3.9 Safety

3.9.1 The Importance of Safety

When designing external areas, one should take into account the effects of day and night (3.9.1a), and the influence of seasonal and climatic changes. The condition of external spaces will change along with the change in time and weather. Facilities in open areas are more susceptible to deterioration and damage due to exposure to weather, close contact by users, and sometimes vandalism.

The patrons of public open spaces are people of all ages and abilities (3.9.1b). The design down to every detail should thus be carefully thought out in terms of safety and convenience to minimize the chance of accidents. Special attention should be paid to the fact that the same detail may perform differently under different conditions in external areas. For example, a stainless steel handrail is easy to maintain and offers a smooth handgrip, however, it may be burning hot under the summer sun.

It should be borne in mind that accident prevention is an important aspect to consider at the beginning of the design concept stage.

3.9.1a Day and night conditions vary in the same external area

3.9.1b People of different age and ability use the same communal open spaces

3.9.2 Safety Considerations

3.9.2.1 Physical Hazards

(a) Slips, trips and falls

Many accidents are relating to slips, trips and falls on floor surfaces (3.9.2.1a). 'About twenty percent of injuries are the result of surface falls..... In 1940, there were 22 deaths per hundred thousand from falls; today that number has fallen to about 1.6. Reductions are due in part to improvement in products and materials.'[1] The importance of good ground surface treatment is undeniable. The following should be taken into consideration in the design and construction of ground surfaces:

- Flooring materials should have good slip resistance (3.9.2.1b). Refer to *Section 3.9.3*.
- Floor finishes should be laid with good levelling and workmanship to avoid undulation and protrusion.
- Adjacent floor tiles should be laid level so that the tile corners do not stick out and cause tripping (3.9.2.1c).
- Joints on flooring materials should be firmly filled, made even and levelled.
- Floor surfaces from outdoor to indoor are black spots for slips during rainy days. Entrance door mats and non-slip materials should be provided at the entry to internal areas (3.9.2.1d).
- Flooring materials with larger static coefficient of friction, or better slip resistance, should be selected for use on ramps and sloping grounds.
- Non-slip inserts, floor dividing strips and alike should be laid flat with the ground surface to avoid trips and falls.

(b) Change in levels

Change in levels should be conspicuous and with a reasonable level difference. In general, a step of less than 100mm high is undesirable (3.9.2.1e). It is

[1] Lecture on Measurement of Slip Resistance, a legal and practical perspective, Copyright Barrett C. Miller, Med, OHST

3.9.2.1a Signage to warn against slips, trips and falls

3.9.2.1b Slip resistant flooring materials should be used

3.9.2.1c Good levelling depends on good workmanship

3.9.2.1d Door mat at entrance from outdoor to indoor can help prevent slips and falls

better to provide a full width ramp with a gentle gradient.

Ramps and sloping grounds should have a gradient of not less than 1:12; it is more desirable if it can be reduced to a gradient of not steeper than 1:20. A short ramp with steep gradient is also hazardous because people could easily miss their step and trip when going down such a ramp.

Visual, tactile and/or audible warning should be provided at a distance before the level change to allow a buffer or preparation zone before reaching the level difference (3.9.2.1f and 3.9.2.1g).

(c) Projections and protrusions
Appropriate spatial and ergonomic dimensions are essential in creating a safe and useful space for people to use. The requirements of people of different statures should be considered. Protruding objects from a wall should not become an obstruction to pedestrians. Projections should not be more than 90mm from the wall. Reachable spaces should have a headroom of at least 2000mm high. Similarly, projecting objects such as bollards should be in conspicuous positions to avoid becoming a hazard.

(d) Spaces with low headroom
Overhead structures and facilities are sometimes found protruding onto pathways resulting in areas with low headroom (3.9.2.1h). Examples are underside of staircases, ramps or escalators. Such spaces should be well protected with barriers to prevent people from approaching, or be designed to have a minimum headroom of 2000mm to allow safe passage.

