Floor Slip Resistance Requirements under 2012 International Building Code

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Learning Objectives

✓ IBC 2012 requirement for slip resistance (ANSI A137.1)
✓ Changes that occurred in ANSI A137.1 in 2014: minimum wet DCOF
✓ Slip resistance testing in lab or on-site for compliance
✓ How to specify and buy safe flooring
✓ Remediation of slippery floors
✓ Using flooring that doesn’t meet the code requirement
Owner’s Objectives

Prevent PAIN, SUFFERING and FINANCIAL LOSSES caused by slip-related falls and ergonomic injuries

Protect all from unjustified or fraudulent LAWSUITS

Previous Situation

- Static coefficient of friction (SCOF) of 0.60 for level floors was not useful and is now abandoned

- Static friction applies to people standing still

- ADA’s Access Board does not recommend using SCOF, and never did
Coefficient of friction

\[ \text{COF} = \frac{\text{Friction force}}{\text{weight}} \]
Ingredients of a slipping incident

Person

Footwear

Activity

Working surface

Environment

Causal factors: Person

- Prescription and other drugs or alcohol

- Drug adverse interactions

- Health factors
  - Osteoporosis (especially women over age 50)
  - Diabetes (neuropathy)
  - Seizures, drop attacks, stroke, arthritis, etc.
Causal factors: Footwear

- Leather or plastic solings and hard heels are slippery on many dry surfaces
- Soft rubber can give good wet traction when it has well-designed tread, but can be treacherous when tread has worn off!
- Bare feet have no tread and can be slippery on a wet floor

Slip Resistance of Footwear

There are NO SAFETY STANDARDS for footwear slip resistance in the USA and most other countries

After an accident, testing of the footwear may determine that it, not the floor, was the cause of a slip

Even expensive shoes (over $3000) are often unsafe
Causal factors: Activity

- Traction requirements depend on the activity
- Rushing, especially in turns or on stairs, requires more traction than strolling
- Pushing (wheelchair, food cart, mop) pulling require extra traction without help from extra weight on shoes

Causal factors: Environment

- Lubricants
  - ✔ Rainwater
  - ✔ Detergent residue
  - ✔ Beverages
  - ✔ Furniture polish, WD-40, perfume
  - ✔ Debris, including food, sauces, dust
- Distractions and lighting
  - ✔ Glare
  - ✔ Poor lighting conceals hazards
Some Key Areas that Need Wet Slip Resistance

- Spa shower-Jacuzzi areas
- Bathroom floors
- Bathtubs
- Dining areas, self-serve
- Kitchens
- Pool decks and stairs
- Outdoor walkways
- Showers

Code Requirements
2012 IBC

2103.6 Ceramic tile. Ceramic tile shall be as defined in, and shall conform to the requirements of, ANSI A137.1.

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ANSI A137.1, Coefficient of Friction Section

“(DCOF) does not predict the likelihood a person will or will not slip on a tile surface …

“… tiles suitable for level interior spaces expected to be walked upon when wet shall have a wet DCOF of 0.42 or greater when tested using SLS (wetting agent) solution as per [BOT-3000E tribometer procedure].”
Tiles with a DCOF of 0.42 or greater are not necessarily suitable for all projects. The specifier shall determine tiles appropriate for specific project conditions, considering by way of example, but not in limitation, “type of use, traffic, expected contaminants, expected maintenance, expected wear, and manufacturers’ guidelines and recommendations.”
Tile Council’s Additions

TILE COUNCIL OF NORTH AMERICA, which wrote the ANSI A137.1 slip resistance section, states that the possibility of a slip may also be affected by:

- The material of the shoe sole and its degree of wear
- The speed and length of stride at the time of a slip
- The physical and mental condition of the individual at the time of a slip
- Whether the floor is flat or inclined
- How the surface is used
- How the tile is structured
- How drainage takes place if liquids are involved

THE Key Word in Lawsuits

NEGLIGENCE
The Bottom Line

ANSI A137.1 sets a low bar: a minimum (0.42) that most tiles exceed ex factory

It does not ensure safety. That’s your job.

Making it Work
What makes wet slip resistance

- **Flat**: slippery when wet or otherwise lubricated
- **Bumps**: may be of little traction benefit
- **Suction cups**: improved traction when kept clean
- **Teeth**: improved traction wet or otherwise lubricated. More energy needed to clean than if flat

Four Extreme Examples
Where can you find DCOF data?

- Crossville’s web site shows DCOF for all their floor products; ranges as high as 0.66–0.76 for “Main Street” tile (five colors at right)
- Others may supply current data on request, but no guarantees
- Agrob Buchtal has long experience with anti-slip tiles
- For planning your long-term projects, data might not be offered because production variables can change

Fitting Slip Resistance to the Situation

- USA offers no standards to account for the many variables that ANSI says must be considered: type of use, traffic, expected contaminants, etc., etc., etc.
- Standards Australia has such standards; in effect since 1999 and fine-tuned in 2014; over 30 situations are covered
- The Aussie standards use pendulum test data, the standard in 49 nations on six continents and in continuous use since 1970
- We believe that using A137.1 PLUS Aussie standards means due diligence, best possible practice, and all that is reasonably practicable
Minimum Pendulum Values Recommended for New Flooring

