PART 1 - GENERAL

1. Purpose
   a. The Pennsylvania State University Office of Physical Plant, in its continued dedication to safety, has developed the following minimum standards to improve fall protection and prevention through proper planning, design, construction and maintenance. These standards are intended to provide guidance and direction on how to remove fall hazards, prevent access to fall hazards, restrict movement at fall hazards and/or provide the proper fall arrest equipment as well as assist in the proper selection, care and use of fall protection equipment. It is Penn State’s goal to provide 100% protection at all roofs.

2. Applicability
   a. Any project which proposes to add, remove or modify any portion of the roofing system or roof-top serviceable equipment, including new construction.
      i. Old Main Building is exempt from the requirements of this design standard. Fall protection methods will be determined by the Fall Protection Management Team.

3. Definitions
   a. Active Fall Protection Systems - Active fall protection systems are dynamic and require the use of special personal protective equipment, training, as well as active participation by the individual. Common Active systems on campus include Life Lines and Anchor Points.
   b. Addition (as stated in IEBC) – an extension or increase in floor area, number of stories, or height of a building or structure.
      i. Fall protection requirements to be the same as required for new construction.
   c. Fall Hazard – condition where distance to adjacent lower level exceeds 48 inches.
   d. Fall Protection Management Team – The Pennsylvania State University Office of Physical Plant has established a team of individuals including members of the Safety, Design Services, Planning, Design & Properties, Work Control Center, Maintenance Programs, Roof Crew, Project Management Offices and Commonwealth Services to establish, maintain and uphold Fall Protection and Prevention Standards.
      i. This team is available to review roof-related fall protection risk assessment priorities during the preliminary design for concurrence on fall protection scope and approach.
   e. Feasible – Relates to these factors: cost justification (installation cost, training, personal fall arrest equipment cost, inspection cost, etc), status of personnel utilizing structure (employee, student, public, etc), structural capabilities, and aesthetics. Final determination made by the Fall Protection Management Team.
   f. Passive Fall Protection Systems - A “passive” fall protection system refers to a system that is non-dynamic, stationary, and does not move, adapt, or change when in or out of use. Passive systems do not require the use of personal protective equipment or active participation from individuals occupying the roof. Common Passive systems on campus include parapets and guardrails.
   g. Path of Travel: The route, whether clearly designated or not with pavers/pads/matting, from the roof access location, along a logical walking path a person would take, to serviceable equipment locations, including paths between serviceable equipment locations, and to other rooftop destinations such as penthouses or enclosures.
   h. Serviceable Equipment: Means such equipment requiring servicing from the roof level such as solar array/structures, green roofs, HVAC, fan units, exhaust units, air handlers etc.
      i. The roof surface, roof drains, gutters, cameras/security cameras, antennas, cell towers and equipment on the roof that can be entirely serviced from beneath the roof level, are not considered serviceable equipment.
      i. Sloped Roof - for the purposes of this design standard a Sloped Roof is considered a roof having a slope greater than 4 in 12.

4. Reference Standards
   a. The following codes and regulations and their appendices, as amended, are hereby incorporated by reference:
      i. IBC requirements (current edition)
      ii. OSHA
1. 1910.29 (Guardrails)
2. 1910.140 (Personal Fall Protection Systems)
3. 1910.28 (Duty to have fall protection and falling object protection).
4. 1910.23 (Fixed Ladders)

iii. Penn State University Ladder Standard
iv. Where discrepancies exist between the above requirements/codes/regulations and this document, this document shall take precedence.