(e) Reachable surfaces
Street furniture, play equipment, planters, low

3.9.2.1e Small and inconspicuous level differences can be hazardous

3.9.2.1f Visual, tactile and audible warning at staircase landing

3.9.2.1g Steps without buffer zone and conspicuous nosing are hazardous

3.9.2.1h Low headroom created by overhanging structure at parapet

walls, etc. in external areas can all be reached easily. Therefore, the materials should be carefully selected to offer a safe-to-touch surface. The texture, roughness and heat retention properties should be considered for various situations.

3.9.2.2 Lighting and Illumination

Lighting and illumination enhances visibility. Good lighting is essential for people to identify faces and objects, enabling one to build up one's own personal or social security. Lighting is also important for way finding and orientation purposes. Refer to *Section 3.8 — Lighting*.

3.9.2.3 Water Areas

Water feature in an open space can serve as a highlight or a landmark (3.9.2.3a). Whether it is just for appreciation or is accessible for play and close contact, it is a popular spot for people to gather around and use as a meeting point. However, water features also can pose hazards to the public if precautionary measures are not integrated into the design.

Whether water feature areas are accessible or not, they should be noticeable so that people are aware of their existence from a distance. Water features just for visual/audio appreciation should be well protected at the edges, or a buffer zone should be provided in between the dry ground and the wet areas to prevent accidental falls into the water.

The water depth in pools should be appropriate so that there is no danger of drowning, even for people of short stature or children.

For accessible water features, the wet areas should be made conspicuous by means of proper signage or warning; people should be made aware of the water's edge. The flooring material of the wet zone should also be carefully selected to prevent slips and falls.

3.9.2.3a Water features should be strategically located so that they do not pose a hazard to users

3.9.2.4 Planting and Soft Landscaping

An important aspect in external space design is planting and soft landscaping. The following considerations should be made in the selection and arrangement of plant species:

(a) The smell of fragrant plant species should not be too strong as to cause any olfactory irritation.
(b) Plants and any fruits within reach should not be poisonous.
(c) Plants within the reach of passers-by should not have needles, sharp edges, thorns and the like; they should not cause any skin irritation when touched (3.9.2.4a).
(d) Plants should be properly trimmed and arranged in such a way that they do not obstruct passageways, accesses, exits or other nearby facilities and equipment (3.9.2.4a).
(e) Accessible trees should have enough headroom underneath the crowns. Otherwise, they should be properly fenced off to keep people away from the areas with low headroom.

3.9.2.5 Corners and Turns

In open spaces and external areas such as parks, accidents sometimes occur due to collision at corners and turns on pedestrian pathways. As many users are running children, parents with stroller, people in wheelchair, and teenagers riding scooter, etc., attention is required particularly at corner junctions where pedestrian traffic is expected to be heavy.

It is therefore desirable to alert people before they reach such turns or corners. This can be done by providing an unobstructed vision area, a corner splay, low-level planting at the turns and so on, to make the other side of the corner more visible. It would help to reduce the risk of collision. Appropriate and adequate manoeuvring space at corners and dead-ends can also help to avoid the chance of collision.

3.9.2.4a Plants within reach should be safe-to-touch and be arranged in such a way that they do not obstruct the passageway

3.9.2.6 Orientation and Way Finding

Open spaces are sometimes designed with meandering pathways and pocket spaces to enhance the travel experience. Getting lost in an external space is an unpleasant experience; it also suggests that the way finding strategy of the space has failed. Psychological safety is one of the fundamental priorities to be satisfied before one can enjoy an external facility.

Finding one's way out from a strange public place is not only time-consuming, it may also involve unnecessary travelling which is definitely not welcomed by any user. To strike a balance between leisure and psychological safety, comprehensive orientation and way finding clues and signage should be carefully thought out and implemented to eliminate those adverse situations. Refer to *Section 3.5 — Way Finding, Orientation and Signage*.

3.9.3a A safe and comfortable travelling surface in external areas is important

3.9.3 Slip Resistance

Mother Nature has tied everything on earth, whether living creatures or non-living objects, to the ground by means of gravity. The ground is undeniably an important element relating to our daily life and activities. For any part of a space, there may not be a wall, there may not be a ceiling, but it would be difficult to find an area that does not have a floor or ground. The performance of the walking surface, or 'travelling surface', is significant and affects us every day (3.9.3a). Amongst its various properties, slip resistance constitutes an important factor relating to safety and comfort when we travel on ground surfaces.

