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VALLAM
PART A

Note: Each question carries two marks.

1. What are the factors to be considered during pile driving?
   - The process of forcing a pile into the ground without excavation is termed as pile driving.
   - The piles should be driven vertically.
   - A pile is supposed to reach a hard stratum when it does not settle more than 10 mm with 10 blows of a 2 tonne hammer falling through a height of 80 cm.

2. Write the need of high strength concrete in pre-stressed concrete.
   - Necessity of using high strength steel and concrete.
   - Recognition of losses of prestress due to various causes.

3. State any two advantages of prefabrication system.
   - Economy in formwork and shuttering
   - Mass production
   - Independent of weather
   - Increased productivity
   - Site labour is minimized
   - Total construction time and project duration is less
   - Better quality control
   - New technological method of construction
   - Less waste may occur.

4. What are the stages of pre-casting?

<table>
<thead>
<tr>
<th>Precasting stage no.</th>
<th>Name of process</th>
<th>Operation involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Procurement and storage of construction materials</td>
<td>Unloading and transport of cement, coarse and fine aggregates and steel and storing them in bins, silos</td>
</tr>
<tr>
<td>2.</td>
<td>Testing of raw materials</td>
<td>Test of all materials including steel</td>
</tr>
<tr>
<td>3.</td>
<td>Design of concrete mix</td>
<td>Testing of raw materials, plotting of grading curves and trial of mixes in laboratory</td>
</tr>
<tr>
<td>4.</td>
<td>Making of reinforcement cages</td>
<td>Unloading of reinforcement bar from wagons or lorries and stacking them in the steel yard, cutting, bending, tying or welding the reinforcements and making in the form of a cage</td>
</tr>
<tr>
<td>5.</td>
<td>Placing a reinforcement cages, inserts and fixtures</td>
<td>The reinforcement cages are placed in the moulds with spacers etc</td>
</tr>
</tbody>
</table>

5. What are the causes of earthquakes?
   - Tectonic activity
   - Volcanic activity
   - Land-slides and rock falls
   - Rock bursting in a mine
   - Nuclear explosions
6. What is an expansion joint?
> Expansion joints are provided in slabs wherever considered essential to prevent local cracking.
> Expansion joints are full depth joints provided at specified intervals along the transverse direction of the pavement.

7. What are escalators?
> Escalator is a moving staircase.
> A conveyor transport device carrying people between floors of building.
> Escalators are used around the world to move pedestrian traffic in places where elevators would be impractical.

8. What are the materials used for repairs in buildings?
> Polymer-based crack fillers
> Mortar admixtures
> Waterproofing compounds
> Bonding agents
> Paint admixtures
> Water repellants, etc.
PART-B

Note: Each question carries three marks

9. Write any five classifications of admixtures.
   ➢ Plasticizers
   ➢ Accelerators
   ➢ Retarders
   ➢ Air entraining admixtures
   ➢ Gas forming admixtures
   ➢ Water proofing admixtures
   ➢ Workability admixtures
   ➢ Colouring admixtures
   ➢ Bonding admixtures

10. Write the uses of fiber reinforced concrete.
    ➢ Used in road pavements.
    ➢ Used in industrial flooring.
    ➢ Used in bridge decks.
    ➢ Used for canal living.
    ➢ Used in explosive resistant structures.
    ➢ Used as refractory livings.

11. Write any five equipments used in pre-cast concrete industry.
    ➢ Mobile block machines
    ➢ Multilayer paver machines
    ➢ Tilting tables and vibration
    ➢ Stationary block making machines
    ➢ Tilt mould machines
    ➢ Paving laying machines
    ➢ Construction lifts and lifting platforms
    ➢ Truck cranes and trailer cranes

12. Write any three precautionary measures to minimize danger of fire.
    ➢ Cigarette and matches are thoroughly extinguished before throwing them in rubbish.
    ➢ Entrust the work of wiring and electrical installations to an expert.
    ➢ Evacuate your home as soon as possible. Do not allow toxic fumes to take control of your mind.
    ➢ If your clothes catch on fire, drop to the floor and roll to extinguish the flames.
    ➢ Never smoke in bed.
    ➢ Train your family members or staff members for fighting a fire and acquaint them with the fire preventive measures.

