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# HoHo Wien

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**Abstract** HoHo Wien in Vienna, the 84-meter mixed-use building, is the tallest timber structure in Austria. This article presents HoHo Wien designed by Rüdiger Lainer + Partner in detail as a case study. It was originally part of the book titled "Mass Timber for High Rise Buildings" written by the authors and published by the Council on Tall Buildings and Urban Habitat.

**Keywords** Tall timber, Glued laminated timber, Cross laminated timber, Concrete-timber hybrid structure

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**Figure 1.** Overall view of HoHo Wien, Vienna. The 84-meter mixed-use building is the tallest timber structure in Austria. © cetus Baudevelopment + kito.at

## 1. Background/Overview

On the northeast side of Vienna, a new 240-hectare greenfield, mixed-use urban community called Seestadt (Lakeside) is being developed around Asperner See (Aspern Lake). Located at the end of a U-bahn (metro) line on the site of a former airfield, the planned community provides fertile ground for experimental new construction. Directly adjacent to the U-bahn station lies HoHo Wien (short for HolzHochhaus, German for "wooden high-rise"), an 84-meter, 24-story, mixed- use building (see Figure 1).

The program includes hotel lobby, a restaurant, and bakery on Level 1 with levels 2 through 4 comprising a gym and spa. Levels 5 through 10 are office spaces, levels 11 through 19 are hotel rooms, and the top levels are serviced apartments (see Figure 2). The varying heights of its three tower volumes, derived from the requirements of the urban plan, are the defining elements of an urban silhouette along the lake (see Figure 3).

## 2. Owner/Developer Motivations

The owner was particularly enamored with the idea of building a project where the biophilic effects of timber could be felt throughout the interior. From the start, there was a desire to use the new city neighborhood as a proving ground for sustainable construction methods.

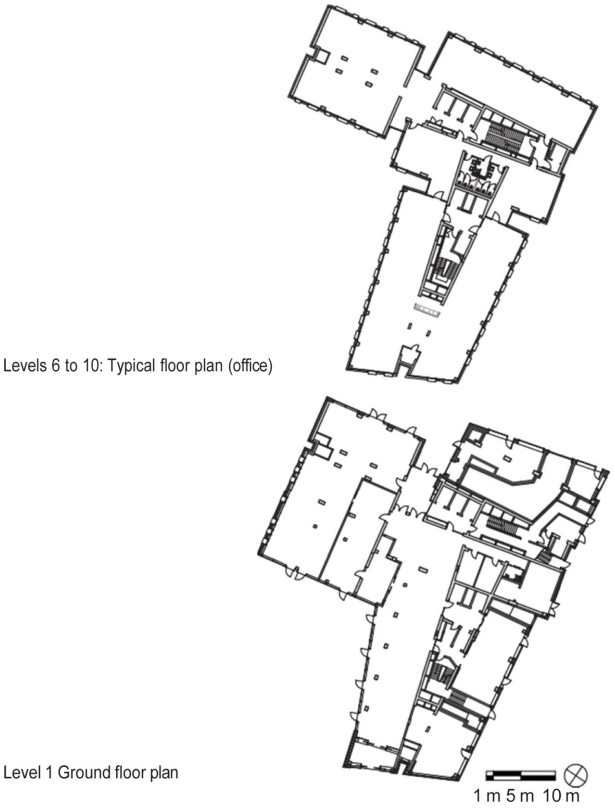



**Figure 2.** Ground and typical floor plans. © Architekt Dipl.-Ing. Gottfried Markom, redrawn by CTBUH.

## 3. Use of Mass Timber

The main use of timber consists primarily of 800 glued laminated timber (GLT) columns; 1,000 cross-laminated timber (CLT) panels incorporated into prefabricated concrete-hybrid floors; and CLT wall panels along the perimeter of the units (see Figure 4).



