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# Construction Material Subject Notes

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# CONSTRUCTION MATERIALS (CMA) (17209)

**Course Name : Civil Engineering Group**

**Course Code : CE/CS/CR/CV**

**Semester : Second**

**Subject Title : Construction Materials**

**Subject Code : 17209**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	03	100	--	--	--	100

**NOTE:**

- Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.
- Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)

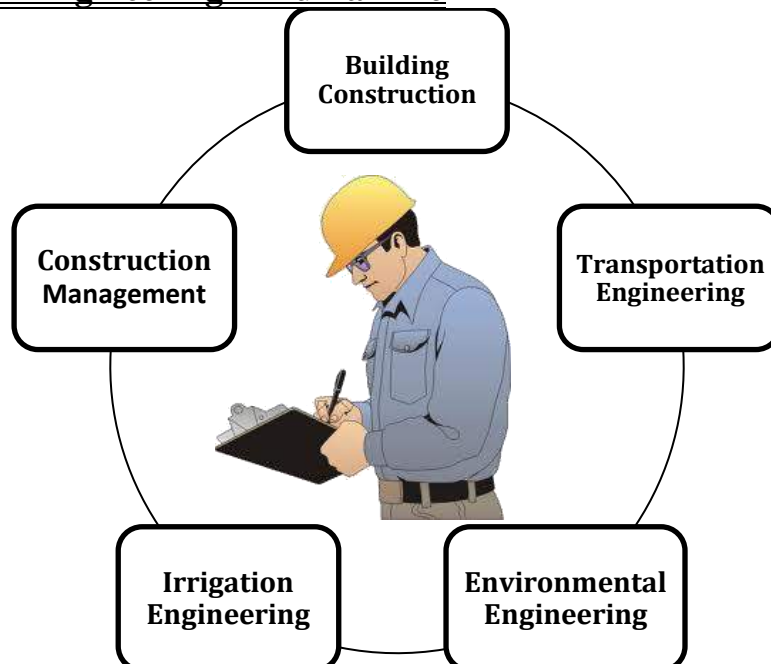
## Chapter –1: Overview of Civil Engineering

**Marks -08**

### Contents:

- [1] Role of Civil Engineering in human life - Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering, Construction Management. (applications only)
- [2] Criteria for Selection of construction materials on the basis of carrying prescribed load, serviceability, aesthetically pleasing, economical, environmental friendly.
- [3] Broad classification of materials – Natural, Artificial, Special, Finishing and Recycled construction materials.

### Role of Civil Engineering in human life –



### **A. Building Construction:**

For any type of building projects like commercial, residential, hospital, industrial & townships constructions, following types of role performed by the civil engineer;

- 1) Civil engineer has to prepare the layout of the proposed construction site
- 2) To prepare the construction site plan & send for approval.
- 3) Civil engineers has to involved in the planning, designing in the construction project.
- 4) To find out the foundation details of the proposed site & also prepare investigation reports.
- 5) To prepare the net estimation cost of the construction & sanction its budget.
- 6) To involve in the lab testing, planning, supervision & execution of the proposed site.
- 7) He could also acts as an arbitrator job.
- 8) In case of big project, he could also play an important role in the operation & maintenance.

### **B. Transportation Engineering:**

The role of civil engineers in transportation engineering is discussed point wise as follows;

- 1) Civil engineer performs the work to move the goods & people from one place to another place safely & efficiently.
- 2) Remote areas & rural areas become accessible & communicable connected by transportation engineering.
- 3) Civil engineers could design, construct & maintains all the types of transport facilities like highways, railway tracks, airports & marine ports etc
- 4) They are also involved in the construction of bridges & tunnels of highways & railways.
- 5) They also deal with the traffic management operation & controlling system of streets & highways in which traffic makes smooth.
- 6) They also fix the sign & symbol boards like emergencies like hospitals & police stations, hotels, villages or city names at a certain km distance of highways.

### **C. Environmental Engineering:**

The role of civil engineers in the environmental engineering is discussed as follows;

- 1) Water supply – Civil engineers perform the work including design, planning, construction of dams & water treatment plants from water supply from rivers, lakes, bore wells etc to the cities.
- 2) Sanitary system – Civil engineers also perform the work for sewage water management of domestic & industrial waste treatments by constructing pipelines. After treatment on sewage water that becomes less harmful.
- 3) Environmental Pollution – Civil engineers also perform the role for construction & designing the structure which controls the water pollution, air pollution, soil pollution, sound pollution & thermal pollution so on.

- 4) **Solid waste management** - Civil engineers also perform their duties for controlling & managing the garbage waste materials from the town, street wastes, hotel & hospitals wastes with proper disposal systems.

#### D. Irrigation Engineering:

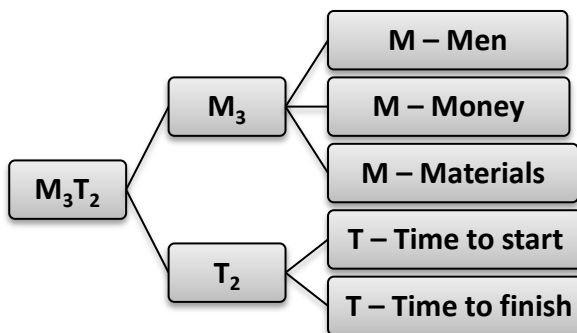
The role of civil engineers in irrigation engineering is discussed as follows;

- 1) Civil engineers can perform the work for the designing & constructing the dams, canals, weirs & barrage system of water supply for the agricultural sectors.
- 2) Ground water storages can also developed by the civil engineers by constructing the percolation tank.
- 3) They could also develop the rivers streams for required sides.
- 4) Irrigation engineering is also used to for the purpose of crop cultivation & for drinking & industrial use.
- 5) They also perform the work with the development of water resources & buildup the proper arrangements of distribution of water.
- 6) Irrigation engineering also deals with the sprinkler system, trickle systems, streams & dripping systems of water conveyor to the farms & agricultural land.

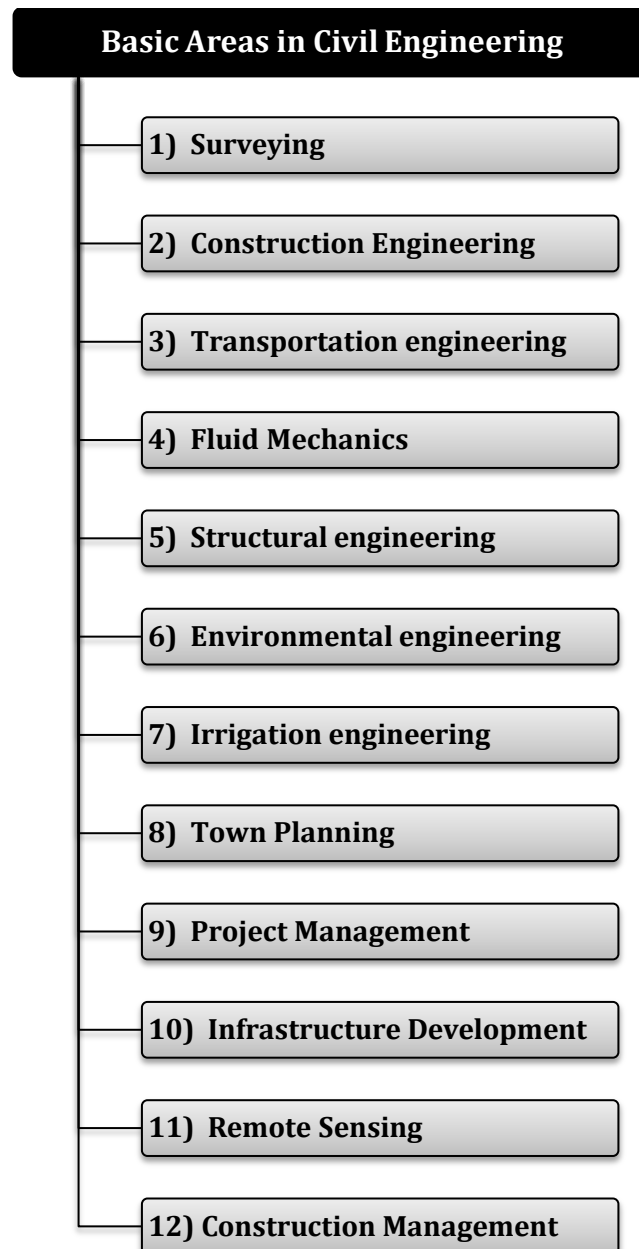
#### E. Construction Management:

The role of civil engineers in the construction management is discussed as follows;

- 1) Civil engineer acts as construction manager, architect, developer, designer of the structures.
- 2) The main role of civil engineer is to survey the site, specifying the scope of the projects.
- 3) They also specify the projects objectives, selecting the project partners & pan out the budget of the projects.
- 4) They can also developing the effective communication, good relations & also resolve the clashes.
- 5) Civil engineer also plays a role of  $M_3T_2$  in construction field; means



- 6) Civil engineer involves in every activities in the construction field like procurement of materials & equipments, site layout, starting schedule, workers requirement etc

**Basic Areas in civil Engineering:**

**Dr. Ravindra Dhivare**

### Criteria for Selection of construction materials –

- 1) **On the basis of carrying prescribed load** – The material should have sufficient strength to carry the prescribed load for building material
- 2) **Serviceability** – serviceability refers to the conditions under which the building is still considered for the use. It should be cost effective serviceable materials used, maintain depot, store houses, warehouses, solid materials without developing cracks, defects, tested materials & so on
- 3) **Aesthetically pleasing** – The materials to be used for the construction purposes should have pleasing appearance. These materials are pleasurable, aesthetics involves all our senses like vision, hearing, touch, taste, smell that are pleasurable for our emotions, commodity, firmness, delight building abilities
- 4) **Economy** – The construction materials should be economical for the transport cost, heavier materials greater is the transport cost, purchase cost, life long , without maintenance etc
- 5) **Environmental friendly** – The construction materials should be eco-friendly. It should not have the leakages, chemicals, gas emissions, volatile organic compounds, toxic, irritating, hazardous compounds. Finally they give better environmental performance.

### Broad classification of materials –

- 1) **Natural materials** - The materials which are obtained from natural sources like earth, plants, and animals are called natural materials.  
*Eg. Stone, timber, bitumen, lime, soil etc*
- 2) **Artificial materials** – The materials which are produced in the industries by chemical or mechanical processes are called artificial materials.  
*Eg. Bricks, tiles, cement, precast concrete, plywood, glass, plastic etc*
- 3) **Special materials** – The materials which are produced for special purposes like waterproofing, sound proofing, damp proofing, thermal insulating are called special materials.  
*Eg. Fibers, ferroconcrete, artificial timber, adhesives, epoxy, geo-synthetic, ceramic materials*
- 4) **Finishing materials** – The materials which are produces for the use of finishing purposes of building constructions are called finishing materials.  
*Eg. Lime mortar, cement mortar, special mortar, Plaster Of Paris, paint, distemper, varnishes, cladding materials, linoleum etc*
- 5) **Recycled construction materials** – The materials which are recycled from the waste construction or destruction are called recycled materials.  
*Eg. Rich husk, baggage, coir fiber, straw, coconut tree trunk, plastic waste, polymer waste, rubber waste, coconut leaves, fly-ash, blast furnace, slag, granite, marbles, polishing wastes*

**Civil Engineering –**

It is the branch of engineering which deals with planning, designing, estimating, execution & maintenance of various structures like buildings, roads, railways, airports, dams, canals, tunnels, bridges, docks, harbors, water supply & sanitary units so on.

**Structural Engineering –**

It is the branch of civil engineering which deals with planning, designing & construction of various structures like buildings columns, beams, slab, footings etc.

**Environmental Engineering –**

It is the branch of engineering which or the basic area of civil engineering which deals with water supply, disposal of waste water from domestic & industrial use & environmental pollution control, sanitizing as well as garbage waste management.

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**Contents:**

[1] 2.1 -----(12)

- **Stone** – Physical Classification of rocks; Requirements of good building stone, characteristics of stone, Quarrying and dressing of stone
- **Timber** – Timber as construction material, structure of timber, properties of good timber, seasoning of timber, defects in timber.

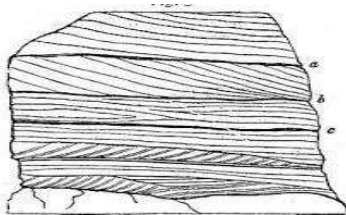
[2] 2.2 -----(12)

- **Bituminous materials and mixtures:** Terminology, different types of asphalt, bitumen, tar used in Civil Engineering works, their properties and uses
- **Lime** – Manufacture of lime, classification, field slaking of lime and properties of lime
- **Soil** –terminology- sand, silt, clay and their suitability in construction work

**Stone –****Physical Classification of rocks**1) **Stratified Rocks** –

These types of rocks possess plane of stratification & they can easily be split up along these planes.

Eg. Sedimentary rocks

2) **Un-stratified Rocks** –

These types of rocks does not possess plane of stratification & they crystalline granular or compact granular.

Eg. Ingenious rocks

3) **Foliated Rocks** –

These types of rocks have a tendency to split up in definite direction only&having foliated structure.

