Prestressed Concrete

CES 5715, Class # 10863

Class periods: Tue., Thu., Periods 3–4 (9:35 am – 11:30 am)
Location: TUR 2354
Academic term: Spring 2025

Instructor:

Dr. Gary R. Consolazio
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Office: 475-J Weil Hall
Office hours: Posted on Canvas
Class website: Canvas (UF E-Learning) – CES5715 Prestressed Concrete

Teaching assistant:

None.

Course description:

Analysis and design of prestressed concrete flexural members; pre- and post-tensioned construction, allowable stress, strength evaluation; design for bending moments and shear; evaluation of serviceability requirements; design of simple bridges, (3 credits).

Course prerequisite:

Behavior and Design of reinforced concrete members subjected to flexure, shear, and compression. (CES 4702 - Analysis and Design in Reinforced Concrete, or equivalent)

Course objectives: By the end of this course, the student will be able to:

- Describe the benefits derived from prestressing reinforced concrete members
- Describe the methods used in constructing prestressed concrete members
- Describe sources of prestress losses and calculate prestress losses
- Analyze and design prestressed concrete beams based on: allowable flexural stresses (serviceability limit state), flexural strength limit state, shear strength limit state
- Calculate prestressed concrete beam camber and deflection
- Describe and calculate secondary moments in continuous (indeterminate) flexural members

Required software:

MathCad (or similar).

Reference materials:

Required:
- *Prestressed Concrete: Building, Design, and Construction*, Dolan, C. W. and Hamilton, H. R.
- ACI 318-19(22) Code and Commentary, American Concrete Institute

Reference:
- PCI Design Handbook, Precast and Prestressed Concrete, Precast/Prestressed Concrete Institute

Required Computer:

UF student computing requirement: news.it.ufl.edu/education/student-computing-requirements-for-uf

Course schedule:

Introduction

- Unreinforced & reinforced concrete behavior, moment-curvature, cracking
- Prestressed concrete behavior, kern, service and strength limit states, moment-curvature, deflections
- Construction methods: pretensioned, post-tensioned, precast, cast-in-place (CIP)
- Pretensioned/precast: construction sequence, standardized shapes, long-line casting
- Post-tensioned: construction sequence, hydraulic jacking, variability of tendon profile
- Equivalent loads and load balancing; stress analysis; sign conventions

Materials

- Property types: specified, derived, confirmed (by testing)
- Concrete: compressive strength (initial, 28-day), compressive stress-strain curve, max. usable compressive strain; tensile strength (split cylinder, modulus of rupture), ACI 318 tensile classifications; modulus of elasticity; time-dependent creep, time-dependent shrinkage
- Prestressing strand: production methods: stress-relieved, low-relaxation; time-dependent stress relaxation; stress-strain models (for various types of prestressing materials); mathematical stress-strain models; mathematical stress relaxation models

Prestress losses

- Lost-estimation approaches: lump sum losses, detailed component losses; industry practices
- Sources of prestress loss; immediate: anchor set, friction (wobble, curvature), elastic shortening; time-dependent: creep, shrinkage, relaxation

Flexure

- Conditions assessed for design: transfer, transportation, service, ultimate
- Service load conditions: deflection limits, stress limits; section stress states
- Ultimate load conditions: nominal flexural strength; strength reduction factors (phi factors), tension-controlled, transitional, compression-controlled
- Prestress transfer length, Hoyer effect, prestress development length
- Bonded nominal flexural strength: strain compatibility analysis, empirical approach, prestressed flexural reinforcement limits
- Unbonded nominal flexural strength: empirical approach

Shear

- Non-prestressed R/C sections, shear stress analysis, Mohr-circle analysis of principal stresses, cracking
- Prestressed concrete sections, Mohr-circle analysis of principal stresses, cracking
- Nominal shear strength, web-shear strength, flexure-shear strength, cracking moment
- ACI approximate and detailed methods for concrete web-shear and flexure-shear contributions
- Shear steel strength contribution, design approach, design requirements (max. spacing, min. reinforcement, etc.)

Camber and deflections

- Prestress-induced camber, deflections under service loads, ACI deflection limits
- Section classification; analysis approaches: effective moment of inertia, bilinear analysis
- Accounting for time-dependent effects and construction sequences/timelines

Continuity (continuous indeterminate beams)

- Continuity: advantages and disadvantages
- Post-tensioned profiles in continuous beams, moment (sign) reversals under pattern loading
- Statically indeterminate beams, restrained deformation, secondary moments, superposition method, equivalent load method

Important dates:

- Tue., Mar. 4, 2025, Exam 1
- Tue., Apr. 22, 2025, Exam 2

Exams will be given within the normal class time slot and in the normal assigned classroom.

Attendance:

Students are expected to attend class. Excused absences must be consistent with university policies in the Graduate Catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Additional information can be found here: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Make-up exam policy:

Make-up exams will not be given except in cases of valid medical emergencies (for which the student must provide written documentation) or certain other admissible emergencies. Students with questions regarding this policy are urged to consult the instructor.

Evaluation of grades:

Assignments: 25%, Exam 1: 35%, Exam 2: 35%, Course participation 5%

Grading policy :

A 100-93; A- 93-90; B+ 90-87; B 87-82; B- 82-80; C+ 80-77; C 77-72; C- 72-70; D+ 70-67; D 67-62; D- 62-60. Grades may be curved at the instructor's discretion.

More information on UF grading policy may be found at:
UF Graduate Catalog (https://catalog.ufl.edu/graduate/?catoid=10&navoid=2020#grades)
Grades and Grading Policies (https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/)

Assignments:

All assignments will be evaluated for overall degree of completion. A randomly selected subset of assignments will be graded in detail.

A due date and time will be indicated on each assignment. Assignments submitted late will be penalized as follows: 0-24 hrs late: 25% penalty; 24-48 hrs late: 50% penalty; 48+ hrs late : 100% penalty. Exceptions may be made in cases where the student has spoken to the instructor *prior* to the due date of the homework or cases where there is a valid excuse (e.g. medical emergency with written proof).

Assignments will consist of hand calculations, computer software use (worksheet development, etc.), or a combination of these. Each student solution will be submitted through Canvas as a single, merged PDF file. Each submitted solution shall begin with a clear statement of the problem being solved. All hand calculations shall be submitted as clear, **undistorted** scans of calculations written on engineering computation paper with accompanying diagrams. Sloppy, disorganized homework will not be graded. Worksheets must include comments documenting the procedures being implemented, variables used, units, etc. Neat hand drawn or computer drawn diagrams shall be included.

Students requiring accommodations:

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course evaluation:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Class honesty policy:

Each student is expected to submit work that constitutes an independent effort on their part. While open discussion of assignments (but not exams) is acceptable and, in fact, encouraged, the written work submitted by each student must reflect that student's understanding of the topics covered. Failure to comply with this policy will result in serious consequences.

University honesty policy:

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a safe and inclusive learning environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software use:

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student privacy:

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus resources:

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints: https://distance.ufl.edu/state-authorization-status/#student-complaint.