



**plug
& live**

Modular System for Polish Large Panel Concrete Housing

Based on an example
of Ustronie estate in Radom
built with the W-70 system.

P5 Architectural Engineering

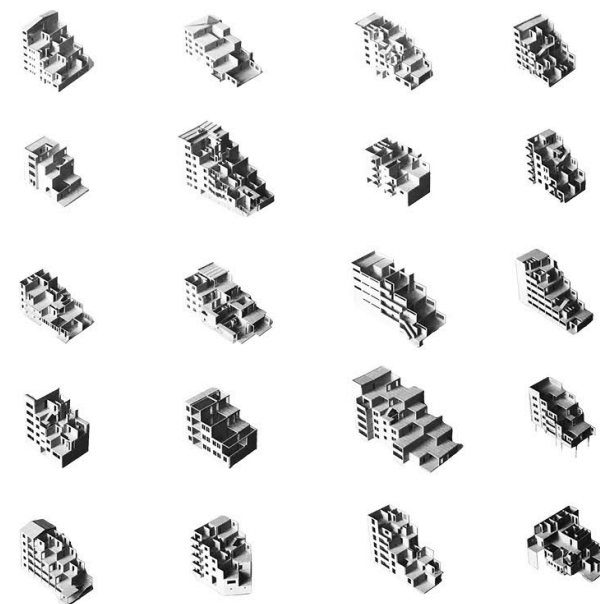
TU Delft, January 2024

Marta Zapaśnik (5609615)

Worldwide phenomenon



Global distribution of 98 trajectories to more than 70 countries.



Showcase models of the country-specific systems.

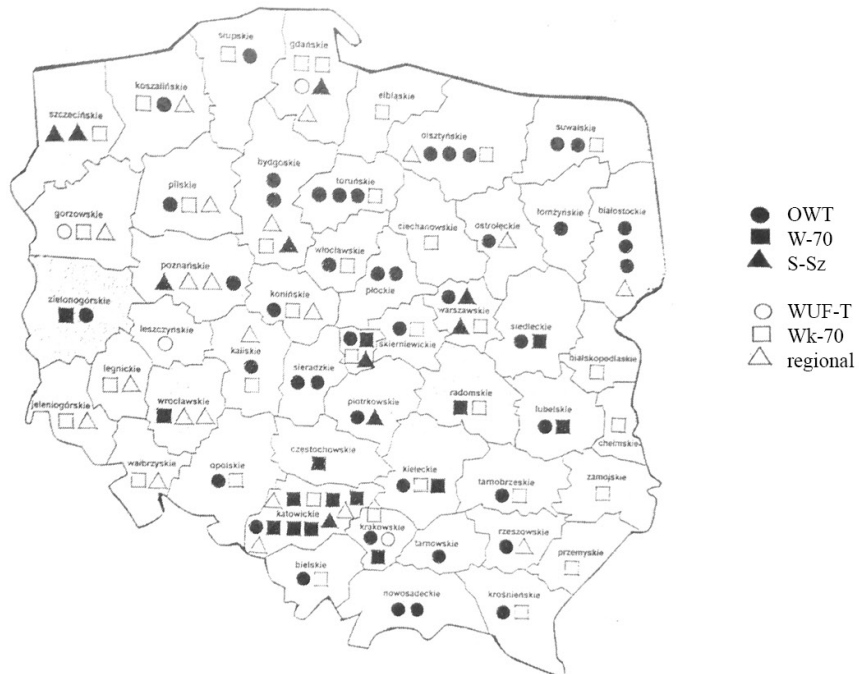
Worldwide large panel concrete building systems (Alonso&Pedro, 2019).

National typification

$\frac{1}{3}$



of the Polish population lives in the
Large Panel concrete system blocks



Large panel concrete systems' manufactures
in Poland until 1996 (Dzierżewicz, 2010).

Large urban scale

Poznań, Stefana Batorego estate



system "Szczecin"

Warsaw, Northern Ursynów estate



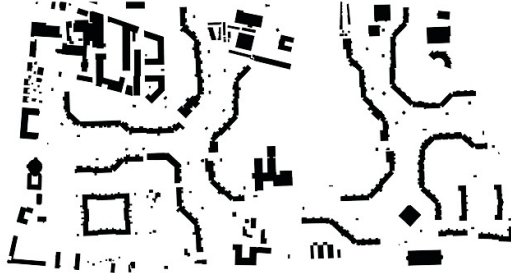
system "Wk-70"

Warsaw, Bemowo Airport



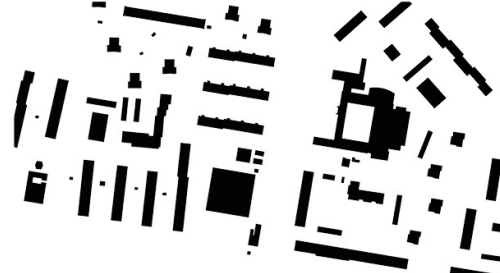
system "Wk-70"

Wrocław, Gaj



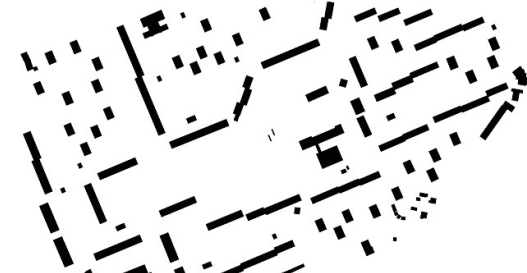
system "WWP"

Kraków, Tysiąclecia estate



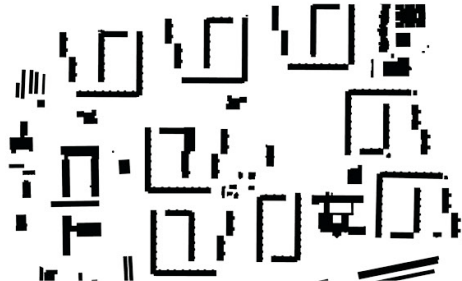
system "OWT"

Łódź, Retkina



system "Szczecin"

Szczecin, Zawadzkiego estate



system "Szczecin"

Bydgoszcz, Przylesie estate



system "Szczecin"

Gdańsk, Zaspą estate

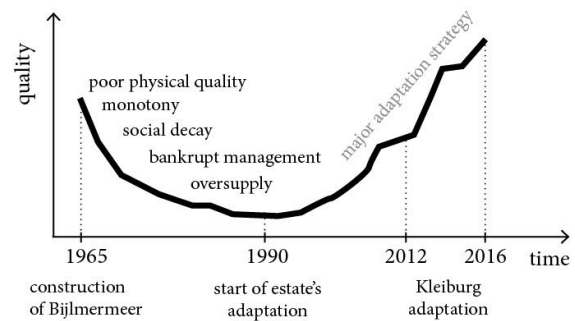


system "Szczecin"

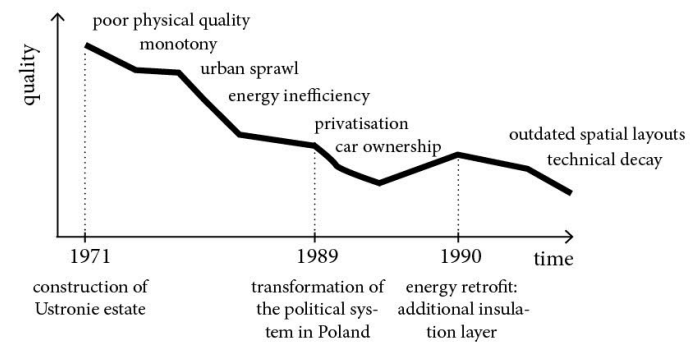
Lack of adaptation strategies



Kleiburg after adaptation in Bijlmermeer, Amsterdam,
source: NL Architects



Ustronie in Radom, Poland



Spot solutions



intrusive densification
profit-driven densification by private developers



energy retrofit
additional insulation and colour



public space
development of sport, greenery, public areas

Housing crisis in Poland

↑ **40%**

house rent prices rise in the EU
between 2015-2021

84%

private housing owns the
majority of the overall stock

↓ **-14%**

negative net migration rate in
the ageing cities



Private sector- and profit-driven housing developments
(Photo by CHEŁSTOWSKI/FORUM)



Urban sprawl and suburbanisation (Photo by Avi Waxman/
Unsplash).

More than just a building system



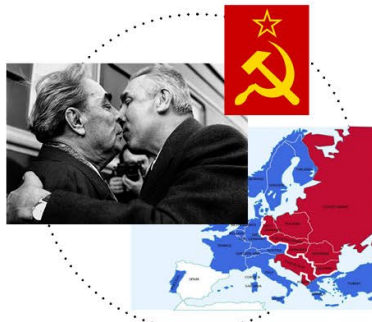
political
propaganda



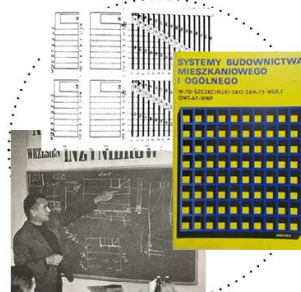
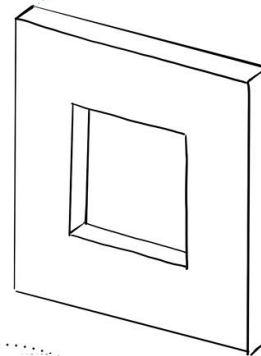
integrated
interior design



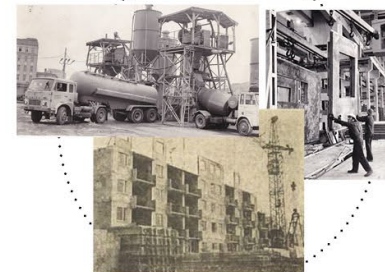
new living
standards and hopes



Cold War and USSR
influence



architects = system
designers

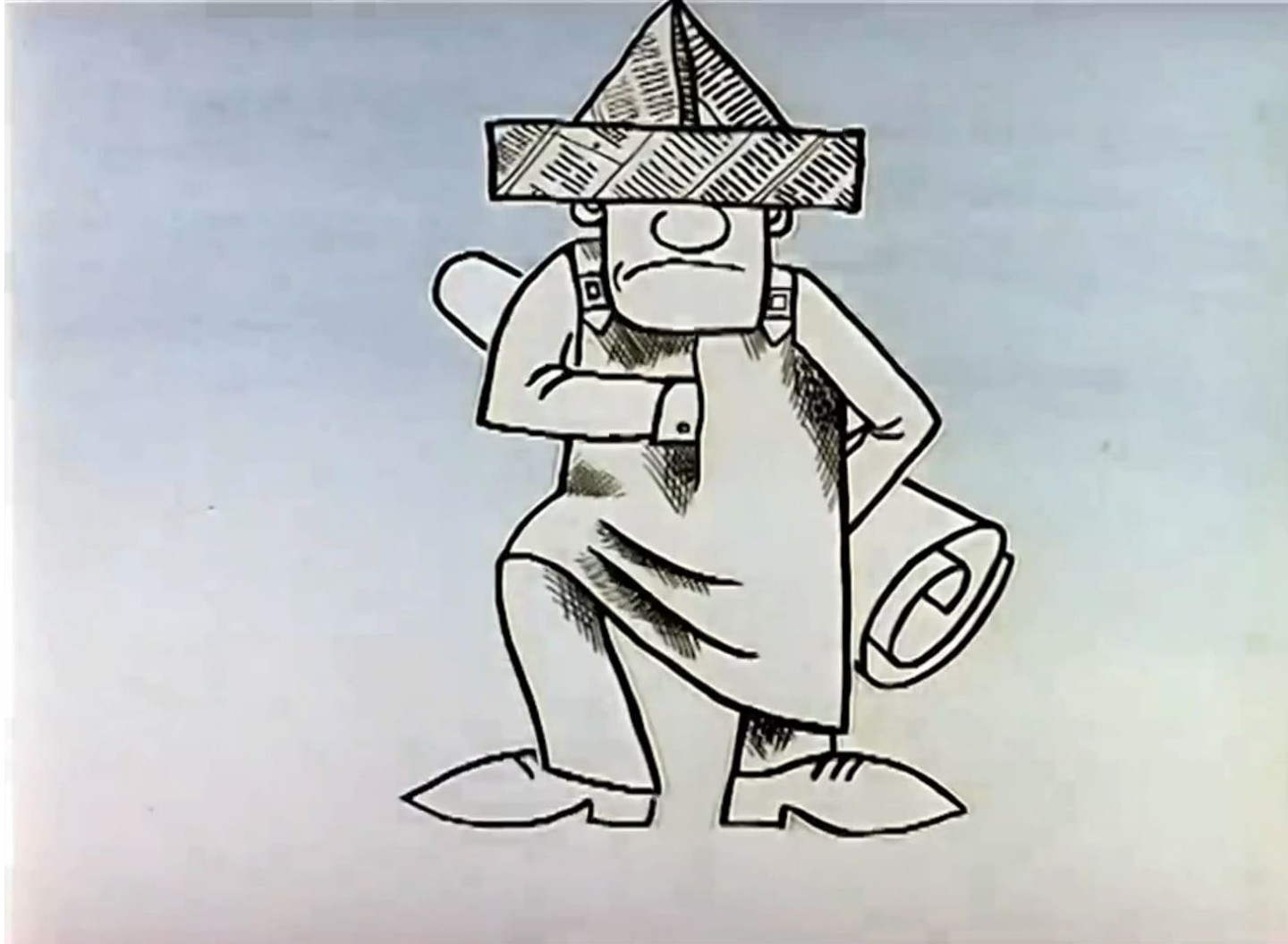


total industrialisation and pre-
fabrication



rapid urbanisation

More than just a building system



Modern perception



popculture: movies,
art, music



ageing neighbourhoods



dominance of
cars and parkings



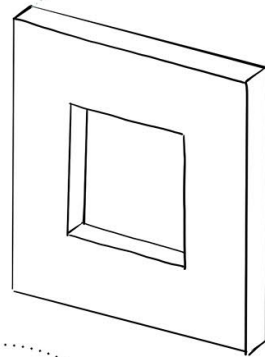
negligence of
the public space



monotony, lack
of human scale



massive scale



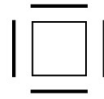
technical and visual
decay

Overall design question

How to adapt the Polish Large Panel Concrete System Housing to increase the living diversity with modular architecture?



Design goals



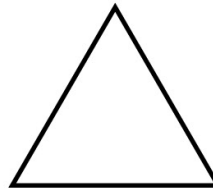
technology

adaptive reuse by
modular architecture



programme

residential
+
mix-use:
work
meet
learn
collaborate



context

large panel concrete system
housing in Poland

firstly built with the
nationally implemented W-70 system
Ustronie, Radom

Choice of the system



W-70



Wk-70

>40%

accounting for the total large panel concrete system housing stock

Showcase site

Location of Radom in Poland



City of Radom



Ustronie, forerunner estate in the W-70 system

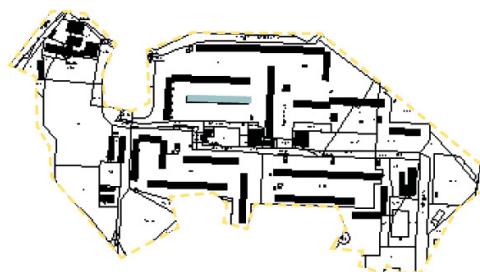
Ustronie estate, masterplan



A division of the estate in smaller units



Focus area

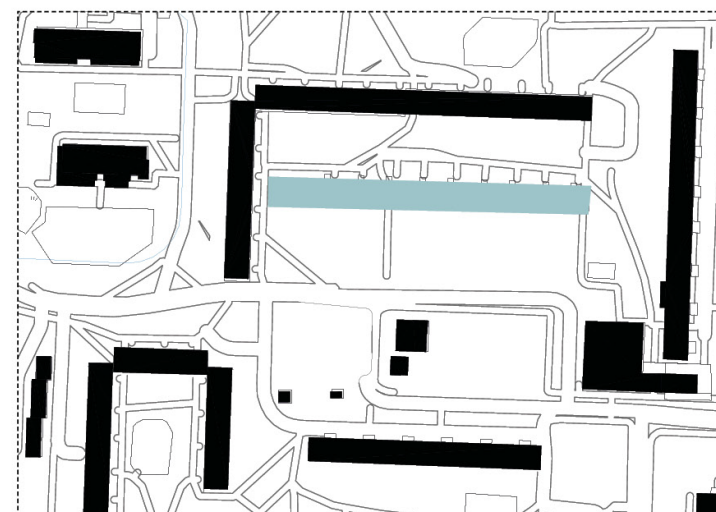


A Unit A
Area: 2,18ha



Chosen building for architectural intervention

Focus building



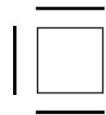
Chosen building for architectural intervention



Thematic Research Question

Main question

What are the possible future-proof adaptation methods for the Polish W-70 Large Panel concrete system residential buildings?



technology

adaptive reuse by modular architecture

Sub-questions

1) Analytical

Which adaptation methods were used for the future-proof revitalisation of the estates built between 1960-1980 in Europe?

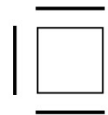
2) Technological

What are the limitations and possibilities of the W-70 building system?

Thematic Research Question

Main question

What are the possible future-proof adaptation methods for the Polish W-70 Large Panel concrete system residential buildings?



technology

adaptive reuse by modular architecture

Sub-questions

1) Analytical

Which adaptation methods were used for the future-proof revitalisation of the estates built between 1960-1980 in Europe?

case studies

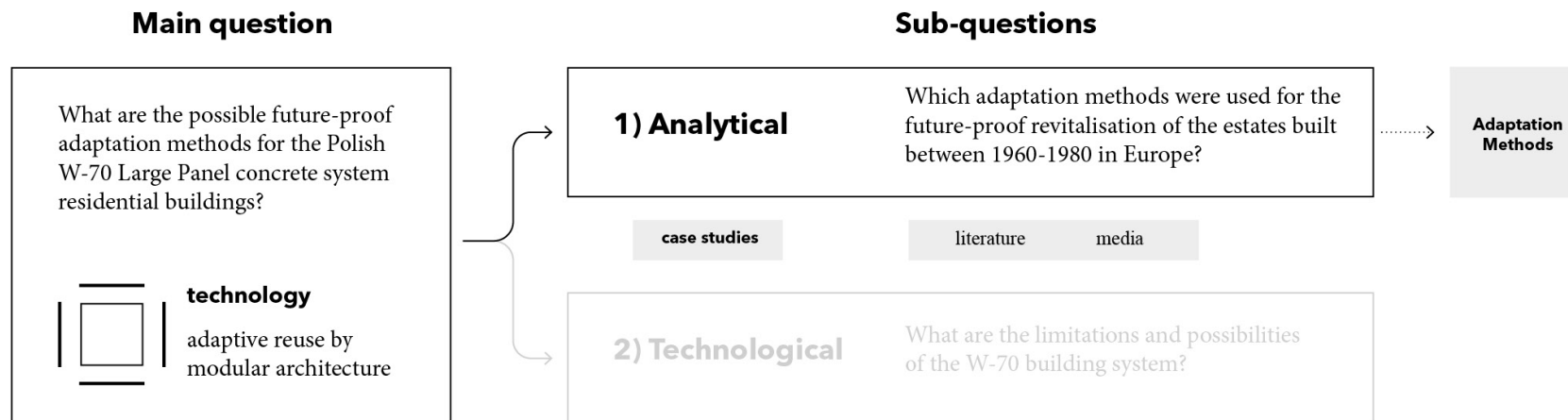
literature

media

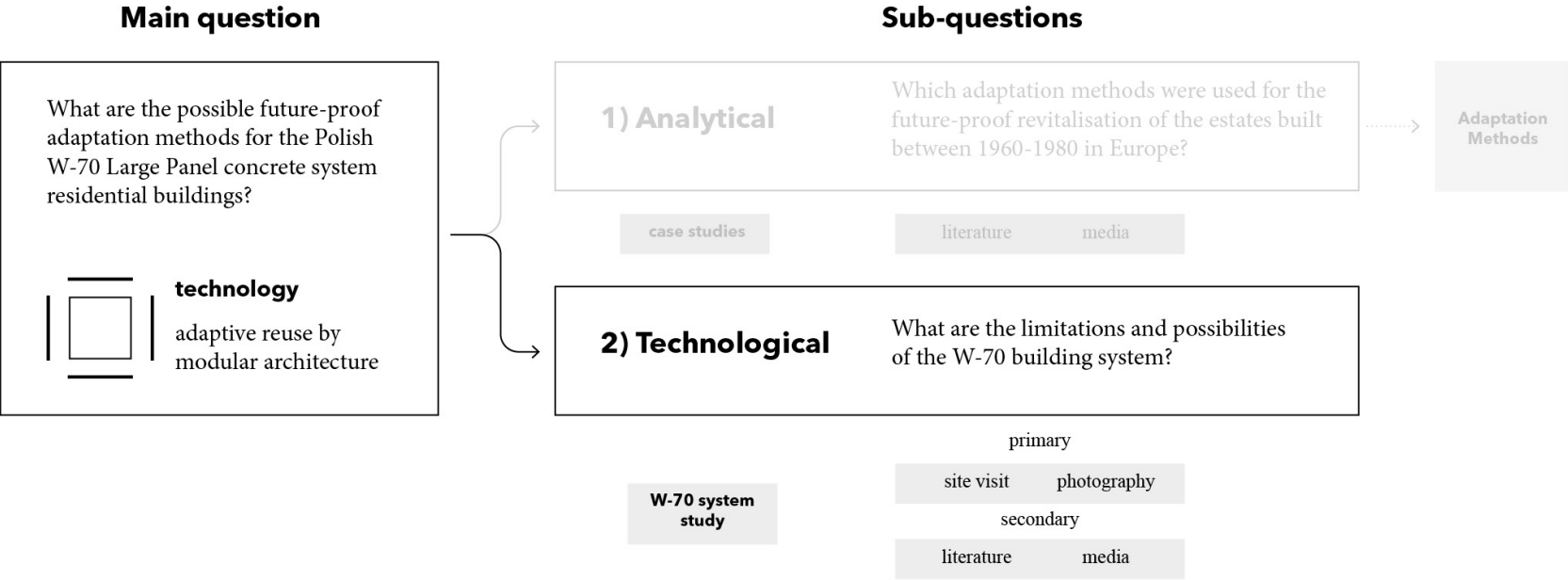
2) Technological

What are the limitations and possibilities of the W-70 building system?

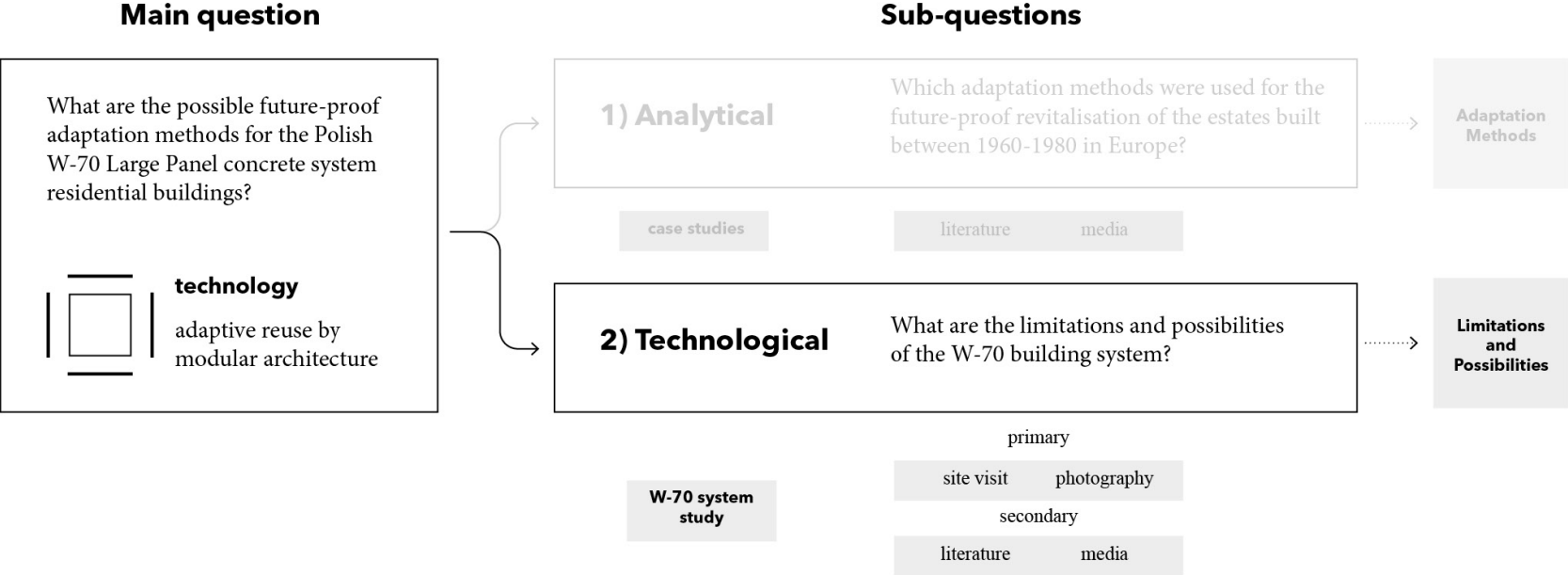
Thematic Research Question



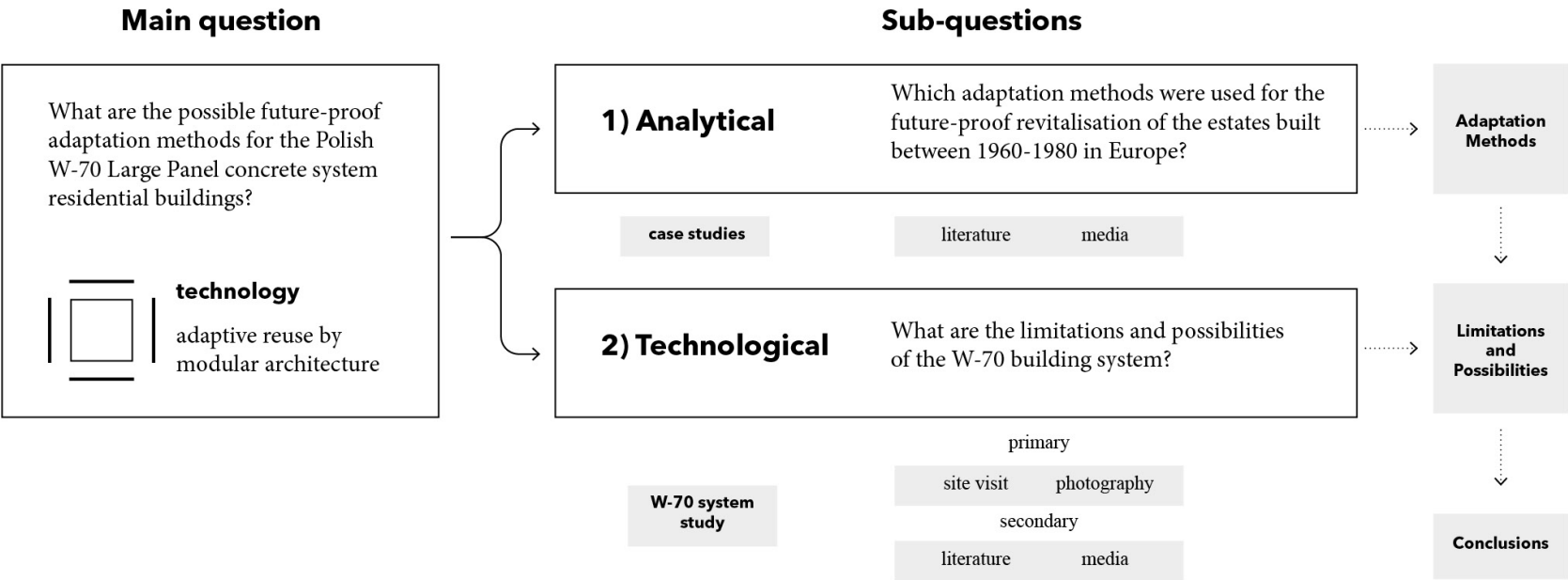
Thematic Research Question



Thematic Research Question



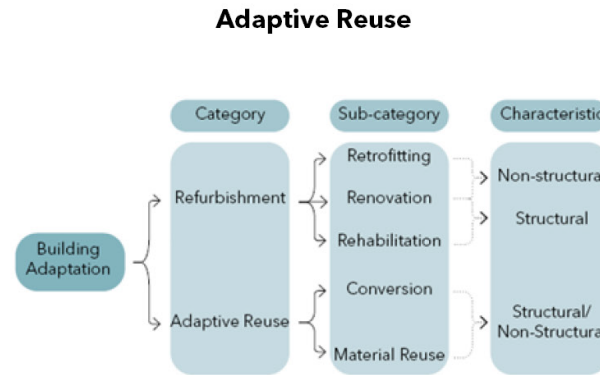
Thematic Research Question



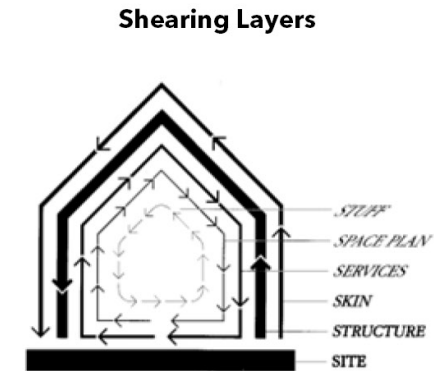
Frame of reference

The modernist buildings should not be perceived as a closed system of one time that passed, but as an open system of the presence.

