



2.0 RAILINGS

2.1 SECTION CONTENTS

This section provides guidance for the design, use, and application of railings and toeboards. Designs for both steel and wood construction are included in this section. Steel construction is preferred and should be considered first. Use of wood should be minimized. See Section 1.5 for additional guidelines.

2.2 General Requirements for Guard Railing, Stair Railing, and Toeboards	2
2.3 Safety Design Requirements for Guard Railings and Toeboards	6
2.4 Steel Guard Railing	8
2.5 The Use of Wood for Handrails	12
2.6 Notes and References	15

NOTE: An asterisk (*) after a section of text indicates that the information in that section is new or revised as of September 1996.

Fed-OSHA 1910.23

2.2 GENERAL REQUIREMENTS FOR GUARD RAILING, STAIR RAILING, AND TOEBOARDS

A. CONDITIONS WHICH REQUIRE GUARD RAILING

Chevron Guidelines

1. Platforms, walkways, ramps, and floors with open sides **which have 4 or more risers or which are 30 inches or higher above the adjacent floor or ground level** require guard railings.*
2. Open sides are those with 3 inches or more gap between platform edge and nearest solid structure, equipment or wall. In such case a standard guardrail is required.
3. Floor openings 12 x 12 inches or greater which are left exposed and unattended require guard railings or barriers.
4. Wall openings 30 inches in height by 18 inches in width, or larger require a standard guardrail or equivalent barrier if a fall through the opening to a level 30 inches or more below is possible.
5. Platforms, walkways, ramps, and floors above or adjacent to dangerous equipment or dangerous hazards require guard railings regardless of platform, walkway, ramp, or floor height.

1. Permanent floor openings for such purposes as stairways, ladders, etc. require a standard guard-rail except at the entrance. Other floor openings require either a standard guard railing or a floor opening cover.

OSHA Definition (1910.21)

A floor opening is an opening 12 inches or more in its least dimension through which a person may fall.

2. The maximum allowable floor opening where a person cannot accidentally walk, such as around machinery and equipment, is 1 inch.
3. Platforms, walkways, ramps and floors with open sides which are 48 inches or higher above the adjacent floor or ground level require guard railings.

Note: 30 inches in California

4. Platforms, walkways, ramps and floors adjacent to dangerous equipment or dangerous hazards require railings regardless of platform, walkway, ramp, or floor height.
5. Wall openings left exposed or unattended require a guard railing or equivalent barrier if a fall through the opening to a level 48 inches or more is possible.

Note: 30 inches in California

OSHA Definition (1910.21)

A wall opening is an opening 30 inches in height by 18 inches in width, or larger through which a person may fall.

6. Window wall openings, where the bottom of the opening is less than 36 inches above the floor, platform, or landing require guarding equivalent to a standard guard rail, if a fall through the opening to a level 48 inches or more is possible.

Note: 30 inches in California

B. CONDITIONS WHICH REQUIRE TOEBOARDS

Chevron Guidelines

1. Platforms, walkways, ramps, and floors with open sides, 48 inches or more above areas where a person can pass or where portable tools, parts, or material are likely to be used, require toeboards.
2. Platforms, walkways, ramps, and floors with open sides, at any elevation above areas with moving machinery or other equipment with which falling material could create a hazard, require toeboards.
3. A toeboard is also required under the first tread of stairs ascending at the open side from platforms, walkways, or floors which require toeboards (see *Figure 2.1*).

1. Platforms, walkways, ramps and floors with open sides 48 inches or more above where a person can pass or where portable tools, parts, or materials are likely to be used, require toeboards.

Note: 6 feet in California

2. Platforms, walkways, ramps and floors with open sides, at any elevation, above areas with moving machinery or other equipment with which falling material could create a hazard, require a toeboard.

