

**REPAIR & REHABILITATION OF STRUCTURES
(CIVL 3221)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Long term change in the volume of concrete caused by loss of moisture is regarded as
 - (a) Drying shrinkage
 - (b) Carbonation shrinkage
 - (c) Plastic shrinkage
 - (d) Autogenous shrinkage
- (ii) Chemical causes which lead to leaching in concrete can be attributed to
 - (a) Chloride attack
 - (b) Salt and sulphate attack
 - (c) Carbonation
 - (d) All of these
- (iii) For moderate exposure conditions, the nominal cover to RC members should be
 - (a) 20 mm
 - (b) 30 mm
 - (c) 45 mm
 - (d) 60 mm
- (iv) Non-structural repairs are undertaken to restore
 - (a) Structural stability to sustain actual loads
 - (b) Load bearing capacity of structures
 - (c) Aesthetic appearance of structures
 - (d) All of these
- (v) Which of the following tests is considered as semi-destructive test in concrete?
 - (a) Carbonation depth test
 - (b) Rebound hammer test
 - (c) Ultrasonic pulse velocity test
 - (d) Profometer test.

- (vi) The wire mesh in ferro-cement usually contains wires of diameter
 - (a) 1.0 mm to 2.0 mm
 - (b) 2.0 mm to 3.0 mm
 - (c) 0.5 mm to 1.0 mm
 - (d) 0.01 mm to 0.1 mm
- (vii) Mortar or concrete conveyed through pressure hose and applied pneumatically at high velocity on to a surface is called
 - (a) Shoring
 - (b) Guniting
 - (c) Sealing
 - (d) Jacketing
- (viii) If the UPV (ultrasonic pulse velocity) value is between 3.0 km/sec to 3.5 km/sec, the quality of concrete mass is regarded as
 - (a) Very good
 - (b) Good
 - (c) Poor
 - (d) Very poor
- (ix) The construction of temporary structure required to support an unsafe structure is called
 - (a) Underpinning
 - (b) Shoring
 - (c) Scaffolding
 - (d) Jacking
- (x) Foundations can be strengthened by
 - (a) Enlarging the area of footing
 - (b) Underpinning
 - (c) Strengthening by micropiles
 - (d) All of (a), (b) & (c).

Fill in the blanks with the correct word

- (xi) Crack width lying between 1mm to 2mm is considered as_____ cracks.
- (xii) The relevant IS code for Ultrasonic Pulse velocity test is _____.
- (xiii) In the stitching method of repair, the crack is bridged with _____.
- (xiv) Half cell potentiometer test is conducted on concrete to determine _____.
- (xv) The type of maintenance work is taken to wear or decay of building is known as _____.

Group - B

- 2. (a) Explain the term “durability” of concrete structures. Also distinguish between repair and rehabilitation. [[C01](Remember/LOCQ)]
- (b) Define shrinkage in concrete. What are the classifications of shrinkage? [[C01](Remember/LOCQ)]

- (c) What is meant by plastic settlement cracks? [[CO1](Understand/IOCQ)]
(2 + 3) + (2 + 2) + 3 = 12
3. (a) Describe various factors causing deterioration in concrete structures. [[CO2, CO2](Remember/LOCQ)]
 (b) Explain how “**faulty design and faulty construction**” affects the service life RCC structures. [[CO1, CO2](Understand/IOCQ)]
 (c) How sulphate attack occurs and what are the parameters considered? How will you reduce sulphate attack on concrete? [[CO1,CO2](Understand/IOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Discuss regarding various symptoms of distress in concrete structures. [[CO1,CO2](Understand/IOCQ)]
 (b) Differentiate between structural and non-structural repairs? Classify cracks occurring in various structural components. [[CO1,CO2](Remember/LOCQ)]
6 + 6 = 12
5. (a) Briefly explain various testing systems of hardened concrete. [[CO3](Analyse/HOCQ)]
 (b) Explain the principles and procedures of the following tests:
 (i) Half-cell potentiometer test
 (ii) Profometer test (or rebar locator)
 Also, provide neat sketches for the above mentioned tests. [[CO3](Understand/IOCQ)]
4 + (4 + 4) = 12

Group - D

6. (a) Mention the various applications and fields of applications of repair materials in concrete structures. [[CO3, CO4](Understand/IOCQ)]
 (b) How are polymers used in repair materials? [[CO3, CO4](Analyze/IOCQ)]
 (c) Describe the methodology for selection of repair materials. [[CO3](Understand/LOCQ)]
5 + 3 + 4 = 12
7. (a) Explain in details about repair methodologies for repair of cracks. [[CO3, CO4](Analyze/IOCQ)]
 (b) With the aid of a hand sketch, elaborately explain guniting and shotcreting process. [[CO4](Understand/IOCQ)]
6 + 6 = 12

Group - E

8. (a) Explain why concrete structures need to be strengthened? [[CO5,CO6](Understand/IOCQ)]
 (b) Explain with neat sketches about the jacketing techniques for the repair of structurally affected beam-column joint in a building. [[CO5,CO6](Understand/IOCQ)]
4 + 8 = 12

9. (a) With neat sketches, explain how retrofit strategies are used in case of RCC structures ? [[CO5, CO6](Understand/IOCQ)]
- (b) List down the conditional assessment of foundations. [[CO5, CO6](Remember/LOCQ)]
- 6 + 6 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.21	65.63	4.17

Course Outcome (CO):

After the completion of the course students will be able to

1. Identify various damages to concrete structures
2. Predict damage assessment of any building showing signs of deterioration and thus should be able to detect the possible cause /source of deterioration.
3. Develop a detailed knowledge of the concrete repair industry equipped with variety of repair materials and techniques.
4. Utilize various types of newly developed repair materials in the process of repair and rehabilitation of structures.
5. Summarize and apply the importance of quality control in concrete construction and significance of protection and maintenance of structures.
6. Assess damage to structures and apply various repair and retrofitting techniques.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*