Dragutinovic & Nikezic, 2020

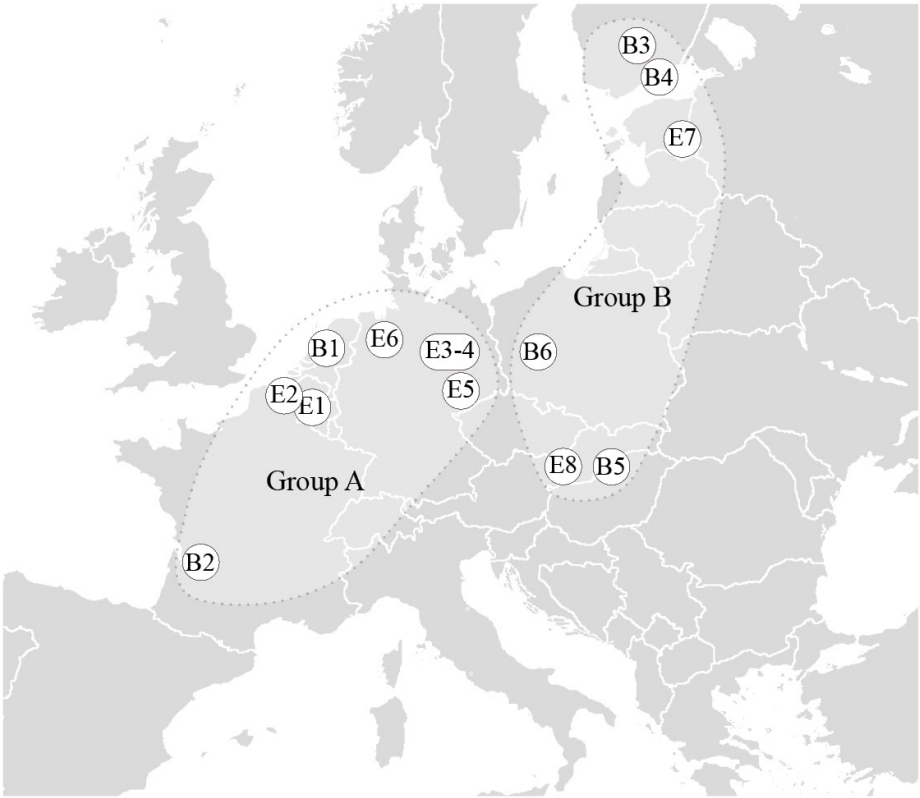


Shahi et al., 2020



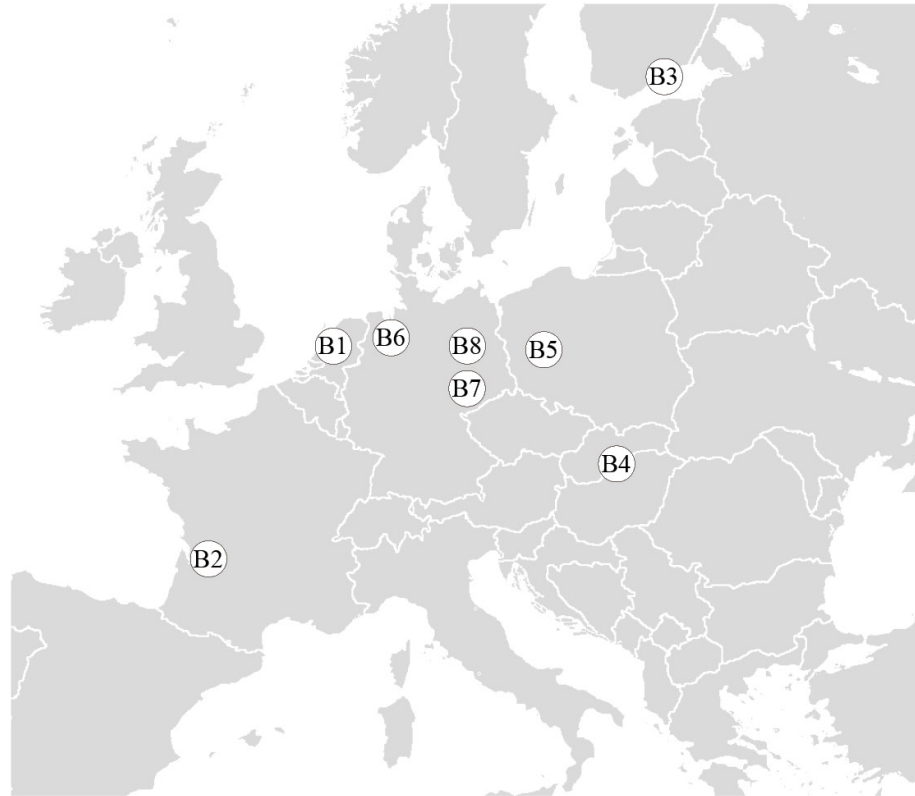
Brand, 1994

Preliminary case studies' scope




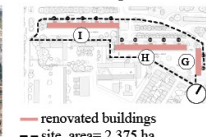
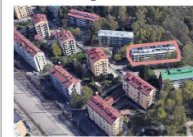








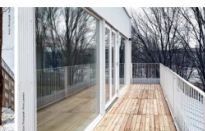


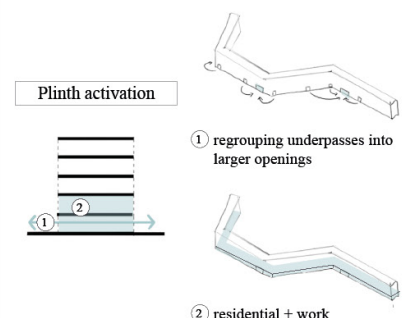
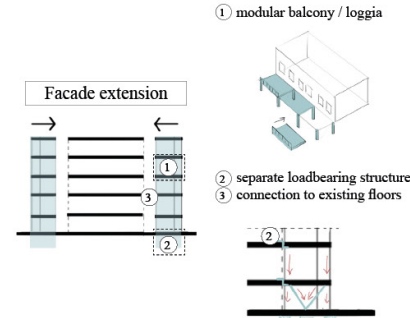
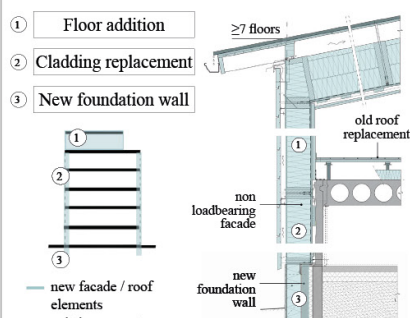
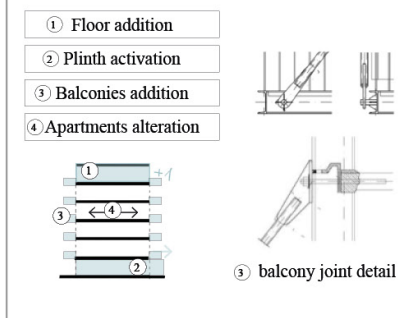
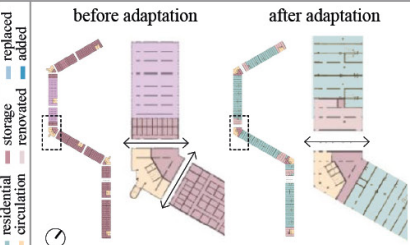

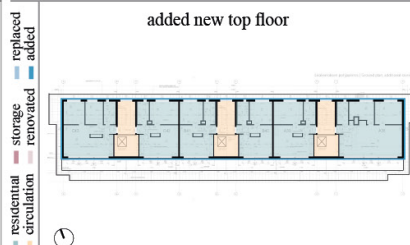
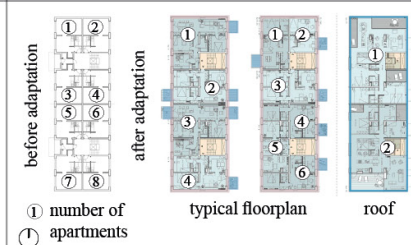


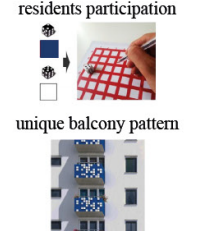
Estate				
	Nb	Estate	City	Country
Group A	E1	Cite Modele	Brussels	Belgium
	E2	Peterbos	Anderlecht	
	E3	Marzahn-Hellersdorf	Berlin	Germany
	E4	Märkisches Viertel	Berlin	
	E5	Krautersiedlung	Dresden-Gorbitz	
	E6	Kattenturm	Bremen	
Group B	E7	Annelinn	Tartu	Estonia
	E8	Luky 4,5,7,8	Bratislava	Slovakia
Building				
	Nb	Estate	City	Country
Group A	B1	Bijlmermeer; Kleiburg	Amsterdam	Netherlands
	B2	Grand Parc	Bordeaux	France
Group B	B3	Paavola	Hyvinkää	Finland
	B4	Vanha Munkkiniemi	Helsinki	
	B5	-	Rimavska Sobota	Slovakia
	B6	Bolesława Chrobrego	Poznań	Poland

Final case studies' scope



Case Study				
Nb	Building	Estate	City	Country
B1	Kleiburg	Bijlmermeer	Amsterdam	Netherlands
B2	G, H, I	Grand Parc	Bordeaux	France
B3	Rakunantie 1	Vanha Munkkiniemi	Helsinki	Finland
B4	Dobšinského 1095/40	P. Dobšinského	Rimavska Sobota	Slovakia
B5	Chrobrego 25-27	Bolesława Chrobrego	Poznań	Poland
B6	Bremer Punkt	Gartenstadt Süd	Bremen	Germany
B7	Forsythenstraße 3-13	Krautersiedlung	Dresden-Gorbitz Ost	Germany
B8	Wilhelmsruher Damm	Märkisches Viertel	Berlin	Germany

DATA	Sequence number	B1	Sequence number	B2	Sequence number	B3	Sequence number	B4
	Location	Kleiburg, Netherlands	Location	Grand Parc, France	Location	V. Munkkiniemi, Finland	Location	Rimavska Sobota, Slovakia
	Net floor building area	6800 m2	Net floor building area	44210 m2 (+23500 m2)	Net floor building area	421 m2	Building area	3775 m2
	Original number of apartments	13000	Original number of apartments	530 (G=80, H=225, I=225)	Original number of apartments	-	Original number of apartments	64
	Apartments after renovation	6000 (-7000)	Apartments after renovation	530 (+8)	Apartments after renovation	(+6)	Apartments after renovation	42 (-18)
	Developer's profile	Public (Nieuw Amsterdam)	Developer's profile	Social housing (Aquitanis)	Developer	Private (Asuntoverstas AF)	Developer	Private
CONTEXT	top view	site plan	top view	site plan	top view	site plan	top view	site plan
								
IMAGE								
	original, built 1965	adapted 2012-2016	original, built 1950s	adapted 2016	adapted 2019	rooftop view	original, built 1960s	adapted 2009-2014
ADAPTATION METHODS								
FLOORPLAN								
SOURCES	Wassenberg, F. (2013). <i>Large housing estates: ideas, rise, fall and recovery: the Bijlmermeer and beyond</i> (dissertation). Delft University Press. http://www.nlarchitects.nl/slideshow/201/		GHI Le Grand Parc (2018) <i>Vital Neighbourhoods. Lessons from international housing renewal</i> : 61-82. Publica. https://www.lacatonvassal.com/ https://www.aquitanis.fr/		Metsa Wood (2016) <i>Finnish wood architecture and construction</i> . 1/16		https://www.gutgut.sk/PANELAK https://vimeo.com/151789985?embedded=true&source=vimeo_logo&owner=7594757	

DATA	Sequence number	B5	Sequence number	B6	Sequence number	B7	Sequence number	B8
	Location	B. Chrobrego, Poland	Location	Gartenstadt Süd, Germany	Location	Forsythienstraße 3-13, Germany	Location	Wilhelmsruher Damm, Germany
	Net floor building area	10100 m2 (x3)	Building area	784 m2 (x3)	Net floor building area	-	Building area	68.307 m2
	Original number of apartments	160 (x3)	Original number of apartments	-	Original number of apartments	252	Original number of apartments	977
	Apartments after renovation	-	Apartments after renovation	4-11	Apartments after renovation	86	Apartments after renovation	977
	Developer	Public	Developer	Social housing (GEWOBA)	Developer	Social housing (EWG)	Developer	Social housing (GESOBAU)
CONTEXT	top view	site plan	masterplan	site plan	top view	site plan	top view	site plan
								
IMAGE								
	estate, 1970s	adapted 2012	Hinrich Fehrs street, built 1960s	adapted 2017	estate, 1970s	adapted 2012	built 1965-68	adapted 2015
ADAPTATION METHODS	<div><div>1</div>Balconies renovation</div> <div><div>2</div>New facade</div> 	<div>art inspiration</div>  <div>residents participation</div>  <div>unique balcony pattern</div>	<div><div>1</div>Densification in between</div> <div><div>2</div>Apartments alteration</div>  <div>prefabricated system</div>  <div>serial diversification</div>	<div><div>1</div>Selective demolition</div> <div><div>2</div>Balconies renovation</div> <div><div>3</div>Layouts alteration</div>  <div>disassembly process of WBS-70 large concrete panels</div>	<div><div>1</div>Services improvement</div> <div><div>2</div>Groundfloor extension</div> <div><div>3</div>Envelope energy retrofit</div>  <div>EIFS facade system</div>	<div><div>2</div>renovation of entrance pavillions</div> 		
FLOORPLAN	replaced storage circulation	added	replaced storage circulation	added	replaced storage circulation	added	replaced storage circulation	added
	“Szczeciński” system typical floorplan		diverse floorplans		typical WBS-70 floorplan (2-5 floor)		1st floor	
								
SOURCES	„Miastoprojekt-Szczecin” (1971) <i>Budownictwo mieszkaniowe z elementów wielkowymiarowych</i> : 9. Szczecin. https://ultra-architects.pl/termomodernizacja-modernizmu-boleslaw-chrobrego-25-26-27/		https://www.lin-a.com/gallery/bremen-competition-lin-project-housing/bremer-punkt		Bundesministerium für Bauordnung, Bauwesen und Städtebau (1997) <i>WBS 70. Wohnungsbauserie 70</i> . Berlin. https://www.ewg-dresden.de/bauvorhaben/stadumbau-ost-ewg-realisiert-projekte-in-gorbitz/		https://www.db-bauzeitung.de/architektur/wohnungsbau/grossmassstabliche-wohnerwertsteigerung/ https://candor-berlin.de/project/wilhelmsruher-damm/#	

Architectural Identity

before



Original, built in 1960s

after



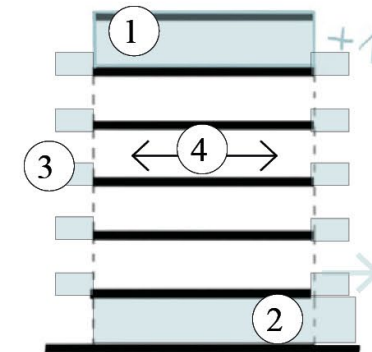
Adapted 2009-2014



Sequence number	B4
Location	Rimavska Sobota, Slovakia
Building area	3775 m2
Original number of apartments	64
Apartments after renovation	42 (-18)
Developer	Private

Adaptation strategies

- ① Floor addition
- ② Plinth activation
- ③ Balconies addition
- ④ Apartments alteration



Architectural Identity

before



Original, built in 1970s



Sequence number	B5
Location	B. Chrobrego, Poland
Net floor building area	10100 m2 (x3)
Original number of apartments	160 (x3)
Apartments after renovation	-
Developer	Public

after

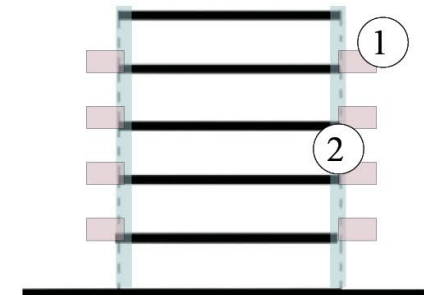


Adapted 2012

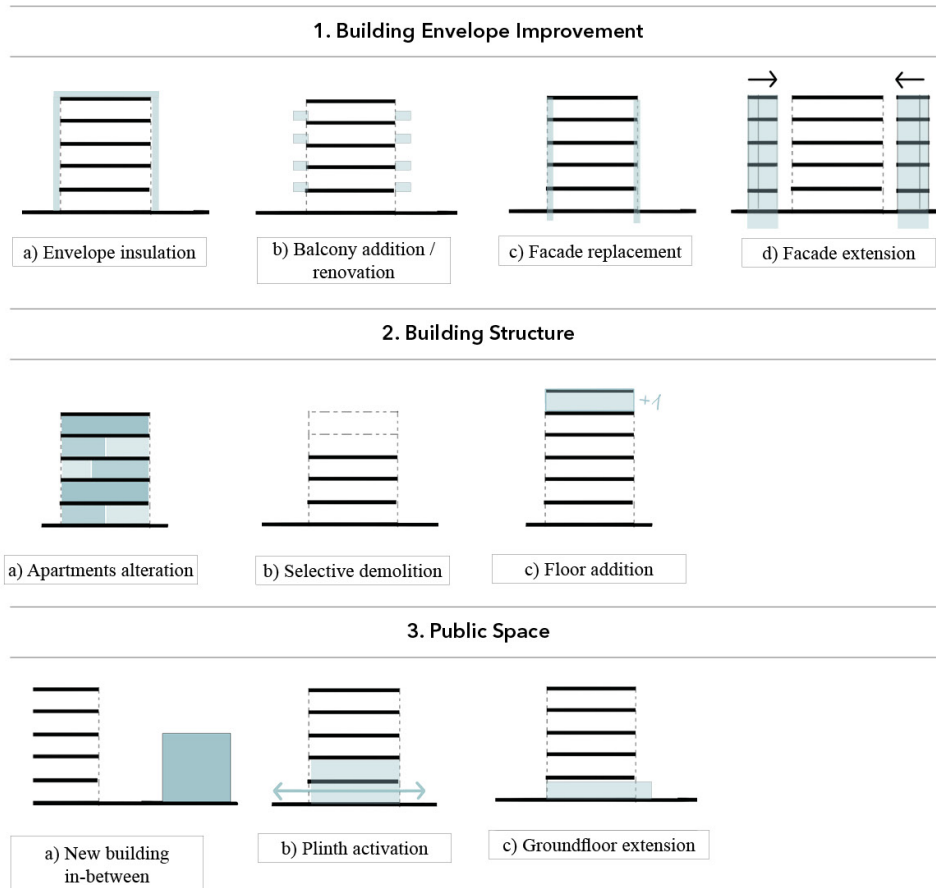
Adaptation strategies

- ① Balconies renovation
- ② New facade

— new facade with insulation
— renovated balconies



Conclusions

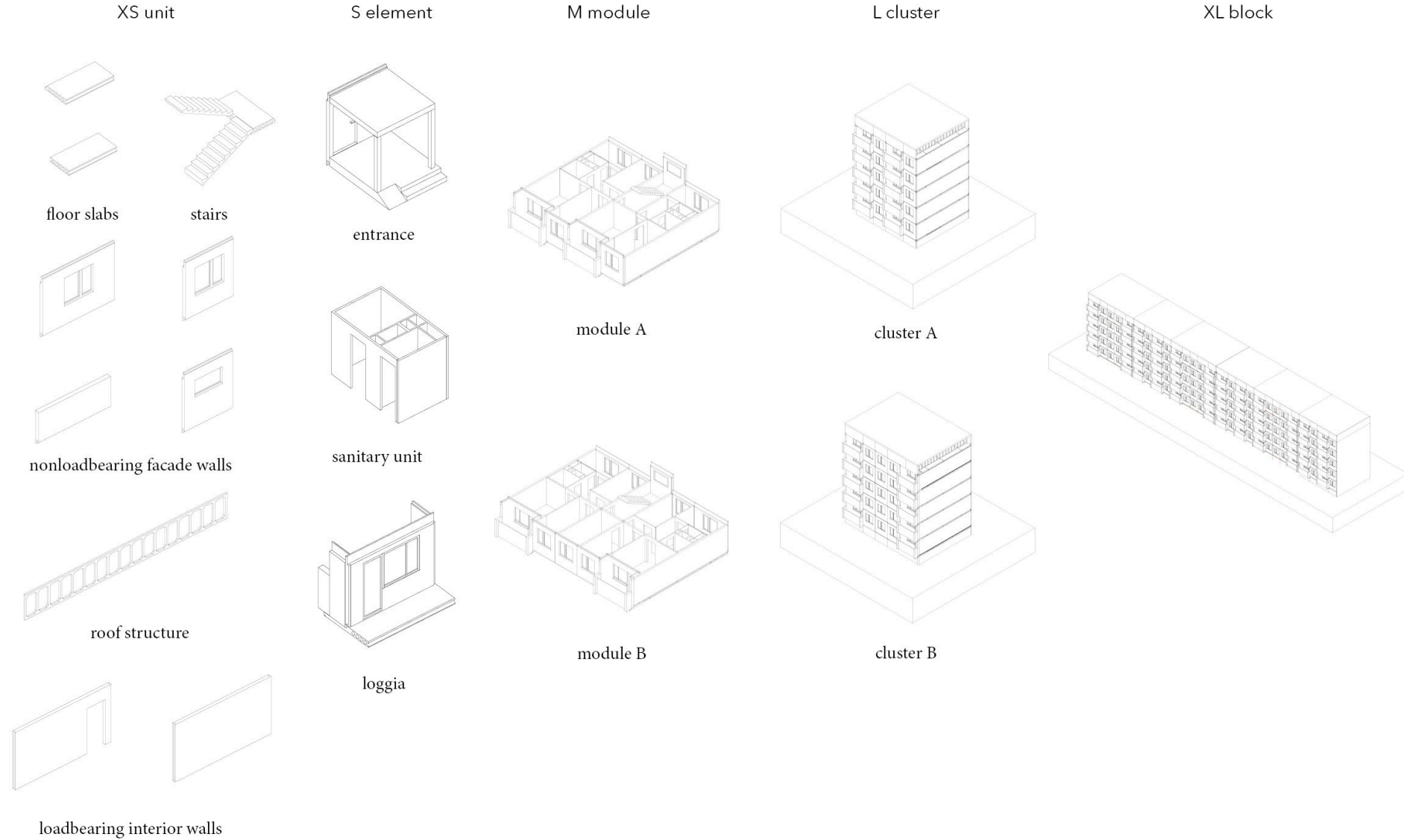


.....>

Implementation Layers

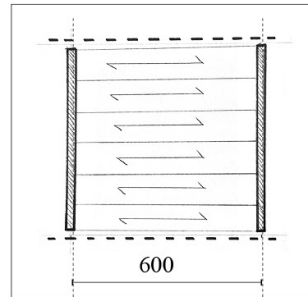
Economy
Residents
Architecture
Urban
Technology
Environment & Social
Ownership

Modularity across scales



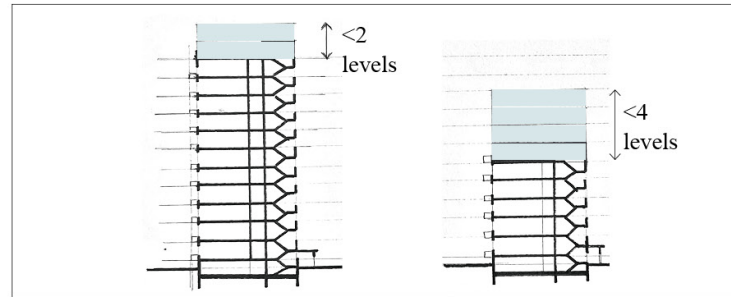
Technology

Facade disassembly



a) Open-nature structure.
Non-loadbearing facade.