Eg. Metamorphic rocks





### Requirements of good building stone:-

- 1) **Crushing** – A good building stone should have better crushing strength i.e. greater than  $100 \text{ N/mm}^2$
- 2) **Hardness** - A good building stone should have sufficient hardness.
- 3) **Durability** - A good building stones must be durable long lasting nature.
- 4) **Fire resistance** - They should have good fire resistance properties.
- 5) **Seasoning/weathering** - They also have good weathering resistance properties.
- 6) **Water resistance** - They should have less water absorption properties.
- 7) **Economy** - They should be economical & easily available.
- 8) **Attrition** – A good building stone should have less wear & tear, abrasion & erosion properties.
- 9) **Facing & dressing** – A good building stones should be easily molded, craved & dressed.
- 10) **Specific gravity** - A good building stone should have higher specific gravity i.e. more than 2.7.
- 11) **Texture** – The structure of the good building stone should be compact fine crystalline. They don't have any cracks, cavities & patches.
- 12) **Toughness** - A good building stone should have strong&tough.

### Characteristics of stone:-

- 1) **Appearance** – Stones should have fine, compact texture & uniform colour.
- 2) **Structure** – the structure of stones should be uniform without cracks, fractures, cavities etc.
- 3) **Strength** - stone should have better crushing strength i.e. greater than  $100 \text{ N/mm}^2$
- 4) **Weight** – The weight of stones should be considerable & suitable for various construction sites.  
Eg. For dam & retaining walls – heavy stones are used  
For domes, arches – light stones are used
- 5) **Hardness** - stones should have sufficient hardness
- 6) **Toughness** - stone should have strong&tough
- 7) **Specific gravity** - stone should have higher specific gravity i.e. in between 2.3 to 2.5.
- 8) **Seasoning** – stones should be well seasoned
- 9) **Workability** – Stones should be workable for cutting, dressing with required shapes.
- 10) **Chemical resistance** – Stones should resist alkalis, acids, corrosive gases etc
- 11) **Durability** - stones should be durable long lasting nature
- 12) **Water resistance** - stones should have less water absorption properties

### Quarrying and dressing of stone

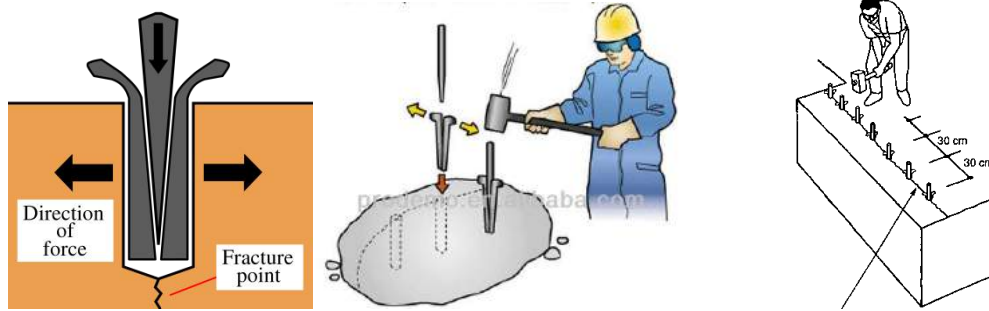
#### Quarrying of stones:

The method of removal of stones from their natural bed by using different operations is called quarrying.

Methods of Quarrying –

- a) **Digging** – This method is used when the quarry consists of small & soft pieces of stones.
- b) **Heating** – This method is used when the natural rock bed is horizontal \* small in thickness.

- c) **Wedging** – This method is used when the hard rock consists of natural fissure. When natural fissures are absent then artificial fissures are prepared by drilling holes.

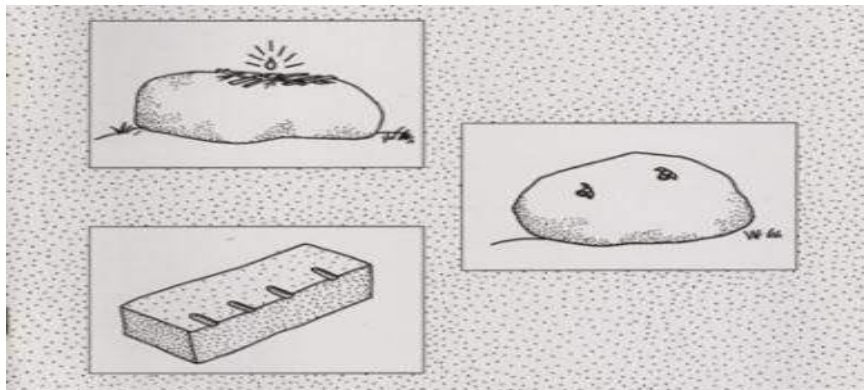


Wedging required tools –

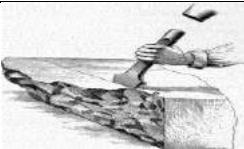
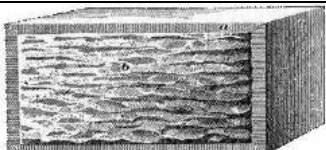
- i) Steel wedge
  - ii) Conical steel pin or plug
  - iii) Flat steel wedge
  - iv) Wooden plug
  - v) Pneumatic drill
- d) **Blasting** – It is the process of removal of stones with the help of controlled explosives is filled in the holes of the stones. Line of least resistance plays very important role in the blasting process.



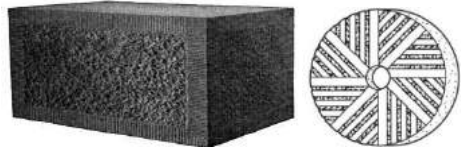

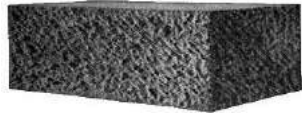
Following steps are used in the blasting process;

- 1) **Drilling holes** – Blast holes are drilled by using drilling machines.
- 2) **Charging** – Explosive powders are fed into the cleaned & dried blast holes.
- 3) **Tamping** – The remaining portion of the blast holes are filled by clay, ash, fuse & wirings.
- 4) **Firing** – The fuses of blasting holes are fired by using electrical power supply or match sticks.



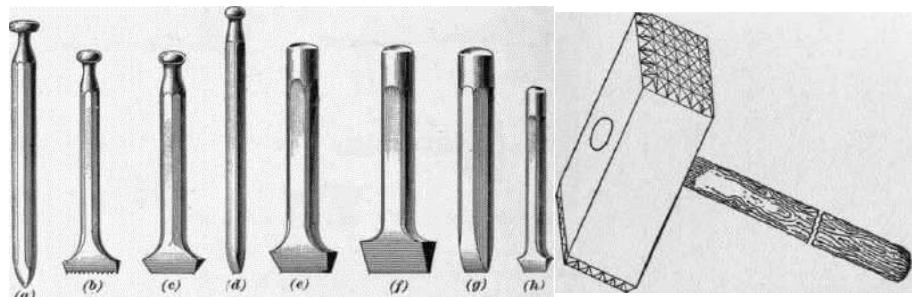
### Dressing of stones:-

<p>1) <b>Rough dressing quarry</b> - It is the process of stone dressing which gives the broken stones in to the suitable pieces the shapes &amp; sizes.</p>	
<p>2) <b>Pitched face dressing</b> - It is the process of stone dressing which gives the same plane &amp; square of the surface</p>	

3) <b>Hammer dressing</b> - It is the process of stone dressing which gives the sharp less irregular corners of the surface distance by using hammer. It is suitable for mensory work.	
4) <b>Rock face dressing</b> - It is the process of stone dressing which gives the four edges having 2.5 cm surface distance by using chisels.	
5) <b>Rough tooling</b> - It is the process of stone dressing which gives more or less parallel, horizontal, vertical at angle 45° of the surface.	
6) <b>Punched dressing</b> - It is the process of stone dressing which gives the parallel ridges with required gaps between the surfaces.	
7) <b>Fine tooling</b> - It is the process of stone dressing which gives the fine & smooth surface of the stones	

### Stone dressing tools:-

- 1) Mason's hammer
- 2) Spacing hammer
- 3) Scabbing hammer
- 4) Club hammer
- 5) Soft stone chisel
- 6) Claw chisel
- 7) Punching chisel
- 8) Point chisel
- 9) Drafting chisel
- 10) Pitching tool



### Timber –

It is refers to wood which is used for the construction works.

### Used as a construction materials:

#### Advantages of timber as a construction material –

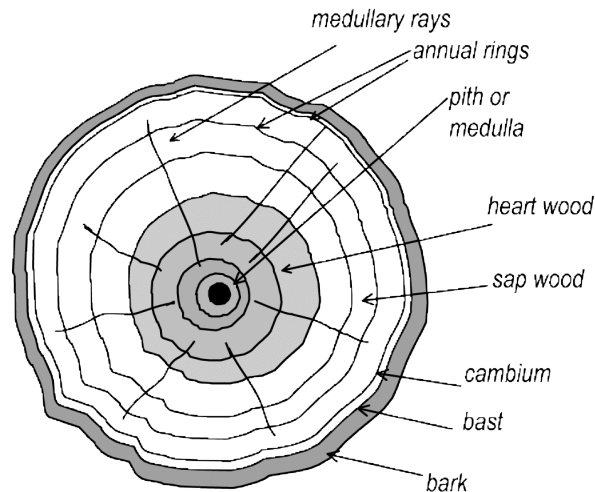
- 1) Timber can be easily handled, pained & joined with simple tools of carpenter.
- 2) It has a massive appearance for the heavy constructions.
- 3) It is quite durable if properly protected against moisture, rain, insects etc
- 4) It is easy to provide the connections in the timber construction.

#### Uses of timbers as a construction material –

- 1) It is used for making doors & windows
- 2) Also used for making furniture & sport goods

- 3) For roofing material
- 4) Making railway sleepers
- 5) It also used as frame work & centering materials
- 6) It is also used for construction of temporary bridges.
- 7) It is also used for engraving works
- 8) It is used for making small houses at a place of heavy snowfall

### Structure of Timber / Cross section of trunk of tree:



- 1) **Pith** – It the innermost central part is called pith
- 2) **Heart wood** – This position is surrounded by the pith. It is strong & dark in colour
- 3) **Sap wood** – this layer is present next to the heart wood. It represents growth with saps.
- 4) **Cambium layer** – This layer is present between sap wood & inner bark.
- 5) **Modularly rays**–these are thin radial fibers extending from pith to cambium layer.
- 6) **Inner bark** – It is the inner skin of tree which protects cambium layer.
- 7) **Outer bark** – The outer skin or cover of the tree is known as outer bark.

### Properties of good timber

- 1) **Colour** – Its colour should be uniform
- 2) **Density** – higher the density, stronger is the timber
- 3) **Strength** - It should have sufficient strength
- 4) **Workability** - It should be easily workable
- 5) **Weathering resistance** – It should resist against weathering actions
- 6) **Hardness** - It should have sufficient hardness
- 7) **Defects** - It should be defect free i.e. dead knots, shakes & cracks
- 8) **Texture** – Texture of good timber is fine & even.

### Seasoning of timber

Seasoning of timber is classified by two ways;

- 1) **Natural seasoning** – It may air seasoning / water seasoning.
  - a) Air seasoning is carried out in a shed with a platform.
  - b) Water seasoning is carried out on the bank of the river.

## 2) Artificial seasoning –

Artificial seasoning is followed by following steps;

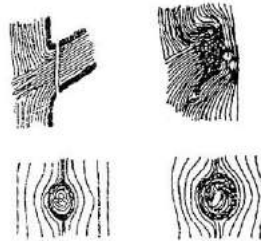
- a) **Boiling** – In this method, the timber is dipped in water & then boiled the water for 3 to 4 hours & dried slowly.
- b) **Kiln seasoning** – In this method The drying of timber is carried out inside an air tight oven
- c) **Chemical seasoning** – In this method Timber is dipped in the suitable salts solutions & taken out for ordinary drying.
- d) **Electrical seasoning** – In this method of seasoning a high frequency alternating currents are used.

### Objects / purposes of seasoning –

- 1) To reduce shrinkage & warping
- 2) To increase the strength of the timber
- 3) To increase the durability & workable properties of the timber
- 4) To reduce its tendency to split & decay of the timber
- 5) To make suitable for painting
- 6) To reduce weight of the timber

### Defects in timber

- 1) Natural defects – These defects may be in the form of knots, twisted fibers, ring shakes, rupture etc
- 2) Defects due to conversion–These defects are formed due to improper seasoning are radial shakes, case hardening, twisted, bowing, honey combing etc



- 3) Defects formed due to insects – In this defect wood is attacked by termites, insects, beetles, stem borers etc
- 4) Defects formed due to fungal action – In this defect wood is infected by fungal attack which reduces the strength of wood.
- 5) Defects due to seasoning – These are in the form of warp, cup, bow, twist etc.

### Bituminous materials and mixtures:

#### Asphalt –

It is the artificial mixture of bitumen & inert matter like alumina, lime, silica etc

Forms of asphalts –

- 1) Cutback asphalt – It is the liquid asphalt formed by the mixing asphalt with volatile solvents. It is used for preparing bituminous paints, for repairing roofs.
- 2) Asphalt emulsion – It is prepared by mixing asphalt with 50-60 % of water in presence of 1% emulsifying agent. It is used for water proofing purposes.
- 3) Asphaltic cement – It is prepared by blowing air through melted asphalt at high temperature. It is used for roofing, flooring, water proofing & filler in expansion joints in concrete.
- 4) Mastic asphalt – It is produced by heating natural asphalt with sand & mineral filters. It is used for damp proofing & water proofing.

### **Classification of asphalt –**

Asphalt is classified into the following categories;

- 1) **Natural asphalt** – It is obtained from the natural sources which is found in lakes & rock formation
- 2) **Residual asphalt** – It is obtained by the fractional distillation of crude petroleum oils.

