

**UNIT 1 – MAINTENANCE AND REPAIR STRATEGIES**  
**PART A**

**1. List down the main objectives of maintenance of buildings (or) What is the importance of maintenance? (Apr / May 2017) (Apr / May 2016) (Apr / May 2014) (May / June 2012) (Nov**

- |   |   |
|---|---|
| a) Improves the service life of structure           | d) Leads to quicker detection of defects            |
| b) Better appearance and aesthetical appealing      | e) Prevents major deterioration leading to Collapse |
| c) Better serviceability of elements and components | f) Ensures safety to user                           |

**2. State the causes of deterioration in reinforced concrete structures (or) What are the causes of distress in concrete structures? Or List Out any four causes of deterioration of structures. (Apr / May 2017) (Nov / Dec 2015) (Apr / May 2011) (Nov/ Dec 2013)(Nov / Dec 2012)( Apr / May 2018)**

- |  |  |
|--|--|
| a) Deterioration due to corrosion  | d) Quality of supervision                          |
| b) Environmental effects   | e) Design errors like inadequate structural Design |
| c) Poor quality material used  |  |
| f) Construction errors like adding water to concrete, improper alignment of formwork, improper curing, movement of formwork, improper location of reinforcing steel. |  |

**3. What is the economic appraisal of structure? (Apr / May 2016) (Apr / May 2014)**

Economic Appraisal of structure is a type of decision method applied to a project ,that takes into account a wide range of costs and benefits.

**4. Define a defect. (Apr / May 2015) (May / June 2013)**

A defect is a physical condition of a structure in which something is wrong with a part of that structure. It is also defined as a fault or problem in the structure that spoils the structure not to use correctly.

**5. What are the causes for surface cracks on the concrete top surface? (Apr / May 2015)**

- a) Applied forces on the members are greater than what they could withstand. The imbalance in the load causes serious strains in the structure and ultimately the sign of distress appear as crack and the imbalance in the distribution stress is released.
- b) The main cause of cracks in the concrete occurs due to the change in moisture of concrete. The Following are the causes for surface cracks on concrete surface:
- i. Temperature of concrete
  - ii. Relative humidity of ambient air
  - iii. Exposure of heat from sun radiation
  - iv. Velocity of wind

**6. Write short notes on weekly and monthly maintenance. (May / June 2013)** Maintenance can also be classified based on duration or frequency

**Weekly Routine Maintenance**

- a) Electrical accessories
- b) Cob webs cleaning
- c) Flushing sewer line
- d) Leakage of water line

**Monthly Routine Maintenance**

- a) Cleaning doors, windows, latches, etc...,
- b) Checking septic tank / sewer
- c) Observation for cracks in the elements
- d) Cleaning of overhead tanks
- e) Peeling of plaster, dampness, floor cracks

**7. Distinguish between Repair and Rehabilitation. (May / June 2012)**

Repair	Rehabilitation
i. Repair refers to modification of a structure partly or wholly which is damaged in appearance and serviceability	i. Rehabilitation is the process of restoring the structure to its service level; it once had and now lost
ii. Repair is the treatment of distress in the structure	ii. Only certain portions or damaged components are treated to enhance the strength of the structure

**8. Define the term maintenance. (Apr / May 2011) (Apr/May 2018)**

Maintenance is the act of keeping something in good condition by checking or repairing it regularly. The two facets of maintenance are – Prevention and Repair

**9. State the rapid structural assessment order. (Nov / Dec 2015)**

- a) Physical inspection of damaged structure
- b) Preparation and documenting the damages
- c) Collection of samples and carrying out tests both in – situ and in lab
- d) Studying the documents including structural aspects

- e) Estimation of loads acting on the structure
- f) Estimate of environmental effects including soil structure interaction
- g) Diagnosis
- h) Taking preventive steps not to cause further damage
- i) Retrospective analysis to get the diagnosis confirmed
- j) Assessment of structural adequacy
- k) Estimation of future use
- l) Remedial measures necessary to strengthen and repairing the structure
- m) Post repair evaluation through tests
- n) Load tests to study the behavior
- o) Choice of course of action for the restoration of structure.

**10. What is preventive maintenance? (Nov / Dec 2012)**

Preventive maintenance is intended to preserve the structure by preventing the failure and detecting the incipient faults. (Work is done before failure takes place).It includes thorough inspection, planning the program of maintenance and executing the work.

**11. Why is inspection needed for damaged structures?(Nov / Dec 2011)**

- a) To improve the life of structure
- b) To improved life period gives better return on investment
- c) Leads to quicker detection of defects and hence remedial measures
- d) To Prevents major deterioration and leading to collapse
- e) To Ensure safety to occupants
- f) To Ensure feeling of confidence on the user

**12. What do you mean by deterioration?(Nov / Dec 2011)**

Corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete. When steel corrodes, the resulting rust occupies a greater volume than the steel. This expansion creates tensile stresses in the concrete, which can eventually cause cracking, delamination and spalling of concrete resulting in deterioration

**13. Define physical inspection of damaged structure.**

Some of the use full information may be obtained from the physical inspection of damaged structure, like nature of distress, type of distress, extent damage and its classification etc, their causes preparing and documenting the damages, collecting the samples for laboratory testing and analysis, planning for in situ testing, special environmental effects which have not been considered at the design stage and information on the loads acting on the existing structure at the time of damage may be, obtained. To stop further damages, preventive measure necessary may be planned which may warrant urgent execution

**14. How deterioration occurs due to corrosion?**

- a) Spalling of concrete cover
- b) Cracks parallel to the reinforcement
- c) Spalling at edges
- d) Swelling of concrete
- e) Internal cracking around the rebar
- f) Reduction in area of steel reinforcement

**15. Discuss about the environment effects which leads to deterioration of concrete structure.**

Micro-cracks present in the concrete are the sources of ingress of moistures atmospheric carbon di-oxide into the concrete which attack reinforcement and with various ingredients of concrete. In aggressive environme4nt concrete structure will be severely reduces.

**16. What is the effect of selecting poor quality material for construction?**

Quality of materials, to be used in construction, should be ensured by means various tests as specified in the IS codes. Alkali-aggregate reaction and sulphate attack results in early deterioration. Clayey materials in the fine aggregates weaken the mortar aggregate bond and reduce the strength. Salinity causes corrosion of reinforcing bars as well as deterioration of concrete.

