Dr Paul Lemon on specifying floors to pr event slips and falls

Testing *floor slipperiness:* The gold standard

IN THIS, the four th of a series of ***CFJ*** articles, I will explain a selection of existing Standar ds used to classify floor slipperiness, along with the development of HSL's new standar d 'lab-based' test method.

As discussed in last month's ***CFJ***, the Health & Safety Laborator y routinely assesses floor slipperiness using the 'Pendulum Test'. However , as HSL are responsible for pr oviding a number of ser vices to the Health and Safety Executive (HSE), (fr om str uctured scientific r esearch through to on-site for ensic testing following slip accidents), we use a number of different slipperiness test methods to suit the cir cumstances.

This ar ticle clarifies why cer tain test methods ar e used for par ticular situations, and describes how HSL's test pr otocols ar e influenced by current Standards. We will also explain other Standar ds that HSL don't use, and explain why their use could lead to confusion.

In an ideal world, a single, per fect method to test the slipperiness of flooring materials would be available which could be used in all circumstances. Unfor tunately, as we've discussed pr eviously in ***CFJ***, no slipperiness test is per fect.

The pendulum can be very good indeed if used cor rectly (in line with BS 7976-2); this is why HSL use it as the basis of our for mal on-site slipperiness assessments, including those under taken to suppor t HSE enforcement.

There are however, circumstances where other tests ar e more appropriate. For example, we've just begun our largest ever research project to investigate aspects of floor slipperiness. For r esearch such as this, we often use lar ge, ramp-based techniques in preference to the pendulum. Ramp tests ar e not only ideal for studying floor slipperiness in contr olled, laborator y conditions, but also to take into account the ef fects of different footwear. Such a test method has been developed by HSL, known (per haps unsurprisingly) as the 'HSL ramp test'.

The HSL ramp test is loosely based on an existing test method used in German National Standar ds (DIN Standards, as discussed below). The modified test r equires trained test subjects, wearing a harness, to r epeatedly walk (in a very controlled way) up and down large floor samples fixed in a test rig.

The floor is then inclined by a degree or so, and the operator walks over the floor again. This is repeated gradually until the operator slips; the angle at which this occurs at is r ecorded by an obser ver.

A simple calculation allows the angle that the slip occurs to be conver ted to a coef ficient of friction, which is a direct indicator of the floor's slipperiness, and is closely related to the value measur ed by the pendulum. The acceptance of the HSL ramp test is gr owing rapidly throughout the UK and Europe. It has already been incorporated into BS4592-0 (Industrial type flooring and stair treads) and is r ecognised by the UK Slip Resistance Gr oup.

We are often asked why it was necessar y to modify the existing German Standard tests; after all, the Germans have been using these tests for years. Ther e are two reasons. The first is that the test subjects used in the Ger man tests are, to an extent, per mitted to move in an uncontrolled way.

The rate of movement and the walking style are not controlled, and this can lead to inaccurate r esults. The HSL ramp test contr ols all of these factors, and mor e. As a result, the accuracy of the test is thought to be better than the German standards; this has been suppor ted by a programme of inter-laborator y testing acr oss Eur ope involving HSL. The second r eason is that the two German standards deal with very specific cir cumstances.

The two German standards in question are known as DIN 51097 and DIN 51130. The first of these, DIN 51097, covers the slipperiness of floors used in bar efoot conditions under contamination with soapy water. As such, the r esults could relate very well to floors used in shower areas or wet rooms, but ar e difficult to relate to other areas. It is difficult to relate the slipperiness experienced by a barefoot pedestrian to that experienced by a pedestrian wearing shoes.

The relationship becomes even more difficult when soapy water is used, as the pr esence of soap can (obviously) make floors mor e slipper y. The second standar d, DIN 51130, concer ns the slipperiness of floors used in industrial ar eas, heavily contaminated with motor oil.

Test subjects wear heavy industrial safety footwear . Again, the results fr om this standar d test could relate very well to floors in specific situations; in this instance, floors such as those in garages or workshops.

In other situations (i.e. anywher e other than shower rooms or garages!), the infor mation given by the standar d DIN tests can be quite unrealistic. It would be extr emely difficult, for instance, to specify a floor sur face for use in a hospital corridor based on a test method which uses motor oil and safety boots. Equally , it would be a challenge to specify a floor for use in a shopping centr e based on a test which used soapy water and barefoot pedestrians. Y et floors in such areas, and thousands of other areas, ar e regularly specified using the DIN standar ds.

The HSL ramp test uses clean water as contaminant, and footwear soled with a standar dised material known as 'Four-S' Rubber (which stands for Standar d Simulated Shoe Sole). This material was originally developed to r epresent an average piece of footwear , and becomes quite slipper y when used on smooth, wet floors, as you would expect. The use of this soling material in clean, wet conditions allows the r esults pr oduced by the HSL ramp test to be r epresentative of a wide range of real situations, such as the hospital cor ridor or the shopping centr e mentioned above.

So, when considering the slipperiness of floor sur face materials, look critically at the data provided. If the data is pr oduced to the DIN Standards, then ask yourself whether the tests ar e representative of the situation your floor will be used in. The standar d HSL ramp test can tell you how it will per form in more representative situations, or can even be customised to suit your exact needs.

The points discussed above ar e consider ed in more detail in an HSE Information sheet for fr ee download from the website: **www.hse.gov.uk/pubns/web/slips01.pdf** 'Assessing the Slip Resistance of Flooring' looks at the advantages and disadvantages of a range of standar d ramp tests, and other , por table tests (such as the pendulum) to classify flooring per formance.

To summarise, classifying the slipperiness of a floor material can be complex, and this is complicated fur ther by the number of test methods available which simply aren't r epresentative of nor mal, real situations. If in doubt ... ask an exper t!

The next in this series of ***CFJ*** articles will discuss the potentially massive ef fect that polishes, sealants and other finishes can have on floor slipperiness . ***CFJ***

Dr Paul Lemon is a senior scientist at HSL, HSE's in-house laborator y, and has specialised in floor surface slipperiness for over a decade. During this time he has developed HSL's ramp-test methodology and optimised HSL's standar d pendulum test method. He is an active member of a number of BSI Committees concerning floor surface slipperiness, and was jointly responsible for the production of BS7976, the UK Slip Resistance Gr oup Guidelines and relevant HSE Guidance. He is curr ently leading the largest ever HSE r esearch project into flooring slipperiness.