### **Properties of asphalt –**

- 1) It is water proof & easily cleaned
- 2) It is durable & tough material
- 3) It is resilient & elastic in nature
- 4) It is good insulator of electricity, heat & sound
- 5) It is good water resistance
- 6) It is not affected by certain chemicals
- 7) It is corrosion resistance

### **Uses of asphalt –**

- 1) It is used as damp proofing
- 2) It is also used for roads & pavements
- 3) It is used in swimming pools, tanks & basements
- 4) It is also used for making paints & roofing felts.

### **Bitumen –**

It is the binding materials in which it is obtained by the fractional distillation from crude petroleum oils as an end product.

Categories / forms of bitumen –

- 1) **Straight run bitumen** – It is the type of bitumen which has definite viscosity or penetration without further treatments.
- 2) **Blown bitumen** – It is the type of bitumen which has been modified by passing air under pressure at high temperature.
- 3) **Cutback bitumen** – It is the type of bitumen which is obtained by fluxing asphaltic bitumen with suitable liquid distillations of petroleum coal tar.
- 4) **Plastic bitumen** – It is the type of bitumen which consist of bitumen, thinner & suitable fillers like asbestos fibers
- 5) **Bitumen emulsion** – It is a liquid product containing bitumen with large amount in water medium.

### **Properties of bitumen –**

- 1) It is brownish black in colour
- 2) It possesses adhesive properties when soften by heat
- 3) It gives distinctive smell when heated
- 4) It is soluble in carbon disulphide

### **Uses of bitumen –**

- 1) It is used as damp proofing
- 2) It is used for preparing paints
- 3) Also used for filling cracks, leakages in mensory structures.
- 4) It is also used for roads & pavements
- 5) **It is used in swimming pools, tanks & basements**

## Tar –

It is obtained by the destructive distillation of organic matters such as coal, oil, wood is called tar.

Classification/types of tar –

- 1) **Coal tar** – It is heavy black & strong smelling liquid. It is prepared by the close heating coal in the closed iron tank. It is used for making roads, preserving timbers.
- 2) **Mineral tar** – It is obtained by the distillation of bituminous shales. It has less volatile matters.
- 3) **Wood tar** – It is obtained by the distillation of pines & other resinous wood. It is used for preserving timbers.

Properties of tar –

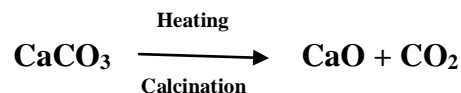
- 1) It is more adhesive
- 2) It is less durable
- 3) It is harden quickly
- 4) Its setting time is more
- 5) It contains high percentage of carbon

Uses of tar –

- 1) It is used in road constructions
- 2) It is also used for preserving woods/timbers
- 3) It is also used for filling leakages or cracks
- 4) It is also used for making paints

## Lime –

The removal of mixture & carbon dioxide by the calcinations of lime stone is known as lime



Types of lime –

- 1) **Fat lime** – It is obtained by the calcination of pure limestone, marble, white chalk etc

Properties –

- a) It hardens very slowly
- b) It has high degree of plasticity
- c) Its setting time is slow
- d) Its colour is perfectly white

- 2) **Hydraulic lime** – It is obtained by moderate burning of raw limestone which contain small amount of clay & iron oxide.

Properties –

- a) It sets under water
- b) Its colour is not perfectly white
- c) It forms thin paste

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3) **Poor lime** – It is obtained from limestone which contains 80-85% CaO & 5% MgO with clay, silica, alumina & iron oxide.

**Properties –**

- a) It sets very slowly
- b) It has poor binding properties
- c) Its colour is muddy white
- d) It makes very poor mortar

**Properties of lime –**

- 1) Lime possesses good plasticity properties
- 2) It stiffens easily
- 3) It has excellent cementing properties
- 4) It shrinks on drying

**Uses of lime –**

- 1) It is used for white washing
- 2) It is also used for preparation of lime sand bricks
- 3) It is also used as mortar in masonry works
- 4) It is used as refractory materials
- 5) It is also used for making cement.

**Field slaking of lime – (Preparation procedure)**

- 1) quick lime is heaped on a masonry / wooden platform
- 2) Water is sprinkled over it till lime is slaked & reduced to powder form
- 3) During sprinkling of water, the heap is turned over & over again till no more water is to be added then required for the lime to convert into the powder form.
- 4) The slaked lime is then screened through I.S. sieve 3.35 mm
- 5) The final product is slaked lime.

**Soil –**

The loose, unconsolidated, inorganic material on the earth crust produced by the disintegration of rocks, overlying hard rock's is known as soil

**Types of soil –**

- 1) **Residual soils** – Are the soils that remain at the place of their formation due to the weathering of parent rocks.
- 2) **Transported soils** – Are the soils which are transported at the other places after their formation due to the weathering of parent rocks.

**Applications of soil in construction field –**

- 1) In the construction of canals
- 2) In the construction earthen dams
- 3) In the construction & foundation designs
- 4) In the construction of the structures



**Sand –**

The natural product which is obtained as river sand & pit sand is called sand.

Requirement of good sand –

- 1) It should be hard
- 2) It should be chemically inert
- 3) It should be free from salts
- 4) It should free from organic matters
- 5) It should be well graded

Uses of sand –

- 1) It is used in mortars
- 2) It is used for the filling the gaps between the building blocks
- 3) It is used as binding materials in the form of paste
- 4) It prevents the shrinkages of cementing materials.

**Silt –**

The granular material of a size somewhere between sand & clay whose mineral origin in quartz & feldspar

Uses of slits –

- 1) It is used to construct bricks
- 2) It is used to make mortar
- 3) It is also used to make concrete
- 4) Also used to make artificial sedimentary rocks

**Clay –**

The earthen mineral mass of fragmentary rocks capable of mixing with water & forming a plastic viscous mass which has a property of retaining its shape when moulded & dried

Suitability of clay in Construction work – (types of clay)

- 1) **Refractory clay** – these are highly disperse & very plastic. These have high content of alumina & low content of impurities. They are used in manufacturing refractory bricks
- 2) **High melting clay** – These are high refractoriness & contains small amount of impurities such as quartz, mica, feldspar etc. They are used for manufacturing facing bricks, floor tiles, sewer pipes etc
- 3) **Low melting clay** – These are medium refractoriness than 1350° C & have varying compositions. They are used for manufacturing building bricks, blocks & tiles.

Uses of clay –

- 1) Clays are used for manufacturing clay bricks, porous & perforated bricks & hollow bricks
- 2) For manufacturing fire or refractory bricks
- 3) For manufacturing pavement blocks, floor tiles & sewer pipers
- 4) For manufacturing light weight porous aggregates.

**Topic - 3 Artificial Construction Materials****Contents :****3.1 -----(10)**

- Bricks – Brick earth and its constituents. Conventional bricks and Standard bricks. Characteristics of good brick, Classification of burnt clay bricks and their suitability, special bricks. Manufacturing of burnt clay bricks. Common Field tests on Bricks- shape and size, colour, sound, hardness test, finger scratch test, water absorption test
- Tiles –flooring and roofing tiles. Characteristic of good tiles, different types of tiles depending upon material used, sizes of tiles, uses of tiles, wall cladding

**3.2 -----(10)**

- Materials for making concrete-:

Cement – definition, Manufacturing of cement, types of cements –

Ordinary Portland, white cement colour cement and their suitability. Different brand name of cement, common pickings available in markets, common field tests on cement- lumps visible, colour, hand feeling , water float test

Aggregate – Definition, types of aggregate - coarse aggregate, fine aggregates (size).

Artificial sand – properties and advantages, suitability

- Pre-cast concrete products – concrete blocks- hollow, solid concrete blocks, pavement blocks, balustrades, their properties and uses.

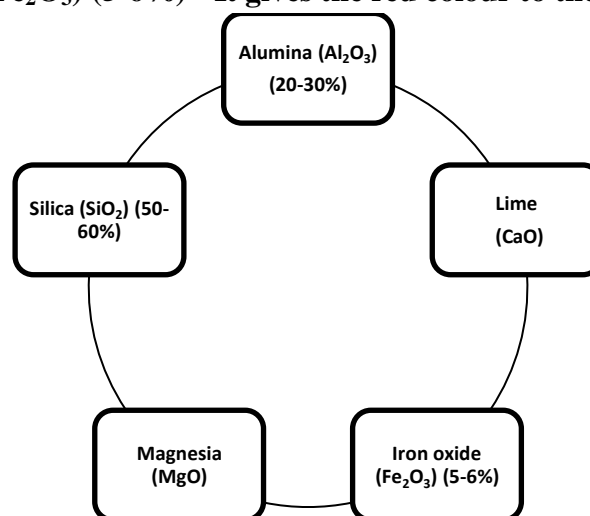
**3.3 -----(10)**

- Plywood, particle board and veneers their properties and uses.
- Glass – properties- thickness and weight, thermal conductivity, light and heat translation, durability sound insulation, types of glass- soda lime glass, lead glass and borosilicate glass. Glass used for cladding.

**Bricks****Brick earth & its constituents –**

The main constituents or ingredients of a good brick earth are

- 1) **Alumina ( $\text{Al}_2\text{O}_3$ ) (20-30%) - It gives the plasticity to the clay.**
- 2) **Silica ( $\text{SiO}_2$ ) (50-60%) - It prevents cracking, shrinking of the raw bricks.**
- 3) **Lime ( $\text{CaO}$ )- It stops the shrinkage of raw bricks and acts as a flux.**
- 4) **Magnesia ( $\text{MgO}$ )- It gives yellow tint to the bricks and reduces shrinkage.**
- 5) **Iron oxide ( $\text{Fe}_2\text{O}_3$ ) (5-6%) - It gives the red colour to the bricks.**



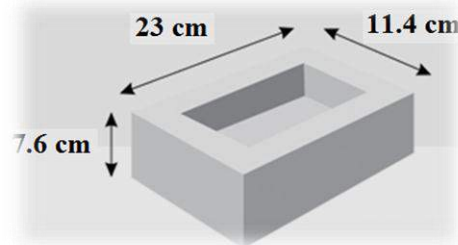
## Harmful ingredients of a brick earth:

- 1) **Lime stone:** It causes bricks to split into pieces.
- 2) **Alkalis:** It affects the overall appearance of the building as it causes 'efflorescence'.
- 3) **Iron pyrites:** It causes decomposition of bricks.
- 4) **Pebbles of stone and gravel:** It breaks the uniformity of bricks.
- 5) **Organic matter or vegetation:** Due to the presence of this, brick becomes more porous.

## Types of Bricks –

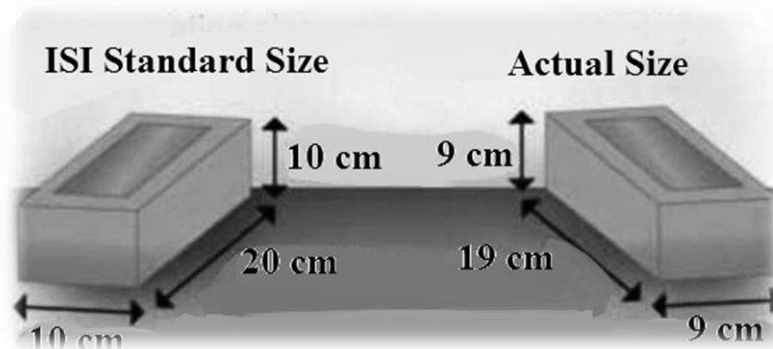
### 1) Conventional bricks or traditional bricks:

The conventional bricks are the bricks which are not standardized in size. The dimensions of conventional bricks vary from 21 to 25 cm in length, 10 to 13 cm in width and 7.5 cm in height in different parts of country. The commonly accepted normal size of a conventional brick is  $23\text{ cm} \times 11.4\text{ cm} \times 7.6\text{ cm}$ .



### 2) Standard bricks or modular bricks :

Indian Standard Institution (ISI) has set up the standard size of the brick. Such a brick is known as modular brick or standard brick. The normal size of modular brick is taken as  $20\text{ cm} \times 10\text{ cm} \times 10\text{ cm}$ . But its actual dimensions are  $19\text{ cm} \times 9\text{ cm} \times 9\text{ cm}$ .



## Characteristics of Good Brick:

- 1) It should have uniform in colour, shape and size.
- 2) It should be well burnt.
- 3) It should be free from cracks.
- 4) It should produce a good metallic ringing sound when two bricks are struck with each other.
- 5) It should not absorb water more than 20% of its dry weight when dipped in water.
- 6) It should be adequately strong.
- 7) It should be fire resistant.

### Classification of Bricks –

- A. **1<sup>st</sup> class bricks:** These bricks are well burnt, rectangular with sharp edges. It is used for better work.
- B. **2<sup>nd</sup> class bricks:** These bricks are well burnt, but they are having irregular shape. It is used for ordinary structure.
- C. **3<sup>rd</sup> class bricks:** These bricks are under burnt, its surface is rough. It is used for temporary structure and the places where rainfall is not heavy.
- D. **4<sup>th</sup> class bricks:** These are overburnt bricks having irregular surface. It is used as aggregates for concrete in foundation.

### Types of Special Bricks:

- 1) **Acid resistant bricks:** It is specially used for chemical plant.
- 2) **Engineering bricks:** It is used for paving purposes.
- 3) **Silica bricks:** It is used in the construction of chimney.
- 4) **Refractory bricks:** It is used in metallurgical process.
- 5) **Sand-lime bricks:** It is used for ornamental work.
- 6) **Blue bricks:** It is used for heavy engineering constructional work like bridges.
- 7) **Coloured bricks:** It is used for decorative work only.
- 8) **Fire bricks:** It is used for the construction of hearth, furnaces and chimney as they have to resist high temperature.

