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NEWSLINE Forest Products Laboratory

In Search of Sustainability

New Facility Aims for Net-Zero Energy and Water

By Andrea Ward, University of Wisconsin, Graduate Journalism Student

The Carriage House currently under construction at FPL is an example of how resource-efficient and sustainable technologies utilized in desert climates can also be applied in cold climates. Together, the Carriage House and FPL's Research Demonstration House represent residential architecture that approaches net-zero energy and water.

The Forest Products Laboratory (FPL) has joined forces with a research partner from the desert southwest to develop new techniques for wise residential water use in a cold climate such as Madison, Wisconsin.

FPL's Advanced Housing Research Center (AHRC) is getting ready to unveil the Carriage House, a project designed to demonstrate and test methods for achieving greater sustainability in residential water and energy use in colder climates.

"Anything we can do to improve the water re-use efficiency in cities will be related to forestry because we're taking pressure off the forest to deliver the water supply to a growing population, and also taking pressure off municipal water systems," said Martin Yoklic, a research scientist at the University of Arizona's Environmental Research Laboratory, who is the lead researcher on the project through the Coalition for Advanced Wood Structures (CAWS), a university, industry, and government partnership.

Located just a few yards south of the Research Demonstration House on the FPL campus in Madison, Wisconsin, the Carriage House will resemble a detached two-car garage. The sustainable energy and water systems housed inside will supply the Research Demonstration House, modeling how similar systems could be incorporated into a typical residential dwelling to achieve a net-zero energy and water demand.

The unfinished Carriage House still blends in with its snowy surroundings, but in early summer it is scheduled to open its doors to the public. When it is completed, visitors to the Carriage House will be able to see a variety of systems in action, all of which are designed to increase the resource sustainability of residential buildings.

Rainwater Harvesting and Management

Rain that falls on the roofs of the Carriage House and the Research Demonstration House is collected in a variety of ways, from the simple and traditional to the complex and cutting-edge.

The most traditional of these systems are simple rain barrels, outfitted with a tap for watering yard and garden plants and located just off the front porch of the house.

The systems for collecting and managing water that will be piped to the interior of the house grow more complex according to the standard of cleanliness demanded by the purpose for which the water will be used.

Inside the attached garage of the Research Demonstration House, a 300-gallon tank collects the rain that falls on one side of the garage roof. The water from this tank is pressurized by a demand pump and plumbed throughout the house, where it is used only for flushing toilets and washing clothes, saving the consumer the cost and the municipality the expense of treating water used for tasks that do not require potable water. It is equipped with automated switching, which taps into the municipal water supply if the water in the tank falls below a certain level.

Back in the Carriage House, the most elaborate of the rainwater harvesting systems collects, stores, filters,

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Check out our website at http://www.fpl.fs.fed.us

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Upcoming Events

Smallwood 2008 and Bioenergy & Wood Products Joint Conference: Cutting Edge Technologies to Optimize Utilization of Smallwood and Woody Biomass

May 13–15, 2008—Monona Terrace Convention Center, Madison, Wisconsin, USA. This conference provides state of the art information on small-tree utilization and foster peer-to-peer learning. An international slate of speakers including researchers, material and equipment suppliers, manufacturers, and end-users will attend. http://www.forestprod.org/confsmallwood08.html.

The Department of the Interior in cooperation with the National Association of Conservation Districts is making a limited amount of financial support available to assist with registration, travel, and lodging for the conference. The primary intended recipients are local officials from conservation districts, RC&Ds, and counties. For more information and scholarship application forms, please access the following internet connection http://www.forestprod.org/smallwood08scholarships.html.

