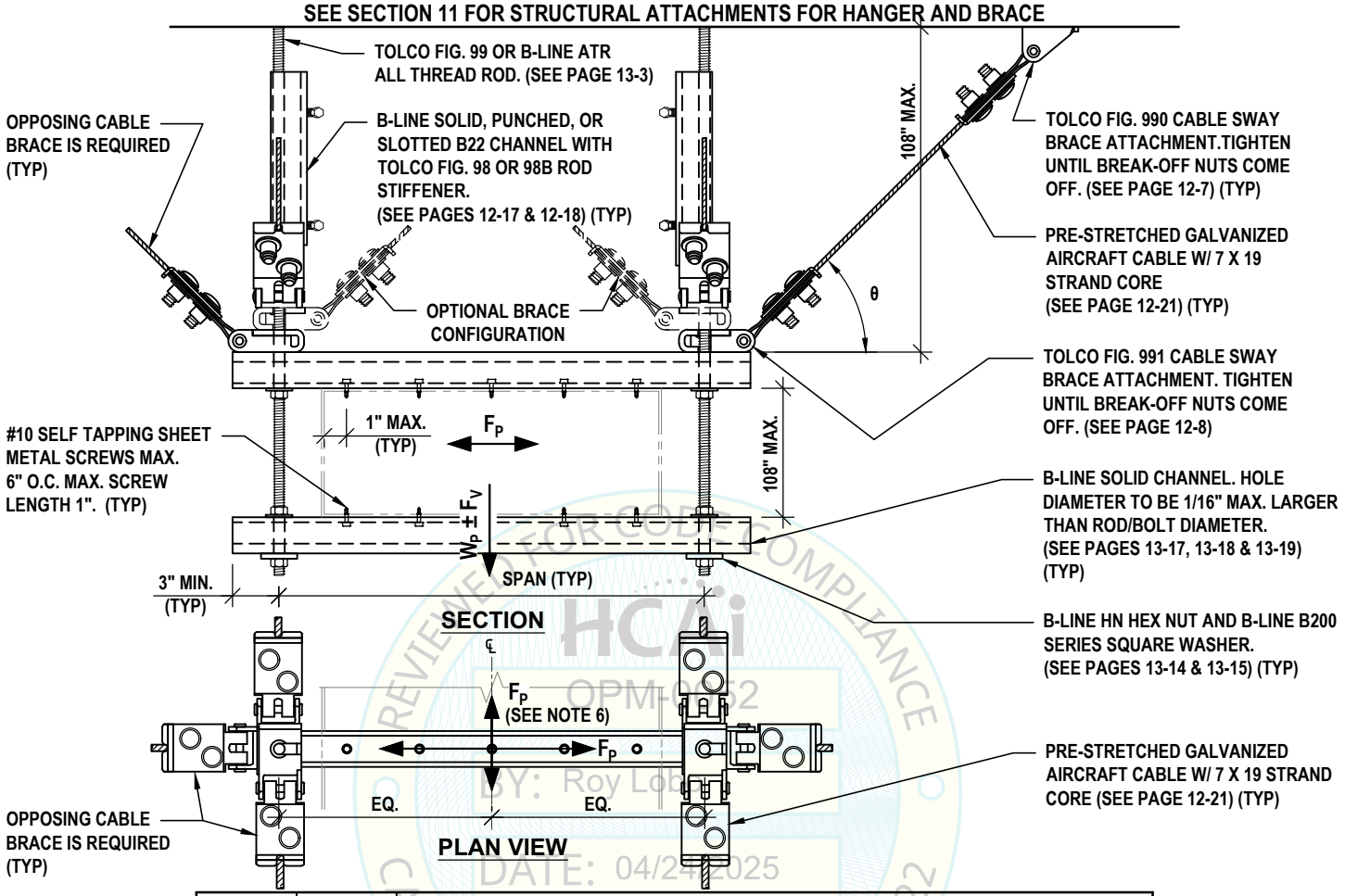
PAGE: **8-14**

DATE: **April 23, 2025**

TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

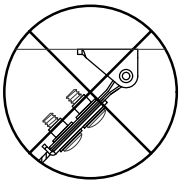
DETAIL
TC-15

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (SEE NOTE 6) (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	301	281	274
3/4"	3/16"	309	319	306



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
3. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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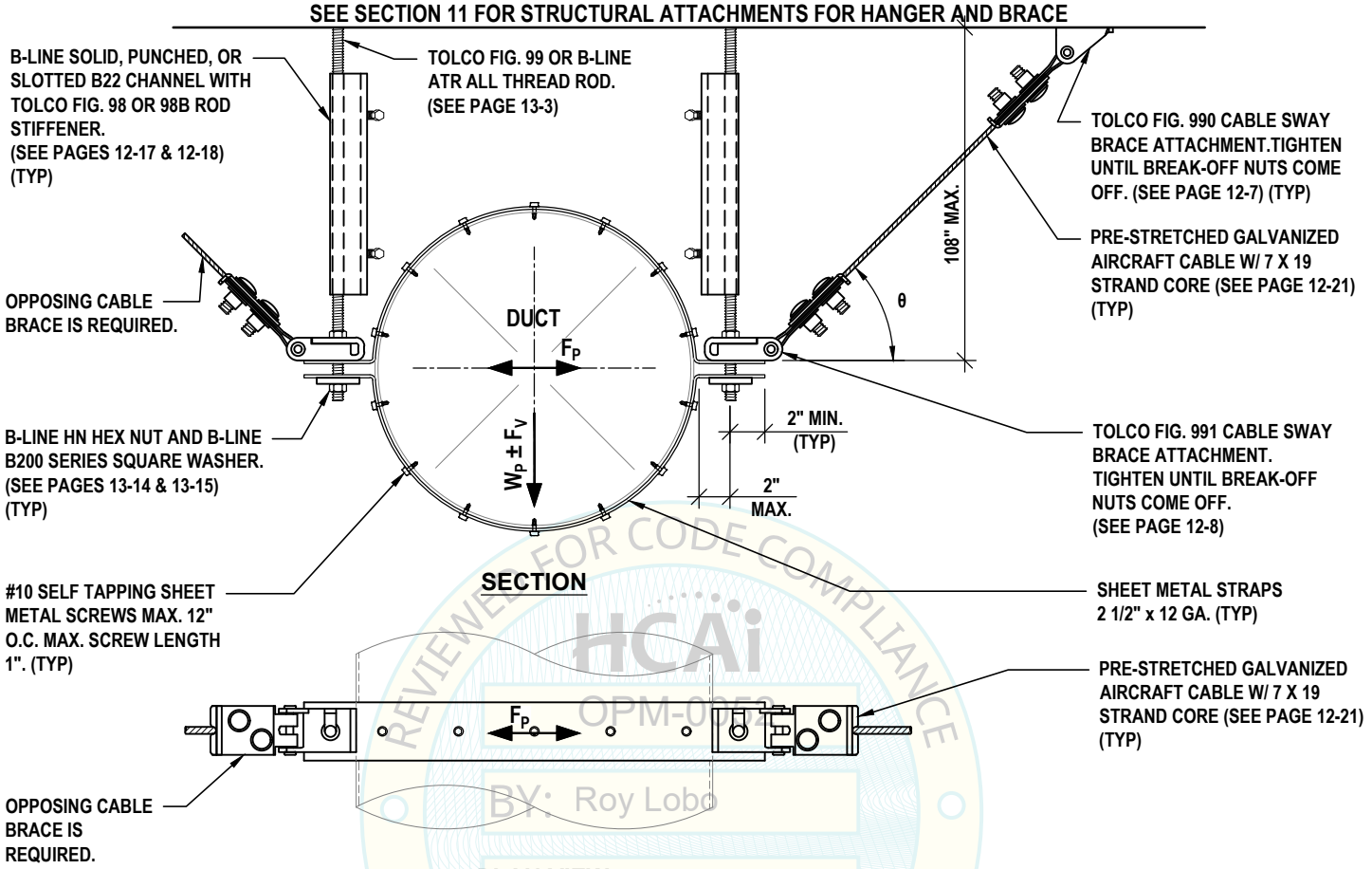
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DATE: **April 23, 2025**

TRANSVERSE CABLE BRACING DETAIL FOR STRAP SUPPORTED ROUND DUCT

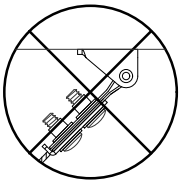
DETAIL
TC-16

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	876	480	435
1/2"	3/16"	1263	893	666
3/4"	3/16"	1492	786	758



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 8-19 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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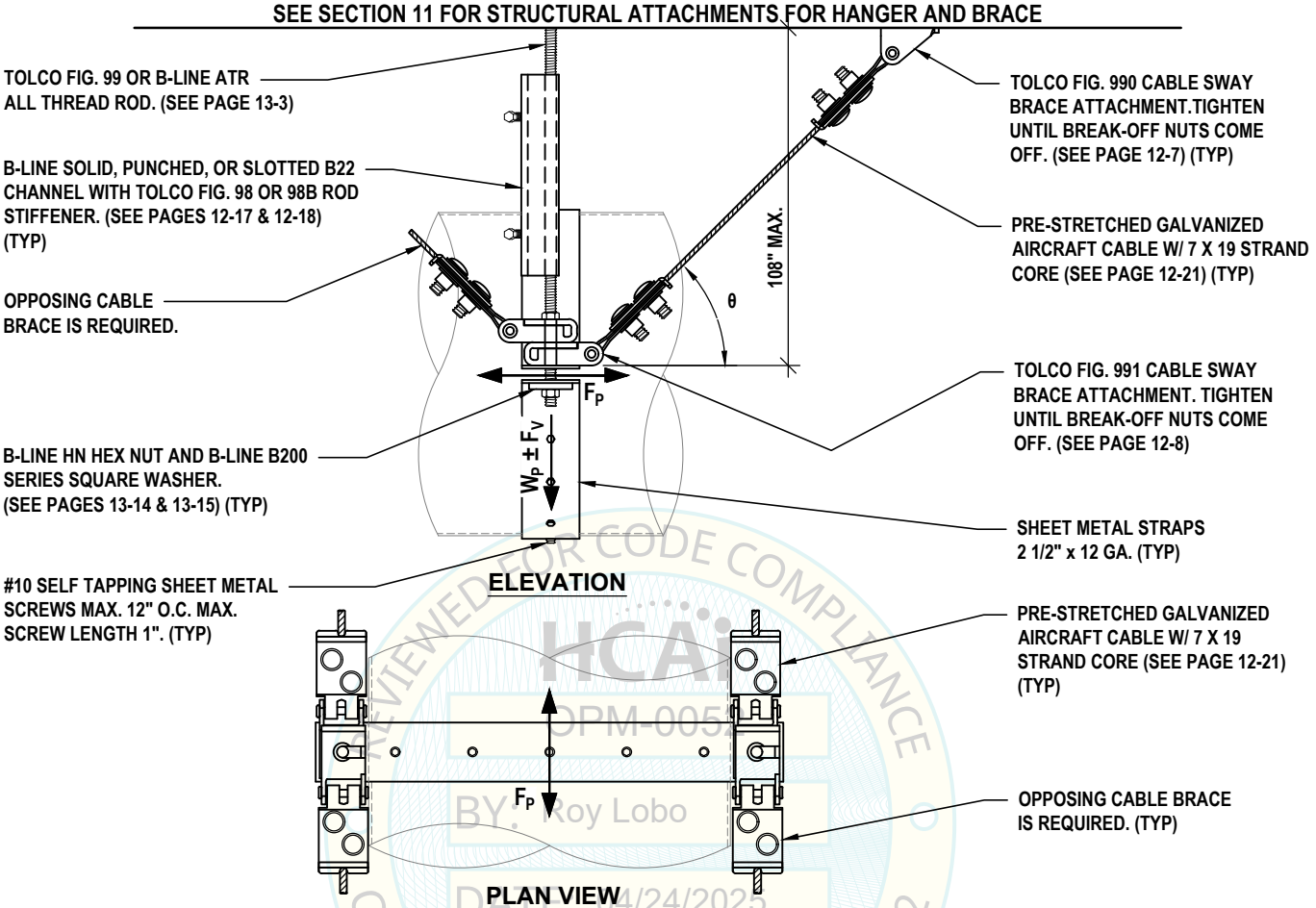
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DATE: **April 23, 2025**

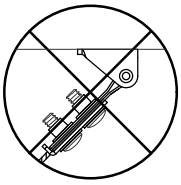
LONGITUDINAL CABLE BRACING FOR TRAPEZE SUPPORTED RECTANGULAR DUCT

DETAIL
TC-17

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



MINIMUM ROD SIZE	MINIMUM CABLE SIZE	LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	419	438	408
1/2"	3/16"	422	424	437
3/4"	3/16"	458	470	447



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGE 8-20 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
3. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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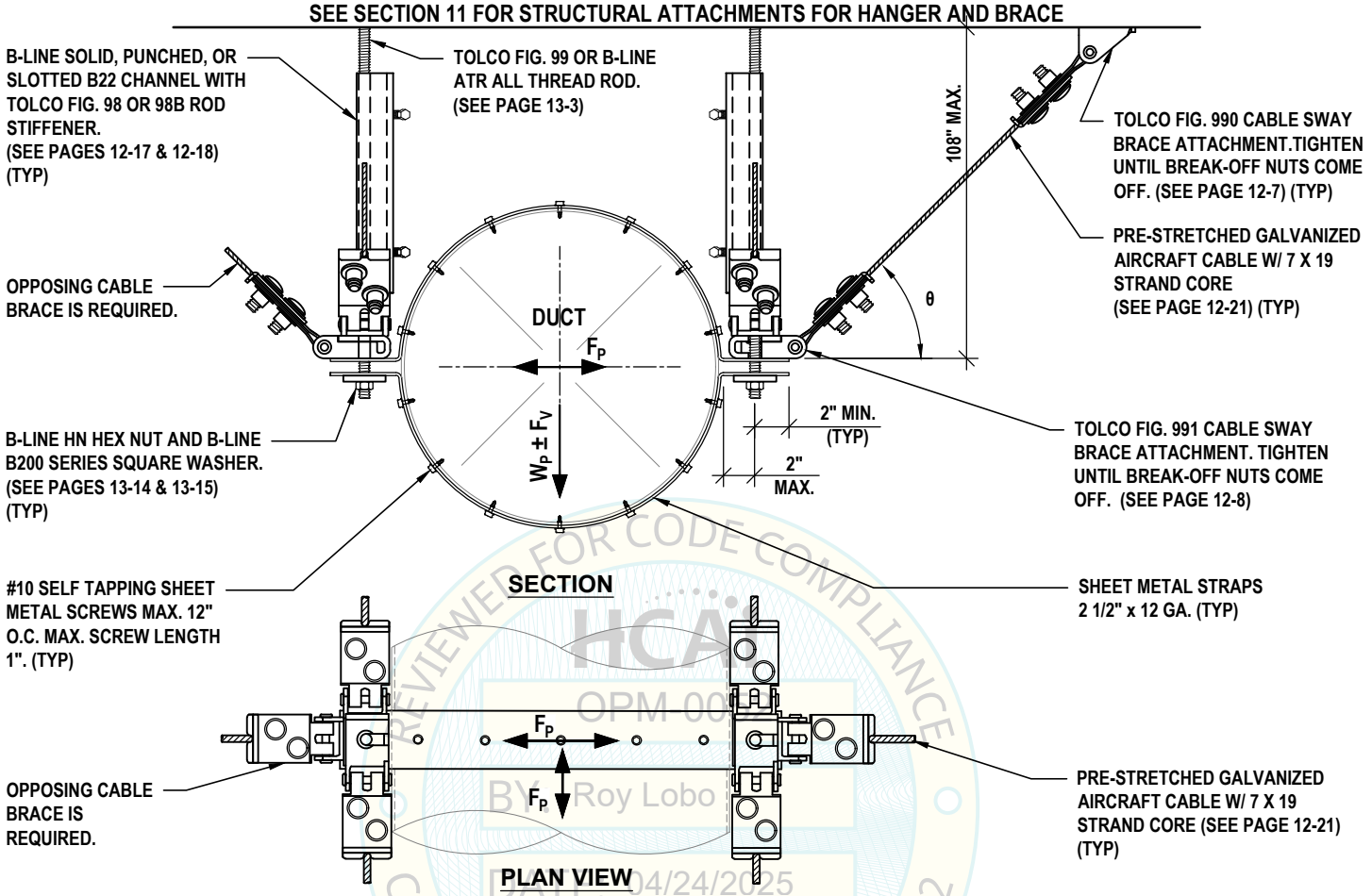
PAGE: **8-17**

DATE: **April 23, 2025**

TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING DETAIL FOR STRAP SUPPORTED ROUND DUCT

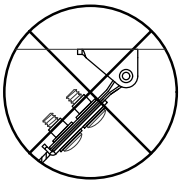
DETAIL
TC-18

SEE SECTION 11 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



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MINIMUM ROD SIZE	MINIMUM CABLE SIZE	TRANSVERSE/ LONGITUDINAL ASSEMBLY ALLOWABLE LOAD, F_P (ASD)(LBS)		
		BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1/8"	253	241	183
1/2"	3/16"	301	281	274
3/4"	3/16"	309	319	306



DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. THE ABOVE ASSEMBLY ALLOWABLE LOADS CAN BE APPLIED CONCURRENTLY TO BOTH TRANSVERSE AND LONGITUDINAL DIRECTIONS WITHOUT REDUCTION.
3. THE LONGITUDINAL BRACES SHALL BE INSTALLED AT 45- DEGREES.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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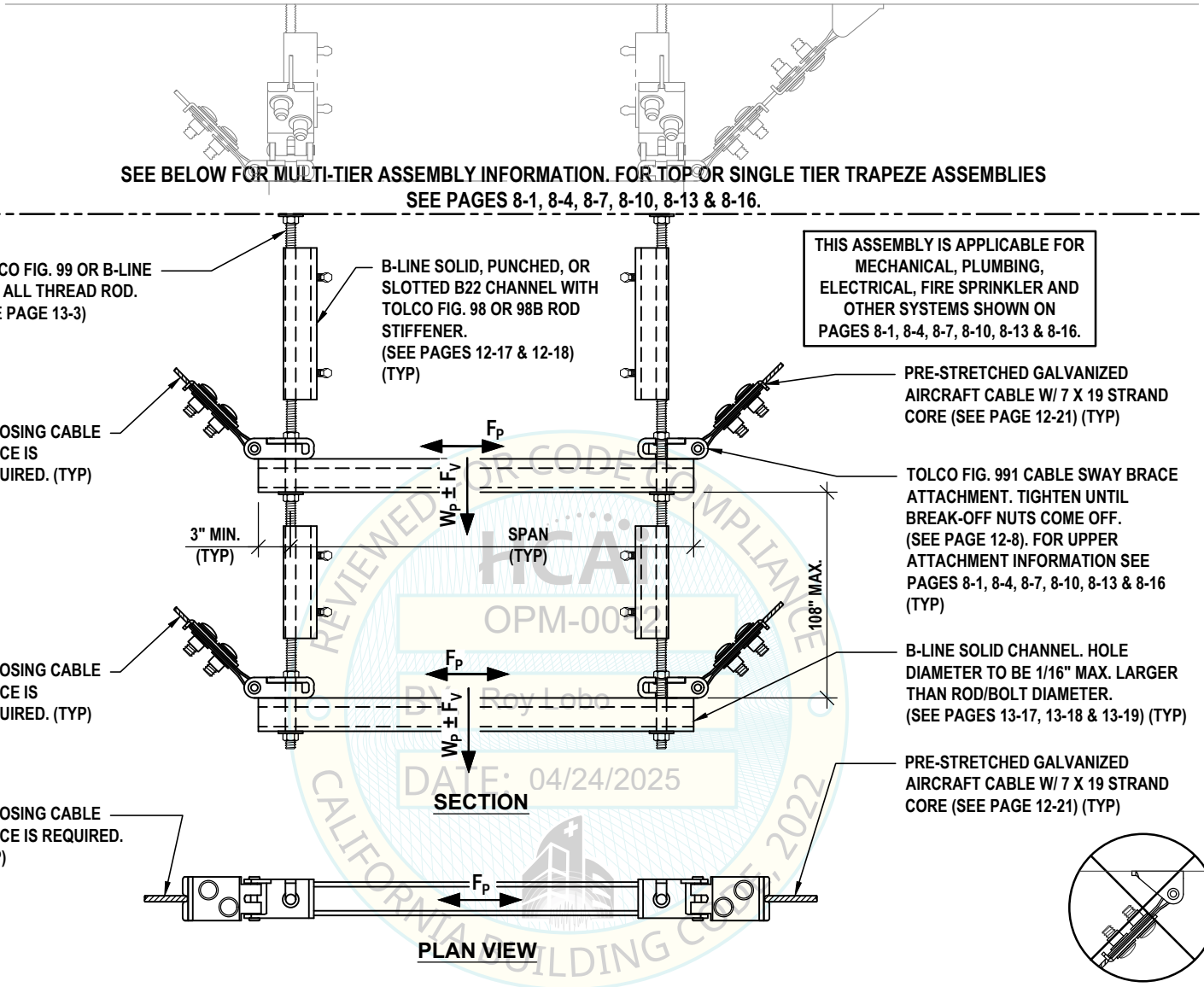
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PAGE: **8-18**

DATE: **April 23, 2025**

TRANSVERSE CABLE BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TC-19



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NOTES:

1. SEE PAGES 8-20, 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME TIME. THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-1, 8-4, 8-7, 8-10, 8-13 AND 8-16.
3. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-1, 8-4, 8-7, 8-10, 8-13 AND 8-16 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 8-1, 8-4, 8-7, 8-10, 8-13 AND 8-16.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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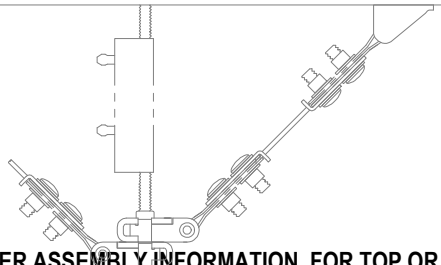
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PAGE: **8-19**

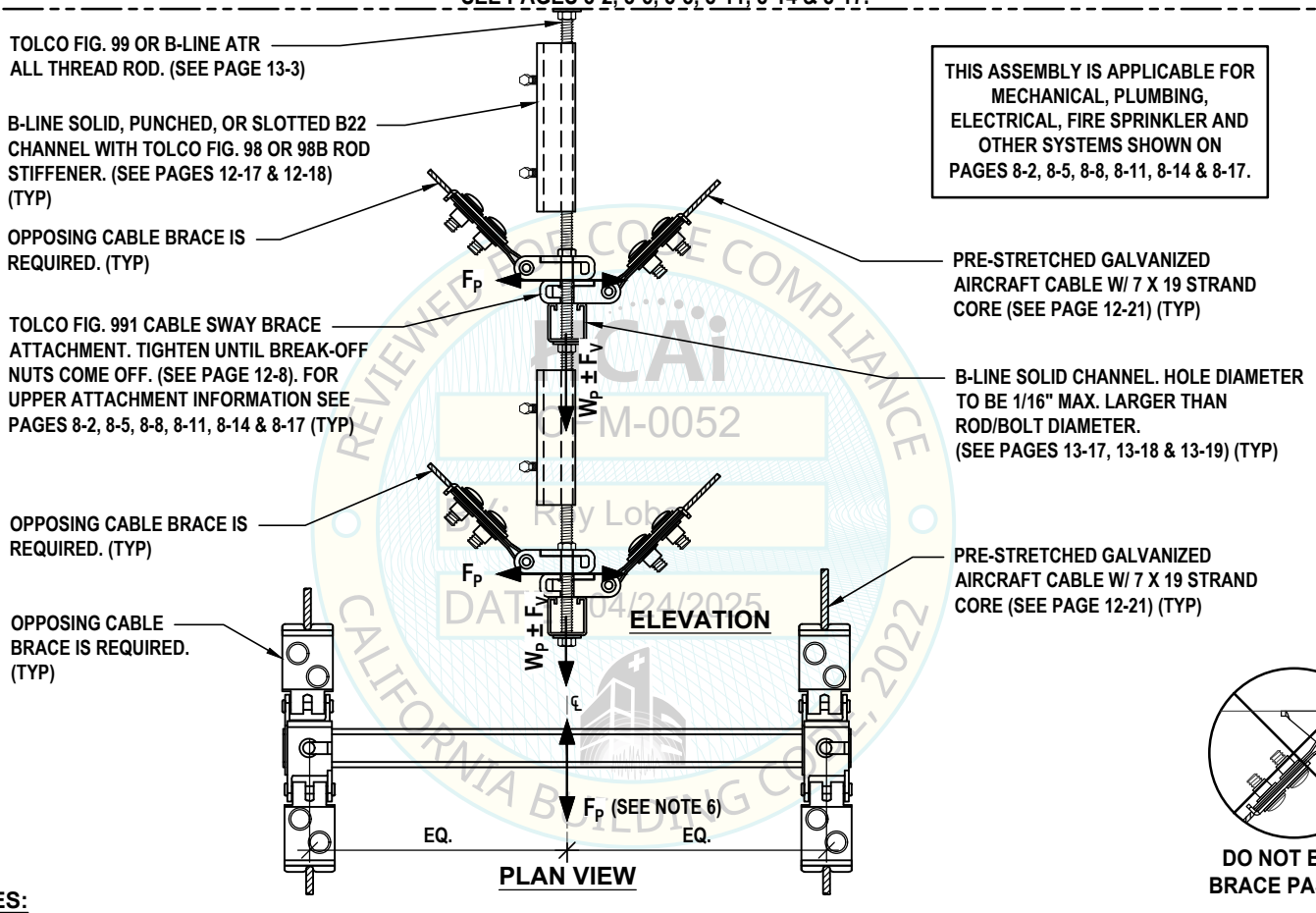
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LONGITUDINAL CABLE BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TC-20



SEE BELOW FOR MULTI-TIER ASSEMBLY INFORMATION. FOR TOP OR SINGLE TIER TRAPEZE ASSEMBLIES SEE PAGES 8-2, 8-5, 8-8, 8-11, 8-14 & 8-17.



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DATE: 04/24/2025
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NOTES:

1. SEE PAGES 8-19, 8-21 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME TIME. THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-2, 8-5, 8-8, 8-11, 8-14 AND 8-17.
3. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-2, 8-5, 8-8, 8-11, 8-14 AND 8-17 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 8-2, 8-5, 8-8, 8-11, 8-14 AND 8-17.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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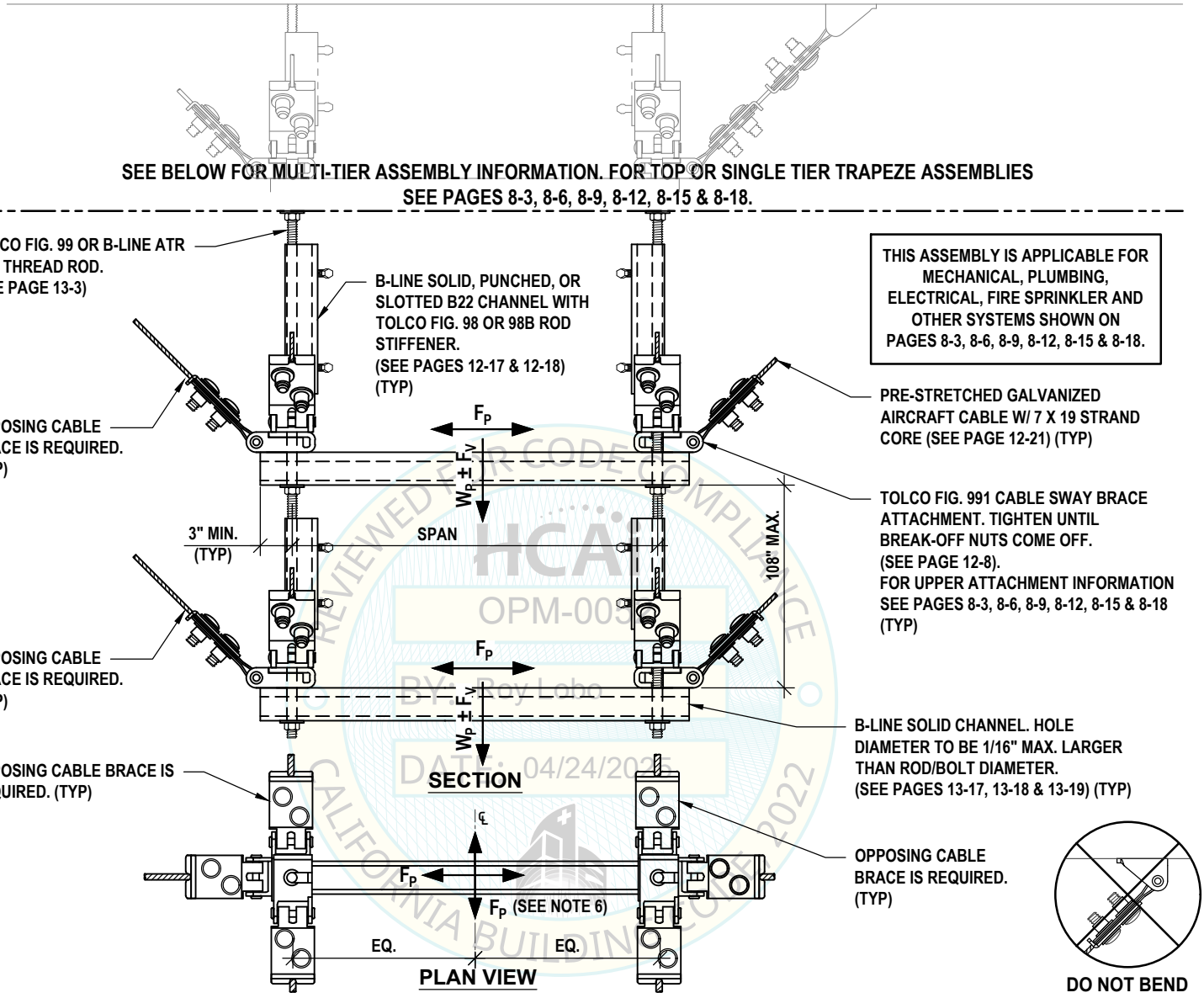
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California SE No. S3545

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DATE: **April 23, 2025**

TRANSVERSE AND LONGITUDINAL COMBINATION CABLE BRACING FOR MULTI-TIER TRAPEZE SUPPORT

DETAIL
TC-21



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NOTES:

1. SEE PAGES 8-19, 8-20 & 8-22 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. WHEN CALCULATING TOTAL VERTICAL LOAD AT HANGER, INDUCED LOADS FROM BOTH BRACES MUST BE CONSIDERED AT THE SAME TIME. THIS TOTAL DEMAND IS THEN USED IN STEP 9 ON PAGE 1-28. THE TOTAL VERTICAL DEMAND OF MULTI-TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-3, 8-6, 8-9, 8-12, 8-15 AND 8-18.
3. THE DEMAND OF EACH TIER SHALL NOT EXCEED THE SINGLE TIER CAPACITY AS GIVEN ON CORRESPONDING PAGES 8-3, 8-6, 8-9, 8-12, 8-15 AND 8-18 AND SHALL COMPLY WITH ALL OTHER RESTRICTIONS ON PAGES 8-3, 8-6, 8-9, 8-12, 8-15 AND 8-18.
4. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
5. DESIGN PROFESSIONAL SHALL CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_P VALUE USED IN DESIGN.
6. WHERE SEISMIC LOAD IS APPLIED FULLY ECCENTRIC, REDUCE F_P BY 50%. LINEARLY INTERPOLATE FOR CONDITION BETWEEN CENTER LINE AND BRACE.
7. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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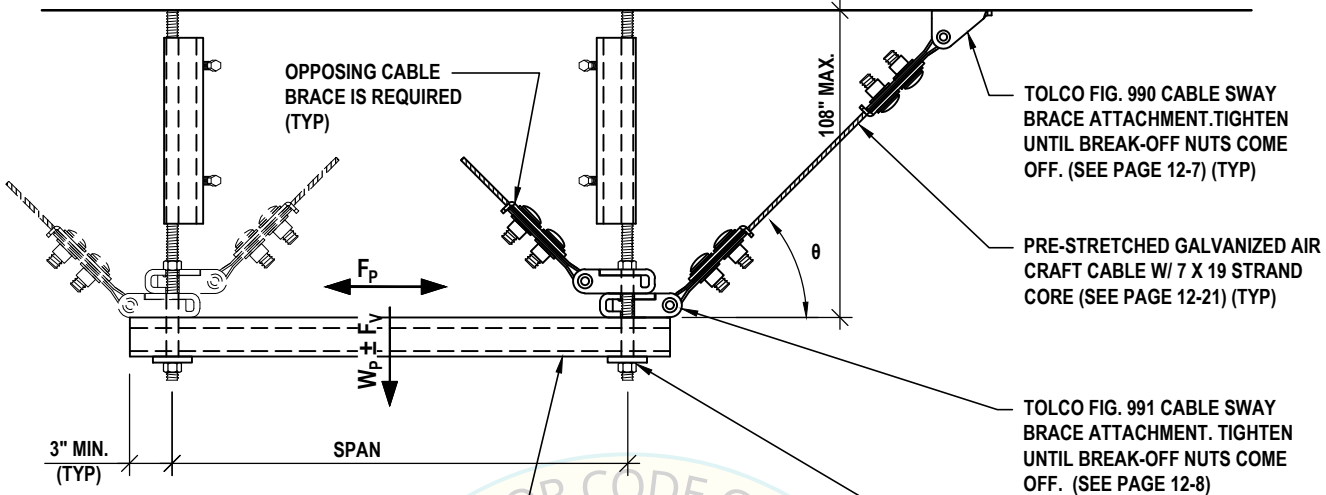
PAGE: **8-21**

DATE: **April 23, 2025**

OPTIONAL CABLE BRACE CONFIGURATIONS

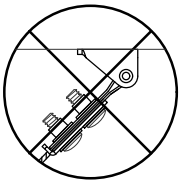
DETAIL
TC-22

SEE BELOW FOR OPTIONAL BRACE CONFIGURATIONS.
FOR TOP OR TRAPEZE ASSEMBLIES SEE PAGE 8-1, 8-3, 8-4, 8-6, 8-7, 8-9, 8-10, 8-12, 8-13, 8-15, 8-16, 8-18, 8-19, & 8-21.



ELEVATION

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DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE PAGES 8-19, 8-20 & 8-21 FOR OPTIONAL AND/OR ADDITIONAL BRACE CONFIGURATIONS.
2. BRACES MAY BE PLACED IN ANY OF THE ABOVE SHOWN CONFIGURATIONS. QUANTITY OF BRACES MAY VARY BASED ON DESIGN CRITERIA.
3. VERIFY THE ADEQUACY OF THE SYSTEM ATTACHMENT TO THE STRUT. THE ATTACHMENT MUST BE ADEQUATE TO TRANSFER TRANSVERSE, LONGITUDINAL AND VERTICAL SEISMIC LOADS TO STRUT AS PER SECTION 13.
4. THIS OPTIONAL BRACE CONFIGURATION IS APPLICABLE TO PAGES 8-1, 8-3, 8-4, 8-6, 8-7, 8-9, 8-10, 8-12, 8-13, 8-15, 8-16, 8-18, 8-19, AND 8-21.
5. SEE PAGES 13-21 THROUGH 13-23 FOR MAXIMUM BEAM SPAN.

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SECTION 9

TRAPEZE CABLE BRACE SPACING CHARTS

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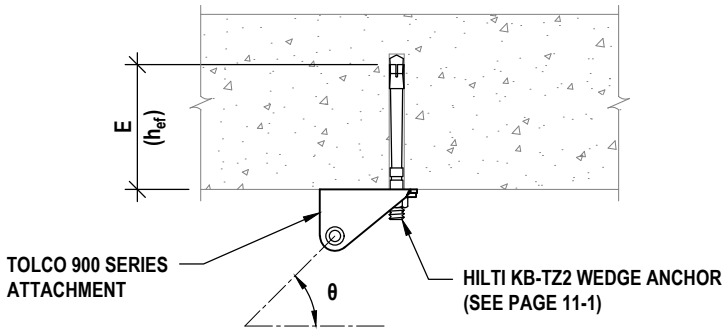
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	1/8"	1	3/8"	2"
30	40	1/8"	1	3/8"	2"
40	40	1/8"	1	3/8"	2"
50	40	1/8"	1	1/2"	3.25"
60	40	3/16"	1	1/2"	3.25"
70	40	3/16"	1	1/2"	3.25"
80	40	3/16"	1	5/8"	3.25"
90	40	3/16"	1	5/8"	3.25"
100	40	3/16"	1	5/8"	4"
125	34	3/16"	1	3/4"	3.75"
150	29	3/16"	1	3/4"	3.75"
175	24	3/16"	1	3/4"	3.75"
200	21	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	1/8"	1	3/8"	2"
30	80	1/8"	1	3/8"	2"
40	80	1/8"	1	3/8"	2"
50	80	1/8"	1	1/2"	3.25"
60	80	3/16"	1	1/2"	3.25"
70	80	3/16"	1	1/2"	3.25"
80	80	3/16"	1	5/8"	3.25"
90	80	3/16"	1	5/8"	3.25"
100	80	3/16"	1	5/8"	4"
125	68	3/16"	1	3/4"	3.75"
150	58	3/16"	1	3/4"	3.75"
175	48	3/16"	1	3/4"	3.75"
200	42	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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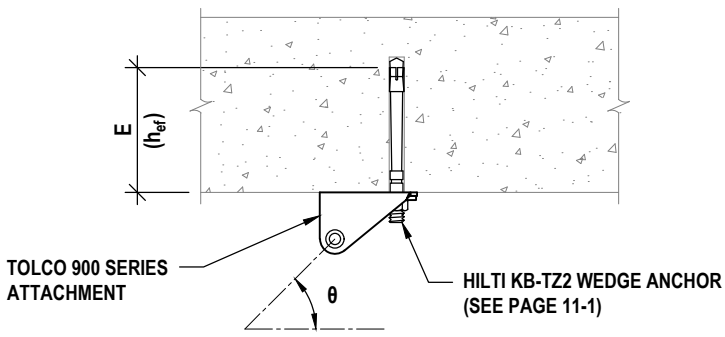
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	1/8"	1	3/8"	2"
30	40	3/16"	1	1/2"	3.25"
40	40	3/16"	1	5/8"	3.25"
50	40	3/16"	1	5/8"	4"
60	36	3/16"	1	3/4"	3.75"
70	31	3/16"	1	3/4"	3.75"
80	27	3/16"	1	3/4"	3.75"
90	24	3/16"	1	3/4"	3.75"
100	21	3/16"	1	3/4"	3.75"
125	17	3/16"	1	3/4"	3.75"
150	14	3/16"	1	3/4"	3.75"
175	12	3/16"	1	3/4"	3.75"
200	10	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	1/8"	1	3/8"	2"
30	80	3/16"	1	1/2"	3.25"
40	80	3/16"	1	5/8"	3.25"
50	80	3/16"	1	5/8"	4"
60	72	3/16"	1	3/4"	3.75"
70	62	3/16"	1	3/4"	3.75"
80	54	3/16"	1	3/4"	3.75"
90	48	3/16"	1	3/4"	3.75"
100	42	3/16"	1	3/4"	3.75"
125	34	3/16"	1	3/4"	3.75"
150	28	3/16"	1	3/4"	3.75"
175	24	3/16"	1	3/4"	3.75"
200	20	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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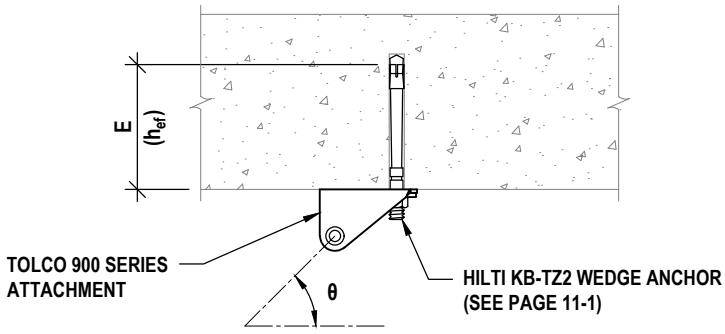
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California SE No. S3545

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DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	3/16"	1	1/2"	3.25"
30	40	3/16"	1	5/8"	3.25"
40	36	3/16"	1	3/4"	3.75"
50	29	3/16"	1	3/4"	3.75"
60	24	3/16"	1	3/4"	3.75"
70	20	3/16"	1	3/4"	3.75"
80	18	3/16"	1	3/4"	3.75"
90	16	3/16"	1	3/4"	3.75"
100	14	3/16"	1	3/4"	3.75"
125	11	3/16"	1	3/4"	3.75"
150	9	3/16"	1	3/4"	3.75"
175	8	3/16"	1	3/4"	3.75"
200	7	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	3/16"	1	1/2"	3.25"
30	80	3/16"	1	5/8"	3.25"
40	72	3/16"	1	3/4"	3.75"
50	58	3/16"	1	3/4"	3.75"
60	48	3/16"	1	3/4"	3.75"
70	40	3/16"	1	3/4"	3.75"
80	36	3/16"	1	3/4"	3.75"
90	32	3/16"	1	3/4"	3.75"
100	28	3/16"	1	3/4"	3.75"
125	22	3/16"	1	3/4"	3.75"
150	18	3/16"	1	3/4"	3.75"
175	16	3/16"	1	3/4"	3.75"
200	14	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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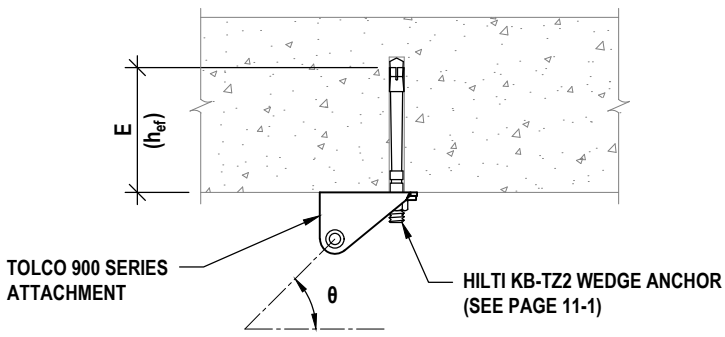
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	3/16"	1	5/8"	3.25"
30	36	3/16"	1	3/4"	3.75"
40	27	3/16"	1	3/4"	3.75"
50	21	3/16"	1	3/4"	3.75"
60	18	3/16"	1	3/4"	3.75"
70	15	3/16"	1	3/4"	3.75"
80	13	3/16"	1	3/4"	3.75"
90	12	3/16"	1	3/4"	3.75"
100	10	3/16"	1	3/4"	3.75"
125	8	3/16"	1	3/4"	3.75"
150	7	3/16"	1	3/4"	3.75"
175	6	3/16"	1	3/4"	3.75"
200	5	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	3/16"	1	5/8"	3.25"
30	72	3/16"	1	3/4"	3.75"
40	54	3/16"	1	5/8"	3.75"
50	42	3/16"	1	5/8"	3.75"
60	36	3/16"	1	3/4"	3.75"
70	30	3/16"	1	3/4"	3.75"
80	26	3/16"	1	3/4"	3.75"
90	24	3/16"	1	3/4"	3.75"
100	20	3/16"	1	3/4"	3.75"
125	16	3/16"	1	3/4"	3.75"
150	14	3/16"	1	3/4"	3.75"
175	12	3/16"	1	3/4"	3.75"
200	10	3/16"	1	3/4"	3.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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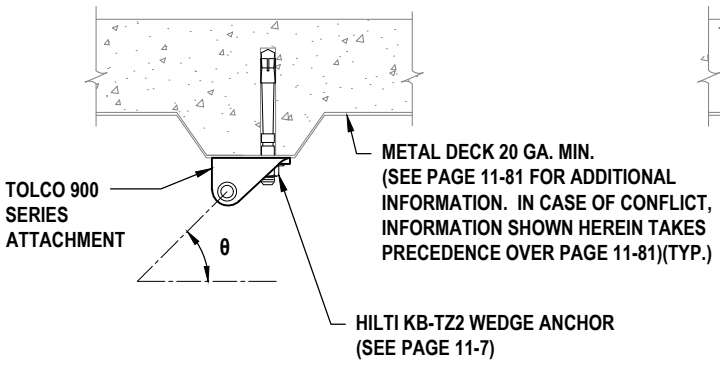
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

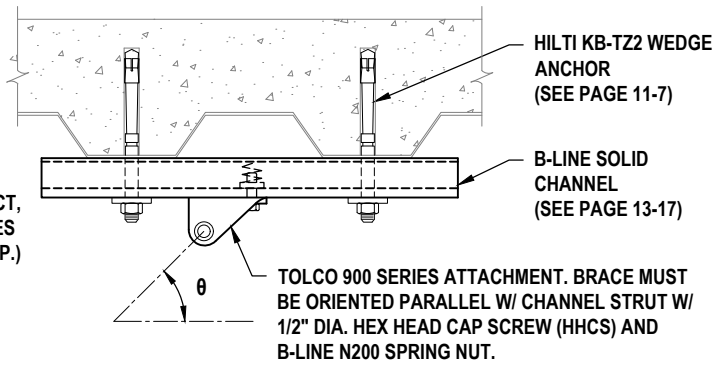
PAGE: 9-4

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	1/8"	1	3/8"	2"
30	40	1/8"	1	1/2"	3.25"
40	40	1/8"	1	1/2"	3.25"
50	40	1/8"	1	5/8"	4"
60	40	3/16"	1	5/8"	4"
70	36	3/16"	1	5/8"	4"
80	31	3/16"	1	5/8"	4"
90	28	3/16"	1	5/8"	4"
100	25	3/16"	1	5/8"	4"
125	20	3/16"	1	5/8"	4"
150	17	3/16"	1	5/8"	4"
175	14	3/16"	1	5/8"	4"
200	12	3/16"	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	1/8"	1	3/8"	2"
30	80	1/8"	1	1/2"	3.25"
40	80	1/8"	1	1/2"	3.25"
50	80	1/8"	1	5/8"	4"
60	80	3/16"	1	5/8"	4"
70	72	3/16"	1	5/8"	4"
80	62	3/16"	1	5/8"	4"
90	56	3/16"	1	5/8"	4"
100	50	3/16"	1	5/8"	4"
125	40	3/16"	1	5/8"	4"
150	34	3/16"	1	5/8"	4"
175	28	3/16"	1	5/8"	4"
200	24	3/16"	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

ICAI OPM-0052 Reviewed for Code Compliance by Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM HILTI KWIK BOLT (KB-TZ2) ANCHOR (ICC ESR-4266, DECEMBER, 2023), WITH SPECIAL INSPECTION.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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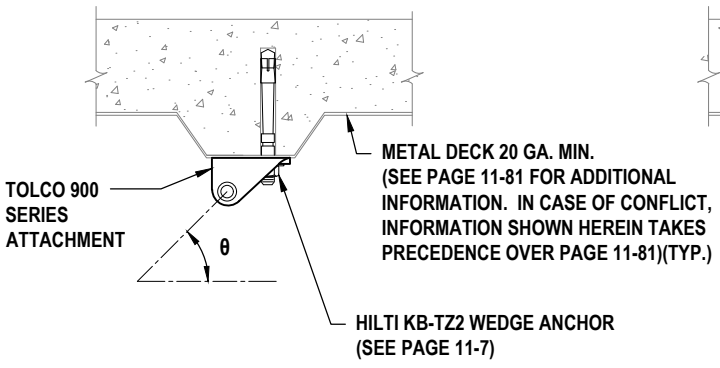
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

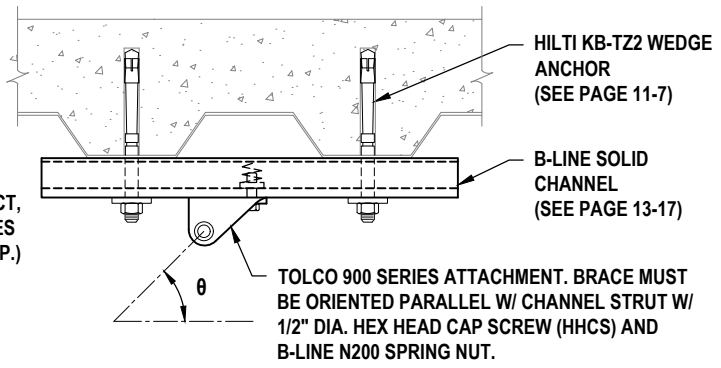
PAGE: 9-5

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	2"
20	40	1/8"	1	1/2"	3.25"
30	40	3/16"	1	5/8"	4"
40	31	3/16"	1	5/8"	4"
50	25	3/16"	1	5/8"	4"
60	21	3/16"	1	5/8"	4"
70	18	3/16"	1	5/8"	4"
80	15	3/16"	1	5/8"	4"
90	14	3/16"	1	5/8"	4"
100	12	3/16"	1	5/8"	4"
125	10	3/16"	1	5/8"	4"
150	8	3/16"	1	5/8"	4"
175	7	3/16"	1	5/8"	4"
200	6	3/16"	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	2"
20	80	1/8"	1	1/2"	3.25"
30	80	3/16"	1	5/8"	4"
40	62	3/16"	1	5/8"	4"
50	50	3/16"	1	5/8"	4"
60	42	3/16"	1	5/8"	4"
70	36	3/16"	1	5/8"	4"
80	30	3/16"	1	5/8"	4"
90	28	3/16"	1	5/8"	4"
100	24	3/16"	1	5/8"	4"
125	20	3/16"	1	5/8"	4"
150	16	3/16"	1	5/8"	4"
175	14	3/16"	1	5/8"	4"
200	12	3/16"	1	5/8"	4"

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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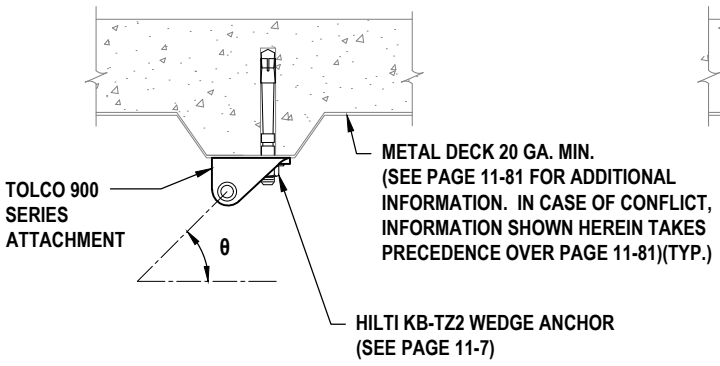
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

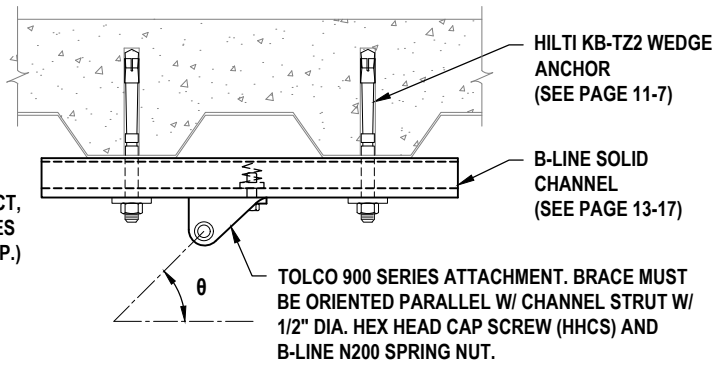
PAGE: 9-6

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Max. Trapeze Weight Per Ft.	Transverse[1]	Cable Diameter	Concrete Anchorage		
	Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	1/2"	3.25"
20	40	3/16"	1	5/8"	4"
30	28	3/16"	1	5/8"	4"
40	21	3/16"	1	5/8"	4"
50	17	3/16"	1	5/8"	4"
60	14	3/16"	1	5/8"	4"
70	12	3/16"	1	5/8"	4"
80	10	3/16"	1	5/8"	4"
90	9	3/16"	1	5/8"	4"
100	8	3/16"	1	5/8"	4"
125	6	3/16"	1	5/8"	4"
150	5	3/16"	1	5/8"	4"
175	4	3/16"	1	5/8"	4"
200	4	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1]	Cable Diameter	Concrete Anchorage		
	Max. Spacing @ 0.75 "G"		Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	1/2"	3.25"
20	80	3/16"	1	5/8"	4"
30	56	3/16"	1	5/8"	4"
40	42	3/16"	1	5/8"	4"
50	34	3/16"	1	5/8"	4"
60	28	3/16"	1	5/8"	4"
70	24	3/16"	1	5/8"	4"
80	20	3/16"	1	5/8"	4"
90	18	3/16"	1	5/8"	4"
100	16	3/16"	1	5/8"	4"
125	12	3/16"	1	5/8"	4"
150	10	3/16"	1	5/8"	4"
175	8	3/16"	1	5/8"	4"
200	8	3/16"	1	5/8"	4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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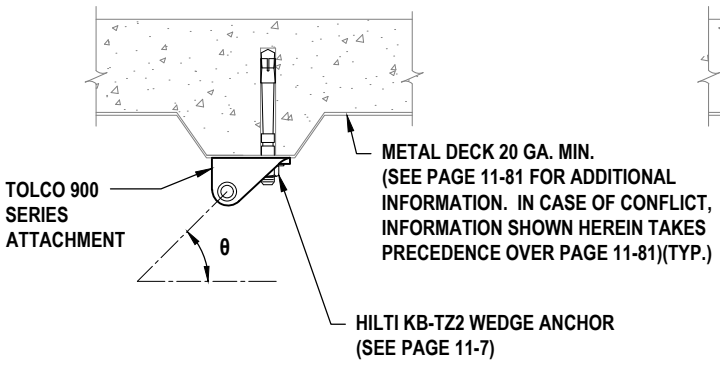
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

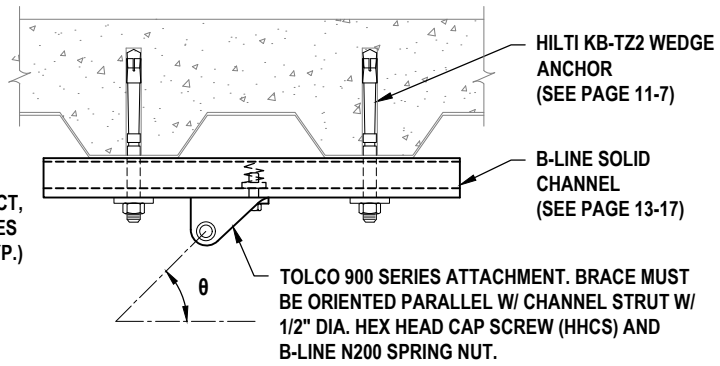
PAGE: 9-7

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE WEDGE ANCHORS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	1/2"	3.25"
20	31	3/16"	1	5/8"	4"
30	21	3/16"	1	5/8"	4"
40	15	3/16"	1	5/8"	4"
50	12	3/16"	1	5/8"	4"
60	10	3/16"	1	5/8"	4"
70	9	3/16"	1	5/8"	4"
80	7	3/16"	1	5/8"	4"
90	7	3/16"	1	5/8"	4"
100	6	3/16"	1	5/8"	4"
125	5	3/16"	1	5/8"	4"
150	4	3/16"	1	5/8"	4"
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	1/2"	3.25"
20	62	3/16"	1	5/8"	4"
30	42	3/16"	1	5/8"	4"
40	30	3/16"	1	5/8"	4"
50	24	3/16"	1	5/8"	4"
60	20	3/16"	1	5/8"	4"
70	18	3/16"	1	5/8"	4"
80	14	3/16"	1	5/8"	4"
90	14	3/16"	1	5/8"	4"
100	12	3/16"	1	5/8"	4"
125	10	3/16"	1	5/8"	4"
150	8	3/16"	1	5/8"	4"
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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REVIEWED FOR CODE COMPLIANCE
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NOTES:

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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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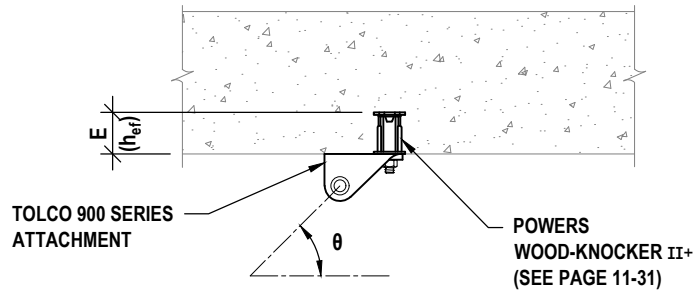
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-8

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	3/8"	1.75"
20	40	1/8"	1	3/8"	1.75"
30	40	1/8"	1	3/8"	1.75"
40	40	1/8"	1	1/2"	1.75"
50	33	1/8"	1	1/2"	1.75"
60	27	1/8"	1	1/2"	1.75"
70	23	1/8"	1	1/2"	1.75"
80	20	1/8"	1	1/2"	1.75"
90	18	1/8"	1	1/2"	1.75"
100	16	1/8"	1	1/2"	1.75"
125	13	1/8"	1	1/2"	1.75"
150	11	1/8"	1	1/2"	1.75"
175	9	1/8"	1	1/2"	1.75"
200	8	1/8"	1	1/2"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	3/8"	1.75"
20	80	1/8"	1	3/8"	1.75"
30	80	1/8"	1	3/8"	1.75"
40	80	1/8"	1	1/2"	1.75"
50	66	1/8"	1	1/2"	1.75"
60	54	1/8"	1	1/2"	1.75"
70	46	1/8"	1	1/2"	1.75"
80	40	1/8"	1	1/2"	1.75"
90	36	1/8"	1	1/2"	1.75"
100	32	1/8"	1	1/2"	1.75"
125	26	1/8"	1	1/2"	1.75"
150	22	1/8"	1	1/2"	1.75"
175	18	1/8"	1	1/2"	1.75"
200	16	1/8"	1	1/2"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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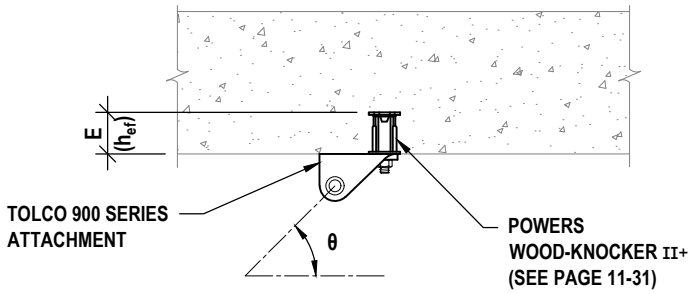
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-9

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	3/8"	1.75"
20	40	1/8"	1	1/2"	1.75"
30	27	1/8"	1	1/2"	1.75"
40	20	1/8"	1	1/2"	1.75"
50	16	1/8"	1	1/2"	1.75"
60	13	1/8"	1	1/2"	1.75"
70	11	1/8"	1	1/2"	1.75"
80	10	1/8"	1	1/2"	1.75"
90	9	1/8"	1	1/2"	1.75"
100	8	1/8"	1	1/2"	1.75"
125	6	1/8"	1	1/2"	1.75"
150	5	1/8"	1	1/2"	1.75"
175	4	1/8"	1	1/2"	1.75"
200	4	1/8"	1	1/2"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	3/8"	1.75"
20	80	1/8"	1	1/2"	1.75"
30	54	1/8"	1	1/2"	1.75"
40	40	1/8"	1	1/2"	1.75"
50	32	1/8"	1	1/2"	1.75"
60	26	1/8"	1	1/2"	1.75"
70	22	1/8"	1	1/2"	1.75"
80	20	1/8"	1	1/2"	1.75"
90	18	1/8"	1	1/2"	1.75"
100	16	1/8"	1	1/2"	1.75"
125	12	1/8"	1	1/2"	1.75"
150	10	1/8"	1	1/2"	1.75"
175	8	1/8"	1	1/2"	1.75"
200	8	1/8"	1	1/2"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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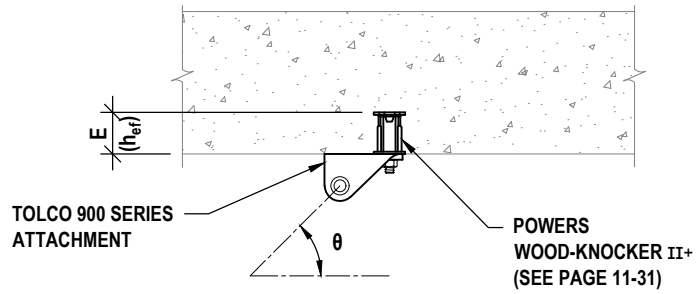
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-10

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	3/8"	1.75"
20	27	1/8"	1	1/2"	1.75"
30	18	1/8"	1	1/2"	1.75"
40	13	1/8"	1	1/2"	1.75"
50	11	1/8"	1	1/2"	1.75"
60	9	1/8"	1	1/2"	1.75"
70	7	1/8"	1	1/2"	1.75"
80	6	1/8"	1	1/2"	1.75"
90	6	1/8"	1	1/2"	1.75"
100	5	1/8"	1	1/2"	1.75"
125	4	1/8"	1	1/2"	1.75"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	3/8"	1.75"
20	54	1/8"	1	1/2"	1.75"
30	36	1/8"	1	1/2"	1.75"
40	26	1/8"	1	1/2"	1.75"
50	22	1/8"	1	1/2"	1.75"
60	18	1/8"	1	1/2"	1.75"
70	14	1/8"	1	1/2"	1.75"
80	12	1/8"	1	1/2"	1.75"
90	12	1/8"	1	1/2"	1.75"
100	10	1/8"	1	1/2"	1.75"
125	8	1/8"	1	1/2"	1.75"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

REVIEWED FOR CODE COMPLIANCE
ICC-ES
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
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6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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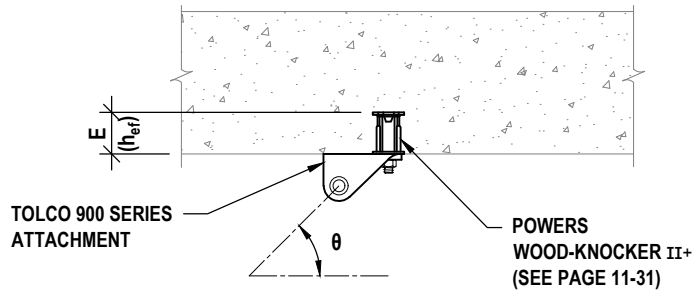
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-11

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	1/2"	1.75"
20	20	1/8"	1	1/2"	1.75"
30	13	1/8"	1	1/2"	1.75"
40	10	1/8"	1	1/2"	1.75"
50	8	1/8"	1	1/2"	1.75"
60	6	1/8"	1	1/2"	1.75"
70	5	1/8"	1	1/2"	1.75"
80	5	1/8"	1	1/2"	1.75"
90	4	1/8"	1	1/2"	1.75"
100	4	1/8"	1	1/2"	1.75"
125					
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	1/2"	1.75"
20	40	1/8"	1	1/2"	1.75"
30	26	1/8"	1	1/2"	1.75"
40	20	1/8"	1	1/2"	1.75"
50	16	1/8"	1	1/2"	1.75"
60	12	1/8"	1	1/2"	1.75"
70	10	1/8"	1	1/2"	1.75"
80	10	1/8"	1	1/2"	1.75"
90	8	1/8"	1	1/2"	1.75"
100	8	1/8"	1	1/2"	1.75"
125					
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.6.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS WOOD-KNOCKER II+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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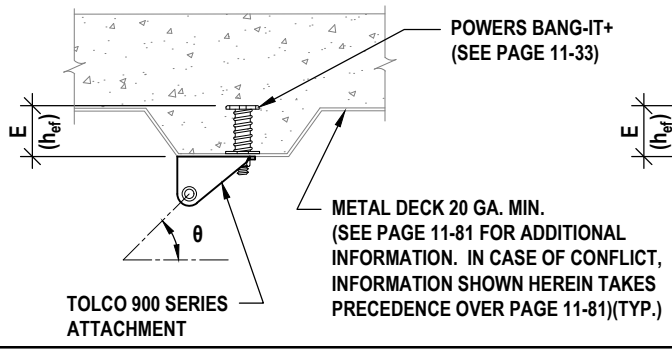
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

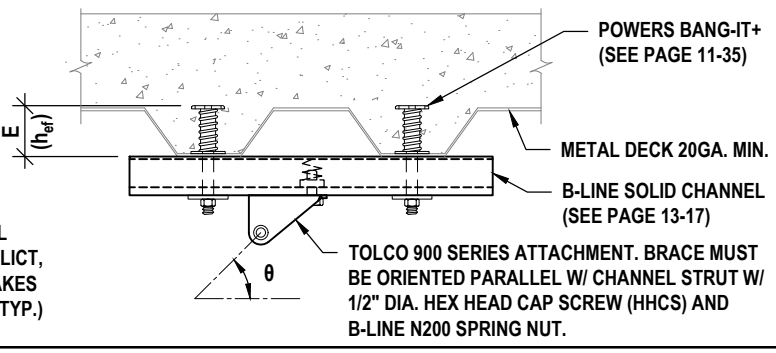
PAGE: 9-12

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	1	3/8"	1.75"
20	40	1/8"	1	3/8"	1.75"
30	40	1/8"	2	3/8"	1.75"
40	40	1/8"	2	3/8"	1.75"
50	39	1/8"	2	5/8"	1.75"
60	32	1/8"	2	5/8"	1.75"
70	28	1/8"	2	5/8"	1.75"
80	24	1/8"	2	5/8"	1.75"
90	21	1/8"	2	5/8"	1.75"
100	19	1/8"	2	5/8"	1.75"
125	15	1/8"	2	5/8"	1.75"
150	13	1/8"	2	5/8"	1.75"
175	11	1/8"	2	5/8"	1.75"
200	9	1/8"	2	5/8"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	1	3/8"	1.75"
20	80	1/8"	1	3/8"	1.75"
30	80	1/8"	2	3/8"	1.75"
40	80	1/8"	2	3/8"	1.75"
50	78	1/8"	2	5/8"	1.75"
60	64	1/8"	2	5/8"	1.75"
70	56	1/8"	2	5/8"	1.75"
80	48	1/8"	2	5/8"	1.75"
90	42	1/8"	2	5/8"	1.75"
100	38	1/8"	2	5/8"	1.75"
125	30	1/8"	2	5/8"	1.75"
150	26	1/8"	2	5/8"	1.75"
175	22	1/8"	2	5/8"	1.75"
200	18	1/8"	2	5/8"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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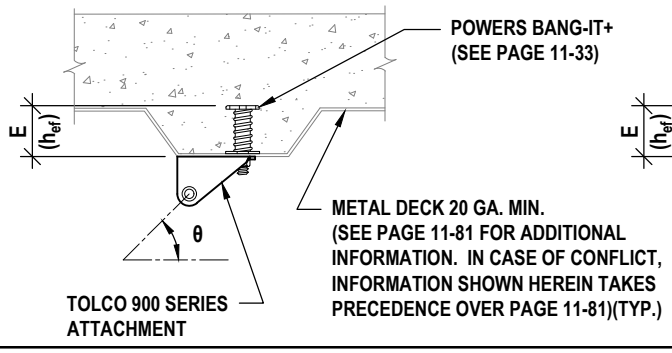
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

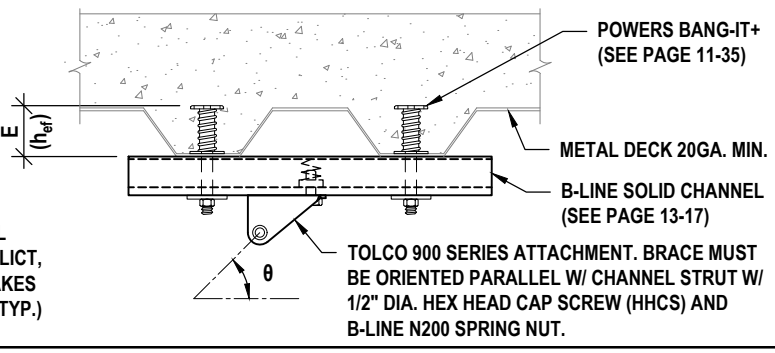
PAGE: 9-13

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.50 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	40	1/8"	1	3/8"	1.75"
20	40	1/8"	2	3/8"	1.75"
30	32	1/8"	2	5/8"	1.75"
40	24	1/8"	2	5/8"	1.75"
50	19	1/8"	2	5/8"	1.75"
60	16	1/8"	2	5/8"	1.75"
70	14	1/8"	2	5/8"	1.75"
80	12	1/8"	2	5/8"	1.75"
90	10	1/8"	2	5/8"	1.75"
100	9	1/8"	2	5/8"	1.75"
125	7	1/8"	2	5/8"	1.75"
150	6	1/8"	2	5/8"	1.75"
175	5	1/8"	2	5/8"	1.75"
200	4	1/8"	2	5/8"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Concrete Anchorage		
			Anchor Per Brace	Min. Diameter	Min. Embed "E"
10	80	1/8"	1	3/8"	1.75"
20	80	1/8"	2	3/8"	1.75"
30	64	1/8"	2	5/8"	1.75"
40	48	1/8"	2	5/8"	1.75"
50	38	1/8"	2	5/8"	1.75"
60	32	1/8"	2	5/8"	1.75"
70	28	1/8"	2	5/8"	1.75"
80	24	1/8"	2	5/8"	1.75"
90	20	1/8"	2	5/8"	1.75"
100	18	1/8"	2	5/8"	1.75"
125	14	1/8"	2	5/8"	1.75"
150	12	1/8"	2	5/8"	1.75"
175	10	1/8"	2	5/8"	1.75"
200	8	1/8"	2	5/8"	1.75"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. CHARTS BASED ON TENSION AND SHEAR LOADS FROM POWERS POWERS BANG-IT+ ANCHOR (ICC ESR-3657, DECEMBER 2023), WITH SPECIAL INSPECTION.
3. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
4. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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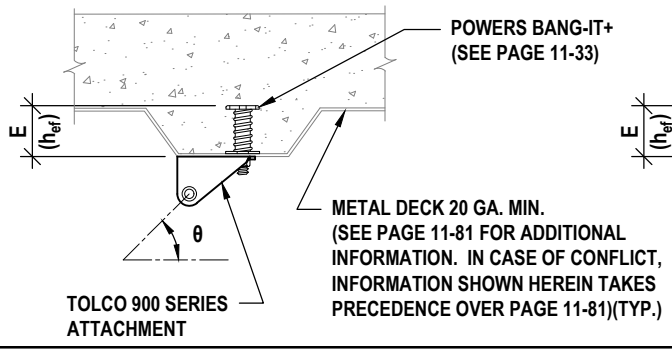
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

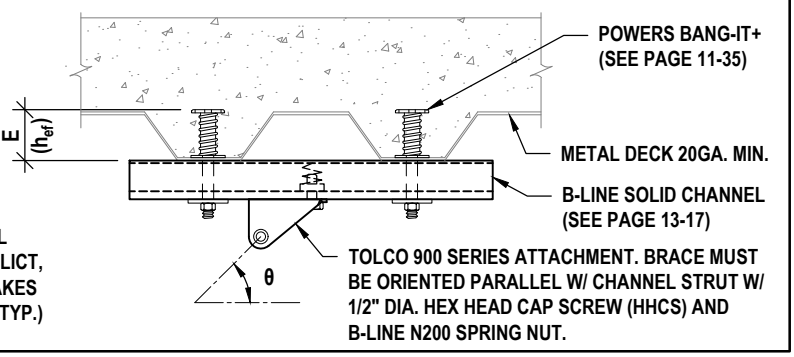
PAGE: 9-14

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

0.75 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	2	3/8"	1.75"
20	32	1/8"	2	5/8"	1.75"
30	21	1/8"	2	5/8"	1.75"
40	16	1/8"	2	5/8"	1.75"
50	13	1/8"	2	5/8"	1.75"
60	10	1/8"	2	5/8"	1.75"
70	9	1/8"	2	5/8"	1.75"
80	8	1/8"	2	5/8"	1.75"
90	7	1/8"	2	5/8"	1.75"
100	6	1/8"	2	5/8"	1.75"
125	5	1/8"	2	5/8"	1.75"
150	4	1/8"	2	5/8"	1.75"
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	2	3/8"	1.75"
20	64	1/8"	2	5/8"	1.75"
30	42	1/8"	2	5/8"	1.75"
40	32	1/8"	2	5/8"	1.75"
50	26	1/8"	2	5/8"	1.75"
60	20	1/8"	2	5/8"	1.75"
70	18	1/8"	2	5/8"	1.75"
80	16	1/8"	2	5/8"	1.75"
90	14	1/8"	2	5/8"	1.75"
100	12	1/8"	2	5/8"	1.75"
125	10	1/8"	2	5/8"	1.75"
150	8	1/8"	2	5/8"	1.75"
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 By: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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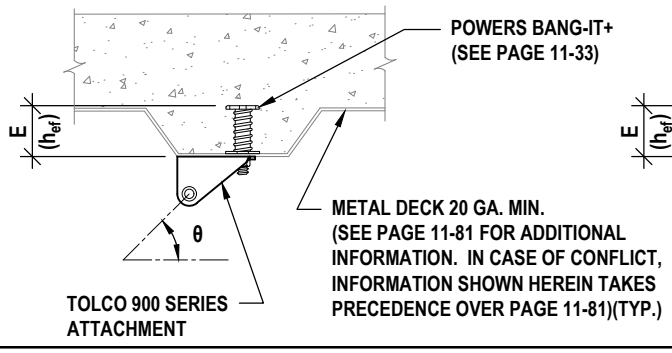
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

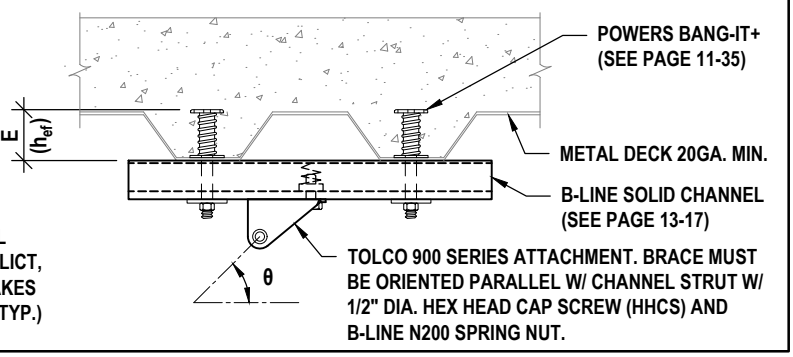
PAGE: 9-15

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART FOR CONCRETE INSERTS IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	40	1/8"	2	3/8"	1.75"
20	24	1/8"	2	5/8"	1.75"
30	16	1/8"	2	5/8"	1.75"
40	12	1/8"	2	5/8"	1.75"
50	9	1/8"	2	5/8"	1.75"
60	8	1/8"	2	5/8"	1.75"
70	7	1/8"	2	5/8"	1.75"
80	6	1/8"	2	5/8"	1.75"
90	5	1/8"	2	5/8"	1.75"
100	4	1/8"	2	5/8"	1.75"
125					
150					
175					
200					

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Concrete Anchorage: Anchor Per Brace	Concrete Anchorage: Min. Diameter	Concrete Anchorage: Min. Embed "E"
10	80	1/8"	2	3/8"	1.75"
20	48	1/8"	2	5/8"	1.75"
30	32	1/8"	2	5/8"	1.75"
40	24	1/8"	2	5/8"	1.75"
50	18	1/8"	2	5/8"	1.75"
60	16	1/8"	2	5/8"	1.75"
70	14	1/8"	2	5/8"	1.75"
80	12	1/8"	2	5/8"	1.75"
90	10	1/8"	2	5/8"	1.75"
100	8	1/8"	2	5/8"	1.75"
125					
150					
175					
200					

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.7.

ICC-ES REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

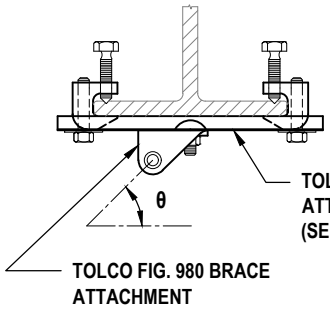
PAGE: 9-16

DATE: April 23, 2025

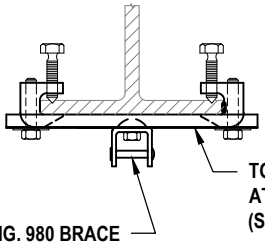
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.25 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G"	
		Perpendicular	Parallel
10	1/8"	40	40
20	1/8"	40	40
30	1/8"	40	40
40	1/8"	40	40
50	1/8"	40	40
60	3/16"	40	40
70	3/16"	40	40
80	3/16"	40	40
90	3/16"	40	40
100	3/16"	40	40
125	1/4"	40	38
150	1/4"	40	31
175	1/4"	40	27
200	1/4"	35	23

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"	
		Perpendicular	Parallel
10	1/8"	80	80
20	1/8"	80	80
30	1/8"	80	80
40	1/8"	80	80
50	1/8"	80	80
60	3/16"	80	80
70	3/16"	80	80
80	3/16"	80	80
90	3/16"	80	80
100	3/16"	80	80
125	1/4"	80	76
150	1/4"	80	62
175	1/4"	80	54
200	1/4"	70	46

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

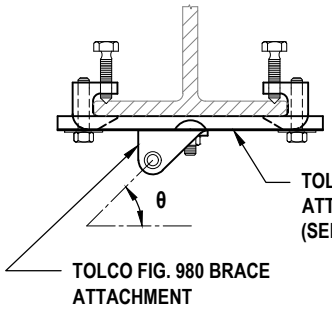
PAGE: 9-17

DATE: April 23, 2025

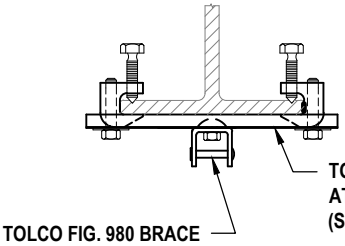
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.50 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G"	
		Perpendicular	Parallel
10	1/8"	40	40
20	1/8"	40	40
30	3/16"	40	40
40	3/16"	40	40
50	3/16"	40	40
60	1/4"	40	39
70	1/4"	40	34
80	1/4"	40	29
90	1/4"	39	26
100	1/4"	35	23
125	1/4"	28	19
150	1/4"	23	15
175	1/4"	20	13
200	1/4"	17	11

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"	
		Perpendicular	Parallel
10	1/8"	80	80
20	1/8"	80	80
30	3/16"	80	80
40	3/16"	80	80
50	3/16"	80	80
60	1/4"	80	78
70	1/4"	80	68
80	1/4"	80	58
90	1/4"	78	52
100	1/4"	70	46
125	1/4"	56	38
150	1/4"	46	30
175	1/4"	40	26
200	1/4"	34	22

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.5.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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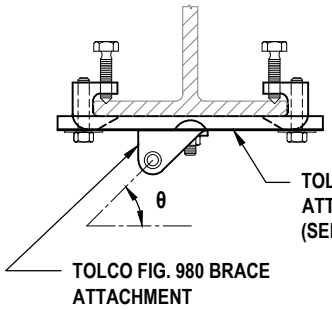
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DATE: April 23, 2025

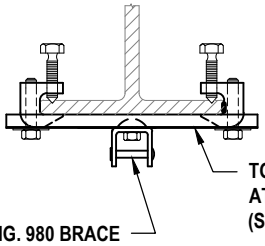
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

0.75 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G"	
		Perpendicular	Parallel
10	1/8"	40	40
20	3/16"	40	40
30	3/16"	40	40
40	1/4"	40	39
50	1/4"	40	31
60	1/4"	39	26
70	1/4"	34	22
80	1/4"	29	19
90	1/4"	26	17
100	1/4"	23	15
125	1/4"	19	12
150	1/4"	15	10
175	1/4"	13	9
200	1/4"	11	7

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Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"	
		Perpendicular	Parallel
10	1/8"	80	80
20	3/16"	80	80
30	3/16"	80	80
40	1/4"	80	78
50	1/4"	80	62
60	1/4"	78	52
70	1/4"	68	44
80	1/4"	58	38
90	1/4"	52	34
100	1/4"	46	30
125	1/4"	38	24
150	1/4"	30	20
175	1/4"	26	18
200	1/4"	22	14

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HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
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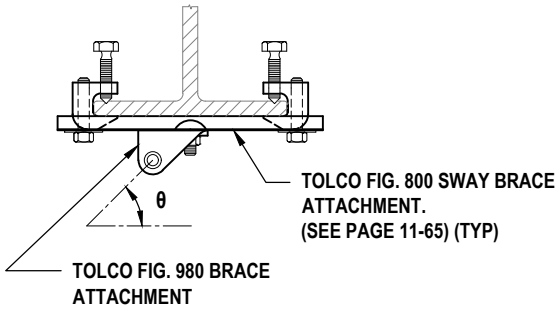
PAGE: 9-19

DATE: April 23, 2025

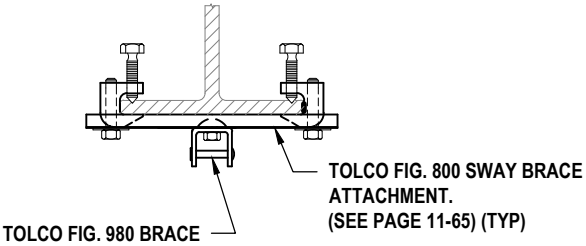
TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL BEAM

1.0 "G"

Brace Perpendicular to Beam



Brace Parallel to Beam



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G"	
		Perpendicular	Parallel
10	3/16"	40	40
20	3/16"	40	40
30	1/4"	40	39
40	1/4"	40	29
50	1/4"	35	23
60	1/4"	29	19
70	1/4"	25	17
80	1/4"	22	14
90	1/4"	19	13
100	1/4"	17	11
125	1/4"	14	9
150	1/4"	11	7
175	1/4"	10	6
200	1/4"	8	5

FOOTNOTES:

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Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"	
		Perpendicular	Parallel
10	3/16"	80	80
20	3/16"	80	80
30	1/4"	80	78
40	1/4"	80	58
50	1/4"	70	46
60	1/4"	58	38
70	1/4"	50	34
80	1/4"	44	28
90	1/4"	38	26
100	1/4"	34	22
125	1/4"	28	18
150	1/4"	22	14
175	1/4"	20	12
200	1/4"	16	10

FOOTNOTES:

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HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

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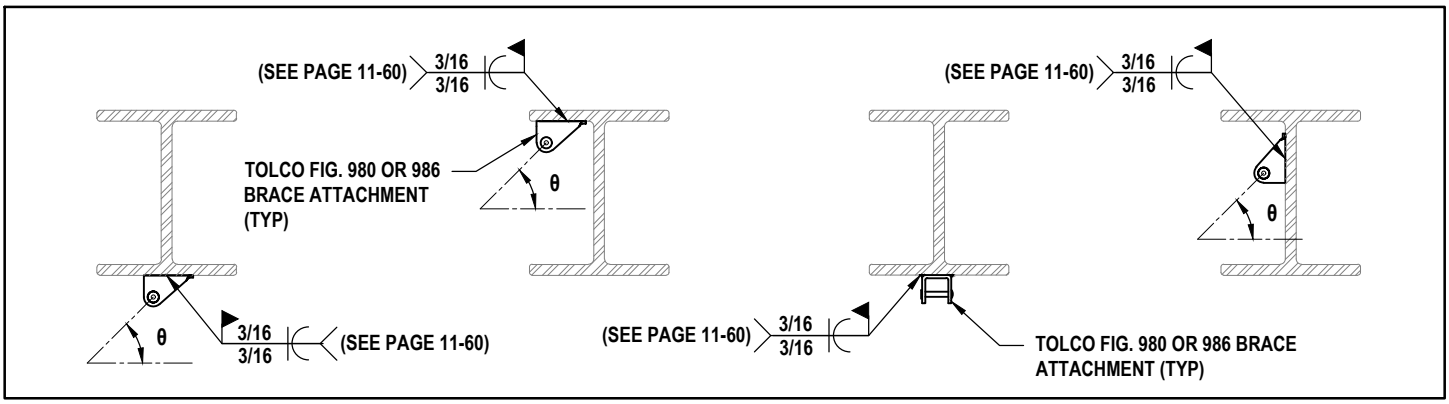
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-20

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.25 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G"
10	1/8"	40
20	1/8"	40
30	1/8"	40
40	1/8"	40
50	1/8"	40
60	3/16"	40
70	3/16"	40
80	3/16"	40
90	3/16"	40
100	3/16"	40
125	1/4"	39
150	1/4"	32
175	1/4"	27
200	1/4"	24

FOOTNOTES:
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"
10	1/8"	80
20	1/8"	80
30	1/8"	80
40	1/8"	80
50	1/8"	80
60	3/16"	80
70	3/16"	80
80	3/16"	80
90	3/16"	80
100	3/16"	80
125	1/4"	78
150	1/4"	64
175	1/4"	54
200	1/4"	48

FOOTNOTES:
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2. DOUBLE BRACING IS REQUIRED.

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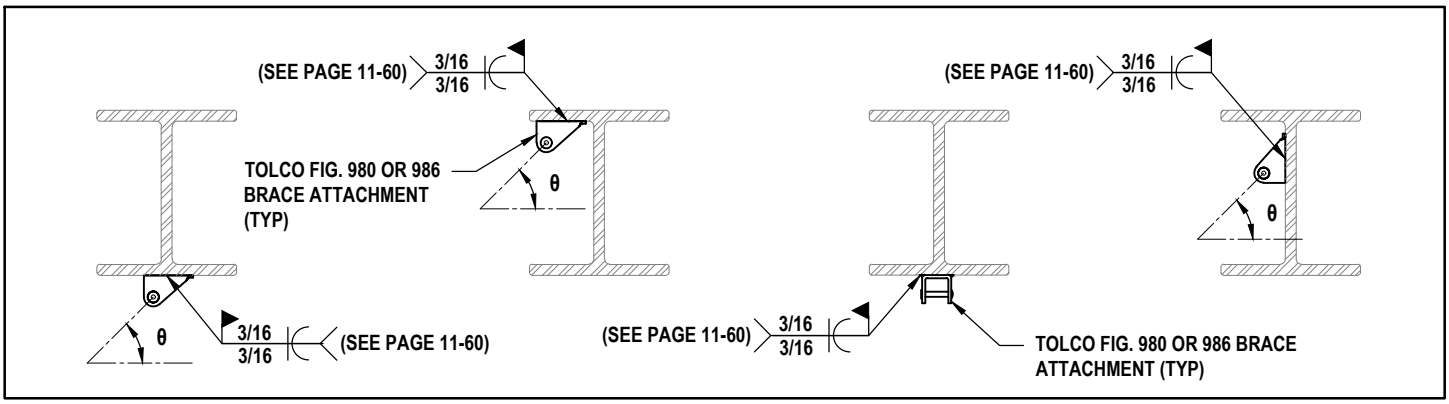
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-21

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.50 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G"
10	1/8"	40
20	1/8"	40
30	3/16"	40
40	3/16"	40
50	3/16"	40
60	1/4"	40
70	1/4"	34
80	1/4"	30
90	1/4"	27
100	1/4"	24
125	1/4"	19
150	1/4"	16
175	1/4"	13
200	1/4"	12

FOOTNOTES:
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Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"
10	1/8"	80
20	1/8"	80
30	3/16"	80
40	3/16"	80
50	3/16"	80
60	1/4"	80
70	1/4"	68
80	1/4"	60
90	1/4"	54
100	1/4"	48
125	1/4"	38
150	1/4"	32
175	1/4"	26
200	1/4"	24

FOOTNOTES:
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   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.

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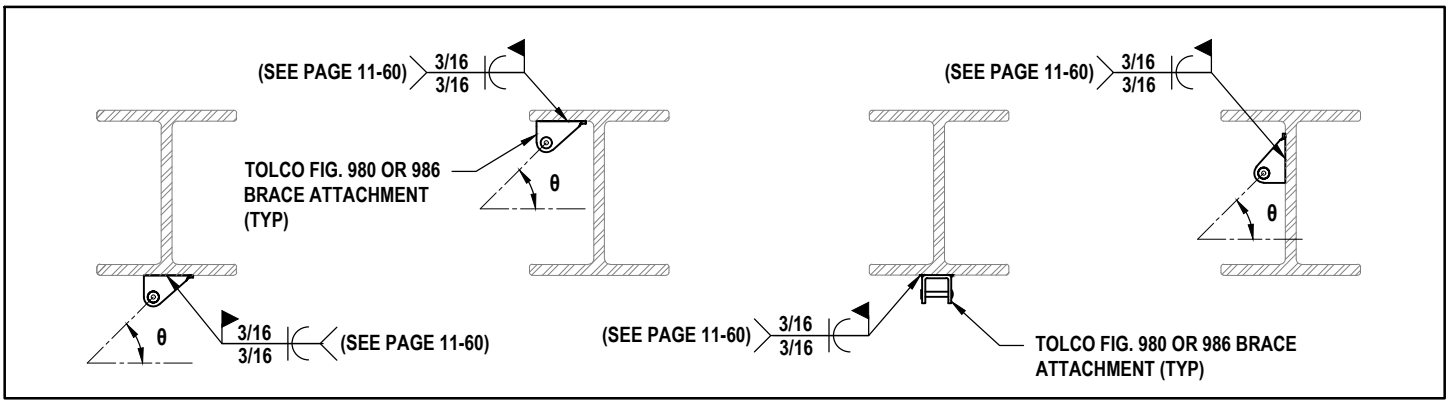
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-22

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

0.75 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G"
10	1/8"	40
20	3/16"	40
30	3/16"	40
40	1/4"	40
50	1/4"	32
60	1/4"	27
70	1/4"	23
80	1/4"	20
90	1/4"	18
100	1/4"	16
125	1/4"	13
150	1/4"	10
175	1/4"	9
200	1/4"	8

FOOTNOTES:
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Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"
10	1/8"	80
20	3/16"	80
30	3/16"	80
40	1/4"	80
50	1/4"	64
60	1/4"	54
70	1/4"	46
80	1/4"	40
90	1/4"	36
100	1/4"	32
125	1/4"	26
150	1/4"	20
175	1/4"	18
200	1/4"	16

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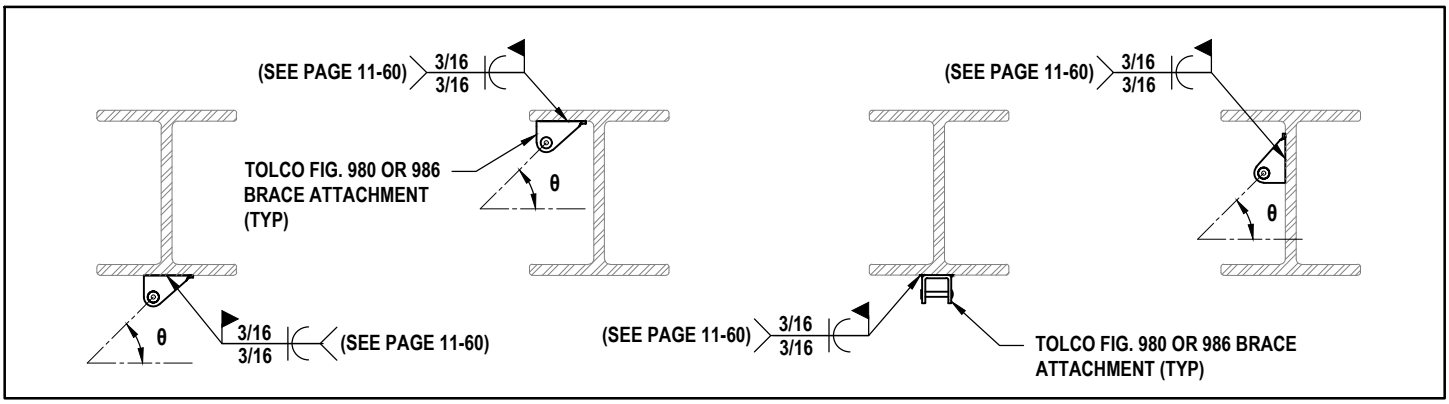
Structural Engineer: Mohammad R. Hariri
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PAGE: 9-23

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TRAPEZE BRACE SPACING CHART
FOR WELDED ATTACHMENT TO STEEL BEAM

1.0 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G"
10	1/8"	40
20	3/16"	40
30	1/4"	40
40	1/4"	30
50	1/4"	24
60	1/4"	20
70	1/4"	17
80	1/4"	15
90	1/4"	13
100	1/4"	12
125	1/4"	9
150	1/4"	8
175	1/4"	6
200	1/4"	6

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
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Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"
10	1/8"	80
20	3/16"	80
30	1/4"	80
40	1/4"	60
50	1/4"	48
60	1/4"	40
70	1/4"	34
80	1/4"	30
90	1/4"	26
100	1/4"	24
125	1/4"	18
150	1/4"	16
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1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.8.
2. DOUBLE BRACING IS REQUIRED.

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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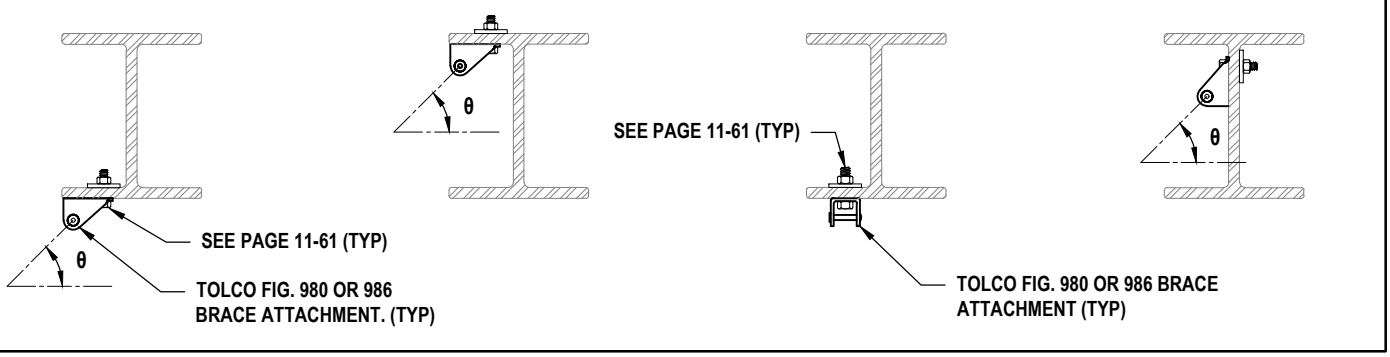
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-24

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.25 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Transverse[1] Max. Spacing @ 0.25 "G"
10	1/8"	3/8"	40
20	1/8"	3/8"	40
30	1/8"	3/8"	40
40	1/8"	3/8"	40
50	1/8"	1/2"	40
60	3/16"	1/2"	40
70	3/16"	1/2"	40
80	3/16"	1/2"	40
90	3/16"	5/8"	40
100	3/16"	5/8"	40
125	1/4"	5/8"	39
150	1/4"	5/8"	32
175	1/4"	5/8"	27
200	1/4"	5/8"	24

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G"
10	1/8"	3/8"	80
20	1/8"	3/8"	80
30	1/8"	3/8"	80
40	1/8"	3/8"	80
50	1/8"	1/2"	80
60	3/16"	1/2"	80
70	3/16"	1/2"	80
80	3/16"	1/2"	80
90	3/16"	5/8"	80
100	3/16"	5/8"	80
125	1/4"	5/8"	78
150	1/4"	5/8"	64
175	1/4"	5/8"	54
200	1/4"	5/8"	48

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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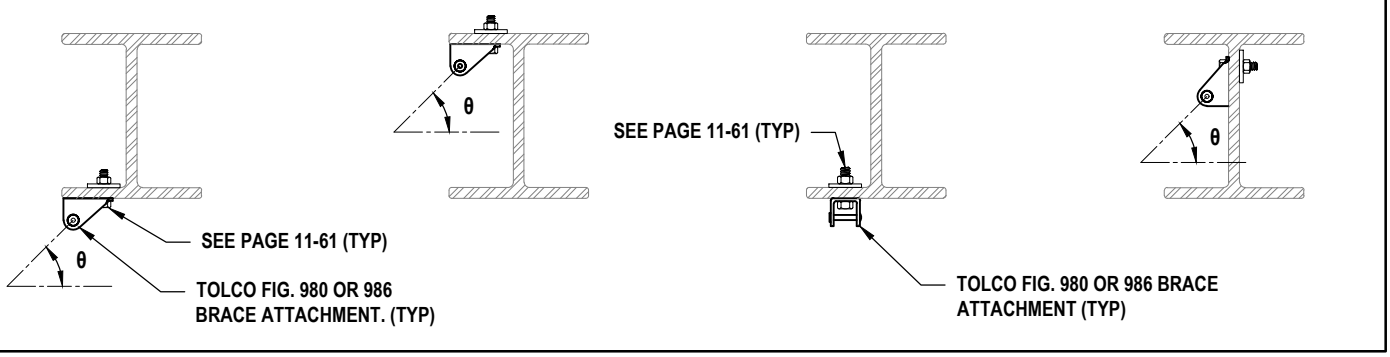
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-25

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.50 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Transverse[1] Max. Spacing @ 0.50 "G"
10	1/8"	3/8"	40
20	1/8"	3/8"	40
30	3/16"	1/2"	40
40	3/16"	1/2"	40
50	3/16"	5/8"	40
60	1/4"	5/8"	40
70	1/4"	3/4"	34
80	1/4"	3/4"	30
90	1/4"	3/4"	27
100	1/4"	3/4"	24
125	1/4"	3/4"	19
150	1/4"	3/4"	16
175	1/4"	3/4"	13
200	1/4"	3/4"	12

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G"
10	1/8"	3/8"	80
20	1/8"	3/8"	80
30	3/16"	1/2"	80
40	3/16"	1/2"	80
50	3/16"	5/8"	80
60	1/4"	5/8"	80
70	1/4"	3/4"	68
80	1/4"	3/4"	60
90	1/4"	3/4"	54
100	1/4"	3/4"	48
125	1/4"	3/4"	38
150	1/4"	3/4"	32
175	1/4"	3/4"	26
200	1/4"	3/4"	24

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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DATE: 04/24/2025
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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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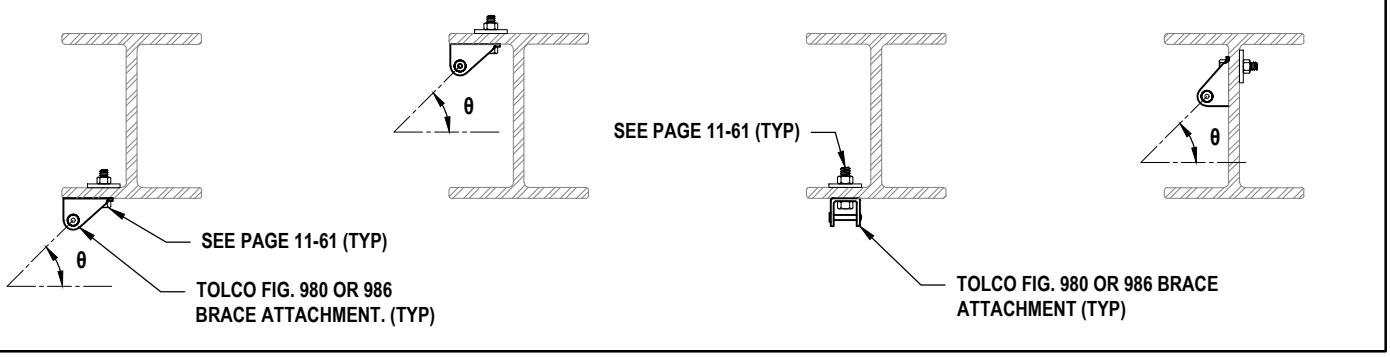
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-26

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

0.75 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Transverse[1] Max. Spacing @ 0.75 "G"
10	1/8"	3/8"	40
20	3/16"	1/2"	40
30	3/16"	5/8"	40
40	1/4"	5/8"	40
50	1/4"	5/8"	32
60	1/4"	5/8"	27
70	1/4"	5/8"	23
80	1/4"	5/8"	20
90	1/4"	5/8"	18
100	1/4"	5/8"	16
125	1/4"	5/8"	13
150	1/4"	5/8"	10
175	1/4"	5/8"	9
200	1/4"	5/8"	8

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G"
10	1/8"	3/8"	80
20	3/16"	1/2"	80
30	3/16"	5/8"	80
40	1/4"	5/8"	80
50	1/4"	5/8"	64
60	1/4"	5/8"	54
70	1/4"	5/8"	46
80	1/4"	5/8"	40
90	1/4"	5/8"	36
100	1/4"	5/8"	32
125	1/4"	5/8"	26
150	1/4"	5/8"	20
175	1/4"	5/8"	18
200	1/4"	5/8"	16

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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HCAi
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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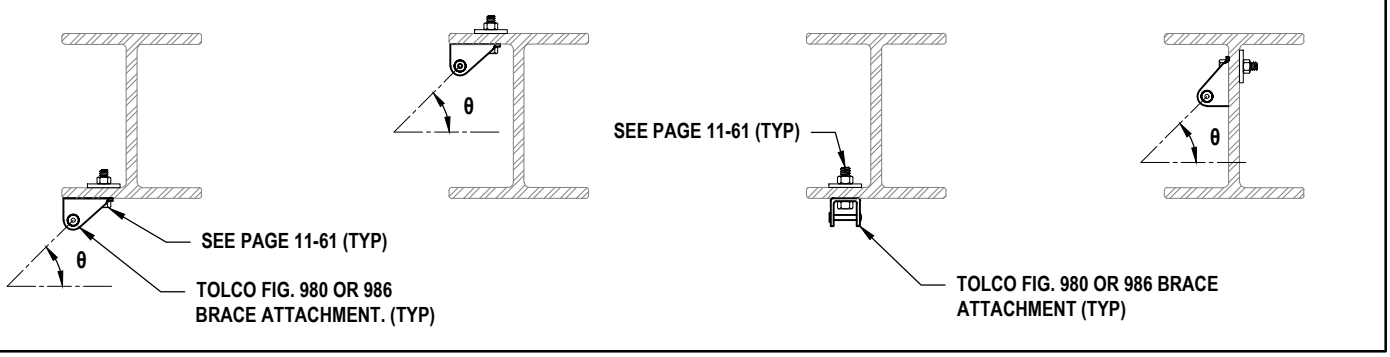
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-27

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR BOLTED ATTACHMENT TO STEEL BEAM

1.0 "G"



Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Transverse[1] Max. Spacing @ 1.0 "G"
10	1/8"	3/8"	40
20	3/16"	1/2"	40
30	1/4"	5/8"	40
40	1/4"	3/4"	30
50	1/4"	3/4"	24
60	1/4"	3/4"	20
70	1/4"	3/4"	17
80	1/4"	3/4"	15
90	1/4"	3/4"	13
100	1/4"	3/4"	12
125	1/4"	3/4"	9
150	1/4"	3/4"	8
175	1/4"	3/4"	6
200	1/4"	3/4"	6

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

Max. Trapeze Weight Per Ft.	Cable Diameter	Bolt Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G"
10	1/8"	3/8"	80
20	3/16"	1/2"	80
30	1/4"	5/8"	80
40	1/4"	3/4"	60
50	1/4"	3/4"	48
60	1/4"	3/4"	40
70	1/4"	3/4"	34
80	1/4"	3/4"	30
90	1/4"	3/4"	26
100	1/4"	3/4"	24
125	1/4"	3/4"	18
150	1/4"	3/4"	16
175	1/4"	3/4"	12
200	1/4"	3/4"	12

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.9.

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BY: Roy Lobo
DATE: 04/24/2025
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NOTES:

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2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, ANCHOR QUANTITY, ANCHOR DIAMETER, AND ANCHOR EMBEDMENT PER THE LONGITUDINAL BRACE TABLE.
6. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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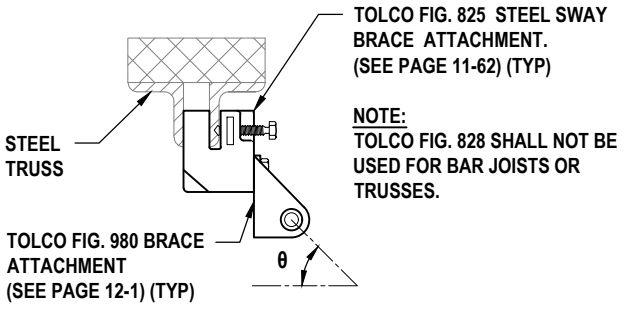
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

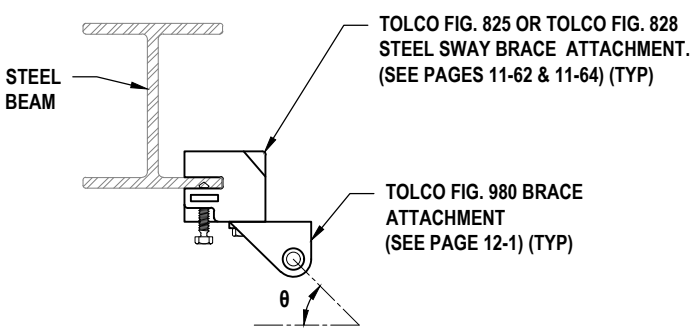
PAGE: 9-28

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.25 "G"





Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	40	40
20	1/8"	40	40
30	1/8"	40	40
40	1/8"	40	40
50	1/8"	40	33
60	3/16"	40	27
70	3/16"	40	23
80	3/16"	40	20
90	3/16"	40	18
100	3/16"	36	16
125	3/16"	28	13
150	3/16"	24	11
175	3/16"	20	9
200	3/16"	18	8

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.25 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	80	80
20	1/8"	80	80
30	1/8"	80	80
40	1/8"	80	80
50	1/8"	80	66
60	3/16"	80	54
70	3/16"	80	46
80	3/16"	80	40
90	3/16"	80	36
100	3/16"	72	32
125	3/16"	56	26
150	3/16"	48	22
175	3/16"	40	18
200	3/16"	36	16

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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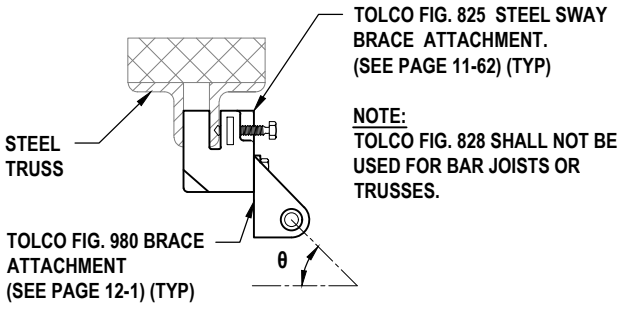
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

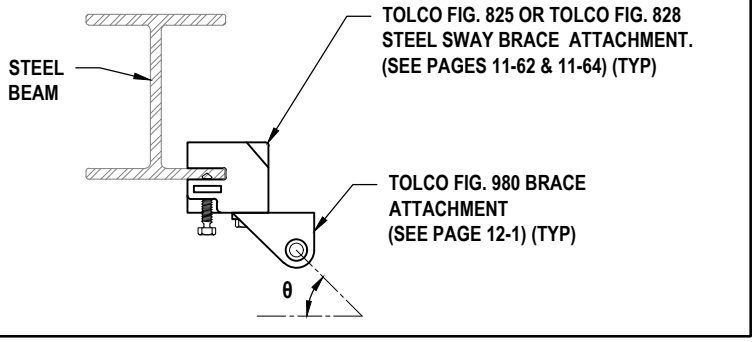
PAGE: 9-29

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.50 "G"





Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	40	40
20	1/8"	40	40
30	3/16"	40	27
40	3/16"	40	20
50	3/16"	36	16
60	3/16"	30	13
70	3/16"	25	11
80	3/16"	22	10
90	3/16"	20	9
100	3/16"	18	8
125	3/16"	14	6
150	3/16"	12	5
175	3/16"	10	4
200	3/16"	9	4

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.50 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	80	80
20	1/8"	80	80
30	3/16"	80	54
40	3/16"	80	40
50	3/16"	72	32
60	3/16"	60	26
70	3/16"	50	22
80	3/16"	44	20
90	3/16"	40	18
100	3/16"	36	16
125	3/16"	28	12
150	3/16"	24	10
175	3/16"	20	8
200	3/16"	18	8

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
7. NO ATTACHMENT SHALL BE MADE WITHIN PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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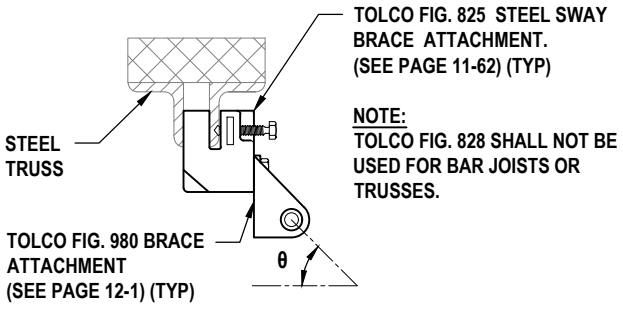
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

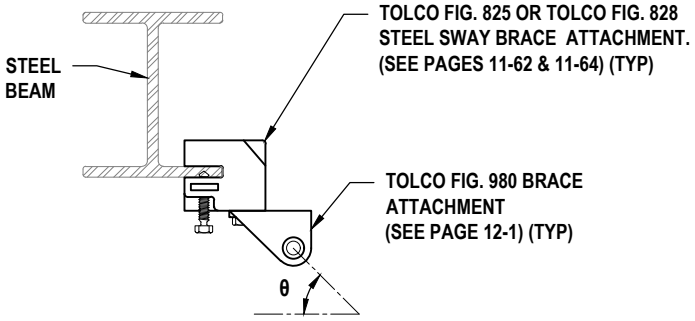
PAGE: 9-30

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

0.75 "G"





Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	40	40
20	3/16"	40	27
30	3/16"	40	18
40	3/16"	30	13
50	3/16"	24	11
60	3/16"	20	9
70	3/16"	17	7
80	3/16"	15	6
90	3/16"	13	6
100	3/16"	12	5
125	3/16"	9	4
150			
175			
200			

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 0.75 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	80	80
20	3/16"	80	54
30	3/16"	80	36
40	3/16"	60	26
50	3/16"	48	22
60	3/16"	40	18
70	3/16"	34	14
80	3/16"	30	12
90	3/16"	26	12
100	3/16"	24	10
125	3/16"	18	8
150			
175			
200			

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. THE SPACINGS LISTED ABOVE ARE BASED ON TOLCO FIG 825. FOR STEEL BEAMS ONLY, SPACINGS MAY BE INCREASED IF TOLCO FIGURE 828 IS USED BASED ON ALLOWABLE LOADS FIGURE 825 AND TOLCO FIGURE 828. SEE PAGES 11-62 & 11-64.
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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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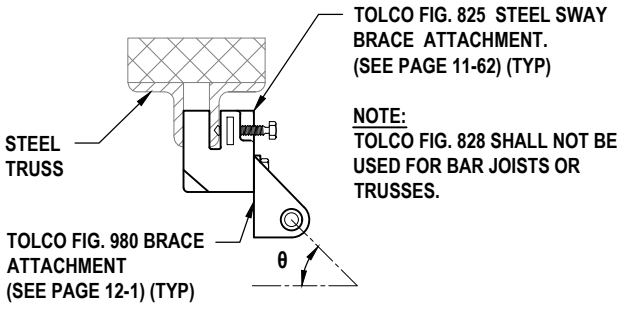
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

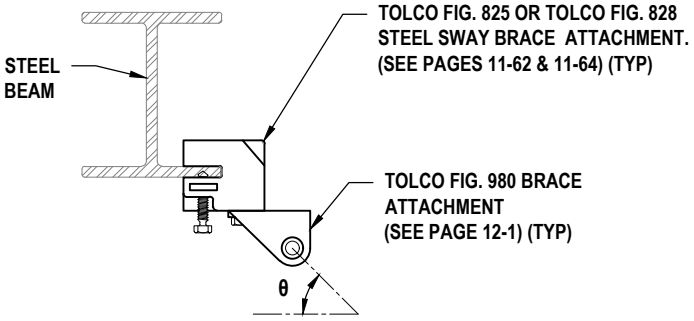
PAGE: 9-31

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR SWAY BRACE ATTACHMENT TO STEEL TRUSS OR STEEL BEAM

1.0 "G"





Max. Trapeze Weight Per Ft.	Cable Diameter	Transverse[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	40	40
20	3/16"	40	20
30	3/16"	30	13
40	3/16"	22	10
50	3/16"	18	8
60	3/16"	15	6
70	3/16"	12	5
80	3/16"	11	5
90	3/16"	10	4
100	3/16"	9	4
125			
150			
175			
200			

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

Max. Trapeze Weight Per Ft.	Cable Diameter	Longitudinal[1] Max. Spacing @ 1.0 "G" Fig. 825 or 828	
		Perpendicular[2]	Parallel[2]
10	1/8"	80	80
20	3/16"	80	40
30	3/16"	60	26
40	3/16"	44	20
50	3/16"	36	16
60	3/16"	30	12
70	3/16"	24	10
80	3/16"	22	10
90	3/16"	20	8
100	3/16"	18	8
125			
150			
175			
200			

FOOTNOTES:
1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 2.3.
2. BRACE ORIENTATION RELATIVE TO STEEL BEAM OR TRUSS/BAR JOIST.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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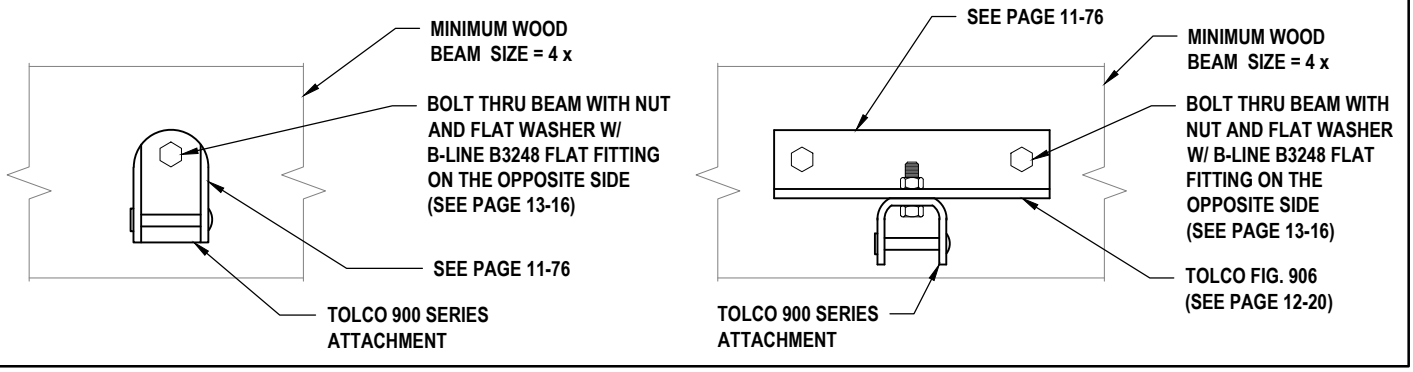
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-32

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	1/2"
20	40	1/8"	1	1/2"
30	40	1/8"	1	1/2"
40	40	1/8"	1	1/2"
50	40	1/8"	2	1/2"
60	40	3/16"	2	1/2"
70	40	3/16"	2	1/2"
80	38	3/16"	2	1/2"
90	34	3/16"	2	1/2"
100	30	3/16"	2	1/2"
125	24	3/16"	2	1/2"
150	20	3/16"	2	1/2"
175	17	3/16"	2	1/2"
200	15	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	1/2"
20	80	1/8"	1	1/2"
30	80	1/8"	1	1/2"
40	80	1/8"	1	1/2"
50	80	1/8"	2	1/2"
60	80	3/16"	2	1/2"
70	80	3/16"	2	1/2"
80	76	3/16"	2	1/2"
90	68	3/16"	2	1/2"
100	60	3/16"	2	1/2"
125	48	3/16"	2	1/2"
150	40	3/16"	2	1/2"
175	34	3/16"	2	1/2"
200	30	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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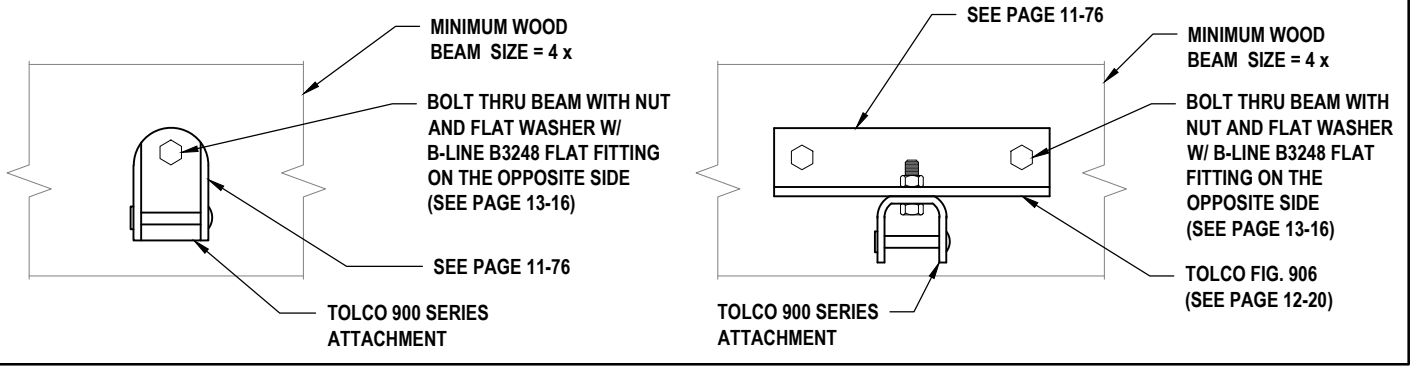
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-33

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	1/2"
20	40	1/8"	1	1/2"
30	40	3/16"	2	1/2"
40	38	3/16"	2	1/2"
50	30	3/16"	2	1/2"
60	25	3/16"	2	1/2"
70	22	3/16"	2	1/2"
80	19	3/16"	2	1/2"
90	17	3/16"	2	1/2"
100	15	3/16"	2	1/2"
125	12	3/16"	2	1/2"
150	10	3/16"	2	1/2"
175	8	3/16"	2	1/2"
200	7	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	1/2"
20	80	1/8"	1	1/2"
30	80	3/16"	2	1/2"
40	76	3/16"	2	1/2"
50	60	3/16"	2	1/2"
60	50	3/16"	2	1/2"
70	44	3/16"	2	1/2"
80	38	3/16"	2	1/2"
90	34	3/16"	2	1/2"
100	30	3/16"	2	1/2"
125	24	3/16"	2	1/2"
150	20	3/16"	2	1/2"
175	16	3/16"	2	1/2"
200	14	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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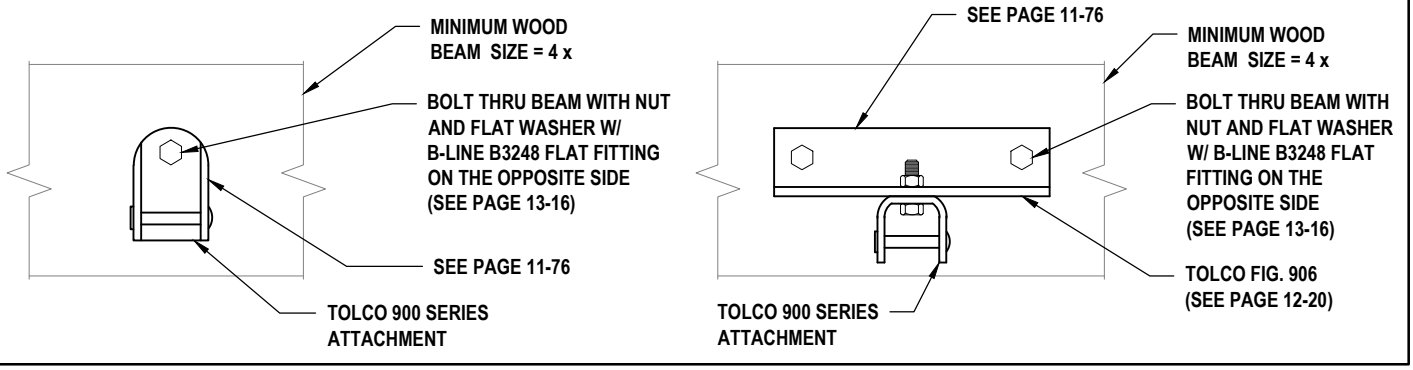
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-34

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	5/8"
20	40	3/16"	2	1/2"
30	34	3/16"	2	1/2"
40	25	3/16"	2	1/2"
50	20	3/16"	2	1/2"
60	17	3/16"	2	1/2"
70	14	3/16"	2	1/2"
80	12	3/16"	2	1/2"
90	11	3/16"	2	1/2"
100	10	3/16"	2	1/2"
125	8	3/16"	2	1/2"
150	6	3/16"	2	1/2"
175	5	3/16"	2	1/2"
200	5	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	5/8"
20	80	3/16"	2	1/2"
30	68	3/16"	2	1/2"
40	50	3/16"	2	1/2"
50	40	3/16"	2	1/2"
60	34	3/16"	2	1/2"
70	28	3/16"	2	1/2"
80	24	3/16"	2	1/2"
90	22	3/16"	2	1/2"
100	20	3/16"	2	1/2"
125	16	3/16"	2	1/2"
150	12	3/16"	2	1/2"
175	10	3/16"	2	1/2"
200	10	3/16"	2	1/2"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE
ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
6. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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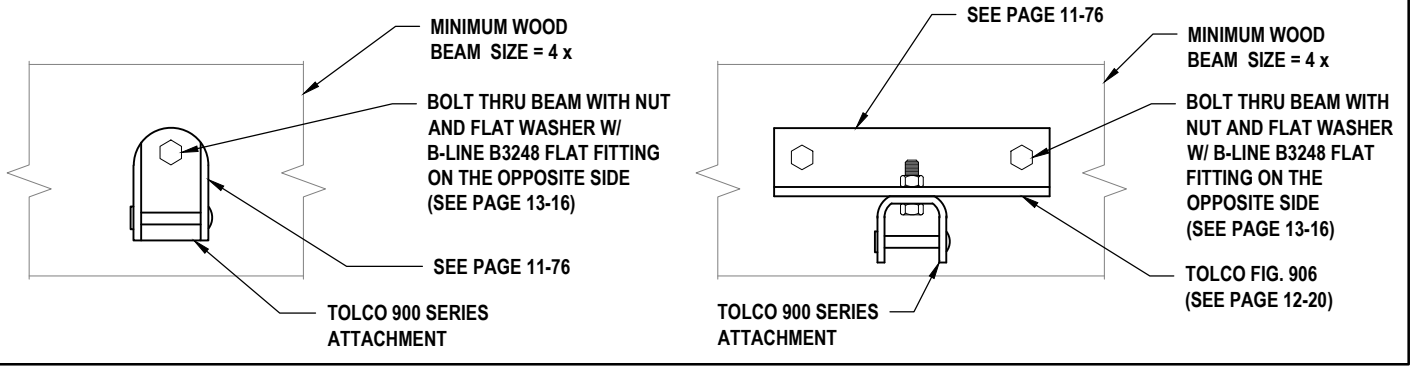
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-35

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	1/2"
20	38	3/16"	2	1/2"
30	25	3/16"	2	1/2"
40	19	3/16"	2	1/2"
50	15	3/16"	2	1/2"
60	12	3/16"	2	1/2"
70	11	3/16"	2	1/2"
80	9	3/16"	2	1/2"
90	8	3/16"	2	1/2"
100	7	3/16"	2	1/2"
125	6	3/16"	2	1/2"
150	5	3/16"	2	1/2"
175	4	3/16"	2	1/2"
200				

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	1/2"
20	76	3/16"	2	1/2"
30	50	3/16"	2	1/2"
40	38	3/16"	2	1/2"
50	30	3/16"	2	1/2"
60	24	3/16"	2	1/2"
70	22	3/16"	2	1/2"
80	18	3/16"	2	1/2"
90	16	3/16"	2	1/2"
100	14	3/16"	2	1/2"
125	12	3/16"	2	1/2"
150	10	3/16"	2	1/2"
175	8	3/16"	2	1/2"
200				

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.9.

REVIEWED FOR CODE COMPLIANCE
ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
8. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
9. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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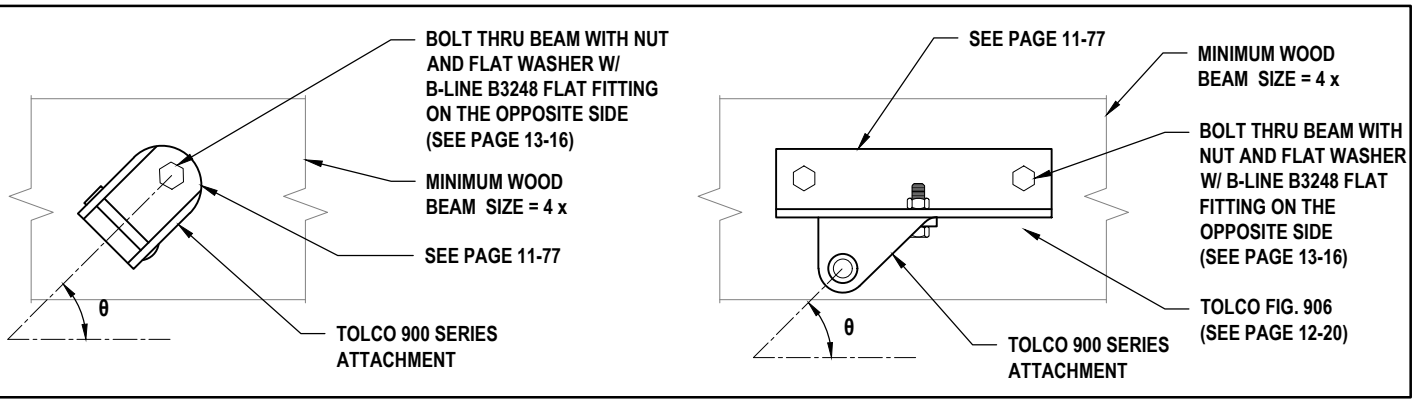
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-36

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	1/2"
20	40	1/8"	1	1/2"
30	40	1/8"	1	3/4"
40	40	1/8"	2	1/2"
50	40	1/8"	2	1/2"
60	40	3/16"	2	1/2"
70	40	3/16"	2	5/8"
80	37	3/16"	2	3/4"
90	33	3/16"	2	3/4"
100	30	3/16"	2	3/4"
125	24	3/16"	2	3/4"
150	20	3/16"	2	3/4"
175	17	3/16"	2	3/4"
200	15	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.25 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	1/2"
20	80	1/8"	1	1/2"
30	80	1/8"	1	3/4"
40	80	1/8"	2	1/2"
50	80	1/8"	2	1/2"
60	80	3/16"	2	1/2"
70	80	3/16"	2	5/8"
80	74	3/16"	2	3/4"
90	66	3/16"	2	3/4"
100	60	3/16"	2	3/4"
125	48	3/16"	2	3/4"
150	40	3/16"	2	3/4"
175	34	3/16"	2	3/4"
200	30	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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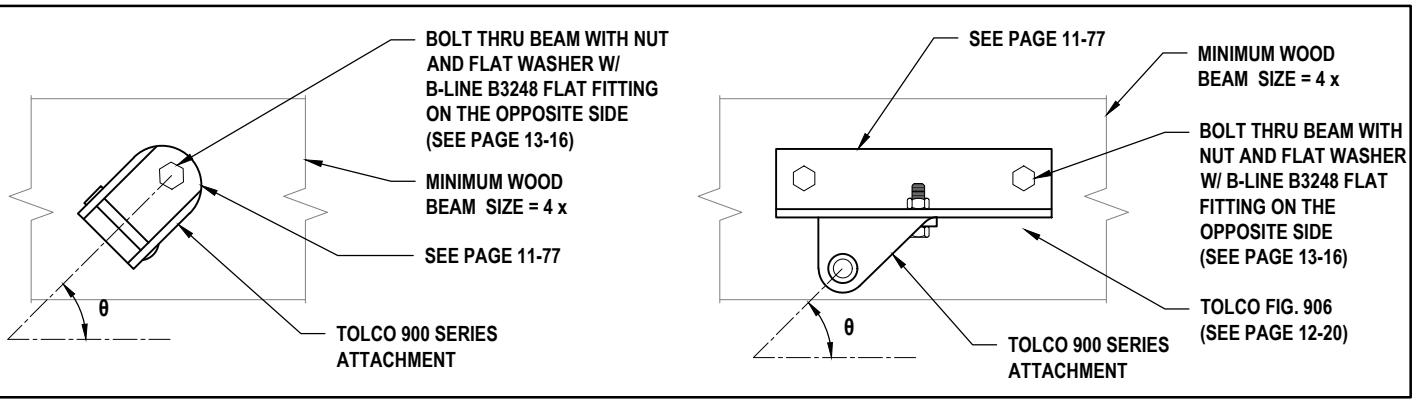
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-37

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	1/2"
20	40	1/8"	2	1/2"
30	40	3/16"	2	1/2"
40	37	3/16"	2	3/4"
50	30	3/16"	2	3/4"
60	25	3/16"	2	3/4"
70	21	3/16"	2	3/4"
80	18	3/16"	2	3/4"
90	16	3/16"	2	3/4"
100	15	3/16"	2	3/4"
125	12	3/16"	2	3/4"
150	10	3/16"	2	3/4"
175	8	3/16"	2	3/4"
200	7	3/16"	2	3/4"

FOOTNOTES:

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   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.50 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	1/2"
20	80	1/8"	2	1/2"
30	80	3/16"	2	1/2"
40	74	3/16"	2	3/4"
50	60	3/16"	2	3/4"
60	50	3/16"	2	3/4"
70	42	3/16"	2	3/4"
80	36	3/16"	2	3/4"
90	32	3/16"	2	3/4"
100	30	3/16"	2	3/4"
125	24	3/16"	2	3/4"
150	20	3/16"	2	3/4"
175	16	3/16"	2	3/4"
200	14	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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ICAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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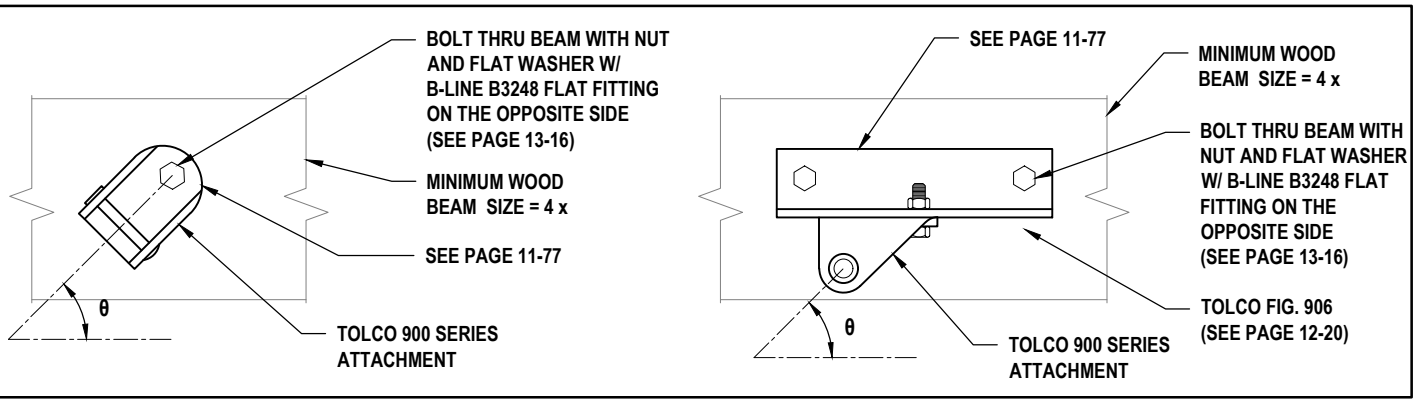
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-38

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	1	3/4"
20	40	3/16"	2	1/2"
30	33	3/16"	2	3/4"
40	25	3/16"	2	3/4"
50	20	3/16"	2	3/4"
60	16	3/16"	2	3/4"
70	14	3/16"	2	3/4"
80	12	3/16"	2	3/4"
90	11	3/16"	2	3/4"
100	10	3/16"	2	3/4"
125	8	3/16"	2	3/4"
150	6	3/16"	2	3/4"
175	5	3/16"	2	3/4"
200	5	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 0.75 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	1	3/4"
20	80	3/16"	2	1/2"
30	66	3/16"	2	3/4"
40	50	3/16"	2	3/4"
50	40	3/16"	2	3/4"
60	32	3/16"	2	3/4"
70	28	3/16"	2	3/4"
80	24	3/16"	2	3/4"
90	22	3/16"	2	3/4"
100	20	3/16"	2	3/4"
125	16	3/16"	2	3/4"
150	12	3/16"	2	3/4"
175	10	3/16"	2	3/4"
200	10	3/16"	2	3/4"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

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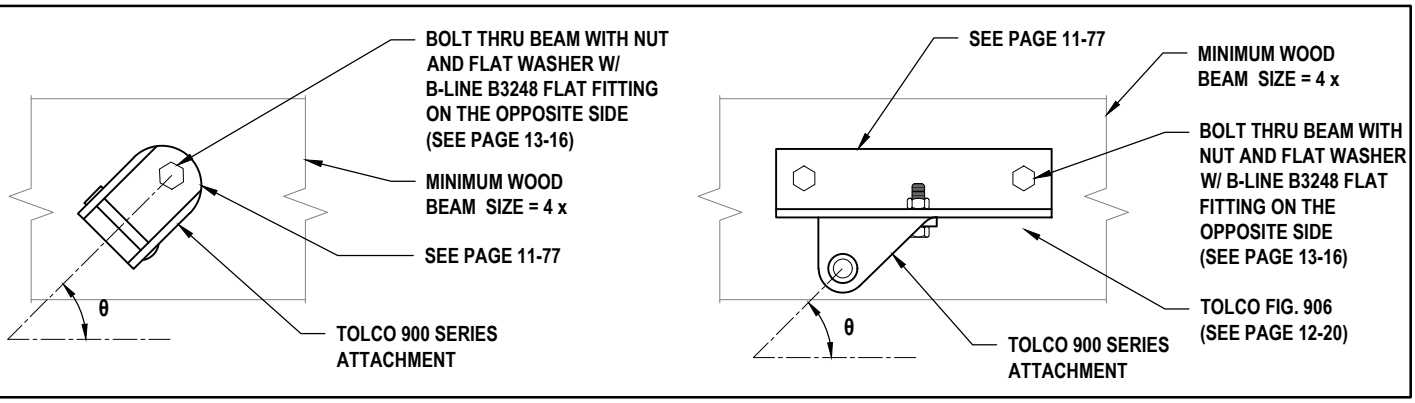
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **9-39**

DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART
FOR THRU-BOLT ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	40	1/8"	2	1/2"
20	37	3/16"	2	3/4"
30	25	3/16"	2	3/4"
40	18	3/16"	2	3/4"
50	15	3/16"	2	3/4"
60	12	3/16"	2	3/4"
70	10	3/16"	2	3/4"
80	9	3/16"	2	3/4"
90	8	3/16"	2	3/4"
100	7	3/16"	2	3/4"
125	6	3/16"	2	3/4"
150	5	3/16"	2	3/4"
175	4	3/16"	2	3/4"
200				

FOOTNOTES:
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Max. Trapeze Weight Per Ft.	Longitudinal[1] Max. Spacing @ 1.0 "G"	Min. Cable Diameter	Thru-Bolts Bolt Qty.	Thru-Bolts Min. Diameter
10	80	1/8"	2	1/2"
20	74	3/16"	2	3/4"
30	50	3/16"	2	3/4"
40	36	3/16"	2	3/4"
50	30	3/16"	2	3/4"
60	24	3/16"	2	3/4"
70	20	3/16"	2	3/4"
80	18	3/16"	2	3/4"
90	16	3/16"	2	3/4"
100	14	3/16"	2	3/4"
125	12	3/16"	2	3/4"
150	10	3/16"	2	3/4"
175	8	3/16"	2	3/4"
200				

FOOTNOTES:
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OPM-0052
BY: Roy Lobo
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5. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY PER THE LONGITUDINAL BRACE TABLE.
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7. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 1.0G.

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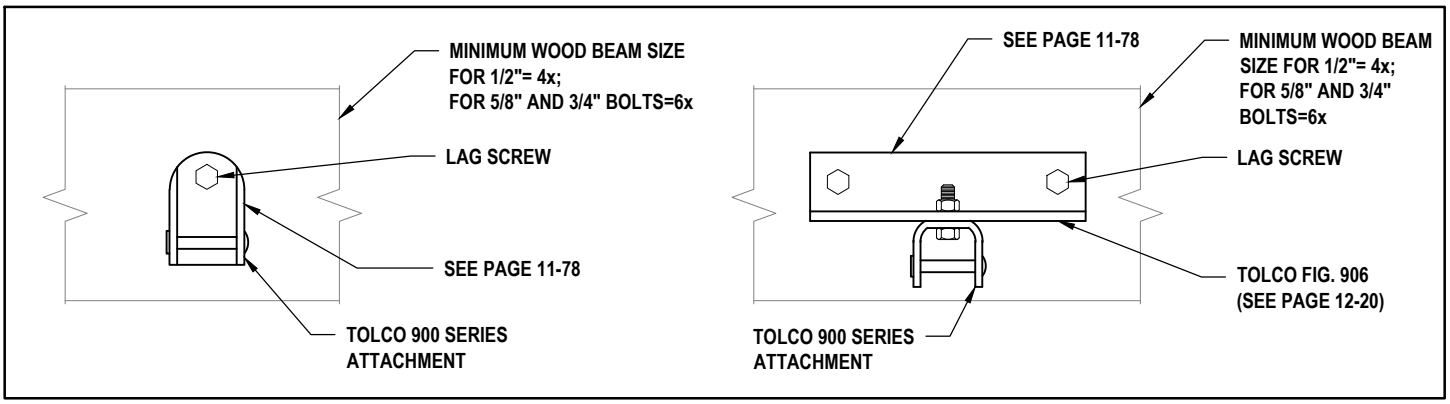
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **9-40**

DATE: **April 23, 2025**

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	1	1/2"	3"
20	40	1/8"	1	5/8"	4"
30	40	1/8"	2	1/2"	3"
40	40	1/8"	2	5/8"	4"
50	33	1/8"	2	3/4"	5"
60	28	1/8"	2	3/4"	5"
70	24	1/8"	2	3/4"	5"
80	21	1/8"	2	3/4"	5"
90	18	1/8"	2	3/4"	5"
100	16	1/8"	2	3/4"	5"
125	13	1/8"	2	3/4"	5"
150	11	1/8"	2	3/4"	5"
175	9	1/8"	2	3/4"	5"
200	8	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	1	1/2"	3"
20	80	1/8"	1	5/8"	4"
30	80	1/8"	2	1/2"	3"
40	80	1/8"	2	5/8"	4"
50	66	1/8"	2	3/4"	5"
60	56	1/8"	2	3/4"	5"
70	48	1/8"	2	3/4"	5"
80	42	1/8"	2	3/4"	5"
90	36	1/8"	2	3/4"	5"
100	32	1/8"	2	3/4"	5"
125	26	1/8"	2	3/4"	5"
150	22	1/8"	2	3/4"	5"
175	18	1/8"	2	3/4"	5"
200	16	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.25G.

