ℓ'_w = effective length of seam weld in inches (mm).

In no case will the spacing be greater than 3 feet (0.9mm). See Figure 7-59.

(d) Non-welded fasteners. Fastening methods other than welds, such as self-drilling, power, actuated, or pneumatically driven fasteners, may be used provided that equivalence to the welded method can be shown by approved test data.

(e) Thickness of steel. The thickness of steel before coating with paint or galvanizing shall be in accordance with the following table. The thickness of the uncoated steel shall not at any location be less than 95 percent of the design thickness.

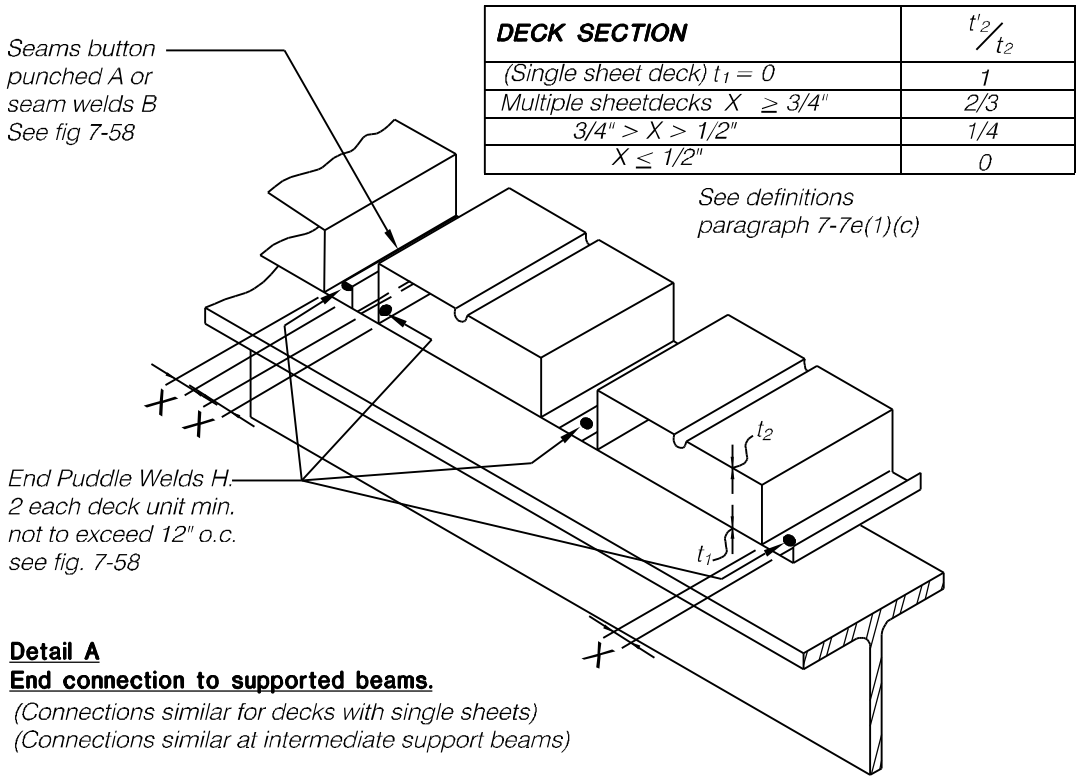
Gauge	Design Thickness	Minimum Thickness
22	0.0295	0.028
20	0.0358	0.035
18	0.0474	0.045
16	0.057	0.0598

