RESEARCH in Progress

Forest Products Laboratory

Potential for Tall Wood Buildings to Sequester Carbon, Support Forest Communities, and Create New Options for Forest Management

The combination of sustainable forest management and durable wood products used in construction of long-lived buildings has the potential to sequester carbon in the near-term, provide attractive, affordable living spaces, and create new opportunities for rural communities. Cross-laminated timber (CLT) is a new engineered wood product that enables greater use of wood in midrise buildings (4 to 12 stories). This work will focus on an integrated "systems" approach to analyzing tall wood buildings, including their environmental, financial, and social impacts, and identifying trade-offs between these attributes.

Architectural rendering of Framework, a 12-story CLT building project in Portland, Oregon.

Background

Traditional wood building construction is generally limited to three or four stories of wood, which in turn limits markets and carbon sequestration potential for wood. Although CLTs are widely accepted in Europe, they are less common in the United States, due in large part to a lack of familiarity on the part of architects, builders, and owners and a lack of manufacturing capacity.

CLTs are competitive solutions for a variety of building systems that are currently based on concrete or steel with their well-known air and water emission issues. CLT can serve the dual role of structural members and wall sections, offering a combination of useful attributes for cost-effective building including rapid installation, improved thermal performance, versatile design, fire resistance, and good seismic performance. The size, shape, and properties of CLT panels can be engineered through proper selection of wood, resin, and connectors. CLT panels are manufactured off-site and then rapidly erected to create the building envelope. This minimizes construction costs and disruptions in urban areas.

The double-height lobby of the Framework building will feature an exposed timber structural frame and an exhibit space about tall wood buildings.

Images: The Framework Project LLC, Courtesy of LEVER Architecture

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Objective

To extend the work begun by the U.S. Tall Wood Building Prize Competition, this research will provide an integrated systems analysis that includes environmental, financial, and social criteria for three comparable buildings systems located in Portland, Oregon. This work provides a consistent set of data and an analytical framework that can be used to identify "hot spots" or high leverage points and the uncertainties that drive the benefits and costs of these alternative buildings systems.

Approach

The project consists of a rigorous side-by-side comparison of three equivalent buildings—CLT, steel and glass, and reinforced concrete. It is a comprehensive, integrated study with four tasks:

1. Life cycle analysis—Evaluate environmental impacts for the CLT building and two comparatives and the potential of carbon sequestration with CLT tall buildings, along with water use and quality, chemical emissions, and other environmental burdens associated with the selection of alternative materials

2. Financial analysis—Evaluate initial construction costs and building life-cycle costs for the three structures, including long-term operations and maintenance

3. Local and regional economic impacts—Analyze local and regional economic impacts of alternative buildings with a focus on rural communities

4. New options for forest management—Identify forest management options given that CLT is an engineered wood product that offers the potential for using different grades and species of wood lumber, which in turn may create new markets for U.S. forest resource and new forest management practices

Expected Outcomes

The primary outcome of this work is to provide integrated analysis of the environmental, financial, and social benefits and costs of using CLT in tall wood buildings. Secondary outcomes will be (1) information, including a design team checkoff that can be used to inform the building community as they make decisions on specific,new building projects, and (2) a informational foundation for these stakeholders and others to begin to evaluate the complex tradeoffs between, and optimization of, environmental, financial, and social benefits and costs.

Timeline

Starting in January 2017, the project is estimated to last two years with all four tasks occurring simultaneously.

Cooperators

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Reference

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