Engineering out slips and falls

While many adults may slip, comparatively few fall. It may thus come as a shock to learn that 135,619 persons were discharged from Australian hospitals in 2003-4 after an unintentional fall[1]. Falls on the level from slipping, tripping and stumbling were clearly the predominant cause of injury. Given the litigious nature of our society, we should obviously do everything possible to prevent slips from occurring.

Occupational health and safety legislation requires that employers and controllers of premises must take reasonable care to identify hazards arising from the physical working environment, including the potential for people slipping, tripping or falling. A controller of premises must ensure that hazards are identified during any design of the premises, and before the premises are provided for use as a place of work. This requires that floors are designed to be safe without risks of slips, trips or falls, with adequate drainage (if necessary) and appropriate floor coverings (if necessary). Employers must ensure that floor surfaces are maintained to minimise the possibility of slips and falls. In some States, persons designing workplaces, supplying and installing materials have to ensure, so far as is reasonably practicable, that nothing about the way in which the workplace is built makes its use unsafe, if it is used for a purpose for which it was designed. Employees must also take reasonable care for the health and safety of people who may be affected by their acts or omissions.

Slip prevention is thus a cradle to grave activity, where building services engineers have a significant responsibility, particularly where slip resistance is considered an essential safety measure that must be maintained, such as paths of travel to exits.

Architects have been using the guidance provided in Standards Australia Handbook 197, *An introductory guide to the slip resistance of pedestrian surface materials, to specify flooring products*. This guidance is based on the wet slip resistance classifications that products receive when tested according to AS/NZS 4586, *Slip resistance classification of new pedestrian surface materials*.

Thus an architect might currently specify a floor surface that has a pendulum classification of X or an oil-wet ramp classification of R10 for the wet areas of the entry foyer in hotels, offices and public buildings. In the dry areas of the foyer, they might specify class Z or R9. It should be noted that while the most slippery of products will receive a Z classification, they will not receive an R9 classification. A frequently asked question is where does the wet area stop and the dry area begin? This obviously varies from building to building, and depends on passive design features and any active measures to prevent the ingress of water into buildings. Such measures would include provision of extra matting on wet days, umbrella stands, and the supply of plastic bags for umbrellas.

In many instances, the floor in the wet areas is maintained in the same manner as the dry areas. This may cause a loss of slip resistance in the more slip resistant area. However, you should realise that most slip resistant surfaces progressively lose some of their slip resistance as they become worn smoother by pedestrian traffic. Although the initial loss

[1] Berry JG & Harrison JE 2007. Hospital separations due to injury and poisoning, Australia 2003–04. Injury research and statistics series no. 30. AIHW cat. no. INJCAT 88. Adelaide: AIHW.

of slip resistance can be quite rapid, the slip resistance classifications will continue to be based on new surfaces until acceptable accelerated wear tests become officially recognised. Such accelerated wear tests are likely to be suitable for preparing specimens for pendulum testing only.

In recognising that the initial slip resistance may be illusory, some builders are commissioning slip resistance tests on newly installed floors, so there is independent documented evidence of what was supplied. Thereafter, it becomes somebody else's problem.

Particular attention needs to be paid to the transition between materials with different characteristics, such that there is not too large a difference in the slip resistance. Where reasonably practicable, differing surfaces should contrast visually to identify the change in material and reduce the potential for slips and stumbles.

Many building owners commission independent quarterly slip resistance audits according to AS/NZS 4663, *Slip resistance measurement of existing pedestrian surfaces*. They may undertake dry tests in 'dry' areas, where one should expect that the floor will always 'pass' if it is reasonably clean and free of dust. A pass is generally considered to be a coefficient of friction result of 0.40 or greater. There is a speculative interpretation that the notional contribution of such a floor surface to the risk of slipping when dry is moderate to very low. The term notional has been used to highlight the need to consider all potential contributing factors to a slip incident. Float glass will give a very high dry result if it is clean, but may be treacherous if dusty. The speculative interpretation may thus be somewhat misleading. Given that the slip resistance of the floor may vary from location to location and over the course of a day, any result may depend on whether the audit was predetermined or unannounced. Businesses that seek to satisfy insurers that their floors are safe have a vested interest in passing.

The pendulum may give a more reliable indication of the dry slip resistance. There are obvious advantages in using one machine rather than two when assessing slip resistance. Products that have a small difference between the wet and dry results are obviously safer than those that have a large difference. While slips have multi-causal factors, the most common factor is that people didn't notice that the floor was wet or contaminated.

The wet pendulum results are also subject to speculative interpretation, without any consideration as to the context of where the measurement has been made. One does have to report the site condition, including any contamination detected, any other relevant observations such as maintenance cleaning procedures (if determined), and the extent and type of cleaning performed on the surface. Such records can be very subjective. Given that the standard states "The test surface shall reflect the nature and purpose of the testing", one may obtain different results and interpretations in the case of accident investigations, since the instructions given in the case of plaintiffs and defendants can be quite different. Perhaps this should cause building owners to seek to have audits undertaken in a worst case scenario, that is, just before the floor is cleaned.

