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exceed an area greater than 20% of the roof area except as permitted under occupancy sections.

1. No individual dome or group of domes or skylights shall exceed 100 square feet.

a. Domes or groups of domes or skylights shall be separated from each other by at least 8 feet laterally and 10 feet along the slope of the roof.

(7) Building locations:

(a) When the distance between buildings located on the same property is less than 10 feet, the following shall apply:

1. Where the combined gross area for these buildings is less than that allowable for one building the exterior wall shall satisfy minimum requirements listed for class of construction in table 51.03-A.

a. Buildings classified as wood frame under subsections Ind 51.03 (7) or (8) shall have exterior walls with a fire-resistive rating of not less than that required for these buildings when satisfying the 10 feet to 30 feet distance to property line shown in table 51.03-A.

2. Where the combined gross area for these buildings is greater than that allowable for one building, one of the opposing walls shall be not less than a 4-hour fire-resistive rated fire division wall or building division wall, whichever applies. Where buildings are of different classes of construction, the lesser allowable gross area shall apply.

(8) Interior balcony or mezzanine. Interior balconies or mezzanine floors shall have fire-resistive ratings as required for the story in which it is located.

(9) No pipes, wires, cables, ducts or other service equipment shall be imbedded lengthwise in the required fire-resistive protection of any structural member except as allowed in approved fire rated assemblies.

(10) Exposed exterior structural columns and framing. The required fire-resistive hourly rating may be omitted on noncombustible columns and framing when the building does not exceed 2 stories and the fire separation to the center of a street, or to the property line or buildings on the same property, is greater than 30 feet.

(11) Stairways, elevators and vertical shafts which serve 3 or more floor levels shall be enclosed with fire-resistive rated construction equal to or better than requirements specified in Table 51.03-A, except as exempted below:

(a) In buildings with 3 floor levels, the stairways in the upper 2 levels may be left open provided all stairways leading to the lowest level are separated from the upper levels with fire-resistive rated construction as specified in Table 51.03-A or better.

(b) Conditions specified in subsections Ind 55.09 (1) (a) and (b) as applied to a place of worship are acceptable.

(c) A building having 3 or more floor levels may have an open interior stairway or floor opening connecting any 2 adjacent floors providing:

1. The floors above and below said openings serve to cut off the openings at these floor levels.

a. The fire-resistive ratings of floors shall satisfy those specified in Table 51.03-A, but in no case shall the rating be less than one-hour combustible or noncombustible, whichever applies.

2. The open stairway between 2 floors is in addition to the required stairways and exit passageways specified in the occupancy chapters of this code.

3. The openings are not prohibited by the occupancy chapters of this code.

(12) (a) Parapet walls shall be provided on exterior walls closer than 10 feet to a property line or to other buildings on the same property except as exempted under Ind 51.02 (12) (a) 4, Wis. Adm. Code. Parapet walls shall satisfy the following requirements:

1. Parapets shall not be less than 2 feet in height.

2. The minimum thickness of masonry parapets shall be 8 inches.

3. Parapets shall have fire-resistive ratings as specified for exterior walls in Table 51.03-A.

4. Parapets are not required on exterior walls which front streets and alleys or where exterior walls connect with roofs of noncombustible construction.

(b) All parapet walls shall be properly coped with noncombustible weatherproof material.

(13) FIRE DIVISION WALLS. Fire division walls shall have not less than a 4-hour fire-resistive rating as specified in section Ind 51.04 and shall comply with one of the following conditions:

(a) The wall shall extend 3 feet above the roof.

(b) The wall shall connect and make tight contact with roof decks of at least 2-hour fire-resistive noncombustible construction on both sides of the wall.

(c) The wall shall connect and make tight contact with roofs of noncombustible construction on both sides of the walls, and the roofs shall be noncontinuous at the wall.

(14) DETERMINATION OF NUMBER OF STORIES.\* For purposes of establishing the maximum allowable stories in the various classes of construction stated in section Ind 51.03, the number of stories shall be determined on the following basis:

(a) The first floor shall be determined first and this level shall satisfy the following conditions:

1. Is the lowest floor having one or more required exits for that floor and for any floor(s) above or below.

a. If condition stated in 1. is not satisfied, the highest floor level shall be considered the first floor.

2. The elevation of the first floor shall be at or not more than 6 feet above an exit discharge grade.

3. The door sill of all required exit discharges from the first floor shall be at or not more than 3 feet above exit discharge grade.

(b) An interior balcony or mezzanine floor which exceeds 25,000 square feet or one third (1/3), whichever is least, of the net area enclosed within exterior walls and/or fire division walls shall be counted as a story.

\* See Appendix A for further explanatory material.

CLASSES OF CONSTRUCTION TABLE 51.03-A FIRE RESISTIVE RATINGS IN HOURS (OR FRACTIONS THEREOF)

BUILDING ELEMENT	MODIFYING CONDITIONS			TYPES OF CONSTRUCTION								APPLICABLE NOTES	
	NUMBER OF STORIES	SEE NOTES (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100)	BEARING OR NON-BEARING	FIRE RESISTIVE TYPE A	FIRE RESISTIVE TYPE B	METAL FRAME PROTECTED	HEAVY TIMBER	EXTERIOR MASONRY	METAL FRAME UNPROTECTED	WOOD FRAME PROTECTED	WOOD FRAME UNPROTECTED		
1. INTERIOR SUPPORTS (COLUMNS, PIERS, FRAME LEGS, POSTS)	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			NC-4	NP	NP	NP	NP	NP	NP	NP	NP	⓪⓪
2.	8 STORIES OR 85' IN HEIGHT OR LESS			NC-3	NC-2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	SEE IND. 51.03(7) 3/4	SEE IND. 51.03(8) 0	NP	⓪⓪⓪
3. FLOOR FRAMING (BEAMS, GIRDERS, JOISTS, SLABS, DECK)	MORE THAN 2 STORIES			NC-3	NC-2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	NP	NP	NP	⓪
4.	2 STORIES OR LESS			NC-2	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	0	SEE IND. 51.03(6) NC-0	3/4	0	NP	⓪⓪
5. ROOF FRAMING	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			NC-2	NP	NP	NP	NP	NP	NP	NP	NP	⓪
6. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	3 TO 8 STORIES OR 85' IN HEIGHT OR LESS			NC-2	NC-1/2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	NP	NP	NP	⓪
7.	2 STORIES, OR UNDER 35' IN HEIGHT			NC-1	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	NC-0	SEE IND. 51.03(7) 3/4	0	NP	⓪⓪
8.	1 STORY - ROOF FRAMING MORE THAN 20 ABOVE FL.			NC-0	SEE IND. 51.03(2) NC-0	NC-0	SEE IND. 51.03(4) H.T. OR I	0	0	0	0	0	⓪
9.	1 STORY - ROOF FRAMING 20 OR LESS ABOVE FL.			NC-1	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	0	0	SEE IND. 51.03(7) 3/4	0	NP	⓪⓪
10. ROOF COVERING	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			CLASS A	NP	NP	NP	NP	NP	NP	NP	NP	⓪
11.	8 STORIES OR 85' IN HEIGHT OR LESS			CLASS A	CLASS A	CLASS A	CLASS B	CLASS B	CLASS C	CLASS C	CLASS C	CLASS C	⓪
12. EXTERIOR WALLS & COURT WALLS		LESS THAN 10 FT.	BEARING	NC-4	NC-3	NC-2	NC-2	NC-2	NC-2	NP	NP	NP	⓪⓪⓪⓪
13.		10 FT. TO 30 FT. INCLUSIVE	BEARING	NC-3	NC-2	NC-3/4	I	NC-1	NC-0	3/4	0	NP	⓪⓪⓪⓪⓪⓪
14.		OVER 30 FT.	BEARING	NC-2	NC-1	NC-0	I	NC-1	NC-0	3/4	0	NP	⓪⓪⓪⓪⓪⓪
15. (NOT INCLUDING INTERIOR FURRING ATTACHED TO INSIDE SURFACE OF WALL)		LESS THAN 10 FT.	NON-BEARING	NC-2	NC-2	NC-1	NC-1	NC-1	NC-1	NP	NP	NP	⓪⓪⓪⓪
16.		10 FT. TO 30 FT. INCLUSIVE	NON-BEARING	NC-1	NC-1	NC-0	I	NC-1	NC-0	3/4	0	NP	⓪⓪⓪⓪⓪⓪
17.		OVER 30 FT.	NON-BEARING	NC-0	NC-0	NC-0	3/4	NC-0	NC-0	3/4	0	NP	⓪⓪⓪⓪⓪⓪
18. INTERIOR WALLS BEARING				NC-3	NC-2	NC-1	I	I	NC-0	3/4	0	NP	⓪⓪⓪
19. PARTITIONS				NC-0	NC-0	NC-0	0	0	0	0	0	0	⓪⓪
20. REQUIRED EXIT CORRIDOR ENCLDS.				NC-2	NC-2	NC-1	I	I	I	3/4	3/4	NP	⓪⓪
21. FIRE ENCLOSURE (STAIRWAYS, ELEVATORS, VERTICAL SHAFTS)	3 STORIES OR MORE			NC-2	NC-2	NC-1	I	I	I	NP	NP	NP	⓪⓪
	3 OR MORE FLOOR LEVELS									3/4	3/4	NP	⓪⓪
22. PENTHOUSE WALLS				NC-0	NC-0	NC-0	0	NC-0	0	0	0	0	⓪
23. PENTHOUSE ROOF				NC-0	NC-0	NC-0	0	0	0	0	0	0	⓪⓪

KEY TO ABBREVIATIONS :

- NC - NON COMBUSTIBLE
- NP - NOT PERMITTED
- H.T. - HEAVY TIMBER
- P/L - PROPERTY LINE

- ⓪ - SEE OCCUPANCY SECTIONS OF THE CODE FOR OTHER BASIC REQUIREMENTS AND MORE RESTRICTIVE LIMITATIONS.
- ⓪ - ROOF COVERING SAME AS FOR MAIN BUILDING.
- ⓪ - WALLS OF SOLID WOOD 4" IN THICKNESS ARE ACCEPTABLE AS EQUAL TO ONE HOUR FIRE-RESISTIVE RATING.
- ⓪ - FIRE RESISTIVE REQUIREMENTS APPLY FOR THOSE BRACING MEMBERS REQUIRED FOR GRAVITY LOADING.
- ⓪ - REFER TO TABLE 51.03-B FOR AREAS FOR WINDOWS AND OTHER OPENINGS IN EXTERIOR WALLS.
- ⓪ - FOR EXCEPTIONS REFER TO IN.
- ⓪ - SETBACKS AND DISTANCES TO P/L OR OTHER BLDG. ON SAME PROPERTY DO NOT APPLY TO P/L ALONG STREET.

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**TABLE 51.03-B**  
**MAXIMUM TOTAL ALLOWABLE AREA OF WINDOWS OR OTHER WALL OPENINGS**  
**IN PERCENT OF TOTAL EXPOSED EXTERIOR WALL SURFACE**

Setback from Property Line, or Other Walls on Same Property <sup>1</sup>	Class of Construction				
	1. Fire-Resistive "A" 2. Fire-Resistive "B" 3. Metal Frame Protected 4. Heavy Timber 5. Exterior Masonry		6. Metal Frame Unprotected	7. Wood Frame Protected	8. Wood Frame Unprotected
	Bearing Wall	Nonbearing Wall			
Less than 5'	No Openings	No Openings	No Openings	Not Permitted	Not Permitted
5' to less than 10'	20% <sup>2</sup> Fire window reqd. <sup>3</sup>	30% <sup>2</sup> Fire window reqd. <sup>3</sup>	30% <sup>2</sup>	Not Permitted	Not Permitted
10' to less than 30'	30% <sup>2</sup>	40% <sup>2</sup>	40% <sup>2</sup>	40% <sup>2</sup>	40% <sup>2</sup>
30' or over	No Limit	No Limit	No Limit	No Limit	No Limit

<sup>1</sup> Does not apply to property lines along streets.

<sup>2</sup> Tabulated percentage of openings shall be applied to each lineal feet of wall. This tabulation will not allow wing walls or high parapets, etc. to be used to increase exposed wall areas and thereby increase allowable total area of openings. Where openings are permitted, such openings protected with approved automatic-closing, 3-hour fire door or shutter assemblies—No Limit.

<sup>3</sup> Fire windows shall be as required for moderate fire exposure— see Ind 51.047.

**History:** Cr. Register, June, 1972, No. 198, eff. 1-1-73; am. table A, Register, September, 1973, No. 213, eff. 10-1-73; am. table B, Register, July, 1974, No. 223, eff. 8-1-74.

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(c) Penthouse(s) with a total area that exceeds 50% of the total roof area shall be counted as a story(ies).

(d) Construction according to subsection Ind 51.02 (4) (b) 1. b. shall also be counted as a story(ies).

(e) Total number of stories shall include the first floor plus all stories above and those stories determined by subsections Ind 51.02 (14) (b), (c) and (d).

1. Floor levels satisfying the definition of basement(s), ground floor(s), attic, interior balcony(ies) and/or mezzanine floor(s), unless otherwise stated, shall not be counted as a story(ies). For exception, see Appendix A-51.02 (14), Illustration No. 4.

(15) DECORATIVE WOOD. Decorative wood may be applied to all required noncombustible exterior surfaces of "0" hourly rated construction or better, up to a limit of 10% of the surface area within any 100 lineal feet of the building.

**History:** Cr. Register, June, 1972, No. 198, eff. 1-1-73; r. (9) and (10), renum. (3) to be (4), (4), (5), (6), (7), (8) to be (6), (7), (8), (9), (10), am. (2) (a), cr. (3), (6), (11), (12), (13) and (14), Register, September, 1973, No. 213, eff. 10-1-73; am. (14) (d), Register, February, 1974, No. 218, eff. 3-1-74; r. and recr. (12) (a); am. (13) (c), Register, May, 1974, No. 221, eff. 6-1-74; cr. (11) (c) and (15), Register, July, 1974, No. 223, eff. 8-1-74.

**Ind 51.03 Frame construction.** **History:** 1-2-56; cr. (2), Register, February, 1971, No. 182, eff. 7-1-71; r. (2), eff. 8-1-71; cr. (2) eff. 1-1-72, Register, July, 1971, No. 187; r. and recr. Register, June, 1972, No. 198, eff. 1-1-73.

**Ind 51.03 Classes of construction standards. (1) FIRE RESISTIVE TYPE A (NO. 1):**

(a) A building is of fire-resistive construction if all the walls, partitions, piers, columns, floors, ceilings, roof and stairs are built of noncombustible material, with a fire-resistive rating as specified in table 51.03-A.

1. Concealed draft openings in columns, walls and partitions shall be firestopped with noncombustible material at each floor level.

(b) All buildings of this classification shall not be restricted in height.

(c) Stairs and stair platforms shall be constructed of noncombustible material.

(d) Doors and windows may be of wood except as otherwise specified in section Ind 51.02 (5), Table 51.03-B, sections Ind 51.17, 51.18, 51.19 and 51.20, or in the occupancy chapters of this code.

1. Doors leading into main public corridors shall be noncombustible or quality certified glued solid wood core flush doors unless otherwise specified above.

**Note:** Public corridors are intended to include principal corridors serving a floor and leading directly to building exits, but do not include communicating passageways within a given use area.

(e) Bays, oriels, and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings as required for exterior walls.

(f) Mansards shall be of noncombustible construction.

1. The wall construction behind mansard shall extend to underside

\* See Appendix A for further explanatory material.

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of roof deck and shall have a fire-resistive rating of not less than that specified for exterior walls in table 51.03-A.

(g) Penthouses and other roof structures shall have enclosing walls of noncombustible construction and roof framing and coverings shall be equal to that specified in table 51.03-A. Wood cooling towers are permitted.

(h) Wood may be used for finished floors, trim and wall paneling if open spaces behind the material are completely firestopped with noncombustible materials unless prohibited under the occupancy requirements of this code.

(i) Acoustical materials may be used on ceilings and walls provided they are noncombustible and the open spaces between furring on walls are completely firestopped with noncombustible material.

(j) In required fire-resistive floor and roof assemblies one electric outlet box, not exceeding 16 square inches in area, may be installed in such ceilings in each 90 square feet of ceiling area. Recessed electric fixtures shall have protection boxes built above the fixture, constructed of approved fire-resistant material of rating equal to that of the ceiling, to cover the opening in case fixture is displaced. Duct openings in ceilings shall be protected by fire dampers.

(2) FIRE-RESISTIVE TYPE B (NO. 2):

(a) A building is of fire-resistive construction if all the walls, partitions, piers, columns, floors, ceilings, roof and stairs are built of noncombustible material, with a fire-resistive rating as specified in table 51.03-A.

(b) All buildings of this classification shall not exceed a height of 85 feet, in which height there shall be not more than 8 stories.

(c) Roofs. Where roof framing is greater than 20 feet above the floor, or highest level of any balcony, roof decks may be:

1. Matched or splined wood roof decking of not less than 2 inches in nominal thickness; or
2. Solid lumber not less than 3 inches in nominal thickness, set on edge securely fastened together; or
3. Approved 1½ inch thick plywood with exterior glue, tongue and groove with all end joints staggered and setting on centers of beams spaced not over 4 feet apart; or
4. Other forms of roof decks, if of noncombustible material.

(d) Stairs and stair platforms shall be constructed of noncombustible material.

(e) Doors and windows may be of wood except as otherwise specified in section Ind 51.02 (5), Table 51.03-B, sections Ind 51.17, 51.18, 51.19 and 51.20, or in the occupancy chapters of this code.

1. Doors leading into main public corridors shall be noncombustible or quality certified glued solid wood core flush doors unless otherwise specified above.

Note: Public corridors are intended to include principal corridors serving a floor and leading directly to building exits, but do not include communicating passageways within a given use area.

(f) Bays, oriels, and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings as required for exterior walls.

\* See Appendix A for further explanatory material.

(g) Mansards shall be of noncombustible construction.  
1. The wall construction behind mansard shall extend to underside of roof deck and shall have a fire-resistive rating of not less than that specified for exterior walls in table 51.03-A.

(h) Penthouse and other roof structures shall have enclosing walls of noncombustible construction and roof framing and coverings shall be equal to that specified in table 51.03-A. Wood cooling towers are permitted.

(i) Wood may be used for finished floors, trim and wall paneling if open spaces behind the material are completely firestopped with noncombustible materials unless prohibited under the occupancy requirements of this code.

(j) Acoustical materials may be used on ceilings and walls provided they are noncombustible and the open spaces between furring strips on walls are completely firestopped with noncombustible material.

(3) METAL FRAME—PROTECTED (NO. 3):

(a) A building is of metal frame protected construction if the structural parts and enclosing walls are of metal, or metal in combination with other noncombustible materials, with time resistance ratings as set forth in table 51.03-A.

(b) All buildings of this classification shall not exceed a height of 75 feet, in which height there shall be not more than 4 stories.

(c) Stairs and stair platforms shall be constructed of noncombustible material.

(d) Bays, oriels and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings not less than that specified for exterior walls in table 51.03-A.

(e) Mansards shall be of noncombustible construction.

1. The wall construction behind mansard shall extend to underside of roof deck and shall have a fire-resistive rating of not less than that specified for exterior walls in table 51.03-A.

(4) HEAVY TIMBER (NO. 4):

(a) A building is of heavy timber construction if the structural frame consists of heavy timber or heavy timber in combination with metal, reinforced concrete or masonry. The structural and enclosing walls shall be as set forth in table 51.03-A.

(b) All buildings of this classification shall not exceed a height of 75 feet, in which height there shall be not more than 4 stories.

(c) Columns:

1. Wood columns shall be not less than 8 inches, nominal, in any dimension when supporting floor loads and not less than 6 inches, nominal, in least dimension and not less than 8 inches, nominal, in other dimension when supporting roof loads only.

2. All wood columns in the structural frame shall be superimposed, end to end, one above the other, and joined by metal or wood connectors.

NOTE: See structural chapter Ind 53 for design requirements.

(d) Floor framing:

1. Beams and girders of wood shall be not less than 6 inches,

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nominal, in any dimension and not less than 45 square inches in actual cross-sectional area.

2. Wood arches which support floor loads shall be not less than 8 inches, nominal, in any dimension.

3. Framed timber trusses supporting floor loads shall have members of not less than 8 inches, nominal, in any dimension.

4. Floor framing and structural framing of material other than wood shall have a fire-resistive protection of not less than one hour.

(e) Roof framing:

1. Beams and girders of wood shall be not less than 6 inches, nominal, in any dimension and not less than 45 square inches in actual cross-sectional area.

2. Wood arches, timber trusses, purlins and rafters for roof construction shall have members not less than 4 inches, nominal, in width and not less than 6 inches, nominal, in depth. Spaced members may be composed of 2 or more pieces not less than 3 inches, nominal, in thickness when blocked solidly throughout their intervening spaces or when such spaces are tightly closed by a continuous wood cover plate of not less than 2 inches, nominal, in thickness; secured to the underside of the members. Splice plates shall be not less than 3 inches, nominal, in thickness.

(f) Floors:

1. Wood floor construction shall be tongued and grooved, or splined lumber not less than 3 inches nominal thickness, or of solid lumber placed on edge and securely fastened together to make a floor not less than 4 inches, nominal, in thickness. A top layer of flooring of one inch nominal thickness shall be placed over all such floor construction.

(g) Stair construction may be of wood in buildings not exceeding 3 stories in height. In 4-story buildings, all stairs, platforms and stair construction shall be constructed of noncombustible material.

(h) Roofs. Roof decks shall be:

1. Matched or splined wood roof decking of not less than 2 inches in nominal thickness; or

2. Solid lumber not less than 2 inches nominal thickness, set on edge, securely fastened together; or

3. Approved 1½ inch thick plywood with exterior glue, tongue and groove with all end joints staggered and butting on centers of beams spaced not over 4 feet apart; or

4. Other forms of roof decks, if of noncombustible material.

(i) EXTERIOR MASONRY (No. 5):

(a) A building is of exterior masonry construction if all enclosing walls are constructed of masonry or reinforced concrete with fire-resistive ratings as set forth in table 51.03-A.

1. Exterior masonry walls shall extend to the underside of projecting roof rafters or joists or bearing points of beams and trusses.

2. Spaces between projecting rafters, joists, beams or trusses shall be filled with nominal 2 inch wood blocking or rigid noncombustible material to the underside of the roof decking.

(b) All buildings of this classification shall not exceed a height of 50 feet, in which height there shall be not more than 4 stories.

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(c) The interior structural framing shall be metal, reinforced concrete, masonry or wood. Fire protection of metal or wood structural members may be omitted except that all such members supporting load-bearing masonry in all parts of buildings of more than one story shall be of metal, reinforced concrete or masonry with not less than one-hour fire-resistive protection of supporting metal.

(d) In walls where fire protection is required, the bottom of lower flange of lintels supporting load-bearing masonry shall be protected for openings exceeding 12-foot spans.

(e) Floors, roofs, partitions and stairs may be of wood but no joist, rafter, stud or stringer shall be less than 2 inches in nominal thickness.

(f) Bays, oriels and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings as required for exterior walls.

(g) A mansard shall be constructed entirely of noncombustible material or fire-retardant treated wood satisfying the definition of "noncombustible" if it is subject to one of the following conditions:

1. If the mansard is closer than 20 feet to the adjoining property line or other building(s) on the same property.
2. If the vertical protected area of the mansard exceeds 30% of the area of the wall surface to which it is attached.

(h) Penthouses and other roof structures shall have enclosing walls of noncombustible construction and roof framing and coverings shall be equal to that specified in table 51.03-A.

**(6) METAL FRAME—UNPROTECTED (NO. 6):**

(a) A building is of metal frame unprotected construction if the enclosing walls are of unprotected metal or unprotected metal in combination with other non-combustible materials and all building elements are as set forth in Table 51.03-A unless otherwise exempted.

1. Heavy timber may be used for interior columns and floor framing.
2. Interior mezzanines and balconies within the first story may be constructed of one-hour fire-resistive construction.

(b) All buildings of this classification shall not exceed a height of 50 feet, in which height there shall be not more than 3 stories.

(c) Stairs and stair platforms may be of wood with stringers not less than 2 inches in nominal thickness.

(d) Bays, oriels and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings not less than that specified for exterior walls in table 51.03-A.

**(7) WOOD FRAME—PROTECTED (NO. 7):**

(a) A building is of wood frame protected construction if the structural parts and enclosing walls are of protected wood, or protected wood in combination with other materials, with fire-resistive ratings as set forth in table 51.03-A. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also deemed a wood frame protected building.

(b) All buildings of this classification shall not exceed a height of 40 feet, in which height there shall be not more than 2 stories.

(c) Floors, roofs, partitions and stairs may be of wood but no joist.

<sup>1</sup> See Appendix A for further definitions and standards.  
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rafter, stud or stringer shall be less than 2 inches in nominal thickness.

(d) The structural members supporting the finished ceiling in the topmost story shall be protected on the underside by fire-resistive material acceptable in systems approved for one-hour fire-resistive ratings as covered in section Ind 51.04.

**(8) WOOD FRAME—UNPROTECTED (NO. 8):**

(a) A building is of wood frame unprotected construction if the structural parts and enclosing walls are of unprotected wood, or unprotected wood in combination with other materials. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also termed a wood frame unprotected building.

(b) All buildings of this classification shall not exceed a height of 50 feet, in which height there shall be not more than 2 stories.

(c) Floors, roofs, partitions and stairs may be of wood but no joist, rafter, stud or stringer shall be less than 2 inches in nominal thickness.

**History:** Cr. Register, June, 1972, No. 198, eff. 1-1-73; am. (1) (d), renum. (1) (e) 1. to be (f), (1) (f) 1. a. to be (1) (f) 1., (1) (f) (g) (h) (i) to be (1) (g) (h) (i) (j), (2) (f) 1. to be (2) (g), (2) (g) 1. a. to be (2) (g) 1., (2) (g) (h) (i) to be (2) (h) (i) (j), (3) (d) 1. to be (e), (2) (e) 1. a. to (3) (e) 1., (7) (b) to be (c), (7) (c) to be (b), am. (2) (a), r. (1) (e) 3., r. and reer. (6) (a), cr. (7) (d), Register, September, 1971, No. 182, eff. 7-1-71; r. and reer. (6) (a), Register, May, 1971, No. 181, eff. 6-1-71; cr. (5) (a) 1. and 2.; am. (5) (i) and r. and reer. (5) (g), Register, July, 1971, No. 187, eff. 8-1-71.

**Ind 51.04 History:** 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71; cr. Register, July, 1971, No. 187, eff. 8-1-71 and expiring 1-1-72.

**Fire-Resistive Standards  
for  
Materials of Construction**

**Ind 51.04 Scope.** This section shall include standards applicable to various types of fire-resistive construction. Requirements established herein are considered minimum safety standards and will not necessarily result in the most advantageous insurance rates.

**History:** Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71 and reer. eff. 1-1-72, Register, July, 1971, No. 187.

**Ind 51.041 History:** Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and reer. eff. 1-1-72, Register, July, 1971, No. 187; r. Register, June, 1972, No. 198, eff. 1-1-73.

**Ind 51.042 General requirements. (1) Construction details and quality of material used for these systems must be those used by the testing laboratory for the test, and/or those dictated by good construction practice.**

**(2) Connection of structural members. (a) The minimum fire-resistive protection of a connection shall be equal to the maximum required for the members to which it is attached.**

**(3) For structural components with a fire-resistive rating obtained by test with restrained ends, the supporting structure shall be designed to provide for this restraint.**

See Appendix C for testing laboratory approval.

