Walking – Working Surfaces

1. **Purpose / Background**

   To minimize the risk of injuries due to falls from changes in elevation, from walking on level surfaces, from floor openings, and from fixed stairs. Per the MIT Environmental, Health and Safety Policy “achieving and maintaining compliance with federal, state and local environmental, health and safety laws and good practices in all of our departments, laboratories, research centers, facilities and operations” and the Guiding Principles, in particular, #11 “standard operating procedures” and #14 “primary responsibility for EHS compliance”. Slips trips and falls (stf) constitute the majority of occupational accidents. They cause 15% of all accidental deaths, and are second only to motor vehicles as a cause of fatalities.

   The Occupational Safety and Health Administration regulations require that workplaces must be kept clean, orderly, and sanitary. Workplace floors must be kept as clean and dry as possible and clear of obstructions. Floor and wall openings and skylights must be guarded to prevent falls. Stairways with four or more risers must have standard stair railings or handrails.

   A *slip* occurs when there is a reduction in traction or friction between the foot (shoe) and the walking surface. During a slip, the body’s center of support rapidly moves out from under the body’s center of gravity. The most frequent slip occurs in the touchdown, when the person’s heal slides forward. This usually results in a backward fall. A slip resulting in the body falling forward may occur when the push off foot slips backward.

   Slippery surfaces, such as icy sidewalks, wet floors, can cause slips. Worn out or smooth shoe soles or certain types of sole material can increase the risks of slips as well. A person’s gait may also be a factor; failure to adjust one’s gait or walking speed when moving from one surface to another can produce a slip.

   A person *trips* when the forward movement of the feet is suddenly interrupted but the body continues to move forward; the body’s center of gravity has moved forward from its center of support (the feet), creating a loss of balance. Trips may be caused by irregularities in the floor. One may encounter a raised lip or edge (as little as 0.25 inches) in an otherwise flat walking surface or there may be an object on the floor in the path of travel.

   A *fall* occurs when a person’s center of gravity either gets ahead or behind the center of support. Falls may be divided into two main categories; falls to the same level and falls to a lower level. Falls may also be caused by other conditions such as missteps, loss of support or over extending. Persons may also be exposed to hazards existing because of floor or wall openings, irregular floor surfaces, elevated platforms, scaffolds and ramps.

   FACTORS that contribute to Slip, Trip, and Fall (STF) hazards are associated with five areas:
1. workers;
2. machine / equipment;
3. work environment;
4. contaminants
5. management

Walking, climbing, carrying materials and working in locations that are elevated and slippery require caution.

Personal factors that contribute to STF hazards include failure to follow prescribed work practices, improper use of equipment, inadequate training, inadequate supervision, fatigue, motor skill impairment, risk taking behavior, failure to use three points of contact while ascending or descending ladders or equipment, and failure to use protective gear.

Machinery and equipment factors include improper design (e.g. ladders, stairs, scaffolds, railings, etc.), missing components (e.g. open sided or unguarded elevated surfaces, etc.), inadequate maintenance, poor housekeeping and defective equipment.

Environmental conditions such as wind, snow, dust, steam, and poor lighting can increase fall risks as well.

The buildup of contaminants is important. Accumulations of spills, leaks, rain, ice or snow on travelways or in work areas must be cleaned up and the causes addressed. Good housekeeping is the responsibility of everyone. Spills can be cleaned up or the area marked off until it can be cleaned up, or absorbent can be spread. Continuous wet floor surfaces should be addressed by other means such as absorbent carpets, raised mats, or waterproof slip resistant footwear.

Management must strive to control the sources of these hazards and work to eliminate or mitigate their adverse effects. STF hazards are exacerbated when no controls are implemented or when controls are ineffective. Management can control personnel, equipment and environmental factors through proper planning, monitoring and corrective action.

2. Scope
This SOP applies to all MIT occupied or owned facilities. The entire MIT community must understand and take an active role in supporting the successful implementation and maintenance of this program.

ALL working and walking surfaces whether permanent or temporary shall comply with the standards of this SOP.

This SOP describes the requirements for the proper care, use, and protection of surface openings, stairs and variations in surface elevations. Walking and working surfaces must be free of conditions which allow for falls from elevated surfaces, falls on same level surfaces (slips and trips), and falls through unprotected openings. Hazardous conditions may
include: wall openings, floor openings, irregular walking surfaces, floor holes, unprotected platform or floor edges, skylights, and stairs.

