Fall 2024

Arch 429-001: Advanced Structures

Rima Taher

NJIT Fall 2024
INSTRUCTOR: Rima Taher, PhD, PE, Senior University Lecturer

ARCH 429-001: Advanced Structures

Lecture Format: Tuesday & Friday: 1 -2:20 pm Face-to-Face – Classroom TBD

Learning Management System at: http://Canvas.njit.edu.

COURSE OVERVIEW:

This course covers advanced topics in structural analysis, design of reinforced concrete structures, design of steel connections, in addition to some topics in wood and masonry structures. The course also includes design examples in relation to various types of foundation systems. It focuses on indeterminate structures in structural analysis and integrated structural systems in designing structures. Case studies of some well-known buildings are covered. Some BIM applications and some computerized calculations are included.

LEARNING OUTCOMES

1) Learn some advanced topics in structural design and cover some case studies of building projects.
2) Develop the ability to select a structural system for a building, and layout a typical floor or roof framing.
3) Develop the ability to use some established rules of thumb for the selection of structural members.
4) Develop skills for using some analytical methods to help prove the design decisions beyond the general rules of thumb.
5) Develop the ability to structurally design simple structural elements such as joists, beams, and columns.
6) Develop the ability to apply the theoretical concepts and methods using some practical design assignments and a main steel building project.
7) Develop the skills to use computer programs such as Revit and the Vitruvius Project through the work assigned in the main project.

NAAB PROGRAM CRITERIA

The National Architectural Accrediting Board (NAAB) accredits NJIT's architecture program. The NAAB has Shared Values of the Discipline and the Profession that must be covered by any architectural curriculum to attain their approval. This course satisfies the following shared values:

Design: Architects design better, safer, more equitable, resilient, and sustainable built environments. Design thinking and integrated design solutions are hallmarks of architecture education, the discipline, and the profession. This course teaches how to design better and more resilient structures and how to integrate design solutions. It also teaches new methods and techniques in structural technology.

Equity, Diversity, and Inclusion: Architects commit to equity and inclusion in the environments we design, the policies we adopt, the words we speak, the actions we take, and the respectful learning, teaching, and working

environments we create. Architects seek fairness, diversity, and social justice in the profession and in society and support a range of pathways for students seeking access to an architecture education. In this course, we are committed to these values.

LEARNING AND TEACHING CULTURE POLICY

In addition to the overarching values and ethics of the university, the New Jersey School of Architecture (NJSoA) is dedicated to optimism, diversity and solidarity, professional conduct, constructive evaluation and instruction, collaborative community, health and wellbeing, time management and school-lifework balance, respectful stewardship and space management, and well-rounded enrichment. The pedagogy of architecture and design is as complex as it is rewarding, and as dynamically evolving as the people who learn and teach it. This understanding resides at the core of the NJIT Learning and Teaching Culture Policy: https://design.njit.edu/learning-and-teaching-culture-policy

COURSE REQUIREMENTS - CANVAS:

Students are expected to take a test, a mid-term examination, and a final examination, in addition to some assignments and a main project. Students will have to submit the course assignments and project using Canvas. Students must check their NJIT email and the Canvas Forum on a regular basis.

Assignments will be posted to Canvas, and a web link will be created for the students to upload the assignment file by the due date and time. Students must have access to a scanner to scan their solution pages. All pages must be combined in a single PDF and uploaded to Canvas. Students are not to post files in formats other than PDF. The instructor must be able to open and read the files. If the file is corrupt or illegible, and the instructor is unable to read the file, the student will receive an F-grade for that assignment. Students are not to email the assignments directly to the instructor.

All students are expected to take the tests in-person as indicated below, on the scheduled date and during the scheduled time. No make-up test or exam will be given if students do not show up as scheduled unless the student has a compelling and valid reason that can be substantiated. Proof of hardship must be presented to the Dean of Students.

The use of electronic devices will not be permitted during tests. Only a basic scientific non-communicating calculator will be allowed.