**17. How can we determine the cause for deterioration of concrete structure?**

- a) Inspect & observe the structure
- b) Observe in bad & good weather
- c) Compare with other constructions on the area or elsewhere & be patient
- d) Study the problem & allow enough time to do the job

**18. What is the broad classification of maintenance?**

- a) Preventive maintenance
- b) Routine maintenance
- c) Remedial maintenance
- d) Special maintenance

**19. What are the steps in repair aspect?**

- a) Finding the deterioration
- b) Determining the cause
- c) Evaluating the strength of existing building or structure
- d) Evaluating the need of repair
- e) Selecting & implementing a repair procedure

- 20. Define the fixed percentage method of evaluating the strength of existing structure.** It is to assume that all members which have lost less than some predetermined % of their strength are still adequate and that all members which have lost more than the strength are inadequate. It is usually from 15% onwards higher values are applicable for piling % stiffness bearing plates etc.
- 21. Discuss about the quality of supervision to be followed at a site**  
Construction work should be carried out as per the laid down specification. Adherence to specified water-cement ratio controls strength, permeability durability of concrete. Insufficient vibration may result in porous and honey combined concrete, whereas excess vibration may cause segregation
- 22. What are the possible decisions that can be made after evaluating the strength of a structure?**
- To permit deterioration to continue
  - To strengthen the construction
  - To make measures to preserve the structure in its present condition without strengthening
  - If deterioration is exceptionally severe, to reconstruct or possibly abandon it.
- 23. How can we evaluate the strength of existing structure by stress analysis?**  
This method is to make detailed stress analysis of the structure, as it stands including allowances for loss of section where it has occurred. This is more difficult & expensive. Here also the first step is to make preliminary analysis by fixed percentage method and if it appears that major repairs will be required, the strength is reevaluated based on detailed stress analysis, considering all contributions to such strength.
- 24. Define the load test method of evaluating the strength of existing structure.**  
Load tests may be required by the local building offered, but they should only be performed where computation indicated that there is reasonable margin of safety against collapse, lest the test bring the structure down. Load test show strengths much greater than computed strengths when performed on actual structures. When performed on actual structures. In repair work every little bit of strength is important.
- 25. What are the possible decisions after finding a structure to be inadequate?**
- If the appearance of the existing condition is objectionable – repair now
  - If appearance is not a problem then put the condition under observation to check if it is dormant or progressive.
  - If dormant – no repair
  - If progressive – check the feasibility & relative economics of permitting deterioration to continue and performing a repair at some later date & of making the repair right away.

### **PART B**

- Explain the importance of maintenance. (Apr / May 2015) (Nov / Dec 2011)
  - What are the facets of maintenance? (Apr / May 2015)
- List any four defects in each concrete and steel structure. Explain the causes and effects. (Apr / May 2015) (May / June 2012)
- Discuss the various facets of maintenance. Explain briefly the various causes of deterioration concrete. (Nov / Dec 2015) (Nov / Dec 2012)
- Explain the various categories of inspection based on methods and interval
  - Draw a flowchart of the general approach adopted pre-repair evaluation of distress concrete structures. (Apr / May 2017) (May / June 2013)
- Prepare a report on damage classification of the structural members based on the output of preliminary investigation. (Apr / May 2017)
- Discuss the various causes of deterioration of concrete structures mentioning their effects / symptoms. (Apr / May 2016) (Nov / Dec 2011)
- Discuss the procedure of assessment for evaluating a damaged structure. (Apr / May 2018)
  - Enumerate the various factors of maintenance of a concrete structure (Apr / May 2016)

### PART C

1. (a) Differentiate between repair and maintenance of building. (4)  
(b) Explain the step by step procedure to be followed to assess damage structure and to carry out rehabilitation work. (12) **(Apr / May 2014)**
2. (a) Discuss the importance of maintenance./ Time based maintenance (6)  
(b) With graph explain the service life behavior of a concrete structure with respect to maintenance. (10). **(May / June 2013) (May / June 2012)**
3. Write the various aspects of inspection? **(Apr/May 2018)**
4. (a) Describe about the inspection to be carried out during and after the construction of structure. (10)  
(b) Under what circumstance premature deterioration of concrete takes place? Briefly explain. (6)  
**(Apr / May 2014)**

## UNIT 2 – STRENGTH AND DURABILITY OF CONCRETE

### PART A

1. Distinguish between structural cracks and non – structural cracks with example. **(Apr / May 2017)**

#### **Non-Structural Crack**

These are small less than 3mm in diameter cracks that do not at the moment threaten the integrity of the home. They appear in foundation. Weather conditions, temperature changes and moisture content naturally cause the foundation to experience these cracks

#### **Structural Crack**

There are a number of different issues that cause structural cracks, like swollen soil, poor soil bearing, poor construction sites and overloading. Structural cracks may result in sloping floors and windows sticking. Generally, structural cracks appear wider than 3mm in length. They can appear in the wall beams, foundation walls or slabs. And they usually extend to the upper floor. They can be vertical, horizontal, diagonal or run like a staircase.

2. **In what way carbonation of concrete affects the structures? (Apr / May 2017)**
  - a) Carbonation of concrete is associated with the corrosion of steel reinforcement and with shrinkage.
  - b) Within a few hours, or a day or two at most, the surface of fresh concrete will have reacted with CO<sub>2</sub> from the air. Gradually, the process penetrates deeper into the concrete at a rate proportional to the square root of time.
  - c) After a year or so it may typically have reached a depth of perhaps 1 mm for dense concrete of low permeability made with a low water/cement ratio, or up to 5 mm or more for more porous and permeable concrete made using a high water/cement ratio.
3. **What is the role of cover in RC structure? (Apr / May 2016) (Nov / Dec 2013)**

Sufficient cover is required for the reinforcement in concrete structures for protection against corrosion. The thicker the cover over the steel is, the longer it will take the chloride ions to reach the steel and reduce the pH and passivity provided by the cement. However, excessive cover can lead to the development of a few wide cracks under overstress, whereas a thinner cover results in many small cracks.
4. **Define “durable concrete”. (Apr / May 2016) (Nov / Dec 2013)**

The durability of cement concrete is defined as its ability to resist weathering action, chemical attack, abrasion, or any other process of deterioration.
5. **List out the causes of cracks. (Apr / May 2014)**
  - a) Use of unsound material
  - b) Freezing & thawing
  - c) Poor & bad workmanship
  - d) Thermal effects
  - e) Use of high water-cement ratio
  - f) Shrinkage stresses

**6. Name any four durable properties of concrete. Or What are the factors that affect the durability of concrete? (Apr / May 2015) (May / June 2013)( Apr / May 2018)**

The following are the durability parameters:

- a) Water – cement ratio
- b) Curing period
- c) Cover to reinforcement
- d) Cement content and its properties
- e) Aggregates
- f) Workability
- g) Admixtures
- h) Environmental interactions
- i) Transition zone between aggregate and cement matrix

**7. Briefly discuss about the effect of climate on hardened concrete. (May / June 2012) (Apr / May 2015)**

The most severe climatic attack on concrete occurs when concrete containing moisture is subjected to cycles of freezing and thawing.

The capillary pores in the cement are of such a size that water in them will freeze when the ambient temperature is below 0°C.

**8. Discuss the effect of temperature on concrete. (May / June 2013)**

- a) Changes in temperature cause corresponding changes in the volume of concrete thereby resulting in shrinkage of concrete.
- b) Heat of hydration is an exothermic reaction. Due to this internal temperature change occurs in the concrete resulting in thermal stresses
- c) In mass concrete, internal core temperature is higher than the surface. Due to differential change in temperature cracking occurs.
- d) Concrete and steel has different co-efficient of thermal expansion. Steel expands first, so reduction in diameter of steel takes place. Therefore interface bond between steel and concrete breaks.

**9. What is the effect of cover thickness in concrete? Or State the Importance of cover thickness in concrete. (Apr / May 2014) (Apr / May 2018)**

- a) Cover thickness is the primary physical protection to the steel reinforcement.
- b) Larger cover thickness delays the initiation of corrosion since the time taken for corrosion products like CO<sub>2</sub>, chloride will take longer for penetration
- c) Optimum cover thickness to be chosen based on the exposure conditions

Exposure conditions	Nominal concrete cover in mm should not be less than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

**10. Explain the importance of “coefficient of thermal expansion” with respect to strength of concrete. (May / June 2012)**

- a) Thermal resistance of concrete decides the lifetime of concrete. It plays a vital role in runways, chemical storage tanks, nuclear power plant, high temperature reactors etc.,
- b) Cement paste, aggregates and reinforcement steel have more or less non – uniform co – efficient of thermal expansion. Here reinforcement steel expands first when subjected to higher temperature, so reduction in diameter of steel takes place.
- c) Hence interface between the bond between the reinforcement steel and cement paste breaks, affecting the strength, durability and stability of concrete. Selection of materials should be compatible to prevent this problem.

