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**FALL PROTECTION DESIGN AND CONSTRUCTION GUIDELINES****Table of Contents**

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## 1.0 Introduction

### 1.1 Purpose

The purpose of this guideline is to provide safe design requirements to architects, engineers, design consultants, and contractors for construction and renovation projects at Emory University. The document contains condensed descriptions of specific design criteria from the Occupational Safety and Health Administration's (OSHA) standards on guarding floor openings, wall openings, holes, fixed ladders, and fixed industrial stairs. If there are any conflicts between these design standards and applicable building codes, the code requirements govern.

### 1.2 Scope

This guideline applies to all construction projects on Emory University properties, including renovation projects.

### 1.3 Definitions

**Anchorage.** A secure point of attachment for lifelines, lanyards or deceleration devices.

**Floor hole.** An opening measuring less than 12 inches but more than 1 inch in its least dimension, in any floor, platform, pavement, or yard, through which materials but not persons may fall; such as a belt hole, pipe opening or slot opening.

**Floor opening.** An opening measuring 12 inches or more in its least dimension, in any floor, platform, pavement or yard through which persons may fall, such as a hatchway, stair or ladder opening, pit or large manhole. Floor openings occupied by elevators, dumb waiters, conveyors, machinery, or containers are excluded from this standard.

**Handrail.** A single bar or pipe supported on brackets from a wall or partition, as on a stairway or ramp, to furnish persons with a handhold in case of tripping.

**Leading edge.** The edge of a floor, roof, or formwork for a floor or other walking/working surface (such as the deck) which changes location as additional floor, roof, decking, or formwork sections are placed, formed, or constructed. A leading edge is considered to be an "unprotected side and edge" during periods when it is not actively and continuously under construction.

**Personal fall arrest system.** A system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

**Platform.** A working space for persons, elevated above the surrounding floor or ground, such as a balcony or platform for the operation of machinery and equipment.

**Runway.** A passageway for persons, elevated above the surrounding floor or ground level, such as a footwalk along shafting or a walkway between buildings.

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**Stair Railing.** A vertical barrier erected along exposed sides of a stairway to prevent falls of persons.

**Standard Railing or Guardrail.** A vertical barrier erected along exposed edges of a floor opening, wall opening, ramp, platform, or runway to prevent falls of persons to a lower level.

**Standard Strength and Construction.** Any construction of railings, covers, or other guards that meets the requirements of the Occupational Safety and Health (OSHA) standards for Walking and Working Surfaces (29 CFR 1910.23).

**Toeboard.** A vertical barrier at floor level erected along exposed edges of a floor opening, wall opening, platform, runway or ramp to prevent falls of materials.

**Wall hole.** An opening less than 30 inches but more than 1 inch high, of unrestricted width, in any wall or partition, such as a ventilation hole or drainage scupper.

**Wall opening.** An opening at least 30 inches high and 18 inches wide, in any wall or partition, through which persons may fall, such as a yard-arm doorway or chute opening.

## 2.0 Guarding of Floor Openings, Wall Openings and Holes

Elevated work areas with a drop of more than four feet to a lower level, including rooftops, must be in accordance with the OSHA standard on guarding floor and wall openings and holes (29 CFR 1910.23).

### 2.1 Stairway Floor Openings

- Ensure every stairway floor opening is guarded by a standard railing constructed according to the Railing, Toeboards, and Cover Specifications listed in this document.
- Provide railings on all exposed sides of a stairway (except at the entrance).
- For infrequently used stairways where traffic across the opening prevents the use of fixed standard railing (as when located in aisle spaces, etc.), ensure that the guarding is made of a hinged floor opening cover of standard strength and construction and removable standard railings on all exposed sides (except at entrance to stairway).

### 2.2 Doors on Gates and Stairways

Provide a platform of sufficient size, where doors or gates open directly on a stairway, such that the swing of the door does not reduce the effective width to less than 20 inches. Every floor opening or platform shall be guarded by a standard railing;

### 2.3 Ladderway Floor Openings

Ensure that every ladderway floor opening or platform is guarded by a standard railing with standard toeboard on all exposed sides (except at the entrance to the opening), with the passage through the railing either provided with a swinging gate or so offset that a person cannot walk directly into the opening.

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## 2.4 Hatchway Floor Openings

Guard every hatchway and chute floor opening by one of the following methods:

- A hinged floor opening cover of standard strength and construction equipped with standard railings or otherwise permanently attached so as to leave only one exposed side. (Consider installing removable standard railings, if it is foreseeable that the cover may not be kept closed, when the hatchway is not in use.)
- A removable railing with toeboard on not more than two sides of the opening and fixed standard railings with toeboards on all other exposed sides.
- Where operating conditions necessitate the feeding of material into any hatchway or chute opening, provide protection to prevent a person from falling through the opening.

