Internal Assessment Test 2 – Apr. 2018

Sub:	Alternative Building Materials					Sub Code:	15CV653	Branch:	CIVIL
Date:	19/ 04 / 18	Duration:	90 mins	Max Marks:	50	Sem/Sec:	VI-A/B		OBE

SOLUTIONS

1. (a) Write about the origin and use of pozzolana citing examples.

Pozzolana: Supplementary Cementitious Materials

- The name Pozzolan comes from the town Pozzuoli, Italy.
- Ancient Romans (~100 B.C.) produced a hydraulic binder by mixing hydrated lime with soil (predominantly volcanic ash)
- Nowadays, the word pozzolan covers a broad range of natural and artificial materials.

Pozzolan: A material that, when used in conjunction with portland cement, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity, or both.

- **Natural (Volcanic ash, volcanic tuff, pumicite)**
- **Artificial (fly ash, silica-fume, granulated blast furnace slag)**

Siliceous or aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in **the presence of moisture**, chemically react with calcium hydroxide $Ca(OH)_2$ to form compounds possessing hydraulic cementitious properties.

IS Codes Used:
Pozzolana Cement code – IS 1489 – 1991
Pozzolanic materials used –
Calcined Clay – IS 1489 Part 2- 1991
Fly Ash – IS 1489 Part 1 – 1991.

1. (b) Discuss the pozolanic action of pozzolana with cement.

(i) In OPC

- Bougue's Compounds:
- C_3S – Tri Calcium Silicate- $3CaO.\ Sio_2$
- C_2S - Di Calcium Silicate- $2CaO.\ Sio_2$
- C_3A - Tri Calcium Aluminate- $3CaO.\ Al_2O_3$
- C_4AF -Tetra Calcium Aluminoferrite- $3CaO.\ Al_2O_3$

(ii) On Hydration

- **C_3S – Tri Calcium Silicate-**

$2(3CaO.\ Sio_2) + 6H_2O \rightarrow 3CaO.\ 2\ Sio_2\ .\ 3H_2O + \underline{3Ca(OH)_2}$

- **C_2S - Di Calcium Silicate- $2CaO.\ Sio_2$**

$2(2CaO.\ Sio_2) + 4H_2O \rightarrow 3CaO.\ 2\ Sio_2\ .\ 3H_2O + \underline{Ca(OH)_2}$

(iii) This Calcium Hydroxide gives the following side effects:

- This is soluble in water so it'll get leached out → Makes concrete porous.
- Durability reduces when its presence increases.
- $Ca(OH)_2$ reacts with sulphates in soil or water → Calcium Sulphate → Calcium sulphate + C_3A → Deteriorates concrete. → Which is called Sulphate Attack

(iv) Solution to this problem:

Convert this $Ca(OH)_2$ to a cementitious product → so use Flyash, Silica Fume etc.

(v) Pozollanic Reactions:

Calcium Hydroxide+Silica+Water → "Calcium-Silicate-Hydrate"

(C-S-H)

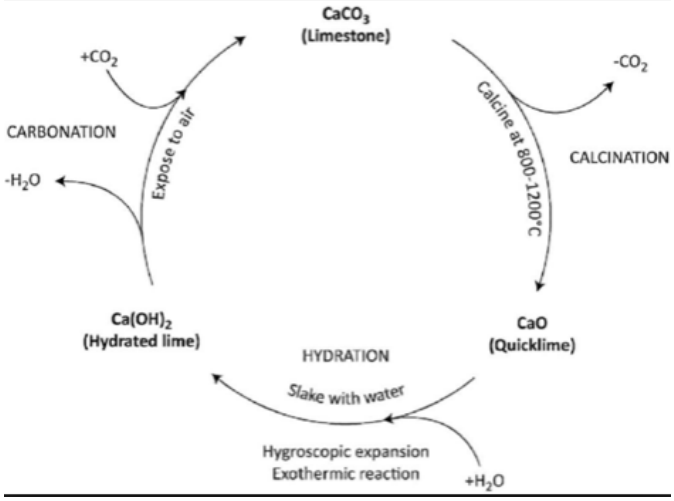
C-S-H provides the hydraulic binding property of the material.

