

## APPENDIX J

# LADDERS, RAMPS, STAIRS AND FIXED LADDERS

## 1. FIXED LADDERS: DESIGN REQUIREMENTS

a. Design considerations. All ladders, appurtenances, and fastenings shall be designed to meet the following load requirements:

- (i) The minimum design live load shall be a single concentrated load of 200 lb (90.7 kg).
- (ii) The number and position of additional concentrated live-load units of 200 lb (90.7 kg) each as determined from anticipated usage of the ladder shall be considered in the design.
- (iii) The live loads imposed by persons occupying the ladder shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.
- (iv) The weight of the ladder and attached appurtenances together with the live load shall be considered in the design of rails and fastenings.

b. Design stresses. Design stresses for wood components of ladders shall not exceed those specified in 29 CFR 1910.25. All wood parts of fixed ladders shall meet the requirements of 29 CFR 1910.25(b). For fixed ladders consisting of wood side rails and wood rungs or cleats, used at a pitch in the range 75° to 90°, and intended for use by no more than 1 person per section, single ladders as described in 29 CFR 1910.25(c)(3)(ii) are acceptable.

## **2. FIXED LADDERS: SPECIFIC FEATURES**

### **a. Rungs and cleats.**

(i) All rungs shall have a minimum diameter of 3/4 in (1.9 cm) for metal ladders, except as covered in subparagraph g.(i) below, and a minimum diameter of 1-1/8 in (2.9 cm) for wood ladders.

(ii) The distance between rungs, cleats, and steps shall not exceed 12 in (30.5 cm) and shall be uniform throughout the length of the ladder.

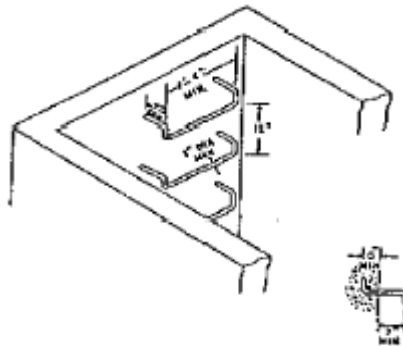
(iii) The minimum clear length of rungs or cleats shall be 16 in (40.6 cm).

(iv) Rungs, cleats, and steps shall be free of splinters, sharp edges, burrs or projections which may be a hazard.

(v) The rungs of an individual-rung ladder shall be so designed that the foot cannot slide off the end. A suggested design is shown in Figure J-1.

**FIGURE J-1**

### **SUGGESTED DESIGN FOR RUNGS ON INDIVIDUAL-RUNG LADDERS**



b. Side rails. Side rails that might be used as a climbing aid shall be of such cross sections as to afford adequate gripping surface without sharp edges, splinters, or burrs. Horizontal grab bars shall be provided for proper grip on side rail extensions for walk-through ladders

c. Fastenings. Fastenings shall be an integral part of fixed ladder design.

d. Splices. All splices made by whatever means shall meet design requirements as noted in paragraph 1 above. All splices and connections shall have smooth transition with original members and with no sharp or extensive projections.

e. Electrolytic action. Adequate means shall be employed to protect dissimilar metals from electrolytic action when such metals are joined.

f. Welding. All welding shall be in accordance with ANSI/AWS D1.0.

g. Protection from deterioration.

(i) Metal ladders and appurtenances shall be painted or otherwise treated to resist corrosion and rusting when location demands. Ladders formed by individual metal rungs imbedded in concrete, which serve as access to pits and to other areas under floors, are frequently located in an atmosphere that causes corrosion and rusting. To increase rung life in such atmosphere, individual metal rungs shall have a minimum diameter of 1 in (2.5 cm) or shall be painted or otherwise treated to resist corrosion and rusting.

(ii) Wood ladders, when used under conditions where decay may occur, shall be treated with a nonirritating preservative, and the details shall be such as to prevent or minimize the accumulation of water on wood parts.

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(iii) When different types of materials are used in the construction of a ladder, the materials used shall be so treated as to have no deleterious effect one upon the other.

### **3. FIXED LADDERS: CLEARANCE**

a. Climbing side. On fixed ladders, the perpendicular distance from the centerline of the rungs to the nearest permanent object on the climbing side of the ladder shall be 36 in (91.4 cm) for a pitch of 76°, and 30 in (76.2 cm) for a pitch of 90° (see Figure J-2), with minimum clearances for intermediate pitches varying between these two limits in proportion to the slope, except as provided in subparagraphs c and d below.

b. Ladders without cages or wells. A clear width of at least 15 in (38.1 cm) shall be provided each way from the centerline of the ladder in the climbing space, except when cages or wells are necessary.

