Subject: Construction Materials

"BRICKS"

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Bricks

Bricks are probably the oldest manufactured material we have today. Although the method of production has changed, bricks still maintain their individual characteristics. Bricks have many advantages over other building materials , e.g. variety of colour, shape and texture. They are durable. They are low cost material. They possess good strength. They are easily available. Brick are light in compared to stones.
Bricks are obtained by moulding clay in rectangular blocks of uniform size and then by drying and burning these blocks. As bricks are of uniform size, they can be properly arranged, light in weight and hence bricks replace stones.

Essential features: While bricks are produced to withstand load bearing compressive loads they must also be fairly impervious, weather / frost resistant and have an attractive appearance.

Composition, Manufacturing process

Alumina: - It is the chief constituent of every kind of clay. A good brick earth should contain 20 to 30 percent of alumina. This constituent imparts plasticity to earth so that it can be moulded. If alumina is present in excess, raw bricks shrink and warp during drying and burning.

Silica-A good brick earth should contain about 50 to 60 percent of silica. Silica exists in clay either as free or combined form. As free sand, it is mechanically mixed with clay and in combined form; it exists in chemical composition with alumina. Presence of silica prevents crackers shrinking and warping of raw bricks. It thus imparts uniform shape to the bricks. Durability of bricks depends on the proper proportion of silica in brick earth. Excess of silica destroys the cohesion between particles and bricks become brittle.

Composition, Manufacturing process

Lime – A small quantity of lime is desirable in finely powdered state to prevents shrinkage of raw bricks. Excess of lime causes the brick to melt and hence, its shape is last due to the splitting of bricks.

Oxide of iron- A small quantity of oxide of Iron to the extent of 5 to 6 percent is desirable in good brick to imparts red colour to bricks. Excess of oxide of iron makes the bricks dark blue or blackish.

Magnesia- A small quantity of magnesia in brick earth imparts yellow tint to bricks, and decreases shrinkage. But excess of magnesia decreases shrink leads to the decay of bricks. The ingredients like, lime, iron pyrites, alkalies, pebbles, organic matter should not present in good brick earth

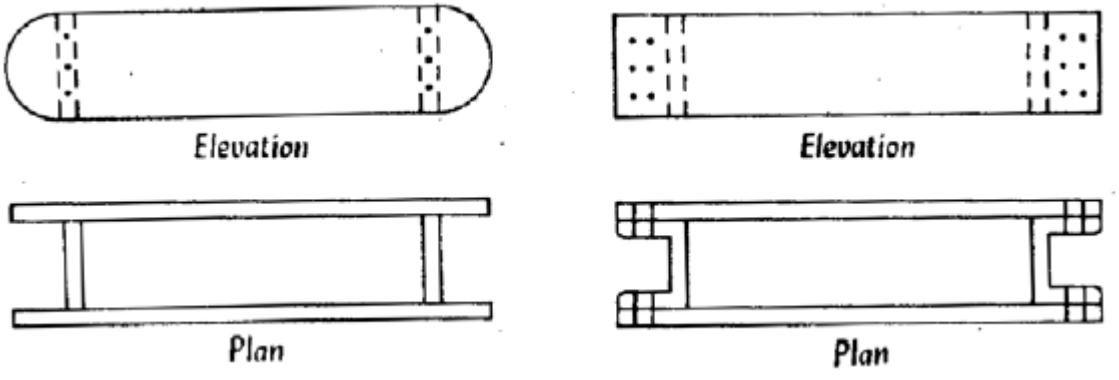
Bricks

Manufacture of bricks: Following operations are involved
1. Preparation of clay, 2. Moulding 3. Drying 4. Burning
(1) Preparation of clay :- The preparation of clay involves following operations
a) **Un-soiling** :- Top layer of 20cm depth is removed as it contain impurities.
Digging: - Clay dug out from ground is spread on level ground about 60cm to 120cm heaps.
c) **Cleaning**:-Stones, pebbles, vegetable matter etc. removed and converted into powder form.
d) **Weathering**:- Clay is exposed to atmosphere for few weeks
e) **Blending**:- Clay is made loose and any ingredient to be added to it is spread out at top and turning it up and down in vertical direction**.**
f) **Tempering**:- Clay is brought to a proper degree of hardness, then water is added to clay and whole mass is kneaded or pressed.

Bricks

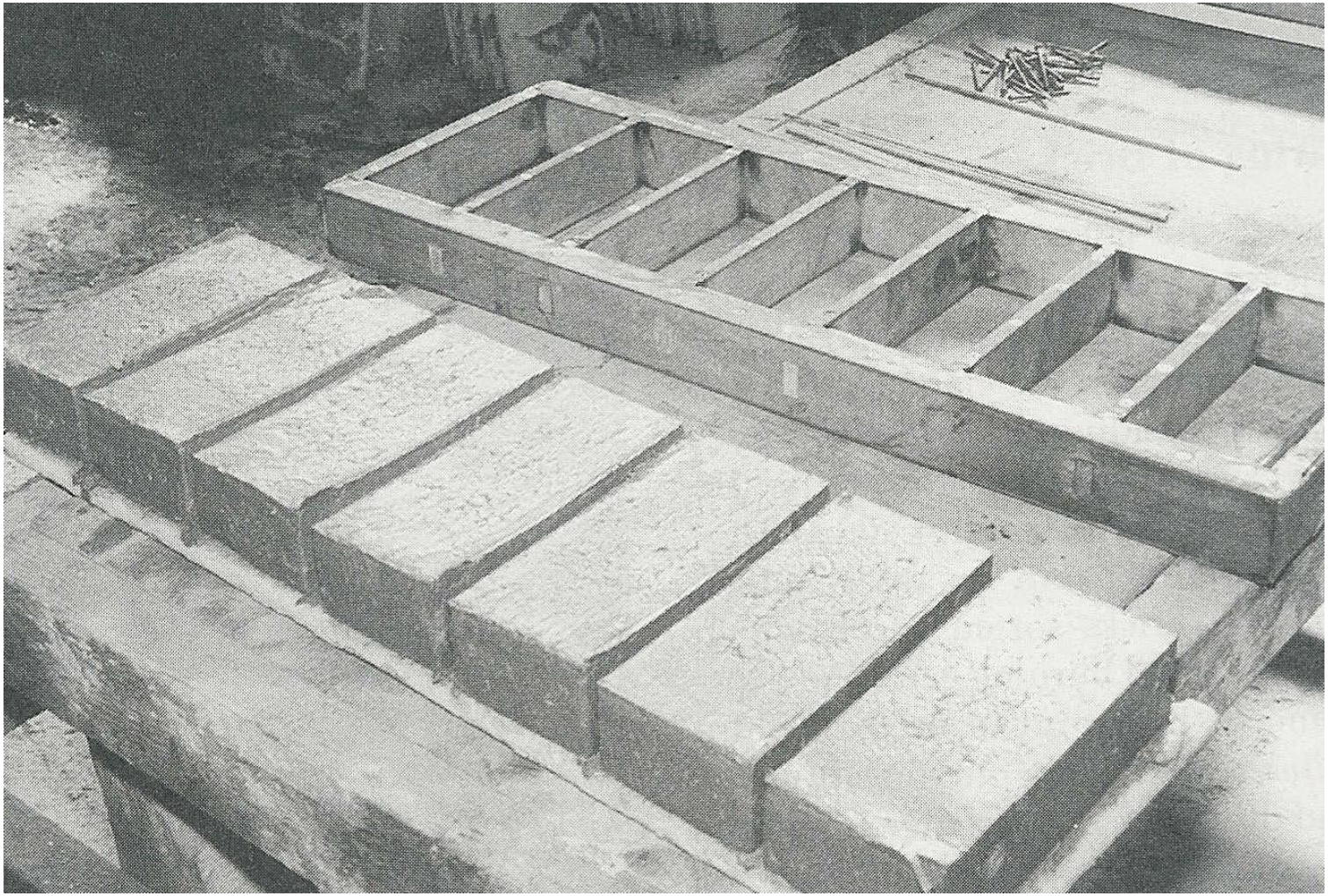
(2) Moulding: Clay, which is prepared from pug mill, is sent for the next operation of moulding. Following are the two ways of moulding.

