

SECTION 21

SAFE ACCESS AND FALL PROTECTION

21.A GENERAL

21.A.01 Safe access shall be provided to all work areas.

- a. Where there is a horizontal or vertical break of 19 in (48.2 cm) or more in a route of access, a stairway, ladder, ramp, or personnel hoist shall be provided.
- b. Means of access constructed of metal shall not be used for electrical work or where they might contact electrical conductors.
- c. When a structure has only one means of access between levels, that means shall be kept clear to permit free passage of employees. If work is performed in an area that restricts free passage, a second means of access shall be provided.
- d. When a structure has two or more means of access between levels, at least one means of access shall always be available for free passage of employees.

21.A.02 The AHA, approved by the GDA, for the activity in which means of access are to be used shall delineate the following:

- a. The design, construction, and maintenance of the means of access, and
- b. Erection and dismantling procedures, including provisions for providing fall protection during the erection or dismantling when the erection or dismantling involves work at heights that expose the workers to falls of 6 ft (1.8 m) or more.

21.A.03 Job-made means of access shall be designed to support, without failure, at least four times the maximum intended load.

EM 385-1-1

3 Nov 03

21.A.04 Means of access shall not be loaded beyond the maximum intended load for which they were designed or beyond their manufactured rated capacity. When loaded, planking and decking shall not deflect more than 1/60 the span length.

21.A.05 The width of accessways shall be determined by the purpose for which they are built and shall be sufficient to provide safe passage for supplying materials and movement of personnel: except for ladders, in no case shall the width be less than 18 in (45.7 cm). > **See 21.D.03.**

21.A.06 Load-carrying timber members shall be a minimum of 1,500 lb-ft/in² (10,342.1 kPa) (stress grade) construction grade lumber.

a. All dimensions are nominal sizes (except where rough sizes are noted) as provided by Voluntary Product Standard DOC PS 20, published by NIST of the US Department of Commerce. Where rough sizes are noted, only rough or undressed lumber of the size specified will satisfy minimum requirements.

b. Lumber shall be reasonably straight-grained and free of shakes, checks, splits, cross grains, unsound knots or knots in groups, decay and growth characteristics, or any other condition that will decrease the strength of the material.

21.A.07 Supporting members and foundations shall be of sufficient size and strength to safely distribute loading.

a. Supporting members shall be placed on a firm, smooth foundation that will prevent lateral displacement.

b. Unstable objects such as barrels, boxes, loose bricks, or concrete blocks shall not be used as supports.

21.A.08 Vertical members (e.g., poles, legs, or uprights) shall be plumb and securely braced to prevent swaying or displacement.

21.A.09 The design and construction or selection of planking and platform for means of access shall be based upon either the number of persons for which they are rated or the uniform load distribution to which they will be subjected, whichever is the more restrictive, in accordance with Tables 21-1 and 21-2:

TABLE 21-1

SELECTION CRITERIA FOR PLANKING AND PLATFORMS

RATED LOAD CAPACITY	DESIGNED AND CONSTRUCTED TO CARRY	LOAD PLACED
1 person	<u>254 lb</u> (115 kg)	at center of span
2 persons	<u>254 lb</u> (115 kg)	<u>18 in</u> (45.7 cm) to left of center of span and
	<u>254 lb</u> (115 kg)	<u>18 in</u> (45.7 cm) to right of center of span
3 persons	<u>254 lb</u> (115 kg)	at center of span and
	<u>254 lb</u> (115 kg)	<u>18 in</u> (45.7 cm) to left of center of span and
	<u>254 lb</u> (115 kg)	<u>18 in</u> (45.7 cm) to right of center of span

TABLE 21-2

MAXIMUM INTENDED LOAD

RATED LOAD CAPACITY	MAXIMUM INTENDED LOAD
light duty	<u>25 lb/ft²</u> (120 kg/m ²) applied uniformly over entire span area
medium duty	<u>50 lb/ft²</u> (240 kg/m ²) applied uniformly over entire span area
heavy duty	<u>75 lb/ft²</u> (360 kg/m ²) applied uniformly over entire span area

EM 385-1-1

3 Nov 03

21.A.10 Planking.