2008 International Conference on Nanotechnology for the Forest Products Industry: Nanotechnology from Research and Development to Application

June 25–27, 2008—Hyatt Regency Hotel, St. Louis, Missouri, USA. This conference provides (1) a forum for showcasing new equipment, services, and materials to the forest products industry and community (2) meeting and engaging industry leaders and innovators, developing collaborative relationships within the forest products sciences community, providing input in research and development directions and technology development and, (3) gaining knowledge of the current priorities and state of the art nanotechnology in the forest products sector.
http://www.fpl.fs.fed.us/notices/events/2008jun25-27--nanotechnology-for-forest-products-conference.pdf

10th International Conference on Progress in Biofibre Plastic Composites

May 12–13, 2008—Toronto Airport Renaissance Hotel, Toronto, ON . This conference provides the latest developments in the science, technology, economics and applications of biofibre plastic composites. The conference will include technical and poster presentations, discussions, and tabletop exhibits, as well as ample opportunities for networking with friends & colleagues from around the world. The following major topics will be covered: materials, processing technologies, design and performance issues, marketing/ distribution, and many other special issues.
http://www.biocomposites-toronto.com/fees-reg.html

and purifies water for potable household uses, including drinking. Rainwater will be diverted from the rooftops and stored in a 2,400-gallon cistern buried beneath one bay of the Carriage House, passing first through a series of gutter filters meant to keep out leaves and larger debris. Inside the carriage house, the downspout leads to a "foul flush" container that captures and diverts the first wave of rainfall, which often contains dust, bird droppings, and other undesirable substances if several dry days have passed between periods of rain.

Belowground in the cistern, the water clarifies further as suspended particulates settle out and the cold, dark environment begins to eliminate some of the organics in the water. The water is pumped out of the cistern through a series of filters, each designed to remove smaller and smaller particulates; through a charcoal filter that absorbs residual minerals such as lead; and finally through a UV purifier that disinfects the water of any microorganisms that remain. From there it is piped over to the Research Demonstration House, ready for household use.

At the Research Demonstration House, both the filtered/disinfected rainwater and municipal water source are connected to the household water distribution system so that either system can be used. This valved connection also includes a back flow preventor on the municipal supply. This switch can be manually engaged in periods of low rainfall.

All the water systems have a mechanism for diverting excess or overflow rainfall into an underground leach field, irrigating the yard while preventing puddles and runoff.

With an average of 30 inches of rain falling on Madison each year, preliminary research indicates that the rainwater collection and management system could cut the average household's municipal water use in half, greatly reducing operating costs for both municipalities and residential consumers.

Researchers emphasize that the rainwater harvesting system, like the other sustainable systems, is meant to work in conjunction with an external water source, either municipal water or a private well. "We work under the premise that the municipal water supply will always be there as a default," says Yoklic. "Connection to the municipal supply is still an important component of the system, but if you build houses like this in the city, you can reduce demand on the city's water system substantively."

Renewable Energy—Passive and Active

The Carriage House makes use of radiant energy from the sun, both passively and actively. Combined with another component of FPL's wood-based renewable energy research, these techniques should generate a substantial portion of the energy needed in a typical household.

The orientation of the Carriage House and its windows is the key to its passive solar heating capacity. The south-facing wall is covered by two large windows made of double-pane clear glass (no low-E film) to allow the maximum of the sun's rays to pass through. An interior wall, painted black and placed just inches behind the windows, creates a "solar hot air collector," where radiant energy is trapped and transformed into heat. As the sunspace warms relative to the temperature inside the carriage house, a thermal comparator will activate a vent fan near the top of the wall to transfer the warm air into the carriage house. Two smaller vents near the floor at the outer corners of the sunspace wall allow