Students enrolled in this course are not to schedule vacation and holiday trips while the course is ongoing and on dates that coincide with test dates. The course will end with the final exam. Airline tickets must not be booked before the final exam date.

This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

MEANS OF EVALUATION:

As indicated in the previous section, students are expected to take a mid-term examination and a final examination, in addition to a major assignment, a project and some regular homework assignments.

Test 1: 20% - Tentative date: Friday September 27

Mid-Term Examination: 25% - Tentative date: Friday October 25

Assignments: 10% - Due dates will be announced.
Project: 15% - Tentative Due Date: December 4
Final Examination: 30% - Online Exam during the final exams' week December 15 to 21

The following grades are used for undergraduate students:

Grade	Description
A	Superior
B+	Excellent
B	Very Good
C+	Good
C	Acceptable
D	Minimum
F	Inadequate
AUD	Audit
I	Incomplete--given in rare instances to students who would normally have completed the course work but who could not do so because of special circumstances. It is expected that coursework will be completed during the next regular semester. If this grade is not removed before final grades are due at the end of the next regular semester, a grade of F will be issued.
W	Withdrawal
S	Satisfactory
U	Unsatisfactory

Grading Scale:

A: 100-90, B+: 89-85, B: 84-80, C+: 79-75, C: 74-70, D: 69-60, F: Below 60

REQUIRED TEXT:

- Simplified Structural Analysis and Design for Architects, Revised Second Edition, by Rima Taher, Cognella, Inc. ISBN # 978-1-5165-1057-3
- The Structural Basis of Architecture, by Sandaker, Eggen and Cruvellier, 2nd Edition, published by Routledge, 2011. This book can be accessed online free of charge using the web link below with the NJIT- UCID and password: https://ebookcentral.proquest.com/lib/njit/detail.action?docID=1111702.

USEFUL REFERENCES:

1. Structural Steel Drafting & Design, 2nd Edition, by David MacLaughlin and Hector Estrada, Cengage Learning, 2009
2. Simplified Engineering for Architects and Builders, 11th Edition, by James Ambrose and Patrick Tripeny, Wiley & Sons, 2011, ISBN # 978-0-470-43627-1
3. Building Construction Illustrated, 4th Edition, by Francis D.K. Ching, Wiley, 2008

4. Structural Design – A Practical Guide for Architects, by Rod Underwood and Michele Chiuini, 2nd Edition, John Wiley $ Sons
5. The Architectural Basis of Architecture, Sandaker, 3rd Edition, Routledge
6. Design of Wood Structures, by Donald Breyer, McGraw Hill, 6th Edition
7. Structural Steel Design, 5th Edition, by Jack C. McCormac, Pearson, Prentice Hall
8. The Architect Studio Companion – Rules of Thumb for Preliminary Design, by Edward Allen and Joseph Iano, Wiley & Sons
9. Shaping Structures – Statics, by Waclaw Zalewski and Edward Allen, Wiley & Sons
10. Steel, Concrete and Composite Design of Tall Buildings, 2nd Edition, by Bungale S. Taranath, McGraw Hill, ISBN # 0-07-062914-5

CODES AND STANDARDS:

1. The 2018 International Building Code (IBC) published by ICC, International Code Council
2. Building Code Requirements for Structural Concrete and Commentary, ACI 318-2019, by the American Concrete Institute
3. Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE 7-2016, by the American Society of Civil Engineers
4. The 2016-AISC Specification for Structural Steel Buildings, and the 15th Edition of the Manual of Steel Construction by AISC, American Institute of Steel Construction
5. National Design Specification for Wood Construction (NDS), 2018, by the American Wood Council (AWC)

INSTRUCTOR:

Rima Taher, PhD, PE, Senior University Lecturer
Instructor will be available for counseling on Tuesday and Friday from 11:45 to 12:30 and by appointment.
Office number: Weston 521 Campus Phone: 973-596-3015.
E-mail address: Taher@njit.edu

ACADEMIC INTEGRITY:

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: ***http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf***.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

ATTENDANCE POLICY

Attendance is critical and an attendance record will be kept in this course. Students need to notify the instructor when absent and explain the reason for not attending.