Static coefficient of friction offers only a reasonable measure of the slip resistance of a material. Since slip resistance is the combined effect of the properties of two surfaces in contact with each other, hence the footwear also accounts for the overall floor performance.

Wheelchairs can be propelled most easily on firm, hard, stable and regular surfaces, but these surfaces can be a potential hazard to other users like young children.

Different materials offer different degree of slip resistance. Combined with the effect of shoe traction, a flooring material can change from 'slippery' to 'non-slippery' and vice versa.

3.9.3.1 Factors Affecting the Slip Resistance of Ground Surfaces

The slip resistance of a travelling surface may also be due to other alien factors not relating to the nature of the flooring material itself.

(a) When there is a mixture of flooring materials used in the same space, the slip resistance of two adjoining materials should be compatible with each other (refer to Figure 3.9.3.3c). A person tends to walk faster on a less slippery material. If one walks from a non-slip surface to a surface with much smaller static coefficient of friction, one may not be able to adjust the walking velocity in time. This may cause a person to slip and fall on the first few steps on the more slippery surface (3.9.3.1a).

(b) Floor patterns can add to the interest and liveliness of a space. Small inserts and borders are popular in flooring designs (3.9.3.1b). The slip resistance of these decorative parts are equally important as the main flooring material.

(c) A material may also change drastically under dry and wet conditions. A non-slip material may become slippery and hazardous; even a small area of stainless steel insert may make a person slip when it is wet.

(d) Abrasions, polishes, or contamination such as stains or dust on a flooring material could affect its slip resistance.

(e) Surface roughness of a flooring material can increase its static coefficient of friction (3.9.3.1c). However, a compromise should be sought between the slip resistance and tripping hazard when a material surface is roughened.

(f) Steeper gradient of the ground increases the safety threshold of the static coefficient of friction.

(g) Shoe traction contributes to the slip resistance of the ground surface. The same person wearing different shoes at different times travelling on the

3.9.3.1a Change in flooring materials with gradual change in slip resistance at entrance area from external ground

3.9.3.1b Slip resistance of small inserts is equally important

3.9.3.1c Strike a balance between good slip resistance and tripping hazard when considering the surface roughness of a flooring material

same surface may experience a difference in slip resistance.

(h) Body weight of a person could affect the surface area of contact between the shoe and the ground surface. Small children with lighter body weight tend to slip easier than adults.

3.9.3.2 Field Measurement

For this study, a field measurement on the relative slip resistance of some commonly used external flooring materials has been carried out. The Method Statement and Testing Procedures are as shown in Figure 3.9.3.2a.

Each selected flooring material at a site is tested twice, one time under dry condition, and another time during rainfall. The following data are recorded for each test:

Test Weight (w grams)
Pushing Force x 5 readings (pf1 to pf5 grams)

For readings taken under 'Dry' condition, data that are beyond 10% of the mean reading out of the 5 readings are discarded. For readings taken under 'Wet' condition, data that are beyond 20% of the mean reading out of the 5 readings are discarded.

See the following example for 'Dry' condition.

Mean Reading pfm =
(pf1 + pf2 + pf3 + pf4 + pf5)/5

If pf4 > pfm x 110%, then pf4 is discarded.
If pf5 < pfm x 90%, then pf5 is discarded.

The adopted Pushing Force is then:
pf = (pf1 + pf2 + pf3)/3

Relative slip resistance = pf/w

3.9.3.3 Relative Slip Resistance Value

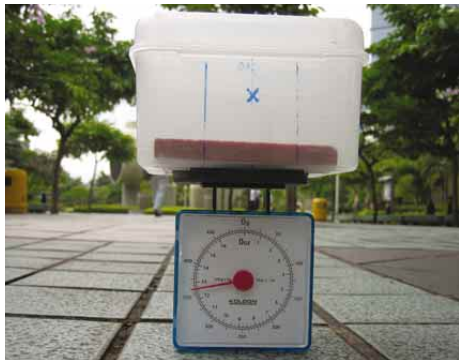
The relative slip resistance of 37 different flooring materials have been obtained using the field measurement in *Section 3.9.3.2* above. The values obtained for each material under dry and wet conditions are presented in the summary in Figure 3.9.3.3a.

