

# **DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY**

## **DEPARTMENT OF CIVIL ENGINEERING**

Second years

### **CE8391 – CONSTRUCTION MATERIALS**

#### **UNIT-I: - STONES – BRICKS – CONCRETE BLOCKS**

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Light weight concrete blocks

#### **PART A (2 MARKS)**

##### **1. What is a stone?**

The stone is always obtained from rock. The rock quarried from quarries is called stone.

Quarried stone may be in the form of stone blocks, stone aggregate, stone slabs, stone lintels etc.

##### **2.What are the uses of stone?**

For masonry work

For lintels and vertical columns

For covering floors and buildings

For paving of roads and footpaths

As an aggregate in cement as well as lime concretes.

##### **3. What are the various tests for stones?**

1. Smith's test

2. Freezing and thawing test

3. Frost action test

4. Acid test

5. Water absorption test

6. Microscopic examination

7. Impact test
8. Attrition test
9. Crushing test
10. Hardness test

#### **4. What are the causes for deterioration of stones?**

1. Temperature variation
2. Wetting and drying of stone
3. Frost action
4. Polluted atmosphere
5. Living organisms
6. Microscopic examination
7. Impact test
8. Attrition test
9. Crushing test
10. Hardness test

#### **5. What is an artificial stone?**

Cast stone or artificial stone is nothing, but hardened plain cement concrete, mould in suitable shape and size. Artificial stone consists of 1.5 parts of coarse aggregate of size 3mm to 6mm and 1.5 parts of coarse aggregate of size less than 3mm.

#### **6. What is meant by dressing of stones?**

Stones obtained from quarry are in irregular sizes and shapes and cannot be used as such in masonry work, without dressing. Dressing of stones is a process, carried out with the help of hand tools, to give proper shape and surface to the stone, before its use in masonry or any other work.

#### **7. What are the various operations of blasting?**

Boring or drilling of holes

Charging of the holes with explosive

Tamping of the holes with clay

Firing

**8. Name some blasting materials.**

Detonators , Fuse

Explosives – Gun powder, Dynamite, Gun cotton, Cordite, Blasting gelatin

**9. What are the classification of bricks?**

1. First class bricks
2. Second class bricks
3. Third class bricks
4. Over burnt or Jhama bricks
5. Under burnt or pilla bricks

**10. What is meant by pugging or tempering of clay?**

Pugging or tempering of clay means breaking up of prepared clay, watering and kneading till the earth becomes a homogeneous mass.

**11. What are the methods of moulding of bricks?**

1. Hand Moulding - Ground moulded and table moulded bricks
2. Machine Moulding – Plastic clay method, Dry pressed clay method

**12. What are the tests for bricks?**

1. Absorption test
2. Crushing strength test
3. Hardness test
4. Shape and size test
5. Soundness test
6. Test for presence of soluble salts.

**13. Define calcination.**

The process of heating the limestone to redness in the presence of atmospheric air is known as calcination.

**14. What are refractory bricks?**

The term refractory is used to indicate the materials which are able to withstand the effects of high temperatures, without affecting the structural strength of the material, by appreciable amount.

**15. Name any two natural pozzolonas.**

Clay and shales, opaline cherts, diatomaceous earth, volcanic tuffs and pumicites.

**16. Name any 2 artificial pozzolonas.**

Surkhi, flyash, blast furnace slag, silica fume, rice husk ash, metakaoline.

**17. What are the ingredients of a good brick earth?**

A good brick earth mainly consists of silica (sand), alumina (clay), lime, oxide of iron and magnesia.

**18. What is the purpose of dressing of stones?**

To get the appearance of stone masonry

To suit the requirements of stone masonry

To make the transportation of stone easy and economical from the quarry.

**19. What are the advantages of artificial stones?**

They can be cast in any shape and size.

They can be made stronger than natural stone.

They can be easily mould and seasoned at the site of work.

They do not require any dressing.

They can be designed for any strength.

**20. what is blending?**

The process of mixing ingredients in the manufacture of bricks is called as blending.

