CLEMSON
WOOD UTILIZATION + DESIGN INSTITUTE

ANNUAL REPORT 2022

Submitted by
Dr. Patricia A. Layton

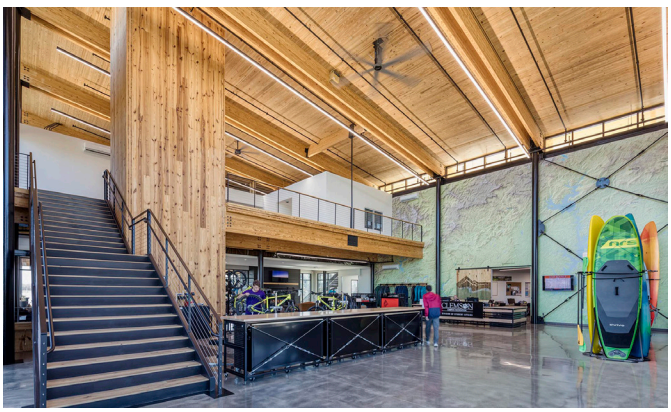
Table of Contents

Introduction

Clemson University's Wood Utilization + Design Institute (WU+D) had an exciting 2022. As always, we have moved forward with teaching, research and outreach. The faculty fellows, their graduate students and undergraduates who work with us in our endeavors are critical to our success and our future growth. We have experienced some gains and losses this year. We said goodbye to Christopher Kitchens, Chemical Engineering, as he moved to Villanova University to become a department chair. Michael Stoner changed roles, moving from a full-time lecturer in Civil Engineering to working half-time in the academic year and full-time all summer with WU+D as a research associate. Dan Harding is completing his service as the Graduate Coordinator in Architecture, and we are happy that he will be more involved with the Institute in 2023. Pat Layton has retired from her faculty position but continues as Director of WU+D part-time.

We received several new grants that will be highlighted in the grants section. With these new grants, you will see new faces among our fellows and graduate students this year.

We continued our outreach this year with many more in-person presentations and tours. Clemson's Andy Quattlebaum Outdoor Education Center and Samuel J. Cadden Chapel are great places to see mass timber buildings. The photos done for Andy's nomination for a wood design award continue to pop up on many of the WoodWorks, Softwood Lumber Board and ThinkWood websites.



Andy Quattlebaum Outdoor Education Center at Clemson University

Teaching about mass timber continues to be a big emphasis for WU+D. WoodWorks is gifting us a Smartlam SYP mass timber teaching structure that students can put together and take apart (see an update on what else we will do in the outreach section). Also, in the teaching arena, this report will update you on the final ACTED grant that supported architecture studios at Clemson, Oregon and Arkansas. Another critical milestone this year was the Timber Design Faculty Development Workshop funded by the Softwood Lumber Board.

It has been a terrific year; read more about our progress in the pages of this year's Annual Report.

$2 Million Gift Endows WU+D Directorship

Micky and Amy Scott have gifted $2 million to the Clemson University Wood Utilization + Design Institute to endow the Institute's directorship. The Patricia "Pat" Layton Endowed Directorship is named in honor of founding director Patricia Layton.

Clemson President Jim Clements with Pat Layton and Micky and Amy Scott

"I am deeply honored and humbled by the Scott Family creating this endowment in my name. The work to make the WU+D Institute what it is today is a team effort that included many people, including Micky Scott and his family. Since 2014, I have served as its director, and it has been the joy of my 45-year career. I have been privileged to work with many faculty and other partners to grow a new industry and bring it to life," Layton said.

The Scotts, with Micky's brothers Bill and Hank, are fourth-generation owners of Collum's Lumber Products, LLC, a wholesale lumber and pole manufacturer in Allendale, South Carolina.

"When you talk about building with wood, Pat Layton is the top cheerleader and a nationally known expert. The purpose of this gift is to make sure WU+D can replace and retain the best director to sustain the Institute and ensure that it continues to play a pivotal role in the success of South Carolina's $21 billion forest products industry for years to come," Scott said.

Mitchell S. "Micky" Scott received a Bachelor of Science in Forest Management from Clemson in 1975. He was recently honored with the Clemson University Distinguished Service Award. He serves on the Committee on Philanthropy, the WU+D Board and is former Chair of Clemson's Timberlands Legacy Committee.

"We cannot thank Micky and Amy enough for their continued support of the College of Agriculture, Forestry and Life Sciences (CAFLS), its students, forestry program and the state's forestry industry. Their gift is not just a testament to their generosity, but also a tribute to Pat's career and to the important role that the WU+D Institute plays in the success of the South Carolina forest industry," said Keith Belli, Dean of Clemson's College of Agriculture, Forestry and Life Sciences.

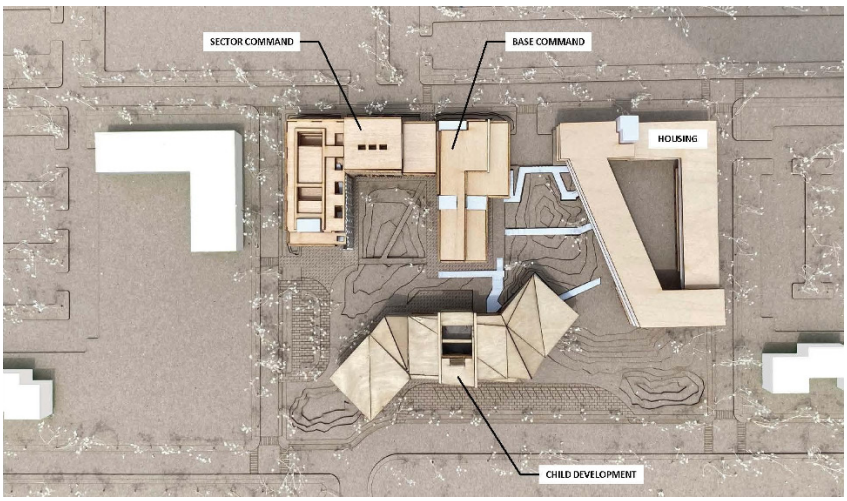
Architecture Activities

ACTED Grant and Architecture Studios

This year marked the end of our 2-year ACTED grant in which students and faculty from Architecture and Civil Engineering studied the use of mass timber for a range of building types found on Department of Defense (DOD) and Department of Homeland Security (DHS) installations. In addition to our team from Clemson, the grant also involved complimentary projects from our partners and sub-awardees at the Universities of Arkansas and Oregon. In September, the final report was issued to our sponsors at the U.S. Endowment for Forests and Communities.

