

GUJARAT TECHNOLOGICAL UNIVERSITY

8th Semester Civil Engineering - PDDC

Subject Code & Name: X80605 - Repairs and Rehabilitation of Structures
(Department Elective-II)

Teaching scheme hours				Subject Credits	Evaluation Scheme (Examination Scheme)				
Theory Hours	Tutorial Hours	Practical Hours	Total Hours		University Exam (E)		Internal Exam		Total Marks
					Theory (E)	Practical (E)	Mid Sem Theory (M)	Practical (I)	
4	2	0	6	6	70	30	30	20	150

Sr. No.	Course content
1.	Repair Strategies: Causes of distress in concrete structures, Construction and design failures, Condition assessment and distress-diagnostic techniques, Assessment procedure for Inspection and evaluating a damaged structure.
2.	Serviceability and Durability of Concrete: Quality assurance for concrete construction concrete properties – strength, Permeability, thermal properties and cracking. – Effects due to climate, temperature, chemicals, corrosion – design and construction errors – Effects of cover thickness and cracking
3.	Materials and Techniques for Repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection.
4.	Repairs, Rehabilitation and Retrofitting of Structures: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, long term health monitoring techniques.
5.	Demolition Techniques: Engineered demolition techniques for Dilapidated structures – case studies

Text Books:

1. Denison Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical UK, 1991.
2. R.T.Allen and S.C.Edwards, Repair of Concrete structures, Blakie and Sons, UK, 1987

References Books:

1. Handbook on Repairs and Rehabilitation of structures, CPWD, Delhi
2. M.S.Shetty, Concrete Technology – Theory and Practice, S.Chand and Company, New Delhi, 1992.
3. Santhakumar, A.R., Training Course notes on Damage Assessment and repairs in Low Cost Housing, "RHDC – NBO" Anna University, July 1992.
4. Raikar, R., Learning from failures – Deficiencies in Design, Construction and Service – R & D centre (SDCPL), Raikar Bhavan, Bombay, 1987.
5. Lakshmipathy, M. et al. Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 -30th October 1999.

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER-VIII EXAMINATION – SUMMER 2016

Subject Code: X80605**Date: 05/05/2016****Subject Name: Repairs and Rehabilitation of Structures****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the causes of distress in structures. **07**
(b) Elaborate on Condition assessment of RC structures and distress-diagnostic techniques. **07**
- Q.2** (a) Explain the various demolition techniques with its advantages and disadvantages. **07**
(b) What is the meaning of durable concrete? What are the test performed to check the durability? **07**
- OR**
- (b) How the corrosion takes place? Explain the various techniques to avoid or delay the corrosion. **07**
- Q.3** (a) Clearly distinguish the three terms: Repair, Rehabilitation and Retrofitting. **07**
(b) Explain the various repair techniques to overcome low strength of member. **07**
- OR**
- Q.3** (a) Explain long term health monitoring techniques. **07**
(b) Explain the retrofitting technique for damaged column. **07**
- Q.4** (a) Under which circumstance shoring and underpinning is used. Draw neat sketches. **07**
(b) Write short note on Foamed Concrete. **07**
- OR**
- Q.4** (a) Write short note on Sulphur infiltrated concrete. **07**
(b) How expansive cement will be made up? Elaborate its uses. **07**
- Q.5** (a) Explain the method of cathodic protection. **07**
(b) Elaborate the use of polymer concrete. **07**
- OR**
- Q.5** (a) How Vacuum concrete will be made up? Elaborate its uses. **07**
(b) Explain the various repair techniques to be used under marine exposure. **07**

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PDDC - SEMESTER-VIII EXAMINATION – WINTER 2015

Subject Code: X80605**Date: 04/12/2015****Subject Name: Repairs and Rehabilitation of Structures (Dep. elective II)****Time: 02:30pm to 05:00pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Explain the causes of distress in concrete structures. **07**
(b) Elaborate the distress diagnostic techniques. **07**
- Q.2** (a) Explain the terms: Strengthening, Restoration, repair and Retrofitting. **07**
(b) Explain the term durability of concrete and factors affecting it. **07**
- OR**
- (b) Explain the term permeability of concrete and factors affecting it. **07**
- Q.3** (a) Elaborate the mechanical properties of repair material that affects the repair. **07**
(b) Write in short "Polymer concrete". **07**
- OR**
- Q.3** (a) Write in short "Vacuum concrete". **07**
(b) Enlist the methods of corrosion protection. Explain any one of them. **07**
- Q.4** (a) Explain about concrete jacketing and its usefulness. **07**
(b) Explain the repair of structures damaged due to earthquakes. **07**
- OR**
- Q.4** (a) Explain the repair of structural member distress due to marine exposure. **07**
(b) Explain the long term health monitoring techniques. **07**
- Q.5** (a) Enlist the factors affecting the selection of demolition methods. **07**
(b) Write in short about "Top down manual method". **07**
- OR**
- Q.5** (a) Write in short on Demolition plan. **07**
(b) Describe the various methods of demolition of framed RC structures. **07**