**PART B**

1. Explain Classification of rocks.
2. Briefly explain Tests for stones.
3. Explain criteria for selection of stones.
4. Briefly explain deterioration and preservation of stone work.
5. Briefly explain classification of bricks.
6. Explain operator diagram for preparation of brick earth
7. Explain in detail about test on bricks
8. Explain water absorption efflorescence test
9. Briefly explain additives in the manufacture of bricks.
10. Explain bricks for special use and refraction brick.
11. Explain in detail heat sketches for manufacture of cement.
12. Explain in detail about ingredients of cement blocks.
13. Explain in detail for preparation of concrete blocks.
14. Explain in detail for preparation of light weight concrete blocks.

## **UNIT-II**

### **LIME- CEMENT AGGREGATES –MORTAR**

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Industrial byproducts – Fly ash – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.

#### **PART A (2 MARKS)**

##### **1. Define lime.**

Lime is one of the earliest binding materials used in buildings because its raw materials are rich and widely distributed, the production process is simple and low-cost and it is easy to use. Therefore, lime is still widely used in construction until now.

##### **2. What is Quick lime.**

The lime obtained from the calcinations of pure limestone is known as quick lime.

##### **3. What is known as setting of lime.**

When lime converted to paste form is exposed to atmosphere, it gradually hardens. This phenomenon of slow hardening of lime in exposed conditions is known as setting of lime.

##### **4. What are the classification of lime.**

1. Fat lime
2. Hydraulic lime
3. Poor lime

**5. What are the varieties of lime.**

1. Stone lime – It is almost pure lime.
2. Kankar lime – It is impure or adulterated lime.
3. Shell lime – It is the purest form of lime.

**6. Define hydraulic lime.**

This lime has the property of setting under water. It is obtained by burning lime stone, containing a lot of clay and other substances which develop hydraulicity. Hydraulicity of this lime depends upon the amount of clay and type of clay present in it.

**7. What are the classifications of lime according to I.S. 712-1984.**

Class A lime, Class B lime, Class C lime, Class D lime, Class E lime, Class F lime

**8. What is natural cement?**

Natural cement is manufactured by burning and then crushing the natural cement stones. Natural cement stones are such stones which contain 20 to 40% of argillaceous matter i.e. clay, and remaining content mainly calcareous matter which is either calcium carbonate alone or a mixture of calcium carbonate and magnesium carbonate.

**9. What is artificial cement?**

Artificial cement is manufactured by burning an approximately proportioned mixture of calcareous and argillaceous materials at a very high temperature and then grinding the resulting burnt mixture to a fine powder.

**10. What is the function of gypsum in the manufacture of cement?**

In order to delay the setting action of cement, when mixed with water, a little percentage of gypsum is added in the clinker before grinding them to fine powder.

**11. What is known as clinker?**

Artificial cement is manufactured by burning approximately proportioned mixture of calcareous and argillaceous materials at a very high temperature and then grinding the resulting burnt mixture to a fine powder. The burnt mixture of calcareous and argillaceous matter is known as clinker.

**12. What are the constituents of ordinary cement?**

Alumina or clay, silica, lime, iron oxide, magnesia, sulphur trioxide, alkalies, calcium sulphate (gypsum).

**13. What are the harmful constituents of cement?**

Alkalies which are oxides of potassium and sodium, and magnesium oxide are the harmful constituents of cement.

**14. What are ball mills?**

Ball mills are used for grinding the clinkers. The ball mills consist of 2 to 2.5m diameter steel cylinder. The clinkers to be ground are fed into the cylinder and the cylinder is rotated about its horizontal axis to carry out the grinding action.

**15. What are the types of cement.**

Ordinary portland cement, rapid hardening cement, low heat cement, blast furnace slag . cement, sulphate resistant cement, air entraining cement, white and coloured cement, high alumina cement, pozzolanic cement, super sulphate cement, expansive cement, quick setting cement, water repellant cement, water proofing cement.

