SPECIFYING
SLIP RESISTANT FLOORING

SlipSTD PAS

Brian G Newell

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- Member of Standards Committees

  BS - CEN - ISO (UK Delegation leader)

- Chairman of UK Tile Association Technical Committee
- Member of CIRIA Steering Group (Construction Industry Research and Information Association)
- Member of HSE Flooring Stakeholder Working Group
- Member of UK Slip Resistance Group (UKSRG)
- Member of the SlipSTD Consortium

Issues

Why is slip resistance a difficult issue?

- No agreement across EU on how to evaluate and classify the slip resistance of hard floor coverings
- Various methods adopted in different countries

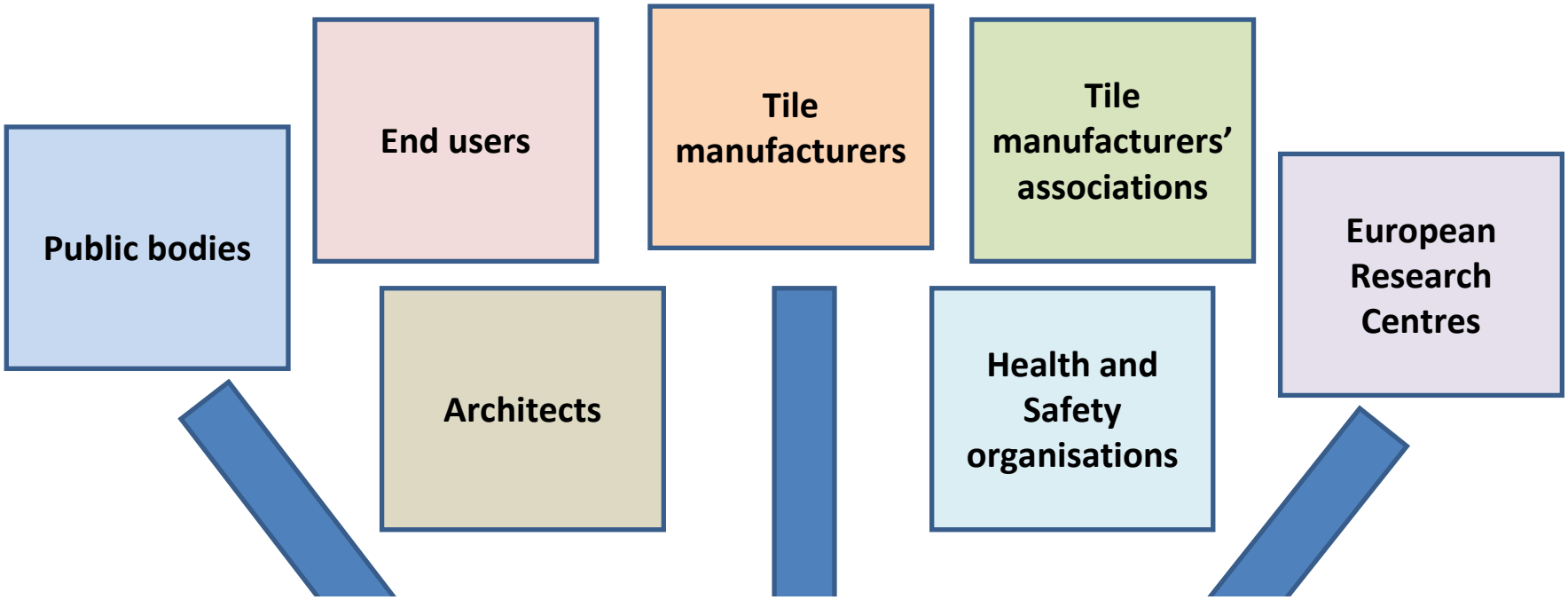
- Difficult for specifiers to cross-reference different test method values
- Inappropriate choices made
- Failure to make progress on CE Marking

SLIP RESISTANCE -
A LONGSTANDING AND CONTENTIOUS ISSUE

How was it to be resolved?