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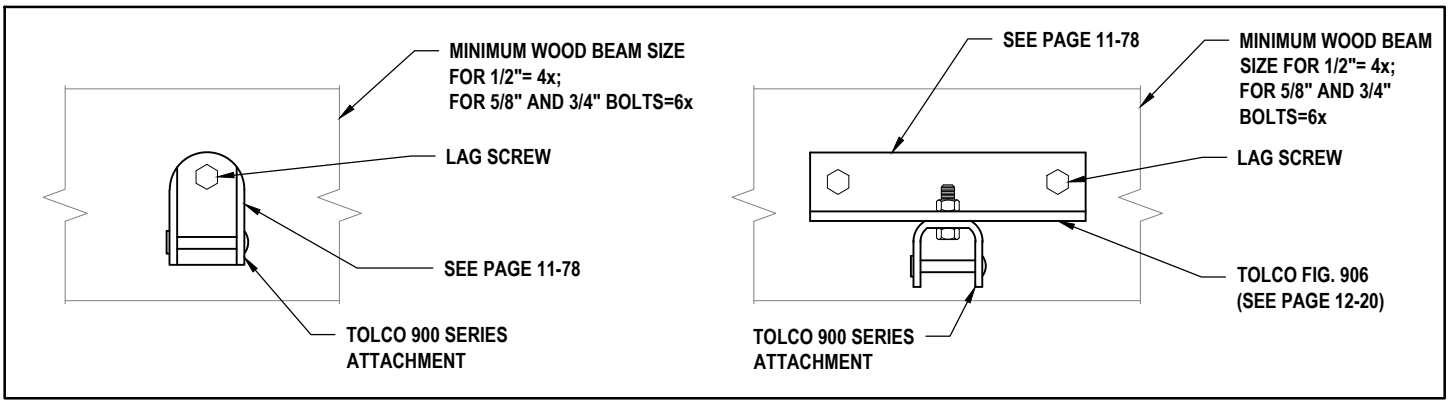
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-41

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	1	5/8"	4"
20	40	1/8"	2	5/8"	4"
30	28	1/8"	2	3/4"	5"
40	21	1/8"	2	3/4"	5"
50	16	1/8"	2	3/4"	5"
60	14	1/8"	2	3/4"	5"
70	12	1/8"	2	3/4"	5"
80	10	1/8"	2	3/4"	5"
90	9	1/8"	2	3/4"	5"
100	8	1/8"	2	3/4"	5"
125	6	1/8"	2	3/4"	5"
150	5	1/8"	2	3/4"	5"
175	4	1/8"	2	3/4"	5"
200	4	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	1	5/8"	4"
20	80	1/8"	2	5/8"	4"
30	56	1/8"	2	3/4"	5"
40	42	1/8"	2	3/4"	5"
50	32	1/8"	2	3/4"	5"
60	28	1/8"	2	3/4"	5"
70	24	1/8"	2	3/4"	5"
80	20	1/8"	2	3/4"	5"
90	18	1/8"	2	3/4"	5"
100	16	1/8"	2	3/4"	5"
125	12	1/8"	2	3/4"	5"
150	10	1/8"	2	3/4"	5"
175	8	1/8"	2	3/4"	5"
200	8	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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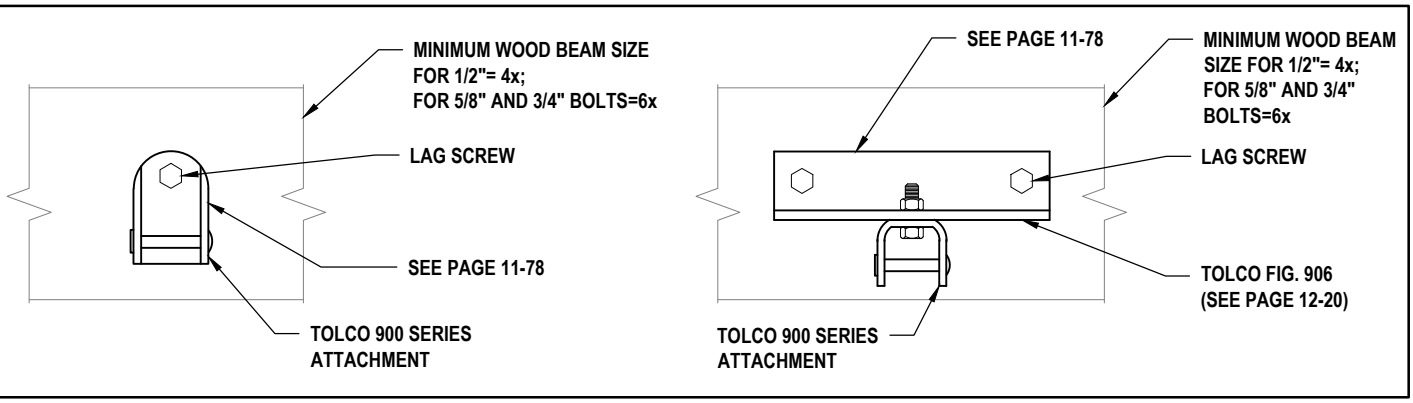
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-42

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	2	1/2"	3"
20	28	1/8"	2	3/4"	5"
30	18	1/8"	2	3/4"	5"
40	14	1/8"	2	3/4"	5"
50	11	1/8"	2	3/4"	5"
60	9	1/8"	2	3/4"	5"
70	8	1/8"	2	3/4"	5"
80	7	1/8"	2	3/4"	5"
90	6	1/8"	2	3/4"	5"
100	5	1/8"	2	3/4"	5"
125	4	1/8"	2	3/4"	5"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	2	1/2"	3"
20	56	1/8"	2	3/4"	5"
30	36	1/8"	2	3/4"	5"
40	28	1/8"	2	3/4"	5"
50	22	1/8"	2	3/4"	5"
60	18	1/8"	2	3/4"	5"
70	16	1/8"	2	3/4"	5"
80	14	1/8"	2	3/4"	5"
90	12	1/8"	2	3/4"	5"
100	10	1/8"	2	3/4"	5"
125	8	1/8"	2	3/4"	5"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 CALIFORNIA BUILDING CODE 2022 Reviewed By: Roy Lobo DATE: 04/24/2025

NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
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8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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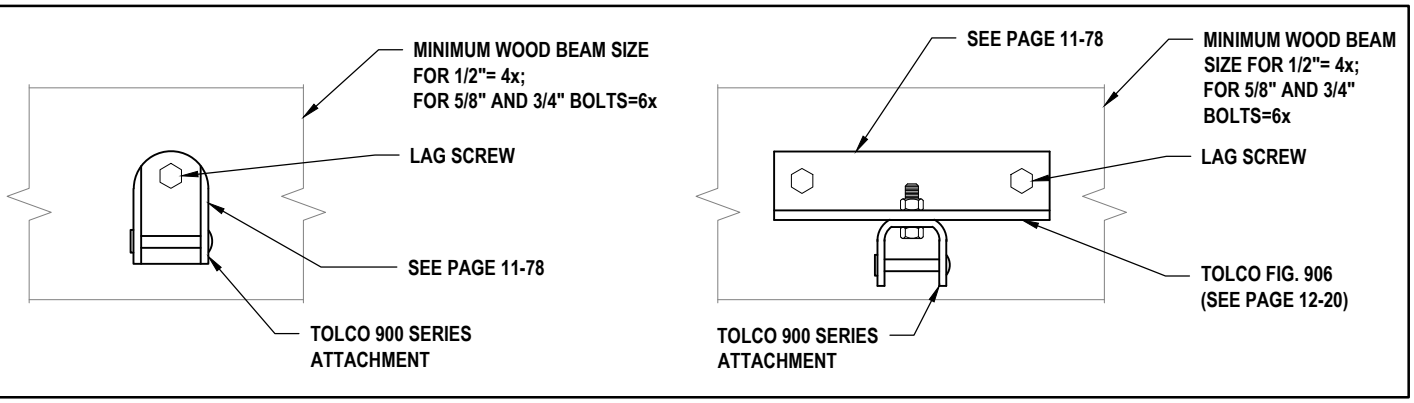
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 9-43

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	2	5/8"	4"
20	21	1/8"	2	3/4"	5"
30	14	1/8"	2	3/4"	5"
40	10	1/8"	2	3/4"	5"
50	8	1/8"	2	3/4"	5"
60	7	1/8"	2	3/4"	5"
70	6	1/8"	2	3/4"	5"
80	5	1/8"	2	3/4"	5"
90	4	1/8"	2	3/4"	5"
100	4	1/8"	2	3/4"	5"
125					
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	2	5/8"	4"
20	42	1/8"	2	3/4"	5"
30	28	1/8"	2	3/4"	5"
40	20	1/8"	2	3/4"	5"
50	16	1/8"	2	3/4"	5"
60	14	1/8"	2	3/4"	5"
70	12	1/8"	2	3/4"	5"
80	10	1/8"	2	3/4"	5"
90	8	1/8"	2	3/4"	5"
100	8	1/8"	2	3/4"	5"
125					
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR BRACING ANGLE FROM HORIZONTAL 0°- 44° NO SPACING CHANGE REQUIRED.
   FOR BRACING ANGLE FROM HORIZONTAL 46°- 60° , DIVIDE SPACING BY 1.8.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

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5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
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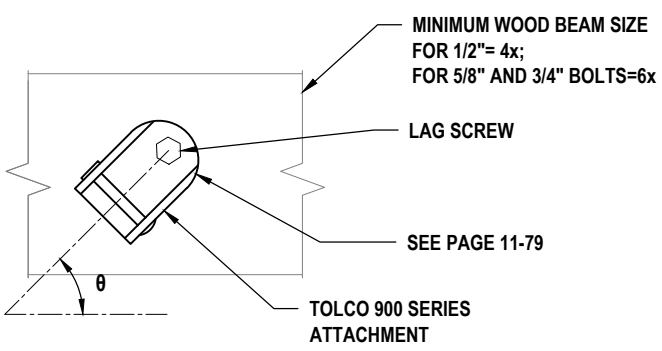
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

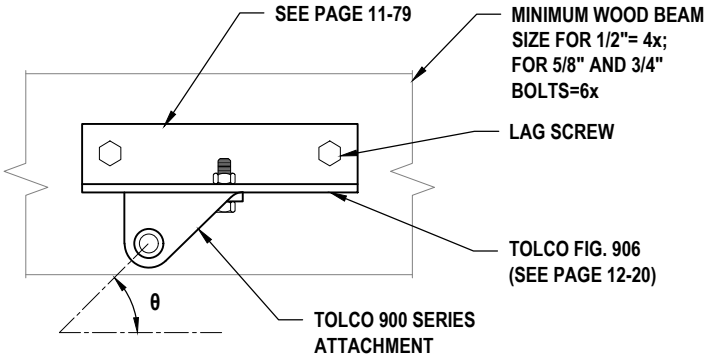
PAGE: 9-44

DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.25 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	1	1/2"	3"
20	40	1/8"	1	3/4"	5"
30	40	1/8"	2	5/8"	4"
40	40	1/8"	2	3/4"	5"
50	32	1/8"	2	3/4"	5"
60	27	1/8"	2	3/4"	5"
70	23	1/8"	2	3/4"	5"
80	20	1/8"	2	3/4"	5"
90	18	1/8"	2	3/4"	5"
100	16	1/8"	2	3/4"	5"
125	13	1/8"	2	3/4"	5"
150	10	1/8"	2	3/4"	5"
175	9	1/8"	2	3/4"	5"
200	8	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.25 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	1	1/2"	3"
20	80	1/8"	1	3/4"	5"
30	80	1/8"	2	5/8"	4"
40	80	1/8"	2	3/4"	5"
50	64	1/8"	2	3/4"	5"
60	54	1/8"	2	3/4"	5"
70	46	1/8"	2	3/4"	5"
80	40	1/8"	2	3/4"	5"
90	36	1/8"	2	3/4"	5"
100	32	1/8"	2	3/4"	5"
125	26	1/8"	2	3/4"	5"
150	20	1/8"	2	3/4"	5"
175	18	1/8"	2	3/4"	5"
200	16	1/8"	2	3/4"	5"

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REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

NOTES:

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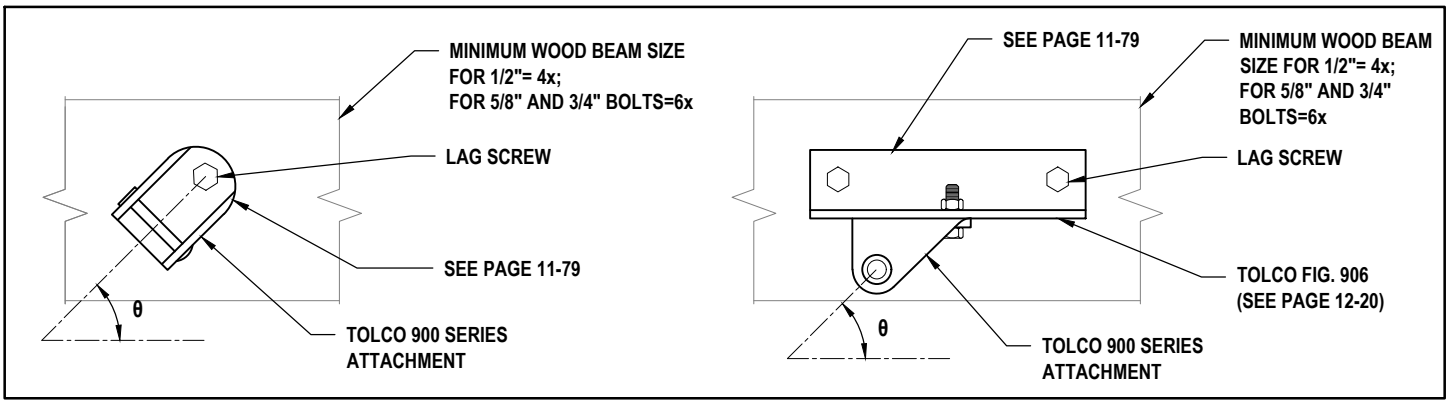
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.50 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	1	3/4"	5"
20	40	1/8"	2	3/4"	5"
30	27	1/8"	2	3/4"	5"
40	20	1/8"	2	3/4"	5"
50	16	1/8"	2	3/4"	5"
60	13	1/8"	2	3/4"	5"
70	11	1/8"	2	3/4"	5"
80	10	1/8"	2	3/4"	5"
90	9	1/8"	2	3/4"	5"
100	8	1/8"	2	3/4"	5"
125	6	1/8"	2	3/4"	5"
150	5	1/8"	2	3/4"	5"
175	4	1/8"	2	3/4"	5"
200	4	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.50 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	1	3/4"	5"
20	80	1/8"	2	3/4"	5"
30	54	1/8"	2	3/4"	5"
40	40	1/8"	2	3/4"	5"
50	32	1/8"	2	3/4"	5"
60	26	1/8"	2	3/4"	5"
70	22	1/8"	2	3/4"	5"
80	20	1/8"	2	3/4"	5"
90	18	1/8"	2	3/4"	5"
100	16	1/8"	2	3/4"	5"
125	12	1/8"	2	3/4"	5"
150	10	1/8"	2	3/4"	5"
175	8	1/8"	2	3/4"	5"
200	8	1/8"	2	3/4"	5"

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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NOTES:

1. SPACING ABOVE IS FOR WELDED STEEL PIPE, RIGID CONDUIT, OR GROOVED PIPING WITH UL 213 LISTED CONNECTIONS. FOR OTHER PIPE TYPES CONSTRUCTED OF NON-DUCTILE MATERIAL (CAST IRON, NO HUB, PLASTIC, ETC.) SPACING SHALL NOT EXCEED 1/2 OF THAT LISTED IN THE ABOVE TABLES.
2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.50G.

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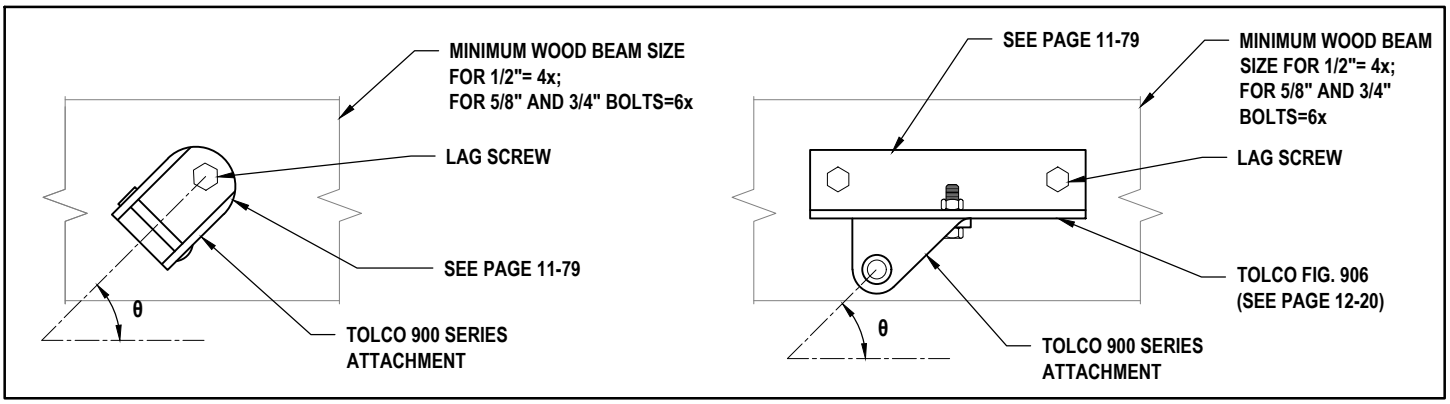
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

0.75 "G"



Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	2	5/8"	4"
20	27	1/8"	2	3/4"	5"
30	18	1/8"	2	3/4"	5"
40	13	1/8"	2	3/4"	5"
50	10	1/8"	2	3/4"	5"
60	9	1/8"	2	3/4"	5"
70	7	1/8"	2	3/4"	5"
80	6	1/8"	2	3/4"	5"
90	6	1/8"	2	3/4"	5"
100	5	1/8"	2	3/4"	5"
125	4	1/8"	2	3/4"	5"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 0.75 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	2	5/8"	4"
20	54	1/8"	2	3/4"	5"
30	36	1/8"	2	3/4"	5"
40	26	1/8"	2	3/4"	5"
50	20	1/8"	2	3/4"	5"
60	18	1/8"	2	3/4"	5"
70	14	1/8"	2	3/4"	5"
80	12	1/8"	2	3/4"	5"
90	12	1/8"	2	3/4"	5"
100	10	1/8"	2	3/4"	5"
125	8	1/8"	2	3/4"	5"
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

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NOTES:

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2. WEIGHTS ARE BASED ON WATER FILLED SCHEDULE 40/30/20 STEEL PIPE WITH INSULATION. SEE APPENDIX C, PAGE C-1 FOR DETAILS.
3. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THAT THE APPLIED LOADS ARE ACCEPTABLE.
4. THE ADEQUACY OF OTHER SUPPORT COMPONENTS AND THE OVERALL SUPPORT SYSTEM FOR THE APPLIED LOADS, IF NOT INCLUDED IN THIS OPM, ARE TO BE VERIFIED BY THE RESPONSIBLE DESIGN PROFESSIONAL.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. WHEN USING TRANSVERSE BRACE AS "DUAL USE" BRACE, USE BRACE QUANTITY, BOLT QUANTITY AND BOLT DIAMETER PER THE LONGITUDINAL BRACE TABLE.
7. SPACING LISTED ABOVE SHALL BE REDUCED IF THE APPLICABLE SPACING LISTED IN SECTION 14 IS LESS THAN THE SPACING LISTED ABOVE BASED ON PIPE MATERIAL, CONSTRUCTION, JOINTS AND DIAMETER.
8. SPACING ABOVE SHALL NOT EXCEED THE CORRESPONDING ALLOWABLE HORIZONTAL LOAD OF TRAPEZE IN SECTION 8 DIVIDED BY THE PRODUCT OF LISTED TRAPEZE WEIGHT TIMES 0.75G.

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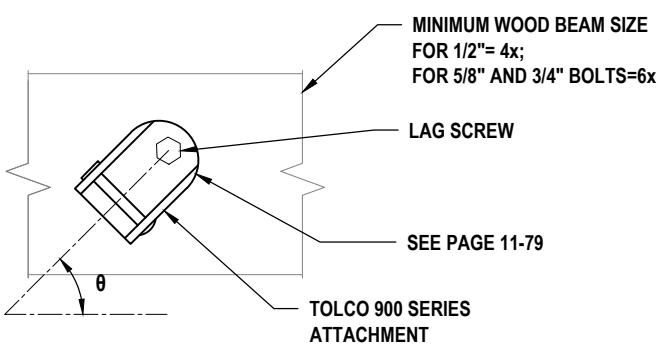
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California SE No. S3545

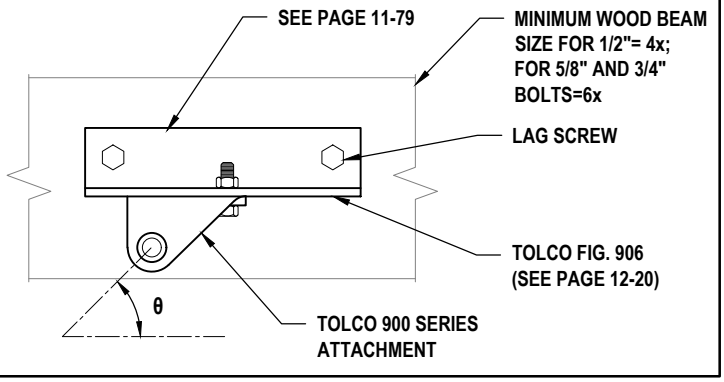
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TRAPEZE BRACE SPACING CHART
FOR LAG SCREW ATTACHMENT TO WOOD

1.0 "G"





Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	40	1/8"	2	3/4"	5"
20	20	1/8"	2	3/4"	5"
30	13	1/8"	2	3/4"	5"
40	10	1/8"	2	3/4"	5"
50	8	1/8"	2	3/4"	5"
60	6	1/8"	2	3/4"	5"
70	5	1/8"	2	3/4"	5"
80	5	1/8"	2	3/4"	5"
90	4	1/8"	2	3/4"	5"
100	4	1/8"	2	3/4"	5"
125					
150					
175					
200					

FOOTNOTES:

1. BRACING ANGLE (θ) FROM HORIZONTAL IS MAXIMUM 31°-45°.
   FOR 0°≤ θ ≤ 44° NO SPACING CHANGE REQUIRED.
   FOR 46°≤ θ ≤ 60° DIVIDE SPACING BY 1.6.

Max. Trapeze Weight Per Ft.	Transverse[1] Max. Spacing @ 1.0 "G"	Cable Diameter	Lag Screws		
			Bolt Qty.	Min. Diameter	Min. Length
10	80	1/8"	2	3/4"	5"
20	40	1/8"	2	3/4"	5"
30	26	1/8"	2	3/4"	5"
40	20	1/8"	2	3/4"	5"
50	16	1/8"	2	3/4"	5"
60	12	1/8"	2	3/4"	5"
70	10	1/8"	2	3/4"	5"
80	10	1/8"	2	3/4"	5"
90	8	1/8"	2	3/4"	5"
100	8	1/8"	2	3/4"	5"
125					
150					
175					
200					

FOOTNOTES:

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SECTION 10

COMPONENT PART NUMBER REFERENCES

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COMPONENT PART NUMBER REFERENCE

TOLCO FIG. 1CBS	
Part Number	**Description**
Y006012	FIG. 1CBS 1 1/4 CLVSBLT SP PGL
12681155	FIG. 1CBS 1 1/4" CLVSBLT SP 316
Y006014	FIG. 1CBS 1 1/2"CLVSBLT SP PGL
12373237	FIG. 1CBS 1 1/2" CLVSBLT SP 316
Y006020	FIG. 1CBS 2" CLVSBLT SP PGL
12298290	FIG. 1CBS 2" CLVSBLT SP 316
Y006024	FIG. 1CBS 2 1/2"CLVSBLT SP PGL
12298292	FIG. 1CBS 2 1/2" CLVSBLT SP 316
Y006030	FIG. 1CBS 3" CLVSBLT SP PGL
12681156	FIG. 1CBS 3" CLVSBLT SP 316
Y006034	FIG. 1CBS 3 1/2"CLVSBLT SP PGL
Y006040	FIG. 1CBS 4" CLVSBLT SP PGL
12298293	FIG. 1CBS 4" CLVSBLT SP 316
Y006050	FIG. 1CBS 5" CLVSBLT SP PGL
Y006060	FIG. 1CBS 6" CLVSBLT SP PGL
12298294	FIG. 1CBS 6" CLVSBLT SP 316
Y006080	FIG. 1CBS 8" CLVSBLT SP PGL

TOLCO FIG. 4B	
Part Number	**Description**
Y086012E	FIG. 4B 1 1/4 PIPE CLAMP EG
Y086012	FIG. 4B 1 1/4 PIPE CLAMP PLN
Y086014E	FIG. 4B 1 1/2 PIPE CLAMP EG
Y086014	FIG. 4B 1 1/2 PIPE CLAMP PLN
12211026	FIG. 4B 1 1/2" PIPE CLAMP HDG
Y086020E	FIG. 4B 2" PIPE CLAMP EG
Y086020	FIG. 4B 2" PIPE CLAMP PLN
Y086020HDG	FIG. 4B 2" PIPE CLAMP HDG
12469720	FIG. 4B 2" PIPE CLAMP 304
12420901	FIG. 4B 2" PIPE CLAMP 316
Y086024E	FIG. 4B 2 1/2 PIPE CLAMP EG
Y086024	FIG. 4B 2 1/2 PIPE CLAMP PLN
Y086024HDG	FIG. 4B 2 1/2 PIPE CLAMP HDG
12435524	FIG. 4B 2 1/2 PIPE CLAMP 316
Y086030E	FIG. 4B 3" PIPE CLAMP EG
Y086030	FIG. 4B 3" PIPE CLAMP PLN
Y086030HDG	FIG. 4B 3" PIPE CLAMP HDG
12889306	FIG. 4B 3" PIPE CLAMP 304
12435525	FIG. 4B 3" PIPE CLAMP 316
Y086040E	FIG. 4B 4" PIPE CLAMP EG
Y086040	FIG. 4B 4" PIPE CLAMP PLN
Y086040HDG	FIG. 4B 4" PIPE CLAMP HDG
12327238	FIG. 4B 4" PIPE CLAMP 304
E9037T001003	FIG. 4B 4" PIPE CLAMP 316
Y086060E	FIG. 4B 6" PIPE CLAMP EG
Y086060	FIG. 4B 6" PIPE CLAMP PLN
12211032	FIG. 4B 6" PIPE CLAMP HDG
12435526	FIG. 4B 6" PIPE CLAMP 316
Y086080E	FIG. 4B 8" PIPE CLAMP EG
Y086080	FIG. 4B 8" PIPE CLAMP PLN
Y086080HDG	FIG. 4B 8" PIPE CLAMP HDG
Y086080304	FIG. 4B 8" PIPE CLAMP 304
E9037T001004	FIG. 4B 8" PIPE CLAMP 316

TOLCO FIG. 4L	
Part Number	**Description**
13521269	FIG. 4L 1" SWAY BRACE ATTACHMENT EG
13521310	FIG. 4L 1" SWAY BRACE ATTACHMENT HDG
13521268	FIG. 4L 1" SWAY BRACE ATTACHMENT PLN
13521068	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT EG
13521069	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT HDG
13521067	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT PLN
13521218	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT EG
13521320	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT HDG
13521219	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT PLN
13521183	FIG. 4L 2" SWAY BRACE ATTACHMENT EG
13521184	FIG. 4L 2" SWAY BRACE ATTACHMENT HDG
13521185	FIG. 4L 2" SWAY BRACE ATTACHMENT PLN
13521336	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT EG
13521337	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT HDG
13521338	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT PLN
13521166	FIG. 4L 3" SWAY BRACE ATTACHMENT EG
13521167	FIG. 4L 3" SWAY BRACE ATTACHMENT HDG
13521168	FIG. 4L 3" SWAY BRACE ATTACHMENT PLN
13521457	FIG. 4L 4" SWAY BRACE ATTACHMENT EG
13521458	FIG. 4L 4" SWAY BRACE ATTACHMENT HDG
13521456	FIG. 4L 4" SWAY BRACE ATTACHMENT PLN
13521313	FIG. 4L 5" SWAY BRACE ATTACHMENT EG
13521311	FIG. 4L 5" SWAY BRACE ATTACHMENT HDG
13521312	FIG. 4L 5" SWAY BRACE ATTACHMENT PLN
13521129	FIG. 4L 6" SWAY BRACE ATTACHMENT EG
13521430	FIG. 4L 6" SWAY BRACE ATTACHMENT HDG
13521128	FIG. 4L 6" SWAY BRACE ATTACHMENT PLN
13521323	FIG. 4L 8" SWAY BRACE ATTACHMENT EG
13521324	FIG. 4L 8" SWAY BRACE ATTACHMENT HDG
13521322	FIG. 4L 8" SWAY BRACE ATTACHMENT PLN

TOLCO FIG. 25	
Part Number	**Description**
Y213002	FIG. 25 3/4-2 SURGERSTNR PGL

TOLCO FIG. 27B	
Part Number	**Description**
Y138000B	FIG. 27B SPEED NUT PGL

TOLCO FIG. 75	
Part Number	**Description**
Y238003E	FIG. 75 3/8" RD SWIVEL ATTACHMENT EG

TOLCO FIG. 98	
Part Number	**Description**
YS1900304	FIG. 98 STIFFENER 304
YS1900316	FIG. 98 STIFFENER 316
YS1900HDG	FIG. 98 STIFFENER HDG

TOLCO FIG. 98B	
Part Number	**Description**
YS1900BEGP	FIG. 98B STIFFENER BREAK-OFF BLT HEAD EG
YS1900BE	FIG. 98B US STIFFENER BREAK-OFF BLT EG

TOLCO FIG. 800	
Part Number	**Description**
12259732	FIG. 800 TYPE1X4-6 ATMT HDG
Y338001E	FIG. 800 TYPE1X4-6 ATMT EG
Y338001	FIG. 800 TYPE1X4-6 ATMT PLN
Y338002	FIG. 800 TYPE1X6-8 ATMT PLN
Y338002E	FIG. 800 TYPE1X6-8 ATMT EG
Y338002HDG	FIG. 800 TYPE1X6-8 ATMT HDG
Y338003	FIG. 800 TYPE1X8-10 ATMT PLN
Y338003E	FIG. 800 TYPE1X8-10 ATMT EG
Y338004	FIG. 800 TYPE1X10-12 ATMT PLN
Y338004E	FIG. 800 TYPE1X10-12 ATMT EG
Y338005	FIG. 800 TYPE1X12-14 ATMT PLN
Y338005E	FIG. 800 TYPE1X12-14 ATMT EG
Y338006	FIG. 800 TYPE1X14-16 ATMT PLN
Y338006E	FIG. 800 TYPE1X14-16 ATMT EG
Y338007	FIG. 800 TYPE1X16-18 ATMT PLN
Y338007E	FIG. 800 TYPE1X16-18 ATMT EG
Y338201	FIG. 800 TYPE2X4-6 ATMT PLN
Y338201E	FIG. 800 TYPE2X4-6 ATMT EG
Y338202	FIG. 800 TYPE2X6-8 ATMT PLN
Y338202E	FIG. 800 TYPE2X6-8 ATMT EG
Y338203	FIG. 800 TYPE2X8-10 ATMT PLN
Y338203E	FIG. 800 TYPE2X8-10 ATMT EG
Y338204	FIG. 800 TYPE2X10-12 ATMT PLN
Y338204E	FIG. 800 TYPE2X10-12 ATMT EG
Y338205	FIG. 800 TYPE2X12-14 ATMT PLN
Y338205E	FIG. 800 TYPE2X12-14 ATMT EG
Y338206	FIG. 800 TYPE2X14-16 ATMT PLN
Y338206E	FIG. 800 TYPE2X14-16 ATMT EG
Y338207	FIG. 800 TYPE2X16-18 ATMT PLN
Y338207E	FIG. 800 TYPE2X16-18 ATMT EG

TOLCO FIG. 825	
Part Number	**Description**
12312720	FIG. 825 BJ EQBATMT HDG
Y340000	FIG. 825 BJ EQBATMT PLN
Y340000E	FIG. 825 BJ EQBATMT EG

TOLCO FIG. 825A	
Part Number	**Description**
Y34000AE	FIG. 825A TYPE AEQB BJ EG
Y34000A	FIG. 825A TYPE AEQB BJ PLN
12278162	FIG. 825A TYPE AEQB BJ HDG

TOLCO FIG. 828	
Part Number	**Description**
13547592	FIG. 828 UNIV STRUCT SWAY BRC ATTACH EG
13547593	FIG. 828 UNV SWY BRC ATT HDG W/SS HDW
13547591	FIG. 828 UNIV STRUCT SWAY BRC ATTACH PLN

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California SE No. S3545

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COMPONENT PART NUMBER REFERENCE

TOLCO FIG. 906	
Part Number	**Description**
E9055T001003	FIG. 906 1 & 1 1/4 H1 1/2, H2 3/8 EG
1351823500	FIG. 906 1 & 1 1/4 H1&H2, 7/16 EG
1225920400	FIG. 906 1 & 1 1/4 H1&H2=11/16 PLN
1255779800	FIG. 906 1 & 1 1/4 H1=11/16 H2=13/16 EG
1223357000	FIG. 906 1 & 1 1/4 H1=11/16 H2=9/16 PLN
1304993600	FIG. 906 1 & 1 1/4 H1=13/16 H2=11/16 PLN
1299905100	FIG. 906 1 & 1 1/4 H1=13/16 H2=9/16 EG
1221999100	FIG. 906 1 & 1 1/4 H1=13/16 H2=9/16 PLN
1226120700	FIG. 906 1 & 1 1/4 H1=5/8 H2=1/2 PLN
1251445200	FIG. 906 1 & 1 1/4 H1=7/16 H2=9/16 PLN
1298716300	FIG. 906 1 & 1 1/4 H1=9/16 H2=7/16 PLN
E9055T001004	FIG. 906 1 & 1 1/4 MFA H1&H2, 5/8 HDG
1245191500	FIG. 906 1 & 1 1/4 MFA H1&H2=1/2 EG
1377794300	FIG. 906 1 & 1 1/4 MFA H1&H2=13/16 EG
1325555400	FIG. 906 1 & 1 1/4 MFA H1&H2=13/16 PLN
1253618300	FIG. 906 1 & 1 1/4 MFA H1&H2=3/4 EG
1221466000	FIG. 906 1 & 1 1/4 MFA H1&H2=3/4 PLN
1260867500	FIG. 906 1 & 1 1/4 MFA H1&H2=3/8 PLN
1226467800	FIG. 906 1 & 1 1/4 MFA H1&H2=5/8 PLN
Y334010012E	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 EG
Y334010012HDG	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 HDG
Y334010012	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 PLN

TOLCO FIG. 909	
Part Number	**Description**
Y33901004E	FIG. 909 1" NO THRD SWVL 1/2" HL EG
Y33901004HDG	FIG. 909 1" NO THRD SWVL 1/2" HL HDG
Y33901004	FIG. 909 1" NO THRD SWVL 1/2" HL PLN
Y33901005E	FIG. 909 1" NO THRD SWVL 5/8" HL EG
Y33901005	FIG. 909 1" NO THRD SWVL 5/8" HL PLN

TOLCO FIG. 910	
Part Number	**Description**
13513501	FIG. 910 1X1/2 SWIVEL SWAY BRC ATTMNT EG

TOLCO FIG. 975	
Part Number	**Description**
Y350010E	FIG. 975 1 W/ 1/2" HOLE STREQBFTNG EG
Y350010	FIG. 975 1 W/ 1/2" HOLE STREQBFTNG PLN
12821994	FIG. 975 1 W/ 5/8" HOLE STREQBFTNG PLN
12525577	FIG. 975 1 W/ 3/4" HOLE STREQBFTNG EG
12821993	FIG. 975 1 W/ 3/4" HOLE STREQBFTNG PLN

TOLCO FIG. 980	
Part Number	**Description**
13520713	FIG. 980 3/8HL UNIVBRCATT EG
13520714	FIG. 980 3/8HL UNIVBRCATT HDG
13520712	FIG. 980 3/8HL UNIVBRCATT PLN
13520884	FIG. 980 1/2HL UNIVBRCATT EG
13520885	FIG. 980 1/2HL UNIVBRCATT HDG
13520883	FIG. 980 1/2HL UNIVBRCATT PLN
13520024	FIG. 980 5/8HL UNIVBRCATT EG
13520025	FIG. 980 5/8HL UNIVBRCATT HDG
13520023	FIG. 980 5/8HL UNIVBRCATT PLN
13520736	FIG. 980 3/4HL UNIVBRCATT EG
13520737	FIG. 980 3/4HL UNIVBRCATT HDG
13520735	FIG. 980 3/4HL UNIVBRCATT PLN

TOLCO FIG. 980S	
Part Number	**Description**
13520715	FIG. 980S 3/8" HL UNIVBRCATT 316
13520886	FIG. 980S 1/2" HL UNIVBRCATT 316
13520026	FIG. 980S 5/8" HL UNIVBRCATT 316
13520738	FIG. 980S 3/4" HL UNIVBRCATT 316

TOLCO FIG. 980H	
Part Number	**Description**
13520487	FIG. 980H 7/8 HDUNIVBRCATT EG
13520488	FIG. 980H 7/8 HDUNIVBRCATT HDG
13520484	FIG. 980H 1 HDUNIVBRCATT EG
13520485	FIG. 980H 1 HDUNIVBRCATT HDG
13520489	FIG. 980H 1 HDUNIVBRCATT PLN
13520486	FIG. 980H 1 1/8 HDUNIVBRCATT EG
13521030	FIG. 980H 1 1/8 HDUNIVBRCATT HDG
13521031	FIG. 980H 1 1/4 HDUNIVBRCATT EG
13521032	FIG. 980H 1 1/4 HDUNIVBRCATT HDG

TOLCO FIG. 986	
Part Number	**Description**
Y355004EGP	FIG. 986 1/2 MECSEISMICSTRUCTL ATTACH EG
12452476	FIG. 986 5/8 MECSEISMICSTRUCTL ATTACH EG
12623262	FIG. 986 3/4 MECSEISMICSTRUCTL ATTACH EG

TOLCO FIG. 990	
Part Number	**Description**
Y347001003PG	FIG. 990 1/8CB 3/8RDSWYBC PGL
Y347001004PG	FIG. 990 1/8CB 1/2RDSWYBC PGL
Y347002005PG	FIG. 990 1/4CB 5/8RD PGL
Y347001006PG	FIG. 990 1/8CB 3/4RDSWYBC PGL
Y347316003PG	FIG. 990 3/16CB3/8RDSWYBC PGL
Y347316004PG	FIG. 990 3/16CB1/2RDSWYBC PGL
Y347316005PG	FIG. 990 3/16CB 5/8 RD SWYBC PGL
Y347316006PG	FIG. 990 3/16CB 3/4RD SWYBC PGL
Y347002003PG	FIG. 990 1/4CB 3/8RDSWYBC PGL
Y347002004PG	FIG. 990 1/4CB 1/2RDSWYBC PGL
Y347002005PG	FIG. 990 1/4CB 5/8RD PGL
Y347002006PG	FIG. 990 1/4CB 3/4RD SWYBC PGL

TOLCO FIG. 990H	
Part Number	**Description**
13348229	FIG. 990H HD 3/16CB 1-1/8RD SWYBC PGL
13384228	FIG. 990H HD 3/16CB 1-1/4RD SWYBC PGL
Y347002007PG	FIG. 990H HD 1/4CB 7/8RD SWYBC PGL
E9055T001005	FIG. 990H HD 1/4CB 1RD SWYBC PGL
12441797	FIG. 990H HD 1/4CB 1-1/8RD SWYBC PGL

TOLCO FIG. 991	
Part Number	**Description**
Y365001003005E	FIG. 991 1/8 CB 3/8-5/8 RD SWY BRC PGL
Y365316003005E	FIG. 991 3/16 CB 3/8-5/8 RD SWY BRC PGL
Y365316006007E	FIG. 991 3/16 CB 3/4-7/8 RD SWY BRC PGL
Y365002003005E	FIG. 991 1/4 CB 3/8-5/8 RD SWY BRC PGL
Y365002006007E	FIG. 991 1/4 CB 3/4-7/8 RD SWY BRC PGL

TOLCO FIG. 99	
Part Number	**Description**
Y245004120GP	FIG. 99 1/2" X 12" ATR PLN
Y245004120	FIG. 99 1/2"X 12" ATR PLN
Y245003120GP	FIG. 99 3/8" X 12" ATR PLN
Y245003180GP	FIG. 99 3/8" X 18" ATR PLN
Y245003240GP	FIG. 99 3/8" X 24" ATR PLN
Y245003300GP	FIG. 99 3/8" X 30" ATR PLN
Y245003720EGP	FIG. 99 3/8" X 72" ATR EG
Y245003120316	FIG. 99 3/8"X 12" ATR 316
Y245003300	FIG. 99 3/8"X 30" ATR PLN

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COMPONENT PART NUMBER REFERENCE

TOLCO FIG. 1000	
Part Number	**Description**
1031453'-2"	FIG. 1000 1" X 1" HDG
Y380010010304	FIG. 1000 1X1 FASTC 304
1151119'-2"	FIG. 1000 1X1 FASTC 316
Y380010010E	FIG. 1000 1X1 FASTC EG
Y380010010	FIG. 1000 1X1 FASTC PLN
Y380010012304	FIG. 1000 1 1/4X1 FASTC 304
Y380010012316	FIG. 1000 1 1/4X1 FASTC 316
Y380010012E	FIG. 1000 1 1/4X1 FASTC EG
Y380010012HDG	FIG. 1000 1 1/4X1 FASTC HDG
Y380010012	FIG. 1000 1 1/4X1 FASTC PLN
Y380010014304	FIG. 1000 1 1/2X1 FASTC 304
Y380010014316	FIG. 1000 1 1/2X1 FASTC 316
Y380010014E	FIG. 1000 1 1/2X1 FASTC EG
Y380010014HDG	FIG. 1000 1 1/2X1 FASTC HDG
Y380010014	FIG. 1000 1 1/2X1 FASTC PLN
Y380010020HDG	FIG. 1000 2X 1 FASTC HDG
Y380010020304	FIG. 1000 2X1 FASTC 304
Y380010020316	FIG. 1000 2X1 FASTC 316
Y380010020E	FIG. 1000 2X1 FASTC EG
Y380010020	FIG. 1000 2X1 FASTC PLN
Y380010024304	FIG. 1000 2 1/2X1 FASTC 304
Y380010024316	FIG. 1000 2 1/2X1 FASTC 316
Y380010024E	FIG. 1000 2 1/2X1 FASTC EG
Y380010024HDG	FIG. 1000 2 1/2X1 FASTC HDG
Y380010024	FIG. 1000 2 1/2X1 FASTC PLN
Y380010030HDG	FIG. 1000 3X 1 FASTC HDG
Y380010030304	FIG. 1000 3X1 FASTC 304
Y380010030316	FIG. 1000 3X1 FASTC 316
Y380010030E	FIG. 1000 3X1 FASTC EG
Y380010030	FIG. 1000 3X1 FASTC PLN
E9055T001002	FIG. 1000 3 1/2X1 FASTC EG
Y380010034	FIG. 1000 3 1/2X1 FASTC PLN
Y380010040HDG	FIG. 1000 4X 1 FASTC HDG
Y380010040304	FIG. 1000 4X1 FASTC 304
Y380010040316	FIG. 1000 4X1 FASTC 316
Y380010040E	FIG. 1000 4X1 FASTC EG
Y380010040	FIG. 1000 4X1 FASTC PLN
1183415'-10"	FIG. 1000 1X1 1/4 FASTC 316
Y380012010E	FIG. 1000 1X1 1/4 FASTC EG
Y380012010	FIG. 1000 1X1 1/4 FASTC PLN
Y380012012E	FIG. 1000 1 1/4X1 1/4FASTC EG
Y380012012	FIG. 1000 1 1/4X1 1/4FASTC PLN
E9055T001001	FIG. 1000 1 1/2X1 1/4FASTC 316
Y380012014E	FIG. 1000 1 1/2X1 1/4FASTC EG
Y380012014	FIG. 1000 1 1/2X1 1/4FASTC PLN
Y380012020316	FIG. 1000 2X1 1/4 FASTC 316
Y380012020E	FIG. 1000 2X1 1/4 FASTC EG
Y380012020	FIG. 1000 2X1 1/4 FASTC PLN
Y380012024E	FIG. 1000 2 1/2X1 1/4FASTC EG
Y380012024HDG	FIG. 1000 2 1/2X1 1/4FASTC HDG
Y380012024	FIG. 1000 2 1/2X1 1/4FASTC PLN
Y380012030HDG	FIG. 1000 3X 1 1/4FASTC HDG
1044296'-4"	FIG. 1000 3X1 1/4 FASTC 304
Y380012030E	FIG. 1000 3X1 1/4 FASTC EG
Y380012030	FIG. 1000 3X1 1/4 FASTC PLN
Y380012034	FIG. 1000 3 1/2X1 1/4FASTC PLN
Y380012040HDG	FIG. 1000 4X 1 1/4FASTC HDG
Y380012040304	FIG. 1000 4X1 1/4 FASTC 304
Y380012040E	FIG. 1000 4X1 1/4 FASTC EG
Y380012040	FIG. 1000 4X1 1/4 FASTC PLN

TOLCO FIG. 1001	
Part Number	**Description**
Y379010010E	FIG. 1001 1 X 1 FC SWBA EG
Y379010010	FIG. 1001 1 X 1 FC SWBA PLN
Y379010012E	FIG. 1001 1 1/4 X 1 FC SWBA EG
12555198	FIG. 1001 1 1/4 X 1 FC SWBA HDG
Y379010012	FIG. 1001 1 1/4 X 1 FC SWBA PLN
Y379010014E	FIG. 1001 1 1/2 X 1 FC SWBA EG
Y379010014	FIG. 1001 1 1/2 X 1 FC SWBA PLN
Y379010020E	FIG. 1001 2 X 1 FC SWBA EG
Y379010020	FIG. 1001 2 X 1 FC SWBA PLN
Y379012024	FIG. 1001 2 1/2 X 1 1/4 FC SWBA PLN
Y379010024E	FIG. 1001 2 1/2 X 1 FC SWBA EG
12321945	FIG. 1001 2 1/2 X 1 FC SWBA HDG
Y379010030E	FIG. 1001 3 X 1 FC SWBA EG
12213012	FIG. 1001 3 X 1 FC SWBA HDG
Y379010030	FIG. 1001 3 X 1 FC SWBA PLN
12228968	FIG. 1001 4 X 1 FC SWBA HDG
Y379010040E	FIG. 1001 4 X1 FC SWBA EG
Y379010040	FIG. 1001 4 X1 FC SWBA PLN
Y379010050E	FIG. 1001 5 X 1 FC SWBA EG
Y379010050	FIG. 1001 5 X 1 FC SWBA PLN
12204741	FIG. 1001 6 X 1 FC SWBA HDG
Y379010060E	FIG. 1001 6 X1 FC SWBA EG
Y379010060	FIG. 1001 6 X1 FC SWBA PLN
Y379010080E	FIG. 1001 8 X1 FC SWBA EG
Y379010080	FIG. 1001 8 X1 FC SWBA PLN
Y379012010E	FIG. 1001 1 X 1 1/4 FC SWBA EG
Y379012010	FIG. 1001 1 X 1 1/4 FC SWBA PLN
Y379012012E	FIG. 1001 1 1/4 X 1 1/4 FC SWBA EG
Y379012012	FIG. 1001 1 1/4 X 1 1/4 FC SWBA PLN
Y379012014E	FIG. 1001 1 1/2 X 1 1/4 FC SWBA EG
Y379012014	FIG. 1001 1 1/2 X 1 1/4 FC SWBA PLN
Y379012020E	FIG. 1001 2 X 1 1/4 FC SWBA EG
Y379012020	FIG. 1001 2 X 1 1/4 FC SWBA PLN
Y379012024E	FIG. 1001 2 1/2 X 1 1/4 FC SWBA EG
Y379012024	FIG. 1001 2 1/2 X 1 1/4 FC SWBA PLN
Y379012030E	FIG. 1001 3 X 1 1/4 FC SWBA EG
12396667	FIG. 1001 3 X 1 1/4 FC SWBA HDG
Y379012030	FIG. 1001 3 X 1 1/4 FC SWBA PLN
12390079	FIG. 1001 4 X 1 1/4 FC SWBA HDG
Y379012040	FIG. 1001 4 X 1 1/4 FC SWBA PLN
Y379012040E	FIG. 1001 4 X1 1/4 FC SWBA EG
Y379012050E	FIG. 1001 5 X 1 1/4 FC SWBA EG
Y379012050	FIG. 1001 5 X 1 1/4 FC SWBA PLN
Y379012060E	FIG. 1001 6 X1 1/4 FC SWBA EG
Y379012060	FIG. 1001 6 X1 1/4 FC SWBA PLN
Y379012080E	FIG. 1001 8 X1 1/4 FC SWBA EG
Y379012080	FIG. 1001 8 X1 1/4 FC SWBA PLN

TOLCO FIG. 2002	
Part Number	**Description**
Y382014024	FIG. 2002 2 1/2X1 1/2SWYBA PLN
Y382014024E	FIG. 2002 2 1/2X1 1/2SWYBA EG
Y382020024	FIG. 2002 2 1/2 X2 SWY B/A PLN
Y382020024E	FIG. 2002 2 1/2 X2 SWY B/A EG
Y382014030	FIG. 2002 3 X 1 1/2SWY B/A PLN
Y382014030E	FIG. 2002 3 X 1 1/2SWY B/A EG
Y382020030	FIG. 2002 3 X 2 SWY B/A PLN
Y382020030E	FIG. 2002 3 X 2 SWY B/A EG
Y382014040	FIG. 2002 4 X 1 1/2SWY B/A PLN
Y382014040E	FIG. 2002 4 X 1 1/2SWY B/A EG
Y382020040	FIG. 2002 4 X 2 SWY B/A PLN
Y382020040E	FIG. 2002 4 X 2 SWY B/A EG
Y382014060	FIG. 2002 6 X 1 1/2SWY B/A PLN
Y382014060E	FIG. 2002 6 X 1 1/2SWY B/A EG
Y382014060HDG	FIG. 2002 6 X 1 1/2SWY B/A HDG
Y382020060	FIG. 2002 6 X 2 SWY B/A PLN
Y382020060E	FIG. 2002 6 X 2 SWY B/A EG
Y382014080	FIG. 2002 8 X 1 1/2SWY B/A PLN
Y382014080E	FIG. 2002 8 X 1 1/2SWY B/A EG
Y382014080HDG	FIG. 2002 8 X 1 1/2SWY B/A HDG
Y382020080	FIG. 2002 8 X 2 SWY B/A PLN

TOLCO FIG. 3000	
Part Number	**Description**
13009304	FIG. 3000 1" CPVC SWAY BRACE ATT EG
13009305	FIG. 3000 1 1/4" CPVC SWAY BRACE ATT EG
13009306	FIG. 3000 1 1/2" CPVC SWAY BRACE ATT EG
13009307	FIG. 3000 2" CPVC SWAY BRACE ATT EG
13009309	FIG. 3000 2 1/2" CPVC SWAY BRACE ATT EG
13009331	FIG. 3000 3" CPVC SWAY BRACE ATT EG

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COMPONENT PART NUMBER REFERENCE

B-LINE HOLD DOWN CLAMPS

Part Number	Description
78101102685	9ZN-1205 COMBINATION CLAMP/GUIDE
78101102695	9G-1205 COMBINATION CLAMP/GUIDE
78101102696	9SS6-1205 COMBINATION CLAMP/GUIDE
78101102681	9ZN-1208 COMBINATION CLAMP/GUIDE
12106604	9G-1208 COMBINATION CLAMP/GUIDE
12100225	9SS6-1208 COMBINATION CLAMP/GUIDE
78101131123	9ZN-1241 HOLD DOWN
78101131117	9G-1241 HOLD DOWN BRKT
78101131121	9SS4-1241
78101193198	9SS6-1241 HOLD DOWN
78101131125	9ZN-1242 HVY DTY HOLD DN
78101131113	9G-1242 HVY DTY HOLD DN
78205130790	9SS4-1242
78101191898	9SS6-1242 HOLD DOWN

B-LINE B11

Part Number	Description
78101120003	B11-120 AL
78101120030	B11-120 GLV
78101120020	B11-120 GRN
78101120007	B11-120 HDG
78205122241	B11-120 YZN
78101120015	B11-240 PLN
78101120014	B11-240 AL
78101120035	B11-240 GLV
78101120025	B11-240 GRN
78101120016	B11-240 HDG
78101183943	B11-240 YZN
12540170	B11S-120 AL
78101120362	B11S-120 GLV
78101120356	B11S-120 GRN
78101120349	B11S-120 HDG
78101120350	B11S-120 PLN
78205122267	B11S-120 YZN
78101120365	B11S-240 GLV
78101120359	B11S-240 GRN
78101120353	B11S-240 PLN
78101183946	B11SH-120 AL
78101120230	B11SH-120 GLV
78101120220	B11SH-120 GRN
78101120209	B11SH-120 HDG
78101120210	B11SH-120 PLN
78101183955	B11SH-120 YZN
78101120214	B11SH-240 AL
78101120235	B11SH-240 GLV
78101120225	B11SH-240 GRN
78101120216	B11SH-240 HDG
78101120215	B11SH-240 PLN
78101183957	B11SH-240 YZN

B-LINE B11A

Part Number	Description
11786782	B11A-120 AL (MIG WELD)
E3651T001012	B11A-120 GLV
78101120430	B11A-120 GLV (MIG WELD)
78101120420	B11A-120 GRN (MIG WELD)
E3651T001014	B11A-120 HDG
78101183965	B11A-120 HDG (MIG WELD)
E3651T001031	B11A-120 PLN
78101120410	B11A-120PLN (MIG WELD)
78205133454	B11A-120 YZN (MIG WELD)
E3651T001013	B11A-240 GLV
78101120435	B11A-240 GLV (MIG WELD)
78101120425	B11A-240 GRN (MIG WELD)
E3651T001015	B11A-240 HDG
78101183966	B11A-240 HDG (MIG WELD)
E3651T001033	B11A-240 PLN
78101120415	B11A-240 PLN (MIG WELD)
78101183944	B11A-240 YZN (MIG WELD)

B-LINE B12

Part Number	Description
78101120540	B12-120 AL
78101120530	B12-120 GLV
78101120520	B12-120 GRN
78101120511	B12-120 HDG
78101120510	B12-120 PLN
78205132762	B12-120 YZN
78101120545	B12-240 AL
78101120535	B12-240 GLV
78101120525	B12-240 GRN
78101120516	B12-240 HDG
78101120515	B12-240 PLN
78205129427	B12-240 YZN
12540173	B12S-120 AL
78101120930	B12S-120 GLV
78101120920	B12S-120 GRN
78101190816	B12S-120 HDG
78101120910	B12S-120 PLN
78101120935	B12S-240 GLV
78101120925	B12S-240 GRN
78101120913	B12S-240 HDG
78101120915	B12S-240 PLN
78101120740	B12SH-120 AL
78101120730	B12SH-120 GLV
78101120720	B12SH-120 GRN
78101120711	B12SH-120 HDG
78101120710	B12SH-120 PLN
78205132763	B12SH-120 YZN
78101120745	B12SH-240 AL
78101120735	B12SH-240 GLV
78101120725	B12SH-240 GRN
78101120716	B12SH-240 HDG
78101120715	B12SH-240 PLN
78205132764	B12SH-240 YZN

B-LINE B12A

Part Number	Description
78101121011	B12A-120 AL (MIG WELD)
78101121030	B12A-120 GLV
11968728	B12A-120 GLV (MIG WELD)
78101121020	B12A-120 GRN
11950267	B12A-120 GRN (MIG WELD)
78101121012	B12A-120 HDG
78101184003	B12A-120 HDG (MIG WELD)
E3651T001032	B12A-120 PLN
78101121010	B12A-120 PLN (MIG WELD)
78205133455	B12A-120 YZN (MIG WELD)
78101183999	B12A-240 GLV
78101121035	B12A-240 GLV (MIG WELD)
78101183998	B12A-240 GRN
78101121025	B12A-240 GRN (MIG WELD)
78101121016	B12A-240 HDG
78101184004	B12A-240 HDG (MIG WELD)
78101183996	B12A-240 PLN
78101121015	B12A-240 PLN (MIG WELD)
E3651T001020	B12A-240 YZN
78205133456	B12A-240 YZN (MIG WELD)

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COMPONENT PART NUMBER REFERENCE

B-LINE B22	
Part Number	**Description**
78101121140	B22-120 AL
78101121130	B22-120 GLV
78101121120	B22-120 GRN
78101121109	B22-120 HDG
78205111312	B22-120 PLN
78101121122	B22-120 SS4
78101104581	B22-120 SS6
78101103984	B22-120 YZN
78101121145	B22-240 AL
78101121135	B22-240 GLV
78101121125	B22-240 GRN
78101121117	B22-240 HDG
78101121115	B22-240 PLN
78101121126	B22-240 SS4
78101181236	B22-240 SS6
78101103986	B22-240 YZN
78101121509	B22S-120 AL
78101121530	B22S-120 GLV
78101121520	B22S-120 GRN
78101121511	B22S-120 HDG
78101121510	B22S-120 PLN
78101181726	B22S-120 SS4
78205136260	B22S-120 SS6
78101191205	B22S-120 YZN
78101121514	B22S-240 AL
78101121535	B22S-240 GLV
78101121525	B22S-240 GRN
78101121516	B22S-240 HDG
78101121515	B22S-240 PLN
78101121517	B22S-240 SS4
78205133849	B22S-240 SS6
11735106	B22S-240 YZN
78101121340	B22SH-120 AL
78101121330	B22SH-120 GLV
78101121320	B22SH-120 GRN
78101121308	B22SH-120 HDG
78101121310	B22SH-120 PLN
78101121312	B22SH-120 SS4
78101121321	B22SH-120 SS6
78101121345	B22SH-240 AL
78101121335	B22SH-240 GLV
78101121325	B22SH-240 GRN
78101121314	B22SH-240 HDG
78101121315	B22SH-240 PLN
78101121317	B22SH-240 SS4
78101101103	B22SH-240 SS6
78101103988	B22SH-240 YZN

B-LINE B22A	
Part Number	**Description**
78101121740	B22A-120 AL
78101121730	B22A-120 GLV
78101184127	B22A-120 GLV (MIG WELD)
78101121720	B22A-120 GRN
78101184116	B22A-120 GRN (MIG WELD)
78101121712	B22A-120 HDG
78101121710	B22A-120 PLN
78101121714	B22A-120 SS4
13148091	B22A-120 SS4 (MIG WELD)
78101184132	B22A-120 SS6
13148101	B22A-120 SS6 (MIG WELD)
78101104665	B22A-120 YZN
78101121745	B22A-240 AL
78101121735	B22A-240 GLV
11656784	B22A-240 GLV (MIG WELD)
78101121725	B22A-240 GRN
78101184117	B22A-240 GRN (MIG WELD)
78101121719	B22A-240 HDG
13050808	B22A-240 HDG (MIG WELD)
78101121715	B22A-240 PLN
11885799	B22A-240 PLN (MIG WELD)
78101184131	B22A-240 SS4
13148092	B22A-240 SS4 (MIG WELD)
78101184133	B22A-240 SS6
13148102	B22A-240 SS6 (MIG WELD)
78101102707	B22A-240 YZN

B-LINE B24	
Part Number	**Description**
78101122040	B24-120 AL
78101122030	B24-120 GLV
78101122020	B24-120 GRN
78101122012	B24-120 HDG
78101122010	B24-120 PLN
78101122016	B24-120 SS4
78101122017	B24-120 SS6
78101102709	B24-120 YZN
78101122045	B24-240 AL
78101122035	B24-240 GLV
78101122025	B24-240 GRN
78101122018	B24-240 HDG
78101122015	B24-240 PLN
78101122021	B24-240 SS4
78101122022	B24-240 SS6
78101103997	B24-240 YZN
78101122409	B24S-120 AL
78101122430	B24S-120 GLV
78101122420	B24S-120 GRN
78101122408	B24S-120 HDG
78101122410	B24S-120 PLN
78101184373	B24S-120 SS4
12305142	B24S-120 SS6
78101184376	B24S-120 YZN
78101122435	B24S-240 GLV
78101122425	B24S-240 GRN
78205136760	B24S-240 HDG
78101122415	B24S-240 PLN
12632170	B24S-240 SS6
78101184377	B24S-240 YZN
78101122240	B24SH-120 AL
78101122230	B24SH-120 GLV
78101122220	B24SH-120 GRN
78101122211	B24SH-120 HDG
78101122210	B24SH-120 PLN
78101122213	B24SH-120 SS4
78101122214	B24SH-120 SS6
78101103993	B24SH-120 YZN
78101122245	B24SH-240 AL
78101122235	B24SH-240 GLV
78101122225	B24SH-240 GRN
78101122216	B24SH-240 HDG
78101122215	B24SH-240 PLN
78101122217	B24SH-240 SS4
78101122218	B24SH-240 SS6
78101103998	B24SH-240 YZN

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California SE No. S3545

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COMPONENT PART NUMBER REFERENCE

B-LINE B24A	
Part Number	**Description**
78101122609	B24A-120 AL
78101122630	B24A-120 GLV
78101122620	B24A-120 GRN
78101122608	B24A-120 HDG
78101122610	B24A-120 PLN
78101122607	B24A-120 SS4
78101103982	B24A-120 SS6
78101122635	B24A-240 GLV
78101122625	B24A-240 GRN
78101122617	B24A-240 HDG
78101122615	B24A-240 PLN
78101122618	B24A-240 SS4
78101103983	B24A-240 SS6

B-LINE B52	
Part Number	**Description**
78101124830	B52-120 GLV
78101124820	B52-120 GRN
78101124808	B52-120 HDG
78101124810	B52-120 PLN
12350591	B52-120 SS4
12349770	B52-120 SS6
78101104707	B52-120 YZN
78101124835	B52-240 GLV
78101124825	B52-240 GRN
78101124816	B52-240 HDG
78101124815	B52-240 PLN
12350593	B52-240 SS4
12349765	B52-240 SS6
78101196180	B52-240 YZN
78101125230	B52S-120 GLV
78101125220	B52S-120 GRN
78101125211	B52S-120 HDG
78101125210	B52S-120 PLN
78101181299	B52S-120 YZN
78101125235	B52S-240 GLV
78101125225	B52S-240 GRN
78101125216	B52S-240 HDG
78101125215	B52S-240 PLN
11874299	B52S-240 YZN
78101125030	B52SH-120 GLV
78101125020	B52SH-120 GRN
78101125011	B52SH-120 HDG
78101125010	B52SH-120 PLN
12339755	B52SH-120 SS4
12347020	B52SH-120 SS6
78101184482	B52SH-120 YZN
78101125035	B52SH-240 GLV
78101125025	B52SH-240 GRN
78101125016	B52SH-240 HDG
78101125015	B52SH-240 PLN
12350594	B52SH-240 SS4
12349766	B52SH-240SS6
78101184483	B52SH-240 YZN

B-LINE HHCS (HEX HEAD CAP SCREW)	
Part Number	**Description**
78101102390	SCRW,HHC 1/4X3/4 SS4
78101104912	SCRW,HHC 1/4X3/4 SS6
78101141517	SCRW,HHC 1/4X3/4 ZN
78101184991	SCRW,HHC 1/4X1 SS4
78101104913	SCRW,HHC 1/4X1 SS6
78101141519	1/4X1 HHCS ZN
78101184985	SCRW,HHC 1/4X1 1/4 SS4
78101185064	SCRW,HHC 1/4X1 1/4 SS6
78101141521	1/4X1 1/4 HHCS ZN
78205122957	SCRW,HHC 1/4X1 1/2 SS4
78101102374	SCRW,HHC 1/4X1 1/2 SS6
78101141523	1/4X1 1/2 HHCS ZN
78205111198	HHCS 3/8X1HDG
12320375	SCRW,HHC 3/8X1PLN
78101102405	SCRW,HHC 3/8X1 SS4
78101102407	SCRW,HHC 3/8X1 SS6
78101141543	3/8X1HHCSZN
78101141545	3/8X11/4HHCSZN
78101102406	SCRW,HHC 3/8X1 1/4 SS4
78101104909	SCRW,HHC 3/8X1 1/4 SS6
78101141545	3/8X11/4HHCSZN
78101102413	SCRW,HHC 1/2X1 SS4
78101102414	SCRW,HHC 1/2X1 SS6
78101141574	1/2X1HHCSZN
78205111183	HHCS1/2X1 1/4HDG
78101102417	SCRW,HHC 1/2X1 1/4 SS4
78101104907	SCRW,HHC 1/2X1 1/4SS6
78101141513	1/2X11/4HHCSZN
12493444	SCRW,HHC 5/8X1 ZN
11906433	HHCS5/8X1 1/4SS4
78101102458	SCRW,HHC 5/8X1 1/4 ZN
11906433	HHCS5/8X1 1/4SS4
78101193706	SCRW,HHC 3/4X1 1/4 ZN

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COMPONENT PART NUMBER REFERENCE

B-LINE B200 SQUARE WASHER

Part Number	Description
78205138160	B200-1/4 ZN
78205138198	B200-1/4 SS4
78101151993	B200 ZN (5/16)
78101151992	B200 GRN 5/16 SQ WSHR
78101151994	B200 HDG 5/16 SQ WSHR
78101151995	B200 SS4 5/16 SQ WSHR
78101185896	B200 SS6 5/16 SQ WSHR
78101198414	B200 YZN 5/16 SQ WSHR
78205119966	B201 PLN (3/8)
78101152003	B201 ZN (3/8)
78101152002	B201 GRN 3/8 SQ WSHR
78101152004	B201 HDG 3/8 SQ WSHR
78101152007	B201 SS4 3/8 SQ WSHR
78101152008	B201 SS6 3/8 SQ WSHR
78101104460	B201 YZN 3/8 SQ WSHR
78101152019	B202 AL 1/2 SQ WSHR
78101152013	B202 ZN (1/2)
78101152012	B202 GRN 1/2 SQ WSHR
78101152014	B202 HDG 1/2 SQ WSHR
78101152016	B202 SS4 1/2 SQ WSHR
78101101383	B202 SS6 (1/2)
78101104463	B202 YZN 1/2 SQ WSHR
78101157094	B202-1 AL 5/8 SQ WSHR
78101157098	B202-1 ZN 5/8 SQ WSHR
78101157097	B202-1 GRN 5/8 SQ WSHR
78101157095	B202-1 HDG 5/8 SQ WSHR
78101157101	B202-1 SS4 5/8 SQ WSHR
78101157116	B202-1 SS6 5/8 SQUARE WSH
78101199351	B202-1 YZN 5/8 SQ WSHR
78101185906	B202-2 AL 3/4 SQ WSHR
78101157107	B202-2 ZN 3/4 SQ WSHR
78101157105	B202-2 GRN 3/4 SQ WSHR
78101157106	B202-2 HDG 3/4 SQ WSHR
78101185905	B202-2 SS4 3/4 SQ WSHR
12015312	B202-2 SS6 3/4 SQ WSHR
78205121968	B202-2 YZN
78101185903	B202-3 ZN (7/8)
78101185907	B202-3 HDG (7/8)
12419395	B202-3 SS6 (7/8)

B-LINE N200WO CHANNEL NUT

Part Number	Description
78101140623.0000	N224WO ZN (1/4) LOCK NUT
78101140626.0000	N224WO (1/4) SS4 LOCK NUT
78101184914.0000	N224WO SS6 (1/4) LOCK NUT
78101140613.0000	N223WO ZN (5/16) LOCK NUT
78205138259.0000	N223WO SS6 (5/16) LOCK NUT
78101140653.0000	N228WO ZN (3/8) LOCK NUT
12660708.0000	N228WO HDG (3/8)
E2051T000008	N228WO SS4 (3/8) LOCK NUT
78101184915.0000	N228WO SS6 (3/8) LOCK NUT
78101196987.0000	N228WO YZN (3/8) LOCK NUT
78101140643.0000	N226WO ZN (7/16) LOCK NUT
12757482.0000	N226WO SS6 (7/16) LOCK NUT
78101140633.0000	N225WO ZN (1/2) LOCK NUT
12711030.0000	N225WO HDG (1/2)
E2051T000007	N225WO SS4 (1/2) LOCK NUT
78101184916.0000	N225WO SS6 (1/2) LOCK NUT
78101198428.0000	N225WO YZN (1/2) LOCK NUT
78101140663.0000	N255WO (5/8) ZN LOCK NUT
12104411.0000	N255WO (5/8) SS6 LOCK NUT
78101140773.0000	N275WO (3/4) ZN LOCK NUT
12165894.0000	N275WO (3/4) SS6 LOCK NUT
78101139013.0000	N278WO (7/8) ZN LOCK NUT
78101101853.0000	N278WO HDG (7/8)
E2051T000010	N278WOSS6

B-LINE N200 SPRING NUT

Part Number	Description
78101140333.0000	N224 ZN (1/4)
12460727.0000	N224 HDG (1/4)
78101102228.0000	N224 SS4 LOCK NUT
78101140334.0000	N224 (1/4) SS6 LOCK NUT
78101184917.0000	N224 YZN
78101140323.0000	N223 (5/16) ZN LOCK NUT
78101101789.0000	N223 (5/16) SS6 LOCK NUT
78205122055.0000	N223 YZN
78101140363.0000	N228 ZN (3/8)
12460876.0000	N228 HDG (3/8)
E2051T000005	N228 (3/8) SS4 LOCK NUT
78101140366.0000	N228 (3/8) SS6 LOCK NUT
78101184919.0000	N228 YZN
78101140353.0000	N226 (7/16) ZN LCK NUT
78205122277.0000	N226 SS6 (7/16)
78101140343.0000	N225 ZN (1/2)
12460878.0000	N225 HDG (1/2)
E2051T000006	N225 (1/2) SS4 LOCK NUT
78101140346.0000	N225 SS6
78101196181.0000	N225 YZN
78101140373.0000	N255 (5/8) ZN LOCK NUT
78205137121.0000	N255 SS6 (5/8)
78101140383.0000	N275 (3/4) ZN LOCK NUT
78205137122.0000	N275 SS6 (3/4)
78205122057.0000	N275 YZN
78101140393.0000	N278 (7/8) ZN LOCK NUT
78205122058.0000	N278 YZN

B-LINE B355

Part Number	Description
78101153401	B355 AL BM CLMP
78101153403	B355 ZN BM CLMP
78101153402	B355 GRN BM CLMP
78101153404	B355 HDG BM CLMP
78101153406	B355 SS4 BM CLMP
11737705	B355 SS6 BM CLMP
78101198417	B355 YZN BM CLMP

B-LINE B1999

Part Number	Description
78101103383	B1999 VIBR-CUSH 20FT ROLL

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COMPONENT PART NUMBER REFERENCE

B-LINE B2000	
Part Number	**Description**
11990374	B2000 HDG 3/8EMT CLAMP
78101160800	B2000 DCU 3/8EMT CLAMP
78101160802	B2000 SS4 3/8EMT CLAMP
78101160803	B2000 ZN 3/8EMT CLAMP
78101186878	B2000 PVC 3/8EMT CLAMP
78205122867	B2000 YZN 3/8EMT CLAMP
78205136254	B2000 SS6 3/8EMT CLAMP
78101160804	B2000PA ZN 3/8EMT CLAMP
11648925	B2001PA SS6 3/8RGD 1/2EMT CLAMP
11653005	B2001PA SS4 3/8RGD 1/2EMT CLAMP
11881402	B2001PA AL SS6HDW 3/8RGD 1/2EMT CLAMP
78101104510	B2001PA YZN 3/8RGD 1/2EMT CLAMP
78101160806	B2001 AL 3/8RGD 1/2EMT CLAMP
78101160809	B2001 HDG 3/8RGD 1/2EMT CLAMP
78101160812	B2001 SS4 3/8RGD 1/2EMT CLAMP
78101160813	B2001 ZN 3/8RGD 1/2EMT CLAMP
78101160814	B2001PA ZN 3/8RGD 1/2EMT CLAMP
78101194637	B2001 HDG SS6HDW 3/8RGD 1/2EMT CLAMP
78101198433	B2001 YZN 3/8RGD 1/2EMT CLAMP
78205130417	B2001 SS6 3/8RGD 1/2EMT CLAMP
11762007	B2002PA SS4 3/4EMT CLAMP
12354819	B2002PA GRN 3/4EMT CLAMP
78101104511	B2002PA YZN 3/4EMT CLAMP
78101160817	B2002 AL 3/4EMT CLAMP
78101160818	B2002 HDG 3/4EMT CLAMP
78101160819	B2002 PVC SS6HDW 3/4EMT CLAMP
78101160820	B2002 SS4 3/4EMT CLAMP
78101160823	B2002 ZN 3/4EMT CLAMP
78101160824	B2002PA ZN 3/4EMT CLAMP
78101186879	B2002 SS6 3/4EMT CLAMP
78101194638	B2002 HDG SS6HDW 3/4EMT CLAMP
78205115610	B2002 YZN 3/4EMT CLAMP
11762119	B2003PA SS4 1EMT CLAMP
12355020	B2003PA GRN 1EMT CLAMP
78101104513	B2003PA YZN 1EMT CLAMP
78101160826	B2003 AL 1EMT CLAMP
78101160828	B2003 HDG 1EMT CLAMP
78101160829	B2003 PVC SS6HDW 1EMT CLAMP
78101160830	B2003 SS4 1EMT CLAMP
78101160833	B2003 ZN 1EMT CLAMP
78101160834	B2003PA ZN 1EMT CLAMP
78101186880	B2003 SS6 1EMT CLAMP
78101194639	B2003 HDG SS6HDW 1EMT CLAMP
78101198421	B2003 YZN 1EMT CLAMP
11762125	B2004PA SS4 1 1/4EMT 1 1/2OD CLAMP
11962411	B2004PA SS6 1 1/4EMT 1 1/2OD CLAMP
78101104514	B2004PA YZN 1 1/4EMT 1 1/2OD CLAMP
78101160837	B2004 AL 1 1/4EMT 1 1/2OD CLAMP
78101160839	B2004 HDG 1 1/4EMT 1 1/2OD CLAMP
78101160840	B2004 PVC SS6HDW 1 1/4EMT 1 1/2OD CLAMP
78101160841	B2004 SS4 1 1/4EMT 1 1/2OD CLAMP
78101160843	B2004 ZN 1 1/4EMT 1 1/2OD CLAMP
78101160844	B2004PA ZN 1 1/4EMT 1 1/2OD CLAMP
78101186881	B2004 SS6 1 1/4EMT 1 1/2OD CLAMP
78101194640	B2004 HDG SS6HDW 1 1/4EMT 1 1/2OD CLAMP
78101198422	B2004 YZN 1 1/4EMT 1 1/2OD CLAMP
11762158	B2005PA SS4 1 1/2EMT 1 3/4OD CLAMP

B-LINE B2000 (CONT'D)	
Part Number	**Description**
78101104515	B2005PA YZN 1 1/2EMT 1 3/4OD CLAMP
78101160847	B2005 AL 1 1/2EMT 1 3/4OD CLAMP
78101160850	B2005 HDG 1 1/2EMT 1 3/4OD CLAMP
78101160851	B2005 PVC SS6HDW 1 1/2EMT 1 3/4OD CLAMP
78101160852	B2005 SS4 1 1/2EMT 1 3/4OD CLAMP
78101160853	B2005 ZN 1 1/2EMT 1 3/4OD CLAMP
78101160854	B2005PA ZN 1 1/2EMT 1 3/4OD CLAMP
78101160855	B2005 ZN EVRD HDW 1 1/2EMT 1 3/4OD CLAMP
78101194624	B2005 HDG SS6HDW 1 1/2EMT 1 3/4OD CLAMP
78101198423	B2005 YZN 1 1/2EMT 1 3/4OD CLAMP
78205110263	B2005 GRN 1 1/2EMT 1 3/4OD CLAMP
78205130418	B2005 SS6 1 1/2EMT 1 3/4OD CLAMP
11762162	B2006PA SS4 2EMT CLAMP
78101104517	B2006PA YZN 2EMT CLAMP
78101160863	B2006 ZN 2EMT CLAMP
78101160864	B2006PA ZN 2EMT CLAMP
78101160865	B2006 AL 2EMT CLAMP
78101160866	B2006 DCU 2EMT CLAMP
78101160868	B2006 GRN 2EMT CLAMP
78101160869	B2006 HDG 2EMT CLAMP
78101160870	B2006 PVC SS6HDW 2EMT CLAMP
78101160871	B2006 SS4 2EMT CLAMP
78101186882	B2006 SS6 2EMT CLAMP
78101194625	B2006 HDG SS6HDW 2EMT CLAMP
78101198424	B2006 YZN 2EMT CLAMP
13467436	B2008 PLN 3/4CT 7/8OD CLAMP
78101104461	B2008PA YZN 1/2RGD 7/8OD CLAMP
78101160094	B2008 AL 1/2RGD 7/8OD CLAMP
78101160095	B2008 AL SS6HDW 1/2RGD 7/8OD CLAMP
78101160096	B2008 DCU 3/4CT 7/8OD CLAMP
78101160098	B2008 HDG 1/2RGD 7/8OD CLAMP
78101160099	B2008 PVC SS6HDW 1/2RGD 7/8OD CLAMP
78101160100	B2008 SS4 1/2RGD 7/8OD CLAMP
78101160101	B2008 SS6 1/2RGD 7/8OD CLAMP
78101161013	B2008 ZN 1/2RGD 7/8OD CLAMP
78101161014	B2008PA ZN 1/2RGD 7/8OD CLAMP
78101161015	B2008PA AL 1/2RGD 7/8OD CLAMP
78101161016	B2008PA HDG 1/2RGD 7/8OD CLAMP
78101186850	B2008PA AL SS6HDW 1/2RGD 7/8OD CLAMP
78101186938	B2008 YZN 1/2RGD 7/8OD CLAMP
78101187186	B2008PA SS4 1/2RGD 7/8OD CLAMP
78101192843	B2008PA HDG SS6HDW 1/2RGD 7/8OD CLAMP
78101194427	B2008 GRN 1/2RGD 7/8OD CLAMP
78101194642	B2008 HDG SS6HDW 1/2RGD 7/8OD CLAMP
78205114438	B2008PA SS6 1/2RGD 7/8OD CLAMP
78205141445	B2008PA DCU 3/4CT 7/8OD CLAMP
12609228	B2009PANS SS6 3/4RGD 1OD CLAMP
78101102568	B2009PA AL SS6HDW 3/4RGD 1OD CLAMP
78101102590	B2009PA SS4 3/4RGD 1OD CLAMP
78101104464	B2009PA YZN 3/4RGD 1OD CLAMP
78101160104	B2009 AL 3/4RGD 1OD CLAMP
78101160106	B2009 AL SS6HDW 3/4RGD 1OD CLAMP
78101160107	B2009 DCU 3/4RGD 1OD CLAMP
78101160109	B2009 GRN 3/4RGD 1OD CLAMP
78101160110	B2009 HDG 3/4RGD 1OD CLAMP
78101161018	B2009 SS4 3/4RGD 1OD CLAMP
78101161020	B2009 PVC SS6HDW 3/4RGD 1OD CLAMP

B-LINE B2000 (CONT'D)	
Part Number	**Description**
78101161023	B2009 ZN 3/4RGD 1OD CLAMP
78101161024	B2009PA ZN 3/4RGD 1OD CLAMP
78101161025	B2009 SS6 3/4RGD 1OD CLAMP
78101161027	B2009PA AL 3/4RGD 1OD CLAMP
78101161028	B2009PA HDG 3/4RGD 1OD CLAMP
78101186884	B2009 YZN 3/4RGD 1OD CLAMP
78101186898	B2009 ZN SS6HDW 3/4RGD 1OD CLAMP
78101186903	B2009 HDG SS6HDW 3/4RGD 1OD CLAMP
78101192844	B2009PA HDG SS6HDW 3/4RGD 1OD CLAMP
78205114439	B2009PA SS6 3/4RGD 1OD CLAMP
11882187	B2010PA GRN 1"STD 1 3/8OD CLAMP
12304583	B2010PA DCU 1 1/4CT 1"STD 1 3/8OD CLAMP
12444858	B2010 USA HDG SS6HDW 1"STD 1 3/8OD CLAMP
13467437	B2010 PLN 1 1/4CT 1 3/8OD 1"STD CLAMP
78101101051	B2010 YZN 1"STD 1 3/8OD CLAMP
78101102569	B2010PA AL SS6HDW 1"STD 1 3/8OD CLAMP
78101102594	B2010PA SS4 1"STD 1 3/8OD CLAMP
78101104465	B2010PA YZN 1"STD 1 3/8OD CLAMP
78101160114	B2010 AL 1"STD 1 3/8OD CLAMP
78101160116	B2010 AL SS6HDW 1"STD 1 3/8OD CLAMP
78101160117	B2010 DCU 1 1/4CT 1 3/8OD 1"STD CLAMP
78101160118	B2010 GRN 1"STD 1 3/8OD CLAMP
78101160120	B2010 HDG 1"STD 1 3/8OD CLAMP
78101161030	B2010 PVC SS6HDW 1"STD 1 3/8OD CLAMP
78101161032	B2010 SS4 1"STD 1 3/8OD CLAMP
78101161033	B2010 ZN 1"STD 1 3/8OD CLAMP
78101161034	B2010PA ZN 1"STD 1 3/8OD CLAMP
78101161035	B2010 SS6 1"STD 1 3/8OD CLAMP
78101161038	B2010PA AL 1"STD 1 3/8OD CLAMP
78101161039	B2010PA HDG 1"STD 1 3/8OD CLAMP
78101186904	B2010 HDG SS6HDW 1"STD 1 3/8OD CLAMP
78101186912	B2010 ZN SS6HDW 1"STD 1 3/8OD CLAMP
78101192845	B2010PA HDG SS6HDW 1"STD 1 3/8OD CLAMP
78101196383	B2010PA SS6 1"STD 1 3/8OD CLAMP
78101102570	B2011PA AL SS6HDW 1 1/4RGD 1 5/8OD CLAMP
78101104469	B2011PA YZN 1 1/4RGD 1 5/8OD CLAMP
78101160124	B2011 AL 1 1/4RGD 1 5/8OD CLAMP
78101160126	B2011 AL SS6HDW 1 1/4RGD 1 5/8OD CLAMP
78101160127	B2011 DCU 1 1/2CT 1 5/8OD 1 1/4RGD CLAMP
78101160130	B2011 HDG 1 1/4RGD 1 5/8OD CLAMP
78101160131	B2011 PVC SS6HDW 1 1/4RGD 1 5/8OD CLAMP
78101160133	B2011 SS4 1 1/4RGD 1 5/8OD CLAMP
78101161041	B2011 SS6 1 1/4RGD 1 5/8OD CLAMP
78101161043	B2011 ZN 1 1/4RGD 1 5/8OD CLAMP
78101161044	B2011PA ZN 1 1/4RGD 1 5/8OD CLAMP
78101161046	B2011PA AL 1 1/4RGD 1 5/8OD CLAMP
78101161047	B2011PA HDG 1 1/4RGD 1 5/8OD CLAMP
78101161048	B2011PA SS4 1 1/4RGD 1 5/8OD CLAMP
78101186899	B2011 YZN 1 1/4RGD 1 5/8OD CLAMP
78101186918	B2011 HDG SS6HDW 1 1/4RGD 1 5/8OD CLAMP
78101192846	B2011PA HDG SS6HDW 1 1/4RGD 1 5/8OD CLMP
78101197523	B2011 GRN 1 1/4RGD 1 5/8OD CLAMP
78101199544	B2011PA SS6 1 1/4RGD 1 5/8OD CLAMP
78205141498	B2011PA DCU 1 1/2CT 1 5/8OD 1 1/4RGD CLP
78101102572	B2012PA AL SS6HDW 1 1/2RGD 1 7/8OD CLAMP
78101102596	B2012PA SS4 1 1/2RGD 1 7/8OD CLAMP
78101104471	B2012PA YZN 1 1/2RGD 1 7/8OD CLAMP

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COMPONENT PART NUMBER REFERENCE

B-LINE B2000 (CONT'D)	
Part Number	**Description**
78101160134	B2012 AL 1 1/2RGD 1 7/8OD CLAMP
78101160135	B2012 AL SS6HDW 1 1/2RGD 1 7/8OD CLAMP
78101160136	B2012 DCU 1 1/2RGD 1 7/8OD CLAMP
78101160138	B2012 GRN 1 1/2RGD 1 7/8OD CLAMP
78101160140	B2012 HDG 1 1/2RGD 1 7/8OD CLAMP
78101160143	B2012 PVC SS6HDW 1 1/2RGD 1 7/8OD CLAMP
78101161051	B2012 SS4 1 1/2RGD 1 7/8OD CLAMP
78101161052	B2012 SS6 1 1/2RGD 1 7/8OD CLAMP
78101161053	B2012 ZN 1 1/2RGD 1 7/8OD CLAMP
78101161054	B2012PA ZN 1 1/2RGD 1 7/8OD CLAMP
78101161059	B2012PA AL 1 1/2RGD 1 7/8OD CLAMP
78101161060	B2012PA HDG 1 1/2RGD 1 7/8OD CLAMP
78101186889	B2012 YZN 1 1/2RGD 1 7/8OD CLAMP
78101186905	B2012 HDG SS6HDW 1 1/2RGD 1 7/8OD CLAMP
78101192847	B2012PA HDG SS6HDW 1 1/2RGD 1 7/8OD CLMP
78101199545	B2012PA SS6 1 1/2RGD 1 7/8OD CLAMP
12100342	B2013 ZN SS6HDW 2RGD 2 3/8OD CLAMP
78101102573	B2013PA AL SS6HDW 2RGD 2 3/8OD CLAMP
78101102597	B2013PA SS4 2RGD 2 3/8OD CLAMP
78101104473	B2013PA YZN 2RGD 2 3/8OD CLAMP
78101160144	B2013 AL 2RGD 2 3/8OD CLAMP
78101160145	B2013 AL SS6HDW 2RGD 2 3/8OD CLAMP
78101160147	B2013 DCU 2RGD 2 3/8OD CLAMP
78101160149	B2013 GRN 2RGD 2 3/8OD CLAMP
78101160151	B2013 HDG 2RGD 2 3/8OD CLAMP
78101161063	B2013 ZN 2RGD 2 3/8OD CLAMP
78101161064	B2013PA ZN 2RGD 2 3/8OD CLAMP
78101161066	B2013 PVC SS6HDW 2RGD 2 3/8OD CLAMP
78101161068	B2013 SS4 2RGD 2 3/8OD CLAMP
78101161069	B2013 SS6 2RGD 2 3/8OD CLAMP
78101161072	B2013PA AL 2RGD 2 3/8OD CLAMP
78101161109	B2013PA HDG 2RGD 2 3/8OD CLAMP
78101186906	B2013 HDG SS6HDW 2RGD 2 3/8OD CLAMP
78101186939	B2013 YZN 2RGD 2 3/8OD CLAMP
78101192848	B2013PA HDG SS6HDW 2RGD 2 3/8OD CLAMP
78101196384	B2013PA SS6 2RGD 2 3/8OD CLAMP
78101101419	B2014 AL SS6HDW 2 1/2RGD 2 7/8OD CLAMP
78101102574	B2014PA AL SS6HDW 2 1/2RGD 2 7/8OD CLAMP
78101104475	B2014PA YZN 2 1/2RGD 2 7/8OD CLAMP
78101160154	B2014 AL 2 1/2RGD 2 7/8OD CLAMP
78101160156	B2014 DCU 2 1/2RGD 2 7/8OD CLAMP
78101160160	B2014 HDG 2 1/2RGD 2 7/8OD CLAMP
78101160162	B2014 PVC SS6HDW 2 1/2RGD 2 7/8OD CLAMP
78101160163	B2014 SS4 2 1/2RGD 2 7/8OD CLAMP
78101161073	B2014 ZN 2 1/2RGD 2 7/8OD CLAMP
78101161074	B2014PA ZN 2 1/2RGD 2 7/8OD CLAMP
78101161075	B2014 SS6 2 1/2RGD 2 7/8OD CLAMP
78101161078	B2014PA AL 2 1/2RGD 2 7/8OD CLAMP
78101161079	B2014PA HDG 2 1/2RGD 2 7/8OD CLAMP
78101186894	B2014 YZN 2 1/2RGD 2 7/8OD CLAMP
78101186907	B2014 HDG SS6HDW 2 1/2RGD 2 7/8OD CLAMP
78101187198	B2014PA SS4 2 1/2RGD 2 7/8OD CLAMP
78101198881	B2014 PVCSS6 SS6HDW 2 1/2RGD 2 7/8OD CLP
78205110264	B2014 GRN 2 1/2RGD 2 7/8OD CLAMP
78205118185	B2014PA HDG SS6HDW 2 1/2RGD 2 7/8OD CLMP
78205121791	B2014PA SS6 2 1/2RGD 2 7/8OD CLAMP
78101102578	B2015PA AL SS6HDW 3RGD 3 1/2OD CLAMP

B-LINE B2000 (CONT'D)	
Part Number	**Description**
78101104477	B2015PA YZN 3RGD 3 1/2OD CLAMP
78101104648	B2015PA SS4 3RGD 3 1/2OD CLAMP
78101125692	B2015PA SS6 3RGD 3 1/2OD CLAMP
78101160164	B2015 AL 3RGD 3 1/2OD CLAMP
78101160167	B2015 AL SS6HDW 3RGD 3 1/2OD CLAMP
78101160169	B2015 DCU 3RGD 3 1/2OD CLAMP
78101160172	B2015 HDG 3RGD 3 1/2OD CLAMP
78101160173	B2015 PVC SS6HDW 3RGD 3 1/2OD CLAMP
78101161082	B2015 SS4 3RGD 3 1/2OD CLAMP
78101161083	B2015 ZN 3RGD 3 1/2OD CLAMP
78101161084	B2015PA ZN 3RGD 3 1/2OD CLAMP
78101161085	B2015 SS6 3RGD 3 1/2OD CLAMP
78101161090	B2015PA AL 3RGD 3 1/2OD CLAMP
78101161091	B2015PA HDG 3RGD 3 1/2OD CLAMP
78101186891	B2015 YZN 3RGD 3 1/2OD CLAMP
78101186908	B2015 HDG SS6HDW 3RGD 3 1/2OD CLAMP
78101186929	B2015 ZN SS6HDW 3RGD 3 1/2OD CLAMP
78101192849	B2015PA HDG SS6HDW 3RGD 3 1/2OD CLAMP
78101194430	B2015 GRN 3RGD 3 1/2OD CLAMP
12246860	B2016PA SS6 3 1/2RGD 4OD CLAMP
78101102582	B2016PA AL SS6HDW 3 1/2RGD 4OD CLAMP
78101104479	B2016PA YZN 3 1/2RGD 4OD CLAMP
78101160174	B2016 AL 3 1/2RGD 4OD CLAMP
78101160175	B2016 AL SS6HDW 3 1/2RGD 4OD CLAMP
78101160176	B2016 DCU 3 1/2RGD 4OD CLAMP
78101160177	B2016 HDG 3 1/2RGD 4OD CLAMP
78101160178	B2016 PVC SS6HDW 3 1/2RGD 4OD CLAMP
78101160179	B2016 SS4 3 1/2RGD 4OD CLAMP
78101161093	B2016 ZN 3 1/2RGD 4OD CLAMP
78101161094	B2016PA ZN 3 1/2RGD 4OD CLAMP
78101161096	B2016PA AL 3 1/2RGD 4OD CLAMP
78101161097	B2016PA HDG 3 1/2RGD 4OD CLAMP
78101186895	B2016 SS6 3 1/2RGD 4OD CLAMP
78101186909	B2016 YZN 3 1/2RGD 4OD CLAMP
78101186928	B2016 HDG SS6HDW 3 1/2RGD 4OD CLAMP
78101187201	B2016PA SS4 3 1/2RGD 4OD CLAMP
78101197304	B2016 GRN 3 1/2RGD 4OD CLAMP
78205134395	B2016PA HDG SS6HDW 3 1/2RGD 4OD CLAMP
78101101104	B2017 YZN 4RGD 4 1/2OD CLAMP
78101101421	B2017 AL SS6HDW 4RGD 4 1/2OD CLAMP
78101102585	B2017PA AL SS6HDW 4RGD 4 1/2OD CLAMP
78101104482	B2017PA YZN 4RGD 4 1/2OD CLAMP
78101104649	B2017PA SS4 4RGD 4 1/2OD CLAMP
78101160184	B2017 AL 4RGD 4 1/2OD CLAMP
78101160188	B2017 DCU 4RGD 4 1/2OD CLAMP
78101160189	B2017 GRN 4RGD 4 1/2OD CLAMP
78101160191	B2017 HDG 4RGD 4 1/2OD CLAMP
78101160193	B2017 PVC SS6HDW 4RGD 4 1/2OD CLAMP
78101161103	B2017 ZN 4RGD 4 1/2OD CLAMP
78101161104	B2017PA ZN 4RGD 4 1/2OD CLAMP
78101161105	B2017 SS4 4RGD 4 1/2OD CLAMP
78101161106	B2017 SS6 4RGD 4 1/2OD CLAMP
78101161107	B2017PA AL 4RGD 4 1/2OD CLAMP
78101161111	B2017PA HDG 4RGD 4 1/2OD CLAMP
78101186937	B2017 HDG SS6HDW 4RGD 4 1/2OD CLAMP
78101187203	B2017PA HDG ZN HDW 4RGD 4 1/2OD CLAMP
78205120836	B2017PA HDG SS6HDW 4RGD 4 1/2OD CLAMP

B-LINE B2000 (CONT'D)	
Part Number	**Description**
78205124531	B2017PA SS6 4RGD 4 1/2OD CLAMP
12021007	B2018 AL SS6HDW 4 1/2RGD 5OD CLAMP
78101160194	B2018 AL 4 1/2RGD 5OD CLAMP
78101160196	B2018 HDG 4 1/2RGD 5OD CLAMP
78101160197	B2018 PVC SS6HDW 4 1/2RGD 5OD CLAMP
78101160198	B2018 SS4 4 1/2RGD 5OD CLAMP
78101161113	B2018 ZN 4 1/2RGD 5OD CLAMP
78101161114	B2018PA ZN 4 1/2RGD 5OD CLAMP
78101187204	B2018PA HDG 4 1/2RGD 5OD CLAMP
78101194605	B2018 HDG SS6HDW 4 1 /2RGD 5OD CLAMP
78205122869	B2018 YZN 4 1/2RGD 5OD CLAMP
78205124338	B2018 SS6 4 1/2RGD 5OD CLAMP
78205135167	B2018PA SS6 4 1/2RGD 5OD CLAMP
78101160204	B2019 AL 5RGD 5 1/2OD CLAMP
78101160205	B2019 AL SS6HDW 5RGD 5 1/2OD CLAMP
78101160206	B2019 HDG 5RGD 5 1/2OD CLAMP
78101160207	B2019 PVC SS6HDW 5RGD 5 1/2OD CLAMP
78101160208	B2019 SS4 5RGD 5 1/2OD CLAMP
78101161121	B2019PA HDG 5RGD 5 1/2OD CLAMP
78101161123	B2019 ZN 5RGD 5 1/2OD CLAMP
78101161124	B2019PA ZN 5RGD 5 1/2OD CLAMP
78101194606	B2019 HDG SS6HDW 5RGD 5 1/2OD CLAMP
78101199182	B2019 SS6 5RGD 5 1/2OD CLAMP
78205113311	B2019PA SS4 5RGD 5 1/2OD CLAMP
78205122335	B2019 YZN 5RGD 5 1/2OD CLAMP
78205128879	B2019PA YZN 5RGD 5 1/2OD CLAMP
78205141364	B2019PA AL 5RGD 5 1/2OD CLAMP
12246862	B2019PASS6 5RGD 5 1/2OD CLAMP
12249076	B2019PAHDG SS6HDW 5RGD 5 1/2OD CLAMP
11664818	B2020 SS6NS 6RGD 6 5/8OD CLAMP
12246864	B2020PASS6 6RGD 6 5/8OD CLAMP
12246865	B2020PAHDG SS6HDW 6RGD 6 5/8OD CLAMP
12711534	B2020US SS6 6RGD 6 5/8OD CLAMP
78101104487	B2020PA YZN 6RGD 6 5/8OD CLAMP
78101160211	B2020 SS6 6RGD 6 5/8OD CLAMP
78101160212	B2020 SS4 6RGD 6 5/8OD CLAMP
78101160213	B2020 PVC SS6HDW 6RGD 6 5/8OD CLAMP
78101160214	B2020 AL 6RGD 6 5/8OD CLAMP
78101160216	B2020 AL SS6HDW 6RGD 6 5/8OD CLAMP
78101160217	B2020 DCU 6RGD 6 5/8OD CLAMP
78101160218	B2020 GRN 6RGD 6 5/8OD CLAMP
78101160220	B2020 HDG 6RGD 6 5/8OD CLAMP
78101161133	B2020 ZN 6RGD 6 5/8OD CLAMP
78101161134	B2020PA ZN 6RGD 6 5/8OD CLAMP
78101186853	B2020PA AL SS6HDW 6RGD 6 5/8OD CLAMP
78101186919	B2020 YZN 6RGD 6 5/8OD CLAMP
78101187188	B2020PA SS4 6RGD 6 5/8OD CLAMP
78101194607	B2020 HDG SS6HDW 6RGD 6 5/8 CLAMP
78205119320	B2020PA HDG 6RGD 6 5/8OD CLAMP
12052983	B2021 AL 7RGD 7 5/8OD CLAMP
12246867	B2021SS6 7RGD 7 5/8OD CLAMP
12246868	B2021PASS6 7RGD 7 5/8OD CLAMP
78101161143	B2021 ZN (7 RGD)
78101161144	B2021PA ZN 7RGD 7 5/8OD CLAMP
78101186902	B2021 PVC SS6HDW 7RGD 7 5/8OD CLAMP
78101186933	B2021 SS4 7RGD 7 5/8OD CLAMP
78205140160	B2021 HDG 7RGD 7 5/8OD CLAMP

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COMPONENT PART NUMBER REFERENCE

B-LINE B2000 (CONT'D)	
Part Number	**Description**
12246921	B2022PASS6 8RGD 8 5/8OD CLAMP
14111392	B2022PA HDG 8RGD 8 5/8OD CLAMP
78101161152	B2022 GRN 8RGD 8 5/8OD CLAMP
78101161153	B2022 ZN 8RGD 8 5/8OD CLAMP
78101161154	B2022PA ZN 8RGD 8 5/8OD CLAMP
78101161155	B2022 HDG 8RGD 8 5/8OD CLAMP
78101161156	B2022 SS4 8RGD 8 5/8OD CLAMP
78101186851	B2022 AL 8RGD 8 5/8OD CLAMP
78101186896	B2022 SS6 8RGD 8 5/8OD CLAMP
78101186901	B2022 PVC SS6HDW 8RGD 8 5/8OD CLAMP
78101194608	B2022 HDG SS6HDW 8RGD 8 5/8OD CLAMP
78205116459	B2022 YZN 8RGD 8 5/8OD CLAMP
78205136569	B2022PA SS4 8RGD 8 5/8OD CLAMP

B-LINE B2400	
Part Number	**Description**
78101163003	B2400-1/2 ZN PIPE STRP
78101163001	B2400-1/2 GRN PIPE STRP
78101163002	B2400-1/2 HDG PIPE STRP
78101163006	B2400-1/2 SS4 PIPE STRP
78205139351	B2400-1/2 SS6
78101163013	B2400-3/4 ZN PIPE STRP
78101163014	B2400-3/4 GRN PIPE STRP
78101163015	B2400-3/4 HDG PIPE STRP
78101163017	B2400-3/4 SS4 PIPE STRP
78101187235	B2400-3/4 SS6
78101163023	B2400-1 ZN PIPE STRP
78101163021	B2400-1 GRN PIPE STRP
78101163022	B2400-1 HDG PIPE STRP
78101163026	B2400-1 SS4 PIPE STRP
78101102889	B2400-1 SS6
78101163033	B2400-1 1/4 ZN PIPE STRP
78101163029	B2400-1 1/4 GRN PIPE STRP
78101163030	B2400-1 1/4 HDG PIPE STRP
78101163034	B2400-1 1/4 SS4 PIPE STRP
78101187236	B2400-1 1/4 SS6
78101163043	B2400-1 1/2 ZN PIPE STRP
78101163038	B2400-1 1/2 GRN PIPE STRP
78101163039	B2400-1 1/2 HDG PIPE STRP
78101163042	B2400-1 1/2 SS4 PIPE STRP
78101163044	B2400-1 1/2 SS6
78101163053	B2400-2 ZN PIPE STRP
78101163054	B2400-2 GRN PIPE STRP
78101163055	B2400-2 HDG PIPE STRP
78101163058	B2400-2 SS4 PIPE STRP
78101163059	B2400-2 SS6
78101163063	B2400-2 1/2 ZN PIPE STRP
78101163062	B2400-2 1/2 GRN PIPE STRP
78101163064	B2400-2 1/2 HDG PIPE STRP
78101163067	B2400-2 1/2 SS4 PIPE STRP
78101187238	B2400-2 1/2 SS6
78101163073	B2400-3 ZN PIPE STRP
78101163071	B2400-3 GRN PIPE STRP
78101163072	B2400-3 HDG PIPE STRP
12275661	B2400-3 PLN PIPE STRP
78101187241	B2400-3 SS4 PIPE STRP
78101187239	B2400-3 SS6
78101163093	B2400-4 ZN PIPE STRP
78101163090	B2400-4 GRN PIPE STRP
78101163091	B2400-4 HDG PIPE STRP
78101163095	B2400-4 SS4 PIPE STRP
78101187244	B2400-4 SS6
13423575	B2400-4 YZN PIPE STRP
78101163103	B2400-5 ZN PIPE STRP
78101163102	B2400-5 GRN PIPE STRP
78101163104	B2400-5 HDG PIPE STRP
78101187246	B2400-5 SS4 PIPE STRP
78101187247	B2400-5 SS6
78101163113	B2400-6 ZN PIPE STRP
78101163114	B2400-6 GRN PIPE STRP
78101163115	B2400-6 HDG PIPE STRP

B-LINE B2400 (CONT'D)	
Part Number	**Description**
E9037T001008	B2400-6 PLN PIPE STRP
78101163118	B2400-6 SS4 PIPE STRP
78101187248	B2400-6 SS6
78101163123	B2400-8 ZN PIPE STRP
13399212	B2400-8 GRN PIPE STRP
78101185304	B2400-8 HDG PIPE STRP
12275811	B2400-8 PLN PIPE STRP
78101163122	B2400-8 SS4 PIPE STRP
78101187249	B2400-8 SS6
E9037T001022	B2400-8 YZN
78101187262	B2400-10 ZN
78101187259	B2400-10 HDG
78101185650	B2400-10 PLN PIPE STRP
78101187254	B2400-10 SS4 PIPE STRP
78101187250	B2400-10 SS6
E9037T001023	B2400-10 YZN
78101187264	B2400-12 ZN
78205119925	B2400-12 GRN
78101185306	B2400-12 HDG
78101185651	B2400-12 PLN
78101187252	B2400-12 SS4
78101187255	B2400-12 SS6
E9037T001020	B2400-12 YZN
78101187264	B2400-12 ZN

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COMPONENT PART NUMBER REFERENCE

B-LINE B3055	
Part Number	**Description**
78101172702	B3055-3/8X2 PLN
78101102610	B3055-3/8X3 PLN
78101102620	B3055-3/8X4 PLN
78101172719	B3055-3/8X4 ZN
11844049	B3055-3/8X5 HDG
78101102650	B3055-3/8X5 PLN
11787002	B3055-3/8X5 ZN
78101102684	B3055-3/8X6 PLN
78101172768	B3055-3/8X6 ZN
11700265	B3055-3/8X7 PLN
11805050	B3055-3/8X7 ZN
11670078	B3055-3/8X8 PLN
78205128850	B3055-3/8X8 ZN
78101102803	B3055-3/8X10 PLN
11816836	B3055-3/8X10 ZN
78101102908	B3055-3/8X12 PLN
78205134716	B3055-3/8X12 ZN
13014400	B3055-1/2X2 HDG
78101102607	B3055-1/2X2 PLN
13014404	B3055-1/2X3 HDG
78101102614	B3055-1/2X3 PLN
12459786	B3055-1/2X4 HDG
78101102911	B3055-1/2X4 PLN
78101102623	B3055-1/2X4 ZN
11844090	B3055-1/2X5 HDG
78101102655	B3055-1/2X5 PLN
12398167	B3055-1/2X5 ZN
78101172852	B3055-1/2X6 HDG 1/2 FLG
78101102916	B3055-1/2X6 PLN
13015827	B3055-1/2X6 SS4
78101102687	B3055-1/2X6 ZN
78101102922	B3055-1/2X7 PLN
13243696	B3055-1/2X7 SS6
78101172876	B3055-1/2X7 ZN
12491911	B3055-1/2X8 HDG
11670044	B3055-1/2X8 PLN
78101172838	B3055-1/2X8 ZN
78101102777	B3055-1/2X9 PLN
13015828	B3055-1/2X9 SS4
12765271	B3055-1/2X9 ZN
78101102939	B3055-1/2X10 PLN
11777633	B3055-1/2X10 ZN
12462143	B3055-1/2X12 HDG
11770546	B3055-1/2X12 PLN
11816835	B3055-1/2X12 ZN
12031066	B3055-5/8X3 PLN
12217272	B3055-5/8X3 ZN
13502332	B3055-5/8X4 HDG
11663129	B3055-5/8X4 PLN
78205126263	B3055-5/8X4 ZN
13235842	B3055-5/8X5 HDG
78101102658	B3055-5/8X5 PLN
11787005	B3055-5/8X5 ZN
78101102690	B3055-5/8X6 PLN
11650829	B3055-5/8X6 ZN
11691602	B3055-5/8X7 PLN
11728484	B3055-5/8X7 ZN

B-LINE B3055 (CONT'D)	
Part Number	**Description**
13502331	B3055-5/8X8 HDG
11670084	B3055-5/8X8 PLN
13015829	B3055-5/8X8 SS4
78101196399	B3055-5/8X8 ZN
78101172981	B3055-5/8X10 PLN
11994595	B3055-5/8X10 ZN
13015506	B3055-5/8X12 HDG
11758520	B3055-5/8X12 PLN
11728477	B3055-5/8X12 ZN
78101172992	B3055-3/4X3 PLN
11850856	B3055-3/4X3 ZN
78205132704	B3055-3/4X4 HDG
78101172994	B3055-3/4X4 PLN
12513136	B3055-3/4X4 SS4
11667132	B3055-3/4X4 ZN
13235841	B3055-3/4X5 HDG
78101102662	B3055-3/4X5 PLN
13028057	B3055-3/4X5 SS6
78101194053	B3055-3/4X5 ZN
11834954	B3055-3/4X6 HDG
78101173012	B3055-3/4X6 PLN
12491033	B3055-3/4X6 SS6
11667144	B3055-3/4X6 ZN
11986903	B3055-3/4X7 PLN
12491031	B3055-3/4X7 SS6
78205124537	B3055-3/4X7 ZN
11822963	B3055-3/4X8 HDG
11670050	B3055-3/4X8 PLN
12224600	B3055-3/4x8 ZN
78101173042	B3055-3/4X9 PLN CLMP
12561656	B3055-3/4X9 ZN CLMP
78101173046	B3055-3/4X10 PLN
11858826	B3055-3/4X10 ZN
13015503	B3055-3/4X12 HDG
78101173059	B3055-3/4X12 PLN
78101173055	B3055-3/4X12 ZN
11965632	B3055-7/8X4 HDG
78101102634	B3055-7/8X4 PLN
11887972	B3055-7/8X4 ZN
78101102666	B3055-7/8X5 PLN
11643470	B3055-7/8X5 ZN
11835013	B3055-7/8X6 HDG
78101102698	B3055-7/8X6 PLN
11837682	B3055-7/8X6 ZN
11680936	B3055-7/8X7 HDG
78101173096	B3055-7/8X7 PLN
13243340	B3055-7/8X7 SS6
11717039	B3055-7/8X7 ZN
11822968	B3055-7/8X8 HDG
11670089	B3055-7/8X8 PLN
12085800	B3055-7/8X8 ZN
78101173109	B3055-7/8X9 PLN
11864050	B3055-7/8X9 ZN
78101173113	B3055-7/8X10 PLN
11820293	B3055-7/8X10 ZN
78101173124	B3055-7/8X12 PLN
11812941	B3055-7/8X12 ZN

B-LINE B3083	
Part Number	**Description**
78101173453	B3083-3/8 HDG W/HDW
78101103870	B3083-3/8 PLN W/HDW BM AT
78101173456	B3083-3/8 RP W/HDW BM ATT
11685009	B3083-3/8 SS4 W/HDW BM AT
11650914	B3083-3/8 ZN W/HDW BM
78101173425	B3083-1/2 HDG W/HDW BM
78101103875	B3083-1/2 PLN W/HDW BM AT
78101173428	B3083-1/2 RP W/HDW BM ATT
12221612	B3083-1/2 SS4 W/HDW BM
11686053	B3083-1/2 ZN W/HDW BM
78101173459	B3083-5/8 GRN W/HDW BM AT
78101173449	B3083-5/8 HDG W/HDW BM AT
78101103880	B3083-5/8 PLN W/HDW BM AT
78101173462	B3083-5/8 RP W/HDW BM ATT
11662730	B3083-5/8 ZN W/HDW BM
78101173458	B3083-3/4 HDG W/HDW BM AT
78101103885	B3083-3/4 PLN W/HDW BM AT
78101173451	B3083-3/4 RP W/HDW BM ATT
12494536	B3083-3/4 SS4 W/HDW BM
78101173452	B3083-3/4 ZN W/HDW BM
11671032	B3083-7/8 HDG W/HDW BM ATTA
78101103890	B3083-7/8 PLN W/HDW BM AT
78101173467	B3083-7/8 RP W/HDW BM ATT
11681182	B3083-7/8 ZN W/HDW
78101173420	B3083-1 HDG W/HDW BM ATTA
78101103895	B3083-1 PLN W/HDW BM ATTA
78101173422	B3083-1 RP W/HDW BM ATTAC
12766431	B3083-1 SS4 W/HDW BM
78101173423	B3083-1 ZN W/HDW WELDED BEAM ATTACHMENT
78101103900	B3083-1 1/8 PLN W/HDW BM
78101173436	B3083-1 1/8 RP W/HDW BM
11664512	B3083-1 1/8 ZN W/HDW BM
78101173433	B3083-1 1/4 HDG W/HDW BM
78101103905	B3083-1 1/4 PLN W/HDW BM
78101173434	B3083-1 1/4 RP W/HDW BM A
78101173435	B3083-1 1/4 ZN W/HDW
11938402	B3083-1 1/2 HDG W/HDW
78101103910	B3083-1 1/2 PLN W/HDW BM
11681179	B3083-1 1/2 ZN W/HDW BM
78101173431	B3083-1 1/2 RP W/HDW BM A
78101103920	B3083-2 PLN W/HDW BM ATTA
78101173442	B3083-2 RP W/HDW BM ATTAC
78101173444	B3083-2 ZN W/HDW BM ATTAC

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COMPONENT PART NUMBER REFERENCE

B-LINE B3083WO	
Part Number	**Description**
78101173498	B3083WO-3/8 HDG BM ATCHMT
78101103800	B3083WO-3/8 PLN BM ATTACH
78101173496	B3083WO-3/8 RP BM ATTACH
12630752	B3083WO-3/8 SS6 BM ATTACH
78101173497	B3083WO-3/8 ZN BM ATTACH
78101173484	B3083WO-1/2 HDG BM ATTACH
11673938	B3083WO-1/2 SS4 BM ATTACH
11940882	B3083WO-1/2 HDG BM ATTACH
78101103805	B3083WO-1/2 PLN BM ATTACH
78101173481	B3083WO-1/2 RP BM ATTACH
78101173483	B3083WO-1/2 ZN BM ATTACH
78101173505	B3083WO-5/8 HDG BM ATTACH
78101103810	B3083WO-5/8 PLN BM ATTACH
78101173503	B3083WO-5/8 RP BM ATTACH
12631796	B3083WO-5/8 SS6 BM ATTACH
78101173504	B3083WO-5/8 ZN BM ATTACH
11660360	B3083WO-3/4 SS4 BM ATTACH
78101173494	B3083WO-3/4 HDG BM ATTACH
78101103815	B3083WO-3/4 PLN BM ATTACH
78101173492	B3083WO-3/4 RP BM ATTACH
12630751	B3083WO-3/4 SS6 BM ATTACH
78101173493	B3083WO-3/4 ZN BM ATTACH
78101173507	B3083WO-7/8 SS4 BM ATTACH
12631739	B3083WO-7/8 SS6 BM ATTACH
78101173509	B3083WO-7/8 HDG BM
78101103820	B3083WO-7/8 PLN BM ATTACH
78101173506	B3083WO-7/8 RP BM ATTACH
78101173508	B3083WO-7/8 ZN BM ATTACH
78101103825	B3083WO-1 PLN BM ATTACH
78101173478	B3083WO-1 RP BM ATTACH
78101173479	B3083WO-1 ZN BM ATTACH
78101173485	B3083WO-1 1/8 RP BM ATTAC
78101173486	B3083WO-1 1/8 ZN BM ATTAC
78101173474	B3083WO-1 1/4 HDG BM
78101173473	B3083WO-1 1/4 ZN BM ATTAC
78101103840	B3083WO-1 1/2 PLN BM ATTA
78101173469	B3083WO-1 1/2 RP BM ATTAC
78101173476	B3083WO-1 3/4 ZN BM ATTAC

B-LINE B3100	
Part Number	**Description**
78101105022	B3100-1 1/4 GRN STD DUTY CLEVIS HANGER
78101105020	B3100-1 1/4 HDG STD DUTY CLEVIS HANGER
78101105018	B3100-1 1/4 PLN STD DUTY CLEVIS HANGER
78101105021	B3100-1 1/4 RP STD DUTY CLEVIS HANGER
78101105713	B3100-1 1/4 SS4 STD DUTY CLEVIS HANGER
78101174558	B3100-1 1/4 SS6 STD DUTY CLEVIS HANGER
78101105019	B3100-1 1/4 ZN STD DUTY CLEVIS HANGER
78101105028	B3100-1 1/2 GRN STD DUTY CLEVIS HANGER
78101105026	B3100-1 1/2 HDG STD DUTY CLEVIS HANGER
78101105024	B3100-1 1/2 PLN STD DUTY CLEVIS HANGER
78101105027	B3100-1 1/2 RP STD DUTY CLEVIS HANGER
78101105714	B3100-1 1/2 SS4 STD DUTY CLEVIS HANGER
78101174556	B3100-1 1/2 SS6 STD DUTY CLEVIS HANGER
E9041T001012	B3100-1 1/2 YZN STD DUTY CLEVIS HANGER
78101105025	B3100-1 1/2 ZN STD DUTY CLEVIS HANGER
78101105034	B3100-2 GRN STD DUTY CLEVIS HANGER
78101105032	B3100-2 HDG STD DUTY CLEVIS HANGER
78101105030	B3100-2 PLN STD DUTY CLEVIS HANGER
78101105033	B3100-2 RP STD DUTY CLEVIS HANGER
78101105715	B3100-2 SS4 STD DUTY CLEVIS HANGER
78101174564	B3100-2 SS6 STD DUTY CLEVIS HANGER
12312133	B3100-2 YZN STD DUTY CLEVIS HANGER
78101105031	B3100-2 ZN STD DUTY CLEVIS HANGER
78101105040	B3100-2 1/2 GRN STD DUTY CLEVIS HANGER
78101105038	B3100-2 1/2 HDG STD DUTY CLEVIS HANGER
78101105036	B3100-2 1/2 PLN STD DUTY CLEVIS HANGER
78101105039	B3100-2 1/2 RP STD DUTY CLEVIS HANGER
78101105716	B3100-2 1/2 SS4 STD DUTY CLEVIS HANGER
78101174567	B3100-2 1/2 SS6 STD DUTY CLEVIS HANGER
E9041T001040	B3100-2 1/2 YZN STD DUTY CLEVIS HANGER
78101105037	B3100-2 1/2 ZN STD DUTY CLEVIS HANGER
78101105047	B3100-3 GRN STD DUTY CLEVIS HANGER
78101105044	B3100-3 HDG STD DUTY CLEVIS HANGER
78101105042	B3100-3 PLN STD DUTY CLEVIS HANGER
78101105045	B3100-3 RP STD DUTY CLEVIS HANGER
78101105717	B3100-3 SS4 STD DUTY CLEVIS HANGER
78101174574	B3100-3 SS6 STD DUTY CLEVIS HANGER
12312134	B3100-3 YZN STD DUTY CLEVIS HANGER
78101105043	B3100-3 ZN STD DUTY CLEVIS HANGER
78101105052	B3100-3 1/2 GRN STD DUTY CLEVIS HANGER
78101105050	B3100-3 1/2 HDG STD DUTY CLEVIS HANGER
78101105048	B3100-3 1/2 PLN STD DUTY CLEVIS HANGER
78101105051	B3100-3 1/2 RP STD DUTY CLEVIS HANGER
78101174575	B3100-3 1/2 SS4 STD DUTY CLEVIS HANGER
78101174576	B3100-3 1/2 SS6 STD DUTY CLEVIS HANGER
78101105049	B3100-3 1/2 ZN STD DUTY CLEVIS HANGER
78101174363	B3100-4 GRN STD DUTY CLEVIS HANGER
78101105056	B3100-4 HDG STD DUTY CLEVIS HANGER
78101105054	B3100-4 PLN STD DUTY CLEVIS HANGER
78101105057	B3100-4 RP STD DUTY CLEVIS HANGER
78101105718	B3100-4 SS4 STD DUTY CLEVIS HANGER
78101174580	B3100-4 SS6 STD DUTY CLEVIS HANGER
12312135	B3100-4 YZN STD DUTY CLEVIS HANGER
78101105055	B3100-4 ZN STD DUTY CLEVIS HANGER
78101174381	B3100-5 GRN STD DUTY CLEVIS HANGER
78101105062	B3100-5 HDG STD DUTY CLEVIS HANGER
78101105060	B3100-5 PLN STD DUTY CLEVIS HANGER

B-LINE B3100 (CONT'D)	
Part Number	**Description**
78101105063	B3100-5 RP STD DUTY CLEVIS HANGER
78101105719	B3100-5 SS4 STD DUTY CLEVIS HANGER
78101174584	B3100-5 SS6 STD DUTY CLEVIS HANGER
78205127035	B3100-5 YZN STD DUTY CLEVIS HANGER
78101105061	B3100-5 ZN STD DUTY CLEVIS HANGER
78101174392	B3100-6 GRN STD DUTY CLEVIS HANGER
78101105065	B3100-6 HDG STD DUTY CLEVIS HANGER
78101105066	B3100-6 PLN STD DUTY CLEVIS HANGER
78101105068	B3100-6 RP STD DUTY CLEVIS HANGER
78101105720	B3100-6 SS4 STD DUTY CLEVIS HANGER
78101174586	B3100-6 SS6 STD DUTY CLEVIS HANGER
78205127036	B3100-6 YZN STD DUTY CLEVIS HANGER
78101105067	B3100-6 ZN STD DUTY CLEVIS HANGER
78101174412	B3100-8 GRN STD DUTY CLEVIS HANGER
78101105071	B3100-8 HDG STD DUTY CLEVIS HANGER
78101105072	B3100-8 PLN STD DUTY CLEVIS HANGER
78101105074	B3100-8 RP STD DUTY CLEVIS HANGER
78101105721	B3100-8 SS4 STD DUTY CLEVIS HANGER
78101174589	B3100-8 SS6 STD DUTY CLEVIS HANGER
78205127038	B3100-8 YZN STD DUTY CLEVIS HANGER
78101105073	B3100-8 ZN STD DUTY CLEVIS HANGER

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COMPONENT PART NUMBER REFERENCE

B-LINE B3380	
Part Number	**Description**
12383328	B3380-3/4 CAL/SIL
12382238	B3380-1 CAL/SIL
12707894	B3380-1 1/2 CAL/SIL
12926457	B3380-2 CAL/SIL
12383470	B3380-2 1/2 CAL/SIL
78101172344	B3380-3 CAL/SIL
78205133288	B3380-4 CAL/SIL
78101172348	B3380-6 CAL/SIL - INA
11677170	B3381-1
11677172	B3381-1 1/2
11677183	B3381-2
12108236	B3381-2 1/2
11677184	B3381-3
11677185	B3381-4
11677193	B3381-6
12712319	B3381-8
12712321	B3381-10
11990436	B3382-1/2
11935569	B3382-3/4
78101172378	B3382-1
78101172379	B3382-1 1/4
78101172380	B3382-1 1/2 CAL/SIL- INA
11741042	B3382-2
11741044	B3382-2 1/2
78205128141	B3382-3
78205128139	B3382-4
11809817	B3382-5
78205128138	B3382-6
78205128137	B3382-8
78101172389	B3382-10 CAL/SIL - INA
12426167	B3382-12 CALCIUM SILICATE
12575128	B3382-14 CALCIUM SILICATE
11988039	B3382-16 CALCIUM SILICATE
12197451	B3382-20
12197450	B3382-24
78101172396	B3383-1/2
78101172397	B3383-3/4 CAL/SIL - INA
12212993	B3383-1 CAL SIL SHIELD
11990433	B3383-1 1/4
11834663	B3383-1 1/2
11867183	B3383-2 SS4
78101172402	B3383-2 1/2 CAL/SIL- INA
78101172403	B3383-3 CAL/SIL - INA
12464064	B3383-3 1/2 CAL/SIL - INA
78205128155	B3383-4
78205128154	B3383-5
78205128153	B3383-6
13468676	B3383-6 SS4
78205128152	B3383-8
78205128151	B3383-10
13468677	B3383-10 SS4
78101172411	B3383-12 CAL/SIL - INA
78101172412	B3383-14
12368401	B3383-16 CALCIUM SILICATE
11668156	B3383-18 CALCIUM SILICATE
12926915	B3383-20 CALCIUM SILICATE

B-LINE B3380 SERIES	
Part Number	**Description**
13118991	B3384-1/2 CAL/SI
12004867	B3384-3/4 CAL/SIL
11837103	B3384-1 CAL/SIL
11734889	B3384-1 1/4 CAL/SIL
11837100	B3384-1 1/2 CAL/SIL
11697932	B3384-2 CAL/SIL
11638916	B3384-2 1/2 CALCIUM SILICATE
78205128150	B3384-3
78205128149	B3384-4
11638919	B3384-5 CALCIUM SILICATE
13468674	B3384-5 SS4
78101172428	B3384-6 CAL/SIL - INA
78101172429	B3384-8 CAL/SIL - INA
78101172430	B3384-10
11806145	B3384-12 CAL/SIL
11834065	B3384-14 CAL/SIL
13468675	B3384-14 SS4
11806039	B3384-16 CAL/SIL
12613528	B3384-18 CALCIUM SILICATE
11806040	B3384-20 CAL/SIL
12212992	B3384-24 CAL/SIL
11990435	B3386-3/4
11990434	B3386-1
12373875	B3386-1 1/4
11990432	B3386-1 1/2
11990479	B3386-2
12076209	B3386-2 1/2
12101422	B3386-3
78205128145	B3386-4
78205128146	B3386-6
78101172471	B3386-8
78101172472	B3386-10
12640382	B3386-12 CALCIUM SILICATE
13394300	B3386-16 CAL/SIL
13394302	B3386-18 CAL/SIL
13394301	B3386-24 CAL/SIL
12018235	B3387-4 CALCIUM SILICATE

B-LINE HN HEX NUT	
Part Number	**Description**
78101104917	NUT,HEX 1/4 SS6
78101102520	NUT,HEX 1/4 SS4
78101142403	1/4 HN ZN
12463698	NUT,HEX 3/8 HDG
78101195453	NUT,HEX 3/8 PLN
78101102540	NUT,HEX 3/8 SS4
78101102538	NUT,HEX 3/8 SS6
78101142423	NUT,HEX 3/8 ZN
78205111179	NUT,HEX 1/2 HDG
78101171840	NUT,HEX 1/2 SS4
78101102525	NUT,HEX 1/2 SS6
78101142433	NUT,HEX 1/2 ZN
12441978	NUT,HEX 5/8 HDG
78101104153	NUT,HEX 5/8 SS4
78101185048	NUT,HEX 5/8 SS6
78101142443	NUT,HEX 5/8 ZN
12441970	NUT,HEX 3/4 HDG
78205115913	NUT,HEX 3/4 SS4
12279555	NUT,HEX 3/4 SS6
78101142453	NUT,HEX 3/4 ZN
78205133165	NUT,HEX 7/8 HDG
78205115396	NUT,HEX 7/8 SS4
78101185051	NUT,HEX 7/8 SS6
78101142463	NUT,HEX 7/8 ZN
12441977	NUT,HEX 1 HDG
78101185280	NUT,HEX 1 ZN

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COMPONENT PART NUMBER REFERENCE

B-LINE ATR	
Part Number	**Description**
78101187873	ATR, 3/8X120 HDG
78101169034	ATR, 3/8X120 PLN
78101187875	ATR, 3/8X120 SS4
78101191953	ATR, 3/8X120 SS6
78101169032	ATR, 3/8X120 YZN
78101169035	ATR, 3/8X120 ZN
78101169036	ATR, 3/8X144 PLN
78101187901	ATR, 3/8X144 SS4
78101104920	ATR, 3/8X144 SS6
78205117007	ATR, 3/8X144 YZN
78101169037	ATR, 3/8X144 ZN
78101187880	ATR, 1/2X120 HDG
78101169044	ATR, 1/2X120 PLN
78101187882	ATR, 1/2X120 SS4
78101104911	ATR, 1/2X120 SS6
78101187897	ATR, 1/2X120 YZN
78101169045	ATR, 1/2X120 ZN
78101187905	ATR, 1/2X144 HDG
78101169046	ATR, 1/2X144 PLN
78101104251	ATR, 1/2X144 SS4
78101187910	ATR, 1/2X144 SS6
78205117016	ATR, 1/2X144 YZN
78101169047	ATR, 1/2X144 ZN
78101187890	ATR, 5/8X120 HDG
78101169054	ATR, 5/8X120 PLN
78101193482	ATR, 5/8X120 SS4
79903802196	ATR, 5/8X120 YZN
78101169055	ATR, 5/8X120 ZN
78101169056	ATR, 5/8X144 PLN
78101187916	ATR, 5/8X144 SS4
78101187917	ATR, 5/8X144 SS6
78101169057	ATR, 5/8X144 ZN
78101187886	ATR, 3/4X120 HDG
78101169064	ATR, 3/4X120 PLN
78101187918	ATR, 3/4X120 SS4
12377616	ATR, 3/4X120 SS6
78101169065	ATR, 3/4X120 ZN
11681009	ATR, 3/4X144 HDG
78101169066	ATR, 3/4X144 PLN
78101187922	ATR, 3/4X144 SS4
78101169067	ATR, 3/4X144 ZN
12708053	ATR, 7/8X120 HDG
78101169074	ATR, 7/8X120 PLN
78101187929	ATR, 7/8X120 SS4
12579591	ATR, 7/8X120 SS6
78101169075	ATR, 7/8X120 ZN
11681296	ATR, 7/8X144 HDG
78101169076	ATR, 7/8X144 PLN
78101187931	ATR, 7/8X144 SS6
78101169077	ATR, 7/8X144 ZN
12004508	ATR, 7/8X144 SS4

B-LINE SEISMIC CABLE	
Part Number	**Description**
Y361002E	1/8" BRC CABLE EG
Y361003E	3/16" BRC CABLE EG
Y361004E	1/4" BRC CABLE EG

SELF-TAPPING SCREW ANCHOR	
Part Number	**Description**
11905735	ATM-37 SELF-TAPPING MACHINE SCREW ANCHOR

CONCRETE SCREW BOLT	
Part Number	**Description**
12978858	ACB-37-175 3/8X1 3/4 CONCRETE ANCHOR-2
12978859	ACB-37-250 3/8X 2 1/2 CONCRETE ANCHOR-2
12979060	ACB-37-300 3/8X3 CONCRETE ANCHOR-2
12979061	ACB-37-400 3/8X4 CONCRETE ANCHOR-2

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DATE: April 23, 2025

COMPONENT PART NUMBER REFERENCE

HILTI KB-TZ-2	
Part Number	**Description**
HILTI PART	KB-TZ2 3/8x2 1/2
HILTI PART	KB-TZ2 1/2x3
HILTI PART	KB-TZ2 1/2x3 3/4
HILTI PART	KB-TZ2 5/8x4 1/4
HILTI PART	KB-TZ2 5/8x4 3/4
HILTI PART	KB-TZ2 3/4x4 3/4

HILTI HDI-P TZ	
Part Number	**Description**
HILTI PART	HDI-P TZ 1/4"
HILTI PART	HDI-P TZ 3/8"

SIMPSON STRONG-BOLT 2	
Part Number	**Description**
SIMPSON PART	STB2-50234R25
SIMPSON PART	STB2-50334
SIMPSON PART	STB2-62312R20
SIMPSON PART	STB2-62412
SIMPSON PART	STB2-75434R10
SIMPSON PART	STB2-75512

TOLCO FIG. 109DD	
Part Number	**Description**
13001967	FIG. 109DD 3/8DDI ICC CONCRETE INSERT
13001968	FIG. 109DD 1/2DDI ICC CONCRETE INSERT
13001969	FIG. 109DD 5/8DDI ICC CONCRETE INSERT
13001990	FIG. 109DD 3/4DDI NO ICC CONCRETE INSERT
13001991	FIG. 109DD 7/8DDI NO ICC CONCRETE INSERT

B-LINE WOOD-KNOCKER II (POWERS WOOD-KNOCKER II+)	
Part Number	**Description**
12979064	ACPW-25 1/4" BROWN WOOD-KNOCKER II
12979065	ACPW-37 3/8" GREEN WOOD-KNOCKER II
12979066	ACPW-50 1/2" YELLOW WOOD-KNOCKER II
12979067	ACPW-62 5/8" RED WOOD-KNOCKER II
12979068	ACPW-75 3/4" PURPLE WOOD-KNOCKER II

B-LINE BANG-IT (POWERS BANG-IT+)	
Part Number	**Description**
78205131154	ACPD-25 BANG-IT
78205131156	ACPD-37 BANG-IT
78205131157	ACPD-50 BANG-IT
78205131158	ACPD-62 BANG-IT
78205131166	ACPD-75 BANG-IT

B-LINE POWER SNAKE (POWERS POWER SNAKE+)	
Part Number	**Description**
POWERS PART	6403SD-PWR

B-LINE RAPID ROD (POWERS POWER HANGERMATE+)	
Part Number	**Description**
12979069	ARC-25-125 1/4 CONCRETE RAPID ROD-2
12979070	ARC-37-150 3/8 CONCRETE RAPID ROD-2

POWERS POWER SCREW-BOLT+	
Part Number	**Description**
POWERS PART	PFM1411340
POWERS PART	PFM1411360
POWERS PART	PFM1411380
POWERS PART	PFM1411420
POWERS PART	PFM1411460
POWERS PART	PFM1411480
POWERS PART	PFM1411520

POWERS POWER-STUD +SD1	
Part Number	**Description**
POWERS PART	7412SD1-PWR
POWERS PART	7420SD1-PWR
POWERS PART	7423SD1-PWR
POWERS PART	7430SD1-PWR
POWERS PART	7433SD1-PWR
POWERS PART	7440SD1-PWR
POWERS PART	7442SD1-PWR

POWERS POWER-STUD +SD2	
Part Number	**Description**
11905757	AWSD-37-300 Wedge Anchor
11909744	AWSD-37-350 Wedge Anchor
11905759	AWSD-37-375 Wedge Anchor
11905760	AWSD-37-500 Wedge Anchor
11905761	AWSD-50-375 Wedge Anchor
11905762	AWSD-50-450 Wedge Anchor
11905763	AWSD-50-550 Wedge Anchor
11905764	AWSD-50-700 Wedge Anchor
11909746	AWSD-62-475 Wedge Anchor
11905765	AWSD-62-500 Wedge Anchor
11905766	AWSD-62-600 Wedge Anchor
11905767	AWSD-62-700 Wedge Anchor
11905768	AWSD-75-550 Wedge Anchor
11905769	AWSD-75-625 Wedge Anchor
11905770	AWSD-75-700 Wedge Anchor

POWERS POWER-STUD +SD4/+SD6	
Part Number	**Description**
POWERS PART	7412SD1-PWR
POWERS PART	7420SD1-PWR
POWERS PART	7423SD1-PWR
POWERS PART	7430SD1-PWR
POWERS PART	7433SD1-PWR
POWERS PART	7440SD1-PWR
POWERS PART	7442SD1-PWR
POWERS PART	7313SD4-PWR
POWERS PART	7322SD4-PWR
POWERS PART	7324SD4-PWR
POWERS PART	7333SD4-PWR
POWERS PART	7342SD4-PWR
POWERS PART	7612SD6-PWR
POWERS PART	7620SD6-PWR
POWERS PART	7623SD6-PWR
POWERS PART	7630SD6-PWR
POWERS PART	7633SD6-PWR
POWERS PART	7640SD6-PWR
POWERS PART	7642SD6-PWR

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PAGE: **10-15**

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SECTION 11

STRUCTURAL ATTACHMENTS

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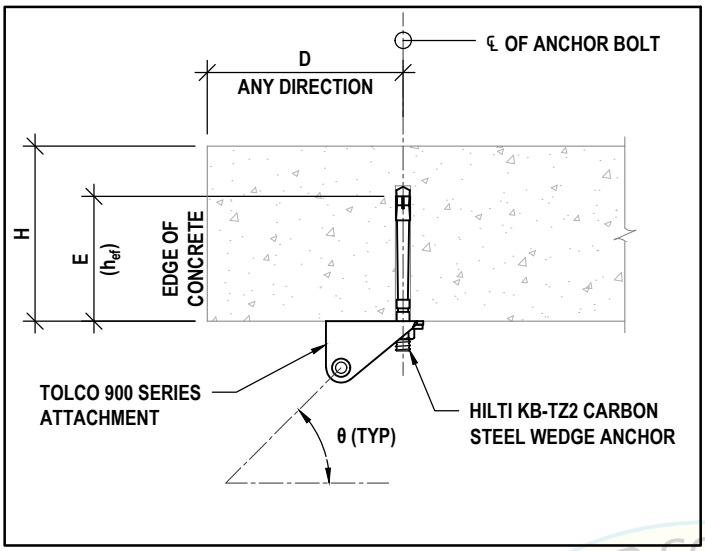
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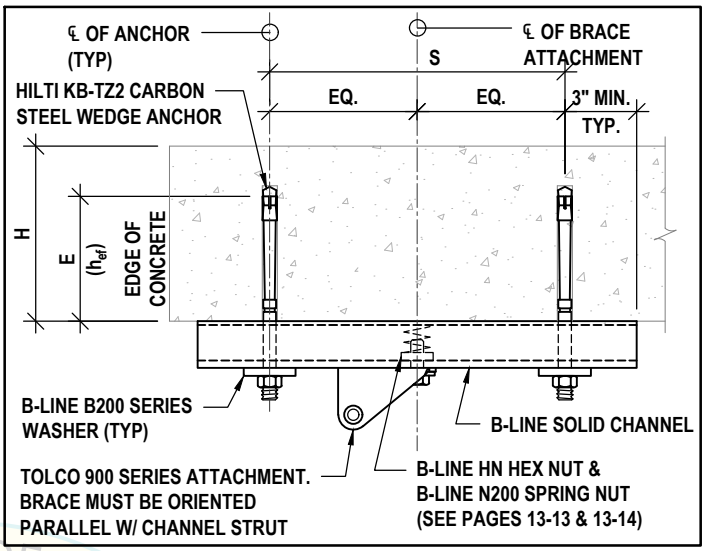
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-0

DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHORS
IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	8"	12"	4"	615	464	179	893	617	473	B22
1/2"	2"	10"	12"	4"	627	470	184	995	617	473	B22
1/2"	3 1/4"	12"	12"	6"	1,143	840	322	995	617	473	B22
5/8"	3 1/4"	12"	12"	6"	1,384	1,022	400	995	617	473	B22
5/8"	4"	12"	12"	6"	1,483	1,105	435	995	617	473	B22
3/4"	3 3/4"	12"	12"	6"	1,591	1,198	484	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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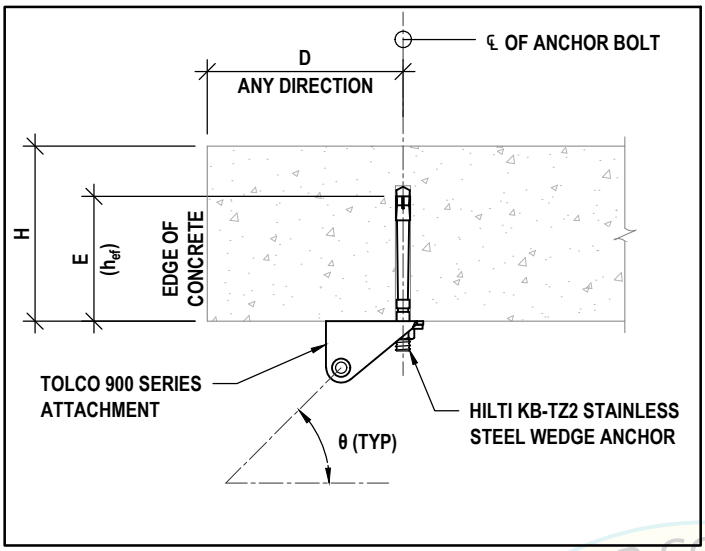
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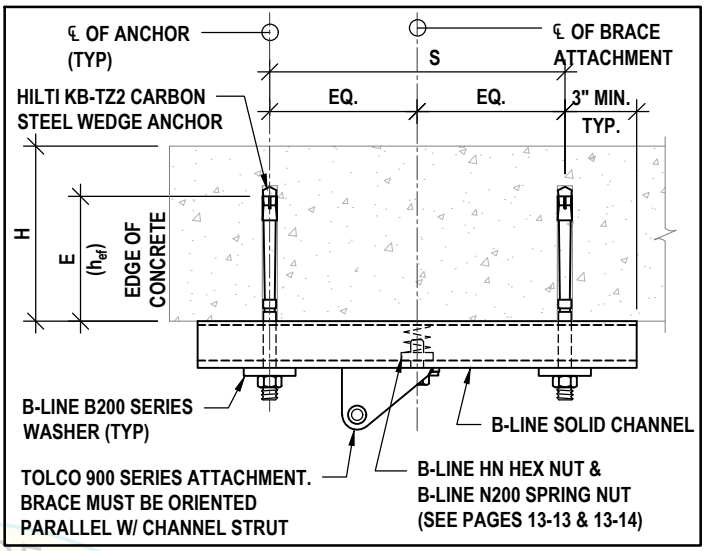
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

HILTI KB-TZ2 SS WEDGE ANCHORS
IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	8"	12"	4"	623	468	180	893	617	473	B22
1/2"	2"	10"	12"	4"	507	381	148	994	617	473	B22
1/2"	3 1/4"	12"	12"	6"	1,204	872	330	994	617	473	B22
5/8"	3 1/4"	12"	12"	6"	1,384	1,022	400	994	617	473	B22
5/8"	4"	12"	12"	6"	1,483	1,105	435	994	617	473	B22
3/4"	3 3/4"	12"	12"	6"	1,591	1,198	484	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 SS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 SS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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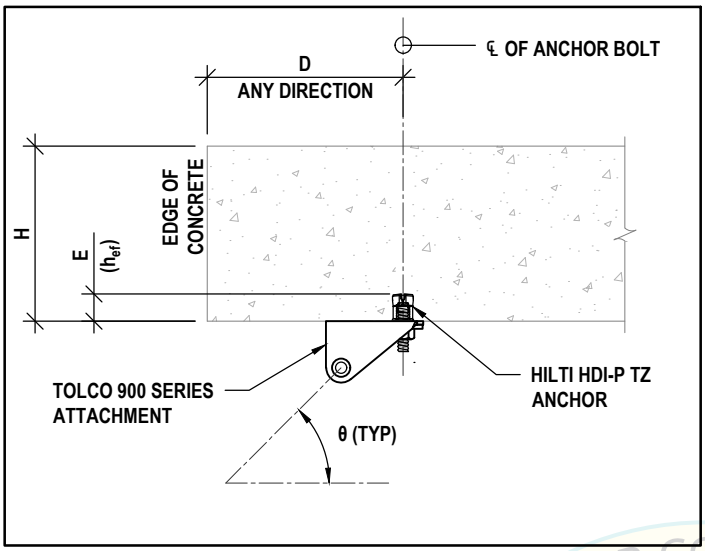
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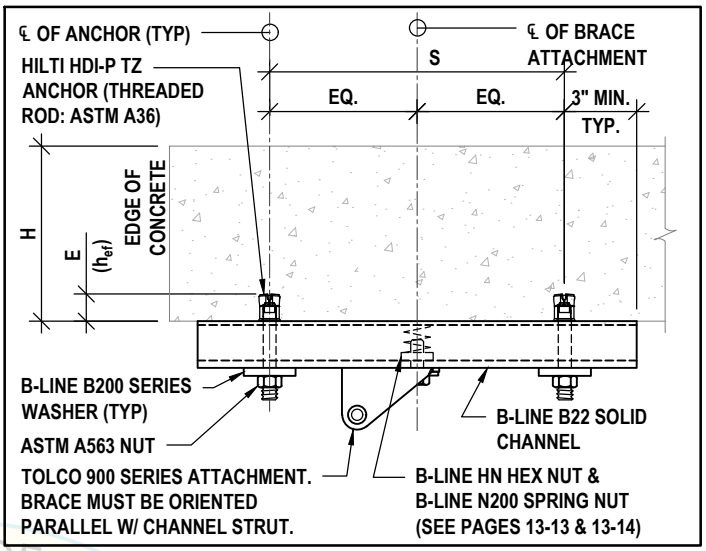
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

HILTI HDI-P TZ ANCHORS
IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 12")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	3/4"	8"	9"	4"	66	48	18	133	96	65	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL HILTI HDI-P TZ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4236 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL 1/16" LARGER THAN THE ANCHOR DIAMETER.

