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The technical side of Granite

Granite is one of the oldest building materials known to man. The use of granite adds both permanence and style to any project. Granite will enhance your project with an aesthetically pleasing image while providing a façade of high performance with low maintenance.

By geological definition, there are hundreds of stone types commonly used as dimension stone products. The commercial

definitions of stones are much broader, allowing stones with similar mineralogy, workability, performance, and behavior to be combined into one classification, discounting the fact that they may be scientifically classified as different stone types. For example, stones such as gabbro, diabase, diorite, anorthosite, etc., are marketed commercially as granites because their properties are similar, even though they are not true granites by geological definition.

Most stones used in dimension stone applications will fall under one of five commercial definitions: Granite, Marble, Limestone, Quartz-Based, or Slate.

The term granite comes from the Latin root word granum, meaning "grain". The geological definition of granite is "any plutonic rock in which the mineral quartz makes up 10 to 50 per cent of the felsic components, and the ratio of alkali to total feldspar is between 65 and 95 per cent." Commercially, any holocrystalline quartz-bearing plutonic rock is generally included in the granite group

The granite group is one of the most versatile stone types available. Granite, and granite-like materials, are capable of taking a wide variety of finishes which allow the designer to custom-tailor the stone to the aesthetic or performance requirements of a specific application.

Resistance to scratching and durability in foot traffic areas are largely dependent upon the hardness of the minerals that make up the stone. In most granites, the primary minerals are quartz and feldspars, accounting for approximately 90% of the stone. The hardness of a mineral is oftentimes defined by use of Moh's Scale of Relative Hardness, developed in 1822 by the Austrian Mineralogist Friedrich Moh. This scale lists 10 minerals in ascending order of scratch resistance:

Feldspar and quartz are the minerals that give granite its exceptional abrasion resistance. This abrasion resistance contributes to its long service life in high traffic areas of public buildings.

The dimensional stability of granite is very good, so good in fact, that granite is the material of choice for high precision applications such as surface plates, machine mounts and press rolls, where tolerances can be measured in micro-inches (millionths of an inch).

Granite, like any solid, will expand and contract with changes in temperature. This change is relatively small. The coefficient of linear thermal expansion of granite is typically in the neighborhood of 4.4 x 10-6 inches per inch per degree Fahrenheit.

Granite will typically return to its original dimension when the original temperature is reestablished. Permanent strain, or failure to return to its original dimension will not normally occur unless the material has been heated to excessive temperatures (above 480°F [250°C]).

Granite has a natural resistance to caustic chemicals. This level of chemical resistance contributes to the ability of granite to resist attack from airborne pollutants associated with acid rain and/or snow-melting chemicals. Certainly there are chemicals that will attack granite, but exposure to them in a typical building environment would be extremely rare.

Flexural strength, or the ability to resist bending force, is a factor that determines the allowable span of a dimension stone panel in a given thickness subjected to given loads. Flexural strength varies amongst different types of granite, and typically is between 1,000 and 2,000 lbs/in^2. This allows the use of "thin" (30 mm) panels for many applications, minimizing both curtainwall cost and dead load for the building frame. Thicker granite panels (15/8" [40 mm], 2" [50 mm] or greater) are available where spans or loads necessitate their use.

For applications that are below grade or in contact with soil, water absorption is an important property. Absorption rates of granites range from 0.10% and 0.40% by weight. Furthermore, most granite materials will effectively allow water to evacuate during freezing cycles to prevent surface damage from the freezing water. Repetitive freeze/thaw cycles, particularly saturated cycles, will result in a reduction of strength in the granite panel. This loss can be significant, perhaps 20%. Laboratory experiments have shown that the strength loss occurs most aggressively in the first 100 cycles, after which the strength loss is much slower paced

Measurement of Physical Properties

The various physical properties of dimension stones are tested by means of the procedures documented by ASTM. ASTM also publishes standards for the major stone types, listing the minimum/maximum values to be expected from a particular stone type in a particular test. It should be noted that there are many stones that do not meet these values, yet have demonstrated satisfactory performance in a variety of applications. This table should then be considered to be more of a general guide than an absolute pass/fail gauge.

Table of Dimension Stone Testing Values per ASTM Standard Specifications

		Absorption (max) per ASTM C 97	Density (min) per ASTM C 97		Modulus of Rupture (min) ASTM C 99(9)(10)		Compressive Strength (min) ASTM C 170		Abrasion Resistance (min) ASTM C 241	Flexural Strength (min) ASTM C 880	
Stone Type	**ASTM Standard**	**%**	**lbs/ft^3**	**kg/m^3**	**lbs/in^2**	**Mpa**	**lbs/in^2**	**Mpa**	**H_a**	**lbs/in^2**	**Mpa**
Granite	ASTM C 615	0.40%	160	2,560	1,500	10.34	19,000	131	25	1,200	8.27
Marble	ASTM C 503	0.20%	162	2,590	1,000	6.89	7,500	52	10	1,000	6.89
Limestone(1)	ASTM C 568	12.00%	110	1,760	400	2.76	1,800	12	10	n/a	n/a
Limestone(2)	ASTM C 568	7.50%	135	2,160	500	3.45	4,000	28	10	n/a	n/a
Limestone(3)	ASTM C 568	3.00%	160	2,560	1,000	6.89	8,000	55	10	n/a	n/a
Quartz-Based(4)	ASTM C 616	8.00%	125	2,000	350	2.41	4,000	28	2	n/a	n/a
Quartz-Based(5)	ASTM C 616	3.00%	150	2,400	1,000	6.89	10,000	69	8	n/a	n/a
Quartz-Based(6)	ASTM C 616	1.00%	160	2,560	2,000	13.79	20,000	138	8	n/a	n/a
Slate(7)	ASTM C 629	0.25%	n/a	n/a	9,000	62.05	n/a	n/a	8	n/a	n/a
Slate(8)	ASTM C 629	0.45%	n/a	n/a	7,200	49.64	n/a	n/a	8	n/a	n/a

Copies of the ASTM Standards and test procedures are available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: (610) 832 9500, or visit www.astm.org.

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