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WOOD-AND-GLUE SKYSCRAPERS ARE ON THE RISE

AND THEY COULD HELP FIGHT CLIMATE CHANGE

By Jeremy Deaton Posted April 26, 2016

Thanks to advances in wood construction, the next generation of skyscraper might be made of spruce, not steel. Architects are designing wood buildings that ditch concrete and steel in favor of a more environmentally friendly material—one that could help fight climate change.

Wood + Glue = Skyscraper Material

Glue might the best thing to happen to the lumber industry. Adhesives permit manufacturers to cheaply produce wood products that are no longer in the shape of trees. The particleboard in your IKEA coffee table, for example, is made from wood fragments that have been glued together.

Lumber producers are now using über-powerful adhesives to assemble massive wood panels with the strength and durability of concrete and steel. Cross-laminated timber, as it's known, is made of small planks

bound together by a polyurethane adhesive. The pioneering technology has freed architects to dream up buildings that were previously inconceivable.

“Not only is [wood] attractive and warms up the building,” said Kris Spickler, a heavy timber specialist at cross-laminated timber manufacturer Structurlam, “I think architects really enjoy being able to use a product that they’ve used for interior spaces, and actually use it for the structure itself.”

Acton Ostry Architects

Tall Wood Student Residence

In 2015, the University of British Columbia approved an 18-story residential building for students, which will be made almost entirely of wood. The Tall Wood Student Residence will rise 174 feet into the air, making it the tallest wooden building in North America.

Beyond its aesthetic appeal, cross-laminated timber boasts several other advantages. Wood construction sites generate less waste, noise, and traffic than conventional sites. And wood buildings can be erected more quickly than steel and concrete structures, keeping the projects cost-competitive. For example, Spickler pointed to a forthcoming skyscraper at the University of British Columbia.

“The building was competitively bid against concrete and steel. It wasn’t a show project,” said Spickler. “I think the speed an the affordability won out, and that’s why we’re building that 18-story.”

To observers, a wood skyscraper may sound like a fire hazard, but Spickler disagrees. Steel is vulnerable to melting in a blaze, twisting and contorting in the heat. Timber, on the other hand, will char on the outside, but flames will not penetrate its core. After a fire recedes, the wood beam will remain standing.

Wood’s greatest virtue, however, is not design potential or fire safety. The fibers of every plank help combat climate change.

Steel and Concrete Produce Carbon Dioxide

Steel and concrete come with a colossal carbon footprint. Cement, the binding agent in concrete, is made by heating limestone and clay in a kiln. Steel is made by heating iron, limestone and a carbon-rich form of coal called coke in a blast furnace. Carbon dioxide is an inevitable byproduct of both processes, from burning coal to generate heat.

According to a 2013 accounting from Ecofys, iron and steel account for nearly five percent of global greenhouse gas emissions. Non-metallic minerals, including the raw ingredients in concrete, amount to 6 percent. Together, these sources contribute about as much to climate change as all the cars and trucks on Earth.

Ecofys

2010 World Greenhouse Gas Emissions Flowchart

Excerpt from Ecofys's flowchart showing world greenhouse gas emissions for 2010. The full chart is available here.

Wood Traps Carbon Dioxide

When it comes to climate, wood beats conventional building materials on two fronts. First, wood boasts a smaller carbon footprint than steel and concrete. Logging, refining and shipping wood products eat up fossil fuels, but a producer will generate more pollution turning a lump of iron into a steel beam than turning a tree into a plank of wood.

Wood's second advantage is its ability to trap carbon dioxide. Some scientists speculate the only way to keep warming under two degrees Celsius, the stated goal of the Paris Climate Agreement, is to provide for negative emissions. That could mean high-tech machines or materials that scrub CO_2 from the air, or eco-friendly farming practices that trap carbon in the soil. So far, however, the most cost-effective tool for carbon removal is a tree.

Compare this to steel and concrete. "If we built a 20-story building out of cement and concrete, the process would result in...1,200 tons of carbon dioxide," said architect Michael Green in a TED Talk. "If we did it in wood, in this solution, we'd sequester about 3,100 tons, for a net difference of 4,300 tons. That's the equivalent of about 900 cars removed from the road in one year."

Green's back-of-the-envelope calculation lines up with more rigorous analyses. According to a 2014 study from researchers at Yale and the University of Washington, up to 31 percent of global carbon dioxide emissions could be avoided by building with wood instead of steel and concrete.

"If you build out of wood instead of concrete or steel or brick, then you avoid all that fossil fuel you would burn to make the steel, concrete and brick," said Chad Oliver, Director of Yale's Global Institute of Sustainable Forestry and lead author on the study. He noted that, because timber weighs less than conventional materials, builders also need less concrete to lay the foundation of a wood structure. When a wood building is finally retired, its component parts can be reused in other buildings, buried in the ground or used to produce electricity.

Smart Logging?

The prospect of leveling forests to erect skyscrapers and generate electricity is enough to make any tree hugger woozy. But Oliver says logging can form an essential part of smart forest management.

"As a general rule, and this varies from place to place, the forests are getting more dense," said Oliver. "You want some areas that are dense, but you don't want to whole forest uniformly dense, because some animals live in that dense forest, but other animals live in an open forest. You need a diversity of conditions." Loggers can foster biodiversity by thinning some parts of the forest and clearing others to create patchwork quilt of habitats where every species has a home.

Logging can also reduce the risk of forest fire. In a uniformly dense forest, flames grow hot and spread quickly through tightly packed trees. In a more varied setting, a fire might hit a meadow and slow down, allowing time for rain or cold to intervene and bring the inferno to a halt.

"If we harvested more of that extra [tree] growth instead of letting it rot or burn in overly dense forests," said Oliver. "We could make a lot more products and use the waste for wood energy."

“We can take smaller trees and laminate [them into] massive panels stronger than concrete and one fifth the weight.”

Cross-lamination allows manufactures to produce larger beams from smaller pieces of wood, meaning the raw materials can be supplied by shorter, more slender trees, including those threatened by rot, fire, and pine beetles. Trees that would otherwise decay or burn, leaking their stores of carbon into the atmosphere, can be made into the building blocks of skyscrapers.

“We have more trees right now in the forest that we can use than we did 50 years ago. So, we can sustainably grow this and harvest it and continue to use it,” said Spickler. “We can take these smaller trees and take the smaller cuts of them, and laminate panels that weigh 10,000 pounds—massive panels bonded together to be stronger than concrete and one fifth the weight.”

Climate change has already ignited revolutions in clean power and transportation. Spickler believes construction may be next. “This revolution has happened rather quietly and happened rather slow,” he said. “But I think we’re in a year right now where we’re going to see it explode.”

Jeremy Deaton writes about the science, policy, and politics of climate and energy for Nexus Media. You can follow him at @deaton_jeremy.

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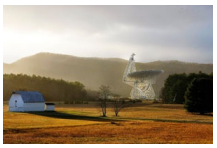
Extreme Science



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