UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Civil and Environmental Engineering
Spring Semester 2021
Instructor: M.J. DeJong

# CE 120 - Structural Engineering

## Course Description

Whether you are designing a house, a 40-story building, or a bridge, you will need to consider the following aspects of the structural design:

- The loads acting on the structure due to gravity, occupancy, wind, earthquake, and other effects;
- The structural layout and materials to efficiently support the loads;
- The internal forces in the structural components;
- The proportions and details of structural components to safely resist the internal forces;
- The deformations of the structure and ways to check if these are acceptable.

This course introduces methods that structural engineers use to consider and find solutions for each of these aspects of the structural design.

## Topical Coverage

The following topics are covered in the course:

- Overview of structural engineering as a profession;
- Gravity, wind, and seismic loads, including building code requirements;
- Idealization of structures and loads for the purpose of structural analysis;
- Analysis of internal forces and deflections in statically-determinate beams, frames, trusses, and cables;
- Modeling of structures for computer analysis; evaluation of results;
- Load combinations to be certain all possible loading conditions are accounted for;
- Behavior and design of wood, steel, and reinforced concrete beams and columns considering safety and serviceability;
- Design and analysis of bridge and building systems considering gravity, wind, and seismic loads.

## Who should take CE120?

CE120 serves students who want to know about the profession and work of structural engineers, but who only want to take one structural engineering course as part of the Civil and Environmental Engineering curriculum. The Professional Engineer (PE) license examination covers structural engineering and CE120 provides fundamental information necessary for this examination. For students considering an emphasis in structural engineering, CE120 is the gateway and prerequisite for design courses (CE122, CE123, and CE124) and the technical elective on advanced structural analysis (CE121). Students in Architecture may take CE120 to complement the structures courses in Architecture and as preparation for the dual masters degree program (Architecture-Structural Engineering).

**Prerequisites**. Civil and Environmental Engineering C30/Mechanical Engineering C85 required (may not be taken concurrently) and CE 60 (may be taken concurrently).

## Course Conduct

**Lectures and Discussions.** Three 50-minute lectures and one 50-minute discussion session per week. Discussion sessions will review topics covered previously in the lectures, work examples, and review materials for upcoming exams.
**All lectures and discussions will be online. Lectures will be recorded and posted on bCourses, and can be viewed asynchronously, although synchronous viewing is highly recommended.

**Reading Assignments**. A reader will be available online on bCourses. A list of reading assignments will be provided to correspond to the class lectures.

**Computer Assignments**. A structural analysis program will be made available for student use.

**Homework Problems**. Homework problems pertaining to the week's lectures will be assigned each week. Solutions are due on the date and time indicated in the assignment, usually one week later. Problem solutions must be **organized, clear, and legible**. Your name, last name first, must appear in the upper right corner of the first sheet, followed on the next line by the date, and followed on the next line by the page number. Begin the solution with a sketch of the problem and brief statement of the objective. The solution procedure and calculations should be organized and neat. Use sketches where helpful and always include free-body diagrams where necessary. Underline or otherwise emphasize the final answer. Provide a summary sketch for solutions to design problems.
***Solutions that do not meet these requirements may be returned ungraded.***

**Exams**. There will be two midterm exams given during regular lecture sessions. The comprehensive final exam is scheduled during the regular final exam period.
***PLEASE NOTE: If you plan to take the course asynchronously, you are still expected to take the exams synchronously, i.e. at the date and time shown on the schedule. Please contact me if extenuating circumstances make this impossible.***

**Grading**. The course grade will be determined by homework problem solutions (20%); midterms (20% each); and the final exam (40%).

**Instructors**. Professor M.J. DeJong. Office hours will be held at times to be announced.
The graduate student instructors (GSIs) for the course will schedule office hours at times to be announced.

