

Advance Design of Reinforced Concrete Structures, Course Content (MSc)

<i>Lecture No.</i>	<i>Title</i>	<i>Content</i>
1	Introduction	Historical Development of Cement and Reinforced Concrete, Building Codes and the ACI Code , The Design and Design Team, Concrete Structural Systems, Limit States and the Design of Reinforced Concrete, Basic Design Relationship, Structural Safety, Probabilistic Calculation of Safety Factors, Design Procedure Specified in the ACI Code, Design Loads for Buildings and other Structures, Load Combinations used in the ACI code, Strength Reduction Factors used in the ACI code, Customary Dimensions and Construction Tolerances.
2	Materials	Concrete, Properties of Concrete, High Strength Concrete, Advantages of Concrete as Construction Material, Concrete Admixtures, Types of Reinforcing Steel, Deformed Bar Reinforcement, ACI Code Provisions for Concrete and Steel
3	Design of RC Members for Flexure and Axial Loads	<p>General</p> <p>Reinforced Concrete Members Subjected to Flexure Load only(Loading Stages Before Collapse, Design of Solid Rectangular Members, Design of Solid T Members, Design of Hollow Rectangular Members)</p> <p>Reinforced Concrete Members Subjected to Axial Compressive Load only (Axial Capacity, Maximum Reinforcement Ratio, Example)</p> <p>Reinforced Concrete Members Subjected to Axial Compressive Load with Uniaxial Bending (Behavior of Columns subjected to Uniaxial Bending, Axial Capacity, Flexural Capacity, Design by Trial and Success Method, Alternative Approach, Interaction Diagram)</p> <p>Reinforced Concrete Members Subjected to Axial Compressive Load with Biaxial Bending (Behavior of Columns subjected to Biaxial Bending, Difficulties in Constructing Biaxial Interaction Surface, Approximate Method for Converting Biaxial case to Uniaxial case, Bresler's Approximate Methods for Design of Biaxial Columns, Reciprocal Load Method, Load Contour Method, Circular Columns)</p>
4	Design of RC Members for Shear and Torsion	<p>Design of RC Members for Shear (Shear Stresses in Rectangular Beams, Diagonal Tension in RC Beams Subjected to Flexure and Shear Loading, Types of Cracks in RC Beams, Shear Strength of Concrete, Web Reinforcement Requirement, ACI Code Provisions for Shear Design, Effect of Axial Force on Shear Strength of Concrete)</p> <p>Design of RC Members for Torsion (Torsional Stresses in Solid Concrete Members, Torsional Strength of Concrete, Reinforcement Requirement, ACI Requirements for Design of RC Members Subjected to Torsion, Steps for Design of RC Member Subjected to Torsion, Example)</p>
5	Serviceability Requirements, Development and Splices of Reinforcement	<p>Section 1: Deflections (Deflection in RC One-way Slabs and Beams, Deflection in RC Two-way Slabs, Examples)</p> <p>Section 2: Cracking in RC Members (Crack Formation, Equations for Maximum Crack Width, Reasons for Crack Width Control, Crack Control Reinforcement in Deep Members, ACI Provisions for Crack Control, Example)</p> <p>Section 3: Development & Splices of Reinforcement (Bond Strength, Bond failure, ACI provisions for Development Length, Splices of Reinforcement)</p>

6	Analysis and Design of RC Slabs	Analysis & design of one way joist system, Analysis & design of two way slab system without beams (flat plate & flat slabs), Analysis & design of two way joist system
7	Idealized Structural Modeling of RC Structures	Design Cycle, Member Sizes Estimation, Idealization of Physical Structure Stiffness Properties Calculation, Transformation from physical structure to idealized model, Loads Idealization and Placement, Closing Note
8	Gravity Load Analysis & Design of RC Structures	Analysis Approaches, Approximate Analysis Methods, Point of Inflection Method, Exact Methods of Analysis, Equivalent Frame Method, Case Study, Limit Analysis, Plastic Analysis, References
9	Seismic Analysis & Design of RC Structures (Part-I)	Introduction, Earthquake Design Philosophy, Seismic Loading Criteria, Analysis for Seismic Loads, Approximate Lateral Load Analysis, References
10	Seismic Analysis & Design of RC Structures (Part-II)	Load Combinations, Analysis using software, Gravity vs. Earthquake Loading, ACI Special Provisions for Seismic Design, ACI Special Provisions for Special Moment Resisting Frame (SMRF), ACI Special Provisions for Intermediate Resisting Frame (IMRF), Miscellaneous Considerations, Design Example, References
11	Design of Beam-Column Connections in Monolithic RC Structures	Introduction, Slenderness in Columns Section 1: Slenderness effects in Non Sway Frames (Non-sway frames, Moment Magnification in non-sway frames, Slender columns in non-sway frames, Determination of secondary moment in RC non-sway frames) Section 2: Slenderness effects in Sway Frames (Sway frames, Sway story in a sway frame, Moment Magnification in sway frames, Determination of secondary moment in RC sway frames)
12	Slenderness Effects in RC Structures	Introduction, Behavior of Connections, Type 2 connections, Forces for Joint Design as per ACI 352, Computation of Horizontal Shear, Shear Capacity of Joint, ACI 352-02 Recommendations, Examples on Connection Design, Connections Design in FEA Based software, References
13	Analysis & Design of RC Shallow Footings	Introduction, Types of Foundations, General Requirements for Design of Foundations, ACI Recommendations for Footings, Design of Spread Footing, Design of Combined Footing, Design of Mat Footing, Case Study: Isolated Footing Example
14	Special Topics: Strut and Tie Models, Brackets and Corbels, Deep Beams etc.	Shear Wall (Introduction, Behavior, ACI Recommendations, Design Examples) Coupling Beam (Introduction, Behavior, ACI Recommendations, Design Examples)