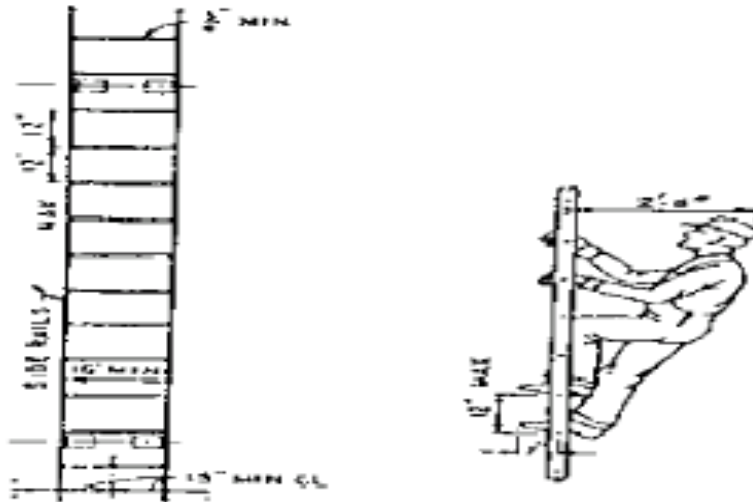
c. Ladders with cages or baskets. Ladders equipped with cage or basket are excepted from the provisions of subparagraphs a and b above, but shall conform to the provisions of paragraph 4.a.(v) below. Fixed ladders in smooth-walled wells are excepted from the provisions of subparagraph a above, but shall conform to the provisions of paragraph 4.a.(vi) below.

d. Clearance in back of ladder. The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7 in (17.8 cm), except when unavoidable obstructions are encountered, minimum clearances as shown in Figure J-3 shall be provided.

e. Clearance in back of grab bar. The distance from the centerline of the grab bar to the nearest permanent object in back of the grab bars shall be not less than 4 in (10.1 cm). Grab bars shall not protrude on the climbing side beyond the rungs of the ladder that they serve.

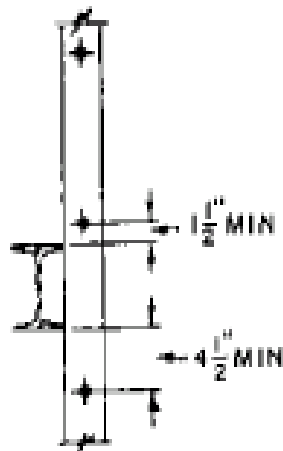
**FIGURE J-2**

**RAIL LADDER WITH BAR STEEL RAILS AND ROUND  
STEEL RUNGS**



**FIGURE J-3**

**CLEARANCE FOR UNAVOIDABLE OBSTRUCTION AT  
REAR OF FIXED LADDER**



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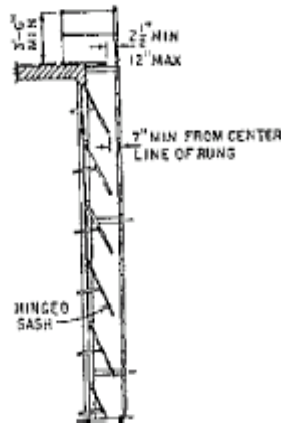
f. Step-across distance. The step-across distance from the nearest edge of ladder to the nearest edge of equipment or structure shall be not more than 12 in (30.5 cm), or less than 2-1/2 in (6.4 cm) (Figure J-4).

g. Hatch cover. Counter weighted hatch covers shall open a minimum of  $60^\circ$  from the horizontal. The distance from the centerline of rungs or cleats to the edge of the hatch opening on the climbing side shall be not less than 24 in (61.0 cm) for offset wells or 30 in (76.2 cm) for straight wells. There shall be not protruding potential hazards within 24 in (61.0 cm) of the centerline of rungs or cleats; any such hazards within 30 in (76.2 cm) of the centerline of the rungs or cleats shall be fitted with deflector plates placed at an angle of  $60^\circ$  from the horizontal as indicated in Figure J-5. The relationship of a fixed ladder to an acceptable counter weighted hatch cover is illustrated in Figure J-6.

h. Openings shall be provided with elevated horizontal grab bars to facilitate access and exit from upper levels.

