

Using natural stone for tiling walls and floors

This as a guide for learning about and choosing natural stone tiles.

Stone has become more popular in recent years as a means of tiling the surfaces of walls and floors in many domestic homes. The reason for this is mainly due to improved mining and processing of the stones quarried and mined from around the world, leading to it becoming affordable as an alternative to ceramic, porcelain or otherwise manufactured tiles.

What few people not directly within the “stone industry” understand is that it cannot be treated (or mistreated as the case may be) as standard ceramic tiles. It in fact requires better surface preparation, adhesives designed and tested for tiling with natural stone, careful cutting and preparation during tiling, and the application of selected cleaning and sealing agents to bring out and allow the maintenance of its natural beauty.

Any type of stone can be used for tiling – but before choosing the stone, it is prudent to ensure that the properties, preparation and maintenance of the tiled surfaces are appropriate for the use intended.

This document aims to provide essential information on some of the widely used (for tiling) stone types to ensure that you choose the right stone, and understand its benefits and limitations. Each of the main stone types is examined below, and includes advice on maintaining it.

AS GENERAL ADVICE, I WOULD SUGGEST THAT STONE TILING IS NOT A SUITABLE DIY PROJECT.

Whilst a dedicated DIY enthusiast can read widely, and prepare according to professional advice it can be very much a toil of love – time consuming, expensive to equip to tile, and frustrating. It is a particular problem with many of the natural stone tiles being marketed (particularly on the internet) is that they are cheap because they contain many natural defects. Stone has natural fracture lines in it and cutting (for example) travertine with a diagonal seam will easily lead to it breaking.

Before deciding on where to apply stone tiling the following general information should also be considered:

1. ***Stone is not flexible.*** If used on any surface where flex can occur naturally (e.g. wood flooring) it is essential to secure wood flooring and overboard with a rigid ply (at least 15mm) of a strong tile backer board. Even then a flexible adhesive should be used. Failure to do this will result in tiles cracking at stress points on the floor.
2. ***Stone is heavy.*** Whether laid on floor or wall the surface to be tiled needs to be strong enough to support tile weight. Most natural stone averages 12mm thickness. This weighs an average of 32kg for every square meter of tiling. In addition the tile adhesive and grout will add at least a further 4kg per square meter in weight. A wall coated in a finishing skim of plaster can only support a weight of 20kg per square meter, and plasterboard can support 32kg per square meter. It is therefore recommended that walls are overboarded with a tile backer board (capable of supporting a weight of 62kg per square meter) and secured to underlying stone/brick/blockwork using at least 7mm rawl plugs and 50mmx4mm screws.

Marble – the elegant beauty of this natural stone has led to it being favoured to give a luxurious finish to floors, wall cladding, countertops, and kitchen worktops. Marble can usually be readily identified by a veined fine textured appearance.

It is a metamorphic rock (rock that has transformed from one type to another – usually by a process of heat and pressure) most commonly derived from limestone or dolomite rock. The metamorphic process causes a variable recrystallization of the original carbonate grains, and the resulting mosaic look of the interlocked crystals gives the stone its differing looks.

Marble tends to be found in mountainous areas in the world although in the United Kingdom, marble is found in the Purbeck area of Dorset. The most highly prized marbles tend to be a pure white (e.g. Carrara Marble from Italy) and the other colours found in many marbles worldwide are due to mineral impurities present when the marble was metamorphosed.

Marble used for construction is a stone that is calcite rich – capable of taking a polish and hence marble tiles are very vulnerable to mild acids. This means that it must be cleaned using pH neutral cleaning solutions and sealing is recommended to reduce stain and discolouration.

Similar stones to marble include **Serpentine** (magnesium silicate based rather than calcite – and therefore more acid resistant) and **Onyx** (sedimentary rock that is cryptocrystalline based, translucent and very vulnerable to abrasion and acid attack).

Care of Marble – clean with pH neutral (acid free) cleaning solution; seal with solvent based stain protector.

Travertine – the soft coloured tones of travertine and its marbled veins have led to a massive popularity in using this stone to decorate many buildings over the last 2 millennia.