**11. Write the needs of quality assurance. (Apr / May 2011)**

The needs of quality assurance are:

- a) Standards
- b) Production control
- c) Compliance control
- d) Task and responsibilities
- e) Guarantees for users

**12. Define corrosion. (Apr / May 2011)**

- a) The gradual deterioration of concrete by chemically aggressive agent is called corrosion.

- b) Corrosion is a natural process, which converts a refined metal to a more chemically-stable form, such as its oxide, hydroxide, or sulphide. It is the gradual destruction of materials (usually metals) by chemical and/or electrochemical reaction with their environment.
- c) Rusting, the formation of iron oxides, is a well-known example of electrochemical corrosion.

**13. What are the symptoms of design error in buildings? (Nov / Dec 2015)**

- a) Abrupt changes in section
- b) Insufficient reinforcement at corners and openings
- c) Inadequate provision for deflection
- d) Inadequate provision for drainage
- e) Insufficient travel in expansion joints
- f) Incompatibility of materials
- g) Neglect of creep effect
- h) Rigid joints between precast units
- i) Unanticipated shear stresses in piers, columns, or abutments
- j) Inadequate joint spacing in slabs

**14. How do you prevent cracks due to biological attack? (Nov / Dec 2015)**

The following actions are inexpensive (for most buildings) and can be effective, and should be considered for any building:

- a) Prevent access to building air intakes;
- b) Upgrade and maintain the HVAC system;
- c) Prevent access to building exhausts;
- d) Prevent access to HVAC equipment;
- e) Prevent access to building and HVAC plans;
- f) Develop and train an emergency response team;
- g) Establish external congregation areas;
- h) Plan and practice responding to a release

**15. What is effect of fire on concrete? (Nov / Dec 2012)**

Concrete temperatures up to 95°C have little effect on the strength and other properties of concrete. Above this threshold cement paste undergoes shrinkage (contraction) due to dehydration and aggregates expand due to temperature rise which results in overall expansion of concrete and reduction in its strength.

**16. What is the result of poor construction practices? (Nov / Dec 2012)**

- a) Discontinuities on the surface of concrete
- b) Improper consolidation leads to bug holes and honey combing
- c) Structural cracking

**17. Define the term “quality assurance” in concrete structures.(Nov / Dec 2011)**

Quality assurance is a function of the implementing unit to verify that the work is done in accordance with the specifications. It includes all those planned and systematic actions necessary to provide confidence that the product or service will satisfy given requirements for quality

**18. What do you mean by structural cracks? Give two examples.(Nov / Dec 2011)**

Structural cracks may arise due to various reasons such as in correct design, overloading of the structural members. Structural cracks endanger the stability of the building and may be difficult to be rectified. Expansive cracking of foundation walls, beams, columns, is an example of structural cracks.

**19. List out the various types of spalling?**

- a) General or destructive spalling
- b) Local spalling which is subdivided as
  - i. Aggregate splitting
  - ii. Comer separations
  - iii. Surface spalling
  - iv. Sloughing off

**20. What are the types of cracks?**

Class-1: Cracks leading to structural failure

Class-2: Cracks causing corrosion

Class-3: Cracks affecting function

Class-4: Cracks affecting appearance

**21. List out some coating for reinforcement to prevent corrosion?**

- a) Organic coating
- c) Metallic coating
- b) Epoxy coating
- d) Zinc coating

**22. Write any two tests for assessment of frost damage?**

The frost damage can be assessed by several ways:

- a) Assessment of loss of weight of a sample of concrete subjected to a certain number of cycles of freezing and thawing is one of the methods
- b) Measuring the change in the ultrasonic pulse velocity or the damage in the change in the dynamic modulus of elasticity of specimen is another method.

**23. List the various components of quality control.**

Five components of a quality (control) assurance system are:

- a) Standards
- d) Task and responsibilities
- b) Production control
- e) Guarantees for users
- c) Compliance control

**24. Give some examples for corrosion inhibitors?**

- a) Anodic inhibitors
- b) Cathodic inhibitors
- c) Mixed inhibitors
- d) Dangerous & safe inhibitors

**25. List some faults in construction planning?**

- a) Overloading of members by construction loads
- b) Loading of partially constructed members
- c) Differential shrinkage between sections of construction
- d) Omission of designed movement joints

**PART B**

1. How do you ensure quality of the day of concreting? Explain in detail (Apr / May 2015)(Nov/ Dec 2015)(May / June 2013)
2. Explain in detail about the effects of sustained elevated temperature on hardened reinforced concrete. Or Effect of Climate on concrete structures? (Apr / May 2015) (Apr/May 2018)
3. Describe the various corrosion prevention techniques. (Nov / Dec 2015)
4. (a) List the functions of quality control during concrete construction  
(b) How materials, water cement ratio, placement of reinforcing steel, formwork, curing, vibration and compaction influence the quality control of the structure? (Apr / May 2017)
5. (a) Explain the importance of concrete cover in RCC structures. Give recommendations of IS 456 – 2000 for nominal cover.  
(b) List various construction and design deficiency which causes distress in the RCC structure. (Apr / May 2017)
6. Explain how quality assurance plays an important role in construction industry. Also explain the parameters affecting the quality of concrete construction. (Apr / May 2016)(Nov / Dec 2012)
7. What is meant by corrosion of rebars? Discuss the factors influencing corrosion. Explain the behavior of concrete construction due to faulty design and corrosion errors. (Apr / May 2016)(Nov / Dec 2012)
8. (a) Explain how concrete structure is affected by thermal condition. Or Effect of Temperature on concrete (8) (May / June 2013) (Apr/May 2018)  
(b) Describe about the design errors for concrete building. (8) (Apr / May 2014)
9. Why quality assurance for structure is needed? Explain the components of quality assurance for building. (Apr / May 2014)
10. With chemical equations, explain the mechanism of corrosion. (May / June 2012)

**PART C**

1. With neat sketches explain the possible design and constructional errors. (May / June 2012)
2. (a) Discuss the property of permeability of concrete its influencing factors and various methods to reduce the same.  
(b) Discuss a method of rebar corrosion in concrete. (Nov / Dec 2011)
3. Write a note on thermal properties of concrete. (Nov / Dec 2011)
4. Explain the different types of cracks found in concrete structures. Also list the Remedial Measures. (Apr/May 2018)

**UNIT 3 – SPECIAL CONCRETE**

**PART A**

1. State the merits and applications of sulphur infiltrated concrete in construction practice. (Apr / May 2017)
  - a) Sulphur – (impregnated) infiltration can be employed in the precast industries.
  - b) Sulphur infiltration concrete should found considerable use in industry situation where high corrosion resistant concrete is required.
2. Why fibre reinforced concrete is preferred in water retaining structures, blast resistance structures and repair and rehabilitation works? (Apr / May 2017)

Due to the following advantages FRC is preferred widely

  - a) Mix becomes cohesive and possibilities of segregation are reduced
  - b) Fibres help to reduce cracking and permit the use of thin concrete sections
  - c) Strength, durability, Impact resistance, tensile and bending strength are improved.

