

Rocks

Introduction:-

The engineering structures are composed of materials. These materials are known as engineering materials or building materials or materials of construction.

It is a necessity for an engineer to become conversant with the properties of such materials.

The service conditions of buildings divide a wide range of materials & various properties such as water resistant, strength, durability, temperature resistant, appearance, permeability etc. are to be properly studied before making final selection of any building material for a particular purpose.

Stone as a building material:-

Stones are obtained from rocks. A rock represents a definite portion of earth's surface. It has no definite chemical composition and shape.

Rocks are known as monomineralic, if they contain only one mineral and it is known as polymineralic if it contains several minerals.

Like magnesite, $2CaSO_4 \cdot H_2O$ are the examples of monomineralic rocks. The basalt and granite are the examples of polymineralic rocks.

Classification of rocks

Rocks are classified into 3 groups.

- 1) Geological
- 2) Physical
- 3) Chemical classification.

Geological classification:-

According to this classification rocks are classified into 3 groups.

- 1) Igneous rocks
- 2) Sedimentary rocks.
- 3) Metamorphic rocks.

Igneous rocks.

The inside portion of earth surface at high temp so as to cause fusion by heat at even ordinary pressure. The molten or paste rocky materials is known as Magma. And this magma ^{occasionally} ~~occasionally~~ ^{tried} to come out through cracks or in weak portion. The rocks which are formed by cooling of magma as known as igneous rocks.

The igneous rocks are recognized as of the following 3 classes.

- 1) Plutonic rocks.
- 2) Hypobysal rocks.
- 3) Volcanic rocks.

Plutonic rocks:-

Such rocks are formed due to cooling of Magma at a considerable depth of earth surface. The cooling is slow and rocks possess coarsely grained Crystalline Structure. The igneous rocks are used in building industries are of plutonic rocks.

Granite is leading example of this type of rocks

Hypobysal rocks:-

Such rocks are formed due to cooling of Magma at a relatively shallow depth from the earth surface. The cooling is quick & hence this rocks possess grain ed Crystalline structure.

Dolerite is a best exa for this type of rocks

Volcanic rocks:-

Such rocks are formed due to pouring of magma at earth surface. The cooling is very rapid as compared to the perforations & case.

Hence, these rocks are found fine grained is

structure. They frequently contain same quantity of glass which is a non-crystalline material.

Basalt is an ex of this type of rock.

Sedimentary rocks:-

These rocks are formed by the deposition of products of weathering on pre-existing rocks. All the products of weathering are ultimately carried away from the place of origin by the agency of transport. Such agencies are frost, rain, wind etc

Following 4 types of deposits are

- 1) Residual deposition.
- 2) Sedimentary deposition.
- 3) Chemical deposition.
- 4) Organic deposition.

1) Residual deposition:- Some portion of product of weathering remains at site of origin. Such deposit is known as a residual deposit.

2) Sedimentary deposition:- The insoluble products of weathering are carried away in suspension or when such product deposit a gives rise to a sedimentary deposit.

3) Chemical deposit:- Some material, that is carried away in solution may be deposited by physico-chemical process such as evaporation and precipitation. It gives rise to chemical deposit.

4) Organic deposit:- Some portion of the product of weathering gets deposited through the agency of organism. Such deposit called as organic deposit.

Example:- sedimentary rocks are gravel, sand stone, lime stone, gypsum, lignite etc.
Metaphorphic

Metamorphic rocks:-

This rocks are formed by the change in character of the pre-existing rocks. Igneous as well as sedimentary rocks are changed in character when they are subjected to heat and pressure this process will change is metamorphism.

Physical Classification:-

This classification is based on general structure of rocks. According to this classification are rocks are following types.

- 1) Stratified rocks.
- 2) Unstratified rocks
- 3) Foliated

Stratified rocks:-

This rocks possess planes of stratification, such rocks can easily be split along this planes. Sedimentary rocks are destinatedly stratified rocks.

Unstratified rocks:-

This rocks are unstratified, the structure may be crystalline or granular or compact granular. The igneous rocks are volcanic agency of sedimentary rocks affected by the movement of the earth.

Foliated rocks:-

This rocks have a tendency to be split up in a definite direction own. Foliated structure is very common in case of metamorphic rocks.

Chemical Classification:-

According to this chemical classification the rocks are in 3 types

1) Silicious rocks.

2) Argillaceous rocks.

3) Calcareous rocks.

Silicious rocks:-

In this rocks silica is predominate. The rocks are very hard and durable but they are not easily affected by weathering.

Silica, however in combination with weaker minerals may this integrate easily.

Argillaceous rocks:-

In this rocks clay is predominate. Such rock may be dense and compact or they may be soft.

Calcareous rocks:-

In this rocks, calcium carbonate is the predominate chemical. The durability of this rock will depends of constituents present in surrounding atmosphere.

ex:- Lime stone and marbles.

12/10/17

Qualities or Requirements of a good building Stones:-

Following are the qualities or requirement of good building stones are,

- 1) Crushing strength.
- 2) Appearance.
- 3) Durability.
- 4) Facility of Dressing.
- 5) Fracture.
- 6) Hardness.
- 7) Percentage wear.
- 8) Resistance to fire.
- 9) Seasoning.
- 10) Specific Gravity.
- 11) Texture.
- 12) Toughness index

13) Water absorption.

14) Water weathering.

1) Crushing strength:- For a good structural stone, crushing strength should be greater than 1000 kg/cm^2

2) Appearance:- The stones which are to be used for face work should be decent in appearance & they should be capable of preserving their colour uniformly for a long time.

3) Durability:- A good building stone will be durable, the various factors contribute into durability of stone or chemical composition, resistance to atmosphere, and other influences, location in structure, etc.

For making stone durable, their natural beds carefully noted. Stone should be arranged in a structure that natural bed is \perp or nearly \perp so as the direction of pressure.

4) Facility of Dressing:- Stone should be such that they can be dressed easily and economically.

5) Fracture:- For a good building stone, its fracture should be sharp, even & clear.

6) Hardness:- Co-efficient of hardness as worked out in hardness test. It should be > 17 for this stone should be used in road work. It is b/w 14 & 17 the stone is said to be medium. If it is < 14 the stone is said to be very poor hardness & such stones should not be used in road work.

7) Percentage wear:- In attrition test, if wear is more than 3% then the stone is not satisfactory. If it's equal to 3% it is just tolerable. For a good building stone wear should be equal to less than 2%.

8) Resistance to Fire:- Minerals composite stones should be such that shape of stone is preserved when a fire occurs. Failure of stone in case of fire is due to various reasons such as rapid rise in temp, sudden cooling, diff. Co-efficient of linear expansion of minerals. The sand, stone and silicate has binding material can resist a fire in better way. Argillaceous stones are poor in strength. But they can't resist fire quite well.