Hand Moulding: Moulds are rectangular boxes of wood or steel, which are open at top and bottom. Steel moulds are more durable and used for manufacturing bricks on large scale as shown in fig. Bricks prepared by hand moulding are of two types. a) Ground moulded bricks and (b) Table moulded bricks



Wooden mould & Steel mould

Wood molds for making brick



Bricks, Hand Moulding

Bricks

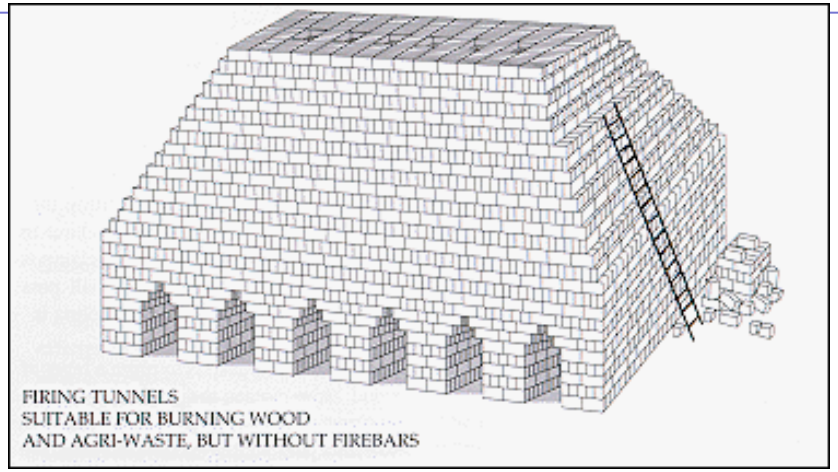
Machine moulding: The clay is placed in the machine, it comes out through the opening under pressure. It is cut to bricks by steel wires fixed into frames. These bricks are also called wire cut bricks. This method proves to be economical when bricks in huge quantity are to be manufactured at the same spot. It is also helpful for moulding hard clay.

Drying:

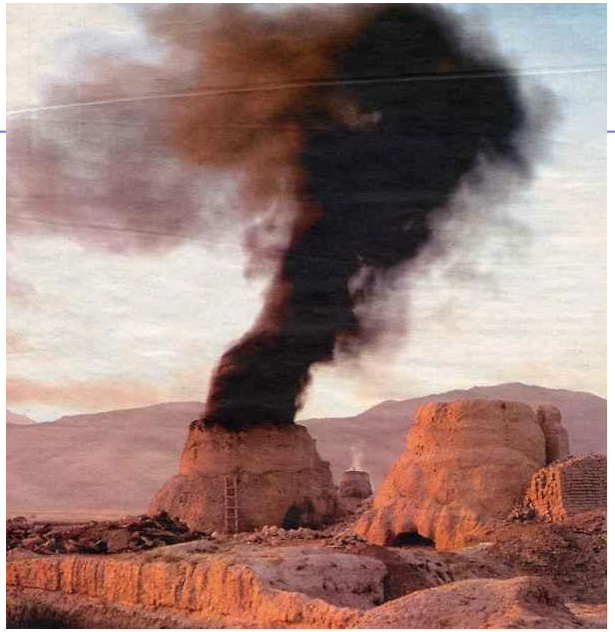
Wet brick from molding or cutting machines contain 7 to 30 percent moisture, depending upon the forming method. Before the firing process begins, most of this water is evaporated in dryer chambers at temperatures ranging from about 100 ºF to 400 ºF (38 ºC to 204 ºC). The extent of drying time, which varies with different clays, usually is between 24 to 48 hours. Heat and humidity must be carefully regulated to avoid cracking in the brick.

Burning of Bricks

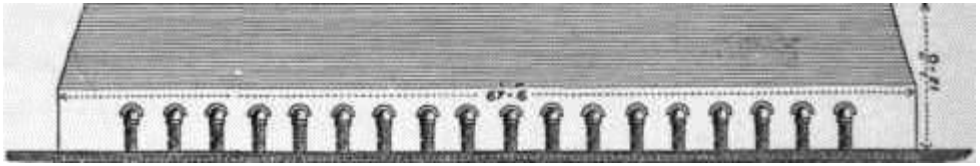
Highly inefficient & labor-intensive. Use coal + fuels, Most common, most primitive, most polluting, Temporary Structures



A typical clamp kiln.



A typical scove kiln.



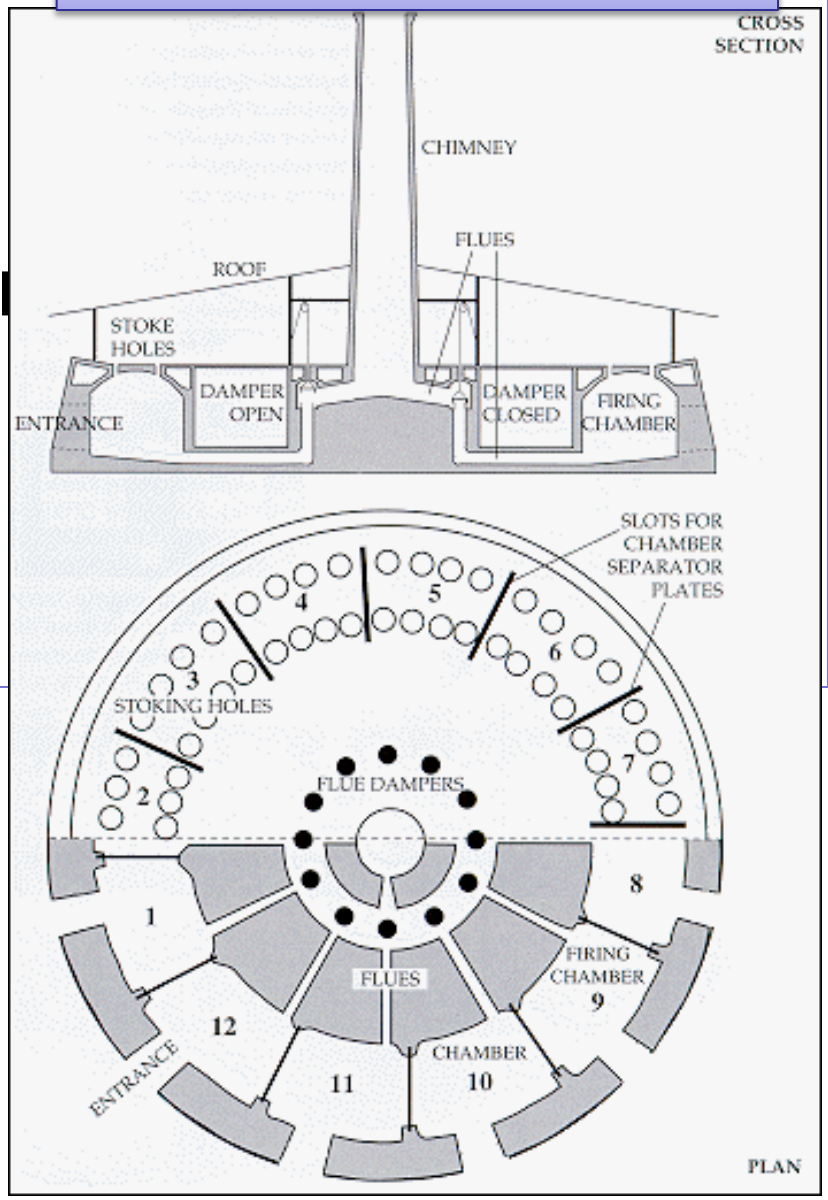
A typical scotch kiln.

Burning of Bricks

CONTINOUS KILN BURNING –
HOFFMAN, BULL'S TRENCH, VERTICAL SHAFT & HABLA

These are permanent structures. Burning is done continuously in kilns. I are of correct size, perfect shape and good quality. Rate of burning is also high in kilns. But initial investment for kiln is very high.