A common international consensus has established to set 0.50 as the minimum safety level for the slip resistance of travelling surfaces. By using the same safety threshold of 0.50, the results of our field measurement reveal that with the exception of 2 samples of glass surfaces, all the other 35 material samples have a relative slip resistance value of higher than 0.50. The chart in Figure 3.9.3.3b shows the flooring materials in descending order of the relative slip resistance. The lower slip resistance value obtained for the same material in dry and wet conditions shown in Figure 3.9.3.3a has been adopted to formulate the chart so as to reflect the worse scenario.

As mentioned in *Section 3.9.3.1(a)*, the difference in slip resistance of adjoining flooring materials needs to be considered in order to contribute to a safer travelling surface. It is recommended that adjoining flooring materials should not have a difference in slip resistance value of more than 0.2. Taking this maximum figure as a guideline, the chart in Figure 3.9.3.3c shows the difference in slip resistance for different pairs of flooring materials when used next to each other. This aims to provide a handy tool for designers to check whether the proposed combination of flooring materials can offer a safer travelling surface in terms of slip prevention.

i) Test box mounted with heeltap

ii) Check levelling of ground surface to be tested



iii) Weigh the heeltap test box with the scale and record the Test Weight

iv) Place the heeltap test box on the levelled flooring material to be tested and set the scale at zero against the front of it

v) Push the scale towards the heeltap test box, increase the force gradually until it just starts to move

vi) Record the reading of the scale as the Pushing Force

vii) Repeat ii) to vi) on an adjacent area of the same material but with a Pushing Force in random direction

viii) A total of 5 spots of the same material at one area is tested to get an average data

ix) Repeat the test under wet condition during rainfall

3.9.3.2a **Method statement and testing procedure for field measurement on relative slip resistance**

