sLender fasaad

uurimisprojekt 2023-2025

Projekti rahastajad:
- EKA teadusfondi rahastus, “sLender fassaad – mass-kohandatav, multifunktsionaalne mahuline hoone piirdetarind“ 2023-2025. Projekti kaasrahastaja on AS Thermory.
- E-hüpe. 2023. Masskohandatava fassaadisüsteemi konfiguraatori prototüüp. Projekt PR05014

Teostajad:
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Algoritmilise Puitarhitektuuri uurimisrühm
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EKA PAKK

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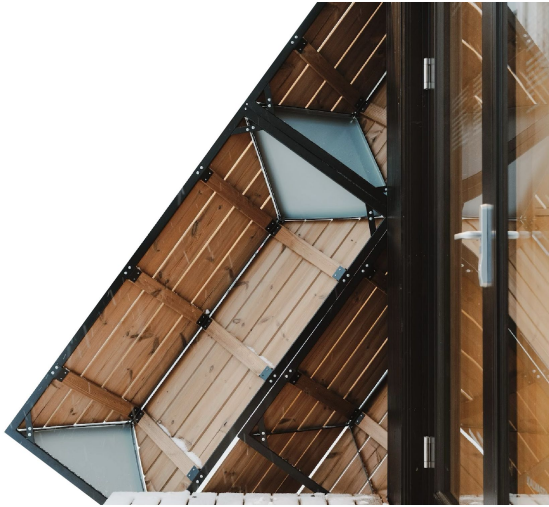
Kaasatud uurimisrühmad
Bollinger+Grohmann R&D group.
Adam Orlinski, Justin Jegorel.
https://www.bollinger-grohmann.com/en.research-and-development.html

TalTechi puitkonstruktsioonide uurimisrühm.
Alar Just, Eero Tuhkanen

EKA PAKK uurimisassistendid:
Johannes Aasmäe
Diana Drobot
Uku Julian Tarvas
Karl Erik Miller



EKA PAKK

EKA Arhitektuur ja linnaplaneerimine

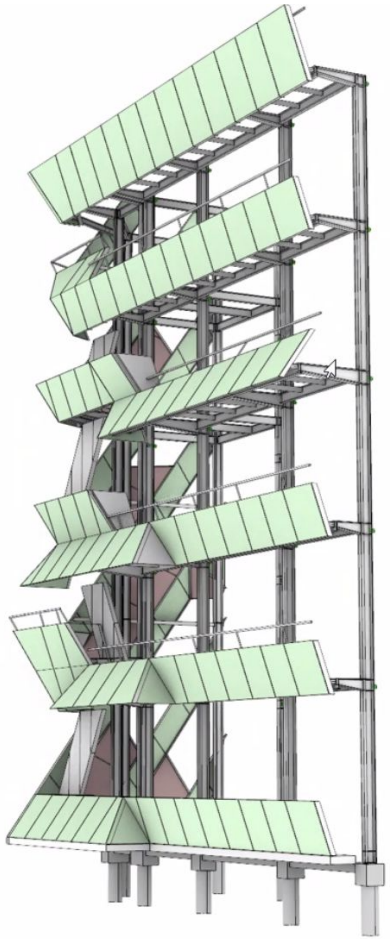
THERMORY®

Rahastanud Euroopa Liit NextGenerationEU

Eesti tuleviku heaks

Väljundid

1. Renoveerimise ökosüsteemi kaardistus (S, M, L, XL)
Uurisime, kuidas erinevad osapooled, tööriistad ja protsessid mõjutavad ruumikvaliteeti renoveerimisel eri mõõtkavades.
2. Teadmislüngad projekteerimisest ehitusse töövoos
Selgus, et süsteem on vähe standardiseeritud ja töövoog on katkendlik, mistõttu liigub info halvasti ühest etapist teise.
3. Prototüüp (S skaala)
Ehitatud näidishoone, kus testime süsteemi toimimist, et saada esmane tõestus kontseptsiooni töökindlusest.
4. Peidetud konstruktsioon (M skaala)
Mahulise renoveerimise konstruktsioon on peidetud soojustuspaneelide vahele ja võimaldab kuni 1,1 meetri pikkust konsooli ning vabalt kohandatavat välisfassaadi.
5. Ehitussüsteemi eskiis
Modulaarne ehitussüsteem, mis sobib mahuliseks renoveerimiseks ja mille osi saab tehases ette toota.
6. Renoveerimisplatvorml kontseptuaalne skeem (XL)
Arendasime välja digiplatvormi funktsionaalse skeemi, mis teeb kõigile osapooltele lihtsamaks renoveerimise kavandamise ja juhtimise, fookusega ruumi kvaliteedi tagamisel.
7. Automaatne tööriist renoveerimise simuleerimiseks + Ühendatud töövoo prototüüp
Loodud on tarkvara, mis näitab renoveerimise lahendusi reaalajas ja võimaldab kõigil osapooltel neid kohe hinnata.
Tööprotsess seob omavahel:
- parameetrilise fassaadidisaini,
- digikaksiku keskkonnad,
- kohapealse andmete kogumise,
- projekteerimisest tootmiseni ulatuvad sammud,
- reaalajas konstruktsioonianalüüsi.
8. Materjalide otsingud
Testisime puidu rakendamist pinnakattena paneelelamutel



1

Renoveerimise ökosüsteemi kaardistus

S, M, L, XL

1

Renoveerimise ökosüsteemi kaardistus

S, M, L, XL

Structural concept

Design tools

Digital tools

slender facade

[S]

Prototype

PAKK Pavilion

Physical built demonstrator in Tallinn, showcasing detailing, connections to structure and spatial experiences

[M]

Chunk

3D vertical sample of combined structures

Exemplary vertical cut out of the old and new structure

[L]

Building

3D example of volumetrically renovated panel building

Visualisations of the building

[XL]

Neighbourhood

Design studio projects

Studentwork of neighbourhood based renovation and volumetric reconstruction

2 Teadmislüngad

Vähene standardiseeritus

2

Teadmislüngad projekteerimisest ehitusse töövoos

Süsteemi vähe standardiseeritus, katkendlik töövoog

Typical panel building
type 1-464
1960s

Volumetrically renovated apartment buildings
type sLender
2030s

2

Teadmislüngad projekteerimisest ehitusse töövoos

Süsteemi vähe standardiseeritus, katkendlik töövoog

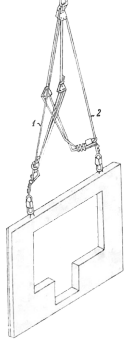
EFA.357.0.90209

EFA.357.0.90210

2

Teadmislüngad projekteerimisest ehitusse töövoos

Süsteemi vähe standardiseeritus, katkendlik töövoog

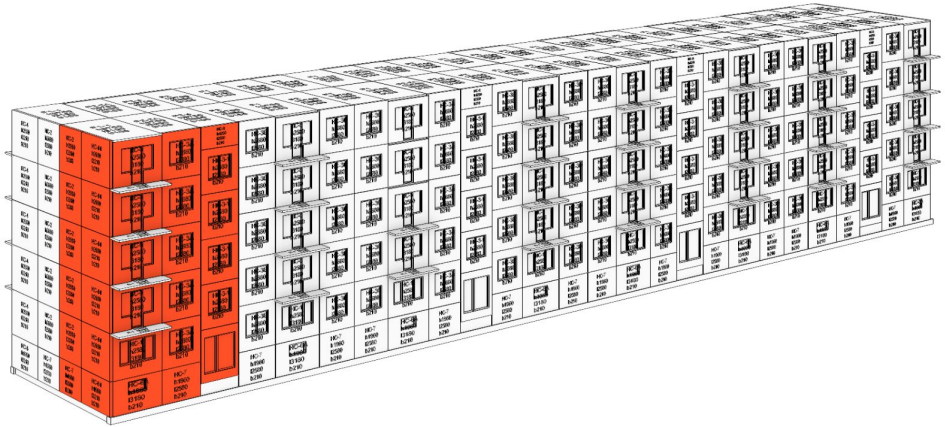


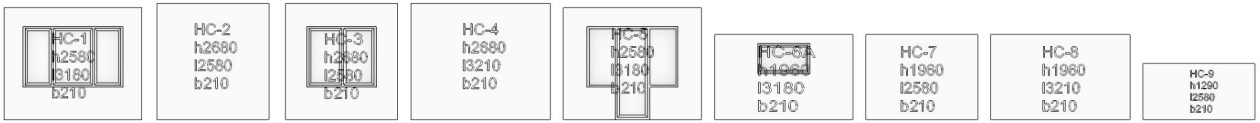
Välisseinte paneelide nomenklatuur:

HC-0

HC-1
HC-2
HC-3 (3A;3B;3C;3D;3-1)
HC-4
HC-5
HC-9

Sokkel:
HC-6A
HC-7
HC-8

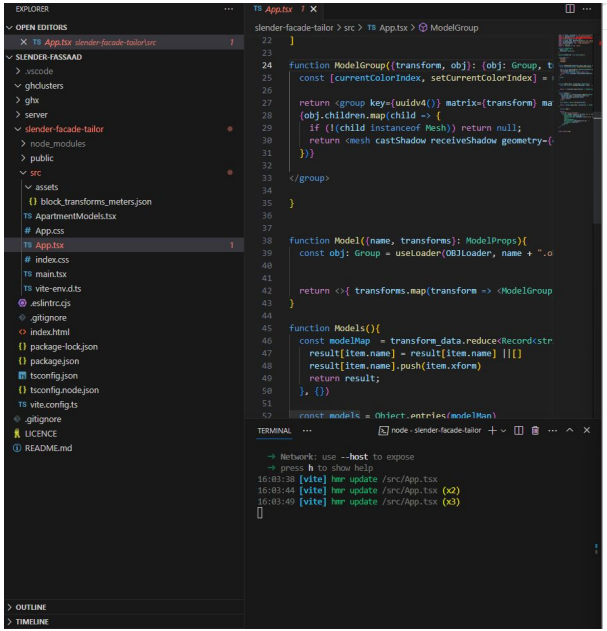


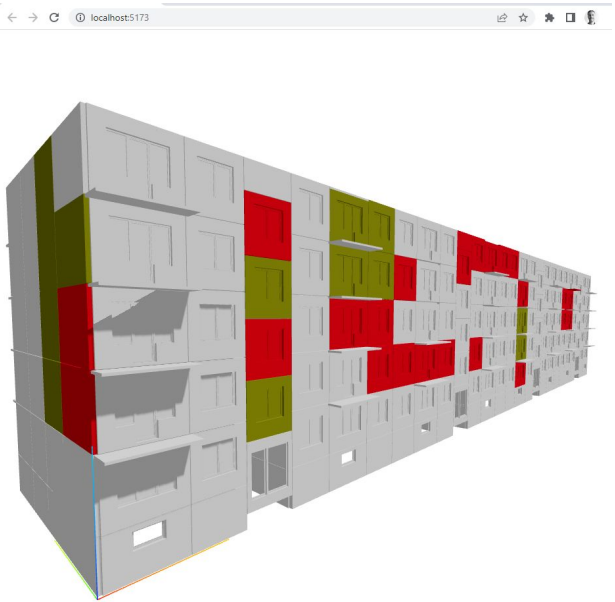


React

Three.js

Interaktiivne 3D mudeli
proof of concept





3

Prototüüp (S skaala)

Näidishoone

3

Prototüüp (S skaala)
Näidishoone

Timber Architecture Research Center test building

PAKK Pavilion

EKA
PAKK
MYCEEN

Research teams

sLender facade
Sille Pihlak, PhD, arhitekt (EKA)
Siim Tuksam, PhD, arhitekt (EKA)
Eero Tuhkanen, PhD, insener (TalTech)

Pattern buildings
Renee Puusepp, vanemteadur (EKA)

Myceen
Siim Karro, sisearhitekt
Killu Leet, biotehnoloogia
Marleen Mäekala, ehitusinsener (TalTech)
Germo Ausin, arhitekt

Project lead

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Eesti Kunstiakadeemia
Timber Architecture Research Center PAKK
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3

Prototüüp (S skaala)

Näidishoone

PAKKu Paviljon on eksperimentaalarendus puitarhitektuurile Tallinna kesklinnas.
Paviljon kombineerib endas kolme uurimisrühma käimasolevaid projekte, mille käigus kogutakse andmeid, testitakse materjale ja prototüübitakse ruumi.

9m2 paviljoni sisemus toimib näitusepinnana, mille eksponaadid on ajas vahetatavad.

3 Research teams

sLender facade and Pattern Buildings
EKA PAKK research team

Sille Pihlak, PhD
Researcher & architect
Dean of the Faculty of Architecture
sLender facade research group
Founder of PAKK

Siim Tuksam, PhD
Researcher & architect
Head of research at the Faculty of Architecture
sLender facade research group
Founder of PAKK

Renee Puusepp, PhD
Senior researcher & architect
Pattern Buildings research group
Founder of PAKK

Anna Tommingas
Head of EKA PAKK
Founder of PAKK

Alar Just, PhD
Senior researcher & professor
Fire safety
Department of Civil Engineering and Architecture (TalTech)

Eero Tuhkanen, PhD
Researcher
Timber structures
Department of Civil Engineering and Architecture (TalTech)

Karl Erik Miller
Research assistant
Timber Architecture Research Center (EKA PAKK)

Myceen
research team

Siim Karro
Myceen co-founder
Product R&D

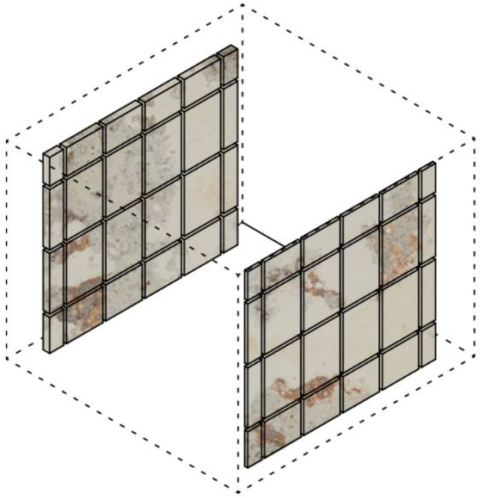
Killu Leet
Biotechnology

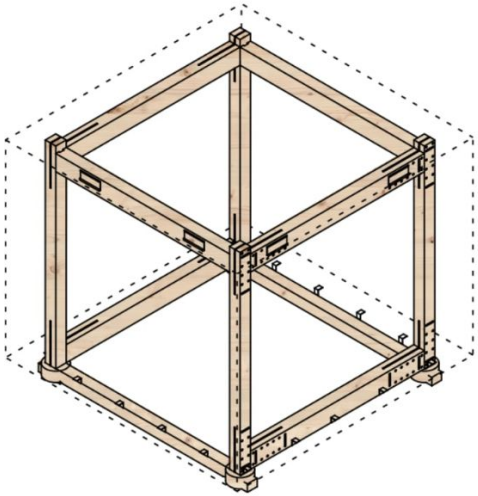
Marleen Mäekala
Civil Engineer (TalTech)

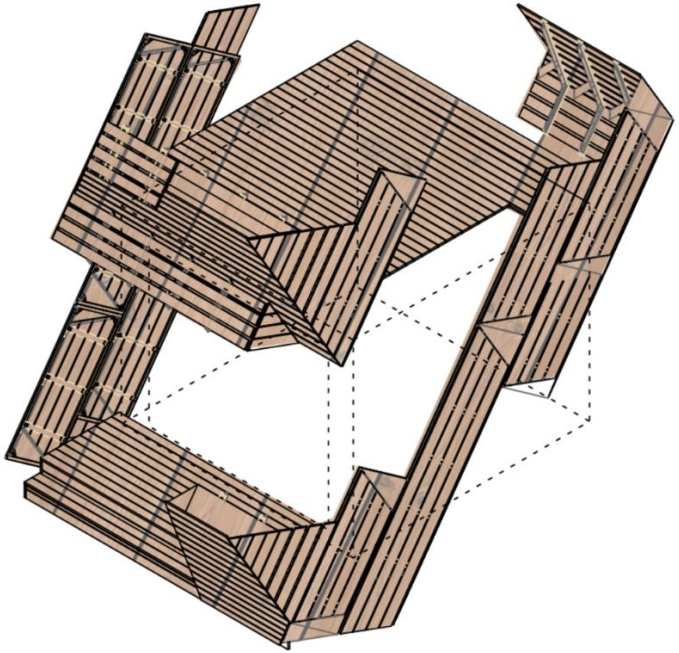
Germo Ausin
Architecture & Design

3Concept

..from flesh to bones to skin







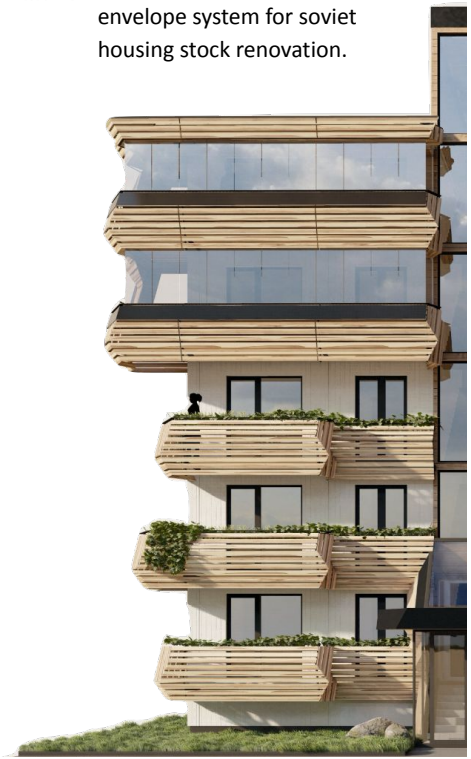
PAKK Pavilion is innovating in all 3 layers of the building: from insulation (flesh) to its construction (bones), from construction to facade (skin).

3 Research

Research teams

1.1 sLender fassaad

A mass-customized volumetric envelope system for soviet housing stock renovation.



www.pakk.artun.ee

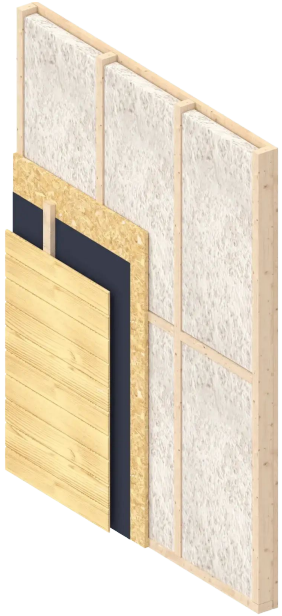
1.2 Pattern buildings

369 Pattern Buildings is an industrial construction system based on modular design for creating up to 7 floor wooden buildings of different typology and appearance.

www.pakk.artun.ee

1.3 Myceen

Carbon-storing insulation materials with fully automated mycelium production technologies.



www.myceen.com

3 Research

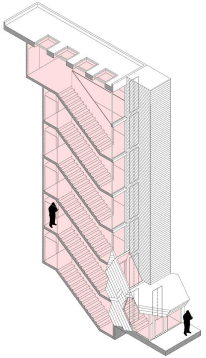
sLender Facade

The Renovation Wave. By 2050 we need to renovate 14 000 apartment buildings. We need to do it fast, efficiently and by increasing the quality of the living environment.

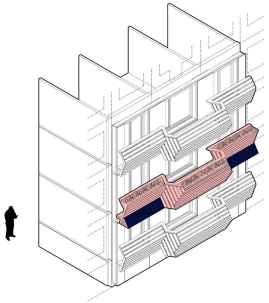
We propose a modular facade system that can be easily configured for various projects using a specially developed digital platform.

Combined with the Digital Twin technology the reconfigurable facade system becomes a fully automated, scalable product ushering in the long awaited era of mass customisation in architecture.

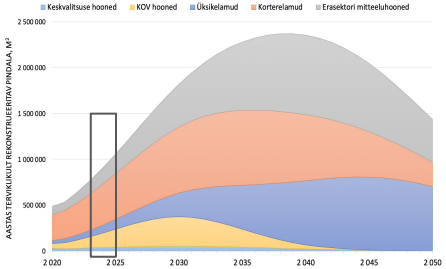
We see mass renovation as an emerging market for architects using both design and process innovation developed at the timber architecture research centre PAKK in collaboration with Thermory.



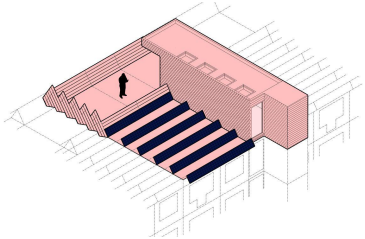
New access. A plug-in elevator and stair module with roof access



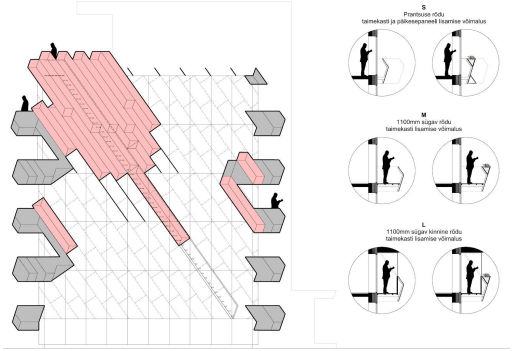
Balconies. Configurable extensions of the private domain to the outside



The Renovation Wave. Cumulative yearly renovation need in m2. Source: *Hoonete rekonstrueerimise pikaajaline strateegia.* TalTech, MKM. Tallinn. June 2020.