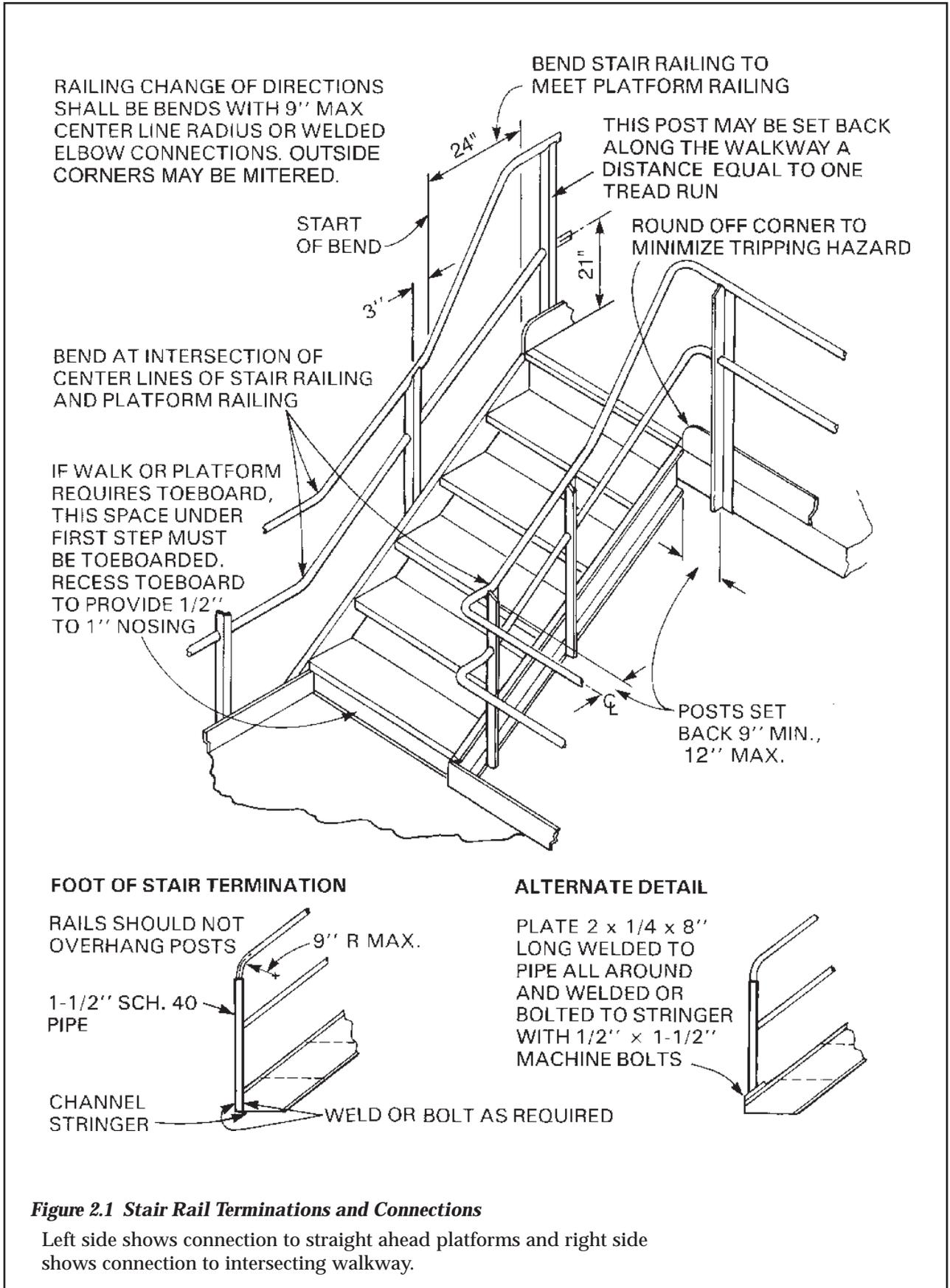


Figure 2.1 Stair Rail Terminations and Connections

Left side shows connection to straight ahead platforms and right side shows connection to intersecting walkway.

4. Floor holes or gaps require a toeboard if the least dimension is greater than 1 inch (see *Figure 2.2*).
5. Floor holes or gaps may be covered provided the cover does not present a tripping hazard (see *Figure 2.2*).

