Prefabricated volumetric modules

Ekaterina / Chia-Yin / Lennart / Yi-Hua

Treet

Architects: ARTEC

Location: Bergen, Norway

Category: Residential

Floor Area: 14-storey
4,500 m²

Completed Year: 2015

European School in Frankfurt

Architects: NKBAK

Location: Frankfurt, Germany

Category: Educational

Floor Area: 3-storey
3,380 m²

Completed Year: 2015

Structural concept

Treet

A cabinet rack filled with drawers. Here, the cabinet rack is formed by large glulam trusses, and the drawers consist of prefabricated residential modules.

Levels 1-4:
- rest on the deck of a concrete garage
- not connected to the load bearing structure

A power storey:
- strengthened glulam storey
- connected to the facade trusses
- do not rest on the building modules below
- carries a prefabricated concrete slab
    - connects trusses
    - increase the mass of the building to improve the dynamic behavior

…

Structural concept

European school in Frankfurt

Modules are load-bearing.
The basic construction consists of spruce cross-laminated timber and is surrounded by a BauBuche frame (beams and columns).

Beam: with a height of only 560 mm, even spans of up to 9 metres could be bridged without any supports.

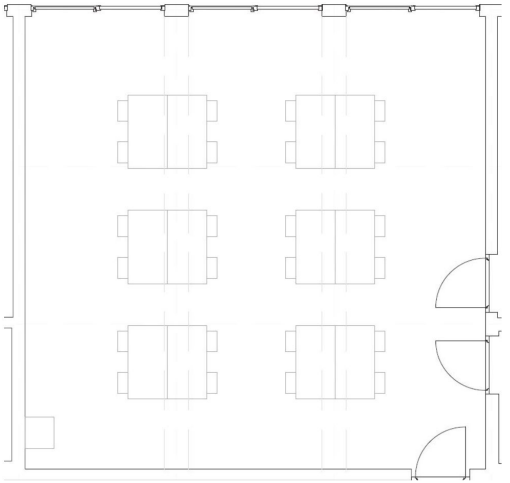
What is a BauBuche beam?

LVL boards are cut up into strips. These strips are sanded and proceed through a second gluing process. The adhesive is applied and the strips are stacked and bonded together, similarly to glued laminated timber, to form large beams.

⇒ exceptional strength

Modules without side walls.

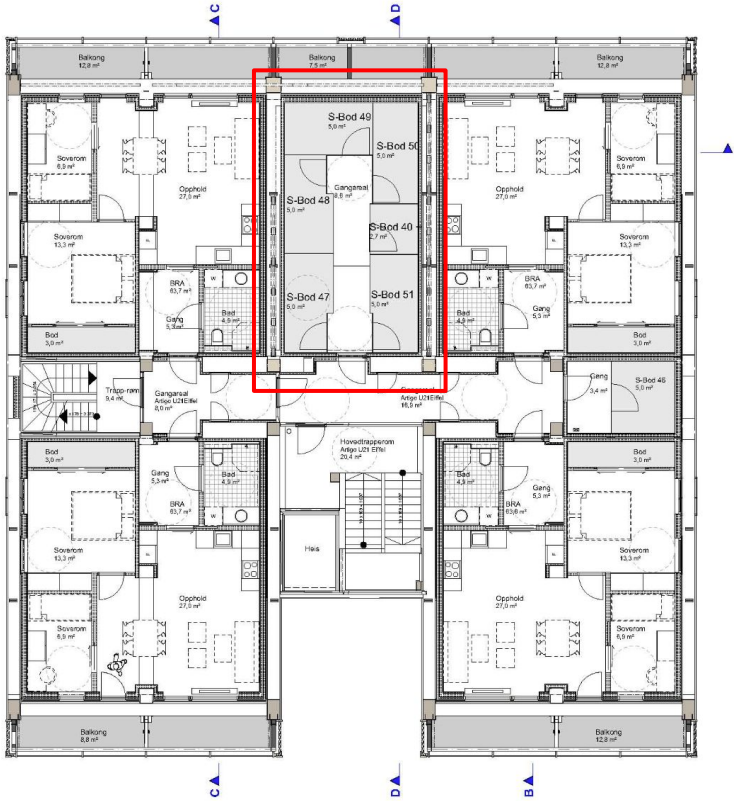
- floor plan design could be carried out flexible
- temporary support during transport



