USDA Forest Products Laboratory

CENTENNIAL RESEARCH FACILITY

An Opportunity for Innovation

Centennial Research Facility

Greetings from the Forest Products Laboratory

As we embark on our second century of research at FPL, we are excited about the many prospects ahead. Innovation in response to market demand has been a hallmark of FPL progress since 1910. With new state-of-the-art facilities and expanded authority to work in cooperation with industry partners, we look forward to building strategic partnerships with others in private industry, academia, and government agencies.

Modern forest products research necessitates a highly technical approach. Our scientists and technical staff work in a wide range of science areas including researching and evaluating safe, durable, and energy-efficient housing; developing high-quality products from undervalued materials; and producing biobased energy to reduce America's dependence on oil and offset the effects of global climate change.

Many innovative research efforts now begin in our new Centennial Research Facility (CRF). The CRF houses three dynamic research work units: Engineered Composites Sciences; Durability and Wood Protection; and the Engineering Mechanics and Remote Sensing Laboratory. The details of equipment, capabilities, and research emphasis areas are outlined in this document.

I would also like to highlight new cooperative research and development opportunities.

The FPL has often entered into cooperative agreements with industry partners. Conducting collaborative research allows for leveraging equipment, expertise, and funding to achieve common goals. Expanded authority from the Federal government now allows for rental of Federal research space and equipment. Cooperative partners can also now sell limited quantities of prototype materials developed for market-testing purposes, whereas in the past regulations required that pilot-test materials be destroyed.

With these new authorities, we anticipate strong interest from many potential partners. Using our extensive facilities and collective expertise to cooperatively develop or refine pilot-scale materials and processes is the central intent behind this expanded authority. We invite you to contact us regarding partnership opportunities and to tour our new facilities.

Thank you for your interest and support as we advance into our second century of innovation.

Sincerely,

Chris Risbrudt

Director, USDA Forest Products Laboratory
Madison, Wisconsin USA

An Opportunity for Partnership

Seeking innovation in forest products research, FPL scientists are eager to explore emerging research needs. As we look to the future, it is clear that collaboration is key to developing new technologies and successfully turning research results into quality products. FPL values cooperative efforts with industry, academia, and other government agencies to maximize research results.

Under recently expanded authority from the Federal government, collaborating with the Forest Products Laboratory has never been more advantageous. ***Private start-ups or other entities needing expanded production resources can rent space and equipment at the FPL to pilot-test new products or process innovations.*** Partners will have access to FPL scientists and technical staff. In some cases, joint venture agreements for collaborative research are also appropriate. Additionally, materials produced through such cooperative agreements can be sold by our associates for the purpose of determining market value. By developing product prototypes without excessive overhead costs, and now being able to sell these products in limited quantities, associates can benefit more than ever by partnering with FPL.

Working with the Forest Products Laboratory presents new and exciting opportunities for developing innovative solutions to natural resource challenges. In the spirit of a new century of service to the Nation, we welcome all inquiries from viable partners.

For more information, please contact:

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Centennial Research Facility

Designed as a dynamic multiple-use laboratory, the 90,000-square-foot Centennial Research Facility (CRF) consolidates research activities, allowing for maximum collaboration between scientists and with outside partners.

The CRF houses state-of-the-art equipment for both the Wood Preservation and Durability and Engineered Composites Sciences work units, as well as the Engineering Mechanics and Remote Sensing Laboratory (EMRSL). It allows scientists to perform full-scale testing of wood-framed buildings, formulate new environmentally friendly wood preservatives, develop composite products in a manufacturing-friendly space, and test the durability of wood products with a one-of-a-kind weathering chamber.

Wood Preservation and Durability

New preservative treatment equipment allows for cutting-edge research in penetration and retention testing of new preservative formulations on commercially available and underutilized wood species.

Moisture Durability Laboratory

A weathering chamber simulates temperature, humidity, sunlight, wind, and rain to test various wall assemblies in a controlled environment.

Engineered Composites Sciences

Composites research focuses on developing highly engineered building products from low-value materials for production of wood- or natural-fiber based composites as well as wood–plastic composites.

Engineering Mechanics and Remote Sensing

The EMRSL provides input for building codes and design standards by conducting physical and mechanical testing and evaluation on a wide range of materials and building systems.

Durability and Wood Protection

Mission: Improving durability and wood protection through improved building design, advances in low-toxicity wood preservatives, and improvements in fire safety.

Wood is an aesthetically pleasing, versatile material and valuable renewable resource. Vulnerability to biodeterioration, moisture, and fire are noteworthy limitations to the expected long service life of wood and can result in significant economic and resource loss. One of the surest ways to extend the available timber supply is by improving the durability of wood in use.