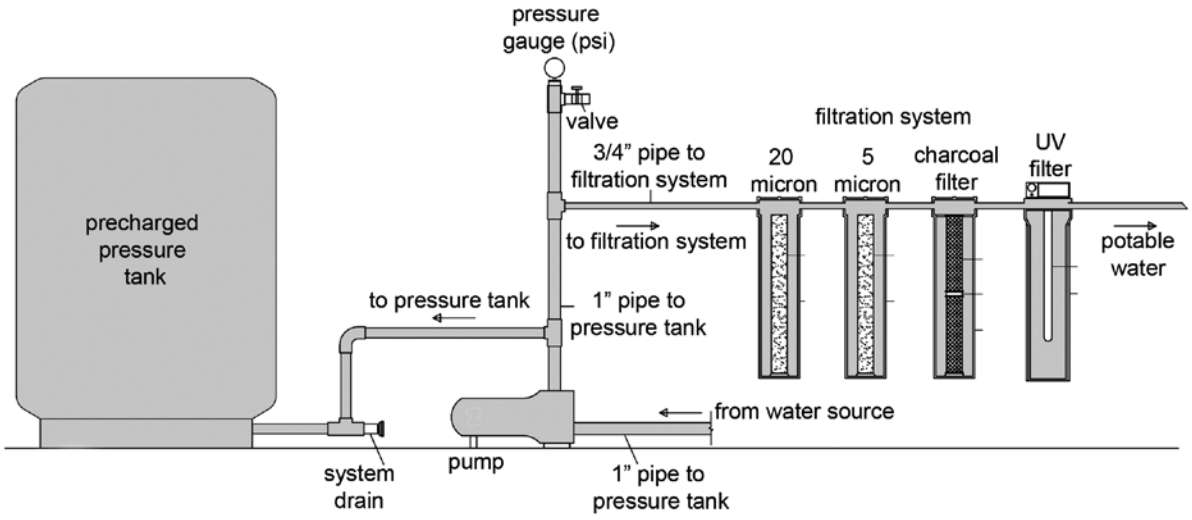

Diagram of water filtration system at the Carriage House.

(continued on pg. 4)

This interior wall, painted black and placed just inches behind two large windows, creates a "solar hot air collector," maximizing the passive solar heating capacity of the Carriage House.

The BioMax generator gasifies wood pellets to produce electricity cleanly.

cooler air from the carriage house back into the sunspace to be heated again. A second thermal comparator turns on a ceiling fan when the air near the ceiling is 5 degrees above floor temperature. Four 2- by 4-foot windows in the wall of the sunspace provide daytime lighting.

This passive heating system, researchers emphasize, can provide supplemental warmth, but would not be enough to heat an entire house in the wintertime. Its intent is to keep the Carriage House warm enough that the water systems would not freeze and comfortable enough to work in for shorter periods of time.

The south-facing roof of the carriage house will be covered by 3 kW of photovoltaic panels to convert solar radiation into electricity. Yoklic notes that a photovoltaic array of that capacity can supply most of the "plug-load" demand (including lights and appliances, but not heating or air-conditioning) for the typical household.

The desire to model a variety of strategies for renewable energy generation and the availability of extra space in the carriage house created the opportunity to test another component of FPL research: a 5-kW "BioMax" generator, which gasifies wood pellets—a highly renewable forest product—at such high heats (1,700–2,000°F) that it produces hydrogen and carbon monoxide, which fuel a piston engine generator to produce electricity cleanly.

"The average household might use an average of 800 W of electricity continually, so they might run the BioMax four hours a day if they were using it for all their electrical needs," said Mark Knaebe, Forest Products Technologist at FPL. In a house with newer appliances and compact fluorescent bulbs, on the other hand, Knaebe estimates that the BioMax might need to be run for only four hours twice a week to offset electrical demand from the local utility.

Both renewable energy systems offset household costs of buying energy from a utility company, and because both are on a "grid-interconnect" system, both use the grid, rather than batteries, for storage. Metered separately, the energy generated by the BioMax system runs the house's electric meter backwards, whereas the solar energy from the photovoltaic system can often be sold to the utility through rebate programs at up to double the purchasing rate under a variety of renewable energy incentive programs that vary state by state.

Sustainable Forest Products

Rather than using conventional lumber and framing techniques, researchers elected to frame the Carriage House with small-diameter roundwood and to use roof decking of the same material. Small-diameter logs are often a byproduct of the forest management practice of thinning out small trees and underbrush to combat devastating forest fires, but these whole small-diameter logs or other products made from those logs have not found many marketable uses. "We're adding value to materials that were considered undesirable," said Knaebe, noting that the roundwood framing has an esthetic quality absent from conventional framing that many consumers might find valuable.

Other building materials developed through FPL research that will be modeled in the carriage house include the siding, which is a wood–plastic composite made from sawdust, wood waste, and recycled plastic milk jugs.

After the carriage house opens in early summer, the real work of testing the sustainable methods will begin. "This will be a work in progress long after the building is finished," said Knaebe. "We're learning from experience as we go."

Yoklic concurs, noting that many of the systems may be years away from economic viability and market acceptance on a large scale. But the purpose of the project is to bring that day closer, and the price and availability of resources—particularly water and energy—may play a role in determining that as well.

