CEE 421 Prestressed Concrete Design
Fall 2025[1]

Instructor:

Arancha Alarcon, PhD, PE, LEED AP, (arancha.alarconfleming @northwestern.edu), Tech A220

Office hours:

Monday & Wednesday 2.30 - 4 pm **or by appointment** at A220

Class times and location:

Monday and Wednesday 12.30-1.50 PM @ LG52

Required Textbook:

None. Notes will be provided.

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.

[1] Updated 09/12/2025

Course Objective:

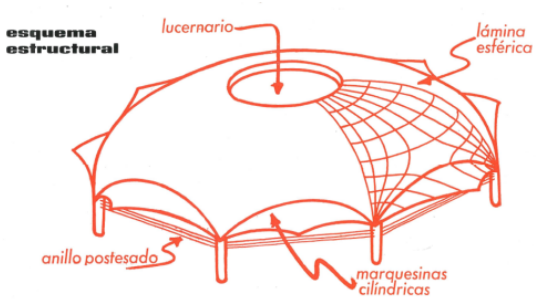
The objective of this course is to introduce graduate and senior undergraduate students to theory and applications of prestressed concrete. Students will build on the knowledge gained through all mechanics related courses of the undergraduate curriculum (statics, mechanics of materials, concrete design,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



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 and Expectations:

Grades are determined based on the following components

- 20% Homework
- 35% Midterm (**Week 6: Monday 10/20/25)**
- 25% Final Group Project (**Due 12/08/25)**
- 10% Project presentation (last week of class)
- 10% Participation

Participation: Students are expected to attend class and actively engage in discussion through questions and comments.

Uses of generative AI

In this course, you are allowed to use Generative Artificial Intelligence (GAI) on assignments only for the purposes specified in assignment prompts. Any use of GAI should be accompanied by a disclosure at the end of an assignment explaining (1) what you used GAI for; (2) the specific tool(s) you used; and (3) what prompts you used to get the results. Any use of GAI beyond where permitted will be viewed as a potential academic integrity violation.

<u>Appropriate use of Generative AI in this course:</u>

- Checking your grammar and spelling
- Synonym tools available in Microsoft Word, Grammarly, and some GPT platforms such as Bard

- Using app recommendations to rephrase sentences or reorganize paragraphs that you wrote
- To brainstorm ideas, however, note that the output of these programs may be inaccurate, incomplete, and problematic in terms of where it came from

Like other tools, however, the use of AI can also hamper the acquisition as well as application of skills. When using Generative AI, be mindful of this tool compromising your ability to create or understand information. Generative AI does not produce or create knowledge; AI is a tool and only a tool

Inappropriate use of Generative AI within this course

- Generative AI cannot, and may not, be presented as your own work. It is unethical to submit any AI-generated work as your own.
- You may not have any AI program generate (draft or final) any assignment given to you unless the assignment explicitly instructs you to use AI.

If you do include material generated by Generative AI in an assignment, it needs to be cited like any other reference materials.

Northwestern University Syllabus Standards

This course follows the Northwestern University Syllabus Standards. Students are responsible for familiarizing themselves with this information