**Figure 3.** A view of HoHo Wien, next to the U-bahn line and station in the Seestadt community development in Vienna. © György Palkó



**Figure 4.** CLT panels were used in the façade walls and composite floors, while GLT was employed in the columns. © cetus Baudevelopment + kito.at

## 4. Structural Systems

HoHo Wien is a concrete-timber hybrid structure (see Figure 5), consisting of a substantial cast-in-place concrete core and shear-wall system, that fans outward from the 24-story, 84-meter tower, and into two other towers, 57 and 40 meters high, respectively. A concrete-timber structural system is attached to the concrete core, flanking it on either side in the 84- and 40-meter towers, and abutting the core in the 57-meter tower. The objective of the system design was to create a flexible, simple, and repeatable module that would make converting programs and making changes relatively easy. In plan view, the cores in the highest and lowest towers taper asymmetrically, with the adjoining concrete-timber hybrid sections flanking either side. On the intermediate tower, rectangular sections nest

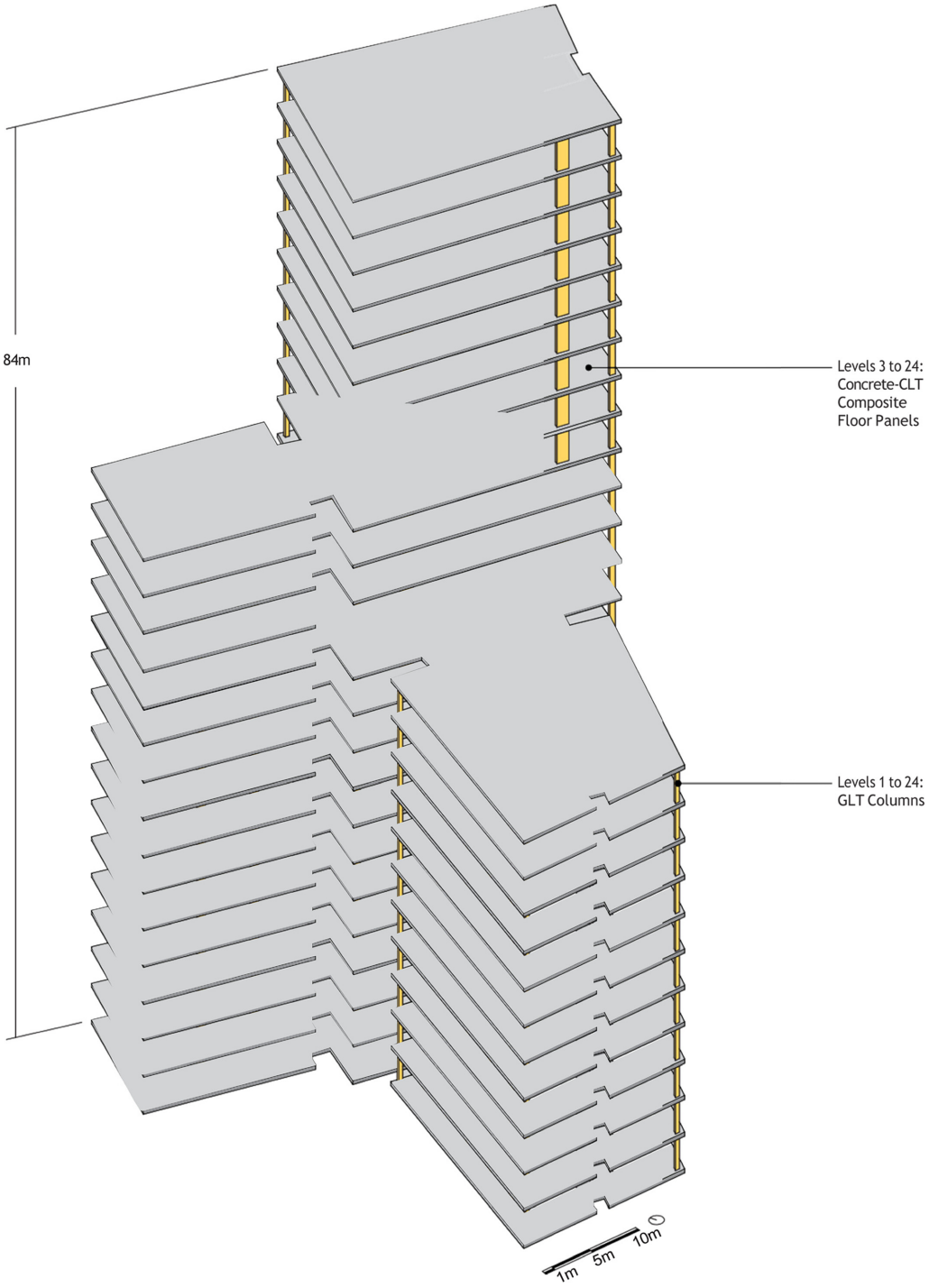



