
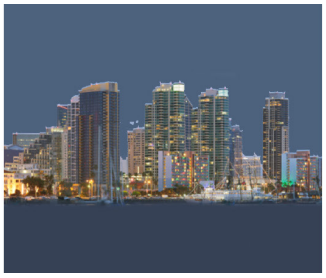

THE BROAD DIMENSION

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In this Edition:

Mass Timber Construction

Anyone in the construction industry will have likely felt the growing media attention and news stories revolving around mass timber. This is due to the growing use and applications that mass timber has in the AEC industry. Mass timber is a term that describes large sections of engineered lumber composed of smaller dimensional lumber or billets. These smaller sections of dimensional lumber make up beams, columns, and panels which make up different types of mass timber products. The products include a soup of acronyms (CLT, DLT, NLT, GLT, MPP, etc.) all of which have their own advantages, disadvantages, suppliers, and limitations.

Photo credit: DCI Engineers

The rock star of the group that is getting the most media attention is Cross Laminated Timber (CLT). The name comes from the process by which it is made. Similar to glue laminated timber products, CLT stacks readily available 2x4 and 2x6 lumber side by side to form a single layer. These layers are then pressed into other layers which cross orthogonally to one another, to form larger panels ranging anywhere from just under 4" thick up to 20" thick and come in widths of 4 feet to 12 feet and are up to 30 feet to 60 feet long, or sometimes longer.

The manufacturing process of CLT is what sets it apart from other types of mass timber products. The orthogonal layers provide an elite dimensional tolerance of an eighth of an inch. CLT panels can also span in both directions due to the strong and weak axis layers of 2x4 and 2x6 lumber, making cross laminated timber a structurally ubiquitous material which can take shear, bending, compression and tension. CLT panels can be used in floor, wall, and roof applications and the number of suppliers in North America has grown from only 2 certified suppliers in 2011 to potentially 7 CLT suppliers by the early part of 2019 (Structurlam, Smartlam, Nordic, DR Johnson, International Beams, Katerra, and Vaagan Lumber).

Photo credit: DCI Engineers

Kris Sprickler is extremely familiar with the North American mass timber market. His team at Structurlam is responsible for completing some of the first mass timber structures in North America, including one of the tallest mass timber structures in the world, Brock Commons, an 18 story project in British Columbia. Kris has seen the amount of mass timber projects grow to over 200 projects per year in North America. "We are seeing a huge increase in our production," he says, "as the majority of clients want a more robust product that is renewable and increases construction speed and accuracy on site. Our goal is to deliver a better overall product, which is faster and more cost effective." The recent tariffs have put some markets in a precarious situation when it comes to international trade. However, Spickler states that due to long term purchasing agreements, engineered wood products, such as CLT are able to keep a more stable price in the market.

From a contractor's standpoint, mass timber holds equally advantageous attributes. Lendlease, a leading international development and construction group with operations in Australia, Asia, Europe and the Americas, has pioneered the use of cross-laminated timber (CLT) around the globe, including the successful delivery of the first all-CLT hotel in the United States. With over 1,100 units in design, pre-construction or completed, Lendlease's CLT experience has demonstrated several important advantages: faster construction schedules, thus reducing carrying costs for owners; smaller crews assembling the structures in less time and in a safer manner; on-time delivery of materials, minimized community disruption during construction; precision and installed dimensional reliability which creates more opportunity for other trades to implement off-site prefabrication as well; and environmental sustainability. Andy Holst, a Senior Project Manager for Lendlease, is keen on the idea of integrating mass timber into structures where it makes sense. "If we were to look at a multi-family project we can increase the amount of productivity by 20% to 30% with the use of a mass timber panel as the floor assembly while still keeping the wood stud walls for gravity support. The speed of construction lends itself in markets with a tight labor market with higher than average wages," says Andy.

Jacob Artier, from the Northern California Carpenters Union, is well aware of the innovation that mass timber brings to the construction market. "We want the carpenters union to be at the forefront of this technology. We are an active participant and supporter of new construction delivery methods and factory built modular construction in the northern California markets. As evolution continues in our industry we intend to be a part of it and make sure our membership grows with it."

From a structural perspective, DCI Engineers sees mass timber as an extremely viable product in certain applications. DCI Engineers has mass timber projects

throughout the country (stretching from Alaska to Texas). In the past three years DCI has had almost 30 projects that utilize some form of mass timber. The most common thus far has been the use of mass timber products for floor and roof applications. Mass timber floors have the possibility of being less than half the weight of traditional type I concrete floor structures. The reduced weight offers a significant amount of savings in terms of cost for the seismic system, which can be designed for a lower amount of force in an earthquake given a lower amount of seismic mass and weight. CLT walls are not as viable in seismic regions as the structural proposals for platform framed CLT structures need to be formalized into the building code so they can be applied without an alternative means and methods request. Updated code provisions for CLT shear walls are aiming to be adopted in the 2021 IBC which will also see a significant change to mass timber building types.

Photo credit: Lendlease

Currently mass timber is allowed in roofs for type I and type II buildings as well as type III, type IV, and type V construction for structures under 85 feet. Mass timber products can be used in instances for type I structures and can also be more aggressively pursued for projects if they seek an alternate means and methods. However the code constraints which currently affect mass timber may be changing. Currently there are proposals before the International Code Council (ICC) to adopt the allowance of 9, 12, and 18 story mass timber structures in the 2021 International Building Code (IBC). The state of Oregon has already enacted a state wide amendment to their building code which adopts the provisions for 9, 12, and 18 story buildings.