1 inch = 25mm

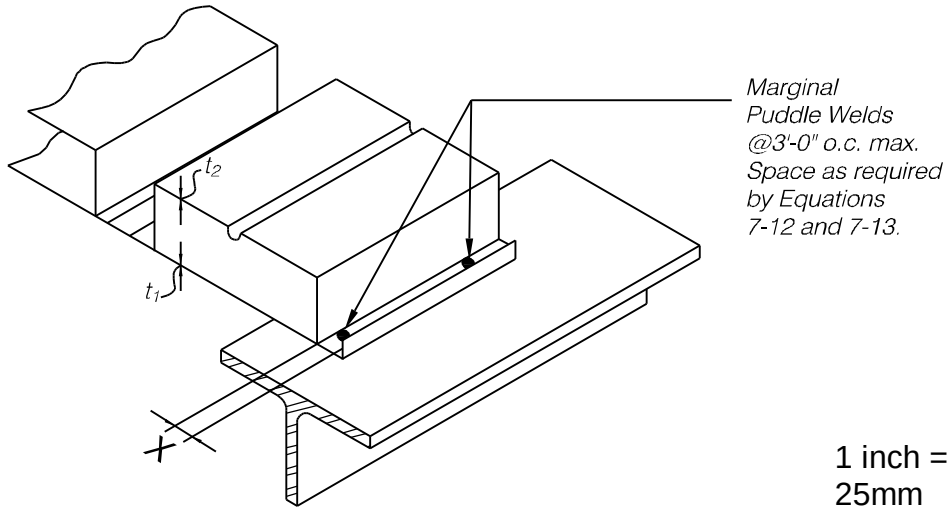
(2) Type A Diaphragms: decks having shear transfer elements directly attached to framing. Multiple-plate steel decks with the flat element adjacent to framing members, and single-plate steel decks, fall into this category of diaphragms when each deck unit is attached to the framing by at least two puddle welds or equivalent fasteners, as described in Figure 7-58. Thickness of the metal deck will not be less than 22 gauge. Seam attachments will be made at least at midspan of L_V, the vertical-load span of the deck, but the spacing of attachments between supports will not exceed 3 feet (0.9mm) on center. Typical details of Type A diaphragms and attachments are shown in Figure 7-60.

(3) Type B diaphragms. These are decks having an elevated plate of shear transfer. Multiple steel decks with fluted elements adjacent to framing members, and single-plate steel decks with fluted elements incapable of being welded to framing with at least two puddle welds or equivalent fasteners per unit, fall into this category of diaphragm. This type of diaphragm has only welded seam attachments. The units will be composed of sheets not less than 30 gauge. Seam attachment spacing will not exceed 3 feet (0.9mm) on center. Typical details of Type B diaphragms and attachments are shown in Figure 7-61.

(4) Steel decks with concrete fill. This type of diaphragm is composed of a galvanized steel deck with a superimposed fill of concrete having a minimum f'_c of 2,500 psi (17.2MPa) at 28 days and a minimum weight of 90 pounds per cubic foot (14.1 N/m^3). Minimum concrete fill over the deck will be 2½ inches (64mm). Temperature reinforcement will be used in the fill with the minimum 6x6-W1.4xW1.4 welded wire fabric. Steel decks less than 1½ inches (38mm) in depth do not qualify as diaphragms; thus, only the concrete is considered as the diaphragm, per Paragraph (a) below. To satisfy the anchorage requirements of Paragraph 7-7e(2), positive interlocking between the steel deck and the concrete can be achieved by either deck embossments or indentations, transverse wires



Detail A
End connection to supported beams.
(Connections similar for decks with single sheets)
(Connections similar at intermediate support beams)



1 inch = 25mm

Detail B
Connection to marginal beams.

Figure 7-59 Steel deck diaphragms Type A - Typical attachments.