**Figure 5.** Isometric diagram of HoHo Wien's structural system, showing the relationship between the concrete core, shear walls, and prefabricated floor panels. © CTBUH.



**Figure 6.** The concrete edge beams connect to the GLT columns using an embedded steel rod. © Zimmerer / Handler.

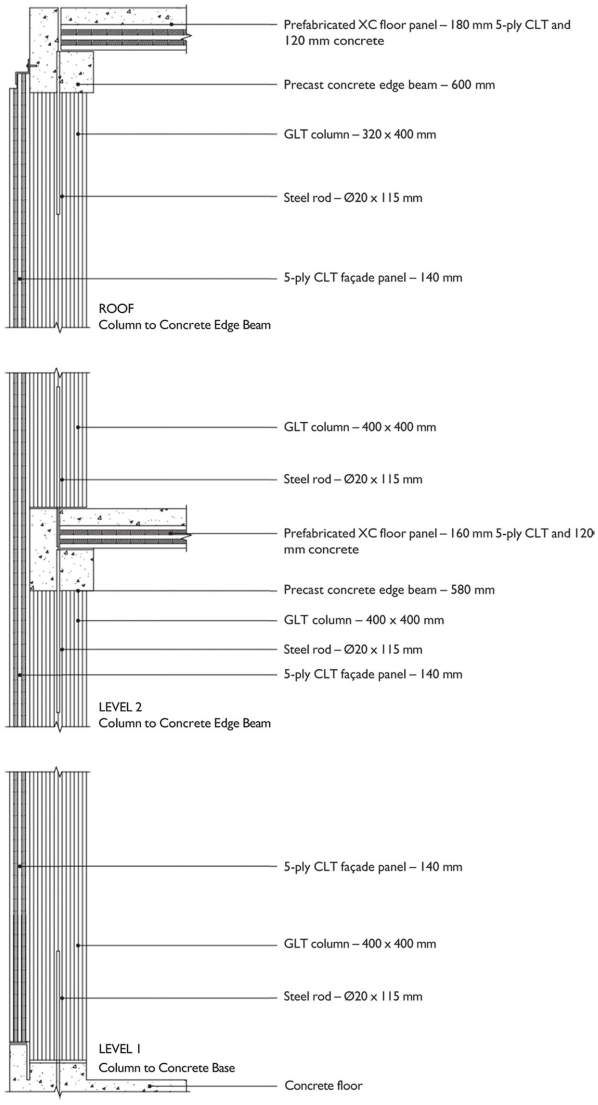



**Figure 7.** The GLT columns and precast concrete edge beams were connected with glued-in steel rods. This allowed for quick construction on-site. © Architekt Dipl.-Ing. Gottfried Markom, redrawn by CTBUH.

between concrete shear walls in the short direction and a cast-concrete frame system in the long direction.

The floor panels are the proprietary X-Lam Concrete (XC) system, produced by MMK, a joint development of Mayr-Menholf and Kirchdorfer. These prefabricated panels, 2.4 meters wide and 7 meters deep, consist of a 120-millimeter-thick concrete slab, fused with a 160-millimeter thick CLT panel underneath, which is placed atop a concrete edge beam. The edge beam rests on GLT columns (see Figures 6 and 7), 400 millimeters deep and between 320 millimeters wide on the highest levels and 1,080 millimeters wide on the lowest (see Table 1), scaled to load requirements. The edge beam protects the load-bearing capacity of the structure in the event of a perimeter column failure.

On the core side, panels rest on a cast concrete ledge extending from the concrete core. The hybrid system spans 7 meters from core to edge at its widest point.

