MOKUKAI.

THE WOOD COMMUNITY

WORKSHOP
HOUSING
STUDIOS
CAFE

COMING 2025

GIDEON DE GRAAF
ARCHITECTURAL ENGINEERING
GRADUATION STUDIO P5

SELFBUILDING
~~NO~~ STUDENT HOUSING
ON TU DELFT CAMPUS
~~NINE TO~~ PAST FIVE ALIVE

MOKUKAI

Empowering students to build a community through self-build architecture

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PROJECT PROPOSAL

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PROJECT NAME

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Mokukai (*Japanese*)

"The Wood Community"

Community building through participating in selfbuilding architecture and the built environment

MOTIVATION
WHY?

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01 Housing shortage

Housing shortage among students.
Currently a shortage of ca. 2400 rooms.

31500 students attend the TU Delft

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Theresia Schouten 18-09-22, 07:00

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02 TU Delft Campus

27000 daily visitors

TU Delft's nine to five working ethic leads to a deserted campus after hours. Contradicting their own vision.

PROJECT OBJECTIVE

Provide students with housing while simultaneously create more social interaction, initiating the transformation from business district to an urban living environment.

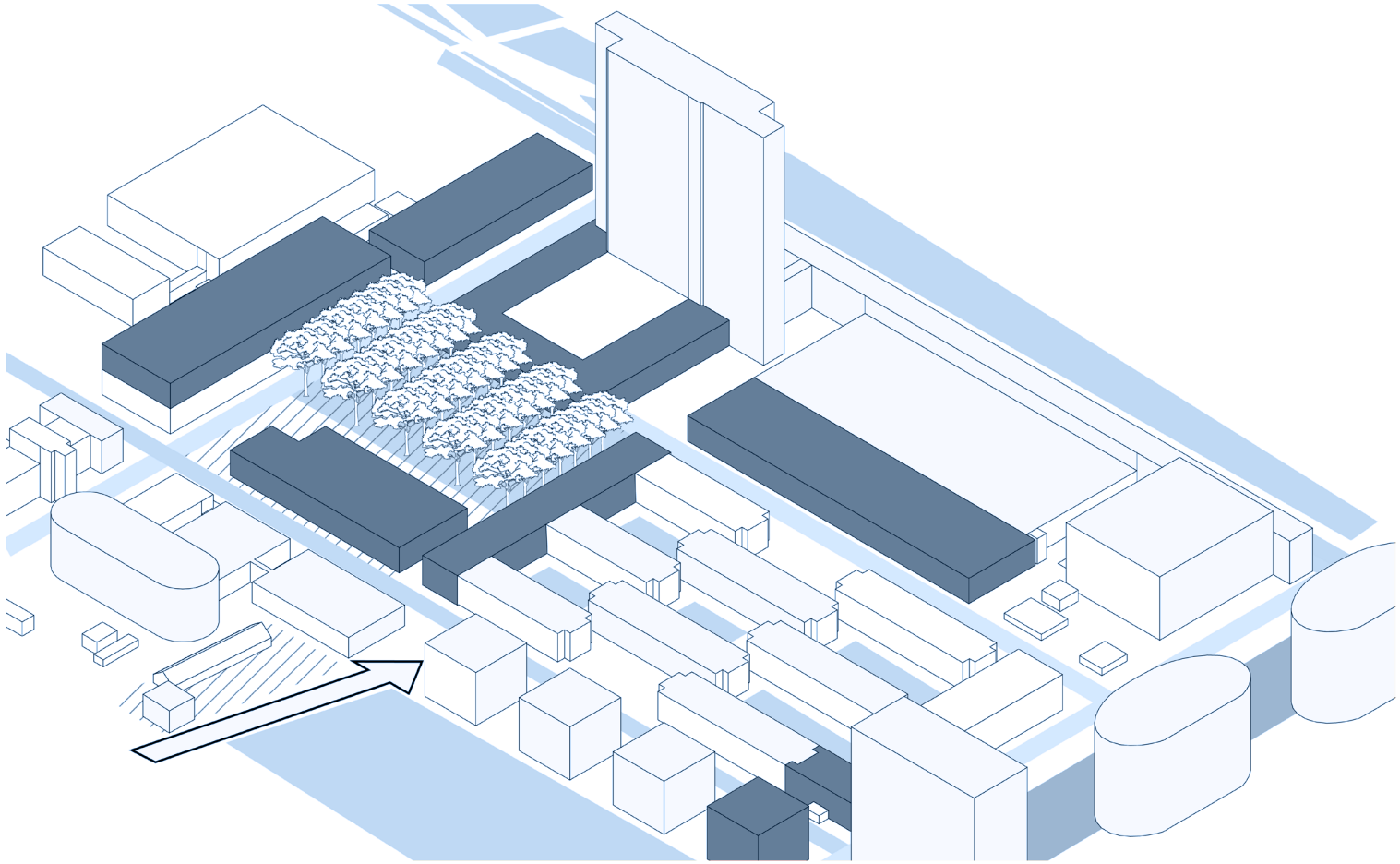
Why Self-Building?

Solution for both problems

I Empowering students to take matters into their own hands

II Stimulate sense of community, by active involvement

LOCATION
TU DELFT CAMPUS MIDDEN



But how do you design for selfbuilding?

RESEARCH OBJECTIVE

Determine what it means to design for self-building

What is required from a timber building system to have students built their own housing?

TOOL DEVELOPMENT
CRITERIA

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Criteria for DfSB
1. Required operator skills
2. Tool complexity / weight / dimension / ability to grip
3. Workspace accessibility
4. Number of component types
5. Connector integration / support integration
6. Number of fastener types
7. Connection type
8. Fragility
9. Number of components
10. Number of fasteners

TOOL DEVELOPMENT
PAIRWISE CRITERIA CHART

	Workspace accessibility	Tool complexity	Required operator skill	Ability to grip	Weight	Dimensions	Connector integration	Support integration	Number of components	Number of component types	Number of fasteners	Number of fastener types	Connection type	Fragility	**Rating**	%
Workspace accessibility		1/2	1/3	1/2	1/2	1/2	3	3	7	1/2	8	4	5	6	**38,8**	9,05
Tool complexity	2		1/2	1	1	1	4	4	8	3	9	5	6	7	**51,5**	12,02
Required operator skill	3	2		2	2	2	5	5	9	4	9	6	7	8	**64**	14,93
Ability to grip	2	1	1/2		1	1	4	4	8	3	9	5	6	7	**51,5**	12,02
Weight	2	1	1/2	1		1	4	4	8	3	9	5	6	7	**51,5**	12,02
Dimensions	2	1	1/2	1	1		4	4	8	3	9	5	6	7	**51,5**	12,02
Connector integration	1/3	1/4	1/5	1/4	1/4	1/4		1	5	1/2	6	2	3	4	**23**	5,37
Support integration	1/3	1/4	1/5	1/4	1/4	1/4	1		5	1/2	6	2	3	4	**23**	5,37
Number of components	1/7	1/8	1/9	1/8	1/8	1/8	1/3	1/3		1/6	2	1/4	1/3	1/2	**4,7**	1,10
Number of component types	1/2	1/3	1/4	1/3	1/3	1/3	2	2	6		7	3	4	5	**31,1**	7,26
Number of fasteners	1/8	1/9	1/9	1/9	1/9	1/9	1/4	1/4	1/2	1/7		1/5	1/4	1/3	**2,6**	0,61
Number of fastener types	1/4	1/5	1/6	1/5	1/5	1/5	1/2	1/2	4	1/3	5		2	3	**16,6**	3,87
Connection type	1/5	1/6	1/7	1/6	1/6	1/6	1/3	1/3	3	1/4	4	1/2		2	**11,4**	2,66
Fragility	1/6	1/7	1/8	1/7	1/7	1/7	1/4	1/4	2	1/5	3	1/3	1/2		**7,40**	1,73

The evaluation tool is ready

But does is work?

VALIDATION
CASESTUDIES

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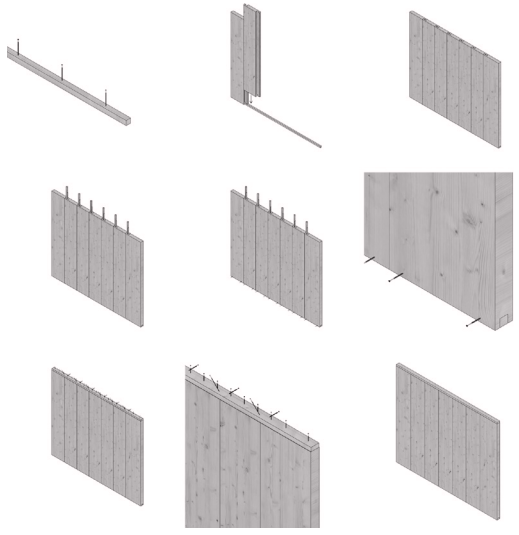
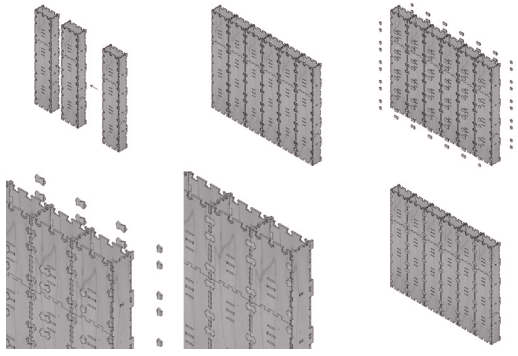
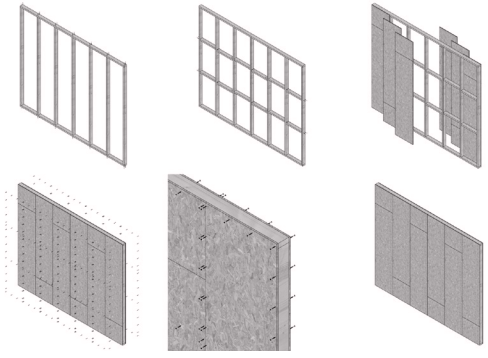


KLIK-KLIK™ WALL by CLT Factory



Skylark 250 by WikiHouse



Conventional timber frame construction

VALIDATION
CASESTUDIES

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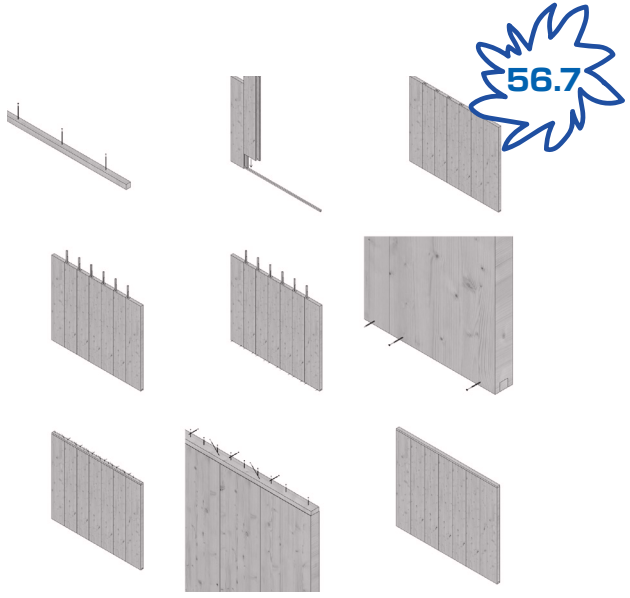

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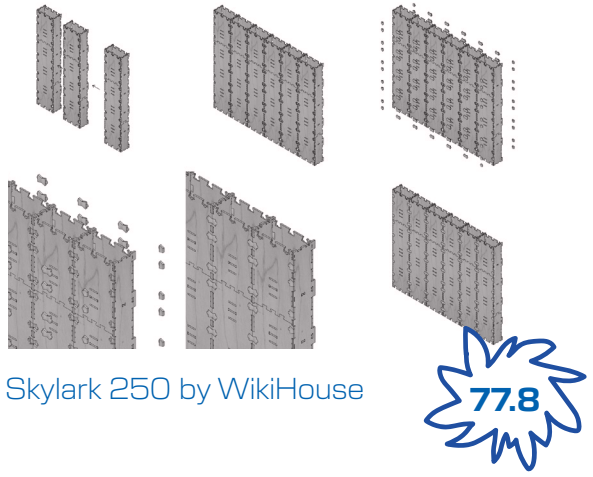

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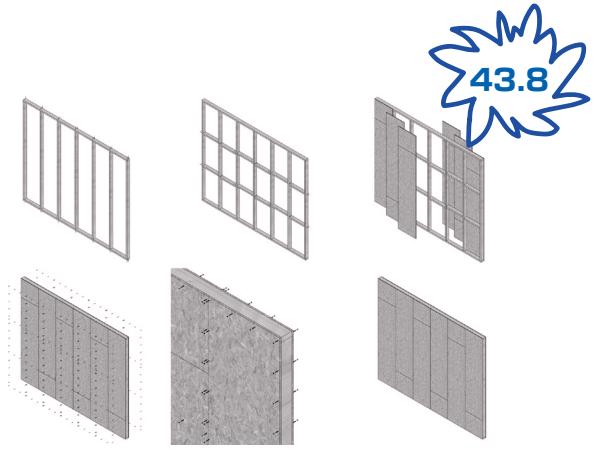

Conventional timber frame construction

FINDINGS

I **Ease of Assembly**: The system should be designed with minimal complexity. This includes clear steps, pre-fabricated components and simple connection mechanisms.