Mechanically speaking, a fall occurs when the center of mass (body weight) of the individual is no longer balanced over their support (feet/legs). When balance is lost for whatever reason, the individual will fall. During ambulation, walking on walkways or stairs, this principally occurs when the individual’s gait is disturbed. This can occur in several ways, by slipping, by tripping or by an unexpected misplacement of the stepping foot. A critical factor in the act of walking is the vertical elevation of the foot above the walking surface. Usually the individual will lift the foot only 0.25 inches above the walking surface as the foot swings under the body. When there is a vertical change in the walkway surface or an obstruction, greater than 0.25 of an inch, if the individual is not aware of the elevation change, the swinging foot is likely to catch on this obstruction and prevent the swinging foot from being placed under the moving center of mass. An unbalanced condition will result unless stability may be retained.

This SOP addresses passive fall protection methods such as covers and railings and condition of walking surfaces.

Refer to the “FALL PROTECTION SAFETY” SOP for conditions or situations requiring active fall protection such as personal fall arrest systems.

3. Prerequisites
   No prerequisites apply

4. Procedures
   4.1 General
   4.1.1 All work areas including passageways, storage areas and laboratories are to be kept clean, orderly and in a sanitary condition.

   4.1.2 All floors shall be kept clean and, so far as possible, dry. Where wet processes are used, drainage shall be maintained. False floors, mats, grating or other dry standing places should be provided where practicable.

   4.1.3 Floors shall be kept in good condition, free from protruding nails, splinters, holes, or loose boards.

   4.1.4 Covers and/or guardrails shall be provided to protect personnel from the fall hazards of open pits, tanks, vats, ditches, chutes, manholes, etc.

   4.1.5 Permanent or temporary floors and platforms shall not be overloaded with materials and/or equipment. Elevated platforms shall be marked with load bearing capacity.
4.1.6 All aisles and passageways must be clearly marked, have adequate width for both the transport of equipment or supplies and passage of persons. Safe clearance at all turns will be maintained. Doors and passageways must not be obstructed by physical barriers or stored materials.

4.2 Floor and wall openings

4.2.1 Every stairway floor opening shall be guarded by a standard railing. The railing shall be provided on all exposed sides, except at the entrance.

4.2.2 Ladderway floor openings or platforms shall be guarded by a standard railing with standard toeboard on all exposed sides except at ladder access. The ladder access shall be protected by a swinging gate or other movable barrier to prevent falling.

4.2.3 Exposed floor openings around machinery/equipment/chutes/conveyors shall be protected by a secured cover that leaves no opening greater than 1 inch wide or protected by a standard railing and toeboard.

4.2.4 Where operating conditions necessitate the feeding of material into a hatchway or chute opening, protection shall be provided to prevent a person from falling through the open space.

4.2.5 Every pit, manhole and trapdoor floor opening, infrequently used, shall be guarded by a cover of sufficient strength. While the cover is not in place, the pit or trap opening shall be constantly attended by someone or shall be protected on all exposed sides by removable standard railings.

4.2.6 Every temporary floor opening shall have standard railings, or shall be constantly attended by someone.

4.2.7 Every floor hole into which a person can accidently step or walk shall be guarded by:
   1. a standard railing with standard toe board on all exposed sides, or
   2. a floor hole cover of standard strength. While the cover is not in place, the floor hole shall be constantly attended by someone or shall be protected by a removable standard railing. The cover shall leave no opening greater 1 inch wide. The cover shall be securely held in place to prevent tools or materials from falling through.

4.2.8 Every wall opening from which there is a drop of more than four (4) feet shall be guarded. When the opening is not in use for the passing or handling of materials, the guard shall be kept in place.

4.2.9 Where there is exposure below to falling materials, a toe board or the equivalent shall be provided.

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4.2.10 Every temporary wall opening shall have adequate guards.

4.2.11 Wall opening barriers (rails, rollers, fences, and half doors) shall be capable of withstanding a load of at least 200 pounds applied in any direction (except upward) at any point on the top rail or corresponding member.

4.2.12 Wall opening screens shall be capable of withstanding a load of at least 200 pounds applied horizontally at any point on the near side of the screen.