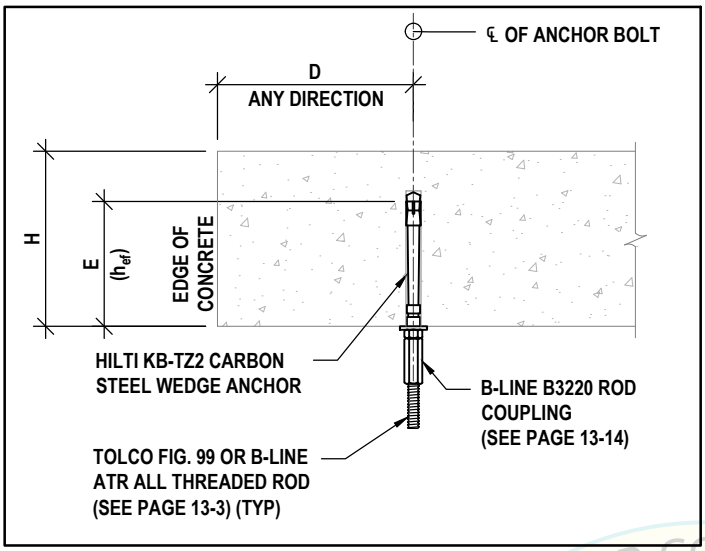
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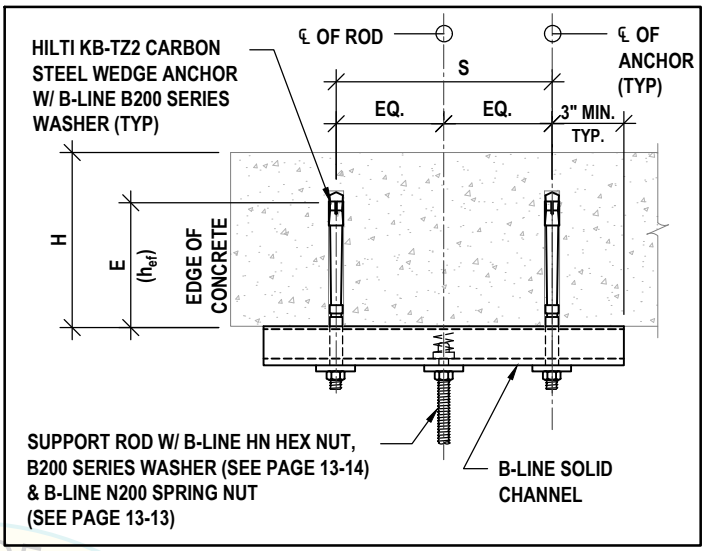
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-3

DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHORS
IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	2"	8"	12"	4"	666	1,331	B12
1/2"	2"	8"	12"	4"	666	1,331	B12
1/2"	3 1/4"	12"	12"	6"	1,117	2,234	B11
5/8"	3 1/4"	12"	12"	6"	1,380	2,565	B11
5/8"	4"	12"	12"	6"	1,525	2,565	B11
3/4"	3 3/4"	12"	12"	6"	1,710	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL OR LARGER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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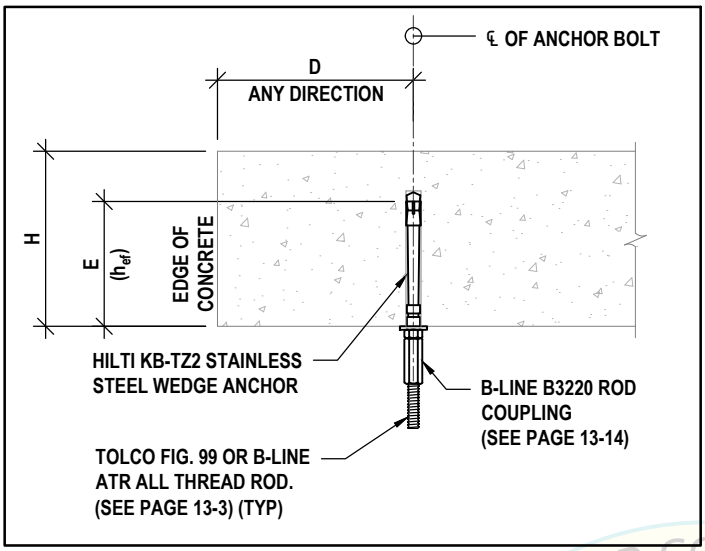
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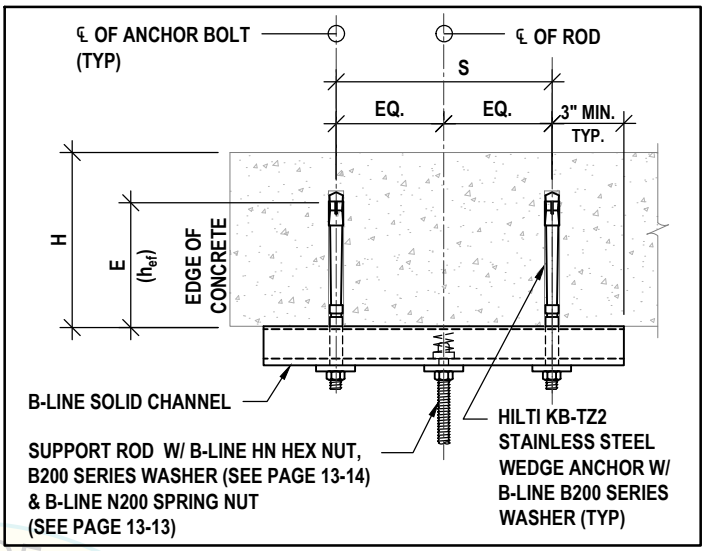
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-4

DATE: April 23, 2025

HILTI KB-TZ2 SS WEDGE ANCHORS
IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	2"	8"	12"	4"	666	1,331	B12
1/2"	2"	8"	12"	4"	539	1,078	B22
1/2"	3 1/4"	12"	12"	6"	1,117	2,234	B11
5/8"	3 1/4"	12"	12"	6"	1,380	2,565	B11
5/8"	4"	12"	12"	6"	1,525	2,565	B11
3/4"	3 3/4"	12"	12"	6"	1,710	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
ICCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 SS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 SS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL OR LARGER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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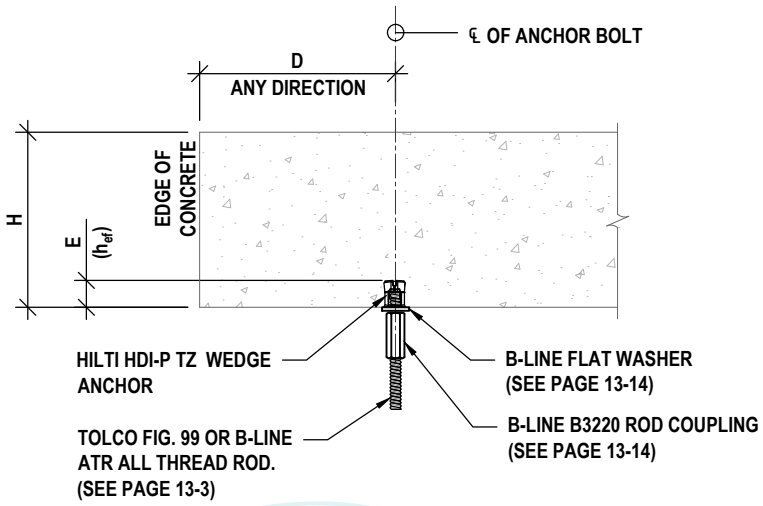
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-5

DATE: April 23, 2025

HILTI HDI-P TZ ANCHORS
IN 3,000 PSI NWC DECK FOR HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1] SINGLE
3/8"	3/4"	8"	4"	62

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL HILTI HDI-P TZ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4236 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL OR LARGER THAN THE ANCHOR DIAMETER.
11. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

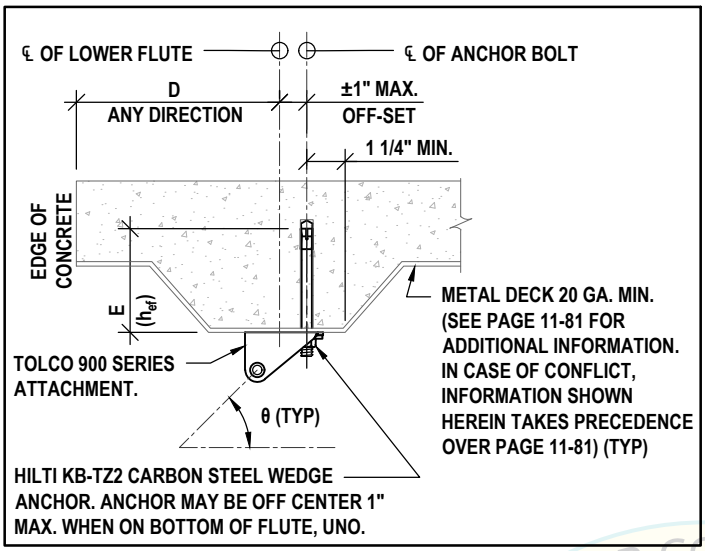
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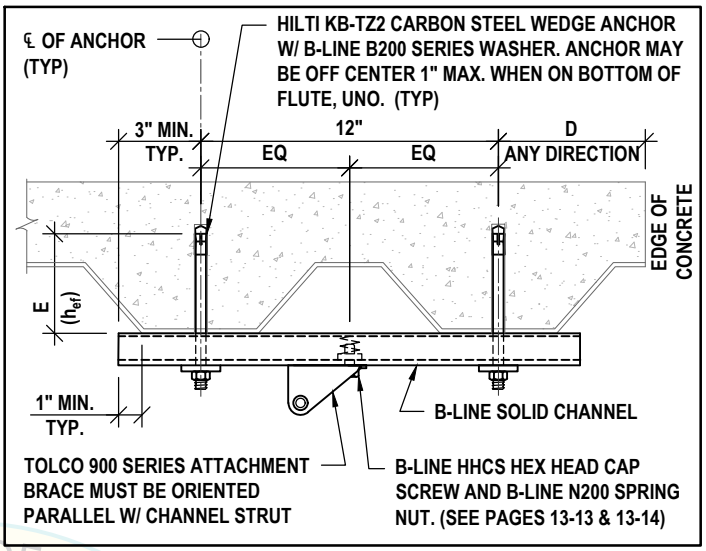
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-6

DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
				SINGLE			DOUBLE			
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	9"	12"	406	311	121	812	617	443	B22
1/2"	2"	9"	12"	408	307	120	816	614	430	B22
1/2"	3 1/4"	9"	12"	711	520	198	995	617	473	B22
5/8"	2 3/4"	9"	12"	715	544	219	995	617	473	B22
5/8"	4"	9"	12"	968	702	270	995	617	473	B22

FOOTNOTES:
1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_0=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

ICC-ES REVIEWED FOR CODE COMPLIANCE WITH THE 2022 CALIFORNIA BUILDING CODE, 2021 INTERNATIONAL BUILDING CODE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-4266 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-4266 (2023).

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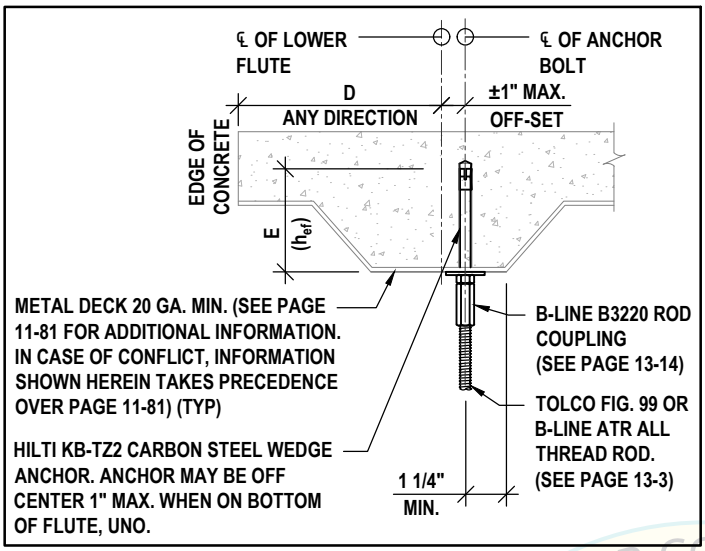
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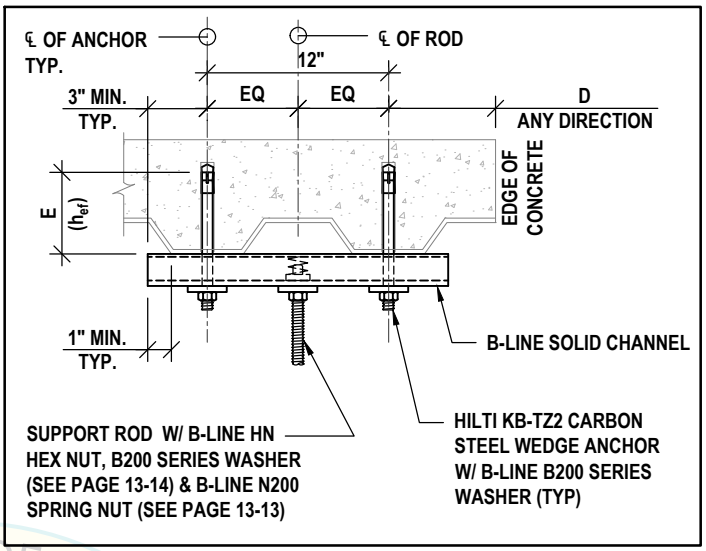
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-7

DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
				SINGLE	DOUBLE	
3/8"	2"	9"	12"	470	940	B22
1/2"	2"	9"	12"	437	874	B22
1/2"	3 1/4"	9"	12"	684	1,368	B12
5/8"	2 3/4"	9"	12"	805	1,609	B12
5/8"	4"	9"	12"	900	1,800	B11

FOOTNOTES:
1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-4266 (2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-4266 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR LARGER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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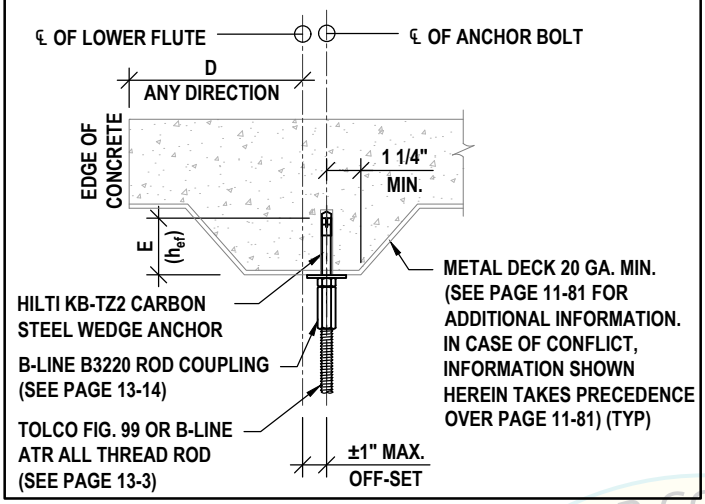
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-8

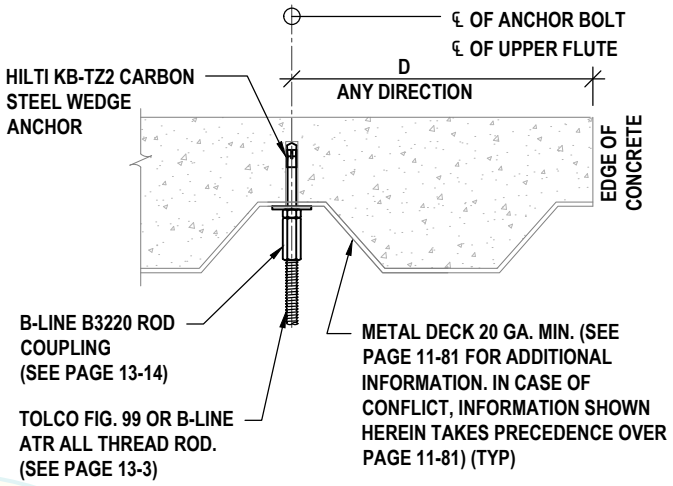
DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS

LOWER FLUTE



UPPER FLUTE



LOWER FLUTE				
ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]
3/8"	2"	9"	12"	470
1/2"	2 1/2"	9"	12"	671
1/2"	3 1/4"	9"	12"	684
5/8"	2 3/4"	9"	12"	805
5/8"	4"	9"	12"	900

FOOTNOTES:
1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

UPPER FLUTE				
ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]
3/8"	1 1/2"	9"	12"	333
1/2"	1 1/2"	9"	12"	338
1/2"	2"	9"	12"	437
5/8"	2 3/4"	9"	12"	805
5/8"	4"	9"	12"	900

FOOTNOTES:
1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
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8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-4266 (2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-4266 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL OR LARGER THAN THE ANCHOR DIAMETER.
13. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
14. FOR INSTALL AT UPPER FLUTE, MIN CONC THICKNESS OVER FLUTES = HOLE DEPTH + CONC COVER

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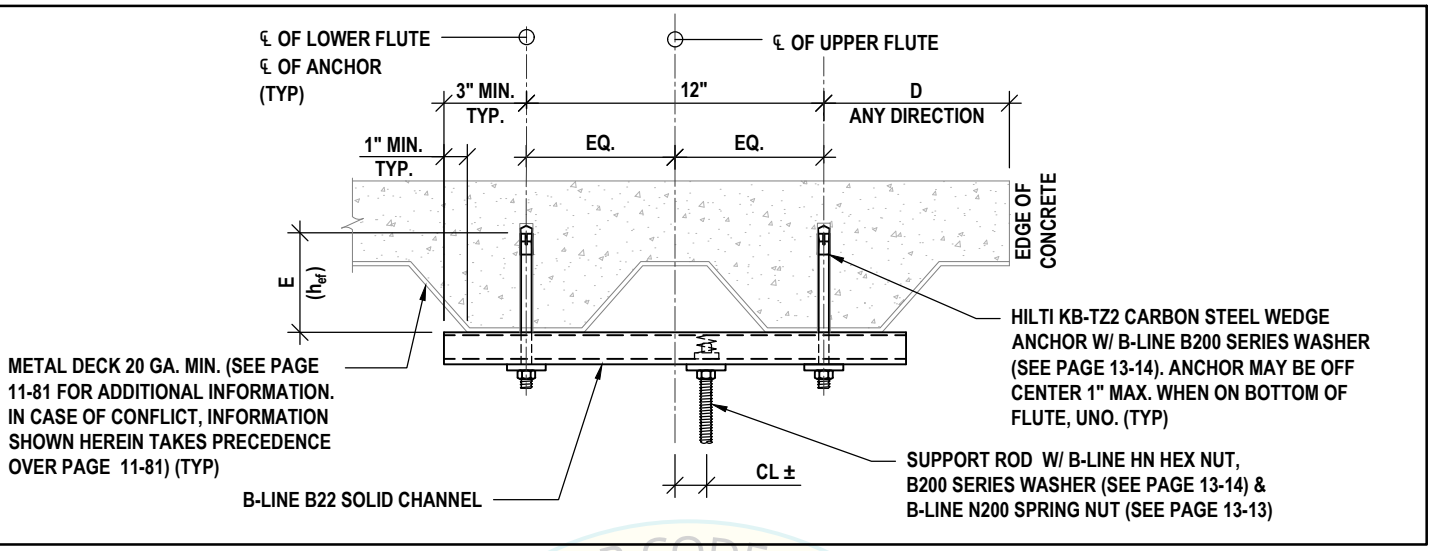
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

DUAL HILTI KB-TZ2 CS ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	TWO ANCHOR CONNECTION: COMBINED TOTAL ALLOWABLE ROD TENSION DESIGN VALUE (LBS) VERTICAL SUPPORT ROD MAX. OFFSET FROM CENTER LINE (LBS)(ASD)[1]					MAX. ALLOWABLE LOAD ON SINGLE ANCHOR (LBS)(ASD)[1]	B-LINE SOLID CHANNEL[2]
				CL ± 0"	CL ± 1"	CL ± 2"	CL ± 3"	CL ± 4"		
3/8"	2"	9"	12"	940	806	705	627	564	470	B22
1/2"	2"	9"	12"	874	749	655	582	524	437	B22
1/2"	3 1/4"	9"	12"	1,305	1,173	1,026	912	821	684	B22
5/8"	2 3/4"	9"	12"	1,305	1,305	1,208	1,074	966	805	B22
5/8"	4"	9"	12"	1,305	1,305	1,305	1,200	1,080	900	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-4266 (2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-4266 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL OR GREATER THAN THE ANCHOR DIAMETER.
13. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS

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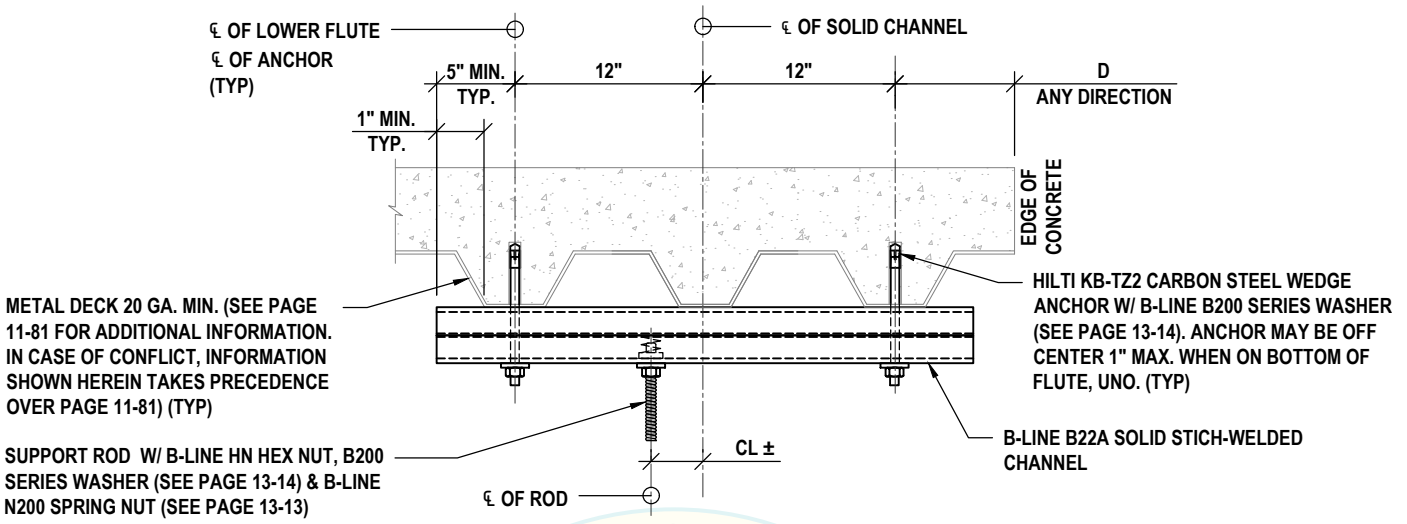
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-10

DATE: April 23, 2025

DUAL HILTI KB-TZ2 CS ANCHOR IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK W/ STITCH-WELDED STRUT FOR HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	TWO ANCHOR CONNECTION: COMBINED TOTAL ALLOWABLE ROD TENSION DESIGN VALUE (LBS) VERTICAL SUPPORT ROD MAX. OFFSET FROM CENTER LINE (LBS)(ASD)[1]					MAX. ALLOWABLE LOAD ON SINGLE ANCHOR (LBS)(ASD)[1]	B-LINE SOLID CHANNEL[2]
				CL ± 0"	CL ± 1"	CL ± 2"	CL ± 3"	CL ± 4"		
3/8"	2"	9"	12"	940	868	806	752	705	470	B22A
1/2"	2"	9"	12"	874	806	749	699	655	437	B22A
1/2"	3 1/4"	9"	12"	1,305	1,263	1,173	1,095	1,026	684	B22A
5/8"	2 3/4"	9"	12"	1,305	1,305	1,305	1,288	1,208	805	B22A
5/8"	4"	9"	12"	1,305	1,305	1,305	1,305	1,305	900	B22A

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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13. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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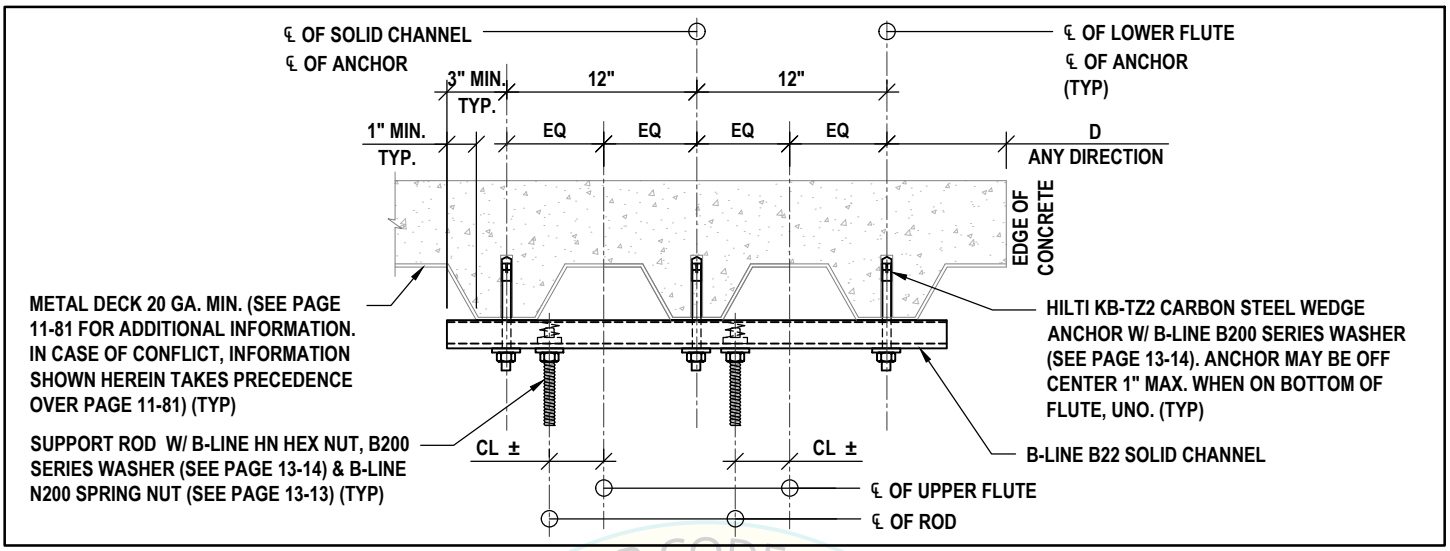
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-11

DATE: April 23, 2025

TRIPLE HILTI KB-TZ2 CS ANCHOR IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR MULTIPLE HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	THREE ANCHOR CONNECTION: COMBINED TOTAL ALLOWABLE ROD TENSION DESIGN VALUE (LBS) VERTICAL SUPPORT ROD MAX. OFFSET FROM CENTER LINE (LBS)(ASD)[1]					MAX. ALLOWABLE LOAD ON SINGLE ANCHOR (LBS)(ASD)[1]	B-LINE SOLID CHANNEL[2]
				CL ± 0"	CL ± 1"	CL ± 2"	CL ± 3"	CL ± 4"		
3/8"	2"	9"	12"	940	806	705	627	564	470	B22
1/2"	2"	9"	12"	874	749	655	582	524	437	B22
1/2"	3 1/4"	9"	12"	1,305	1,173	1,026	912	821	684	B22
5/8"	2 3/4"	9"	12"	1,305	1,305	1,208	1,074	966	805	B22
5/8"	4"	9"	12"	1,305	1,305	1,305	1,200	1,080	900	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
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REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

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1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
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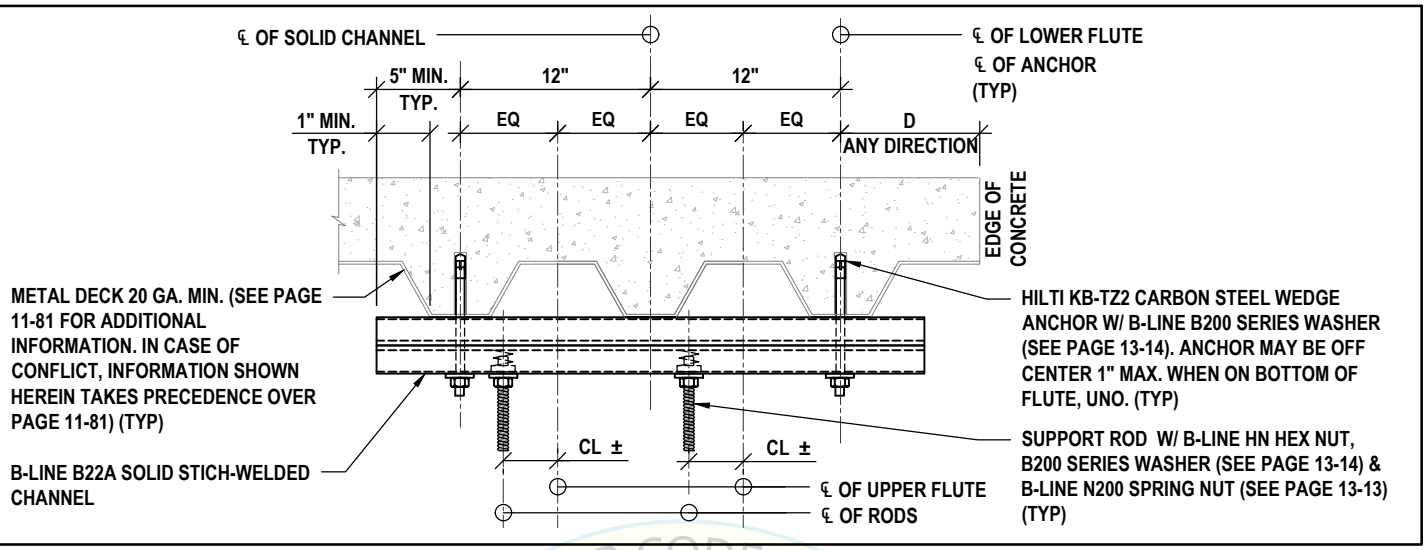
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-12

DATE: April 23, 2025

DUAL HILTI KB-TZ2 CS ANCHOR IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK W/ STITCH-WELDED STRUT FOR MULTIPLE HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	TWO ANCHOR CONNECTION					MAX. ALLOWABLE LOAD ON SINGLE ANCHOR (LBS)(ASD)[1]	B-LINE SOLID CHANNEL[2]
				COMBINED TOTAL ALLOWABLE ROD TENSION DESIGN VALUE (LBS) VERTICAL SUPPORT ROD MAX. OFFSET FROM CENTER LINE (LBS)(ASD)[1]						
				CL ± 0"	CL ± 1"	CL ± 2"	CL ± 3"	CL ± 4"		
3/8"	2"	9"	12"	627	594	564	537	513	470	B22A
1/2"	2"	9"	12"	582	552	524	499	477	437	B22A
1/2"	3 1/4"	9"	12"	912	864	821	782	746	684	B22A
5/8"	2 3/4"	9"	12"	1,074	1,017	966	920	878	805	B22A
5/8"	4"	9"	12"	1,200	1,137	1,080	1,029	982	900	B22A

FOOTNOTES:

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2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

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9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
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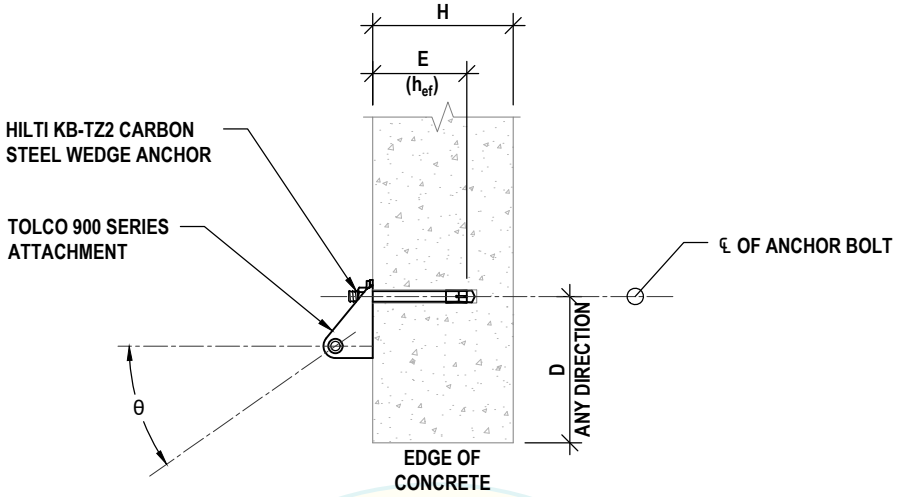
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-13

DATE: April 23, 2025

HILTI KB-TZ2 CS WEDGE ANCHORS
IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2"	8"	4"	541	464	355
1/2"	2"	8"	4"	558	470	362
1/2"	3 1/4"	12"	6"	977	840	660
5/8"	3 1/4"	12"	6"	1,219	1,022	799
5/8"	4"	12"	6"	1,327	1,105	856
3/4"	3 3/4"	12"	6"	1,454	1,198	919

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

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10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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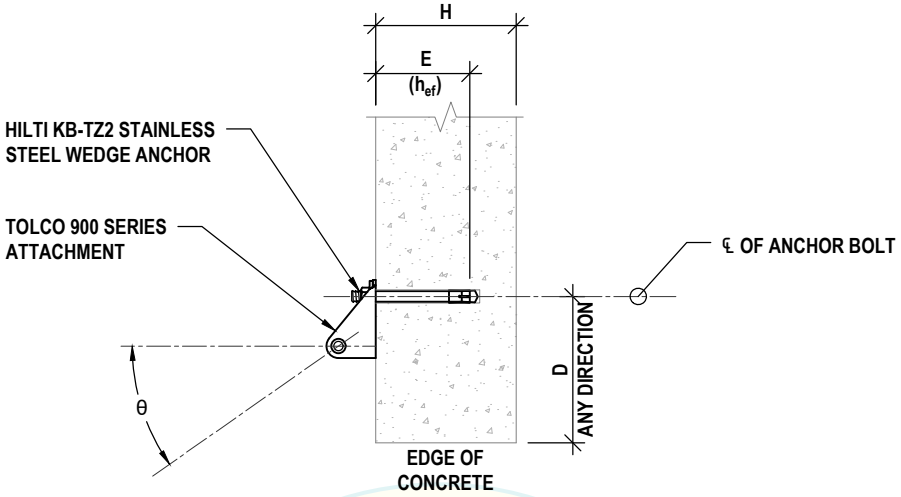
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-14

DATE: April 23, 2025

HILTI KB-TZ2 SS WEDGE ANCHORS
IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2"	8"	4"	544	468	359
1/2"	2"	8"	4"	452	381	293
1/2"	3 1/4"	12"	6"	1,003	872	695
5/8"	3 1/4"	12"	6"	1,219	1,022	799
5/8"	4"	12"	6"	1,327	1,105	856
3/4"	3 3/4"	12"	6"	1,454	1,198	919

FOOTNOTES:

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4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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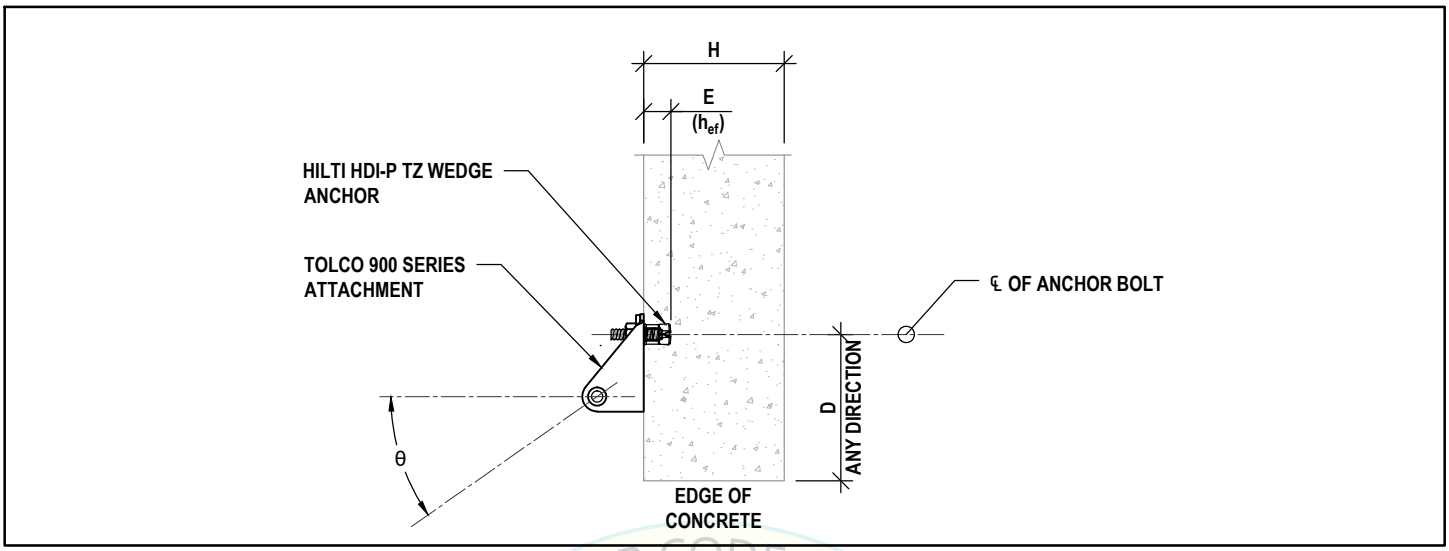
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-15

DATE: April 23, 2025

HILTI HDI-P TZ ANCHORS
IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD)		
				MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	3/4"	8"	4"	54	48	38

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL HILTI HDI-P TZ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4236 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-4236 (HILTI HDI-P TZ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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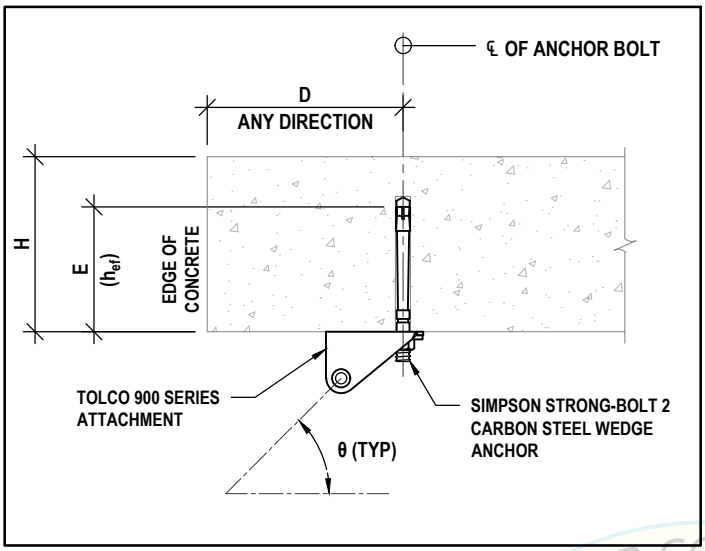
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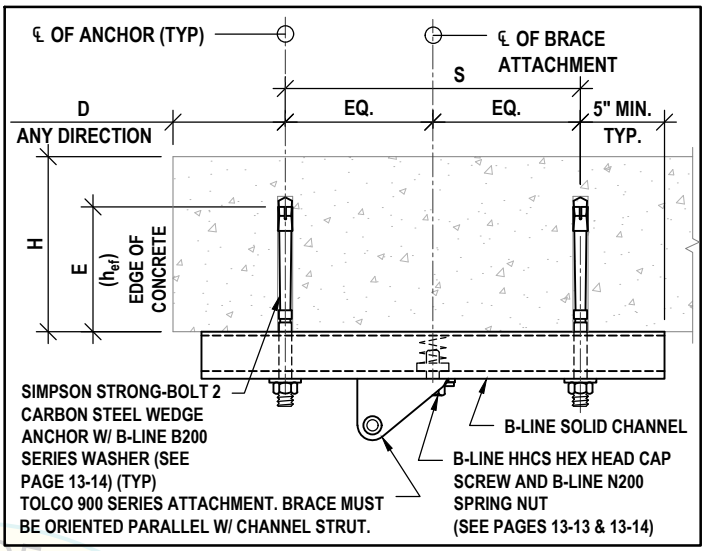
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-16

DATE: April 23, 2025

SIMPSON STRONG-BOLT 2 WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
1/2"	2 1/4"	8"	12"	4"	606	455	177	994	617	473	B22
1/2"	3 3/8"	8"	12"	6"	975	746	296	994	617	473	B22
5/8"	2 3/4"	8"	12"	5 1/2"	863	639	250	994	617	473	B22
5/8"	4 1/2"	8"	12"	8"	1,305	1,006	409	994	617	473	B22
3/4"	3 3/8"	8"	12"	6"	1,071	811	330	-	-	-	-
3/4"	5"	8"	12"	8 3/4"	1,525	1,190	497	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3037 (SIMPSON STRONG-BOLT-2 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ESR-3037 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
By: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

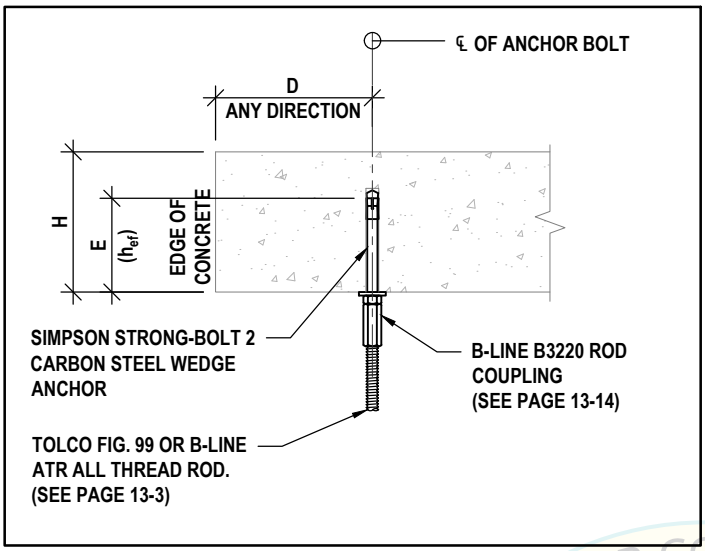
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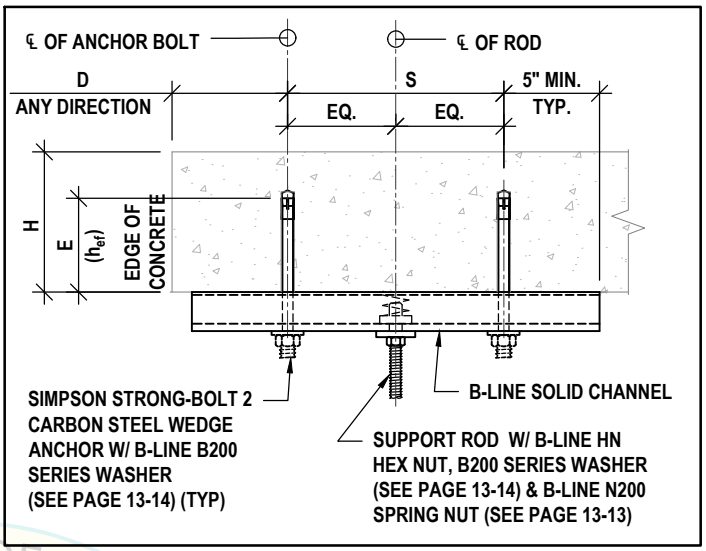
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-17

DATE: April 23, 2025

SIMPSON STRONG-BOLT 2 WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
1/2"	2 1/4"	8"	12"	4"	643	1,287	B22
1/2"	3 3/8"	8"	12"	6"	1,118	2,236	B11
5/8"	2 3/4"	8"	12"	5 1/2"	869	1,739	B11
5/8"	4 1/2"	8"	12"	8"	1,546	2,565	B11
3/4"	3 3/8"	8"	12"	6"	1,182	-	-
3/4"	5"	8"	12"	8 3/4"	1,906	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3037 (SIMPSON STRONG-BOLT-2 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3037 (2023).
4. 4.WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

REVIEWED FOR CODE COMPLIANCE RCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

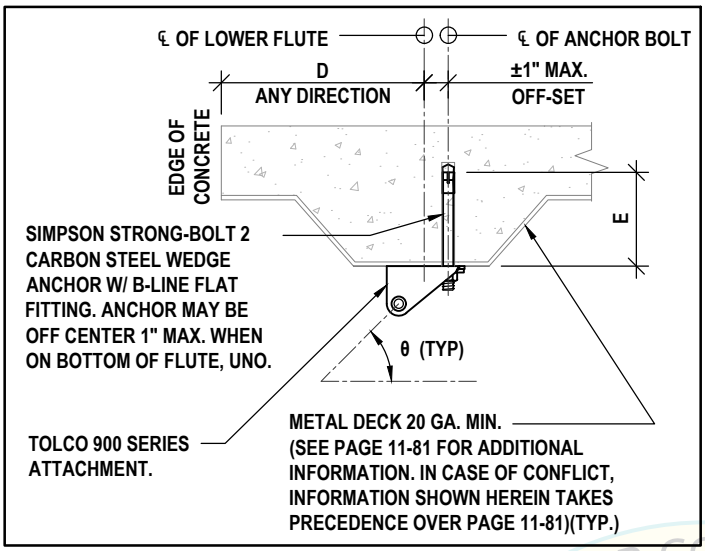
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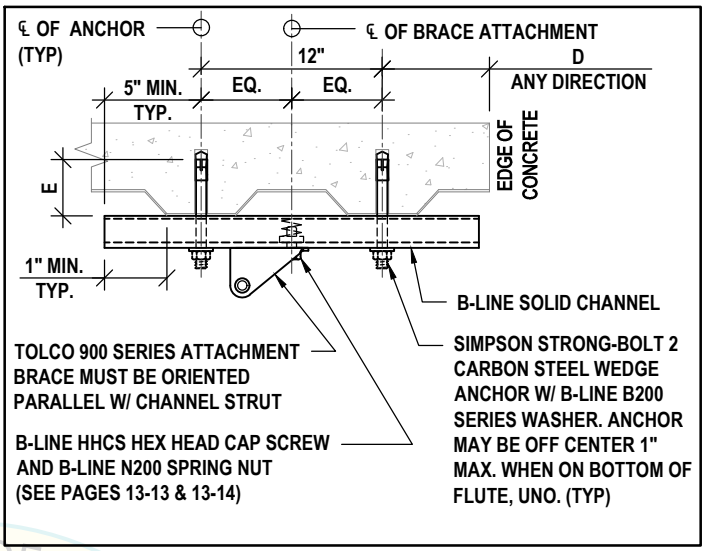
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-18

DATE: April 23, 2025

SIMPSON STRONG-BOLT 2 WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
				SINGLE			DOUBLE			
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
1/2"	2 1/4"	9"	12"	364	278	110	729	557	396	B22
1/2"	4"	9"	12"	721	538	209	994	617	473	B22
5/8"	2 3/4"	9"	12"	457	351	142	915	617	473	B11
5/8"	5"	9"	12"	1,046	769	299	994	617	473	B11

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
IAPMO
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3037 (SIMPSON STRONG-BOLT-2 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3037 (2013).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-3037 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-3037 (2023).

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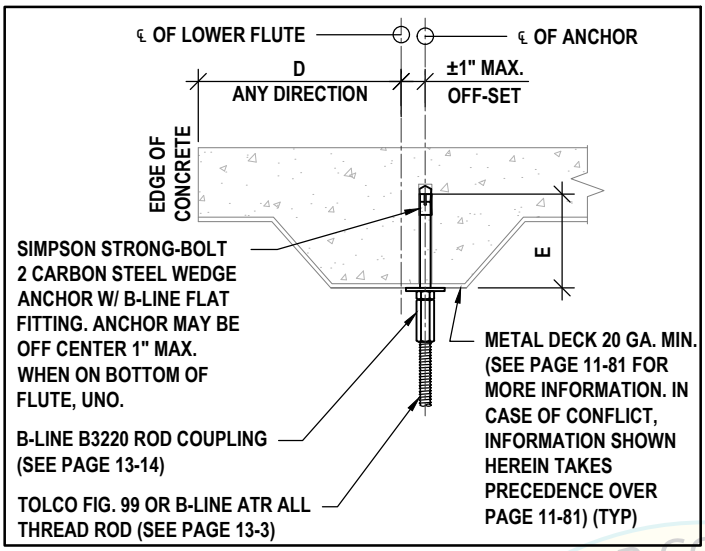
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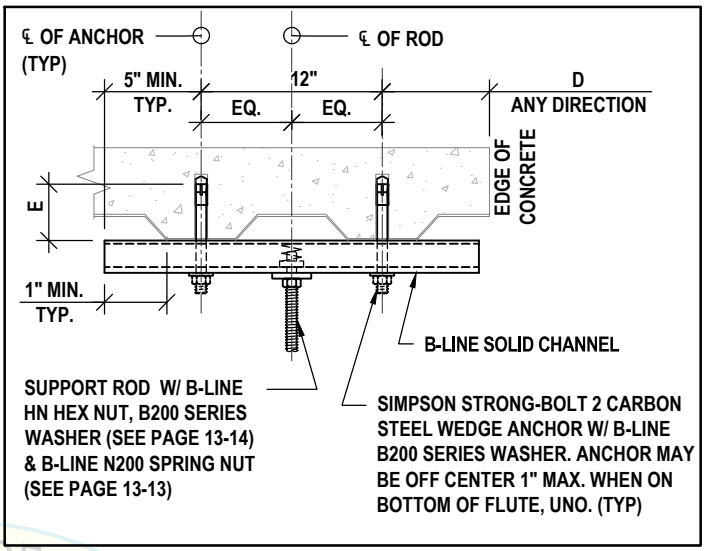
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-19

DATE: April 23, 2025

SIMPSON STRONG-BOLT 2 WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
				SINGLE	DOUBLE	
1/2"	2 1/4"	9"	12"	417	835	B22
1/2"	4"	9"	12"	746	1,493	B12
5/8"	2 3/4"	9"	12"	536	1,071	B11
5/8"	5"	9"	12"	1,022	2,044	B11

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3037 (SIMPSON STRONG-BOLT-2 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3037 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
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8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-3037(2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-3037 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS

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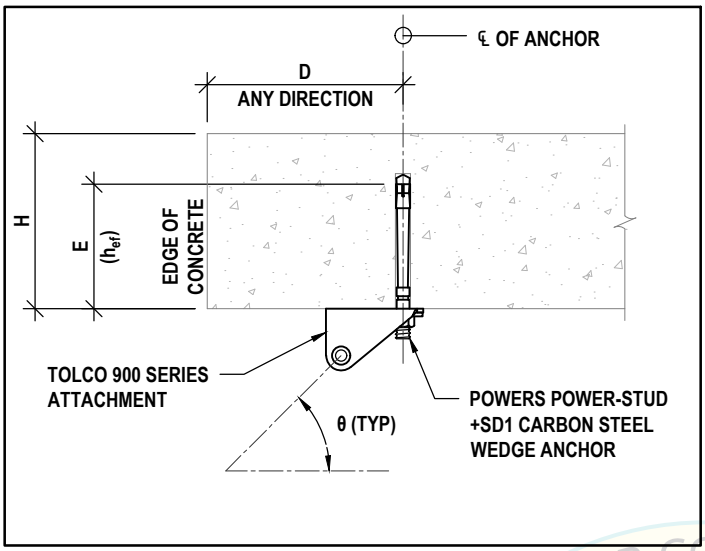
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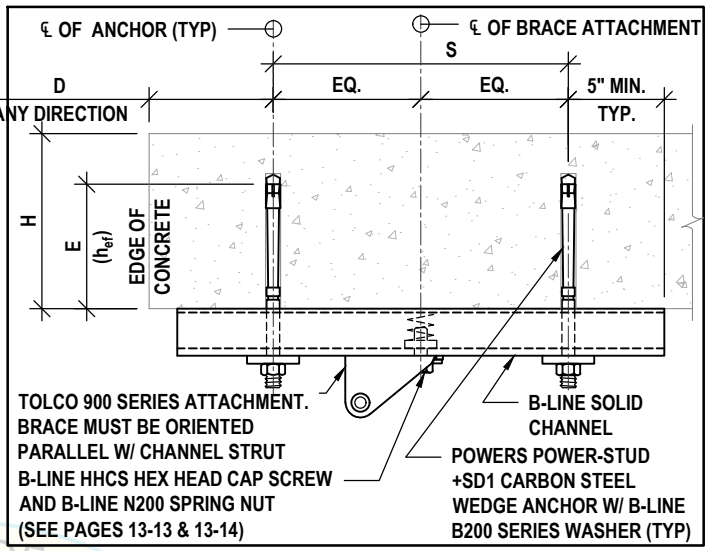
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-20

DATE: April 23, 2025

POWERS POWER-STUD +SD1 CS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	8"	12"	4"	433	34	124	867	617	452	B22
1/2"	2"	8"	12"	4"	507	381	148	994	617	473	B22
1/2"	3 1/4"	8"	12"	6"	614	443	167	994	617	473	B22
5/8"	2 3/4"	8"	12"	6"	882	650	253	994	617	473	B22
5/8"	4"	8"	12"	7"	1,009	744	290	994	617	473	B22
3/4"	3 1/8"	8"	12"	6"	1,156	880	359	994	617	473	B11
3/4"	4 3/4"	8"	12"	10"	1,600	1,244	518	994	617	473	B11

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2818 (POWERS POWER-STUD +SD1 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2818 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

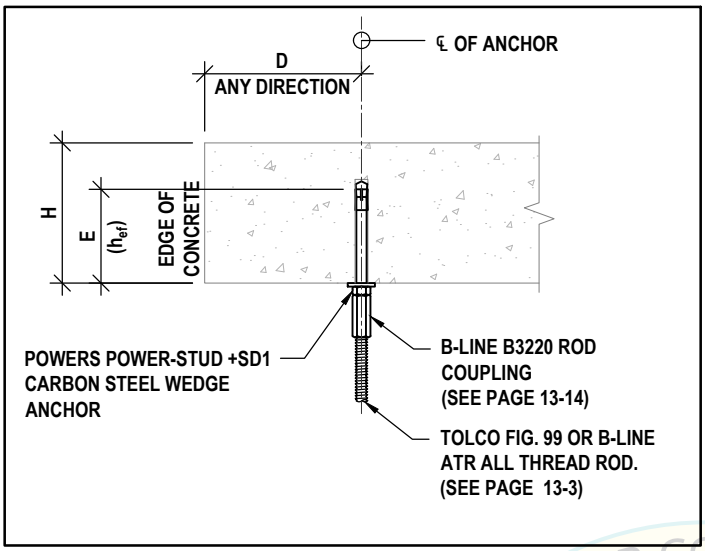
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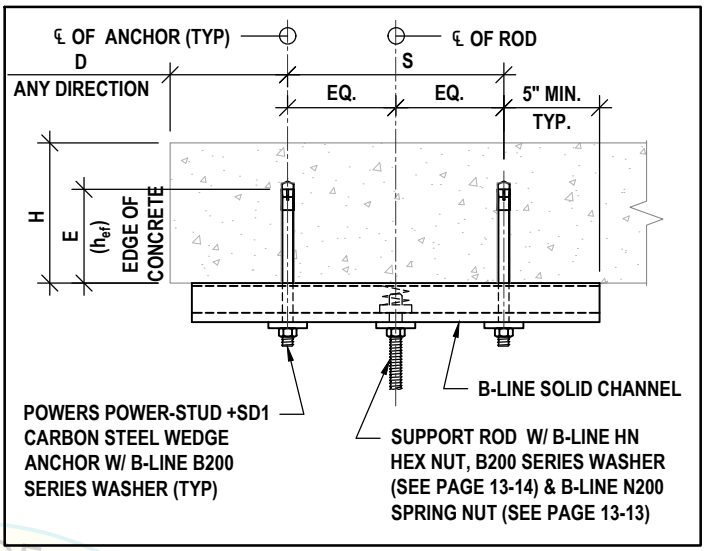
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-21

DATE: April 23, 2025

POWERS POWER-STUD +SD1 CS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	2"	8"	12"	4"	456	912	B22
1/2"	2"	8"	12"	4 1/2"	539	1,078	B22
1/2"	3 1/4"	8"	12"	6"	562	1,123	B22
5/8"	2 3/4"	8"	12"	6"	869	1,739	B11
5/8"	4"	8"	12"	8"	998	1,996	B11
3/4"	3 1/8"	8"	12"	7"	1,301	-	-
3/4"	4 3/4"	8"	12"	10"	1,974	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2818 (POWERS POWER-STUD +SD1 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2818 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

ICC-ES RECOGNIZED FOR CODE COMPLIANCE OPM-0052 REVIEWED BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

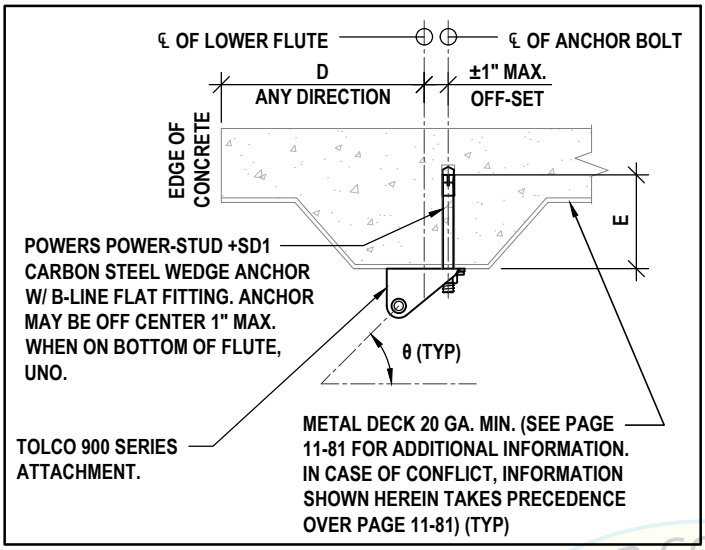
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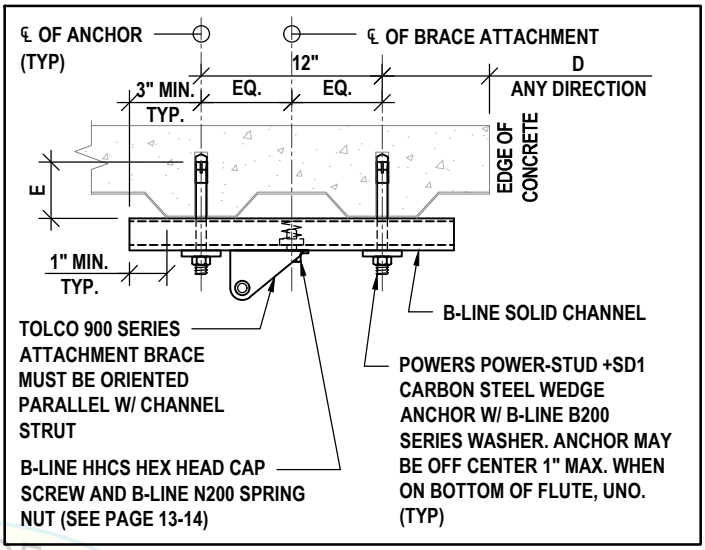
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-22

DATE: April 23, 2025

POWERS POWER-STUD +SD1 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
				SINGLE			DOUBLE			
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	9"	12"	317	227	83	634	454	304	B22
1/2"	2"	9"	12"	431	329	130	863	617	466	B22
1/2"	3 1/4"	9"	12"	431	329	130	863	617	466	B22
5/8"	2 3/4"	9"	12"	497	347	129	994	617	456	B22
5/8"	4"	9"	12"	497	347	129	994	617	456	B22
3/4"	3 1/8"	9"	12"	666	474	182	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2818 (POWERS POWER-STUD +SD1 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2818 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
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9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2818 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2818 (2023).

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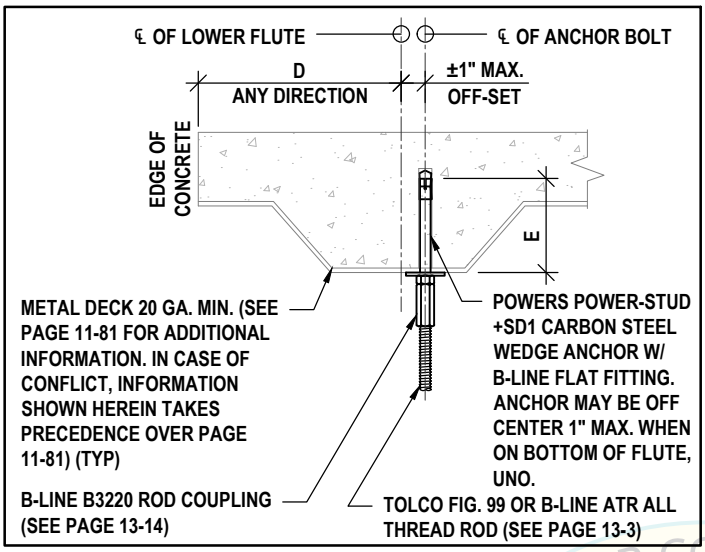
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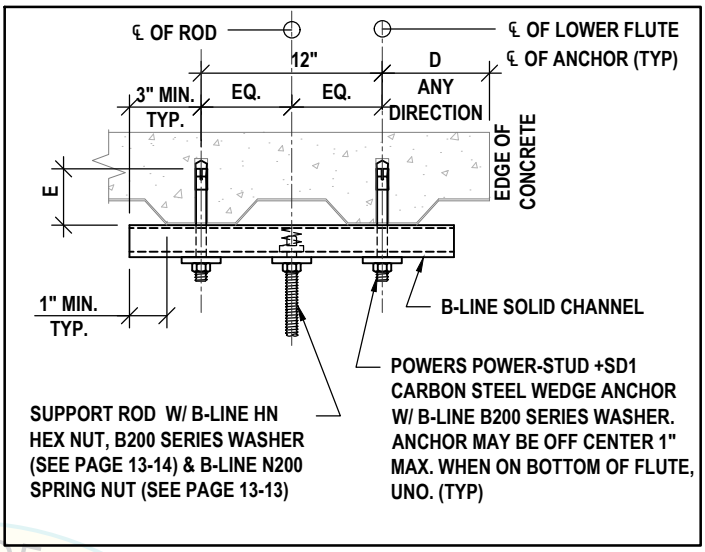
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-23

DATE: April 23, 2025

POWERS POWER-STUD +SD1 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
				SINGLE	DOUBLE	
3/8"	2"	9"	12"	281	563	B22
1/2"	2"	9"	12"	489	979	B22
1/2"	3 1/4"	9"	12"	489	979	B22
5/8"	2 3/4"	9"	12"	405	811	B22
5/8"	4"	9"	12"	405	811	B22
3/4"	3 1/8"	9"	12"	578	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2818 (POWERS POWER-STUD +SD1 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
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3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2818 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
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8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2818(2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2818 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS

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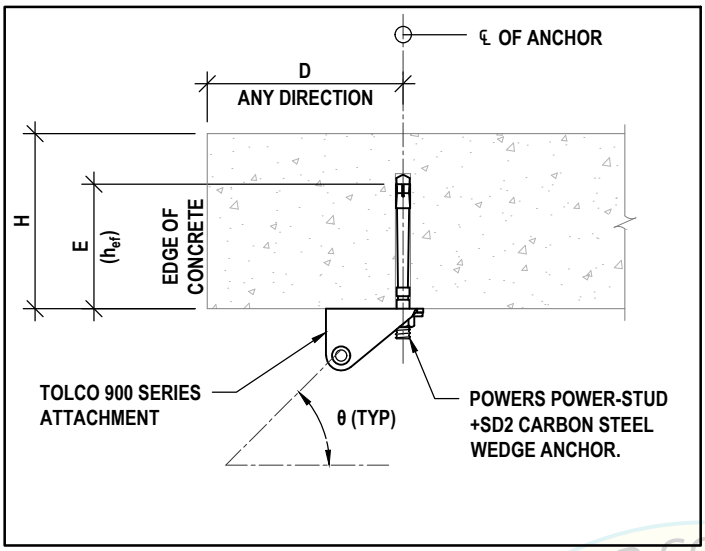
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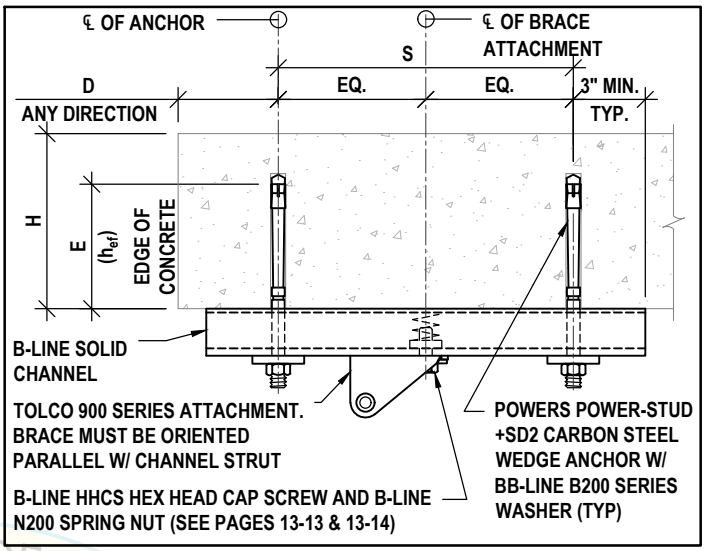
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-24

DATE: April 23, 2025

POWERS POWER-STUD +SD2 CS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	8"	12"	4"	442	332	127	884	617	464	B22
1/2"	2"	8"	12"	4 1/2"	507	381	149	994	617	473	B22
1/2"	3 1/4"	8"	12"	6"	889	674	265	994	617	473	B22
5/8"	3 1/4"	8"	12"	6"	1,009	765	306	994	617	473	B22
5/8"	4 1/4"	8"	12"	8"	1,252	990	413	994	617	473	B22
3/4"	3 3/4"	8"	12"	7"	1,212	926	379	-	-	-	-
3/4"	5"	8"	12"	10"	1,529	1,169	479	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD2 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
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10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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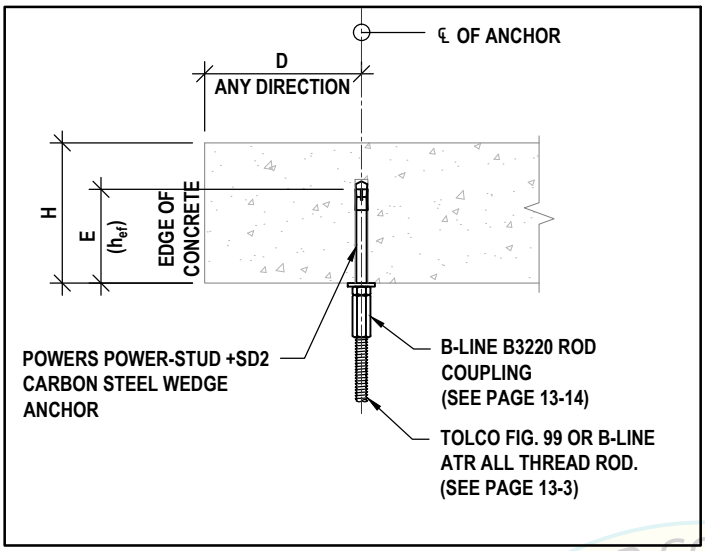
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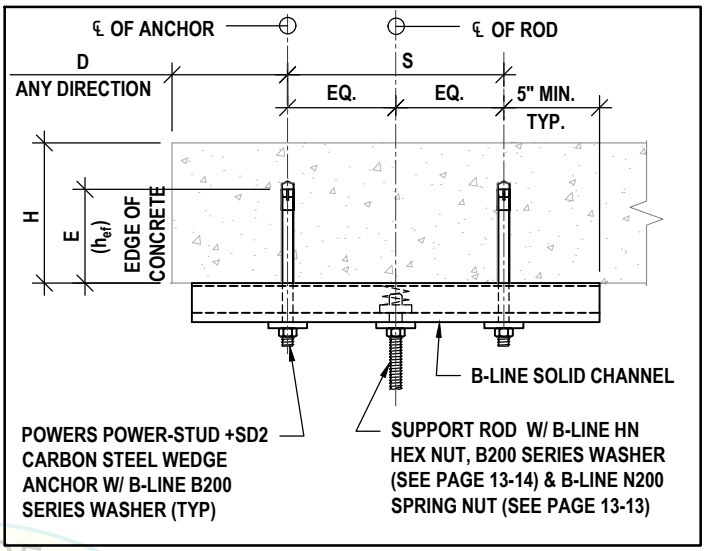
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-25

DATE: April 23, 2025

POWERS POWER-STUD +SD2 CS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	2"	8"	12"	4"	471	942	B22
1/2"	2"	8"	12"	4 1/2"	539	1,079	B22
1/2"	3 1/4"	8"	12"	6"	981	1,962	B11
5/8"	3 1/4"	8"	12"	6"	1,117	2,234	B11
5/8"	4 1/4"	8"	12"	8"	1,670	2,565	B11
3/4"	3 3/4"	8"	12"	7"	1,384	-	-
3/4"	5"	8"	12"	10"	1,748	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

ICCAi OPM-0052 REVIEWED FOR CODE COMPLIANCE BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD2 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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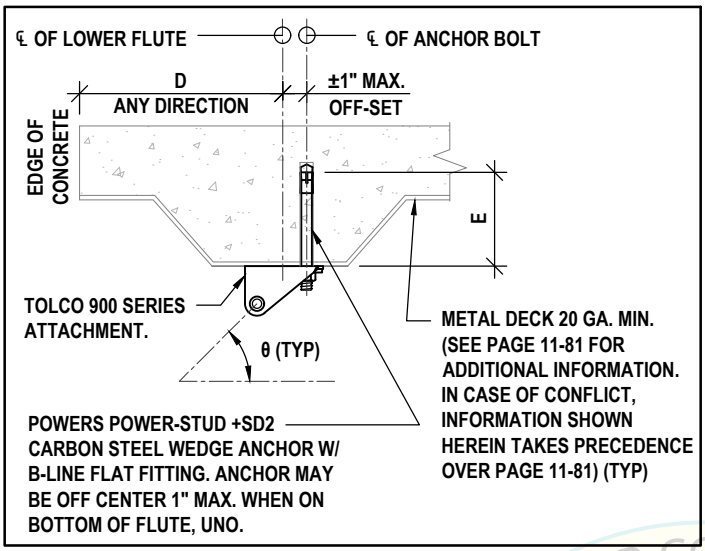
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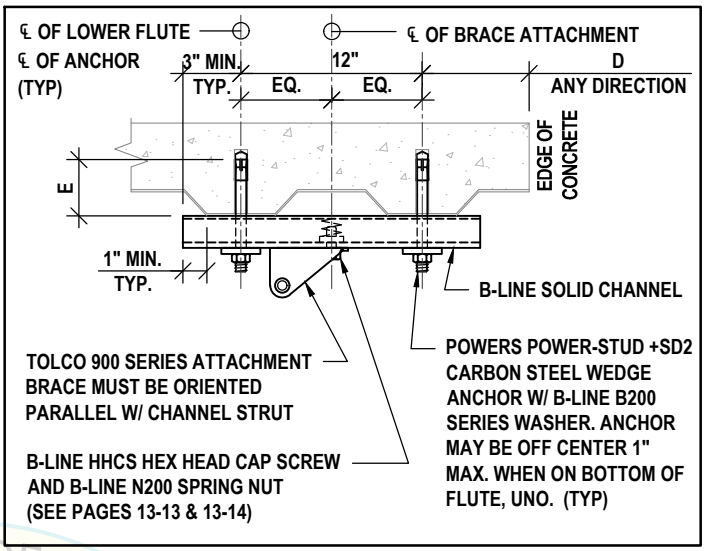
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-26

DATE: April 23, 2025

POWERS POWER-STUD +SD2 WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
				SINGLE			DOUBLE			
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	2"	9"	12"	293	217	82	586	434	300	B22
1/2"	2"	9"	12"	415	279	96	831	558	346	B22
1/2"	3 1/4"	9"	12"	662	460	168	994	617	473	B22
5/8"	3 1/4"	9"	12"	539	421	173	994	617	473	B22
5/8"	4 1/4"	9"	12"	879	681	278	994	617	473	B22
3/4"	3 3/4"	9"	12"	568	443	185	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD2 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2013).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2502 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2502 (2023).

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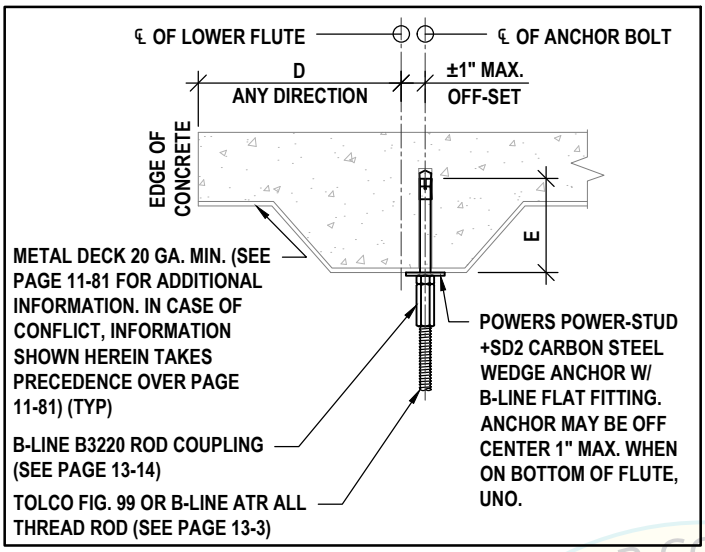
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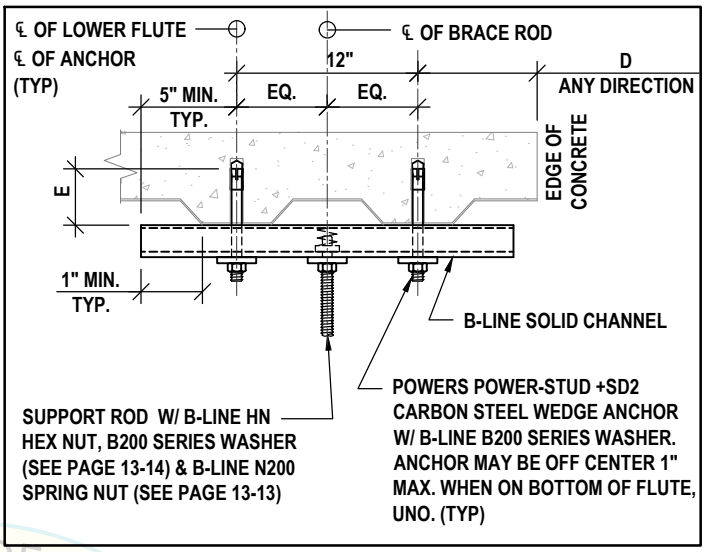
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-27

DATE: April 23, 2025

POWERS POWER-STUD +SD2 CS WEDGE ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1] SINGLE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1] DOUBLE	B-LINE SOLID CHANNEL[2]
3/8"	2"	9"	12"	296	591	B22
1/2"	2"	9"	12"	300	600	B22
1/2"	3 1/4"	9"	12"	532	1,064	B22
5/8"	3 1/4"	9"	12"	677	1,353	B11
5/8"	4 1/4"	9"	12"	1,068	2,135	B11
3/4"	3 3/4"	9"	12"	710	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD2 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2502 (2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2502 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS

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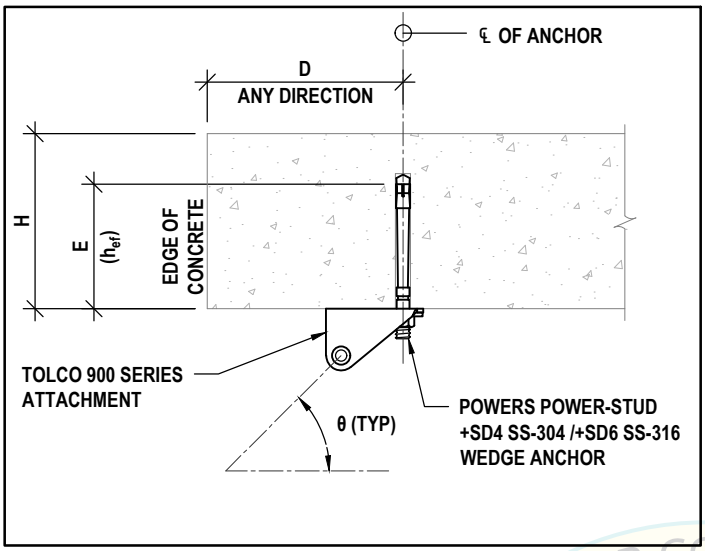
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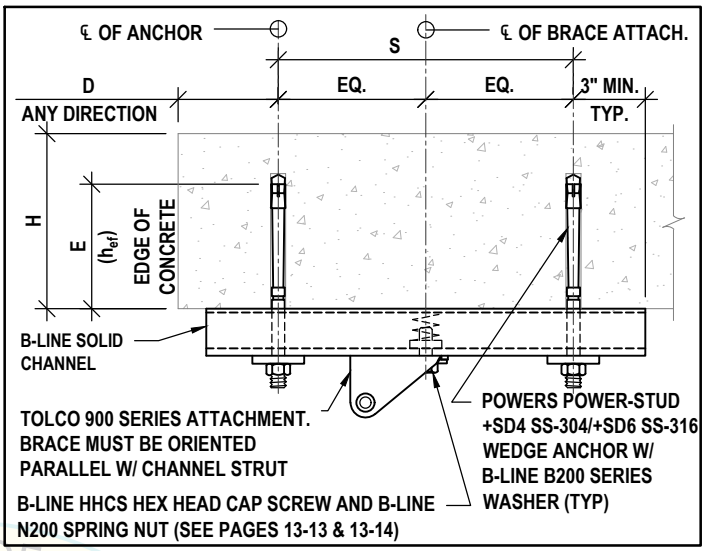
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-28

DATE: April 23, 2025

POWERS POWER-STUD +SD4/+SD6 SS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B-LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	1 1/2"	8"	12"	4"	269	211	85	538	423	309	B22
1/2"	2"	8"	12"	4"	547	424	171	994	617	473	B22
5/8"	2 3/4"	8"	12"	5"	970	736	294	994	617	473	B22
3/4"	3 3/4"	8"	12"	6"	1,254	997	424	-	-	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_0=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD4 SS-304/+SD6 SS-316 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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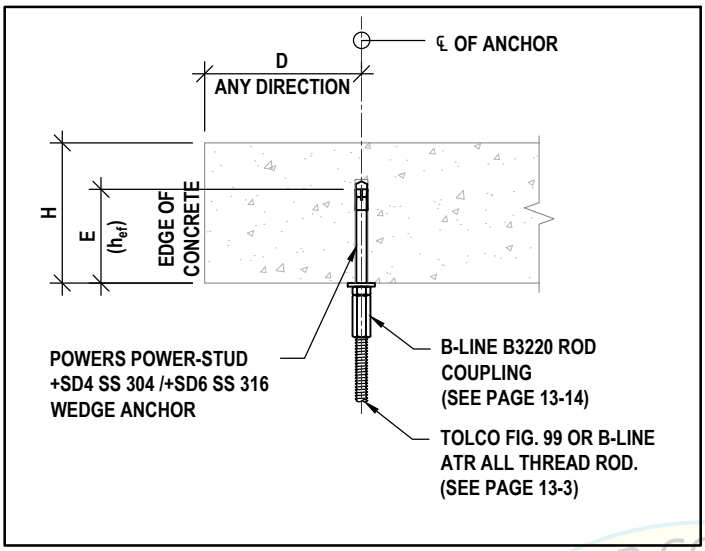
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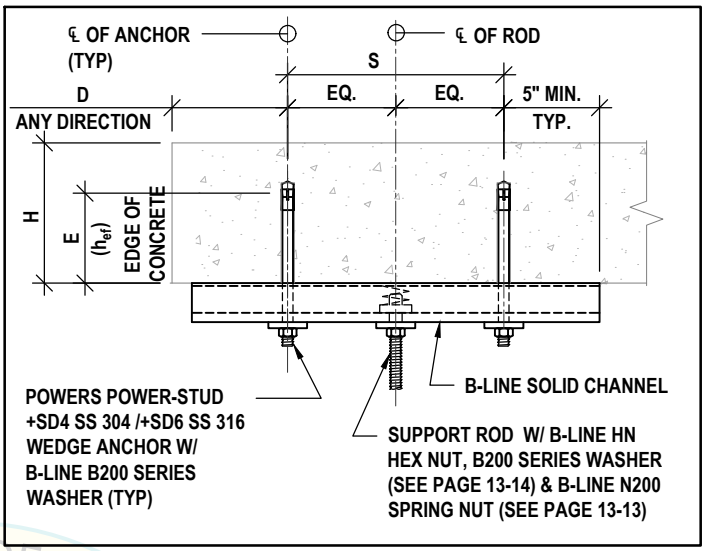
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-29

DATE: April 23, 2025

POWERS POWER-STUD +SD4/+SD6 SS WEDGE ANCHORS IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	1 1/2"	8"	12"	4"	350	700	B22
1/2"	2"	8"	12"	4"	666	1,332	B12
5/8"	2 3/4"	8"	12"	5"	1,074	2,148	B11
3/4"	3 3/4"	8"	12"	6"	1,710	-	-

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD4/+SD6 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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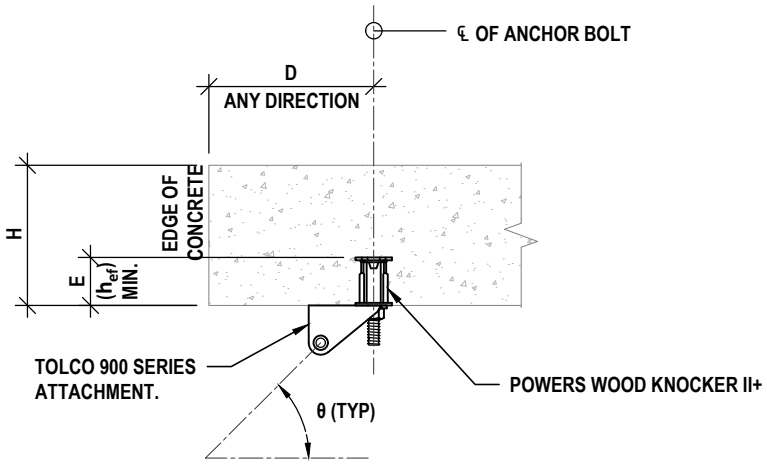
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-30

DATE: April 23, 2025

POWERS WOOD KNOCKER II+ CONCRETE INSERT IN 3,000 PSI NWC DECK FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD)		
				MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	1 3/4"	8"	3 1/2"	428	349	145
1/2"	1 3/4"	8"	3 1/2"	606	459	181
5/8"	1 3/4"	12"	3 1/2"	606	459	184
3/4"	1 3/4"	12"	3 1/2"	606	459	187

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

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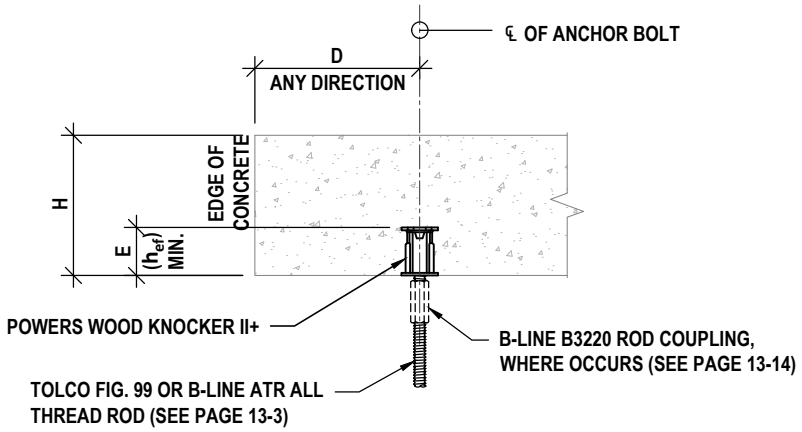
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-31

DATE: April 23, 2025

POWERS WOOD KNOCKER II+ CONCRETE INSERT IN 3,000 PSI NWC DECK FOR HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]
3/8"	1 3/4"	12"	3 1/2"	671
1/2"	1 3/4"	12"	3 1/2"	671
5/8"	1 3/4"	12"	3 1/2"	671
3/4"	1 3/4"	12"	3 1/2"	671

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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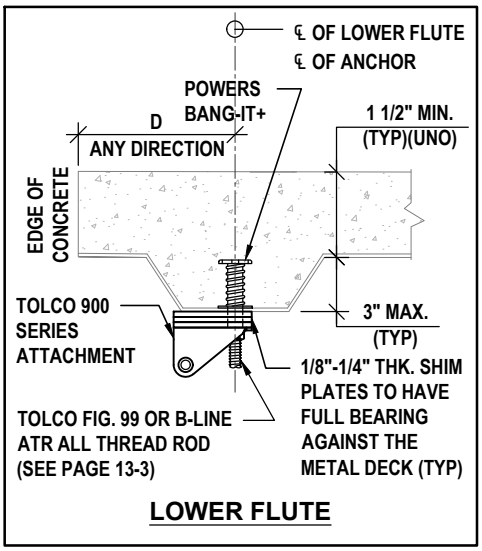
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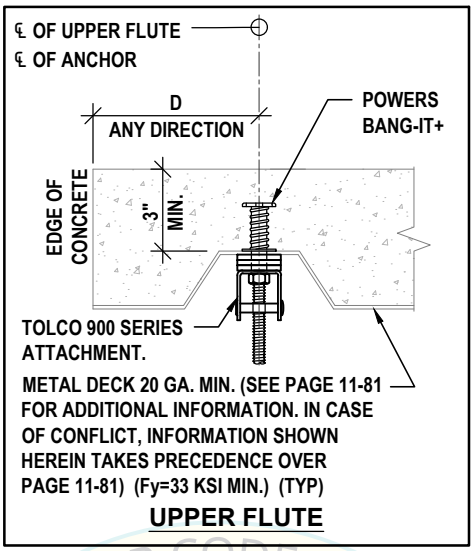
PAGE: 11-32

DATE: April 23, 2025

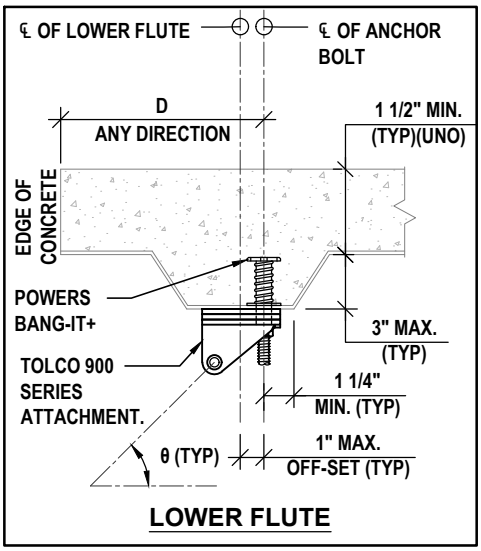
POWERS BANG-IT+ CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES



LOWER FLUTE



UPPER FLUTE



LOWER FLUTE

ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	ALLOWABLE STRESS DESIGN (ASD)					
			MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]					
			UPPER FLUTE			LOWER FLUTE		
			θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	1 3/4"	12"	386	303	121	328	244	93
1/2"	1 3/4"	12"	413	319	128	347	255	97
5/8"	1 3/4"	12"	458	347	139	376	270	103
3/4"	1 3/4"	12"	458	347	141	376	270	104

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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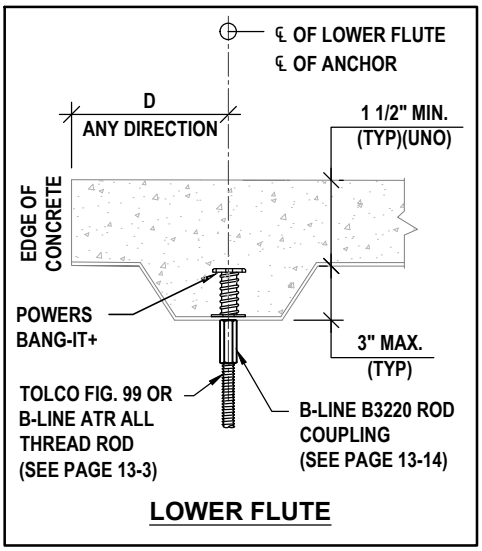
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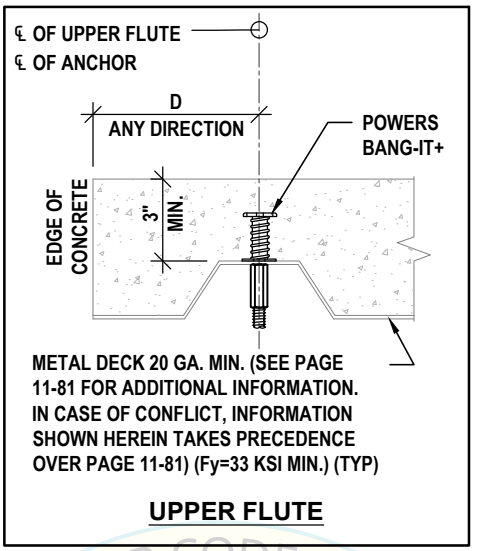
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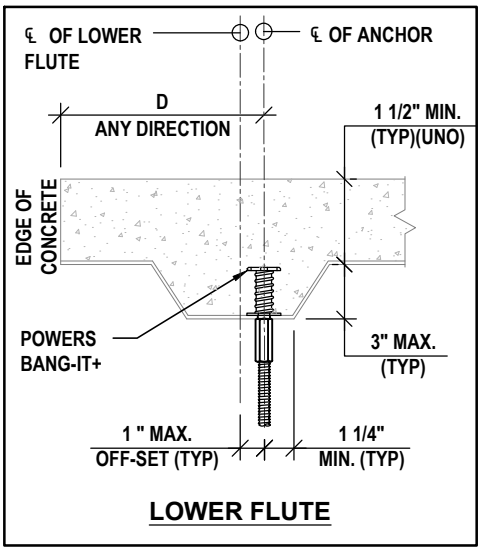
POWERS BANG-IT+ CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS



LOWER FLUTE



UPPER FLUTE



LOWER FLUTE

ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	ALLOWABLE STRENGTH DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]	
			UPPER FLUTE	LOWER FLUTE
3/8"	1 3/4"	9"	497	337
1/2"	1 3/4"	9"	497	337
5/8"	1 3/4"	9"	505	337
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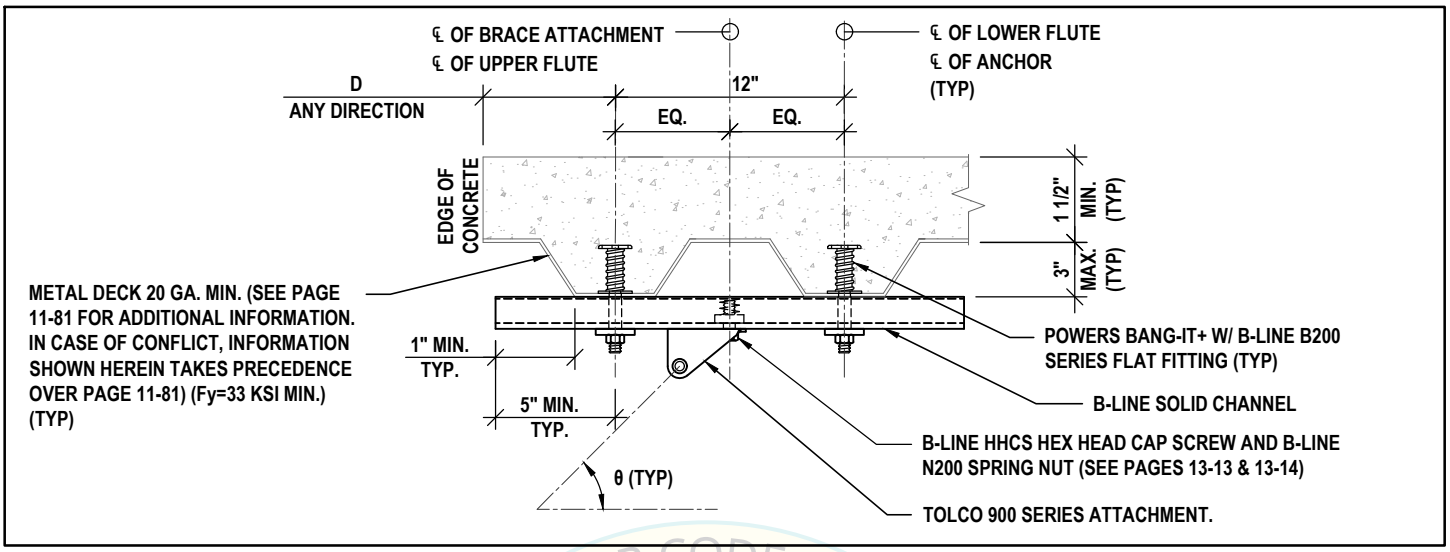
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-34

DATE: April 23, 2025

DOUBLE POWERS BANG-IT+ CONCRETE INSERT IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]			B-LINE SOLID CHANNEL[2]
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	1 3/4"	9"	12"	657	489	339	B22
1/2"	1 3/4"	9"	12"	695	510	349	B22
5/8"	1 3/4"	9"	12"	753	540	363	B22
3/4"	1 3/4"	9"	12"	753	540	363	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
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ICAT OPM-0052 REVIEWED FOR CODE COMPLIANCE BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

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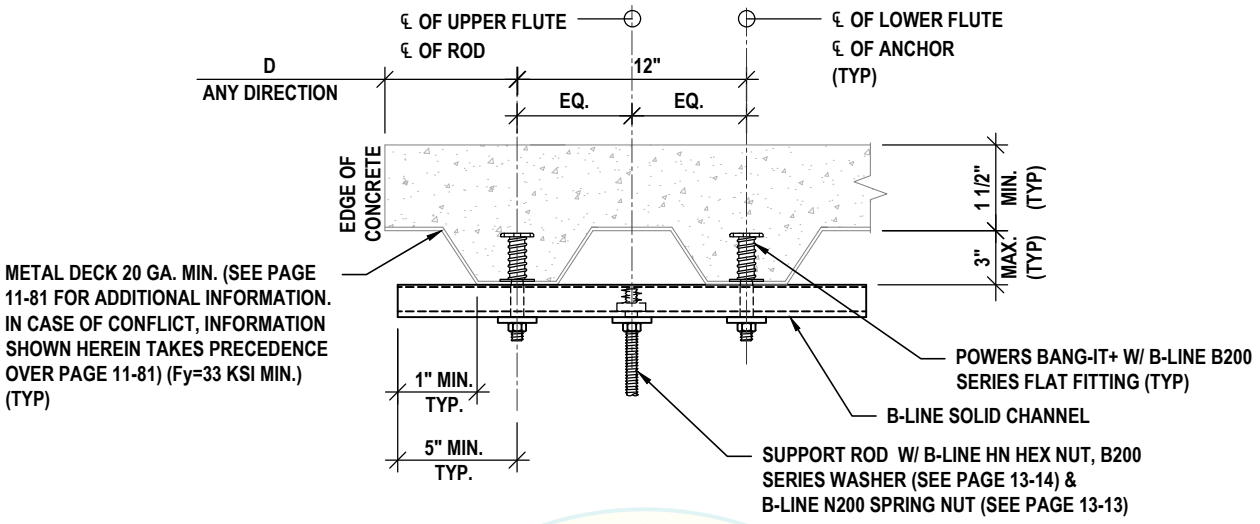
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MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-35

DATE: April 23, 2025

DOUBLE POWERS BANG-IT+ CONCRETE INSERT IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]	B-LINE SOLID CHANNEL[2]
3/8"	1 3/4"	9"	12"	675	B22
1/2"	1 3/4"	9"	12"	675	B22
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5. CALIFORNIA BUILDING CODE STATES: "ALL BOLTS SHALL BE ACCURATELY AND SECURELY SET PRIOR TO PLACEMENT OF CONCRETE..." NAILS OR SCREWS MAY BE USED. TYPICAL FOR ALL APPLICATIONS.
6. A HOLE MUST BE MADE IN THE STEEL DECK USING A STEP-DRILL, HOLE SAW, DECK PUNCH, OR EQUIVALENT IN ACCORDANCE WITH THE ANCHOR DIAMETER.
7. THE POWER BANG-IT+ PLASTIC SLEEVE MUST BE PLACED IN THE HOLE, AND FOLLOWING THIS, THE HEAD OF THE INSERT MUST BE IMPACTED WITH SUFFICIENT FORCE TO COMPRESS THE OUTER SPRING AND DRIVE THE FLARED PLASTIC FINS OF THE SLEEVE COMPLETELY THROUGH THE HOLE IN THE STEEL DECK. THE BANG-IT+ METAL BASE PLATE MAY BE SCREWED TO THE DECK FOR ADDITIONAL STABILITY (OPTIONAL).
8. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
9. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOB SITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE PER ICC ESR-3657 (POWERS BANG-IT+) REQUIREMENTS.
10. MINIMUM SPACING BETWEEN THE INSERTS SHALL BE 3 TIMES THE EMBEDMENT DEPTH OR 6 TIMES THE ANCHOR DIAMETER (WHICHEVER IS GREATER), UNLESS NOTED OTHERWISE.
11. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
12. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
13. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" OR LARGER THAN THE ANCHOR DIA.
14. ROD COUPLING DOES NOT NEED TO BE TIGHT UP AGAINST THE UNDERSIDE OF THE METAL DECK.
15. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

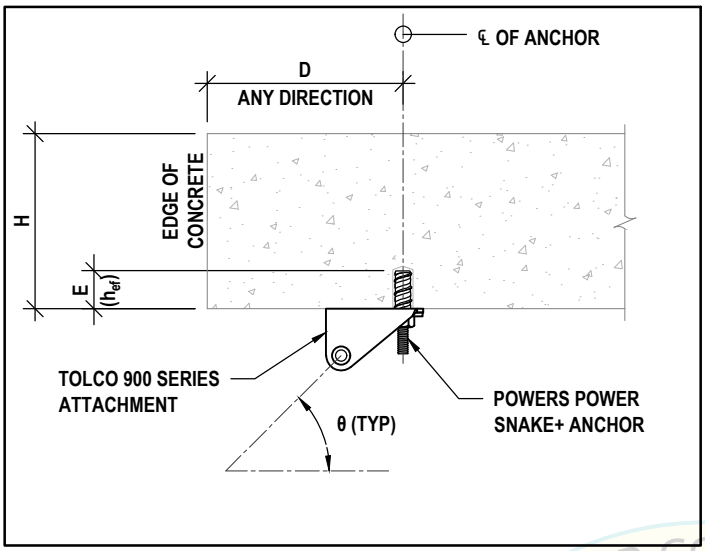
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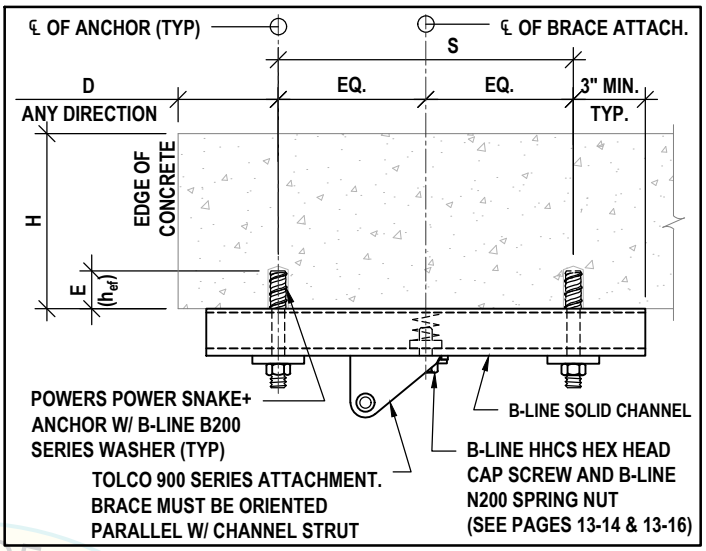
MRH
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-36

DATE: April 23, 2025

POWERS POWER SNAKE+ ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR DIA.[3]	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	1.10"	8"	12"	4"	154	123	50	308	247	184	B22
1/2"	1.54"	8"	12"	4"	339	257	101	678	514	362	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. POWERS POWER SNAKE+ ANCHORS ANCHORS SHALL BE INSTALLED PER ICC ESR-2272 BUT THE MAX TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT SHALL NOT EXCEED THE VALUES PROVIDED IN THE FOLLOWING TABLE.

ANCHOR DIA.	MAXIMUM TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT (FT-LBS)
3/8"	8
1/2"	36

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2272 (POWERS POWER SNAKE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER SNAKE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2272 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-2272 (POWERS POWER SNAKE+) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 HCAI CALIFORNIA BUILDING CODE 2022

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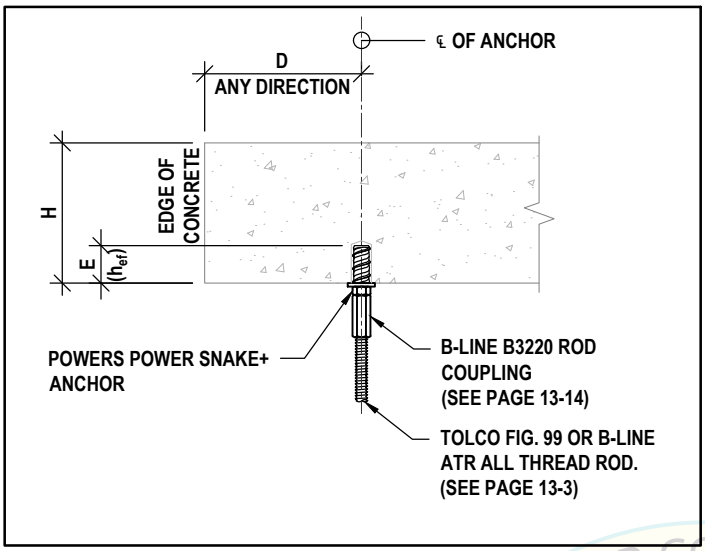
MRH

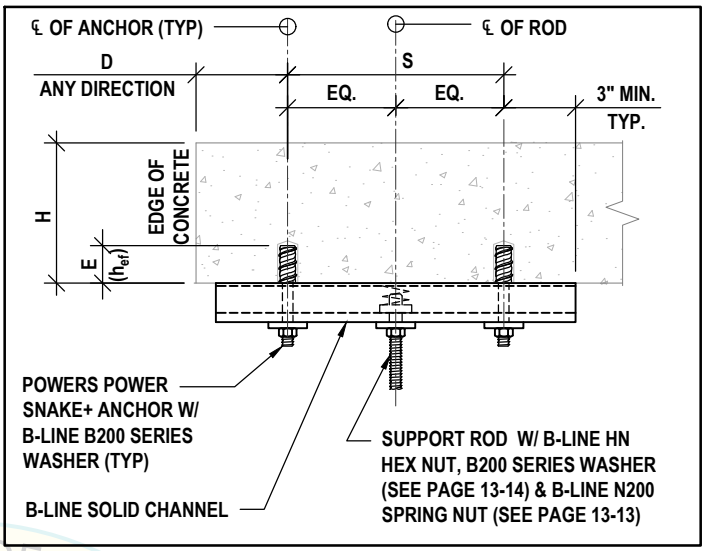
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-37

DATE: April 23, 2025

POWERS POWER SNAKE+ ANCHORS
IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA.[3]	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
3/8"	1.10"	8"	12"	4"	220	440	B22
1/2"	1.54"	8"	12"	4"	373	747	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. POWERS POWER SNAKE+ ANCHORS ANCHORS SHALL BE INSTALLED PER ICC ESR-2272 BUT THE MAX TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT SHALL NOT EXCEED THE VALUES PROVIDED IN THE FOLLOWING TABLE.

ANCHOR DIA.	MAXIMUM TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT (FT-LBS)
3/8"	8
1/2"	36

REVIEWED FOR CODE COMPLIANCE
IAPMO UES ER
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2272 (POWERS POWER SNAKE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER SNAKE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2272 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-2272 (POWERS POWER SNAKE+) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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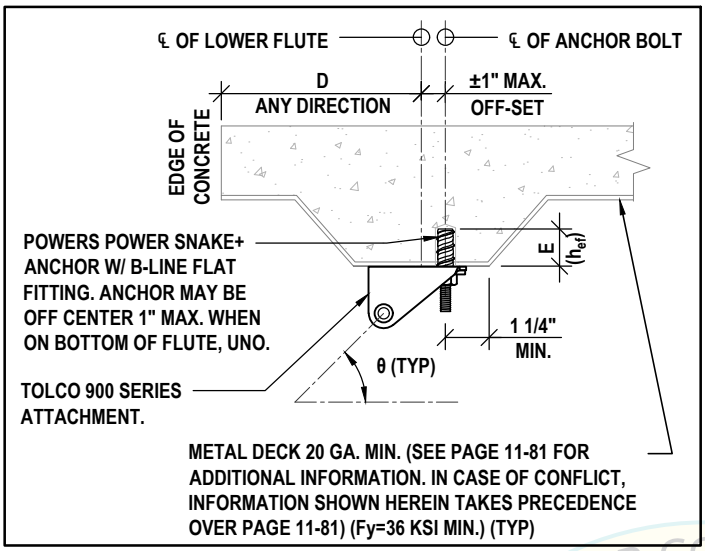
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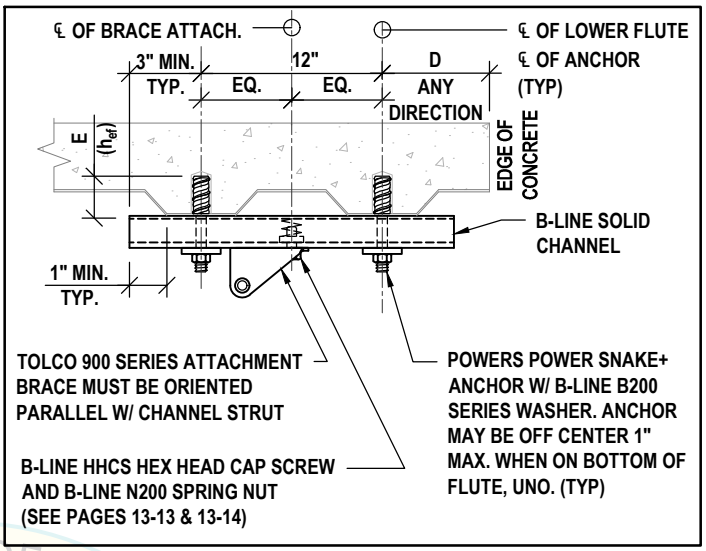
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-38

DATE: April 23, 2025

POWERS POWER SNAKE+ ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.[3]	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL LOAD BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
				SINGLE			DOUBLE			
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
3/8"	1.10"	9"	12"	154	123	50	308	247	184	B22
1/2"	1.54"	9"	12"	288	208	79	577	417	282	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. POWERS POWER SNAKE+ ANCHORS ANCHORS SHALL BE INSTALLED PER ICC ESR-2272 BUT THE MAX TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT SHALL NOT EXCEED THE VALUES PROVIDED IN THE FOLLOWING TABLE.

ANCHOR DIA.	MAXIMUM TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT (FT-LBS)
3/8"	8
1/2"	36

HCAI OPM-0052 REVIEWED FOR CODE COMPLIANCE BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2272 (POWERS POWER SNAKE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. 3.FOLLOW ALL POWERS POWER SNAKE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2272 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-2272 (POWERS POWER SNAKE+) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2272 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2272 (2023).

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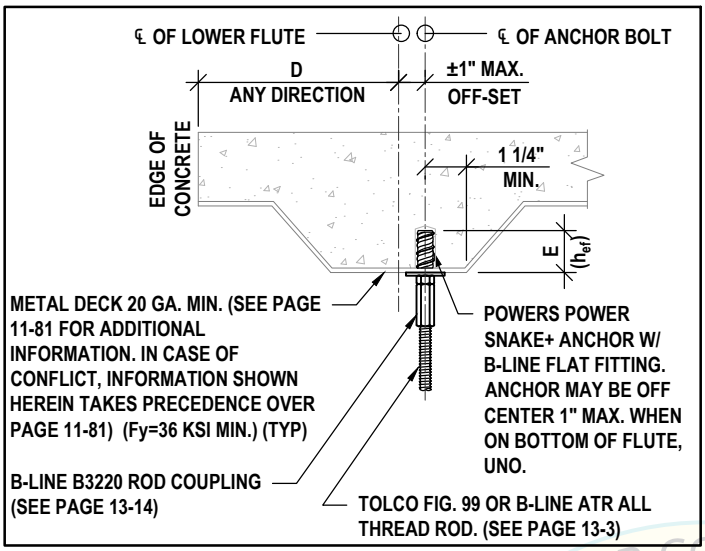
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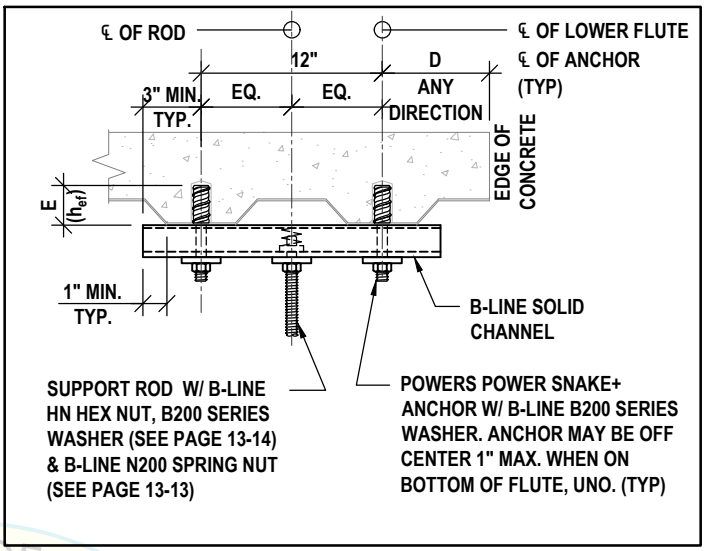
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-39

DATE: April 23, 2025

POWERS POWER SNAKE+ ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA.[3]	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
				SINGLE	DOUBLE	
3/8"	1.10"	9"	12"	220	440	B22
1/2"	1.54"	9"	12"	266	533	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. POWERS POWER SNAKE+ ANCHORS ANCHORS SHALL BE INSTALLED PER ICC ESR-2272 BUT THE MAX TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT SHALL NOT EXCEED THE VALUES PROVIDED IN THE FOLLOWING TABLE.

ANCHOR DIA.	MAXIMUM TIGHTENING TORQUE OF STEEL INSERT THREADED ROD/BOLT (FT-LBS)
3/8"	8
1/2"	36

HCAi OPM-0052 REVIEWED FOR CODE COMPLIANCE BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2272 (POWERS POWER SNAKE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER SNAKE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2272 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-2272 (POWERS POWER SNAKE+) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-2272(2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-2272 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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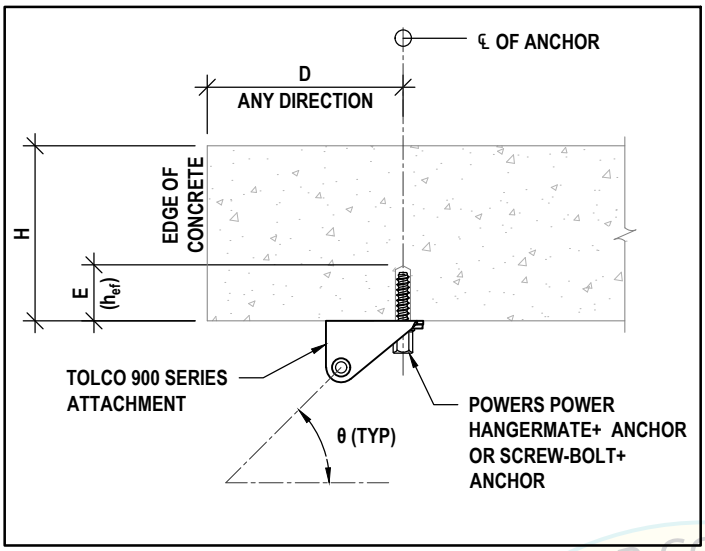
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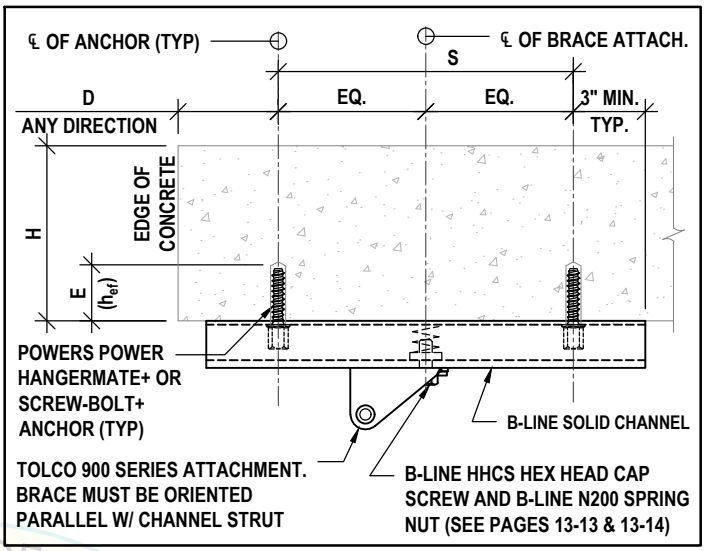
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-40

DATE: April 23, 2025

POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHORS IN 3,000 PSI NWC DECK FOR BRACES





ANCHOR		'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONC. DECK THK.	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
						SINGLE			DOUBLE			
TYPE	DIA.					θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
HANGERMATE+	3/8"[3]	1.33"	8"	12"	4"	153	120	48	306	241	177	B22
SCREW-BOLT+	3/8"	1.75"	8"	12"	4"	373	275	104	747	551	378	B22
	1/2"	2.17"	8"	12"	5"	553	411	159	995	617	473	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. THE DIAMETER OF THE SCREW IS DEFINED AS "SCREW ANCHOR BODY" PER TABLE 4 OF ICC ESR-3889.

REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3889 (POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3889 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-3889 (POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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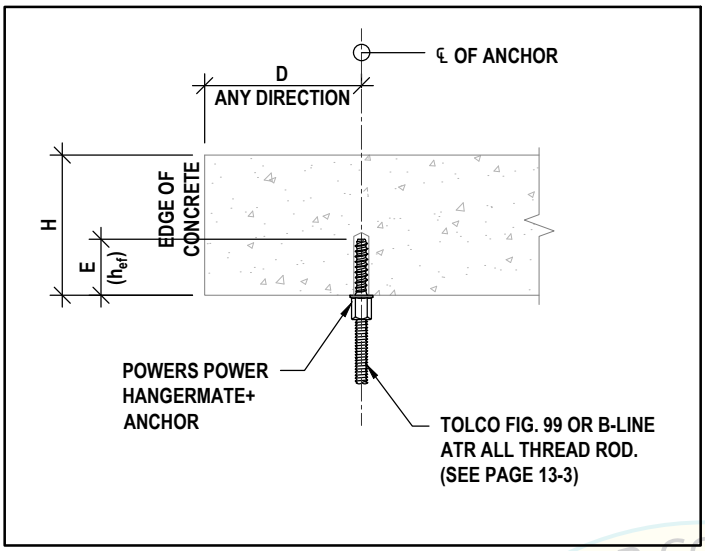
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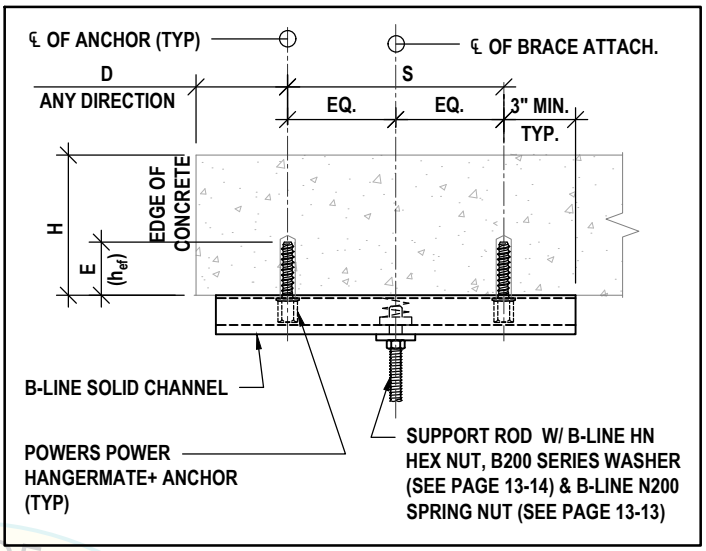
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-41

DATE: April 23, 2025

POWERS POWER HANGERMATE+ ANCHORS IN 3,000 PSI NWC DECK FOR HANGERS





ANCHOR DIA. (3)	COUPLER SIZE (UNC)	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	'H' MIN. CONCRETE DECK THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)(1)		B-LINE SOLID CHANNEL(2)
						SINGLE	DOUBLE	
1/4"	1/4" - 20	1.20"	8"	12"	4"	78	155	B22
1/4"	3/4" - 16	1.94"	8"	12"	4"	253	506	B22
3/8"	3/4" - 16	1.33"	8"	12"	4"	202	403	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. THE DIAMETER OF THE SCREW IS DEFINED AS "SCREW ANCHOR BODY" PER TABLE 4 OF ICC ESR-3889.

REVIEWED FOR CODE COMPLIANCE OPM-0052 BY: Roy Lobo 2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3889 (POWERS POWER HANGERMATE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER HANGERMATE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3889 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-3889 (POWERS POWER HANGERMATE+ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
11. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
12. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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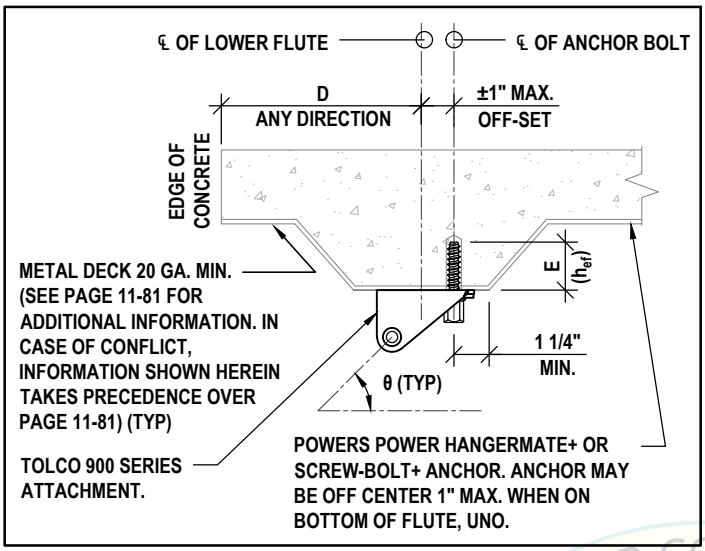
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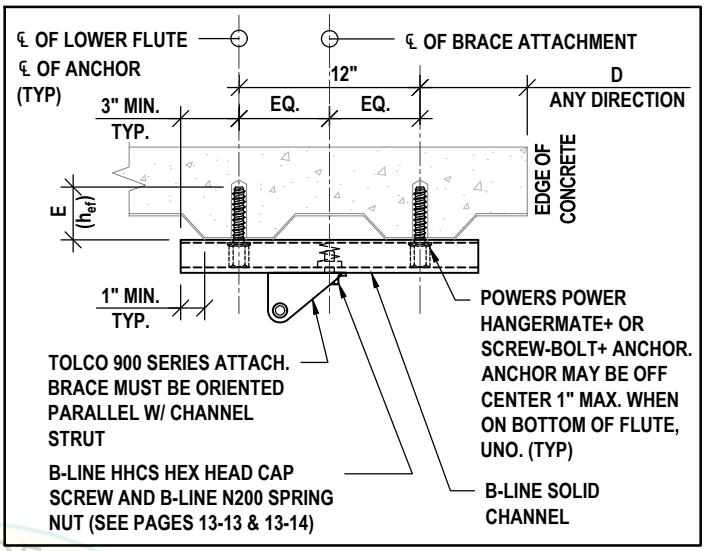
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-42

DATE: April 23, 2025

POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR		'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]						B- LINE SOLID CHANNEL[2]
					SINGLE			DOUBLE			
TYPE	DIA.				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
HANGERMATE+	3/8"[3]	1.33"	9"	12"	164	124	48	329	249	176	B22
SCREW-BOLT+	3/8"	1.75"	9"	12"	313	233	88	626	466	323	B22
	1/2"	2.17"	9"	12"	386	300	121	772	601	434	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. THE DIAMETER OF THE SCREW IS DEFINED AS "SCREW ANCHOR BODY" PER TABLE 4 OF ICC ESR-3889.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 4/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3889 (POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3889 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-3889 (POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
11. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-3889 (2023).
12. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-3889 (2023).

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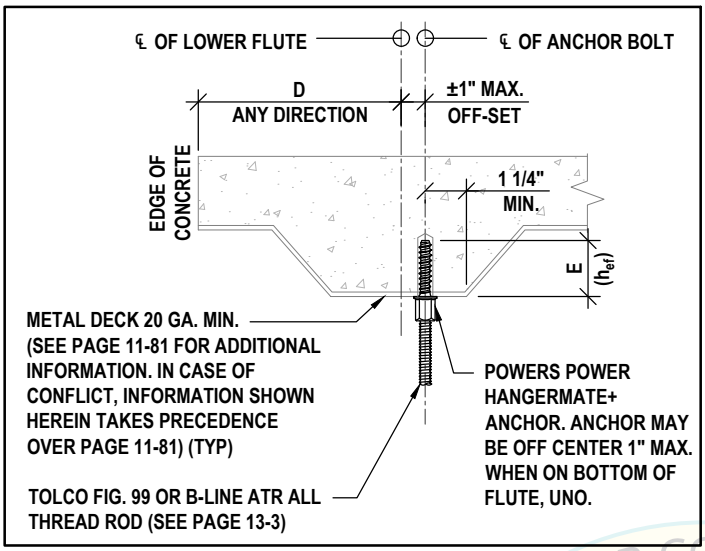
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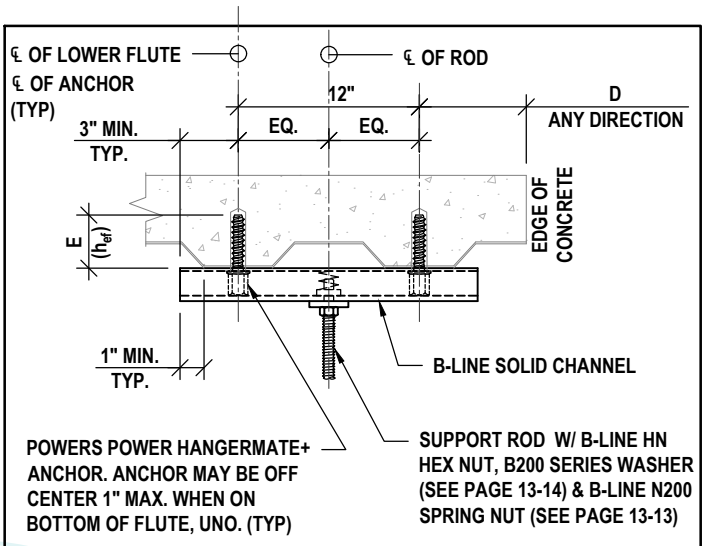
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-43

DATE: April 23, 2025

POWERS POWER HANGERMATE+ ANCHOR
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS





ANCHOR DIA. [3]	COUPLER SIZE (UNC)	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 16")	ALLOWABLE STRESS DESIGN (ASD) MAX. VERTICAL LOAD (LBS)[1]		B-LINE SOLID CHANNEL[2]
					SINGLE	DOUBLE	
1/4"	1/4" - 20	1.20"	9"	12"	59	118	B22
1/4"	3/4" - 16	1.94"	9"	12"	188	376	B22
3/8"	3/4" - 16	1.33"	9"	12"	182	364	B22

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
2. SOLID CHANNEL HOLE SIZE SHALL NOT BE LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. THE DIAMETER OF THE SCREW IS DEFINED AS "SCREW ANCHOR BODY" PER TABLE 4 OF ICC ESR-3889.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3889 (POWERS POWER HANGERMATE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL POWERS POWER HANGERMATE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3889 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, AND ANCHOR EMBEDMENT PER ICC ESR-3889 (POWERS POWER HANGERMATE+ ANCHOR) REQUIREMENTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. MINIMUM CONCRETE THICKNESS SHALL BE IN COMPLIANCE WITH ICC ESR-3889 (2023).
11. HOLE DIAMETER THROUGH METAL DECKS SHALL NOT EXCEED ANCHOR HOLE DIAMETER AS REQUIRED BY ICC ESR-3889 (2023).
12. HANGER ROD DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE ANCHOR DIAMETER.
13. IF ALLOWABLE LOAD FOR ONE ANCHOR IS USED, HANGER ROD MAY BE OFF CENTER WHEN USING TWO ANCHORS WITH STRUT.
14. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.

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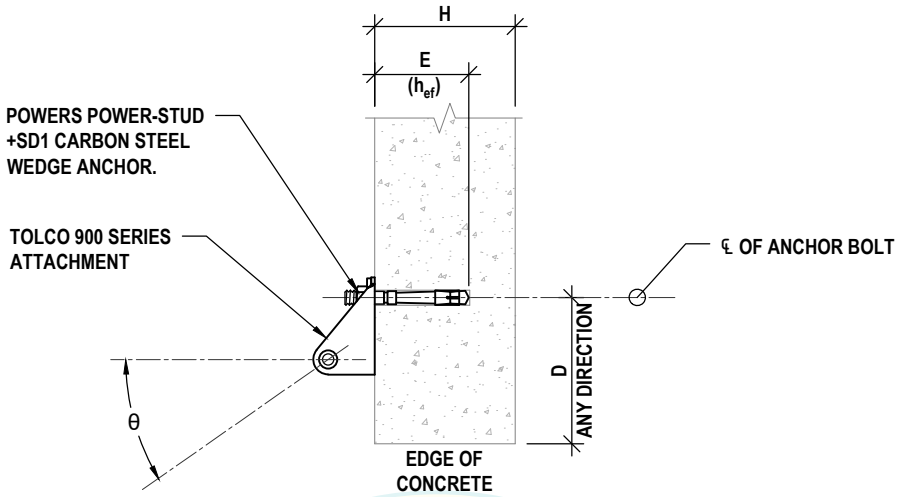
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-44

DATE: April 23, 2025

POWERS POWER-STUD +SD1 CS WEDGE ANCHORS IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2"	8"	4"	376	324	250
1/2"	2"	8"	4"	452	381	293
1/2"	3 1/4"	8"	6"	508	443	354
5/8"	2 3/4"	8"	6"	773	650	509
5/8"	4"	8"	7"	885	744	582
3/4"	3 1/8"	8"	6"	1,079	880	667
3/4"	4 3/4"	8"	10"	1,557	1,244	924

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2818 (POWERS POWER-STUD +SD1 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-82 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2818 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-82 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" OR LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM 0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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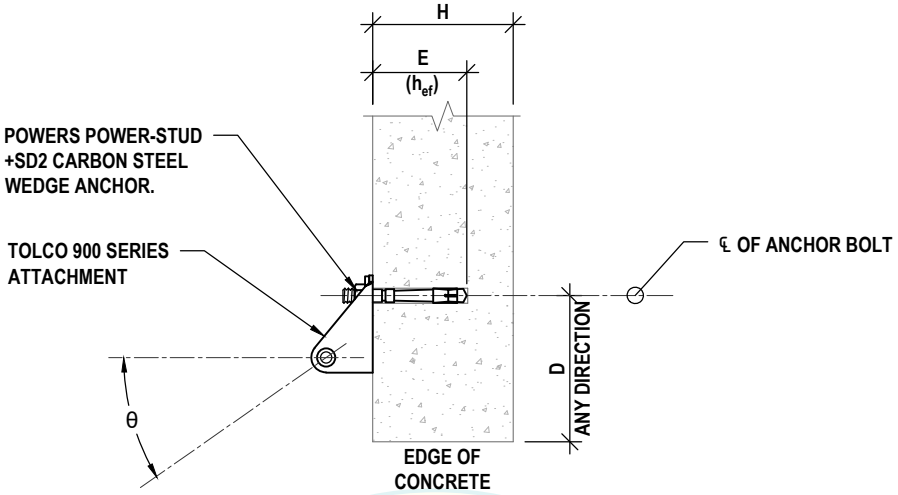
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-45

DATE: April 23, 2025

POWERS POWER-STUD +SD2 CS WEDGE ANCHORS IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2"	8"	4"	385	332	255
1/2"	2"	8"	4.5"	452	381	293
1/2"	3 1/4"	8"	6"	806	673	513
5/8"	2 3/4"	8"	6"	934	765	582
5/8"	4"	8"	8"	1,259	990	722
3/4"	3 1/4"	8"	7"	1,139	926	699
3/4"	4 3/4"	8"	10"	1,437	1,168	882

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD2 CS ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-81 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
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8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM 0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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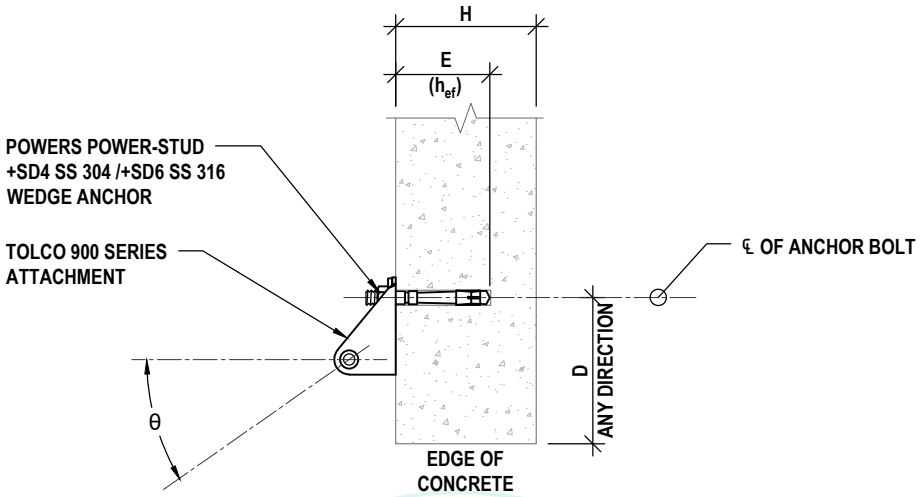
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-46

DATE: April 23, 2025

POWERS POWER-STUD +SD4/+SD6 SS WEDGE ANCHORS IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD)		
				MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	1 1/2"	8"	4"	256	211	155
1/2"	2"	8"	4"	519	424	316
5/8"	2 3/4"	8"	5"	899	736	560
3/4"	4 1/2"	8"	6"	1,273	997	724

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAI
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2502 (POWERS POWER-STUD +SD4/+SD6 ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-81 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2502 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. SEE PAGE 11-81 FOR SUBMITTAL OF TEST REPORT OF THE RESULTS.
8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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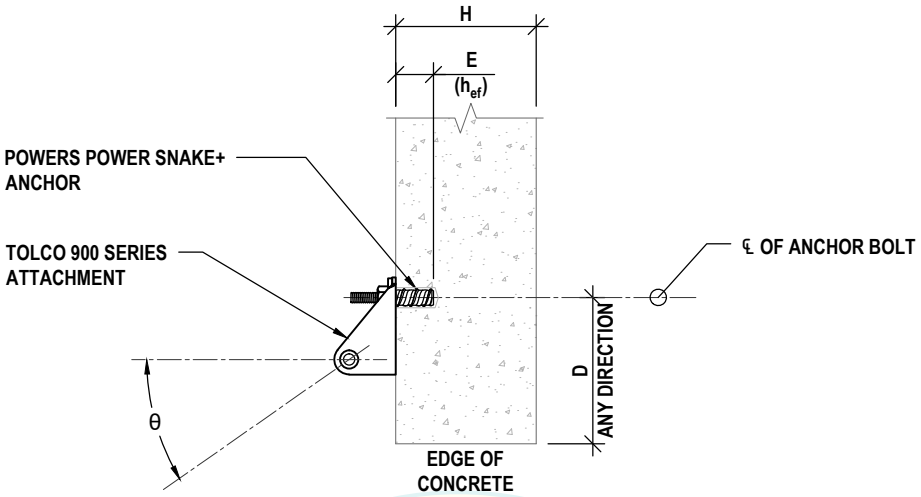
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-47

DATE: April 23, 2025

POWERS POWER SNAKE+ ANCHORS
IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBEDMENT DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD)		
				MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	1.10"	8"	4"	152	123	89
1/2"	1.54"	8"	4"	307	257	195

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAI
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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-2272 (POWERS POWER SNAKE+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS
3. FOLLOW ALL POWERS POWER SNAKE+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-2272 (2023).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
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8. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
9. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
10. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

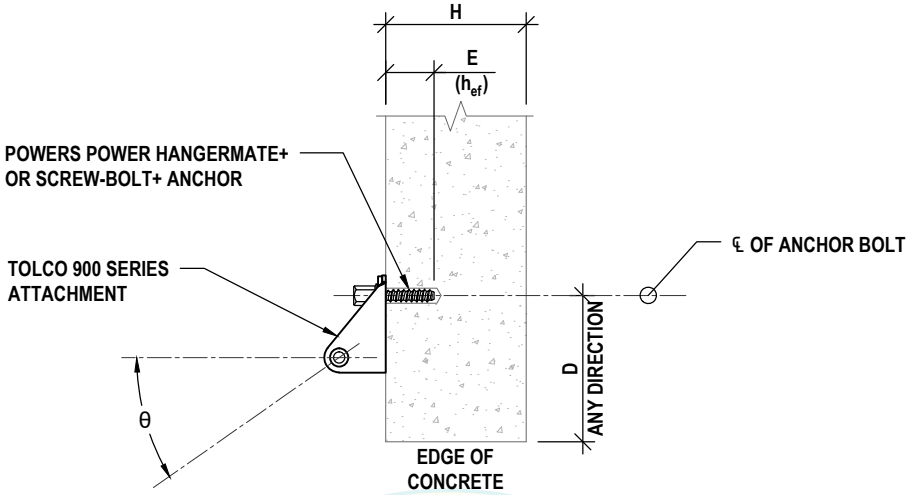
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California SE No. S3545

PAGE: 11-48

DATE: April 23, 2025

POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHORS IN 3,000 PSI NWC WALL / BEAM FOR BRACES



ANCHOR		'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BEAM THICKNESS	ALLOWABLE STRESS DESIGN (ASD)		
					MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
TYPE	DIA.				θ = 30°	θ = 31°- 45°	θ = 46°- 60°
HANGERMATE+	3/8"	1.33"	8"	4"	147	120	88
SCREW-BOLT+	3/8"	1.75"	8"	4"	314	275	215
	1/2"	2.17"	8"	5"	483	411	319

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-3889 (POWERS POWER
2. HANGERMATE+/SCREW-BOLT+ ANCHOR) FOR ANCHORS IN **CRACKED CONCRETE**. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
3. TENSION TEST SHALL BE PERFORMED FOR 100% OF THE DISPLACEMENT-CONTROLLED ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE 11-83 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS
4. FOLLOW ALL POWERS POWER HANGERMATE+/SCREW-BOLT+ ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-3889 (2023).
5. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
6. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
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9. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
10. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
11. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.

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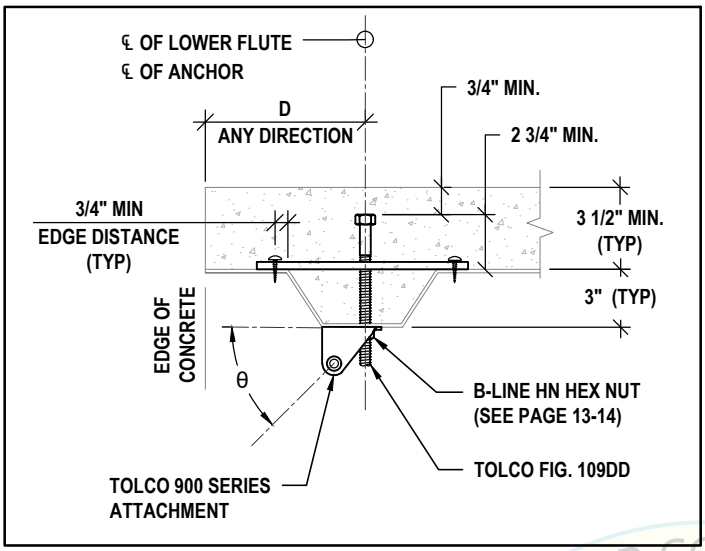
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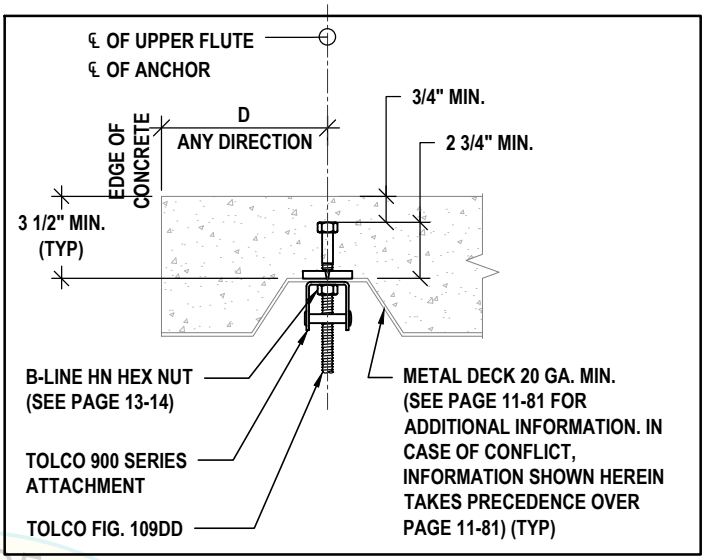
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-49

DATE: April 23, 2025

TOLCO FIG. 109DD CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES





ANCHOR DIA.	'E' MIN. ANCHOR EMBEDMENT DEPTH ABOVE UPPER FLUTE	'D' MIN. EDGE DISTANCE	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
			θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2 1/2"	12"	510	389	140
1/2"	2 1/2"	12"	757	530	165
5/8"	2 1/2"	12"	928	602	169

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE.
2. CALIFORNIA BUILDING CODE STATES: "ALL BOLTS SHALL BE ACCURATELY AND SECURELY SET PRIOR TO PLACEMENT OF CONCRETE" FASTENERS OR JAMB NUT MAY BE USED. TYPICAL FOR ALL APPLICATIONS.
3. MOUNTING HOLES ARE STANDARD. IF THE PLATE IS NOT MECHANICALLY SECURED TO THE DECK RIBS A JAMB NUT IS REQUIRED TO PREVENT THE ANCHOR BOLT FROM LAYING OVER WHEN CONCRETE IS POURED.
4. THE MOUNTING PLATE AND SCREWS USED TO ATTACH THE MOUNTING PLATE TO THE STEEL DECK ARE MEANS TO KEEP THE INSERT IN PLACE DURING CONSTRUCTION. THE MOUNTING PLATE AND SCREWS ARE NOT A STRUCTURAL PART OF THE INSERT. ALTERNATE MEANS MAY BE USED TO HOLD THE INSERT IN PLACE DURING CONSTRUCTION.
5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
6. SPECIAL INSPECTION SHALL BE PROVIDED PER SECTION 1705.1 AND TABLE 1705.3 OF 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS AND ANCHOR EMBEDMENT.
7. MINIMUM SPACING BETWEEN INSERTS SHALL BE 3 TIMES THE EMBEDMENT DEPTH OR 12 TIMES THE ANCHOR DIAMETER (WHICH EVER IS GREATER), UNLESS NOTED OTHERWISE.
8. TOLCO FIGURE 109DD IS A CAST-IN-SPECIALLY INSERT AND COMPLIES WITH CHAPTER 17 OF ACI 318-19 AND DOES NOT REQUIRE ADDITIONAL TESTING -CERTIFICATION.
9. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
10. 20GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_Y = 50 KSI.
11. INSERT SHALL NOT BE INSTALLED AT THE INCLINE BOTTOM FLUTE OF THE DECK.

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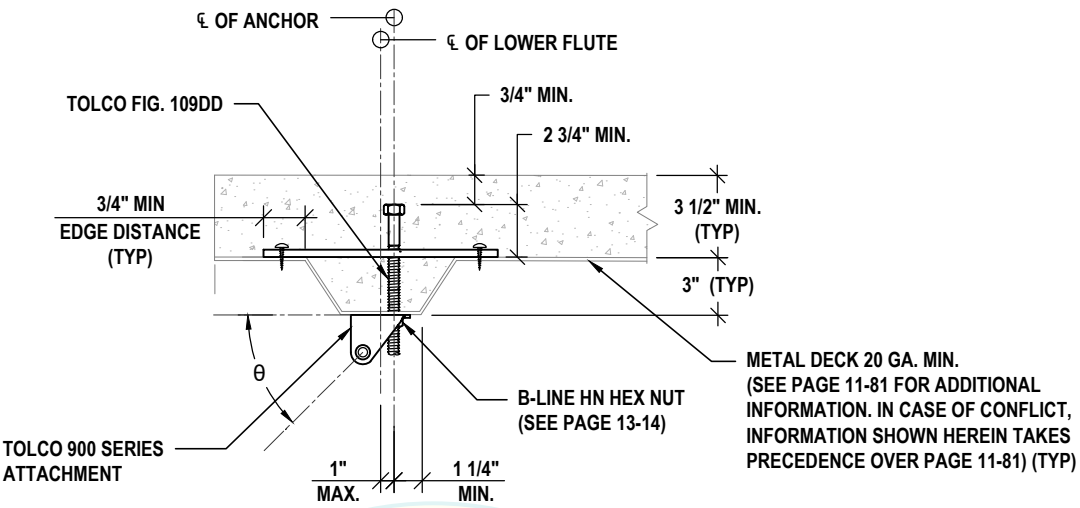
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-50

DATE: April 23, 2025

TOLCO FIG. 109DD CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR BRACES



ANCHOR DIA.	'E' MIN. ANCHOR EMBEDMENT DEPTH ABOVE UPPER FLUTE	'D' MIN. EDGE DISTANCE	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
			θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	2 1/2"	12"	439	321	124
1/2"	2 1/2"	12"	618	416	144
5/8"	2 1/2"	12"	721	455	146

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

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DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE.
2. CALIFORNIA BUILDING CODE STATES: "ALL BOLTS SHALL BE ACCURATELY AND SECURELY SET PRIOR TO PLACEMENT OF CONCRETE" FASTENERS OR JAMB NUT MAY BE USED. TYPICAL FOR ALL APPLICATIONS.
3. MOUNTING HOLES ARE STANDARD. IF THE PLATE IS NOT MECHANICALLY SECURED TO THE DECK RIBS A JAMB NUT IS REQUIRED TO PREVENT THE ANCHOR BOLT FROM LAYING OVER WHEN CONCRETE IS POURED.
4. THE MOUNTING PLATE AND SCREWS USED TO ATTACH THE MOUNTING PLATE TO THE STEEL DECK ARE MEANS TO KEEP THE INSERT IN PLACE DURING CONSTRUCTION. THE MOUNTING PLATE AND SCREWS ARE NOT A STRUCTURAL PART OF THE INSERT. ALTERNATE MEANS MAY BE USED TO HOLD THE INSERT IN PLACE DURING CONSTRUCTION.
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7. MINIMUM SPACING BETWEEN INSERTS SHALL BE 3 TIMES THE EMBEDMENT DEPTH OR 12 TIMES THE ANCHOR DIAMETER (WHICH EVER IS GREATER), UNLESS NOTED OTHERWISE.
8. TOLCO FIGURE 109DD IS A CAST-IN-SPECIALTY INSERT AND COMPLIES WITH CHAPTER 17 OF ACI 318-19 AND DOES NOT REQUIRE ADDITIONAL TESTING -CERTIFICATION.
9. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
10. 20GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_y = 50 KSI.
11. INSERT SHALL NOT BE INSTALLED AT THE INCLINE BOTTOM FLUTE OF THE DECK.

