Safety & Accessibility of Walking Surfaces

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1 Introduction

Slips Trips and Falls are the greatest source of pedestrian injury, it is therefore to the management's benefit to ensure flooring is safe and practical.

- **The statistics are clear; over 30% of all non-fatal major injuries in Local Authority and HSE-enforced premises are caused by a slip, trip or fall at the same floor level. (HSE UK 2001)**
- **Fifty percent of all reported accidents to members of the public cost employers an eye-watering £512m per year, with a cost to the health service of £133m annually. (European Journal of Manufacturing June 2005.)**

Minor slips and trips are rarely reported. People are embarrassed and they accept the fact they are falling. Often when people fall, they pop up right away and hope nobody saw them. They don't report the incident and so nothing is done to correct the problem.

Ironically, company management can take a variety of very effective steps to reduce or eliminate slips and falls. Experts say a good first step is to stop blaming the victims. Many managers jump to the conclusion that slips and falls are the employee's fault, the result of horseplay or not paying attention. In reality, slips and falls can arise from a complex set of causes that may have much more to do with management practices than employee behaviour.

In a slip, people are walking forward with a certain amount of momentum and they suddenly reach ground which does not have the same purchase or coefficient of friction. Their lower body then goes ahead of their upper body so they slip backward.

Contributing to the slip occurring may be a variety of factors in addition to simply a slippery walking surface. Those factors can include environmental factors such as worn flooring or shoes with worn-down soles, or the presence of grease, oil or water on a floor.

When you perceive a slippery condition, you change your gait and you prepare accordingly. Slips and falls happen when you least expect it. You don't see that spot on the floor, or you're on a carpeted floor and then you step onto a vinyl-composition tile floor. It's polished and waxed, there's a little water on it, you don't see it and there you go.

Human factors such as inattention, carrying objects, poor vision, bifocals and the use of over-the-counter medications can all contribute to slips and falls are particularly at risk for slips and falls. As people age they do not see as well, their muscles are not as strong so they do not recover their balance as readily and their reaction time is slowed. With the work force and customers ageing,

there is even more incentive for companies to take a more proactive approach to preventing slips, trips and falls.

safety experts warn that attempts to prevent injuries with single remedies, such as slip-resistant shoes or improved maintenance, are much less likely to succeed than a comprehensive program that includes good design, maintenance, training, proper footwear, record keeping and other good practice activities.

Flooring and finishes. Safety experts say flooring materials are too often chosen on the basis of initial cost and how they look, with little regard for how slippery they may be. Any floor is slip-resistant when dry but add water or contaminants such as grease, oil or dirt and now you are dealing with an entirely different situation.

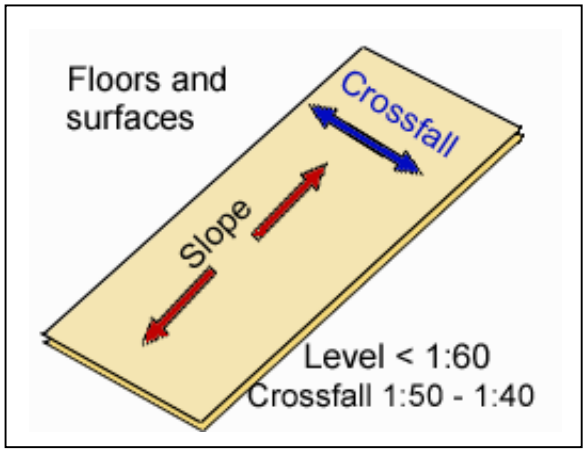
1.1 Ability and Surface

People who have difficulty walking or maintaining balance or who use crutches, walking sticks, or walker frames, people with restricted gaits and people with visual and hearing impairments are particularly sensitive to slipping and tripping hazards. Particularly for people with these impairments, a stable and regular surface is necessary for safe walking, particularly on stairs.

