CEE176N: Engineering with Wood Syllabus, Summer 2026

Course Information

Course: CEE176N: Sustainable Structures: Engineering with Wood (3 units)
Department: Civil and Environmental Engineering
Term: Summer 2026
Time: TBA
Canvas: TBA

Instructor Contact Information

Instructor: Gustavo A. Araújo R. (he/him)
Email address: garaujor@stanford.edu
You may call me by my first name in writing and when we talk.

Student Hours: TBD (Blume Center), or by appointment if you prefer to talk 1:1 (email me)

Course Overview/Description

Wood has been one of humanity's most versatile materials for millennia, used for homes, tools, furniture, and countless other purposes. Today, as the construction industry faces increasing pressure to reduce carbon emissions, wood has reemerged as a material of growing interest for its ability to store carbon, renewability, and biodegradability. Advances in engineering continue to reveal new ways to design structures with wood, making it an essential topic for those interested in the future of sustainable construction. This course introduces students to wood as an engineering material in modern civil and architectural applications, emphasizing how its unique composition and structure influence mechanical and physical behavior, and how these characteristics are applied in structural design and construction. Topics include the anatomy of wood, moisture effects, mechanical properties, stress grading and design values, fastenings, and modern engineered wood products such as glued-laminated and cross-laminated timber. The class also examines durability, fire safety, and sustainability considerations in wood construction. As a capstone project, students will work in teams to design and build a small-scale bridge using balsa wood, which will be tested under increasing load until failure; a hands-on opportunity to apply the concepts learned in the course. No prior engineering experience is required. The course is ideal for students interested in materials science, sustainable design, or civil and architectural engineering.

Prerequisites and Necessary Background

There are **no formal prerequisites** for this course. Students should be comfortable with **basic algebra and geometry** and with **interpreting graphs and tables**, and have **familiarity with introductory physics concepts** such as forces, equilibrium, and basic mechanics, typically obtained in high school or an introductory college course. Familiarity with statics or strength of materials may be helpful but is not required; all necessary concepts will be introduced in class.

Course Learning Goals

Through active engagement and completion of course activities, you will be able to:

- explain how wood's biological structure influences its mechanical and physical behavior, including anisotropy, variability, moisture effects, and common failure modes
- apply simplified design principles to design wood structural members and connections subjected to axial and flexural loading
- explain how engineered wood products, such as glue-laminated timber (glulam) and cross-laminated timber (CLT), are transforming modern structural design and construction
- analyze how wood structural systems are assembled from members, connections, and engineered wood products to resist gravity and lateral loads
- evaluate how durability and fire performance influence the design and evaluation of wood structuress

Course Schedule

Subject to change, based on student feedback and input!

Table 1 Course Schedule

Week	Module	Topics
Week 1:	Wood as a Biological and Sustainable Material	Wood structure and anatomy; softwoods vs. hardwoods; wood identification; species differences and variability
Week 2:	Moisture and Physical Properties of Wood	Moisture content and equilibrium moisture; shrinkage and swelling; physical properties
Online:	Structural Analysis Basics	Axial force, bending moment, and shear force; stress distributions; deflections; load paths; types of loads
Week 3:	Mechanical Properties and Engineered Wood Products	Mechanical behavior in tension, compression, bending, and shear; introduction to engineered wood products (glulam, LVL, CLT)
Week 4:	Lumber, Engineered Products, and Design Values	Commercial lumber and engineered products; grading concepts; defects; basis of design values
Week 5:	Design of Wood Members	Beam behavior; axial forces; combined axial force and bending; strength and serviceability concepts
Week 6:	Wood Structural Systems	Wood structural panels; diaphragms; shear walls; conceptual behavior of lateral systems
Week 7:	Wood Connections	Types of fasteners and connections; nailed connections; bolts, lag screws, and other connectors; good practices for connection design
Week 8:	Durability, Fire, and Structural Performance	Biodeterioration, preservatives, and fire behavior

Course Materials

Technology
You will need to have access to a device that connects to the internet so that you can access email and Canvas. All course details and materials will be posted on our Canvas course site. Students can borrow equipment and access other learning technology from the Lathrop Learning Hub. For tech support, see Student Tech Resources and Support.