Plan

Treet

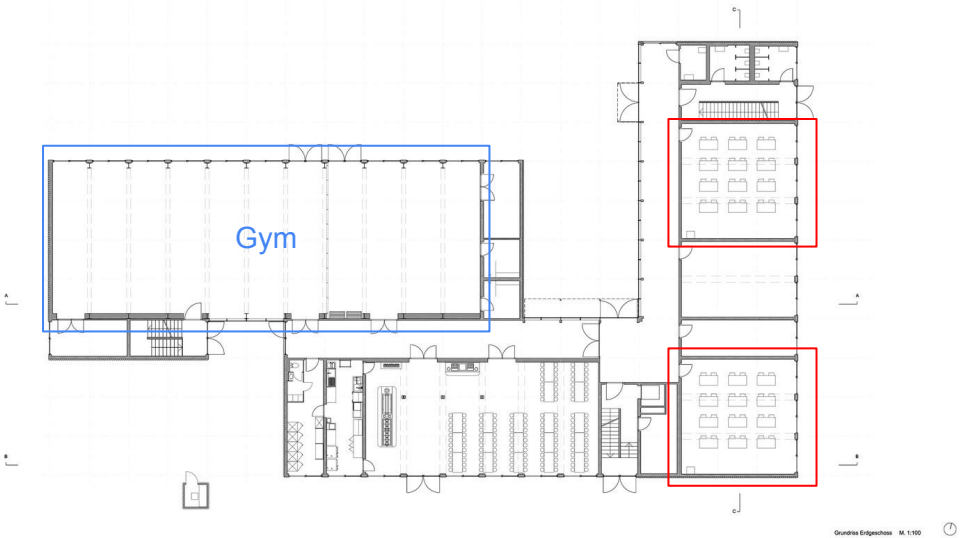
Typical floor plan



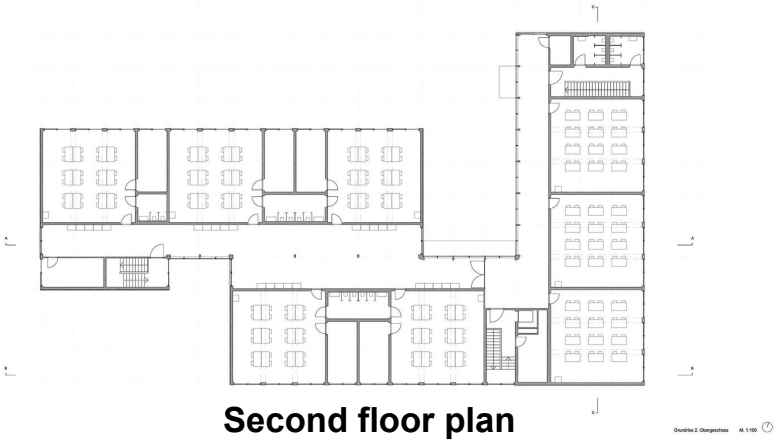
Typical floor plan on a power floor

Plan

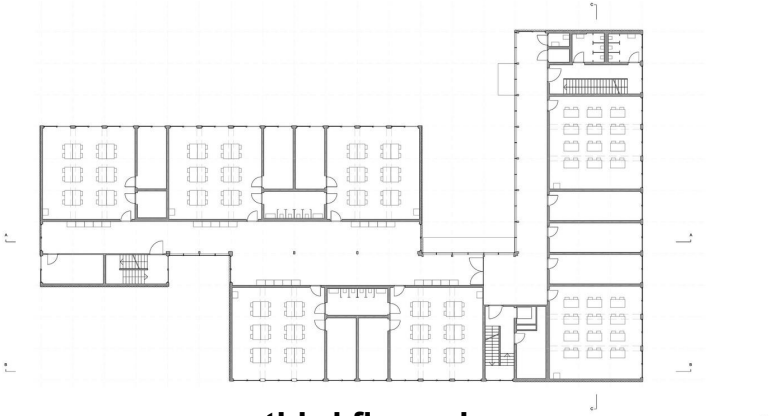
European school in Frankfurt



Ground floor plan



Second floor plan



third floor plan

1.1 - What constraints were imposed by the system in terms of prefabrication, transport and site work conditions?

