

Techno India NJR Institute of Technology



Repair and Rehabilitation of Structures

(Subject Code: 5CE5-14)

Bhupendra purohit
(Assistant Professor)
Department of CE

For Techno India NJR Institute of Technology
पंकज पोखवाल
Dr. Pankaj Kumar Porwal
(Principal)



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. (Civil Engineering)

5CE5-14: REPAIR AND REHABILITATION OF STRUCTURES

Credit: 2

Max. Marks: 100(IA:20, ETE:80)

2L+0T+0P

End Term Exam: 2 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Deterioration of Concrete Structures: Penetrability of concrete- permeability, sorptivity, diffusion. Physical processes- abrasion, erosion. Chemical- carbonation, chloride and sulfate attack. Alkali - Aggregate Reaction. Corrosion- mechanism. Factors affecting and Preventive measures : for all the above, including water - proofing techniques for various conditions, sacrificial anode, corrosion resistant steel, corrosion inhibitors, protective coatings etc.	8
3	Cracks in Concrete and Masonry Structures- Types, patterns, measurement and preventive measures	3
4	Assessment of Risk/Damage in Structures: <i>Preliminary investigation-</i> visual, history collection etc. <i>Detailed Investigation:</i> core cutting, rebar locator, corrosion meter, penetration resistance, pull out tests, half-cell potential, concrete resistivity etc. Interpretation of non destructive test data from all the above tests as well as rebound hammer number and ultra sonic pulse velocity. Destructive and chemical tests- on material samples from site.	5
5	Materials for Repair: polymers and resins, self curing compounds, FRP, ferro-cement- properties, selection criterion, cement based and polymer modified mortars etc	4
6	Repair Techniques: Grouting, Jacketing, External bonded plates- processes, limitations, design computations etc. including numerical problems. Under Water Repair: Processes	6
7	Case Studies: related to rehabilitation of bridge piers, heritage structures, masonry structures etc.	2
	TOTAL	28

For Techno India NJR Institute of Technology
पंकज कुमार पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

Course Overview:

Student will learn basics of RRH from this 28 hours course. They will be able to 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. Structural repairs and rehabilitation is a process of reconstruction and renewal of a facility or its structural elements. This involves determining the origin of distress, removing damaged materials and causes of distress, as well as selecting and applying appropriate repair materials that extend a structure's life

RRH is the basic requirement for the job role of Civil Engineer in the companies like L &T,NCC Ltdetc.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	Synthesis	Student will be able to Plan and understand the repair strategies for buildings and Rehabilitation of structure
2	Analysis	Student will be able to analyse the serviceability and Durability of concrete
3	Evaluation	Students will be able to Able to choose the materials and repair techniques or method.
4	Synthesis	Students will be able to Able to Develop of "DEMOLITION TECHNIQUES" Engineered demolition techniques for Dilapidated structures – case study
5	Application	Students will be able to apply method of repairs, rehabilitation and retrofitting of Structures.

For Techno India NJR Institute of Technology
पंकज कुमार पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

Prerequisites:

1. Analyze strength and materials deficiency in concrete structures.
2. Suggest methods and techniques used in repairing / strengthening existing concrete structures.
3. Apply Non-Destructive Testing techniques to field problems.
4. Apply cost effective retrofitting strategies for repairs in buildings.
5. Estimate causes for distress and deterioration of structures

Course Outcome Mapping with Program Outcome:

Repair and Rehabilitation of Structures															
Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO367.1	3	2	2	2	2	2	2	1	2	1	1	1	2	2	3
CO367.2	2	2	2	2	1	2	2	1	2	1	2	1	2	2	2
CO367.3	3	2	2	2	2	2	2	1	2	1	1	1	2	2	3
CO367.4	2	2	3	3	2	1	2	1	2	1	1	1	3	3	1
CO367.5	2	2	3	3	2	1	2	1	2	1	1	1	3	3	1
CO367 (AVG)	2.4	2	2.4	2.4	1.8	1.6	2	1	2	1	1.2	1	2.4	2.4	2

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	1	INTRODUCTION: Objective, scope and outcome of the course
2	2	DETERIORATION OF CONCRETE STRUCTURES: Penetrability of concrete- permeability
3	2	Sportively, diffusion. Physical processes- abrasion, erosion
4	2	Chemical - carbonation, chloride and sulfate attack
5	2	Alkali – Aggregate Reaction. Corrosion- mechanism.