9) Seasoning:- Stone should be well seasoned before coating into use. Stone obtained freshly from quarry contains some moisture content which is known as quarry sap. Presence of this moisture makes the stone soft. Hence, freshly quarried stones contain quarry sap are easy to work. It is therefore, desired to do design or carving etc.

When stone contains quarry sap, stone should be seasoned or dried before they are used in structural work.

10) Specific Gravity:- For a good building stone the specific gravity should be greater than 2.7.

11) Texture:- A good building stone should have crystalline structure. The stones with such structure the stones with such texture are strong or durable.

12) Toughness index:- In impact test, if the value of toughness index comes below 13 the stone is not tough. If it's comes b/w 13 to 19 the stone is said to be moderately tough. If it's exceeds 19 the toughness of stone is said to be very high.

13) Water absorption:- For a very good stone, % absorption by weight after 24 hr should not exceed 0.6.

14) Weathering:- A good building stone should possess better weathering quality. It should be capable of withstanding, adverse effects of various atmospheric or external agencies such as rain, frost, wind etc.

Purpose of Dressing of Stone:-

Stones, after being quarried are to be cut into suitable sizes & width suitable surface. This process is known as dressing of stone & it is carried out for the following purposes.

- * To get the desired appearance from stone work.
- * To make the transport from quarry easy & economic.
- * To suit the requirements of stone masonry.
- * To take advantage of local man near to quarry who are trained for such type of work etc.

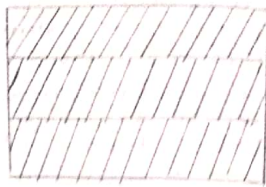
15) Following are the varieties of finishes obtained by dressing of stone.

1) Axed Finish:-

The surfaces of hard stones such as granites are dressed by means of an axed. Such a finish is termed as an Axed finish.

3) Boasted or Dressed finish:-

In this type of finish Boast is used to make a non-continuous 11° marks on the stone surface as shown in fig. These marks are 11° , inclined or vertical. A booster is a chisel having an edge of width about 60mm.



3) Chisel - Draughted margins:-

In order to obtain uniform joints in stone works, margins are placed which may be square or pitched or chamfer form.

4) Circular - Finish:-

In this type of finish, surface of stone is made round or circular as in case of a column.

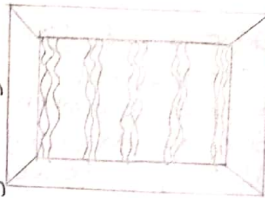
5) Dragged or Combed finish:-

In this type of finish, a drag or a comb, which is a piece of steel with a no. of teeth is rubbed on the surface. In all directions and the surface is shown in fig. is obtained. This finish is suitable for soft stone only.



6) Furrowed Finish:-

In this type of finish, a margin of above 30mm width is sunk on all the edges of stones & the central position is made to project about 15mm and of vertical & parallel grooves about 10mm wide or form on this projected position.



7) Moulded - Finish:-

The surface of the stone can be moulded in any desired shape so has to improve the appearance of the work. The moulding can be made either by hand or machine.

8) Hammer - Dressed Finish:-

In this type of finish, stones are made roughly square, rectangular may means of waller's hammer are shown in figure.



9) Plain - Finish:-

In this type of finish, surface of the stone is made approximately is more with a saw or with a chisel.

10) Polished - Finish:-

The surface of the stones such as marbles, granite etc can be polished either with hand or with machine.

11) Punched - machine:-

On the stone surface, depressions are made by using a punch. Surface of the stones take the form of a series of hollows or ridges.

12) Scabbling Finish:-

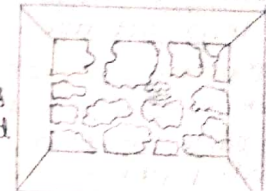
In this type of finish, regular projections are removed with a scabbling hammer & this way. The stones are roughly dressed.

13) Rubbed Finish:-

This type of finish is obtained by rubbing a piece of stone with a surface or by rubbing ^{surface} by using suitable machine. Water & sand are freely used to facilitate the process of rubbing.

14) Reticulated Finish:-

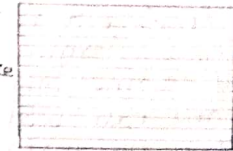
This type of finish presents a net like appearance as shown in fig. A margin about 30mm above white is marking is made the edges of stones & irregular sinking is made on the enclosed.



A margin about 10mm wide is provided around a regular shape is provided at its use put a mark on such sink surface so as to present a peacock appearance.

15) Tooled - finish:-

Is finished by means of chisel and parallel continuous marks either 11° or inclined or vertical or left on the surface as shown in fig.



16) Self - Faced or Rock faced Finish:-

The stones are obtained by the quarry possess smooth surface & they can be directly placed on the work. Such a stone surface is termed as self-faced.

17) Sunk - Finish:-

This finish is obtained by sinking the surface below the original level in the form of wild grooves, chamfers, inclined surface or etc.

18) Vermiculated Finish:-

This finish is similar to reticulated type except the sinking are more curved this finish presents a worm eaten appearance.

Deterioration:- of Stones:-

Stones which exposed faces or acted upon by various atmospheric and external agency, so as to cause they Deterioration.

Following are a causes of Decay of stone.

1) Alternate wetness and Drying:- The stones are may wet by a veries agency such as rain, frost. etc such wet surface is dried by sun shine. It is found that stone subjected to such alternate wetness & Drying wear out quickly.

2) Frost:- In hills stations or very cooled places, moisture presents in the atmosphere is deposited in pores of stones. At freezing point, this moisture freezes and in doing so it expands in volume & causes the splitting of stone.

3) Impurities in atmospheric:- The atmosphere contains various impurities which have adress effect on stone for instance acids & fumes are predominate in industrial towns. This impurities are act as carbonate of lime & cause the deterioration of stones.

4) Living organism:- Some living organism like worms & bacteria act upon stones & deteriorate them.

5) Movement of chemicals:- If stones of different variety such as lime stone & sand stone are used side by side in the same structure, the chemicals formed by the action of atmospheric agency of one variety may move on the other & cause the deterioration of stone.

6) Rain water:- Action of rain water on stones is two fold physical & chemical, the rain wets the surface of the stone & it is dried by sun shine. such alternative wetness & drying results in the deterioration of stone. This is the physical action of rain water.

The rain water as it descends through the atmosphere here to the surface of earth absorb carbon dioxide (CO_2), hydrogen sulphide (H_2S) other gases present in the atmosphere.