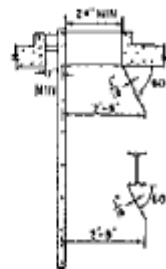
**FIGURE J-4**

**LADDER FAR FROM WALL**



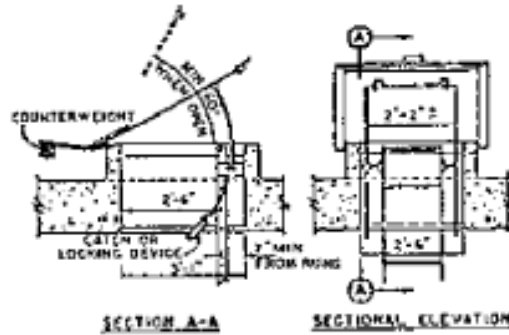
**FIGURE J-5**

**DEFLECTOR PLATES FOR HEAD HAZARDS**



**FIGURE J-6**

**RELATIONSHIP OF FIXED LADDER TO A SAFE ACCESS HATCH**



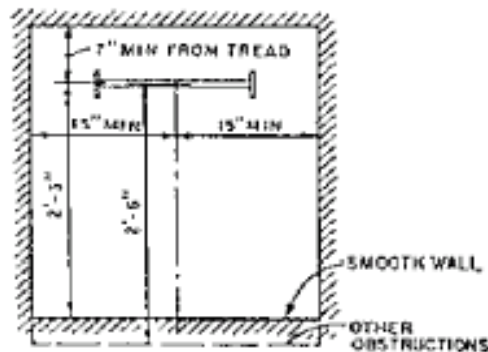
**4. FIXED LADDERS: SPECIAL REQUIREMENTS**

**a. Cages or wells.**

(i) Cages or wells (except on chimney ladders) shall be built, as shown on the applicable drawings, covered in detail in Figures J-7, J-8, and J-9, or of equivalent construction.