### Manufacturing of clay bricks –

The clay for bricks is prepared by the following steps;

- 1) **Unsoiling :**  
Unsoiling is the process in which the top layer of soil, about 20cm in depth, is taken out and thrown away as it contains impurities.
- 2) **Digging :**  
After removing top soil, the clay is then dug out from the ground.
- 3) **Weathering :**  
The clay is then exposed to atmosphere for softening or mellowing.
- 4) **Blending :**  
The clay is made loose and any ingredient to be added to it, is spread out at its top. The mass is then mixed uniformly with spades.
- 5) **Tempering :**  
Tempering consists of kneading the earth with feet so as to make the mass stiff and plastic.

### Moulding –

It is a process of giving a required shape to the brick from the prepared brick earth.

### Two types of moulding:

- A. **Hand Moulding:** In hand moulding, the bricks are moulded by hand i.e. manually. It is further classified as –
  - a) **Ground Moulding:** In this process, the ground is leveled and sand is sprinkled on it. The bricks are then moulded on ground.



b) **Table Moulding:** The bricks are moulded on stock boards nailed on the moulding table.

B. **Machine Moulding:** In this method, the bricks are moulded by using machines. It proves to be economical when bricks in huge quantity are to be manufactured. These machines are broadly classified in two categories :

- a) Plastic clay machines
- b) Dry clay machines

#### Field tests of the good quality bricks:

- 1) **Uniformity in shape & size:** A good brick should have rectangular plane surface and uniform in size. This check is made in the field by observation.
- 2) **Uniformity in colour :** A good brick will have uniform colour
- 3) **Structure:** Few bricks may be broken in the field and their cross-section is observed. The section should be homogeneous, compact and free from defects such as holes and lumps.
- 4) **Sound test:** If two bricks are struck with each other they should produce clear ringing sound. The sound should not be dull.
- 5) **Hardness test:** Scratch the brick with nail. If no impression is marked on the surface, the brick is sufficiently hard.
- 6) **Water absorption:** Brick specimen is weighted dry. Then they are immersed in water for 24 hrs. It is weighted again and the difference indicates amount of water absorption. This should not be more than 20%.

#### Tiles:-

Types of tiles depending upon the materials used for their construction;

- 1) Clay tiles
- 2) Quarry tiles
- 3) Cement tiles
- 4) glazed earthenware tiles

#### Classification of building tiles with their suitability -

##### 1) **Roofing tiles:**

- Roofing tiles are used to cover sloping roofs.
- They are supported on wooden reapers.
- Normally these tiles are having curved surface having ribbed sections, so that with thin section they are sufficiently strong to resist the load.
- These tiles should be leak proof.

##### 2) **Flooring tiles:**

- These tiles are used as finish surface for floors.
- The thickness of these tiles varies from 15 to 20 mm.
- These tiles are flat and they have pleasing appearance.

### Characteristics of a good tile:

- 1) It should be free from any cracks.
- 2) It should be regular in shape and size.
- 3) It should be sound, hard and durable.
- 4) It should have uniform texture and colour.
- 5) It should have low water absorption (less than 15%)
- 6) It should have sufficient resistance to atmosphere and dampness.

### Different types of tiles:

- 1) **Clay tiles:** These tiles are made from good clay of even texture. These are made in various shapes and sizes according to their uses. They are used for roofing & flooring purposes.
- 2) **Quarry tiles:** These tiles are also made from clays. Quarry tiles can be made in different colours and mosaic. These tiles are suitable for flooring in residential, public and industrial building where floor comes in contact with acid or alkalies.
- 3) **Glazed earthenware tiles:** These are made of earthenware covered by a glaze. These tiles are generally used in finishing floors and walls of kitchens, bathrooms, water closets etc.
- 4) **Cement tiles:** These tiles are made from cement. These tiles possess uniform texture, high strength, and good weather resistance property & water tightness. These are used for roofing and flooring purposes.

### Uses of tiles –

- 1) Tiles are used for covering slopping roofs.
- 2) Tiles are used as finish surface for floors of houses.
- 3) Tiles are used as finish surfaces for walls of kitchen, bath-rooms, water closet etc.
- 4) Tiles are used for decoration of walls and roofs.

### Different sizes of tiles -

*Different sizes of tiles for roofing purposes;*

- 1) 250mm X 200mm X 25mm    2) 150mm X 100mm X 20mm    3) 150mm X 75mm X 15mm

*Different sizes of tiles for flooring purposes;*

- 1) 150mm X 150mm X 18mm    2) 200mm X 200mm X 25mm    3) 250mm X 250mm X 30mm

### Wall cladding –

Wall cladding is a decorative covering used on building walls. This is made by using tiles, stones



## Materials for Making Concrete



**Cement: -**

It is a material, which is produced by calcining an intimate mixture of calcareous, siliceous and aluminous substances at high temperature and crushing the resultant clinkers to a fine powder.

### Chemical ingredients / constituents of cement –

Sr. No.	Name of the constituents	Formula	Percentage
1	Lime	CaO	60-67 %
2	Silica	SiO <sub>2</sub>	17-25 %
3	Alumina	Al <sub>2</sub> O <sub>3</sub>	3-8 %
4	Iron Oxide	Fe <sub>2</sub> O <sub>3</sub>	0.5-6 %
5	Magnesia	MgO	0.1-4 %
6	Sulphur trioxide	SO <sub>3</sub>	1-2 %
7	Soda & Potash	Na <sub>2</sub> O + K <sub>2</sub> O	0.5-1.3 %
8	Gypsum ( Calcium Sulphate)	CaSO <sub>4</sub> .2H <sub>2</sub> O	3 – 4 %

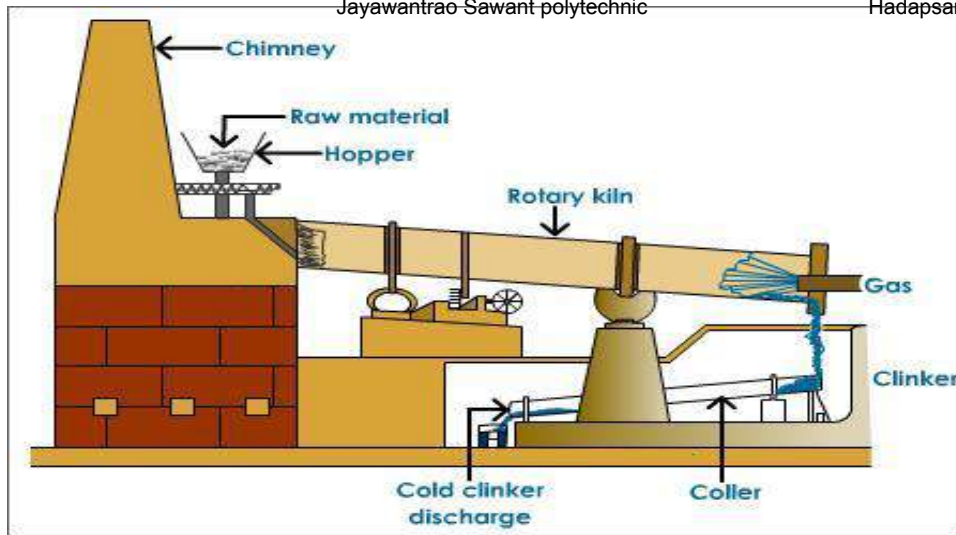
Manufacturing of cement by following processes -

### Dry Process –

- 1) The raw materials are crushed by grinding mill by proper proportion
- 2) Then the blended is sieved & fed into the rotating mill with 12% water
- 3) Then it is passed into the rotary kiln in presence of heat
- 4) Finally clinkers were obtained
- 5) After cooling the clinkers & mixed with 2-3% gypsum & then pulverized.

### Wet process -

- 1) **Mixing raw materials:** In this stage, 10% of chalk and 30% of clay which contains some sand, iron oxide, magnesia, etc. are crushed, grounded and then mixed uniformly, then it is thoroughly mixed with water. The water is then taken out and the slurry is dried in an oven.
- 2) **Burning:** Burning of the above dried slurry is carried out in a rotary kiln. Kiln rotates at the rate of one revolution per minute about its longitudinal axis.
- 3) **Grinding:** In this process, the clinkers obtained from rotary kiln are ground to fine powder in ball mills and tube mills. During grinding, about 3 to 4% of gypsum is added. Gypsum acts as a retarder. The final produce which is obtained is cement.



### Ordinary Portland cement:

- 1) It is used in important structures, where great strength is required such as heavy buildings and bridges etc.
- 2) It is used for plastering and painting.
- 3) It is used for drainage & water supply works.
- 4) It is used for making cement mortar, plain concrete, reinforced concrete etc.

### White cement: Preparation & Uses

- 1) The cement when made free from colouring oxides of Fe, Mn and Cr, it results into white cement.
- 2) In the manufacturing of this cement, the oil fuel is used instead of coal for burning.

#### Uses -

- 1) It is used for floor finishing.
- 2) It is used for ornamental works.
- 3) It is used for plastering.
- 2) In swimming ponds white cement is used to replace glazed tiles. It is used for fixing marbles and glazed tiles.

### Coloured cement: Preparation & Uses

- 1) The cement of desired colour is produced by intimately mixing pigments with ordinary cement.
- 2) The chromium oxide ( $\text{CrO}_4$ ) gives green colour. Cobalt produce blue colour.
- 3) Iron oxide ( $\text{Fe}_2\text{O}_3$ ) with different proportion produce brown, red or yellow colour.
- 4) Addition of manganese dioxide ( $\text{MnO}_2$ ) gives black or brown coloured cement.

#### Uses -

- 1) It is used for finishing of floors.
- 2) It is used for painting.
- 3) It is used for finishing of walls, roofs and window sills.



### Important properties of good cement:

- 1) It gives strength to the masonry.
- 2) It is an excellent binding material.
- 3) It is easily workable.
- 4) It has good resistance to the moisture.
- 5) It possesses a good plasticity.
- 6) It solidifies or hardens quickly.
- 7) It is fire proof.

### Common packing of cement available in market;

- 1) The packing of cement is mostly done in our country in conventional jute or gunny bags. These bags have proved to be satisfactory containers as their shape and size make them convenient to handle.
- 2) However, the main drawback of such type of packing is at every point of handling, some portion of cement is wasted.
- 3) The National Council of Cement and Building Materials have developed an improved jute bag having close-knit design.
- 4) Such bags are technically superior to the conventional jute bags and they are expected to reduce substantially the loss of cement.

### Different Brands of cements –

Ambuja Cement		JK cement	
ACC cement		Birla-Shakti Cement	
Ultra-Tech Cement		Reliance Cement	

### Field tests of cement:

- 1) **Presence of lumps:** The cement should be free from any hard lumps.
- 2) **Colour:** The colour of the cement should be uniform. It should be typical cement colour i.e. grey colour with a light greenish shade.
- 3) **Hand feeling:** If hand is inserted in a bag or heap of cement, it should feel cool.
- 4) **Water float test:** If a small quantity of cement is thrown in a bucket of water, the particles should float for some time before it sinks if the cement is of good quality.

## Aggregates -

Aggregates are divided into following two categories on the basis of size;

- 1) **Coarse aggregates:** The aggregates having size greater than **4.75 mm** are called as coarse aggregates.
- 2) **Fine aggregates:** The aggregates having size 4.75 mm or less are called as fine aggregates.



## Artificial sand –

Artificial sand is sand made by crushing the rocks.

### Properties of artificial sand:

- 1) The surface texture of the particles should be smooth.
- 2) There should not be any organic impurities.
- 3) The sand should be sharp, clean & coarse.
- 4) All the sand particles should have higher crushing strength.
- 5) The grains should be of durable material.

### Advantage of artificial sand:

- 1) If artificial sand is produced by proper machines, it can be a better substitute to river sand.
- 2) When fine particles are in proper proportion, the sand will have fewer voids; hence the cement quantity will be less.
- 3) Natural sand takes millions of years to form, where as artificial sand can be produced within a short period of time.
- 4) The transportation cost will be less. Artificial sand can be produced within a city.
- 5) The sand of required size particles can be produced as per the demand of a builder.

### Alternative purposes of artificial sand -

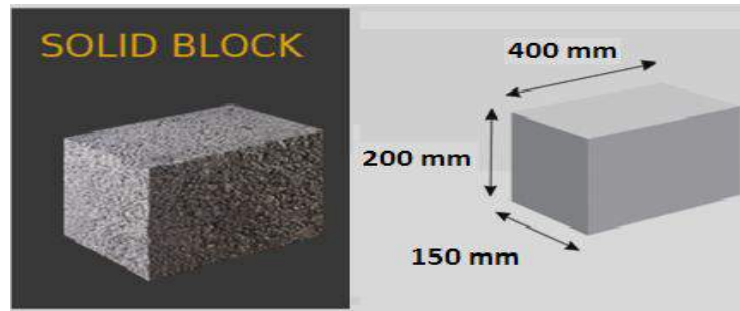
- 1) It is used as a main component in mortar.
- 2) It is used for filling in foundation design.
- 3) It is used in road construction.
- 4) It is used as fine aggregates for concrete.

## Precast concrete -

It is obtained by mixing various ingredients of concrete under highest technical control are known as precast concrete.

### Solid concrete blocks -

- Solid concrete blocks of size 400mm x 200mm x 150mm are commonly manufactured.
- To reduce the weight of the block, no fine concretes are preferred.
- No fine concrete is the concrete in which fine aggregate is not used, but round aggregates of size less than 12mm are used.

