

Wederopbouw 2.0



Densifying and revitalizing post war neighborhoods with **Biobased top-ups**

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Problem statement | **Housing shortage**



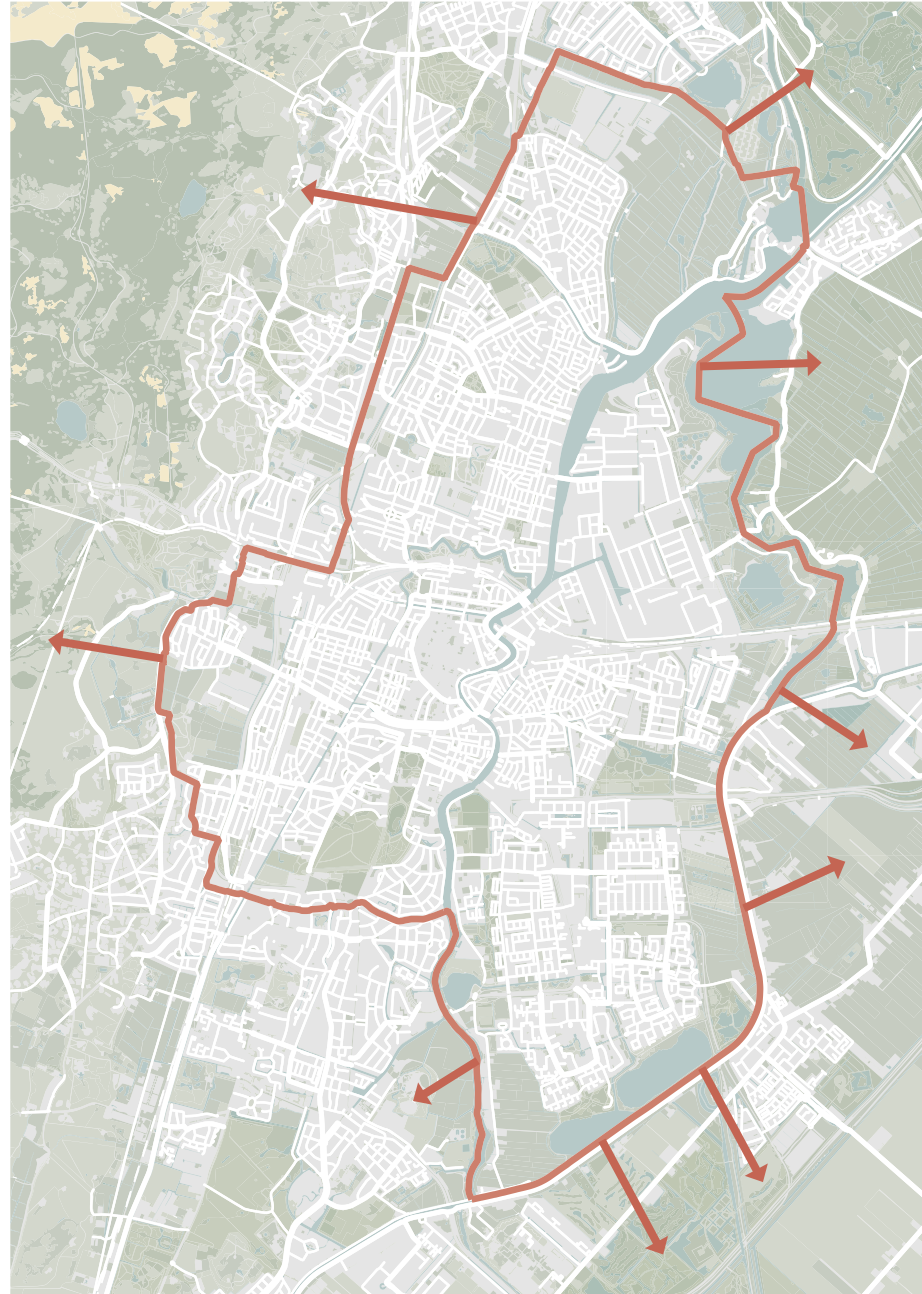
Housing shortage of 390.000 houses in the Netherlands (NOS, 2023)

Problem statement | **Housing shortage**



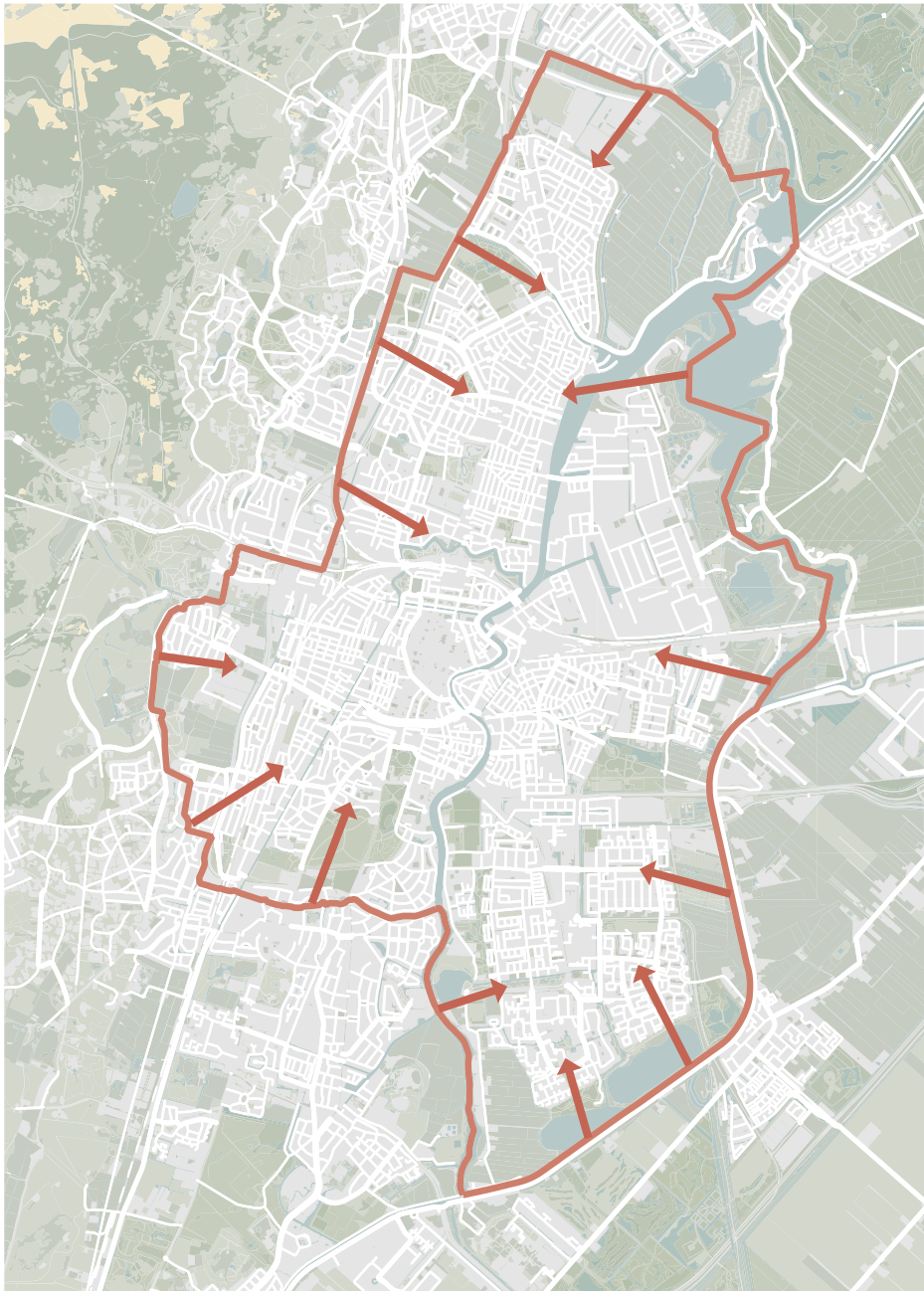
By 2050 2 million new houses should be build
while 7 million houses should make sustainable
improvements (Cobouw, 2021)

Problem statement | **Housing shortage**



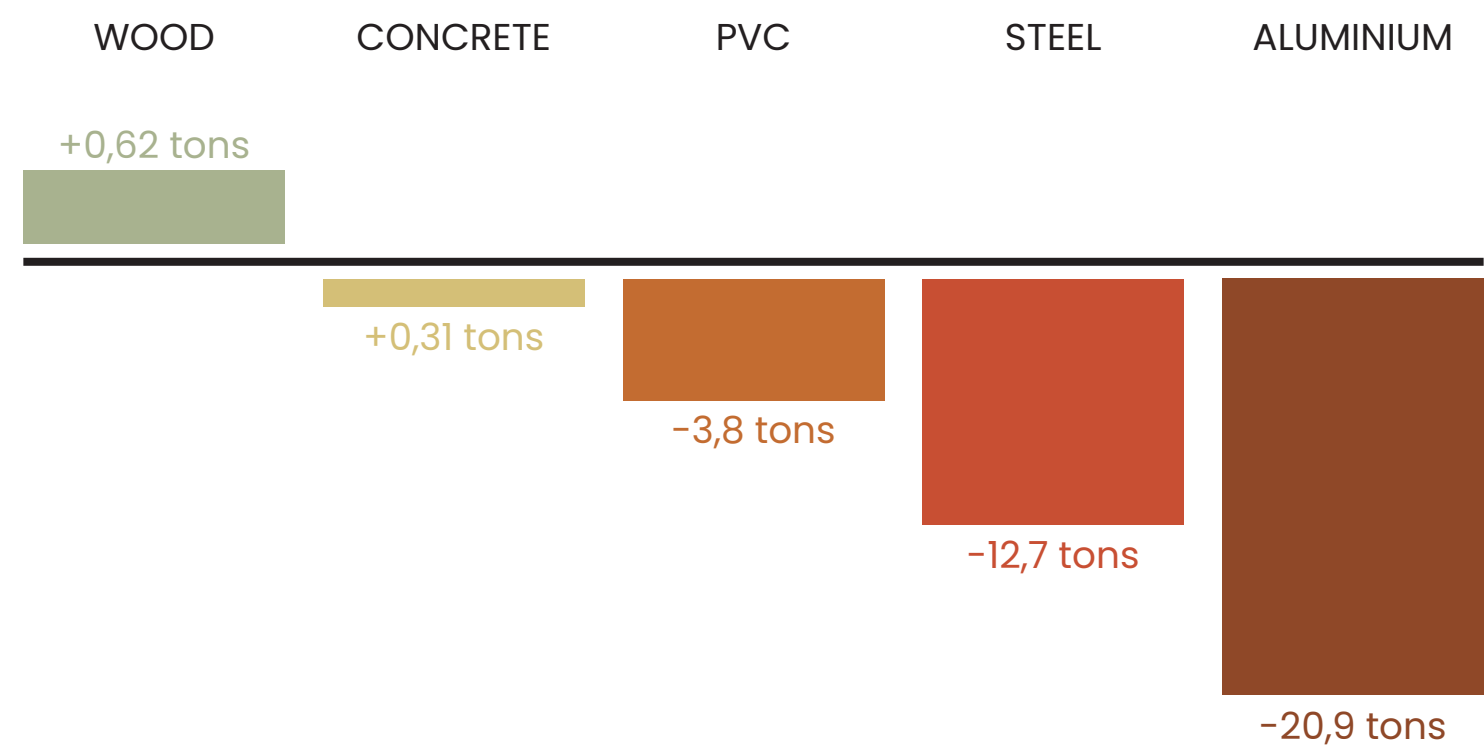
Expanding cities comes at the expense of the surrounding nature, inefficient new infrastructure and facilities

Problem statement | **Housing shortage**



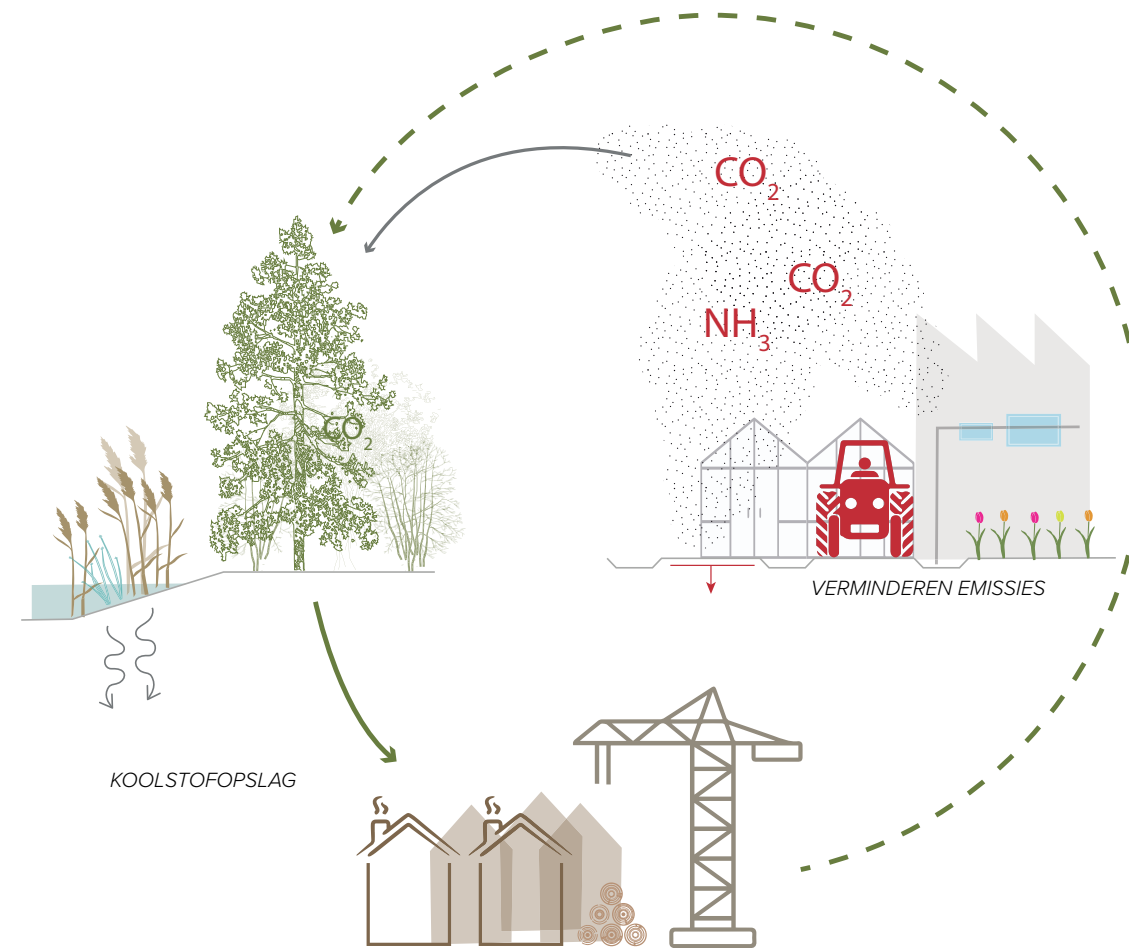
More efficient is to look for space in the city to densify

Problem statement | **Material use**



Current construction practices are responsible for 40% of global CO2 emissions, with 11% attributed to material use (Cityforster, 2022)

Problem statement | **Material use**



Biobased materials made from biological and renewable, store CO_2 , lightweight, healthy living environment, sustainable processes, recyclable

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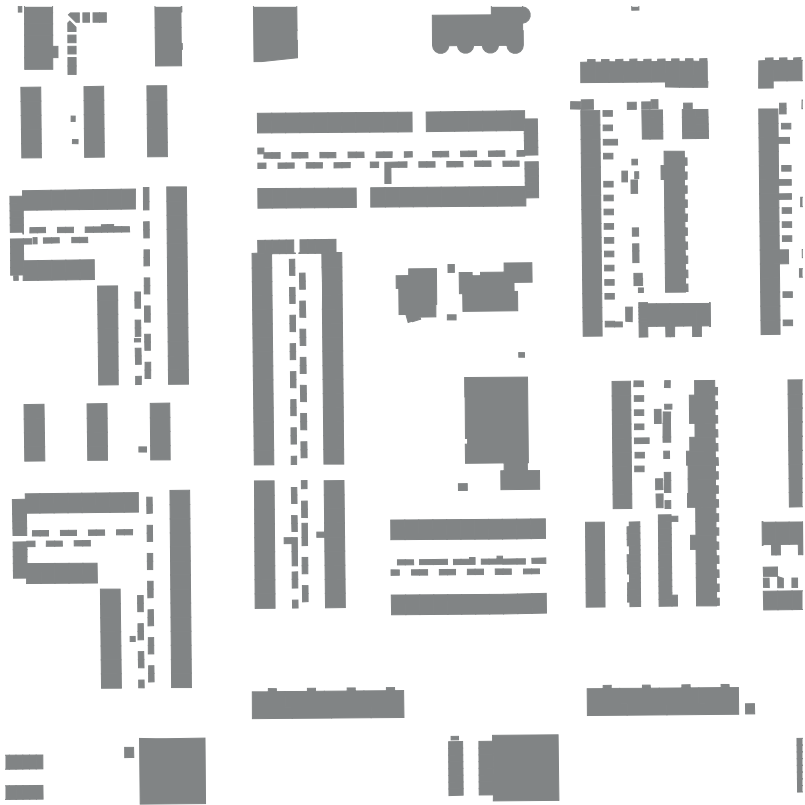
Context | **Post-war neighborhood**



Oude stad, Haarlem
9.100 residents per km2



Kloverpark, Haarlem
7.900 residents per km2



Boerhaavewijk, Haarlem
3.700 residents per km2

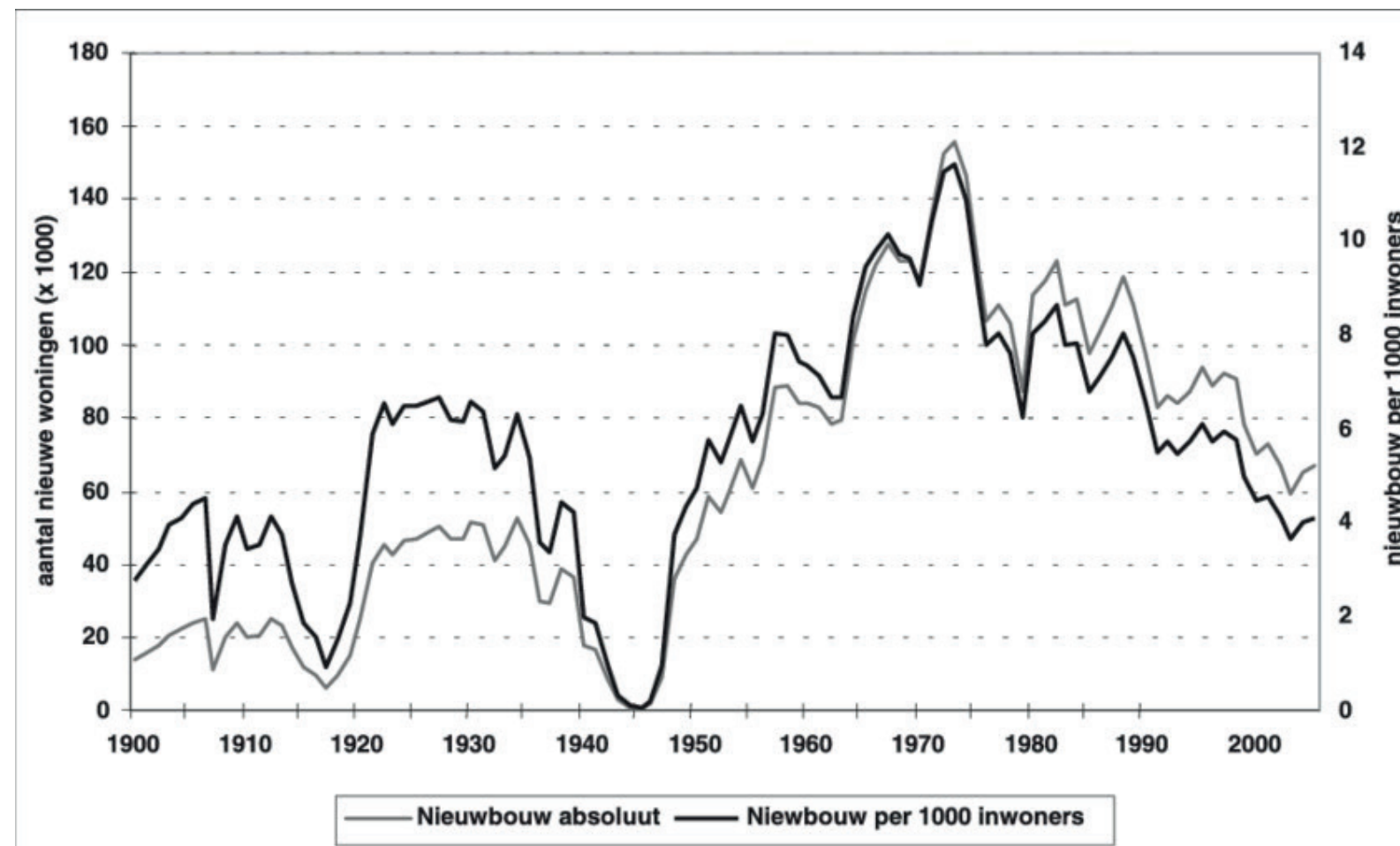
The Post-war neighborhoods that have very low density

Context | **Post-war neighborhood**



These are often neighborhoods at the bottom of the housing market hierarchy, often with social problems, not meeting the modern energy and living standards (NRC, 2023)

Context | Post-war neighborhood



35% of the housing stock in the Netherlands comes from the period after the Second World War (CBS, 2018)

Context | **Post-war neighborhood**



Better living conditions after the second world war, more light, air and space, filled with greenery for children to play.

