

## STONE & CERAMICS SUMMARY and KEYWORDS:

Stages in the construction of a building:

1. Surveying the land
2. Leveling the land
3. Pouring the foundations
4. Raising the frame
5. Building interior partitions
6. Building the roof
7. Wiring and Plumbing
8. Installing the windows
9. Laying the floor tiles
10. Painting and decorating

### 1. Stone Materials

According to size there are two types of natural stones:

- Stones blocks: Large blocks which are obtained on quarries using methods such as controlled explosions, mechanical drilling or expansive cement. They are cut in smaller pieces with a diamond wire saw or with wedges, shaped with lathes and polished with abrasive discs.
- Aggregates (áridos): Aggregates are gravel of various sizes and sand. The process to obtain aggregates are cleaning, crushing and sorting. There are aggregates that come from rivers, **river rocks**, which are smooth and round (used for decoration and pavements). On the other hand there are **crushed rocks**, that have irregular edges that provide more friction (used for paths or roads, and for making concrete).

#### - Natural Stone

The most common are:

- Limestone: Porous, off-white sedimentary rock, may contain animal fossils. Used for sculptures, buildings, ... It is used to produce lime and cement.
- Marble: Hard, dense metamorphic rock. Resistance to compression and extreme weather conditions; shiny finish when it is polished. Wide variety of colors. Used for sculptures, decorations, floors, walls, kitchen countertops, ...
- Granite: Igneous rock composed mostly of quartz, feldspar and mica. Very resistant to impacts, compression and erosion. Wide variety of colors. Used for floors, walls, kitchen countertops, sculptures, ...
- Slate: Dark blue, black or grey metamorphic rock, formed by the compression of fine clay. It is not very hard neither heavy, it is waterproof. Traditionally used for roofs, walls and pavements.
- Tuff: A porous rock formed by the cooling of volcanic ash and lava. Very good thermal insulator. Uses very often in the Canary islands to build walls.

- Stone Binders (**conglomerantes**)

Plaster, lime and cement are used as binders. When water is added to binders a **setting process** (**fraguado**) happens, afterwards materials and binders are joined, the finishing is hard and resistant.

- Plaster is made for gypsum rock. Plaster dissolves in water, creating a sticky paste that dries quickly. It is resistant to compression and fire. Iron and steel will rust with plaster. It is used for lining walls and ceilings, prefabricated mouldings and sculptures. The lining of walls with plaster, firstly with black plaster and later with white, is called **plastering** (**enlucido**).
- Lime is produced by heating limestone to 900°C, a process called calcination. It is used for whitewashing walls, also to do mortars.
- Cement is a mixture of limestone and clay, heated to 1250°C, plus plaster and additives. It is used for cement boards, pipes, pavements, bricks, blocks and mortars.
- Mortar is a mixture of binder plus sand and water. A very much used one is the mortar made out of cement, sand and water. There are two kinds: Hydraulic (those which can set underwater) and Non-Hydraulic (those which can't). It is used for binding bricks, rough finishes (cement rendering = **enfoscado**), foundations, beams, bridges, ports, etc...

- Artificial Stone

It is made with binders and various materials, such as fiber, hempcrete, gravel and sand.

- Concrete is a mixture of gravel, sand, water and cement that sets to form a rock-like material. It takes the shape of the formwork (**encofrado**) that is used to mould it. It is not very resistant to traction, to solve it, a framework of steel bars (corrugated steel) or mesh can be added = **reinforced concrete**. It is used to make foundations, structural elements, prefabricated pieces, etc...
- Fibre cement is composed of fibers + mortar. In the past these fibres were asbestos, now forbidden. Now these fibers are fibreglass or cellulose fibre. It is used mainly for roofs and cladding.
- Hempcrete bricks and adobes are made with soil and fibres along with lime as a binder. For the hempcrete the fibers is hemp and for adobes is straw. They don't need to be baked, so very little energy is needed to make them. They are strong, resistant and good insulators. They are usually used as bricks.
- Terrazzo is a mixture of gravel and white cement and it is often used for floors. It can be installed as *tiles* or *poured on-site* and then polished. It is used for floors, but also outdoors to make benches, fountains, window ledges, ...
- Silestone is a material composed of 93% of quartz, polyester resin and additives. It is waterproof, resistant to scratches and also has antibacterial properties. It is used for surfaces in bathrooms, countertops for kitchens, hospitals, laboratories as an alternative to marble or granite.

## 2. Ceramic materials

- Ceramic materials are made from clay. When clay dries it becomes porous and chemically inert, so will not rust, etc.. It also becomes resistant to high temperatures. Ceramic materials are very versatile.
- How are made:
  1. Preparation: The clay is cleaned.
  2. Mixing: The clay is mixed with water, colouring, degreasers and flux.
  3. Shaping: By moulds, presses or extruding machines.
  4. Drying: The clay is dried to eliminate water.
  5. Firing: This is done in kilns, at temperatures between 700°C and 1700°C.
  6. Decoration: After baked, it can be decorated with different types of glaze.
- Classification
  - Coarse ceramics
    - Terracotta: Made with ordinary clay. Hard, rough and fragile, usually with matte red colour. Uses: bricks, roof tiles, pottery such as flower pots, jars, ...
    - Earthenware: Made from white clay, silica and feldspar. Hard, fine and smooth. Uses: Crockery, decorative objects, bathroom tiles, ...
    - Refractory ceramics: Made with baked clay and metal oxides. They can resist temperatures up to 3000 °C. Use for blast furnace linings, electronics components,...
  - Fine ceramics
    - Stoneware: Made from refractory clay, has a glass-like appearance. Hard enough to scratch glass. Uses: Very hard and durable tiles, tubes and bricks.
    - Porcelain: Made from kaolin. Acid resistant, hard enough to scratch glass. Uses: Tableware, decorative objects, bathroom fixtures, materials for chemical industry.

## 3. Glass

- Glass is a transparent material that can take different colours. It is hard, smooth, fragile, resistant to weather and chemical agents and good thermal, electrical and acoustic insulator. It is a mixture of sand, quartz, lime and soda. When heated it becomes to a hot paste that can be shaped with a variety of techniques.
- Forming techniques
  - Hand-blown glass: A glassblower uses a long metal tube to take a ball of molten glass out of a kiln. The artisan blows and shape the bubble. During the work the glass is reheated as many times as needed. Finally the glass will cold down in a annealing kiln.
  - Automatic blow moulding: Hot glass is poured into a hollow mould with the required shape. The mould is closed and then compressed air is used to push the glass against the sides of the mould. Uses: bottles, jars, bulbs, etc...

- Casting: Hot glass is poured into a mould and allowed to cool until it solidifies. Hollow objects are made by using two moulds and joining them afterwards. Uses: containers, bottles, glass bricks for construction, ...
- Drawing: Hot glass is drawn, or pulled to form sheets. The thickness of the sheets depends on the temperature of the glass and how quickly is pulled. The product will cool down slowly in an annealing kiln. Uses: windows, windscreens, etc...
- Floating: Hot glass is poured into a tank that contains liquid metal, such as tin. The glass floats and spreads out in a thin sheet because the metal is denser than the glass. Then the sheet of glass is moved into an annealing kiln by a system of rollers, ...Uses: for big sheets of glass, plate glass, ...
- Calendering and lamination: To making laminated glass, as smart glass or safety glass. Laminated glass is made with alternating layers of glass and a plastic material called polyvinyl butyral. If the glass breaks, the plastic layers would keep the glass from shattering. The layers of plastic inside laminated glass can be used to add images or give the final product a particular colour. Also to make smart glass, which can change its appearance from transparent to reflective.