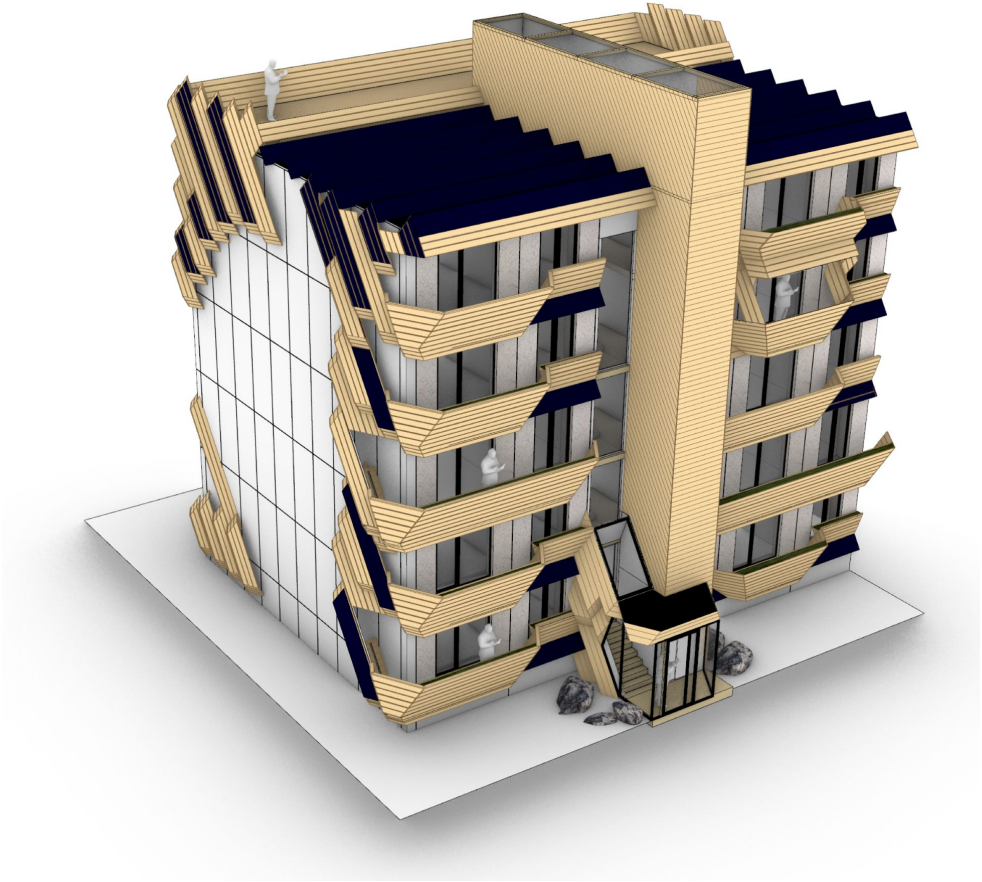


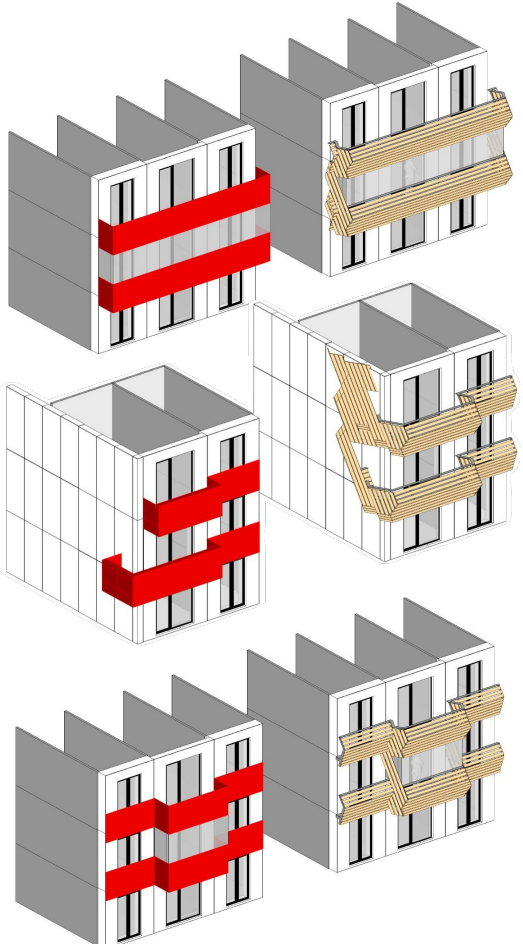
Roof Terrace. A terrace module is proposed as well as PV panel solutions



End Wall. The elements on the end wall can house vertical greenery and PV panels as well as provide an additional escape/access route.

3 Research
sLender Facade





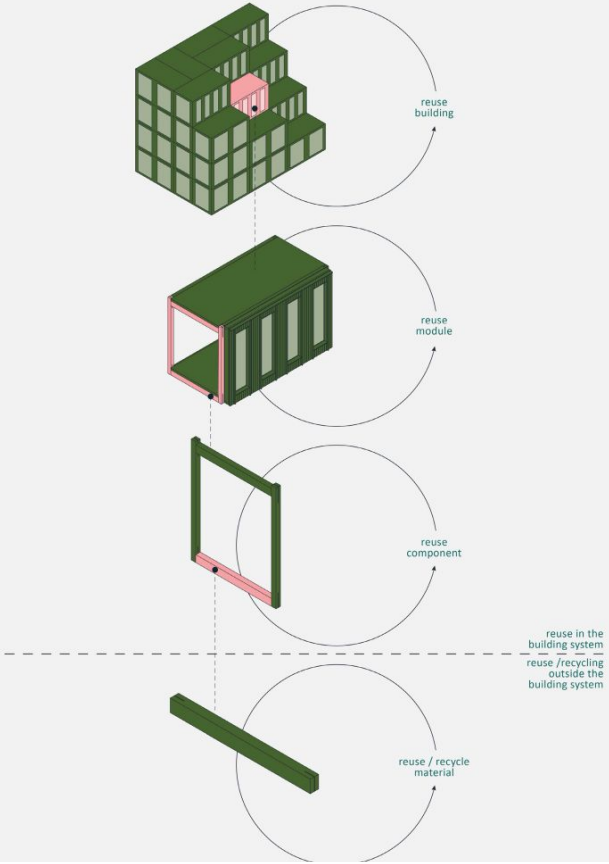
3 Research
Pattern Buildings

CIRCULARITY

3cycle buildings are circular in multiple levels. The largest circular unit in the system is the ***entire building***, as it can be demounted, moved and reassembled on a different site, if the need occurs. Secondly, full ***room modules*** can be reassembled, removed or added to a building. The smallest reusable parts of the building systems are its ***components***. They are designed for disassembly, allow for easy repair or upgrade and can be easily reused in differing combinations in the same or other buildings. All building components, designed based on the principles of the *3cycle* system, should be recyclable and maximise the use of low-emission and bio-based materials.

The core of the building system is its design for disassembly, following the standard *ISO 20887*. Connections are easy to open and demounting does not result in damage or contamination of the buildings, modules or components materials. Preserving their value keeps the materials from being dumped on landfills or burned in incineration plants and makes them more attractive for future reuse. All the materials which continue to be reused and which are circulating in the building stock save on future extractions of resources and productions of materials, thus reducing the environmental impact on climate and ecosystems. This way, *3cycle* buildings can contribute to the transition towards a sustainable building sector with responsible consumption and production.

To ensure the circularity of the *3cycle* system any future adaptations should be in accordance with the described circularity levels and the standard *ISO 20887*.

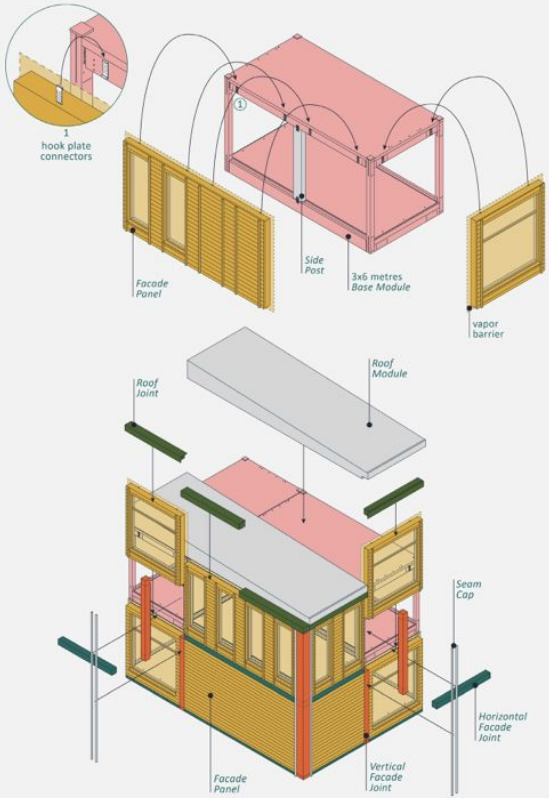


BUILDING ENVELOPE

The building envelope consists of roof and facade elements which are fixed to the *Base Modules*.

The ***Exterior Facade Panels*** are hung with hook plate connectors to the *End Frames* or *Upper Side Beams* of the *Base Modules*. These panels are insulated and protect against wind and rain. Windows and exterior doors are placed in them. The type of construction, thermal performance, window ratio and design can be chosen based on the project. However, the weight and structure of the panels have to be according to the limitations and positions of the hook plate connectors.
Each *Exterior Facade Panel* is a bit lower and shorter than the *Base Module* it is attached to. The resulting gaps between different *Exterior Facade Panels* in horizontal and vertical direction are required to join the vapor barrier after assembly on-site. This way, *Exterior Facade Panels* can be installed already in the factory and only lightweight ***Facade Joints*** have to be added on-site.

Different kinds of insulated roof constructions can be added on top of the *Base Modules*. However, in order to preserve the building's adaptability over time it is recommended to use ***Roof Modules*** which are based on the same 3 by 3 meters design grid as the building system. If *Roof modules* are used which do not extend above the *Exterior Facade Panels* the latter can be demounted or mounted independently during a building's life. In this case insulated ***Roof Joints*** are placed above *Exterior Facade Panels* to avoid cold bridges.

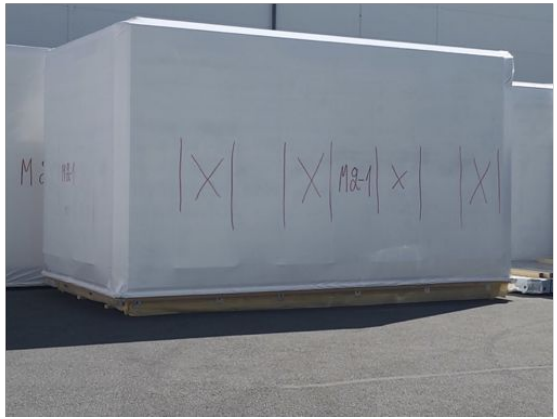


Available on https://patternbuildings.com/downloads/

3 Research
Pattern Buildings








3 Research
Myceen

Construction industry is responsible for 50% of all used raw materials, 40% of energy consumption and 37% of CO^2 emissions. At the same time 75% of EU buildings are inefficient, the target is to renovate 35 mln houses by 2030 for carbon neutrality of buildings.

As a solution, Myceen is developing carbon-storing building materials and their large scale production technologies. As the epitome of efficiency, great unit economics and sustainability, mycelium material is a perfect example of a circular economy combining industries' leftovers with mushroom mycelium.

The main raw material can be a wide selection of organic industrial leftovers containing lignocellulose, in local (Estonian) context mainly sawdust. Mycelium binds these residues into strong and high-performing materials with various great properties (e.g. insulation properties as good as or better than those of mineral wools, acoustics, fire resistance, etc).

Mycelium acts as a glue and binds different leftovers into strong solid materials

Mycelium material can withstand heat and flame

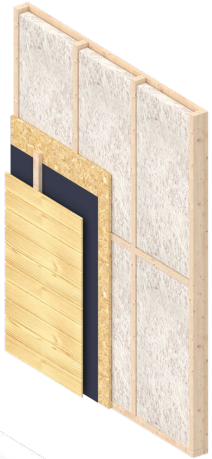
Mycelium-based materials can be used in wide variety of applications

Circular mycelium bricks forming a partitioning wall

3 Research
Myceen

Focusing on rigid insulation panels that have thermal conductivity value of λ = 0,037 W/mK and a footprint of -1kg/CO_2 per 1kg of mycelium material, makes it a valid option for carbon-neutral architecture.

In the test pavilion Myceen's wall insulation materials will be measured with sensors. the data will be used to compare the performance and durability with conventional insulation materials. The findings will be analysed in Marleen Mäekala's (TalTech) Master's thesis.

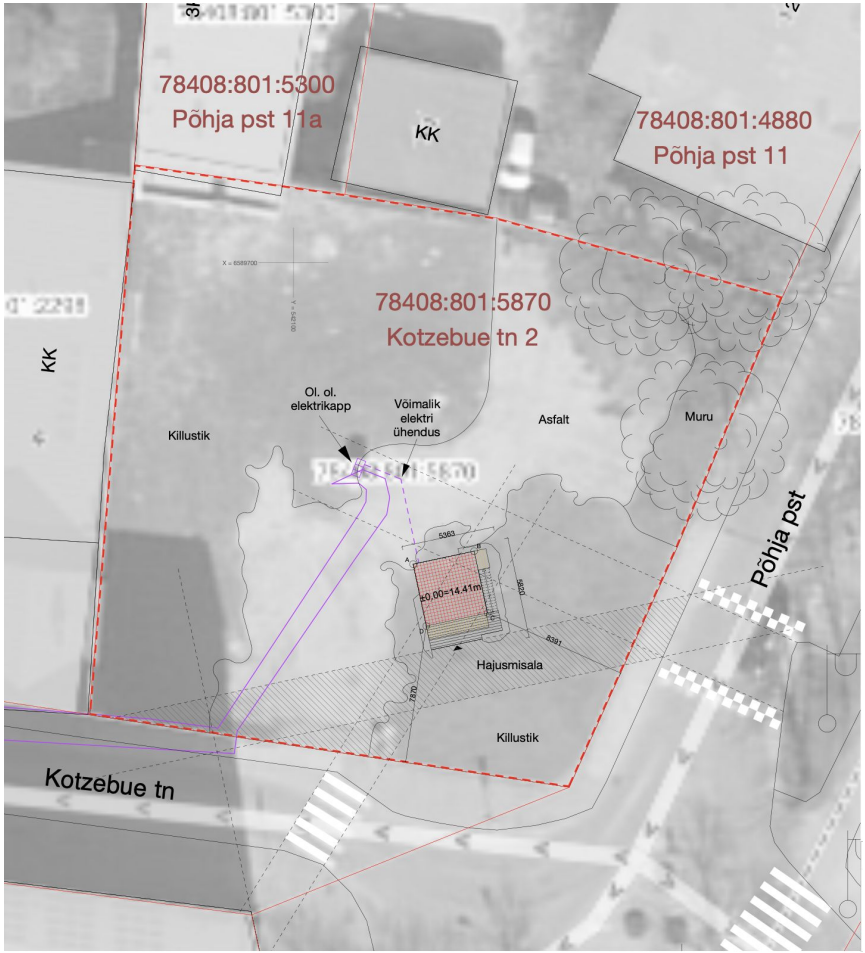


Myceen's acoustic/insulation panels, Future Room, Museum of the Home, London

3

Prototüüp (S skaala)

Näidishoone



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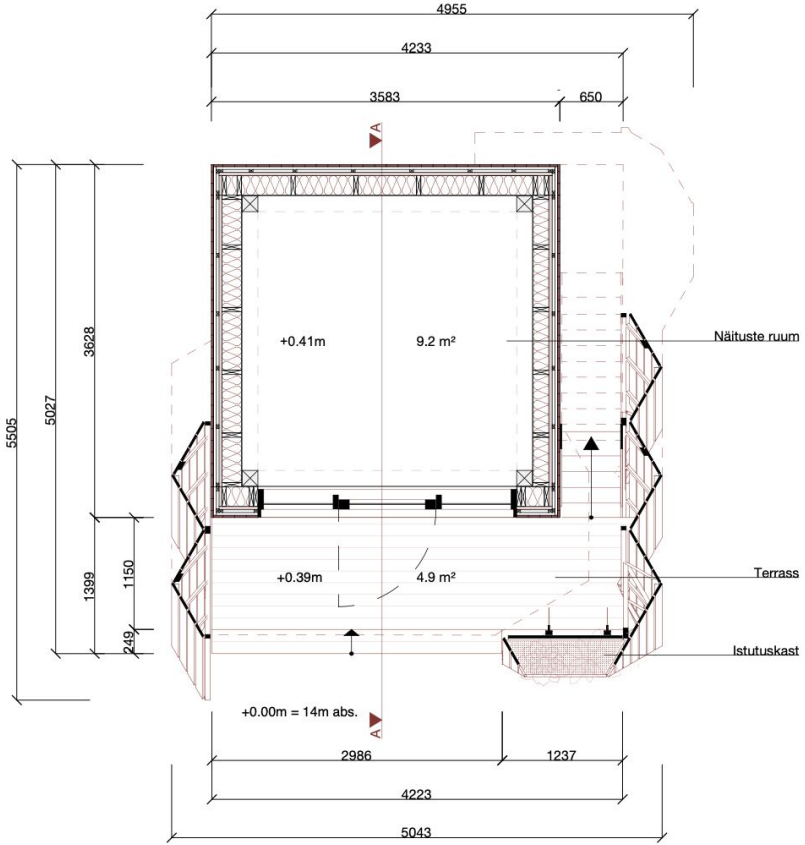
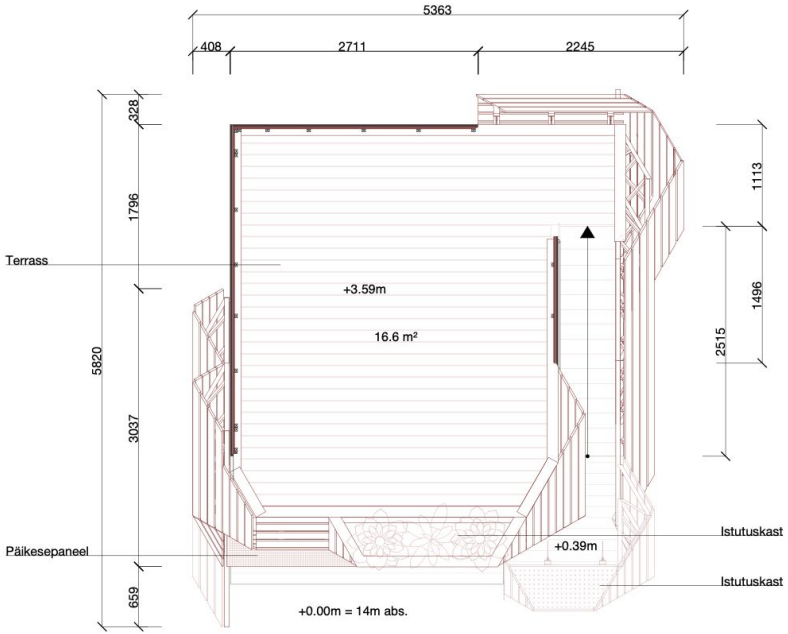
Prototüüp (S skaala)

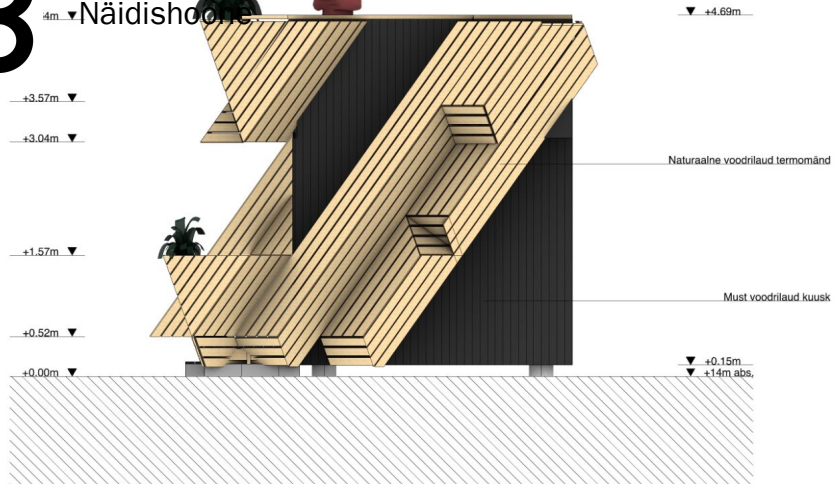
Näidishoone

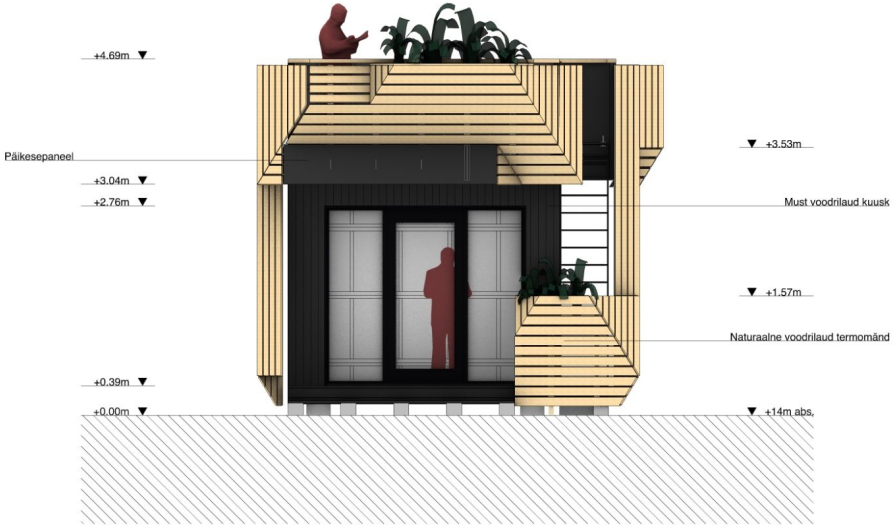


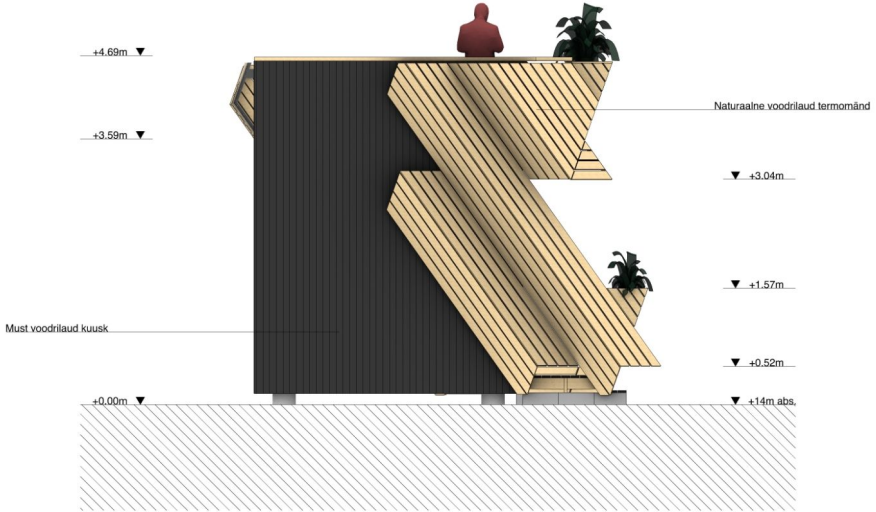


3 Prototüüp (S skaala)

Näidishoone







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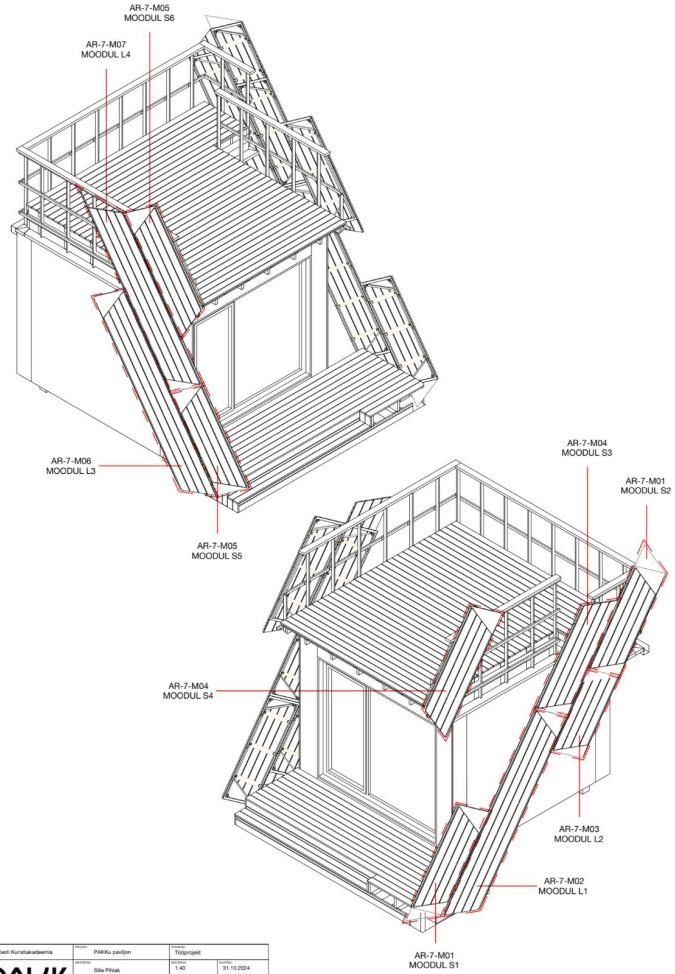
Prototüüp (S skaala)