4.2.13 Every platform which is more than four (4) feet above the lower level shall have a standard guard rail. The work side of loading docks do not require a guardrail if it would prevent the performance of work. All other sides of the loading dock must be guarded with a rail. The edge of the loading dock shall be identified by contrasting colored warning strip and posted danger warning signs, “DANGER – Loading Dock Fall Hazard”. Employees that may be exposed to fall hazards shall be trained to recognize and avoid hazards.

4.2.14 Every window wall opening at a stairway landing, floor, platform, or balcony, from which there is a drop of more than four (4) feet and where the bottom of the opening is less than three (3) feet above the platform or landing, shall be guarded by a standard railing or equivalent. A toe board shall be provided where the window opening is below the landing or platform.

4.3. **Open-sided Floors, Platforms, and Runways**

4.3.1 Every open-sided floor or platform more than four (4) feet above adjacent floor or ground level shall be guarded by a standard railing on all open sides except where there is an entrance to a ramp, stairway or fixed ladder. A toe board shall be provided wherever people can pass under, there is moving machinery, or there is equipment with which falling materials could create a hazard.

4.3.2 Every runway shall be protected by a standard railing (or the equivalent) on all sides four (4) feet or more above floor or ground level. Where ever tools, machine parts or materials are likely to be used on the runway, a toe board shall be provided on each exposed side.

4.3.3 Runways used exclusively for special purposes may have the railing on one side omitted where operating conditions necessitate such omission, providing the runway is not less than 18 inches wide. Where persons entering upon a runway may become exposed to machinery, electrical equipment or other hazard, additional guarding may be required for protection.

4.3.4 Regardless of height, open-sided floors, walkways, platforms, or runways above or adjacent to dangerous equipment, thermal exposure, electrical exposure, open tanks or similar hazards shall be guarded with a standard railing and toe board.

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4.4 Guardrails—toe boards

4.4.1 A standard railing shall consist of a top rail, intermediate rail, and posts and shall have a vertical height of 42 inches nominal from the upper surface of the top rail to the floor, platform, runway, or ramp level. The top rail shall be smooth-surfaced throughout the length of the railing. The intermediate rail shall be approximately halfway between the top rail and the floor, platform, runway, or ramp. The ends of the rails shall not overhang the terminal posts to create a projection hazard.

4.4.2 For wood railings, the posts shall be of at least 2 X 4 stocks spaced not to exceed 6 feet; the top and intermediate rails shall be of at least 2 X 4 stock. If the top rail is made of two right-angle pieces of 1 X 4 stock posts may be spaced on 8 foot centers, with a 2 X 4 intermediate rail.

4.4.3 Pipe railings shall consist of posts and top and intermediate railings at least 1.5 inches nominal diameter with posts spaced not more than 8 feet on center.

4.4.4 Structural steel railings shall consist of posts, top, and intermediate rails of at least 2 X 2 X .375 inch angles or other metal shapes of equivalent bending strength with posts spaced not more than 8 feet on centers.

4.4.5 The post anchors and the framing members for rails if all types shall be capable of withstanding a load of at least 200 pounds applied in ANY direction at ANY point on the top rail.

4.4.6 Other types, sizes, and arrangements of railing construction are acceptable provided they meet the previous stated conditions.

4.4.7 A standard toe board shall be 4 inches nominal in vertical height from the top edge to the floor, platform, runway, or ramp. The toe board shall be securely fastened with not more than 0.25 inches clearance under the toe board. The toe board may be constructed of any substantial material either solid or with openings not over 1 inch in the greatest dimension.

4.4.8 Where material is piled to such a height that a standard toe board does not provide protection, paneling from floor to intermediate rail or to the top rail shall be provided.

4.5 Stairs

4.5.1 Where doors or gates open directly onto a stairway, a platform shall be provided at the top of the stairs, and the swing of the door or gate shall not reduce the effective width to less than 20 inches.
4.5.2 Every flight of stairs having four or more risers shall be equipped with standard stair railings. The width of the stair is to be measured clear of all obstructions except handrails.

4.5.3 All open sided stairs shall have a handrail on the open sides.

4.5.4 All stairs less than 44 inches wide will have at least one handrail.

4.5.5 A handrail is required on each side of a stairway more than 44 inches wide but less than 88 inches wide.

4.5.6 On stairways 88 inches or more in width, handrails will be installed on each side and a railing will be located approximately at the center of the width.