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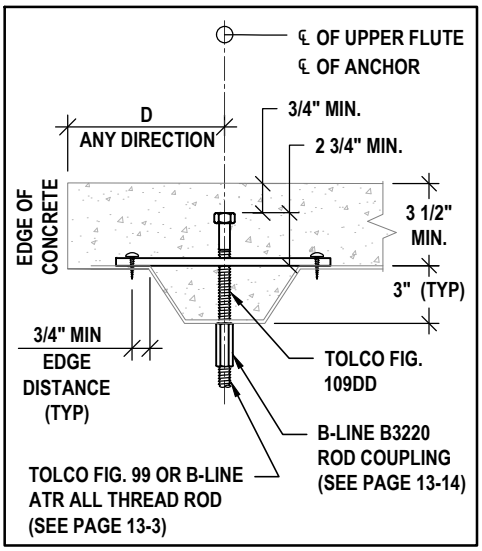
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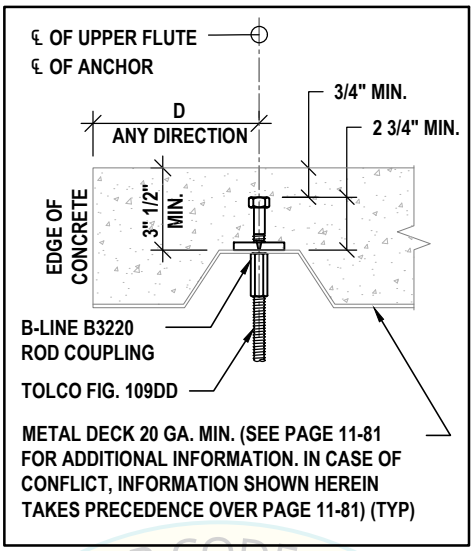
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

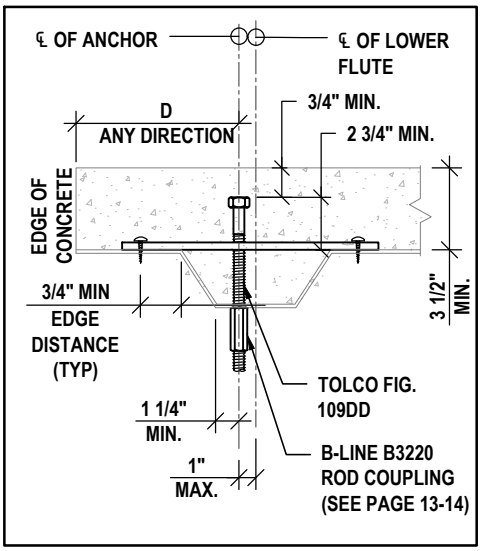
PAGE: 11-51

DATE: April 23, 2025

TOLCO FIG. 109DD CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS







ANCHOR DIA.	'E' MIN. ANCHOR EMBEDMENT DEPTH ABOVE UPPER FLUTE	'D' MIN. EDGE DISTANCE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE VERTICAL SEISMIC LOAD W/ BRACE (LBS)(1)
3/8"	2 1/2"	12"	375
1/2"	2 1/2"	12"	548
5/8"	2 1/2"	12"	520

FOOTNOTES:
1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE.
2. CALIFORNIA BUILDING CODE STATES: "ALL BOLTS SHALL BE ACCURATELY AND SECURELY SET PRIOR TO PLACEMENT OF CONCRETE" FASTENERS OR JAMB NUT MAY BE USED. TYPICAL FOR ALL APPLICATIONS.
3. MOUNTING HOLES ARE STANDARD. IF THE PLATE IS NOT MECHANICALLY SECURED TO THE DECK RIBS A JAMB NUT IS REQUIRED TO PREVENT THE ANCHOR BOLT FROM LAYING OVER WHEN CONCRETE IS POURED.
4. THE MOUNTING PLATE AND SCREWS USED TO ATTACH THE MOUNTING PLATE TO THE STEEL DECK ARE MEANS TO KEEP THE INSERT IN PLACE DURING CONSTRUCTION. THE MOUNTING PLATE AND SCREWS ARE NOT A STRUCTURAL PART OF THE INSERT. ALTERNATE MEANS MAY BE USED TO HOLD THE INSERT IN PLACE DURING CONSTRUCTION.
5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
6. SPECIAL INSPECTION SHALL BE PROVIDED PER PER SECTION 1705.1 AND TABLE 1705.3 OF 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS AND ANCHOR EMBEDMENT.
7. MINIMUM SPACING BETWEEN INSERTS SHALL BE 3 TIMES THE EMBEDMENT DEPTH OR 12 TIMES THE ANCHOR DIAMETER (WHICH EVER IS GREATER), UNLESS NOTED OTHERWISE.
8. TOLCO FIGURE 109DD IS A CAST-IN-SPECIALTY INSERT AND COMPLIES WITH CHAPTER 17 OF ACI 318-19 AND DOES NOT REQUIRE ADDITIONAL TESTING -CERTIFICATION.
9. ROD COUPLING DOES NOT NEED TO BE TIGHT UP AGAINST THE UNDERSIDE OF THE DECK.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR 1/8" (MAX.) LARGER THAN THE ANCHOR DIAMETER.
11. 20GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_y = 50 KSI.
12. INSERT SHALL NOT BE INSTALLED AT THE INCLINE BOTTOM FLUTE OF THE DECK.

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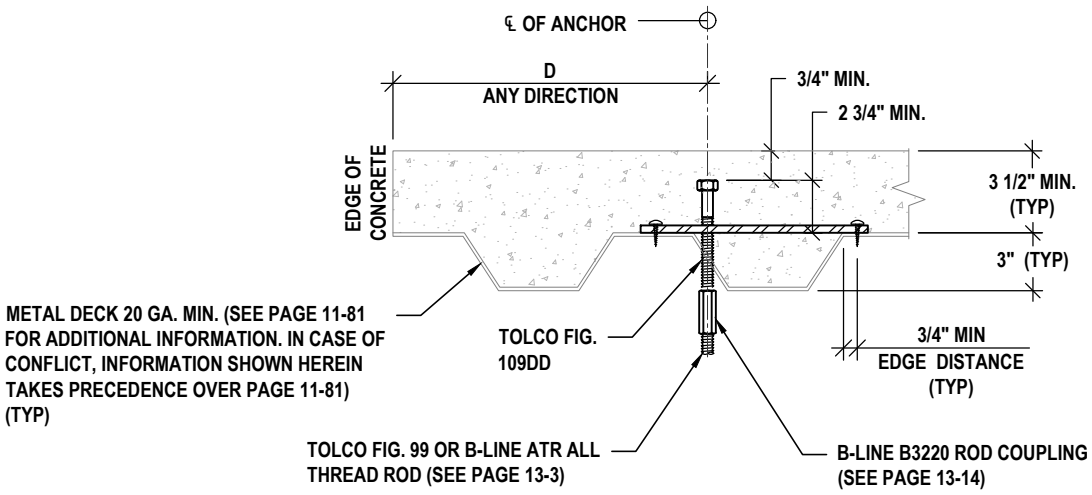
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 11-52

DATE: April 23, 2025

TOLCO FIG. 109DD CONCRETE INSERT
IN 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	'E' MIN. ANCHOR EMBEDMENT DEPTH ABOVE UPPER FLUTE	'D' MIN. EDGE DISTANCE	ALLOWABLE STRESS DESIGN (ASD) MAX. ALLOWABLE VERTICAL SEISMIC LOAD W/ BRACE (LBS)[1]
3/8"	2 1/2"	14"	375
1/2"	2 1/2"	14"	548
5/8"	2 1/2"	14"	520

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

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5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
6. SPECIAL INSPECTION SHALL BE PROVIDED PER PER SECTION 1705.1 AND TABLE 1705.3 OF 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS AND ANCHOR EMBEDMENT.
7. MINIMUM SPACING BETWEEN INSERTS SHALL BE 3 TIMES THE EMBEDMENT DEPTH OR 12 TIMES THE ANCHOR DIAMETER (WHICH EVER IS GREATER), UNLESS NOTED OTHERWISE.
8. TOLCO FIGURE 109DD IS A CAST-IN-SPECIALLY INSERT AND COMPLIES WITH CHAPTER 17 OF ACI 318-19 AND DOES NOT REQUIRE ADDITIONAL TESTING -CERTIFICATION.
9. ROD COUPLING DOES NOT NEED TO BE TIGHT UP AGAINST THE UNDERSIDE OF THE DECK.
10. HANGER ROD DIAMETER SHALL BE EQUAL TO OR 1/8" (MAX.) LARGER THAN THE ANCHOR DIAMETER.
11. 20GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_y = 50 KSI

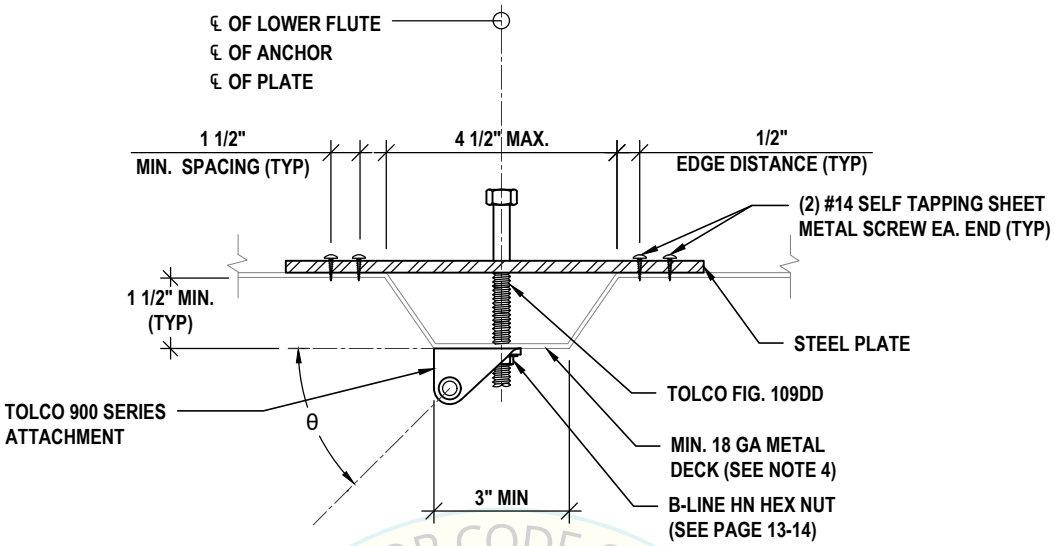
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TOLCO FIG. 109DD DECK INSERT INTO UNFILLED MIN. 18 GA. METAL DECK FOR BRACES



ANCHOR DIA.	STEEL PLATE			ALLOWABLE STRESS DESIGN (ASD)		
	THICKNESS	WIDTH	LENGTH	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)[1]		
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
3/8"	3/16"	1 1/4"	12"	130	85	60
1/2"	3/16"	1 1/4"	12"	130	85	53
5/8"	3/16"	1 1/4"	12"	130	76	44

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
3. STEEL PLATE SHALL BE INSTALLED PERPENDICULAR TO FLUTES.
4. 18GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_y = 50 KSI.
5. MIN. SPACING BETWEEN HANGERS IN ANY DIRECTION SHALL BE 48".
6. INSERT SHALL NOT BE INSTALLED AT THE INCLINE BOTTOM FLUTE OF THE DECK.

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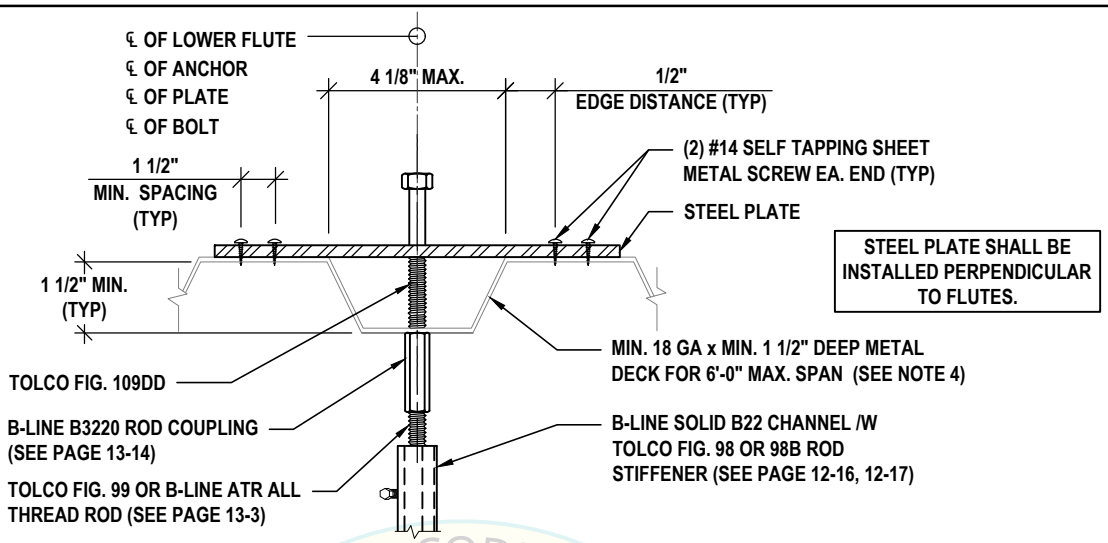
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TOLCO FIG. 109DD DECK INSERT INTO UNFILLED MIN. 18 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	STEEL PLATE			ALLOWABLE STRESS DESIGN (ASD)
	THICKNESS	WIDTH	LENGTH	MAX. ALLOWABLE VERTICAL SEISMIC LOAD (LBS)[1]
3/8" - 5/8"	3/16"	1 1/4"	12"	90

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE 1/16" LARGER THAN THE ANCHOR DIAMETER.
3. STEEL PLATE SHALL BE INSTALLED PERPENDICULAR TO FLUTES.
4. 18GA. MIN. METAL DECK PER ASTM A653 SS GRADE 50 MIN. AND F_y = 50 KSI.
5. MIN. SPACING BETWEEN HANGERS IN ANY DIRECTION SHALL BE 48".
6. INSERT SHALL NOT BE INSTALLED AT THE INCLINE BOTTOM FLUTE OF THE DECK.

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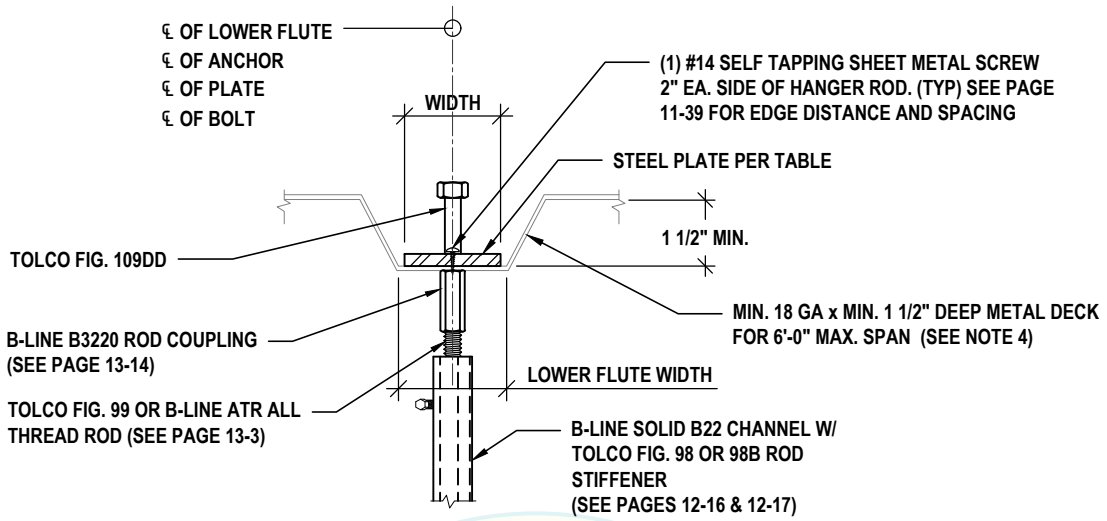
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TOLCO FIG. 109DD DECK INSERT INTO UNFILLED MIN. 18 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	STEEL PLATE			STEEL ROOF DECK	ALLOWABLE STRESS DESIGN (ASD)
	THICKNESS	WIDTH	LENGTH	MAX. LOWER FLUTE WIDTH (L.F.W.)	MAX. ALLOWABLE VERTICAL SEISMIC LOAD (LBS)[1]
3/8" - 5/8"	3/16"	1 1/4"	12"	1 3/4"	150

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE METAL DECK FOR THE TABULATED ALLOWABLE LOADS IN ADDITION TO ALL OTHER LOADS.
2. HANGER ROD DIAMETER SHALL BE EQUAL TO OR 1/8" (MAX.) LARGER THAN THE ANCHOR DIAMETER.
3. STEEL PLATE SHALL BE INSTALLED PARALLEL TO AND IN FULL CONTRACT WITH LOWER FLUTES.
4. THIS DETAIL SHALL NOT BE USED AT LOWER FLUTE SIDE LAPS.
5. ROD HANGER SHALL NOT BE INSTALLED AT METAL DECK SIDE LAP (LOWER FLUTE).
6. STEEL DECK SHALL BE MIN. 18 GA. x MIN. 1.5" DEEP PER ASTM A-653 SS GRADE 50 OR A-1063 SS WITH Fy = 50 KSI (MIN.)
7. MAX. VERTICAL LOAD IS INTENDED TO BE VERTICAL SEISMIC LOADS.
8. MIN. SPACING BETWEEN HANGERS IN ANY DIRECTION SHALL BE 48".

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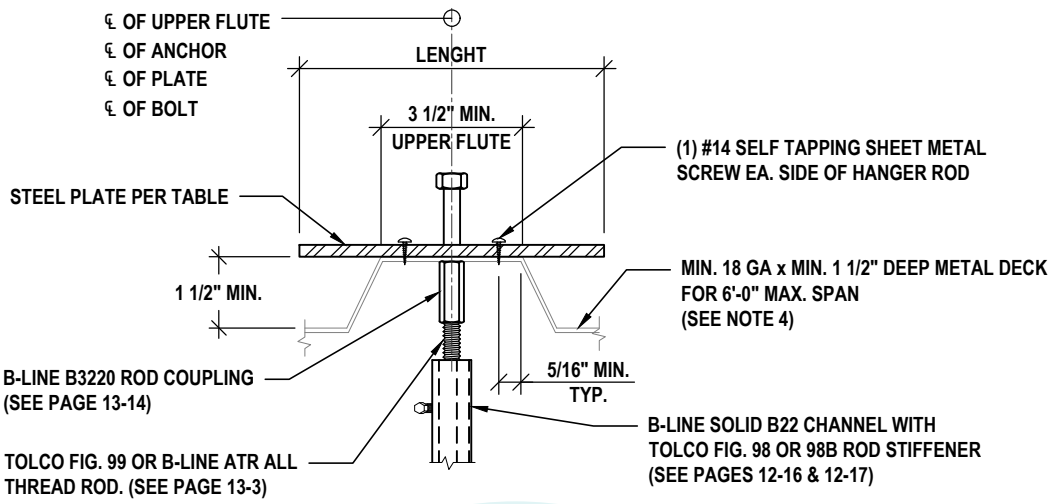
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TOLCO FIG. 109DD DECK INSERT INTO UNFILLED MIN. 18 GA. METAL DECK FOR HANGERS



ANCHOR DIA.	STEEL PLATE			STEEL ROOF DECK	ALLOWABLE STRESS DESIGN (ASD)
	THICKNESS	WIDTH	LENGTH	MAX. LOWER FLUTE WIDTH (L.F.W.)	MAX. ALLOWABLE VERTICAL SEISMIC LOAD (LBS)[1]
3/8" - 5/8"	3/16"	1 1/4"	12"	1 3/4"	162

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE METAL DECK FOR THE TABULATED ALLOWABLE LOADS IN ADDITION TO ALL OTHER LOADS.
2. HANGER ROD DIAMETER SHALL BE EQUAL TO OR 1/8" (MAX.) LARGER THAN THE ANCHOR DIAMETER..
3. STEEL PLATE SHALL BE INSTALLED PERPENDICULAR TO UPPER FLUTES.
4. STEEL DECK SHALL BE MIN. 18 GA. x MIN. 1.5" DEEP PER ASTM A-653 SS GRADE 50 OR A-1063 SS WITH Fy = 50 KSI (MIN.)
5. MAX. VERTICAL LOAD IS INTENDED TO BE VERTICAL SEISMIC LOADS.
6. MIN. SPACING BETWEEN HANGERS IN ANY DIRECTION SHALL BE 48".

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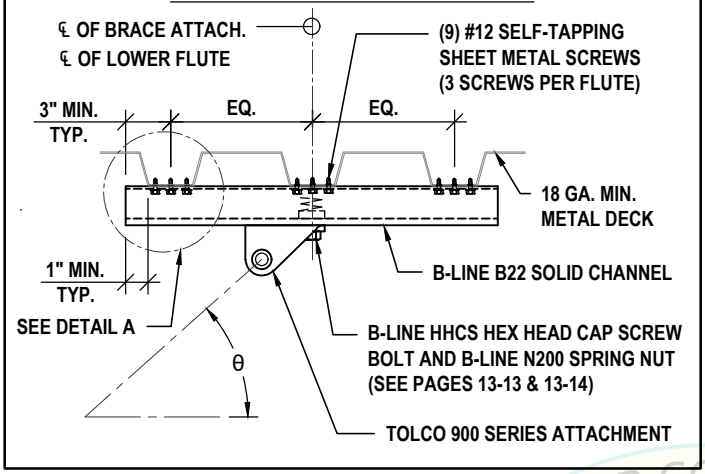
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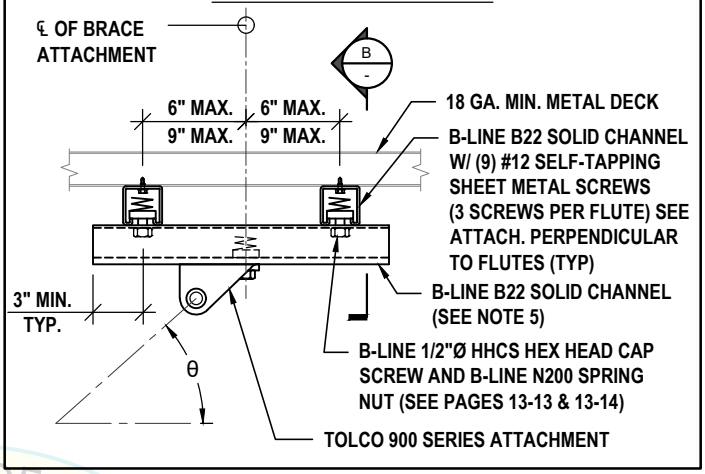
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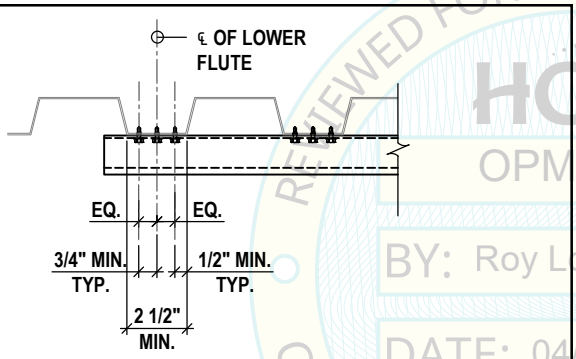
SCREW ATTACHMENT TO UNFILLED MIN. 18 GA. METAL DECK FOR BRACES

SHOWN WITH 900 SERIES ATTACHMENT PERPENDICULAR TO FLUTES

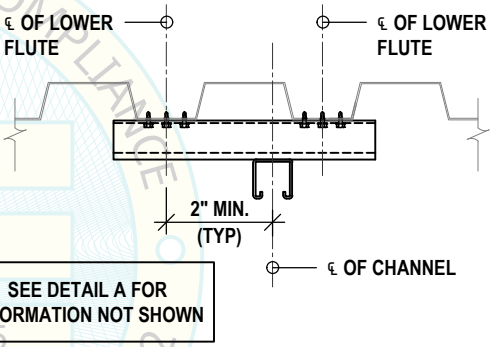


SHOWN WITH 900 SERIES ATTACHMENT PARALLEL TO FLUTES





DETAIL A



DETAIL B

ALLOWABLE STRESS DESIGN (ASD)	
MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)	
PERPENDICULAR TO FLUTES	PARALLEL TO FLUTES
θ = 0°- 60°	θ = 0°- 60°
100	100

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. STRUT NUTS MAY BE USED INSTEAD OF SPRING NUTS AS SHOWN.
3. SCREWS SHALL BE 1" MIN. LONG.
4. SCREWS SHALL BE SPACED AT 3/4" MINIMUM SPACING WITH 1/2" MIN. EDGE DISTANCE.
5. SOLID CHANNEL SIZE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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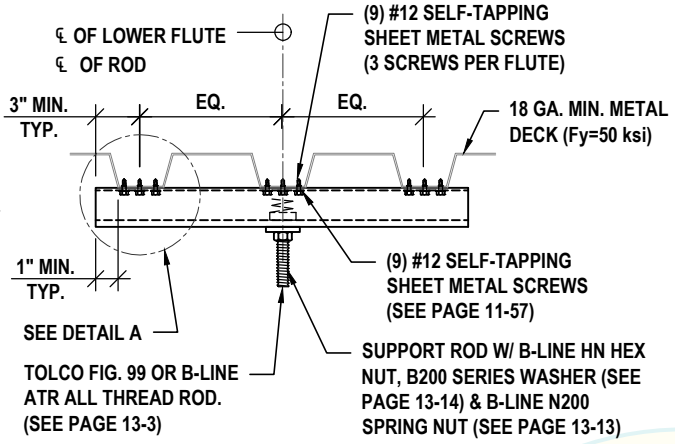
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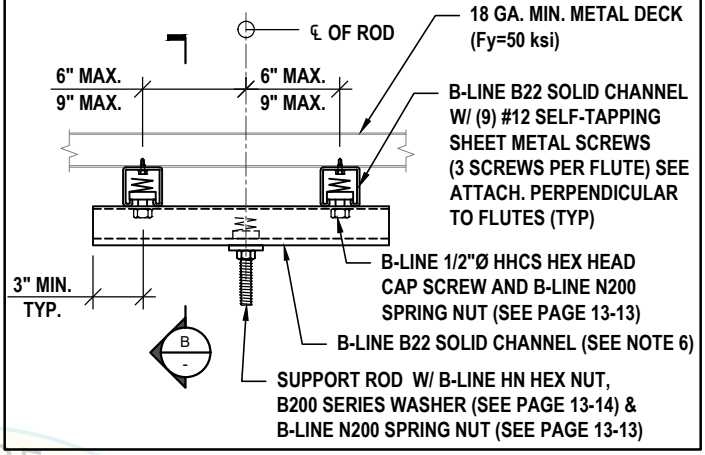
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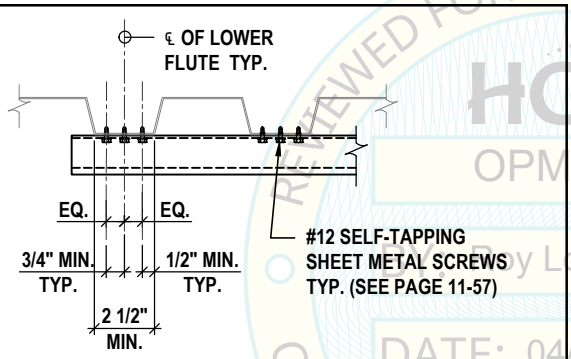
SCREW ATTACHMENT TO UNFILLED MIN. 18 GA. MIN. METAL DECK FOR HANGERS

SHOWN WITH 900 SERIES ATTACHMENT PERPENDICULAR TO FLUTES

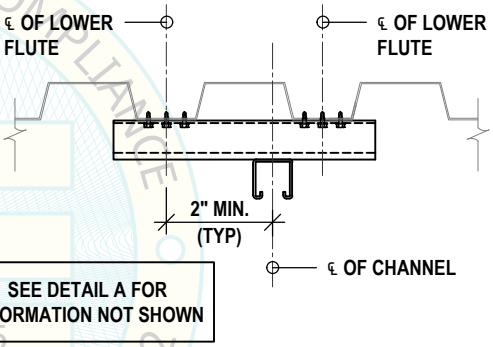


SHOWN WITH 900 SERIES ATTACHMENT PARALLEL TO FLUTES





DETAIL A



DETAIL B

ALLOWABLE STRESS DESIGN (ASD)	
MAX. ALLOWABLE VERTICAL LOAD (LBS)	
PERPENDICULAR	PARALLEL
100	100

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. STRUT NUTS MAY BE USED INSTEAD OF SPRING NUTS AS SHOWN.
3. SCREWS SHALL BE 1" MIN. LONG.
4. SCREWS SHALL BE SPACED AT 3/4" MINIMUM SPACING WITH 1/2" MIN. EDGE DISTANCE.
5. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
6. SOLID CHANNEL SIZE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.

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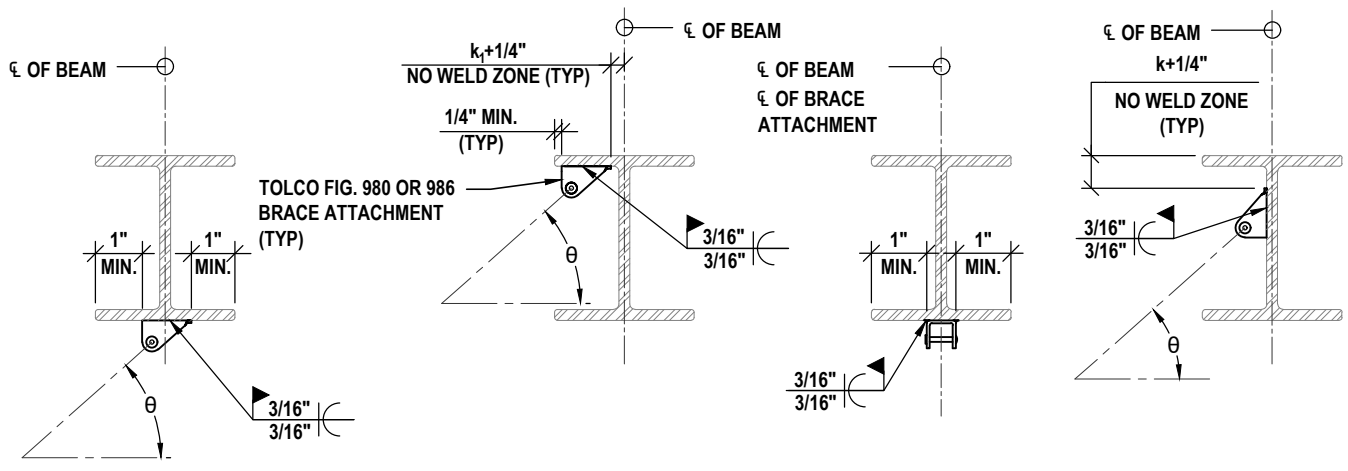
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WELDED ATTACHMENT
TO STEEL BEAM FOR BRACES



BRACE ATTACHMENT	ALLOWABLE STRESS DESIGN (ASD)		
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
TOLCO FIG. 980	1,818	1,484	1,050
TOLCO FIG. 986	1,218	1,347	788

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NOTES:

1. ALL STRUCTURAL STEEL SHALL BE A36 OR EQUAL
2. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
3. CONNECTION TO STRUCTURAL BEAM SUBJECT TO PRIOR APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH THE LATEST EDITION OF THE STRUCTURAL WELDING CODE OF THE AMERICAN WELDING SOCIETY.
7. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
8. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
9. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
10. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

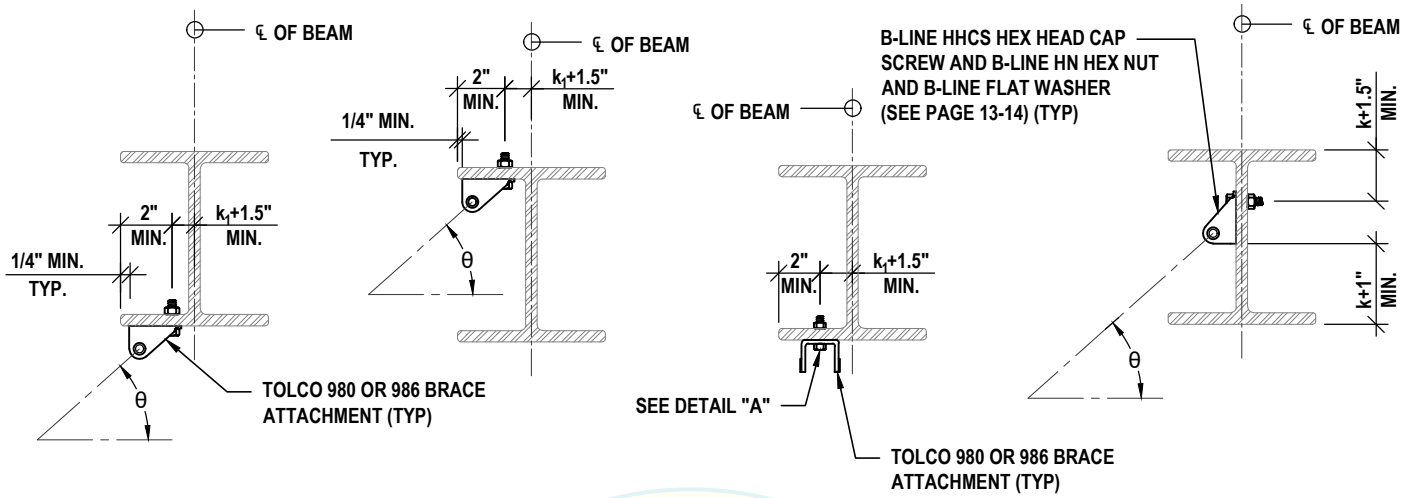
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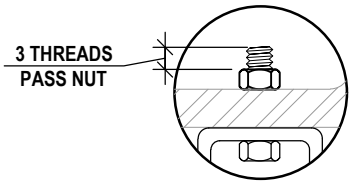
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BOLTED ATTACHMENT
TO STEEL BEAM FOR BRACES



BRACE ATTACHMENT	BOLT DIAMETER	ALLOWABLE STRESS DESIGN (ASD) MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
		θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
TOLCO 980	3/8"	570	530	190
	1/2"	1,040	960	340
	5/8"	1,660	1,484	540
	3/4"	1,818	1,484	800
TOLCO 986	3/8"	570	530	190
	1/2"	1,040	960	340
	5/8"	1,218	1,347	540
	3/4"	1,218	1,347	788

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DETAIL A

NOTES:

1. ALL STRUCTURAL STEEL SHALL BE A36 OR EQUAL
2. FASTENERS SHALL BE A307 BOLTS OR BETTER
3. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
4. CONNECTION TO STRUCTURAL BEAM SUBJECT TO PRIOR APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
5. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
6. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

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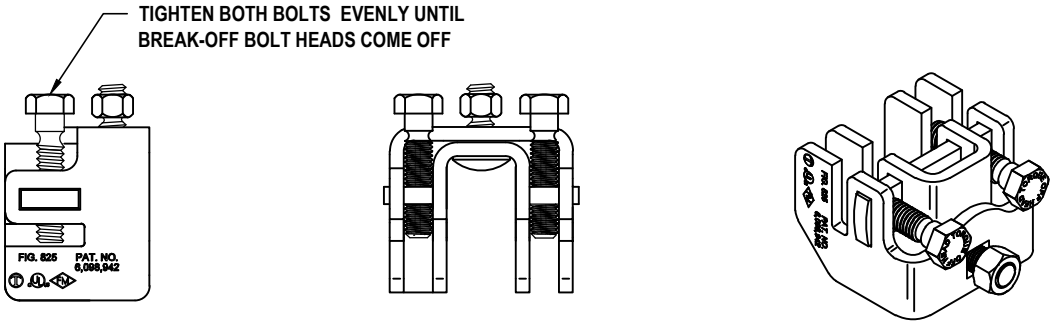
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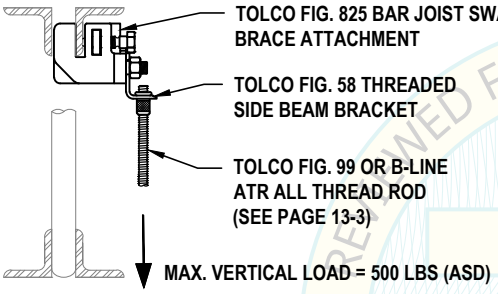
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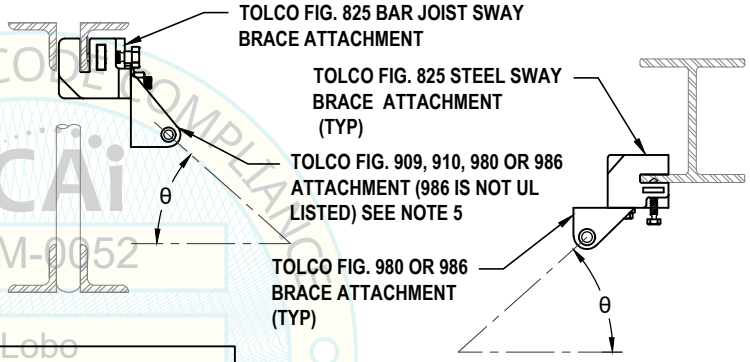
TOLCO FIG. 825 BAR JOIST SWAY BRACE ATTACHMENT TO STEEL TRUSS / BEAM



HANGER ASSEMBLY CONFIGURATION



SEISMIC BRACE ASSEMBLY CONFIGURATION



NOTES:

1. STEEL BAR JOIST OR TRUSS THICKNESS SHALL BE 1/8" MINIMUM AND 3/8" MAXIMUM.
2. STEEL BEAM FLANGE THICKNESS SHALL BE 3/8" MINIMUM AND 7/8" MAXIMUM.

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ORIENTATION	ALLOWABLE STRESS DESIGN (ASD)[1]		
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
PERPENDICULAR TO BEAM, BAR JOIST OR TRUSS	990	990	990
PARALLEL TO BEAM, BAR JOIST OR TRUSS	460	460	460

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40, GB/T 3091, OR JIS G3454 STEEL PIPE AS THE BRACE MEMBER.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
4. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION 10, PAGE 10-2 FOR TOLCO FIG. 909, 910, 980 OR 986 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS .
5. TOLCO FIG. 825 IS NOT UL LISTED WHEN USED IN COMBINATION WITH TOLCO FIG. 986.

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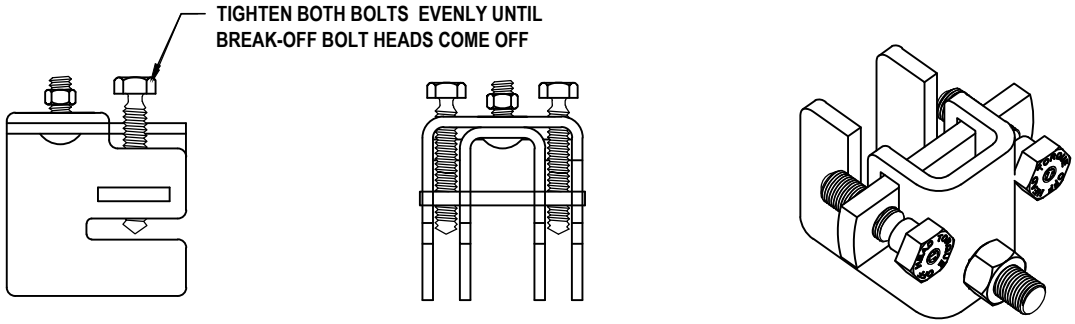
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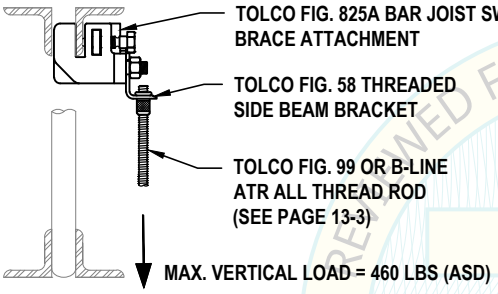
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TOLCO FIG. 825A BAR JOIST SWAY BRACE ATTACHMENT TO STEEL TRUSS



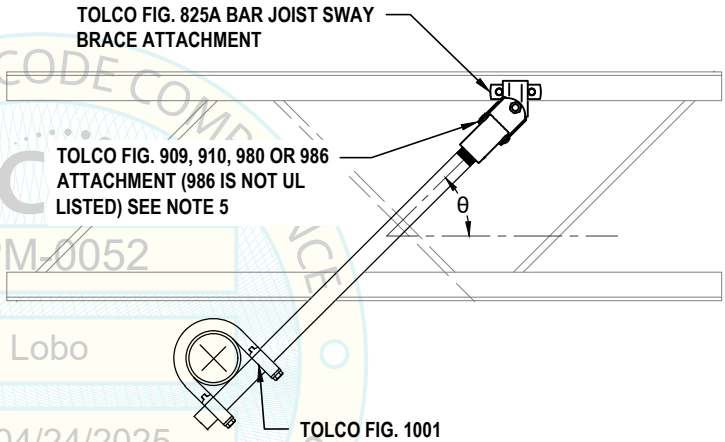
HANGER ASSEMBLY CONFIGURATION



NOTES:

1. STEEL BAR JOIST OR TRUSS THICKNESS SHALL BE 1/8" MINIMUM AND 3/8" MAXIMUM.

SEISMIC BRACE ATTACHEMENT



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ORIENTATION	ALLOWABLE STRESS DESIGN (ASD)[1]
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)
	θ = 0°- 60°
PARALLEL TO BAR JOIST OR TRUSS[2]	460

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40, GB/T 3091, OR JIS G3454 STEEL PIPE AS THE BRACE MEMBER.
2. TOLCO FIG. 825A SHALL NOT BE USED PERPENDICULAR TO BAR JOISTS OR TRUSSES.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
4. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION 10, PAGE 10-2 FOR TOLCO FIG. 909, 910, 980 OR 986 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS .
5. FIG. 825A IS NOT UL LISTED WHEN USED IN COMBINATION WITH FIG. 986.

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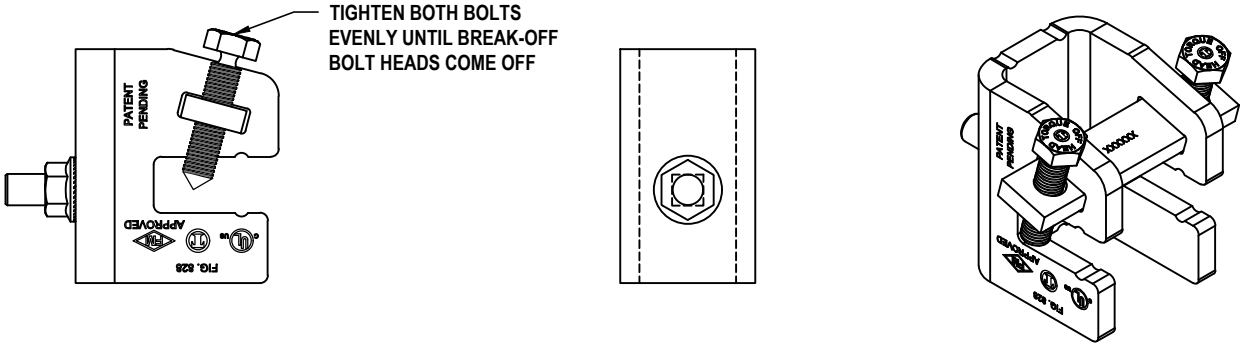
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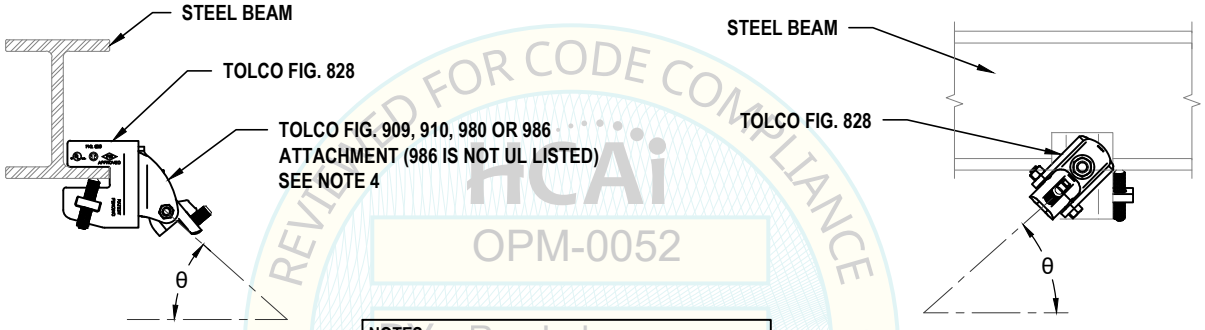
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TOLCO FIG. 828 UNIVERSAL SWAY BRACE ATTACHMENT TO STEEL BEAM



SEISMIC BRACE ATTACHEMENT



NOTES:

1. STEEL BEAM FLANGE THICKNESS SHALL BE 3/8" MINIMUM AND 7/8" MAXIMUM.

ORIENTATION	ALLOWABLE STRESS DESIGN (ASD)[1]		
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
PERPENDICULAR TO BEAM	2,505	1,650	735
PARALLEL TO BEAM	1,118	952	615

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40, GB/T 3091, OR JIS G3454 STEEL PIPE AS THE BRACE MEMBER.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF JOIST TO RESIST ALL BRACE LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION 10, PAGE 10-2 FOR TOLCO FIG. 909, 910, 980 OR 986 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS .
4. FIG. 828 IS NOT UL LISTED WHEN USED IN COMBINATION WITH FIG. 986.

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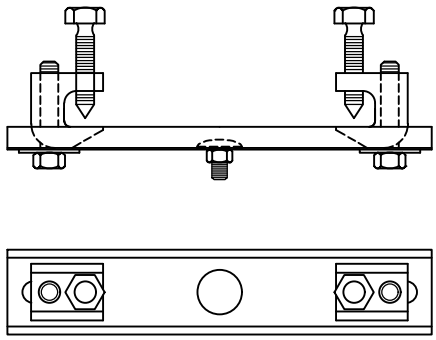
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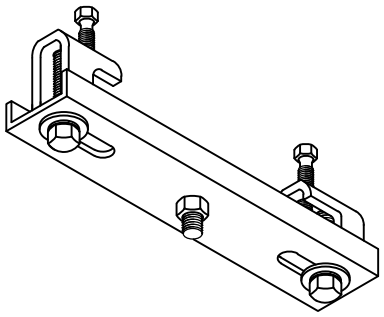
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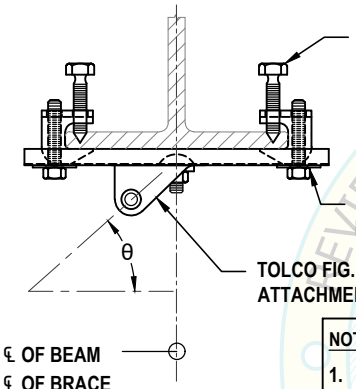
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TOLCO FIG. 800 ADJUSTABLE SWAY BRACE ATTACHMENT TO STEEL BEAM FOR BRACES

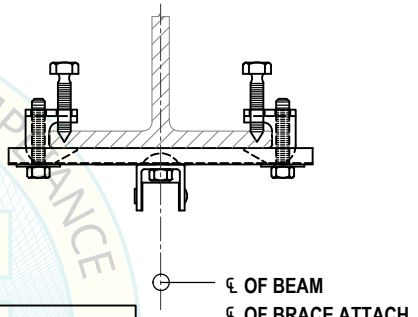




SHOWN WITH 900 SERIES ATTACHMENT ACROSS BEAM



SHOWN WITH 900 SERIES ATTACHMENT ALONG BEAM



NOTES:
1. STEEL BEAM FLANGE THICKNESS SHALL NOT EXCEED 3/4".
2. STEEL BEAM FLANGE WIDTH SHALL BE 4" MIN. AND 12" MAX.

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ORIENTATION	ALLOWABLE STRESS DESIGN (ASD)[1] MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
PERPENDICULAR TO BEAM OR BAR JOIST	1,980	1,970	1,430
PARALLEL TO BEAM OR BAR JOIST	1,610	1,310	930

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40, GB/T 3091, OR JIS G3454 STEEL PIPE AS THE BRACE MEMBER.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STEEL MEMBER TO RESIST ALL BRACE LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. FOR FIG. 980, MUST USE PART NUMBERS 13520713, 13520714, 13520712, 13520884, 13520885, 13520883, 13520024, 13520025, 13520023, 13520736, 13520737 OR 13520735 (SEE SECTION 10, PAGE 10-2).

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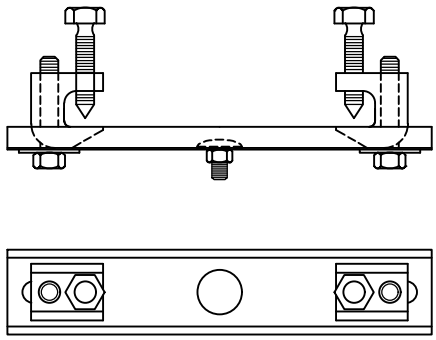
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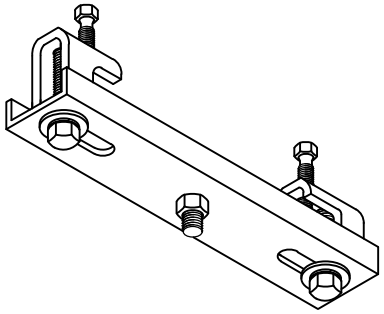
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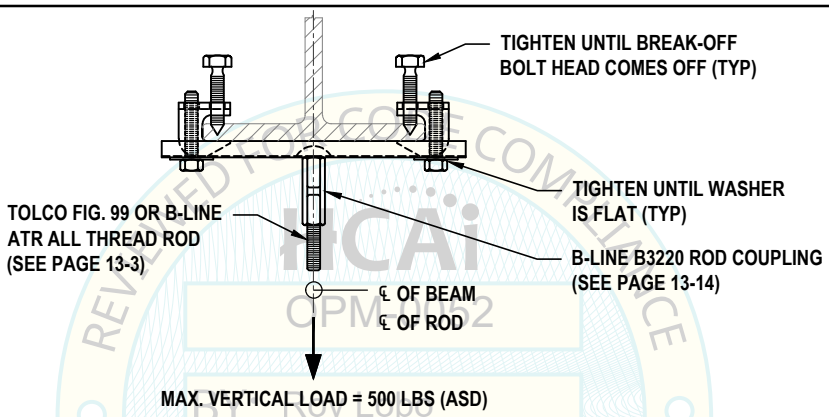
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TOLCO FIG. 800 ADJUSTABLE SWAY BRACE ATTACHMENT TO STEEL BEAM FOR HANGERS







NOTES:

1. STEEL BEAM FLANGE THICKNESS SHALL NOT EXCEED 3/4".
2. STEEL BEAM FLANGE WIDTH SHALL BE 4" MIN. AND 12" MAX.

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).

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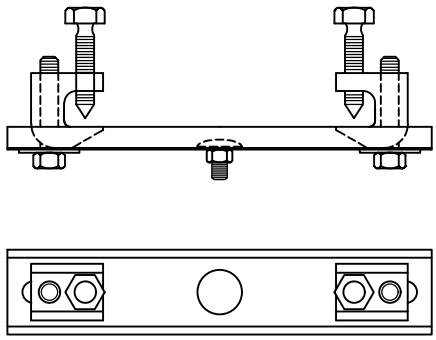
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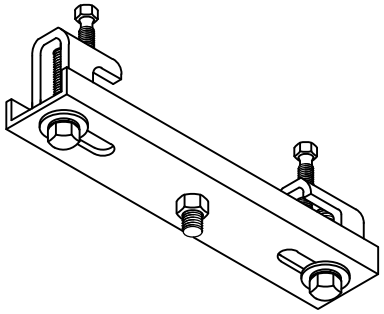
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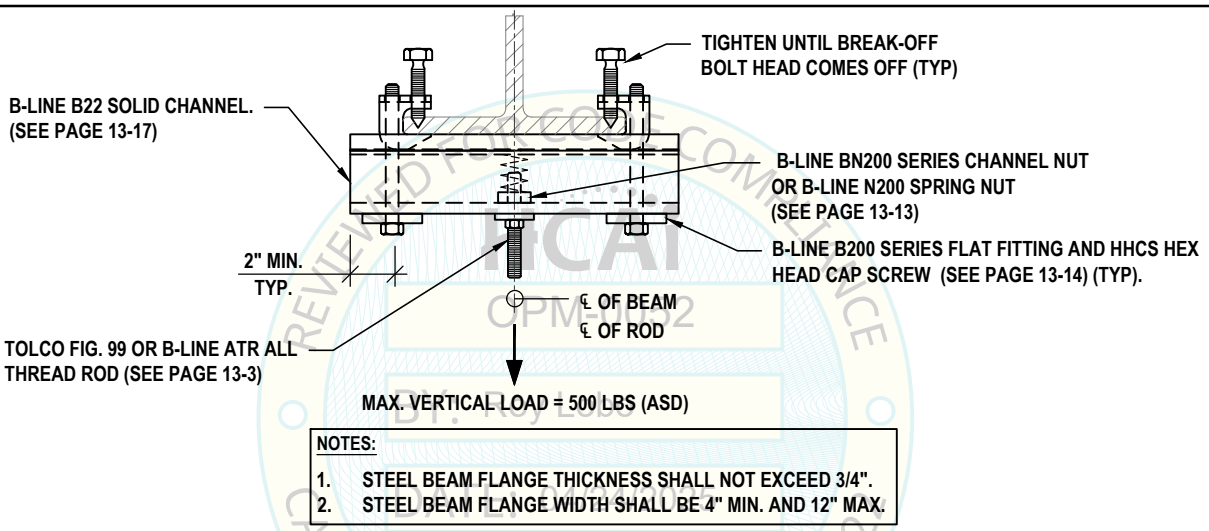
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TOLCO FIG. 800 ADJUSTABLE SWAY BRACE ATTACHMENT TO STEEL BEAM FOR HANGERS







NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.

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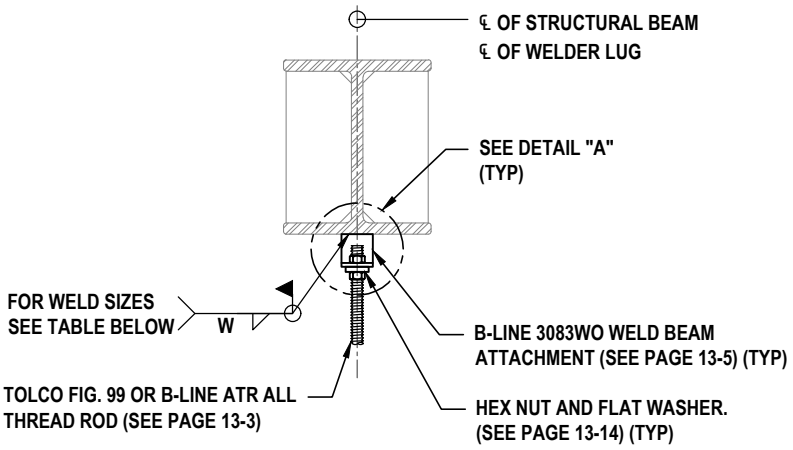
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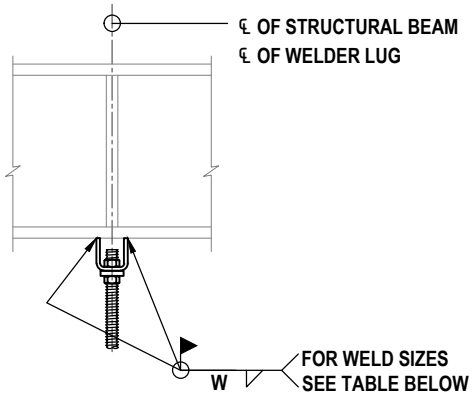
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WELDED LUG ATTACHMENT
TO STEEL BEAM FOR HANGERS



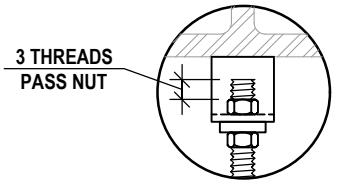


HANGER ROD DIAMETER	'W' MINIMUM WELD SIZE	ALLOWABLE STRESS DESIGN (ASD)
		MAX. ALLOWABLE VERTICAL (LBS)
3/8"	1/4"	730
1/2"	1/4"	1,350
5/8"	1/4"	2,160
3/4"	1/4"	3,230
7/8"	1/4"	4,480
1"	1/4"	4,480

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NOTES:

1. CONNECTION TO STRUCTURAL BEAM SUBJECT TO PRIOR APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOADS.
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PREFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
7. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.



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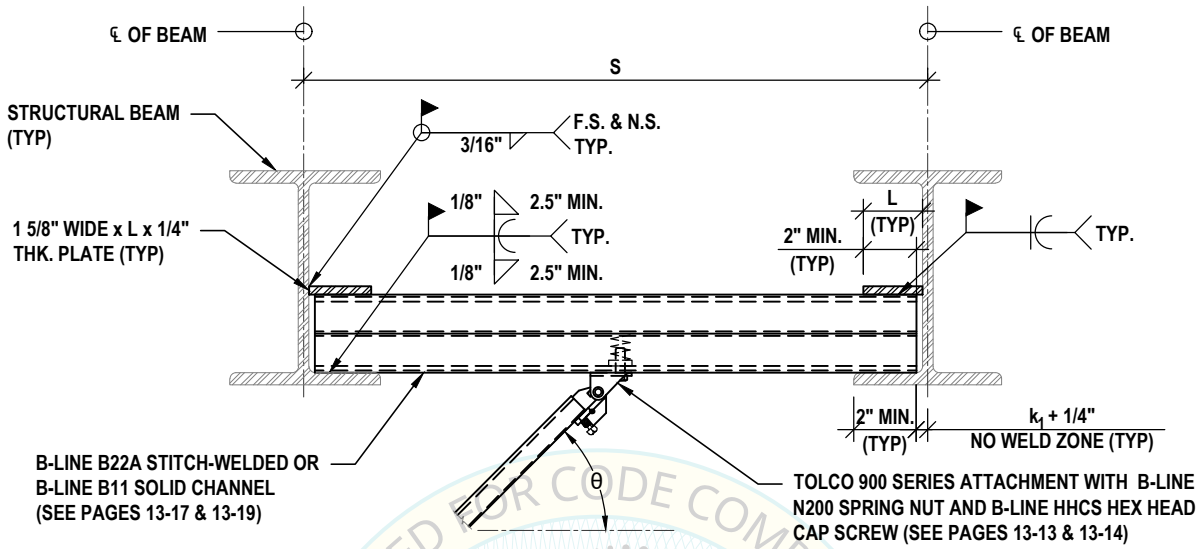
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BRACE ATTACHMENT TO SUPPLEMENTAL STRUT

BRACE PARALLEL TO SUPPLEMENTAL STRUT



'S' MAX. BEAM SPACING	ALLOWABLE STRESS DESIGN (ASD)		
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
6'-0"	943	544	314
10'-0"	495	286	165

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NOTES:

1. ONLY ONE BRACE SHALL BE INSTALLED WITHIN THE BEAM SPACING.
2. BRACE SHALL BE INSTALLED PARALLEL TO THE CHANNEL WITH MAXIMUM ±5° TOLERANCE OFF PARALLEL.
3. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOADS.
4. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
5. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
6. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
7. ALL WELDING SHALL BE PREFORMED BY A CERTIFIED WELDER.
8. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
9. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING
10. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
11. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

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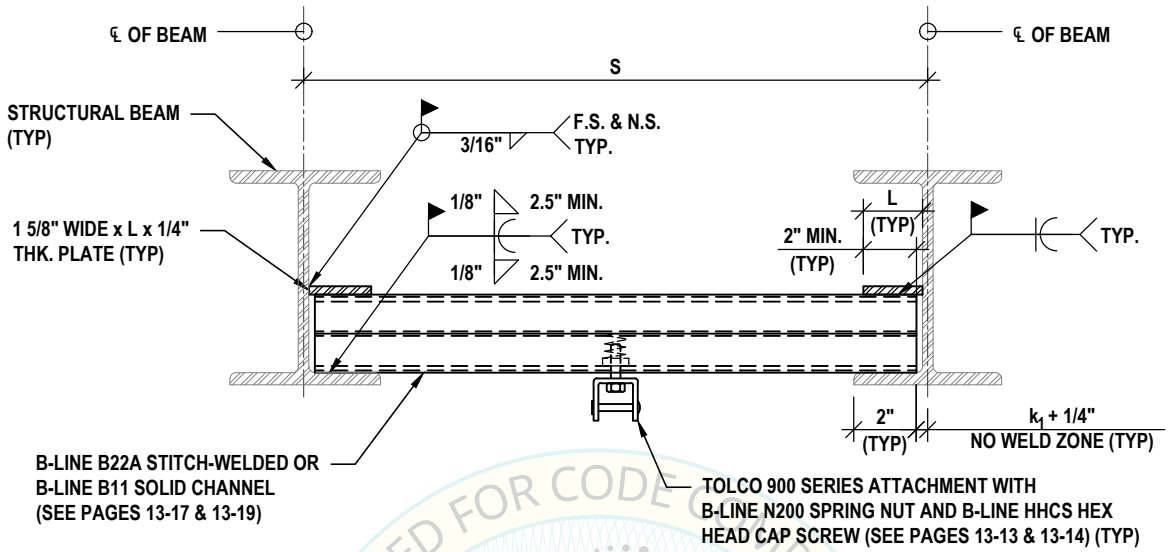
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BRACE ATTACHMENT TO SUPPLEMENTAL STRUT

BRACE PERPENDICULAR TO SUPPLEMENTAL STRUT



'S' MAX. BEAM SPACING	ALLOWABLE STRESS DESIGN (ASD)		
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
6'-0"	350	270	200
10'-0"	190	145	105

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NOTES:

1. BRACE SHALL BE INSTALLED PERPENDICULAR TO THE CHANNEL WITH MAXIMUM ±5° TOLERANCE OFF PARALLEL.
2. ALLOWABLE LOADS SHALL BE CALCULATED PER STRUT SECTION PROPERTIES. (SEE PAGES 13-18, 13-19 & 13-20).
3. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOADS.
4. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
5. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
6. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
7. ALL WELDING SHALL BE PREFORMED BY A CERTIFIED WELDER.
8. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
9. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
10. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

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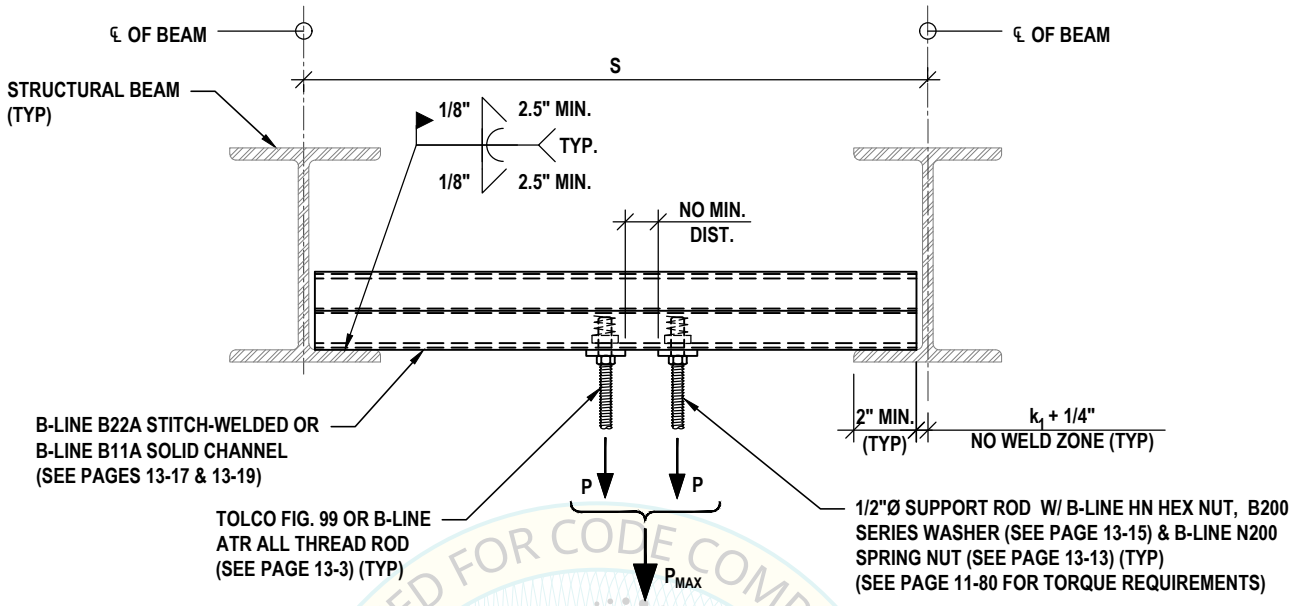
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HANGER ATTACHMENT TO SUPPLEMENTAL STRUT



'S' MAX. BEAM SPAN	MAX. VERTICAL ALLOWABLE LOAD (ASD) TOTAL OF ALL APPLIED INDIVIDUAL LOADS SHALL NOT EXCEED P_{MAX} (LBS)
6'-0"	613
10'-0"	308

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
3. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOADS.
4. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
5. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
6. ALL WELDING SHALL BE PREFORMED BY A CERTIFIED WELDER.
7. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
8. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING
9. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
10. ECCENTRIC LOADING IS NOT ALLOWED.
11. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.
12. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

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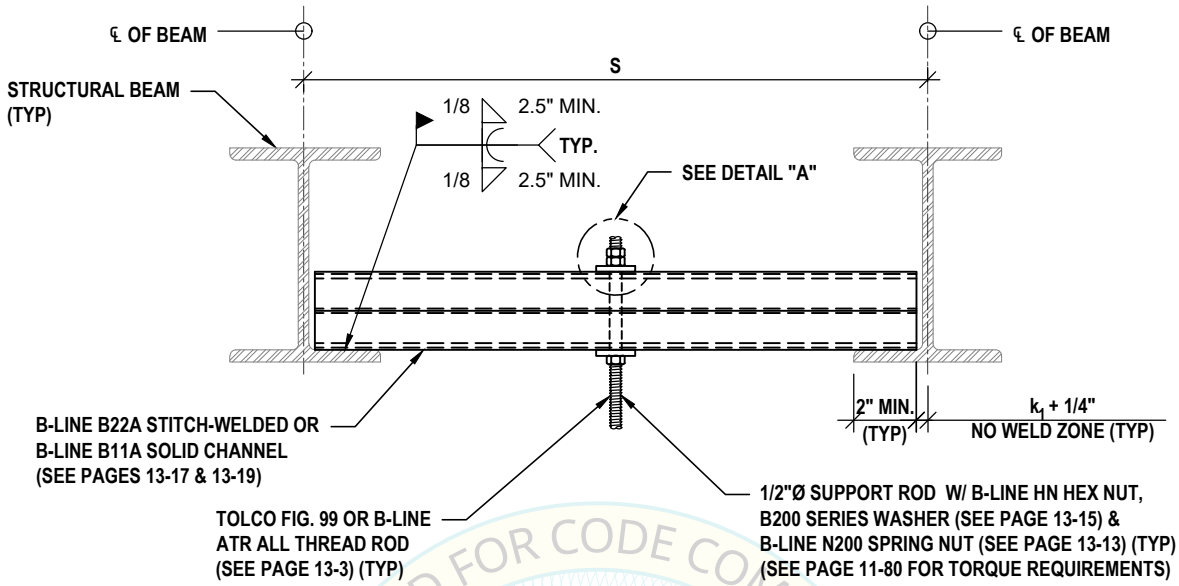
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HANGER ATTACHMENT TO SUPPLEMENTAL STRUT

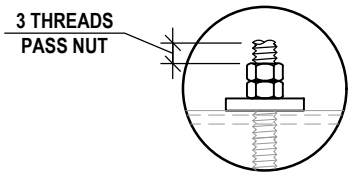


'S' MAX. BEAM SPAN	MAX. VERTICAL ALLOWABLE LOAD (ASD) (LBS)
6'-0"	589
10'-0"	308

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NOTES:

1. STRUT SHALL BE WELDED TO THE BOTTOM-UNDERSIDE OF BEAM FLANGE USING THE SAME WELD AS WHEN WELDED TO THE TOP OF BEAM BOTTOM FLANGE.
2. ALLOWABLE LOADS SHALL BE CALCULATED PER STRUT SECTION PROPERTIES. (SEE PAGES 13-18, 13-19, 13-20 & 13-21).
3. STRUCTURAL ENGINEER OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOADS.
4. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
5. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
6. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
7. ALL WELDING SHALL BE PREFORMED BY A CERTIFIED WELDER.
8. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
9. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
10. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
11. ECCENTRIC LOADING IS NOT ALLOWED.
12. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.
13. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.



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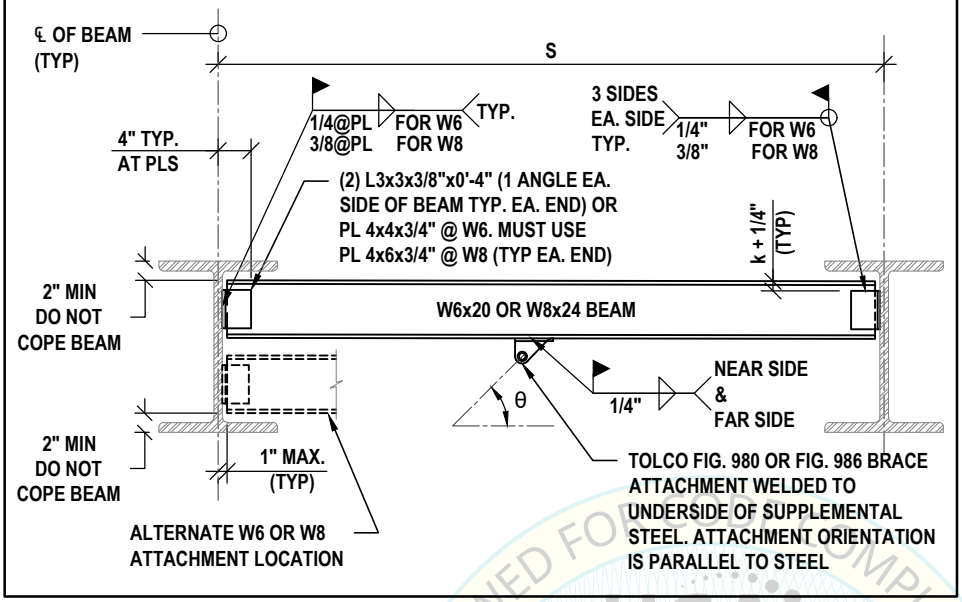
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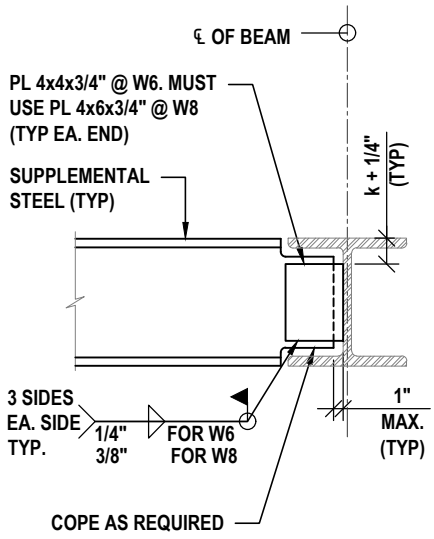
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BRACE ATTACHMENT
TO SUPPLEMENTAL STEEL BEAM



OPTIONAL ATTACHEMENT



BEAM SIZE	'S' MAXIMUM BEAM SPAN	BRACE ATTACHMENT	(ASD) MAX. HORIZONTAL ALLOWABLE LOAD (LBS) TOTAL OF ALL APPLIED INDIVIDUAL LOADS SHALL NOT EXCEED F_P		
			θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
W6x20	10'-0"	TOLCO FIG. 980	1,818	1,484	1,050
		TOLCO FIG. 986	1,218	1,347	788
W8x24	20'-0"	TOLCO FIG. 980	1,818	1,484	1,050
		TOLCO FIG. 986	1,218	1,347	788

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341)
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
7. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
8. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
9. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

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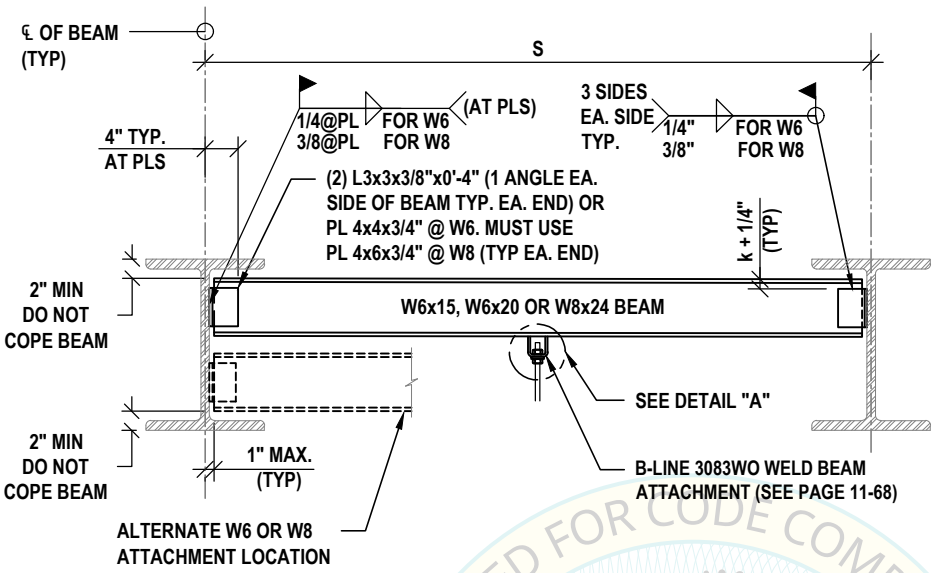
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California SE No. S3545

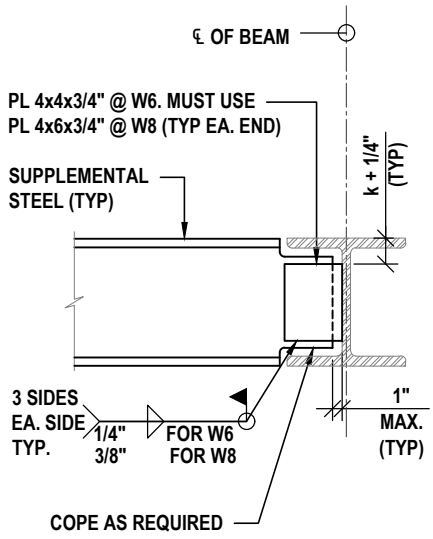
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HANGER ATTACHMENT
TO SUPPLEMENTAL STEEL BEAM



OPTIONAL ATTACHEMENT

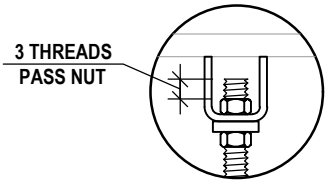


BEAM SIZE	'S' MAX. BEAM SPAN	HANGER ROD DIAMETER	MAXIMUM VERTICAL ALLOWABLE LOAD (ASD) (LBS)
W6x20	10'-0"	3/8"	730
		1/2"	1,350
		5/8"	2,160
		3/4"	3,230
		7/8"	4,480
		1"	4,480
W8x24	20'-0"	3/8"	730
		1/2"	1,350
		5/8"	2,160
		3/4"	3,230
		7/8"	4,480
		1"	4,480

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NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
7. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
8. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
7. ECCENTRIC LOADING IS NOT ALLOWED.
8. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.



DETAIL A

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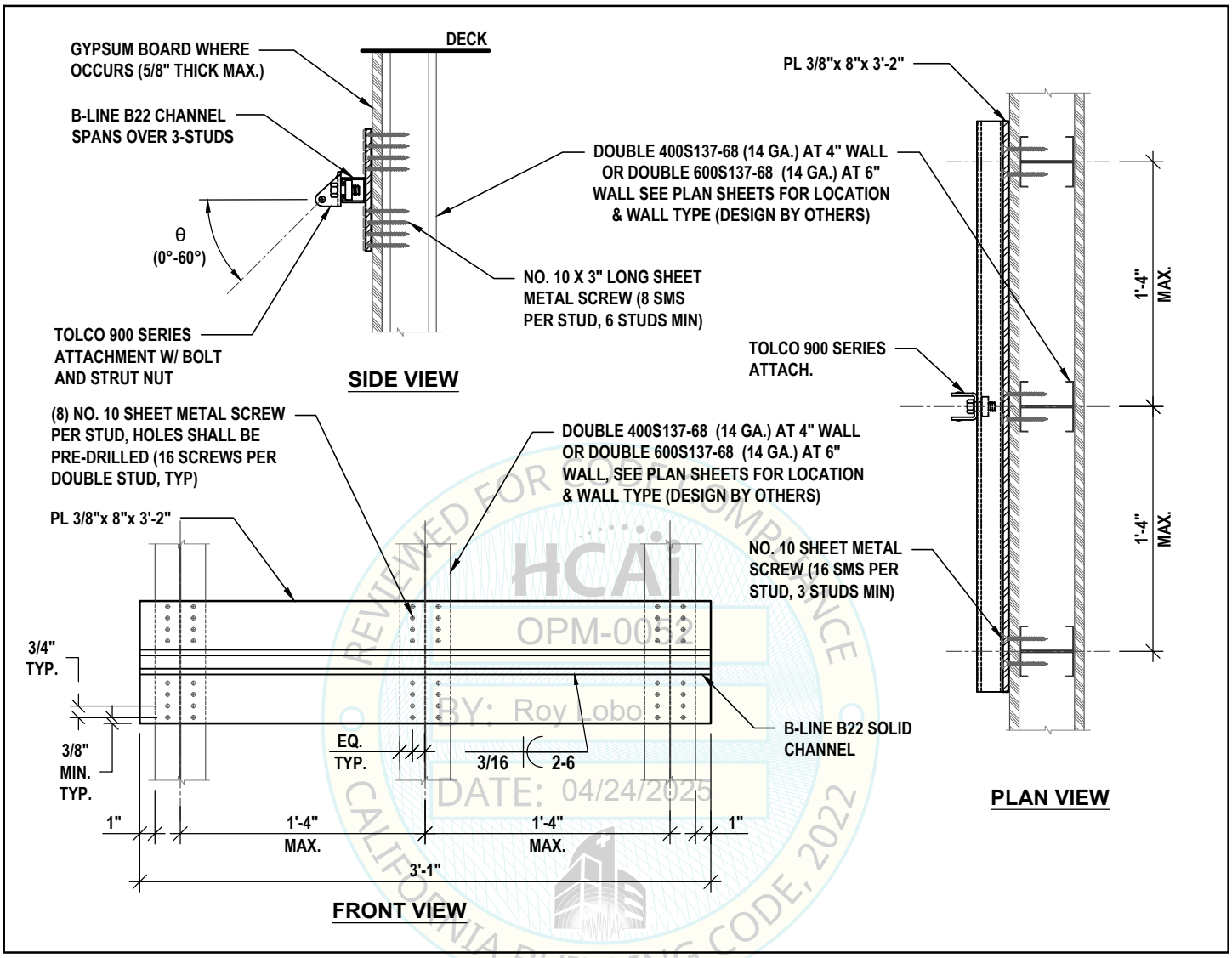
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BRACE ATTACHMENT TO STUD WALL



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(ASD) MAXIMUM HORIZONTAL ALLOWABLE LOAD (LBS)
500

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. ALLOWABLE HORIZONTAL SEISMIC LOAD = 500 LBS AT 0°-60° ANGLE MEASURED FROM HORIZONTAL.
3. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.

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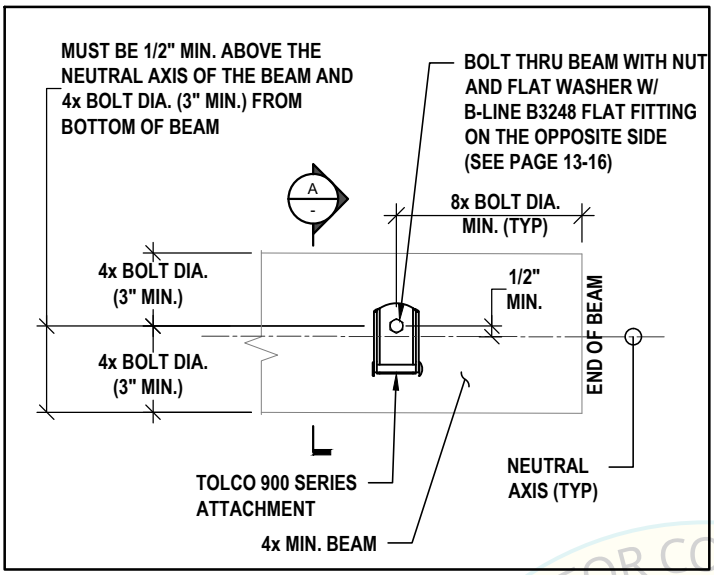
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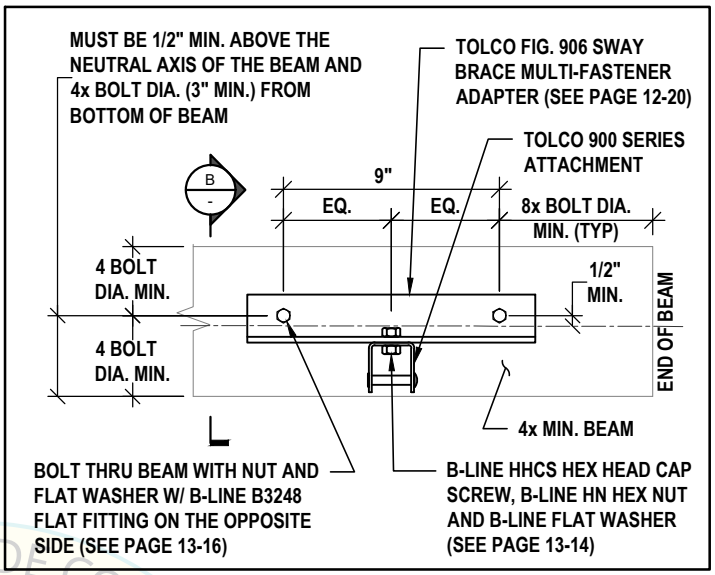
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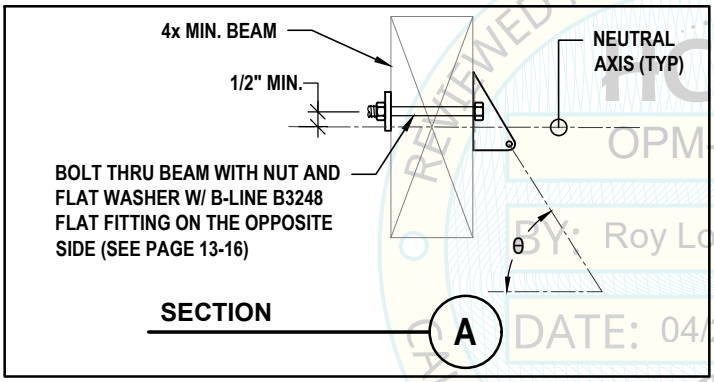
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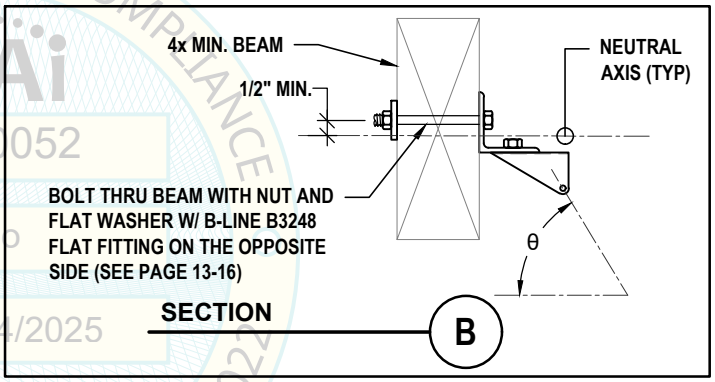
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THRU-BOLT STRUCTURAL ATTACHMENTS
PERPENDICULAR TO WOOD BEAM FOR BRACES









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BOLT DIAMETER	ALLOWABLE STRESS DESIGN (ASD)					
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)					
	1 BOLT			2 BOLTS		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
1/2"	370	444	244	1,471	847	482
5/8"	378	478	267	1,471	847	482
3/4"	385	500	281	1,471	847	482

NOTES:

1. BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x.
3. LOADS FOR THRU-BOLT ATTACHMENTS WERE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.

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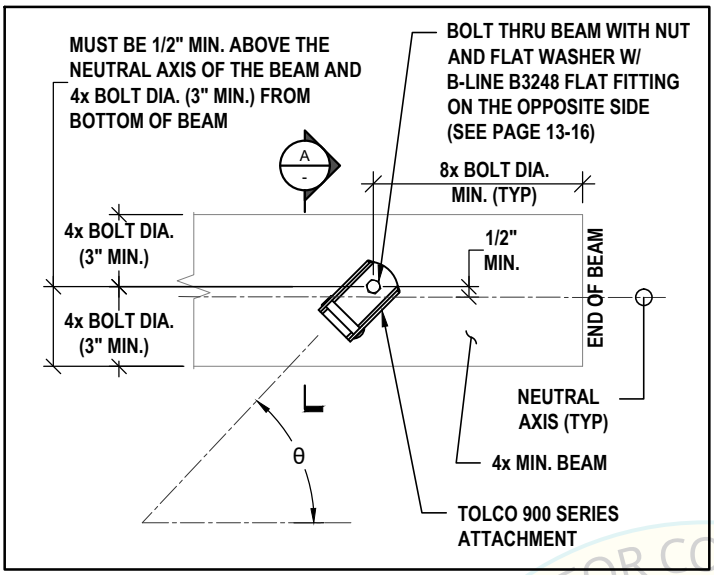
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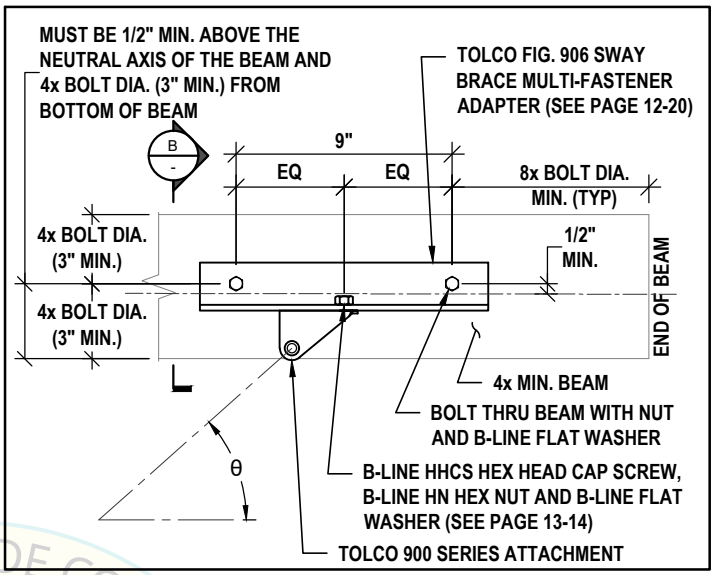
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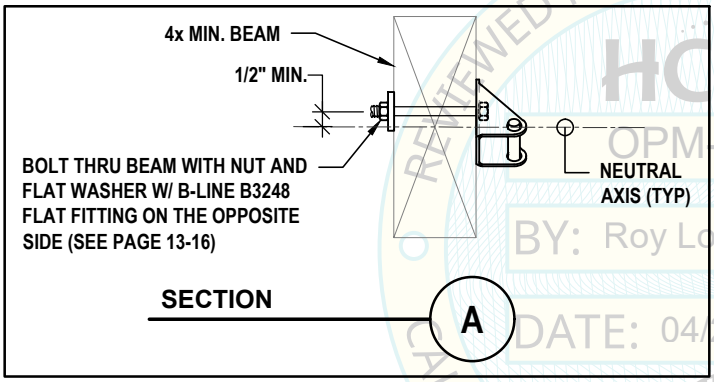
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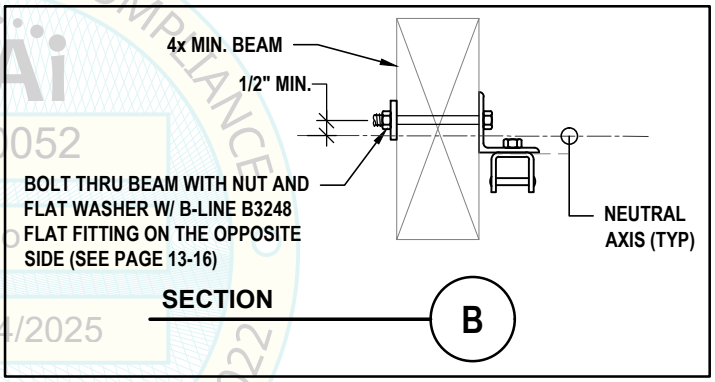
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THRU-BOLT STRUCTURAL ATTACHMENTS
PARALLEL TO WOOD BEAM FOR BRACES









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BOLT DIAMETER	ALLOWABLE STRESS DESIGN (ASD)					
	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)					
	1 BOLT			2 BOLTS		
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
1/2"	378	296	201	883	702	487
5/8"	424	329	222	1,060	779	511
3/4"	462	356	238	1,205	834	526

NOTES:

1. BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x.
3. LOADS FOR THRU-BOLT ATTACHMENTS WERE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5. FASTENERS SHALL BE A307 BOLTS OR BETTER.

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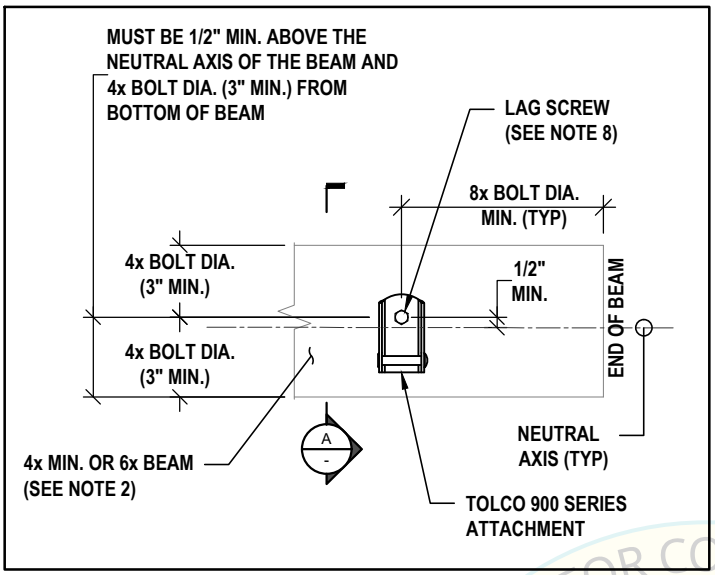
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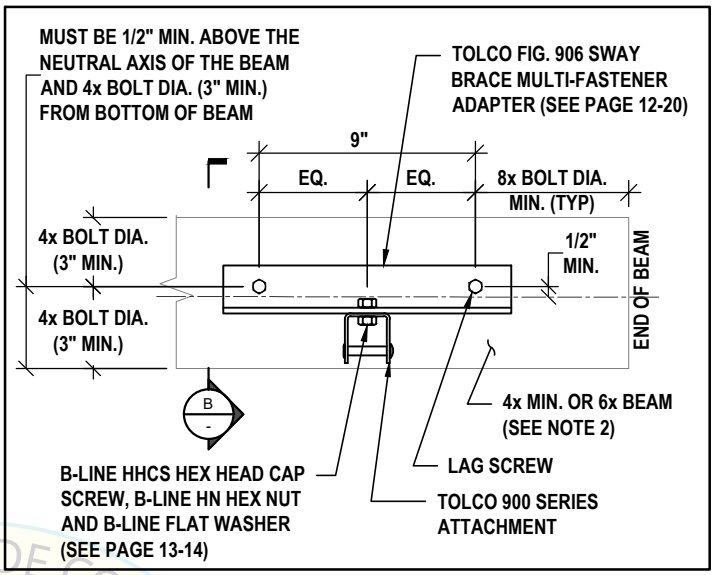
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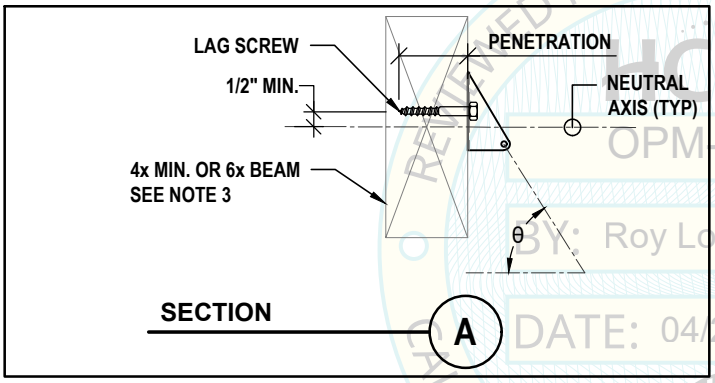
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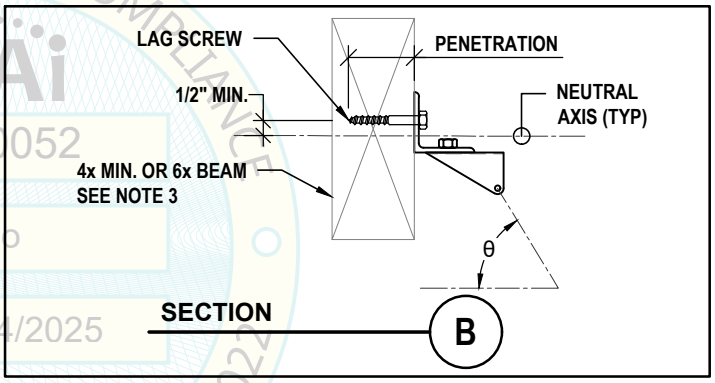
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LAG SCREW STRUCTURAL ATTACHMENTS PERPENDICULAR TO WOOD BEAM FOR BRACES









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LAG SCREW DIA.	MIN. LAG SCREW PENETRATION	LAG SCREW SHANK	LAG SCREWS PILOT HOLE SIZES	ALLOWABLE STRESS DESIGN (ASD)					
			PILOT HOLE SIZES	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)					
			THREADED SECTION	1 SCREW			2 SCREWS		
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
1/2"	3"	1/2"	5/16"	277	191	106	554	382	212
5/8"	5"	5/8"	7/16"	283	221	160	566	442	320
3/4"	5"	3/4"	1/2"	289	232	175	578	464	350

NOTES:

1. LAG SCREW HOLE SHALL BE BORED TO THE MIN. SIZE LISTED ON LAG SCREW PILOT HOLE SIZES TABLE.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x FOR 1/2" AND 6x FOR 5/8" & 3/4" LAG SCREWS.
3. LOADS FOR THRU-BOLT ATTACHMENTS WERE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. ADAPTER HOLE SIZE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
7. HHMB FASTENERS SHALL BE A307 BOLTS OR BETTER.
8. LAG SCREW SHALL MEET ANSI/ASME STANDARD B18.2.1 MINIMUM MATERIAL SPECIFICATIONS, Fy = 45,000 PSI (MIN.).

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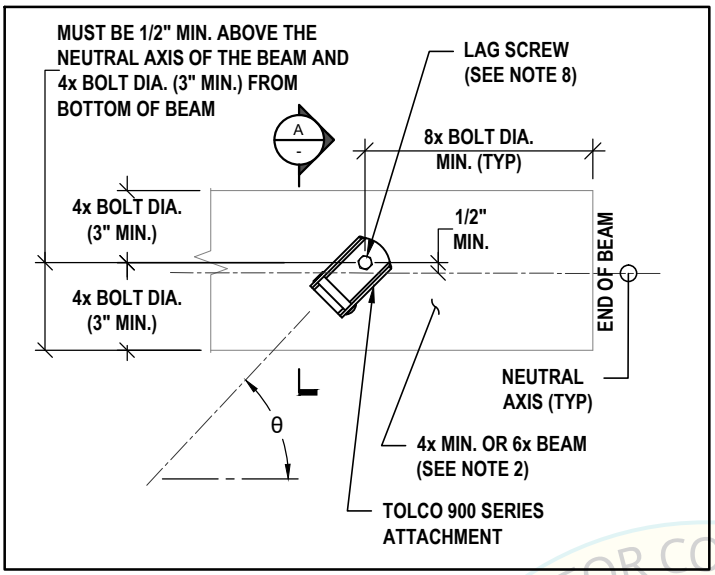
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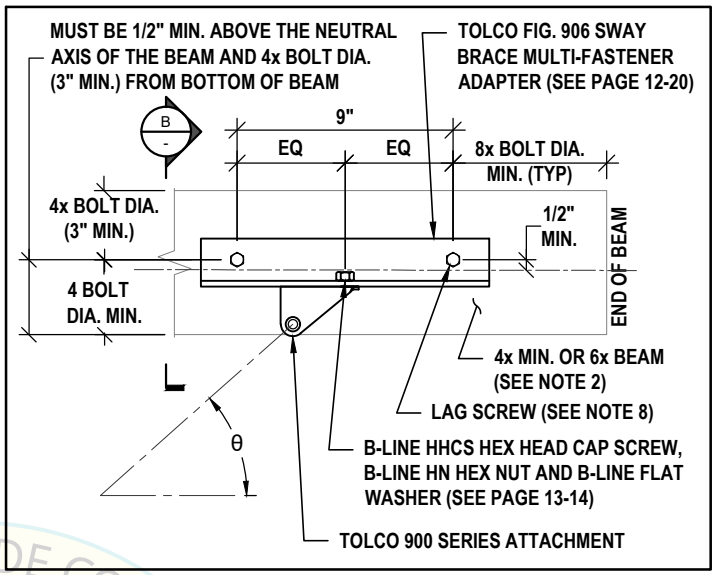
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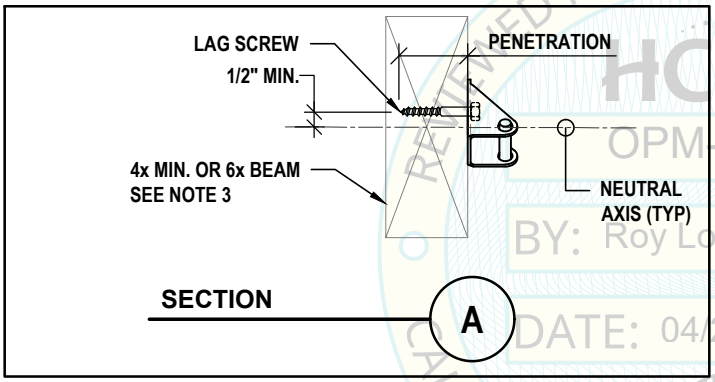
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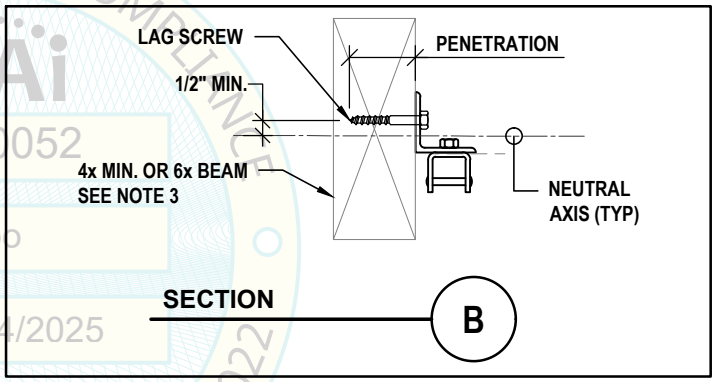
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LAG SCREW STRUCTURAL ATTACHMENTS
PARALLEL TO WOOD BEAM FOR BRACES









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LAG SCREW DIA.	MIN. LAG SCREW PENETRATION	LAG SCREW SHANK	LAG SCREWS PILOT HOLE SIZES	ALLOWABLE STRESS DESIGN (ASD)					
			PILOT HOLE SIZES	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) MEASURED FROM HORIZONTAL (LBS)					
			THREADED SECTION	1 SCREW			2 SCREWS		
				θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°
1/2"	3"	1/2"	5/16"	188	143	95	376	286	190
5/8"	5"	5/8"	7/16"	264	204	137	528	408	274
3/4"	5"	3/4"	1/2"	290	224	150	580	448	300

NOTES:

1. LAG SCREW HOLE SHALL BE BORED TO THE MIN. SIZE LISTED ON LAG SCREW PILOT HOLE SIZES TABLE.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x FOR 1/2" AND 6x FOR 5/8" & 3/4" LAG SCREWS.
3. LOADS FOR THRU-BOLT ATTACHMENTS WERE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5. LAG SCREWS SHALL NOT BE USED FOR BRACING FIRE SPRINKLER SYSTEMS.
6. ADAPTER HOLE SIZE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
7. HHMB FASTENERS SHALL BE A307 BOLTS OR BETTER.
8. LAG SCREW SHALL MEET ANSI/ASME STANDARD B18.2.1 MINIMUM MATERIAL SPECIFICATIONS, Fy = 45,000 PSI (MIN.).

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BOLT AND STRUT NUT TIGHTENING REQUIREMENTS

TORQUE FOR A307 AND A36 THREADED ROD

SIZE (IN)	TORQUE (FT-LB)
1/4	6
3/8	20
1/2	49
5/8	97
3/4	173
7/8	200
1	250

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TORQUE FOR STRUT NUTS

SIZE (IN)	TORQUE (FT-LB)
1/4	6
3/8	19
1/2	50
5/8	100
3/4	125

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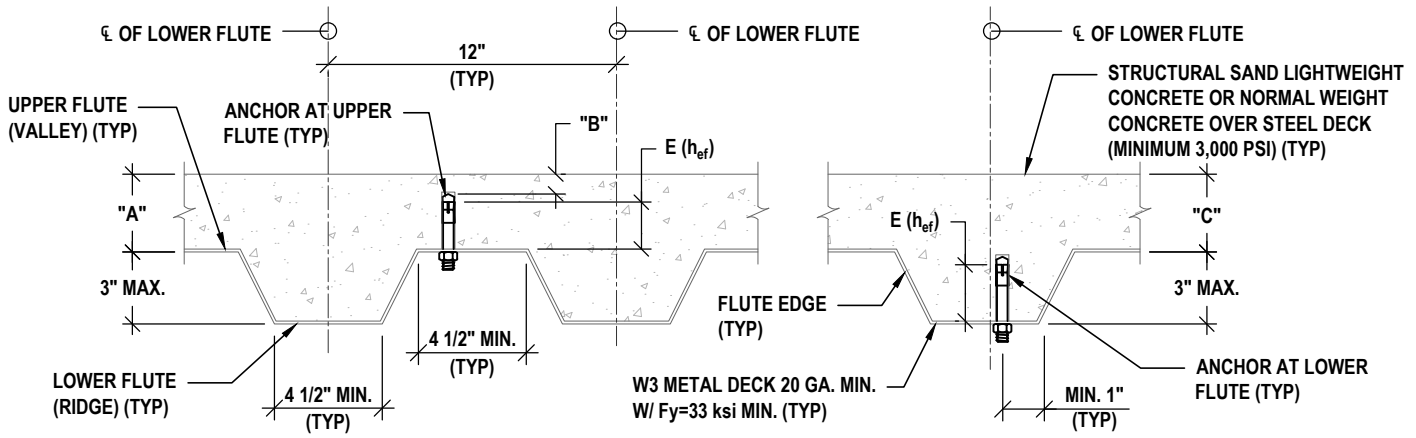
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INFORMATION AND REQUIREMENTS FOR W3 METAL DECK



NOTE: CONCRETE FILLED DECK SHALL BE 20 GAUGE W3 METAL DECK WITH Fy= 33 KSI MINIMUM.

WEDGE OR EXPANSION ANCHOR TYPE	ANCHOR DIAMETER	UPPER FLUTE		LOWER FLUTE	'E (h_{ef})' MIN. EFFECTIVE EMBEDMENT DEPTH	ICC-ESR APPROVAL
		'A' [1] MINIMUM CONCRETE FILL COVER	'B' MINIMUM COVER	'C' [1] MINIMUM CONCRETE FILL COVER		
HILTI KB-TZ2 CS	3/8"	3 3/8"	3/4"	3 3/8"	PER ICC-ESR	ESR-4266
	1/2"					
	5/8"					
SIMPSON STRONG BOLT SB-2	1/2"	3 1/4"	3/4"	3 1/4"	PER ICC-ESR	ESR-3037
	5/8" [2]					
POWERS POWER-STUD +SD1 CS	3/8"	3 1/4"	3/4"	3 1/4"	PER ICC-ESR	ESR-2818
	1/2"					
	5/8"					
	3/4"					
POWERS POWER-STUD +SD2 CS	3/8"	3 1/4"	3/4"	3 1/4"	PER ICC-ESR	ESR-2502
	1/2"					
	5/8"					
	3/4"					

FOOTNOTES:
1. CONCRETE COVER SHALL ACCOMMODATE THE ANCHOR EMBEDMENT AND MINIMUM COVER.
2. NOT PERMITTED IN THE UPPER FLUTE.

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ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES FOR NORMAL WEIGHT CONCRETE OR SAND LIGHT-WEIGHT CONCRETE

ANCHOR INSTALLATION AND TESTING NOTES:

1. ALL POST-INSTALLED ANCHORS SHALL BE INSTALLED PER THEIR CORRESPONDING ICC RESEARCH REPORT.
2. ALL POST-INSTALLED ANCHORS SHALL BE TESTED.
3. TESTING AND INSPECTION OF EXPANSION ANCHORS SHALL BE PERFORMED BY AN APPROVED INDEPENDENT AGENCY EMPLOYED BY THE FACILITY OWNER PER CBC 1704A & 1910A.5, AND CAC 7-149.
4. THE TENSION TESTING OF THE POST-INSTALLED ANCHORS SHALL BE DONE IN THE PRESENCE OF THE PROJECT INSPECTOR. THE REPORTS OF THE TEST RESULTS SHALL BE SUBMITTED TO THE INSPECTOR OF RECORD, OWNER AND THE ARCHITECT OR ENGINEER IN RESPONSIBLE CHARGE OF PROJECT PER CAC 7-149.
5. TEST ACCEPTANCE CRITERIA:

   ACCEPTANCE CRITERIA FOR POST-INSTALLED ANCHORS SHALL BE BASED ON ICC-ESR USING CRITERIA ADOPTED IN THE 2022 CBC. FIELD TEST SHALL SATISFY FOLLOWING MINIMUM REQUIREMENTS.

   TORQUE WRENCH METHOD:

   ANCHORS TESTED WITH A CALIBRATED TORQUE WRENCH MUST ATTAIN THE SPECIFIED TORQUE WITHIN 1/2 TURN OF THE NUT.

   EXCEPTIONS:

   WEDGE OR SLEEVE TYPE:
   ONE QUARTER (1/4) TURN OF THE NUT FOR 3/8" SLEEVE ANCHOR ONLY.

6. TEST LOADS:

   A. LOAD TESTING SHALL BE PERFORMED AFTER A MINIMUM 24 HOURS ELAPSED SINCE INSTALLATION.

   REQUIRED TEST LOADS SHALL BE PER THE FOLLOWING ANCHOR BOLT TEST LOAD TABLE:

TORQUE VALUES PER ICC-ESR REPORTS

REQUIRED TEST LOAD TABLE FOR HILTI KB-TZ2 WEDGE ANCHOR (ICC ESR-4266)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)	
	CARBON STEEL (CS)	STAINLESS STEEL (SS)
3/8"	30	30
1/2"	50	40
5/8"	40	60
3/4"	110	125

REQUIRED TEST LOAD TABLE FOR POWERS POWER-STUD +SD1 WEDGE ANCHOR (ICC ESR-2818)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)
	CARBON STEEL (CS)
3/8"	20
1/2"	40
5/8"	80
3/4"	110

REQUIRED TEST LOAD TABLE FOR POWERS POWER-STUD +SD4 WEDGE ANCHOR (ICC ESR-2502)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)
	STAINLESS STEEL (SS)
3/8"	25
1/2"	40
5/8"	60
3/4"	110

REQUIRED TEST LOAD TABLE FOR SIMPSON STRONG BOLT 2 WEDGE ANCHOR (ICC ESR-3037)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)	
	CARBON STEEL (CS)	STAINLESS STEEL (SS)
1/2"	60	65
5/8"	90	80
3/4"	150	150

REQUIRED TEST LOAD TABLE FOR POWERS POWER-STUD +SD2 WEDGE ANCHOR (ICC ESR-2502)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)
	CARBON STEEL (CS)
3/8"	20
1/2"	40
5/8"	60
3/4"	110

REQUIRED TEST LOAD TABLE FOR POWERS POWER-STUD +SD6 WEDGE ANCHOR (ICC ESR-2502)

ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)
	STAINLESS STEEL (SS)
3/8"	25
1/2"	40
5/8"	60
3/4"	110

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BY ROY LOBO
DATE: 04/24/2025
CALIFORNIA PLUMBING CODE, 2022

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ANCHOR INSTALLATION, TESTING NOTES AND TENSION VALUES FOR NORMAL WEIGHT CONCRETE OR SAND LIGHT-WEIGHT CONCRETE

ANCHOR INSTALLATION AND TESTING NOTES:

1. ALL POST-INSTALLED ANCHORS SHALL BE INSTALLED PER THEIR CORRESPONDING ICC RESEARCH REPORT.
2. ALL POST-INSTALLED ANCHORS SHALL BE TESTED.
3. TESTING AND INSPECTION OF EXPANSION ANCHORS SHALL BE PERFORMED BY AN APPROVED INDEPENDENT AGENCY EMPLOYED BY THE FACILITY OWNER PER 2022 CBC 1704A & 1910A.5, AND CAC 7-149.
4. THE TENSION TESTING OF THE POST-INSTALLED ANCHORS SHALL BE DONE IN THE PRESENCE OF THE PROJECT INSPECTOR. THE REPORTS OF THE TEST RESULTS SHALL BE SUBMITTED TO THE INSPECTOR OF RECORD, OWNER AND THE ARCHITECT OR ENGINEER IN RESPONSIBLE CHARGE OF PROJECT PER CAC 7-149.
5. TEST ACCEPTANCE CRITERIA:

   TENSION TEST LOAD SHALL BE:

   A. TWICE THE MAXIMUM ALLOWABLE TENSION LOAD

   B. ONE AND A QUARTER (1 1/4) TIMES THE MAXIMUM DESIGN STRENGTH OF ANCHORS AS PROVIDED IN AN APPROVED EVALUATION REPORT USING CRITERIA ADOPTED IN THIS CODE OR DETERMINED IN ACCORDANCE WITH CHAPTER 17 OF ACI 318.

   NOTES:

   TENSION TEST LOAD NEED NOT EXCEED 80 PERCENT OF THE NOMINAL YIELD STRENGTH OF THE ANCHOR ELEMENT $(= 0.8\ A_{se}\ f_{ya})$.

6. TEST LOADS:

   A. LOAD TESTING SHALL BE PERFORMED AFTER A MINIMUM 24 HOURS ELAPSED SINCE INSTALLATION.

   B. REQUIRED TEST LOADS SHALL BE PER THE FOLLOWING ANCHOR BOLT TEST LOAD TABLE:

TENSION VALUES

REQUIRED TEST LOAD TABLE FOR HILTI HDI-P TZ WEDGE ANCHOR (ICC ESR-4236)

ANCHOR DIAMETER	TENSION (LBS)
3/8"	124

REQUIRED TEST LOAD TABLE FOR POWERS WOOD KNOCKER II+ ANCHOR (ICC ESR-3657)

ANCHOR DIAMETER	TENSION (LBS)
3/8"	1,342
1/2"	1,342
5/8"	1,342
3/4"	1,342

REQUIRED TEST LOAD TABLE FOR POWERS SNAKE+ ANCHOR (ICC ESR-2272)

ANCHOR DIAMETER	LIGHT-WEIGHT CONC. OVER METAL DECK (LBS)	NORMAL-WEIGHT CONC. SOLID SLAB (LBS)
3/8"	440	440
1/2"	532	746

REQUIRED TEST LOAD TABLE FOR POWERS HANGERMATE+ ANCHOR (ICC ESR-3889)

ANCHOR DIAMETER	MIN. EFFECTIVE EMBED. DEPTH 'h_{ef}'	LIGHT-WEIGHT CONC. OVER METAL DECK (LBS)	NORMAL-WEIGHT CONC. SOLID SLAB (LBS)
1/4"	1.20"	118	156
1/4"	1.94"	376	506
3/8"	1.33"	364	404

REQUIRED TEST LOAD TABLE FOR POWERS BANG-IT+ ANCHOR (ICC ESR-3657)

ANCHOR DIAMETER	LOWER FLUTE (LBS)	UPPER FLUTE (LBS)
3/8"	674	994
1/2"	674	994
5/8"	674	1,010
3/4"	674	1,010

REQUIRED TEST LOAD TABLE FOR POWERS SCREW BOLT+ ANCHOR (ICC ESR-3889)

ANCHOR DIAMETER	LIGHT-WEIGHT CONC. OVER METAL DECK (LBS)	NORMAL-WEIGHT CONC. SOLID SLAB (LBS)
3/8"	642	736
1/2"	954	1,128

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SECTION 12

SEISMIC BRACE SUPPORTS & ATTACHMENTS

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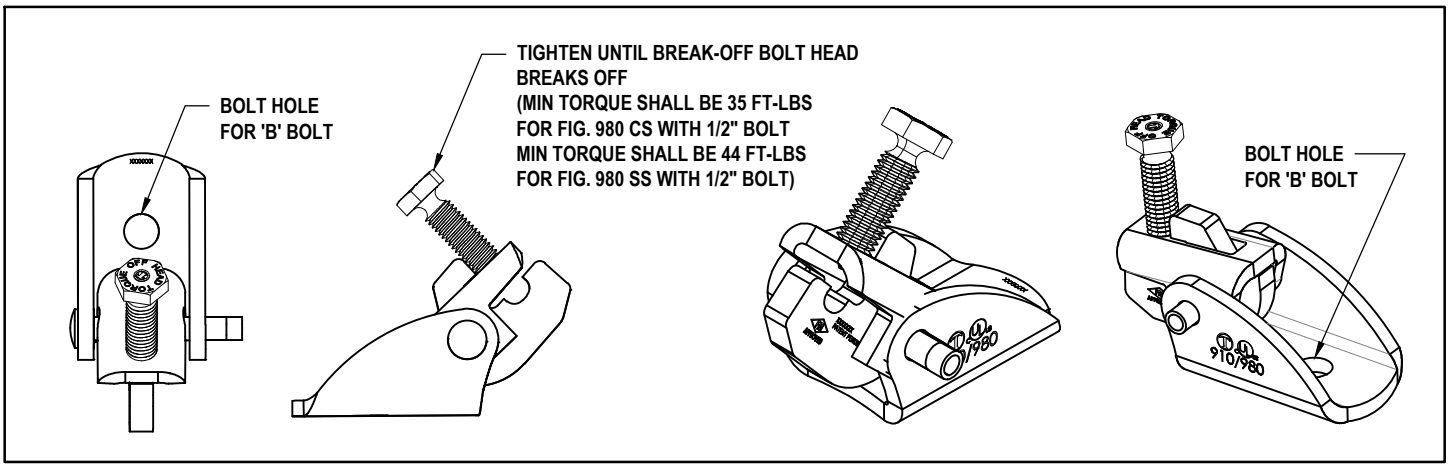
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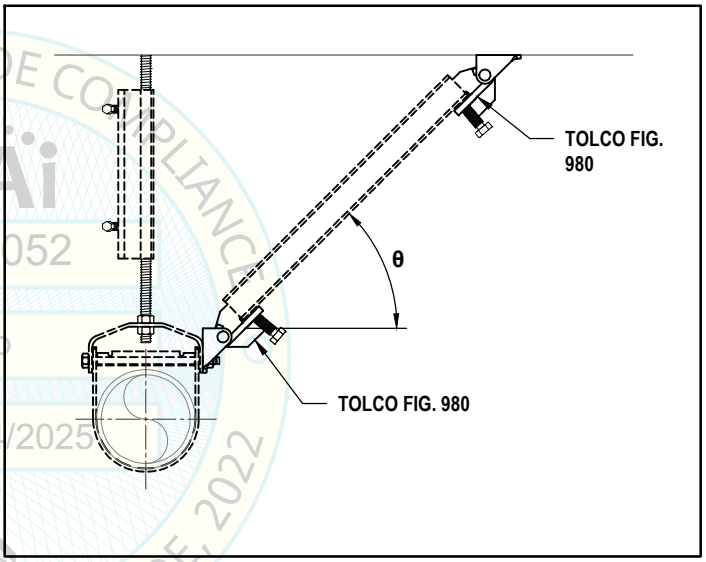
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TOLCO FIG. 980
UNIVERSAL SWIVEL SWAY BRACE ATTACHMENT

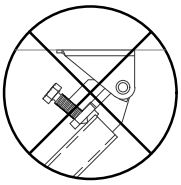


COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
'B' BOLT DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	1,385	1,131	800
1/2" - 3/4"	1,818	1,484	1,050



NOTES:

1. FOR B-LINE B3100 MAXIMUM CROSS BOLT DIAMETER IS 5/8", FOR B-LINE FIG. 4B MAX. BOLT DIAMETER IS 3/4". SEE FIG. 980H FOR LARGER ROD OR BOLT DIAMETER.
2. FOR FIG. 980 MAXIMUM BOLT DIAMETER OF 3/4" IS APPLICABLE FOR CONNECTION TO THE SUPPORTING STRUCTURE.
3. FIG. 980 HOLE DIAMETER SHALL BE 1/16" LARGER THAN ROD OR BOLT DIAMETER.
4. BRACE MAY BE B-LINE B22 SOLID CHANNEL, SCH. 40 STEEL PIPE, OR OTHER APPROVED MEMBERS. SEE PAGE 12-21.
5. MAY BE INSTALLED AT THE STRUCTURE OR AT THE HANGER LOCATION.
6. BOLT SIZE IS MINIMUM 3/8"Ø AND MAXIMUM 3/4"Ø. BOLT HOLE SIZE SHALL BE BOLT DIAMETER PLUS 1/16".



DO NOT BEND BRACE PAST 90°

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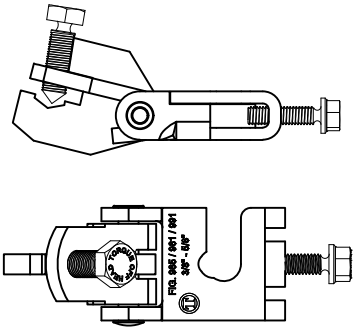
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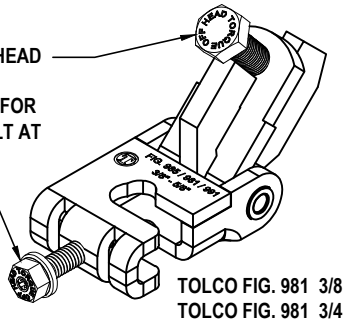
TOLCO FIG. 981
"FAST ATTACH" UNIVERSAL SWIVEL SWAY BRACE ATTACHMENT

VARIATION "A"



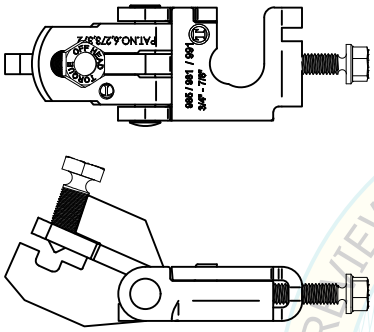
TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF
(MIN TORQUE SHALL BE 35 FT-LBS FOR FIG. 981 WITH 1/2" BREAK-OFF BOLT AT BRACE)

TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF
(MIN TORQUE SHALL BE 11 FT-LBS FOR FIG. 981 WITH 3/8" BREAK-OFF BOLT AT ROD)



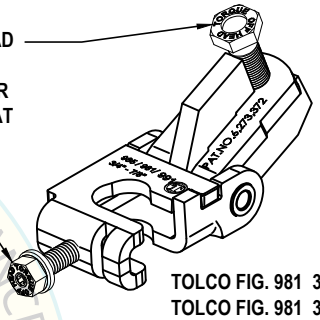
TOLCO FIG. 981 3/8 - 5/8 SHOWN,
TOLCO FIG. 981 3/4 - 7/8 SIMILAR

VARIATION "B"



TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF
(MIN TORQUE SHALL BE 35 FT-LBS FOR FIG. 981 WITH 1/2" BREAK-OFF BOLT AT BRACE)

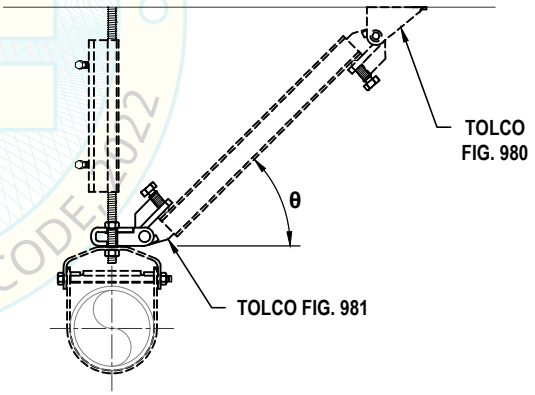
TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF
(MIN TORQUE SHALL BE 11 FT-LBS FOR FIG. 981 WITH 3/8" BREAK-OFF BOLT AT ROD)



TOLCO FIG. 981 3/4 - 7/8 SHOWN,
TOLCO FIG. 981 3/8 - 5/8 SIMILAR

COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)

MIN. ROD DIAMETER	MAX. ROD DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	5/8"	1,385	1,131	800
3/4"	3/4"	1,818	1,484	1,050



NOTES:

1. MAXIMUM ROD DIAMETER IS 3/4". USE FIG. 980H FOR LARGER ROD DIAMETERS .
2. MAXIMUM ROD DIAMETER IS 3/4" FOR CLEVIS HANGERS.
3. BRACE MAY BE B-LINE B22 SOLID CHANNEL, SCH. 40 STEEL PIPE, OR OTHER APPROVED MEMBER. SEE PAGE 12-21.
4. MAY ONLY BE INSTALLED AT HANGER LOCATION, NOT TO THE STRUCTURE AS AN ATTACHMENT.

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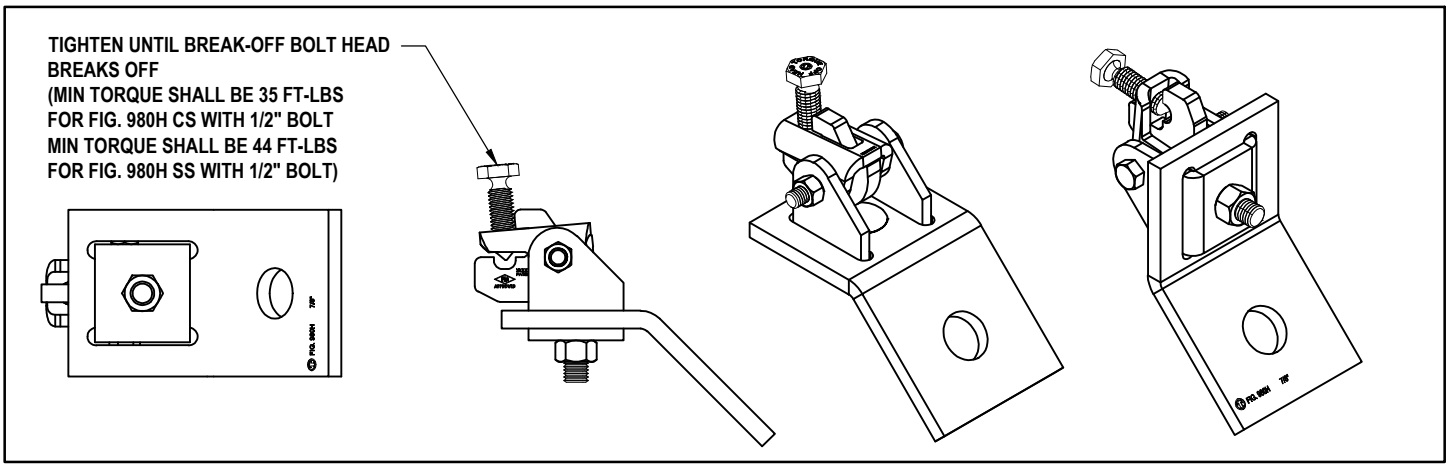
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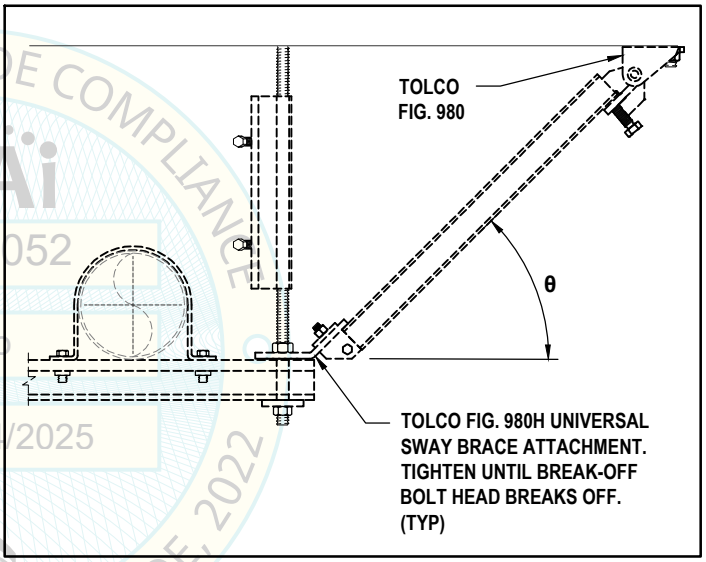
PAGE: 12-2

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TOLCO FIG. 980H
UNIVERSAL SWIVEL SWAY BRACE ATTACHMENT



COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
MIN. ROD OR BOLT DIAMETER	MAX. ROD OR BOLT DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL	
		θ = 45°	θ = 60°
7/8"	1 1/4"	1,401	1,633



NOTES:

1. MAX. ROD OR BOLT DIAMETER IS 7/8" - 1 1/4". USE FIG. 980 FOR SMALLER ROD OR BOLT DIAMETER.
2. FIG. 980H HOLE DIAMETER SHALL BE 1/16" LARGER THAN ROD OR BOLT DIAMETER.
3. BRACE MAY BE B-LINE B22 SOLID CHANNEL, SCH. 40 STEEL PIPE, OR OTHER APPROVED MEMBER. SEE PAGE 12-21.
4. MAY BE INSTALLED AT THE STRUCTURE OR AT THE HANGER LOCATION.

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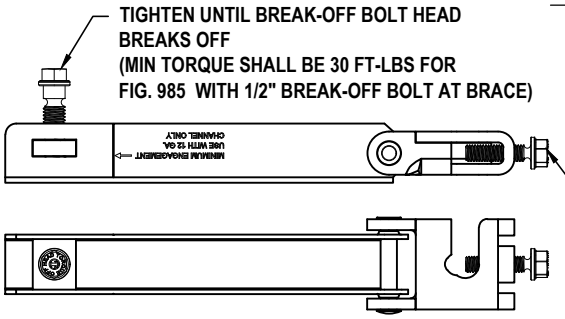
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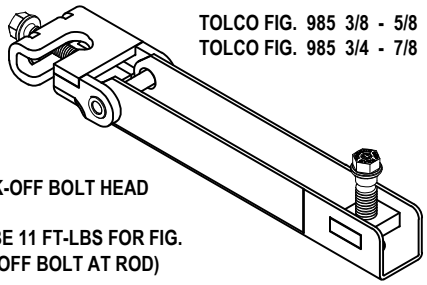
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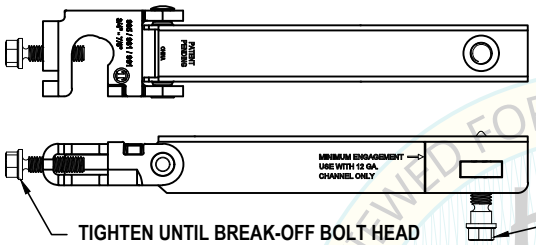
TOLCO FIG. 985
"FAST ATTACH" SWIVEL SWAY BRACE ATTACHMENT

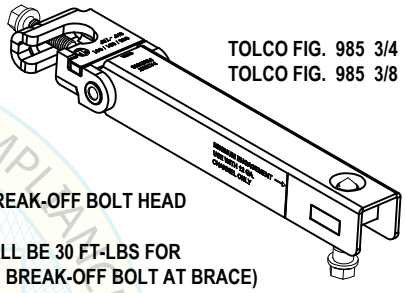
VARIATION "A"



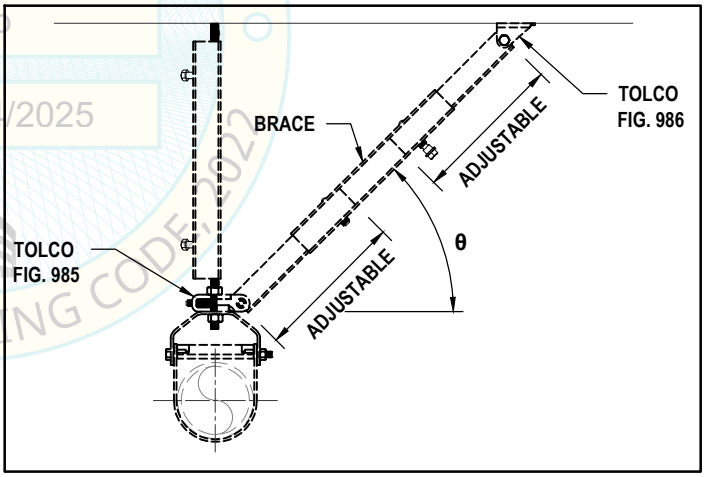


VARIATION "B"





COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)				
MIN. ROD SIZE	MAX. ROD SIZE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
		θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
3/8"	5/8"	1,268	1,010	913
3/4"	7/8"	1,493	1,197	760



NOTES:

1. FOR ROD SIZE 3/8" THRU 5/8" AND 3/4" THRU 7/8".
2. FIG. 985 PROVIDES 6" OF ADJUSTABILITY; 12" WHEN USED IN COMBINATION WITH FIG. 986.
3. BRACE MUST BE B-LINE B22 SOLID CHANNEL. SEE PAGE 12-21.
4. MAY ONLY BE INSTALLED AT HANGER LOCATION, NOT TO THE STRUCTURE.
5. THE FIG. 985 3/8 - 5/8 AND THE FIG. 985 3/4 - 7/8 CAN COME IN BOTH VARIATIONS DEPENDING ON THE TOOLING THAT IS USED TO MAKE THEM. VARIATIONS ARE NOT RELATED TO ATR SIZE BUT RATHER TO THE TOOLING THE ALLOWABLE LOAD TABLE IS APPLICABLE TO BOTH VARIATIONS.

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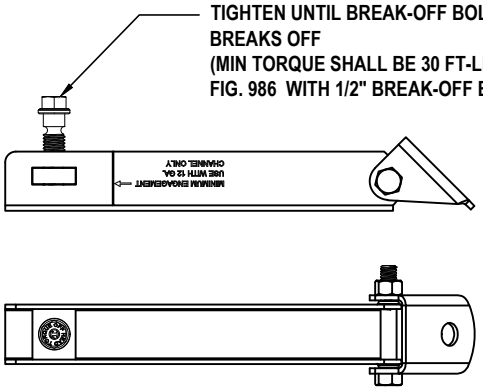
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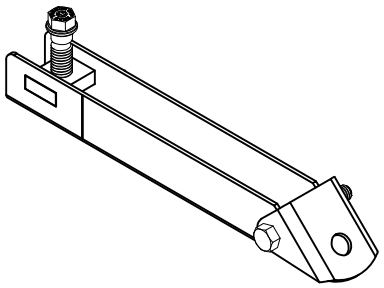
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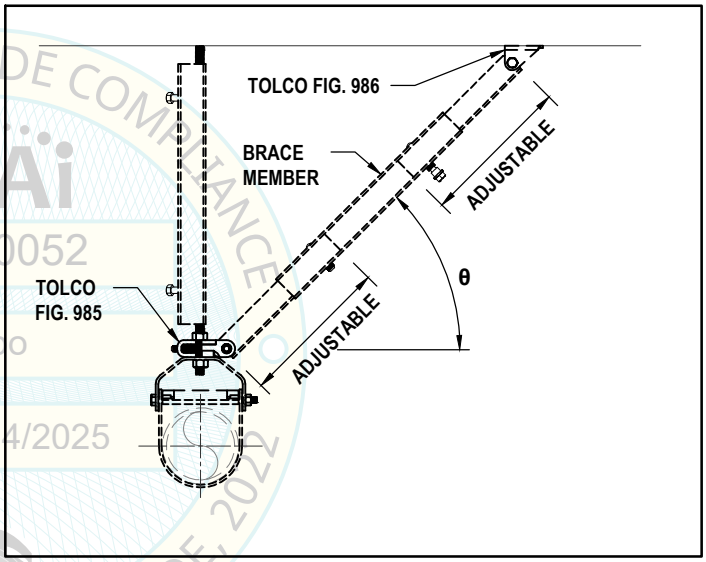
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TOLCO FIG. 986
SWIVEL SWAY BRACE ATTACHMENT



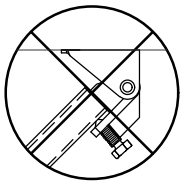


COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
MIN. ROD OR BOLT DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1/2"	1,218	1,347	788



NOTES:

1. FOR ROD SIZE 1/2" THRU 3/4".
2. BOLT HOLE SIZE SHALL BE BOLT DIAMETER PLUS 1/16".
3. FIG. 986 PROVIDES 6" OF ADJUSTABILITY; 12" WHEN USED IN COMBINATION WITH FIG. 985.
4. BRACE MUST BE B-LINE B22 SOLID CHANNEL. SEE PAGE 12-21.
5. MAY BE INSTALLED AT THE STRUCTURE OR AT THE HANGER LOCATION.
6. HOLE FOR FIG. 986 MUST MATCH ROD SIZE.



DO NOT BEND BRACE PAST 90°

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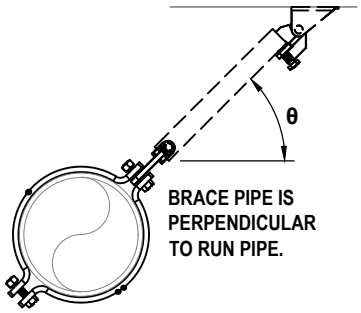
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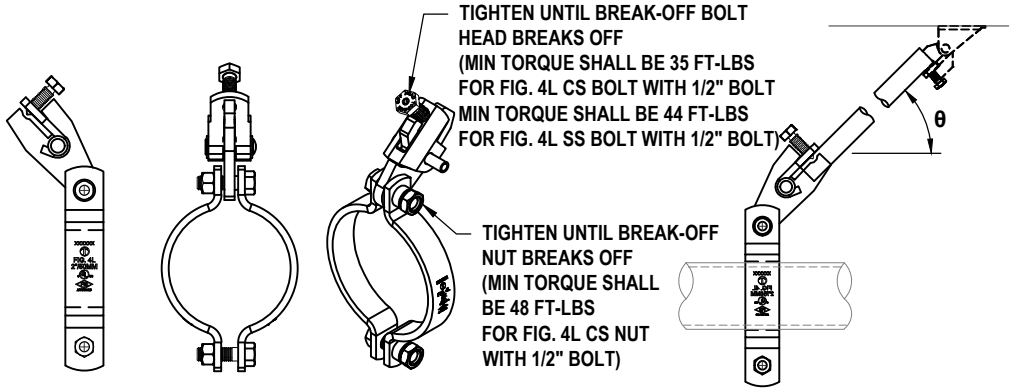
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TOLCO FIG. 4L
"IN-LINE" PIPE CLAMP SWAY BRACE ATTACHMENT

TOLCO FIG. 4L - LATERAL ORIENTATION



TOLCO FIG. 4L - LONGITUDINAL ORIENTATION



LATERAL ORIENTATION (RUN PIPE BRACED LATERALLY)

COMPONENT	PART DESCRIPTION	RUN PIPE SIZE	RUN PIPE REFERENCE	COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD) BRACE ANGLE (θ) MEASURED FROM HORIZONTAL			REMARKS
				θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°	
TOLCO FIG. 4L	TRANSVERSE IN-LINE ATTACHMENT	2 1/2"	SCHED. 10, SCHED. 40	866	707	500	a, c
		3", 4", 5"	SCHED. 10, SCHED. 40	866	707	500	a, c
		6"	SCHED. 10, SCHED. 40	1,039	848	600	a, c
		8"	0.188, SCHED. 40	1,039	848	600	a, b, c

REMARKS:

a. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO SCHEDULE 40 STEEL PIPES.
b. LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKNESS WALL.
c. FM APPROVED WHEN USED W/ 1", 1 1/4", 1 1/2", OR 2" SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.

LONGITUDINAL ORIENTATION (RUN PIPE BRACED LONGITUDINALLY)

COMPONENT	PART DESCRIPTION	RUN PIPE SIZE	RUN PIPE REFERENCE	COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD) BRACE ANGLE (θ) MEASURED FROM HORIZONTAL			REMARKS
				θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°	
TOLCO FIG. 4L	LONGITUDINAL IN-LINE ATTACHMENT	2 1/2"	SCHED. 10, SCHED. 40	1,420	1,180	1,030	a
		3", 4"	SCHED. 10, SCHED. 40	890	730	530	a
		5", 6", 8"	0.188, SCHED. 40	830	680	490	a, b

REMARKS:

a. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO SCHEDULE 40 STEEL PIPES.
b. LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKNESS WALL.

NOTES:

1. BREAK-OFF NUTS FOR 4L SS SHALL NOT BE TORQUED.

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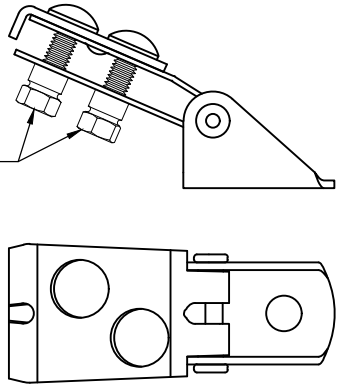
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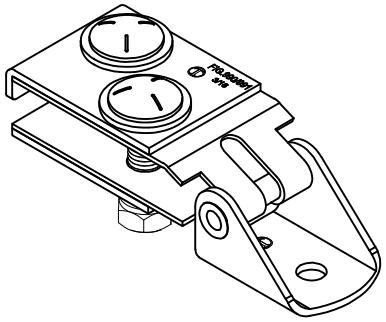
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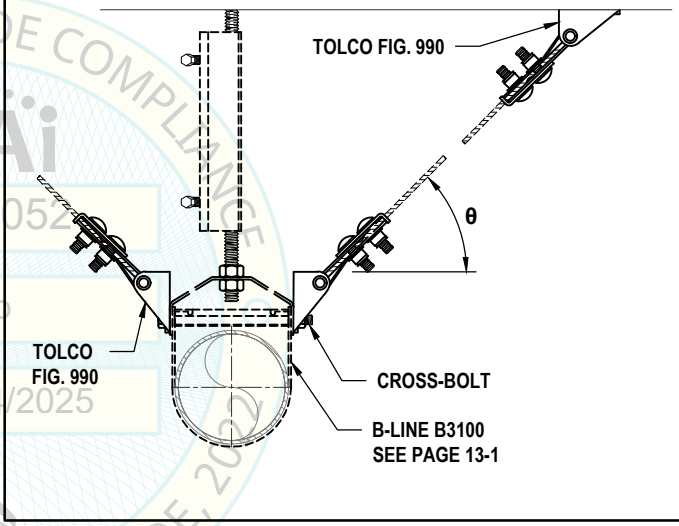
TOLCO FIG. 990
CABLE SWAY BRACE ATTACHMENT



TIGHTEN UNTIL BREAK-OFF NUTS
BREAKS OFF
(MIN TORQUE SHALL BE 21 FT-LBS
FOR FIG. 990 NUTS WITH 3/8" BOLT)



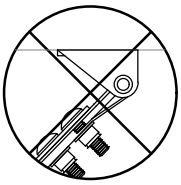
COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
CABLE DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 30°	θ = 31° - 45°	θ = 46° - 60°
1/8"	303	579	380
3/16"	1,197	1,215	799
1/4"	1,570	1,864	1,331



NOTES:

1. USE FIG. 990 FOR MAX. CROSS-BOLT SIZE 5/8".
2. FOR CABLE BRACE SEE PAGE 12-21.
3. 1/8" AND 3/16" CABLE REQUIRE A MINIMUM OF 3/8" CLEVIS CROSS BOLT. 1/4" CABLE REQUIRES A MINIMUM OF 1/2" CLEVIS CROSS BOLT.
4. FOR FIG. B3100, MINIMUM CROSS BOLT SHALL BE 3/8"Ø FOR USE WITH FIG. 990.
5. PRE-STRETCHED GALVANIZED, 7 x 19, AIRCRAFT CABLE SHALL BE IN COMPLIANCE WITH ASTM A1023..
6. TOLCO FIG. 990 IS NOT ALLOWED TO BE ATTACHED TO CLEVIS HANGER RODS.