**3. Name any two special mortars for repair with applications. (Apr / May 2016)**

**Fire shielding mortars:** They are produced by aluminous cements and finely powdered fire bricks in the ratio of 1:2.

Used for setting refractory bricks in the furnace linings where the temperature is too high

**Damp – Proofing mortars:** They are prepared using high grade sulphate-resisting Portland cement or sulphur resisting pozzolana cement and quartz sand or sand from crushed rock. It is used as water proofing seams and joints.

**4. List any two properties of concrete chemicals. (Apr / May 2016)**

- a) Accelerators reduce the setting time, generally produce early removal of forms and early setting of concrete repair, and patch work. They are helpful in cold weather concreting
- b) Retarders increase the setting time of the concrete mix and reduce the water-cement ratio.
- c) A plasticizer is defined as an admixture added to wet concrete mix to impart adequate workability properties.

**5. What is meant by volume fraction in FRC? (Apr / May 2015)**

The amount of fibers added to a concrete mix is expressed as a percentage of the total volume of the composite (concrete and fibers), termed "volume fraction" (Vf)

**Effect:** The strength of the composite largely depends on the quantity of fibres, the effect of volume on the toughness and strength. The fibre volume at which this situation is reached depends on the length and diameter of the fibre.

**6. State the application of Ferro – cement. (Apr / May 2014)**

- a) Rehabilitation of distressed elements
- b) Construction of domes, vaults, shells
- c) Used in precast application
- d) Precast walls panels, floor slabs, water tanks, sunshades, manhole covers, etc...

**7. What is the role of inhibitors in resisting corrosion in reinforcement? (Apr / May 2014)**

Corrosion inhibitors are meant for protecting the reinforcement against corrosion.

It undergoes a chemical reaction and forms a strong protective medium which prevents the ingress of corrosion.

**8. What are admixtures? Give examples (May / June 2013)**

Admixtures are materials other than cement, aggregate and water that are added to concrete either before or during its mixing to alter its properties, such as workability, curing temperature range, set time or color.

Examples:

- a) Accelerating admixtures – Calcium Chloride
- b) Retarding admixtures – Calcium lingo – sulphonates and Carbohydrates derivatives
- c) Air – entraining admixtures – Natural wood resins and sulphonated compounds
- d) Water reducing admixtures – lingo – Sulphonates and hydrocarbolic acid salts
- e) Super plasticizers – Polycarboxylate derivatives, esters, etc.,

**9. What do mean by aspect ratio? (May / June 2013)**

- a) The fibre is often described by a convenient parameter called "aspect ratio". It is given by (L/d). The aspect ratio of the fibre is the ratio of its length to its diameter.
- b) Aspect ratio is the important factor which influences the properties and behavior of the fibre composite.
- c) Up to the aspect ratio of 75, increase in the aspect ratio increases the ultimate strength of the concrete. Beyond 75, relative strength and toughness is reduced.

**10. Classify cracks based on its thickness. (May / June 2012)**

Based on thickness, cracks are classified as

- a) Fine cracks, (width < 0.1 mm)
- b) Thin cracks, (0.1 mm – 0.3 mm)
- c) Medium cracks, (0.3 mm – 0.7 mm)
- d)
- d) Wide cracks, (0.7 mm – 2.0 mm)
- e) Very wide cracks, (width > 2 mm)

**11. What are the applications of expansive cement? (May / June 2012)**

- a) Used for grouting anchor bolts or grouting machine foundations or the cement used in grouting the prestress concrete ducts and precast architectural panels.
- b) Mostly used in preventing of water leakage.
- c) Some of the important applications of expansive cement are:
  - i. Airport and Highway pavement
  - ii. Tunnel linings
  - iii. Parking structure
  - iv. Industrial warehouse

**12. What are the applications of polymer cement concrete? (Apr / May**

**2011) The applications of polymer cement concrete are:**

- a) For factory floors, particularly where chemicals or oils are liable to be split



- b) For repair of old or damaged concrete
- c) For surfacing steel bridge or ship deck
- d) For flooring in frozen food factory
- e) For loading ramps where the abrasive wear of concrete is high
- f) For cementing Ceramic tiles to concrete

**13. Define the terms: (a) Shoring and (b) under – pinning. (Apr / May 2011)**

<b>Underpinning</b>	<b>Shoring</b>
Underpinning is employed to replace or strengthen the foundation of an existing structure	Shoring is employed to prevent a damaged structure due to foundation settlement or other reasons from collapse
Remedial underpinning is done to provide additional foundation strength to an inadequately supported structure	It is also used to provide temporary supports to a structure which is being remodeled or altered
Underpinning must be made only on load bearing walls	Shoring may be provided internally or externally or from both sides of the wall For supporting light loads timber is used whereas steel beam or braced sections is used for heavier loads
<b>METHODS:</b> Pit & Pile Method	<b>TYPES:</b> Raking shores, Horizontal shores, Vertical shores

**14. How will you select the repair materials? (Nov / Dec 2015) (Nov / Dec 2012)**

- a) Repair materials are of high performance, high durability but low maintenance
- b) Repair materials that are easy to use, increased productivity and reduced construction cycle time. The essential parameters for deciding upon a repair material are:
  - i. Low shrinkage properties
  - ii. Setting / hardening properties
  - iii. Workability
  - iv. Compatible coefficient of thermal expansion
  - v. Compatible mechanical properties to that of the substrate
  - vi. Alkaline character
  - vii. Low air and water permeability
  - viii. Aesthetics
  - ix. Cost
  - x. Durable, non-degradable or non-biodegradable

**15. What are the special materials used in expansive cement? (Nov / Dec 2015)**

Expansive cements has been developed by mixing about 8 to 20 parts of the sulpho aluminate clinker with 100 parts of the OPC and 15 parts of the stabilizer.

**16. Write short notes on Ferro – Cement. (Nov / Dec 2013)**

Ferro cement is a composite material in which the filter material (called matrix), cement, mortar, is reinforced with fibres, usually steel mesh dispersed throughout the composite, which results in better structural performances than individual ones.

Types of reinforcement used in Ferro cement

- a) Wire mesh with closely spaced wires
- b) Expanded metal mesh,
- c) Welded wire fabrics
- d) Square steel wire mesh
- e) Hexagonal or chicken wire mesh

**17. What are the applications of special concrete? (Nov / Dec 2013)**

- a) Fiber reinforced concrete is used in hydraulic structures, airfield pavements, highway pavements, bridges, heavy duty floors and tunnel linings
- b) Low density concrete is used for precast floor and roofing units
- c) Shrinkage compensating concrete is used in structural elements, pavements, prestressed beams and roofs

**18. List the types of polymer concrete composites. (Nov / Dec 2012) (Apr/May 2018)**

- a) Polymer impregnated concrete (PIC)
- b) Polymer cement concrete (PCC)
- c) Polymer Concrete (PC)
- d) Partially impregnated and surface coat
- e) Polymer Concrete.
- f) Polymer impregnated concrete (PIC)

**19. List the methods of corrosion protection. (Nov / Dec 2011)**

- a) Good Concrete practice
- b) Use of latex modified concrete
- c) use of silica fume concrete
- d) Epoxy coated reinforcing bars
- e) Use of membranes and sealers
- f) Cathodic protection

**20. What is Sulphur infiltrated concrete?(Nov / Dec 2011)**

Sulphur infiltrated concrete is obtained by infiltrating the lean concrete with molten Sulphur. Sulphur infiltrated concrete was developed as an alternative to polymer impregnated concrete to be used for higher strength and durable precast concrete elements.