Context | **Boerhaavewijk**



The location, spacious layout of the neighborhood creates an imbalance between architecture and urban planning.

Context | **Boerhaavewijk**



There are hard transitions between private and public space, due to closed facades and fences, creating unused public spaces with no social control

Context | **Boerhaavewijk**



These hard transitions, together with the flat facades, also ensure that there is little privacy in the homes and many people close the curtains.

Context | **Site**



No relationship between the neighborhood and the green landscape

Context | **Boerhaavewijk**



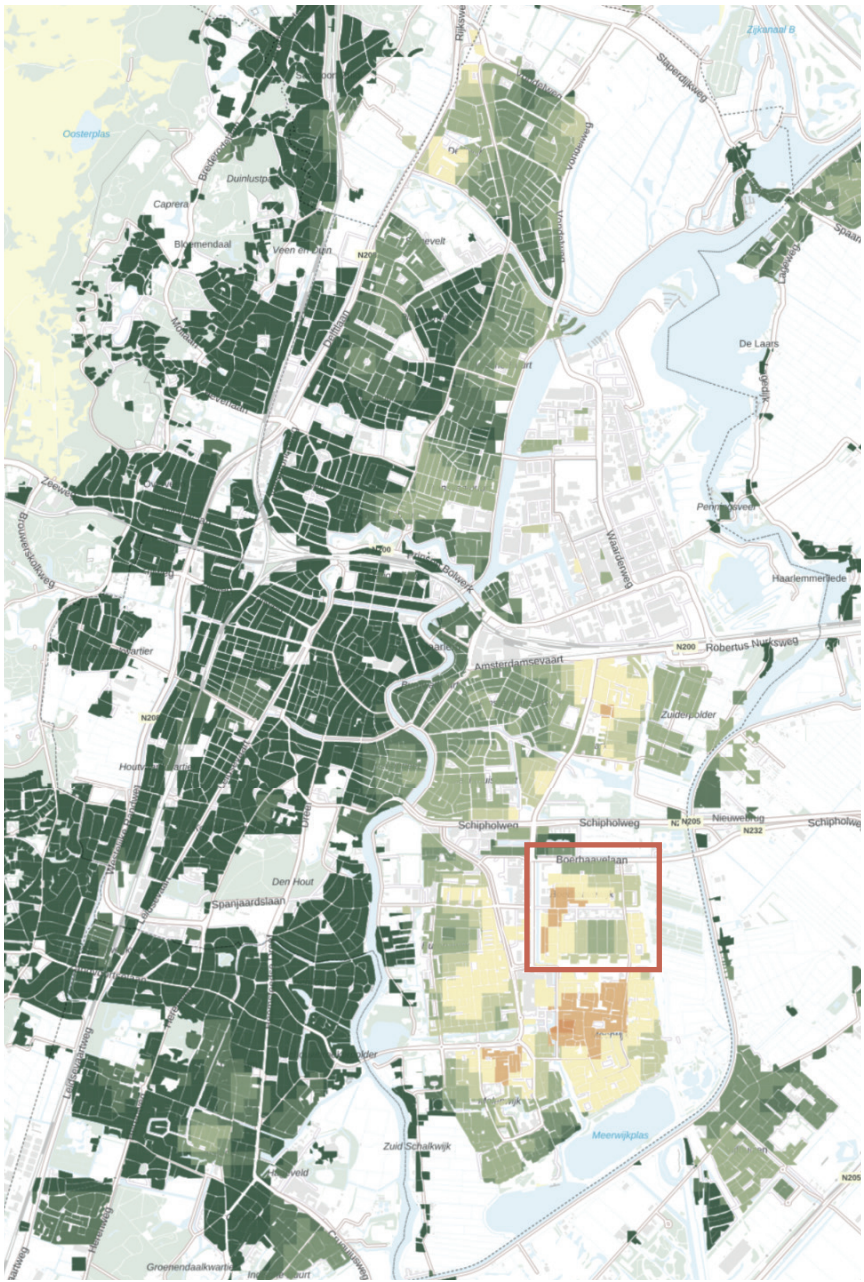
Cars and garage boxes are dominantly present in the public space, unattractive

Context | Functions



Post-war neighbourhoods are designed using the 'wijkgedachte' to create social cohesion and a liveable city.

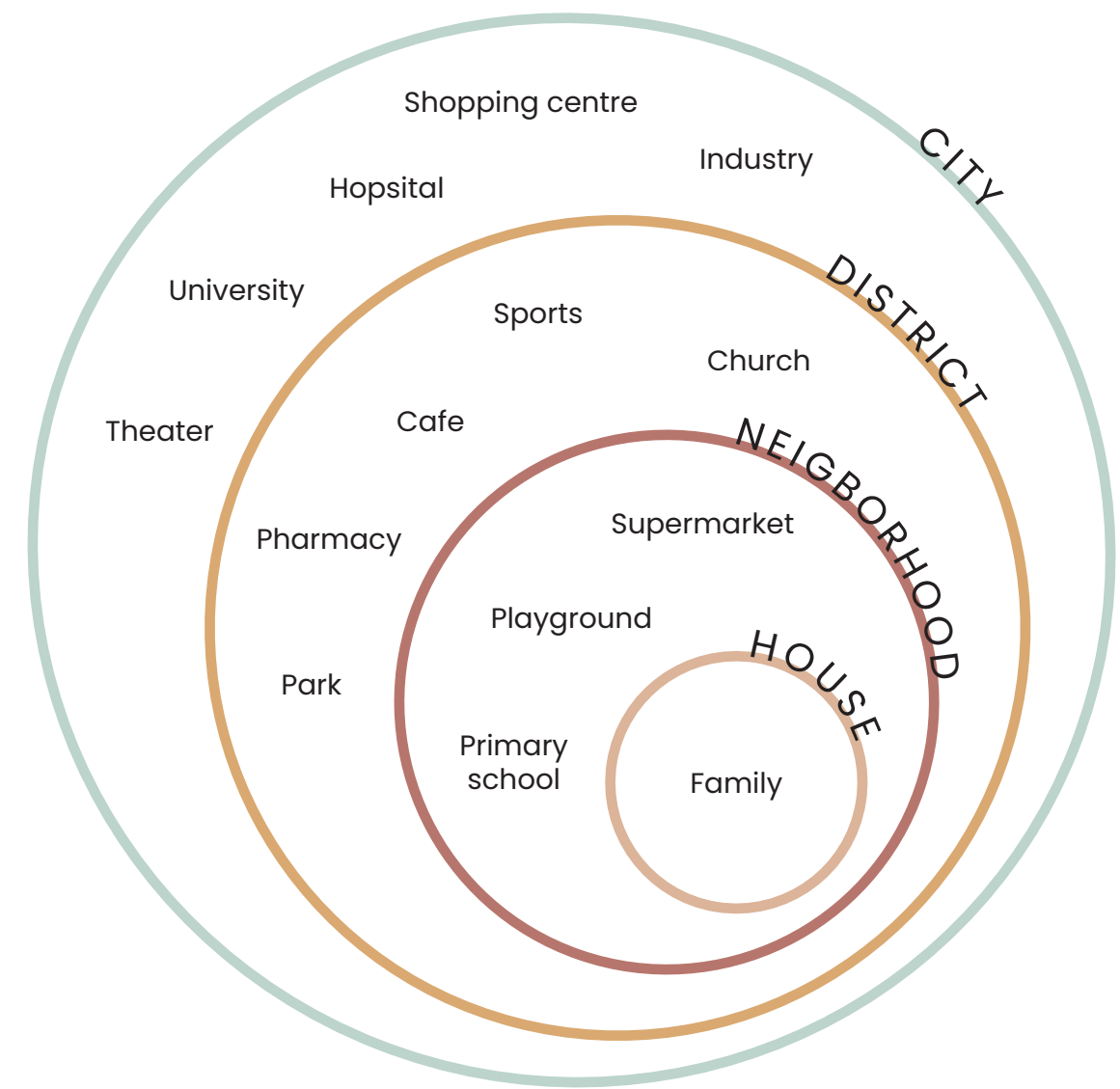
Context | **Functions**



(Leefbaarometer, 2022)

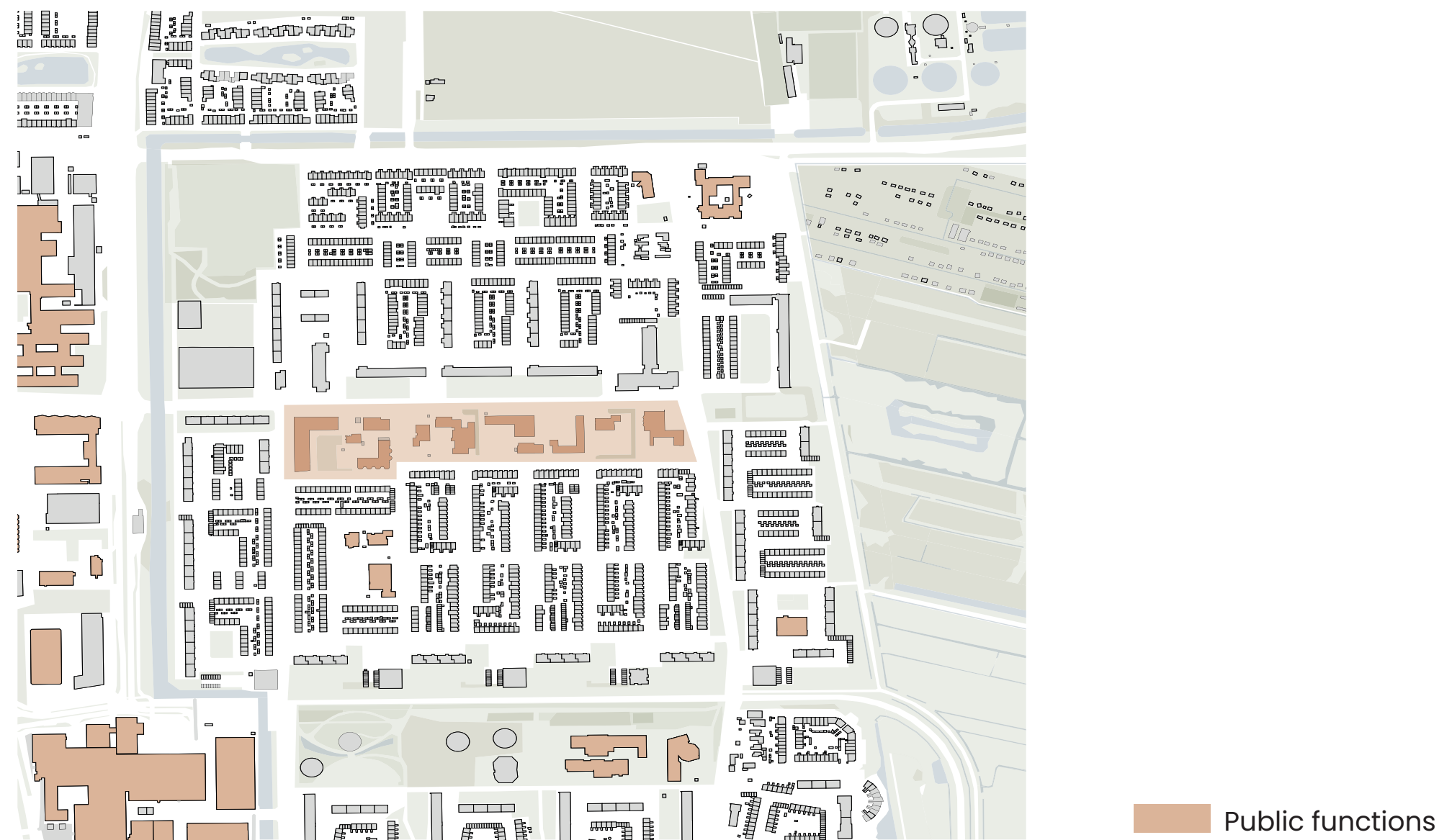
These neighborhoods often score low on liveability.

Context | **Functions**



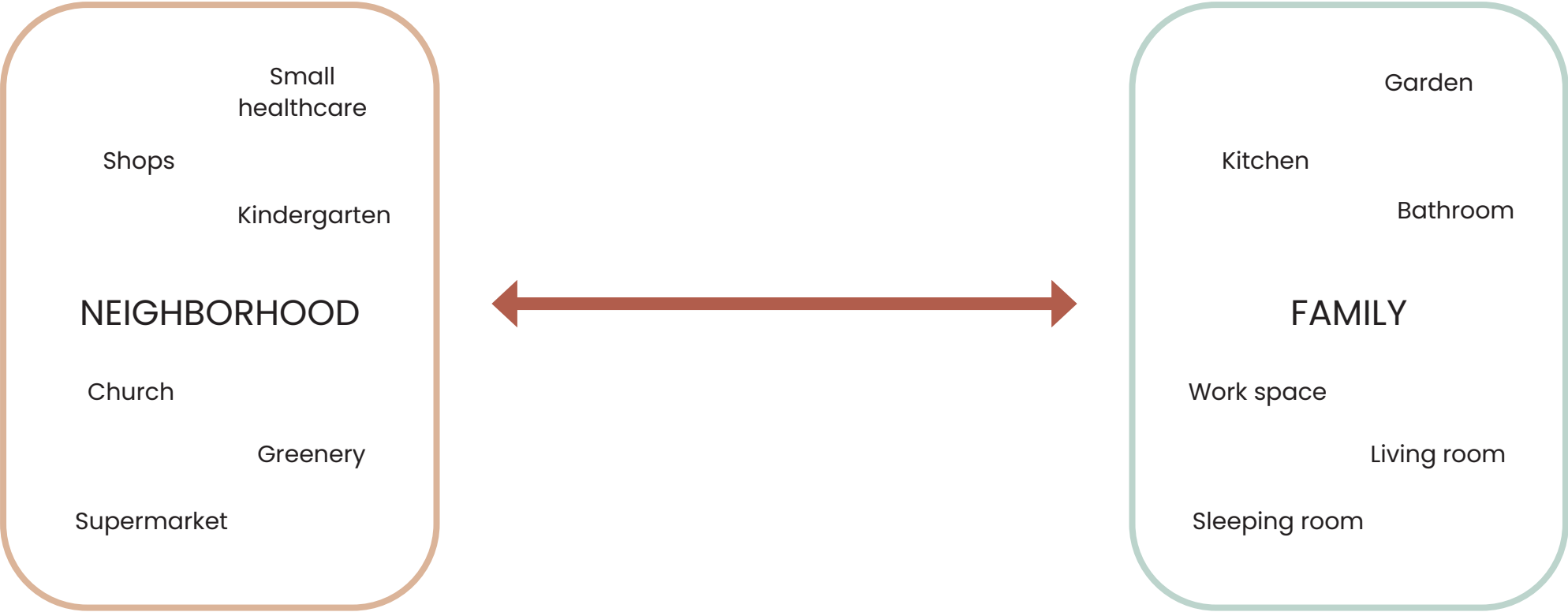
The smallest scale is a neighborhood with 6.800 people, many people to stimulate social cohesion between them

Context | **Functions**



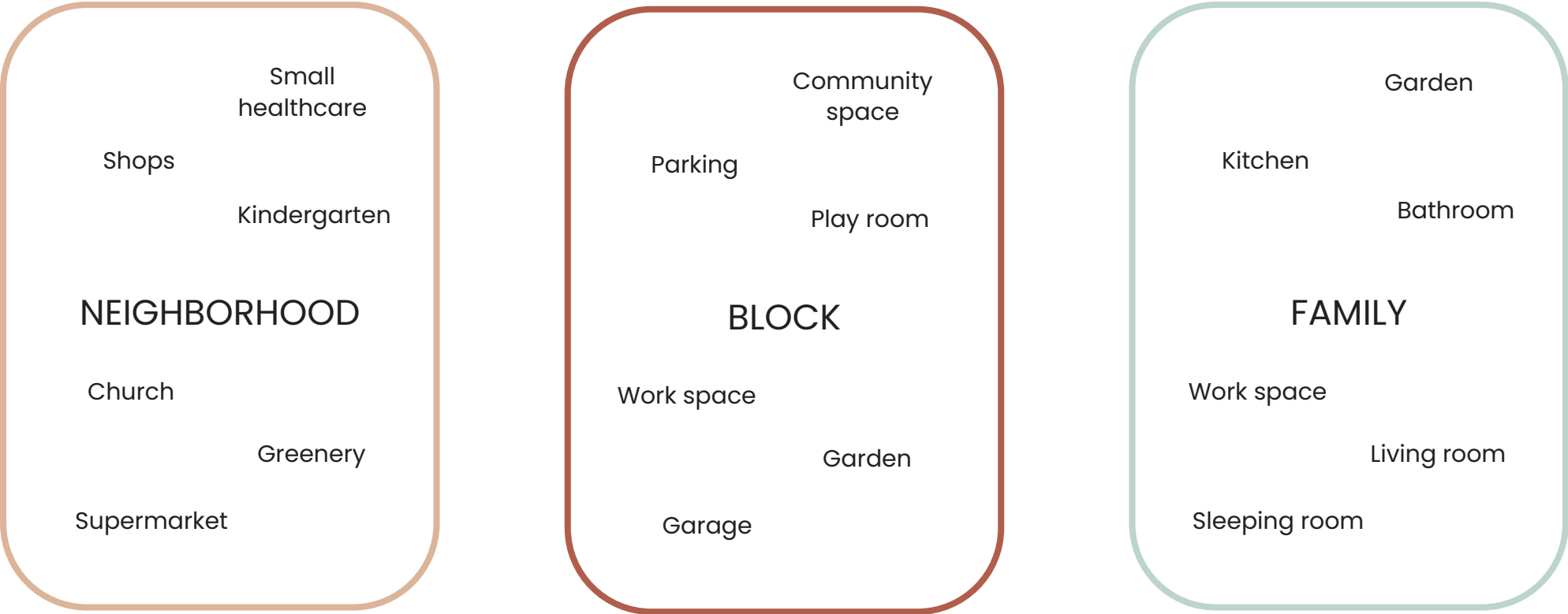
The public functions are only found in the core of the neighborhood; little encounters.

Context | **Functions**



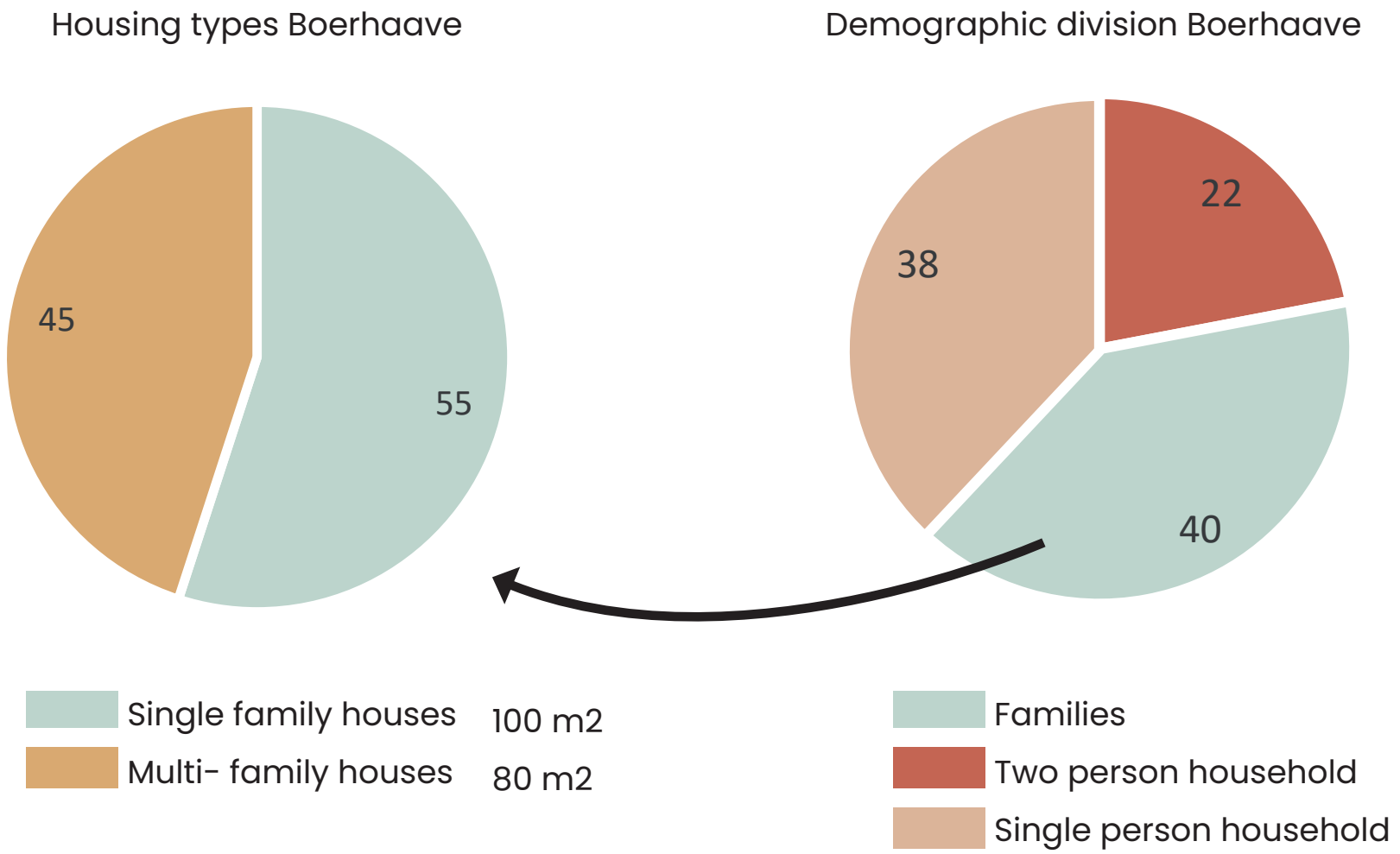
The distance between a neighbourhood and a family is still very large.