a. All wood planking shall be selected for scaffold plank use as recognized by grading rules established by a recognized independent inspection agency for the species of wood used. The maximum permissible spans for 2-in x 10-in (5-cm x 25.4-cm) (nominal) or 2-in x 9-in (5-cm x 22.8-cm) (rough) solid sawn wood planks shall be as shown in Table 21-3:

TABLE 21-3

WOOD PLANK SELECTION

Maximum intended load <u>lb/ft² (Pascal (Pa))</u>	Maximum permissible span - full thickness undressed lumber <u>ft (m)</u>	Maximum permissible span - nominal thickness undressed lumber <u>ft (m)</u>
<u>25.1 (1,200)</u>	<u>9.8 (3.0)</u>	<u>7.9 (2.4)</u>
<u>50.1 (2,400)</u>	<u>7.9 (2.4)</u>	<u>(1.8)</u>
<u>75.2 (3,600)</u>	<u>5.9 (1.8)</u>	n/a

The maximum permissible span for 1 1/4 in x 9 in (3.1 cm x 22.8 cm) or wider wood plank of full thickness with a maximum intended load of 50 pounds per square foot (psf) shall be 4 ft (1.2 m).

b. Fabricated planks and platforms may be used in lieu of solid sawn wood planks. Maximum spans for such units shall be as recommended by the manufacturer based on the maximum intended load being calculated as specified in Table 21-1.

c. Planking shall be secured to prevent loosening, tipping, or displacement and supported or braced to prevent excessive spring or deflection. Intermediate beams shall be provided to prevent dislodgement of planks due to deflection. > **See 21.A.04.**

d. Planking shall be laid with edges close together across the entire access surface. There will be no spaces through which personnel, equipment, or material could fall.

e. When planking is lapped, each plank shall lap its supports at least 12 in (30.4 cm).

f. Where the ends of planks abut each other to form a flush floor, the butt joint shall be at the centerline of a pole and abutted ends shall rest on separate bearers.

21.A.11 Accessways shall have overhead protection equal to 2-in (5-cm) solid planking whenever work is performed over them or if personnel are exposed to hazards from falling objects.

21.A.12 Nails shall be driven full length. Double-headed nails shall not be used on decks, guardrails, or handrails.

21.A.13 Accessways shall be inspected daily and maintained in a safe manner.

a. Accessways shall be kept free of ice, snow, grease, mud, debris or any other material or equipment that could obstruct passage, cause a tripping hazard, or render them unsafe in any other way.

b. Where accessways are slippery, abrasive material shall be used to assure safe footing.

c. All obstructions or projections into an accessway shall be removed or conspicuously marked. Obstructions or projections that are sharp or pointed, or that may cause lacerations, contusions, or abrasions shall be covered with protective material.

d. Accessways, including their accessories, that become damaged or weakened shall not be used until they are repaired or replaced.

EM 385-1-1

3 Nov 03

21.A.14 When moving platforms to the next level, the old platform shall be left undisturbed until the new bearers have been set to receive the platform planks.

21.A.15 Fall protection.

a. Employees exposed to fall hazards shall be protected by standard guardrail, catch platforms, temporary floors, safety nets, personal fall protection devices, or the equivalent, in the following situations:

(1) On accessways (excluding ladders), work platforms, or walking/working surfaces from which they may fall 6 ft (1.8 m) or more;

(2) On accessways or work platforms over water, machinery, or dangerous operations;

(3) On runways from which they may fall 4 ft (1.2 m) or more; and

(4) On installing or removing sheet pile, h-piles, cofferdams, or other interlocking materials from which they may fall 6 ft (1.8 m) or more.

b. Every stairway and ladder way floor opening shall be guarded on all exposed sides, except the entrance opening, by securely anchored standard guardrail. Entrance openings shall be offset or provided with a gate to prevent anyone walking into the opening. > **See Section 24.**

c. Platforms, except scaffolds, 4 ft to 6 ft (1.2 m to 1.8 m) in height, having a minimum horizontal dimension in either direction of less than 45 in (114.3 cm) shall have standard railing installed on all open sides and ends of the platform or the workers shall use personal fall protection.