Floor addition



b) Schematic estimation of additional level, based on 11 - (left) and 5-storey (right) typical W-70 buildings.

Legend

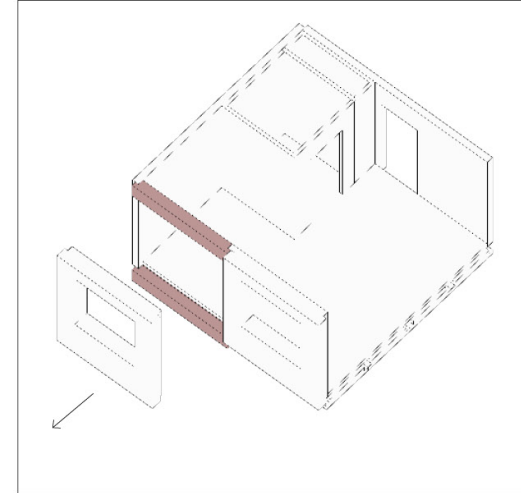
- module disassembly
- additional support
- additional level

Modularity



c) Possibilities for module demountability.

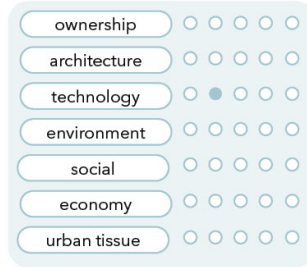
Structural reinforcement



d) Need for structural reinforcement while demounting particular panels.

Technology

Minimal solution:
thermal insulation



existing



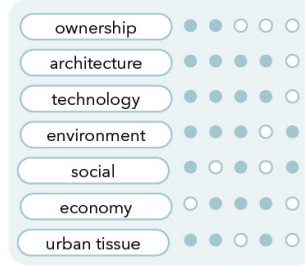
$U=1,7$

thermal insulation



$U=0,2$

Design goals



existing



$U=1,7$

modular envelope

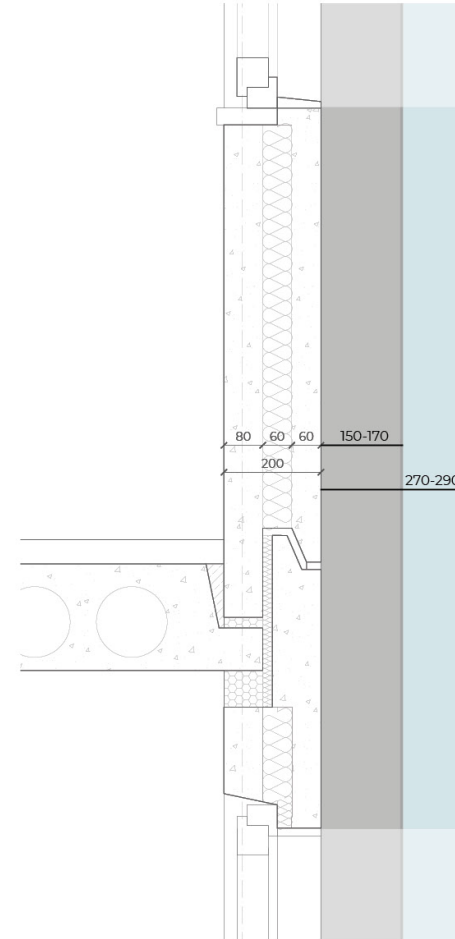


$U=0,12$

		U value		
		layers	LP housing	PI normative
external wall	1	1,5-1,7	0,2	0,12
	3	0,9		
window		2,6	0,9	0,85
		annual energy demand		
		250	65	15

Existing
single-layer wall
 $U_1=1,5-1,7$
three-layer wall
 $U_2=0,9$

→ -78-88% **PL building norms**
external wall
 $U=0,2$
→ -87-93% **Passive house**
external wall
 $U=0,12$



Architecture



Southern Facade



Western Facade



Northern Facade



Eastern Facade



Environment & Social



community gardening as a cultural phenomenon in Poland

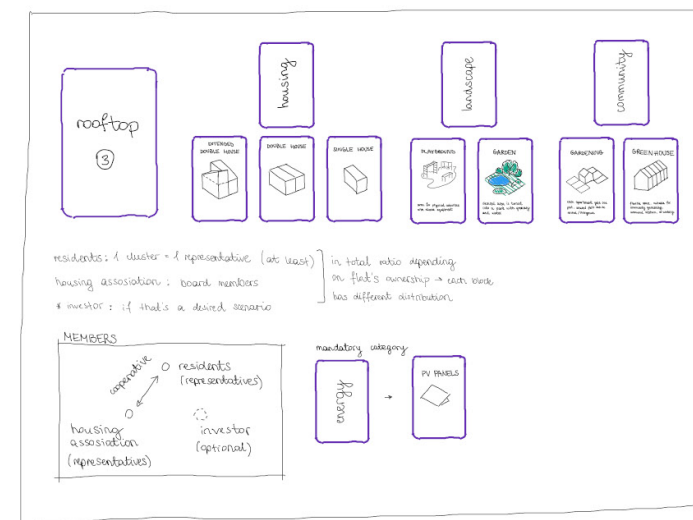
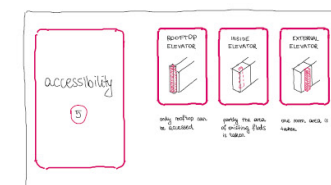
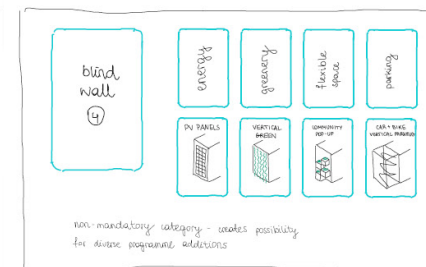
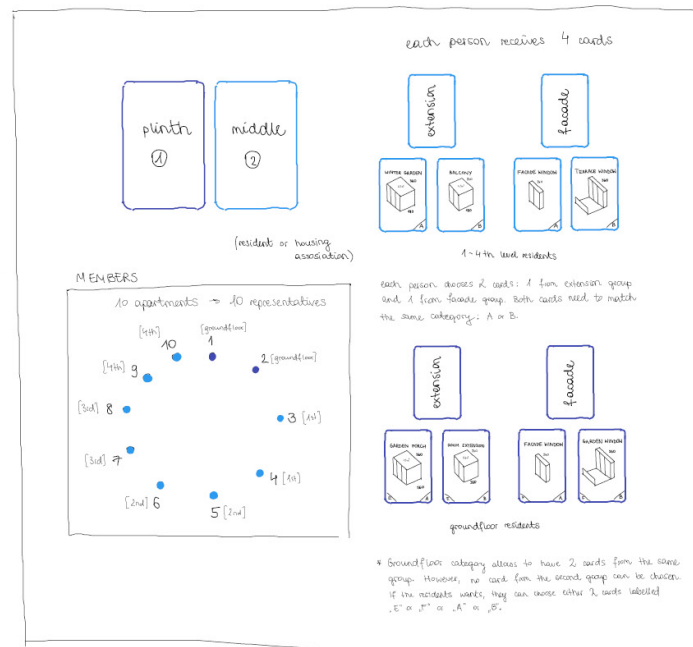
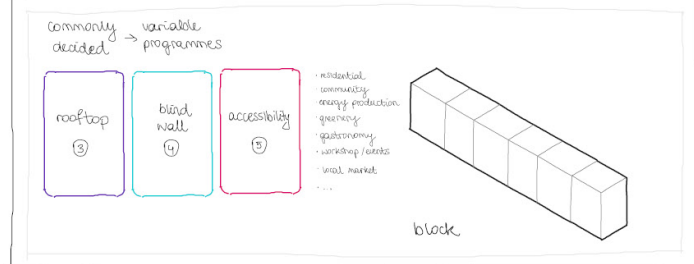
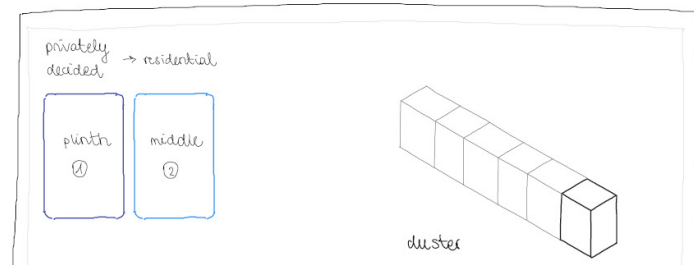
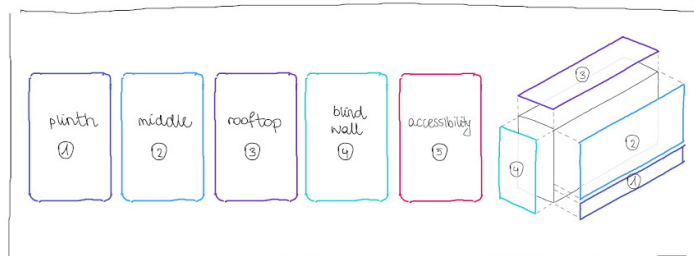