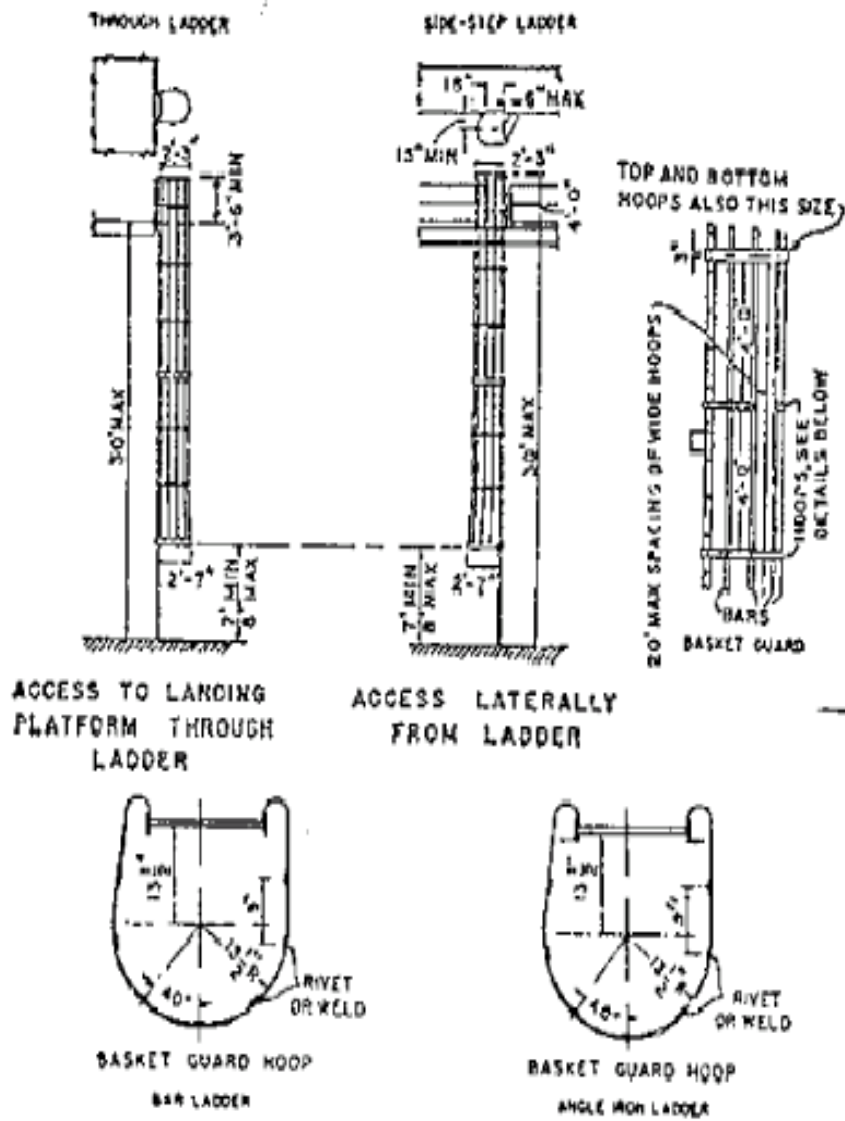
**FIGURE J-7**

**CAGES FOR LADDERS MORE THAN 20 FT (6.1 M) HIGH**



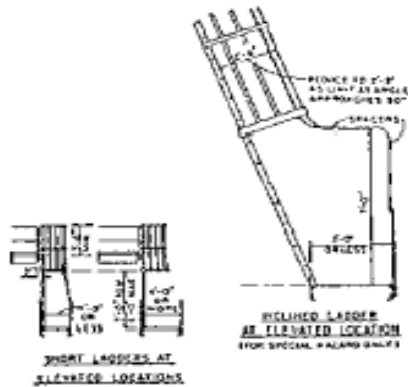
**FIGURE J-8**

**CLEARANCE DIAGRAM FOR FIXED LADDER IN WELL**

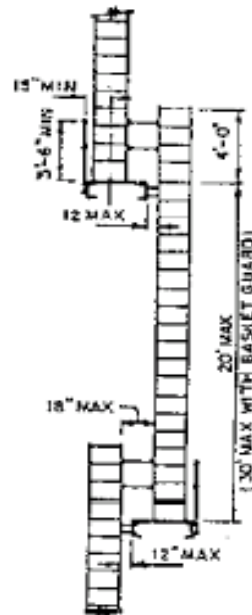




**FIGURE J-9**  
**CAGES - SPECIAL**  
**APPLICATIONS**



**FIGURE J-10**  
**OFFSET FIXED**  
**LADDER SECTIONS**



(ii) Cages or wells (except as provided in subparagraph e below conforming to the dimensions shown in Figures J-7, J-8, and J-9 shall be provided on ladders of more than 20 ft (6.1 m) to a maximum unbroken length of 30 ft (9.1 m).

(iii) Cages shall extend a minimum of 42 in (106.7 cm) above the top of landing, unless, other acceptable protection is provided.

(iv) Cages shall extend down the ladder to a point not less

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than 7 ft (2.1 m) nor more than 8 ft (2.4 m) above the base of the ladder, with bottom flared not less than 4 in (10.1 cm), or portion of cage opposite ladder shall be carried to the base.

(v) Cages shall not extend less than 27 in (68.6 cm) nor more than 28 in (71.1 cm) from the centerline of the rungs of the ladder. Cage shall not be less than 27 in (68.6 cm) in width. The inside shall be clear of projections. Vertical bars shall be located at a maximum spacing of  $40^\circ$  degrees around the circumference of the cage; this will give a maximum spacing of approximately 9-1/2 in (24.1 cm), center to center.

(vi) Ladder wells shall have a clear width of at least 15 in (38.1 cm) measured each way from the centerline of the ladder. Smooth-walled wells shall be a minimum of 27 in (68.6 cm) from the centerline of rungs to the well wall on the climbing side of the ladder. Where other obstructions on the climbing side of the ladder exist, there shall be a minimum of 30 in (76.2 cm) from the centerline of the rungs.

b. Landing platforms. When ladders are used to ascend to heights exceeding 20 ft (6.1 m) (except on chimneys), landing platforms shall be provided for each 30 ft (9.1 m) of height or fraction thereof, except that, where no cage, well, or ladder safety device is provided, landing platforms shall be provided for each 20 ft (6.1 m) of height or fraction thereof. Each ladder section shall be offset from adjacent sections. Where installation conditions (even for a short, unbroken length) require that adjacent sections be offset, landing platforms shall be provided at each offset.

(i) Where a climber has to step a distance greater than 12 in (30.5 cm) from the centerline of the rung of a ladder to the nearest edge of structure or equipment, a landing platform shall be provided. The minimum step-across distance shall be 2-1/2 in (6.4 cm).

(ii) All landing platforms shall be equipped with standard railings and toeboards, so arranged as to give safe access to the ladder. Platforms shall be not less than 24 in (61.0 cm) in width and 30 in (76.2 cm) in length.