"We're in the process of showing how it can be done, what the systems look like, how they perform, and the capacity of the materials to do the work," said Yoklic. "As we move into the future … and demand on resources increases, we will see more and more interest in these sustainable technologies."

Spotlight on Partnerships

By Rebecca Wallace, Public Affairs Specialist

A current Iowa State University research project involves a needs assessment for advancing timber utilization in mainline and short-line railroad applications.

Forest Products Laboratory (FPL) researchers have a long history of successful partnerships with a vast array of organizations, from industry to academia, non-government to government organizations, tribes to trade associations. Combining ideas, skills, expertise, lab facilities, and equipment with various partners has expanded our capabilities—and those of our partners—to everyone's benefit. Here is one example of long-standing, productive partnership between FPL and academia.

Iowa State University Bridge Engineering Center

The Bridge Engineering Center (BEC) at Iowa State University was established in 1986 and is now a part of the Center for Transportation Research and Education. The mission of the BEC is to conduct research on technologies to help bridge designers and owners design, build, and maintain long-lasting bridges.

According to BEC Director Terry Wipf, the Center's primary research focuses on four areas:

- Field testing and monitoring the structural health of bridges
- Monitoring and evaluating bridge construction and performance
- Designing and evaluating low-volume bridges
- Strengthening and rehabilitation of bridges

The Bridge Engineering Center has had a longstanding partnership with the Forest Products Laboratory for over 20 years. One collaborative project focused on evaluating glued laminated bridges. Bridges throughout the United States were tested to establish structural performance characteristics. The test results were used to help in validating and developing bridge design specification for wood bridges.

A cooperative research project with Iowa State University involved remote monitoring of historic covered timber bridges in Madison County to prevent arson and vandalism.

A current collaborative effort is focusing on developing "smart timber structure" technology, which involves placing sensors in or on newly constructed wood bridges, enabling continuous monitoring and evaluation of the long-term performance of bridge components. A better understanding of typical in-place behavior will lead to improved bridge durability.

Partnership efforts between FPL and the BEC have mainly focused on improving the national bridge infrastructure. "We believe that this partnership has had a positive impact at the national level, particularly with the creation of national design standards and design specifications for wood bridges," says Wifp.

Ask FPL

We get thousands of inquiries each year. We print what we feel are some of the best questions. Here is one we recently received.

Questions?

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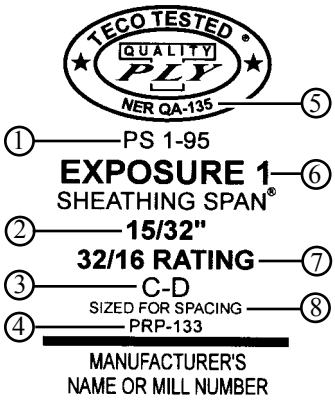
I've always been interested in the stamps used to identify different grades of lumber and panel products. Can you explain what information they contain??

By Rebecca Wallace, Public Affairs Specialist

Although it's called a grade stamp, the marking you see on lumber and panel products contains much more information than just the grade. Other elements of the marking can include the moisture content of the product, the manufacturer's mill number, the size of the product, the species of wood, or the identifying mark of the agency that certified the product.

To get a better understanding of what can be learned from grade stamps, take a look at these examples and the explanation of their main components:



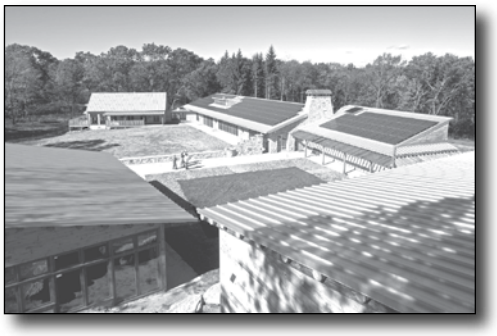
1) Identified the product standard that governs the specifics of production for construction and industrial plywood
2) Nominal thickness of the panel (subject to acceptable tolerances)
3) Panel grade designation—This indicates the minimum veneer grade used for the face and back of the panel, or it can be a grade name based on panel use.
4) Performance-rated panel standard, identifying a structural-use panel test procedure recognized by National Evaluation Service (NES)
5) NES report number from the Council of American Building Officials
6) Exposure durability classification—Exposure 1 indicates this is an interior panel with exterior glue suitable for uses not permanently exposed to weather.
7) Span rating indicating the maximum spacing of roof and floor supports for ordinary residential construction applications
8) This label denotes panels that have been sized to allow for spacing of panel edges during installation to reduce the possibility of buckling.

