

# Slips, trips, and falls guide: Low-rise and mid-rise residential and commercial building environments

By Ray Howard,  
Director, Technical Engineering and  
Risk Solution Services Training



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## About Markel's Risk Solution Services team

**Risk Solution Services** provides technical insight related to existing and potential insured risk at Markel. The team partners with our customers, claims, and underwriters to educate on both current and future risk trends and supports our clients with a broad offering of risk management solutions.

E-mail our team at [riskolutions@markel.com](mailto:riskolutions@markel.com).



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## Slips, trips, and falls guide: Low-rise and mid-rise residential and commercial building environments

Many organizations, both public (e.g., the Center for Disease Control, the National Institutes of Health, the US Bureau of Labor Statistics, the Occupational Safety and Health Administration) and private (e.g., the National Safety Council, the National Institute on Aging, NSFI, AARP), and others nationally and internationally regularly research, report, and make recommendations on slip, trip, and fall (STF) hazards with potential measures for controlling and/or eliminating STFs. Though figures vary considering the time frame, depth, and type of research performed and reporting entity. However, many agree that injuries from STFs are among the most significant of the general liability losses—especially in numbers. STFs can be extremely costly to all parties involved, and risk increases from any number of factors broadly classified as human, environmental, and task(s) being performed at the time of the STF occurrence.



## Slips, trips, and falls defined

STFs are broadly defined by most professional organizations as falling on the same level due to:

- **Slip** - loss of balance when there is not enough friction between a contacting element (e.g., foot, shoe) and a contacted element (e.g., ladder, floor) (e.g., person stepping on a wet or improperly waxed or freshly waxed floor)
- **Trip** - loss of balance when a contacting element (e.g., foot, shoe) collides with, strikes, or hits an object in its path or loss of balance when a contacting element encounters unexpectedly a lower-level surface or steps up unexpectedly to a higher-level surface. It is commonly postulated that a one-quarter to one-half inch in unexpected elevation change is generally enough to cause an STF
- **Fall** - downward movement, typically rapidly and freely, when balance is too far off-center. It is typically divided into two categories for statistical purposes: (1) fall on the same level or walking or working surface and (2) fall from different levels or walking or working surfaces. For general purposes, STFs discussed in this guide involve only definition (1) above<sup>4</sup>

An STF event is by definition an uncontrolled event that has the potential to cause either minor or substantial bodily injury as well as other losses generally associated with claim values. Even the straightforward and common STFs (e.g., slipping on a wet floor) can easily cost from \$150,000 to \$300,000 and up depending on the track litigation pursues and type of injury claimed (e.g., back injury, neck injury, etc.). From an environment perspective, good design, construction, and effective preventative maintenance, as well as corrective maintenance procedures, substantially reduce the potential for STF losses.

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To complicate STF, issues such as a facility change of use or change of occupancy classification, hazardous areas, and additions of all types generally add to an STF risk. This is generally due to the facility not having been originally contemplated and designed for the new use it is being put and hence not having been designed for significant human traffic pattern changes and habits. This includes increases in potential third-party access.

Fall protection always ranks among the top Occupational Safety and Health Administration (OSHA) **serious** and **willful** violations year after year generally ranking in the top three. OSHA defines a **serious** violation as “one in which there is a substantial probability that death or serious physical harm could result, and the employer knew or should have known of the hazard.” OSHA defines a **willful** violation as one “committed with an intentional disregard of or plain indifference to the requirements of the Occupational Safety and Health Act and requirements.” Most falls occur on the same level or walking or working surface. The level offsets in such falls are often minor—typically one to 1½ inch or less (e.g., leaving an elevator that is not properly aligned with its landing).<sup>6</sup>

According to the US Department of Health and Human Services (DHHS) and the National Institutes of Health (NIH), about half (50 percent) of all traumatic brain injuries (i.e., an injury caused by a blow, jolt, or penetrating object that disrupts normal functioning of the brain) in children are caused by falls from objects like stairs and bicycles. This leads to unintentional blunt trauma, motor vehicle crashes, and deaths.<sup>7</sup>