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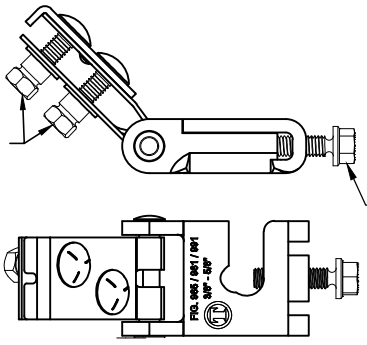
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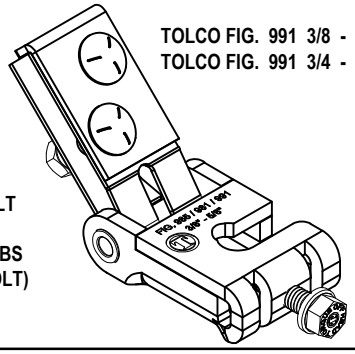
TOLCO FIG. 991
"FAST ATTACH" CABLE SWAY BRACE ATTACHMENT

VARIATION "A"



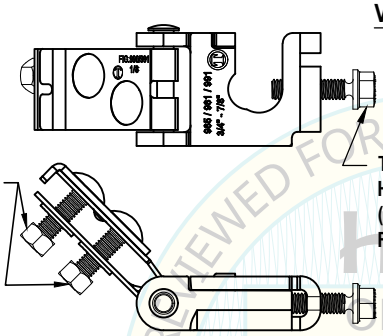
TIGHTEN UNTIL BREAK-OFF NUTS BREAKS OFF (MIN TORQUE SHALL BE 21 FT-LBS FOR FIG. 991 NUTS WITH 3/8" BOLT)

TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF (MIN TORQUE SHALL BE 11 FT-LBS FOR FIG. 991 BOLT WITH 3/8" BOLT)



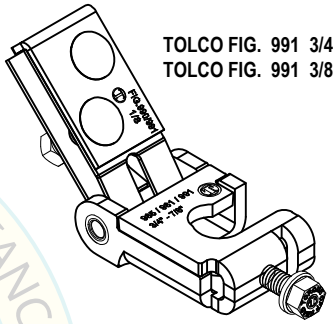
TOLCO FIG. 991 3/8 - 5/8 SHOWN, TOLCO FIG. 991 3/4 - 7/8 SIMILAR

VARIATION "B"



TIGHTEN UNTIL BREAK-OFF NUTS BREAKS OFF (MIN TORQUE SHALL BE 21 FT-LBS FOR FIG. 991 NUTS WITH 3/8" BOLT)

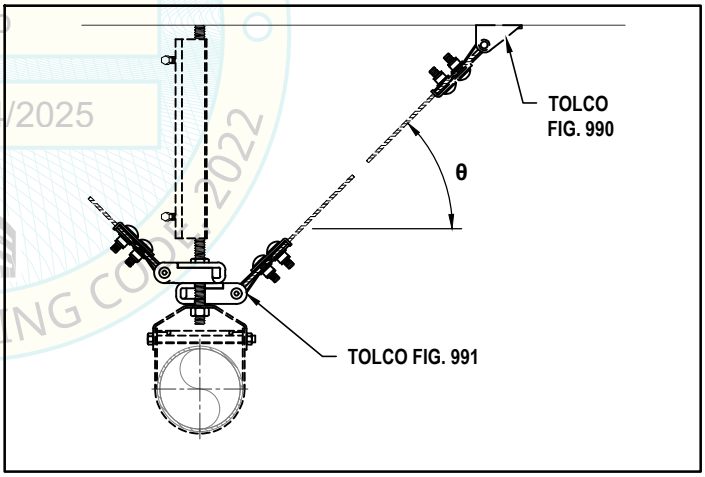
TIGHTEN UNTIL BREAK-OFF BOLT HEAD BREAKS OFF (MIN TORQUE SHALL BE 11 FT-LBS FOR FIG. 991 BOLT WITH 3/8" BOLT)



TOLCO FIG. 991 3/4 - 7/8 SHOWN, TOLCO FIG. 991 3/8 - 5/8 SIMILAR

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COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
CABLE DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
1/8"	943	579	380
3/16"	1,359	1,215	799
1/4"	1,450	1,528	1,331



NOTES:

1. USE FIG. 991 FOR MAX. ROD SIZE 3/4".
2. FOR CABLE BRACE SEE PAGE 12-21.
3. MINIMUM 3/8" CLEVIS CROSS BOLT FOR 1/8" AND 3/16" CABLES. MINIMUM 5/8" CLEVIS CROSS BOLT FOR 1/4" CABLES.
4. PRE-STRETCHED GALVANIZED, 7 X19, AIRCRAFT CABLE SHALL BE IN COMPLIANCE WITH ASTM A1023.
5. THE FIG. 991 3/8" - 5/8" AND THE FIG. 991 3/4" - 7/8" CAN COME IN BOTH VARIATIONS DEPENDING ON THE TOOLING THAT IS USED TO MAKE THEM. VARIATIONS ARE NOT RELATED TO ATR SIZE BUT RATHER TO THE TOOLING THE ALLOWABLE LOAD TABLE IS APPLICABLE TO BOTH VARIATIONS.

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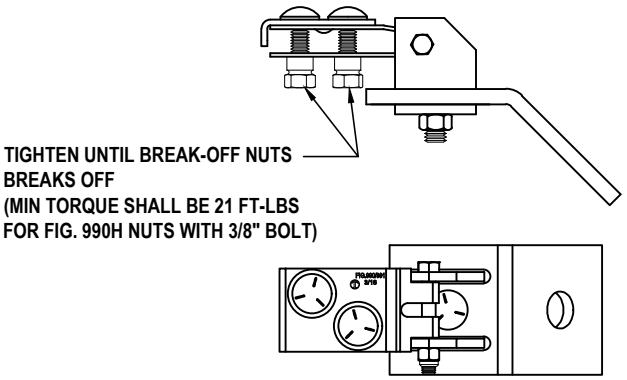
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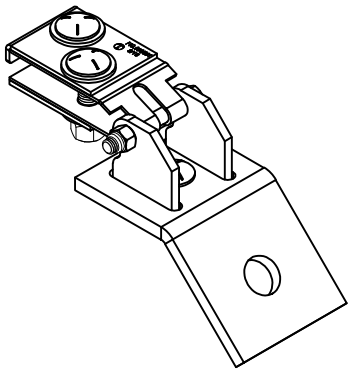
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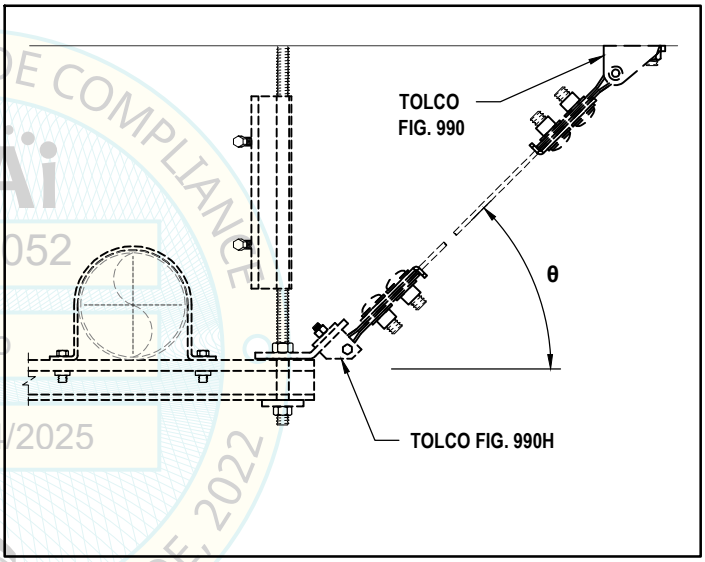
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TOLCO FIG. 990H
CABLE SWIVEL SWAY BRACE ATTACHMENT





COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
CABLE DIAMETER	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
1/4"	1,139	1,465	1,331



NOTES:

1. USE FIG 990H FOR ROD SIZE 7/8" AND LARGER (USE FIG. 990 FOR SMALLER ROD DIAMETERS).
2. FOR CABLE BRACE SEE PAGE 12-21.
3. PRE-STRETCHED GALVANIZED , 7 x 19, AIRCRAFT CABLE SHALL BE IN COMPLIANCE WITH ASTM A1023.
4. 1/4" CABLE REQUIRED A MINIMUM OF 7/8" CONNECTION.

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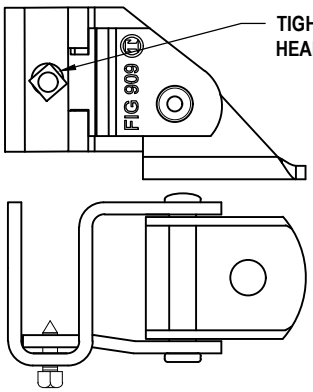
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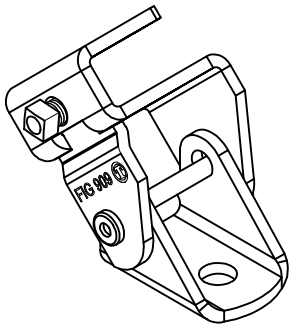
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TOLCO FIG. 909
NO THREAD SWIVEL SWAY BRACE ATTACHMENT

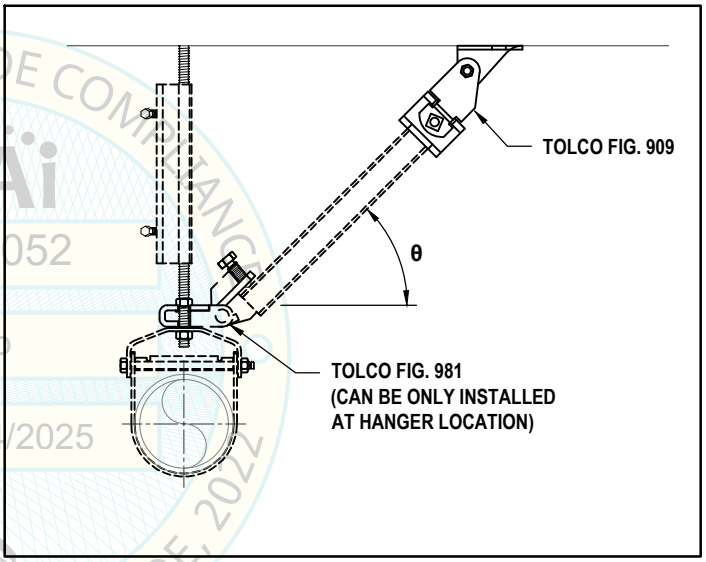


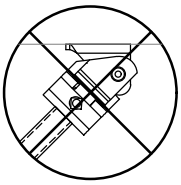


COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
MINIMUM BOLT SIZE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
1/2"	1,186	968	685

NOTES:

1. USE FIG. 981 FOR MAX. ROD SIZE 3/4" FOR CLEVIS HANGER, FOR LARGER ROD DIAMETERS USE FIG. 980H.
2. BRACE MEMBER, 1" STEEL PIPE, MUST BE SCH10 OR SCH40. SEE PAGE 12-21.





DO NOT BEND
BRACE PAST 90°

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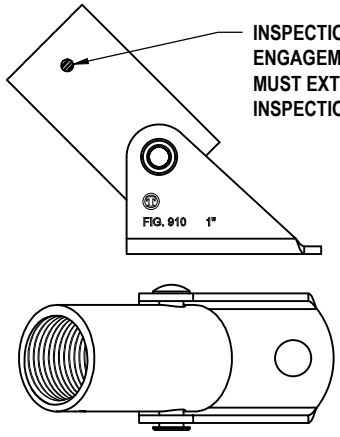
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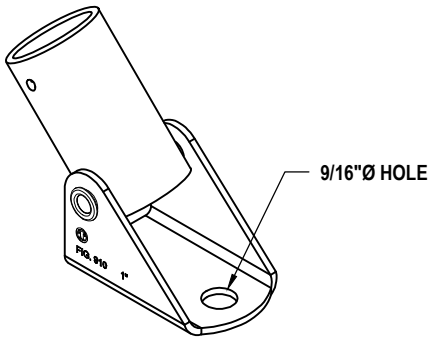
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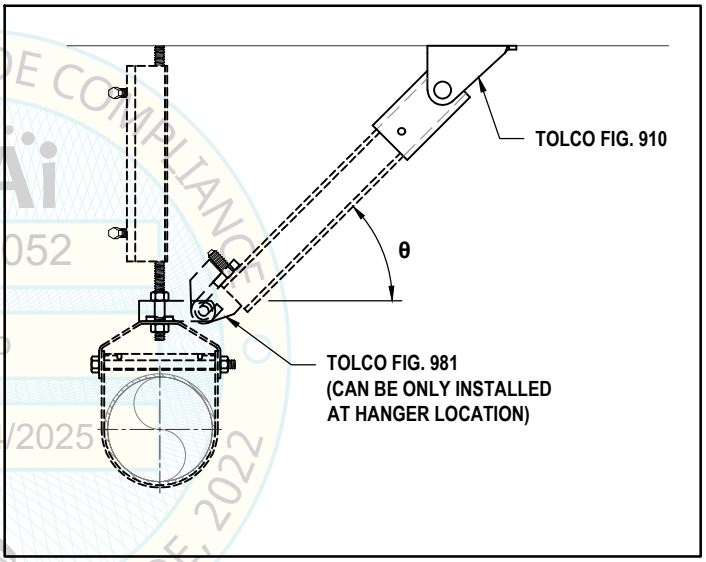
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TOLCO FIG. 910
SWIVEL SWAY BRACE FITTING





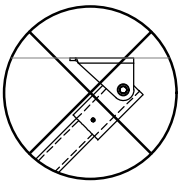
COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)			
BOLT SIZE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL		
	θ = 0° - 30°	θ = 31° - 45°	θ = 46° - 60°
1/2"	1,386	1,132	800



NOTES:

1. FOR BRACE PIPE SIZES LARGER THAN 1", USE FIG. 980.
2. FOR FIG. 910, ANCHOR SIZE SHALL BE 1/2"Ø.
3. BRACE MEMBER, 1" STEEL PIPE, MUST BE SCH40. SEE PAGE 12-21.

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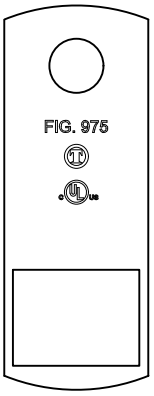
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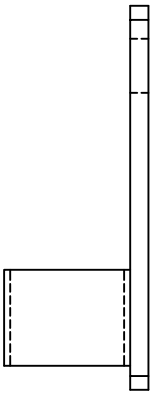
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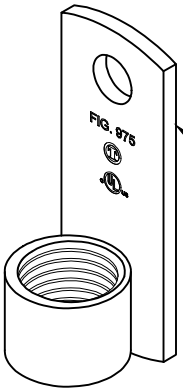
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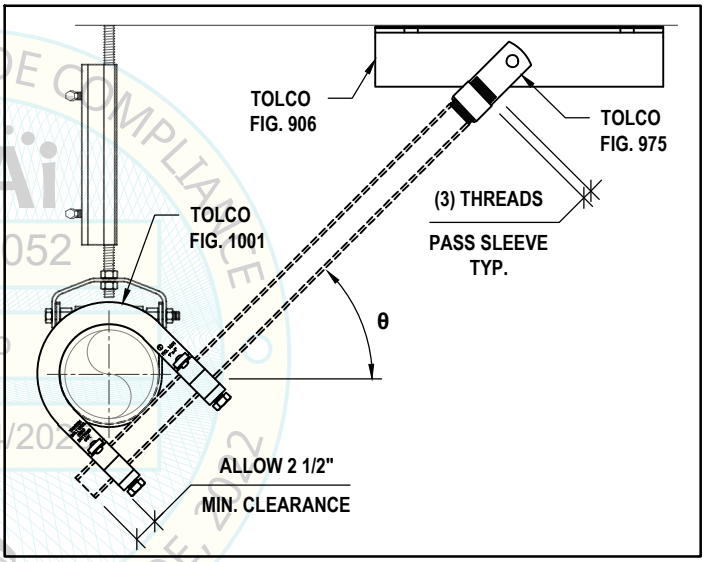
TOLCO FIG. 975
STRAIGHT SWAY BRACE FITTING







COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)	
BOLT SIZE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL
	θ = 0° - 60°
1/2" - 3/4"	1,050



NOTES:

1. FOR BRACE PIPE SIZES LARGER THAN 1", USE FIG. 980.
2. USE FIG. 975 FOR MAX. BOLT SIZE OF 3/4".
3. BOLT HOLE SHALL BE BOLT DIAMETER PLUS 1/16".
4. BRACE MEMBER, 1" STEEL PIPE, MUST BE SCH40. SEE PAGE 12-21.

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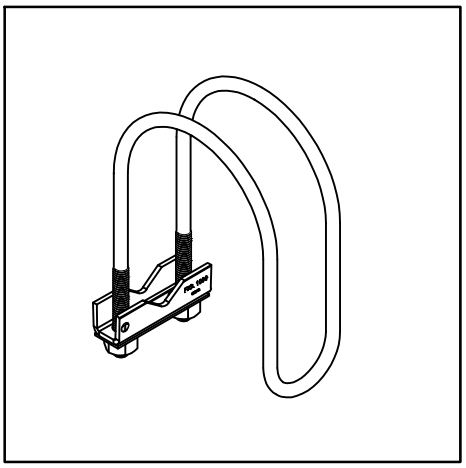
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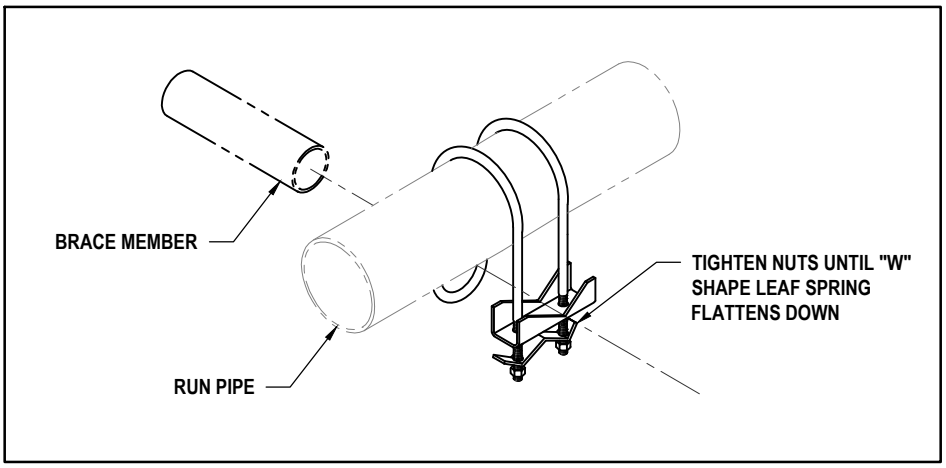
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TOLCO FIG. 1000
FAST CLAMP

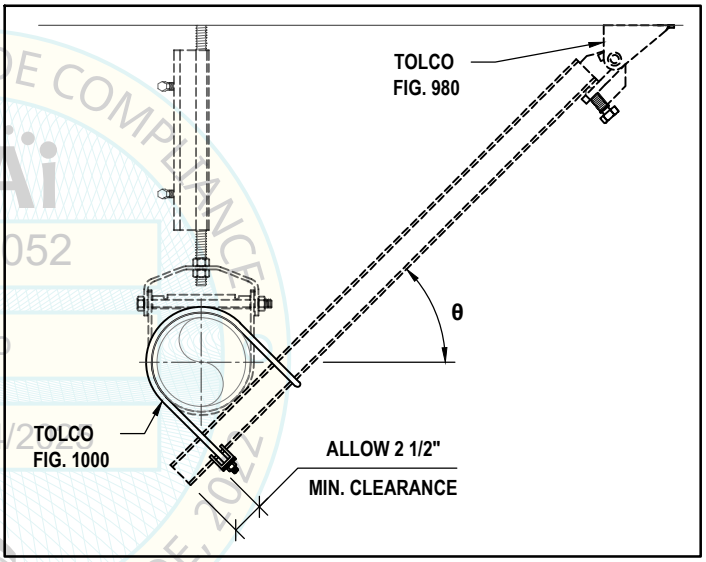




COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)				
RUN PIPE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL			REMARKS
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
1.25" - 2.5" SCHEDULE 10/40	340	280	200	a, b
3" - 4" SCHEDULE 10/40	400	320	230	a, b

REMARKS

a. FM APPROVED WHEN USED WITH 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.



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NOTES:

1. FIG. 1000 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. FIG. 1000 MAY BE INSTALLED SUCH THAT NUTS ARE ON THE OPPOSITE SIDE THAN AS SHOWN.

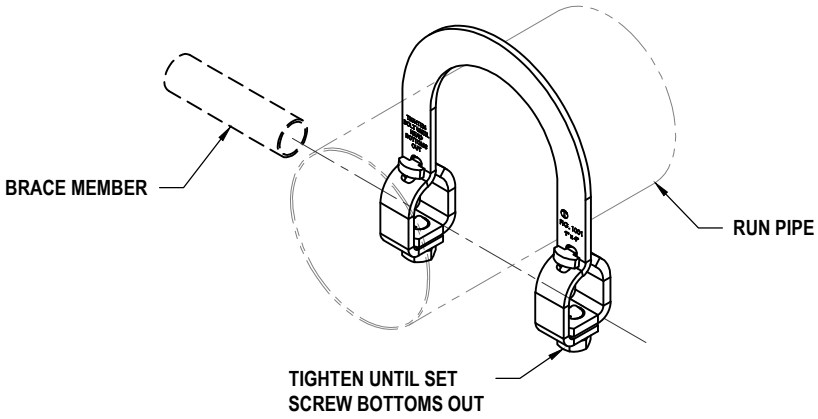
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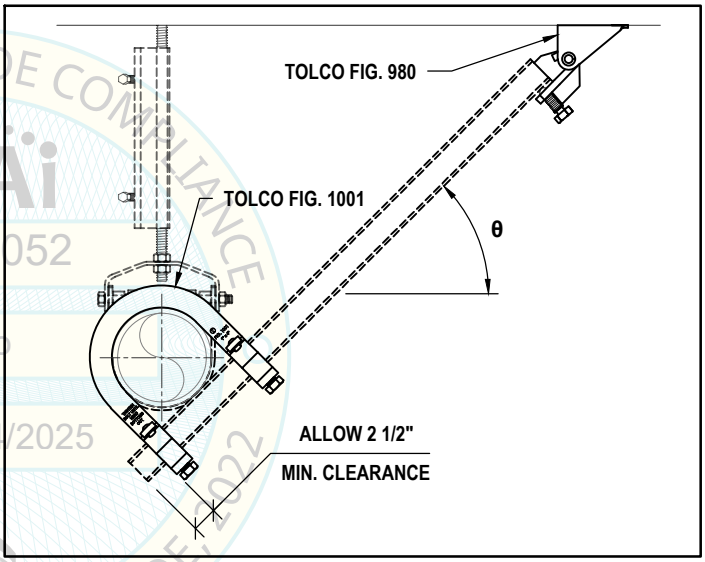
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TOLCO FIG. 1001
SWAY BRACE ATTACHMENT



COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)				
RUN PIPE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL			REMARKS
	θ = 0°- 30°	θ = 31°- 45°	θ = 46°- 60°	
1" SCHEDULE 10/40	3,120	2,550	1,800	a, b
1-1/4" - 2" SCHEDULE 10/40	2,140	1,740	1,230	a, b
2-1/2" SCHEDULE 10/40	1,380	1,130	800	a, b
3" - 4" SCHEDULE 10/40	1,470	1,200	850	a, b
5" - 8" SCHEDULE 10/40	890	730	510	a, b



REMARKS

a. FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255M AND H, JIS G3454, FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.

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NOTES:

1. FIG. 1001 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
3. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THIN WALL PIPE AND SCHEDULE 40 STEEL PIPES.

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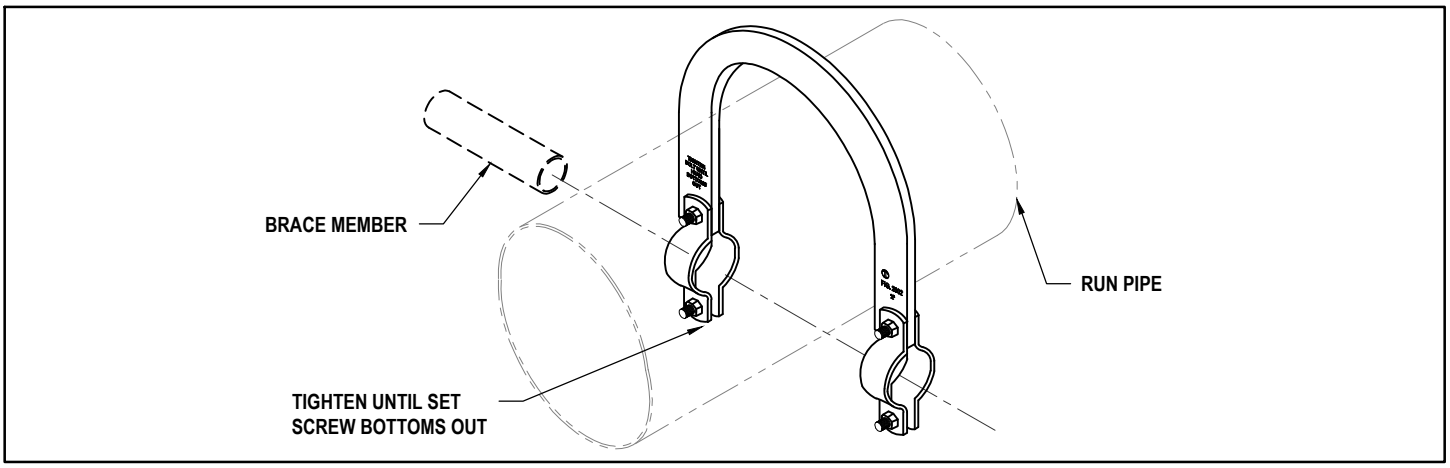
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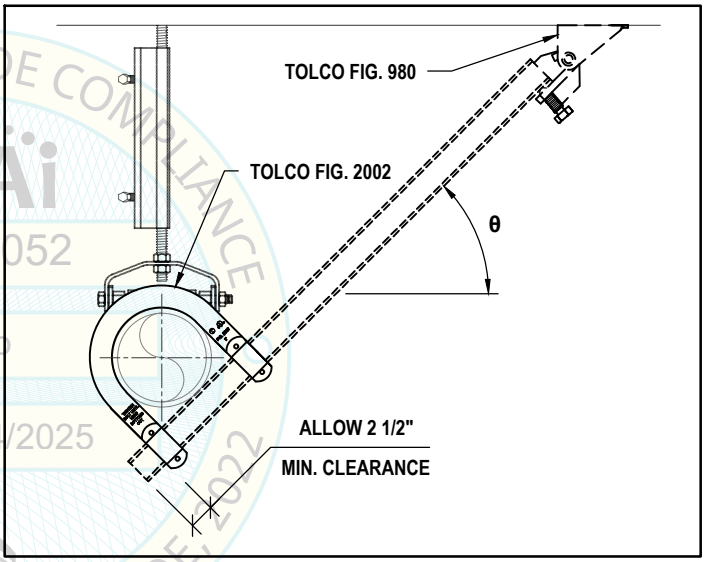
TOLCO FIG. 2002
SWAY BRACE ATTACHMENT



COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)		
RUN PIPE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL	REMARKS
	θ = 0°- 60°	
2-1/2", 3, 3-1/2" SCHEDULE 10	1,000	a, b
4", 5", 6", 8" SCHEDULE 10	1,000	a, b

REMARKS

a. FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b. LOAD RATING FOR SCHEDULE 10 RUN PIPES ABOVE MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255M AND H, JIS G3454, FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.



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NOTES:

1. FIG. 2002 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
3. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THIN WALL PIPE AND SCHEDULE 40 STEEL PIPES.

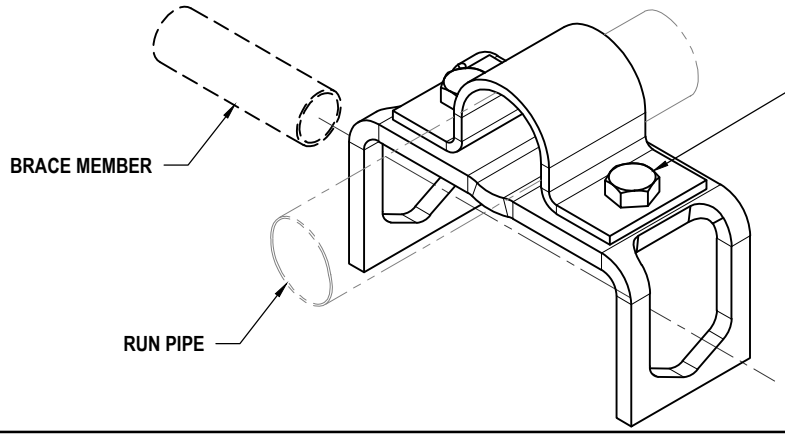
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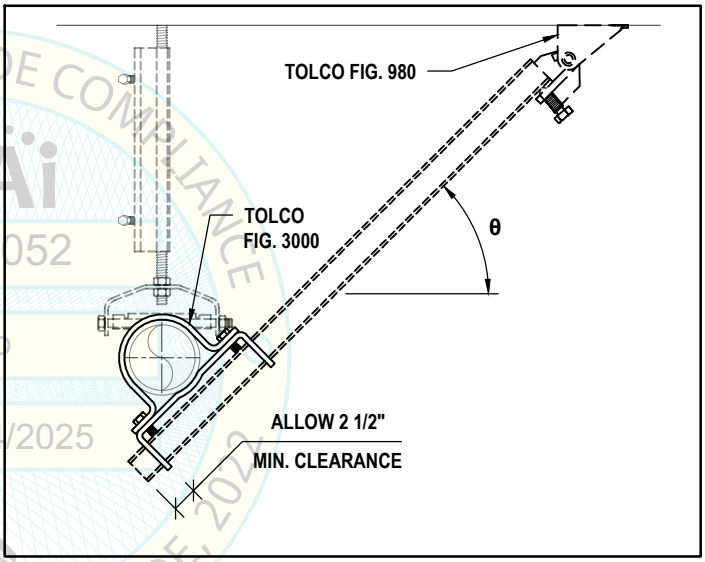
TOLCO FIG. 3000
SWAY BRACE ATTACHMENT



COMPONENT ALLOWABLE HORIZONTAL LOAD (LBS)(ASD)		
RUN PIPE	BRACE ANGLE (θ) MEASURED FROM HORIZONTAL	REMARKS
	θ = 0°- 60°	
1" SCHEDULE 40	350	a, b
1-1/4", 1-1/2", 2", 2-1/2", 3" SCHEDULE 10	350	a, b

REMARKS

a. WHEN USED WITH 1 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b. LOAD RATING FOR SCHEDULE 10 RUN PIPES ABOVE MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255M AND H, JIS G3454, FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.



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NOTES:

1. FIG. 3000 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. WHEN USED WITH 1 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
3. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO THIN WALL PIPE AND SCHEDULE 40 STEEL PIPES.

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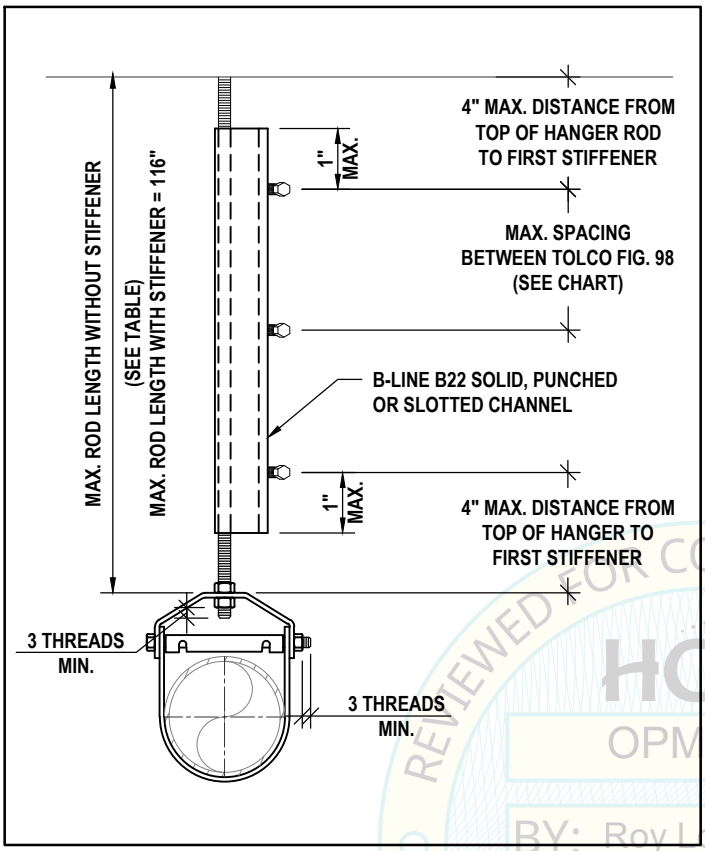
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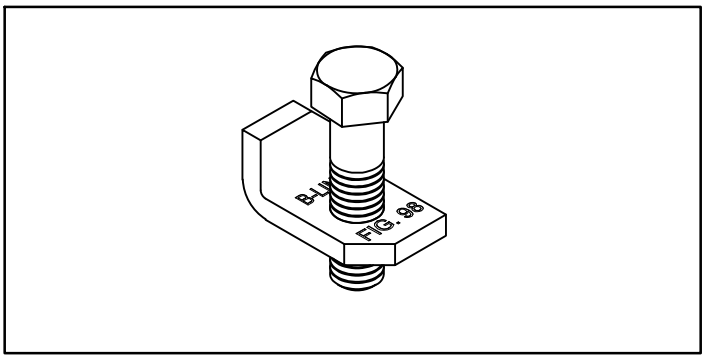
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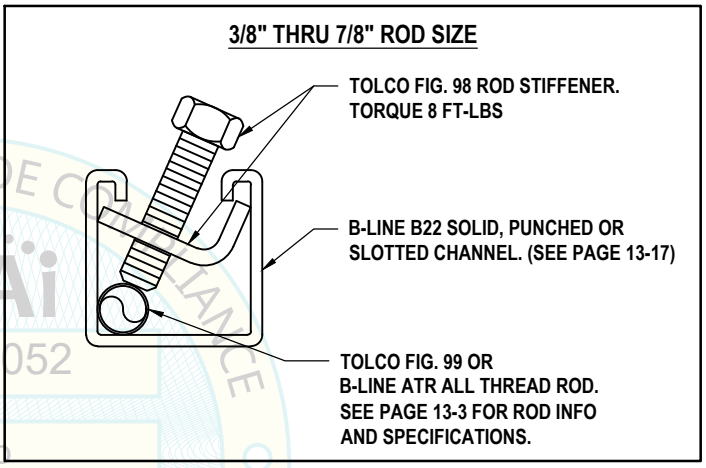
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TOLCO FIG. 98
ROD STIFFENER







ROD SIZE	MAX. ROD LENGTH WITHOUT ROD STIFFENER	MAX. COMPRESSION FORCE WITHOUT STIFFENER (ASD)	MAX. SPACING BETWEEN TOLCO FIG. 98	MAX. COMPRESSION FORCE WITH STIFFENER (ASD)
3/8"	18"	410	13"	1,246
1/2"	25"	730	18"	2,105
5/8"	31"	1,160	23"	3,187
3/4"	37"	1,690	28"	4,493
7/8"	43"	2,320	33"	6,021

NOTES:

1. ROD STIFFENERS ARE REQUIRED ONLY ON VERTICAL STRUT COMPONENT OF THE SEISMIC BRACE SYSTEM ON HANGER AND TRAPEZE ASSEMBLIES THAT HAVE SEISMIC BRACING BRACING ATTACHED AT OR WITHIN 6" OF THE ROD. A MINIMUM OF TWO ROD STIFFENERS (TOLCO FIG. 98) MUST BE INSTALLED.
2. DETAIL APPLIES TO ALL HUNG UTILITIES INCLUDING SINGLE HUNG UTILITIES, TRAPEZE HUNG UTILITIES, AND HUNG EQUIPMENT.
3. AN EXCEPTION IS THE USE OF TWO OPPOSING RIGID BRACES AT THE SAME LOCATION. FOR INDIVIDUALLY HUNG PIPE THE TWO OPPOSING RIGID BRACES MUST BE AT THE SAME HANGER ROD; TOTAL OF TWO (2) FOR TRANSVERSE, OR TWO (2) FOR LONGITUDINAL. FOR A TRAPEZE HANGER THE TWO OPPOSING RIGID BRACES MUST BE AT THE SAME HANGER ROD; TOTAL OF TWO (2) FOR TRANSVERSE, OR FOUR (4) FOR LONGITUDINAL. THE TWO OPPOSING BRACES MUST BE AT THE SAME ANGLE FROM HORIZONTAL AND WITHIN 5-DEGREES OF 180 DEGREES FROM EACH OTHER. IN THIS CASE NO STIFFENING OF VERTICAL ROD IS NECESSARY.
4. MATERIAL SPECIFICATIONS FOR TOLCO FIG. 98, BODY: ASTM A-1011-CS TYPE B SAE 1006, BOLT: HEX BOLT GRADE 5

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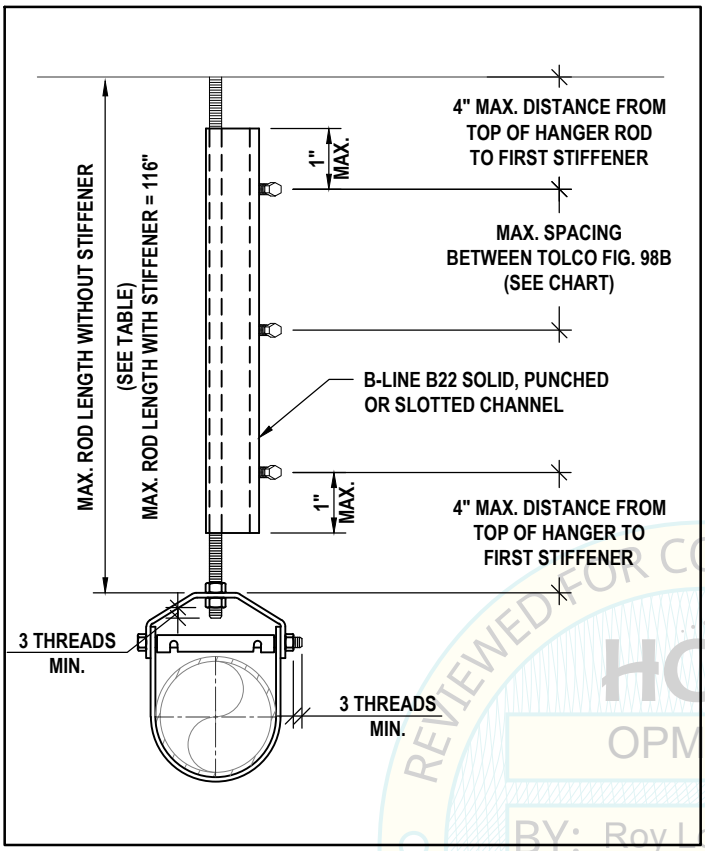
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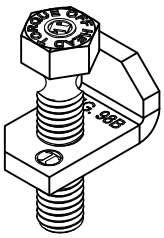
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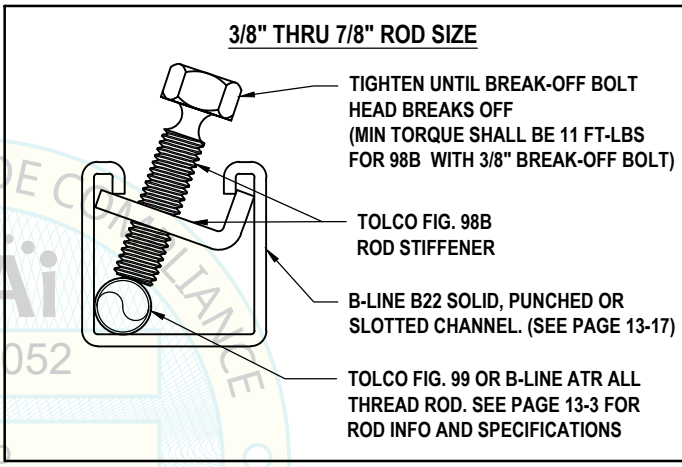
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TOLCO FIG. 98B
ROD STIFFENER







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ROD SIZE	MAX. ROD LENGTH WITHOUT ROD STIFFENER	MAX. COMPRESSION FORCE WITHOUT STIFFENER (ASD)	MAX. SPACING BETWEEN TOLCO FIG. 98	MAX. COMPRESSION FORCE WITH STIFFENER (ASD)
3/8"	18"	410	13"	1,246
1/2"	25"	730	18"	2,105
5/8"	31"	1,160	23"	3,187
3/4"	37"	1,690	28"	4,493
7/8"	43"	2,320	33"	6,021

NOTES:

1. ROD STIFFENERS ARE REQUIRED ONLY ON VERTICAL STRUT COMPONENT OF THE SEISMIC BRACE SYSTEM ON HANGER AND TRAPEZE ASSEMBLIES THAT HAVE SEISMIC BRACING BRACING ATTACHED AT OR WITHIN 6" OF THE ROD. A MINIMUM OF TWO ROD STIFFENERS (TOLCO FIG. 98B) MUST BE INSTALLED.
2. DETAIL APPLIES TO ALL HUNG UTILITIES INCLUDING SINGLE HUNG UTILITIES, TRAPEZE HUNG UTILITIES, AND HUNG EQUIPMENT.
3. AN EXCEPTION IS THE USE OF TWO OPPOSING RIGID BRACES AT THE SAME LOCATION. FOR INDIVIDUALLY HUNG PIPE THE TWO OPPOSING RIGID BRACES MUST BE AT THE SAME HANGER ROD; TOTAL OF TWO (2) FOR TRANSVERSE, OR TWO (2) FOR LONGITUDINAL. FOR A TRAPEZE HANGER THE TWO OPPOSING RIGID BRACES MUST BE AT THE SAME HANGER ROD; TOTAL OF TWO (2) FOR TRANSVERSE, OR FOUR (4) FOR LONGITUDINAL. THE TWO OPPOSING BRACES MUST BE AT THE SAME ANGLE FROM HORIZONTAL AND WITHIN 5-DEGREES OF 180 DEGREES FROM EACH OTHER. IN THIS CASE NO STIFFENING OF VERTICAL ROD IS NECESSARY.
4. MATERIAL SPECIFICATIONS FOR TOLCO FIG. 98B, BODY: ASTM A-1011 CS TYPE B SAE; BREAK-OFF BOLT: 1035 (AISI-SAE) CASE HARDENED TO 0.015 MIN. DEPTH THRU HARDENED @ 45-55 RC FROM ANNEALED CONDITION.

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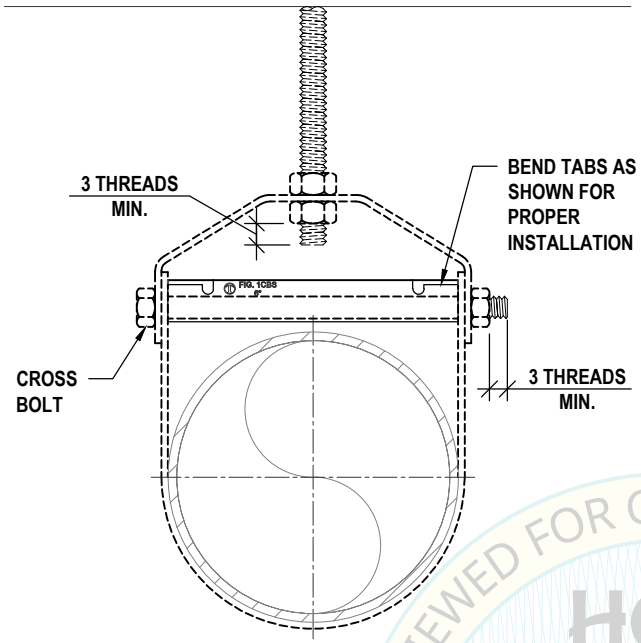
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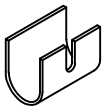
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TOLCO FIG. 1CBS
CROSS BOLT SPACER

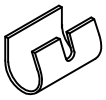


FOR PIPE SIZES UP TO 1 1/2"

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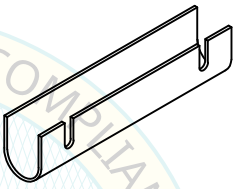


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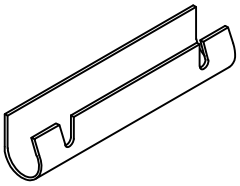


FOR PIPE SIZES 2" AND UP

UNINSTALLED



INSTALLED



NOTES:

1. CROSS BOLT SPACER ONLY REQUIRED AT SEISMIC BRACING LOCATIONS.
2. COSS BOLT SPACER ONLY TO BE USED WITH TOLCO FIG. 1 OR B-LINE B3100.
3. SIZE OF CROSS BOLT IDENTIFIED ON PAGE 13-1.

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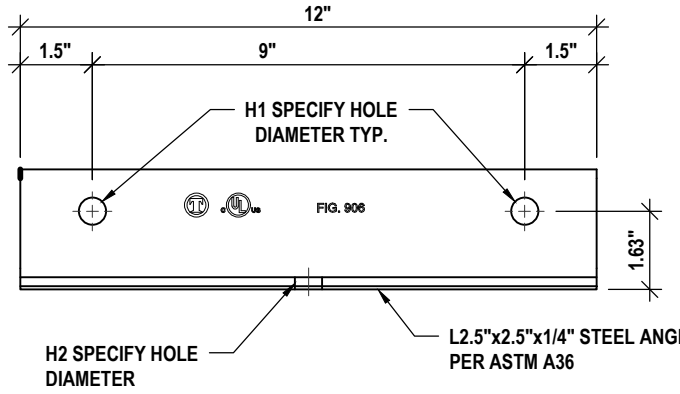
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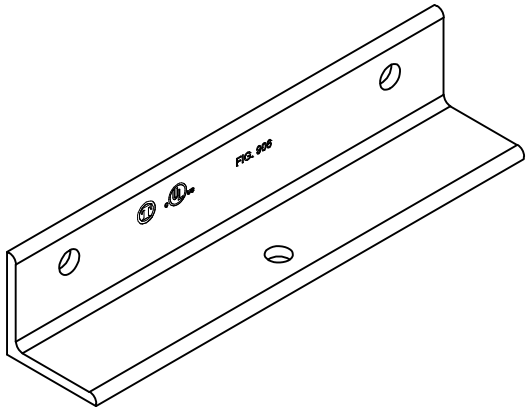
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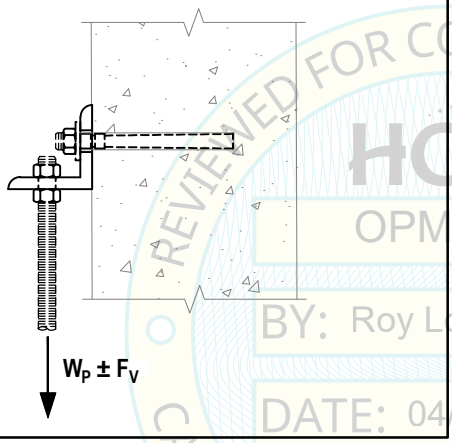
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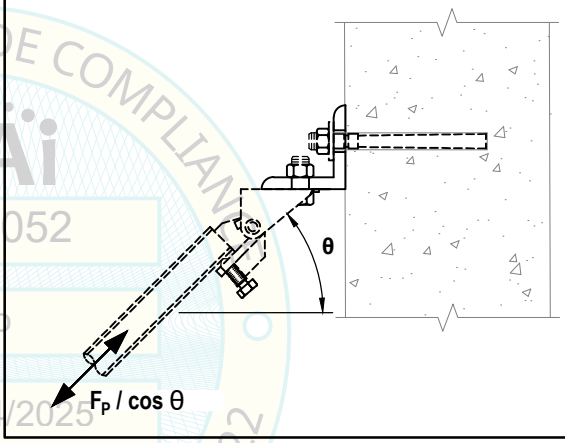
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TOLCO FIG. 906
SWAY BRACE MULTI-FASTENER ADAPTER









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NOTES:

1. FOR DESIGN LOADS SEE STRUCTURAL ATTACHMENT SECTION 11.
2. HOLE DIAMETER TO BE 1/16" MAX. GREATER THAN BOLT DIAMETER, PER AISC 360-16.
3. H1 AND H2 13/16" DIAMETER MAX.

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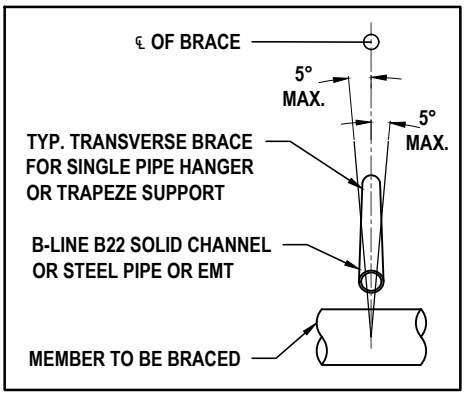
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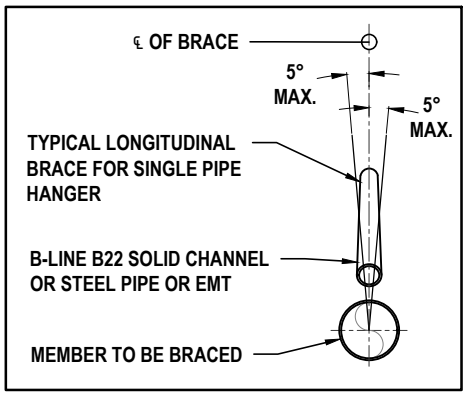
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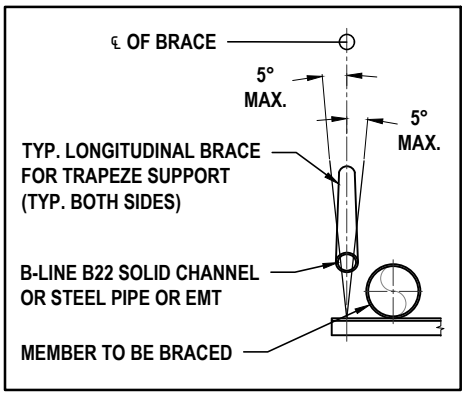
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MAXIMUM ALLOWABLE LENGTHS AND HORIZONTAL LOADS FOR BRACE MEMBERS







BRACING MEMBER (STEEL PIPE)					
PIPE DIA.	MAX. LENGTH	SCHED.	ALLOWABLE HORIZONTAL SEISMIC LOAD (LBS)(ASD)		
			BRACE ANGLE MEASURED FROM HORIZONTAL		
			0° - 30°	31° - 45°	46° - 60°
SEISMIC BRACING KL/R = 200					
1"	7'-0"	40	1,085	852	560
1-1/4"	9'-0"	40	1,454	1,141	750
1-1/2"	10'-4"	40	1,778	1,395	917
2"	13'-1"	40	2,396	1,880	1,236
3"	19'-6"	10	3,109	2,439	1,604
3-1/2"	22'-4"	10	3,490	2,738	1,800
4"	24'-0"	10	3,924	3,079	2,024

BRACING MEMBER (EMT)				
EMT DIA.	MAX. LENGTH	ALLOWABLE HORIZONTAL SEISMIC LOAD (LBS)(ASD)		
		BRACE ANGLE MEASURED FROM HORIZONTAL		
		0° - 30°	31° - 45°	46° - 60°
SEISMIC BRACING KL/R = 200				
1"	6'-0"	455	350	225
1-1/2"	9'-0"	766	607	388
2"	12'-0"	963	746	492

BRACING MEMBER (STRUT)				
STRUT SIZE	MAX. LENGTH	ALLOWABLE HORIZONTAL SEISMIC LOAD (LBS)(ASD)		
		BRACE ANGLE MEASURED FROM HORIZONTAL		
		0° - 30°	31° - 45°	46° - 60°
SEISMIC BRACING KL/R = 200				
B-LINE B22	9'-6"	1,180	926	609
BLINE B24	9'-6"	668	524	344

BRACING MEMBER (CABLE)				
PRE-STRETCHED GALVANIZED 7x19 AIRCRAFT CABLE DIAMETER	MAX. LENGTH	ALLOWABLE HORIZONTAL SEISMIC LOAD (LBS)(ASD)		
		BRACE ANGLE MEASURED FROM HORIZONTAL		
		0° - 30°	31° - 45°	46° - 60°
1/8"	∞	737	579	380
3/16"	∞	1,548	1,215	799
1/4"	∞	2,580	2,025	1,331

NOTES:

1. ALL LONGITUDINAL AND TRANSVERSE BRACING UTILIZING PIPE OR CHANNEL AS THE BRACING MEMBER HAS A TOLERANCE OF 5° FROM CENTER IN ANY PLANE WITHOUT AFFECTING THE ALLOWABLE LOADS.
2. TABULATED LOADS ARE SUBJECT TO LIMITS GOVERNED BY THE CAPACITY OF THE PRIMARY STRUCTURE, INCLUDING BUT NOT LIMITED TO, THE CONCRETE FILL OVER METAL DECK. CAPACITY PER THE CONTRACT DOCUMENTS.
3. STEEL PIPE PER ASTM A53 TYPE E GRADE B.
4. "MAXIMUM LENGTH" IS MEASURED FROM ENDS OF PIPE, OR ENDS OF STRUT, OR FROM ATTACHMENTS OF CABLE.
5. PRE-STRETCHED GALVANIZED , 7 X19, AIRCRAFT CABLE SHALL BE IN COMPLIANCE WITH ASTM A1023.

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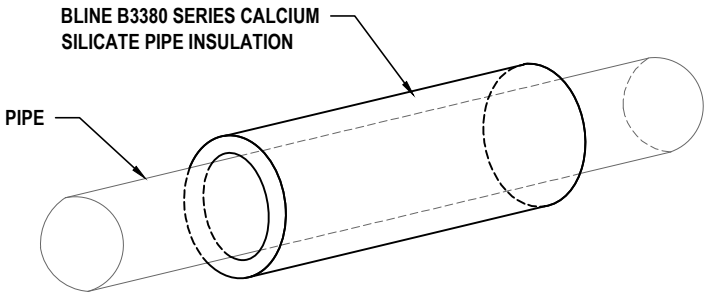
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BLINE B3380 SERIES
CALCIUM SILICATE PIPE INSULATION



NOTES:

1. PIPE SIZE 1" - 3" B-LINE B3380 SERIES ASTM C533 1" MAXIMUM INSULATION THICKNESS.
2. PIPE SIZE 4" AND 5" B-LINE B3380 SERIES ASTM C533 1.5" MAXIMUM INSULATION THICKNESS.
3. PIPE SIZE 6" AND 8" B-LINE B3380 SERIES ASTM C533 2" MAXIMUM INSULATION THICKNESS.

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SECTION 13

SEISMIC HANGER COMPONENTS

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NOTES:

1. ALL SEISMIC HANGER COMPONENTS INCLUDED HERE HAVE BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
2. THESE COMPONENTS CANNOT BE REPLACED BY ANY OTHER COMPONENTS, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
3. DESIGN IS CONTROLLED BY SEISMIC FORCES. NON-SEISMIC FORCES SUCH AS GRAVITY ARE OUTSIDE THE SCOPE OF THIS OPM.

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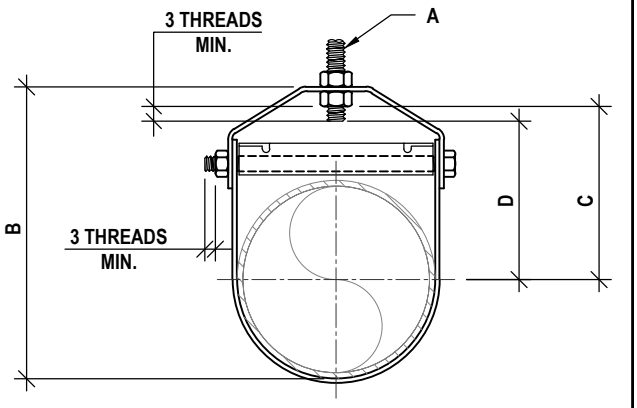
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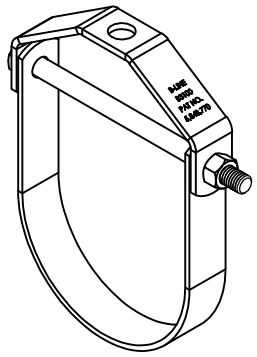
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B-LINE B3100 STANDARD CLEVIS HANGER





PIPE SIZE	'A' ROD SIZE		'B' BOTTOM OF PIPE TO TOP OF HANGER	'C' CENTER OF PIPE TO TOP OF HANGER	'D' CENTER OF PIPE TO BOTTOM OF HANGER ROD	CROSS BOLT
	STD	NFPA				
2 1/2"	1/2"	3/8"	5 3/8"	3 15/16"	3 1/16"	5/16"
3"	1/2"	3/8"	6 1/2"	4 3/4"	3 15/16"	5/16"
3 1/2"	1/2"	3/8"	7 1/4"	5 1/4"	4 1/16"	5/16"
4"	5/8"	3/8"	7 3/4"	5 1/2"	5 1/2"	5/16"
5"	5/8"	1/2"	8 3/4"	6 1/8"	6"	3/8"
6"	3/4"	1/2"	10 5/16"	6 15/16"	7"	1/2"
8"	3/4"	1/2"	12 3/4"	8 7/16"	7 1/8"	1/2"

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NOTES:

1. CONFORMS TO FEDERAL SPECIFICATION WWH-171E, TYPE 1 AND MANUFACTURERS STANDARDIZATION SOCIETY SP-58-2009 TYPE 1.
2. 1CBS CROSS BOLT SPACER IS REQUIRED AT ALL SEISMIC LOCATIONS ONLY. (SEE PAGE 12-19).
3. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTION 2, 4, 6 AND 8.
4. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
5. THE DESIGN LOAD IS GOVERNED BY THE ASSEMBLY. CAN ONLY BE USED WHERE SHOWN IN SECTIONS 2 THRU 8.

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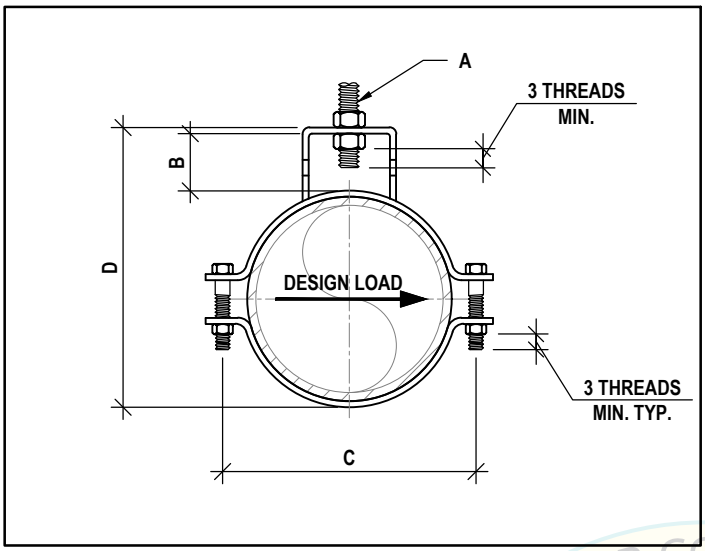
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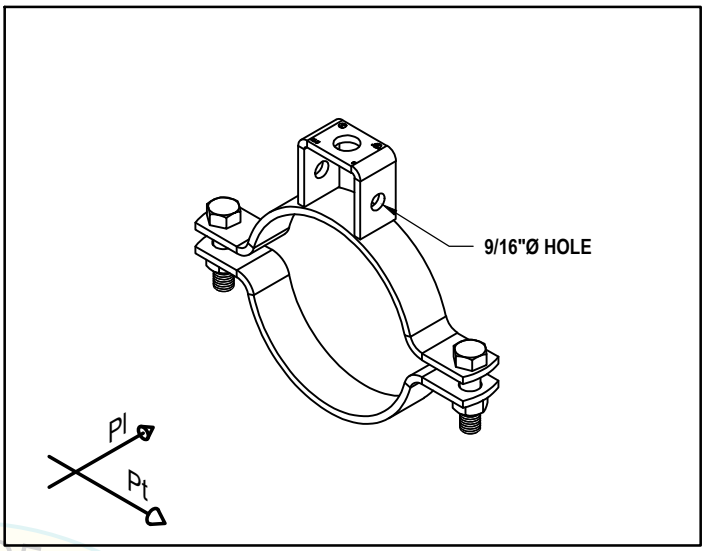
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California SE No. S3545

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TOLCO FIG. 4B SPECIAL PIPE CLAMP





PIPE SIZE	4B CLAMP SIZE	'A' ROD ZIZE	'B'	'C'	'D'	BOLT SIZE	HOLE SIZE	DESIGN LOAD (LBS) (ASD)	
								Pt	Pl
1 1/4"	1 1/4"	3/8"	1"	3 9/16"	3 1/4"	5/16"	3/8"	1,032	1,093
1 1/2"	1 1/2"	3/8"	1"	3 13/16"	3 7/16"	5/16"	3/8"	1,032	1,093
2"	2"	3/8"	1 1/2"	5 1/8"	4 5/8"	5/16"	3/8"	1,032	1,093
2 1/2"	2 1/2"	1/2"	1 3/4"	5 5/8"	5 3/8"	3/8"	7/16"	1,032	1,093
3"	3"	1/2"	1 7/8"	6 3/4"	6 1/8"	3/8"	7/16"	1,032	1,093
3 1/2"	3 1/2"	1/2"	2"	7 1/4"	6 3/4"	3/8"	7/16"	1,032	1,093
4"	4"	5/8"	2"	8 5/8"	7 1/4"	1/2"	9/16"	1,211	1,281
5"	5"	5/8"	2"	9 7/8"	8 15/16"	5/8"	11/16"	1,148	1,425
6"	6"	3/4"	2 1/8"	10 15/16"	9 1/2"	5/8"	11/16"	1,334	1,653
8"	8"	7/8"	2 1/8"	13 7/16"	11 1/2"	3/4"	13/16"	1,943	1,089

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NOTES:

1. CONFORMS TO FEDERAL SPECIFICATION WWH-171E, TYPE 1 AND MANUFACTURERS STANDARDIZATION SOCIETY SP-58 TYPE 4.
2. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
3. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
4. TIGHTEN BOLTS TO FOLLOWING TORQUE VALUES:
   a. FOR 5/16" 11 FT-LBS
   b. FOR 3/8" 19 FT-LBS
   c. FOR 1/2" 50 FT-LBS
   d. FOR 5/8" 65 FT-LBS
   e. FOR 3/4" 75 FT-LBS
5. VERTICAL CAPACITY GOVERNED BY ASSEMBLY. SEE SECTIONS 2 THRU 8 FOR APPROVED ASSEMBLIES. NOTE, CAN BE USED IN LIEU OF B3100.
6. TOLCO FIG. 4B SHALL NOT BE USED WITH INSULATION.

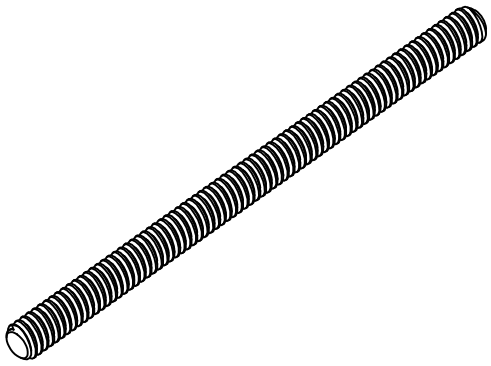
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DATE: April 23, 2025

TOLCO FIG. 99 OR B-LINE ATR ALL THREADED ROD CUT-TO-LENGTH OR TOLCO FIG. 100 ALL THREADED ROD



ROD SIZE	DESIGN LOAD (LBS) (ASD)
3/8"	730
1/2"	1,350
5/8"	2,160
3/4"	3,230
7/8"	4,480

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NOTES:

1. ROD MEETS ASTM A307 SPECIFICATIONS.
2. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
3. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
4. DESIGN LOAD (ASD) VALUES FROM MSS SP-58 (2009), TABLE 2 AND ARE INTENDED FOR USE IN DETERMINING VERTICAL HANGER SPACING WHEN CALCULATING MAXIMUM TRANSVERSE SPACING.
5. SEISMIC CAPACITY GOVERNED BY ASSEMBLY. SEE SECTIONS 2 THRU 8 FOR APPROVED ASSEMBLIES.

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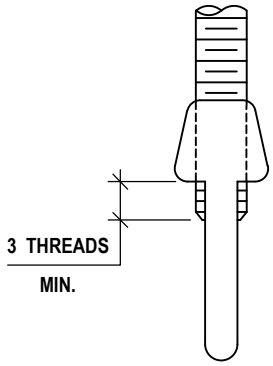
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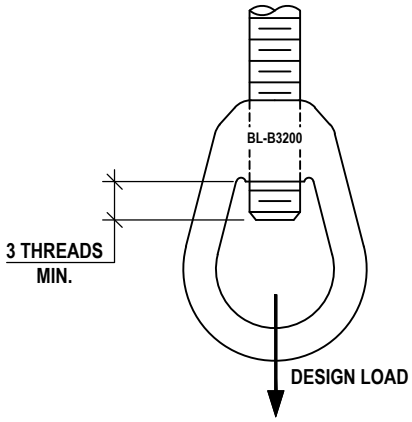
PAGE: 13-3

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B-LINE B3200 WELDLESS STEEL EYE NUT



SIDE VIEW



FRONT VIEW

ROD SIZE	DESIGN LOAD (LBS) (ASD)
3/8"	730
1/2"	1,350
5/8"	2,160
3/4"	3,230
7/8"	4,480

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NOTES:

1. CONFORMS TO MSS SP-58 TYPE 17 (STEEL WELDLESS EYENUT).
2. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
3. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.

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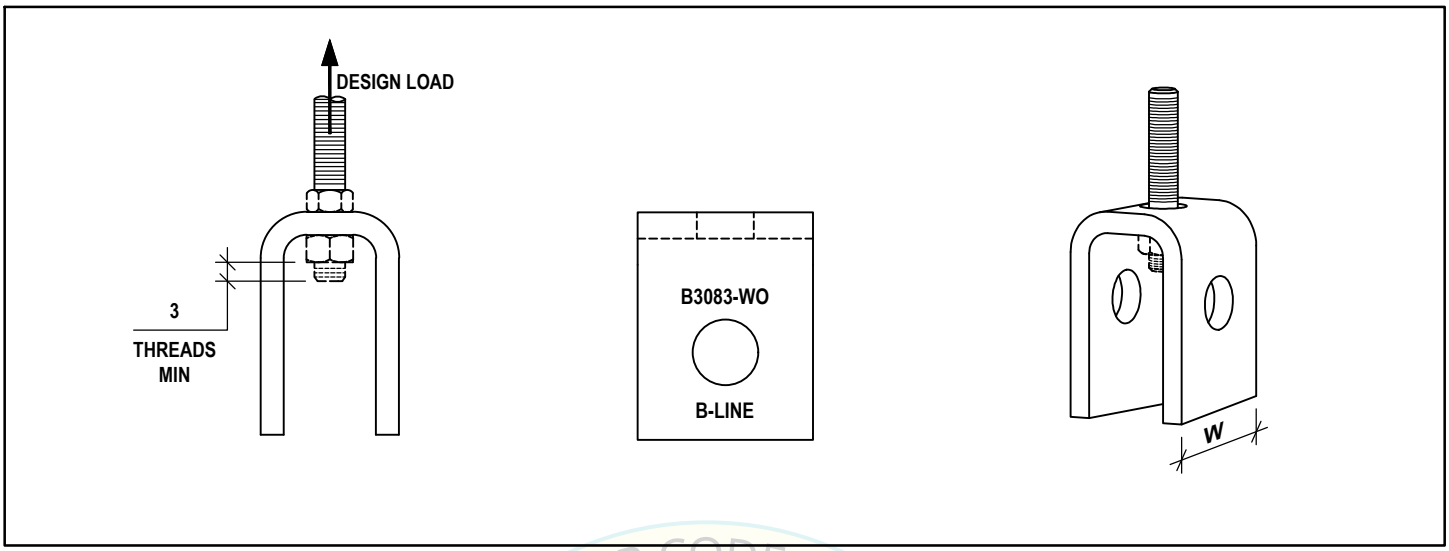
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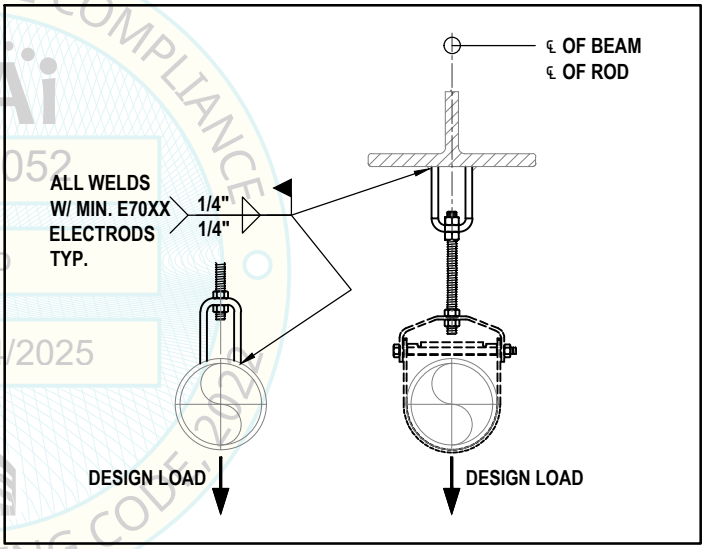
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B-LINE B3083WO WELDED STEEL ATTACHMENT



ROD SIZE	'W' (IN)	DESIGN LOAD (LBS) (ASD)
3/8"	2	730
1/2"	2	1,350
5/8"	2	2,160
3/4"	2 1/2	3,230
7/8"	2 1/2	4,480



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NOTES:

1. CONFORMS TO FEDERAL SPECIFICATION WW-H-171E, TYPE 22 AND MANUFACTURERS STANDARDIZATION SOCIETY MSS SP-58 (2009), TYPE 22
2. CROSS BOLT SPACER ONLY REQUIRED AT SEISMIC BRACING LOCATIONS AT B3100. (SEE PAGE 12-19).
3. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
4. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
5. E70XX ELECTRODE SHALL BE USED FOR ALL WELDS.
6. WHEN WELDING TO PIPE, PIPE TO BE OF A WELDABLE MATERIAL, SUCH AS BUT NOT LIMITED TO, ASTM 53 (GR. B) OR ASTM A500 (GR. B).
7. THIS ATTACHMENT SHALL BE USED FOR SCHEDULE 40 PIPES LARGER THAN 4" ONLY.

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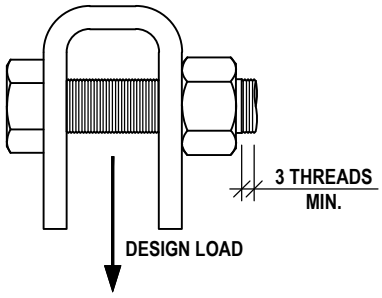
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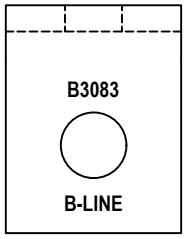
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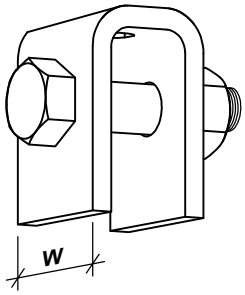
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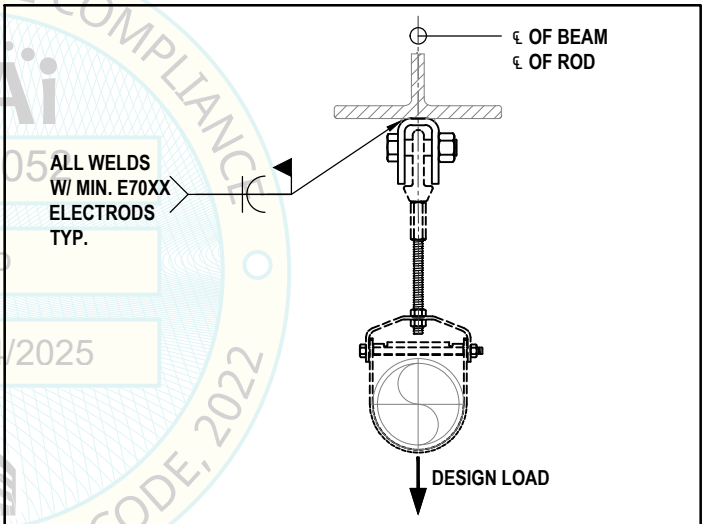
B-LINE B3083 WELDED STEEL ATTACHMENT







ROD SIZE	'W' (IN)	DESIGN LOAD (LBS) (ASD)
3/8"	2	730
1/2"	2	1,350
5/8"	2	2,160
3/4"	2 1/2	3,230
7/8"	2 1/2	4,480



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NOTES:

1. CONFORMS TO FEDERAL SPECIFICATION WW-H-171E, TYPE 22 AND MANUFACTURERS STANDARDIZATION SOCIETY MSS SP-58 (2009), TYPE 22
2. CROSS BOLT SPACER ONLY REQUIRED AT SEISMIC BRACING LOCATIONS AT B3100. (SEE PAGE 12-19).
3. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
4. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
5. E70XX ELECTRODE SHALL BE USED FOR ALL WELDS.
6. WHEN WELDING TO PIPE, PIPE TO BE OF A WELDABLE MATERIAL, SUCH AS BUT NOT LIMITED TO, ASTM 53 (GR. B) OR ASTM A500 (GR. B).

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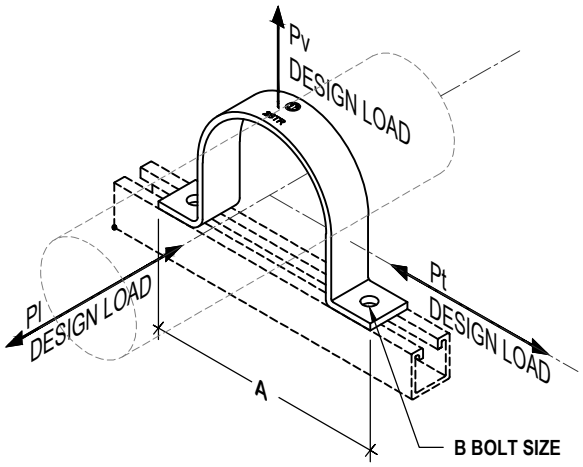
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B-LINE B2400 2 HOLE PIPE STRAP (SCHEDULE 40 PIPES)



PIPE SIZE	PIPE OUTSIDE DIA.	'A'	'B' BOLT SIZE	DESIGN LOAD "Pv" (LBS)(ASD)	DESIGN LOAD "Pt" (LBS)(ASD)	DESIGN LOAD "Pl" (LBS)(ASD)
3/4"	1.050	3 1/16"	1/4"	2,884	1,425	581
1"	1.315	3 7/16"	1/4"	2,974	1,501	755
1 1/4"	1.660	3 3/4"	1/4"	2,974	1,501	755
1 1/2"	1.900	4 1/8"	1/4"	2,974	1,501	755
2"	2.375	5 5/8"	3/8"	2,974	1,501	755
2 1/2"	2.875	6 3/16"	3/8"	2,974	1,501	755
3"	3.500	6 3/4"	3/8"	2,974	1,501	755
3 1/2"	4.000	7 7/16"	3/8"	4,463	1,502	762
4"	4.500	7 13/16"	1/2"	4,463	1,325	762
5"	5.563	9 9/16"	1/2"	4,463	1,325	762
6"	6.625	10 3/8"	1/2"	6,723	1,865	762
8"	8.825	12 3/8"	1/2"	5,923	1,325	762
12"	12.750	16"	1/2"	5,923	1,325	133

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NOTES:

1. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
2. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
3. MOUNTING HARDWARE SEE BELOW:
   USE 1/4" x 1 1/4" HARDWARE ON 1 1/2" PIPE AND SMALLER (TORQUE TO 6 FT./LBS).
   USE 3/8" x 1 1/4" HARDWARE ON 2" - 3 1/2" PIPE (TORQUE TO 19 FT./LBS).
   USE 1/2" x 1 1/4" HARDWARE ON 4" PIPE AND LARGER (TORQUE TO 50 FT./LBS).
4. PIPE SIZE PERMITTED FOR SCHEDULE 40 OR HEAVIER WALL PIPES ARE 1"Ø THRU 12"Ø.
5. IF PIPES WITH A HEAVIER WALL THAN SCHEDULE 40 ARE USED, O.D. OF THAT PIPE MUST MATCH THAT OF SCHEDULE 40 PIPE.
6. PIPE INSULATION SHALL BE INSTALLED AS SHOWN ON PAGE 12-22 AND SECTION 4 AND 8. USE REDUCTION FACTORS AS INDICATED IN SECTIONS 4 AND 8.
7. TO SELECT PIPE STRAP SIZES, ADD 2 TIMES INSULATION THICKNESS TO PIPE OUTSIDE DIAMETER.

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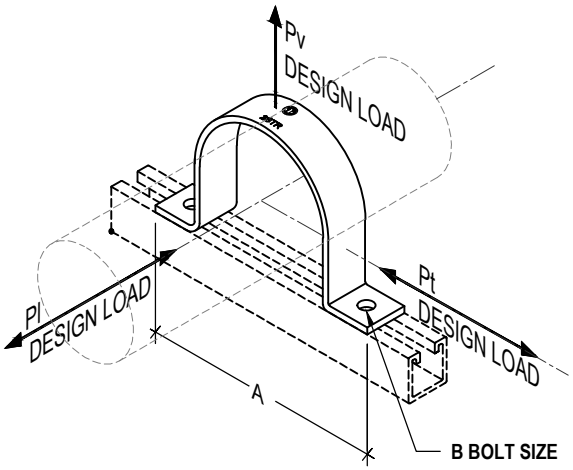
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B-LINE B2400 2 HOLE PIPE STRAP (SCHEDULE 10 PIPES)



PIPE SIZE	PIPE OUTSIDE DIA.	'A'	'B' BOLT SIZE	DESIGN LOAD "Pv" (LBS)(ASD)	DESIGN LOAD "Pt" (LBS)(ASD)	DESIGN LOAD "Pl" (LBS)(ASD)
3/4"	1.660	3 3/4"	1/4"	2,884	1,425	581
1"	1.660	3 3/4"	1/4"	2,884	1,425	581
1 1/4"	1.660	3 3/4"	1/4"	2,884	1,425	581
1 1/2"	1.900	4 1/8"	1/4"	2,884	1,425	581
2"	2.375	5 5/8"	3/8"	2,884	1,425	581
2 1/2"	2.875	6 3/16"	3/8"	2,884	1,425	581
3"	3.500	6 3/4"	3/8"	2,884	1,425	581
3 1/2"	4.000	7 7/16"	3/8"	2,884	1,425	581
4"	4.500	7 13/16"	1/2"	3,742	1,426	582
5"	5.563	9 9/16"	1/2"	3,733	1,118	543
6"	6.625	10 3/8"	1/2"	3,733	1,118	543

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NOTES:

1. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
2. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
3. MOUNTING HARDWARE SEE BELOW:
   USE 1/4" x 1 1/4" HARDWARE ON 1 1/2" PIPE AND SMALLER (TORQUE TO 6 FT.-LBS).
   USE 3/8" x 1 1/4" HARDWARE ON 2" - 3 1/2" PIPE (TORQUE TO 19 FT.-LBS).
   USE 1/2" x 1 1/4" HARDWARE ON 4" PIPE AND LARGER (TORQUE TO 50 FT.-LBS).
4. PIPE INSULATION SHALL BE INSTALLED AS SHOWN ON PAGE 12-22 AND SECTION 4 AND 8. USE REDUCTION FACTORS AS INDICATED IN SECTIONS 4 AND 8.
5. TO SELECT PIPE STRAP SIZES, ADD 2 TIMES INSULATION THICKNESS TO PIPE OUTSIDE DIAMETER.

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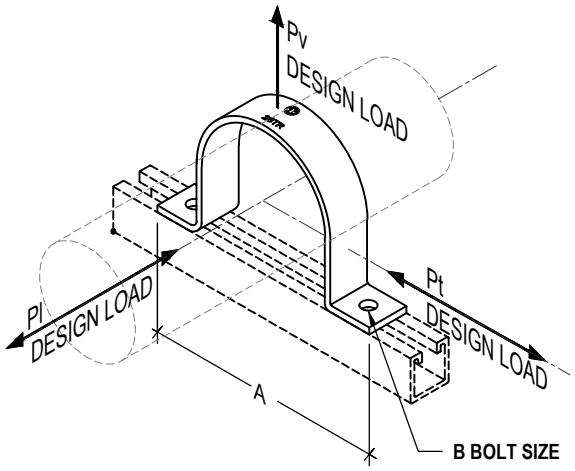
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DATE: April 23, 2025

B-LINE B2400 2 HOLE PIPE STRAP (EMT CONDUIT)



PIPE SIZE	PIPE OUTSIDE DIA.	'A'	'B' BOLT SIZE	DESIGN LOAD "Pv" (LBS)(ASD)	DESIGN LOAD "Pt" (LBS)(ASD)	DESIGN LOAD "Pl" (LBS)(ASD)
2 1/2"	3.000	6 3/4"	3/8"	2,799	1,643	1,409
3"	3.500	6 3/4"	3/8"	2,799	1,643	1,409
3 1/2"	4.000	7 7/16"	3/8"	2,418	1,643	1,409
4"	4.500	7 13/16"	1/2"	2,418	1,659	1,431

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NOTES:

1. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
2. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
3. MOUNTING HARDWARE SEE BELOW:
   USE 3/8" x 1 1/4" HARDWARE ON 2" - 3 1/2" PIPE (TORQUE TO 19 FT./LBS).
   USE 1/2" x 1 1/4" HARDWARE ON 4" PIPE AND LARGER (TORQUE TO 50 FT./LBS).

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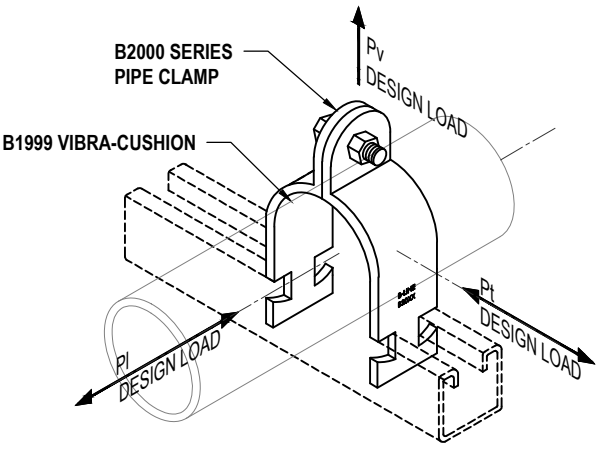
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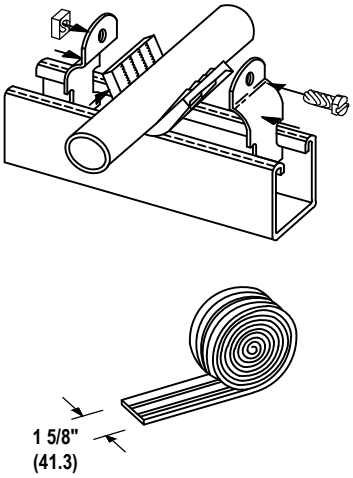
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DATE: April 23, 2025

B-LINE B1999 CUSHION CLAMP





FOR RIGID CONDUIT OR IRON PIPE					UPWARD	LAT	LONG
NORMAL SIZE		LENGTH OF VIBRA-CUSHION		USE CLAMP NO	LOAD "Pv" (LBS)(ASD)	LOAD "Pt" (LBS)(ASD)	LOAD "Pl" (LBS)(ASD)
3/4"	(20)	3 1/4"	(82.5)	B2031	2,174	136	261
1"	(25)	4 1/8"	(104.8)	B2004	2,174	136	261
1 1/4"	(32)	5 3/16"	(131.8)	B2012	2,174	136	261
1 1/2"	(40)	5 15/16"	(150.8)	B2038	2,174	70	261
2"	(50)	7 1/2"	(190.5)	B2042	2,174	70	261
2 1/2"	(65)	9"	(228.6)	B2046	2,433	70	287
3"	(80)	11"	(279.4)	B2051	2,871	104	527
3 1/2"	(90)	12 1/2"	(317.5)	B2055	2,871	57	484
4"	(100)	14 1/2"	(368.3)	B2059	2,871	57	484
5"	(125)	17 7/16"	(442.9)	B2067	2,871	57	484
6"	(150)	20 3/4"	(527.0)	B2116	3,151	57	484

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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
2. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
3. MAY BE USED ON SCHEDULE 40 OR THICKER WALLED PIPE.
4. NOT INTENDED FOR USE WITH CALCIUM-SILICATE INSULATION.

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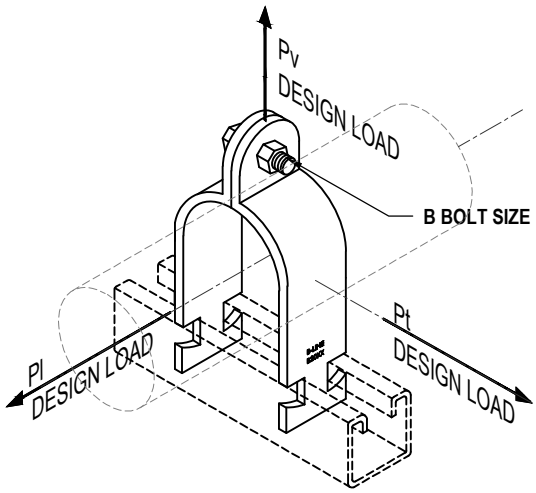
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California SE No. S3545

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B-LINE B2000 SERIES CLAMP



PIPE SIZE	PIPE OUTSIDE DIA.	'B' BOLT SIZE	BOLT HOLE	DESIGN LOAD "Pv" (LBS)(ASD)	DESIGN LOAD "Pt" (LBS)(ASD)	DESIGN LOAD "Pl" (LBS)(ASD)
3/4"	1.050	1/4"	5/16"	2,195	353	612
1"	1.315	1/4"	5/16"	2,195	353	612
1 1/4"	1.660	1/4"	5/16"	2,195	353	612
1 1/2"	1.900	5/16"	3/8"	2,195	353	537
2"	2.375	5/16"	3/8"	2,195	353	537
2 1/2"	2.875	5/16"	3/8"	2,752	573	537
3"	3.500	5/16"	3/8"	2,533	573	504
3 1/2"	4.000	5/16"	3/8"	2,533	573	487
4"	4.500	5/16"	3/8"	2,533	573	487
5"	5.563	5/16"	3/8"	2,533	573	487
6"	6.625	3/8"	7/16"	3,695	573	487
8"	8.625	3/8"	7/16"	3,919	741	736

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3. MOUNTING HARDWARE SEE BELOW:
   USE 1/4" x 1" HARDWARE ON 1 1/4" PIPE AND SMALLER (TORQUE TO 6 FT.-LBS).
   USE 5/16" x 1 1/4" HARDWARE ON 1 1/2" - 5" PIPE (TORQUE TO 11 FT.-LBS).
   USE 3/8" x 1 1/4" HARDWARE ON 6" PIPE AND LARGER (TORQUE TO 19 FT.-LBS).
4. MAY BE USED ON SCHEDULE 40 OR THICKER WALLED PIPE.
5. PIPE INSULATION SHALL BE INSTALLED AS SHOWN ON PAGE 12-22 AND SECTIONS 4 AND 8. USE REDUCTION FACTORS AS INDICATED IN SECTIONS 4 AND 8.

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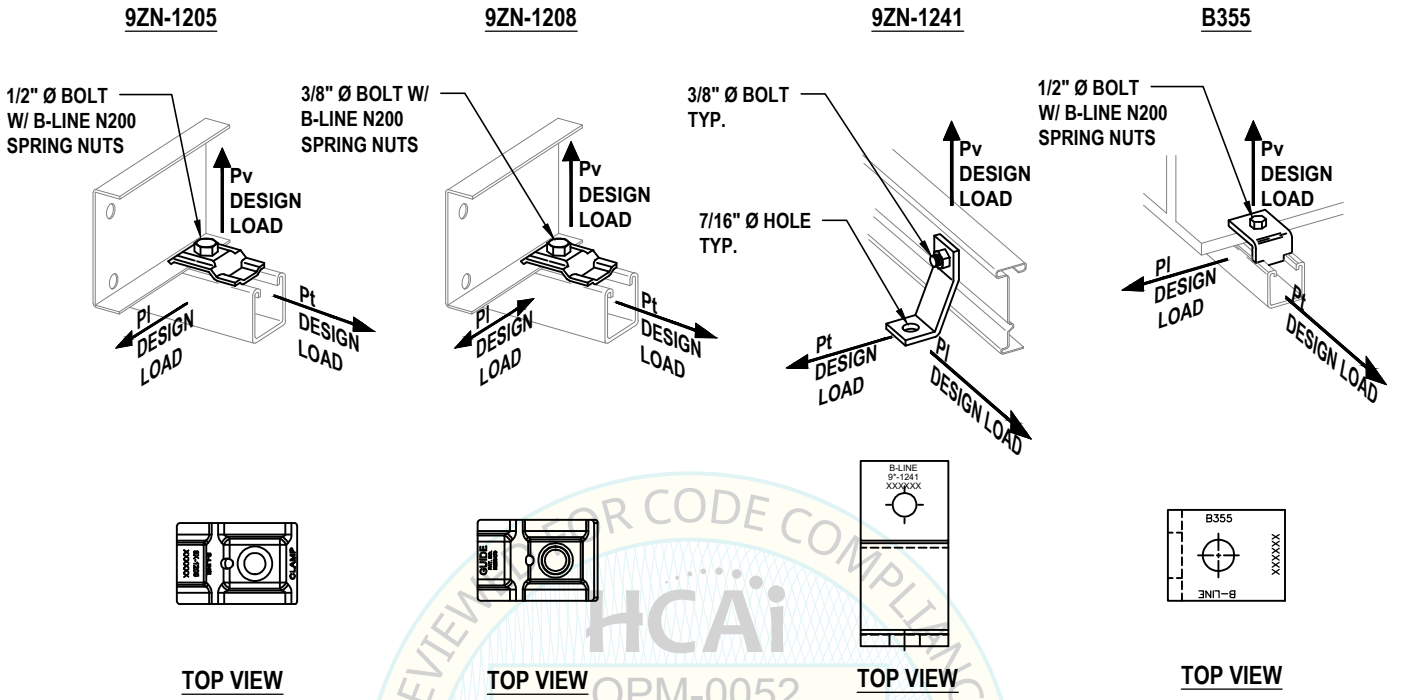
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California SE No. S3545

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DATE: April 23, 2025

B-LINE 9ZN-1205, 9ZN-1208, 9ZN-1241 & B355
HOLD DOWN CLAMP



PART NUMBER	CLAMP		
	DESIGN LOAD "Pv" (LBS)(ASD)	DESIGN LOAD "Pt" (LBS)(ASD)	DESIGN LOAD "Pl" (LBS)(ASD)
9ZN-1205	1,069	1,527	407
9ZN-1208	791	1,096	622
9ZN-1241	1,831	632	441
B355	3,704	2,869	1,130

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NOTES:

1. LOADS ARE BASED ON CLAMPS BEING USED IN PAIRS.
2. LOADS APPLICABLE ONLY WITH B-LINE STRUT.
3. TIGHTEN BOLTS TO FOLLOWING TORQUE VALUES:
   a. FOR 9ZN-1205 TORQUE HARDWARE TO 50 FT.-LBS FOR 1/2"Ø BOLT
   b. FOR 9ZN-1208 TORQUE HARDWARE TO 19 FT.-LBS FOR 3/8"Ø BOLT
   c. FOR 9ZN-1241 TORQUE HARDWARE TO 19 FT.-LBS FOR 3/8"Ø BOLT
   d. FOR B355 TORQUE HARDWARE TO 50 FT.-LBS FOR 1/2"Ø BOLT
4. THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
5. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS. TO CHECK COMBINED TENSION AND SHEAR LOADS FOR UNITY, USE THE FOLLOWING:
   $(Fv/Pv) + (Ft/Pt) + (Fl/Pl) \leq 1.0$ (WHERE Fv, Ft AND Fl ARE APPLIED LOADS)

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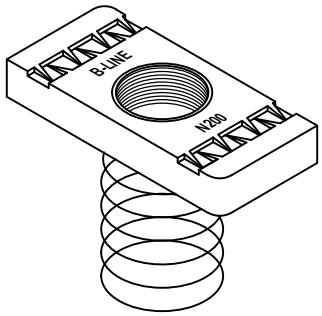
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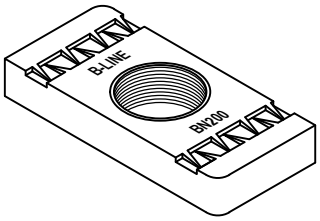
DATE: April 23, 2025

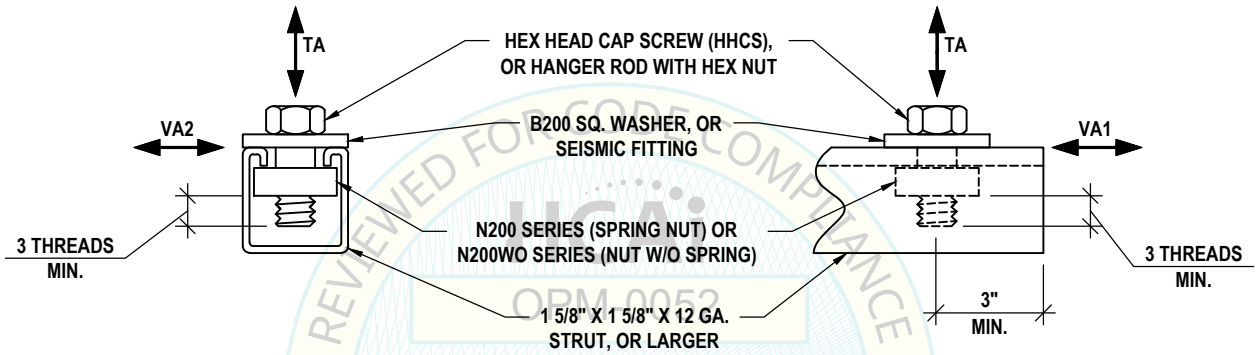
B-LINE N200 SPRING NUT AND B-LINE N200WO NUT WITHOUT SPRING

B-LINE N200 SERIES (SPRING NUT)



B-LINE N200WO SERIES (NUT WITHOUT SPRING)





METHOD OF ATTACHMENT	BOLT DIAMETER	DESIGN LOAD (ASD) RESISTANCE TO SLIP PARALLEL TO 12 GA. CHANNEL "VA1" (LBS)	DESIGN LOAD (ASD) RESISTANCE TO SLIP PERPENDICULAR TO 12 GA. CHANNEL "VA2" (LBS)	DESIGN LOAD (ASD) PULL-OUT STRETCH 12 GA. CHANNEL "TA" (LBS)	TORQUE (FT-ALBS)
900/980 SERIES ATTACHMENTS (WITH PRYING)	3/8"	1,329	632	645	19
	1/2" - 3/4"	1,342	791	723	50
DIRECT ATTACHMENT (WITHOUT PRYING)	3/8"	2,179	1,261	3,953	19
	1/2" - 3/4"	3,115	1,412	3,737	50

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3. TO CHECK COMBINED TENSION AND SHEAR LOADS FOR UNITY USE THE FOLLOWING:
   a. FOR T & V1 USE $(V1/VA1)^{0.88} + (T/TA)^{0.88} \leq 1.0$
   b. FOR T & V2 USE $(V2/VA2)^{1.66} + (T/TA)^{1.66} \leq 1.0$
   c. FOR T, V1 & V2 USE $(V1/VA1)^{0.88} + (V2/VA2)^{0.88} + (T/TA)^{0.88} \leq 1.0$
4. MATERIAL SPECIFICATIONS FOR B-LINE N200 SPRING NUT AND B-LINE BN200 CHANNEL NUT WITHOUT SPRING: ASTM A307, SAE J429, OR ASTM A563

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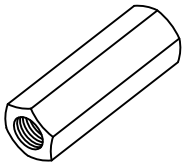
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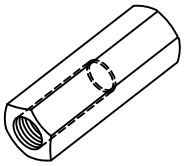
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FASTENERS

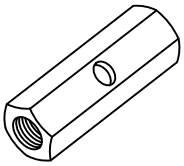
B-LINE B655 SERIES
ROD COUPLING NUT



B-LINE B656 SERIES
REDUCER ROD COUPLING NUT



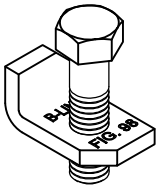
B-LINE B3220 SERIES
ROD COUPLING



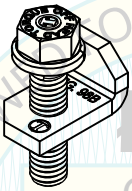
TOLCO FIG. 121
TEK SCREW



TOLCO FIG. 98
ROD STIFFENER



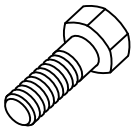
TOLCO FIG. 98B
ROD STIFFENER



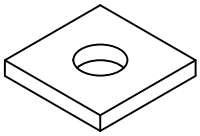
B-LINE HN HEX NUT



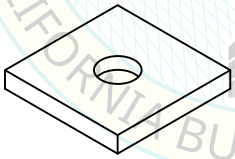
B-LINE HHCS
HEX HEAD CAP SCREW



B-LINE B200 THRU B202
SQUARE WASHER



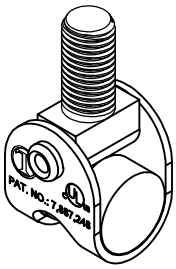
B-LINE B3248
STEEL WASHER PLATE



B-LINE FW
FLAT WASHER



FIG. 75
SWIVEL ATTACHMENT



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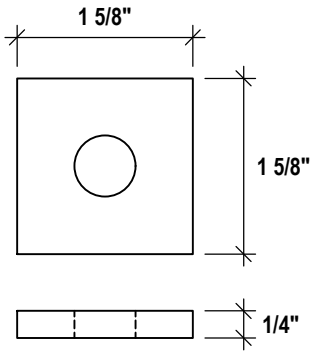
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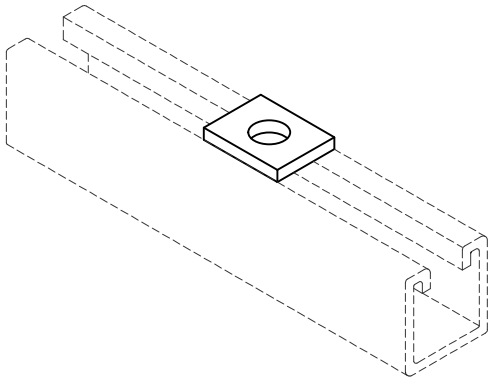
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B-LINE B200 SERIES FLAT FITTING





PART NUMBER	BOLT SIZE	HOLE SIZE
B200	5/16"	3/8"
B201	3/8"	7/16"
B202	1/2"	9/16"
B202-1	5/8"	11/16"
B202-2	3/4"	13/16"
B202-3	7/8"	15/16"

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3. MATERIAL SPECIFICATIONS FOR B-LINE B200 SERIES FLAT FITTINGS: ASTM A307, SAE J429, OR ASTM A563.

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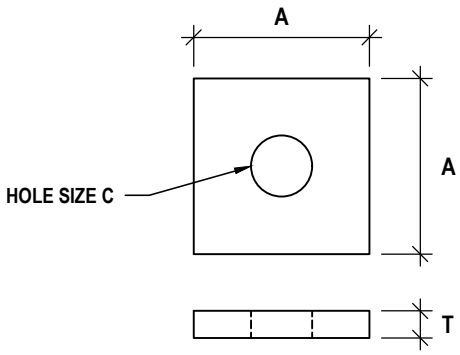
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DATE: **April 23, 2025**

B-LINE B3248 STEEL WASHER PLATES



PART NUMBER	ROD SIZE	'C' (HOLE SIZE)	'A' (LENGTH)	'T' (THICKNESS)
B3248 - 3/8"	3/8" - 16	7/16"	2"	1/4"
B3248 - 1/2"	1/2" - 13	9/16"	2"	1/4"
B3248 - 5/8"	5/8" - 11	11/16"	2 1/2"	1/4"
B3248 - 3/4"	3/4" - 10	13/16"	2 1/2"	3/8"
B3248 - 7/8"	7/8" - 9	15/16"	3"	3/8"
B3248 - 1"	1" - 8	1 1/16"	4"	3/8"

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2. MATERIAL SPECIFICATIONS FOR B-LINE B3240 STEEL WASHER PLATES: ASTM A307, SAE J429, OR ASTM A563.

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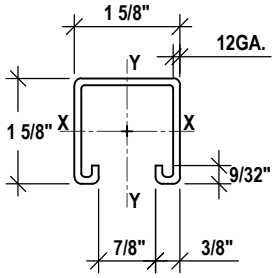
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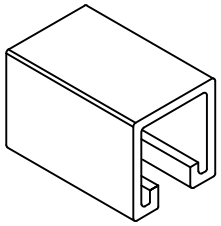
PAGE: 13-16

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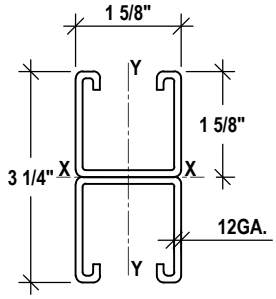
B-LINE B22 AND B22A STITCH-WELDED SOLID CHANNEL (FOR GRAVITY LOAD ONLY)

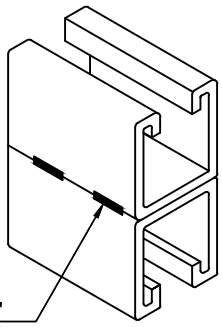
B-LINE B22



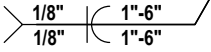


B-LINE B22A STITCH-WELDED





PROVIDE FIRST WELD MAX. OF 3" FROM EACH END OF DOUBLE STRUT



B22 BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		REMARKS
	AXIS X-X		
	LBS (ASD)	INCHES	
12"	2,610	0.014	
18"	2,269	0.031	
24"	1,702	0.056	
30"	1,361	0.087	
36"	1,135	0.126	
42"	972	0.172	
48"	851	0.224	
60"	681	0.351	
72"	567	0.505	
84"	486	0.687	
96"	425	0.898	
108"	378	0.114	
120"	340	1.403	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-22	1.910	0.562	0.191	0.213	0.583	0.240	0.295	0.653

I = MOMENT OF INERTIA, **S** = SECTION MODULES, **r** = RADIUS OF GYRATION

B22A BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		REMARKS
	AXIS X-X		
	LBS (ASD)	INCHES	
12"	2,610*	0.002	* FAILURE DETERMINED BY WELD SHEAR
18"	3,610*	0.007	
24"	2,610*	0.017	
30"	2,610*	0.033	
36"	2,610*	0.057	
42"	2,610*	0.091	
48"	2,405	0.125	
60"	1,924	0.195	
72"	1,603	0.281	
84"	1,374	0.383	
96"	1,202	0.500	
108"	1,069	0.633	
120"	962	0.782	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-22ASW	3.820	1.124	0.973	0.599	0.931	0.480	0.591	0.653

I = MOMENT OF INERTIA, **S** = SECTION MODULES, **r** = RADIUS OF GYRATION

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CALIFORNIA BUILDING CODE

NOTES:

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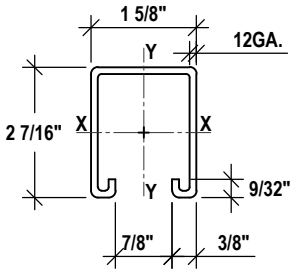
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

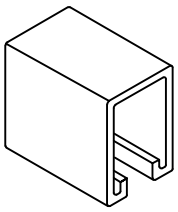
PAGE: 13-17

DATE: April 23, 2025

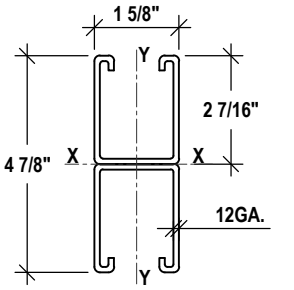
B-LINE B12 AND B12A STITCH-WELDED SOLID CHANNEL (FOR GRAVITY LOAD ONLY)

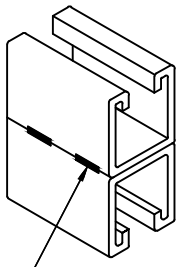
B-LINE B12





B-LINE B12A STITCH-WELDED





PROVIDE FIRST WELD MAX. OF 3" FROM EACH END OF DOUBLE STRUT

1/8" 1"-6"
1/8" 1"-6"

B12 BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
24"	3,275	0.038	
36"	2,182	0.086	
48"	1,636	0.153	
60"	1,309	0.240	
72"	1,091	0.345	
84"	935	0.470	
96"	818	0.614	
108"	727	0.777	
120"	655	0.959	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-12	2.480	0.731	0.535	0.406	0.856	0.383	0.416	0.680

I = MOMENT OF INERTIA, **S** = SECTION MODULES, **r** = RADIUS OF GYRATION

B12A BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
24"	3,880*	0.008	* FAILURE DETERMINED BY WELD SHEAR
36"	3,880*	0.028	
48"	3,880*	0.067	
60"	3,847*	0.130	
72"	3,206	0.188	
84"	2,748	0.255	
96"	2,404	0.334	
108"	2,137	0.422	
120"	1,924	0.521	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-12ASW	4.970	1.462	2.904	1.192	1.409	0.676	0.832	0.680

I = MOMENT OF INERTIA, **S** = SECTION MODULES, **r** = RADIUS OF GYRATION

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

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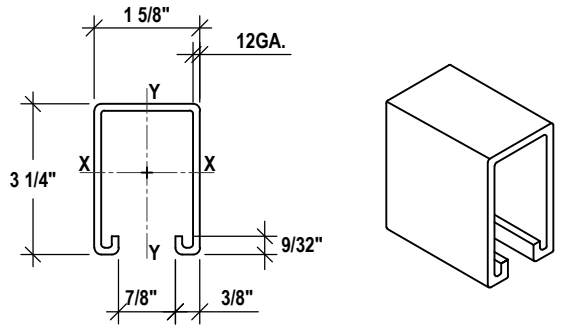
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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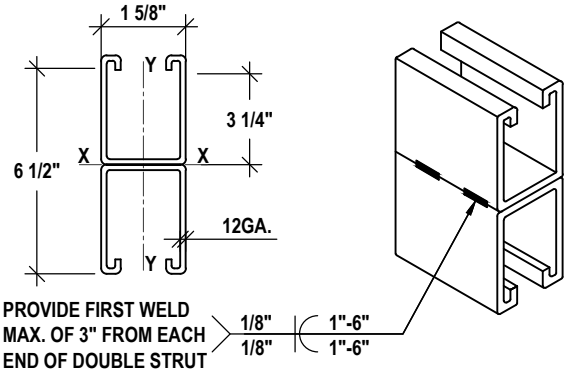
DATE: April 23, 2025

B-LINE B11 AND B11A STITCH-WELDED SOLID CHANNEL (FOR GRAVITY LOAD ONLY)

B-LINE B11



B-LINE B11A STITCH-WELDED



B11 BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
24"	5,130	0.029	
36"	3,488	0.065	
48"	2,616	0.117	
60"	2,093	0.183	
72"	1,744	0.263	
84"	1,495	0.358	
96"	1,308	0.468	
108"	1,163	0.592	
120"	1,046	0.731	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-11	3.060	0.900	1.120	0.647	1.116	0.436	0.536	0.696

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B11A BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
24"	5,130*	0.005	* FAILURE DETERMINED BY WELD SHEAR
36"	5,130*	0.017	
48"	5,130*	0.040	
60"	5,130*	0.079	
72"	5,130*	0.136	
84"	4,552	0.191	
96"	3,983	0.250	
108"	3,541	0.317	
120"	3,187	0.391	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-11ASW	6.120	1.800	3.393	1.967	1.885	0.871	1.073	0.696

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HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

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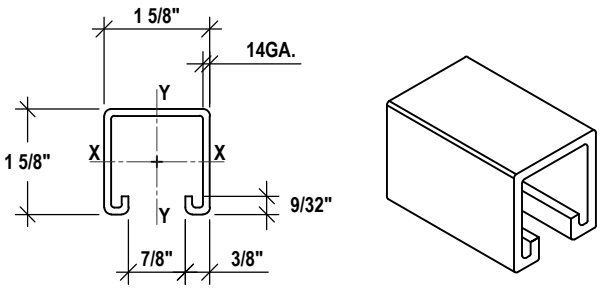
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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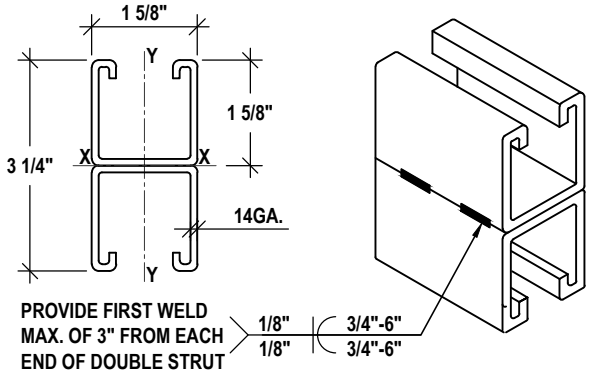
DATE: April 23, 2025

B-LINE B24 AND B24A STITCH-WELDED SOLID CHANNEL (FOR GRAVITY LOAD ONLY)

B-LINE B24



B-LINE B24A STITCH-WELDED



B24 BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
12"	1,750	0.014	
24"	1,379	0.057	
36"	910	0.128	
48"	680	0.227	
60"	550	0.355	
72"	450	0.511	
84"	390	0.695	
96"	340	0.908	
108"	300	1.149	
120"	270	1.419	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-24	1.442	0.424	0.149	0.167	0.594	0.186	0.229	0.662

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B24A BEAM SPAN	UNIFORM BEAM LOAD AND DEFLECTION		
	AXIS X-X		REMARKS
	LBS (ASD)	INCHES	
12"	1,750*	0.002	* FAILURE DETERMINED BY WELD SHEAR
24"	1,750*	0.014	
36"	1,750*	0.048	
48"	1,750*	0.115	
60"	1,518	0.195	
72"	1,265	0.281	
84"	1,084	0.383	
96"	949	0.500	
108"	843	0.633	
120"	759	0.782	

CHANNEL	WEIGHT (LBS/FT)	AREA OF SECTION (SQ. IN)	AXIS X-X			AXIS Y-Y		
			I (IN^4)	S (IN^3)	r (IN)	I (IN^4)	S (IN^3)	r (IN)
B-24ASW	2.884	0.848	0.751	0.462	0.941	0.371	0.457	0.662

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REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
LOS ANGELES BUILDING CODE

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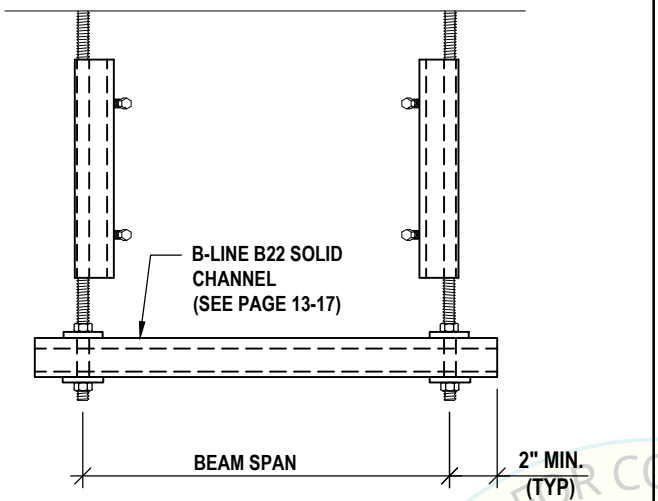
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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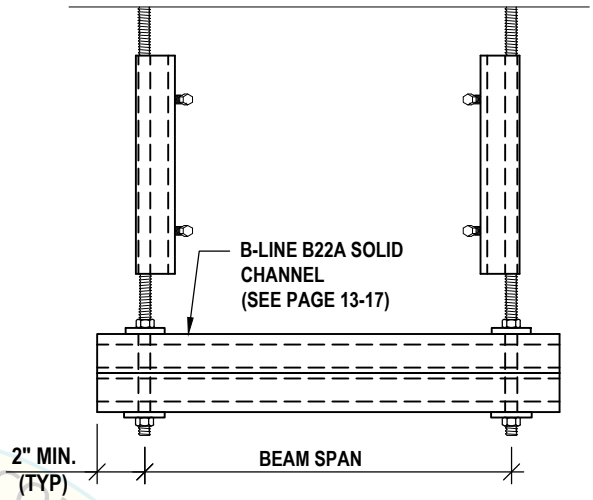
DATE: April 23, 2025

B-LINE B22 AND B22A STITCH-WELDED SOLID CHANNEL BEAM ALLOWABLE GRAVITY AND SEISMIC LOAD FOR TRAPEZE

B-LINE B22



B-LINE B22A STITCH-WELDED



B-LINE B22 UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
12"	2,116	1,726	1,457	1,261
18"	1,649	1,345	1,136	983
24"	1,236	1,009	852	737
30"	989	807	681	589
36"	803	657	556	481
42"	671	550	466	405
48"	574	471	400	347
60"	439	361	307	267
72"	351	289	245	213
84"	289	238	202	176
96"	244	201	171	149
108"	210	173	147	127
120"	183	150	128	111

B-LINE B22A UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
12"	2,610	2,610	2,610	2,610
18"	2,610	2,610	2,610	2,436
24"	2,610	2,598	2,145	1,827
30"	2,610	2,078	1,716	1,462
36"	2,194	1,732	1,430	1,218
42"	1,881	1,484	1,226	1,044
48"	1,646	1,299	1,072	913
60"	1,310	1,034	855	728
72"	1,063	842	697	595
84"	884	701	581	496
96"	749	595	493	421
108"	644	512	425	363
120"	560	446	370	317

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0052 REVIEWED BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE

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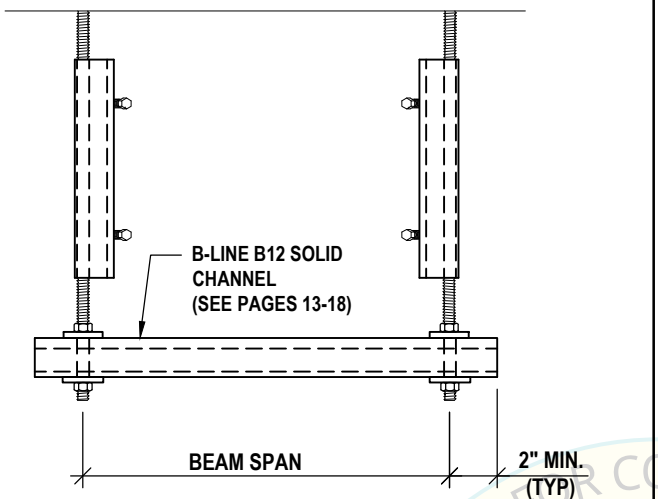
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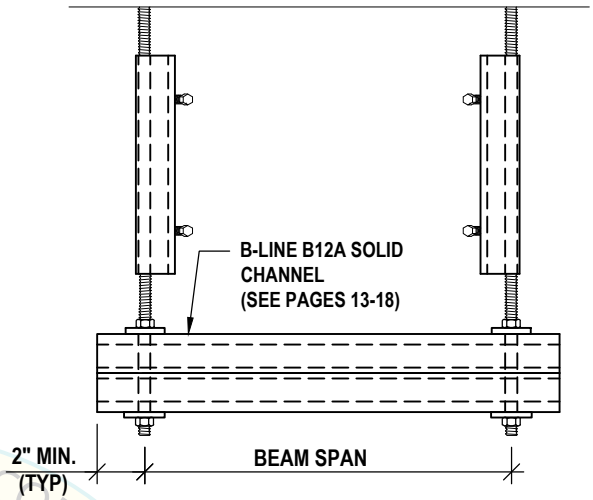
DATE: April 23, 2025

B-LINE B12 AND B12A STITCH-WELDED SOLID CHANNEL BEAM ALLOWABLE GRAVITY AND SEISMIC LOAD FOR TRAPEZE

B-LINE B12



B-LINE B12A STITCH-WELDED



B-LINE B12 UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
24"	2,247	1,780	1,474	1,258
36"	1,409	1,125	936	802
48"	969	782	655	563
60"	708	576	486	420
72"	539	443	376	327
84"	422	349	297	259
96"	339	281	241	210
108"	278	232	199	174
120"	234	196	169	148

B-LINE B12A UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
24"	3,880	3,880	3,712	3,107
36"	3,880	3,074	2,475	2,071
48"	3,042	2,305	1,856	1,553
60"	2,365	1,801	1,454	1,219
72"	1,898	1,454	1,178	990
84"	1,563	1,205	980	826
96"	1,309	1,016	830	701
108"	1,109	866	710	602
120"	948	743	612	519

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OPM-0052
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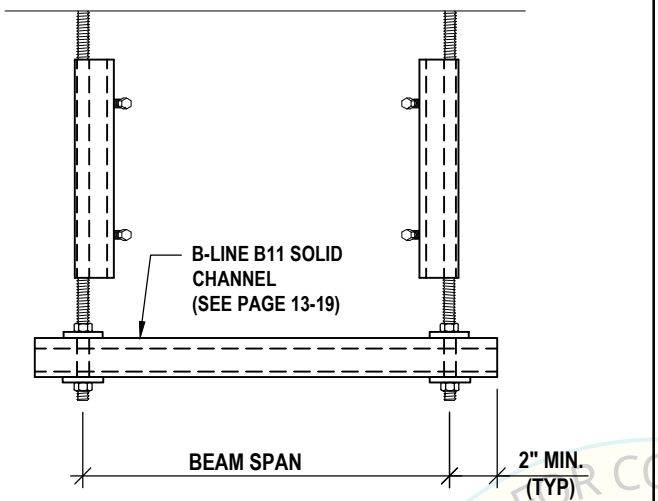
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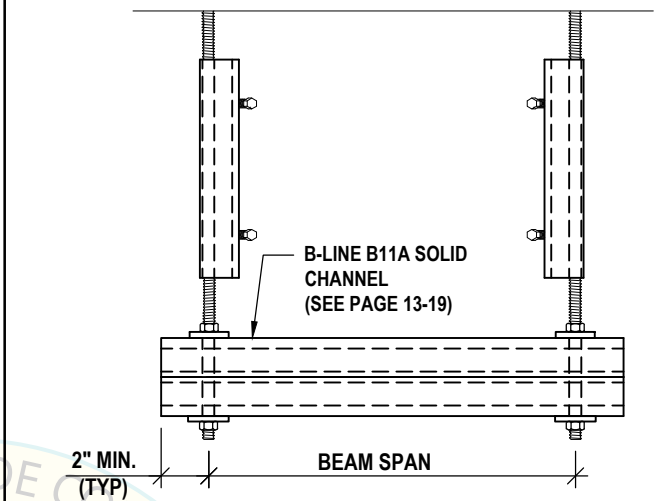
DATE: April 23, 2025

B-LINE B11 AND B11A STITCH-WELDED SOLID CHANNEL BEAM ALLOWABLE GRAVITY AND SEISMIC LOAD FOR TRAPEZE

B-LINE B11



B-LINE B11A STITCH-WELDED



B-LINE B11 UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
24"	3,434	2,657	2,167	1,830
36"	2,113	1,654	1,359	1,153
48"	1,409	1,120	930	795
60"	978	791	664	572
72"	692	569	483	419
84"	511	425	365	319
96"	397	334	288	253
108"	321	272	235	207
120"	267	227	197	174

B-LINE B11A UNIFORM BEAM LOAD (LBS)(ASD)

BEAM SPAN	F_P / W_P 0.25g	0.50g	0.75g	1.00g
	F_V / W_P 0.11g	0.22g	0.33g	0.44g
24"	5,130	5,130	5,130	4,320
36"	5,130	4,598	3,631	3,000
48"	4,686	3,440	2,718	2,246
60"	3,605	2,666	2,115	1,753
72"	2,871	2,141	1,707	1,419
84"	2,339	1,760	1,411	1,177
96"	1,932	1,468	1,183	991
108"	1,611	1,236	1,003	844
120"	1,349	1,047	855	723

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NOTES:

1. LISTED BEAM LOADS ARE MAXIMUM ALLOWABLE UNIFORMLY DISTRIBUTED GRAVITY LOADS ONLY. FOR LOADS CONCENTRATED AT CENTER OF SPAN MULTIPLY UNIFORM LOAD AT TABLE BY 0.5 AND MULTIPLY THE DEFLECTION AT TABLE BY 0.8. WHEN DEFLECTION IS NOT A FACTOR USE ALLOWABLE STRESS OF 25,000 PSI. WHEN DEFLECTION IS A FACTOR USE DEFLECTION OF (SPAN / 480). ADEQUATE LATERAL BRACING IS PROVIDED BY SUPPORTED PIPES, DUCTS, CONDUITS, OR CABLE TRAYS (PIPES, DUCTS, CONDUITS OR CABLE TRAYS ARE MOUNTED DIRECTLY TO THE TOP OR BOTTOM OF THE STRUT CHANNEL BEAMS. FOR PIPES, DUCTS, CONDUITS OR CABLE TRAYS HANGING FROM STRUT CHANNEL BEAMS WITH HANGER RODS CONSULT FACTORY FOR LOADS).
2. LISTED BEAM LOADS ARE FOR SOLID CHANNELS ONLY.
3. THIS SEISMIC SUPPORT COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
4. THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.
5. THE SEISMIC VERTICAL AND HORIZONTAL LOADS ARE CONSIDERED SIMULTANEOUSLY.

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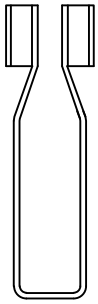
MRH

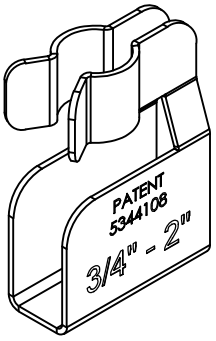
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TOLCO FIG. 25 END-OF-LINE RESTRAINT ATTACHMENT





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NOTES:

1.) CAN BE USED AS ALTERNATIVE TO RUNNING ROD TO PIPE ON FIRE PROTECTION BRANCH LINE RESTRAINTS.
2.) THIS SEISMIC HANGER COMPONENT HAS BEEN TESTED FOR SEISMIC APPLICATION AS SHOWN IN SECTIONS 2, 4, 6 AND 8.
3.) THIS COMPONENT CANNOT BE REPLACED BY ANY OTHER COMPONENT, HCAI APPROVED OR OTHERWISE, UNLESS TESTED PER SECTIONS 2, 4, 6 AND 8 USING TOLCO SEISMIC COMPONENTS.

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SECTION 14

MAXIMUM SEISMIC BRACING SPACING TABLES

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STEEL PIPE (STANDARD SCHEDULE) INSULATED AND FILLED WITH WATER
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	PIPE SCHEDULE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	40	2.00	6	23	18	16	14	13
1	40	2.80	7	27	22	19	17	16
1-1/4	40	3.80	7	32	26	22	20	18
1-1/2	40	4.50	8	34	28	25	22	20
2	40	6.20	10	38	32	29	26	24
2-1/2	40	9.10	11	40	35	31	29	27
3	40	12.10	12	40	39	35	32	30
4	40	18.10	14	40	40	39	37	32
5	40	26.60	15	40	40	40	38	33
6	40	34.80	17	40	40	40	40	35
8	40	55.10	19	40	40	40	40	38
10	40	80.20	20	40	40	40	40	40
12	STD	109.00	20	40	40	40	40	40

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS EQUATION. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. MAXIMUM GRAVITY SUPPORT SPACING IS BASED ON MSS SP- 58- 2009 TABLE 4 LIMITED TO 20 FEET. PIPE WEIGHTS USED ARE BASED ON STANDARD SCHEDULE STEEL PIPES (40S) INCLUDING WATER AND INSULATION (REFER TO APPENDIX). PIPES WITH THICKER WALLS AND / OR FILLED WITH VAPOR OR GAS MAY USE SPACINGS AS TABULATED.
3. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8, & 9.
4. BRACE SPACINGS ARE BASED ON STEEL PIPE CONFORMING TO ASTM SPECIFICATION A53, TYPE E, GRADE B WITH MINIMUM Fy = 35 ksi AND SA=17.3 ksi AT MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 400psi AND 650° F, RESPECTIVELY. FOR ASTM A53, TYPE E, GRADE A WITH MINIMUM Fy=30 ksi AND SA= 14.6 ksi AT MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 400psi AND 650° F, PER ASME B31, REDUCE SPACING BY FACTOR OF 1.2. FOR STEEL PIPES, INCLUDING STAINLESS, WITH Fy AND SA VALUES MEETING OR EXCEEDING ABOVE STATED MINIMUMS PER APPENDIX A OF ASME B31, TABULATED SPACINGS MAY BE USED WITH APPROPRIATE REDUCTION FACTORS, WHERE APPLICABLE.
5. PIPE FITTINGS AS IDENTIFIED IN ASME B31.1 APPENDIX D MAY INCLUDE THE FOLLOWING: WELDING ELBOW OR PIPE BEND, WIDELY SPACED MITER BEND, WELDING TEE PER ASME B16.9, REINFORCED FABRICATED TEE, BRANCH WELDED-ON FITTING (INTEGRALLY REINFORCED) PER MSS SP-97, AND WELDED-IN CONTOUR INSERT.
6. PIPE FITTINGS IDENTIFIED AS: UNREINFORCED FABRICATED TEE, AND EXTRUDED OUTLET MEETING THE REQUIREMENTS OF PARA. 104.3.1(G) DEFINED IN ASME B31.1 APPENDIX D SHALL NOT BE USED.
7. ACCEPTABLE PIPE CONNECTIONS INCLUDE BUTT WELDS, FILLET WELDS, OR FLANGES AND RIGID GROOVED COUPLINGS. RIGID GROOVED COUPLINGS LISTED FOR UL STANDARD 213 MAY USE LISTED MAXIMUM BRACE SPACINGS (SEE NOTE 17, PAGE 1-11)
8. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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STEEL PIPE (SCHEDULE 10) INSULATED AND FILLED WITH WATER
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	PIPE SCHEDULE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	10	1.72	6	21	17	14	13	12
1	10	5.51	7	26	21	18	16	15
1-1/4	10	3.31	7	30	24	21	19	18
1-1/2	10	3.95	8	32	27	23	21	18
2	10	5.22	10	36	29	23	20	18
2-1/2	10	7.09	11	33	23	19	16	14
3	10	9.24	12	32	22	18	15	13
4	10	13.38	14	27	18	15	12	10
5	10	20.20	15	29	20	16	13	11
6	10	26.33	17	22	14	10	-	-
8	10	41.09	19	20	12	-	-	-
10	10	60.80	20	22	14	6	-	-
12	10	82.40	20	27	18	13	8	-

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS EQUATION. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. PIPE WEIGHTS USED ARE BASED ON PIPE SCHEDULED WEIGHT INCLUDING WATER AND INSULATION (REFER TO APPENDIX). PIPES WITH THICKER WALLS AND / OR FILLED WITH VAPOR OR GAS MAY USE SPACINGS AS TABULATED.
3. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8, & 9.
4. BRACE SPACINGS ARE BASED ON STEEL PIPE CONFORMING TO ASTM SPECIFICATION A53, TYPE E, GRADE A WITH MINIMUM Fy = 30 ksi AND SA= 14.6 ksi AT A MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 400psi AND 400° F, RESPECTIVELY. FOR STEEL PIPES, INCLUDING STAINLESS, WITH Fy VALUES MEETING OR EXCEEDING ABOVE STATED MINIMUMS PER APPENDIX A OF ASME B31, TABULATED SPACINGS MAY BE USED WITH APPROPRIATE REDUCTION FACTORS, WHERE APPLICABLE.
5. PIPE FITTINGS AS IDENTIFIED IN ASME B31.1 APPENDIX D MAY INCLUDE THE FOLLOWING: WELDING ELBOW OR PIPE BEND, CLOSELY SPACED MITER BEND, WIDELY SPACED MITER BEND, WELDING TEE PER ASME B16.9, REINFORCED FABRICATED TEE, BRANCH WELDED-ON FITTING (INTEGRALLY REINFORCED) PER MSS SP-97, AND WELDED-IN CONTOUR INSERT.
6. PIPE FITTINGS IDENTIFIED AS: UNREINFORCED FABRICATED TEE, AND EXTRUDED OUTLET MEETING THE REQUIREMENTS OF PARA. 104.3.1(G) DEFINED IN ASME B31.1 APPENDIX D SHALL NOT BE USED.
7. ACCEPTABLE PIPE CONNECTIONS INCLUDE BUTT WELDS, FILLET WELDS, OR FLANGES AND RIGID GROOVED COUPLINGS. RIGID GROOVED COUPLINGS LISTED FOR UL STANDARD 213 MAY USE LISTED MAXIMUM BRACE SPACINGS.
8. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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STEEL PIPE (SCHEDULE 80) INSULATED AND FILLED WITH WATER
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	PIPE SCHEDULE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	80	2.30	6	24	19	16	15	13
1	80	3.20	7	29	23	20	18	16
1-1/4	80	4.40	7	33	27	23	21	19
1-1/2	80	5.30	8	35	30	26	23	21
2	80	7.30	10	40	34	30	28	25
2-1/2	80	10.70	11	40	37	33	31	28
3	80	14.40	12	40	40	37	34	32
4	80	21.80	14	40	40	40	39	36
5	80	31.60	15	40	40	40	40	40
6	80	43.20	17	40	40	40	40	40
8	80	59.50	19	40	40	40	40	40
10	80	100.70	20	40	40	40	40	40
12	80	138.60	20	40	40	40	40	40

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS EQUATION. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. PIPE WEIGHTS USED ARE BASED ON PIPE SCHEDULED WEIGHT INCLUDING WATER AND INSULATION (REFER TO APPENDIX). PIPES WITH THICKER WALLS AND / OR FILLED WITH VAPOR OR GAS MAY USE SPACINGS AS TABULATED.
3. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7 ,8, & 9.
4. BRACE SPACINGS ARE BASED ON STEEL PIPE CONFORMING TO ASTM SPECIFICATION A53, TYPE E, GRADE A WITH MINIMUM Fy = 35 ksi AND SA=17.3 ksi AT A MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 400psi AND 400° F, RESPECTIVELY. FOR STEEL PIPES, INCLUDING STAINLESS, WITH Fy VALUES MEETING OR EXCEEDING ABOVE STATED MINIMUMS PER APPENDIX A OF ASME B31, TABULATED SPACINGS MAY BE USED WITH APPROPRIATE REDUCTION FACTORS, WHERE APPLICABLE.
5. PIPE FITTINGS AS IDENTIFIED IN ASME B31.1 APPENDIX D MAY INCLUDE THE FOLLOWING: WELDING ELBOW OR PIPE BEND, WELDING TEE PER ASME B16.9, REINFORCED FABRICATED TEE, BRANCH WELDED-ON FITTING (INTEGRALLY REINFORCED) PER MSS SP-97, AND WELDED-IN CONTOUR INSERT.
6. PIPE FITTINGS IDENTIFIED AS: UNREINFORCED FABRICATED TEE, AND EXTRUDED OUTLET MEETING THE REQUIREMENTS OF PARA. 104.3.1(G) DEFINED IN ASME B31.1 APPENDIX D SHALL NOT BE USED.
7. ACCEPTABLE PIPE CONNECTIONS INCLUDE BUTT WELDS, FILLET WELDS, OR FLANGES AND RIGID GROOVED COUPLINGS. RIGID GROOVED COUPLINGS LISTED FOR UL STANDARD 213 MAY USE LISTED MAXIMUM BRACE SPACINGS.
8. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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COPPER PIPE (TYPE L) DRAWN WITH SOLDERED JOINTS
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	PIPE SCHEDULE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	WATER	1.26	6	16	12	11	9	8
1	WATER	1.71	6	19	15	12	11	9
1-1/4	WATER	2.23	6	22	17	14	12	10
1-1/2	WATER	2.81	6	25	19	15	13	11
2	WATER	4.09	10	26	18	15	13	11
2-1/2	WATER	5.75	10	30	21	17	15	13
3	WATER	7.58	10	33	23	19	16	14
4	WATER	13.80	10	36	25	20	18	15
5	WATER	19.30	10	40	28	23	20	17
6	WATER	26.00	10	40	31	25	21	19
8	WATER	44.70	10	40	39	32	28	24
10	WATER	68.00	10	40	45	37	32	28
12	WATER	93.20	10	40	48	39	34	29
1/2	GAS	0.30	6	17	14	12	11	10
3/4	GAS	0.50	6	22	17	15	13	12
1	GAS	0.70	6	26	20	18	16	15
1-1/4	GAS	0.90	6	30	24	21	19	17
1-1/2	GAS	1.10	6	33	27	24	22	20
2	GAS	1.80	10	38	32	26	23	20
2-1/2	GAS	2.50	10	40	35	29	25	22
3	GAS	3.30	10	40	39	32	28	24
4	GAS	5.40	10	40	40	36	31	27
5	GAS	8.10	10	40	40	38	33	29
6	GAS	11.70	10	40	40	39	34	30
8	GAS	20.30	10	40	40	40	40	37
10	GAS	30.10	10	40	40	40	40	43
12	GAS	40.40	10	40	40	40	40	46

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NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. MAXIMUM GRAVITY SPACING IS BASED ON MSS SP- 58- 2009 TABLE 4, LIMITED TO 10 FEET.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACINGS IN SOME CASES. FOR BRACE CAPACITY SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9. TO DETERMINE WHETHER CONNECTION CAPACITY FURTHER LIMITS THE MAXIMUM BRACE SPACINGS ON A PROJECT SPECIFIC BASIS, THE REGISTERED DESIGN PROFESSIONAL SHALL PROVIDE ON THE CONSRUCTION DOCUMENTS THE REQUIREMENTS OR MANUFACTURE'S CERTIFICATION BY ANALYSIS, TESTING OR EXPERIENCE DATA FOR THE NONSTRUCTURAL BRACE COMPONENT IN ACCORDANCE WITH ASCE 7-16 SECTION 13.2.1 ITEM NO. 2, WHERE SUCH CERTIFICATION IS REQUIRED BY 2022 CBC SECTIONS 1705A.14.2 & 1705A.14.3.
4. BRACE SPACINGS ARE BASED ON PIPE CONFORMING TO ASTM SPECIFICATION B88 TYPE L DRAWN COPPER PIPE WITH SOLDERED JOINTS AND MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 100psi AND 250° F, RESPECTIVELY. FOR TYPE L DRAWN COPPER PIPE WITH BRAZED JOINTS, THESE CHARTS MAY BE USED IF THEY OCCUR WITHIN 6" OF A GRAVITY SUPPORT. FOR CASES WHERE THE DISTANCE FROM A BRAZED JOINT TO A GRAVITY SUPPORT EXCEEDS 6", REFER TO SEISMIC BRACE SPACING TABLE FOR ANNEALED TYPE L COPPER PIPES.
5. WHEN BRAZING OR WELDING IS USED TO JOIN DRAWN TUBE, THE CORRESPONDING ANNEALED RATING SHALL BE USED, PER CDA PUBLICATION A4015-14/20, COPPER TUBE HANDBOOK.
6. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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COPPER PIPE (TYPE L) ANNEALED
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	PIPE SCHEDULE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	WATER	1.26	6	9	6	5	4	-
1	WATER	1.71	6	12	8	6	5	4
1-1/4	WATER	2.23	6	14	9	8	6	5
1-1/2	WATER	2.81	6	15	11	9	7	6
2	WATER	4.09	10	9	5	-	-	-
2-1/2	WATER	5.75	10	13	9	6	4	-
3	WATER	7.58	10	17	11	9	7	5
4	WATER	13.80	10	19	13	10	8	7
5	WATER	19.30	10	22	15	12	10	9
6	WATER	26.00	10	25	17	14	12	10
8	WATER	44.70	10	34	24	19	17	14
10	WATER	68.00	10	40	28	23	19	17
12	WATER	93.20	10	40	30	24	21	18
1/2	GAS	0.30	6	17	13	11	9	8
3/4	GAS	0.50	6	21	15	12	10	9
1	GAS	0.70	6	23	16	13	11	10
1-1/4	GAS	0.90	6	26	18	15	13	11
1-1/2	GAS	1.10	6	29	20	17	14	12
2	GAS	1.80	10	27	19	15	13	11
2-1/2	GAS	2.50	10	31	21	17	15	13
3	GAS	3.30	10	34	24	19	17	14
4	GAS	5.40	10	39	27	22	19	17
5	GAS	8.10	10	40	29	24	20	18
6	GAS	11.70	10	40	30	25	21	18
8	GAS	20.30	10	40	39	35	27	24
10	GAS	30.10	10	40	40	37	32	28
12	GAS	40.40	10	40	40	40	34	30

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NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. MAXIMUM GRAVITY SPACING IS BASED ON MSS SP- 58- 2009 TABLE 4, LIMITED TO 10 FEET.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACINGS IN SOME CASES. FOR BRACE CAPACITY SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9. TO DETERMINE WHETHER CONNECTION CAPACITY FURTHER LIMITS THE MAXIMUM BRACE SPACINGS ON A PROJECT SPECIFIC BASIS, THE REGISTERED DESIGN PROFESSIONAL SHALL PROVIDE ON THE CONSRUCTION DOCUMENTS THE REQUIREMENTS OR MANUFACTURE'S CERTIFICATION BY ANALYSIS, TESTING OR EXPERIENCE DATA FOR THE NONSTRUCTURAL BRACE COMPONENT IN ACCORDANCE WITH ASCE 7-16 SECTION 13.2.1 ITEM NO. 2, WHERE SUCH CERTIFICATION IS REQUIRED BY 2022 CBC SECTIONS 1705A.14.2 & 1705A.14.3.
4. BRACE SPACINGS ARE BASED ON PIPE CONFORMING TO ASTM SPECIFICATION B88 TYPE L ANNEALED COPPER PIPE WITH SOLDERED JOINTS AND MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 100psi AND 250° F, RESPECTIVELY. FOR TYPE L ANNEALED COPPER PIPE WITH BRAZED JOINTS, THESE CHARTS MAY BE USED IF THEY OCCUR WITHIN 6" OF A GRAVITY SUPPORT. FOR CASES WHERE THE DISTANCE FROM A BRAZED JOINT TO A GRAVITY SUPPORT EXCEEDS 6", REFER TO SEISMIC BRACE SPACING TABLE FOR DRAWN TYPE L COPPER PIPES.
5. WHEN THIS MATERIAL IS USED FOR WELDED OR BRAZED CONSTRUCTION, THE ALLOWABLE STRESS VALUES USED SHALL NOT EXCEED THOSE GIVEN FOR THE SAME MATERIAL IN THE ANNEALED CONDITION PER ASME B31.1-2016.
6. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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DATE: April 23, 2025

COPPER PIPE (TYPE K) DRAWN WITH SOLDERED JOINTS
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	SERVICE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	WATER	1.40	6	16	13	11	10	9
1	WATER	1.90	6	19	15	13	12	11
1-1/4	WATER	2.40	6	22	17	15	13	12
1-1/2	WATER	3.00	6	25	20	17	15	13
2	WATER	4.40	10	30	22	17	15	13
2-1/2	WATER	6.10	10	34	25	20	17	15
3	WATER	8.20	10	37	27	22	19	17
4	WATER	13.40	10	40	32	26	22	19
5	WATER	20.40	10	40	35	28	24	21
6	WATER	28.40	10	40	39	32	28	24
8	WATER	49.60	10	40	40	40	34	30
10	WATER	75.90	10	40	40	40	39	34
12	WATER	107.40	10	40	40	40	40	38
1/2	GAS	0.30	6	17	14	12	11	10
3/4	GAS	0.60	6	21	17	15	13	12
1	GAS	0.80	6	25	20	17	16	14
1-1/4	GAS	1.00	6	29	23	20	18	17
1-1/2	GAS	1.40	6	31	25	22	20	18
2	GAS	2.10	10	36	30	27	24	21
2-1/2	GAS	2.90	10	40	34	31	27	24
3	GAS	4.00	10	40	37	33	30	26
4	GAS	6.50	10	40	40	39	34	29
5	GAS	9.70	10	40	40	40	37	32
6	GAS	13.90	10	40	40	40	40	36
8	GAS	25.90	10	40	40	40	40	40
10	GAS	40.30	10	40	40	40	40	40
12	GAS	57.80	10	40	40	40	40	40

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CALIFORNIA BUILDING CODE 2022

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. MAXIMUM GRAVITY SPACING IS BASED ON MSS SP- 58- 2009 TABLE 4, LIMITED TO 10 FEET.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACINGS IN SOME CASES. FOR BRACE CAPACITY SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9. TO DETERMINE WHETHER CONNECTION CAPACITY FURTHER LIMITS THE MAXIMUM BRACE SPACINGS ON A PROJECT SPECIFIC BASIS, THE REGISTERED DESIGN PROFESSIONAL SHALL PROVIDE ON THE CONSRUCTION DOCUMENTS THE REQUIREMENTS OR MANUFACTURE'S CERTIFICATION BY ANALYSIS, TESTING OR EXPERIENCE DATA FOR THE NONSTRUCTURAL BRACE COMPONENT IN ACCORDANCE WITH ASCE 7-16 SECTION 13.2.1 ITEM NO. 2, WHERE SUCH CERTIFICATION IS REQUIRED BY 2022 CBC SECTIONS 1705A.14.2 & 1705A.14.3.
4. BRACE SPACINGS ARE BASED ON PIPE CONFORMING TO ASTM SPECIFICATION B88 TYPE K DRAWN COPPER PIPE WITH SOLDERED JOINTS AND MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 100psi AND 250° F, RESPECTIVELY. FOR TYPE K DRAWN COPPER PIPE WITH BRAZED JOINTS, THESE CHARTS MAY BE USED IF THEY OCCUR WITHIN 6" OF A GRAVITY SUPPORT. FOR CASES WHERE THE DISTANCE FROM A BRAZED JOINT TO A GRAVITY SUPPORT EXCEEDS 6", REFER TO SEISMIC BRACE SPACINGS TABLE FOR ANNEALED TYPE K COPPER PIPES.
5. WHEN BRAZING OR WELDING IS USED TO JOIN DRAWN TUBE, THE CORRESPONDING ANNEALED RATING SHALL BE USED, PER CDA PUBLICATION A4015-14/20, COPPER TUBE HANDBOOK.
6. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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COPPER PIPE (TYPE K) ANNEALED
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	SERVICE	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	WATER	1.40	6	15	10	8	7	6
1	WATER	1.90	6	16	11	9	7	6
1-1/4	WATER	2.40	6	16	11	9	8	7
1-1/2	WATER	3.00	6	18	13	10	9	8
2	WATER	4.40	10	14	10	7	5	-
2-1/2	WATER	6.10	10	18	12	10	8	6
3	WATER	8.20	10	21	15	12	10	8
4	WATER	13.40	10	26	18	15	13	11
5	WATER	20.40	10	29	21	17	14	12
6	WATER	28.40	10	34	24	19	17	14
8	WATER	49.60	10	40	31	25	22	19
10	WATER	75.90	10	40	36	29	25	22
12	WATER	107.40	10	40	40	32	28	24
1/2	GAS	0.30	6	17	14	12	11	10
3/4	GAS	0.60	6	21	17	15	13	11
1	GAS	0.80	6	25	20	16	14	12
1-1/4	GAS	1.00	6	29	20	16	14	12
1-1/2	GAS	1.40	6	30	21	17	15	13
2	GAS	2.10	10	30	21	17	14	12
2-1/2	GAS	2.90	10	34	24	19	17	14
3	GAS	4.00	10	37	26	21	18	16
4	GAS	6.50	10	40	30	24	21	18
5	GAS	9.70	10	40	34	27	24	21
6	GAS	13.90	10	40	37	30	26	23
8	GAS	25.90	10	40	40	37	32	28
10	GAS	40.30	10	40	40	40	36	31
12	GAS	57.80	10	40	40	40	39	34

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NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASME B31E DESIGN BY ANALYSIS. PIPE SIZE, MATERIALS, PRESSURES, ETC. NOT USED TO DETERMINE THESE TABLES MAY USE ASME B31E DESIGN BY ANALYSIS TO DETERMINE THE MAXIMUM SEISMIC BRACE SPACINGS ON A PROJECT BY PROJECT BASIS.
2. MAXIMUM GRAVITY SPACING IS BASED ON MSS SP- 58- 2009 TABLE 4, LIMITED TO 10 FEET.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACINGS IN SOME CASES. FOR BRACE CAPACITY SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9. TO DETERMINE WHETHER CONNECTION CAPACITY FURTHER LIMITS THE MAXIMUM BRACE SPACINGS ON A PROJECT SPECIFIC BASIS, THE REGISTERED DESIGN PROFESSIONAL SHALL PROVIDE ON THE CONSRUCTION DOCUMENTS THE REQUIREMENTS OR MANUFACTURE'S CERTIFICATION BY ANALYSIS, TESTING OR EXPERIENCE DATA FOR THE NONSTRUCTURAL BRACE COMPONENT IN ACCORDANCE WITH ASCE 7-16 SECTION 13.2.1 ITEM NO. 2, WHERE SUCH CERTIFICATION IS REQUIRED BY 2022 CBC SECTIONS 1705A.14.2 & 1705A.14.3.
4. BRACE SPACINGS ARE BASED ON PIPE CONFORMING TO ASTM SPECIFICATION B88 TYPE K ANNEALED COPPER PIPE WITH SOLDERED JOINTS AND MAXIMUM OPERATING PRESSURE AND TEMPERATURE OF 100psi AND 250° F, RESPECTIVELY. FOR TYPE K ANNEALED COPPER PIPE WITH BRAZED JOINTS, THESE CHARTS MAY BE USED IF THEY OCCUR WITHIN 6" OF A GRAVITY SUPPORT. FOR CASES WHERE THE DISTANCE FROM A BRAZED JOINT TO A GRAVITY SUPPORT EXCEEDS 6", REFER TO SEISMIC BRACE SPACING TABLE FOR DRAWN TYPE K COPPER PIPES.
5. WHEN THIS MATERIAL IS USED FOR WELDED OR BRAZED CONSTRUCTION, THE ALLOWABLE STRESS VALUES USED SHALL NOT EXCEED THOSE GIVEN FOR THE SAME MATERIAL IN THE ANNEALED CONDITION PER ASME B31.1-2016.
6. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.