## 2.5 Skylight Floor Openings

- Guard every skylight floor opening and hole with a standard skylight screen or install fixed standard railing on all exposed sides. **NOTE: If a plastic skylight is installed which provides the necessary structural integrity required in the specifications for Skylights, further safeguarding is not required, as this skylight would meet the intended function of the screen as well.**
- Ensure skylight screens are capable of withstanding a load of at least 200 pounds applied perpendicularly at any one area on the screen. Under ordinary loads or impacts, these screens will not deflect downward sufficiently enough to break the glass underneath.
- Openings in grillwork can be no more than 4 inches long.
- Openings in slatwork can be no more than 2 inches wide (with length unrestricted).

## 2.6 Floor Holes

Guard every floor hole into which persons can accidentally walk with one of the following:

- A standard railing with a standard toeboard on all exposed sides, or
- A floor hole cover of standard strength and construction.
- Guard every floor hole into which persons cannot accidentally walk (on account of fixed machinery, equipment, or walls) by a cover that is securely held in place and allows no openings more than 1 inch wide.

## 2.7 Wall Openings and Holes

- Guard every wall or chute opening from which there is a drop of more than 4 feet with one of the following:
- A rail, half door, or equivalent barrier with grab handles of standard strength and installation provided on each side of the opening (with the center approximately 4 feet above floor level); or
- An extension platform onto which materials can be hoisted for handling, and which has side rails or equivalent guards designed according to standard specifications.

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- Where there is a hazard of materials falling through a wall hole, protect the hole by installing a standard toeboard, or an enclosing screen either of solid construction, or as otherwise defined in the specification for Wall Opening Screens.

**2.8 Window Wall Opening**

- Provide effective guarding by means of standard slats, standard grillwork (as defined in the specification for Wall Opening Screens), or standard railing for every window wall opening at a stairway landing, floor, platform, or balcony, from which there is a drop of more than 4 feet, and where the bottom of the opening is less than 3 feet above the platform or landing.
- Where the window opening is below the landing, or platform, install a standard toe board.

**2.9 Open-sided floors, platforms, and runways**

- Protect every open-sided floor, platform, or runway 4 feet or more above adjacent floor or ground level by installing standard railing (or the equivalent) on all open sides except where there is an entrance to a ramp, stairway, or fixed ladder.
- Provide a standard toeboard with the railing, where beneath the open sides:
- Persons can pass,
- There is moving machinery, or
- There is equipment with which falling materials could create a hazard.
- Runways used exclusively for special purposes (such as oiling, or shafting) may have the railing on one side omitted, where operating conditions necessitate such omission, provided the runway is 18 inches wide.
- Regardless of height, any open-sided floors, walkways, platforms, or runways that are located above or adjacent to dangerous equipment (degreasing units or similar hazards) must be guarded with a standard railing and toe board.

**2.10 Open-sided Rooftops**

- Ensure that every open-sided floor (leading-edge) of a rooftop is effectively guarded to prevent roof fall hazards where employees are expected to perform work.
- Provide at least one stair access location to the roof where workers have the ability to carry objects while climbing and where the entrance to the roof is in an enclosed location such that fall protection would not be required, when feasible.
- Where feasible, install mechanical equipment that requires periodic or frequent maintenance a minimum of 10 feet from the edge of the roof and conventional fall protection barriers to allow sufficient access for personnel to perform work.
- In order of preference, protect personnel from fall hazards on rooftops by a parapet wall, guardrail or a personal fall arrest system for attaching personnel, such as an anchor point, as follows:

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- Install a parapet wall on every flat roof, extending to a minimum height of 42 inches from the top edge of the wall to the floor of the roof (preferred fall protection method);
- Where a parapet wall is not feasible, install a standard guardrail that extends along all open-sides of the rooftop (except at the entrance). If access to the roof is provided through the railing, ensure the entrance has an inward swinging gate or is so offset that a person on the roof cannot walk directly into the opening;
- Where a standard guardrail is not feasible or is not desired by the architect, ensure that an adequate number of anchor points are installed for use during the performance of all work, while on the roof. Ensure that the design, fabrication and installation of the roof anchors meet the requirements for a fall arrest system, not fall restraint.