According to annual US Department of Labor (DOL) reports, slips, trips, and falls each year account for:

- The second-highest category of nonfatal occupational injury and illness incident rates (i.e., closely following overexertion and bodily reaction)
- Approximately 15 percent of all accidental deaths per year, regularly the second-leading cause behind motor vehicles
- About 25 percent of all reported injury claims per fiscal year
- Approximately 100 million lost workdays per year—about 65 to 70 percent of all workdays lost<sup>5</sup>

Statistics collected on injuries associated with slips, trips, and resultant falls indicate the majority top four inside occurrences of STF take place when individuals walked on or used:

- Floors
- Staircases/stairways
- Walks
- Ramps<sup>5</sup>



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## Examples of applicable standards

- **American National Standards Institute, (ANSI) Z535**  
– Guideline for alert symbols and pictograms that communicate hazards with standard sign and label colors and signal words
- **OSHA Regulation 29 CFR 1910.22, Occupational Safety and Health Standards, 1910 Subpart D, Walking-Working Surfaces, General requirements**
- **OSHA Regulation 29 CFR 1910.145** – Guideline for signs and tags that identify hazards
- **American Society for Testing and Materials (ASTM) D1894-14, Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting**, ASTM International, West Conshohocken, PA ([astm.org](http://astm.org))

## Floors

Floors, flooring materials, and inadequate maintenance frequently appears as the number one area of concern in regard to STFs with deleterious foreign materials on the floor. Usually the culprit is improper flooring and flooring maintenance materials being used with low coefficients of friction.

Safety maintenance of floors focuses on evaluating floors, floor coverings, and substrates for general safety, including contaminants such as spilled foods and fluids, oils, greases, and other lubricants, water, and other liquids like coffee and other refreshments in addition to reviewing floor coefficients of friction.<sup>1</sup>



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Friction is important; it is a force that resists movement between two objects. Typically in STF cases, friction comes from bare feet or shoes and floors, carpets, or walks. The coefficient of friction (COF) is the ratio of the force needed to move or slide one surface (e.g., shoe) horizontally over another (e.g., floor). ASTM D1894-14 is one of the most widely used standards for dictating the method for COF measurement. This method involves a polymer sheet or film with a fixed weight on top. The polymer sample is dragged and measurements are recorded.

The COF of floor surfaces is a test to measure the traction level of floors. A reasonable measure of slip resistance is static coefficient of friction. A COF of 0.5 on a scale of 0 to 1, which is based upon studies by the University of Michigan and reported in the *Work surface friction: definitions, laboratory and field measurements, and a comprehensive bibliography*, is recommended as a guide to achieve proper slip resistance. However, as noted by OSHA, a COF of 0.5 is not intended to be an absolute standard value. Measurement is often also done using a tribometer, which measures tribological quantities such as COF on a meter of 0 to 1—the higher the number, the higher the traction. Because many slip-and-fall accidents happen due to reduced traction between the foot and the floor surface, the reading can tell about the friction conditions of a floor and the potential for STF occurrences.<sup>1</sup> However, it should be noted that some footwear due to design and materials can cause more friction that might be desired and also lead to slips and falls. Very little study has been done in this area.

Most COF testing is performed in laboratories with stationary equipment; however, currently the BOT-3999E slip tester test device is often utilized at sites. It crawls along the floor under study and moves under its own power as it records results. It is known to be very accurate.

Common design and maintenance problems as well as human factors that contribute to STFs on floors include:

- Lack of housekeeping
- Lack of correct floor cleaning procedures
- Dam mopping instead of using a two-step mopping process
- Improper use of wax and other maintenance materials with resultant loss of COF
- Highly polished floors due to materials that are slick (e.g., marble, ceramic tile)
- Floor material transitions (e.g., carpet to marble or tile to wood)
- Improper use of signs and access to dangerous areas or situations (e.g., using signs that are taller than generally needed with flags on top to make them visible at eye level and highly visible at a distance, flashing lights, or barrier products such as caution tape)