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CAST IRON SOIL PIPE FILLED WITH WATER
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	FILLED WITH	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				MAX. LONGITUDINAL SPACING PER LATERAL "G" FORCE (FT.)			
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"
3	WATER	9.40	8	17	12	9	8	34	24	18	16
4	WATER	14.20	8	20	14	11	9	40	28	22	18
5	WATER	22.70	8	20	14	11	9	40	28	22	18
6	WATER	26.90	8	20	16	13	11	40	32	26	22
8	WATER	45.70	8	20	18	15	13	40	36	30	26
10	WATER	69.60	8	20	20	18	16	31	40	36	32
12	WATER	96.20	8	20	20	18	16	10	40	36	32

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASTM C1540, FM 1680 CLASS I, AND ASCE 7-16 SECTION 13.6.7, NOTE c, 10 PERCENT OF THE MATERIAL MINIMUM SPECIFIED TENSILE STRENGTH FOR CAST IRON.
2. MAXIMUM GRAVITY SUPPORT SPACING IS BASED ON SUPPORT OF STANDARD 10 FOOT MAXIMUM PIPE LENGTH SEGMENTS SUPPORTED 1 FOOT IN EACH DIRECTION FROM JOINT CONNECTION. TRIBUTARY WEIGHT ON EACH SUPPORT IS BASED ON 5 FEET OF PIPE AND WATER. PIPE WEIGHTS CONSIDERED FULL OF WATER.
3. BRACE SPACINGS ARE BASED ON CAST IRON PIPE CONSTRUCTED TO ASTM A 888 OR CISPI 301 STANDARDS WITH A MINIMUM TENSILE STRENGTH OF 21,000 PSI.
4. BRACE SPACING SHALL BE 10 FEET MINIMUM AND 40 FEET MAXIMUM. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9.
5. CAST IRON PIPE BRACE SPACINGS SHALL NOT EXCEED THE TABULATED SPACINGS. NO-HUB COUPLINGS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C1540, SHALL BE CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS I, AND GRAVITY HANGERS SHALL BE SPACED PER THE REQUIREMENTS OF TABLE 313.3 OF THE 2022 CALIFORNIA PLUMBING CODE (CPC 2022) FOR NO-HUB CAST IRON PIPE.

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CAST IRON SOIL PIPE FOR EMPTY SYSTEMS (NO WATER)
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	FILLED WITH	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				MAX. LONGITUDINAL SPACING PER LATERAL "G" FORCE (FT.)			
				0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"
3	NO WATER	6.00	8	20	17	14	12	40	34	28	24
4	NO WATER	8.00	8	20	20	17	15	40	40	34	30
5	NO WATER	10.40	8	20	20	19	17	40	40	38	34
6	NO WATER	13.00	8	20	20	20	18	40	40	40	36
8	NO WATER	20.00	8	20	20	20	20	40	40	40	40
10	NO WATER	29.00	8	20	20	20	20	40	40	40	40
12	NO WATER	38.00	8	20	20	20	20	10	40	40	40

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASTM C1540, FM 1680 CLASS I, AND ASCE 7-16 SECTION 13.6.7, NOTE c, 10 PERCENT OF THE MATERIAL MINIMUM SPECIFIED TENSILE STRENGTH FOR CAST IRON.
2. MAXIMUM GRAVITY SUPPORT SPACING IS BASED ON SUPPORT OF STANDARD 10 FOOT MAXIMUM PIPE LENGTH SEGMENTS SUPPORTED 1 FOOT IN EACH DIRECTION FROM JOINT CONNECTION. TRIBUTARY WEIGHT ON EACH SUPPORT IS BASED ON 5 FEET OF PIPE.
3. BRACE SPACINGS ARE BASED ON CAST IRON PIPE CONSTRUCTED TO ASTM A 888 OR CISPI 301 STANDARDS WITH A MINIMUM TENSILE STRENGTH OF 21,000 PSI.
4. BRACE SPACING SHALL BE 10 FEET MINIMUM AND 40 FEET MAXIMUM. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8 & 9.
5. CAST IRON PIPE BRACE SPACINGS SHALL NOT EXCEED THE TABULATED SPACINGS. NO-HUB COUPLINGS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C1540, SHALL BE CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS I, AND GRAVITY HANGERS SHALL BE SPACED PER THE REQUIREMENTS OF TABLE 313.3 OF THE 2022 CALIFORNIA PLUMBING CODE (CPC 2022) FOR NO-HUB CAST IRON PIPE.

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INTERMEDIATE METAL CONDUIT (IMC)
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
			0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	1.23	7	25	20	17	16	14
1	1.82	7	28	22	19	17	16
1-1/4	2.67	10	34	28	25	22	20
1-1/2	3.42	10	36	30	27	24	22
2	5.04	10	40	33	30	27	25
2-1/2	7.75	10	40	37	34	31	29
3	10.69	10	40	40	36	34	32
3-1/2	13.46	10	40	40	38	35	32
4	16.32	10	40	40	40	37	33

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASCE 7-16 SECTION 13.6.7, NOTE b, 70 PERCENT OF THE MATERIAL MINIMUM SPECIFIED TENSILE STRENGTH FOR STEEL TUBING WITH THREADED CONNECTIONS.
2. IMC CONSIDERED WITH CONDUCTORS WHEN DETERMINING WEIGHT.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8, & 9.
4. BRACE SPACINGS ARE BASED ON INTERMEDIATE METAL CONDUIT (IMC) CONSTRUCTED TO UL-1242 OR ANSI C-80.6 WITH A MINIMUM YIELD STRENGTH OF 30,000 PSI.
5. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.
6. COUPLINGS CONNECTING IMC SEGMENTS SHALL BE DESIGNED OR TESTED TO ACCEPT SEISMIC LOADS, WHEN THREADED COUPLINGS ARE NOT USED, AND MAY LIMIT THE BRACE SPACING TO MANUFACTURER'S RATINGS. MANUFACTURER'S RATINGS MUST BE BASED ON REVIEWED CAPACITIES AND APPROVED BY **HCAI**.
7. RIGID GROOVED COUPLINGS LISTED FOR UL STANDARD 213 MAY USE LISTED MAXIMUM BRACE SPACINGS.
8. FOR LONGITUDINAL BRACE SPACING, DOUBLE THE MAXIMUM TRANSVERSE BRACE SPACING LISTED IN THE ABOVE TABLE. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES.

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ELECTRICAL METALLIC TUBING (EMT)
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
			0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	0.84	7	23	18	16	14	13
1	1.30	7	26	21	18	16	15
1-1/4	2.12	7	30	24	21	19	17
1-1/2	2.70	7	32	26	22	20	18
2	4.02	10	34	29	25	22	19
2-1/2	5.79	10	39	33	30	26	22
3	8.26	10	40	35	30	26	23
3-1/2	10.98	10	40	37	32	28	24
4	13.64	10	40	39	33	28	25

NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASCE 7-16 SECTION 13.6.7, NOTE b, 70 PERCENT OF THE MATERIAL MINIMUM SPECIFIED TENSILE STRENGTH FOR STEEL TUBING.
2. EMT CONSIDERED WITH CONDUCTORS WHEN DETERMINING WEIGHT.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8, & 9.
4. BRACE SPACINGS ARE BASED ON ELECTRICAL METALLIC TUBING (EMT) CONSTRUCTED TO UL-797 OR ANSI C-80.3 WITH A MINIMUM YIELD STRENGTH OF 30,000 PSI.
5. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.
6. COUPLINGS FOR UP TO 2 1/2" EMT TO MEET PROJECT SPECIFICATIONS. HOWEVER, COMPRESSION COUPLINGS OR COUPLINGS WITH MINIMUM (2) SCREWS AT EACH END; e.g., COUNDUIT CAN BE PUSHED INTO COUPLING ≈ 2" AND SET WITH MINIMUM (2) SCREWS, SHALL BE USED FOR 3", 3 1/2", AND 4" EMT.
7. FOR LONGITUDINAL BRACE SPACING, DOUBLE THE MAXIMUM TRANSVERSE BRACE SPACING LISTED IN THE ABOVE TABLE. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES.

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RIGID METAL CONDUIT (RMC)
MAXIMUM SEISMIC BRACE SPACING (ASD)

PIPE DIAMETER (IN)	MAX. WEIGHT (PLF)	MAX. GRAVITY SUPPORT SPACING (FT)	MAX. TRANSVERSE SPACING PER LATERAL "G" FORCE (FT.)				
			0.25 "G"	0.50 "G"	0.75 "G"	1.00 "G"	1.31 "G"
3/4	1.46	10	26	20	18	16	15
1	2.19	12	31	25	21	19	18
1-1/4	3.18	14	34	29	25	23	21
1-1/2	4.09	14	36	30	27	24	22
2	5.94	16	40	34	31	28	24
2-1/2	9.01	16	40	37	33	31	27
3	12.59	20	40	40	37	33	28
3-1/2	16.04	20	40	40	39	34	30
4	19.67	20	40	40	40	36	31
5	28.86	20	40	40	40	39	34
6	40.10	20	40	40	40	40	37

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NOTES:

1. MAXIMUM BRACE SPACING IS BASED ON ASCE 7-16 SECTION 13.6.7, NOTE b, 70 PERCENT OF THE MATERIAL MINIMUM SPECIFIED TENSILE STRENGTH FOR STEEL TUBING WITH THREADED CONNECTIONS.
2. THE MAXIMUM WEIGHT IN THE TABLE IS THE WEIGHT OF THE CONDUIT PLUS THE PERMITTED WEIGHT OF THE CONDUCTOR.
3. BRACE AND OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES. SEE SECTIONS 2, 3, 4, 5, 6, 7, 8, & 9.
4. BRACE SPACINGS ARE BASED ON RIGID METAL CONDUIT (RMC) CONSTRUCTED TO UL-6 OR ANSI C-80.1 WITH A MINIMUM YIELD STRENGTH OF 30,000 PSI.
5. FOR VALUES BETWEEN 0.5 "G", 0.75 "G", AND 1.0 "G", IT IS ACCEPTABLE TO INTERPOLATE FOR INTERMEDIATE VALUES. IT IS INTENDED THAT 1.31 "G" BE THE MAXIMUM.
6. COUPLINGS CONNECTING RMC SEGMENTS SHALL BE DESIGNED OR TESTED TO ACCEPT SEISMIC LOADS, WHEN THREADED COUPLINGS ARE NOT USED, AND MAY LIMIT THE BRACE SPACING TO MANUFACTURER'S RATINGS. MANUFACTURER'S RATINGS MUST BE BASED ON REVIEWED CAPACITIES AND APPROVED BY **HCAI**.
7. RIGID GROOVED COUPLINGS LISTED FOR UL STANDARD 213 MAY USE LISTED MAXIMUM BRACE SPACINGS.
8. FOR LONGITUDINAL BRACE SPACING, DOUBLE THE MAXIMUM TRANSVERSE BRACE SPACING LISTED IN THE ABOVE TABLE. BRACE AND / OR CONNECTION CAPACITY MAY GOVERN MAXIMUM SPACING IN SOME CASES.

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DATE: April 23, 2025

SECTION 15

SPECIAL SEISMIC FOR FLOOR SUPPORT DETAILS

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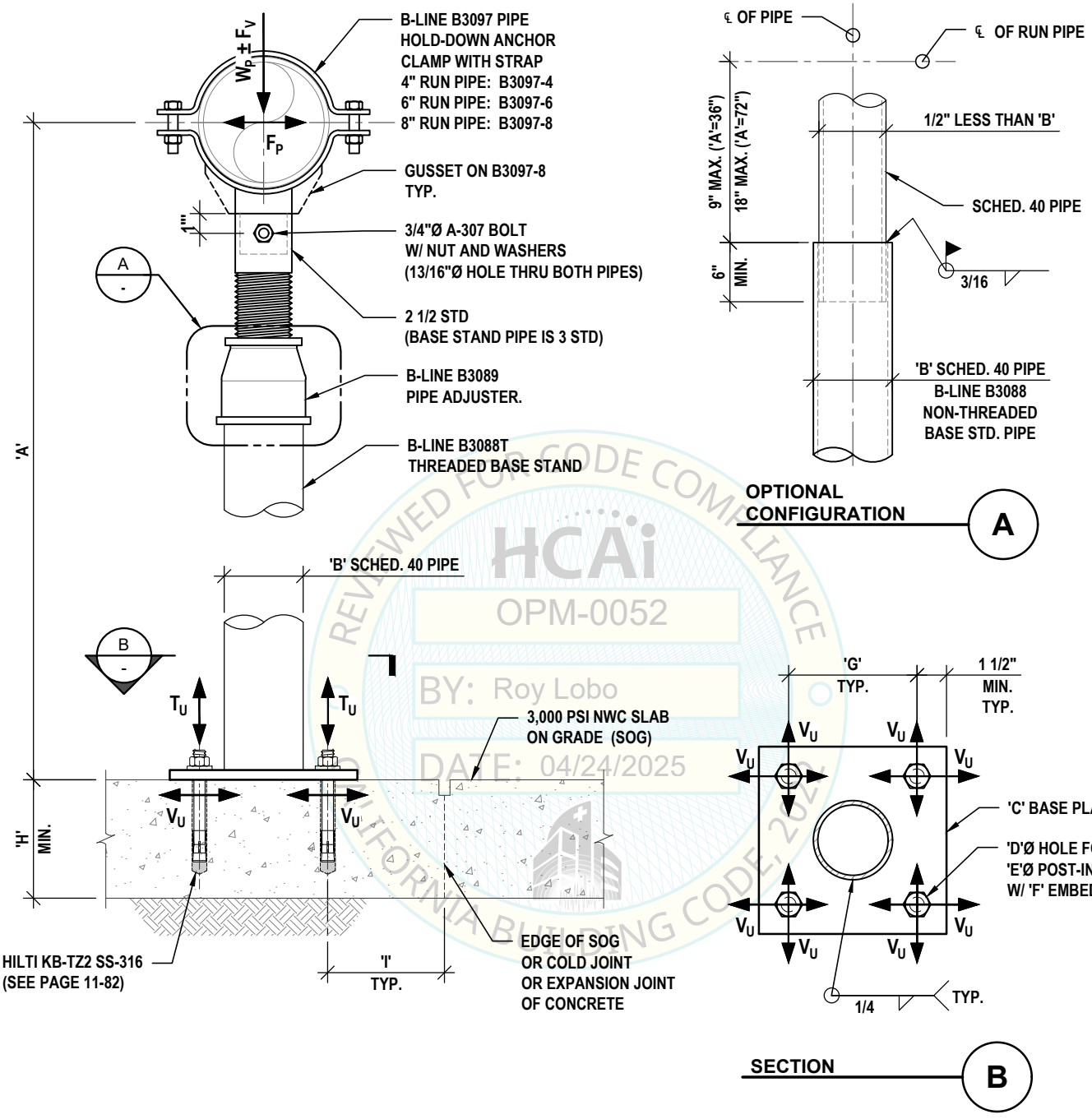
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **15-0**

DATE: **April 23, 2025**

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE	DETAIL PS-A



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NOTES:

1. SEE PAGE 15-A2 FOR ADDITIONAL INFORMATION AND DATA TABLES.

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ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	ADJUSTER B-LINE B3089 PIPE SIZE (IN)	"B" BASE STAND (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
A-1	4	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
A-2	4	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
A-3	6	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
A-4	6	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
A-5	8	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
A-6	8	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" HILTI KB-TZ2 CS ANCHOR SIZE(1) THRU (7) (IN)	"F" ANCHOR EMBED. (IN)(hef)	"G" ANCHOR SPACING (IN)	"H" MIN. CONC. SLAB ON GRADE THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u(8) PER ANCHOR (LRFD)(LBS)	V_u(8) PER ANCHOR (LRFD)(LBS)
A-1	4	36	3/4	3.25	9	6	9	1,841	230
A-2	4	72	3/4	3.25	9	6	9	1,835	113
A-3	6	36	3/4	3.25	9	6	9	1,841	229
A-4	6	72	3/4	3.75	9	6	9	1,835	113
A-5	8	36	3/4	3.75	9	6	9	1,841	229
A-6	8	72	3/4	3.75	9	6	9	1,835	113

(1) KWIK BOLT KB-TZ2 ANCHOR BOLTS SHALL BE INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION FOR ANCHORS IN CRACKED CONCRETE, PER ICC ESR-4266.
(2) TORQUE TEST SHALL BE PERFORM FOR 100% THE EXPANSION TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION.
(3) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(4) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(5) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(6) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(7) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(8) THE MAXIMUM ANCHOR REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

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NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 4" RUN PIPE WEIGHING 18.1 LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (200 LBS.) / (1.27) / 18.1 LBS/FT) = 8'-8". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P) , THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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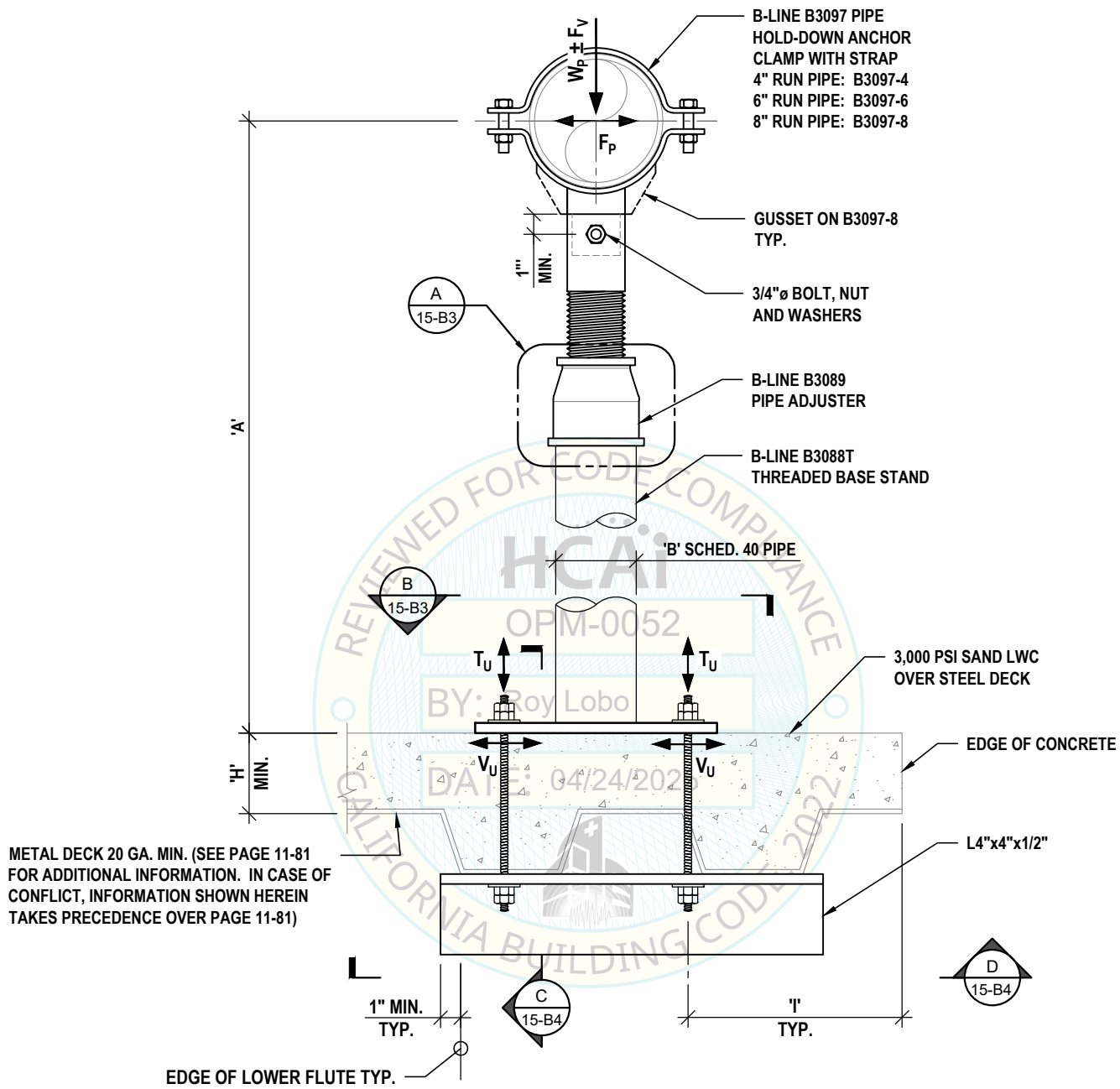
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 15-A2

DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK	DETAIL PS-B



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NOTES:

1. SEE PAGES 15-B2, 15-B3, 15-B4 & 15-B5 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. USE THIS DETAIL WHEN BASE PLATE IS OVER ONE LOWER FLUTE.

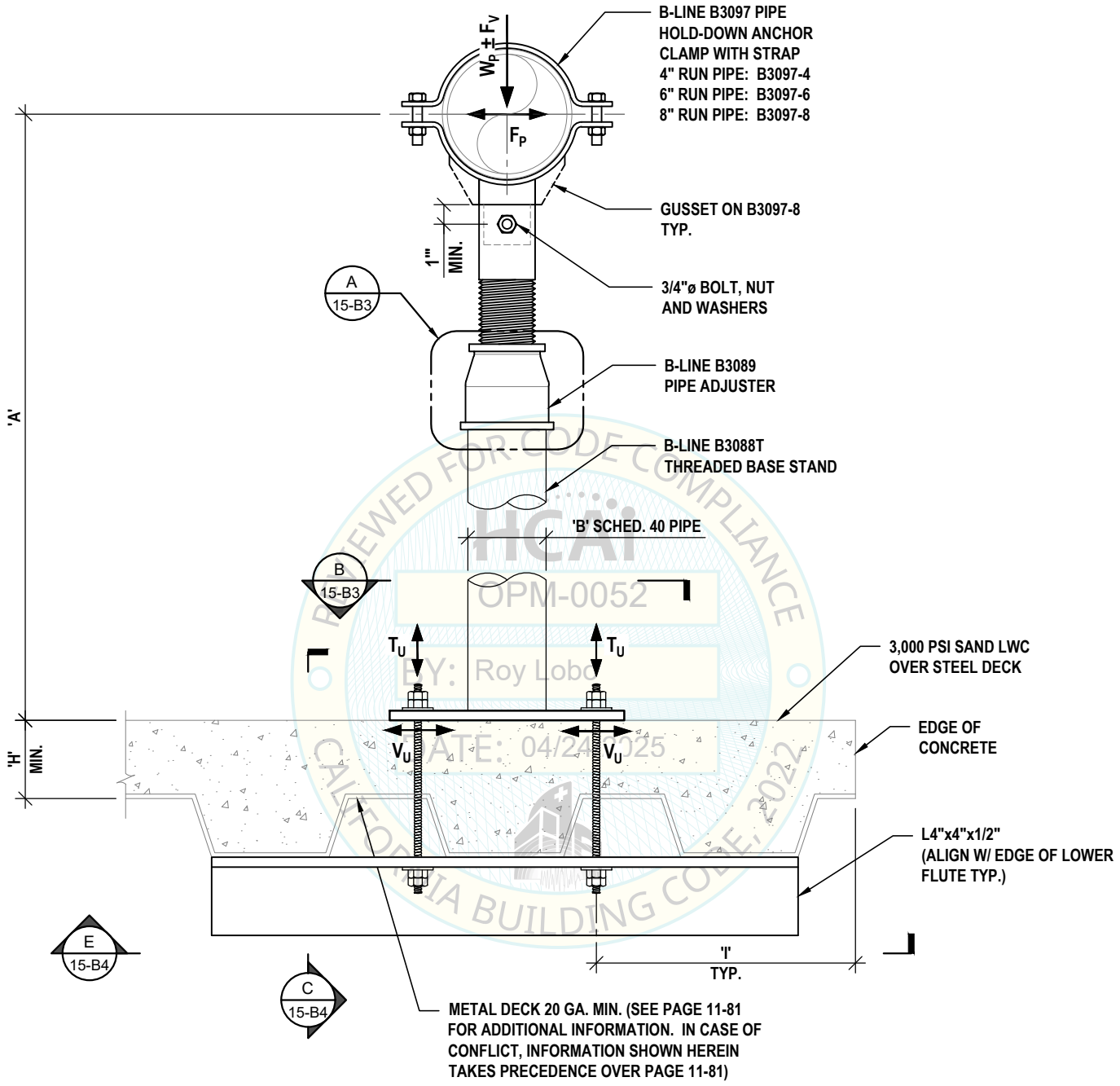
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DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)	DETAIL PS-B



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NOTES:

1. SEE PAGES 15-B1, 15-B3 & 15-B4 & 15-B-5 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. USE THIS DETAIL WHEN BASE PLATE IS OVER TWO LOWER FLUTE.

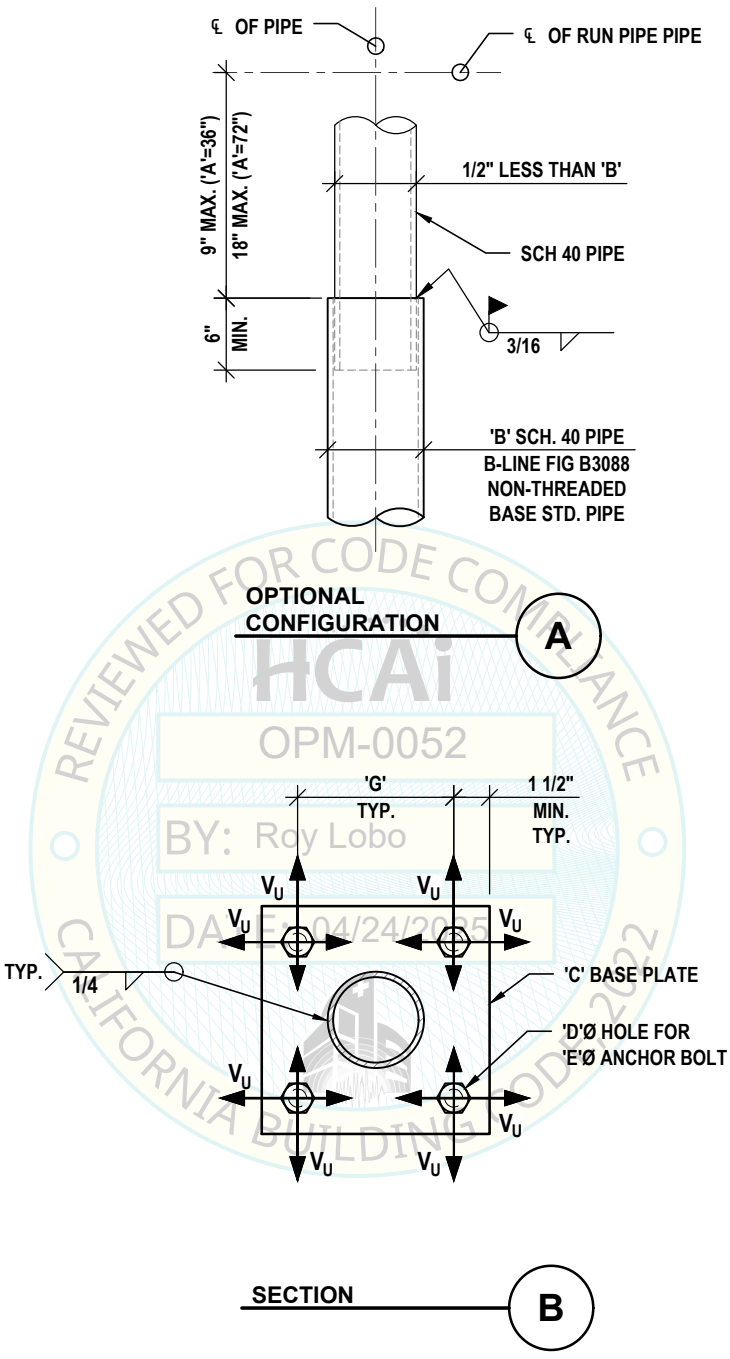
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DATE: April 23, 2025

ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



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NOTES:

1. SEE PAGES 15-B1, 15-B2, 15-B4 & 15-B5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

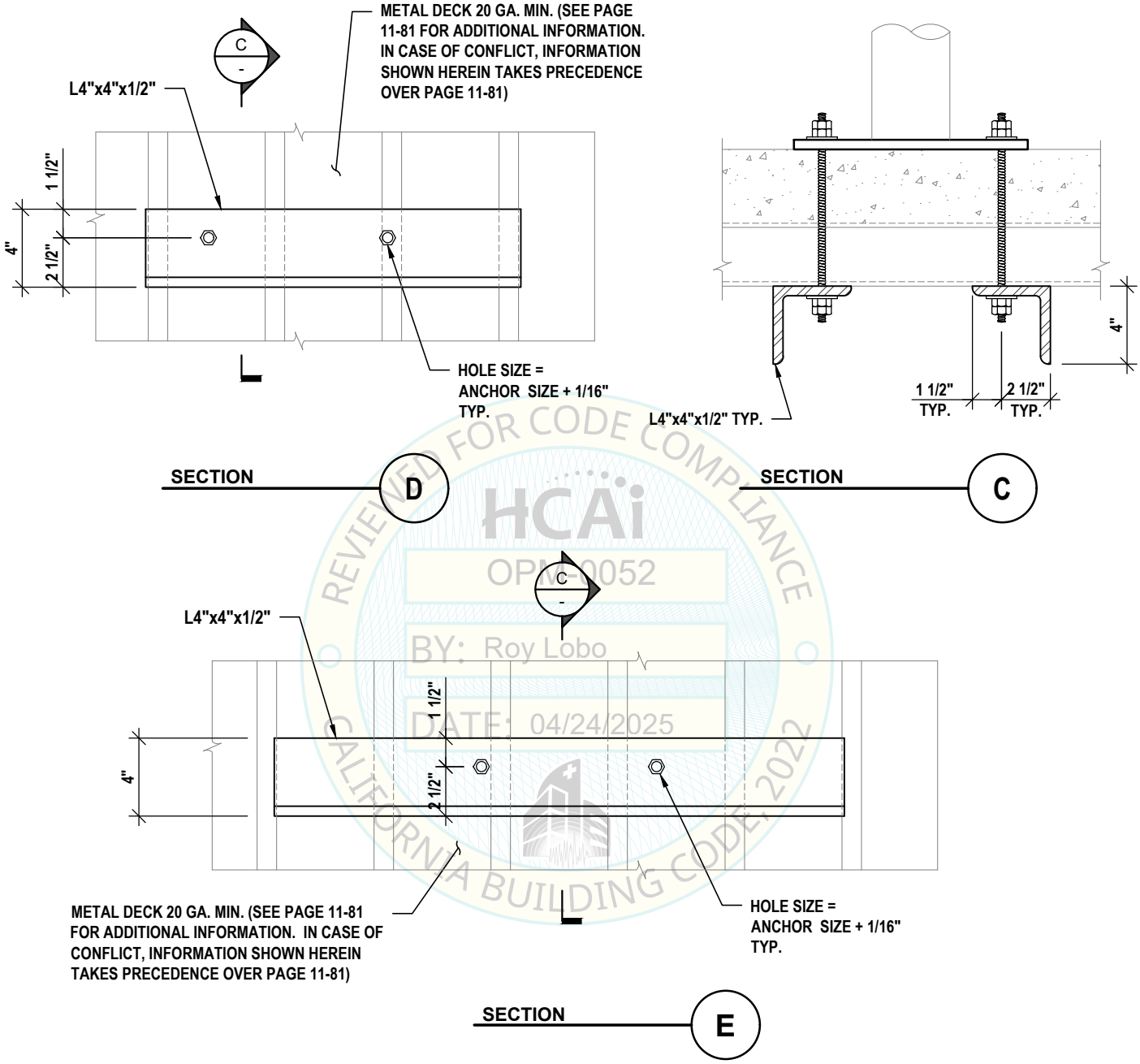
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DATE: April 23, 2025

ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



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NOTES:

1. SEE PAGES 15-B1, 15-B2, 15-B3 & 15-B5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

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LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 4", 6" & 8" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)	DETAIL PS-B

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE[(1)] (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE[(1)] (ASD)(LBS)	ADJUSTER B-LINE B3089 PIPE SIZE (IN)	"B" BASE STAND (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
B-1	4	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
B-2	4	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
B-3	6	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
B-4	6	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
B-5	8	36	204	161	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16
B-6	8	72	100	79	B3089-2 1/2	3" STD PIPE	3/8 x 12 x 12	13/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD IS APPLIED CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" ANCHOR BOLT SIZE[(1) THRU (6)] (IN)	"F" (NOT USED)	"G" ANCHOR SPACING (IN)	"H" UPPER FLUTE MINIMUM THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u PER ANCHOR (LRFD)(LBS)	V_u[(7)] PER ANCHOR (LRFD)(LBS)
B-1	4	36	3/4	-	9	3	12	2,278	230
B-2	4	72	3/4	-	9	3	12	2,278	113
B-3	6	36	3/4	-	9	3	12	2,278	229
B-4	6	72	3/4	-	9	3	12	2,278	113
B-5	8	36	3/4	-	9	3	12	2,278	229
B-6	8	72	3/4	-	9	3	12	2,278	113

(1) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(2) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(3) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(4) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(5) ANCHOR BOLTS SHALL BE ALL THREADED PER STM F1554 GRADE 105.
(6) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(7) THE MAXIMUM ANCHOR SHEAR FORCE REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

HCAi OPM-0052 BY: Roy Lobo DATE: 04/24/2025 REVIEWED FOR CODE COMPLIANCE CALIFORNIA BUILDING CODE 2022

NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 4" RUN PIPE WEIGHING 18.1 LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (200 LBS.) / (1.27) / 18.1 LBS/FT) = 8'-8". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P), THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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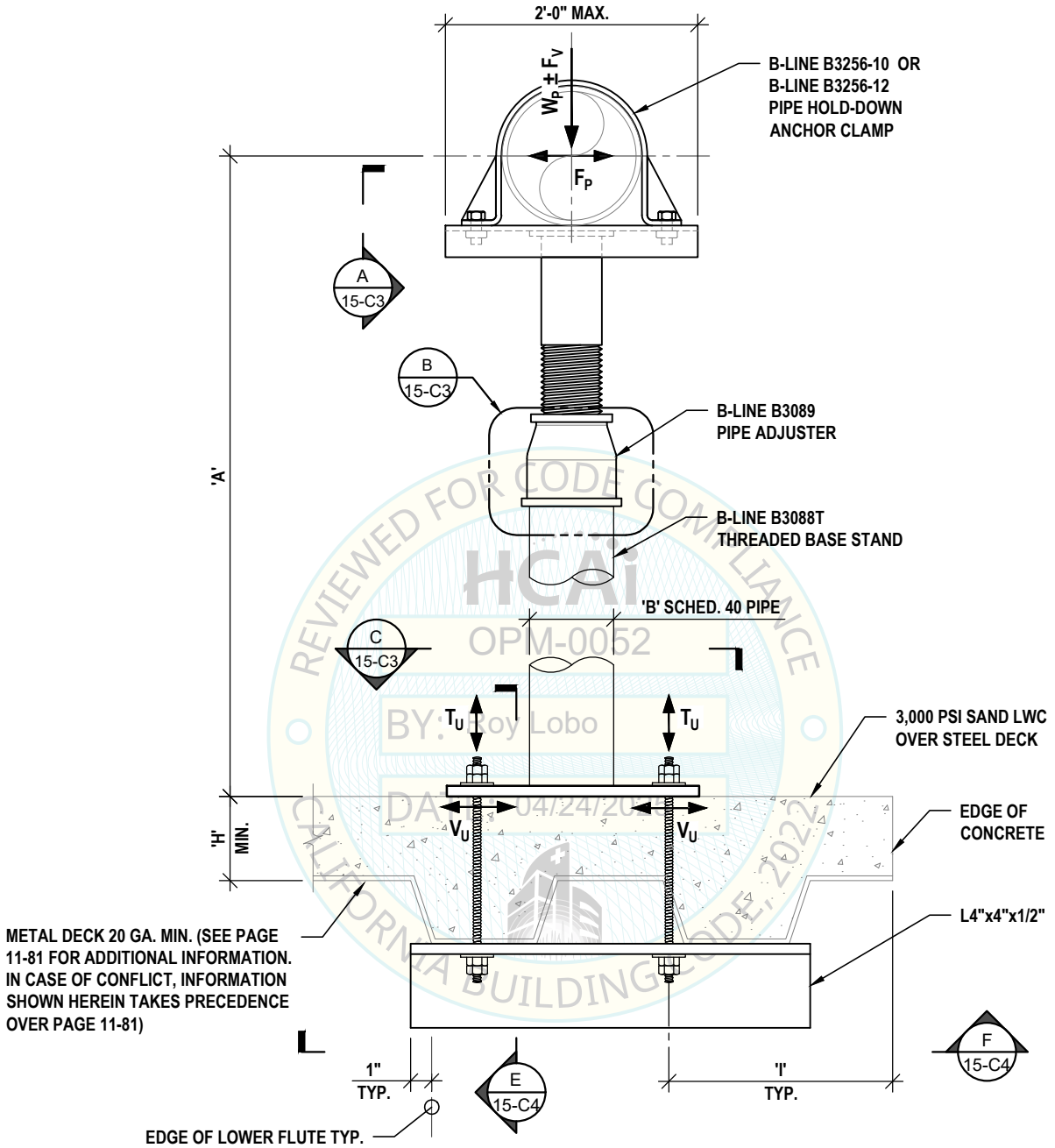
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LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 10" & 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK	DETAIL PS-C



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NOTES:

1. SEE PAGES 15-C2, 15-C3, 15-C4 & 15-C5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

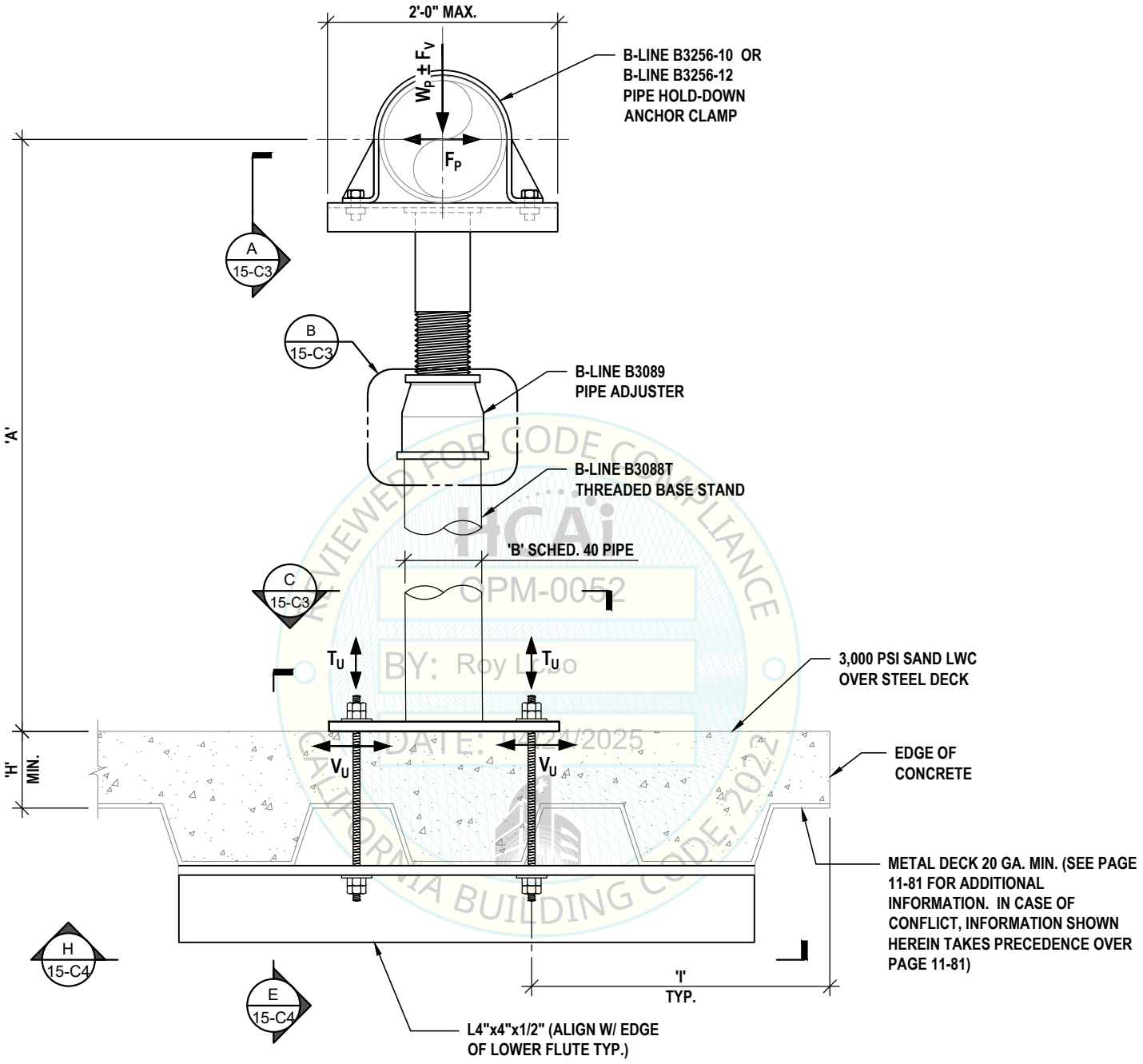
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PAGE: 15-C1

DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	ADJUSTABLE PIPE STAND SUPPORTING 10" & 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)	DETAIL PS-C



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NOTES:

1. SEE PAGES 15-C1, 15-C3, 15-C4 & 15-C5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

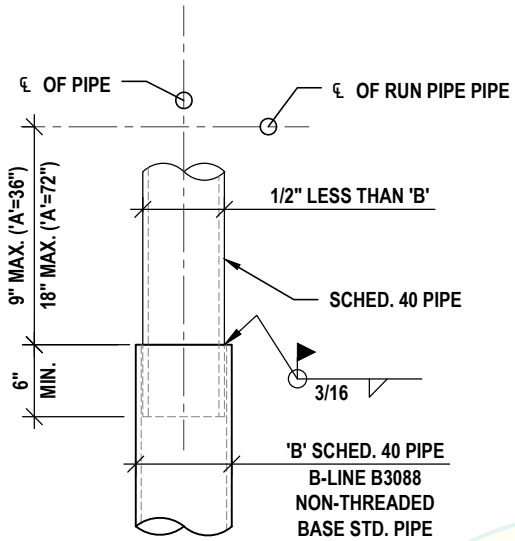
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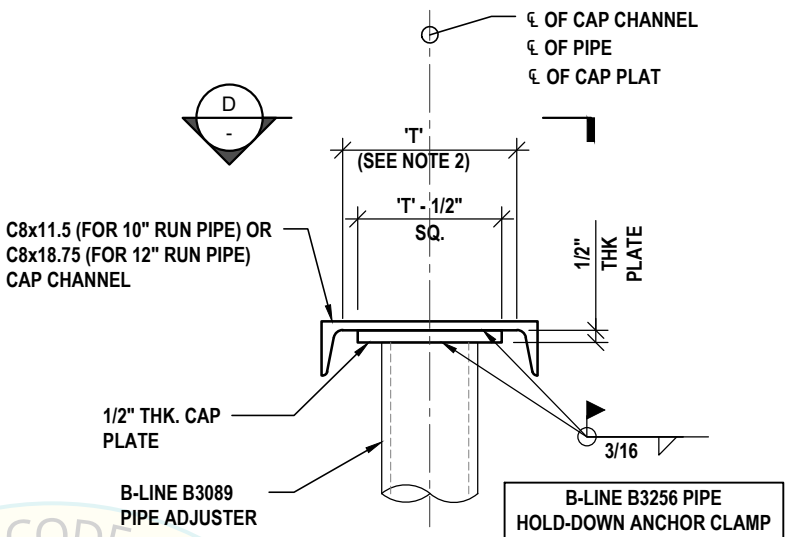
PAGE: 15-C2

DATE: April 23, 2025

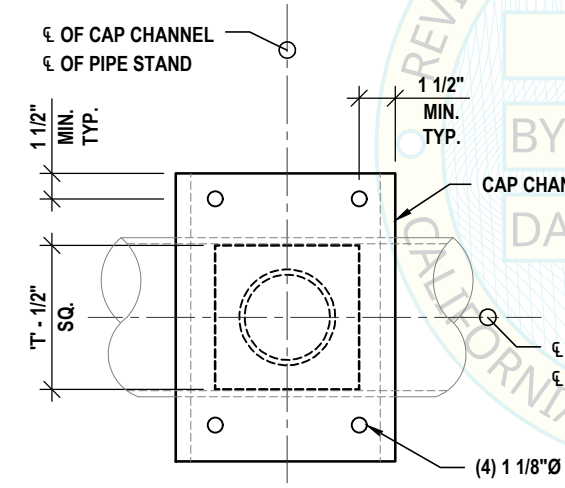
ADJUSTABLE PIPE STAND SUPPORTING 10" & 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



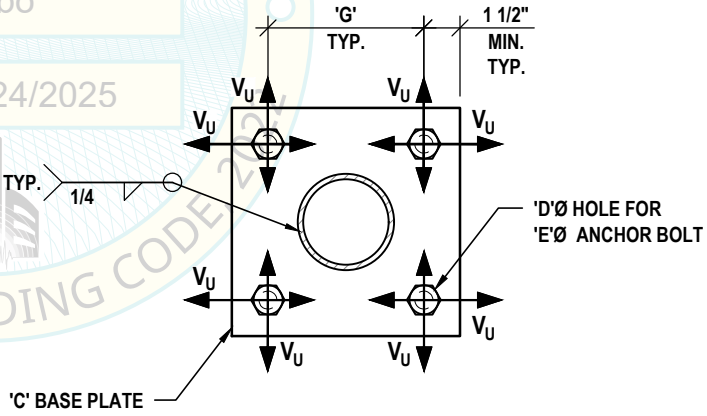
OPTIONAL CONFIGURATION — B



SECTION — A



PLAN VIEW — D



SECTION — C

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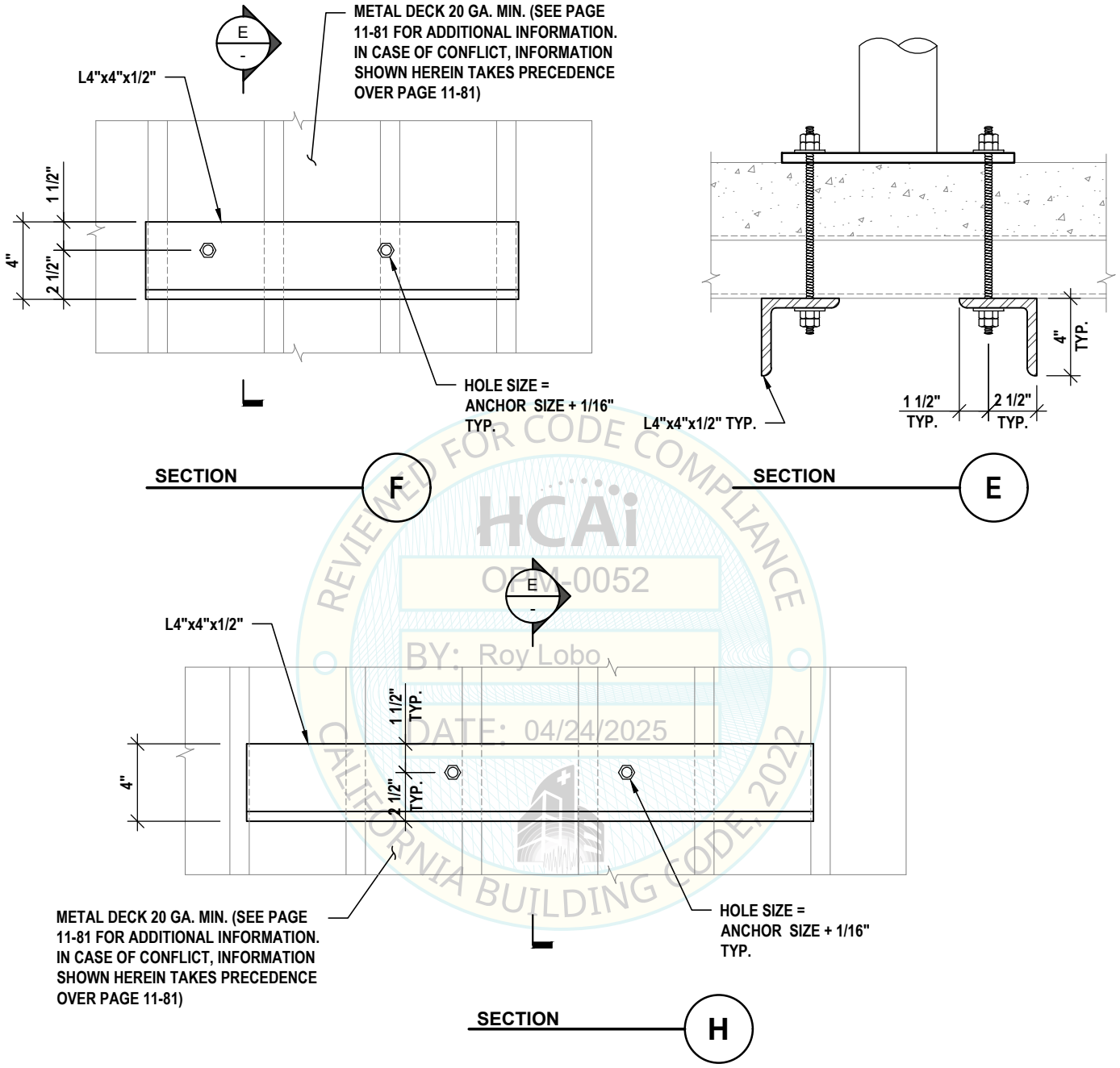
NOTES:

1. SEE PAGES 15-C1, 15-C2, 15-C4 & 15-C5 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. 'T' IS DISTANCE BETWEEN WEB TOES FILLETS AT TOP AND BOTTOM OF WEB PER AISC 360-16.

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ADJUSTABLE PIPE STAND SUPPORTING 10" & 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



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NOTES:

1. SEE PAGES 15-B1, 15-B2, 15-C3 & 15-C5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

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ADJUSTABLE PIPE STAND SUPPORTING 10" & 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	ADJUSTER C-LINE B3089 PIPE SIZE (IN)	"B" BASE STAND (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
C-1	10	36	573	452	B3089-3	4" STD PIPE	1/2 x 12 x 12	15/16
C-2	10	72	282	222	B3089-3	4" STD PIPE	1/2 x 12 x 12	15/16
C-3	12	36	573	452	B3089-3	4" STD PIPE	1/2 x 12 x 12	15/16
C-4	12	72	282	222	B3089-3	4" STD PIPE	1/2 x 12 x 12	15/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD IS APPLIED CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" ANCHOR BOLT SIZE(1) THRU (6) (IN)	"F" (NOT USED)	"G" ANCHOR SPACING (IN)	"H" UPPER FLUTE MINIMUM THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u PER ANCHOR (LRFD)(LBS)	V_u(7) PER ANCHOR (LRFD)(LBS)
C-1	10	36	7/8	-	9	3	18	4,050	645
C-2	10	72	7/8	-	9	3	18	4,050	317
C-3	12	36	7/8	-	9	3	18	4,050	645
C-4	12	72	7/8	-	9	3	18	4,050	317

(1) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(2) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(3) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(4) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(5) ANCHOR BOLTS SHALL BE ALL THREADED PER STM F1554 GRADE 105.
(6) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(7) THE MAXIMUM ANCHOR SHEAR FORCE REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 10" RUN PIPE WEIGHING 80.2 LB/FT, AT 36" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (762 LBS.) / (1.27) / 80.2 LBS/FT) = 7'-5". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P) , THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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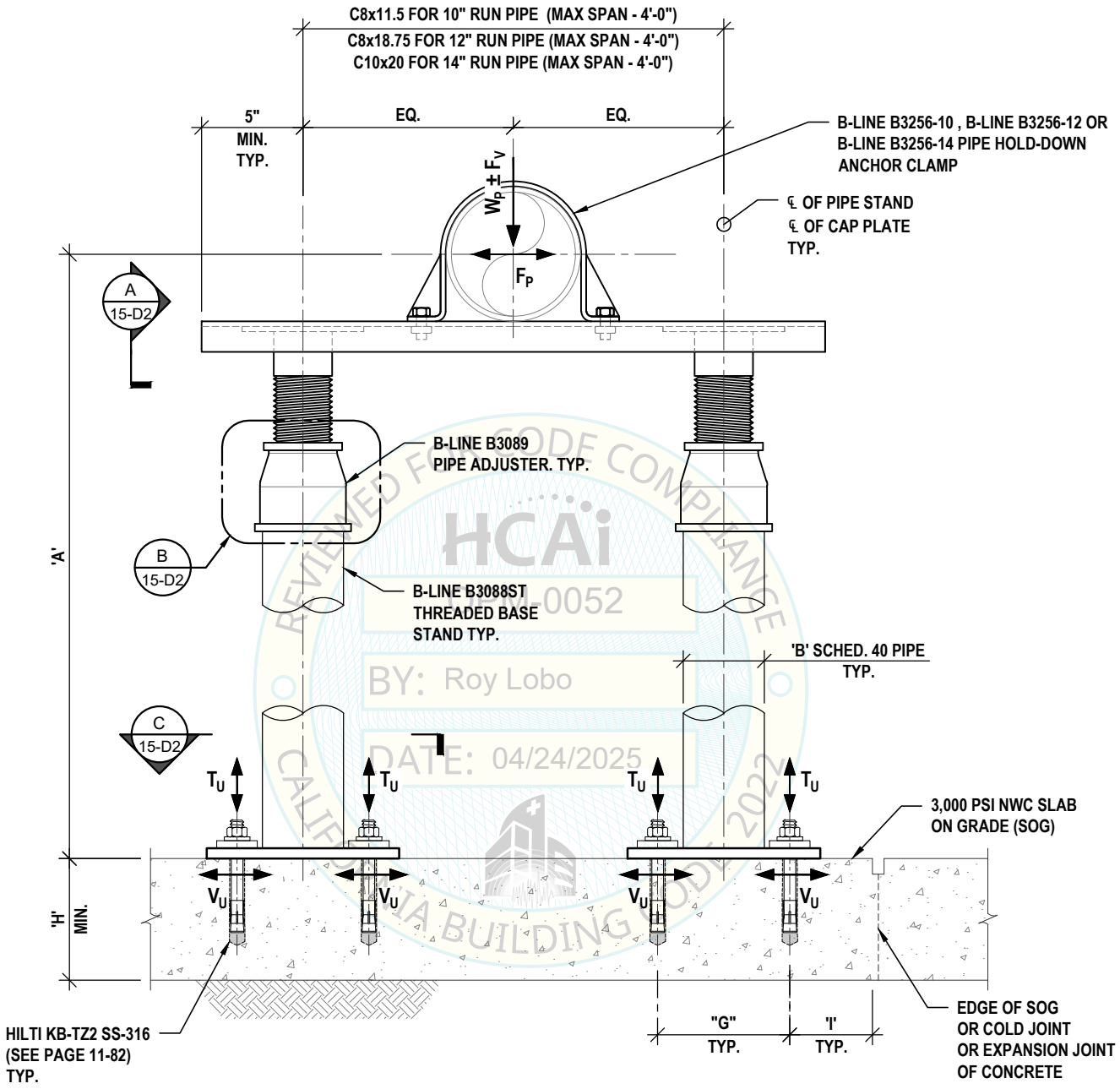
MRH

Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	TWO ADJUSTABLE PIPE STANDS SUPPORTING 10", 12" & 14" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE	DETAIL PS-D



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NOTES:

1. SEE PAGES 15-D2, 15-D3 & 15-D4 FOR ADDITIONAL INFORMATION AND DATA TABLES.

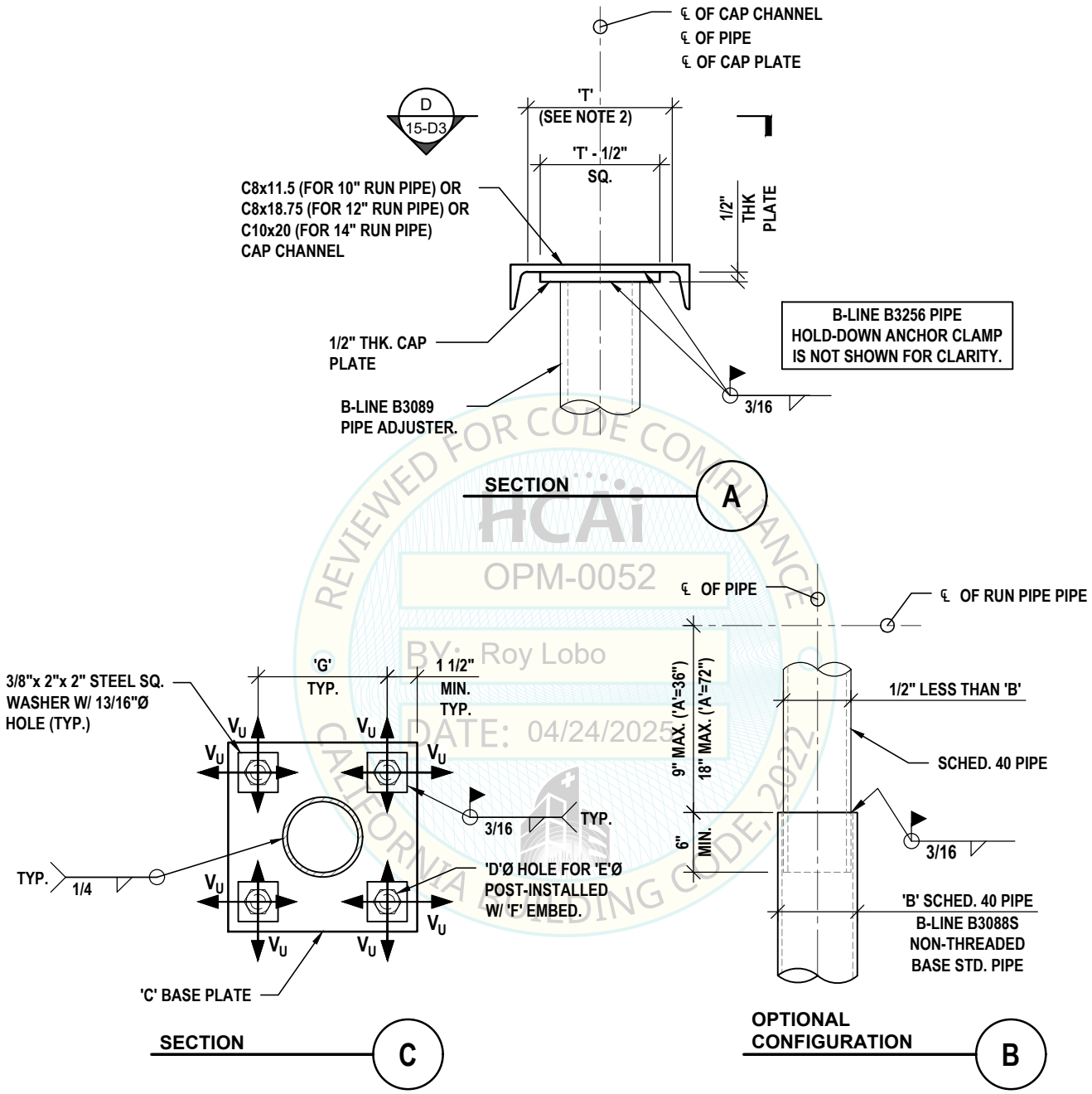
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California SE No. S3545

PAGE: 15-D1

DATE: April 23, 2025

TWO ADJUSTABLE PIPE STANDS SUPPORTING 10", 12" & 14" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)



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NOTES:

1. SEE PAGES 15-D1, 15-D3 & 15-D4 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. 'T' IS DISTANCE BETWEEN WEB TOES FILLETS AT TOP AND BOTTOM OF WEB PER AISC 360-16.

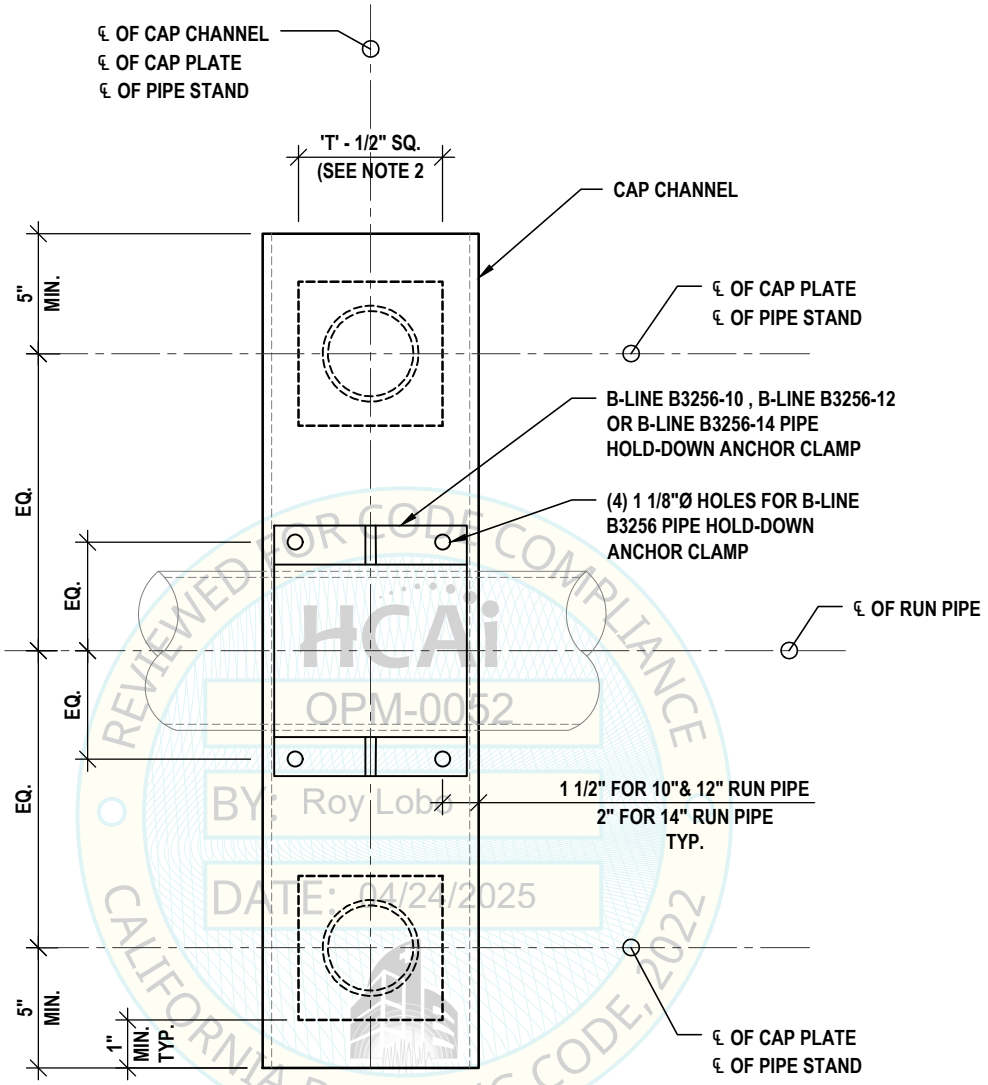
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DATE: April 23, 2025

TWO ADJUSTABLE PIPE STANDS SUPPORTING 10", 12" & 14" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)



PLAN VIEW D

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NOTES:

1. SEE PAGES 15-D1, 15-D2 & 15-D4 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. 'T' IS DISTANCE BETWEEN WEB TOES FILLETS AT TOP AND BOTTOM OF WEB PER AISC 360-16.

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DATE: April 23, 2025

TWO ADJUSTABLE PIPE STANDS SUPPORTING 10", 12" & 14" RUN PIPES ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	ADJUSTER B-LINE B3089 PIPE SIZE (IN)	"B" BASE STAND (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
D-1	10	36	1,016	802	B3089-3	4 STD PIPE	1/2x12x12	15/16
D-2	10	72	562	444	B3089-3	4 STD PIPE	1/2x12x12	15/16
D-3	12	36	1,143	903	B3089-3	4 STD PIPE	1/2x12x12	15/16
D-4	12	72	562	444	B3089-3	4 STD PIPE	1/2x12x12	15/16
D-5	14	36	1,143	903	B3089-3	4 STD PIPE	1/2x12x12	15/16
D-6	14	72	562	444	B3089-3	4 STD PIPE	1/2x12x12	15/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD IS APPLIED CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" HILTI KB-TZ2 CS ANCHOR SIZE(1) THRU (7) (IN)	"F" ANCHOR EMBED. (IN)(hef)	"G" ANCHOR SPACING (IN)	"H" MIN. CONC. SLAB ON GRADE THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u(8) PER ANCHOR (LRFD)(LBS)	V_u(8) PER ANCHOR (LRFD)(LBS)
D-1	10	36	3/4	4.75	9	8	9	3,063	573
D-2	10	72	3/4	4.75	9	8	9	3,438	317
D-3	12	36	3/4	4.75	9	8	9	3,449	645
D-4	12	72	3/4	4.75	9	8	9	3,438	317
D-5	14	36	3/4	4.75	9	8	9	3,449	645
D-6	14	72	3/4	4.75	9	8	9	3,438	317

(1) KWIK BOLT KB-TZ2 ANCHOR BOLTS SHALL BE INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION FOR ANCHORS IN CRACKED CONCRETE, PER ICC ESR-4266.
(2) TORQUE TEST SHALL BE PERFORM FOR 100% THE EXPANSION TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION.
(3) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(4) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(5) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(6) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(7) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(8) THE MAXIMUM ANCHOR REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

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NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 10" RUN PIPE WEIGHING 80.2 LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (791 LBS.) / (1.27) / 80.2 LBS/FT) = 7'-9". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P) , THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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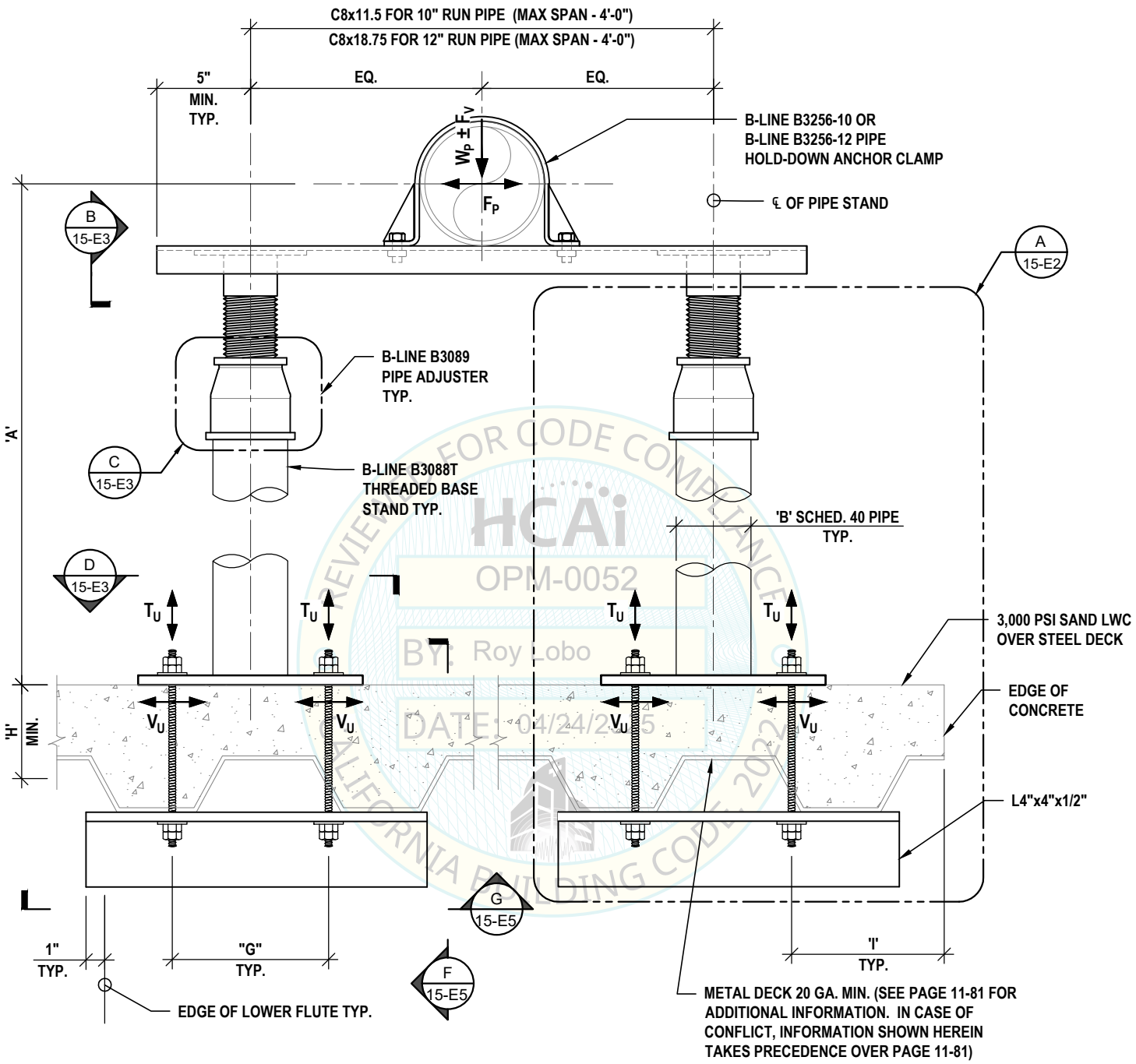
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 15-D4

DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK	DETAIL PS-E



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NOTES:

1. SEE PAGES 15-E2, 15-E3, 15-E4, 15-E5 & 15-E6 FOR ADDITIONAL INFORMATION AND DATA TABLES.

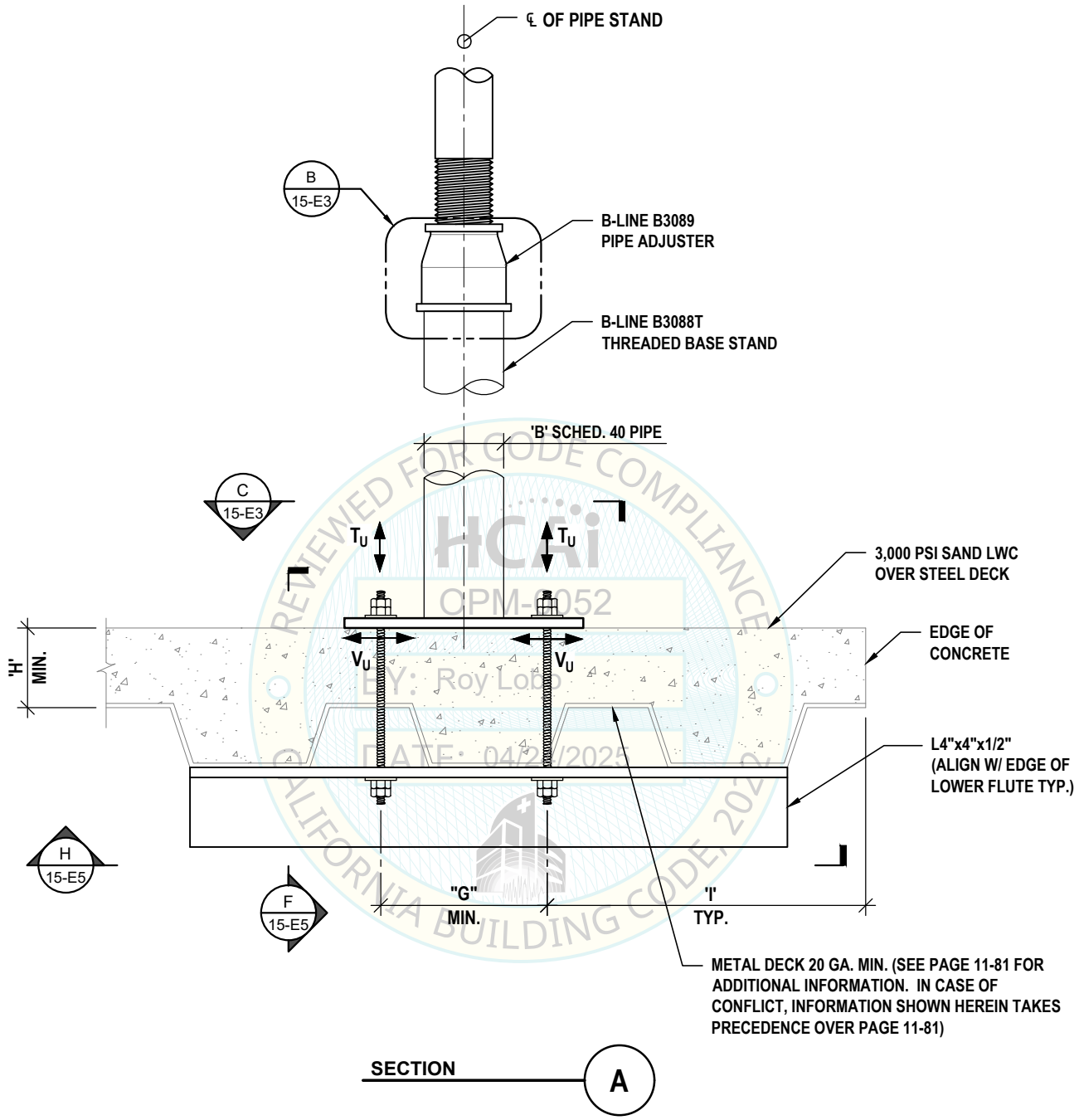
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DATE: April 23, 2025

TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



SECTION A

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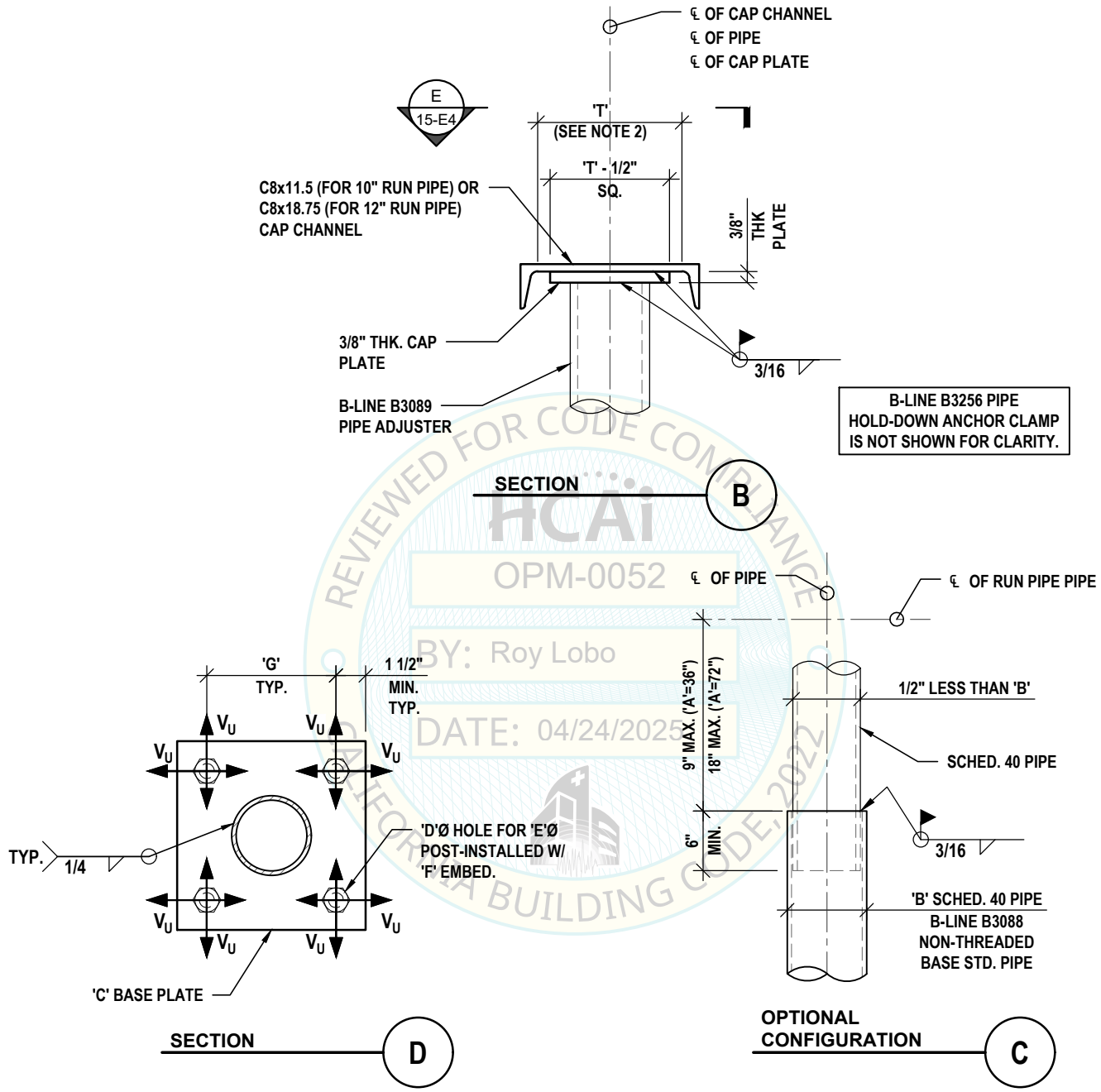
NOTES:

1. SEE PAGES 15-E1, 15-E3, 15-E4, 15-E5 & 15-E6 FOR ADDITIONAL INFORMATION AND DATA TABLES.

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TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



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NOTES:

1. SEE PAGES 15-E1, 15-E2, 15-E4, 15-E5 & 15-E6 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. 'T' IS DISTANCE BETWEEN WEB TOES FILLETS AT TOP AND BOTTOM OF WEB PER AISC 360-16.

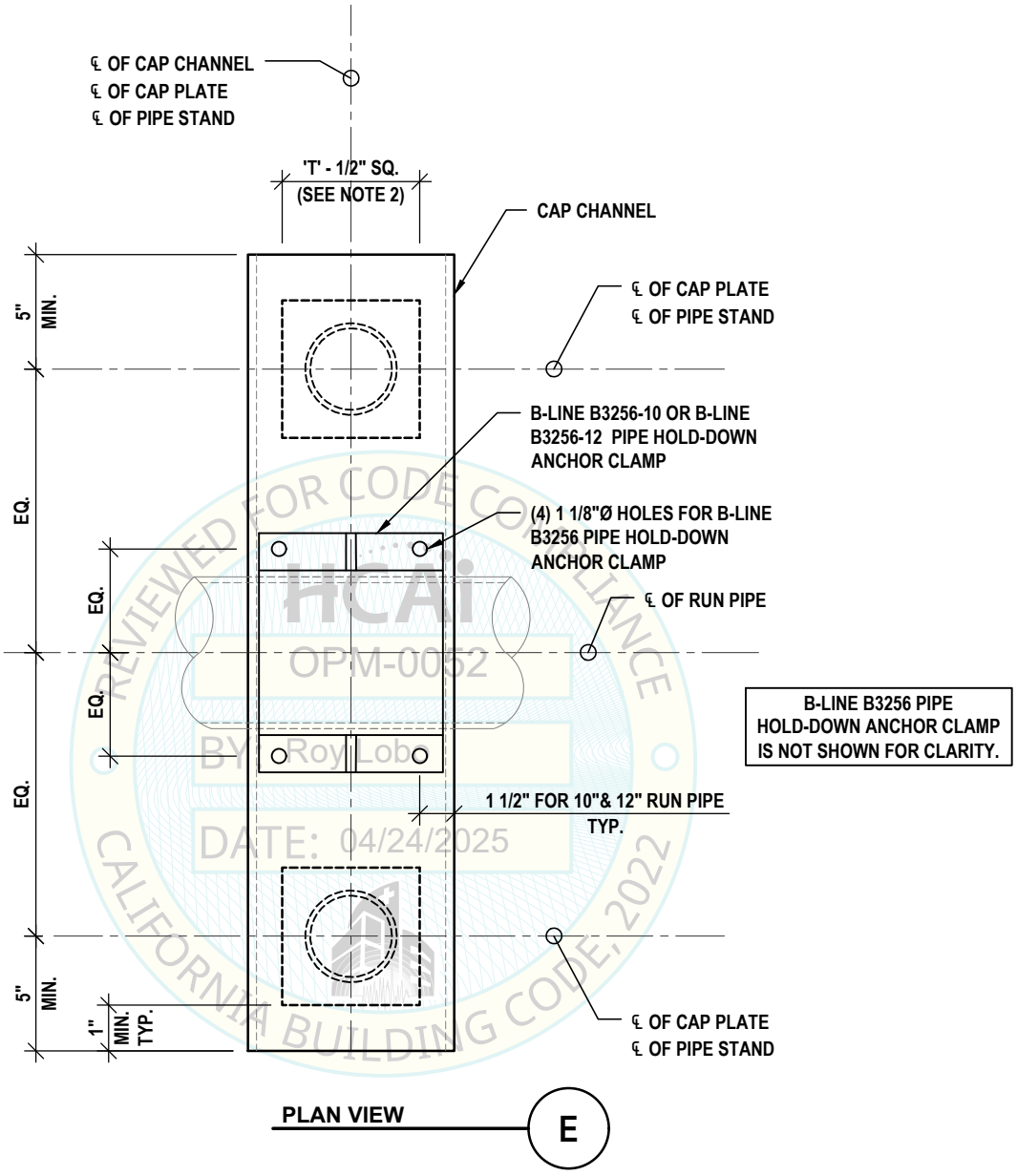
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TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



PLAN VIEW — E

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NOTES:

1. SEE PAGES 15-E1, 15-E2, 15-E3, 15-E5 & 15-E6 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. 'T' IS DISTANCE BETWEEN WEB TOES FILLETS AT TOP AND BOTTOM OF WEB PER AISC 360-16.

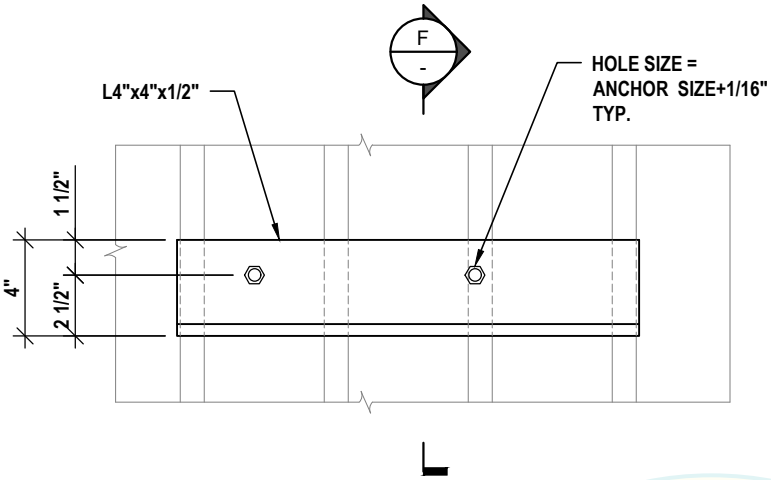
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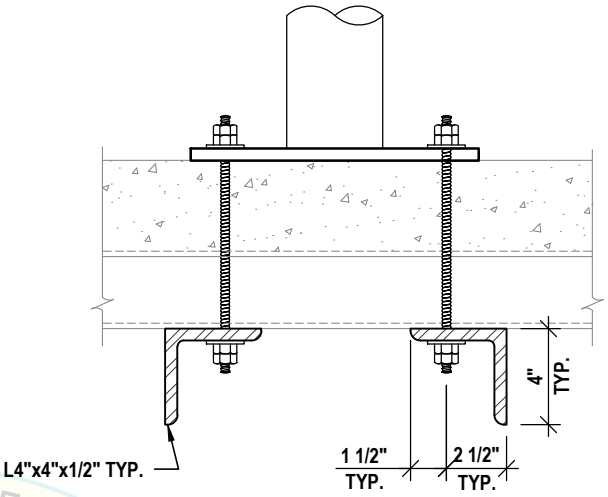
PAGE: 15-E4

DATE: April 23, 2025

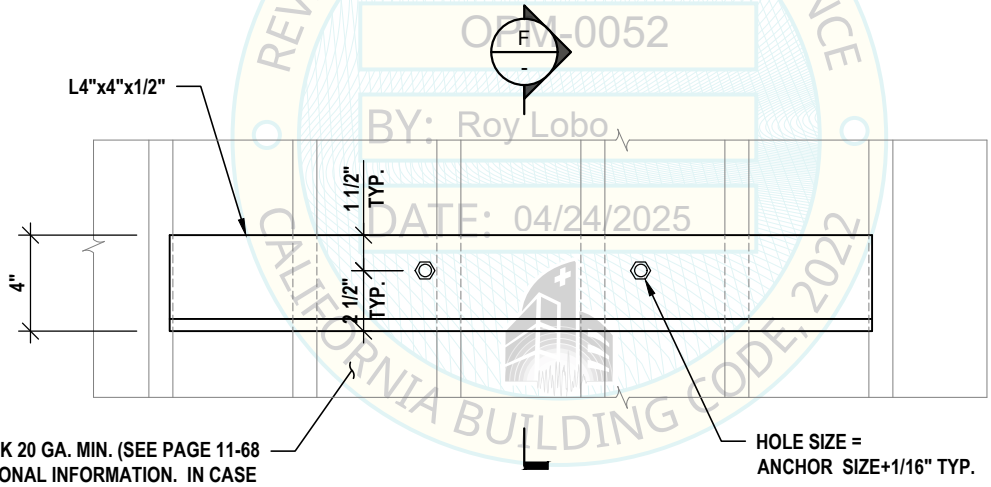
TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)



SECTION G



SECTION F



SECTION H

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NOTES:

1. SEE PAGES 15-B1, 15-B2, 15-C3 & 15-C5 FOR ADDITIONAL INFORMATION AND DATA TABLES.

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TWO ADJUSTABLE PIPE STANDS SUPPORTING 10"& 12" RUN PIPES ON 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE[1] (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE[1] (ASD)(LBS)	ADJUSTER B-LINE B3089 PIPE SIZE (IN)	"B" BASE STAND (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
E-1	10	36	1,019	802	B3089-3	4" STD PIPE	1/2 x 12x 12	15/16
E-2	10	72	564	444	B3089-3	4" STD PIPE	1/2 x 12x 12	15/16
E-3	12	36	1,128	888	B3089-3	4" STD PIPE	1/2 x 12x 12	15/16
E-4	12	72	564	444	B3089-3	4" STD PIPE	1/2 x 12x 12	15/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD IS APPLIED CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" ANCHOR BOLT SIZE[1] THRU [6] (IN)	"F" (NOT USED)	"G" ANCHOR SPACING (IN)	"H" UPPER FLUTE MINIMUM THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u PER ANCHOR (LRFD)(LBS)	V_u[7] PER ANCHOR (LRFD)(LBS)
E-1	10	36	7/8	-	9	3	18	3,658	1,146
E-2	10	72	7/8	-	9	3	18	4,050	634
E-3	12	36	7/8	-	9	3	18	4,050	1,269
E-4	12	72	7/8	-	9	3	18	4,050	634

(1) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(2) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(3) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(4) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(5) ANCHOR BOLTS SHALL BE ALL THREADED PER STM F1554 GRADE 105.
(6) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(7) THE MAXIMUM ANCHOR SHEAR FORCE REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

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NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 10" RUN PIPE WEIGHING 80.2 LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (750 LBS.) / (1.27) / 80.2 LBS/FT) = 7'-4". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P) , THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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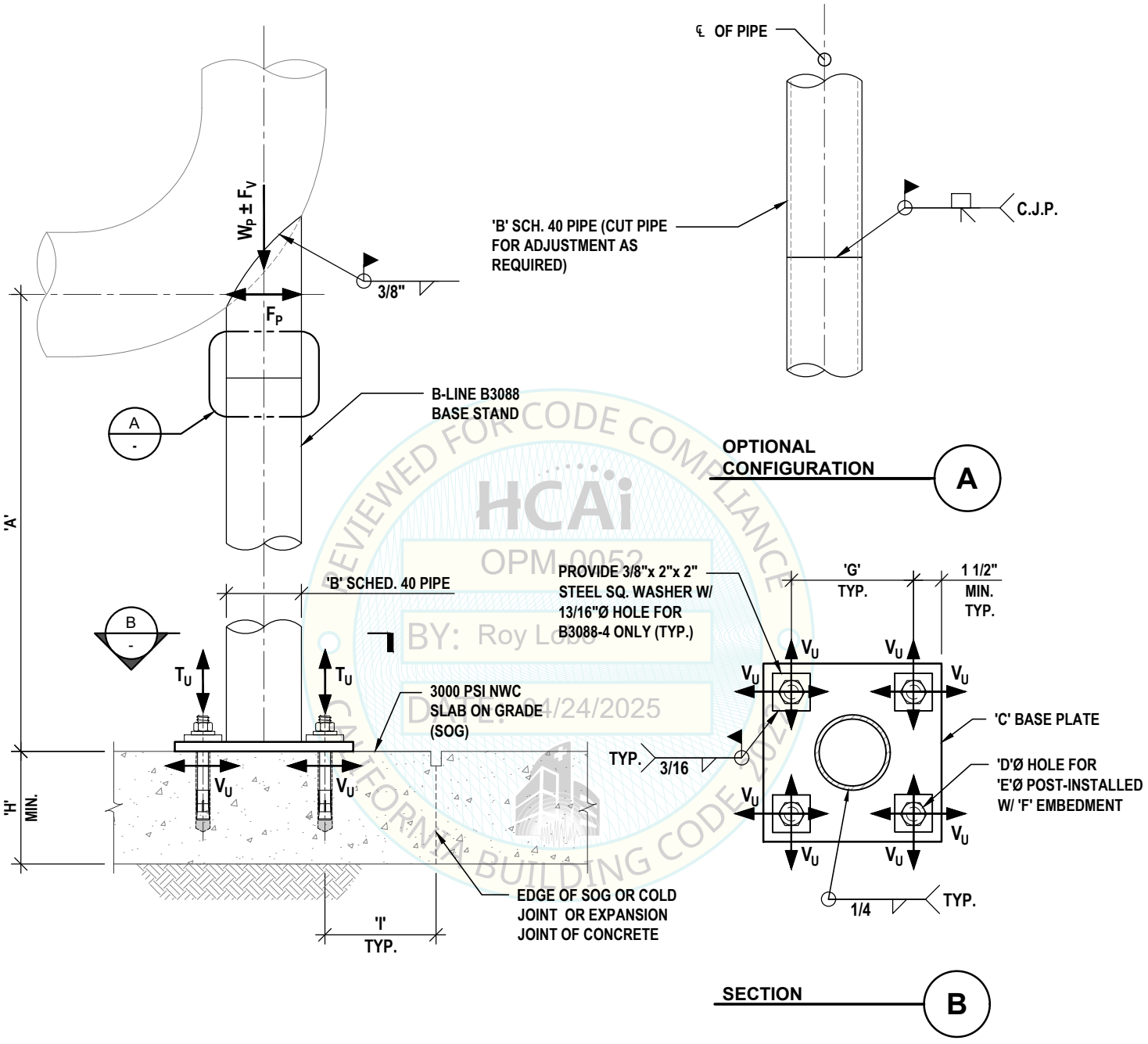
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California SE No. S3545

PAGE: 15-E6

DATE: April 23, 2025

LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	WELDED BASE ELBOW ON 3,000 PSI NWC SLAB ON GRADE	DETAIL PS-F



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NOTES:

1. SEE PAGES 15-F2 & 15-F3 FOR ADDITIONAL INFORMATION AND DATA TABLES.
2. CONCRETE THICKNESS IS BASED UPON ANCHOR REQUIREMENT.
3. CONDITIONS THAT INCLUDE THERMAL & THRUST LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.

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WELDED BASE ELBOW
ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE (IN)	"A" RUN PIPE CENTER-LINE (IN)	MAXIMUM VERTICAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	MAXIMUM HORIZONTAL LOAD @ CENTER-LINE(1) (ASD)(LBS)	BASE STAND PART NUMBER	"B" BASE STAND PIPE SIZE (IN)	"C" BASE PLATE (IN)	"D" HOLE SIZE FOR ANCHOR (DIA)(IN)
F-1	4	36	204	161	B3088-3	3" STD PIPE	3/8x 12x 12	13/16
F-2	4	72	100	79	B3088-3	3" STD PIPE	3/8x 12x 12	13/16
F-3	6	36	204	161	B3088-3	3" STD PIPE	3/8x 12x 12	13/16
F-4	6	72	100	79	B3088-3	3" STD PIPE	3/8x 12x 12	13/16
F-5	8	36	574	452	B3088-4 (2)	4" STD PIPE	1/2x 12x 12	15/16
F-6	8	72	282	222	B3088-4 (2)	4" STD PIPE	1/2x 12x 12	15/16

(1) IT IS ACCEPTABLE TO APPLY THE MAXIMUM HORIZONTAL LOAD AND THE MAXIMUM VERTICAL LOAD IS APPLIED CONCURRENTLY. THIS CONDITION CORRESPONDS TO THE APPLICATION OF THE GRAVITY LOAD, THE HORIZONTAL SEISMIC FORCE OF 1.0 G ($F_{P(ASD)}$ / W_P) AND WITH THE VERTICAL SEISMIC FORCE OF 0.27 G ($F_{P(ASD)}$ / W_P) .

(2) PROVIDE 3/8"x 2"x 2" STEEL SQ. WASHER W/ 13/16"Ø HOLE FOR B3088-4 ONLY. SEE DETAIL A ON PAGE 15-F1 FOR WELDING.

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NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 4" RUN PIPE WEIGHING 18.1 LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (200 LBS.) / (1.27) / 18.1 LBS/FT) = 8'-8". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P), THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.

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LATERAL FORCE F_P = 1.00g (ASD) VERTICAL FORCE F_{PV} = 0.27g (ASD)	WELDED BASE ELBOW ON 3,000 PSI NWC SLAB ON GRADE (CONT'D)	DETAIL PS-F

PIPE STAND TYPE	RUN PIPE OR SUPPORTED PIPE SCHEDULE 40 (IN)	"A" RUN PIPE CENTERLINE (IN)	"E" HILTI KB-TZ2 CS ANCHOR SIZE(1) THRU (7) (IN)	"F" ANCHOR EMBED. (IN)(hef)	"G" ANCHOR SPACING (IN)	"H" MIN. CONC. SLAB ON GRADE THICKNESS (IN)	"I" MIN. DIST. OF ANCHOR TO CONC. EDGE (IN)	T_u(8) PER ANCHOR (LRFD)(LBS)	V_u(8) PER ANCHOR (LRFD)(LBS)
F-1	4	36	3/4	3.25	9	6	9	1,841	230
F-2	4	72	3/4	3.25	9	6	9	1,835	113
F-3	6	36	3/4	3.25	9	6	9	1,845	229
F-4	6	72	3/4	3.25	9	6	9	1,841	113
F-5	8	36	3/4	3.25	9	6	9	3,438	646
F-6	8	72	3/4	3.25	9	6	9	3,438	317

(1) KWIK BOLT KB-TZ2 ANCHOR BOLTS SHALL BE INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION FOR ANCHORS IN CRACKED CONCRETE, PER ICC ESR-4266.
(2) TORQUE TEST SHALL BE PERFORM FOR 100% THE EXPANSION TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION.
(3) WHEN INSTALLING ANCHORS IN CONCRETE, LOCATE REINFORCING STEEL AND AVOID CUTTING OR DAMAGING REINFORCING STEEL.
(4) ANCHORS SHALL NOT BE INSTALLED IN PRESTRESSED CONCRETE.
(5) FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED.
(6) ANCHOR BOLTS, NUTS AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
(7) 4 ANCHORS PER BASE PLATE ARE REQUIRED.
(8) THE MAXIMUM ANCHOR REACTIONS INCLUDE OVER-STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

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NOTES:

1. TO DETERMINE MAXIMUM SUPPORT SPACING, DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.27 THEN DIVIDE BY WEIGHT-PER-FOOT OF PIPE.
2. FOR EXAMPLE, IF SUPPORTING A 4" RUN PIPE WEIGHING 18.1LB/FT, AT 72" CENTERLINE (CL) ABOVE THE BASE, THEN THE MAXIMUM SPACING IS (200 LBS.) / (1.27) / 18.1 LBS/FT) = 8'-8". MAXIMUM SUPPORT SPACING SHALL NOT EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. IF THE HORIZONTAL SEISMIC FORCE EXCEEDS 1.0 G ($F_{P(ASD)}$ / W_P) , THEN DO NOT USE CAST IRON OR SIMILAR NON-DUCTILE PIPE.
6. RUN SUPPORTED PIPE SHALL BE SCHEDULE 40.
7. THE ABOVE TABLES SHALL BE USED ONLY FOR PIPING IN ACCORDANCE WITH ASME B31, INCLUDING IN-LINE COMPONENTS, CONSTRUCTED OF HIGH- OR LIMITED-DEFORMABILITY MATERIALS, WITH JOINTS MADE BY THREADING, BONDING, COMPRESSION COUPLINGS, OR GROOVED COUPLINGS.

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SECTION 16

SPECIAL SEISMIC DETAILS FOR WALL SUPPORT

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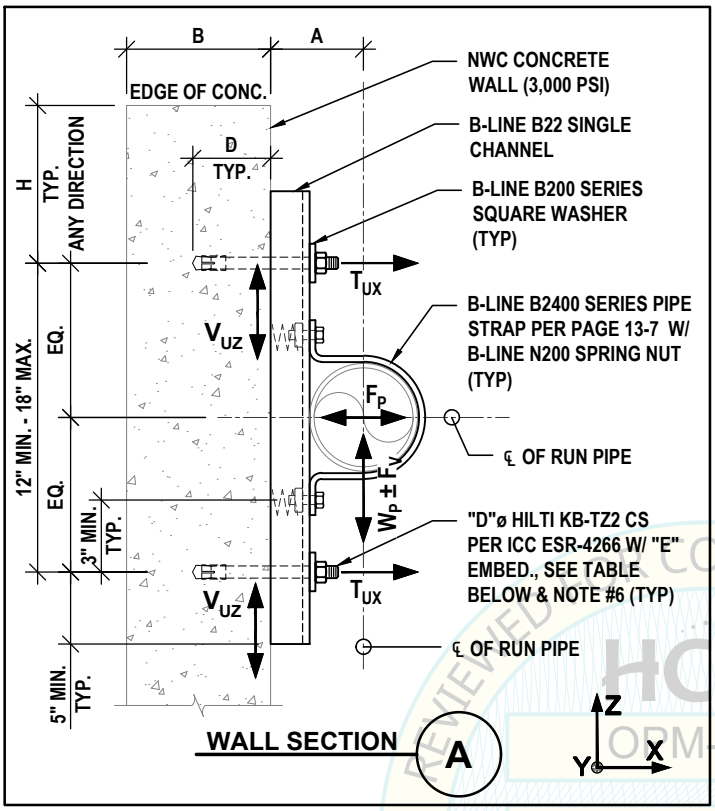
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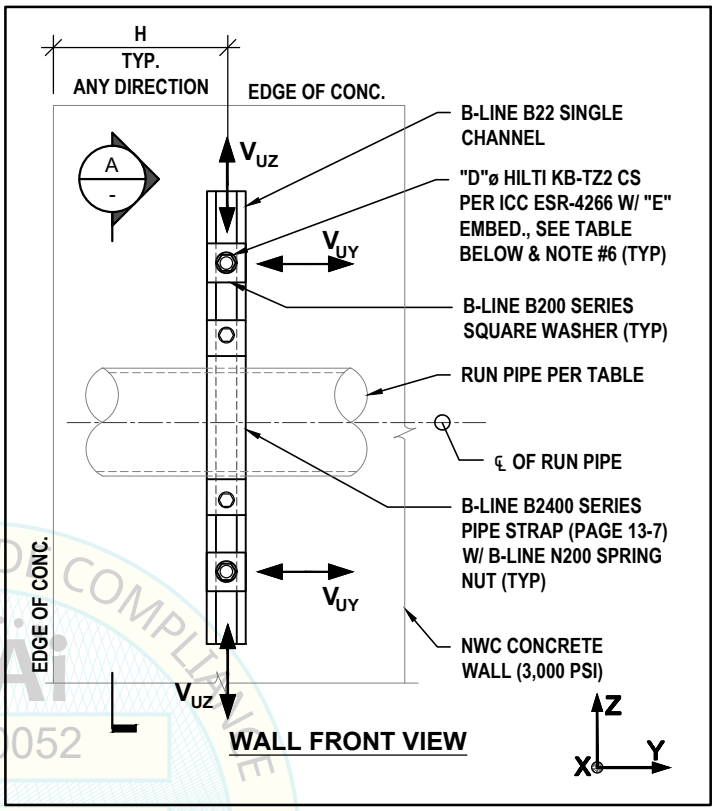
PAGE: 16-0

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WALL SUPPORT FOR HORIZONTAL STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL

DETAIL
WS-1





MAX. SCHED. 40 RUN PIPE	MAX. SUPPORT SPACING (FT)	"A" CL OF RUN PIPE FROM WALL (IN)	"B" MIN. CONC. THK. (IN)	MAX. VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)	MAX. HORIZ. LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	"D" ANCHOR DIA. (IN)	"E" ANCHOR EMBED. $[h_{ef}]$ (IN)	"H" MIN. ANCHOR TO CONC. EDGE (IN)	$T_{UX}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UY}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UZ}^{(2)}$ PER ANCHOR (LBS)(LRFD)
1"-1/2"	10	2.6	5	72	50	3/8	2	8	420	110	50
4"	10	3.9	6.5	288	200	1/2	3-1/4	8	2,200	410	190
6"	8	5.0	10	442	306	3/4	4-3/4	12	3,610	520	290
8"	5	6.0	10	438	303	3/4	4-3/4	12	3,850	470	290

FOOTNOTES:

1. IT IS ACCEPTABLE TO APPLY MAX. HORIZONTAL LOAD CONCURRENTLY WITH MAX. VERTICAL LOAD. THIS CONDITION CORRESPONDS TO A 1.0G HORIZONTAL SEISMIC FORCE [$(F_P / W_P) = 1.0$ G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [$(F_V / W_P) = 0.44$ G (ASD)].
2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. THESE FORCES INCLUDE MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

NOTES:

1. STRUT (WALL SUPPORT) ORIENTATION SHALL BE VERTICAL.
2. TO DETERMINE MAXIMUM SUPPORT SPACING DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.44 x WEIGHT-PER-FOOT OF PIPE. FOR EXAMPLE, IF SUPPORTING A 4" PIPE WEIGHING 18.1 LB/FT, AT 3 7/8" CL, THEN THE MAXIMUM SPACING IS 288 LB. / (1.44 x 18.1 LB/FT) = 11'-0", NOT TO EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. THIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
6. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
7. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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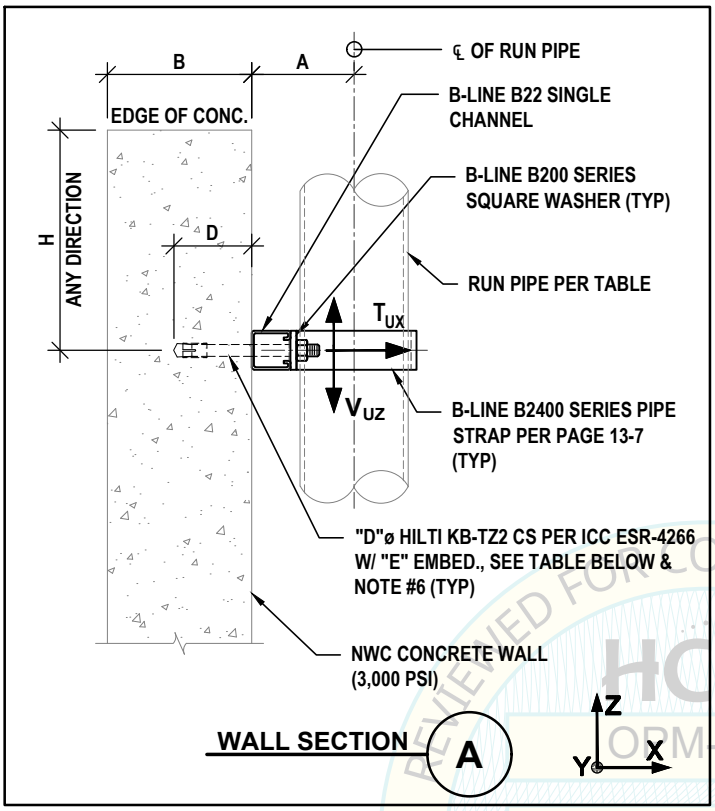
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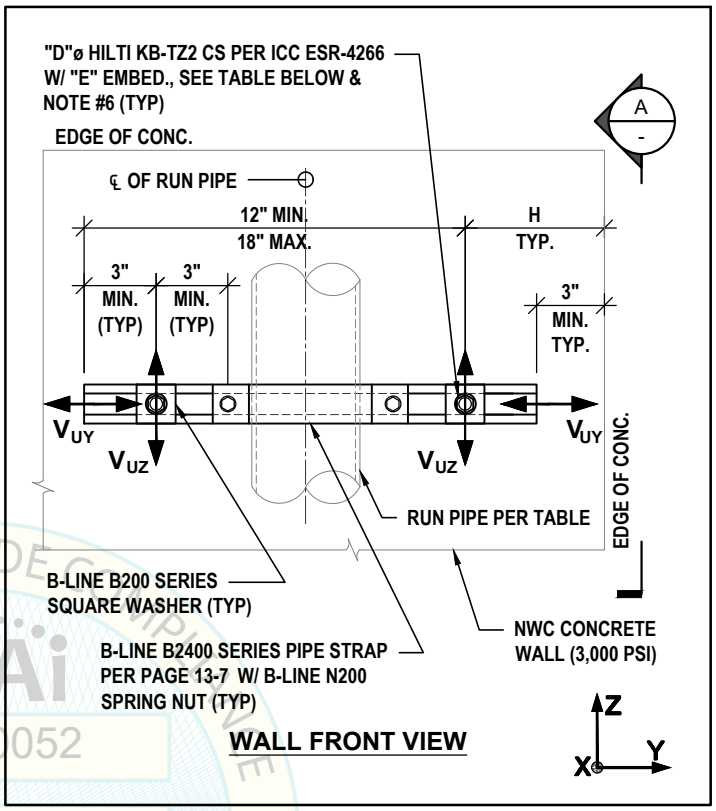
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WALL SUPPORT FOR VERTICAL STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL

DETAIL
WS-2





MAX. SCHED. 40 RUN PIPE	MAX. SUPPORT SPACING (FT)	"A" CL OF RUN PIPE FROM WALL (IN)	"B" MIN. CONC. THK. (IN)	MAX. VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)	MAX. HORIZ. LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	"D" ANCHOR DIA. (IN)	"E" ANCHOR EMBED. $[h_{ef}]$ (IN)	"H" MIN. ANCHOR TO CONC. EDGE (IN)	$T_{UX}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UY}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UZ}^{(2)}$ PER ANCHOR (LBS)(LRFD)
1"-1/2"	10	2.6	5	72	50	3/8	2	8	360	80	40
4"	10	3.9	6.5	288	200	1/2	3-1/4	8	1,800	290	130
6"	8	5.0	8	442	306	3/4	4-3/4	12	2,700	440	170
8"	5	6.0	8	438	303	3/4	4-3/4	12	2,900	440	170

FOOTNOTES:

1. IT IS ACCEPTABLE TO APPLY MAX. HORIZONTAL LOAD CONCURRENTLY WITH MAX. VERTICAL LOAD. THIS CONDITION CORRESPONDS TO A 1.0G HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. THESE FORCES INCLUDE MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

NOTES:

1. STRUT (WALL SUPPORT) ORIENTATION SHALL BE HORIZONTAL.
2. TO DETERMINE MAXIMUM SUPPORT SPACING DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.44 x WEIGHT-PER-FOOT OF PIPE. FOR EXAMPLE, IF SUPPORTING A 4" PIPE WEIGHING 18.1 LB/FT, AT 3 7/8" CL, THEN THE MAXIMUM SPACING IS 288 LB. / (1.44 x 18.1 LB/FT) = 11'-0", NOT TO EXCEED 10'-0".
3. DO NOT EXCEED ANY PROJECT LIMITS.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
5. THIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
6. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
7. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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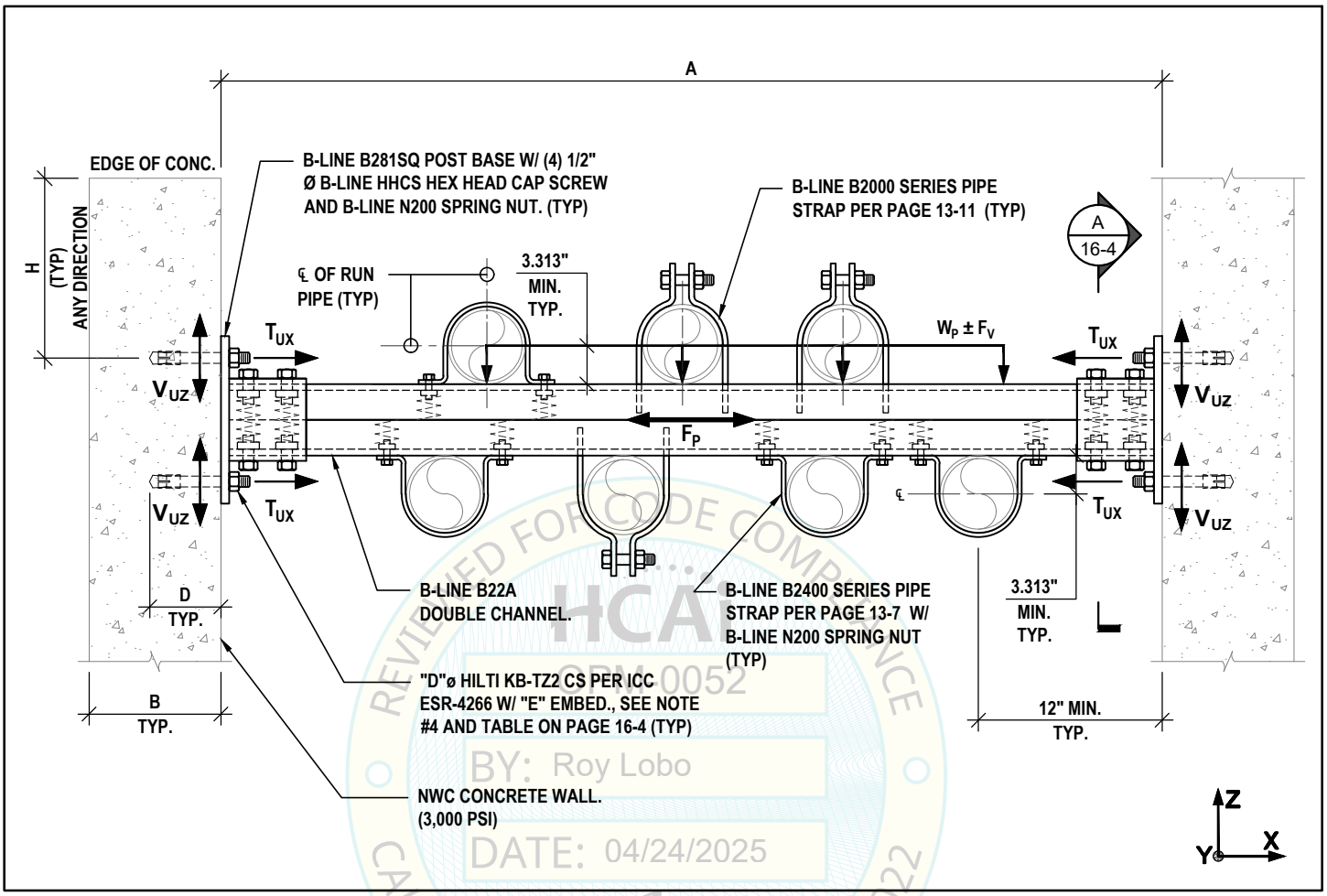
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WALL-TO-WALL SUPPORT (STRUT) FOR STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL

DETAIL
WS-3



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NOTES:

1. SEE PAGE 16-4 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 16-4.
3. THIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
4. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
5. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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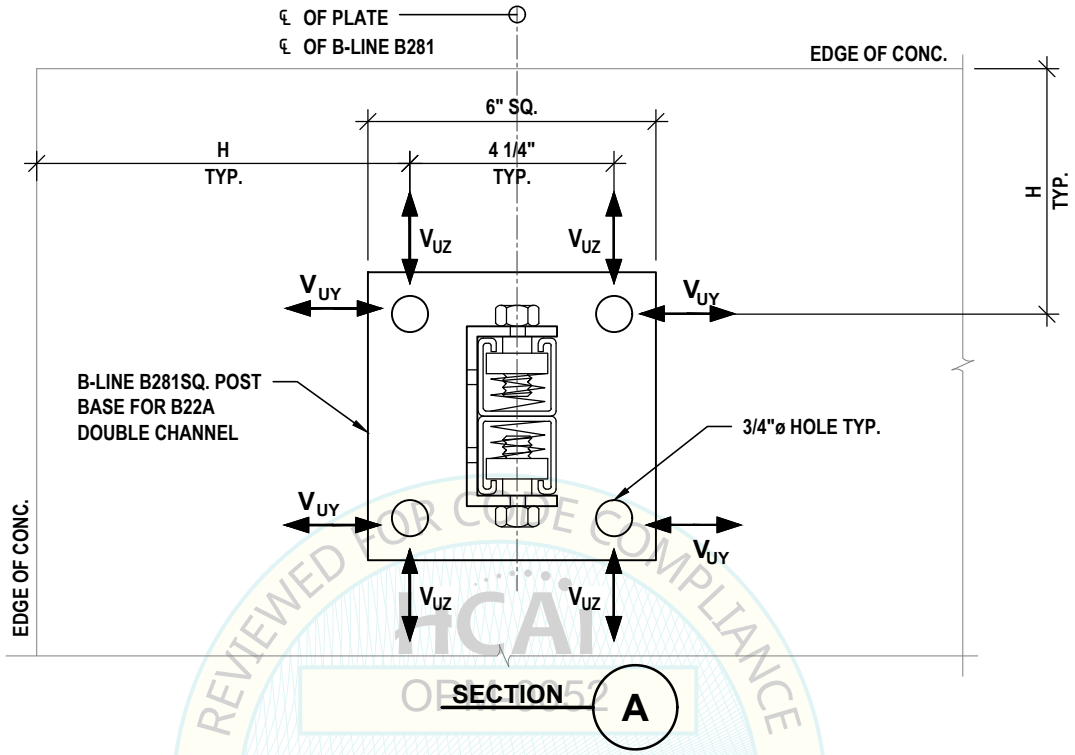
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WALL-TO-WALL SUPPORT (STRUT) FOR STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL (CONT'D)

DETAIL
WS-3



MAX. SCHED. 40 RUN PIPE	"A" MAX. (IN)	"B" MIN. CONC. THICKNESS (IN)	MAX. VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)	MAX. HORIZ. LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	"D ANCHOR DIA. (IN)	"E" ANCHOR EMBED. $[h_{ef}]$ (IN)	"H" MIN. ANCHOR TO CONC. EDGE (IN)	$T_{UX}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UY}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UZ}^{(2)}$ PER ANCHOR (LBS)(LRFD)
6"	84	8	433	300	5/8"	3.25"	12	110	220	140
6"	53	8	809	560	5/8"	3.25"	12	200	400	260

FOOTNOTES:

IT IS ACCEPTABLE TO APPLY MAX. HORIZONTAL LOAD CONCURRENTLY WITH MAX. VERTICAL LOAD. THIS CONDITION CORRESPONDS TO A 1.0G HORIZONTAL SEISMIC FORCE [$(F_P / W_P) = 1.0$ G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [$(F_V / W_P) = 0.44$ G (ASD)].

2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. THESE FORCES INCLUDE MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

NOTES:

1. TO DETERMINE MAX. SUPPORT SPACING DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.44 x TOTAL WEIGHT-PER-FOOT OF PIPE. FOR EXAMPLE, IF SUPPORTING (x3) 4" PIPE WEIGHING 18.1 LB/FT x 3 = 54.3 LB/FT, AT A=84", THEN THE MAXIMUM SPACING IS 433 LB. / (1.44 x 54.3 LB/FT) = 5'-6". MAXIMUM SUPPORT SPACING 10'-0".
2. DO NOT EXCEED PROJECT LIMITS.
3. DISTRIBUTED LOADS SHOWN.
4. THIS SUPPORT DOES NOT CONSIDER DEFORMATION COMPATIBILITY BETWEEN WALLS. USE OF THIS DETAIL SHALL BE PENDING SEOR APPROVAL.
5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
6. THIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
7. HORIZONTAL SEISMIC FORCE, 1.0 G [$(F_P / W_P) = 1.0$ G (ASD)], [G (ASD)] MAY BE APPLIED IN TRANSVERSE AND LONGITUDINAL DIRECTION.
8. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
9. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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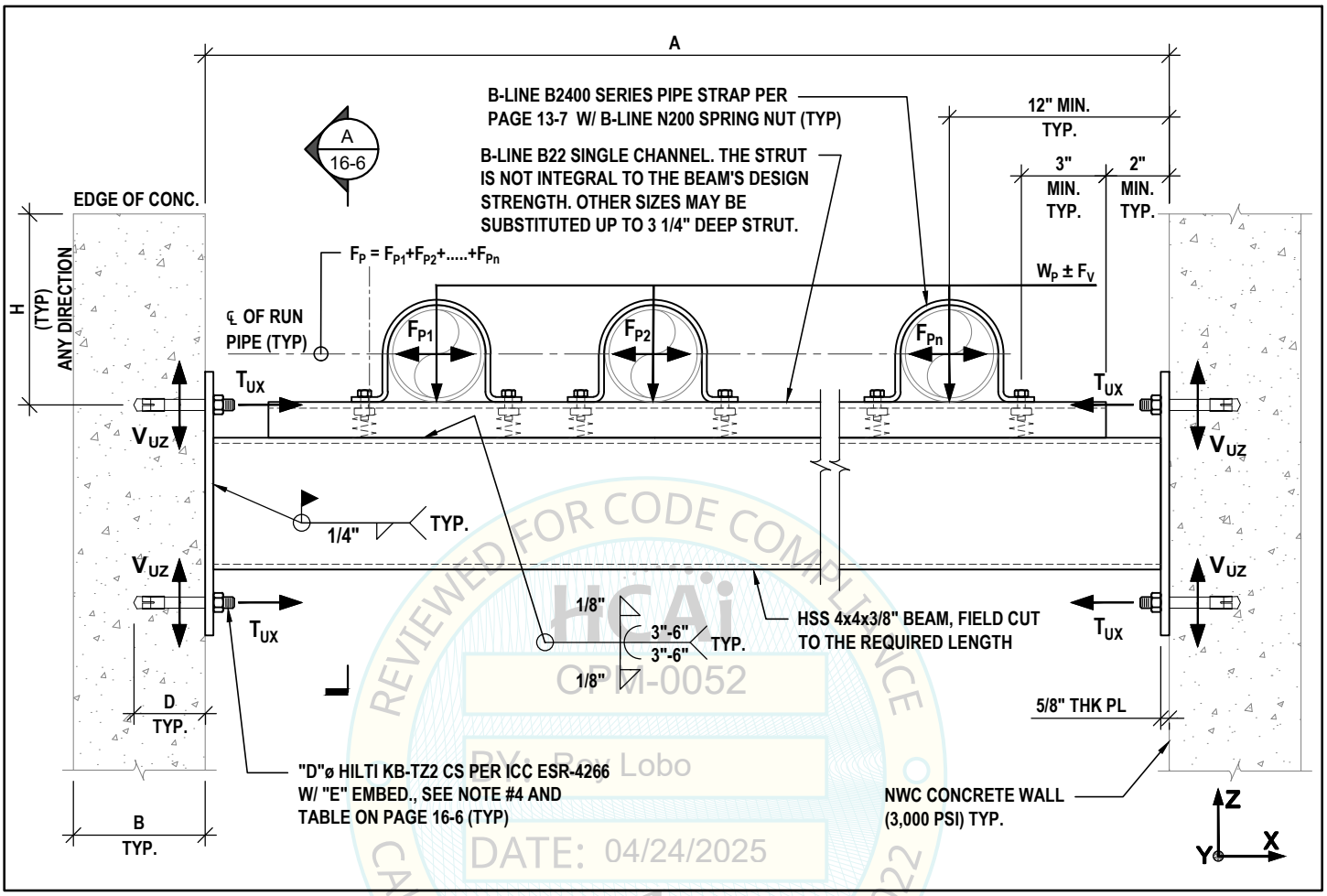
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WALL-TO-WALL SUPPORT (HSS) FOR STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL

DETAIL
WS-4



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CALIFORNIA BUILDING CODE, 2022

NOTES:

1. SEE PAGE 16-6 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 16-6.
3. THIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
4. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
5. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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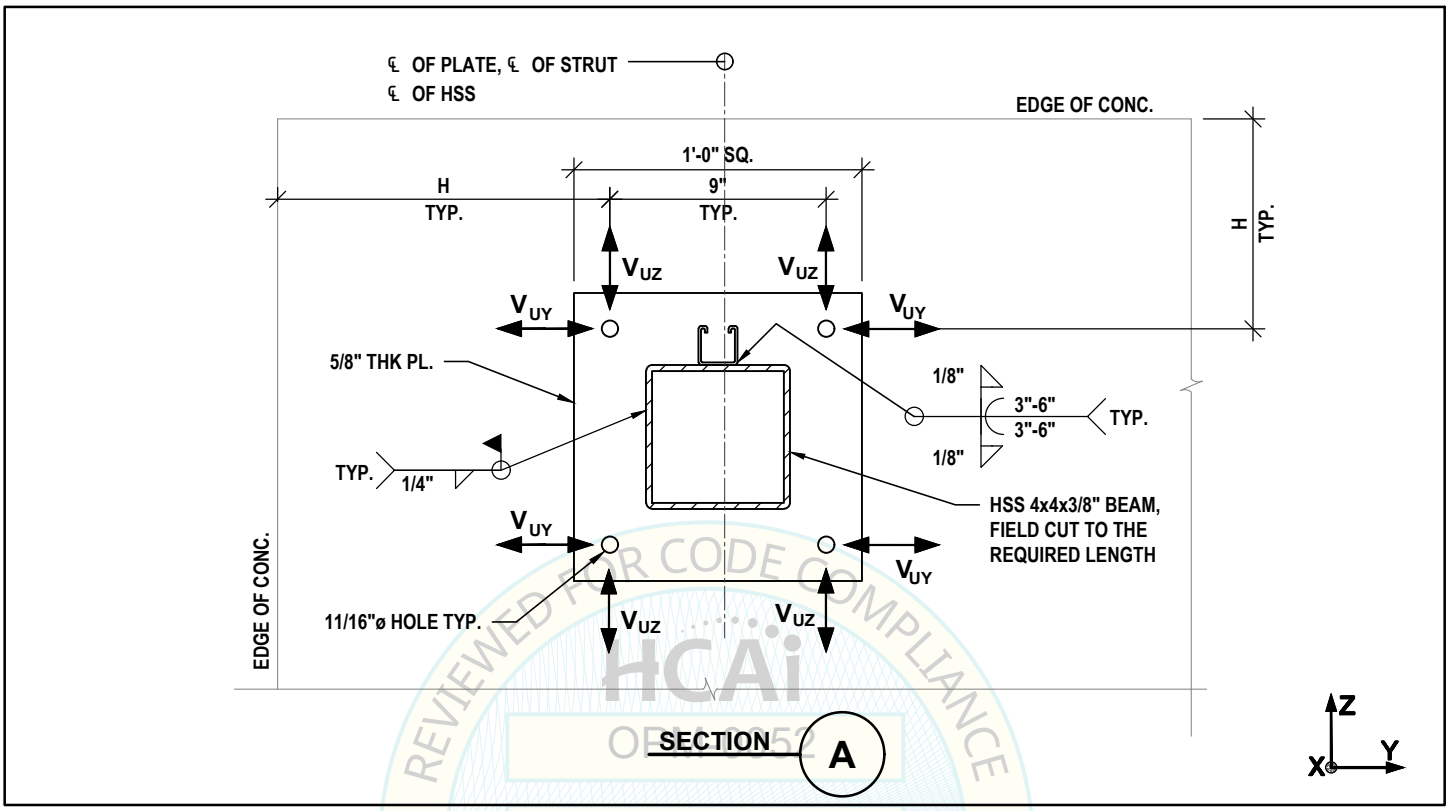
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WALL-TO-WALL SUPPORT (HSS) FOR STEEL PIPE ANCHORED TO 3,000 PSI NWC WALL (CONT'D)

DETAIL
WS-4



MAX. SCHED. 40 RUN PIPE	"A" MAX. (IN)	"B" MIN. CONC. THK. (IN)	MAX. VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)	MAX. HORIZ. LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	"D" ANCHOR DIA. (IN)	"E" ANCHOR EMBED. $[h_{ef}]$ (IN)	"H" MIN. ANCHOR TO CONC. EDGE (IN)	$T_{UX}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UY}^{(2)}$ PER ANCHOR (LBS)(LRFD)	$V_{UZ}^{(2)}$ PER ANCHOR (LBS)(LRFD)
6"	120	8	2,311	1,600	5/8"	4.00"	12	900	1,150	740

FOOTNOTES:

IT IS ACCEPTABLE TO APPLY MAX. HORIZONTAL LOAD CONCURRENTLY WITH MAX. VERTICAL LOAD. THIS CONDITION CORRESPONDS TO A 1.0G HORIZONTAL SEISMIC FORCE [$(F_P / W_P) = 1.0$ G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE. [$(F_V / W_P) = 0.44$ G (ASD)].

2. V_{UY}, V_{UZ} & T_{UX} ARE FORCES PER ANCHOR IMPOSED ON THE SUPPORTING STRUCTURE. THESE FORCES INCLUDE MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI 318-19.

NOTES:

1. TO DETERMINE MAX. SUPPORT SPACING DIVIDE "MAXIMUM VERTICAL LOAD" BY 1.44 x TOTAL WEIGHT-PER-FOOT OF PIPE. FOR EXAMPLE, IF SUPPORTING (x6) 6" PIPE WEIGHING 34.8 LB/FT x 6 = 208.8 LB/FT, AT A=120", THEN THE MAXIMUM SPACING IS 2,311 LB. / (1.44 x 208.8 LB/FT) = 7'-8", NOT TO EXCEED 10'-0".
2. DO NOT EXCEED PROJECT LIMITS.
3. DISTRIBUTED LOADS SHOWN.
4. THIS SUPPORT DOES NOT CONSIDER DEFORMATION COMPATIBILITY BETWEEN WALLS. USE OF THIS DETAIL SHALL BE PENDING SEOR APPROVAL.
5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
6. TTHIS DETAIL IS APPLICABLE FOR SCHEDULE 40 STEEL PIPE ONLY.
7. HORIZONTAL SEISMIC FORCE, 1.0 G $[(F_P / W_P) = 1.0$ G (ASD)], [G (ASD)] MAY BE APPLIED IN TRANSVERSE AND LONGITUDINAL DIRECTION.
8. SEE PAGE 11-82 FOR ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
9. NCW CONCRETE WALL SHALL HAVE A MINIMUM STRENGTH , f'_C, OF 3,000 PSI AT THE TIME OF INSTALLATION.