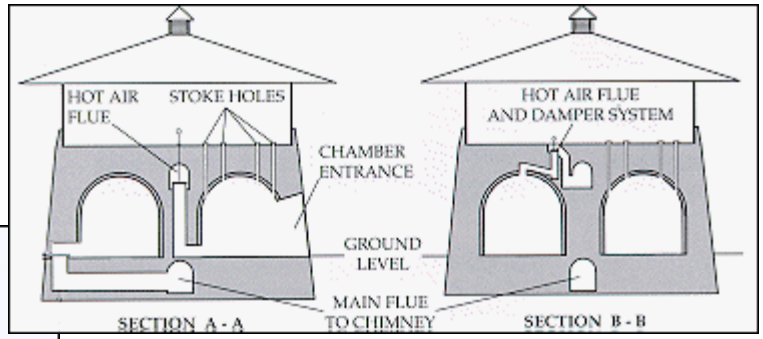
HOFFMANN KILN – ORIGINAL

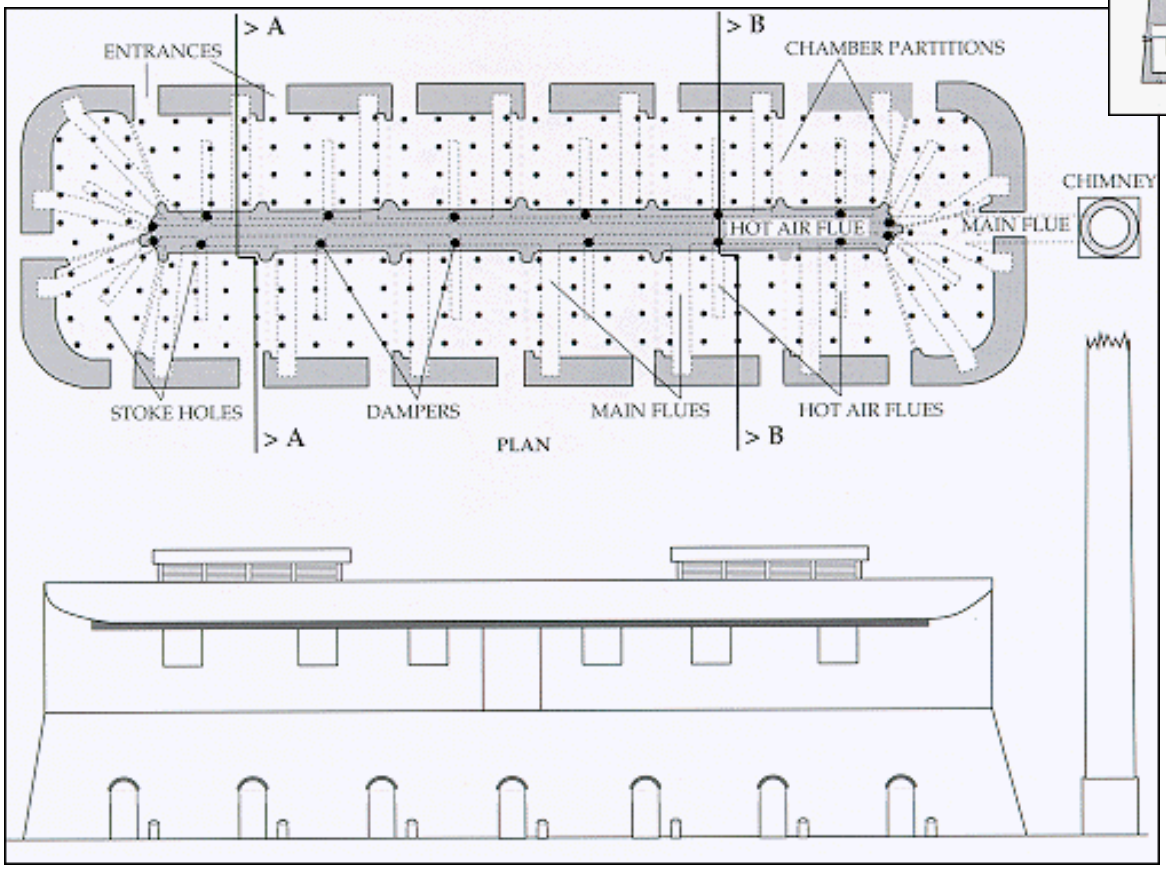


Burning of Bricks

HOFFMANN KILN – MODERN & HYBRID

- Widely used in China = 90% of bricks
- Can use coal or natural gas



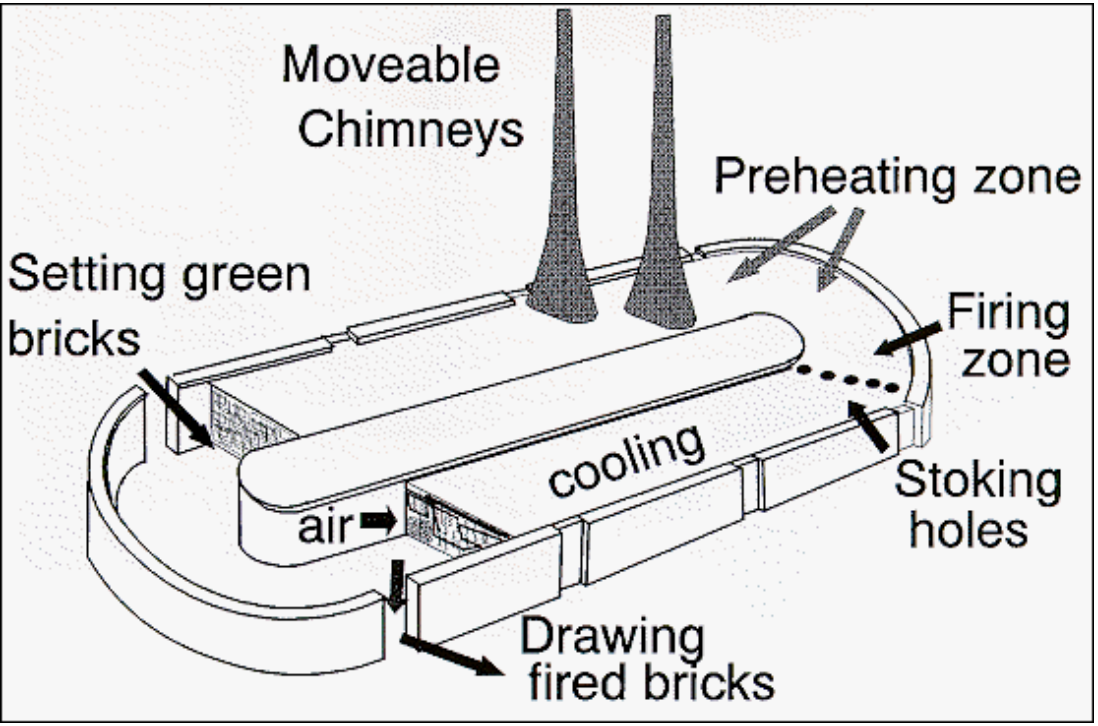


Burning of Bricks

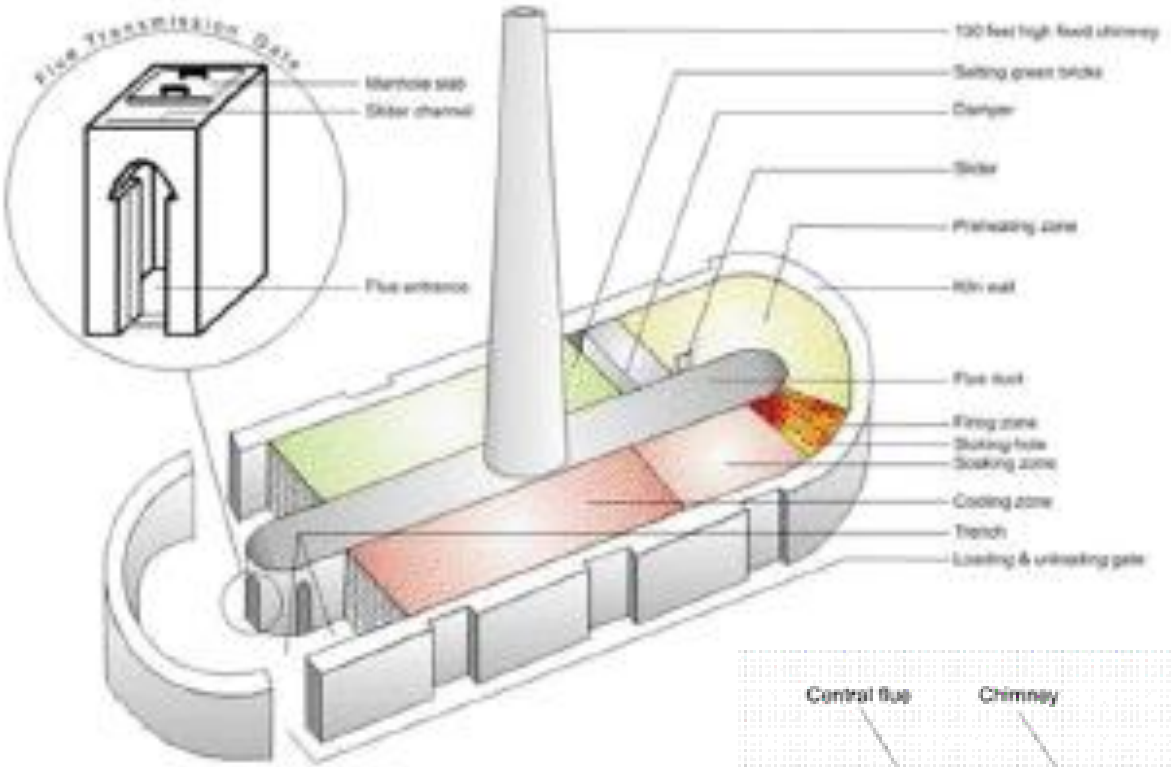
BULL'S TRENCH KILN

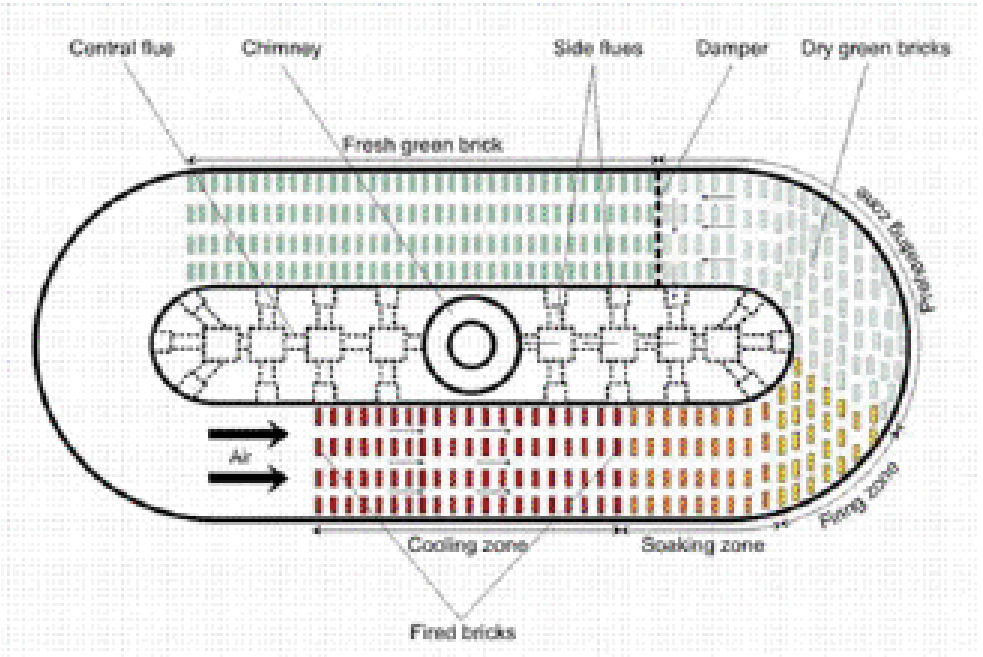
Used in India, Pakistan, Nepal, Bangladesh

Uses coal and scavenged fuels



Burning of Bricks





Bricks types

Unburnt or sun dried bricks:

These are dried under sunlight. These are used for temporary and cheap construction. It is also used for filling works.

Basic types of brick:

Common brick: Units made of clay where color and surface finish are not a factor, because of use as a "backup" structural material in an area where it will never be seen.

Face brick: Units made where appearance is the main consideration. Face brick for commercial use is still made with specific colors of clay.

Special bricks may be made for specific purposes. Should an Architect desire a special shape to be used in creating an unusual desired effect in a design, brick companies will custom make the units.

Bricks types

Fire brick is made of a specific type of white clay, with special additives for use in the firebox of fireplaces, ovens, kilns, and other firing mechanisms.

Bricks, generally are made with holes (except fire brick) to reduce the weight of material not needed for structure, and to provide a method for additional adherence of mortar.

Bricks made of the same material as concrete masonry units are available on a limited basis, but have never been accepted for widespread use.

Bricks types

Burnt bricks:

- First class bricks, Second class bricks, Third class bricks &
- Fourth class bricks

First class bricks:

- Made of good earth which is free from saline deposits and are sand molded.
- Burnt thoroughly and have deep red, cherry and copper color.
- Regular and uniform in shape and size with sharp and square edges and parallel faces.
- Must be homogeneous in texture and emit a clear ringing sound on being struck together.
- Free from flaws, cracks, chops, stones and lime.