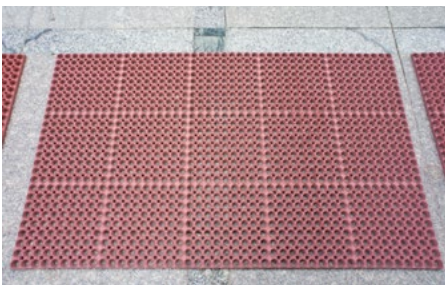
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- Lack of handrails
- Poor illumination
- Winding floor designs and/or intersecting floors
- Doors with direct access to floor areas used for general movement of personnel, egress or ingress
- Use of improper footwear, no footwear, or shower-type shoes and sandals or non-slip-resistant shoes
- Lack of intermediate landings between floors of different levels
- Poor maintenance
- Lack of use of beveled edge, flat, and continuous mats
- Unsecured mats without slip-resistant backing
- Obstacles and clutter on floors and around work areas
- Individual behavior

Slip resistance can vary from surface to surface, or even on the same surface, depending upon surface conditions and employee footwear. Slip-resistant flooring material such as textured, serrated, or punched surfaces and steel grating may offer additional slip resistance. These types of floor surfaces should be installed in work areas that are generally slippery because of wet, oily, or dirty operations. Slip-resistant footwear may also be useful in reducing slipping hazards.



### Walks

The most important characteristic of walks is that they must be smooth without being slippery. A ridge or irregularity of one-half inch or greater is sufficient to cause tripping. Common types of protrusions are usually a result of pavement movements as walks settle or the pressuring out of expansion joints (e.g., strips of wood used between concrete or cement walk segments).



Walks must be designed so that changes in direction or other hazards are circumvented or avoided by pedestrians. Walks must also be well maintained, including the removal of debris or ice and snow on walks during inclement weather conditions.

Common design and maintenance problems as well as human factors that contribute to STFs on walks include most of the factors previously discussed concerning floors with the following additions:

- Irregular steps
- Winding staircases
- Lack of intermediate landings
- Slippery segments
- Protrusions of one-half inch or more, including expansion joints, stones, blocks, and other construction constituents

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## Staircases/stairways

Injuries associated with staircases have historically been a major source of general liability loss. Injuries resulting from these STF occurrences range from minor cuts and lacerations to deaths. The causes are typically categorized as those due to human behavior and physical defects in the staircases.



Common design and maintenance problems as well as human factors that contribute to STFs on staircases include most of the factors previously discussed concerning floors and walks with the following being of extreme significance:

- Irregular steps
- Lack of dimensional uniformity
- Inconsistent surface traction
- Tread or landing slope in excess of one-quarter inch
- Rise and run length
- Width of stairs
- Lack of handrails
- Poor illumination
- Winding, curved, or spiral staircases
- Doors with direct access to stairways
- Lack of intermediate landings
- Poor maintenance
- Slippery steps
- Individual behavior

Step geometry is detailed in local, state, and national building codes (e.g., NFPA Life Safety Code 101) and is a major contributing factor to STF staircase and stairway occurrences. Older homes and buildings had different specifications and are generally much more dangerous, especially due to short runs. Dimensions of steps are usually designated as a rise of seven-to-eight inches and run depth is usually nine-to-11 inches depending on jurisdiction, code referenced, and whether it is considered new or existing construction.

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- The run or tread is the part of the stairway that a person steps on. Its length is measured from the outer edge of the step which includes the nosing if it is present to the vertical portion of the stair called the riser
- The rise or height of a step is measured from the top of one tread to the top of the next tread. It is not the physical height of the riser because this excludes the thickness of the tread

### Guards, handrails, and stair rails

Guards (i.e., vertical protective barriers erected along exposed edges of stairways), handrails, and stair rails on staircases and ramps are prescribed by most building codes. Many serious falls still occur where handrails are present but are inadequate in design, elevation, or attachment.