II **Lightweight and manageable components**: The components should be lightweight and easy to handle, ensuring that individual components can be moved and assembled by one or two people without specialised equipment

III **Minimal tool requirements**: The system should require none or only basic, easy accessible tools, reducing the need for specialised skills or equipment.

IV **Safety and stability**: The system must ensure structural integrity and safety, even when assembled by non-professional builders, to prevent accidents and ensure long-term durability.

FINDINGS

Why was this useful?

I Guidelines for Design for Self-Building

II A tool to test building systems on their ability to self-build

WIKIHOUSE

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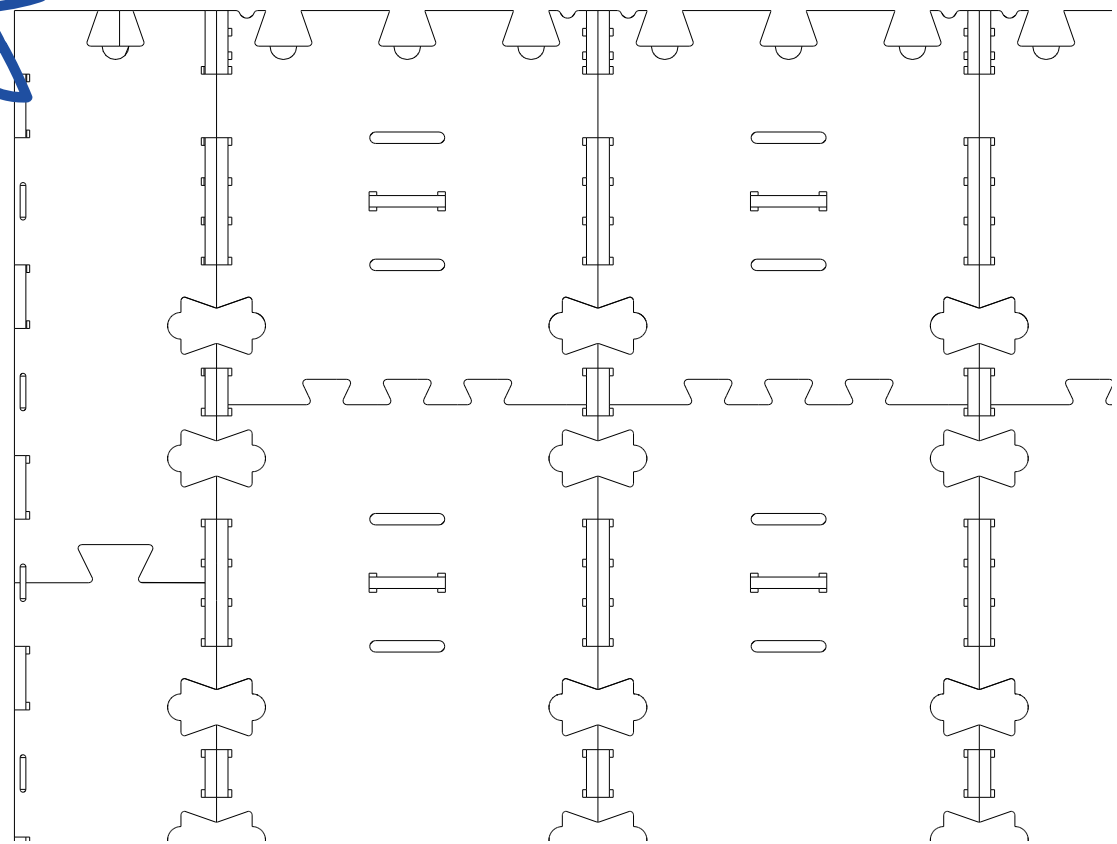
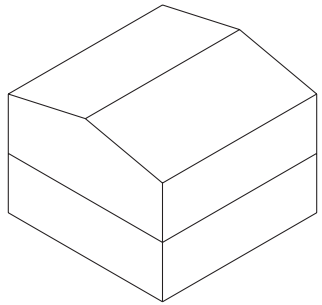


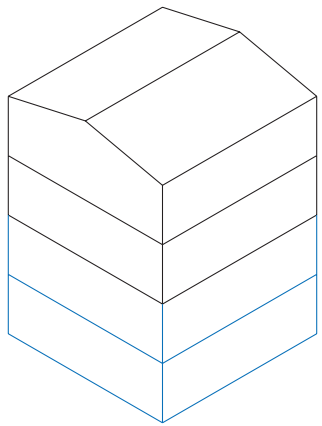
Wikihouse is a open source building system that uses cnc-milled sheet material to create building elements.

These elements are assembled with nails or screws and fastened together with bowties.



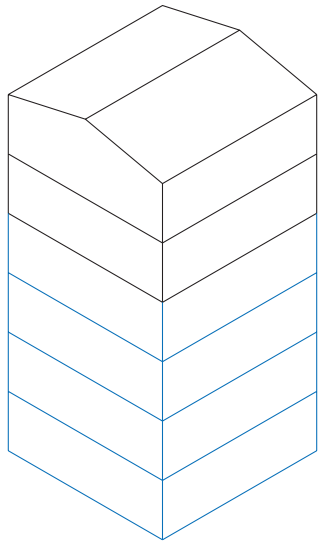
WIKIHOUSE IS DESIGNED FOR SINGLE DWELLINGS UP TO TWO STOREYS

ISSUE



MULTIPLE
~~TWO~~ STOREYS

ISSUE



MULTIPLE
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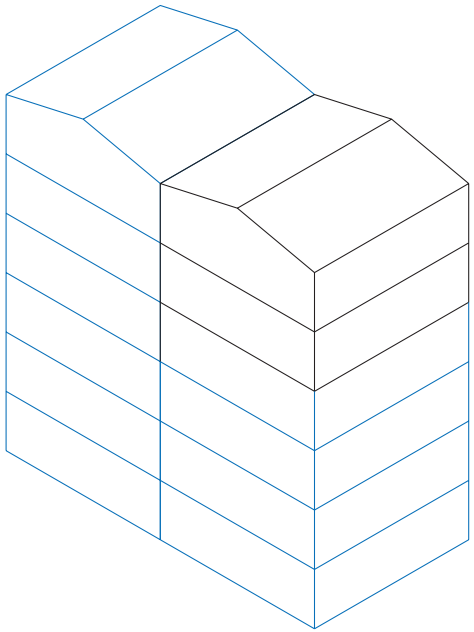
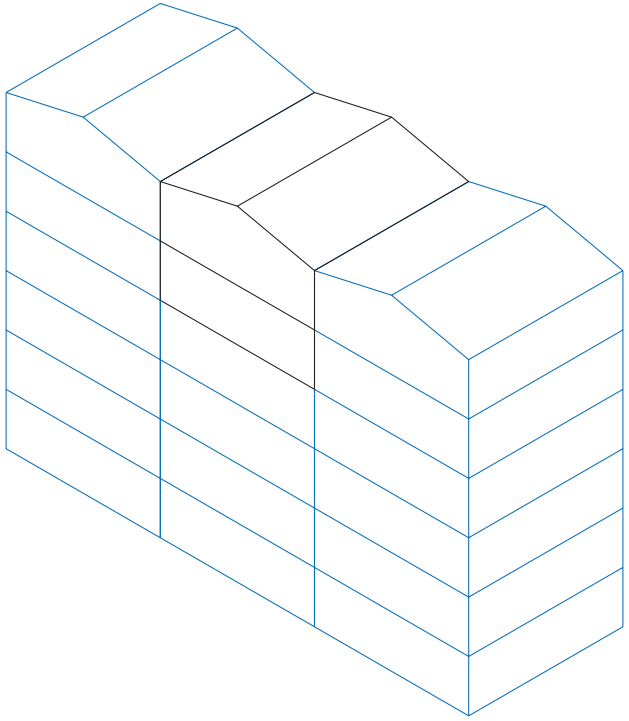


MULTIPLE
~~TWO~~ STOREYS

ISSUE

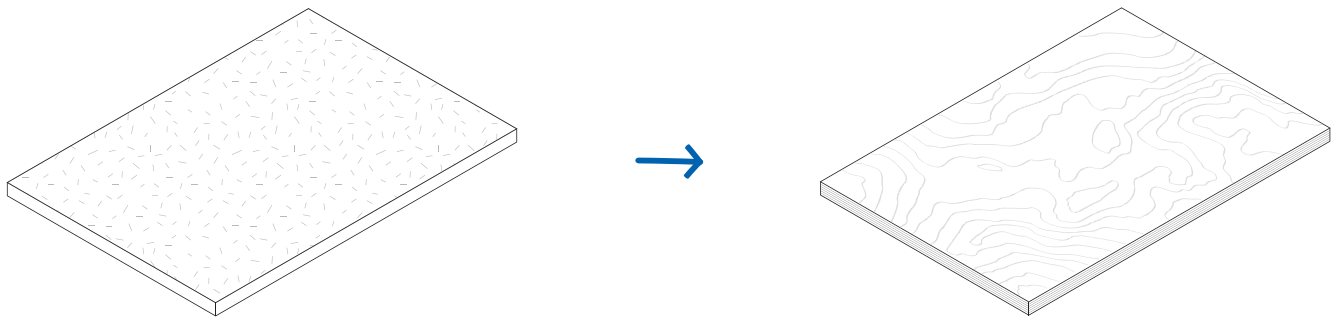


MULTIPLE
~~TWO~~ STOREYS

ISSUE

It needs reinforcement!

The first step is to switch from OSB (oriented strand board) to birch plywood.



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SOLUTIONS

The second step was comparing the system to traditional ways of timber construction

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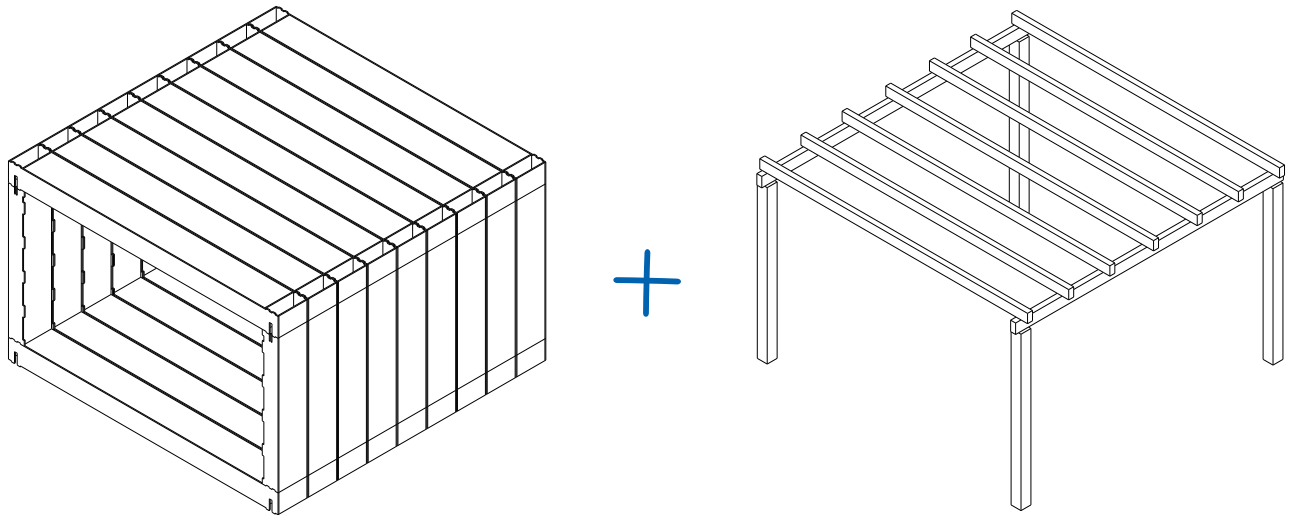
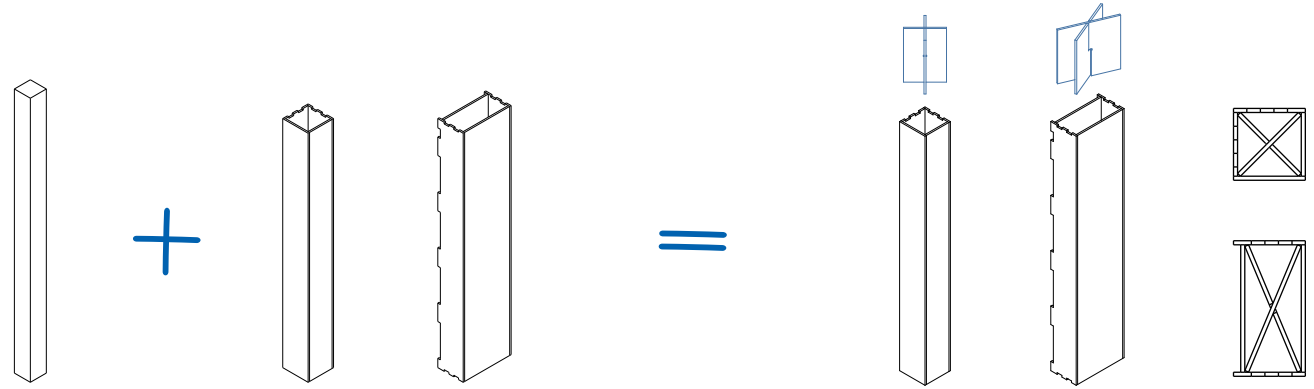


SOLUTIONS

Corner and wall elements have been beefed up with cross members to resemble a solid wooded column.



