

Performance-Based Design of Structures

CGN 6905 Section ART5

Class Periods: M Period 8 (3:00 – 3:50 PM), W Period 8 – 9 (3:00 – 4:55 PM)

Location: M FLI 111, W WEIM 2050

Academic Term: Spring 2025

Instructor:

Dr. Arthriya Subgranon

arthriya@ufl.edu

Office Hours: M W 10:30 – 11:30 AM or by appointment, 475-F Weil Hall

Course Description

Traditional building codes are prescriptive in nature with the aim to provide a life-safety level of protection against a design-level event, such as an earthquake or hurricane. This approach, however, does not provide designers with a means to determine if other performance levels are met. Performance-Based Design (PBD) is a concept that allows the designers to evaluate the risk of life, occupancy, and economic loss that may occur as a result of extreme events. PBD is based on an assessment of a structure's design to determine the probability of experiencing different types of losses, considering the range of potential hazards that may affect the structure.

Course Pre-Requisites / Co-Requisites

This course will assume a basic knowledge of dynamics of structures and inelastic structural behavior (these concepts will be reviewed at the beginning of the course). Some experience with Matlab programming is preferred.

Course Objectives

The aim of this course is to introduce students to state-of-the-art performance-based engineering and the theoretical and practical tools necessary for carrying out performance assessments of structures subject to extreme loads from natural hazards such as seismic and wind events. Students acquire theoretical knowledge of performance assessment frameworks that entail hazard analysis, response simulations, damage evaluation, and loss estimation as well as an understanding of how to apply them to engineering projects.

Textbook

There is no required textbook for this course. The following resources may provide useful supplemental materials:

[1] FEMA P-58-1, Seismic Performance Assessment of Buildings, Volume 1 – Methodology, 2nd Edition.

[2] FEMA P-58-2, Seismic Performance Assessment of Buildings, Volume 2 – Implementation Guide, 2nd Edition.

[3] Anil K. Chopra, Dynamics of Structures, Prentice Hall, 2011.

Tentative Schedule

Class	Date (2023)	Topic	Homework	
			Assigned	Due
1	M 01/13	Introduction		
2	W 01/15	Seismology		
3	W 01/22	Ground motion parameters		
4	M 01/27	Seismic hazard analysis I	1	
5	W 01/29	Seismic hazard analysis II		
6	M 02/03	Seismic hazard analysis III		
7	W 02/05	-No Class-		
8	M 02/10	Dynamics review I	2	1
9	W 02/12	Dynamics review II		
10	M 02/17	Response spectra		
11	W 02/19	Design spectra		
12	M 02/24	Ground motion selection	3	2
13	W 02/26	Application of the P-58 ground motion selection procedure		
14	M 03/03	Performance-based design I		
15	W 03/05	Non-linear dynamics I		
16	M 03/10	Non-linear dynamics II		3
17	W 03/12	Midterm		
18	M 03/17	-Spring break-		
19	W 03/19	-Spring break-		
20	M 03/24	Case study/Demands and residual drifts	4	
21	W 03/26	Collapse analysis	*p	
22	M 03/31	Performance-based design II (P-58 overview)		
23	W 04/02	Fragility functions		
24	M 04/07	Performance groups		4
25	W 04/09	Consequence functions and loss analysis		
26	M 04/14	PACT example		
27	W 04/16	Performance-based wind engineering I		
28	M 04/21	Performance-based wind engineering II		
29	W 04/23	Final		P

*Project assigned

Attendance Policy, Class Expectations, and Make-Up Policy

This class meets twice a week. Each period will start with a brief review of previous material and/or questions on homework, followed by a lecture on new material. Regular attendance is strongly recommended for success in this course. While attendance does not make up a specific component of the course grade, it will be reflected in homework and test grades. 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://gradcatalog.ufl.edu/graduate/regulations/>

Homework: Homework assignments will make up 30% of your final grade. Four problem sets will be assigned throughout the semester (see tentative course schedule). Homework assignments will be posted on the course website. Homework must be submitted through Canvas, scanned with a clearly defined problem statement, given information, required information, and a clearly indicated solution(s). Homework that cannot be read will not be graded. All solutions must have correct units; solutions without correct units will be penalized. Assignments are due at 11:59 PM on the due date unless otherwise stated. Late homework will not be accepted and will receive a grade of zero.

Exam: A mid-term exam will comprise 30% of your final grade. All work and solutions are to be shown and clearly explained. The exam will be administered before the spring break.

Final Project: A project will comprise 40% of your final grade. Students will be assigned to teams to work together on the final project. Each team will have about a month to work on the project (see tentative schedule) and will have to make a presentation on the last day of class.

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework Sets	30%
Midterm Exam	30%
Final Project	40%
	100%

Grading Policy

Percent	Grade	Grade Points
93.0 - 100	A	4.00
90.0 – 92.9	A-	3.67
87.0 - 89.9	B+	3.33
83.0 - 86.9	B	3.00
80.0 - 82.9	B-	2.67
77.0 - 79.9	C+	2.33
73.0 - 76.9	C	2.00
70.0 - 72.9	C-	1.67
67.0 - 69.9	D+	1.33
63.0 - 66.9	D	1.00
60.0 - 62.9	D-	0.67
00.0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

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.bluer.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.

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 Honor 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. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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 varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed,

color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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 Coordinator
- HWC OE 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: <https://counseling.ufl.edu>, 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://elearning.ufl.edu/>.

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/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.