TECHNICAL BULLETIN – TB144

ISSUES WITH FIXING SCHISTOSE AND LAYERED STACKED STONE TILES

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INTRODUCTION & SCOPE

In the last 7 years or so, before the issue of this bulletin, a type of natural stone facing has come onto the market, which is 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.

These cladding tiles' long-term performance and durability depend on the rock's minerals. 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 like the well-known rocks called Slates. Both are metamorphic rocks formed by intense pressure but moderate heat. Schists are metamorphosed to a higher degree than Slates, creating 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 Himalayas, China or Pakistan-India (although some are locally quarried as well).

These rocks are shiny and range in colour from pale silvery grey to shades of greenish grey, brown, dark grey and black. The colour depends on the schist's basic mineralogy, but the platy and easily broken mineral Mica is the main mineral present. 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, so Schists and Slates 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 OF SCHIST CLADDING TILES

A few people are trained petrologists; what features 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 is smooth and can feel slippery to soapy or slightly greasy to touch
- They can be scratched easily with a knife blade, and some can be scratched with a fingernail.
- The cleavage is strongly developed, and the layers can be easily broken away.
- Very strongly metamorphosed schists have large Mica crystals that can flake off.

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

ASSESSMENT OF THESE SCHISTOSE CLADDING STONES

The folia are effective conduits for water penetration, 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, particularly salty or pool water, will hasten the weathering of the Chlorite and Mica to clay minerals. Mica also provides a flaky, inherently weak surface and is hard to bond.

The stability of this rock is questionable in wet applications and would be more marginal in areas where wetting and drying occur, 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 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 the tile's de-bonding from the adhesive.

Slates and other natural rock types

ARDEX has observed several 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 several de-bonding episodes. There are two options: either do not use these tiles or use a structural epoxy adhesive. Sometimes, 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; in this case, a combination of adhesive and mechanical fastening is required. The rear face of these stacked stones may not be flat, leading to problems with adhesive bed thickness and coverage. ARDEX recommends that a deeper profile notch trowel be used, or if severely irregular, the stone may also require adhesive buttering. Note that whilst a thicker build of adhesive may be necessary, excessively high thickness can lead to shrinkage and drying issues.

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

CONCLUSION

ARDEX Australia does not recommend using any of its ceramic tile adhesives on any type of substrate to fix the weak schistose or dimensionally unstable pseudo-slate stone cladding tiles discussed in this bulletin.

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

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

Figure 1B

Figure 1A

Figure 2. This cladding is a graphitic slate. As can be seen, it has a dark grey and shiny surface due to 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 be 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 2B

Figure 2A

Figure 3. The stack is made from Quartz Mica Hornfels, which have been epoxy-glued parallel to the laminations. This rock is very hard and strong and does not easily fracture. When carefully examined 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, this sample's weight was 90kg/2, which is too high for adhesive-only fixing and too great for the substrate, which de-bonded. Adhesive and mechanical fixing is required.

Figure 3B

Figure 3A

Figure 4. A final type of stacked stone that has been troublesome since around 2009 is layered mudstone, which is marketed as slate. The surface is normally brown and rusty, as seen in Fig 4a. Side views show the fine grey laminations.

On several occasions, these tiles have been shown to be both moisture—and thermally unstable. They warp in service, de-bonding off the walls.

The rear view, Fig 4b, shows the other common problem with stack stones: 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.

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Australia: 1300 788 780
New Zealand: 643 384 3029

Web: www.ardexaustralia.com
email: technical.services@ardexaustralia.com
Address: 2 Buda Way, Kemps Creek NSW 2178