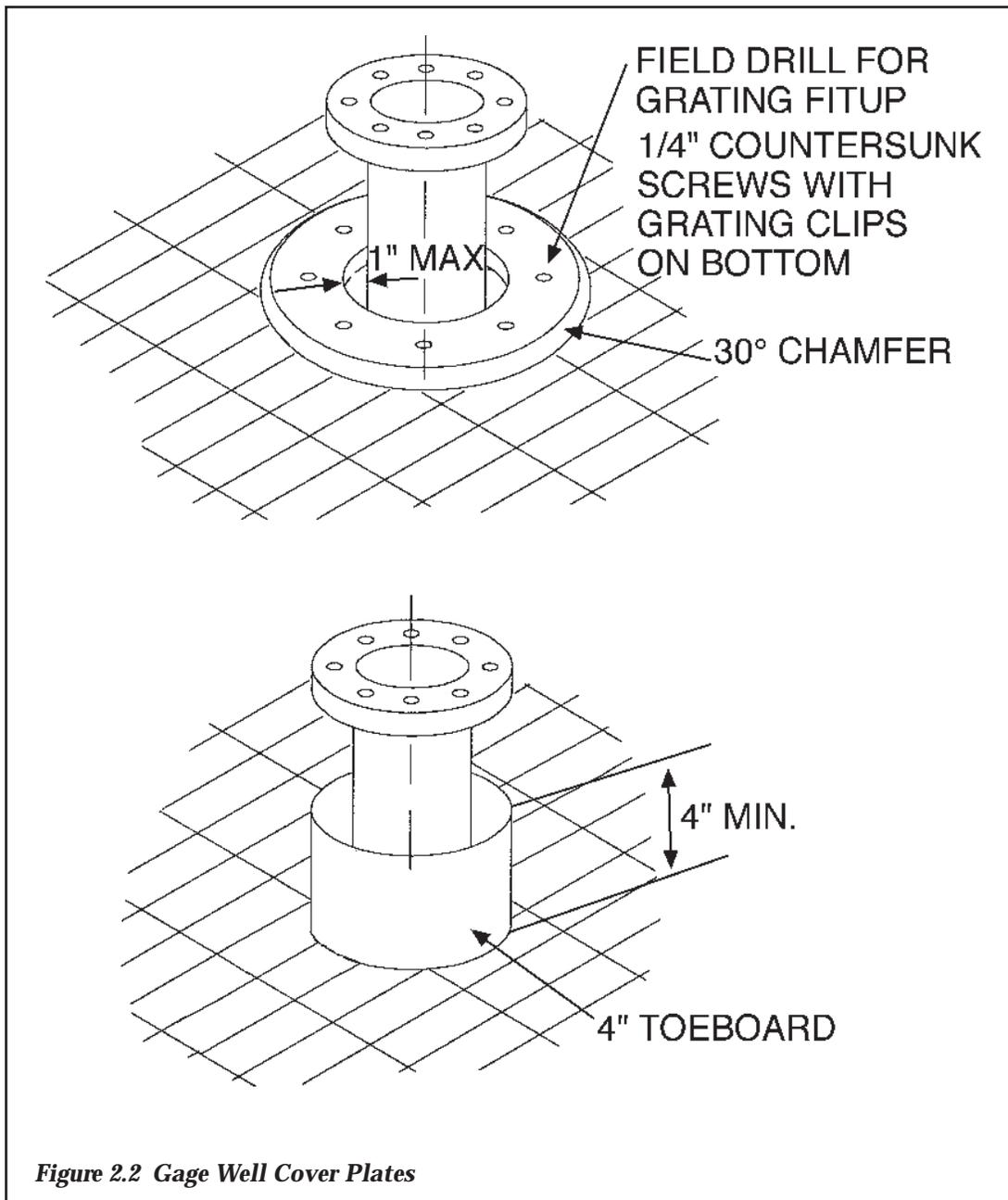


Figure 2.2 Gage Well Cover Plates

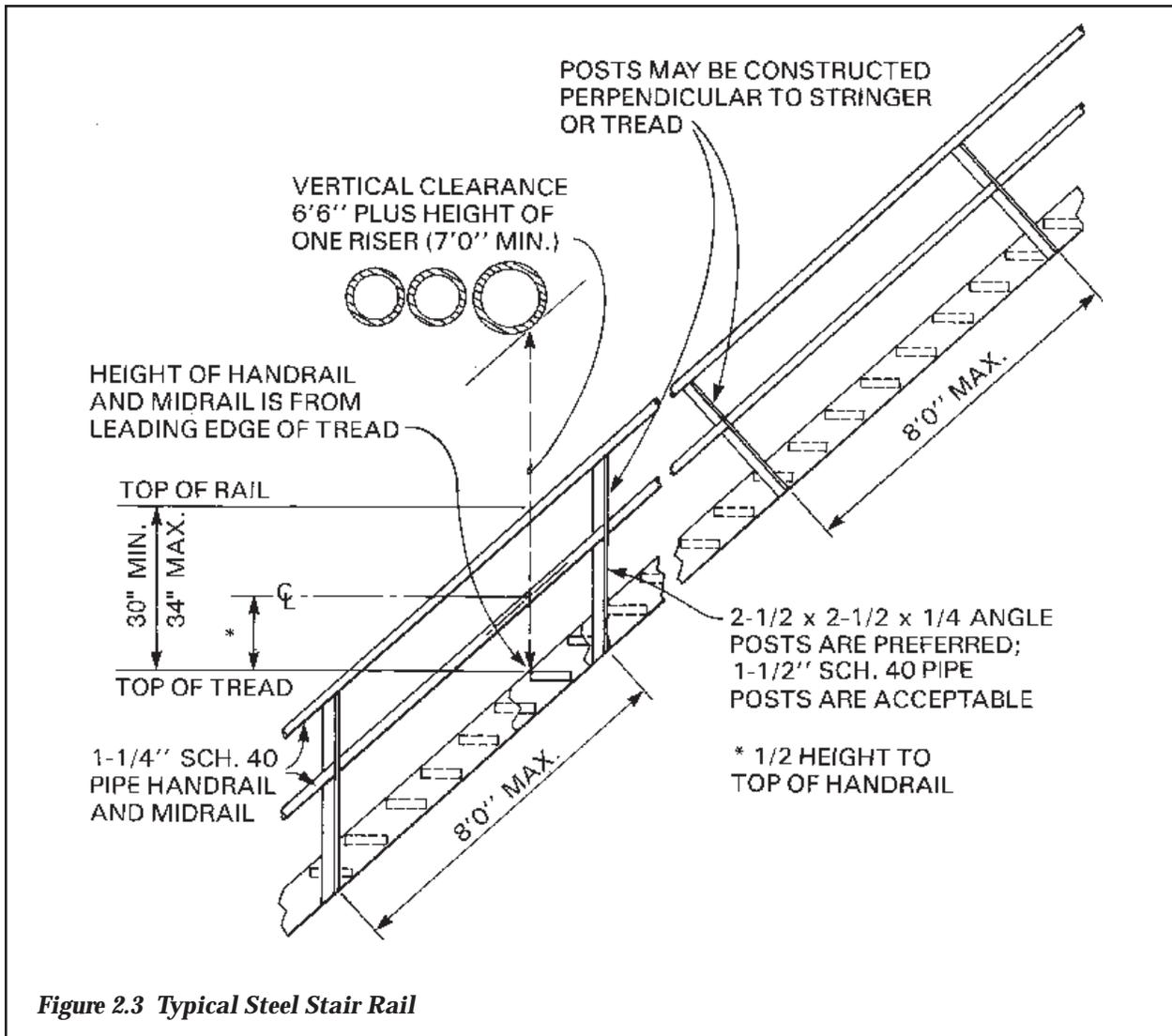


C. CONDITIONS WHICH REQUIRE STAIR HAND/GUARD RAILING

Chevron Guidelines

1. Open sides of stairs which have 4 or more risers or which are more than 30 inches above adjacent floor or ground level at any point along the stairs require stair railings (open sides are those with 6 inches or more gap between stair stringer and nearest solid structure, equipment, or wall).
2. Stairs with enclosed sides which have 4 or more risers require at least one stair railing or handrail on one side (preferably on the right side when descending).
3. Stairs wider than 44 inches may require additional stair railings and/or handrails (see 29 CFR 1910.23(d)).
4. *Figure 2.1 and Figure 2.3 show typical arrangements for steel railings, terminations and connections.*

1. Open sides of stairs which have 4 or more risers require a standard stairway railing having a vertical height of 30 - 34 inches from the upper surface of top rail to surface of tread in line with face of riser at forward edge of tread.
 2. Stairs with enclosed sides which have 4 or more risers require at least a handrail on one side (preferably on the right side when descending).
- Note:** Stairs wider than 44 inches may require additional hand/guard railings (see 29 CFR 1910.23 (d)).



Fed-OSHA 1910.23

2.3 SAFETY DESIGN REQUIREMENTS FOR GUARD RAILINGS AND TOEBOARDS

A. DESIGN*

1. All types of railing (steel, wood, etc.) must withstand anticipated loads - but not less than 200 lb. at any point and in any direction when applied to the top rail.

1. A standard guard railing consists of a top rail and a mid-rail. The top rail shall have a vertical height of 42 inches from the upper surface of the top rail to the floor or platform. The midrail centerline shall be 21 inches below the top rail centerline.
2. A standard stairway railing consists of a top rail and mid-rail. The construction is similar to a standard guardrail, except that the top rail on stair railing serves as a hand-rail. The top railing shall have a vertical height of 30 - 34 inches from the upper surface of the top rail to the surface of the tread in line with the face of the riser at the forward edge of the tread.
3. The 30 inch stairway handrail height is most commonly used. The 34 inch handrail height may be used on circumferential stair railings.
4. All types of railing (steel, wood, etc.) must withstand anticipated loads - but not less than 200 lb. at any point and in any direction when applied to the top rail.

B. RAILING CLEARANCE

Chevron Guidelines

1. All handrails and railings shall be provided with a clearance of not less than 3 inches between the handrail or railing and any other object.

Note: 1-1/2 inches in California

✚ OSHA Interpretation

A clearance of 1-1/2 inches is allowed. [Fed-OSHA Instruction Std. 1-1.6, (10-30-78)]

1. A minimum clearance of **3 inches** along the top rail, or handrail, shall be maintained.*
2. Equipment should not be attached to top rails. Where attachments to the top rail are unavoidable, use a Z-type connection as shown in *Figure 2.4*, or other arrangement which maintains the minimum clearance.

C. GAPS IN GUARD RAILING

Chevron Guidelines

1. The allowable clear opening of gaps in guard railing on platforms, walkways, ramps, or floors should not be more than 3 inches.



Fed-OSHA 1910.23

D. CORNERS AND EDGES

Chevron Guidelines

- 1. Exposed corners, edges, burrs or rough spots on guardrails, stair rails, and handrails shall be ground or filed smooth. Welds should be ground or filed smooth, but not flush with the metal surface.*

- 1. The top rail of guardrail shall be smooth-surfaced throughout the length of the railing.

E. TOEBOARDS

Chevron Guidelines

- 1. The maximum allowable clear horizontal opening at the toeboard is 1 inch. Gaps at toeboards should be avoided where possible.
- 2. The maximum allowable toeboard gap above the surface of the platform, walkway, ramp or floor is 1/4 inch vertically and 1/4 inch horizontally.
- 3. Toeboard thickness should be 1/4 inch minimum.

- 1. A standard toeboard is 4 inches nominal in vertical height from its top edge to the level of the platform, walkway, ramp or floor.

OSHA Interpretation

3-1/2 inches is allowed. [ANSI A12.1-1967 incorporated by reference 1910.31]

- 2. The maximum allowable toeboard gap above the surface of the platform, walkway, ramp or floor is 1/4 inch.

Chevron Interpretation

The maximum allowable gap is 1/4 inch vertically and 1/4 inch horizontally.