The third and final Clemson design studio project was completed during the Spring 2022 semester, during which the Graduate Architecture Comprehensive Studio completed proposals for several facilities being planned for the new U.S. Coast Guard Super-Base in North Charleston, South Carolina. The 6-credit studio of 37 graduating M.Arch students was led by Professors Dustin Albright, Dan Harding, Ulrike Heine and Kate Schwennsen. The U.S. Coast Guard (USCG) currently operates a base headquartered in downtown Charleston. In addition to this Tradd Street location, the USCG docks and supports their largest vessels (called “cutters”) at the site of the former U.S. Navy base in North Charleston. The plan is to move all of USCG Base Charleston to the North Charleston site.

The Studio was tasked with focusing on a subset area within the USCG portion of the master plan (a master plan coincidentally developed by a couple of this grant’s University of Oregon collaborators). Described as a “town center,” this area is slated to feature an office building (Base + Sector command), a child-development center and a medical/dental facility. Additionally, this area carries space for future “notional” buildings. The studio elected to propose multifamily housing as a program for notional building B, and to split the proposed office building into two smaller structures, one focused on “Sector” command and the other on “Base” command.



Site Model of Submaster Plan by Super Team 4

Working in teams of two or three, students completed design proposals for 16 projects, (4 of each: Sector Command, Base Command, Child Development Center and Housing). Additionally, 4 alternative master plans were developed for this portion of the new base, each one featuring a combination of the individual building designs. In addition to the programmatic requirements associated with each of these buildings, the students were

required to carefully consider sea-level rise and projected flood elevations while designing resilient structures and landscapes for the base. Early conceptual designs were shared with USCG representatives and other invited guests at a design charrette in mid-February, providing students with valuable feedback and suggestions. Guided tours of the future base site and the current base on Tradd Street were also a part of this February visit.

Students went on to develop mass timber framing diagrams and construction details, along with preliminary carbon sequestration calculations, illustrating their understanding of mass timber design. Strategies for resilience intersected with the ways that prefabricated mass timber systems are leveraged for their light weight, speed in construction and unparalleled life cycle carbon benefits. Master of Landscape Architecture students provided consultation. Additional input was invited from graduate students working in Clemson's Architecture + Health program who focused on designing the USCG medical/dental facility on the USCG site.

Final student presentations were coordinated and shared with Capt. John Barry (Commanding Officer, Facilities Design and Construction Center), Mike Jackson (Senior Planner, SILC-DD Miami) and Lt. John Houk (Facilities Engineer, Base Charleston). In addition to these collaborations with our USCG partners, the Clemson students had been introduced, at the beginning of the semester, to the Base Charleston master plan through a virtual presentation by Barry Gordon, University of Oregon collaborator and a principal of The Urban Collaborative, the master planners for the USCG site.

Section Perspective Drawing and Mass Timber Carbon Summary by Emma Gibson and Sydney Parker

Additional cross-university collaborations included Clemson Professor Albright providing a lecture on critical metrics in designing with mass timber to the University of Arkansas students and faculty. Moreover, Albright served as a guest reviewer during the Arkansas' studios final presentations in May. In the interim, Clemson Professor Weichiang Pang and his students from Civil Engineering served as remote structural consultants to the Arkansas architecture students.

On Aug. 12, 2022, Professor Albright made a follow-up visit to the Coast Guard in Charleston, providing them with the physical site models from the studio plus the final book documenting the student proposals. These materials were shared with approximately 25 base personnel in a drop-in format, and were left behind for ongoing
review and discussion by the USCG.

(A) Student Visit to Existing USCG Base Charleston
(B) Design Charrette in Charleston with USCG Personnel and Other Guests

The detailed studio book comprising all of the student projects can be viewed (in four parts) at the following links:

PART 1
PART 2
PART 3
PART 4

Following the completion of the studio and the final presentations from the students, the USCG partners reflected on this collaboration and on the resulting projects. They provided the following statements:

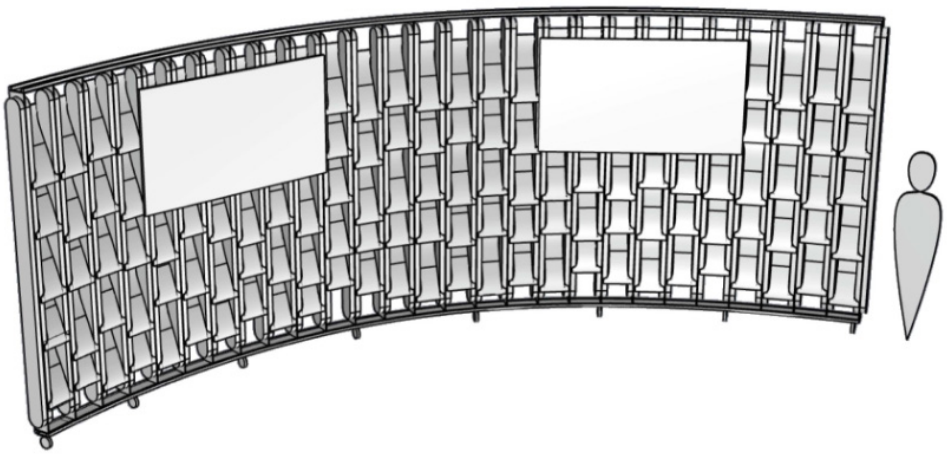
> "As the United States Coast Guard undertakes the largest construction program in our Service's history, the Clemson University School of Architecture students brought a unique blend of creativity, advances in technology and out of the box thinking to this project. Their presentations combined conventional concepts of space planning and resiliency with innovative ones like sustainability and carbon emission avoidance. This approach has made us think differently about the way we construct future shore facilities in Charleston and around the globe."
> *Captain John Berry, Commanding Officer USCG Facilities Design and Construction Center*

