

Course Code	Course Title	L	T	P	C
17CE008	REPAIR AND REHABILITATION OF STRUCTURES	4	0	0	4

### Course Objectives:

1. To understand the causes of failure of structures.
2. To enable students to diagnose distress of structures.
3. To expose students to modern techniques of retrofitting.
4. To familiarize students with case studies.
5. To understand various seismic retrofitting strategies

### Course Outcomes:

At the end of the course student will be able

1. To understand the causes of failure of structures.
2. To diagnose distress of structures.
3. To analyze the debonding pattern of externally plated members
4. To understand the significance of orientation of RC buildings.

### Activities:

1. Compare the rate of corrosion for completely submerged and partially submerged structural steel.
2. Identify any distress observed in the university premises and suggest remedial measures.
3. Perform the cost analysis of various bonding techniques.
4. Illustrate the effect of discontinuity on load with the help of a working model.

### Skills:

1. Ability to judge the rate of corrosion in various exposure conditions.
2. Developing the caliber to provide practical remedial solutions for distress.
3. Ability to select a suitable bonding technique as per the requirements.
4. Ability to judge the effect of seismic loads on discontinuities.

### UNIT-I: Introduction

Deterioration of structures with aging – Need for rehabilitation – effects due to climate, temperature, chemicals, wear and erosion, design and construction errors, corrosion mechanism – effects of cover thickness and cracking – Method of corrosion production – corrosion inhibitors – corrosion resistant steel – coatings – cathodic production – causes of distress in structural members – Holistic models for deterioration of concrete – Types of damages – sources or causes for damage – case studies.

### UNIT –II: Diagnosis and Assessment of Distress

Visual inspection – non-destructive tests – ultrasonic pulse velocity method – rebound hammer technique – ASTM classifications – pullout tests – Bremor test – Windsor probe test – crack detection techniques – case studies – single and multistoried buildings – Fibre optic method for prediction of structural weakness – An overview of structural Health monitoring – SHM Vs NDT

Case studies – buildings - heritage buildings - high rise buildings - water tanks – bridges and other structures.

### UNIT-III: Materials and Methods of Repair and Repair Strategies

Definitions: Maintenance, Repair, Rehabilitation – Facets of Maintenance – Preventive measures on various aspects - Selection of repair materials for concrete - Essential parameters for repair materials - Strength and durability aspects, cost and suitability aspects - Materials for

repair- Special concrete and mortar - concrete chemicals – Ferro cement – fibre reinforced concrete - Premixed cement concrete and mortars - polymer modified mortars and concrete – Shotcreting – Grouting – Jacketing - epoxy and epoxy systems including epoxy mortars and concrete, polyester resins, coatings

#### **UNIT-IV: Bonded Installation Techniques**

Externally bonded Steel - Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding- CDC debonding- plate end debonding- strengthening of floor of structures.

#### **UNIT-V: Seismic Retrofitting of Reinforced Concrete buildings**

Introduction – considerations in retrofitting of structures – sources of weakness in RC frame building – structural damage due to the discontinuous load path – structural damage due to lack of deformation – quality of workmanship and materials – classification of retrofitting techniques – Retrofitting strategies for RC buildings – Structural level (Global) retrofit methods – Member level (Local) retrofit methods – comparative analysis of methods of retrofitting.

#### **TEXT BOOKS:**

1. Raikar, R. N., “Learning from Failures – Deficiencies in Design”, Construction and Service R&D Centre (SDCPL), Raikar Bhavan, 1987.
2. R.N.Raikar, “Diagnosis and Treatment of Structures in Distress”, published by R&D Centre of Structure Designers & Consultants Pvt. Ltd., Mumbai, 1994
3. Pankaj Agarwal and Manish Shrikhande, “Earthquake resistant design of structures”, Prentice – Hall of India, 2006.

#### **REFERENCES**

1. Dov Kaminetzky , “Design and Construction Failures”, Galgotia Publication, New Delhi, 2001.
2. Santhakumar A.R., “Concrete Technology”, Oxford University Press, New Delhi, 2007.
3. Govt of India Press, “CPWD Handbook on Repair and Rehabilitation of RCC buildings” New Delhi, 2002.
4. Shen-En Chen, R. Janardhanam, C. Natarajan, “Forensic Practices - Investigation Techniques and Technology”, Ryan Schmidt, Ino-U.S. ASCE, U.S.A., 2010