Pozzolanic Activity: Capacity of pozzolan to form alumino-silicates with lime to form cementitious products.

2. (a) Write the properties and uses of at least 4 agro waste.

S. No.	Waste Name	Source	Use	Processing Required/ Properties	Benefits
1	Rice Husk			RH + Phenol = Boards	Replacement of plywood, Environment friendly
2	Rice Husk Ash			RH burnt under controlled condition --> Amorphous silica --> Pozollanic properties	
3	Bagasse	Sugarcane	For wattle and daub walls		
4	Lantane	Weed	Substitute for cane	Termite resistant properties --> Mats woven to make daub and wattle walls	
5	Sugar cane tops		Thatching		In roofs--> Lasts for more than 5 years.
6	Cane		1. For funiture & Wattle and daub walls, 2. Long rounded cane lengths used in truss.		
7	Coir Fibre		1. Fibre cement composites, 2. Alternative to glass fibre reinforced polyester composites	Fibre + Polyester resin	Cheaper, energy efficient alternative to glass fibre reinforced polyester composites.
8	Sisal fibre		1. Fibre cement composites, 2. Alternative to glass fibre reinforced polyester composites	Fibre + Polyester resin	Cheaper, energy efficient alternative to glass fibre reinforced polyester composites.
9	Straw		Roofs		Not durable not last for more than a year and for rainfall more than 1000mm
10	Bamboo		North east region, wattle and daub walls in Mysore and Shimoga		
11	Coconut & Areca Nut Tree trunks		Tibre substitute		
12	Coconut Leaves		Tatching		

2. (b) Draw the lime cycle.



3. What is a composite wall explain with neat diagrams.

When walls are constructed with two or more types building materials, it is termed as composite masonary.

The composite masonary is adopted due to following reasons:-

1. It reduces overall cost of construction.
2. It improves the appearance of the structure by concealing the inferior work.
3. It makes the use of locally available materials, to obtain optimum economy.

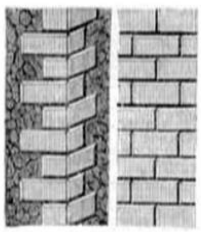
How are they built?

- Sometimes the facing and backing of a wall are constructed with different classes of masonry or of different materials.
- Following are the usual combination
  - Facing of ashlar masonry and backing of rubble masonry brickwork
  - Facing of stone slabs and backing of concrete or brickwork
  - Facing of brickwork and backing of rubble masonry
  - Facing of brickwork and backing of cement concrete
  - Facing of brickwork and backing of hollow cement concrete blocks

Ashlar facing with rubble backing

In this type of composite masonry rough tooled and chamfered stones are provided in facing while rubble masonry in backing

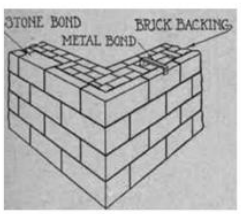
This may reduce the cost of construction as the rubble are available at a cheap rae