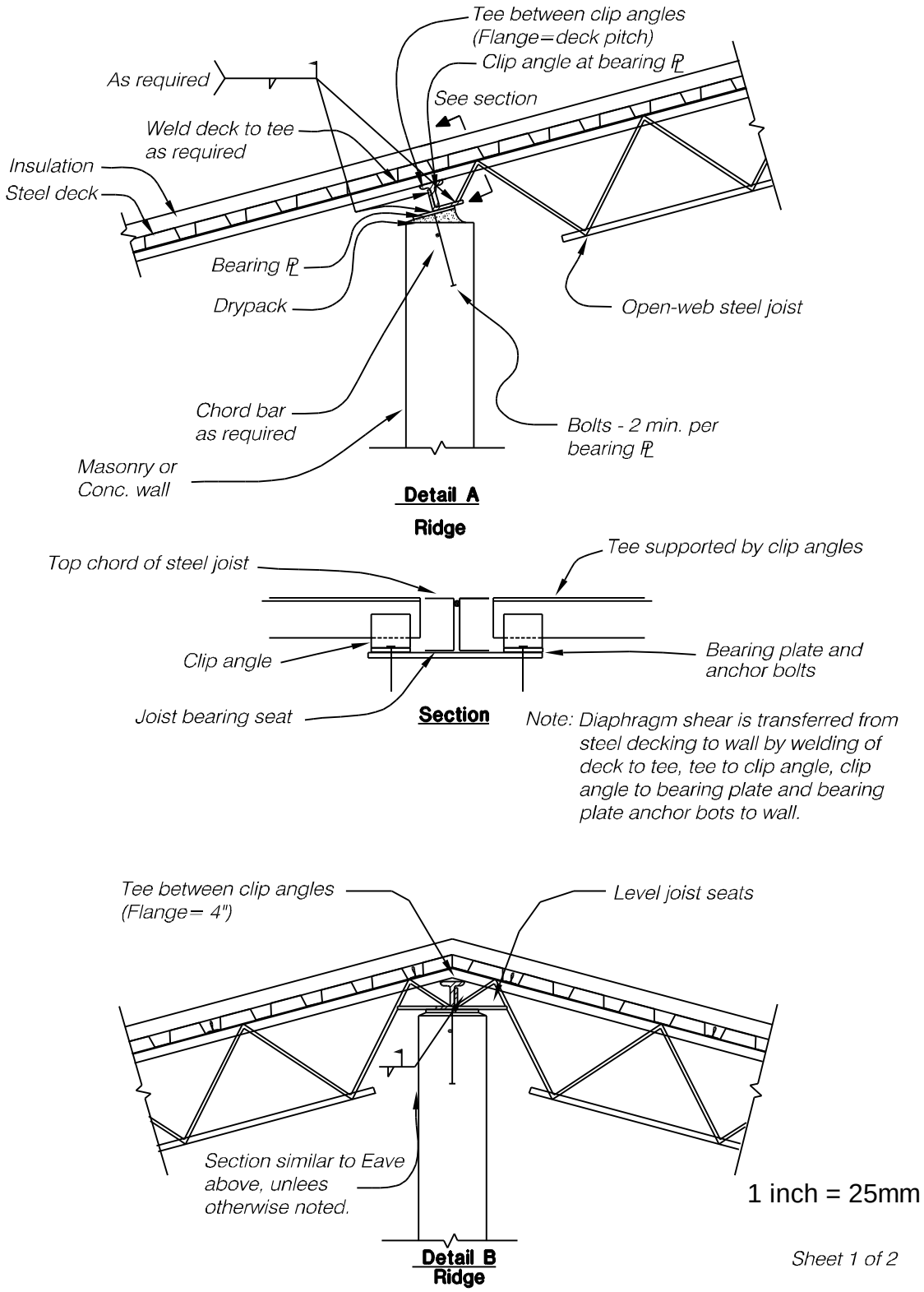
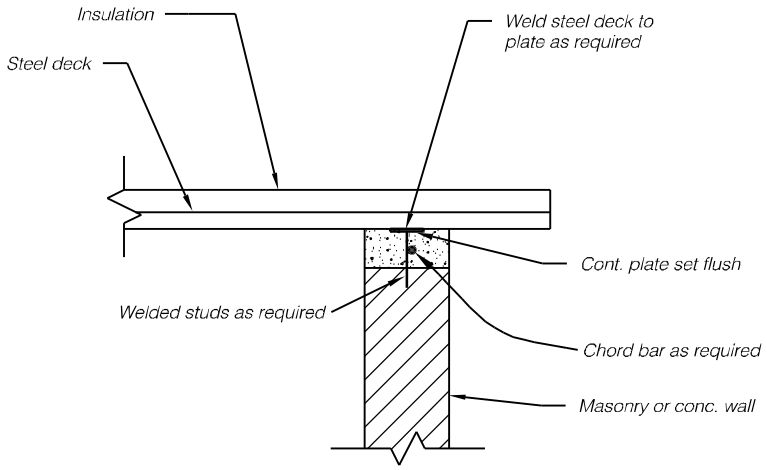