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P.D.D.C - SEMESTER- VIII • EXAMINATION – SUMMER 2015

Subject Code: X80605

Date: 13/05/2015

Subject Name: Repairs and Rehabilitation of Structures

Time: 10:30 am - 01:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) List out various Non Destructive Test (NDT) used to determine strength of existing structure. Explain any one of them. **07**
- (b) Explain the Significance of quality control. What are the recommendations given in I.S.456-2000 to produce good quality concrete. **07**
- Q.2** (a) Explain concrete repairing by grouting. **07**
- (b) Explain Temperature effect on concrete. **07**
- OR**
- (b) What do you understand by sulphate attack on concrete? **07**
Discuss the factors responsible for it. How does it affect RCC elements?
- Q.3** (a) Define durability of concrete and explain the major causes of inadequate durability. **07**
- (b) What are the main objectives of condition assessment of structure ? **07**
- OR**
- Q.3** (a) Write a short note on (any three) : **14**
1. Polymer concrete
 2. Cathodic protection
 3. Rust eliminator and corrosion inhibitor
 4. Guniting and shotcrete
- Q.4** (a) Write the significance of cracking of concrete. What are the major causes of cracking in concrete and how can it be prevented? **07**
- (b) Describe various methods of demolition of framed reinforced concrete structure. . What are its basic principles? **07**
- OR**
- Q.4** (a) What method will you adopt for curing of concrete in area of water shortage? **07**
How does a surface active agent increase workability?
- (b) What are the different means of chloride ingress in concrete? How does it affect the concrete properties?
- Q.5** (a) Explain shoring and underpinning technique for foundation rehabilitation. **07**
- (b) List the materials which can be used as laminate for an existing reinforced concrete beam. What are the preliminary requirements of laminate attachment? **07**
- OR**
- Q.5** (a) Enlist common design and construction errors. **07**
- (b) Write steps to assess damage in an earthquake damaged RCC framed structure involving visual inspection to physical testing. **07**

Seat No.: _____

Enrolment No. _____

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BE - SEMESTER-VI • EXAMINATION – WINTER • 2014

Subject Code: X80605

Date: 03-12-2014

Subject Name: Repairs and rehabilitation of structures

Time: 02:30 pm - 05:00 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a) What are the objectives of Condition Survey. Explain any two stages of conditional survey in detail. 07
- (b) List down the various Construction and Design deficiencies which causes distress in RCC structures. 07
- Q.2 (a) What are the major causes of deterioration in Concrete structures. List the various signs of distress in concrete structures. 07
- (b) What is the importance of the subject of Repairs & Rehabilitation of structures. Distinguish between Repair & Rehabilitation. 07
- OR
- (b) List down the Causes and Symptoms against the Problems mentioned below (any four): 07
- (a) Alkali Silica Reaction
 - (b) Corrosion of reinforcement
 - (c) Construction errors
 - (d) Design Errors
 - (e) Settlement and Movement of foundation
- Q.3 (a) Explain briefly the Structural & Non-Structural cracks in buildings. Support your description with examples for each type. 07
- (b) What is the importance of the field and laboratory testing for damage assessment of the structure. 07
- OR
- Q.3 (a) Discuss various schemes of retrofitting beams for different types of structural deficiency. 07
- (b) Explain in detail – Repair Materials for buildings 07
- Q.4 (a) Explain in detail the Local and the global deficiencies in buildings. 07
- (b) Differentiate (any two) 07
- 1. Porosity vs Permeability
 - 2. Abrasion vs Erosion
 - 3. Repair vs Rehabilitation
- OR
- Q.4 (a) What is meant by Jacketing? Discuss repair and strengthening of columns by jacketing. 07
- Q.4 (b) Define Non Destructive testing of Concrete. Explain any one NDT in detail 07
- Q.5 (a) Explain the crack repair by Routing and Sealing. 07
- (b) Explain durability of concrete along with the factors affecting the 07

durability of concrete.

OR

Q.5 (a) Write short notes on the following (any four)

14

- 1) Alkali-Silica reaction
- 2) Mechanism of Micro-cracking due to differential thermal exposure.
- 3) Classification of Damage
- 4) Criteria for selecting the repair material.
- 5) Techniques of Demolition.