Näidishoone

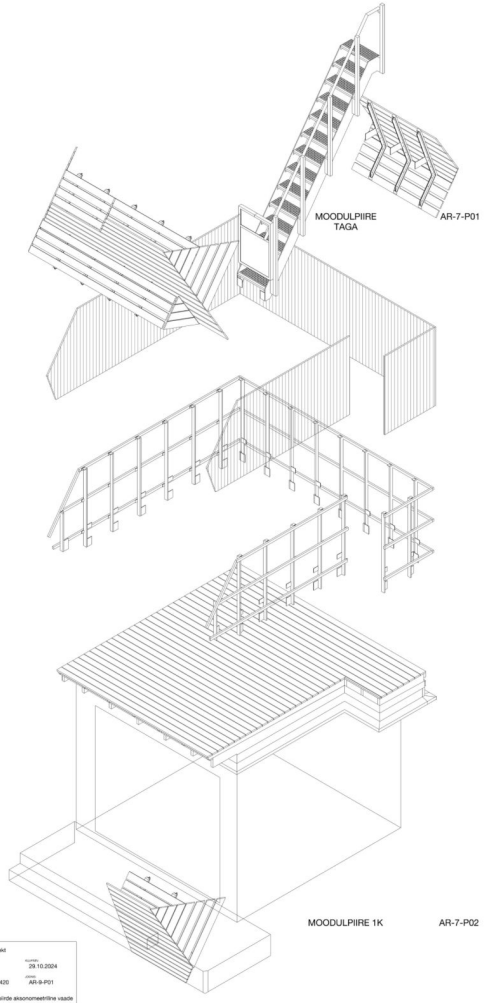
3

Prototüüp (S skaala)

Näidishoone



AR-7-P06	TREPP
AR-7-P03 AR-7-P04 AR-7-P05 AR-9-P02	MOODULPIIRE EES
AR-6-P02	LAUDIS
AR-5-P01 AR-6-P01	PIIRDEPOSTID +ROOVID
	KATUSE KONSTRUKTIOON
	KUUBIK
	TERRASS



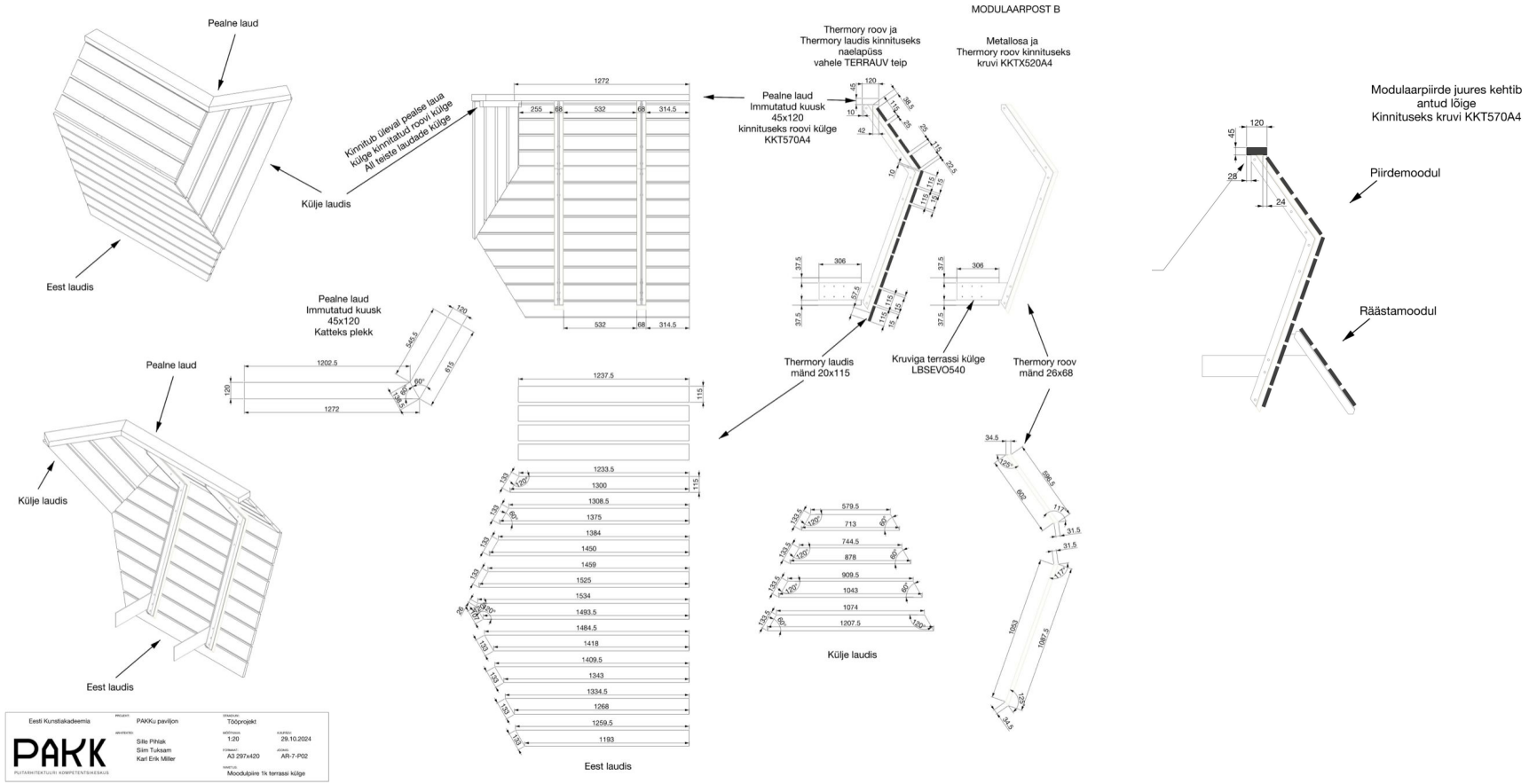
Eesti Kunstiakadeemia	PROJEKT: PAKKu paviljon	STAADIUM: Töötõnejõest	
PAKK	AUTORID: Sille Pihlak Siim Tuksam Karl Erik Miller	MÕÕTKAVA: 1:40	KUUPÄEV: 31.10.2024
		FORMAAT: A3 297x420	JOONIS: AR-9-M01
		NIMETUS: Modulaarsed fassaadielemendid	

Eesti Kunstiakadeemia	PROJEKT: PAKKu paviljon	STAADIUM: Töötõnejõest	
PAKK PUITARHITEKTUURI KOMPETENTSIKESKUS	AUTORID: Sille Pihlak Siim Tuksam Karl Erik Miller	MÕÕTKAVA: 1:40	KUUPÄEV: 29.10.2024
		FORMAAT: A3 297x420	JOONIS: AR-9-P01
		NIMETUS: Katuse piirde aksonomeetriline vaade	

3

Prototüüp (S skaala)

Näidishoone



3

Prototüüp (S skaala)

Näidishoone

3

KALVASTA TIMBER

Viking

THERMORY LEAVE A LASTING IMPACT

RAITWOOD

rothoblaas

Timberwise FLOOR FOR LIFE

SILMAN

BEAMLINE ACCELERATOR

KIK ENVIRONMENTAL INVESTMENT CENTRE

REPUBLIC OF ESTONIA MINISTRY OF CLIMATE

ETAG 10

PUUSTER

Co-funded by the European Union

Investing in your future

4

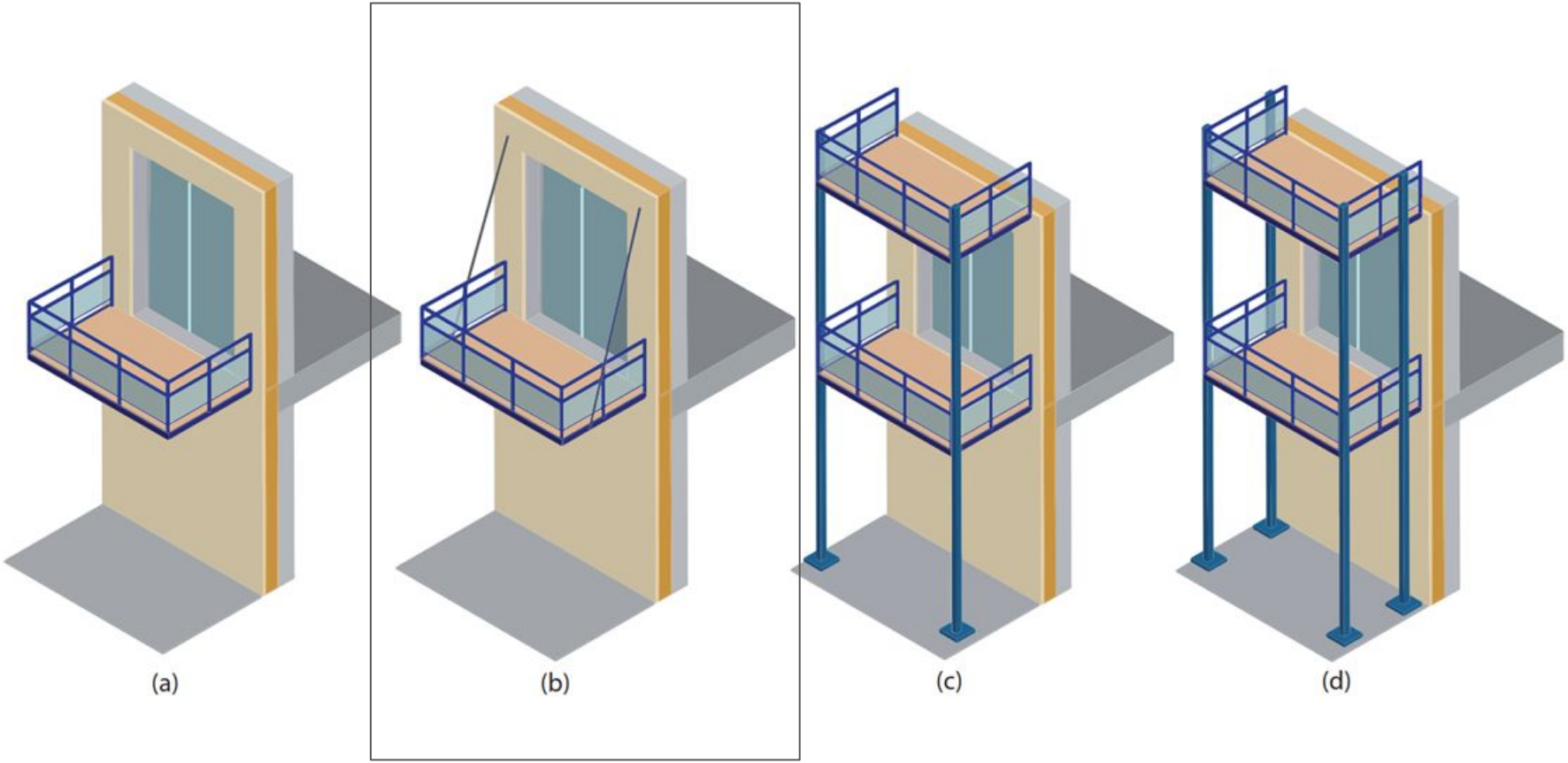
Konstruktsioon (M skaala)

Peidetud struktuur, mis võimaldab 1,2 meetrist konsooli

4

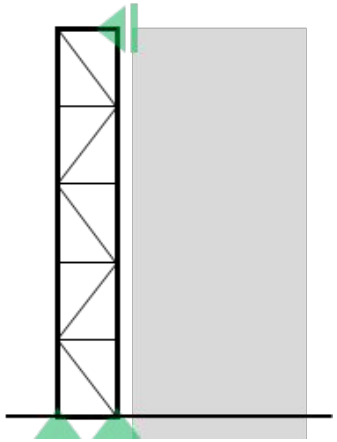
Konstruktsioon (M skaala)

Peidetud struktuur



4 Konstruktsioon (M skaala)

Peidetud struktuur



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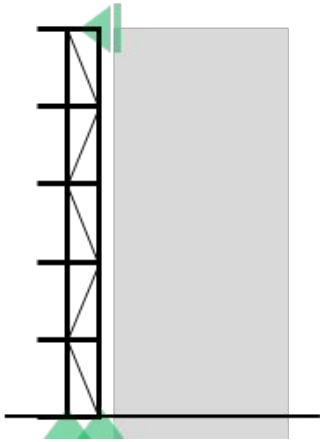

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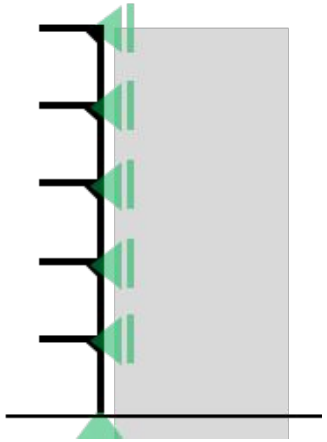


2a 2b

4 Konstruktsioon (M skaala)

Peidetud struktuur

Loads:

G = Gravity

G‘ – SDL Decking – LL 3kN/m²

G“– Railing or Cladding 0.6 kN/ml

Q‘ – LL 2kN/m²

Q‘ – LL 0,7kN/m²

Deflection Criteria:

L/150 – vertical deflections

L/200 – vertical deflections

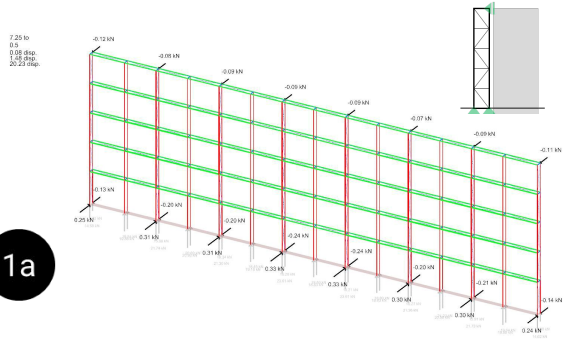
L/500 – horizontal deflections

Material:

S 235

For the initial step and comparison study, a vertical uniform load of 5 kN/m² was applied to all horizontal surfaces, along with a horizontal wind load of 1 kN/m².

The load hypothesis will be updated to align with local regulations and the evolving architectural design.



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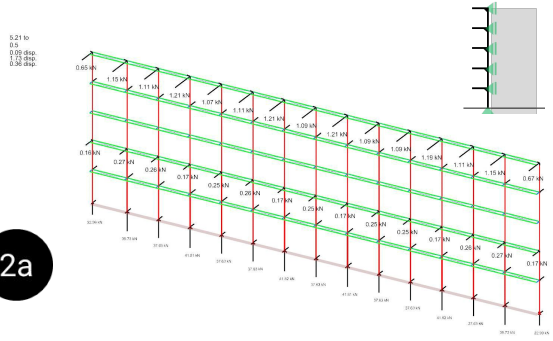

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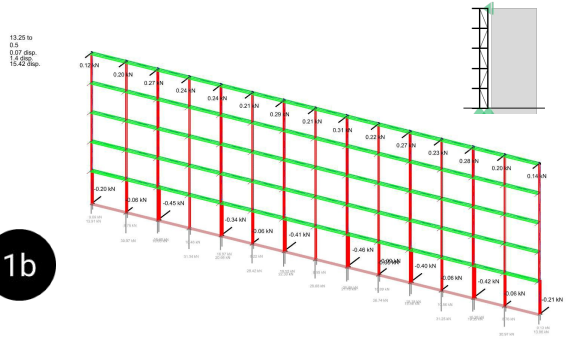

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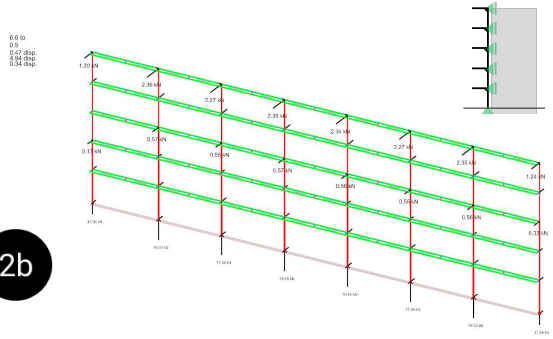


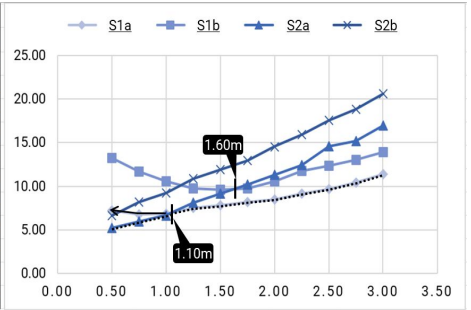
2b

4 Konstruktsioon (M skaala)

Peidetud struktuur

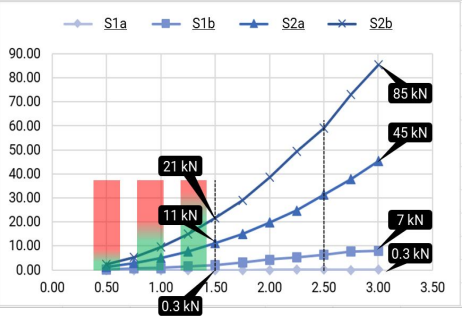
Steel Weight

Offset	System 1a	System 1b	System 2a	System 2b
m	to	to	to	to
0.50	7.21	13.25	5.21	6.60
0.75	6.75	11.68	5.94	8.22
1.00	6.84	10.59	6.67	9.22
1.25	7.54	9.74	8.14	10.84
1.50	7.83	9.57	9.13	11.87
1.75	8.18	9.76	10.17	12.94
2.00	8.48	10.55	11.30	14.54
2.25	9.16	11.75	12.43	15.88
2.50	9.70	12.38	14.60	17.56
2.75	10.45	13.05	15.19	18.80
3.00	11.37	13.94	16.98	20.62



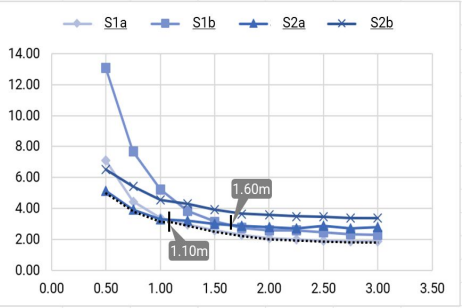
Max. Horizontal Reaction, *LC1*

Offset	horizontal	horizontal	horizontal	horizontal
m	pull	pull	pull	pull
0.50	0.05	0.31	1.21	2.36
0.75	0.00	0.62	2.78	5.30
1.00	0.00	0.85	4.94	9.59
1.25	0.00	1.45	7.77	14.86
1.50	0.01	2.03	11.29	21.57
1.75	0.02	3.07	15.07	28.96
2.00	0.02	4.33	19.86	38.64
2.25	0.19	5.36	24.77	49.37
2.50	0.19	6.30	31.47	58.97
2.75	0.05	7.59	37.89	73.07
3.00	0.08	7.86	45.28	85.48



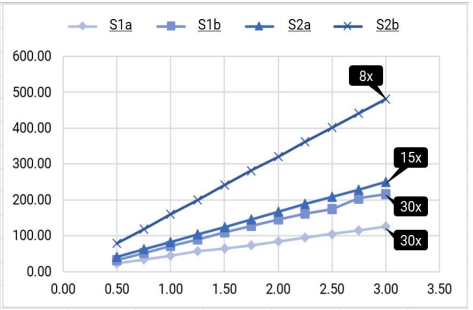
Steel Weight / m²

Offset	System 1a	System 1b	System 2a	System 2b
m	to	to	to	to
0.50	7.12	13.09	5.15	6.52
0.75	4.44	7.69	3.91	5.41
1.00	3.38	5.23	3.29	4.55
1.25	2.98	3.85	3.22	4.28
1.50	2.58	3.15	3.01	3.91
1.75	2.31	2.75	2.87	3.65
2.00	2.09	2.60	2.79	3.59
2.25	2.01	2.58	2.73	3.49
2.50	1.92	2.45	2.88	3.47
2.75	1.88	2.34	2.73	3.38
3.00	1.87	2.29	2.80	3.39