Figure 1 - A polished marble floor



Figure 2 - Polished travertine walls and floor

It is a sedimentary rock (formed by the deposit of materials on the earth's surface) that is a form of limestone. However, where limestone is formed from marine deposits in the sea, travertine is formed on land in mineral springs. The purest forms of travertine are actually white in colour, but are most commonly found in the soft brown tones due to impurities present during formation.

The Romans most famously used travertine extensively for construction of temples aqueducts, and coliseums. However the material is characteristically pitted with holes that are normally filled either using a resin (typically by stone processing plants preparing the stone for tiling) or with cement based grout (usually by tile installers when fixing stone to walls and

floors). Travertine is also calcium based and therefore vulnerable to acid exposure requiring cleaning with pH neutral cleaners and sealing to protect from staining after installation.

Limestone and dolomite are variations of travertine. **Limestone** is very similar in property to travertine. **Dolomite** is denser, less absorbent, stronger and less susceptible to abrasion damage – making it more suitable to be installed in more commercial environments.

Care of Travertine – clean with pH neutral (acid free) cleaning solution; seal with solvent based stain protector.

Slate – with its laminar construction has proved an ideal sheet building material, retaining a reasonable strength allowing it to be used for roofing, tables, steps and blackboards. Slate is a metamorphic rock that is foliated (an additional fabric of sediment) and derived from shale type sedimentary rocks, typically of clay and volcanic ash. Slate occurs in a variety of colours, but is frequently found coloured grey. Slate deposits can be found across the world, and in recent years, massive slate deposits have been quarried to provide a ready source of cheap slate for construction. In the UK there are extensive deposits of slate which are in a wide variety of colours including yellow, green and purple.

Slate is extensively used in construction in the UK, not just for roof tiling, but as damp proof membranes in walls, shims to level floor joists, and in the case of some buildings in North Wales to construct the whole building. It is currently very popular as a floor tile, but efflorescence (a process of water loss that crystallises a salt onto the surface) can be a significant problem, and it is extremely slippery when wet. It is therefore highly recommended to use sealer on the tile when laying on the floor – to reduce the occurrence of these problems as well as reducing staining. The stone is also naturally “soft” and is susceptible to abrasive damage.

Soapstone is a similar material that is highly heat resistant and is frequently utilised in the construction of fireplaces.

Care of Slate – clean with pH neutral (acid free) cleaning solution; seal with wax polish or on a surface likely to get wet use a non-impregnating sealer.

SLATE AND SOAPSTONE HAVE A CONTENT OF SILICA THAT POSES A HEALTH HAZARD IN DUST FORM. DUST FROM THESE STONES CAN CAUSE SILICOSIS, AND THEY SHOULD ONLY BE CUT WET AND EVEN THEN WEARING A FFP2 DUST MASK IS ESSENTIAL. When vacuuming dust on these surfaces it is recommended that the vacuum cleaner has a Hepa filtration system and the dust bag should be emptied into a sealable plastic bag. Using either a wax polish or non-impregnating sealer is the best method of preventing stone dust generation.

Granite – the inherent strength, abrasion resistance and durability make it a popular choice as a surfacing material in heavily trafficked and exposed areas. Its natural beauty is not weathered as quickly as other

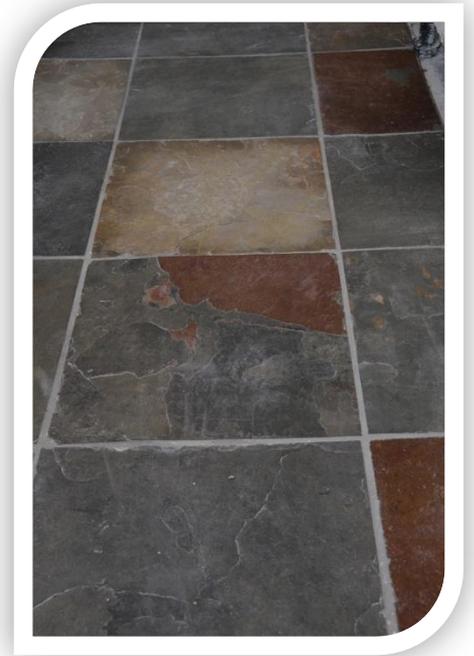


Figure 3- natural UK slate used for flooring

stones making it the perfect choice for flooring. It is readily identified by its distinct crystal or flecked pattern – it will have very little veining visible.