"Thank you to the staff and students at Clemson University's School of Architecture for the remarkable partnership while designing facilities and infrastructure in support of the United States Coast Guard Base Charleston build-out. The proposed site presents unique challenges related to environmental impact, project phasing, coastal resiliency and user experience. All of the final presentations exceeded expectations, incorporating creative design features and cutting-edge practices that would ensure mission support and operational success at an installation positioned to become the premier Coast Guard center of gravity on the east coast".
Lieutenant John Houk, USCG Base Charleston Facilities Engineer

In addition to this design studio project with the USCG, Clemson faculty Dustin Albright (Architecture) and Michael Stoner (Civil Engineering) teamed up with M.Arch students Rachel Glanton and Michael Caraballo to complete a comparative LCA study for new facility at Tyndall Air Force Base (Panama City, FL) which had been the subject of the Fall 2021 Design Studio for the ACTED Grant. The study was performed using the actual design files for the 325th Fighter Wing Headquarters building, as provided by the Army Corps of Engineers and the professional AE Firm responsible for that project. Our research team completed a redesign using mass timber and compared its embodied carbon footprint to the steel-frame design scheduled for construction. Among other outcomes, we found that a mass timber approach could reduce the greenhouse gas emissions associated with the production and construction of the structural frame by as much as 54%.

Multimedia Display Wall

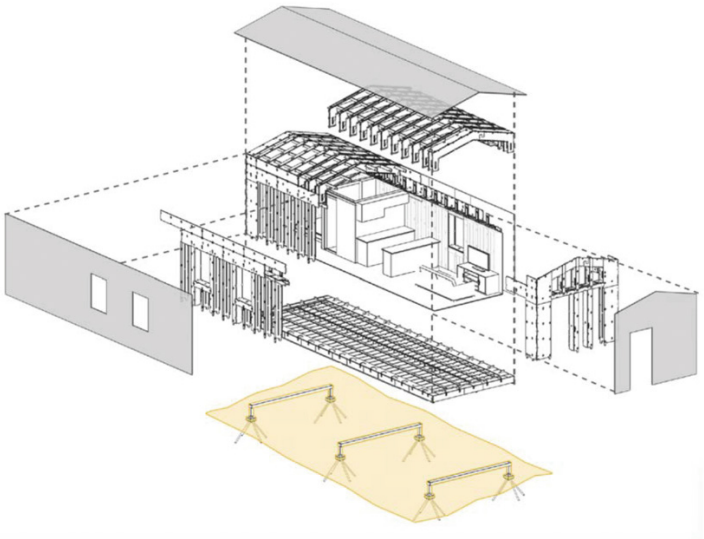
A team led by Professor Dan Harding is nearing completion on the design and construction of a mobile, multimedia display wall for Clemson's Lee Hall 3, home to our School of Architecture. The wall will serve as a backdrop for presentations and project reviews, supporting two large screen monitors as well as drawings and other materials which can be pinned to its surfaces. Open wood stud construction will be complemented by felt acoustical baffles, providing much needed sound absorption in a space always abuzz with the noises of hands-on studio courses and other activities. This project is being generously supported through funding from Weyerhaeuser, a WU+D Institute Partner organization.



Post-Disaster Direct Housing Studies

This year, we completed our work on a project titled “Integrated Housing Design and Logistics for Disaster Relief.” The project, which was supported by the USDA through its Forest Products Laboratory, focused on designs for deployable, post-disaster structures for healthcare and recovery housing, with an emphasis on flexibility and adaptability across uses. We emphasized solutions that could transition from short-term to long-term recovery scenarios. Working with our WU+D colleagues from Civil Engineering, our team developed detailed designs for core housing and medical units which are expandable for growth. One solution utilized Clemson’s Sim[PLY] framing system, a plywood kit-of-parts approach designed for rapid and easy on-site construction with unskilled laborers. Other solutions focused on modular units framed with cross-laminated timber panels while still another, developed by Civil Engineering student Jason Leonard, utilized hinged light-wood-framed panels for a foldable/unfoldable scheme.

Some of these concepts have carried over into a new project funded through NSF’s Disaster Resilience Research Grants (DRRG) program. The project, titled “An Integrated Housing Design and Logistics Operations Modeling and Analysis Framework for Hurricane Relief,” is being led by faculty members Yongjia Song (Industrial Engineering), Weichiang Pang (Civil Engineering), Michael Stoner (Civil Engineering) and Dustin Albright (Architecture), with additional support from David Vaughn (College of Engineering). The central objective of the research is to investigate the effectiveness of housing design solutions in disaster relief and recovery by creating an integrated modeling and analysis framework for disaster housing logistics planning and operations. This framework analyzes novel, adaptable disaster housing solutions from a systematic perspective of logistics planning and operations, drawing on converging research from our different disciplines: novel architectural design, natural hazard and fragility analysis and relief logistics network design and operations planning under the uncertainty of disaster housing demand caused by hurricanes. Architectural solutions are examined across a range of production and delivery formats, from volumetric modular to prefab wall, roof and floor panels to kit-of-parts approaches like our Sim[PLY] system. In March, the team plans to host a related workshop with knowledgeable stakeholders from state agencies who operate on the front lines of disaster preparedness and response.