**21. How can we manufacture sulphur infiltrated concrete?**

Sulphur is heated to bring it into molten condition to which coarse and fine aggregates are poured and mixed together. On cooling, this mixture gave fairly good strength, exhibited acid resistance and also other chemical resistance, but it proved to be either than ordinary cement concrete.

**22. Give the various monomers used in polymer concrete.**

a) Methylmethacrylate (MINS) c) Acrylonitrile b) Styrene d) t-butylstyrene

**23. What is self stressing cement?**

This cement when used in concrete with restrained expansion includes compressive stresses which approximately offset the tensile stresses induced by shrinkage "self Stressing cement"

**24. Define polymer partially impregnated concrete.**

Polymer partially impregnated or coated in deep (CID) and surface coated (SC) control partially impregnated concrete is used to in the strength of concrete. Partially impregnated concrete is sufficient in situations there the major required surface persistent against chemical and mechanical attacks.

**25. What is meant by geo-polymer concrete? List the Materials used for Making Geopolymer concrete. (Apr/May 2018)**

Geopolymer concrete is a type of concrete that is made by reacting aluminate and silicate bearing materials with a caustic activator. Commonly, waste materials such as fly ash or slag from iron and metal production are used, which helps lead to a cleaner environment. Geopolymer concrete is does not require heat to make it and it does not produce carbon dioxide. Standard Portland cement based concrete requires both heat and carbon dioxide.

**PART B**

1. Explain in detail about polymer concrete. (or) Explain in detail about the special materials manufacturing procedure and application of polymer modified concrete. (Apr / May 2015) (May / June 2012) (Apr/May 2018)
2. What is meant by fibre reinforced concrete? How is it manufactured? What are its advantages? (Apr / May 2015)
3. Explain the methods of improving ductility and impact resistance of concrete with the help of fibre reinforced concrete. (Nov / Dec 2015)
4. (a) Discuss the difference between Sulphur concrete and Sulphur – infiltrated concrete.  
(b) Explain the types of polymer concrete composites with their advantages. (Nov / Dec 2015)
5. (a) Under what circumstances vacuum treatment is given to concrete? Explain with neat sketch the arrangement for vacuum treatment of concrete with its merits and applications in construction practice. (10)  
(b) Summarize the sequence of operation in preparation of polymer – impregnated concrete elements. (6) (Apr / May 2017)
6. Explain briefly the materials, mechanisms and behavior of fresh and hardened state of High performance concrete. Also indicate their merits and demerits in construction practice. (Apr / May 2017)
7. (a) State the method adopted for accelerated strength gaining of concrete. Explain. (8)  
(b) Explain about the fibre reinforced concrete. State its applications (8) (Apr / May 2014)(Nov / Dec 2011)
8. Write short notes on: (a) Sulphur in- filtrated concrete(Nov / Dec 2011)  
(b) Concrete Chemical (c) Expansive cement (Apr / May 2014)
9. Discuss the functional classifications and requirements of repair materials with various aspects. (Apr / May 2016)
10. Explain the functions and applications of polymer concrete and fibre reinforced concrete as repair material.(or) Explain the behavior of steel fibre reinforced concrete as a repair materials. (Apr / May 2016)(Nov / Dec 2012)
11. Briefly explain about the manufacturing process and applications of expansive cement. (May / June 2013)
12. Tabulate the different types of fibres used in concrete. What are its advantages? (May / June 2013)
13. With respect to fibre reinforced concrete explain aspect ratio and volume fraction. Also explain their effects on fresh and hardened concrete properties. Explain with its stress – Strain curve. (May / June 2012)

**PART C**

1. Discuss the use of concrete chemicals to enhance the performance of concrete. Explain the types of polymer concrete composites with their advantages? How ferro – cement can be used as a material for repair? (Nov / Dec 2012)
2. Briefly discuss special elements for accelerated strength gain.(Nov / Dec 2011)
3. Explain in Detail about Self Compacting Concrete (Apr/May 2018)

4. Explain the manufacturing process, properties and uses of High Performance Concrete? (Apr/May 2018)

#### **UNIT 4 - TECHNIQUES FOR REPAIR AND PROTECTION METHODS**

##### **PART A**

1. **Under what situations the use of underpinning is warranted? Or What is the purpose of underpinning? (April/May 2017) (Apr/May 2018)**

- (i) Underpinning may be necessary for a variety of reasons:
- (ii) The original foundation is not strong or stable enough.
- (iii) The usage of the structure has changed.
- (iv) The properties of the soil supporting the foundation may have changed (possibly through subsidence) or were mischaracterized during design.
- (v) The construction of nearby structures necessitates the excavation of soil supporting existing foundations.
- (vi) To increase the depth or load capacity of existing foundations to support the addition of another storey to the building (above or below grade).
- (vii) It is more economical, due to land price or otherwise, to work on the present structure's foundation than to build a new one.
- (viii) Earthquake, flood, drought or other natural causes have caused the structure to move, requiring stabilisation of foundation soils and/or footings.

2. **Enumerate the advantage of cathodic protection system over conventional method of repetitive repair and replacement (April/May 2017)**

**Cathodic protection (CP)** is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. A simple method of protection connects the metal to be protected to a more easily corroded "sacrificial metal" to act as the anode.

3. **What are the advantages of vacuum concrete? (April/May 2015)**

- (i) Compressive strength of floor increases by up to 60 percent
- (ii) Tensile strength increases approximately by 70 percent
- (iii) Shrinkage and wrapping of floor are reduced

4. **What are corrosion inhibitors? (April/May 2015) (May/June 2009) (Apr/May 2018)**

Corrosion inhibitors are admixture that is used in concrete to prevent the steel metal embedded in concrete from corroding.

Types of corrosion inhibitors

- (i) Anodic inhibitor
- (ii) Cathodic inhibitors
- (iii) Mixed inhibitors

5. **What is meant by underpinning? (April/May 2014) (Nov/Dec 2012) (May/June 2009)**

The placing of new foundation below an existing foundation or the process of strengthening the existing foundation is known as under pinning of foundation.

6. **What do you mean by critical length of fibre? (May/June 2012)**

Critical length  $l_c$ , defined as the minimum length at which the center of the fiber reaches the ultimate (tensile) strength  $s_f$ , when the matrix achieves the maximum shear strength  $t_m$

7. **What is a dry pack? (May/June 2012) (April/May 2016) (May/June 2013)**

Dry packing is the hand placement of a very dry mortar and subsequent tamping or ramming of a mortar in to place producing an intimate contact between the old and new concrete work.

Dry Pack Grout is designed for use where high-strength, non-shrink characteristics are required. Dry Pack Grout contains only natural aggregate and is designed to be mixed with minimum water for placement at a damp pack consistency where flowable, fluid or plastic grouts are not possible or desired.