standard surfaces for
a safer environment

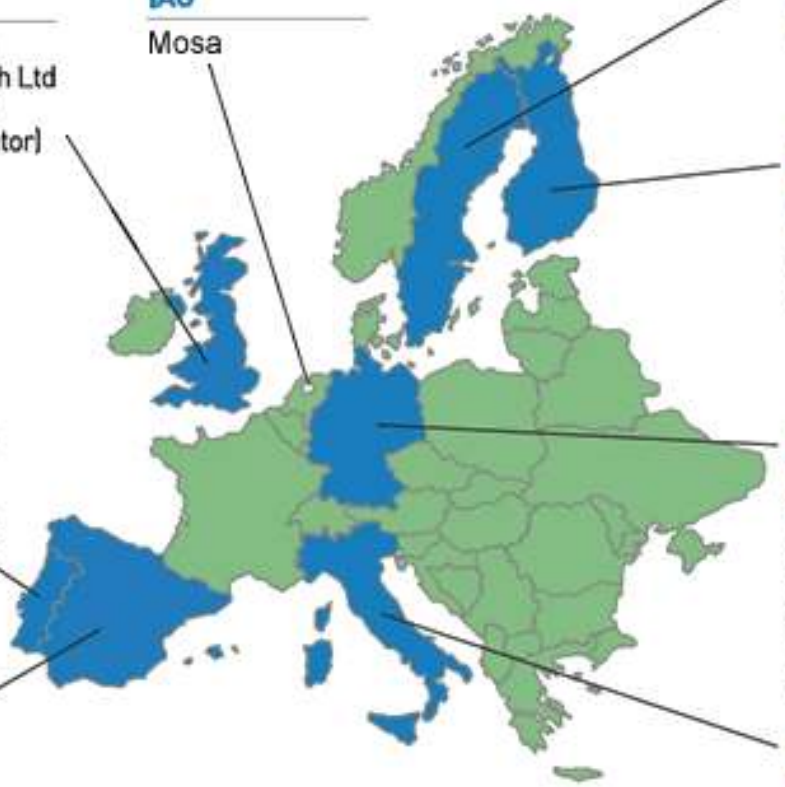
Slip STD Consortium



Co-ordinated by CERAM and partially funded by the EU

SLIP STD
standard surfaces for a safer environment

Slip STD Consortium



UNITED KINGDOM

IAG	RTD
The Tile Association (TTA) UK Health and Safety Executive Royal Institute of British Architects (RIBA)	CERAM Research Ltd (Project coordinator)

NETHERLANDS

IAG
Mosa

SWEDEN

RTD
Uppsala Universitet

FINLAND

RTD
Työterveyslaitos (Finnish Institute of Occupational Health)

PORTUGAL

IAG	SME
Associação Portuguesa da Indústria Cerâmica (APICER)	TopCer Industria de Ceramica SA

GERMANY

IAG	SME	RTD
BG-Institute for Occupational Safety and Health (of HVBG)	Alois Korzilius Interbau GmbH	Forschungsinstitut für Anorganische Werkstoffe (FGK) Fraunhofer-Institut für Produktions–technologie

SPAIN

IAG	SME
Asociación Espanola de Fabricantes de Azulejos y Pavimentos Cerámicos (ASCER)	Ceracasa SA

ITALY

IAG	SME	RTD
Associazione dell'Industria Ceramica Italiana (CONFINDUSTRIA CERAMICA)	Cedir, Ceramiche di Romagna Spa	Centro Ceramico di Bologna

IAG – Industry Association Groups RTD – Research Technical Development SME – Small/medium sized enterprises

Purpose of Consortium

"To define common 'European' minimum slip resistance requirements for hard floor coverings based on <u>defined and measurable surface properties</u> in preference to traditional slip resistance testing."

Major ‘deliverable’ of project

SlipSTD PAS (Publicly Available Specification)

PAS?

“A PAS can be seen as a step in the process of standardisation. It includes useful and practical information that can be made available quickly to suit the market need of the developers and users of a product, process or service”. **BSI**

Expectations of the PAS?

- Should help designers, architects, contractors and their clients to specify and maintain hard floors in ***interior pedestrian areas***
- Should offer an ***objective classification system*** taking into account anticipated ***types of contamination*** and existence of ***slip reducing controls*** and ***cleaning regimes***
- Should offer a ***harmonised and unbiased validation tool*** to design and assess slip resistance ***consistently***
- Should clarify the ***shared responsibilities*** for ensuring a floor's original and continued slip performance properties

Major obstacle?