Readings
The primary course references are:

- **Forest Products Laboratory.** ***Wood Handbook: Wood as an Engineering Material***. U.S. Department of Agriculture, Forest Service. This open-access reference is available for free online and will serve as the main technical resource for the course.
- **Breyer, D. E., Fridley, K. J., Pollock, D. G., & Cobeen, K. E.** ***Design of Wood Structures***. This text will be used as a supplementary reference to support discussion of structural behavior, design concepts, and engineered wood products. Copies are available through the Stanford Libraries, and students may choose to purchase a personal copy if they wish.

In addition, the course will make reference to how the design of wood members is formalized in professional practice. The following standards will be used:

- **American Wood Council.** ***National Design Specification® (NDS®) for Wood Construction.*** Referenced as a **professional standard** for design values and member behavior. The current edition is available free of charge at: https://awc.org/publications/2024-nds/
- **American Wood Council.** ***NDS® Supplement: Design Values for Wood Construction.*** Referenced for examples of **published design values and tabulated material properties**. Available free of charge at: https://awc.org/publications/2024-nds-supplement/
- **American Wood Council.** ***Special Design Provisions for Wind and Seismic (SDPWS).*** Referenced at a **conceptual level** for wood structural systems, including sheathing, diaphragms, and shear walls. Available free of charge at: https://awc.org/publications/2021-sdpws/

Additional readings, case studies, figures, videos, and excerpts from professional and research sources will be posted on Canvas. These materials will represent a range of perspectives from engineering practice, research, and contemporary wood construction.

Laboratory and Project Materials

Materials required for the course project (e.g., balsa wood and basic construction supplies) will be provided or coordinated through the course. Students will not be expected to purchase specialized tools or equipment.

Affordability of Course Materials
All students should retain receipts for books and other course-related expenses, as these may be qualified educational expenses for tax purposes. If you are an undergraduate receiving financial aid, you may be eligible for additional financial aid for required books and course materials if these expenses exceed the aid amount in your award letter. For more information, review your award letter or visit the Student Budget website (financialaid.stanford.edu/undergrad/budget/index.html).

Coursework and Grading Scheme

This is a reading-, discussion-, and presentation-intensive course. This course is worth **3 units of credit**, or **9 hours of work per week**, including class time. Between weekly participation in class, this leaves approximately 6 hours of potential work outside of class.

Grading policy

For students taking the course for a letter grade, the final numerical score (on a scale of 0–100) will be converted to a letter grade according to the following scale:
A: 93 and above, **A-**: 89-92.9%, **B+**: 86-88.9% **B**: 83-85.9% **B-**: 79-82.9%, and so on.

Category	**% of course letter grade**	**Notes**
Attendance and participation	10%	Includes attendance, engagement in discussion, and in-class activities. **Two absences are permitted without penalty.** Arrival >15 min late counts as an absence. Additional absences may be made up with alternative work.
Weekly assignments	30%	Conceptual and applied assignments distributed throughout the term. Students must complete **at least 6 of 8** assignments; **the lowest two scores are dropped**. See late policy.
Midterm exam	30%	Take-home exam focused on conceptual understanding and application of course material.
Final Project	30%	Team-based balsa wood bridge contest. Evaluation is based primarily on structural performance, with a **minimum passing grade awarded for successful participation**, regardless of performance outcome.

For students taking the course for Credit / No Credit (CR/NC), the criteria for receiving course credit are outlined below:

Category	**To receive course credit (C/NC)**
Attendance and participation	Includes attendance, engagement in discussion, and in-class activities. **Two absences are permitted without penalty.** Arrival >15 min late counts as an absence. Additional absences may be made up with alternative work.
Weekly assignments	Students must complete **at least 6 of 8** assignments. See late policy.
Midterm exam	Mandatory. Students must earn a **minimum score of 60/100** to receive course credit.
Final Project	Mandatory participation in the team-based balsa wood bridge contest. **Credit is awarded for participation**, regardless of performance outcome.

Grade revisions

The instructor may revise a student's end-quarter grade only under specific circumstances. It is allowable to change a grade when the revision is due to a computational error or when a student's submitted work was unintentionally overlooked. It is not allowable to change a grade due to a revision of judgment on the instructor's part or on the basis of new work submitted (e.g., a new exam or additional work completed after the end of the quarter)

Course Policies

Presence and Participation

Thinking through difficult problems is most productive and fun when done with others. This is why attendance and participation is part of your course grade (10%). Being 15 minutes or more late to a class or section counts as an absence. Students who anticipate persistent challenges to participating in class or submitting work on time should share this with me as soon as possible.

