

**Methods of Measuring Some Physical Properties of Different Types of Rocks  
(Effects of Rocks Properties on Their Suitability for Using as Building Stones)**

Physical properties of rocks are:

Natural moisture content ( $I_N$ )                      محتوى الرطوبة الطبيعي

Saturated moisture content ( $I_S$ )                      محتوى الرطوبة المشبع

Porosity (n)                      المسامية

Void ratio (e)                      نسبة الفراغات (الفجوات)

Dry density ( $D_d$ )                      الكثافة الجافة

Apparent specific gravity (T)                      الوزن النوعي الظاهري

The different weights of rocks are:

N= Natural weight (gm)                      الوزن الطبيعي

W= Saturated weight (gm)                      الوزن المشبع

S= Submerged weight (gm)                      الوزن المغمور

$$V_V (\text{cm}^3) = \frac{W - D}{1 \text{ gm/cm}^3} \quad \text{حجم الفراغات}$$

$$V_S (\text{cm}^3) = \frac{D - S}{1 \text{ gm/cm}^3} \quad \text{حجم الجزء الصلب من الصخرة}$$

$$V_{\text{total}} (\text{cm}^3) = V_V + V_S = W - \cancel{D} + \cancel{D} - S = W - S \quad \text{الحجم الكلي للصخرة}$$

$$I_N (\%) = \frac{N - D}{D} * 100$$

$$I_S (\%) = \frac{W - D}{D} * 100$$

$$n (\%) = \frac{V_V}{V} * 100$$

$$e (\%) = \frac{V_V}{V_S} * 100$$

$$D_d (\text{gm/cm}^3) = \frac{D}{V}$$

$$T = \frac{D}{D - S}$$

**Natural moisture (water) moisture:** is the quantity of naturally occurred water contained in a rock. It is expressed as a ratio from zero (completely dry) to the value of the rock's porosity at saturation. It can be given in a volumetric or gravimetric basis.

**Apparent specific gravity:** is the ratio of density of a rock to the density (mass of the same unit volume) of a reference substance (water) in air. It is the ratio of the weight of volume of the rock to the weight of an equal volume of the reference substance (water) in air. Apparent specific gravity is dimensionless (unitless) quantity as it is a ratio of densities.

<b><u>Rock type</u></b>	<b><u>Specific gravity</u></b>
Limestone	2.3 – 2.7
Marble	2.4 – 2.7
Granite	2.6 – 2.7
Sandstone	2.2 – 2.8
Shale	2.0 – 2.4

**Porosity:** is the percentage of void spaces in a rock. It is defined as the ratio of the volume of the voids or pores space divided by the total volume. It is written as either a decimal fraction between (0 -1) or as percentage. For most rocks, porosity varies from less than 1% to 40%.

The porosity of rock depends on many factors, including the rock type, and how the grains of rock are arranged. For example; granite has a very low porosity (<1%), sandstones have much higher porosities (10-35%). Clay is more porous than sand. Typical porosity of silt and clay is (35-50%) and (33-60%), respectively.

**Permeability:** is a characteristic that allows the fluid to flow through the rock. The permeability of a rock is a measure of the resistance to the flow of a fluid to through a rock. Sandstone is hard but porous.

## **Rocks and Building Sections**

**Limestone:** flooring, exterior (facades), interior, staircases and foundations. The highly crystalline limestone is pure, dense and hard, so it is not used in facades.

**Marble:** Metamorphic rock by regional metamorphism, interlocked mosaic texture, large grains, very durable, used for exterior applications (facades), interior decoration, flooring marble tiles and staircases. Monuments such as (Taj Mahal in India) and Alhambra (in Spain). It is easy to use, clean and maintain. Unsuitable for insulation due to its very low porosity (~0%).

**Granite:** Igneous rock with beautiful appearance and various colors, used as dimension stones for building, walls, facades, flooring tiles, stairs, and foundations.

**Gabbro:** ornamental facing stone.

**Sandstone:** Clastic, soft but depends on type of cementing material (siliceous, ferrous or clayey), solid sandstone is used as paving and building materials in interior applications.

**Chalk:** Very fine calcite crystals, deposit in very deep and quiet environments, very limited in building, having little resistance to water and frost, and degrading rapidly. Used for heat and sound insulation due to its high porosity.

**Gypsum:** walls and ceilings (heat and sound insulation, fire-resistant). Not used in parts that are in direct contact with water.

**Slate:** Metamorphic rock, fire-resistant with high cleavage allowing it to split into thin slabs. Used for roofing purposes.

**Pumice:** Very porous, used for insulation.

**Basalt:** Igneous rock, used as building stone and for insulation.

**Schist:** metamorphic rock, used as building stone (dimension stone).

**Gneiss:** metamorphic rock used as building stone.

**Shale:** some shale are used as building stones for sidewalks.

**Travertine:** exterior (facades), interior applications, paving and flooring tiles.