facade and rooftop modules with gardens

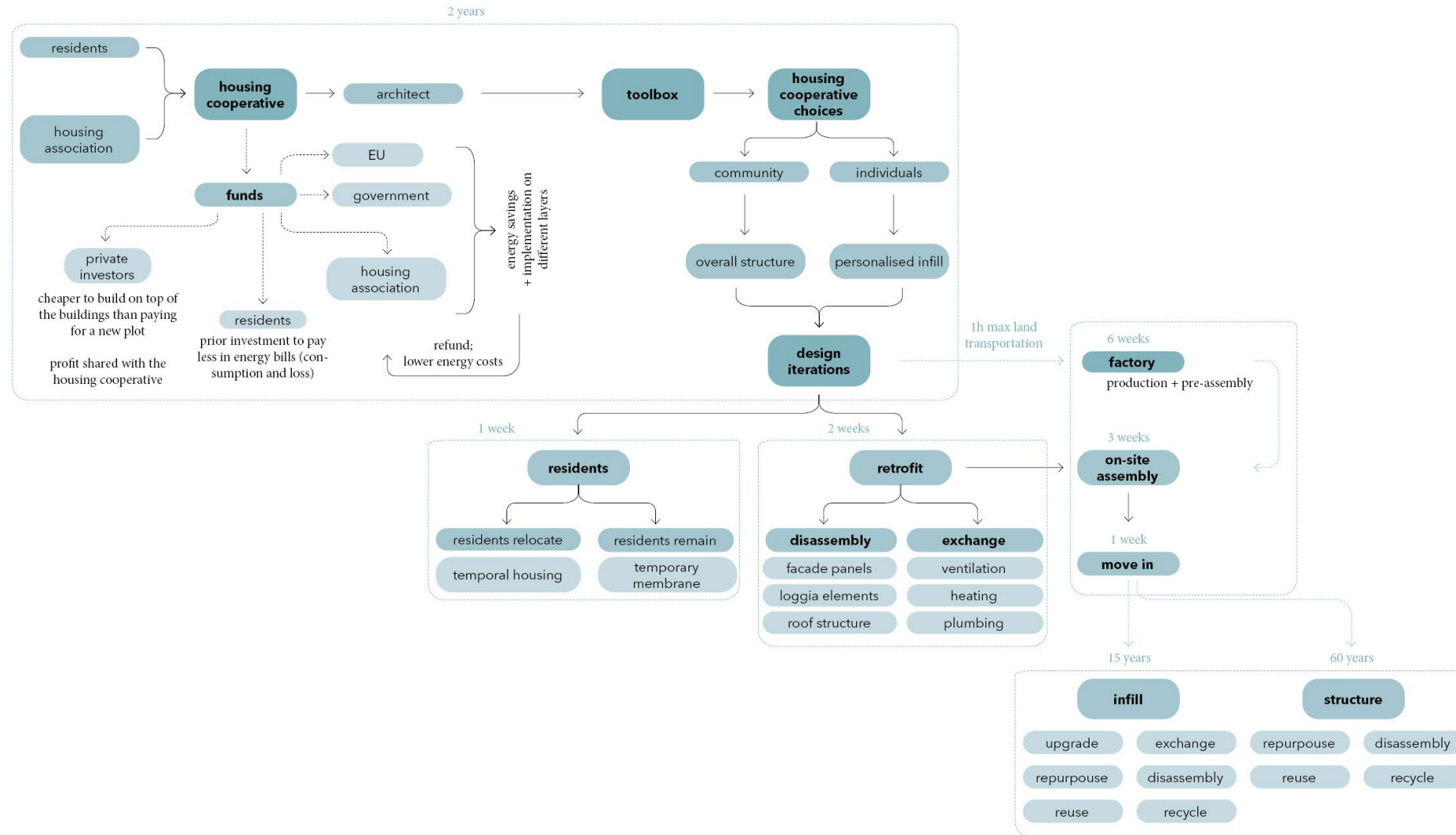
Design Strategy



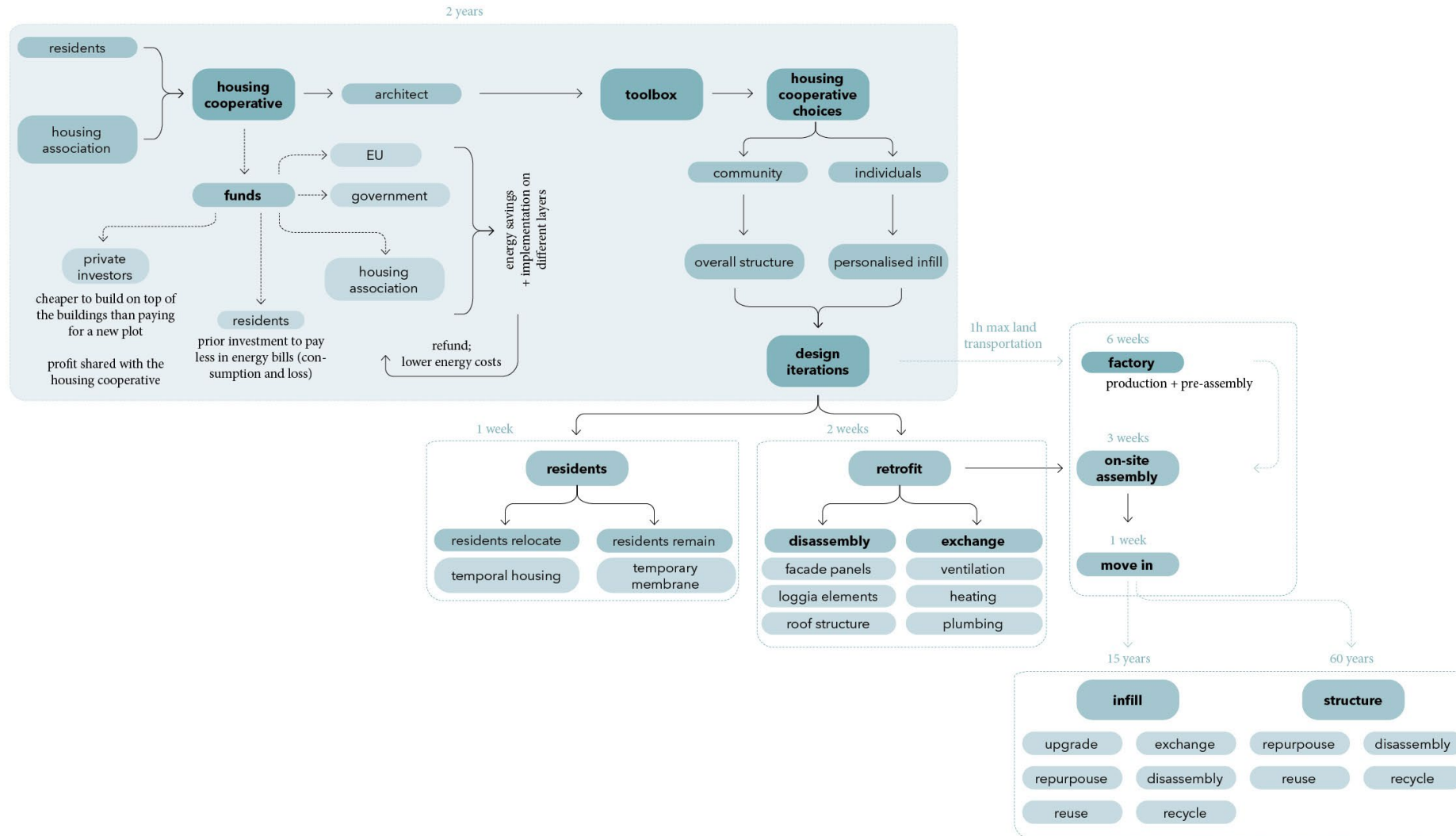
Resident's participation



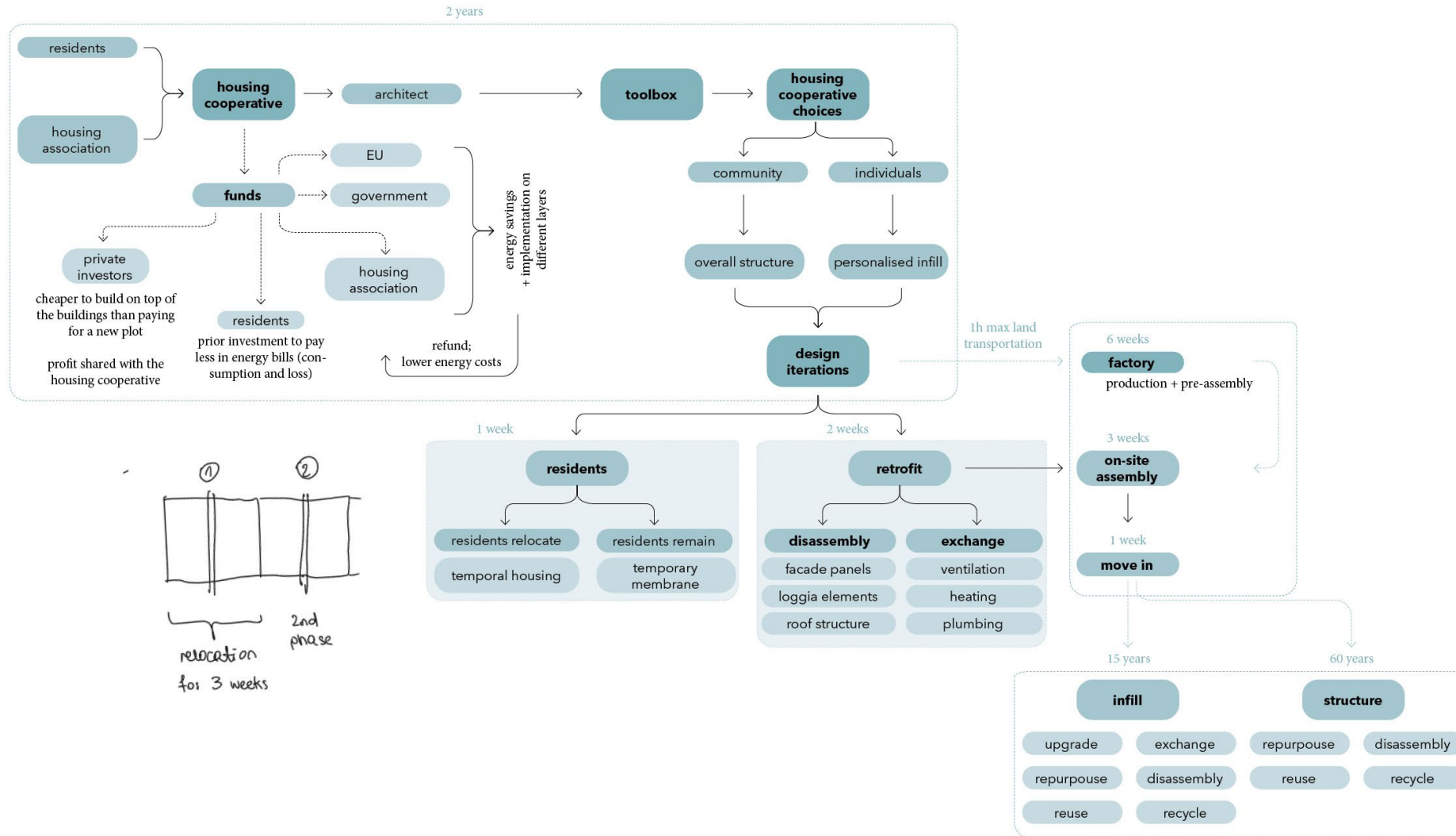
Strategy



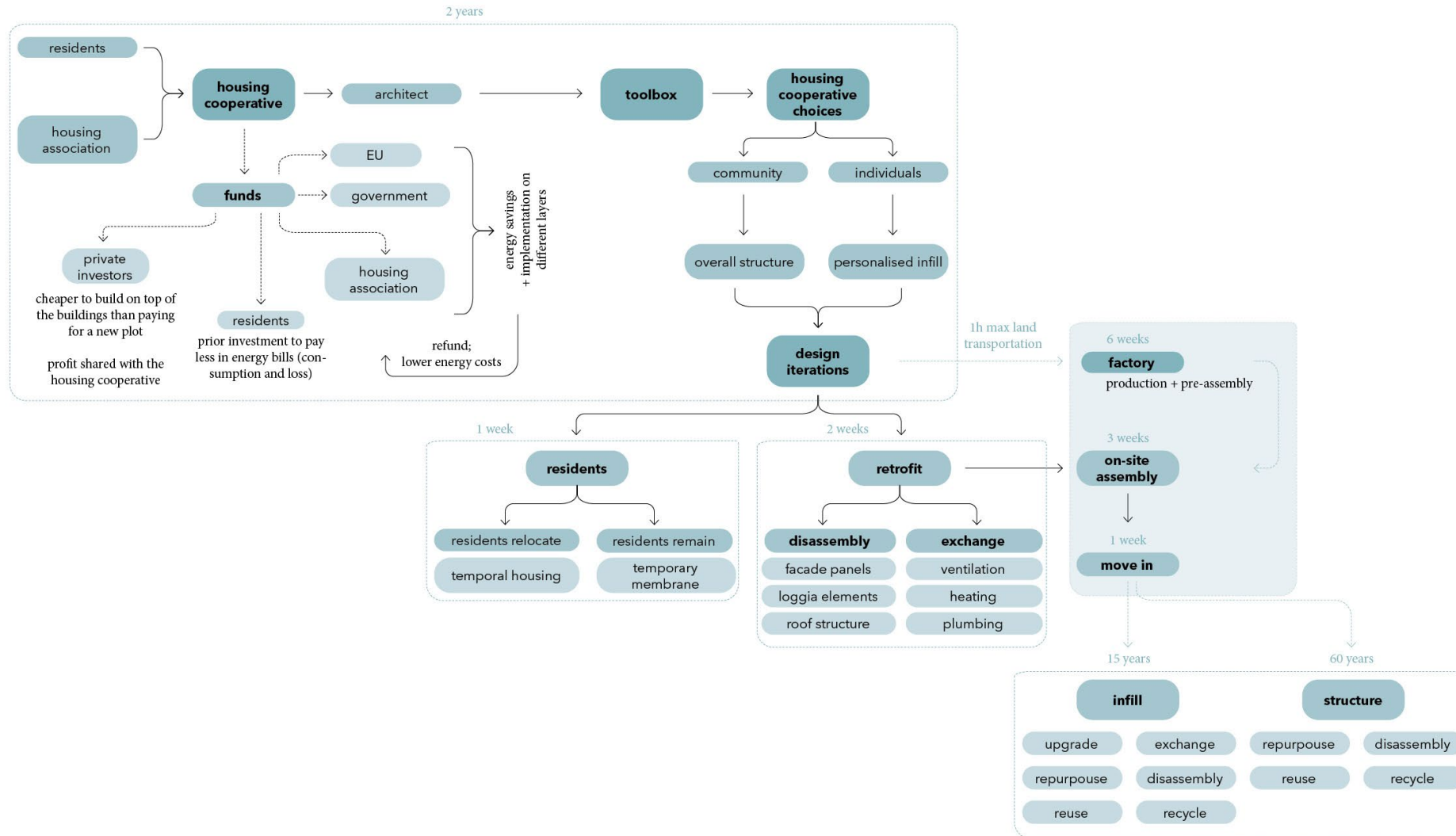
Strategy



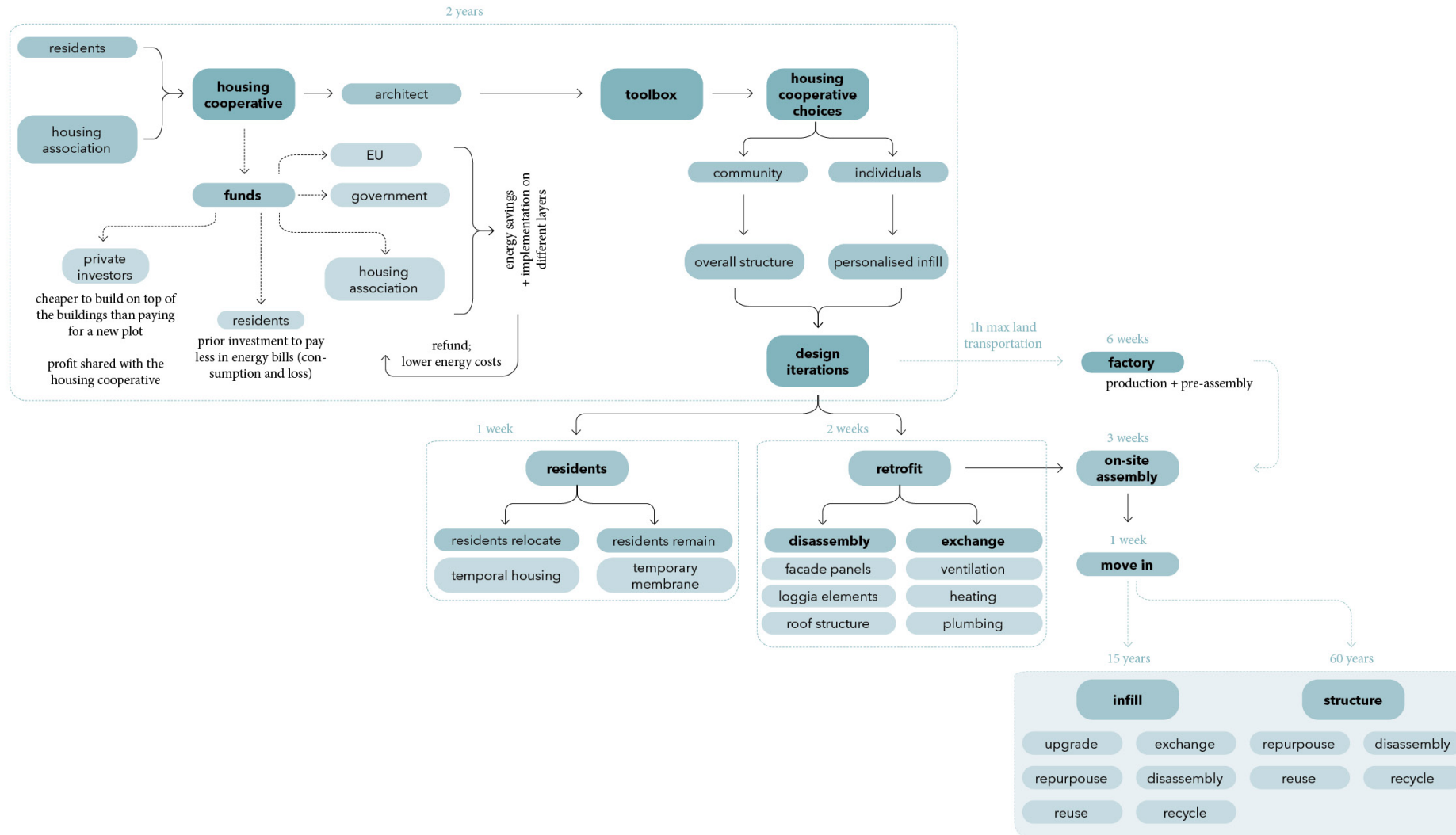
Strategy



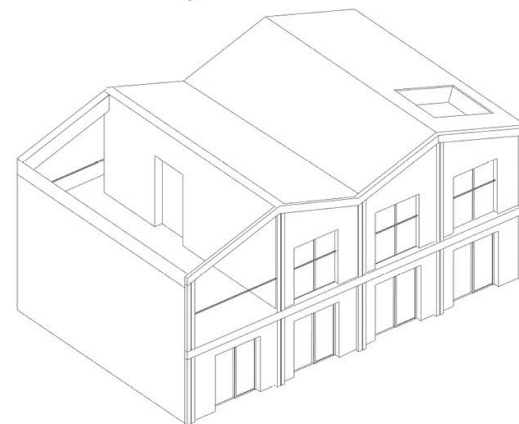
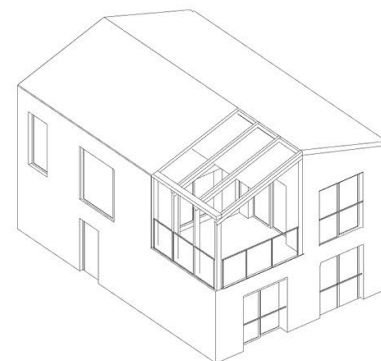
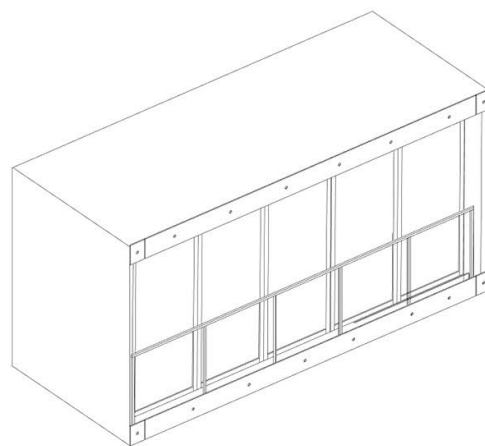
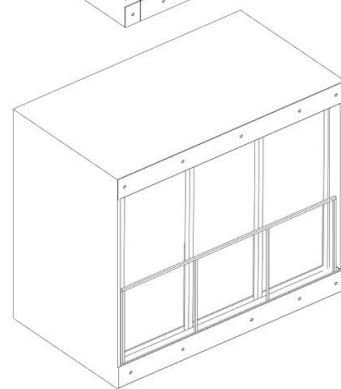
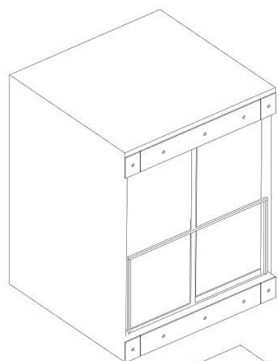
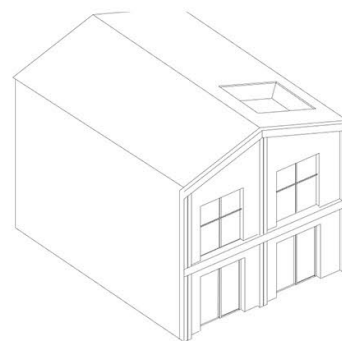
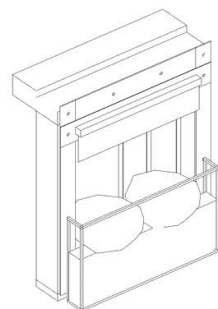
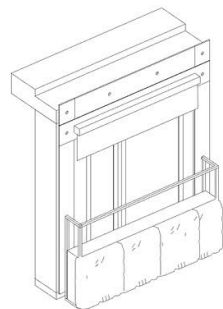
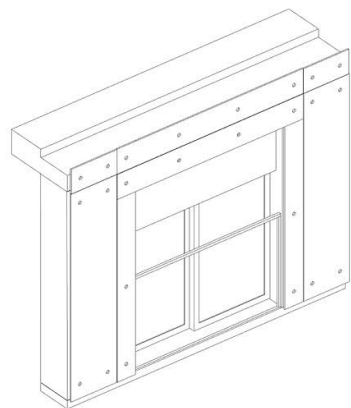
Strategy



Strategy

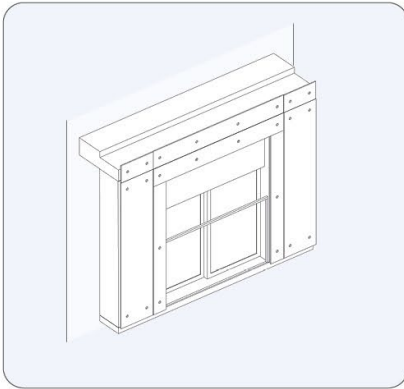




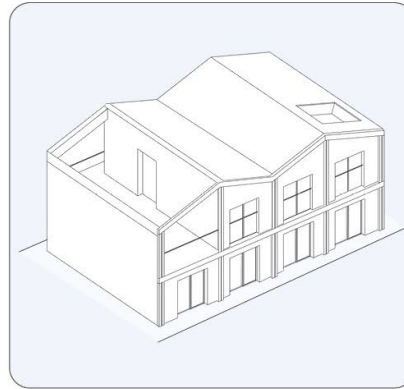


plug
& live

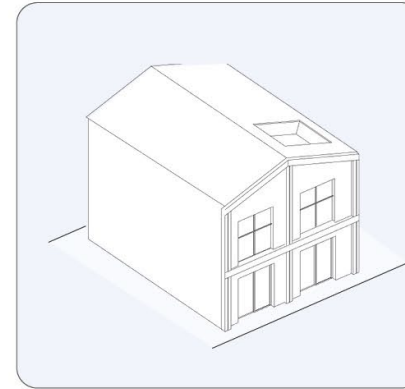
My Facade



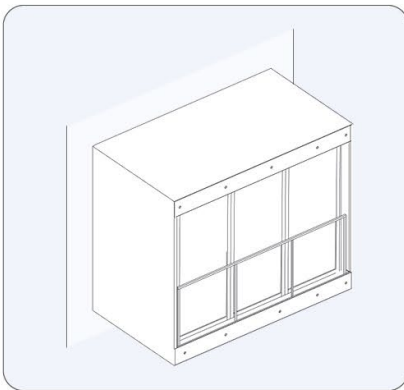
Shared House



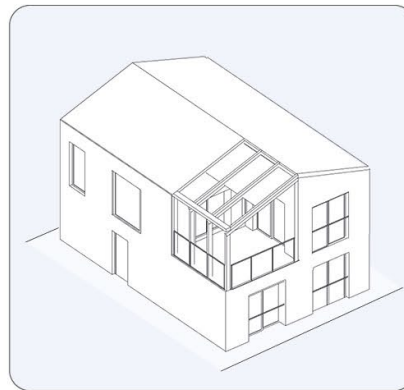
Family House



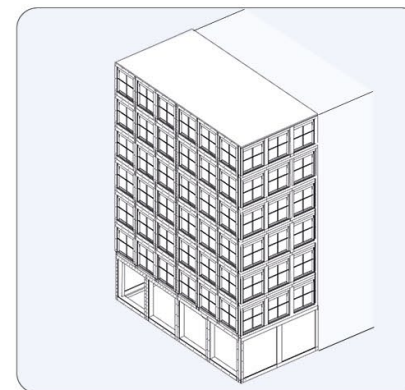
My Extension



Community Center



Multi-Space

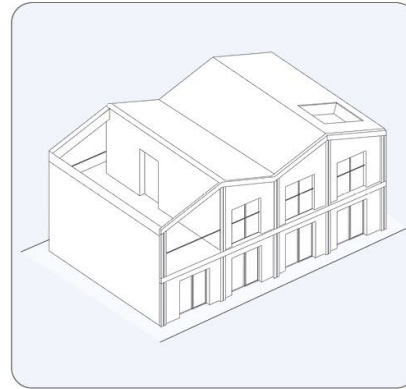




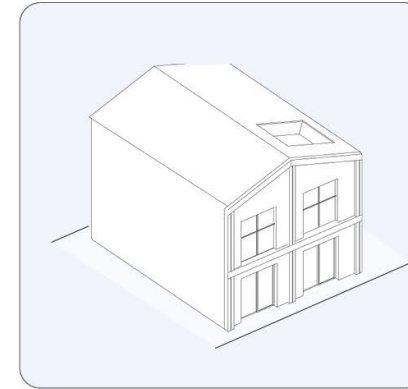
My Facade



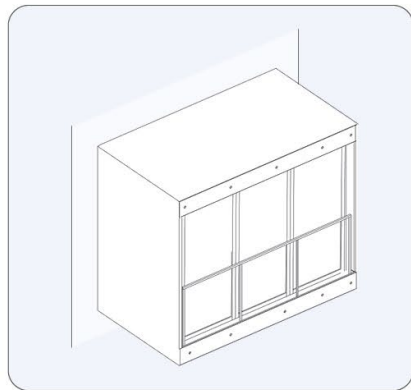
Shared House



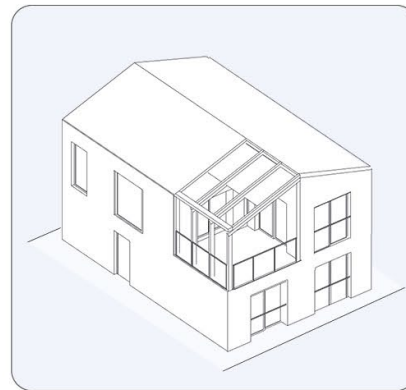
Family House



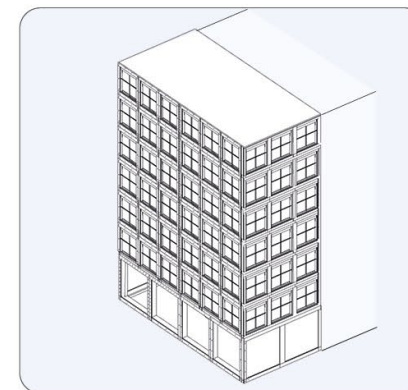
My Extension



Community Center

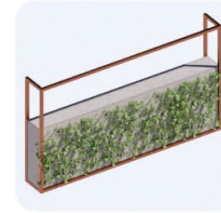


Multi-Space





greenery



plant pot



vertical panel



green wall



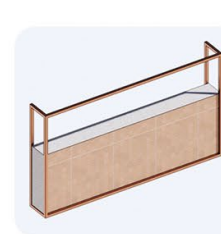
photovoltaics



facade cover

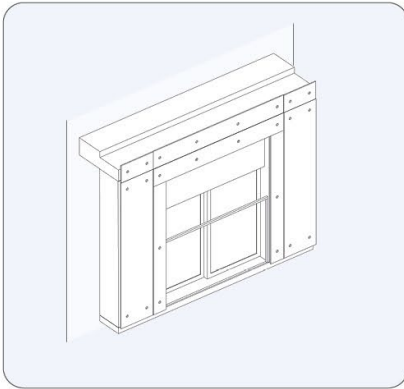


shading panel

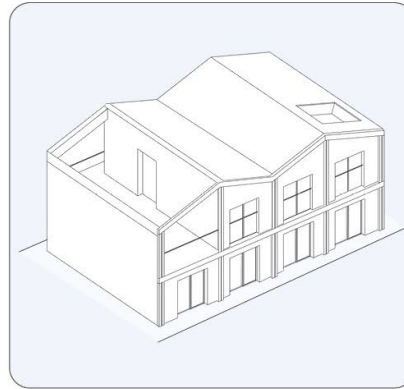


ballustrade

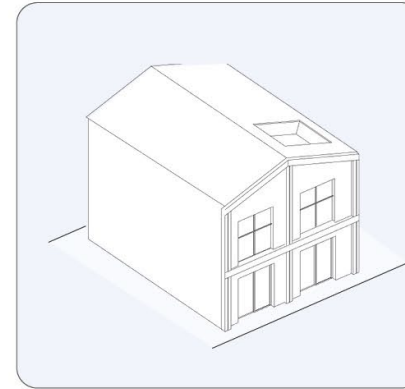
My Facade



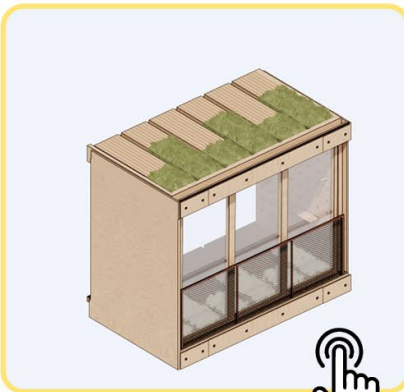
Shared House



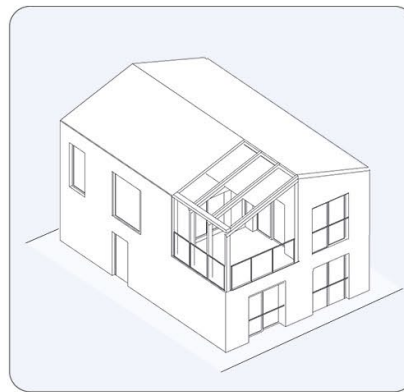
Family House



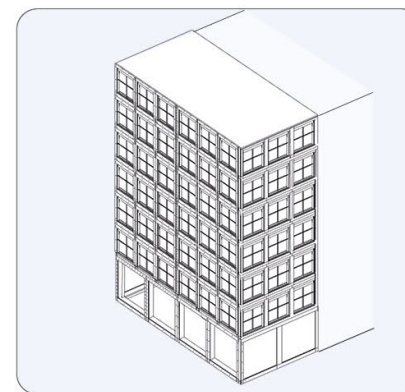
My Extension



Community Center

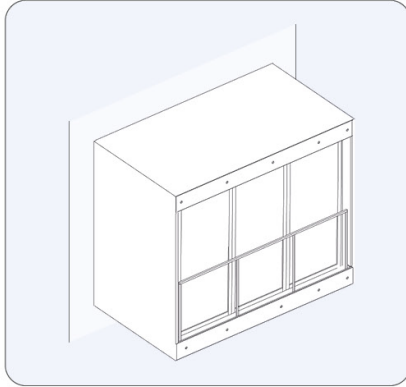


Multi-Space

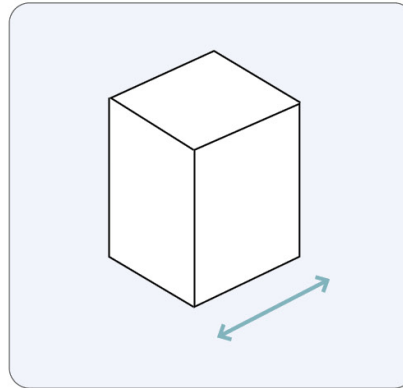


plug
& live

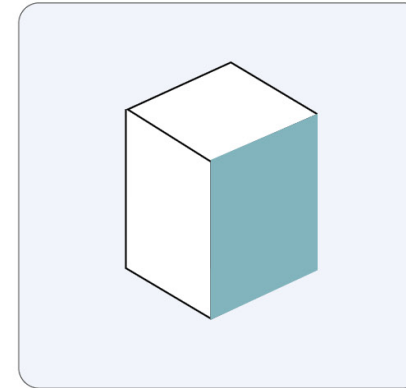
My Extension



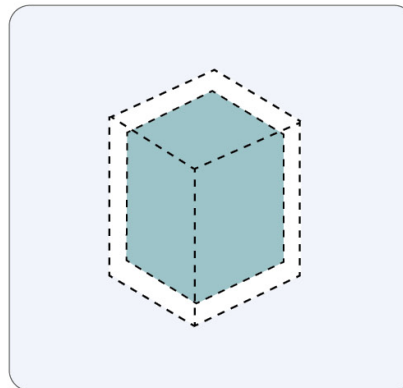
size



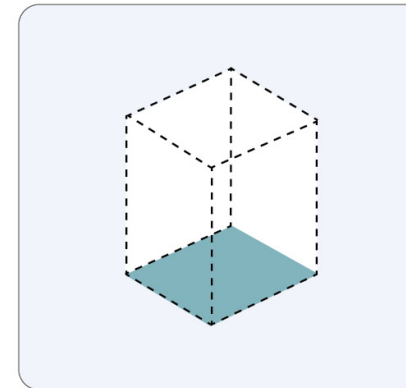
facade



interior

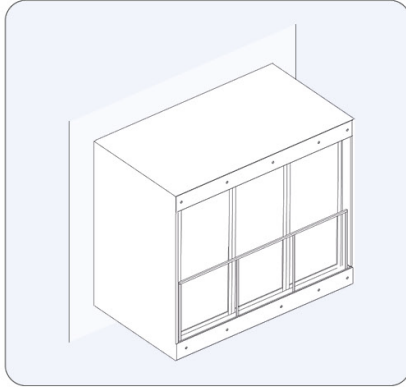


floor

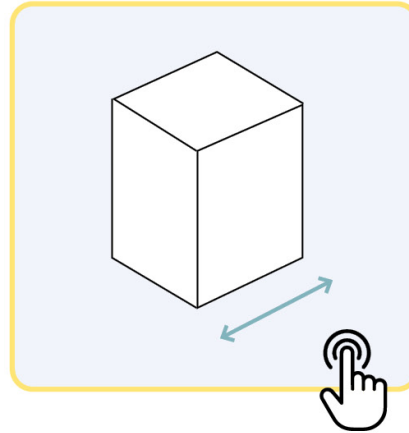


plug
& live

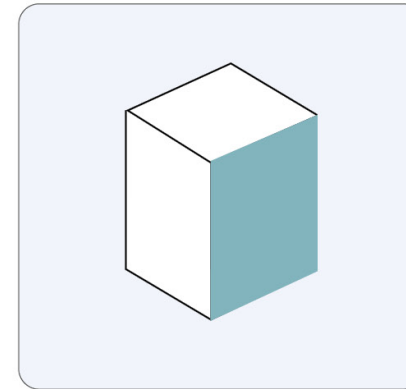
My Extension



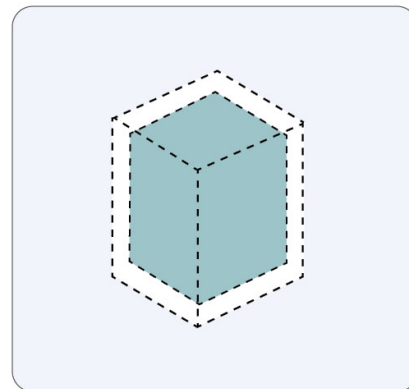
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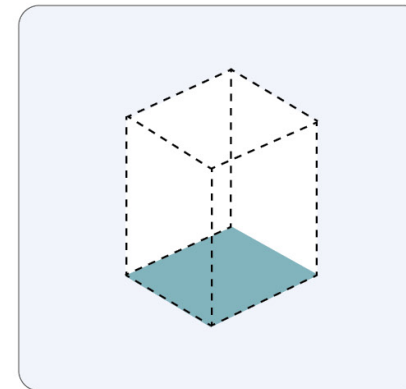
facade



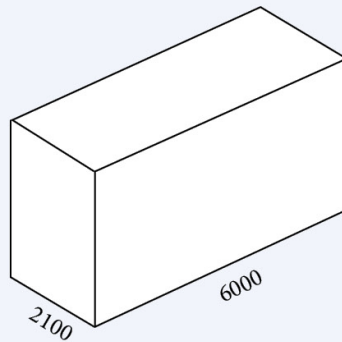
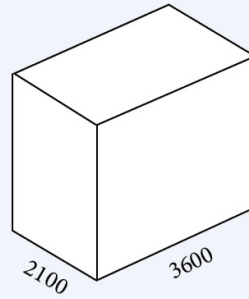
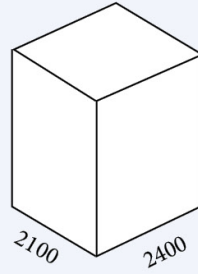
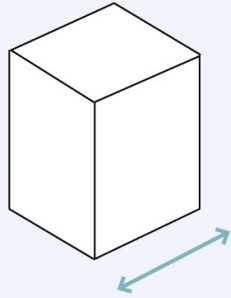
interior



floor



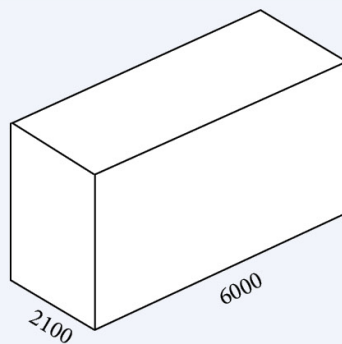
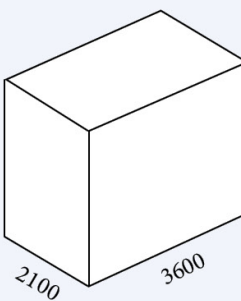
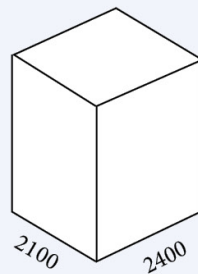
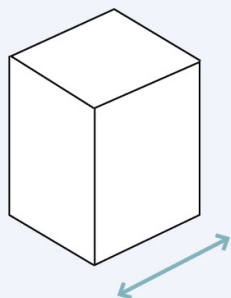
size



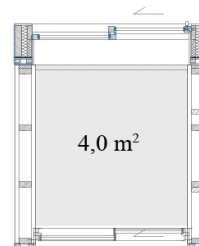
plug
& live

My Extension

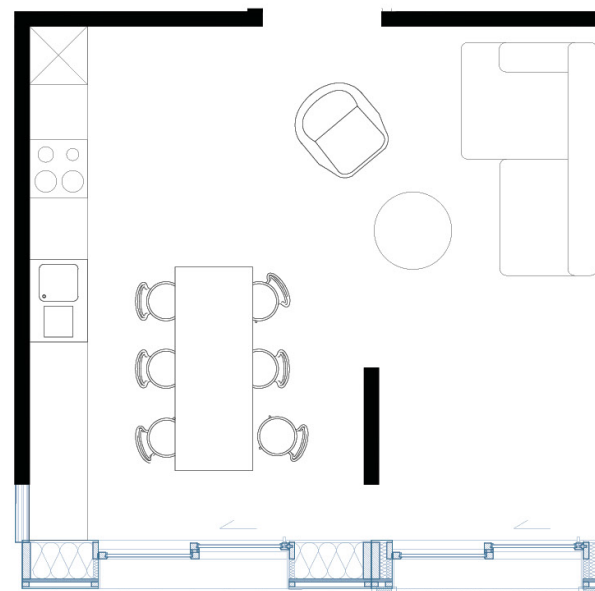
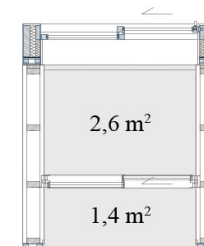
size



winter garden



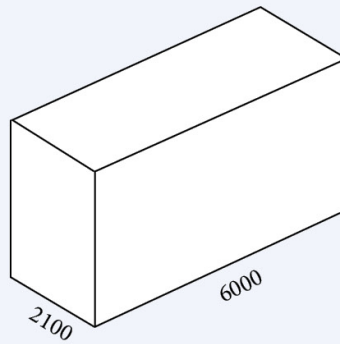
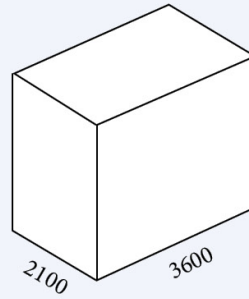
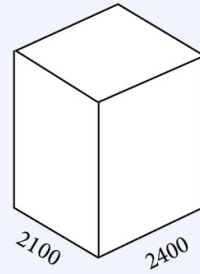
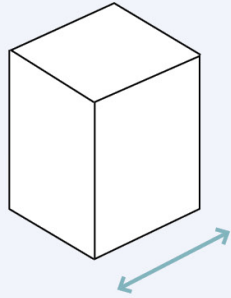
winter garden
+ balcony