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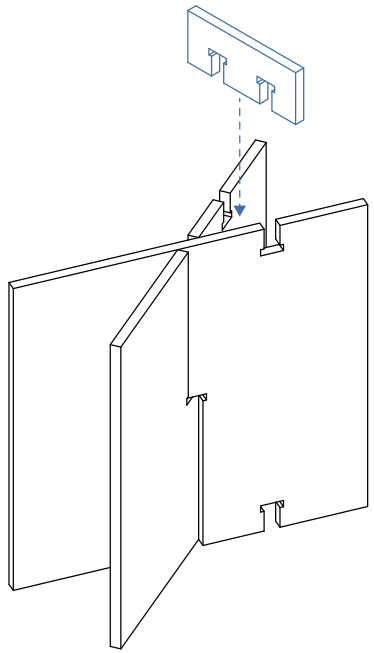
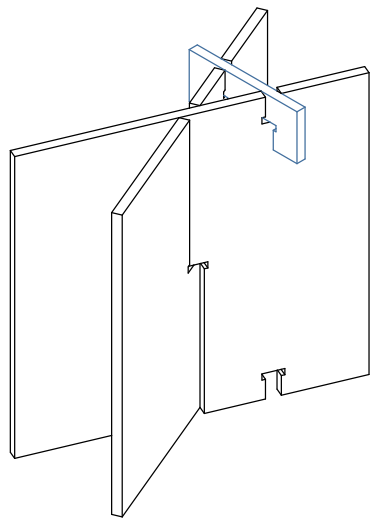
SOLUTIONS

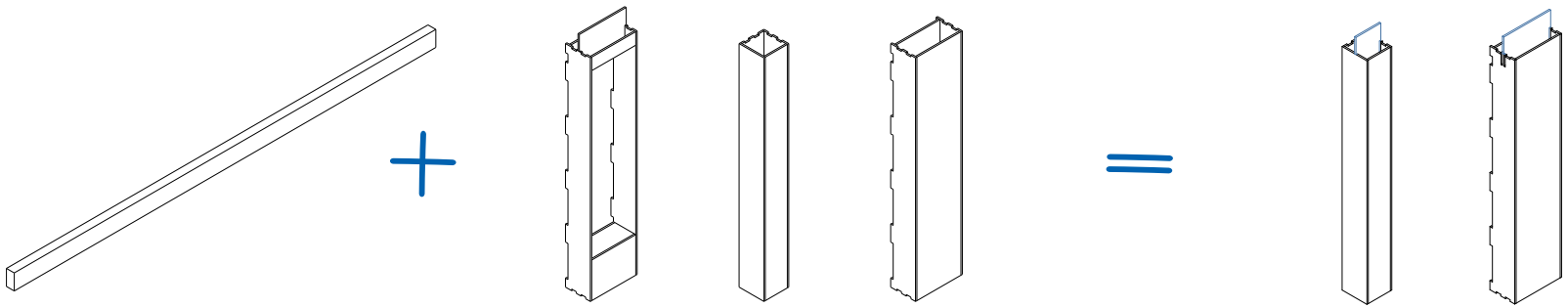
The cross members are made from the same plywood and are milled on the cnc. Two pieces slot together and a third one locks them is place.





SOLUTIONS

The final step has been the introduction of a beam within the system.



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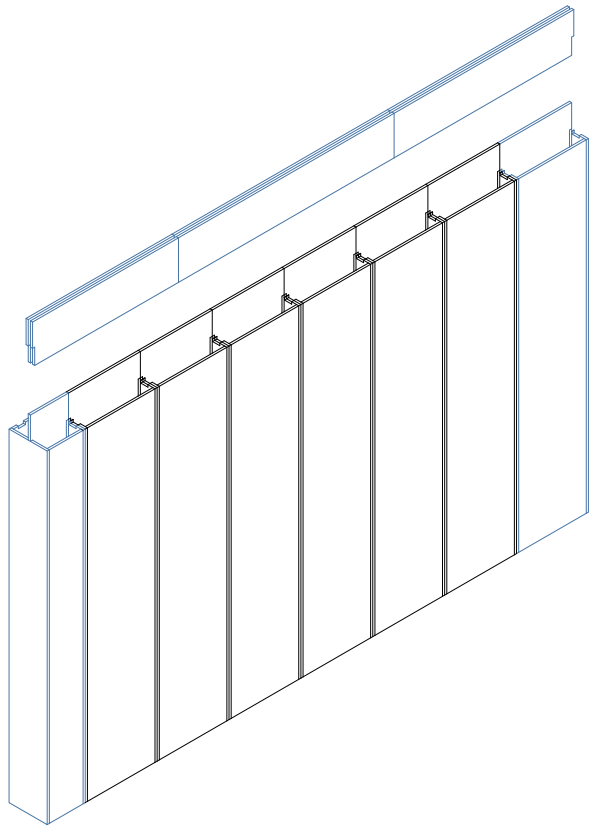
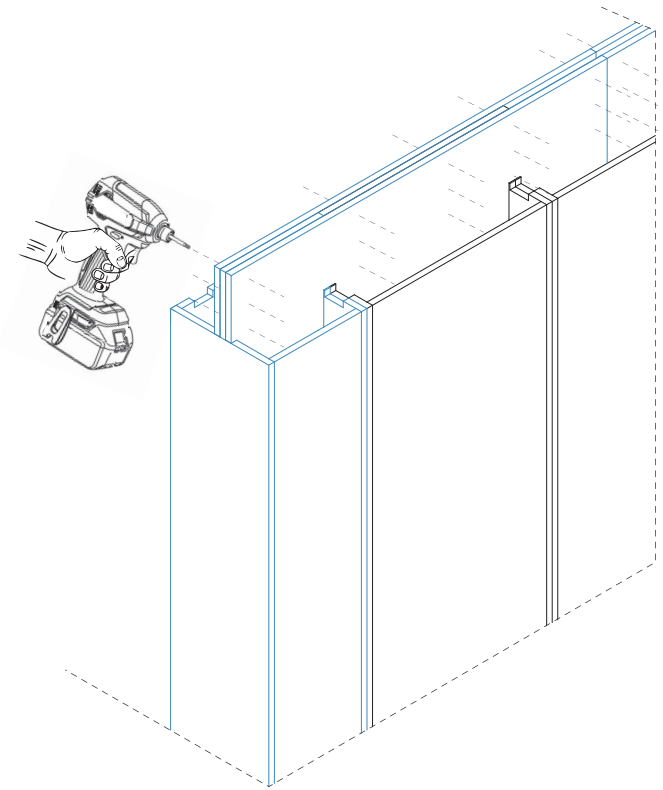
SOLUTIONS

The lintels get sandwiched between to longer pieces of plywood and create a beam between reinforced elements.





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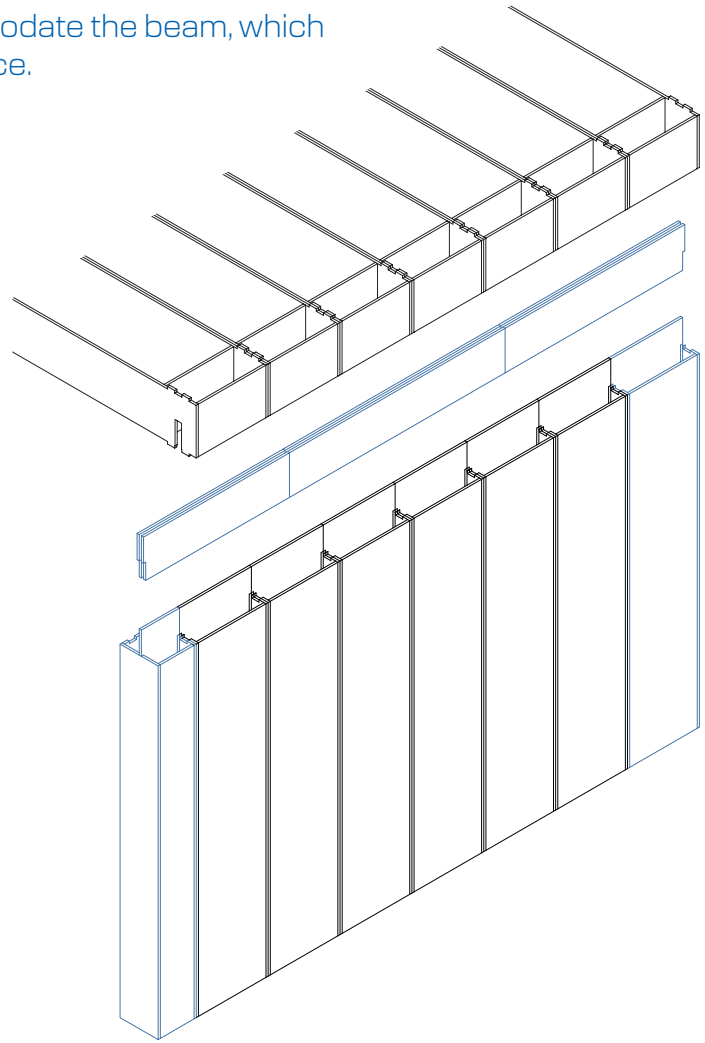
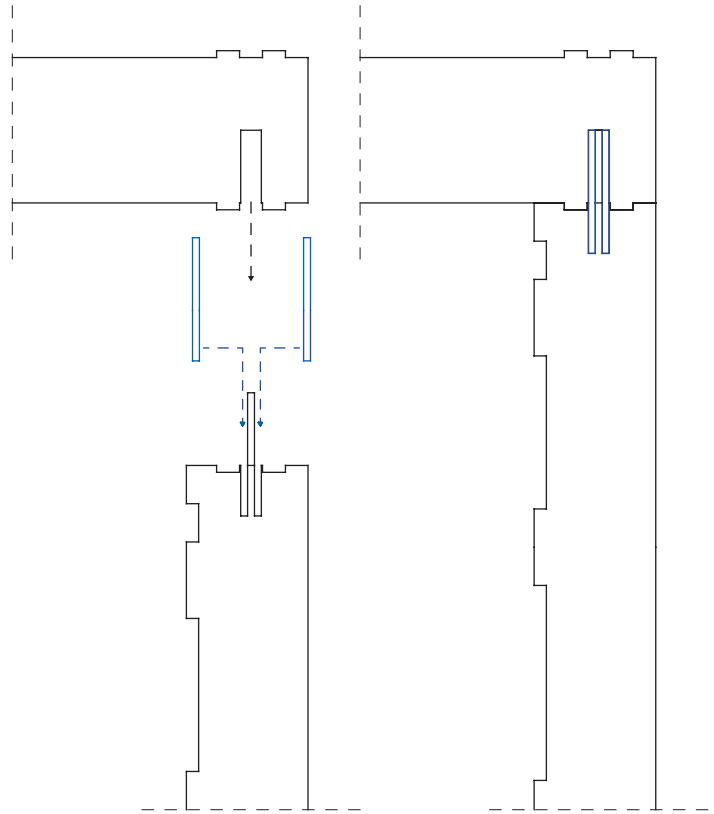
SOLUTIONS

Eventually the floor elements have a slot to accommodate the beam, which locks it into place.