## 5. Material Testing

About four months of testing was necessary to prove the structural integrity of the timber elements. Of particular concern were the connections between the edge beam, top of the column, and underside of the floor panel. A mock-up of this assembly was burned for 90 minutes at 1,000°C, and the structural integrity was maintained

## 6. Fire Engineering

In 2016, Vienna did not permit timber for structural use in buildings exceeding 22 meters, or six stories. Exemptions could be granted if the applicant could prove that escape routes are provided, fire brigade access is defined, and the building can stay structurally intact for 90 minutes during

**Table 1.** General mass timber/structural information.

| General Mass Timber/Structural Information | | | |
|---|---|---|---|
| Structural Systems | | | |
| Concrete-Timber Hybrid | | Core system | Cast-in-place reinforced concrete |
| | | Floors | Levels -2 to 1: cast-in-place reinforced concrete<br>Levels 2 to 24: X-Lam Concrete (XC) system (Concrete over CLT panel) |
| | | Walls | Concrete shear wall system |
| | | Columns | Levels 1 to 24: GLT columns |
| | | Beams | Levels 2 to 24: precast concrete edge beams |
| | | Lateral system | Concrete core and shear wall system |
| | | Building envelope | Prefabricated panel system with non-load- bearing CLT |
| Engineered Mass Timber Products | | | |
| General | | Species | Spruce |
| | | Density | 470 kg/m$^3$ |
| Cross-Laminated Timber (CLT) | Floors | Panel thickness | 160 mm |
| | | Panel dimensions | 2.4 × 7 m |
| | | Total volume | 2,670 m$^3$ |
| | | Total weight | 1,254,900 kg |
| | Walls | Panel thickness | 140 mm |
| | | Panel dimensions | 4.8 × 3.5 m |
| | | Total volume | 1,592 m$^3$ |
| | | Total weight | 748,076 kg |
| Glued Laminated Timber (GLT) | Columns | Grid spacing | 4.8 m |
| | | Number of columns per typical floor | Levels 1 to 11: 31<br>Levels 12 to 16: 20<br>Levels 17 to 24: 12 |
| | | Column height | 3.5 m |
| | | Typical column dimensions | 400 × (320-1080) mm |
| | | Total volume | 371 m$^3$ |
| | | Total weight | 174,238 kg |
| Mass Timber | | Total volume | 4,633 m$^3$ |
| | | Total weight | 2,177,214 kg |

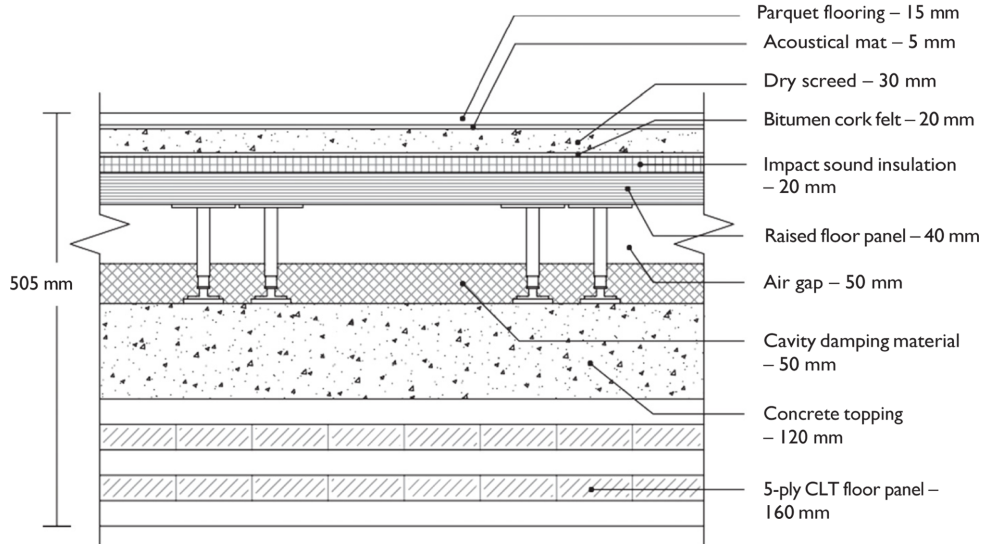



**Figure 8.** Typical floor assembly. © Architekt Dipl.-Ing. Gottfried Markom, redrawn by CTBUH.



**Figure 9.** Air ducts are carefully suspended from the ceiling to minimize the impact of covering the exposed timber in the space. © cetus Baudevelopment + kito.at