Wheelchairs and other mobility vehicles can be propelled most easily on surfaces that are hard, stable, and regular. Soft loose sand or gravel, wet clay, and irregular surfaces such as cobblestones can significantly impede wheelchair movement.

2 Specifying

In new buildings or refurbishment owners should specify their flooring requirements in outline leaving it to the architect or designer to come up with a floor finish which meets the artistic, durability, and ease of maintenance needs of the premises. While at the same time being safe for all users and meets the requirements of accessibility for older and disabled people.



- **A stable surface is one that remains unchanged by contaminants or applied-force, so that when the contaminant or force is removed, the surface returns to its original condition.**
- **A firm surface resists deformation by either indentations or particles moving on its surface.**
- **A slip-resistant surface provides sufficient frictional counter force to the forces exerted in walking to permit safe walking.**

The Safety & Accessibility requirements are

1. **Level surface max ± 5 mm upstand, max 10 mm gap if filled and if unfilled no wider than 5 mm gap.**
   a) **Max undulations not exceeding 3 mm under a 1m straight edge for formless materials.**
   b) **Max cross fall for flooring is 1:60 (including stair/ramp platforms and landings)**
   c) **Max cross fall for drainage is 1:50 as standard, and 1:40 where water flows can be a problem.**
   d) **Ramp (inclines greater than 1:21) surfaces have an increased skip-resistance and offer a change of colour and texture.**
2. **Is firm resists rutting by heals etc.**
3. **Is stable does not bounce, bend and flex**
4. **Has a low slip coefficient (slip resistant)**
   Note: A higher slip-resistance is necessary in wet areas such as shower and toilet areas including routes to dressing/drying areas. Vinyl and glazed tile flooring are unlikely to meet this requirement.
5. **Has a low reflection coefficient (prevents glare and reflection)**
6. **Contrasts with walls and furnishings**
   a) **Does not have confusing or complex patterns.**
   b) **Have defined pedestrian and vehicle routes, separating them from seating, storage or working areas.**
7. **Carpeting**
   a) **Is fixed in position and edge held down. (does not slide when stepped on)**
   b) **Has a low pile. (see Carpet below)**
   c) **No confusing or complex patterns**
   d) **Is well maintained, no rips or bare patches**
   e) **It takes 1500 mm (min) of carpet to dry a manual wheelchair's wheels when moving slowly.**
   f) **It takes eight steps on carpet to dry a person's feet.**
8. **Acoustics a good floor surface adds to the control and absorption of echo and reverberation of sounds. A footstep should not echo, although some change in surface sound can be of use e.g. warning of a staircase or door swing.**
9. **When selecting a flooring system consider performance first followed by appearance and design. Your floor system must withstand the chemicals of exposure, the abrasion anticipated, and any temperature variations. Within this selected group the**

appearance (colour) and texture (finish coat) can then be specified.

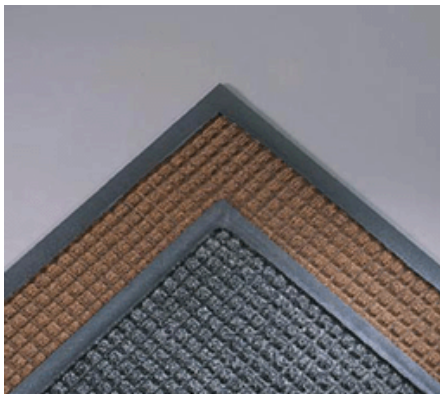
Due to the foregoing it can be seen that no single set of technical specifications or measurement standards can encompass all criteria that contribute to the safety of a walking surface.

2.1 Part M

The guidelines given in Part M & BS8300 require only that newly-constructed or altered ground and floor surfaces of accessible routes on sites and in buildings and facilities be stable, firm, and slip-resistant . No standards or methods of measurement are specified in scoping or technical provisions.