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SOLUTIONS

DESIGN

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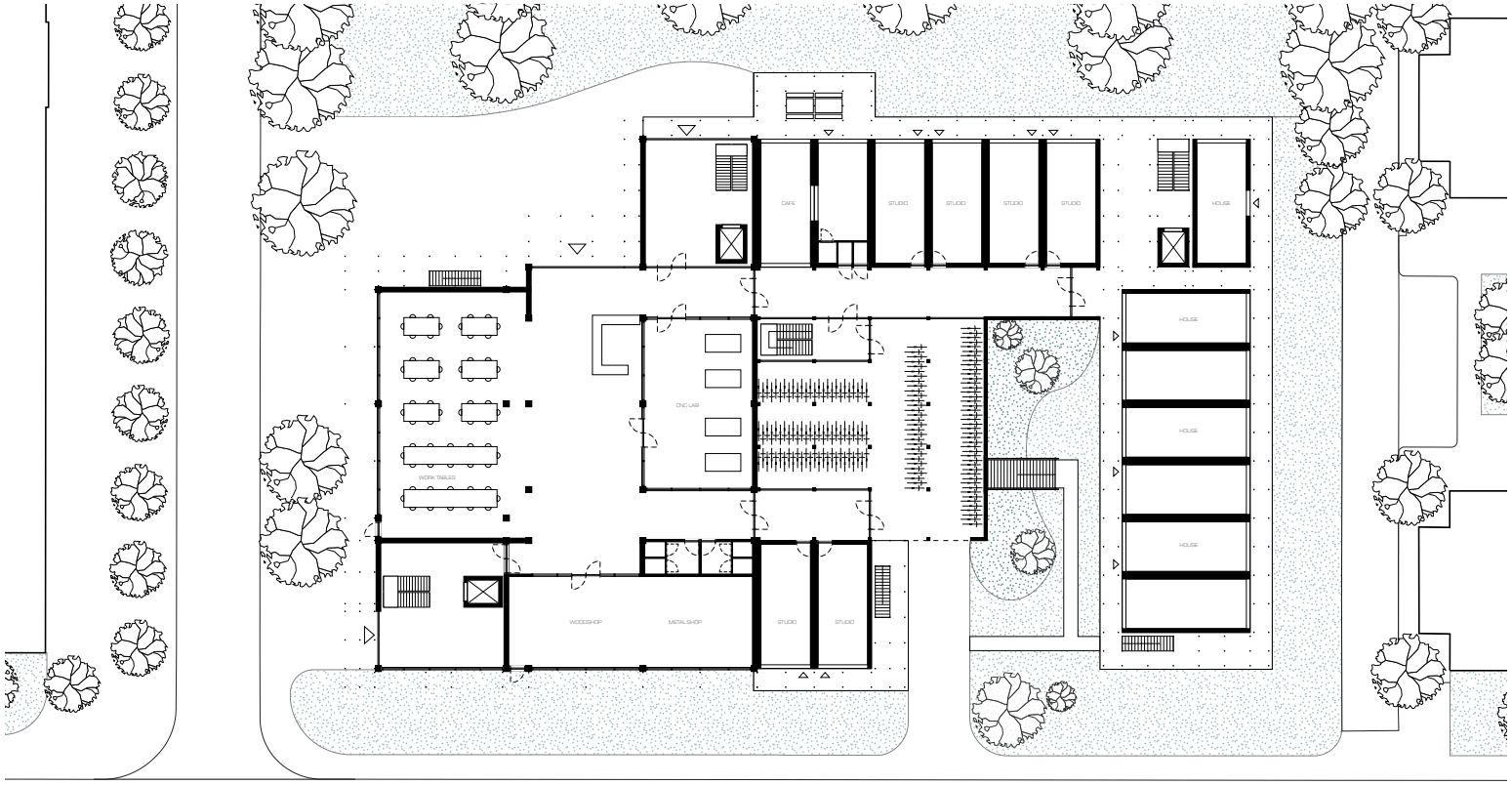
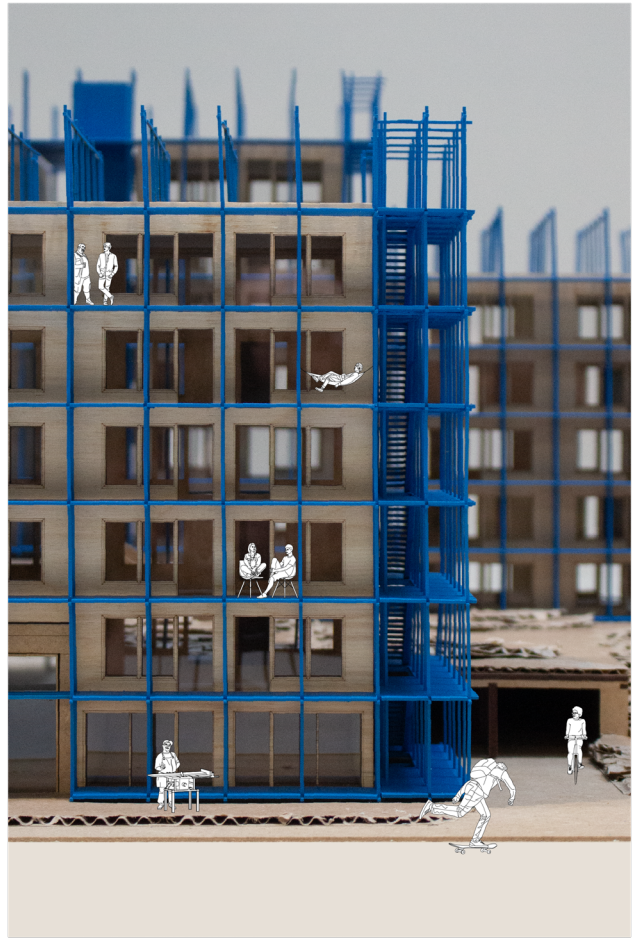


MAKERSPACE


JOIN THE COMMUNITY
JOIN THE COMMUNITY
JOIN THE COMMUNITY
MO KU KAI

WORK STUDIOS



CAFE COFFEE☆'S NEW LOCATION

Now let's build a house

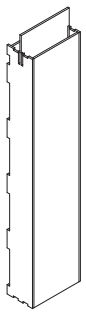
HOUSING
WHAT CAN YOU BUILD?

CATALOG

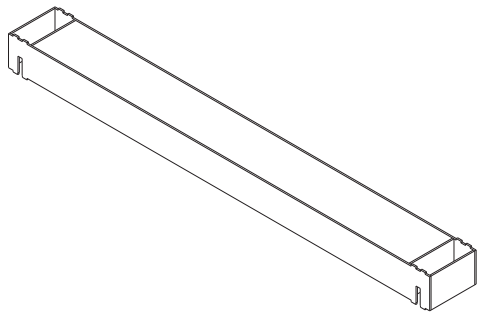
*NEW**

COLUMN
l: 318, w: 318, h: 2700

*NEW**

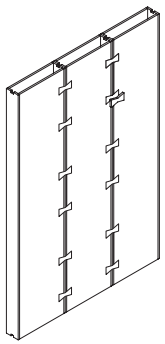


WALL
l: 600, w: 318, h: 2700



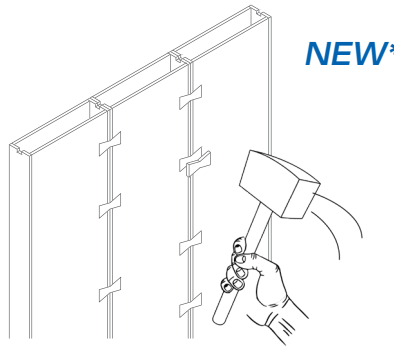
FLOOR
l: 4836, w: 600, h: 380

CATALOG



NEW*

INTERNAL WALL
l: 600, w: 150, h: 2700



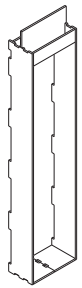
NEW*

Wikihouse is designed only as the outer shell of the house. Therefore internal walls still rely on traditional carpentry to be put up.

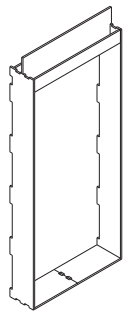
That's where this adapted version comes into play. It uses the same development process and installation as the outer shell.

Just a slimmer version

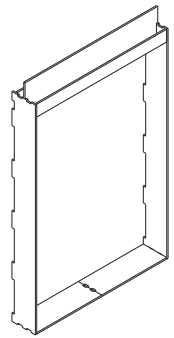
CATALOG



WINDOW SMALL 1
l: 600, w: 318, h: 2700

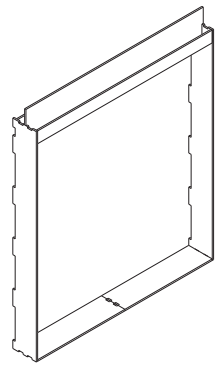


WINDOW MEDIUM 1
l: 1200, w: 318, h: 2700



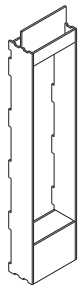
WINDOW LARGE 1
l: 1800, w: 318, h: 2700

*NEW**



WINDOW XLARGE 1
l: 2400, w: 318, h: 2700

CATALOG



WINDOW SMALL 2
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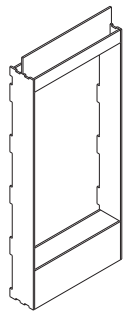

WINDOW MEDIUM 2
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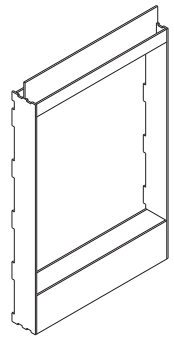

WINDOW LARGE 2
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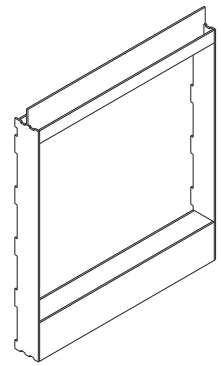
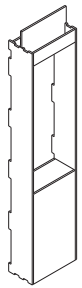
*NEW**



WINDOW XLARGE 2
l: 2400, w: 318, h: 2700

CATALOG



WINDOW SMALL 3
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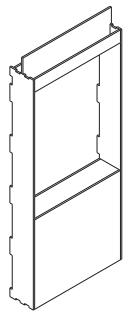
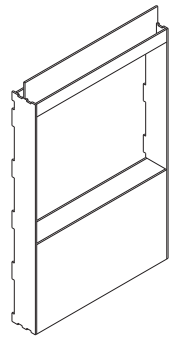
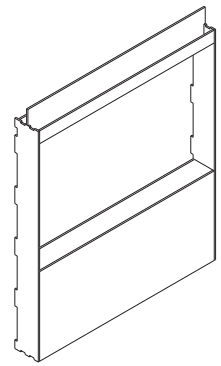