Max. Vertical Reaction, *LC1*

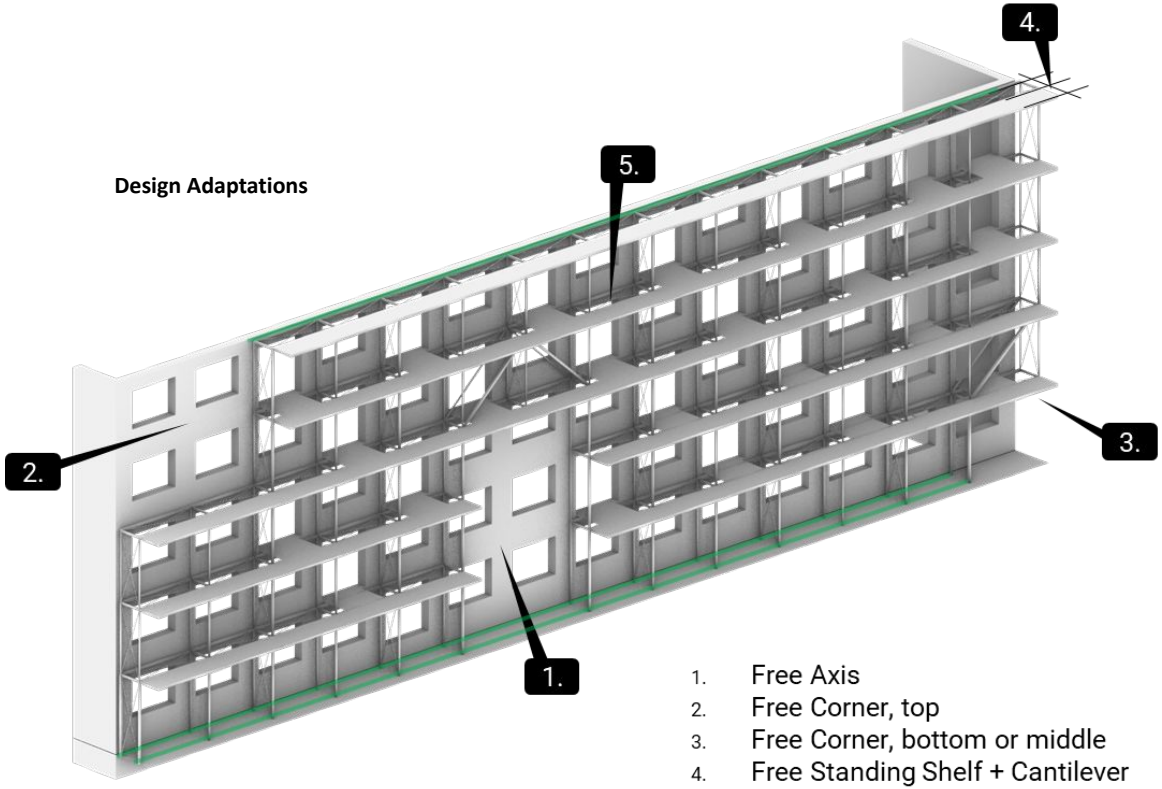
Offset	vertical	vertical	vertical	vertical
m	push	push	push	push
0.50	22.37	31.34	41.82	79.45
0.75	34.20	52.06	62.73	119.05
1.00	44.11	72.00	82.71	160.36
1.25	56.74	89.57	103.41	199.43
1.50	64.65	109.95	124.45	240.66
1.75	73.09	127.37	146.18	281.73
2.00	84.23	146.14	166.70	320.31
2.25	94.58	161.81	188.24	361.36
2.50	104.99	174.80	208.22	401.55
2.75	114.75	204.27	228.56	441.65
3.00	125.89	216.08	250.10	480.98

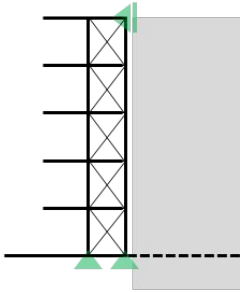


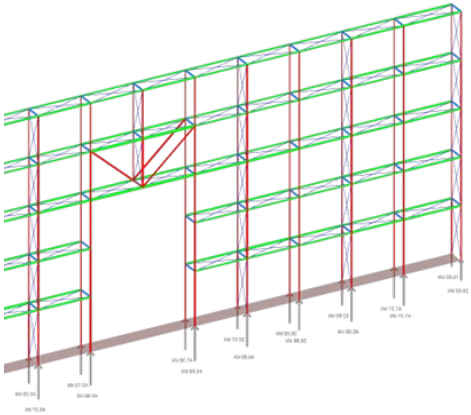
4 Konstruktsioon (M skaala)

Peidetud struktuur

Design Adaptations





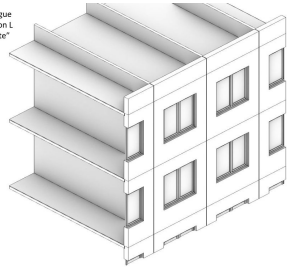


1. Free Axis
2. Free Corner, top
3. Free Corner, bottom or middle
4. Free Standing Shelf + Cantilever
5. Partial Population

4 Konstruktsioon (M skaala)

Peidetud struktuur

5. Catalogue
5.3. Option L
5.3.1. "Site"



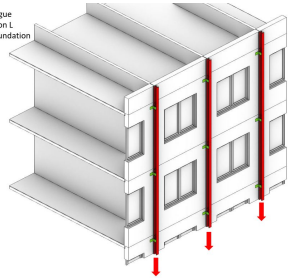
BOLLINGER + GROHMANN

Nimi: Tüüpmaja 1-464 (tüüpemalt vaatluse all tüüp 1-464A-14)
Projekteerimisorganisatsioon: tüüp 1-464 "Üldprojektiindustria", 1-464A-14 RPI "Eesti-Projekt"
Projekt autorid 1-464: N. P. Rozanov, V. G. Kochenkhov,

A. G. Rosenfeld, I. P. Polozov / tüüp 1-464A-14 – Tõu Argus
Aadress: E. Vilde tee 121b, Mustamäe
Projekteerimisaasta: **1966**
Valmimisaasta: 1972

32

5. Catalogue
5.3. Option L
5.3.4. Foundation



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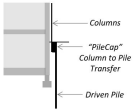
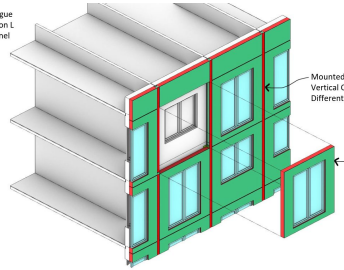
Local Foundation Piles, without need for Excavation



35

5. Catalogue
5.3. Option L
5.3.4. Panel



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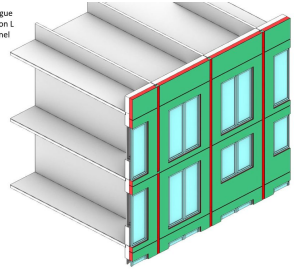
36

5. Catalogue
5.3. Option L
5.3.4. Panel



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Timber Substructure

Insulation Infill

Exterior Finish

KTM Prefab System

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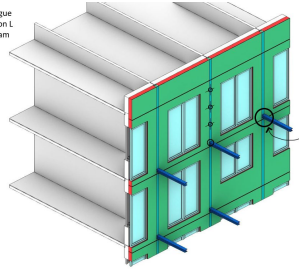
5. Catalogue
5.3. Option L
5.3.5. Beam



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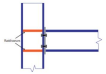

Typical Screwed Connection Detail

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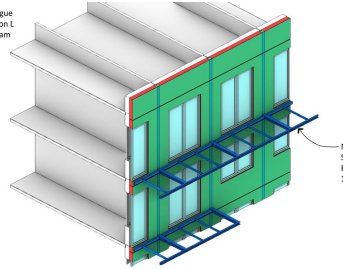
5. Catalogue
5.3. Option L
5.3.5. Beam



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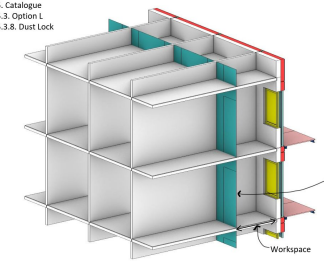
40

5. Catalogue
5.3. Option L
5.3.8. Dust Lock



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Integratbale „Door" Dust Barrier

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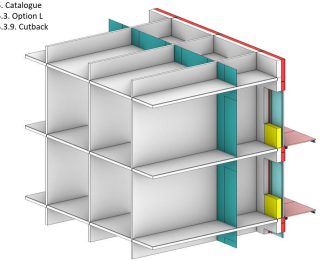
5. Catalogue
5.3. Option L
5.3.9. Cutback



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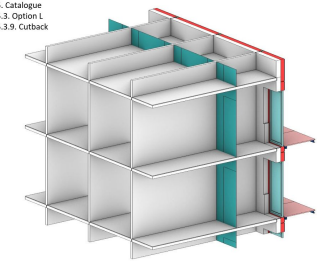
Timbeco

46

5. Catalogue
5.3. Option L
5.3.9. Cutback



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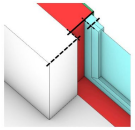


Panel Cutting

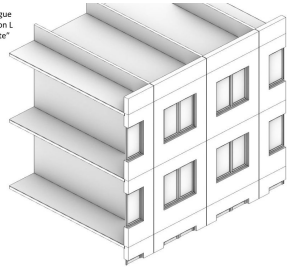
Panel Cutting Within a Tight But Realistic Workspace from Within + Outside the Building. Opening the Door, Or potentially Removing Door Wind would allow for space from inside and outside

47

4 Konstruktsioon (M skaala)

Peidetud struktuur

5. Catalogue
5.3. Option L
5.3.1. "Site"



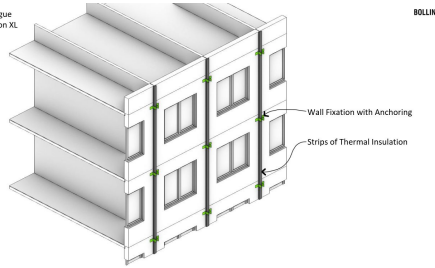
BOLLINGER+GROHMANN

Nimi: Tüüpmaja 1-464 (tüpsemalt vaatluse all tüüp 1-464A-14)
Projekteerimisorganisatsioon: tüüp 1-464 "Üleroostreindustria", 1-464A-14 RPI "Eesti-Projekt"
Projekt autorid 1-464: N. P. Rosanov, V. G. Kochenkiov,

A. G. Rosenfeld, I. P. Polozov / tüüp 1-464A-14 – Tõu Argus
Aadress: E. Vilde tee 121b, Mustamäe
Projekteerimisaasta: **1966**
Valmimisaasta: 1972

32

5. Catalogue
5.4. Option XL



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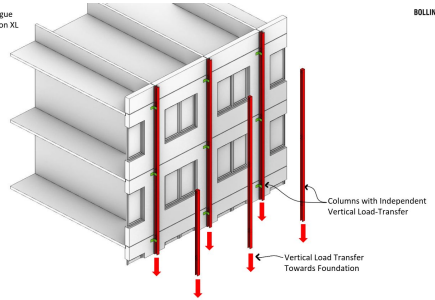
5. Catalogue
5.4. Option XL



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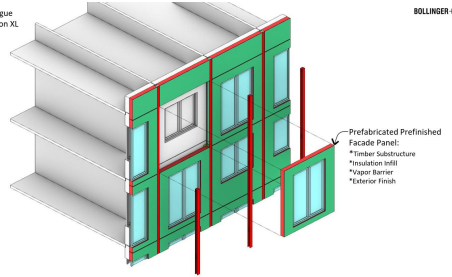
5. Catalogue
5.4. Option XL



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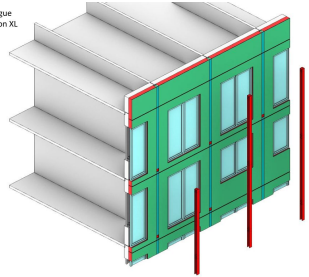
5. Catalogue
5.4. Option XL



Typical example of independent
exterior building strucutre

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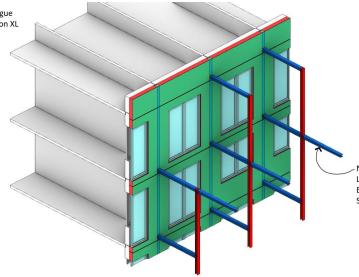
5. Catalogue
5.4. Option XL



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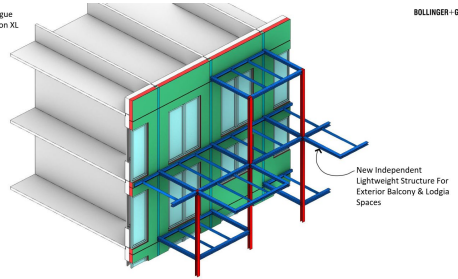
5. Catalogue
5.4. Option XL



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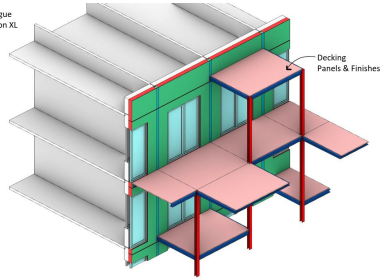
5. Catalogue
5.4. Option XL



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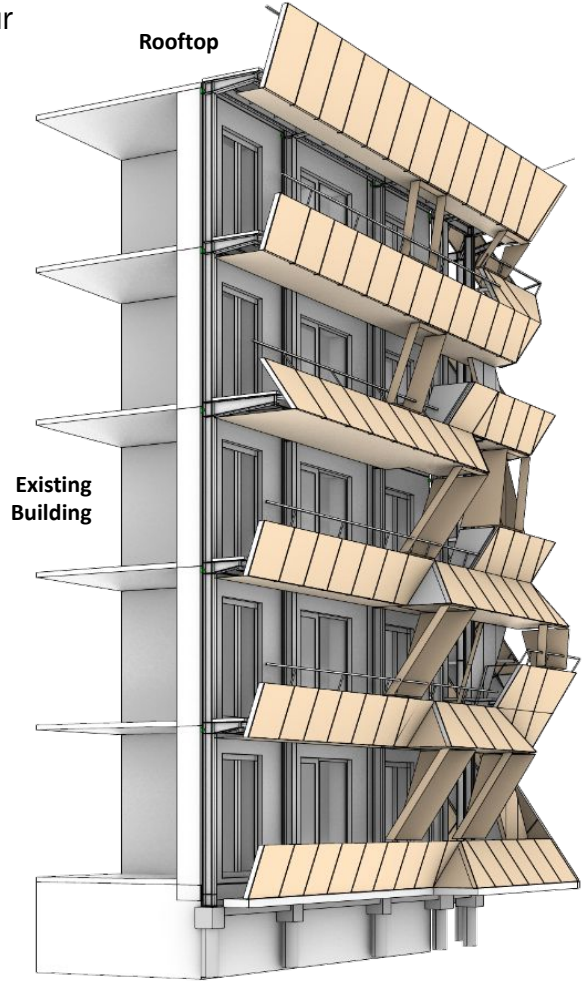
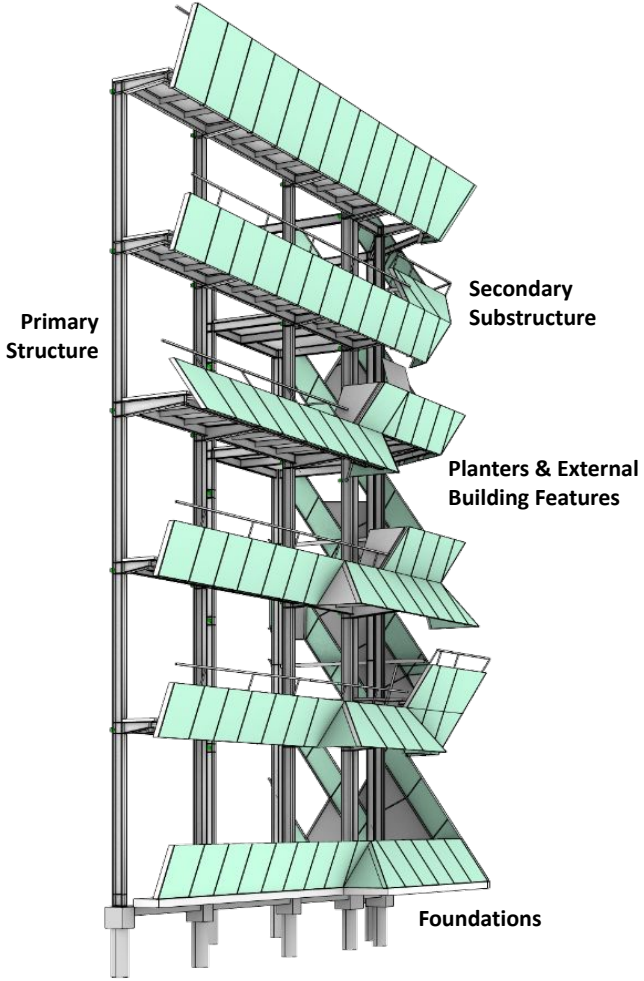
4 Konstruktsioon (M skaala)

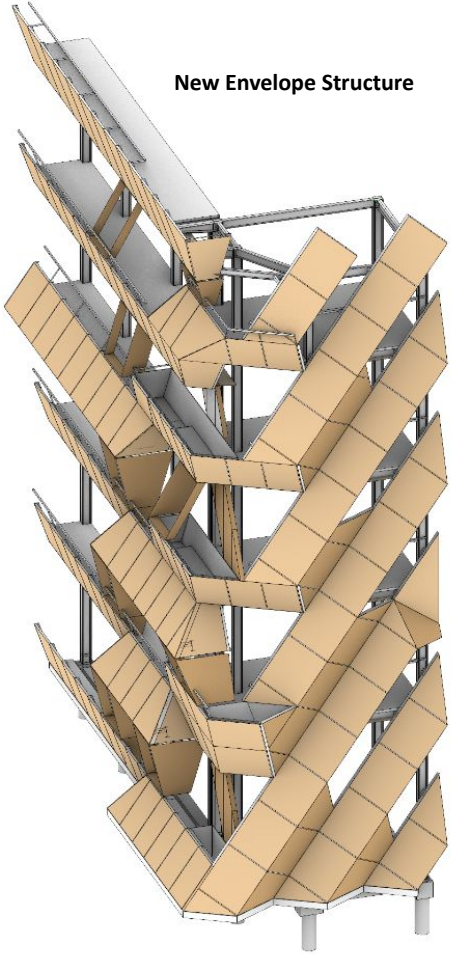
Peidetud struktuur

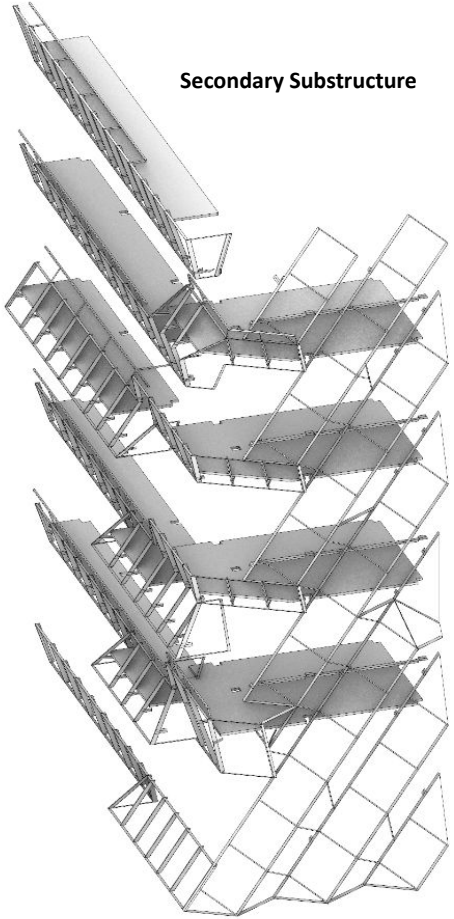


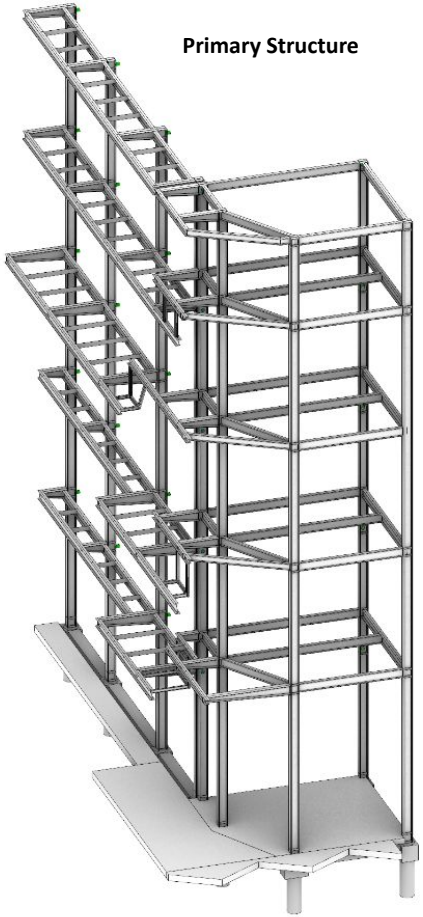


4 Konstruktsioon (M skaala)

Peidetud struktuur







5

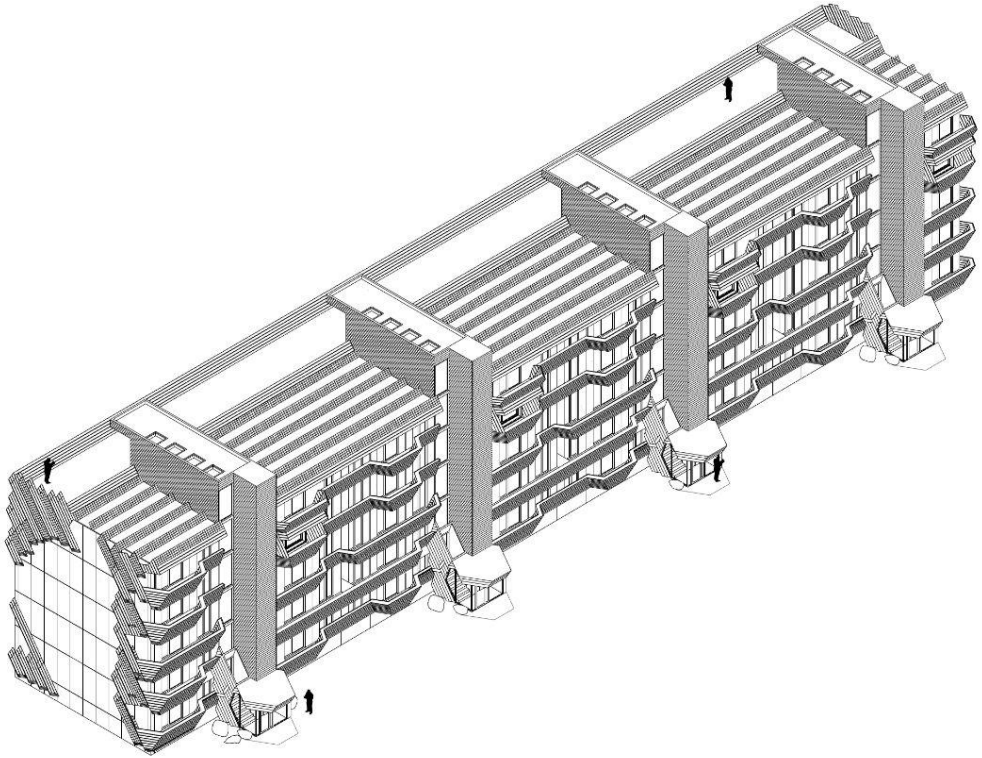
Ehitussüsteemi eskiis

Modulaarne, mahuline, tehastoodetav

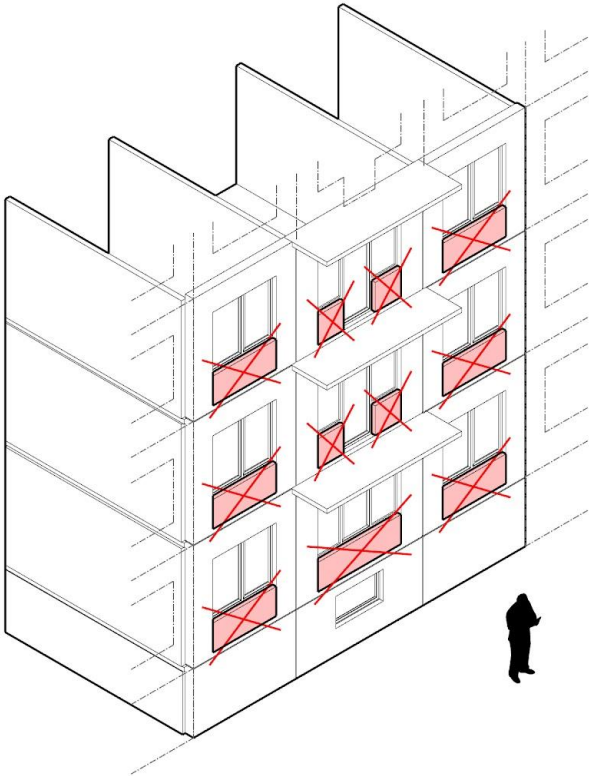
5

Ehitussüsteemi eskiis

Modulaarne, mahuline, tehastoodetav



5 3D mudel
. Konfiguraatori diagrammid



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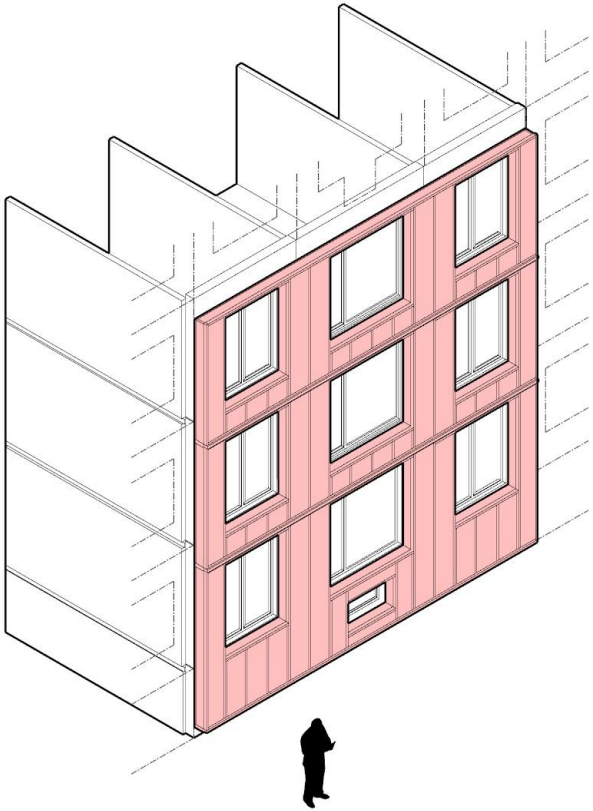
. Konfiguraatori diagrammid