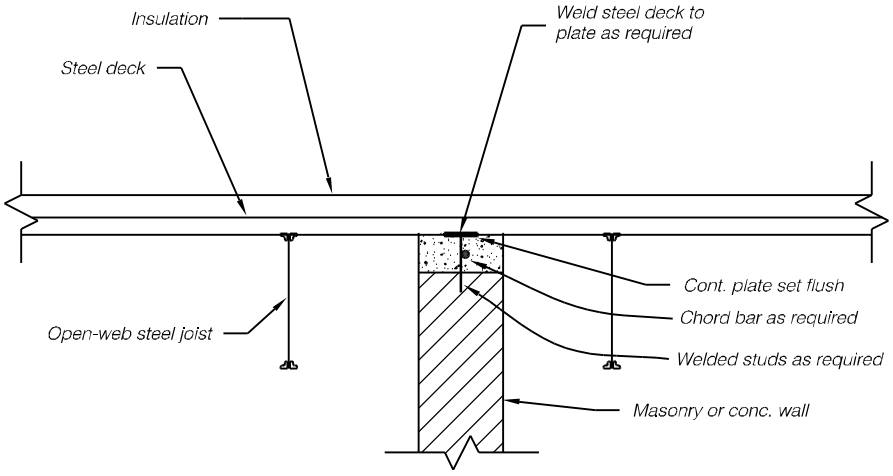


