Session No. 704

Ergonomics-based Methods of Inspecting, Assessing and Documenting Environmental Sites of Injurious Falls

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Introduction

This presentation is primarily based on decades of methodological experience developing, testing, implementing, publishing and debating methods that are key to assessing and documenting sites of injurious falls that lead to litigation in which environmental flaws are suspected, alleged, assessed, documented and demonstrated, often in a relatively rigorous fashion through the legal process. Furthermore, the most important of the methods have been published in the scientific/technical literature on ergonomics of falls as well as being reflected in technical requirements of codes and standards for the built environment. The presentation also draws, in part, from a three-hour workshop at the Annual Meeting of the Human Factors and Ergonomics Society on October 1, 2007. However, despite this extensive record, the methods are apparently little known to many investigators called upon to provide initial documentation of fall sites. Also, some investigators and "experts" lack sufficient skills to identify all of the environmental factors that should be considered in the analysis of certain falls, in this context restricted to falls resulting from missteps on small elevation differences, slopes and steps. This means that many fall sites are not adequately assessed, as well as being poorly documented. In turn this means that dangers are allowed to persist and responsibility for such dangers is not properly considered in legal proceedings ensuing after some injurious falls.

A secondary basis for the presentation is extensive experience gained by the second author in home inspection and teaching of home inspection. In addition to not focusing solely on fall hazards, such home inspections are conducted in a commercial context that imposes some constraints on the breadth and detail possible in the inspection and subsequent reporting. Nonetheless, such inspections are potentially important as, unlike post-incident investigations conducted for forensics reasons, home inspections can address injury dangers in a proactive fashion. The extent to which home inspections actually can be proactive and injury-prevention oriented is addressed briefly along with institutional reasons retarding widespread or universal reliance on commercial home inspection for fall prevention. Also addressed are real-world limitations on other inspections performed in home settings by regulatory authorities enforcing minimum requirements of design and construction codes.

Both authors have experience with serving on national committees responsible for developing national model codes and standards that include, to an admittedly small or compromised degree, provisions intended to reduce the likelihood of injurious falls in homes and other buildings. The limited extent to which even such incomplete requirements are enforced in the inspection of new homes and other buildings is a major concern addressed in the presentation which, in the very limited time available, can only cover inspection issues incompletely. However, even with the limited scope, some important pitfalls will be identified as will relatively simple, positive steps that, if competently employed, could improve the quality and utility of *all* inspections done at any stage of a home or other building's life to help identify if not reduce injurious fall dangers.

Among the critical limitations of the presentation is the focus on fall dangers in which slipping is not the primary misstep mechanism. This is done because there already is much attention paid to slip dangers, especially in occupational settings that are a prime focus of many professionals in the American Society of Safety Engineers (ASSE). Other misstep types, identified below, receive much less attention among such professionals and this is one of the relatively unusual presentations that attempt to redress the imbalance in coverage.

Objectives

- To increase *awareness* of the need to assess and document—systematically and in detail—environmental sites of injurious falls.
- To demonstrate *how* such assessments and documentation should be done, based on extensive experience in the detailed examination of falls that lead to litigation in which multidisciplinary, internationally recognized, scientific and technical expertise is employed.
- To describe inspection techniques that, although intended for less rigorous applications (including home inspections), are based on principles utilized in the more demanding forensics examinations.
- To underline the importance of increased attention to environmental factors that should be identified and mitigated, if not eliminated, to help reduce the toll of predictable and preventable fall-related injuries in homes and other buildings.

Types of Missteps Leading to Falls

Presentations given by Pauls to recent annual meetings organized by the International Ergonomics Association (IEA) Slips, Trips and Falls Committee have dealt with fall-prevention programs in the home, with inspection and documentation techniques as well as with basic terminology issues in the "missteps and falls" field (the preferred general term in place of "slips, trips and falls").[1-3] Within recent ASSE Professional Development Conferences (PDCs), there was also a presentation by Pauls focused on fall issues associated with stairways.[4] Within these papers, especially one from 2006, efforts were made to utilize falls terminology that did not prejudice the cause of the fall and which took pains to include the full range of potential missteps—the departures from normal gait—that could lead to a fall. As fully described in a guide to "forensic human factors terminology" in the *Handbook of Human Factors in Litigation*,[5] the misstep types include the following:

- **Air Step:** unexpected step into a hole, depressed part of a walkway (which could be a sloped surface such as a ramp) or an unanticipated step of a stair.
- **Heel Scuff:** catching ones heel on the riser of a stair during descent.
- **Overstep:** placement of ones foot too far forward on a stair tread.

