

**PART -A**

1. Define Maintenance.

Maintenance is the act of keeping something in good condition by checking or repairing it regularly.

2. Define Repair.

Repair is the process of restoring something that is damaged or deteriorated or broken, to good condition.

3. Define Rehabilitation.

Rehabilitation is the process of returning a building or an area to its previous good conditions.

4. What are the two facets of maintenance?

The two facets of maintenance are

- i) Prevention
- ii) Repair

5. What are the causes of deterioration?

- i) Deterioration due to corrosion
- ii) Environmental effects
- iii) Poor quality material used
- iv) Quality of supervision
- v) Design and construction flaws

6. 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.

7. How deterioration occurs due to corrosion?

- Spalling of concrete cover
- Cracks parallel to the reinforcement
- Spalling at edges
- Swelling of concrete
- Dislocation
- Internal cracking and reduction in area of steel reinforcement.

8. What are the steps in selecting a repair procedure?

- Consider total cost
- Do repair job in time
- If defects are few & isolated repair on an individual basis. Otherwise do in generalized manner
- Ensure the repair prevents further development of defects
- In case of lost strength, repairs should restore the strength
- If appearance is a problem, the number of applicable types of repairs become limited & the repairs must be covered
- Repair works should not interface with facilities of the structure
- Take care in addition of section to a member and in redistributing live loads and other live load moments. After selecting a suitable method of repairs, and after considering all the ramifications of its application, the last step is to prepare plans & specification and proceed with the work.

9. 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 environment concrete structure will be severely reduces.

10. 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.

11. 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

12. What are the factors to be considered by the designer at the construction site?

- Minimum and maximum temperatures
- temperature cycles
- exposure to ultra violet radiation
- amount of moisture
- wet/dry cycles
- presence of aggressive chemicals

13. What are the steps in repair aspect?

- i. finding the deterioration
- ii. determining the cause
- iii. evaluating the strength of existing building or structure
- iv. Evaluating the need of repair

v. Selecting & implementing a repair procedure

14. 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.

15. Discuss about the design and construction errors leading to deterioration of a structure.

Design of concrete structures governs the performance of concrete structures. Well designed and detailed concrete structure will show less deterioration in comparison with poorly designed and detailed concrete, in the similar condition. The beam-column joints are particularly prone to defective concrete, if detailing and placing of reinforcement is not done properly. Inadequate concrete cover may lead to carbonation depth reaching up to the reinforcement, thus, increasing the risk of corrosion of the reinforcement.

16. 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.

17. What are the possible decisions that can be made after evaluating the strength of a structure?

- a. to permit deterioration to continue
- b. to make measures to preserve the structure in its present condition without strengthening
- c. to strengthen the construction
- d. if deterioration is exceptionally sever, to reconstruct or possibly abandon it.

18. 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 stop 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.

19. 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 sown. 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.

20. 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

21. Define Maintenance.

Maintenance is preventive in nature. Activities include inspection and works, necessary to fulfill the intended function or to sustain original standard of service.

22. Define Repair.

Repair is the technical aspects of rehabilitation. It refers to the modification of a structure, partly or wholly, which is damaged in appearance or serviceability.

23. Define Rehabilitation.

Rehabilitation is the process of restoring the structure to service level, once it had and now lost, strengthening consists in endowing the structure with a service level, higher than that initially planned by modifying the structure not necessarily damaged structure.

24. What are the facts of maintenance?

- i. The avoidance of accidents, which may harm people.
- ii. The continued operation of facility.
- iii. The protection of the capital investment in the asset.

25. Write down the importance of maintenance.

- i. It improves the life of structure.
- ii. Improved life period gives better return on investment.
- iii. Better appearance and aesthetically appearing.
- iv. Leads to quicker detection of defects and hence remedial measures.
- v. Prevents major deterioration that leads to collapse.
- vi. Ensure safety occupants.

26. What are the types of maintenance?

- i. Daily Routine maintenance.
- ii. Weekly Routine maintenance.

iii. Monthly Routine maintenance.

iv. Yearly Routine maintenance.

27. What are the causes of deterioration?

i. Design and construction flaws.

ii. Environmental Effects.

iii. Usage of poor quality of material

iv. Quality of supervision.

v. Deterioration due to corrosion.

28. Write a short notes on Deterioration due to corrosion.

- Spalling of concrete cover
- Cracks parallel to the reinforcement .
- Spalling at edges
- Swelling of concrete
- Dislocation internal cracking & reduction in area of steel reinforcement.

29. Write any assessment procedure for evaluating the structure.

1. Physical inspection of damaged structure
2. Preparation and document ting the damages.
3. Collection of samples and carrying out tests both in-situ and in lab.
4. Studying the documents including structural aspects.
5. Estimation of load acting on the structure.

30. What are the stages inspection and maintenance?

i. Inspection

ii. Analysis

iii. Action Possibilities.

