

**SUBJECT TITLE** : MAINTENANCE AND REPAIR OF BUILDINGS  
**SUBJECT CODE** : 5013  
**SUBJECT CATEGORY** : E  
**PERIODS/WEEK** : 4  
**PERIODS/SEMESTER** : 72  
**CREDITS** : 4

**TIME SCHEDULE**

<b>MODULE</b>	<b>TOPIC</b>	<b>PERIODS</b>
I	Building maintenance	17
	Test I	1
II	Cracks and failure	17
	Test II	1
III	Water proofing	17
	Test III	1
IV	Water proofing systems	17
	Test IV	1
	<b>TOTAL</b>	<b>72</b>

**OBJECTIVES**

Upon the completion of the course the students should be able to,

- 1.1.0 Appreciate the need for maintenance
- 1.1.1 Understand the types of maintenance
- 1.1.2 Understand the importance of inspection
- 1.1.3 Adopt the maintenance programmes
- 1.1.4 Understand the performance of construction materials and components
- 1.1.5 Evaluate the causes of deterioration
- 1.1.6 Study the principles of assessment of materials
- 1.2.0 Understand restoration
- 1.2.1 Realize the affordability of work required
- 1.2.2 Understand the importance of cleaning
- 1.2.3 Evaluate surface deterioration
- 1.2.4 Understand the importance of major work
- 1.2.5 Understand rebuilding
- 1.2.6 Understand structural restoration
  
- 2.1.0 Understand the construction failures
- 2.1.1 Identify deferent types of cracks based on IS code SP 25
- 2.1.2 Understand Corrosion of reinforcement
- 2.1.3 Understand Diagnosis and repair of cracks at different parts of building
- 2.1.4 Understand the Measures for prevention of cracks based on different factors.
- 2.1.5 Evaluate the causes of Corrosion of reinforcements
- 2.1.6 Diagnosis the repair of cracks
- 2.1.7 Understand the measures for prevention of cracks

- 2.2.0 Understand the thermal expansion and contraction
- 2.2.1 Evaluate Expansion Joints, types and function
- 2.2.2 Understand the common Causes of Failure of concrete
- 2.2.3 Evaluate the extent of damage and need for repair
- 2.2.4 Select the repair materials and apply the repair solution
- 2.2.5 Apply the methods for strengthening the existing structures

- 3.1.0 Understand Moisture Control and causes
- 3.1.1 Identify the moisture problems
- 3.1.2 Understand Water proofing and damp proofing materials
- 3.1.3 Understand Admixtures for cement mortar and cement concrete and their functions
- 3.1.4 Understand the Terrace protection with Bitumen layer
- 3.1.5 Understand use of water proofing chemicals in cement mortars
- 3.1.6 Understand the Wall protection from dampness
- 3.1.7 Understand the damp proof course

- 4.1.0 Understand Structural Repairs
- 4.1.1 Identify the repairs in reinforced cement concrete
- 4.1.2 Understand Structural Strengthening
- 4.1.3 Understand Foundation repair and replacement
- 4.1.4 Adopt the modifications to building
- 4.1.5 Study the factors depends on removal and replacement of interior and exterior wall
- 4.2.0 Conduct the maintenance and repair in stucco work
- 4.2.1 Understand the common failures in stucco
- 4.3.0 Understand maintenance of wood work
- 4.3.1 Adopt wood staining
- 4.3.2 Understand metal refinishing
- 4.4.0 Conduct leak repairing work in building
- 4.4.1 Understand building restoration
- 4.4.2 understand cleaning and drying methods for damaged materials

## **CONTENT OUTLINE**

### **MODULE-I Building Maintenance**

Need for maintenance– Types of maintenance- Efficient Building Inspections- Maintenance Programs. Moisture movement - thermal movement. Performance of Construction materials and components. Causes of deterioration. Preventive measures and maintenance. Principles of assessment of weathering and durability characteristics of materials. Restoration - Scope of Restorations- the need - the status of the building- affordability of the work required. Structural Restoration-Building Envelope Restoration. Building cleaning - Pressure Cleaning. cleaning the external facade of a building. Surface deterioration, efflorescence, causes, prevention and protection. Major repair - especially to work affected by pollutants and moisture, or which has weathered or decayed to a structurally unsound or aesthetically displeasing condition. Rebuilding - to replace severely damaged or missing parts of a building.