- **Slip:** loss of traction at the interface of a foot/shoe and the walking surface.
- **Trip:** catching a part of ones foot/shoe on a projection or on a surface with unexpectedly high friction characteristics; the latter sometimes is referred to as a "stumble."
- **Understep:** inadequate placement of a foot/shoe on a stair tread in ascent.
- **Unstable Footing:** lack of stable support in the walking surface so that ones foot/shoe rotates awkwardly potentially twisting the ankle.

"Slips" and "trips" get disproportionately large attention in the occupational safety field and are the labels often applied generally to misdiagnosed misstep scenarios. For example, as a result, many falls that are characterized as "slips"—the most common descriptor used by ordinary people to describe the mechanism of a fall they experienced, *simply because it has become a broad term to describe what ergonomics professionals have described more exactly as "missteps—*are not properly coded, let alone investigated. On stairs this leads to well-intended interventions that, in some cases, make the stair more dangerous, not less so. Therefore, much of the lead author's concern is about the equitable distribution of research skills and other resources. Some missteps, notably air steps, have not gotten their fair share of study (for example, in comparison to extensive resources devoted to tribology in true slip missteps).

There is also evidence that some professionals give such other missteps short shrift or rule them out entirely, for example when investigating an incident, simply on the basis that they are neither a slip nor a trip. An example of this occurred at the 2006 ASSE PDC in Seattle in the presentation of the paper by Joganich.[6] An incident that the presenter could not explain using the terms "slip" or "trip" appeared to be improperly dismissed as a deliberate "jump" by the fall victim even though the described misstep appeared, from his description including an uneven collection of compacted snow, to be an air step misstep leading to a fall. That this was the presenter's apparent testimony in a legal action makes the possibility of a diagnostic error even more troubling especially in a paper intended to address biomechanics.

Even more troubling is the current plethora of programs in fall prevention and mitigation that are based on possible misconceptions about what they are trying to prevent or mitigate. A prime example, addressed in part by Pauls,[2] is in home safety programs that focus on tacking down or otherwise keeping small rugs and mats from "slipping" when these interventions ignore or exacerbate tripping and stumbling problems. The relatively short-stride gait of older pedestrians appears, to this author, to make tripping on a fixed rug edge—elevated with some widely recommended interventions— a greater problem than having a rug slip on a floor.

Injuries can occur even if a misstep does not lead to a fall. Among the scenarios for this are those resulting in fractured or sprained ankles as well as damaged knees, hips and spines when a person—*without uncontrollably losing balance*—experiences an "air step." Such a step down could be on the order of an inch (25 mm) or several inches; however, if the unexpected drop does not exceed about 7 inches (180 mm), ones body cannot begin to respond to the unexpected drop of the foot and take mitigating actions reflexively or otherwise.[7] The seriously injurious misstep by former President Clinton at on the exterior stair at Greg Norman's home was of this type because, apparently, Mr. Clinton was unaware of an additional, lowest step on a stair flight and, moreover, he reportedly did not fall to the ground as he was caught by Secret Service agents. However, the knee trauma had already occurred simply from the jarring foot landing in the air step. The fall by President Fidel Castro, captured on video and widely shown, was a classic air step which, in his case, led to multiple uncontrollable impacts of hands and knees to the floor with resulting serious injuries. In both cases, neither president anticipated or expected there would be, respectively, another step or a step at all.