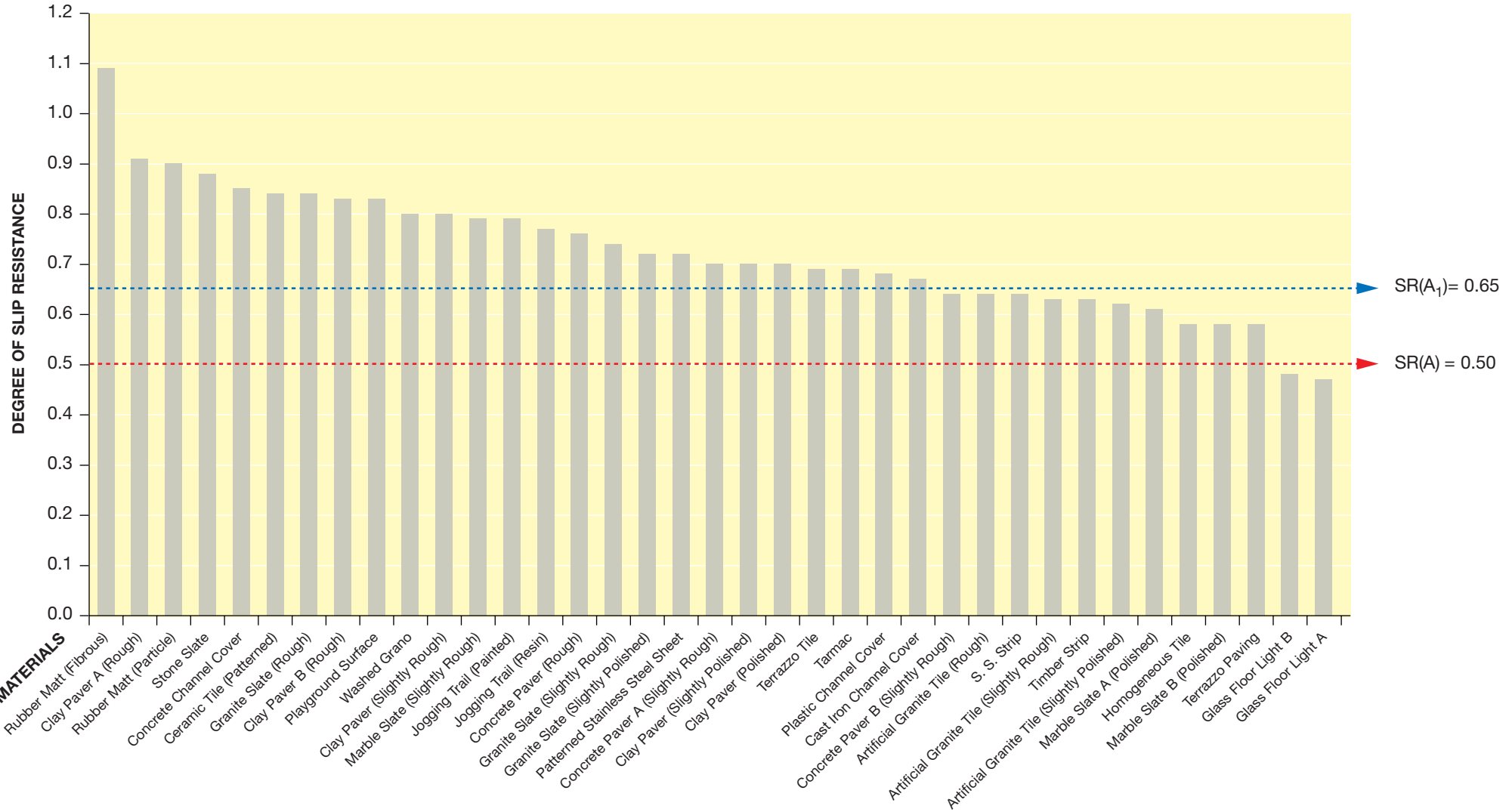
Item	A	B	C	D	E	F	G	H	I	J
Flooring Material	Rubber Mat	Clay Paver	Marble/ Stone Slate	Channel/ Light Cover	Concrete Paver	Granite	Tiles	Washed Grano/ Terrazzo	Painting	Miscellaneous
Degree	More Slip Resistant ◄								► Less Slip Resistant	
Photo										
Material	Rubber Mat (Fibrous)	Clay Paver A1	Stone Slate	Plastic Channel Cover	Concrete Paver 1	Granite Slate 1	Ceramic Tile 2	Washed Grano	Jogging Trail (Painted)	Tarmac
SR(dry)	1.09	0.94	0.91	0.89	0.89	0.84	0.84	0.80	0.79	0.74
SR(wet)	1.11	0.91	0.88	0.68	0.76	0.84	0.78	0.88	0.84	0.69
Photo										
Material	Rubber Mat (Particle)	Clay Paver B1	Marble Slate 2	Glass Floor Light A	Concrete Paver A2	Granite Slate 2	Artificial Granite Tile 1	Terrazzo Tile	Jogging Trail (Resin)	Patterned SS Sheet
SR(dry)	0.90	0.88	0.79	0.86	0.84	0.78	0.73	0.71	0.77	0.72
SR(wet)	0.92	0.83	0.82	0.47	0.70	0.74	0.64	0.69	0.93	0.74
Photo										
Material	Playground Surface	Clay Paver 2	Marble Slate A4	Concrete Channel Cover	Concrete Paver B2	Granite Slate 3	Homogenous Tile	Terrazzo Paving		SS Strip
SR(dry)	0.83	0.80	0.72	0.85	0.80	0.61	0.73	0.58		0.68
SR(wet)	1.04	0.81	0.62	0.88	0.64	0.68	0.58	0.63		0.64
Photo										
Material		Clay Paver 3	Marble Slate B4	CI Channel Cover			Artificial Granite Tile 2			Timber Strip
SR(dry)		0.79	0.58	0.81			0.63			0.68
SR(wet)		0.70	0.63	0.67			0.64			0.63
Photo										
Material		Clay Paver 4		Glass Floor Light B			Artificial Granite Tile 3			
SR(dry)		0.70		0.48			0.62			
SR(wet)		0.84		0.51			0.65			

Legend
1 SR(dry) & SR(wet) denote relative slip resistance values of the external flooring materials under dry & wet condition respectively
2 "SS" denotes stainless steel