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- **Prefabrication:**
  Modules were engineered, designed and produced by Kodumaja, Estonia.

- **Transportation:**
  Because of the site location next to the water, modules could be delivered by ship.This provided the possibility of using wider modules than Norwegian road regulations allow (only max. 4.2m wide transport possible.)

- **Construction Site:**
  Glulam frames are delivered by Moelven (in Sweden) and are assembled after each stack of four modules.

1.2 - What constraints were imposed by the system in terms of prefabrication, transport and site work conditions?

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- **Prefabrication:**
  The wood beams were produced by Pollmeier in Creuzburg, Germany.
  The Modules were prefabricated by Kaufmann Bausysteme GmbH, Reuthe, Austria.

- **Transportation:**
  Modules could be delivered by trucks from Austria to Germany.

- **Construction Site:**
  Frankfurt, Germany

3.1 - Which elements are standard and which ones are unique?

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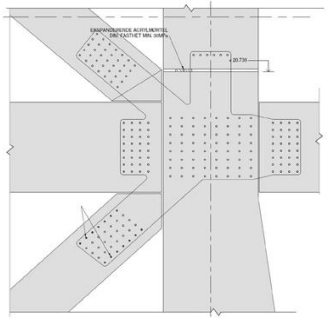
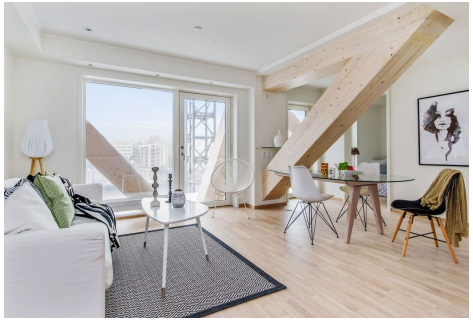
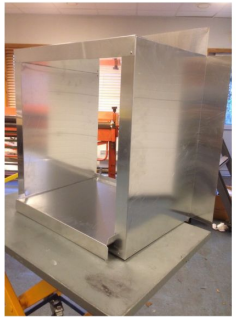
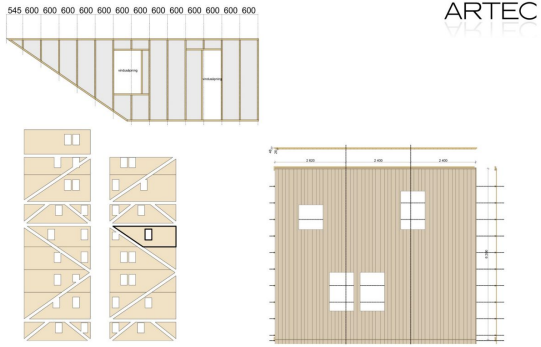
Standard elements



Unique elements







3.2 - Which elements are standard and which ones are unique?

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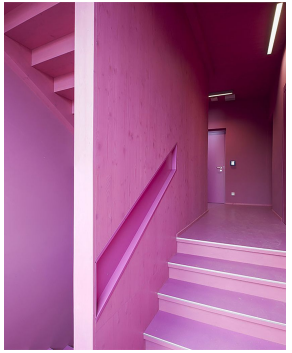
Standard elements

Unique elements



4 - Draw a typical joint that shows how the elements were joined on site.