- Different countries have become firmly wedded to their favoured slip resistance testing methodologies and rating systems

  - The Pendulum
  - The Ramp
  - The Tortus

The Pendulum

- Preferred method of testing in UK
- Recommended by HSE and UKSRG
- Originally designed in US in 1940s
- Refined at the UK Transport Research Laboratory in the 1960s (for testing road surfaces)
- Further refined and adopted by HSE as standard method of assessing slipperiness of pedestrian trafficked flooring surfaces in wet and dry conditions

The Pendulum

- Delivers Pendulum Test Value (PTV)
- A ‘rubber soled heel’ swings through an arc over a test surface
- The ‘follow through’ after contact is measured
- Gives slip ratings for floors in wet or dry conditions
- Fully portable
- Doesn’t always accurately measure heavily profiled surfaces

The Ramp test

- Preferred method of testing in Germany, France, Benelux countries
- Requires a person (in harness) to stand on ramped surface
- Surfaces sprayed with contaminants
- Incline gradually increased
- Slip resistance values determined by angle at which person feels unsafe
- Equipment not portable

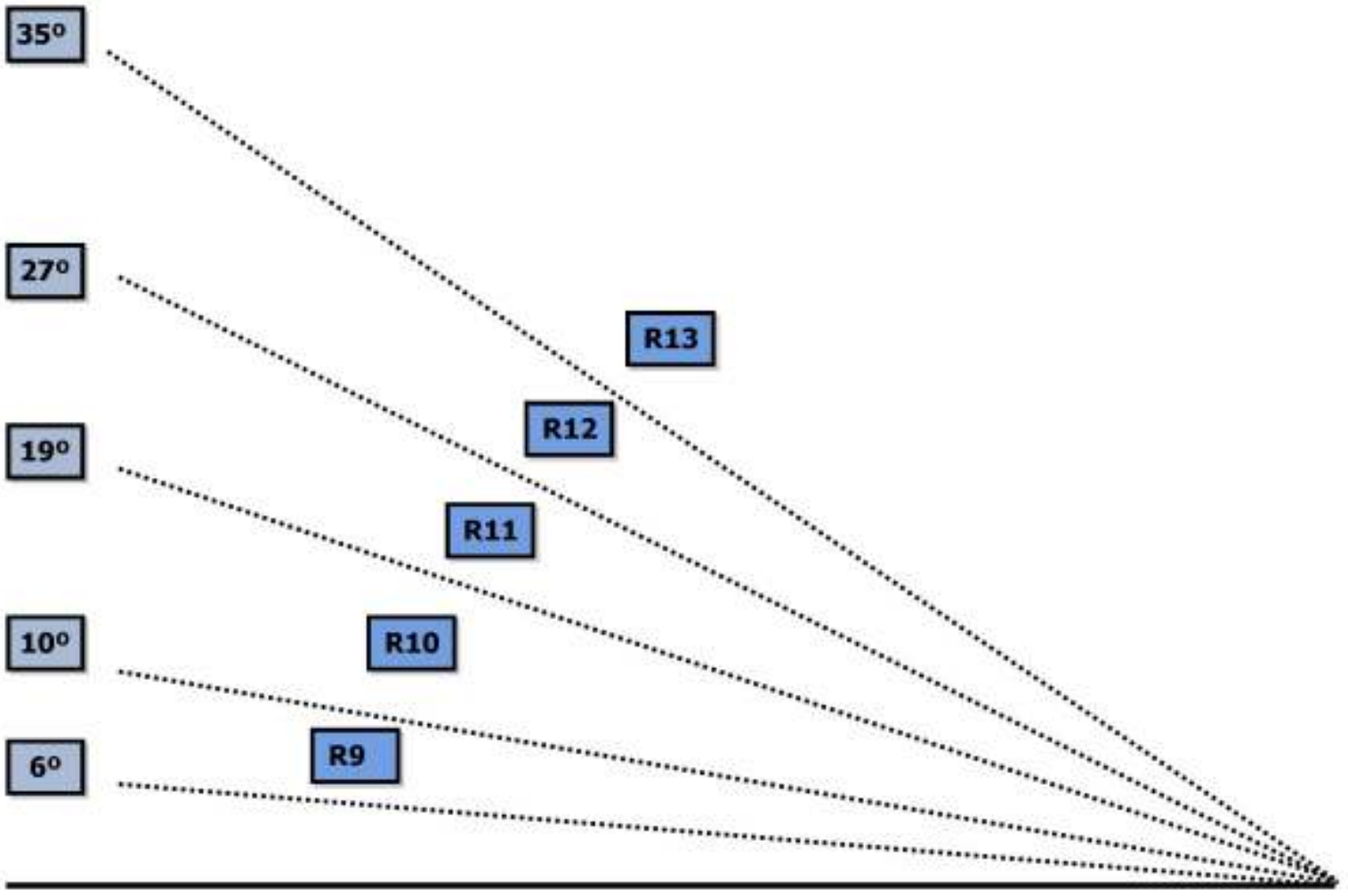
Image courtesy of CERAM

Ramp Test DIN 51130

- Person in harness wears heavily cleated safety boots
- Surface being tested is contaminated with motor oil
- Type of contaminants very questionable
- Test used to determine ‘R’ values
- R9 to R13 classifications often misunderstood or misinterpreted

