
Bricks

One of the oldest building material brick continues to be a most popular and leading construction material because of being cheap, durable and easy to handle and Work with. Clay bricks are used for building-up exterior and interior walls, partitions, piers, footings and other load bearing structures, brick is rectangular in shape and of size that can be conveniently handled with one hand. Brick may be made of burnt clay or mixture of sand and lime or of Portland cement concrete. Clay bricks are commonly used since these are economical and easily available. Bricks can define as a construction unit made of inorganic metal strong and solid compounds in regular geometric shapes.

Brick and knows many titles, depending on the quality and source of raw materials and preparation method in various forms, as well as its durability and resistance to standard conditions of thermal insulation, moisture prevent, acid erosion and physical phenomena like Expansion, contraction and, freezing water in pores.

Classification of Bricks

- 1- Clay brick
- 2- Glass brick
- 3- Sand (Lime) brick
- 4- Concrete blocks

Clay Brick

Clay brick is made of clay materials contains mainly of metal compounds with varying proportion according to quarries result geological composition of the soil, which will lead to many kinds of

brick. it may require blending two types of soil for the purpose of obtaining a certain type of brick and specific properties, in order to understand the properties of bricks must know the nature of the raw materials and its basic elements.

Raw Materials

Clay is one of the most abundant natural mineral materials on earth. For brick manufacturing, clay must possess some specific properties and characteristics. Such clays must have plasticity, which permits them to be shaped or molded when mixed with water, they must have sufficient wet and air-dried strength to maintain their shape after forming. Also, when subjected to appropriate temperatures, the clay particles must fuse together.

Clays occur in three principal forms, all of which have similar chemical compositions but different physical characteristics:

- **Surface Clays:** Surface clays may be the up thrusts of older deposits or of more recent sedimentary formations. As the name implies, they are found near the surface of the earth.
- **Shales:** Shales are clays that have been subjected to high pressures until they have nearly hardened into slate.
- **Slate:** Are sedimentary rocks that have undergone the influence of strong ground pressure, affecting hardness and weaker strength.

All three types of clay are composed of silica and alumina with varying amounts of metallic oxides. Metallic oxides act as fluxes promoting fusion of the particles at lower temperatures. Metallic oxides

(particularly those of iron, magnesium and calcium) influence the color of the fired brick.

1. Clay Preparation

Clay preparation methods may have to accommodate the physical characteristics of the raw material and special provision may have to be made to deal with certain impurities. Preparation consists of transforming the clay rock into plastic moldable material by a process of grinding and mixing with water. A typical factory might have a Primary crusher, these are used to break down large lumps of rock to manageable size, which can then be fed to a Secondary crusher, where the clay is reduced in size further. Water can be added here or if it is a dry pan the clay is reduced to dust and water added later.

2. Forming

Molds required for making a brick are made of rectangular blocks slightly large in size (10% larger than the burnt bricks). It is done to allow for shrinkage of the molded brick on drying and burning. The molding is improved by the following:

a- Dry press process: In this method, clay is not made sufficiently plastic, but only small amount of water is mixed with clay as to form a damp powder. With plunger machines, this powder is compressed in the mold, in the form of bricks: Such bricks are directly burned, no drying is needed, but care is to be taken during burning where the temperature should be raised gradually.

b- Stiff mud process: In this process the clay is only sufficiently moist to process the required coherence under moderate pressure, which results in economy of time in drying and fuel in burning. Such clay is forced to come out of any opening having dimensions equal to length of bricks, by means of a wire. Hence these are also known as wire cut bricks.

c. Soft mud process: This process is used where the clay is too wet, there for, it must be dried before molding. Bricks are molded under pressure in a soft mud brick machine, which tempers the clay in its pigging chamber, sands or wets the molds, presses the clay into 4 to 9 molds at a time, strikes off the excess clay, bumps the molds uniformly and dumps the bricks into a pallet. The pallets of bricks are carried away to the dryer as fast as made.

3. Drying

Before the bricks can be fired, as much moisture as possible must be removed or they will explode in the kilns. Drying involves the removal of water from the wet brick in such a way as to dry them out evenly from inside out. If the outer skin of the brick dries first it becomes impossible for the moisture inside to escape. In the kiln the extreme temperatures will force out this moisture and some cracking may occur. To prevent this happening the dryers are kept temperatures of about 80-120 degrees centigrade and the atmosphere is very humid keeping the exterior of the brick as moist as possible. This is monitored very closely to reduce surface cracking.