**16. What are the 2 methods of manufacture of cement**

1. Dry process 2. Wet process

**17. Define mortar.**

The mortar is a paste like substance prepared by adding required amount of water to a dry mixture of sand or fine aggregate with some binding material like clay, lime or cement.

**18. What is meant by grading of aggregates?**

Grading of aggregate means particle size distribution of the aggregate. If all the particle of an aggregate were of one size, more voids will be left on the aggregate mass properly graded aggregate produces dense concrete and needs smaller quantities of fine aggregate and cement. Grading determines the workability of the mix, which controls segregation, bleeding, water-cement ratio, handling, placing, and other characteristics of the mix.

**19. What are the types of mortars?**

1. Mud mortar
2. Lime mortar
3. Gauged mortar

**20. Define mud mortar.**

When clay is used as a binding material, the resulting mortar is known as mud mortar.

**PART B (16 MARKS)**

1. Briefly explain with neat sketcher for manufacture of lime
2. Briefly explain in detail about classification of lime.
3. Explain different types of lime and uses.
4. Briefly explain constituents of lime stone.
5. Briefly explain with neat sketcher for manufacture of cement.
6. Explain in detail about types and grades of cement.
7. Briefly explain properties of cement and cement mortar.
9. How to calculate compressive strength and tensile strength
11. Briefly explain laboratory test for fineness soundness and consistency of cement.
12. Explain setting time of cement and industrial by products.
15. Explain time following details-
  - (a) Crusting Strength
  - (b) Impact Strength
  - (c) Flakiness Index
  - (d) Elongation Index
16. Explain detail about grading and sand bulking.

**UNIT III**

**CONCRETE**

Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix



proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete.

## **PART A**

### **1. What are the methods of proportioning of concrete mixes?**

1. Arbitrary standard method
2. Minimum voids method
3. Fineness Modulus method
4. Maximum density method

### **2. Define Abram's water cement law.**

According to Abram's water cement law, the strength of concrete depends on the water cement ratio used.

### **3. Define bleeding.**

The tendency of water to rise to the surface of freshly laid concrete is known as bleeding.

### **4. Define laitance.**

The water rising to the surface during bleeding carries with it, particles of sand and cement, which on hardening form a scum layer known as laitance.

### **5. What are the steps adopted to control bleeding.**

By adding more cement

By using more finely ground cement

By using little air entraining agent

By increasing finer part of fine aggregate

By properly designing the mix and using minimum quantity of water.

### **6. Define Segregation.**

The tendency of separation of coarse aggregate grains from the concrete mass is called segregation.

### **7. What are the methods adopted to avoid segregation of concrete.**

1. Addition of little air entraining agents in the mix.

2. Restricting the amount of water to the smallest possible amount.
3. Concrete should not be allowed to fall from larger heights.

**8. Define workability.**

Workability is that property of concrete which determines the amount of internal work necessary to produce full compaction. It is a measure with which concrete can be handled from the mixer stage to its final fully compacted stage.

**9. What are the factors affecting workability.**

1. Quantity of water in the mix
2. Proper grading of the aggregate mix
3. Ratio of fine aggregate and coarse aggregate
4. Maximum size of coarse aggregates
5. Method of compaction of concrete

**10. What are the factors affecting proportioning of concrete mixes.**

1. Water cement ratio
2. Cement content
3. Temperature
4. Age of concrete
5. Size, shape and grading of aggregate
6. Curing

**11. Define mixing of concrete.**

The process of mixing cement, water, fine aggregate and coarse aggregate in suitable proportion is known as mixing of concrete.

**12. What are the methods of consolidation or compaction of concrete.**

1. Hand compaction
2. Machine compaction – i) Internal vibrators  
ii) Form vibrators

iii) Surface vibrators

**13. Define curing of concrete.**

Curing is the operation by which moist conditions are maintained on finished concrete surface, to promote continued hydration of cement .

**14. What are admixtures.**

Admixtures are ingredients other than cement, fine aggregate and coarse aggregate to improve the quality of concrete. The addition of an admixture may improve the concrete with respect to its strength, hardness, workability, water resisting power etc.