21.A.16 Training.

a. Each employee who might be exposed to fall hazards shall be trained by a competent person qualified in the following areas, in the safe use of accessways and fall protection systems and the recognition of hazards related to their use, including:

- (1) The nature of access and fall hazards in the work area;
- (2) The correct procedures for constructing, erecting, maintaining, using, and dismantling accessways and fall protection systems;
- (3) The maximum intended load-carrying capacities of accessways and fall protection systems; and
- (4) All applicable requirements from this Section;
- (5) The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs, the correct procedures for handling and storage of equipment and materials, and the erection of overhead protection; and
- (6) Rescue equipment and procedures.

b. Retraining shall be provided as necessary for employees to maintain an understanding of these subjects.

c. The employer shall verify employee training by a written certification record that identifies the employee trained, the dates of the training, and the signature of the trainer.

21.B STANDARD GUARDRAILS AND HANDRAILS

21.B.01 A standard guardrail shall consist of toprails, midrails, and posts, and shall have a vertical height of 42 in +/- 3 in (106.6 cm +/- 7.6 cm) from the upper surface of the toprail to the

EM 385-1-1

3 Nov 03

floor, platform, runway, or ramp level. Standard guardrail systems shall be provided with toe boards on all open sides/ends at locations where persons are required or permitted to pass or work under the elevated platform or where needed to prevent persons and material from falling from the elevated platform.

21.B.02 Guardrail systems shall be designed to meet the following requirements.

- a. Capable of withstanding, without failure, a force of at least 200 lb (60.9 kg) applied within 2 in (5 cm) of the top edge, in any outward or downward direction, at any point along the top edge.
- b. When the force described in a, above, is applied in a downward direction, the top edge of the guardrail shall not deflect more than 3 in (7.6 cm) nor to a height less than 39 in (99 cm) above the walking/working level.
- c. Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 150 lb (68 kg) applied in any downward or outward direction at any point along the midrail or other member.
- d. Toe boards shall withstand without failure a force of 50 lbs (23 kg) applied in any outward or downward direction at any point along the toe board.

21.B.03 Dimensions of standard guardrail components. The following guidelines may be used in designing guardrail systems to satisfy the requirements specified in 21.B.02. The employer is still responsible for designing a complete system and assembling these components in accordance with 21.B.02.

- a. For wood railings:
 - (1) Toprails shall be of at least 2-in x 4-in (5-cm x 10.1-cm) lumber,

(2) Midrails shall be at least 1-in x 6-in (2.5-cm x 15.2-cm) lumber, and

(3) Posts shall be at least 2-in x 4-in (5-cm x 10.1-cm) lumber spaced not to exceed 8 ft (2.4 m) on centers.

b. For pipe railings:

(1) Toprails and midrails shall be at least 1.5 in (3.8 cm) nominal diameter (schedule 40 pipe), and

(2) Posts shall be at least 1.5 in (3.8 cm) nominal diameter (schedule 80 steel pipe) spaced not more than 8 ft (2.4 m) on centers.

c. For structural steel railings:

(1) Toprails and midrails shall be at least 2-in x 2-in x 3/8-in (5-cm x 5-cm x 0.9-cm) angles, and

(2) Posts shall be at least 2-in x 2-in x 3/8-in (5-cm x 5-cm x 0.9-cm) angles spaced not more than 8 ft (2.4 m) on centers.

21.B.04 Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations and to prevent snagging of clothing.

21.B.05 Toprails and midrails.

a. Midrails shall be halfway between the toprails and the floor, platform, runway, or ramp.

b. The ends of the toprails and midrails shall not overhang the terminal posts except where such overhang does not create a projection hazard.

c. Synthetic or natural fiber ropes shall not be used as toprails or midrails. Wire rope may be used as toprails or midrails if

EM 385-1-1

3 Nov 03

tension is maintained to provide not more than 3-in (7.6-cm) deflection, in any direction from the center line, under a 200-lb (90.7-kg) load, if support posts are located not more than 8 ft (2.4 m) apart, and if the wire rope is flagged at not more than 6 ft (1.8 m) intervals with high-visibility material.

21.B.06 Toe boards.

- a. Toe boards shall be 1-in x 4-in (2.5-cm x 10.1-cm) (minimum 4-in (10.1-cm) (nominal) vertically) lumber or the equivalent.
- b. Toe boards shall be securely fastened in place and have not more than 1/4 in (0.6 cm) clearance above floor level.
- c. Toe boards shall be made of any substantial material, either solid or with openings not greater than 1 in (2.5 cm) in greatest dimension.
- d. Where material is piled to such a height that a standard toe board does not provide protection, paneling or screening from floor to top rail or midrail shall be provided.