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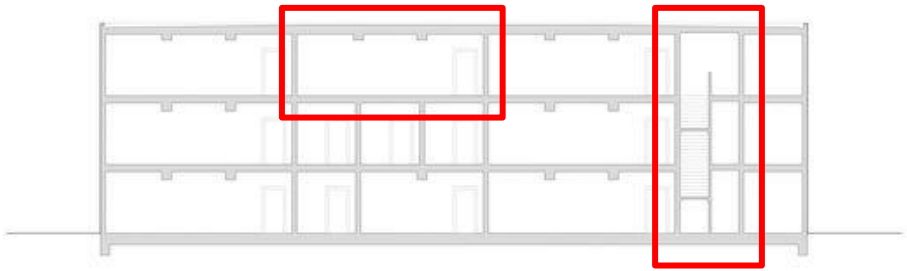
Fire Units-

One set of 4 modules needs to be fire resistant for 90 minutes.

One classroom with 3 modules needs to be fire resistant.



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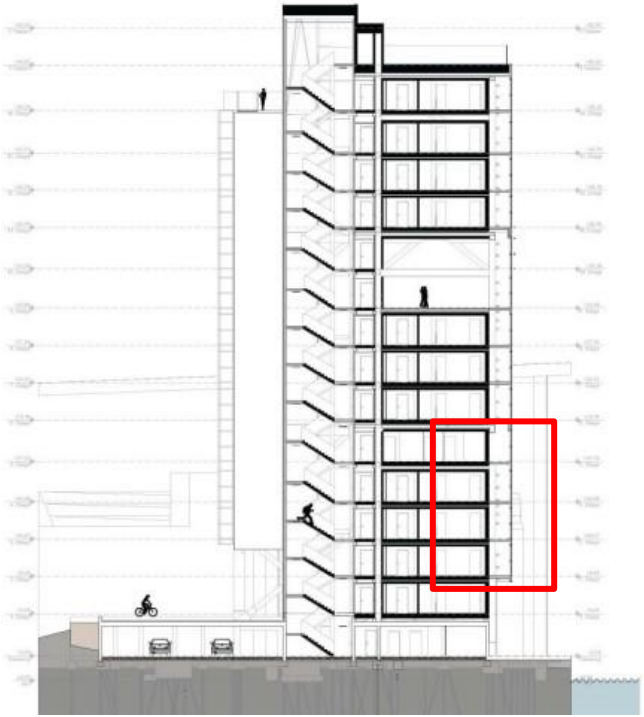

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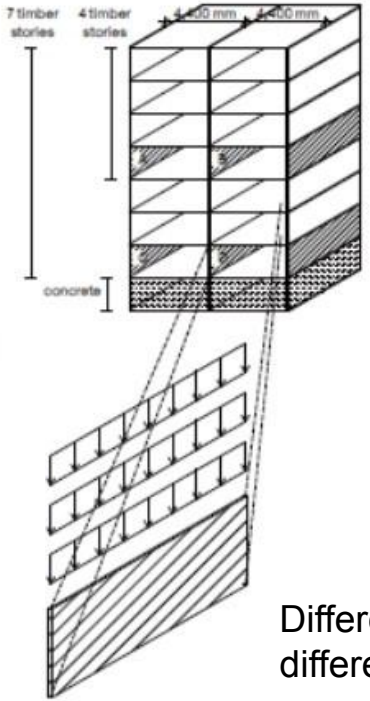
4 - Draw a typical joint that shows how the elements were joined on site.

Volume system

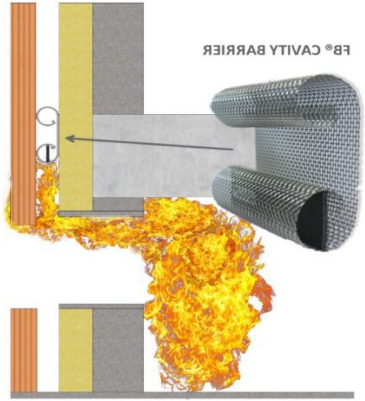
Fire-stopping principle



Different fire resistant according to different load-bearing.

Other fire-stopping

Outside



Stop the fire spreading from down stair to upper or other floors

4 - Draw a typical joint that shows how the elements were joined on site.