If you are unable to attend a lecture session, you may make up an absence by e-mailing a summary of the lecture and how you would have contributed. Even if an absence is excused, any work due in that class/section is subject to late policies.

Diverse Ways of Participating

In this course, I recognize diverse ways of participating, both in class and online, that contribute to our collective learning environment. For example:

- Ask a question or make a comment:

    - that encourages another person (including me, the instructor, and other students) to elaborate on something they have already said.
    - that takes us in a promising or provocative new direction.
    - points out an issue we are dodging.
- Share a resource that:
    - adds new information or unexplored perspectives to our learning.
    - clarifies a complicated concept or procedure.
- Make a connection between two:
    - people's contributions
    - topics or methods taught in different parts of this course or in different courses
- Share your thought process to help expose common misconceptions or pain points in learning that might be overlooked by me due to expert-forgetting.

Late Policy

Despite the best planning, however, life happens! Students may submit up to **two weekly assignments up to 48 hours late**, no questions asked. Late submissions beyond this allowance will not be graded. Note that the two lowest weekly assignment scores are dropped, so additional non-submissions will count toward those dropped scores. Students are encouraged to use their late passes thoughtfully and to plan accordingly.

Communication

I will reply to course-related questions within 24 hours. To communicate via Zoom outside of office hours, please e-mail me to schedule a time. All course-related e-mails will be answered during standard business hours (M–F, 8:00–17:00 PST). E-mails sent after standard business hours will be answered on the next business day.

The Honor Code

Class meetings and sections in this course will be highly interactive; you will hear plenty of great ideas from your peers, and if things go as planned, you might even *change your mind* based on what others say! However, you will be evaluated in this course as an individual and are expected to cite sources and individuals from whom you have learned and borrowed as a display of academic, intellectual, and creative integrity. In addition, while I encourage collaboration during class activities and assignments as an aid to your learning (with collaborators and their contributions cited in submissions), I expect you to complete the take-home exam unaided to demonstrate your proficiency with course material. This means conversations about exam questions and consultation of course or other resources while working on exam questions are not permitted.

Failure to abide by these expectations is a violation of Stanford's Honor Code and is a serious offense, even when the violation is unintentional. Conduct prohibited by the Honor Code includes all forms of academic dishonesty, among them unpermitted collaboration and representing others' work as one's own. Please review Stanford's Honor Code and documentation and citation resources from the Hume Center for

Writing and Speaking. When in doubt, contact your section leader.

Course Policies for Use of Generative AI

Various next-generation tools are at your disposal. Generally, their use is not barred in this course, provided their use does not violate the honor code. However, your learning implies a responsibility to the course material. Writing, reading, and critical thinking/analysis all require a significant amount of practice. These are skills that require substantial experience, and the use of generative AI before you yourself are confident in the material will undermine your ability to learn and to think for yourself. Generative AIs often learn based on the "average" of a cumulative dataset, with bias towards what data is available. Do not be afraid to be better than average, to extrapolate, to think outside the box, or to be unique in your approach to problem-solving.

Please note that, following guidance from the Board of Judicial Affairs, use of generative AI to "substantially complete" an assignment or exam by entering the prompt and submitting the output as one's own work is **not permitted.**

Extended Absences

Despite our efforts to take precautions and protect ourselves and those around us, it is possible that one or more of us in the class will get sick, will need to give care to someone sick, or for other reasons will require an extended absence during the quarter.

- If a student requires an extended absence before more than 70% of coursework is completed, there might be opportunities to *withdraw* from the course or develop a schedule for making up and submitting coursework later in the quarter. Students in this situation should talk to a staff member at the Office of Accessible Education and to their section or course instructor as soon as possible.
- If a student requires an extended absence after at least 70% of coursework is completed at a passing grade or higher, students may request an Incomplete. Incompletes do not award any credit and can drop students below the minimum required unit load. This could negatively impact academic progress, graduation, NCAA and veteran's certifications, and financial aid. Students in this situation should talk to their section leader to discuss options.