21.B.07 Guardrails receiving heavy stresses from employees trucking or handling materials shall be provided additional strength by using heavier stock, closer spacing of posts, bracing, or by other means.

21.B.08 Handrails.

- a. A standard handrail shall be of construction similar to a standard guardrail except that it is mounted on a wall or partition and does not include a midrail.
- b. Handrails shall have smooth surfaces along the top and both sides.
- c. Handrails shall have an adequate handhold for anyone grasping it to avoid falling.

- d. Ends of handrails shall be constructed so as not to constitute a projection hazard.
- e. The height of handrails shall be not more than 34 in (86.3 cm) nor less than 30 in (76.2 cm) from upper surface of handrail to surface of tread, in line with face of riser or to surface of ramp.
- f. The height of stair rails shall be not more than 34 in (86.3 cm) nor less than 30 in (76.2 cm) from the upper surface of the top rail to surface of tread in line with face of riser at forward edge of tread.

21.B.09 All handrails and railings shall be provided with a clearance of approximately 3 in (7.6 cm) between the handrail or railing and any other object.

21.C PERSONAL FALL PROTECTION SYSTEMS AND SAFETY NETS

21.C.01 Personal fall protection devices (personal fall arrest systems and positioning devices), independently attached or attended, or safety nets shall be used when performing such work as the following when the requirements of 22.A.04a cannot be met.

- a. Work in hoppers, bins, silos, tanks, or other confined spaces;
- b. Work on hazardous slopes, structural steel, or poles;
- c. Erection or dismantling of safety nets;
- d. Tying reinforcing bars;
- e. Work from boatswain's chairs, swinging scaffolds, or other unguarded locations at elevations greater than 6 ft (1.8 m);

EM 385-1-1

3 Nov 03

f. Work on skips and platforms used in shafts by crews when the skip or cage does not block the opening to within 1 ft (0.3 m) of the sides of the shaft, unless cages are provided.

g. Leading edge work and roofs.

21.C.02 Selection of personal fall protective equipment shall be based on the type of work; the work environment; the weight, size, and shape of the user; the type and position of anchorage; and the length of the lanyard. > **See Section 05.F.**

21.C.03 Personal fall arrest systems, when stopping a fall, shall:

a. Limit maximum arresting force on an employee to 1,800 lb (816.4 kg) when used with a full-body harness;

b. Be rigged such that an employee can neither free fall more than 6 ft (1.8 m) nor contact any lower level or other physical hazard;

c. Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 ft (1 m); and

d. Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 ft (1.8 m) or the free fall distance permitted by the system, whichever is less.

21.C.04 Positioning device systems shall:

a. Be rigged such that an employee cannot free fall more than 2 ft (0.6 m); and

b. Be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 lb (1,360.7 kg), whichever is greater.

c. When using body belt, the maximum arresting force on an employee shall not exceed 900 lb (409 kg).

21.C.05 When necessary, body belts and harnesses shall have two lanyards to ensure that a person is tied-off with at least one lanyard at all times, or where the lanyard is the primary support for operations such as rock-scaling and high-wall concrete finishing.

21.C.06 The manufacturer's recommendations shall be followed in the fitting, adjustment, use, inspection, testing, replacement, and care of personal fall protection equipment. Before an employee uses personal fall protection equipment, he/she shall receive instruction in these recommendations and the potential fall hazards of the activity.

21.C.07 Personal fall protection equipment shall be inspected by the worker prior to each use to determine that is in a safe working condition. A competent person shall inspect the equipment at least once semi-annually and whenever subjected to severe use: defective equipment shall be immediately replaced.

21.C.08 Personal fall protection equipment shall be used only for employee safeguarding. Any such equipment subjected to impact loading shall be immediately removed from service, and shall not be used again for employee safeguarding.

21.C.09 Lifelines.

a. When vertical lifelines are used, each employee shall be attached to a separate lifeline.

b. On suspended scaffolds or similar work platforms with horizontal lifelines that may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

c. Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person as part of a complete fall arrest system that maintains a safety factor of at least two.

EM 385-1-1

3 Nov 03

Rope grab shall not be used or connected to the horizontal life line.

d. Lifelines used on rock-scaling operations or in areas where the line may be subject to cutting or abrasion shall be specifically designed and constructed for such applications.