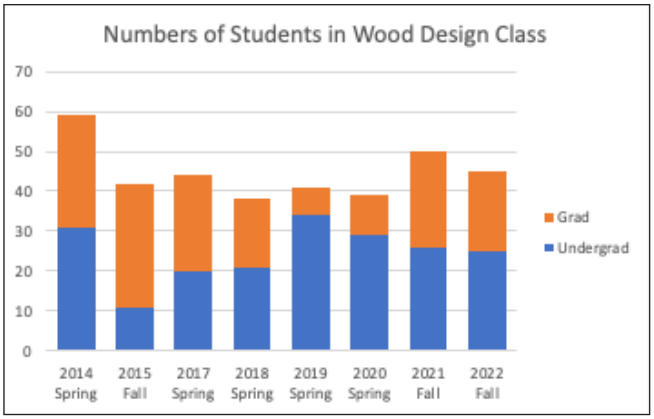


Post-Disaster Core Housing Unit w/ Sim[PLY] Framing. Illustration by Daniel Mecca

Engineering Activities

Wood Design Class – Civil Engineering

The numbers of students educated in structural wood design since 2014 are shown in the bar chart. In this academic year (2022), 45 students took the Civil Engineering Wood Design class (25 undergraduate students and 20 graduate students). This course teaches engineering students how to design wood buildings and other structures following the National Design Specifications for Wood Construction (commonly known as the NDS code). Over 350 students have taken the wood design course since 2014 and, on average, about 40 to 45 students enrolled in the wood design course each academic year.



The Charles Ingram Lumber has been sponsoring the wood design class at Clemson with free NDS codes for our students over the past 8 years. The kind support from Charles Ingram Lumber makes the Wood Design class among one of the most popular courses in Civil Engineering Department (Figure 1).

Figure 1: NDS codes sponsored by Charles Ingram Lumber and distributed to students in the Fall 2022 Civil Engineering Wood Design class

Engineering Students Serve as Consultants to Architecture Design Studio

In Spring 2022, several civil engineering graduate students from the Civil Engineering Department at Clemson served as structural consultants remotely via web conference meetings to the architecture design studio class of the University of Arkansas Community Design Center led by Dr. Stephen Luoni. The civil engineering students provided technical advice and recommendations in terms of structural solutions to architecture students on their architectural designs. One of the designs consulted by the Clemson Civil Engineering consultants – A Social Center for the Little Rock Air Force Base: The Shed – was selected as a finalist in The Plan Award 2022 in the Mixed-Use Future category along with 11 other worldwide projects.

Ongoing Research: Evaluation of Long-Term Deflection of CLT

By Aaron DeSantis

While current design standards for cross-laminated timber (CLT) subjected to long term deflection or creep provide a design value, direct validation of such factors has not been conducted. Current code recommends a long-term deformation factor of 2.0 for CLT and 1.5 for glue-laminated timber (GLT). CLT creep testing will be loaded under at three levels to determine the measured value for the long-term deformation factor. Design loads were obtained from monotonic bending tests. Peak long-term deflection readings will be compared to instantaneous deflections to calculate the creep factor over the course of the test.

Figure 1: CLT bending specimen after failure

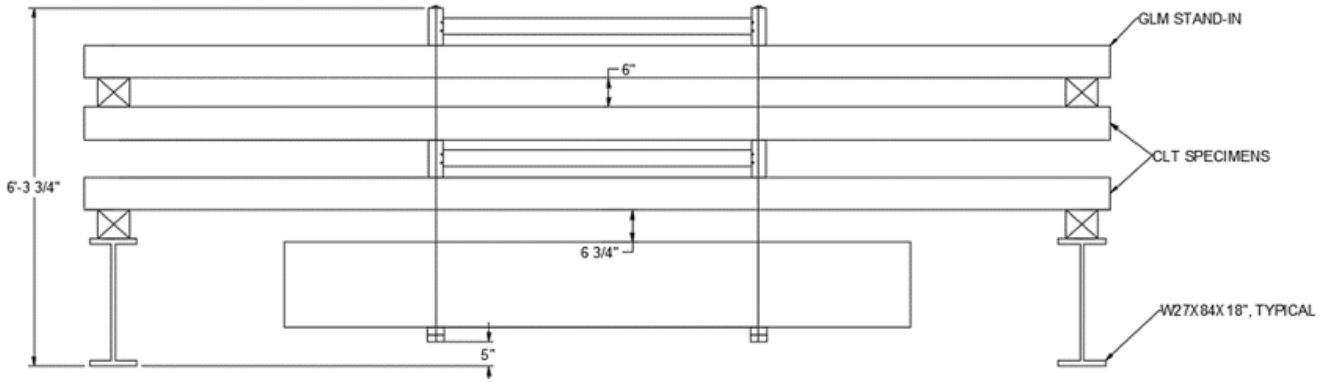


Figure 2: Long-term testing schematic

Ongoing Research: Mass Timber Noise Barrier

The team has completed the design and analysis of Mass Timber Noise Barrier. Using the noise barrier design requirements outlined in the AASHTO code and referring to FHWA guidelines, the team has proposed a design that utilizes a 3-ply southern yellow pine CLT panel and W 10x33 steel posts for a theoretical site in Georgia. The team plans to install another CLT noise barrier at the same location with uncoated CLT panels to provide benchmark data of moisture content in CLT panels. They will also investigate additional treatment options for CLT panels. Preliminary moisture measurements on the mock-up wall indicated that the moisture content in the CLT panel increases due to rainfall events, but quickly returns to pre-rainfall levels. Further statistical analysis and control testing is being performed to benchmark the performance of the CLT noise barrier.