Context | **Functions**



The goal is to add more functions at block level, at this scale residents can really connect with each other, share functions, and this will create more encounters spread throughout the neighborhood

Context | **Housing types**



Another issue in the neighborhood is the lack of diverse housing types, as most homes are sized only for families

Context | **Housing types**



Starters



Single parents



Empty nesters



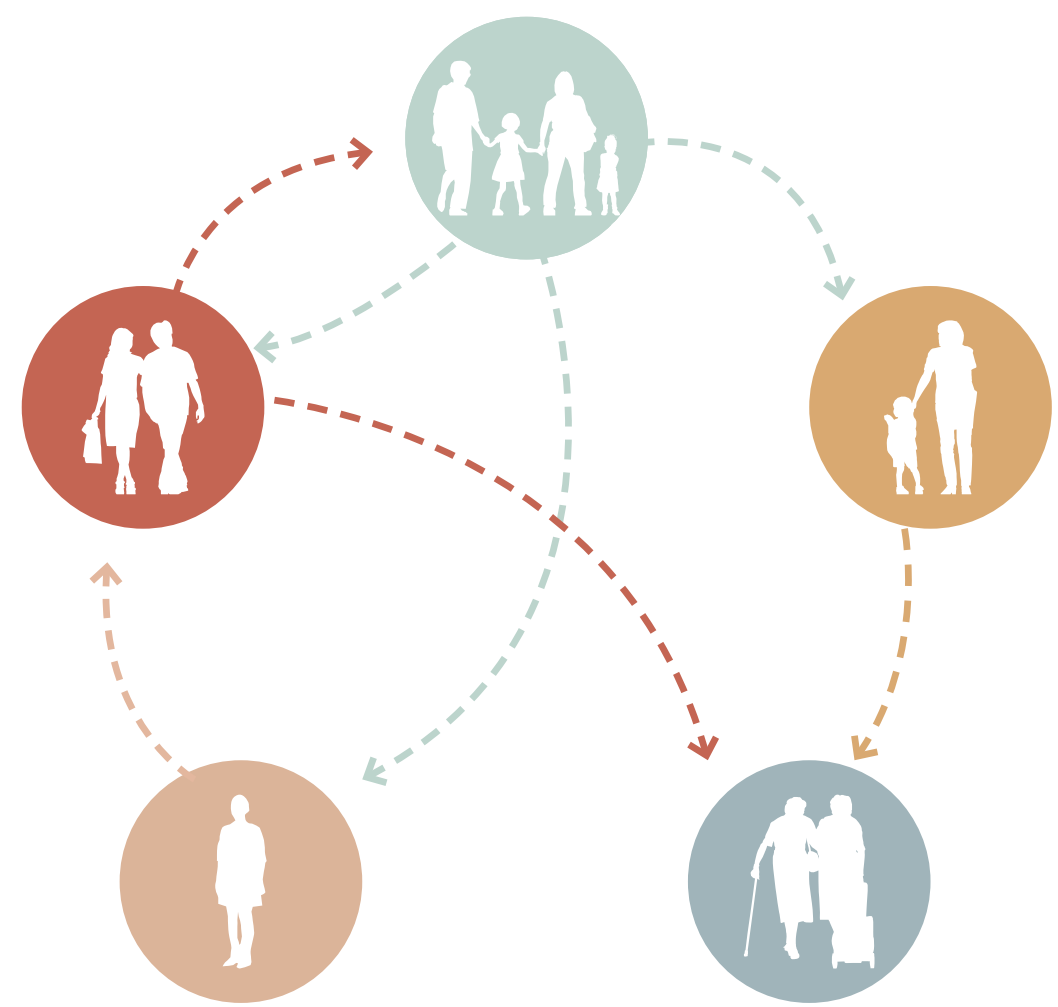
Elderly



Families

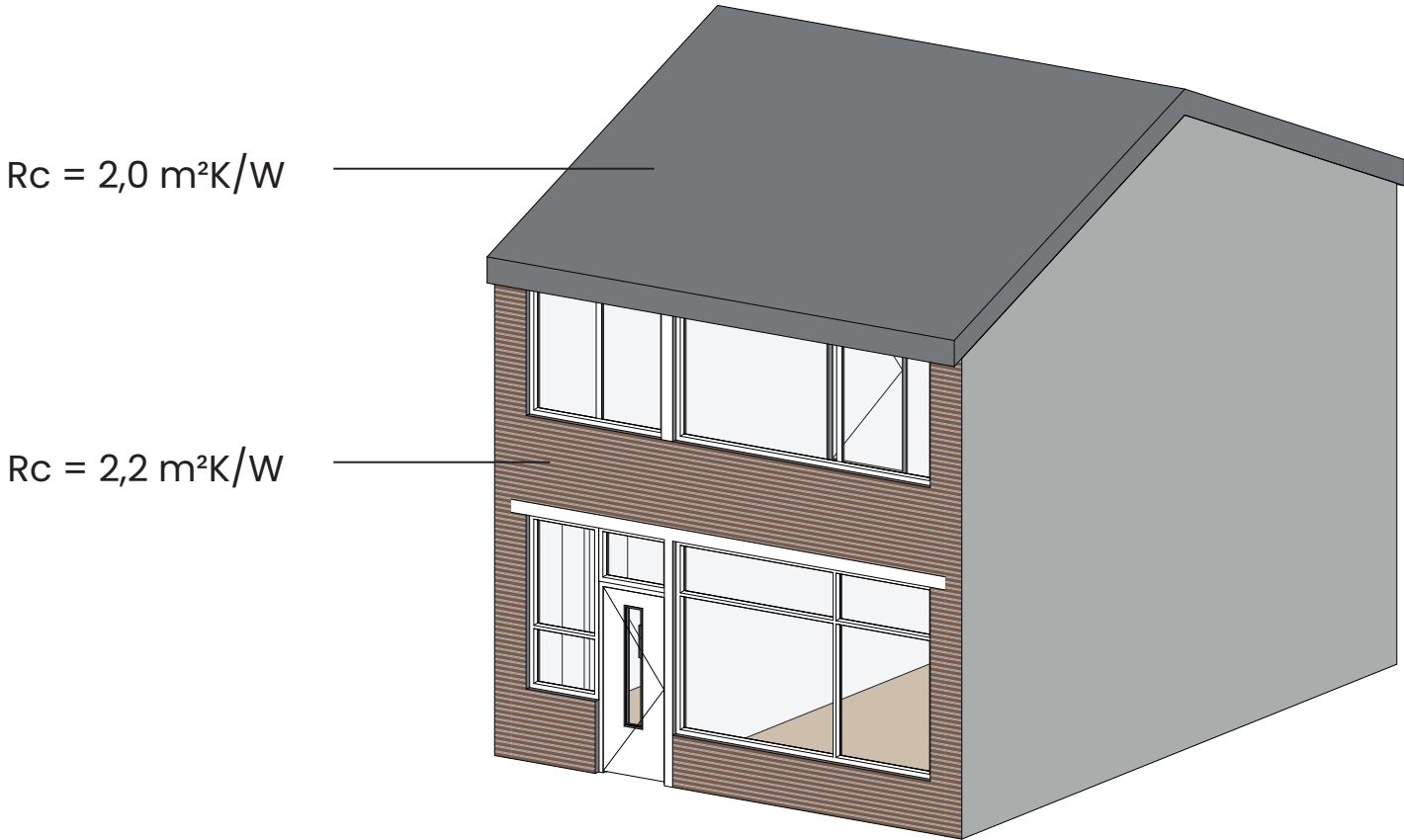
The goal is to offer more diverse housingtypes to facilitate the diverse housholdtypes

Context | **Housing types**



Residents can stay in the neighbourhood and move to other more suitable houses

Context | **Houses**



To meet the climate goals, existing homes must be better insulated, put off the gas and have efficient installations

Context | Houses



Two versions of the same type, low aesthetic value, repetitive,
personal modifications messy street image

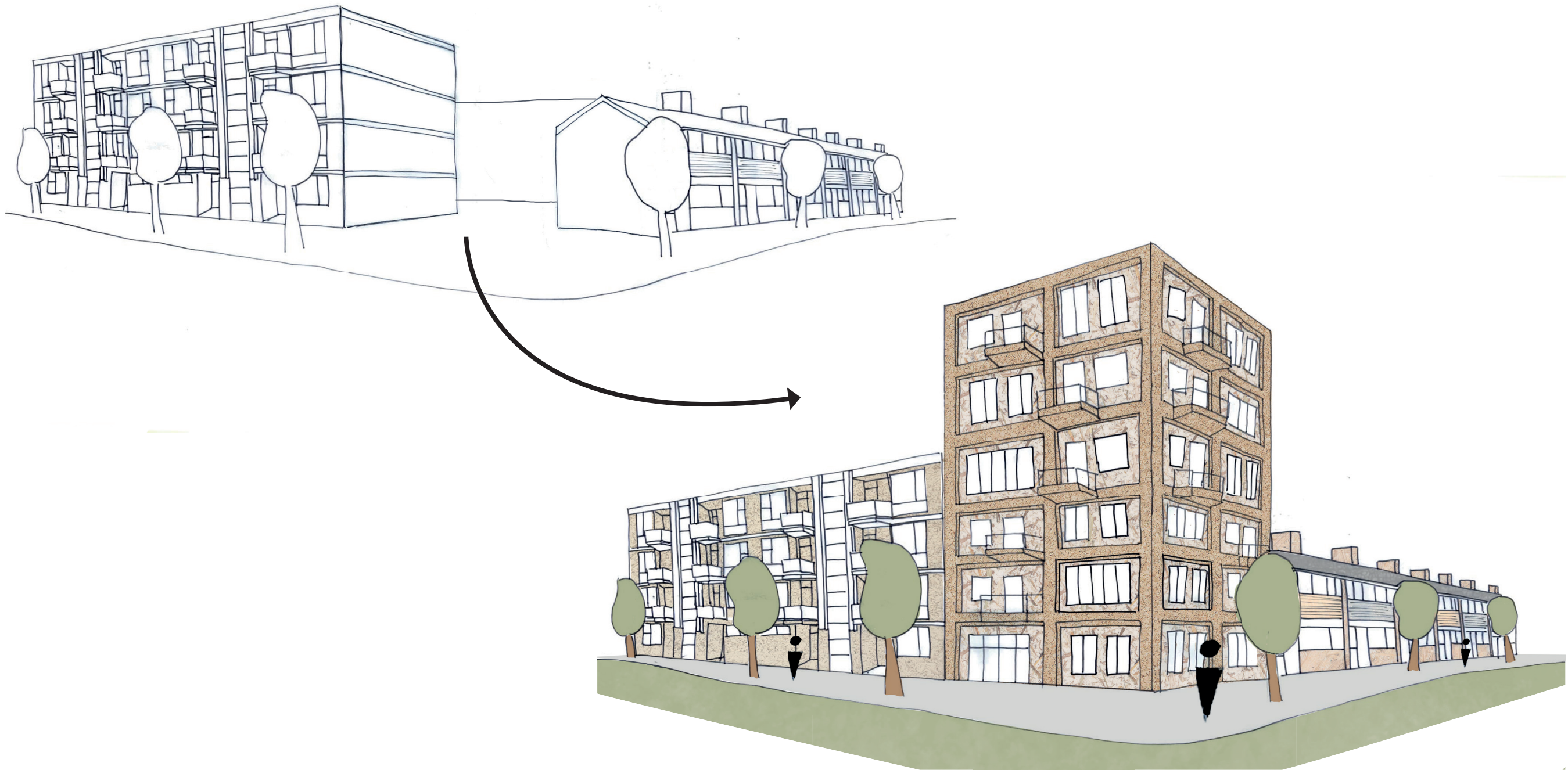
Context | Houses



(De architect & Schaatsbergen, 2024)

Often demolished, but high-quality renovation over a 30-year operational period is 10-30% cheaper than equivalent new construction (College van Rijksadviseurs, 2022)

Context | Design objective



Transformation and densification of post-war neighborhoods. Sustainable material choices must harmonize with architectural expression to restore vitality and a better balance between public and private

Context | **Design goal**



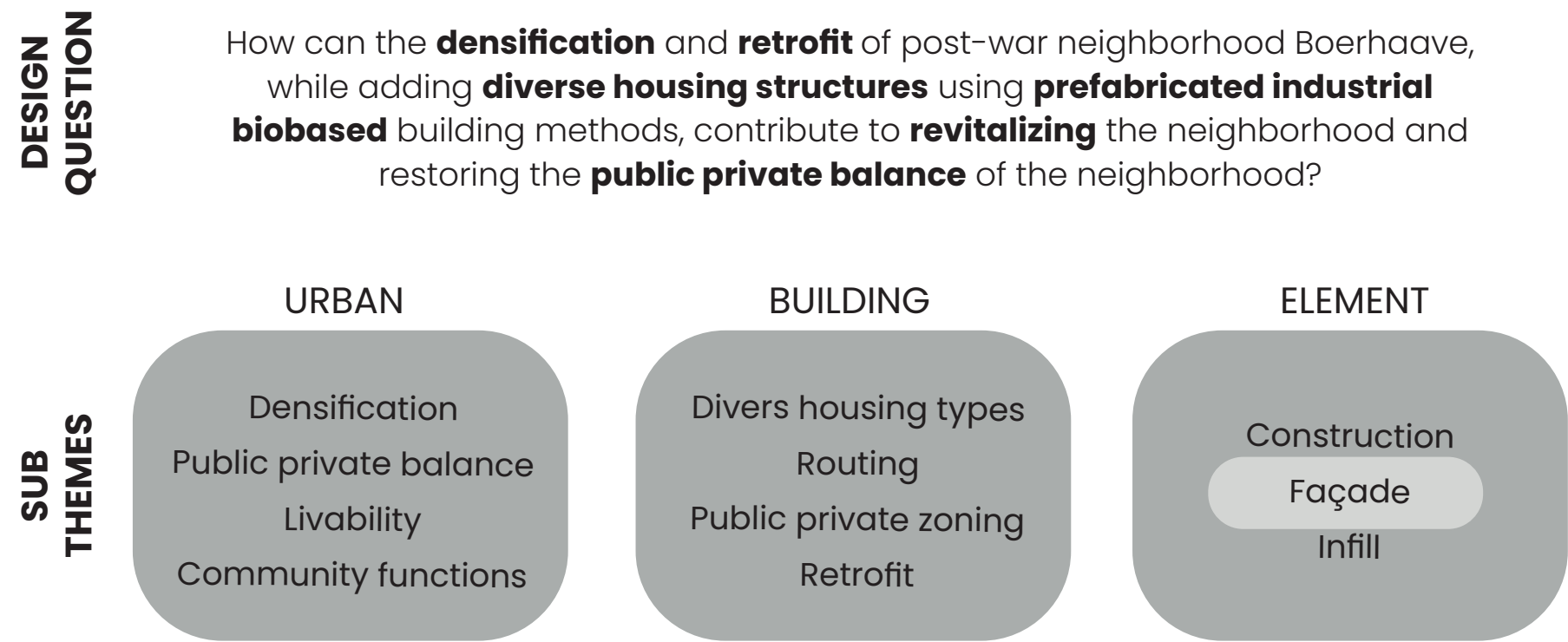
Desify while adding value, building up on the design principles with which the neighborhood was originally designed, livable and healthy city, social cohesion, living in the green

Problem statement | **Design question**

**DESIGN
QUESTION**

How can the **densification** and **retrofit** of post-war neighborhood Boerhaave, while adding **diverse housing structures** using **prefabricated industrial biobased** building methods, contribute to **revitalizing** the neighborhood and restoring the **public private balance** of the neighborhood?

Problem statement | **Design question**



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Problem statement

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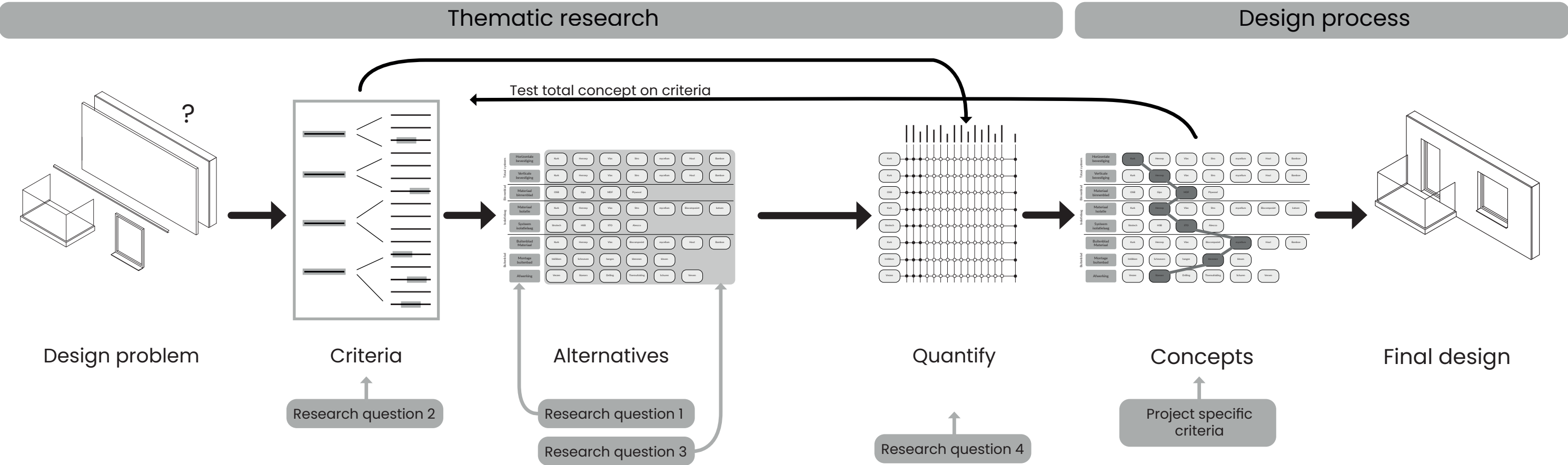
Design



There is a lot of experimentation with the application of biobased materials, but how do you know when to use which material and how to make optimal use of the properties?

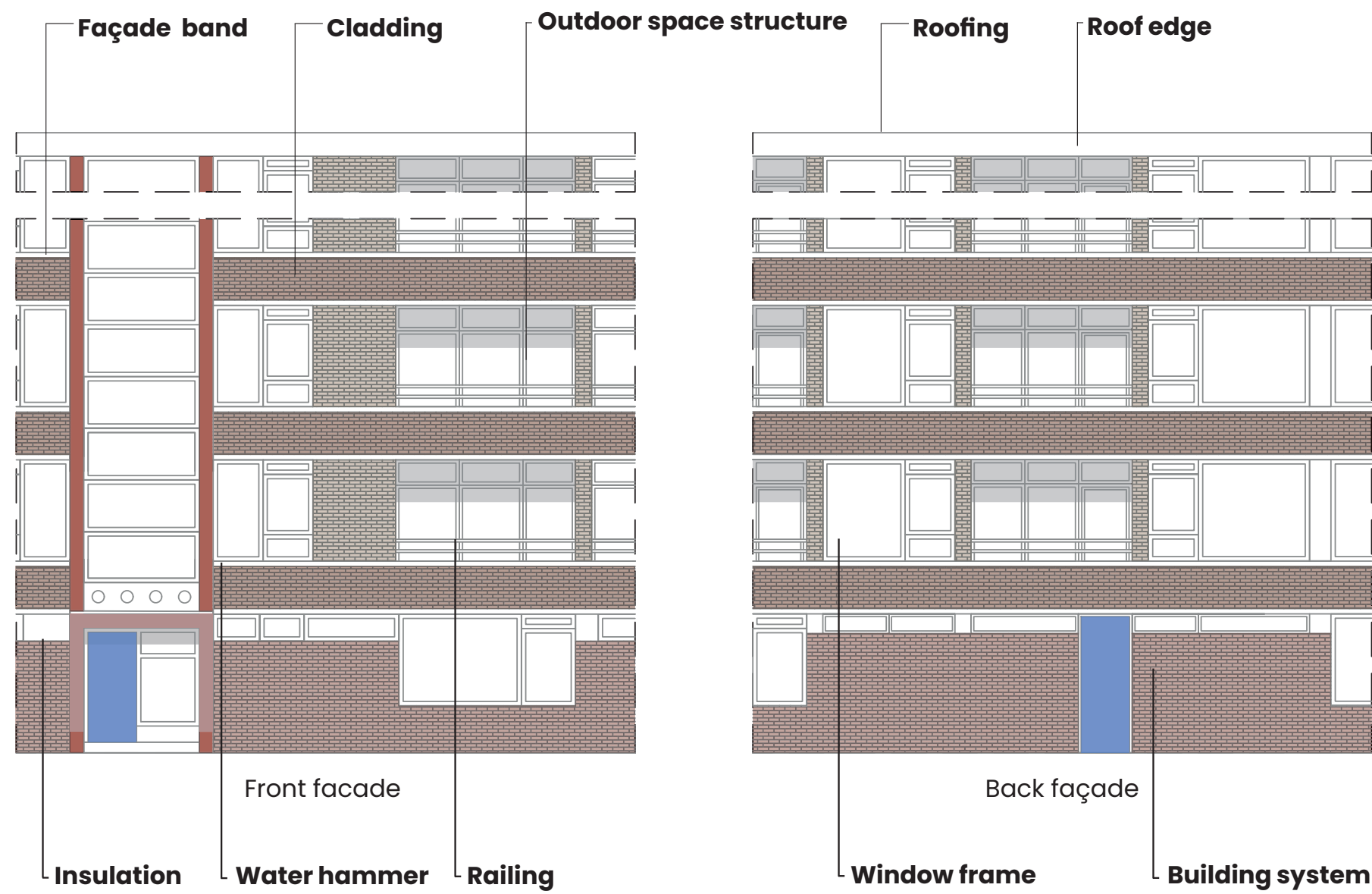
Research | **Main question**

*How can an **industrial biobased façade element** for the Boerhaave neighborhood be developed with **product development methodology** in which the **properties** of the materials are **used optimally** and at the same time the designer has the freedom to give the façade a **certain identity**?*



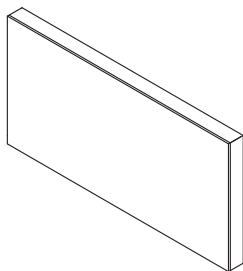
By applying the product development methodology, the problem is divided into sub-problems, for which alternatives are quantified against established criteria, to generate sub solutions.

