

REPAIR & REHABILITATION OF STRUCTURES
(CIVL 3221)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which one is one of the chemical causes for damage/distress in concrete structures?
(a) Creep (b) Shrinkage
(c) Freeze-thaw (d) Sulphate attack.
- (ii) The shrinkage in concrete which occurs in fresh concrete after placing and before setting is
(a) autogenous shrinkage (b) drying shrinkage
(c) plastic shrinkage (d) carbonation shrinkage.
- (iii) Cracks with width more than 2 mm are known as
(a) thin cracks (b) wide cracks
(c) medium cracks (d) crazing.
- (iv) If the velocity of UPV lies between 2.5 and 3 km/sec, then quality of concrete can be assumed as
(a) very good (b) fair
(c) medium (d) poor.
- (v) Natural fiber material used in fiber-reinforced concrete is
(a) cellulose (b) polypropylene
(c) glass (d) carbon.
- (vi) For an infinite, homogenous, isotropic elastic medium, the wave velocity is given by the formula, where v = compression wave velocity (km/sec); k = constant; E_d = dynamic modulus of elasticity; ρ = mass density; γ = dynamic Poisson's ratio
(a) $v = k\sqrt{E_d} / \rho$ (b) $v = kE_d / \rho$
(c) $v = \sqrt{k} E_d / \rho$ (d) $v = E_d \rho / \sqrt{k}$

- (vii) Which one of these is a semi-destructive test to evaluate concrete strength?
(a) Schmidt rebound hammer test (b) Petrographic test
(c) Ultrasonic pulse velocity test (d) Core Test.
- (viii) In ferrocement, steel content varies from
(a) 200 kg to 300 kg per cubic meter of concrete
(b) 100 kg to 150 kg per cubic meter of concrete
(c) 300 kg to 500 kg per cubic meter of concrete
(d) 10 kg to 50 kg per cubic meter of concrete.
- (ix) "Shotcrete" is defined as
(a) Mortar or concrete pneumatically projected at high speed onto a surface
(b) freely flowable cement concrete
(c) ferrocement
(d) fiber reinforced concrete.
- (x) The test used to detect corrosion potential of reinforcement bars in concrete
(a) schmidt rebound hammer test (b) windsor probe test
(c) carbonation depth test (d) half-cell electrical potential.

Group- B

2. (a) What is meant by durable structures? Mention the physical factors which influence durability of concrete. [(CO1)(Remember)/LOCQ]
(b) Explain the following terms:
(i) Plastic shrinkage
(ii) Autogenous shrinkage
(iii) Drying shrinkage. [(CO1)(Remember)/LOCQ]
(2 + 4) + (3 × 2) = 12
3. (a) Mention all the causes for damage or distress in concrete structures. [(CO2)(Remember)/LOCQ]
(b) Clearly explain corrosion mechanism of embedded reinforcement bars and explain the chemical reactions involved in the corrosion process of steel in RCC structures. [(CO2)(Understand)/LOCQ]
4 + 8 = 12

Group – C

4. (a) Define following terms:
(i) Rehabilitation of concrete structures
(ii) Retrofitting of concrete structures. [(CO2)(Remember/LOCQ)]
(b) Describe delamination and spalling of concrete. [(CO2)(Remember/LOCQ)]
(c) Explain about the poor construction practices and design errors for a concrete structure. [(CO2)(Remember)/LOCQ]
(3 + 3) + 3 + 3 = 12

5. (a) Describe in brief about the Non-destructive tests for a concrete structure. [[C03](Remember/LOCQ)]
- (b) Write short notes on:
- (i) Electrical resistivity test
 - (ii) Ultrasonic pulse velocity test
 - (iii) Carbonation test. [[C03](Remember)/LOCQ]
- 5 + (2 + 3 + 2) = 12**

Group - D

6. (a) For a repairing material, describe it's
- (i) Compressive strength
 - (ii) Modulus of elasticity
 - (iii) Bonding and Thermal. Expansion. [[C04](Understand/IOCQ)]
- (b) Elaborately explain the process of guniting and shotcreting. [[C04](Remember/IOCQ)]
- (2 × 3) + 6 = 12**
7. (a) Mention any 5 repair techniques to be applied on concrete structures. [[C04](Remember/IOCQ)]
- (b) Explain stitching of cracks and discuss its benefits. [[C05](Remember/IOCQ)]
- (c) Provide neat self-explanatory sketches for external stressing of flexural members and repair of cracks by flexible sealing. [[C05](Remember/IOCQ)]
- 3 + 5 + 4 = 12**

Group - E

8. What are the various techniques for strengthening/retrofitting of structures? Also provide neat sketches. [[C05](Remember)/LOCQ]
- 12**
9. Explain the details for various retrofit techniques adopted for foundation damages with neat sketches. [[C06](Apply)/HOCQ]
- 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	62.5	25	12.5

Course Outcome (CO):

The course will assist the students to:

CO1: Identify various damages to concrete structures.

CO2: Predict damage assessment of any building showing signs of deterioration and thus should be able to detect the possible cause / source of deterioration.

- CO3: Develop a detailed knowledge of the concrete repair industry equipped with variety of repair materials and techniques.
- CO4: Utilize various types of newly developed repair materials in the process repair and rehabilitation of structures.
- CO5: Summarize and apply the importance of quality control in concrete construction and significance of protection and maintenance of structures.
- CO6: Assess damage to structures and various repair and retrofitting techniques.

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