Expectation and the Importance of Visual Testing and Documentation

Generally, "expectation" is a key factor in missteps and falls of many types and this must affect the nature of what is documented when investigating a site and other factors after a fall. A classic error made by many fall site investigators is indiscriminate use of auxiliary lighting and of wide-angle lenses when photographing a fall site. Unless the fall occurs in a mining situation where it is common for workers to have a light on the top of their head, it is unheard of for a typical pedestrian faller to have a light on his/her head immediately prior to experiencing a misstep and fall. Thus it is improper to utilize such an auxiliary light to illuminate a scene when trying to photograph a scene—*as it was supposedly seen by the fall victim.*

Similarly, the optics of human eyesight are not those of a wide-angle lens of a camera which tends to distort the relative size and placement of objects in the visual field. Thus, to reasonably document a fall site in a way that is representative of what a falling person would have seen immediately before a fall one must use photographic equipment wisely, including use of a reasonably normal perspective lens and a tripod to hold the camera steadily so that long exposures—allowing good depth of field—can be taken using available light only—*specifically light comparable to that present at the time of the fall.* Appropriate, time-tested techniques for doing this, and preparing the multi-image exhibits or "panoramas," were described by Pauls.[1] The correct way of viewing such multi-image panoramas is depicted in Exhibit 1; this describes the site of an air step at a doorway to an underground parking garage where there was a hidden step down, shown with zebra marking added in the exhibit. Other protocols to observe generally in investigative photography have been addressed comprehensively by Wenzel.[8]

Exhibit 1: Correct viewing of normal-perspective photo panorama is depicted by Jake Pauls

A serious but perhaps very pervasive defect in many homes, and occasionally in other buildings, is found where the landing nosing of a stair does not have the same projection that is found on all the treads of the stairs. The unfortunate result is that the top tread has an effective tread depth that exceeds all of the other treads in the flight by an amount equal to the nosing projection. The defect is relatively easy to detect visually if one knows what to look for; simply sight down the line of the step nosings to see if they all line up—including the upper landing nosing. This simple visual test, taking less than 10 seconds to perform and requiring no equipment, could catch all of these defects which increase the risk of an overstepping misstep on the second or third treads of the stair by orders of magnitude. The defect is also relatively inexpensive to fix, particularly when the stair is newly constructed and first inspected by the code authorities; however the error apparently often goes undetected by the authorities even though, under model building codes in the USA, the defect is explicitly prohibited as a dimensional nonuniformity. (In Canada, where the defect appears also to be fairly common in new homes, the building codes are more confused on this matter.)

The bottom line is that many home stairway users, using the stairs with an expectation of dimensional uniformity, are needlessly exposed to the most potent of all stairway defects, a significant nonuniformity in the tread dimensions. Exhibit 2 depicts such a defect on a home stairway being documented photographically by the lead author with the help of a large mirror provided on the stairway. This illustrates the 10-second crouch and view test for initial assessment of step uniformity and nosing visibility.

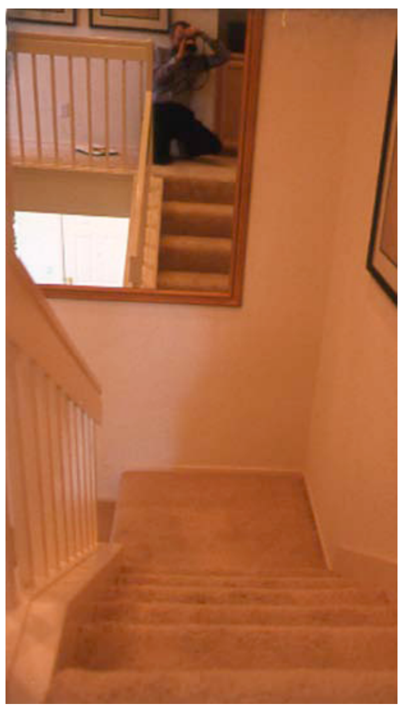

Exhibit 2: Jake Pauls illustrates the 10-second crouch and view test for intial assessment of step uniformity and nosing visibility on a home stairway.