GUJARAT TECHNOLOGICAL UNIVERSITY
PPDC - SEMESTER- VIII • EXAMINATION – SUMMER 2014

Subject Code: X80605**Date: 31-05-2014****Subject Name: Repairs and rehabilitation of structure****Time: 10.30 am TO 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Which are the various parameters that influence crack -width. **07**
Explain in detail.
- (b) What is the importance of the subject of Repairs & Rehabilitation **07**
of structures. Distinguish between Repair & Rehabilitation

- Q.2** (a) What are the major causes of deterioration in Concrete structures. **07**
List the various signs of distress in concrete structures.
- (b) Air and moisture permeability of the concrete adversely affects **07**
the strength of concrete. Justify with relevant examples.

OR

- (b) Differentiate between the following: (any two) **07**
- (a) Rehabilitation & Retrofitting
 - (b) Porosity & Permeability
 - (c) Micro-cracking & Macro cracking
 - (d) Plastic Shrinkage & Drying shrinkage

- Q.3** (a) Define Durability of Concrete. Explain the holistic model of **07**
deterioration of concrete.
- (b) What is the importance of the field and laboratory testing for **07**
damage assessment of the structure?

OR

- Q.3** (a) Explain the various requirements as per IS 456:2000 for the **07**
durability of the RCC structures.
- (b) Which are the distinct stages to be recognized while taking up **07**
any repair work.

- Q.4** (a) Explain in detail the Local and the global deficiencies in **07**
buildings.
- (b) Make a list of the causes that leads to the following deficiency: **07**

1. Construction error
2. Design error
3. Accidental loading
4. Chemical attack
5. Temperature changes
6. Freezing & Thawing
7. Differential settlement of foundation

OR

- Q.4 (a)** What is meant by Jacketing? Discuss repair and strengthening of columns by jacketing. **07**
- Q.4 (b)** Define Non Destructive testing of Concrete. Explain any one NDT in detail **07**
- Q.5 (a)** Explain the crack repair by Routing and Sealing. **07**
- Q.5 (b)** Write down the basic criteria to be kept in mind for selecting the repair material. **07**

OR

- Q.5 (a)** Write short notes on the following (any four) **14**
- 1) Construction & Design deficiencies
 - 2) Classification of the cracks
 - 3) Classification of Damage
 - 4) Corrosion of Concrete & reinforcement
 - 5) Demolition Techniques
 - 6) General requirements of Quality repair

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER-VIII • EXAMINATION – SUMMER 2013

Subject Code: X80605**Date: 15-05-2013****Subject Name: Repairs and Rehabilitation of Structures****Time: 10.30 pm - 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a) Which are the major signs of deterioration in concrete. Write a brief note on each. **07**
- (b) Explain the distinct stages to be recognized before taking up any repair work. **04**
- (c) What are the basic differences involved in the execution of a repair work in contrast to a new construction work. **03**
- Q.2 (a) With respect to the corrosion of steel in concrete explain the following : **07**
- (i) Thickness of the cover to concrete
- (ii) Chloride Ingress & Carbonation
- (iii) Expansion of concrete & Cracking
- (b) Explain the various causes of cracks in Reinforced Concrete Structures. Explain the same specifically in terms of cracks due to volumetric changes & corresponding stresses. **07**
- OR
- (b) What do you understand by the term Durability. How would you ensure the durability of the structure. **07**
- Q.3 (a) Mention the various types of repair materials available and their application range. **07**
- (b) Explain the Preliminary and Detailed Conditional Assessment of structures. Describe in detail the Structural Investigation **07**
- OR
- Q.3 (a) Explain any one repair material in detail. Also state its application technique and its use to treat the distress. **07**
- (b) Define “Conditional Assessment” of Structures. Explain in detail the various stages of the same. **07**
- Q.4 (a) Enlist the various objectives of Conditional Survey. Explain the grouping of the structural members in this context. **07**
- (b) Explain various methods of demolition techniques. State the precautions to be taken when the building is pulled down. **07**
- OR
- Q.4 (a) State the types of Cracks. Also make a list of the parameters that you will look for while recording the cracks **04**

- Q.4 (b) Write Short notes on the below (any two) **10**
- (i) Essential Parameters for the Repair Material
 - (ii) Classes of Damage and Repair Classification
 - (iii) Methods of Corrosion Protection
 - (iv) Weathering effects on concrete
 - (v) Durability requirements as per IS:456

- Q.5 (a) Discuss any one real life building failure in detail & also explain lessons learnt from structural engineering aspect. **07**
- (b) Discuss various schemes of retrofitting RCC column for different types of structural deficiency. **07**

OR

- Q.5 (a) Discuss various schemes of retrofitting RCC beam for different types of structural deficiency. **07**
- (b) Explain any one in detail: (a) Ferro Cement (b) Fibre reinforced concrete (c) Shoring & Underpinning (d) Mortar repair for cracks. **07**