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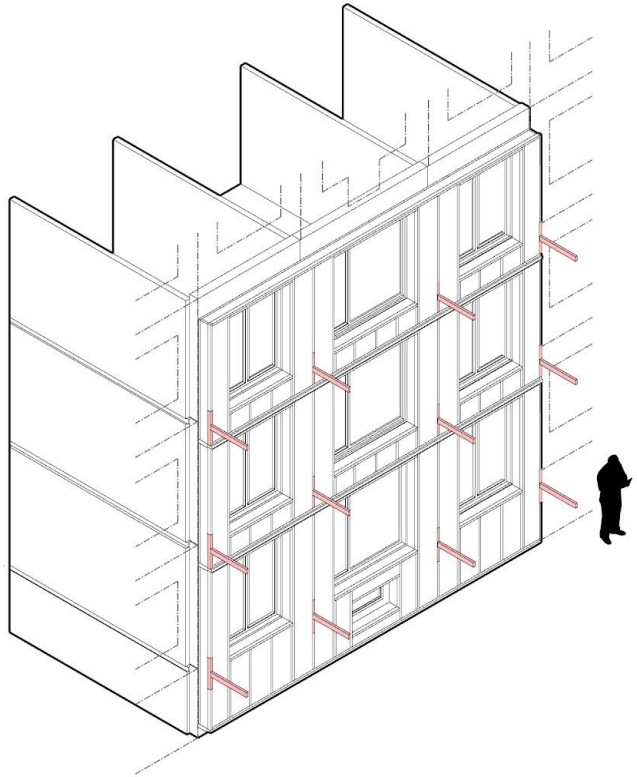
. Konfiguraatori diagrammid



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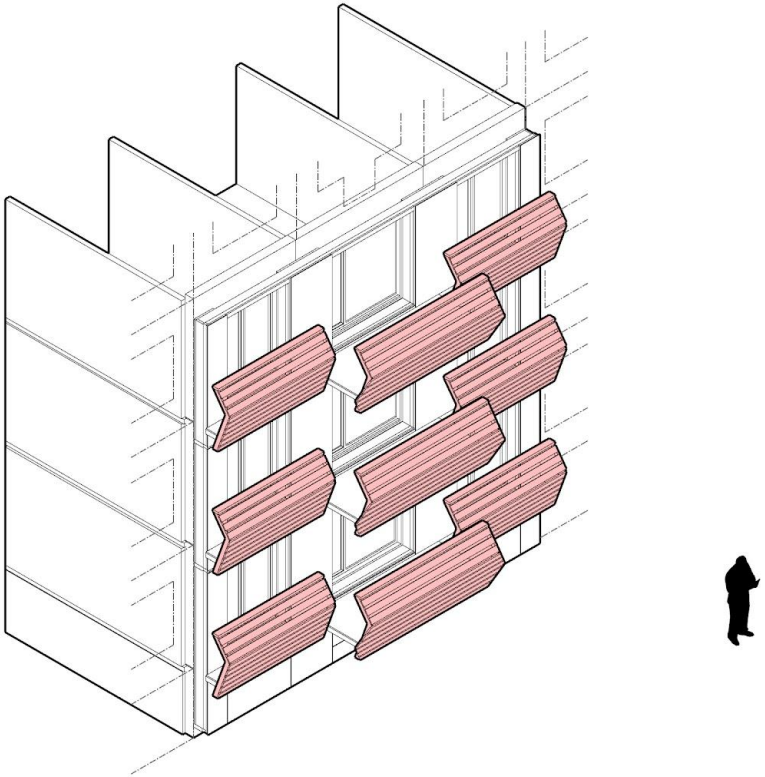

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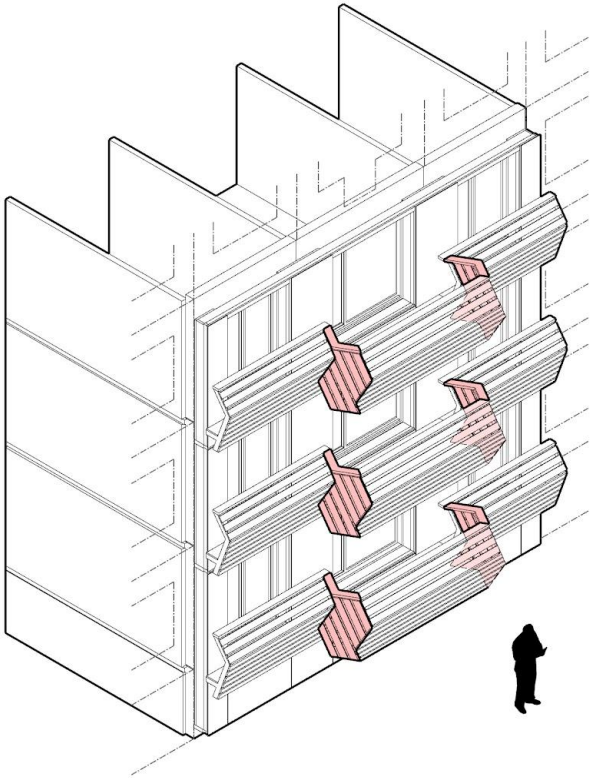

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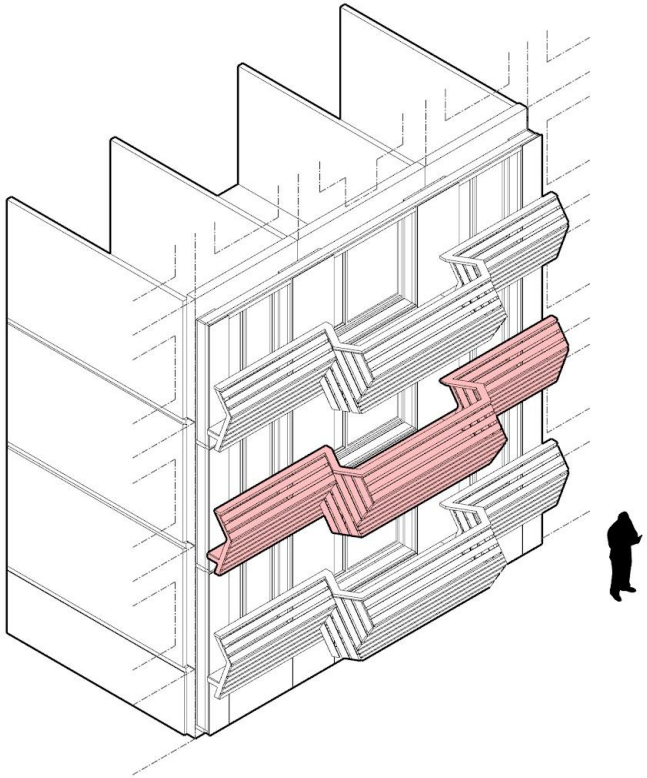

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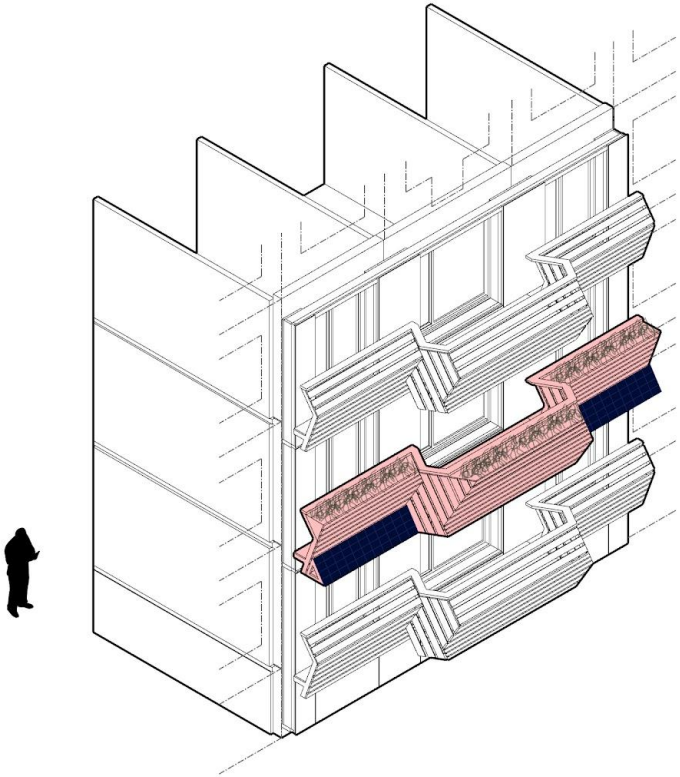

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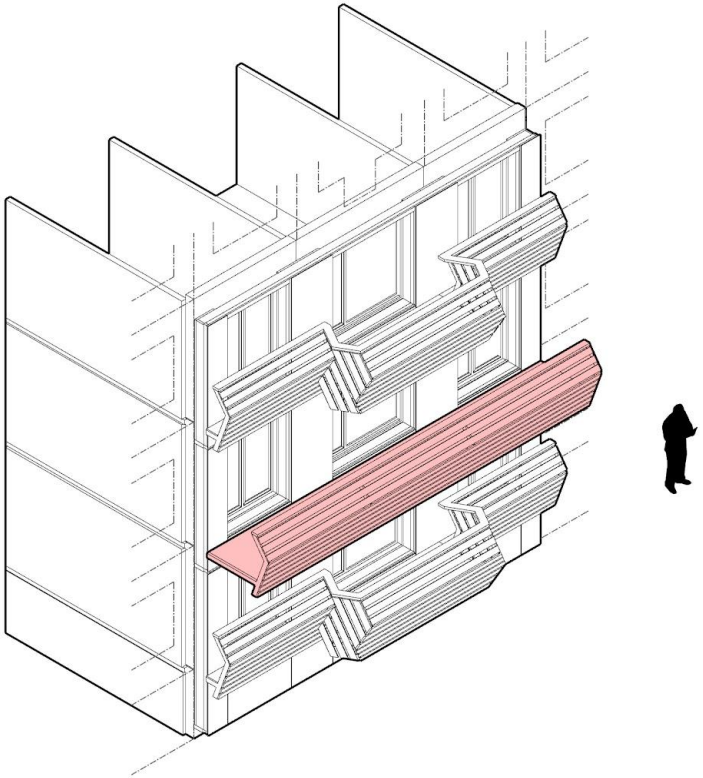

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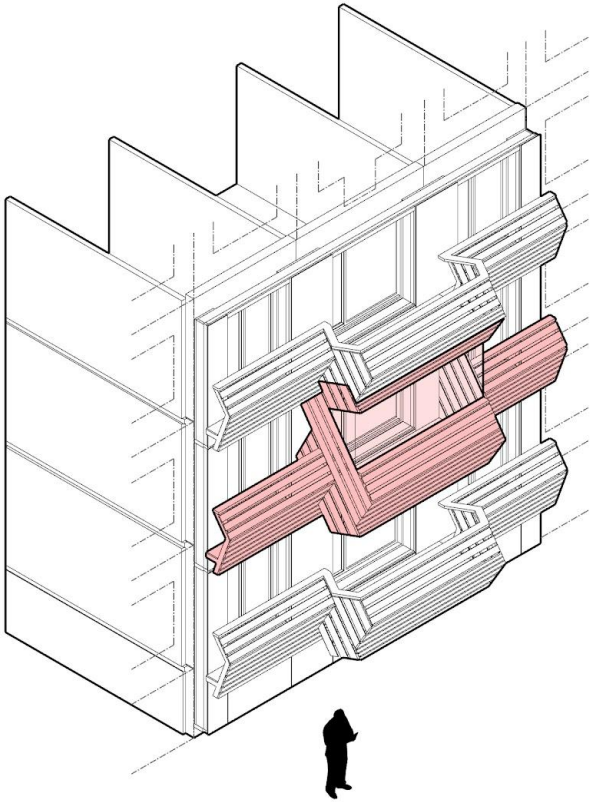

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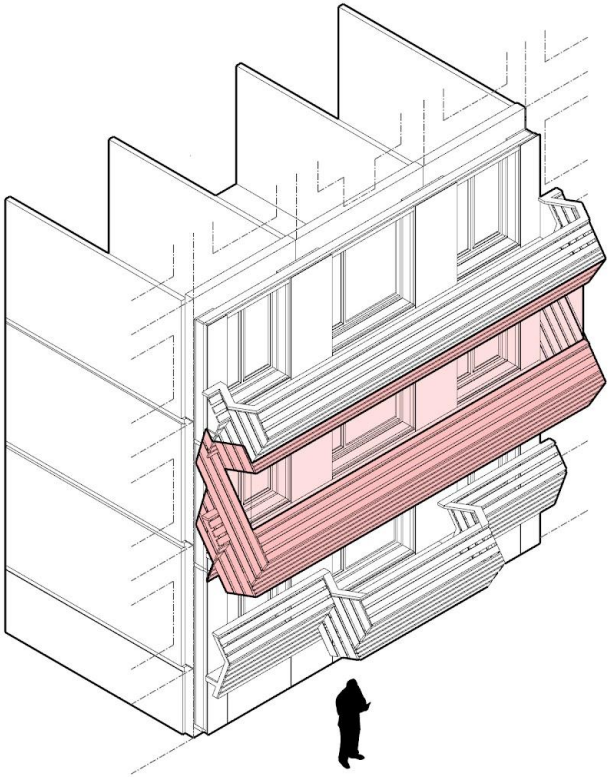
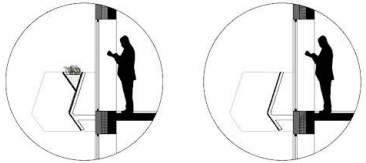
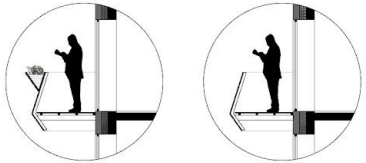


5 3D mudel
4. Joonised

S
Prantsuse rõdu
taimekasti ja päikesepaneeli lisamise võimalus



M
1100mm sügav rõdu
taimekasti lisamise võimalus



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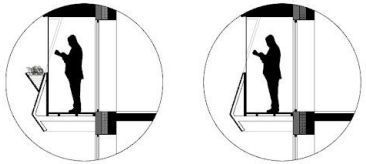
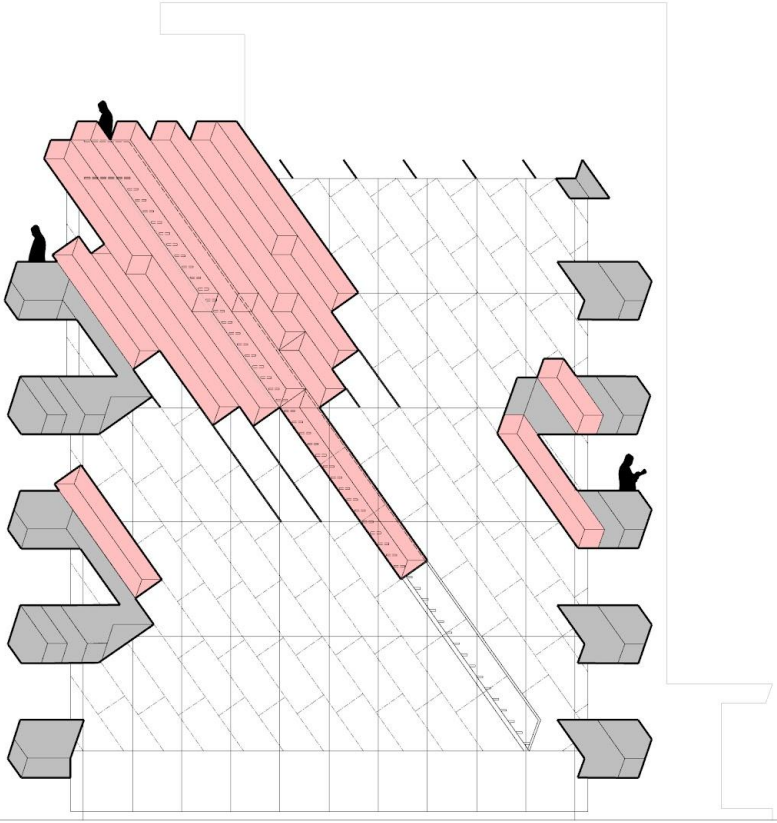
1100mm sügav kinnine rõdu
taimekasti lisamise võimalus





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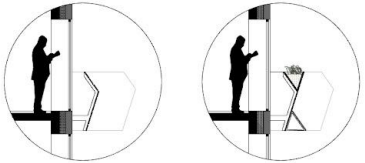
taimekasti ja päikesepaneeli lisamise võimalus



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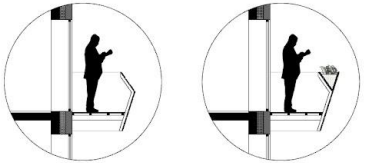
1100mm sügav rõdu
taimekasti lisamise võimalus



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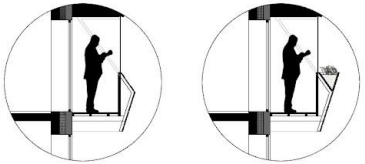
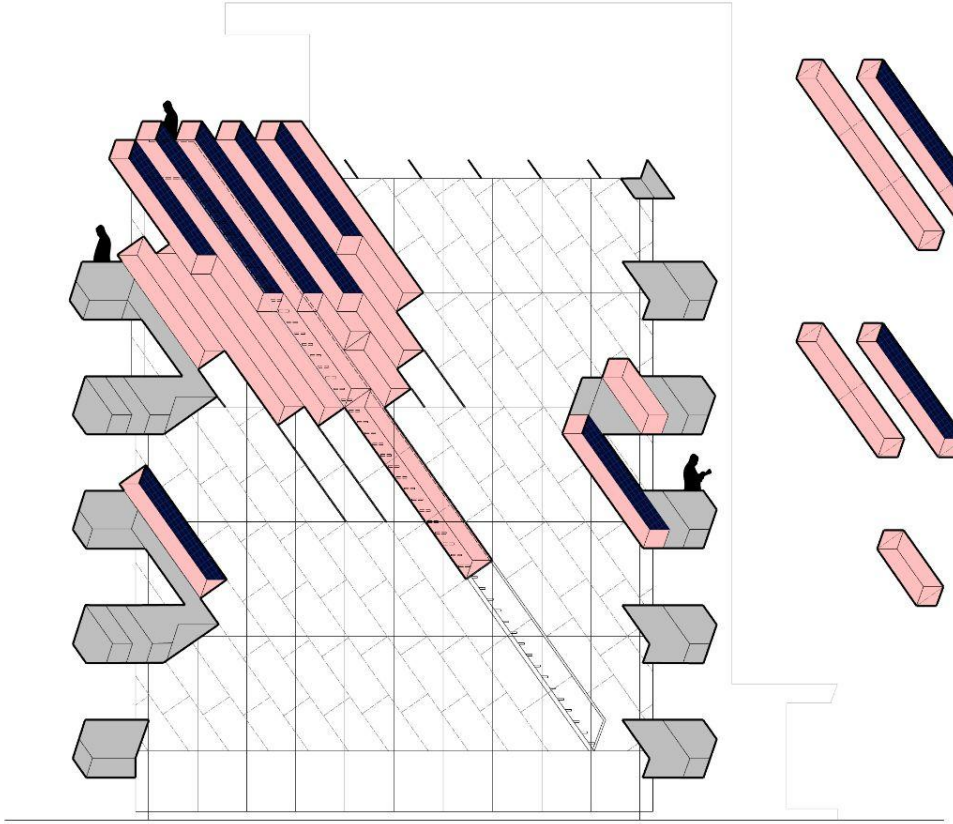
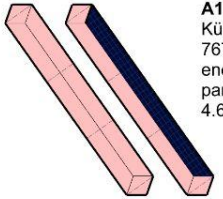
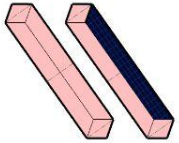