**PART-B**

1. Describe the steps in the assessment procedure for evaluate damages in a structure.
2. Explain the various causes for deterioration of concrete structures.
3. Describe in detail about the prevention aspect of maintenance.
4. Describe in detail about the repair aspect of maintenance
5. Explain in detail about the permeability of concrete.

**PART-A**

1. How can use prevent the effect of freezing and thawing in concrete?

Concrete can be restricted from frost action, damage of the structure by the entrainment of air. This entrainment of air is distributed through the cement paste with spacing between bubbles of no more than about 0.4mm.

2. Write any two tests for assessment of frost damage?

The frost damage can be assessed by several ways:

- i) 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
- ii) 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.

3. How does a concrete structure get affected by heat?

Heat may affect concrete and as a result of:-

- the removal of evaporable water
- the removal of combined water
- alteration of cement paste
- alteration of aggregate
- change of the bond between aggregate and paste

4. How can you control cracks in a structure?

- Use of good coarse aggregates free from clay lumps
- Use of fine aggregate free from silt, mud & organic constituent.
- Use of sound cement.
- Provision of expansion & contraction joint.
- Provide less water-cement ratio.

5. Define aggregate splitting?

This phenomenon occurs most frequently when hard aggregates are used in concrete. The thermal stresses except close to corners are predominantly compressive near to the heated surface. This stress causes the aggregate to split in this direction and the fractures may propagate through the mortar matrix leading to deterioration.

6. What the factor affecting chemical attack on concrete?

- High porosity
- Improper choice of cement type for the conditions of exposure
- Inadequate curing prior to exposure
- Exposure to alternate cycles of wetting and drying

7. Write the methods of corrosion protection?

- Corrosion inhibitors
- corrosion resisting steels
- coatings for steel
- Cathodic protection

8. List out some coating for reinforcement to prevent corrosion?

- Organic coating
- Epoxy coating
- Metallic coating
- Zinc coating

9. Define corner repairation?

This is a very common occurrence and appears to be due to a component of tensile stress causing splitting across a corner. In fire tests, corner separation occurs most often in beams and columns made of Quartz aggregate and only infrequently with light weight aggregates

10. List any four causes of cracks?

- Use of unsound material
- Poor & bad workmanship
- Use of high water-cement ratio
- Freezing & thawing
- Thermal effects
- Shrinkage stresses

11. What are the types of cracks?

- i) Class-1: Cracks leading to structural failure
- ii) Class-2: Cracks causing corrosion
- iii) Class-3: Cracks affecting function
- iv) Class-4: Cracks affecting appearance

12. What changes occur, when hot rolled steel is heated to 500oc?

At temp of 500oc-600oc the yield stress is reduced to the order of the working stress and the elastic modulus is reduced by one-third. Bars heated to this temp virtually recover their normal temperature.

13. List out the various types of spalling?

- i) General or destructive spalling
- ii) Local spalling which is subdivided as
  - aggregate splitting
  - comer separations
  - surface spalling
  - Sloughing off



14. List some faults in construction planning?

- Overloading of members by construction loads
- Loading of partially constructed members
- Differential shrinkage between sections of construction
- Omission of designed movement joints

15. Define corrosion?

The gradual deterioration of concrete by chemically aggressive agent is called “corrosion”

16. Give some examples for corrosion inhibitors?

- i) Anodic inhibitors
- ii) Cathodic inhibitors
- iii) Mixed inhibitors
- iv) Dangerous & safe inhibitors

17. Define effective cover?

The cover to reinforcement measured from centre of the main reinforcement up to the surface of concrete in tension is called “Effective cover”

18. Define corrosion inhibitor?

Corrosion inhibitor is an admixture that is used in concrete to prevent the metal embedded in concrete from corroding.

19. What are the operations in quality assurance system?

- Feed back
- Auditing
- Review line
- Organization

20. List the various components of quality control.

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

- Standards
- Production control
- Compliance control
- Task and responsibilities and
- Guarantees for users

21. Define Quality Assurance.

Quality assurance scheme is a management system, which increases confidence that a material, product or service will conform to specified requirements, policies, designated responsibilities and requirements to the owner.

22. What is the need for quality assurance?

The QA involved with the construction and use of a concrete structures are concerned that the quality of necessary to give good performance throughout its intended life is attained.

23. What are the causes of faults?

- i. Mis – interpretation of the client needs
- ii. Lack of good communication between members of the design team.
- iii. Production of and reference to inadequate and imprecise specifications
- iv. Mis – interpretation of design standards or codes of practices.
- v. Use of incorrect or out – of – date data.

24. Define the term “Strength of concrete”.

The strength of concrete is its resistance to rupture. It may be measured in a number of ways, such as strength in compression, in tension , in shear or flexure. All these indicate strength with reference to a particular method of testing.

The compressive strength of concrete is usually determined by testing cubes of cylinders, made in lab or field or cores drilled from hardened concrete at site, or from the non-destructive testing of the specimen or actual structures.