- Have a minimum crushing strength of 105 kg per sq. cm when tested according to the test

Bricks types

SECOND CLASS BRICKS

- They shall be well burnt or slightly over burnt.
- They must give clear ringing sound when struck.
- The may have slight irregularities in size, shape and color.
- They may have slight chips, flaws or surface crack but must be free from lime.

- The minimum crushing strength of second class brick should be 70 kg per sq cm.

Bricks types

THIRD CLASS BRICKS: These bricks are slightly under burnt or over burnt.

- They are not uniform in shape, size and
- They shall not observe water more than dry weight after 24 hours, immersion in c
- They have some signs of efflorescence

FOURTH CLASS BRICKS

- These are over burnt bricks which are dark in colour and are irregular in size and shape.
- These are used as aggregate in concrete and for flooring and foundation.
- Over burnt bricks are not used for building construction.

Bricks types

Clay brick

These are made from clay composed mainly of silica and alumina with small quantities of lime, iron and manganese, which are moulded into shape and baked in a kiln. These are the most common type of brick used today

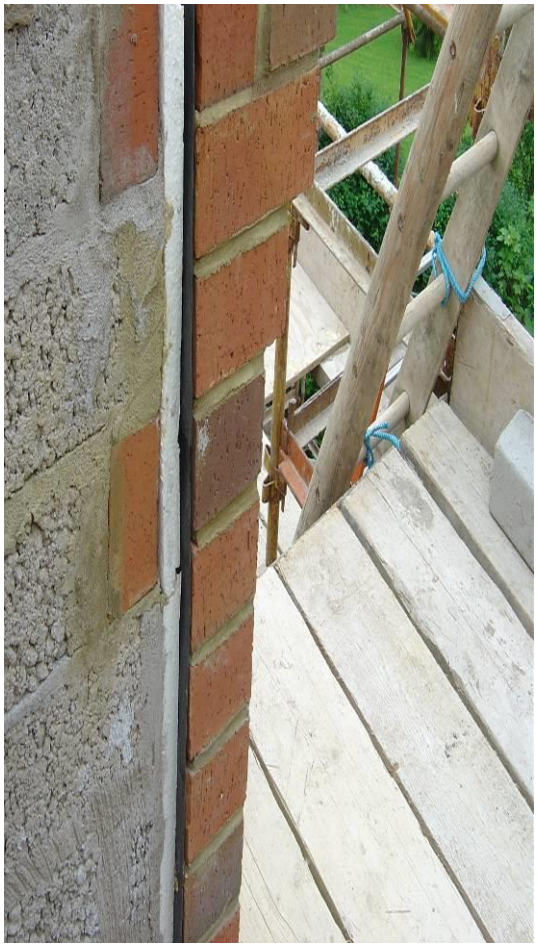
Calcium silicate bricks

These are made from sand and lime and hardened by exposure to steam at pressure.

Bricks

Common brick

These are generally building bricks which can vary considerably in quality and which do not have a decorative face. They are much cheaper and can be used for unseen work.



Facing brick

The term used to describe a brick specifically used for decorative appearance. Facing brick are much more expensive than common brick.

Engineering brick

These are very hard dense brick with a smooth texture. They have a high load-bearing capacity and are used when strength and durability are required.

Bricks

❑BRICK ARRANGEMENT TERMINOLOGY

Bricks are laid in a variety of arrangements, mostly today for the sake of appearance. In earlier times when a wall consisted of several layers thickness, bricks were turned endways through the wall for structural bond. Named patterns evolved in the process, such as English bond, Flemish bond, etc.