4.5.7 Winding stairs shall be equipped with a handrail offset to prevent walking on all portions of the treads having width less than 6 inches.

4.5.8 A stair handrail shall be mounted directly on a wall, partition, or vertical support by means of brackets attached to the lower side of the handrail so that there is no obstruction to a smooth surface along the top and sides of the handrail. The top surface of the handrail shall be rounded or have rounded edges that will furnish an adequate handhold. The ends of the handrail should be rounded or otherwise arranged so as not to constitute a projection hazard.

4.5.9 The height of handrails shall be not more than 34 inches nor less than 30 inches from the upper surface of the handrail vertically to the surface of the step nose or to the surface of the ramp.

4.5.10 The handrail will be positioned to allow for a minimum of three (3) inches clearance between the handrail and the wall or any other object. The spacing of the support brackets shall not exceed eight (8) feet.

4.5.11 Hardwood handrails shall be at least two (2) inches in diameter. Metal pipe handrails shall be at least 1.5 inches in diameter. Handrails shall be constructed to be capable of withstanding a load of at least 200 pounds applied in any direction at any point on the rail.

### 4.6 Fixed Industrial Stairs

4.6.1 This section specifies the safe design and construction of fixed industrial stairs. This classification includes interior and exterior stairs around machinery, tanks, and other equipment as well as stairs leading to or from floors, platforms or pits. This section does not apply to stairs used for emergency egress purposes, or to construction operations.

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4.6.2 Fixed stairs shall be provided:
   1. For access from one structure level to another where operations necessitate regular travel between levels;
   2. For access to operating platforms at any equipment which routinely requires attention during operations;
   3. Where access to elevations is daily or at each shift for such purposes as gauging, inspection, regular maintenance, etc.;
   4. Where such work may expose employees to acids, caustics, gases or other harmful substances;
   5. Where the carrying of tools or equipment by hand is normally required.

4.6.3 It is not the intent of this section to preclude the use of fixed ladders for access to elevated tanks, towers, and similar structures.

4.6.4 Spiral stairs shall not be permitted except for special limited usage and secondary access situations where it is not practical to provide a conventional stairway. Winding stairways may be installed on tanks and similar round structures where the diameter of the structure is not less than five (5) feet.

4.6.5 Fixed stairways shall be designed and constructed to carry a load of five times the normal live load anticipated or a moving concentrated load of 1000 pounds, whichever is greater.

4.6.6 Fixed stairways shall have a minimum width of 22 inches.

4.6.7 Fixed stairs shall be installed at angles between $30^\circ$ to $50^\circ$ from the horizontal. Any uniform combination of rise/tread dimensions may be used that will result in a stairway within the permissible angle range. The rise height of the stair treads may be between 6.5 inches and 9.5 inches but must be uniformly distributed through all steps. The tread run of the steps may be between 8.0 inches and 11.0 inches but, must be uniformly distributed through all steps.

4.6.8 All treads shall be reasonably slip resistant and the nosings shall be of nonslip finish. Rise height and tread width shall be uniform throughout any flight of stairs including any foundation structure used as one or more treads of the stairs.

4.6.9 Stairway platforms shall be no less than the width of a stairway and a minimum of 30 inches in length measured in the direction of travel.

4.6.10 Standard railings shall be provided on the open sides of all exposed stairways and stair platforms. Handrails shall be provided on at least one side of closed stairways. Stair railings and hand rails shall be installed in accordance with section 4.5.
4.6.11 Vertical clearances above any stair tread to an overhead obstruction shall be at least 7 feet measured from the leading edge of the tread.

4.7 Skylights
4.7.1 Skylight opening and hole shall be guarded by a screen or guard rail frame of sufficient strength to prevent a person falling through the skylight.

4.7.2 Skylight screens shall be able to withstand a minimum loading of at least 200 pounds applied perpendicularly at any one area on the screen. The screen and frame under loading or impact shall not deflect downward sufficiently to the glass of the skylight. The construction shall be of grillwork with openings not more than 4 inches long or of slatwork with openings not more than 2 inches wide with length unrestricted.

5. Roles & Responsibilities
The entire MIT community must understand slip, trip, and fall (STF) causes and hazards and take an active role in supporting the successful implementation and maintenance of this program.