This gases act as adversely on stones & they cause decay of stone. This is the chemical action of stone rain.

7) Temperature variation:- Raise of temp results in an expansion of stone. Fall of temp cause contraction of stone. If raise or fall of temp or frequent of temp stones are easily deteriorate.

8) Vegetable Growth:- Certain trees & Creepers of stone surface with their roots joints b/w the stones.

Such root attack moisture & keep the stone surface damp. At a some time they tried to expand such action the accelerate the decay of stones.

9) Wind:- The wind contains fine particles of dust. If it's growing with high velocity, such particles are strike against to stone surface such stone will be decay.

Preservation Of Stones:-

Decay of building stones of interior quality is to some extent, prevented, if they are For this purpose preservatives are applied on the stone surfaces.

- An ideal preservative as the following properties.
- * It doesn't allow moisture to penetrate stone surface.
 - * It doesn't subject objectionable colour.
 - * It hardness sufficiently, so has to resist effects due to various atmospheric agents.
 - * It is easily penetrated in stone surface.
 - * It is economical.
 - * It is non corrosive & arm less.
 - * It remains effective for a long time after a dng.
 - * Its application of stone surface is easy.

Following are the preservative commonly adapted to preserve stone.

1) Coal-Tar:- If coal tar is applied on stone surface it preserve stone but the colour of coal-tar produces objectionable appearance.

2) Linseed-Oil:- This preservative may be used either as raw linseed oil or boil linseed oil but it required frequent reatment usually one in a year.

3) Paints:- An application of paint on stone surface serves as a preservative. The paint change original colour of the stone.

4) Paraffin:- This preservative can used alone it may be dissolve in netha and then applied on stone surface.

5) Solution Of Alum and Soap:- Alum and soft Soap are taken in proportion about 75gm & 50gm resp. -ectivity & dissolve in liter of water. This solution is applied in a stone surface acts like a preservatives.

Bricks:- The common brick is the one of oldest building material & it extensively used a leading material of construction. bc. of the available, reliability, low cost and easy available.

The bricks are obtained mouldable clay in rectangular blocks of uniform size & then by drying & burning this blocks. Thus, ~~the~~ ^{where} places the stones are not easily available, but there is plenty of clay bricks replace stones.

Manufacturing of Clay-Bricks:-

In the process of manufacturing bricks the following 4 operations are involved.

- 1) Preparation of Clay.
- 2) Moulding.
- 3) Drying.
- 4) Burning.

Preparation of clay:-

The clay for brick is prepared in the following order.

- 1) Unsoiling.
- 2) Digging.
- 3) Cleaning.
- 4) Weathering.
- 5) Blending.
- 6) Tempering.

1) Unsoiling:- The top layer of soil, about 20cm in depth is taken out & thrown away. Clay in top layer is full of impurities and hence it is to be rejected for the purpose of preparing bricks.

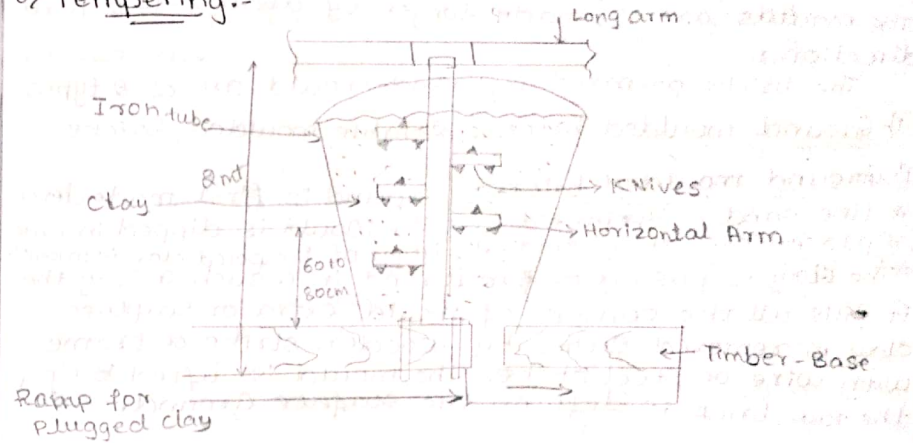
2) Digging:- The clay is then dug out from the ground it is spread on the level ground. The height of heaps. If clay is about 60-120cm.

3) Cleaning:- The clay is obtained from the purpose of digging should be cleaned stones, pebbles, vegetable matter etc. The lumps of clay should be converted into powder form.

4) Weathering:- The clay is then exposed to atmosphere for softening. The period of exposure varies from five weeks to full season.

5) Blending:- Clay is made loose and any ingredient to be added it is spreaded out at its top. The blending indicates mixing. It is carried out by taking small portion of clay every time by turning it up & down in vertical direction. Blending makes fitting for next stage tempering.

6) Tempering:-



In the process of tempering, clay is brought to a proper degree of hardness & it is made next operation are moulden. The H₂O required quantity added to a clay & hole mass is needed knives are pressed under the feed of man or cattle. The tempering is should be done extra.

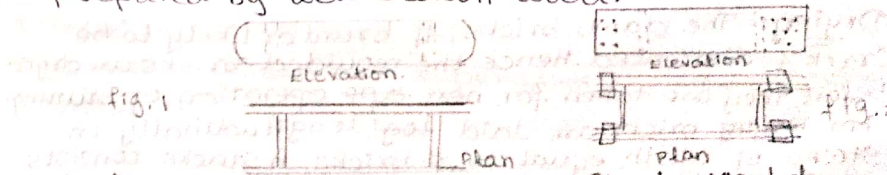
For manufacturing of good bricks on a large scale tempering is usually done in pug mill. this is shown in fig.

Moulding:- The clay which is prepared as above the -n is send for next operation of moulding following are the 2 types of moulding.

- 1) Hand moulding.
- 2) Machine moulding.

Hand moulding:- The moulds are rectangular boxes which are open at top & bottom. They may be wood or steel.

The typical wood mould is as shown in fig. It is prepared by well season wood.



Steel mould as shown in fig. 8.

It is prepared from combination of Steel plates & Channels. They are used for manufacturing of bricks on large scale. The steel moulds are durable than wooden & they turn of bricks of uniform size.

Bricks shrink during dry & burning, hence moulds are to be made larger than size of fully burnt bricks. The moulds are \therefore made longer by about 8-12% in all directions.

The bricks prepared by hand mould are of 2 types.

1) Ground moulded bricks. 2) Table moulded bricks.