Figure 1: A mock-up construction of the proposed CLT noise barrier instrumented with moisture sensors and rain gauge for long-term moisture monitoring.

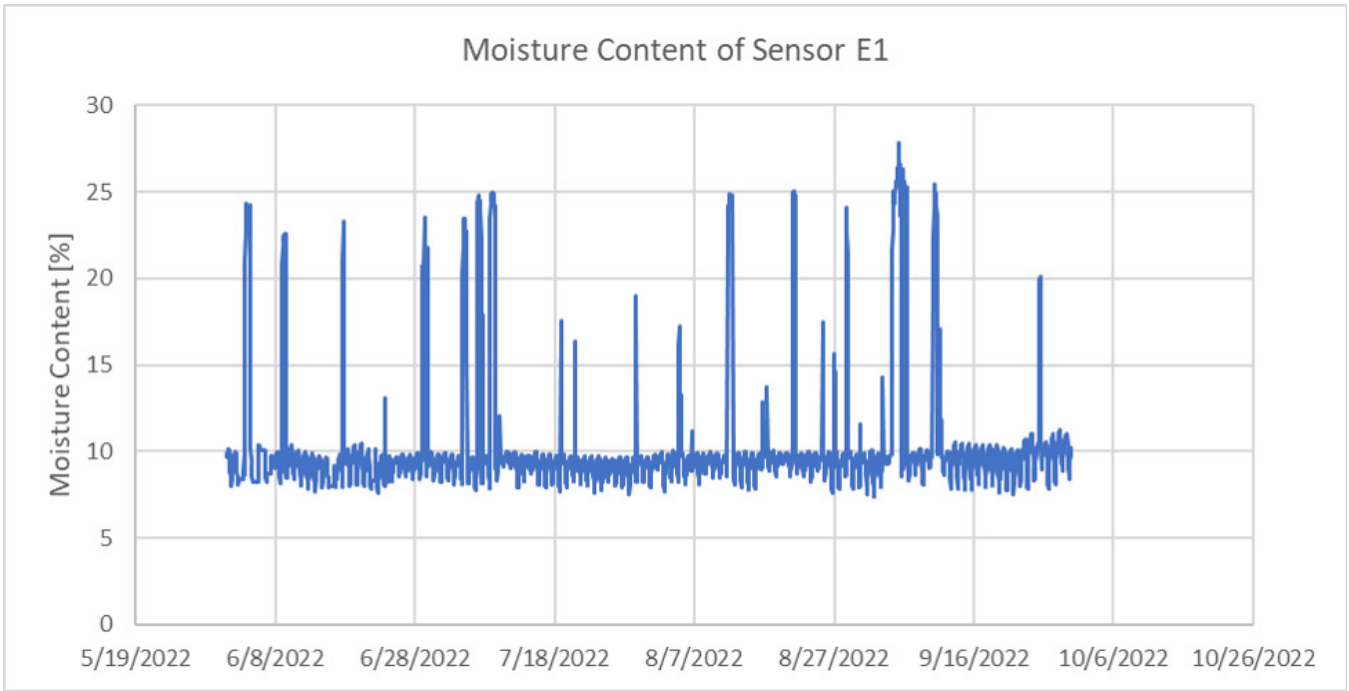


Figure 2: Example of moisture time history from sensors placed inside CLT panels

Ongoing Research: Enable the Use of Mass Timber Products for Non-Residential Buildings in High-Velocity Hurricane Zone

By Sovanroth Ou

Figure 1. CLT specimen during the cyclic test.

Florida is one of the areas prone to hurricane hazards. The International Building Code (IBC) is a model building code for the US. It governs the wind design requirements for all regions designated as wind-borne debris regions. In Florida, stricter requirements apply to regions with high hurricane wind speeds, referred to as High-Velocity Hurricane Zone (HVHZ). To use Cross-Laminated Timber (CLT) in educational and commercial buildings in Florida, it must be evaluated and meet Section 1626 of the Florida Building Code (FBC). This project aims to qualify the use of CLT in HVHZ by conducting the necessary tests.

The two required experimental tests are (1) large debris impact tests, and (2) followed by cyclic wind pressure tests. The CLT panel dimensions selected for this project are 4' by 8' which fits nicely with the pressure chamber for the cyclic test, shown in Figure 1. The specimen is first impacted with a 2x4 lumber missile, traveling with a speed of more than 54.5 mph, to simulate the impact from wind-born debris (Figure 2) and followed by cyclic wind pressure tests with a maximum pressure of 117 psf. The results from a preliminary test show the highest indentation depth of 0.50" during the impact test and a maximum deformation of 0.62" during the cyclic test with little to no permanent deformation.

Figure 2. CLT specimen during the impact test.

Completed Research: Investigation of the Lateral Behavior of Cantilever Cross-laminated Timber Diaphragms

By Bibek Bhardwaj

Cross-laminated timber (CLT) shows great potential as a construction material. CLT has been recognized as a versatile material with which major components of a structure such as walls, floors and roofs can be built. As public interest in CLT grows, the quantification of its strength and stiffness properties, along with the understanding of its performance in a structural environment, becomes indispensable. The goal of this research was to quantify the in-plane strength and stiffness properties of CLT diaphragms through (1) full-scale testing and (2) computer modeling. The methodology adopted for this research is listed as follows:

1. Destructive tests were carried out on two full-scale 20 ft. x 20 ft. CLT diaphragms using a displacement-controlled cyclic loading protocol. The test results revealed that the ultimate capacity of the diaphragm exceeded the LRFD design capacity by a factor close to two which met the target ultimate-to-design strength ratio aimed in the latest US wood design code (National Design Specifications (NDS) for Wood Construction). The ductility of the diaphragm assembly was observed to be governed largely by the ductility of metal dowel connections (i.e. nails and screws) while the CLT panels acted mainly as rigid elements. The diaphragm also demonstrated a 'deep beam' effect, with significant strain observed on the extreme panels with little to no contribution from the inside panels.