Figure 7-60 Steel deck diaphragms - typical details with open web joists.



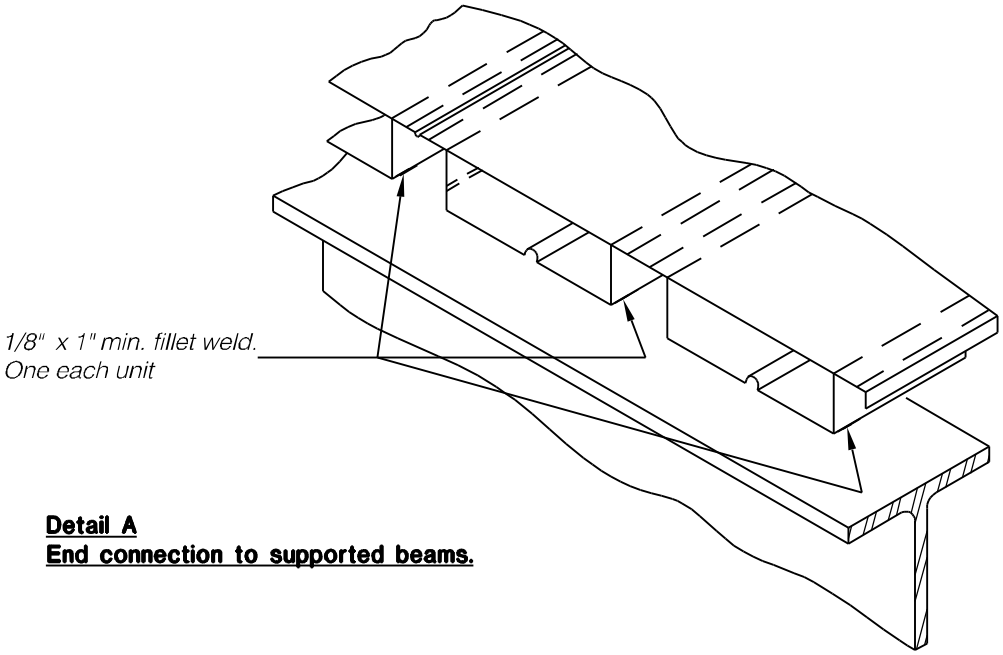
Detail A - Rake



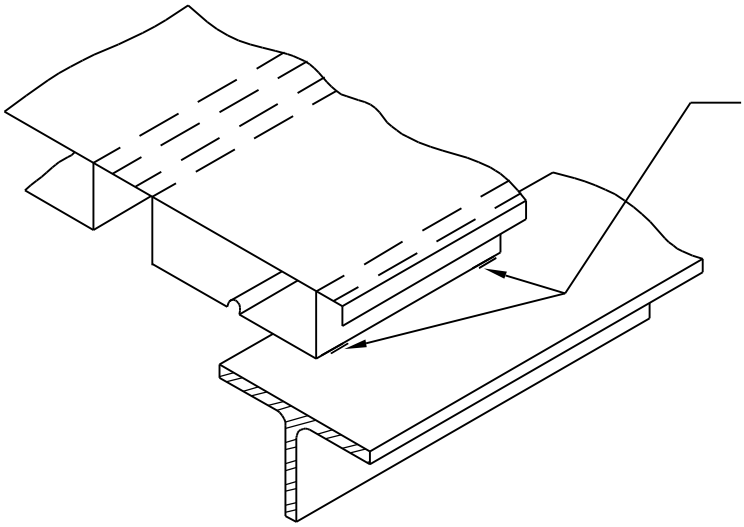
Detail B - Transverse shear wall

Sheet 2 of 2

Figure 7-60 continued



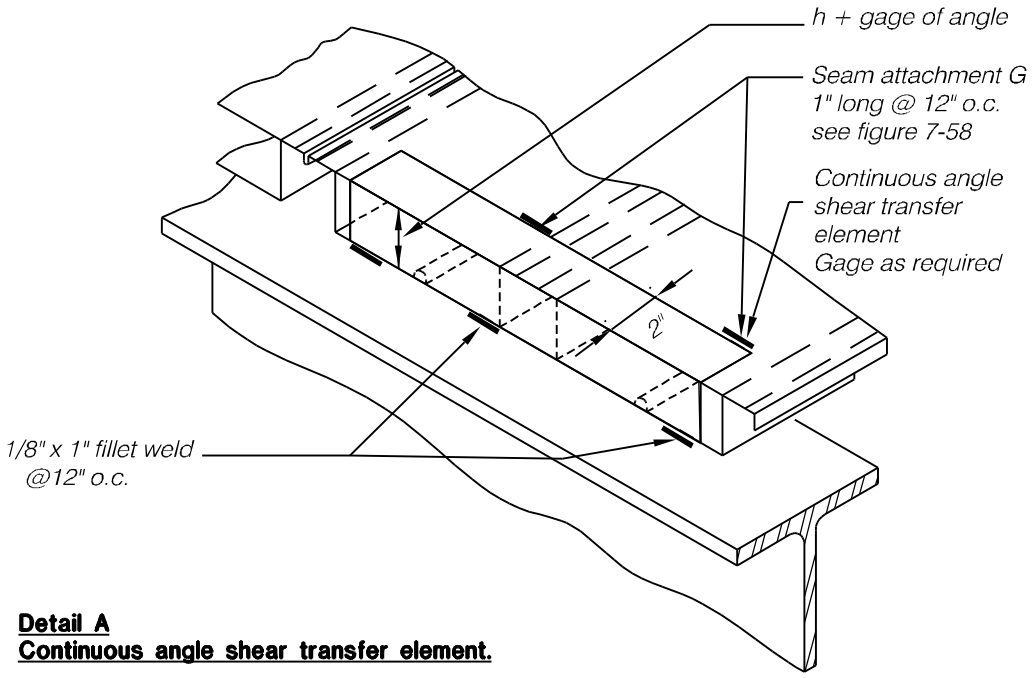
Detail A
End connection to supported beams.



