



BUILDING TECHNOLOGY II: STRUCTURAL ELEMENTS

SPRING 2022 LECTURE | Arch 2615–5615

TUESDAYS AND THURSDAYS 9:40 AM – 10:55 AM

INSTRUCTOR: JONATHAN OCHSHORN (JO24@CORNELL.EDU)

Concepts and procedures for the design, manufacture, and construction of structural components (e.g., walls, columns, beams, slabs) in steel, concrete, masonry, and timber.

Instructor: Jonathan Ochshorn
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Office Hours: 10:00 – 11:00 am Fridays — see: <https://jonochshorn.com/academics/officeHours/>

Grading: Letter grade only for B.Arch and M.Arch students

I. Rationale: Concepts and procedures for the design, manufacture, and construction of structural components (e.g., walls, columns, beams, slabs) in steel, concrete, masonry, and timber. The purpose of this course is to provide an overview of the construction of structural systems, included discussion of design methods—at an appropriate level for architecture students—as well as properties of structural materials and strategies for producing, configuring, and assembling structural systems.

II. Course Aims and Objectives:

Aims

A. Students learn how to design structural elements in timber, steel, and reinforced concrete using principles of allowable stress design (wood), available strength design (steel) and strength design (reinforced concrete) as well as free online calculators.

B. Students learn about the manufacture and construction of wood, steel, reinforced concrete, and masonry structural elements.

NAAB Specific Learning Objectives:

The department is required by the National Architectural Accrediting Board (NAAB), as part of the accreditation process, to collect specific course material for each course taught. See Section XIV below.

III. Format and Procedures:

Lecture format.

IV. My assumptions:

I teach the material based on current codes promulgated by relevant industry organizations: American Institute of Timber Construction, American Institute of Steel Construction, and the American Concrete Institute. The course looks at determinate structures in wood and steel, and at indeterminate framed structures in reinforced concrete for which moment values can be found. I use the allowable stress design method for wood, the available strength design method for steel, and the strength design method (a version of LRFD) for reinforced concrete.

V. Course Requirements:

1. Attendance is required. Students with an excused absence (in general, this means illness, death in family, or other circumstances beyond one's control) may make arrangements to take make-up exams or turn in assignments late without penalty. Students in these circumstances should contact the professor as soon as possible. Project due dates or extraordinary quantities of work assigned in other courses do *not* constitute an excuse for missing the prelim exams or turning in a late assignment. If I'm able to record the lectures, then students who miss any class must watch the recorded lecture.

2. Course readings: Required text: Ochshorn, *Structural Elements for Architects and Builders*, Third Edition, available as low-cost paperback, free pdf, or web version (<https://jonochshorn.com/structuralelements/>)

3. How many credits? 3

4. Additional requirements: N/A

VI. Grading Procedures:

Grades will be based on three prelims, a final exam, 6 homework assignments, and class participation. Because attendance is required, a grade penalty will be assessed for unexcused absences.

IMPORTANT: Homework assignments must be turned in on time, uploaded through the CANVAS interface. A grace period of two days (where assignments are accepted without penalty) applies to all assignments but should not be abused.

Late assignments will not be accepted, since solutions may be posted online.

The course grade is based on the following:

1. Homework assignments (35% grade)
2. Prelims (30%)
3. Final exam (20% grade)
4. Participation (15%)

VII. Academic Integrity

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity:

<https://theuniversityfaculty.cornell.edu/dean/academic-integrity/code-of-academic-integrity/>

Any work submitted by a student in this course for academic credit will be the student's own work, except in the cases of projects that are specifically structured as group endeavors.

Students are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. Students can give "consulting" help to or receive "consulting" help from such students.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Pursuant to Copyright Law of the United States (Title 17 of the U.S. Code) and Cornell University Policy 4.15, faculty own the copyright to all original course content – their copyright embodies course lectures as well as notes summarizing or capturing the lecture content. Students may take and use lecture notes solely for personal scholarship, and may share lecture notes only with others enrolled in the subject course. Students may not post, copy, republish, distribute or share lecture, course, or class content in any form or medium with anyone not enrolled in the subject course absent the express written permission of the faculty copyright holder. This prohibition applies to any platform or medium to which course lectures or notes are posted for the purpose of further distribution, whether for-profit or fee-free. Impermissible uses of copyrighted content constitute acts of copyright infringement and may further subject the student to violation(s) of the Code of Academic Integrity.