Research | **Façade elements**

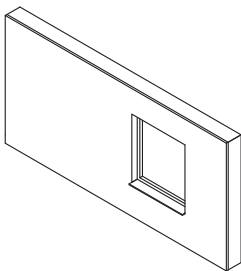


Facade elements in the Boerhaave neighborhood

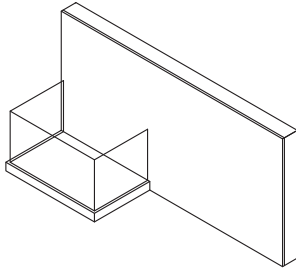
Research | **Façade elements**



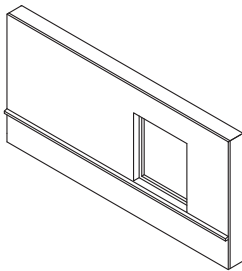
Cladding



Window frames



Balcony construction



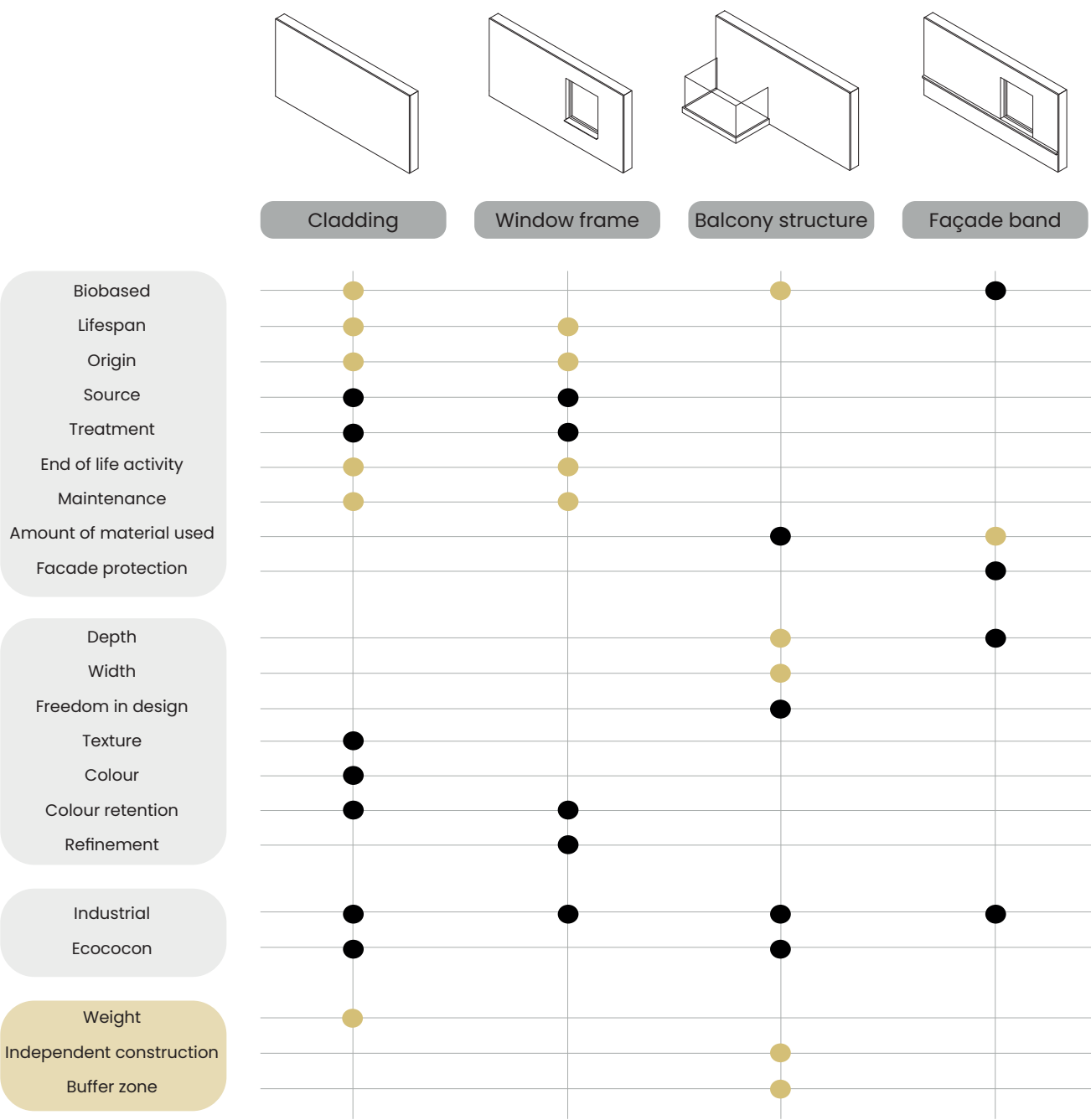
Façade band

Materials

Systems

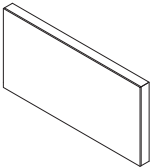
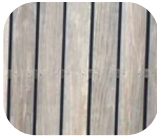
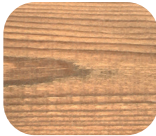
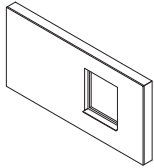
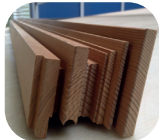
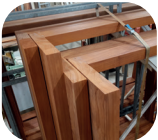
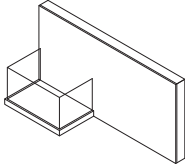
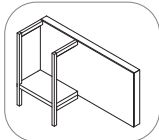
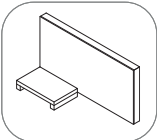
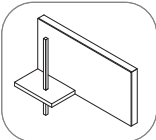
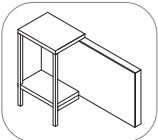
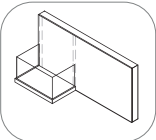
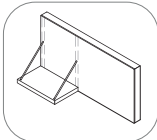
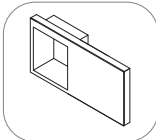
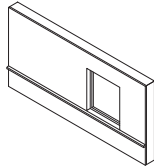
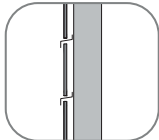
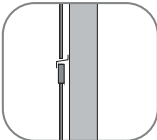
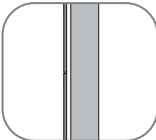
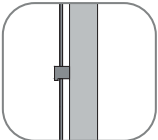
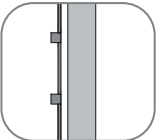
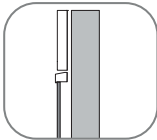
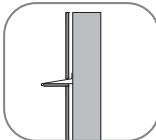
From which four elements were chosen, two materials and two systems

Research | Criteria



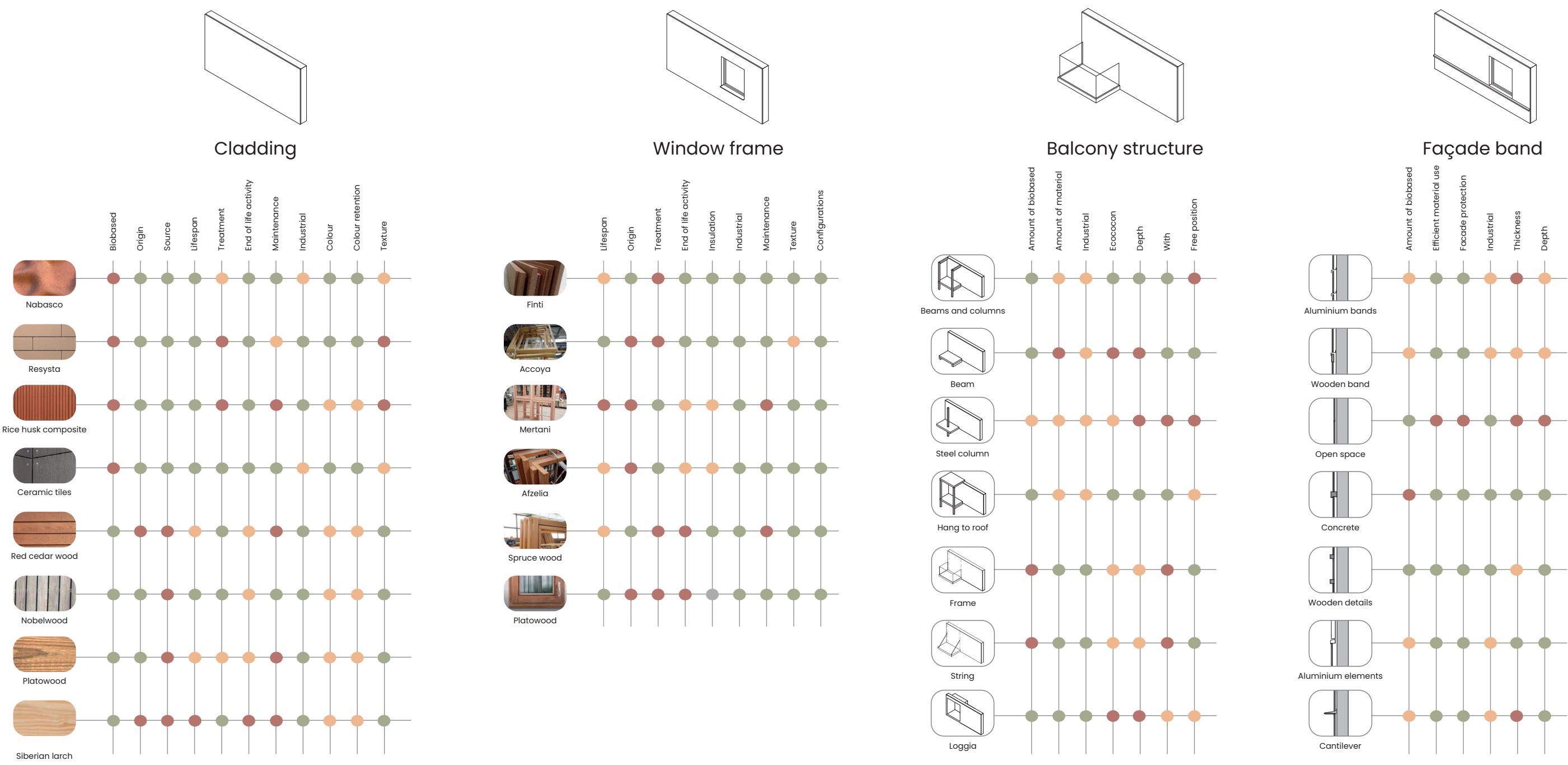
Criteria were then established, later more project specific criteria where added, weighted the criteria

Research | **Alternatives**

 Cladding	 Nabasco	 Resysta	 Rice husk composite	 Ceramic tiles	 Red cedar wood	 Nobelwood	 Spruce wood	 Seberian larch
	 Accoya	 Bamboo	 Burnt wood	 Corck	 Mycelium			
 Window frames	 Finti	 Accoya	 Mertani	 Afzelia	 Spruce wood	 Platowood		
 Balcony construction	 Beams and columns	 Beam	 Steel column	 Hang to roof	 Frame	 String	 Loggia	
 Façade band	 Aluminium bands	 Wooden band	 Open space	 Concrete	 Wooden details	 Aluminium elements	 Cantilever	

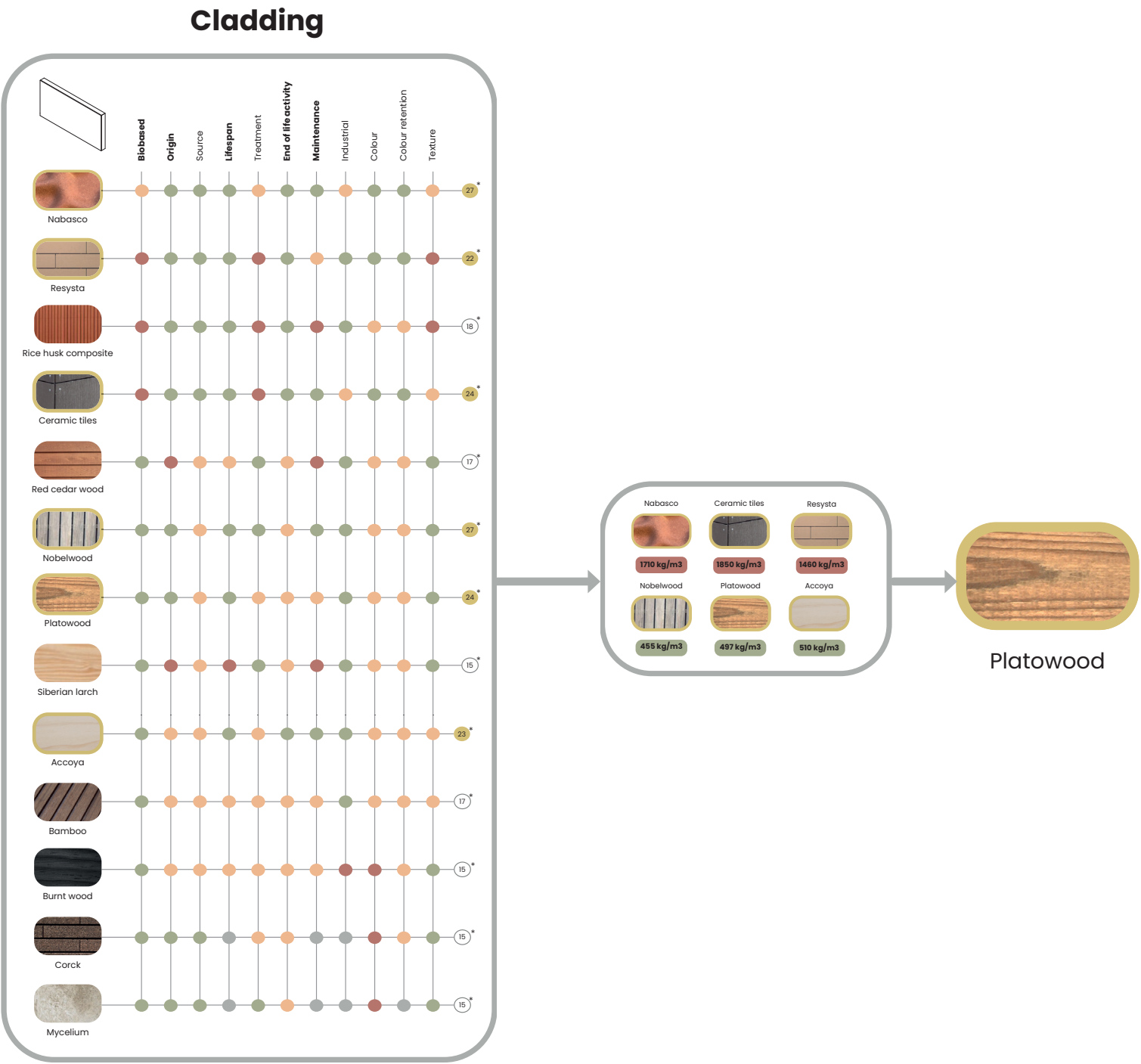
Alternatives for each element

Research | **Alternatives**



The alternatives were then quantified for each element according to the criteria, little depht, lack of information

Research | **Alternatives**



Further research, Platowood, the good properties, lifespan, maintenance, wood from Europe, treatment without chemicals

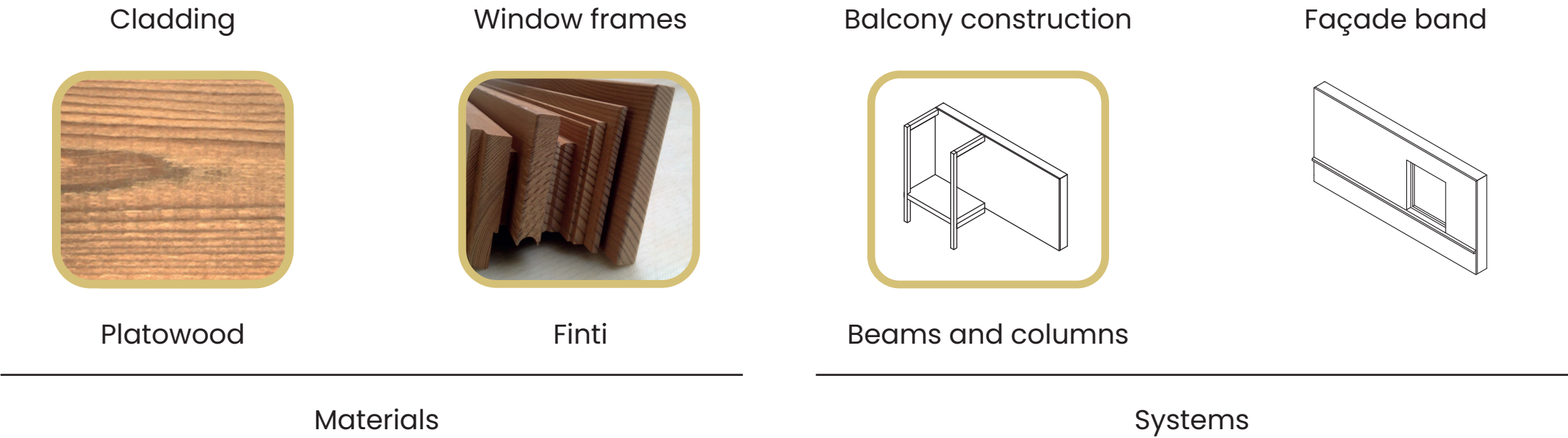
Research | **Final concept**

	Biobased (%)	Origin	Lifespan	End of life activity	Maintenance	Weight (kg/m3)
 Nabasco	66	NL	>50		5*	1710
 Kerloc	90	EU	>50		5*	1850
 Resysta	60	EU	>50		5*	1460
 Nobelwood	100	AM	>50		5*	455
 Platowood	100	EU	50		5*	497
 Accoya	95	AS	>50		5*	510

The data about the materials can be used to convince clients of the use of biobased materials and show that these materials also have good properties

* Maintenance for colour retention

Research | **Final concept**



Ultimately, two materials and a system were chosen.
Facade bands were not used in the design