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(4) ASTM standard methods of test. (a) All products manufactured and tested according to ASTM standard methods prior to effective dates of standards specified in "Fire-Resistive Standards for Materials of Construction" shall be accepted unless the ASTM standard method used in the test is judged to be inadequate in comparison with the currently adopted standard method.

(5)\* The heat transmission requirements of ASTM E-119 (25b), with the exception of high hazard areas, penal and health care facilities and warehouses for combustible materials, may be reduced to one-half (½) of the hourly rating required by this code, but not less than one hour.

NOTE: For ASTM E-119 Standard adopted see Ind 51.25 (90).

(a) The fire-resistive rating for structural integrity required by this code shall be maintained where the heat transmission criteria has been reduced.

(6) The use of fire-resistive protection implies consent by owner to maintain material in a serviceable condition. Where this protection is concealed, provisions shall be made for periodic visual inspection of the structural insulating material at each story.

NOTE: Definition of owner--see 101.01 (13), Wis. Stats.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and rec. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 51.043 Approved rating methods. (1) Ratings of fire-resistive assemblies shall be determined by one of the following methods:

(a) Test by approved testing laboratories (see Ind 51.044).

(b) Typical examples as listed in this code in lieu of approved test (see Ind 51.045).

(c) Approved method of calculation in lieu of approved test (see Ind 51.046).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and rec. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 51.044 Approved testing laboratories. (1) Fire rating tests conducted according to table 1 listed ASTM standards shall be acceptable if conducted by the recognized testing laboratory for referenced test.

NOTE: Other testing laboratories will be recognized as an approved agency if accepted in writing by the department.

\* See Appendix A for further explanatory material.

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TABLE 1

Name of Recognized Laboratories	ASTM Standard Tests					
	E-84	E-108	E-119	E-136	E-152	E-163
Forest Prod. Lab., Madison, Wis.*			X		X	
Nat'l. Bureau of St'd., Washington, D.C.			X	X		
Ohio State Univ., Columbus, Ohio			X	X	X	X
Portland Cement Assoc., Skokie, Ill.			X			
Southwest Research Inst., San Antonio, Tex.	X					
Underwriters' Lab., Inc., Chicago, Ill.	X	X	X		X	X
Underwriters' Lab., Inc., Scarborough, Ont., Canada	X	X	X	X	X	X
Univ. of Calif., Berkeley, Calif.		X	X			X

\*NOTE: Reference based on research and development data. Facility is not available for conducting routine rating tests.

NOTE: For column identification and specific standards adopted, see subsections Ind 51.25 (88) thru (93).

History: Cf. Register, February, 1971, No. 182, (ff. 7-9-71); r. off. 5-1-71, and reg. off. 1-1-72. Register, July, 1971, No. 187.

Ind 51.045 Typical examples of Fire-Resistive Structural Components. (1) Basic design and construction for specified fire-resistive protection of structural components listed in table 2, including references (a) through (p), shall be acceptable.

NOTE: The following table is based on performance, interpretation of various test data and/or data from ASTM E-119 test (see table 2).

\* See Appendix A for further explanatory material.



having not less than 4 longitudinal rails, and vertical lattice bars not more than 8 inches apart, and proper stiffening braces or brackets.

(9) **LADDER TO ROOF.** Every fire escape which extends higher than the second floor shall be provided with a ladder leading from the upper platform to the roof, unless the fire escape stairway leads to the roof. The ladder shall have stringers not less than 1 1/4 inch pipe, or not less than 2 x 3/8 inch flat bars, at least 17 inches apart in the clear. The rungs shall be not less than 1/2 inch square or 3/4 inch round bars, 14 inches center to center. The stringers shall be securely tied together at intervals no greater than every fifth rung. The stringers of each ladder shall extend not less than 4 feet above the roof coping and return to within 2 feet of the roof, with the top rung of the ladder level with the coping.

(10) **OTHER TYPES OF FIRE ESCAPES.** Sliding or chute fire escapes may be used, upon the approval of the department of industry, labor and human relations, in place of "A" or "B" fire escapes. Every sliding fire escape shall be provided with a ladder constructed as in subsection Ind 51.20 (9), extending from 5 feet above grade, to 4 feet above the roof coping.

**History:** 1-2-56; am. Register, December, 1962, No. 84, eff. 1-1-63; am. (1) (a), Register, February, 1971, No. 182, eff. 7-1-71; am. (7), Register, February, 1971, No. 181, eff. 3-1-71; r. and recr. 51.20 (1) (a) eff. 8-1-71 and exp. 1-1-72 and cr. (1) (a) eff. 1-1-72; Register, July, 1971, No. 187; am. (1) (a), Register, June, 1972, No. 198, eff. 7-1-72.

**Ind 51.21 Standpipes. (1) CLASSES OF SERVICE.** Standpipe systems are designed for 2 classes of service: (a) for use by fire departments or others trained in handling heavy streams from 2 1/2 inch hose, and (b) for use by occupants of a building on incipient fires. These are referred to in these sections as fire departments, and first aid standpipes, respectively. The features of each system may be combined in a single equipment, if served by an automatic water supply conforming to subsection (2) (g) or (h). All threads on hose and hose connections shall be interchangeable with those of the public fire department.

(2) **FIRE DEPARTMENT STANDPIPES. (a)** Standpipes shall be provided for all buildings exceeding 50 feet in height. Required standpipes shall be installed as construction progresses, to make them available to the fire department in the topmost floor constructed.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 30 feet by a nozzle attached to 100 feet of hose connected to the standpipe. When 2 or more standpipes are required, they shall be cross connected at the bottom, and equipped with individual controlling valves located not higher than the first story.

(c) Standpipes shall be protected against mechanical and fire damage, with outlets in stairway enclosures; where stairways are not enclosed, outlets shall be at inside or outside of outside walls, within one foot of a fire tower, interior stairway or fire escape. Dry standpipes shall be accessible for inspection and not concealed.

(d) No required standpipe shall be less than 4 inches in diameter, and not less than 6 inches in diameter for buildings exceeding 75

\* See Appendix A for further explanatory material.

feet in height. Material shall be steel or wrought iron pipe with approved fittings, designed for a working pressure of 100 pounds in excess of the static pressure due to elevation. An approved 2½ inch hose valve shall be located at each story, not over 5 feet above the floor level. An approved pressure reducing device shall be installed at hose valves where the pressure would otherwise be in excess of 50 pounds. Where a standpipe is not normally under pressure, hose valves shall be equipped with a tight fitting cap on a chain and having lugs for a spanner wrench.

(e) An approved siamese connection with a check valve in each inlet shall be installed on a 4 inch pipe connecting with each standpipe system and shall be marked "To Standpipe". The elevation of the connection shall be not over 3 feet above the sidewalk or ground. An automatic drip valve shall be installed where necessary to prevent freezing. In buildings with several standpipes, more than one siamese connection may be required.

(f) Fire department standpipes need not be equipped with attached hose.

(g) Automatic water supplies will not ordinarily be required, except as provided in subsection (2) (h), or where judged necessary by reason of the high combustibility or potential hazard of the occupancy. When required, they shall be designed to provide not less than 40 pounds flowing pressure at the top outlet, with volume for two fire streams. Any of the following supplies will be acceptable:

1. Connection to city water works system when providing required minimum volume and pressure.
2. Gravity tank of not less than 3,500 gallons capacity, elevated 50 feet above the top story.
3. Pressure tank of 5,250 gallons gross capacity (3,500 gallons water capacity).
4. Automatic pump or pumps, with combined effective capacity of 500 gallons per minute.

(h) An automatic water supply from an approved fire pump shall be provided in buildings over 150 feet high, or in buildings over 10,000 square feet in area per floor and requiring a standpipe. The capacity of the pump shall be not less than 500 gallons per minute for a 4 inch standpipe, 750 gallons per minute for 2 interconnected 4 inch or single 6 inch standpipes, and 1,000 gallons per minute for larger systems.

(3) **FIRST AID STANDPIPES.** (a) Standpipes shall be provided as required in sections Ind 54.14, 55.33, and 57.21.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 20 feet by a nozzle attached to not more than 75 feet of hose connected to a standpipe.

*Note:* Standpipe outlets should be located in occupied areas, and usually at interior columns in large area buildings. Asylums and places of detention may require special arrangements. It should be possible in all cases to direct the stream into all important enclosures, such as closets, etc.

(c) No required standpipe shall be less than 2 inches in diameter, and not less than 2½ inches in diameter for buildings 5 stories or more in height. Material shall be wrought iron or steel and pipe and fittings shall be of suitable weight for the pressure used. An ap-

\* See Appendix A for further explanatory material.



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proved 1½ inch hose valve shall be located in each story, not more than 5 feet above the floor level; valves of the gate type shall be equipped with a suitable open drip connection. An approved pressure-reducing device shall be installed at hose valves where pressure would otherwise be over 50 pounds.

(d) Not more than 75 feet of hose shall be attached to each outlet. Hose shall be of unlined linen construction, 1½ inches in diameter, with a ½ inch nozzle attached, and shall be located in approved cabinets or racks.

(e) Water supply shall be automatic, and be designed for 70 gallons per minute for 30 minutes with 25 pounds flowing pressure at the top outlet. Such supply may be from city connection, gravity tank, pressure tank or pump.

*Note:* Data on the design of standpipe systems can be found in the Standards of the National Board of Fire Underwriters for the Installation of Standpipe and Hose Systems. The department of industry, labor and human relations will ordinarily approve any installation which is approved by the Underwriters.

Ind 51.22 Fire extinguishers. (1) Where fire extinguishers are required, they shall be of a type approved by the department of industry, labor and human relations. All fire extinguishers shall be charged in accordance with the instructions of the manufacturer.

(2) Extinguishers shall be conspicuously located where they will always be readily accessible and so distributed as to be immediately available in event of fire. They shall be hung on hangers or set on brackets or shelves so that the top of the extinguisher is not more than 5 feet above the floor.

*Note:* The department of industry, labor and human relations will ordinarily approve any extinguisher which bears the Underwriters' label and which is of the size, and suitable, for the hazard for which it is intended. Consult the department of industry, labor and human relations for lists of approved extinguishers.

Ind 51.23 Automatic sprinklers. (1) Required automatic sprinkler systems shall be designed and constructed in conformity with good established practice. Only materials and devices approved by the department of industry, labor and human relations may be used. Reinstallation of used sprinkler heads is prohibited, and other second-hand devices may be installed by special permission only.

(2) Where an automatic sprinkler system is required throughout a building, supply shall be from a city water main, or from a gravity or pressure tank. If the city water supply is inadequate in either pressure or volume, a tank of not less than 5,000 gallons capacity shall be provided. The bottom of a gravity tank shall be not less than 35 feet above the under side of the roof.

(3) Where automatic sprinklers are required in a basement only, the supply shall be from a city water main. Where there is no city water supply, such basement sprinklers need not be installed; but at such time as a city supply becomes available, such required basement sprinklers shall be installed.

(4) Every basement sprinkler system shall also include sprinklers in all shafts (except elevator shafts) leading to the story above.

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(5) Every sprinkler system shall have a suitable audible alarm and an approved siamese connection marked "To Automatic Sprinklers", and otherwise conforming to section Ind 51.21 (2) (e).

*Note:* It will be the policy of the department of industry, labor and human relations to approve equipment conforming to standards of the National Board of Fire Underwriters for Sprinkler Equipment, also materials and devices currently listed by the Underwriters' Laboratories. The commission reserves the right to order a sprinkler system in any building, regardless of height or number of persons, if the occupancy is especially hazardous.

**Ind 51.24 Fire alarm systems. Interior fire alarm systems required under Wis. Adm. Code sections Ind 54.16, 56.19 and 57.22 shall be designed and constructed in conformity with the following requirements:**

(1) All such alarm systems shall consist of operating stations on each floor of the building, including the basement, with bells, horns, or other approved sounding devices which are effective throughout the building. The system shall be so arranged that the operation of any one station will actuate all alarm devices connected to the system except in the case of a presignal system. Fire alarms shall be readily distinguishable from any other signalling devices used in the building. A system designed for fire alarm and paging service may be used if the design is such that fire alarm signals will have precedence over all others.

(2) Every fire alarm system shall be electrically operated or activated by non-combustible, non-toxic gas except as provided in section Ind 56.19. Electrically operated systems shall be operated on closed circuit current under constant electrical supervision, so arranged that upon a circuit opening and remaining open or in case of a ground or short circuit in the undergrounded conductor, audible trouble signals will be given instantly. Gas activated systems shall be mechanically supervised and under constant gas pressure, so arranged that in case of a pressure drop an audible trouble signal will be given instantly. Means shall be provided for testing purposes.

(3) In buildings more than 3 stories in height, coded fire alarm systems shall be provided, and the systems shall be so arranged that the code transmitted shall indicate the location and the story of the structure in which the signal originated.

*Exception:* (a) In apartment buildings, non-coded continuous sounding fire alarm systems under constant electrical or gas activated supervision will be approved.

(4) Operating stations shall be prominently located in an accessible position at all required exit doors and required exit stairways. Operating stations shall be of an approved type and shall be conspicuously identified. All such operating stations shall be of a type, which after being operated, will indicate that an alarm has been sent therefrom until reset by an authorized means. (Operating stations having a "Break Glass" panel will be acceptable. On coded systems having a device to permanently record the transmission of an alarm, "Open Door" type stations may be used). The fire alarm operating stations shall be mounted not less than 4 feet nor more than 5 feet above the finished floor as measured from the floor to the center of the box.

\* See Appendix A for further explanatory material.

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(5) All such alarm systems shall be tested at least once a week and a record of such tests shall be kept.

(6) Existing fire alarm systems that are effective in operation will be accepted if approved by the department of industry, labor and human relations.

(7) The gas for operation of non-combustible, non-toxic gas activated fire alarm systems shall be supplied from approved pressure cylinders on the premises. The cylinders shall have sufficient capacity and pressure to properly operate all sounding devices connected to the system for a period of not less than 10 minutes. Cylinders shall be removed for recharging immediately after use and shall be replaced by fully charged cylinders.

(8) Spare cylinders shall be kept on the premises at all times for immediate replacement and separate cylinders for testing shall be incorporated in the system.

(9) Tubing in connection with non-combustible, non-toxic gas activated fire alarm systems shall be installed in rigid metal conduit, flexible metal conduit, or surface metal raceways where subject to mechanical injury. Non-corrosive metallic tubing not less than 3/16" in diameter which will withstand a bursting pressure of not less than 500 pounds per square inch shall be used. The maximum length of 3/16" tubing shall not exceed 300 feet between charged cylinders. All tubing and other component parts shall be installed by skilled workmen in accordance with the provisions of this code.

*Note:* The following sections are taken from the Wisconsin Administrative Electrical Code.

(10) The energy for the operation of electrical fire alarm systems shall be taken from sources suited to the design of the system. Batteries on systems of less than 110 volts shall not be used.

(11) A 3-wire 120-240 volt or 120-208 volt (3 phase 4 wire) service will be accepted for supervised systems provided the operating current is secured from one ungrounded conductor and the neutral, or ungrounded conductor, and the current for operating trouble signal or signals is secured from the other ungrounded conductor and the neutral or grounded conductor.

(12) Electrical wiring in connection with fire alarm systems shall be installed in rigid metal conduit, flexible metal conduit, electrical metallic tubing or surface metal raceways. Armored cable (metal) may be used where it can be fished in hollow spaces of walls or partitions in apartments or rooming houses not over 3 stories in height. Where the wiring is subject to excessive moisture or severe mechanical injury, rigid metal conduit shall be used. The smallest size conductor to be used in any fire alarm system in a building over 3 stories in height shall be No. 14 AWG or No. 16 AWG for buildings not over 3 stories in height. The wires shall be provided with insulation suitable for use on circuits not exceeding 600 volts. Fire alarm systems shall be connected to the line inside of the main service switch or to the emergency feeder through 2 single pole breakers or switches used for no other purpose and arranged so they can be locked in the "on" position, and under the supervision of a qualified person.

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The breaker or switches shall be identified by a red color. Two pole breakers shall not be used.

History: 1-2-66; am. (4) (a), Register, November, 1963, No. 96, eff. 12-1-63; am. Register, August, 1964, No. 104, eff. 9-1-64.

**NOTICE:** Sections Ind 51.25, 51.26 and 51.27 following are effective January 1, 1975.

Ind 51.25 Adoption of ASTM Standards. Pursuant to section 227.025, Wis. Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards of the American Society of Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103. Copies of the standards in reference are on file in the offices of the department, the secretary of state, and the revisor of statutes.

- (1) GENERAL REQUIREMENTS FOR DELIVERY OF ROLLED STEEL PLATES, SHAPES, SHEET PILING AND BARS FOR STRUCTURAL USE. Part 4 ASTM Designation A 6-72.
- (2) STRUCTURAL STEEL. Part 4 ASTM Designation A 36-70a.
- (3) COLD-DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 82-72.
- (4) ZINC-COATED (GALVANIZED) IRON OR STEEL FARM-FIELD AND RAILROAD RIGHT-OF-WAY WIRE FENCING. Part 3 ASTM Designation A 116-71.
- (5) ZINC COATING (HOT-DIP) ON IRON AND STEEL HARDWARE. Part 3 ASTM Designation A 153-73.
- (6) DEFORMED AND PLAIN BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 615-72.
- (7) RAIL-STEEL DEFORMED AND PLAIN BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 616-72.
- (8) AXLE-STEEL DEFORMED AND PLAIN BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 617-72.
- (9) GYPSUM. Part 9 ASTM Designation C 22-50 (1972).
- (10) CHEMICAL ANALYSIS OF LIMESTONE, QUICKLIME, AND HYDRATED LIME. Part 9 ASTM Designation C 25-72.
- (11) STRUCTURAL CLAY LOAD-BEARING WALL TILE. Part 12 ASTM Designation C 34-62 (1970).
- (12) COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS. Part 10 ASTM Designation C 39-72.
- (13) OBTAINING AND TESTING DRILLED CORES AND SAWED BEAMS OF CONCRETE. Part 10 ASTM Designation C 42-68.
- (14) SAMPLING, INSPECTION, PACKING, AND MARKING OF LIME AND LIMESTONE PRODUCTS. Part 9 ASTM Designation C 50-57 (1968).
- (15) GYPSUM PARTITION TILE OR BLOCK. Part 12 ASTM Designation C 52-54 (1972)

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- (16) CONCRETE BUILDING BRICK. Part 12 ASTM Designation C 55-71.
- (17) STRUCTURAL CLAY NON-LOAD-BEARING TILE. Part 12 ASTM Designation C 56-71.
- (18) STRUCTURAL CLAY FLOOR TILE. Part 12 ASTM Designation C 57-57 (1972).
- (19) BUILDING BRICK (SOLID MASONRY UNITS MADE FROM CLAY OR SHALE). Part 12 ASTM Designation C 62-69.
- (20) SAMPLING AND TESTING BRICK. Part 12 ASTM Designation C 67-66.
- (21) HOLLOW LOAD-BEARING CONCRETE MASONRY UNITS. Part 12 ASTM Designation C 90-70.
- (22) MASONRY CEMENT. Part 9 ASTM Designation C 91-71.
- (23) ABSORPTION AND BULK SPECIFIC GRAVITY OF NATURAL BUILDING STONE. Part 12 ASTM Designation C 97-47 (1970).
- (24) MODULUS OF RUPTURE OF NATURAL BUILDING STONE. Part 12 ASTM Designation C 99-52 (1970).
- (25) PHYSICAL TESTING OF QUICKLIME AND HYDRATED LIME. Part 9 ASTM Designation C 110-71.
- (26) SAMPLING AND TESTING STRUCTURAL CLAY TILE. Part 12 ASTM Designation C 112-60 (1970).
- (27) Not used.
- (28) SAMPLING AND TESTING CONCRETE MASONRY UNITS. Part 12 ASTM Designation C 140-70.
- (29) AGGREGATE FOR MASONRY MORTAR. Part 12 ASTM Designation C 144-70.
- (30) SOLID LOAD-BEARING CONCRETE MASONRY UNITS. Part 12 ASTM Designation C 145-71.
- (31) PORTLAND CEMENT. Part 9 ASTM Designation C 150-73a.
- (32) COMPRESSIVE STRENGTH OF NATURAL BUILDING STONE. Part 12 ASTM Designation C 170-50 (1970).
- (33) HYDRATED LIME FOR MASONRY PURPOSES. Part 9 ASTM Designation C 207-49 (1968)
- (34) MORTAR FOR UNIT MASONRY. Part 12 ASTM Designation C 270-71.
- (35) GYPSUM CONCRETE. Part 9 ASTM Designation C 317-64 (1970).
- (36) MICROSCOPICAL DETERMINATION OF AIR-VOID CONTENT AND PARAMETERS OF THE AIR-VOID SYSTEM IN HARDENED CONCRETE. Part 10 ASTM Designation C 457-71.
- (37) CHEMICAL ANALYSIS OF GYPSUM AND GYPSUM PRODUCTS. Part 9 ASTM Designation C 471-72.

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(38) PHYSICAL TESTING OF GYPSUM PLASTERS AND GYPSUM CONCRETE. Part 9 ASTM Designation C 472-73.

(39) PHYSICAL TESTING OF GYPSUM BOARD PRODUCTS AND GYPSUM PARTITION TILE OR BLOCK. Part 9 ASTM Designation C 473-68.

(40) MORTAR AND GROUT FOR REINFORCED MASONRY. Part 12 ASTM Designation C 476-71.

(41) HOLLOW BRICK (HOLLOW MASONRY UNITS MADE FROM CLAY OR SHALE). Part 12 ASTM Designation C 652-70.

(42) RESISTANCE OF CONCRETE TO RAPID FREEZING AND THAWING. Part 10 ASTM Designation C 666-73.

(43) ESTABLISHING STRUCTURAL GRADES AND RELATED ALLOWABLE PROPERTIES FOR VISUALLY GRADED LUMBER. Part 16 ASTM Designation D 245-70.

(44) EVALUATING THE PROPERTIES OF WOOD-BASE FIBER AND PARTICLE PANEL MATERIALS. Part 16 ASTM Designation D 1037-72a.

(45) LOAD-SETTLEMENT RELATIONSHIP FOR INDIVIDUAL PILES UNDER STATIC AXIAL LOAD. Part 11 ASTM Designation D 1143-69.

(46) CONDUCTING STRENGTH TESTS OF PANELS FOR BUILDING CONSTRUCTION. Part 11 ASTM Designation E 72-68.

(47) SURFACE BURNING CHARACTERISTICS OF BUILDING MATERIALS. Part 14 ASTM Designation E 84-70.

(48) FIRE TESTS OF ROOF COVERINGS. Part 14 ASTM Designation E 108-58 (1970).

(49) FIRE TESTS OF BUILDING CONSTRUCTION AND MATERIALS. Part 14 ASTM Designation E 119-73.

(50) NONCOMBUSTIBILITY OF ELEMENTARY MATERIALS. Part 14 ASTM Designation E 126-73.

(51) BOND STRENGTH OF MORTAR TO MASONRY UNITS. Part 14 ASTM Designation E 149-66.

(52) FIRE TESTS OF DOOR ASSEMBLIES. Part 14 ASTM Designation E 152-73.

(53) FIRE TESTS OF WINDOW ASSEMBLIES. Part 14 ASTM Designation E 163-65 (1972).

(54) COMPRESSIVE STRENGTH OF MASONRY ASSEMBLAGES. Part 14 ASTM Designation E 447-72.

History: R. and rec., Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 51.26 Adoption of ACI Standards.** Pursuant to section 227.025, Wis. Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards of the American Concrete Institute (ACI), P. O. Box 4754, Redford Station, Detroit, Michigan 48219. Copies of the standards in reference

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are on file in the offices of the department, the secretary of state, and the revisor of statutes.

(1) BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE, ACI 318-71.

(2) RECOMMENDED PRACTICE FOR MANUFACTURED REINFORCED CONCRETE FLOOR AND ROOF UNITS, ACI 512-67.

(3) MINIMUM REQUIREMENTS FOR THIN-SECTION PRECAST CONCRETE CONSTRUCTION, ACI 525-63.

*History:* R. and rec., Register, July, 1974, No. 223, eff. 1-1-75.

Ind 51.27 Adoption of miscellaneous standards. Pursuant to section 227.025, Wis. Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards. Copies of the standards in reference are on file in the offices of the department, the secretary of state, and the revisor of statutes.

(1) Aluminum Association (The), 750 Third Avenue, New York City 10017, SPECIFICATIONS FOR ALUMINUM STRUCTURES, Aluminum Construction Manual, Section 1, second edition, November 1971.

(2) American Institute of Steel Construction, 101 Park Avenue, New York, N.Y. 10017, SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, February 12, 1969; and COMMENTARY ON THE SPECIFICATIONS FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, February 12, 1969.

(3) American Institute of Timber Construction, 333 West Hampden Ave., Englewood, Colorado 80110, STANDARD SPECIFICATIONS FOR STRUCTURAL GLUED LAMINATED TIMBER OF DOUGLAS FIR, WESTERN LARCH, SOUTHERN PINE AND CALIFORNIA REDWOOD, AITC 117-71; STANDARD SPECIFICATIONS FOR HARDWOOD GLUED LAMINATED TIMBER, AITC 119-71; STANDARD SPECIFICATIONS FOR STRUCTURAL GLUED LAMINATED TIMBER USING "E" RATED AND VISUALLY GRADED LUMBER OF DOUGLAS FIR, SOUTHERN PINE, HEM-FIR, AND LODGEPOLE PINE, AITC 120-71.

(4) American Iron and Steel Institute, 150 East 42nd St., New York, N. Y. 10017, SPECIFICATION FOR THE DESIGN OF COLD-FORMED STEEL STRUCTURAL MEMBERS, 1968 edition, including Addendum No. 1, Nov. 19, 1970; SPECIFICATION FOR THE DESIGN OF LIGHT GAGE, COLD-FORMED STAINLESS STEEL STRUCTURAL MEMBERS, 1968 edition.

(5) American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, SPECIFICATION FOR REINFORCED GYPSUM CONCRETE, ANSI A 59.1-1968 (Rev. 1972); SPECIFICATION FOR VERMICULITE CONCRETE ROOFS AND SLABS ON GRADE, ANSI A 122.1-1965.

(6) American Welding Society, 2501 NW 7th Street, Miami, Florida 33125, STRUCTURAL WELDING CODE, AWS D 1.1-72.

\* See Appendix A for further explanatory material.

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(7) American Wood Preservers' Association, 1625 Eye Street NW, Washington, D. C. 20006, ALL TIMBER PRODUCTS, STANDARD FOR PRESERVATIVE TREATMENT BY PRESSURE PROCESSES, AWPA C 1-73; LUMBER, TIMBERS, BRIDGE TIES AND MINE TIES, PRESERVATIVE TREATMENT BY PRESSURE PROCESSES, AWPA C 2-73; ROUND POLES AND POSTS USED IN BUILDING CONSTRUCTION—PRESERVATIVE TREATMENT BY PRESSURE PROCESSES, AWPA C 23-72.

(8) National Forest Products Association (Recommended by), 1619 Massachusetts Ave. NW, Washington, D. C. 20036, NATIONAL DESIGN SPECIFICATION FOR STRESS-GRADE LUMBER AND ITS FASTENINGS, 1973 edition, including SUPPLEMENT TO 1973 EDITION, dated April 1973.