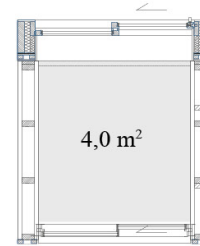
plug
& live

My Extension

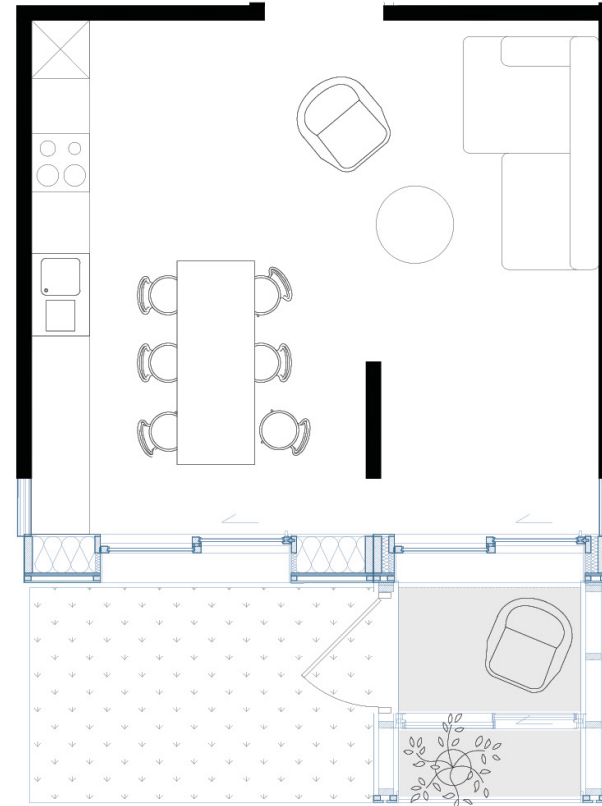
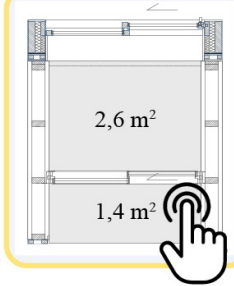
size



winter garden



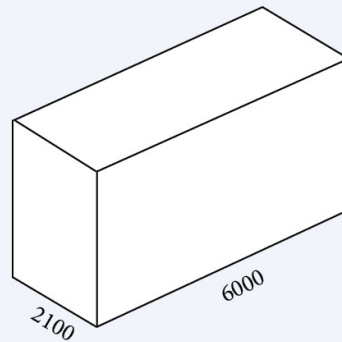
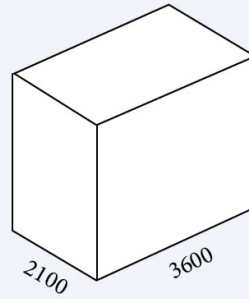
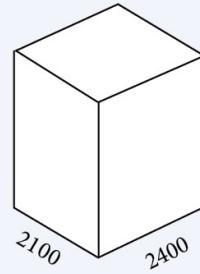
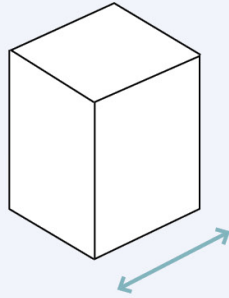
winter garden
+ balcony



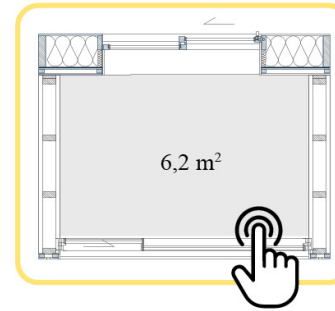
plug
& live

My Extension

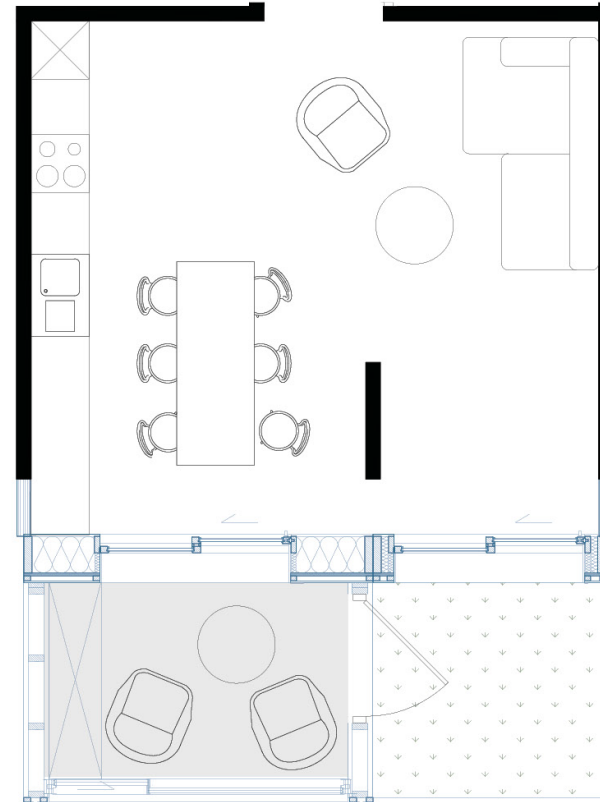
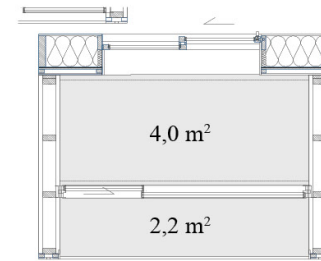
size



winter garden



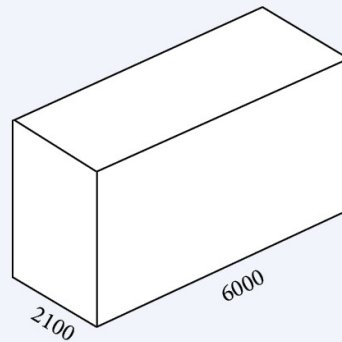
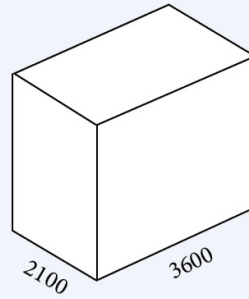
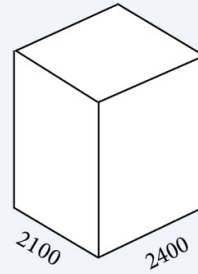
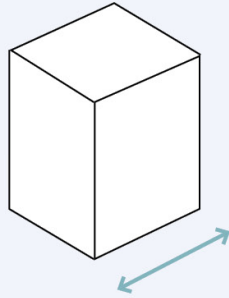
winter garden
+ balcony



plug
& live

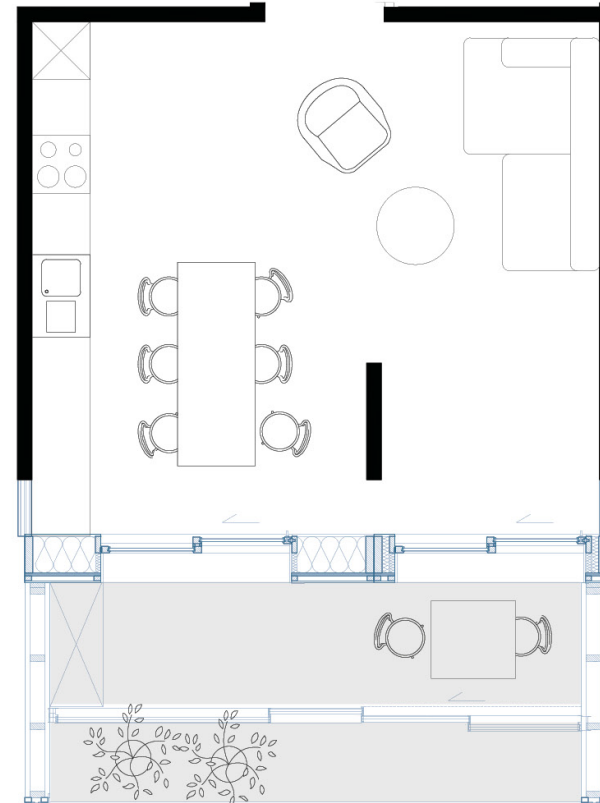
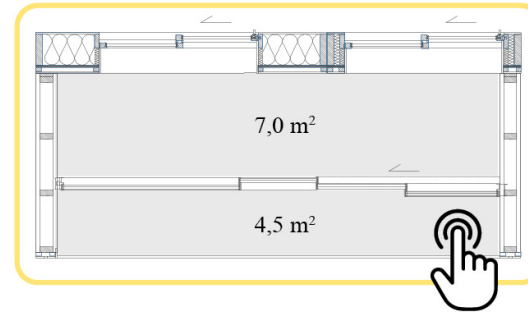
My Extension

size



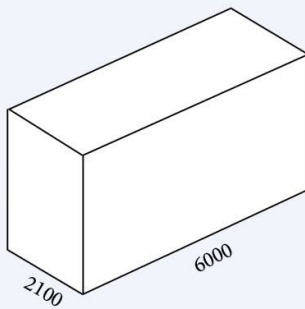
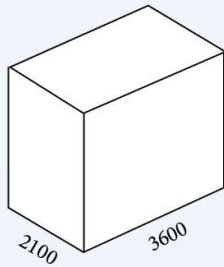
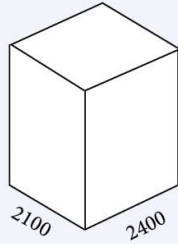
winter garden

winter garden
+ balcony



plug
& live

My Extension



Groundfloor

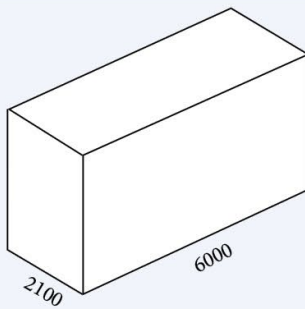
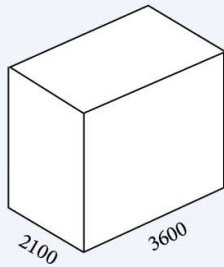
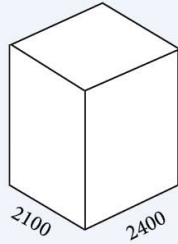
existing
apartment
49.7 m²



existing
apartment
56.8 m²

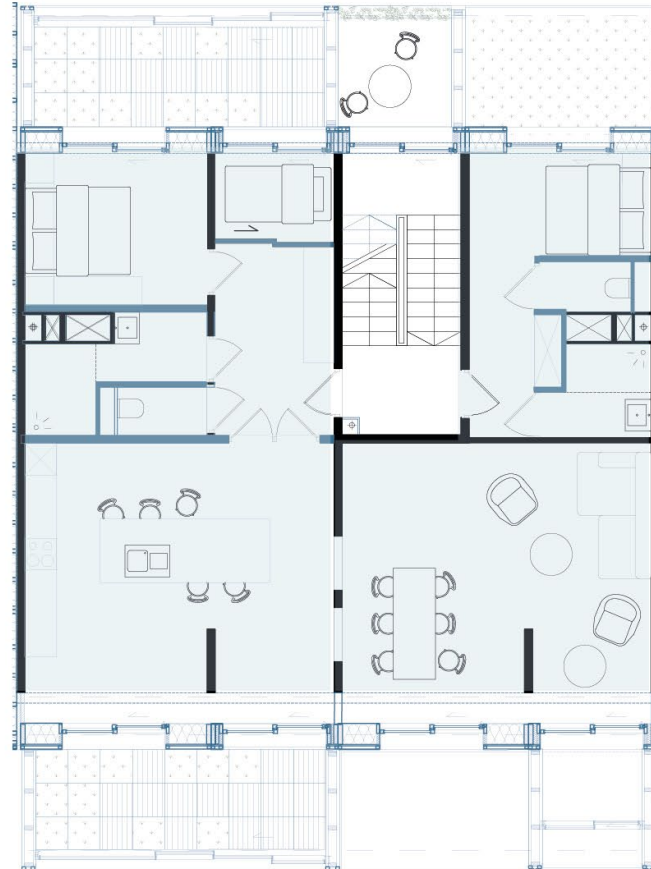
plug
& live

My Extension



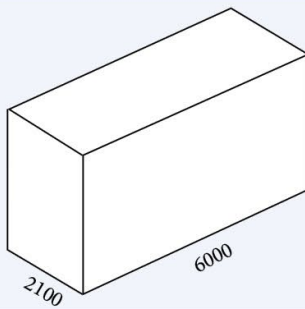
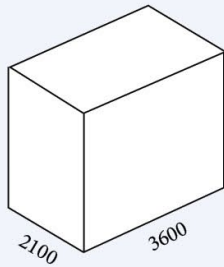
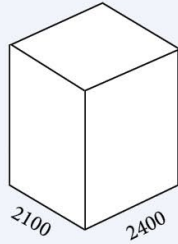
co-house
97.8 m²

Typical Floor



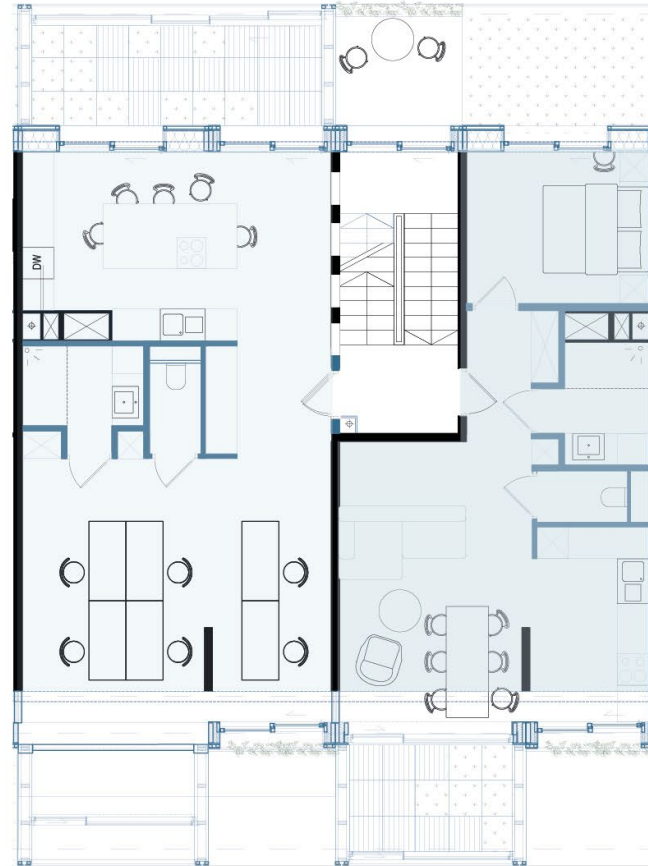
plug
& live

My Extension



Typical Floor

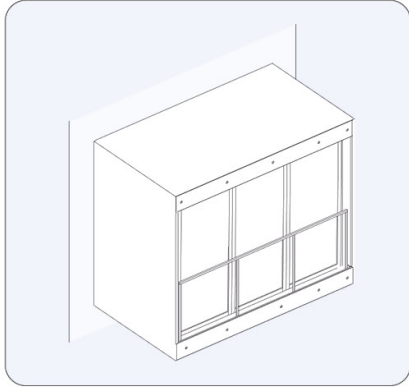
office
52.1 m²



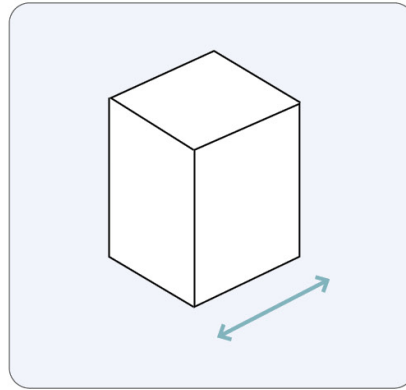
apartment
45.7 m²

plug
& live

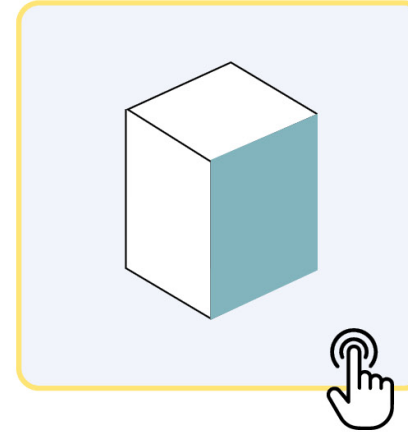
My Extension



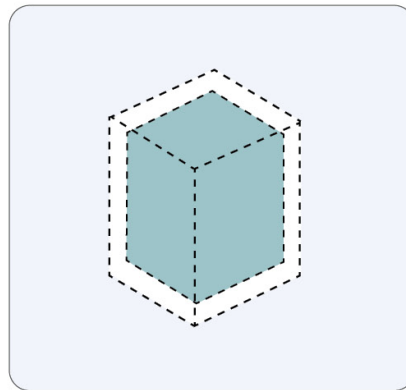
size



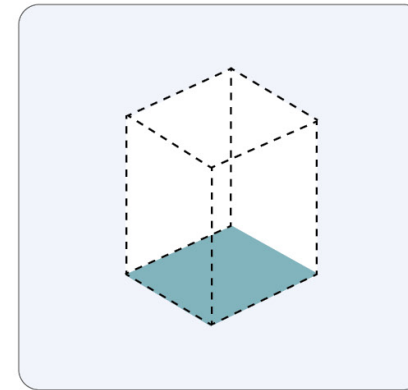
facade

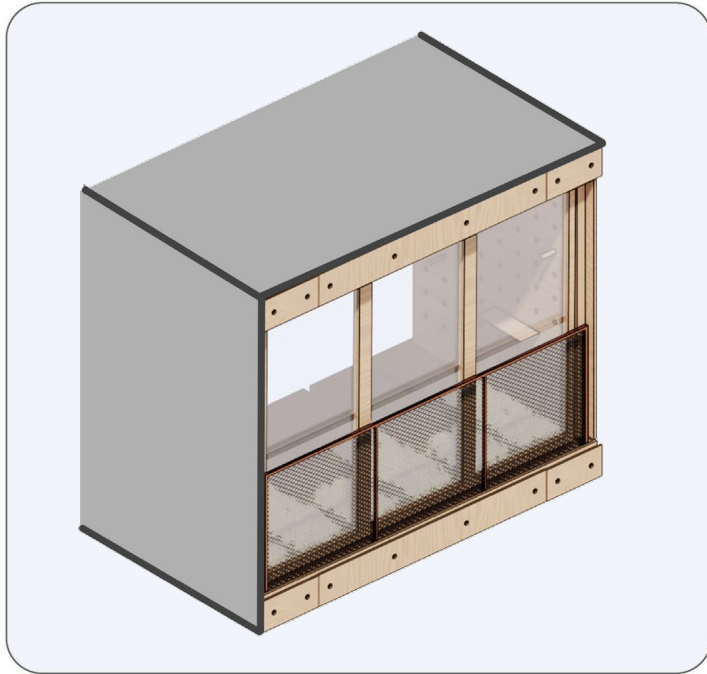


interior



floor





greenery



plant pot



vertical panel



green wall



photovoltaics



facade cover



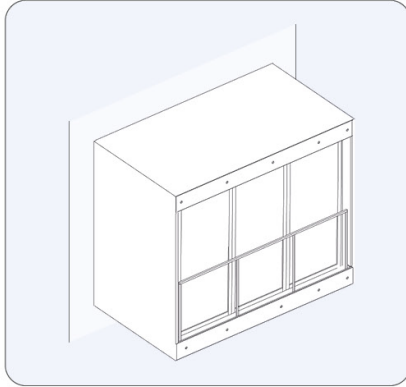
shading panel



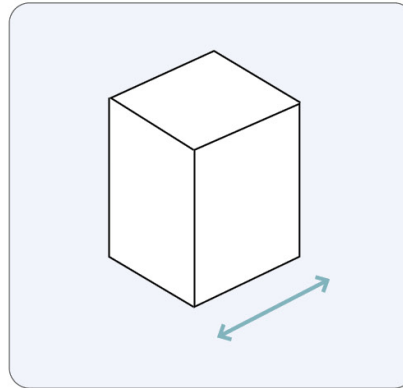
ballustrade

plug
& live

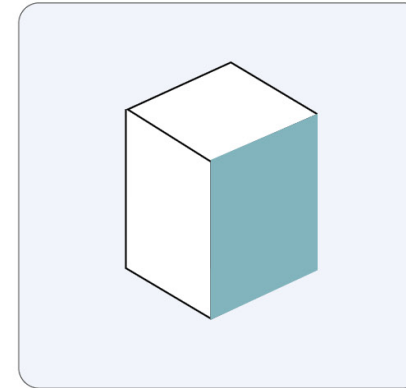
My Extension



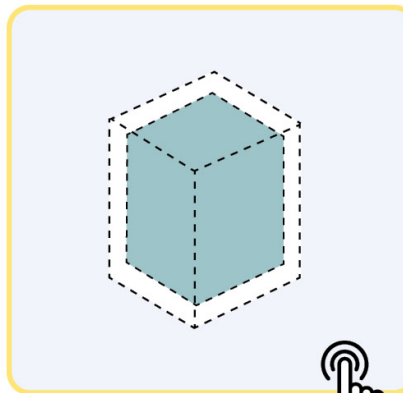
size



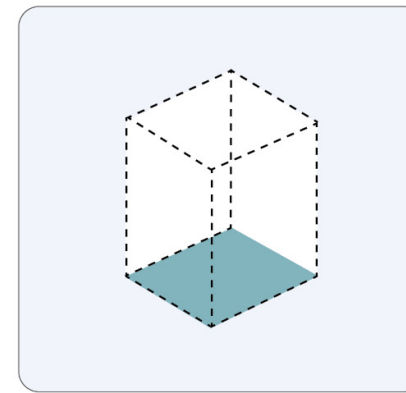
facade



interior



floor





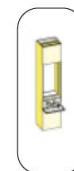
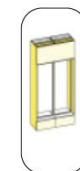
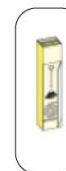
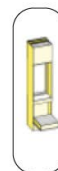
5.2m²



extra storage



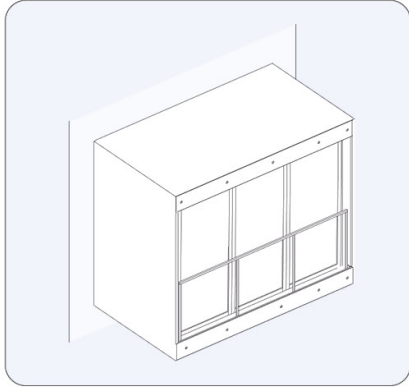
integrated furniture



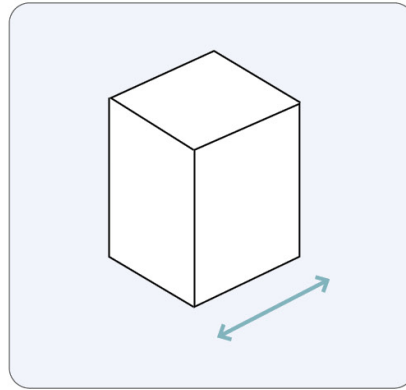
source: <https://thenewmakers.com/projects/microwoning/>

