TECHNICAL BULLETIN – TB 144

Issues with Fixing Schistose and Layered Stacked Stone Tiles

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INTRODUCTION & SCOPE

In the last 7 years or so prior to the issue of this bulletin, a type of natural stone facing has come onto the market which is composed of typically 20-30mm wide by 15-30mm thick laths of cut rock. These laths are bonded together with an engineering type adhesive such as an epoxy, as determined suitable by the stone manufacturers. The size varies but a nominal set of dimensions are typically around 400mm x 100mm x 25mm, and depending on the rock bulk density (which varies between 1800-2100kg/m^3 for the lower density types, but can be up to 2800kg/m^3), the load weights on the walls can range from 40 to 90kg/m^2. This exceeds the Ardex recommendation for cladding weight on rendered surfaces, specified in TB001 of 32kg/m^2.

The long term performance and durability of these cladding tiles is dependant on the minerals in the rock. Many are made from *sound rock bases* which have successfully been bonded with tile adhesives or combinations of adhesive and mechanical fixing. These include tiles made from volcanic rocks such as so-called Victorian Bluestone (basalt *senso lato*, Fig. 5), Quartzite (*senso stricto,* Fig. 4), hard Slates, some Sandstones and also hard metamorphic rocks (Hornfels Fig. 3, and Gneiss), or igneous rocks such as 'granites' (be they true granitic rocks like Granite, Granodiorite, Adamellite or Syenite, or trade named as such e.g. Black Granite which is actually Gabbro and not Granite at all, and migmatites and gneisses which are sold under a wide range of exotic names). However, other tiles are not stable and the subject of this bulletin is cladding tiles made from rocks known as Schists.

COMPOSITION OF THE STONE

What is Schist? Schist is superficially similar to the well known rocks called Slates. Both rocks are of a type of metamorphic rock formed by intense pressure, but moderate heat. Schists are metamorphosed to a higher degree than Slates and this creates their notable features that can lead to problems. The types we see in this country are predominantly imported from Asia and quarried from the great folded mountain belts associated with the Himalaya, China or Pakistan-India (although some are locally quarried as well).

To look at, these rocks are shiny, and range in colour from pale silvery grey, to shades of greenish grey, brown, dark grey and black. The colour is dependant on the basic mineralogy of the schist, but the main mineral present is the platy and easily broken mineral Mica. Mica has the property of separating along layers and creating thin leaves of material, in other words it has a natural in-built plane of weakness along which it fails. Micas are also relatively easily weathered and break down to clay which is very weak, and swells when wet. The rocks may also contain other minerals which can alter their properties.

In Schist, the Mica plates are all strongly aligned in one direction which creates their closed book-like appearance in cross-section. This appearance is called a fabric, and the generic name is schistosity. This fabric is a plane of weakness and is the reason that Schists and Slates as well, can be split easily into sheets, and large tiles or shingles. The name of this splitting is cleavage and the planes of Mica grains are often called folia.

A particularly problematic type of cladding tile seen recently by Ardex is silvery greenish-grey, and has the mineralogy and rock fabric consistent with Schists composed mainly of white Mica, but also appears to contain greenish Chlorite and is also possibly Talc rich. The rock may also contain some dark grey Graphite. The highly developed schistosity of the rock means that it is inherently weak and can break up without significant stress. The possible presence of Talc or Graphite would make the surface difficult to bond to as the minerals are natural lubricants and can act as bond breakers (Figs. 1A-1B).

RECOGNISING THESE TYPES SCHIST CLADDING TILES

As few people are trained petrologists, what features that can be used to identify these tiles:

- They are commonly a silver grey-green to metallic grey colour and have shiny slightly ripply surfaces along the cleavage plains.
- The surface of the cleavage plains are smooth, and can feel slippery to soapy or slightly greasy to touch
- They can commonly be scratched easily with a knife blade, and some can be scratched with fingernail.
- The cleavage is strongly developed and the layers can be easily broken away.
- Very strongly metamorphosed schists have large Mica crystals which can be flaked off.

Some slates have slightly shiny surfaces as well, but in general slates are harder and do not flake or split as easily. Slates that may prove problematic are usually those that a highly metallic silvery grey lustre or are black as these normally contain Graphite.

ASSESSMENT OF THESE SCHISTOSE CLADDING STONES

The folia are effectively conduits for the penetration of water which would significantly increase the weight of the cladding stone units. Water penetration will increase the likelihood of breakdown by providing a lubricant along which the cleavage planes can part. Water, and in particularly salty or pool water will hasten weathering of the Chlorite and Mica to clay minerals. Mica also provides a flaky surface which is inherently weak and hard to bond to.

The stability of this rock is questionable in wet applications and would be more marginal in areas where wetting and drying occurs as this would lead to faster mechanical breakdown of the rock along the folia due to stresses resulting from shrinkage and expansion.