Tentative schedule

**CE 120 - Spring 2021**

| Legend |
|---|
| Holiday |
| Exam |
| HW Due |

| Week | Date | Lecture | Lecture subject | Reading | Discussion subject |
|---|---|---|---|---|---|
| 1 | 1/20/21 | 1 | Introduction to course | Chapter 1 | None |
| | 1/22/21 | 2 | Equilibrium, stability, indeterminacy | 2.1-2.5 | |
| 2 | 1/25/21 | 3 | reactions, shear and moment diagrams for beams | 2.6 | reactions, shear and moment |
| | 1/27/21 | 4 | deflected shapes of beams and frames | 2.7 | diagrams for beams |
| | 1/29/21 | 5 | frame analysis, superposition | 2.8-2.10 | |
| 3 | 2/1/21 | 6 | 3-hinge arches | | Deflected shapes |
| | 2/3/21 | 7 | truss analysis | 3.1-3.4.1 | |
| | 2/5/21 | 8 | truss analysis and design | 3.4.2 | |
| 4 | 2/8/21 | 9 | cable structures | 4.1-4.3 | Frames, trusses, cables |
| | 2/10/21 | 10 | cable structures under uniform load | 4.4 | |
| | 2/12/21 | 11 | Codes, gravity loads | Ch. 8, 9.1-9.4.2 | |
| 5 | 2/15/21 | | Holiday | | None |
| | 2/17/21 | 12 | Load paths, tributary area concept | 9.6 | |
| | 2/19/21 | 13 | Wind loads | 10.0-10.3 | |
| 6 | 2/22/21 | 14 | ASCE 7 design provisions for wind | | Reviw for exam |
| | 2/24/21 | 15 | Transfer of wind loads through buildings | 10.4-10.6 | |
| | 2/26/21 | | Exam 1 | | |
| 7 | 3/1/21 | 16 | Earthquakes and loading effects | 11.1-11.3 | Load paths, gravity |
| | 3/3/21 | 17 | ASCE-7 EQ design provisions | 11.4 | calculations |
| | 3/5/21 | 18 | Transfer of earthquake loads through buildings | 11.5-11.7 | |
| 8 | 3/8/21 | 19 | Introduction to computer analysis | 7.1-7.7 | Wind loads |
| | 3/10/21 | 20 | More computer analysis | 7.8 | |
| | 3/12/21 | 21 | Introduction to virtual work | 5.1-5.3 | |
| 9 | 3/15/21 | 22 | Virtual work | 5.4 | Seismic design example |
| | 3/17/21 | 23 | Influence lines | 5.5-5.6, 9.4.4 | |
| | 3/19/21 | 24 | Virtual forces/beam deflections | | |
| 10 | 3/22/21 | | Spring Break | | |
| | 3/24/21 | | Spring Break | | |
| | 3/26/21 | | Spring Break | | |
| 11 | 3/29/21 | 25 | Virtual forces/beam deflections | 6.1-6.6.1 | Influence lines and their use |
| | 3/31/21 | 26 | Truss deflections | 6.6.2 | |
| | 4/2/21 | 27 | Design methods, wood properties | 6.6.3 | |
| 12 | 4/5/21 | 28 | Design of wood beams | 12.1-12.5, 13.1-13.6 | Deflections |
| | 4/7/21 | 29 | Design of wood columns | 13.7 | |
| | 4/9/21 | 29 | Wood examples | | |
| 13 | 4/12/21 | 30 | Steel beam design | Chapter 14 | Wood design & Review for |
| | 4/14/21 | 31 | Steel beam design LRFD | | exam |
| | 4/16/21 | | Exam 2 | | |
| 14 | 4/19/21 | 32 | Steel examples | Chapter 15 | Steel beam design |
| | 4/21/21 | 33 | RC design for flexure | | |
| | 4/23/21 | 34 | RC design for flexure | | |
| 15 | 4/26/21 | 35 | RC design for shear | | Concrete beam design |
| | 4/28/21 | 36 | RC design for shear | | |
| | 4/30/21 | 37 | Last Class | | |
| | 5/3/21 | | RRR | | |
| | 5/5/21 | | RRR | | |
| | 5/7/21 | | RRR | | |
| | 5/11/21 | | Final (7-10pm) | | |