### 3.0 Fixed Ladder Specifications

- Install, design and construct fixed ladders such that all components of the ladder system (handrails, cages, rungs, etc.) are free of all projection hazards including splinters, sharp edges, and burrs; and that all welding is in agreement with the Code for Welding in Building Construction (AWS D1.0-1966).
- Ensure all fixed ladders include fastenings as an integral part of the design.
- Ensure that side rails used as a climbing aid are designed to afford adequate gripping surface.
- Protect metal ladders and accessories from deterioration by painting or otherwise treating the metal to resist corrosion and rusting, when location demands.
- Provide an adequate means of protection when different types of materials are used in the construction of a ladder to prevent one from having a damaging effect upon the other (such as electrolytic action of dissimilar metals).
- Ensure that fixed ladders, accessories, and fasteners are designed to meet the following live load requirements:
  - A minimum single concentrated load of 200 pounds;
  - Additional concentrated units of 200 pounds each are considered, as determined from anticipated usage of the ladder;
  - Live loads are considered to be concentrated at such points as will cause the maximum stress in the structural member being considered;
  - The weight of the ladder, attached accessories, and the live load are considered together in the design of rails and fastenings.
- Ensure that fixed ladders are installed within the preferred pitch of range of 75 degrees and 90 degrees with the horizontal. **NOTE: Ladders having a pitch in excess of 90 degrees with the horizontal are prohibited.**
- Ensure rungs of metal ladders have a minimum diameter of 3/4 inch. **NOTE:** Ladders formed by individual metal rungs imbedded in concrete and located such that they may corrode or rust, the individual metal rungs must have a minimum diameter of 1 inch, be painted or otherwise be treated to resist corrosion and rusting.

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- Ensure the distance between rungs, cleats, and steps does not exceed 12 inches and the distance is uniform throughout the length of the ladder.
- Ensure grab bars do not protrude on the climbing side beyond the rungs of the ladder which they serve and conform to the following provisions:
- When located in the horizontal position, grab bars are spaced by a continuation of the rung spacing.
- When located in the vertical position, grab bars have the same spacing as the ladder side rails.
- Grab-bar diameters are equivalent to the round-rung diameters.

**3.1 Ladder Cages**

- Provide cages or wells on ladders of more than 20 feet up to a maximum unbroken length of 30 feet.
- Extend cages down the ladder to a point not less than 7 feet or more than 8 feet above the base of the ladder.
- Ensure the bottom of the cage is flared a minimum of 4 inches.
- Extend the cage a minimum of 42 inches above the top of the landing, unless other acceptable protection is provided.
- Fasten horizontal bands of individual rung ladders to the side rails of rail ladders or directly to the structure, building, or equipment.
- Space horizontal bands at intervals not more than 4 feet apart, measured from centerline to centerline.

**3.2 Clearance**

- On the climbing side of the ladder, ensure the perpendicular distance from the centerline of the rungs to the nearest permanent object is 36 inches for a pitch of 76 degrees, and 30 inches for a pitch of 90 degrees, with minimum clearances for intermediate pitches varying between these two limits in proportion to the slope, except where:
- Fixed ladders are equipped with a cage;
- Fixed ladders are installed in smooth-walled wells; and
- Where grab bars are mounted.
- For fixed ladders without cages or wells, provide a clear width of at least 15 inches each way from the centerline of the ladder in the climbing space.
- For fixed ladders equipped with cage or basket, ensure the following:
- Cages extend between 27 and 28 inches from the centerline of the rungs of the ladder;
- The cage has a minimum width of 27 inches;
- The inside of the cage is clear of projections;
- Vertical bars are located at a maximum spacing of 40 degrees around the circumference of the cage.
- Vertical bars are located on the inside of the horizontal bands and are fastened to the horizontal bands.
- Where fixed ladders are installed in smooth-walled, ensure the following:
- Ladder wells have a clear width of at least 15 inches measured each way from the centerline of the ladder;
- There is a minimum of 27 inches from the centerline of rungs to the well wall on the climbing side of the ladder; and

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- Where other obstructions on the climbing side of the ladder exist, there is a minimum of 30 inches from the centerline of the rungs.
- Ensure the distance from the centerline of rungs, cleats, or steps, to the nearest permanent object in back of the ladder is not less than 7 inches. Where unavoidable obstructions are encountered, ensure minimum clearances are provided. **NOTE: For a description of Clearance for Unavoidable Obstruction at Rear of Fixed Ladder, see figure D-3 of 29 CFR 1910.27.**
- Ensure the distance from the centerline of the grab bar to the nearest permanent object in back of the grab bars is not less than 4 inches.

### 3.3 Hatch Covers

- Design counterweighted hatch covers to open a minimum of 60 degrees from the horizontal
- Ensure the distance from the centerline of rungs or cleats to the edge of the hatch opening on the climbing side is not less than 24 inches for offset wells or 30 inches for straight wells.
- Never allow protrusion or head hazards within 24 inches of the centerline of the rungs or cleats.
- When an unavoidable hazard exists within 30 inches of the centerline of the rungs or cleats, ensure that it is fitted with a deflector plate that is placed at an angle of 60 degrees from the horizontal.