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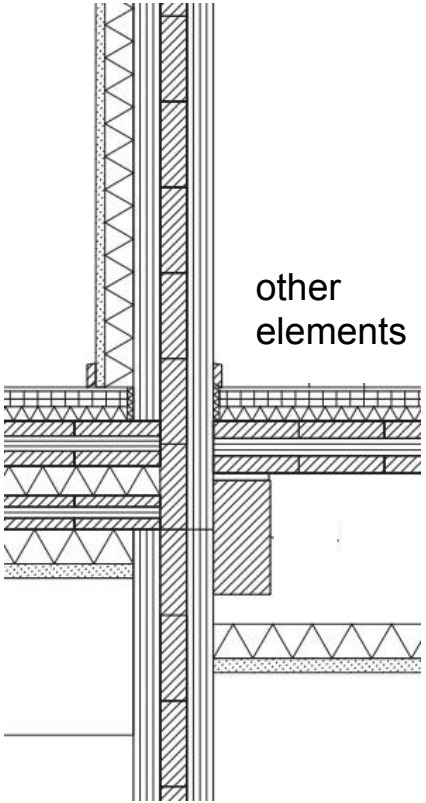
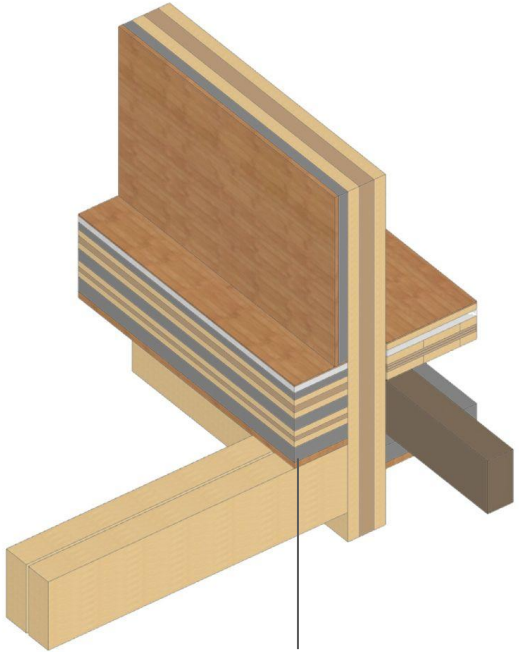
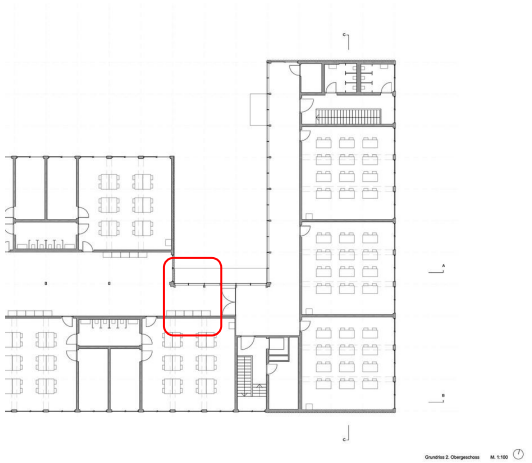
modular

