

### **Cross Laminated Timber Construction— Innovation Description**

Skyscrapers and midrise buildings are constructed primarily of concrete and steel, resulting in a high carbon footprint. An alternative to reduce this embodied carbon is Cross Laminated Timber (CLT). This system is essentially thick pieces of plywood made from sheets oriented at 90 degree angles. Orientation of the grain of outer layers depends on where the panel is used, whether in a floor or wall. This more sustainable structural material is particularly important as cities continue to increase in density and require mid and high-rise construction to house a rapidly growing population. Wood is a natural carbon sink and requires less overall energy to produce than steel or concrete.

CLT has numerous characteristics that make it competitive with traditional structure systems. CLT is primarily assembled in the factory, which cuts down on construction time. This also makes it highly dimensionally stable. Delivered to the site, it is lifted directly into place from the delivery vehicle. Its installation process is comparable to that of tilt-up concrete. CLT requires only a small crane and light weight power tools to erect. By using one material, it is a lower-risk structure to build, as it requires only one trade to install. No drying or curing times means that subsequent trades can begin work immediately after erection of structure. Trades show as much as 20 to 30% increased speed of installation on some projects. Furthermore, as the panels are factory made, construction waste and noise on site are significantly reduced. Scraps produced from the factory can be used as pellets to burn and generate energy or be recycled into other wood products. For fire resistance, a layer of drywall can be added to the CLT to reach code requirements of 60 and 90 minute fire resistance ratings. CLT buildings see a decrease in cost; the Graphite Apartments, made of CLT, was 15% less expensive than if it had been constructed of concrete. Some tout CLT's interior wood aesthetic as superior to that of typical drywall construction. The exposed wood interior also eliminates the use of drywall and painting. One of the best reasons to use CLT is that it results in less weight in overall structure, resulting in reduced substructure size and cost.

There are some limitations to the use of CLT. Because panels are transported from the factory, transportation can be difficult if adequate site access cannot be arranged. Planks are limited to sizes that the factory can produce. Structural opening sizes and locations may be limited, and acoustics must be addressed through additional layers of acoustic insulation to the CLT. In terms of structural configuration, CLT requires many load bearing walls, which can limit the flexibility of the interior of the tower. This has

resulted in some different responses from the design community, including SOM's proposal of a "concrete jointed timber frame." This proposed a structure which uses wood for primary structural members. Concrete is used for connectors at beams and columns and at the exterior perimeter. CLT also cannot be exposed to weather, necessitating its rapid construction and protection from weather. Concrete or steel can be used at the base of the structure, where contact with water is more prevalent.

Cross laminated timber was originally invented in the 1970s in Europe, with factories primarily in Austria, Germany and Scandinavia. CLT has been steadily gaining traction with the advent of the green building movement, which recognized it as a sustainable alternative to typical steel and concrete construction. From completed projects like the Graphite Apartments, Whitmore Road, and the CLT Academy Building in the UK, CLT has been demonstrated that it can be used to create safe, sustainable, and aesthetically pleasing architecture. SOM's proposal furthermore illustrates that with some adaptation to the CLT system, it can be applicable to higher story buildings.



THE WHITMORE ROAD PROJECT.

COURTESY WAUGH THISTLETON



SOM'S PROPOSAL FOR A 40-STORY TIMBER TOWER WITH A CONCRETE CORE IS BASED ON A STRUCTURAL SYSTEM DESIGNED BY FAZLUR KAHN IN 1965.

COURTESY SOM