Research Focus Areas

- Extending the service life of residential and nonresidential buildings through proper design and operation
  - Replacement of decayed wood resulting from moisture damage to homes consumes an estimated 10% of the annual U.S. timber harvest
- Developing wood treatments to improve durability of wood products without adversely affecting the environment
  - Almost 400 million cubic feet of preservative-treated wood is produced and consumed in the United States annually
- Formulating new sharply targeted inhibitors to protect wood products in service and prevent economic and resource loss from biodeterioration
  - Developing targeted preservative systems offers a way to control wood-degrading organisms in an environmentally responsible manner

Wood Preservation Treatment Plant

- Split system for water- and oil-based treatments
- Three circulation tanks heat and circulate chemicals to each vessel
- System of pans hold smaller samples within the vessels to
  - Heat and circulate chemicals
  - Reduce chemical use and allow treatment of sample volumes significantly below the full capacity of each vessel

Equipment and Capabilities

- Five pilot-scale pressure treatment cylinders
  - Water- and oil-based chemical treatments
  - Vessels hold 59, 170, or 940 gallons equivalent to 1,775, 3,500, or 13,050 pounds when filled
  - Temperatures up to 250°F with maximum pressure capabilities of 250 psi
- Three work tanks, which hold 280 to 1,500 gallons reaching 3,750 to 17,600 pounds when filled

Moisture and Durability Laboratory

Mission: The Chamber for Analytic Research on Wall Assemblies exposed to Simulated weather, or CARWASh, addresses the need for research on wind-driven rain intrusion in walls.

Moisture management research is a critical component for the development of durable, energy-efficient housing. This one-of-a-kind, custom-designed moisture testing facility permits realistic weather simulation in a controlled laboratory setting. The chamber offers realistic simulations of wind-driven rain impinging on full-scale wall assemblies.

Applications

- Program individual tests with weather data taken from any global location and set to run for weeks or months at a time
- Study wind-driven rain intrusion in walls and drying rates after wetting events
- Test window installations, flashing and cladding products, drainage/drying details, and water-resistive barrier products
- Study independent air temperature and humidity control on each side of a test wall with static or dynamic air pressure differences across the wall assembly
- Provide experimental data for validation of heat, air, and moisture transfer models
- Study the effects of air infiltration and exfiltration on moisture levels in walls

Dimensions

- Outdoor simulation chamber: 21 feet long, 18 feet wide, and 16 feet high
- Test wall assembly for a straight wall: 10 feet wide by 10 feet high

Simulation Parameters

- Weather data can be taken from anywhere in the world, as limited by wind speed or temperature (we're not simulating hurricane conditions or cold climates)
- We are interested in storm conditions producing wind-driven rain; coastal areas in the U.S. Southeast and Pacific Northwest are good examples

Temperature Range

- Outdoor chamber: 30°F to 110°F
- Indoor chamber: 60°F to 80°F

Humidity Range

- Outdoor chamber: 25°F dew point to 80°F dew point
- Indoor chamber: 30% Relative Humidity (RH) to 70% RH

Rainfall Range

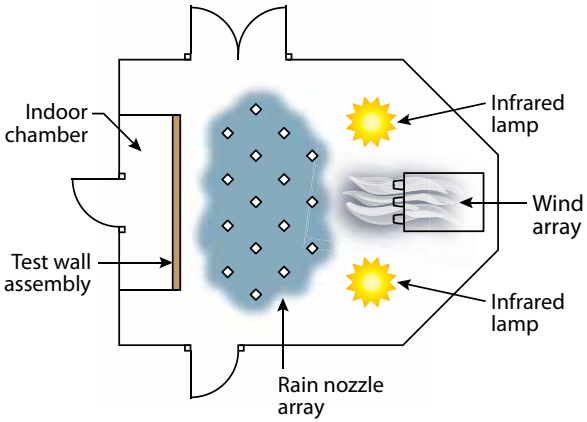
- 0.25 to 6 inches per hour

Infrared Intensity (Simulating Sunlight)

- 0 to 100 watts per square foot

Wind Speed

- 2 to 25 mph (gusting up to 55 mph for up to 5 seconds can be simulated by pressurization)



Engineered Composites Sciences

Mission: Understanding relationships between materials, process, and performance to engineer biocomposites that benefit users while promoting the sustainability of both virgin and recycled forest resources.

A composite product is a single material manufactured from two or more dissimilar materials. We define a composite as any wood material combined with a non-wood substance.

