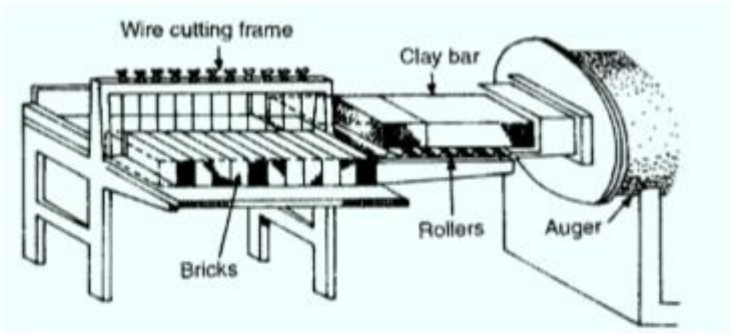
Molding

It is a process of giving a required shape to the brick from the prepared brick earth. Molding may be carried out by hand or by machines. The process of molding of bricks may be the soft-mud (hand molding), the stiff-mud (machine molding) or the dry- press process (molding using maximum 10 per cent water and forming bricks at higher pressures). Fire-brick is made by the soft mud process. Roofing, floor and wall tiles are made by dry-press method. However, the stiff-mud process is used for making all the structural clay products



Drying

Green bricks contain about 7–30% moisture depending upon the method of manufacture. The object of drying is to remove the moister to control the shrinkage and save fuel and time during burning. The drying shrinkage is dependent upon pore spaces within the clay and the mixing water.

Clay products can be dried in

1- Open air driers

2- Artificial driers.

The artificial driers are of two types

1- The hot floor drier.

2- The tunnel drier.

In the former, heat is applied by a furnaces placed at one end of the drier or by exhaust steam from the engine used to furnish power and is used for fire bricks, and clay pipes.

Tunnel driers are heated by fuels underneath, by steam pipes, or by hot air from cooling kilns. They are more economical than floor driers. In artificial driers, temperature rarely exceeds 120°C. The time varies from one to three days.

Burning

The burning of clay may be divided into three main stages.

1- Dehydration (400-650) °C

This is also known as water smoking stage. During dehydration,

(a) The water which has been retained in the pores of the clay after drying is driven off and the clay loses its plasticity.

(b) Some of the carbonaceous matter is burnt.

(c) A portion of sulphur is distilled from pyrites.

(d) Hydrous minerals like ferric hydroxide are dehydrated.

(e) The carbonate minerals are more or less decarbonized.

2- ***Oxidation period (650-900) °C***

During the oxidation period,

(a) Remainder of carbon is eliminated.

(b) The ferrous iron is oxidized to the ferric form.

(c) The removal of sulphur is completed only after the carbon has been eliminated. Sulphur on account of its affinity for oxygen, also holds back the oxidation of iron. Consequently, in order to avoid black or spongy cores, oxidation must proceed at such a rate which will allow these changes to occur before the heat becomes sufficient to soften the clay and close its pore. Sand is often added to the raw clay to produce a more open structure and thus provide escape of gases generated in burning.

3-Vitrification period (900-1250°C)

To convert the mass into glass like substance — the temperature ranges from 900–1100°C for low melting clay and 1000–1250°C for high melting clay. Great care is required in cooling the bricks below the cherry red heat in order to avoid checking and cracking. Vitrification period may further be divided into:

(a) incipient vitrification, at which the clay has softened sufficiently to cause adherence but not enough to close the pores or cause loss of space—on cooling the material cannot be scratched by the knife;

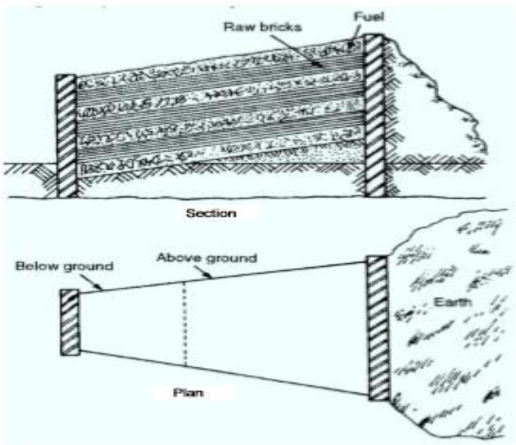
(b) Complete verification, more or less well-marked by maximum shrinkage;

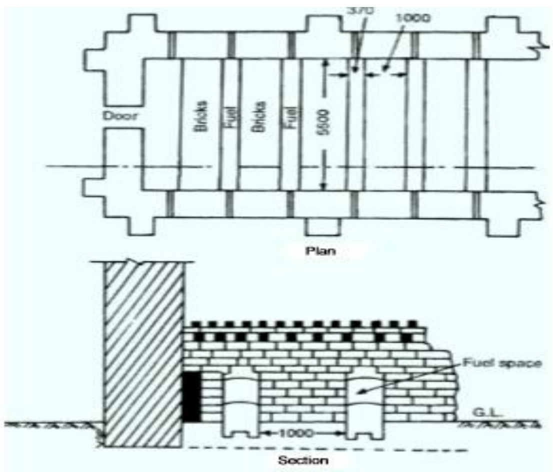
(c) Viscous vitrification, produced by a further increase in temperature which results in a soft molten mass, a gradual loss in shape, and a glassy structure after cooling. Generally, clay products are vitrified to the point of viscosity.

Burning of bricks is done in a clamp or kiln

A typical clamp is shown below. The bricks and fuel are placed in alternate layers. The amount of fuel is reduced successively in the top layers. Each brick tier consists of 4–5 layers of bricks. Some space is left between bricks for free circulation of hot gasses.

