

## TECHNICAL BULLETIN – TB223

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

Date, Friday, 13 July 2018

### 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.

These topics have separate detailed Technical Bulletins to explain various aspects (Ardex Technical Bulletins TB001, 010 and 148), but this bulletin gives some basic tools that can be used to check these properties.

### DEAD LOAD ESTIMATES

Ardex has recommended tile dead loads on a per square metre basis for various types of substrate. There seems to be a limited understanding of the need for considering dead load of a cladding system. The properties of the adhesive are one thing, but the properties of the substrate surface also have to be accounted for. The tiles are under gravity and want to slide down the wall under shear stress. Where this applied stress exceeds the capabilities of the system under the tiles there will be a problem in the making.

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.

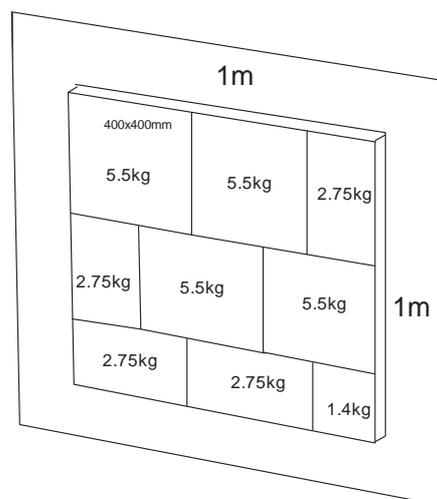
For example, a 400x400mm tile that weighs 5.5kg. The thickness is not important for this calculation.

$$400\text{mm} = 0.4\text{m}$$

$$0.4\text{m} \times 0.4\text{m} = 0.16\text{m}^2 \text{ per tile}$$

$$1\text{m}^2 \div 0.16\text{m}^2 = 6.3 \text{ tiles per m}^2 \text{ of finished surface (as shown below)}$$

$$6.3 \text{ tiles} \times 5.5\text{kg} \cong 34\text{kg/m}^2$$



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

## 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  $\text{kg/m}^3$ .

For example, dense limestones have a density of  $\sim 2700\text{kg/m}^3$  which is equivalent to an S.G. of 2.7.

A limestone tile 10mm thick is to be installed.

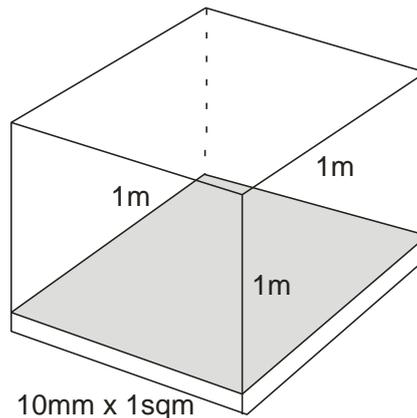
$$1\text{m}^3 = 1000 \times 1000 \times 1000\text{mm} \text{ (or } 1\text{m} \times 1\text{m} \times 1\text{m)}$$

$$10\text{mm} \div 1000 = 0.01\text{m}$$

$$\text{Volume in } \text{m}^3 = 0.01\text{m} \times 1\text{m} \text{ (which is } 1/100 \text{ of a } \text{m}^3\text{)}.$$

$$\text{Mass of tiles} = \text{density in } \text{kg/m}^3 \times \text{volume in } \text{m}^3$$

$$2700\text{kg/m}^3 \times 0.01\text{m} = 27\text{kg/m}^2.$$



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.

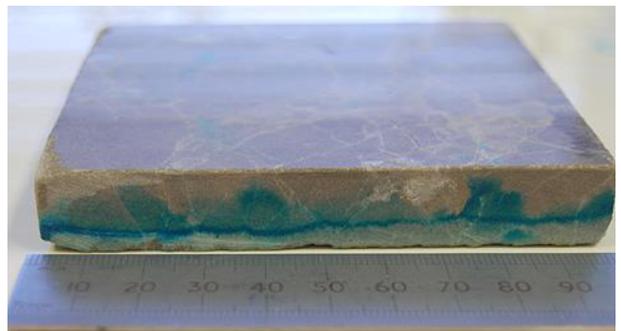
There is a relatively easy way to check for moisture sensitivity, and that is to place the tile on a damp surface and see what happens over the space of four to six hours, though testing could continue for longer as required.

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.



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

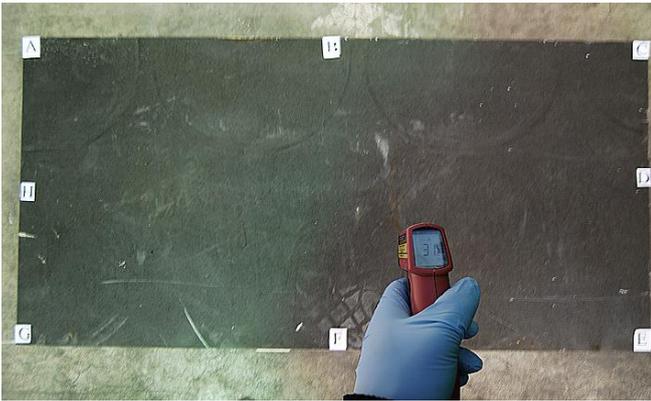


Another tile sensitive to moisture marking but less so than that shown on left.

## 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 the 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.



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.

## 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.

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

### **IMPORTANT**

This Technical Bulletin provides guideline information only and is not intended to be interpreted as a general specification for the application/installation of the products described. Since each project potentially differs in exposure/condition specific recommendations may vary from the information contained herein. For recommendations for specific applications/installations contact your nearest Ardex Australia Office.

### **DISCLAIMER**

The information presented in this Technical Bulletin 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 a product for a particular application. Users are asked to check that the literature in their possession is the latest issue.

### **REASON FOR REVISION - ISSUER**

Periodic review. Minor text change concerning effects of dead load.

### **DOCUMENT REVIEW REQUIRED**

36 months from issue.

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