Which Stone Where – a beginners guide to material selection

We have all been bamboozled by salespeople trying to explain the virtues of the latest product – whether it be a computer or a car.

Choosing stone need not be the same experience. By understanding stone's basic properties you can make an educated decision when you are selecting stone for your next project.

The 'right stone' for your project needs to meet requirements based on appearance and performance. Selecting suitable flooring, for example, is firstly a matter of personal taste. One of the appealing aspects of using stone is how its unique character can be used to display your own distinctive personality.

The range of colours, textures and finishes available in stone now rivals the range available in more 'traditional' floor coverings. Like these coverings, choosing a stone that is durable and resistant to staining and wear is important. The first step is to understand the strengths and challenges of the various types of stone available.

Below is a brief beginner's guide to the seven main stone types commercially available.

Stone Type: Sandstone

Formation and composition: A sedimentary rock composed predominantly of quartz usually cemented together with clay and/or fused with secondary silica which has been chemically deposited. Minor minerals containing iron and manganese (among others) give the stone its unique characteristics. The movement of these soluble minerals throughout the stone can produce banding or develop as a uniform colour.

Surface finishes: The typical gritty nature of sandstone precludes the development of a polished finish, but some dense materials can produce a honed finish. Coarser surface textures include sawn, sandblasted, bush hammer and rock-face.

Appearance: Typically white, gold or brown but also available in shades of red, purple, grey, green and black.

Common usage: Sandstone is commonly used as pedestrian paving, internal and external cladding, statuary and masonry construction.

Reasons for selection: Sandstone is a very versatile material that can easily be cut and transformed into just about any form imaginable. Most surface finishes will comply with the most rigorous slip resistance requirements. As sandstone doesn't absorb heat rapidly, it tends to stay cool under foot and is therefore a good choice for entertaining areas.

Characteristics to consider: Some types of sandstone contain expansive clays which can be a problem when the stone is subjected to repetitive wet-dry cycles. These cycles can make the clay expand and contract leading to decay or bowing of the tiles. Sandstone has a relatively high water absorption (~2 – 8% by weight) which can make the stone sensitive to staining and salt attack. Sandstone generally has a low resistance to wear and tends to produce a gritty residue. This grit can be harmful to softer floor coverings such as marble or carpet.

Performance evaluation criteria: When selecting a particular type of sandstone it is important to ensure that it will perform in the intended location. Basic physical properties such as water absorption and density will assist in evaluation of stain resistance and durability. Compressive strength and modulus of rupture (3-point bending strength) allow evaluation of the stone's

performance under load. It is important to evaluate the strength of sandstone in both a wet and dry condition as sandstone can lose more than 50% of its strength when wet. Resistance to salt attack determines the degree and mode of decay when the stone is exposed to salt and frequent wetting and drying cycles. The dimensional stability test determines the linear expansion of the stone following soaking. The installation of unstable stone can lead to accelerated decay as well as 'dishing' or bowing of panels or tiles. Determining abrasion resistance is also of benefit if the stone is to be used as commercial paving.

Stone Type: Granite

Formation and composition: An igneous rock formed at depth. True granites contain quartz, mica and feldspar but in the commercial sense the term covers just about any igneous rock that will take a polish. The colour and texture of granite varies greatly and is dependent on the stone's mineral composition and rate of cooling.

Appearance: The most versatile of materials. Granite can be processed to produce a wide range of finishes from a highly reflective polish to a rough exfoliated (flamed) surface. Other surface finishes include honed, sandblasted, antiqued and water-jet blasted.

Colour range: Granite covers the whole pallet of colours, from jet black to ice white. Other common colours are red, brown, green, grey, yellow-gold, blue. Granite, by definition is 'granular', but the grain size varies widely from less than 1mm to more than 5cm.

Common usage: Paving, internal and external cladding, wall and floor tiles, bench tops and monuments.

Reasons for selection: Granite could be considered the most durable stone type; it is generally strong and hard wearing. Granite has a relatively low water absorption capacity and combined with chemically inert minerals gives the stone good resistance to most stains.