(9) Steel Joist Institute, 2001 Jefferson Davis Highway, Arlington, Virginia 22202, STANDARD SPECIFICATIONS AND LOAD TABLES, 1973.

(10) Truss Plate Institute, 919 18th Street NW, Washington, D. C. 20006, DESIGN SPECIFICATIONS FOR LIGHT METAL PLATE CONNECTED WOOD TRUSSES, TPI-74.

(11) Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, U. S. PRODUCT STANDARDS PS 1-66 for softwood plywood/construction and industrial, including all amendments through No. 6, dated June 8, 1970 (National Bureau of Standards).

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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\* See Appendix A for further explanatory material.

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## CHAPTER IND 53

### STRUCTURAL REQUIREMENTS

Ind 53.01	Scope	Ind 53.323	Engineered masonry
Ind 53.10	Dead loads	Ind 53.33	Construction
Ind 53.11	Live loads	Ind 53.34	Miscellaneous design- construction details
Ind 53.12	Wind loads	Ind 53.35	Tests
Ind 53.13	Impact loads	Ind 53.36	Veneer, furring and trim
Ind 53.14	Load combinations	Ind 53.37	Concrete requirements
Ind 53.20	General	Ind 53.41	Gypsum concrete require- ments
Ind 53.21	Soil bearing capacity	Ind 53.42	Vermiculite concrete re- quirements
Ind 53.22	Unprepared fill material, organic material	Ind 53.50	Structural steel require- ments
Ind 53.23	Frost penetration	Ind 53.51	Cold-formed steel re- quirements
Ind 53.24	Piling	Ind 53.52	Steel joist requirements
Ind 53.25	Settlement	Ind 53.53	Structural welding of steel
Ind 53.26	Protection of adjoining property	Ind 53.54	Aluminum framing re- quirements
Ind 53.27	Cut or fill slopes	Ind 53.55	Stainless steel require- ments
Ind 53.28	Pole foundations	Ind 53.56	Other metals
Ind 53.30	General	Ind 53.60	General
Ind 53.31	Materials	Ind 53.61	Materials and design of structural elements
Ind 53.311	Masonry units	Ind 53.62	Special systems
Ind 53.312	Mortar	Ind 53.63	Minimum construction re- quirements
Ind 53.313	Masonry grout		
Ind 53.314	Cementitious materials		
Ind 53.315	Water		
Ind 53.316	Reinforcing, ties and anchors		
Ind 53.32	Design		
Ind 53.321	Types of masonry		
Ind 53.322	Empirical method of de- sign		

**History:** Chapter Ind 53 as it existed on December 31, 1971, was repealed and a new chapter Ind 53 was created Register, July, 1974, No. 223, effective January 1, 1975.

**Note:** Ind 53.26 is effective January 1, 1976.

**Ind 53.01 Scope.** This chapter provides the minimum requirements for the structural design of all buildings, structures and foundations to provide safe support of all dead loads, superimposed live and special loads, without exceeding the prescribed allowable stresses or departing from accepted engineering practice.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Note:** References. All standards referred to in this chapter will be identified by the designation and the number of standard followed by a cross-reference. The cross-reference will give full detail of the subject name and year of standard. Example: ASTM C-35 [Ind 53.25 (16)].

### MINIMUM ALLOWABLE LOADS

**Ind 53.10 Dead loads.** All buildings and structures, and parts thereof, shall be designed and constructed to support the actual dead weight of all component members in addition to the weight of partitions, ceiling finishes, floor finishes, stairways, safes and service equipment such as sprinkler systems, plumbing stacks, heating and air conditioning equipment, electrical equipment, elevators, flues and similar fixed equipment which become a part of the building.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Note:** Unless the project owner submits a written application for waiver, the department will consider 3 pounds per square foot as minimum service equipment load.

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Ind 53.11 Live loads. (1) All buildings and structures, and parts thereof, shall be designed and constructed to support the superimposed live loads, specified in Table 53-I, uniformly distributed in pounds per square foot of horizontal area. These load requirements shall be considered only as a minimum. In every case where the loading is greater than this minimum, the design of the building or structure, or part thereof, shall be for the actual load and loading conditions. The most severe distribution, concentration and combination of design loads and forces shall be taken into consideration.

**TABLE 53-I**  
**FLOOR LOADINGS**

Occupancy	PSF
<b>(a) Business</b>	
1. Offices	50
2. Offices with heavy business machines, heavy files, book stacks	100
<b>(b) Mercantile</b>	
1. Retail stores, shops, banks, restaurants, taverns, funeral homes	100
2. Wholesale stores	125
<b>(c) Industrial</b>	
1. Manufacturing, light	100
2. Manufacturing, heavy	150
<b>(d) Storage</b>	
1. Warehouse, light	125
2. Warehouse, heavy	250
3. Paper storage	
a. Compact	50 psf per ft. of ht.
b. Loose	30 psf per ft. of ht.
4. Garages—storage or repair or 8,000 pound axle load in any possible position (whichever produces larger stresses).	80
5. Parking decks	
a. All areas for passenger cars	50
b. Top floors, if open to sky, shall comply with Ind 53.11 (4) (roof loads) in addition to	50
c. Express lanes and ramps with a slope of 12% or more, the vertical loading (50 psf) shall be increased by 25%	
d. All areas for trucks and buses or 8,000 pound axle load in any possible position (whichever produces larger stresses)	80
<b>(e) Assembly areas</b>	
1. Armories, drill rooms	150
2. Assembly halls, auditoriums, lecture halls, churches, lodge rooms, theaters, courtrooms, balconies, with:	
a. Fixed seats	60
b. Movable seats	100
3. Dance floors, gymnasiums, exhibition rooms, passenger stations, skating rinks, restaurant serving and dining areas	100
4. Recreational areas such as bowling alleys and pool rooms	75

Table 53-I (cont.)

Occupancy	PSF
5. Floors supporting portable reviewing stands, grandstands or bleachers	130
Note: See Ind 53.56 for designing of portable units.	
6. Stage floors	150
(f) Educational	
1. Schools and related facilities	
a. Classrooms, study rooms, laboratories, display areas, offices	50
b. Floors of open plan schools	75
c. Industrial arts, home economics, music and band rooms	80
d. Gymnasiums, cafeteria areas	100
2. Libraries (public or in schools)	
a. Reading areas	60
b. Stack areas (20 psf per foot of height) but not less than	150
3. Museums and art galleries	80
(g) Residential	
1. Apartments, dormitories, guest rooms in hotels and motels	40
(h) Institutional	
1. Ward and private rooms in hospitals, nursing homes, asylums, cells in penal institutions	40
2. Operating rooms in hospitals, clinics	60
(i) Miscellaneous (applies to all occupancies above)	
1. Stairways, corridors, vestibules, lobbies	
a. in residential and institutional buildings	80
b. in all other buildings	100
2. Rest rooms and toilet rooms in public places	50
3. Equipment rooms (heating-ventilating, mechanical, electrical) equipment weight plus 40 psf, but not less than	75
4. Structural sidewalks and promenade decks	
a. with no vehicular restriction or 12,000 pounds concentrated load in any position	250
b. with vehicular restriction	100

(2) Loads not specified in Table 53-I. See Ind 53.11 (1).

(3) Live load reductions.

(a) No reduction of live load shall be allowed in the design of any slab or joist.

(b) No reduction of live load shall be allowed in the occupancies mentioned in Table 53-I subsections (d) storage and (e) assembly areas.

(c) For determining the total live load carried by foundations, columns, piers and walls, the following reductions can be applied to the entire floor area tributary to these members:

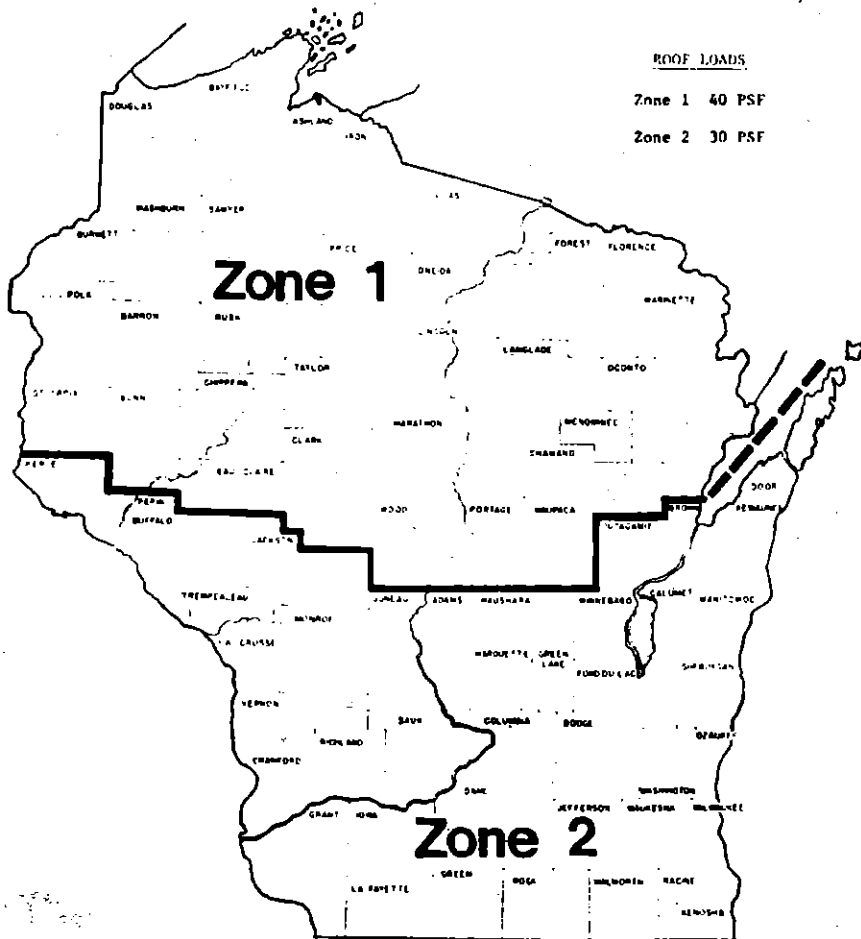
carrying the roof	0%
carrying 1 floor and roof	0%
carrying 2 floors and roof	10%
carrying 3 floors and roof	20%

carrying 4 floors and roof -----	25%
carrying 5 floors and roof -----	30%
carrying 6 floors and roof -----	35%
carrying 7 floors and roof -----	40%
carrying 8 floors and roof -----	45%
carrying 9 or more floors and roof -----	50%

(d) A reduction in live load of one % per 20 square feet is allowed for beams and girders which have a tributary area in excess of 150 square feet. The maximum reduction should not exceed 15% and such reduction shall not be carried into the structural members supporting these beams and girders.

(4) Roof loads. Roof loads shall be as indicated in the zone map for roof loads. (The loads are to be applied to horizontal projections.)

ZONE MAP FOR ROOF LOADS



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(a) *Special-purpose roofs.* Greenhouses shall be designed for not less than 20 pounds per square foot.

(b) *Increase in roof loads.* When there are elevation differences on roof levels, parapets, canopies or valleys which may cause excess snow, ice and/or water accumulation, the designer shall make special provisions for increased loading at such locations.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Note: The department will accept special provisions such as outlined in, but not limited to "Structural Information for Building Design in Canada," Supplement No. 3, National Building Code of Canada; or the recommendations of the Metal Building Manufacturers Association.

**Ind 53.12 Wind loads.** (1) **LOADING.** Every building (including all components of the exterior wall) and structure shall be designed to resist a minimum total wind load in accordance with the following table:

Up to 50 feet -----	20 psf
Over 50 to 100 feet -----	25 psf
Over 100 to 150 feet -----	30 psf
Over 150 to 200 feet -----	35 psf
Over 200 feet -----	40 psf

The wind pressure shall be taken on the gross area of the vertical projection of the building or structures facing the wind. No allowance shall be made for the shielding effect of other buildings and structures. For purposes of wind load design, the height shall be measured above the average level of the adjoining ground.

(2) **UPLIFT AND SUCTION FORCES.** Buildings and structures, including attachment of roof to building or structure and anchorage of building or structure to the foundation, shall be designed and constructed to withstand a wind pressure acting outward normal to the surface equal to the values set forth in Ind 53.12 (1). These suction and uplift forces need not be considered as additive to the design wind loads in the overall analysis of the building or structure.

(3) **OVERTURNING MOMENT.** The overturning moment due to wind load shall not exceed  $\frac{1}{4}$  of the moment of stability due to dead load only, unless the building or structure is anchored to foundations of sufficient weight to resist this force. The weight of earth superimposed over footings may be used to calculate the dead load resisting moment. Sufficient diaphragm bracing, diagonal bracing or rigid connections between uprights and horizontal members shall be provided to resist distortions.

(4) **SHAPE FACTORS.** The following shape factors may be used for the design of structures such as chimneys, tanks and solid towers in conjunction with Ind 53.12 (1).

<i>Horizontal cross-section</i>	<i>Shape factors</i>
square or rectangular -----	1.0
hexagonal or octagonal -----	0.8
round or elliptical -----	0.6

(5) **WIND LOAD ANALYSIS.** More exact wind load analysis will be acceptable if a recognized procedure is used.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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**Note:** The department will accept recognized procedures such as, but not limited to Department of Navy, Bureau of Yards and Docks, NAVFAC DM-2 (Dec. 1967); or "Wind Forces on Structures," by the Structural Division of ASCE, Test Committee on Wind Forces (ASCE Transactions, Vol. 126, Part II, Paper No. 3269).

**Ind 53.13 Impact loads.** (1) **LOADING.** Structural elements carrying live loads which induce impact shall have the live loads increased by the following minimum percentages in the structural design consideration of such forces:

For supports of elevators -----	100
For traveling crane support girders and moving loads -----	25
For supports of light machinery -----	20
For supports of vibrating machinery or power driven units --	50
For hangers supporting floors and balconies -----	33

(2) **HORIZONTAL AND LONGITUDINAL CRANE FORCES.** The lateral force on crane runways shall be equal to 20% of the sum of the crane capacity and the crane trolley (but exclusive of other parts of the crane). The force shall be assumed to be applied at the top of the rail, one-half on each side of the runway, and shall be considered acting in either direction normal to the runway rail. The longitudinal force (in the direction of rail) shall be taken as 10% of the maximum wheel loads of the crane applied at the top of the rail.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.14 Load combinations.** Allowable stresses may be increased 33 1/3% when wind loads are acting in combination with dead, live and impact (if any) loads. The section computed on this basis shall be not less than that required for the design dead, live and impact (if any) loads, computed without the 33 1/3% stress increase.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

## FOUNDATIONS

**Ind 53.20 General.** All submittals for plan examination of new buildings or structures, and for the alteration of a permanent structure which requires changes in foundation loads and distribution, shall have the soil types and bearing capacities (indicating verified or presumptive) used in the design of footing and foundations shown on the plans. Sufficient records and data to establish the soil character, nature and load-bearing capacity shall be available to the department upon request.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.21 Soil bearing capacity.** Bearing capacity of soils shall be determined by one of the following methods:

(1) **VERIFIED.** The soil shall be subjected to field or laboratory tests to determine its bearing capacity. A report, certified by a registered architect or registered professional engineer, shall be available to the department upon request.

(2) **PRESUMPTIVE.** (a) The type of soil under buildings shall be assigned a value not exceeding the bearing capacity, in pounds per square foot, as specified in Table 53-II. The type of soil shall be determined by explorations made at or adjacent to the site. The actual

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loading of the soil shall not exceed the specified bearing capacity unless verified by a written report (as explained in subsection (1) above).

TABLE 53-11  
PRESUMPTIVE SOIL BEARING VALUES

Type of Soil	PSF
1. Wet soft clay; very loose silt; silty clay -----	Verified method Ind 53.21 (1)
2. Loose fine sand; medium clay; loose sandy clay soils ----	2,000
3. Stiff clay; firm inorganic silt -----	3,000
4. Medium (firm) sand; loose sandy gravel; firm sandy clay soils; hard dry clay -----	4,000
5. Dense sand and gravel; very compact mixture of clay, sand and gravel -----	6,000
6. Rock -----	12,000

(b) Confirmation. The presumed soil bearing values shall be confirmed by exploring the type of soil to a depth of at least 5 feet below the footings during or before construction. The designer shall submit a report of confirmation to the department.

(c) Varying soil strata. Where the bearing materials directly under a foundation overlie a stratum having smaller allowable bearing values, such smaller values shall not be exceeded at the level of such stratum.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.22 Unprepared fill material, organic material. No foundation of buildings or structures shall be placed upon unprepared fill material, organic soil, alluvial soil or mud unless evidence has been presented to the department showing that the proposed load will be adequately supported. This evidence shall be in the form of a written report and shall be based on soil analyses, load tests or other acceptable criteria.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.23 Frost penetration. (1) Footings and foundations shall be placed below the frost penetration level, but in no case less than 42 inches below adjacent ground. Such footings shall not be placed over frozen material.

(2) Exceptions. (a) The edges of floating slabs constructed on grade need not be installed below the minimum frost penetration line provided adequate measures have been taken to prevent frost forces from damaging the structure.

(b) Grade beams need not be installed to the minimum frost penetration line, provided adequate measures are taken to prevent frost forces from damaging the structure.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.24 Piling. (1) GENERAL REQUIREMENT. Pile foundations shall be designed and installed to adequately transfer the structure loads to underlying or adjacent soil bearing strata.

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(2) **INSTALLATION.** Piles shall be handled and installed to the required penetration by methods which leave their strength unimpaired and that develop and retain the required load bearing capacity. Any damaged pile shall be satisfactorily repaired or the pile shall be rejected.

(3) **ALLOWABLE LOADS BASED ON SOIL CONDITIONS.** (a) *By driving formula.* For individual pile design loads not exceeding 40 tons per pile, the safe working load may be determined by a recognized formula or by the following formula:

$$P = \frac{2WH}{S + 1} \text{ for drop hammer}$$

$$P = \frac{2E}{S + 0.1} \text{ for double-acting hammer}$$

in which:

P = safe load (lbs.)

W = weight of striking part of hammer (lbs.)

H = fall of striking part of hammer (ft.)

E = manufacturer's rated energy (ft. — lbs.)

S = average penetration of pile under last 6 blows (inches/blow)

(b) *Substantiation of higher allowable loads.* Allowable loads greater than 40 tons will be permitted when substantiating data justifying such higher loads is submitted to the department by a foundation designer knowledgeable in the field of soil mechanics and pile foundations and familiar with the locale of the proposed project. Substantiating data such as test borings, laboratory test results, soil profiles, and pile load tests may be required by the department. The load test shall be in accordance with the procedure outlined in ASTM D-1143 [Ind 51.25 (45)].

(c) *Group pile action.* When friction piles are placed in groups, consideration shall be given to the reduction of load per pile.

(d) *Piles in subsiding areas.* Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer material, consideration shall be given to the downward frictional forces which may be imposed on the piles by the subsiding upper strata.

(e) *Lateral support.* Water, air and fluid soils shall not be considered as offering lateral support to piles. In any other type of material the piles may be designed as a short column. Positive permanent lateral support shall be provided at or near the top of all piles.

(4) **ALLOWABLE LOADS BASED ON PILE MATERIAL STRENGTH.**

(a) The compressive stress in any cross-section of a pile shall not exceed the normal allowable compressive stress of the material used for the pile, except as given in Ind 53.24 (5). The piles may be designed as short columns except as stated in section Ind 53.24 (3) (e).

(b) *End-bearing piles.* For end-bearing piles more than 40 feet in length, it may be assumed that 75% of the load is carried by the tip, except for piles installed in a material referred to in section Ind 53.22.

(c) *Friction piles.* For friction piles, the full load shall be computed at the cross section located at two-thirds of the embedded length of the pile measured up from the tip.



(5) TYPE OF PILES.

(a) *Timber piles.* Timber piles shall conform to National Design Specifications, Part X [Ind 51.27 (8)]. In addition, the tops of treated piles, at cutoff, shall be given 3 coats of hot creosote, followed by a coat of coal-tar pitch; and the cutoff shall be encased not less than 4 inches in concrete footing of the foundation.

(b) *Precast concrete piles.* Precast concrete piles shall be cast in one piece and shall attain a compressive strength of not less than 3,000 psi prior to driving. There shall be a minimum concrete covering of 2 inches over all reinforcing bars. Precast concrete piles shall be designed to resist stresses induced by handling, driving and super-imposed loads.

(c) *Cast-in-place concrete piles.* All concrete for cast-in-place piles shall develop a compressive strength of not less than 3,000 psi. Reinforcement shall have a concrete cover of one inch in cased piles and 2 inches in uncased piles.

1. *Uncased piles.* Cast-in-place piles in contact with earth shall be limited in length to 30 times the average diameter of the pile. The allowable compressive stress in concrete shall not exceed 0.33  $f_c$ . The concrete shall be deposited in a shaft free of foreign matter in a continuous operation so as to insure a full sized pile without voids or segregation.

2. *Metal formed piles.* Cast-in-place piles in contact with a steel shell or casing shall have a minimum tip diameter of 8 inches and a minimum average diameter of 10 inches. The shell and casing shall be sufficiently strong to resist collapse and sufficiently watertight to exclude water and foreign material during the placing of concrete. The shell or casing cannot be considered as a load carrying part of the pile. The allowable compressive stress in concrete shall be as stated for uncased piles, but it may be increased to a maximum value of 0.40  $f_c$  if the following conditions are satisfied:

a. The thickness of casing is not less than 0.0747 inches (14 ga AISI).

b. The casing is seamless or is provided with seams of strength equal to that of the casing.

c. The pile diameter is not greater than 18 inches.

(d) *Concrete-filled pipe and tapered tubular piles.* Concrete-filled pipe and tapered tubular piles may be driven open-ended or closed-ended. Pipe or tapered tube piles driven with closed ends shall be treated as a cast-in-place concrete pile with metal casing and shall be governed by the same regulations applicable thereto with suitable load-bearing allowance made for the metal casing. When driven open-ended to rock, no concrete shall be deposited until the pipe is cleaned free of all soil or loose rock chips and satisfactory proof furnished of the condition of the rock. The allowable stress in steel is .35  $F_y$ , but shall not exceed 12,000 psi. The minimum wall thickness of all load-bearing pipe, tube and shells shall be 1/10 inch. When the soil surrounding the pile contains destructive chemical elements, the pile shall be provided with an approved protective jacket or coating which will not be rendered ineffective by driving.

(e) *Structural steel piles.* No section shall have a nominal thickness of metal less than  $\frac{3}{8}$  inch. When an H-shaped section is used, the flange projection shall not be more than 14 times the minimum thickness of metal. The steel stress shall not exceed  $0.35 F_y$ .

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.25 Settlement.** Where footings or floating slabs are placed upon clays or other materials which are subject to settlement, an analysis for such buildings shall include consideration of total and differential settlements anticipated.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

*Note:* Section Ind 53.26 following is effective January 1, 1976.

**Ind 53.26 Protection of adjoining property.** (1) Any person making or causing an excavation to be made to a depth of 12 feet or less, below the grade, shall protect the excavation so that the soil of adjoining property will not cave in or settle, but shall not be liable for the expense of underpinning or extending the foundation of buildings on adjoining properties where his excavation is not in excess of 12 feet in depth. Before commencing the excavation the person making or causing the excavation to be made shall notify in writing the owners of adjoining buildings not less than 30 days before such excavation is to be made and that the adjoining buildings should be protected. The owners of the adjoining property shall be given access to the excavation for the purpose of protecting such adjoining buildings.

(2) Any person making or causing an excavation to be made exceeding 12 feet in depth below the grade shall protect the excavation so that the soil of adjoining property will not cave in or settle, and shall extend the foundation of any adjoining buildings below the depth of 12 feet below grade at his own expense. The owner(s) of the adjoining buildings shall extend the foundations of their buildings to a depth of 12 feet below grade at his own expense as provided in the preceding paragraph.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-76.

**Ind 53.27 Cut or fill slopes.** (1) **PERMANENT CUT OR FILL SLOPES.** Cuts or fills adjacent to any building, structure or property line shall be so constructed or protected that they do not endanger life and/or property. Permanent cut slopes shall not be steeper than 1½ horizontal to one vertical and permanent fill slopes shall not be steeper than 2 horizontal to one vertical unless substantiating data justifying steeper slopes are submitted.

(2) **TEMPORARY CUT OR FILL SLOPES.** For temporary cuts and fills, refer to Wis. Adm. Codes Chapter Ind 6—Trench, Excavation and Tunnel Construction, and Chapter Ind 35—Safety in Construction.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.28 Pole foundations.** Structures that use poles embedded in earth or embedded in concrete footings in the earth to resist axial and lateral loads shall have their depth of embedment determined as specified in this section.

(1) **CONSTRUCTION BACKFILL REQUIREMENTS.** The space around the pole shall be backfilled in accordance with one of the following methods:

(a) The hole shall be made 4 inches larger than the diameter or

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diagonal dimension of rectangular or square poles. It shall be back-filled with 2,000 psi concrete.

(b) The backfill shall be of thoroughly compacted clean sand.

(2) DESIGN-NONRESTRAINED POLES. The following formula shall be used in determining the depth of embedment required to resist lateral loads where no constraint is provided at the ground surface.

$$d = \frac{A}{2} \left( 1 + \sqrt{1 + \frac{4.36h}{A}} \right)$$

where:  $d$  = depth of embedment, ft.

$A = 2.34P/S_1B$

$P$  = applied horizontal force on pole, lb.

$S_1 = pd/3$ , see Table 53-III

Note: For first approximation of "d", the following formula may be used:

$$d = \sqrt[3]{\frac{12hP^2}{Bp}}$$

$B$  = diameter of concrete casing, ft.; when noncased in concrete, diameter or diagonal dimension of square or rectangular pole, ft.

$h$  = height above ground line at which force "P" is applied [if pole has fixity at top, such as provided by knee brace, "P" acts at inflection point (may be assumed at  $\frac{2}{3}h$ )], ft.

$p$  = allowable lateral passive soil pressure,† psf.

† Unless a more exact soil analysis method is used, the allowable passive soil pressure shall be determined as follows:

TABLE 53-III  
ALLOWABLE LATERAL SOIL PRESSURE

Soil Types (see Table 53-II)	Allowable Passive Soil Pressure, psf per foot of depth below grade	$S_1$ and $S_2$ values shall not exceed, psf
1 and 2 (Not well drained).....	100	1,500
3 and 4 (Well drained).....	200	2,500
5 and 6 (Well drained).....	300	3,000

(3) DESIGN—RESTRAINED POLES. Where constraint is provided at the ground surface, such as a rigid floor or pavement, the depth of embedment shall be in accordance with the following formula:

$$d = \sqrt{\frac{4.25 Ph}{S_1 B}}$$

where:  $S_1 = pd$ , see Table 53-III.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

## MASONRY

Ind 53.30 General. (1) SCOPE. The requirements of Ind 53.30 through 53.36 herein shall apply to the design, construction and materials used in all masonry and similar work under this code.

(2) DEFINITION. Masonry as used herein shall be considered as any built-up construction or combination of building units or materials of clay, shale, concrete, stone, gypsum, glass, metal or other approved units.

(3) DIMENSIONS. Dimensions specified herein are nominal unless otherwise stated. The actual dimensions may vary from the nominal by the thickness of a mortar joint, but not more than one-half inch.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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**Ind 53.31 Materials.** (1) **GENERAL REQUIREMENTS.** Components used in the construction of masonry shall be as required in sections Ind 53.311 through Ind 53.316.