8. **Brief the mechanism of cathodic protection. (April/May 2016) (May/June 2013)**

- a) Cathodic protection is a technique by which the electrical potential of the steel is increased to a level at which corrosion cannot take place.
- b) Cathodic protection prevents corrosion by converting all of the anodic (active) sites on the metal surface to cathodic (passive) sites by supplying electrical current (or free electrons) from an alternate source. Usually this takes the form of galvanic anodes, which are more active than steel

9. **What are the disadvantages of FRP? (May/June 2013)** Disadvantages of FRP

- a) High cost

- b) Lower shear strength
- c) Low ductility
- d) Susceptibility to stress

**10. How do you determine the temperature attained by concrete during fire? (May/June 2013)**

Fire on concrete building damages the concrete as well as steel reinforcement causing disintegration of the concrete and buckling of steel. The temperature gradient is extreme 30 to 40°C in the outer face and above 800°C on the interface.

**11. How do repair the cracks by dry pack? (Nov/Dec 2013)**

Dry pack method involves hand placement of a low-water-content mortar followed by tamping or ramming of the mortar into place, producing intimate contact between the mortar and the existing concrete. Because of the low water-cement ratio of the material, there is little shrinkage, and the patch remains tight and is of good quality with respect to durability, strength, and watertightness.

**12. Give the methods of corrosion protection techniques. (Nov/Dec 2013)**

- a) Coatings - (i) Painting (ii) Plating
- b) Corrosion inhibitors - (i) Liquid phase inhibitors (LPIs) (ii) Volatile corrosion inhibitors (VCI)s and
- c) Cathodic protection - (i) Sacrificial Anode (ii) Impressed Current Cathodic Protection (ICCP)

**13. What are the advantages of shotcrete? (Nov/Dec 2012)**

- a) It is useful where considerable savings and peculiar adaptability is needed and it is more suitable than conventional placing methods.
- b) Shuttering and formwork need be erected only on side of the work and hence there will be considerable saving in the shuttering costs

**14. What is meant by weathering corrosion? (April/May 2011)**

It is the agent, which transports the abrasive material and assists the physical weathering. Its action is aggravated during rains and when it is moving with high speed it may contain some acidic gases like CO<sub>2</sub> fumes which may act over the material and penetrate quite deeply in the materials and structures.

**15. Write short notes on leakage in structures. (April/May 2011)**

Leakage in concrete structures causes inevitable damage to the reinforcement. Construction joints, shrinkage and restraint cracks may form leak packs. The amount of water involved vary from damp – patched which tend to evaporate as they are formed to running leaks which may eventually form pools on undrained surfaces. Damp – patches may also be formed when water passes through the voids along reinforcing bars formed due to plastic settlement.

The other common routes for larger volume leaks are honey-combed concrete, movement joints expansion and contraction joints. In the case of water – retaining structures, the extent of leakage may be measured by monitory loss of liquid from the structure.

For an effective leak sealing, it is essential to identify, the routes and sources of leakage and due consideration must be given the likely cause and their behavior once the structure is in service.

**16. What is the effect of temperature on compressive strength of concrete? (Nov/Dec 2011)**

- a) The temperature difference within a concrete structure, result in differential volume change.
- b) When the tensile strain due to differential volume change exceeds the tensile strain capacity of concrete, it will crack.

**17. What are the stages in dry mix process in shotcrete?**

- a) In this process, the concrete is mixed with water as for ordinary concrete before conveying through the delivery pipeline to the nozzle, at which point it is jetted by compressed air, onto the work in the same way as that if mix process.
- b) The wet process has been generally desired in favour of the dry mix process, owing to the greater success of the latter.

**19. What is pre-weakening?**

- a) Buildings and structures normally have structural elements designed to carry safely the loading likely to be imposed during their life.
- b) As a preliminary to a deliberate controlled collapse, after loads such as furnishings, plant and machinery have been removed, the demolition contractor may be able to weaken some structural elements and remove those new redundant.
- c) This pre-weakening is essentially a planned exercise and must be preceded by an analysis of its possible effects on the structure until it collapses, to ensure that the structural integrity of the building is not jeopardized accidentally. Insufficient information and planning relating to the structure may result in dangerous and unsafe work.

**20. What cases demolition by machine can be done?**

Simple roof structures supported on wall plates should normally be demolished to the level of wall plates by hand, but if this may involve unsafe working, then demolition totally by machine may be appropriate.

**21. What is a hydraulic pusher arm?**

Articulated, hydraulically-powered pusher-arm machines are normally mounted on a tracked or wheeled chassis, and have a toothed plate or hook for applying for applying a horizontal force to a wall. The machine should stand on a firm level base and apply force by a controlled movement of the pusher arm.

**22. Factors Influencing corrosion of Reinforcement**

Various factors initiate and sustain the process of corrosion in R.C. structures. They are broadly divided into two groups:

**a) General Influencing factors**

pH Value, Moisture Oxygen, Carbonation Chlorides, Ambient temperature, Severity of exposure, Quality of concrete Cover to the reinforcement, Initial curing condition, Formation of cracks

**b) General Accelerating factors:** The following are the factors which accelerates the process of corrosion in R.C. structures

Chlorides, Sulphates, Chlorine Electrical Charges, Methane Acids

**23. Explain the various techniques available for repair of cracks.**

The following techniques are available for repairing cracks

- |                         |                       |
|-------------------------|-----------------------|
| a) Bonding with epoxies | e) Blanketing         |
| b) Routing and sealing  | f) Overlays           |
| c) Stitching            | g) Grouting           |
| d) External stressing   | h) Autogenous healing |

**24. How to study the condition of the material in a structure?**

A number of tests are available to study the condition of the material in a structure.

The tests are grouped as follows:

- Non – destructive tests:** A material is tested without causing any damaged to the structure
- Destructive tests:** A sample of the material is removed for evaluation. Adequate repair is necessary to compensate for the removal of the sample.
- Load tests:** A structure is tested to gather information for similar type of buildings.

**25. What are the types of Non-Destructive tests?**

- Rebound hammer for strength of concrete
- Ultrasonic pulse velocity apparatus for crack detection
- Magnetic detector for locating reinforcement bares and measuring thickness cover
- Extensor meter and template microscope for measuring crack width.
- Pressure transducer, hydraulic force for measuring crack width.
- Strain gauge, results for strain measurement
- Vibration measuring equipment.

**PART B**

- List the significance of performance and integrity test on concrete and explain any one method in detail. (8)(**April/May 2017**)
  - How to estimate the strength of concrete in existing structure? Explain the method in which the longitudinal pulse velocity (km/s) is used to predict the quality of concrete. (8) (**April/May 2017**)
- Write the step by step procedure adopted in epoxy injection for repair works. (8) (**April/May 2017**)
  - Enumerate the types of shoring and describe the use of raking shore under the following (a) To support unsafe walls for a building, with the height of 12 meters (b) To support unsafe walls of a building with height of 8 meters.(8) (**April/May 2017**)
- Explain about the manufacturing process, materials used and advantages of foamed concrete.(**April/May 2015**)
  - How is corrosion resistant steel made?
    - Explain the properties of good coatings steel (**April/May 2015**)
- Explain the various methods of polymer coating applied on the surface of rebar? (**April/May 2014**)(**April/May 2016**)
  - What is vacuum concrete? Explain the application (**April/May 2014**)(**May/June 2012**)(**April/May 2016**)

