

CE-804 Pre-stressed Concrete Structures

| Code | Credit Hours | Category |
|--------|--------------|----------|
| CE-804 | 3 | Elective |

Course Description:

This course provides the knowledge and understanding of fundamental principles about the structural behaviour and design criteria of Prestressed Concrete Structures. The fundamental mechanics to define the internal forces are presented; the current technology available to prestress concrete structures is reviewed; and the formulae to estimate the initial and time-dependent losses are derived. Emphasis is placed on fundamentals. The serviceability limit states that are critical for the design of conventional prestressed concrete structures are presented, and the inequalities to fulfil such limit states are derived, allowing the prestressing force and its eccentricity to be determined. The specific implications for the ultimate limit states are also covered.

Introduction to prestressed concrete-prestressing concepts; pre-tensioning and post-tensioning; full and partial prestress; the need for prestress; advantages and disadvantages; methods of prestressing; Forces imposed by prestressing (straight, draped and kinked tendon profiles); Load balancing; Introductory examples. Design requirements: strength and serviceability; Material properties. Design for serviceability: stress limits; serviceability criteria; determination of prestress and eccentricity; cable profiles; cracked section analysis; decompression and cracking moment; effect of cracking at service loads; short-term deflection calculations; crack control. Design for strength: limit state design. Rectangular stress block. Ultimate moment capacity. Effect of non-prestressed steel; ductility; transfer strength; design for shear-effect of prestress on shear; stirrup design. Special problems in prestressing: losses; effect of creep and shrinkage; end block design-bursting and spalling forces in post anchorages; transmission lengths in pre-tensioned members. Statically indeterminate beams: introduction to continuous prestressed concrete beams; secondary moments.

Text Book:

- Prestressed Concrete Analysis and Design by Antoine Naaman. 2nd edn.

Reference Books:

- Prestressed Concrete, a fundamental approach by Nawy 5th edn.
- PCI. Precast Pre-stressed Concrete Bridge design manual. Precast Pre-stressed Concrete Institute (PCI) Vol. 1 and 2, Chicago, IL, 1997.
- American Concrete Institute code ACI 318-14.

Prerequisites:

- BE (Civil, Architecture, Construction Engineering & Management)

Assessment System

| Component | Percentage Range |
|--------------------|------------------|
| Quizzes | 10-15% |
| Assignments | 10-15% |
| Mid Terms | 20-30% |
| ESE | 40-50% |
| Project (optional) | 10-15% |

Teaching Plan:

| Week No | Topic |
|---------|---|
| 1 | Introduction to CE 804, Objectives, Outcomes and Assessment Method. Basic concept and principles of Prestressed Concrete, General Analysis of Prestressed Concrete, |
| 2 | Types and stages of loading, Prestressing Systems and Devices, Review |
| 3 | Prestressing Materials, Concrete, Grout. Prestressing Steel, |
| 4 | Losses in Prestress Friction and Anchorage Slip, Review |
| 5 | Flexural Analysis and Design – Working Stress Approach Problem based Activity on Losses in Prestress, Quiz 1 |
| 6 | Flexural Analysis and Design – Working Stress Approach |
| 7 | Flexural Analysis and Design – Ultimate Stress Approach |
| 8 | Flexural Analysis and Design – Ultimate Stress Approach |
| 9 | Mid Term Exam/ OHT, (As per NUST Exam Policy) |
| 10 | Shear Design Problem Solving Activity on Analysis and Design for Flexure, Quiz 2 |
| 11-12 | Design for Shear and Torsion, Problem Solving Activity on Analysis and Design for Shear and Torsion, Quiz 3 |
| 13-14 | Composite Beams, |
| 15 | Continuous Beams, Review |
| 16 | Deflection and Camber |
| 17,18 | End Semester Exam |