(2) **LABELING.** All packaged materials shall be clearly identified by name (portland cement, masonry cement, lime, gypsum, etc.) and applicable standards which are met.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.311 Masonry units.** (1) **GENERAL.** (a) *Solid and hollow units.* A solid masonry unit is a unit whose net cross-sectional area in every plane parallel to the bearing surface is 75% or more of its gross cross-sectional area measured in the same plane. A hollow masonry unit has a net cross-sectional area less than 75% of its gross cross-sectional area.

(b) *Quality.* All masonry units shall be free from cracks, laminations and other defects or deficiencies, including admixtures and coatings, which may interfere with proper laying of the unit or impair the strength or permanence of the structure.

(c) *Used masonry units.* Masonry units may be reused when clean, whole and conforming to requirements for new masonry units.

(d) *Marking requirements.* Masonry units shall be of distinctive design or appearance, or marked so that the manufacturer is identified, as required by the department.

(e) *Surface condition at time of use.* Every masonry unit shall have all surfaces, to which mortar or grout is to be applied, capable of developing the required strength and bond. Coating or facings permitted and applied to masonry unit surfaces prior to their installation shall not supersede this requirement.

(f) *Positioning in structure.* Hollow masonry units shall be laid only in positions as tested for compliance.

(2) **CLAY AND SHALE UNITS.** Clay and shale units shall be made of burned clay or shale or mixtures thereof with or without admixtures.

(a) *Solid units (brick).* Units shall conform to grade SW requirements of ASTM C-62 [Ind 51.25 (19)].

(b) *Hollow units (tile and hollow brick).*

1. *Load-bearing units.* Units for use in load-bearing and exterior walls shall conform to grade LBX requirements of ASTM C-34 [Ind 51.25 (11)], or grade SW requirements of ASTM C-652 [Ind 51.25 (41)].

2. *Non-load-bearing units.* Units for use in non-load-bearing partitions shall be specially marked and shall conform to the requirements of ASTM C-56 [Ind 51.25 (17)]. Such units may also be used for non-structural purposes in concrete floor construction.

3. *Units for floor construction.* Units for structural use in floor construction shall conform to grade FT 1 requirements of ASTM C-57 [Ind 51.25 (18)].

(3) **CONCRETE UNITS.** Concrete units shall be made with portland cement, water and suitable mineral aggregates, with or without admixtures.

(a) *Solid units.* 1. *Small units (brick).* Units shall conform to grade N requirements of ASTM C-55 [Ind 51.25 (16)].

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2. **Large units (solid block).** Units shall conform to grade N requirements of ASTM C-145 [Ind 51.25 (30)].

(b) **Hollow units (blocks).** Units shall conform to grade N requirements of ASTM C-90 [Ind 51.25 (21)].

(4) **NATURAL STONE.** All natural building stone for use in masonry shall be sound and free from loose or friable inclusions, and shall meet the strength and fire resistance requirements for the proposed use. Where the cleavage plane of stone units is pronounced, the stone shall be laid only on its natural bed. Stone exposed to soil, weather or frost action shall be such that the strength and structure of the stone will not be affected when so exposed.

(5) **CAST STONE.** Units covered under this category are homogeneous or faced, dry cast concrete products other than conventional concrete masonry units (brick or block), but of similar size.

(a) **Composition.** Units shall be made with portland cement, water and suitable mineral aggregates, with or without admixtures, and reinforced if required.

(b) **Standards.** Units shall have a minimum compressive strength of 6500 psi and a maximum water absorption of 6% when tested as 2 x 2 inch cylinders or cubes.

(6) **ARCHITECTURAL PRECAST CONCRETE.** Units covered under this category are homogeneous or faced, wet cast non-load-bearing concrete products. Load-bearing precast concrete units shall conform to the requirements of Ind 53.40.

(a) **Composition.** Units shall be made with portland cement, water and suitable aggregates, with or without admixtures, and reinforced as required.

(b) **Standards.** Units shall conform to the requirements of Table 53-IV.

TABLE 53-IV  
ARCHITECTURAL PRECAST CONCRETE PHYSICAL REQUIREMENTS

Use	Compressive Strength† Minimum (psi)		Water Absorption Maximum (%)	Purposefully Entrained Air Minimum (%)
	Avg. of 3	Individual		
Exposed to freeze-thaw cycles (exterior)	4,500	3,800	8	3
All others (interior)	3,500	3,000	10	..

† Compressive strength shall be determined by procedures outlined in ASTM C-39 [Ind 51.25 (12)] or C-42 [Ind 51.25 (13)].

(7) **GYPHUM UNITS.** Units shall conform to the requirements of ASTM C-52 [Ind 51.25 (15)]. Gypsum units shall not be used in exterior or load-bearing walls or locations exposed to frequent or continuous wetting.

(8) **MISCELLANEOUS UNITS.** See Ind 50.12 for all other potential masonry units.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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Ind 53.312 Mortar. (1) GENERAL. Mortar as used herein shall be considered as a mixture containing cementitious materials used to permanently bond masonry or other structural elements.

(2) MORTAR FOR UNIT MASONRY. (a) *Composition.* Conventional mortar shall be composed of cementitious materials, fine aggregates and water. Suitable admixtures are allowed.

(b) *Standards.* All materials used as ingredients in mortar when delivered to the mixer shall conform to the requirements outlined below:

1. Cementitious materials. See Ind 53.314.
2. Aggregates. Aggregates shall conform to the following requirements and to the requirements of ASTM C-144 [Ind 51.25 (29)].
  - a. Aggregates shall be graded within the limits of Table 53-V.

TABLE 53-V  
MASONRY SAND GRADATION REQUIREMENTS

Sieve Size	Percentage Passing	
	Natural Sand	Manufactured Sand
No. 4.....	100	100
No. 8.....	95 to 100	95 to 100
No. 16.....	70 to 100	70 to 100
No. 30.....	40 to 75	40 to 75
No. 50.....	10 to 35	20 to 40
No. 100.....	2 to 15	10 to 25
No. 200.....		0 to 10

b. The aggregate shall have not more than 50% retained between any 2 consecutive sieves of those listed in Table 53-V, nor more than 25% between the No. 50 and No. 100 sieves.

c. If the fineness modulus varies by more than 0.20 from the value assumed in selecting proportions for the mortar, suitable adjustments shall be made in proportions to compensate for the change in grading.

3. Water. See Ind 53.315.

4. Admixtures. Where metal ties, anchors or reinforcement are imbedded in masonry, chloride, nitrate and sulphate base salts or materials containing same shall not be used in masonry construction.

(c) *Requirements.* Mortar for masonry shall conform to the property requirements of Table 53-VI and to the requirements of ASTM C-270 [Ind 51.25 (34)] unless otherwise noted in this section. If approved laboratory testing is not conducted to indicate compliance with Table 53-VI, the mortar mix shall be restricted to the provisions of Table 53-VII.

TABLE 53-VI  
MORTAR PROPERTY REQUIREMENTS

Mortar Type	Compressive Strength† Min. (psi)	Water Retention Min. (%)	Air Content Max. (%)
M.....	2,500	75	18
S.....	1,800	75	18
N.....	750	75	18
O.....	350	75	18

† See Ind 53.35 (3).

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TABLE 53-VII  
MORTAR PROPORTION RESTRICTIONS

Mortar Type	Cementitious Materials (Proportions by Volume)			Aggregate (Measured in a dump loose condition)
	Portland Cement	Masonry Cement	Lite	
Lite Cement Mortar				Not less than 2 1/4 and not more than 3 times the sum of the separate volumes of cementitious materials.
N	1		1/2	
O	1		over 1/2 to 3/2	
Masonry Cement Mortar			over 1/2 to 1 1/4	
M	1/2		over 1 1/4 to 2 1/2	
S				
N				
O				

(3) GYPSUM MORTAR. (a) *Standards.* Gypsum mortar shall be composed of one part of unfibred calcined neat gypsum to not more than 3 parts sand by weight, with sufficient water added for workability.

(b) *Use restrictions.* Gypsum mortar shall be used only with gypsum tile and block units or as fireproofing.

(4) MISCELLANEOUS MORTARS. (a) *High bond mortars.* See section Ind 50.12 for all such mortars, glues and special additives.

(b) *Special use mortars.* See Table 53-VIII.

(5) BOND. It is required that sufficient bond be developed to hold the masonry assemblage together and let it act as a single unit.

**Note:** Initial rate of absorption of masonry units and quantity of entrained air in mortar are factors affecting bond strength.

(6) MORTAR USE. Masonry shall be laid in mortar of the types listed in Table 53-VIII.

TABLE 53-VIII  
MORTAR USE REQUIREMENTS

Kind of Masonry	Types of Mortar Permitted
Load-bearing or non-load bearing masonry in contact with earth	M or S
All other load-bearing masonry	M, S or N
Non-load-bearing masonry in exterior and exposed locations where a high degree of resistance to frost action is desired	M, S or N
All other non-load-bearing walls and partitions	M, S, N or O
Fireproofing	M, S, N, O or gypsum
Special masonry:	
Gypsum partition tile or block	Gypsum
Firebrick or tile	Refractory air setting
Stack or chimney walls	Composed of portland cement, hydrated lime putty and aggregate

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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**Ind 53.313 Masonry grout.** Masonry grout for non-engineered masonry shall be type M, S or N mortar, as used in the construction, to which water is added to produce a consistency for pouring without segregation.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Note:** Masonry grout for reinforced masonry shall conform to the requirements of ASTM C-476 [Ind 51.25 (40)].

**Ind 53.314 Cementitious materials.** (1) **PORTLAND CEMENT.** Portland cement shall conform to the requirements of ASTM C-150 [Ind 51.25 (31)].

(2) **MASONRY CEMENT.** Masonry cement shall conform to the requirements of ASTM C-91 [Ind 51.25 (22)].

(3) **HYDRATED LIME.** Hydrated lime shall conform to Type S requirements of ASTM C-207 [Ind 51.25 (33)].

(4) **GYPSUM.** Gypsum shall conform to the requirements of ASTM C-22 [Ind 51.25 (9)].

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.315 Water.** Water shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter and other deleterious substances.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.316 Reinforcing, ties and anchors.** (1) **REINFORCING BARS.** Reinforcing bars shall conform to the requirements of ASTM A-165 [Ind 51.25 (6)], A-616 [Ind 51.25 (7)], and A-617 [Ind 51.25 (8)].

(2) **CONTINUOUS JOINT REINFORCEMENT.** (a) *Material.* Ties shall be fabricated from the equivalent of cold drawn wire conforming to the requirements of ASTM A-82 [Ind 51.25 (3)].

(b) *Coating.* Ties in exterior walls and potentially wet areas shall have noncorrodible cross wires for the intended use. Conformance with Class 3 requirements of ASTM A-116 [Ind 51.25 (4)] is acceptable.

(c) *Assembly.* Ties shall consist of the equivalent of at least 2 No. 9 steel wire gage longitudinal wires or rods with No. 9 steel wire gage cross wires or rods spaced not over 16 inches apart along each longitudinal wire or rod electrically flush or butt welded to tie the outside wires or rods together and provide mechanical bond.

(d) *Limitations.* Ties shall be of such dimensions that they provide the following:

1. Overlap of at least 6 inches at splices.
2. Engagement of both adjacent wythes; out-to-out spacing of side rods to be approximately 2 inches less than the total wall thickness.
3. Minimum actual cover over all but the cross wires or rods of  $\frac{3}{8}$  inch clear from all masonry unit faces and their joint surfaces.

(3) **INDIVIDUAL TIES AND ANCHORS.** (a) *Material.* Ties and anchors shall be fabricated from steel, brass, bronze or other approved material. See Ind 53.322 (5) (c) 1. b.

(b) *Coating.* Ties and anchors for use in exterior walls and potentially wet areas shall be noncorrodible for the intended use. Zinc

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coating (hot dip) conforming to the requirements of ASTM A-153 [Ind 51.25 (5)] is acceptable.

(c) *Limitations.* Ties and anchors shall be of such a dimension as to engage masonry units a minimum of 2 inches on each wythe in which the tie is placed and retain a minimum actual cover of  $\frac{3}{4}$  inch clear from all exposed masonry faces and joints.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.32 *Design.* (1) **GENERAL REQUIREMENTS.** Design of plain (non-reinforced) masonry shall be based either on the empirical method and limitations of section Ind 53.322 or on a detailed engineering analysis according to the provisions of section Ind 53.323. Design of reinforced masonry shall be based on the provisions of section Ind 53.323.

(2) **PRACTICE.** All masonry shall be designed with adequate strength and proportions to support all intended superimposed loads, resist all vertical or horizontal loads as required by this code, and comply with the fire-resistive construction requirements set forth in section Ind 51.04.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.321 *Types of masonry.* (1) **VENEER, FURRING AND TRIM.** Veneer, furring and trim comprise a facing of weather-resistant non-combustible materials securely attached to a backing, but not so bonded as to exert common action under load. See section Ind 53.36 for requirements.

(2) **PANEL WALL.** A panel wall is composed of weather resisting noncombustible large masonry units, or small masonry units pre-fabricated into larger assemblages, securely anchored to the framing of the structure.

(3) **SINGLE WYTHER WALL.** A single wythe wall is one masonry unit in thickness and is built of conventional size masonry units.

(4) **MULTI-WYTHER WALL.** A multi-wythe wall is composed of 2 or more wythes of conventional size masonry units of the same or different materials all tied or bonded together.

(a) *Grouted wall.* A grouted wall is a multi-wythe wall with all spaces between wythes solidly filled with masonry grout, as defined in section Ind 53.313.

(b) *Slushed or parged wall.* A slushed or parged wall is a multi-wythe wall with all spaces between wythes nominally filled with mortar.

(c) *Hollow wall (includes conventional cavity wall).* A hollow wall is a multi-wythe wall with an air space maintained between wythes. A water-repellent or water-resistant insulation may be placed between wythes. The description of a hollow wall is determined by its nominal out-to-out dimension.

(5) **SPECIAL WALLS** (a) *Stack or chimney walls.* See section Ind 52.10 and Table 53-VIII for general requirements.

(b) *Special use walls.* See section Ind 53.34 for special requirements.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

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Ind 53.322 Empirical method of design. (1) STRESSES. (a) *General.*

1. In determining the stresses in masonry, the effects of all loads and conditions of loading and the influence of all forces affecting the design and strength of the several parts shall be taken into account.

2. When the effects of eccentricity of vertical loads, including loads produced by the deflection of floor and roof units, are likely to cause tensile stresses in the masonry, the masonry shall be designed in accordance with the requirements of section Ind 53.323.

(b) *Allowable stresses.* 1. Compressive stresses. The compressive stresses in masonry shall not exceed the values given in Table 53-IX.

2. Bearing stresses. See Ind 53.34 (3) (b).

3. Composite masonry. In composite masonry with different kinds or grades of units or mortars, the maximum stress shall not exceed the allowable stress for the weakest combination of units and mortar of which the masonry is composed.

4. Stone flexural members. The maximum allowable flexural stress for natural stone shall be  $1/6$  of its modulus of rupture.

5. Bolts and anchors. See Ind 53.34 (5).

(2) THICKNESS AND HEIGHT

(a) *Height of masonry.* The height of a wall is defined for purposes of limitation as the maximum vertical distance between structural members completely supporting the weight of the wall or between the upper such support and the top of the wall, whichever is greater.

(b) *Thickness of load-bearing walls.* The minimum thickness of load-bearing masonry walls shall be at least 12 inches for the upper 36 feet of their height, and shall be increased 4 inches for the lower 36 feet or fraction thereof. Where a masonry load-bearing wall is made up of 2 or more wythes, the thickness of the wall shall not include any wythe less than 4 inches thick.

(bm) *Exceptions to thickness of load-bearing walls* [Ind 53.322 (2) (b)]. 1. *Stiffened walls.* Where single wythe or grouted multi-wythe masonry load-bearing walls composed of units of the same material are laterally supported at distances not greater than 12 feet apart by masonry crosswalls or by reinforced concrete floors, they may be of 12-inch thickness for the whole 72 feet.

2. *Top-story walls.* Top-story walls may be of 8-inch thickness provided that they are not over 12 feet in height and the roof construction imparts no lateral thrust to the walls.

3. *One-story walls.* In one-story buildings not exceeding 9 feet in height, the walls may be of 6-inch thickness provided that the roof span does not exceed 18 feet.

4. *Penthouses and roof structures.* Masonry walls above the main roof level, 12 feet or less in height, enclosing stairways, machinery rooms, shafts or penthouses may be of 8-inch thickness, and may be considered as neither increasing the height nor requiring any increase in the thickness of the masonry below.

5. *Walls of apartment buildings.* In buildings defined as places of abode (Ind 57.001 (2) not including hospitals) not more than 3

**TABLE 53-IX  
ALLOWABLE COMPRESSIVE STRESSES IN UNIT MASONRY<sup>1</sup>**

Type of Masonry	Type of Masonry Units	Average Ultimate Compressive Strength of Masonry Unit <sup>2</sup> (psi)	Allowable Compressive Stresses on Gross Cross-Sectional Area <sup>3</sup> (psi)			
			Type M Mortar and Grout	Type S Mortar and Grout	Type N Mortar and Grout	Type O Mortar and Grout <sup>4</sup>
Single wythe and grouted multi-wythe masonry	Rubble stone .....	.....	140	120	100	80
	Ashlar granite .....	.....	800	720	610	590
	Ashlar limestone and marble .....	.....	600	450	400	325
	Ashlar sandstone and cast stone .....	.....	400	300	320	250
	Solid units except concrete block	10,000 and over	450	400	350	250
		8,000 to 10,000	400	350	300	200
		6,000 to 8,000	300	275	250	175
		4,000 to 6,000	250	225	200	150
		2,500 to 4,000	175	160	140	100
		Solid concrete block	1,800 and over	175	160	140
	Hollow load-bearing units	1,000 and over	90	80	75	60
Flushed or parged multi-wythe masonry	All allowable compressive stress values to be 20% less than those for equivalent types of single-wythe and grouted multi-wythe masonry.					
Hollow multi-wythe masonry	Solid units except concrete block .....	2,500 and over	140	130	110	80
	Solid concrete block .....	1,800 and over	140	130	110	80
	Hollow load-bearing units .....	1,000 and over	70	60	55	40

<sup>1</sup> Where a type of masonry unit, mortar or grout is not provided for in Table 53-IX, it will be the practice of the department to allow a maximum compressive stress in the masonry which is no more than 15% of the ultimate compressive strength of a masonry assemblage as determined by an approved test.

<sup>2</sup> No individual masonry unit shall have a compressive strength less than 80% of the average ultimate compressive strength.

<sup>3</sup> Stresses shall be calculated on actual dimensions rather than nominal dimensions, with consideration for reductions such as raked joints and cavities.

<sup>4</sup> Type O mortar is permitted only in certain non-load-bearing masonry. See Table 53-VIII.

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stories in height, walls may be of 8-inch thickness when not over 36 feet in height and the roof imparts no horizontal thrust.

**6. Walls below grade.** Foundation walls shall be not less than 8 inches in thickness nor less than the thickness of the wall which it supports. When subject to lateral pressures, foundation walls shall be limited to a height over thickness ( $h/t$ ) ratio of 9 and shall also have lateral support from vertical elements at a spacing required by Table 53-X.

**7. Metal tied hollow walls.** Hollow walls shall not exceed 36 feet in height. The space (cavity) between wythes shall be not more than 4 inches. The backing wythe shall be at least as thick as the facing wythe. When both the facing and backing wythes have a thickness of 4 inches, the height of such hollow walls shall not exceed 24 feet.

**8. Masonry banded hollow walls.** Not allowed.

*Note:* For definition of hollow walls, see Ind 53.321 (4) (c).

**9. Rubble stone walls.** All rubble stone walls shall be 4 inches thicker than required in (b) above, but in no case less than 16 inches in thickness. Other exceptions above do not apply to rubble stone walls.

**10. Composite walls.** Walls containing clay and concrete masonry units shall not exceed 48 feet in height.

**(c) Thickness of exterior non-load-bearing walls and parapets.** Non-load-bearing exterior masonry walls may be 4 inches less in thickness than required for load-bearing walls [including the exceptions under (bm)], but the thickness shall not be less than 8 inches except where 6-inch walls are specifically permitted.

**(cm) Exceptions to thickness of exterior non-load-bearing walls and parapets** [Ind 53.322 (2) (c)]. **1. Panel walls.** Panel walls shall be designed with sufficient strength and thickness and anchored to the structure so as to insure adequate support and resistance to wind or other lateral forces. Panel walls shall not be less than 2 inches in actual thickness and the maximum ratio of height to thickness shall not exceed 30.

**2. Parapet walls.** Parapet walls shall not exceed 3 times their thickness in clear height.

**(d) Thickness of interior non-load-bearing walls (partitions).** Non-load-bearing interior partitions shall be not less than 4 inches in thickness. Where partitions designed for lateral support at the top are not in tight contact with at least a 2-hour fire-resistive construction at the top, such partitions shall be not more than 24 times their thickness in clear height (see Ind 53.322 (3) (a) 3.).

**(3) LATERAL SUPPORT.** (a) *Requirements.* All masonry shall be laterally supported in conformance with the following:

**1. Exterior walls.** Exterior masonry walls, whether they be load-bearing or non-load-bearing, shall be laterally supported either horizontally or vertically at intervals not exceeding those indicated in Table 53-X.

TABLE 53-X  
MAXIMUM RATIO OF Laterally UNSUPPORTED HEIGHT OR  
LENGTH TO THICKNESS FOR ALL EXTERIOR WALLS

Type of Masonry	Mortar Type			
	M	S	N	O
Single wythe walls of solid units or grouted walls of solid units.....	22	22	20	18
Flushed or parged walls of solid units.....	20	20	18	16
Hollow wall or walls containing hollow units	18	18	16	12

† In computing the ratio for hollow walls, the value for thickness shall be the sum of the nominal thickness of the inner and outer wythes.

2. *Load-bearing interior walls.* Load-bearing interior walls shall have lateral supports at either vertical or horizontal intervals not exceeding 24 times the wall thickness for solid masonry units and 20 times the wall thickness for hollow masonry units.

3. *Non-load-bearing interior walls (partitions).* Non-load-bearing partitions shall have lateral supports at either vertical or horizontal intervals not exceeding 30 times the thickness of the wall.

4. *Special masonry walls.* Exterior masonry walls having no lateral support at the top or at the ends (free standing), shall have their height limited to 4 times their thickness. (See Ind 53.322 (2) (c) 2. for parapet walls.) Similar interior walls (free standing), shall have their height limited to 6 times their thickness.

(b) *Methods of lateral support.* 1. *General.* Lateral support shall be provided by cross walls, pilasters or vertical structural members of sufficient strength to provide the required support when the limiting distance is measured horizontally; and/or by floors, roofs or horizontal structural elements which are of sufficient strength to provide the required support when the limiting distance is measured vertically. Provisions shall be made to transfer all lateral forces to the foundation.

2. *Limitations.* When horizontal structural elements are depended upon for lateral support, lateral support by vertical elements shall also be provided at intervals of not more than 72 times the wall thickness.

(c) *Pilasters.* A pilaster is a reinforced or nonreinforced masonry section which is thicker than and integrally bonded or mechanically keyed to the adjoining wall by alternate course bonding of masonry or by the use of pilaster blocks. A mechanically keyed control joint will be permitted on only one side of a pilaster which is used to provide lateral support. The projecting portion of the pilaster shall be bonded to the wall portion of the pilaster by lapping at least 50% of the units at the intersection or using special pilaster units.

1. All pilasters relied upon to provide lateral support shall not be less than 4 inches thicker than the wall supported nor less than 1/12 times the pilaster height. The width of pilasters shall be not less than 16 inches.

2. Where a pilaster is needed to carry a concentrated load from a flexural element, the least dimension shall be not less than 1/40 of the span of such an element and the height of the pilaster shall not exceed 12 times the least dimension of the pilaster.

(d) *Piers*. A pier is an isolated column of masonry. A load-bearing wall not bonded at the sides into associated masonry shall be considered a pier when its horizontal dimension measured at right angles to the thickness does not exceed 4 times its thickness.

1. All piers shall have lateral supports so that the vertical distance between such supports does not exceed 10 times their least dimension for single wythe or grouted masonry walls of solid masonry units, 8 times their least dimension for slushed or parged masonry walls of solid masonry units, and 6 times their least dimension for other masonry.

2. The least dimension of piers carrying flexural members shall be not less than 1/30 of the span of the flexural members.

3. Piers shall be laid in running bond unless reinforced as required for stack bond walls.

(4) **OPENINGS**. Unless evidence is provided to show that openings do not cause lateral stability and stress requirements to be exceeded, the amount of openings in a masonry wall shall not exceed the limits set forth in Table 53-XI.

TABLE 53-XI  
MAXIMUM RATIO OF LATERALLY UNSUPPORTED HEIGHT OR  
LENGTH TO THICKNESS FOR EXTERIOR WALLS  
WITH OPENINGS†

Type of Masonry	Percent of Openings at any Horizontal Plane of Wall			
	20	40	60	Over 60
Single wythe walls of solid units or grouted walls of solid units	20	16	12	Submit design calculations
All other masonry	18	14	10	

† The percentage of openings shall be calculated for each 100 lineal feet of wall or portion thereof at any horizontal plane of wall. See Table 53-X for additional restrictions when type "N" or "O" mortar is used.

(5) **BONDING**. (a) *General*. All types of masonry shall be adequately bonded.

(b) *Longitudinal bond*. 1. Running bond. In each wythe of masonry, not less than 60% of the units in any transverse vertical plane shall lap the ends of units above and below a distance not less than 2 inches or 1/2 the height of the unit, whichever is greater. Masonry not lapped as required above will be considered as stack bond and shall be reinforced longitudinally as required in 2. below for masonry units laid in stack bond.

2. Stack bond. In each wythe of masonry with units laid in stack bond, the masonry shall be reinforced by a continuous tie assembly, as defined in Ind 53.316 (2), at vertical intervals not exceeding 16 inches. For interior non-load-bearing partitions this spacing may be increased to 24 inches. (For load-bearing walls, see also Ind 53.34 (3) (b) 4.)

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3. Single wythe exterior concrete masonry walls. When units are laid in running bond, such masonry walls shall be reinforced by a continuous tie assembly, as defined in Ind 53.316 (2), at vertical intervals not exceeding 24 inches.

(c) *Transverse bond.* In multi-wythe masonry, adjacent wythes shall be bonded with either metal ties or headers in accordance with the following:

1. Bonding with metal ties. Adjacent wythes of masonry shall be bonded by embedment of reinforcement in the horizontal mortar joints with one of the following methods:

a. Continuous tie assemblies, as defined in Ind 53.316 (2), spaced at vertical intervals not exceeding 16 inches.

b. Individual ties, the equivalent of not less than 3/16 inch diameter steel rods, with one tie for not more than each 4 1/2 square feet of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance shall not exceed 18 inches. The maximum horizontal distance shall not exceed 36 inches. Ties bent to rectangular shape shall be used with hollow masonry units. With solid masonry units, either rectangular ties or ties bent to 90 degree angles, Z shaped, to provide hooks not less than 2 inches long shall be used. In hollow walls, additional ties shall be provided at all openings, spaced not more than 3 feet apart around the perimeter and within 12 inches of the opening.