(iii) One rung of any section of ladder shall be located at the level of the landing laterally served by the ladder. Where access to the landing is through the ladder, the same rung spacing as used on the ladder shall be used from the landing platform to the first rung below the landing.

c. Ladder extensions. The side rails of through or side-step ladder extensions shall extend 3-1/2 ft (1.1 m) above parapets and landings. For through ladder extensions, the rungs shall be omitted from the extension and shall have not less than 18 in (45.7 cm) nor more than 24 in (61.0 cm) clearance between rails. For side-step or offset fixed ladder sections, at landings, the side rails and rungs shall be carried to the next regular rung beyond or above the 3-1/2 ft (1.1 m) minimum (Figure J-10).

d. Grab bars. Horizontal grab bars shall be provided to facilitate grip in case of a fall. Grab bars shall be spaced by a continuation of the rung spacing when they are located in the horizontal position. Vertical grab bars shall have the same spacing as the ladder side rails. Grab-bar diameters shall be the equivalent of the round-rung diameters.

e. Ladder safety devices. Ladder safety devices may be used on tower, water tank, and chimney ladders over 20 ft (6.1 m) in unbroken length in lieu of cage protection. No landing platform is required in these cases. All ladder safety devices such as those that incorporate life belts, friction brakes, and sliding attachments shall meet the design requirements of the ladders that they serve.

**5. LADDERS, RAMPS, AND STAIRS: PITCH**

**a.** Preferred pitch. The preferred pitch of fixed ladders shall be considered to come in the range of 75° and 90° with the horizontal (Figure J-11).

**b.** Substandard pitch. Fixed ladders shall be considered as substandard if they are installed within the substandard pitch range of 60° and 75° with the horizontal. Substandard fixed ladders are permitted only where it is found necessary to meet conditions of installation. This substandard pitch range shall be considered as a critical range to be avoided, if possible.

**c.** Scope of coverage in this section. This section covers only fixed ladders within the pitch range of 60° and 90° with the horizontal.

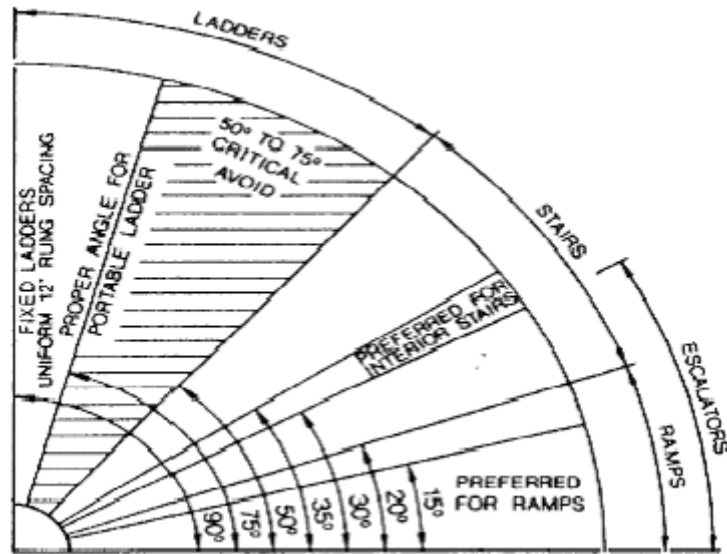
**d.** Pitch greater than 90°. Ladders having a pitch in excess of 90° with the horizontal are prohibited.

**6. LADDER MAINTENANCE.** All ladders shall be maintained in a safe condition. All ladders shall be inspected regularly, with the intervals between inspections being determined by use and exposure.

**7. JOB MADE LADDERS.** Job made ladders will be made following the design of ANSI A14.4. Examples of some requirements are displayed in Figures J-12 through J-21.