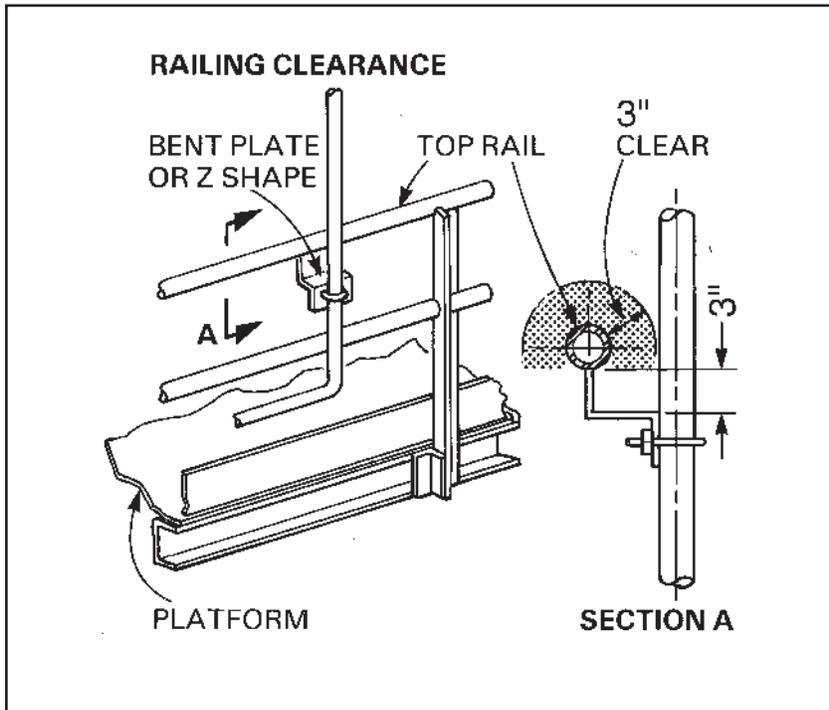


Figure 2.4 Equipment Attachment to Top Rail

Note: 3 inch clearance for both top and sides of top rail, and that attachment connection is at bottom of top rail.

Fed-OSHA 1910.23

2.4 STEEL GUARD RAILING

A. GENERAL REQUIREMENTS FOR STEEL GUARD RAILING

Chevron Guidelines

1. A standard guard railing consists of a top rail, midrail and toeboard and has a vertical height of 42 inches nominal from the top of the rail to the upper surface of the platform, walkway, ramp or floor. The midrail shall be approximately halfway between the top rail and the platform, walkway, ramp or floor. The ends of the rails shall not overhang the terminal posts where such overhang creates a projection hazard.

✚ OSHA Interpretation

- The maximum opening between the top rail and the midrail is 19 inches. [Fed-OSHA Instruction Std. 1-1.10, (6-30-81)]
2. Pipe top rails, midrails and posts shall be at least 1-1/2 inches nominal diameter with posts spaced no more than 8 feet on centers.

1. The dimensions for a standard guardrail are provided in *Figure 2.5*.
2. *Figure 2.6* shows only two of several acceptable bolted supports.
3. 1-1/4 inch schedule 40 pipe is the preferred material for handrails and midrails.
4. Angle posts are preferred because of ease of fabrication. However, 1-1/2 inch schedule 40 pipe may be used as shown in *Figure 2.5*.
5. Fabrication by welding is always preferred.

