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A CURRENT EVALUATION OF SLIP AND TRIP/FALL ACCIDENTS

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Abstract: *Falls are often the result of a failure to provide adequate design, construction, and maintenance safeguards to pedestrians. The purpose of this presentation is to present a brief synopsis of the author's base of knowledge regarding the causation of slips and trips. This paper will also detail pertinent standards and present human factors elements of pedestrian ambulation.*

INTRODUCTION

Falls are a common albeit undesirable part of life. Often as a person falls, embarrassment sets in; the victim limps away claiming, "I'm alright." Only hours later do the effects of an injured limb begin to manifest. While we may have all experienced the perceived feeling of "tripping over our own feet" experience has indicated there are more often structural or site related elements present indicating causation for these unfortunate events. This presentation shall discuss such issues.

DEFINITIONS

Defining a slip or trip is less problematic than the problem of defining pornography wherein we all know what pornography is when we see it but do not agree on a common definition. Due to our probable uniform experiences, "slips" and "trips' are easier to define.

I caution the practitioner to consider the difference between a "slip" and a "trip." All too often are found filed legal Complaints referencing "slip and fall incident(s)" wherein the facts clearly represent a "trip and fall" (and vice versa). This seemingly small detail is sufficient for an allegation of misrepresentation of facts and potential cause for a case to be dropped from consideration, or at least the attorney and expert's expertise to be questioned.

In the case of pedestrians, slips occur when either foot slides over a surface. There is some degree of sliding to each step we take; however, the minimal effects of the foot's sliding force is soon overcome resulting in a stable gait. One common element to slips and falls is that overwhelmingly the person slips and falls to the rear or onto either side although rarely a pedestrian may slip and fall forward.

Trips on the other hand, generally occur when the leading foot stops abruptly, often the cause of striking a protruding object. The forward momentum continues and a forward fall can result. Another type of trip, often referred to as a "missed step," is the result of an unseen rise or otherwise depression in a normally planar walkway. In either case, unlike slips, trips generally result in a fall forward often resulting in injuries to hands,

wrists, knees, and the face.

HUMAN FACTORS

Human factors is defined by one source as the ”science of understanding the properties of human capability[1]” Human factors as related to falls, generally requires that range of visibility be established and that an abnormal condition caused the fall. The expert may also need to establish that the victim was not running, carrying a large or heavy object, or otherwise utilizing an unsafe route.

Visual acuity is the ability to perceive and react accordingly. Paramount to this issue is the “cone or field of vision” or the ability to observe sufficiently lighted objects in one’s intended direction. Various published sources indicate measured lateral and vertical fields of vision. Typically, an alert person has a vertical field of vision of approximately 60°, that is approximately 35° above a horizontal line (i.e., looking straight ahead) and 25° below that line. Some sources even limit that field of vision to 15° both above and below for a total horizontal field of vision of 30°. My purpose herein is not to endorse one study over the other, but rather to alert the reader of this critical issue.

Field of vision often is stressed by the Defense team in order to indicate that at some point in time a tripping hazard or other defect should have been observed by the victim. The question often asked is, “Didn’t the victim have some responsibility to watch where they were going?” Logic dictates that people do, indeed, watch where they are going; however, accidents still occur.

During trial, a picture may be produced indicating the clearly visible “alleged” hazard. There are several fallacies in this attempt as a presentation in logic. First, the photographic display is simply a **graphic representation** intended to portray to a jury the obvious nature of the suggested hazard. An expert practitioner simply should place the photo at his or her feet, look straight ahead and question, “photo, what photo?” since the display will be outside his or her field of vision. Second, short-term memory is such that, of all the continually changing natural and manufactured elements within a persons view at any point in time, it would be unnatural to recall and process each and every one of them. What may be observed in the distance may not be perceived among the multitude of other objects as a hazard at some distance away. Finally, pedestrians typically do not tilt their heads and look down as they walk toward their objective. For example, a shopper exiting a grocery or retail store would primarily be expected to look toward their objective (e.g., a parked car).