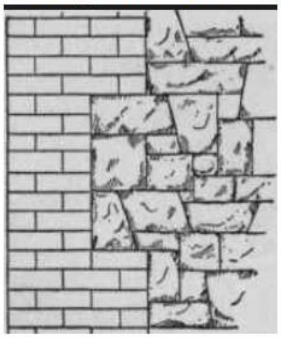
Ashlar facing with brick backing

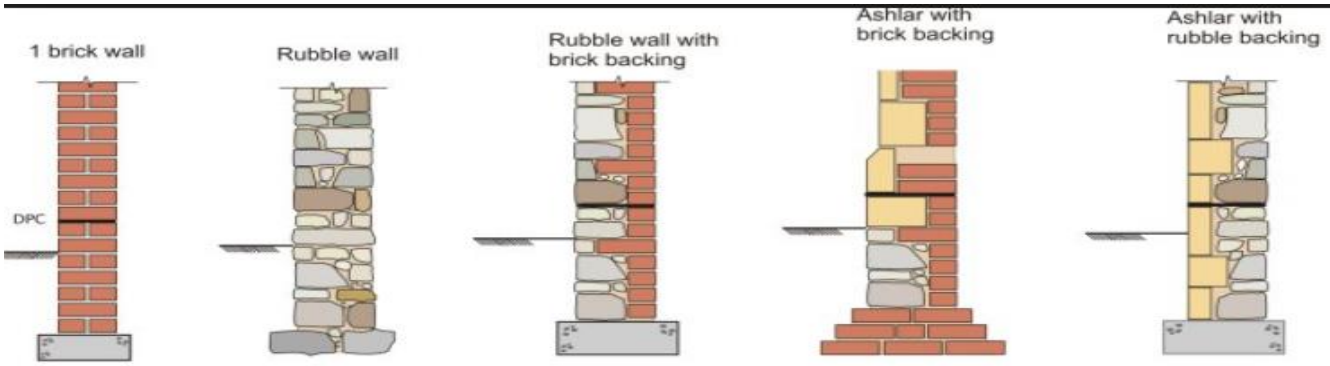
-Composite masonry rough tooled, chamfered stones are provide in facing while brick work is provide in backing.

-Alternate courses of ashlars may be header under each projecting course of ashlar,header brick should be used.

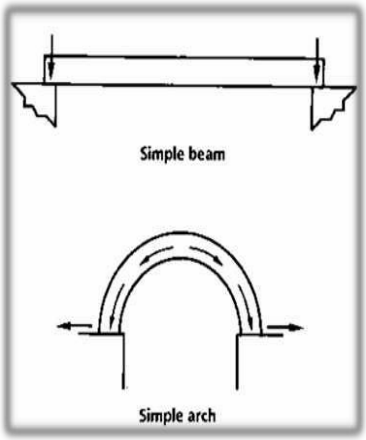


Brick Backing with Stone facing

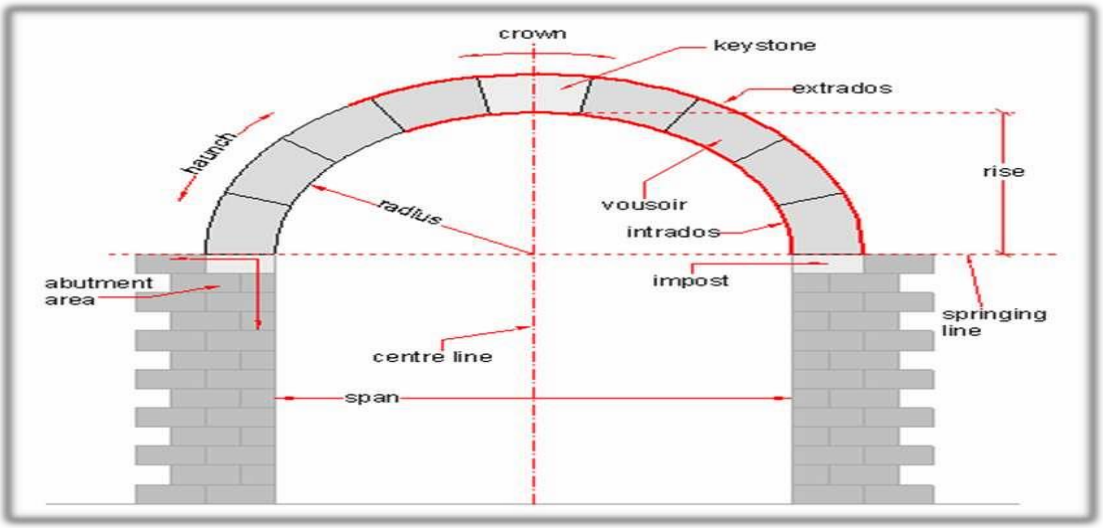




4. (a) How does an arch work?