Exam Policy

There will be **one take-home exam** in this course. Students will have a 24-hour window to complete and submit the exam once it is released on Canvas. **Late submissions will not be accepted**.

Students are expected to plan accordingly. If you anticipate or encounter extenuating circumstances that may interfere with your ability to complete the exam within the 24-hour window, please contact the instructor as early as possible.

Course Privacy Statement

As noted in the university's recording and broadcasting courses policy, students may not audio or video record class meetings without permission from the instructor (and guest speakers, when applicable). If the instructor grants permission or if the teaching team posts videos themselves, students may keep recordings only for personal use and may not post recordings on the Internet or otherwise distribute them. These policies protect the privacy rights of instructors and students and the intellectual property and other rights of the university. Students who need lectures recorded for the purposes of an academic accommodation should contact the Office of Accessible Education.

Course Policies for In-Person Instruction

All live instruction and participation in this course will be in person. In addition, given how interactive class time will be, there will be minimal lecturing and few reasons to support class recordings. However, we understand circumstances may arise that will interfere with your ability to attend class; this also includes the possibility that your peers or we, the teaching team, may not be able to attend class. In light of these considerations, we request that you:

- skip class/lab/section if you're feeling unwell.
- review class notes and activity artifacts posted on Canvas for class sessions you miss.
- complete asynchronous assignments posted on Canvas for class sessions you miss.
- participate in Zoom office hours with your primary instructor and/or TA as you are able to ask questions and get caught up.
- rest assured that your lowest score/grade in each assignment bucket (reading response, quiz, lab report, section, exam, project status update, etc) will be dropped.
- remember that you are permitted to miss up to 4 graded class components (class attendances and/or class assignments) without any questions or penalties.
- remember that for students required to miss more than 6 days of class/section/lab due to medical reasons, the teaching team will devise an alternative plan for you to complete coursework if needed.

We want you to learn, and enjoy learning, in this course as much as possible, and we are committed to meeting you where you are and helping you complete the course successfully. Please reach out to us, your Academic Advisor, or both, to discuss your concerns and questions so that we can work together to address them.

Academic Accommodations

Stanford is committed to providing equal educational opportunities for disabled students. Disabled students are a valued and essential part of the Stanford community. We welcome you to our class.

If you experience disability, please register with the Office of Accessible Education (OAE). Professional staff will evaluate your needs, support appropriate and reasonable accommodations, and prepare an Academic Accommodation Letter for faculty. To get started, or to re-initiate services, please visit oae.stanford.edu.

If you already have an Academic Accommodation Letter, we invite you to share your letter with us. Academic Accommodation Letters should be shared at the earliest possible opportunity so we may partner with you and OAE to identify any barriers to access and inclusion that might be encountered in your experience of this course.

Student athletes who anticipate challenges in being able to participate in class or submit assignments on time should speak to a course instructor or teaching assistant as soon as possible about available alternatives or allowances.

Neurodivergent students, those with documented or self-identified ADHD, autism, learning disabilities, or other mental or physical health conditions, can also seek academic support through the Center for Teaching and Learning's neurodiversity-focused programs and resources.

Learning Resources

Have you ever noticed that elite performers across different fields—from athletes to musicians to leaders—work regularly with coaches? No matter what the domain and where you are starting from, consistent practice, reflection, and guidance from others can help you improve your skills. In the academic context, this includes specific skills, such as essay-writing or quantitative problem-solving, as well as the more general skills of learning (anything) effectively and maintaining your well-being. Stanford has a wide range of tutors, coaches, and other resources to help you up your game. Which will you take advantage of?

For this course, we especially recommend:

- Writing tutors from the Hume Center for Writing and Speaking, to sharpen your essay-writing skills
- Academic coaches from the Center for Teaching and Learning, to help you manage your time and work effectively
- Study halls, organized by the Center for Teaching and Learning, to work and learn in quiet companionship with other students

Other campus resources include:

- Study Tips and Tools, from the Center for Teaching and Learning
- Undergraduate Advising Directors, Academic Advising
- Well-Being services, including well-being coaches, Vaden Health Center
- Subject Matter Tutoring, CTL
- Language Conversation Partner Program, CTL

- Tutoring for Student Athletes, AARC
- English for Speakers of Other Languages courses for international graduate students
- Student Tech Resources & Support, includes support for personal devices and Stanford services