1) Ground moulded bricks:- Ground is first made level & fine sand is sprinkled over it. Mould is dipped in water & placed over the ground. The lump of tempered clay is taken & pressed in the mould. The clay is passed or forced in a such a way that it fills all the corners of mould extra or surplus clay is removed either by wooden strike or frame with wire or steel strike. The mould is lifted up & the raw brick is left on the surface ground.

NOTE:- FROG is a mark about 10-20mm which is placed on raw brick during moulding. It serve 2 purpose.

1) It indicates the trade name of manufacturer.

2) In bricks work, bricks are laid with frog upper most. Thus it offers a key for mortar when next brick placed over it.

2) Table moulded bricks:- The process of moulding, this bricks is just similar to above method. But in the case the moulds stands inner the table of size about 1m x 8mt. Clay mould, water pot, stand board, strikers. and pallets boards are placed on this tables. The bricks are moulded on the table & sent for further process of drying.

Machine Moulding:- The moulding may also be achieved by machine. It cross to economical when bricks is huge quantity are to be manufacture at the same spot. It is also helpful for moulding hard & strong clay.

Drying:- The damp bricks, if burnt or likely to be crack & distorted. Hence the moulded bricks are dried before they are taken for next operation of burning. For Drying bricks are laid long longitudinally in

stacks in alternate layers of all bricks are placed a

1) Artificial drying.

2) Circulation of air drying.

3) Drying yard.

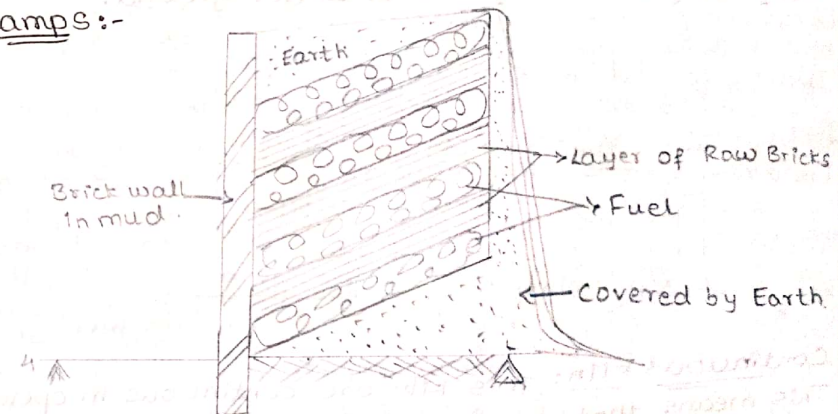
4) Period of Drying.

5) Screens.

Burning:- This is very important operation in the manufacture of bricks. It imparts hardness & strength to bricks & makes them dense and durable, The bricks should be burnt properly. If bricks are over burnt, they will be brittle and hence break easily. If they are under burnt they will be soft. and hence can't carry load.

The burning of bricks is done either in clamps or kilns. The clamps are temporary structure & they are adapted to manufacture of bricks in small scale. Kilns are permanent structure & they adapted to manufacture of bricks in large scale.

Clamps:-



Advantages of clamp bricks.

- * Burning & cooling of bricks are gradual in clamps.
- * Burning of bricks by clamp prove to be cheap & economical.
- * There is considerable saving of fuel.
- * No skilled labour and supervision are required for the construction of clamp.

Disadvantages:-

* Bricks are not in regular shape, this may be due to shatter bricks when fuel near is for burn & turn to ashes.

* It is very slow process.

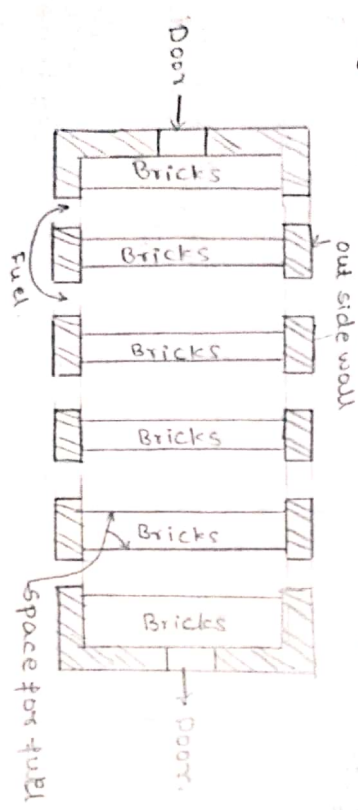
* It is not possible to regulate fire in a clamp.

* Quality of bricks is not uniform. The bricks near the bottom is over burn. Those near sides and top are under burn.

Kilns:- Is a large oven which is used to burnt the bricks. The kilns which one used in manufacture of bricks are of the following 3 types.

- 1) Intermittent kiln.
- 2) Continuous kiln.

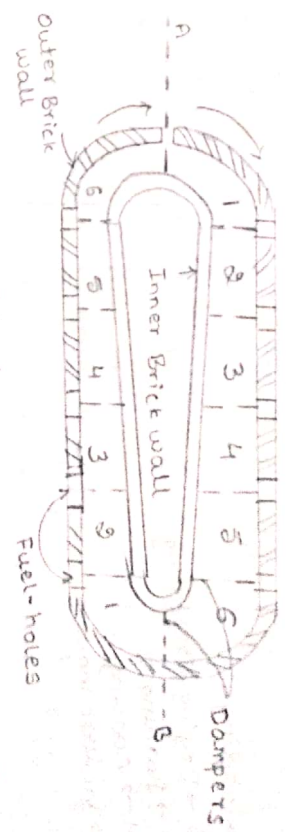
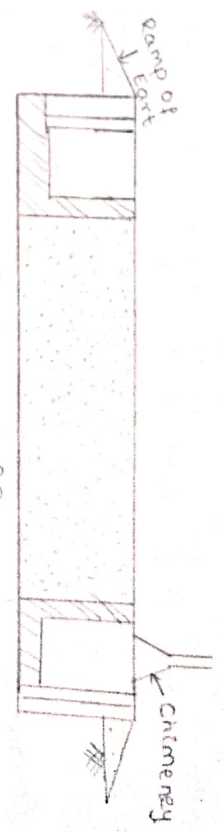
Intermittent kiln:- This kiln are intermittent in operation which means that they are loaded, cooled or unloaded. Such kiln may either be rectangle or circular in plan. They may be over ground or under ground.



Continuous kiln:- This kiln are continuous in operation. This means that loading, firing, cooling and unloading are carried out continuously in this kiln. There are various types of continuous kiln. The following 2 variety are discuss below.

- 1) Bull's - Trench kiln.
- 2) Tunnel kiln.

