Olympic Oval. Courtesy of FII.

Can Using More Wood Reduce Your Environmental Footprint?

By Roxane Ward

Building designers have long recognized the influence they have in addressing the world's most pressing environmental issues. In the late 1970s, the oil crisis helped to initiate what has now been 30+ years of increasing energy efficiency. Today, concern about climate change is resulting in a similar focus on carbon dioxide (CO_2). However, while buildings in the United States account for approximately 39 percent of the country's energy consumption and contribute 38 percent of its CO_2 emissions, there is growing awareness that material choices also factor greatly – and that wood, in particular, can have a positive impact on a building's environmental footprint.

Carbon Absorption and Storage

"The fact that wood is the only major building material that's renewable and sustainable is just part of the picture," says Dwight Yochim, national director of the WoodWorks program, which provides education and technical support to engineers and architects designing non-residential wood buildings. "Sustainably managed forests such as those in North America, and the products made from those forests, also have the potential to play a significant role in addressing climate change."

As a tree grows, it absorbs CO_2 from the atmosphere, using the carbon (C) for growth and releasing the oxygen (O_2). "That's as much as most people think about," says Yochim. "But wood is about 50 percent carbon by weight and wood products continue to store this carbon indefinitely. In a building, for example, it's stored for many decades. But wood buildings are also easily adaptable and it's becoming increasingly common to see the wood reclaimed for other uses – so the carbon is actually kept out of the atmosphere considerably longer."

According to the research firm Dovetail Partners, Inc., the amount of carbon stored in U.S. wood products is about 3.5 billion metric tons (including landfill sites). However, more important from a climate change perspective is the cumulative impact over time. Each year, new wood products represent an estimated 60 million metric tons of additional stored carbon. Most of this is in the nation's housing stock, so assuming that more homes are built than dismantled, and adding any increase in non-residential wood buildings, the amount of stored carbon can be expected to grow considerably.

Given that wood is made using the sun's energy, greenhouse gas emissions are also avoided when wood is used in place of materials which require large amounts of fossil fuels to manufacture. For example, although cost and speed of construction were the reasons that HMC Architects chose wood as the main framing and structural material for Harada Elementary School in California, the building includes more than 23,000 cubic feet of wood, which stores an estimated 490 metric tons of carbon and is responsible for another 990 metric tons in avoided CO_2 emissions. The 2010 Olympic Speed Skating Oval in British Columbia, which has a six-acre free-spanning wood roof, includes almost 135,000 cubic feet of wood, stores an estimated 2,940 metric tons of CO_2 and is responsible for avoided emissions of another 8,820 metric tons of CO_2.

Two things complete the cycle, says Yochim – the use of biomass as a carbon-neutral energy source and forest regeneration. "Forests absorb more carbon when they're young because that's when they're growing most vigorously. As they get older they absorb less, until eventually they start to decay and begin releasing their stored carbon back into the atmosphere. Obviously this doesn't mean that all forests should be managed for timber. North American forests can and should be sustainably managed to provide a full range of environmental, social and economic values. However, those that are managed for wood products help to reduce greenhouse gases in an endless cycle of carbon absorption and storage."

Choosing Materials Based on their Life Cycle Impacts

In terms of material choices, the green building movement is shifting away from a prescribed approach and toward the life cycle evaluation of actual performance, says Lisa Podesto, P.E., a technical director for WoodWorks and current chair of the Structural Engineers Association of Central California Sustainable Design Committee.

"A prescribed approach assumes that certain materials or practices are better for the environment regardless of the situation," says Podesto. "For example, some people might think that recycled

Forest regeneration. Courtesy of Sandy McKellar.

products are automatically preferable even though they may require a large amount of energy to produce and transport, and the alternate choice may be wood from a local, sustainably managed forest. It isn't that you shouldn't use recycled materials, just that other considerations may weigh more heavily on the product's life cycle environmental impacts, depending on the situation. It's important for designers to be able to assess the impacts of their choices."

To compare materials, life cycle assessment methodology, or LCA, has received strong support from the international scientific community and is increasingly being integrated into green building rating systems such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) system and the Green Building Initiative's Green Globes®. The process of analysis considers the environmental impacts of a material or assembly over its lifespan – from extraction and harvesting to manufacturing, transportation, installation, use, maintenance and disposal or recycling.