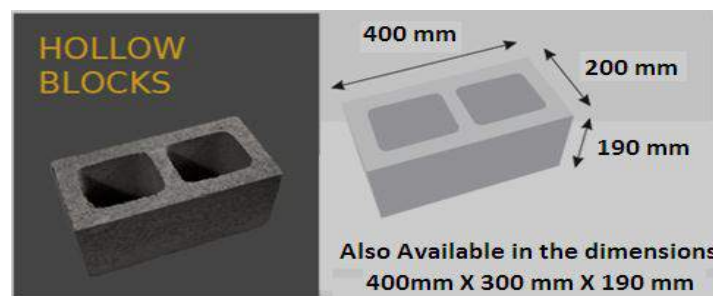


### Properties of solid concrete blocks:

- 1) They are solid in nature.
- 2) They have less thermal insulation
- 3) They are heavy
- 4) They should satisfy the strength requirement of  $4 \text{ N/mm}^2$

### Hollow concrete blocks -

- To reduce the weight of concrete blocks, they may be made hollow.
- Hollow blocks of sizes 400mm x 200mm x 190 mm and also of sizes 400mm x 300mm x 190mm are manufactured.
- These block need richer mixes. Fine aggregates up to 60% and coarse aggregate up to 40% are used.



### Properties of hollow concrete blocks:

- 1) They are hollow in nature.
- 2) They have less weight.
- 3) They have more thermal insulation.
- 4) They should satisfy the strength requirement of  $4 \text{ N/mm}^2$

### **Uses of Solid & Hollow concrete blocks -**

- 1) Both solid and hollow blocks can be used for the construction of load bearing as well as partition walls.
- 2) They are ideally suited for the construction of compound walls.

### **Precast concrete pavement blocks -**

- 1) Precast concrete pavement blocks are used for the construction of domestic drive ways, footpaths, access roads, parking bays etc.
- 2) Pavement blocks are available in variety of colours, coatings, shapes and textures supporting different structural functions.
- 3) These are manufactured to high strength and placed so that they are locked in both the horizontal and vertical planes.



### **Properties of precast pavement blocks:**

- 1) They should have uniform shape and texture.
- 2) They should have high compressive strength.
- 3) They should have high weathering resistance.
- 4) They should have high wearing resistance.
- 5) They should have low water absorption.

### **Uses of Pavement blocks –**

Pavement blocks are used for the construction of

- a) Domestic drive ways
- b) Footpaths
- c) Roads access or entrance
- d) Parking

### **Balustrade –**

A balustrade is a row of repeating balusters i.e. small posts that support the upper rail of railing.



***Properties of balustrades:***

- 1) They should have good architectural shape.
- 2) They should be strong enough to resist the stresses coming on the rails.
- 3) They should be durable.
- 4) They should have sufficient weathering resistance.

***Uses of Balustrades –***

- 1) Balustrades are used for supporting the coping of a parapet
- 2) Making Handrail of a staircase.
- 3) Used for making Balconies

***Plywood -***

Plywood is boards which are prepared from thin layers of wood or veneers.

***Properties of plywood -***

- 1) They possess uniform tensile strength in all directions.
- 2) They are light in weight.
- 3) They are not easily affected by moisture.
- 4) Their expansion and shrinkage are very low.
- 5) They do not split in an axial direction.

***Uses of plywood:***

- 1) Plywoods are used for partitions.
- 2) Plywoods are used for concrete formwork.
- 3) Plywoods are used in railway coaches.
- 4) Plywoods are used for paneling walls.
- 5) Plywoods are used in the construction of furniture's and doors.

***Particle board –***

Particle boards are made of wood particles or rice husk or baggase, mixed in resin and heated with required pressure.



**Dr. Ravindra Dhivare**

### **Types of glass:**

- 1) **Soda-lime glass:** It is mainly a mixture of sodium silicate and calcium silicate. It is used as window panes and for the laboratory tubes and apparatus.
- 2) **Lead glass:** It is obtained by fusing a mixture of silica, lead and potash. It is used for making electric bulbs, optical glasses, radio valves etc.
- 3) **Borosilicate glass:** It is obtained by fusing a mixture of silica, borax, lime and feldspar. It is used for making laboratory equipments and cooking utensils.

### **Glass Cladding -**

**Glass Cladding** is the application of one material over another to provide a skin or layer intended to control the infiltration of weather elements.



- 1) Glass cladding is suitable to most applications, both internal and external.
- 2) Glass cladding is often used as an architectural feature in restaurants, shops, office reception areas and in many other applications such as cupboard or as an outside covering of buildings.
- 3) Glass cladding is ideal for wet areas, such as kitchens, bathrooms, laundry rooms and swimming pools.
- 4) Glass cladding comes in a variety of different colours. Another upside of glass cladding is that it maintains its appearance for a long time.

## Chapter –4: Special Construction materials

Marks -20

### Contents

#### 4.1 -----(10)

- Water proofing and damp proofing materials – Brand names, packings available properties and uses.
- Termite proofing materials -need , names and uses
- Thermal insulating materials- properties, names and situations where used
- Sound insulating materials- properties, names and situations where used

#### 4.2 -----(10)

- Fibres – Types –Jute, Coir, Steel Fibres, Carbon Fibres, Glass Fibres, Plastic Fibres, Asbestos Fibres properties and uses
- Miscellaneous materials – artificial timber, ferrocrete, adhesives, epoxy and Geosynthetic materials, ceramic materials -properties and uses.

### Waterproofing and Damp Proofing Materials:

Waterproofing of a surface is the treatment of the surface to prevent the passage of water like rainwater or ground water from one side of a structure to the other under normal pressure.



### Methods of water proofing -

- 1) Waterproofing with bituminous sheets.
- 2) Water proofing by slurry coats on the roof and covering it with tiles.
- 3) Waterproofing with elastomeric paints.
- 4) Waterproofing with epoxy formulations.



Most of the waterproofing materials are available in liquid and powder form.

Integral liquid waterproofing compounds are available in plastic bottles of different sizes while integral powder waterproofing compounds are available in waterproofing boxes or polyethylene bags.



**Properties of waterproofing materials:**

- 1) It should be impervious
- 2) It should be durable
- 3) It should be able to resist loads to which it will be subjected.
- 4) It should be in position to accommodate some structural movement without fracture.

**Dampness –**

Dampness in a building is the presence of moisture in various parts of building like floor, wall, roof etc.

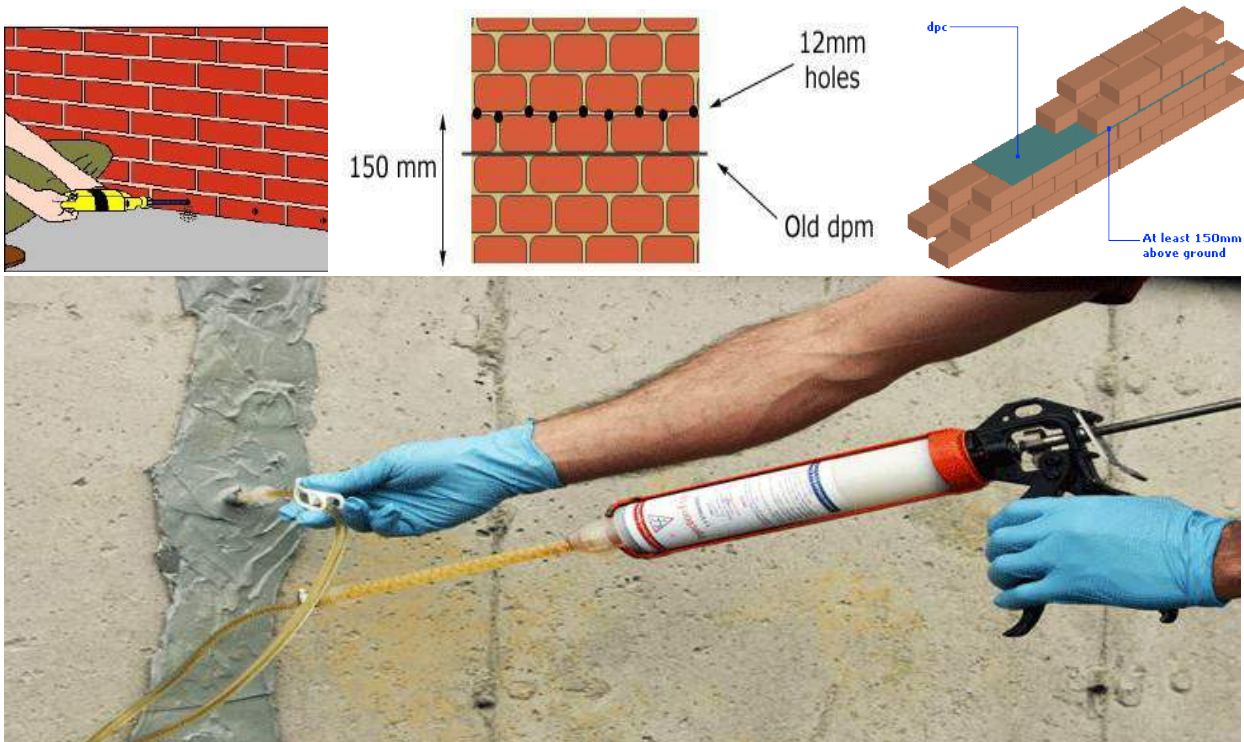
**Causes dampness in a structure:**

- 1) Poor drainage at the building site.
- 2) Imperfect orientation: Walls getting less sunlight and heavy showers may remain damp.
- 3) Imperfect roof slope: It is especially in the case of flat roofs.
- 4) Defective construction: Imperfect wall joints, joints in roofs, defective throttling etc.
- 5) Absorption of water from defective rain water pipes.

**Ill effects of dampness:**

- 1) Patches develop and destroy the appearance of the building.
- 2) Colour wash, white wash and paintings are damaged.
- 3) Plaster crumbles.
- 4) Bricks and stone disintegrate endangering the building.
- 5) Steel in the slabs and beam start rusting. It reduced the life of structure.
- 6) Dry rotting of wood takes place.

Damp proofing is the treatment of a surface to stop the rise of water by capillary action.

**Properties of ideal damp proofing material:**

- 1) It should be impervious.
- 2) It should be flexible
- 3) It should be durable

- 4) It should be easy to carry out leak proofing joints.
- 5) It should resist the load safely.

#### Some commonly materials are used for damp proofing:

- 1) Flexible materials like hot bitumen, bituminous felts, plastic sheet, metal sheet of lead, copper etc.
- 2) Semi-rigid materials like mastic asphalt.
- 3) Rigid materials like impervious bricks, stones, slates, cement mortar or cement concrete painted with bitumen.
- 4) Mortar with water proofing compounds.
- 5) Continuous plastic sheets under floor.

#### Methods of building damp proofing:

- 1) Use of damp proofing course (D.P.C.) Membrane damp proofing.
- 2) Integral damp proofing.
- 3) Surface treatment
- 4) Cavity wall construction.
- 5) Guniting
- 6) Pressure grouting

#### Brand names of various damp proofing materials:

- 1) Dr. Fixit
- 2) Ridex Flexifil
- 3) Algahard – X
- 4) Polysil C
- 5) Hydroproof- IWL



#### Termite proofing materials -

Termites are of two types:

- 1) **Dry wood termites:** These termites live in dry wood in small colonies, without maintaining any connection with the soil. They are generally found in humid coastal areas.
- 2) **Sub-terranean termites:** These termites have their main colonies in soil underground. They cannot survive without maintaining connection with their prime colonies in the soil.

#### Categories of anti-termites treatment:

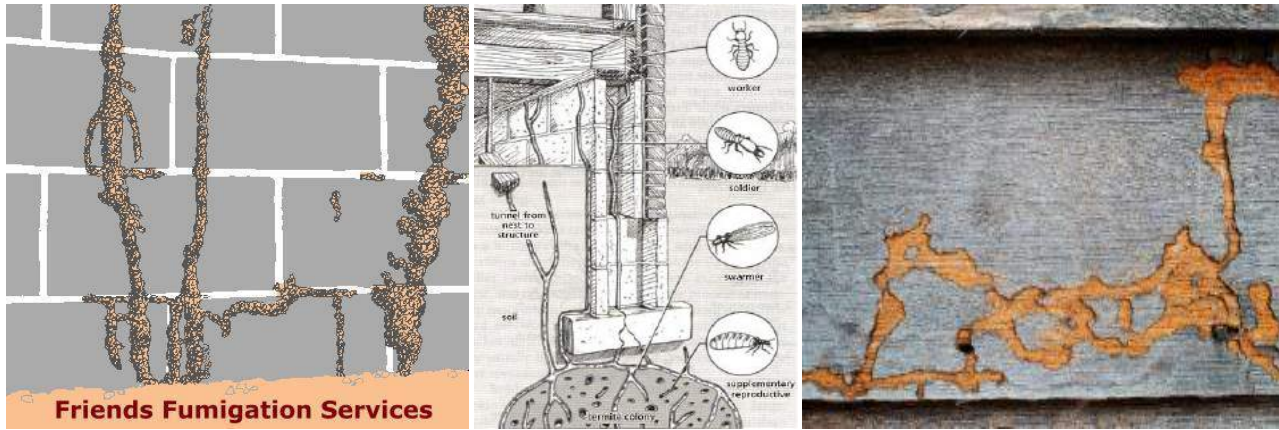
Anti-termite treatment may be divided into following two categories:

- 1) **Pre-construction treatment:** This treatment is started right at the initial stage of construction of building. Pre-construction treatment can be divided into three operations:
  - a) Soil preparation
  - b) Soil treatment
  - c) Structural barriers.
- 2) **Post-construction treatment:** For post-construction operation, a pressure pump will be required for proper penetration of chemicals into the surface to be treated.