2.2 Entry mats

Wiper Mat with Gripper Bottom - For indoor use. Soft stiff fibres remove dirt to help prevent tracking and slipping. Non-slip cleated bottom grips carpets and smooth floors being set into a floor cavity take care it does not present a step in the surface level. Loop pile polypropylene fibres absorb moisture and dry quickly. Rubber backed and edges for impact absorption or aluminium grating for a more robust finish in heavily trafficked areas.



3 Slip Resistance

Slip resistance has a commonly applied unit of measurement - the coefficient of friction, which may be measured as static (at rest) or dynamic (in motion). Its calculation is complex and the methods and equipment of its measurement vary according to the standards and test equipment employed.

At its simplest, a slip resistant surface is one that will permit an individual to walk across it without slipping. Contrary to popular belief, however, some slippage is in fact necessary for walking, especially for people with restricted step who may drag their feet slightly: A common condition with mobility impairment and with increased age of the person. While increasing the slip-resistance of a surface is desirable within certain limits, a very high coefficient of friction may actually hinder safe and comfortable movement by older people and people with disabilities. In truth, a truly non-slip surface could not be negotiated.

Building owners and access auditors should measure the slip resistance of existing flooring in both dry and wet condition and not

rely on manufacturers statements. Where other materials are likely to be spilled on the surface sand, flour, saw dust etc. take readings with these contaminants.

If a slip resistant coating is to be applied make sure it is tested in combination with the actual flooring material and use. A product which may be affective with one surface is not necessarily effective with another.

Tests should be carried out in a number of areas for example including

- Indoors - the entrance foyer, restaurant, kitchens, dance floors, stairs, landings, pool areas, bath rooms, and lavatories.
- Outdoors - Approach paths, parking areas, ramps, steps, landings.

Note: ramps and inclines need to be measured in relation to moving up hill and down hill. The point of heel impact and sole traction vary with the direction, i.e. touch down, full load and push off.

Two test methods are recommended for slip assessment.

- The first involves the use of a pendulum with a rubber pad which swings across the floor surface and measures the coefficient of dynamic friction.
  When it is measured when the surfaces are in relative motion, it is called the "dynamic coefficient of friction".
  When the coefficient of friction is measured from a resting position, it is called the "static coefficient of friction" (SCOF).
- The second instrument measures the micro-roughness of the floor which for a smooth surface, such as the terrazzo-type tiles laid in the some areas, is typically less than 10 millionths of a metre.

Measuring the dynamic COF is difficult and requires a strict laboratory environment for accurate results. Almost all portable and laboratory meters measure only the static COF and most measuring devices (slip meters) refer to static COF. The higher the SCOF, the less slippery the surface – it is possible to have too high a SCOF; the surface can be too slip resistant and difficult to walk on.

It is impossible to correctly specify a slip-resistance rating without identifying the testing method, tester, and sensor material to be used in evaluating the specified product and equally invalid to compare values obtained through one methodology to those resulting from different testing protocols. The HSE has published a website guide http://www.hse.gov.uk/slips/index.htm

3.1 Surface Type Resistance

For example

- **Synthetic resin flooring provides an excellent slip resistant finish in wet or dry conditions.**
- **Vinyl and glazed tile flooring is unlikely to meet the non-slip requirement s when wet.**

3.1.1 Slip-Resistance of Typical Flooring Surfaces

This is a rough guide only based on published USA measurements which are not always calculated by consistent methods.

Material	Dry and Unpolished	Wet	Remarks
Clay tiles carborumdum finish	Very good	Very good	May be suitable for external stairs
Carpet	Very good	Good	Highly variable related to material, pile and density.
Clay tiles textured	Very good	Good	May be suitable for external stairs
Cork tiles	Very good	Fair	Susceptible to water damage and wear cracking and lifting.
Coated plywood	Good	Good	Susceptible to water damage and wear cracking and lifting
PVC with non-slip granules	Very good	Good	Susceptible to debonding.
PVC	Very good	Poor to fair	Slip-resistance when wet may be improved if PVC is textured. Edges of sheet liable to cause tripping if not fixed firmly to base.
Rubber sheets or tiles	Very good	Very poor	Not suitable near entrance doors or on ramps and steps. Susceptible to debonding and bubbling.
Glass Fibre	Fair	Very poor	Not suitable near entrance doors or on ramps and steps. Tendency to cracking.
Mastic asphalt	Good	Good	
Vinyl asbestos tiles	Good	Fair	Not suitable near entrance doors or on ramps and steps.

