



CEE 421 Prestressed Concrete Design Fall 2023

Instructor: Arancha Alarcón, PhD, PE, LEED AP, (arancha.alarconflemin@northwestern.edu), Tech A220

Office hours: Monday & Wednesday 2.30 - 4 pm or by appointment at A220

Class times and location: 12.30-1.50 PM Monday and Wednesday @ LG52

Required Textbook None

Reference Textbooks

1. Prestressed Concrete – A Fundamental Approach. Fifth Edition." by E. G. Nawy. Prentice Hall Edition.
2. Design of Prestressed Concrete Structures, T.Y. Lin and Ned Burns
3. Creep and Shrinkage: Their effect on the behavior of concrete structures” by H. Rusch, D. Junwirth and H. Hilsdorf
4. Philosophy of Structures by E. Torroja

Prerequisites: Graduate standing, Senior undergraduate or permission of instructor

Description Principles of prestressed concrete. Prestressing systems, end anchorage, and loss of prestress. Analysis and design of sections for flexure, shear, bond, bearing, and deflection. Continuous beams, slab, tension, and compression members. Circular prestressing.

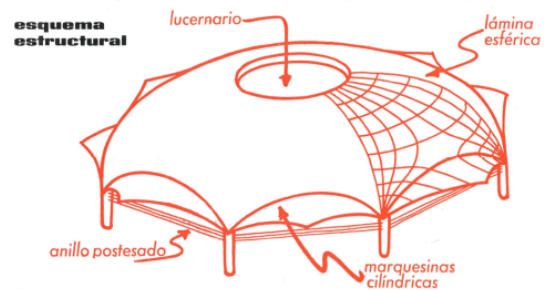
Course Objective: The objective of this course is to introduce graduate and senior undergraduate students to theory and applications of prestressed concrete. Students will build on the knowledge gained through all mechanics related courses of the undergraduate curriculum (statics, mechanics of materials, concrete design, etc.).

Course Outcomes: Upon successful completion of the course, students will have an advanced understanding of the behavior of prestressed concrete structures as well as knowledge of design specifications currently used in practice. In addition, students will have the necessary skills to analyze, and design prestressed concrete structures and will be able to:

1. Describe typical prestressing systems.



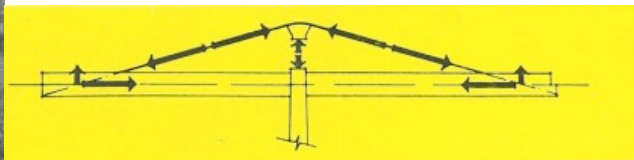
2. Describe the mechanical behavior of typical concrete and steel used in prestressed concrete construction.
3. Calculate prestress losses.
4. Analyze and design prestressed concrete members in bending under service loads.
5. Analyze and design prestressed concrete members in bending under ultimate loads.
6. Compute shear and torsional strength of prestressed concrete members.
7. Solve statically indeterminate prestressed concrete structures.
8. Compute camber and deflection of prestressed concrete members.



Algeciras Market (Spain) by Eduardo Torroja (1936)



Tempul aqueduct (Cádiz, Spain) by Eduardo Torroja (1925)





Course Outline

1. Introduction to prestressing, equivalent loads to prestressing
2. Material properties of Concrete and Steel
3. Rheological Equations. Mechanical Models
4. Axially Loaded Members
5. Prestress Losses
6. Brief approach of Matrix Structural Analysis (Direct Method) of Statically Indeterminate Prestressed Beams
7. Design of Sections for Flexure (Service and Ultimate)
8. Design of Sections for Shear
9. Strut and Tie Method

Course Assessment: Grades are determined based on the following components

- 30% Homework
- 30% Midterm (Wed. 10/18/23)
- 30% Final Project (Due 12/6/23)
- 5% Project presentation (last week of class)
- 5% Participation

Academic Integrity

Student-teacher relationships are built on trust. Acts, which violate this trust, undermine the educational process. Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide". All work submitted for credit in this course must be submitted electronically unless otherwise instructed. Your written work may be tested for plagiarized content. Submission of any assignment that is in violation of this policy will result in zero points granted for that specific assignment.

For details regarding academic integrity at Northwestern or to download the guide, visit: <https://www.northwestern.edu/provost/policies/academic-integrity/index.html>



Prohibition of Recording Classes by Students

Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Unauthorized recording is unethical and may also be a violation of university policy and state law. Students requesting the use of assistive technology as an accommodation should contact [AccessibleNU](#).

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Accessibility

Northwestern University is committed to providing the most accessible learning environment as possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (e: accessiblenu@northwestern.edu; p: 847-467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

Support for Wellness and Mental Health

Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS), Religious and Spiritual Life (RSL) and the Center for Awareness, Response and Education (CARE). Additional information on all of the resources mentioned above can be found here:

<https://www.northwestern.edu/counseling/>
<https://www.northwestern.edu/religious-life/>
<https://www.northwestern.edu/care/>