TECHNICAL BULLETIN

QUICK CHECKS FOR NATURAL STONE TILES – DEAD LOADS AND ENVIRONMENTAL STABILITY

INTRODUCTION & SCOPE

When natural stone tiles are recommended for an installation, commonly the properties of the tiles are not fully considered. Two of these properties, are moisture sensitivity (marking and deformation) and tile dead load on a square metre basis.

DEAD LOAD ESTIMATES

DUNLOP has recommended tile dead loads on a per square metre basis for various types of substrate. It possible to estimate a tile's dead load several ways depending on the information about the tile that is to hand.

1) Sample size and weight are known:

The tile size can be used to decide how many tiles there will be in a square metre of tiled surface.

For example, a 400x400mm tile that weighs 5.5kg—see Fig. 1.

The thickness is not important for this calculation.

* 400mm = 0.4m
* 0.4m x 0.4m = 0.16m^2 per tile
* 1m^2 ÷ 0.16m^2 = 6.3 tiles per m^2 of finished surface (as shown below)
* 6.3 tiles x 5.5kg @ 34kg/m^2

It is important to recognise that the dead load increases when the tiles are saturated after rain.

2) Rock density and tile thickness are known:

Commonly natural stone suppliers will give an indicative rock bulk density either as an SG (specific gravity) or a density in kg/m^3.

For example, dense limestones have

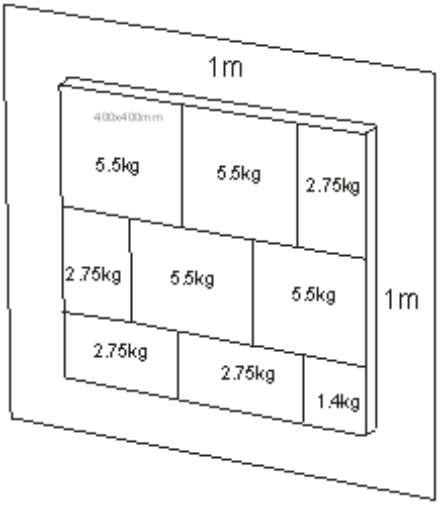

Figure 1 . Weight distribution for 5.5kg tiles laid.

Note – this diagram is not intended to be a recommended tile placement pattern.

a density of ~2700kg/m^3 which is equivalent to an SG of 2.7.

A limestone tile 10mm thick is to be installed.

* 1m^3 = 1000 x 1000 x 1000mm (or 1m x 1m x 1m)
* 10mm ¸ 1000 = 0.01m
* Volume in m^3 = 0.010m x 1m (which is 1/100 of a m^3).

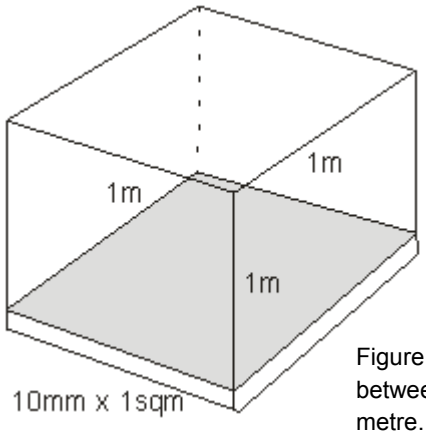

Figure 2. A schematic showing the relationship between a stone slab and a volume of 1 cubic metre.

* Mass of tiles = density in kg/m^3 x volume in m^3
* 2700kg/m^3 x 0.010m = 27kg/m^2.

From these figures, it is then possible to determine whether the tile is a suitable weight for the substrate, and/or whether it requires the use of mechanical supports for heights above 3m.

MOISTURE SENSITIVITY

Moisture sensitivity is divided into separate problems, deformation of the tile and/or marking and show through on the tile front face.

There is a relatively easy way to check for moisture sensitivity, and that is to place the tile on a damp surface and see what happens over the space of four to six hours, though testing could continue for longer as required.

The simplest method of creating the damp surface is thoroughly wet a bath towel and fold it to approximately the size of the tile. The tile is placed on top, and then examined for moisture darkening, or warping against a straight edge.

Staining potential can be checked by using water dyed with blue or green food colouring.

Absorbent tiles will show colour patching, which is a sign that the tile may also display permanent darkening or other changes when installed.

THERMAL MOVEMENT SENSITIVITY

Related to movement sensitivity to moisture is thermal movement resulting from sun exposure. This property is more difficult to directly check, but can be approximated by

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Figure 3. An example of a stone tile with significant potential for moisture marking.

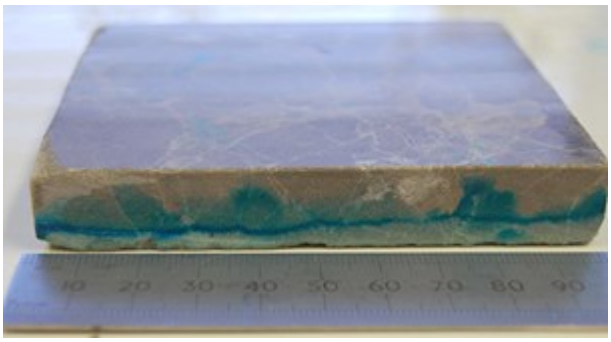

Figure 4. Another tile sensitive to moisture marking but less so than that shown on left.