THREE PRINCIPLES OF SAFETY ENGINEERING

In order of preference, the three principles of Safety Engineering are:

1. If a hazard exists, ideally remove the hazard.

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[1] Definition: source, Wikipedia, http://en.wikipedia.org/wiki/Human_factors

2. If a hazard cannot be removed, at least guard against the hazard.

3. If a hazard cannot be removed or effectively guarded, provide warnings.

Identifying a hazard may be the most critical but essential issue since most property owners, risk managers, security “officers”, etc. cannot identify any but the most blatant and obvious hazards.

Many hazards such as wheelstops (to be discussed in following sections) are not realized by design engineers, architects, contractors, property owners, etc. as detrimental or hazardous to pedestrians. Then again, the principles that “ignorance is bliss” or “plausible denial” are often prevalent.

The second principle of guarding against a hazard is temporary and first requires knowledge of a defective condition. A gaping sink hole may be universally recognized as a hazard; however, a raised utility vault lid or crack in a concrete sidewalk may not be recognized as such by an untrained risk manger or owner’s representative.

Warnings, are a “last resort” and feeble attempt to provide safety. If effect, warnings do nothing to remove a hazard.

SLIPS

Slips occur on both wet and dry surfaces generally when the static coefficient of friction is relatively low. Some experts have claimed that slips do not occur on dry surfaces. In total disagreement, I suggest an icy pond is dry but clearly not a slip-resistant, safe surface upon which to walk. Experts have also claimed that slips occur when walking between different textured surfaces. While that may be true, that condition is different from the classic slip and fall.

Static coefficient of friction (SCOF) is a measure of a relative friction between two surfaces. A dimensionless number, SCOF represents the “slip resistant” value between two surfaces at which time a slip **begins**. On the other hand, dynamic or kinetic COF (DCOF) is the value at which a slip **continues**. In the context of slips and falls, it is the SCOF value of primary importance to the expert practitioner.

While there is generally no mandatory minimum (safe) value of SCOF, a widely adopted standard is 0.5 (read, “zero point five”) as defined by American Society of Testing and Materials, ASTM D 2047. Critical to this definition is the material to be used to determine this “specification.” As mandated within ASTM Stnd. D 2047, the “shoe” test material for specification testing is required to reconstituted leather and must conform to Federal Specification KK-L-165C. While other test materials may be used, they do not conform to specification testing, and I contend, do not conform to the 0.5 standard. Many experts may use neolite although there is no standard minimum value of acceptance for this material which is also subject to light and temperature changes.

Numerous devices can be used to determine the SCOF (and DCOF) of walkways. Perhaps the two most common (and portable) are the Horizontal Pull Slipmeter (HPS) and the English XL Variable Incidence Tribometer (VIT). The HPS has been an ASTM approved device for many years without interruption. The VIT was originally accepted by the ASTM in 1996 and has been in continuous use except for several years beginning in 2006 when it was withdrawn by the ASTM for failure to meet precision criteria and for providing proprietary information where this information was not permitted by the ASTM. Both devices are portable and relatively simple to calibrate and use. Both devices allow a myriad of test materials, most often the referenced leather, neolite, and rubber. While both devices can be used in testing dry and wet surface, the leather or similar materials cannot be used for testing of wet surfaces by either device due to absorption of the liquid into the test specimen causing an effect known as "stiction."

Slips often occur on smooth dry surfaces such as linoleum, tile, marble, etc. Most large retail and grocery stores and also wholesale centers have extremely smooth floors. In the case of applied floor surfaces such as tile, ease of cleaning is the presumed benefit and reason for a smooth "shiny" surface. With regard to wholesale centers, one finds highly troweled concrete floors, again for ease of cleaning but also to reduce wear and tear of tightly turning forklifts. Compared with most public standards for concrete sidewalks which often require a "light broom finish" private properties seem to disregard the effects of smooth walkways resulting in low SCOF and potentially slippery surfaces (wet and dry).

Although there is no mandatory standard for the SCOF of a wet surface, tests I have performed in the past indicate a wet SCOF approximately 60 - 70% that of similarly tested dry value. While this may be of some value as a classification, quantitative determination of (wet) SCOF as it may relate to an accident site is rarely possible. Essentially, there is no determinative value for wet SCOF but perhaps even more important, the nature and quantitative values of the liquid is often undetermined. Was the spill/debris purely water? How large was the spill? How long had the spill existed? Were the spill and material verified?

