CPD ACADEMY

ARDEX Technical Note 3.1:

Specify Natural Stone Wall and Floor Tiling – Understanding natural stone tiles

Natural stone is the fundamental primary, durable construction material dating back to prehistory. Its aesthetic beauty and elegance, the variety of colours, textures and finishes provide never ending possibilities for architectural design. An understanding of stone geology helps the process of selecting stone suitable for tiling, cladding and decorative use.

Stone geology

There are three main types of rock: **Igneous, sedimentary** and **metamorphic**.

- **Igneous rock** is formed through the cooling and solidification of magma or lava. Igneous rock may form with or without crystallization, either below the surface as intrusive (plutonic) rocks or on the surface as extrusive (volcanic) rocks. This magma can be derived from partial melts of pre-existing rocks in either a planet's mantle or crust. Typically, the melting is caused by one or more of three processes: an increase in temperature, a decrease in pressure, or a change in composition.

  Depending on the chemistry of the melt, the rock can end up yellow, white, grey, green, blue or black: Granite, Grabbo and Basalt belong to this group. A good rule of thumb is the darker the rock, the more metals and alkali minerals within; and the lighter the rock, the more non-metals and acid minerals there are within. This is important to consider as cement-based adhesives are alkaline, which can react with the acid minerals in granite and cause staining.

- **Sedimentary rocks** are laid down by surface processes such as wind, water or biological activity. The types of rocks found are shale, sandstone, chalk, limestone, travertine, breccia and conglomerate. The environment of deposition and energy involved in transport and deposition will determine the size of the grains and also the structures seen within the rock. These can be anything from delicate fossils, coral reefs, sand dunes, stalactites or even preserved mudslides.

Sedimentary rocks are usually grains cemented together by pore water leaving the system as it is squeezed at depth. Three common cements are quartz, calcite and iron oxide. Quartz can be relatively strong, calcite is softer and more brittle and softer and iron oxide is weakest of all. The latter does give the desert varnish associated with red sandstone but in reality only a very little oxide is needed to give a bright red colouration and can often lead to staining and contamination issues as it is still soluble. It would not be uncommon to find two cements holding the grains in place as the waters moving from great depth will pass through all the rock above and precipitate along the way.

- **Metamorphic rocks** are formed when existing rocks are taken to a deeper hotter location than where they formed. Subsequently new minerals form to be stable in the new conditions. This can result in vivid coloured large crystals forming as the presence of pore water, heat and pressure and lead to diverse localised chemistries. The extent of new mineral growth depends on the depth, temperature and duration of burial.

For stone tiles and cladding some examples of metamorphic rocks are slate, marble and serpentinite. Metamorphic rocks can resemble igneous rocks as the new minerals are crystalline and often random orientation in macroscopic sample. Metamorphic rocks are also much more localised and variable within a single deposit compared to granite or sandstone.

Metamorphic rocks must be considered with caution as many of them contain clay minerals and new assemblages which were dehydrated. When water is reintroduced, they can swell and curl the stones with the increase in volume. They can also be rather absorbent and have a pore structure which is not visible to the naked eye.

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Stone extraction

To ensure a safe construction and avoid costly mistakes, below are set out as general guidance on understanding stone extraction and its impact.

Once a deposit or resource has been found, the top soil and poor quality leached top stone removed, the process of large block quarrying can start. The internal structures and consistency of the stone will determine the height of the benches cut or blasted. Blasting is often a soft explosion or wet explosion down small drill holes with a bed of sand in front of the block. When detonated, the block is shifted sufficiently to dislocate it from the bedrock and if it falls forward it is cushioned and will remain intact so that the largest possible slices can be garnered from the block.

High pressure water jet is commonly used modern day cutting technology, which can be millimetre precise. The water gets recycled, corners are tighter and waste is reduced. Polishing can be on various grades of fineness and finish. No additional finishing is often desirable for a slip resistant surface in a wet area. For work surfaces or counters a high polish gives a pristine, clean finish and facilitates effective cleaning.

If possible paying a visit to the quarry or mine and factory is always advisable to examine the stone faces and the stock and note the geological features. The following watch-points are worth paying attention to:

- Look for variation in different parts of the face.
- Carefully compare the features seen in the faces to the stocks.
- Examine the size of blocks in stock and the total quantity.
- Establish the rate of extraction
- Consider whether a pre-purchase of the stone is needed to secure the supply of a particular stone or block size for the intended project.
- Environmental and ethical impacts of the extraction operations.

Environmental and social impacts

Large quarry companies may be certified to schemes such as ISO 14001 or EU Eco-Management and Audit Scheme (EMAS). Most dimension stone operations are relatively small and few may be certificated. But most companies will have an Environmental Policy and a phased restoration plan that can be compared with the actual operation. Some sites will have measured the carbon footprint their operation and a plan to reduce the emission of greenhouse gases. Similar policies may be in place to reduce water extraction and avoid unnecessary waste.

The quarry should have consultation with the local communities about the impact of their operations and there should be encouragement for learning and development for learning. Most UK and EU sites will have these in place. It becomes more important when stones are being considered from developing countries.