For Techno India NJR Institute of Technology
पंकज कुमार पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

6	2	Factors affecting and Preventive measures: for all the above
7	2	Water – proofing techniques for various conditions
8	2	Sacrificial anode, corrosion resistant steel
9	2	Corrosion inhibitors, protective coatings etc.
10	3	CRACKS in Concrete and Masonry Structures- Types of cracks
11	3	Patterns of cracks
12	3	Measurement and preventive measures
13	4	ASSESSMENT OF RISK/DAMAGE IN STRUCTURES: Preliminary investigation- visual, history collection etc
14	4	Detailed Investigation: core cutting, rebar locator, corrosion meter, penetration resistance,
15	4	Pull out tests, half–cell potential, concrete resistivity etc
16	4	Interpretation of nondestructive test data from all the above tests as well as rebound hammer number and ultra-sonic pulse velocity
17	4	Destructive and chemical tests- on material samples from site.
18	5	MATERIALS FOR REPAIR: Polymers and resins
19	5	Self-curing compounds, FRP
20	5	Ferro-cement- properties, selection criterion
21	5	Cement based, and polymer modified mortars etc
22	6	REPAIR TECHNIQUES: Grouting
23	6	Jacketing
24	6	External bonded plates- processes, limitations
25	6	Design computations etc
26	6	Design computations etc. Including numerical problems
27	6	Under Water Repair: Processes
28	7	CASE STUDIES: Related to rehabilitation of bridge piers, heritage structures, masonry structures etc

TEXT/REFERENCE BOOKS

1. Properties of Concrete by A.M. Neville, Pearson.
2. Concrete Technology by M.S. Shetty, S. Chand & Comp.
3. Handbook of Analytical Techniques in Concrete Tech by V.S. Ram Chandran,

For Techno India NJR Institute of Technology
 पंकज कुमार पोरवाल
 Dr. Pankaj Kumar Porwal
 (Principal)

Course Level Problems (Test Items):

CO.NO.	Problem description
1	1) Explain in detail the penetrability and permeability of concrete 2) Write a note on Physical process of concrete 3) Write a note on Chemical process of concrete 4) Explain in detail about water proofing techniques 5) Write about Corrosion Resistance steel
2	1) Write a note on Masonry structures 2) Explain in detail Different types of cracks in concrete 3) Explain in detail different types of patterns of crack 4) Write a note on Measurement and preventive measures for cracks
3	1) Explain detail preliminary Investigations. 2) Write a note on Core cutting investigations 3) Explain in detail the method of corrosion meter and rebar locaters 4) Explain in detail Ultra sonic pulse velocity test. 5) Write about Chemical test on material sample
4	1) Write about different types of polymers 2) Write about self-Curing Compounds 3) Write about Ferro cement Properties in detail 4) Explain in detail Cement based materials

	5) Write a note on Resistivity method of Investigation
5	1) Write about Grouting in detail 2) Explain use of External bonded plates and processes 3) Explain in detail Underwater Repair techniques 4) Write about Repairing of bridges

Assessment Methodology

1. Assignments one from each unit.
2. Midterm subjective paper where they have to write about subject. (Twice during the semester)
3. Final paper at the end of the semester subjective.