Finishes
1 Rough
2 Slightly Rough/ Patterned
3 Slightly Polished
4 Polished

3.9.3.3a Summary of slip resistance values of different external flooring materials

Relative Slip Resistance Value of Various Flooring Materials



Legend SR: Relative Slip Resistance Value of Flooring Materials

Remarks
(i) Flooring materials with SR < A (0.5) are not recommended
(ii) Flooring materials with SR > A (0.5) & < A_1 (0.65) may be considered subject to appropriate planning on design, extent and profile etc. of the surfaces
(iii) Flooring materials with SR > A_1 (0.65) are recommended

3.9.3.3b Relative slip resistance value of different external flooring materials

Flooring Material (Item)			Item	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
			Mat.	RM(F)	CP A1	RM(P)	CoP 1	CP B1	GFL A	CrT 2	GS 1	PS	CoP B2	WG	JT(P)	GS 2	JT(R)	TaM	HoT	MS A4	TS	AGT 3	MS B4	GFL B
Flooring Material			Photo																					
Item	Mat.	SR	Photo	1.09	0.94	0.90	0.89	0.88	0.86	0.84	0.84	0.83	0.80	0.80	0.79	0.78	0.77	0.74	0.73	0.72	0.68	0.62	0.58	0.48
1	RM(F)	1.09		0	0.15	0.19	0.20	0.21	0.23	0.25	0.25	0.26	0.29	0.29	0.30	0.31	0.32	0.35	0.36	0.37	0.41	0.47	0.51	0.61
2	CP A1	0.94		0.15	0	0.04	0.05	0.06	0.08	0.10	0.10	0.11	0.14	0.14	0.15	0.16	0.17	0.20	0.21	0.22	0.26	0.32	0.36	0.46
3	StS	0.91		0.18	0.03	0.01	0.02	0.03	0.05	0.07	0.07	0.08	0.11	0.11	0.12	0.13	0.14	0.17	0.18	0.19	0.23	0.29	0.33	0.43
4	RM(P)	0.90		0.19	0.04	0	0.01	0.02	0.04	0.06	0.06	0.07	0.10	0.10	0.11	0.12	0.13	0.16	0.17	0.18	0.22	0.28	0.32	0.42
5	PCC	0.89		0.20	0.05	0.01	0	0.01	0.03	0.05	0.05	0.06	0.09	0.09	0.10	0.11	0.12	0.15	0.16	0.17	0.21	0.27	0.31	0.41
6	CoP 1	0.89		0.20	0.05	0.01	0	0.01	0.03	0.05	0.05	0.06	0.09	0.09	0.10	0.11	0.12	0.15	0.16	0.17	0.21	0.27	0.31	0.41
7	CP B1	0.88		0.21	0.06	0.02	0.01	0	0.02	0.04	0.04	0.05	0.08	0.08	0.09	0.10	0.11	0.14	0.15	0.16	0.20	0.26	0.30	0.40
8	GFL A	0.86		0.23	0.08	0.04	0.03	0	0	0.02	0.02	0.03	0.06	0.06	0.07	0.08	0.09	0.12	0.13	0.14	0.18	0.24	0.28	0.38
9	CCC	0.85		0.24	0.09	0.05	0.04	0.03	0.01	0.01	0.01	0.02	0.05	0.05	0.06	0.07	0.08	0.11	0.12	0.13	0.17	0.23	0.27	0.37
10	CoP A2	0.84		0.25	0.10	0.06	0.05	0.04	0.02	0	0	0.01	0.04	0.04	0.05	0.06	0.07	0.10	0.11	0.12	0.16	0.22	0.26	0.36
11	CrT 2	0.84		0.25	0.10	0.06	0.05	0.04	0.02	0	0	0.01	0.04	0.04	0.05	0.06	0.07	0.10	0.11	0.12	0.16	0.22	0.26	0.36
12	GS 1	0.84		0.25	0.10	0.06	0.05	0.04	0.02	0	0	0.01	0.04	0.04	0.05	0.06	0.07	0.10	0.11	0.12	0.16	0.22	0.26	0.36
13	PS	0.83		0.26	0.11	0.07	0.06	0.05	0.03	0.01	0.01	0	0.03	0.03	0.02	0.03	0.04	0.07	0.08	0.09	0.13	0.19	0.23	0.33
14	CIC	0.81		0.28	0.13	0.09	0.08	0.07	0.05	0.03	0.03	0.02	0.01	0.01	0.02	0.03	0.04	0.07	0.08	0.09	0.13	0.19	0.23	0.33