PART 2 - REQUIREMENTS

1. General Requirements
   a. All roof surfaces and/or impacted material require testing for hazardous materials before removal or penetrating.
   b. All projects shall consider fall protection requirements at the earliest design phase possible as part of the Prevention Through Design effort and shall be revisited at each subsequent phase to ensure all issues have been addressed.
      i. Design deliverables include drawings identifying the fall protection hazards and proposed design response. Responses shall include viability of relocating existing equipment to eliminate the fall hazard. A separate meeting with the Fall Protection Management Team may be required.
      ii. As-Built deliverables include Roof Protection Diagram provided by the designer. See paragraphs 4 and 5 below for more details.
   c. Passive fall protection systems such as parapet walls and/or guardrails integrated with the design of the building, are preferred in all situations to minimize the need for personal fall arrest systems, and the associated expenses, inspection, maintenance, personal protection equipment and training of such systems.
   d. All projects must consider how roofs are accessed, the condition of the access system, whether the access system is up to current standards, and if a better location or type would minimize hazards and/or improve aesthetics. Roof access options in order of preference: Elevator or direct access from man door, interior stairs to man door, interior stair to roof hatch, fixed ladder to roof hatch, exterior fixed ladder.
      i. In certain instances, permanent exterior ladders may not be appropriate such as at canopies or single-story buildings with infrequent access. The team shall consider access with a portable ladder and installation of a portable ladder anchor. Review required by Fall Protection Management Team.
   e. Planning Design & Properties – University Architect shall be consulted regarding the architectural design and finishes of passive fall protection systems as well as location and finish of access systems.

2. Project Requirements
   a. New construction (i.e. new building construction) including additions:
      i. 100% protection required.
      ii. In order to minimize the frequency of rooftop access, all serviceable equipment shall be located inside the building or outside the building at ground level.
      iii. Hatches, elevators, interior stairs leading to roof man door, and pathways to serviceable equipment shall be located 15 feet or further from any roof edge.
      iv. Roof ladders shall be concealed from view as much as possible.
      v. Passive fall protection systems such as parapet walls and/or guardrails shall be installed along all rooftop edges. Parapet walls or guardrails shall comply with all applicable design standards referenced herein.
         1. Canopies and special architectural elements may be excluded if no serviceable equipment is present, subject to review and approval of the Fall Protection Management Team. Active protection may still be required.
         vi. Sloped roofs preferably have permanent anchor points installed to protect 100% of the roof surface. Review required by Fall Protection Management Team.
   b. Roof replacement, including partial roof replacement, at an existing building:
i. Passive protection required for all serviceable equipment and/or travel paths less than 15’ from the roof edge included in the work area.

1. For equipment and pathways within 15 feet of the roof edge, consideration should be given to relocating the equipment or changing it to be serviceable from below to eliminate the condition requiring passive fall protection.

2. Should the designer determine passive fall protection is not feasible (see definition), the designer shall submit a proposal to the Project Leader for review and approval which includes, but is not limited to, details on the proposed alternative (fixed anchor points or horizontal lifeline system), evaluating the lifecycle cost comparison between the preferred passive system and the proposed alternative system, outlines the required maintenance, inspection and training requirements. No active systems may be constructed without written approval from the Project Leader where proposed active systems would replace passive system requirements.

ii. Active fall protection systems shall be provided at all remaining roofs that are included in the proposed roof replacement work area.

iii. Sloped roofs preferably have permanent anchor points installed to protect 100% of the roof surface. Review required by Fall Protection Management Team.

c. All other roof modifications, including but not limited to new serviceable equipment installations, and retrofit of existing roofs with the sole purpose of providing fall protection:

i. Proposed new or replacement serviceable equipment and related walking path should be located 15 feet or further from any roof edge.

ii. Passive protection required for all serviceable equipment and/or travel paths less than 15’ from the roof edge.

1. Should the designer determine passive fall protection is not feasible (see definition), the designer shall submit a proposal to the Project Leader for review and approval which includes, but is not limited to, details on the proposed alternative (fixed anchor points or horizontal lifeline system), evaluating the lifecycle cost comparison between the preferred passive system and the proposed alternative system, outlines the required maintenance, inspection and training requirements. No active systems may be constructed without written approval from the Project Leader where proposed active systems would replace passive system requirement.

iii. Temporary/movable fall protection systems (i.e. portable railing, carts) may be utilized if roof is scheduled for replacement within five (5) years or as determined appropriate by the Fall Protection Management Team. No temporary systems may be constructed without consulting the Fall Protection Management Team and written approval from the Project Leader.

1. Existing temporary railings encountered near a project area shall be reviewed by the Fall Protection Management Team.

3. Technical Requirements:

a. Passive Fall Protection Systems:

i. Parapet design criteria

1. Parapet walls shall measure forty-two (42) inches from top of finished roof grade, be compatible with adjacent building materials and comply with all reference standards.

ii. Guardrail design criteria

1. Guardrails must comply with all applicable reference standards.

2. Guardrails shall be a minimum of forty-two (42) inches in height as measured from the top of finished roof grade with spacing in accordance with current IBC.