Material	Dry and Unpolished	Wet	Remarks
Linoleum	Good	Poor to fair	Edges of sheets may cause tripping if not securely fixed to base. Not suitable near entrance doors or on ramps and steps.
Methacrilate resin	Fair	Poor	Cracks and chips.
Stainless Steel	Poor	Very Poor	Little of no slip resistance contributes to glare
Brass (studs, strips)	Poor	Very Poor	Little or no slip resistance.
Concrete	Good	Poor to fair	If a textured finish or a non-slip aggregate is used, slip-resistance value when wet may be increased to good.
Asphalt (TarMac)	Good	Good	May become polished and contaminated over time reducing it to poor.
Gritted epoxy on metal	Very Good	Good	Fairly good wearing qualities.
Granolithic	Good	Poor to fair	Slip-resistance when wet may be improved to good by texturing and incorporating carborumdum finish.
Glazed Porcelain etc	Poor	Very Poor	Provides little of no slip resistance, tendency to crack,
Clay tiles	Good	Poor to fair	Slip-resistance when wet and polished very poor. Not suitable near entrance doors or on ramps and steps.
Terrazzo	Good	Poor to fair	Non-slip nosing necessary on stairs. Slip-resistance when polished or if polish is transferred by shoes from adjacent surfaces very poor.

Material	Dry and Unpolished	Wet	Remarks
*Very good: means surface suitable for areas where special care is required, approximates to C.O.F < 0.75. *Good means: surface satisfactory for normal use, approximates to C.O.F 0.4 < 0.75. *Poor to Fair: means surface below acceptable safety limits, approximates to C.O.F 0.2 < 0.4. *Very Poor: means surface unsafe, approximates to C.O.F < 0.2			

Highly aggressive surfaces as required in parking decks and some wet environments utilise aggregates incorporated into the flooring system to maximise the peak-to-trough differential. Aggregate selection in these systems will affect the long-term slip resistance. Sand is typically used as an inexpensive aggregate in textured floors, but aluminium oxide can be substituted to provide a much harder, longer lasting profile. Aluminium oxide is available is several different size ranges to yield a slight texture (220 mesh) to extremely aggressive (46 mesh) finish.

A static coefficient of friction of 0.6 is recommended for accessible routes and 0.8 for ramps and that other walking surfaces have a static coefficient of friction of 0.5.

Rubber, polymer composite, polymer concrete and unglazed ceramic materials all discoloured during trials.

3.1.2 Mobility Vehicles & Surfaces

The following figures based on a sample of 400 users in UK made by the Imperial College London UK.

Urban Barriers wheelchairs & scooters	% users finding problems	Urban Barriers wheelchairs & scooters	% users finding problems
Street furniture	42	Lack of dropped kerbs	66
Raised manhole covers	43	Gravel surfaces	69
Uneven paving slabs	47	Deep gutters	73
Congested pavements	50	High kerbs	75
Cobbled surfaces	56	Handrails not on ramps	76
Difficult cambers	56	Steps	81
Steep gradients	62	Dropped kerbs not adjacent	91
Narrow pavements	65		

Rolling Resistance for unladen manual wheelchairs on different types of surface.

	Quality of Surface		
Surface	Good	Fair	Poor
	Average lb's pull	Average lb's pull	Average lb's pull
Concrete	3.5	6.54	7.27
Paving	4.5	7.53	9.70
Brick paving	7	5.59	10.52
Tarmac	7	11.97	16.72
Grass	15	26.62	N/A
Gravel	20	N/A	N/A

Most people do not have even the most basic idea of just how difficult a place like the average town/city centre is to navigate a scooter or in a wheelchair except those who have no choice in the matter.