When handrails are missing or defective, defense against lawsuits is difficult. Most codes specify a staircase having a width of 44 inches or less must have at least one handrail. If the width of a staircase is 88 inches or more, an intermediate handrail must be provided down the center of the staircase. Most building codes require that handrails are at least 34 inches and no more than 38 inches above the nosing of the treads or the finished floor again, depending on jurisdiction, code referenced, and whether it is considered new or existing construction.

Common design and maintenance problems as well as human factors that contribute to STFs involving guards, handrails, and stair rails include most of the factors previously discussed concerning floors, walks and stairs, steps, and stairways with the following being of extreme significance:

- Not having handrails on both sides unless specifically permitted



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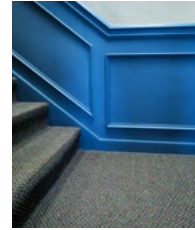


- Lack of uniformity
- Lack of continuity
- Projections that might engage loose clothing
- Poor illumination
- Correct distancing above the tread
- Correct distancing from the wall
- Not being continuously graspable along the entire length
- Not continuing adequately above the top riser or below the lowest riser
- Poor maintenance
- Slippery steps
- Individual behavior



Landings are extremely important areas in stair runs. Landings are generally designated as:

- Top landings
- Intermediate landings
- Bottom landings



Common functions of landings include the following:

- The top landing area provides a point where a person can view a flight of stairs and access its layout and condition
- The top landing serves as a place where a person can locate a handrail and grasp it before descending a flight of stairs
- An intermediate landing functions as an area where the ascending or descending person can stop, rest, and access each flight of stairs
- Intermediate landings also prevent a falling person from falling down the balance of the stairs
- Bottom landings give respite to users and also allow an area to wait for others using the stairs

Common design and maintenance problems as well as human factors that contribute to STFs on landings include most of the factors previously discussed with the following additions being most paramount:

- Lack of handrails
- Poor illumination
- Multiple level landings
- Doors with direct access to landings
- Lack of intermediate landings
- Poor maintenance
- Slippery landings
- Individual behavior

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## Ramps

A ramp is an inclined plane used to move from one elevation to another without encountering obstructions, irregularities, or discontinuous surfaces and can be very dangerous especially when users are either pushing or pulling loaded transport vehicles. Ramps with less than a four-degree angle of rise are difficult to visually detect and may not be apparent to users, resulting in frequent tripping. Ramps are usually designed with rise angles between four and 15 degrees. Most building codes specify a slope of no greater than one unit vertical and eight units horizontal.



Common design and maintenance problems as well as human factors that contribute to STFs on ramps include most of the factors previously discussed with the following additions:

- Lack of proper dimensioning—typically slopes and widths
- Drop-offs not protected
- Curbs and barriers no less than four inches in height
- Lack of guards
- Lack of handrails
- Poor prevention against water accumulation
- Poor illumination
- Winding ramps
- Doors with direct access to ramps
- Lack of landings
- Poor maintenance
- Slippery ramps
- Individual behavior

## Issues for risk management to consider

- According OSHA Standard 1910.22, the employer must ensure:
  - All places of employment, passageways, store rooms, service rooms, and walking-working surfaces are kept in a clean, orderly, and sanitary condition
  - The floor of each workroom is maintained in a clean and, to the extent feasible, in a dry condition. When wet processes are used, drainage must be maintained and, to the extent feasible, dry-standing places such as false floors, platforms, and mats must be provided
  - Walking-working surfaces are maintained free of hazards such as sharp or protruding objects, loose boards, corrosion, leaks, spills, snow, and ice
  - Loads. The employer must ensure that each walking-working surface can support the maximum intended load for that surface
  - Access and egress. The employer must provide and ensure each employee uses a safe means of access and egress to and from walking-working surfaces

