Italian Travertine in Building Heritage

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Travertine is one of the most common stone for building construction used in many countries starting from ancient times.

It’s a durable stone despite the weathering caused by air pollution. It is observed in urban areas that the facades may be covered with a black crust where gypsum and calcite are the main minerals.
Aim and methodology of research

9 different types of travertine from Tuscany and Umbria (Italy) have been investigated:
From Tuscany quarries (Italy) : MB, MCN, MGE, RC, RV, RS, Sc, Si
From Umbria quarry (Italy) : MM

Technical determination executed:
Characterization Test:
Petrographic analysis, water absorption, porosity (o.p.), flexural strength (F.S.), compression strength
Artificial ageing test :
Freeze thaw , Thermal shock resistance have been performed.

Different textures (identified as l, n.l., l.c., l.s) have been identified in order to correlate TRAVERTINE DURABILITY and petrographic features.
Italian travertine and their physical mechanical features - 1

**MB - Not laminated**
- o.p.: 7.38%
- F. S: 10.6MPa

**MCN - Not laminated**
- o.p.: 6.43%
- F. S: 12.4MPa

**MGE - l. concentric sheets**
- o.p.: 10.8%
- F. S: 11.1MPa
Italian travertine and their physical mechanical features - 2

RC - Not laminated
o.p. : 6,48 % - F. S: 13,2 MPa

RV -- Sub parallel sheets
o.p. : 10,58% - F. S: 12,8 MPa

RS -- Not laminated
o.p. : 6,71 % - F. S: 9,3 MPa
Italian travertine and their physical mechanical features - 3

**SC -- Not laminated**
- o.p.: 6.35 %
- F. S: 13.6 MPa

**SI - Laminated**
- o.p.: 3.23 %
- F. S: 10.8 MPa

**MM - Not laminated**
- o.p.: 6.5 %
- F. S: 13.65 MPa
Travertine characterization and Conclusions

From the data analysis, the Travertine durability is not connected only with porosity and petrographic features. The analysis of the complex texture of this Heritage stone cannot give a simple and unique relation related to its durability. Both compact travertine as SI and those porous as MGE, in laboratory suffered the artificial ageing, but in site this kind of stone can be still defined durable. For this reason the next step should be the recognition of decay form on building where there is the certainty of travertine origin.

### Travertine tested

<table>
<thead>
<tr>
<th>Travertine tested</th>
<th>W.A. (%)</th>
<th>Bulk density (kg/m³)</th>
<th>Open porosity (%)</th>
<th>Compressive strength (MPa)</th>
<th>F.s in Natural Conditions (Mpa)</th>
<th>F.S. after artificial ageing (MPa)</th>
<th>Relative variation in F.S. after artificial ageing (%)</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCN</td>
<td>1,0</td>
<td>2520</td>
<td>6,43</td>
<td>71,7</td>
<td>12,4</td>
<td>11,6</td>
<td>6,5</td>
<td>n.l.</td>
</tr>
<tr>
<td>MGE</td>
<td>1,4</td>
<td>2340</td>
<td>11,11</td>
<td>64,3</td>
<td>10,8</td>
<td>7,3</td>
<td>32,4</td>
<td>l.c.</td>
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<tr>
<td>RC</td>
<td>1,1</td>
<td>2460</td>
<td>6,48</td>
<td>68,6</td>
<td>13,2</td>
<td>10,5</td>
<td>20,5</td>
<td>n.l.</td>
</tr>
<tr>
<td>RV</td>
<td>2,2</td>
<td>2390</td>
<td>10,58</td>
<td>52,9</td>
<td>12,8</td>
<td>11,1</td>
<td>13,3</td>
<td>l.s.</td>
</tr>
<tr>
<td>RS</td>
<td>1,4</td>
<td>2490</td>
<td>6,71</td>
<td>70,3</td>
<td>9,3</td>
<td>7,8</td>
<td>16,1</td>
<td>n.l.</td>
</tr>
<tr>
<td>SC</td>
<td>0,8</td>
<td>2490</td>
<td>6,35</td>
<td>71,8</td>
<td>13,6</td>
<td>10,1</td>
<td>25,7</td>
<td>n.l.</td>
</tr>
<tr>
<td>SI</td>
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<td>2540</td>
<td>3,23</td>
<td>87,1</td>
<td>10,8</td>
<td>7,3</td>
<td>32,4</td>
<td>l</td>
</tr>
<tr>
<td>MM</td>
<td>2,6</td>
<td>2470</td>
<td>6,5</td>
<td>70,6</td>
<td>13,65</td>
<td>12</td>
<td>12,1</td>
<td>n.l.</td>
</tr>
</tbody>
</table>