Timber Tectonics in the Digital Age

An Oregon State University and University of Oregon Collaboration

ARCH 4/584 FALL 2023 CHENG & RIGGIO – Timbertectonics.com

This studio immerses students into digital workflows for AEC collaborative design, simulation and fabrication of timber structures. Working in an integrated design team, students will learn how technology is shaping Materials (engineered wood products), Design (parametric modeling and virtual testing), and Construction (manufacturing and assembly). Students will learn about how material properties, structural forces and fabrication practices influence architectural form and connection design of timber structures. They will explore form using both physical and digital models. They will receive guidance in parametric modeling and conceptual structural design, which will enable them to fluidly create and evaluate various design variations. This approach will empower them to unite structural considerations and visual aesthetics, leading to purposeful and efficient designs. Co-taught with Oregon State University (OSU) Associate Professor Dr. Mariapaola Riggio, an architect and structural engineer who specializes in timber, this studio provides a unique chance to partner with OSU students from fields such as Wood Science, Civil Engineering and Construction Management.

This year's project will focus on **Design for Change and the Circular Economy**. Given the dimensions of factory off-cuts and previously used wood, students will develop a modular structural system that can be extended and aggregated. Elements will be designed for pre-fabrication, easy assembly and disassembly so that they can be repurposed.

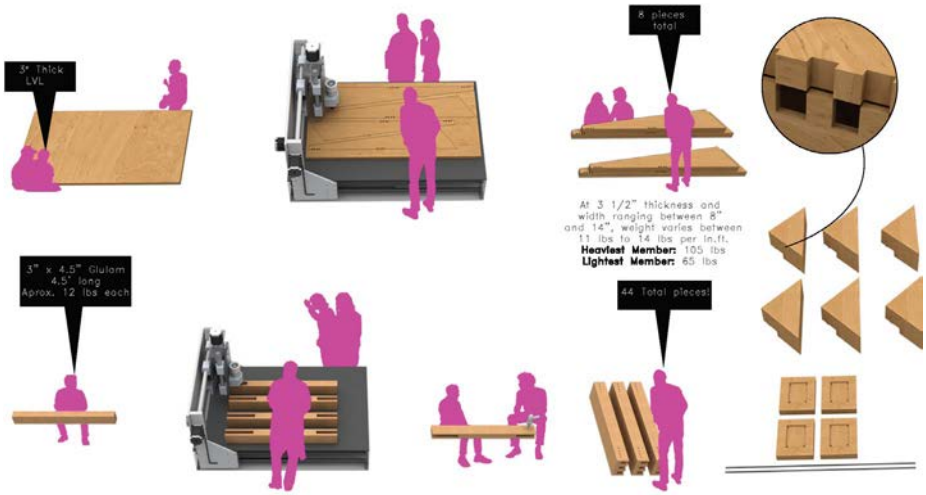
The challenge is to:

- Minimize waste and maximize flexible use of components in the current project
- Maximize future material reuse by minimizing cuts, standardizing dimensions and using notched connections
- Maximize the spanning ability of small pieces by using reciprocal frame systems

Outside of the UO-OSU collaboration, UO architecture students will address programming, site design, and function. Together with OSU students, they will develop the design, detailing and construction of the structural system that fits within the larger context. These interdisciplinary teams will develop and model how the system works at scales from intimate furnishings to long-span canopies, adapting the materials, joints, pre-fabrication, and on-site assembly for each scale. The class will select from the best ideas for building full-scale mock-ups.

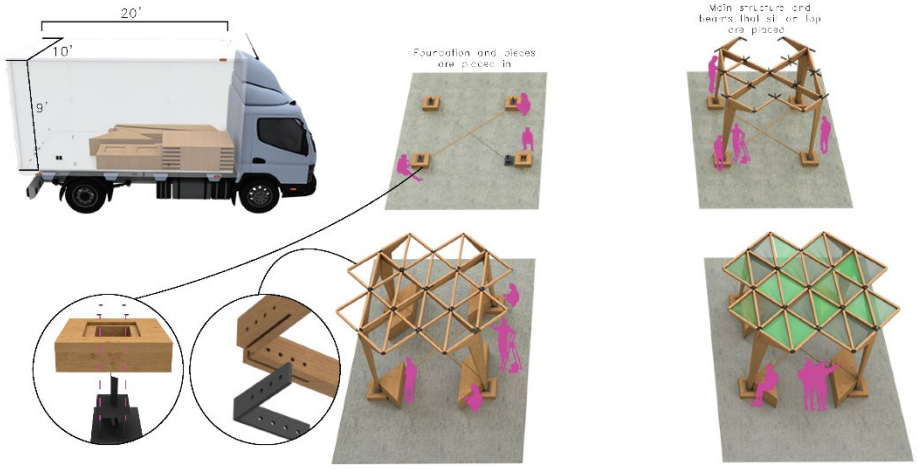
From taking this course students will

- Practice integrated AEC collaboration; visualize and experience construction processes.
- Learn how to design and analyze parametric variations of timber structures
- Learn design implications of how wood can be engineered, manufactured and assembled



Off-site pre-fabrication (above) and on-site pavilion assembly (next page) illustrated in a project by Joel Mbala-Nkanga, Jasmine Martinez, Walker Maddalozzo and Emily Pollman

Hybrid Format



This studio supports a creative, iterative process, bringing together a group with diverse skill sets. Expect to spend a lot of time working with your small group (including 6 hours per week with OSU partners) as well as independently accessing online materials. During the term, class activities will build on each other. You will be developing and testing your ideas, applying new knowledge, sharpening your skills, and receiving continuous, personal feedback on your work from the instructors and external reviewers. Learning will occur through:

- Lectures on structural principles and timber construction methods
- Case studies: examine how principles and techniques were used in classic & contemporary structures.
- Software tutorials
- Woodshop demonstrations and applications
- Design speculations using principles, examples, software and woodshop methods.
- Reflective writing of forum questions and work-in-progress reports
- Collaborative work and interdisciplinary communication

Students are expected to be available MWF 1:00-4:50pm for class sessions, with online meeting sessions with OSU starting at 3:00pm. There will be some flexibility for shifting work time to accommodate woodshop and partner availability. **We will take two trips to OSU: the 1st is tentatively Friday, Sept 29** to meet partners and tour facilities, the 2nd will be at the end of the term.

Draft Schedule

Weeks 1-4	- Build knowledge about timber products, reciprocal frame structures & design for disassembly (through lectures, discussions, quizzes, case study research) - Build parametric design and structural analysis skills (through tutorials & digital experiments) - Build material and connection understanding (through hands-on woodshop construction of small prototypes)
Weeks 5-7	- Develop design collaboration abilities through a small group project by applying skills and knowledge from weeks 1-4.
Weeks 8-11	- Deepen understanding by refining and producing a large-scale structure

Measurable Student Learning Outcomes

1. Describe various types of timber structural systems, their behavior and use in contemporary practice
2. Design and analyze parametric variations of these structural systems
3. Understand the design implications of how wood materials can be engineered, manufactured and assembled
4. Develop structural solutions to support architectural design
5. Develop fabrication solutions to support architectural design
6. Collaborate in an integrated design team
7. Document design solutions, visualize construction processes and communicate to different audiences

See http://timbertectonics.com for more information.