25. Write a short note on Thermal Conductivity.

This measures the ability of material to conduct heat. Thermal conductivity is measured in joules per second per square meter of area of body when the temperature difference is 1°C per meter thickness of the body.

26. What is mean by Thermal Diffusivity?

Diffusivity represents the rate at which temperature changes within the concrete mass. Diffusivity is simply related to the conductivity by the following

$$\text{Diffusivity} = \text{Conductivity} / C\rho$$

Where C is the specific heat , and  $\rho$  is the density of concrete. The range of diffusivity of concrete is between 0.002 to 0.006 m<sup>2</sup>/h.

27. What is mean by specific Heat?

It is defined as the quantity of heat required to raise the temperature of a unit mass of material by one degree centigrade.

28. Define Co – efficient of Thermal expansion.

Co-efficient of thermal expansion is defined as the change in unit length per degree change of temperature. In concrete it depends upon the mix proportions.

29. Write a short note on Cracking.

Cracking will occur whenever the tensile strain, to which the concrete is subjected, exceeds the tensile strain capacity of the concrete. The tensile strain capacity of concrete varies with the age and rate of application of strain.

30. How the cracks are classified?

Cracks may be classified in terms of their effects.

- i. Those cracks which indicate immediate structural distress
- ii. Those cracks which may lead in the long run to a reduction of safety, through corrosion of steel.
- iii. Cracks which lead to malfunction of the structure as evidence

31. Classification of chemical attack on concrete?

- a) Acid attack
- b) Alkali attack
- c) Carbonation
- d) Chloride attack
- e) Leaching
- f) Salt attack
- g) Sulphate attack

32. Effect of penetration may be influenced in chemical attack?

- a) Temperature gradient
- b) Freezing
- c) Loading
- d) Electric current and
- e) Other factor

33. What is meant by sulphate attack on the concrete?

Mechanism-sulphates are found in most of the solid as calcium, potassium, sodium and magnesium sulphates. Solid salts do not attack concrete, but when present in solution they can react with hardened cement paste. Sulphates are present in seawater, industrial effluents and some ground water. Sulphate attack occurs when pore system in concrete is penetrated by solution of Sulphate.

34. What are the parameters is depended in Sulphate reaction?

- a) Concentration of Sulphate ions
- b) Cations present in the sulphate solution
- c) C3A content of cement
- d) Density, permeability of the concrete

35. What is meant by chloride attack on concrete?

Chloride can be introduced into concrete by coming into contact with environments containing chloride, such as seawater or deicing salts. Penetration of the chloride starts at the surface and then moves inward.

36. What is meant by salt attack on concrete/salt weathering?

Solid salts do not attack concrete, but when present in solution they can react with hardened concrete. It is a more general problem in masonry structure. Efflorescence is the formation of calcium carbonate precipitate on the concrete surface owing to carbonation.

37. What are the preventive measures in salt attack?

- a) Using sound materials free from salts
- b) Proper concrete proportioning
- c) Consolidation and curing
- d) Preventing the access of moisture to the structure.

38. What are the preventive measures on acid attack?

- a) By increasing cement content and reducing w/c ratio
- b) By improving quality of cover concrete
- c) By treating the surface with sodium silicate known as water glass
- d) By surface treatment with coal, tar, bituminous paints, epoxy resins etc.

39. What are the factor influencing on carbonation attack?

- a) Time
- b) Cover to reinforcement
- c) Concentration of carbondioxide in the atmosphere
- d) Permeability of concrete
- e) Alkali content in the concrete

f) Condition of concrete cover.

40. What are the main types of aggressive fluid to which concrete will be exposed?

- a) Mineral acid
- b) Some organic acid
- c) Solution of sulphates, chloride, sugar, nitrates, phenols, and ammonium compound.

**PART-B**

1. Explain in detail about quality assurance.
2. Describe the various components of quality control.
3. Discuss in detail about the thermal properties of concrete.
4. Elaborately explain about the effect of temperature on concrete.
5. Explain the various corrosion protection methods.
6. Discuss the factors affecting permeability of concrete structures.
7. Explain clearly about the mechanism of freezing and thawing.
8. Explain in detail plastic shrinkage and drying shrinkage.
9. Discuss briefly the strength and behavior of concrete subjected to high temperatures.



**PART-A**

1. What is expansive cement?

A slight change in volume on drying is known as expansion with time will prove to be advantage for grouting purpose. This type of cement which suffers no overall change in volume on drying is known as “Expansive cement”.

2. What is the action of shrink comb in expansive cement?

Shrink comb grout acts like a Portland cement. It (shrinks) sets and hardens; it develops a compressive strength of about 140kg/cm<sup>2</sup> at 7days and 210kg/cm<sup>2</sup> at 28 days.