### **MODULE-II Cracks and Failure**

Diagnosis of construction failures – Dealing with cracks (as per IS code SP 25) – cracks due to thermal movement. Horizontal cracks- vertical cracks- cracks on Expansion joints- in slabs. Cracking in brick panel wall- vertical and horizontal- cracks due to foundation movement and settlement of soil. Cracks due to vegetation. Corrosion of reinforcements. Diagnosis and repair of cracks – wall- slab-sunshade-around door and window frames. Measures for prevention of cracks – choice of materials- specification of mortar and concrete-architectural design of buildings-structural design-foundation design-construction practice and techniques-environments. Thermal expansion and contraction. Expansion Joints- function- types-Concrete Expansion Joint-Teflon Expansion Joint-Rubber Expansion Joint-Metal Expansion Joint-Vinyl Expansion Joint. Causes of Failure-common causes of damage to concrete - Excess concrete mix water- Corrosion of reinforcing steel - Construction defects - Excessive corrosion due to environmental exposure - Structural installation or design deficiencies. Determine the cause(s) of damage - Evaluate the extent of damage - Evaluate the need to repair - Determine the repair solution - Select the repair materials - Apply the repair solution. Cure the repair properly by surface coatings and painting, water proofing, grouting. Methods for strengthening the existing structures.

### **MODULE-III- WATER PROOFING**

**Moisture Control** - Water damage -leaks or condensation - causes. Moisture intrusion issues - poor construction practices- Building materials- Moisture problems –roof- deck or window leaks- landscaping or gutters that direct water into or under the building-Delayed maintenance or insufficient maintenance - Moisture migration within walls due to interior condensation and humidity -Excessive ground water along with poor drainage around the foundation.

Water proofing and damp proofing materials: Properties and functions of various types of water proofing materials commonly available-Admixtures for cement mortar and cement concrete – Functions of Admixtures-Accelerators, Retarders, Air repelling chemicals. Method of mixing-Bad effects of excessive admixtures in R.C.C.. Water proofing systems - Materials and application methods. Terrace protection with Bitumen layer-various sizes and thicknesses of bitumen sheets - preparation of surface-method of Application-Maintenance. Wall protection from dampness - Use of water proofing chemicals in cement mortars - Special primers and paints. Ingredients used in paints for water proofing, water Repelling. Filler material for cracks-floor and wall protection from capillary water pressure –damp proof course-grade beams above ground level. Dadoing of bathroom and kitchen walls-sealing of floor concrete –different materials used.

### **MODULE-IV REPAIRS**

Structural Repairs-Concrete Repairs- Spalling and Delamination -Reinforcing Steel (Rebar) - Expansion and Control Joint Repairs -Structural Cracks Structural settlement - Structural Strengthening-Expansion Joint Installation. Foundation repair and replacement -Sagging floor and bowed wall repair -Elevated slab repairs - Beam, column and footing repair and replacement. Adaptive reuse, conversions, expansions and modifications to buildings - Interior and exterior wall -removal/replacement .

Stucco Maintenance and Repairs-Periodic inspections-Identify potential water intrusion sources-Repair cracks and penetrations-Install proper sealant details-Maintain paint coating systems. Common Stucco Failures - Poor installation by untrained, unmanaged field crews –lack of curing- prematurely painted-lack of hardness-Water infiltration into the building structure.

Architectural Wood Finishing-Architectural Wood Refinishing -Cabinet Finishing -Kitchen Cabinet Finishing - Refinishing Windows, Doors and Railings -Wood Staining. Metal Refinishing -When exposed to moisture. Architectural metal cleaning and maintenance – aluminium-brass-iron-steel. Water Damage Repair .Building Leak Repair - Skylight Leak Repair- Window Leak Repair - Building Restoration-Granite / Marble / Brick Facade Restoration- Window Replacements-Drywall Repair- Containment, Demolition and Remediation-select appropriate cleaning and drying methods for damaged/contaminated materials.

### **REFERENCE BOOKS**

1. S.C.Rangawala-Engineering materials-Charotar publishing
2. W.B.Mckay-Building construction,Vol 1-4- Longmans,U.K
3. Francis D.K.Ching-Building construction Illustrated,
4. M.S.Shetty,Concrete technology,S.Chand & Co.
5. Proceedings of International Conference on Maintenance & Durability of Concrete Structures – Edited by P. Dayaratnam, NV Ramana Rao.
6. Advances in Building Materials and Construction – Mohan Rai, M.P. Jaisingh
7. Properties of Concrete – A.M. Neville
8. Water proofing
9. IS code on Hand book on causes and prevention of cracks in buildings