ARTEC

Treet – World`s tallest timber building
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Treet – World’s tallest timber building
Address - Damsgårdsveien 99, Bergen, Norway
Treet – World’s tallest timber building

Site
• Pre-study in 2007-2008, led by The Norwegian Wood Council (Treteknisk), recommended a combination of modules and laminated timber. This study was used as a background for the project.
• ARTEC was picked due to previous experience with modules.
• Main deliverer, Moelven, and structural engineer team, Sweco Lillehammer, was already picked by the time we joined.
• At the time, they were the only ones with such experience in Norway, working closely together for several years on related projects such as wooden bridges and large wooden constructions.
• First sketch project for Treet was developed winter 2010 – spring 2011.
• BOB - Developer
• ARTEC - Architect
• Sweco Norge - Technical advisers—all fields
• NTNU - In partnership with Sweco RIB
• Moelven - Supplier of laminated timber
• Kodumaja - Supplier of wooden elements and modules
• Smedsvig - Landscape architect
ASSEMBLY
1. MODULES

four modules on top of each other on concrete basement
2. FRAMEWORK

supporting structure
with power floor
3. MODULES

smaller modules
in power floor
4. PLATFORM
platform as a base for the next four modules
5. MODULES
four new modules
6. FRAMEWORK
supporting structure
with power floor
7. MODULES
modules
and platform as a base for the next modules
8. MODULES
last four modules and stabilizing structure
9. ROOF
roof construction and terraces
10. BALCONIES

balcony floor and supporting structure for glass facade
11. FACADE
glass on north and south facades
12. FACADE
metal cladding on east and west facades
COMPONENTS
MODULES
+ FRAMEWORK IN LAMINATED TIMBER
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Module study
Alternative 1 - classic    Alternative 2 - L    Alternative 3 – the cube    Alternative 4 - Z

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4 proposals
<table>
<thead>
<tr>
<th>ALTERNATIVE 1</th>
<th>ALTERNATIVE 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Flexible</td>
<td>+ Tall and skinny</td>
</tr>
<tr>
<td>+ Nice common terraces</td>
<td>+ Simpel geomtri</td>
</tr>
<tr>
<td>+ Potential for further development</td>
<td>+ Efficient plan</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>- Seems small and thick</td>
<td>- Fixed shape – little to work with</td>
</tr>
<tr>
<td>- To many difficult transitions to weather proof</td>
<td>- No common terraces</td>
</tr>
<tr>
<td>- Long corridor</td>
<td>- Plain look</td>
</tr>
<tr>
<td>- Not space efficient</td>
<td>- Lacks flexibility</td>
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**KONKLUSJON – kombinere kvalitetene fra 1 og 4 i alternativ 1 smal**

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Choice between 1 and 4
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Concept: combination of 1 and 4
• We have no «recipe» - no one has done this before
• Weather proofing of the building and during assembly
• Durability of chosen materials and need for maintenance in use
• Assembly of the building – safety and choice of scaffolding
• Needed tolerances for assembly
• Economy – long planning process and costs of materials
• Lack of experience among contractors can cause overpricing
• Marked respons
• Structural challenges with possible swinging in strong wind
• Movement of components and shrinking after assembly
• Include the main contractors in development of the project – contractors know their product and demands for efficient use and assembly
• Put together the entire team as early as possible so all aspects can be considered
• Prefabricate as much as possible and only do assembly on site
• Plan assembly of each component as soon as it is proposed - if it`s complicating the process it needs to be re-designed
• Entire project has been designed in 3D (BIM) to have a control of all components, phases and possible collisions
• Step by step models – virtual assembly to discover possible problems and to avoid surprises

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How do we do this?
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Typical floor plan
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Typical floor plan on a power floor
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Sections
Where to place main construction?

Construction built in

Structural powerfloors between appartments

Construction placed outside – separated from modules
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Construction concept
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Snapshot from 3D model – early phase
Weatherproof facade and timber structure separately

Weatherproof everything together

Glass inn the entire building

Cladding outside the construction

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Weather proofing of timber constructions
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Balconies
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Principle glass facade
• Pre approved: fire safety classification between each floor
• Every triangle instead of every floor
• Window casing with EI30
• Securo along the laminated beam – open for ventilation, sealed in case of fire
• Cavity between cladding and module is insulated

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Fire safety classification of gable facade
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Window case – prototype manufactured
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Test - prefabricated facade elements
Facade before and after metall cladding

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Facade before and after metall cladding
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Detail gable wall – fire, weather and sound protection
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Detail gable wall – picture from construction site
• The building is fully sprinklered, including the balconies
• All main constructive parts have a R90 fire resistance
• Modules are dimensioned to withstand fire for 74min
• One set of 4 modules needs to be fire resistant for 90 minutes, but simulation shows that a full course of fire for one apartment is only 74 minutes
• Horizontal division with concrete at two levels is helping the total fire resistance
• All exposed timber elements are fire painted
• No cavities with combustible materials are left uninsulated
• Originally the building was planned with timber cladding – at the time we weren’t able to find any fire treatment which was durable for more than 5 years, an impossible frequency considering maintenance costs

• All indoor advantages of exposed timber, such as regulation of humidity in air is stopped by the fire treatment

• Fire treatment contains various chemicals which are not so good for the environment

Despite this – we still think it is a good idea to build tall buildings in timber but there is a need for more development and research on this topic
• Gym is the not made as a modul
• The room has double height, and exposes the construction of a powerfloor
• Balconie in front og gym is included as a part of the room, and therfor fully insulated
• Floor is hanging on main structure and all wals are soundproofed

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Gym
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Gym
Roof terrace is divided into tree areas - two on 14th and one on 15th floor.

It is a concrete deck on top of modules – supported by main structure.

This solution is mainly chosen for the weight which is needed to reduce swinging to comfort level.

Glass railing is reducing sound impact from the heavy trafficked bridge below.

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Roof terrace – 15th floor
• Delivered by Kodumaja and shipped to site
• Maximum width of a module is 5.3m (maximum for transport on Norwegian roads 4,2m)
• Each apartment is built as passive house and with universal design
• Modules on top of each sequence of 4 and modules in power floors are made with sloping roofs to prevent water from collecting during assembly
• The modules are weather protected and can stand outside during the assembly phase
• Modules arrive on site complete, including parquet, kitchen and closets

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Components - modules
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Modules
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Stacking of modules
Laminated timber is supplied by Moelven Limtre

The delivery is divided in three phases

Dimension of the largest components are 650x405mm

All exposed laminated timber, both inside and outside, is fire treated

All laminated timber is prefabricated and cut in Moelv in Norway

Main construction is made of norwegian timber
• Trusses are assembled entirely in the factory before they are dismantled and sent by truck to Bergen
• Trusses are assembled again on site before being lifted into place
• The size of the laminated timber construction is partly due to fire requirements and not only due to the construction
• Trusses are exposed several places inside the building, among others outside the main entrance, main staircase and on the balconies
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Components – laminated timber
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Components – laminated timber
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Laminated timber
• Main stairs, elevator shaft and walls in corridors and staircases are made in CLT
• CLT is delivered by Moelven but produced by Merk Timber in Germany.
• All exposed timber is treated and has a whitewashed surface

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Components- CLT
The balconies are a supporting system for the glass facade – mainly hanging in two large laminated timber beams.

- Balcony slabs are made of CLT and span between CLT plates that are attached to laminated columns.
- Both floors, walls and ceilings are exposed and untreated CLT.

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Balconies
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Picture taken at the construction site
Thank you for your attention

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