5 3D mudel
4. Joonised





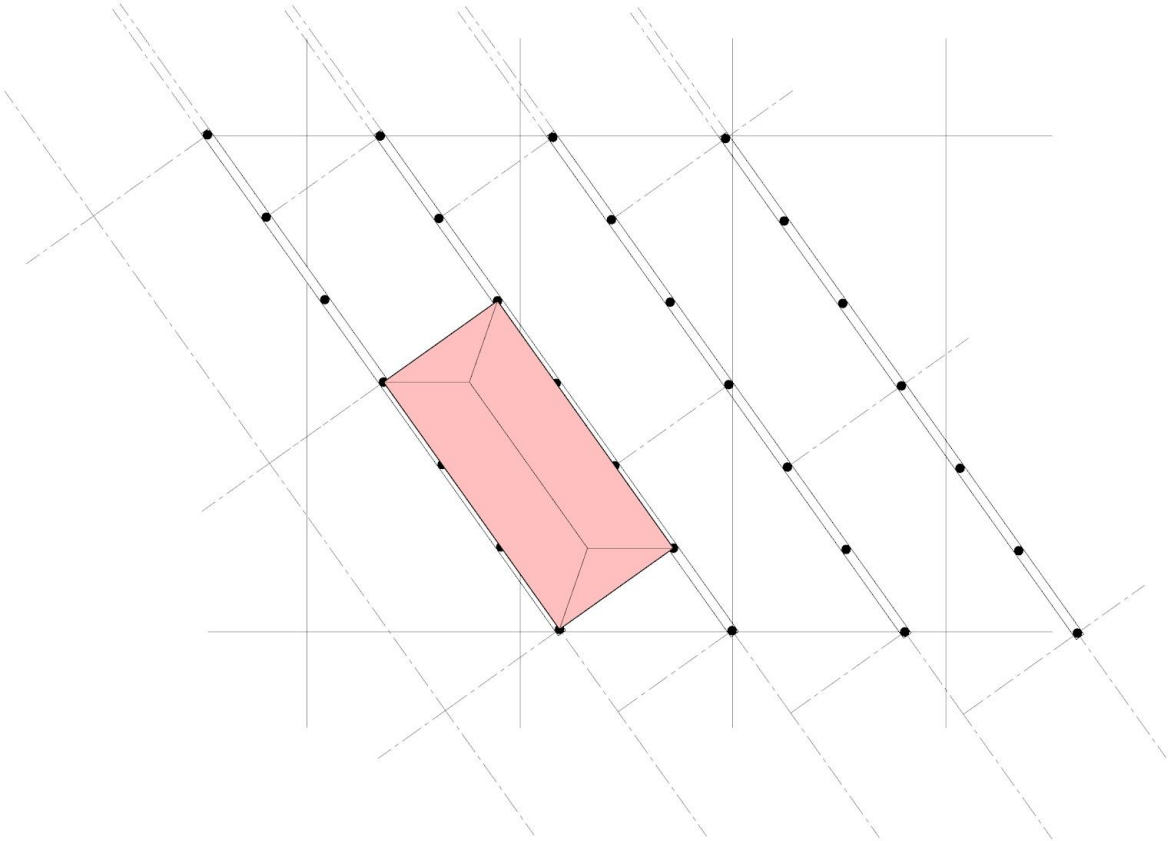
A1
Küljefassaadi paneel
767mm*4959mm, sügavus 285mm
energiapaneeli lisamise võimalus
paneel 2tk 389mm*1824mm
4.69m² puitu



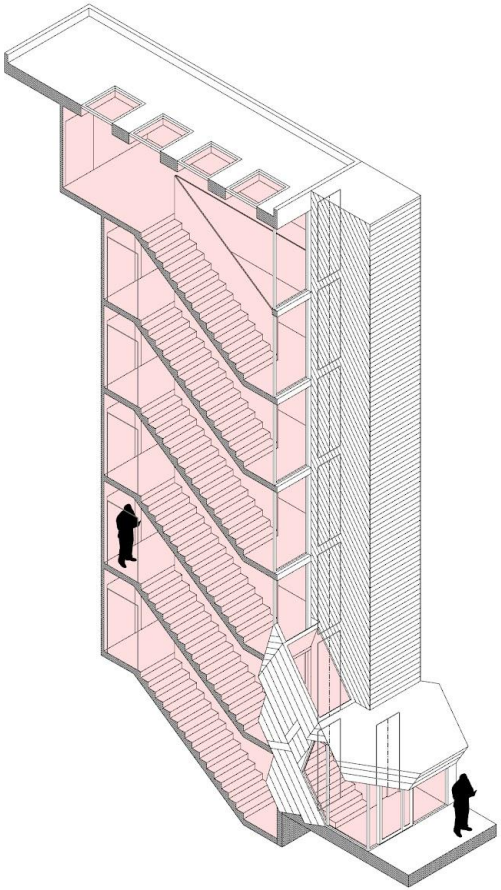
A2
Küljefassaadi paneel
767mm*3333mm, sügavus 285mm
energiapaneeli lisamise võimalus
paneel 389mm*1824mm
3.15m² puitu

