

TABLE 16A-O—HORIZONTAL FORCE FACTOR, C_p

ELEMENTS OF STRUCTURES, NONSTRUCTURAL COMPONENTS AND EQUIPMENT ¹	VALUE OF C_p	FOOTNOTE
1. Elements of structures 1. Walls including the following: a. Unbraced (cantilevered) parapets b. Other exterior walls above the ground floor c. All interior bearing and nonbearing walls and partitions d. Masonry or concrete fences over 6 feet (1829 mm) high 2. Penthouse (except when framed by an extension of the structural frame) 3. Connections for prefabricated structural elements other than walls, with force applied at center of gravity 4. Diaphragms	2.00 0.75 0.75 0.75 0.75 0.75 —	2 11 4,12 5
2. Nonstructural components 1. Exterior and interior ornamentations and appendages 2. Chimneys, stacks, trussed towers and tanks on legs: a. Supported on or projecting as an unbraced cantilever above the roof more than one half their total height b. All others, including those supported below the roof with unbraced projection above the roof less than one half its height, or braced or guyed to the structural frame at or above their centers of mass 3. Signs and billboards 4. Storage racks (include contents) with upper storage level more than 5 feet (1524 mm) in height 5. Anchorage for permanent floor-supported cabinets and book stacks more than 5 feet (1524 mm) in height (include contents) 6. Anchorage for suspended ceilings and light fixtures 7. Access floor systems 8. Wall hung cabinets and storage shelving (plus contents)	2.00 2.00 0.75 2.00 0.75 0.75 0.75 0.75	12 10,17 12,16,17 4,6,7,11,18, 19 4,9,12
3. Equipment 1. Tanks and vessels (include contents), including support systems and anchorage 2. Electrical, mechanical and plumbing equipment and associated conduit, ductwork and piping, and machinery. <i>In hospitals and essential services buildings, this includes all piping, electrical conduits, cable trays and air-handling ducting necessary to the continuing operation of the facility</i> 3. Anchorage of emergency power supply systems, essential communications equipment, battery racks and fuel tanks necessary for operation of such equipment 4. Anchorage of hospital equipment when permanently attached to the building utility services such as surgical, morgue and recovery room fixtures, radiology equipment, medical gas containers, food service fixtures, essential laboratory equipment, TV supports, etc. 5. Power cable-driven elevators or hydraulic elevators with lifts over 5 feet (1524 mm): a. Hoistway structural framing providing the support for guide rail brackets b. Guide rails and guide rail brackets c. Car and counterweight auxiliary guiding members or retainer plates d. Driving machinery, pump unit tanks operating devices and control equipment cabinets	0.75 0.75 1.0 0.75	12,16 8,12,14,15 12,13 12 20,21

¹See Section 1630A.2 for items supported at or below grade for formula using C_p and for definitions. Horizontal forces are to be applied in any horizontal direction. The value of C_p shall not be reduced for all walls. Welded, bolted or other intermittent connections such as inserts for anchorage of nonstructural components shall not be allowed the one-third increase in allowable stress permitted in Section 1603A.5.

²See Section 1631A.2.4 and Section 1630A.2.

³Deleted)

⁴Applies to Seismic Zones 2, 3 and 4 only.

⁵See Section 1631A.2.9.

(Continued)

FOOTNOTES TO TABLE 16A-O—(Continued)