13. What are the precautions to be taken during earthquake?
    ➢ Stay where you are taking cover and be ready to move until the tremors stop.
    ➢ Building lay down on the floor, use door frames as shelter.
    ➢ Stay away from glazed windows, fireplaces, stores.
    ➢ Find a safe place under your bed or table that is strong enough.
    ➢ Move to an open space, away from large trees or buildings.
Stay away from cracks in ground caused by earthquake.
Driving a car, stop when it is safe, and stay inside the car.
On a beach, immediately go to higher ground.
Large scale earthquake can cause dangerous tsunamis for several minutes.

14. **Write any the methods adopted for repair of cracks.**
- Resin injection
- Routing and scaling
- Stitching
- External stressing
- Bonding
- Blanketing
- Overlays
- Dry pack
- Vacuum impregnation
- Polymer impregnation
- Flexible sealing

15. **Write the materials used for filling cracks.**
- Epoxy primer and epoxy moldable putty for fine to medium cracks i.e. hairline to 15 mm wide.
- Structural epoxy pouring resin for cracks over 15 mm wide.
- Premixed cement concrete or mortars.
- Polymer modified mortars and concrete.
- Fillet seal powder or bond acryl for floor to wall joint filling.

16. **Explain modular kitchen.**
- Modular kitchens are those designed and constructed in modules, usually of standard sizes.
- Units which are kept on the floor are called as ‘floor unit’, ‘floor cabinets’ or ‘base cabinets’.
- This unit consists of a kitchen worktop, often made of granite or marble.
- The units placed on the wall for storage purpose are termed as ‘wall units’ or ‘wall cabinets’.
- These storage units are available as tall units which help in effective storage in small kitchen areas, say in apartments.
PART-C
Note: Each question carries ten marks

17. (a) Explain about the causes of failure of piles.
- Absence of statistical data regarding the nature of strata through which piles are to be driven.
- Actual load coming on the pile being more than the designed load.
- Attack by insects, etc. on wooden piles, causing thereby decay of timber piles.
- Bad workmanship in case of cast-in-situ cement concrete piles.
- Breakage due to overdriving especially in case of timber piles.
- Damage due to abrasion resulting from the absence of suitable protective covering.
- Improper choice of the method of driving the pile. (5 Marks)

- Improper choice of the type of pile.
- Improper classification of soils.
- Insufficient reinforcement or misplacement of reinforcement in case of RCC piles.
- Lateral forces not being taken into the design of the pile.
- Misinterpretation of the results obtained during test loads.
- Presence of soft strata just below the tips of piles.
- Wrongful use of pile formula for determining its load bearing capacity. (5 Marks)

(Or)

(b) (i) Explain the production process of fiber reinforced concrete.
- Mixing of fiber reinforced concrete needs more skill to avoid balling of fibers, segregation, and uniform mixing of materials.
- Increase in the aspect ratio, volume percentage and size and quantity of coarse aggregate intensify the difficulties and balling tendencies.
- Steel fiber content in excess of 2 percent by volume and an aspect ratio of more than 100 are difficult to mix. (1 Mark)

- The typical proportions for fiber reinforced concrete are given below.
  - Cement concrete: 325 to 550 kg/m³
  - Water - cement ratio: 0.4 to 0.6
  - Percentage of sand to total aggregate: 50 to 100
  - Maximum aggregate size: 10 mm
  - Air content: 6 to 9 % by volume of mix
  - Fiber content: 0.5 to 2.5 % by volume of mix
  - Steel: 1% = 78 kg/m³
  - Glass: 1% = 25 kg/m³
  - Nylon: 1% = 11 kg/m³

- It is important that the fibers are dispersed uniformly throughout the mix.
- This can be achieved by adding fibers before water is added.
For even distribution of fibers, when mixing is done in a laboratory mixer, the fibers are introduced through a wire mesh basket.