A3
Küljefassaadi paneel
767mm*1630mm, sügavus 285mm
1.59m² puitu

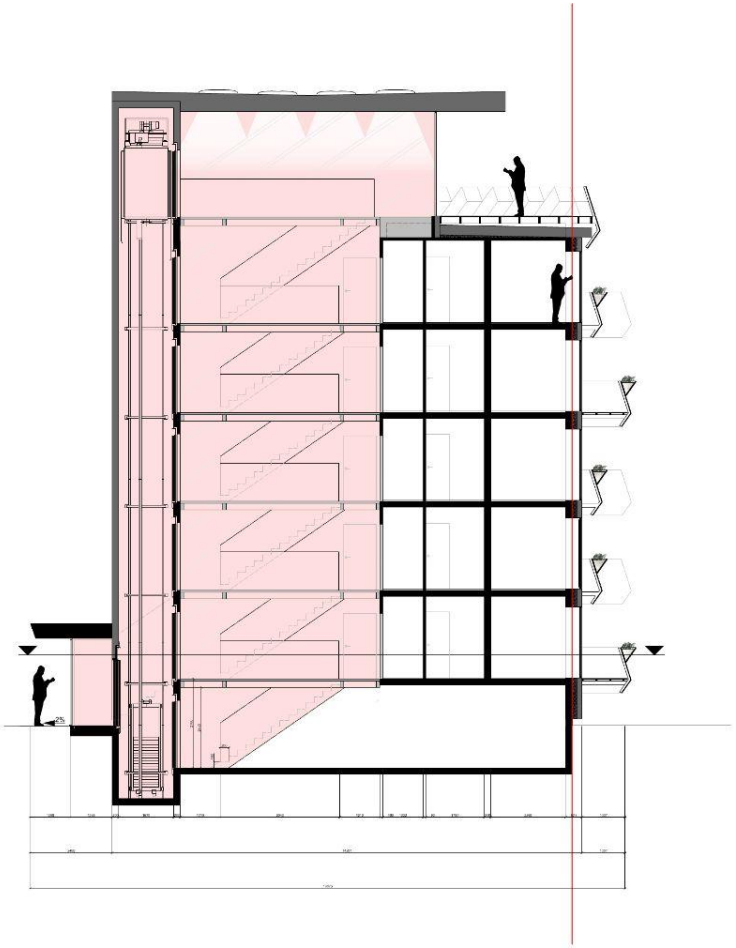
5 3D mudel
4. Joonised



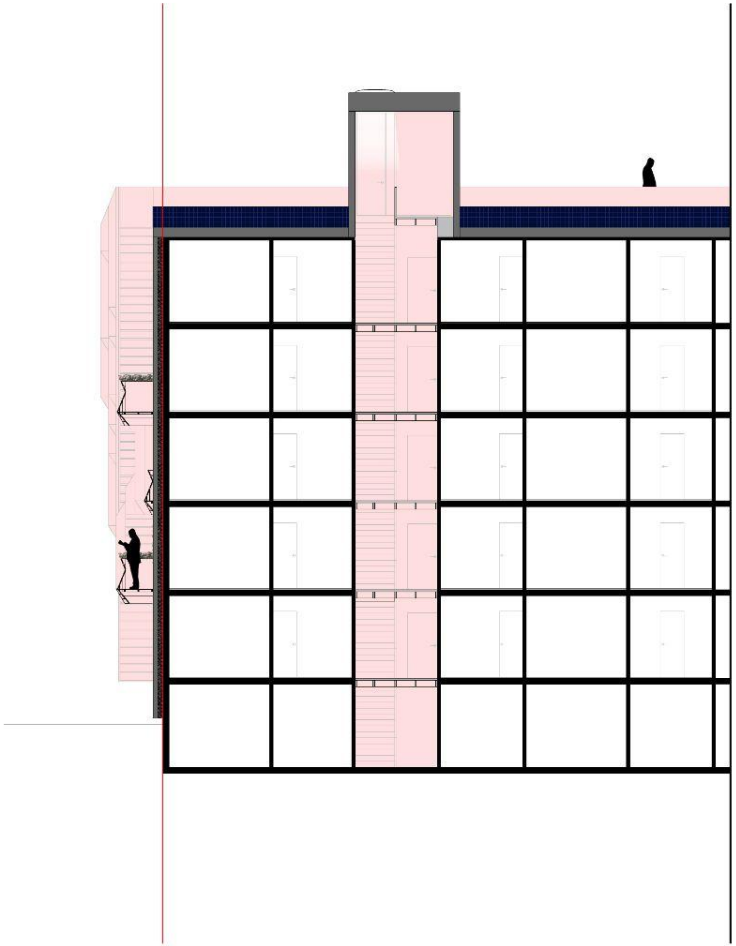
5 3D mudel
4. Joonised



5 3D mudel
4. Joonised

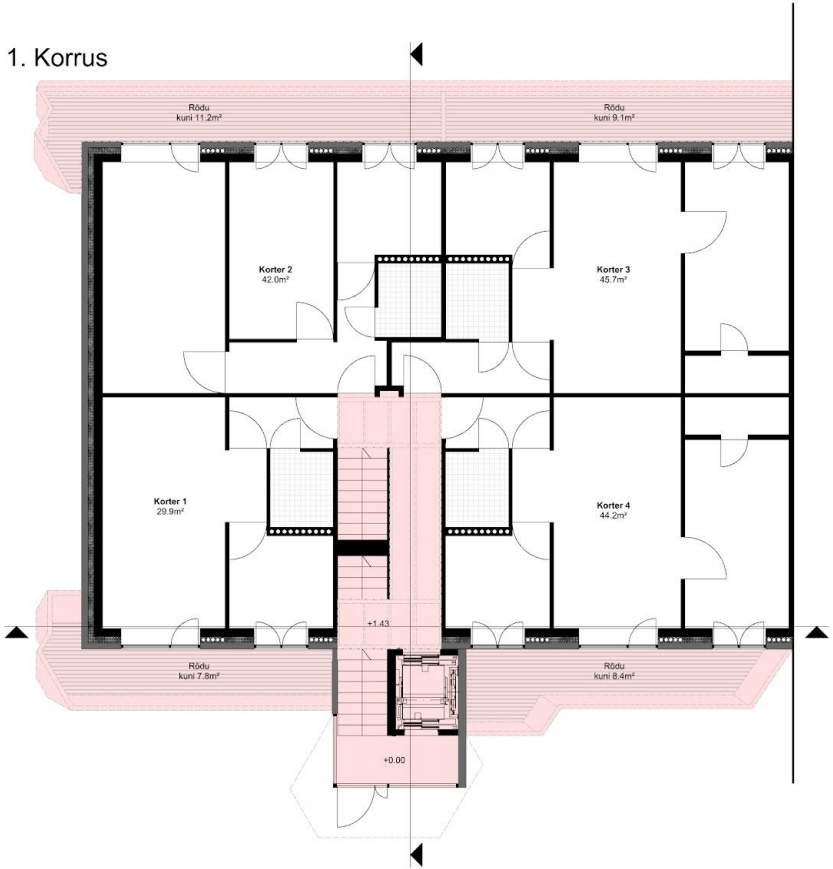


5 3D mudel
4. Joonised



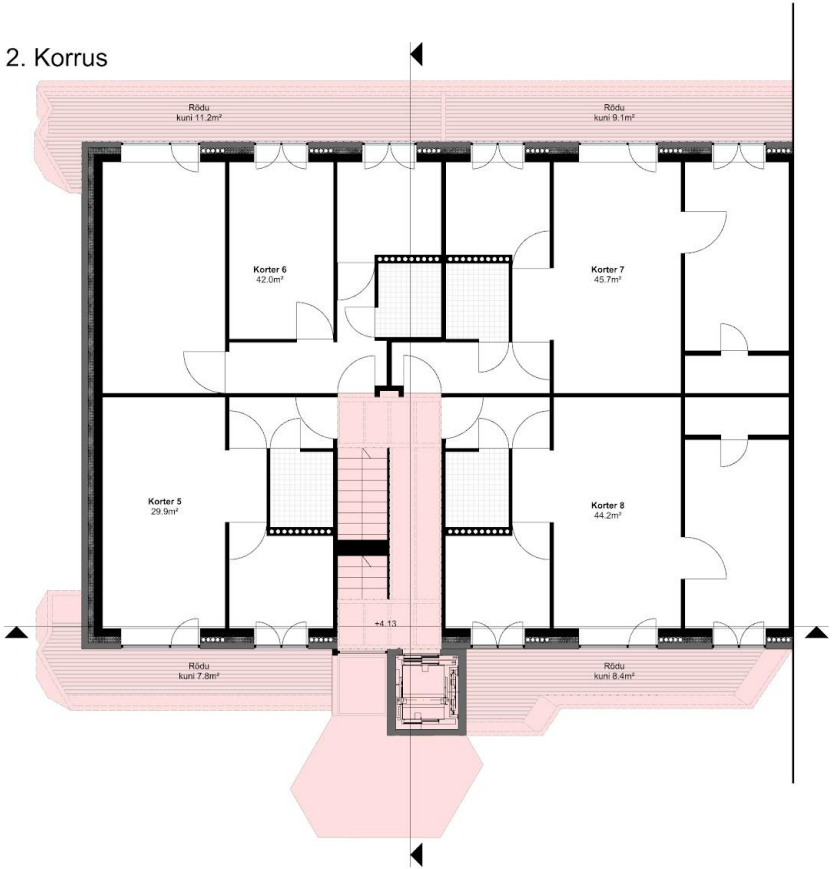
5 3D mudel
4. Joonised

1. Korrus

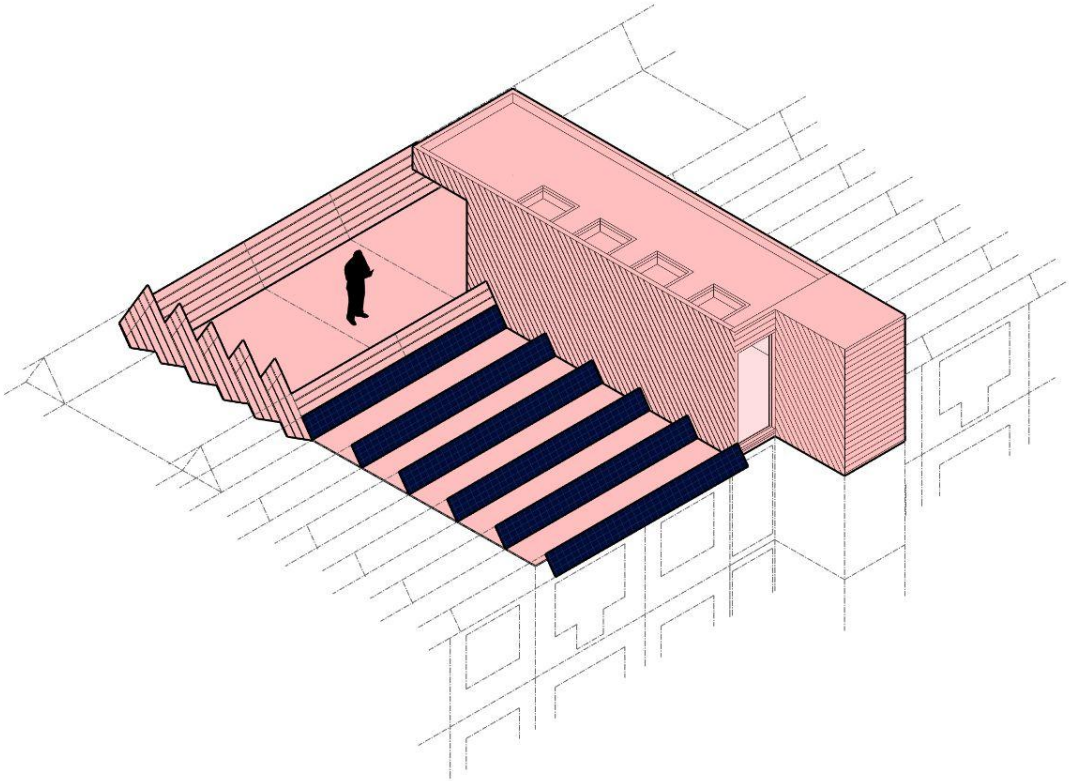


5 3D mudel
4. Joonised

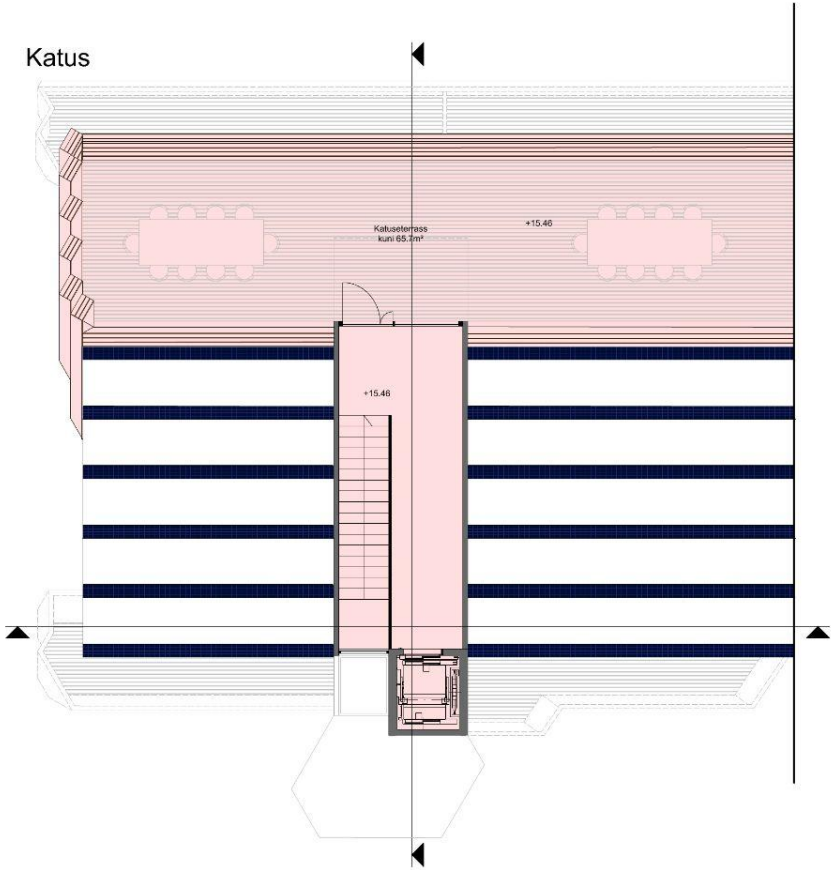
2. Korrus

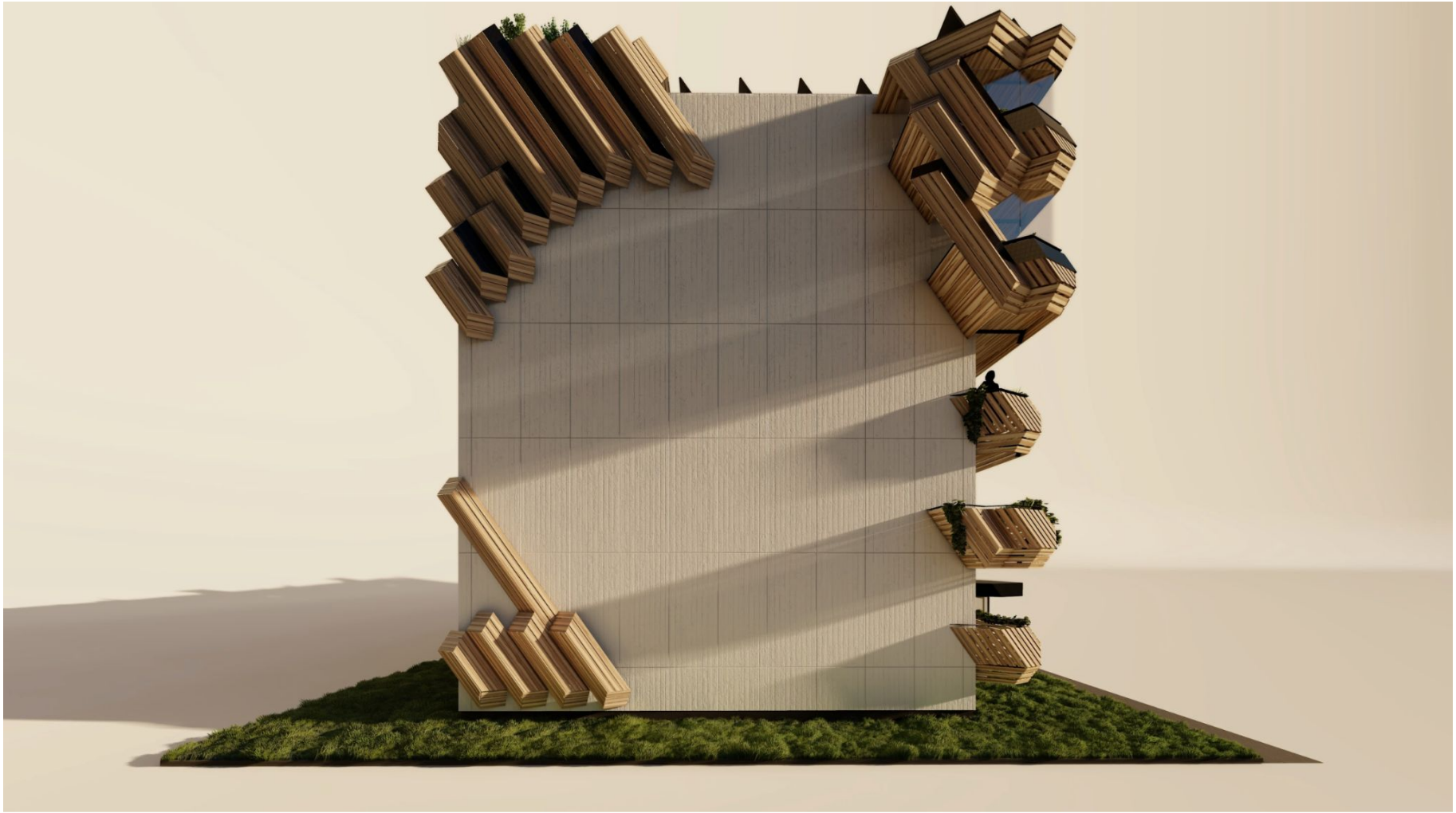


5 3D mudel
4. Joonised



5 3D mudel
4. Joonised





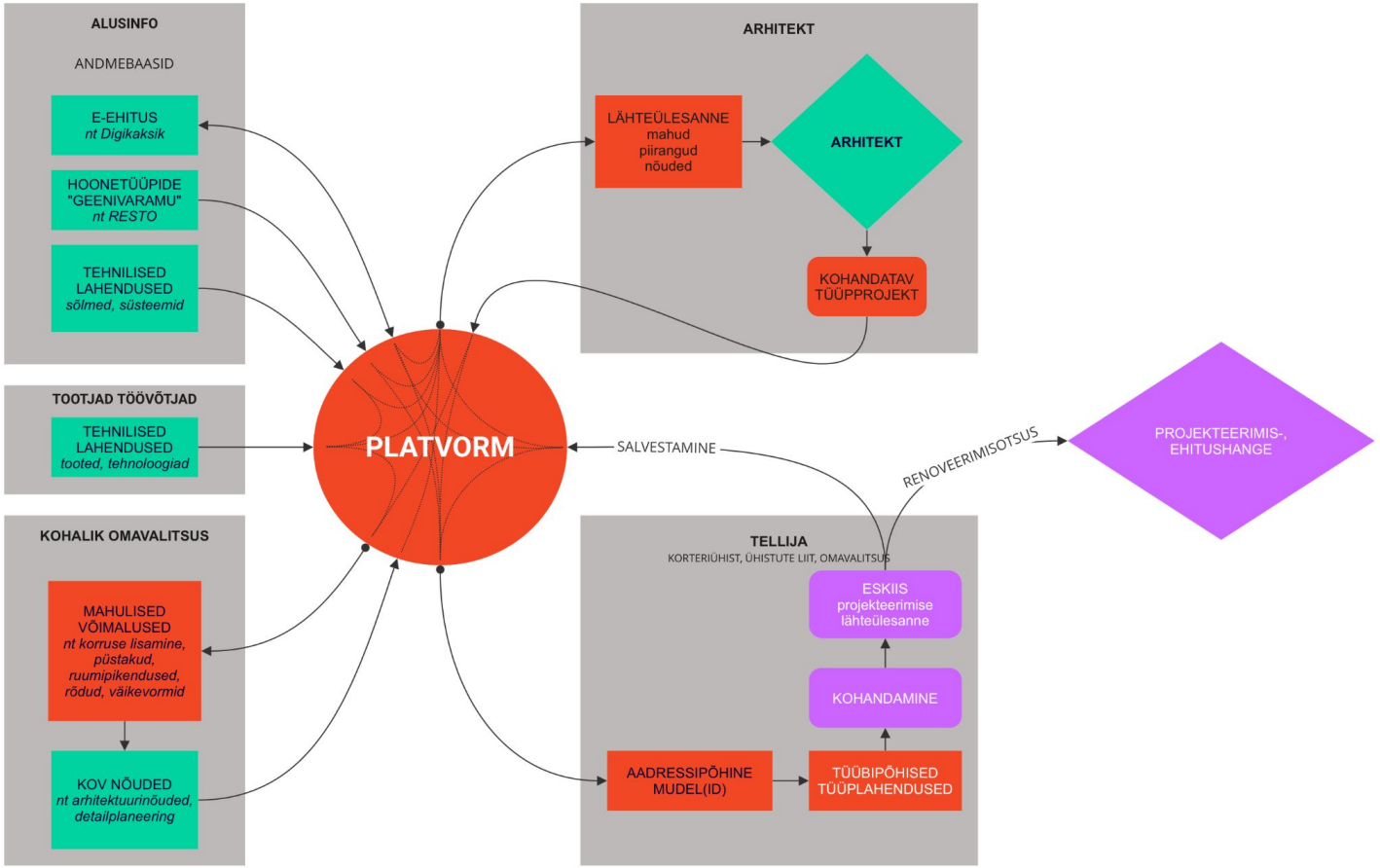
6

Renoveerimisplatvormi kontseptuaalne skeem (XL)

Digiplatvormi prototüüp renoveerimise kavandamiseks ja juhtimiseks, fookusega ruumi kvaliteedi tagamisel.

6

Renoveerimisplatvormi kontseptuaalne skeem (XL)
Digiplatvormi prototüüp renoveerimise kavandamiseks ja juhtimiseks, fookusega ruumi kvaliteedi tagamisel.



6

Renoveerimisplatvormi kontseptuaalne skeem (XL)
Digiplatvormi prototüüp renoveerimise kavandamiseks ja juhtimiseks, fookusega ruumi kvaliteedi tagamisel.

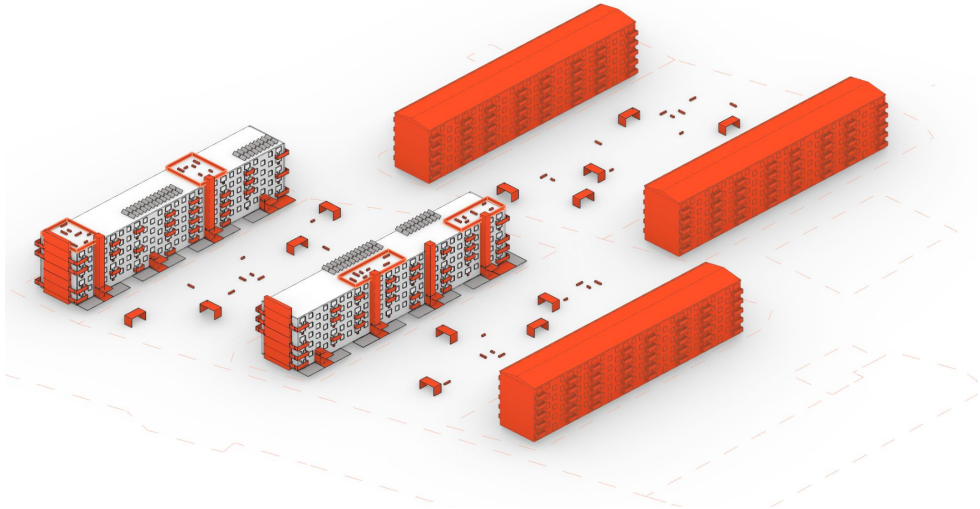
1. **Visualiseerida** korteriühistutele rekonstrueerimise võimalusi kasutajasõbraliku konfiguraatori abil.
2. Ligikaudne **maksumuse** kalkulatsioon.
3. Ligikaudne **energia bilanss**
4. Toetada **naabruskonna rekonstrueerimist**
5. Toetada **avaliku ruumi** kvaliteeti
6. Kaasata **arhitekte suuremal määral**

ENERGIABILANSS

kulu enne	A
kulu pärast	B
tootmine pärast	C
SÄÄST KOKKU	A-B-C

EELARVE

		ÜHIK	KOGUS	HIND
✓	SOOJUSTAMINE	m2	x	xN
✓	KÜTTESUSTEEM	tk	x	xN
✓	VENTILATSIOON	tk	x	xN
✓	PÄIKESEPANEELID	m2	x	xN
✓	VIIMISTLUS	m2	x	xN
✓	RÕDUD	tk	58	58N
❑	LIFTID	tk	3	3N
✓	KATUSETERRASS	m2	x	xN
❑	ROHFASSAAD	m2	0	0

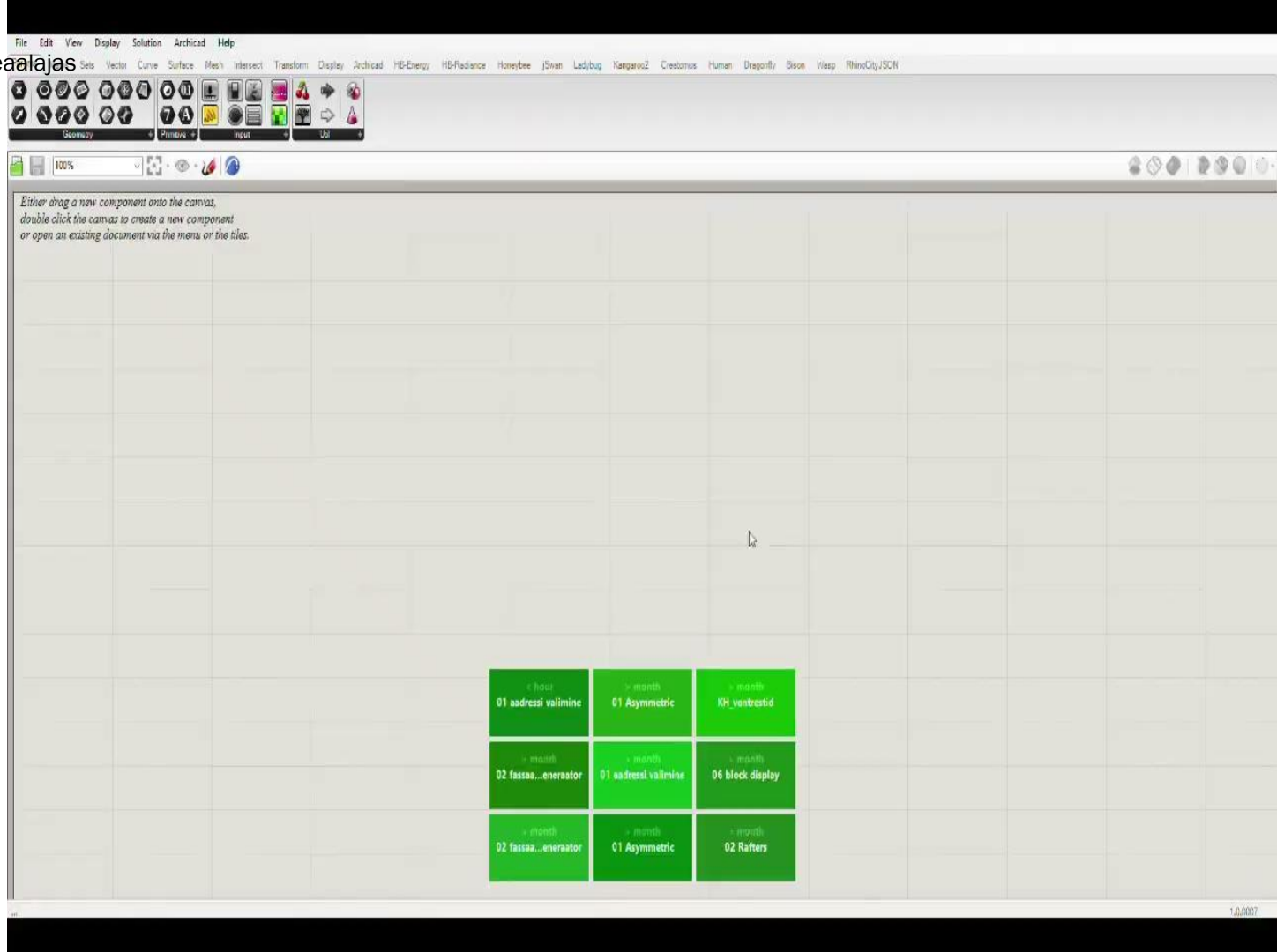


7

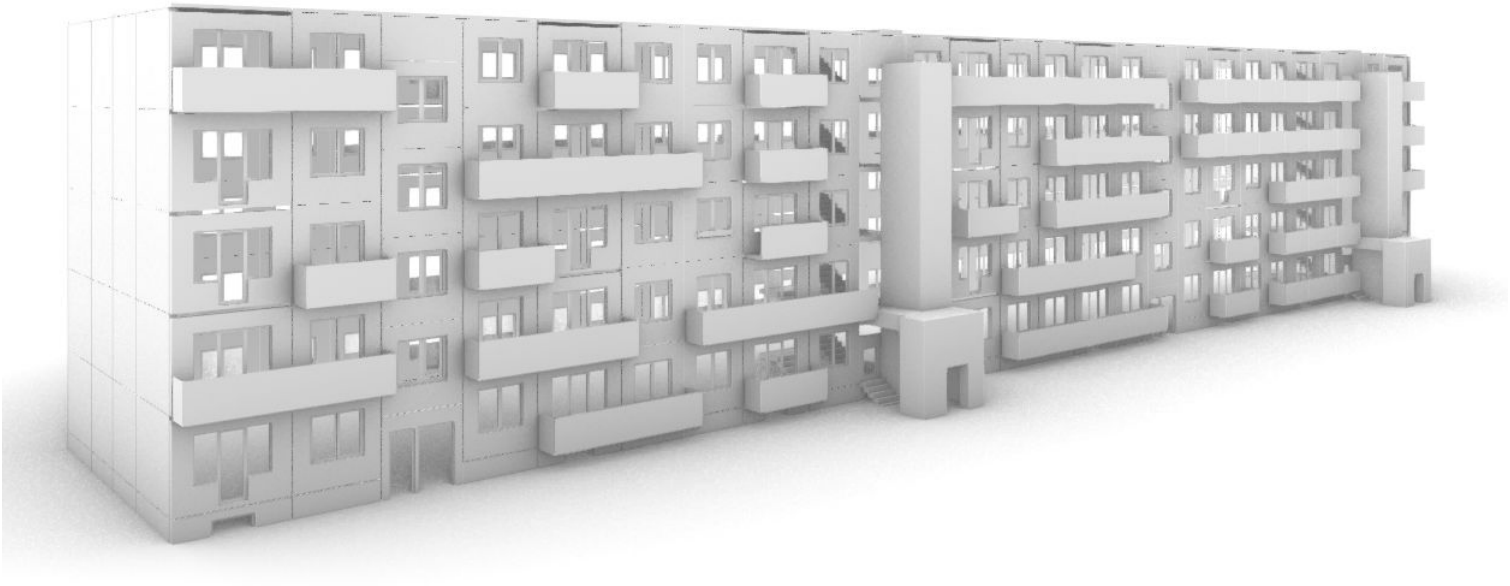
Simulatsiooni tööriist
+ühendatud töövooprototüüp
Renoveerimise lahendused reaalajas

TEHNILINE LAHENDUS VIDEO

Ühendatud töövoo prototüüp
Tööprotsess seob omavahel:
- parameetrilise fassaadidisaini,
- digikaksiku keskkonnad,
- kohapealse andmete kogumise,
- projekteerimisest tootmiseni ulatuvad sammud,
- reaalajas konstruktsioonianalüüsi.



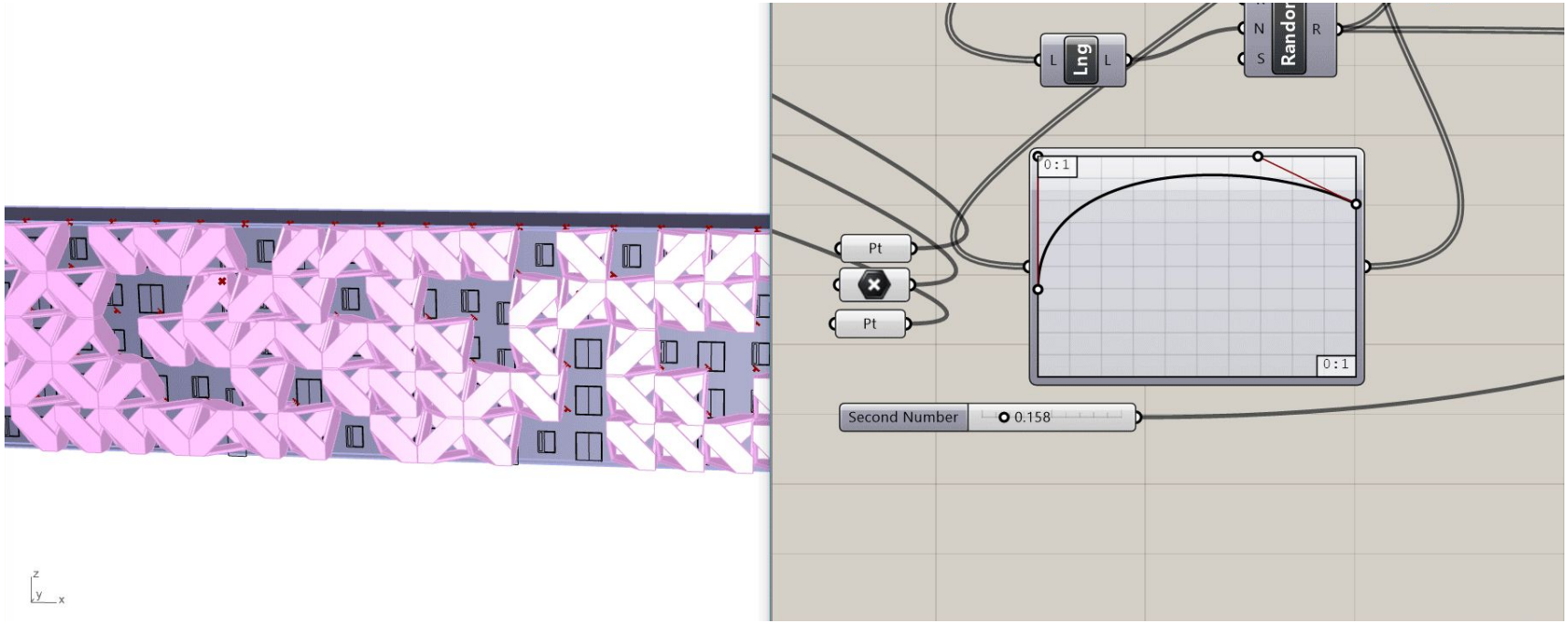
TEHNILINE LAHENDUS - HOONE



7

Simulatsiooni tööriist

Renoveerimise lahendused reaalajas



pakk.artun.ee

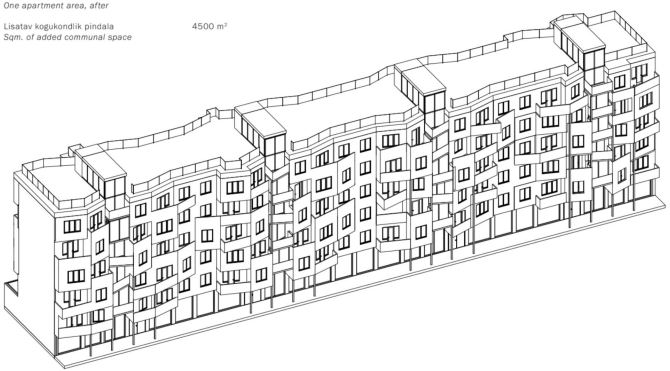
7

Simulatsiooni tööriist

Renoveerimise lahendused reaalajas

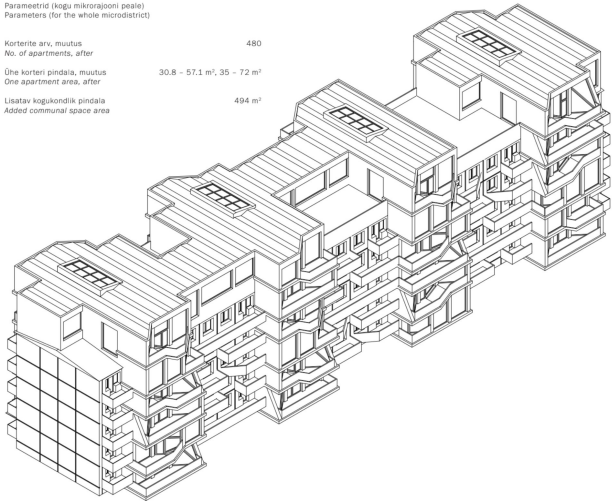
Parameetrid (kogu mikrorajooni peale)
Parameters (for the whole microdistrict)

Korterite arv, muutus *No. of apartments, after*	480
Ühe korteri pindala, muutus *One apartment area, after*	30.8 – 57.1 m²
Lisatav kogukondlik pindala *Sqm. of added communal space*	4500 m²



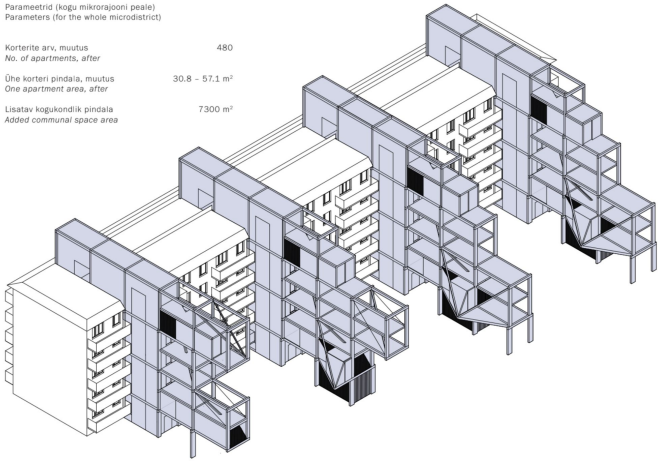
Parameetrid (kogu mikrorajooni peale)
Parameters (for the whole microdistrict)

Korterite arv, muutus *No. of apartments, after*	480
Ühe korteri pindala, muutus *One apartment area, after*	30.8 – 57.1 m², 35 – 72 m²
Lisatav kogukondlik pindala *Added communal space area*	494 m²



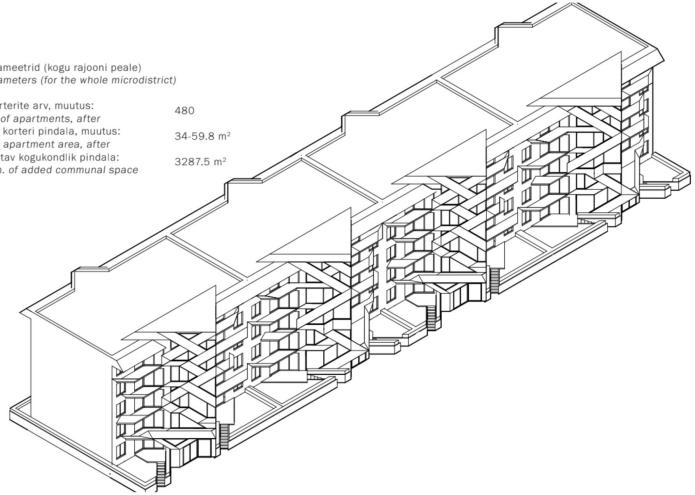
Parameetrid (kogu mikrorajooni peale)
Parameters (for the whole microdistrict)

Korterite arv, muutus *No. of apartments, after*	480
Ühe korteri pindala, muutus *One apartment area, after*	30.8 – 57.1 m²
Lisatav kogukondlik pindala *Added communal space area*	7300 m²



Parameetrid (kogu rajooni peale)
Parameters (for the whole microdistrict)