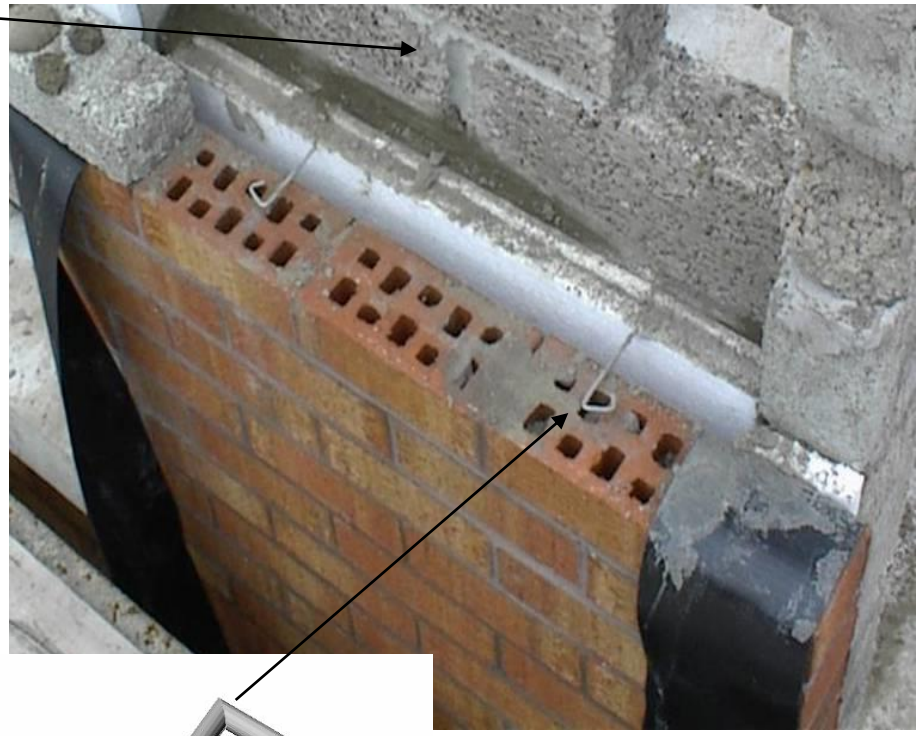
Common course pattern for structure and appearance:

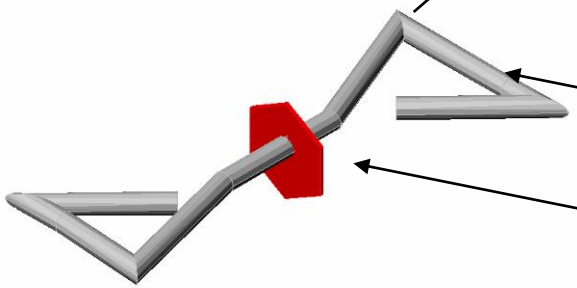
- ❑Stretcher – Bricks laid flat end to end.
- ❑Soldier – Laid vertically so the outside long edge shows.
- ❑Rowlock - Laid so the end shows, vertically.
- ❑Header – Laid so the end shows, horizontally

Blocks

Concrete Blocks

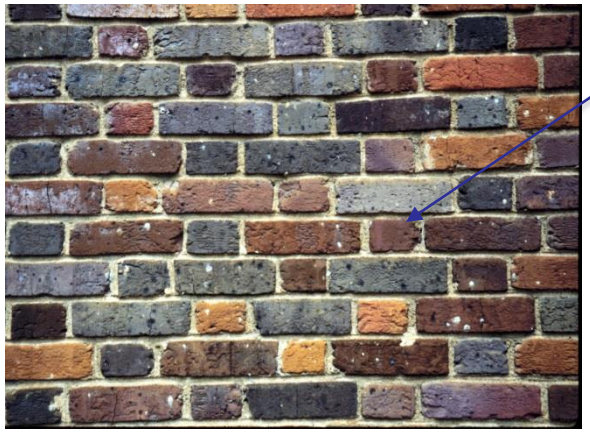
Blocks are produced in a range of shapes and sizes. Blocks are usually 450mm long by 150mm or 225mm high. They are usually 100 mm wide but they can be up to 150mm or 200 mm wide. The blocks are manufactured from sand, cement and aggregate. They are usually used where the surface will be covered with plaster.





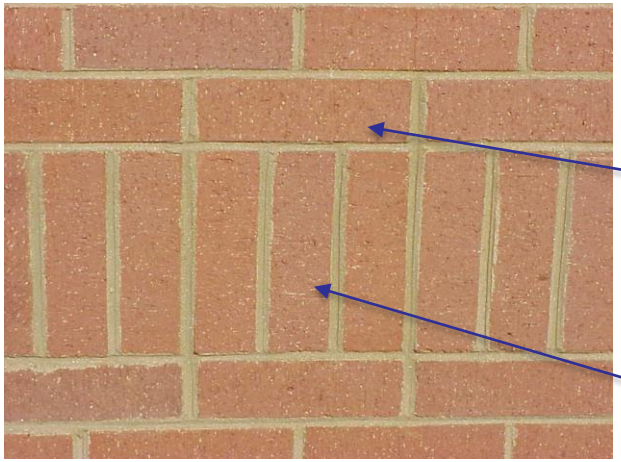
Stainless-steel wire wall tie with plastic disc to hold sheet insulation in place.