The authors believe that no other test performed in home and other building inspection, if diligently carried out, would have a similar fall and injury prevention impact as this one test would. As the defect appears to be most prevalent in homes, including perhaps a sizable fraction of all new homes constructed in recent decades, this might be a factor in the extraordinary growth in home-stair related injuries reported in the US Consumer Product Safety Commission (CPSC) National Electronic Injury Surveillance System (NEISS) national estimates especially in the last decade. Compared to an essentially flat trend for stairs not in homes, CPSC/NEISS national estimates for hospital emergency department-treated injuries reported for home stairs have a 4-percent annual growth rate with a 40 percent increase in the last ten years or so.[9] Exhibit 3 depicts the trends.

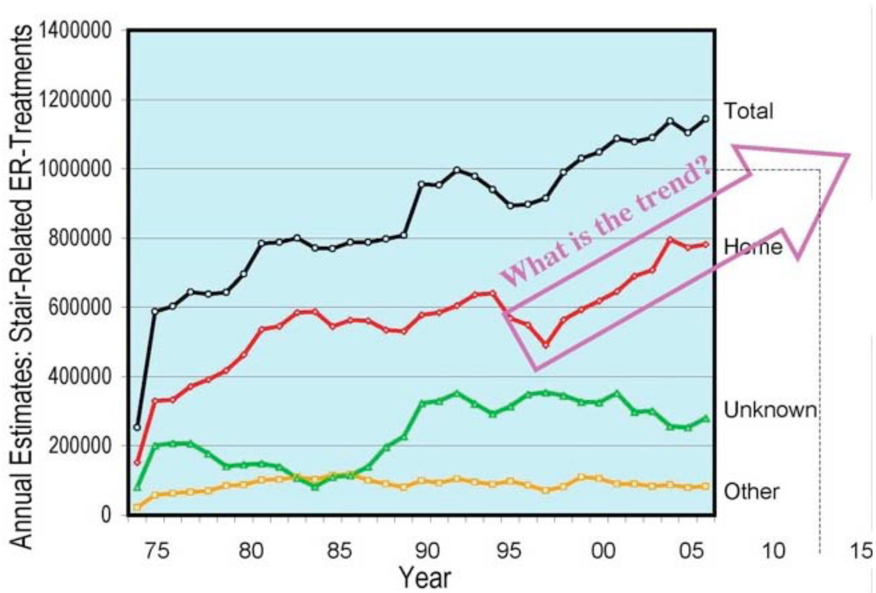

Exhibit 3: National estimates of stair-related injuries are based on US CPSC/NEISS data.

Although the vast majority of stair-related injuries, where the location is known, occur in home settings, relatively few of these are ever litigated, mainly because the homeowner cannot generally be sued by the people who use the home stairs most commonly, the homeowner and his/her family. This fact underlines the increasing importance of whatever inspection should be done by regulatory authorities at the time of original home construction and, more frequently, as a matter of fairly common course when the home changes owners and a private-sector home inspection is done.

Realities of Governmental Code Inspection and Private-Sector Home Inspection, Particularly with Regard to Stairways

Unfortunately from what the second author has seen, building departments that evaluate new homes for building code compliance, are far more often than not understaffed and overworked considering the number of residential new construction code inspections each inspector is expected to perform in a given time frame. There might well be additional factors, including disincentives to challenge builders and ignorance of the relative public health impact of various home defects, for example, those related to fires as opposed to falls which are not generally recognized as being on the order of a ten to a hundred times larger in public health impact than are fires. In Exhibit 3, if fire-related injuries were plotted they would lie below the lowest, "other" curve and would show a 50 percent drop over a three-decade period, contrasting sharply with the 100 percent increase for all stair-related injuries during the same period. (See also Exhibit 4 regarding burden of injury for stair-related injuries.)