Koerterite arv, muutus: *No. of apartments, after*	480
Ühe korteri pindala, muutus: *One apartment area, after*	34-59.8 m²
Lisatav kogukondlik pindala: *Sqm. of added communal space*	3287.5 m²



8

Materiaalsus

Kontrastid ja testimine

8 Materiaalsus

Kontrastid ja testimine

References

3d model

Prototype

8 Materiaalsus
Kontrastid ja testimine

Thermory laudise paigaldamine Annelinna fassaadile.
Sügis 2023. BuildEST LIFE IP

PAKKu paviljon

8 Materiaalsus

Kontrastid ja testimine

8 Materiaalsus
Kontrastid ja testimine

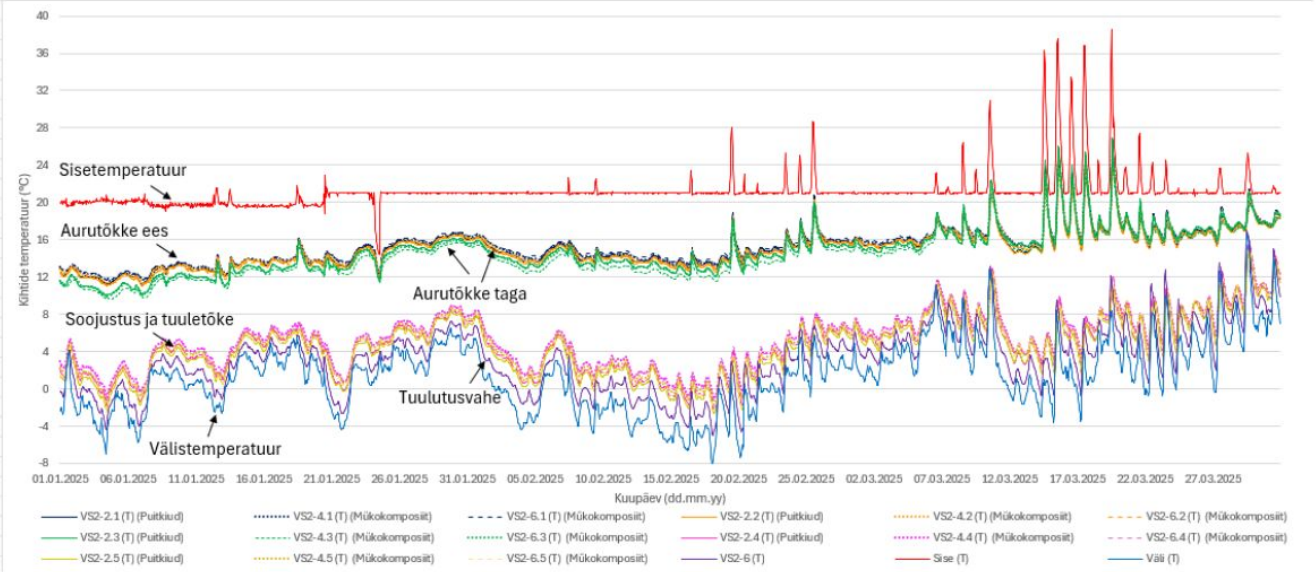
Myceeni visioon ehitussektori jalajälje vähendamisel põhineb uudsel biofabrikatsiooni tehnoloogial, kus **seeneniidistikuga seotud tööstusjäägid, nagu saepuru, muudetakse biokomposiitideks, mida saab kasutada ehitusmaterjalidena.**

Uurimuse partnerid

Uniflex Systems (Neeme Takis)
TalTech (T. Kalamees, A. Ruus, M. Mäekala)

JÄRELDUS nr 1
Mükokomposiitmaterjalil on võrreldavad soojusomadused traditsiooniliste soojustusmaterjalidega

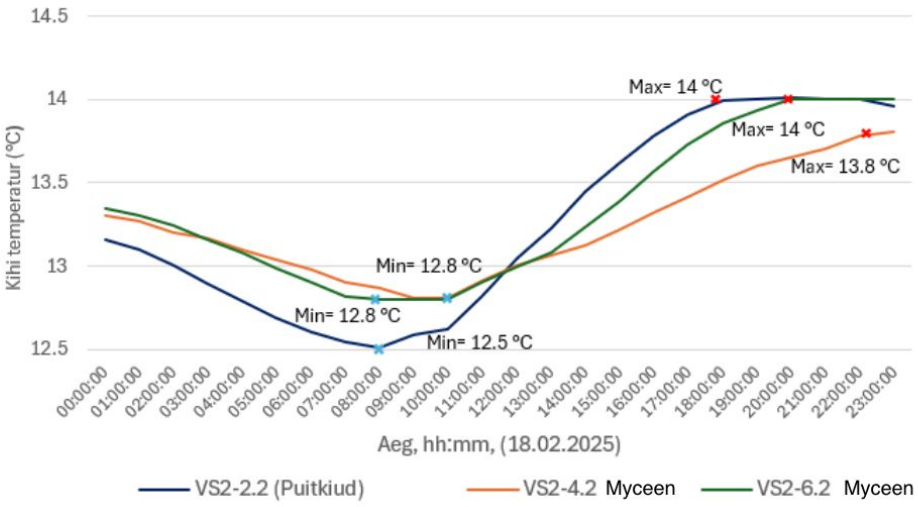
- Konstruktsiooni eri kihtide temperatuuri andmed omistavad mükokomposiidile sarnaseid omadusi enimlevinud, puitkarkassiga kergtarindi soojustuslahendustega võrreldes.



Joonis 3.11 Välisseina 2 (VS2) temperatuurid erinevates kihtides

JÄRELDUS nr 2
Mükokomposiitmaterjalid reageerivad temperatuuri muutustele stabiilsemalt

- Seega on mükokomposiidil võrreldes mineraal- või puitkiudvillaga paremad omadused stabiilse sisekliima loomiseks, arvestades ööpäevaseid temperatuuri amplituude

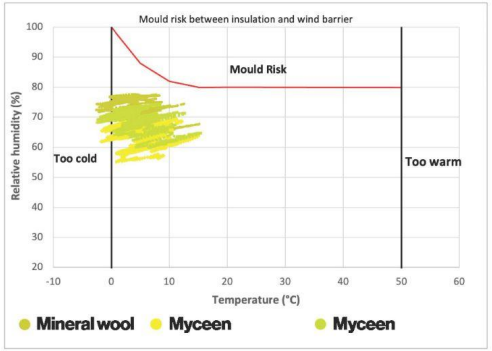


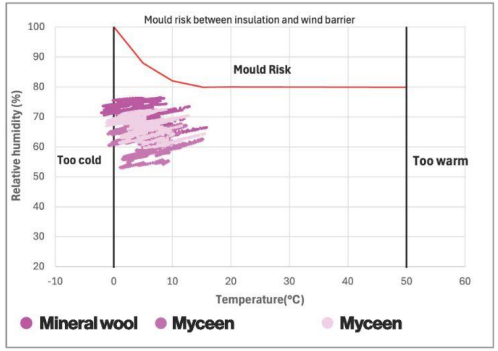
Joonis 3.18 18.veebruar 2025 VS2 temperatuurid aurutõkke ja soojustuse vahelises kihis

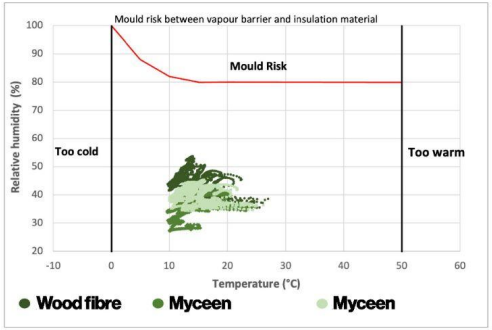
JÄRELDUS nr 3
Konstruktsioonis ei esinenud kondenseerumisriski puudus hallituskasvu tõenäosus

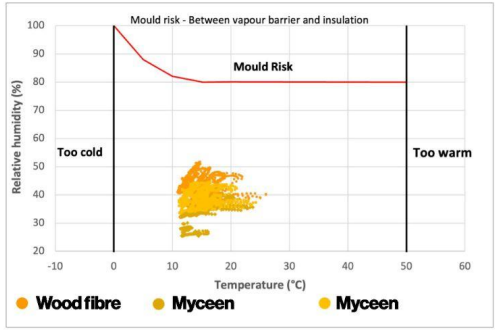
- Kondensatsiooni- ja hallitusrisk konstruktsiooni tundlikumates piirkondades oli mükokomposiitmaterjali puhul madalam kui mineraal- või puitkiudvillal.

Lower Mould Risk









Structural concept

Design tools

Digital tools

Prototyping

slender facade

[S]

Prototype

PAKK Pavilion

Physical built demonstrator in Tallinn, showcasing detailing, connections to structure and spatial experiences

[M]

Chunk

3D vertical sample of combined structures

Exemplary vertical cut out of the old and new structure

[L]

Building

3D example of volumetrically renovated panel building

Visualisations of the building

[XL]

Neighbourhood

Design studio projects

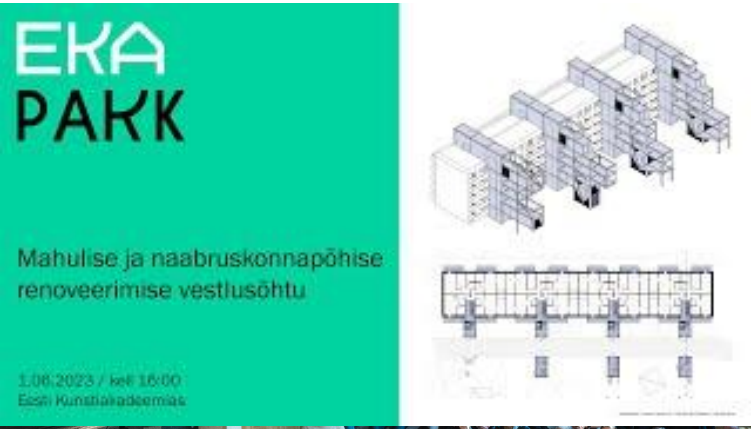
Studentwork of neighbourhood based renovation and volumetric reconstruction

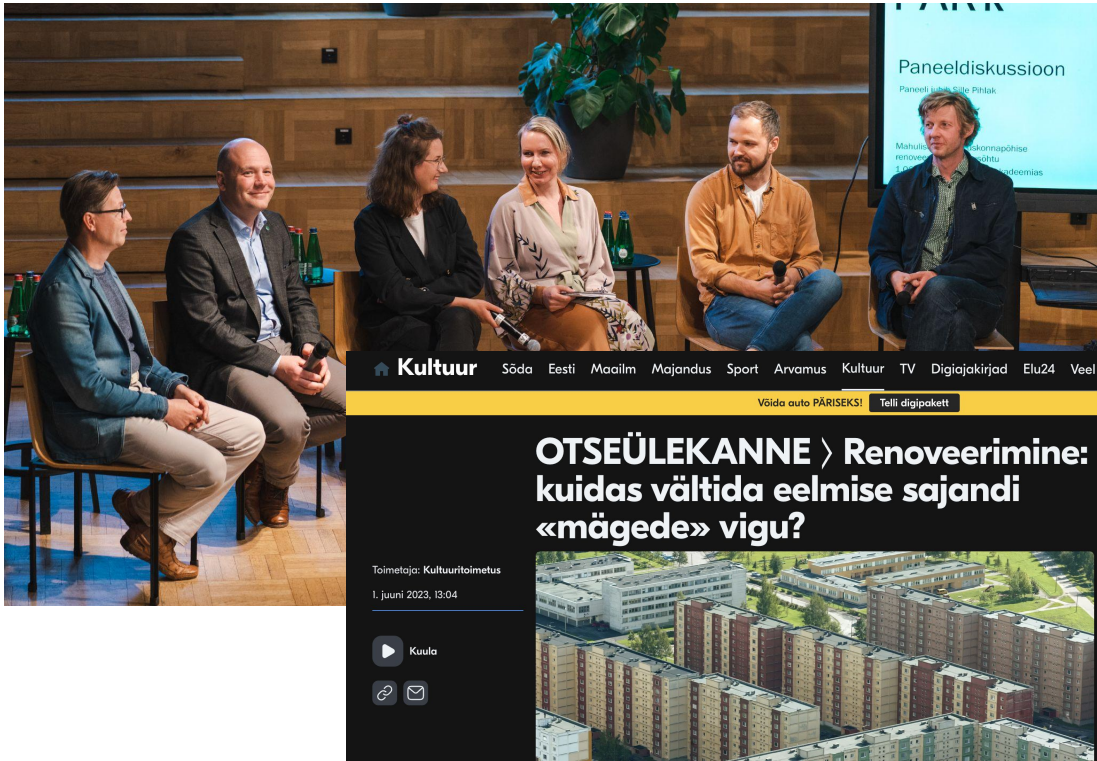
9 Kommunikatsioonitegevused
Kogukonnaõhtud

2023

Slenderhood. Mahulise ja naabruskonnapõhise renoveerimise vestlusõhtu

https://kultuur.postimees.ee/7786929/otseulekanne-renoveerimine-kuidas-valtida-eelmise-sajandi-magede-vigu





9 Kommunikatsioonitegevused
Kogukonnaõhtud

2024

sLenderBlock : Mahulise ja naabruskonnapõhise renoveerimise diskussiooniõhtu

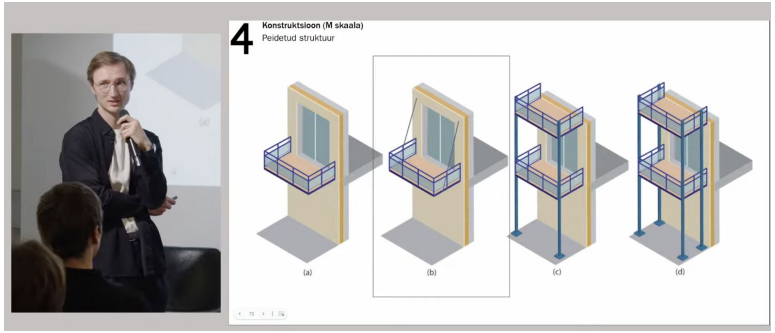
https://kultuur.postimees.ee/8033321/renoveerimismaraton-hada-hrustsovkadega-isegi-sellest-hoonetuubist-saab-asja-ruumilise-renoveerimisega

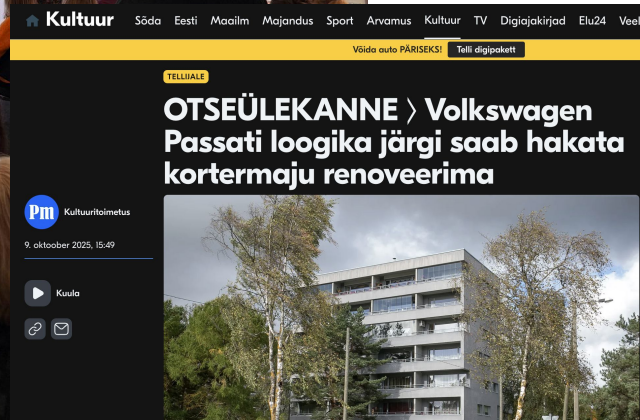
9 Kommunikatsioonitegevused
Kogukonnaõhtud

2025

Renoveerimisteemaline kogukonnaõhtu “Kuidas edasi?”

https://kultuur.postimees.ee/8339625/otseulekanne-volkswagen-passati-loogika-jargi-saab-hakata-kortermaju-renoveerima





9 Kommunikatsioonitegevused
Näitused

2023

Tudengitöödenäitus

sLenderHood : Mahuline ja naabruskonnapõhine renoveerimine

9 Kommunikatsioonitegevused
Näitused

2024

Tudengitöödenäitus
sLenderBlock : Mahuline ja naabruskonnapõhine renoveerimine

9 Kommunikatsioonitegevused
Näitused

2024

Tudengitöödenäitus
RUUMI(line) RENOVEERIMINE

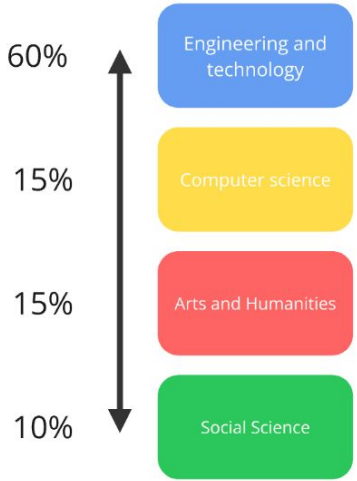
2024 Thermory Design Talks
Sille Pihlak

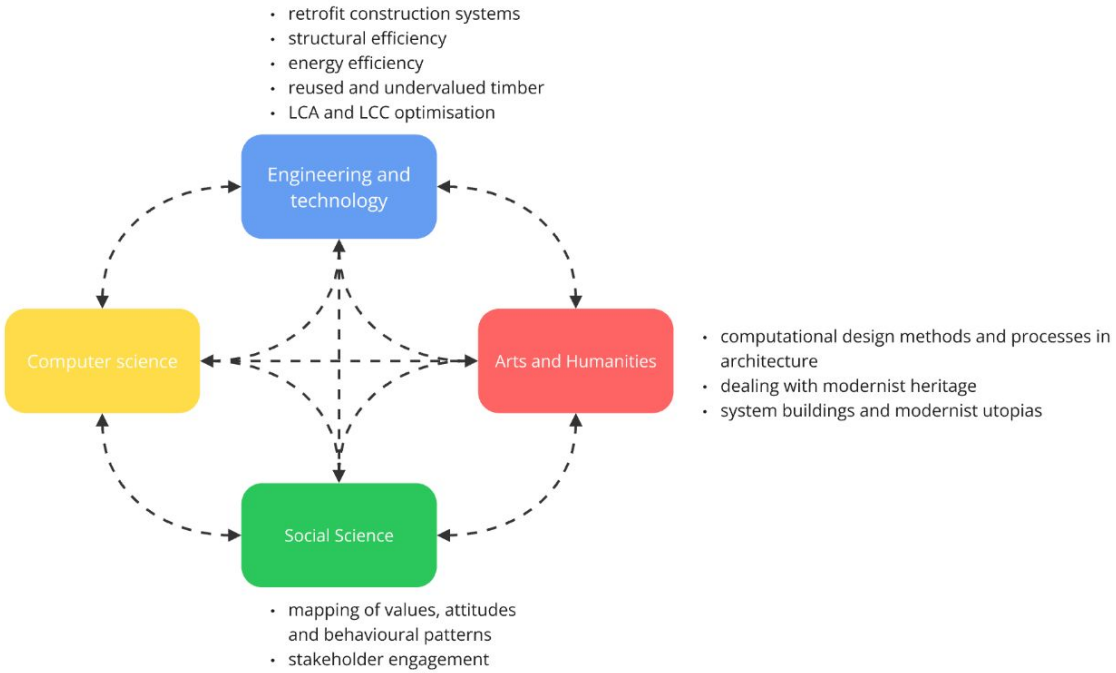
2023 Ehituse e-hüppe kogukonna inspiratsiooniõhtu
Masskohandatava fassaadisüsteemi konfiguraatori prototüüp
Siim Tuksam

Kuidas edasi?

Renoveerimine…

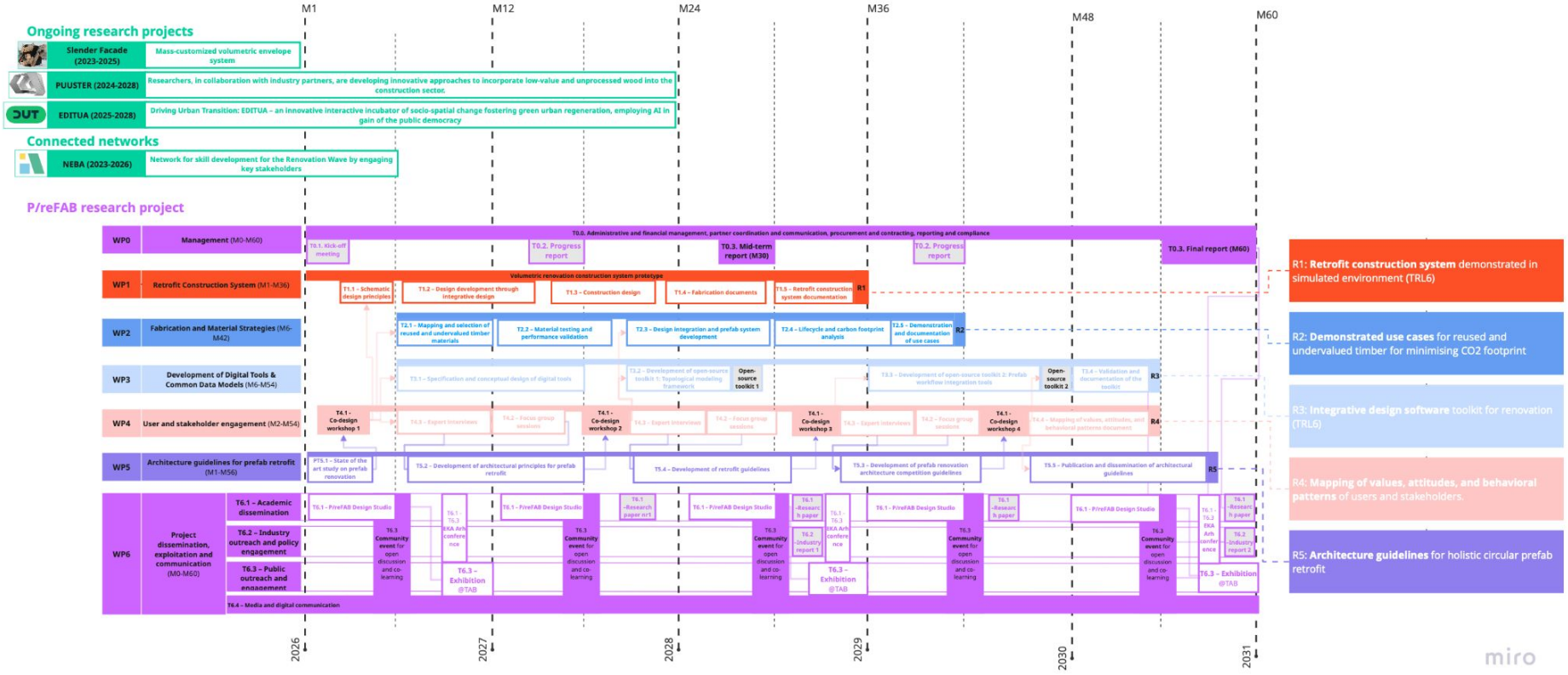
Ei ole ainult inseneeria, vaid mikstuur insenertehnilistest lahendustest, digiteadustest, humanitariast ja sotsiaalteadustest





P/reFAB

Integrative design of prefabricated construction systems for increased architectural quality in retrofit and adaptive reuse



EKA PAKK

Kaasrahastanud Euroopa Liit

Eesti tuleviku heaks

EKA Arhitektuur ja linnaplaneerimine

THERMORY®