

CLT PANELS: HISTORY, ADVANTAGES AND DISADVANTAGES

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We also discuss the history of construction of multistorey buildings from wooden CLT plates as well as their advantages and disadvantages.

People have been building wooden houses since the ancient times. Mainly the following types of structural timber have been used:

- regular and rounded timber – for log buildings;
- square-sawn timber – profiled and glued-laminated – for timber beam buildings;
- wooden plates – for stick-frame or prefabricated wooden plate buildings;
- wooden blocks – for timber beam of rounded log buildings.

Modern construction materials and technologies make it possible to build high-rise buildings with more than 25 floors. It is possible due to using CLT panels (Fig. 1) that mean cross laminated timber. So, today construction of high-rise wooden buildings is not considered as a fantasy of architects: more and more new projects are appearing in different countries.

The first samples of cross laminated timber were invented in Switzerland in the early 1990's. The first samples of modern CLT panels were created in 1996 in Austria during scientific research works. In the following couple of years the progress in this sphere was slow, but at the beginning of 2000's the use of CLT panels in construction rapidly increased due to popularization of sustainable construction techniques, increase in the efficiency of materials and better marketing policies [1].

The important factor was the understanding that CLT is not an "easy" construction material. In Europe many residential apartment blocks and public buildings are built from CLT panels. The biggest CLT producing countries are Austria, Germany, Switzerland, Sweden, Norway and the United Kingdom. New CLT factories will open soon in Sweden, Australia and North America. The first multistorey building built from CLT is a 9-floor, 29-apartment Stadhaus in London Borough of Hackney. It was built in 28 days by only four workers [2].

CLT (Cross Laminated Timber) in its simple meaning is a multi-layer timber. It is used for making bearing structures and beams, floor slabs and wall panels. The panels are a laminated solid structure made of slats turned on 90 degrees relative to one another. Each slat is also made of laminated planks or beams with oppositely directed wood fibres. Cross lamination provides the total absence of internal tension and deformation of material, increased durability, excellent resistance to compression and tensioning. At the same time the material is eco-friendly because it consists of only natural laminants that allow timber to "breathe" [2].



Fig. 1. A CLT panel

CLT panels have many advantages compared with other construction materials (reinforced concrete, metal):

- Light weight. Such a panel made of crosswise located slats has five times lighter weight than a concrete one. It allows to save on their transportation and on preparing of foundation (it can have a lighter weight than a foundation for a concrete or a brick building).
- Fast and easy installation. All panels come numbered and cut. To build a house from CLT panels is the same as to build a Lego house, but of a bigger size.
- Absence of gaps. Due to the solid structure of a plate a premise will be protected from draughts and other negative weather factors.
- Eco-friendliness. Construction of houses from CLT panels is a green technology.
- High bearing capacity. CLT panels are used for construction of bridges.
- Durability. Some research was carried out in Japan. The result of this research showed that buildings made of CLT panels can hold seismic vibrations with the intensity up to 7,5.
- No building settlement. Unlike laminated square timber, CLT panels don't swell or shrink under high temperatures and humidity because of their cross layers.
- Fire resistance. CLT panels cannot be compared to any other construction timber in terms of fire resistance because they are totally protected from fire. A factory test was carried out: during one-hour burning of a fireplace with a temperature of 1200 °C the temperature of the other side of a panel (with the thickness 18 cm) rose only by 10 °C.
- Good sound isolation. Long service life. European companies that produce such panels give a 200-year warranty for their products.
- Ideal geometry. At factories panels are already produced with consideration of locations of openings for windows, doors and utilities. All of them have ideally straight lines and flat surface.
- High thermal insulation characteristics. Compared to laminated square timber, CLT panels have a 35% higher thermal insulation level [3].

As any other material, CLT panels have their own disadvantages:

- If a house is built in a place with a cold climate it is required to make the weatherization of walls, which results in additional expenses;
- Production of such material requires expensive equipment that affects the price of CLT panels. The construction work should be done by highly qualified personnel;
- Although the laminant with low formaldehyde content not exceeding the natural limits is used for production of CLT panels, the words about eco-friendliness of houses made from CLT panels should be taken with some degree of scepticism;
- As the technology has become to be implemented only in the recent years, the developers, who will be interested in this material, should remember that because of the small service life of buildings made using this technology it is difficult to forecast how a building will behave in the future [4].

The technology of building houses from CLT panels is simple. For installation of a building (Fig. 2) only basic electrical tools, a lifting crane and a small group of workers are needed. All panels are numbered and are delivered in accordance with the building plan. Installation work is carried out in a short time: installation of one panel requires around 20 minutes, and a full scope of work, for example, building a house for one family, takes around 8 hours [1]. The dry method of construction allows to begin interior fit-out work immediately, which shortens the building commissioning time – panels do not shrink, warp or get cracks. A factory laminated solid wooden board made of dry wood doesn't require plastering, that allows to shorten the period of fit-out work and building commissioning time. More often panels with 3–7 layers are used. At a factory panels containing all necessary openings and, sometimes, holes for electric wiring and utility installations are cut in accordance with detailed drawings. The maximum possible sizes are 16,5 m × 2,95 m × 0,5 m, but usually the length is smaller: sizes of panels are limited due to the necessity of transportation.

After that all panels are marked and delivered to a construction site together with an assembly diagram. This stage is one of the longest because in many cases bulk timber materials are transported from one country to another not only by land but also cross an ocean: for example, bearing structures for the residential house in Melbourne were produced in Austria [5].

Conclusion. Based on the afore said, it is possible to say that CLT panels are a modern and advanced material for construction of multistory buildings. Construction of houses from CLT panels has lots of advantages, for example, high thermal insulation characteristics, light weight, absence of gaps, eco-friendliness, high speed and easiness of installation, high bearing capacity, durability, absence of shrinkage, fire resistance, good sound isolation and ideal geometry.



Fig. 2. Construction of a residential building Forté in Melbourne

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