1. Student IP:

Students own the copyright to their work except under conditions specified in University Policy. The instructor and department may use students' copyrighted works in their teaching, lectures, etc., internal to the course. If the Instructor wishes to further display or distribute the work beyond Cornell's academic environment, the instructor will obtain of express permission from the student and provide appropriate attribution. Permission forms will be available in the College communications office.

2. Images of students:

For reasons including FERPA, DACA, and other privacy concerns, student permission is required before sharing photos or vides taken in studio, class, or on a field trip.

VIII. Diversity and Inclusion

We (i.e., the administrators who created this text, but not necessarily the course instructor, who believes that "design," aka "architecture," is more often a tool to reinforce wealth and power) believe that design is a principal instrument of positive social change, and that progress and innovation are driven by a commitment to inclusion across race, class, ethnicity, gender, age, religion, ability and identity. For this reason, we explicitly confirm our resolute commitment to accelerate Cornell University's actions to be a diverse and inclusive institution. We embrace the responsibilities of ongoing internal critical reflection, dialogue, and action as individuals and as a community. We support the Cornell teaching community—our faculty, staff, and students—in their efforts to act with an ethos of inclusivism and antiracism in creating and sustaining diverse teaching and learning environments.

Bias-related Incident Reporting System

Cornell University is committed to fostering a safe, respectful, and inclusive living, learning, and working environment for our entire community. The bias-related incident reporting system is one step toward promoting that we, as an institution, live out these values. The reporting system allows for you to safely and anonymously report an incident you may have experienced or witnessed, receive support, and explore options for resolution.

To report an incident, individuals can use one of the following methods:

- *By submitting an incident report online at <https://www.biasconcerns.cornell.edu/> (non-emergency)*
- *By contacting the [Cornell University Police Department](#) (CUPD) at (607) 255-1111 or 911 for emergency assistance*

IX. Accommodations for students with disabilities

In compliance with the Cornell University policy and equal access laws, the instructor is available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for in unusual circumstances, so arrangements can be made. Students are encouraged to register with Student Disability Services to verify their eligibility for appropriate accommodations.

X. Religious Holidays

Cornell University is committed to supporting students who wish to practice their religious beliefs. Students are advised to discuss religious absences with their instructors well in advance of the religious holiday so that arrangements for making up work can be resolved before the absence.

The New York State Legislature (since July 1, 1992) requires all institutions (public and private) of higher education not to discriminate against students for their religious beliefs. Accordingly, the pertinent parts of Sections 3 and 4 of the law state:

“3. It shall be the responsibility of the faculty and of the administrative officials of each institution of higher education to make available to each student who is absent from school, because of his or her religious beliefs, an equivalent opportunity to . . . make up any examination, study or work requirements which he or she may have missed because of such absence on any particular day or days...”

“4. If . . . classes, examinations, study or work requirements are held on Friday after four o’clock post meridian or on Saturday, similar or makeup classes, examinations, study or work requirements shall be made available on other days, where it is possible and practicable to do so.”

A list of religious holidays can be found here:

<https://scl.cornell.edu/religiousholidays>

XI. Land Acknowledgement

The Department of Architecture acknowledges that Cornell University is located on the traditional homelands of the Gayoghó:nq’ (Cayuga Nation). The Gayoghó:nq’ are members of the Haudenosaunee Confederacy, an alliance of six sovereign Nations with a historic presence on this land. The Confederacy precedes the establishment of Cornell University, New York State, and the United States of America. We acknowledge the painful history of Gayoghó:nq’ dispossession, and honor the ongoing connection of Gayoghó:nq’ people, past, and present, to these lands and waters.