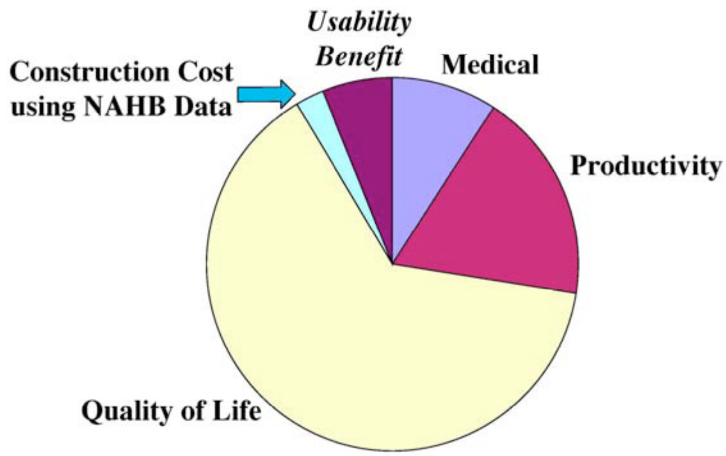

Exhibit 4: Total burden of stair-related injuries (medical costs, lost productivity and quality of life losses totaling $47 Billion in USA in 1995,[10]) is compared with stair usability benefit (based on $0.002 per person-story use) and original construction cost (0.3 percent of overall home selling price according to National Association of Home Builders, NAHB[11]).

Some consumer homebuyers, who have the opportunity to watch their house being built, recognize that governmental, usually municipal, inspection is faulty even before their home is complete. They at least try to find a home inspector who is knowledgeable in residential construction building code to double check the work of the municipal building inspector. While less than 5% of the typical home inspectors calls will be for new construction, a home inspector trained in the residential codes can make an effective effort to catch the code violations that the municipal building inspector didn't have the time to catch.

Of the new single-family detached homes that the second author has inspected after the home has been "finaled" by the municipal inspector, it is typical to find a minimum of about 30 problem items in the home. Unfortunately, by just judging the statistics on new construction versus existing homes that sell in a typical year, we can suggest that approximately at least 75% or more of the new homes are not being inspected beyond the municipal inspection. While the codes have requirements for stairways, these do not match the standards recommended by internationally recognized stairway experts. Thus, whether due to poor code requirements or inadequate inspection, many homes have risky stairway geometry and other defects that place many homeowners at risk starting with first use and continuing for decades.

Regarding "poor code requirements," the NAHB and its many state and local builders associations have been very successful in preventing unamended adoption of even the already compromised 7.75-inch (197 mm) maximum rise by 10-inch (250 mm) minimum tread depth in the widely used *International Residential Code*. The builders have largely succeeded, across the USA, in maintaining actually adopted and (partly) enforced traditional requirements with 8.25-inch (210 mm) maximum rise and 9-inch (230 mm) minimum tread depth. Notably, as discussed below, the actual dimensions at the time of home occupation are even worse as carpeting and padding further increase the effective step rise (by about 0.5 inch or 13 mm) and reduce the effective tread depth (by as much as a inch or 25 mm). In Canada, the homebuilders have succeeded in maintaining even worse step geometry requirements, indeed the worst model code requirements for home stairways in the English-speaking world. Contrasting dramatically with these commonly encountered home step dimensions are the results of extensive testing by the UK Building Research Establishment which showed that minimum tread depth or run ("going" in UK parlance) dimensions are not even "optimum" until about 14 inches (350 mm) in size.[12] Surveys by the same researchers also showed a direct correlation between improved tread depth ("going") dimensions and a major reduction in reported falls on home stairs.[13]

Following the original construction inspection, the next time that a home typically receives a significant inspection is when it is sold and the buyer hires a home inspector to inspect the home as an existing home. Existing homes typically have high-risk stairways because—the older the house—the code, when enforced, was set at a much riskier standard. In informal surveys conducted on those who have reviewed home inspections in a large number of states, even currently, the typical home inspection identifies only in the range of about 5-15 defects in the home. An independent home inspector—defined as a home inspector who is not likely to be influenced by possible outside pressure to "white wash" the home in the inspection report—will typically find at least around 40 defects and on the average up to about 60 defects, some of which are likely to be stairway defects. In addition, as a general rule, home inspectors utilize inspection forms that tend to de-emphasize stair geometry because there are no home inspection standards for evaluating stairs as part of a home inspection and because rigorous stairway standards are typically avoided by home inspectors. Even the simple, 10-second crouch and view test checking the alignment of nosings on a stairway (as depicted in Exhibit 2) is rarely used by home inspectors.