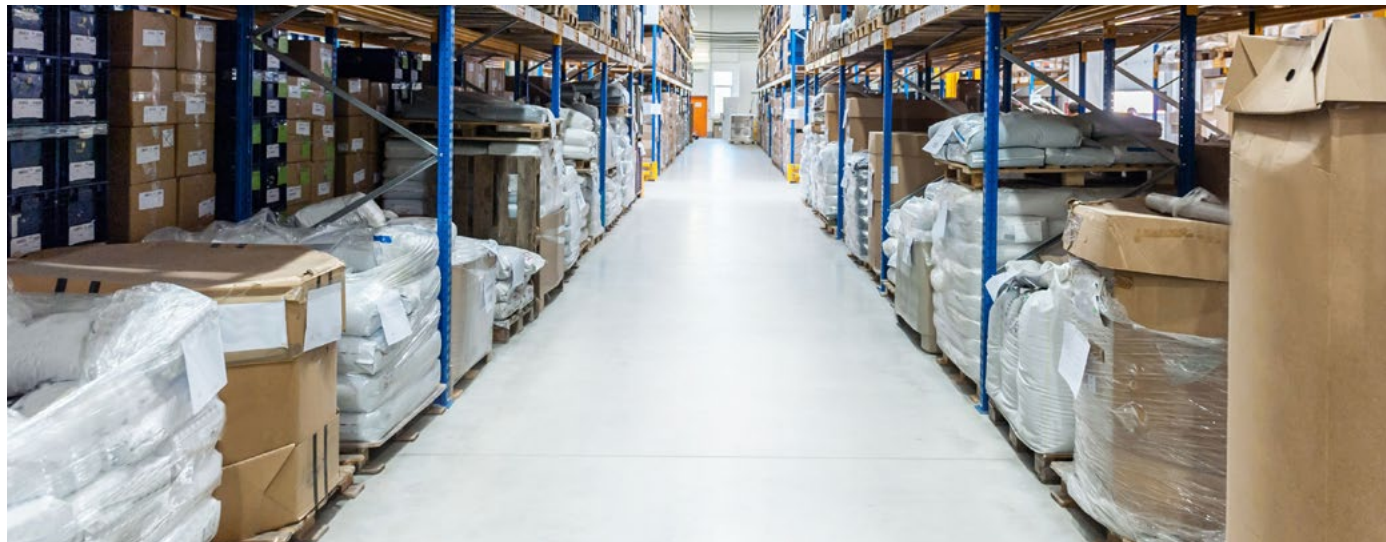


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- Inspection, maintenance, and repair. The employer must ensure:
  - Walking-working surfaces are inspected, regularly and as necessary, and maintained in a safe condition
  - Hazardous conditions on walking-working surfaces are corrected or repaired before an employee uses the walking-working surface again. If the correction or repair cannot be made immediately, the hazard must be guarded to prevent employees from using the walking-working surface until the hazard is corrected or repaired
  - When any correction or repair involves the structural integrity of the walking-working surface, a qualified person performs or supervises the correction or repair<sup>3</sup>
- Guardrails are required by most building codes to protect occupants from falling
- Poor maintenance is an important factor in STF-related injuries. Broken steps or handrails and loose materials, such as carpets that are not in good repair, are the cause of many accidents
- Regular inspection and maintenance program on staircases, associated lighting, and warning signs is essential to providing an adequate level of safety in these areas
- Slippery treads are a major cause of accidents that occur on staircases. Most building codes require a non-slip surface for stair treads
- Debris on walking surfaces account for a significant portion of injuries reported by state agencies. Proper housekeeping in work and traffic areas is still the most effective control measure in avoiding the proliferation of these types of hazards:
  - Keep all work areas, passageways, store rooms, and service areas clean and orderly



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- Avoid stringing cords, cables, or air hoses across hallways or in any designated aisle
- In office areas, avoid leaving boxes, files, briefcases, or purses in the aisles
- Encourage safe work practices, such as closing file cabinet drawers after use and picking up loose items from the floor
- Conduct periodic inspections
- Outdoor STF control measures can help reduce the inside incidence of slips, trips, and falls. Traction on indoor surfaces can change considerably when weather conditions change and users entering from outside enter a building with wet shoes, boots, and clothing. Those conditions affect indoor surfaces as pedestrian traffic increases moisture
- Traction control procedures should be constantly monitored for their effectiveness:
  - Sidewalks should be kept clean and in good repair condition
  - Snow and ice should be removed or treated
  - Adhesive striping material or anti-skid paint should be used whenever possible
  - Provide umbrella staging areas at both egress and ingress
  - Moisture-absorbent mats with beveled edges should be used in entrance areas
  - Signage should be displayed as needed
  - Anti-skid adhesive tape should be utilized in troublesome areas
  - Spills must be cleaned up immediately