For field use, other suitable methods must be adopted. (4 Marks)

(ii) Explain Lee McCull system of pre-stressing with a neat sketch.

- Lee-McCall system, the tendons comprise high tensile bars of diameter varying from 12 to 40 mm which are threaded at the ends.
- To insert the bar into the flexible rubber tube and suitably placed and tied in position in the formwork of the member to be concreted.
- Concrete is poured into the form work and after it has attained required strength.
- Perforated bearing plates with one hole for each rod are provided at each end.
- At each end of the bar one nut with washer is screwed.
- Hydraulic jacks are used for applying prestressing force.
- When the rod is stretched to the required length, the nuts are tightened. (3 Marks)

![Lee McCull System](image)

- Cement grout is then forced through the grouting holes to fill the annular space of rod completely.
- Finally, the projecting rod cut off and the end anchorage is plastered. (1 Mark)

18. (a) Write briefly the preparation and storage of materials for pre-fabrication of structural element.

- Storage of material is of considerable importance in the precasting industry, as a mistake in planning in this aspect can greatly influence the economics of production.
- From experience in construction, it is clear that there will be very high percentage of loss of materials as well as poor quality due to bad storage and transport.
- So, in precast factory, where everything is produced with special emphasis on quality, proper storage and preservation of building materials especially cements, coarse and fine aggregates, is of prime importance. (2 Marks)
Storage of cement

Storage of cement can be effective either in specially erected storage sheds where cement can be stored in the form of bags or in silos where it is stored loose. (2 Marks)

Storage or coarse and fine aggregates

The coarse and fine aggregates can be stacked either in open or in bunkers.
In the case of open storage, the parallel - boxes method with dividing walls up to about 3 meters in height, is considered to be most convenient and economical.
The dividing walls can be made of precast RCC retaining walls or steel or timber panels inserted between the columns.
In planning this method of storage, the following points shall be kept in mind.
The stored aggregate shall be protected from mixing up with the local earth, clay or coal.
The various bins or boxes shall be properly designated about the size and type of material stored.
Dumping of one class or size of aggregates in the wrong bin should be avoided.
Yet another method of open storage is by heaps under which a tunnel is provided with conveyor belt system to extract from the heap whichever material is required.
In planning the storage of coarse and fine aggregate, bins, silos, etc. shall have a minimum storage capacity and shall be designed to supply requirement of the factory.
As far as batching silos are concerned, 2 to 4 hours storage capacity shall be provided. (6 Marks)

(Or)

(b) Write a brief note on manufacture of pre-cast concrete elements.

Factory prefabrication

Factory prefabrication is resorted to in a centrally located plant for manufacture of standardized components on a long term basis.
It is capital intensive production where work is done throughout the year preferably under a closed shed to avoid effects of seasonal variations.
High level of mechanization can always be introduced on this system where the work can be organized in a factory- like manner with the help of constant team of workmen. (5 Marks)

Site fabrication

The components are manufactured at site or near the site of work as possible.
This system is normally adopted for a specific job order for a short period.
The work is normally carried out in open space with locally available labour force.
The equipment machinery and moulds are of mobile nature. (5 Marks)
19. (a) Explain seismic force and effect of seismic forces on buildings.

- Earthquake consists of various forms of waves originating at centre of disturbance and causing horizontal and vertical ground movements or vibrations.
- The movements are complicated due to forced and superimposed vibrations.
- These movements are divided into vertical and horizontal vibrations.
- The horizontal vibrations are much greater than the vertical ones and these horizontal vibrations are mainly considered in designing earthquake resisting structures.

(3 Marks)

Effect of seismic forces on buildings

- The most destructive force is caused by horizontal earth motion.
- When the ground below a structure is moved suddenly to one side, the building will try to remain in its original position because of its inertia.
- A earthquake may occur in any direction, hence buildings should be strong enough to resist lateral forces in any direction.