Kiln used for burning bricks may be underground, e.g. Bull's trench kiln or over ground, e.g. Hoffman's kiln. These may be rectangular, circular or oval in shape. When the process of burning bricks is continuous, the kiln is known as continuous kiln, e.g. Bull's trench and Hoffman's kilns. On the other hand if the process of burning bricks is discontinuous, the kiln is known as intermittent kiln.





Selection of site for manufacturing of ordinary bricks:

1- Suitable quality of soil is available.
2- Such sites are normally found near river banks, valleys, or plains.
3- If good quality of soil is not available near the site, then cost of transportation of soil will be very high.

4- Water and sand are also essential for brick making therefore must be available near the site.
5- The fuels reassign to be available near the site.
6- The site should be connected with communication roads for transporting materials.

Tests on Bricks

The following laboratory tests may be conducted on the bricks to find their suitability:

(i) Crushing strength (ii) Absorption (iii) Shape and size and (iv) Efflorescence.

Crushing Strength:

The brick specimen is immersed in water for 24 hours. The frog of the brick is filled flush with 1:3 cement mortars and the specimen is stored in damp jute bag for 24 hours and then immersed in clean water for 24 hours. The specimen is placed in compression testing machine with 6 mm plywood on top and bottom of it to get uniform load on the specimen. Then load is applied axially at a uniform rate of 14 N/mm^2. The crushing load is noted. Then the crushing strength is the ratio of crushing load to the area of brick loaded. Average of five specimens is taken as the crushing strength.

Absorption Test:

Brick specimen is weighed dry. Then they are immersed in water for a period of 24 hours. The specimen are taken out and wiped with cloth. The weight of each specimen in wet condition is determined. The difference in weight indicates the water absorbed. Then the percentage absorption is the ratio of water absorbed to dry weight multiplied by 100. The average of five specimens is taken. This value should not exceed 20 per cent.

Shape and Size:

Bricks should be of standard size and edges should be truly rectangular with sharp edges. To check it, 20 bricks are selected at random and they are stacked along the length, along the width and then along the height.

Efflorescence:

The presence of alkalis in brick is not desirable because they form patches of gray powder by absorbing moisture. Hence to determine the presence of alkalis this test is performed as explained below: Place the brick specimen in a glass dish containing water to a depth of 25 mm in a well-ventilated room. After all the water is absorbed or evaporated again add water for a depth of 25 mm. After second evaporation observe the bricks for white/grey patches. The observation is reported as 'nil', 'slight', 'moderate', 'heavy' or serious to mean (a) Nil: No patches (b) Slight: 10% of area covered with deposits (c) Moderate: 10 to 50% area covered with deposit but unaccompanied by flaking of the surface. (d) Heavy: More than 50 per cent area covered with deposits but unaccompanied by flaking of the surface. (e) Serious: Heavy deposits of salt accompanied by flaking of the surface.

Uses of Bricks

Bricks are used in the following civil works:

(1) As building blocks.

(2) For lining of ovens, furnaces and chimneys.

(3) For protecting steel columns from fire.

(4) As aggregates in providing water proofing to R.C.C. roofs.

(5) For pavers for footpaths and cycle tracks.

(6) For lining sewer lines.

Additives in brick

1- Fly ash: A waste material available in large quantities from thermal power plants can be added .The proportion of fly ash mixed as an additive to the brick earth should be optimum to reduce drying shrinkage, check drying losses and to develop strength on firing without bloating or black coring in fired product.

2- Sandy loam: Addition of sandy loam is often found effective in controlling the drying behavior of highly plastic soil mass containing expanding group of clay minerals.

3- Rice husk ash: The ash should preferably have un burnt carbon content in the range of 3–5% and should be free from extraneous material. It can be used with plastic black red soils showing excessive shrinkage.

4- Basalt stone dust: Basalt stone occurs underneath the black cotton soil and its dust is a waste product available in large quantity from basalt stone crushing units. The finer fraction from basalt stone units is mixed with soil mass to modify the shaping, drying and firing behavior of bricks.

The Thermal Analysis Method (DTA):-

Is using identify of clays based on the observation or measurement of the heat changes which occur when a material undergoes physical or chemical changes on being heated or cooled. All reactions involve an energy changes which is usually manifested as a thermal effect and are termed (exothermic) when heat is evolved and (endothermic) when heat is absorbed.

Apparatus:-

A fixed weight of clay sample is placed into one cylindrical silica glass crucible, the other one is also built of silica glass, filled with inert materials which have no thermal reaction over the range of temperature of the test. (Al_2O_3) is used as inert sample. Because it is stable until (1100°C) it is called as reference sample. The crucibles holder which is made of sintered aluminum fits in tubular electric furnace. The peaks in (DTA) curves represent heat changes associated with specific reactions. In clays and other minerals the following major effects can give characteristic and diagnostic results:

1- Loss of free, or absorbed water. Endothermic peak in the temperature ranging (100-150°C).

2- Break down of hydrates, hydroxides, and other minerals which contain lattice water is an endothermic effects which often take place between (200 and 800°C), depending on the type of minerals.

3- Break down of other oxy-salts, such as carbonates, sulfates; these are also endothermic changes and may occur between (500-1200°C).

4- Oxidation reaction involving exothermic change.

5- Re crystallization reaction from amorphous or disordered phase often result in overall exothermic change.

6- Change of state either from solid to liquid or liquid to gas, show endothermic effects often at diagnostic temperature.