4.(b) What are the various parts of an arch? Show it in a neat diagram.



5. What are fibres? Draw its shape and explain its uses.

Fibres are reinforcing materials in concrete.
They are:

- Metallic fibres
- Polymeric fibres
- Mineral fibres
- Natural fibres

(i) Metallic Fibres:

- Metallic fibres are made of steel.
- The tensile strength of fibres ranges from 345MPa to 1380MPa.
- Minimum suggested by ASTM is 345MPa.
- The modulus of elasticity is about 200GPa.
- The fibres may be rectangular, square, or irregular .
- The length of the fibre is normally less than 75mm.
- The aspect-ratio varies from 30 to 100.

VARIOUS SHAPES OF STEEL FIBRES

- Steel fibres commonly used has diameter 0.4mm to 0.8mm and a length of 25mm – 60mm.
- Aspect ratio – Length to diameter ratio(non circular c/s)

(ii) Polymeric Fibres:

- Synthetic polymeric fibres have been produced as a result of research and development in the petrochemicals and textile industries.
- Fibre types that have been tried with cement matrices include acrylic, aramid, nylon, polyester, polyethylene, and propylene.
- All these fibres have high tensile strength; however, except aramid fibres all have low modulus of elasticity. Primary limitations which comes with aramid fibres is their high cost.

(iii) Mineral Fibres:
Glass Fibres:

- Glass fibres are primarily used for glass fibre reinforced cement sheets. Regular E-glass fibres were found to deteriorate in concrete. This observation led to the development of alkali resistant AR-glass fibres.
- There are however two main problems in the use of glass fibres in Portland cement products, namely, the breakage of fibres and the surface degradation of the glass by the high alkalinity of the hydrated cement paste.

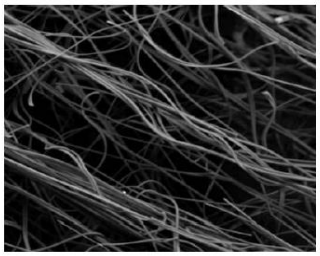
(iv) Natural Fibres:

- The oldest forms of fibre reinforced composites were made with naturally occurring fibres such as straw and horse hair.
- Modern technology has made it possible to extract fibres economically from various plants such as jute and bamboo to be used in cement composites.
- A unique aspect of these fibres is the low amount of energy required to extract these fibres.
- Example of Natural fibres are : Bamboo fibres , Coconut fibres & Jute fibres



(v) Carbon Fibres:

- Carbon fibres have high modulus of elasticity and are two to three times stronger than steel.
- They are also very light with a specific gravity 1.9.
- They are also inert to most of the chemicals.



6. Can you make use of industrial waste in any of the building element? If so discuss the waste source, its properties and what element of building can be made?

S. No.	Waste Name	Source	Use	Processing Required/ Properties	Benefits
1	Fly ash			Amorphos silica & Alumina - Pozzolanic Properties	
2	Blast furnace slag	Slag from B. F	Portland Blast furnace cement		Can be used in aggressive environment
3	Iron ore Tailings	150 Million Tons - Kudremukh Iron ore tailings		79% Sand & 19% silt	
4	Gold Mine tailings	Gold extracted from finely crushed granite, 35 Million tons Kolar gold fields waste		Silty in nature & No pozzolanic properties	
5	Granite fines				
6	Marble polishing fines		Used in Manufature of Quick and Hydraulic Lime; 1. Quick Lime: Mix boiled starch & make ball aggregate - burn 2. Hydraulic lime: Mix with clay and make ball -Burn	10 - 20% clay	Making fine concrete - 20% fines + 80% sand+ 6-7% cement (can only be compacted and not vibrated)
7	Demolished building wastes		<2mm Size - Sieved out- used as sand in mortar and plastering. 2. Broken concrete and brick bats - In low strength conc. - flooring		Low strength conc can only be got.