This is divided into following operations:

- a) Treatment of foundation
- b) Treatment of soil under floors

### c) Treatment of masonry at plinth level.



#### Necessity of termite control:

- 1) Wooden structures like doors, windows, wooden roof truss, ceilings and wardrobes of building are most vulnerable.
- 2) Termites have a great affinity to wooden materials although they attack other household articles.
- 3) A building without the control of termite is totally unsuitable for stores, record rooms and even for dwelling purposes. Therefore it is necessary to apply anti-termite treatment on buildings.

#### List of anti-termite chemicals –

- 1) BHC
- 2) DDT
- 3) Aldrin
- 4) Chlordane
- 5) Heptachlor
- 6) Chloropyrifos

#### Thermal Insulating Materials:

##### Properties of thermal insulating materials:

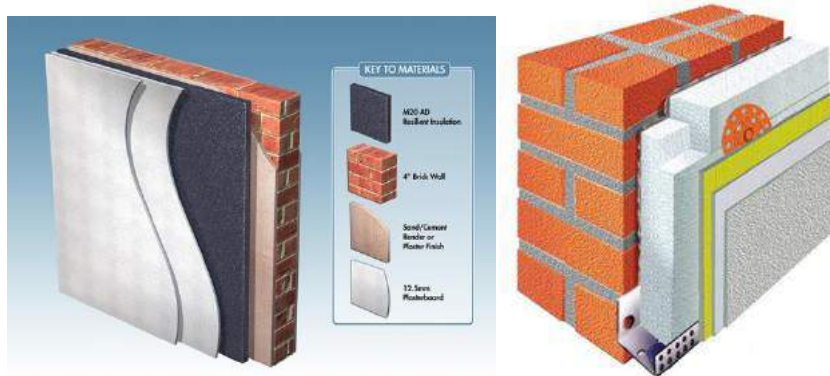
- 1) It should have low thermal conductivity.
- 2) It should be impermeable.
- 3) It should be fire proof.
- 4) It must resist attack of insects.

##### Types of Thermal insulating materials:

- 1) Cork
- 2) Glass wool
- 3) Fiber boards
- 4) Aerated concrete
- 5) Foam plastic
- 6) Cavity wall
- 7) Reflecting paints

### Suitability of Thermal insulating materials:

The heat insulation requirements for different types of buildings are achieved through one or more of the following things:



- 1) The use of thicker exterior walls provides insulation against heat and cold.
- 2) The use of cavity wall construction affords protection from the outside heat as the hollow space acts as an insulating material.
- 3) The use of heat insulating materials such as slag wool, rock wool, light weight concrete, reflective materials etc. for filling air spaces in construction materials, which are used for walls, roofs, floors etc.
- 4) The roofs of the multi-storeyed building have also been insulated against heat by using a layer of thermocole, cork or glass wool.

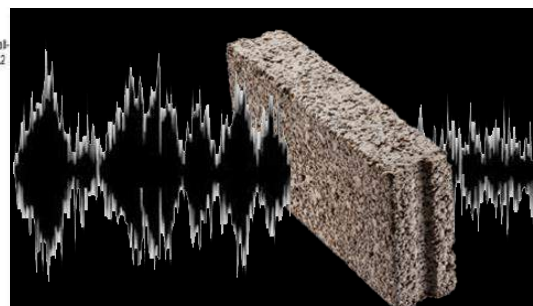
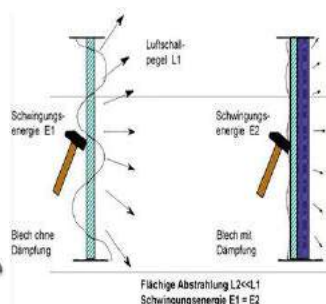
### Sound Insulating Materials:

#### Properties of good sound insulating materials:

- 1) It should have low density.
- 2) It should have porous texture
- 3) It should have pleasing look
- 4) It should be incombustible
- 5) It should be easy to handle and fix.

#### Types of sound insulating materials:

1) Glass wool	2) Cellular concrete
3) Glass silk	4) Rock wool
5) Porous tiles	6) Cane fibers
7) Asbestos	8) Mineral wool boards



**Suitability / requirement of sound proofing materials:**

The sound insulation requirements for different types of buildings are achieved through one or more of the following things.

- 1) The use of cellular concrete provides insulation against sound through slabs and floors.
- 2) The use of sound insulating materials such as rock wool, glass wool, glass silk etc. for filling air spaces in construction materials, which are used for walls, roofs, floors etc.
- 3) The roofs of the multi-stroreyed building have also been insulated against sound by using porous tiles.
- 4) Acoustic plastics such as gypsum plaster are very effective in sound insulation.

**Fibers –**

Natural or synthetic filaments that may be span into yarn like cotton or nylon are called fibers.

**Types of fibers:**

1) Jute fibers	2) Coir fibers
3) Carbon fibers	4) Steel fibers
5) Glass fibers	6) Plastic finbers
7) Asbestos fibers	

**Jute Fibers:****Properties of jute fiber:**

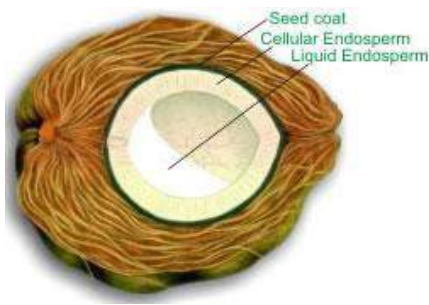
- 1) Jute fibers have low thermal conductivity.
- 2) They have high tensile strength.
- 3) They have low extensibility.
- 4) They are bio-degradable.

**Uses of jute fibers:**

- 1) Jute fibers are used for making fiber reinforced mortar and concrete.
- 2) Jute fibers are used to make rope.
- 3) Jute fibers are used for making geo-textiles.
- 4) Jute fibers are used to make cloths.
- 5) Jute fibers are also used to make pulp and paper.

**Coir Fibers –**

Coir is the fibrous materials found between the hard, internal shell and the outer coat of a coconut.



### **Properties of coir fibers:**

- 1) They have low density
- 2) They have high specific strength to weight ratio.
- 3) They are non-toxic.
- 4) They are bio-degradable.

### **Uses of coir fibers:**

- 1) They are used in floor mats, brushes, mattresses, floor tiles and sacking.
- 2) They are used for insulation and packing.
- 3) They are used for manufacturing of rope.
- 4) They are also used for making fishing nets.
- 5) They are used for making geo-textiles.

### **Steel Fibers:**



### **Properties of steel fibers:**

- 1) They have high tensile strength.
- 2) They have high elastic modulus.
- 3) They have high bond strength.
- 4) They have high ductility.

### **Uses of steel fibers:**

- 1) Steel fibers are mainly used for manufacturing steel fiber reinforced concrete which has broad applications in construction works.

### **Carbon Fibers –**

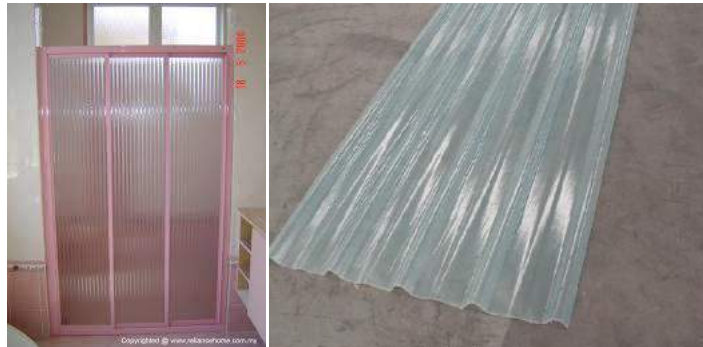


**Properties of carbon fibers:**

- 1) They have high strength to weight ratio.
- 2) They are corrosion resistant and chemically stable.
- 3) They have good fatigue resistance.
- 4) They have good tensile strength.
- 5) They have low coefficient of thermal expansion.

**Uses of carbon fibers:**

- 1) Carbon fibers can be used in machine, equipment and apparatus construction.
- 2) They can be used for interior furnishing or as protective clothing.
- 3) They are used in the construction of road cars.
- 4) They are used for manufacturing sport equipments.

**Glass Fibers:****Properties of glass fibers:**

- 1) Glass fiber is a dimensionally stable material.
- 2) Glass fibers do not absorb moisture.
- 3) Glass fibers are more fire resistant.
- 4) Glass fibers have low coefficient of thermal expansion.
- 5) Glass fibers have high strength to weight ratio.

**Uses of glass fibers:**

- 1) Glass fibers are used for making home furnishing fabrics.
- 2) Glass fibers are used as heat shields for aeronautical equipment.
- 3) Glass fibers are used as reinforcement in fiber reinforced concrete.
- 4) Glass fibers are used for roof insulation.
- 5) They are used to reinforce thermoplastics.

**Plastic Fibers:**

**Properties of plastic fibers:**

- 1) They have low thermal conductivity.
- 2) They are flexible
- 3) They are light and strong.
- 4) They are un-reactive.

**Uses of plastic fibers:**

- 1) Plastic fibers are used for manufacturing fiber reinforced mortar and concrete.
- 2) They are used in automotive and medical industries.
- 3) Plastic fibers are used for making geo-textiles.
- 4) Plastic fibers are used in digital home applications.

**Asbestos Fibers:****Properties of asbestos fibers:**

- 1) They have good tensile strength.
- 2) They possess good elasticity.
- 3) They are chemically stable.
- 4) They possess high bond strength.

**Uses of asbestos fibers:**

- 1) Asbestos fibers are used for manufacturing insulating cement.
- 2) They are used for manufacturing insulating blocks.
- 3) They are used in fire bricks.
- 4) They are used in floor tiles.
- 5) They are used for making textiles.

**Miscellaneous Materials:****Artificial Timber or wood:**

Artificial timber is a wood substitute made from solid wastes like fly ash, silica, bituminous and other biodegradable materials.





***Properties of artificial timber:***

- 1) Artificial timber is harder than natural wood.
- 2) It is termite-proof and don't require any anti-termite treatment.
- 3) It is fire resistant.
- 4) It has high resistance against the action of hot water and chemicals.
- 5) It does not wear out quickly.

***Uses of artificial timber:***

- 1) It is used for building boats.
- 2) It is used as a flooring material.
- 3) It is used for manufacturing windows and doors.
- 4) It is used for making furniture.
- 5) It is used for paneling and partition work.

**Ferrocete:**

Ferrocete is a super-strong building material that is composed of concrete and steel-like materials bonded together at the molecular level.

***Properties of ferrocete:***

- 1) Ferrocete is not affected by water or frost.
- 2) Ferrocete provides high early strength.
- 3) Ferrocete possesses a good plasticity.
- 4) It offers a good resistance to moisture.

***Uses of ferrocete:***

- 1) Ferrocete is used for manufacturing precast concrete products.
- 2) Ferrocete is used to produce high strength mortar and concrete.
- 3) Ferrocete is used for grouting.
- 4) Ferrocete is used for construction in cold weather.

**Adhesives or Bonding materials:**

An adhesive is a substance which enables two surfaces to stick together and behave as a single unit.



**Properties of adhesives:**

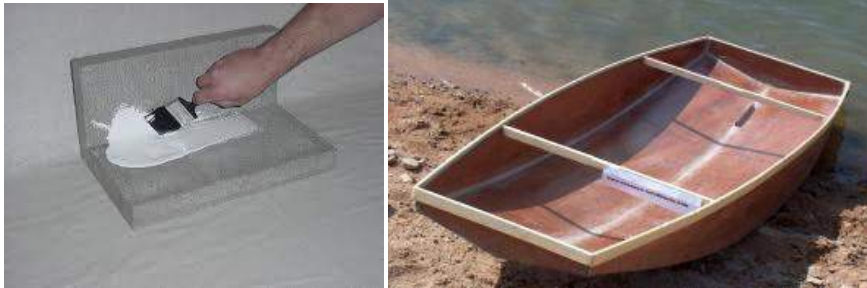
- 1) Adhesives should have high tensile strength.
- 2) Adhesives should have more cohesive strength.
- 3) Adhesive should form a strong bond between the surface and the adhesive.
- 4) Adhesive should be durable.
- 5) Adhesive must wet the surface thoroughly as it spreads.

**Uses of adhesives:**

- 1) Adhesives are largely used in the manufacture of veneers, plywood, blackboards.
- 2) Adhesives are used for fixing wall and ceiling linings and floor coverings.
- 3) Adhesives are used for joining rubber, plastic, glass etc.
- 4) Adhesives are used for making furniture.

**Epoxy or Epoxy resins:**

Epoxy is a thermosetting epoxide polymer that cures when mixed with a hardener.

**Properties of epoxy:**

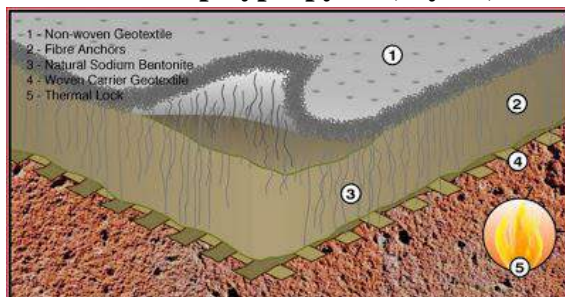
- 1) Epoxy has excellent chemical and corrosion resistance.
- 2) It has excellent adhesion.
- 3) It has low shrinkage.
- 4) It has excellent thermal insulation.
- 5) It is more durable in extremely warm conditions.