### 3.4 Landing Platforms

- Where ladders are installed to heights exceeding 20 feet (except on chimneys), provide landing platforms for each 30 feet of height (or fraction of height).
- If there is no safeguarding provided, such as a cage, well, or ladder safety device, ensure that landing platforms are provided for each 20 feet of height (or fraction of height).
- Ensure that each ladder section is offset from adjacent sections, even for short, unbroken lengths, and install landing platforms at each offset.
- Provide landing platforms when the step across distance from the centerline of the rung of a ladder to the nearest edge of the structure or equipment is greater than 12 inches
- Equip landing platforms with standard railings and toeboards.
- Landing platforms cannot be less than 24 inches wide and 30 inches long
- Landing platforms must be so arranged as to give safe access to the ladder.
- Ensure that the rung of the ladder at the landing platform is located at the level of the landing platform laterally served by the ladder.

### 3.5 Ladder Extensions

- Ensure the side rails of through or side-step fixed ladders extend 42 inches above parapets and landings.

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- When the parapet is cut to permit passage through the opening, provide ladder access at the roof. If the parapet is continuous, design the access level from the top of the parapet.
- For through ladder extensions, ensure that the rungs are omitted from the extension and that the rails are flared, allowing between 18 inches and 24 inches clearance between the rails.
- For side-step or offset fixed ladder sections at landings, ensure the side rails and rungs are carried to the next regular rung beyond or above the 42 inch minimum. **NOTE: For a description of Offset Fixed Ladder Sections, see figure D-10 of 29 CFR 1910.27.**

### 3.6 Ladder Safety Devices

- In lieu of cage safeguarding and a landing platform, ladder safety devices may be installed on tower, water tank, and chimney ladders over 20 feet in unbroken length.
- Ensure all ladder safety devices such as those that incorporate lifebelts, friction brakes, and sliding attachments meet the design requirements of the ladders which they serve.
- Verify ladder safety devices and related support systems for fixed ladders conform to the following:
- Capable of withstanding without failure a drop test consisting of an 18 inch drop of a 500 pound weight;
- Permits the employee using the device to ascend or descend without continually having to hold, push, or pull any part of the device, leaving both hands free for climbing;
- Activates within 2 feet after a fall occurs and limits the descending velocity of an employee to 7 feet/second or less; and
- The connection between the carrier or lifeline and the point of attachment to the body belt or harness does not exceed 9 inches in length.
- Install ladder safety devices for fixed ladders according to the following:
- Attach mountings for rigid carriers at each end of the carrier, with intermediate mountings, as necessary, spaced along the entire length of the carrier to provide the strength necessary to stop employees' falls;
- Attach mountings for flexible carriers at each end of the carrier and install cable guides for locations where the system could be exposed to wind. The guides should be installed between 25 feet and 40 feet along the entire length of the carrier to prevent damage to the system; and
- Perform the design and installation such that the design strength of the ladder will not be reduced.

## 4.0 Personal Fall Protection System Specifications

### 4.1 Anchorages

The design, fabrication and installation of anchors must meet or exceed design requirements for fall protection systems in new facilities.

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- Ensure all anchor points and completed equipment installations are inspected and certified by a professional engineer, according to the following:
- Before being placed into service; and
- Following any major alteration to an existing installation.
- Ensure all anchorages to which personal fall arrest equipment is attached is capable of supporting at least 5,000 pounds per employee attached, or is designed and installed as part of a complete personal fall arrest system which maintains a safety factor of at least two.

**4.2 Certification Records**

- Provide copies of the certification record of each required inspection and test to Emory University, or the University's designated representative, such as the project manager, building architect, or facility engineer.
- Ensure that the certification record includes the date of the inspection, the signature of the person who performed the inspection, and the number, or other identifier, of the building support structure and equipment which was inspected.

**5.0 References**

- Occupational Safety and Health Administration (OSHA) Walking and Working Surfaces – Guarding Floor and Wall Openings and Holes (29 CFR 1910.23 Subpart D)
- Occupational Safety and Health Administration (OSHA) Personal Fall Arrest Systems – Non-Mandatory Guidelines (29 CFR 1926 Subpart M App C)
- Occupational Safety and Health Administration (OSHA) Positioning Device Systems – Non-Mandatory Guidelines (29 CFR 1926 Subpart M App D)
- Occupational Safety and Health Administration (OSHA) Standards for Construction – Ladders (29 CFR 1926.1053 Subpart X)
- American National Standards Institute / International Window Cleaning Association (ANSI/IWCA) Window Cleaning Safety – ANSI/IWCA 1-14.1-2001