21.C.10 Anchorage and attachment.

a. Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage used to support or suspend platforms and shall be capable of supporting at least 5,000 lb (2,267.9 kg) per employee attached.

b. The attachment point for body belts in a positioning device system shall be located on the sides or on the front; the attachment point for body harnesses shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.

c. Personal fall arrest systems shall not be attached to guardrail systems nor shall they be attached to hoists.

d. When a personal fall arrest system is used at hoist areas, it shall be rigged to allow the movement of the employee only as far as the edge of the walking/working surface.

21.C.11 Installation of safety nets.

a. Safety nets shall be installed as close under the work surfaces as practical but in no case more than 25 ft (7.6 m) below such work surface. Nets shall be hung with sufficient clearance to prevent contact with the surfaces or structures below. Such clearance shall be determined by impact load testing. When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

b. Nets shall extend outward from the outermost projection of the work surface as shown in Table 21-4:

TABLE 21-4
SAFETY NET DISTANCES

VERTICAL DISTANCE FROM WORKING LEVEL TO HORIZONTAL PLANE OF NET	MINIMUM REQUIRED HORIZONTAL DISTANCE OF OUTER EDGE OF NET FROM EDGE OF WORKING SURFACE
<u>Up to 4.9 ft</u> (up to 1.5 m)	<u>7.9 ft</u> (2.4 m)
<u>4.9 ft up to 9.8 ft</u> (1.5 m up to 3.0 m)	<u>9.8 ft</u> (3.0 m)
<u>more than 9.8 ft</u> (more than 3.0 m)	<u>13.1 ft</u> (4 m)

c. Operations requiring safety net protection shall not be undertaken until the net(s) is in place and has been tested without failure.

(1) Safety nets and safety net installations shall be tested in the suspended position immediately after installation and before being used as a fall protection system, whenever relocated, after major repair, and when left at one location, at not more than 6 month intervals.

(2) The test shall consist of dropping into the net a 400 lb (180 kg) bag of sand, not more than 30 in +/- 2 in (76.2 cm +/- 5 cm) in diameter, at least 42 in (106.6 cm) above the highest working/walking surface at which employees are exposed to fall hazards.

EM 385-1-1

3 Nov 03

21.C.12 Debris nets.

- a. When used with personnel safety nets, debris nets shall be secured on top of the personnel safety net but shall not compromise the design, construction, or performance of the personnel nets.
- b. A competent person shall determine, and document, the size, weight, and height-of-fall of anticipated debris. The debris netting shall have a mesh of the size and strength sufficient to contain the expected debris without penetration when properly supported.

21.C.13 Debris shall be removed from safety and debris nets. Nets and debris shall be protected from sparks and hot slag resulting from welding and cutting operations.

21.C.14 Inspection of safety and debris nets.

- a. Safety and debris nets shall be inspected by a competent person in accordance with the manufacturer's recommendations.
- b. Inspections shall be conducted after installation, at least weekly thereafter, and following any alteration, repair, or any occurrence that could affect the integrity of the net system. Inspections shall be documented.
- c. Defective nets shall not be used; defective components shall be removed from service

21.C.15 If any welding or cutting operations occur above the nets, weld protection shall be provided. The frequency of inspections shall be increased in proportion to the potential for damage to the nets.

21.C.16 Materials, scrap pieces, equipment, and tools that have fallen into the safety net shall be removed as soon as possible from the net and at least before the next work shift.

21.D LADDERS

21.D.01 The construction, installation, and use of ladders shall conform to ANSI A14.1, ANSI A14.2, ANSI A14.3, and ANSI A14.4, as applicable.

21.D.02 Length.

- a. All portable ladders shall be of sufficient length and shall be placed so that workers will not stretch or assume a hazardous position.
- b. Portable ladders used as temporary access shall extend at least 3 ft (0.9 m) above the upper landing surface.
 - (1) When a 3-ft (0.9-m) extension is not possible, a grasping device (such as a grab rail) shall be provided to assist employees in mounting and dismounting the ladder.
 - (2) In no case shall the length of the ladder be such that ladder deflection under a load would, by itself, cause the ladder to slip from its support.
- c. The length of portable stepladders shall not exceed 20 ft (6 m).
- d. When splicing is required to obtain a given length of side rail, the resulting side rail must be at least equivalent in strength to a one-piece side rail made of the same material.
- e. Fixed ladders shall extend 42 in (106.6 cm) above the top of the access level or landing platform served by the ladder.