WINDOW MEDIUM 3
l: 1200, w: 318, h: 2700



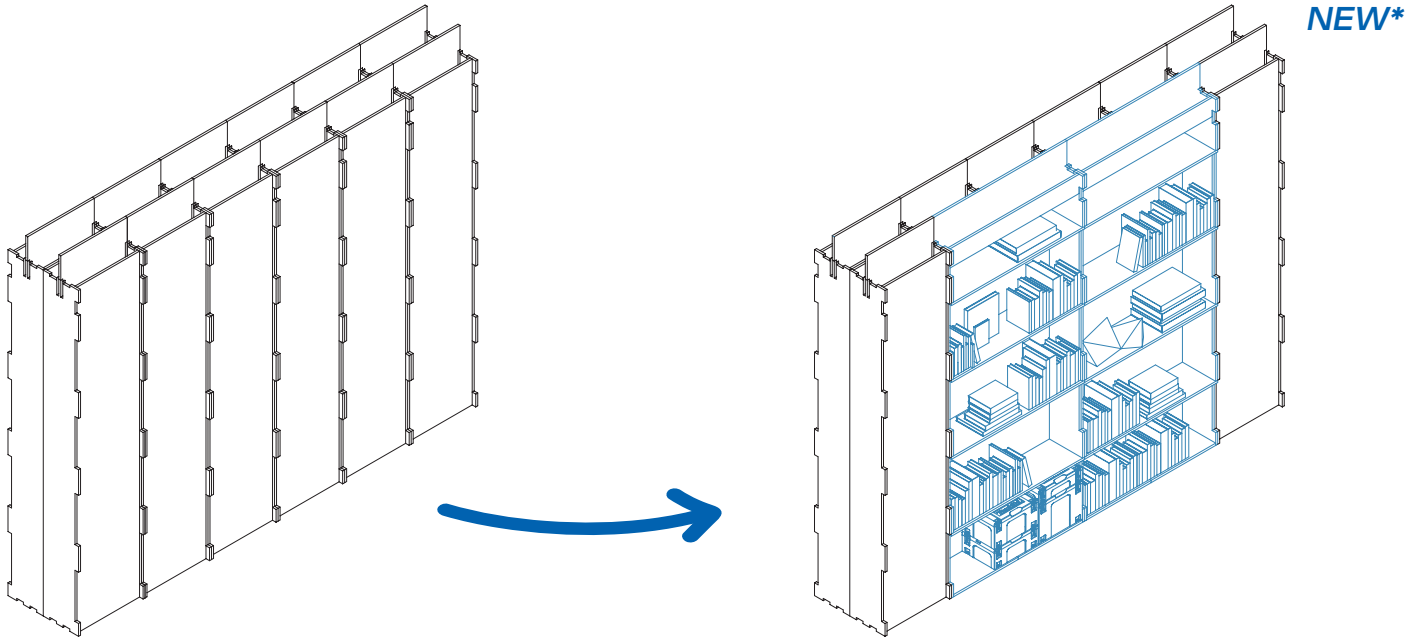
WINDOW LARGE 3
l: 1800, w: 318, h: 2700

*NEW**

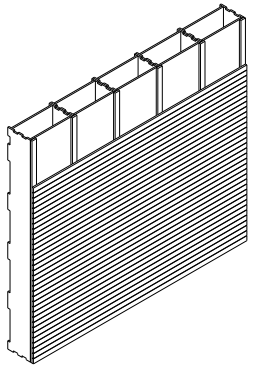


WINDOW XLARGE 3
l: 2400, w: 318, h: 2700

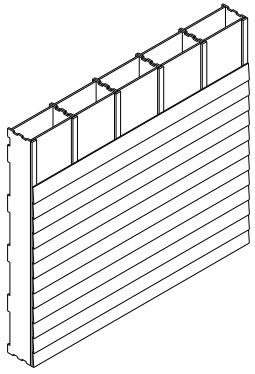
CATALOG



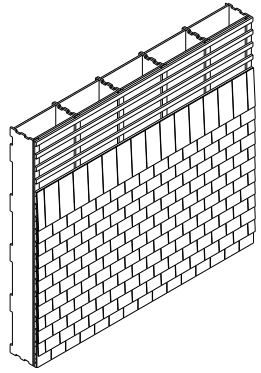
CATALOG



CLICKWOOD
Horizontal or vertical slats



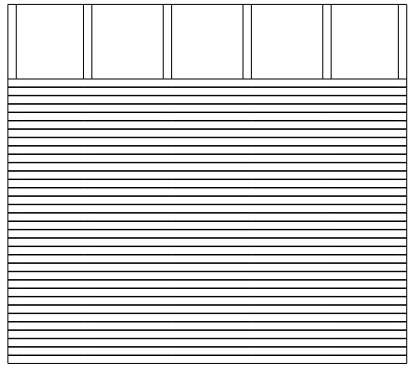
SWEDISH RABAT
Horizontal boards



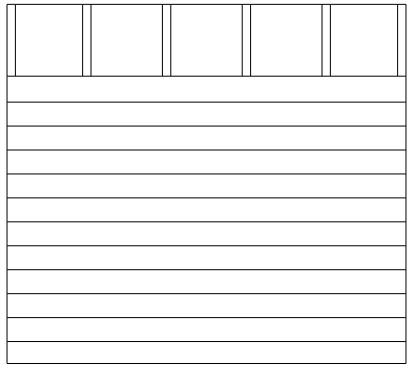
SHINGLES
Wooden 'tiles'

MO
KU
KAI.

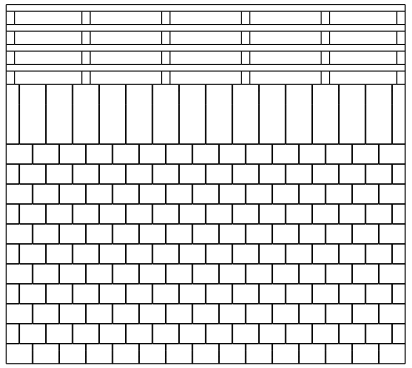
CATALOG



CLICKWOOD
Horizontal or vertical slats



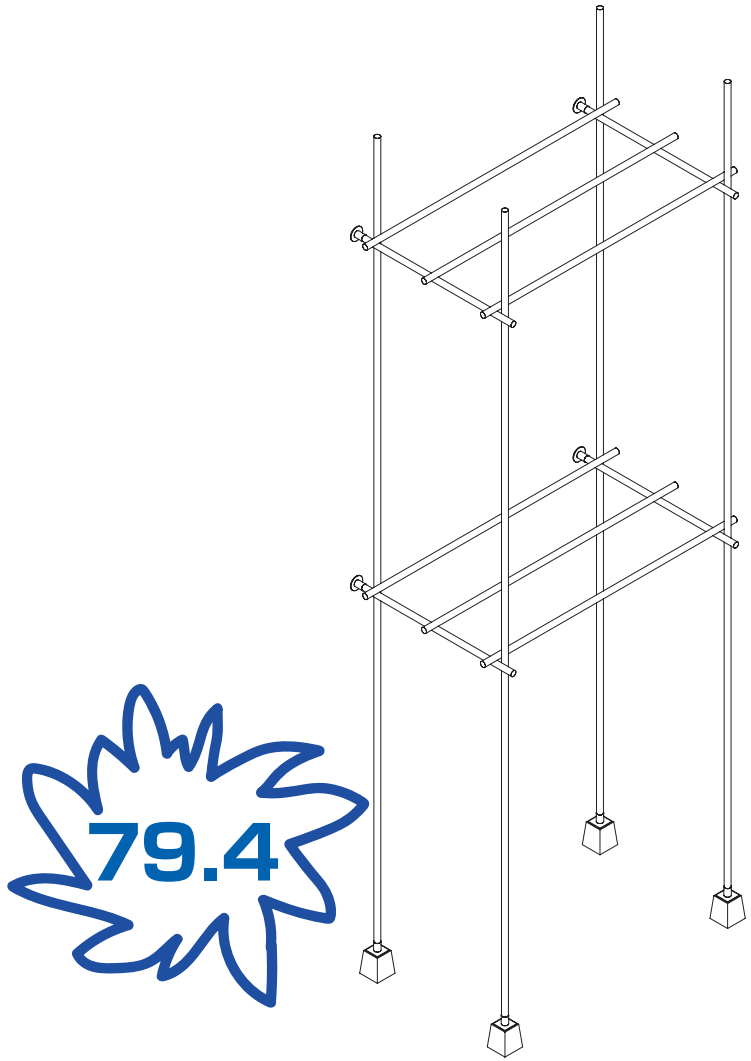
SWEDISH RABAT
Horizontal boards



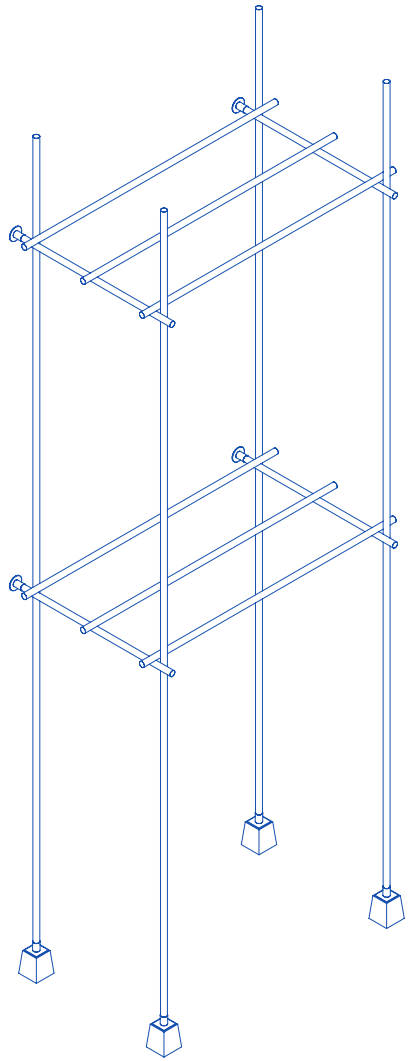
SHINGLES
Wooden 'tiles'

Douglas fir

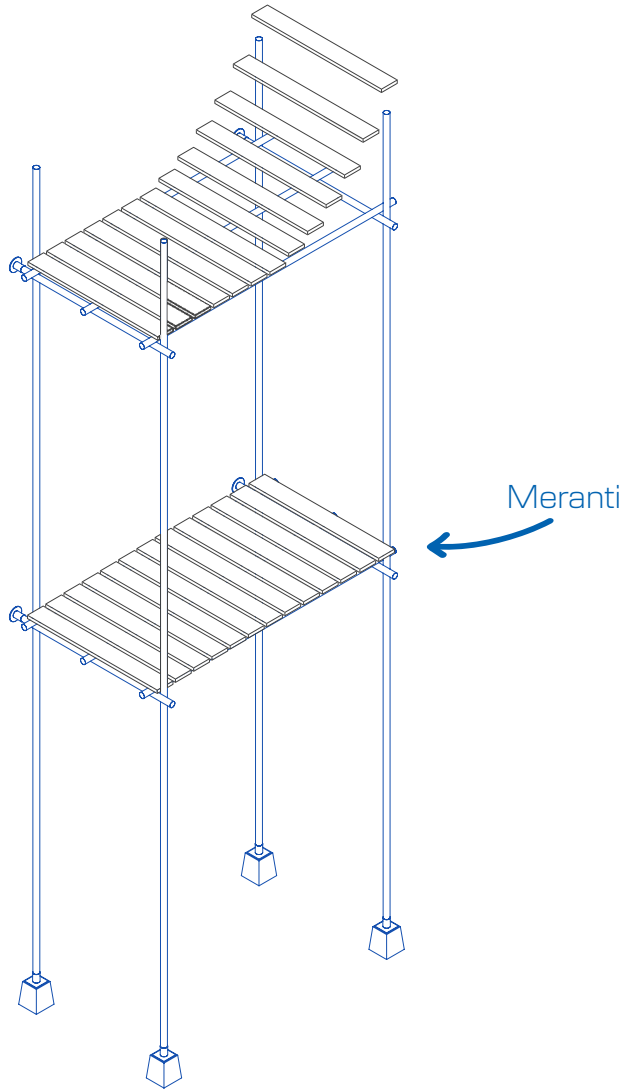
SCAFFOLDING



SCAFFOLDING



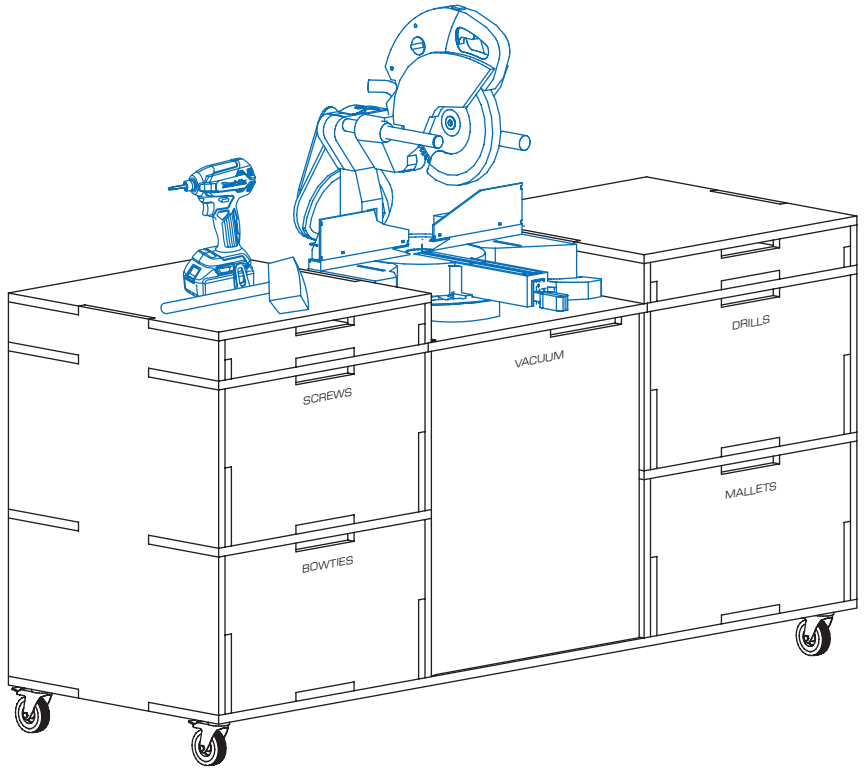
SCAFFOLDING



TOOLS

After the CNC-machine has milled the birch plywood into the right dimensions, the assembly of the building elements can start.

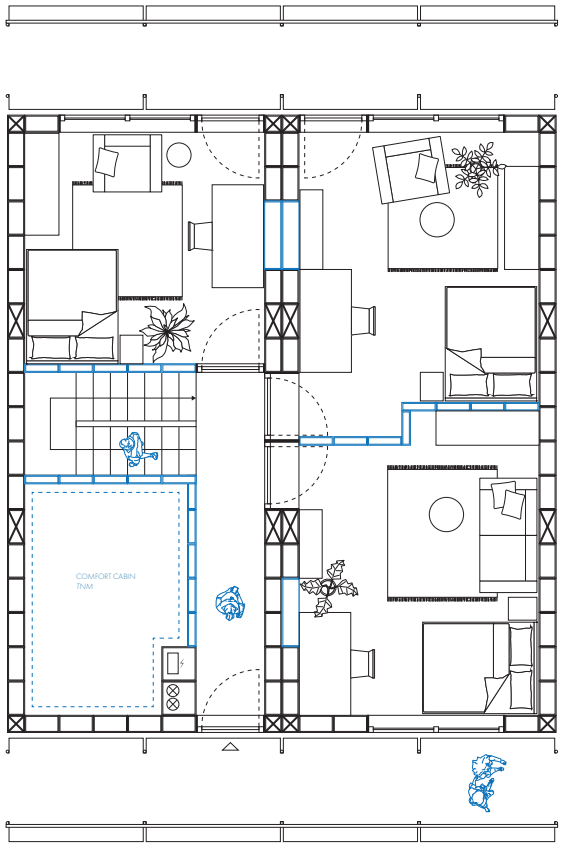
For assembly several tools are required. Therefore students can take one of these tool carts up to their building site.