3. List the various types of polymer concrete.

- i) Polymer impregnated concrete (PIC)
- ii) Polymer cement concrete (PCC)
- iii) Polymer Concrete (PC)
- iv) Partially impregnated and surface coat
- v) Polymer Concrete.
- vi) Polymer impregnated concrete (PIC)

4. Give the various monomers used in polymer concrete.

- Methylmethacrylate (MINS)
- Styretoc
- Aerylonitrile
- t-butyle slynene

5. Define polymer concrete.

Polymer concrete is a aggregate bound a polymer binder instead of Portland cement as in conventional concrete pc is normally use to minimize voids volume in aggregate mars. This can be achieve by properly grading and mixing of a to attain the max density and (mixing) the aggregates to attain (maximum) minimum void volume. The entrapped aggregated are pre packed and vibrated in a mould.

6. What are the uses of Polymer concrete?

During curing Portland cement form mineral voids. Water can be entrapped in these voids which are freezing can readily attack the concrete. Also alkaline Portland cement is easily attached by chemically aggressive materials which results in rapid determination, there as using polymers can compact chemical attack.

7. What is sulphur infiltrated concrete?

New types of composition have been produced by the recently developed techniques of impregnating porous material like concrete with sulphur. Sulphur impregnation has shown great improvement in strength.

8. What are the applications of sulphur infiltrated concrete?

Sulphur – (impregnated) infiltration can be employed in the precast industries. Sulphur infiltration concrete should find considerable use in industry situation where high corrosion resistant concrete is required. This method cannot be conveniently applied to cast-in place concrete. Sulphur impregnation has shown area improvement in strength.

9. What is drying shrinkage?

Concrete made with ordinary Portland cement shrinks while setting due to loss of water. Concrete also shrinks continuously for long time. This is known as “drying shrinkage”.

10. 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”

11. What is polymer impregnated concrete?

PIC is a widely used polymer composition concrete, cured and dried in oven or dielectric heating from which the air in the (pores) open cell is removed by vacuum. Then low density monomer is diffused through an open cell and polymerized by using radiation, application of heat or by chemical initiation.

12. Define polymer partially impregnated concrete.

Polymer partially impregnated or coated in depth (CID) and surface coated (SC) concrete. Partially impregnated concrete is used to increase the strength of concrete. Partially impregnated concrete is sufficient in situations where the major requirement is surface persistence against chemical and mechanical attacks.

13...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.

14. What is the difference between ordinary cement and expansive cement?

Ordinary concrete shrinks while setting whereas expansive cement expands while setting

15. What are the uses of gas forming and expansive chemicals?

Gas formation and expansive chemicals to produce light weight concrete as well as to cause expansion on application such as grouts for anchor bolts. They are non shrinking type. Principal chemicals used are Hydrogen peroxide, metallic aluminum or activated or activated carbon. Sometimes bentonite clays and natural gum are also used.

16) what is the use of corrosion inhibiting chemicals?

They resist corrosion of reinforcement in adverse environment sodium benzoate, calcium ligno sulphonate and sodium nitrate have good results.



17) Write the use of anti fungus admixtures

These are added to control and inhibit growth of bacteria or fungus in surfaces exposed to moisture. Polyhalogenated phenol, Dieldrin emulsion and copper compounds are some of the chemicals used for this

18) What are uses of curing compounds?

They are either wax based or resin based. When coated in freshly laid concrete they form a temporary film over the damp surface which stops water evaporation and allows sufficient moisture retention in concrete for curing

19) What are the uses of sealants?

They are used to seal designed joints. They are formulated from synthetic rubbers or polysulphides. The choice of a sealant depends on the location of the joint, its movement capability and the function the sealant is expected to perform.

20) What are the uses of flooring?

These are usually toppings based on metallic or non metallic aggregates which are mixed with cement and placed over freshly laid concrete sub floor. These compounds in high viscosity liquid, form mixed with recommended filters at site are based on resins and polymers such as epoxy, acrylic, polyurethane or polysulphide.

31. What are the special concrete?

- i. High Alumina cement concrete.
- ii. Shrinkage compensated concrete.
- iii. Polymer concrete.
- iv. Polymer Impregnated concrete.
- v. Polymer – cement concrete.
- vi. Epoxy concrete.

32. What is the necessity for adding concrete chemicals?

- a. To improve the performance of concrete.
- b. To have early strength gain as early as possible.
- c. To make the structure water proof.
- d. To accelerate the setting time of cement,

33. Write a short note on Expansive cement.

Expansive cement, when mixed with water, forms a paste that, after setting, tends to increase in volume to significantly greater degree than Portland cement paste. This expansion may be used to compensate for the volume decrease due to shrinkage, or to induce tensile stress in reinforcement.

34. What are the applications of Polymer cement concrete?

PC are several times more expensive than plain concretes so that they will only be used for special applications. The principal advantages shown these concretes are:

- i. Greater failure strain
- ii. Good bond with old concrete.
- iii. Improved resistance to abrasion.
- iv. Improved durability and resistance to chemical attack.

35. Write a short note on sulphur Infiltrated concrete.

Sulphur was made to impregnate (saturate) into lean porous concrete, to improve its strength and other useful properties considerably. In this method, the quantity of sulphur used is also comparatively less, and thereby the process is made economical. It is reported that compressive strength of about 100 MPa could be achieved in about 2 day's time.