Classification	R9	R10	R11	R12	R13
Slip angle (°)	6-10	10-19	19-27	27-35	>35

Ramp Test DIN 51130

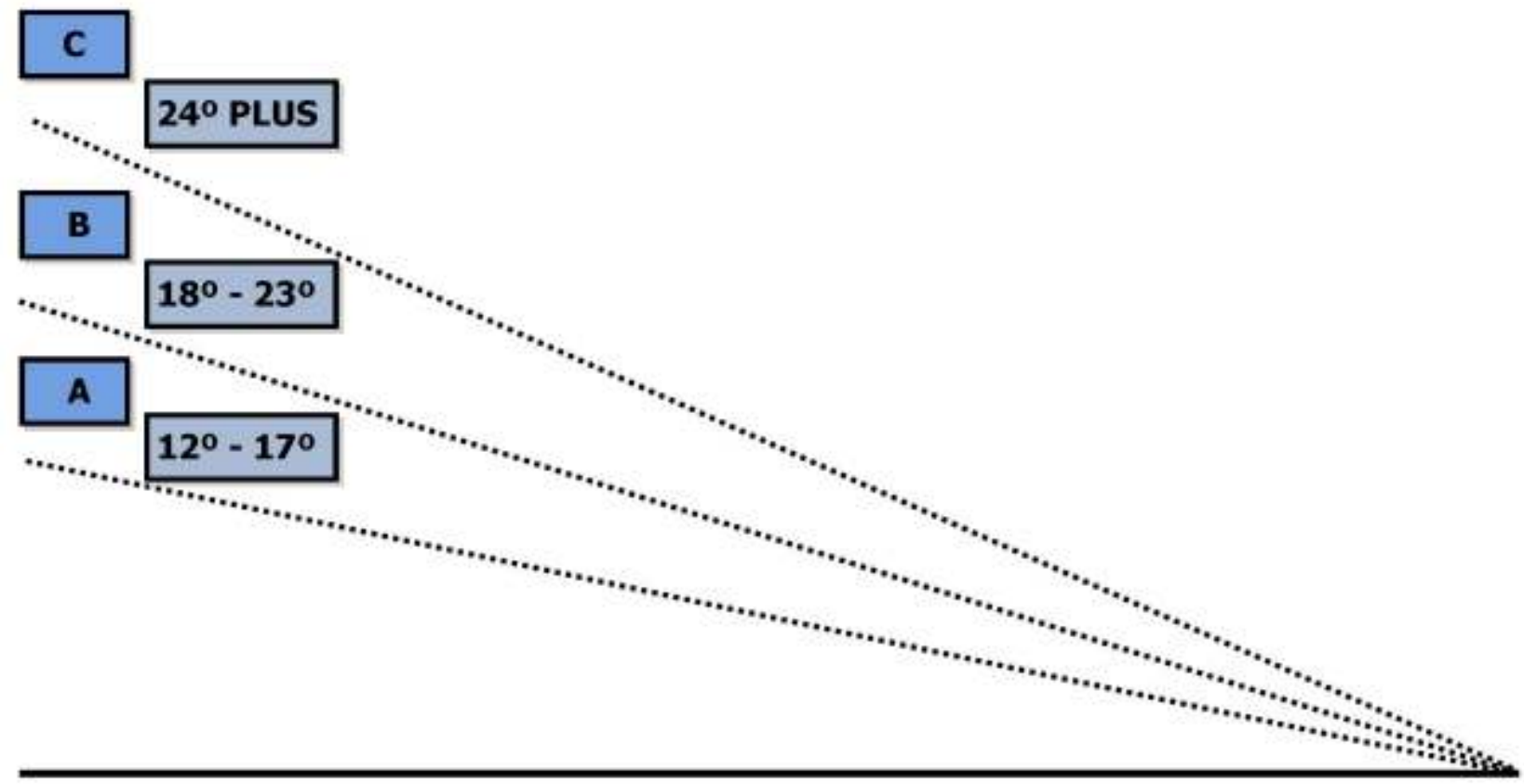


Ramp Test DIN 51097

- Person in harness is ***barefoot***
- A soap solution is used as the contaminant
- Test used to determine A,B,C values
- ‘B’ - suitable and safe for pool surrounds.
- ‘C’ - suitable and safe for use in shower areas

Classification	**A**	**B**	**C**
Slip angle (°)	**12-17**	**18-23**	**>24**

Ramp Test DIN 51097



The BCRA Tortus Test

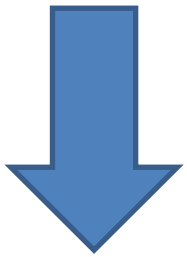
- Test method popular in Italy
- A ‘sled-style’ trolley moves across the flooring surface, measuring the dynamic coefficient of friction

Disadvantages

- Can give over-optimistic slip resistance readings on wet, polished or glazed surfaces
- Not generally viewed in the UK as being reliable.