5. (i) Explain the method of preventing corrosion in the structure. (April/May 2014) .(April/May 2016)(May/Jun-2009) (or) Explain in detail any two corrosion protection methods.(May/June 2012)(May/June 2013)  
(ii) Explain how cracks may be sealed by using epoxy injection resin. (April/May 2014)(April/May 2016)
6. Write short notes on (1) Epoxy injection (2) Corrosion inhibitors. (3) Cathodic protection. (4) Vacuum concrete (5) Underpinning (Nov/Dec 2013) (Apr/May 2018)
7. Explain the procedure of epoxy coating of rebars. Give the procedure of epoxy injection to structural crack repair in RC structural elements. Also give the advantages and disadvantages.(Nov/Dec 2012)(May/Jun-2009)
8. Write short notes on : (i) Ferrocement , (ii) Sulphur infiltrated concrete.(April/May 2011), (iii) Foamed Concrete (8) (May/June 2012)

### PART C

1. Explain in detail construction chemicals for waterproofing. (April/May 2011)
2. Explain in detail the methods to improve the load carrying capacity of beams and columns.(Nov/Dec 2011)
3. How do you evaluate, repair and rehabilitate a structure distressed due to fire and marine exposure?(Nov/Dec 2011)
4. Write elaborate notes on the following Non-destructive testing techniques as per IS (a) Rebound hammer test (b) Ultra Sonic pulse velocity Test (Apr/May 2018)

### UNIT 5 - REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

#### PART A

1. Write the typical ranges of Thermal conductivity, Thermal diffusivity, specific heat, coefficient of thermal expansion of ordinary concrete. (April/May 2017)
  - a) **Thermal conductivity (K):** Thermal Conductivity Thermal Conductivity is a measure of the ability of concrete to conduct Heat It is defined as the ratio of flux of heat to temperature gradient Thermal conductivity is measured in joules per second per square metre of area of the body when temperature difference is 1 o C per metre of thickness of the body.  
Thermal conductivity of concrete at room temperature is in the range of 1.4 and 3.6 W/m°K and varies with temperature
  - b) **Thermal diffusivity(δ) :** Thermal Diffusivity Thermal Diffusivity is a measure at which temperature changes within the mass takes place. It is related to the conductivity (K) by the following equation:  
The range of diffusivity in ordinary concrete is between 0.002 to 0.006 m<sup>2</sup>/h
  - c) **Specific Heat (C):** The Common range of values for concrete is between 840 and 1170 J/kg per ° C. Specific Heat increases with increase in moisture content of concrete.
  - d) **coefficient of thermal expansion:** Coefficient of expansion of aggregate For ordinary Concrete value is  $9 \times 10^{-6} / ^\circ C$

2. **List the pre-planning activities to be done before demolition of a structure. (April/May 2017)** Considerations should be given to:-
  - a) Conducting a site and building survey, with a structural bias;
  - b) The examination of drawings and details of existing construction where available;
  - c) The preparation of details and drawings from site survey activities where no such information is available;
  - d) Establishing previous use of premises, especially with regard to flammable substances or substances hazardous to health or safety;
  - e) Programming the sequence of demolition work;
  - f) The preparation of a Method Statement.
  
3. **What are the effects of fire on concrete?(April/May 2015)**
  - a) Reduction in strength of concrete
  - b) Cracking and spalling of concrete
  - c) Deflection and deformation of members
  - d) Discolouration
  - e) Loss of anchorage of reinforcement
  - f) Excessive deflection in beams and slab.
  
4. **When do you demolish a building?(April/May 2015)**
  - a) Building is very old , and for further period it cannot be put in use
  - b) Whenever, structural changes required
  - c) Expansion or extension of buildings over existing buildings if required
  
5. **What is meant by jacking? (April/May 2014)**  
 Jacketing consists of restoring or increasing the section of an existing member by encasing it in a new concrete. This method is useful for protection of section against further deterioration by providing additional to in member.
  
6. **List out the repairing methods of excessive deflection of beams. (April/May 2014)**  
 Following are the design techniques to reduce deflections of reinforced concrete beams and slabs
 

a) Make the element deeper	d) Add tension reinforcement
b) Make the member wider	e) Apply or increase prestressing
c) Introduce compression reinforcement	f) Revise geometry of the structure
h) deflection limit criteria	g) Review
  
7. **What are the characteristics of good coatings?(May/June 2012)**

a) Excellent waterproofing property	g) High durable
b) Outstanding colour retention	h) Good flexibility
c) Excellent bonding properties	i) Resistant to chemical and environment
d) Excellent scrub resistance	j) Resistant to water penetration
e) Resistance to dilute acids	k) Resistant to abrasion
f) Low viscous	
  
8. **How do you determine the temperature attained by concrete during fire?(May/June 2012)** Fire on concrete building damages the concrete as well as steel reinforcement causing disintegration of the concrete and buckling of steel. The temperature gradient is extreme 30 to 40°C in the outer face and above 800°C on the interface
  
9. **List the methods to overcome low member strength in concrete structures. (April/May 2016) (Nov/Dec 2012) (Apr/May 2018)**
  - a) Internal strength restoration by adding interior reinforcement
  - b) Strengthening by adding exterior reinforcement (encased or exposed)
  - c) Strengthening by external post-tensioning
  - d) Strengthening by use of jackets, brackets and collars
  - e) Increasing the width
  - f) Providing an overlay
  
10. **What is the preventive measure to be adopted to make the structure stable against marine exposure?(April/May 2016) (Nov/Dec 2012)**
  - a) Protective coating to steel reinforcement
  - b) Corrosion inhibitors
  
11. **What are the chemical disruptions involved in concrete structures? (Nov/Dec 2013)**  
 Chemical disruption
  - a) Resistance of concrete to chemical attack:

- b) The cement composition used in the concrete.
  - c) Conditions under which the cement paste hardened
  - d) All determine properties of concrete
    - 1. Sulphate Attack
    - 2. Alkali reaction
12. **How do arrest the leakage in RC structures? (Nov/Dec 2013)**
- a) Filling of joints
  - b) Epoxy resin Injection
  - c) Chemical coating
  - d) Crack injection method.
13. **What do you mean by dilapidated structures?(April/May 2011)**  
 A dilapidated structure means the structure that has lost its functional value and most of the major components of the structure have lost their strength and they will collapse at any time.  
 There are many reasons for a structure to get dilapidated: prolonged poor maintenance, over loading of structural members, poor design, faulty construction and poor quality of materials used.
14. **Write a short note on epoxy injection. (April/May 2011)**  
 Epoxy injection is a technique for bonding the cracks in concrete. Cracks in concrete are drilled from the face of the concrete. Water is injected to flush out the foreign matter. The surface is then allowed to dry. The epoxy is then injected in to drilled holes until it flows out through the other holes.
15. **What do you mean by Engineered demolition? (Nov/Dec 2011)**
- a) Hydraulic rock breakers
  - b) Diamond sawing and drilling
  - c) Diamond wire sawing system
16. **List out the different types of demolition techniques.(Nov/Dec 2011) (Apr/May 2018)**  
 Demolition techniques may be categorized as:-
- |  |                                   |
|--|-----------------------------------|
| a) Piecemeal demolition, using hand-held tools | g) Clam Shell                     |
| b) Mechanical method by                        | h) Other Methods like             |
| c) Hydraulic crusher with Long Boom arm        | i) Non Explosive Demolition Agent |
| d) Wrecking Ball                               | j) Explosive Demolition           |
| e) Pusher Arm                                  | k) Saw cutting                    |
| f) Wire Rope Pulling                           | l) Cutting and Lifting            |
|  | m) Water Jet                      |
17. **What are the major factors in selecting a demolition procedure?**  
 Major factors to be considered in selecting an appropriate technique include:-
- a) Safety of personnel and public
  - b) Working methods
  - c) Legislation applicable
  - d) Insurance cover
18. **What cases demolition by machine can be done?**  
 Simple roof structures supported on wall plates should normally be demolished to the level of wall plates by hand, but if this may involve unsafe working, then demolition totally by machine may be appropriate.
19. **How clamps are used to overcome low member strength?**  
 The distress is due to inadequate stirrups either due to deficiency in the of provision of C- stamps, U-clamp fixed externally along the length of beam to provide adequate these will be protected by covering with rich mortar or concreting as the a later stage.
20. **Give some concrete materials used to overcome weathering action on concrete.**  
 The two concrete repair materials used were
- (i) a flow able concrete with 16 mm aggregate and containing a plasticizer and a shrinkage-compensating additive, to be cast against forms in heights up to 1.5m, and
  - (ii) a patching mortar to be applied brendering, for areas less than .01 m<sup>2</sup>.