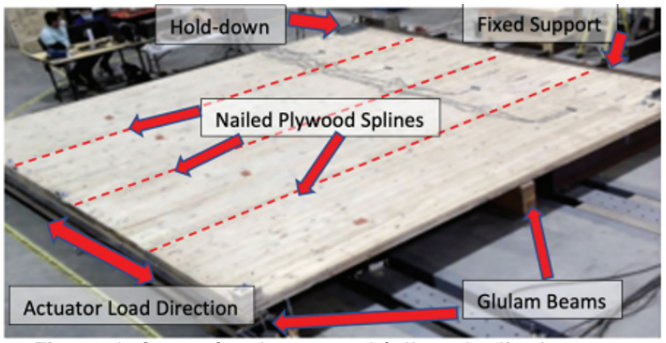


Figure 1: Setup for the second full-scale diaphragm test

2. The NDS code outlines four different deflection mechanisms for diaphragm deflection, namely: panel bending, panel shear deformation, slips in dowel connections (nails and screws), and rocking. According to the current NDS code, the bending and shear deformations of panels are the two greatest contributors to the overall diaphragm deflection. Observations made during the test strongly suggest that slips in dowel connections and rocking contributed the most to the overall deflection of the tested diaphragms.

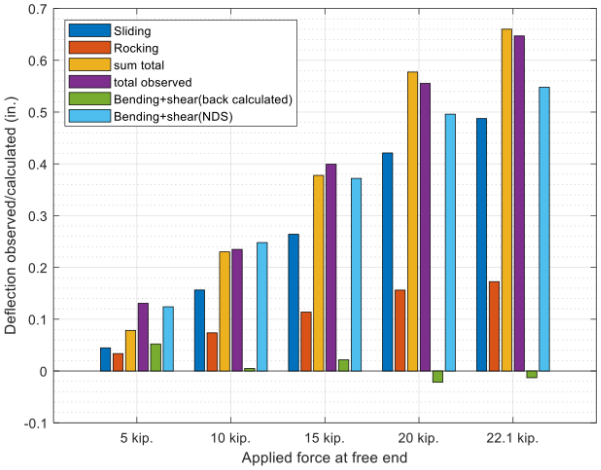


Figure 2: Contributions of different mechanisms to diaphragm deflection

3. Numerical models for diaphragms have been developed that can reasonably replicate the behavior observed during the actual tests. The connection parameters for the models were obtained through small-scale connection tests done at the fastener-level for the different fasteners used to construct the test diaphragms. The models are currently being utilized to predict the behavior of a wide range of diaphragm assemblies with varying layouts, fasteners and connection types.

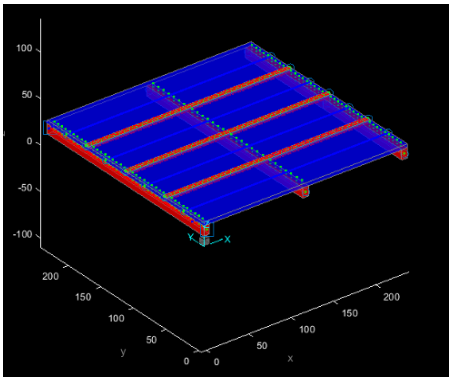
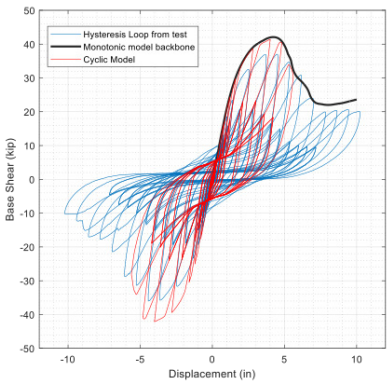


Figure 3: (a) Numerical model for the second diaphragm



(b) prediction made by the numerical model

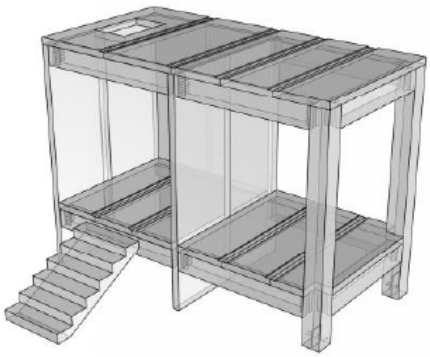
Outreach

Tours

WoodWorks Regional Staff (February 3)
Keeping Forests Annual Meeting (April 5)
Forest Resources Association SE Regional Meeting (April 26)
Auburn College of Forestry & Wildlife Sciences tour for Clemson faculty & students (April 29)
Forest Tour for Timber Design Faculty Development Workshop (May 19)
Dr. Myron Floyd, Dean of the College of Natural Resources, NC State University (May 26)
Southern NAUFRP Deans and Chairs (June 6)
DPR Tour, Charlie Walls and Scott Brown (June 27)
SC DNR tour (September 27)

Mass Timber Structure Training Program

WU+D and the Nieri Family Department of Construction Science and Management (CSM) are developing an active training program for mass timber construction in conjunction with WoodWorks –Wood Products Council (WW). WW will provide the materials needed to construct and deconstruct a mass timber structure at Clemson's Experimental Learning Yard.



Mass Timber Structure Mock-Up

The structure will be used by CSM students and contractors in the region for training employees and subcontractors on mass timber construction. Trainings in the actual installation process can be paired with tours of existing buildings on campus such as The Andy Quattlebaum Outdoor Education Center and the Samuel J. Cadden Chapel, as well as buildings that may be under construction on campus or in the upstate area to provide an excellent training scenario for contractors and subcontractors at all levels within the construction industry.