Teaching and Learning resources unit-wise:

Unit-1

Deterioration of concrete Structures

Video Tutorials: <https://www.youtube.com/watch?v=xlmiCWaYHXk>

Theory concepts:

https://www.researchgate.net/publication/267422589_Deterioration_and_rehabilitation_of_concrete_structures_in_hot_and_arid_regions

Sample Quiz: <https://www.discountpdh.com/evaluation-and-repair-of-concrete-structures-quiz>

Unit-2

Cracks in concrete

Video Tutorials: https://www.youtube.com/watch?v=gkG_a60IvOE

For Techno India NJR Institute of Technology
 पंकज कुमार
 Dr. Pankaj Kumar Porwal
 (Principal)

Theory concepts:

https://www.researchgate.net/publication/286601793_STUDY_ON_DIFFERENT_TYPES_OF_CRACKS_IN_PLAIN_AND_REINFORCED_CONCRETE

Sample Quiz: https://www.concreteconstruction.net/how-to/repair/some-questions-and-answers-on-the-mechanism-of-cracking_o

Unit-3

Assessment of risk / Damage in structure

Video Tutorials: <https://www.youtube.com/watch?v=NdLwHk-A0hc>

Theory

concepts: http://webarchiv.ethz.ch/ibk/emeritus/fa/education/ws_safety/Safety07/Script_secure.pdf

Sample Quiz: <https://www.discountpdh.com/how-to-avoid-earthquake-damage-in-new-buildings-quiz>

Unit-4

Material for Repair

Video Tutorials: <https://www.digimat.in/nptel/courses/video/105102088/L09.html>

Theory concepts: <https://bie.tg.nic.in/Pdf/BuildingMaterialsConstruction.pdf>

Sample Quiz: <https://www.indiabix.com/civil-engineering/building-materials/>

Unit-5

Repair Techniques

Video Tutorials: <https://www.youtube.com/watch?v=fikRPFpbgVo>

For Techno India NJR Institute of Technology
पंकज पोखराल
Dr. Pankaj Kumar Porwal
(Principal)

Theory concepts: <https://nptel.ac.in/courses/105/106/105106202/>

Sample Quiz: <https://www.discountpdh.com/evaluation-and-repair-of-concrete-structures-quiz>

Previous Year Question Papers:

For Techno India NJR Institute of Technology
पंकज पोखराल
Dr. Pankaj Kumar Porwal
(Principal)

0180973

5E1349	Roll No. _____	[Total No. of Pages : 2]
	5E1349 B.Tech. V - Semester (Main) Examination, Nov. - 2019 PCC/PEC Civil Engg. 5CE5-14 Repair and Rehabilitation of Structures	

Time : 2 Hours

Maximum Marks : 80
Min. Passing Marks : 28

Instructions to Candidates:

Attempt all five questions from Part A, four questions out of six questions from Part B and two questions out of three from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Part - A

(Answer should be given up to 25 words only)

All questions are compulsory

(5×2=10)

1. What is the role of alkalis in concrete?
2. Define "Guniting" and "Bonding Aspect".
3. Write about self curing compound.
4. Explain the diffusion process.
5. Write the effect of chloride on concrete.

Part - B

(Analytical/Problem solving questions)

Attempt any four questions

(4×10=40)

1. Give the detail study about the alkali reactions. Also write the Mechanism of AAR.
2. Write the factor affecting and respective preventive measures of corrosion. Brief the corrosion Mechanism.
3. Explain different types of cracks.
4. What do you mean by ultra sonic pulse velocity? What are the equipments used in this test. Write its principle and its procedure of testing.
5. How Penetration resistance and pull out test are different from core cutting test.
6. What is the application of shotcreting? How it is done?

5E1349 /2019

(1)

[Contd....]

For Techno India NJR Institute of Technology

पंकज पुरवाल
Dr. Pankaj Kumar Perwal
(Principal)

<http://www.rtuonline.com>

Part - C

(Descriptive/Analytical/Problem Solving/Design Question)

Attempt any two questions

(2×15=30)

(3×5=15)

1. Write notes on :
 - i) Grouting
 - ii) Under water repair
 - iii) Externally bonded plates.
2. Write notes on :
 - i) Mapping of data
 - ii) Rebound hammer test.
 - iii) A Case study of rehabilitation of dam.
3. a) Discuss properties and selection criteria of epoxy, polyester and resins. (7)
b) Explain the material, advantages, and applications of FRP and ferro - cement. (8)



For Techno India NJR Institute of Technology
पंकज पेरवाल
Dr. Pankaj Kumar Perwal
(Principal)