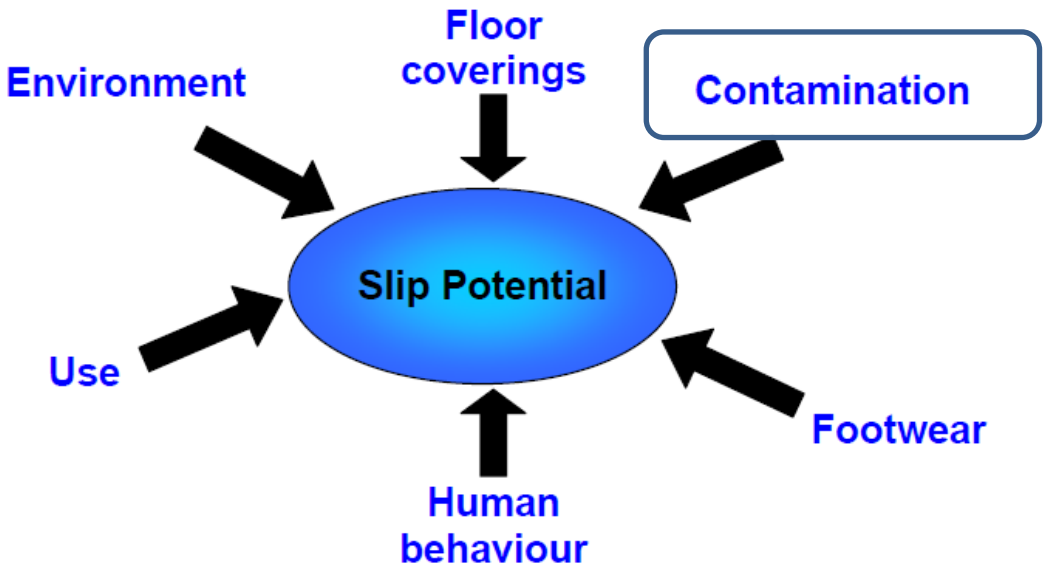
No Consensus

- No single test currently in use is perfect
- All have benefits
- All have their own flaws and disadvantages
- All measuring slip resistance but all based on different principles – no correlation



A FRESH APPROACH WAS NEEDED

A fresh approach from SlipSTD



- One of main causes of pedestrian slip accidents is contamination, from liquid or dry soil
- Floor usage and maintenance hugely affects slip propensity
- New evaluation system must determine acceptable slip resistance levels appropriate to ***intended usage*** and the ***level and type of foreseeable contamination***