B. REMOVABLE STEEL GUARD RAILING

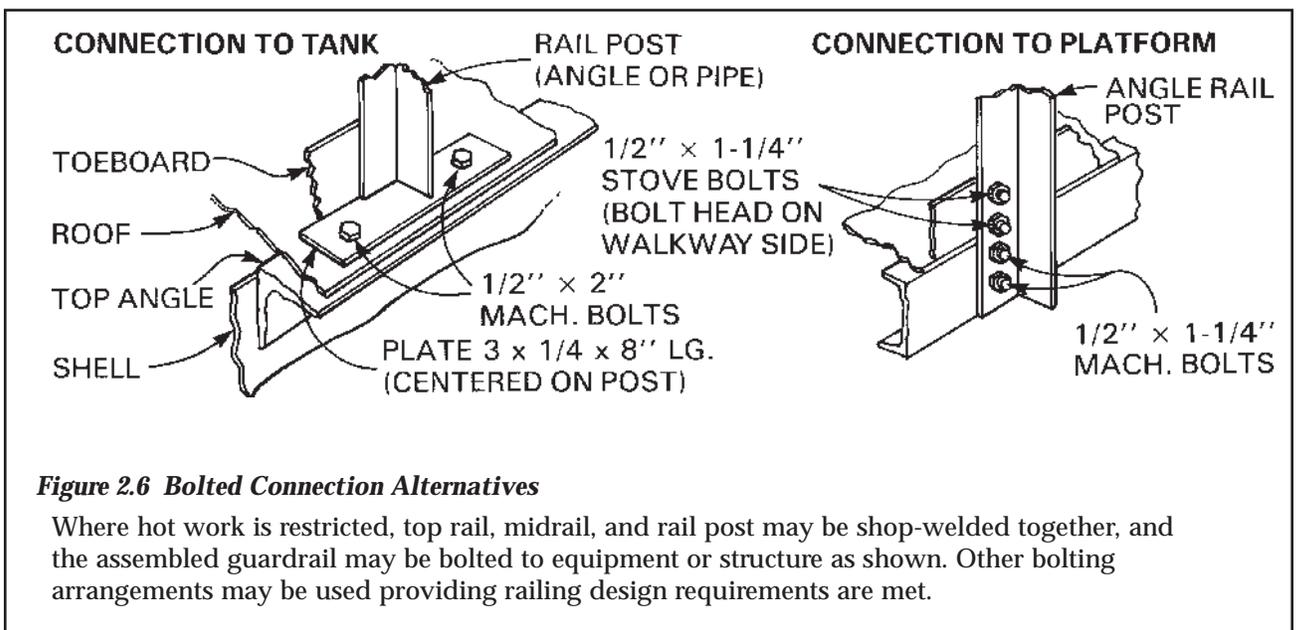
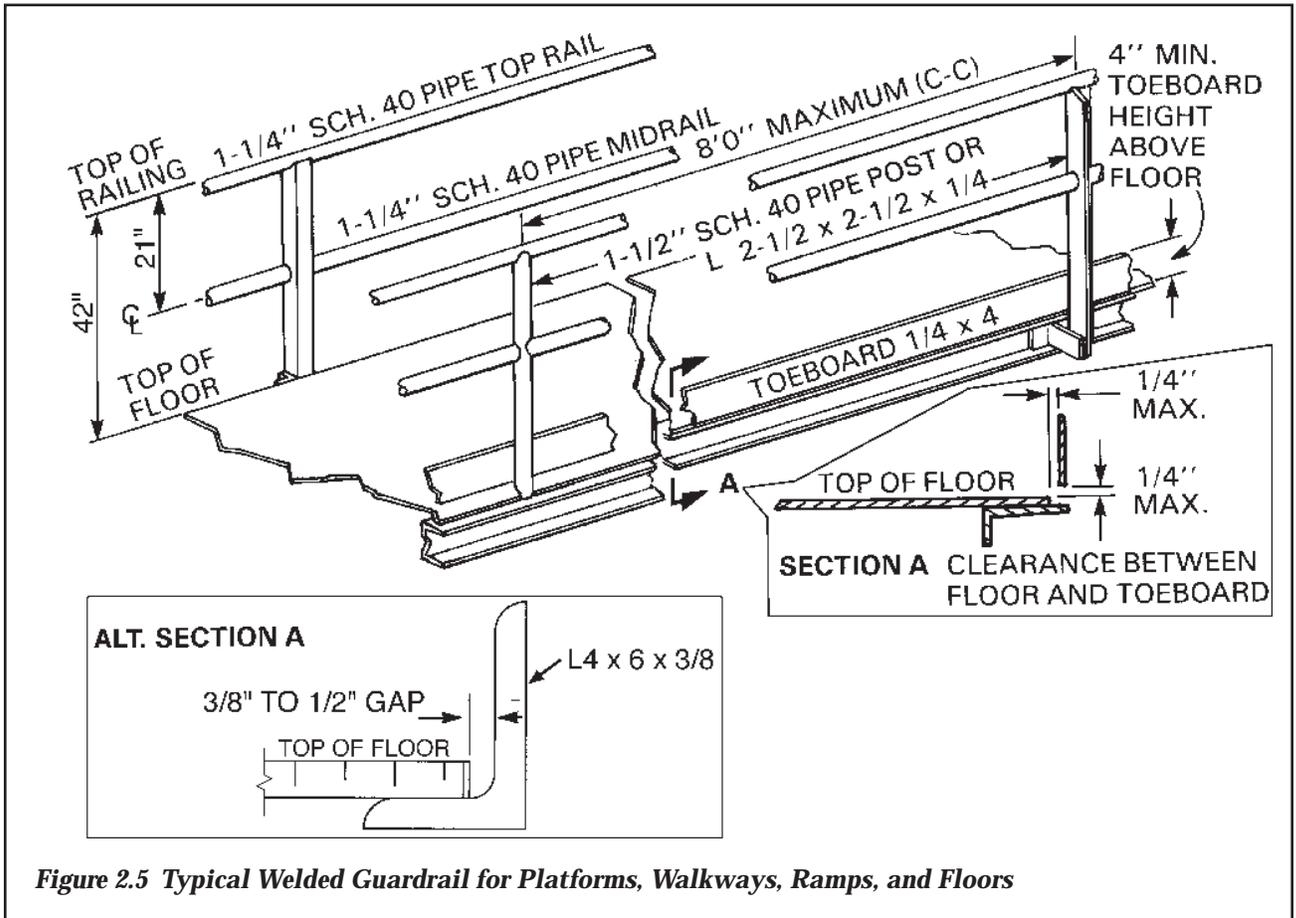
Chevron Guidelines

1. Removable steel guard railing may be used to facilitate the removal of equipment or material handling, provided the safety of personnel is not jeopardized.
2. *Figure 2.7* shows only one of several acceptable supports.
3. Brace bar shall be installed on the platform side of removable handrails to prevent outward movement.
4. Provide a 2-inch clearance between fixed and removable railing, except at the toeboard where the gap should be 1 inch maximum.

C. TANK ROOF STEEL GUARD RAILING

Chevron Guidelines

1. Tanks with diameters of 20 feet or less should have a guardrail and toeboard around the entire roof if access to the roof is required. (Not required when railed walkways and platforms are provided).* See *Figure 2.8*.



2. Tanks with diameters greater than 20 feet require a standard guardrail including a toeboard along the roof perimeter extending 8 feet from the designated work area or 8 feet beyond the roof platform entrance (*Figure 2.9*).
3. Unusual circumstances may require running rail completely around tanks greater than 20 feet in diameter. Example - in locations where heavy snow requires shoveling off a tank's roof, the roof should be completely enclosed by a standard railing (including a toeboard).