15	CoP B2	0.80		0.29	0.14	0.10	0.09	0.08	0.06	0.04	0.04	0.03	0	0	0.01	0.02	0.03	0.06	0.07	0.08	0.12	0.18	0.22	0.32
16	CP 2	0.80		0.29	0.15	0.10	0.09	0.08	0.06	0.04	0.04	0.03	0	0	0.01	0.02	0.03	0.06	0.07	0.08	0.12	0.18	0.22	0.32
17	WG	0.80		0.29	0.15	0.10	0.09	0.08	0.06	0.04	0.04	0.03	0	0	0.01	0.02	0.03	0.06	0.07	0.08	0.12	0.18	0.22	0.32
18	JT(P)	0.79		0.30	0.16	0.11	0.10	0.09	0.07	0.05	0.05	0.04	0.01	0.01	0	0.01	0.02	0.05	0.06	0.07	0.11	0.17	0.21	0.31
19	CP 3	0.79		0.30	0.16	0.11	0.10	0.09	0.07	0.05	0.05	0.04	0.01	0.01	0	0.01	0.02	0.05	0.06	0.07	0.11	0.17	0.21	0.31
20	GS 2	0.78		0.31	0.17	0.12	0.11	0.10	0.08	0.06	0.06	0.05	0.02	0.02	0.01	0	0.01	0.04	0.05	0.06	0.10	0.16	0.20	0.30
21	JT(R)	0.77		0.32	0.18	0.13	0.12	0.11	0.09	0.07	0.07	0.06	0.03	0.03	0.02	0.01	0	0.03	0.04	0.05	0.09	0.15	0.19	0.29
22	TaM	0.74		0.35	0.20	0.16	0.15	0.14	0.12	0.10	0.10	0.09	0.06	0.06	0.05	0.04	0.03	0	0.01	0.02	0.06	0.15	0.19	0.29
23	AGT 1	0.73		0.36	0.21	0.17	0.16	0.15	0.13	0.11	0.11	0.10	0.07	0.07	0.06	0.05	0.04	0.01	0	0.01	0.05	0.11	0.15	0.25
24	HoT	0.73		0.36	0.21	0.17	0.16	0.15	0.13	0.11	0.11	0.10	0.07	0.07	0.06	0.05	0.04	0.01	0	0.01	0.05	0.11	0.15	0.25
25	PSS	0.72		0.37	0.22	0.18	0.17	0.16	0.14	0.12	0.12	0.11	0.08	0.08	0.07	0.06	0.05	0.02	0.01	0	0.04	0.10	0.14	0.24
26	MS A4	0.72		0.37	0.22	0.18	0.17	0.16	0.14	0.12	0.12	0.11	0.08	0.08	0.07	0.06	0.05	0.02	0.01	0	0.04	0.10	0.14	0.24
27	TT	0.71		0.38	0.23	0.19	0.18	0.17	0.15	0.13	0.13	0.12	0.09	0.09	0.08	0.07	0.06	0.03	0.02	0.01	0.03	0.09	0.13	0.23
28	CP 4	0.70		0.39	0.24	0.20	0.19	0.18	0.16	0.14	0.14	0.13	0.10	0.10	0.09	0.08	0.07	0.04	0.03	0.02	0.02	0.08	0.12	0.22
29	TS	0.68		0.41	0.26	0.22	0.21	0.20	0.18	0.16	0.16	0.14	0.11	0.11	0.10	0.09	0.08	0.05	0.04	0.03	0	0.06	0.10	0.20
30	SSS	0.68		0.41	0.26	0.22	0.21	0.20	0.18	0.16	0.16	0.15	0.12	0.12	0.11	0.10	0.09	0.06	0.05	0.04	0	0.06	0.10	0.20
31	AGT 2	0.63		0.46	0.31	0.27	0.26	0.25	0.23	0.21	0.21	0.20	0.17	0.17	0.16	0.15	0.14	0.11	0.10	0.09	0.05	0.01	0.05	0.15
32	AGT 3	0.62		0.47	0.32	0.28	0.27	0.26	0.24	0.22	0.22	0.21	0.18	0.18	0.17	0.16	0.15	0.12	0.11	0.10	0.06	0	0.04	0.14
33	GS 3	0.61		0.50	0.33	0.29	0.28	0.27	0.25	0.23	0.23	0.22	0.19	0.19	0.18	0.17	0.16	0.13	0.12	0.11	0.07	0.01	0.03	0.13
34	MS B4	0.58		0.51	0.36	0.32	0.31	0.30	0.28	0.26	0.26	0.25	0.22	0.22	0.21	0.20	0.19	0.16	0.15	0.14	0.10	0.04	0	0.10
35	TP	0.58		0.51	0.36	0.32	0.31	0.30	0.28	0.26	0.26	0.25	0.22	0.22	0.21	0.20	0.19	0.16	0.15	0.14	0.10	0.04	0	0.10
36	GFL B	0.48		0.61	0.46	0.42	0.41	0.40	0.38	0.36	0.36	0.35	0.32	0.32	0.31	0.30	0.29	0.26	0.25	0.24	0.20	0.14	0.10	0