- ⁶Ceiling weight shall include all light fixtures and other equipment or partitions which are laterally supported by the ceiling. For purposes of determining the seismic force, a ceiling weight of not less than 4 pounds per square foot (19.5 kg/m²) shall be used.
- ⁷Ceilings constructed of lath and plaster or gypsum board screw or nail attached to suspended members that support a ceiling at one level extending from wall to wall need not be analyzed provided that the minimum distance between opposing walls is not over 50 feet (15 240 mm) apart.
- ⁸Equipment includes, but is not limited to, boiler, chiller, heat exchanger, pump, air-handling unit, cooling tower, control panel, motor, switch gear, transformer and life-safety equipment. It includes major conduit, ducting and piping serving such machinery and equipment and fire sprinkler systems. See Section 1630A.2 for additional requirements for determining C_p for nonrigid or flexibly mounted equipment.
- ⁹ W_p for access floor systems shall be the dead load of the access floor system plus 25 percent of the floor live load plus a 10 psf (0.479 kN/m²) partition load allowance.
- ¹⁰In lieu of the tabulated values, steel storage racks may be designed in accordance with Chapter 22A, Division VI, subject to the limitations of Sections 1630A.5 and 1632A.5, Item 3.
- ¹¹Light fixtures and mechanical services installed in metal suspension systems for acoustical tile and lay-in panel ceilings shall be independently supported from the structure above as specified in U.B.C. Standard 25-2, Part III. See also Section 1610A.2 for minimum load and deflection criteria for interior partitions.
- ¹²The component anchorage shall be designed for the horizontal force, F_p , acting simultaneously with a vertical seismic force equal to one third of the horizontal force, F_p .
- ¹³Emergency equipment should be located where there is the least likelihood of damage due to earthquake. Such equipment should be located at ground level, and where it can be easily maintained to assure its operation during an emergency.
- ¹⁴Seismic restraints may be omitted from the following installations:
- ^{14.1} Gas piping less than 1 inch (25 mm) inside diameter.
 - ^{14.2} Piping in boiler and mechanical equipment rooms less than 1.25 inches (32 mm) inside diameter.
 - ^{14.3} All piping less than 2.5 inches (64 mm) inside diameter.
 - ^{14.4} All piping suspended by individual hangers 12 inches (305 mm) or less in length from the top of pipe to the bottom of the support for the hanger.
 - ^{14.5} All electrical conduit less than 2.5 inches (64 mm) inside diameter.
 - ^{14.6} All rectangular air-handling ducts less than 6 square feet (0.56 m²) in cross-sectional area.
 - ^{14.7} All round air-handling ducts less than 28 inches (711 mm) in diameter.
 - ^{14.8} All ducts suspended by hangers 12 inches (305 mm) or less in length from the top of the duct to the bottom of the support for the hanger.
- ¹⁵For rigidly supported piping, electrical conduit, cable trays or air-handling ducts, the product of IC_p need not exceed 1.2 for any value of I .
- ¹⁶Floor-supported storage racks, cabinets or book stacks not more than 5 feet (1524 mm) in height need not be anchored if the width of the supporting base or width between the exterior legs is equal to or greater than two thirds the height. In addition to gravity loads, storage racks or cabinets shall be designed and constructed to resist the horizontal force, F_p , with the base assumed to be anchored.
- ¹⁷Mobile storage racks or cabinets mounted on wheels and not restrained by fixed tracks are not subject to approval by the enforcement agency when the rack or cabinet is not more than 5 feet (1524 mm) in height and the width of the supporting base or width between the exterior legs/wheels is equal to or greater than two thirds the height. All such racks or cabinets shall be restrained to prevent movement when not in use. Movable storage racks or cabinets mounted on wheels or glides restrained by fixed tracks shall be designed and constructed to resist the horizontal force, F_p , with the base of the rack or cabinet assumed to be anchored. Provisions shall be made to resist translation perpendicular to the track and overturning both perpendicular and parallel to the track.
- ¹⁸Suspension systems for light fixtures which have passed shaking table tests approved the enforcement agency, or which, as installed, are free to swing a minimum of 45 degrees from the vertical in all directions without contacting obstructions, shall be assumed to comply with the lateral-force requirements of Section 1630A.2. Unless the cable type, free-swinging suspension systems shall have a safety wire or cable attached to the fixture and structure at each support capable of supporting four times the supported load.
- ¹⁹For suspended and surface-mounted light fixtures, the product of IC_p need not exceed 1.2 for any value of I .
- ²⁰See Part 7, Title 24, California Code of Regulations. All requirements therein shall be met as a minimum.
- ²¹The design of guide rail support-bracket fastenings and the supporting structural framing shall be in accordance with Section 3030 (k), Part 7, Title 24, using the weight of the counterweight or maximum weight of the car plus not less than 40 percent of its rated load. The seismic forces shall be assumed to be distributed one third to the top guiding members and two thirds to the bottom guiding members of cars and counterweights, unless other substantiating data are provided. Minimum seismic forces shall be 0.5g acting in any horizontal direction. Retainer plates are required for both car and counterweight, designed in accordance with Section 3032 (c), Part 7, Title 24, California Code of Regulations. Retainer plates are required top and bottom of car and counterweight, except where safety devices acceptable to the enforcement agency are provided which meet all requirement of the retainer plates, including full engagement of the machined portion of the rail. The design of the car and counterweight guide rails for seismic forces shall be based on the following requirements:
- ^{21.1} The lateral forces shall be based on horizontal acceleration of 0.5g for all buildings.