(2 Marks)

EARTH MOTION

- The sudden change from rest to motion is the cause of forces on the superstructure in a direction opposite to that of the earth movement.
- An earthquake produces movements in the ground in the form of waves it should be reasonable to take into account the ‘ridge’ and ‘valley’ effects in buildings.
- Every building has a natural period of vibration.
- When vibrations are introduced in a building by an earthquake having the same period of vibrations as the natural period of vibration of the building, would occur and the building would be completely destroyed.
- The vibration periods of earthquakes have a rate of 1 to 2.5 seconds.
- The self- vibration periods of reinforced concrete building vary between 0.3 and 0.5 second for building up to 27.50 meters in height.
- Floors and cross walls should be continues throughout the buildings and openings should be avoided near the outside corners.
- The fire resistance of monolithic concrete makes its use desirable in earthquake proof building construction.

(4 Marks)
(Or)

(b) Explain the general rules for fire resistant buildings.

Alarm systems

- These systems are installed with a view to give an alarm and to call for assistance in case of fire.
- The fire alarm also gives enough time and warning to the occupants to reach to a safe place.
- Alarm systems may be either automatic or manual.
- Automatic alarm system is usually installed in large industrial buildings which are unoccupied at night.
- The automatic fire alarm sends the information to the nearest control point and at the same time, message is also sent to the nearest fire brigade station. (1 Mark)

Production of openings

- Solid timber doors of thickness not less than 40 mm may be used in situations where some degree of fire resistance is to be achieved.
- All openings for communication in the fire-resisting structures should be fitted with double fire proof doors and the remaining openings should be fitted with single fire proof doors.
- Fire-proof windows usually consist of 60 mm thick wired glass fixed in steel frame.
- If any structure is situated within a distance of 6 meters from fire-resistant structures, all doors and windows of fire-resistant structures facing the other structure should be made of fire-proof construction. (1 Mark)

![Diagram of fire-resistant doors](image)

- The doors are the usual means of escape when fire occurs.
- Such escape doors should be given special treatment and they should be provided with suitable fittings which are not affected by heat.
- The exit doors should not be covered with curtains and they should be clearly visible.
- The doors should open in the direction of escape.
- The self-closing device of the door should not be such as to ease resistance to the opening of the door. (1 Mark)
Common wall
- When a fire-resisting building adjoins another building, the common wall dividing the two structures should be of a minimum thickness of two bricks.
- Such a common wall should be raised above roof level by at least 90 cm.

(1 Mark)

Partition wall
- The partition wall should be carried up to same height as any roof within a distance of 120 cm of it and any roof feature such as dormer, lantern, etc.

(1 Mark)

Stair
- An emergency ladder should be provided in the fire resisting building.
- The ladder should be at least 90 cm wide and it should be constructed from fire resisting materials.
- Such an emergency stair should be provided with a fire proof door and the door should be fixed in such a way that it can only be closed from inside of the building.

(1 Mark)

Floors
- The floors of fire resisting building should be of RCC of minimum thickness 15 cm or of 6 mm thick steel plates.

(1 Mark)

Fire extinguishing arrangements
- Depending upon the importance of the building from the view point of fire, suitable arrangements are to be made for extinguishment of fire.
- The usual equipments required for fire extinguishing are as follows:
  (i) Manual fire extinguishing equipment
      - These include portable fire extinguishers, the usual being carbon dioxide type.
      - Sometimes buckets of water, sand and asbestos blankets may be kept ready at all times to extinguish fire.

(ii) Internal hydrants
    - Hydrants should be located in or around the building so that water can be easily available for fire-fighting.

(iii) Automatic sprinkler installation
    - This arrangement is adopted for important structures such as textile mills, paper mills, factories, warehouses, theatres, hospitals, machine shops, coal conveyors, etc.
    - The arrangement consists of a system of overhead pipes which are fixed in the ceiling of the room.
    - The pipes are usually provided at a centre to centre distance of 3 meters.
    - Heat actuated devices, known as sprinkler heads, are fitted at regular intervals usually 3 meters, along the pipes.