There are a lot of people who are excited by the idea of high rise mass timber structures up to 60 stories or greater. However, buildings above 15 floors represent less than 2% of the construction market. The real goal should be to get mass timber into the general market and this is exactly what the code proposals for the 9, 12, and 18 story options will provide. With a growing constraint on the markets labor force and a trend toward sustainable buildings and renewable materials, the new code proposals could come at an opportune time to provide other options to the construction industry.

Dean Lewis, DCI Engineers

AI in Construction

AI (artificial intelligence) has been moving into business and our private lives in a big way recently (think Siri and Alexa). The construction industry has been a late adopter of the technology, but even here the pace is picking up, and new uses are being thought up.

At the design stage, AI systems can suggest design options for specific situations, review documents for things that might be missing, carry out clash detection, speed up the cost estimating process even at early conceptual stages, and start the construction scheduling process, among other things. One of the advantages AI has is that computers can process a lot of options in a short period of time and compare the results without any preconceived biases.

During construction, AIs can take control of construction plants in various ways including; driving excavators and brick- or CMU-laying machines, monitoring construction sites looking for deviations from plans and for safety violations (such as workers without hard hats), maintaining and updating the construction schedule, and monitoring subcontractors. We hear a lot about autonomous cars these days, but they drive on well mapped streets. A construction site is constantly changing, so an autonomous excavator would need to have its map constantly updated and an AI can do that using images and 3D scans from drones and/or other imaging systems.

Post construction, AIs can monitor the building occupancy to economically control the internal climate, and using building sensors connected to the Internet of Things (IoT) they can recommend maintenance work, warn of potential failures, and in the event of a catastrophe (such as an earthquake or hurricane) can send emergency services to areas of the buildings where they are most needed.

Unlike traditional computer programs, AI systems need to be trained, and to do that they need a lot of related data that they can sort through to establish patterns and arrive at viable solutions. IBM's Watson supercomputer was given a lot of data that it used to win at the TV quiz game Jeopardy. It was then put to a more practical use, diagnosing cancer patients and initially it was getting good reviews. More recently it has been criticized for recommending dangerous treatments for some patients, and it turns out that this was largely due to it having learnt from a relatively small number of cancer cases. It would be an exaggeration to say that this was a case of "garbage in – garbage out", but it does show the necessity of a substantial quantity of good data to work from.

There are multiple ways that companies are collecting data today, and new ones, such as scanning and photography from drones, are becoming more common. All of this data can be useful for AI systems, but obviously the larger companies are the ones that will have more data, and will therefore be the ones that can benefit most from AI technology. One possible solution to this dilemma, might be if government departments, professional institutions, or similar organizations involved in construction could coordinate the collection of data and share it.

Naturally there are fears that AI will take away people's jobs, and we have seen headlines that talk of 500,000 jobs being lost in the construction industry to such technologies. On the other hand, construction workers are in short supply anyway, and AI has been making its way into other industries for quite a while, and do we see unemployment rising or being at record low levels? We know it is the latter. The type of work is certainly going to change, with a need for companies to implement methods for employees to develop new skills, but history indicates that technology change does not take away jobs. In fact, companies developing AI systems are finding it at least as hard to find staff as construction companies are.

Newsletter designed by Katie Levine

Tariffs & Escalation

Construction prices have been driven to new record highs over the past few years by the fact that the volume of construction has been putting pressure on the capacities of contractors to meet the demand. It has become hard to get multiple contractors, and especially subcontractors, to bid on projects, reducing the level of competition with an inevitable rise in bid prices. The contractors have to cover the risks of having to pay higher prices for resources, and they also have little incentive to keep their profit margins low.

Prices for construction labor and materials have continued to rise, but only at a rate approximating that of the Consumer Price Index, so while they have contributed to the rise in bid prices, their effects have been small. Then in 2017 we saw the imposition of roughly 20% tariffs on Canadian lumber, and this year has seen 25% tariffs on imported steel and 10% on aluminum, and these are putting more pressure on bid prices.

Looking at steel, the effects of the tariffs adds about $300 to the material costs. Assuming the installed cost of structural steel members was about $4000/ton, then the percentage increase works out at 7.5%. Then say that steel constitutes about 16% of the cost of a commercial building, and it gives an increase on the bid price of 1.2%, and to that would be added increases related to timber and aluminum tariffs.

The initial effects of the increases would have been muted by materials suppliers stockpiling as soon as tariffs were proposed, and likewise contractors locking-in their orders as soon as possible. On the other hand, increases in some materials were seen ahead of the actual tariffs, in anticipation of the rising prices. There was little incentive on suppliers to carry any increases themselves.

The tit-for-tat retaliation as one side or the other imposes tariffs has only increased the risk situation for contractors, when their construction contract probably doesn't allow them to recoup price increases, and the contractors' books are already full.

In summary, the tariffs will inevitably add something to the inflationary pressures, the main effect is more likely to result from the uncertainty surrounding where tariffs will go next, making the bidding market even more precarious.

Geoff Canham, Editor, TBD San Francisco