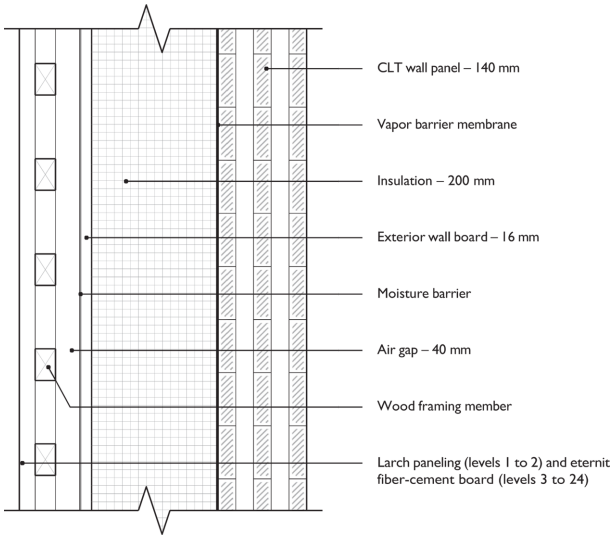



**Figure 10.** Typical section detail showing wall assembly for HoHo Wien. The panelized wall system was prefabricated in a shop and assembled on-site. © Architekt Dipl.-Ing. Gottfried Markom, redrawn by CTBUH.

a fire, while avoiding fire spread to neighboring buildings.

Similar to other high-rises of this scale, HoHo Wien is sprinklered, alarmed, and has stairwell pressurization and fire- brigade lifts. Inside the units, sprinkler heads are set flush with the exposed timber ceilings. There are no vertical shafts in the timber sections, nor any cavities with exposed timber surfaces. Generally, corridors, elevator shafts, stairwells and other common areas are within the concrete core and shear-wall system and/or fully encapsulated.

The typical high-rise building in Austria needs to have a fire-protected means of egress for every 800 square meters of area. With the somewhat narrow wings of the floor, in which concrete-enclosed areas were always in close proximity to timber-enclosed areas, it meant that the size of the so-called “fire lobby” was reduced to 400 square meters.

## 7. MEP Systems

The mechanical and plumbing lines are exposed within the office spaces, running below the soffit (see figures 8 and 9), suspended via hangers from the timber ceiling above. There are cuts milled into the gypsum and CLT soffits at key locations to allow services to pass through. Cold air return grates are built into the tops of the concrete edge beams along the window line. A raised floor accommodates electrical conduits and fan coils, which draw the return air back into the system.

## 8. Exposed Timber

The opportunity to expose timber was one of the major motivations behind the project. The GLT columns, the CLT walls, and the ceilings are all exposed within the units. Even some smaller details, like the inside edges of the window mullions, are made of wood.

## 9. Building Envelope

The primary building block of the envelope is a non-load-bearing wall, consisting of CLT panels 4.8 meters wide and 3.5 meters high. These consist of a 140-millimeter-thick sheet of CLT, windproof sheeting, 200 millimeters of non-combustible thermal insulation, and rear-ventilated facing (see Figures 10 and 11). On the first two levels of the tower, under the partial weather protection of a steel canopy, the façade consists of vertical-strip larch paneling.

On higher levels the panels are made of Eternit, a fiber-reinforced cement panel system. Windows and sunshades are installed in the factory before the panel travels to the site.

## 10. Construction Process

*Sourcing and Supply Chain*

The spruce trees used in HoHo Wien were cut from Hasslacher's managed forests in the Austrian state of Carinthia. In Sachsenburg, the trees are cut, dried and graded. The sawn timber then moves about 48 kilometers to Hasslacher Holzbausysteme GmbH in Hermagor or to Noritec Holzindustrie GmbH in Stall, 38 kilometers away (see Table 2). About 800 GLT columns and 14,400 square meters of CLT wall panels were produced. About 50 trucks were used to transport the finished products from Carinthia to Vienna, a distance of about 390 kilometers.