2. Bonding with masonry bond units (headers). a. Adjacent wythes of masonry shall be bonded by the equivalent of a full header course overlapping both wythes at least 3 inches and spaced at intervals not greater than every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid units and 24 inches for hollow units. One-seventh of the wall surface shall be header or bond units.

b. In ashlar masonry, bond stones uniformly distributed shall be provided to the extent of not less than 10% of the area of exposed faces.

c. Rubble stone masonry shall have not less than one bond stone for each 6 square feet of wall surface on both sides. Such walls, 24 inches or less in thickness, shall have bond stones with a maximum spacing of 3 feet vertically and 3 feet horizontally.

d. Hollow walls shall not be bonded with headers.

Note: For definition of hollow walls, see Ind 53.321 (4) (c).

3. *Interrupted bond.* Where a structural member interrupts a backing wythe such that transverse bond otherwise required cannot be achieved, the facing wythe shall be bonded to that structural member as in 1. above.

(d) *Bond at intersections and corners.* Masonry that changes direction, or meets or intersects other masonry, where dependent for lateral support, shall be bonded by one of the following methods:

1. *Walls laid separately.* Provide joints with not less than the following:

a. For load-bearing elements, the equivalent of 1 1/4 inch by 1/4 inch anchors with ends turned up not less than 2 inches and not less than 24 inches between turned ends, embedded equally into each adjacent wall and spaced not more than 2 feet vertically. Where

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there is not sufficient thickness of masonry to embed such anchors properly, equivalent anchorage shall be provided by cross-pins or other means.

b. For non-load-bearing elements, the equivalent of  $\frac{3}{4}$  inch by 22 U.S. gage anchors, 8 inches or more in length, embedded equally into each adjacent wall and spaced not more than 16 inches vertically.

c. When regularly toothed or blocked, the vertical spacing of anchors required above may be doubled.

2. *Walls laid simultaneously.* Provide joints satisfying one of the following:

a. Lap at least 50% of the units at the intersection.

b. Use details which are designed to permit differential movement at the intersection of interior and exterior masonry, provided such details are consistent with the requirements for lateral stability of the masonry.

(6) ANCHORAGE. (a) *General.* All masonry dependent upon structural elements for continuity or lateral support shall be securely anchored thereto in such a manner as to resist all forces, especially wind and all lateral forces acting either inward or outward.

(b) *Load-bearing masonry.* 1. *Floor anchorage.*

a. All types of concrete floor systems which bear continuously on masonry with concrete to masonry contact may be considered to provide adequate lateral support.

b. All other structural elements intended to provide lateral support shall be securely anchored to the masonry.

2. *Roof anchorage.* Roof structures shall be securely anchored to load-bearing masonry with the equivalent of at least  $\frac{1}{2}$ -inch diameter bolts spaced not more than 6 feet on center and embedded in the masonry according to one of the following methods:

a. A steel plate having a minimum surface area of 6 square inches securely attached to the head of each bolt and completely embedded in the masonry at least 12 inches.

b. A continuous bond beam the equivalent of not less than 8-inch lintel (bond beam) blocks with 2 continuous No. 4 bars embedded in 2,500 psi concrete fill provided at the top of the masonry. The bolts shall be embedded at least 6 inches and hook beneath the longitudinal reinforcement.

(c) *Exterior non-load-bearing masonry.* 1. *Anchorage of masonry to the structural framework.* Where masonry is dependent upon the structural framework for lateral support or transmission of lateral loads, such masonry shall be anchored on at least 2 opposite sides of its perimeter to the framework, with the equivalent of a one-inch wide by  $\frac{1}{2}$ -inch thick anchor for each 12 square feet of wall surface, embedded at least 8 inches into the masonry, and spaced not more than 36 inches on center. Wedging will not be considered as an equivalent method.

2. *Anchorage of panel walls suspended from the structural framework.* Exterior prefabricated masonry assemblages and other elements larger than conventional size masonry units shall be anchored to their weight supports with the equivalent of  $\frac{3}{4}$  inch minimum diameter stainless steel bolts or  $\frac{3}{4}$  inch minimum diameter corrosion resistant plated steel bolts.



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(d) *Interior non-load-bearing masonry.* Where masonry is dependent upon the structural framework for lateral support, such masonry shall be anchored with the equivalent of a flexible 3/16 inch diameter anchor for each 12 square feet of wall surface, embedded at least 4 inches into the masonry, and spaced not more than 48 inches on center. Wedging may be used to anchor the top of a masonry partition to its top horizontal support.

(7) **JOINTING.** Joints commensurate with lateral stability requirements shall be installed in all exterior masonry to allow for expected growth of clay products and shrinkage of concrete products.

(a) *Vertical jointing.* Vertical control joints shall be provided at a spacing in compliance with Table 53-XII.

**Note:** To accomplish the intended purpose, joints should be located at critical locations such as (but not limited to) changes in building heights, changes in framing systems, columns built into exterior walls, major wall openings and changes in materials.

TABLE 53-XII  
MAXIMUM SPACING OF EXTERIOR MASONRY CONTROL JOINTS BETWEEN UNRESTRAINED ENDS† (FEET)

Loading Conditions	Type of Material	Openings (Percentage of total wall area)			
		0 to 20		More than 20	
		Joint to Joint	Joint to Corner	Joint to Joint	Joint to Corner
Load-bearing	Clay units	100	70	100	50
	Concrete units	60	30	40	20
Non-load-bearing walls	Clay units	100	50	60	40
	Concrete units	50	25	30	20

† Jointing required is a minimum and is not intended to prevent minor cracking. The distances given for maximum spacing of joints are for a single wall plane. For composite walls, the maximum spacing of joints shall be governed by the masonry material type used in the exterior wythe.

(b) *Horizontal jointing.* Where supports such as shelf angles or plates are required to carry the weight of masonry above the foundation level [see Ind 53.322 (2) (a) and Ind 53.36 (4) (b)], a pressure-relieving joint shall be provided between the structural support and any masonry which occurs below this level. The joint width shall be such as to prevent any load being transmitted from the support to any element directly below. All mortar and rigid materials shall be kept out of this joint. This type of joint shall be provided at all such supports in a concrete frame structure where clay masonry is exposed to the weather.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.323 Engineered masonry.** (1) **DEFINITION.** Engineered masonry means design of plain or reinforced masonry based on an engineering analysis.

(2) **REQUIREMENTS.** Calculations or other substantiating data to justify a reduction in requirements shall be submitted for all items in conflict with sections Ind 53.322, 53.33 or 53.34.

**Note:** It will be the practice of the department to approve designs in conformance with the following: (1) clay and shale units—"Building

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Code Requirements for Engineered Brick Masonry," Structural Clay Products Institute (now known as Brick Institute of America), 1750 Old Meadow Road, McLean, Virginia 22101 (August 1969); (2) concrete units—"Specifications for the Design and Construction of Load-Bearing Concrete Masonry," National Concrete Masonry Association, P. O. Box 9185, Rosslyn Station, Arlington, Virginia 22209 (1970); (3) cast stone and architectural precast concrete units—"Design of Precast Concrete Wall Panels," Title No. 68-46, *ACI Journal*, July 1971 (also see section Ind 53.40); and (4) standards of accepted engineering practice, provided proposed materials are in successful similar use or proven by test to be adequate.

(3) **LIMITATIONS.** Where design by engineering analysis is based upon material of a higher grade or a superior workmanship than is generally provided in accepted practice, it must be clearly established to the satisfaction of the department by test or other evidence that such quality exists and will only be employed under special inspection or field testing.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.33 Construction.** (1) **PRECAUTIONS.** See the requirements of Wis. Adm. Code chapter Ind.35—Safety in Construction.

(2) **COLD WEATHER WORK.** Adequate cold weather construction and protection provisions shall be taken to prevent masonry from being damaged by freezing.

*Note:* It will be the practice of the department to accept conformance with "Recommended Practices for Cold Weather Masonry Construction," International Masonry Industry All-Weather Council, 1970 (Available from International Masonry Institute, 823 15th Street NW, Washington, D. C. 20005.)

(3) **WORKMANSHIP FOR LOAD-BEARING MASONRY**

(a) The maximum thickness of a mortar joint shall be  $\frac{1}{2}$  inch.

(b) Except for head joints used for weep holes and ventilation, solid masonry units shall be laid so as to achieve full head and bed joints.

(c) Hollow masonry units shall be laid with full head joints and full bed joints under the full bearing areas of the face shells (and under webs where the adjacent cells are to be filled with grout).

(4) **CLEANING.** Chemical cleaning agents shall be prevented from harming the metal reinforcement of structural components.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 54.34 Miscellaneous design-construction details.** (1) **SPECIAL USE WALLS.** (a) *Hollow walls.*

1. In exterior hollow walls, suitable flashing shall be installed at the bottom of the cavity so as to drain any water outward.

2. Open vertical joints or weep holes of  $\frac{3}{8}$  inch minimum diameter shall be provided in the facing just above the flashing at a horizontal spacing not exceeding 3 feet.

(b) *Parapet walls.* 1. See Ind 51.02 (12) for requirements of parapet walls.

2. When roof drains are needed to remove precipitation and are the sole means of water escape, there shall be placed in all parapet walls scuppers or relief openings to prevent overloading of the roof.

(c) *Retaining walls.* The tops of exposed retaining walls shall be coped with noncombustible weatherproof material.

(d) *Reuse of existing walls.* Existing masonry may be used in the alteration of extension of a structure, provided that under the new

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conditions imposed it meets the requirements of this code or is made so by reasonable repairs.

(2) **CHANGES IN THICKNESS OR PLANE.** (a) *Nonvertical planes.* Details and techniques for all masonry to be installed in a nonvertical plane shall be submitted to the department for approval.

(b) *Thickness change requirements.* Where hollow walls or walls of hollow masonry units change in thickness, a course of solid masonry, concrete-filled hollow units or a continuous bearing element shall be interposed between the thicker and thinner sections.

(c) *Increase in thickness, including corbels.* The thickness of masonry shall not be increased (in the upward direction), except for corbels as follows:

1. The maximum horizontal projection of a corbel from the face of the wall from which it projects shall not exceed  $\frac{1}{2}$  the thickness of the wall.

2. The maximum projection of a masonry unit shall not exceed  $\frac{1}{2}$  the height of the unit nor  $\frac{1}{2}$  its bed depth.

(d) *Variation in thickness (chases and recesses).* Walls shall not be less than their required thickness between horizontal lateral supports except where permitted for chases and recesses as follows:

1. Chases or recesses shall not be made in load-bearing walls 8 inches or less in thickness. Pipes, ducts, conduits or similar noncombustible items may be installed in cores of hollow units.

2. Chases or recesses shall not be closer than 2 feet to any pilaster, buttress, cross wall, end wall or other stiffener that provides lateral support.

3. The maximum depth of any chase or recess shall not exceed  $\frac{1}{2}$  the thickness of the wall.

4. The length along the wall of any chase or recess shall not exceed 4 feet.

5. The clear distance between chases and recesses or each other shall not be less than 4 times the wall thickness.

6. Any chase or recess in conflict with the previous requirements shall be considered as an opening (see Ind 53.34 (3) (a) 4.).

7. No chase or recess shall reduce the thickness of material below the minimum required for fire walls, fire division, fire partitions or fire protective covering of structural members.

(e) *Protection.* In masonry exposed to the weather, pockets or crevices in which water may accumulate shall be avoided or protected to prevent damage.

(3) **BEARING.** (a) *Weight support of masonry.*

1. *General requirements.* The bearing support for all masonry shall be of noncombustible material and have lateral stability.

2. *Projections.* The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed  $1\frac{1}{4}$  inches, unless at least  $\frac{2}{3}$  the mass of the wythe of masonry involved is located directly over the load-carrying member.

3. *Shelf angles.* See Ind 53.322 (7) (b).

4. *Openings.* The masonry above openings shall be adequately supported. The bearing length of structural elements which support the

masonry above the opening shall be not less than 4 inches. The bearing stresses at these locations shall not exceed those allowed in Ind 53.322 (1).

(b) *Bearing on masonry.* Bearing stresses in masonry shall not exceed those specified in Ind 53.322 (1). Flexural members shall have bearing details that allow rotation at their supports without causing local failures.

1. Concentrated loads. Beams, girders, trusses, joists and other members causing concentrated loads shall bear a minimum of 3 inches in length in the direction of span upon at least one of the following:

a. Concrete beam. The equivalent of a nominally reinforced 2,500 psi concrete beam 8 inches in height.

b. Solid masonry. At least 8 inches in height of masonry composed of solid units.

c. Metal plate. A metal plate of sufficient thickness and size to safely distribute the load to masonry units. For piers and columns, the bearing plate shall not exceed 60% of the cross-sectional area of the pier or column and the resultant reaction of all vertical and horizontal loads shall fall within the middle third of the member.

d. Bond beam. The bond beam shall be the equivalent of not less than 8-inch lintel (bond beam) blocks with 2 No. 4 bars embedded in 2,500 psi concrete fill. The loads shall bear on the concrete fill.

2. Continuous loads. Joists, trusses and beams other than wood [for wood, see Ind 53.63 (4)], spaced 4 feet or less on center and 40 feet in span, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing length of 3 inches upon solid masonry at least 2 $\frac{1}{2}$  inches in height, or as indicated for concentrated loads.

3. Multi-wythe walls. Ties required for transverse bond shall be installed in the first horizontal mortar joint below the required beam, solid masonry or metal plate.

4. Stack bond walls. Concentrated loads shall be distributed into masonry laid in stack bond by a concrete beam or bond beam (as defined in 1. above). For masonry of solid units, 2 additional rows of a continuous tie assembly [as defined in Ind 53.316 (2)] may be used instead of a concrete beam or bond beam.

5. Support of wood floor members.

a. Where a wood structural member is buried in masonry for support, it shall be firecut or a self releasing device shall be used.

b. Where the end of a wood structural member is built into an exterior wall, a  $\frac{1}{2}$ -inch air space shall be provided at the sides, top and end of such member.

(4) JOINTING. See Ind 53.322 (7) for jointing.

(5) BOLTS AND ANCHORS. The allowable shear on steel bolts and anchors shall not exceed the values given in Table 53-XIII.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

Ind 53.35 Tests. (1) GENERAL. All masonry materials shall meet the requirements of section Ind 53.31, and the department may require submittal of test data, at any time, to show conformity.

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**TABLE 53-XIII**  
**ALLOWABLE SHEAR ON BOLTS AND ANCHORS**

Bolt or Anchor Diameter (Inches)	Embedment† (Inches)	Allowable Shear (Pounds)
3/8	4	270
1/2	4	410
5/8	4	550
3/4	4	750
7/8	5	1100
1	6	1500
1 1/8	7	1850
1 1/4	8	2250

† Bolts and anchors shall be solidly embedded in mortar or grout.

(2) **SAMPLING AND TESTING.** The selection and construction of all test specimens shall conform to standard test procedures and shall be truly representative of the materials, workmanship and details to be normally applied in practice.

(3) **STANDARDS.** The testing of all masonry shall be in accordance with Table 53-XIV.

**TABLE 53-XIV**  
**STANDARD METHODS OF SAMPLING AND TESTING**

Classification	Item	ASTM Test Method Including Ind 51.25 (No.)
Base Materials	Portland Cement	C 150(31)
	Masonry Cement	C 91(22)
	Hydrated Lime	C 25(10), C 50(14), C 110(25)
	Gypsum	C 471(37), C 472(38)
	Aggregate	C 144(29)
Mortar	Mortar	C 270(34)
Masonry Units	Clay and Shale	C 67(20), C 112(26)
	Concrete	C 140†(28)
	Natural Stone	C 97(23), C 99(24), C 170(32), C 666(42)
	Cast Stone	C 42(13), C 97(23)
	Arch. Precast Concrete Gypsum	C 39(12), C 12(13), C 97(23), C 157(36), C 473(39)
Assemblies		E 72(46), E 149(51), E 447(54)

† Mortar in the field, tested in a laboratory, shall test at least 85% of the minimum compressive strength required, and the field mortar will serve as the final basis for mortar approval. When mortar is not proportioned according to limitations of Table 53-VII, mortar shall be periodically tested by an impartial testing laboratory. Results of such required testing shall be submitted as evidence of conformity, when requested by the department.

‡ Typical hollow load-bearing concrete masonry units shall be initially tested for compliance; thereafter periodic testing may be required as directed by the department. Sampling shall be done only by the department or its authorized agents. The time and place of sampling will be at the discretion of the department.

Note: A record of initial test and subsequent spot checks will be kept by the department.

**(4) SPECIAL TESTS.**

(a) *Fire tests.* See section Ind 51.04.

(b) *Load tests.* Whenever there is reasonable doubt as to the stability or structural safety of a completed structure or part thereof, the department may require a load test on the building or portion of the structure in question.

*Mandatory:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.36 Veneer, furring and trim.** (1) **GENERAL.** Veneer, furring and trim as used in this section refers to a facing of weather-resistant noncombustible materials securely attached to a backing, but not so bonded as to exert common action under load.

(a) Veneer shall not be considered as part of the masonry when computing strength or required thickness.

(b) Veneer shall not be assumed as supporting any load other than its own weight.

(2) **MATERIAL REQUIREMENTS.** (a) *General.* See section Ind 53.31 for typical requirements of common masonry materials.

(b) *Tile and terra-cotta.* Such units shall be frost-proof and not more than 288 square inches in area.

(3) **THICKNESS.** No materials used for veneer shall have a thickness less than the values listed in Table 53-XV.

TABLE 53-XV  
MINIMUM THICKNESS OF VENEERS

Material	Minimum Actual Thickness (Inches)
Clay Brick or Tile	1 $\frac{1}{2}$
Concrete Masonry Units	1 $\frac{1}{2}$
Natural Stone	1 $\frac{1}{2}$
Cast Stone	1 $\frac{1}{2}$
Architectural Precast Concrete	$\frac{3}{4}$
Marble Slabs	$\frac{7}{8}$
Slate	$\frac{7}{8}$
Architectural Terra-cotta	1
Ceramic Veneer—Mechanical Anchorage	1
Ceramic Veneer—Adhesion Anchorage	$\frac{3}{4}$
Asbestos-Cement Boards	$\frac{1}{2}$
Aluminum Clapboard Siding	.024
Metal—Corrosion Resistant	.0149
Stucco and Exterior Plaster	$\frac{3}{4}$

(4) **BEARING AND BACKING SUPPORTS.** (a) Bearing and backing supports shall be weather-resistant and shall provide sufficient strength and stability to adequately support the veneer.

(b) Masonry veneer 1 $\frac{1}{2}$  inches or greater in thickness shall be supported by shelf angles or other equivalent weight supports. The spacing between such supports shall not exceed 18 feet vertically when the veneer is more than 30 feet above grade.

(5) **ATTACHMENT.** (a) *General.* All veneers, supports and attachments shall be capable of resisting a horizontal force equal to the wind loads specified in section Ind 53.12. Attachment shall be accomplished by mechanical methods or adhesion.

(b) *Attachment by mechanical methods.* All anchors shall be corrosion-resistant.

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1. Veneer of conventional size masonry units (one square foot or less). Such veneer shall be securely attached to its backing by anchors the equivalent of 22 U.S. gage corrugated sheet steel  $\frac{3}{8}$  inch wide with at least one such tie located in every 2 square feet of wall.

2. Veneer of large size masonry units (greater than one square foot). Such veneer shall be securely attached with anchors the equivalent of not less than  $\frac{3}{4}$  inch diameter bolts in accordance with either of the following:

a. Each unit individually anchored to the supporting framework with at least 3 anchors.

b. Individual units doweled to each other at all horizontal joints and anchored to the backing at all horizontal and vertical joints so that one anchor is provided for every 6 square feet of wall surface.

3. Veneer of metal. Exterior metal veneer shall be securely attached to its backing or supporting framework with the equivalent of wire of at least No. 9 steel wire gage spaced not more than 24 inches apart both horizontally and vertically. Wider spacing where proved adequate may be used when units exceed 4 square feet in area, provided there are at least 4 proper attachments per unit.

(c) *Attachment by adhesion.* Veneer one inch or less in thickness may be cemented to a masonry or concrete wall or to exterior portland cement plaster on high rib galvanized metal lath with an adhesive, provided that the bond is sufficient to withstand a shearing stress of 50 psi after curing for 28 days. Individual units so attached shall not exceed 30 inches in any one dimension nor have more than 540 square inches of face area.

(6) **JOINTING.** Pressure-relieving joints commensurate with lateral stability requirements shall be provided both horizontally and vertically where needed to compensate for differential movement between veneer and backing or frame. See also Ind 53.322 (7).

(7) **GROUNDING.** Metal veneers fastened to supporting elements which are not a part of the grounded metal framing of a building shall be effectively grounded.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

## CONCRETE

Ind 53.40 Concrete requirements. (1) **GENERAL.** The design and construction of structures in concrete of cast-in-place or precast construction, plain, reinforced or prestressed shall conform to the rules and principles of the following standards:

(a) ACI Std. 318 [Ind 51.26 (1)], Building Code Requirements for Reinforced Concrete.

(b) ACI Std. 512 [Ind 51.26 (2)], Recommended Practice for Manufactured Reinforced Concrete Floor and Roof Units.

(c) ACI Std. 525 [Ind 51.26 (3)], Minimum Requirements for Thin Section Precast Concrete Construction.

*History:* Cr. Register, July, 1974, No. 223, eff. 1-1-75.

*Note:* The following standards (1) through (12) are recognized by the department as being good engineering practice: (1) "Commentary on Building Code Requirements for Reinforced Concrete," ACI Report 318; (2) "Recommended Practice for Selecting Proportions for Concrete," ACI Std. 211.1; (3) "Recommended Practice for Selecting Proportions for Structural Lightweight Concrete," ACI Std. 211.2; (4)

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"Recommended Practice for Hot Weather Concreting," ACI Std. 605; (5) "Recommended Practice for Cold Weather Concreting," ACI Std. 306; (6) "Manual of Standard Practice for Detailing Reinforced Concrete Structures," ACI Std. 315; (7) "Recommended Practice for Evaluation of Compression Test Results of Field Concrete," ACI Std. 214; (8) "Recommended Practice for Measuring, Mixing and Placing Concrete," ACI Std. 614; (9) "Recommended Practice for Concrete Formwork," ACI Std. 347; (10) "Specification for the Design and Construction of Reinforced Concrete Chimneys," ACI Std. 505; (11) "Suggested Design of Joints and Connections in Precast Structural Concrete," ACI Report 512 (Copies of above standards may be obtained from American Concrete Institute, P. O. Box 4751, Redford Station, Detroit, Michigan 48219); (12) "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction," AWS Std. 12.1 (American Welding Society, 2501 NW 7th St., Miami, Florida 33125).

**Ind 53.41 Gypsum concrete requirements.** (1) **GENERAL.** The design and construction of gypsum concrete shall be in accordance with the following standards:

(a) **ASTM C 317** [Ind 51.25 (35)], Standard Specifications for Gypsum Concrete.

(b) **ANSI A 59.1** [Ind 51.27 (5)], Specifications for Reinforced Gypsum Concrete.

(2) **LIMITATIONS.** Gypsum concrete shall not be used where exposed directly to weather or where subject to wetting. Gypsum concrete shall be protected from freezing or coming in contact with moisture during shipment, storage, erection or pouring.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.42 Vermiculite concrete requirements.** Vermiculite concrete, when used in roof systems and slabs-on-grade, shall be in accordance with: **ANSI A 122.1** [Ind 51.27 (5)], "Specifications for Vermiculite Concrete Roofs and Slabs-on-Grade." Vermiculite concrete shall not be used where it can be subjected to moisture.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

## METALS

**Ind 53.50 Structural steel requirements.** The design, fabrication and erection of structural steel for buildings and structures shall conform to: **AISC** [Ind 51.27 (2)], "Specification for Design, Fabrication and Erection of Structural Steel for Buildings," and the provisions of the accompanying commentary for this specification, with the following modifications:

(1) **FABRICATOR SPLICES.** Any shop or field connection or splice not specifically shown on the designer's drawings shall have been previously approved by the designer and a record shall be kept of this approval. This record shall be submitted to the department when requested.

(2) **LATERAL BRACING MEMBERS.** Individual bracing members providing lateral restraint to columns or to compression flanges of beams and girders or to compression chords of trusses shall be proportioned to resist at least 2 percent of the compression force at the brace location unless a suitable analysis is made to determine the appropriate strength and stiffness of the bracing member.

(3) **CERTIFICATION AND IDENTIFICATION.**

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(a) **Certification.** All structural steel shall have a mill report or a test report made in accordance with ASTM A-6 [Ind 51.25 (1)] from the steel supplier; the reports shall include the information on the minimum yield strength and chemistry of the steel furnished. Upon request by the department, the supplier or fabricator shall furnish certified mill reports, test reports, affidavits and/or other information about the steel for the specific project.

(b) **Marking of steel.** Steel used for main components in completed members or assemblies shall be marked. This marking shall be accomplished by color coding or other means of identification as to its type or grade prior to shipment from the mill. The marking shall be continued through the fabricator's plant to the construction site. Steel which conforms to ASTM A-36 [Ind 51.25 (2)] designation may be fabricated without marking.

(c) **Acceptable steel types.** Steel of structural quality shall conform to the standards specified in section 1.4.1.1 of the AISC [Ind 51.27 (2)]. Steel types not listed in the above mentioned section of the AISC may be used if approved by the designer. An approval letter indicating conformance with Ind 53.50 (a) and (b) shall be sent to the department.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.51 Cold-formed steel requirements.** The design of cold-formed steel for buildings and structures shall conform to the AISI [Ind 51.27 (4)] "Specification for the Design of Cold-Formed Steel Structural Members," and the provisions of the accompanying commentary for this specification, with the following modifications:

- (1) **FABRICATOR SPLICES.** See Ind 53.50 (1)
- (2) **LATERAL BRACING MEMBERS.** See Ind 53.50 (2).
- (3) **CERTIFICATION.** See Ind 53.50 (3) (a).

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.52 Steel joist requirements.** The design, fabrication and erection of steel joists shall conform to the "Standard Specifications for: Open Web Steel Joists, Longspan Steel Joists and Deep Longspan Steel Joists" adopted by the SJI [Ind 51.27 (9)].

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.53 Structural welding of steel.** The requirements of this section shall apply to all welds on or between materials within the scope of Ind 53.50, Ind 53.51 and Ind 53.52.

(1) **BASE METALS.** Steels to be welded under this code are listed in AWS D 1.1, sections 8.2 and 10.2 [Ind 51.27 (6)].

(2) **FILLER METALS.** Filler metal requirements that are acceptable under this code are listed in AWS D 1.1, section 4.1 [Ind 51.27 (6)].

(3) **WELDING PROCESSES.** (a) Manual shielded metal arc, submerged arc, gas metal arc and flux cored arc welding processes conforming with the procedures established in AWS D 1.1, sections 2, 3

† **Note:** The type and grading may be indicated by the ASTM specification designation or a designation correlated to the information included on the certified mill or test report.

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or 4 [Ind 51.27 (6)] shall be considered as prequalified and are approved for use without performing procedure qualification tests.

(b) Electroslag and electrogas welding processes will not be considered as prequalified. They may be used provided a procedure is developed and provided it conforms to the applicable provisions of AWS D 1.1, sections 2, 3 or 4 [Ind 51.27 (6)].

(4) WELDING PROCEDURES. (a) *Procedure specification.* All welding procedures shall be prepared as a written procedure specification. This written procedure specification shall be prepared by the manufacturer, fabricator or contractor and shall be made available or submitted to the department when requested.

