ATLAS SAFETY & SECURITY DESIGN, INC.

SLIPS & FALLS

A Slip and Fall Primer

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Falls are the second leading cause of accidental death in both the home and public places in the United States. Only motor vehicle accidents kill more people. In 1985,

11,300 people were killed in falls. This represents about twelve percent of the accidental death toll. Of these, 6,100 people were killed in falls in and around the home and 3,800 were killed in falls in public places. There are 200,000 to 300,000 disabling injuries in work-related falls each year according to National Safety Council estimates, and the Bureau of Labor Statistics has named slipping, or loss of footing, as the primary event involved in a fall. An additional 25% named loss of balance or losing grip on the object they were holding as the reason for a fall. More than four out of five accidents occurred while going downstairs. Slippery surfaces were by far the most common hazard cited in the falls.

External stair treads should have a perforated, or a well-drained surface. Polished wood, polished stone, and smooth ceramic tile should not be used for stair treads. Mat wells should be provided to remove moisture from people's feet. Non-slip strips parallel with the edge of the tread should not be used as they are likely to be confusing to users with bad eyesight. This position is consistent with the AIA's Design for Aging, a guide that recommends that different colors and surfaces be used to differentiate tread edges in facilities used by the elderly. This guide further states that risers and treads of contrasting colors are particularly helpful to people with visual impairments. Friction must not be too great or the foot may lock on the tread surfaces. The user must be able to slide and pivot his foot slightly while ascending or descending a stair. Thus, rubber matting is not recommended as an acceptable covering for the treads.

When attorneys refer to slip and fall accidents, they can include:

- slippery surface falls
- stairway falls
- balcony or landing falls
- ramp falls
- foreign object-caused falls
- parking lot falls
- sidewalk falls
- bathtub-shower falls

The most important points attorneys look for in liability and negligence cases are:

- presence or absence of handrails and guardrails
- inadequate lighting and barriers
- presence of a non-slip surface
- adequacy of landing areas
- field of vision, health status, and behavior of the victim

- biomechanics of the fall, weather conditions, and maintenance

There are a number of items which are recognized as design and construction failures acting as contributors in stair fall accidents. Some of these are winders, open risers, single steps, doors opening onto stairways, low headroom, high thresholds, low riser heights, poor lighting, handrails that are not continuous, unmarked brick, terrazzo, waxed treads or marble, loose carpet and walls or posts intruding into stairwells. While it may not seem that many of these issues are the result of design, there have been a lot of judgments awarded that cost the architect money. Most experts agree that proper stair design lessens the probability of accidents. However, since there is no consensus on exactly what a safe stair entails, standard setting organizations are focusing their attention on proper sizing of risers and treads, shapes of nosings, size and placement of landings, dimensions of handrails, etc.

There is a need for warning people so that they are not surprised by stairs. Changes in floor surfaces, an extension of a wall decoration or an inclination of a handrail are ways in which people can be cued. Visual confusion, misleading information, and distractions must be avoided. For example, people are particularly prone to falling if any of the following factors exist:

- They fail to observe a stairway when the change in levels connected by the stairway is small
- A stairway is in an unexpected position behind a doorway
- The person is distracted by light from outdoors or street scenes
- The person doesn't realize the danger of one or two isolated steps
- The person is impaired by glare caused by windows or skylights

Riser height, which is the vertical distance from one tread surface to the adjacent tread surface, has considerable effect on the way the pedestrian's foot will land on a stair tread. If the riser is too high, it will cause the foot coming off of it to land further out on the tread below. If the riser is too low, it will cause the foot coming off of it to land further back on the tread. Thus, a high riser will result in the ball of the foot landing where there is little or no tread surface to support it and a lower riser will result in the back of the foot being caught on the tread surface. The result is a misstep and usually a fall.

It is imperative that in the future there be little or no variation between riser systems (most codes require uniformity in risers within a 3/16 inch). Studies of stair accidents have indicated that the majority of stairs on which accidents occurred had riser height variations. The AIA Design for Aging guide claims that a high percentage of the falls that occur in housing for the elderly can be traced to a simple riser whose height is different from the other uniform risers in the system.

Tread depth is the distance from the front edge of the step to the riser wall at the back, exclusive of the nosing and overhang. Tread depth is critical for the human gait when descending stairs since the ball of the foot must have a firm surface on which to step. If there is too little tread, the ball will slide off the edge of the tread. Too much tread will cause the heel of the opposite foot to get caught on the front portion of the tread as it attempts to clear the surface. Most building codes require uniformity in tread depth within a 3/16 inch variation.

The brain must properly perceive the change in elevation if it is to successfully negotiate a stairway or ramp. Any variations from what the brain has been taught to expect will result in improper placement of the foot and could result in a slip and fall accident.

While there are slight variations in the minimum dimensions for stairs as specified in the national building codes used in the U.S. (BOCA, SBC, UBC, SFBC) the standards established have provided the necessary critical dimensions that are required for safe use of stairs.

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Steps, Stairs, and Slipping

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Accidents caused by slipping on a floor usually occur on a forward step as the rear edge of the heel meets the floor surface. At this stage of walking the other foot remains in contact with the floor until the heel rocks forward and the leading foot is

fully planted. For slipping to be avoided, the friction between the sole-heel of the footwear and the floor surface must be sufficient to resist the maximum horizontal forces.