**Uses of epoxy:**

- 1) It is popularly used as glue.
- 2) It is used in house repairs and auto repairs.
- 3) It is used for joining metal, glass, wood, stones, plastics etc.
- 4) It is used in construction of cars, boats, snow boards etc.
- 5) It is used in paints.
- 6) It is used for coating reinforcement to protect them from corrosion.

**Geo-synthetic materials:**

Geo-synthetics are made of polypropylene, nylon, PVC and other synthetic materials.



***Properties of geo-synthetics:***

- 1) **Geo-synthetics are visco-elastic**
- 2) **They have better resistant to atmospheric weathering action.**
- 3) **They have high tensile strength.**
- 4) **They are more flexible.**

***Uses of geo-synthetic materials:***

- 1) **Geo-synthetics are used for filtration.**
- 2) **They are used as reinforcement in road pavements, earthen dams etc.**
- 3) **They can be used as moisture barrier.**
- 4) **They are used for seepage control.**
- 5) **They are used for soil stabilization.**
- 6) **They are used for water proofing.**

**Ceramics:**

Ceramics refers to polycrystalline materials and products formed by baking natural clays and mineral admixtures at a high temperature.

***Properties of ceramic materials:***

- 1) **They are capable of withstanding high temperature, thermal shocks and rough usage.**
- 2) **They have minimum expansion and contraction**
- 3) **They are chemically inactive at high temperatures.**
- 4) **They have good thermal insulation and low electrical conductivity.**

***Categories of ceramics:***

- 1) **Glass**
- 2) **White wares, including art-ware and structural ceramics.**
- 3) **Refractories**

***Uses of ceramic materials:***

- 1) **They are used for the thermal insulation of combustion chambers, valve seats, spark plugs, gas turbines etc.**
- 2) **They are used for manufacturing glazed and unglazed tiles.**
- 3) **They are used for manufacturing sanitary ware in the form of toilets and lavatories.**
- 4) **They are used for manufacturing drainpipes, roofing tiles and road pavers.**
- 5) **They are used for making art-wares.**

## Chapter –5: Finishing materials

Marks -08

### Contents

- Plastering Materials – Mortars: Lime Mortar, Cement Mortar, Special Mortars – Properties, proportion, situations where used
- Plaster of Paris – Constituents, properties and uses POP finishing boards, sizes, purpose.
- Paints, Distempers and Varnishes – types, properties and uses
- Cladding materials – properties, names of different cladding materials and uses
- Linoleum- properties, sizes, use, method of fixings to floor

### Plastering Materials –

#### Mortars-

The term mortar is used to indicate a paste prepared by adding required quantity of water to a mixture of binding material like cement or lime and fine aggregate like sand.



#### Properties of a good mortar:

- 1) It should be cheap.
- 2) It should be durable.
- 3) It should set quickly.
- 4) It should be easily workable.
- 5) It should be capable of developing good adhesion with the building units such as bricks, stones etc.
- 6) It should be capable of resisting penetration of rain water.

#### Uses of mortar:

- 1) To form joints of pipes.
- 2) To bind the building units such as bricks, stones, etc. into a solid mass.
- 3) To carry out pointing and plaster work on exposed surface of masonry.
- 4) To improve the general appearance of structure.
- 5) To hide the open joints of brickwork and stonework.
- 6) To fill up the cracks detected in the structure during maintenance process.

### Lime mortar

- In lime mortar the lime is used as binding material. The lime may be fat lime or hydraulic lime may be fat lime or hydraulic lime.
- The lime mortar has a high plasticity and it can be placed easily.
- It possesses good cohesiveness with other surfaces and shrinks very little. It is sufficiently durable, but it hardens slowly.
- It is generally used for lightly loaded above-ground parts of buildings.



### Properties of lime mortar:

- 1) It shrinks very little.
- 2) It is durable.
- 3) It hardens slowly.
- 4) It has a high plasticity and can be placed easily.
- 5) It possesses good cohesiveness with other surfaces.

### Cement Mortar:

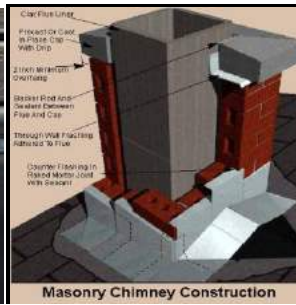
- In cement mortar, the cement is used as binding materials.
- Depending upon the strength required and importance of work, the proportion of cement to sand by volume varies from 1:2 to 1:6 or more.



- The proportion of cement with respect to sand should be determined with due regard to the specified durability and working conditions.
- The cement mortar is used where a mortar of high strength and water-resisting properties if required such as underground constructions, water saturated soils, etc.

### Properties of cement mortar:

- 1) It is more durable.
- 2) It hardens very quickly.
- 3) A well proportioned mortar provides impervious surface.
- 4) A mix richer than 1:3 is prone to shrinkage.



- 1) **Fire-resistant mortar:** It is used with fire-bricks for lining furnaces, fire places, ovens, etc.
- 2) **Light weight mortar:** This mortar is used in the sound-proof and heat-proof constructions.
- 3) **Sound absorbing mortar:** To reduce the noise level, the sound – absorbing plaster is formed with the help of sound absorbing mortar.
- 4) **X-ray shielding mortar:** This type of mortar is used for providing the plastering coat to walls and ceiling of X-ray cabinets.

### Plaster of Paris:

When finely ground gypsum is heated at the temperature of 160°C to 170°C, it loses about 14.7 per cent of its water content in the form of steam. The resulting product is known as the plaster of pairs.



### Properties of Plaster of Pairs:

- 1) It is light in weight.
- 2) It shows good adhesions to the fibrous materials.
- 3) It sets with negligible shrinkage on drying.
- 4) It is not affected by bacteria It is a fire resisting material and it does not allow heat to pass easily.

### Uses of Plaster of Pairs:

- 1) It is used for ornamental plaster work.
- 2) It is used as an insulating material to protect wood or metal columns and beams from high temperature.
- 3) It is used in artwork, pottery, dentistry and in surgery for the shaping of fractured bones.
- 4) POP boards are used for ceiling, for internal lining of wall and for partition walls.

## Availability of POP –

POP finishing boards are available in widths 400, 600, 800, 900, 1200mm and in length 1200, 1800 to 3600 mm in steps of 100mm and in thickness 9.5 to 15mm.

Because of good insulating properties, POP finishing boards are normally used for ceiling, partition walls and internal lining of walls.

## Paints –

The paints are the coatings of fluid materials which are applied as a final finish to all surfaces, such as walls, ceilings, wood work, metal work etc.

The process of application of paint as a coating is termed as painting.

### Constituents of paints -

- 1) **Base:** A base is a solid substance of a metallic oxide in fine state of division. It is a principal constituent of paint.
- 2) **Vehicle:** A vehicle is a liquid substance which keeps the ingredients of paint in liquid suspension.
- 3) **Drier:** A drier is a substance which accelerates the process of drying of a paint film
- 4) **Colouring pigment:** Colouring pigment gives required colour for paints.
- 5) **Solvent:** It is a liquid which is mixed in a paint to make the paint thin so that it can be easily applied on the surface.

### Properties of an ideal paint:

- 1) It should be possible to apply easily and freely.
- 2) It should dry in a reasonable time.
- 3) It should form hard and durable surface.
- 4) It should not be easily affected by atmosphere.
- 5) It should possess attractive and pleasing appearance.
- 6) It should not be harmful to be health of workers.

### Objects of painting:

- 1) It prevents decay of wood and corrosion of metals.
- 2) It is used to give good appearance to the surface.
- 3) It protects the surfaces from weathering effects of the atmosphere.
- 4) It provides a smooth surface for easy cleaning.

### Different types of paints depending upon their constituents:

- 1) **Aluminium paint:** It contains finely ground aluminium in spirit or oil varnish. It is widely used for painting gas tanks, water pipes and oil tanks.
- 2) **Oil paint:** This is the ordinary paint and it is generally applied in three coats of varying composition. The oil paints are used in general for all types of surfaces, such as wood work, walls, ceilings, metal work etc.

- 3) **Enamel paint:** It contains white lead, oil petroleum spirit and resinous material. It can be used for both external and internal walls.
- 4) **Bituminous paint:** This type of paint is manufactured by dissolving asphalt or vegetable bitumen in oil or petroleum. It is used for painting iron works under water.
- 5) **Emulsion paint:** It contains binding materials such as polyvinyl acetate, synthetic resins etc. This paint is recommended for use on stucco, bricks and masonry surfaces which contain free alkali.
- 6) **Cement paint:** This paint consists of white cement, pigment, accelerator and other additives. Cement paints are being extensively used for painting plastered brickwork, stone masonry and concrete.

## Distempers -

Distempers are the cheaper variety of paints in which chalk is used as base and water is used as a carrier.

### Properties of distemper:

- 1) They are generally light in colour.
- 2) They give reflective coating.
- 3) The coatings are generally thick.
- 4) They are less durable than oil paints.
- 5) They exhibit poor workability.

*The application of distemper is carried out in the following way -*

- 1) **Preparation of surface:** The surface is thoroughly rubbed and cleaning. In case of a new plastered surface, the surface is kept exposed to weather, for drying before the application of distemper. The efflorescence and patches, if any should be wiped out by a clean cloth. Cracks found on the surface if any should be filled with putty.
- 2) **Priming Coat:** After preparing the surface to receive the coats of distemper, a priming coat is applied and it is allowed to become dry.
- 3) **Final coat:** Two or three coats of distemper are applied. Each coat should be applied only after the previous coat has dried.

### The various types of distempers are:

- 1) **White distempers:** They are made by mixing only whiting i.e. powdered chalk and glue size.
- 2) **Coloured distempers:** They are prepared by mixing the desired colouring pigment to the whiting before mixing it with glue size.
- 3) **Oil bound distempers:** There is a variety of oil paints in which the drying oil is so treated that it mixes with water. Such distempers are diluted or thinned with water when required.
- 4) **Casein paints:** These paints are prepared by mixing a finely ground casein with a white base usually slaked lime.



## Different brands of distemper:



## **Varnishes -**

Varnish is a nearly homogeneous solution of resins or resinous substances either in alcohol, oil or turpentine.

### **Purposes of varnishing coat:**

- 1) To brighten the appearance of the grain in wood.
- 2) To render brilliancy to the painted surface.
- 3) To protect painted surface from atmospheric action.
- 4) To protect the unpainted wooden surfaces of doors, windows, roof trusses, etc. from atmospheric action.

### **Properties of an ideal varnish:**

- 1) It should render the surface glossy.
- 2) It should dry rapidly or quickly.
- 3) It should not shrink or show cracks after drying.
- 4) The protecting film developed by varnish should be tough, hard and durable.
- 5) The colour of varnish should not fade away when the surface is exposed to atmospheric actions.

### **Classification of varnishes –**

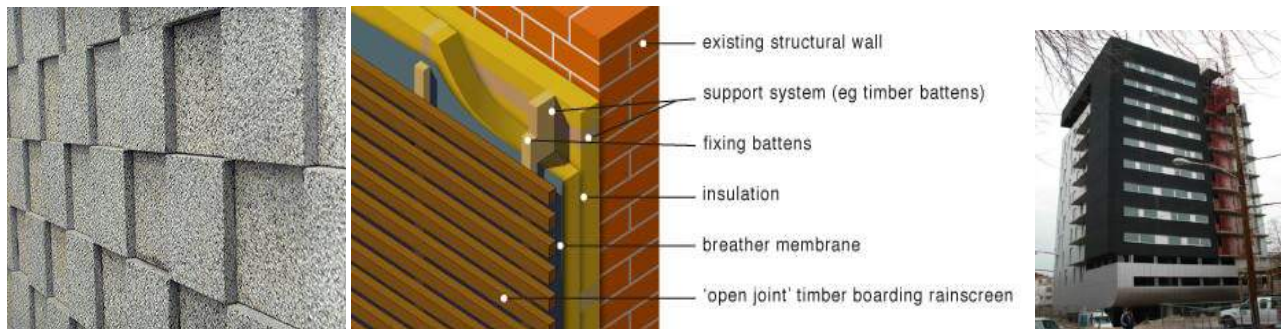
Varnishes are classified into the following four categories depending upon the solvent:

- 1) **Oil varnishes:** The linseed oil is used as solvent in this type of varnish. Oil varnishes are very suitable for exposed work which requires frequent cleaning.
- 2) **Spirit varnishes:** The methylated spirits of wine are used as solvent in this type of varnish. These varnishes are mostly used for wooden furniture.
- 3) **Turpentine varnishes:** The turpentine is used as solvent in this type of varnish. They are not durable and tough as oil varnishes.
- 4) **Water varnishes:** These varnishes consist of shellac dissolved in hot water to which enough quantity of ammonia, borax, soda or potash is added. These are used for varnishing maps and pictures.

## Steps of varnish coatings:

- 1) **Preparation of surface:** The wood work is made smooth by rubbing it with sand paper and the surface is cleaned.
- 2) **Knotting:** The knotting is the process of covering or killing of all knots in wood work with a substance through which the resin cannot come out or exude.
- 3) **Stopping:** The surface of the wood work is then rubbed again and cleaned. Before rubbing, the surface is applied with size of hot, weak glue.
- 4) **Varnishing coats:** Varnish is then applied in two coats. The second coat is applied after the first has dried.