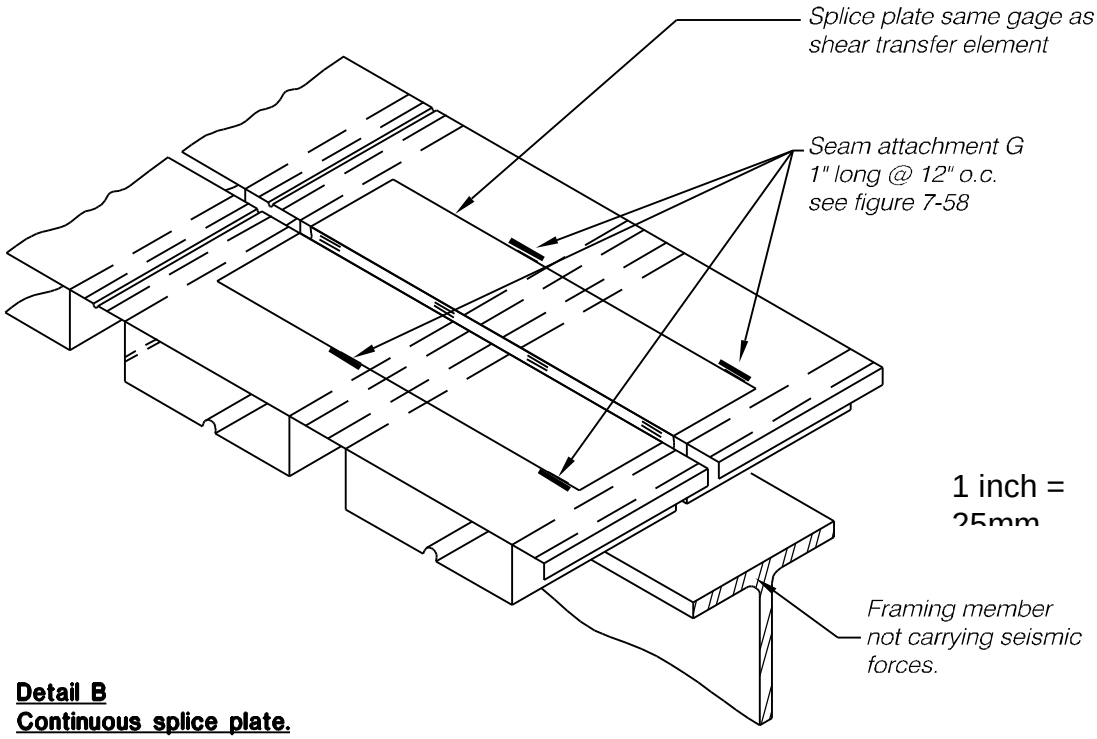
Detail B
Connection to marginal beams.

Sheet 1 of 3

Figure 7-61 Steel deck diaphragms Type B - Typical attachments to frame.



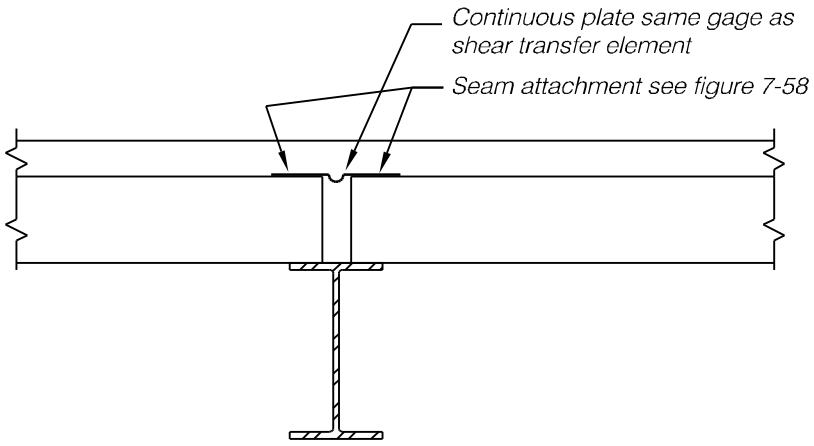
Detail A
Continuous angle shear transfer element.



Detail B
Continuous splice plate.
See sheet 3 for cross section.

Sheet 2 of 3

Figure 7-61 Continued



Detail C

Splice at support

Figure 7-61 continued

attached to the deck corrugations, holes placed in the corrugations, or deck profile in which the fluted elements are placed up so that the fill is keyed with the deck. If interlocking between the deck and the concrete is not achieved, then mechanical anchorages will be required to anchor the fill to the supporting member, as prescribed in Paragraph 7-7e(2).

(a) Concrete as a diaphragm. If the diaphragm is loaded and reacted without shear stresses passing through the steel deck or its attachments, the diaphragm is a concrete diaphragm as described in Paragraph 7-7d. Typical attachment details are shown in Figure 7-62, details A and B.

(b) Steel deck as a diaphragm.

1. Shear strength. Nominal shear strength of steel deck diaphragm shall be determined in accordance with approved analytical procedures or with test procedures prepared by a licensed design professional experienced in testing cold-formed steel assemblies, and approved by the authority having jurisdiction. The steel deck installation for the structures, including fasteners, should comply with the test assembly arrangement.