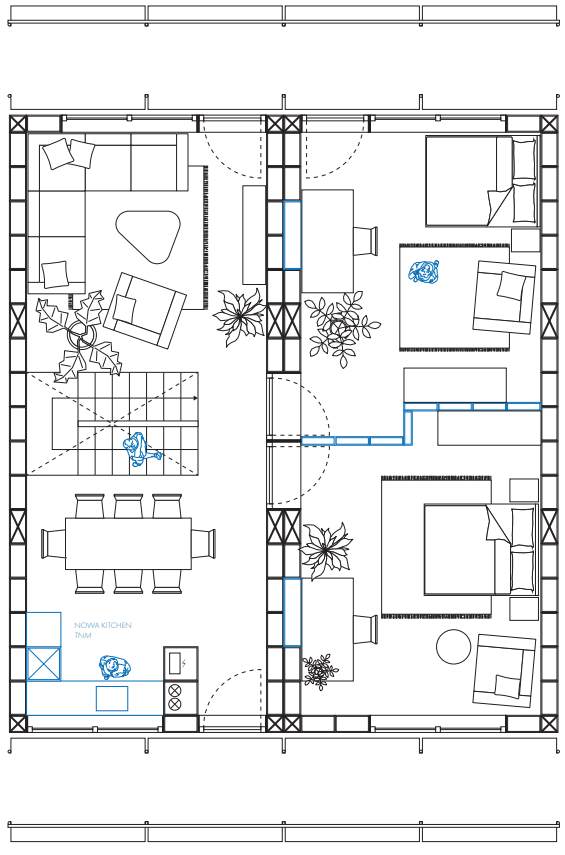


FLOORPLANS
SUGGESTIONS

MO
KU
KAI.

5 person
maisonette

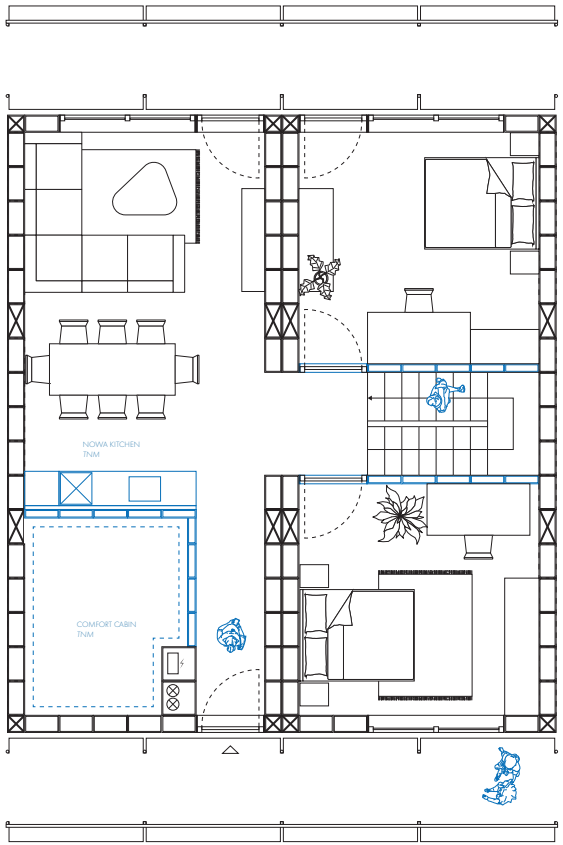


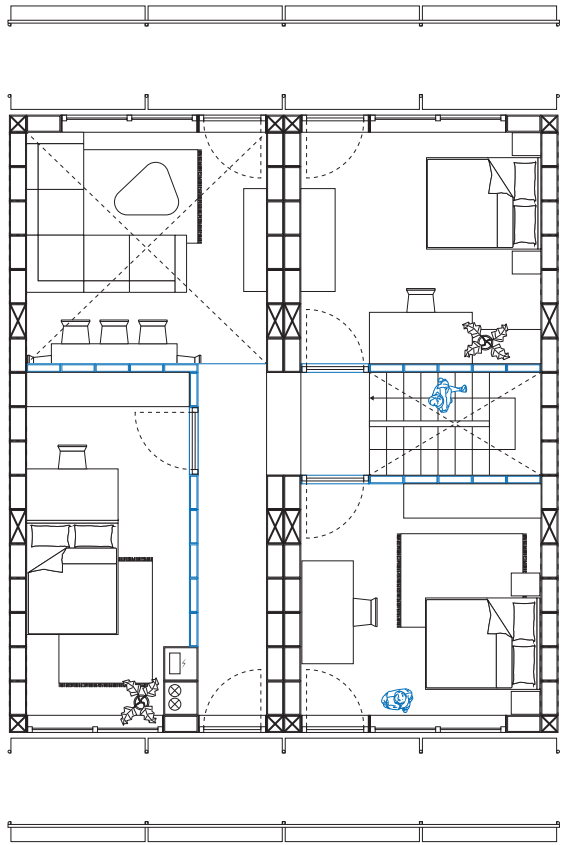


FLOORPLANS
SUGGESTIONS

MO KU KAI.

5 person
maisonette with
entresol

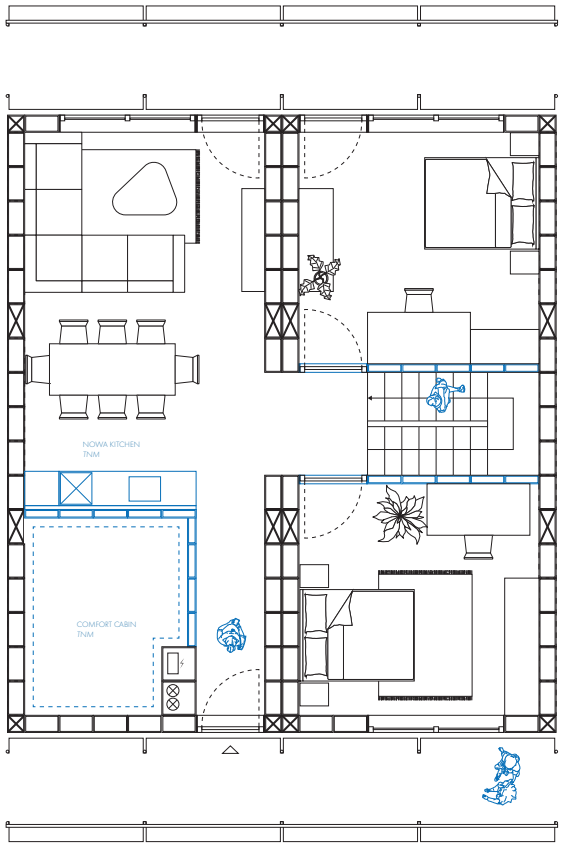


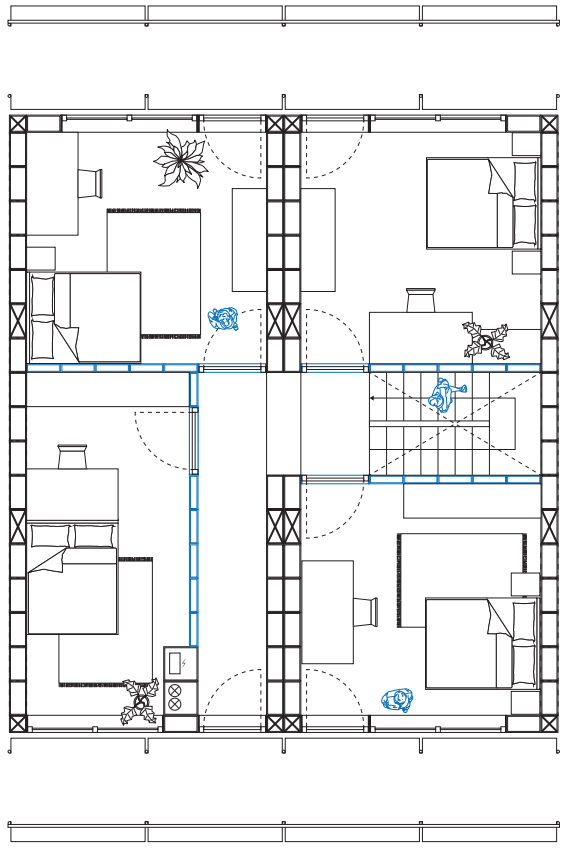


FLOORPLANS
SUGGESTIONS

MO
KU
KAI.

6 person
maisonette

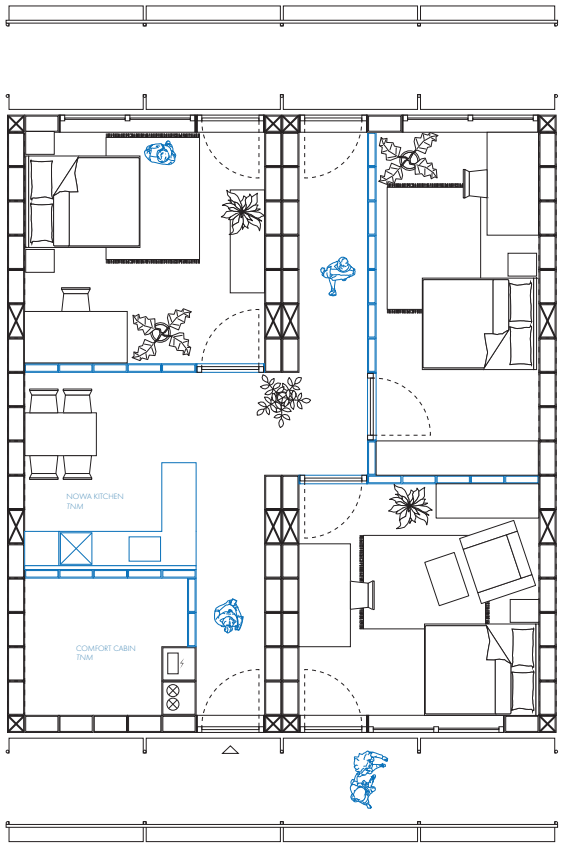




FLOORPLANS
SUGGESTIONS

MO
KU
KAI.

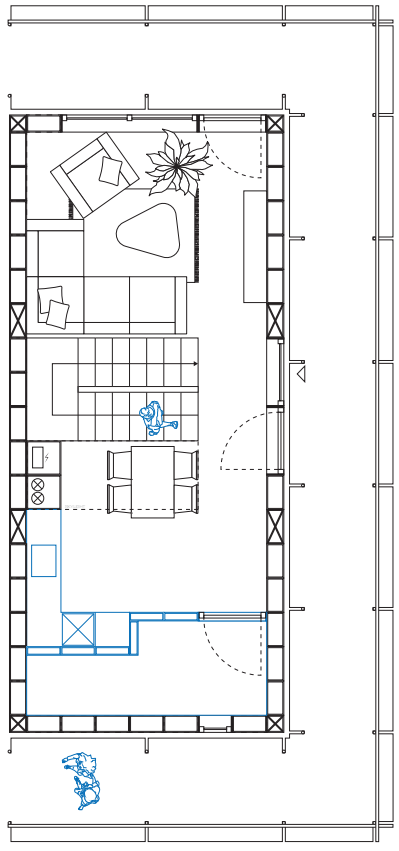
3 person
single floor

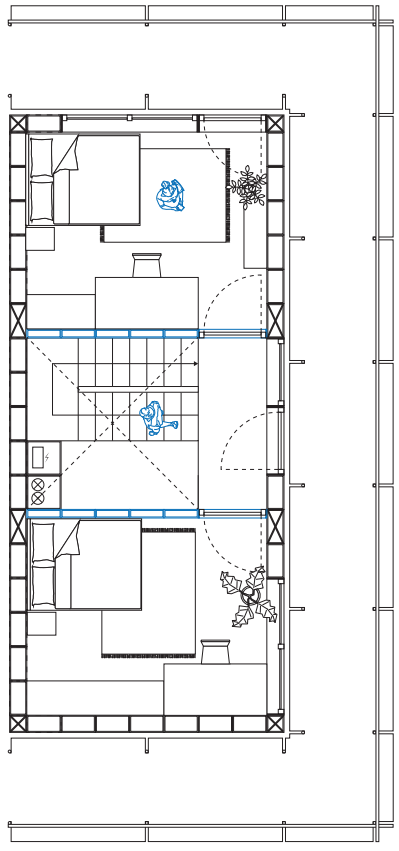


FLOORPLANS
SUGGESTIONS

MO
KU
KAI.