<table>
<thead>
<tr>
<th>Minimum Wet Pendulum Test Value PTV, Hard rubber slider</th>
<th>Soft rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry areas, incl. supermarket aisles</td>
<td>12</td>
</tr>
<tr>
<td>Hospital or aged care bathroom</td>
<td>35</td>
</tr>
<tr>
<td>Pool deck</td>
<td>45</td>
</tr>
<tr>
<td>External walkway, slope &lt;1:14</td>
<td>45</td>
</tr>
<tr>
<td>External ramp slope &gt; 1:14</td>
<td>55</td>
</tr>
<tr>
<td>Pool stairs or ramps into water</td>
<td>55</td>
</tr>
<tr>
<td>Commercial kitchen</td>
<td>55</td>
</tr>
<tr>
<td>Basketball court</td>
<td>--</td>
</tr>
</tbody>
</table>

for more see http://safetydirectamerica.com/improving-the-worlds-most-sophisticated-floor-slip-resistance-testing-standards/
DIN 51097 for Barefoot Flooring

Two walkers test barefoot wet

Categories A, B, C (C has highest slip resistance)

A: Locker rooms
B: Pool decks
C: Stairs leading into water

Cost of Testing

- Lab tests:
  - ✔ $161 – $368 depending on type and number of tests;
  - 3-day turnaround

- Field tests: $98/hour plus expenses

- When to test?
Quality Assurance: When to test wet DCOF

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Event</th>
<th>Example of potential problem</th>
<th>Where test is conducted</th>
<th>Who is protected by the test (who pays for it)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Purchase order</td>
<td>Slip resistance not as advertised</td>
<td>Laboratory</td>
<td>Architect</td>
</tr>
<tr>
<td>2</td>
<td>Delivery</td>
<td>Product as delivered not to spec</td>
<td>Laboratory</td>
<td>General contractor</td>
</tr>
<tr>
<td>3</td>
<td>Post-installation</td>
<td>Slip resistance affected by sealer, grout deposits on surface or inappropriate choice of flooring for use of area (shower, pool, entrance lobby, etc.)</td>
<td>In situ</td>
<td>Installer</td>
</tr>
<tr>
<td>4</td>
<td>Handover</td>
<td>Slip resistance destroyed by construction cleanup or by deposits left by constructors</td>
<td>In situ</td>
<td>Building owner</td>
</tr>
</tbody>
</table>

Maintaining Good Wet Slip Resistance

- Flooring that is slip-resistant when wet takes more energy to clean than slippery flooring
- Sometimes abrasive pads are used for cleaning, even immediately after installation; risky practice
- Some flooring can lose its good wet slip resistance before it has been used for one day
- What’s needed is sustainable slip resistance under real-world conditions
Some Companies Implementing Sustainable Slip Resistance

- McDonalds
- Toyota
- Westfield
- Aldi Supermarkets
- Stockland
- Carnival Cruise Lines
- Royal Caribbean

McDonalds SSR Spec
Sustainable Slip Resistance (SSR) Test

- Test with pendulum
- Abrade wet for at least 500 cycles with 3M green pad loaded with 1 kg
- Test again with pendulum
- Cost: $290 per sample including wet PTV before and after abrasion

- McDonalds spec for customer areas: PTV of 35 or higher after abrasion

Using “Slippery When Wet” Flooring

- Smooth, glossy flooring is generally slippery when wet, regardless of ANSI A137.1 test result
- Such flooring can be safe if it’s kept dry
- Even if safe, a floor can draw slip-and-fall lawsuits due to other factors (footwear, substance abuse, fraud, etc.)
Keeping Slippery Floors Dry

1. Overhang outside
2. Mats — at least 12 feet. Velvet ropes if needed
3. Umbrella bag stand
4. Dust-mopping
5. Documented surveillance for spills, etc.

Outdoor Surfaces

- Not covered in ANSI A137.1 or any U.S. standard
- Posting hazard warnings is no substitute for safe design
- BOT-3000E is low-speed and not appropriate for where people may be running
- We recommend pendulum tests for outdoor surfaces and for pool decks; endorsed by Ceramic Tile Institute of America since 2001
Benefits of DCOF monitoring

- Periodic dry and/or wet testing after installation confirms floor has maintained good slip resistance

- Testing before and after an accident documents that property owner exercised *due diligence, best possible practice, and all that is reasonably practicable*

- Testing of footwear from an accident may indicate that it was the cause of the slip

- Can reduce payouts by up to 98 percent in large properties

Benefits of Floor Monitoring to Owner

- Confirm that floor surfaces are compliant
- Document due diligence, best possible practice, and all that is reasonably practicable
- Protection from creative expert witnesses
- Protection from fraudulent claims
- Avoid liability for problems caused by others (unsafe footwear, intoxication, etc.)
Recap

- 2012 IBC requires minimum DCOF of 0.42 for ceramic tile in level areas that may get wet.
- Testing in lab or on-site uses BOT-3000E digital tribometer.
- Safety may require DCOF much higher than 0.42; pendulum test standards can provide reasonable criteria as Pendulum Test Values of 12–55 or higher.
- Strategic testing can prevent costly problems.
- Chemical treatments, transparent abrasive coatings, and abrasive paints and tapes can remediate slippery floors.
- Flooring that’s slippery wet can be fine if it’s kept dry.