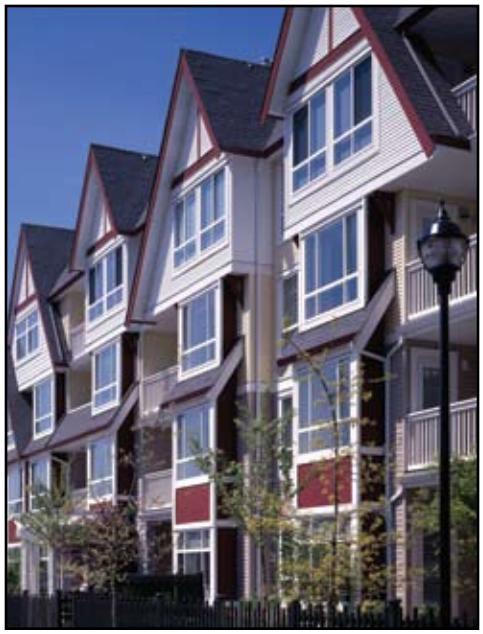
"It's an area where wood excels," said Podesto. "Using the scientific LCA approach shows that wood buildings are better for the environment than other materials in areas such as air and water pollution, greenhouse gas emissions and embodied energy. And the thing engineers need to know – because we're a sceptical bunch – is that apples-to-apples are being compared in LCA studies; wall systems with the same R value and floor systems designed to carry the same load."

Energy and Resource Efficiency

In the green building world, embodied energy has received less attention than operational energy because operational energy needs have been so proportionally high. About a third of the energy consumed in developed countries goes toward heating, cooling, lighting and the operation of appliances in non-industrial buildings. However, as buildings become more and more energy efficient, the significance of embodied energy will continue to rise because it will represent a larger piece of the overall energy pie.

At the same time, wood also contributes to operational energy efficiency. Because its cellular structure has air pockets that limit its ability to conduct heat, it's a better insulator than other materials – which have higher conductivity and must overcome lower R-values associated with thermal bridging. As a result, they require more insulation to meet the same level of thermal performance.

Along similar lines, the concept of advanced framing or optimum value engineering is gaining popularity – with engineers and as part of green building codes – because of its impact on energy and resource efficiency.



Multi-family wood structure. Courtesy of FII.

At a presentation to architects and engineers in California, Katy Hollbacher, P.E., principal of Beyond Efficiency, Inc. said key elements of advanced framing include optimizing the layout for efficient material use, using structural-rated wood materials to their full approved capacities, eliminating structural materials where non-structural materials are adequate and

reducing structural redundancies inherent with conventional stick framing. Among other things, she suggests laying the building out on a 2-foot module, which maximizes the efficiency of 24-inch framing and 4x8 sheet materials, sizing headers based on load, leaving open wall corners and using ladder framing at wall intersections.

More commonly used in residential and multi-family structures, this approach leaves more room for insulation and facilitates increased operational efficiency, while minimizing the amount of wood needed for a project and reducing waste – both of which contribute to efficient use of the resource.

Likewise, the wood industry has increased its own efficiency through optimized sawmill operations and the use of wood chips and sawdust (once considered waste) to produce paper and composite products, or as fuel for bio-energy. The North American wood industry now uses an average of 98 percent of every tree brought to a mill for harvesting.

Forest Sustainability

According to *State of the World's Forests* reports going back to the 1990s, the United States and Canada have about the same amount of forested land now as they did a century ago. Over the past 50 years, less than 2 percent of the standing tree inventory in the U.S. was harvested each year while net growth was 3 percent. In Canada, which is a significant exporter of wood products to American customers, less than one half of 1 percent of the managed forest is harvested annually and the law requires all areas to be promptly regenerated.

Wood is also the only major building material with third-party certification programs in place to verify that products come from a sustainably managed resource – an approach Yochim, who is also a Registered Professional Forester, would like to see adopted by other industries. "There is never going to be a time when sustainability is less important than it is today," he said. "The forest industry has embraced certification as a way to assure people that its practices are sustainable. Why shouldn't others do the same?"