21.D.03 Width.

- a. The minimum clear distance between the sides of individual-rung/step ladders shall be 16 in (40.6 cm).

EM 385-1-1

3 Nov 03

- b. The minimum clear distance between side rails for all portable ladders shall be 12 in (30.4 cm).

21.D.04 Spacing of rungs, cleats, and steps.

- a. On portable ladders, shall be uniformly spaced at 12 in (30.4 cm) on center.

- b. On step stools, spacing shall be not less than 8 in (20.3 cm), nor more than 12 in (30.4 cm), apart as measured from their centerlines.

- c. On extension trestle ladders, spacing on the base section shall be not less than 8 in (20.3 cm), nor more than 18 in (45.7 cm), apart as measured from their centerlines. On the extension section spacing shall not be less than 6 in (15.2 cm), nor more than 12 in (30.4 cm), apart as measured from their centerlines.

21.D.05 Ladders shall be surfaced so as to prevent injury to an employee from punctures or lacerations and to prevent snagging of clothing.

21.D.06 Wood ladders shall not be coated with any opaque covering, except for identification or warning labels that may be placed on only one face of a side rail.

21.D.07 A metal spreader bar or locking device shall be provided on each stepladder to hold the front and back sections in an open position.

21.D.08 Set-up.

- a. Ladders shall not be placed in passageways, doorways, drives, or any locations where they may be displaced by any other work unless protected by barricades or guards.

- b. Portable ladders shall be used at such a pitch that the horizontal distance from the top support to the foot of the ladder will not be greater than one-fourth the vertical distance between these points.
- c. Wood job-made ladders with spliced rails shall be used at an angle such that the horizontal distance is one-eighth the length of the ladder.
- d. Ladders shall be secured by top, bottom, and intermediate fastenings as required to hold them rigidly in place and to support the loads that will be imposed upon them.
- e. The steps or rungs of all ladders shall be set to provide at least 7-in (17.7-cm) toe space from the inside edge of the rung to the nearest interference.
- f. The top of a non-self supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.

21.D.09 Use.

- a. No work requiring lifting of heavy materials or substantial exertion shall be done from ladders.
- b. When ladders are the only means of access to or from a working area for 25 or more employees, or when a ladder is to serve simultaneous two-way traffic, double-cleated ladders shall be used.
- c. Portable ladders shall have slip-resistant feet.
- d. Ladders shall not be moved, shifted, or extended while occupied.

EM 385-1-1

3 Nov 03

e. The top or top step of a stepladder shall not be used as a step unless it has been designed to be so used by the manufacturer.

f. Ladders shall be inspected for visible defects on a daily basis and after any occurrence that could affect their safe use.

g. Broken or damaged ladders shall be immediately tagged "**DO NOT USE**," or similar wording, and withdrawn from service until restored to a condition meeting their original design.

h. Ladders shall be restricted to their intended use.

i. Ladders shall not be climbed by more than one person at a time unless it is designed to be climbed by more than one person.

j. Keep loose tools off the steps and top platform.

k. Ensure latches are in place before climbing an extension ladder.

21.D.10 Fixed ladders shall comply with the requirements in Appendix J.

21.D.11 Single-rail ladders shall not be used. Three-legged ladders may be used for specific tasks if approved by the GDA.

21.E STAIRWAYS

21.E.01 On all structures 20 ft (6 m) or more in height, stairways shall be provided during construction.

a. Where permanent stairways are not installed concurrently with the construction of each floor, a temporary stairway shall be provided to the work level.

- b. Alternatives to the use of stairways shall be addressed in the AHA and shall be accepted by the GDA.

21.E.02 Design.

- a. Temporary stairways shall have landings not less than 30 in (76.2 cm) in the direction of travel and extend at least 22 in (55.8 cm) in width at every 12 ft (3.6 m) or less of vertical rise.
- b. Stairs shall be installed between 30° and 50° from horizontal.
- c. Risers shall be of uniform height and treads of uniform width.

21.E.03 Metal pan landings and metal pan treads, when used, shall be secured in place and filled with concrete, wood, or other material at least to the top of each pan.

21.E.04 Wooden treads shall be nailed in place.