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California SE No. S3545

PAGE: **16-6**

DATE: **April 23, 2025**

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BY: Roy Lobo
DATE: 04/24/2025
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SECTION 17

SPECIAL SEISMIC FOR RISER SUPPORT DETAILS

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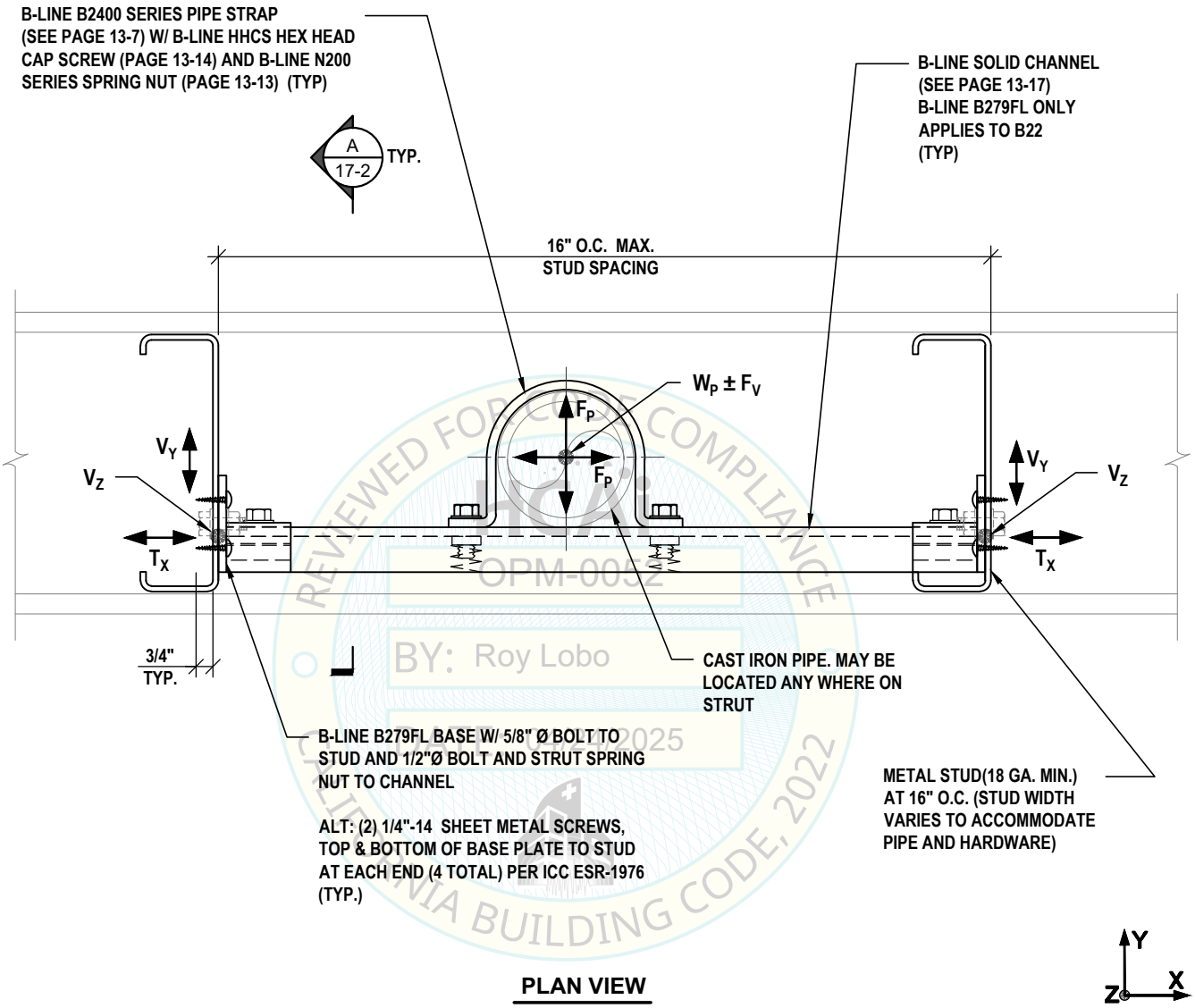
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 17-0

DATE: April 23, 2025

IN-WALL CAST IRON PIPE RISER

DETAIL
PRS-1



PLAN VIEW

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NOTES:

1. SEE PAGES 17-2 & 17-3 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
3. V_Y, V_Z & T_X ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-3.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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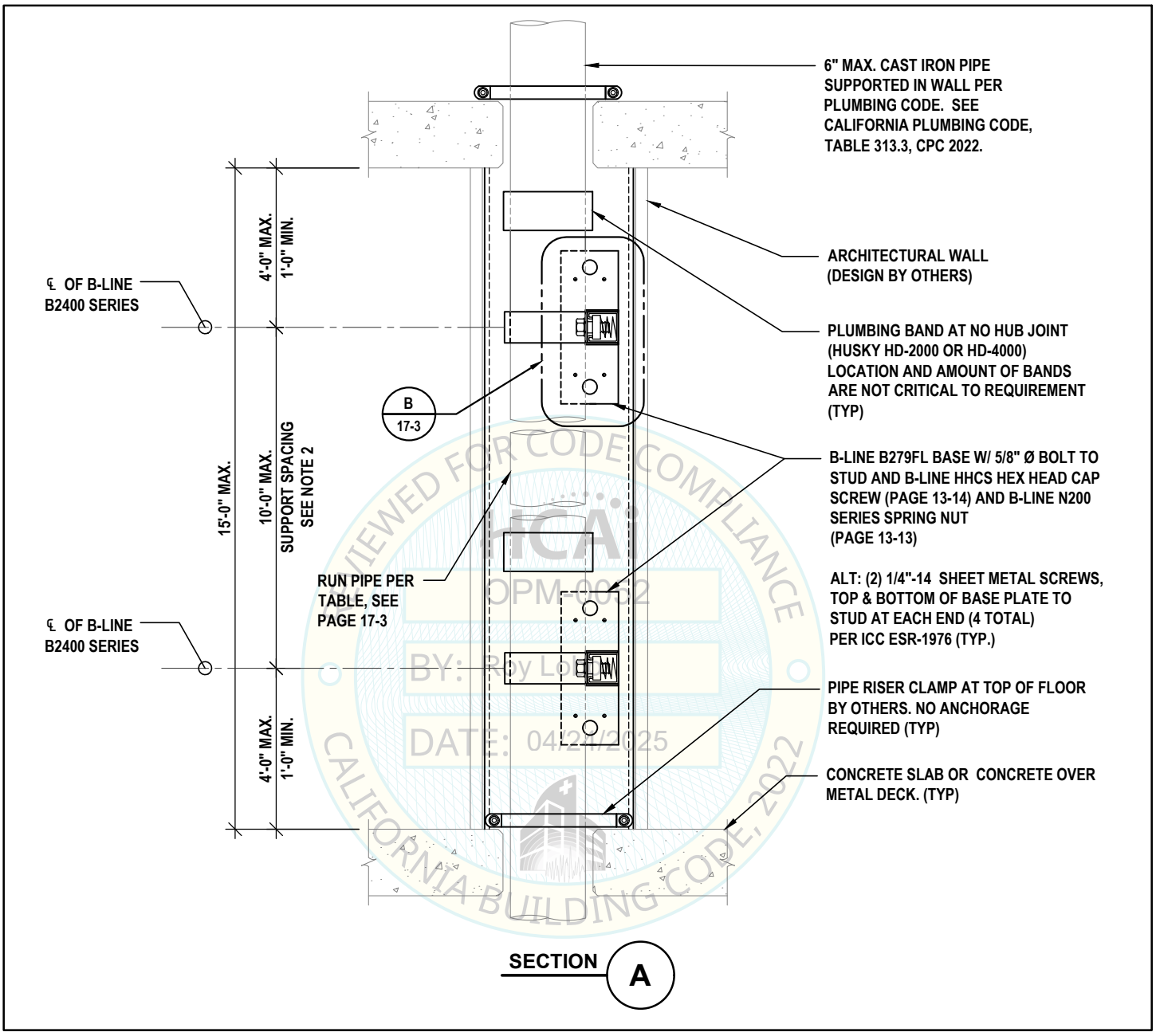
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE:
17-1

DATE:
April 23, 2025

IN-WALL CAST IRON PIPE RISER (CONT'D)

DETAIL
PRS-1



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NOTES:

1. SEE PAGES 17-1 & 17-3 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEE SECTION 1, PAGE 1-11 NOTE 18 REGARDING PIPE PENETRATION THROUGH FLOOR.
3. PROVIDE ADDITIONAL LATERAL SUPPORT TO SATISFY MAXIMUM SUPPORT SPACING.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

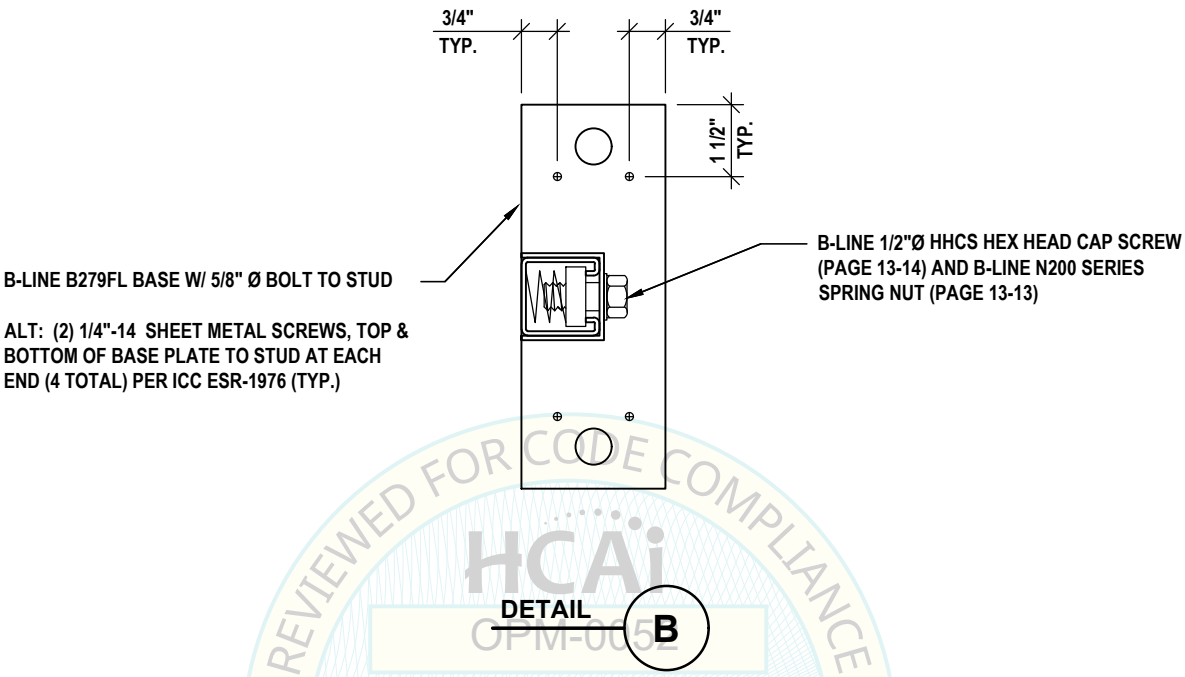
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PAGE: **17-2**

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IN-WALL CAST IRON PIPE RISER (CONT'D)



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MAXIMUM LOADS TO STRUCTURE (ASD)							
MAXIMUM RUN PIPE DIAMETER	MAXIMUM SUPPORT SPACING (FT.)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE [$W_P + F_V$](1) (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE [F_P](1) (LBS)(ASD)	T_X(2) (LBS) (ASD)	V_Y(2) (LBS) (ASD)	V_Z(2) (LBS) (ASD)
		W_P GRAVITY	F_V SEISMIC				
4"	10	275	123	275	140	190	280
6"	5	220	100	306	110	160	220

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_Y, V_Z & T_X ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. SEE PAGES 17-1 & 17-2 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
2. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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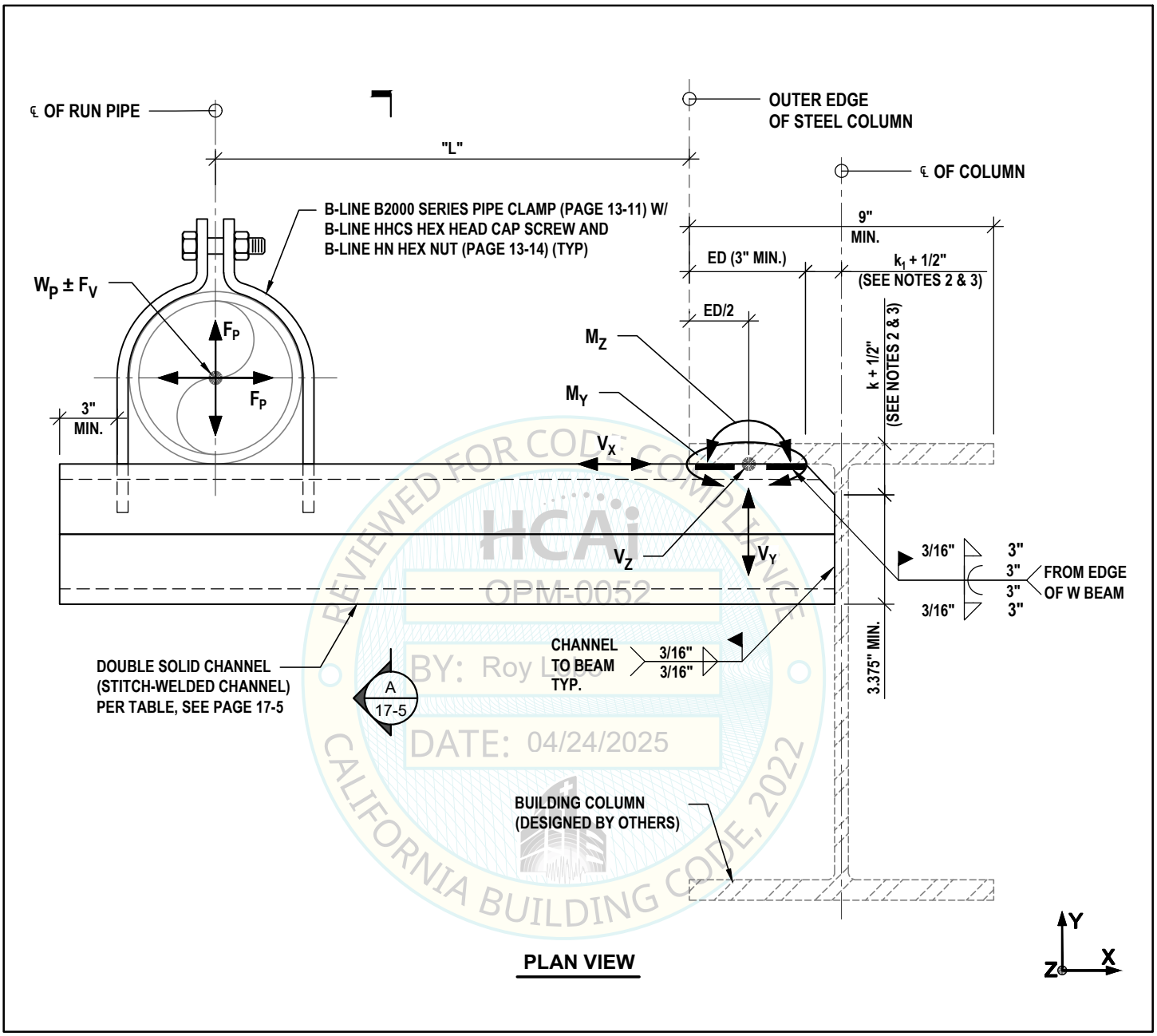
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 17-3

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RISER SUPPORT TO BUILDING STEEL COLUMN WEB W/ PIPE CLAMP AND DOUBLE SOLID CHANNEL

DETAIL
PRS-2



PLAN VIEW

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NOTES:

1. SEE PAGE 17-5 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONE (SEE AISC 341, SECTION 7.4).
3. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR "k" & "k_1" VALUES.
4. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
5. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-5.
6. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-5.
7. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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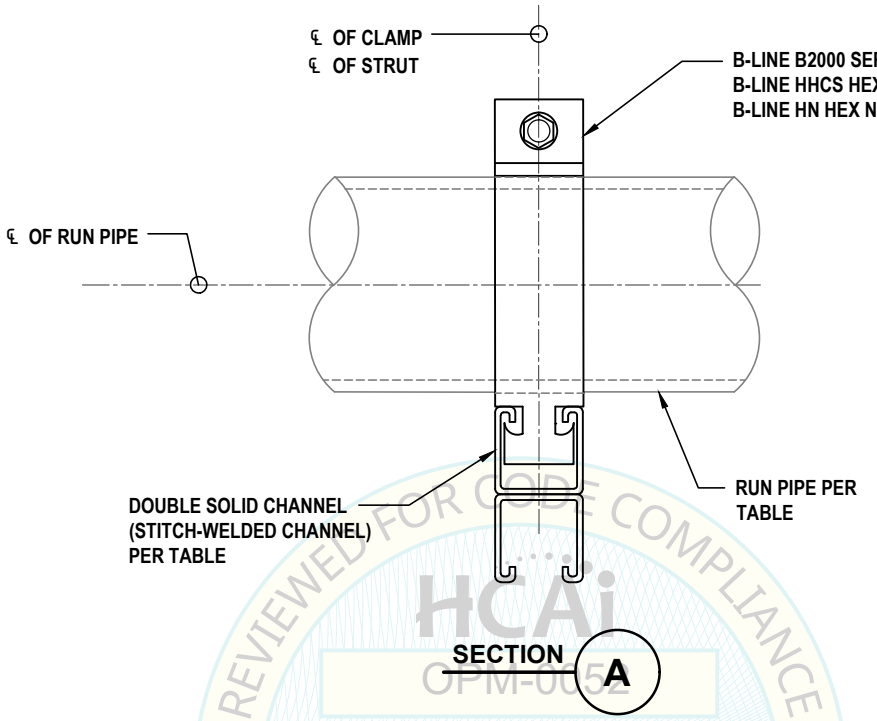
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DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN WEB W/ PIPE CLAMP AND DOUBLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-2



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MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ (LBS) (ASD)	$V_Y^{(2)}$ (LBS) (ASD)	$V_Z^{(2)}$ (LBS) (ASD)	$M_Y^{(3)}$ (LB-IN) (ASD)	$M_Z^{(3)}$ (LB-IN) (ASD)
				W_P GRAVITY	F_V SEISMIC						
2.5"	B12A	10	18	140	60	140	140	140	200	3,500	2,500
4"	B12A	10	18	275	125	275	275	275	400	7,200	5,400
6"	B12A	6	18	270	120	270	270	270	390	6,900	5,300

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.
3. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-4 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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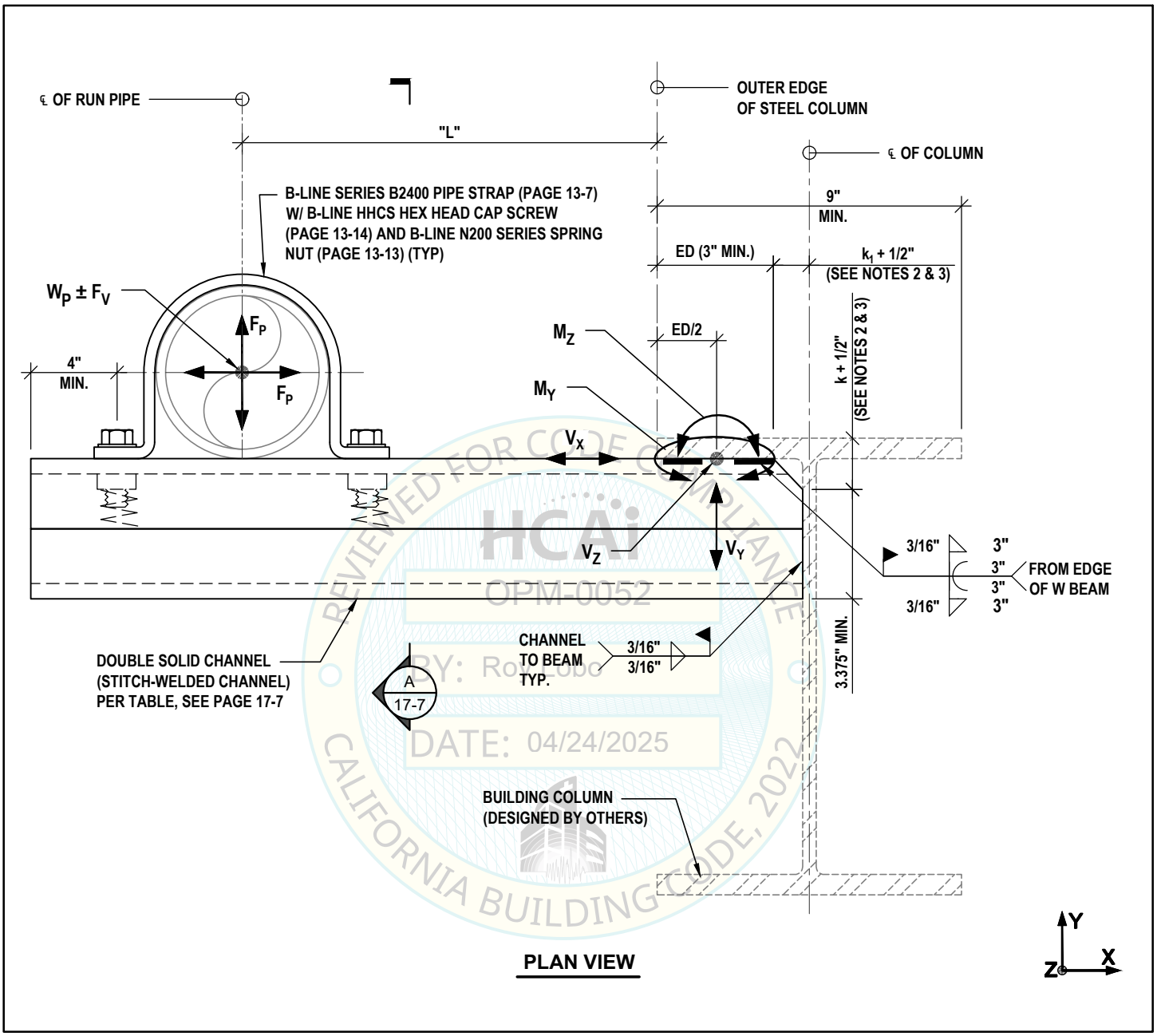
Structural Engineer: Mohammad R. Hariri
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DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN WEB W/ PIPE STRAP AND DOUBLE SOLID CHANNEL

DETAIL
PRS-3



PLAN VIEW

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NOTES:

1. SEE PAGE 17-7 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONE (SEE AISC 341, SECTION 7.4).
3. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR "k" & "k_1" VALUES.
4. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
5. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-7.
6. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-7.
7. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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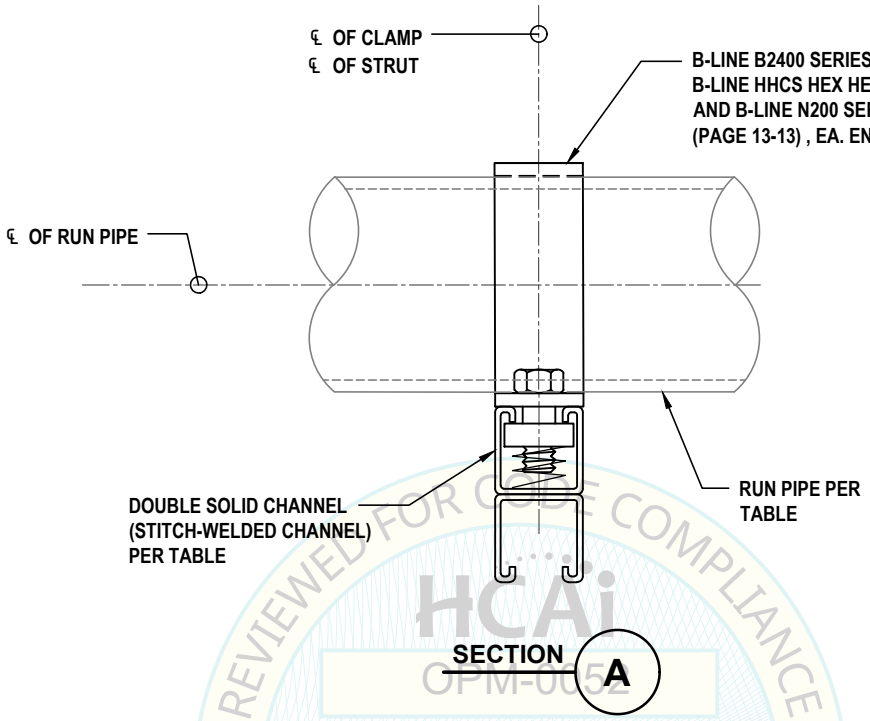
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-6**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN WEB W/ PIPE STRAP AND DOUBLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-3



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MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ (LBS) (ASD)	$V_Y^{(2)}$ (LBS) (ASD)	$V_Z^{(2)}$ (LBS) (ASD)	$M_Y^{(3)}$ (LB-IN) (ASD)	$M_Z^{(3)}$ (LB-IN) (ASD)
				W_P GRAVITY	F_V SEISMIC						
2.5"	B12A	10	18	140	60	140	140	140	200	3,500	2,500
4"	B12A	10	18	275	125	275	275	275	400	7,200	5,400
6"	B12A	6	18	270	120	270	270	270	390	6,900	5,300

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.
3. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-6 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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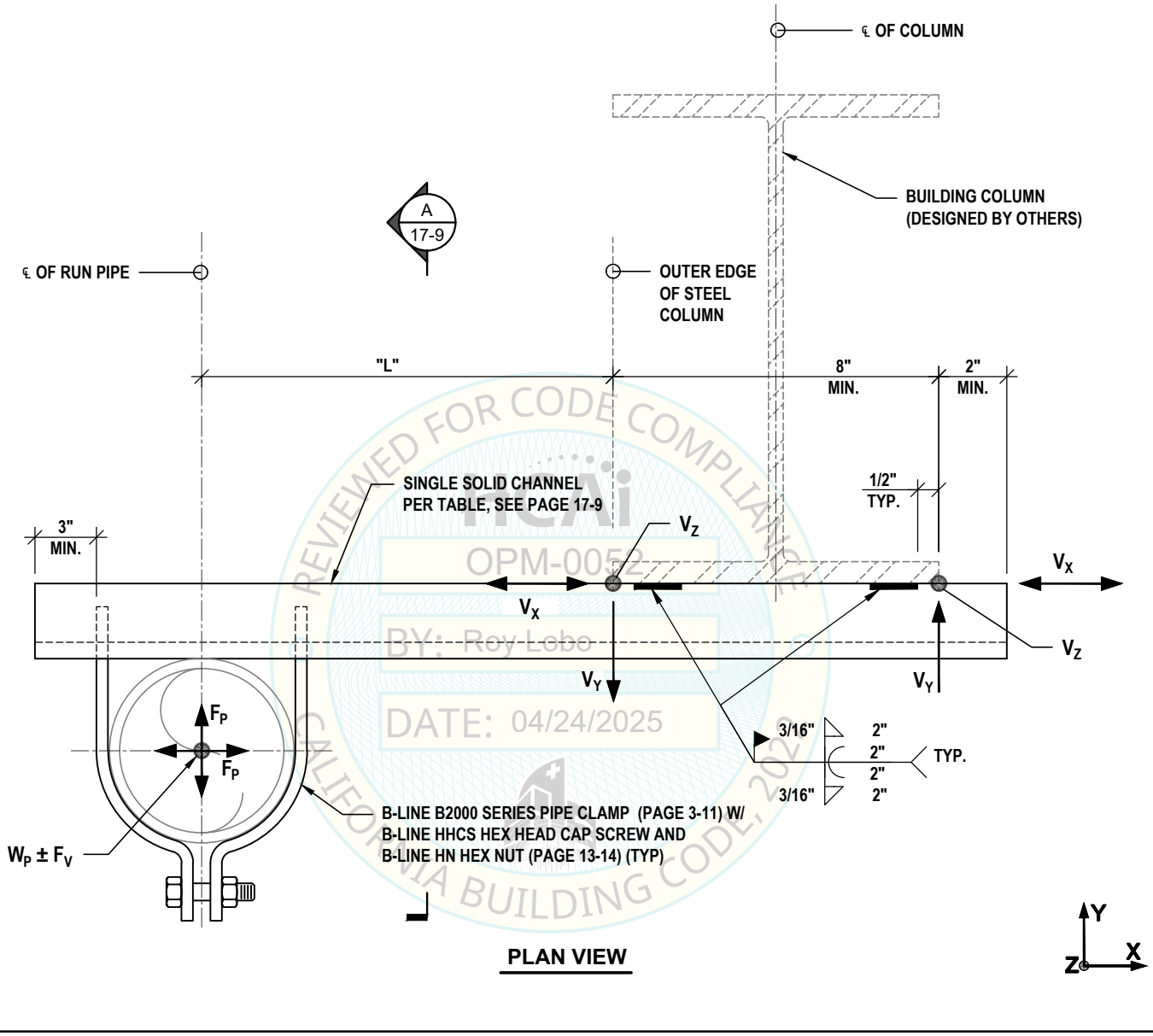
Structural Engineer: Mohammad R. Hariri
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DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND SINGLE SOLID CHANNEL

DETAIL
PRS-4



PLAN VIEW

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CALIFORNIA BUILDING CODE, 2022

NOTES:

1. SEE PAGE 17-9 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONE (SEE AISC 341, SECTION 7.4).
3. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR k_l VALUE.
4. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
5. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-9.
6. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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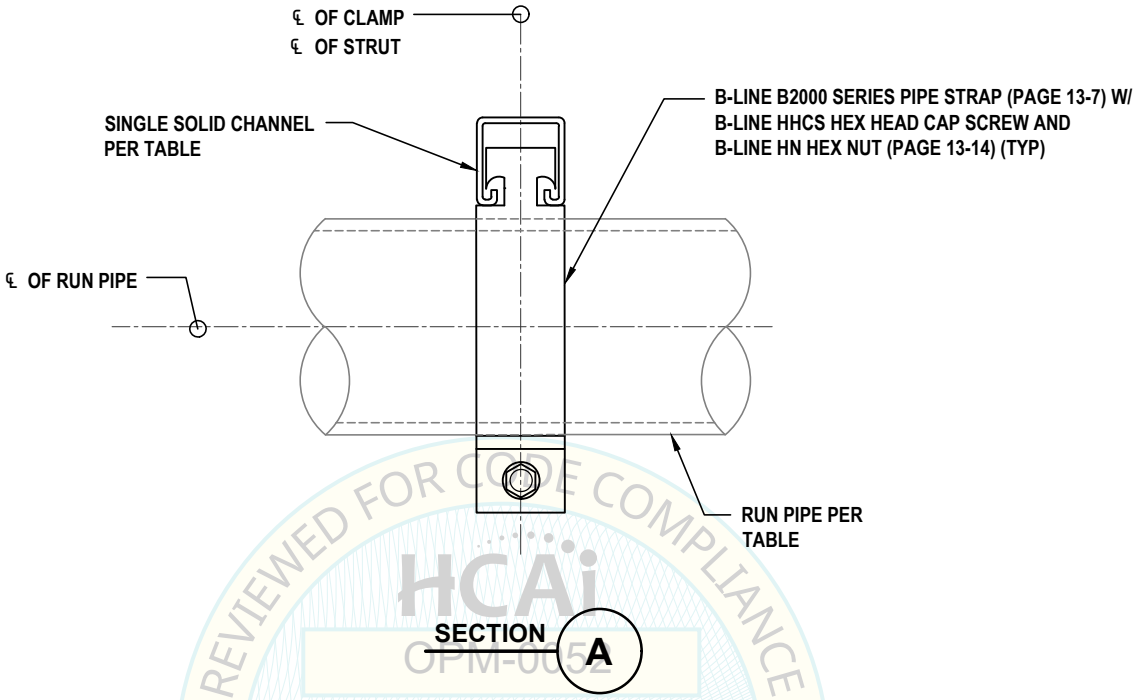
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California SE No. S3545

PAGE: **17-8**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND SINGLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-4



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CALIFORNIA BUILDING CODE 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ PER ANCHOR (LBS) (ASD)	$V_Y^{(2)}$ PER ANCHOR (LBS) (ASD)	$V_Z^{(2)}$ PER ANCHOR (LBS) (ASD)
				W_P GRAVITY	F_V SEISMIC				
2.5"	B22	10	15	140	60	140	70	630	860
4"	B12	10	12	280	130	280	140	1,150	1,530
6"	B11	7	12	270	120	270	140	1,100	1,470

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-8 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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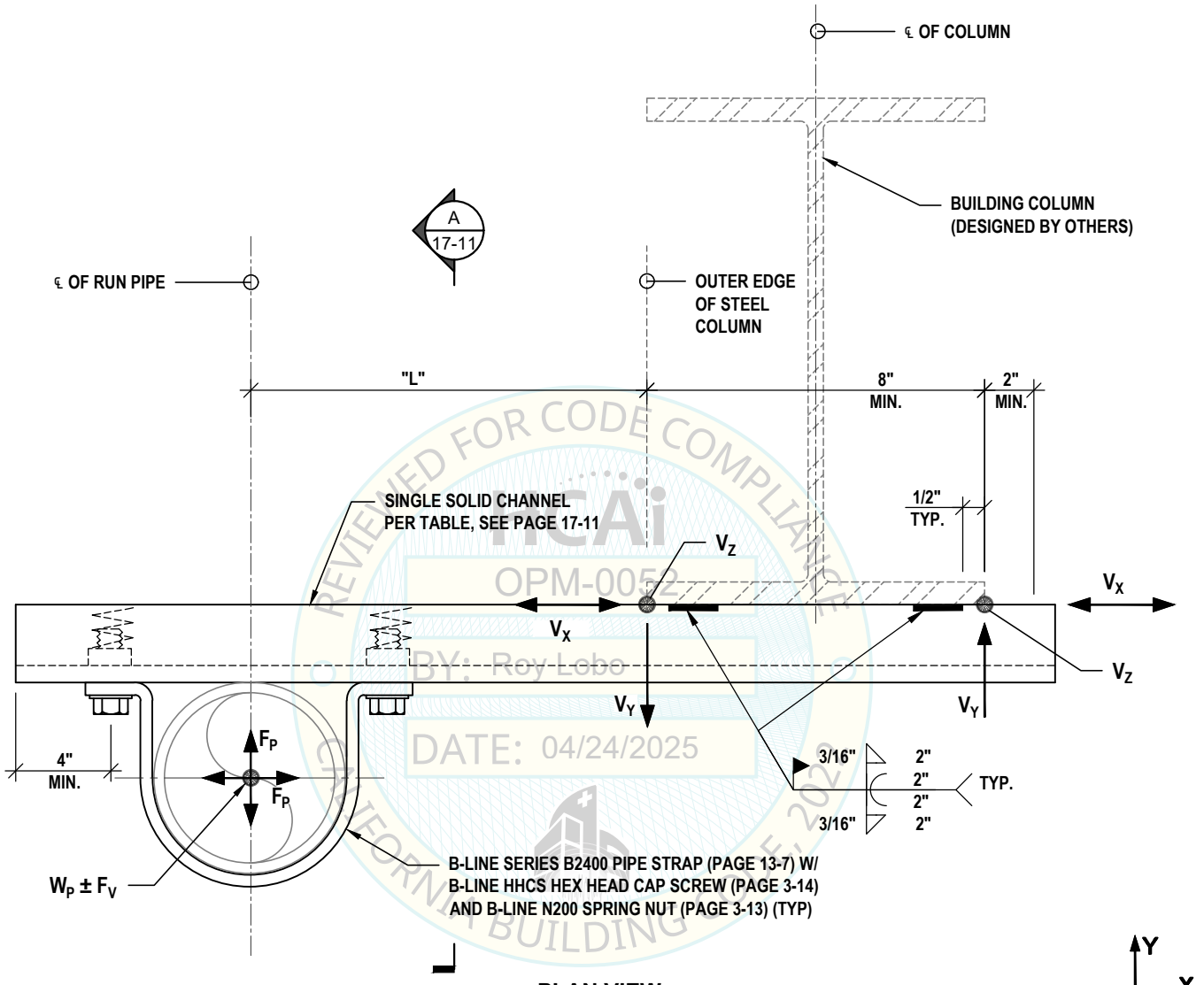
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-9**

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RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND SINGLE SOLID CHANNEL

DETAIL
PRS-5



PLAN VIEW

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CALIFORNIA BUILDING

NOTES:

1. SEE PAGE 17-11 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONE (SEE AISC 341, SECTION 7.4).
3. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR k_l VALUE.
4. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
5. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-11.
6. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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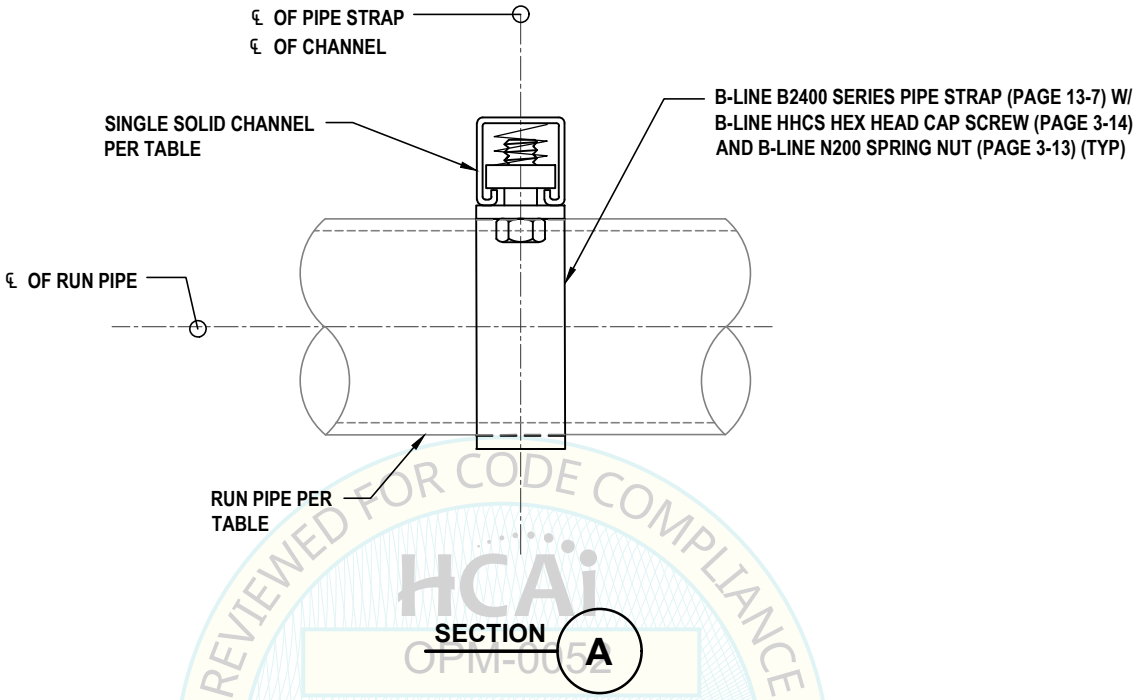
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PAGE: 17-10

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RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND SINGLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-5



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MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ PER ANCHOR (LBS) (ASD)	$V_Y^{(2)}$ PER ANCHOR (LBS) (ASD)	$V_Z^{(2)}$ PER ANCHOR (LBS) (ASD)
				W_P GRAVITY	F_V SEISMIC				
2.5"	B22	10	15	140	60	140	70	630	860
4"	B12	10	12	280	130	280	140	1,150	1,530
6"	B11	7	12	270	120	270	140	1,100	1,470

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-10 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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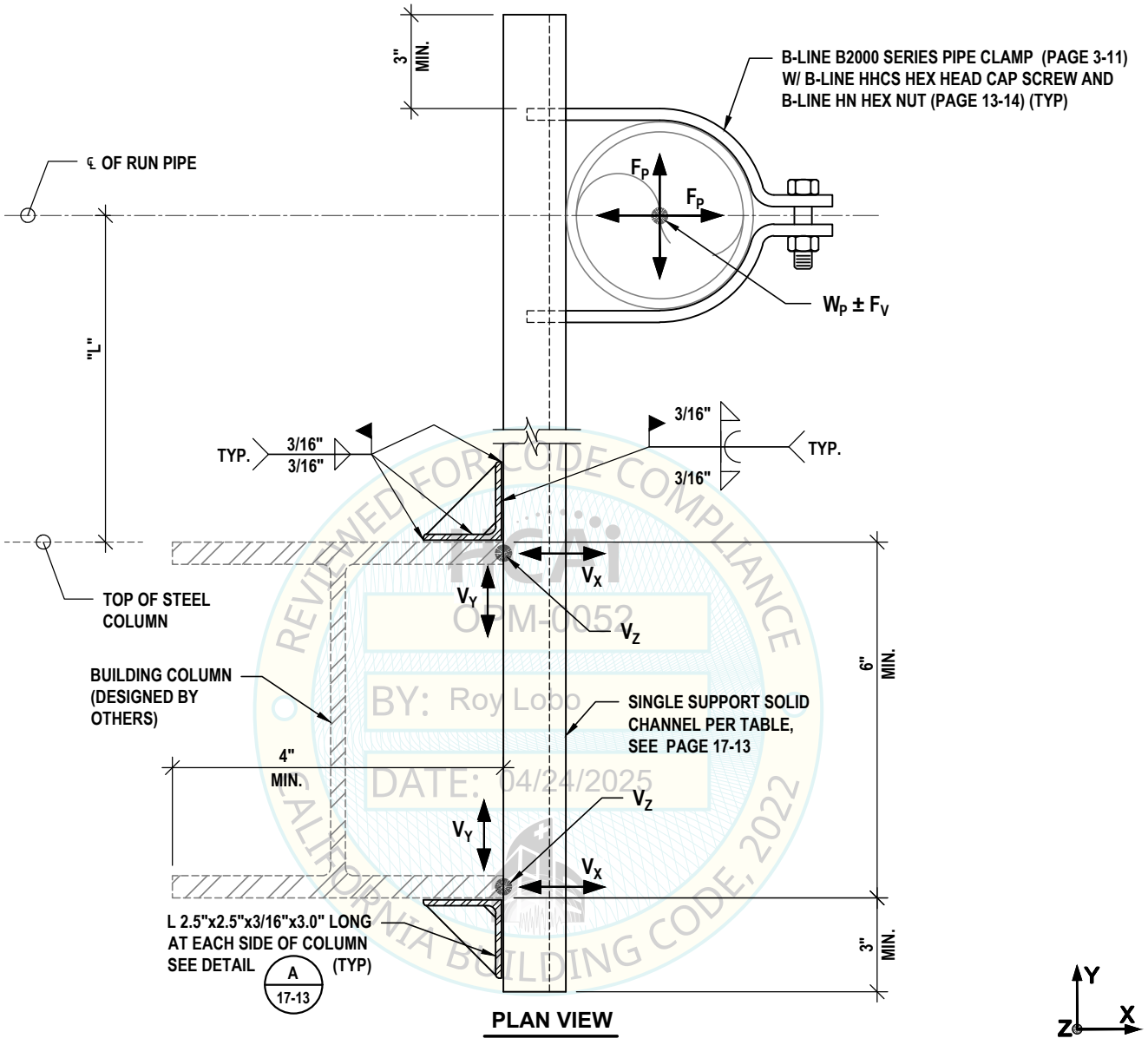
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California SE No. S3545

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DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND SINGLE SOLID CHANNEL

DETAIL
PRS-6



PLAN VIEW

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NOTES:

1. SEE PAGE 17-13 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
3. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-13.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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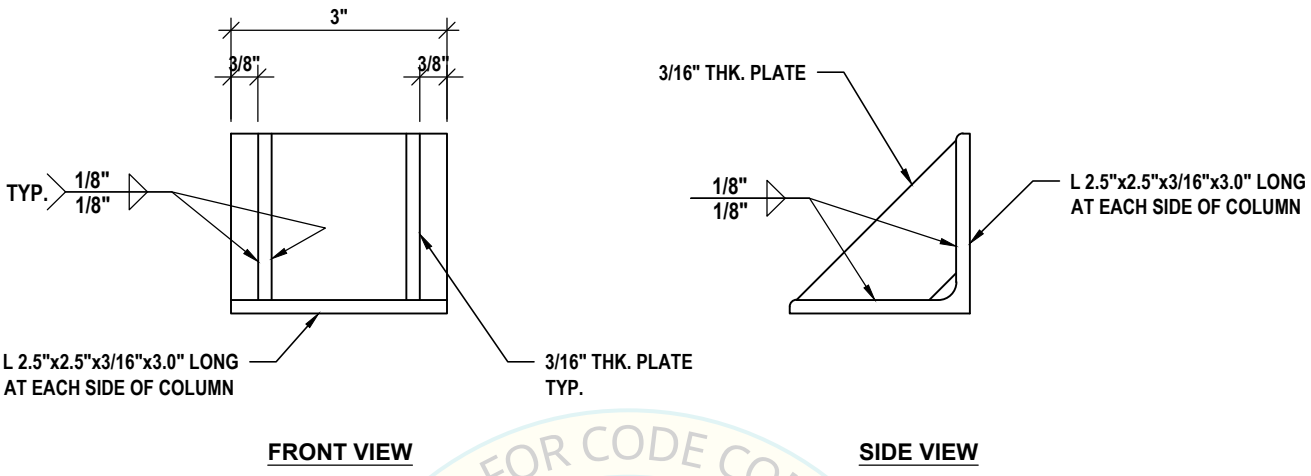
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 17-12

DATE: April 23, 2025

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND SINGLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-6



FRONT VIEW **SIDE VIEW**

DETAIL A

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OPM-0052
BY: Roy Lobo
DATE: 4/24/2025
CALIFORNIA BUILDING CODE 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ (LBS) (ASD)	$V_Y^{(2)}$ (LBS) (ASD)	$V_Z^{(2)}$ (LBS) (ASD)
				W_P GRAVITY	F_V SEISMIC				
2.5"	B22	10	15	140	60	140	400	70	560
4"	B12	10	12	280	130	280	740	140	1,000
6"	B11	6	12	270	120	270	730	140	960

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-12 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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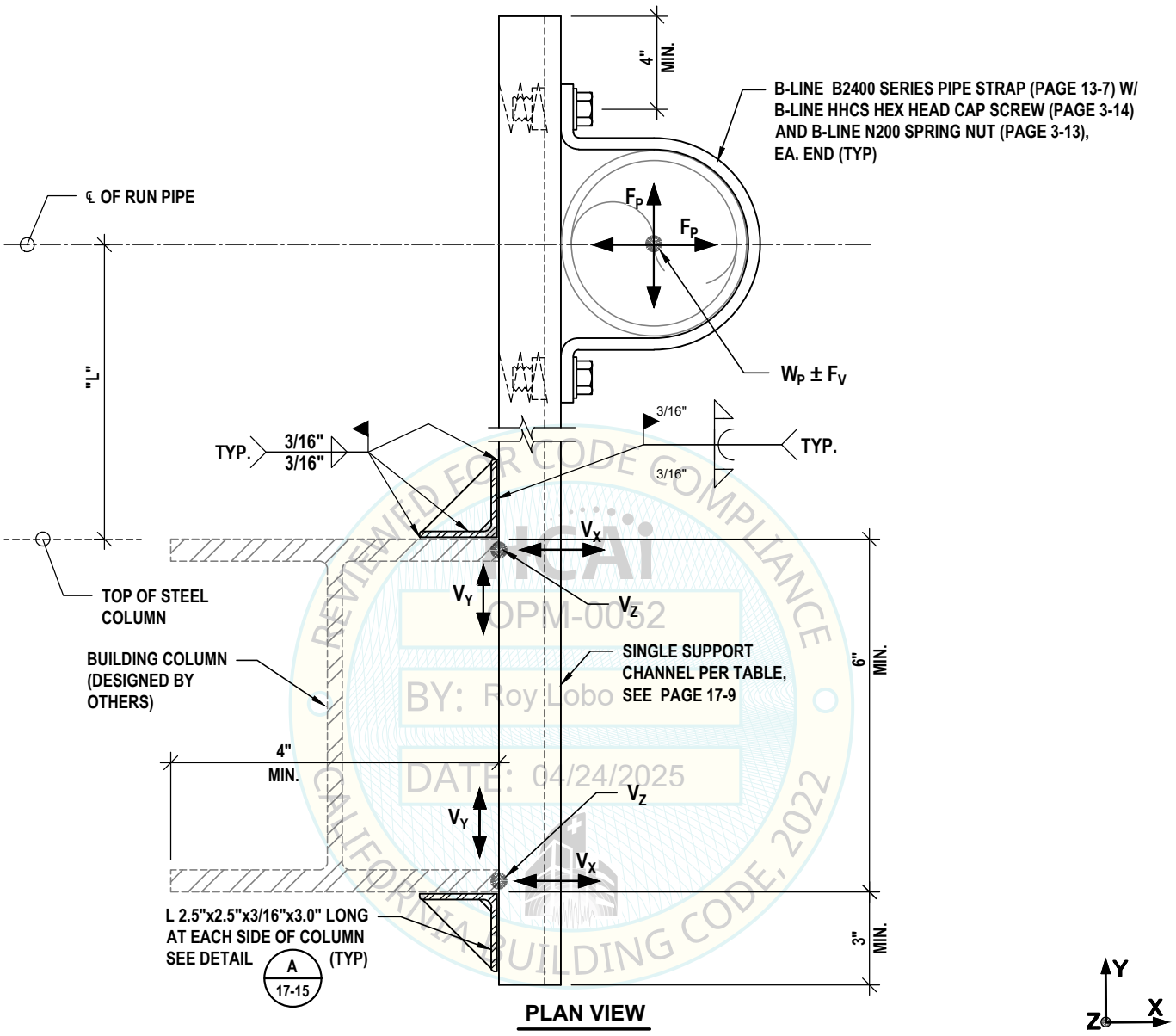
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-13**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND SINGLE SOLID CHANNEL

DETAIL
PRS-7



PLAN VIEW

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BY: Roy Lobo
DATE: 04/24/2025

NOTES:

1. SEE PAGE 17-15 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
3. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-15.
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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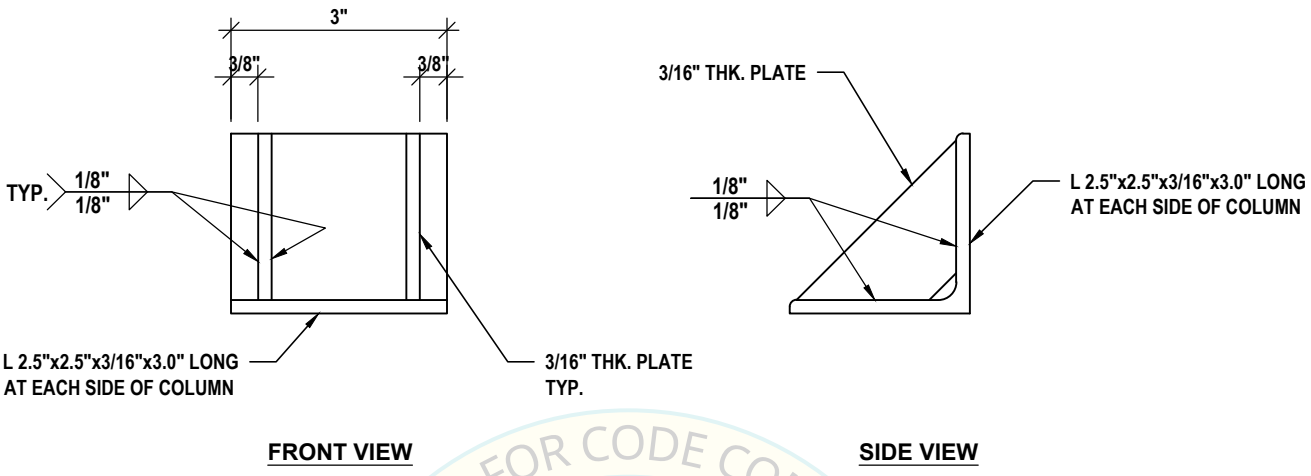
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE:
17-14

DATE:
April 23, 2025

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND SINGLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-7



FRONT VIEW **SIDE VIEW**

DETAIL A

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DATE: 4/24/2025
CALIFORNIA BUILDING CODE 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ (LBS) (ASD)	$V_Y^{(2)}$ (LBS) (ASD)	$V_Z^{(2)}$ (LBS) (ASD)
				W_P GRAVITY	F_V SEISMIC				
2.5"	B22	10	15	140	60	140	400	70	560
4"	B12	10	12	280	130	280	740	140	1,000
6"	B11	6	12	270	120	270	730	140	960

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-14 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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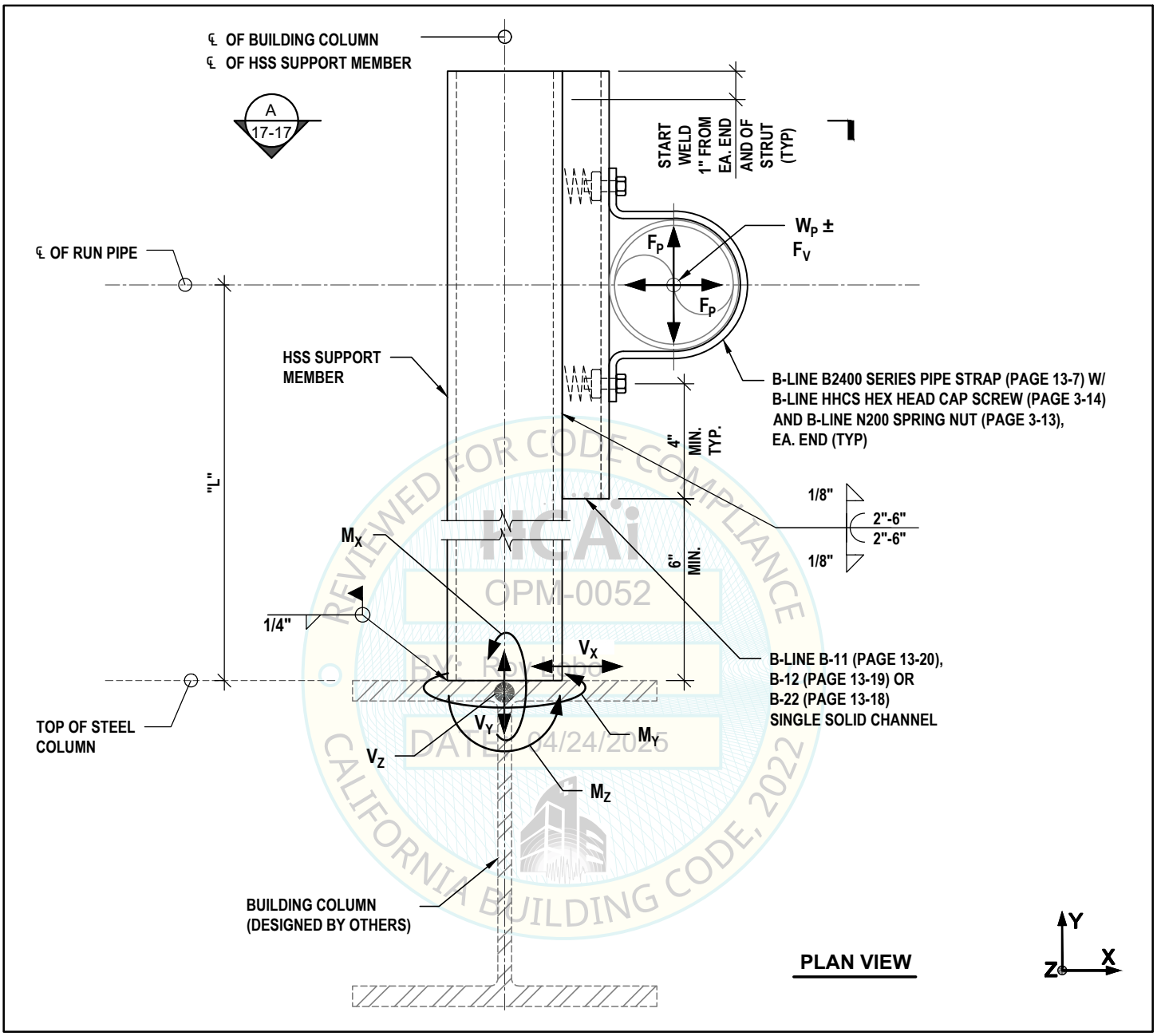
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-15**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND HSS

DETAIL
PRS-8



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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. SEE PAGE 17-17 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
3. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-17.
4. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-17.
5. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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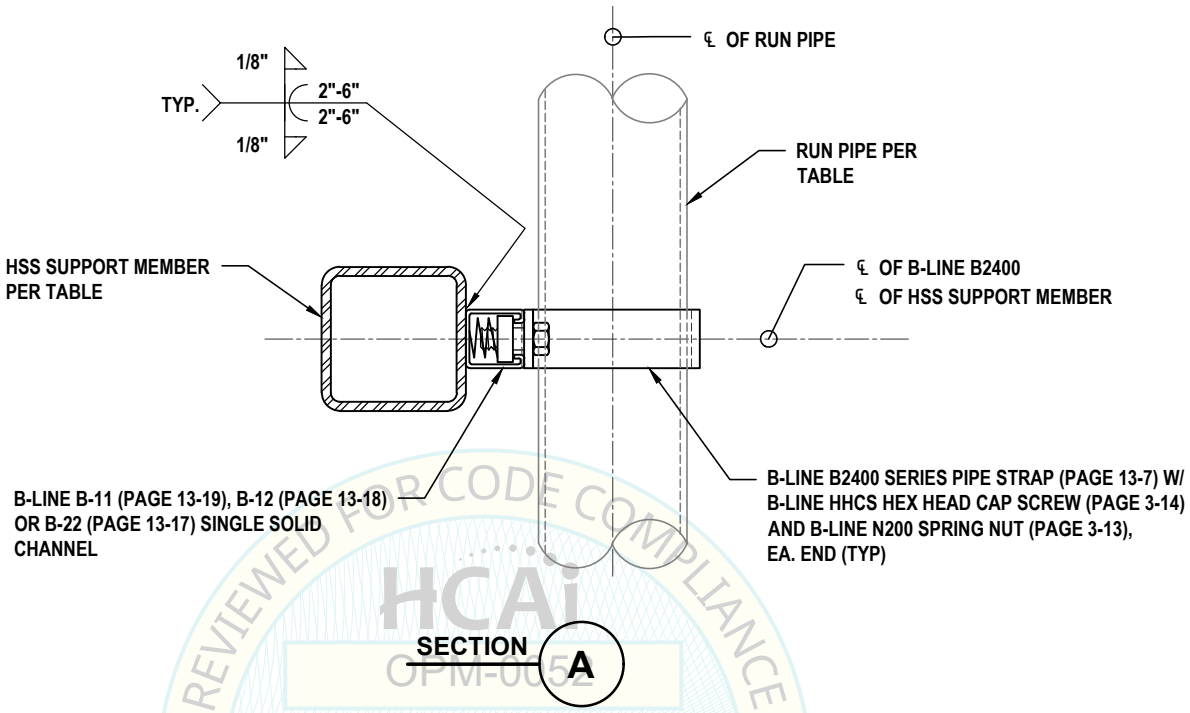
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-16**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND HSS (CONT'D)

DETAIL
PRS-8



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04/24/25
CALIFORNIA BUILDING CODE, 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	SUPPORT CHANNEL	MAXIMUM SUPPORT SPACING (FT)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE $[W_P + F_V]^{(1)}$ (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE $[F_P]^{(1)}$ (LBS)(ASD)	$V_X^{(2)}$ (LBS)(ASD)	$V_Y^{(2)}$ (LBS)(ASD)	$V_Z^{(2)}$ (LBS)(ASD)	$M_X^{(3)}$ (LB-IN) (ASD)	$M_Z^{(3)}$ (LB-IN) (ASD)
				W_P GRAVITY	F_V SEISMIC						
4"	HSS 4"x4"x1/4"	10	42	280	130	280	280	280	400	17,000	12,500
6"	HSS 4"x4"x1/4"	10	42	440	200	440	440	440	640	27,000	20,000
4"	HSS 3"x3"x1/4"	10	30	280	130	280	280	280	410	12,000	9,000
6"	HSS 3"x3"x1/4"	10	30	440	200	440	440	440	640	19,500	14,500

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.
3. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-16 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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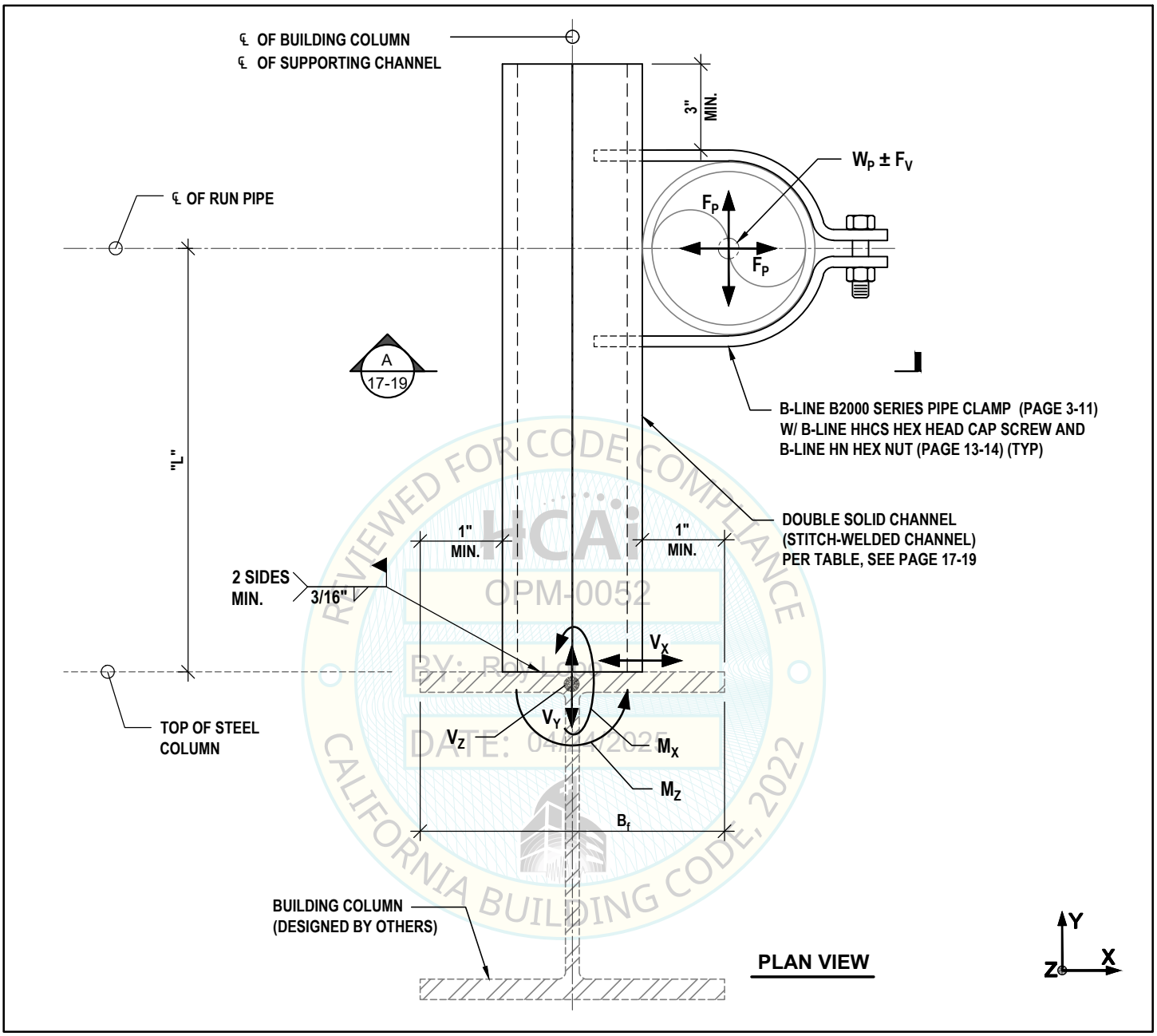
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **17-17**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND DOUBLE SOLID CHANNEL

DETAIL
PRS-9



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OPM-0052
BY: ROY LOBO
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. SEE PAGE 17-19 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR B_f (FLANGE WIDTH) DIMENSION.
3. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
4. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-19.
5. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-19.
6. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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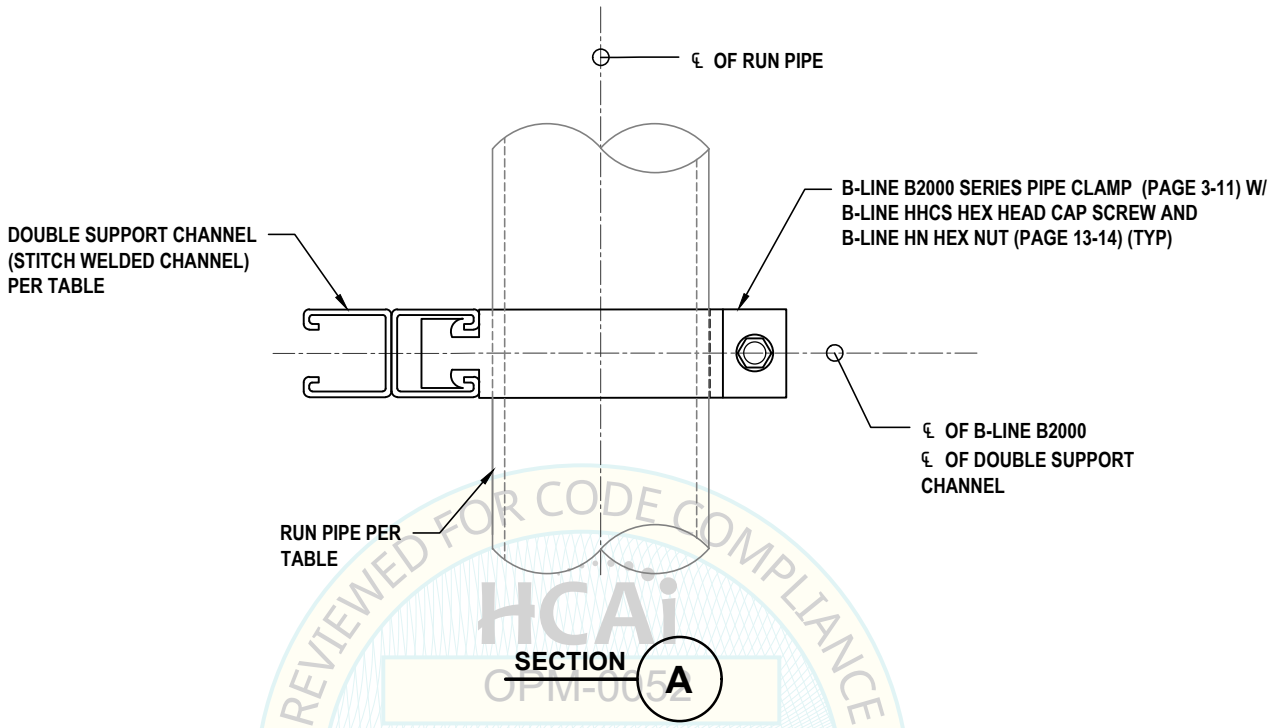
Structural Engineer: Mohammad R. Hariri
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PAGE: **17-18**

DATE: **April 23, 2025**

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE CLAMP AND DOUBLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-9



REVIEWED FOR CODE COMPLIANCE
HCAi
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BY: Roy Lobo
CALIFORNIA BUILDING CODE, 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	DOUBLE SUPPORT CHANNEL (STICH WELDED CHANNEL)	MAXIMUM SUPPORT SPACING (FT)	"B_F"(2) (IN)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE [W_P + F_V](1) (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE [F_P](1) (LBS)(ASD)	V_X(3) (LBS)(ASD)	V_Y(3) (LBS)(ASD)	V_Z(3) (LBS)(ASD)	M_X(4) (LB-IN) (ASD)	M_Z(4) (LB-IN) (ASD)
					W_P GRAVITY	F_V SEISMIC						
2.5"	B22A	10	6	18	140	60	140	140	140	200	3,500	2,500
4"	B12A	10	8	18	275	125	275	275	275	400	7,200	5,400
6"	B11A	6	10	18	270	120	270	270	270	390	6,900	5,300

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR B_f (FLANGE WIDTH) DIMENSION.
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.
3. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-18 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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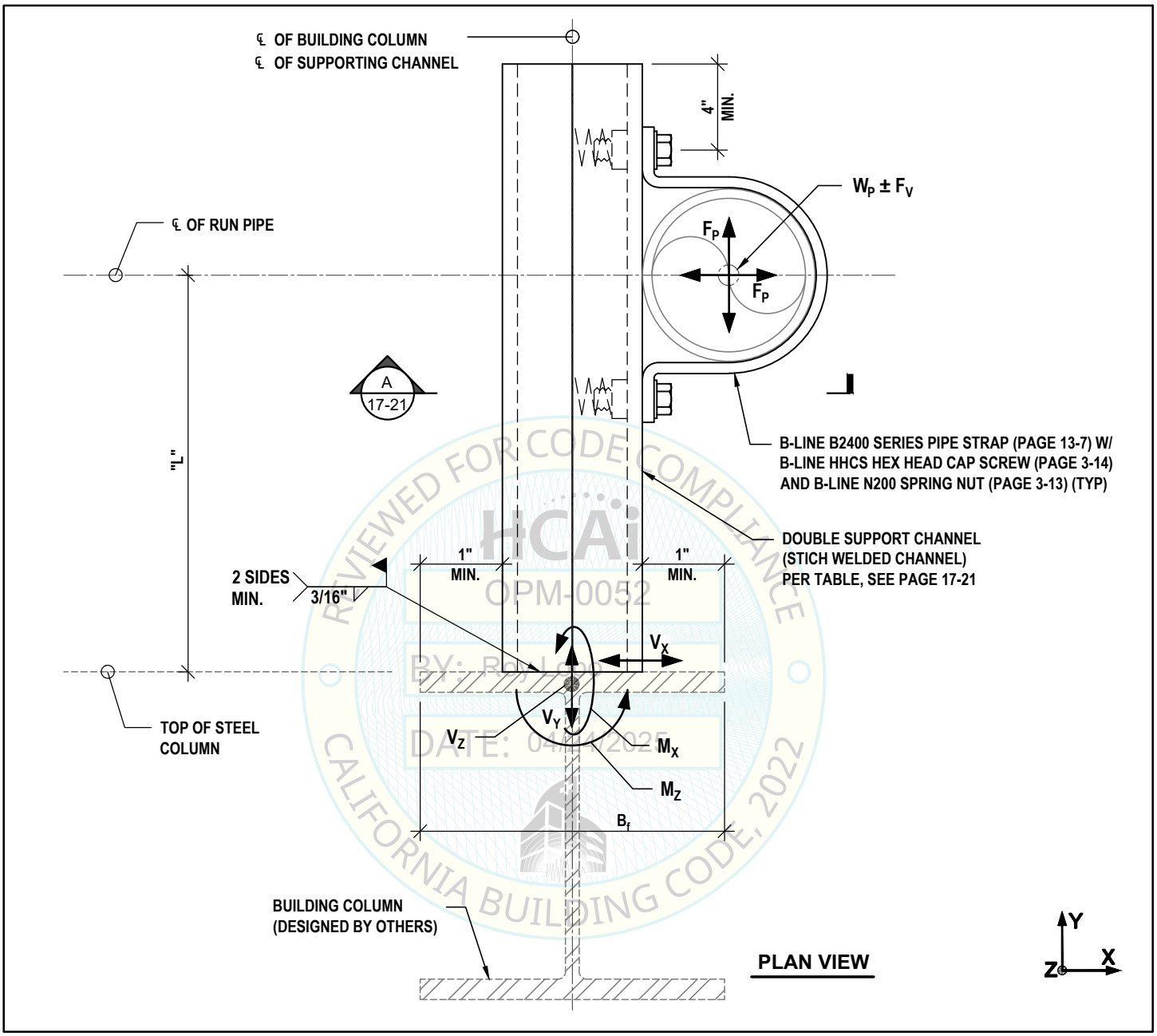
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE:
17-19

DATE:
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RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND DOUBLE SOLID CHANNEL

DETAIL
PRS-10



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BY: ROY LOBO
DATE: 04/24/2025
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NOTES:

1. SEE PAGE 17-21 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR B_f (FLANGE WIDTH) DIMENSION.
3. SEISMIC LATERAL FORCE IS (F_P / W_P) = 1.0 G (ASD) AND SEISMIC VERTICAL FORCE IS (F_V / W_P) = 0.44 G (ASD).
4. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-21.
5. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE. SEE PAGE 17-21.
6. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.

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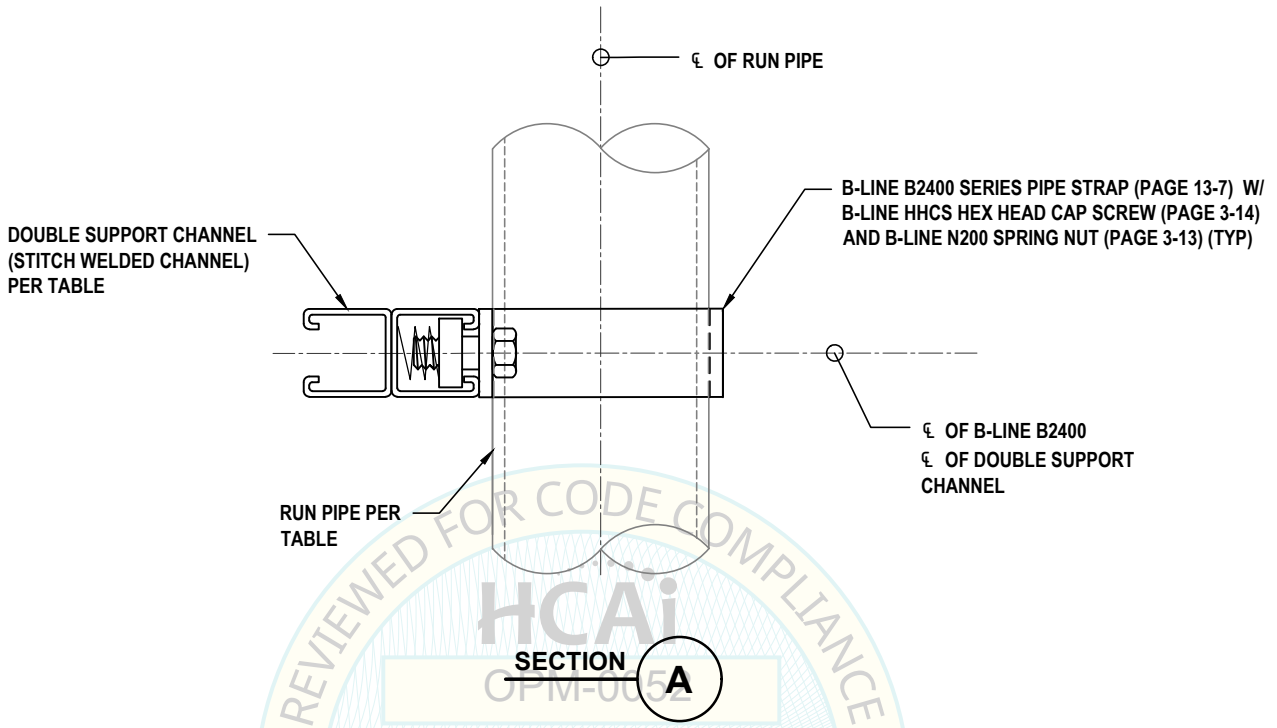
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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 17-20

DATE: April 23, 2025

RISER SUPPORT TO BUILDING STEEL COLUMN FLANGE W/ PIPE STRAP AND DOUBLE SOLID CHANNEL (CONT'D)

DETAIL
PRS-10



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HCAi
OPM-0052
BY: Roy Lobo
CALIFORNIA BUILDING CODE, 2022

MAXIMUM LOADS TO STRUCTURE (ASD)

MAX. RUN PIPE DIA.	DOUBLE SUPPORT CHANNEL (STICH WELDED CHANNEL)	MAXIMUM SUPPORT SPACING (FT)	"B_F"[2] (IN)	"L" (IN)	MAXIMUM VERTICAL LOAD @ CL OF RUN PIPE [W_P + F_V][1] (LBS)(ASD)		MAXIMUM HORIZONTAL LOAD @ CL OF RUN PIPE [F_P][1] (LBS)(ASD)	V_X[3] (LBS)(ASD)	V_Y[3] (LBS)(ASD)	V_Z[3] (LBS)(ASD)	M_X[4] (LB-IN) (ASD)	M_Z[4] (LB-IN) (ASD)
					W_P GRAVITY	F_V SEISMIC						
2.5"	B22A	10	6	18	140	60	140	140	140	200	3,500	2,500
4"	B12A	10	8	18	275	125	275	275	275	400	7,200	5,400
6"	B11A	6	10	18	270	120	270	270	270	390	6,900	5,300

FOOTNOTES:

1. THIS CONDITION CORRESPONDS TO 1.0 "G" HORIZONTAL SEISMIC FORCE [(F_P / W_P) = 1.0 G (ASD)], GRAVITY VERTICAL FORCE AND 0.44 "G" VERTICAL SEISMIC FORCE [(F_V/ W_P) = 0.44 G (ASD)].
2. SEE AISC STEEL CONSTRUCTION MANUAL 15TH EDITION FOR B_f (FLANGE WIDTH) DIMENSION.
2. V_X, V_Y & V_Z ARE FORCES IMPOSED ON THE SUPPORTING STRUCTURE.
3. M_Y & M_Z ARE MOMENTS IMPOSED ON THE SUPPORTING STRUCTURE.

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
2. SEE PAGE 17-20 FOR DETAILS AND INFORMATION NOT SHOWN HERE.
3. HUSKY PLUMBING BAND (WHERE OCCURS) OR CONFORM TO ASTM C-1540, CERTIFIED IN ACCORDANCE WITH FM 1680 CLASS 1.

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PAGE: **17-21**

DATE: **April 23, 2025**

SECTION 18

SPECIAL SEISMIC PIPE SUPPORT AND ATTACHMENT DETAILS

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DATE: 04/24/2025
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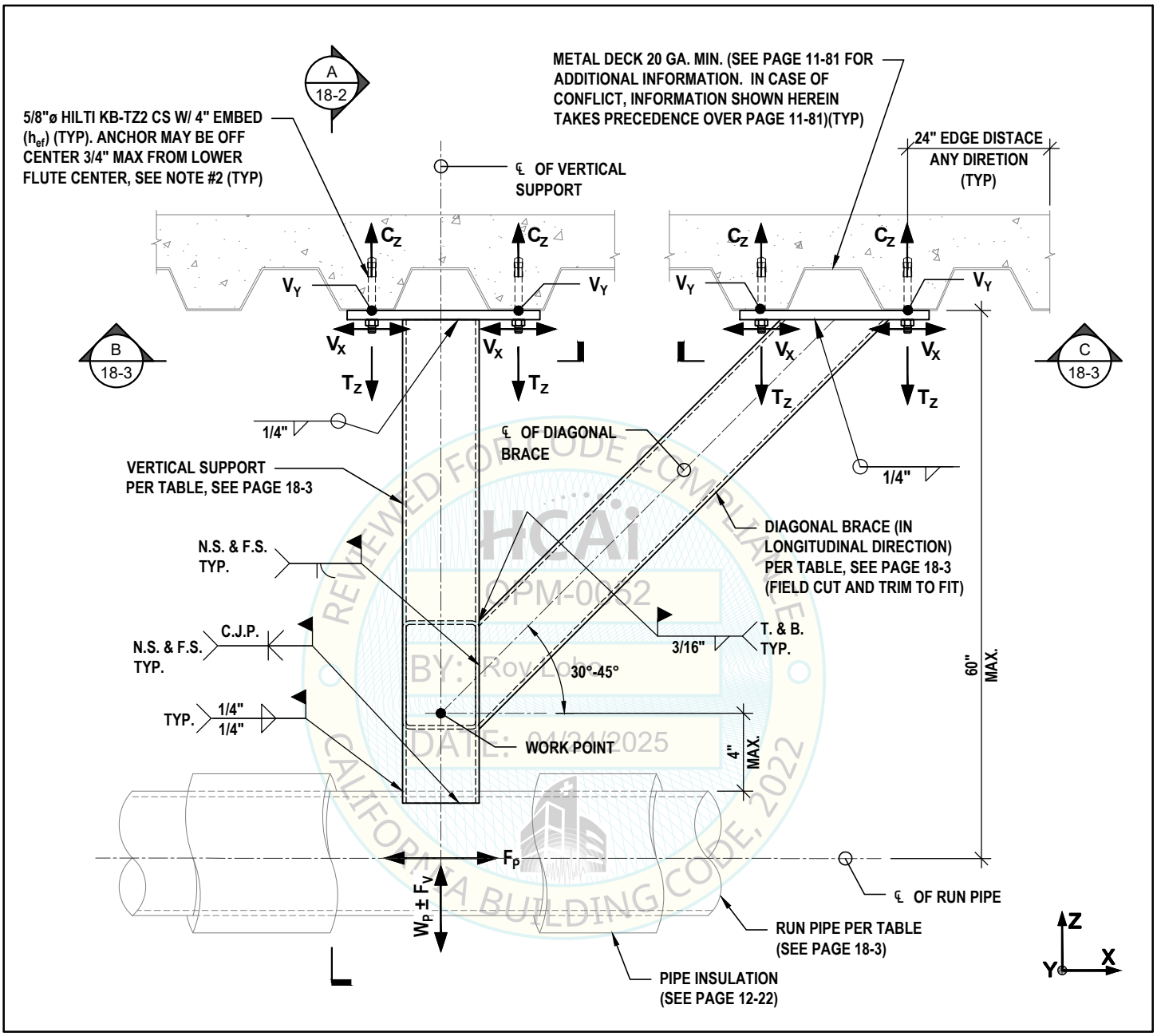
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: 18-0

DATE: April 23, 2025

PIPE (EMPTY) SUPPORT AND ATTACHMENT TO 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK

DETAIL
PSA-1



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BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. SEE PAGES 18-2 & 18-3 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEE PAGES 11-81 & 11-82 FOR METAL DECK REQUIREMENTS, ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
3. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
4. CONDITIONS THAT INCLUDE THERMAL AND THRUST LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.
5. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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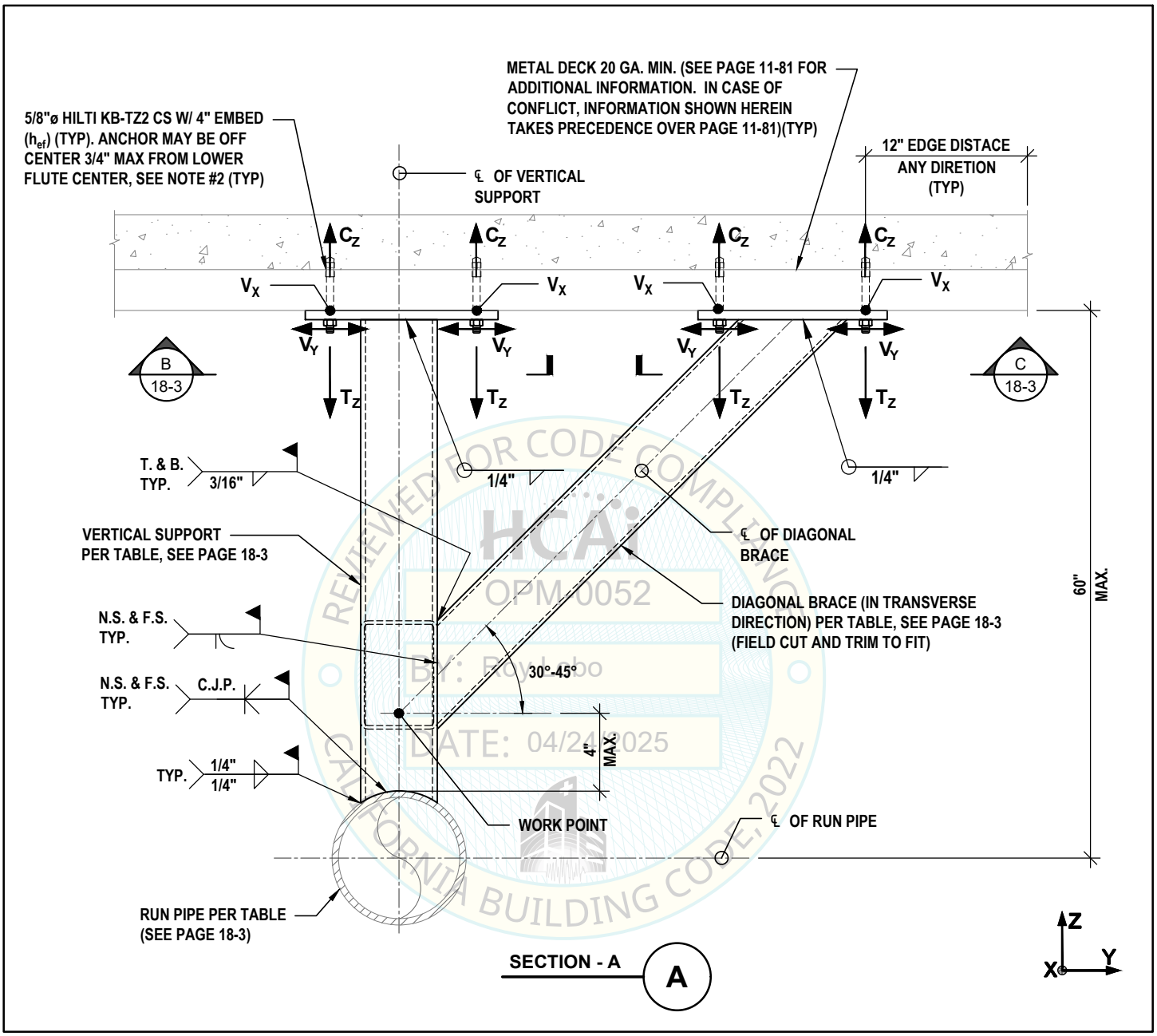
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: **18-1**

DATE: **April 23, 2025**

PIPE (EMPTY) SUPPORT AND ATTACHMENT TO 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)

DETAIL
PSA-1



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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

NOTES:

1. SEE PAGES 18-1 & 18-3 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. SEE PAGE 11-81 & 11-82 FOR METAL DECK REQUIREMENTS, ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES.
3. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
4. CONDITIONS THAT INCLUDE THERMAL AND THRUST LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.
5. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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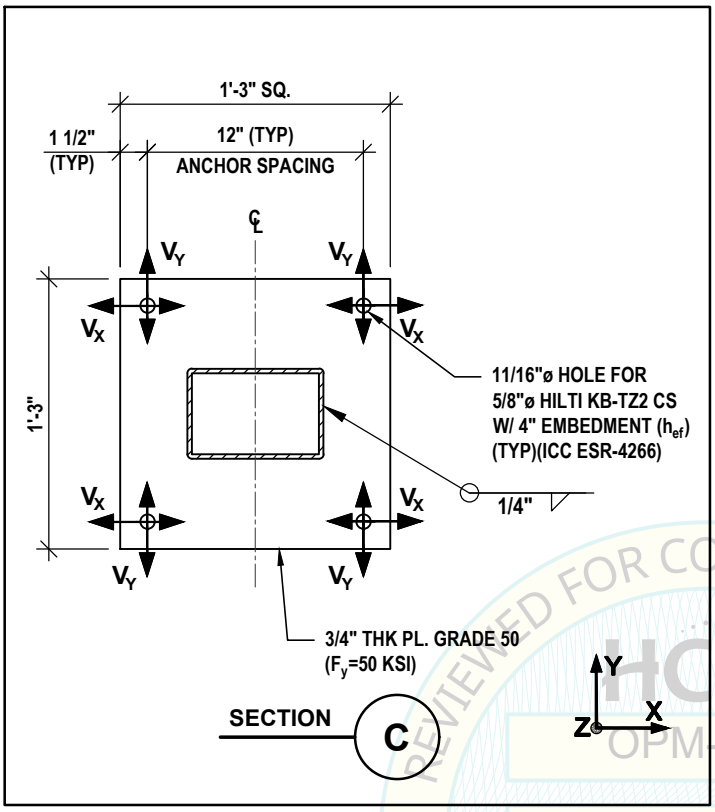
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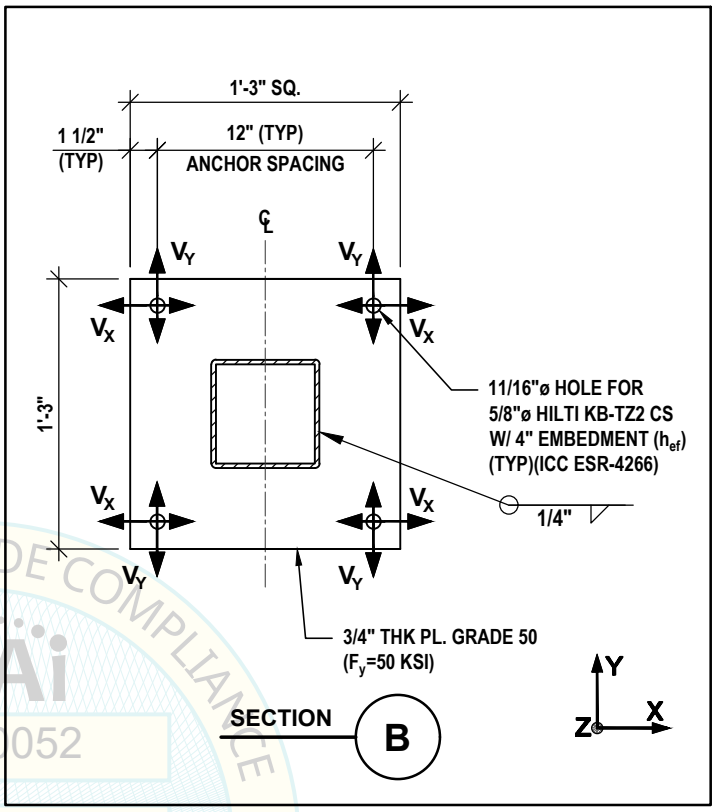
PAGE: **18-2**

DATE: **April 23, 2025**

PIPE (EMPTY) SUPPORT AND ATTACHMENT TO 3,000 PSI SAND LWC OVER MIN. 20 GA. METAL DECK (CONT'D)

DETAIL
PSA-1





MAX. RUN PIPE DIA. (1)(2)	VERTICAL SUPPORT	DIAGONAL BRACING	MAX. SEISMIC BRACE SPACING (FT)		MAX. VERTICAL LOAD @ CL OF RUN PIPE (LBS)(ASD)		MAX. HORIZONTAL LOAD @ CL OF RUN PIPE (LBS)(ASD)		V_X (3) PER ANCHOR (LBS) (ASD)	V_Y (3) PER ANCHOR (LBS) (ASD)	T_Z / C_Z (3) PER ANCHOR (LBS) (ASD)
			TRANS.	LONGIT.	GRAVITY	SEISMIC	TRANS.	LONGIT.			
4"	HSS 3 x 3 x 1/4	HSS 2 x 2 x 3/16	20	40	140	65	280	560	450	450	1,270
6"	HSS 4 x 4 x 1/4	HSS 3 x 3 x 3/16	20	40	250	110	500	1,000	790	790	2,100
8"	HSS 6 x 6 x 1/4	HSS 4 x 4 x 3/16	10	20	370	170	370	740	590	590	1,600

FOOTNOTES:

1. ALL PIPE TYPES SHALL BE SCHEDULE 40.
2. WEIGHT OF PIPE INCLUDES, PIPE SELF WEIGHT AND INSULATION ONLY; PIPE ASSUMED TO BE EMPTY FOR STEAM.
3. MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
4. LATERAL SEISMIC FORCE 1.0 G [(F_P / W_P) = 1.0 G (ASD)].
5. VERTICAL SEISMIC FORCE 0.44 G [(F_V / W_P) = 1.0 G (ASD)].
6. CONDITIONS THAT INCLUDE THERMAL AND THRUST LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.
7. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
8. SEE PAGE 11-82 FOR HILTI KB-TZ2 REQUIREMENTS ARE NOT SHOWN HERE.
9. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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BY: Roy Lobo
DATE: 04/24/2025
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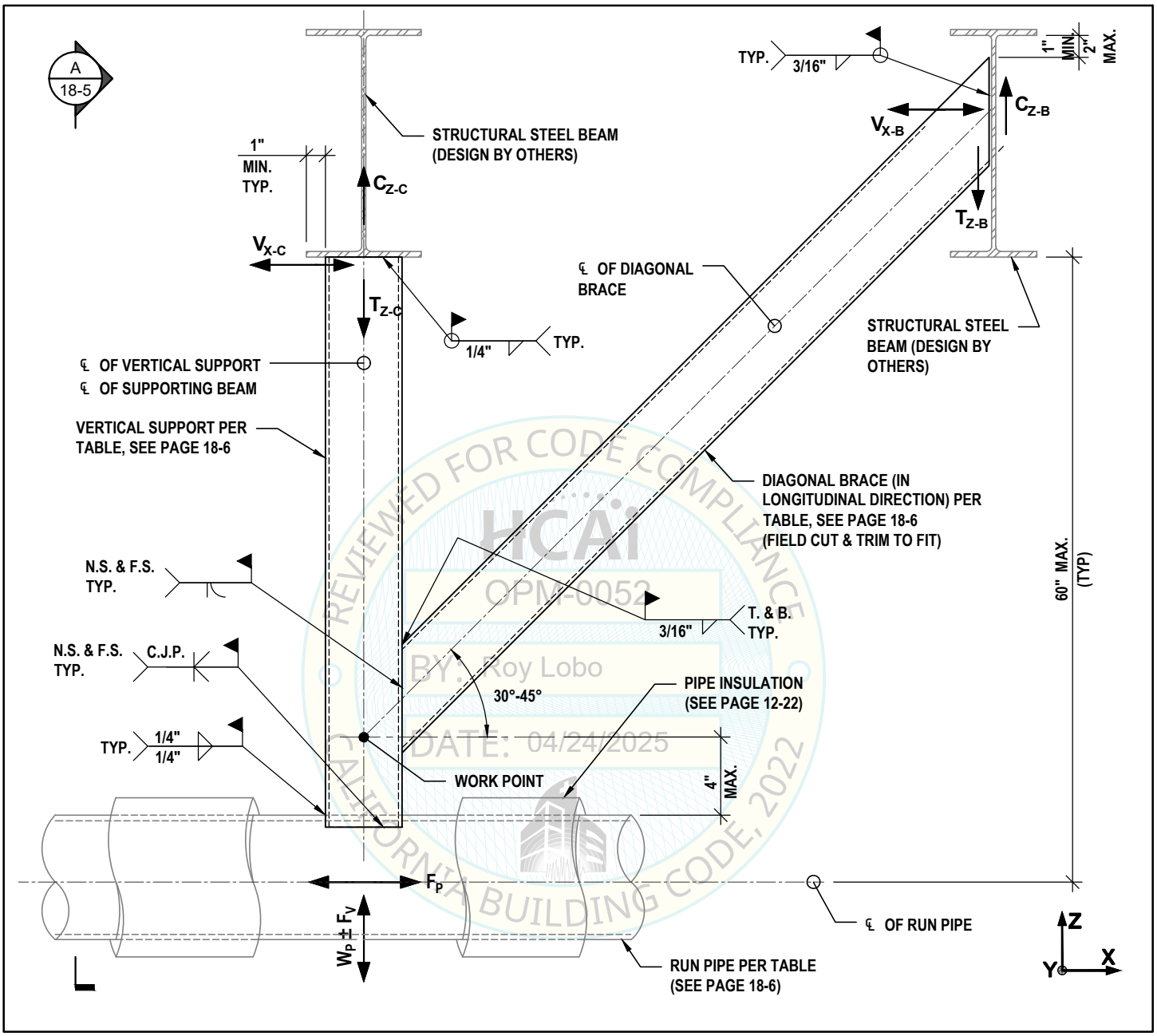
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: **April 23, 2025**

PIPE (EMPTY) SUPPORT AND ATTACHMENT TO STEEL BEAM

DETAIL
PSA-2



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NOTES:

1. SEE PAGES 18-5 & 18-6 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
3. CONDITIONS THAT INCLUDE THERMAL LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.
4. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONES (SEE AISC 341, SECTION 7.4).
5. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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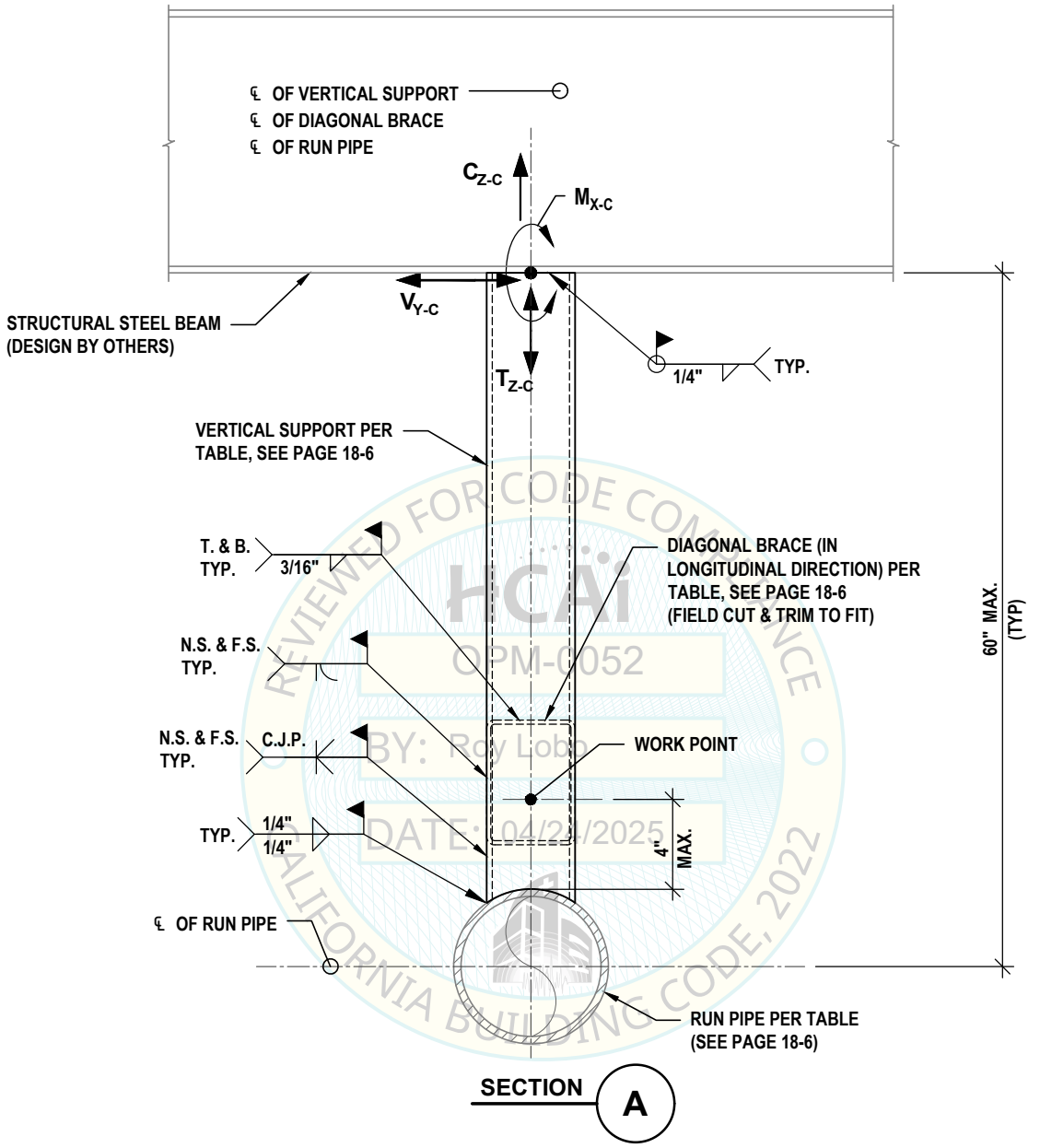
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DATE: **April 23, 2025**

PIPE (EMPTY) SUPPORT AND ATTACHMENT TO STEEL BEAM (CONT'D)

DETAIL
PSA-2



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NOTES:

1. SEE PAGES 18-4 & 18-6 FOR DETAILS AND INFORMATION NOT SHOWN HERE AND MAXIMUM LOADS.
2. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF SUPPORTING STRUCTURE. DESIGN OF SUPPORTING STRUCTURE BY STRUCTURAL ENGINEER OF RECORD.
3. CONDITIONS THAT INCLUDE THERMAL AND THRUST LOADING ARE TO BE DESIGNED ON A PROJECT SPECIFIC BASIS.
4. NO ATTACHMENT SHALL BE MADE IN THE PROTECTION ZONES (SEE AISC 341, SECTION 7.4).
5. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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PIPE (EMPTY) SUPPORT AND ATTACHMENT TO STEEL BEAM (CONT'D)

DETAIL
PSA-2

MAX. RUN PIPE DIA. (1)(2)	VERTICAL SUPPORT	DIAGONAL BRACING	MAX. SEISMIC BRACE SPACING (FT)		MAX. VERTICAL LOAD @ CL OF RUN PIPE (LBS)(ASD)		MAX. HORIZONTAL LOAD @ CL OF RUN PIPE (LBS)(ASD)		$V_{X\text{-}C}$ (3) (LBS) (ASD)	$V_{Y\text{-}C}$ (3) (LBS) (ASD)	$T_{Z\text{-}C}/C_{Z\text{-}C}$ (3) (LBS) (ASD)	$M_{X\text{-}C}$ (3) (LBS-IN) (ASD)	$V_{X\text{-}B}$ (3) (LBS) (ASD)	$T_{Z\text{-}B}/C_{Z\text{-}B}$ (3) (LBS) (ASD)
			TRANS.	LONGIT.	GRAVITY	SEISMIC	TRANS.	LONGIT.						
4"	HSS 3 x 3 x 1/4	HSS 2 x 2 x 3/16	20	40	140	65	280	560	70	280	880	16,600	620	620
6"	HSS 4 x 4 x 1/4	HSS 3 x 3 x 3/16	20	40	250	110	500	1,000	120	500	1,540	29,400	1,100	1,100
8"	HSS 6 x 6 x 1/4	HSS 4 x 4 x 3/16	10	20	370	170	740	1,480	170	730	2,280	43,700	1,630	1,630

FOOTNOTES:

1. ALL PIPE TYPES SHALL BE SCHEDULE 40.
2. WEIGHT OF PIPE INCLUDES, PIPE SELF WEIGHT AND INSULATION ONLY; PIPE ASSUMED TO BE EMPTY FOR STEAM.
3. MAXIMUM LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.
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9. THE MAXIMUM VERTICAL SUPPORT SPACING IS 10 FEET.

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APPENDIX A

2022 CALIFORNIA BUILDING CODE
DESIGN FORCE FORMULAS

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2022 CALIFORNIA BUILDING CODE - DESIGN FORCE FORMULAS

As stated in the ASCE 7-16, the horizontal seismic force (F_P) may be calculated using the formula below.

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}\, W_P}{R_P} \right] \left(1 + 2 \left(\frac{z}{h} \right) \right) W_P$$

F_P shall not be less than:	$(0.3\, S_{DS}\, I_P)\, W_P$
F_P need not be greater than:	$(1.6\, S_{DS}\, I_P)\, W_P$

F_P = Seismic Design Force

R_P = Component Response Modification Factor

a_P = Component Amplification Factor

I_P = Component Importance Factor

S_{DS} = Design spectral response acceleration at short period

z = Element or component attachment elevation with respect to grade
Note: (z) shall not be taken less than 0.0

h = Average structure roof elevation with respect to grade.

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APPENDIX B

METRIC CONVERSION CHARTS

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METRIC CONVERSION CHART

Convert From	To	Multiply By
Angle		
degree	radian(rad)	1.7453×10^{-2}
radian(rad)	degree	5.7296×10^{1}
Area		
$foot^2$	square meter (m^2)	9.2903×10^{-2}
$inch^2$	square meter (m^2)	6.4516×10^{-4}
circular mil	square meter (m^2)	5.0671×10^{-10}
sq. centimeter (cm^2)	square inch (in^2)	1.5500×10^{-1}
sq. meter (m^2)	$foot^2$	1.0764×10^{1}
sq. meter (m^2)	$inch^2$	1.5500×10^{3}
sq. meter (m^2)	circular mil	1.9735×10^{9}
Temperature		
degree Fahrenheit	degree Celsius	t°C = (t°F-32) /1.8
degree Celsius	degree Fahrenheit	t°F = 1.8t°C + 32
Force		
pounds-force (lbs)	newtons (N)	4.4482
Length		
foot (ft)	meter (m)	3.0480×10^{-1}
inch (in)	meter (m)	2.5400×10^{-2}
mil	meter (m)	2.5400×10^{-5}
inch (in)	micrometer (μm)"	2.5400×10^{4}
meter (m)	foot (ft)	3.2808
meter (m)	inch (in)	3.9370×10^{1}
meter (m)	mil	3.9370×10^{4}
micrometer (μm)	inch (in)	3.9370×10^{-5}
Volume		
$foot^3$	cubic meter (m^3)	2.8317×10^{-2}
$inch^3$	cubic meter (m^3)	1.6387×10^{-5}
cubic centimeter (cm^3)	cubic inch (in^3)	6.1024×10^{-2}
cubic meter (m^3)	$foot^3$	3.5315×10^{1}
cubic meter (m^3)	$inch^3$	6.1024×10^{4}
gallon (U.S. liquid)	cubic meter (m^3)	3.7854×10^{-3}

Convert From	To	Multiply By
Mass		
pound (avoirdupois)	kilogram (kg)	4.5359×10^{-1}
kilogram (kg)	pound (avoirdupois)	2.2046
Mass Per Unit Length		
lb/ft	kilogram/meter (kg/m)	1.4882
lb/in	kilogram/meter (kg/m)	1.7858×10^{1}
kg/m	lb/ft	6.7197×10^{-1}
kg/m	lb/in	5.5997×10^{-2}
Mass Per Unit Volume		
lb/ft^3	kilogram/meter (kg/m^3)	1.6018×10^{1}
lb/in^3	kilogram/meter (kg/m^3)	2.7680×10^{4}
kg/m^3	lb/ft^3	6.2428×10^{-2}
kg/m^3	lb/in^3	3.6127×10^{-5}
lbs/ft^3	lbs/in^3	1.7280×10^{3}
Mass Per Area Unit		
lb/ft^2	kilogram/sq.meter(kg/m^2)	1.6018×10^{1}
kg/m^2	kilogram/sq.meter(kg/m^2)	2.7680×10^{4}
Mass Per Unit Volume		
lbf/in^2 (psi)	pascal (Pa)	6.8948×10^{3}
kip/in^2 (ksi)	pascal (Pa)	6.8948×10^{6}
$lbf/in^{2(}$psi)	megapascals (MPa)	6.8948×10^{-3}
pascal (Pa)	pound force/sq. inch(psi)	1.4504×10^{-4}
pascal (Pa)	kip per sq. inch (ksi)	1.4504×10^{-7}
Bending Moment or Torque		
lbf . ft	newton meter (N . m)	1.3559
lbf . in	newton meter (N . m)	1.1299×10^{-1}
N . m	lbf . ft	7.3756×10^{-1}
N . m	lbf . in	8.8507

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APPENDIX C

PIPE WEIGHT TABLES,
CONDUIT WEIGHT TABLES,
RECTANGULAR DUCT WEIGHT TABLES,
ROUND DUCT WEIGHT TABLE
AND
GALV. SHEET METAL CONVERSION TABLE

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PIPE WEIGHT TABLES

STEEL PIPE						
Pipe Dia.	Pipe Sch.	Insulation Thickness	Weight Per Foot (lbs.)			
			Pipe	Water	Insulation	Total
1"	40	1"	1.7	0.4	0.7	2.8
1-1/4"	40	1"	2.3	0.7	0.8	3.8
1-1/2"	40	1"	2.7	0.9	0.9	4.5
2"	40	1"	3.7	1.5	1.0	6.2
2-1/2"	40	1"	5.8	2.1	1.2	9.1
3"	40	1"	7.6	3.2	1.3	12.1
3-1/2"	40	1"	9.1	4.3	1.5	14.9
4"	40	1"	11.0	5.5	1.6	18.1
5"	40	1-1/2"	16.0	8.7	2.9	27.6
6"	40	1-1/2"	19.0	12.5	3.3	34.8
8"	40	1-1/2"	29.0	22.0	4.1	55.1
10"	40	1-1/2"	41.0	34.0	5.2	80.2
12"	40	1-1/2"	54.0	49.0	6.0	109.0
14"	30	1-1/2"	55.0	60.0	7.0	122.0
16"	30	1-1/2"	63.0	79.0	7.5	149.5
18"	30	1-1/2"	82.0	100.0	8.0	190.0
20"	20	1-1/2"	79.0	126.0	8.5	213.5
24"	20	1-1/2"	95.0	184.0	10.0	289.0

COPPER PIPE - TYPE L				
Pipe Diameter	Weight Per Foot (lbs.)			
	Pipe	Water	Insulation	Total Wt. Per Foot
1"	0.66	0.36	0.70	1.71
1-1/4"	0.88	0.55	0.80	2.23
1-1/2"	1.14	0.77	0.90	2.81
2"	1.75	1.34	1.00	4.09
2-1/2"	2.48	2.06	1.20	5.74
3"	3.33	2.95	1.30	7.58
3-1/2"	4.29	2.99	1.50	8.78
4"	5.38	5.19	1.80	12.37
5"	7.61	8.08	2.90	18.59
6"	10.20	11.62	3.30	25.12

COPPER PIPE - TYPE K				
Pipe Diameter	Weight Per Foot (lbs.)			
	Pipe	Water	Insulation	Total Wt. Per Foot
1"	0.84	0.34	0.7	1.88
1-1/4"	1.04	0.53	0.8	2.37
1-1/2"	1.36	0.74	0.9	3.00
2"	2.05	1.31	1.0	4.36
2-1/2"	2.92	2.02	1.2	6.14
3"	4.00	2.87	1.3	8.17
3-1/2"	5.12	3.89	1.5	10.51
4"	6.51	5.09	1.8	13.40
5"	9.67	7.87	2.9	20.44
6"	13.87	11.20	3.3	28.37

CAST IRON PIPE - CLASS 150			
Pipe Diameter	Weight Per Foot (lbs.)		
	Pipe	Water	Total
3"	12.2	3.7	15.9
4"	16.4	5.7	22.1
5"	25.7	12.8	38.5
7"	36.7	23.1	59.8
10"	48.7	35.5	84.2
12"	62.9	51.0	113.9
14"	78.8	69.3	148.1
16"	95.0	90.3	185.3
18"	114.7	114.0	228.7
20"	135.9	141.5	227.4
24"	190.4	201.0	391.4

CAST IRON SOIL PIPE			
Pipe Diameter	Weight Per Foot (lbs.)		
	Pipe	Water	Total
2"	3.6	1.3	4.9
3"	5.2	2.9	8.1
4"	7.4	5.0	12.4
5"	9.4	7.9	17.3
6"	10.1	11.3	21.4
8"	18.0	19.8	37.8
10"	25.8	31.1	56.9

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CONDUIT WEIGHT TABLES

STEEL CONDUIT				
Conduit Diameter	Wall Thickness	Conduit Weight Per Foot (lbs.)	"Max. Wt./Ft. of Conduit And Conductor (lbs.)"	
			Lead Covered	Non-Lead Covered
1/2"	0.112	0.852	1.172	1.042
3/4"	0.124	1.134	1.754	1.398
1"	0.124	1.684	2.614	2.347
1-1/4"	0.155	2.281	4.311	3.581
1-1/2"	0.167	2.731	5.891	4.546
2"	0.172	3.678	8.528	7.208
2-1/2"	0.219	5.819	11.509	10.219
3"	0.219	7.616	16.506	14.506
3-1/2"	0.219	9.202	19.052	17.491
4"	0.219	10.889	24.749	21.479
5"	0.367	14.810	35.870	30.830
6"	0.367	19.185	50.685	43.425

ELECTRICAL METALLIC TUBING (EMT)			
Conduit Diameter	Conduit Weight Per Foot (lbs.)	Conductor Weight Per Foot (lbs.)	Max. Wt./Ft. of Conduit And Conductor (lbs.)
1/2"	0.29	0.22	0.51
3/4"	0.44	0.40	0.84
1"	0.64	0.66	1.30
1-1/4"	0.95	1.17	2.12
1-1/2"	1.10	1.60	2.70
2"	1.40	2.62	4.02
2-1/2"	2.05	3.74	5.79
3"	2.50	5.76	8.26
3-1/2"	3.25	7.73	10.98
4"	3.70	9.94	13.64

INTERMEDIATE METAL CONDUIT (IMC)			
Conduit Diameter	Conduit Weight Per Foot (lbs.)	Conductor Weight Per Foot (lbs.)	Max. Wt./Ft. of Conduit And Conductor (lbs.)
1/2"	0.60	0.22	0.82
3/4"	0.82	0.41	1.23
1"	1.16	0.66	1.82
1-1/4"	1.50	1.17	2.67
1-1/2"	1.82	1.60	3.42
2"	2.42	2.62	5.04
2-1/2"	4.28	3.47	7.75
3"	5.26	5.43	10.69
3-1/2"	6.12	7.34	13.46
4"	6.82	9.50	16.32

RIGID METAL CONDUIT (RMC)			
Conduit Diameter	Conduit Weight Per Foot (lbs.)	Conductor Weight Per Foot (lbs.)	Max. Wt./Ft. of Conduit And Conductor (lbs.)
1/2"	0.79	0.22	1.01
3/4"	1.05	0.41	1.46
1"	1.53	0.66	2.19
1-1/4"	2.01	1.17	3.18
1-1/2"	2.48	1.61	4.09
2"	3.32	2.62	5.94
2-1/2"	5.27	3.74	9.01
3"	6.82	5.77	12.59
3-1/2"	8.31	7.73	16.04
4"	9.72	9.95	19.67
5"	13.14	15.62	28.76
6"	17.45	22.58	40.03

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RECTANGULAR DUCT WEIGHT TABLE - 18 GAGE (12"x12" TO 44"x78")

RECTANGULAR DUCT WEIGHTS - 18 GAGE (LBS/FT)

SIZE (in)	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44
12	9.2	10.0	10.8	11.5	12.3	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6
14	10.0	10.8	11.5	12.3	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3
16	10.8	11.5	12.3	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1
18	11.5	12.3	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9
20	12.3	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6
22	13.1	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4
24	13.9	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2
26	14.6	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9
28	15.4	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7
30	16.2	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5
32	16.9	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2
34	17.7	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0
36	18.5	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8
38	19.2	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6
40	20.0	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3
42	20.8	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1
44	21.6	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9
46	22.3	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6
48	23.1	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4
50	23.9	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2
52	24.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9
54	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7
56	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5
58	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3
60	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0
62	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8
64	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6
66	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3
68	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1
70	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9
72	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6
74	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4
76	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2
78	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9

NOTES:

1. Loads in lbs./ft.
2. Published loads allow for seams and laps.
3. Weights below the line are for 6 square feet and larger

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: **April 23, 2025**

RECTANGULAR DUCT WEIGHT TABLE - 18 GAGE (46"x12" TO 78"x78")

RECTANGULAR DUCT WEIGHTS - 18 GAGE (LBS/FT)

SIZE (in)	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78
12	22.3	23.1	23.9	14.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6
14	23.1	23.9	14.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4
16	23.9	14.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2
18	14.6	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9
20	25.4	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7
22	26.2	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5
24	26.9	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3
26	27.7	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0
28	28.5	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8
30	29.2	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6
32	30.0	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3
34	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1
36	31.6	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9
38	32.3	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6
40	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4
42	33.9	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2
44	34.6	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9
46	35.4	36.2	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9	47.7
48		36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.5
50			38.5	39.3	40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.5	49.3
52				40.0	40.8	41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.5	49.3	50.0
54					41.6	42.3	43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.5	49.3	50.0	50.8
56						43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.5	49.3	50.0	50.8	51.6
58							44.6	45.4	46.2	46.9	47.7	48.5	49.3	50.0	50.8	51.6	52.3
60								46.2	46.9	47.7	48.5	49.3	50.0	50.8	51.6	52.3	53.1
62									47.7	48.5	49.3	50.0	50.8	51.6	52.3	53.1	53.9
64										49.3	50.0	50.8	51.6	52.3	53.1	53.9	54.6
66											50.8	51.6	52.3	53.1	53.9	54.6	55.4
68												52.3	53.1	53.9	54.6	55.4	56.2
70													53.9	54.6	55.4	56.2	57.0
72														55.4	56.2	57.0	57.7
74															57.0	57.7	58.5
76																58.5	59.3
78																	60.0

NOTES:

1. Loads in lbs./ft.
2. Published loads allow for seams and laps.
3. Weights below the line are for 6 square feet and larger

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Structural Engineer: Mohammad R. Hariri
California SE No. S3545

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DATE: April 23, 2025

RECTANGULAR DUCT WEIGHT TABLE - 20 GAGE (12"x12" TO 44"x78")

RECTANGULAR DUCT WEIGHTS - 20 GAGE (LBS/FT)

SIZE (in)	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44
12	7.1	7.7	8.3	8.8	9.5	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6
14	7.7	8.3	8.8	9.5	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2
16	8.3	8.8	9.5	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8
18	8.8	9.5	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4
20	9.5	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9
22	10.1	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5
24	10.7	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2
26	11.2	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7
28	11.8	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3
30	12.5	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9
32	13.0	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5
34	13.6	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1
36	14.2	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7
38	14.8	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3
40	15.4	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8
42	16.0	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5
44	16.6	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1
46	17.2	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6
48	17.8	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2
50	18.4	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8
52	18.9	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4
54	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0
56	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6
58	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2
60	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8
62	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4
64	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0
66	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5
68	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2
70	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8
72	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3
74	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9
76	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5
78	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1

NOTES:

1. Loads in lbs./ft.
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DATE: April 23, 2025

RECTANGULAR DUCT WEIGHT TABLE - 20 GAGE (46"x12" TO 78"x78")

RECTANGULAR DUCT WEIGHTS - 20 GAGE (LBS/FT)

SIZE (in)	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78
12	17.2	17.8	18.4	11.2	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6
14	17.8	18.4	11.2	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2
16	18.4	11.2	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8
18	11.2	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4
20	19.5	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0
22	20.2	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6
24	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2
26	21.3	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8
28	21.9	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4
30	22.5	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0
32	23.1	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5
34	23.7	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2
36	24.3	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8
38	24.8	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3
40	25.5	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9
42	26.1	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5
44	26.6	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1
46	27.2	27.8	28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1	36.7
48		28.4	29.0	29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1	36.7	37.3
50			29.6	30.2	30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1	36.7	37.3	37.9
52				30.8	31.4	32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1	36.7	37.3	37.9	38.5
54					32.0	32.5	33.2	33.8	34.3	34.9	35.5	36.1	36.7	37.3	37.9	38.5	39.1
56						33.2	33.8	34.3	34.9	35.5	36.1	36.7	37.3	37.9	38.5	39.1	39.7
58							34.3	34.9	35.5	36.1	36.7	37.3	37.9	38.5	39.1	39.7	40.2
60								35.5	36.1	36.7	37.3	37.9	38.5	39.1	39.7	40.2	40.8
62									36.7	37.3	37.9	38.5	39.1	39.7	40.2	40.8	41.5
64										37.9	38.5	39.1	39.7	40.2	40.8	41.5	42.0
66											39.1	39.7	40.2	40.8	41.5	42.0	42.6
68												40.2	40.8	41.5	42.0	42.6	43.2
70													41.5	42.0	42.6	43.2	43.8
72														42.6	43.2	43.8	44.4
74															43.8	44.4	45.0
76																45.0	45.6
78																	46.2

NOTES:

1. Loads in lbs./ft.
2. Published loads allow for seams and laps.
3. Weights below the line are for 6 square feet and larger

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PAGE: C-6

DATE: April 23, 2025

ROUND DUCT WEIGHT TABLE

ROUND DUCT WEIGHTS (LBS/FT)		
DUCT DIAMETER (IN)	**18 GAGE**	**20 GAGE**
12	7.05	5.42
14	8.19	6.30
16	9.32	7.17
18	10.45	8.04
20	11.58	8.91
22	12.71	9.78
24	13.84	10.65
26	14.97	11.51
28	16.10	12.38
30	17.23	13.25
32	18.36	14.12
34	19.49	14.99
36	20.62	15.86
40	22.88	17.60
44	25.15	19.35
48	27.41	21.08
50	28.54	21.95
54	30.80	23.69
56	31.93	24.56
60	34.19	26.30

NOTES:

1. Loads are in lbs./ft.
2. Published loads allow for seams and laps.

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PAGE: **C-7**

DATE: **April 23, 2025**

GALVANIZED SHEET METAL CONVERSION TABLE

CONVERTING HEAVIER GAGES TO LIGHTER GAGES		
GAGE	**20**	**18**
24	0.70	0.53
22	0.85	0.65

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PAGE: **C-8**

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PART B

FIRE PROTECTION (FP)

HCAI PRE-APPROVED TOLCO "FP" GUIDELINES

REVIEWED FOR CODE COMPLIANCE
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

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PAGE: FP-0-0

DATE: April 23, 2025

SECTION FP-1

GENERAL NOTES, INFORMATION, TYPICAL DESIGN EXAMPLES FOR SEISMIC BRACE SPACING AND MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE

ICC-ES
BY: Roy Lobo
DATE: 7/24/2025
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PAGE: FP-1-0

DATE: April 23, 2025

FP.1.0 PREFACE

This HCAI Pre-approval of Manufacturer's Certification (OPM) is based on the 2022 CBC.
The demand (Design Forces) for use with this OPM shall be based on the 2022 CBC.

1. SCOPE AND LIMITATIONS:

This pre-approval is for the seismic bracing of interior fire sprinkler piping. It does not address other loads such as, but not limited to, those generated by thermal growth, pressure, fluid dynamics, pipe rupture or movements of equipment that braced components are attached to. It does not address components that cross seismic separations of buildings or components attached to portions of the structure or equipment that will experience relative seismic drifts other than pipe risers.

2. The ranges of components sizes and material included in the pre-approval are as follows:

A. Fire Sprinklers Pipe:
- Steel Pipe Sizes:
  - Schedule 5 (LW): 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6"
  - Schedule 10: 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8"
  - 8" Pipe with Wall Thickness ≥ 0.188"
  - Schedule 40: 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8", 10", 12"

B. Brace Pipe:
- Steel (ASTM A53 Type E Grade B) Schedule 40: 1", 1 1/4", 1 1/2", 2" NPS

3. The substrates included in this pre-approval are as follows:

A. Concrete
B. Concrete Filled Metal Deck
C. Steel
D. Wood

4. This Pre-approval is for the design of supports and attachments of fire sprinkler piping seismic sway bracing only.

5. Construction Tolerances:

A. Construction tolerances shall be as noted on the drawing details and appendices.
B. Construction tolerance for angles of all braces shall be limited to ±5°, out of plan as shown on Page FP-4-6.
C. The recommended brace angle is 45° for the diagonal brace, or 1 (vertical) to 1 (horizontal) brace ratio. However, the brace can be installed between 30°-90° from vertical. See Page FP-4-6.

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PAGE: FP-1-1
DATE: April 23, 2025

FP-1.1 INTRODUCTION

1. This manual is prepared as a guideline for seismic bracing design for fire sprinkler system piping. Following is an outline of the manual:

Section FP-1: **General Information**. Presents general notes and requirements for seismic bracing fire protection systems. It also includes a general step by step procedure for seismic bracing design using this manual. Additionally tables for the maximum allowable load in the Zone of Influence (ZOI) of a lateral sway brace for Schedule 5, Schedule 10 and Schedule 40 steel pipes are presented.

Section FP-2: **Single Hanger Rigid Brace Details**. Includes seismic bracing details for individually hung piping using rigid brace members.

Section FP-3: **Structural Attachments**. Shows structural attachment details and allowable strengths for attaching seismic bracing to supporting structure. It includes structural attachments to concrete slabs, metal deck filled with sand lightweight concrete, attachments to steel beams and bar joists, and attachments to wood beams.

Section FP-4: **Seismic Brace Components**. Includes details and allowable strengths for seismic bracing components used in the seismic bracing design. Components include brace attachment fittings.

Section FP-5: **Fire Protection Component Part Number References**.

Appendix FP-A: **2022 California Building Code - Design Force Formulas & Seismic Factors Calculations**.

Appendix FP-B: **Metric Conversion Chart**.

Appendix FP-C: **Pipe Weight Tables**. Pipe weight tables are for reference only and are not within scope of work of the OPM approval.

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FP-1.1 INTRODUCTION (CONT'D)

2. This pre-approval may be used for the design of seismic sway bracing of fire sprinkler systems. A California Licensed Structural Engineer (CLSE) has designed this pre-approval, along with supporting calculations. Therefore, the pre-approved details and calculations are not to be re-reviewed by regional staff. However, each fire sprinkler system requires submittals that must be reviewed and approved by HCAI.

3. Seismic bracing design and layout drawings shall be either prepared by a Registered Structural Engineer licensed in California with experience in the design of seismic bracing for fire protection systems, or prepared by a qualified engineer with experience in the design of seismic bracing for fire protection systems and reviewed, stamped and signed by a Registered Structural Engineer licensed in California with experience in the design of seismic bracing fire protection systems. This is the definition of "user" below and as allowed for Licensed Specialty Contractors for Fire Protection systems where none of the fire sprinkler system piping exceeds 2 1/2" in diameter by CAC 2022, Title 24, Part 1, 7-115(c).

4. Modifications and/or changes to the designs shown in this guideline shall be performed or reviewed by a qualified Registered Structural Engineer and approved by HCAI.

5. When more than one criteria is presented, the more stringent criteria shall be used. The data presented in this manual is subject to change without notice. Refer to the appropriate codes and standards for additional information and requirements.

6. It is the responsibility of the user of this manual to be familiar with all requirements for seismic bracing and shall be proficient in determining and applying utility loads for their application.

7. The user of this manual shall determine the spacing and layout for the required bracing. The user shall determine the maximum horizontal, vertical and axial force component of the earthquake demand loads. The user's calculations must take into consideration the increases in loads caused by construction tolerances.

8. As with all pre-approved details, systems, etc., construction documents are still required showing how and where this pre-approved support, attachment and bracing system will be applied on a project specific basis. This process is needed to verify that the appropriate detail has been selected and applied for each condition and for the actual substrate that it will be connected/attached to.

9. The Structural Engineer of Record (SEOR) must review and forward the support, attachment and bracing plans for plan check with a notation indicating that the plans have been reviewed and they have been found to be in general conformance with the design of the project. A "shop drawing stamp" is usually acceptable for compliance with this requirement. The regional staff, on a project specific basis, must review support, attachment and bracing details and supporting calculations that are not part of this pre-approval. Review of support, attachment and bracing details of this nature does not constitute a pre-approval that may be used on other projects without the benefit of plan review. The structural engineer of record shall verify the adequacy of the supporting structure and its components for the loads applied to the supporting structure and its components by the seismic bracing systems, and compliance with the applicable codes and standards.

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FP-1.1 INTRODUCTION (CONT'D)

10. Layout Drawings:

A. Layout drawings of the support and bracing systems per this pre-approval shall be submitted to the discipline in responsible charge of the project for review to verify that the details are in conformance with all code requirements. The layout drawings shall be in accordance with ASCE 7-16 (including supplements nos. 1 & 2) as modified by the 2022 CBC Section 1617A.

- The Structural Engineer of Record (SEOR) shall verify that the supporting structure is adequate for
- the loads imposed on it by the supports and braces installed per the pre-approval in addition to all
- other loads.

- The SEOR will forward the supports, attachments and bracing plans (including approved change orders for supplementary framing where required) to the discipline in responsible charge with a notation indicating that the plans have been reviewed and are in general conformance with this pre-approval, the design of the project (CAC 2022, Section 7-153.1), and NFPA 13-2022 Edition.

- A "shop drawing stamp" may be used to indicate compliance with this requirement.

- The Registered Design Professional (other than the SEOR) may provide the shop drawing stamp for small installations at the discretion of the District Structural Engineer.

B. The SEOR shall design any supplementary framing that is needed to resist the loads, maintain stability and/or is required for installation of this pre-approval. The supplementary framing shall be submitted to HCAI as an Amended Construction Document (ACD).

C. The layout drawings (with the shop drawing stamp) shall be submitted to HCAI to review:

- Structure supporting the distribution system has adequate structural capacity.
- Seismic Design Forces (F_{PW}) are in accordance with the 2022 CBC.
- Verify that the submittal is within the scope of the HCAI Pre-approval of Manufacturer's Certification (OPM):

  a. Size of distribution system components.
  b. Spacing of bracing and flex joints.
  c. Substrate for attachments.

D. The layout drawings (with the shop drawing stamp) shall be kept on the jobsite and can then be used for installation for the support and bracing. HCAI field staff will review the installation.

E. A copy of this pre-approval shall be on the jobsite prior to starting installation of hangers and/or braces. It is the contractor's and IOR's responsibility to obtain copies of HCAI Pre-approvals from the HCAI Pre-approval Program's website.

11. Components of two or more pre-approved bracing systems shall not be mixed. Only this pre-approved bracing system may be used for a run of pipe. Any substitution of a component of this pre-approval shall require HCAI review and approval.

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FP-1.2 BUILDING CODES, STANDARDS, AND GUIDELINES

1. The Tolco Seismic Restraint Guidelines are designed to meet or exceed the requirements of the following:

   - 2022 California Building Code (2022 CBC)
   - 2018 National Design Specification for Wood Construction (ANSI / AWC NDS-2018)
   - 2022 NFPA 13 Standard for the Installation of Sprinkler Systems 2022 Edition (NFPA 13-2022)
   - 2019 American Concrete Institute Building Code Requirements for Structural Concrete (ACI 318-19)
   - 2016 American Society of Civil Engineers (ASCE 7-16) Including Supplements 1, 2 & 3.
   - 2016 American Institute of Steel Construction (ANSI/AISC 360-16)
   - 2016 Seismic Provisions for Structural Steel Buildings (ANSI/AISC 341-16)

   These guidelines are intended to describe seismic restraints for the fire protection industry's most commonly used single hung pipe for up to 12-inch pipe.

   Determine bracing design based on NFPA 13-2022 zone of influence, Annex E.

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FP-1.3 SEISMIC BRACING GENERAL REQUIREMENTS - FIRE PROTECTION PIPING

$$a_P = 2.5;\ R_P = 4.5;\ S_{DS} = 2.5;\ \Omega_o = 2.0;\ I_P = 1.5;\ z/h \leq 1$$

1. Lateral (transverse) Seismic Bracing is required for the following fire protection piping.

   A. For Seismic Design Category C, D, E, or F, and Ip is equal to 1.5.
   - All mains.
   - All cross mains.
   - All branch lines 2 1/2" and larger
   - The last length of pipe at the end of a feed or cross main shall be provided with a lateral brace.

2. Transverse bracing shall be provided at 40 ft. maximum spacing for welded steel pipe.

   A. Lateral (transverse) seismic bracing is to protect piping against movement perpendicular to the run of pipe.
   B. Lateral (transverse) seismic bracing shall be spaced at a maximum of 40' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 30' maximum span (piping smaller than 2 1/2" diameter).
   C. A lateral (transverse) seismic brace placed on the pipe run section at the opposite side of an elbow within 24" may act as a longitudinal brace. For an example, see Page FP-1-8.
   D. The minimum required bracing for runs longer than 5' is a transverse brace at each end, and a longitudinal brace at one of those two positions. For an example, see Page FP-1-10.
   E. Rigid grooved couplings listed for UL Standard 213 shall be permitted in horizontal runs of pipe. Flexible grooved couplings listed for UL Standard 213 shall be permitted in vertical risers (to accommodate drift) and at other locations (e.g. seismic separations, equipment nozzles, etc.) to accommodate small movement and/or rotation. Non-UL listed grooved couplings shall not be used unless approved on a project specific basis.

   Exceptions

   All piping suspended by individual hanger rods 6 inches or less in length from the top of the pipe to the bottom of the support structure where hanger is connected. All of the hangers of a run must comply with the 6 inch rule or bracing is required.

3. Longitudinal bracing shall be at 80 ft. maximum spacing for welded steel pipe.

   A. Longitudinal seismic bracing is to protect piping against movement parallel to the run of pipe.
   B. Longitudinal seismic bracing shall be spaced a maximum of 80' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 60' maximum span (piping smaller than 2 1/2" diameter) for an example, see Page FP-1-9.
   C. Each pipe run shall have at least one longitudinal brace, additional longitudinal braces are required when the maximum longitudinal spacing is exceeded. For an example, see Page FP-1-9.

4. When determining horizontal load requirements, follow NFPA 13-2022 Zone of Influence (ZOI) requirements.

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FP-1.3 SEISMIC BRACING GENERAL REQUIREMENTS - FIRE PROTECTION PIPING (CONT'D)

5. A piping system shall not be braced to different parts of the building that may respond differently during seismic activity.

   The following TOLCO products were engineered with torque indicators to ensure proper installation (See Sections FP-3 and FP-4):

   - Fig. 4L (Page FP-4-2) Braced Pipe Attachments have break-off bolts heads.
   - Fig. 800 (Page FP-3-8) , Fig. 825 (Page FP-3-6) & Fig. 828 (Page FP-3-7) Adjustable Sway Brace Attachments to Steel and Joist have break-off head bolts.
   - Fig. 980 (Page FP-4-1) Universal Swivel Sway Brace Attachments have a break-off bolt head.
   - Fig. 1000 (Page FP-4-3) Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement.
   - Fig. 1001 (Page FP-4-4) Sway Brace Attachments have bolt heads that bottom out.

6. Refer to the appropriate codes and standards for additional information and requirements.

7. See Pages FP-1-19 through FP-1-21 for lateral sway bracing tables.

8. Vertical Offsets / Risers:

   A. Top of vertical offsets/risers exceeding 2'-0" in length shall be provided with a four-way brace. Bracing shall be located within 24" of the end of the vertical run.
   B. Distance between four-way braces for risers shall not exceed 20'-0".

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1.4 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS

1. The TOLCO Seismic Restraint Guidelines provides for the protection of suspended pipe systems against excessive movement due to seismic forces.

2. The seismic restraint assemblies in this guideline are designed to simultaneously resist vertical loads due to the weight of the component and its contents and both horizontal and vertical seismic loads.

3. Horizontal loads are braced with two types of seismic restraints;

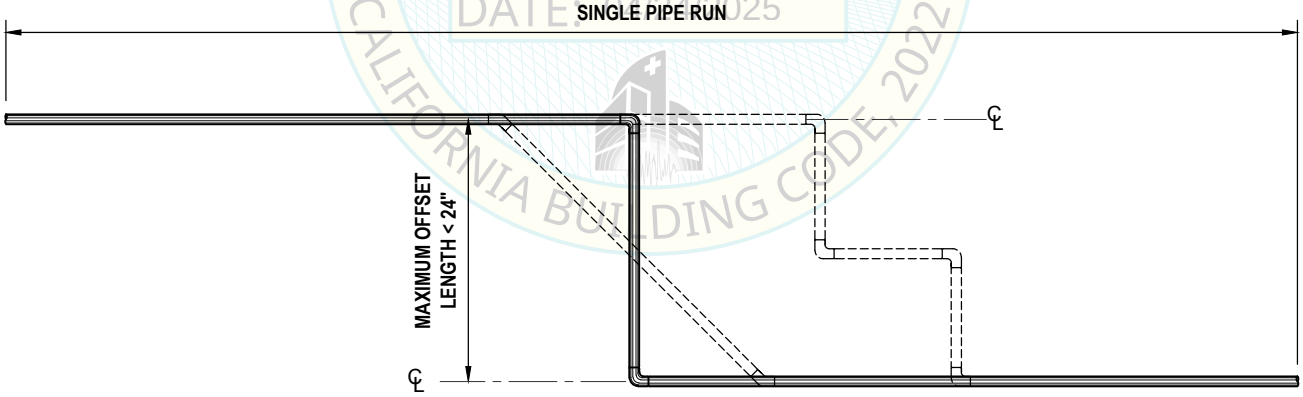
   A. Transverse Brace to protect pipe against movement perpendicular to its run.

   B. Longitudinal Brace to protect pipe against movement parallel to its run.

4. For the purpose of these guidelines, refer to the following legend for the parameters shown:

LEGEND	
(T)	Transverse Location
(L)	Longitudinal Location
(TL)	Transverse Location also acting as Longitudinal
(VSB)	A Vertical Seismic Brace (VSB) shall be placed within 6" of all Single Transverse & Longitudinal braces. See Page FP-1-11, Item 16.

5. A run of pipe is defined as a continuous straight length, or one with allowable offsets, that are less than 24". If the offset is 24" or greater, each straight segment shall be treated as an independent run and shall be braced. Refer to partial plan on Page FP-1-10.



PLAN VIEW

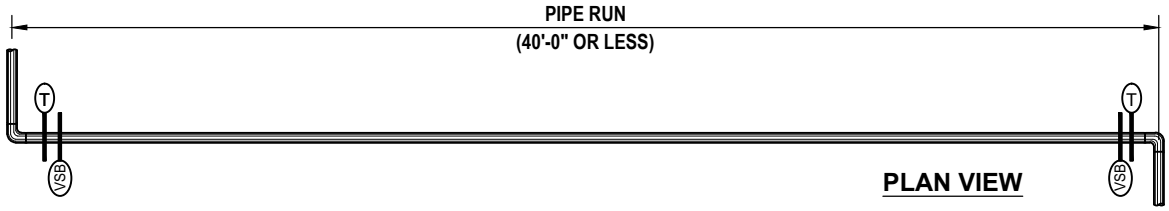
Note:

When a run of pipe that requires bracing transitions down to a size that does not, the point of transition is considered the end of the run and will require a transverse brace. For an offset less than 24", this is still considered a single run of pipe.

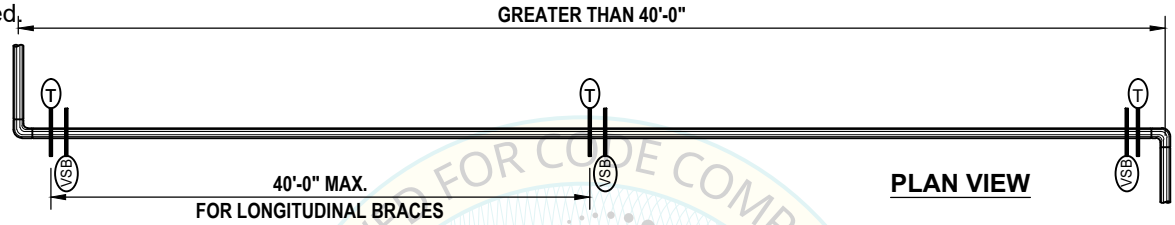
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1.4 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

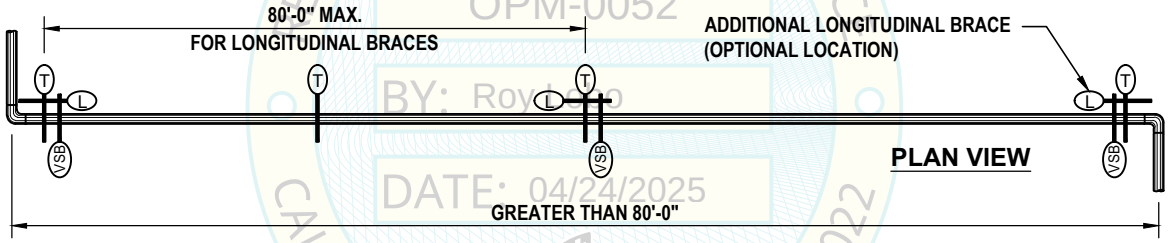
6. Each run of pipe requires a minimum of two transverse braces, one at each end of the run.



7. If the distance between the two transverse braces exceeds the maximum allowable spacing, add transverse braces as needed.

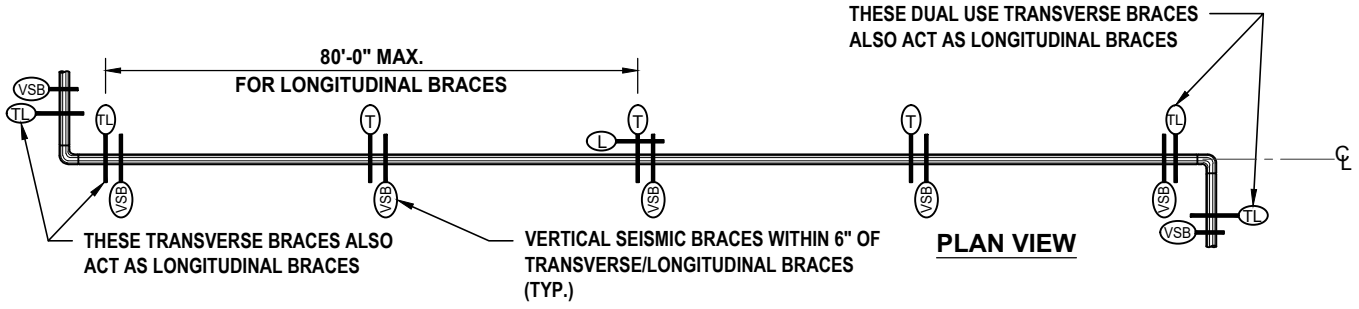


8. Each pipe run must have at least one longitudinal brace. If the maximum allowable longitudinal spacing is exceeded then add longitudinal braces to meet the spacing requirement.



9. Each run of pipe requires a minimum of one longitudinal brace. However, a transverse brace placed on the run section at the opposite side of an elbow or tee within 24" may act as a longitudinal brace, and is labeled a "DUAL USE" brace. See layout example below.

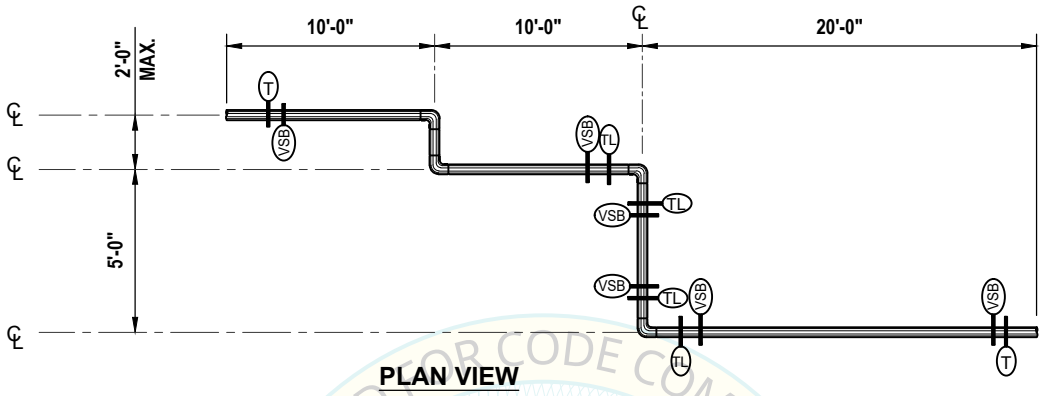
   A. Longitudinal and Longitudinal "DUAL USE" braces on single supported pipe shall be attached directly to the pipe.
   B. Bracing installed to smaller piping shall not be used to brace larger piping.



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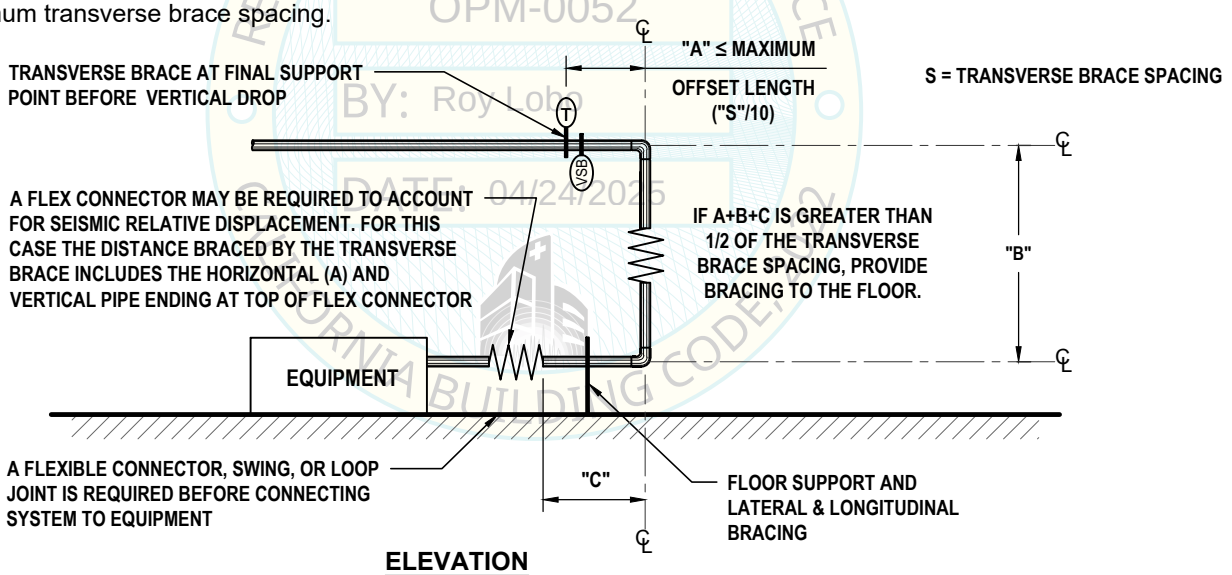
1.4 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

10. In some cases several short runs may occur in close proximity. By following the preceding guidelines each run should have longitudinal and transverse bracing. Transverse bracing may be used as longitudinal bracing and vice versa on runs adjacent to each other as long as the total length of pipe tributary to the brace does not exceed the maximum allowable spacing. In cases where it does, additional braces are required.



PLAN VIEW

11. At vertical pipe drop to equipment, where pipe is connected to the equipment using a flexible connection, provide transverse bracing before the vertical drop. The total length from the transverse brace to the vertical drop should not be more than the allowable offset previously determined. Provide transverse bracing at the floor after the vertical drop if the total length of the pipe from the transverse brace before the vertical drop to the flexible connection is greater than ½ of the maximum transverse brace spacing.



ELEVATION

12. When pipe crosses a building seismic separation or seismic joint it must be capable of accommodating the maximum joint displacements as specified by the engineer of record of the building.

13. A rigid pipe shall not be braced to dissimilar parts of a building structure or two dissimilar building systems that may move different from one another during an earthquake. Bracing should be attached to the part of the building structure that is supporting the pipe.

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1.4 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS (CONT'D)

14. Transverse and longitudinal braces shall be installed as shown in this guideline up to 90° from horizontal. However, the recommended brace ratio is 45° from horizontal, or 1 (vertical) to 1 (horizontal) brace ratio. Spacing for additional brace angles may be achieved by the following:

15. All transverse, longitudinal, and vertical braces utilizing steel pipe with Tolco Fig. 900 series fittings may have an alignment tolerance of 5° from center without adversely affecting the given loads.

16. The seismic brace assemblies in this guideline consist of three important components; Anchorage and connections to building structure, brace member such as pipe, and seismic brace attachments. For details and load information of structural attachments see Section FP-3, for details of brace assemblies see applicable "Brace Details" section(s).

17. Single Rigid Brace locations are required to be at or within 6 inches of a vertical seismic brace (VSB) assembly to protect against vertical movement. An exception to this would be the use of two opposing rigid braces at the same location. In this case no additional vertical seismic brace assembly is necessary.

18. Steel bolt connections to steel structure or components shall not have a diameter less than 1/16" less than the mounting hole. Steel bolt connections to concrete structure shall not have a diameter less that 1/8" less than the mounting hole.

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PAGE: **FP-1-11**

DATE: **April 23, 2025**

1.5 GENERAL DESIGN PROCEDURE

The following presents a general procedure for design of seismic bracing. The following assumes that a piping design layout has been provided, and that gravity hanger supports have been designed by others. The following also assumes that seismic bracing has been determined to be required. Refer to the appropriate codes and standards for additional information and requirements.

STEP 1: Seismic Force Coefficient

Determine the total design lateral seismic force coefficient based on the applicable code, project drawings, and specifications. This coefficient is commonly referred to as the "G-factor"; i.e. F_P = 0.5G (ASD). In case of a conflict, use the more stringent criteria. The total design horizontal seismic force coefficient, when multiplied by the weight of the system, represents the total design lateral seismic force.

According to 2022 CBC and ASCE 7-16 the total design lateral seismic force, F_P (LRFD), or per NFPA 13-2022, C_P (ASD) and the total vertical seismic force, ± 0.2 S_{DS} (herein referred to as F_v (LRFD), shall be determined from the following formulas. The final F_P (LRFD) and F_V (LRFD) shall be multiplied by 0.7 to convert the strength based seismic force to the allowable stress based seismic force (ASD). This is necessary because the loads and brace spacing in this manual are based on the allowable stress design.

Method 1 - Per 2022 CBC (AISC 7-16):

Horizontal Seismic Force:

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}} \left(1+2\,\frac{z}{h}\right) W_P \right] \qquad \text{(LRFD)}$$

Except that: F_P need not to be greater than (0.3 S_{DS} I_P W_P) and shall not be less than (1.6 S_{DS} I_P W_P)

F_{PW} = 0.70 F_P (ASD)

Vertical Seismic Force:

F_V = 0.2 S_{DS} W_P (LRFD)

F_{VW} = 0.70 F_V (ASD)

Where:

S_{DS} = Design spectral acceleration for short periods
a_P = Component amplification factor (Per ASCE 7-16 and FPA 13-2022, for steel pipe a_P = 2.5)
I_P = Component importance factor (Per ASCE 7-16 and NFPA 13-2022, I_P = 1.5)
W_P = Component operating weight (Per ASCE 7-16 and NFPA 13-2022, Section 18.5.9.2, W_P shall be taken as 1.15 x weight of the water filled piping)
R_P = Component response modification factor (Per ASCE 7-16 and NFPA 13-2022, for steel pipe, R_P = 4.5)
z = Height of structure at point of attachment of component with respect to the base (For worst case scenario, use z/h = 1)
h = Average roof height of structure with respect to the base (For worst case scenario, use z/h = 1)

$S_{DS} = \frac{2}{3} F_a \,.\, S_S$

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1.5 GENERAL DESIGN PROCEDURE (CONT'D)

Method 1 - Per 2022 CBC (ASCE 7-16) (Cont'd):

S_S = Mapped MCER, 5% damped, special response acceleration parameter at Short-Periods.
S_S = Short-Period site coefficient per NFPA 13-2022, per following table:

S_S	0.33 or less	0.50	0.75	1.00	1.25
F_a	1.60	1.40	1.20	1.20	1.20

F_P = The Lateral Seismic Force Acting on Component per ASCE 7-16 (LRFD).
F_{PW} = The Lateral Seismic Force Acting on Component per NFPA 13-2022 or ASCE 7-16 (ASD).
F_V = The Vertical Seismic Force Acting on Component per ASCE 7-16 (defined as E_V) (LRFD).
F_{VW} = The Vertical Seismic Force Acting on Component (ASD).

Refer to 2022 CBC codes for additional information & requirements.

Method 2 - Per NFPA 13-2022:

Horizontal Seismic Force:

$F_{PW} = C_P W_P$ (ASD)

C_P = Seismic Coefficient (ASD), per following table or following equation:

$C_P = 0.467 S_S F_a$ (ASD)

If using the table linear interpolation shall be permitted to be used for intermediate values of S_S.

$$C_P = C_{P\text{-Low}} + \left[\frac{C_{P\text{-High}} - C_{P\text{-Low}}}{S_{S\text{-High}} - S_{S\text{-Low}}} (s_S - s_{S\text{-Low}}) \right] \quad \text{(ASD)}$$

S_S	C_P (ASD)
0.33 or less	0.25
0.50	0.33
0.75	0.43
1.00	0.56
1.25	0.71
1.50	0.84
2.00	1.12
2.50	1.40
3.00	1.68
3.50	1.96
3.75	2.11

S_S = Mapped MCER, 5% damped, spectral response acceleration parameter at short periods.
The value of S_S shall be obtained from the authority having jurisdiction or from seismic hazard maps.

F_a = Short-period site coefficient per NFPA 13-2022, per following table:

S_S	0.33 or less	0.50	0.75	1.00	1.25
F_a	1.60	1.40	1.20	1.20	1.20

W_P = Component operating weight (Per NFPA 13-2022, Section 18.5.9.2, W_P shall be taken as 1.15 times the weight of the water filled piping).

Where the horizontal seismic load used exceeds ([0.5 W/P] and the brace angle is less than 45 degrees from vertical or where the horizontal seismic load used exceeds [1.0 W/P]) and the brace angle is less than 60 degrees from vertical, the braces shall be arranged to resist the net vertical force produced by the horizontal load.

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1.5 GENERAL DESIGN PROCEDURE (CONT'D)

Step 2: Seismic Bracing Detail

Select a seismic bracing detail. For example, if a rigid transverse brace is required for installation, go to Pages FP-2-1 through FP-2-7 in Section FP-2 "Single Hanger Rigid Brace Details" for all applicable transverse brace details.

Step 3: Structural Attachment Detail

Select a structural attachment detail. For example, if a wedge anchor into normal weight concrete slab is required for installation at a seismic brace location, go to Pages FP-3-1 through FP-3-3 in Section FP-3 "Structural Attachment" for all applicable seismic brace attachment details corresponding to various wedge anchor types.

Step 4: Brace Spacing

allowable loads for the specific structural attachment detail previously selected.

The brace spacing shall not exceed the maximum allowable brace spacing requirements listed in Section FP-1 general notes.

Also see Pages FP-1-19 through FP-1-21 for lateral sway bracing tables for ZOI weights of various brace spacing and sprinkler pipe specifications.

Step 5: Brace Member

Select a brace member and determine its total length. A brace member must be steel pipe (per Page FP-1-1) . Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on Page FP-4-6. The maximum applied horizontal seismic load shall be equal to or less than the maximum allowable horizontal seismic loads.

Step 6: Bracing Layout

Layout the seismic bracing as explained in the Sub-Section 1.4 on Page FP-1-8, for "Seismic Bracing Layout - General Requirements".

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1.6 GENERAL INSTALLATION NOTES

Single Hanger Rigid Brace Installation Guideline

A. The design of all gravity hangers is not in the scope of this pre-approval. SEOR to verify the vertical seismic brace within 6" of the diagonal brace member are designed for gravity load plus vertical seismic loads. The design of the gravity hangers not within 6" of seismic braces to be approved on a project specific basis by HCAI.