External stair treads should have a perforated, or a well-drained surface. Polished wood, polished stone, and smooth ceramic tile should not be used for stair treads. Mat wells should be provided to remove moisture from people's feet. Non-slip strips parallel with the edge of the tread should not be used as they are likely to be confusing to users with bad eyesight. This position is consistent with the AIA's Design for Aging, a guide that recommends that different colors and surfaces be used to differentiate tread edges in facilities used by the elderly. This guide further states that risers and treads of contrasting colors are particularly helpful to people with visual impairments. Friction must not be too great or the foot may lock on the tread surfaces. The user must be able to slide and pivot his foot slightly while ascending or descending a stair. Thus, rubber matting is not recommended as an acceptable covering for the treads.

Building codes in this country are silent with regard to standards for the slip resistance of walkway surfaces, other than those for stairs and ramps which must have a "non-slip" surface. However, few codes define what a "non-slip" surface is.

The most appropriate measure of the slip resistant quality of various walkway surfaces is the static anti-slip coefficient of friction (COF). The accepted industry standard as adopted by Underwriter's Laboratories and the American Society Testing Materials is that a static anti-slip coefficient of friction of .50 or above is safe on a dry walkway surface. A reading below .50 indicates an unsafe walkway surface.

Architects are responsible for specifying the materials used for floor surfaces, and they can be called as defendants in major slip and fall cases. For that reason, materials with a history of being dangerous should be avoided. Terrazzo has a very low anti-slip coefficient of function, i.e., it is very slippery. Terrazzo is composed of granite and marble chips bonded with cement and chemically sealed. Terrazzo is extremely slippery under wet conditions and is so dangerous that the National Bureau of Standards has listed it as a high-risk material for stairway treads. The safety of marble as a walkway surface depends on whether it has worn to a higher safer COF value or sealed and polished to a low unsafe COF value. Marble steps generally have a low COF. One way to make an unsafe marble or terrazzo area safe is through the use of non-slip mats. Tile comes in so many different surface conditions that it is difficult to generalize. Its COF depends on whether it is glazed, has non-slip additives, or is in a virgin fired condition. The architect should review the product literature and specifications with regard to the coefficient of friction. Brick often has a good COF if it is dry and grease free, but it is sometimes difficult to perceive brick step edges. It is crucial that brick tread edges be painted white or treated with a bright or contrasting color.

Standards for coefficient of friction do not exist in the Southern Building Code, South Florida Building Code, the Uniform Building Code, and the BOCA Basic Building Code. Thus, an architect must utilize standards from the National Bureau of Standards, American National Standards Institute, and American Society Testing Materials

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Ramps, Railings, and Rounded Edges

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A ramp is an inclined plane used as a walkway for pedestrians to move from one elevation to another without encountering any obstruction. For the handicapped individual, a ramp is an important necessity of life which provides safety and improves the quality of life.

Falls on ramps often arise from the failure of users to see the edge formed by the level and sloping surface. On an upward slope the stride is suddenly shortened and the victim tends to fall forward; on a downward slope the stride is suddenly lengthened and the victim falls backward. Cues to the change in level are important, and edges should be as distinct as possible. For safety sake, a ramp is preferable to stairs because gentle slopes are usually safer than steps.

Ramp fall accidents represent only about 10% of all slip and fall accidents, but that number is increasing as older buildings are being equipped with ramps and most new

buildings have them at front entrances and at level changes inside. The problem is that too often these ramps are not being built to building code and architectural barrier standards for the handicapped.

Ramps should have a maximum slope of 1 in 12 or approximately 5%. The slope should not vary between landings with the landing being level. Directional changes should only occur on the landing. Ramps also need handrails. One important requirement of the South Florida Building Code is that level changes less than 2 feet should be accomplished by a ramp. Thus, those couple of mystery steps at your local mall probably should have been a ramp and not a stair.

Handrails have become one of the architect's favorite items for creative and aesthetic details. If the handrail is not designed for the human hand it poses a liability risk. It is important to remember that a plaintiff may have a good case where improper handrails or no handrails were present, even though it cannot be determined what in fact caused the person to fall. Where improper handrails were present or lacking, or a violation of the code established,the plaintiff's case is strongest.

A handrail should be at least 2-5/8 inches clear of the wail, with the ends of the handrail returned to the wall so that sleeves, handbags, etc., are not caught and the stairway user thrown off balance. The rail should be uninterrupted for the length of the stairway and continue horizontally for about one foot at the head of the stairway and about 2 tread widths at the foot of the stairway to lead the user into and out of the stairway. Railings should be within the accepted range of heights above the pitch line of 30-34 inches. The railings should be designed to resist a load of 25 pounds per square foot (PSF) for residences, and 51 PSF for commercial establishments. The South Florida Building Code states handrails must support an applied minimum load of 200 pounds or 50 pounds per linear foot.

Efforts should be made to eliminate sharp edges from the design of stairways to minimize injury when a fall occurs on a stairway. Brick steps with sharp jagged edges can produce serious lacerations, yet the same bricks with rounded edges would probably confine injury to bruising. When a person falls while ascending a stair, the reflex is to put the hands out in an attempt to break the fall. With rounded nosing the risk of injury is lessened, while sharp edges can result in cuts and lacerations. If there are open risers and the hand misses the tread, the victim may fall forward and hit his face on the edge of the tread.

Injury to the user can be a liability issue for the architect, and preventive steps should be taken to reduce and limit exposure. Stairs, ramps, and walkway surfaces should meet all local building codes and national standards. Even when foresight and good care is used, there is no guarantee that it will prevent injury or litigation. However, the

issue of negligence and standard of care will be more sympathetic to the responsible architect.

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