2022 Forest Products Summer Camp

WU+D Director Pat Layton led the Clemson University 2022 Forest Products summer camp, which includes tours of the forest products industry of South Carolina, emphasizing those products and processes of some distinction or special interest. The camp is part of Clemson's Forest Resource Management curriculum, which is accredited by the Society of American Foresters and provides a strong program in the basic knowledge and skills required of a professional forester.

Timber Design Faculty Development Workshop

From March 16-19, Clemson welcomed a total of 20 Architecture faculty members from among 18 different universities around the United States to participate in an in-person, hands-on workshop addressing a range of topics relating to mass timber design and building, while focusing on strategies for incorporating this subject matter into teaching, research and outreach. The workshop was led by an experienced panel of presenters including: Professors Dustin Albright, Dan Harding, Pat Layton, Weichiang Pang and Michael Stoner from Clemson's WU+D Institute, plus Shawna and Chris Meyer from the University of Miami School of Architecture and its Littoral Urbanism Lab and Edward Becker from Virginia Tech's School of Architecture + Design.

The 3.5-day workshop included five sessions aimed at equipping attendees with examples of successful studio course projects, effective cross-disciplinary collaborations, creative partnerships with industry, plus discussions of curricular and program structures, among other topics. Additionally, the workshop included tours of both mass timber buildings on Clemson's campus (the Samuel J. Cadden Chapel and the Andy Quattlebaum Outdoor Education Center), plus visits to our Built Environment Lab, the Clemson Outdoor Lab (and Experimental Forest) and Lee Hall (home to Clemson's School of Architecture). Travel, lodging and meals for all attendees were covered by the grant from the Softwood Lumber Board.

More information, including testimonials from some participants, can be found at the following webpages:

Timber Design Faculty Development Workshop Webpage

LinkedIn Story

Grants & Contracts

New for 2022

Clemson University received an ARPA-E award as part of the Harnessing Emissions into Structures Taking Inputs from the Atmosphere (HESTIA) program. As part of this grant, an entirely wood "mass timber" floor system for buildings will be developed and demonstrated. The system will extend the capabilities and market advantages of mass timber and will address opportunities and challenges throughout the entire building lifecycle, from design and construction, through occupancy and operation, and eventually to end of life of (or future life of) materials. To promote widespread implementation, the floor system will be designed to fit within existing design, construction and building code constraints. Construction plans, design guidance, performance information and education materials will also be created to promote implementation. Full-scale components and specimens will be physically built and tested to evaluated structural safety, day-to-day structural performance, acoustic performance and viability of de/re/construction (d/r/c). In the United States, buildings are often demolished even though they are still in functional condition. By designing for d/r/c, the proposed system will allow building components to have a second life instead of demolition and disposal. The floor system will contribute towards the ARPA-E missions of reducing greenhouse gas (GHG) emissions and maintaining US scientific leadership. Carbon stored in the timber floor (and taken out of the atmosphere) will offset carbon emitted during production and construction of other building materials. The forest products industry in the US has an annual impact of over $200 billion; technology developed through this project will help to support and grow the industry's scientific and financial base. The project brings together members from civil engineering, architecture and environmental engineering to conduct a full system design and analysis that aims to satisfy the proposed targets.

"An Entirely Wood Floor System Designed for Biogenic Carbon Storage, Adaptability, and End of Life De/Re/Construction." U.S. Department of Energy. Awarded Nov. 2022. Co-Investigators include Brandon Ross (PI), Weichiang Pang, Michael Stoner, Mik Carbajales-Dale, Dustin Albright and Dan Harding. Grant in the amount of $1,042,934 to investigate a novel long-span mass timber floor system with integrated MEP chases, all designed for disassembly and re-use.

"Timber Design Faculty Development Workshop." Softwood Lumber Board. Awarded Jan. 2022. Co-Investigators include Pat Layton (PI), Dustin Albright, Dan Harding, Weichiang Pang, and Michael Stoner. Grant in the amount of $50,000 to host 3.5-day workshop for architecture faculty on topics relating to teaching and researching mass timber design.

"The Clemson Mass Timber Structure Training Program." USDA Forest Service. Awarded Sept. 2022. Co-Investigators include Pat Layton and Mike Jackson. Grant in the amount of $128,093 to develop an active training program for mass timber construction. This will be done in conjunction with WoodWorks – The Wood Products Council.

“Mass Timber Reconstruction of a High-Profile Academic Building at Clemson University: Lehotsky Hall.” USDA Forest Service. Awarded Sept. 2022. Principal Investigator is Pat Layton. Grant in the amount of $250,000 will support funding for the mass timber engineering and Life Cycle Assessment (LCA) of a new mass timber building at Clemson University to replace Lehotsky Hall, home to several high-profile University environmental programs. This work will be used by WU+D to promote healthy working forests and the direct connection to mass timber and a more sustainable building future.

Ongoing

“An Integrated Housing Design and Logistics Operations Modeling and Analysis Framework for Hurricane Relief,” National Science Froundation, $399,999, (2021 - 2023).

“Enable the Use of Mass Timber Products for Non-Residential Buildings in High Velocity Hurricane Zone,” United States Department of Agriculture, Forest Service (FS), $249,999, (2019-2022).

“Development and Promotion of Mass Timber Noise Barriers for Highways,” United States Department of Agriculture, Forest Service (FS), $248,809, (2019-2022).

“Integrated Housing Design and Logistics for Disaster Relief,” USDA, Forest Products Laboratory, $50,000, (2019-2021).

“Full-scale testing of cross-laminated timber diaphragm in-plane shear and development of a design guide for practitioners,” United States Endowment for Forestry and Communities, $305,000, (2017-2022).