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Problem statement

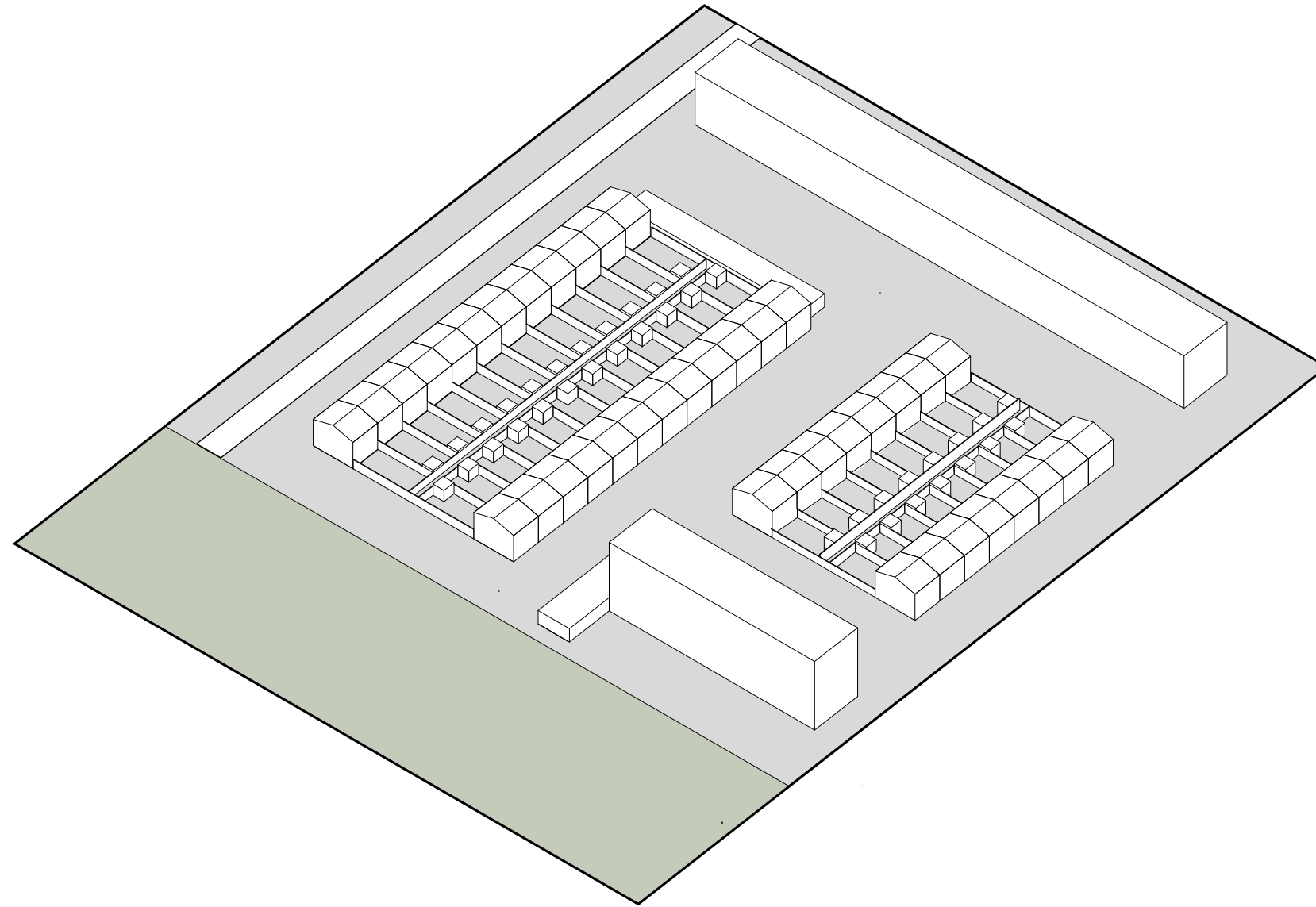
Context

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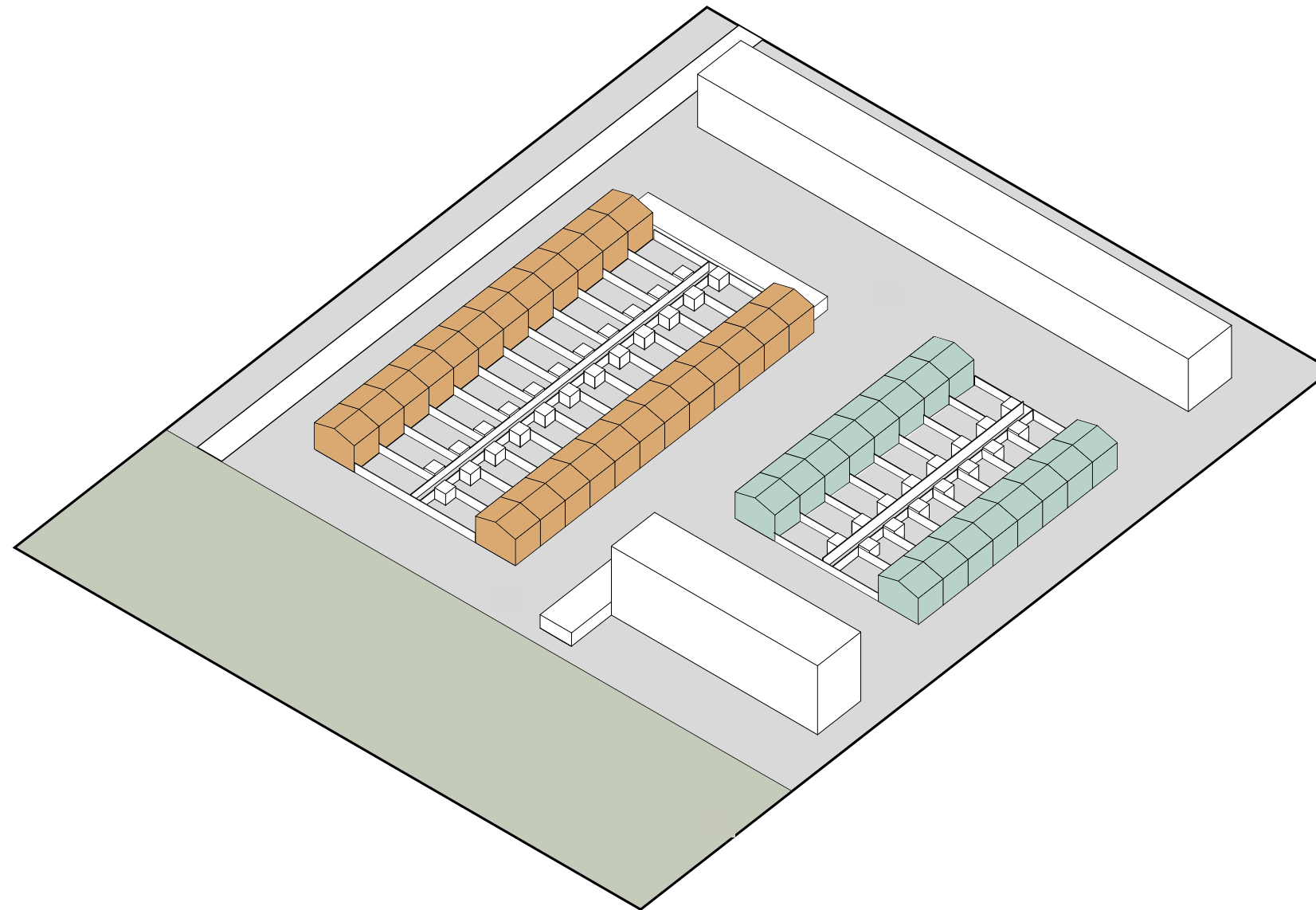
Design

Strategy | Phasing



Goals is to desify, making sustainable improvements to the existing houses, create a more liveable neighborhood

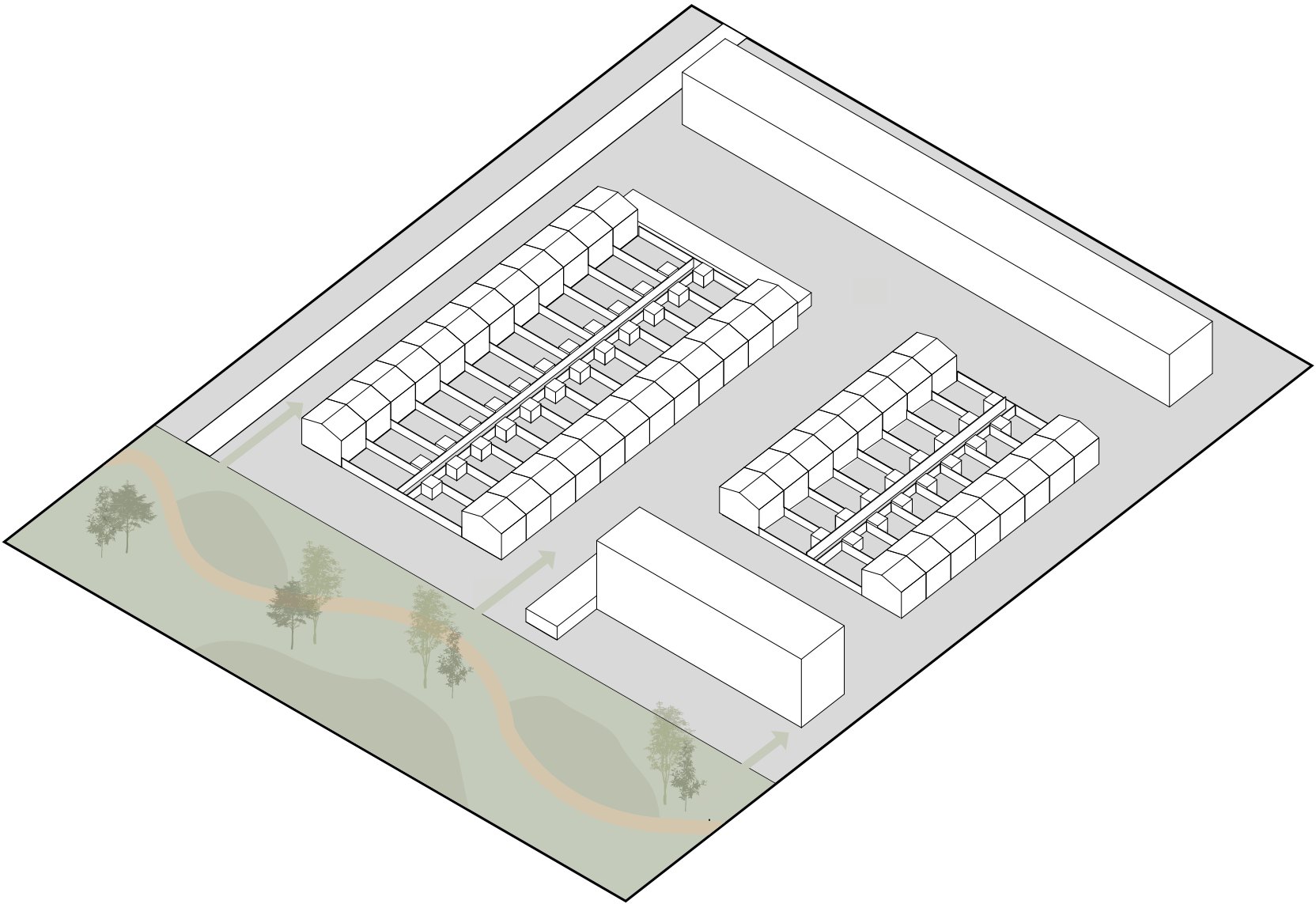
Strategy | Phasing



 Social houses
 Owned houses

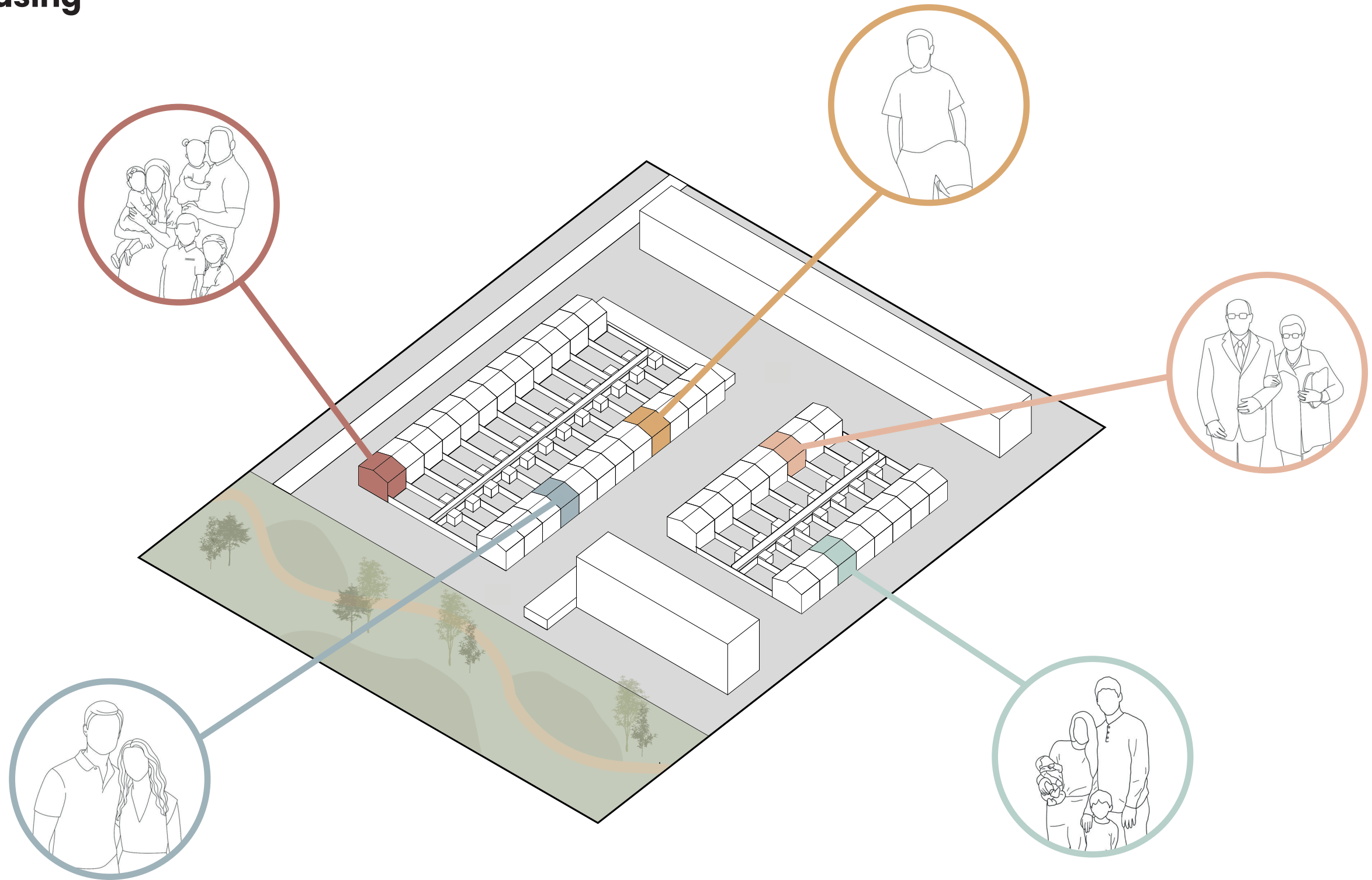
The existing block consists of 22 social houses and
16 owned houses

Strategy | **Phasing**



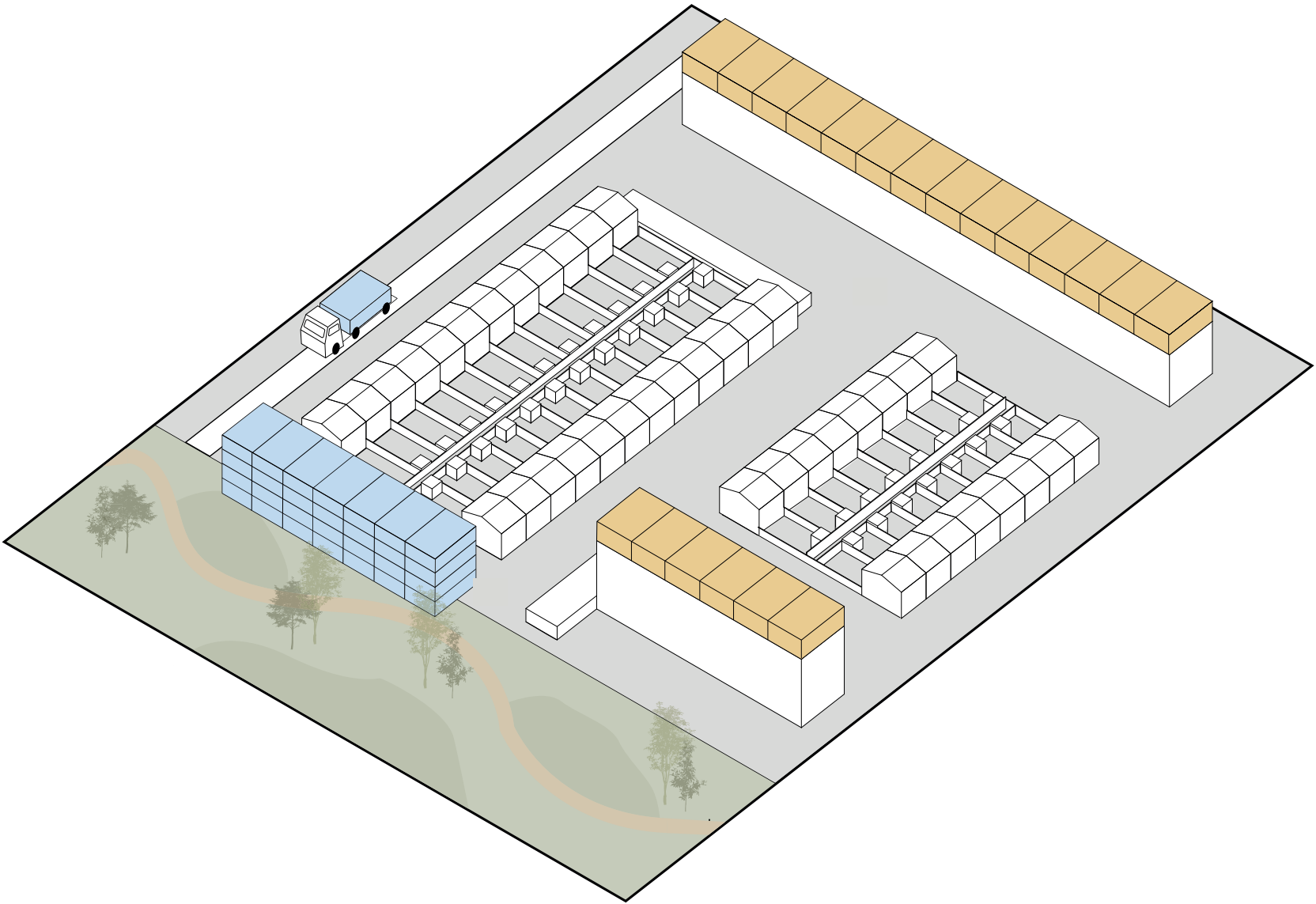
1. First, a park is created, improved connection to the block, stimulating the first interactions between neighbours, starting the process.

Strategy | Phasing



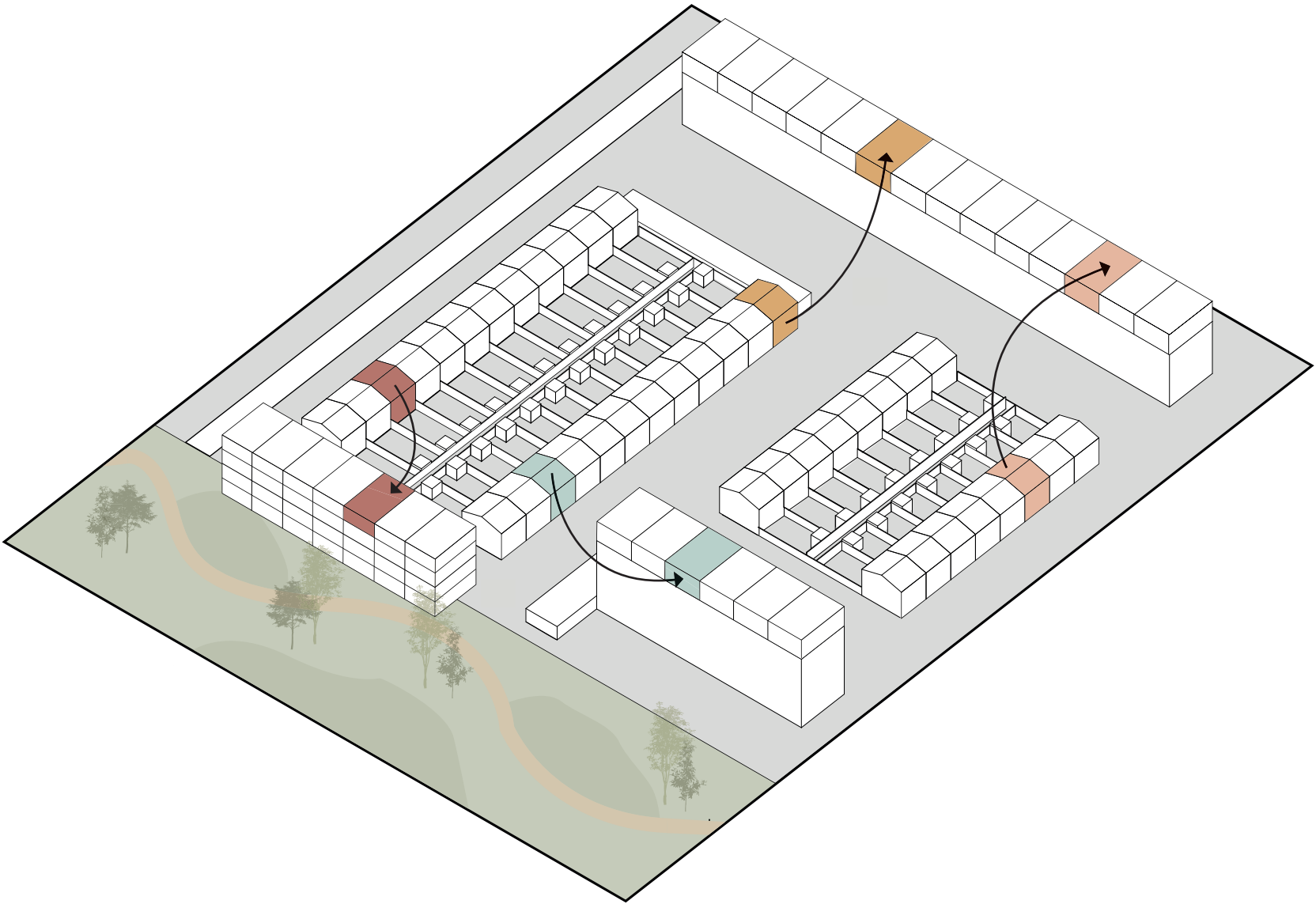
2. Conversations are held with residents to explain the plans and gather their input. Topics include the placement of galleries and the facilities in the block