36. Define Shoring.

The arrangement employed to prevent a damaged structure, due to either foundation settlement or other reasons from collapse, is called shoring. It is also used for providing temporary support to a structure, which is being remodeled.

37. Write a short note on underpinning.

The process of providing new permanent foundation as known as underpinning.

The underpinning may be done by the following methods:

- i. Pit underpinning
- ii. Pier underpinning
- iii. Pile underpinning

38. Define Guniting or Shotcrete:

Guniting can be defined as mortar conveyed through a hose and pneumatically at high velocity on to a surface. Recently the method has been further developed by the introduction of small sized coarse aggregate into the mix deposited to obtain considerably greater thickness in operation and also to make the process economical by reducing the cement content.

39. What are the methods involved in Epoxy injection?

There are three methods of providing entry ports.

- i. Drilled holes with fittings inserted and bonded, with the adhesive used for sealing.
- ii. Bonded flush fittings, attached by means of the sealing adhesive.
- iii. Interrupted seal, using a gasket that unsealed portion ( the interruption to the seal can easily be made by placing 6mm wide strips of masking tape over the crack before the seal is placed).

40. Define "Mortar repair for Cracks".

Wide cracks which are not active, may be repaired by routing out to a wide of about 20mm, and filling with drypack or Epoxy mortar. Wide active cracks must be effectively converted into a movement joint. In water – carrying conduits transverse cracks, which move with the temperature and moisture conditions, may be sealed by cutting out the crack to about 12mm width and caulking (making water tight) it thoroughly with wick and mastic (water proof filler).

41. Write the necessity of Polymer coating to rebars.

The alkalinity of polymer coatings to rebars keeps the environment around steel in alkaline state, even though the cover subsequently gets carbonated. This situation helps greatly in maintaining a passive  $\gamma\text{-Fe}_2\text{O}_3$  film on the steel, thereby preventing corrosion. Besides this film being cement based, is compatible with concrete does not result in any loss of bond strength, making the structural engineers work easy. Moreover, the film is quite tough as well as flexible and cement does not peel off, as it would otherwise happen. In addition, being a one pack polymer system, hardening of unused material or setting of the material due o delayed use etc., is more or less eliminated

42. What are the types of shoring?

- i. Racking shores
- ii. Horizontal or Flying shores
- iii. Vertical or Dead shores

43. Define Mortar and Dry pack.

Dry pack is suitable for filling holes, whose depth is at least equal to the smallest surface dimension of the repair area. For example, it may be used for filling she-bolt holes, holes left by removal of form ties, and narrow slots, cut for repair of cracks. The holes should be at least 25mm deep. Dry pack is not suitable for shallow depression. Where lateral restraint of the filling material is not possible, or for holes, hat go right through the concrete section, where the filling cannot be properly rammed.

44. What is meant molten sulphur?

It is has been used either on its own or in combination with tar-based additives as a quick hardening patch fir concrete. It has also been used to impregnate deteriorated concrete and as a binder for concrete.

45. What are the four steps to built up the epoxy system?

1. The surface is primed with a low viscosity epoxy
2. A 50 mil thick coat of the filled epoxy is then placed
3. A woven glass fabric is then applied
4. After the epoxy has partially cured

46. What is meant by surface hardeners?

Generally refers to a materials used to upgrade a floors wear resistance, reduce dusting and increase chemical resistance. Two main categories are in current use: sprinkled shake hardeners and liquid hardeners.

47. What are the overlays of polymer concrete?

1. Polymer-impregnated concrete
2. Polymer-modified concrete
3. Polymer-based concrete.

48. Mention the two purposes of sealants are flexibilized polymeric materials are used?

- a) To plug irregular gaps between two rigid surface and
- b) To provide a dynamic bridge across the gap between two surfaces

49. What is meant by sealant classes?

It can be grouped into three class: low, medium and high range, according to their moment capability, service life and cost.

50. What is range sealants?

The group includes the silicones, urethanes. Polysulfide, solvent release acrylics, and certain proprietary compounds. The products are designed for use in working and moving joints.

51. What is meant by polyacrylate ester?

Carboxylated synthetic polymers acts as highly effectively dispersant.

52. What are the types of polymers?

Thermoplastic polymers

Thermosetting polymers

53. What is meant by epoxide resins?

The formulators market epoxide resins and have the special properties required for the specific use to which they will be put.

54. What are the two types of polyester resins?

- a) The so-called saturated polyester resins such as polyethylene terephthalate or terylene.
- b) The unsaturated polyester resins which can be cross-linked.

**PART-B**

1. Explain in detail about expansive cement.
2. Briefly explain about polymer concrete and its types.
3. Explain in detail about Sulphur infiltrated concrete.
4. Explain in detail Ferro cement.
5. Explain in detail Fiber Reinforced Concrete.
6. Explain in detail fiber reinforced polymeric meshes.