1) Moisture content–heat treatment—In this case, S–DRY indicates a moisture content of 19% or less.
2) Product grade, shown by number, name or official abbreviation
3) Species or species grouping
4) American Lumber Standard supervisory agency logo indicates product has been graded under the supervision of an accredited American Lumber Standard Committee agency.
5) Mill name or a unique number assigned by the grading agency

Lumber grade stamp and information courtesy of the Northeastern Lumber Manufacturers Association.

Aldo Leopold Legacy Center: As Green as it Gets

By Rebecca Wallace, Public Affairs Specialist



The Aldo Leopold Legacy Center, still under construction when it was featured in the Winter 2007 edition of NewsLine, was completed in June 2007 and has since received LEED Platinum certification and the highest ranking yet awarded from the U.S. Green Building Council, making it the greenest building in the world.

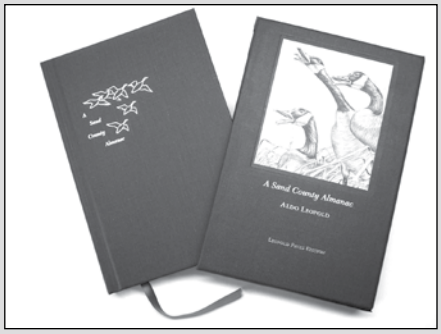
Located just one mile from the famous Leopold shack near Baraboo, Wisconsin, the Legacy Center was built to the highest standards of energy efficiency and sustainability. Operations at the Center are carbon neutral due to the integration of energy efficiency, renewable energy, and sustainable forestry.

The Aldo Leopold Legacy Center is also a "net zero energy" building—annual building energy demand is matched by the output of clean, renewable energy on site. The Center will produce approximately 115% of annual building energy needs; in fact, in the first few months of operation, the Aldo Leopold Foundation actually earned money by selling energy back to the local utility.

Forest Products Laboratory (FPL) researchers, along with the State and Private Forestry Technology Marketing Unit (TMU), lent technical assistance to the project through their expertise in small-diameter roundwood construction. Pine trees planted by the Leopold family were harvested in the interest of improving forest health and, with FPL's and TMU's help, were used in round form in the stewardship workshop, entrance foyer, exhibit hall, and office area.

Due in part to the use of site-harvested materials in the construction process, the Center was also awarded the Forest Stewardship Council's (FSC) "Designing and Building with FSC Award," which recognizes building projects that have furthered responsible forest management through their use of FSC-certified wood products. A total of 78% of the wood used in the building was FSC-certified, and of that amount, 92% was site-harvested and locally produced.

For more information on the Aldo Leopold Legacy Center, visit www.aldoleopold.org/legacycenter



A Sand County Almanac: Special Leopold Pine Edition

Thinning the Leopold pines for use in the construction of the Legacy Center also resulted in treetops and other materials not suitable for building. With assistance from the Forest Products Laboratory and the UW–Stevens Point Paper Science Laboratory, these materials were used to produce pulp for the creation of archival-quality paper. Now, for the first time, Leopold's classic is printed on this very paper, made from pines the family planted together in the 1930s and 40s. The Leopold Pines Edition is a hardcover facsimile of the first edition of *A Sand County Almanac* printed in 1949, featuring a new introduction by Leopold's surviving children, archival photos of Leopold at the "Sand County" farm, and an afterword telling the story of the Leopold pines. *A Sand County Almanac: Special Leopold Pine Edition* is available at www.aldoleopold.org.

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IN THIS ISSUE *Winter 2008*

WOOD YOU BELIEVE...

The top five recreational activities done in national forests include viewing natural features, general relaxation, hiking, viewing wildlife, and driving for pleasure.

There are over 4,300 campgrounds and 122,000 camp sites available for public use on national forest lands.

There are over 134,000 miles of national forest trails for recreational activities.

http://www.fs.fed.us/recreation/programs/facts/facts_sheet.shtml