3. Where guardrails are visible from street level, they shall be designed to blend in or be otherwise minimally visible. Consideration should be given to sight lines, related/nearby building massing, alternative railing materials and color. Designs shall be reviewed by the University Architect.

4. Guardrails where required shall extend six (6) feet beyond edge of serviceable equipment and roof access hatches.

iii. No wood material shall be used.
b. Active Fall Protection Systems:
   i. Anchor point design criteria
      1. Anchor points must comply with OSHA design standards found in 1910.140.
      2. Anchor point quantity, spacing and load rating shall be designed to ensure two workers
         can work concurrently at the same location. It is the responsibility of the design
         professional to provide supporting calculations regarding load ratings.
   ii. Horizontal Lifeline design criteria:
      1. Shall be designed in accordance with all applicable codes, regulations and manufacturers’
         specifications.
      2. Horizontal Lifelines shall be designed to allow for “pass through” system. Those
         designed for use with a Y-lanyard are not acceptable.
      3. Lifeline shuttles or trolleys must be detachable type.
         1) Provide storage unit near roof access point should none exists with adequate
         capacity.
      4. Consideration should be given to maintain visibility of lifeline while minimizing trip
         hazards due to snow fall, nearby equipment nearby, etc. Consult Fall Protection
         Management Team.
   c. Marking and Signage
      i. Approved tie off locations shall be marked with stamped stainless-steel tag including, but not limited
         to, the following information: building number, tie off sequential number, and rating (maximum
         number of people allowed to hook to). Tags may be secured on structural member, adjacent to tie off,
         or wire connected to loop.
      ii. Close out submittal requirement - Contractor shall provide log of tie off sequential number and
         information with general description of location.
      iii. Roof Protection Diagram – The design professional shall provide a diagram (CAD drawing, ‘as-
         built’) to the Project Leader of each roof section that Penn State will post on roof which includes, but
         is not limited to, the following
         1. Locations of all fall protection features;
         2. Load rating for each fall protection feature, if applicable;
         3. Maximum number of people permitted on each anchor point, where applicable;
         4. Type of personal protection equipment required at each fall protection feature (i.e.
            connection devices/lanyard/retractable lanyard, etc.).
   d. Skylights that are not fall protection rated shall be protected per OSHA Section 1910.28(b)(3)(i).
   e. Fixed Ladder Access and Stairs
      i. Fixed ladder access and/or stairs shall be provided in accordance with OSHA 1910.23 and OSHA
         1910.25 respectively.
      ii. Fixed ladders over 24 feet shall be equipped with ladder safety system.
         1. Rigid rail design is required for the ladder safety system.
         2. Trolleys or shuttles shall be located in a secured, labeled box at the bottom of the ladder.
      iii. Fixed roof access ladders over four (4) feet high must have guardrails at the top that extend a
           minimum of six (6) feet on each side and a self-closing swing gate. Alternative configurations that
           provide the same level of protection and reduce the visual impact will be considered by the Fall
           Protection Management Team.
      iv. For full details pertaining to fixed ladder installations refer to the Penn State University - Ladder
          Design Standards.
   f. Roof Hatch or Scuttle
i. All roof hatches and scuttles shall be protected in accordance with OSHA 1910.28.

ii. Access to roof hatches or scuttles in new construction shall be by stair.

iii. All roof hatches and scuttles with fixed ladders shall be equipped with at least the following features:
   1. A means of assistance for transition from access ladder onto rooflop (i.e. Ladder safety post, grab bar, folding post, etc.);
   2. Lift assist feature which is shock or spring activated;
   3. Be able to be secured (locked).

iv. Roof hatches and scuttles shall be appropriately sized to accommodate the type of access (stair, ships ladder or fixed ladder), but in no case smaller than three (3) feet by three (3) feet and shall open at least 70 degrees from horizontal if the hatch is counterbalanced.

4. As-Builts
   a. At a minimum, as-built drawings shall include, but are not limited to the precise location of all fall protection features with design criteria and identifying information

5. O&M from Designers
   a. Manufacturer’s maintenance and inspection requirements must be provided by the designer prior to final payment.
   b. Warranty information must be provided by the designer prior to final payment.

End of Document

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