**PART-A**

1. What are the techniques required for repairing cracks?

- Bonding with epoxies
- Routing and sealing
- Stitching
- Blanketing
- External stressing
- Grouting
- Autogenous healing

2. Define stitching.

The tensile strength of a cracked concrete section can be restored by stitching in a manner similar to sewing cloth.

3. 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 paten in which case the repair may be more property termed as “Blanketing”.

4. Define external stressing.

Development of cracking in concrete is due to tensile stress and can be arrested by removing these stresses. Further the cracks can be closed by including a compressive force sufficient to overcome the tension a residual compression.

5. Write short notes on Autogenous healing.

The inherent ability of concrete to heal cracks within “autogenous healing”. This is used for sealing dormant cracks such as precast units cracked in handling of cracks developed during the precast pilling sealing of cracks in water hands and sealing of cracks results of temporary conditions.

6. What is overlay?

Overlays may be used to restore a spelling or disintegrated surface or to protect the existing concrete from the attack of aggressive agents. Overlays used for this purpose include concrete or mortar, bituminous compounds etc. Epoxies should be used to bond the overlays to the existing concrete surface

7. Give short note on Jacketing.

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.

8. Give an account on how metal bonding is done on concrete member.

On the tension side of the beam 2 to 3mm steel plates are to be attached to the existing beam to increase its capacity. The glue or adhesive should be compatible with the existing concrete with behavioral characteristics under load addition to providing integrity with parent member.

9. How clamps are used to overcome low member strength?

The distress is due to inadequate stirrups either due to deficiency in the 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.

10. Define grouting.

Grouting can be performed in a similar manner as the injection of an epoxy. However the use of an epoxy is the better solution except where considerations for the resistance of cold weather prevent such use in which case grouting is the comparable alternative.

11. Give a short note on epoxy coatings.

These are organic compound which when activated with suitable hardening agents form strong chemically resistant structures having excellent adhesive properties. They are used as binders or adhesives to bond new concrete patches to existing surfaces or hand together cracked portions. Once hardened, this compound will not melt, flow or bleed. Care should be taken to place the epoxy within the pot life period after mixing.

12. What are protective surface coatings?

During of concrete can be substantially improved by preventive maintenance in the form of weather proofing surface treatments. These treatments are used to seal the concrete surface and to inhibit the intrusion of moisture or chemicals.

13. List some materials used as protective surface coatings.

Materials used for this purpose include oils such as linseed oils, petroleum etc.

14. Define dry pack.

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

15. Give a brief account on routing and sealing.

This method involves enlarging the cracks along its exposed surface, filling and finally sealing it with a suitable material. This is the simplest and most common technique for sealing cracks and is applicable for sealing both fine pattern cracks and larger isolated.

16. List any four causes of cracks?

- Use of unsound material
- Poor & bad workmanship

- Use of high water-cement ratio
- Freezing & thawing
- Thermal effects
- Shrinkage stresses

17. What are the types of cracks?

- v) Class-1: Cracks leading to structural failure
- vi) Class-2: Cracks causing corrosion
- vii) Class-3: Cracks affecting function
- viii) Class-4: Cracks affecting appearance

18. What is pneumatically applied mortar?

Pneumatically applied mortar is used for the restoration of when the location of deterioration is relatively at shallow depth. It can be used on vertical as well as on horizontal surfaces and is particularly restoring surfaces spalled to corrosion of the reinforcement. Damaged concrete elements also retrofitted using this method. This also has known as gunning or shotcreting techniques.

19. What is caging with steel?

A steel caging is prepared and made to surround the existing masonry so that lateral expansion when it is loaded in compression. The confinement of masonry will steel cage increases its capacity and ductility.

20. Give a brief note on dogs in stitching.

The dogs are thin and long and to cannot take much of compressive force. The dogs must be stiffened and strengthened by encasement in an overlay or some similar means.

21. 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 b rendering, for areas less than .01 m<sup>2</sup>.

22. What is mean by weathering?

Many bridges and parking structures in cold climates have been severely damaged by de-icing salt causing corrosion of reinforcement and required repair. The process is generally labour- intensive and costly.

23. Write down the sequence of weathering.

1. Break-out in areas of delamination to 20mm behind reinforcement. The area was exerted as needed to expose 50mm length of un corroded steel, a requirement that significantly increased the amount of break out.

- ii. Replace the any reinforcement which had lost over 10 percent of effective area.



iii. Mix and place concrete.

iv. Erect the form work to provide pour depth not greater than m.

24. Write down the repair strategies.

i. All unsound and carbonated concrete was removed and cutting was extended to give clear space of 15mm round any exposed bars.

ii. The cutting out was extended along corroded bars to give a 40 bar diameter lap length of uncorroded bar.

iii. Badly corroded length of bar were cut out and the reminder blast cleaned.

iv. The exposed surfaces were treated with a polymer bonding agent, which was allowed to become tacky before rebuilding again.