*Note:* Suggested form SB-223A, showing the information required in the procedure specification, may be obtained from the department.

(b) *Procedure qualification.* All joint welding procedures shall be previously qualified by tests as prescribed in AWS D 1.1, section 5.6 [Ind 51.27 (6)], except for the prequalified procedures exempted in Ind 53.53 (3) (a). The test shall be conducted under the supervision of an approved testing laboratory and the test results shall be submitted to the department for approval.

(5) DESIGN OF WELDED CONNECTIONS AND JOINTS. The details of all joints shall comply with the requirements of AWS D 1.1, section 2 and section 10, parts III and IV [Ind 51.27(6)]. A joint form not specified in AWS D 1.1, section 2 and section 10, parts III and IV, shall not be used until it is qualified to the satisfaction of the department.

(a) *Stud welding.* Stud welding shall be done by a procedure qualified in accordance with the requirements of AWS D 1.1, section 4, part VI [Ind 51.27 (6)].

(6) OPERATOR QUALIFICATIONS. All structural welding work shall be done by certified [as defined in Ind 53.53 (7)] welders. The required qualification test shall be conducted under the supervision of an approved testing laboratory. The weld test report shall be submitted to the department for evaluation. Test specimens shall be submitted when requested by the department.

(a) The manual welder shall be tested and qualified in accordance with AWS D 1.1, section 5, part III [Ind 51.27 (6)].

(b) The manual tackers shall be tested and qualified in accordance with AWS D 1.1, section 5, part V [Ind 51.27 (6)].

(c) The welding machine operator shall be tested and qualified in accordance with AWS D 1.1, section 5, part IV [Ind 51.27 (6)].

(7) OPERATOR CERTIFICATION. The department will issue to the operator who has successfully passed prescribed qualification tests, a certificate bearing his name, social security number, identifying mark, the process, the procedure specification number and other pertinent information from his qualification test. This certificate will remain in effect for one year provided the operator is continuously engaged in welding operations without an interruption of more than 3 consecutive months. If the interruption exceeds 3 consecutive months, the certificate shall automatically become void.

*Note:* See Wis. Adm. Code Chapter 69, Fee Schedule, for issuance of certificate SB-15.

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(a) The annual renewal of a certificate shall be granted upon the submittal of documentary evidence stating that the welder has been continuously employed in welding operations or by testing

(b) Each manual welder and tacker or machine operator shall be retested every 3 years in accordance with Ind 53.53 (6).

(8) **WELD IDENTIFICATION.** Each structurally significant member shall have its welding identified by a distinguishing mark stamped on the member by the certified welders involved.

(9) **CRITERION OF FINAL ACCEPTANCE.** All structural welding is subject to examination by approved inspectors and such inspection shall be the final criterion for conformance and acceptability for the intended use.

(10) **STRUCTURAL WELDING DONE OUTSIDE THE STATE OF WISCONSIN.** All welding shall conform with the requirements of section Ind 53.53. In addition, manufacturers and suppliers of structural steel shall, prior to commencing any welded construction, submit evidence of procedure qualification and welder certification that has been approved by an independent testing laboratory which is acceptable to the department.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.54 Aluminum framing requirements.** The design, fabrication and erection of aluminum structural framing members shall conform to "Specifications for Aluminum Structures" [Ind 51.27 (1)], published by The Aluminum Association.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.55 Stainless steel requirements.** The design, fabrication and erection of light gage stainless steel framing members shall conform to AISI [Ind 51.27 (4)], "Specification for the Design of Light Gage, Cold-Formed Stainless Steel Structural Members."

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.56 Other metals.** The design, fabrication and erection of other metals or metal alloys not specifically listed in this section shall be in accordance with the provisions of section Ind 50.12.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

## WOOD AND WOOD FIBER PRODUCTS

**Ind 53.60 General.** (1) **SCOPE.** The requirements of sections Ind 53.60 to 53.63, inclusive, shall apply to the materials, design, and construction procedures used in all wood and wood fiber products construction work under this code.

(2) **DEFINITION.** Wood and wood fiber products include those structural elements derived from solid wood, structural glued-laminated timber, plywood, fiberboard, hardboard and other wood-fiber-based materials.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.61 Materials and design of structural elements.** (1) **SAWN LUMBER.** The material characteristics and the design provisions of load-bearing structural sawn lumber shall be in accordance with the following adopted standard and listed exceptions:

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(a) "National Design Specifications for Stress-Grade Lumber and Its Fastenings" [Ind 51.27 (8)] and its Supplement Table 1, including Tables 1a and 1b.

1. Exceptions:

a. Section 200-B-1. The provisions of this section shall also apply to reused lumber. Reused lumber shall be considered to have a duration of load factor of 0.90.

b. Section 200-G-1. In addition to requiring grading in conformance with ASTM D 245 [Ind 51.25 (43)], lumber (including reused lumber) of species and grades not listed in Table 1 of the supplement to the NDS [Ind 51.27 (8)] shall be identified by the grade mark of, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent.

c. Section 203-A. The cumulative effects of short-time loads, such as snow, shall be considered in determining duration of load. For snow load, no greater duration of load factor than 1.05 shall be used.

d. Section 102-D. Refer to section Ind 53.11. The combination of full snow load with wind load shall be taken into consideration.

e. Part IX is deleted. Refer to section Ind 53.61 (2).

(2) **STRUCTURAL GLUED-LAMINATED TIMBER.** Structural glued-laminated timber is an engineered, stress-rated product of a timber laminating plant comprising assemblies of specially selected and prepared wood laminations securely bonded together with adhesives. The grain of all laminations is approximately parallel longitudinally. The following standards are adopted as part of this building code for the design and production of structural glued-laminated timber:

(a) AITC 117 [Ind 51.27 (3)], "Standard Specifications for Structural Glued-Laminated Timber of Douglas Fir, Western Larch, Southern Pine and California Redwood."

(b) AITC 119 [Ind 51.27 (3)], "Standard Specifications for Hardwood Glued-Laminated Timber."

(c) AITC 120 [Ind 51.27 (3)], "Standard Specifications for Structural Glued-Laminated Timber Using 'E' Rated and Visually Graded Lumber of Douglas Fir, Southern Pine, Hem Fir and Lodgepole Pine."

(3) **ROUND POLES.** Allowable unit stresses for nongraded round poles used as structural members other than piling shall be 80 percent of the allowable unit stresses for select structural grade beams and stringers (19 percent moisture content) of the appropriate species as listed in Table 1, supplement to the National Design Specification for Stress Grade Lumber and Its Fastenings [Ind 51.27 (8)]. No obviously unsound load-bearing poles are to be used. Higher allowable stresses will be permitted for round poles graded in accordance with a recognized standard.

**Note:** ASTM designation D 3200-73 "Standard Specification and Methods for Establishing Recommended Design Stresses for Round Timber Construction Poles" is acceptable for graded round poles. ANSI Standard 05.1-1972 may be used for poles subject to transverse loads only.

(4) **PILING.** See section Ind 53.24.

(5) **PLYWOOD.** (a) *General.* The quality and design of all plywood used in construction of all buildings and structures shall conform to the minimum standards under this section. All plywood when used

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structurally, including among others, use for siding, roof and wall sheathing, subflooring, diaphragms, and built-up members, shall conform to the performance standards for its type in U.S. Product Standard PS 1 [Ind 51.27 (11)] for softwood plywood construction and industrial. Each panel or member shall be identified for grade and glue type by the trademarks of an approved testing and grading agency. In addition, all plywood when permanently exposed in outdoor applications shall be of exterior type.

**Note:** It will be the policy of the department to approve designs in conformance with the following: (1) "Plywood Design Specification," including Supplement No. 1, "Design of Plywood Curved Panels"; Supplement No. 2, "Design of Plywood Beams"; Supplement No. 3, "Design of Flat Plywood Stressed-Skin Panels"; and Supplement No. 4, "Design of Flat Plywood Sandwich Panels"; (2) "Plywood Diaphragm Construction"; (3) Laboratory Report 121, "Plywood Folded Plate Design and Details"; (4) Laboratory Report 93, "Load-Bearing Plywood Sandwich Panels"; and (5) "Fabrication Specifications Plywood-Lumber Components: CP-8, BB-8, SS-8, SP-61, FP-62, PW-61" (above publications available from the American Plywood Association, 1119 A Street, Tacoma, Washington 98401); (6) Design Guide HP-SG-71, "Structural Design Guide for Hardwood Plywood" (available from the Hardwood Plywood Manufacturers Association, 2310 South Walter Reed Drive, Arlington, Virginia 22206).

(b) No part of any of the above referenced standards shall supersede the general live load requirements of section Ind 53.11.

(6) RECONSTITUTED WOOD BASE-FIBER AND PARTICLE PANEL MATERIALS. Materials of this type, when used structurally, shall be approved by the department in accordance with the requirements of section Ind 50.12. Evaluation will be based on ASTM D 1037 [Ind 51.25 (44)].

(7) SOLID WOOD FLOOR AND ROOF SHEATHING. Minimum thickness of nonstress rated lumber used for floor and roof sheathing shall be in accordance with Table 53-XVI.

(a) The above dimensions shall be the minimum dimensions for lumber with grades as specified in Table 53-XVII.

(8) TIMBER FASTENERS. The design and use of timber fasteners shall be in accordance with the requirements of National Design Specifications for Stress-Grade Lumber and Its Fastenings [Ind 51.27 (8)].

(a) *Fastener identification.* Light gauge perforated metal plate connectors shall be permanently identifiable with regard to their gauge and manufacturer.

**History:** Cr. Register, July, 1974, No. 223, eff. 1-1-75.

TABLE 53-XVI  
MINIMUM NET THICKNESS OF LUMBER PLACED (INCHES)

Use	Span (Inches)	Perpendicular to Support		Diagonal to Support	
		Surfaced Dry†	Surfaced Unseasoned	Surfaced Dry†	Surfaced Unseasoned
Floors.....	24 16	3 4 5 8	25 32 11 16	3 4 5 8	25 32 11 16
Roofs.....	24	5 8	11 16	3 4	25 32

† Maximum 19% moisture content.

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TABLE 53-XVII  
MINIMUM BOARD GRADES†

Grading Agency	Solid Floor or Roof Sheathing	Spaced Roof Sheathing
West Coast Lumber Inspection Bureau.....	Utility	Standard
Western Wood Products Association.....	4 Common or Utility	3 Common or Standard
Southern Pine Inspection Bureau.....	No. 3	No. 2
Redwood Inspection Service.....	Merchantaible	Construction, common
National Lumber Grades Authority.....	4 Common or Utility	3 Common or Standard
Northern Hardwood and Pine Manufacturers Association.....	4 Common	3 Common
Northeastern Lumber Manufacturers Association.....	4 Common	3 Common

† The above grades are taken from grading rules approved by the American Lumber Standards Committee.

**Ind 53.62 Special systems.** (1) **WOOD TRUSSES.** Wood trusses shall be constructed in accordance with the following recommended standard and the listed exceptions:

(a) "Design Specifications for Light Metal Plate Connected Trusses" [Ind 51.27 (10)].

1. Exceptions and additions:

a. Section 301.2. Moment coefficients used in design of top or bottom chord members shall be based on the assumption of no fixity at member ends or joints due to plate connectors.

b. Metal plate connectors shall be identifiable as stated in Ind 53.61 (8) (a).

(b) For trusses with nail-glued plywood gusset plates, calculations and design reference source shall be submitted to the department.

(c) Mechanically fastened trusses shall conform to Part V, "Timber Connector Joints," of National Design Specifications [Ind 51.27 (8)].

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.

**Ind 53.63 Minimum construction requirements.** The requirements of this section shall apply to all wood framing.

**Note:** Recognized wood framing and construction details indicated in "Wood Construction Data No. 1 and No. 5" of the National Forest Products Association, Technical Services Division (1619 Massachusetts Ave. NW, Washington, D.C. 20036) is recommended as good design and construction practice.

(1) **FIRE STOPS.** Fire stops shall be provided at all intersections of interior and exterior walls with floors, ceilings and roof in such manner as to effectively cut off communication by fire through hollow concealed spaces and prevent both vertical and horizontal drafts.

(a) Furred walls shall have fire stops placed immediately above and below the junction of any floor construction with the walls, or shall be fire-stopped the full depth of the joist.

(b) All spaces between chimney and wood framing shall be solidly filled with noncombustible material at floor levels.

(c) All wood fire stops as required in this section shall be lumber not less than 2 inches in nominal thickness, or ¾-inch thick plywood with joints backed, and not less in width than the enclosed space within the partition except as provided for chimneys. Fire stops may also be of gypsum board, cement asbestos board, mineral wool or other approved noncombustible materials, securely fastened in place.

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(2) **WOOD FRAMING INTO FIRE-RATED MASONRY WALLS.** See Ind 51.045 (1) (m).

(3) **FIRE-CUTTING.** Wood members supported in masonry walls shall have the ends of such members splayed or fire-cut to allow free end rotation in the vertical plane of the member, out of the masonry wall. See also Ind 53.34 (3) (b) 5. b.

(4) **BEARING.** (a) *Joists and trusses.* The ends of each joist or truss shall have not less than 1½-inch length of bearing on wood or metal nor less than 3-inch length on hollow or solid masonry units.

(b) *Beams and girders.* The ends of beams or girders supported on masonry or concrete shall have not less than 4-inch length of bearing. See also Ind 53.34 (3).

(5) **NOTCHING AND DRILLING.** No notching of outer fibers of structural members is permitted unless substantiated by design calculations. Circular holes bored in joists and studs that are within the middle one-third of the depth of joist or studs are permitted without design calculations.

(6) **DECAY PREVENTION.** Where wood is used in parts of a building exposed to moisture that causes the moisture content of wood to exceed 19 percent, the wood shall be adequately ventilated or treated with preservative in accordance with the following standards: AWPA C 1, AWPA C 2, and AWPA C23 [Ind 51.27 (7)].

(a) All wood columns, posts and frame legs whose base is subject to deterioration due to moisture shall bear on concrete or other inorganic materials which extend at least 3 inches above the adjacent surface unless treated with preservative.

(b) The ends of wood structural members built into exterior masonry walls or into concrete shall be treated with preservative or a moisture-proof barrier shall be installed on the bearing surface.

**Note:** In areas subject to termite attack, refer to "Design of Wood Structures for Permanence" (published by the National Forest Products Association, 1619 Massachusetts Ave. NW, Washington, D. C. 20036) as suggested by National Design Specifications [Ind 51.27 (8)], Appendix F, section B.2.

(7) **TRUSS BRACING AND ANCHORAGE.** All wood trusses shall be securely fastened to the supports and each truss shall be secured in position in accordance with National Design Specifications [Ind 51.27 (8)], Appendix F, section J.

(8) **ANCHORAGE.** Anchorage shall be in accordance with subsection Ind 53.12 (2).

(9) **CROSS BRIDGING.** Cross bridging shall be furnished in accordance with paragraph 300-J of NDS [Ind 51.27 (8)]. When joists support floor or roof decks other than wood or wood decks which are not adequately attached, cross bridging shall be provided at 8-foot intervals.

(10) **SOLID BLOCKING.** All floor and roof joists shall be supported laterally at the ends and at each support by solid blocking except when the ends of joists are nailed to a header, band or rim joist or to an adjoining stud. Solid blocking shall be provided between floor joints where subjected to concentrated loads. Solid blocking shall be

not less than 2 inches in nominal thickness and the full depth of the joist.

(11) **JOIST SUPPORT.** Floor or roof joists shall not be toe nailed into the side of beams and girders for support. Such joists shall be supported by joist hangers, ledgers or metal plate connectors of adequate structural capacity.

(12) **STUD WALLS.** Unless evidence is provided to indicate otherwise, the maximum spacing and height of studs shall be in accordance with Table 53-XVIII. Notching and drilling of studs shall conform

**TABLE 53-XVIII  
MAXIMUM SPACING AND HEIGHT OF STUDS**

Size	Grade Referring to F <sub>1</sub> and F <sub>2</sub>	Height (Feet)	Spacing (Inches)	
			Exterior or Load-Bearing	Interior & Non-Load-Bearing
2 by 4 or larger	Utility	8	16	24
2 by 3	Standard and better	8	16	16
2 by 4 — 3 by 4	Standard and better	12	16	24
2 by 6 or larger	Standard and better	18	24	24

**TABLE 53-XIX  
MINIMUM RECOMMENDED NAILING SCHEDULE**

Connection	Nailing (using common nails)
Joist to sill or girder, toe nail	2-8d
Bridging to joist, toe nail each end	2-8d
Ledger strip	3-16d at each joist
1" X 6" subfloor or less to each joist, face nail	2-8d
Over 1" X 6" subfloor to each joist, face nail	3-8d
2" subfloor to joist or girder, blind and face nail	2-16d
Sole plate to joist or blocking, face nail	16d at 16" oc
Top plate to stud, end nail	2-16d
Stud to sole plate, toe nail	1-8d
Doubled studs, face nail	16d at 24" oc
Doubled top plates, face nail	16d at 16" oc
Top plates, laps and intersections, face nail	2-16d
Continuous header, two pieces	16d at 16" oc along each edge
Ceiling joists to plate, toe nail	3-8d
Continuous header to stud, toe nail	4-8d
Ceiling joists, laps over partitions, face nail	3-16d
Ceiling joists to parallel rafters, face nail	3-16d
Rafter to plate, toe nail	3-8d
One-inch brace to each stud and plate, face nail	2-8d
1" X 8" sheathing or less to each bearing, face nail	2-3d
Over 1" X 8" sheathing to each bearing, face nail	3-8d
Built-up corner studs	16d at 24" oc
Built-up girders and beams	20d at 32" oc along each edge

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to subsection Ind 53.63 (5). Where load-bearing studs are spaced at 24-inch intervals, the roof trusses, rafters, and joists shall be centered over the studs or, in lieu thereof, solid blocking equal in size to the studs shall be installed to reinforce the double plate above.

(13) MINIMUM RECOMMENDED NAILING SCHEDULE. Unless evidence of design for the connection is provided, the connection shall have a minimum nailing in accordance with Table 53-XIX or its equivalent.

History: Cr. Register, July, 1974, No. 223, eff. 1-1-75.



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Theaters, assembly halls

Chapter Ind 55

THEATERS AND ASSEMBLY HALLS

Ind 55.001	Theaters	Ind 55.35	Automatic sprinklers
Ind 55.01	Assembly halls	Ind 55.39	Use of "safety-base" film
Ind 55.02	Class of construction	Ind 55.40	Motion picture machine booths, general
Ind 55.03	Height above grade		Construction of booth
Ind 55.04	Exposure and courts	Ind 55.41	Doors
Ind 55.05	Separation from other occupancies	Ind 55.42	Openings
Ind 55.06	Capacity	Ind 55.43	Ventilation of booths
Ind 55.07	Number and location of exits	Ind 55.44	Relief outlets
Ind 55.08	Type of exits	Ind 55.45	Electric wiring
Ind 55.09	Stairways	Ind 55.46	Motion picture machine
Ind 55.10	Exit doorways and doors	Ind 55.47	Fire protection in booth; care and use of film
Ind 55.11	Exit lights	Ind 55.48	Portable booths
Ind 55.12	Width of exits	Ind 55.49	Maintenance
Ind 55.13	Seating	Ind 55.50	Grandstands
Ind 55.14	Width of aisles	Ind 55.51	Exits
Ind 55.15	Lobbies and foyers	Ind 55.52	Aisles and passageways
Ind 55.16	Inclines and aisle steps	Ind 55.53	Seating
Ind 55.17	Obstruction	Ind 55.54	Guard rails
Ind 55.18	Mirrors and false openings	Ind 55.55	Portable grandstands or bleachers
Ind 55.19	Decorations	Ind 55.56	Inspection
Ind 55.20	Elevator and vent shafts	Ind 55.57	Tents
Ind 55.21	Stage separation	Ind 55.58	Structural requirements
Ind 55.22	Proscenium wall	Ind 55.59	Flame resistance
Ind 55.23	Proscenium curtain	Ind 55.60	Fire hazards
Ind 55.24	Automatic smoke outlet	Ind 55.61	Exits
Ind 55.25	Stage vestibules	Ind 55.62	Electrical installations
Ind 55.26	Footlight trough	Ind 55.63	Fire extinguishing equipment
Ind 55.27	Fireproof paint	Ind 55.64	Illumination: exit lights and signs
Ind 55.28	Stage accessory rooms	Ind 55.65	Boiler and furnace room
Ind 55.29	Boiler and furnace rooms	Ind 55.66	Toilet facilities
Ind 55.30	Lights and lighting	Ind 55.67	Outdoor theaters
Ind 55.31	Sanitary equipment	Ind 55.68	
Ind 55.32	Standpipes		
Ind 55.33	Fire extinguishers		
Ind 55.34			

Ind 55.001 Theaters. In the theater classification, are included all buildings or parts of buildings, containing an assembly hall, having a stage which may be equipped with curtains or permanent or movable scenery, or which is otherwise adaptable to the showing of plays, operas, motion pictures or similar forms of entertainment.

Ind 55.01 Assembly halls. (1) In the assembly hall classification are included all buildings, or parts of buildings, other than theaters, which will accommodate more than 100 persons for entertainment, recreation, worship or dining purposes.

Note: For assembly areas in connection with schools and other places of instruction, refer to Wis. Adm. Code chapter Ind 56.

(a) Every assembly hall which will accommodate not more than 100 persons shall conform to the requirements of Wis. Adm. Code chapter Ind 54, covering factories, office and mercantile buildings.

History: 1-2-56; am. (1) (Intro. par.). Register, March, 1972, No. 195, eff. 4-1-72.

Ind 55.02 Class of construction. (1) The capacities of buildings or parts of buildings in this classification for the various types of con-

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struction shall not exceed, and shall comply with, the following requirements:

#### MAXIMUM CAPACITIES

Type of Construction	With Stage	Without Stage
Type No. 1 and No. 2	No limit	No limit
Type No. 3 and No. 4	750	1,500
Type No. 5 and No. 6	500	1,000
Type No. 7 and No. 8	300	750

(a) Exception. For unlimited capacity, the fire protection of structural steel supporting the roof may be omitted for one-story buildings meeting type No. 1, 2 and 3 construction provided the building has no ground or basement floors. Heavy timber columns and roof framing may be substituted for structural steel framing. The roof decking shall be of noncombustible construction meeting the fire-resistive ratings of Table 51.03-A.

(2) Type No. 7 and No. 8 construction. (See Ind 51.03.) Where buildings of these classifications are erected of Type No. 7 or No. 8 construction, the following restrictions shall apply:

(a) Not more than one story in height without a balcony, and with no ground floor or basement except a heating and fuel room enclosed with fire-resistive construction as specified in section Ind 55.29, with all interior openings protected with self-closing fire-resistive doors as specified in section Ind 51.047.

(b) Located at least 20 feet from any other building or adjoining property line.

(c) Is not built in connection with a building used for any other purpose.

(d) Is provided with foundation walls and piers of masonry construction.

(e) Where motion picture booths are required, they shall be enclosed with 2-hour fire-resistive construction.

*Exception:* In places of worship, a full basement and a balcony seating not more than 30 persons may be provided.

(3) Balconies accommodating more than 100. In any theater or assembly hall, balconies which accommodate more than 100 persons shall be of Type No. 1 or No. 2 construction as specified in section Ind 51.03.

*History:* 1-2-56; (1); (1) (a); (2); (2) (a); (2) (b); (2) (c); (2) (d); (2) (e); (2) (f); (3); am. Register, June, 1956; No. 6, eff. 7-1-56; am. (1) (a), Register, August, 1957, No. 20, eff. 9-1-57; am. Register, January, 1961, No. 61, eff. 2-1-61; am. (2) (a), Register, February, 1971, No. 182, eff. 7-1-71; r. and recr. (2) (a) eff. 8-1-71 and exp. 1-1-72; cr. (2) (a) eff. 1-1-72; Register, July, 1971, No. 187; r. and recr. (1), am. (2) intro. par., and (3), Register, June, 1972, No. 198, eff. 1-1-72; cr. (1) (a), Register, September, 1973, No. 213, eff. 10-1-73; am. (2) (a), Register, May, 1974, No. 221, eff. 6-1-74; am. (1) (a), Register, July, 1974, No. 223, eff. 8-1-74.

Ind 55.03 Height above grade. (1) THEATERS. The height of the sills of the principal entrance doors to any theater, as defined in section Ind 55.001, shall be not more than 18 inches above the outside grade at that point. The floor level at the highest row of seats on the main floor shall not be more than 6 feet above the outside grade at the main entrance; the floor level at the lowest row of seats on

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exceed an area greater than 20% of the roof area except as permitted under occupancy sections.

1. No individual dome or group of domes or skylights shall exceed 100 square feet.

a. Domes or groups of domes or skylights shall be separated from each other by at least 8 feet laterally and 10 feet along the slope of the roof.

(7) Building locations:

(a) When the distance between buildings located on the same property is less than 10 feet, the following shall apply:

1. Where the combined gross area for these buildings is less than that allowable for one building the exterior wall shall satisfy minimum requirements listed for class of construction in table 51.03-A.

a. Buildings classified as wood frame under subsections Ind 51.03 (7) or (8) shall have exterior walls with a fire-resistive rating of not less than that required for these buildings when satisfying the 10 feet to 30 feet distance to property line shown in table 51.03-A.

2. Where the combined gross area for these buildings is greater than that allowable for one building, one of the opposing walls shall be not less than a 4-hour fire-resistive rated fire division wall or building division wall, whichever applies. Where buildings are of different classes of construction, the lesser allowable gross area shall apply.

(8) Interior balcony or mezzanine. Interior balconies or mezzanine floors shall have fire-resistive ratings as required for the story in which it is located.

(9) No pipes, wires, cables, ducts or other service equipment shall be imbedded lengthwise in the required fire-resistive protection of any structural member except as allowed in approved fire rated assemblies.

(10) Exposed exterior structural columns and framing. The required fire-resistive hourly rating may be omitted on noncombustible columns and framing when the building does not exceed 2 stories and the fire separation to the center of a street, or to the property line or buildings on the same property, is greater than 30 feet.

(11) Stairways, elevators and vertical shafts which serve 3 or more floor levels shall be enclosed with fire-resistive rated construction equal to or better than requirements specified in Table 51.03-A, except as exempted below:

(a) In buildings with 3 floor levels, the stairways in the upper 2 levels may be left open provided all stairways leading to the lowest level are separated from the upper levels with fire-resistive rated construction as specified in Table 51.03-A or better.

(b) Conditions specified in subsections Ind 55.09 (1) (a) and (b) as applied to a place of worship are acceptable.

(12) (a) Parapet walls shall be provided on exterior walls closer than 10 feet to a property line or to other buildings on the same property except as exempted under Ind 51.02 (12) (a) 4, Wis. Adm. Code. Parapet walls shall satisfy the following requirements:

1. Parapets shall not be less than 2 feet in height.

2. The minimum thickness of masonry parapets shall be 8 inches.

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3. Parapets shall have fire-resistive ratings as specified for exterior walls in Table 51.03-A.

4. Parapets are not required on exterior walls which front streets and alleys or where exterior walls connect with roofs of noncombustible construction.

(b) All parapet walls shall be properly coped with noncombustible weatherproof material.

(13) **FIRE DIVISION WALLS.** Fire division walls shall have not less than a 4-hour fire-resistive rating as specified in section Ind 51.04 and shall comply with one of the following conditions:

(a) The wall shall extend 3 feet above the roof.