**21. What do you mean by blanketing?**

This is the simplest and most common technique for sealing cracks and is applicable for sealing both fine pattern cracks and larger isolated. The cracks should be dormant unless they are opened up enough to put in a substantial pattern in which case the repair may be more properly termed as “blanketing”.

**22. State the preventive measure taken during demolition. (April/May 2014)**

- a) The demolition shall not be commenced until precautionary measures have been inspected and approved. It is advisable to inform adjoining neighbours prior to the demolition so that they may close windows or take other measures.
- b) Before demolition is commenced and also during the progress of such work, all electric cables or apparatus which are liable to be a source of danger, other than a cable or apparatus used for the demolition works shall be disconnected.
- c) All practicable precautions shall be taken to avoid danger from collapse of a building when any part of a framed or partly framed building is removed.
- d) Any asbestos present on the site should be removed in accordance with the Occupational Health and Safety (Asbestos) Regulations 2003 by an approved asbestos removalist registered by the Victorian Work Cover Authority.
- e) When the demolition site adjoins a street or public walkway, a 2.4 metre high solid hoarding shall be erected on the street boundary unless the building is setback at least twice its height from the street boundary, in which case a security fence having a minimum height of 1.5 metres may be utilised. Notices lettered in accordance with AS1319, displaying the words “WARNING DEMOLITION IN PROGRESS” to be fixed to the hoarding or security fence.
- f) When the site adjoins a footpath or public thoroughfare in addition to hoarding required by Clause 1.5.1.5 of AS2601-2001, the footpath shall be covered by an overhead protective structure unless the vertical height above the footpath is less than four metres or the least horizontal distance between footpath and the nearest part of the structure is greater than half the height of the structure. (It should be noted that Regulation 604(4) requires the consent and report of the Relevant Council be obtained before a building permit is issued which requires the erection of safety precautions over the road reserve).
- g) Demolished material shall not be allowed to remain on any floor or structure if the weight of the material exceeds the safe carrying capacity of the floor or structure and such material shall be so piled or stacked that it will not endanger workmen or other persons, and shall be removed as soon as practicable from the site unless otherwise authorised by the Building Surveyor.

**23. Write short notes on demolition by hand (Piecemeal Demolition).**

- a) For demolitions of reinforced concrete buildings by hand, tools such as electric, pneumatic breakers, jack hammers etc are commonly being used.
- b) Oxy-acetylene torch could be used to cut the reinforcements.
- c) The reinforcements shall remain until all the concrete connecting to or supported by the reinforcement is broken away or when its supports are no longer required.
- d) Cantilever canopies, balconies and exterior walls are critical elements in building demolition.
- e) In congested areas, these features could critically impact on the safety of the public.
- f) Demolition of these features shall be performed with extreme caution.
- g) If rope or tie wires are used to pull down the structural elements, the pulling wire must be at least 4 times stronger than the anticipated pulling force.
- h) In addition, workers shall be shielded from the rope or tie wires. The rope or tie wire shall be checked at least twice per day.
- i) Lifting appliances may be necessary to hold larger structural members during cutting and for lowering severed structural members and other debris.
- j) Chutes may be used to discharge debris into a vehicle or hopper.
- k) Foundations would normally be grubbed up by excavation machines.

**24. How to identify the corrosion effects in structures.**

- a) Brown marks associated with the cracks indicate corrosion.
- b) Bigger cracks on the beam and column also indicate corrosion.
- c) A physical inspection after removing the cover will reveal the corrosion if present.
- d) Corroded reinforcement can be picked easily with the help of fingers as they are very weak.

**25. What are the advantages of slab jacking technique?**

- a) Cost effectiveness – grouts levelling is frequently the most economical method.
- b) Down time it's generally faster than other methods of repair.

- c) Surface maintenance – for concrete pavements, the repair maintains the surface of texture and appearance provides a smooth riding surface and extends the useful life of the concrete surfacing.

### **PART B**

1. (i) Explain the procedure for demolishing main structural members like columns, beams and slabs with the help of neat sketch. (12) **(April/May 2017)**  
(ii) What are the allied activities accompanying the demolition process? (4) **(April/May 2017)**
2. (i) Under what condition strengthening of foundation is required? Explain how columns strengthened by section enlargement technique with the help of neat sketch?(8) **(April/May 2017)**  
(ii) What are the precautions to be taken to prevent water leakage in roof / fault roofs and sunken floors in toilet? **(April/May 2017)**
3. How do you assess and repair a structure distressed due to marine atmosphere? **(April/May 2015)**
4. Explain how the building is affected by (a) High temperature (b) Marine exposure **(April/May 2014)**
5. (i) How do you strengthen a heavily corroded RCC beam in a structure?  
(ii) State and explain the various options for strengthening a concrete with low member strength. **(April/May 2014)**
6. How do you repair and rehabilitate a structure distressed due to fire **(May/June 2012) (Apr/May 2018)**
7. With simple sketches explain the methods of improving the strength of existing columns and beams. **(April/May 2016) (April/May 2015) (May/June 2013) (April/May 2011) (May/June 2012) (or)**  
How do you strengthen the various structural elements? Explain in detail with sketches. **(Nov/Dec 2012)**
8. Explain the different methods of strengthening the concrete structures against earthquake. **(April/May 2016) (May/June 2013)**
9. How do you repair various types of cracks? Explain with neat sketches **(Nov/Dec 2013)**
10. Explain about the jacking and plate bonding techniques in rehabilitation to overcome the low member strength. **(Nov/Dec 2013)**

### **PART C**

1. Explain the methods used for fire protection in RC buildings. Discuss the sea water attack on concrete. **(Nov/Dec 2012)**
2. Discuss a case study on engineered demolition techniques for a structure using implosion technology. **(Nov/Dec 2011) (Apr/May 2018)**
3. Discuss the following methods of demolition : (i) Non explosive demolition agents (ii) Saw cutting (iii) Water jet (iv) Explosive **(Nov/Dec 2011)**
4. How do you demolish distressed overhead water tank? Explain in detail. **(May/June 2009)**
5. Explain the detail the various types of demolition techniques. **(Nov/Dec 2012) (April/May 2011) (Nov/Dec 2013)**