Strategy | **Phasing**



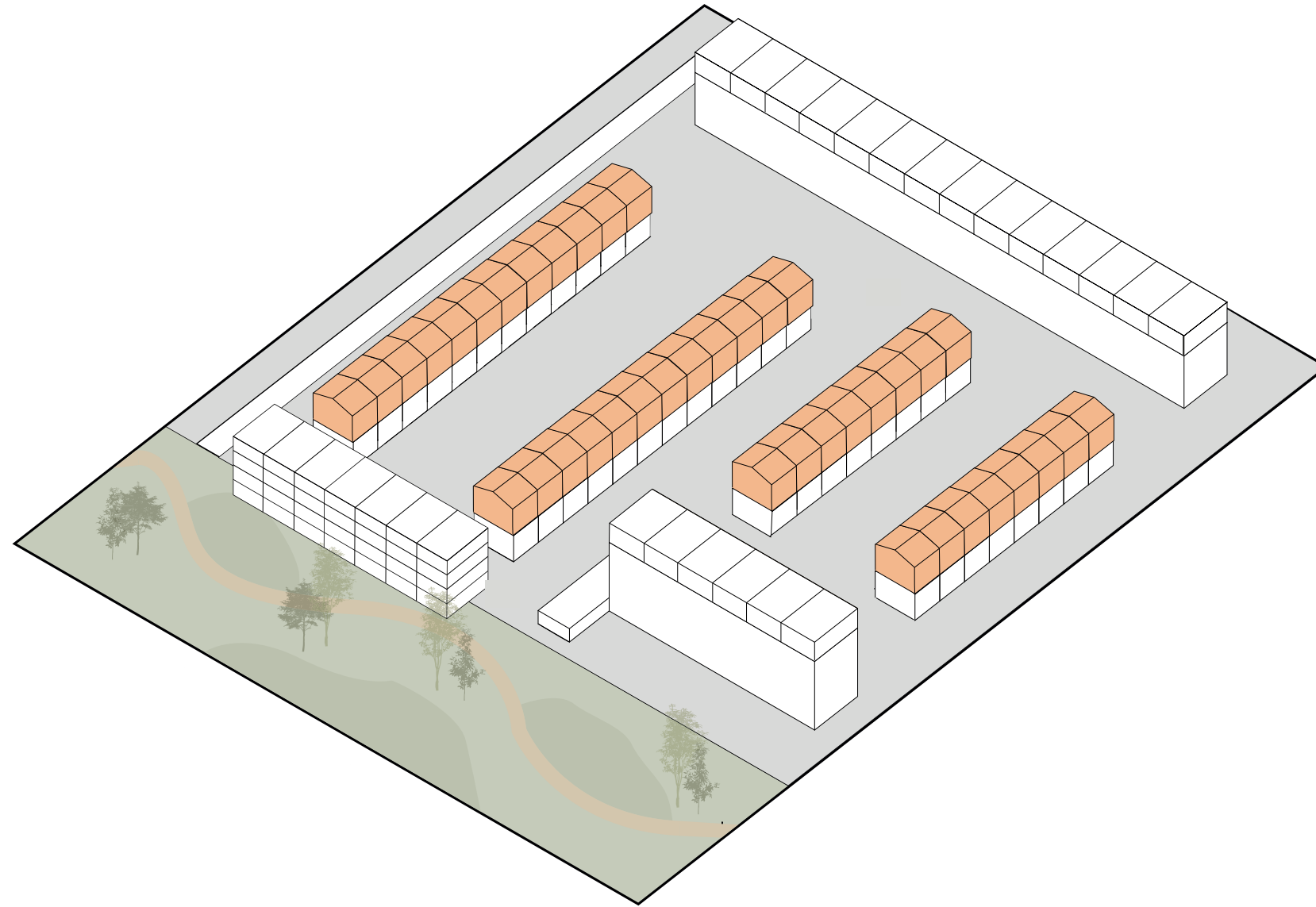
3. The modular top ups of the walk up apartments
and the new houses are build with 3D modules,
quick construction time

Strategy | **Phasing**



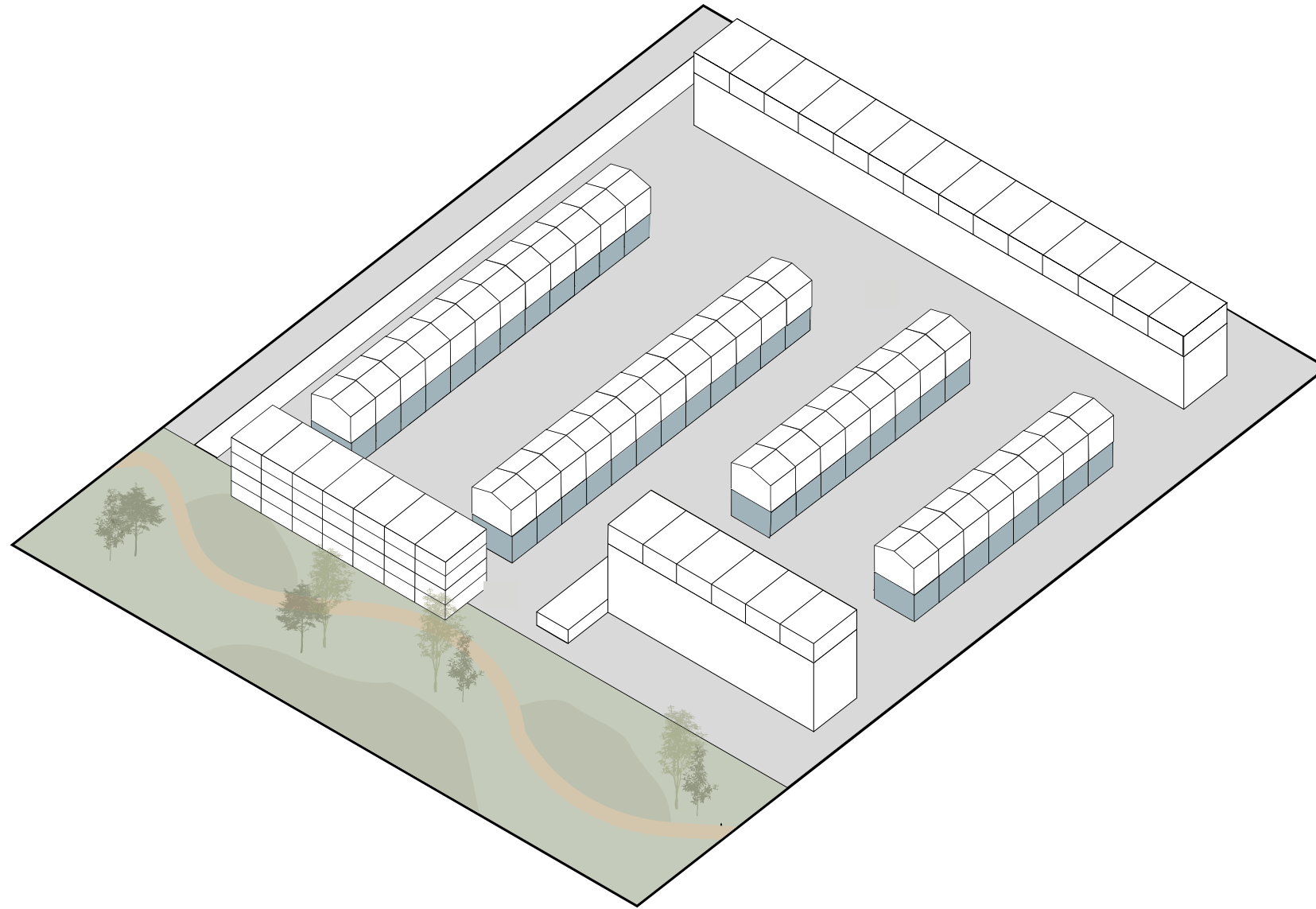
4. The existing residents can temporarily live in the new units, with their belongings stored nearby.

Strategy | Phasing



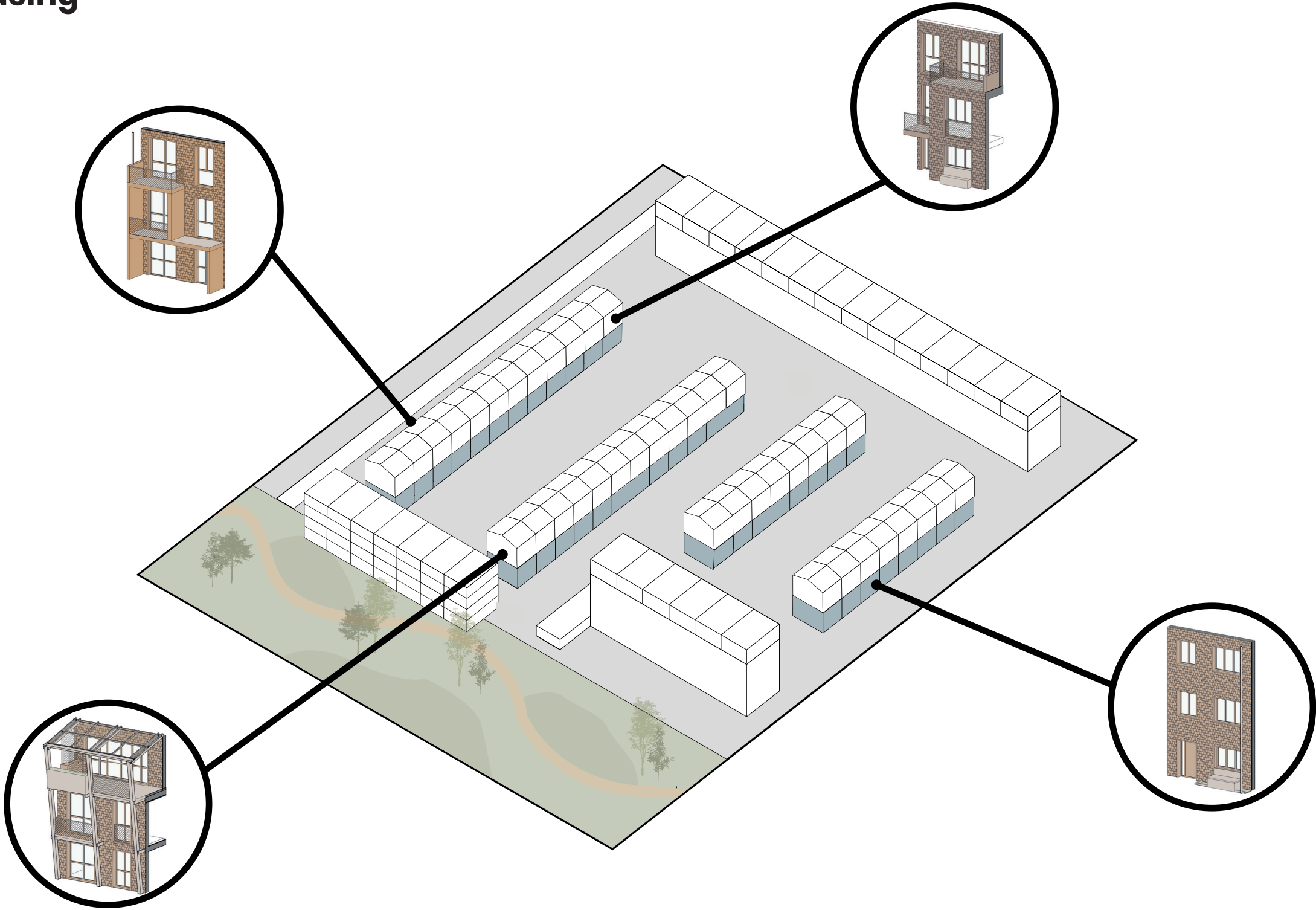
5. The top-ups can be built, with 1D and 2D elements. The construction cost per top-up is approximately €130,000, while they can be sold for €250,000.

Strategy | Phasing



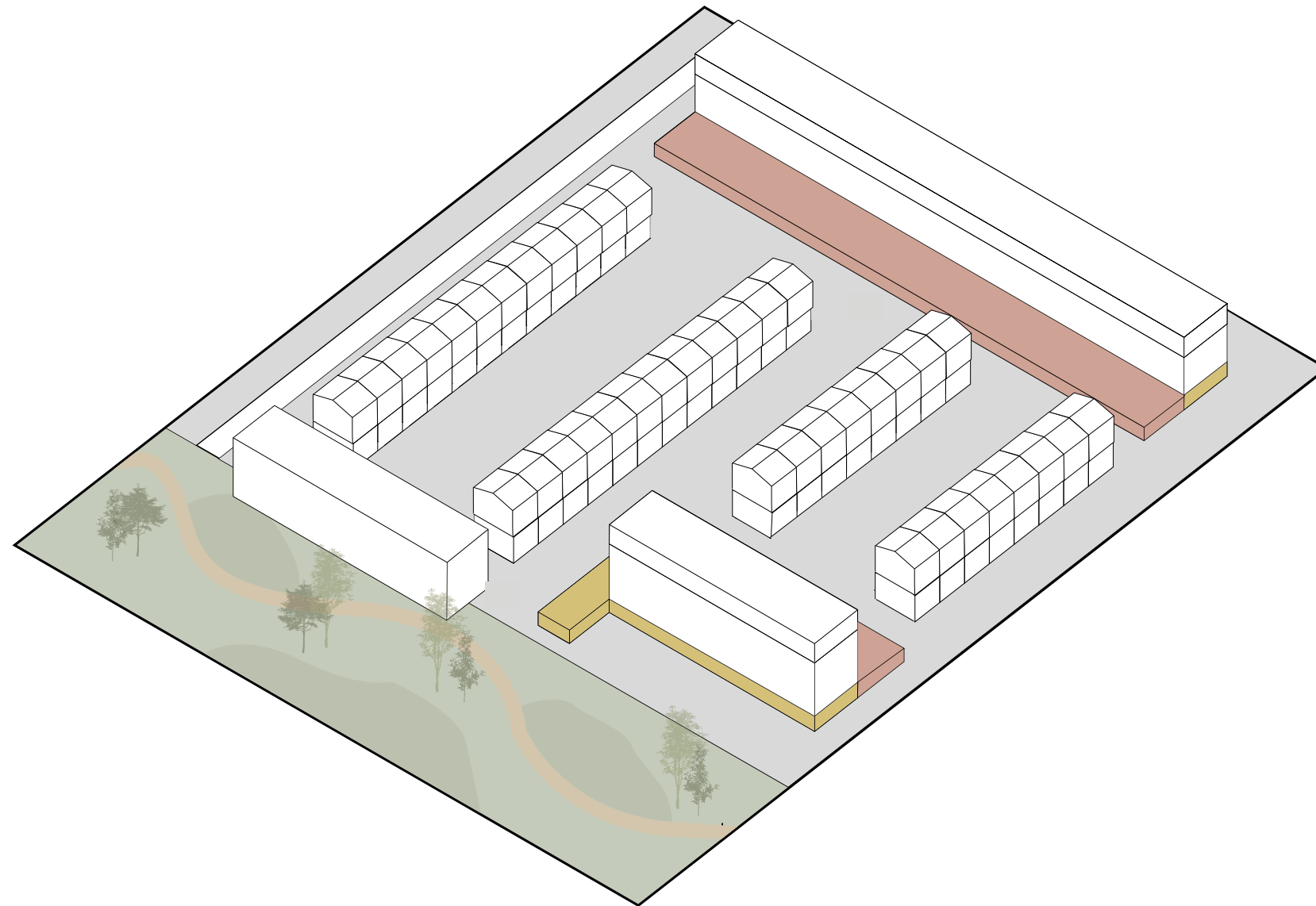
6. 20% of the price, €50,000, will go to the existing house owners. One part is required to pay for the new facade, and new installations upgrading to a high energy label

Strategy | **Phasing**



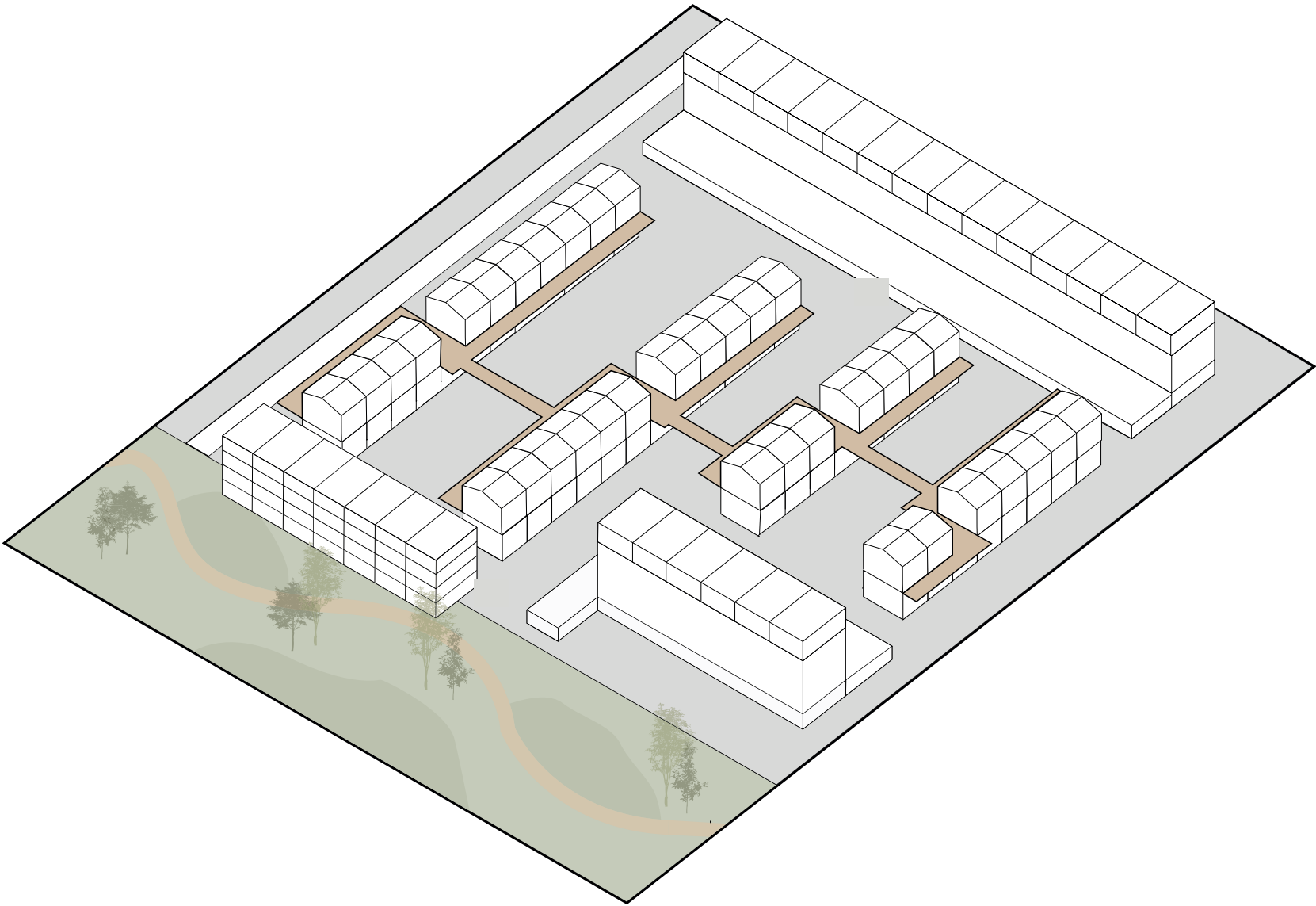
7. The owners can choose to use the remaining money for an extension, a new bathroom, or a new kitchen