other elements





insulation layer



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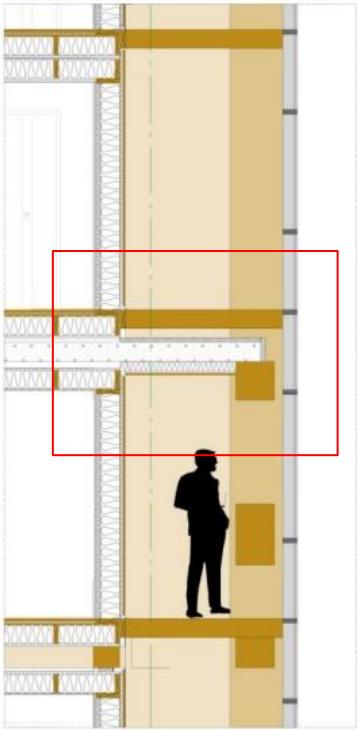
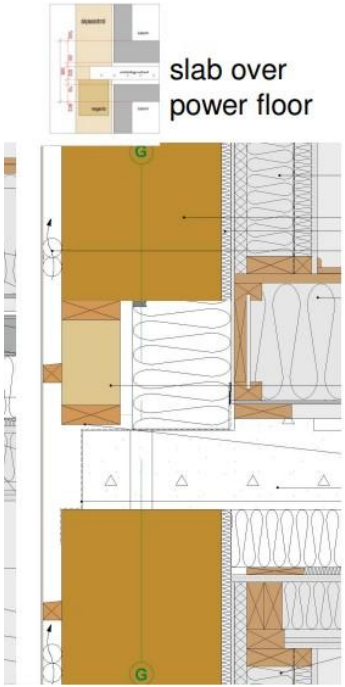
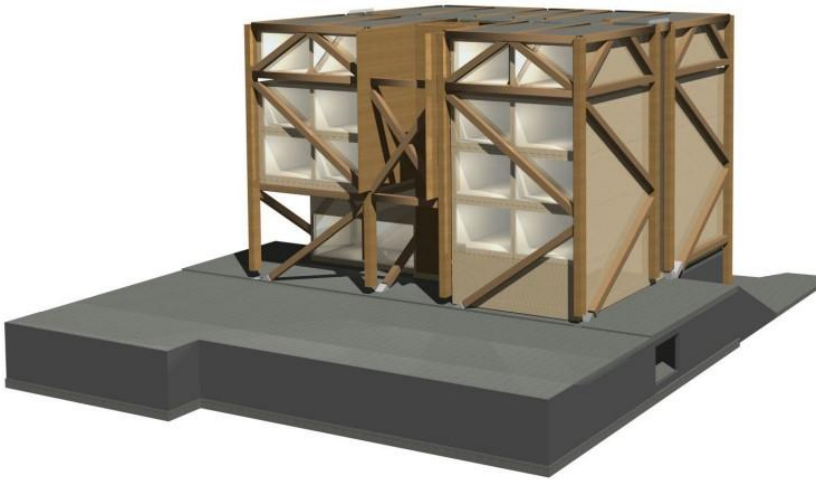




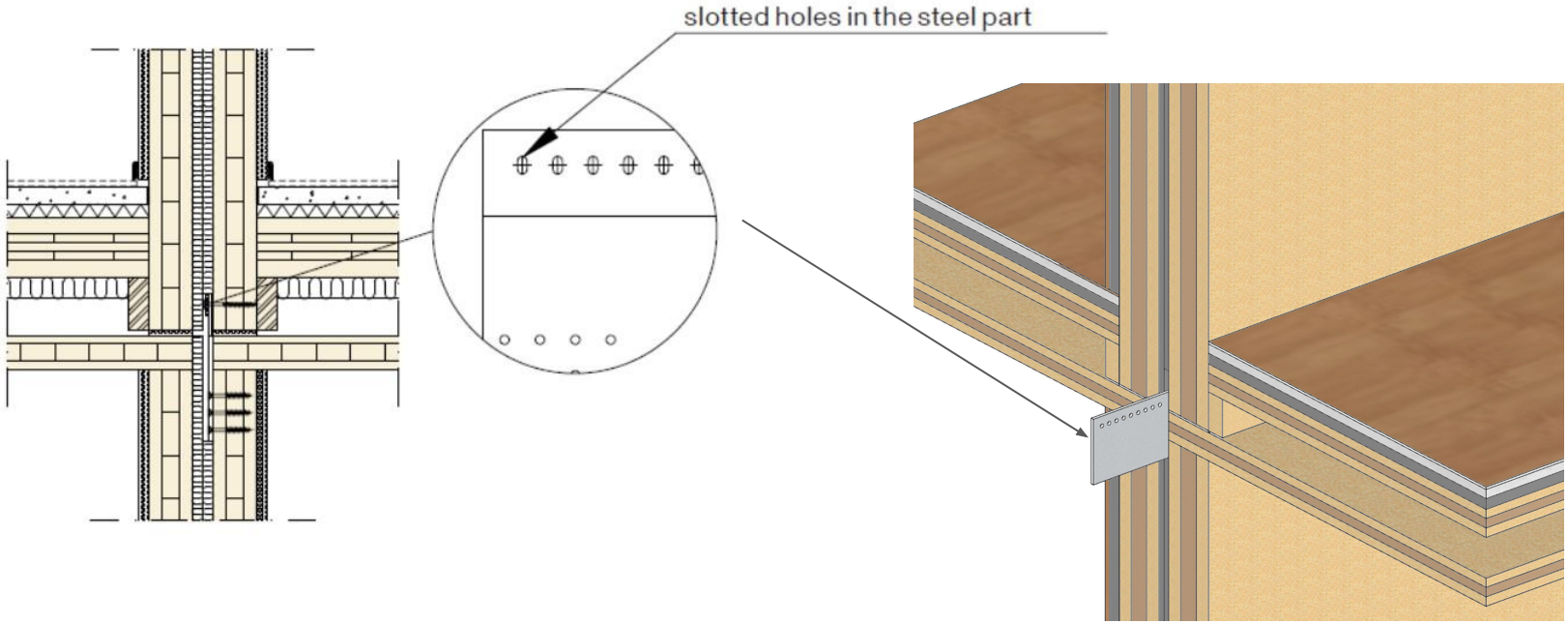
Platform as a base for the next four modules