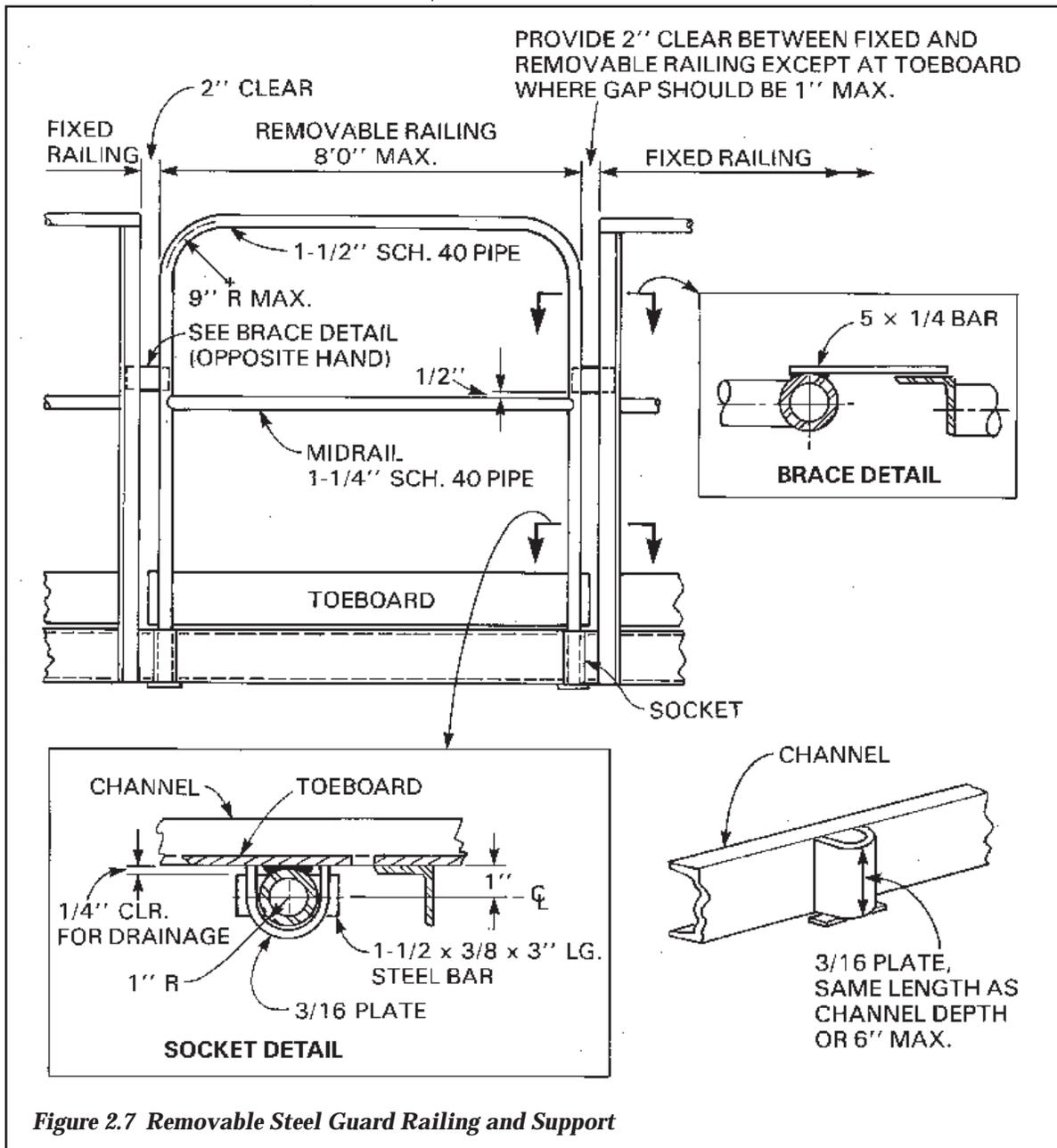


Figure 2.7 Removable Steel Guard Railing and Support

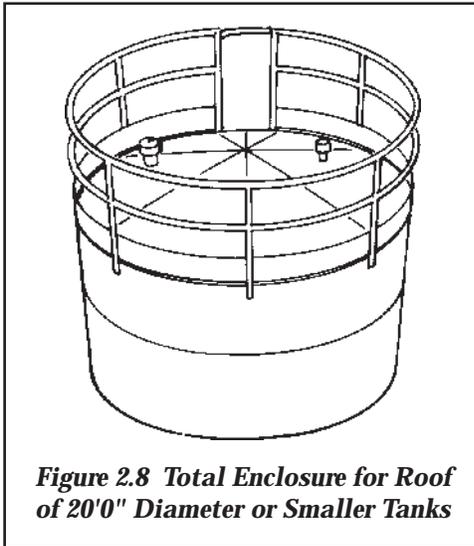


Figure 2.8 Total Enclosure for Roof of 20'0" Diameter or Smaller Tanks

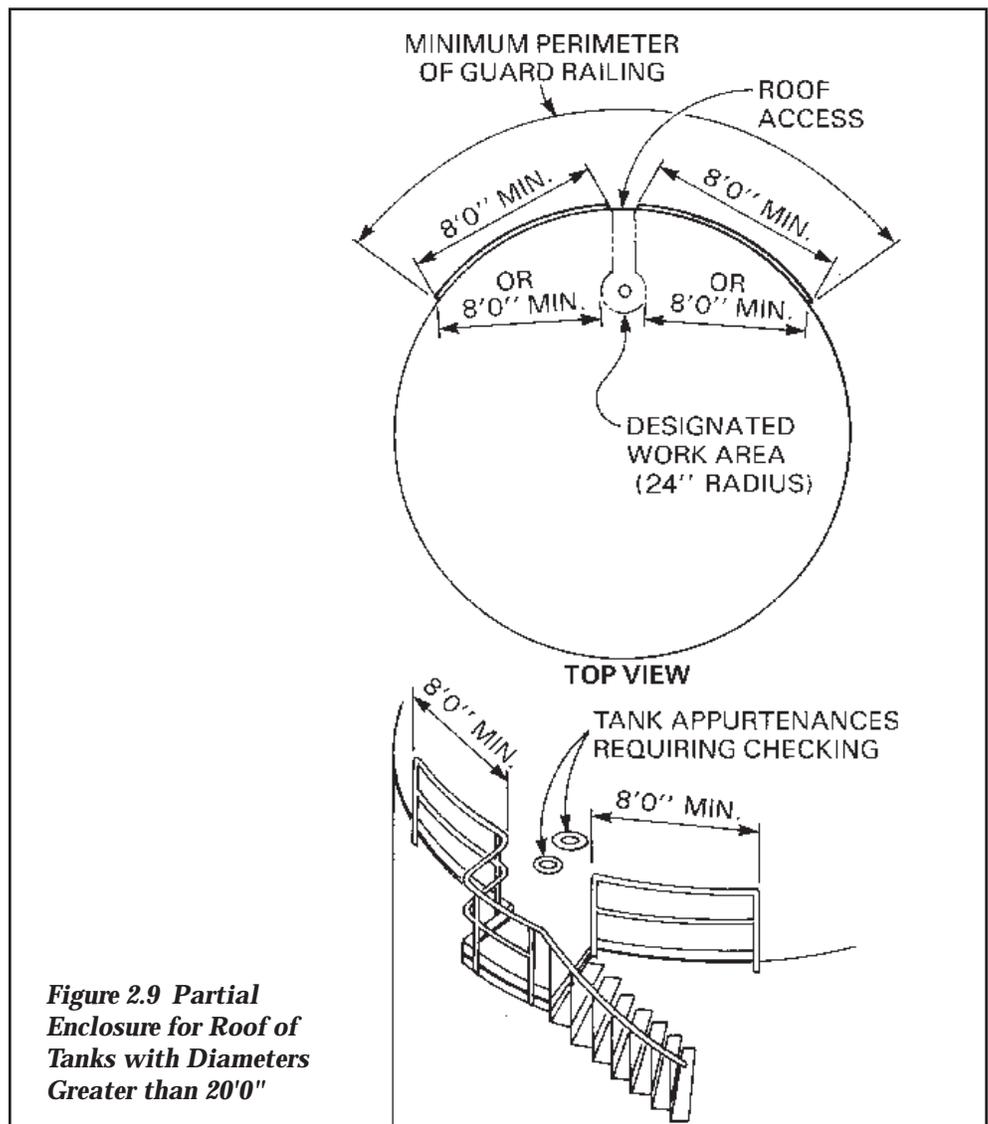


Figure 2.9 Partial Enclosure for Roof of Tanks with Diameters Greater than 20'0"

Fed-OSHA 1910.23

2.5 THE USE OF WOOD FOR HANDRAILS

A. CHEVRON REQUIREMENTS FOR THE USE OF WOOD

General Requirements

1. See Section 1.5, Chevron requirements for use of wood.

B. GENERAL REQUIREMENTS WOOD GUARD RAILING

Chevron Guidelines

1. *Figure 2.10* shows only two of several acceptable supports.
2. Lumber shall be construction grade Douglas fir or equal.
3. All wood to be surfaced four sides (S4S). Top rails shall be smooth and have corners rounded.
4. It is preferable to mount top rail on top of the posts but they may be mounted on the inside of the posts. Midrails and toeboards should always be on the inside of the posts.