Strategy | Phasing



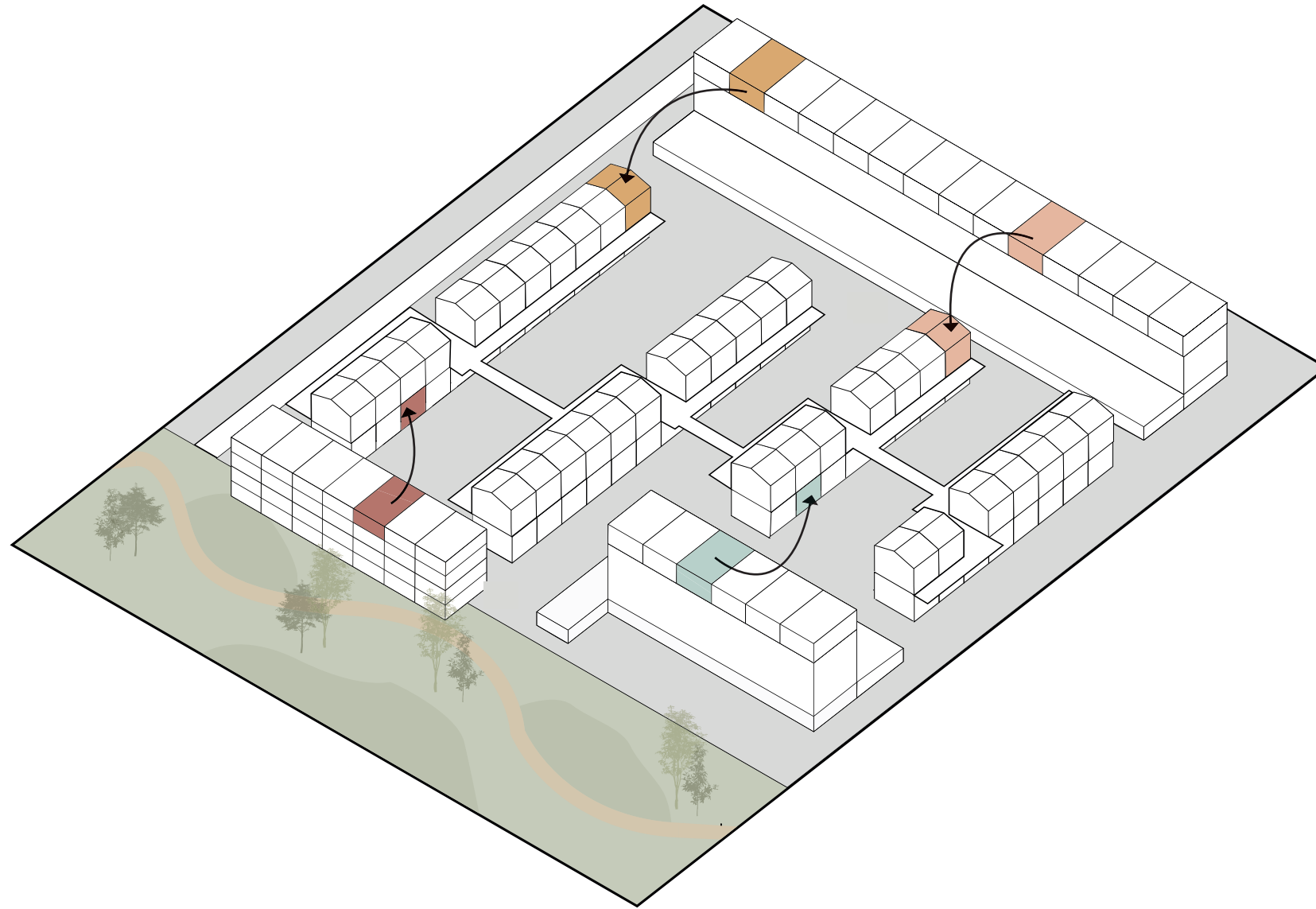
8. The other part of the profit will be used to build communal facilities and parking garages

Strategy | **Phasing**



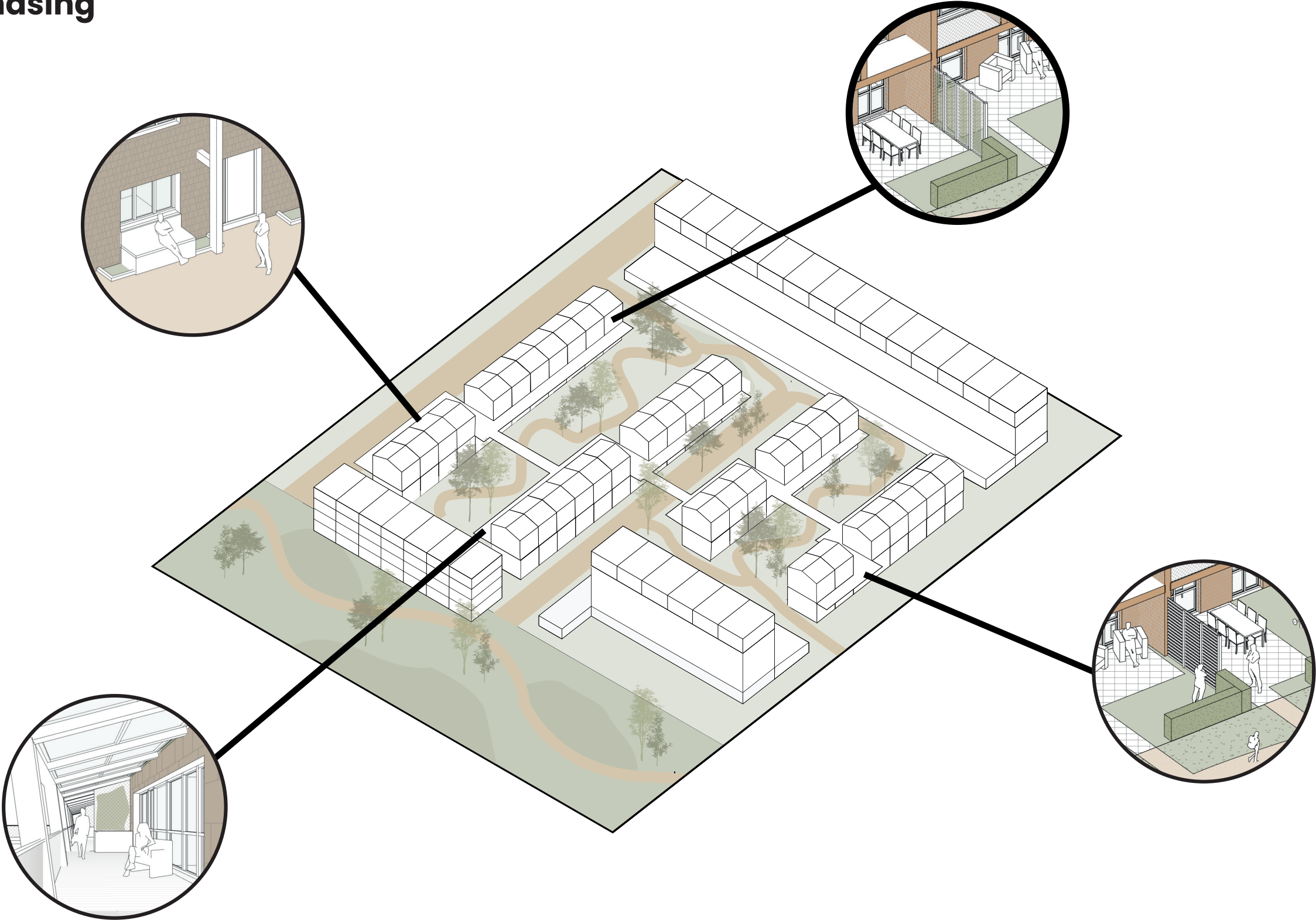
8. and the galleries that provide access to the top-ups.

Strategy | Phasing



9. The residents will return to their original homes or move to a smaller unit in the top-up if it better suits their household type.

Strategy | **Phasing**



10 . The collective garden is created, residents can make personal choices in, separation fences between gardens and balconies, planters or benches to the street, choose level of privacy

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Problem statement

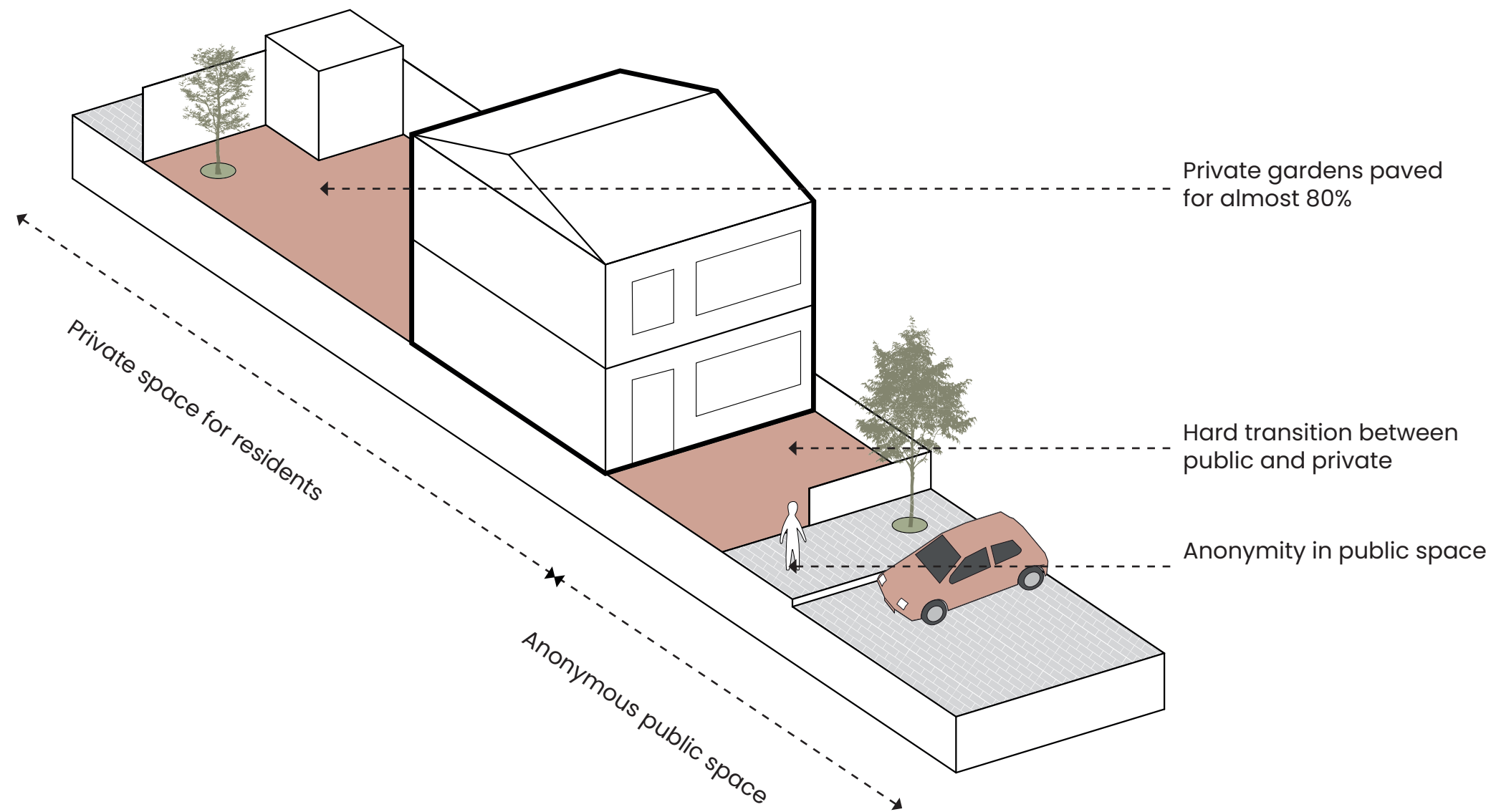
Context

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Strategy

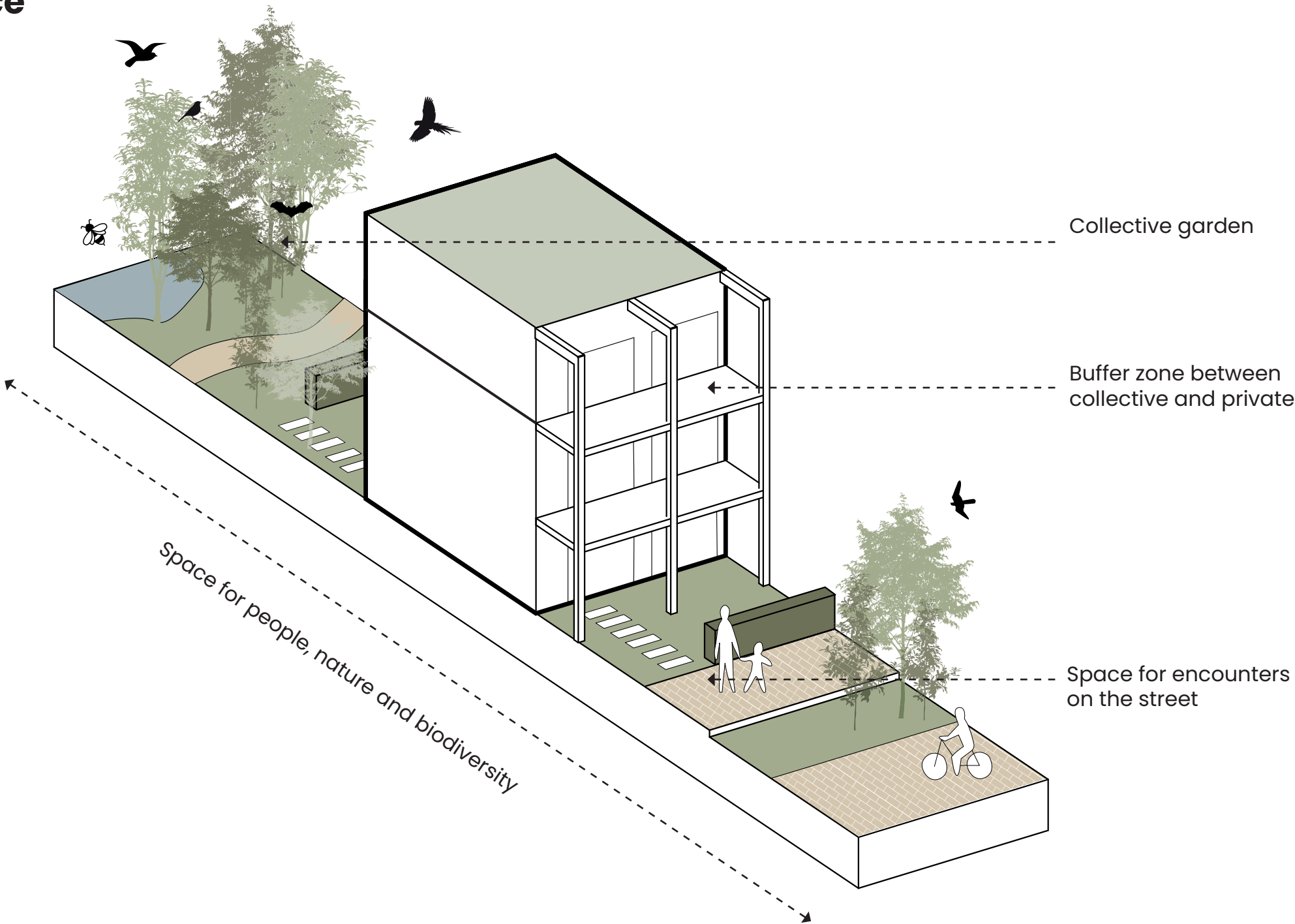
Design

Strategy | Use of space



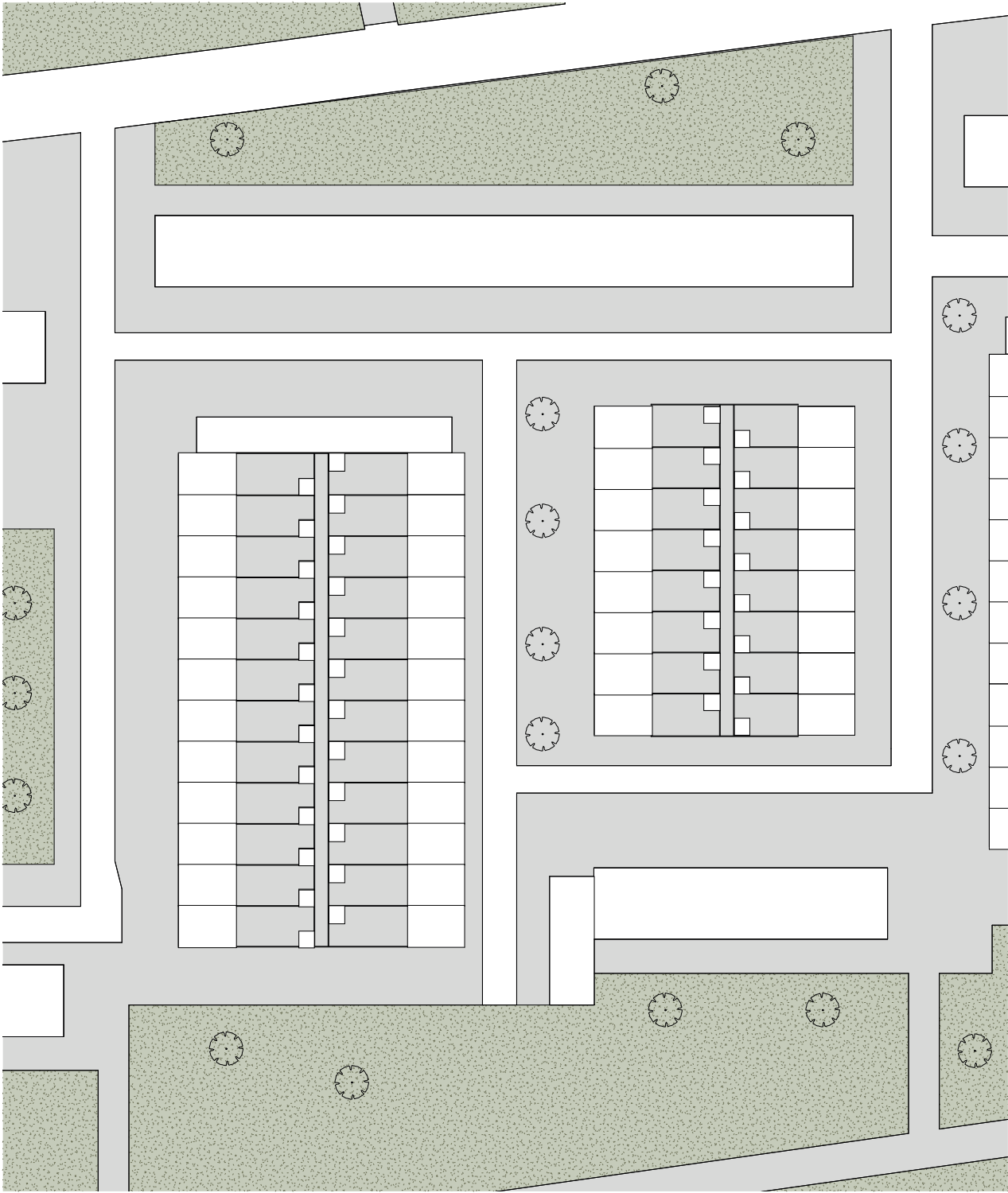
Alters space usage, hard transitions from anonymous public areas

Strategy | **Use of space**



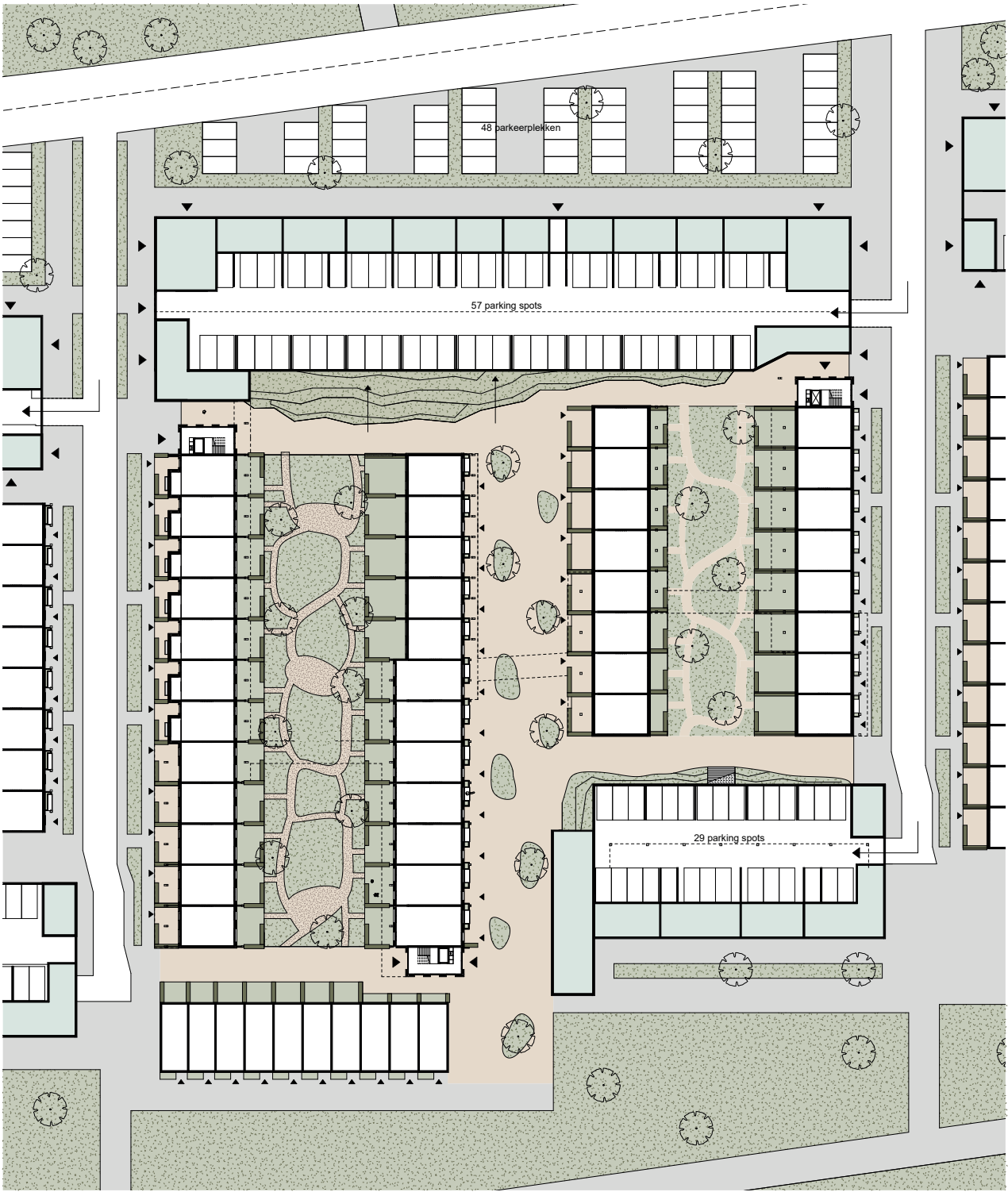
Row house keeps it function but the transitions from public to private are softer, more space is given to collective use encouraging interactions.