That irritating paving stone that walking people trip over occasionally is yet another spine jarring jolt as the un-sprung castor of a wheelchair or scooter wheel hits it.

120 mm of kerb is a major mountaineering expedition in a manual or powered wheelchair or scooter, requiring expert timing regarding traffic dangers as well as having to get it right first time as once a manoeuvre is started there is not always the option of backing out of it. Flush dropped kerbs should be available on all main pedestrian routes.

3.2 Carpet

Much more needs to be done in developing both quantitative arid qualitative criteria for carpeting (i.e., problems associated with texture and weave need to be studied). However, certain functional characteristics are well established.

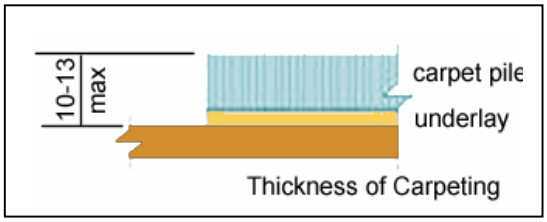
When both carpet and padding are used, it is desirable to have minimum movement (preferably none) between the floor and the pad and the pad and the carpet which would allow the carpet to hump or warp.

In heavily trafficked areas, a thick, soft (plush) pad or cushion, particularly in combination with long carpet pile, makes it difficult for individuals riding mobility vehicles and people with other

ambulatory disabilities to get about. This surface accelerates exhaustion due to increased effort and can become a slip hazard especially when wetted.

A firm carpet surface can be achieved through proper combination of pad and carpet, in some cases with the elimination of the pad or cushion, and with suitable installation.

IF carpet or carpet tile is used on a ground or floor surface, then it must be securely attached: have a firm cushion, pad, or backing, or no cushion or, pad, and have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. The maximum pile thickness shall be 10-13 mm. Exposed edges of carpet shall be fastened to floor surfaces and have trim along the entire length of the exposed edge. Carpet edges should be trim and comply with changes in level below.



Carpeting designed with a weave that causes a zig-zag effect when wheeled across is strongly discouraged.

A three-step process for mats is recommended:

1) A porous mat outside to pull off as much contaminant as possible from footwear;
2) A smoother but still relatively rough mat in the foyer to pull off the next layer of contaminants and absorb moisture, and
3) Walkoff mats to remove moisture so it doesn't get tracked into the building.

Mats can create their own hazard if they slide around or fold up easily. Mats that are made of a very dense material, are hard to move, have a slip-resistant backing and are very difficult to fold over on themselves are essential elements in preventing slips, trips and falls.

Although the slip resistance ratings of carpet fall within the recommended ranges for use on ramps, its rolling resistance makes most types of carpeting inappropriate for sloped surfaces.

Carpet on stairs can be slippery and unless short piled and closely fitted be a tripping hazard due to slippage, humping and rounding of the nosing.

3.3 Coatings

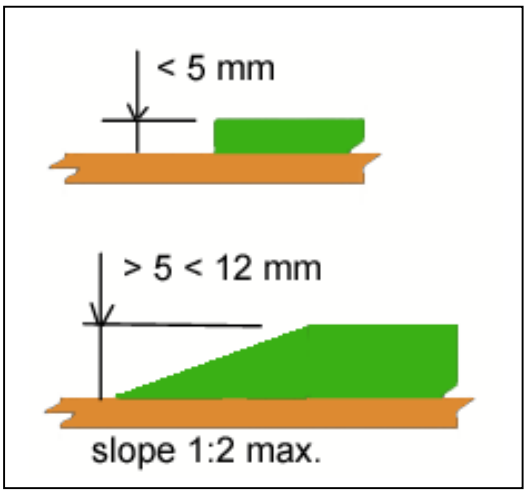
Floor coatings and treatments: A variety of slip-resistant floor coatings are available to increase traction on slippery floors. They have an abrasive grit mixed into an adhesive base material.