25. What is mean by Freeze and thaw?

The effect of cycles of freezing and thawing becomes serious when the concrete is critically saturated during freezing. If saturation is not prevented by a suitable surface treatment or if the concrete in these critical locations is not air – entrained, then significant deterioration is likely to occur.

26. What is mean by Wear?

Where concrete has been damaged by erosion it is almost certain that any repaired section will again be damaged unless the cause of the erosion is removed. The best concrete made will not withstand the forces of cavitations or severe abrasion for a prolonged period.

27. Define the term “Fire Damaged structure”.

Most fire damaged structure can be repaired. A survey of over 100 fire damaged building in U.K, reported by Tovey and Crook, showed that most of the structures were repaired and that others that were not repaired for reasons other than the structural damage sustained.

28. What are the forms of Fire damages?

i. Spalling

ii. Strength reduction in concrete

iii. Loss of anchorage of reinforcement

iv. Excessive deflection of beams and slabs

v. distortion of the whole structural framing.

29. Write a short note on leakage.

Water – retaining structures which leak are not adequately fulfilling their function and repair often becomes necessary. Equally, structures designed to exclude water, such as roofs and basement walls, may need repair when water gets in some useful guidance on different techniques for dealing with these situations.

**PART-B**

1. Explain the various techniques available for repair of cracks.
2. Explain the various techniques to repair spalling and disintegration of concrete.
3. Describe the various strengthening techniques to overcome low member strength.
4. Explain in detail about Chemical disruption on concrete.
5. Describe in detail about the weathering action on concrete.
6. Write a brief note on deflection and Cracking.
7. Explain the following terms : i. Disruption ii. Weathering corrosion  
a. iii. Leakage, iv. Marine exposure.

PART-A

1. What is Vacuum concrete?

Only about half of the water added in concrete goes into chemical combination and the remaining water is used to make concrete workable. After laying concrete, water which was making concreting workable is extracted by a special method known as “vacuum method”.

2. What are the equipments used in vacuum concrete?

The equipment essentially consists of:-

- i. vacuum pump
- ii. water separator and
- iii. filtering mat

3. What is Guniting?

Guniting can be defined as mortar conveyed through a hose and pneumatically projected at a high velocity on to a surface.

4. What are the two types of process in Shotcrete?

- a. Wet mix process
- b. Dry mix process

5. What are the stages in dry mix process in shotcrete?

i. 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 of wet mix process.

ii. The wet process has been generally desired in favour of the dry mix process, owing to the greater success of the latter.

6. What is shotcrete?

Shotcrete is a recent development on the similar principle of guniting for achieving greater thickness with small coarse aggregate.

7. What are the preliminary investigations before demolition of a structure?

The demolition contractor should have ample experience of the type of work to be offered;

1. Fully comprehensive insurance against all risks must be maintained at all times;
2. An experienced supervisor should be continuously in charge of the work;
3. The contract price should include all safety precautions included in the relevant building regulations;
4. The completion date should be realistic, avoiding any need to take risks to achieve the date.

8. Write about protective clothing given before demolition.

Buildings where chemicals have been stored or where asbestos, lead paint, dust or fumes may be present will require specialized protective clothing,

9. Give a brief note on shoring and underpinning in demolition.

The demolition contractor has a legal obligation to show technical competence when carrying out the work. When removing sections of the building which could have leave other parts unsafe, adequate temporary supports and shoring etc. must be provided.

10. What are the major factors in selecting a demolition procedure?

Majors factors to be considered in selecting an appropriate technique include:-

1. Safety of personnel and public
2. Working methods
3. Legislation applicable
4. Insurance cover.

11. Give the categories of demolition techniques.

Demolition techniques may be categorized as:-

- Piecemeal demolition, using hand-held tools or machines, to reduce the height of the building or structure gradually;
- Deliberate controlled collapse, demolition to be completed at ground level.
- 

12. Write short notes on demolition by hand.

Demolition of buildings or structure by hand-held tools such as electric or pneumatic breakers, sometimes as a preliminary to using other methods, should be carried out, where practicable, in the reverse order to the original construction sequence. Lifting appliances may be necessary to hold larger structural members during cutting and for lowering severed structural members and other debris.

13. In 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.

14. Write short notes on balling machine.

Balling machines generally comprise a drag-line type crawler chassis fitted with a lattice crane jib. The demolition ball, with a steel anti-spin device, is suspended from the lifting rope and swung by the drag rope.

15. How are explosives used for demolition of a structure?

If explosives are to be used for demolition, the planning and execution, include pre-weakening, should be under the control of a person competent in these techniques. For large demolition, the competent person is likely to be an experienced explosive engineer; for smaller work, a shot-firer may be sufficient.

16 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 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.

17. What is pre-weakening?

Buildings and structures normally have structural elements designed to carry safely the loading likely to be imposed during their life. 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. This preweakening 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.