My experience of examples of slip-causing debris has included spilled liquids, condensate from nearby coolers, large quantities of paper napkins intentionally strewn across dance floors, confetti shot out of cannons at nightclubs, and personal items of clothing removed by revelers!

Standards for evaluation of slippery surfaces are typically voluntary, not mandatory. The most widely used sources for the standardization of SCOF are the ASTM, Underwriters Laboratories, OSHA, and Liberty Mutual, all of which, to my knowledge, adopt the minimum value of 0.5 as being a safe walkway. Interestingly, many building codes and especially the ADA require that specific surfaces must be "slip resistant" although no definition of "slip resistance" is offered!

TRIPS

Trips are generally easier to evaluate because of the presence of quantifiable and verifiable evidence and mandatory standards whereas “slip standards” are largely voluntary. Lighting levels can be measured and compared to local standards. Changes in level along walkways can be measured. Steps along stairways can be analyzed and compared to local mandates. The slope of ramps can be easily measured.

Change in Level

Trips most often occur because of an unseen “change in level.” The Federally mandated Americans with Disabilities Act (ADA) requires that a (vertical) change in level of greater than 1/4" requires edge treatment. From 1/4" to 1/2" the edge must be beveled at a slope of 1 : 2 (read, “one to two”). “Changes in level greater than ½ inch (13 mm) shall be accomplished by means of a ramp. . . .[2]” While this standard is generally perceived to be applicable only to disabled persons, a review of this ADA source reveals the referenced standards are a clearly mandatory extension of local building codes. The ADAAG (see footnote no. 2) or similar standard is to be incorporated into local building codes thereby applicable to nearly all properties (along an accessible route which includes most elements of building and site design).

An alternate “accessibility” code is often referenced, that of the American National Standards Institute (ANSI) Stnd. A117.1. Similar in nature to that of the ADAAG, the ANSI A117.1 standard was used to create the ADAAG and is similar in many respects.

Falls on sidewalks and walkways often occur due to unseen changes in level. Sidewalk cracks are often unrepaired; expansion joints are not properly formed at the time of initial construction. Tree roots or deficient drainage often raise sections of sidewalks causing tripping hazards. The expert may occasionally find a 4 - 8" rise in a walkway whereas a ramped or sloped surface would have eliminated the single-step-riser, often recognized among experts as a serious tripping hazard.

Stairways and ramps are typically required to be designed, constructed, and maintained to strict standards requiring conformance to slope, riser height, step tread length, and handrail configuration. Local building standards often clarify the method of determining the rise and run leaving little to interpretation. Single step risers are notoriously hazardous and currently are prohibited by many codes. Occasionally, the expert may be asked to analyze what may be described by one party not a stairway but simply a “series of landings.” For reasons unknown to me, an architect or contractor occasionally opts for the multiple landings scenario which may not be seen as having to comply with the strictest definition of a stairway (often two or more risers) and may not require handrails. If there ever was an “accident waiting to happen” this is it! When one can alternatively construct a proper stairway or ramp, one should consider the safest design.

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[2] Americans with Disabilities Act, Americans with Disabilities Act Accessibility Guidelines (ADAAG), Sec. 4.5.2, 1990.

There are often conflicts between building codes and their relevancy to elements beyond the envelope of the building. Building officials are often heard to stress that they are only "building officials" and that their plan review does not extend beyond the exterior of a building. Since the City's public works officials generally insure proper development only on public streets, there appears to be a perceived "no man's land" from the property line to the building! As such, many building officials claim they have no jurisdiction beyond the building's exterior. A review of past and current building standards clearly reveals an opposing conclusion.

Many building standards require a safe exit from a building to a "public way" which is further and generally defined as a parcel of land unobstructed to the sky, a "safe harbor." The purpose of a safe exit is to provide adequate escape from a roof collapse, fire, or other disaster. Accordingly, exit requirements typically include lighting standards and conformance to ramp and stairway design. The exit begins at an appropriate location within a foom , extends to a point exiting the building and then, terminates at a safe distance from the building. As a result, standards for trip and fall conditions such as ramp and stairway standards apply both within and outside a building.