Hard floors in all types of locations

Hard floors in all types of locations

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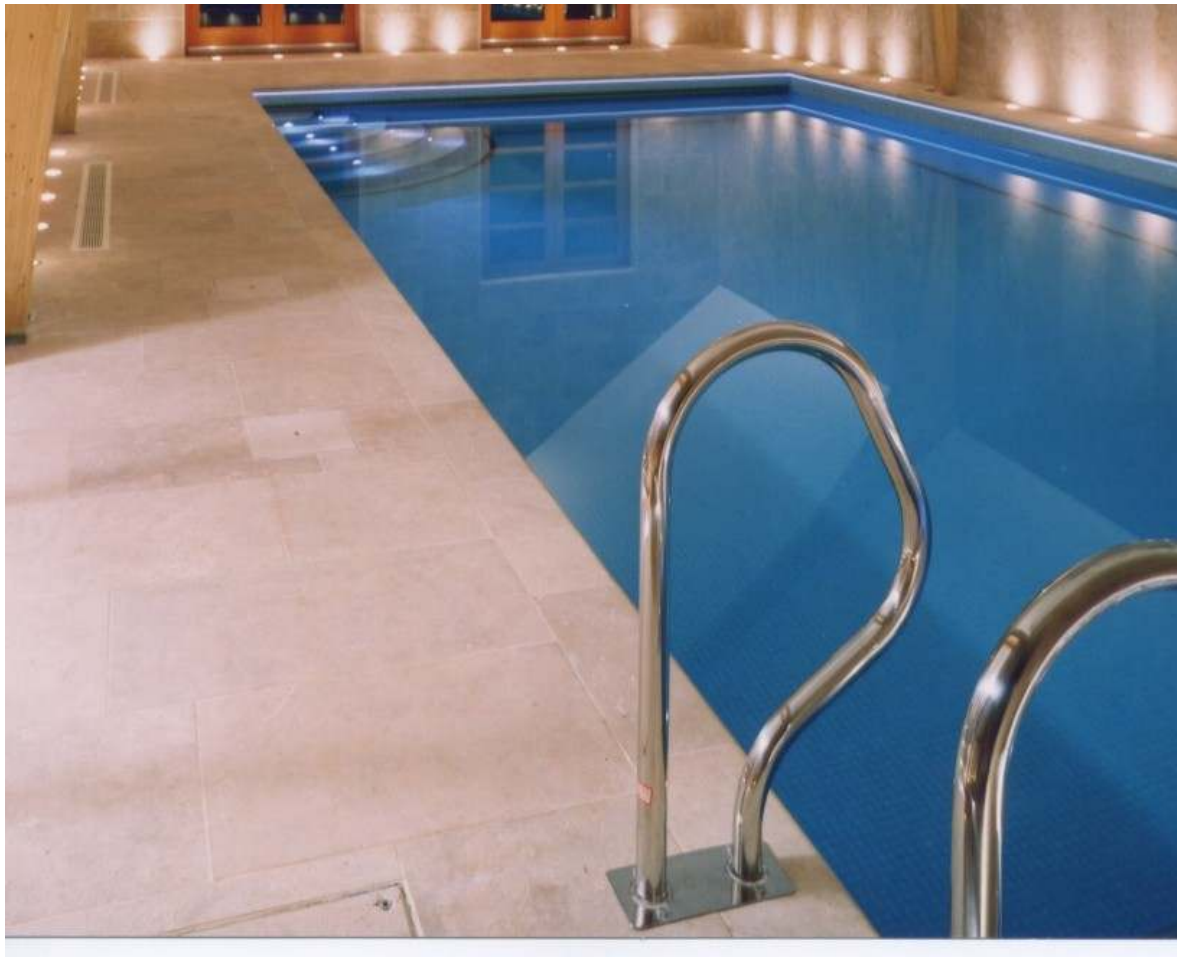


Maintenance and cleaning

A fresh approach

- To set out objective design principles for a flooring surface's intrinsic topography

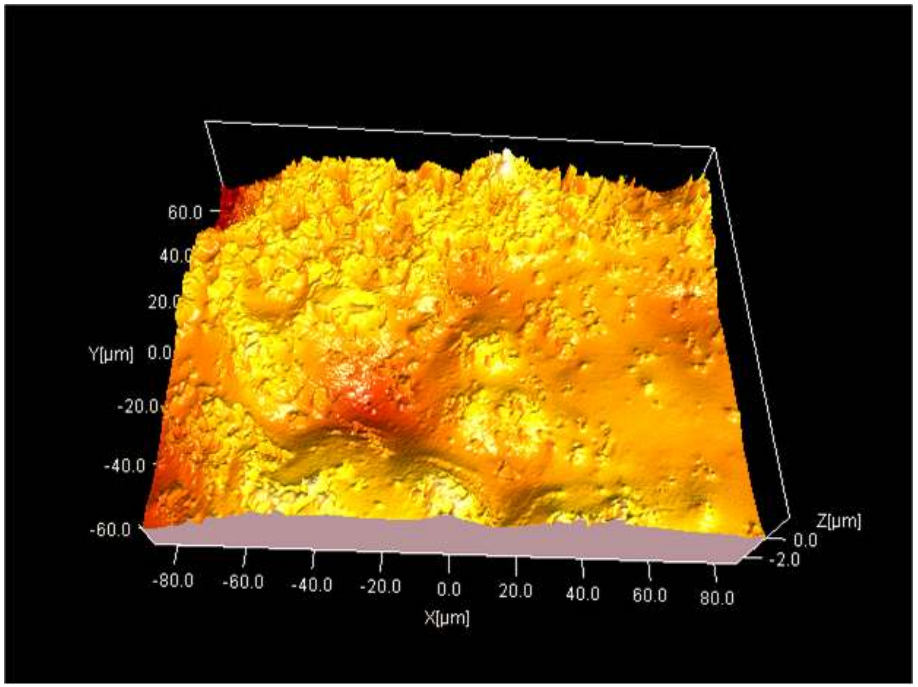


Image courtesy of CERAM

- Can be assessed using optical white light techniques

A fresh approach

- Could a blueprint for slip resistant flooring be designed scientifically?
- Computer modelling techniques required
- Leading academics from the European universities involved with the project gathered all the research data in existence
- Embarked on a development project to generate prototype surfaces with characteristics *known* to deliver slip resistance