## Cladding:



## Properties of cladding materials:

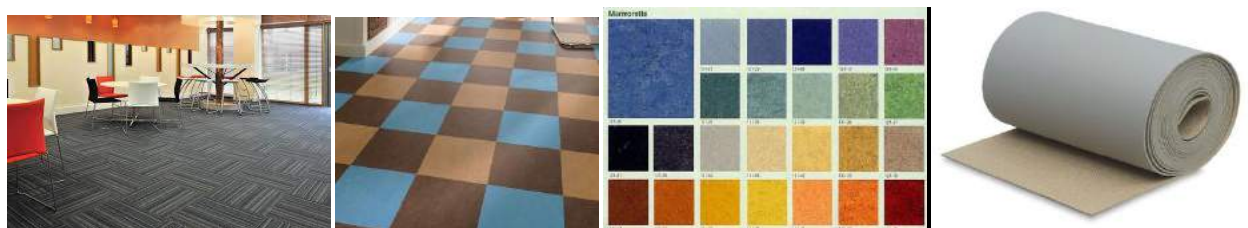
- 1) It should be durable.
- 2) It should be watertight.
- 3) It should be light in weight.
- 4) It should have good insulation against sound and heat.

## Uses of cladding:

- 1) It is used to make the structure sound proof.
- 2) It is used to cover worn or unattractive walls.
- 3) It is used to make the structure attractive.
- 4) It is used to protect the walls and roofs from rainwater.
- 5) It is used to protect the structure from high temperature.

## Linoleum:

Linoleum is a covering lay over wooden or concrete floors in order to hide the defects of flooring or to enhance its appearance.

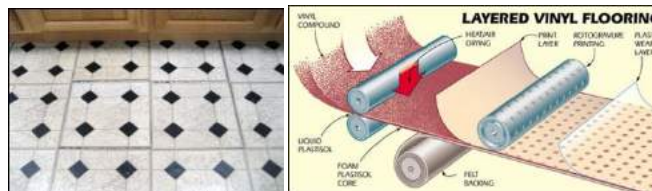


### Properties of linoleum:

- 1) It is washable and dustproof.
- 2) It reduces noise effectively.
- 3) It forms a long-wearing and durable surface.
- 4) It gives a decorative floor finish which looks very attractive
- 5) It is economical.

### Uses of linoleum –

- 1) Linoleum is most suitable decorative floor covering for wood and concrete floors
- 2) It is largely used in residential buildings, offices, schools, hospitals, libraries, restaurants
- 3) It is also used for railway carriages and buses etc.



- Linoleum is classified as plain, printed and inlaid. It is available in the form of tiles and rolls.
- The plain linoleum of a uniform colour is available in thickness of 2 to 4.5 mm.
- The thickness of printed linoleum range from 1.25 to 2mm.
- The width of the linoleum roll varies from 2 to 4 m.
- Linoleum floors require a dry and damp-proof surface.
- It is important to brush away all dust and dirt from the floor before the flooring is laid.
- Linoleum, if used as sheets, must be unrolled and lay loose for 2 to 3 days before it is cut to size as it shrinks in length and expands in width after rolling.
- Special adhesive is required for sticking the linoleum tiles to the floor.
- The adhesive is brushed over the base and allowed to become tacky.
- The sheet is then firmly pressed down and rolled with a light cast iron roller to ensure that no air pocket remains under the sheet.
- Sandbags are placed over the edges and joints to keep the sheet pressed down and prevent curling.

### Cladding Materials –

- 1) Timber
- 2) Stone
- 3) Vinyl
- 4) Glass
- 5) Weather boards
- 6) Aluminium
- 7) Tiles
- 8) Steel

## Chapter –6: Building materials from Agro & Industrial Wastes

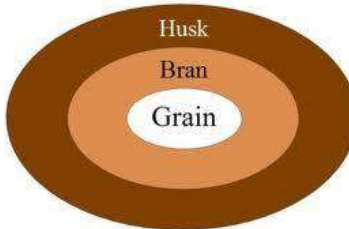
Marks -10

### Contents

- properties and uses of -: Rice husk, Bagasse, coir fibers, straw, coconut and Areca nut tree trunks, coconut leaf, Fly ash, Blast furnace slag, Granite and marble polishing waste, construction waste, Sawdust, Plastic, Polymer, rubber waste.

### Rice Husk

The outermost layer of the paddy grain is called rice husk. It is separated from the brown rice in rice mill.



#### Properties of rice husk:

- 1) Rice husk is difficult to ignite.
- 2) It is highly resistant to moisture penetration and fungal decomposition.
- 3) Rice husk has high silica content.
- 4) Rice husk has low bulk density.
- 5) Rice husk has high average calorific value.

#### Uses of rice husk:

- 1) Rice husk is used as insulating material.
- 2) It is used as renewable energy source.
- 3) It is used for manufacturing bricks.
- 4) Rice husk ash is used as fine aggregate in mortar and concrete.
- 5) Rice husk is used as fuel in boilers and for power generation.

### Bagasse

The dry, fibrous residue remaining after the extraction of juice from the crushed stalks of sugarcane is called as bagasse.



### Uses of bagasse :

- 1) It is used for making pressed building boards.
- 2) It is used for manufacturing acoustical tiles.
- 3) Bagasse ash is used as replacement for fine aggregates.
- 4) Bagasse ash is used for manufacturing bricks.

### Coir Fibers:



### Properties of coir fibers:

- 1) They have low density.
- 2) They have high specific strength to weight ratio.
- 3) They are non-toxic
- 4) They are bio-degradable.

### Uses of coir fibers:

- 1) They are used in floor mats, brushes, mattresses, floor tiles and sacking.
- 2) They are used for insulation and packing.
- 3) They are used for manufacturing rope.
- 4) They are also used for making fishing nets.
- 5) They are used for making geo-textiles.

### Straw:

The dry stalks of cereal plants, after the grain and chaff have been removed are called as straw.



### Properties of straw:

- 1) Straw has excellent thermal insulation property.
- 2) Straw has excellent sound insulation property.
- 3) Straw is inherently flammable.
- 4) Straw has low compressive and flexural strength and stiffness.

**Uses of straw:**

- 1) Straw is used to build straw bale houses.
- 2) Straw ash is used for manufacturing bricks.
- 3) Straw ash is used for manufacturing light weight mortar and concrete.
- 4) Straw is used for making mattress and packing materials.

**Coconut and Areca nut Tree****Properties of coconut & areca nut trunks:**

- 1) They possess good strength
- 2) Reasonably strong
- 3) Good thermal insulating properties
- 4) They are bio degradable

**Uses of coconut and areca tree trunks:**

- 1) They are used as pillars, trusses, ceiling joists and horizontal studs.
- 2) They are suitable for general structural purposes, such as furniture, window and doorframes, floors etc.
- 3) They are used for paneling, internal trim and ceilings as well as home-wares.
- 4) They are also used for making interior design materials.

**Uses of coconut leaves:**

- 1) Coconut leaves are plaited and used for thatching houses and sheds in rural areas.
- 2) Plaited coconut leaves are also used for making baskets, headgears and for erection of temporary fences.
- 3) Midribs of leaves are used to make brooms of different types.
- 4) Coconut leaves are also used to make paper pulp, hats and mats, fruit trays etc.

## Fly Ash

**Ans. Fly ash is the residue from the combustion of pulverized coal collected by mechanical or electrostatic separators from the flue gases or power plants.**



### Properties of fly ash:

- 1) Fly ash possesses pozzolanic property.
- 2) Fly ash particles are almost totally spherical in shape.
- 3) The 'Ball-bearing' effect of fly ash particles creates a lubricating action when concrete is in its plastic state.
- 4) Long term pozzolanic action of fly ash decreases permeability of concrete.
- 5) Lubricating action of fly ash reduces water content & drying shrinkage of concrete.

### Uses of fly ash:

- 1) It is used as structural fills in embankments, dams, dikes and levees.
- 2) It is used as sub-base and base courses in road way construction.
- 3) It is used for manufacturing bricks.
- 4) It is used in the form of fine aggregate for concrete and mortar.
- 5) It is used as land fill for land reclamations for residential, commercial and recreational development projects.
- 6) It is used for producing light weight refractory material and exotic high temperature resistant tiles.

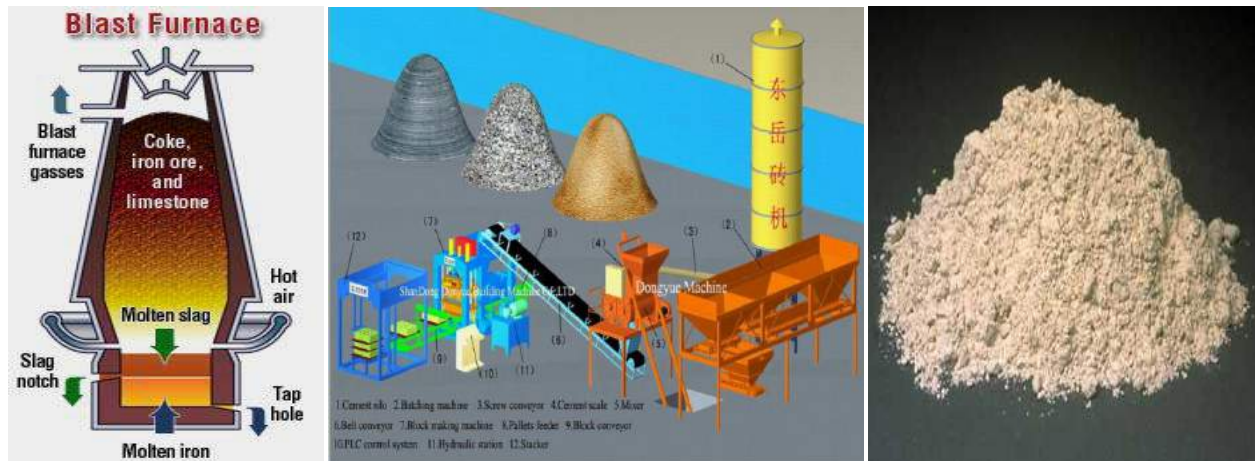
### Objectives of fly ash:

Following are the main objectives of using fly ash in concrete are to achieve one or more of the following benefits:

- 1) It improves the workability.
- 2) Fly ash reduces the cement content which reduces costs.
- 3) It reduces heat of hydration, especially in mass concreting.
- 4) It attains required levels of strength in concrete at ages beyond 56 days.

## Blast Furnace Slag:

Blast furnace slag is a by-product obtained while smelting iron ore in blast furnace.



### Properties of blast furnace slag:

- 1) It possesses cementations property.
- 2) It is mildly alkaline.
- 3) It contains a small component of elemental sulphur.
- 4) It has high water absorption value.

### Uses of blast furnace slag:

- 1) It is used for manufacturing aggregates.
- 2) It is used in the manufacturing light weight concrete.
- 3) It is used in the manufacturing of cement.
- 4) It is used in road bases.

## Granite and Marble Polishing Waste



### Properties of granite and marble polishing waste:

- 1) Good strength
- 2) Moisture resistance
- 3) High density
- 4) Possesses cementation properties



### Uses of granite and marble polishing waste:

- 1) It is used as aggregates in mortar and concrete.
- 2) It is used in the manufacturing of bricks.
- 3) It is used for manufacturing artificial stones.
- 4) It is used for manufacturing paving blocks.

## Construction Waste

### Types of construction wastes –

- 1) Wooden sheet materials
- 2) Paper
- 3) Rubber
- 4) Metals
- 5) Wood trims
- 6) Card board & boxes
- 7) Plastic sheets
- 8) Brick bats
- 9) Saw dust

### Uses of construction waste:

- 1) Waste generated from the construction should be recycled and reused.
- 2) Waste from the timber, such as saw dust can be used for making light weight concrete.
- 3) The pieces of bricks, hardened mortar and concrete can be used in the manufacturing of concrete blocks.
- 4) Metal and plastic pieces should be recycled and sent to metal & plastic industries for manufacturing of new product.

## Sawdust



### Uses of sawdust:

- 1) Sawdust is used for making concrete block.
- 2) Sawdust is used to make light weight mortar.
- 3) Sawdust ash is used as fine aggregate in concrete.
- 4) It is used in manufacturing of light weight aggregates.

## Plastics



### Properties of plastics:

- 1) It has low thermal conductivity.
- 2) It can be moulded to any desired shape or size.
- 3) It has high tensile and compressive strengths.
- 4) It has high strength to weight ratio.
- 5) It has high refractive index.

### Uses of plastics:

- 1) It is used as a substitute of glass for doors and windows.
- 2) It is used for insulation of electric cables, light fittings, hand rails etc.
- 3) It is used for manufacturing of electric equipments, refrigerator parts, food containers etc.
- 4) It is used for manufacturing of drainage pipes, floor finishes and emulsion paints.

## Polymers

A polymer is a chemical compound or mixture of compounds consisting of repeating structural units created through a process of polymerization.

### Properties of polymer:

- 1) Polymers change dramatically with temperature.
- 2) Polymers are light in weight with significant degrees of strength.
- 3) Polymers have good corrosion resistance.
- 4) Polymers have poor tensile strength.
- 5) Polymers have low coefficient of friction.
- 6) Polymers have good mould ability.

### Uses of polymers:

- 1) Polymers are used for insulation and packings
- 2) Polymers are used for cladding panels, sinks, surfaces, coatings.
- 3) Polymers are used as glazing sealants.
- 4) Polymers are used for making polymer concrete.

## Rubber Wastes



### Properties of rubber waste:

- 1) Good elasticity property
- 2) Good insulating properties
- 3) Water resistance
- 4) Excellent sealing properties
- 5) High compressive strength

### Uses of rubber waste:

- 1) Rubber waste can be used in cement mortar to make polymer mortar and improve its bonding and water proofing qualities.
- 2) It can be used in concrete for making polymer concrete.
- 3) It can be used for manufacturing rubber tiles for rubber floors.
- 4) It can be used for manufacturing tyres.

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