

2020 Hixon Center Urban Conference

Future Cities' Material Flows: Implications of Design, Production & Waste

Co-Convened by the Yale School of Architecture, Yale School of the Environment, The Forest School, Center for Industrial Ecology and Hixon Center for Urban Ecology

Conference Brief summarized by Eudora Miao

On November 6th, the Hixon Center for Urban Ecology at the Yale School of the Environment (YSE), The Forest School, the Center for Industrial Ecology and the Yale School of Architecture co-convened the virtual conference “Future Cities’ Material Flows: Implications of Design, Production & Waste”. The conference focused on the potential of mass timber as a primary building material in cities. Over 200 participants attended the conference virtually, including professional foresters, architects, city planners, developers, researchers, and Yale University students and alumni.

The conference began with the opening remarks from Karen Seto, the Frederick C. Hixon Professor of Geography and Urbanization Science at YSE. She observed that this conference came at a critical time – “the world is rapidly urbanizing and this will require significant resources to build the cities of tomorrow”. Dr. Seto emphasized the rapid rate of urbanization – “between today and the middle of the century, we are going to add about two and half billion urban dwellers on the planet.” Her research forecasts impending land use change: this increase in urban population will require us to build out urban areas equivalent to “23,000 football fields, every day, until 2050, or an entire New York City, every eight days”. Many places around the world, from the metropolitan Shanghai in China, to the small town of Charikot in Nepal, are all rapidly urbanizing. Research shows that the “business as usual” scenario of building these cities of tomorrow could result in more demand of raw materials than our planet can supply, and significant greenhouse gas emissions. Seto raised the question central to this discussion: “How do we build better and more sustainably?”

Following Professor Seto’s opening remarks, the first panel focused on the state of the art in mass timber fabrication and its application in urban midrise buildings. Steve Marshall, VP for Sales, Marketing, and Policy at SmartLam North America moderated the session with panelists from a background of architecture, private business, non-profit, and development. Alan Organschi, a principal and partner at Gray Organschi Architecture and senior critic at Yale School of Architecture, described the challenges we are facing as “a design problem between two landscapes – the city and the forest” and the question of how do we turn cities from a significant source of carbon emissions to a potential carbon sink. He emphasized the importance of a design methodology, which is interdisciplinary and runs across the supply chain. Organschi raised key questions: “can the mass timber market grow fast enough? Can forests sustainably supply necessary demand? Can we include more biogenic materials in building assemblies? And can we collaborate across disciplines and all along the supply chain to build regeneratively with wood from the forest?”

Jennifer Cover, President and CEO of the nonprofit WoodWorks, presented the drivers for mass timber utilization. She highlighted the business benefits of mass timber as a win-win for the construction and design industry and sustainability efforts. Business benefits include innovation and aesthetic appeal that contributes to faster lease and higher lease rates, faster speed of construction and fewer constraints from site and labor shortages, superior structural performance and lightweight, as well as health implications such as decreased heart rate and anxiety level. Ms. Cover also noted that while there has been a quick uptake of mass timber by the US market, there is still opportunity to grow the market substantially.

Nick Milestone, Chairman of TRADA (The Timber Research and Development Association) and Senior Vice President Strategy & Partnerships, Softwood Lumber Board highlighted the hybrid use of mass timber with other building materials. Mr. Milestone reviewed the European market for mass timber noting that 64% of the Europe market is based on hybrid design of Cross Laminated Timber (CLT) with structural steel or concrete. Having briefly explained the “disruptor” history of CLT, he also spoke about the potential future of mass timber in volumetric modular construction, pod and panel, and even timber cities.

John Beauchamp, Chief Investment Officer of Hixon Properties Incorporated, added a developer’s perspective to the panel offering his experience of constructing the “Soto”, a recently completed mass timber building, to the discussion. Mr. Beauchamp shared that intrigued developers routinely want to visit the Soto because of the distinct and beautiful appearance. He also highlighted that Soto engages three different senses, namely the sight, smell, and feel, of those who visit, providing a big differentiator. Mr. Beauchamp flagged some common challenges, such as higher insurance, uncertain delivery of CLT, as well as how city planners may respond to timber buildings. He advises that those who are considering mass timber to “get into [the city planner’s] office early and make sure you sniff out any problem early”.

The implications of material selection in building design on the forests and the carbon budget was the focus of the second panel session. Moderated by Yuan Yao, Assistant Professor of Industrial Ecology and Sustainable Systems at YSE, this session brought together six different experts from climate research, industrial ecology, forestry and forest investment backgrounds.