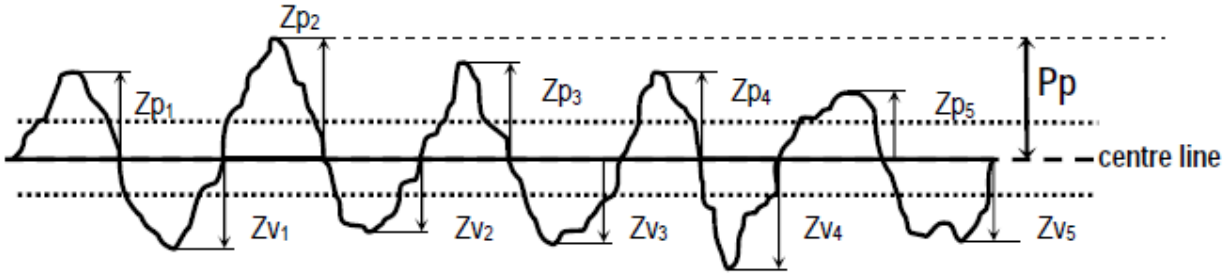
A fresh approach

- No single parameter of surface roughness alone is an effective or accurate indicator of slip resistance

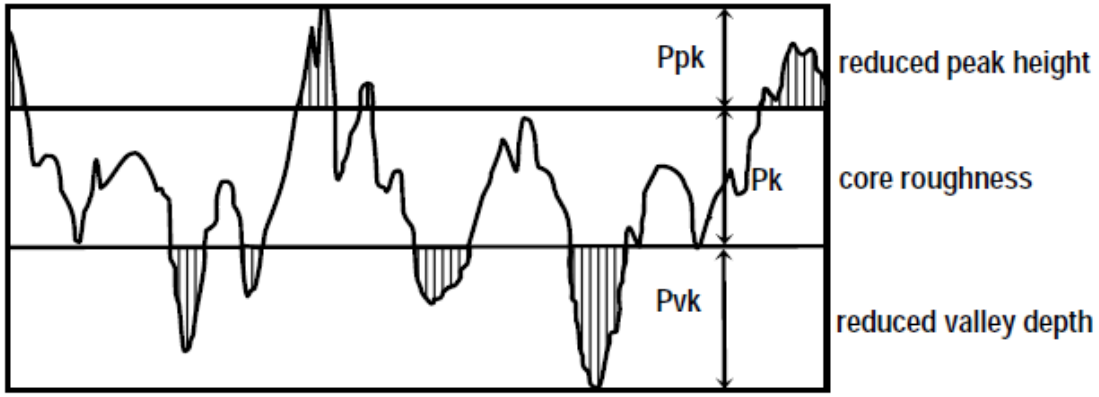
Key parameters:

- **Pp (primary profile)** - relates to the maximum height of the profile above the mean line
- **Pk (primary core roughness depth)** - concentrates on the load bearing area of the surface
- **Roughness parameters**
  - **Ra** -Arithmetic average value or centre line average of the profile ordinates within the sampling length
  - **Rz** - Largest peak to valley height within a single sampling length