2. Acceptance criteria.

i. The response modification factors, *R*, for steel deck diaphragms conforming to Performance Objective 1A, shall be based on the factor for the applicable structural system in Table 7-1. The allowable shear strength shall be taken as 1.50 times the allowable stress values published by the Steel Deck Institute, or the International Conference of Building Officials.

ii. Modification factors, *m*, for enhanced performance objectives shall be taken as 1.0 for Performance Objective 3B; 1.5 for Performance Objectives 2A and 2B; and 2.0 for Performance Objective 1A.

iii. Steel decking and its attachments are considered to be force-controlled components, and the strength, Q_{CL}, shall be determined as indicated in Paragraph i above.

f. Wood Diaphragms.

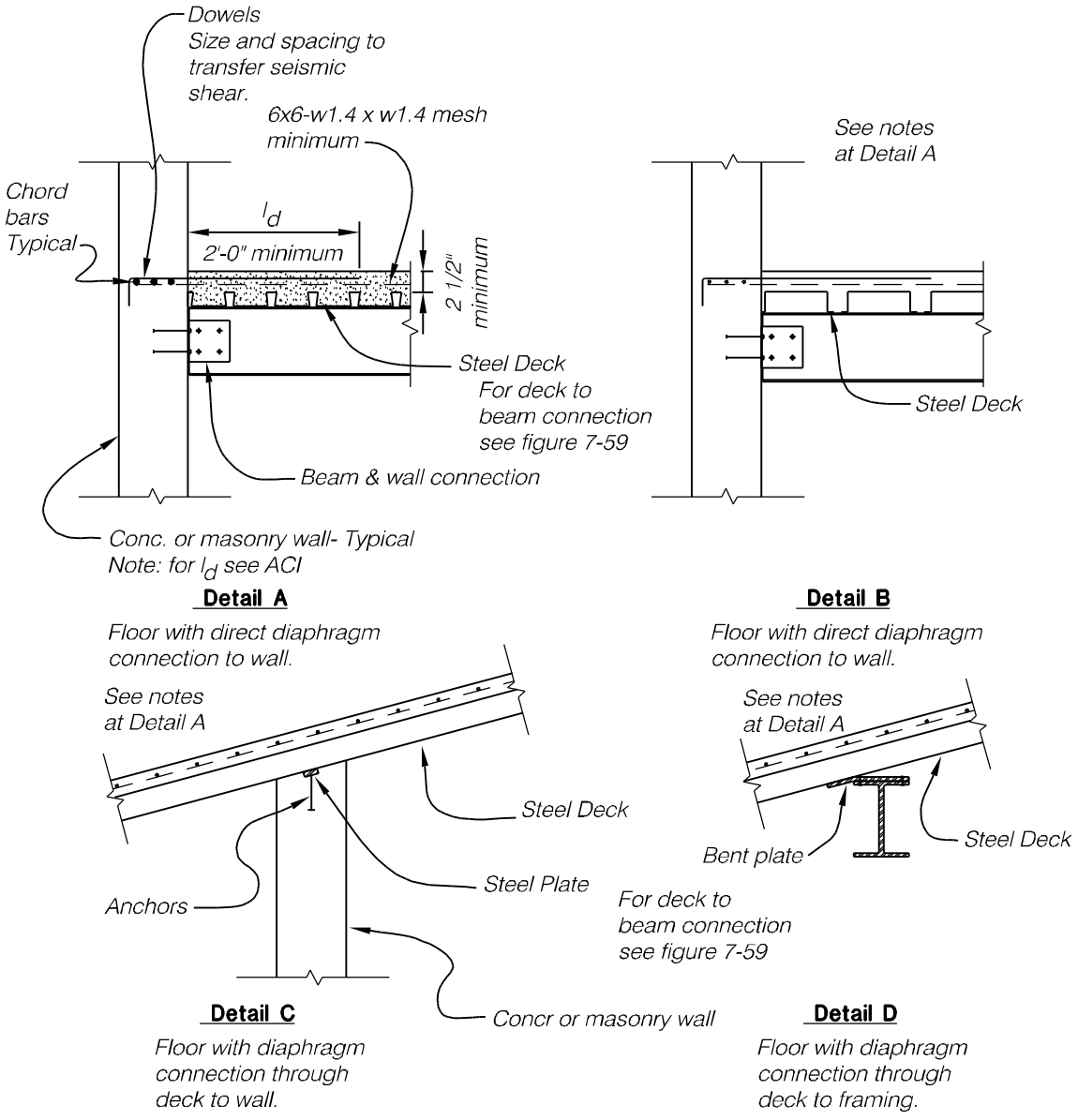
(1) General design criteria. Wood diaphragms will be designed with reference to Section 12.4 of FEMA 302, and the additional criteria of this section.