plug
& live

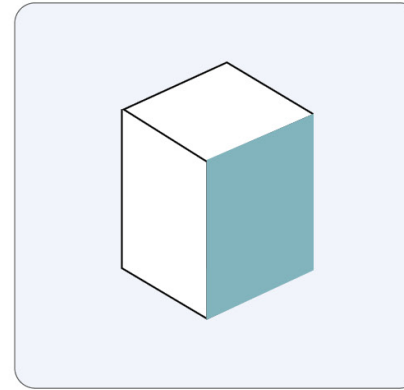
My Extension



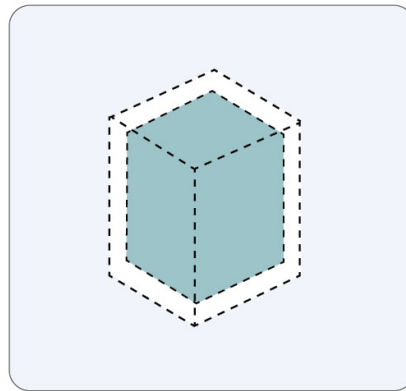
size



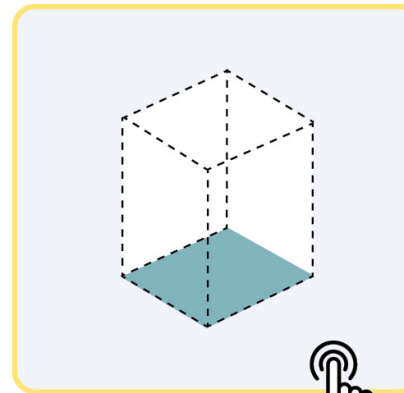
facade



interior



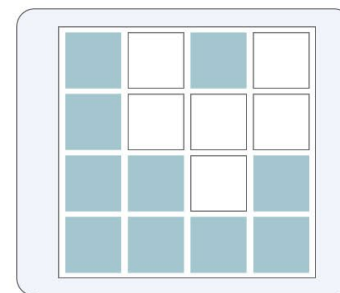
floor



My Extension

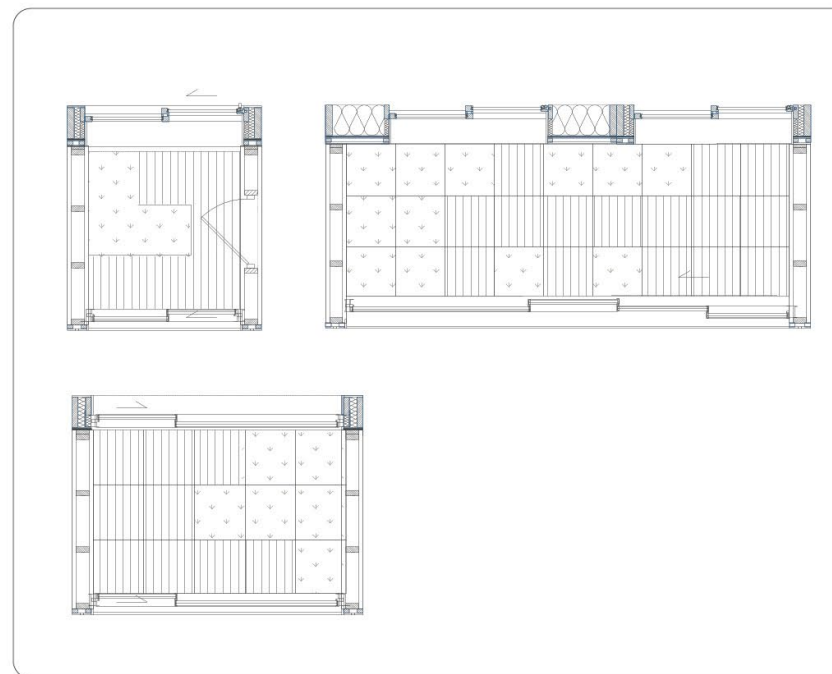


floor



greenery

wood



3m²  green area

50x
80x  plants

3l  per day

x9
45l  pot planters

1.5kg  O₂ per year

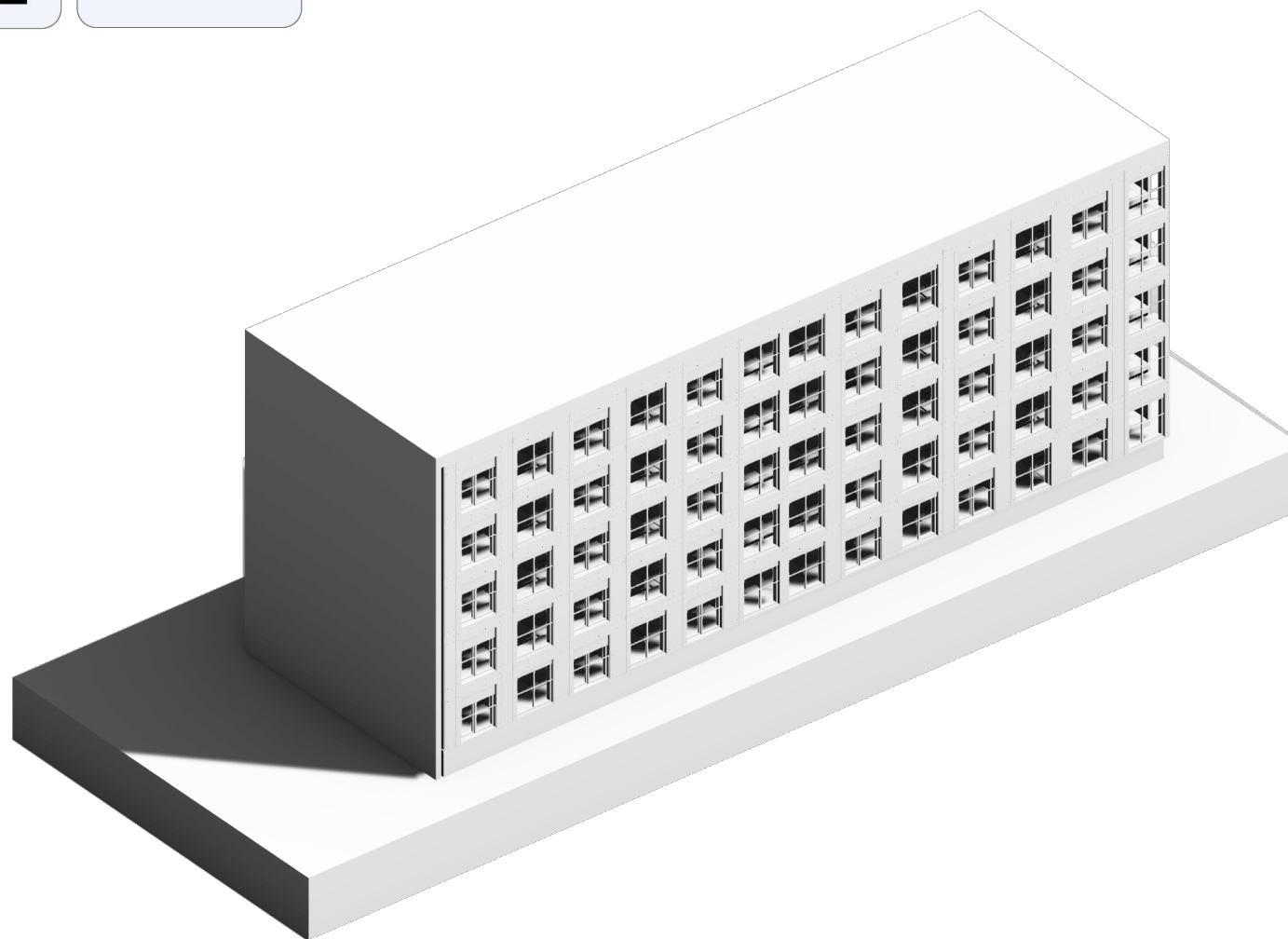
0.6 kWp  capacity



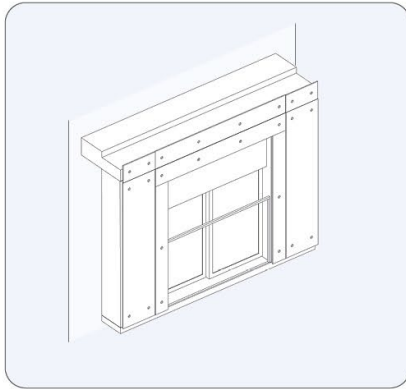


plug
& live

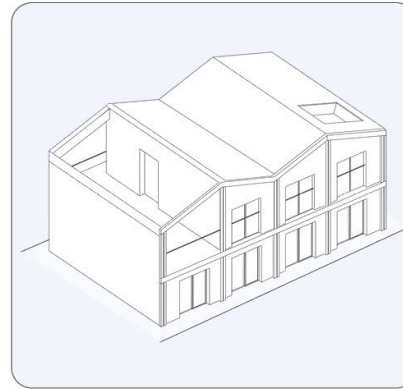
My Extension



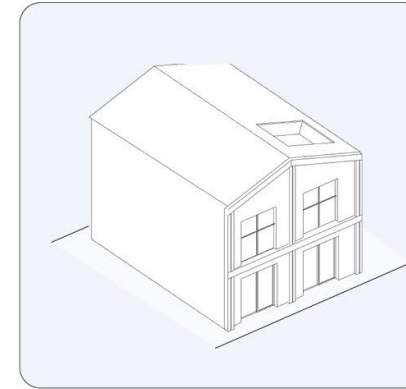
My Facade



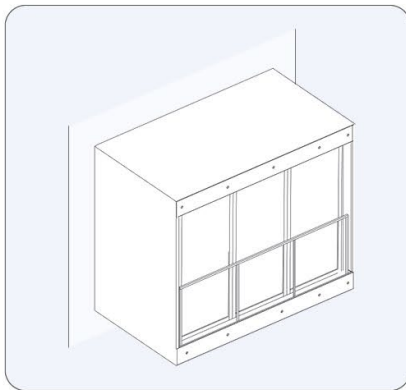
Shared House



Family House



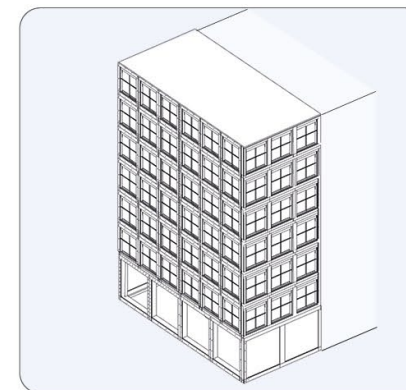
My Extension



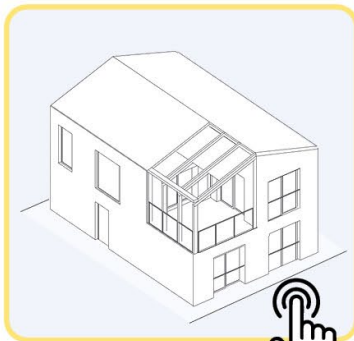
Community Center



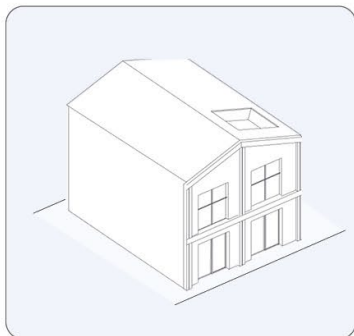
Multi-Space



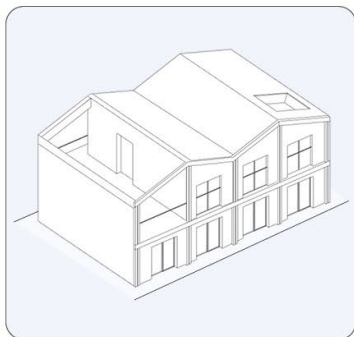
Community Center



Family House



Shared House

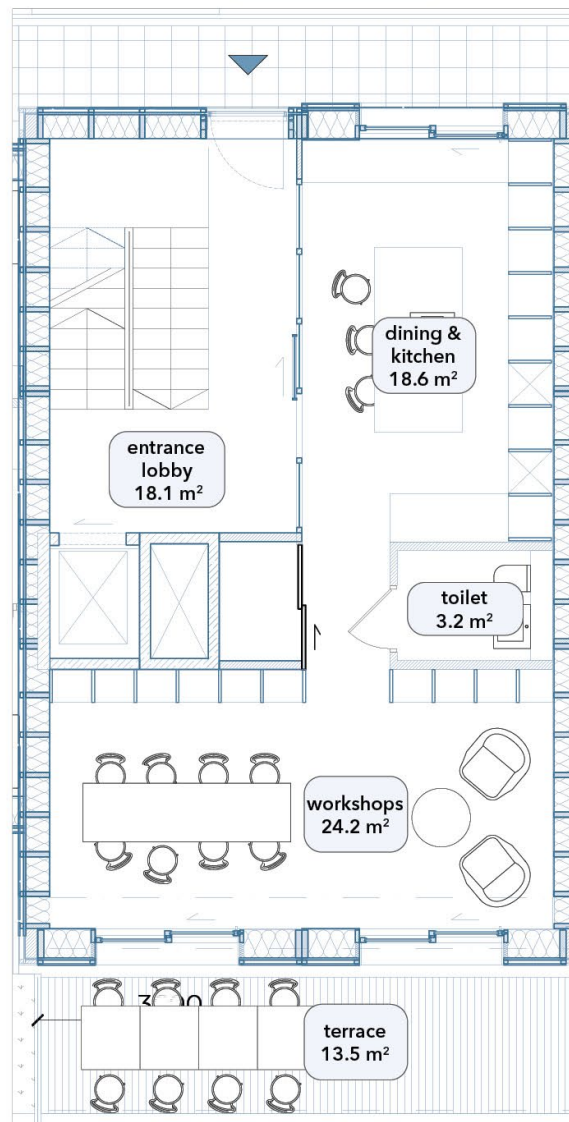


125 m²

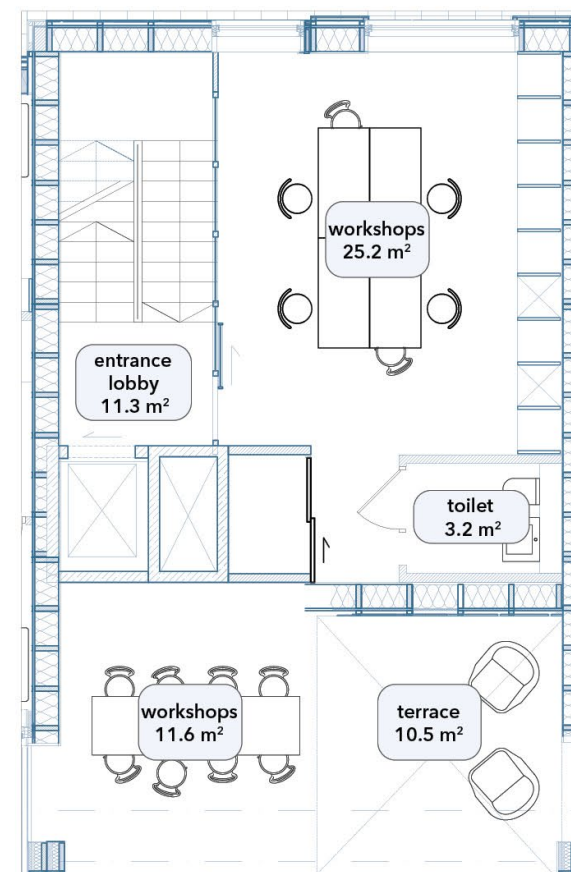


20x

Groundfloor



1st Floor



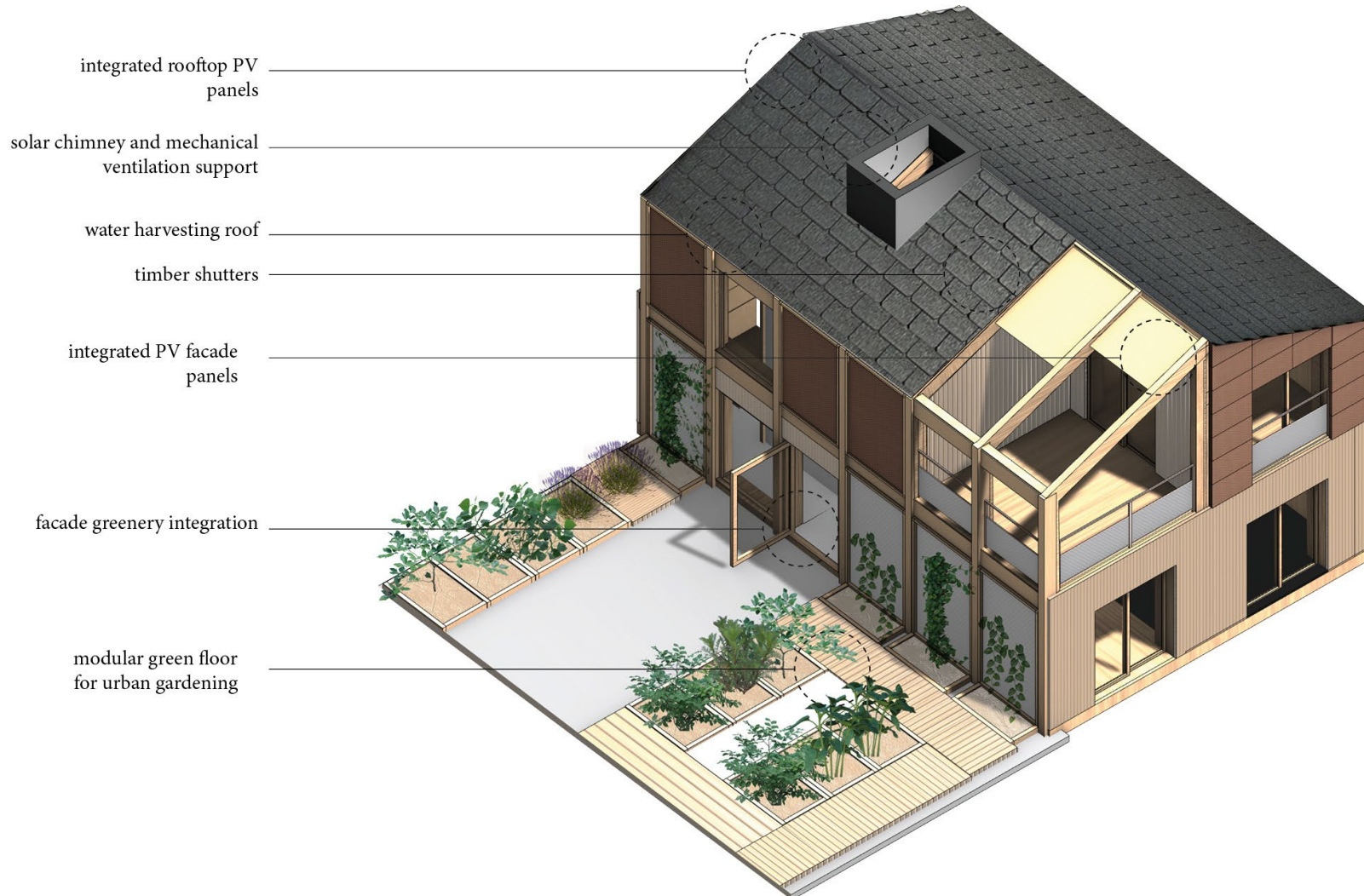
6.2 m²  green

120 l  per day

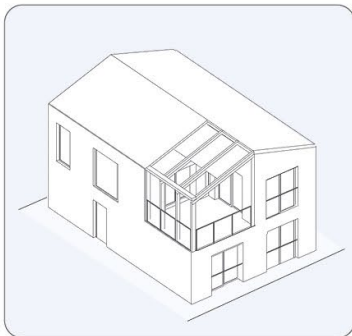