Legend

AGT	Artificial Granite Tile
CCC	Concrete Channel Cover
CIC	Cast Iron Channel Cover
CP	Clay Paver
CoP	Concrete Paver
CrT	Ceramic Tile
GFL	Glass Floor Light
GS	Granite Slate
HoT	Homogenous Tile
JT(P)	Jogging Trail (Painted)
JT(R)	Jogging Trail (Resin)
MS	Marble Slate
PS	Playground Surface
PSS	Patterned SS Sheet
PCC	Plastic Channel Cover
StS	Stone Slate
RM(F)	Rubber Mat (Fibrous)
RM(P)	Rubber Mat (Particle)
SSS	Stainless Steel Strip
TaM	Tarmac
TP	Terrazzo Paving
TS	Timber Strip
TT	Terrazzo Tile
WG	Washed Grano

(yellow) Cell of absolute value of the difference in slip resistance within the acceptable limit (0.2)

(grey) Cell of absolute value of the difference in slip resistance greater than or equal to the acceptable limit (0.2)

SR Slip Resistance Value (SR) of the Flooring Material

Mat. Material

Finishes 1 Rough
2 Slightly Rough
3 Slightly Polished
4 Polished

3.9.3.3c Difference in slip resistance for pairs of external flooring materials

3.9.4 Safety for Persons with Visual Impairment

The conveyance of information is one of the most important aspects to consider when designing for persons with visual impairment. Since visual messages are not useful to them for identification of orientation and direction, clear information on way finding needs to be conveyed to enable them to find their own way.

The incorporation of clear voice messages or audible signals as orientation and directional guide is important to assist the visually impaired (3.9.4a). Other useful tools include sufficient Braille signs at appropriate locations, tactile guide paths, and/or handrails as road guides.

Signage should also be conspicuous, with high luminous contrast, and be of sufficient size for use by the visually impaired. Refer to *Section 3.5 — Way Finding, Orientation and Signage*.

3.9.4a Audible signal for the visually impaired

3.9.5 Importance of Maintenance

A perfectly designed facility incorporating universal accessibility considerations still cannot be sustained without good management and maintenance. Facilities and equipment installed in external areas are exposed to the effects of weather; hence the rate of deterioration and damage may be greater than indoor installations.

The outdoor facilities, if not properly and frequently maintained and preserved, may easily turn into unsafe elements posing hazards to users (3.9.5a).

The upkeep of soft landscaping and water areas, for example, is essential for the safety and enjoyment by users. Damaged furniture and fittings should be replaced promptly to eliminate any danger to users. Refer to *Section 3.10 — Management and Maintenance*.

3.9.5a Poor maintenance of facilities may render them unusable or hazardous