Granite is an intrusive, felsic igneous rock. This broadly means that it is formed under the earth's surface, is a



Figure 4 - grey coloured granite rock (source Wikipedia)

silicate containing lighter elements such as silicon, oxygen and aluminium, and is formed by the cooling of magma or lava. This is popularly given the term “volcanic rock.” The crystalline structure of granite is coarse grained and varies so that it may be more or less than the groundmass from which it is formed – hence differing crystalline appearance of the stone. The colours of the stone tend to vary between grey and pink.

Granite forms a major part of the earth's continental crust, and is often found as a Pluton (where the magma has extruded beyond the earth's crust) which leads to the formation of batholiths,

dikes, sills, laccoliths and lopoliths (terms for formations of granite). It is therefore found at various locations around the world, and particularly in mountainous areas. It is now believed that as much as 2/3 of the world's supply of granite now comes from just 3 countries – China, India and Brazil.

Granite has been used extensively as a construction material for many years with examples of its use found as far back as 2600BC in the construction of the Red Pyramid and Great Pyramid in Egypt. It can be usefully used as a “dimension stone” (trimmed, cut and fabricated often formed from crushed rocks in a quarry) and in Aberdeen, Scotland local granite has been used extensively in the construction of buildings. Granites hardwearing properties in particular its scratch resistance have made it extremely popular to be used as kitchen worktops and as flooring tiles. Granite also has a strong resistance to many caustic chemicals used for cleaning making its maintenance easier and cheaper. Finally it has a naturally low porosity making it more stain resistant than other stone types – although it is still prudent to seal the surface in normal conditions.

Care of Granite – clean with pH neutral (acid free) although an acid based cleaner can be used when recommended by supplier cleaning solution; seal with solvent based stain protector. **GRANITE HAS A CONTENT OF SILICA THAT POSES A HEALTH HAZARD IN DUST FORM. DUST FROM THESE STONES CAN CAUSE SILICOSIS, AND THEY SHOULD ONLY BE CUT WET AND EVEN THEN WEARING A FFP2 DUST MASK IS ESSENTIAL.** *When vacuuming dust on these surfaces it is recommended that the vacuum cleaner has a Hepa filtration system and the dust bag should be emptied into a sealable plastic bag. Using either a wax polish or non-impregnating sealer is the best method of preventing stone dust generation.*

Limestone – in reality, limestone and travertine are essentially the same stone – travertine is a variety of limestone. Limestone’s popularity stems from a ready availability, it’s natural brown appearance often leading to people classing limestone generically as “stone” and has a long tradition as a building material in the UK. Limestone is can be visually identified by the presence of shell or fossil impressions.

Limestone is a sedimentary rock (created by deposits in seas on the earth’s surface) composed mainly of the minerals calcite and aragonite. The main feature of limestone is the calcite present – most commonly formed from the marine organisms. The calcite can be either dissolved or precipitated by water making it particularly vulnerable to weathering. The colours often seen in exposed limestone are caused by impurities deposited including clay, sand, red oxides and

organic remains.

The propensity of limestone to erode when exposed leads to some spectacular rock features where outcrops appear at the surface – examples include the Niagara Falls and Cheddar Gorge.



Figure 5- Oolitic Limestone (source UCL dept earth sciences)



Figure 6 - sandstone (source UCL Dept earth sciences)

The use of limestone in construction is extensive in the UK. It is widely used as an aggregate base for road building, many famous buildings in London are built from Portland (lime) stone, it is the essential raw material for cement and mortar (and tile adhesives and grouts), it is used as a white pigment and filler for products like toothpaste, paper, plastic, paint, and ceramic tiles. It is also popular for sculpting because it is an excellent material to carve shapes and figures.

Care of Limestone – clean with pH neutral (acid free) although an acid based cleaner can be used when recommended by supplier cleaning solution; seal with solvent based stain protector.