Characteristics to consider: Dark coloured granites usually have a tendency to show oil stains. As dark colours tend to absorb more heat, it is important that expansion joints are properly designed especially where the materials is to be used in an exposed location. Light coloured stones are more likely to show rust stains, whether they are from an external source or from altered minerals within the stone. Poor extraction techniques (e.g. blasting) may introduce stress cracks into the granite which will weaken the stone.

Performance evaluation criteria: Water absorption and density are good indicators of the freshness and general strength of granite. Determining flexural strength (4-point bending strength) is vital to determine the suitability of a stone for use as large format cladding or paving. Coefficient of thermal expansion provides information on the linear expansion of the stone upon heating which can be used to determine the size and spacing of expansion joints. A thorough petrographic examination can be carried out to determine the 'freshness' of the stone, the presence of micro-cracks, or minerals that may cause staining at a later stage.

Stone Type: Limestone

Formation and composition: A sedimentary rock composed predominantly of calcium carbonate. Most limestone is formed by the deposition and compaction of marine fossil debris (e.g. shells, coral and bones) but freshwater and aeolian (wind blown) deposits are also known and available commercially.

Surface finishes: The density of limestone varies considerably and this affects the surface finishes available for different types of limestone. High density limestone (e.g. Jura from Germany) can be processed to produce a 'satin' honed finish. Coarser and less dense types of limestone are limited to a sawn or coarse-honed finish.

Appearance: Predominantly white, cream or tan sometimes with golden 'highlights' due to the presence of limonite (iron hydroxide). Limestone is also available in blue-grey, grey and black.

Common usage: Paving, internal and external cladding, floor and wall tiles.

Reasons for selection: Limestone is a sensual stone being pleasing to the eye as well as to the touch. It offers a range of subtle pastel and natural colours which blend in with today's minimalist trend while still imbuing warmth. Most limestone is resistant to salt attack making it a good choice for pool surrounds.

Characteristics to consider: Because limestone is composed of calcium carbonate it is sensitive to acid which can dissolve the stone. On 'polished' or fine-honed surfaces this acid attack will leave unsightly etching marks on the surface. Limestone is relatively soft (compared to granite) and this can result in surface wear and loss of polish in high traffic areas – black limestone is particularly sensitive to tracking. Most types of limestone contain linear features (veins) known as stylolites. These features may be lined with clay which can weaken the stone, especially when wet leading to premature failure or surface spalling

Performance evaluation criteria: Water absorption, density, compressive strength, modulus of rupture, resistance to salt attack (for low density stone), dimensional stability, abrasion resistance, petrographic examination.

Stone Type: Travertine

Formation and composition: A sedimentary rock formed by the precipitation of calcium carbonate from mineral springs. The calcium carbonate is often deposited onto vegetation such as moss or algae which plays a part in developing the typical porous nature of the stone.

Surface finishes: Commercial travertine usually has a relatively high density; therefore it usually processed to produce a 'satin' honed finish. The material can be used with the pores unfilled or filled with a stable cementitious or polymer filler. Travertine can also be processed with textured finishes such as sandblasted or bush hammered finish.

Appearance: Predominantly white, cream or tan sometimes with subtle golden or blue-grey tones. The appearance of travertine can vary dramatically depending on how it is cut. Cutting travertine across the 'grain' highlights the tonal variations in the deposition layers and exposes the large, normally elongated pores. Material slabbed in this fashion is called vein-cut. If the travertine is cut parallel, or along the grain, the variations in the layers are presented as a flowery, blotchy or circular pattern – this slabbing orientation is called cross-cut or fleuri cut.

Common usage: Internal and external cladding, floor and wall tiles.

Reasons for selection: The unique patterning and texture of travertine has been admired for thousands of years. Travertine is generally a dense and durable material that is soft to the touch and stays cool under foot which makes it a good choice for barefoot areas such as bathrooms or pool surrounds.

Characteristics to consider: If used unfilled, the characteristic porous nature of travertine can lead to entrapment of dirt and grime. Although travertine is a relatively strong material, the elongated pores within vein-cut travertine can cause a considerable reduction in flexural strength compared to cross-cut material. Like limestone, travertine is composed of calcium carbonate and is therefore sensitive to acid attack.