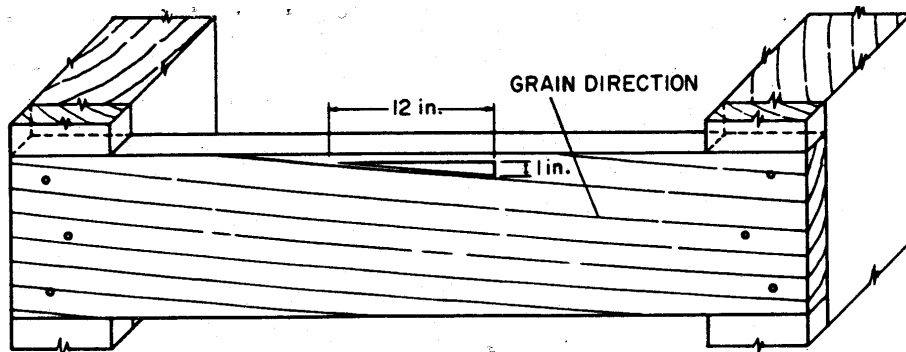
**FIGURE J-11**

**SLOPE OF LADDERS, RAMPS, AND STAIRS**



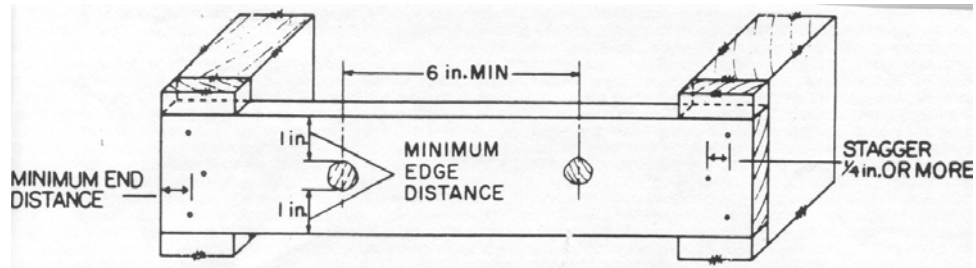
**FIGURE J-12**

**SLOPE OF WOOD GRAIN FOR JOB MADE LADDERS**



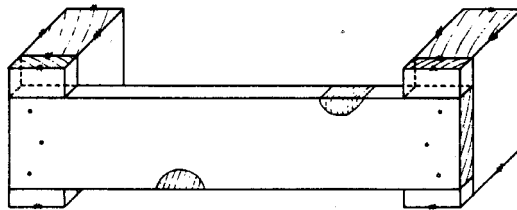
**FIGURE J-13**

**EXAMPLE OF IMPERMISSIBLE KNOT SPACING**



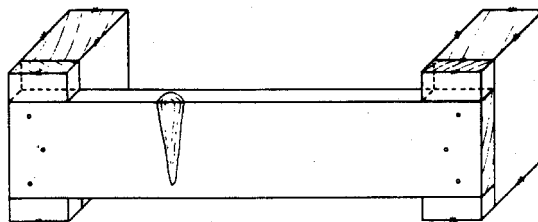
**FIGURE J-14**

**EXAMPLE OF IMPERMISSIBLE KNOTS AT EDGE**



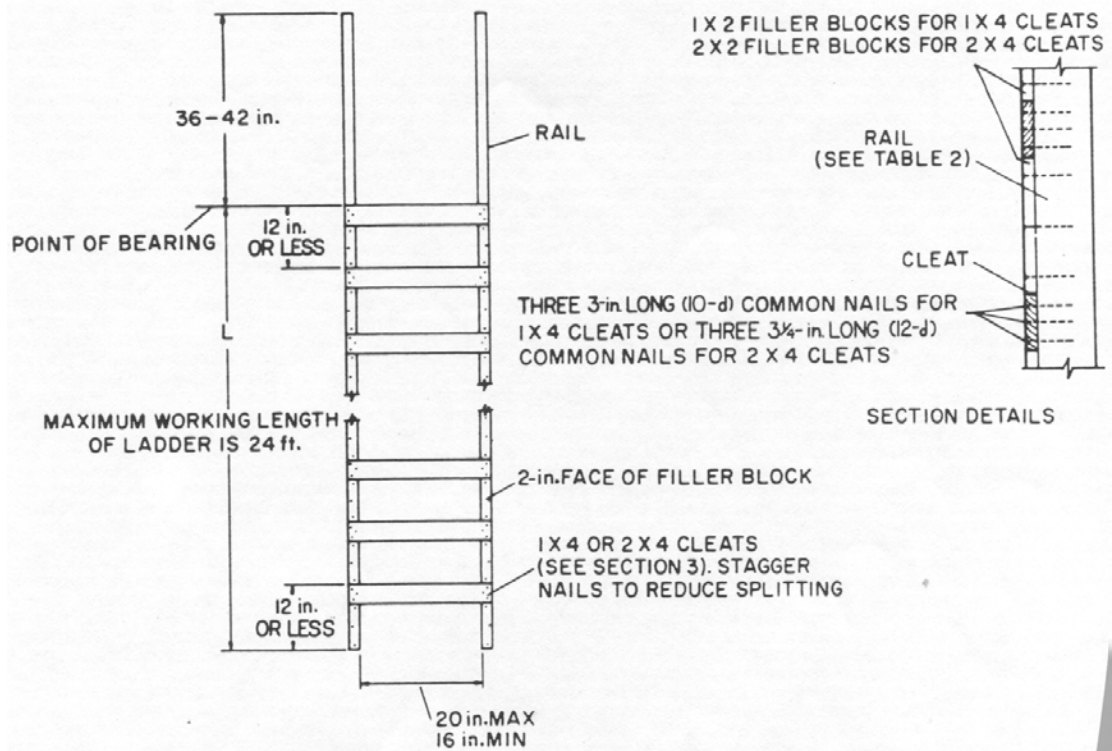
