

Pre-stressed Concrete Structures - Video course

RESTRESSED CONCRETE DESIGN

Module 1: Introduction, Prestressing Systems and Material Properties (7 Hours)

Topic	Hours
Basic Concept Early Attempts of Prestressing Brief History Development of Building Materials	1
Definitions Advantages of Prestressing Limitations of Prestressing Types of Prestressing <ul style="list-style-type: none"> • Source of prestressing force • External or internal prestressing • Pre-tensioning or post-tensioning • Linear or circular prestressing • Full, limited or partial prestressing • Uniaxial, biaxial or multiaxial prestressing 	1
Prestressing Systems and Devices Pre-tensioning <ul style="list-style-type: none"> • Introduction • Stages Advantages Disadvantages Devices <ul style="list-style-type: none"> • Jacks • Anchoring devices • Harping devices 	1
Post-tensioning <ul style="list-style-type: none"> • Introduction • Stages Advantages Disadvantages Devices <ul style="list-style-type: none"> • Anchoring devices • Sequence of anchoring • Jacks • Couplers • Grouting 	1
Constituents of Concrete <ul style="list-style-type: none"> • Introduction • Aggregate • Cement • Water • Admixtures Hardened Concrete <ul style="list-style-type: none"> • Strength of concrete • Stiffness of concrete • Durability of concrete • High performance concrete • Allowable stresses in concrete 	1
Hardened Concrete <ul style="list-style-type: none"> • Stress-strain curves for concrete • Creep of concrete • Shrinkage of concrete Properties of Grout Codal Provisions	1



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Prestressing Steel <ul style="list-style-type: none"> • Introduction • Forms of prestressing steel • Types of prestressing steel • Properties of prestressing steel • Stress-strain curves for prestressing steel • Relaxation of steel • Durability • Fatigue Codal Provisions	1
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Module 2: Losses in Prestress (3 Hours)

Topic	Hours
Notations <ul style="list-style-type: none"> • Geometric properties • Load variables Losses in Prestress <ul style="list-style-type: none"> • Elastic shortening • Pre-tensioned axial members • Pre-tensioned bending members • Post-tensioned axial members • Post-tensioned bending members 	1
Losses in Prestress (Part I) <ul style="list-style-type: none"> • Friction • Anchorage slip Force Variation Diagram	1
Losses in Prestress (Part II) <ul style="list-style-type: none"> • Creep of concrete • Shrinkage of concrete • Relaxation of steel Total Time-dependent Loss	1

Module 3: Analysis of Members (6 Hours)

Topic	Hours
Analysis of Members Under Axial Load <ul style="list-style-type: none"> • Introduction • Analysis at transfer • Analysis at services loads • Analysis of ultimate strength • Analysis of behavior 	1
Analysis of Member Under Flexure (Part I) <ul style="list-style-type: none"> • Introduction Analysis at Service Loads <ul style="list-style-type: none"> • Based on stress concept • Based on force concept • Based on load balancing concept 	1
Analysis of Member Under Flexure (Part II) <ul style="list-style-type: none"> • Cracking moment • Kern point • Pressure line 	1
Analysis of Member Under Flexure (Part III) Analysis for Ultimate Strength <ul style="list-style-type: none"> • Variation of stress in steel • Condition at ultimate limit state Analysis of Rectangular Sections	1
Analysis of Flanged Sections	1
Analysis of Partially Prestressed Sections Analysis of Un-bonded Post-tensioned Beams Analysis of Behaviour	1

Module 4: Design of Members (6 Hours)

Topic	Hours
Design of Members <ul style="list-style-type: none"> • Calculation of demand Design of members for Axial Tension <ul style="list-style-type: none"> • Design of prestressing force • Analysis of ultimate strength 	1

Design of Member for Flexure • Calculation of moment demand. • Preliminary design	
Design of Sections for Flexure (Part I) • Final design • Final design for type 1 members • Special case	1
Design of Sections for Flexure (Part II) • Final design of type 2 members	1
Design of Sections for Flexure (Part III) • Choice of sections • Determination of limiting zone • Post-tensioning in stages	1
Design of sections for Flexure (Part IV) • Magnel's graphical method	1
Detailing Requirements for Flexure Detailing Requirements for Shear Detailing Requirements for Torsion	1

Module 5: Analysis and Design for Shear and Torsion (6 Hours)

Topic	Hours
Analysis for Shear • Introduction • Stress in an uncracked beam • Types of cracks • Components of shear resistance • Modes of failure • Effect of prestressing force	1
Design for Shear (Part I) • Limit state of collapse for shear • Maximum permissible shear stress • Design of transverse reinforcement • Detailing requirement for shear	1
Design for Shear (Part II) • General comments • Design steps • Design of stirrups for flange	1
Analysis for Torsion • Introduction • Stresses in an uncracked beam • Crack pattern under pure torsion • Components of resistance for pure torsion • Modes of failure • Effect of prestressing force	1
Design for Torsion (Part I) • Limit state of collapse for torsion • Design of longitudinal reinforcement • Design of transverse reinforcement	1
Design for Torsion (Part II) • Detailing requirements • General comments • Design steps	1

Module 6: Calculations of Deflection and Crack Width (1 Hour)

Topic	Hours
Calculation of Deflection • Deflection due to gravity loads • Deflection due to prestressing force • Total deflection • Limits of deflection • Determination moment of inertia • Limits of span-to-effective depth ratio Calculation of Crack Width • Method of calculation • Limits of crack width	1

Module 7: Transmission of Prestress (2 Hours)

Topic	Hours
Transmission of Prestress (Part I) • Introduction • Pre-tensioned members Transmission length Development length End zone reinforcement	1
Transmission of Prestress (Part II) • Post-tensioned members End zone reinforcement Bearing plate	1

Module 8: Cantilever and Continuous Beams (3 Hours)

Topic	Hours
Cantilever Beams • Introduction • Analysis • Determination of limiting zone • Cable profile	1
Continuous Beams (Part I) • Introduction • Analysis • Incorporation of moment due to reactions • Pressure line due to prestressing force	1
Continuous Beams (Part II) • Concordant cable profile • Cable profiles • Partially continuous beams • Analysis at ultimate limit state • Moment redistribution	1

Module 9: Special Topics (6 Hours)

Topic	Hours
Composite Sections • Introduction • Analysis of composite sections • Design of composite sections • Analysis for horizontal shear transfer	1
One-way Slabs • Introduction • Analysis and design	1
Two-way Slabs (Part I) • Introduction • Analysis • Features in modeling and analysis • Distribution of moments to strips	1
Two-way Slabs (Part II) • Checking for shear capacity • Spandrel beams • Anchorage devices • Additional aspects	1
Compression Members • Introduction • Analysis • Development of interaction diagram • Effect of prestressing force	1
Circular Prestressing • Introduction • General analysis and design • Prestressed concrete pipes • Liquid storage tanks • Ring beams Conclusion	1

