



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Civil Engineering

Subject Code: DI05006071

Subject Name: Maintenance & Rehabilitation of Structures

w. e. f. Academic Year:	2026-27
Semester:	5th
Category of the Course:	PEC-04

Prerequisite:	Professional Elective Course
Rationale:	<p>Civil engineering structures such as buildings, bridges, dams, and pavements are designed to serve society for many decades. However, due to factors like environmental exposure, material deterioration, aging, overloading, poor construction practices, natural disasters, and lack of periodic maintenance, these structures may develop defects, cracks, corrosion, and other forms of distress. If these problems are not addressed in time, the safety, serviceability, and durability of the structures may be seriously affected.</p> <p>In the present scenario, many existing structures are reaching the end of their design life or are experiencing deterioration due to increasing urbanization and environmental impacts. Replacing these structures completely is often costly and impractical. Therefore, proper inspection, maintenance, repair, strengthening, and rehabilitation techniques are essential to extend the service life of structures and ensure their safe performance. If the structure gets dilapidated, then sometimes it needs to be demolished.</p> <p>This subject aims to provide diploma civil engineering students with fundamental knowledge about causes of structural deterioration, methods of condition assessment, non-destructive testing techniques, maintenance strategies, and modern repair and rehabilitation methods. Students will also learn about materials used for repair, corrosion protection techniques, crack repair methods, and retrofitting practices.</p> <p>The knowledge gained from this course will enable diploma engineers to assist in the inspection, maintenance planning, and rehabilitation of structures, thereby contributing to sustainable infrastructure management and public safety.</p>



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Course Outcome:

After completion of the course, the student will be able to:

No	Course Outcomes	RBT Level
01	Explain the basic concepts, importance, and types of maintenance in buildings.	R, U, A
02	Evaluate the Damage structure by physical investigation and distress diagnostic techniques	R, U, A
03	Assess the durability of concrete under different weather conditions	R, U, A
04	Select suitable materials and techniques for repair, strengthening, retrofitting, and rehabilitation of damaged structures.	R, U, A
05	Describe demolition and dismantling techniques , including safety measures and reuse of materials from environmental and economic perspectives.	R, U, A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Basics of maintenance and repairs 1.1 Introduction 1.2 Importance of maintenance 1.3 Types of maintenance - daily, weekly, monthly, Annually 1.4 General Maintenance - Painting of Buildings - Home Electricity System	5	10% (07 marks)
2.	Causes and detection of damage 2.1 Causes of Damage in structures due to distress, Earthquake, Wind, Floods, Dampness, Corrosion, Fire, Dilapidation and Pests 2.2 Causes of Damage in structures due to Construction and design failures. 2.3 Inspection and evaluating damaged structure. 2.4 Condition assessment and distress-diagnostic techniques using	07	10% (07 marks)



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	Rebound Hammer, ultrasonic pulse velocity test, rebar locator, crack detection microscope, chloride test, sulphate attack, pH measurement and Half-cell potential test.		
3.	Durability and Serviceability of Concrete 3.1 Quality assurance for concrete construction based on concrete properties like (a) strength (b) Permeability (c) Thermal properties (d) cracking 3.2 Effects due to (a) climate (b) temperature (c) chemicals (d) corrosion 3.3 Design and construction errors 3.4 Effects of cover and cracks	06	20% (14 marks)
4.	Material and strengthening techniques for repair 4.1 Materials for Repair - Special concrete and mortar - concrete chemicals - construction chemicals - Expansive cement - polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fiber reinforced concrete - Rust eliminators and polymers coating for rebars - foamed concrete - dry pack - vacuum concrete - asphalt sheeting 4.2 Techniques for Repairs -Guniting, grouting and Shotcrete - Epoxy injection	11	26% (18 marks)



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	<ul style="list-style-type: none"> -Jacketing - shoring and underpinning - Methods of corrosion protection <ul style="list-style-type: none"> a) corrosion inhibitors b) corrosion resistant steels c) coating and cathodic protection 		
5.	<p>Repair Retrofitting and Rehabilitation</p> <p>5.1 Repair of - stone, brick and block masonry (Cracks, dampness, efflorescence, joint separation, etc.)</p> <ul style="list-style-type: none"> – Flooring - Roofs (sloping, flat, pitched, etc.) – Concrete members due to Steel Corrosion (Lack of Bond shear, tension, torsion, compression failure - Rainwater Leakage in Buildings - Leakage in Basement, toilet area <p>5.2 Control on Termites (White Ants) in Buildings</p> <p>5.3 Fungus Decay of wood works in Buildings</p> <p>5.4 Estimation of Repair and retrofitting</p>	10	23% (16 marks)
6.	<p>Demolition and Dismantling Techniques</p> <p>6.1 Define: Demolition</p> <p>6.2 Demolition techniques</p> <ul style="list-style-type: none"> (a) Non-Engineering Demolition - Manual Demolition (b) Engineering Demolition - Mechanical <ul style="list-style-type: none"> (i) Wrecking Ball (ii) Pusher Arm technique (iii) Thermic Lance Technique (iv) Non – Explosive Demolition (v) Concrete Sawing Method (vi) Deliberate Collapse Method. (vii) Pressure Jetting-Impllosion - Deconstruction Method <p>6.3 Safety measures during demolition operation</p> <p>6.4 Dismantling of buildings and reuse of materials/fittings from environmental and financial point of view.</p>	6	11% (08 marks)
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-