Basic Brickwork Terminology



Header - Bonds two wythes together
Wythe: vertical layer 1 unit thick

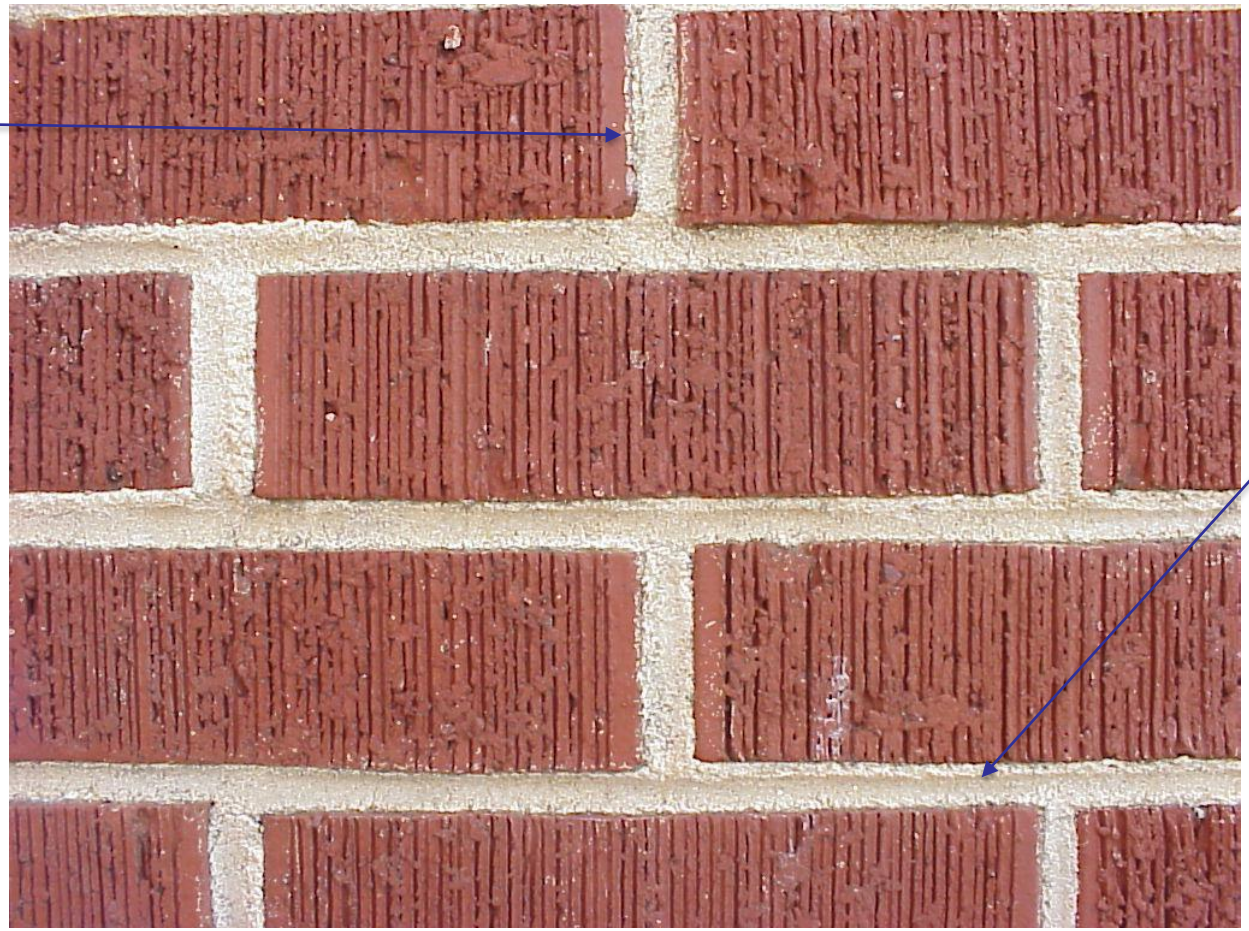
Rowlock -
laid on face,
end visible



Stretcher - long dimension horizontal & face parallel to the wall

Soldier - Laid on its end, face parallel

Basic Brickwork Terminology

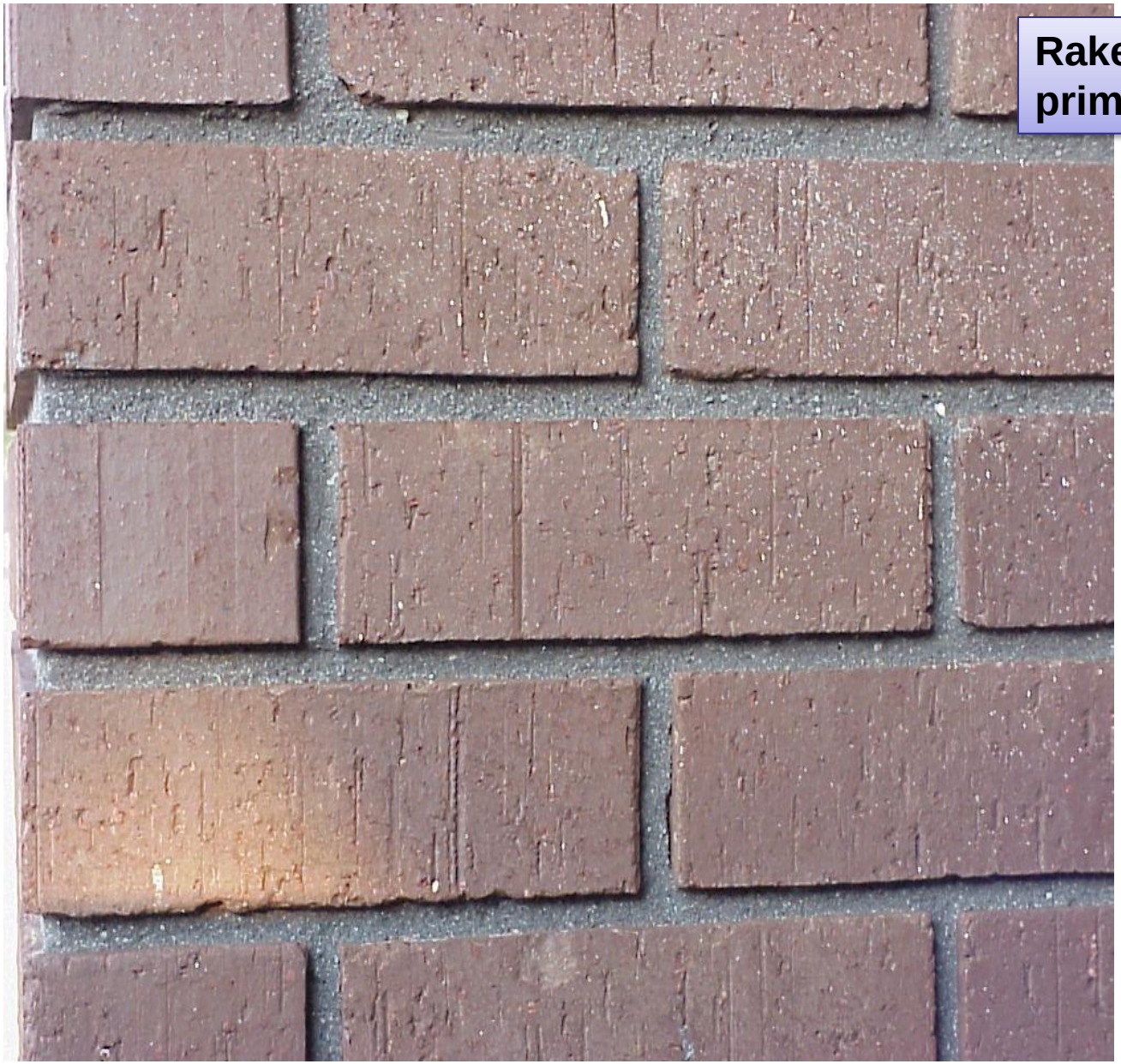


Basic Brickwork Terminology

Basic Brickwork Terminology

Concave joints done primarily for weather proofing

Basic Brickwork Terminology



Raked joints are made primarily for appearance

Mortar for Bricks and Blocks

A typical mortar for laying bricks and blocks will normally include water plus sand, cement, lime or plasticiser.

Sand

Using a well graded clean sand (aggregate) will help to produce a good workable mix of adequate strength.

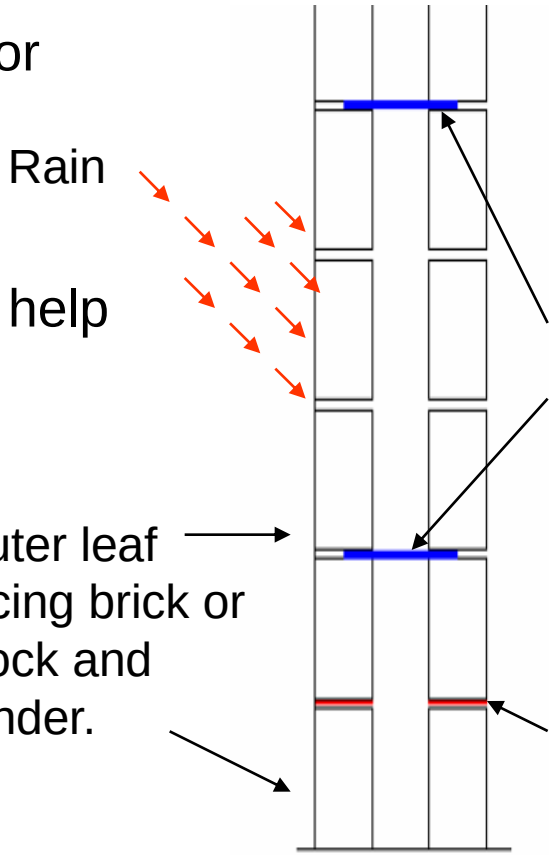
Cement

Ordinary Portland Cement is normally used for mortar.

Plasticizer

This is an additive which can be mixed with cement mortar to make it more workable.

Section through a Cavity Wall



The two leaves of the wall must be tied together with stainless-steel cavity wall ties.

Mortar for Bricks and Blocks

Water

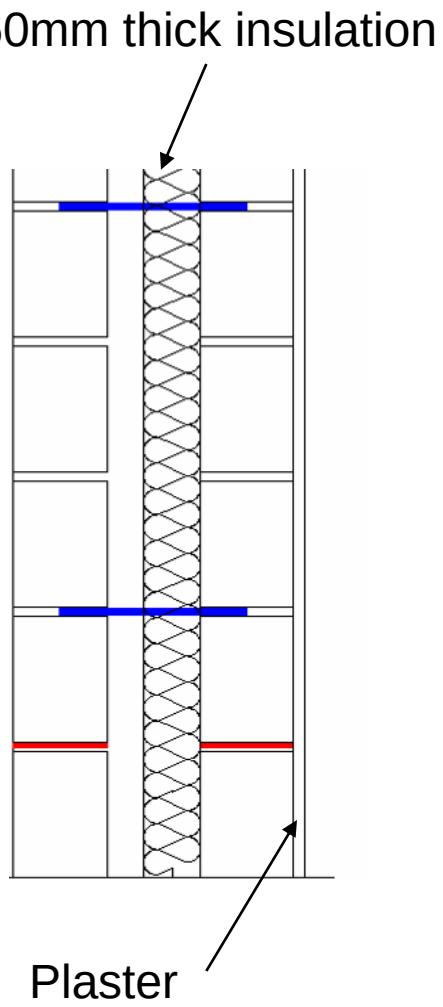
The water should be clean. All materials used for mortar should be properly batched.

Types of mortar

In designing mortar, one must ensure that there is adequate strength and ability to form a close bond with the bricks and blocks being used. Should there be any settlement in the wall structure the mortar joint must fail first not the bricks or blocks. Therefore the mortar must not be too strong.

Insulation

Various types of insulation are available to place in a cavity wall. This insulation helps prevent heat loss in the building.



Damp Proof Course

Function of a D.P.C.

Prevent the passage of moisture or water through those parts of a structure in contact with the ground.

To prevent the downward passage of moisture or water through those parts of the wall structure such as window jambs i.e. vertical DPC and cavity trays.