Some 1,000 load-bearing XC composite ceilings, comprising about 16,000 square meters, were produced at




**Figure 11.** The envelope façade panels were pre-assembled in the factory and included the framing, insulation, vapor barrier, and exterior cladding. © cetus.at and Thomas Lerch.

**Table 2.** Travel distances and methods of mass timber materials delivered during the construction of HoHo Wien, Vienna.

| Transportation Distance and Method | | | |
|---|---|---|---|
| Material | Source | Distance from Factory to Site (km) | Transportation Method |
| CLT | Hasslacher Holzbausysteme GmbH, Hermagor, Austria | 383 | Truck |
| GLT | Noritec Holzbausysterne GmbH, Latzendorf/Stall, Austria | 388 | Truck |
| XC System | MMK Holz-Beton-Fertigteile GmbH, Gerasdorf, Austria | 14 | Truck |

**Table 3.** Rate of construction and workforce associated with the construction of HoHo Wien.

| Rate of Construction and Workforce | |
|---|---|
| Overall | |
| October 2016 to June 2019 | 32 months |
| Phase 1 | |
| Concrete foundation, Level 1, Level 2, Concrete cores | 15 months |
| Prefabrication of envelope panels, columns, and floor panels (3 months) | |
| Phase 2 | |
| Erection of mass timber elements and installation of the building envelope panels | 5 months |
| Phase 3 | |
| Interiors, finishes, and building systems | 12 months |
| Workforce/Equipment | |
| Workforce | 3 crews (4 members each, 12 people total) |
| Equipment | 2 cranes |



**Figure 12.** The prefabricated façade panels slot into the concrete edge beams below, using steel rods embedded in the top and bottom of the GLT columns. © cetus Baudevelopment + kito.at

Gerasdorf, about 13 kilometers from the site, and delivered on a just-in-time basis.

*Prefabrication*

The concrete beams were precast in the factory, ensuring accuracy and reducing messy site work. Windows were preinstalled in the wall elements, along with the vapor barrier.

*Site Delivery*

Columns, walls and beams were delivered directly to the construction site by the manufacturer. Due to the long distance required, this was always coordinated at least one day in advance. The ceiling elements were delivered and moved into place just-in-time as construction finished on the floor below.

*On-Site Construction*

The total construction period took 32 months (see Table 3). The first major site work after the pouring of the foundation was the erection of the concrete core, which was advanced via self-climbing formwork. On each floor, the GLT columns were placed simultaneously with the perimeter CLT walls (see Figure 12). The precast concrete beams were then craned into position and placed atop the columns (see Figure 13). This was followed by the installation of the floor panels (see Figures 14 and 15) with integrated MEP systems, delivered just-in-time. Gaps and openings were grouted and sealed as necessary, followed lastly by gypsum encapsulation where required.

Tolerances and Accuracy Testing According to Austrian engineering standards, there are three domains in which tolerances need to be checked:

reinforced concrete, composite prefabricated parts, and timber construction. The differences between the relative tolerances of these domains needed to be taken into account.

Due to legal requirements in Austria, including the "damage consequence class" assigned to each material type, quality assurance measures had to be developed and implemented. These were always carried out and checked every three stories. Activities included surveying work for misalignment and height measurements, on-site strength tests of the potting materials (grouts and sealants), and factory tests of the prefabricated elements.

*Fire Protection During Construction*

The dry fire riser always had to be a minimum of one



**Figure 13.** The precast concrete edge beam was placed on top of the columns using a pin connection. © Zimmerer I Handler.



**Figure 14.** The composite floor panels spanned from the precast edge beams to either the core (at right) or from precast concrete beams placed on top of GLT columns (at left). © Zimmerer I Handler.

story below the level currently under construction. In other words, at the construction of Level 10, the standpipe was required to have been above the floor of Level 9. On the ground floor (Level 1), there was a pump that could fill the pipes in case of fire, dispensing water before arrival of the fire brigade. In addition, fire monitoring was conducted 24/7 by two workers.