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Where R: Remember; U: Understanding; A: Application, N: Analyse and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book	Author	Publication with place, year and ISBN
1	<i>Handbook on Repair and Rehabilitation of RCC Buildings,</i>	Central Public Works Department (CPWD), Government of India	CPWD, New Delhi, India, 2011 (First published 2002)
2	Concrete Technology-Theory and Practice	M.S.Shetty	S. Chand & Company Ltd., New Delhi, India, 2019. ISBN: 978-8121922043.
3	<i>Repair and Rehabilitation of Structures,</i>	Krishna, R. N. and Santhakumar, A. R.	Standard Book House, New Delhi, India, 2022. ISBN: 978-9391651015.
4	<i>Rehabilitation of Concrete Structures,</i>	Vidivelli, B.	Standard Publishers Distributors, New Delhi, India, 2009. ISBN: 978-8180141560.
5	<i>Maintenance and Repairs of Structures,</i>	Deshpande, S. P. and Joshi, A. P.	Nirali Prakashan, Pune, India, 2023. ISBN: 978-9389825428.
6	<i>Maintenance Engineering (Repair and Maintenance of Civil Works and Structures),</i>	Khanna, P. K.	Khanna Publishers, New Delhi, India, 2015. ISBN: 978-8174090997.
7	<i>Maintenance & Repair of Civil Structures</i>	B.L.Gupta	Standard Publishers Distributors, New Delhi, India, 2010. ISBN: 978-8180141423.
8	<i>Maintenance, Repair, Rehabilitation and Minor Works of Buildings,</i>	Varghese, P. C.	Prentice Hall of India (PHI Learning Pvt. Ltd.), New Delhi, India, 2014. ISBN: 978-8120349896.



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Sr. No.	Title of Book	Author	Publication with place, year and ISBN
9	IS 13311 (Part 1 & 2): 1992 – <i>Non-Destructive Testing of Concrete – Methods of Test</i>		Bureau of Indian Standards (BIS), New Delhi.
10	IS 13311 (Part 1 & 2): 1992 – <i>Non-Destructive Testing of Concrete – Methods of Test</i>		Bureau of Indian Standards (BIS), New Delhi.
11	IS 15988: 2013 – <i>Guidelines for Repair and Strengthening of Concrete Structure</i>		Bureau of Indian Standards (BIS), New Delhi.
12	IS 13935: 1993 – <i>Code of Practice for Strengthening of Concrete Structures</i>		Bureau of Indian Standards (BIS), New Delhi.

(b) Open-source software and website:

List of **open-source (or free-to-use)** software tools that can be used for teaching or learning **Maintenance and rehabilitation of structures:**

1. NPTEL Course: Maintenance and Repair of Concrete Structures– IIT Madras
<https://nptel.ac.in/courses/112106231>
2. NPTEL Course: Retrofitting and Rehabilitation of Civil Infrastructure– IIT Kharagpur
<https://nptel.ac.in/courses/112106231>
3. Ministry of Education – SWAYAM (Construction Courses) <https://swayam.gov.in/>.
4. National Council for Cement and Building Materials, <https://www.ncbindia.com/structural-assessment-rehabilitation.php>

Suggested Course Practical List:

Sr. No.	Practical	Unit No.	Approx. Hrs. required
1	Prepare a report on i. Importance of Maintenance. ii. Various routine maintenance works in building	1	2
2	Prepare a report on i. Causes of damage to structures ii. Points to be considered for inspection and evaluation of damaged structure	2	4



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Sr. No.	Practical	Unit No.	Approx. Hrs. required
3	Prepare sketches of equipment/tools for repair works. (Based on internet search and site visits)	4, 5, 6	4
4	Study the maintenance of a nearby building/civil structure being carried out (or carried out recently) and prepare a case study on it including financial aspects. (this may include study of maintenance of cracks)	1 and 2	4
5	Study the guidelines of the Municipal Corporation or R& B department, BIS standards etc regarding declaring buildings/structures unsafe for living/use and based on this identify buildings/structures if any in your locality and prepare a case study on it. OR Study the preservation work of a historical building being carried out by Archaeological department in a nearby location and prepare a report on it.	5	4
6	Determine the compressive test of concrete using Rebound Hammer.	2	2
7	Determine the extent of Damage of structural members using ultrasonic pulse velocity test.	2	2
8	Determine the corrosion of reinforcement bar using half cell potentiometer of structural members for damaged and undamaged structures.	2	2
9	Seminar (Present case studies and reports prepared in above practical in seminar type situation)	All	6
Total hours			30 Hrs.

List of Laboratory/Learning Resources Required:

Sr. No	Learning Resources	Practical No.
1	Rebound Hammer: The standard Type N hammer has an impact energy of 2.207 Nm, weighing about 1-2 kg, and conforms to BS-1881-202	2
2	Ultrasonic velocity test apparatus: range 0.1 to 7930 μ s, resolution: 0.1 to 1 μ s, Display 7", Color 800x400, pulse voltage 100-450 Vpp, bandwidth 20-500 Khz	2



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Sr. No	Learning Resources	Practical No.
3	Half Cell potentiometer: Voltage 220, Electric Power source, frequency 50 Hz, corrosion monitoring technic standardized by ASTM	2

Suggested Project List:

1. Visit, inspect and evaluate damaged structures and give suggestions about repair techniques. (in a group of 3 to 4)
2. Prepare estimate for repairing the damaged structure visited.
3. Each group may prepare a report and give seminar with Power Point Presentation.
4. Check the parameters such as permeability, moisture content, extent of efflorescence at a retrofitting site or lab and prepare a detailed report.
5. Check the parameters such as carbonation of concrete and compressive test using core cutter at a retrofitting site or lab.

Suggested Activities for Students: If any

- a) Prepare a list of materials available for repair and retrofitting by a market survey.
- b) Prepare a list of advanced retrofitting techniques performed on site.
- c) Prepare a case study of implosion technique used in India recently.
- d) Prepare a checklist for maintenance activities to be performed for residential, commercial buildings, bridges and steel structures.