To prevent moisture penetrating a building at sill or head level.

A DPC rapped round a window sill

Tests on bricks

- Water Absorption test
- Crushing strength test
- Hardness test
- Efflorescence test
- Size, Shape and Color test
- Soundness test
- Structure test

Tests on bricks

(1) **Water Absorption:** A good should not absorb not more than 20 percent of weight of dry brick

2) **Compressive strength:** crushing or compressive strength of brick is found out by placing it in compression testing machine. It is pressed till it breaks. Minimum crushing strength of brick is 35kg/cm2 and for superior bricks, it may vary from 70 to 140 kg/cm2.

3) **Hardness:** No impression is left on the surface the brick istreated to be sufficiently hard

4) **Presence of soluble salts**: The bricks should not show any grey or white deposits after immerted in water for 24 hours

5) **Shape and size:** It should be standard size and shape with sharp edges

6) **Soundness**: The brick should give clear ringing sound struck each other

7) **Structure**: The structure should be homogeneous, compact and free from any defects.

Uses of bricks

Structural uses: such as foundations walls and floors.
Decorative/ornamental uses: May be cast to from moldings and other decorative features may be carved also may be used in a variety of colors, textures, bonds and joints. May be concealed by other finish materials such as stucco, plaster or paint, or may be exposed both on the interior and exterior. Bricks are also used in the *metallurgy and glass industries* for lining furnaces. This type of brick must have good thermal shock resistance, under load, high melting point, and satisfactory porosity. Bricks are used for *building and pavement* . Earlier brick pavement was found incapable of withstanding heavy traffic, but it is coming back into use as a method of traffic calming or as a decorative surface in pedestrian ways.

Qualities of bricks

Qualities of Good Brick:

(i) Bricks should be table moulded, well burnt in kilns, copper coloured, free from cracks and with sharp and square edges.
(ii) Bricks should be uniform shape and should be of standard size.
(iii) Bricks should give clear ringing sound when struck each other.
(iv) Bricks when broken should show a bright homogeneous and compact structure free from voids.
(v) Bricks should not absorb water more than 20 percent by weight for first class bricks and 22 percent by weight for second class bricks, when soaked in coldwater for a period of 24 hours.

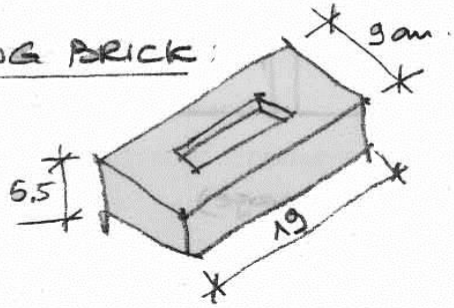
Bricks

Qualities of Good Brick:

(vi)Bricks should be sufficiently hard no impression, should be left on brick surface, when it is scratched with finger nail.
(vii) Bricks should be low thermal conductivity and they should be sound proof.
(viii) Bricks should not break when dropped flat on hard ground from a height of about one meter.
(ix) Bricks, when soaked in water for 24hours, should not show deposits of white salts when allowed to dry in shade.
(x) No brick should have crushing strength below 55kg/cm2

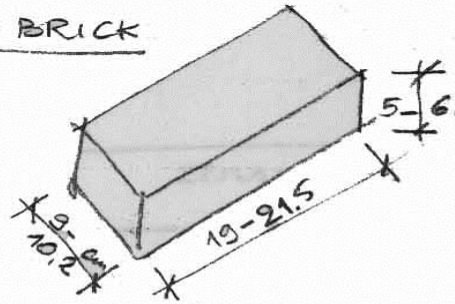
* SOLID BRICKS

(a) BUILDING BRICK:



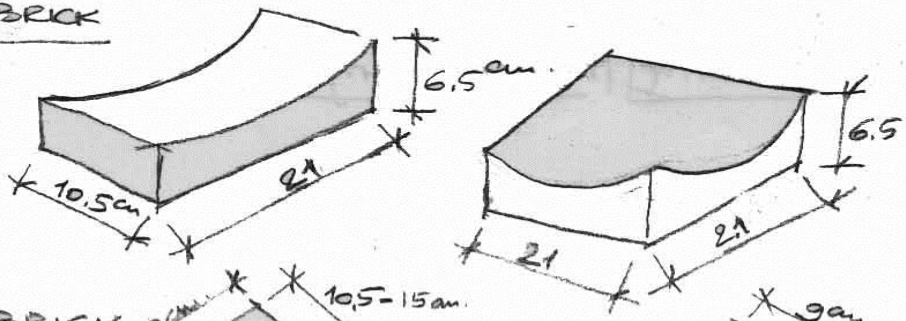
The cheapest, and lowest quality brick with sandy reddish colored surface.

(b) PRESSED BRICK

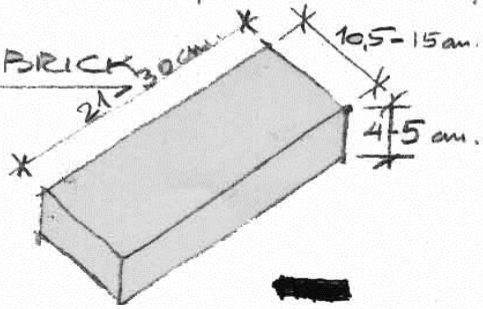


Weight = 1,7 - 3 kg.

(c) SEWER BRICK

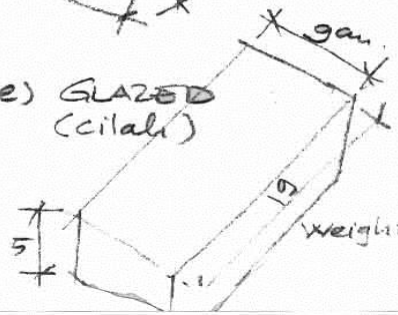


(d) PAVING BRICK



Weight =
2,5 kg.
2,1 "

(e) GLAZED (cilali)



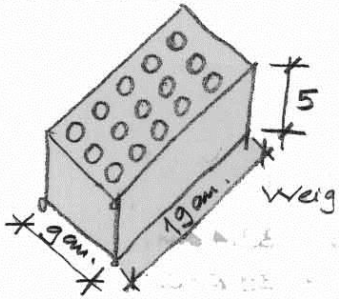
Weight = 1,700 kg.

2- HOLLOW BRICKS *

(a) STRUCTURAL CLAY TILES

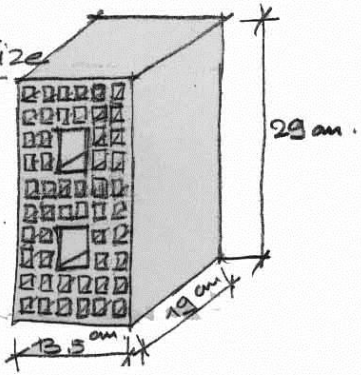
(i) LOAD BEARING :

Small Size



Weight = 1.3 kg.

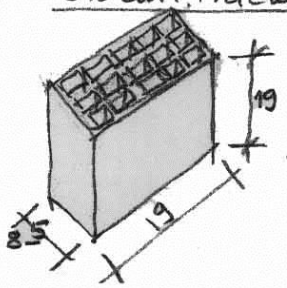
Large Size



Weight = 5.6 kg.

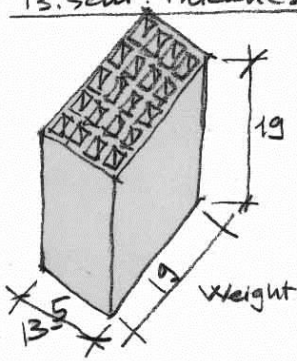
(ii) NON-LOAD BEARING

8.5 cm. Thickness



Weight = 2 kg.

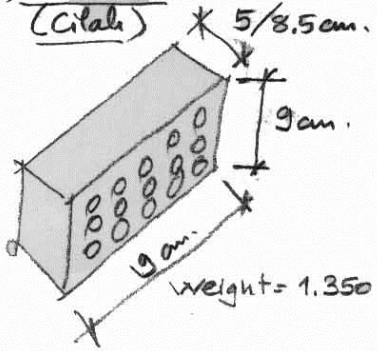
13.5cm. Thickness



Weight = 3 kg.