(1 Mark)
20. (a) Explain the various types of mechanical methods of demolition of buildings.

i) Demolition hall:

- Used for fairly large brick structures and for reinforced concrete buildings.
- For breaking up mass concrete and reinforced slabs and floors.
- Crane operator has to work at some distance from the structure being demolished.
- The structure being demolished should be detached from any other building.

(4 Marks)

ii) Pusher arm method:

- Involves the use of an extended arm and steel pad fitted to tracked vehicle in place of the excavator bucket.
- The pusher arm placed on the top most section of a brick wall and forward motion is applied.
- This type of machine is more versatile than the other machinery.

(3 Marks)

iii) Clam shell

- Demolition by clamshell typically involves the use of a crane equipped with a clam shell attachment which progressively bites away the structure.
- The clam shell shall be operated not less than 1m above the structure being demolished.

(3 Marks)

(Or)

(b) Explain about repairs of various elements of a building.

Resin injection

The resin injection under pressure will ensure that the sealing material or sealant penetrates to the full depth of the cracks.
- The injection holes are drilled at close intervals along the length of the crack and the epoxy is injected under pressure in each hole in turn till the injection material starts to flow out of the next hole.

Routing and sealing

- Groove cut with saw or chipping tools
- Minimum
- Joint sealant

- This is a simple and most common method which can be used to seal both fine pattern cracks and large isolated cracks.
- This technique is used to seal the crack against the ingress of moisture, chemical and carbon dioxide.
- Care should be taken to ensure that the entire crack is routed and sealed.

Stitching

- Note variable length, location and orientation of staples so that tension across crack is distributed in the concrete rather than concentrated on a single plane.
- Holes drilled in concrete to receive staples. Fill holes with nonshrink grout or epoxy.
In this technique, the crack is bridged with U-shaped metal units called stitching dogs before being repaired with a rigid resin material.

External stressing

- Cracks are developed due to tensile stress and this is arrested by including compression force sufficient enough to overcome the compressive force by using the prestressing wires or rods and some form of abutment is needed for anchorage.

Bonding
- Cracks are bonded by the injection of epoxy bonding compounds under pressure.

Dry packing
- Dry packing is the hand placement of a low w/c ratio mortar which is subsequently rammed in to place to produce a dense mortar plug having tight contact to the existing concrete.

Vacuum impregnation
- This treatment is used for treating large number of cracks.
- The part of the structure to be treated is enclosed with an air tight plastic cover and then the air form all cracks within the cover is sucked by applying vacuum.
- This process is extensively used to reduce the permeability of weak concrete or masonry.

Drilling and plugging
- This is particularly useful for cracks running in reasonably straight lines and accessible at one end.
- The crack is drilled down the length and filled with grouting material.

Coatings
- A wide range of surface penetrating sealers and coating ranging from thin, purely cosmetic treatment to thick membranes can be applied to cracked concrete.
- Anti-carbonation coatings applied to concrete surface to arrest the carbonation process.

21. (a) Write a note on property renovation.

Property renovation
- This is defined as the process of restoring to an earlier condition by repairing or remodeling.
(i) **Modular kitchens**
- Modular kitchens are those designed and constructed in modules, usually of standard sizes.
- Module is a segment of a unit which one can choose.
- These pre-manufactured modules bring down the cost of a kitchen.
- Units which are kept on the floor are called as 'floor units', 'floor cabinets' or 'base cabinets'.
- This unit consists of a kitchen worktop, often made of granite or marble.
- The units placed on the wall for storage purpose are termed as 'wall units' or 'wall cabinets'.
- These storage units are available as tall units which helps in effective storage in small kitchen area, say in apartments. (1 Mark)