Bull's - Trench kiln:-



This kiln may be rectangular, circular or

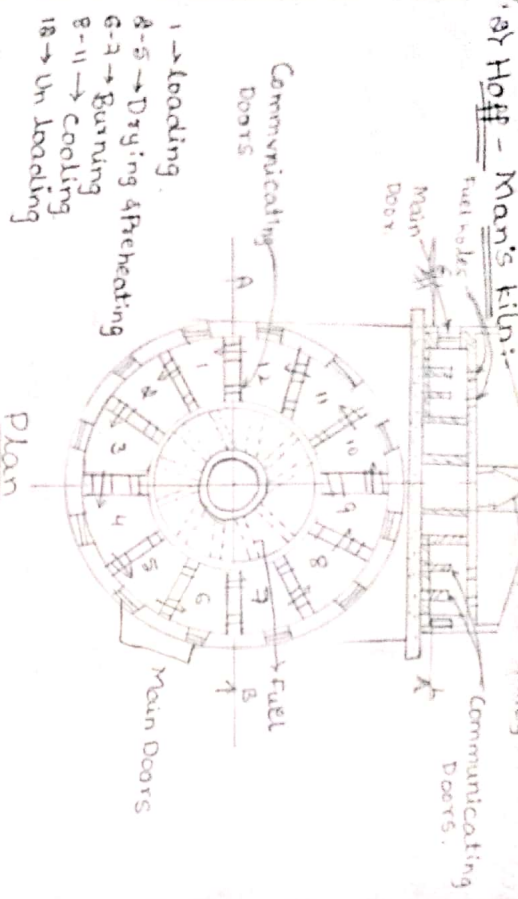
It is contracted a trench excavated in ground. It fully under ground or partially projecting above the ground. In later case ramps of earth should be provided on outside the wall. Outer & inner walls are to be contracted of bricks. The opening are generally provided in the outer wall to acts as fuel holes. The dampers are in the form of iron plates and they are used to devide the kiln in suitable planes.

The bricks are arranged in section, fuel is placed in flues & it is ignited through flue holes after covering top surfaces with earth and ashes to prevent escape of heat. Usually two moveable iron chimney are employed to form draught. This chimney are placed in advance the section being fired. Hence, hot gases leaving the chimney warm up the bricks in next section. Each day section has been burnt, flue holes are closed & it is allowed to cool down gradually.

Fire is advance to next section & chimney are moved forward as shown by arrows.

Bull's trench kiln is working continuous as all the operation loading, burning, cooling or unloading are carried out simultaneously. The section wise process mention above of index.

3) Hoff - Man's Kiln:-



Hoff - Man's Kiln

This kiln is constructed on over ground & hence it is some time known as flame kiln. Its shape is circular in plan & its divided into no. of compartment chamber. The fig. shown plan & section of hoff-man's kiln with 12 chamber. Each chamber is provided due to 1) A main door for loading & unloading of bricks. 2) Communicate door which is act as fuels in open condition.

- 3) A radial flow connected with central chimney.
- 4) Fuel hole covert with drop fuel, which may be in the form of powder into a burning chamber.

- 1 -> Loading
- 2-5 -> Drying & Preheating.
- 6-7 -> Burning
- 8-11 -> cooling
- 12 -> Unloading.

The initial cost of installing this kiln is high but it posses the following advantage.

- 1) Bricks are burn equally & evenly, hence brick are good quality are produce.
- 2) It is possible to regulate the heat inside the chamber through fuel holes.
- 3) Supply of bricks is continuous.
- 4) There is considerable saving in fuel due to pre heating of raw bricks by flue gas.

The capacity of the kiln is depends upon If each chamber is about 12m length, 4.5m average width & 2.5m in height. It will contain above 25000 bricks. Hence if it is should be arrange the one chamber will be unloaded daily such a kiln will manufacture about 25000 bricks every day about 2-9 million bricks annually.

3) Tunnel Kiln:-

This type of kiln is in the form of tunnel which may be straight, circular or It contain a stationary zone of 5. The raw brick are place on trolleys which are then moved from one end to other end of tunnel. The raw bricks get dried and pre-heated as they approach zone of fire. In the zone of fire, bricks are burn to required degree & they are pushed to cooling. When the bricks are sufficiently cool this bricks are known unloading. This kiln proves to be economical, when bricks are to be manufactured on a large scale.

As temp is under control uniform bricks are better quality are produced.

Comparison between clamp burning & kiln burning

Item	Clamp Burning.	Kiln Burning.
1. Capacity	About 20000-30000 bricks can be prepared at a time.	Average 25000 bricks can be prepared per day
2. Cost of fuel	Low as grass, litter etc may be used	Generally high cost dust is to used.
3. Initial cost	Very low, as no structure are to be build.	More as permanent structure are to be constructed.
4. Quality of bricks.	% of good quality bricks is small about 60%	% of good quality bricks is very high upto 90% & above
5. Regulation of fire.	It is not possible to control. Regulate fire during the process of burn.	Fire is under control throughout process of burning.
6. Skilled Supervision	Not necessarily the light the process of burning	continuous skilled supervision is necessary

7. Structure	Temporary	Permanent.
8. Suitability	It is suitable, when bricks are to be manufactured in a small scale.	It is also suitable when bricks are to be manufactured in a large scale.
9. Type of burning & cooling	It required 2-6 month for burning & cooling of bricks.	The actual time for burning of 1 chamber is about 24 hrs. & only about 12 months required to cooling.

Quality of Good Bricks:-

The good bricks which are used for construction of important structure should possess the following quality.

- ⊗ The brick should be table moulded, well burnt in kiln. ^{upto} about copper colour, free from cracks and with sharp & and square shape.
- ⊗ The bricks should be uniform in shape and should be of standard size. [without mortar 9cm x 9cm x 10cm, with mortar 10cm x 10cm x 20cm].
- ⊗ Bricks should give clear ringing sound when struck with each other.
- ⊗ Bricks broken should be homogenous & compact structure.
- ⊗ Bricks should not absorb water more than 20% by weight for first class bricks & 25% by weight for 2nd class bricks. Where the bricks are soaked in a cooled water for a period of 24hrs.
- ⊗ The bricks should be sufficiently hard, no impression should be left on bricks surface when it is scratched with finger nail.
- ⊗ The brick should not break when dropped flat on hard surface ground from a height of 1 meter.
- ⊗ The brick should have low thermal conductivity & they should be sound proof.

Test for bricks (or) Field and Laboratory test for bricks:-

The following are the field & laboratory test are conducted for bricks.

- 1) Compression strength test. (or) Crushing strength.
- 2) Water absorption test
- 3) Efflorescence test.
- 4) Dimension and warpage test.