“Utilization of Cross Laminated Timber (CLT) in Low and Mid-rise Buildings for Enhanced Wind Performance,” United States Department of Agriculture, Forest Service (FS), $244,956, (2016-2021).

Completed in 2022

“Advancing Mass Timber Design and Education.” U.S. Endowment for Forests and Communities. Awarded, Nov. 2020. Two-year grant in the total amount of $370,000. Co-Investigators included Pat Layton (PI), Kate Schwennsen, Dustin Albright, Dan Harding and Weichiang Pang. Additional research support from Michael Stoner.

Publications & Presentations

Layton, P. 2022. Mass Timber Opportunities. Online presentation to Forest Climate Working Group. January 12, 2022.

Layton, P. 2022. Panelist, Southeastern Wood: Rising Prospects of Envelope Design in Hybrid Timber Construction. Panel at Facades + Atlanta Conference, presented by The Architect's Newspaper, February 25, 2022.

Layton, P. 2022. Panel Moderator, Mass Timber: Transformative Research and Applications for the Next Generation of Buildings. Facades + Atlanta Conference, presented by The Architect's Newspaper, February 25, 2022.

Layton, P. 2022. Mass Timber and the Forest. Presented at Mass Timber: Transformative Research and Applications for the Next Generation of Buildings. Facades + Atlanta Conference, presented by The Architect's Newspaper, February 25, 2022.

Layton, P. 2022. Ask For Wood: Mass Timber Opportunities and Modular Construction. Presented to Southern Group of State Foresters, Services, Utilization, and Markets (SUM) Committee. March 8, 2022. Via zoom. (in-person meeting in Oklahoma)

Layton, P. 2022. Ask For Wood: Mass Timber Opportunities and Modular Construction. Presented to SE Region Forest Resources Association, Patrick Square Inn, Clemson, SC. April 27, 2022.

Layton, P. 2022. Mass Timber Growth and Sustainability- Conference Wrap-Up. Presented at The Sustainable Future of CLT in the South: Grow. Design. Build. Sponsored by the College of Forestry & Wildlife Sciences. Auburn Univ, The Hotel at Auburn & Dixon Conference Center, April 28, 2022

Pat Layton presents at Auburn University

Redmond, L., Pang, W., Bothra, H., Heigel, A., and Layton, P, "Exploring the Use of Mass Timber Panels for Highway Noise Barrier," Proceeding of the 118th American Wood Protection Association (AWPA) Annual Meeting. Charleston, SC, May 15-17, 2022

Layton, P. 2022. Mass Timber and the Forest: A Sustainable Partnership. Presented at the Clemson Timber Design Faculty Development Workshop, May 19, 2022
Albright, D. 2022. Exploring Timber Building Systems for Deployable Recovery Structures: Modular and Kit-of-Parts Solutions. Presented at the CivilMeet2022 Conference, Munich, Germany, May 23, 2022

Leonard, J. "Rapidly Deployable Structures for Disaster Relief and Military Use", M.S. Thesis, Clemson University, August 2022

Layton, P. and M. Jackson. 2022. Workforce Development & Research Opportunities through Higher Education. Panel presentation at the 2022 Building Systems Housing Summit September 18 – 20, 2022 at The Starling Hotel Midtown in Atlanta, GA. September 19, 2022

Layton, P. 2022. Major Institutional Progress Report. Clemson University, Presented at the Mass Timber Research Conference, Madison, WI. September 20, 2022.

Layton, P. 2022. Panel Moderator: Breakthrough Technology in Urban Housing Solutions at the IWBC Conference Moscone Center, San Francisco, CA. November 2, 2022.

Layton, P. 2022. Keynote Panel Moderator: The Power of Designing Homes as a Consumer Product at the IWBC Conference Moscone Center, San Francisco, CA. November 2, 2022.

Media

Industry Publications

“Biden Administration announces $32 million to advance mass timber construction, expand wood markets”
USDA, June 10, 2022

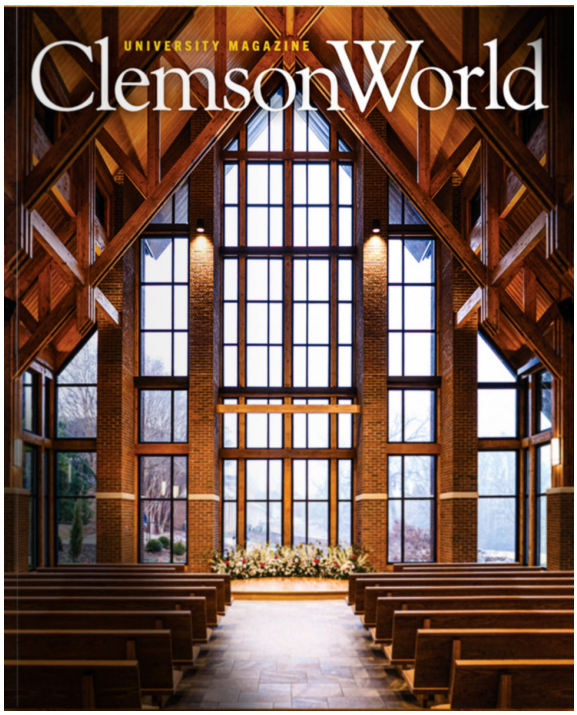
“Institutes Of Timber Learning Universities Accelerate Mass Timber Market Adoption,”
Miller Wood Trade Publications, May 2022

“Cooper Carry on Navigating Sustainability in Design,”
GB&D Magazine, January 5, 2022

Clemson University

“$2 million gift endows Clemson University Wood Utilization + Design Institute directorship,”
Clemson News, May 2022

“The Heart of Campus: The Samuel J. Cadden Chapel at Clemson,” Clemson World, Winter 2022



Members

Partners

Corporate Partners

www.clemson.edu/wud
Patricia A. Layton, Director
wudclemson@gmail.com