The bricks will shrink in the dryers as the clay particles come together and they become strong enough to be stacked, but at this stage

they have no weather resistant qualities. Drying schedules vary between 18 to 40 hours is typical for an automated plant. Special shapes and large units can take up to a week or more. The dry bricks are then set onto kiln cars ready to be fired.

4. Firing

The burning of clay in a kiln requires an average time of 3 to 4 days. The process of burning may be divided into the following stages:

a. Dehydration: Dehydration consists of expelling chemically combined water by breaking down the clay molecules. It begins at about 425°C and complete at about 750°C.

b. Oxidation: Oxidation begins during the dehydration stage. All combustible matter is consumed, carbon is eliminated, the fluxing materials are changed to oxides, and sulfur is removed. It begins at about 300-900°C.

c. Vitrification: when extensive fluxing occurs and the mass becomes tight, solid and nonabsorbent; leading to a deformed shape.

5. kilns

There are several different types of kiln but they can be allocated to two main categories;

- **Intermittent kilns:** These are static, usually small kilns and are used for firing small batches of products eg. Special shapes.
- **Continuous kilns:** For large scale production continuous kilns are more economical and are capable of turning out large quantities of

bricks at a steady constant rate. There are two main types of continuous kiln Chamber and Tunnel.

1. Chamber kiln : In its simplest form a chamber kiln is an annular tunnel divided off into chambers (usually 12-20). A section of the kiln (about 4-5 chambers) is being fired at any one time. The firing is drawn round the kiln with chambers being lit in front of the firing and the chambers behind are allowed to go out. Bricks are loaded into the kiln in front of the fire and pre-heat for 1-2 days before the fire reaches them. The bricks then fire for 2-3 days. Once the fire has passed, the bricks cool before being removed from the kiln. They are then replaced with fresh dry bricks awaiting the fire's next circuit.

2. Tunnel kiln: In a tunnel kiln dry bricks are loaded onto a fireproof trolley or kiln car. This then travels very slowly through the kiln. Typical schedule through the kiln from end to end is 3-4 days but variations occur depending on production schedules.

Properties of Bricks

The raw materials and the manner and degree of burning influence the physical properties greatly and therefore wide ranges in values are to be expected for each property.

1-Compressive strength:

The test is carried out in accordance with Iraqi standard No. 24. The brick placed between two plywood sheets and carefully centered between plates of the compression testing machine. The load shall be applied at a uniform rate until failure occurs.

Compressive strength= Load at failure/ Cross sectional area subjected to load

Bricks used in construction works are classified into three grades:

Grade A: Intended for use in building construction and footing subjected to loads and exposed to sever abrasion by weathering action.

Grade B: Intended for use in building construction subjected to loads and not exposed to sever abrasion by weathering action, such as exterior walls not exposed to penetration of water.

Grade C: Intended for use in building construction not subjected to loading such as interior masonry walls and partitions, not exposed to sever abrasion by weathering action.

2-Water absorption:

The absorption of water by brick is often considered to be indicative of its probable durability. The test also provides a means of checking on the consistency of the bricks produced by one factory. In this test the specimen shall be dried to constant weight in a ventilated oven at 110°C to 115°C for about 48 hours. Next the specimen shall be completely immersed in clean water for 24 hours. Each specimen shall then be removed, the surface water wiped off with a damp cloth and the specimen weight.

$$\text{Water absorption} = \{ (W_2 - W_1) / W_1 \} \times 100\%$$

Where: **W2:** weight of brick after 24 hours in water

W1: weight of dry brick

3- Effloresce:

Soluble salts, if present in bricks, will cause effloresce on the surface of bricks. Effloresce test is carried out in accordance with Iraqi standard No. 24. The test is very useful for comparing samples of bricks from different sources, such as when we want to test bricks from several different factories at one time. In this test take a representative sample of 10 bricks and place them on end in the pan containing distilled water to a depth of 2.5 cm for 7 days. Allow the bricks to dry for 3 more days in similar pan not containing water.

4- Thermal insulation

Clay bricks is not a good insulating material where the wall with a single brick thickness is not enough to isolate according to British Building Systems.

5- Fire resistance

The clay brick good material for fire resistant where a wall built of cement mortar and thickness of half brick has portability fire for two hours, which is a good period.

6- Shape

- **Solid:** for foundation and structure which need high strength resistance.
- **Perforated:** for building and semi-loaded structures.
- **Hollow:** partitions and non-loading walls.
- **Cellular:** partitions and non-loading walls.