21.E.05 Every flight of stairs with four or more risers or rising more than 30 in (76.2 cm) shall have standard stair railings (defined below) or standard handrails. > **See 21.B for standard handrail requirements.**

- a. On stairways less than 44 in (111.7 cm) wide having both sides enclosed, at least one standard handrail shall be installed, preferably on the right side descending.
- b. On stairways less than 44 in (111.7 cm) wide having one side open, at least one standard stair railing shall be installed on the open side.
- c. On stairways less than 44 in (111.7 cm) wide having both sides open, one standard stair railing shall be installed on each side.

EM 385-1-1

3 Nov 03

d. On stairways more than 44 in (111.7 cm) wide, but less than 88 in (223.5 cm) wide, one standard handrail shall be installed on each enclosed side, and one standard stair railing installed on each open side.

e. On stairways 88 in (223.5 cm) or more wide, one standard handrail shall be installed on each enclosed side, one standard stair railing on each exposed side, and a standard handrail in the middle of the stairway.

21.E.06 Standard stair railing shall be installed around all stairwells.

21.E.07 Standard stair railing.

a. A stair railing shall have a vertical height not less than 36 in (91.4 cm) from the upper surface of the stair rail system to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

b. Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be provided between the toprail and the stairway steps.

(1) Midrails shall be located at a height midway between the top edge of the stairway system and the stairway steps.

(2) Screens or mesh, when used, shall extend from the toprail to the stairway steps and along the entire opening between rail supports.

(3) Intermediate vertical members, when used, shall be not more than 19 in (48.2 cm) apart.

(4) Other structural members, when used, shall be installed in such a manner that there are no openings in the stair rail system that are more than 19 in (48.2 cm) wide.

21.E.08 Doors or gates opening onto a stairway shall have a platform; swinging of the door shall not reduce the width of the platform to less than 20 in (50.8 cm).

21.E.09 Spiral stairways shall not be permitted except for special limited usage and secondary access where it is not practical to provide a conventional stairway.

21.F RAMPS, RUNWAYS, AND TRESTLES

21.F.01 Inclined ramps, runways, and platforms shall be as flat as conditions will permit. Where the incline exceeds 1-on-5 (1 ft (0.3 m) in a 5-ft (1.5-m) run), traverse cleats shall be applied to the working surface.

21.F.02 Vehicle ramps, trestles, and bridges on which foot traffic is permitted shall be provided with a walkway and guardrail outside the roadway. The roadway structures shall be provided with wheel guards, fender logs, or curbs not less than 8 in (20.3 cm) high placed parallel and secured to the sides of the runway.

21.F.03 All locomotive and gantry crane trestles that extend into or pass over a work area, except where a crane is hoisting between rails, shall be decked solid with not less than 2-in (5-cm) planking, or the equivalent, for the full length of the extension into the working area.

21.F.04 When used in lieu of steps, ramps shall be provided with cleats to ensure safe access.

21.G PERSONNEL HOISTS AND ELEVATORS

21.G.01 Standards for design, construction, installation or erection, operation, inspection, testing, and maintenance.

- a. Design, construction, installation or erection, operation, inspection, testing, and maintenance of personnel hoists and elevators shall be in accordance with the manufacturer's recommendations and the applicable ANSI standard.

EM 385-1-1

3 Nov 03

(1) Track-guided personnel hoist systems and structures that are temporarily installed inside or outside buildings during construction, alteration, or demolition shall be in compliance with ANSI A10.4;

(2) Rope-guided personnel hoist systems that are temporarily erected during construction, alteration, or demolition shall be in compliance with ANSI A10.22;

(3) Non-guided personnel hoist systems that are temporarily erected during construction, alteration, or demolition shall be in compliance with ANSI A10.8 and ANSI A10.22. (An air-tugger hoist, or the equivalent meeting the criteria of 4.2, ANSI A10.22, may be substituted for a base mounted hoist.)

(4) Elevators operating in permanent hoistways on the permanent guide rails for handling personnel during construction shall be in compliance with ANSI/ASME A17.1

b. A copy of the manufacturer's manual covering construction, installation or erection, operation, inspection, testing, and maintenance and a copy of the applicable ANSI standard shall be available on site.

c. Personnel hoists and elevators shall comply with applicable requirements from Section 16 of this manual.

21.G.02 Personnel hoists used in bridge tower construction shall be approved by a registered engineer and erected under the supervision of a registered engineer competent in this field.