FOOTNOTES TO TABLE 16A-O—(Continued)

- 21.2 W_p shall equal the weight of the counterweight or the maximum weight of the car plus not less than 40 percent of its rated load.
- 21.3 With the car or counterweight located in the most adverse position, the stress in the rail shall not exceed the limitations specified in these regulations, nor shall the deflection of the rail relative to its supports exceed the deflections listed below:

Rail Size (weight per foot of length, pounds)	Width of Machined Surface (inch)	Allowable Rail Deflection (inch)
8	1 ¹ / ₄	0.20
11	1 ¹ / ₂	0.30
12	1 ³ / ₄	0.40
15	1 ³ ¹ / ₃₂	0.50
18 ¹ / ₂	1 ³ ¹ / ₃₂	0.50
22 ¹ / ₂	2	0.50
30	2 ¹ / ₄	0.50

For SI: 1 inch = 25 mm, 1 foot = 305 mm.

NOTE: Deflection limitations are given to maintain a consistent factor of safety against disengagement of retainer plates from the guide rails during an earthquake.

- 21.4 Where guide rails are continuous over supports and rail joints are within 2 feet (610 mm) of their supporting brackets, a simple span may be assumed.

[DSA/SS & OSHPD 5/96] Amendment to Table 16A-O becomes effective April 1, 1998.

TABLE 16A-P— R_W FACTORS FOR NONBUILDING STRUCTURES

STRUCTURE TYPE	R_W
1. Vessels, including tanks and pressurized spheres, on braced or unbraced legs.	3
2. Cast-in-place concrete silos and chimneys having walls continuous to the foundation.	5
3. Distributed mass cantilever structures such as stacks, chimneys, silos and skirt-supported vertical vessels.	4
4. Trussed towers (freestanding or guyed), guyed stacks and chimneys.	4
5. Inverted pendulum-type structures.	
5.1 Single-column structures	3
5.2 Multicolumn structures with strut ties capable of developing the capacity of the column	4
6. Cooling towers.	5
7. Bins and hoppers on braced or unbraced legs.	4
8. Storage racks.	5
9. Signs and billboards.	5
10. Amusement structures and monuments.	3
11. All other self-supporting structures not otherwise covered.	4

TABLE 16A-Q—MAXIMUM DIAPHRAGM DIMENSION RATIOS

	HORIZONTAL DIAPHRAGMS MAXIMUM SPAN-WIDTH RATIOS ¹		VERTICAL DIAPHRAGMS MAXIMUM HEIGHT-WIDTH RATIOS
	Masonry and Concrete Walls	Wood and Light-steel Walls	
Concrete	3:1		
Steel deck (continuous sheet in a single plane)	3:1	3:1	
Steel deck (without continuous sheet)	2:1	3:1	
Poured reinforced gypsum roofs	3:1	3:1	
Plywood (nailed all edges)	3:1	3:1	2:1 ⁴
Plywood (nailed to supports only, blocking may be omitted between joists)	2 ¹ / ₂ :1 ²	3:1	Footnote 3
Diagonal sheathing (special)	Footnote 3	3:1	1:1
Diagonal sheathing (conventional construction)	Footnote 3	2:1	Footnote 5

¹Where lateral forces are resisted primarily by rotation, span-width ratios shall not exceed one half of the tubular values. In concrete or masonry buildings, wood diaphragms or diaphragms of similar flexibility shall not be permitted to resist lateral forces by rotation.

²The use of unblocked horizontal plywood diaphragms for buildings having masonry or reinforced concrete walls shall be limited to one-story buildings or to the roof of a top story.

³Not permitted.

⁴See Section 2316A.2 for use with masonry or concrete walls.

⁵See Section 2314A.2.1.

TABLE 16A-R—MAXIMUM ALLOWABLE DEFLECTION NORMAL TO THE SURFACE OF WALL ELEMENT UNDER LATERAL FORCE LOADING

WALL ELEMENT	LOADING CONDITION	MAXIMUM ALLOWABLE DEFLECTION ¹
Exterior walls—brittle construction	Seismic or wind	L/240
Exterior walls—flexible construction	Seismic or wind	L/180
Veneered walls, anchored veneers and adhered veneers over 1 inch (25 mm) thick, including the mortar backing	Seismic	L/480

¹L is the span between vertical or horizontal supports.