4 - Draw a typical joint that shows how the elements were joined on site.

Deformation

The structure of volume system consists of each modular units with various loading.
Steel part with sloted holes used to reduce the effects of the deformation within modulars



5.1 - How were the elements transported and lifted on site? Define or evaluate the size of the elements.

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Delivered by Kodumaja and shiped to site
Maximum width of a module is 5.3m
Modules arrive on site complete, including parquet, kitchen and closetsc
Dimension of the largest main structure components are 650x405mm

5.2 - How were the elements transported and lifted on site? Define or evaluate the size of the elements.

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Maximum width of a module is 3x3x9m
Prefabric modules with windows in factories.
Modules arrive on site complete

6 - Are there any restrictions to the system? Are cantilevers, overhangs or large openings possible?

	Treet, Bergen	European School in Frankfurt
cantilevers	no due the frame structure	no : the different type of modules (2-, 3-walls): the solid facade
overhangs	no	no
large openings	yes, openings in modules could be larger, because frame bears load	no

7.1 - What particular innovations can be seen in this application of the system?

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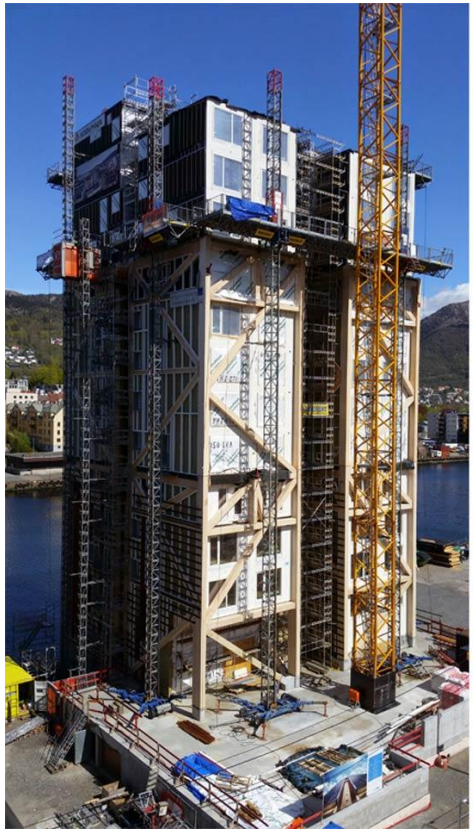