**FIGURE J-15**

**EXAMPLE OF IMPERMISSIBLE SPIKE KNOTS**



**FIGURE J-16**

**CLEAT ATTACHMENT, SINGLE-CLEAT LADDER**



**NOTES:**

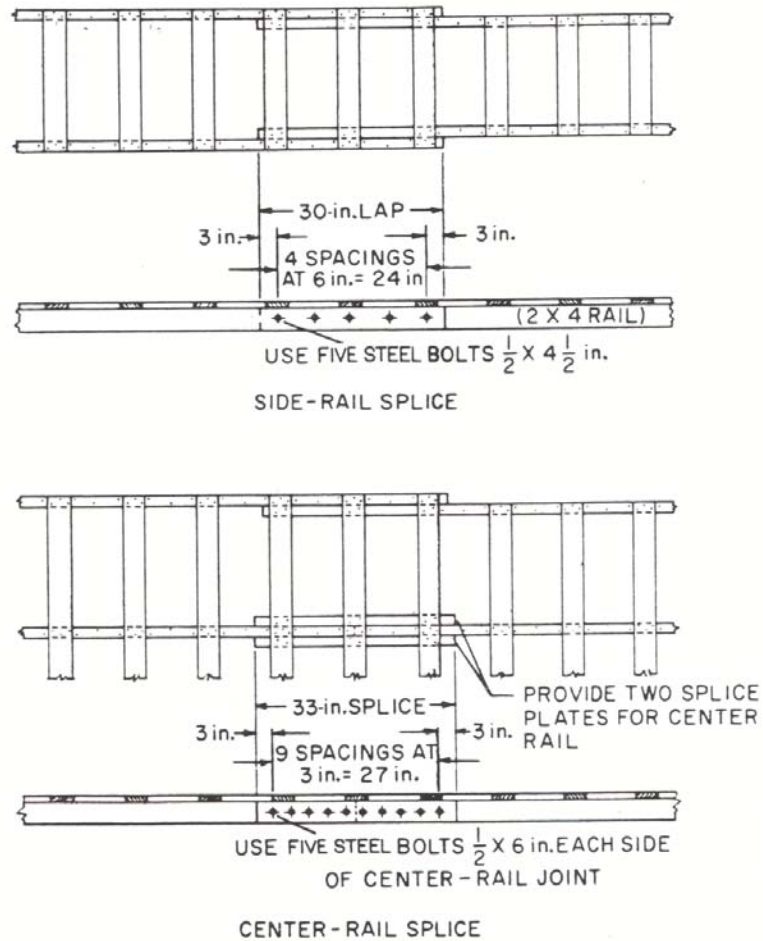
- (1) All material shall comply with Section 21D.**
- (2) All lumber sizes are nominal.**
- (3) 1-1/2 in (3.8 cm) end distance shall be provided for top and bottom nails on filler blocks.**