XII. Course schedule (in progress; see online course outline for latest schedule)

PART I. Wood

Week 1

Tuesday, Jan 25: Overview: loads

Thursday, Jan 27: Review of statics and strength of materials

Week 2

Tuesday, Feb. 1: Wood properties

Thursday, Feb 3: Wood systems

Week 3

Tuesday, Feb. 8: Wood beam design principles

Thursday, Feb. 10: Design of other wood elements

Week 4

Tuesday, Feb. 15: Mass timber

Thursday, Feb. 17: Review

Week 5

Tuesday, Feb. 22: Prelim #1 (wood)

PART II. Steel

Week 5 (continued)

Thursday, Feb. 24: Steel properties

Week 6

Tuesday, March 1 (February break: no class)

Thursday, March 3: Steel systems

Week 7

Tuesday, March 8: Steel beam design principles

Thursday, March 10: Design of other steel elements

Week 8

Tuesday, March 15: Steel building details

Thursday, March 17: Review

Week 9

Tuesday, March 22: Prelim #2 (steel)

PART III. Masonry, reinforced concrete

Week 9 (continued)

Thursday, March 24: Load-bearing masonry properties and systems (I)

Week 10

Tuesday, March 29: Load-bearing masonry properties and systems (II)

Thursday, March 31: Reinforced concrete beam design principles

Week 11

Tuesday, April 5 (Spring break: no class)

Thursday, April 7 (Spring break: no class)

Week 12

Tuesday, April 12: Design of other reinforced concrete elements

Thursday, April 14: Reinforced concrete properties

Week 13

Tuesday, April 19: Reinforced concrete systems

Thursday, April 21: Review

Week 14

Tuesday, April 26: Prelim #3 (reinforced concrete)

Thursday, April 28: Case study

PART IV. Last week and finals

Week 15

Tuesday, May 3: TBD

Thursday, May 5: TBD

Week 16

Tuesday, May 10: TBD

Final exam: Date and time TBD

XIII. Additional Resource Readings

Allen, *Fundamentals of Building Construction, 7th edition* (electronic resource)

XIV. Co-meeting Courses

For co-meeting courses only: Graduate assignment: Per New York State Department of Education, graduate level courses must be 5000 level and must be differentiated from the undergraduate course. Please be specific about how the assignment(s) for graduate and undergraduate students will differ.

- Undergraduate students and graduate students at Cornell have the same background and preparation (i.e., none) for this course. The same accreditation expectations for course content apply equally to undergraduate and graduate professional architecture students. There is nothing in graduate students' prior education that might justify a differentiated curricular response in this course. This is an introductory course for *both* undergraduate and graduate students and does not build upon prior intellectual knowledge or practical experience that might otherwise distinguish graduate students from their undergraduate peers. However, to comply with the New York State requirement for differentiation between graduate and undergraduate content, Assignment 5 has been appropriately differentiated, with separate reading assignments for the graduate and undergraduate cohorts. Undergraduate students read Chapter 2 ("Structure"), whereas graduate students read Chapter 12 ("Expression of Structure"), in Jonathan Ochshorn, *Building Bad: How Architectural Utility is Constrained by Politics and Damaged by Expression*, London: Lund Humphries, 2021.

XV. NAAB Student Criteria

SC.1 Health, Safety, and Welfare in the Built Environment—How the program ensures that students understand the impact of the built environment on human health, safety, and welfare at multiple scales, from buildings to cities.

Specific course elaboration:

Structural safety is discussed in relation to model codes for structural materials, as implemented through the IBC and adopted by the various states. See discussion of wood (weeks 2–4), steel (week 5–7), and reinforced concrete (week 12–13).

SC.3 Regulatory Context—How the program ensures that students understand the fundamental principles of life safety, land use, and current laws and regulations that apply to buildings and sites in the United States, and the evaluative process architects use to comply with those laws and regulations as part of a project.

Specific course elaboration:

The regulatory context for issues of structural safety is discussed in relation to model codes for structural materials, as implemented through the IBC and adopted by the various states. See discussion of wood (weeks 2–4), steel (week 5–7), and reinforced concrete (week 12–13).

SC.4 Technical Knowledge—How the program ensures that students understand the established and emerging systems, technologies, and assemblies of building construction, and the methods and criteria architects use to assess those technologies against the design, economics, and performance objectives of projects.

Specific course elaboration:

See the course schedule for topics related to emerging systems, technologies, and assemblies, for example, the discussion in week 4 of mass timber systems.