The NJIT office of the Dean of Students (DOS) also maintains a way for students to explain absences that instructors can use to regulate absenteeism by providing verifiable documentation through filing an online Student Absence Excuse Request form related to the absences within 14 days. The DOS will communicate with the instructor. Nonetheless, the DOS only verifies documentation, and it remains the instructor's discretion to provide any accommodation and the student's responsibility to follow up with the instructor. Accepted reasons for absence include bereavement, medical concerns, military activity, legal obligations, or university-sponsored events. Additional DOS information is outlined here: https://www.njit.edu/dos/student-excusals

WEEK-BY-WEEK SCHEDULE:

Week 1 9/2 to 9/7

- Introduction
- Review of Structural Analysis
- Indeterminate Structures: Continuous Beams and Rigid Frames

Week 2 9/8 to 9/14

- Indeterminate Structures: Continuous Beams and Rigid Frames (Continued)

Week 3 9/16 to 9/21

- Design of Steel Connections: Bolted Connections – Welded Connections

Week 4 9/22 to 9/28

- Reinforced Concrete Construction
- Review of the Traditional Concrete Structural Systems, General Properties and Structural Rules of Thumb, Framing Plans
- **Test 1: Friday 9/27**

Week 5 9/29 to 10/5

- Reinforced Concrete and Prestressed Concrete Structural Systems
- Design of Reinforced Concrete Beams

Week 6 10/6 to 10/12

- Design of Reinforced Concrete Beams (Continued)

Week 7 10/13 to 10/19

- Approximate Frame Analysis – Approximate Analysis of Reinforced Concrete Indeterminate Structures – Examples

Week 8 10/20 to 10/26

- Design of Reinforced Concrete Slabs – One-Way Slabs – Two-Way Slabs
- **Mid-Term Exam: Friday 10/25**

Week 9 10/27 to 11/2

- Design of Reinforced Concrete Slabs – One-Way Slabs – Two-Way Slabs (Continued)

Week 10 11/3 to 11/9

- Design of Reinforced Concrete Slabs – One-Way Slabs – Two-Way Slabs (Continued)
- Design of Reinforced Concrete Columns

Week 11 11/10 to 11/16

- Foundation Design – Detailed Design of a Column Footing – Design Example – Computer Applications
- **Project Assigned:** Design of a Reinforced Concrete Building with a One-Way Slab System – Computer Applications
- **Last Day to Withdraw: Monday 11/11**

Week 12 11/17 to 11/23

- Foundation Design - Simplified Design of Footings and Piles – Design Examples

Week 13 11/24 to 11/30

- **Tuesday 11/26: Thursday Schedule**
- **Wednesday 11/27: Friday Schedule**
- **Thursday 11/28 and Friday 11//29 Thanksgiving Break – No class**
- Case Studies of Complex Concrete and Steel Modern Buildings:
    1. Satolas TGV Station (Calatrava)
    2. Cincinnati's New Art Center (Zaha Hadid)
    3. Sears Tower, Chicago (SOM)

Week 14 12/1 to 12/7

- Additional Case Studies of Complex Modern Buildings:
    1. China's National Stadium/ Bird's Nest (Herzog & De Meuron)
    2. Italy's Fiera Milano/ Milan's Fairgrounds (Massimiliano Fuskas)
    3. The New Terminal at Toronto's Pearson International Airport (SOM)
- **Project Tentative Due Date: 12/4**

Week 15 12/8 to 12/14

- Design of Retaining Wall Systems

Week 16 12/15 to 12/21

- **Last lecture Tuesday 12/9**
- Examples of Reinforced Masonry Structures
- Review for the Final Exam

Last Day of Class at NJIT: Wednesday 12/11

Reading Day 1: Thursday 12/12

Reading Day 2: Friday 12/13

<u>Final Exam Week:</u> From December 15 to 21