**FIGURE J-18**

**LADDER SPLICES - 2 X 4 RAIL**

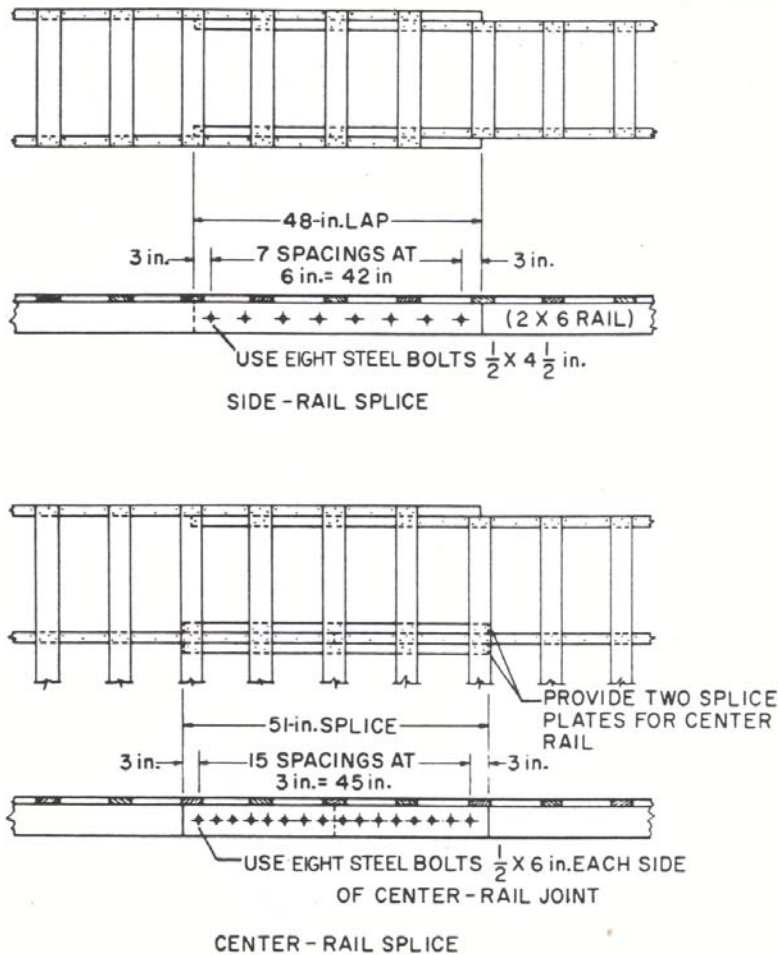


**NOTES:**

- (1) The splice shall be located as near the top point of the bearing as possible
- (2) Holes shall be drilled along the rail centerline, with bolt hole not to exceed bolt diameter by more than  $\frac{1}{32}$  in (.08 cm).
- (3) Two 1 in (2.5 cm) diameter,  $\frac{3}{32}$  in (0.24 cm) thick steel washers and a lock washer shall be provided with each bolt.
- (4) Ladders with splices shall not be used at a pitch flatter than 1 in 8.

**FIGURE J-19**

**LADDER SPLICES - 2 X 6 RAIL**

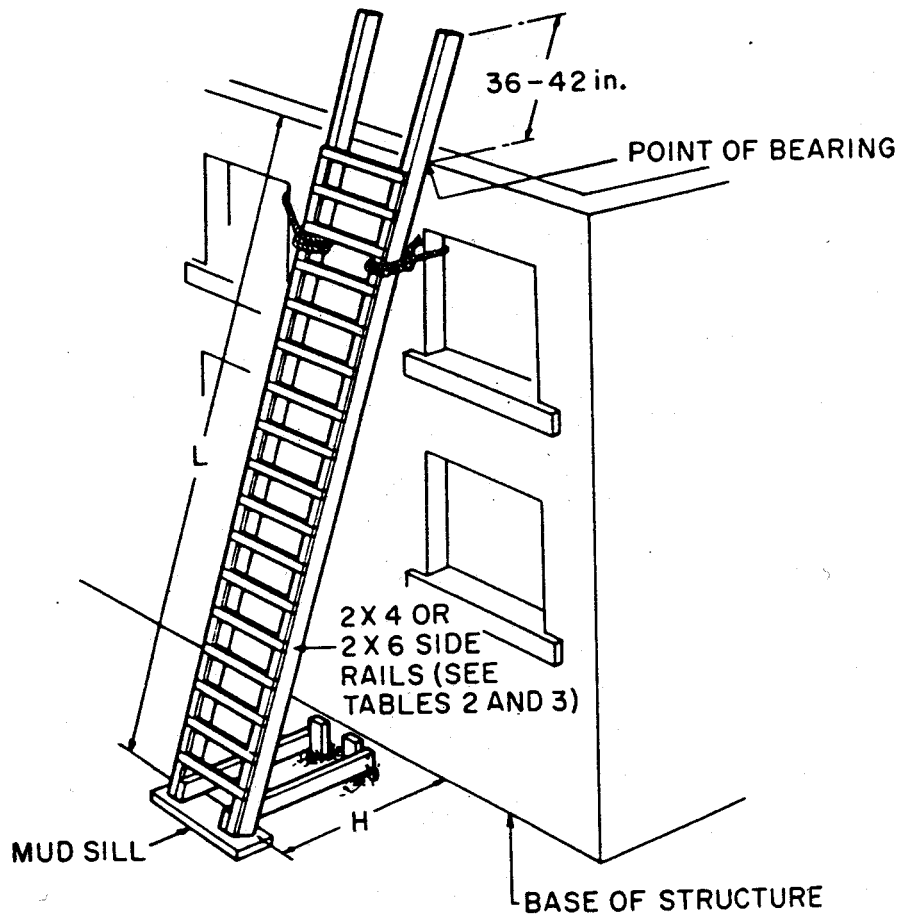


**NOTES:**

- (1) The splices shall be located as near the top point of the bearing as possible.
- (2) Holes shall be drilled along the rail centerline, with bolt hole not to exceed bolt diameter by more than  $\frac{3}{32}$  in (0.24 cm).
- (3) Two 1 in (2.5 cm) diameter,  $\frac{3}{32}$  in (0.24 cm) thick steel washers and a lock washer shall be provided with each bolt.
- (4) Ladders with splices shall not be used at a pitch flatter than 1 in 8.

**FIGURE J-20**

**LADDER PITCH**



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**FIGURE J-21**

**METHODS FOR SECURING BASE**