B. All vertical seismic braces must be plumbed to the support structure.

C. The recommended brace angle is 45° for the diagonal brace, or 1 (Vert.) to 1 (Horiz.) brace ratio. However, the brace can be installed between 30°-90° degrees from vertical.

D. All transverse, longitudinal , and vertical braces utilizing steel pipe with Tolco Fig. 900 series fitting has an alignment tolerance of 5° from center without adversely affecting the given capacities. See Page FP-4-6 for more information.

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1.7 TYPICAL DESIGN EXAMPLE

1. GENERAL

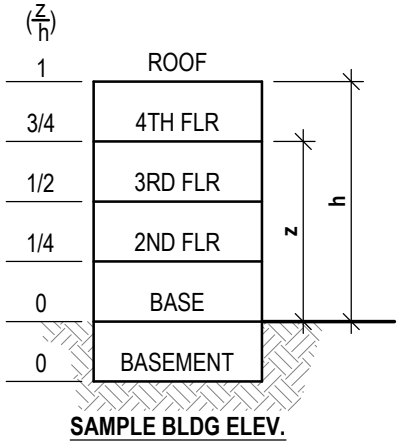
The Registered Design Professional (RDP) shall review Method 1 in Section FP-1, Page FP-1-12 - overview of this OPM.

2. DEMAND

Step 1: The RDP determines the lateral acceleration and vertical acceleration "G" (C_P in NFPA 13-2022) for the seismic forces F_P and F_{PV} using information provided in the project documents. In the example below, the maximum horizontal and vertical forces on the seismic braces are calculated for use anywhere within the state of California. Please note that these maximum values may be reduced for the site specific project location as well as for the location within the height of a building in order to obtain lower demand values if so required to meet brace spacing criteria.

ASCE 7-16 AS AMENDED BY 2022 CBC

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}} (1+2\,\frac{z}{h})\, W_P \right] \quad \text{(LRFD)} \quad \text{(ASCE 7-16, Section 13.3.1.1)}$$



SAMPLE BLDG ELEV.

where:

$a_P = 2.5$ (ASCE 7-16, Section 13.6-1)
$R_P = 4.5$ (component response modification factor for piping not in accordance w/ ASME B31) (ASCE 7-16, Table 13.6-1)
$\Omega_o = 2.0$ (over-stregnth factor for concrete anchors)
$S_{DS} = 2.5$ (State of California value)
$I_P = 1.5$ (ASCE 7-16, Section 13.1.3, Item 1)
$z = h$ $\quad \frac{z}{h} \leq 1.0$

$F_P = 2.5\, W_P$ (LRFD) (ASCE 7-16, Section 13.3.1.1)
$F_{P\text{-}Max} = (1.6)(S_{DS})(I_P)(W_P) = 6.0\, W_P$ (LRFD) (ASCE 7-16, Section 13.3.1.1)
$F_{P\text{-}Min} = (0.3)(S_{DS})(I_P)(W_P) = 1.125\, W_P$ (LRDF) (ASCE 7-16, Section 13.3.1.1)

$$F_{P\text{-}Min} \leq F_P \leq F_{P\text{-}Max}$$

$F_{PV} = (\pm 0.20)(S_{DS})(W_P) = \pm 0.50\, W_P$ (LRDF) (ASCE 7-16, Section 13.3.1.1)

For Seismic Braces

$F_{PW} = (2.5\, W_P)\,(0.7) = 1.75\, W_P$ (ASD)
$F_{VW} = (\pm 0.50\, W_P)\,(0.7) = \pm 0.35\, W_P$ (ASD)

For Anchorage to Concrete

$(\Omega_o)(F_P) = (2.0)\,(2.5\, W_P) = 5.0\, W_P$ (LRFD)

Step 2: The RDP uses the NFPA 3-2022 guidelines to prepare the fire sprinkler layout drawings.

Step 3: The RDP determines the brace locations and shows them on the layout drawings.

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DATE: April 23, 2025

1.7 TYPICAL DESIGN EXAMPLE (CONT'D)

2. DEMAND (CONT'D)

Step 4: The RDP determines the branch line weight plus tributary main line weight (W) for each seismic brace using the NFPA 13-2022 zone of influence (ZOI) method. For this example assume that W = 400 lbs. for a 4" diameter schedule 10 main line service pipe.

Step 5: The RDP compares the calculated 400 lbs. weight to the allowable weight (W) shown in permissible total weight tables for service pipes. The 400 lbs. for this example was taken from the "Water Filled" column of Appendix FP-C, Page FP-C-1, and must be factored as shown in Step 7 on this page, and as shown on Page FP-1-20, the maximum permissible weight of 473 lbs. will allow a lateral transverse brace spacing of 25 feet for the 4" diameter main line service pipe.

Step 6: The RDP makes adjustments to the lateral transverse brace spacing and recalculates (W) if so required.

Step 7: The RDP determines the operating weight (W_P = 1.15W) by applying the 1.15 factor as per NFPA 13-2022 Section 18.5.9.2. In this example:

W_P = (1.15) (400 LBS.) = 460 LBS.

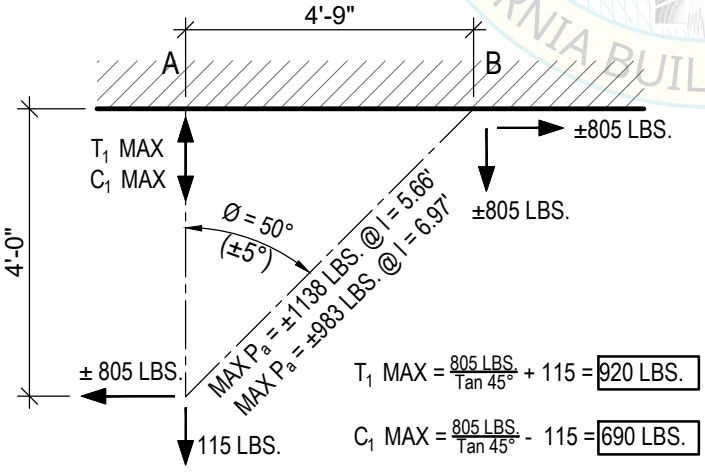
If TOTAL weight values from tables on Page FP-C-1 are used, skip this step, since 1.15 factor is already included in table values. The 400 lbs. for this example does not included the 1.15 factor and so is applied here.

Step 8: The RDP calculates the lateral force F_{PW} and Vertical force F_{VW} on the seismic brace using the W_P provided by the specialty Contractor. Note that in the example, it is conservatively assumed that the vertical gravity load is based on the maximum allowable vertical hanger spacing for the main service pipe line per Table 17.4.2.1(a) of NFPA 13-2022 (15'-0"). For this example, at ASD level of design:

W_P = 460 LBS.
F_{PW} = (±1.75) (460 LBS.) = ±805 LBS. (ASD)
F_{VW} = (±0.35) (460 LBS.) = ±161 LBS. (ASD)

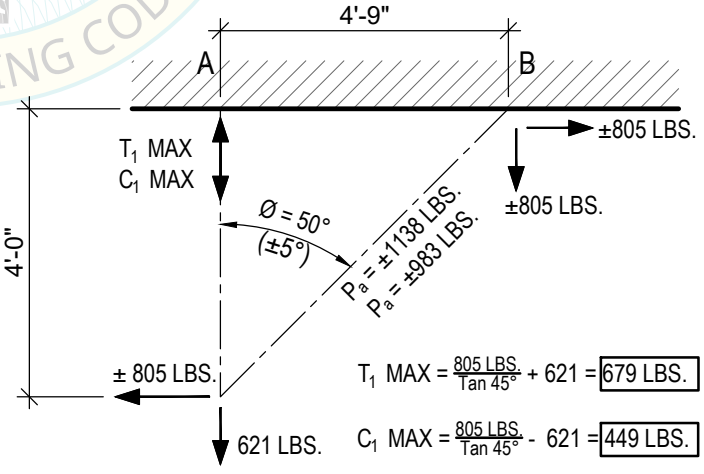
LOAD COMBINATION 1

$(0.6\ W_P - F_{VW}) = (0.6)\ (460) - 161 = 276 - 161 = 115$ LBS



LOAD COMBINATION 2

$(W_P + F_{VW}) = 460 + 161 = 621$ LBS



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1.7 TYPICAL DESIGN EXAMPLE (CONT'D)

2. DEMAND (CONT'D)

Step 9: The RDP verifies that there is a vertical seismic brace within six inches of each transverse and longitudinal brace.

Step 10: The RDP chooses appropriate seismic brace support elements per Pages FP-2-2 and FP-4-4 of the OPM. For this example the Tolco Fig. 1001 Fast Clamp connection is chosen for both the transverse and vertical seismic brace. Refer to Pages FP-2-2 and FP-4-4.

Step 11: The RDP chooses appropriate seismic attachment elements to structure as per Section FP-3 of the OPM.

3. CAPACITY

Step 1: The RDP determines the governing capacity of the assembled supports and attachment.

A. Determine capacity of support element for service pipe per tested values on Page FP-4-4. Per Page FP-4-4, the Tolco Fig. 1001 Fast Clamp capacity for a 4" diameter, schedule 10 service pipe is 1200 lbs. for any brace angle between 45 to 59 degrees. Since this is more than the demand, the Tolco Fig. 1001 can be used as part of the brace assembly for this example.
B. Determine capacity of brace pipe support per calculated allowable values in table provided on Page FP-4-6. For this example, it is assumed that the brace pipe is no longer than 7 feet.
C. A 1-1/4" diameter brace pipe has a horizontal capacity of 1266 lbs. for any brace angle between 45 to 59 degrees and can be used as part of the transverse. Also, A 1-1/4" diameter brace pipe has a vertical capacity of 1963 lbs. for brace at 0 degrees and can be used the vertical brace in this example.
D. Determine capacity of the typical Tolco Fig. 980 support between brace pipe and seismic attachment element. Per Page FP-4-1 the Tolco Fig. 980 has a capacity of 1484 lbs. for any brace angle between 45 to 59 degrees and can be used as part of the brace assembly in this example.
E. Determine capacity of seismic attachment elements to support structure as per Section FP-3 of the OPM, anchorage to concrete. For this example, choose a 5/8" diameter Hilti KB-TZ2 with 4" (hef) embedment concrete anchor as shown on Page FP-3-1. The maximum allowable horizontal load capacity of the attachment for any brace angle of between 45 to 59 degrees is 684 lbs. This is less than the calculated demand of 805 lbs. therefore, the demand shall be reduced by reducing the brace spacing (See step 3).
F. Please note that for anchorage to concrete, use combined forces are checked per ACI 318-19 including the over strength factor Ω_o per ASCE 7-16 for concrete that is included in the Section FP-3 tables.

Step 2: The RDP determines whether the demand on the brace is less than the capacity of the assembly. In this example, the brace pipe capacity of 684 lbs. is found to be much less than the calculated demand of 805 lbs. , thus, the brace spacing (i.e. (W) based on ZOI) needs to be reduced.

Step 3: The RDP determines using a capacity versus demand ratio the approximate revised allowable brace spacing. For this example, the allowed brace transverse spacing of 25ft shall be adjusted by dividing the brace pipe capacity of 684 lbs. by the calculated demand of 805 lbs. which yields to (684 lbs./805 lbs.) 25 ft = 21 ft. on center and should be used for the revised spacing.

Note:

Per Table 17.4.2.1(a) of NFPA13-2022, for steel pipe except threaded light-wall, the maximum vertical spacing shall be 15'-0" on center therefore the lateral brace spacing should be at 15'-0" on center.

1.8 MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE

Schedule 5 Steel Pipe[1][2][3][4][5]

Pipe Size[6] (in)	Outside Dia. OD[6] (in)	t_{nom}[6] (in)	S[7] (in^3)	Z[8] (in^3)	M_{Max} (ft-lb)	Weight with Water W_P[9] (lb/ft)	$(1.15)W_P+F_{VW}$ (lb/ft)	Hanger Spacing[10] S_{Hanger} (ft)	Applied Moment M_{Hanger} (ft-lb)	Max Horiz. $M_{Horizontal}$ (ft-lb)	Max Load from ZOI in lb., F_{PW} Transverse Brace Spacing in ft.					Max Weight from ZOI in lb., W $W = F_{PW} / 1.15\ C_P$ Transverse Brace Spacing in ft.				
											20	25	30	35	40	20	25	30	35	40
1	1.315	0.065	0.071	0.095	95	1.36	2.12	12	38	87	50	40				25	20			
1-1/4	1.660	0.065	0.117	0.155	154	1.93	2.99	12	54	145	83	66				41	33			
1-1/2	1.900	0.065	0.156	0.205	204	2.37	3.68	12	66	193	110	88	72			55	44	36		
2	2.375	0.083	0.248	0.324	323	3.35	5.21	12	94	309	177	141	116			88	70	58		
2-1/2	2.875	0.083	0.462	0.604	603	50.30	7.80	12	140	587	335	268	220			167	133	109		
3	3.500	0.083	0.695	0.904	903	6.88	10.68	12	192	882	504	403	330	283	237	250	200	164	141	118
3-1/2	4.000	0.083	0.915	1.188	1186	8.55	13.27	12	239	1161	664	531	435	373	312	330	264	216	185	155

FOOTNOTES:

1. Density of medium: 62.4 lbs/cu. ft.
2. Density of pipe: 500 lbs/cu. ft.
3. F_{PW} = 1.75 W_P
4. F_{VW} = 0.35 W_P
5. Steel strength F_y: 30,000 psi
6. Steel pipe dimensions per NFPA 13-2022 Table A.18.5.9
7. $S = PI \times [OD^4 / - (OD - (2 \times 0.93 \times t_{nom}))^4] / (32 \times OD)$
8. $Z = [OD^3 - (OD - (2 \times 0.93 \times t_{nom}))^3] / 8$
9. The weight of the system being braced (W_p) shall be taken as 1.15 times the wight of the water-filled piping. (Section A.18.5.9.1).
10. Maximum distance between hangers per NFPA 13-2022, Table 17.4.2.1 (a).

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DATE: April 23, 2025

1.8 MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE (CONT'D)

Schedule 10 Steel Pipe[1][2][3][4][5]

Pipe Size[6] (in)	Outside Dia. OD[6] (in)	t_{nom}[6] (in)	S[7] (in^3)	Z[8] (in^3)	M_{Max} (ft-lb)	Weight with Water W_P[9] (lb/ft)	$(1.15)W_P+F_{VW}$ (lb/ft)	Hanger Spacing[10] S_{Hanger} (ft)	Applied Moment M_{Hanger} (ft-lb)	Max Horiz. $M_{Horizontal}$ (ft-lb)	Max Load from ZOI in lb., F_{PW} Transverse Brace Spacing in ft.					Max Weight from ZOI in lb., W $W = F_{PW} / 1.15\ C_P$ Transverse Brace Spacing in ft.				
											20	25	30	35	40	20	25	30	35	40
1	1.315	0.109	0.109	0.150	149	1.81	2.81	12	51	141	80	64				40	**32**			
1-1/4	1.660	0.109	0.182	0.247	246	2.52	3.91	12	70	236	135	108	88			67	**54**	44		
1-1/2	1.900	0.109	0.245	0.328	328	3.04	4.72	12	133	300	171	137	112			85	**68**	56		
2	2.375	0.109	0.395	0.524	523	4.22	6.55	12	184	490	280	224	183			139	**111**	91		
2-1/2	2.875	0.120	0.644	0.853	851	5.89	9.14	12	257	811	464	371	304			230	**184**	151		
3	3.500	0.120	0.975	1.282	1279	7.94	12.33	12	347	1231	704	563	461	395	331	350	**280**	229	196	164
3-1/2	4.000	0.120	1.289	1.688	1684	9.78	15.18	12	427	1629	931	745	610	523	438	463	**370**	303	260	218
4	**4.500**	**0.120**	**1.647**	**2.150**	**2145**	**11.78**	**18.29**	**12**	**514**	**2083**	**1190**	**952**	**780**	**669**	**560**	**591**	**473**	**388**	**332**	**278**
6	6.625	0.134	4.059	5.266	5256	23.03	35.75	12	1006	5159	2948	2358	1932	1656	1387	1465	**1172**	960	823	689
8	8.625	0.188	9.611	12.486	12461	40.08	62.22	12	1750	12338	7050	5640	4621	3961	3317	3503	**2803**	2296	1968	1648

FOOTNOTES:

1. Density of medium: 62.4 lbs/cu. ft.
2. Density of pipe: 500 lbs/cu. ft.
3. F_{PW} = 1.75 W_P
4. F_{VW} = 0.35 W_P
5. Steel strength F_y: 30,000 psi
6. Steel pipe dimensions per NFPA 13-2022 Table A.18.5.9
7. $S = PI \times [OD^4 - (OD - (2 \times 0.93 \times t_{nom}))^4] / (32 \times OD)$
8. $Z = [OD^3 - (OD - (2 \times 0.93 \times t_{nom}))^3] / 8$
9. The weight of the system being braced (W_p) shall be taken as 1.15 times the wight of the water-filled piping. (Section A.18.5.9.1).
10. Maximum distance between hangers per NFPA 13-2022, Table 17.4.2.1 (a).

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PAGE: FP-1-20

DATE: April 23, 2025

1.8 MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE (CONT'D)

Schedule 40 Steel Pipe[1][2][3][4][5]

Pipe Size[6] (in)	Outside Dia. OD[6] (in)	t_{nom}[6] (in)	S[7] (in^3)	Z[8] (in^3)	M_{Max} (ft-lb)	Weight with Water W_P[9] (lb/ft)	$(1.15)W_P+F_{VW}$ (lb/ft)	Hanger Spacing[10] S_{Hanger} (ft)	Applied Moment M_{Hanger} (ft-lb)	Max Horiz. $M_{Horizontal}$ (ft-lb)	Max Load from ZOI in lb., F_{PW} Transverse Brace Spacing in ft.					Max Weight from ZOI in lb., W $W = F_{PW} / 1.15\ C_P$ Transverse Brace Spacing in ft.				
											20	25	30	35	40	20	25	30	35	40
1	1.315	0.133	0.126	0.176	176	2.10	3.26	12	59	166	95	76	62			47	38	31		
1-1/4	1.660	0.140	0.222	0.305	305	3.00	4.66	12	84	293	167	134	110			83	67	55		
1-1/2	1.900	0.145	0.308	0.421	420	3.60	5.59	15	157	390	223	178	146			111	89	73		
2	2.375	0.154	0.529	0.714	713	5.20	8.07	15	227	676	386	309	253			192	154	126		
2-1/2	2.875	0.203	1.005	1.364	1362	7.90	12.26	15	345	1317	753	602	493			374	299	245		
3	3.500	0.216	1.625	2.189	2185	10.80	16.77	15	472	2133	1219	975	799	685	573	606	485	397	340	285
3-1/2	4.000	0.226	2.253	3.022	3016	13.40	20.80	15	585	2959	1691	1352	1108	950	795	840	672	551	472	395
4	4.500	0.237	3.023	4.040	4032	16.50	25.62	15	720	3967	2267	1814	1486	1274	1067	1127	901	738	633	530
6	6.625	0.280	7.972	10.554	10533	31.50	48.90	15	1375	10443	5967	4774	3911	3352	2807	2965	2372	1943	1666	1395
8	8.625	0.322	15.757	20.766	20724	51.00	79.18	15	2227	20604	11774	9419	7717	6615	5539	5850	4680	3835	3287	2752
10	10.750	0.365	28.012	36.802	36729	75.00	116.44	15	3275	36583	20904	16724	13701	11744	9834	10387	8310	6808	5836	4886
12	12.750	0.406	44.092	57.817	57701	103.00	159.91	15	4497	57526	32872	26297	21545	18467	15464	16334	13067	10706	9176	7684

FOOTNOTES:

1. Density of medium: 62.4 lbs/cu. ft.
2. Density of pipe: 500 lbs/cu. ft.
3. $F_{PW} = 1.75\ W_P$
4. $F_{VW} = 0.35\ W_P$
5. Steel strength F_y: 30,000 psi
6. Steel pipe dimensions per NFPA 13-2022 Table A.18.5.9
7. $S = PI \times [OD^4 - (OD - (2 \times 0.93 \times t_{nom}))^4] / (32 \times OD)$
8. $Z = [OD^3 - (OD - (2 \times 0.93 \times t_{nom}))^3] / 8$
9. The weight of the system being braced (W_p) shall be taken as 1.15 times the wight of the water-filled piping. (Section A.18.5.9.1).
10. Maximum distance between hangers per NFPA 13-2022, Table 17.4.2.1 (a).

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SECTION FP-2

SINGLE HANGER BRACE DETAILS

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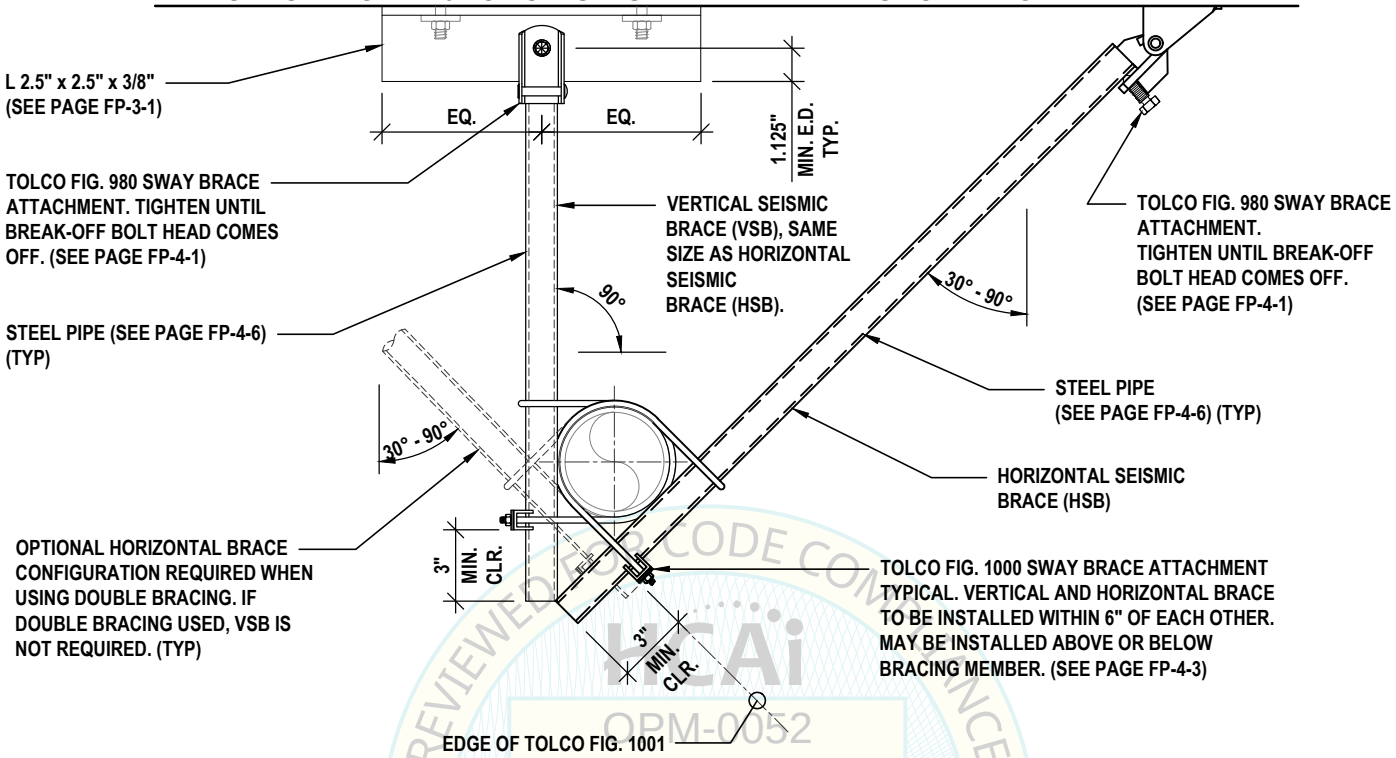
PAGE: FP-2-0

DATE: April 23, 2025

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE WITH FIG. 1000 FAST CLAMP

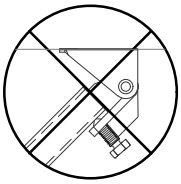
DETAIL
1G-A

SEE SECTION FP-3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1" - 4" PIPE MAX

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DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE SECTION FP-3 AND SECTION FP-4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
2. DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY HCAI.
3. VERTICAL SEISMIC BRACE (VSB) AND HORIZONTAL SEISMIC BRACE (HSB) MAY USE DIFFERENT APPROVED COMPONENTS.

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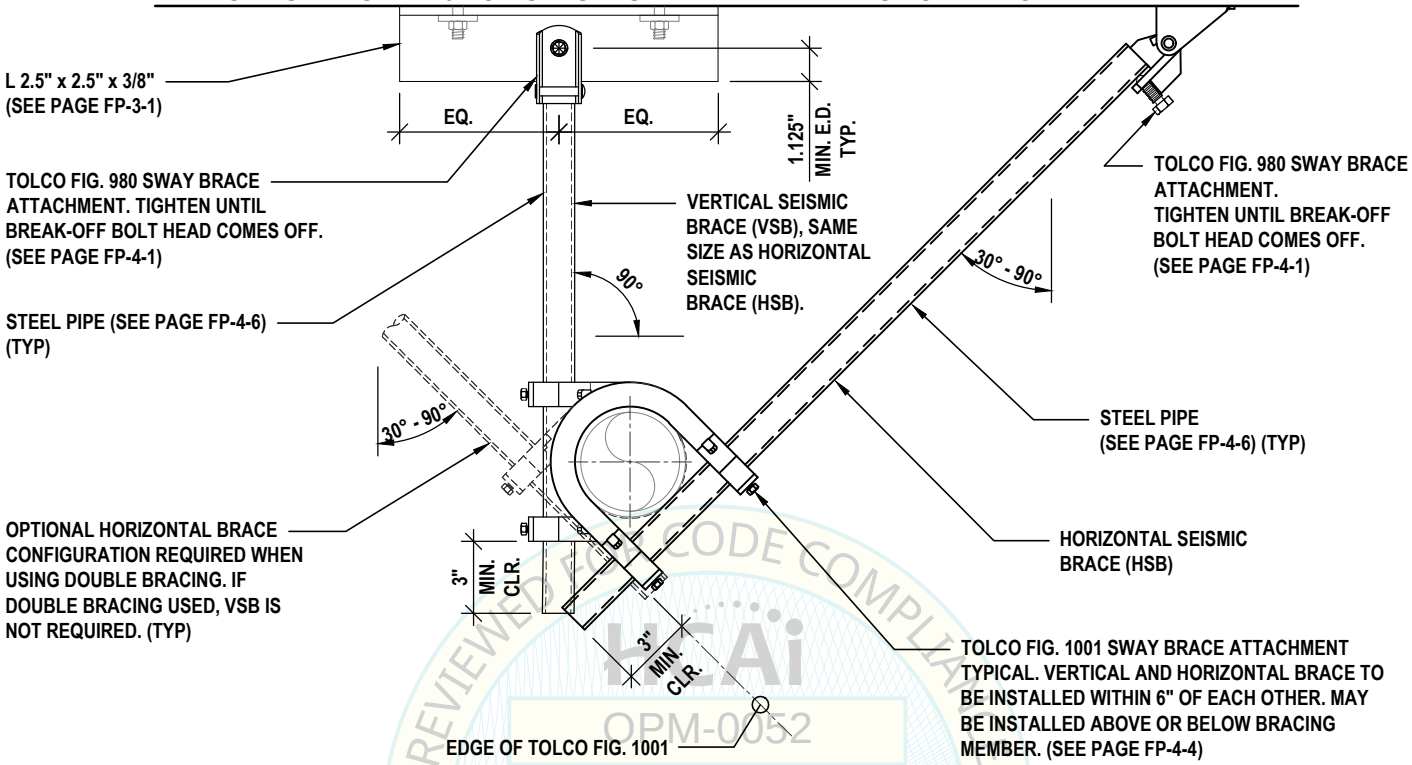
PAGE: **FP-2-1**

DATE: **April 23, 2025**

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE WITH FIG. 1001 FAST CLAMP

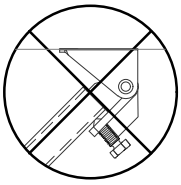
DETAIL
1G-B

SEE SECTION FP-3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1" - 8" PIPE MAX

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DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE SECTION FP-3 AND SECTION FP-4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
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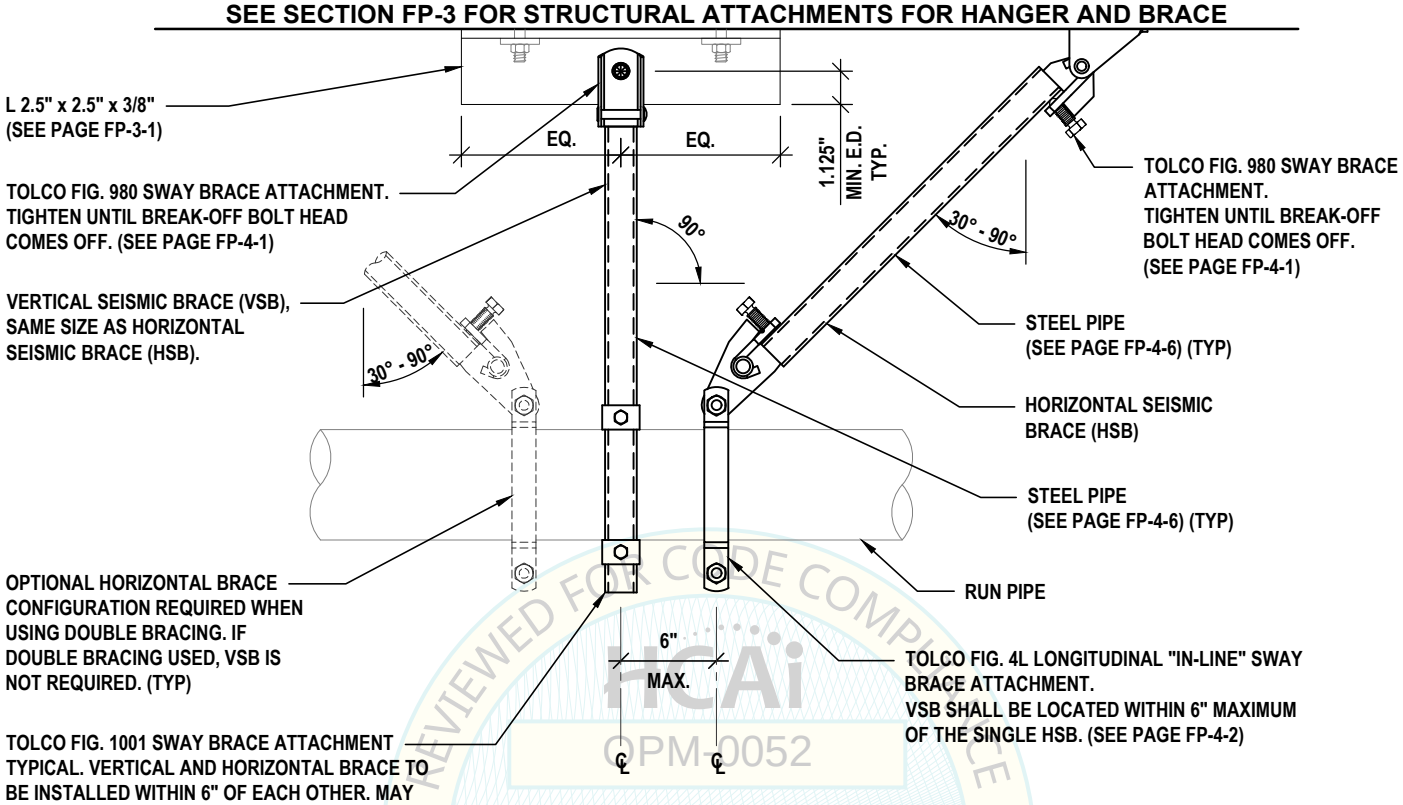
PAGE: **FP-2-2**

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LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE WITH LONGITUDINAL "IN-LINE" PIPE CLAMP

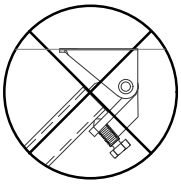
DETAIL 2L

SEE SECTION FP-3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



2 1/2" - 8" PIPE MAX

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DO NOT BEND BRACE PAST 90°

NOTES:

1. SEE SECTION FP-3 AND SECTION FP-4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
2. DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY HCAI.
3. VERTICAL SEISMIC BRACE (VSB) AND HORIZONTAL SEISMIC BRACE (HSB) MAY USE DIFFERENT APPROVED COMPONENTS.

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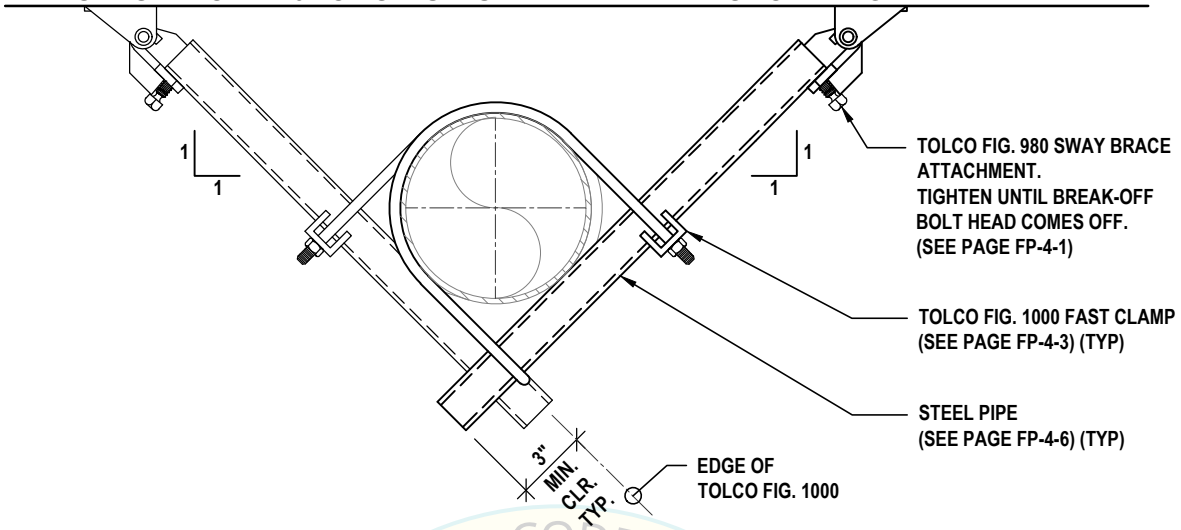
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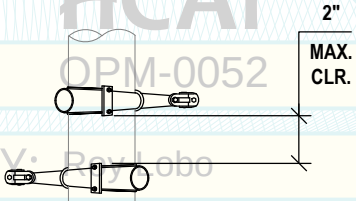
DOUBLE FAST CLAMP RISER BRACE

DETAIL
R1-A

SEE SECTION FP-3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE

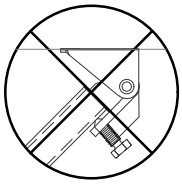


PLAN VIEW



ELEVATION

1" - 4" PIPE MAX



DO NOT BEND BRACE PAST 90°

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NOTES:

1. SEE SECTION FP-3 AND SECTION FP-4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
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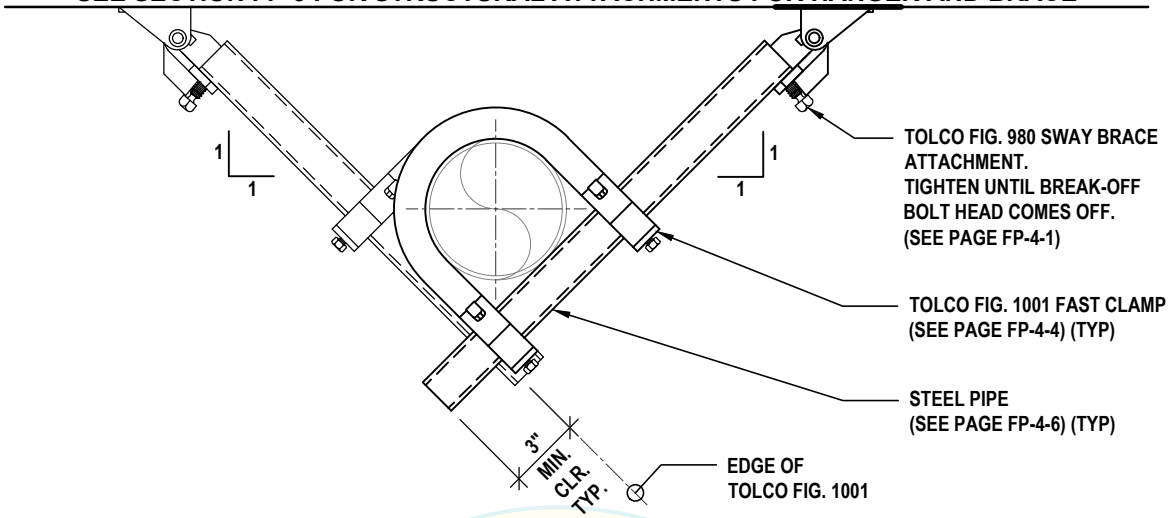
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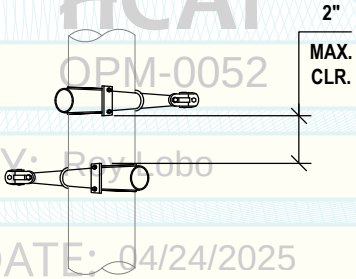
DOUBLE FAST CLAMP RISER BRACE

DETAIL
R1-B

SEE SECTION FP-3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE

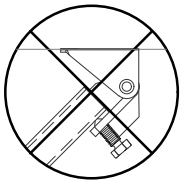


PLAN VIEW



ELEVATION

1" - 8" PIPE MAX



DO NOT BEND BRACE PAST 90°

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NOTES:

1. SEE SECTION FP-3 AND SECTION FP-4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
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SECTION FP-3

STRUCTURAL ATTACHMENT

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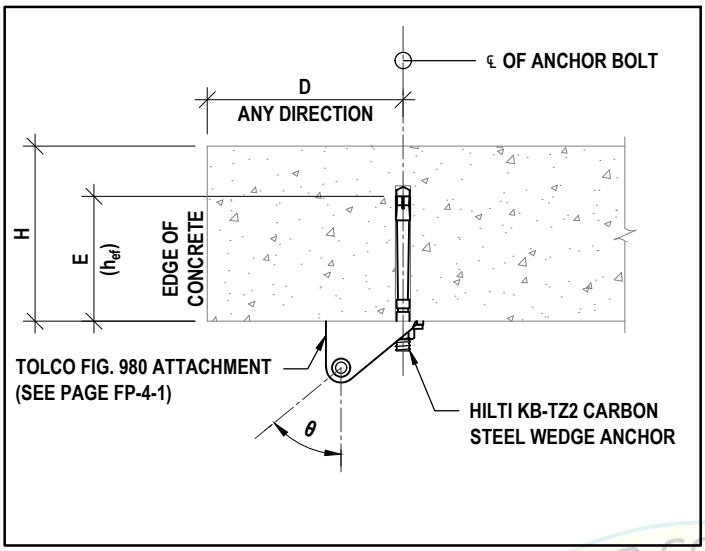
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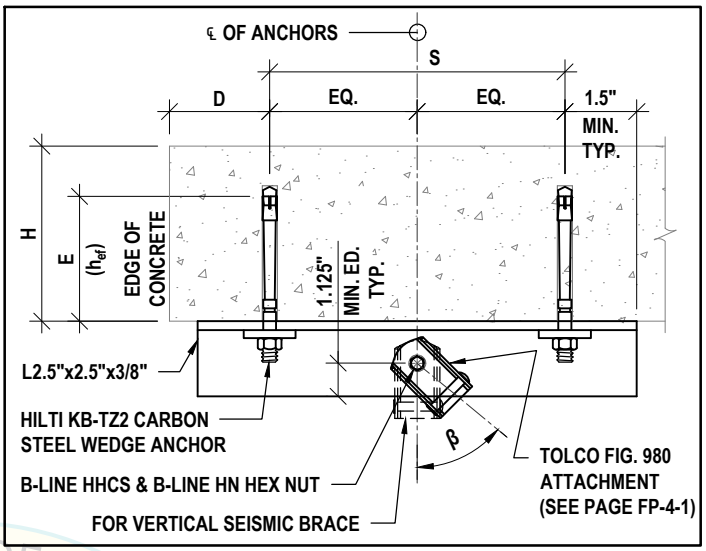
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PAGE: FP-3-0

DATE: April 23, 2025

HILTI KB-TZ2 (CS) WEDGE ANCHORS
IN 3,000 PSI NORMAL WEIGHT CONCRETE DECK





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX. 12")	'H' MIN. CONCRETE THICKNESS	SINGLE ANCHOR CAPACITY				DOUBLE ANCHOR CAPACITY
					MAX. HORIZONTAL LOAD W/ BRACE ANGLE (θ) MEASURED FROM VERTICAL (LBS)(ASD)				MAX. VERTICAL LOAD W/ BRACE ANGLE (β) MEASURED FROM VERTICAL (LBS)(ASD)
					θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	β = 0°
3/8"	2"	12"	6"	4"	89	281	602	780	970
1/2"	2"	12"	6"	4"	92	288	621	828	970
1/2"	3 1/4"	12"	10"	6"	161	515	1,131	1,553	1,627
5/8"	3 1/4"	12"	10"	6"	200	633	1,384	1,867	2,010
5/8"	4"	12"	12"	6"	217	684	1,483	1,980	2,100
3/4"	3 3/4"	12"	12"	6"	242	750	1,591	2,028	2,100

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE FP-3-13 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. TEST REPORTS OF THE RESULTS SHALL BE SUBMITTED TO HCAI.
8. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.
9. HOLE SIZE IN ANGLE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISC. HOLE EDGE DISTANCE SHALL BE 1.25". FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
10. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
11. TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4.
12. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.

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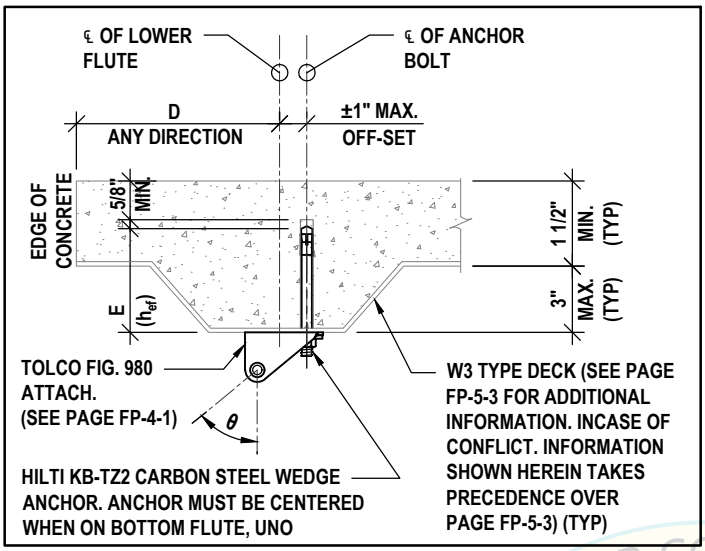
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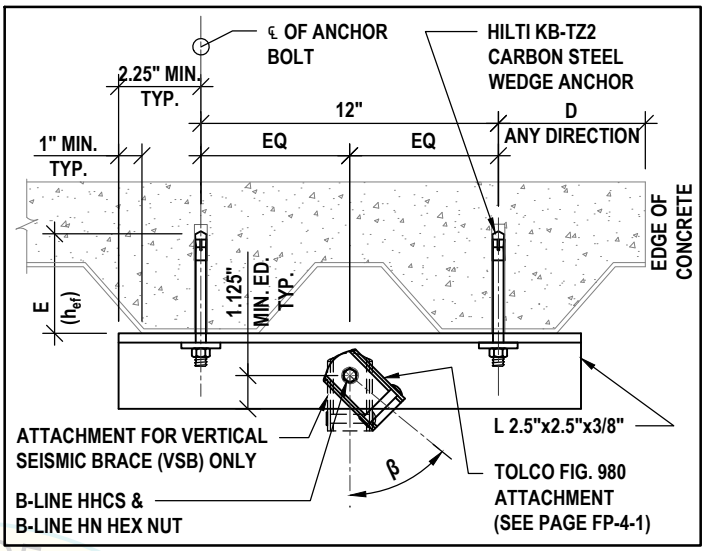
Structural Engineer: Mohammad R. Hariri
California SE No. S3545

PAGE: FP-3-1

DATE: April 23, 2025

HILTI KB-TZ2 (CS) WEDGE ANCHOR
IN 3,000 PSI SAND LIGHTWEIGHT CONCRETE OVER MIN. 20 GA. METAL DECK





ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUE	SINGLE ANCHOR CAPACITY				DOUBLE ANCHOR CAPACITY
				MAX. HORIZONTAL LOAD W/ BRACE ANGLE (θ) MEASURED FROM VERTICAL (LBS)(ASD)				MAX. VERTICAL LOAD W/ BRACE ANGLE (β) MEASURED FROM VERTICAL (LBS)(ASD)
				θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	β = 0°
3/8"	2"	12"	10"	60	188	397	504	684
1/2"	2"	12"	10"	60	188	404	537	637
1/2"	3 1/4"	12"	10"	99	319	704	972	997
5/8"	3 1/8"	12"	10"	109	337	714	927	1,169
5/8"	4"	12"	10"	135	435	968	1,341	1,309

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE HCAI OPM-0052 BY: Roy Lee DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE FP-3-13 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. TEST REPORTS OF THE RESULTS SHALL BE SUBMITTED TO HCAI.
8. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.
9. HOLE SIZE IN ANGLE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISC. HOLE EDGE DISTANCE SHALL BE 1.25". FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
10. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
11. TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4.
12. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.

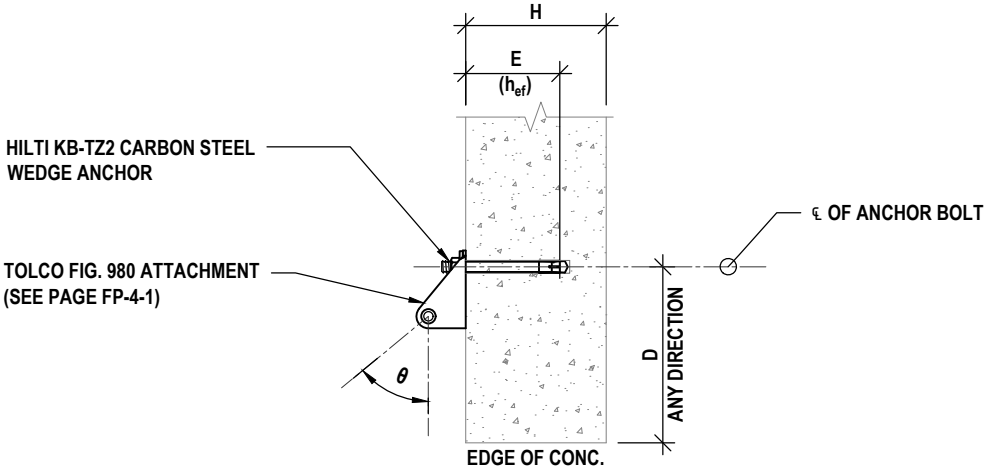
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PAGE: **FP-3-2**

DATE: **April 23, 2025**

HILTI KB-TZ2 (CS) WEDGE ANCHORS
IN 3,000 PSI NORMAL WEIGHT CONCRETE WALL / BEAM



ANCHOR DIA.	'E' MIN. EFFECTIVE EMBED. DEPTH h_{ef}	'D' MIN. EDGE DISTANCE	'H' MIN. CONCRETE WALL/BM. THICKNESS	ANCHOR CAPACITY		
				MAX. HORIZONTAL LOAD W/ BRACE ANGLE (θ) MEASURED FROM VERTICAL (LBS)(ASD)		
				θ = 45°-59°	θ = 60°-74°	θ = 75°
3/8"	2"	12"	6"	276	293	319
1/2"	2"	12"	6"	285	302	326
1/2"	3 1/4"	12"	6"	509	529	547
5/8"	3 1/4"	12"	8"	629	659	690
5/8"	4"	12"	8"	680	717	763
3/4"	3 3/4"	12"	10"	749	800	872

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

REVIEWED FOR CODE COMPLIANCE HCAi OPM-0058 BY: Roy Lobo DATE: 04/24/2025 CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN DETERMINED IN ACCORDANCE WITH THE REQUIREMENTS OF CHAPTER 17 OF ACI 318-19.
2. TORQUE TEST SHALL BE PERFORMED FOR 100% OF THE EXPANSION-TYPE ANCHORS AFTER A MINIMUM 24 HOURS HAVE ELAPSED SINCE INSTALLATION. SEE PAGE FP-3-13 FOR POST-INSTALLED ANCHOR TESTING REQUIREMENTS.
3. FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-4266 (HILTI KB-TZ2 CS EXPANSION ANCHOR).
4. WHEN INSTALLING ANCHORS IN NON-PRESTRESSED REINFORCED CONCRETE, AVOID NICKING AND DAMAGING REINFORCING STEEL. ANCHORS SHALL BE INSTALLED 1" CLEAR OF EXISTING REINFORCING STEEL.
5. WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE, MAP AND LOCATE PRESTRESSING STRANDS AND REINFORCING STEEL BY NON-DESTRUCTIVE TESTING METHODS TO AVOID NICKING AND DAMAGING THEM.
6. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS AND LOCATION OF ANCHORS.
7. SPECIAL INSPECTION SHALL BE PROVIDED IN ACCORDANCE WITH 2022 CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT, AND TIGHTENING TORQUE. TEST REPORTS OF THE RESULTS SHALL BE SUBMITTED TO HCAI.
8. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.
9. HOLE SIZE IN ANGLE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISC. FULL ENGAGEMENT OF NUTS AND WASHERS SHALL BE PROVIDED FOR ALL ANCHOR BOLTS.
10. ANCHOR BOLTS, NUTS, AND WASHERS SHALL NOT BE USED OR EXPOSED TO CORROSIVE ENVIRONMENTS AND CONDITIONS.
11. TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4.
12. TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.

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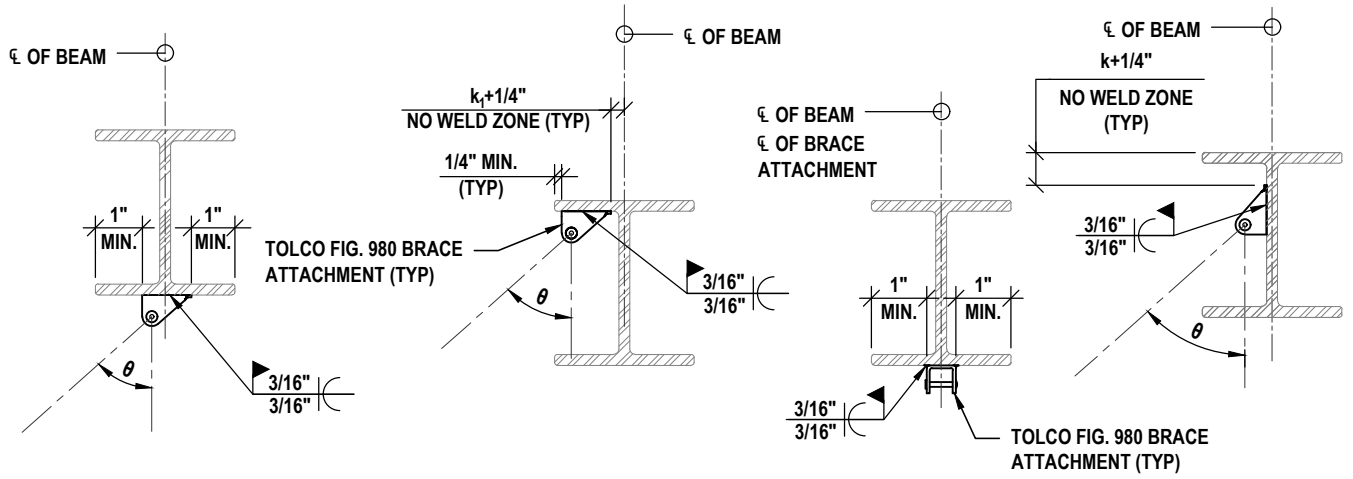
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Structural Engineer: Mohammad R. Hariri
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PAGE: **FP-3-3**

DATE: **April 23, 2025**

WELDED ATTACHMENTS TO STEEL BEAM



BRACE ATTACHMENT	MIN. WELD	MAX. ALLOWABLE HORIZONTAL LOAD W/ BRACE ANGLE (θ) @ 45° FROM VERTICAL (LBS)(ASD)	MAX. ALLOWABLE VERTICAL LOAD W/ BRACE ANGLE (θ) @ 0° FROM VERTICAL (LBS)(ASD)
TOLCO 900 SERIES	3/16"	1,484 (1)	1,050 (1)

FOOTNOTES:

1. LOAD GOVERNED BY TOLCO FIG. 980 BRACE ATTACHMENT.

REVIEWED FOR CODE COMPLIANCE
CALIFORNIA BUILDING CODE, 2022
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025

NOTES:

1. ALL STRUCTURAL STEEL SHALL BE A36 OR EQUAL.
2. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
3. CONNECTION TO STRUCTURAL BEAM SUBJECT TO PRIOR APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH THE LATEST EDITION OF THE STRUCTURAL WELDING CODE OF THE AMERICAN WELDING SOCIETY.
7. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
8. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
9. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
10. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

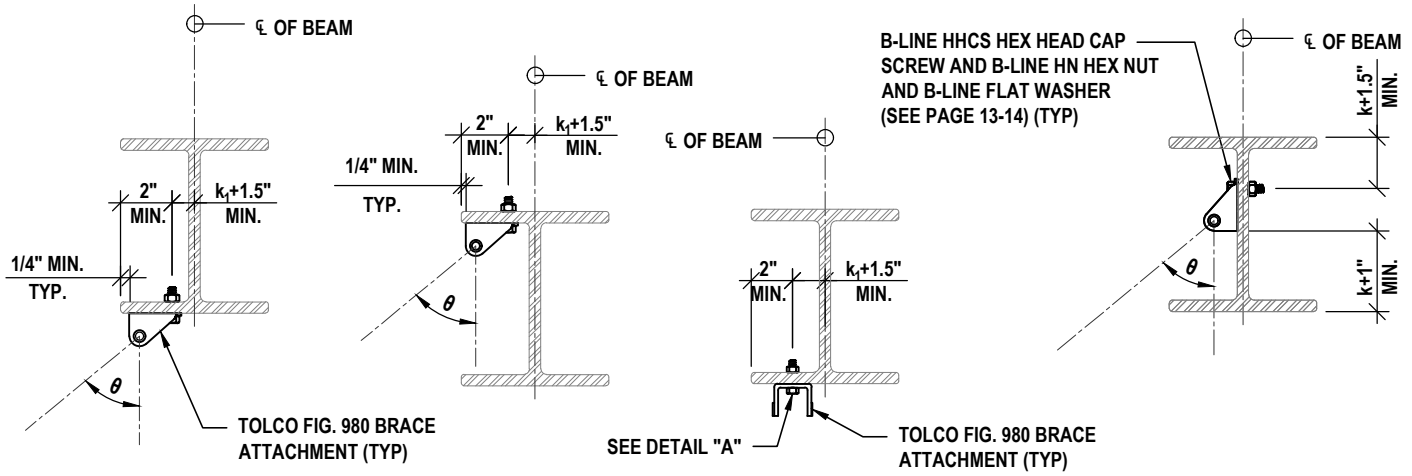
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PAGE: FP-3-4

DATE: April 23, 2025

BOLTED ATTACHMENTS TO STEEL BEAM



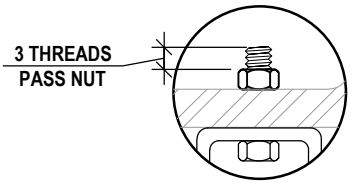
BRACE ATTACHMENT	BOLT DIAMETER	MAX. ALLOWABLE HORIZONTAL LOAD W/ BRACE ANGLE (θ) @ 45° FROM VERTICAL (LBS)(ASD)	MAX. ALLOWABLE VERTICAL LOAD W/ BRACE ANGLE (θ) @ 0° FROM VERTICAL FOR CASE 4 ONLY (LBS)(ASD) [2] [3]
TOLCO 900 SERIES	3/8"	371	227
	1/2"	668	405
	5/8"	1,056	632
	3/4"	1,484 [1]	911 [1]

FOOTNOTES:
1. LOAD GOVERNED BY TOLCO FIG. 980 BRACE ATTACHMENT.
2. MAXIMUM ALLOWABLE VERTICAL LOAD FOR CASE 4 ONLY.
3. CASES 1, 2 & 3 SHALL NOT BE USED TO SUPPORT VERTICAL LOAD.

REVIEWED FOR CODE COMPLIANCE
OPM-0032
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

NOTES:

1. ALL STRUCTURAL STEEL SHALL BE A36 OR EQUAL
2. FASTENERS SHALL BE A307 BOLTS OR BETTER
3. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
4. CONNECTION TO STRUCTURAL BEAM SUBJECT TO PRIOR APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
5. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
6. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.



DETAIL A

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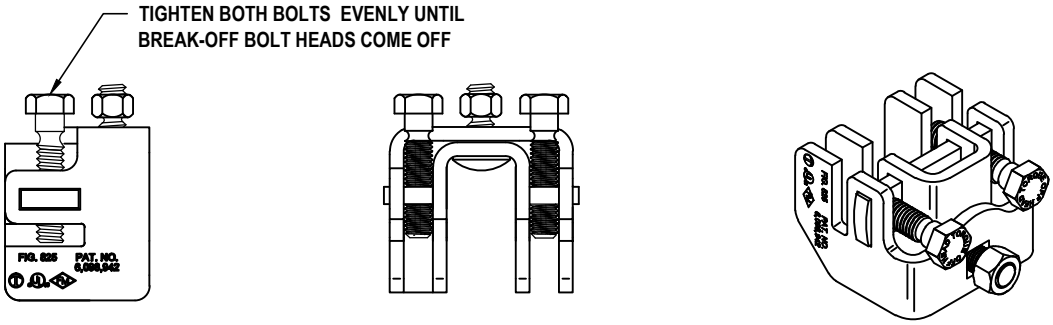
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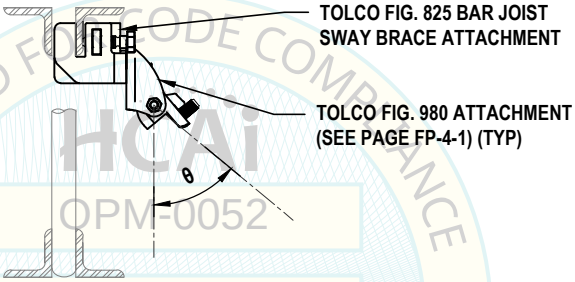
PAGE: FP-3-5

DATE: April 23, 2025

TOLCO FIG. 825 BAR JOIST SWAY BRACE ATTACHMENT TO STEEL TRUSS



SEISMIC BRACE ASSEMBLY CONFIGURATION



NOTES:

STEEL BAR JOIST OR TRUSS THICKNESS SHALL BE 1/8" MINIMUM AND 3/8" MAXIMUM.

REVIEWED FOR CODE COMPLIANCE
HCAi
OPM-0052
BY: Roy Lobo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE 2022

ORIENTATION	MAX. ALLOWABLE HORIZONTAL CAPACITY PER INSTALLATION BRACE ANGLE (θ) FROM VERTICAL (LBS)(ASD)				REMARKS
	θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
PERPENDICULAR TO BAR JOIST OR TRUSS	990	1,360	1,670	NOT ALLOWED	SEE FOOTNOTES 1 & 2
PARALLEL TO BAR JOIST OR TRUSS	990	630	770	860	SEE FOOTNOTES 1 & 2

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
2. BAR JOIST OR TRUSS THICKNESS: MINIMUM 1/8" AND MAXIMUM 3/8".

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
4. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION FP-5, PAGE FP-5-1 FOR TOLCO FIG. 980 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS.

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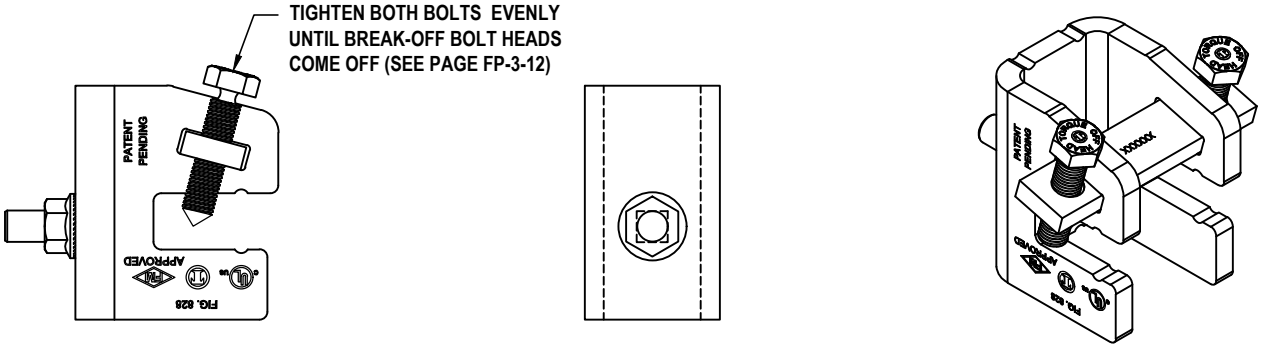
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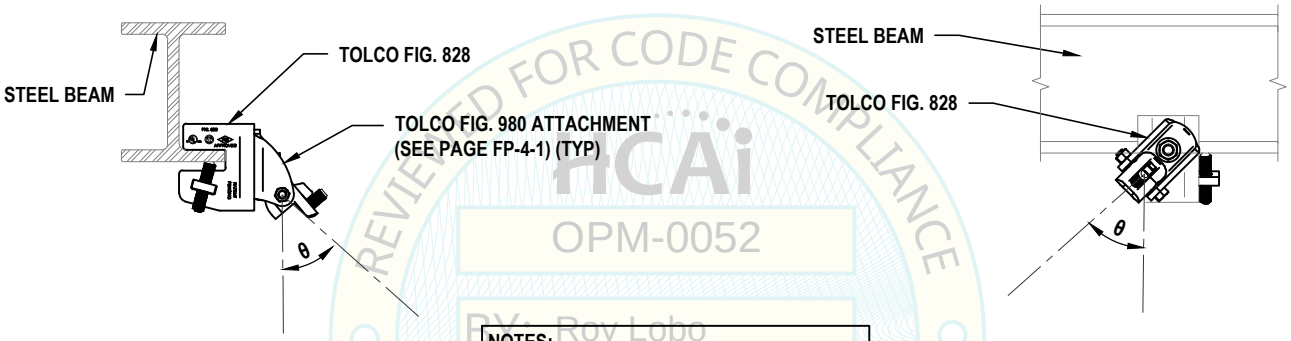
PAGE: FP-3-6

DATE: April 23, 2025

TOLCO FIG. 828 UNIVERSAL SWAY BRACE ATTACHMENT TO STEEL BEAM



SEISMIC BRACE ATTACHEMENT



PERPENDICULAR TO BEAM

NOTES:

STEEL BEAM FLANGE THICKNESS SHALL BE 3/8" MINIMUM AND 7/8" MAXIMUM.

PARALLEL TO BEAM

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ORIENTATION	MAX. ALLOWABLE HORIZONTAL CAPACITY PER INSTALLATION BRACE ANGLE (θ) FROM VERTICAL (LBS)(ASD)				REMARKS
	θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
PERPENDICULAR TO BEAM	1,570	2,220	1,210	NOT ALLOWED	SEE FOOTNOTES 1 & 2
PARALLEL TO BEAM	690	970	1,210	1,330	SEE FOOTNOTES 1 & 2

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
2. BEAM FLANGE THICKNESS: MINIMUM 3/8" AND MAXIMUM 7/8".

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STEEL MEMBER TO RESIST ALL BRACE LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION FP-5, PAGE FP-5-1 FOR TOLCO FIG. 980 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS.

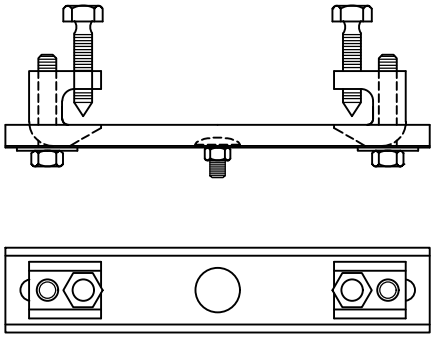
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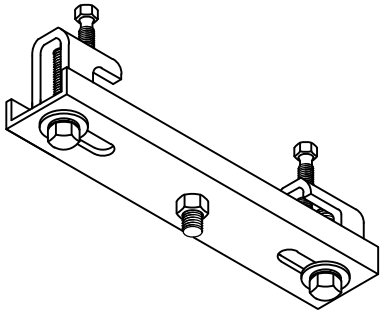
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Structural Engineer: Mohammad R. Hariri
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PAGE: **FP-3-7**

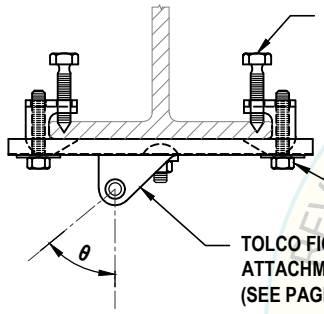
DATE: **April 23, 2025**

TOLCO FIG. 800 ADJUSTABLE SWAY BRACE ATTACHMENT TO STEEL BEAM

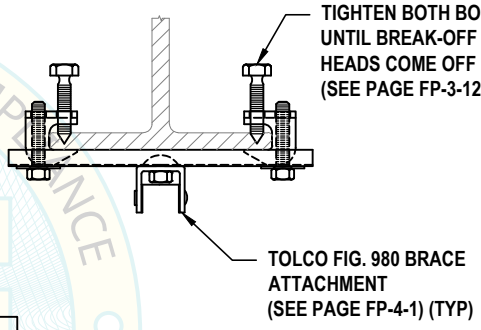




SEISMIC BRACE ATTACHEMENT



PERPENDICULAR TO BEAM



PARALLEL TO BEAM

NOTES:

STEEL BEAM FLANGE THICKNESS SHALL BE 3/8" MINIMUM AND 7/8" MAXIMUM.

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DATE: 04/24/2025
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ORIENTATION	MAX. ALLOWABLE HORIZONTAL CAPACITY PER INSTALLATION BRACE ANGLE (θ) FROM VERTICAL (LBS)(ASD)				REMARKS
	θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
PERPENDICULAR TO BEAM	1,430	1,970	1,980	NOT ALLOWED	SEE FOOTNOTES 1, 2 & 3
PARALLEL TO BEAM	930	1,310	1,610	1,800	SEE FOOTNOTES 1, 2 & 3

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
2. BEAM FLANGE THICKNESS: MINIMUM 3/8" AND MAXIMUM 3/4".
3. BEAM FLANGE WIDTH: MINIMUM 4" AND MAXIMUM 18".

NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STEEL MEMBER TO RESIST ALL BRACE LOADS.
2. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341).
3. PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. SEE SECTION FP-5, PAGE FP-5-1 FOR TOLCO FIG. 980 PART NUMBERS THAT MAY BE USED FOR THE SPECIFIC BRACE ATTACHMENTS.

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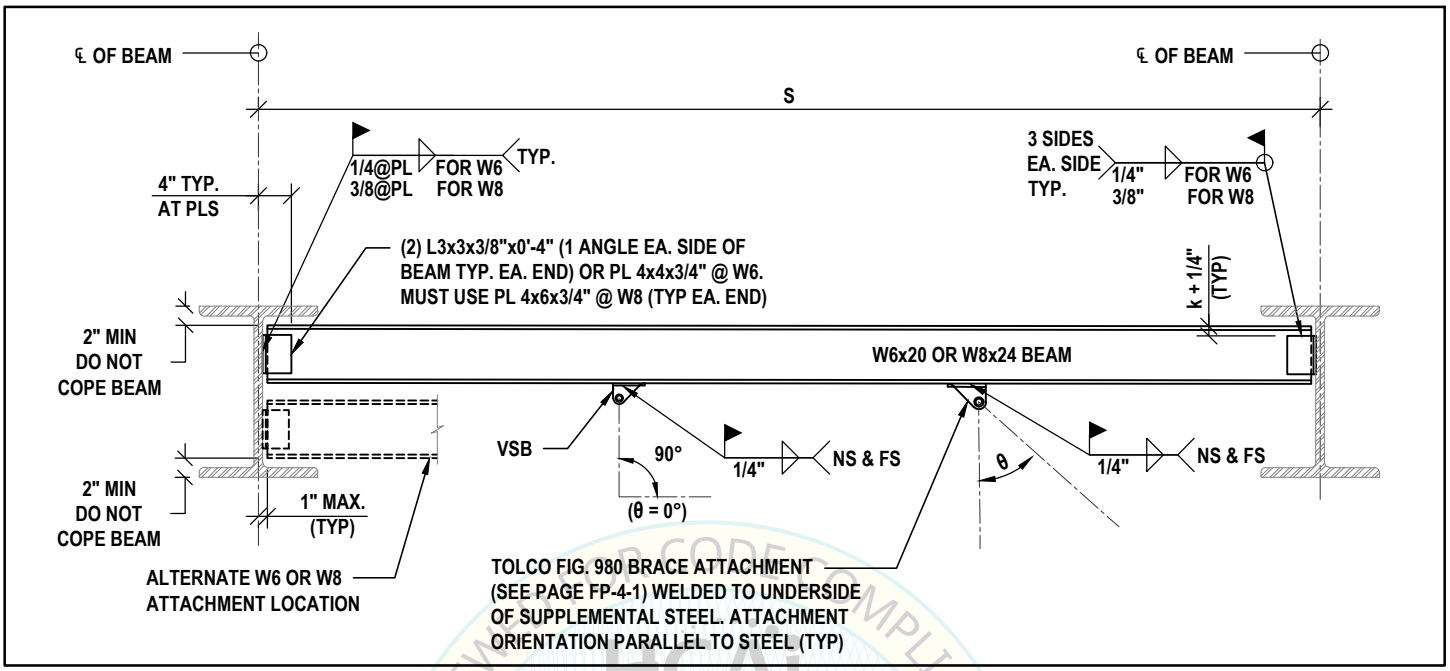
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PAGE: FP-3-8

DATE: April 23, 2025

HORIZONTAL AND VERTICAL SEISMIC BRACE ATTACHMENT TO SUPPLEMENTAL STEEL BEAM

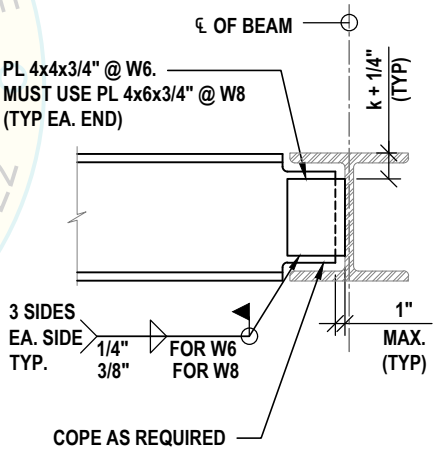


BEAM SIZE	'S' MAX. BEAM SPAN	MAX. HORIZONTAL LOAD W/ BRACE ANGLE (θ) MEASURED FROM VERTICAL (LBS)(ASD)				MAX. VERTICAL LOAD FOR VERTICAL SEISMIC BRACE (VSB) W/ BRACE ANGLE (β) MEASURED FROM VERTICAL (LBS)(ASD)
		θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	θ = 0°
W6x20	10'-0"	1,050	1,484	1,818	2,028	2,100
W8x24	20'-0"	1,050	1,484	1,818	2,028	2,100

FOOTNOTES:

1. MAX. LOAD INCLUDES OVER STRENGTH FACTOR Ω_o=2.0 PER ASCE 7-16, TABLE 13.6-1 TO SATISFY ACI-318-19.

OPTIONAL ATTACHEMENT



NOTES:

1. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2. CONNECTION TO STRUCTURAL STEEL BEAMS SUBJECT TO APPROVAL FROM STRUCTURAL ENGINEER OF RECORD.
3. NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES (DESIGNATED BY PROVISIONS OF AISC 341)
4. WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
5. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
6. ALL WELDS SHALL BE IN CONFORMANCE WITH 2022 CALIFORNIA BUILDING CODE (CBC).
7. CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
8. LOADS ARE BASED ON ALLOWABLE STRENGTH DESIGN.
9. SEE AISC 360 FOR "k" AND "k_1" DIMENSIONS.

NEW CODE COMPLIANCE
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OSHPD
BY: Roy Lo
DATE: 04/24/2025
CALIFORNIA BUILDING CODE, 2022

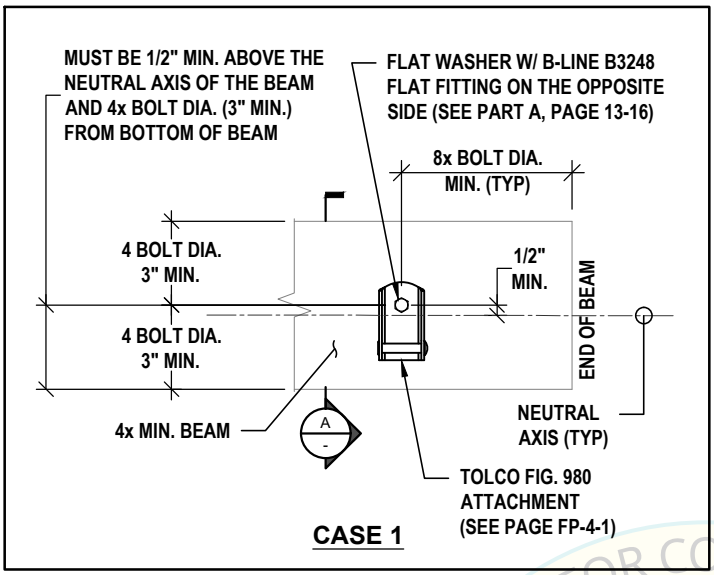
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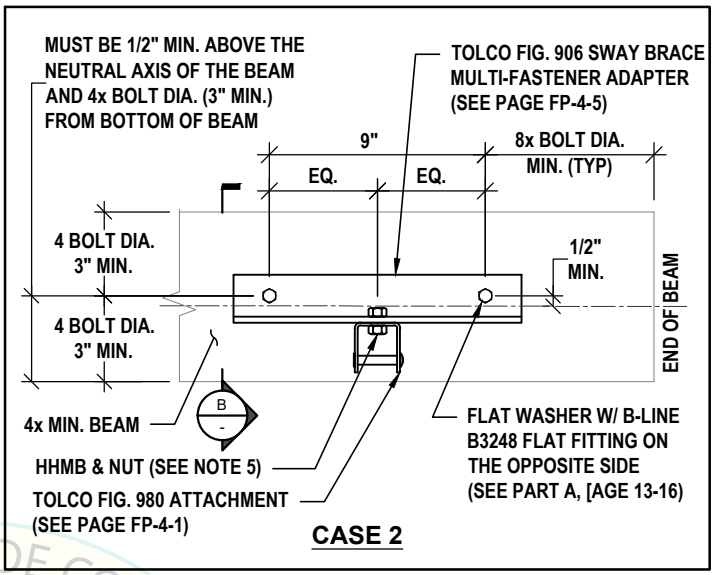
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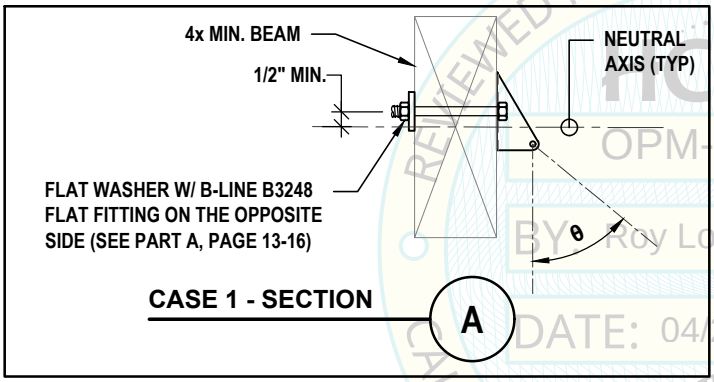
PAGE: FP-3-9

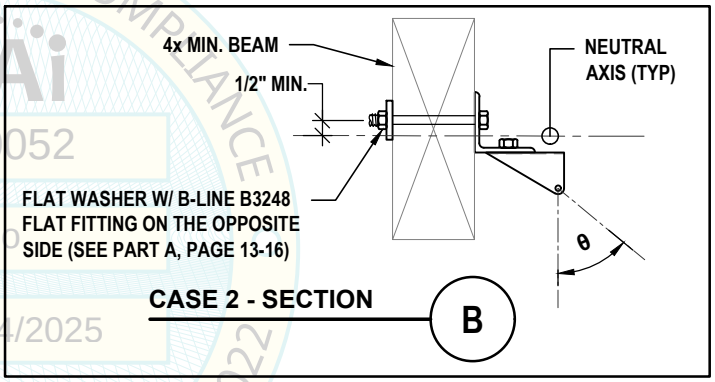
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THRU-BOLT STRUCTURAL ATTACHMENTS
PERPENDICULAR TO WOOD BEAM









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CALIFORNIA BUILDING CODE 2022
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OPM-0052
BY: Roy Lobo
DATE: 04/24/2025

BRACE ATTACHMENT	BOLT DIAMETER	MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) @ 45° FROM VERTICAL (LBS)(ASD)		MAX. ALLOWABLE VERTICAL SEISMIC LOAD W/ BRACE ANGLE (θ) @ 0° FROM VERTICAL (LBS)(ASD)	
		CASE 1 - 1 BOLT	CASE 2 - 2 BOLTS	CASE 1 - 1 BOLT	CASE 2 - 2 BOLTS
TOLCO FIG. 980	1/2"	340	680	550	SEE NOTE 7
	5/8"	380	760	650	SEE NOTE 7
	3/4"	410	820	720	SEE NOTE 7

NOTES:

1. BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x.
3. LOADS FOR THRU-BOLT ATTACHMENTS ARE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5. BOLTS SHALL BE PER ASTM A307 OR BETTER.
6. DESIGN LOAD INFORMATION LISTED IN TABLE BECOMES INVALID WHEN THE BRACE ANGLE IS GREATER THAN 45° FROM THE VERTICAL. SUCH USE IS NOT INCLUDED IN THE SCOPE OF THIS PRE-APPROVAL AND IS TO BE SUBMITTED FOR REVIEW AND APPROVAL ON A PROJECT SPECIFIC BASIS BY HCAI, EXCEPT WHEN BRACE IS 0° FROM VERTICAL.
7. CASE 2 SHALL NOT BE USED TO SUPPORT VERTICAL LOAD.

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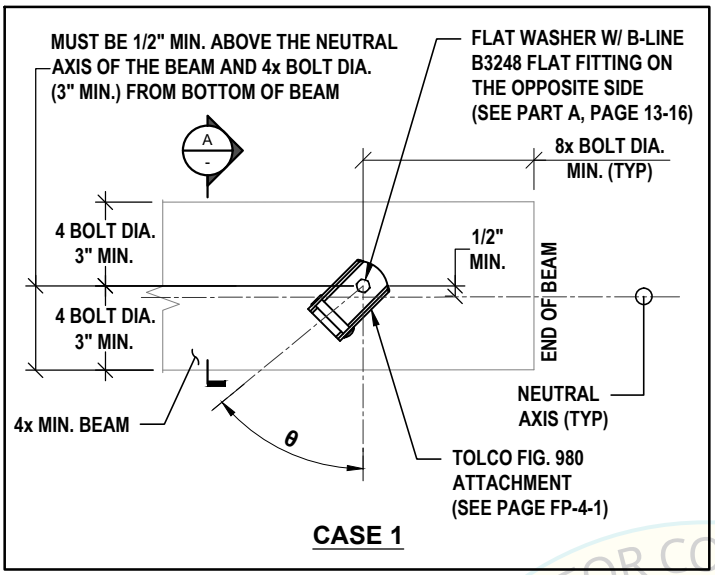
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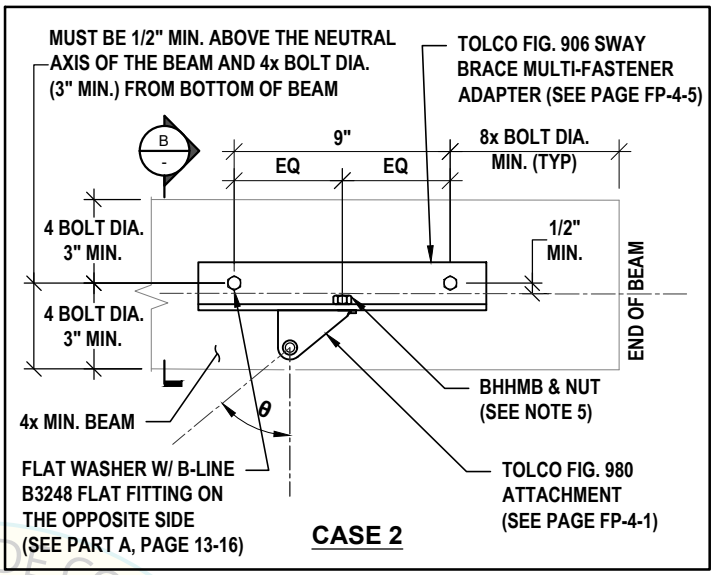
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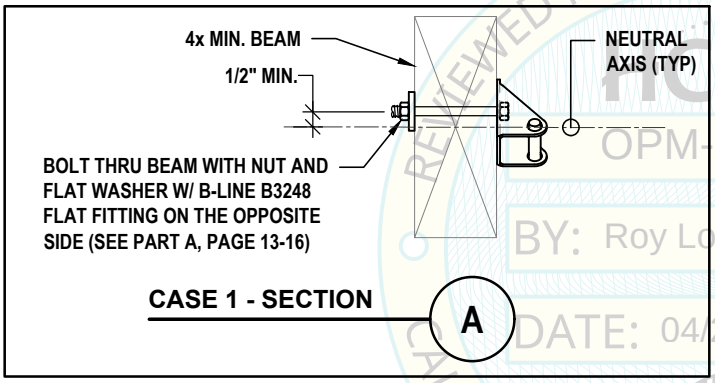
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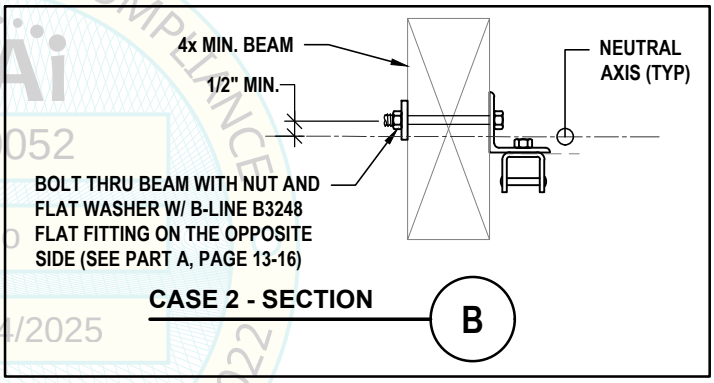
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THRU-BOLT STRUCTURAL ATTACHMENTS
PARALLEL TO WOOD BEAM









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BRACE ATTACHMENT	BOLT DIAMETER	MAX. ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE ANGLE (θ) @ 45° FROM VERTICAL (LBS)(ASD)		MAX. ALLOWABLE VERTICAL SEISMIC LOAD W/ BRACE ANGLE (θ) @ 0° FROM VERTICAL (LBS)(ASD)	
		CASE 1 - 1 BOLT	CASE 2 - 2 BOLTS	CASE 1 - 1 BOLT	CASE 2 - 2 BOLTS
TOLCO FIG. 980	1/2"	300	560	420	SEE NOTE 7
	5/8"	340	600	460	SEE NOTE 7
	3/4"	400	640	540	SEE NOTE 7

NOTES:

1. BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2. WOOD BEAM SHALL BE DOUGLAS FIR-LARCH (S.G. = 0.50) PER 2022 CBC AND NDS 2018. MINIMUM BEAM SIZE SHALL BE 4x.
3. LOADS FOR THRU-BOLT ATTACHMENTS ARE DERIVED FROM 2022 CBC AND NDS 2018 FOR DOUGLAS FIR-LARCH [S.G. = 0.50].
4. STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5. BOLTS SHALL BE PER ASTM A307 OR BETTER.
6. DESIGN LOAD INFORMATION LISTED IN TABLE BECOMES INVALID WHEN THE BRACE ANGLE IS GREATER THAN 45° FROM THE VERTICAL. SUCH USE IS NOT INCLUDED IN THE SCOPE OF THIS PRE-APPROVAL AND IS TO BE SUBMITTED FOR REVIEW AND APPROVAL ON A PROJECT SPECIFIC BASIS BY HCAI, EXCEPT WHEN BRACE IS 0° FROM VERTICAL.
7. CASE 2 SHALL NOT BE USED TO SUPPORT VERTICAL LOAD.

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BOLT AND STRUT NUT TIGHTENING REQUIREMENTS

TORQUE FOR NUTS USED W/ A307 AND GRADE A36 THREADED ROD

SIZE (IN)	TORQUE (FT-LB)
1/4	6
5/16	11
3/8	20
1/2	49
5/8	97
3/4	173

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APPROXIMATE TORQUE FOR BREAK-OFF BOLTS

COMPONENT	TORQUE (FT-LB)
FIG. 4L	36 - 40
FIG. 800	36 - 40
FIG. 825	31 - 35
FIG. 828	31 - 35
FIG. 828	36 - 40

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ANCHOR INSTALLATION, TESTING NOTES AND TORQUE VALUES FOR NORMAL WEIGHT CONCRETE OR SAND LIGHTWEIGHT CONCRETE

ANCHOR INSTALLATION AND TESTING NOTES:

1. ALL POST-INSTALLED ANCHORS SHALL BE INSTALLED PER THEIR CORRESPONDING ICC RESEARCH REPORT.
2. ALL POST-INSTALLED ANCHORS SHALL BE TESTED.
3. TESTING AND INSPECTION OF EXPANSION ANCHORS SHALL BE PERFORMED BY AN APPROVED INDEPENDENT AGENCY EMPLOYED BY THE FACILITY OWNER PER CBC 1704A & 1910A.5, AND CAC 7-149.
4. THE TENSION TESTING OF THE POST-INSTALLED ANCHORS SHALL BE DONE IN THE PRESENCE OF THE PROJECT INSPECTOR. THE REPORTS OF THE TEST RESULTS SHALL BE SUBMITTED TO THE INSPECTOR OF RECORD, OWNER AND THE ARCHITECT OR ENGINEER IN RESPONSIBLE CHARGE OF PROJECT PER CAC 7-149.
5. TEST ACCEPTANCE CRITERIA:

   ACCEPTANCE CRITERIA FOR POST-INSTALLED ANCHORS SHALL BE BASED ON ICC-ESR USING CRITERIA ADOPTED IN THE 2022 CBC. FIELD TEST SHALL SATISFY FOLLOWING MINIMUM REQUIREMENTS.

   TORQUE WRENCH METHOD:

   ANCHORS TESTED WITH A CALIBRATED TORQUE WRENCH MUST ATTAIN THE SPECIFIED TORQUE WITHIN 1/2 TURN OF THE NUT.

   EXCEPTIONS:

   WEDGE OR SLEEVE TYPE:
   ONE QUARTER (1/4) TURN OF THE NUT FOR 3/8" SLEEVE ANCHOR ONLY.

6. TEST LOADS:

   A. LOAD TESTING SHALL BE PERFORMED AFTER A MINIMUM 24 HOURS ELAPSED SINCE INSTALLATION.

   REQUIRED TEST LOADS SHALL BE PER THE FOLLOWING ANCHOR BOLT TEST LOAD TABLE:

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TORQUE VALUES PER ICC-ESR REPORTS

REQUIRED TEST LOAD TABLE FOR HILTI KB-TZ2 WEDGE ANCHOR (ICC ESR-4266)	
ANCHOR DIAMETER	INSTALLATION TORQUE (FT-LB)
	CARBON STEEL (CS)
3/8"	30
1/2"	50
5/8"	40
3/4"	110

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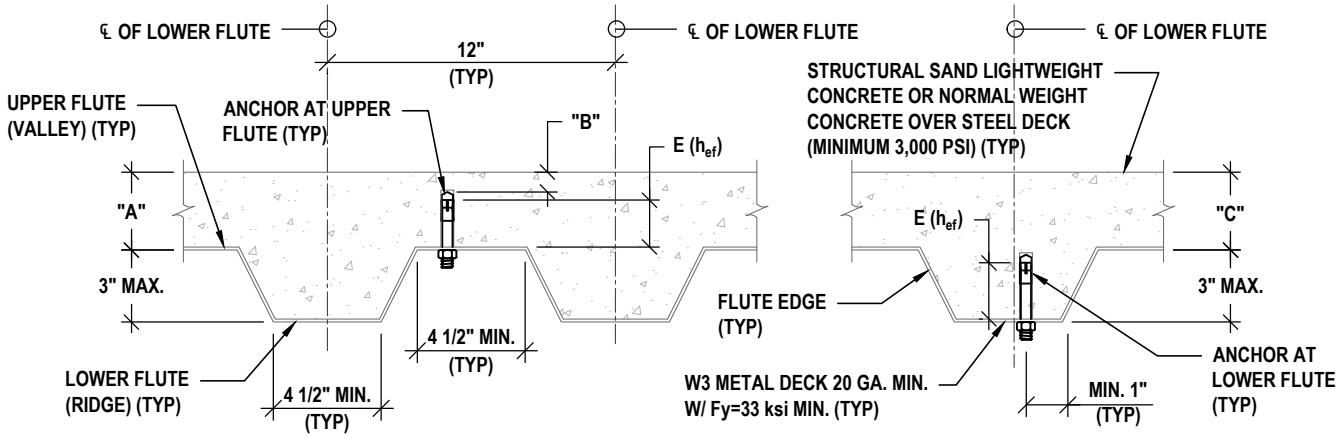
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INFORMATION AND REQUIREMENTS FOR W3 METAL DECK



NOTE: CONCRETE FILLED DECK SHALL BE 20 GAUGE W3 METAL DECK WITH Fy= 33 KSI MINIMUM.

WEDGE OR EXPANSION ANCHOR TYPE	ANCHOR DIAMETER	UPPER FLUTE		LOWER FLUTE	'E (h_{ef})' MIN. EFFECTIVE EMBEDMENT DEPTH	ICC-ESR APPROVAL
		'A' (1) MINIMUM CONCRETE FILL COVER	'B' MINIMUM COVER	'C' (1) MINIMUM CONCRETE FILL COVER		
HILTI KB-TZ2 CS	3/8"	3 3/8"	3/4"	3 3/8"	PER ICC-ESR	ESR-4266
	1/2"					
	5/8"					

FOOTNOTES:

1. CONCRETE COVER SHALL ACCOMMODATE THE ANCHOR EMBEDMENT AND MINIMUM COVER.

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SECTION FP-4

SEISMIC BRACE COMPONENTS

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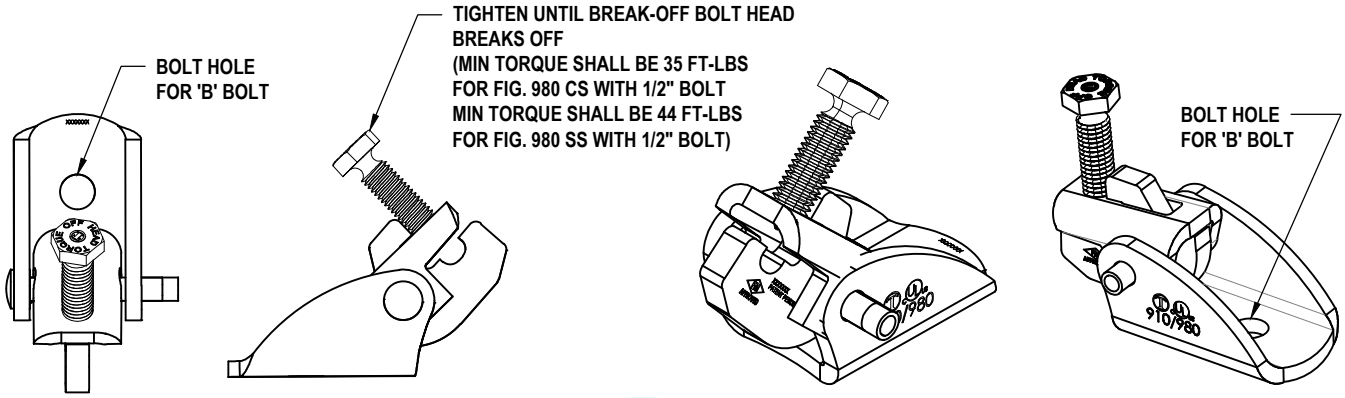
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TOLCO FIG. 980
UNIVERSAL SWIVEL SWAY BRACE ATTACHMENT



MAX. ALLOWABLE HORIZONTAL CAPACITY PER INSTALLATION BRACE ANGLE FROM VERTICAL (LBS)(ASD)				REMARKS
30°- 44°	45°- 59°	60°- 74°	75°- 90°	
1,050	1,484	1,818	2,028	SEE FOOTNOTE 1

FOOTNOTES:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.

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NOTES:

1. DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY HCAI.
2. "B" BOLT SIZE IS MINIMUM 1/2"Ø AND MAXIMUM 3/4"Ø. BOLT HOLE SIZE SHALL BE BOLT DIAMETER PLUS 1/16".
3. FIG. 980 HOLE DIAMETER SHALL BE 1/16" LARGER THAN BOLT DIAMETER.
4. FOR FIG. 980 MAXIMUM BOLT DIAMETER OF 3/4" IS APPLICABLE FOR CONNECTION TO THE SUPPORTING STRUCTURE.
5. BRACE MUST BE SCHEDULE 40 STEEL PIPE.

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TOLCO FIG. 4L
"IN-LINE" PIPE CLAMP SWAY BRACE ATTACHMENT

FIG. 4L - LONGITUDINAL ORIENTATION

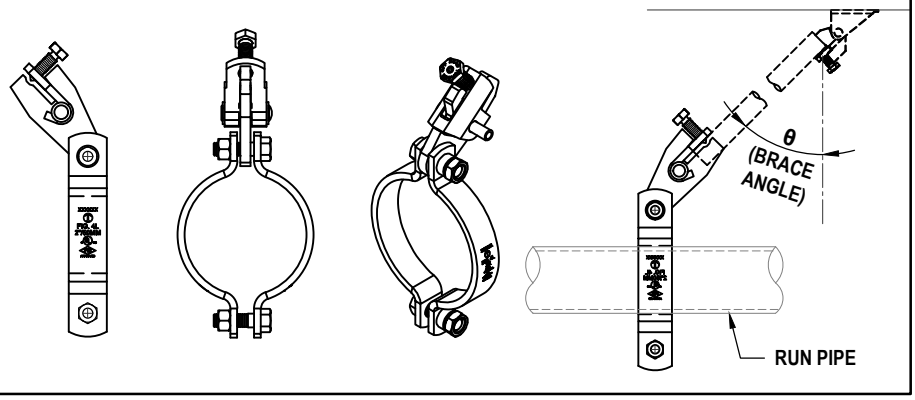
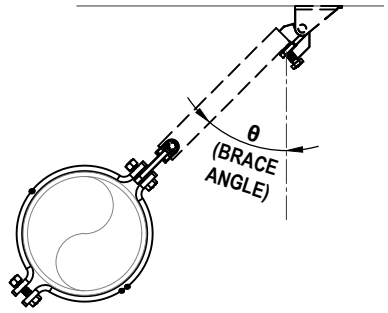


FIG. 4L - LATERAL ORIENTATION



LATERAL ORIENTATION (RUN PIPE BRACED LATERALLY)

COMPONENT	PART DESCRIPTION	RUN PIPE SIZE	RUN PIPE REFERENCE	ALLOWABLE HORIZONTAL LOAD (LBS)(ASD) BRACE ANGLE (θ) MEASURED FROM VERTICAL				REMARKS
				θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
TOLCO FIG. 4L	TRANSVERSE IN-LINE ATTACHMENT	2 1/2"	SCHED. 10, SCHED. 40	1,000	1,000	1,000	1,000	a
		3", 4", 5"	SCHED. 10, SCHED. 40	1,000	1,000	1,000	1,000	a
		6", 8"	0.188, SCHED. 40	1,200	1,200	1,200	1,200	a, b

REMARKS:

a. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO SCHEDULE 40 STEEL RUN PIPES.
b. LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKNESS WALL.
c. BRACE MUST BE SCHEDULE 40 STEEL PIPE.

LONGITUDINAL ORIENTATION (RUN PIPE BRACED LONGITUDINALLY)

COMPONENT	PART DESCRIPTION	RUN PIPE SIZE	RUN PIPE REFERENCE	ALLOWABLE HORIZONTAL LOAD (LBS)(ASD) BRACE ANGLE (θ) MEASURED FROM VERTICAL				REMARKS
				θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
TOLCO FIG. 4L	LONGITUDINAL IN-LINE ATTACHMENT	2 1/2"	SCHED. 10, SCHED. 40	1,030	1,180	1,420	1,590	a
		3", 4"	SCHED. 10, SCHED. 40	530	730	890	990	a
		5", 6", 8"	0.188, SCHED. 40	490	680	830	930	a, b

REMARKS:

a. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO SCHEDULE 40 STEEL RUN PIPES.
b. LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKER WALL.
c. BRACE MUST BE SCHEDULE 40 STEEL PIPE.

NOTES:

TIGHTEN BOLTS TO FOLLOWING TORQUE VALUES:

1. FOR 1/4" ---------- 6 FT-LBS
2. FOR 5/16" ---------- 11 FT-LBS
3. FOR 3/8" ---------- 20 FT-LBS
4. FOR 1/2" ---------- 49 FT-LBS
5. FOR 5/8" ---------- 97 FT-LBS
6. FOR 3/4" ---------- 173 FT-LBS
7. FOR 1" ---------- 250 FT-LBS

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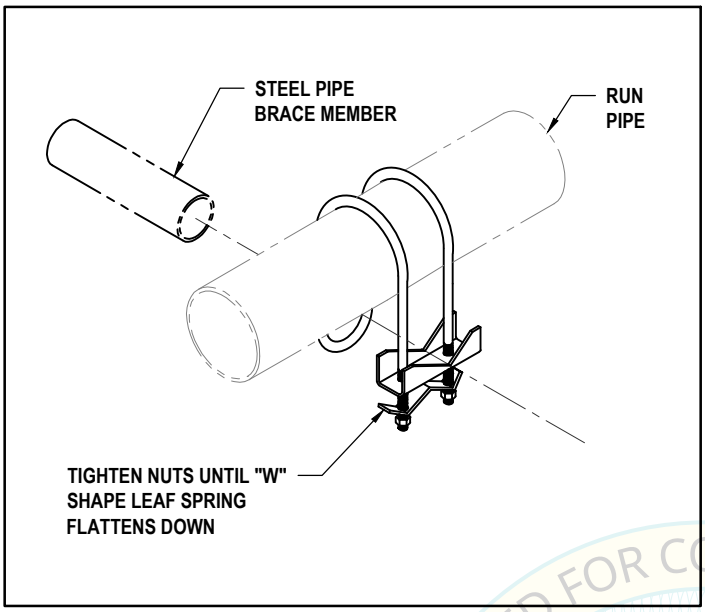
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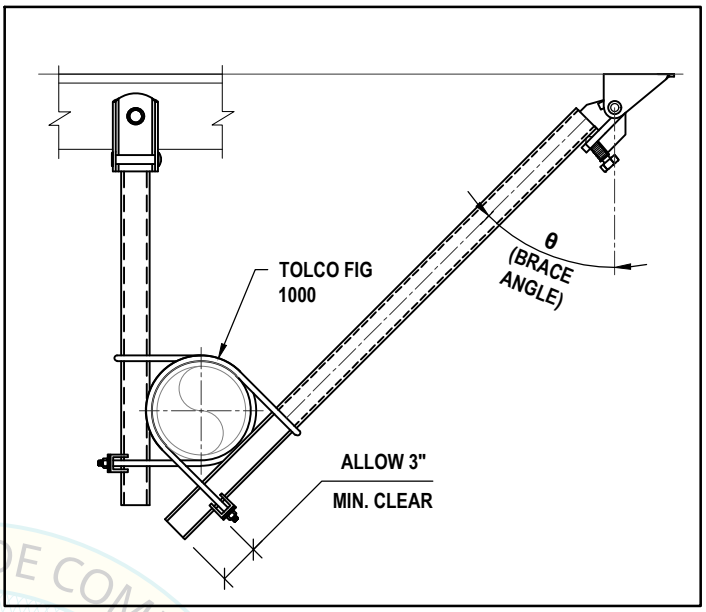
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TOLCO FIG. 1000
FAST CLAMP





MAX. ALLOWABLE HORIZONTAL CAPACITY (LBS)(ASD)

ORIENTATION	RUN PIPE REFERENCE	RUN PIPE SIZE	INSTALLATION BRACE ANGLE (θ) FROM VERTICAL				REMARKS
			θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
LATERAL	LW. 10, 40	1", 1 1/4", 1 1/2", 2", 2 1/2"	200	280	340	380	SEE FOOTNOTES 1 & 2
	LW. 10, 40	3", 4"	230	320	400	450	SEE FOOTNOTES 1 & 2

REMARKS:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
2. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL RUN PIPES.
3. BRACE MUST BE SCHEDULE 40 STEEL PIPE.

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NOTES:

1. FIG. 1000 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. FIG. 1000 MAY BE INSTALLED SUCH THAT NUTS ARE ON THE OPPOSITE SIDE THAN AS SHOWN.
3. DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY HCAI.

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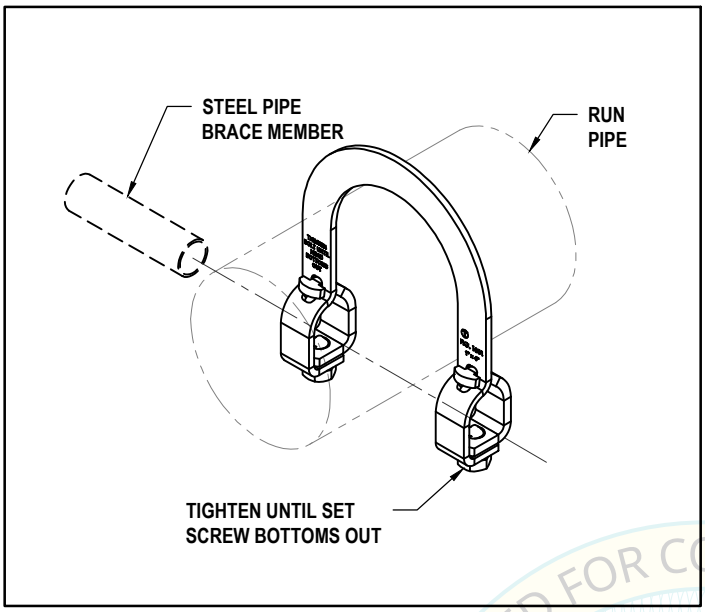
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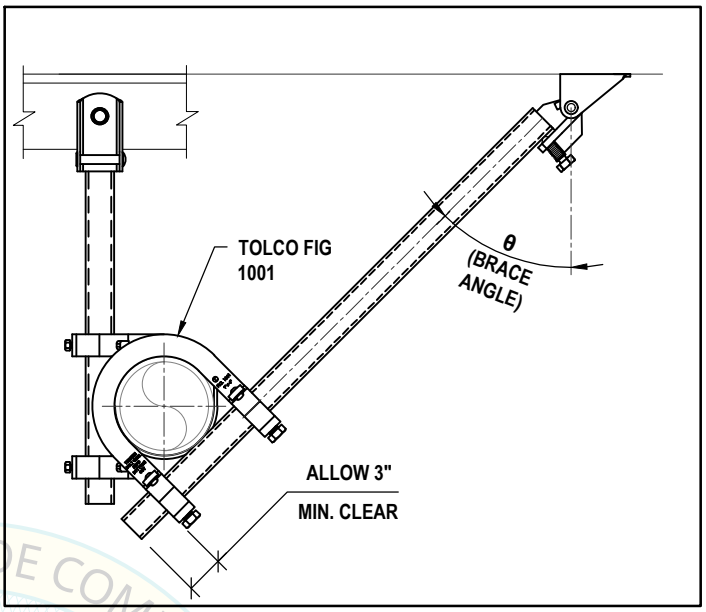
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TOLCO FIG. 1001
SWAY BRACE ATTACHMENT





MAX. ALLOWABLE HORIZONTAL CAPACITY (LBS)(ASD)

ORIENTATION	RUN PIPE REFERENCE	RUN PIPE SIZE	INSTALLATION BRACE ANGLE (θ) FROM VERTICAL				REMARKS
			θ = 30°-44°	θ = 45°-59°	θ = 60°-74°	θ = 75°-90°	
LATERAL	LW. 10, 40	1"	1,800	2,550	3,120	3,490	SEE FOOTNOTES 1 & 2
	LW. 10, 40	1 1/4", 1 1/2", 2"	1,230	1,740	2,140	2,380	SEE FOOTNOTES 1 & 2
	LW. 10, 40	2 1/2"	800	1,130	1,380	1,540	SEE FOOTNOTES 1 & 2
	LW. 10, 40	3", 4"	850	1,200	1,470	1,640	SEE FOOTNOTES 1 & 2
	LW. 10, 40	5", 6", 8"	510	730	890	990	SEE FOOTNOTES 1 & 2

REMARKS:

1. FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
2. LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255M AND H, JIS G3454, FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL RUN PIPES.
3. BRACE MUST BE SCHEDULE 40 STEEL PIPE.

NOTES:

1. FIG. 1001 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.
2. DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY HCAI.

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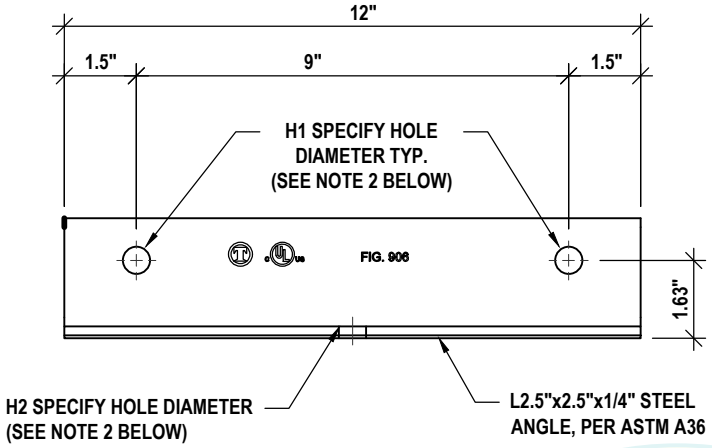
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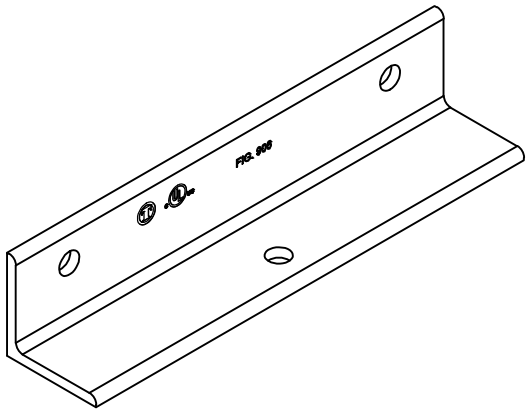
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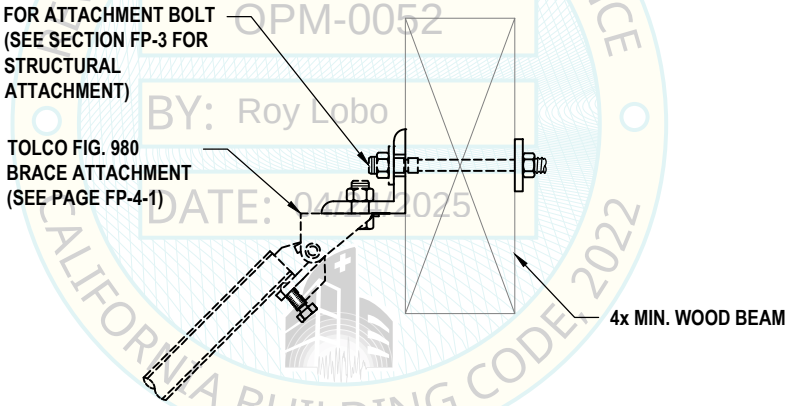
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TOLCO FIG. 906
SWAY BRACE MULTI-FASTENER ADAPTER







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NOTES:

1. FOR DESIGN LOADS SEE PAGES FP-3-10 AND FP-3-11 FOR STRUCTURAL ATTACHMENT.
2. HOLE DIAMETER TO BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3. APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS, VERTICAL SEISMIC LOAD AND HORIZONTAL SEISMIC LOADS.

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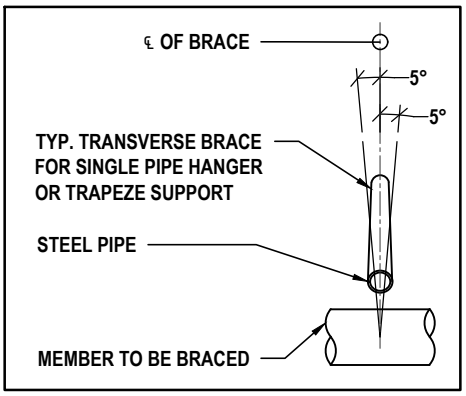
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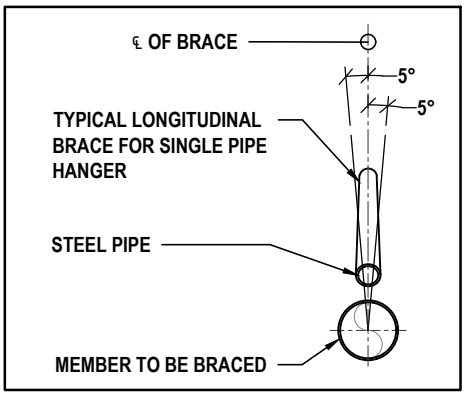
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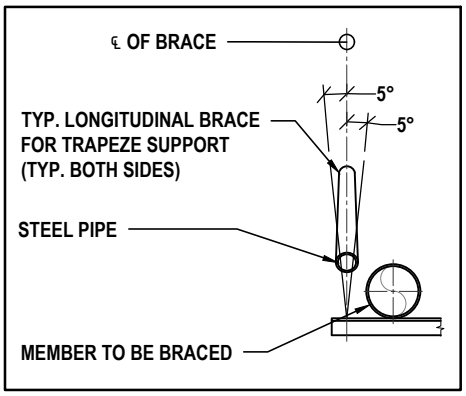
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MAXIMUM ALLOWABLE LENGTHS AND HORIZONTAL AND VERTICAL LOADS FOR BRACE MEMBERS







PIPE DIA.	MAX. LENGTH	SCHEDULE	BRACING CAPACITY				
			ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE @ MAX. INSTALLATION BRACE ANGLE FROM VERTICAL (ASD)(LBS)				MAX. VERTICAL SEISMIC LOAD W/ BRACE ANGLE FROM VERTICAL
			30°- 44°	45°- 59°	60°- 74°	75°- 90°	0°
SEISMIC BRACING KL/R = 200							
1"	7'-0"	40	613	932	1,188	1,363	1,444
1-1/4"	9'-0"	40	833	1,266	1,614	1,851	1,963
1-1/2"	10'-4"	40	1,006	1,530	1,950	2,236	2,371
2"	13'-1"	40	1,357	2,063	2,629	3,016	3,198
SEISMIC BRACING KL/R = 300							
1"	10'-6"	40	309	469	598	686	727
1-1/4"	13'-6"	40	418	636	811	930	986
1-1/2"	15'-7"	40	499	758	967	1,109	1,176
2"	19'-9"	40	676	1,028	1,311	1,504	1,594

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NOTES:

1. ALL LONGITUDINAL AND TRANSVERSE BRACING UTILIZING PIPE AS THE BRACING MEMBER HAS A TOLERANCE OF 5° FROM CENTER IN EITHER DIRECTION WITHOUT AFFECTING THE ALLOWABLE LOADS.
2. TABULATED LOADS ARE SUBJECT TO LIMITS GOVERNED BY THE CAPACITY OF THE PRIMARY STRUCTURE, INCLUDING, BUT NOT LIMITED TO CONCRETE FILL OVER METAL DECK CAPACITY. PER THE CONTRACT DOCUMENTS.
3. STEEL PIPE SHALL BE PER ASTM A53 TYPE E GRADE B, SCHEDULE 40: 1", 1 1/4", 1 1/2", 2" NPS. SEE ALSO PAGE FP-1-1.

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BRANCH LINE RESTRAINT WITH ROD CAPACITY TABLES

ROD DIA.	MAX. LENGTH	"I" RADIUS OF GYRATION (IN)	ALLOWABLE HORIZONTAL SEISMIC LOAD W/ RESTRAIN ROD @ MAX. INSTALLATION BRACE ANGLE FROM VERTICAL (ASD)(LBS)			MAX. VERTICAL SEISMIC LOAD W/ RESTRAIN ROD ANGLE FROM VERTICAL
			45°- 59°	60°- 74°	75°- 90°	0°
SEISMIC RESTRAIN ROD KL/R = 200						
3/8"	15"	0.07675	186	238	273	289
1/2"	20"	0.10425	354	451	517	548

ROD DIA.	MAX. LENGTH	"I" RADIUS OF GYRATION (IN)	ALLOWABLE HORIZONTAL SEISMIC LOAD W/ RESTRAIN ROD @ MAX. INSTALLATION BRACE ANGLE FROM VERTICAL (ASD)(LBS)			MAX. VERTICAL SEISMIC LOAD W/ RESTRAIN ROD ANGLE FROM VERTICAL
			45°- 59°	60°- 74°	75°- 90°	θ = 0°
SEISMIC RESTRAIN ROD KL/R = 300						
3/8"	23"	0.07675	77	98	113	120
1/2"	30"	0.10425	154	197	226	239

ROD DIA.	MAX. LENGTH	"I" RADIUS OF GYRATION (IN)	ALLOWABLE HORIZONTAL SEISMIC LOAD W/ RESTRAIN ROD @ MAX. INSTALLATION BRACE ANGLE FROM VERTICAL (ASD)(LBS)			MAX. VERTICAL SEISMIC LOAD W/ RESTRAIN ROD ANGLE FROM VERTICAL
			45°- 59°	60°- 74°	75°- 90°	0°
SEISMIC RESTRAIN ROD KL/R = 400						
3/8"	30"	0.07675	47	60	69	73
1/2"	40"	0.10425	89	114	131	138

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NOTES:

1. THE INTENT OF THIS PAGE IS TO SHOW COMPLIANCE WITH NFPA 13-2022, SECTION 18.6.1 (5).
2. PER NFPA 13-2022, SECTION 18.6.1 : RESTRAINT IS CONSIDERED A LESSER DEGREE OF RESISTING LOADS THAN BRACING.
3. RESTRAINT MAY BE PROVIDED USING HANGERS NOT LESS THAN 45 DEGREES FROM VERTICAL INSTALLED WITHIN 6 INCHES OF THE VERTICAL HANGER ARRANGED FOR RESTRAINT AGAINST UPWARD MOVEMENT, PROVIDED IT IS UTILIZED SUCH THAT KL/R DOES NOT EXCEED 400, WHERE THE ROD SHALL EXTEND TO THE PIPE OR HAVE A SURGE CLIP INSTALLED, PROVIDED THAT THE RESTRAINT COMPONENT DOES NOT SUPPORT DEAD LOAD.

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SECTION FP-5

FIRE PROTECTION
COMPONENT PART NUMBER REFERENCES

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FIRE PROTECTION
COMPONENT PART NUMBER REFERENCE

TOLCO FIG. 4L	
Part Number	**Description**
13521269	FIG. 4L 1" SWAY BRACE ATTACHMENT EG
13521310	FIG. 4L 1" SWAY BRACE ATTACHMENT HDG
13521268	FIG. 4L 1" SWAY BRACE ATTACHMENT PLN
13521068	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT EG
13521069	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT HDG
13521067	FIG. 4L 1 1/4" SWAY BRACE ATTACHMENT PLN
13521218	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT EG
13521320	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT HDG
13521219	FIG. 4L 1 1/2" SWAY BRACE ATTACHMENT PLN
13521183	FIG. 4L 2" SWAY BRACE ATTACHMENT EG
13521184	FIG. 4L 2" SWAY BRACE ATTACHMENT HDG
13521185	FIG. 4L 2" SWAY BRACE ATTACHMENT PLN
13521336	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT EG
13521337	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT HDG
13521338	FIG. 4L 2 1/2" SWAY BRACE ATTACHMENT PLN
13521166	FIG. 4L 3" SWAY BRACE ATTACHMENT EG
13521167	FIG. 4L 3" SWAY BRACE ATTACHMENT HDG
13521168	FIG. 4L 3" SWAY BRACE ATTACHMENT PLN
13521457	FIG. 4L 4" SWAY BRACE ATTACHMENT EG
13521458	FIG. 4L 4" SWAY BRACE ATTACHMENT HDG
13521456	FIG. 4L 4" SWAY BRACE ATTACHMENT PLN
13521313	FIG. 4L 5" SWAY BRACE ATTACHMENT EG
13521311	FIG. 4L 5" SWAY BRACE ATTACHMENT HDG
13521312	FIG. 4L 5" SWAY BRACE ATTACHMENT PLN
13521129	FIG. 4L 6" SWAY BRACE ATTACHMENT EG
13521430	FIG. 4L 6" SWAY BRACE ATTACHMENT HDG
13521128	FIG. 4L 6" SWAY BRACE ATTACHMENT PLN
13521323	FIG. 4L 8" SWAY BRACE ATTACHMENT EG
13521324	FIG. 4L 8" SWAY BRACE ATTACHMENT HDG
13521322	FIG. 4L 8" SWAY BRACE ATTACHMENT PLN

TOLCO FIG. 99	
Part Number	**Description**
Y245004120GP	FIG. 99 1/2" X 12" ATR PLN
Y245004120	FIG. 99 1/2"X 12" ATR PLN
Y245003120GP	FIG. 99 3/8" X 12" ATR PLN
Y245003180GP	FIG. 99 3/8" X 18" ATR PLN
Y245003240GP	FIG. 99 3/8" X 24" ATR PLN
Y245003300GP	FIG. 99 3/8" X 30" ATR PLN
Y245003720EGP	FIG. 99 3/8" X 72" ATR EG
Y245003120316	FIG. 99 3/8"X 12" ATR 316
Y245003300	FIG. 99 3/8"X 30" ATR PLN

TOLCO FIG. 800	
Part Number	**Description**
12259732	FIG. 800 TYPE1X4-6 ATMT HDG
Y338001E	FIG. 800 TYPE1X4-6 ATMT EG
Y338001	FIG. 800 TYPE1X4-6 ATMT PLN
Y338002	FIG. 800 TYPE1X6-8 ATMT PLN
Y338002E	FIG. 800 TYPE1X6-8 ATMT EG
Y338002HDG	FIG. 800 TYPE1X6-8 ATMT HDG
Y338003	FIG. 800 TYPE1X8-10 ATMT PLN
Y338003E	FIG. 800 TYPE1X8-10 ATMT EG
Y338004	FIG. 800 TYPE1X10-12 ATMT PLN
Y338004E	FIG. 800 TYPE1X10-12 ATMT EG
Y338005	FIG. 800 TYPE1X12-14 ATMT PLN
Y338005E	FIG. 800 TYPE1X12-14 ATMT EG
Y338006	FIG. 800 TYPE1X14-16 ATMT PLN
Y338006E	FIG. 800 TYPE1X14-16 ATMT EG
Y338007	FIG. 800 TYPE1X16-18 ATMT PLN
Y338007E	FIG. 800 TYPE1X16-18 ATMT EG
Y338201	FIG. 800 TYPE2X4-6 ATMT PLN
Y338201E	FIG. 800 TYPE2X4-6 ATMT EG
Y338202	FIG. 800 TYPE2X6-8 ATMT PLN
Y338202E	FIG. 800 TYPE2X6-8 ATMT EG
Y338203	FIG. 800 TYPE2X8-10 ATMT PLN
Y338203E	FIG. 800 TYPE2X8-10 ATMT EG
Y338204	FIG. 800 TYPE2X10-12 ATMT PLN
Y338204E	FIG. 800 TYPE2X10-12 ATMT EG
Y338205	FIG. 800 TYPE2X12-14 ATMT PLN
Y338205E	FIG. 800 TYPE2X12-14 ATMT EG
Y338206	FIG. 800 TYPE2X14-16 ATMT PLN
Y338206E	FIG. 800 TYPE2X14-16 ATMT EG
Y338207	FIG. 800 TYPE2X16-18 ATMT PLN
Y338207E	FIG. 800 TYPE2X16-18 ATMT EG

TOLCO FIG. 828	
Part Number	**Description**
13547592	FIG. 828 UNIV STRUCT SWAY BRC ATTACH EG
13547593	FIG. 828 UNV SWY BRC ATT HDG W/SS HDW
13547591	FIG. 828 UNIV STRUCT SWAY BRC ATTACH PLN

TOLCO FIG. 825	
Part Number	**Description**
12312720	FIG. 825 BJ EQBATMT HDG
Y340000	FG 825 BJ EQBATMT
Y340000E	FIG. 825 BJ EQBATMT EG

TOLCO FIG. 906	
Part Number	**Description**
E9055T001003	FIG. 906 1 & 1 1/4 H1 1/2, H2 3/8 EG
13518235	FIG. 906 1 & 1 1/4 H1&H2, 7/16 EG
12259204	FIG. 906 1 & 1 1/4 H1&H2=11/16 PLN
12557798	FIG. 906 1 & 1 1/4 H1=11/16 H2=13/16 EG
12233570	FIG. 906 1 & 1 1/4 H1=11/16 H2=9/16 PLN
13049936	FIG. 906 1 & 1 1/4 H1=13/16 H2=11/16 PLN
12999051	FIG. 906 1 & 1 1/4 H1=13/16 H2=9/16 EG
12219991	FIG. 906 1 & 1 1/4 H1=13/16 H2=9/16 PLN
12261207	FIG. 906 1 & 1 1/4 H1=5/8 H2=1/2 PLN
12514452	FIG. 906 1 & 1 1/4 H1=7/16 H2=9/16 PLN
12987163	FIG. 906 1 & 1 1/4 H1=9/16 H2=7/16 PLN
E9055T001004	FIG. 906 1 & 1 1/4 MFA H1&H2, 5/8 HDG
12451915	FIG. 906 1 & 1 1/4 MFA H1&H2=1/2 EG
13777943	FIG. 906 1 & 1 1/4 MFA H1&H2=13/16 EG
13255554	FIG. 906 1 & 1 1/4 MFA H1&H2=13/16 PLN
12536183	FIG. 906 1 & 1 1/4 MFA H1&H2=3/4 EG
12214660	FIG. 906 1 & 1 1/4 MFA H1&H2=3/4 PLN
12608675	FIG. 906 1 & 1 1/4 MFA H1&H2=3/8 PLN
12264678	FIG. 906 1 & 1 1/4 MFA H1&H2=5/8 PLN
Y334010012E	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 EG
Y334010012HDG	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 HDG
Y334010012	FIG. 906 1 & 1 1/4 MFA H1&H2=9/16 PLN

TOLCO FIG. 980	
Part Number	**Description**
13520713	FIG. 980 3/8HL UNIVBRCATT EG
13520714	FIG. 980 3/8HL UNIVBRCATT HDG
13520712	FIG. 980 3/8HL UNIVBRCATT PLN
13520884	FIG. 980 1/2HL UNIVBRCATT EG
13520885	FIG. 980 1/2HL UNIVBRCATT HDG
13520883	FIG. 980 1/2HL UNIVBRCATT PLN
13520024	FIG. 980 5/8HL UNIVBRCATT EG
13520025	FIG. 980 5/8HL UNIVBRCATT HDG
13520023	FIG. 980 5/8HL UNIVBRCATT PLN
13520736	FIG. 980 3/4HL UNIVBRCATT EG
13520737	FIG. 980 3/4HL UNIVBRCATT HDG
13520735	FIG. 980 3/4HL UNIVBRCATT PLN

TOLCO FIG. 980S	
Part Number	**Description**
13620715	FIG. 980S 3/8" HL UNIVBRCATT 316
13520886	FIG. 980S 1/2" HL UNIVBRCATT 316
13520026	FIG. 980S 5/8" HL UNIVBRCATT 316
13520738	FIG. 980S 3/4" HL UNIVBRCATT 316

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FIRE PROTECTION
COMPONENT PART NUMBER REFERENCE

TOLCO FIG. 1000	
Part Number	**Description**
12377438	FIG. 1000 1" X 1" HDG
Y380010010304	FIG. 1000 1X1 FASTC 304
13813430	FIG. 1000 1X1 FASTC 316
Y380010010E	FIG. 1000 1X1 FASTC EG
Y380010010	FIG. 1000 1X1 FASTC PLN
Y380010012304	FIG. 1000 1 1/4X1 FASTC 304
Y380010012316	FIG. 1000 1 1/4X1 FASTC 316
Y380010012E	FIG. 1000 1 1/4X1 FASTC EG
Y380010012HDG	FIG. 1000 1 1/4X1 FASTC HDG
Y380010012	FIG. 1000 1 1/4X1 FASTC PLN
Y380010014304	FIG. 1000 1 1/2X1 FASTC 304
Y380010014316	FIG. 1000 1 1/2X1 FASTC 316
Y380010014E	FIG. 1000 1 1/2X1 FASTC EG
Y380010014HDG	FIG. 1000 1 1/2X1 FASTC HDG
Y380010014	FIG. 1000 1 1/2X1 FASTC PLN
Y380010020HDG	FIG. 1000 2X 1 FASTC HDG
Y380010020304	FIG. 1000 2X1 FASTC 304
Y380010020316	FIG. 1000 2X1 FASTC 316
Y380010020E	FIG. 1000 2X1 FASTC EG
Y380010020	FIG. 1000 2X1 FASTC PLN
Y380010024304	FIG. 1000 2 1/2X1 FASTC 304
Y380010024316	FIG. 1000 2 1/2X1 FASTC 316
Y380010024E	FIG. 1000 2 1/2X1 FASTC EG
Y380010024HDG	FIG. 1000 2 1/2X1 FASTC HDG
Y380010024	FIG. 1000 2 1/2X1 FASTC PLN
Y380010030HDG	FIG. 1000 3X 1 FASTC HDG
Y380010030304	FIG. 1000 3X1 FASTC 304
Y380010030316	FIG. 1000 3X1 FASTC 316
Y380010030E	FIG. 1000 3X1 FASTC EG
Y380010030	FIG. 1000 3X1 FASTC PLN
E9055T001002	FIG. 1000 3 1/2X1 FASTC EG
Y380010034	FIG. 1000 3 1/2X1 FASTC PLN
Y380010040HDG	FIG. 1000 4X 1 FASTC HDG
Y380010040304	FIG. 1000 4X1 FASTC 304
Y380010040316	FIG. 1000 4X1 FASTC 316
Y380010040E	FIG. 1000 4X1 FASTC EG
Y380010040	FIG. 1000 4X1 FASTC PLN
14200990	FIG. 1000 1X1 1/4 FASTC 316
Y380012010E	FIG. 1000 1X1 1/4 FASTC EG
Y380012010	FIG. 1000 1X1 1/4 FASTC PLN
Y380012012E	FIG. 1000 1 1/4X1 1/4FASTC EG
Y380012012	FIG. 1000 1 1/4X1 1/4FASTC PLN
E9055T001001	FIG. 1000 1 1/2X1 1/4FASTC 316
Y380012014E	FIG. 1000 1 1/2X1 1/4FASTC EG
Y380012014	FIG. 1000 1 1/2X1 1/4FASTC PLN

TOLCO FIG. 1000 (CONT'D)	
Part Number	**Description**
Y380012020316	FIG. 1000 2X1 1/4 FASTC 316
Y380012020E	FIG. 1000 2X1 1/4 FASTC EG
Y380012020	FIG. 1000 2X1 1/4 FASTC PLN
Y380012024E	FIG. 1000 2 1/2X1 1/4FASTC EG
Y380012024HDG	FIG. 1000 2 1/2X1 1/4FASTC HDG
Y380012024	FIG. 1000 2 1/2X1 1/4FASTC PLN
Y380012030HDG	FIG. 1000 3X 1 1/4FASTC HDG
12531556	FIG. 1000 3X1 1/4 FASTC 304
Y380012030E	FIG. 1000 3X1 1/4 FASTC EG
Y380012030	FIG. 1000 3X1 1/4 FASTC PLN
Y380012034	FIG. 1000 3 1/2X1 1/4FASTC PLN
Y380012040HDG	FIG. 1000 4X 1 1/4FASTC HDG
Y380012040304	FIG. 1000 4X1 1/4 FASTC 304
Y380012040E	FIG. 1000 4X1 1/4 FASTC EG
Y380012040	FIG. 1000 4X1 1/4 FASTC PLN

TOLCO FIG. 1001	
Part Number	**Description**
Y379010010E	FIG. 1001 1 X 1 FC SWBA EG
Y379010010	FIG. 1001 1 X 1 FC SWBA PLN
Y379010012E	FIG. 1001 1 1/4 X 1 FC SWBA EG
12555198	FIG. 1001 1 1/4 X 1 FC SWBA HDG
Y379010012	FIG. 1001 1 1/4 X 1 FC SWBA PLN
Y379010014E	FIG. 1001 1 1/2 X 1 FC SWBA EG
Y379010014	FIG. 1001 1 1/2 X 1 FC SWBA PLN
Y379010020E	FIG. 1001 2 X 1 FC SWBA EG
Y379010020	FIG. 1001 2 X 1 FC SWBA PLN
Y379012024	FIG. 1001 2 1/2 X 1 1/4 FC SWBA PLN
Y379010024E	FIG. 1001 2 1/2 X 1 FC SWBA EG
12321945	FIG. 1001 2 1/2 X 1 FC SWBA HDG
Y379010030E	FIG. 1001 3 X 1 FC SWBA EG
12213012	FIG. 1001 3 X 1 FC SWBA HDG
Y379010030	FIG. 1001 3 X 1 FC SWBA PLN
12228968	FIG. 1001 4 X 1 FC SWBA HDG
Y379010040E	FIG. 1001 4 X1 FC SWBA EG
Y379010040	FIG. 1001 4 X1 FC SWBA PLN
Y379010050E	FIG. 1001 5 X 1 FC SWBA EG
Y379010050	FIG. 1001 5 X 1 FC SWBA PLN
12204741	FIG. 1001 6 X 1 FC SWBA HDG
Y379010060E	FIG. 1001 6 X1 FC SWBA EG
Y379010060	FIG. 1001 6 X1 FC SWBA PLN
Y379010080E	FIG. 1001 8 X1 FC SWBA EG
Y379010080	FIG. 1001 8 X1 FC SWBA PLN
Y379012010E	FIG. 1001 1 X 1 1/4 FC SWBA EG
Y379012010	FIG. 1001 1 X 1 1/4 FC SWBA PLN
Y379012012E	FIG. 1001 1 1/4 X 1 1/4 FC SWBA EG
Y379012012	FIG. 1001 1 1/4 X 1 1/4 FC SWBA PLN
Y379012014E	FIG. 1001 1 1/2 X 1 1/4 FC SWBA EG
Y379012014	FIG. 1001 1 1/2 X 1 1/4 FC SWBA PLN
Y379012020E	FIG. 1001 2 X 1 1/4 FC SWBA EG
Y379012020	FIG. 1001 2 X 1 1/4 FC SWBA PLN
Y379012024E	FIG. 1001 2 1/2 X 1 1/4 FC SWBA EG
Y379012024	FIG. 1001 2 1/2 X 1 1/4 FC SWBA PLN
Y379012030E	FIG. 1001 3 X 1 1/4 FC SWBA EG
12396667	FIG. 1001 3 X 1 1/4 FC SWBA HDG
Y379012030	FIG. 1001 3 X 1 1/4 FC SWBA PLN
12390079	FIG. 1001 4 X 1 1/4 FC SWBA HDG
Y379012040	FIG. 1001 4 X 1 1/4 FC SWBA PLN
Y379012040E	FIG. 1001 4 X1 1/4 FC SWBA EG
Y379012050E	FIG. 1001 5 X 1 1/4 FC SWBA EG
Y379012050	FIG. 1001 5 X 1 1/4 FC SWBA PLN
Y379012060E	FIG. 1001 6 X1 1/4 FC SWBA EG
Y379012060	FIG. 1001 6 X1 1/4 FC SWBA PLN
Y379012080E	FIG. 1001 8 X1 1/4 FC SWBA EG
Y379012080	FIG. 1001 8 X1 1/4 FC SWBA PLN

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APPENDIX FP-A

2022 CALIFORNIA BUILDING CODE
DESIGN FORCE FORMULAS
AND
SEISMIC FACTORS CALCULATIONS

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FIRE PROTECTION
2022 CALIFORNIA BUILDING CODE - DESIGN FORCE FORMULAS

This HCAI Pre-approval of Manufacturer's Certification (OPM) is based on the 2022 CBC. The demand (design forces) for use with this OPM shall be based on the 2022 CBC. The ASCE 7-16 is a referenced document in the 2022 CBC. As stated in the ASCE 7-16 SECTION 13.3.1, the horizontal seismic force (F_P) may be calculated using the formula below.

$$F_P = \left[\frac{0.4\, a_P\, S_{DS}\, W_P}{R_P} \right] \left(1 + 2 \left(\frac{z}{h} \right) \right) W_P \qquad \text{(LRFD)}$$

F_P shall not be less than: $(0.3\, S_{DS}\, I_P)\, W_P$ (LRFD)

F_P need not be greater than: $(1.6\, S_{DS}\, I_P)\, W_P$ (LRFD)

F_P = Seismic Design Force (LRFD)

R_P = Component Response Modification Factor

a_P = Component Amplification Factor

I_P = Component Importance Factor

S_{DS} = Design spectral response acceleration at short period

z = Element or component attachment elevation with respect to grade
Note: (z) shall not be taken less than 0.0

h = Average structure roof elevation with respect to grade.

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PIPING SEISMIC FORCE FACTOR (HIGH DEFORMABILITY)

Seismic force per California Building Code (CBC) 2022, Title 24 Part 2, and California Maximum Seismic

$a_P = 2.5$	Component Amplification Factor
$R_P = 4.5$	Component Response Modification Factor
$S_{DS} = 2.5$	Design Spectral Response Acceleration at Short
$I_P = 1.5$	Component Importance Factor
$F_P = \left[\frac{0.4\, a_P\, S_{DS}}{\frac{R_P}{I_P}}\right] (1 + 2\frac{z}{h}) = 2.5$	Seismic Horizontal Coefficient Controls (LRFD)
$F_{P\text{-}MIN} = 0.3\, S_{DS}\, I_P = 1.125$	Seismic Horizontal Coefficient, Lower Limit (LRFD)
$F_{P\text{-}MAX} = 1.6\, S_{DS}\, I_P = 6$	Seismic Horizontal Coefficient, Upper Limit (LRFD)
$F_{PW} = F_P = 2.5$	Seismic Horizontal Coefficient (LRFD)
$F_{PW} = F_P\, (0.7) = 1.75$	Seismic Horizontal Coefficient (ASD)
$F_{VW} = 0.2\, S_{DS} = 0.5$	Seismic Vertical Coefficient (LRFD)
$F_{VW} = 0.2\, S_{DS}\, (0.7) = 0.35$	Seismic Vertical Coefficient (ASD)

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California SE No. S3545

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DATE: **April 23, 2025**

APPENDIX FP-B

METRIC CONVERSION CHARTS

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FIRE PROTECTION
METRIC CONVERSION CHART

Convert From	To	Multiply By
Angle		
degree	radian(rad)	1.7453×10^{-2}
radian(rad)	degree	5.7296×10^{1}
Area		
$foot^2$	square meter (m^2)	9.2903×10^{-2}
$inch^2$	square meter (m^2)	6.4516×10^{-4}
circular mil	square meter (m^2)	5.0671×10^{-10}
sq. centimeter (cm^2)	square inch (in^2)	1.5500×10^{-1}
sq. meter (m^2)	$foot^2$	1.0764×10^{1}
sq. meter (m^2)	$inch^2$	1.5500×10^{3}
sq. meter (m^2)	circular mil	1.9735×10^{9}
Temperature		
degree Fahrenheit	degree Celsius	t°C = (t°F-32) /1.8
degree Celsius	degree Fahrenheit	t°F = 1.8t°C + 32
Force		
pounds-force (lbs)	newtons (N)	4.4482
Length		
foot (ft)	meter (m)	3.0480×10^{-1}
inch (in)	meter (m)	2.5400×10^{-2}
mil	meter (m)	2.5400×10^{-5}
inch (in)	micrometer (μm)"	2.5400×10^{4}
meter (m)	foot (ft)	3.2808
meter (m)	inch (in)	3.9370×10^{1}
meter (m)	mil	3.9370×10^{4}
micrometer (μm)	inch (in)	3.9370×10^{-5}
Volume		
$foot^3$	cubic meter (m^3)	2.8317×10^{-2}
$inch^3$	cubic meter (m^3)	1.6387×10^{-5}
cubic centimeter (cm^3)	cubic inch (in^3)	6.1024×10^{-2}
cubic meter (m^3)	$foot^3$	3.5315×10^{1}
cubic meter (m^3)	$inch^3$	6.1024×10^{4}
gallon (U.S. liquid)	cubic meter (m^3)	3.7854×10^{-3}

Convert From	To	Multiply By
Mass		
pound (avoirdupois)	kilogram (kg)	4.5359×10^{-1}
kilogram (kg)	pound (avoirdupois)	2.2046
Mass Per Unit Length		
lb/ft	kilogram/meter (kg/m)	1.4882
lb/in	kilogram/meter (kg/m)	1.7858×10^{1}
kg/m	lb/ft	6.7197×10^{-1}
kg/m	lb/in	5.5997×10^{-2}
Mass Per Unit Volume		
lb/ft^3	kilogram/meter (kg/m^3)	1.6018×10^{1}
lb/in^3	kilogram/meter (kg/m^3)	2.7680×10^{4}
kg/m^3	lb/ft^3	6.2428×10^{-2}
kg/m^3	lb/in^3	3.6127×10^{-5}
lbs/ft^3	lbs/in^3	1.7280×10^{3}
Mass Per Area Unit		
lb/ft^2	kilogram/sq.meter(kg/m^2)	1.6018×10^{1}
kg/m^2	kilogram/sq.meter(kg/m^2)	2.7680×10^{4}
Mass Per Unit Volume		
lbf/in^2 (psi)	pascal (Pa)	6.8948×10^{3}
kip/in^2 (ksi)	pascal (Pa)	6.8948×10^{6}
lbf/in^2(psi)	megapascals (MPa)	6.8948×10^{-3}
pascal (Pa)	pound force/sq. inch(psi)	1.4504×10^{-4}
pascal (Pa)	kip per sq. inch (ksi)	1.4504×10^{-7}
Bending Moment or Torque		
lbf . ft	newton meter (N . m)	1.3559
lbf . in	newton meter (N . m)	1.1299×10^{-1}
N . m	lbf . ft	7.3756×10^{-1}
N . m	lbf . in	8.8507

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APPENDIX FP-C

PIPE WEIGHT TABLES

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FIRE PROTECTION
PIPE WEIGHT TABLES

STEEL PIPE (SCHEDULE 5)			
Pipe Diameter	Pipe Schedule	Weight Per Foot (lbs.)	
		Water Filled	1.15 x Water Filled [1]
1"	5	1.36	1.57
1-1/4"	5	1.93	2.22
1-1/2"	5	2.37	2.73
2"	5	3.35	3.86
2-1/2"	5	5.03	5.79
3"	5	6.88	7.92
3-1/2"	5	8.55	9.84

FOOTNOTES:

1. WATER FILLED WEIGHT BASED ON NFPA 13-2022, TABLE A.18.5.9, WEIGHT TABLES PLUS 15% FITTINGS ALLOWANCE.

STEEL PIPE (SCHEDULE 10)			
Pipe Diameter	Pipe Schedule	Weight Per Foot (lbs.)	
		Water Filled	1.15 x Water Filled [1]
1"	10	1.81	2.08
1-1/4"	10	2.52	2.90
1-1/2"	10	3.04	3.50
2"	10	4.22	4.85
2-1/2"	10	5.89	6.77
3"	10	7.94	9.13
3-1/2"	10	9.78	11.25
4"	10	11.78	13.55
5"	10	17.30	19.90
6"	10	23.03	26.49
8"	10	40.08	46.09

FOOTNOTES:

1. WATER FILLED WEIGHT BASED ON NFPA 13-2022, TABLE A.18.5.9, WEIGHT TABLES PLUS 15% FITTINGS ALLOWANCE.

STEEL PIPE (SCHEDULE 40)			
Pipe Diameter	Pipe Schedule	Weight Per Foot (lbs.)	
		Water Filled	1.15 x Water Filled [1]
1"	40	2.10	2.42
1-1/4"	40	3.00	3.45
1-1/2"	40	3.60	4.14
2"	40	5.20	5.98
2-1/2"	40	7.90	9.09
3"	40	10.80	12.42
3-1/2"	40	13.40	15.41
4"	40	16.50	18.98
5"	40	24.70	28.41
6"	40	31.50	36.23
8"	40	51.00	58.65 [2]
8"	FOOTNOTE [3]	47.70	54.86
10"	40	75.00	86.25 [2]
12"	40	103.00	118.45 [2]

FOOTNOTES:

1. FOR PIPE SIZES 1"-6" WATER FILLED WEIGHT BASED ON NFPA 13-2022, TABLE A.18.5.9, WEIGHT TABLED PLUS 15% FITTINGS ALLOWANCE.
2. WATER FILLED WEIGHT PLUS 15% FITTINGS ALLOWANCE.
3. WALL PIPE = 0.188"

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