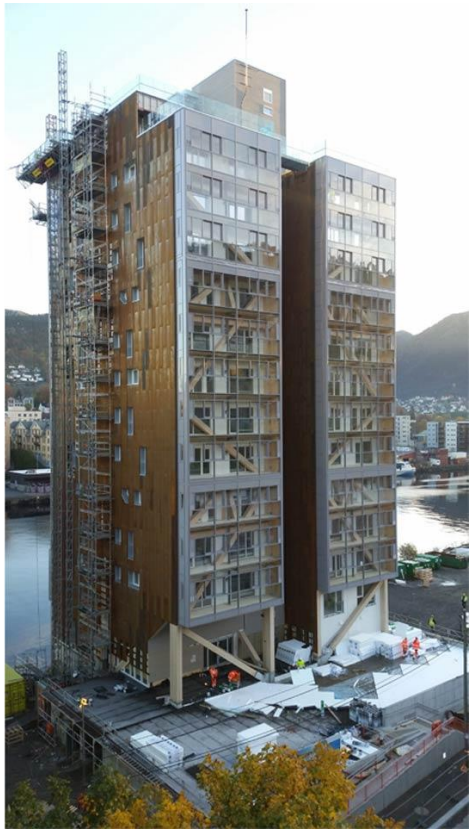

- Combination different systems:
  Glulam trusses frame +
  CLT residential modules

- Different floors:
  typical floor / power floor

- Window unit

7.2 - What particular innovations can be seen in this application of the system?

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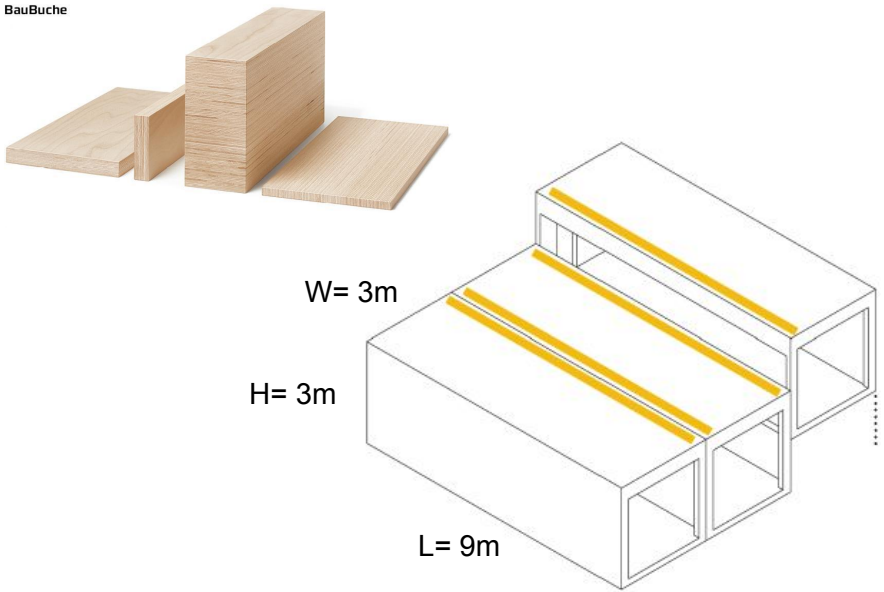

- The modules have spans of up to 9m as self-supporting structures.
  Wood beams out of 'Baubuche' (Laminated beech plywood) were used the first time due to their high strength especially for slender structures with large spans.

- Double beams - flexibility of space using

Resources - Treet

https://wood-works.ca/wp-content/uploads/Edmonton_wood-fair_marina.pdf

https://urbannext.net/treet/

https://kodumaja.ee/en/references/treet/

http://treetsameie.no/wp-content/uploads/pdf/Treet_prospekt.pdf

https://www.timberdesign.org.nz/wp-content/uploads/2018/05/2014Vol22Iss3-Abrahamsen-Paper.pdf

Microsoft PowerPoint - 04 Ole and Rune - Construction of Treet - Part one (wood-works.ca)

Some structural design issues of the 14-storey timber framed building “Treet” in Norway | SpringerLink

Resources - European School in Frankfurt am Main

https://nkbak.de/de/europaeische-schule-frankfurt/

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