Compression strength test:-

Crushing strength of bricks are found out by placed in it in compression test machine. It is compressed till it is break. As per IS-1077:1970, the min. crushing strength of brick is 3.5 N/mm². The brick with a crushing strength 7 N/mm² upto 14 N/mm² are graded as class A. Brick. And those the bricks having above 14 N/mm² are graded a CLASS "AA".

Water absorption test:-

A brick is taken & ~~it~~ it weigh and Dry. It is can immersed in water for a period of 60hrs - 24hrs. It is weighted again & the diff in weight indicate the amount of water absorb by the brick. It should not exceed 20% by the weight of brick.

Efflorescence test:-

If soluble salt if present in bricks, will cause efflorescence on the surface of the bricks. For finding out the presents of soluble salts in brick, it is immerse in water in 24hrs. & it is taken out allowed to Dry in shade. The absence of gray or water white

If the white deposit above 10% surface area, the efflorescence said to slight. If it's 30% it is said to be moderate. & if it's more than 50% it is said to be heavy & it is treated as seriously. When such deposits are converted into powder powder form.

Dimension & Warpage test:-

In this test the brick is closely inspected & it should be as standard size & it's shape should be truly rectangular with shape edges. For this purpose 20 bricks of standard size: 90mm x 90mm x 190mm are selected at randomly & they are stacked lengthwise along the width & along the height in equal number.

bricks, the results can be within the following permissible limits.

Length \rightarrow 3680mm to 3920mm.

Width \rightarrow 1740mm to 1860mm.

Height \rightarrow 1740mm to 1860mm.

Classification of Bricks:-

Bricks can be divided into 2 categories

- 1) Unburnt or Stone Sun Dried Bricks.
- 2) Burnt bricks.

Unburnt bricks:- These bricks are dried with the help of heat received from sun after the process of moulding. These bricks can be used in the construction of temporary structure.

Burnt Bricks:- These bricks are used in construction are burnt bricks & they are classified into following 4 categories.

1) 1st class bricks.

2) 2nd class bricks.

3) 3rd class bricks.

4) 4th class bricks.

First class bricks:- These bricks are table moulded & standard shape. The surfaces & edges of the bricks are sharp, square and straight. They comply completely with all the qualities of good quality which are mentioned earlier. These bricks are used for superior quality of permanent structure or nature.

Second class bricks:- These bricks are ground moulded, these are burnt in kilns. The surface of the bricks is rough & shape is also slightly irregular. These bricks are used in a place where bricks works to be provided with a coat of plastic.

3rd class bricks:- These bricks are ground moulded & they are burnt in clamps. These bricks are not hard & they have rough surfaces & with irregular & distorted.

These bricks are fit for unimportant construction

4th class bricks:- These are over burnt bricks with irregular shape & dark in colour. These bricks are used as aggregate for concrete foundation floors and roads etc.

Cement Concrete blocks:- The concrete offers flexibility in production which is not there in brick manufacture. The brick manufacture comes to a grinding halt during the monsoon, while concrete block making carried out throughout the year. The investment needed by the way of land & capital is much less for concrete block manufacture compared to bricks making.

Classification of Concrete blocks.

1) Hollow concrete blocks (Open & closed cavity type)

These blocks are classified by IS into a following 3 grades.

a) Grade A:- These blocks are used for load bearing walls. They should have min. specific compressive strength of 7.0 N/mm^2 in 28 days & they should have a min. density of 1500 kg/m^3 .

b) Grade B:- These are also used for load bearing walls. They should have min. specified compressive strength of 2.0, 3.0, ... 5.5 N/mm^2 in 28 days & should have a density below 1500 kg/m^3 .

c) Grade C:- These are used for non load bearing walls. They are made for specified strength of 1.5 N/mm^2 in 28 days & its density should not be less than 1000 kg/m^3 .

2) Solid Concrete blocks:- These blocks are used as load bearing walls. They are manufactured for a specific compressive strength of 4.0 to 5.0 N/mm^2 in 28 days. They should have density not less than 1800 kg/m^3 .

3) Paver blocks:- These blocks are solid concrete blocks of various shape specially made for exterior ground pavement, driveway, parking lots, industrial floors, petrol pumps etc.

Manufacturing of Concrete blocks.

1) The concrete mix for concrete block should not be richer than 1 part of cement 1 part of volume of aggregates.

- 1) Berco of Indian standard recommends a finer modulus of up to the combined aggregates blw 3.6 to 4.
- 2) 60% of fine aggregate, 40% of coarse aggregate is the mixed recommended and coarse aggregates of 6:12 is generally used.
- 3) Blocks can be man made or machine made or a simple machine can be made upto 1600 block in at 8 hrs shift.
- 4) The cost blocks are cured in a water tank for atleast 14 days. when immersed in tank the H₂O shall be change atleast for every 4 days.
- 5) After the curing the blocks are dried for a period of 4 days before being used on work. The blocks can also be steel cured & dried. This process allows the complete shrinkage of the block to take place before they are laid on the wall.
- 6) Freshly made & uncured concrete blocks can't be used for construction.

Dimension and Tolerance:-

Normal size of concrete blocks are,
 Length: 400, 450, 500 or 600mm.
 Height :- 100 to 200mm.
 Width :- 50, 75, 100, 150, 200, 250 or 300mm.

The actual size will be less by 10mm, that is mortar thickness. The maxi. variation allowed is ± 5 mm in length and \pm in height and width.

Advantages of Concrete blocks:-

- 1) The concrete blocks usually made large in size, so that the block work is faster & consumes less cement in joints than the brick work.
- 2) The special made hollow blocks are used for load bearing walls, such works are useful in reducing the dead load of masonry in building.
- 3) Manufacturing of blocks can be carried out throughout the year.
- 4) The invest needed by the way of land & capital is much less where compare to bricks

Disadvantages:-

- 1) The main disadvantage of concrete block is shrinkage due to movement of moisture which is absent in bricks.
- 2) Blocks are much larger in size than bricks any fundation movement will cause block work to crack more than bricks works.
- 3) Blocks which are in cured for 14 days & dried for 4 weeks can only be used for construction works.
- 4) Ordinary unrefined block work in wall is very week for resisting lateral load.

Stabilized Mud Blocks:-

The block manufacture by stabilized mud [soil] is called as stabilized mud blocks.

Concepts:-

When a soil or soils are compacted using external energy. The density of soil reaches a max. value of moisture content known as the optimum moisture content [OMC].

The value of OMC & max. density depends on the energy input during compaction. The compressive strength of soil in dry state depends on the density. Thus the process of mechanical compaction can lead to densification & strengthening of a soil. A stabilized mud blocks technology. The stabilization is achieved by a compaction of densification & mixing of stabilizing additive. A variety of stabilized material can used for stabilization may be cement, lime, bitumen bitumen.