(ii) **Bathrooms**
- Bathrooms are often one of the smallest rooms in the house and also one of the most expenses to renovate.
- A well-designed and decorated and updated bathroom can increase the value of a home by more than the actual cost of the work.
- Some examples of renovation are:
  - Re-tiling walls and floors alone or replacing the old vanity, basin and toilet.
  - If the bathroom looks small, re-doing it in pale colours can make the room appear larger.
  - Or adding mirror to give the feeling of spaciousness.
  - To make the new bathroom eco friendly, consider the following:
    - Water-saving showerheads, taps and appliances
    - Greywater recycling systems
    - Under floor or exterior rainwater tanks
    - A composting toilet
    - Eco-friendly finishes (1 Mark)

(iii) **New Windows**
- Windows enhance the ambience of a room and play a crucial role in maintaining and energy efficient home.
- The tighter seals and more advanced construction of many modern windows prevent cold and hot air from escaping and help keep a more comfortable.
- In addition, attractive windows can breathe new life into older homes.
- Replacement windows should be double glazed low emissivity to conserve heat. (1 Mark)

(iv) **Doors and Timber floors**
- **Doors**
  - New doors can be doors of a different size large or small, or doors with sidelights, windows on the sides of the doors.
  - As a first step the size of the frame should be modified. (1 Mark)
- **Timber floors**
  - Wood floors that show of the grain and beauty of the wood are an instant eye-catcher in a home.
Renovating is well worth your investment, especially when the floors are antique. 
Steps involved in renovation of timber floors.
- Remove any staples or nails from the surface of the floor.
- Sand down the floor with the power sander, working in the direction of the boards, and not across them.
- Fill in any large holes with wood filler.
- Fill in the hole with a scraper, smooth over and allow to dry according to the directions.
- Apply a coat of wood sealer to close the pores in the wood floor surface.
- Allow it to dry for about two hours.

(v) **Roof insulation**
- The ideal way to insulate any home or industrial premises and give higher thermal resistance is to have it insulated through particular roof insulation material.
- Roof insulation material has many advantages and some of them are stopping radiant heat, preserving energy and amending more comfort with less utility cost.

![Roof insulation diagram](image)

- Roof insulation foil will reduce the amount of sun's radiant heat that penetrate in summer up to 97% and also render better thermal protection in colder situation in winter.
- Roof insulation materials are basically of two different types; reflective insulation material and bulk insulation materials in the form of blankets, blown in cellulose, sprayed foam and rigid boards.
- Roof insulation material also helps in saving money because every bit of loss in temperature can result into higher energy consumption and higher expense.

(vi) **Dry lining**
- Internal insulation involves fixing insulation to the inner surfaces of the external walls and covering it with a vapour barrier layer and plasterboard or, alternatively, composite boards of plasterboard backed with insulation and incorporating a vapour barrier.
(vii) Building energy rating
- A building energy rating is a rating on the overall energy efficiency of a residential building or a commercial.
- The rating is similar to the energy label for a household electrical appliance.
- It is denoted on scale of A to G with A being the most energy efficient and G being the least energy efficient.

(1 Mark)

(Or)

(b) Write a note on drafting a construction contract.
- Title the contract- The title should describe the purpose of the contract.
- Name the parties of the contract - Specify who the parties of the contract are and designate each as either contractor or client.
- The address where the work will be done.
- Describe the work that will be done - It should be as clear as possible about exactly what work is covered under the contract.
- Describe the time frame in which the work will be completed.
- Describe how any changes to the work order will be handled.
- Contractor who requires a written agreement signed in both parties in order to change the work order.
(5 Marks)

- Check your state law for required inclusions. Many states require certain notices and disclosure be provided to consumers, some in the contract itself.
- Warranties—many states require construction contracts to contain various warranties regarding the labour and materials to be used.
- Resolution of disputes—Contract for construction in some states must contain a clause spelling out the available methods of dispute resolution.
- Notice of right to cancel - Some states require construction contracts to notify homeowners of their right to cancel the contract within a certain period of time.
Determine what, if any, standard clauses you may need. Standard clauses one might wish to include in a construction contract include:
- Choice of law
- Successors and assigns
- Severability.

Create a signature line; the signature line should include space for each party to sign with his or her typed or printed name, address, and telephone number below the signature.

(5 Marks)

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It is certified that all the answers are correct in the key.

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