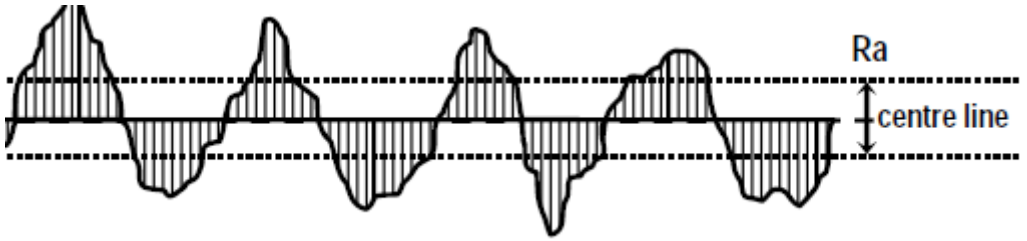
Measuring Pp



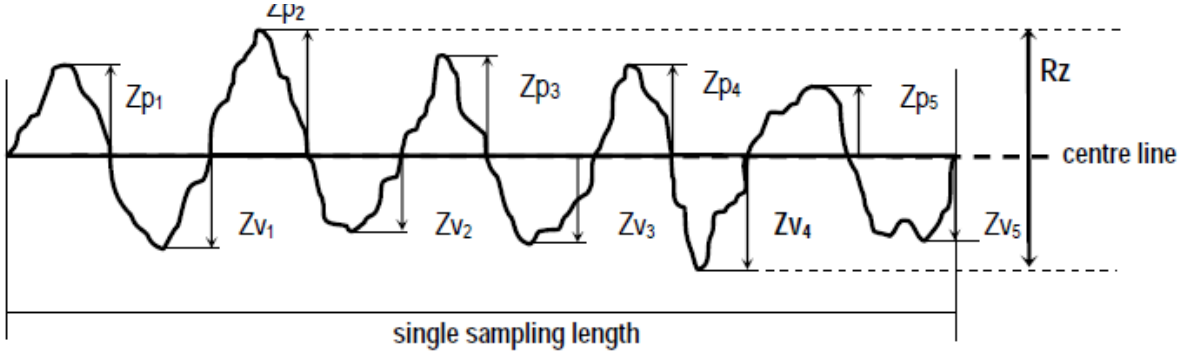
Measuring Pk



Measuring Ra



Measuring Rz

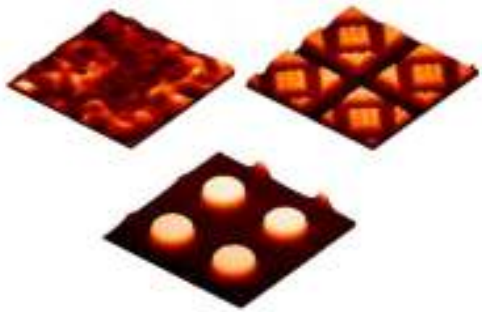


Types of floor surface

Surfaces can be grouped according to surface features, detectable by visual and tactile inspection, and by their primary surface parameters Pp and Pk (assessed using optical white light techniques)

Group 1 – smooth surfaces – tend to be slippery when contaminated

Group 2 –non profiled, essentially even surfaces but with a gritty texture



Group 3 – profiled, textured or structured surfaces

Categories of usage and contamination

Class 1	**For those areas which are foreseeably clean and dry, and which are routinely maintained as such**
Class 2A	**For those areas which are foreseeably contaminated with water and/or dry contaminants.**
Class 2B	**For areas which are foreseeably contaminated with other liquid contaminants with viscosity higher than water, such as oil or grease.**

Relating parameters to types of surface

	Surface Groups		
	Group 1	**Group 2**	**Group 3**
Class 1	No requirements	No requirements / not advisable	No requirements / not advisable
Class 2A	Not applicable	P_k> 50 μm and P_p> 90 μm	P_k> 100 μm and P_p> 200 μm
Class 2B	Not applicable	Not applicable	P_k> 150 μm and P_p> 300 μm

Correlating Slip STD PAS classifications with existing test criteria

Country	United Kingdom	Germany	Germany	Spain	Italy
Test methods	BS 7976 Pendulum 4S Slider	DIN 51130 Ramp method oil/shoe	DIN 51097 Ramp method water/barefoot	CTE Pendulum-Pendulum rubber slider	BCRA Tortus
Slip resistant requirements/ recommendations	HSE/UKSRG Guidelines	BGR 181	GUV-I 8527	Documento Básico SU(03/2006)	Decree DM 14.06.1989
Class 2A	PTV >36 with relevant contaminant	Generally not applicable except cases reported in BGR 181 (R10)	A,B, C according to application	35<Rd≤45	BCR wet (>0.4)
Class 2B	PTV >36 with relevant contaminant	R11 - R13	Not applicable	Rd>45	BCR wet (>0.4)

(Source SlipSTD PAS)

Setting out responsibilities for Pedestrian Safety

- **Flooring manufacturers -** responsible for the declared properties of their products
- **Designers and specifiers –** responsible for selecting appropriate floor coverings and for good floor design
- **Installers –** responsible for standards of workmanship and compliance with design specification and manufacturer's recommendations
- **Client and maintenance team –** responsible for ensuring that floor covering continues to provide a safe pedestrian surface

Conclusions

- Hard flooring products can now be marked with a common slip resistance classification in all EC countries
- Designers can be sure of meeting national slip resistance requirements regardless of country of origin of flooring products
- Progress at last , overcoming national interests and moving the issue of slip measurement forward
- SlipSTD PAS is to be used in conjunction with existing national regulations and Health and Safety directives
- SlipSTD PAS could be the forerunner of a CE mark