(b) The wall shall connect and make tight contact with roof decks of at least 2-hour fire-resistive noncombustible construction on both sides of the wall.

(c) The wall shall connect and make tight contact with roofs of noncombustible construction on both sides of the walls, and the roofs shall be noncontinuous at the wall.

(14) **DETERMINATION OF NUMBER OF STORIES.\*** For purposes of establishing the maximum allowable stories in the various classes of construction stated in section Ind 51.03, the number of stories shall be determined on the following basis:

(a) The first floor shall be determined first and this level shall satisfy the following conditions:

1. Is the lowest floor having one or more required exits for that floor and for any floor(s) above or below.

a. If condition stated in 1. is not satisfied, the highest floor level shall be considered the first floor.

2. The elevation of the first floor shall be at or not more than 6 feet above an exit discharge grade.

3. The door sill of all required exit discharges from the first floor shall be at or not more than 3 feet above exit discharge grade.

(b) An interior balcony or mezzanine floor which exceeds 25,000 square feet or one third (3), whichever is least, of the net area enclosed within exterior walls and/or fire division walls shall be counted as a story.

(c) Penthouse(s) with a total area that exceeds 50% of the total roof area shall be counted as a story(ies).

(d) Construction according to subsection Ind 51.02 (4) (b) 1. b. shall also be counted as a story(ies).

(e) Total number of stories shall include the first floor plus all stories above and those stories determined by subsections Ind 51.02 (14) (b), (c) and (d).

1. Floor levels satisfying the definition of basement(s), ground floor(s), attic, interior balcony(ies) and/or mezzanine floor(s), unless otherwise stated, shall not be counted as a story(ies). For exception, see Appendix A-51.02 (14), Illustration No. 4.

**History:** Cr. Register, June, 1972, No. 198, eff. 1-1-73; r. (9) and (10), renum. (3) to be (4), (4), (5), (6), (7), (8) to be (6), (7), (8), (9), (10), am. (2) (a), cr. (3), (5), (11), (12), (13) and (14), Register, September, 1973, No. 213, eff. 10-1-73; am. (14) (d), Register, February, 1974, No. 218, eff. 3-1-74; r. and recr. (12) (a); am. (13) (c), Register, May, 1974, No. 221, eff. 6-1-74.

\* See Appendix A for further explanatory material.

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**CLASSES OF CONSTRUCTION TABLE 51.03-A FIRE RESISTIVE RATINGS IN HOURS (OR FRACTIONS THEREOF)**

BUILDING ELEMENT ↓	MODIFYING CONDITIONS			TYPES OF CONSTRUCTION								APPLICABLE NOTES SEE IND. 51.03 FOR CONSTRUCTION STANDARDS
	SEE NOTES ①②	BLDG SETBACK DIS TO P/L OR TO OTHER BLDG ON SAME PROP	BEARING OR NON-BEARING	FIRE RESISTIVE TYPE A	FIRE RESISTIVE TYPE B	METAL FRAME PROTECTED	HEAVY TIMBER	EXTERIOR MASONRY	METAL FRAME UNPROTECTED	WOOD FRAME PROTECTED	WOOD FRAME UNPROTECTED	
	NUMBER OF STORIES			NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	
1. INTERIOR SUPPORTS (COLUMNS, PIERS, FRAME LEGS, POSTS)				NC-4	NP	NP	NP	NP	NP	NP	NP	③④
2. FLOOR FRAMING (BEAMS, GIRDERS, JOISTS, SLABS, DECK)	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			NC-3	NC-2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	SEE IND. 51.03(7) 3/4	SEE IND. 51.03(8) 0	③④⑤⑥
3. ROOF FRAMING	MORE THAN 2 STORIES			NC-3	NC-2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	NP	NP	③
4. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	2 STORIES OR LESS			NC-2	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	0	SEE IND. 51.03(6) NC-0	3/4	0	③④
5. (NOT INCLUDING INTERIOR FURRING ATTACHED TO INSIDE SURFACE OF WALL)	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			NC-2	NP	NP	NP	NP	NP	NP	NP	③
6. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	3 TO 8 STORIES OR 85' IN HEIGHT OR LESS			NC-2	NC-1 1/2	SEE IND. 51.03(3) NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	SEE IND. 51.03(6) NC-0	NP	NP	③
7. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	2 STORIES OR UNDER 35' IN HEIGHT			NC-1	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	SEE IND. 51.03(5) 0	NC-0	SEE IND. 51.03(7) 3/4	0	③④
8. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	1 STORY - ROOF FRAMING MORE THAN 20' ABOVE FL.			NC-0	SEE IND. 51.03(2) NC-0	NC-0	SEE IND. 51.03(4) H.T. OR I	0	0	0	0	③
9. (TRUSSES, BEAMS, GIRDERS, JOISTS, FRAME RAFTERS, PURLINS, DECK)	1 STORY - ROOF FRAMING 20' OR LESS ABOVE FL.			NC-1	NC-1	NC-1	SEE IND. 51.03(4) H.T. OR I	0	0	SEE IND. 51.03(7) 3/4	0	③④
10. ROOF COVERING	OVER 8 STORIES OR MORE THAN 85' IN HEIGHT			CLASS A	NP	NP	NP	NP	NP	NP	NP	③
11. ROOF COVERING	8 STORIES OR 85' IN HEIGHT OR LESS			CLASS A	CLASS A	CLASS A	CLASS B	CLASS B	CLASS C	CLASS C	CLASS C	③
12. EXTERIOR WALLS & COURT WALLS		LESS THAN 10 FT.	BEARING	NC-4	NC-3	NC-2	NC-2	NC-2	NC-2	NP	NP	③④⑤⑥⑦
13. EXTERIOR WALLS & COURT WALLS		10 FT. TO 30 FT. INCLUSIVE	BEARING	NC-3	NC-2	NC-3/4	I	NC-1	NC-0	3/4	0	③④⑤⑥⑦⑧
14. EXTERIOR WALLS & COURT WALLS		OVER 30 FT.	BEARING	NC-2	NC-1	NC-0	I	NC-1	NC-0	3/4	0	③④⑤⑥⑦⑧
15. EXTERIOR WALLS & COURT WALLS		LESS THAN 10 FT.	NON-BEARING	NC-2	NC-2	NC-1	NC-1	NC-1	NC-1	NP	NP	③④⑤⑥⑦
16. EXTERIOR WALLS & COURT WALLS		10 FT. TO 30 FT. INCLUSIVE	NON-BEARING	NC-1	NC-1	NC-0	I	NC-1	NC-0	3/4	0	③④⑤⑥⑦⑧
17. EXTERIOR WALLS & COURT WALLS		OVER 30 FT.	NON-BEARING	NC-0	NC-0	NC-0	3/4	NC-0	NC-0	3/4	0	③④⑤⑥⑦⑧
18. INTERIOR WALLS BEARING				NC-3	NC-2	NC-1	I	I	NC-0	3/4	0	③④⑤⑥⑦
19. PARTITIONS				NC-0	NC-0	NC-0	0	0	0	0	0	③④
20. REQUIRED EXIT CORRIDOR ENCLOS.				NC-2	NC-2	NC-1	I	I	I	3/4	3/4	③④
21. FIRE ENCLOSURE (STAIRWAYS, ELEVATORS, VERTICAL SHAFTS)	3 STORIES OR MORE			NC-2	NC-2	NC-1	I	I	I	NP	NP	③④
21. FIRE ENCLOSURE (STAIRWAYS, ELEVATORS, VERTICAL SHAFTS)	3 OR MORE FLOOR LEVELS									3/4	3/4	③④
22. PENTHOUSE WALLS				NC-0	NC-0	NC-0	0	NC-0	0	0	0	③
23. PENTHOUSE ROOF				NC-0	NC-0	NC-0	0	0	0	0	0	③④

**KEY TO ABBREVIATIONS :**

- NC - NON COMBUSTIBLE
- NOT PERMITTED
- HEAVY TIMBER

- ③ - SEE OCCUPANCY SECTIONS OF THE CODE FOR OTHER BASIC REQUIREMENTS AND MORE RESTRICTIVE LIMITATIONS.
- ④ - ROOF COVERING SAME AS FOR MAIN BUILDING.
- ⑤ - WALLS OF SOLID WOOD 4" IN THICKNESS ARE ACCEPTABLE AS EQUAL TO ONE HOUR FIRE-RESISTIVE RATING.
- ⑥ - FIRE RESISTIVE REQUIREMENTS ALSO FOR THOSE BRACING MEMBERS REQUIRED FOR GRAVITY LOADING.
- ⑦ - REFER TO TABLE 51.03-B FOR ALL AREAS FOR WINDOWS AND OTHER OPENINGS IN EXTERIOR WALLS.
- ⑧ - FOR EXCEPTIONS REFER TO IND. 51.03.

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underside of the members. Splice plates shall be not less than 3 inches, nominal, in thickness.

(f) Floors:

1. Wood floor construction shall be tongued and grooved, or splined lumber not less than 3 inches nominal thickness, or of solid lumber placed on edge and securely fastened together to make a floor not less than 4 inches, nominal, in thickness. A top layer of flooring of one inch nominal thickness shall be placed over all such floor construction.

(g) Stair construction may be of wood in buildings not exceeding 3 stories in height. In 4-story buildings, all stairs, platforms and stair construction shall be constructed of noncombustible material.

(h) Roofs. Roof decks shall be:

1. Matched or splined wood roof decking of not less than 2 inches in nominal thickness; or

2. Solid lumber not less than 3 inches in nominal thickness, set on edge securely fastened together; or

3. Approved 1½ inch thick plywood with exterior glue, tongue and groove with all end joints staggered and butting on centers of beams spaced not over 4 feet apart; or

4. Other forms of roof decks, if of noncombustible material.

(5) EXTERIOR MASONRY (NO. 5):

(a) A building is of exterior masonry construction if all enclosing walls are constructed of masonry or reinforced concrete with fire-resistive ratings as set forth in table 51.03-A.

(b) All buildings of this classification shall not exceed a height of 50 feet, in which height there shall be not more than 4 stories.

(c) The interior structural framing shall be metal, reinforced concrete, masonry or wood. Fire protection of metal or wood structural members may be omitted except that all such members supporting load-bearing masonry in all parts of buildings of more than one story shall be of metal, reinforced concrete or masonry with not less than one-hour fire-resistive protection of supporting metal.

(d) In walls where fire protection is required, the bottom of lower flange of lintels supporting load-bearing masonry shall be protected for openings exceeding 12-foot spans.

(e) Floors, roofs, partitions and stairs may be of wood but no joist, rafter, stud or stringer shall be less than 2 inches in nominal thickness.

(f) Bays, oriels and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings as required for exterior walls or approved fire-retardant treated wood satisfying the definition for "noncombustible" [Ind 51.01 (86) (c)].

(g) Where exterior overhangs are closer than 20 feet to the adjoining property line or other building on the same property, exterior wood siding, trim and shingles of projecting canopies, cornices, roof overhangs, dormers and mansard roofs may be used if the construction complies with the following:

1. All exposed material shall be noncombustible material or fire-retardant treated wood satisfying the definition for "noncombustible" [Ind 51.01 (86) (c)].

\* See Appendix A for further explanatory material.

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2. Exterior masonry walls shall extend to the underside of roof rafters or joists or bearing points of beams and trusses.

3. Spaces between rafters, joists, beams or trusses shall be fire-stopped with nominal 2-inch wood blocking or rigid noncombustible material to the underside of the roof decking.

(h) Penthouses and other roof structures shall have enclosing walls of noncombustible construction and roof framing and coverings shall be equal to that specified in table 51.03-A.

**(6) METAL FRAME—UNPROTECTED (NO. 6):**

(a) A building is of metal frame unprotected construction if the enclosing walls are of unprotected metal or unprotected metal in combination with other noncombustible materials and all building elements are as set forth in Table 51.03-A unless otherwise exempted.

1. Heavy timber may be used for interior columns and floor framing.

2. Interior mezzanines and balconies within the first story may be constructed of one-hour fire-resistive construction.

(b) All buildings of this classification shall not exceed a height of 50 feet, in which height there shall be not more than 3 stories.

(c) Stairs and stair platforms may be of wood with stringers not less than 2 inches in nominal thickness.

(d) Bays, oriels and similar exterior projections from the walls shall be constructed of material with fire-resistive ratings not less than that specified for exterior walls in table 51.03-A.

**(7) WOOD FRAME—PROTECTED (NO. 7):**

(a) A building is of wood frame protected construction if the structural parts and enclosing walls are of protected wood, or protected wood in combination with other materials, with fire-resistive ratings as set forth in table 51.03-A. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also termed a wood frame protected building.

(b) All buildings of this classification shall not exceed a height of 40 feet, in which height there shall be not more than 2 stories.

(c) Floors, roofs, partitions and stairs may be of wood but no joist, rafter, stud or stringer shall be less than 2 inches in nominal thickness.

(d) The structural members supporting the finished ceiling in the topmost story shall be protected on the underside by fire-resistive material acceptable in systems approved for one-hour fire-resistive ratings as covered in section Ind 51.04.

**(8) WOOD FRAME—UNPROTECTED (NO. 8):**

(a) A building is of wood frame unprotected construction if the structural parts and enclosing walls are of unprotected wood, or unprotected wood in combination with other materials. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also termed a wood frame unprotected building.

(b) All buildings of this classification shall not exceed a height of 35 feet, in which height there shall be not more than 2 stories.

\* See Appendix A for further explanatory material.

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Definitions and standards

(c) Floors, roofs, partitions and stairs may be of wood but no joist, rafter, stud or stringer shall be less than 2 inches in nominal thickness.

**History:** Cr. Register, June, 1972, No. 198, eff. 1-1-73; am. (1) (d), renum. (1) (e) 1. to be (f), (1) (f) 1. a. to be (1) (f) 1.; (1) (f) (g) (h) (1) to be (1) (g) (h) (1) (j), (2) (f) 1. to be (2) (g), (2) (g) 1. a. to be (2) (g) 1., (2) (g) (h) (1) to be (2) (h) (1) (j), (3) (d) 1. to be (a), (3) (e) 1. a. to (3) (e) 1., (7) (b) to be (e), (7) (c) to be (b), am. (2) (e), r. (4) (e) 3., r. and recr. (6) (a), cr. (7) (d), Register, September, 1973, No. 213, eff. 10-1-73; r. and recr. (6) (a), Register, May, 1974, No. 221, eff. 6-1-74.

**Ind 51.04 History:** 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71; cr. Register, July, 1971, No. 187, eff. 8-1-71 and expiring 1-1-72.

**Fire-Resistive Standards  
for  
Materials of Construction**

**Ind 51.04 Scope.** This section shall include standards applicable to various types of fire-resistive construction. Requirements established herein are considered minimum safety standards and will not necessarily result in the most advantageous insurance rates.

**History:** Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71 and recr. eff. 1-1-72, Register, July, 1971, No. 187.

**Ind 51.041 History:** Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and recr. eff. 1-1-72, Register, July, 1971, No. 187; r. Register, June, 1972, No. 193, eff. 1-1-73.

**Ind 51.042 General requirements.** (1) Construction details and quality of material used for these systems must be those used by the testing laboratory for the test, and/or those dictated by good construction practice.

(2) Connection of structural members. (a) The minimum fire-resistive protection of a connection shall be equal to the maximum required for the members to which it is attached.

(3) For structural components with a fire-resistive rating obtained by test with restrained ends, the supporting structure shall be designed to provide for this restraint.

(4) ASTM standard methods of test. (a) All products manufactured and tested according to ASTM standard methods prior to effective dates of standards specified in "Fire-Resistive Standards for Materials of Construction" shall be accepted unless the ASTM standard method used in the test is judged to be inadequate in comparison with the currently adopted standard method.

(5)\* The heat transmission requirements of ASTM E-119 (25b), with the exception of high hazard areas, penal and health care facilities and warehouses for combustible materials, may be reduced to one-half (½) of the hourly rating required by this code, but not less than one hour.

**NOTE:** For ASTM E-119 Standard adopted see Ind 51.25 (90).

(a) The fire-resistive rating for structural integrity required by this code shall be maintained where the heat transmission criteria has been reduced.

\* See Appendix A for further explanatory material.

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(6) The use of fire-resistive protection implies consent by owner to maintain material in a serviceable condition. Where this protection is concealed, provisions shall be made for periodic visual inspection of the structural insulating material at each story.

NOTE: Definition of owner—see 101.01 (13), Wis. Stats.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and recr. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 51.043 Approved rating methods. (1) Ratings of fire-resistive assemblies shall be determined by one of the following methods:

(a) Test by approved testing laboratories (see Ind 51.044).

(b) Typical examples as listed in this code in lieu of approved test (see Ind 51.045).

(c) Approved method of calculation in lieu of approved test (see Ind 51.046).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and recr. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 51.044 Approved testing laboratories. (1) Fire rating tests conducted according to table 1 listed ASTM standards shall be acceptable if conducted by the recognized testing laboratory for referenced test.

NOTE: Other testing laboratories will be recognized as an approved agency if accepted in writing by the department.

TABLE 1

Name of Recognized Laboratories	ASTM Standard Tests					
	E-84	E-108	E-119	E-136	E-162	E-169
Forest Prod. Lab., Madison, Wis.*	-----	-----	X	-----	X	-----
Nat'l. Bureau of St'd., Washington, D.C.	-----	-----	X	X	-----	-----
Ohio State Univ., Columbus, Ohio	-----	-----	X	X	X	X
Portland Cement Assoc., Skokie, Ill.	-----	-----	X	-----	-----	-----
Southwest Research Inst., San Antonio, Tex.	X	-----	-----	-----	-----	-----
Underwriters' Lab., Inc., Chicago, Ill.	X	X	X	-----	X	X
Underwriters' Lab., Inc., Scarborough, Ont., Canada	X	X	X	X	X	X
Univ. of Calif., Berkeley, Calif.	-----	X	X	-----	-----	X

\*NOTE: Reference based on research and development data. Facility is not available for conducting routine rating tests.

NOTE: For column identification and specific standards adopted, see subsections Ind 51.25 (88) thru (93).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71; r. eff. 8-1-71, and recr. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 51.045 Typical examples of Fire-Resistive Structural Components. (1) Basic design and construction for specified fire-resistive protection of structural components listed in table 2, including references (a) through (p), shall be acceptable.

NOTE: The following table is based on performance, interpretation of various test data and/or data from ASTM E-119 test (see table 2).

\* See Appendix A for further explanatory material.

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Theaters, assembly halls

Chapter Ind 55

**THEATERS AND ASSEMBLY HALLS**

Ind 55.001	Theaters	Ind 55.35	Automatic sprinklers
Ind 55.01	Assembly halls	Ind 55.39	Use of "safety-base" film
Ind 55.02	Class of construction	Ind 55.40	Motion picture machine booths, general
Ind 55.03	Height above grade	Ind 55.41	Construction of booth
Ind 55.04	Exposure and courts	Ind 55.42	Doors
Ind 55.05	Separation from other occupancies	Ind 55.43	Openings
Ind 55.06	Capacity	Ind 55.44	Ventilation of booths
Ind 55.07	Number and location of exits	Ind 55.45	Relief outlets
Ind 55.08	Type of exits	Ind 55.46	Electric wiring
Ind 55.09	Stairways	Ind 55.47	Motion picture machine
Ind 55.10	Exit doorways and doors	Ind 55.48	Fire protection in booth: care and use of film
Ind 55.11	Exit lights	Ind 55.49	Portable booths
Ind 55.12	Width of exits	Ind 55.50	Maintenance
Ind 55.13	Seating	Ind 55.51	Grandstands
Ind 55.14	Width of aisles	Ind 55.52	Exits
Ind 55.15	Lobbies and foyers	Ind 55.53	Aisles and passageways
Ind 55.16	Inclines and aisle steps	Ind 55.54	Seating
Ind 55.17	Obstruction	Ind 55.55	Guard rails
Ind 55.18	Mirrors and false openings	Ind 55.56	Portable grandstands or bleachers
Ind 55.19	Decorations	Ind 55.57	Inspection
Ind 55.20	Elevator and vent shafts	Ind 55.58	Tents
Ind 55.21	Stage separation	Ind 55.59	Structural requirements
Ind 55.22	Proscenium wall	Ind 55.60	Flame resistance
Ind 55.23	Proscenium curtain	Ind 55.61	Fire hazards
Ind 55.24	Automatic smoke outlet	Ind 55.62	Exits
Ind 55.25	Stage vestibules	Ind 55.63	Electrical installations
Ind 55.26	Footlight trough	Ind 55.64	Fire extinguishing equipment
Ind 55.27	Fireproof paint	Ind 55.65	Illumination: exit lights and signs
Ind 55.28	Stage accessory rooms	Ind 55.66	Boiler and furnace room
Ind 55.29	Boiler and furnace rooms	Ind 55.67	Toilet facilities
Ind 55.30	Lights and lighting	Ind 55.68	Outdoor theaters
Ind 55.32	Sanitary equipment		
Ind 55.33	Standpipes		
Ind 55.34	Fire extinguishers		

Ind 55.001 Theaters. In the theater classification, are included all buildings or parts of buildings, containing an assembly hall, having a stage which may be equipped with curtains or permanent or movable scenery, or which is otherwise adaptable to the showing of plays, operas, motion pictures or similar forms of entertainment.

Ind 55.01 Assembly halls. (1) In the assembly hall classification are included all buildings, or parts of buildings, other than theaters, which will accommodate more than 100 persons for entertainment, recreation, worship or dining purposes.

Note: For assembly areas in connection with schools and other places of instruction, refer to Wis. Adm. Code chapter Ind 56.

(a) Every assembly hall which will accommodate not more than 100 persons shall conform to the requirements of Wis. Adm. Code chapter Ind 54, covering factories, office and mercantile buildings.

History: 1-2-56; am. (1) (intro. par.). Register, March, 1972, No. 195. eff. 4-1-72.

Ind 55.02 Class of construction. (1) The capacities of buildings or parts of buildings in this classification for the various types of con-

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struction shall not exceed, and shall comply with, the following requirements:

#### MAXIMUM CAPACITIES

Type of Construction	With Stage	Without Stage
Type No. 1 and No. 2 -----	No limit	No limit
Type No. 3 and No. 4 -----	750	1,500
Type No. 5 and No. 6 -----	500	1,000
Type No. 7 and No. 8 -----	300	750

(a) *Exception.* One-story buildings are permitted for unlimited capacities providing the following conditions are satisfied:

1. The class of construction requirements satisfy Type No. 3, 4 or 6.
2. There are no ground floors or basements.
3. The setback satisfies the requirements of Table 51.03-A for over 30 feet distance.

(2) Type No. 7 and No. 8 construction. (See Ind 51.03.) Where buildings of these classifications are erected of Type No. 7 or No. 8 construction, the following restrictions shall apply:

(a) Not more than one story in height without a balcony, and with no ground floor or basement except a heating and fuel room enclosed with fire-resistive construction as specified in section Ind 55.29, with all interior openings protected with self-closing fire-resistive doors as specified in section Ind 51.047.

(b) Located at least 20 feet from any other building or adjoining property line.

(c) Is not built in connection with a building used for any other purpose.

(d) Is provided with foundation walls and piers of masonry construction.

(e) Where motion picture booths are required, they shall be enclosed with 2-hour fire-resistive construction.

*Exception:* In places of worship, a full basement and a balcony seating not more than 30 persons may be provided.

(3) Balconies accommodating more than 100. In any theater or assembly hall, balconies which accommodate more than 100 persons shall be of Type No. 1 or No. 2 construction as specified in section Ind 51.03.

*History:* 1-2-56; (1); (1) (a); (2); (2) (a); (2) (b); (2) (c); (2) (d); (2) (e); (2) (f); (3); am. Register, June, 1956, No. 4, eff. 7-1-56; am. (1) (a), Register, August, 1957, No. 20, eff. 9-1-57; am. Register, January, 1961, No. 61, eff. 2-1-61; am. (2) (a), Register, February, 1971, No. 182, eff. 7-1-71; r. and recr. (2) (a) eff. 8-1-71 and exp. 1-1-72; cr. (2) (a) eff. 1-1-72, Register, July, 1971, No. 187; r. and recr. (1), am. (2) intro. par., and (3), Register, June, 1972, No. 198, eff. 1-1-73; cr. (1) (a), Register, September, 1973, No. 213, eff. 10-1-73; am. (2) (a), Register, May, 1974, No. 221, eff. 6-1-74.

Ind 55.03 Height above grade. (1) THEATERS. The height of the sills of the principal entrance doors to any theater, as defined in section Ind 55.001, shall be not more than 18 inches above the outside grade at that point. The floor level at the highest row of seats on the main floor shall not be more than 6 feet above the outside grade at the main entrance; the floor level at the lowest row of seats on

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Chapter Ind 56

SCHOOLS AND OTHER PLACES OF INSTRUCTION

Ind 56.001	Scope	Ind 56.09	Passageway*
Ind 56.01	Maximum height	Ind 56.10	Access to attic and roof
Ind 56.02	Classes of construction	Ind 56.13	Auditoriums, gymnasiums and field houses
Ind 56.04	Subdivisions and fire stops	Ind 56.14	Seats, desks and aisles
Ind 56.05	Exterior wall openings	Ind 56.15	Heating plants
Ind 56.06	Type, location and number of exits	Ind 56.16	Sanitary facilities
Ind 56.07	Total width of exits	Ind 56.17	Lighting
Ind 56.08	Exit doors	Ind 56.18	Fire extinguishers
		Ind 56.19	Fire alarms

Ind 56.001 Scope. The requirements of this chapter, sections Ind 56.001 to Ind 56.19 inclusive, shall apply to all public and private schools, universities, colleges, academies, seminaries, libraries, museums and art galleries; including all buildings or parts of buildings used primarily for instructional purposes.

History: 1-2-56; am. Register, May, 1971, No. 185, eff. 6-1-71.

Ind 56.01 Maximum height. (1) Buildings occupied primarily by pupils up to and including grade 12 shall not exceed 4 stories or 48 feet in height.

(a) Exception. Buildings provided with complete automatic sprinkler or automatic smoke detection systems, occupied primarily by students of grades 9 through 12, shall be no more than 6 stories or 72 feet in height.

Note: Also see requirements for classes of construction.

History: 1-2-56; r. Register, May, 1971, No. 185, eff. 6-1-71; cr. Register, September, 1973, No. 213, eff. 10-1-73.

Ind 56.02 Classes of construction. (1) Every building not more than one story in height may be of type No. 7 or No. 8 construction as specified in section Ind 51.03.

(2) Every 2-story building shall be not less than type No. 6 construction as specified in section Ind 51.03 with the exception that all floors and their supports shall be at least noncombustible one-hour fire-resistive rating.

(3) Every building 3 or more stories in height shall be of type No. 1 or No. 2 construction as specified in section Ind 51.03.

(4) Auditoriums, gymnasiums or field houses, or those parts of buildings similarly used, shall comply with the following:

(a) Limitations when occupancy is restricted to first story or ground floor only.

Type of Construction	Maximum Number of Occupants in Any Room Used for Auditorium, Gymnasium, or Field House Purposes	
	With Stage	Without Stage
Type No. 1 and No. 2	No limit	No limit
Type No. 3 and No. 4	750	1500
Type No. 5 and No. 6	500	1000
Type No. 7 and No. 8	300	750

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1. Exception. For unlimited capacity, the fire protection of structural steel supporting the roof may be omitted for one-story buildings meeting type No. 1, 2 and 3 construction provided the building has no ground or basement floors. Heavy timber columns and roof framing may be substituted for structural steel framing. The roof decking shall be of noncombustible construction meeting the fire-resistive ratings of Table 51.03-A.