(2) Wood diaphragms in concrete and masonry buildings; refer to Section 12.3.4.1 of FEMA 302.

(3) Wood buildings with walls on three sides. Provide for rotation as discussed in Paragraph 7-7b(2). Straight sheathing will not be used to resist shears in rotation. The depth of the diaphragm normal to the open side will not exceed 25 feet (7.5m), or two-thirds of the diaphragm width, whichever is the smaller depth.

Exceptions:

(a) One-story wood-frame structures with the depth normal to the open side not greater than 25 feet



Note:

When decks are attached at all shear transfer points similar to details A and B, the diaphragms will be designed in accordance with paragraph 7-7, concrete diaphragms. When shear transfer is through the welds between the steel deck and framing, the diaphragm will be designed in accordance with paragraph 7-7e(4)(b).

1 inch = 25.4 mm
1 foot = 0.3 m

Figure 7-62 Steel deck diaphragms with concrete fill.

(7.5m) may have a depth equal to the width.

(b) Where calculations show that diaphragm deflections can be tolerated, the depth normal to the open end may be increased to a depth-to-width ratio not greater than 1½:1 for diagonal sheathing, or 2:1 for special diagonally sheathed or plywood diaphragms.

(4) Material requirements.

(a) Straight sheathing. Straight sheathing diaphragms will be constructed of 1- or 2-inch (25 or 50mm) nominal boards, 6 or 8 inches (150 or 200mm) nominal in width, with boards laid at right angles to the rafters or joists. Boards will be nailed to each rafter or joist and to peripheral blocking with two 8d common nails for 1-inch by 6-inch (25 x 150mm) and 1-inch by 8-inch (25 x 200mm) sheathing. For 2-inch (50mm) sheathing, nails will be three 16d. End joints of adjacent boards will be separated by at least two joist or rafter spaces, with at least two boards between joints on the same support. They will not be used for the lateral support of masonry, concrete, or other walls that would be seriously affected by high floor-to-floor deflection. Straight sheathing diaphragms are permitted only for buildings in Seismic Design Category A or B.

(b) Diagonal sheathing.

1. Conventional construction. These diaphragms will be made up of 1-inch (25mm) nominal sheathing boards laid at an angle of approximately 45 degrees to supports. Sheathing boards will be nailed directly to each intermediate bearing member with not less than two 8d nails for 1- by 6-inch (25 x 150mm) boards and three 8d nails for boards 8 inches (200mm) or wider, and in addition, three 8d nails and four 8d nails will be used for 6-inch (150mm) and 8-inch (200mm) boards, respectively, at the diaphragm boundaries. End joints in adjacent boards will be separated by at least two joist or stud spaces, and there will be at least two boards between joints on the same support. The boundary or chord members at the edges of diaphragms will be designed to resist direct tensile and compressive chord stresses. This category of diaphragms will also be considered very flexible; such diaphragms will not be used for the lateral support of masonry or concrete walls.

2. Special construction. Special diagonally sheathed diaphragms will include two adjoining layers of 1-inch (25mm) nominal sheathing boards laid diagonally and at 90 degrees to each other. Special diagonally sheathed diaphragms also include single-layered diaphragms, conforming to conventional construction, and which, in addition, will have all elements designed in conformance with the following provision: each chord or portion thereof may be considered as a beam loaded with a uniform load per foot equal to 50 percent of the unit shear due to diaphragm action. The load will be assumed as acting normal to the chord in the plane of the diaphragm, and either toward or away from the diaphragm. The span of the chord, or portion thereof, will be the distance between structural members of the diaphragm, such as joists or blocking, which serve to transfer the assumed load to the sheathing. Special diagonally sheathed diaphragms may be used to resist shears due to seismic forces, provided such shears do not stress the nails beyond their allowable safe lateral strength. For approximating deflections, a value of F of 75 will be used; thus, special diagonally sheathed diaphragms also fit into the category of flexible diaphragms.