The speculative wet floor interpretations unfortunately match the ranges that establish the Pendulum classifications, where classes V and Z might be incorrectly equated with very low and very high contributions to the risk of slipping. A result of 35 BPN is

required to achieve an X classification. The same result is also interpreted as the floor providing a moderate contribution to the risk of slipping when water wet. This is irrelevant of whether the surface is in a residential kitchen, an abattoir, or forms a public footpath. One should obviously consider the context when providing an interpretation or it may be quite misleading. A classification of W is recommended for public footpaths, where the minimum required result would be 45 BPN. If a result of 35 BPN is obtained, does this mean that the footpath represents an unreasonable risk?

Let us consider a practical example. The sawn basalt that has long been used to pave Melbourne streets typically has a Four S wet pendulum result of 65 BPN when first installed. With much time, the result decreases to the low 30s. People have a higher friction demand when running. When it rains in Melbourne, many people run on wet footpaths, on the level and both up and down slopes. However, very few fall, even if the notional contribution of the worn basalt is that there is a high risk of slipping when people are walking on it in a wet condition. The speculative interpretation is inconsistent with the performance of the basalt. Given that speculative interpretations have also been used in prejudicial ways in 'expert' reports, it is intended to remove the interpretation from the test method and to provide greater depth of guidance in a revised version of Handbook 197.

Any accident or near-accident requires some form of investigation and a risk assessment. Prior to this, one might use a checklist that might ask "Are the floors sometimes slippery, e.g., when they are wet due to cleaning, spilling of liquids (e.g., oil), rain or mud, or dusty due to work processes?", where the response might be somewhat subjective. However, a near-accident warrants an independent audit, unless the incident can be reliably attributed to some aspect other than the possible contribution of the floor.

Any risk assessment should identify existing measures to reduce the likelihood of harm. Risks have to be reduced 'so far as is reasonably practicable'. An easy way of doing this is to compare what is already being done with 'good practice'. If there is a difference, you need to determine who will take what necessary action and by when. It may be a matter of posting temporary warnings, using more appropriate cleaning methods, improving lighting, providing workers with suitable footwear, or preventing the floor from becoming contaminated. However, some remedial treatment may be necessary, or it may be more expedient to replace the floor surface.

Few remedial floor treatments identify where they may be unsuitable. Some claims of improvement can be quite misleading. A 150% increase in slip resistance might not yield a significant improvement if the base result was very low. Some treatments will change the appearance of the floor. Some companies offer a variety of remedial treatments. Some will undertake on-site measurements of the slip resistance using the Pendulum, the dry Floor Friction Tester, or the SlipAlert. Others might use more dubious measurements. Some remedial treatment companies will provide test results of untreated and treated specimens. It should be recognised that those treatments which create pores in the floor surface may discolour if the pores become soiled, whereupon any beneficial anti-slip characteristics might also be lost. Some companies use the SlipAlert to demonstrate an improvement in the slip resistance, while also recommending independent Pendulum audits. There may be complex issues associated

with the independence of Pendulum data provided by remedial treatment companies should an accident ever occur on the treated floor.

While third party testing is most defensible, some large property owners use the SlipAlert for internal auditing purposes, for both wet and dry assessments. The SlipAlert can be used to monitor the floor for any changes in slip resistance, but preferably in conjunction with an initial Pendulum audit. The SlipAlert[2] is a very user-friendly device. It is readily portable, robust, easy to set up, requires minimal training, is very quick in use, and is relatively inexpensive. The SlipAlert can be used for the instantaneous initial investigation of any incidents, and removes any subjectivity when assessing slip resistance potential. You cannot assess the risk of slipping unless you can properly assess the slip resistance of the floor.

How often should the slip resistance of floors be checked? This is very much a function of the potential hazard they represent. Floors that have marginal slip resistance, or that may be exposed to heavy contamination would need more frequent testing.

An associated issue is the inspection of floors throughout the day. Many managers of large retail properties, as a part of their risk management policy, attempt to achieve 'cleaning cycles' through the whole property every 15 to 20 minutes. This cycle is regarded by the Courts as the benchmark for a suitable cleaning system, where the floors represent a high risk of slipping if contaminated. In effect this policy has cleaners constantly moving between points where their presence is recorded. However, they may have little time to effectively clean up any contamination they spot along the way. This problem may be compounded on wet days and during lunch times, when food courts may require additional attention.

The International Standards Organisation has defined safety as 'a state of freedom from unacceptable risks of personal harm'. This recognises that no activity is absolutely safe or free from risk. No building can be absolutely safe and some risk of harm to users may exist in every building. Building service engineers should seek to limit the risk of slips to an acceptable level by identifying hazards that can be addressed through technological and educational initiatives.

While there will be some significant changes to the slip resistance standards later this year, the principles of ensuring pedestrian safety will remain unchanged.

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[2] www.slipalert.com