Using the Goldilocks principle and virtual reality environments to develop appropriate models for the risk of slipping

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Introduction

This presentation utilises some insights developed from determining human responses to perceived underfoot hazards in virtual reality environments (Begg) to reconsider how architects might specify flooring materials and maintenance systems in order to best provide sustainable inclusive slip resistant environments that accommodate all building users.

Changing Paradigms

Slips, trips and falls in buildings have been recognised (Ozanne-Smith) as a large and costly public health problem, where investment in effective preventative solutions is imperative. Falls in the elderly are primarily due to biomedical conditions, where the occurrence of self-reported slips would appear to greatly exceed the true number of falls that are due to physical slips. Slips are almost entirely due to environmental conditions where the underfoot conditions provide less (available) traction than is demanded. When people slip, they often remark “If only I had…” indicating a failure to perceive or react to a foreseeable risk.

When developing models for the risk of slipping, we need to consider separately (1) those who are frail and may fall for biomedical reasons unrelated to slipping; (2) those who fail to perceive or react to a slipping hazard; and (3) the remainder of the population. In work place situations we may need to individually consider those who do not wear the stipulated footwear, but in general populations we will have to recognise the variable slip resistant characteristics of footwear types, as well as the fact that with sufficient wear, footwear will lose its slip resistance.

The Goldilocks principle seeks to get slip resistance specifications just right and in accordance with universal (inclusive) design principles: floors should not be too slip resistant initially (so as to be hard to clean); and sufficiently slip resistant at the end of their working life. This is consistent with the European Construction Products Regulation No 305/2011, which requires that floors must be safe (slip resistant) at the end of an economically reasonable working life.

Although the ex-factory slip resistance of some flooring products may be illusory in that it may decrease considerably in use, this is often the only measure provided. While accelerated wear conditioning methods may provide an indication of the probable level of future slip resistance, much developmental work is still required to choose the appropriate abrasive pads and number of cycles in order to model the effects of wear in specific environments over time. Use of pads with hard abrasive minerals that are rarely naturally present may cause wear that would not normally occur. However, such pads induce wear more rapidly.

Virtual reality offers a means of determining the typical traction demand in specific environments and in situations where people transition from one environmental condition to another, as well as changes in surfaces. Thus one might study the behaviour as people enter or exit a building, when the natural lighting is low, at night, or when sunshine causes reflected glare. What surface patterns or textures reveal the presence of water (as a hazard) and which tend to disguise it? People tend to walk more sedately in some situations, such that their traction demand is lower, allowing for the use of flooring that may be inappropriate elsewhere. Such data can be used to develop models of risk for specific environments, where the level of traction demand and associated behaviour can indicate what level of available traction is likely to be required throughout any product’s working life.

This ‘end of life’ data is one means of indicating the stage at which remedial maintenance may be required, effectively providing slip auditors with a transition point. The same data could also be used, in conjunction with accelerated wear studies, as a basis for designing floors, although there are other considerations. Nevertheless, it would make far more sense for designs to be based on fulfilling a slip
resistance requirement at the end of an economically reasonable working life, than to incorporate unidentified safety factors in the requirements for specific situations, as is currently done, based on the false assumption that the magnitude of the loss of slip resistance is the same across most products.

**Reality check**

Slips and falls are complex events. While slip prevention requires a multi-pronged approach, virtual reality should provide new types of data that have been lacking so far. Similarly, accelerated wear testing should prove to be another useful tool in empowering architects and merchants to make appropriate design and specification decisions. However, since we lack much data on the slip resistance of the built infrastructure, there will still be a need to conduct some benchmarking of the level of available traction in real world conditions, and particularly after slips have occurred.

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**References**