3.1 kg  /year

2.9 kWp  capacity





Community Center



Family House

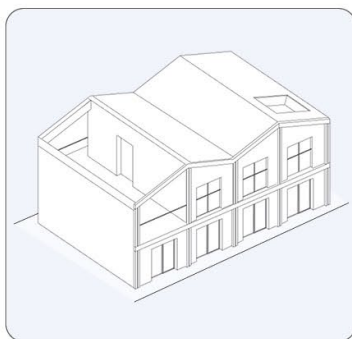


85 m²

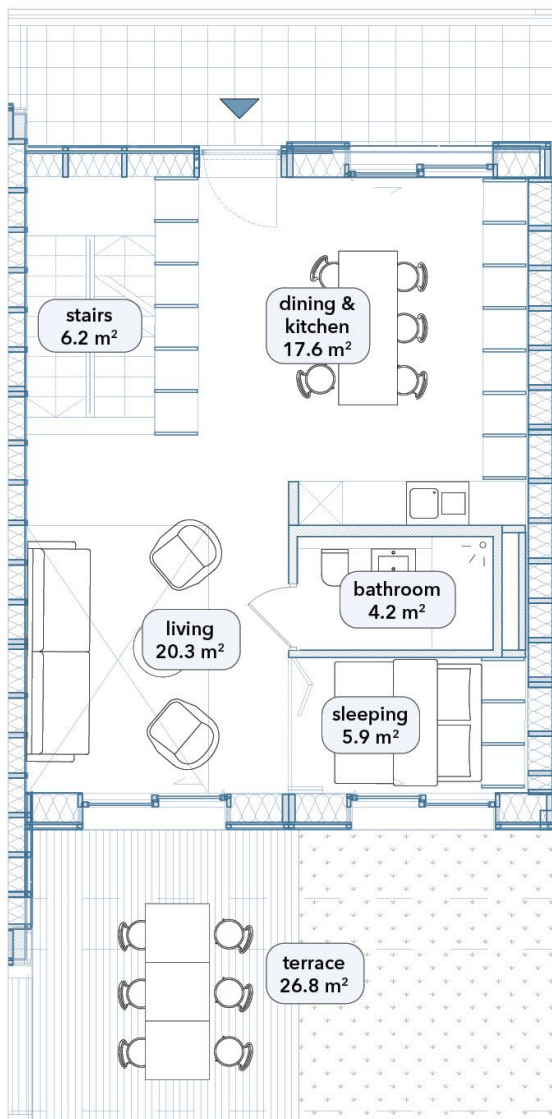


4x

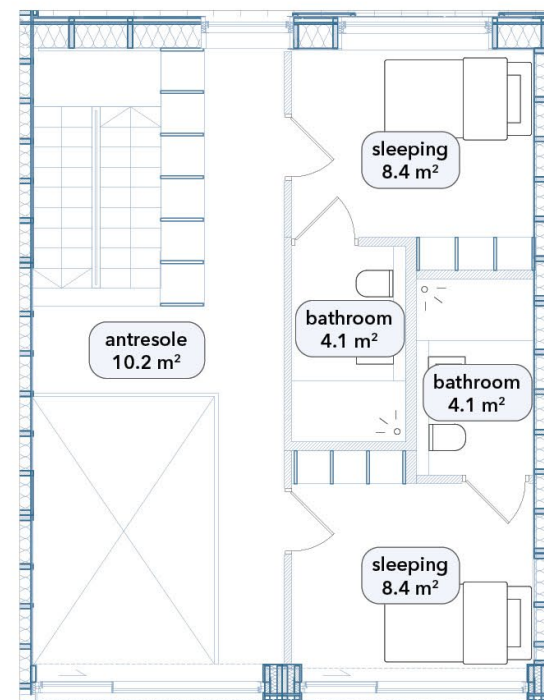
Shared House



Groundfloor



1st Floor



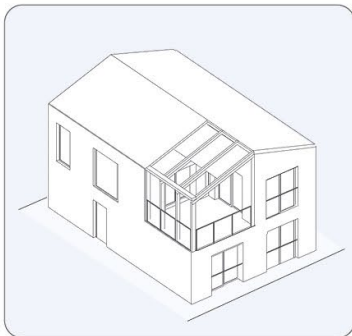
14.9 m²  green

105 l  per day

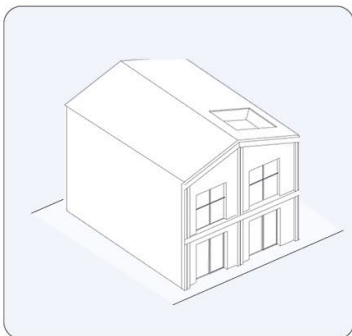
7.5 kg  /year

2.9 kWp  capacity

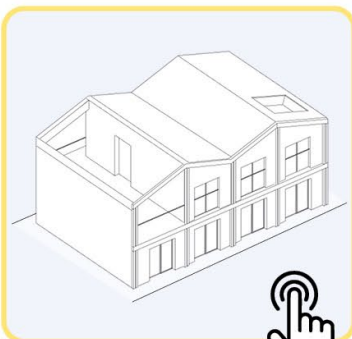
Community Center



Family House



Shared House

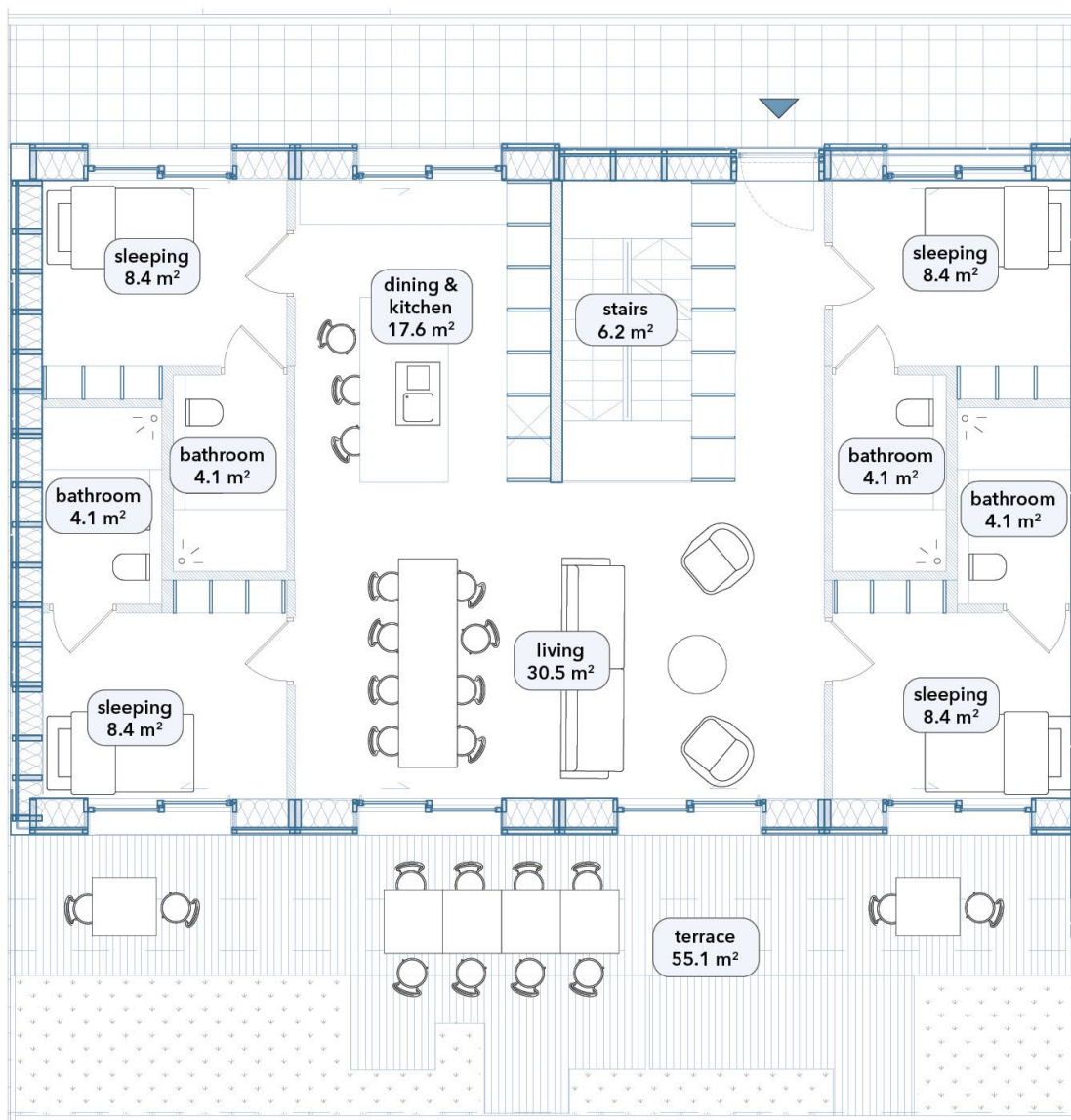


140 m²



8x

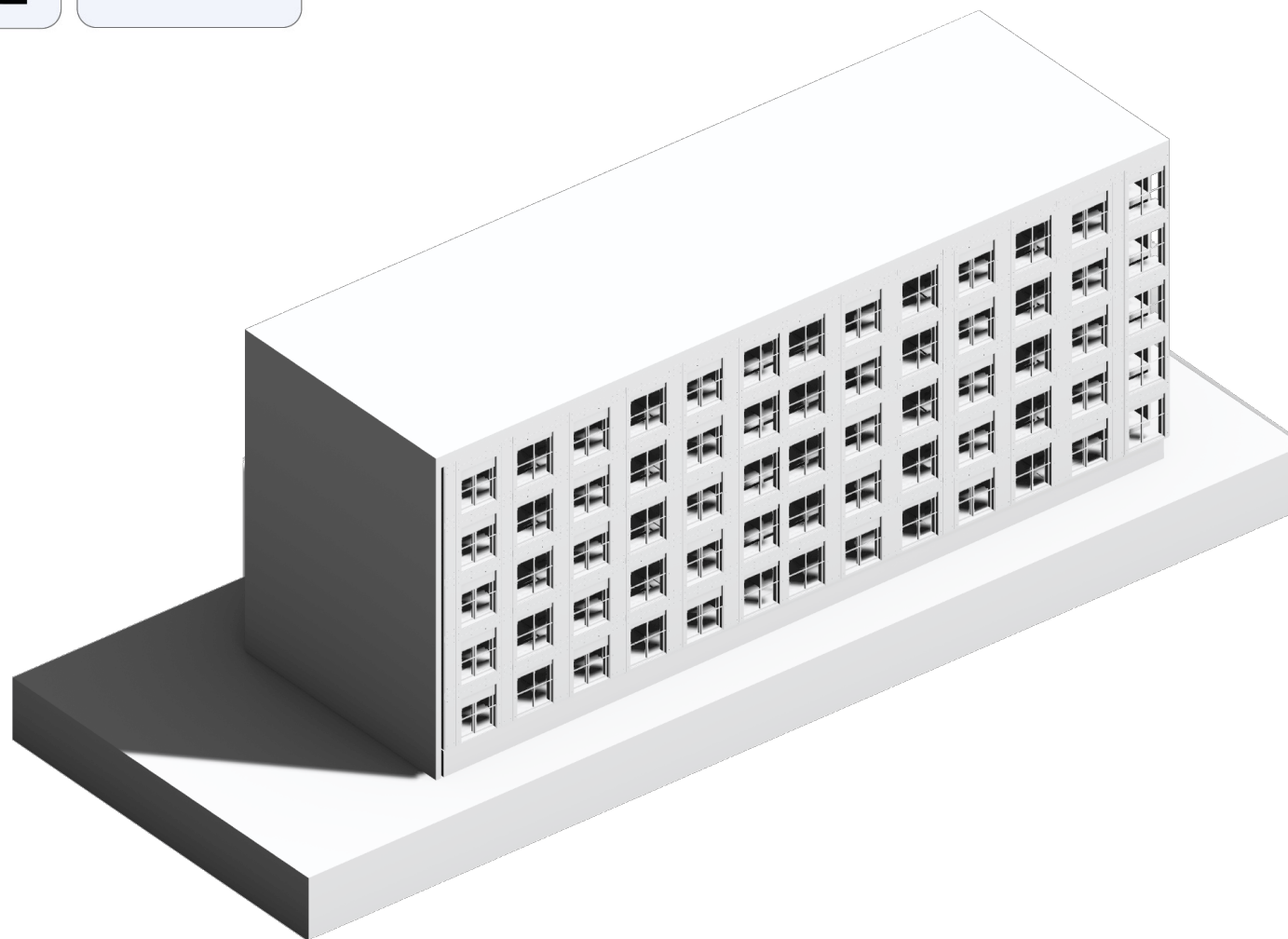
Groundfloor





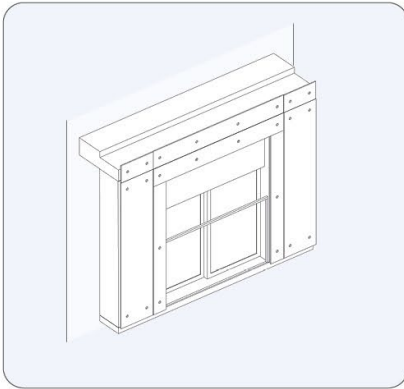
plug
& live

Rooftop House

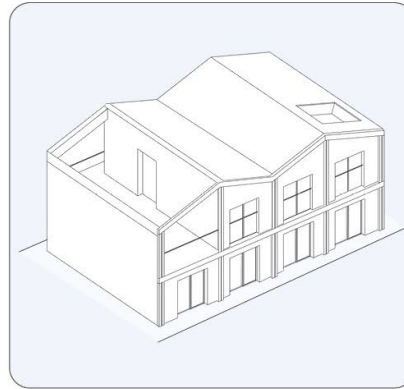




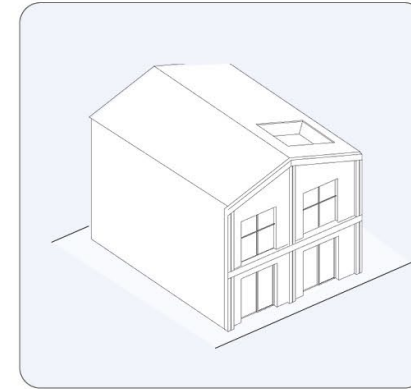
My Facade



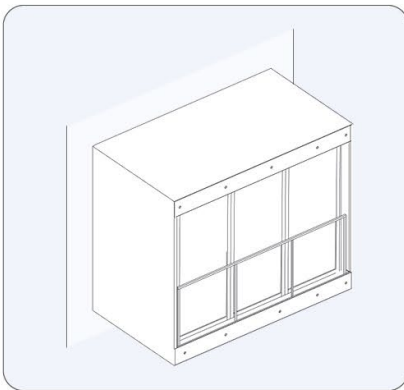
Shared House



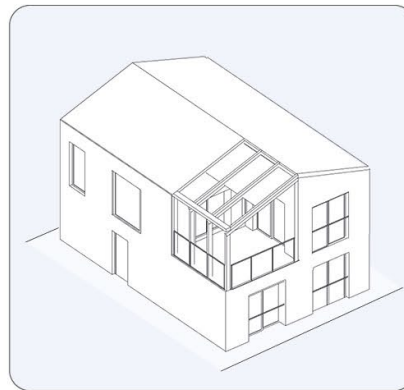
Family House



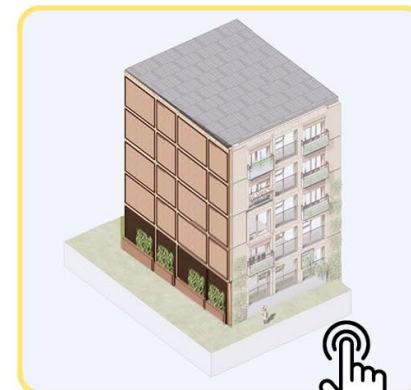
My Extension



Community Center

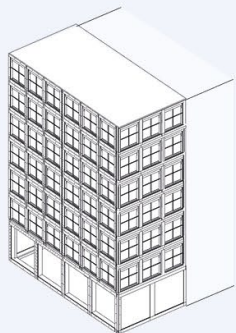


Multi-Space



plug
& live

Multi-Space

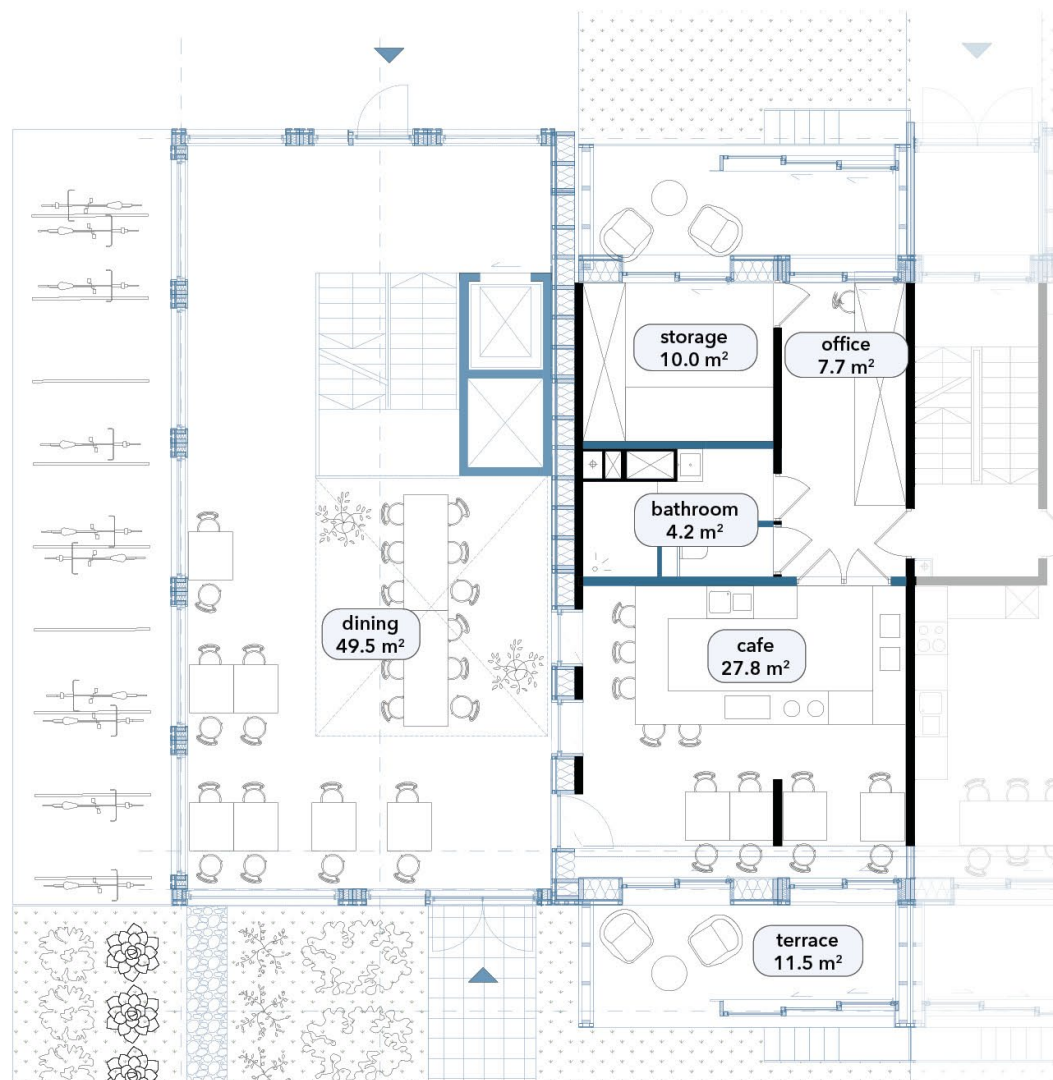


Facade



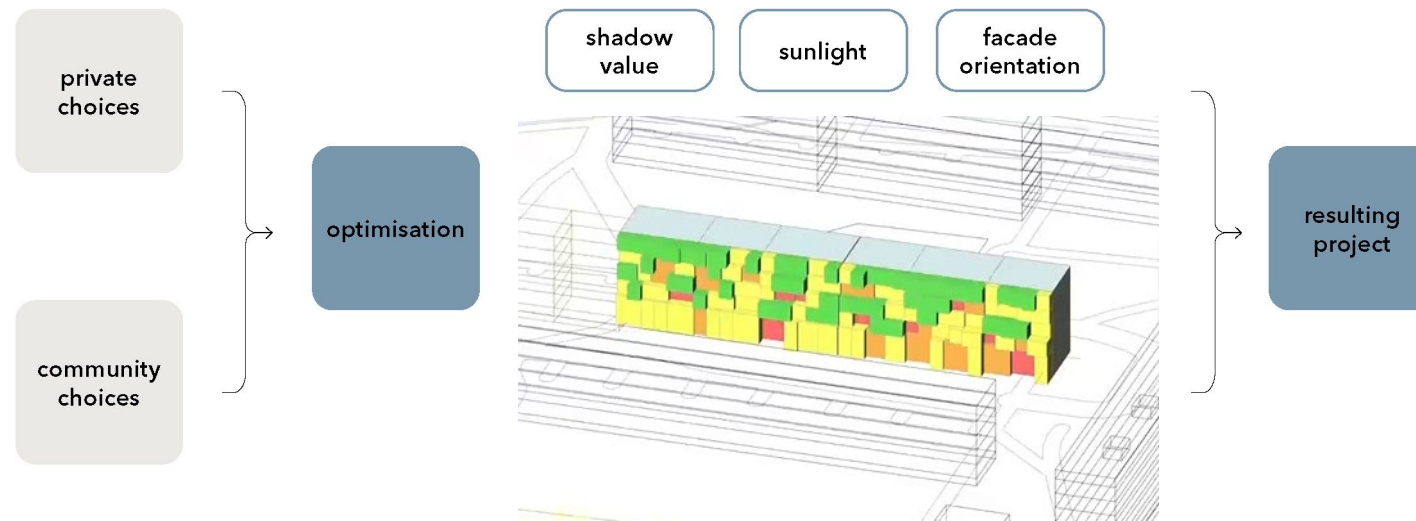
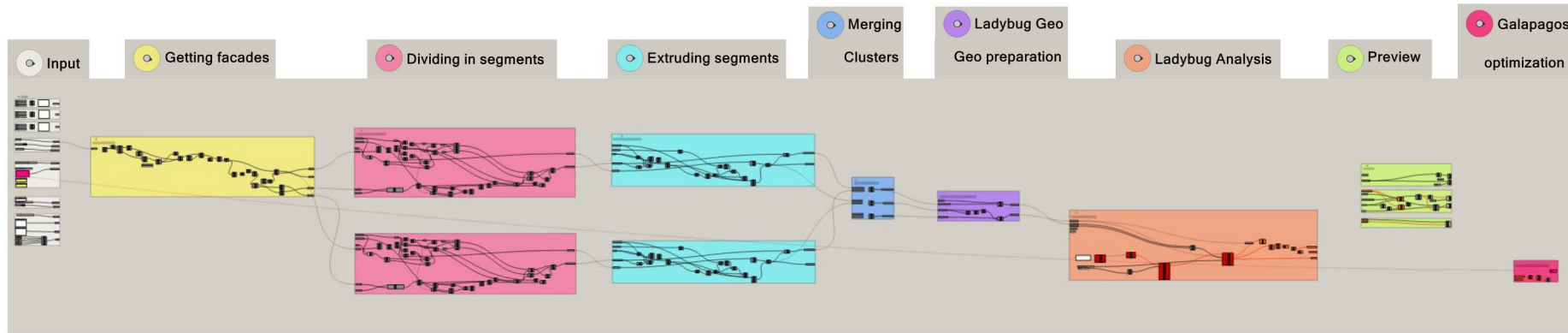
37.2 kWp  capacity