Performance evaluation criteria: Water absorption, density, flexural strength and abrasion resistance.

Stone Type: Marble

Formation and composition: A metamorphic rock composed predominantly of calcite formed from limestone after the application of heat and/or pressure. Commercially, the term is also used for types of high density limestone that will take a polish.

Surface finishes: The high density and low porosity of marble allows it to be processed to a high polish. Other surface finishes available are honed, sawn and sandblasted.

Appearance: Typically white, often with some minor veining but also available in colours such as black, blue-grey, red and pink. Marble is generally very fine grained although some types with large grains (+5cm) are available.

Common usage: Paving, internal and external cladding, bench and vanity tops, floor and wall tiles.

Reasons for selection: Its translucent nature and pearly lustre is unique and no other material suggests elegance like marble. The range of materials available allows selection of uniform colours, subtle veining or a dramatic mosaic effect.

Characteristics to consider: Most types of marble are composed predominantly of calcium carbonate and are therefore sensitive to acid attack. Marble is also relatively soft making it sensitive to scratching and surface wear. The use of textured finishes in high traffic areas is likely to polish leading to a reduction in slip resistance. Some types of marble have been known warp when used externally as large format panels.

Performance evaluation criteria: Water absorption, density, compressive strength, flexural strength, dimensional stability, petrographic examination.

Stone Type: Slate

Formation and composition: A fine grained metamorphic rock that has developed a foliation (sheet like layers) due to the pressure imposed upon it. Slate is mainly composed of quartz and muscovite with lesser amounts of chlorite, hematite and pyrite. Other trace minerals that have an effect on the stone's colour may be present.

Surface finishes: The natural foliation of the slate is used to produce a rough split-face finish. Some slates can also be produced with a honed, sawn or bush hammered finish.

Appearance: Typically various shades of grey although black, green, red and purple materials are also commercially available.

Common usage: Wall, floor and roof tiles, internal and external paving. Massive slates can be processed to produce bench or billiard table tops.

Reasons for selection: The natural split-face finish of slate makes it a relatively simple material to process that is highly slip resistant. Its low porosity and chemically inert composition make it stain resistant and is a popular and durable choice for indoor and outdoor paving.

Characteristics to consider: Some slate contains pyrite which may decay to iron oxide and leave rust stains. Poor quality slates may delaminate (split) or soften with age leading to failure. Many types of slate are not calibrated (processed to an exact thickness) which requires additional work when laying to produce a level surface.

Performance evaluation criteria: Water absorption, density, modulus of rupture, resistance to acid attack.

Stone Type: Bluestone

Formation and composition: Bluestone is a loose term covering a range of stone types that are not easily dressed such as sandstone (classed as a 'freestone'). In Victoria, basalt is known as bluestone while in South Australia the term refers to a range of metamorphic rocks including schists and siltstone. Porphyry quarried in Queensland could also be classed as bluestone.

Surface finishes: Most types of bluestone are marketed with 'natural' split or rock face finishes. Victorian bluestone (basalt) is usually used with a sawn finish. Some bluestone products are also available with honed and sandblasted finishes.

Appearance: Victorian bluestone is black to dark grey-blue while South Australian bluestone is predominantly grey-blue with 'autumn' colour highlights. Porphyry is available in grey-blue tones as well as golden autumn colours. Victorian bluestone is characterised by large pores called vesicles but commonly known as 'cats paws'.

Common usage: Bluestone is processed as cubic material for masonry construction and also as setts or flags for pedestrian and vehicular paving. Victorian bluestone can be sawn into calibrated slabs and tiles for use as paving and cladding.

Reasons for selection: Bluestone is a group of stone materials that is generally considered to be strong, dense, durable and stain resistant. In Victoria and South Australia, bluestone is seen as an integral part of the local history and the earthy colour range is effectively used to blend the contemporary and natural environments.

Characteristics to consider: Most types of bluestone are not calibrated during processing therefore significant thickness variations needs to be taken into account during installation.

Performance evaluation criteria: Water absorption, density, modulus of rupture, secondary mineral content.

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