- Inadequate lighting or illumination is a contributing factor causing many staircase STFs. Appropriate lighting must be installed at the base, top, and along the entire length and landings of staircases. While some building codes permit staircase illumination levels as low as a one-foot candle, the recommendation of the Illuminating Engineering Society of North America is for 10- to 20-foot candles
- Personal behavior is the toughest to control. It's human nature to be distracted by random thoughts or doing multiple activities. Being in a hurry will result in walking too fast or running which increases the chances of a STF. Taking shortcuts, not watching where one is going, using a cell phone, carrying materials which obstruct vision, wearing sunglasses in low-light areas, not using designated walkways, and speed are common factors in many on-the-job injuries
- Proper foot gear plays a big part in preventing falls. The slickness of the soles and the type of heels worn need to be evaluated to avoid slips, trips, and falls. Shoelaces need to be tied correctly. Whenever a fall-related injury is investigated, the footwear needs to be evaluated to see if it contributed to the incident. Employees are expected to wear footwear appropriate for their work duties
- Workers carrying a load too heavy and/or which obstructs vision can cause a STF



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- Proper housekeeping is a routine. It is an ongoing procedure that is simply done as a part of each worker’s daily performance
- Slips and falls are the primary cause of lost days from work and slips and falls are the leading cause of workers compensation claims
- Floors and flooring materials contribute directly to more than two million fall injuries each year
- Hip fractures are the most serious fall injuries and lead to the greatest health problems and number of deaths

**Questions risk management should ask**

- Is there a safety manager?
- Is there a formal health and safety program?
- Has there been a change in use of the facility under review?
- Is there a formal and complete STF safety program in effect which includes regularly scheduled inspections? If so, is it available for review?
- Has there been a change in the occupancy classification of the facility under review?
- Does the entity have all required state and any other required jurisdictional safety inspection licenses including elevator, and are they current? (The elevator egress and ingress area(s) are high hazard for STFs.)
- What is the facility workers compensation mod?
- Has the facility been cited by OSHA? What was the outcome? If recommendations were made and/or fines levied, are they complete and available for review?

**Partial references**

<sup>1</sup>American National Standards Institute, ANSI B101.5-2014, “Standard Guide for Uniform Labeling Method for Identifying the Wet Static and Wet Dynamic Coefficient of Friction (Traction) of Floor Covering, Floor Coverings with Coatings, and Treated Floor Coverings.”

<sup>2</sup>National Fire Protection Association (NFPA), “NFPA 101, Life Safety Code (2018 ed.),” Quincy, Massachusetts.

<sup>3</sup>US Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), OSHA Standard 1910.22, “Occupational Safety and Health Standards, 1910 Subpart D, Walking-Working Surfaces, General Requirements.” Washington, DC, OSHA.gov.

<sup>4</sup>US Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), eTools, Newsletter, “Healthcare Wide Hazards, Slips, Trips, and Falls.” Washington, DC, OSHA.gov.

<sup>5</sup>US Department of Labor Statistics, US Department of Labor (US DOL), November 2019, “2018 Survey of Occupational Injuries and Illnesses Charts Package,” November 7, 2019.

<sup>6</sup>US DHHS, National Institute of Health (NIH), US National Library of Medicine, Journal, Hsiao H. (2014). “Fall prevention research and practice: a total worker safety approach.” Industrial health, 52(5), 381–392, doi.org/10.2486/indhealth.2014-0110.

<sup>7</sup>US DHHS, National Institute of Health (NIH), (2020). “Traumatic Brain Injury (TBI): Pediatric Causes and Prevention Strategies,” infographic. Content owner: Office of Communications. Last reviewed date April 22, 2020.

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