(b) Limitations when occupancy is above the first story.

Type of Construction	Maximum Number of Occupants	No. of Stories
Type No. 1 and No. 2	No limit	See Ind 56.01†
Type No. 3 thru No. 5	400	2nd story
Type No. 3 thru No. 6	200	3rd and 4th story

† One smokeproof stair tower from the level of the assembly hall leading directly to the exterior at street grade shall be provided for every 750 persons capacity, or fraction thereof. These stairways shall be at least 44 inches wide and shall be in addition to other required stairways in the building.

History: 1-2-56; r. and recr. Register, May, 1971, No. 185, eff. 6-1-71; am. (1) and (2) and r. and recr. (3), Register, June, 1972, No. 198, eff. 1-1-73; cr. (4), Register, September, 1973, No. 213, eff. 10-1-73; r. and recr. (4) (a) 1, Register, May, 1974, No. 221, eff. 6-1-74.

Ind 56.0† History: 1-2-56; am. Register, February, 1971, No. 182, eff. 7-1-71; r. Register, May, 1971, No. 185, eff. 6-1-71.

Ind 56.04 Subdivisions and fire stops. Every building of this classification which is built in connection with a building of a lower grade of construction shall be separated from such other building by walls of 4-hour fire-resistive construction as specified in section Ind 51.04, and all communicating openings shall be protected by fire-resistive doors as specified in section Ind 51.047 or equal. If such openings are used as a means of egress, they shall be kept normally open during the occupancy of the building.

History: 1-2-56; am. Register, February, 1971, No. 182, eff. 7-1-71; r. and recr. eff. 8-1-71 and exp. 1-1-72; cr. eff. 1-1-72, Register, July, 1971, No. 187.

Ind 56.05 Exterior wall openings. (1) One-story buildings with no floor levels below the first floor need not be provided with exterior wall openings other than required exits.

(2) Buildings with basements shall at such levels be protected with an approved automatic sprinkler system (Ind 51.23) or an approved automatic smoke detection system, either of which shall be connected to the required fire alarm (Ind 56.19).

Note: See section Ind 51.01 for definitions of "automatic" and "basement."

(3) Buildings more than one story shall be provided with wall openings for emergency purposes above the first story as specified in subsection Ind 52.02 (2) except as follows:

(a) The requirements for wall openings is waived in buildings provided throughout with an approved automatic sprinkler system (Ind 51.23) or an approved automatic smoke detection system, either of which shall be connected to the required fire alarm (Ind 56.19).

History: 1-2-56; am. Register, January, 1961, No. 61, eff. 2-1-61; r. and recr., Register, May, 1971, No. 185, eff. 6-1-71; r. and recr., Register, September, 1973, No. 213, eff. 10-1-73.

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Boiler and furnace rooms-----Wis. Adm. Code sections Ind 54.13,  
Ind 55.29, 56.15, 57.20, 57.50

Heating and ventilating equipment and  
wiring-----Wis. Adm. Code section E 1-E 900

**Ind 59.22 Design conditions. (1) INSTALLATION OF EQUIPMENT.** All heating, ventilating and air conditioning installations shall be designed and installed to provide the service and results required by this code.

**Note:** Compliance with this code shall not constitute assurance of proper installation or operation of the heating, ventilating and air conditioning system. This code is not to be used as a design manual but it is established as a minimum standard for safety, health and general welfare of the public.

**(2) CAPACITY AND ARRANGEMENT.** The calculated capacity and the arrangement of all installations for required heating and ventilating shall be based upon simultaneous service to all parts of the building, unless otherwise provided in this code.

**(3) OUTSIDE TEMPERATURE DESIGN CONDITIONS.** In the accompanying map, the state of Wisconsin has been divided into 3 zones. The maximum heat losses for a heating system shall be calculated on the basis of the temperatures indicated in Table 1 with reference to location of the project in each respective zone.

**(4) INSIDE TEMPERATURE DESIGN AND OPERATION CONDITIONS.** The heating system shall be designed to maintain a temperature of not less than that shown in Table 2 and must be operated at not less than that temperature during occupied periods.

TABLE 2

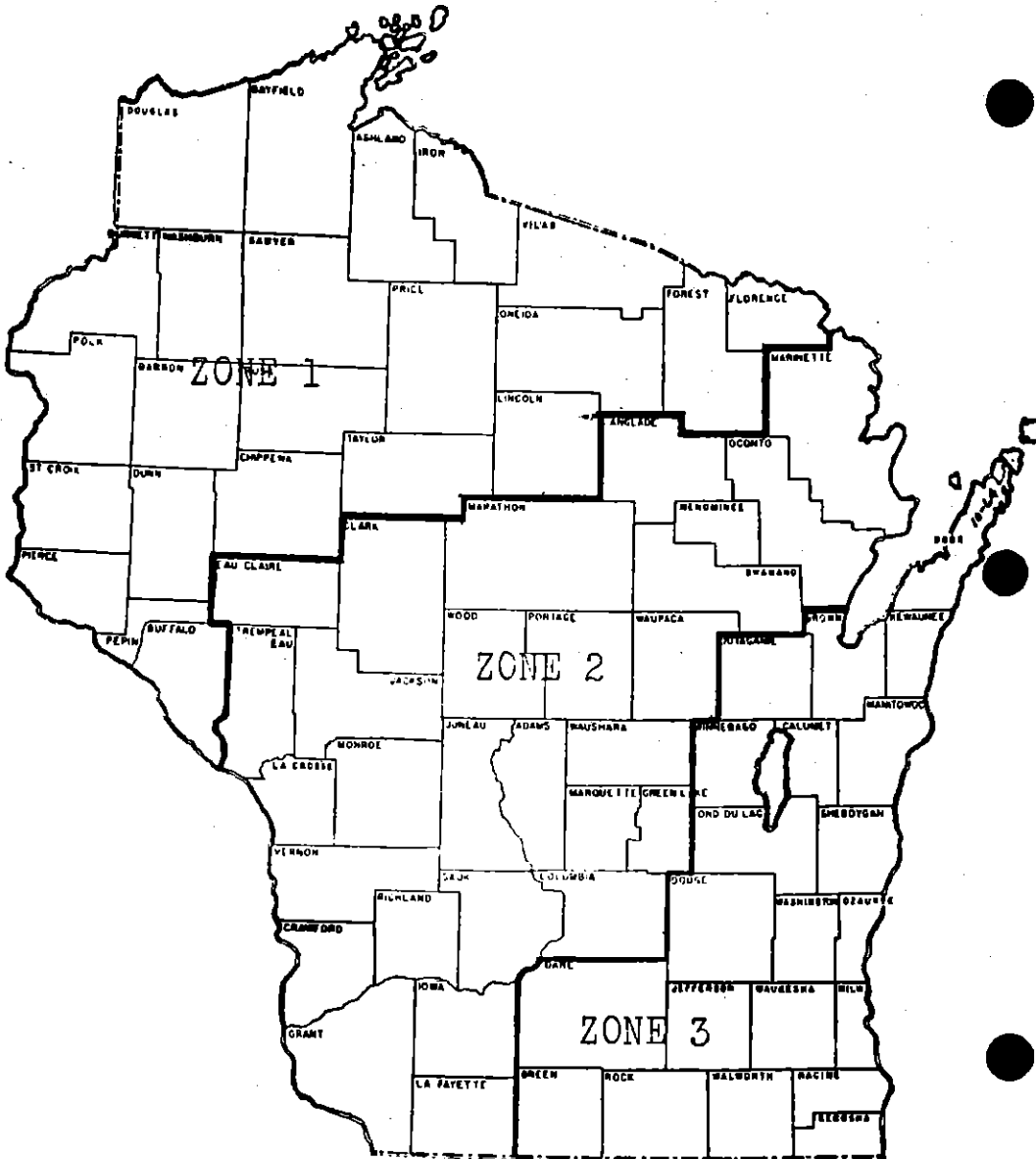
Type of Building	Deg. Fahr.	Type of Building	Deg. Fahr.
Barber Shops and Beauty Parlors	67	Hotels:	
Schools:		Bedrooms and Baths	67
Classrooms	67	Dining Rooms	67
Gymnasiums	55	Kitchens and Laundries	60
Wardrobe	67	Ballrooms and Assembly Halls	67
Locker and Shower Rooms	70	Service Rooms	60
Kitchens	60	Residential:	
Dining and Lunch Rooms	65	Apartments	67
Play Rooms	60	Housing for the Elderly	70
Natoriums and Bathrooms	70	Halls	67
Toilet Rooms	65	Offices	67
Hospitals and Nursing Homes:		Stores	65
Private Rooms	75	Factories and Machine Shops	60
Operating Rooms	70	Foundries and Boiler Shops	50
Wards	75	Toilet and Locker Rooms:	
Kitchens and Laundries	60	General	65
Bathrooms	75	With Shower	70
Toilet Rooms	75	Garages:	60
Libraries and Museums	67	Repair and Service Areas	
Theaters and Assembly Halls:		Storage and Parking	NMR
Seating Space	67	Warehouses	NMR
Lounge Rooms	67		

NMR = No minimum required.

**(5) AIR-CLEANSING APPARATUS. (a) Air-cleansing apparatus shall be designed and installed to permit access to the equipment for maintenance and to insure proper operation of the heating and ventilating system.**

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TABLE 1  
 MAP OF WISCONSIN SHOWING DESIGN TEMPERATURE ZONES



Zone 1 - - - - - 30° Below Zero F.  
 Zone 2 - - - - - 25° Below Zero F.  
 Zone 3 - - - - - 15° Below Zero F.

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(6) **SUPPLY AIR TEMPERATURE.** The design condition of the supply air temperature shall not exceed 140° Fahrenheit.

(7) **CONTROLS.** Where ventilation is required by this code, controls shall be provided so that minimum air circulation, supply and exhaust shall be maintained continuously during periods of occupancy.

(8) **AIR QUANTITY.** The quantity of air used to ventilate a given space during period of occupancy shall always be sufficient to maintain the standards of air temperature, air quality, air motion and air distribution as required by this code. (See Wis. Adm. Code section Ind 59.24).

(9) **NUMBER AND ARRANGEMENTS.** The capacity, number and arrangement of outlets, returns and exhausts shall insure a uniform distribution of air.

(10) **ELEVATOR SHAFTS AND STAIRWELLS.** Air shall not be transferred through elevator shafts and stairwells where doors are required at any floor level.

(11) **GRILLES OR DIFFUSERS REQUIRED.** All air supply outlets and returns shall be equipped with grilles or devices which will provide a uniform distribution of air.

(12) **CORRIDOR VENTILATION.** Air in a volume equal to the outside air required from a room may be discharged and recirculated through a corridor and exhausted through lockers, toilet rooms, kitchens, janitor closets and similar areas. Additional exhaust ventilation shall be provided where the volume of air exhausted from the corridor is less than the volume of air supplied.

History: Cr. Register, January, 1965, No. 109, eff. 2-1-65; am. table 2, cr. (9), (10), (11) and (12), Register, September, 1973, No. 213, eff. 10-1-73; emer. r. and recr. (4), eff. 1-5-74; r. and recr. (4), Register, May, 1974, No. 221, eff. 6-1-74.

Ind 59.24 General requirements for heating, ventilating and exhaust systems. (1) **HEATING SYSTEMS REQUIRED.** Heating systems complying with the requirements of this code shall be provided, maintained and operated for all occupied areas within the scope of this code.

(2) **GUARDING OF SURFACES.** Equipment located in occupied areas and installed less than 7 feet above the floor shall be guarded to prevent bodily contact with:

- (a) Any surface temperatures that exceed 180° F.
- (b) Surfaces that are likely to cause lacerations.

Notes: For more restrictive conditions, see Ind 59.66 (2).

(3) **VENTILATING SYSTEMS REQUIRED.** Ventilating systems shall be provided, maintained and operated to accomplish required ventilation service for all occupied areas within the scope of this code.

Note: Cross reference: For requirements pertaining to all places of employment or occupancy where smoke, gas, dust, fumes, steam, vapor, industrial poisons, or other detrimental materials are used, stored, handled, or are present in the air in sufficient quantities to obstruct the vision, or to be irritating, or to be injurious to the health, safety or welfare of the employees or frequenters, see Wis. Adm. Code Chapter Ind 20—Dusts, Fumes, Vapors and Gases.

(4) **NATURAL VENTILATION.** Where outdoor openings are used for natural ventilation the openings shall be within 100 feet, or 5 times the least dimensional width of the occupied area, whichever is the least.

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(a) Outdoor openings below grade will not be accepted unless there is a clear space outside of the opening having a width not less than  $1\frac{1}{2}$  times the distance below grade at the bottom of the opening.

Note: Width of clear space is the horizontal distance measured at right angles to the plane of the opening.

(b) Outdoor openings shall be at least 5 feet from a property line and/or lot line or an adjacent building on the same property. This distance restriction does not apply to property lines along streets.

Note: For further restrictions, see Table 51.03-B and section Ind 59.60.

(5) GRAVITY DIRECT-INDIRECT SYSTEMS. The installation of gravity direct-indirect systems is prohibited.

Note: This rule is intended to prohibit the use of direct-indirect radiation whereby the outside air supply is admitted to the base and delivered at the top without mechanical assistance.

(6) HOT WATER HEATING AND VENTILATING SYSTEMS. Hot water systems installed in areas where ventilation is required under this code shall comply with the following requirement:

(a) The system hot water shall be circulated continuously by mechanical means.

(7) EXHAUST VENTILATING SYSTEM. (a) Exhaust ventilating systems shall be designed to reasonably prevent contaminated air reentering the building.

(b) The required exhaust ventilating systems shall operate continuously whenever the space exhausted is occupied.

Note: See Wis. Adm. Code Chapter Ind 20.

(8) TEMPERED AIR SUPPLY. (a) Where ventilation is affected by exhaust methods, an outside tempered air supply shall be provided to replace the air exhausted from the area if the volume of air exhausted exceeds one air change per hour.

(b) Where heat gain from a process is equal to all or part of the ventilation heat load, the air may be recirculated and supplied mechanically within the immediate area and mixed with a quantity of outside air to temper the air supply, provided that dampers and temperature controls are installed in the system to maintain a discharge temperature of not less than 50° F.

Note: See other applicable sections of Chapter Ind 59 for further restrictions.

(c) A tempered air supply depending on a negative pressure within the space is prohibited except in foundries, steel fabricating shops and similar areas.

(9) CONTAMINATION OF ADJACENT AREA. The ventilation of all equipment and system service rooms which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination, shall be such as to prevent spreading of any such contamination to other parts of the building occupied by people.

(a) Areas where chlorinated hydrocarbons are introduced shall be arranged to satisfy the following conditions:

Note: Some of the chlorinated hydrocarbons commonly used are: trichloroethylene, perchloroethylene, carbon tetrochloride, methylene chloride, methyl chloroform, Freon F-11, Freon F-12, Freon F-21 and

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Freon F-114. For example, these materials are used in dry cleaning establishments, in degreasing operations, and where pressure can propellants are used. Pressure cans are used for such products as enamels, lacquers, paint removers, stencil inks, lubricants, pesticides, hair sprays, shaving lathers, shampoos and colognes.

1. The area shall have an exhaust system capable of maintaining a negative pressure within the enclosed area.
2. The volume and distribution of air movement within the area shall be such that the average threshold limit values of specific airborne contaminants are not exceeded. See Wis. Adm. Code Chapter Ind 20—Dusts, Fumes, Vapors and Gases.
3. No direct-fired heating unit with or without a heat exchanger shall be located within this area nor shall it recirculate air from this area.
4. Surface temperatures of any kind of heating equipment used in these areas shall be below the temperature at which toxic materials may be released.

Note: Toxic materials are those covered in Wis. Adm. Code Chapter Ind 20—Dusts, Fumes, Vapors and Gases.

(b) Ventilation air shall not be drawn from an area of greater contamination to satisfy code requirements.

Note: The following examples are typical of acceptable systems: corridor to toilet; corridor to cloak rooms or janitor closets; dining room to kitchen; locker room to toilet room; gymnasium to locker room; and showroom to garage.

(10) FINAL TEST REQUIRED. The designer or installer shall be responsible for the testing and balancing of every heating, ventilating and air conditioning system.

(11) INSTRUCTIONS. The designer or installer shall provide the owner with written instructions for the operation and maintenance of the system and equipment.

History: Cr. Register, January, 1965, No. 109, eff. 2-1-65; r. and recr., Register, September, 1973, No. 213, eff. 10-1-73.

Ind 59.25 Maintenance and operation. (1) MAINTENANCE. All heating, ventilating, exhaust and air conditioning systems shall be maintained in good working order and shall be kept clean and sanitary.

(2) OPERATION. All heating, ventilating and exhaust systems shall be operated to satisfy the requirements of this code during periods the building is occupied unless otherwise exempted by this code.

History: Cr. Register, January, 1965, No. 109, eff. 2-1-65.

Ind 59.40 Occupancy classification. (1) The various occupancies to which the provisions of this code apply shall be classified as follows:

- (a) Require ventilation on an occupancy basis.
- (b) Require ventilation on an occupancy basis unless otherwise exempted.
- (c) Require exhaust.
- (d) Require ventilation on the basis of floor area.

(2) Table 3 is a list of occupancies to determine ventilation requirements and number of persons.

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TABLE 3

Use or Occupancy	Classification	Basis of Capacity
Arenas and field houses*	(a)	4 sq. ft. per person. Use seated area only.
Armories (drill halls)	(a)	30 sq. ft. per person.
Assembly halls*	(a) or (b)	7 sq. ft. per person. See Wis. Adm. Code section Ind 59.42.
Banquet halls*	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.42.
Barber shops	(b)	20 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Bath and shower rooms	(c)	See Wis. Adm. Code section Ind 59.48.
Beauty parlors	(b)	20 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Billiard rooms	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Bowling alleys	(a) or (b)	Seating capacity, plus 6 persons per alley. Terminate occupied area at foul line. See Wis. Adm. Code section Ind 59.51.
Brokerage board rooms	(a) or (b)	7 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Cafeterias*	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.42.
Churches and places of worship	(a) or (b)	See Wis. Adm. Code section Ind 59.44.
Chapel	(a) or (b)	7 sq. ft. per person.
Dining and social rooms	(a) or (b)	15 sq. ft. per person.
Nave or auditorium	(a) or (b)	7 sq. ft. per person.
Club rooms	(a) or (b)	Depends on usage.
Dance halls	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Dining rooms*	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.42.
Educational facilities†		
Academic classrooms-regular	(a)	20 sq. ft. per person.
Administrative and office space	(a) or (b)	75 sq. ft. per person.
Arts, crafts, drafting	(a) or (c)	30 sq. ft. per person. Also see Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
Bleachers	(a)	One seat per 18 inches of bench length.
Gymnasiums, field houses, auditoriums, theaters, lecture rooms (fixed seating)	(a)	6 sq. ft. per person.
Gymnasiums, field houses, multipurpose rooms, cafeterias, study halls, commons and other level floor areas with nonfixed individual seating	(a)	10 sq. ft. per person.
Home economics, business education	(a)	30 sq. ft. per person.
Industrial arts-vocational shop	(a) or (c)	30 sq. ft. per person. See Ind 59.52 and Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
Laboratories-science (fixed lab. tables)	(a) or (c)	30 sq. ft. per person. Also see Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
Libraries and resource centers	(a)	20 sq. ft. per person.
Museums and art galleries	(a)	40 sq. ft. per person.
Music		
Vocal	(a)	10 sq. ft. per person.
Instrumental	(a)	20 sq. ft. per person.
Special education (mentally retarded, physically handicapped, etc.)	(a)	35 sq. ft. per person.
Factories and machine shops	(b)	See Wis. Adm. Code section Ind 59.53. Also see rules of Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
First-aid rest rooms	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.53.
Foundries and boiler shops	(b)	See Wis. Adm. Code section Ind 59.53. Also see rules of Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.

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TABLE 3—Continued

Use or Occupancy	Classification	Basals of Capacity
Funeral homes.....		See Wis. Adm. Code section Ind 59.44.
Chapel.....	(a) or (b)	7 sq. ft. per person.
Garages and service stations.....	(d)	See Wis. Adm. Code section Ind 59.52.
General offices*.....	(a) or (b)	See Wis. Adm. Code section Ind 59.50.
Gymnasiums and combined gymnasiums and assembly halls*.....	(a)	6 sq. ft. per person for seated space. 15 sq. ft. per person for space not seated.
Hospitals.....	(a) or (b)	See Wis. Adm. Code section Ind 59.56. See Wis. Adm. Code section Ind 57.17 and Ind 57.19.
Hospitals (Mental).....		See Wis. Adm. Code section Ind 59.55.
Day rooms.....	(b)	See Wis. Adm. Code section Ind 57.19.
Dormitories.....	(b)	See Wis. Adm. Code section Ind 57.17 and Ind 57.19.
Janitor closets.....	(c)	See Wis. Adm. Code section Ind 59.48 and Ind 59.56.
Kitchens.....	(c)	See Wis. Adm. Code section Ind 59.49.
Laboratories*.....	(a) or (c)	25 sq. ft. per person. See rules of Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
Laundries*.....	(c)	See Wis. Adm. Code section Ind 59.56 (a).
Lecture halls*.....	(a)	7 sq. ft. per person. Use seated area only.
Library reading rooms*.....	(a)	20 sq. ft. per person.
Locker rooms.....	(c) or (d)	See Wis. Adm. Code section Ind 59.48 and Ind 59.53.
Lodge halls.....	(a) or (b)	6 sq. ft. per person for seated space. 15 sq. ft. per person for space not seated. See Wis. Adm. Code section Ind 59.51.
Mental hospitals.....		See Wis. Adm. Code section Ind 59.55.
Day rooms.....	(b)	See Wis. Adm. Code section Ind 57.19.
Dormitories.....	(b)	See Wis. Adm. Code section Ind 57.17 and Ind 57.19.
Motion picture booths.....	(a) or (c)	See Wis. Adm. Code section Ind 59.43.
Penal institutions.....		See Wis. Adm. Code section Ind 57.17 and Ind 57.19.
Jail cell (overnight lockup).....	(b) & (c)	6 air changes per hour.
Places of employment*.....	(b)	75 sq. ft. per person. See Wis. Adm. Code section Ind 59.53.
Playrooms (unfinished areas)*.....	(c)	23 sq. ft. per person.
Printing establishments.....	(b)	See Wis. Adm. Code section Ind 59.53. Also see rules of Wis. Adm. Code chapter Ind 20—Dusts, Fumes, Vapors and Gases.
Restaurants.....	(a) or (b)	13 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Retail establishments.....	(a) or (b)	Basement: 40 sq. ft. per person. Other floors: 60 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Security vaults (occupied).....	(d)	2 CFM per sq. ft.
Skating rinks.....	(a) or (b)	15 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Sunday School.....	(b)	13 sq. ft. per person.
Swimming pools.....	(c)	See Wis. Adm. Code section Ind 59.48.
Taverns.....	(a) or (b)	20 sq. ft. per person. See Wis. Adm. Code section Ind 59.51.
Theaters*.....	(a)	7 sq. ft. per person.
Theater lobbies*.....	(a)	15 sq. ft. per person.
Theater lounge rooms*.....	(a)	15 sq. ft. per person.
Toilet rooms.....	(c)	See Wis. Adm. Code section Ind 59.48.
Wardrobes, lockers and cloak rooms.....		2 CFM per sq. ft. floor area. See Wis. Adm. Code section Ind 59.48 and Ind 59.53.

\*These occupancies are other than those related to educational facilities under Chapter Ind 56.

†For areas listed under "educational facilities," the department will accept maximum capacities stated on building plans according to section Ind 54.07.

History: Cr. Register, January, 1965, No. 109, eff. 2-1-65; am. (3) table 3, Register, September, 1973, No. 213, eff. 10-1-73.

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**Ind 59.41 General requirements for occupancies under (a) and (b) classifications. (1) SCOPE.** The requirements of this rule shall apply to all occupancies listed in Wis. Adm. Code section Ind 59.40 (1) (a) and (b) unless otherwise exempted by this code.

**(2) AIR MOVEMENT.** The total air circulated for all occupancies in this classification shall not be less than 6 air changes per hour unless otherwise provided by this code.

**(a) The air delivery capacity of all equipment supplying air for heating, ventilating and air conditioning purposes shall be based on standard air ratings.**

**Note:** Standard air is substantially equivalent to dry air at 70° Fahrenheit and 29.92 inches (Hg) barometric pressure.

**(b) An air movement of less than 6 air changes per hour is permitted where mechanical cooling (air conditioning) is provided and the heat gain requirement for the space has been satisfied.**

**(c) The air change may be based on actual room heights up to 10 feet from the floor level of the room in question. The volume above 10 feet, in rooms which are more than 10 feet in height, need not be considered in the air change requirement. The required air change shall be designed to occur in the occupied space.**

**(3) OUTSIDE SUPPLY.** The outside air supply maintained during occupancy of a given space shall not be less than 5 cubic feet per minute per occupant. Exhaust ventilation in an equal volume shall be maintained simultaneously.

**(a) One of the following methods shall be used in determining the number of occupants in a given space:**

1. Wis. Adm. Code section Ind 59.40 (2) Table 3; or

2. Based on the actual occupancy of a given space provided the expected occupancy is stated and substantiated by the owner to the department and indicated on the plans; or

3. If the system is able to deliver required quantities of outside air to each area when needed, the department will recognize diversity and the system may be designed on actual occupancy.

**Note #1:** The intent of this statement is not to require full outside air when there is not full occupancy of the building. The opening of outside air intakes may be delayed one hour after initial occupancy of the building.

**Note #2:** None of the above changes affect the dust, fumes, vapors and gases requirements of Chapter Ind 20.

**(4) AIR DISTRIBUTION.** All air outlets and returns shall be so located, arranged or equipped as to provide a uniform distribution of air.

**(5) RECIRCULATION.** No air contaminated by other than human occupancy shall be used for recirculation, except within the same occupancy classification.

**(6) AUTOMATIC CONTROLS.** Automatic controls shall be provided to maintain temperature and controlled ventilation to satisfy the following conditions during periods the area is occupied.

**(a) Provide a continuous air movement of not less than the minimum required by this code.**

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(b) Provide a continuous supply of tempered outside air as determined by the number of occupants of not less than 5 cubic feet of air per minute per person.

(c) Maintain design temperature.

(7) **AIR CLEANSING DEVICES.** Approved air cleansing devices shall be installed in a manner to filter the outside air and recirculated air used with mechanical heating and ventilating systems except as follows:

(a) Filters are not required in garages, factories, foundries and similar occupancies.

(b) Filters are not required for use with unit heaters designed for heating and recirculation.

(c) Where jet systems or blend-air systems are approved, air filters are not required in the ducts that are installed for the recirculation of air within the same occupied space.

*Note:* The department of industry, labor and human relations recognizes as approved, filters listed in Building Materials List published by the Underwriters Laboratories, Inc. and test data of any other recognized testing agency for the purpose for which it is used.

*History:* Cf. Register, January, 1965, No. 109, eff. 2-1-65; enorg. et. (2) (c) and (3) (a), eff. 4-5-74; et. (2) (c), f. and rear, (3) and am. (6) (b), Register, May, 1971, No. 221, eff. 6-1-71.

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