Thus, whether due to inadequate home inspection standards or the avoidance of the rigorous inspection of stairs by home inspectors, risky stairway geometry put in place at the time the home was built, continues to place many homeowners at risk long after the house is built. (Indeed, if carpeting on steps is not properly installed and maintained, the effective step geometry further deteriorates over time.) As a result of this, the second author often refers to American housing as "hand-me-down" housing. In other words, in the end, a trail of inspections over the life of a home without adequate emphasis on stairway geometry continually place many home owners at risk throughout their lifetime regardless of how many different homes they live in during that time.

Other Aspects of Stairway Step Geometry Including Measurement Methods Using Digital Levels and Laser Levels plus Effects of Carpeting on Effective Dimensions

US model building codes correctly specify a stair's rise and tread depth (run or going) dimensions as being measured nosing-to-nosing, respectively as the vertical and horizontal distances. Many investigators and inspectors appear to be unaware of this as they blithely use a relatively crude, error-prone method of measuring the step geometry using a measuring stick or tape casually-placed against the riser and tread. Over a decade ago, the lead author presented a more-sophisticated and more-correct method utilizing an electronic level to measure the inter-nosing angle (to 0.1 degree) and distance (to 1 mm).[14] Exhibit 5 illustrates the method. From these data, taken for each and every step in a flight, sine and cosine functions are used to calculate the vertical and horizontal dimensions corresponding to the actual rise and tread depth to the closest mm or 0.01 inch. The method was subsequently checked out by a stair safety investigation colleague and published in greater detail, including guidance on how the method could be utilized where the stair treads were carpeted.[15] Exhibit 6 illustrates one method for using the technique with a carpeted stair where it is important to identify where a person's foot would be supported by solid structure below the carpet and possible padding.

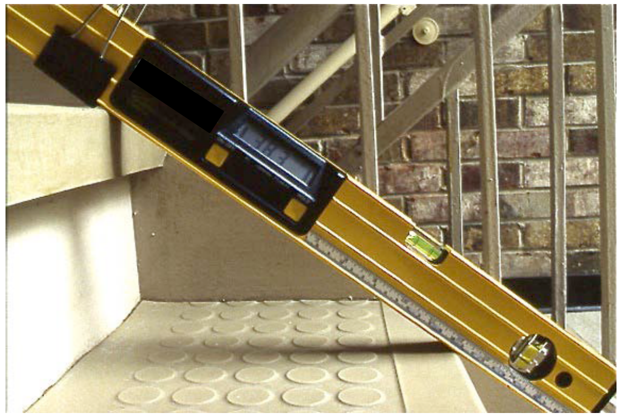

Exhibit 5: Electronic level is used to make accurate measurements of a stair's nosing-to-nosing dimensions, the step rise and tread depth.

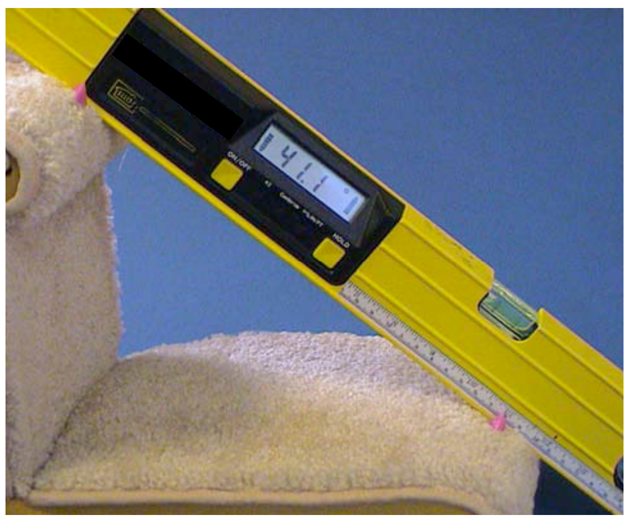

Exhibit 6: Electronic level method used with marker pins stuck through carpeted stair.