Many falls occur over speed bumps. Speed bumps can be found in most cities but are typically prohibited along public streets. Generally found in parking lots or on private streets, they are an attempt to control speeding traffic where other speed-limiting procedures are ignored or untried. Speed bumps are generally 6" in height, approx. 18" wide and as long and numerous as an effective asphalt salesman can emphatically convince the unknowledgeable buyer of their need. Speed bumps are known hazards to both pedestrians and vehicles.

> *Speed bumps have been installed in some parking lots with an intent of slowing traffic speeds. A major study by the City of San Jose, California, found bumps on streets to be hazardous and recommend against their use. Evidently, pedestrians can also trip and fall over such impediments. Use of speed bumps may be considered undesirable in parking lots.*[3]

An alternative to speed bumps are "speed humps," similar in height and length but wider than speed bumps. A properly designed and constructed speed hump would be at least 12 times wider than tall (from center to each side). Therefore, for a 6" high speed bump, the total width would be at least 12' (6' min. each side). Why, one may ask the seemingly excessive width? The reason is that tests have proved speed humps are at least as effective as speed bumps, create less havoc to the vehicle and driver, and the side slope simulates that of an acceptable ramp (at a minimum 1 : 12 slope) thus rendering the side slopes safer for pedestrians to traverse.

No discussion of tripping hazards would be complete without a hearty reference to wheelstops, wheel stops, parking bumpers, or however else they may be referenced.

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[3] Pline, James L., Editior, Traffic Engineering Handbook, 4th Edition, Institute of Transportation Engineers, pg. 215, Prentice Hall, Englewood Cliffs, New Jersey, 1992.

The term “wheelstop” is descriptive enough and the term will be continued herein.

Wheelstops are often concrete in construction although other materials are occasionally used. Wheelstops are typically 6' long, approx. 6 - 8" in height and approx. 6" wide. At this time I want to emphasize my professional opinions regarding wheelstops. **Wheelstops are <u>never</u> an acceptable site element when placed in an area of predictable pedestrian passage!** Wheelstops are pedestrian tripping hazards. It is as simple as that!

Incredibly, while most wheelstops are placed in the center of parking stalls, many are placed across the common line between two stalls. If a patron is lucky enough to miss tripping over a wheelstop entering a retail store, he or she has another chance at injury while exiting presumably, while carrying a bag of groceries, clothes, or other purchased goods, particularly at night when pole or wall-mounted lights cast shadows between parked cars. I’m often asked by a Defense attorney if I’m familiar with X, Y, or Z parking lot (often supported by photos wherein the visual display indicates parking spaces including wheelstops). My normal reaction is, “Yes, regrettably so.” Finally, predicting the “surprise evidence” presented to me and the jury, I have typically already provided my client (i.e., Plaintiff’s attorney) with a similar set of photos of other parking lots without wheelstops. My experience has shown that there are more parking spaces without wheelstops than those which include these tripping hazards. And one has not truly experienced a major injury until the victim has fallen over a darkened wheelstop at night carrying a bag full of groceries which, along with the injured party, come crashing down to the hard asphalt parking lot!

Incredibly, I find that most often wheelstops are placed in front of accessible (i.e., “handicap”) spaces. Again, if a patron is not handicapped going in, he or she may be coming out!

So what are the alternatives to wheelstops? Beyond the obvious decision to not install them, bollards are an effective means of (1) defining the forward position of a parked vehicle and (2) placement of signs atop the bollard. Bollards are those familiar concrete-filled steel pipes (approx. 6 - 8" in diameter and approx. 30" in height) placed vertically at the front of some parking stalls. Bollards are move visible than wheelstops, pedestrians would be hard pressed to trip over bollards, and they make an excellent sign base which otherwise, the sign would be struck and bent.

CONCLUSION

Slips and trips are life threatening events and are avoidable. The expert witness should be aware of mandatory standards and even those of a voluntary basis which may also be the “standard of the industry.” The expert witness should be aware of voluntary and mandatory codes and of safety features often not considered by designers, architects, engineers, contractors, and property owners. Realizing that accidents often happen for a reason, the properly armed slip and trip/fall expert is in a position to generate unique expertise.

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