Sandstone – often found in soft brown and red tones, it is a popular building material, and

it is as easy to locate, quarry and manipulate as a building material as limestone is. Used in many buildings from around the world since prehistoric times.

It is a clastic (fragments of pre-existing rock) sedimentary rock of sand sized minerals mostly comprising of quartz or feldspar. Whilst tan/brown/red are the predominant colours, it can be found in a variety of colours depend on the minerals comprising the outcrop including yellows, greys, pinks, whites and blacks. The main agents to bind the grains of sand together are calcites, clays and silica. If you can imagine a river flowing where sediment is building up at various places then you know how the first process of creating sandstone works. As the deposits build up, the weight of the newer deposits compacts the older ones and the binding minerals fuse the grains together.

As a building material sandstone tends to get used in thicker sizes and is not commonly strong enough to be utilised as a tile. It has a lower bending strength and therefore tends to be found in buildings as sills, copings and water tables. Certain stronger varieties of sandstone have been used as work tops and shower trays.

Quartzite is a form of sandstone that is most likely to be used for tiling – it is a metamorphic rock formed from sandstone. Its crystalline structure resembles granite, it is normally white and gray in colour, but impurities of iron deposits sometimes lead to red and pink crystals being present.

Care of Sandstone – clean with pH neutral (acid free) although an acid based cleaner can be used when recommended by supplier cleaning solution; seal with solvent based stain protector.

Terracotta – is not natural stone, but is clay fired to an unglazed ceramic (the term Terra-cotta means “baked earth” in Latin). It is a popular as a building material as well as being a product used in sculpture. The resultant material is red in colour and highly porous, however when glazed it becomes highly water resistant and is even used for water carrying pipes.

The use of terracotta as a floor tile stems from a historical desire to have a warmer surface underfoot than natural stone. Even the colours of orange, reds and browns give a warmer feel to a room tiled with terracotta floor tiles.



Figure 7 - A terracotta tiled floor

Care of Terracotta – Like ceramic tiles, terracotta tiles can be cleaned using an acid based cleaner. Sealing with a good quality sealer is highly recommended to prevent the tiles becoming permanently stained from spillages. The sealer is likely to need several coats because of the high porosity of the material. Traditionally terracotta has been sealed with linseed oil. This is still an effective and cheaper option than proprietary sealers, but if too much is applied it can oxidise on the surface leaving unsightly black stains.

Composite or Engineered stone – originally designed and manufactured to improve hardwearing capabilities and reduce maintenance in worktops and floor tiles, these have developed to become ultra chic (“designer”) style materials that are filling the tile and kitchen showrooms. Think deep red with silver and gold flecks as a classic composite stone design, but these can also be extremely expensive!

Effectively it is made of crushed stone and bound with a resin. A major filler of this is quartz with some other added materials e.g. coloured glass, shells, metals and even mirrors. The resin used depends entirely on the manufacturer, but epoxy and polyester are popular types.

Because these can be manufactured so differently, the only suitable advice on care, maintenance, installation and safety is the manufacturers' advice. It is essential that retailers provide this information to their customers at the time of purchase.

Quarry Tiles – This is not a “natural stone tile” despite its name. It is made by an extrusion process using natural clay or shale, and can be either glazed or unglazed. The unglazed tiles have been particularly popular as a floor tile due to the ability to create an anti-slip surface that is relatively easy to maintain in difficult commercial environments.



Figure 8 - Floor laid with unglazed quarry tiles

Again the whole question of care, maintenance and installation depends on the manufacturers' recommendations that should be made clear by the retailer selling the products. Unglazed quarry tiles will need to be sealed with a water or solvent based sealer to prevent unsightly staining. However, some quarry tiles are sold as “glazed” and may not need further sealing.

Resources for this article:

<http://www.globalstoneportal.com/stone-catalogue>

<http://www.mine-engineer.com/>

<http://www.marble-institute.com/>

http://webpages.sdsmt.edu/~lstetler/merlot/rock_mechanics.htm

http://www.mandarinstone.com/technical/rock_types

<http://www.es.ucl.ac.uk/schools/Intro/london.htm>