Raw materials used:-

The soil containing 10-15% of clay & 65-75% of sand is satisfactory. The cement may added to a tune of 6-8% by weight of soil. In case of soil having high clay content sand or sandy additive like "quartz material" or "quartz dust" may be added to correct the grading of the soil. A combination of cement or lime can also be used as a stabilizer.

Manufacturing

- 1) Sieve the soil in 4mm sieve to remove stones & lumps of clay.

- 3) Mix sand of quarry dust to correct clay sand % in the soil.
- 3) Add cement or cement & lime or cement in appropriate proportion & mix thoroughly in the dry condition.
- 4) Sprinkle moisture of the mixture & further mix thoroughly & the mixture is then homogenous. Test for optimum moisture by trying to make a wall of the soil in hand. If ball can be made without the soil sticking to the hands the moisture content is rise.
- 5) weigh the correct amount of moistened soil such that a fresh density of 2.05 g/cc can be achieved the weight depends on the volume of the finished block.
- 6) The weighed soil is pored into a soil compaction press like mardini.
- 7) The weighing soil is now pored into a soil compaction test like mardini.
- 7) The block is now pressed by operating the toggle lever after closing the lid.
- 8) The lid may be open & the blocks are ejected by again using the same lever.
- 9) The ejected blocks is then staked in a frame of six blocks high stack for curing.
- 10) The blocks are sprinkled with water & pressed upto 21 days. To complete the block making process

The typical size of blocks are

$230 \times 190 \times 100 \text{ mm}$

or $305 \times 143 \times 100 \text{ mm}$.

Requirements of Good blocks:-

- 1) The blocks should have sufficient compressive strength to with stand the load.
- 2) It should have standard size & dimension.
- 3) It should be cheap & economical.
- 4) The block should have required density.
- 5) The block should be adequately cure & cool.

Mortar :-

The mixture of binding material & fine aggregate & water will required proportion is called a mortar. The mortar can be classified on the following bases.

- 1) Bulk - Density.
- 2) Kind of Binding material.
- 3) Nature of Application.
- 4) Special mortar.

Bulk - Density:- According to the bulk density of mortar in dry state or condition. There are 2 types.

- 1) Heavy mortar.
- 2) Light weight mortar.

1) Heavy mortar:- The mortar having bulk density of 15 kN/m^3 and more are known as heavy mortar. The fine aggregates of this type of mortar is manufacture from heavy quartz & other sand.

2) Light weight mortar:- The mortar having bulk density less than 15 kN/m^3 are known as light weight mortar. They are prepared from pumice & other fine aggregates having less density.

Kind of Binding materials:-

It can be classified into 1) lime mortar
2) Surki mortar 3) Cement mortar 4) Grauge mortar
5) Gypsum mortar.

1) Lime mortar:- In this type of mortar lime is used as a binding material. It may flat lime or hydrolic lime. The lime mortar has a high plasticity & it can be placed easily. It posses high cohesionness with other surfaces & sprinches is very little. It is sufficiently durable but it harden slowly. It is generally used for lightly loaded above ground parts of the building.

2) Surki mortar:- This type of mortar is prepare by using fully surki instead of sand or by replacing half of sand. The Surki mortar is used for ordinary massonary work of all kinds in fundation & super structure. But it cannot be used for

pointing & plastering, since it is likely to disintegrate after some time.

3) Cement mortar:- In this type of mortar cement used as a binding material. It should be noted surkhi & Ginder are not chemical inert substance, hence cannot be used with cement. Thus, sand only can be used in cement mortar. Cement mortar is used, where mortar of high strength & water resisting properties is required.

4) Gauge mortar:- To improve the quality of lime mortar & active ~~cast~~ early strength of the cement is some times added to it. This process is known as Gauge. It makes the lime water economical, stronger & denser. The usual proportional of cement to lime by volume is above 1:6 or 1:8. It is also known as composite or lime cement mortar.

5) Gypsum mortar:- This mortar are prepared from Gypsum binding material such as building gypsum.

Nature Of Application:- According to the Nature of application mortar is classified into 2 categories. i.e.,

1) Brick laying mortar 2) Finishing mortar.

1) Brick laying mortar:- The mortar for brick laying are intended to use for brick work & walls.

2) Finishing mortar:- This mortar include common plastering work & mortars for developing architectural or ornamental effects & aesthetic views.

Special mortar:- It can be classified into

- 1) Fire resistance mortar 2) Light weight mortar.
- 3) Packing mortar 4) Sound absorbing mortar.
- 5) X-Ray Shielding mortar.

1) Fire resistance mortar:- This mortar are prepared by adding aluminous cement to the finely crushed & powdered fired bricks. The use of proportion is one part of aluminous cement to 2 parts of powder of fire bricks. This type of mortar is used along with the fire bricks for lining furnace fire places, oven etc

2) Light weight mortar:- This mortar is prepared by adding material such as wood powder, jute fibres coils etc. This mortar are used in the sound & heat proof of construction.

3) Packing mortar:- To pack oil wells the special mortar possessing a high homogeneity, water resistance, ability to form solid water proof in plugs in cracks & voids of rocks etc are to form. The varieties packing mortar includes cements & loam, cement loam & sand.

4) Sound Absorbing mortar:- To reduce the noise level the sound absorbing plaster is form. The density of such mortar varies from 6-12 kN/m³. The binding materials employed by port land cement, lime, gypsum etc. The aggregates are formed from light weight porous materials such as pumice, Gindres etc

5) X-Ray shielding mortar:- This type of mortar is used for providing the plastering coat to walls & ceilings of x-ray cabinets. It is a heavy type of mortar with bulk density over 22 kN/m³. The aggregates are obtained from heavy rocks & suitable admixtures are added to enhance the protective property of such mortar.

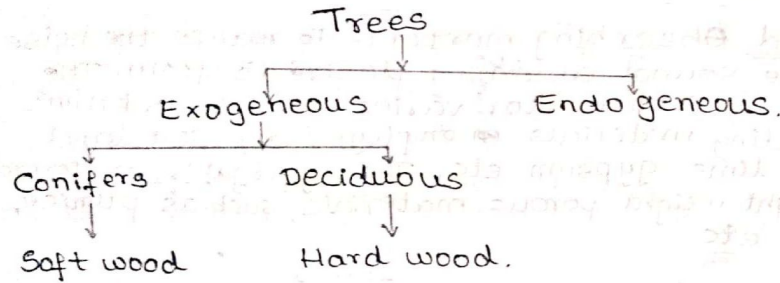
Requirement of good mortar:-

- * It should be capable of developing good adhesion with the building such as
- * It should be capable of resisting penetration of rain water.
- * It should be cheap & economical.
- * It should durable.
- * It should be easily workable.
- * It shouldn't effect the durability of materials with which it comes into contact
- * It should set quickly so that speedy construction is achieved.
- * The joints formed by mortar should n't develop any cracks.