Stairway Visibility, Marking and Illumination

In recent years, stairway safety investigators Cohen and Pauls have collaborated on a handbook chapter focused on visibility issues, marking and warnings for pedestrian dangers; this provides an authoritative treatment of these topics. For example, the dangers of incomplete marking of some nosings of stairs are noted. Exhibit 7 shows a classic example how visually confusing the marking of only top and bottom nosings of a stair can be, illustrating the worst-possible scenario with a three-riser stair with the middle nosing left unmarked, the stair finish being one of the inherently camouflaged stone surfaces and—as if that were not enough—the designers have added an additional confusing marking on the landing. The subject stair is in a prestigious California hotel lobby and provides a damning indictment of the commonly used rule or convention in California to mark only the top and bottom nosings of stair flights. Further exacerbating the dangers of the stairway is the presence of veiling glare in the background that would further reduce an older person's ability to safely detect the presence and location of all the steps.

Exhibit 7: This hotel lobby stairway illustrates the dangers of marking only the top and bottom step nosings, leaving unmarked the middle one in this case. Note other safety problems with this stairway including camouflagued tread surfaces, confusing markings on the lower level and veiling glare on the floor ahead.

<u>Steps at Doorways</u>

Single-riser stairs, with the exception of sidewalk curbs which are in an expected location and of expected height, are relatively dangerous. Having single steps at doors, such as is often done at home entrances makes their dangers as well as their nuisance value even greater. Ironically, since 1988, the National Fire Protection Association *Life Safety Code* (NFPA 101, an ANSI standard) has had an excellent section near the beginning of its chapter on means of egress dealing with limited elevation differences in means of egress—affecting both stairs and sloped surfaces—but the *Code* still has a vestige requirement permitting a step down at the entrance door to a dwelling unit.

Exhibit 8 depicts a badly constructed, undersized platform at the entrance to a new home; the woman owner of the home fell on her first use of the entrance after she had insisted the builder add the platform because the original step down at the door was considerably higher than permitted even by the relatively lax code for dwelling construction used in the locality. Given that such platforms, not at the level of the doorway (unlike here), are permitted by codes, such cases pose challenges for the expert serving on behalf of the plaintiff. Careful attention must be paid in such cases to the minimum landing sizes called up by the codes as well as other, non-code issues such as visibility of the landing edges; both were serious problems with the exposed aggregate concrete finish and undersized platform employed here.

Exhibit 8: This home entrance was the site of a fall by the building owner on her first use of the entrance after the builder, responding to the owner, added the platform but made it too small and difficult to see for a person coming out the doorway.

Visitability, the increasingly popular movement to step-free home entrances (in addition to a few other modest accessibility/usability provisions), will someday be more widely adopted—as it has been nationally adopted for about a decade for new homes in the UK. With this, there will be a significant safety benefit as the awkward, ergonomically challenging combination of door use and stair use will no longer be combined in a relatively dangerous package. Meanwhile, efforts by the authors go on within the NFPA codes committees (on which they serve as consumer representatives on behalf of the American Public Health Association) to require for new homes the same step-free entrances that are the norm for all other new buildings.

Handrails for Stairs and Ramps

Just because a stairway or ramp is provided with a railing does not mean that there is a functional handrail available. Thus, in any investigation of a fall site, not merely the presence or absence of a railing should be noted. Relevant to the usability and effectiveness of a railing—to be counted on as a useful handrail—are its cross section, size, surface characteristics, height, continuity, spacing, clearance to nearby objects, conspicuity, etc. Most contemporary home stairway railing systems are virtually worse than useless as they do not function adequately as handrails and are more valued for their purely decorative functions. A prime example of misplaced priorities in railing selection—as well as code provisions under the *International Residential Code* (IRC)—are what are termed "Type 2 handrails." Such handrails, based for example on the type 6010 railing profile and larger examples of such profiles (employing a wider top section and a slightly narrower portion onto which one is expected to lock ones fingers—NOT) have been permitted in the IRC but not the NFPA codes. Exhibit 9 illustrates two railing sections, both available in retail home improvement stores; there is an inverse relationship between the sections' quality plus safety and their cost. One permits a power grip; the other (the "Type 2" one) does not.