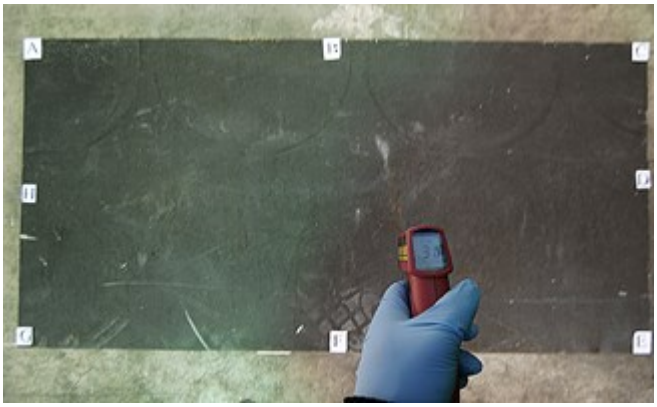

Figure 5. Conducting a sun exposure trial of a large format 'blue stone tile'. Measuring the surface temperature of the tile. The letters mark the positions for measurement with a straight edge laid across the tile. This measures the unrestrained movement of the tile.

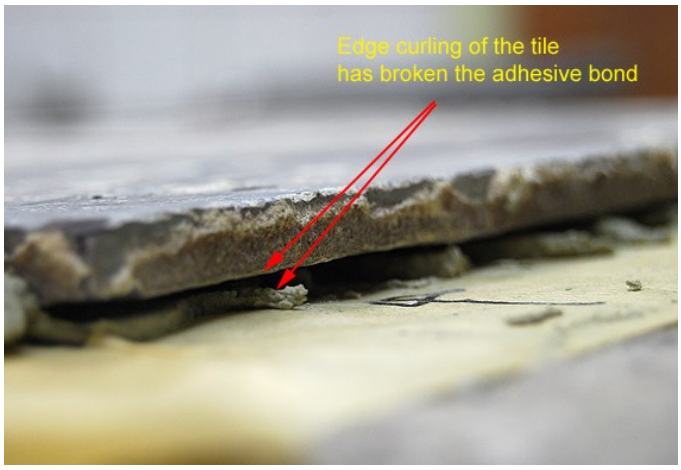

Figure 6. A tile which has thermally warped and broken the adhesive bond as a result of deformation.

laying a tile in the direct sun and periodically checking it for warping with straight edge. A contact or indirect reading laser thermometer will also give an idea of the temperature of the tile surface. A side effect of dark coloured tiles is that they can heat up significantly and therefore create a hot surface skin on a building which may have an effect on the heat balance for the airconditioning system.

Permanent Changes

In general when the tiles are removed from their exposure conditions, they regain their original shapes, albeit they might display hysteresis in doing so. Though rare, any changes in shape or flatness, that do not disappear as the tile cools or dries out should be a considered a warning that the tiles themselves are highly suspect.

Permanent marking is mainly an indication that care is required with adhesive choices and sealing, but also maintenance and cleaning.

Summary

Whilst it is possible to do some trials for the stability properties, ultimately a test area may be required to check the tile performance with the adhesive or grouts being considered, where possible in the real site services conditions.

TECHNICAL BULLETIN

Design of structures and supports for high dead load tiles are the domain of an engineer and advice must be sort for these systems.

Notes

Always refer to the product data sheets for specific usage details. The information contained herein is to the best of our knowledge true and accurate.

No warranty is implied or given as to its completeness or accuracy in describing the performance or suitability of the product application.

Users are asked to check that the literature in their possession is the latest issue.

It is the responsibility of the users to confirm that all products are suitable for the application and system, and are compatible with products in the application.

More detailed technical advice can be obtained by ringing DUNLOP on free call using the numbers shown below or via email from the contact us page at the DUNLOP DIY website.

ARDEX AUSTRALIA PTY LTD,

ABN 82 000 550 005

7/20 Powers Road, Seven Hills, NSW. 2147.

GLOSSARY

Dead load—This is load created by object on a surface due to its weight and the effects of gravity. It has no component of active loading due to factors such as wind or earth movements, but does take into account changes due to saturation.

Density—This is defined as weight per unit volume. Like dead load, the apparent density can alter when the rock is dry vs saturated. The usual definition is kg per cubic metre (kg/m^3), but rock sourced from places such as the USA may describe it as pounds per square foot (lbs/ft^3—1lb/ft^3 equals 16kg/m^3).

The rock density when combined with tile thickness and area can be used to work out the dead load.

Live loads—Not discussed in this bulletin, live loads are created when an external force acts on the tile surface. Examples include wind loading, earthquake forces, building movements and such things as vibration from passing vehicles.

Moisture and thermal sensitivity—For the purposes of classifying tiles, DUNLOP determines the moisture or thermal deflection in the vertical axis (“Z” strain axis). For moisture tiles are placed against water on one side, and for thermal exposed to heating from one side to 70^0C.

The following stability classes are considered:

<0.25mm low instability

>0.26<0.4mm medium instability

>0.41<0.7mm high instability

>0.71mm extreme instability.

DUNLOP has no adhesive specifically designed for moisture sensitive tiles (>0.26mm). Thermally sensitive tiles can be fixed with certain adhesives, for tiles up to the 0.4mm level bonding is feasible with DUNLOP TILE ALL.

Permanent changes vs reversible—Colour changes in rock from adhesives are nearly always permanent. This is because components from adhesive have been drawn into the rock fabric. By contrast deformations can be permanent which implies that the rock has suffered a permanent alteration, or reversible. The majority of deformations will be reversible (it dries out or cools down), unless the rock has actually fractured in some way.