

Mississippi State University

Introduction

Mississippi State University (MSU) is dedicated to serving the people of Mississippi and training its youth. Founded near Starkville, Mississippi, in 1878 as a land-grant institution, the state's largest university has since emerged as one of the nation's premier research and service universities.

With more than 16,000 students, 900 faculty members, and an alumni family of 90,000, the university has excelled in graduating men and women who have gone on to become state and national leaders in business and industry, government, education, and many other fields. Strong academic and research programs, skilled and talented students, and an energized and motivated faculty are bringing Mississippi State University into the 21st century as one of the top institutions in the Southeast.

Mississippi State University ranks 57th among public universities in total research and development expenditures (\$132.5 million, as reported by the National Science Foundation). It ranks 5th in agricultural sciences research and 34th in engineering research among both public and private universities in the United States.

Research Areas and Programs

MSU participation in housing research through the Coalition for Advanced Housing and Forest Products Research involves the Forest and Wildlife Research Center, College of Architecture, Bagley College of Engineering, and Center for Sustainable Design. A summary of key research areas within each of these units follows.

Forest and Wildlife Research Center

Housing research in the Forest and Wildlife Research Center's Department of Forest Products concentrates on durability issues related to biodeterioration and high-wind events. Prevention and control of agents causing wood deterioration—including decay fungi, subterranean termites, and beetles—have been significant parts of the Department of Forest Products research program since 1964. Study areas include the following:

- Testing and evaluating the efficacy of wood preservative systems
- Determining the utility of wood preservatives for protecting various building components
- Formulating new wood preservative systems

- Determining non-biocidal methods of preventing colonization of building components by fungi and insects

Causes of building failure during high-wind events and studies of advanced building materials to improve building performance are more recent additions to the Department of Forest Products research program. Ongoing research focuses on structural performance of the building envelope and lateral-force-resisting systems. Studies include the following:

- Observing building failures resulting from wind storms and tornados
- Developing methodology for high-wind and seismic design of shear walls
- Determining performance characteristics and biodegradation effects of sheathing-to-framing connections in shear walls
- Developing standard test methods for shear walls and computer programs for analyzing shear wall test results
- Evaluating a new engineered wood product utilizing small-diameter trees
- Developing test methods and equipment for evaluating mechanical properties of building materials

College of Architecture

The College of Architecture is currently conducting research in several housing-related areas. The Small Town Center (STC), located within the College, has been involved in developing well-designed, affordable, and energy-efficient regionally contextual housing. One research initiative is the development of a sustainable, energy-efficient manufactured home. Overall research for this type of housing addresses the basic structure and envelope, passive design issues such as natural lighting and ventilation, site design, materials, appliances and mechanical systems, flexibility, foundations, and computer-aided-design/computer-aided-manufacturing (CAD/CAM). Part of this research focuses on refining and using structural insulated panel systems (SIPs), which provide manufactured quality control, speed of assembly, and exceptional energy efficiency. The Center is also working on methods to improve the use of SIPs in conventional site-built housing.

The Jackson Community Design Center focuses on the design of housing for urban, inner city locations. The majority of these housing types incorporate a vernacular

style using wood frame and siding appropriate to their inner city context.

Bagley College of Engineering

The Bagley College of Engineering conducts housing-related research in three departments: Aerospace Engineering, Civil Engineering, and Mechanical Engineering. These departments conduct research in structural engineering and building systems engineering. For example, in the structural area, Civil Engineering has a unique laboratory where dynamic wind pressures are simulated. In building systems engineering, Mechanical Engineering conducts research on desiccant dehumidification equipment for building heating and cooling systems. Aerospace Engineering houses extensive composite materials testing and manufacturing research.

Center for Sustainable Design

The Center for Sustainable Design (CSD), residing within the Landscape Architecture and Biological Engineering Departments—College of Agriculture and Life Sciences, is actively involved in many aspects of creating sustainable landscapes for human developments. These landscapes are designed based on regenerative processes within the natural ecological system and include residential facility design. Research also focuses on regenerative technologies, including water harvesting, biological-based sewage treatment, food production, and shelter design using overhangs and passive heating and cooling.

Research Facilities and Capabilities

Forest and Wildlife Research Center

Research in the Department of Forest Products on the biological durability of building components is supported by microbiological, mechanical testing, and wood pressure treatment laboratories. Field test sites have been established near MSU and in south Mississippi; Gainesville, Florida; and Hilo, Hawaii. In cooperation with Louisiana State University, separate field test sites are also being established in south Louisiana and Mississippi, where it will be possible to conduct replicated studies to determine the susceptibility of building components to the Formosan subterranean termite, *Coptotermes formosanus*, and to study the influence of building design and construction techniques in determining the likelihood of a structure being colonized by *C. formosanus*. At least one test house will be constructed at each site. All the test sites are in American Wood Preservers' Association (AWPA) Deterioration Hazard Zone 5 (severe), except one located near MSU, which is in AWPA Hazard Zone 4 (high).

Facilities for studying the structural performance of buildings include the following:

- 460-ft² mechanical testing laboratory equipped with three universal servo-hydraulic testing machines, with capacities ranging from 5,000 to 50,000 lb, and a toughness test machine
- Machine and wood shops that allow in-house manufacturing of test setup components, fixtures, and specimens
- Four environmental chambers and one cold room (32°F) for conditioning small-size specimens to desired moisture contents prior to testing
- New laboratory (nearing completion) for mechanical testing of full-scale assemblies and components (such as shear walls, diaphragms, large beams), including large environmental rooms for conditioning full-size specimens

Construction of a demonstration house is planned adjacent to the Department of Forest Products. This demonstration house will feature designs and construction techniques recommended for warm, moist climates common to the Southeastern United States (AWPA Deterioration Hazard Zones 4 and 5).