2 person
maisonette





Kees

25 yrs
Mechanical Engineering
Industrial Design

Jonne

24 yrs
Architecture
Urbanism

Lotte

24 yrs
Industrial Design
Geo design

Micha

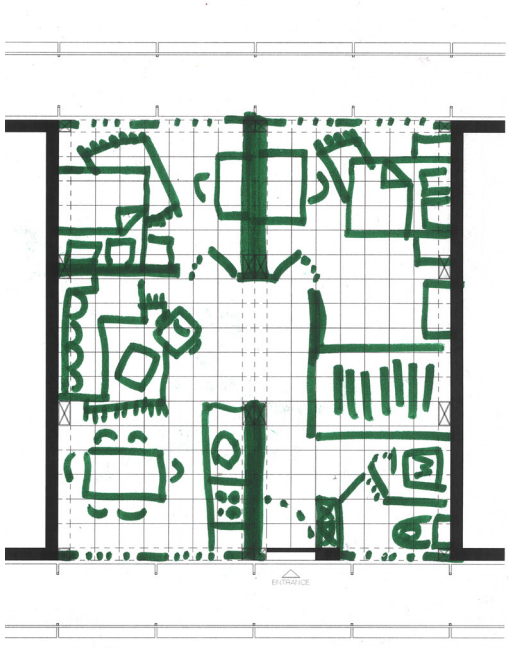
26 yrs
Policy Analysis

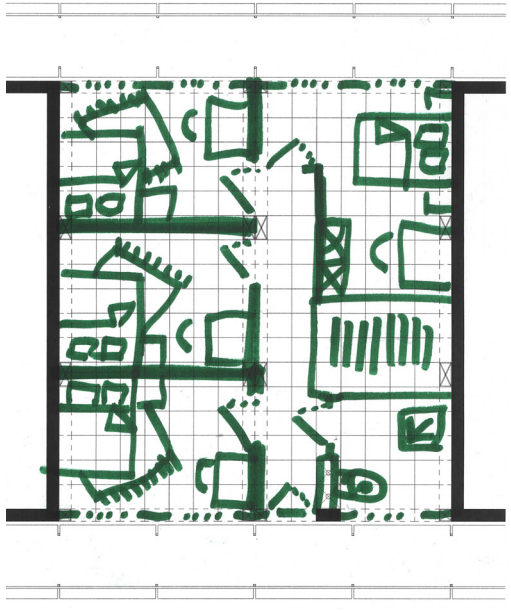
MO
KU
KAI.

EXPERIMENT

Kees

25 yrs
Mechanical Engineering
Industrial Design



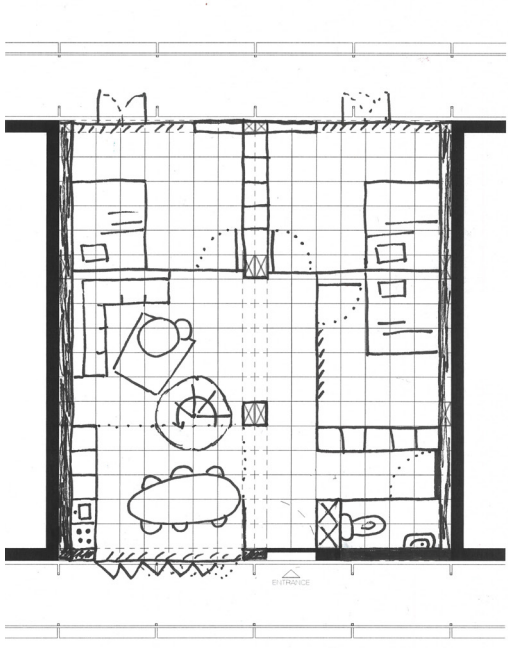


Large rooms. Bathroom next to utility chute. No structural issues

One room without direct sunlight

Jonne

24 yrs
Architecture
Urbanism

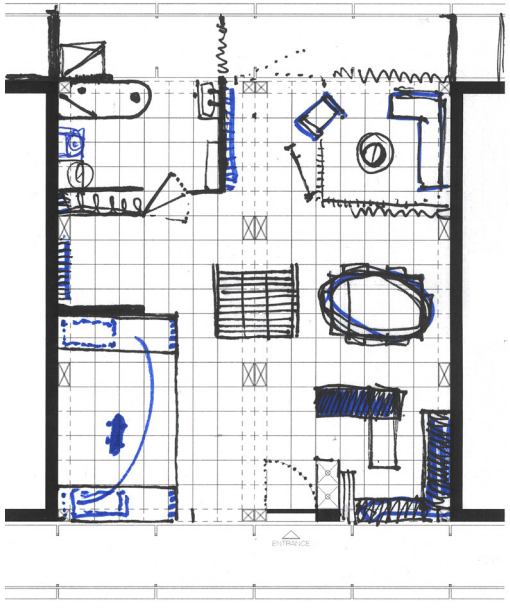


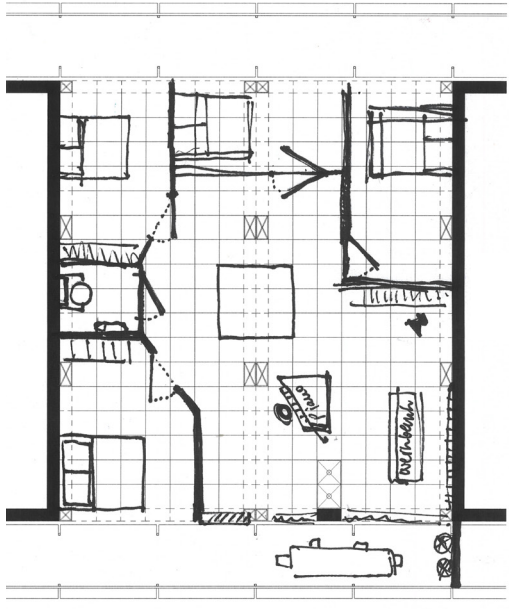
Spiral staircase. Bathroom as close as possible to utility chute

Two rooms without direct sunlight. some structural issues

Lotte

24 yrs
Industrial Design
Geo design





Moving walls. Foldable glass wall. Connecting inside with outside. Outdoor shower.

Bathroom as far away from utility chute as possible. A lot of structural issues

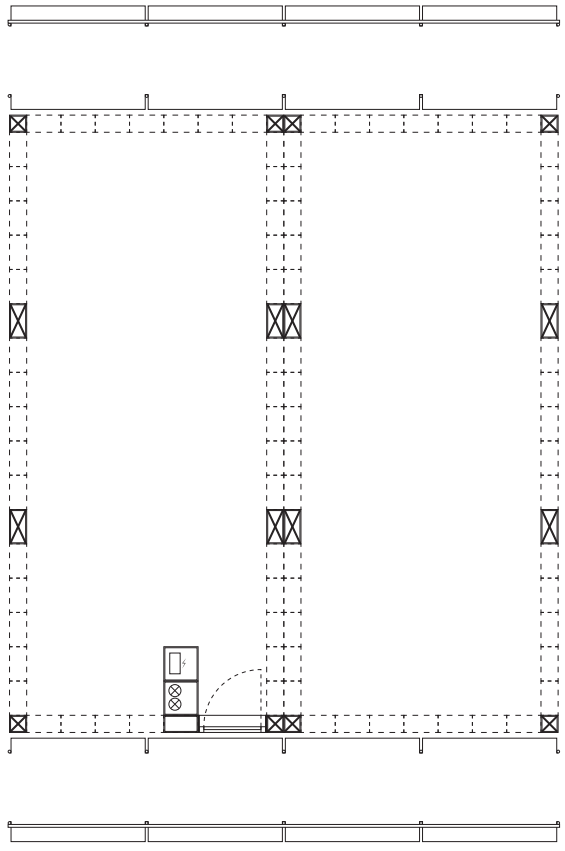
Micha

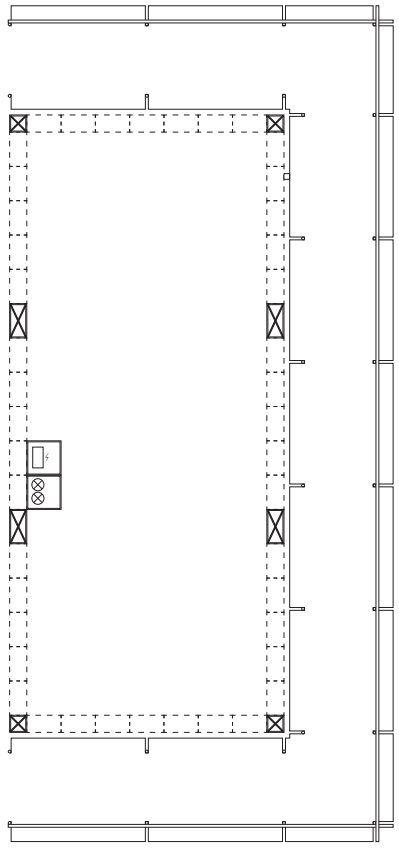
26 yrs
Policy Analysis

Pushed back facade to create a bigger balcony.

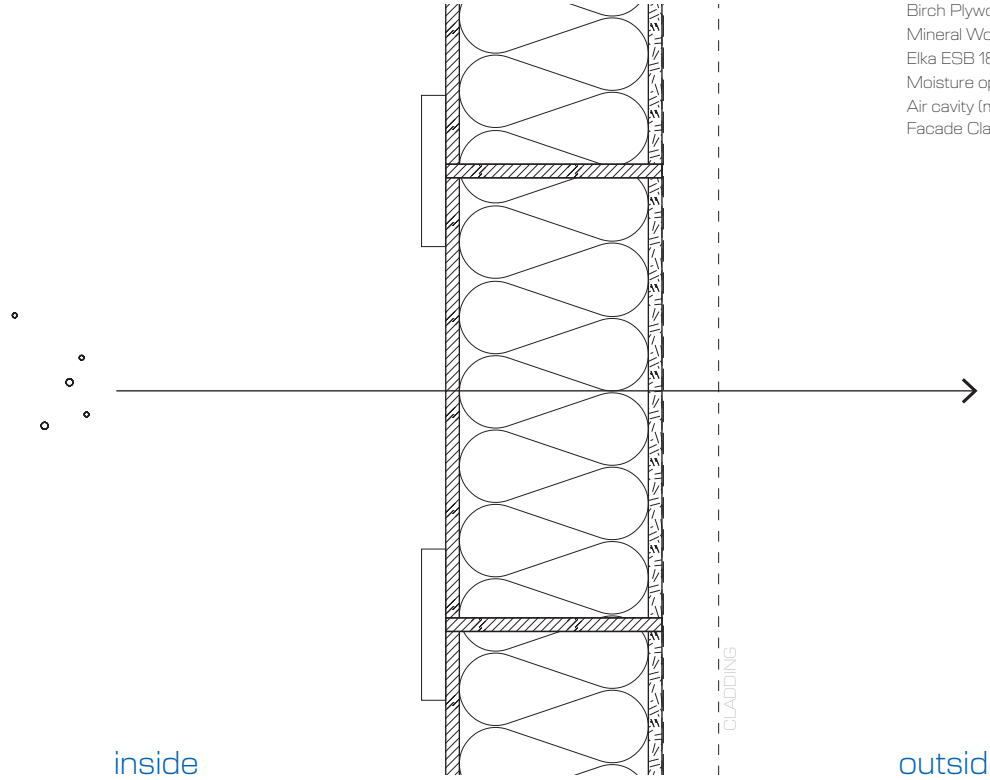
One room without direct sun of daylight. A lot of structural issues

NON DEBATABLE
STRUCTURAL





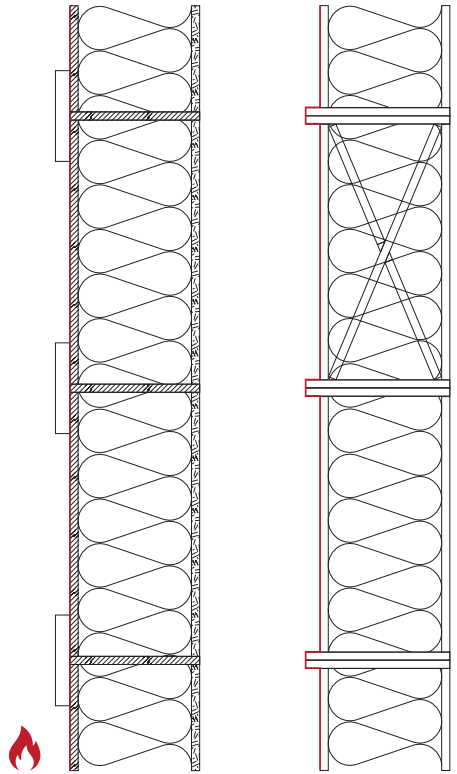
NON DEBATABLE
MOISTURE OPEN



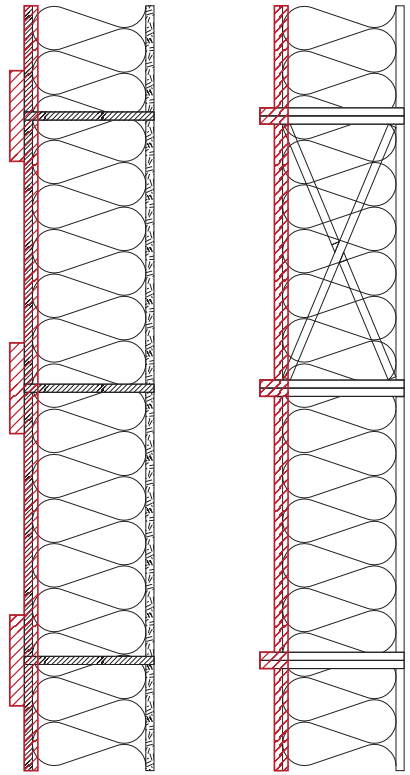
NON DEBATABLE
SAFETY

MO
KU
KAI.