Suggested Fabrication Details

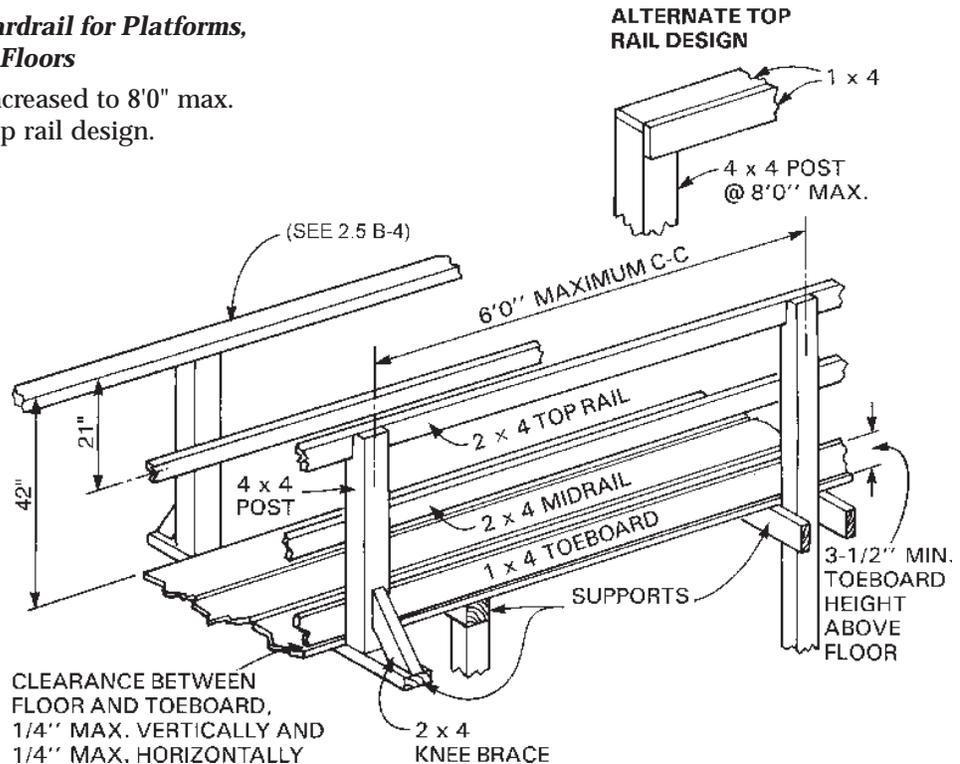
5. Fasteners should be galvanized. Attach top rail and mid-rail top post with one 20d and two 8d nails. Attach toe-board to post with three 8d nails. (1/2-inch carriage bolts may be used in lieu of nails.) Attach posts to walkway stringers with two 1/2-inch machine bolts with washers placed at a minimum of 2 inches from edges of stringers.

Note: See Section 2.2 A for OSHA design requirements for guard rails of all types.

1. Wood top rails, midrails, and posts shall be at least 2 inch x 4 inch stock. Spacing of posts shall not exceed 6 feet. If the top rail is made of at least two right angle pieces of 1 x 4 inch stock, posts may be spaced on 8-foot centers.
2. When used, hardwood handrails must be at least 2 inches in diameter.

Figure 2.10 Wooden Guardrail for Platforms, Walkways, Ramps, and Floors

Post spacing may be increased to 8'0" max. C-C with alternative top rail design.





C. WOOD STAIRWAY HAND/GUARD RAILING AND TERMINATIONS

Chevron Guidelines

1. Railing designs different from those in *Figure 2.11* may be used as long as they are capable of withstanding any anticipated loads and meet design requirements.
2. Sills should be rough construction treated Douglas fir or equal. Other lumber to be construction grade Douglas fir.
3. Wood, except sills, shall be surfaced four sides. Handrails shall be smooth and have corners rounded.

Note: See Section 2.2 C for OSHA design requirements for stairway hand/guard rails of all types.