Outreach activities involve distance education, short courses and seminars, publications, and news releases. Technology transfer and dissemination of information is by peer-reviewed publications, patents, and news releases. The Forest and Wildlife Research Center has approximately 40 publications available on-line, with approximately 1,000 copies downloaded each month.

College of Architecture

The Small Town Center and the Jackson Community Design Center both provide outreach to small communities and to inner city neighborhoods. They work with the Mississippi State Extension Service to help bring these design services to the communities. The College has a 2,000-ft² shop and fabrication area to build mock-ups and test components.

Bagley College of Engineering

The Departments of Aerospace and Civil Engineering are located in the Walker Engineering Laboratories Building on the campus of Mississippi State University; the Department of Mechanical Engineering is housed in nearby Carpenter Hall. These two buildings contain administrative, faculty, and student offices, classrooms, and teaching laboratories.

Structural research laboratories include a high-bay test facility serviced with an 8,000-lb overhead crane. Equipment includes numerous universal testing machines with capacities ranging from 6,000 to 600,000 lb, associated data acquisition systems, load cells, and displacement transducers. A special dynamic testing laboratory has the capability to apply a continuously varying (space and time) dynamic wind pressure. A wood shop and a machine shop, staffed by full-time engineering laboratory

technicians, aid in specimen construction and fixturing for experimental work.

The departments currently have access to three servo-hydraulic testing machines for fatigue and fracture testing, with the purchase of additional machines anticipated in the near future. Electron microscopes are operated at a central facility on campus. A recent National Science Foundation equipment proposal is being used to upgrade the electron microscopy facility with a high-resolution, fully analytical instrument. The field emission microscope will be equipped with a full suite of detectors for elemental and crystalline structural analysis.

Computational resources include numerous single and dual processor personal computer workstations. Finite element analysis is performed using several commercial software packages. If required, additional computational capabilities and software are available at the Engineering Research Center.

Center for Sustainable Design

The new Landscape Architecture Facility is the first sustainable development constructed for the State of Mississippi Building Commission. Facility plans feature a complex of three structures that have been designed for passive heating, natural day lighting, and passive cooling and include ground source geothermal systems. Plans also include water harvesting, creating potable water, and sewage treatment using rock reed technologies. The facility has received local and national recognition, and the Tennessee Valley Authority selected the site for a 17-kW photovoltaic demonstration facility. Tours of the facility are available and have already been enjoyed by many school and civic groups. The facility was programmed and its final design guided by the Center for Sustainable Design.

Links

- Mississippi State University -- <http://www.msstate.edu>
- College of Forest Resources -- <http://www.cfr.msstate.edu>
- Forest and Wildlife Research Center--
<http://www.cfr.msstate.edu/fwrc/fwrc.htm>
- Department of Forest Products--
<http://www.cfr.msstate.edu/forestp/fphome.htm>
- School of Architecture -- <http://www.sarc.msstate.edu>
- College of Engineering -- <http://www.engr.msstate.edu>
- Department of Civil Engineering --
<http://www.civil.msstate.edu>
- Center for Sustainable Design --
<http://abe.msstate.edu/csd/toc-csd.html>
- Landscape Architecture Department --
<http://www.msstate.edu/dept/la/index.htm>
- Biological Engineering Department --
<http://www.abe.msstate.edu>

Staff and Contact Information

Forest and Wildlife Research Center

- Dr. Terry Amburgey (tamburgey@cfr.msstate.edu), study of mold and decay fungi and wood-inhabiting insects to develop non-biocidal control procedures
- Dr. H. Michael Barnes (mbarnes@cfr.msstate.edu), effect of preservatives on wood properties and the field evaluation of preservative efficacy
- Dr. Darrel Nicholas (dnicholas@cfr.msstate.edu), formulation and testing of new preservative systems
- Dr. Tor Schultz (tschultz@cfr.msstate.edu), formulation and testing of new preservative systems

College of Architecture

- Dr. Larry Barrow (lbarrow@sarc.msstate.edu), manufacturing housing, CAD/CAM, digital technology
- Dr. Michael Berk (mberk@sarc.msstate.edu), sustainable housing design
- Dr. Jane Greenwood (jbrittg@sarc.msstate.edu), housing design and construction detailing to mitigate weathering and insect habitation effects
- Dr. David C. Lewis (dclewis@sarc.msstate.edu), housing design and construction

Bagley College of Engineering

- Dr. Shane Buchanan (shaneb@enr.msstate.edu), testing and evaluation of construction materials
- Dr. Harry Cole (cole@civil.msstate.edu), development of civil engineering design specifications and engineering education
- Dr. Christopher Eamon (eamon@enr.msstate.edu), finite element analysis of complex structures and reliability of structural systems
- Dr. Carl A. James (cjames@me.msstate.edu), air quality
- Dr. Dean Norman (norman@enr.msstate.edu), structural mechanics and response of structures to blast loads
- Dr. Ralph Sinno (sinno@enr.msstate.edu), hazard mitigation and timber structures

Center for Sustainable Design

- Dr. Tom Cathcart (tc@abe.msstate.edu), biological engineering, heat transfer related to insulation and wall and slab configurations, biological based sewage treatment systems
- Pete Melby (pm@ra.msstate.edu), landscape architecture, programming and sustainable design based on natural processes of regeneration and the indefinitely sustainable natural ecological system

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