Atlantic Station. Courtesy of APA.

The 2010 Olympic Oval made use of wood certified through the Sustainable Forestry Initiative (SFI) and Canadian Standards Association's Sustainable Forest Management Standard (CSA), and is seeking green building certification through both LEED and Green Globes.

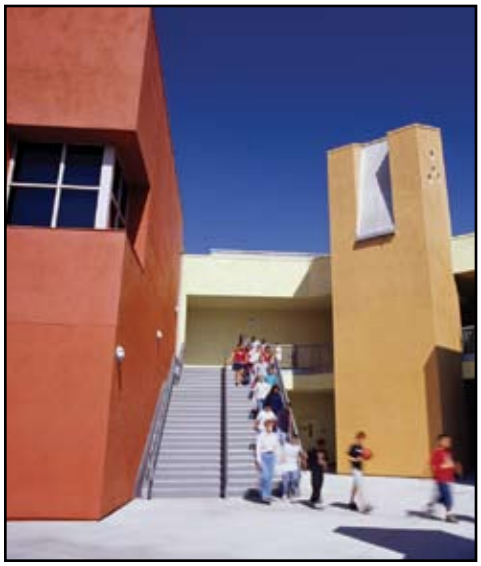
FSC-certified wood was used in the three buildings that comprise the Portola Valley Town Center, which include a town hall, community hall and library. The Center is expected to receive LEED platinum certification and was also chosen as an AIA Committee on the Environment *Top Ten Green Project* for 2009. "With this project, wood was a good material of choice," says Lynn Deutschbauer, S.E., a senior engineer with Forell/Elsesser Engineers, Inc. in California. "Sustainability was a high priority from the client's perspective, and seismic issues were also important because the project is next to a fault. This was addressed architecturally with multiple, low-rise buildings and also with the wood system because of its flexibility and resilience."

As of September 2009, close to 480 million acres were certified to one of the four main certification programs in North America, including the Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), Canadian Standards Association's Sustainable Forest Management Standard (CSA) and American Tree Farm System. Among developed countries, which have the majority of certified forests, North America has more than all of the others combined.

Sustainability as a Design Objective

Marcy Wong of Marcy Wong Donn Logan Architects frequently uses wood in her designs and says she gives equal weight to renewability, sustainability, life cycle and climate change benefits. "Clients often request wood for its environmental and aesthetic aspects," she says. "For the Meyer Sound Theatre, the clients wanted wood for carbon storage and climate change reasons as well as its warmth. For another project, the clients selectively culled the surrounding forest and used the harvested wood to build their house. In the case of another, the LEED-certified Freight and Salvage Theatre, the project involved deconstructing an existing building and re-using the wood for wall and ceiling finishes."

However, although sustainability and green building represent an increasing priority for many designers, the decision to use wood often comes down to cost.



Harada Elementary School. Courtesy of HMC Architects.

In the United Kingdom, the world's largest mixed-use wood building received approval from authorities largely because of its reduced carbon footprint. Compared to a similar concrete design, architect Andrew Waugh projected that the nine-story building would save the equivalent of about 300 metric tons of carbon – which was equivalent to meeting the city's new 10 percent CO_2 reduction target for 210 years. However, as with the Harada Elementary School, it was the building's lower cost and speed of construction that convinced the developers to use wood.

Likewise, architect Ron LaPage attended a green building seminar hosted by WoodWorks in Chicago before changing a design he was working on to wood framing. LaPage was at the schematic design stage for an addition to The Birches assisted living facility in Clarendon Hills, Illinois – a 16,000-square-foot, two-story building attached to the main facility by a covered walkway. "Using a sustainable material like wood is important to me and I'm aware of the life cycle benefits," he said, "but we also found that the wood structure was going to cost about 5 percent less. That's what ultimately swayed the decision."

"Cost is of course a factor," says Podesto, "especially in this economy. But we're also seeing more projects where sustainability is a priority – and given the opportunity that building designers have to impact issues such as climate change, I think we can expect to see many more in the future."▪

Roxane Ward is a Vancouver, Canada-based writer who has written extensively on sustainability, forest and wood-related issues for more than 15 years. She may be reached via email at ***roxane@woodworks.org****.*