FIRE



Fire (st ar t 0 min.)

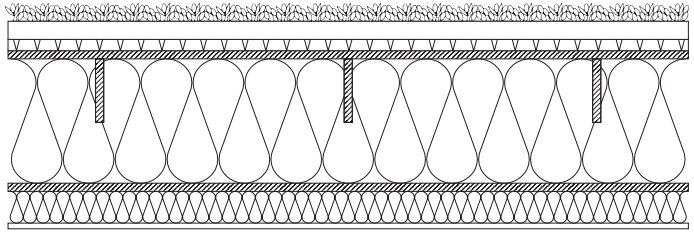


Fire (30 min., 1mm/pmin)

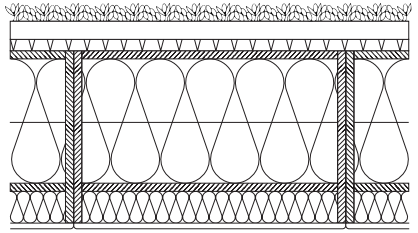
NON DEBATABLE
SAFETY

MO KU KAI.

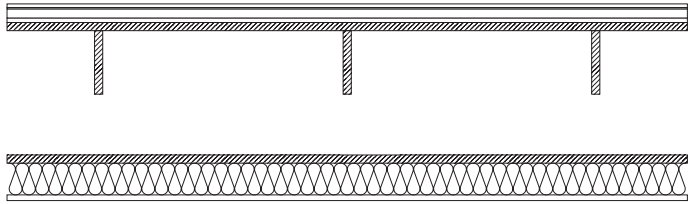
FIRE & SOUND



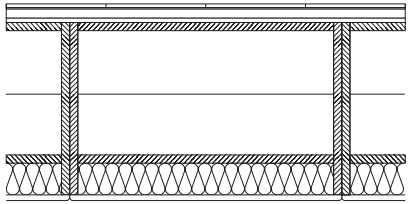
Roof



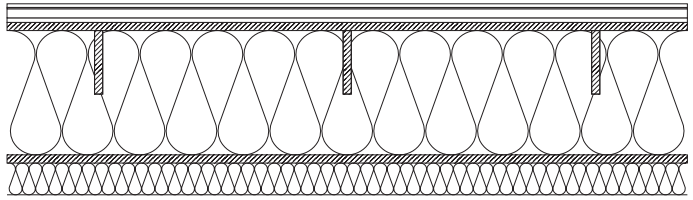
Vegatation 20-40mm
Substrate Layer 40mm
Drainage Layer 25mm
Waterproofing
Birch Plywood 18mm
Mineral Wool Insulation 274mm
Birch Plywood 18mm
Mineral Wool Insulation 70mm
Moistureproofing
Gibson Board 12,5mm



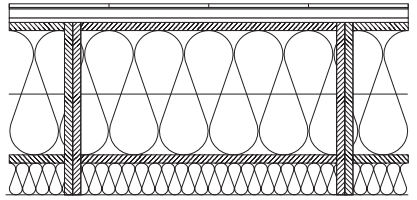
Floors



Laminate Flooring MDF
Isoline Eco 3mm
Fermacell 2E32
Birch Plywood 18mm
Birch Plywood 18mm
Mineral Wool Insulation 70mm
Gibson Board 12,5mm

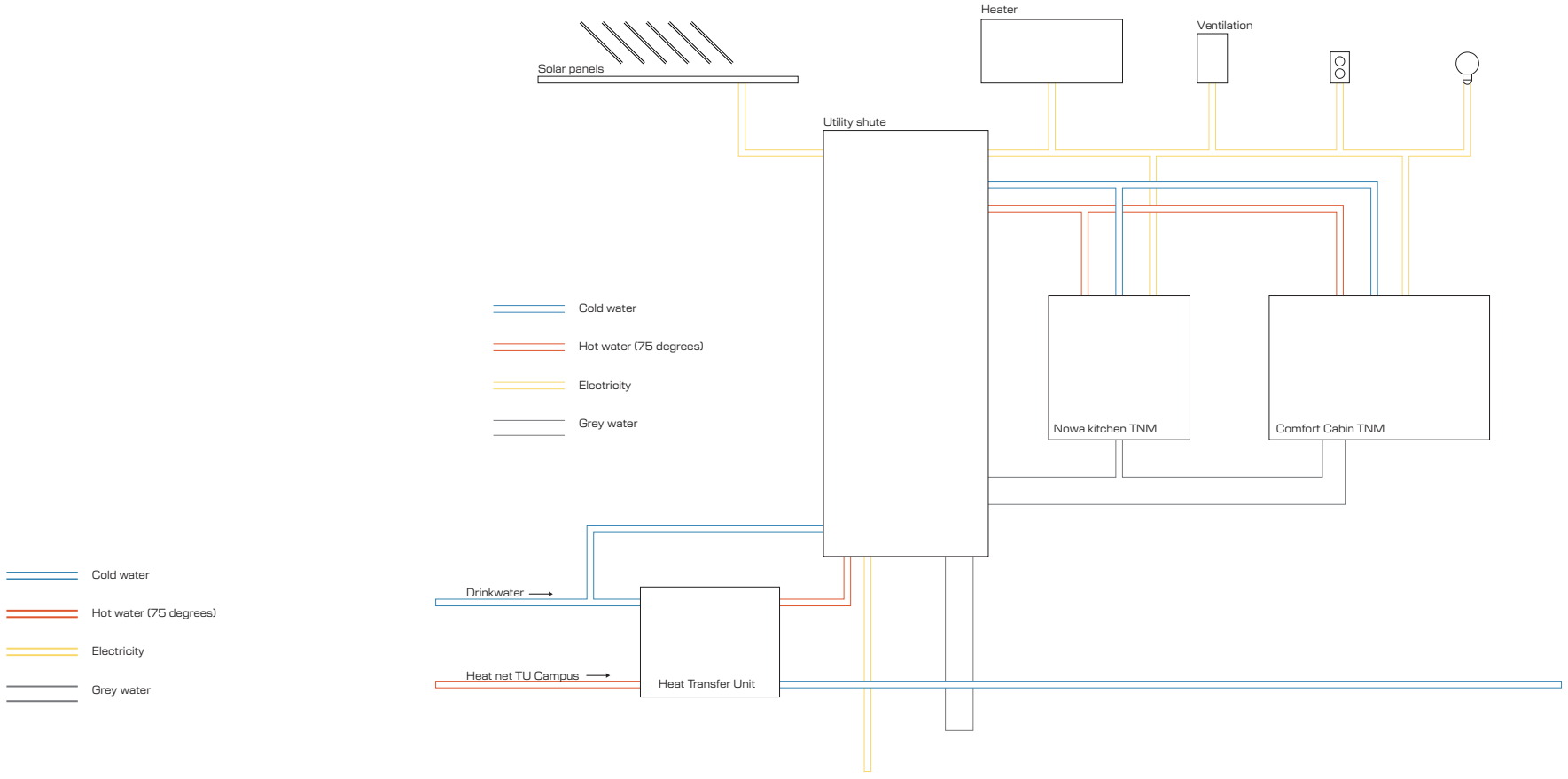


Ground Floor

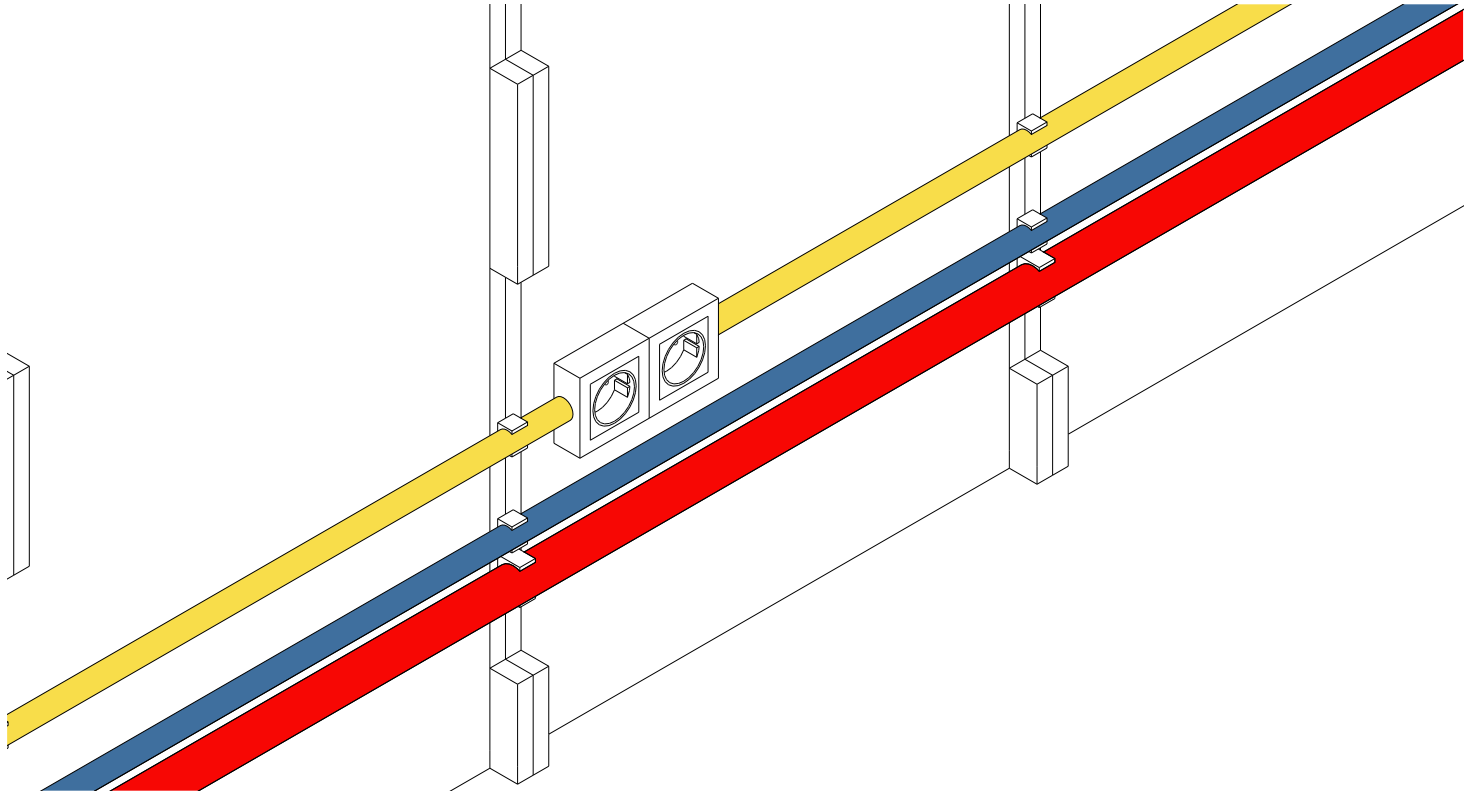


Laminate Flooring MDF
Isoline Eco 3mm
Fermacell 2E32
Moistureproofing
Birch Plywood 18mm
Mineral Wool Insulation 274mm
Birch Plywood 18mm
Mineral Wool Insulation 70mm
Waterproofing

NON DEBATABLE
INSTALLATIONS



NON DEBATABLE
INSTALLATIONS



PROJECT PHASING
WHEN WILL WHAT HAPPEN?

MO
KU
KAI.

TIMELINE

Phase 1:
Designing

MO
KU
KAI.

Architect

TIMELINE

Phase 1:
Designing

Phase 2:
Financial feasabiliity study

MO
KU
KAI.

Architect, Contractor, Housing Association

TIMELINE

Phase 1:
Designing

Phase 2:
Financial feasabiliity study

Phase 3:
Building makerspace, bike storage and elevator cores

MO
KU
KAI.

Architect, Contractor, Housing Association, Students

TIMELINE

MO
KU
KAI.

Phase 1:
Designing

Phase 2:
Financial feasabiliity study

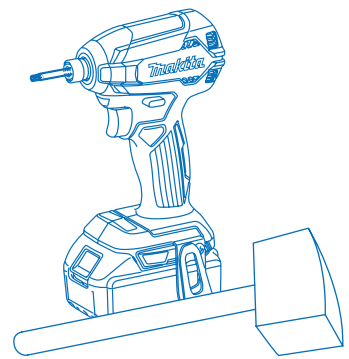
Phase 3:
Building makerspace, bike storage and elevator cores

Phase 4:
Students start building their housing

Architect, **Contractor, Housing Association, Students**

RECAP

So who would like to join?



Thank you for your time

Are there any questions?