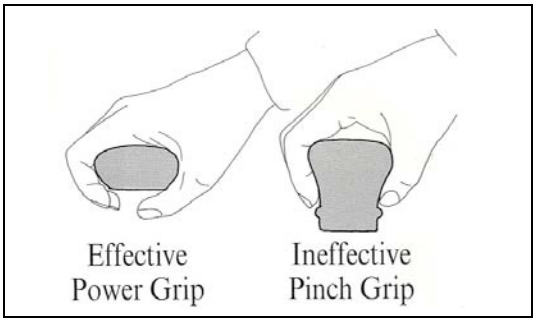

Exhibit 9: Two basic types of grip for two railings having the same upper profile.

Experts and investigators wanting to review the best international review of research evidence for various handrail parameters, including section shape and size, are referred to the Feeney-Webber report from 1994.[17] As with the Canadian biomechanical studies initiated by the lead author during his time with the National Research Council of Canada, this critical review of all studies to that time concluded a few things "with confidence." One was the section shape and size of the handrail for acceptable safety and usability: circular with a 32 to 50 mm (1.26 to 2.0-inch) diameter or oval with a thickness 18 to 37 mm (0.71 to 1.46-inch) horizontally 32 to 50 mm (1.26 to 2.0–inch) vertically. Height recommended "with confidence" for adults was 935 to 1000 mm (36.8 to 39.4 inches above step nosings. For recommendations for children, reference should be made to the stairways chapter of a new handbook on ergonomics for children.[18]

<u>Documenting Changes of Level and Slopes Other than for Stairs</u>

Sidewalk discontinuity cases need the same kind of careful attention to detail that is needed for cases involving stairs. An electronic level as well as laser levels should be employed to establish exact elevations and walking surface slopes. A variety of photos should be used to establish context (with lighting conditions, shadows, etc. similar to those at the time of the fall) as well as the details of the area where the misstep occurred. Exhibit 10 shows a pair of many photographs taken to document a fall site at the junction of a grated area and a concrete sidewalk.

Concluding Comments

As has been stressed in the foregoing introductory guide to measurement and documentation of misstep and fall sites, there is no substitute for an open mind toward various kinds of missteps—beyond slips and trips—and there is no substitute for careful data collection. While some investigators rely on a tribometer in fall site investigations, this paper has focused on the many kinds of falls where slipping is not the primary misstep mechanism nor is a classic trip involved. Air steps, the unexpected step onto a lower walking surface, are a prime example of a misstep that involve neither a slip or a trip. Calling such a misstep a "trip" or "slip" does not contribute to its understanding, nor does attribution of such missteps to mistakes or lack of attention on the part of the falling person. Many dangerous walkway settings are set up to deceive those walking along them; sometimes during particular lighting conditions including contrasts between shadowed and directly illuminated areas. Careful attention to time of day, season, weather conditions might be essential to fairly and accurately assess a situation.

Exhibit 10: This is an example of two of many photographs taken to document the exact location of a misstep and fall as well as the context that had special importance to the person falling. In this case, other documentation showed there were elevation differences here that are visually hidden.

Above all, the careful investigator of falls must always keep in mind what was the expectation of the person experiencing the problem. This is at the heart of an ergonomics-based approach. Ask if the person's expectation was reasonable generally, i.e., the steps of a stair are assumed to be of consistent dimensions. Ask if normal expectations were violated by the situation. What warnings were provided? Never assume that a walking surface is without flaw. Check levels and slopes with reliable instruments. Be prepared to be surprised.

Finally, never assume that a facility complies with the building codes or that, even if it does, that there are not residual safety issues. Codes are neither complete nor up to date. Also, after you become an expert in the investigation of falls, do what you can to help revise and update the codes and standards that design professionals, builders, owners and others rely upon for guidance as to what is required. If advising such people on the codes, remind them and yourself that compliance with a code is necessary but not sufficient for safety. We still have things to learn about fall safety and we have much that has been learned that has yet to affect the codes.

Endnotes

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