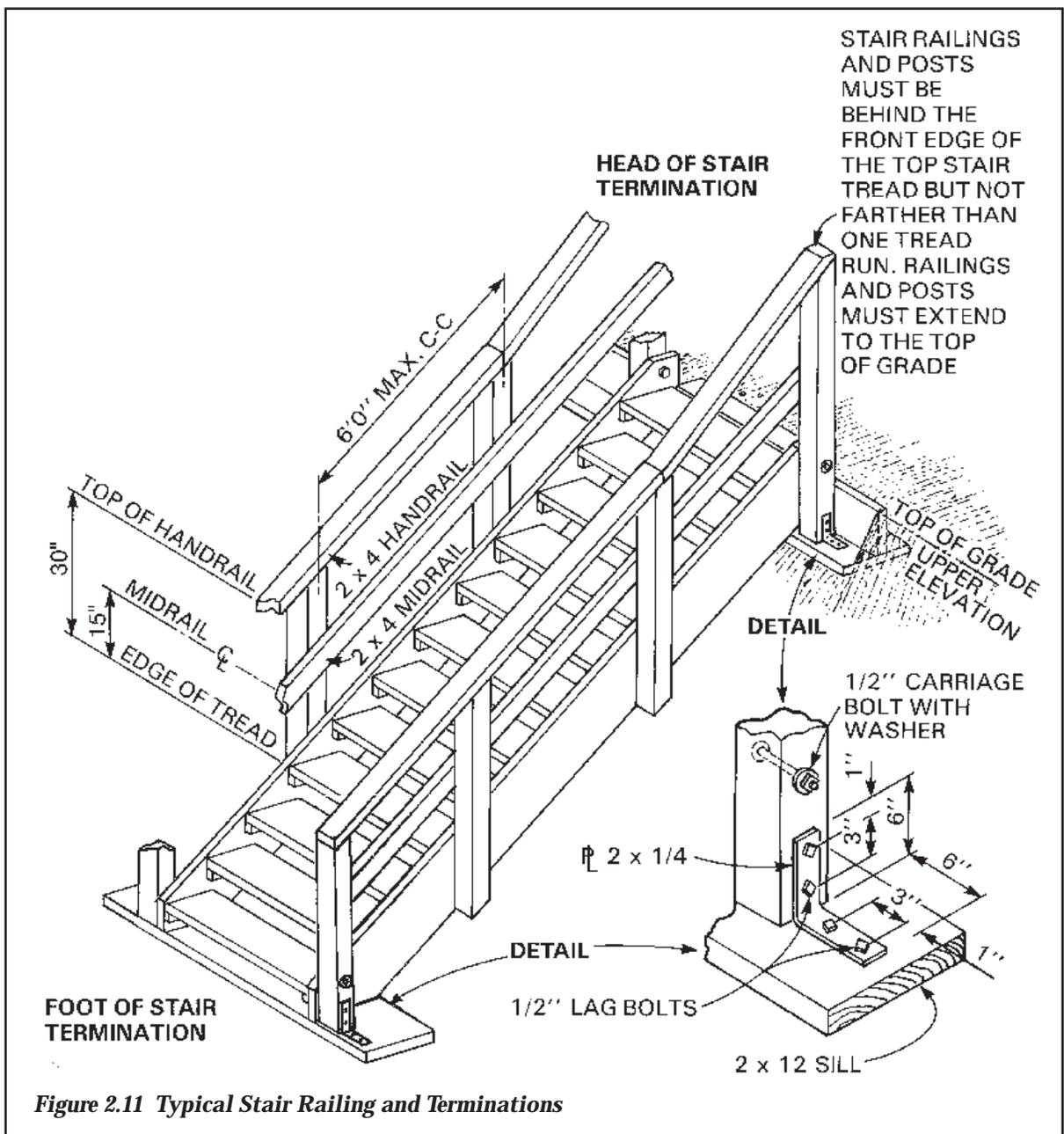
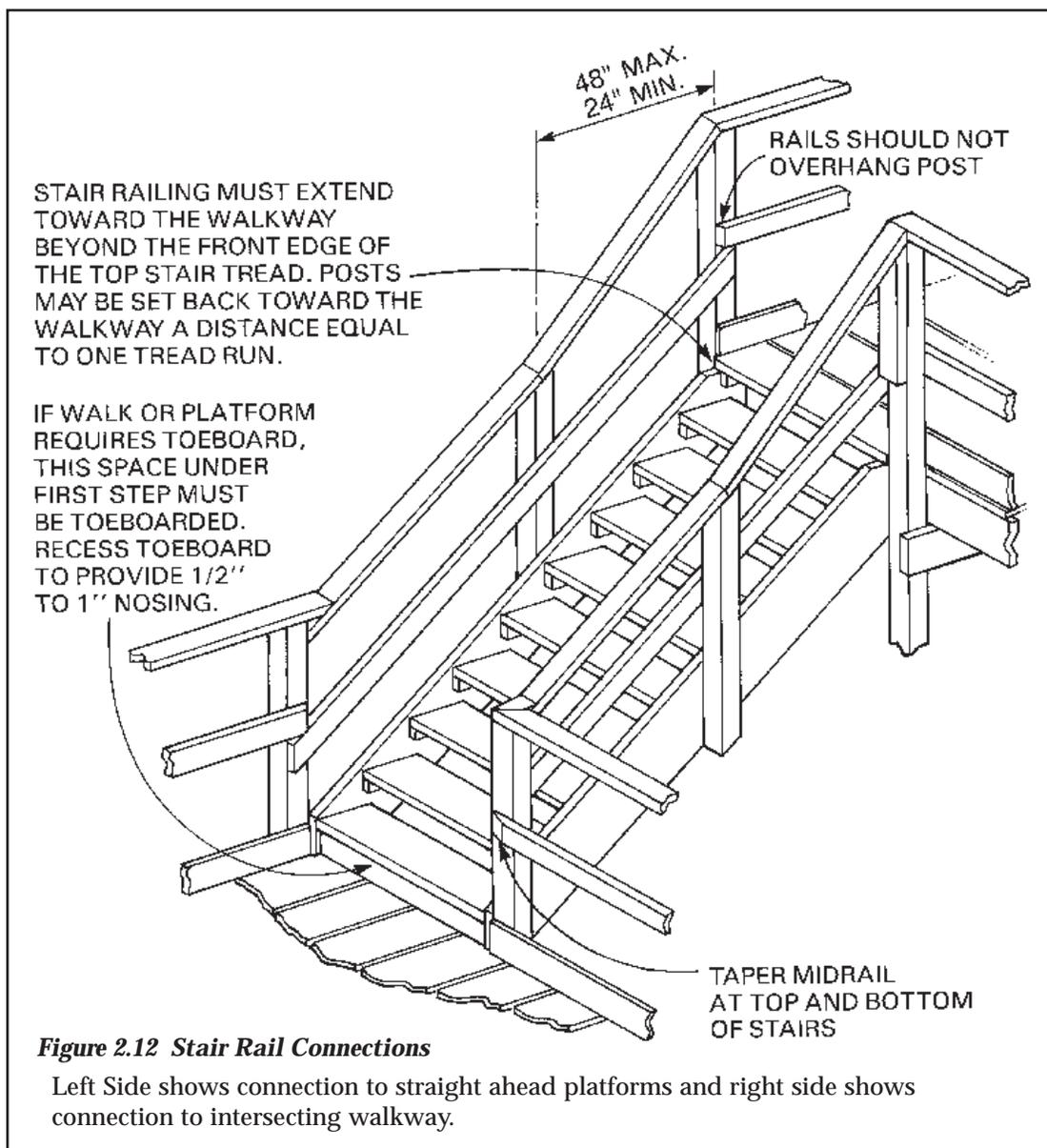


Figure 2.11 Typical Stair Railing and Terminations

Fed-OSHA 1910.23
D. WOOD STAIRWAY HAND/GUARD RAILING CONNECTIONS
Suggested Fabrication Details

Note: See Section 2.2 C for OSHA design requirements for stairway handrails and guardrails of all types.

1. All fasteners should be galvanized. Attach handrails and midrails to posts with one 20d and two 8d nails. (1/2-inch carriage bolts may be used in lieu of nails.) Attach posts to stringers with two 1/2-inch carriage bolts with washers placed a minimum of 2 inches from edge of stringer.
2. It is preferable to mount handrails on top of the posts but they may be mounted on the inside of the posts. Midrails and toeboards should always be on the inside of the posts.





2.6 NOTES AND REFERENCES

OTHER GUIDES

24 Cal. Code of Regs. 2-3305 State Building Code
"Stairways"

Uniform Building Code Section 1711
"Guardrails"

A1264.1-1995 ANSI Standard
"Safety Requirements for Floor and Wall Openings, Stairs, and Railing Systems."

ADDITIONAL REFERENCES

CRTC Standard Drawing GF-M99645
"Standard Railing"