Research Focus Areas

- Understanding fundamental relationships between wood, natural fiber, and alternative materials to optimize composite processing and performance
- Improving the performance, durability, and value of existing composites while defining the next generation of hybrid composites made from natural fibers and alternative materials
- Developing tools to address resource sustainability, enhance recyclability, and minimize the environmental effects of composite processing
- The Engineered Composites unit uses naturally renewable wood-based materials to
  - Promote resource sustainability and recycling
  - Improve forest health by manufacturing high-value products from low-value resources
  - Provide improved value, service life, and utility to consumers
  - Improve economic health by promoting jobs in forest-dependent rural communities

Ongoing Research Includes:

- Value-added composite lumber and oriented strandboard (OSB) panels from waste biomass and small diameter wood
- Medium density fiberboard (MDF) from wood fiber, rice straw, and agricultural residuals
- Reactive extrusion of composites from wood-derived materials and polymers
- Microstructure evaluation to improve performance of polymer composites
- 3-D engineered fiberboard processing and optimization
- Destructive and non-destructive testing
- Understanding fundamental changes caused by weathering

- Microwave heating and pressing in a pressurized/vacuum environment
- Producing cellulose nanocomposites by breaking down wood fibers into their elementary nanofibrils then using those nanofibers to reinforce various composites

Equipment and Capabilities

The engineered composites science team has multidisciplinary strengths in physics, mechanical engineering, chemical engineering, and materials science.

Research examines the following products:

- Conventional wood-based composites
  - Plywood; OSB; particleboard; fiberboard; medium density fiberboard; hardboard
- Wet-formed composites such as 3-D engineered fiberboard
- Wood–thermoplastic composites
- Nanocomposites

Conventional Wood Composites

- 20- by 20-inch, 36- by 36-inch, 50- by 50-inch, and 26- by 104-inch hot-platen computer-controlled presses
- 4- and 8-foot drum blenders
- 2-foot by 8-foot wet-process former

Wood–Plastic Composites

- Twin-screw compounding extruder
- Single-screw profiling extruder
- Injection molder
- Thermokinetic mixer
- Torque rheometer

Nanocomposites

- Microcompounding and microprocessing system
- High-shear microfluidizer

Computer Simulation and Modeling

- Structural performance of wood-based panels
- Internal stresses and warping

Testing and Analysis

- FTIR (Fourier Transform Infra-red) microscopic spectrometer
- FT-NIR (Fourier Transform Near Infra-red) spectrometer
- Vertical Density Profiler
- Impact testing machine
- Universal testing machine
- Moisture analyzer
- Xenon-arc accelerated weathering apparatus

Engineering Mechanics and Remote Sensing Laboratory

Mission: To test and evaluate wood, wood products, and wood component specimens to determine their mechanical and material properties.

The Engineering Mechanics and Remote Sensing Laboratory (EMRSL) conducts physical and mechanical tests on a wide range of materials, building systems, and structures—from houses to transportation structures. Results inform the development of building codes and structural design.

Testing involves samples ranging from toothpick-sized to full structural beams (50 feet long) made of solid wood or combinations of wood fibers, plastics, adhesives, and metal.

Static tests can simulate snow loads or dead loads, while dynamic tests simulate seismic, fatigue, and wind loads.

The EMRSL uses desktop-sized testing machines, rated from 1 to 10,000 pounds, and stand-alone machines, rated from 60,000 to 130,000 pounds.

A strong floor and wall system allows researchers the ability to apply loads from multiple directions for full-scale testing of three-dimensional structures such as wood-framed building mock-ups up to 20 feet tall.

Equipment and Capabilities

Strong Floor

- 50 feet by 30 feet with anchor points at 2 feet on center, with 336 anchor points total
- 3-foot-thick concrete with 0.875-inch-diameter rebar at 8 inches on center both ways
- Top and bottom embeds for anchor points approximately 2 feet, 8 inches long
- 1.25-inch-diameter threadbar with 2-inch by 6-inch by 6-inch steel plate cast in concrete
- Compressive strength of 4,000 psi

Strong Wall

- 10 “H”-shaped blocks, 10 feet on a side and 2 feet high stacking to 20 feet high total
- 13 holes in each block for threadbar to fasten to strong floor anchor points
- Pull-out capacity of 75,000 pounds at each anchor point
- Maximum load capacity of strong wall with all 13 rods engaged at full 20-foot height is 50,000 pound horizontal load or 1,000,000 ft-lb moment

Other Features

- Strong wall sections each weigh 15,600 pounds
- Two 10-ton cranes that operate independently or synchronized
- High-pressure hydraulics
- High voltage
- Accessible by 18-wheel trucks

For more information on the Forest Products Laboratory, visit

www.fpl.fs.fed.us

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