**15. Name the types of joints in concrete.**

1. Construction joints
2. Expansion joints
3. Contraction joints
4. Working joints

**16. Write the formula used for tensile strength of concrete.**

$$\text{Tensile strength} = \frac{\text{compression load along axis}}{\text{area in tension}} = \frac{2p}{\pi dl}$$

Where, p= load

d= diameter , l= length of the cylinder

**17. Define slump test.**

The standard apparatus for this test is the slump cone. It is used to measure the workability of concrete. Workability is used to define the ease or difficulty with which the concrete can be handled, transported and placed.

**18. What are the tests on fresh concrete?**

1. slump test
2. Flow test
3. Bleeding test
- 4 setting time

**PART B**

1. a) Explain any three tests for fresh concrete in detail.
- b) Explain any three tests for hardened concrete in detail.
2. Explain the design procedure for IS methods in manufacturing concrete.

3. Design the concrete mix for the following data: characteristic compressive strength=20mpa, maximum size of aggregate =20mm (angular), degree of workability =0.9CF, degree of quality control =good and type of exposure=severe. Water absorption by CA =0.5% and moisture concrete FA=2.0%. Assume any suitable missing data.
4. a) Explain the batching process of concrete.  
b) What are the methods of transportation of concrete? Explain them.
5. a) Explain finishing method in concrete surfaces.  
b) Explain the methods of pumping of concrete.
6. Describe the importance of curing? When should it be commenced? For how long should it be continued?
7. What are the reasons for the cracking of concrete and how does it affect durability.
8. What do you understand by carbonation of concrete? How is it tested?
9. a) Describe the hydration reaction of important Bogue's compounds indicating the products of hydration.  
b) What are the various factors which affect the workability of concrete?
10. a) Write in detail about Self Compacting Concrete.  
b) Write in detail about High Strength Concrete.

#### **UNIT IV**

#### **TIMBER AND OTHER MATERIALS**

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.

#### **PART A (2 MARKS)**

### **1. What is timber?**

Timber is obtained from trees. Timber denotes structural wood

### **2. What is standing timber?**

A standing living tree is known as standing timber.

### **3. What is rough timber?**

When a tree has been cut and its stem and branches are roughly converted into pieces of suitable lengths, it is known as rough timber.

### **4. What is converted timber?**

When roughly converted timber is further sawn and converted into commercial sizes such as planks, logs, battens, posts, beams, etc, it is called converted timber.

### **5. What is conversion of timber?**

The process by which timber is cut and sawn into suitable marketable sizes is known as conversion of timber.

### **6. Define seasoning of timber?**

A freshly felled tree contains a lot of moisture which is usually in the form of sap. The excess moisture has to be removed, before timber can be used for any structural purposes. The process of removing excess surplus moisture from freshly converted timber is known as seasoning of timber.

Name some common diseases of timber.

Dry rot & Wet rot

Define Artificial seasoning

Artificial seasoning – Water seasoning, boiling seasoning, kiln seasoning, chemical seasoning, electrical seasoning.

### **9. What is meant by distempering?**

It is a process of applying wash or coating like white-washing or color washing on the surface.

### **10. What is meant by varnish?**

Varnish is a solution of some resinous substance in alcohol, oil or turpentine. The process of covering the surface with varnish is known as varnishing. Varnishing is done on wooden surface.

**11. What are the constituents of the varnish?**

Resinous material

Driers

Solvents

**12. What are the constituents of oil paints?**

A base, an inert extender or filler, a vehicle or carrier, a drier, a solvent or thinner, a coloring pigment.

**13. What is veneers?**

Veneers are thin sheets or slice of wood of superior quality having thickness varying from 0.4mm to 0.6mm or more.

**14. What is thermocole?**

It is a light cellular plastic material used for sound and heat insulation of ceiling walls, refrigerators and for air conditioning of the building.

**15. What is laminate panel?**

It is a type of manufactured timber made from thin sheets of substrates or wood veneer.