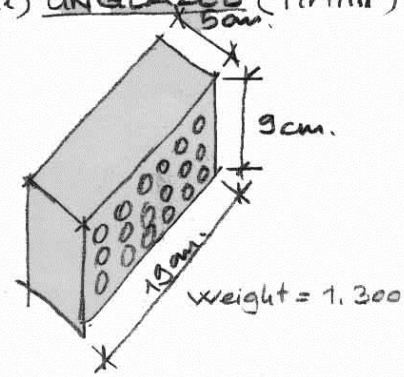
(b) STRUCTURAL FACING TILE

(i) GLAZED (Cilah)



Weight = 1.350 kg.

(ii) UNGLAZED (Tirtih)



Weight = 1.300 kg

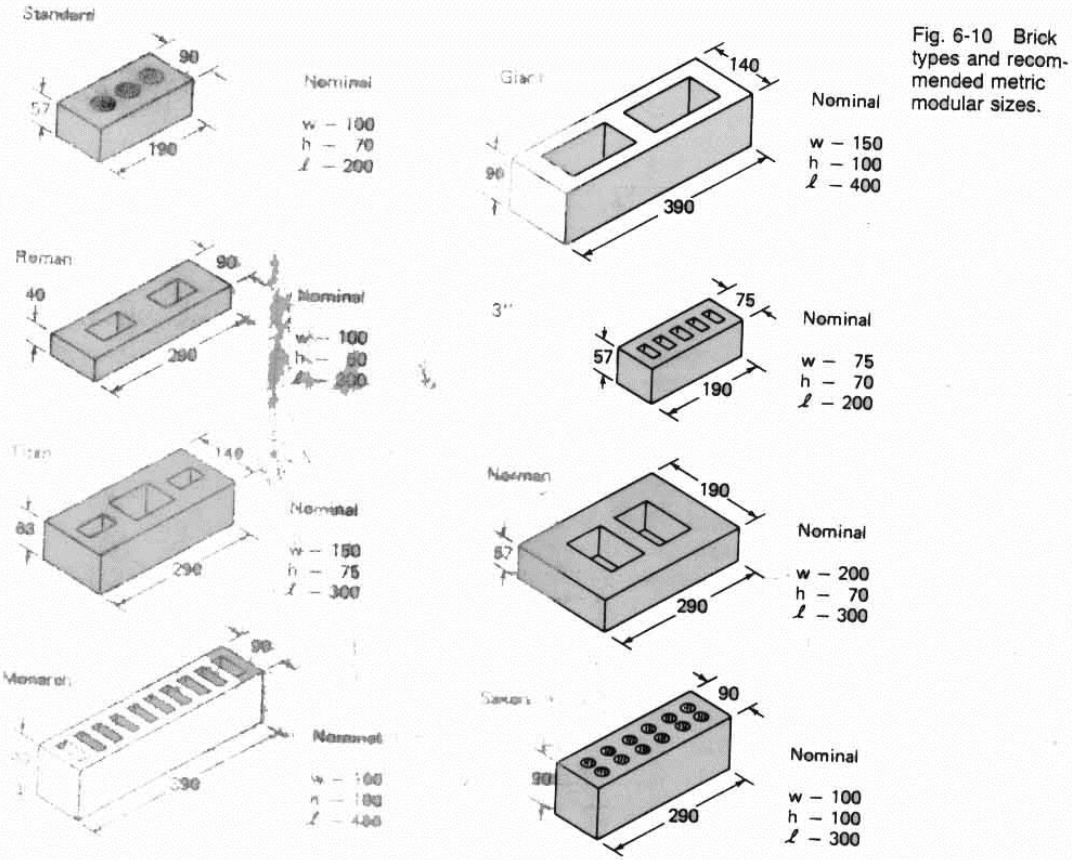
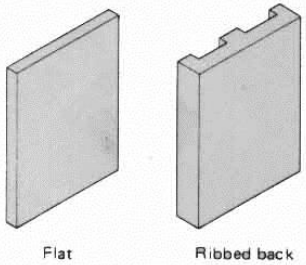


Fig. 6-10 Brick types and recommended metric modular sizes.



Ceramic veneer.

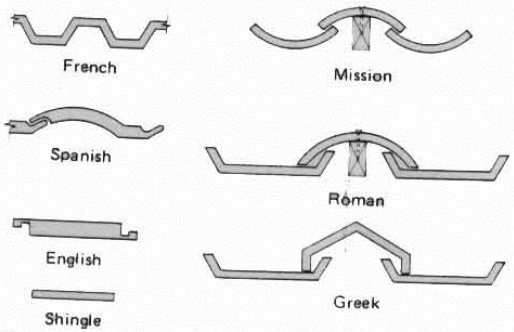
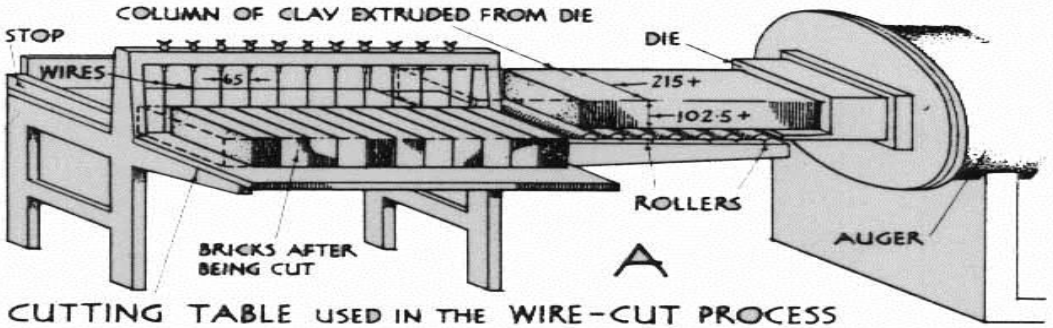
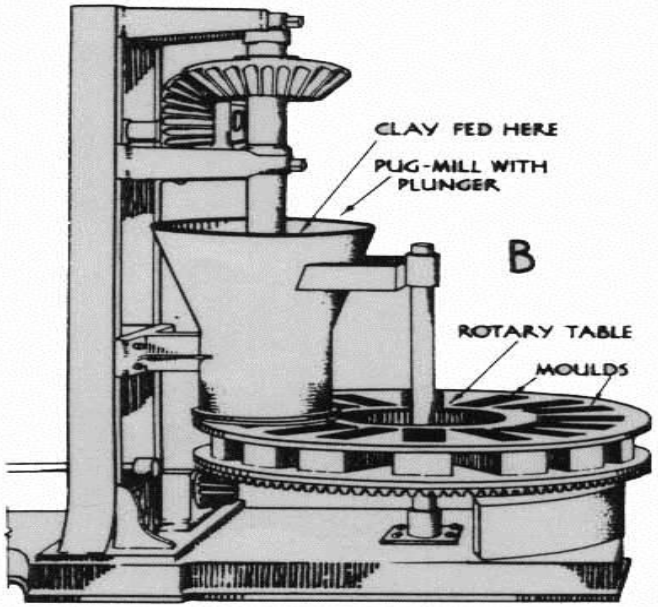


Fig. 6-37 Clay roof tile shapes.

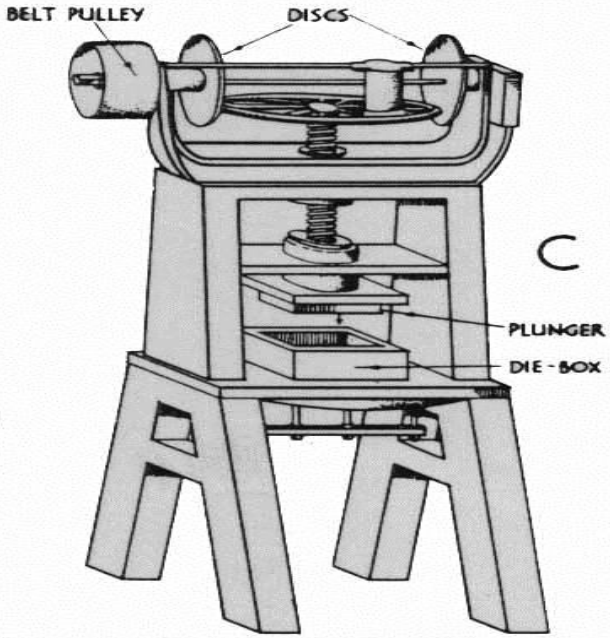
SKETCHES OF BRICK MOULDING MACHINERY



CUTTING TABLE USED IN THE WIRE-CUT PROCESS



ROTARY PRESS



BELT-DRIVEN PRESS

USED IN THE PRESSURE PROCESS

NOT TO SCALE

Bricks manufacturing