Companies must consider if the treatment is applicable for their floor and if its properties are a match for the contaminants present.

There are also etching treatments that put micro-grooves into tile or soft surface. While they may require less maintenance than the reapplication of surface coatings, they do impact the life of the floor because some of the floor surface is removed.

3.4 Changes in Surface Level

Changes in level up to 5 mm may be vertical and without edge treatment. Changes in level between 5 mm and 12 mm should be bevelled with a slope no greater than 1:2. Changes in level greater than 12 mm should be accomplished by means of a ramp that it should be 1:20 to 1:15.



These changes apply to any edge in a footway indoors (carpet or floor) or outdoors (footpath end, inset/upstand of grating).

3.5 Outdoor Surfaces

Materials such as gravel, wood chips, or sand, often used for outdoor walkways, are neither firm nor stable, nor can they generally be considered slip-resistant.

Footways surfaced in these materials could never be classed as an accessible route.

Some natural/semi-natural surfaces, such as compacted earth, soil treated with consolidants, or materials stabilised and retained by permanent or temporary geotextiles, gridforms, or similar construction may perform satisfactorily for persons using wheelchairs and walking aids dependent on the spacing of the grid. Some grid surfaces may also deflect wheels causing mobility vehicles to wobble.

Cobbled (and similar) surfaces are not suitable or safe for people with impaired mobility or vision and using wheelchairs or other mobility vehicles.

3.5.1 Paving

Integral colours in concrete and asphalt surfaces are economical to use because they are mixed into the concrete and require little additional labour to finish. Because integral colours extend throughout the slab, the colour shows through even if the slab wears chips or is exposed.

Colours are made with pure, concentrated pigments especially treated for mixing into concrete. They are lightfast, alkali-resistant,

weather resistant, and formulated to give long-lasting appeal to concrete.

In general, integrally coloured concrete pavement is produced the same way as high-quality uncoloured pavement. This surface may not provide adequate slip resistance outdoors or in wet areas. Silicon carbide gives concrete a sparkling appearance; aluminium oxide does not. Both abrasives can be used to improve slip-resistance.

Coloured concrete paving can be successfully installed by concrete masons with satisfactory experience in architectural concrete flatwork. However some special concrete finishing techniques may require installers to have additional qualifications such as training or licensing by manufacturer of patterning tools.

When specifying concrete mix, 4" slump is recommended. If greater slump is required, use water-reducing or super-plasticising admixture instead of adding water. Low water-cement ratio promotes richer, darker concrete colours. Note special mixes which may be required to produce various finishes. For example, pattern stamping requires small sized coarse aggregate like pea gravel. As with any natural material, some variation in appearance is a normal design feature of concrete, whether coloured or not. Note that concrete lightens as it cures; allow up to 28 days for process to occur.

3.5.2 Tactile Paving

Overall, tactile surfaces have been shown to give confidence to people with vision and hearing impairment in their ability to travel independently and it is essential to consult with disabled people to ensure the use and location of guidance and information surfaces are appropriate. The key issues identified in the use of tactile surface are: consistency of profile and layout of the surface for each function; long term stability of the material (colour, profile, slip resistance and bond); Safe installation and maintenance including restitution following subsurface works.

There area a number of difficulties with installing tactile surfaces which are fabricated on-site, such as moulding or stamping surfaces. The difficulties include obtaining a consistent profile of the surface, dome height and concrete hardness. Installation requires expert contractors.

Few studies have assessed the safety benefits of installing tactile surfaces in hazardous locations.

For further details see our guide ‘Tactile Paving UK’.

3.6 Bonded Surfaces

The installation of some tactile surfaces is affected by weather conditions and temperature constraints, especially for those which bond to existing surfaces. These issues should be considered to ensure the material is suitable for use indoors and outdoors.