LIMITATIONS AND RECOMMENDATIONS

Schistose rock cladding

Due to the properties of this rock type, Ardex Australia specifies the following limitations on installing highly Micaceous and easily split schistose stone tiles with Ardex tile adhesive:

Ardex warranty provisions exclude any failures resulting from delamination and break-down in the stone structure when exposed to its intended service environment.

Installers need to confirm that the types of rock the tiles are made from are physically sound, and that the minerals in them will not act as bond breakers, leading to de-bonding of the tile from the adhesive.

Slates and other natural rock types

Ardex has observed a number of rock stack stone tiles that are marketed as slates, but which are really mudstone or argillite (Fig.4). These tiles have displayed very unstable behaviour in terms of moisture and thermal stability which has resulted in a number of de-bonding episodes. There are two options, either do not use these tiles at all, or use a structural epoxy adhesive. In some cases there is no easy way to identify these tiles other than to test them.

The major issue with the other types of stone cladding tiles is the weight per square metre and in this case a combination of adhesive and mechanical fastening is required. The rear face of these stacked stones may not be flat, which can lead to problems with adhesive bed thickness and adhesive coverage. Ardex recommends that a deeper profile notch trowel is used, or if severely irregular then adhesive buttering of the stone may also be required. Note that whilst a thicker build of adhesive may be required, excessively high thickness can lead to shrinkage and drying issues.

The general provisions of heavily tiles are discussed in Ardex Technical Bulletin TB001 Large Format Tiles.

CONCLUSION

Ardex Australia does not recommend the use of any its ceramic tile adhesives for fixing the weak schistose or dimensionally unstable pseudo-slate stone cladding tiles discussed in this bulletin, on any types of substrate.

Sound types of rock used for stone cladding are acceptable, but installers need to observe the load weight restrictions.

Figure 1. The attached photos are an example of an unstable stacked cladding stone, made by gluing together laths of Micaceous Schist. As can be seen some of the laminations are breaking along the cleavages. The epoxy adhesive was applied onto the cleavage which then breaks parallel to it.

Figure 1A

Figure 1B

Figure 2. This cladding is a graphitic slate. As can be seen it has a dark grey and shiny surface due Mica and Graphite (Fig 2A). The laminations are strongly bonded and the tile is quite robust and hard (Fig 2B). Provided the adhesive is not 'bond broken' by the graphite content, this cladding would suitable for adhesive and mechanical fixing. The face of the tile is formed by cleavage plains, and the structural epoxy was applied across the cleavage/laminations.

Figure 2A

Figure 2B

Figure 3. In case the stack is made from Quartz Mica Hornfels which has been epoxy glued parallel to the laminations. This rock is very hard and strong and does not easily fracture. When looked at carefully in hand specimen the quartz crystals can be seen glittering and the broken faces look 'sugary' in texture (Fig 3A). As a tile, this type of rock is very durable, however the weight of this particular sample worked out to be 90kg/^{2} which is too high for adhesive only fixing and also too great for the substrate which de-bonded. Adhesive and mechanical fixing is required.

Figure 3A

Figure 3B

Figure 4. A final type of stacked stone which has given trouble since around 2009, is a layered mudstone which is marketed as slate. The surface is normal a brown and rusty colour as seen in Fig 4a. and side views show the fine grey laminations.

These tiles have been shown on a number of occasions to be both moisture and thermally unstable and warp in service, de-bonding off the walls.

The rear view Fig 4b, shows the other common problem with stackstone – contamination of the rear face with the epoxy layer bonding agent.

Figure 4a

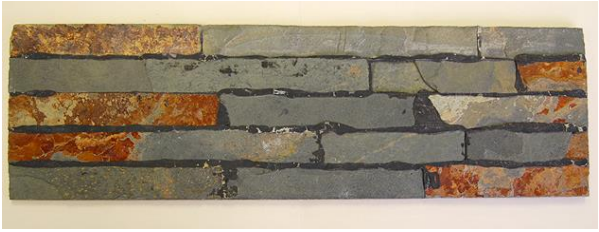

Figure 4b

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

24 month review.

DOCUMENT REVIEW REQUIRED

24 months from issue.

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Technical Services 1800 224 070. email: technicalservices@ardexaustralia.com
Australia http://www.ardexaustralia.com

NSW-HO 61 2 9851 9100, **QLD** 07 3817 6000, **VIC** 03 8339 3100, **SA/NT** 08 8406 2500, **WA** 08 9256 8600
Customer Service and Sales 1300 788 780

New Zealand Christ Church 64 3373 6900, Auckland 9636 0005, Wellington 4568 5949
Technical Inquiries NZ 0800 2 ARDEX New Zealand http://www.ardex.co.nz

Web: Corporate: http://www.ardex.com