Individuals should follow prescribed work practices, use equipment for its intended purpose, avoid risk taking behavior, practice good housekeeping, and utilize protective equipment. Housekeeping is the responsibility of every worker. It involves cleaning up a spill, marking the area until it can be cleaned, or spreading an absorbent; it may also involve activities such as removing debris, tools or other potential obstacles.

Supervisors and managers should strive to identify STF hazards and work to eliminate or mitigate their adverse effects. STF hazards are enhanced when no controls are implemented or when controls are ineffective. Management can control personnel, equipment, and environmental factors through proper planning, monitoring and corrective action.

The Department of Facilities (DoF) organization is responsible for implementing the standards identified within this SOP into the design of new structures or the extensive remodeling of existing structure. The DOF will assist with custodial services in the cleanup of non hazardous wet or dry contamination. Hazardous Material spill cleanup is discuss in SOP “Spill and Release Response Procedures, EHS-0004”

The EHS coordinator will report any defects or deficiencies found within the Level II inspection findings process.

The EH&S organization will provide advise and council on the implementation of this SOP.

6. Training

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To insure that walkway surfaces and stairways are safe, they must be constructed in conformance with applicable building codes and ADA standards, and safety regulations. The surfaces must have a uniform slip-resistance and be maintained free of foreign substances and contamination, which can change the slip-resistance. The surfaces must also be free from obstructions, obstacles or other foreign materials, which can confuse or interfere with the pedestrian’s gait. Anyone responsible for the care and maintenance of walkway and stairway surfaces should be knowledgeable in these codes and standards.

Employees that may be exposed to fall hazards while working at loading docks shall be trained to recognize and avoid hazards.

7. Monitoring Requirements
Planning and control go hand and hand. To control, one must monitor and measure. Unsafe conditions, unsafe acts and behaviors must be identified and eliminated. Timely follow-up on reported hazards is essential.

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8. Record Management
Not applicable

9. References
9.1. Standards
9.1.1 Regulations
29 CFR 1926.500
780 CMR Massachusetts State Building Code 7th Ed.
521 CMR Architectural Access Board
Architectural Barriers Act of 1968 (US)
9.1.2 Standards
• ASTM F-1637 Standard Practice for Safe Walking Surfaces
• ANSI / ASSE A1264.1-2007 Safety requirements for Workplace Walking / working Surfaces and Their Access: Workplace, Floor, wall and Roof Openings; Stairs and Guardrail Systems

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9.2. Other SOP/ SOGs
9.2.1 Fall Protection Safety
9.2.2 Ladder Safety, Portable
9.2.3 Laboratory and Facility Design and Construction Review Services

9.3. Supplementary Document
- OSHA Standard Interpretations 12/18/1997 – General Industry Standard as it applies to the electric utility industry, Question #5.

10. Definitions

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 subpart.

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.

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.

Standard railing: A vertical barrier erected along exposed edges of a floor opening, wall opening, ramp, platform, or runway to prevent falls of persons.

Standard strength and construction: Any construction of railings, covers, or other guards that meets the requirements of 1910.23.

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

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.

Handrail: A single bar or pipe supported on brackets from a wall or partition to provide a continuous handhold for persons using a stair.

Nose, nosing: That portion of a tread projecting beyond the face of the riser immediately below.

Open riser: The air space between the treads of stairways without upright members (risers).

Platform: An extended step or landing breaking a continuous run of stairs.

Railing: A vertical barrier erected along exposed sides of stairways and platforms to prevent falls of persons. The top member of railing usually serves as a handrail.

Rise: The vertical distance from the top of a tread to the top of the next higher tread.

Riser: The upright member of a step situated at the back of a lower tread and near the leading edge of the next higher tread.

Stairs, stairway: A series of steps leading from one level or floor to another, or leading to platforms, pits, boiler rooms, crossovers, or around machinery, tanks, and other equipment that are used more or less continuously or routinely by employees, or only occasionally by specific individuals. A series of steps and landings having three or more risers constitutes stairs or stairway.

Tread: The horizontal member of a step.

Tread run: The horizontal distance from the leading edge of a tread to the leading edge of an adjacent tread.

Tread width: The horizontal distance from front to back of tread including nosing when used.