Timber:-

The timber denotes wood which is suitable for building or carpentry or various other engineering work purposes and it's applied to the trees measuring not more than 6mm "grith" or circumference of the "trunk"

The classification of timber is as shown in fig.



Exogeneous:- This trees are increases in bulk by growing outwards & distinct conjugative rings are form in the horizontal section of such a tree. This this rings are known as "annual rings," because one such ring is added every year. & This rings are useful in predicting age of the tree. Most of the trees are used in enggi purpose is obtained from this category of tree.

This exogeneous trees further sub divided into 2 groups. 1) Conifers 2) Deciduous.

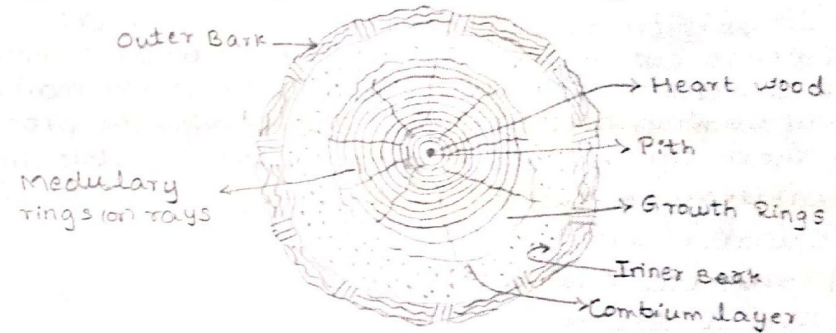
Conifers:- This trees are also known as evergreen trees. As these trees bear cone shapes fruits, it's called as conifers. This trees yields soft woods which are generally light in weight & weak. They show distinct annual ring.

Deciduous:- This are also known as the broad leave trees. The timbers for engg. purpose is most derived from deciduous trees. These tree yield hard wood which are usually closed grained, strong, heavy & durable. They donot show distinct annual rings.

Softwood and hard wood:-

The wood obtained from Conifer class of tree is soft wood & that obtained from broad leave tree as called as hard wood. It is quickly like some variety of soft wood may prove to be stronger than some variety hard wood.

Structure of Exogeneous trees:-



Processing of timber:-

Following are the 4 stages of processing of timber.

- 1) Felling of trees.
- 2) Seasoning of timber.
- 3) Conversion of timber.
- 4) Preservation of timber.

Felling of trees:- The trees have to fell on to the ground in order to obtained the timber. The tree should be felled when they have reached near to the maturity. The heart of the wood starts decaying if it is felled after maturity & sap wood would be in excess, if feled before attainment of maturity. The age for felling of good trees varies from 50-100 years. The fe trees should be feld the sap is at rest

Seasoning of timber:- when is newly felled tree it contains about 50% or more of its own dry weight of water. The water is to be removed before the timber is use for any Engg. purposes. This process of dring of a timber is known as seasoning of timber. The moisture should be extracted in season-ing under the controled condition as nearly as

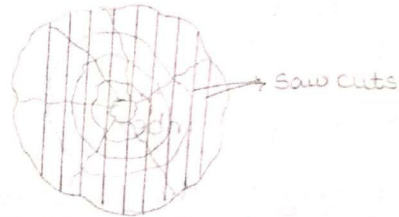
possible at a uniform rate from all parts of timbers. The natural seasoning is carried out by natural air & hence it is some times referred as air sea-soning. And for this purposes the timber is stop-ped under roof with open spaces & free air is allowed to circulate. The various methods of artificial seasoning are boiling, kiln seasoning, water seasoning, chemical seasoning and Electrical seasoning.

3) Conversion of timber:- The process by which the timber is cut & saw into suitable section is known as conversion. For this purpose the power machines may be employed at different stages of process. There are 4 types of sawing are as following

- a) Ordinary or flat or slab sawing.
- b) Quarter sawing.
- c) Tangential sawing.
- d) Radial sawing.

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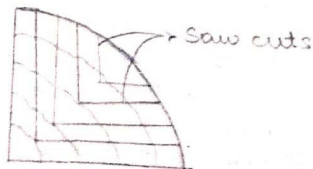
a) Ordinary or flat or slab sawing:-



Ordinary - Sawing

In this type the saw cuts are tangential to the angular rings and write through the cross section of the timber piece. This is very quickly & easy method of sawing and widely adapted in our country. It is also the most economical method & the wastage is minimum.

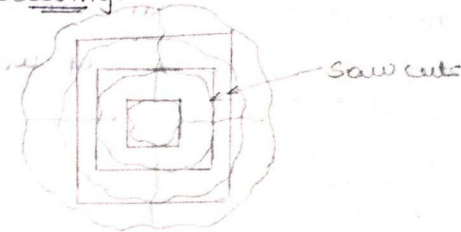
b) Quarter Sawing:-



Quarter Sawing

The saw cuts are at right angles to each other. It produces fine figures when adapted in case of timber having distinct medulary rays.

c) Tangential Sawing:-



Tangential Sawing:

The saw cuts are tangential to the annual rings and they meet each other at right angle. This meth-od is adapted when the annual rings are very distinct and medulary rays are not clearly defined.

d) Radial Sawing:-



The saw cuts are made radially in a para-llel direction to the medulary rays. This method is used for the conversion of hard timber. It gives wood with decorative effects. The timber obtained by this method shrinks and waps to be less degree and it is distorted to the minimum, but the wastage is maximum & the cost sawing proove-s to be higher. and cost sawing prooves to be higher.

4) Preservation of timber:-

In order to increase the life of the timber it as to be protected from the attack of fungi, insects etc. This process is known as Preservation of timber. The most commonly used preservatives are codtar, oil paint etc.

Market forms of timber:-

The following are the various forms of converted timber.

1) Batten:- This a piece of timber in which breath & thickness don't exceeds 50mm.

2) Board:- It is a plank, the timber of pieces with parallel size. Its thickness is less than 50mm & width exceeds 150mm.

3) Plank:- It is a timber pieces with parallel sides. Its thickness is less than 50mm.

4) Pole:- It is a long log of wood. Its diameter don't exceed 230mm.

5) Scantling:- It is a timber piece - whose breadth & width is not exceeds 50mm but the length of is less than 200mm.

6) Quartering:- It is a square piece of timber, the length of the side being 50mm to 150mm.

MODULE - 2

Foundation