CEN TC 246 ++ info for the ASTM C 18 meeting in St Louis

April 2010
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The relevant technical committees (TC)

- **TC 125** Masonry: Part 6 Natural stone masonry units
- **TC 128/SC 8**: Roofing products/Slate
- **TC 178/WG 2**: Paving products/Natural stone
- **TC 246** Natural stones:
  1. WG 1 Terminology, classification and characteristics
  2. WG 2 Test methods
  3. WG 3 Product standards
  4. WG 4 Agglomerated stones

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TC 128/SC 8 Roofing slates

• Part 1 - Specifications
• Part 2 – Test methods
• Part 1 and 2 are presently in their final phase of revision

Three new parts are planned:
1. One part for products of higher metamorphic grade e.g. schists (Norwegian schists)
2. One part for lower grade e.g. Brasilian
3. One part for coated slates
Almost 1000 year tradition and now, no CE-mark no market?

- Håkonshall in Bergen built in 1261.
- New roofing in 1290.
- Quarrying roofing schist in Hardanger since ca. 1100!
- Continuous activity in the same quarry until today.
About 1540 (dendrochronology)
TC 178 Paving products, WG 2 Natural stones

The three product standards for paving (setts, kerbs and slabs) are being revised and final changes are planned for early May

• Test methods are taken out (referred to TC 246 stds)

• Tolerances are changed

• Clarifications of definitions

• Factory production control improved substantially
TC 246 Natural stones

All product standards/specification standards are now due for their first 5 year review. Start early May with these:

4. prEN 1467, Natural stone – Rough blocks – Requirements
5. prEN 1468, Natural stone – Rough slabs – Requirements
6. prEN 1469, Natural stone products – Slabs for cladding – Requirements
7. prEN 12057, Natural stone products – Modular tiles – Requirements
8. prEN 12058, Natural stone products – Slabs for floors and stairs – Requirements
9. prEN 12059, Natural stone products – Dimensional stone work – Requirements

W1, New standard for Countertops and vanity (furniture tops)
TC 246: 5 years review of test methods

- EN 14066: Thermal shock (lower the T from 221 F to about 158 F and change the sample dimensions)
- EN 14146: E-modulus by resonance frequency
- EN 14147: Salt mist
- EN 14157: Abrasion resistance
- EN 14158: Rupture energy
- EN 14205: Knoop hardness
- EN 14231: Slip resistance by pendulum
- EN 14579: Sound speed propagation
- EN 14581: Thermal expansion (TEAM recom. moisture to be introduced)
Current work items

1. WI 00246076: Natural stone test methods - Determination of resistance of marble to thermal and moisture cycles (The TEAM test)
2. WI 00246077: Natural stone test methods - Determination of sensitivity to accidental staining
3. WI 00246069: Natural stone test methods – Determination of frost resistance (almost finished)
4. WI 00246072: Resistance to fixing placed on rearside
5. WI xxxxxx: Thermal shock - Discolouration
6. WI xxxxxx: Resistance to the combined effect of salt and frost
WI 00246077: Accidental staining

NT BUILD 514

Further developed into a European std
Discolouration potential

Modified Thermal shock tests:

- One for change in strength, 70°C (158°F)
- One for oxidation, pure water 105°C (221°F)
- One for marble and limestone with an alkaline solution, 55°C (131°F)
Resistance towards the combined effect of salt and frost

- Two temperature regimes: -12°C (10°F) and -17.5°C (0.5°F)
- 56 cycles
- Only partly saturated!
- Frozen in air (in plastic bags)
- Bending strength after
Meetings ahead

MADRID

• 5th May: **CEN/TC 246 WG2** "Natural stones-Test Methods"
• 6th May: **CEN/TC 246/WG 3** Working group Product specifications
• 7th May: **TC 246** Plenary meeting
• And a short meeting in **TC 178/WG 2** Paving unit of stone
• 3rd and 4th June: **TC 128/SC 8**: Roofing slate, schist etc (Brussels)
More stuff if time allows

1. Outdoor marble cladding (Case study: Nyköping City hall, 60 miles SW Stockholm)
2. Petrographic analysis – more information is hidden in the microstructure
3. From small scale strength tests to full scale tests and product performance
WI 00246076: Marble, moisture and temp.

Finlandia Hall, Helsinki
Late nineties: maximum of 6 in bow on 5 ft long panels

2001: half a year after replacement
Nyköping City Hall – TEAM results are used
### Requirements for Nyköping city hall marble

<table>
<thead>
<tr>
<th>Important properties</th>
<th>Acceptance limit</th>
<th>Quality classes and points for different classes</th>
<th>Max points</th>
<th>Actual points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bow test - Amount of bow</td>
<td>&lt; 4 mm/m after 50 cycles and less increase than 0.02 mm/m</td>
<td>≤0.2 0.21-0.4 0.41-0.6 0.61-0.8 0.81-1.0</td>
<td>40 30 20 15 10 10</td>
<td>40</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bow test - Strength reduction</td>
<td>&lt;25%</td>
<td>&lt;10% 10-20% 20-25%</td>
<td>10</td>
<td>2</td>
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<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Petrography incl. AGA</td>
<td>&gt;7</td>
<td>AGA &gt;9 AGA = 8 AGA = 7</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Alkaline water test</td>
<td>No significant change</td>
<td>no change slight change</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexural strength</td>
<td>12MPa</td>
<td>&gt;16 14.1-16 12.1-14 10-12</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Breaking load at dowel holes (N)</td>
<td>Depends on the above</td>
<td>&gt;2500 2001-2500 1501-2000 1000-1500 &lt;1000</td>
<td>10</td>
<td>5</td>
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<tr>
<td>Classification</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Thermal shock</td>
<td>No significant change</td>
<td>no change slight change</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Frost resistance</td>
<td>&lt;15 % change</td>
<td>≤5 5.1-10 10.1-15</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Classification</td>
<td></td>
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<tr>
<td>Water absorption</td>
<td>&lt;0.5 wt %</td>
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<tr>
<td>Density</td>
<td>No limit, only declared value</td>
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</tr>
<tr>
<td>Sum</td>
<td>100</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Lab. bow test results of the marble to be used
Adjacent Grain Analysis

A quantitative measure of the complexity of the microstructure
Average number of neighbours for median sized grains is 8 for the marble to be used
Discolouration test, in alkaline water
Other current European projects

1. Natural History museum in Geneva
2. Stoclet Palace in Brussels (100 years)
3. Museum of Contemporary art in Nice
Making more out of the petrographic analysis

Different filtering effects
SEM – What and why?

One example

Perimeter-analysis (circumference of mineral aggregates)

Los Angeles Value. Fragmentation due to brittleness

Perfect correlation
E.g. to avoid this problem

Brittleness – How to determine

• Micro cracks (lower left corner)?
• Rupture energy (lower right corner)?
• Los Angeles value (previous page)?
Strength and dimensioning

- Modulus of rupture (C99)
- Flexural str. (C 880)

Different sample size => different results!
Wet or only dry?
From small scale to full scale
Relevant tests and math. models

• Static point loads (present standard)
• Dynamic loads (are more important!)
• How to include the road base?
Testing and modelling is the future

3-point load (MoR) = Line load in the test and then modelled (FEM)

FEM, modelling of a truck tyre on the edge and in the middle. This slab is placed in mortar. We can now calculate the maximum allowed load carried by the entire construction.

Available free software for cladding panels:
http://expertsystem.sp.se/
Thank you for your attention!