4 Issue Shoes & Boots

Consider footwear. Footwear varies significantly in the traction provided. In some cases, restricting employee footwear is a practical solution to slip-and-fall injuries.

Where management issues footwear to employees they have a responsibility to ensure that these shoes or boots are safe and do not become slippery under expected work conditions. (Contaminants, work loads, etc.)

> **The slip resistance of commercial safety boot and experimental footwear solings has been studied over a period of 15 years. Shoes, with experimental solings, were worn in a factory, and the coefficient of friction (CoF) measured at intervals, using a walking traction test. These measurements have shown that a microcellular polyurethane, AP66033 (formerly T66/103) gives the greatest slip resistance of any soling material on wet or oily factory floors and laboratory test surfaces. This performance is attributed to the statistically significant relationship between CoF and mean peak to trough roughness (Rtm). The surface structure of soling materials was examined using Scanning Electron Microscopy, and images compared with Rtm measurements. There is now sufficient experimental evidence to confirm that surface roughness is one of the determinants of CoF on lubricated floors. The wear characteristics of the floor/sole combination must be considered; some soling materials may become polished on certain floors. However, AP66033 cannot be polished**
>
> **From Surface Roughness of Footwear Soling Materials: Relevance to Slip Resistance - Rowland FJ, Jones C, Manning DP**

Slip-resistant soles are typically made of a softer rubber than regular street shoes, so companies should have a program to make sure they are replaced as they wear out.

5 Maintenance

5.1 Specify floor maintenance procedures.

Floor maintenance is an extremely important factor in determining slip resistance. A wet floor usually creates a slip hazard. In areas such as restaurants and food service areas, discuss the concept of immediate removal of spilled food or drink. In floor areas adjacent to the street, such as retail stores or lobbies, specify walkoff mats. In addition to removing water from the bottom of shoes, these mats will also remove the dirt or sand that can severely damage the floor's surface. Additional mats should be placed near the entrance during rain or snow conditions. Regular floor maintenance will also result in the removal of dirt and particularly dust, a common creator of slippery floors. Proper floor maintenance also requires that maintenance chemicals be reapplied on an "as needed" basis. Make sure that cleaning chemicals are compatible with sealers. In addition, certain waxes can create a slipping hazard.

5.2 Stone

Architects and designers should always specify the maintenance requirements for floors in the Building Manual provided at the time of completion of work.

The most common problem people call to solve is the removal of stains from stone floors and counters. In some cases, it's just surface dirt. However, stains often occur because the stone has never been impregnated, or the impregnator has been applied improperly. A properly applied high quality impregnator will greatly reduce the porosity of the stone and inhibits stains. Not all stone installers are competent is applying impregnators

Selecting dense stones is always a good idea.

The second most common problem is lippage, in which the tiles are not installed level. In this case, these can be ground down to the floor down, until it becomes level.

You can almost always able to remove stains from stone. Once you determine the type of substance that is causing the stain, you can usually remove it with either the application of an appropriate chemical cleaner or sanding the surface.

An impregnator can sometimes cause damage to stones used outside if water gets trapped underneath. In this instance, the impregnator may not allow the moisture to escape through the surface. Though do keep in mind that the manufactures of the high quality impregnators will often recommend their products for exterior stones.

You can use traditional floor polish machines to eliminate scratches and maintain polished stone surfaces. On certain hard to polish

marbles we will use recrystallisation chemicals to achieve a better polish. Care must be taken that this polish does not make the floor slippery. Hard stone, such as granite, requires a lower polishing frequency that softer stone, such as marble. Dark coloured stones show more wear than lighter colours, and therefore need to be polished more often.

