

CE 521 – REINFORCED CONCRETE MEMBERS

FALL 2026-2027

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COURSE OUTLINE

1. Introduction

Concrete material properties, shrinkage, creep, basic mechanical properties

2. Behavior of Axially Loaded Members

Deformation characteristics of axially loaded members, cracking and stress distributions in cracked concrete, crack widths and spacing, tension stiffening, models for confined concrete

3. Behavior of Members in Flexure

Analysis of members in flexure, compatibility and equilibrium conditions, tensile stresses in concrete, layer-by-layer evaluation of sectional forces, evaluation of member deformations using moment-curvature relations

4. Behavior of Members Subjected to Shear

History of research on concrete under shear, diagonal cracking of concrete, ACI 318 approach to cracking shear stress, shear behavior after diagonal cracking, Mörch's 45-degree truss model, variable-angle truss models, Simplified Modified Compression Field Theory (SMCFT), shear provisions of ACI 318, Canadian Code CSA A23.3 and Eurocode 2

5. Behavior of Members Subjected to Torsion

Thin-walled tubes in torsion, torsional response after cracking, variable-angle space truss model for combined torsion, shear and flexure, redistribution of torsion in statically indeterminate structures; equilibrium and compatibility torsion, CSA A23.3, Eurocode 2 and ACI 318 code procedures and detailing requirements for torsion

6. Design of Disturbed Regions

B- and D-regions, Strut and Tie models, strength of struts, ties and nodal zones, deep beams, corbels

SUGGESTED REFERENCES

- *Collins, M. P. and Mitchell, D., "Prestressed Concrete Structures", Prentice-Hall, New Jersey, 1991.*
- *Wight, J. K., "Reinforced Concrete: Mechanics and Design", Seventh Edition, Prentice-Hall, New Jersey, 2017.*
- *CSA A23.3-24: Design of Concrete Structures, Canadian Standards Association, Mississauga, Ontario, Canada, 2024.*
- *ACI 318-25: Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute, Farmington Hills, MI, 2025.*
- *Eurocode 2: EN 1992-1-1:2023 - Design of concrete structures. General rules and rules for buildings*

GRADING

Midterm: 30%

Final: 30%

Project: 15%

Assignments: 25%