**16. What is a hot-rolled steel section?**

Steel used for fabrication of trusses, column, beams etc., of the buildings are made by rolling hot steel ingots into various shapes in specially designed rolling mills.

**17. What is pigment?**

A pigment or strainer is a finely divided solid material which provides required shade and color to paint.

**18. What is thinner?**

It is a volatile substance that is added to paint which make its application easy and smooth.

**19. What is drier?**

It is a substance which acts as catalyst and quickens the drying of the vehicle used in the paint

## **PART B**

1. (a) Explain in details the types of paint works in buildings.  
(b) Explain the consideration in choosing paints.
2. What are the advantages of aluminium in construction?
3. Explain the types of hot-rolled steel sections and cold formed steel sections.
4. What are tests made for steel used in reinforced concrete construction?
5. Explain in details heat treatment of steel.
6. Explain any three common industrial product of timber.
7. Explain in detail the causes of decay of wood work and their preservation.
8. Explain in defects in timber with suitable diagrams.
9. Write in detail about the process of seasoning of timber.
10. Write about the manufacture of TMT bars.

## **UNIT V**

### **MODERN MATERIALS**

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geomembranes and Geotextiles for earth reinforcement.

### **PART A (2 MARKS)**

#### **1. Define glass.**

It is a mixture of a number of metallic silicates, one of which is usually that of an alkali metal. Various varieties of glass have developed in recent times for various purpose and today, it is possible to make glass lighter than a cork.

#### **2. What are the types of glass?**

Soda lime glass, borosilicate glass, potash lead glass, potash lime glass, common glass.

#### **3. Name the process of manufacturing of glass.**

Like metal, glass is solidified liquid and is manufactured by following processes:

Float glass process

Rolled glass process

Architectural glazing systems manufacturing process

#### **4. What is meant by heat treatment process?**

To improve the strength of glass it is usually heat-treated. The heat treatment processes develop compression in the outer surface of the glass, thus increasing the resistance to a tensile failure. The heat treatment consists of either heating the outside surface, or the entire glass sheet.

#### **5. What are the applications of treatment of glass?**

Cutting and grinding

Bending

Opaque making

Silvering

#### **6. Define Sealant.**

Contraction and expansion joints are provided in concrete work. Hence these joints must be filled by some material which should adjust itself as per contraction and expansion. Such materials are called as sealant.

#### **7. What are the types of sealant?**

Normal sealant for building joint

Sealant for runways- It must have sufficient resistant against fuel solvents, i.e., liquid fuels.

#### **8. Define the term ceramics.**

The term ceramics means the technology and the art of making objects with clay and similar materials by treating with fire.

#### **9. What is geosynthetics?**

Geofabrics are also called geosynthetics or geotextiles. These are synthetic fabrics which are sufficiently durable to last a good length of time in soil environment used in geotechnical engineering.

#### **10. What are geomembranes?**



These materials are available in wide range of permeability. Continuous geomembrane barriers of sufficiently low permeability can be used to control fluid migration in geotechnical engineering while those of high permeability are used for drainage.

### **11. Define porcelain.**

The term porcelain is used to the white translucent, strong ceramic material made of kaolin and feldspar with transparent glaze. They are produced by firing at very high temperature.

### **12. What are the considerations in choosing floor tiles for a building?**

- Water absorption
- Quality and thickness of glaze
- Wall and floor tiles
- Aesthetics
- Function
- cost

## **PART B**

1. What is Glass? Explain the various properties of Glass?
2. Describe the process of manufacturing of Glass? What are the Uses of glass in construction industry?
3. What are the classifications of Glass?
4. Write a short note on Ceramic products? What are the various applications of ceramic products?
5. Explain in detail about Reinforced Plastics? What are the properties and uses?
6. Explain in detail about Composite materials and its Uses?
7. Explain in detail about Refractories? What are the different types of refractory Bricks?
8. What are Geosynthesis? How are they classified? What are the advantages & applications?
9. What is Terra cotta? How it is manufactured?
10. Write in detail about Earth reinforcement using Geomembrane?