*Moisture Management During Construction*

The CLT panels used for the wall sections had waterproof membranes applied to the exterior-facing surface in the factory, before they were brought to the site. The exposed sides of all timber elements had to be wrapped in plastic, which was removed just prior to being lifted into place by crane.

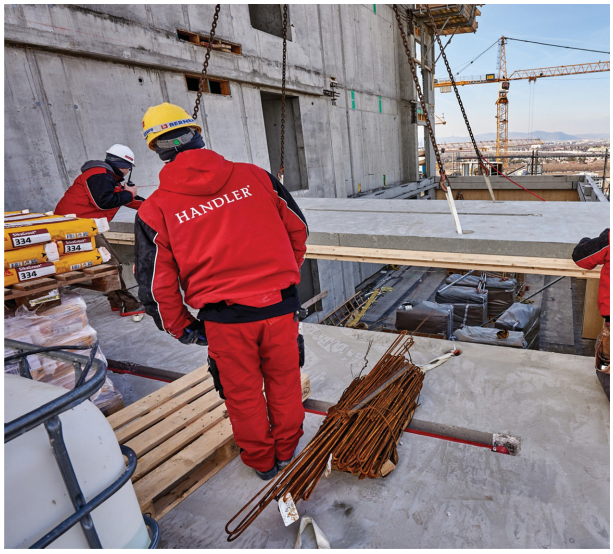



**Figure 15.** The composite floor panels combined CLT and precast concrete, with anchor locations cast into the concrete. ©

## 11. Carbon/Sustainability Overview

A total of 4,000 cubic meters of timber was used on this project: comprising the exposed ceilings, columns and exterior walls. Compared with a conventional concrete structure of the same scale, about 3,000 metric tons of carbon-dioxide equivalent was saved by choosing timber.

## Appendix

Status
► Completed: 2019
Building Function
► Mixed-Use
Level 1: hotel lobby, restaurant, and bakery
Levels 2 to 5: fitness, health, wellness, and beauty centers Levels 6 to 10: office
Levels 10 to 19: hotel
Levels 20 to 23: serviced suites
Level 24: technical
Structural Classification
► Concrete-Timber Hybrid
Structural Materials
► Mass Timber:
Columns (GLT): levels 1 to 24 Floors (CLT): levels 3 to 24
► Concrete: Foundations Floors: levels -2 to 2
Columns: levels -2 to 2
Beams: levels 1 to 24
Cores: levels 1 to 24
Building Milestone Dates
► Construction start: October 2016
► Completion date: June 2019
► Construction period: 32 months
Height
► Height to architectural top: 84 meters
► Height to highest occupied floor: 79.2 meters
► Height to tip: 84 meters
Number of Floors
► Above grade: 24
► Below grade: 2
Building Floor Area
► Total gross floor area: 25,000 m2
► Net internal area: 19,700 m2
► Area of building footprint: 1,372 m2
► Entire site/plot: 3,920 m2
► Site coverage: 35%
Number of Units
► 24 apartments
► 119 hotel rooms
Number of Elevators
► 6
Building Occupancy
► 818 Persons
Building Density
► 31 $m^2$ GFA/person
Project Team
Owner: AVV
Developer: cetus Baudevelopment GmbH; Kerbler
Architect: Rudiger Lainer + Partner (Design); Baumeister Josef Panis GmbH & Co., Architekt Dipl.Ing. Gottfried Markom (Architects of Record) Structural Engineer: RWT PLUS ZT GmbH MEP Engineer: ENGIE; Dr. Ronald Mischek ZT GmbH Main Contractor: Handler
Timber Suppliers: MMK (Ceiling Panels); Hasslacher Norica Timber; Noritec Holzindustrie GmbH (CLT and GLT) Fire & Life Safety: kunz Die Innovativen Brandschutzplaner Gmbh
Other Consultants: ENGIE (Building Monitoring); Arch. Dipl.Ing. Christine Binder-Ruff (Interiors); Zencon | Planung | Management | Immobilien GmbH (Planning); ViennaEstate Immobilien AG (Property Management) Other Material Suppliers: Doka GmbH (Formwork); Katzbeck (Windows)

## References

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