- **In residential installations, with less people walking on the floor, require less frequent polishing. Residential floors tend to get maintenance once or twice a year.**
- **For commercial floors, you may wish to polish the floors as often as once a week, however, once a month is more common**

Questions about slip resistance do not come up very often after the floor is installed as operators rarely question the suitability of the floor to their users.. It is very rare to hear about people slipping on stone floors, unless the floor is wet. It is recommend that people put down mats on rainy and snowy days and that they make sure that water is removed from floors as soon as possible. Sometimes people are concerned about polished floors being slippery because of their assumption that a polished finish creates a slippery condition. This has not been found to be the case.

5.2.1 Cleaning Floor

Dust mop interior floors frequently using a clean non-treated dry dust mop. Sand dirt and grit do the most damage to natural stone surfaces due to their abrasiveness. Mats or area rugs inside and outside an entrance will help to minimise the sand, dirt and grit that will scratch the stone floor. Be sure that the underside of the mat or rug is a non-slip surface. Normally, it will take a person about eight steps on a floor surface to remove sand or dirt from the bottom of their shoes. Do not use vacuum cleaners that are worn. The metal or plastic attachments or the wheels may scratch the surface.

5.2.2 Cleaning other surface

Clean stone surfaces with a few drops of neutral cleaner, stone soap (available at hardware stores or from your stone dealer) or a mild liquid dishwashing detergent and warm water. Use a clean rag mop on floors and a soft cloth for other surfaces for best results. Too much cleaner or soap may leave a film and cause streaks. Do not use products that contain lemon, vinegar or other acids on marble or limestone. Rinse the surface thoroughly after washing with the soap solution and dry with a soft cloth. Change the rinse water frequently. Do not use scouring powders or creams; these products contain abrasives that may scratch the surface.

5.2.3 Bath and Other Wet Areas

In the bath or other wet areas, soap scum can be minimised by using a squeegee after each use. To remove soap scum, use a non-acidic soap scum remover or a solution of ammonia and water (about 1/2 cup ammonia to a gallon of water). Frequent or over-use of an ammonia solution may eventually dull the surface of the stone.

5.2.4 Vanity Top Surfaces

Vanity tops may need to have a penetrating sealer applied. Check with your installer for recommendations. A good quality marble wax or non-yellowing automobile paste wax can be applied to minimise water spotting.

5.2.5 Food Preparation Areas

In food preparation areas, the stone may need to have a penetrating sealer applied. Check with your installer for recommendations. If a sealer is applied, be sure that it is non-toxic and safe for use on food preparation surfaces. If there are questions, check with the sealer manufacturer.

5.2.6 Outdoor Pool & Patio Areas

In outdoor pool, patio or hot tub areas, flush with clear water and use a mild bleach solution to remove algae or moss.

5.2.7 Cleaning Do's and Don'ts

- **Do dust mop floors frequently**
- **Do clean surfaces with mild detergent or stone soap**
- **Do thoroughly rinse and dry the surface after washing**
- **Do blot up spills immediately**
- **Do protect floor surfaces with non-slip mats or area rugs and countertop surfaces with coasters, trivets or place-mats. Note: loose unfixed mats are a slip and trip hazard and can be difficult for wheelchair and mobility aid users.**
- **Don't use vinegar, lemon juice or other cleaners containing acids on marble, limestone, travertine or onyx surfaces**
- **Don't use cleaners that contain acid such as bathroom cleaners, grout cleaners or tub & tile cleaners on stone. Marble or clay surfaces.**
- **Don't use abrasive cleaners such as dry cleansers or soft cleansers**
- **Don't mix bleach and ammonia; this combination creates a toxic and lethal gas**

6 Reference

- **Stone Source - http://www.stonesource.com**
- **Marble Institute - http://www.marble-institute.com**
- **Resin flooring Association (UK) - Tel: 01252 739149 Fax: 01252 739140. FERA, Association House, 99 West Street, Farnham, Surrey GU9 7EN**
- **Experimental Studies For Evaluation Of A Stumble And A Slip Of The Elderly On Concrete Block Pavements – Nippon Road**
- **The best flooring materials for stations - Phase 1 – Rail Safety & Standards Board.**