Chad Oliver, the Emeritus Pinchot Professor of Forestry and Environmental Studies at Yale School of Environment, took on the question of supply meeting demand for mass timber. “If we look at different parts of the trees in different parts of the forest for different uses, we can find that we have more wood than we thought before”, in particular by expanding the number of species we are willing and capable of using. Dr. Oliver also emphasized that across most of the globe the volume of timber supply has been increasing over the past decade (with the exception of Brazil and Indonesia), and that we are only harvesting 20% of the wood that we can potentially grow worldwide.

Galina Churkina, senior scientist at the Potsdam Institute for Climate Impact Research focused on the global cycle of carbon and discussed the global picture of increasing carbon sinks. She pointed out that the interaction between forest, carbon, and climate is not straight forward; for example, in some areas, planting trees can actually increase the albedo value, thereby increasing the warming effect. With climate change, we are also more likely to have more fire and insect outbreaks, meaning more risks for forests. Dr. Churkina also emphasized the importance of considering the end-of-life for mass timber as an important factor in whether it could be a successful solution to mitigate climate change.

Rupert Myers, Lecturer in Sustainable Materials Engineering and leader of the Myers Group at Imperial College London, provided the audience with insights into the production of cement and concrete, materials, which mass timber might replace. He highlighted the big carbon footprint of the current production of cement – 20% of the industrial CO₂ emissions and 5% of total anthropogenic CO₂ emissions. Dr. Myers also noted decarbonizing efforts by the cement industry, such as the Low-Carbon Cement Initiative supported by UN Environment. There are also innovations to substitute the cement in concrete production with by-products from coal and iron production, reducing the CO₂ emission of concrete to 60% of the original level. However, most of the CO₂ mitigation efforts have focused on the production stage. Dr. Myers emphasized the importance of reducing emissions throughout the life cycle, which is challenging given the many actors involved.

Barbara Reck, Senior Research Scientist at the Center for Industrial Ecology at YSE discussed the significant carbon emissions from global steel production and the potentially substantial role of mass timber to substitute steel. “In 2019,” she said, “the iron and steel industry accounted for 20% of industrial energy use, and 8% of total energy use – and a third of this steel was used for buildings.” While secondary production using scrap saves a significant amount of energy when compared to steel production that uses primary raw materials, the limited availability of scrap means that this could not be a main tactic for reducing the impact of steel. To date, efforts to improve the material efficiency of steel are manifold, including for example extended building lifetimes. Yet, the opportunity of substituting steel for alternative building materials such as mass timber is still a relatively novel concept, with the potential to substantially reduce the carbon footprint of cities.

Clark Binkley, Managing Director of International Forestry Investment Advisors, LLC, sought to answer the questions “is there enough sustainably sourced timber to meet the growing demand for mass timber?” That mass timber uses *sawn lumber* and not *standing timber* complicates the answer. Mass timber in general, and CLT specifically, may add something like a 10% increase in lumber demand over the next 15 years. Dr. Binkley highlighted a few additional sources of lumber supply to meet such demand: technical innovations to improve the “lumber recovery factor (LRF)” in existing sawmills, improvement in plantation yields, excess sawtimber inventory in the US South, and fire treatment on public lands in the West. He also emphasized

the importance of getting such infrastructure as new sawmills and CLT factories in place, and raised the possibility of using carbon credits to pay for that infrastructure development.

Mark Wishnie, Chief Sustainability Officer at BTG Pactual Timberland Investment Group, framed his discussion on the concept of Natural Climate Solutions (NCS). Forests represent 73% of the total opportunities, and given the changes required from climate change, tapping into the timber and forest product market for solutions is needed. Mr. Wishnie explained how forest production can have multiple impacts on climate in the sequestration, storage, substitution, and end-of-life domain, and the need to calculate the climate benefit or detriment with all domains in mind. Wishnie also raised the question of social license – forest products are still gaining acceptance as a climate solution because the forest sector is not widely acknowledged as “environmentally responsible”, “sustainable”, or “socially responsible”, according to a recent survey.

The closing remarks from Phillip Bernstein, Associate Dean and Professor Adjunct at Yale School of Architecture, highlighted the key issue of information exchange in the building supply chain. He called on the audience to consider: “what are the agency of the players working in the process? How do we mesh our methodologies together so we can have insights across the supply chain? And how do value propositions interlock with each other so things make social, ecological, and business sense?”