Community Cafe



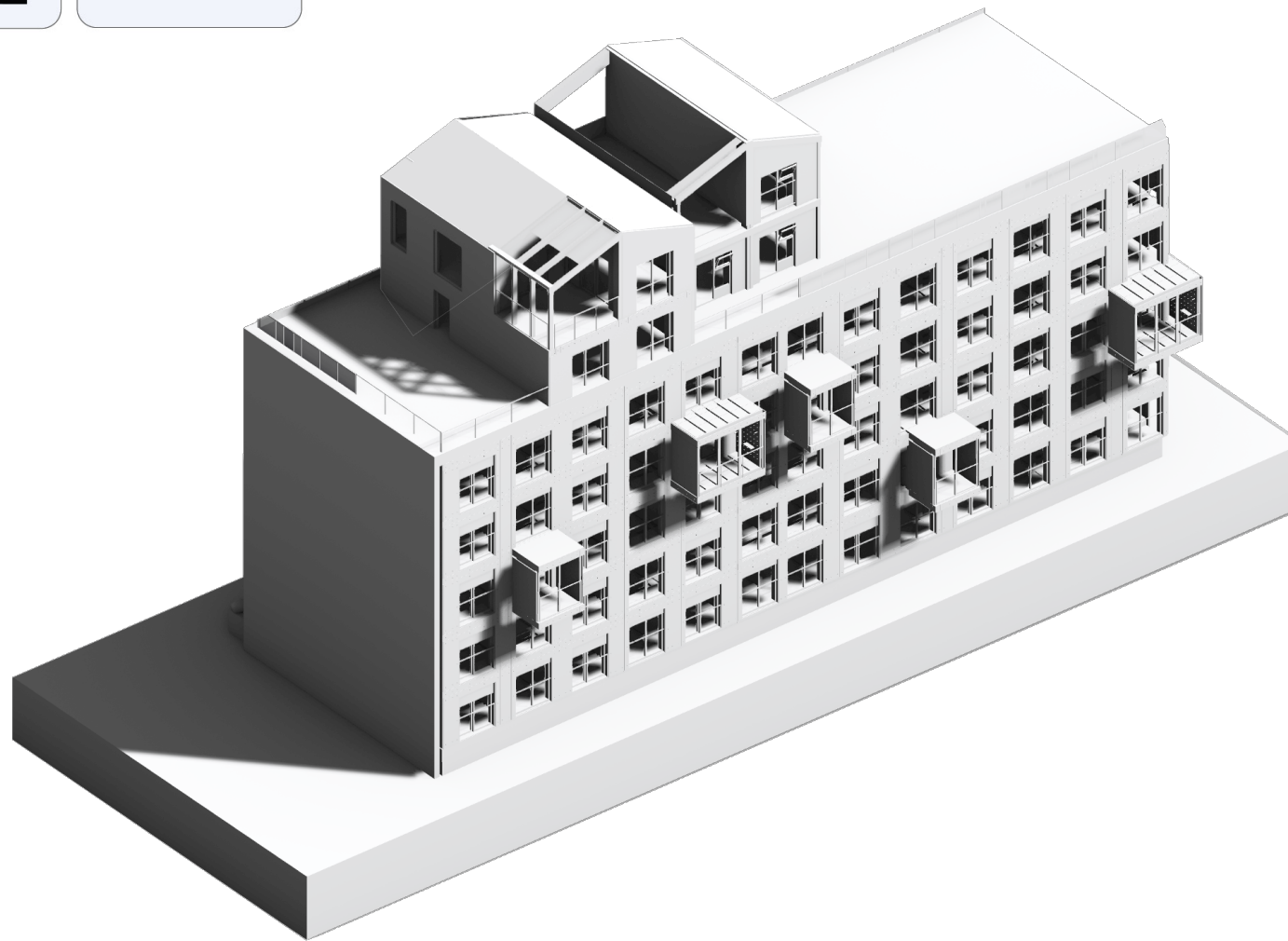


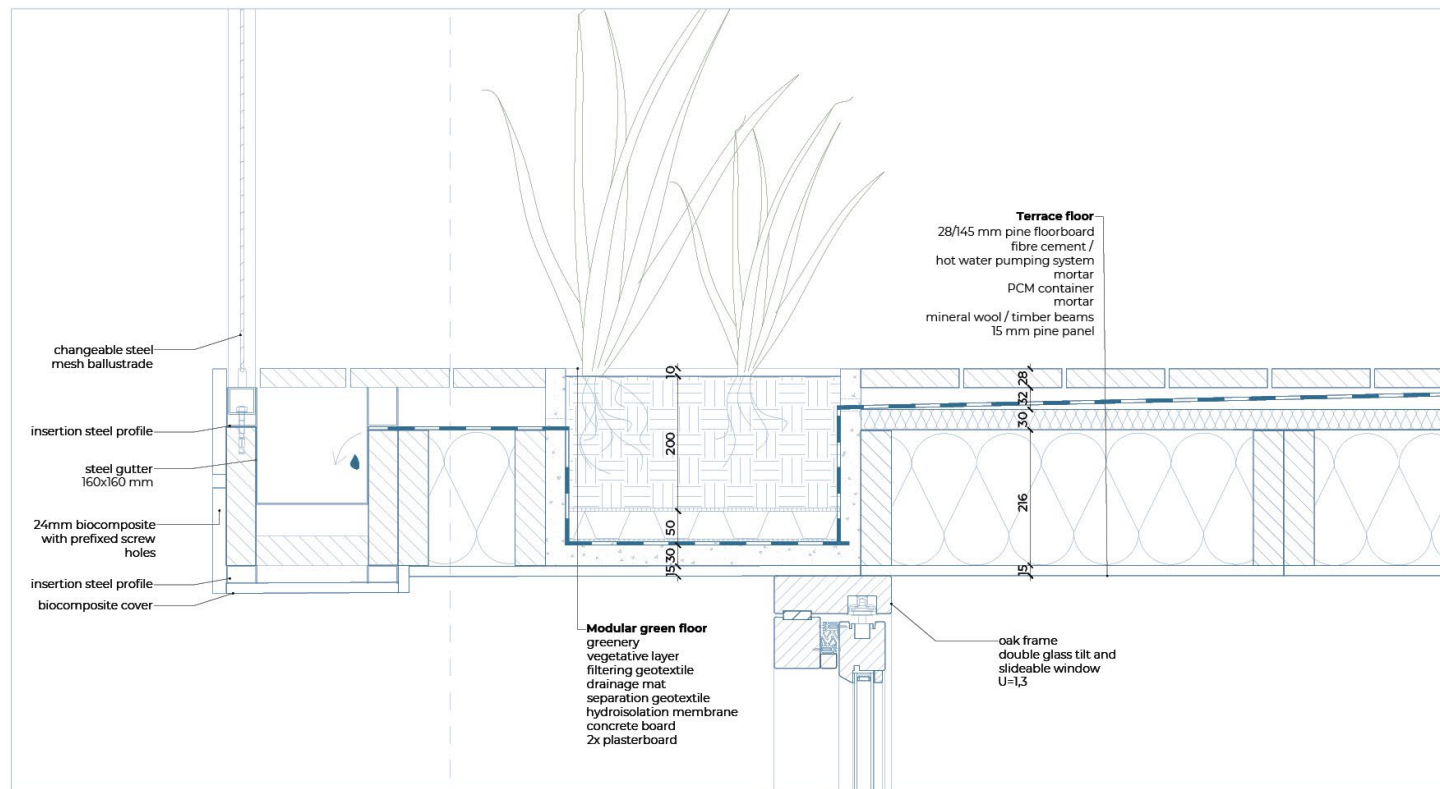
Optimisation script



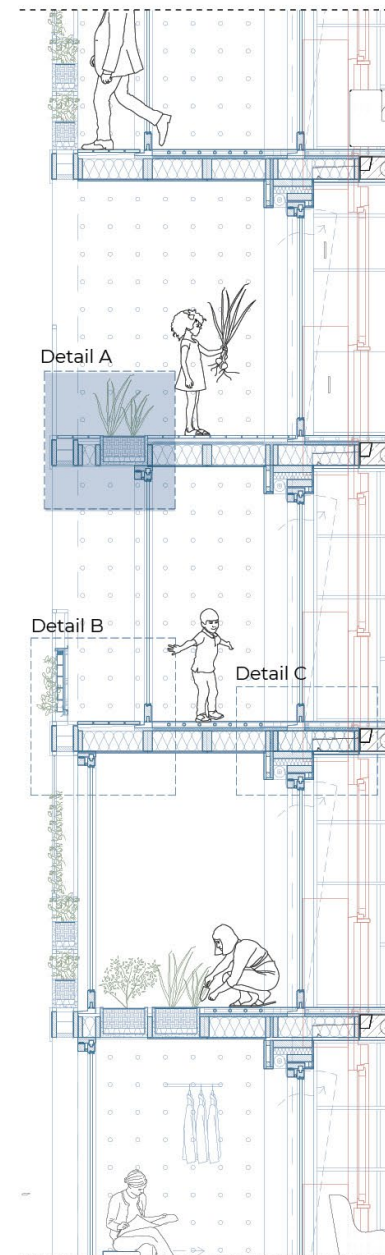
plug
& live

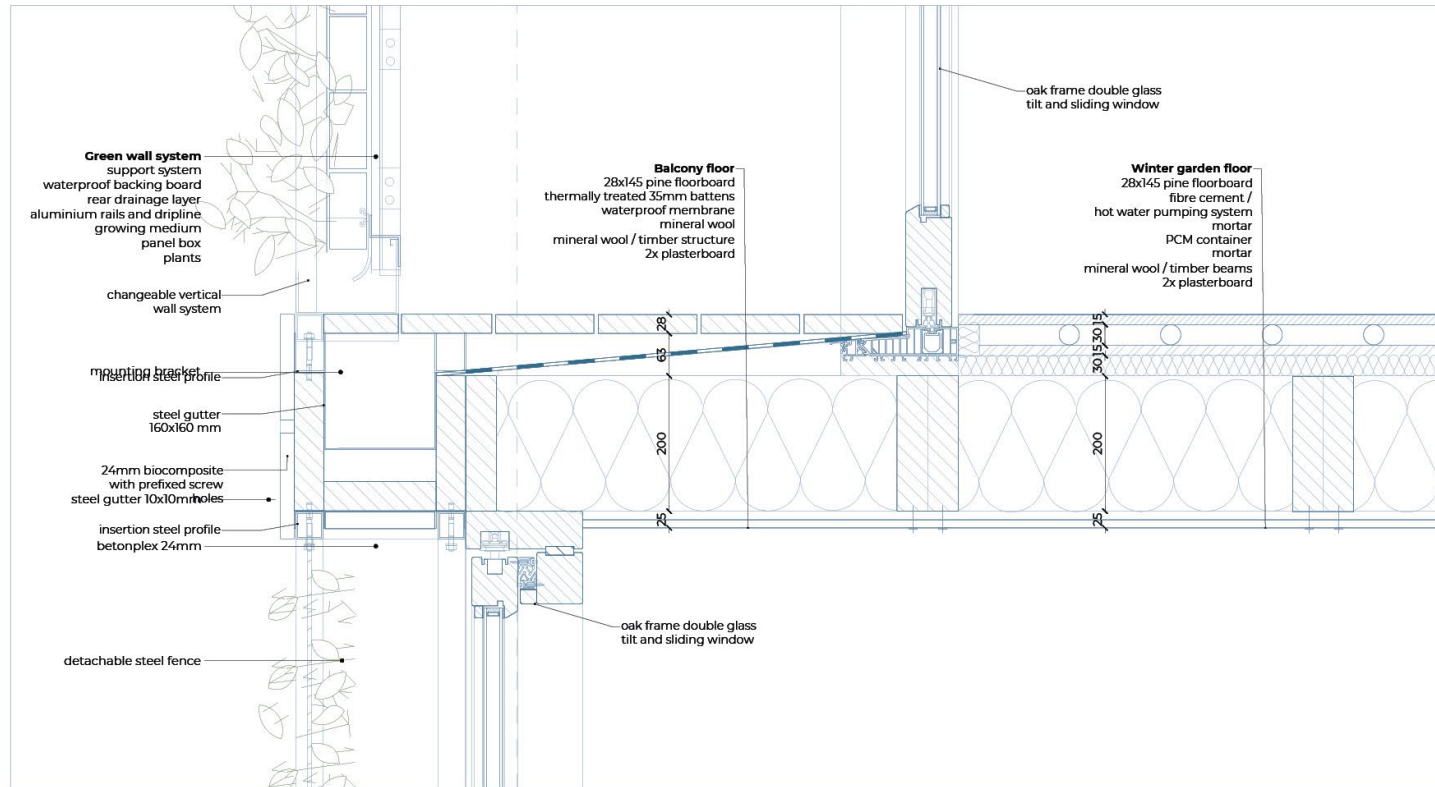
End Project



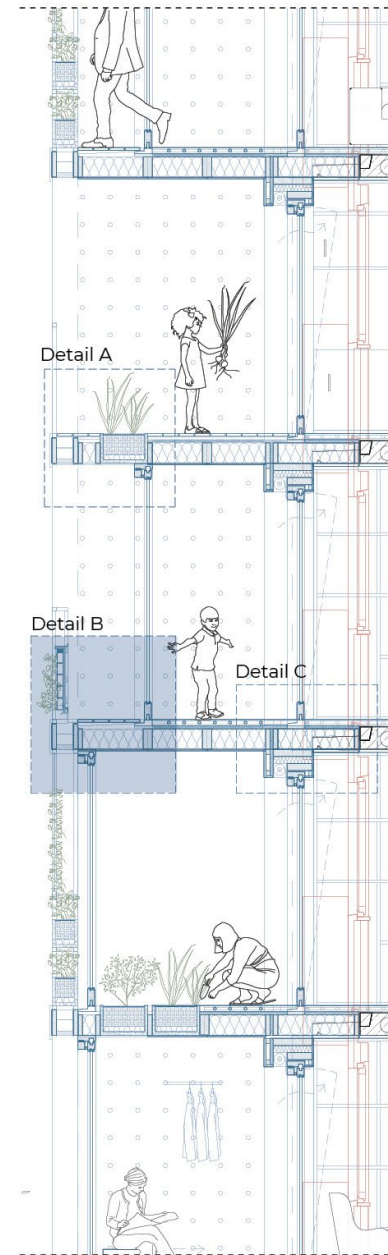


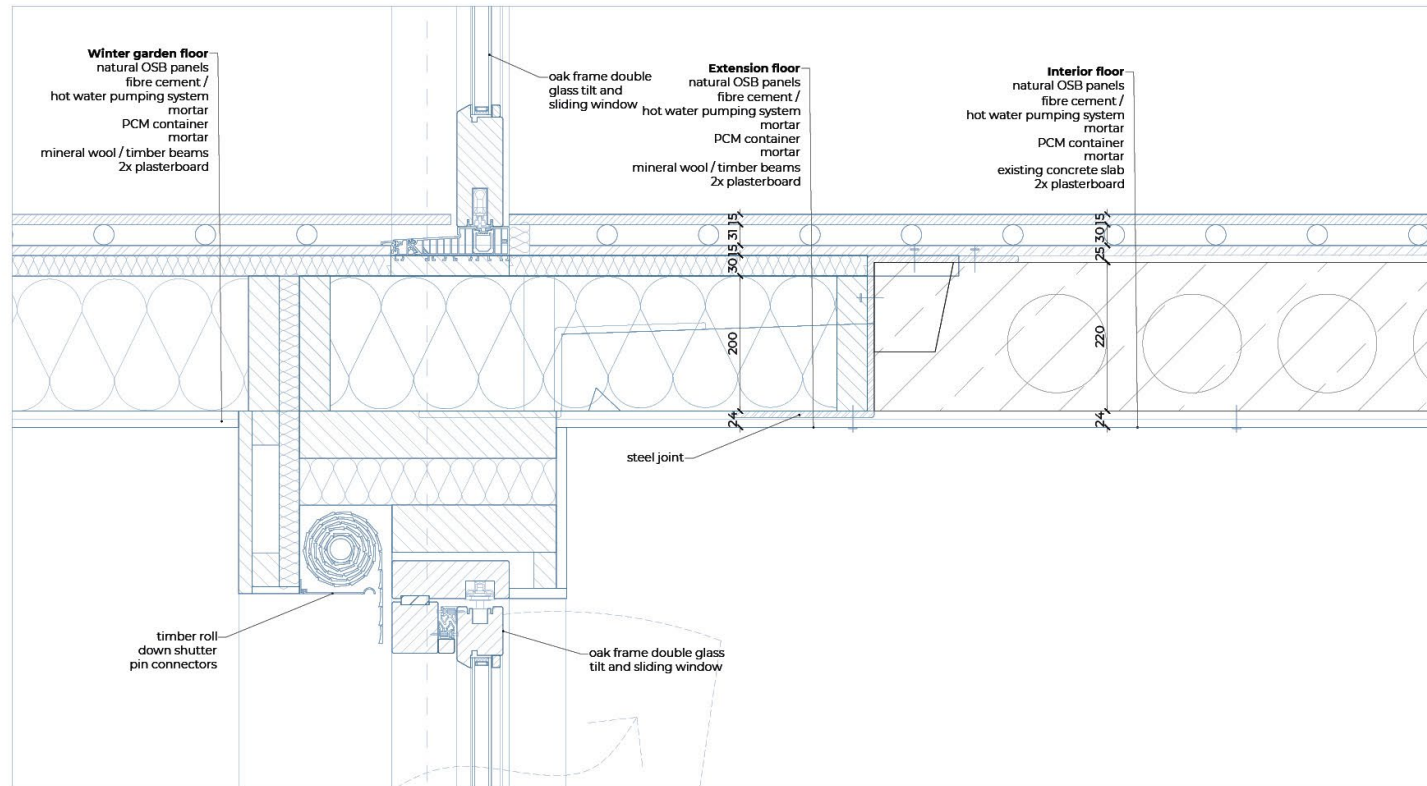
Detail A | extension module terrace to balustrade connection



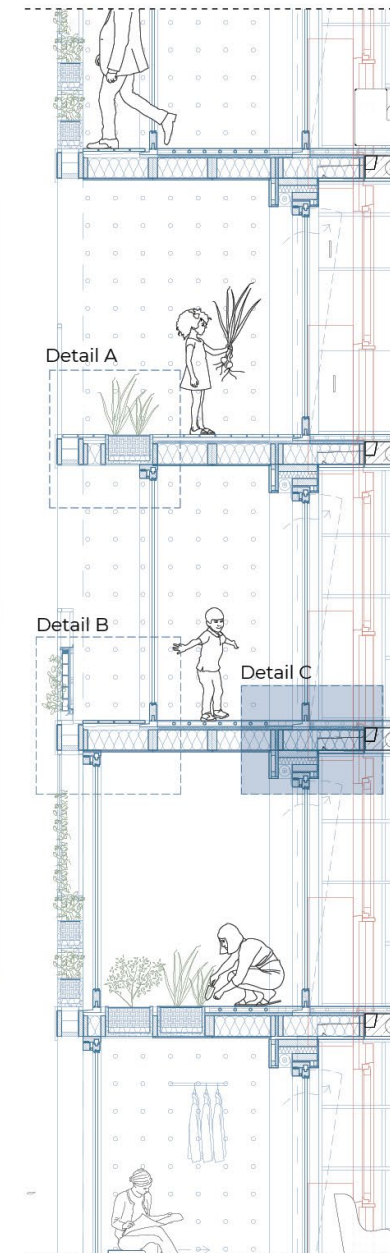


Detail B | extension module floor to wall connection

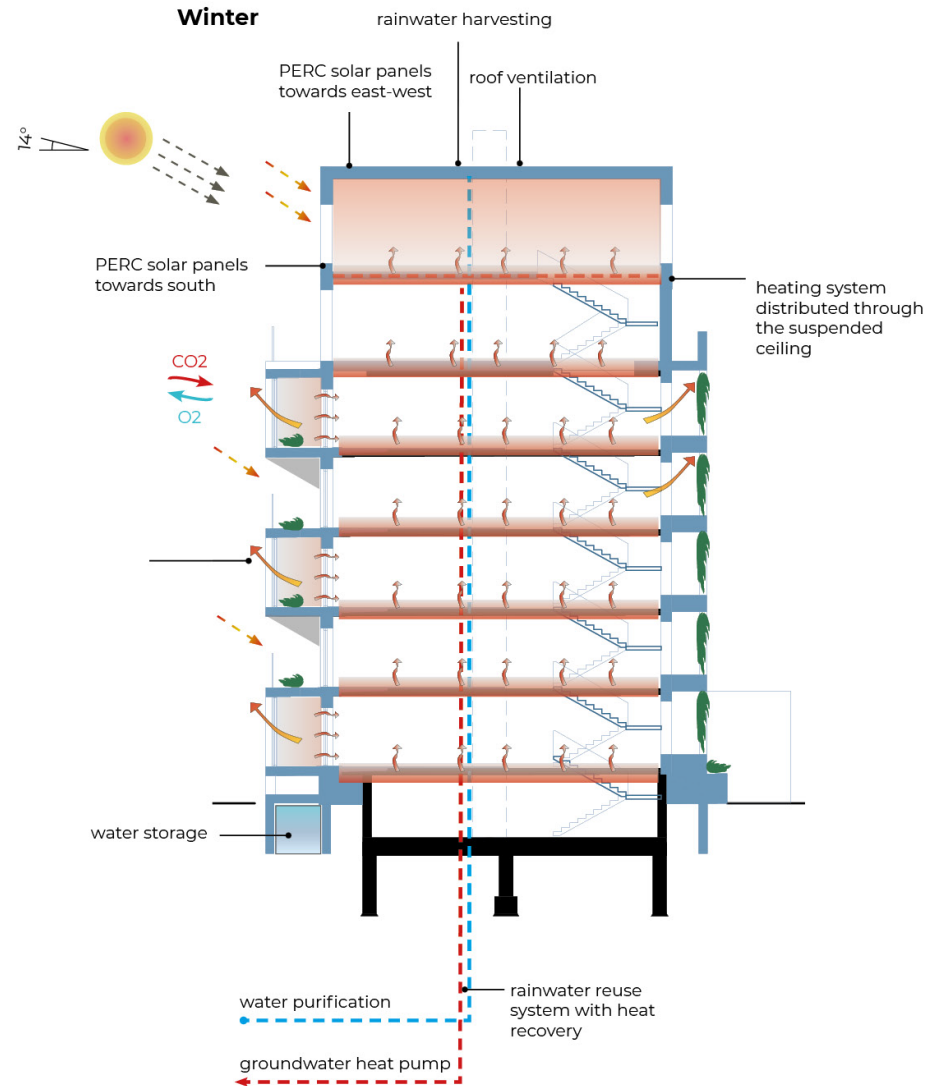
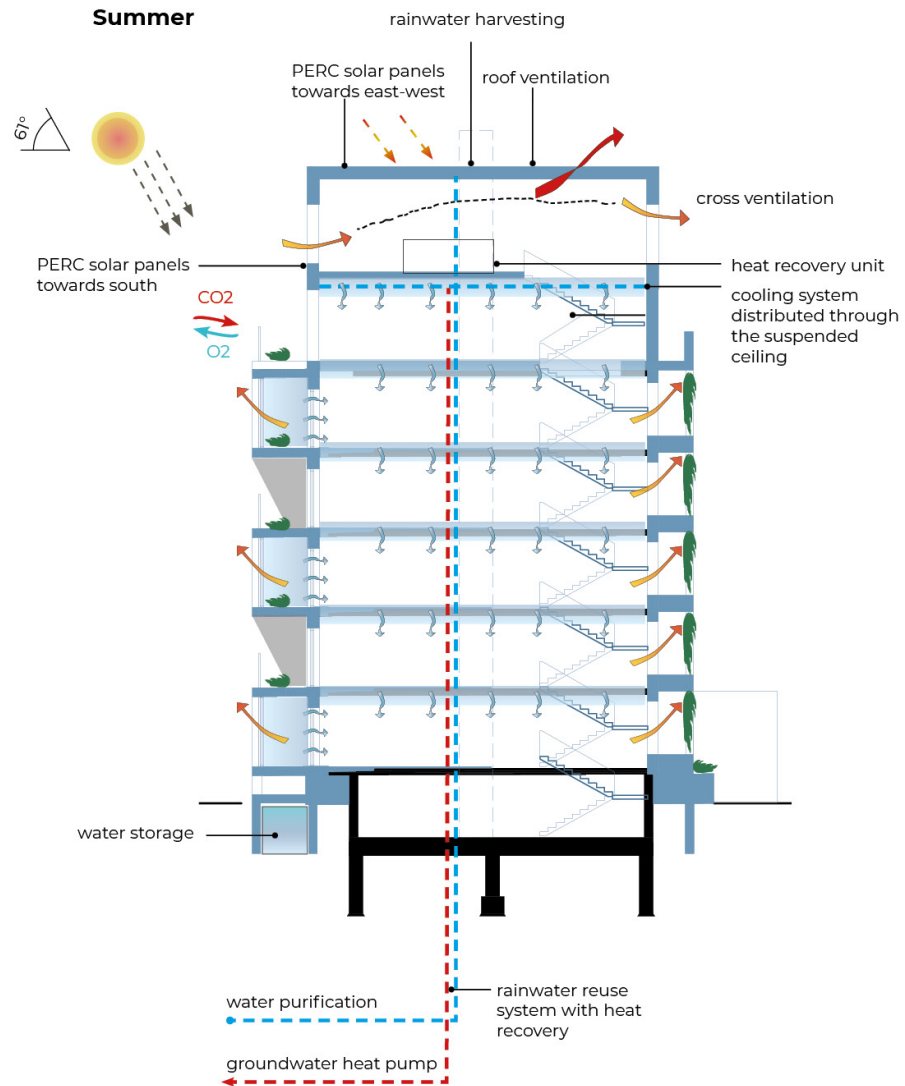




Detail C | new module to existing floor slab connection



Climate scheme



Materials

site-specific

material harvesting

- Disassembled building elements
- facade panels
 - non-structural walls
 - concrete debris

concrete's second life

↓
element's
reuse



concrete
panel

↓
raw material
transformation



cement



aggregates

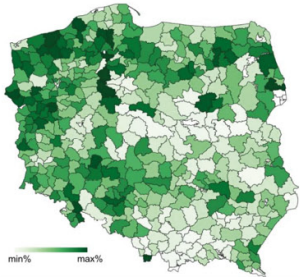
↓
physical
transformation



crushed
concrete

systematic

structural wood



Map of wood production in Poland
(Lasy Państwowe, 2019).

↗ constant increase
in the afforestation

29,4% high percentage
of afforestation



Materials

wood: spruce, pine, larch



CLT



timber

byproducts
↓

insulation



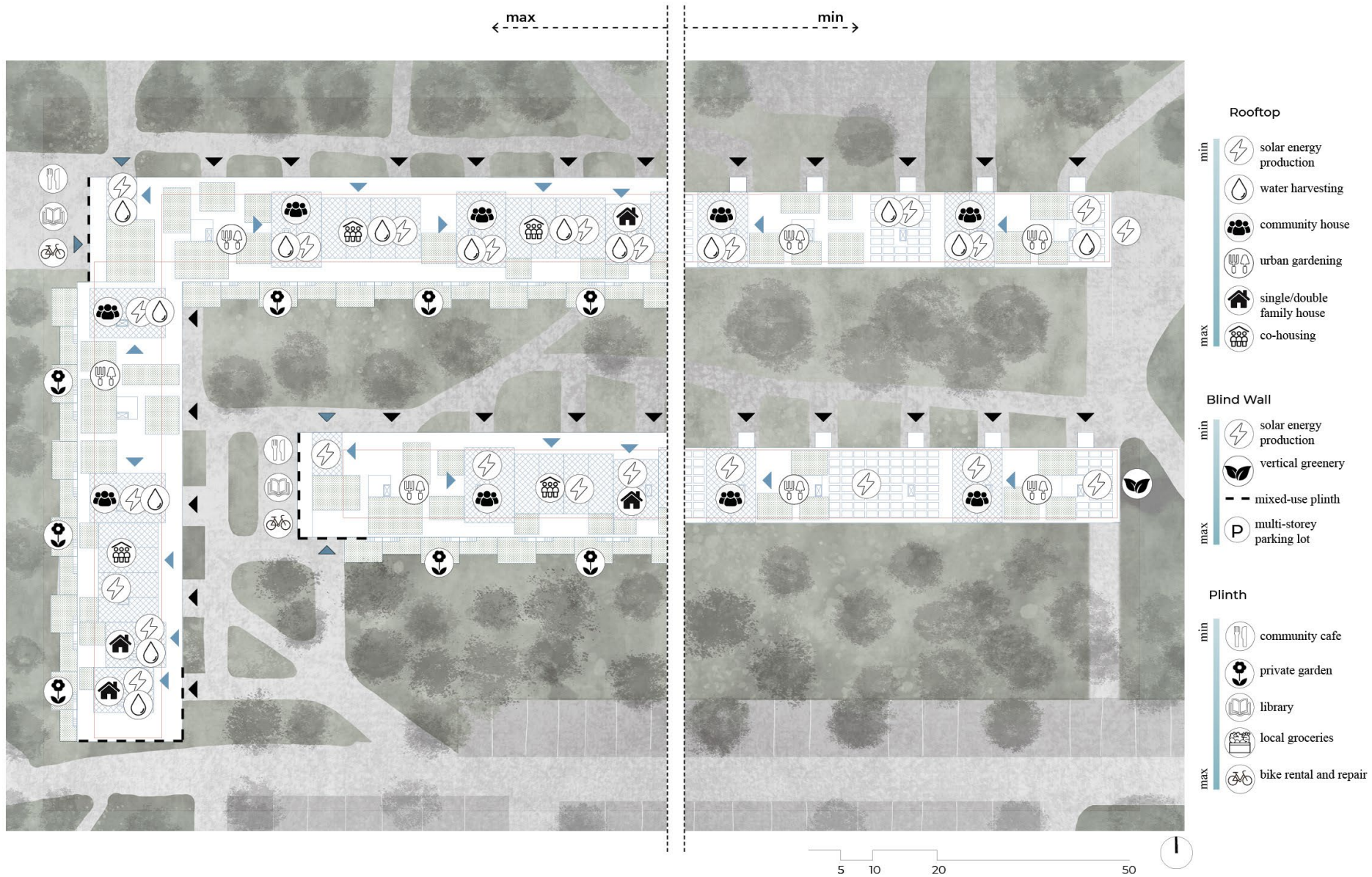
cellulose

finishing

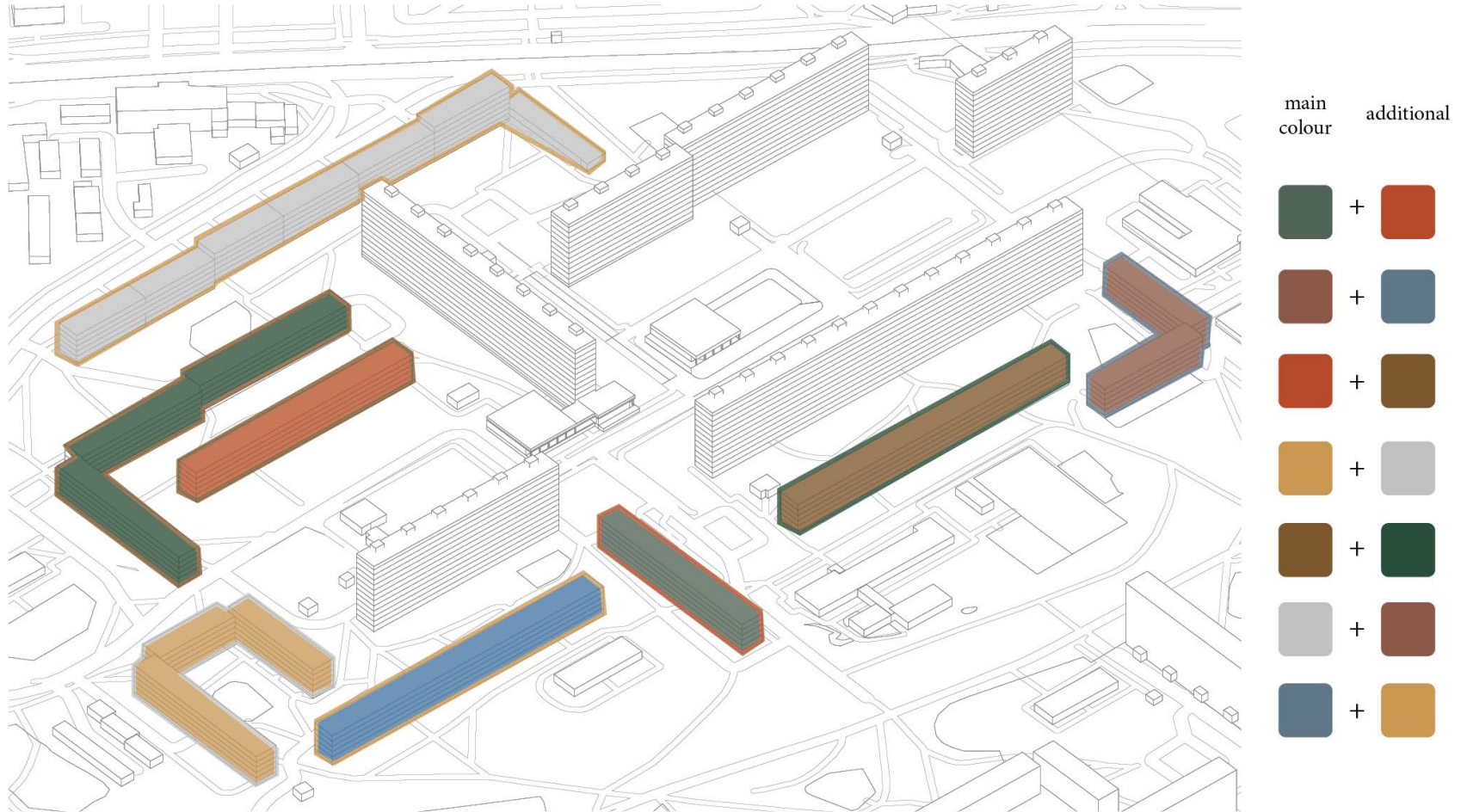


OSB panel

Site plan

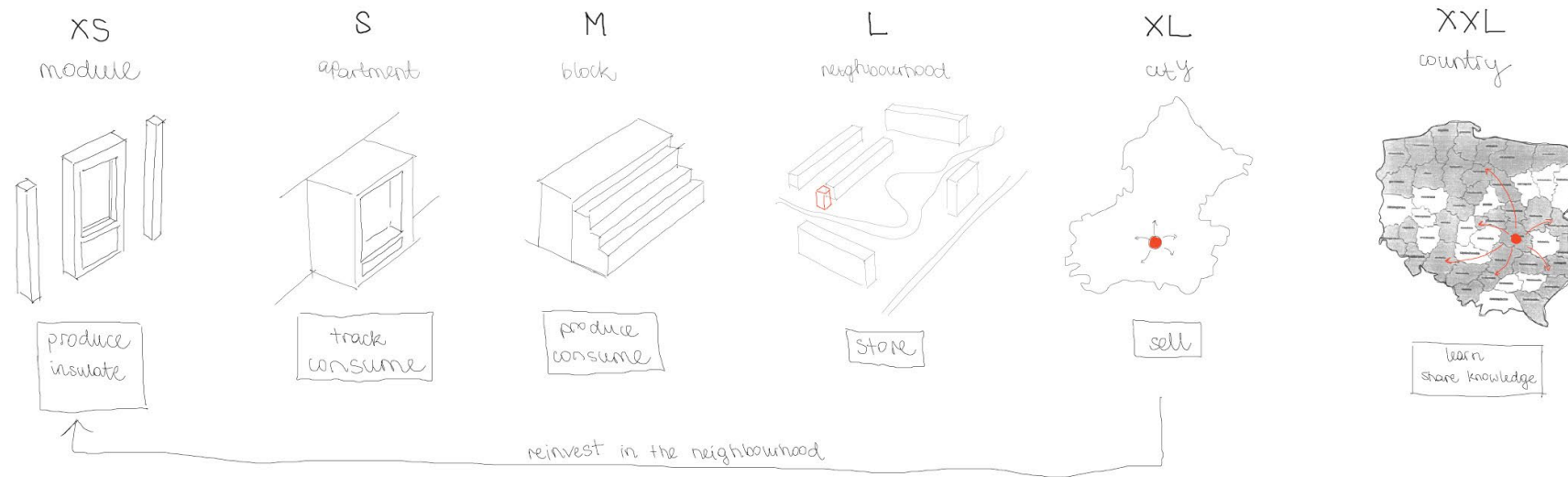


Colour identification



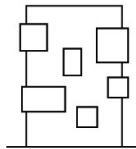


Transferability

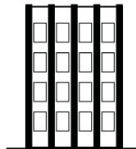


Architectural Identities

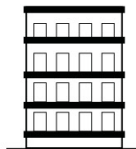
facade composition



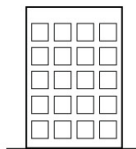
variable



vertical



horizontal



grid

...

shape



rectangular



tilted



rounded

...

material

wood-based

reused materials

glass

...

colour & transparency



...

Relevance



Academic debate



Practice: energy transition








Technology: concrete reuse



Environment: circularity goals

Reflection

Problem statement			
housing crisis in Poland		lack of adaptation strategies	large urban scale
8% is the social housing stock in Poland		 leads to a constant decay in diverse social, economic, visual or technical layers	$\frac{1}{3}$  of the Polish population lives in the Large Panel concrete system blocks
Objective			
 programme housing + mix-use	 context Ustronie estate in Radom, Poland	 technology adaptive reuse by modular architecture	
Overall design question		Thematic research question	
DQ How to adapt the Polish Large Panel Concrete System Housing to increase the living diversity with modular, demountable architecture?		RQ What are the possible future-proof adaptation methods for the Polish W-70 Large Panel concrete system residential buildings?	
Sub-questions		Methods	
1) Analytical	Which adaptation methods were used for the future-proof revitalisation of the estates built between 1960-1980 in Europe?	methodology	
		case studies	sources secondary literature media
2) Technological	What are the limitations and possibilities of the W-70 building system?	W-70 system study	primary site visit photography
			secondary literature media



How to adapt the Polish Large Panel concrete system housing to increase the living diversity with modular architecture?



**plug
& live**

**Thank you for
your attention!**

P5 Architectural Engineering

TU Delft, January 2024

Marta Zapašnik (5609615)