18. What is deliberate collapse?

The deliberate collapse of the whole or part of a building or structure requires particularly high standards of planning, supervisions and execution, and careful consideration of its effect on other parts of the structure or on adjacent buildings or structures. A surrounding clear area and exclusion zone are required to protect both personnel and property from the fall of the structure itself and debris which may be thrown up by the impact.

19. How can you develop a demolition strategy?

The strategy will need to take into account the method of construction used for the original building and its proximity to other buildings, structures and the general public. These factors, together with location, the cost and availability of tipping and disposal and the desirability and economics of reuse, must be taken into account in the development of an appropriate strategy for the demolition of a structure.

20. What are nibblers?

Nibblers use a rotating action to snap brittle materials such as concrete or masonry. In either case, material should be removed from the top of walls or columns in courses not greater than 600mm in depth, steel reinforcement should be cut separately as necessary.

21. What are the considerations before demolition?

Considerations should be given to:-

- Conducting a site and building survey, with a structural bias;
- The examination of drawings and details of existing construction where available;
- The preparation of details and drawings from site survey activities where no such information is available;
- Establishing previous use of premises, especially with regard to flammable
- substances or substances hazardous to health or safety;
- Programming the sequence of demolition work;
- The preparation of a Method Statement.

22. What are the Principles of dismantling?

- i. Primary Dismantling
- ii. Secondary dismantling

23. Write a short note on Primary and secondary dismantling.

Primary dismantling:

- i. To break up the structure with an aim to reduce the height and size of the elements.
- ii. To break the structural elements into handle able pieces for immediate removal from on site location.

Secondary dismantling:

To reduce the size of the demolished debris for proposal, salvage of swap or processing.

24. Mention the Primary dismantling methods.

- i. Splitters
- ii. Non – Explosive cracking agent.
- iii. Controlled Demolition.
- iv. Thermal lancing
- v. Crane and Ball method
- vi. Robotic machine.
- vii. Diamond sawing.

25. Write down the secondary dismantling method.

- i. Rock breakers
- ii. Jack Hammers – Pneumatic, Electrical, hydraulic, Petrol engine.
- iii. Concrete Pulverisers.
- iv. Hand held chippers.
- v. Hydro demolition.

26. What are the modern demolition techniques?

- a. Hydraulic Rock breakers
- b. Diamond sawing and drilling.
- c. Silent expansive chemicals
- d. Controlled demolition.
- e. Thermal lancing.

f.. Core drilling – uses of diamond tipped bits with hydraulic/electric/pneumatic geode drill motors – maximum dia – 200mm.

27. Write a short note on ‘Wire sawing’.

Wire sawing is used as ultimate demolition tool. In wire sawing, a diamond beaded wire is reared around the RCC members, to be cut. The wire is rotated at a high speed (100km/hr) by a special machine constantly applying a pulling force. The diamond wire penetrates and cuts through the steel and concrete.

Water is used as a lubricating coolant. Wire sawing has limitations on the size. Of RCC member to be cut. This technique is ideal for past primary demolition.

28. Define Hand sawing.

Hand sawing uses a light weight held machine, with diamond blade to cut RCC in any direction. By this technique, even over head cutting is possible. Maximum depth of cut is 150mm.

29. What are the advantages of Diamond?

- ✚ Time
- ✚ Dimensional accuracy
- ✚ Structural integrity
- ✚ Less Noise, Dust and Debris
- ✚ Limited access.
- ✚ These are the some of advantages of diamond cuttings.

30. Write down the dismantling tools.

- i. Hand operated Machines
- ii. Crane Mounted Machines
- iii. Excavator Mounted machine
- iv. Special machines
- v. Robotic machine.

31. What are the factors to be considered while selecting the tools to be used for job on hand?

- i. Volume of concrete to be dismantled.
- ii. Space available for walling.
- iii. Risks involved
- iv. Acceptable noise and vibration levels

32. What are the types of Hand Held Machine?

- Electrical Operated
- Battery Operated
- Pneumatic
- Hydraulic
- Engine

33. Write down the advantages and disadvantages of Hand held machines.

Advantages	Disadvantages
<ol style="list-style-type: none"> <li>1. Easy to handle</li> <li>2. Unskilled labour can be used</li> <li>3. Ideal for dismantling small volumes</li> <li>4. Ideal for short term jobs</li> <li>5. Ideal for vibration less chipping</li> </ol>	<ul style="list-style-type: none"> <li>Requires great muscular power</li> <li>Limited removal due to low hammer weight.</li> <li>Little impact from small diameter chisel.</li> <li>High labour cost</li> <li>Harmful to body due to vibrations</li> <li>Harmful to finger blood vessels.</li> <li>Danger from dust &amp; falling debris.</li> </ul>

**PART-B**

1. Briefly explain about vacuum concrete.
2. Explain in detail about Guniting.
3. Explain Rust Eliminators
4. Describe the preliminary procedures in demolition of a structure.
5. Explain the demolition process of a damaged structure
6. Describe in detail about the various demolition techniques.
7. Describe in detail about the impulsion method of demolition of structures.
8. Discuss in detail about any case study on demolition of structures.