Design | Existing plan



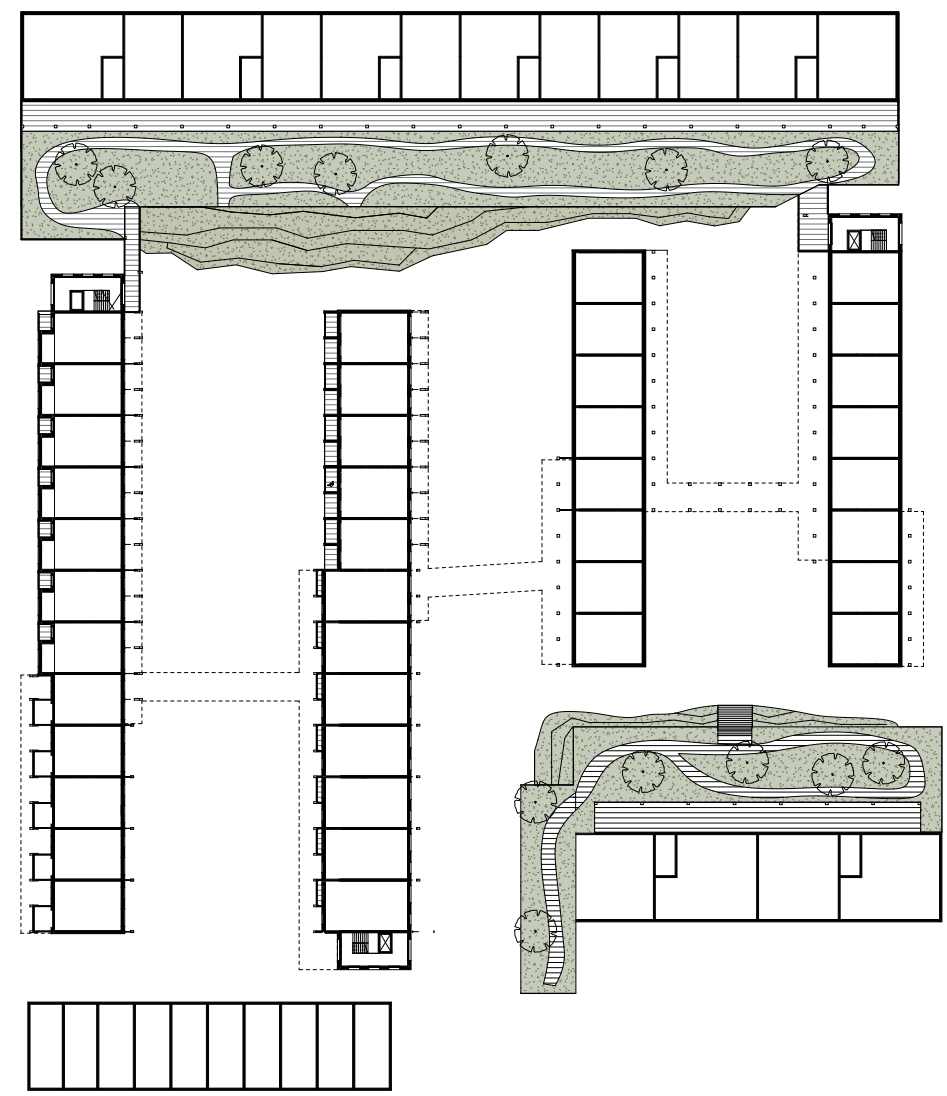
Existing plan block

Design | **Ground floor**



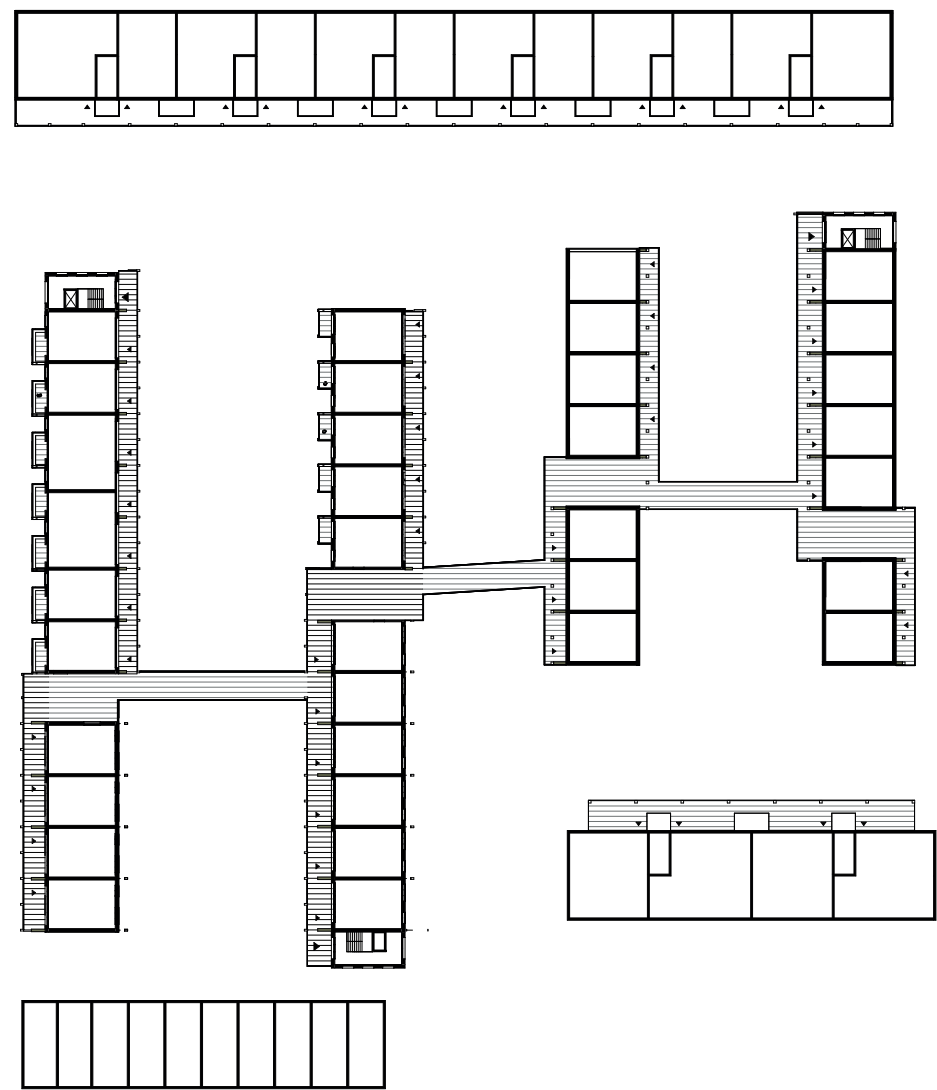
Garages, collective functions, work, washing, small buinesses
workshops spaces, row is added to enclose the block, three different
'streets'

Design | **First floor**



The collective gardens extend onto the garage decks, where vegetable gardens are located.

Design | **Second floor**



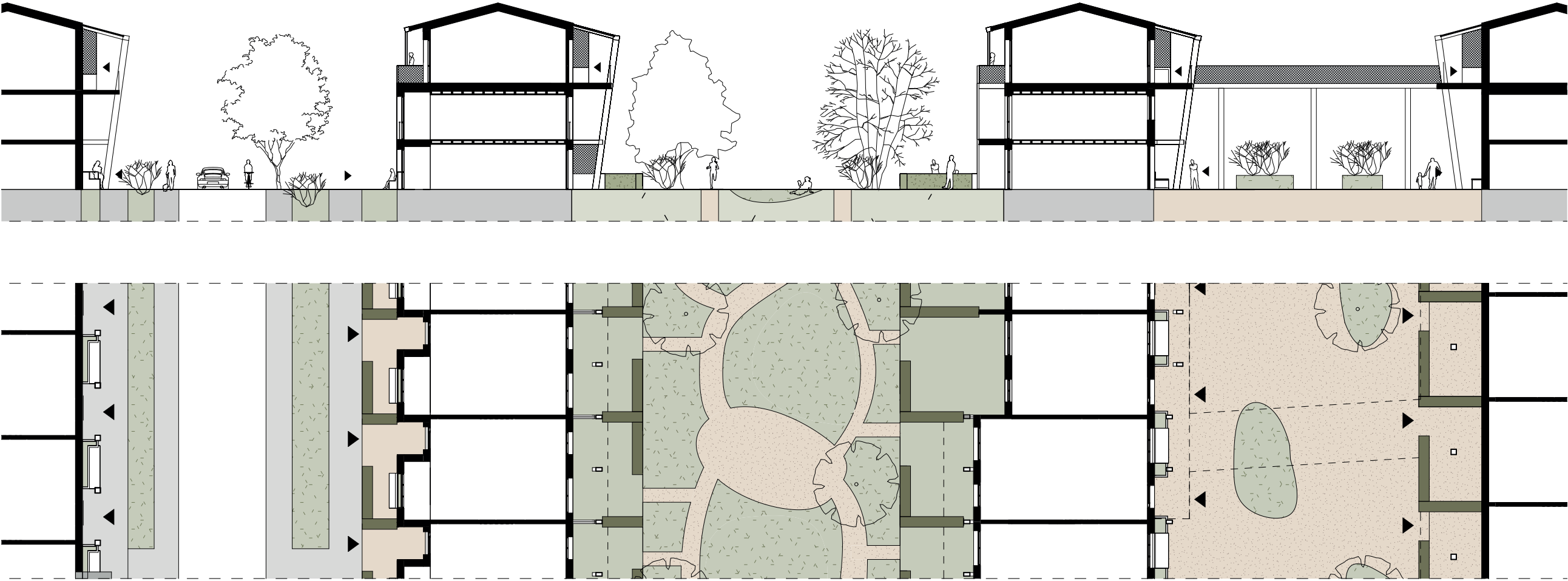
Gallery, accessible by stairs and lift cores
attached to the end walls of the houses

Design | **Densification**

	Existing			New		
	Percentage	Number	Size m2	Percentage	Number	Size m2
Total	100	92		165	152	
Family houses		40	100	30%	46	100
Apartments		52	80	30%	46	80
Single person houses				20%	30	50
Two persons houses				20%	30	75
Social housing	80					
Community space						260
Public space						780
Parking spots		94			134	

Desify with 65% and a parking norm of 0.9

Design | **street section**



Every street has different levels of publicity, the structures for galleries and outdoor spaces create a separation between public and private

Design | **Livability**



The rowhouses retain their function, but the relationship between private and public is softened to create more liveable neighborhood



Balconies facing the gardens creating social control

Design | **Livability**



And make it possible to interact with people in the garden, watch children that play here



There are many benches on the streets and in facades
that encourage encounters between residents

Design | **Livability**



Outside spaces are integrated in the gallery, even when it rains people can stay here and meet their neighbours.



Garden dividers have been lowered at the ends of the gardens, encouraging interaction



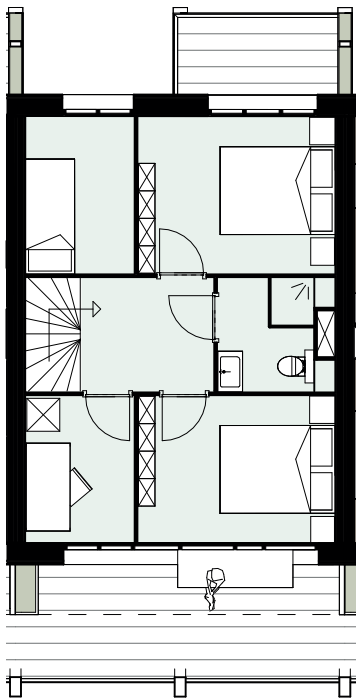
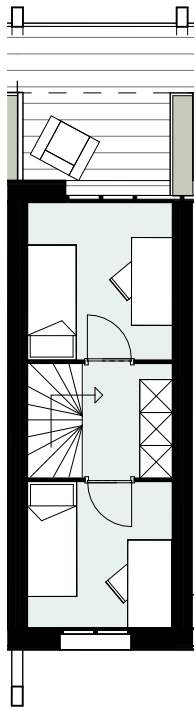
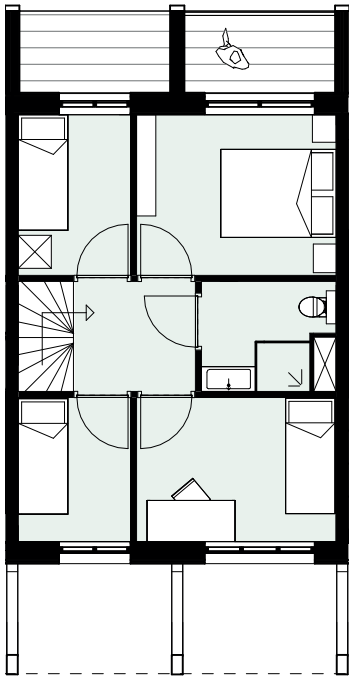
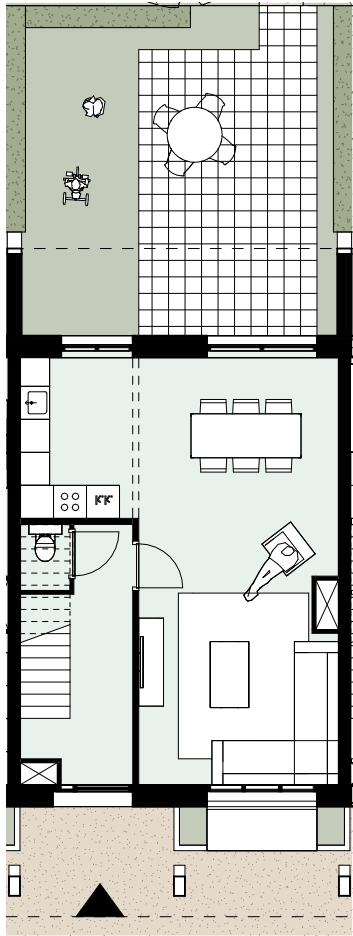
But at the same time, the vegetation provides an extra buffer and gives both the residents and the people in the garden more privacy

Design | Existing houses



The existing layout is retained as much as possible but can be adapted to the wishes of the residents, who can opt for an extension or new bathroom or kitchen

Design | Housing types



Families
100 m2

+0.5 grid
Families
125 m2

+1 grid
Families
150 m2

Existing houses al suitable for families, bigger families
can extend their house with the top up

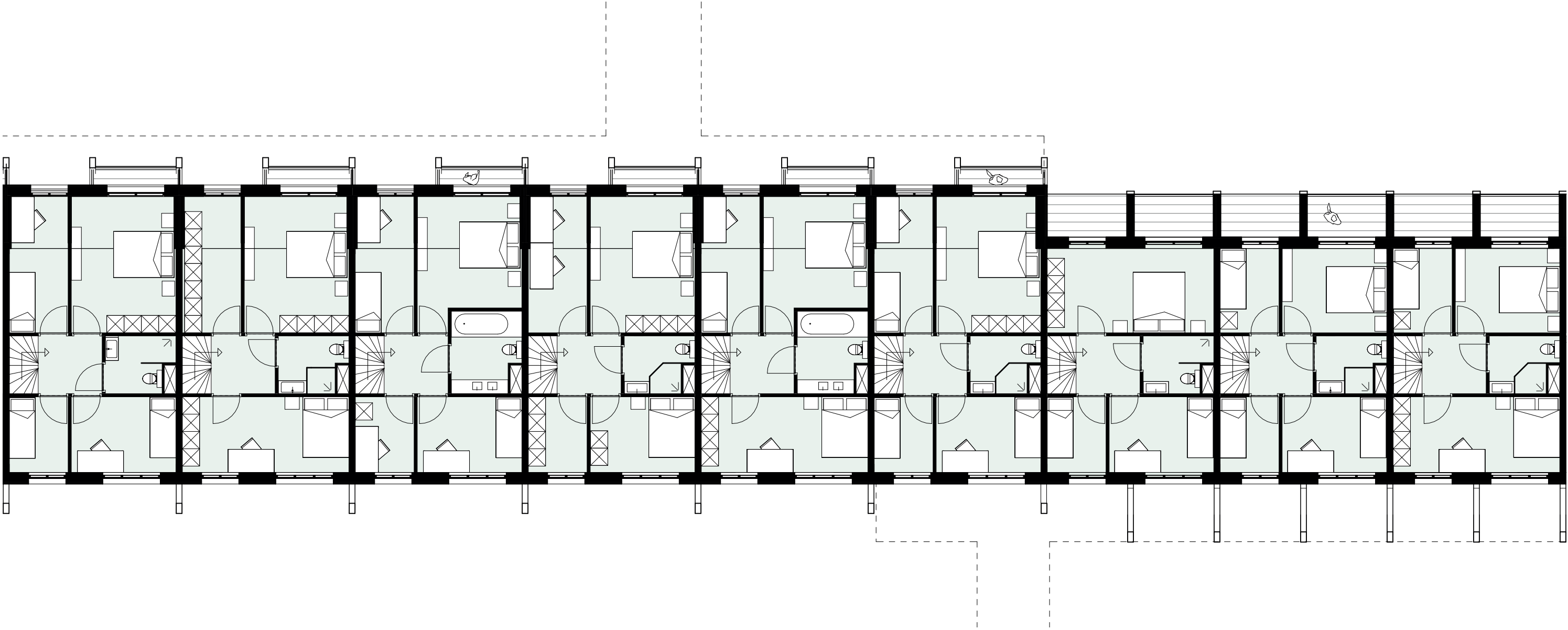
Design | **Ground floor**



Different configurations of family houses transformed to the wishes of the owners



Design | **First floor**



Different family houses



Design | **Second floor**



Single parent
70 m2



Empty nesters
70 m2



Elderly
70 m2

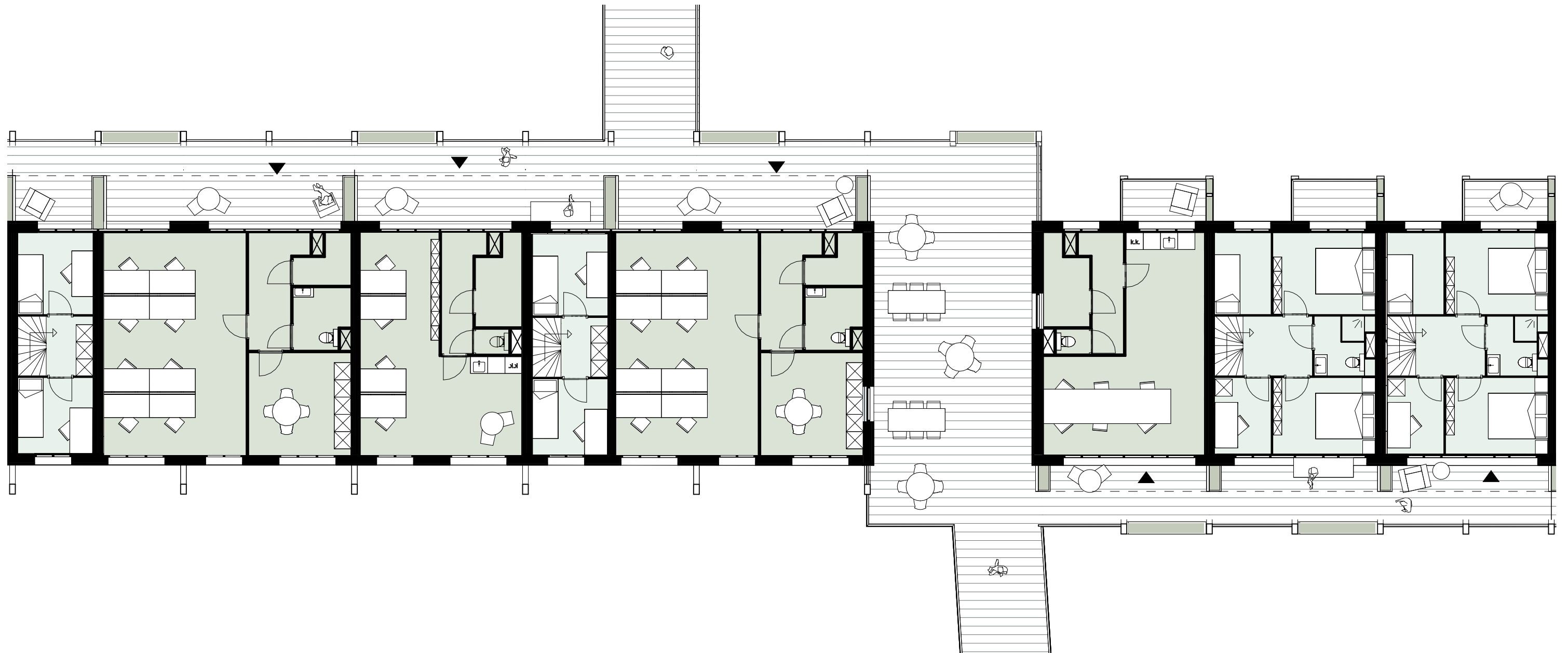


Starters
50 m2

Different housingtypes, galleries wider on the south side, private outside spaces

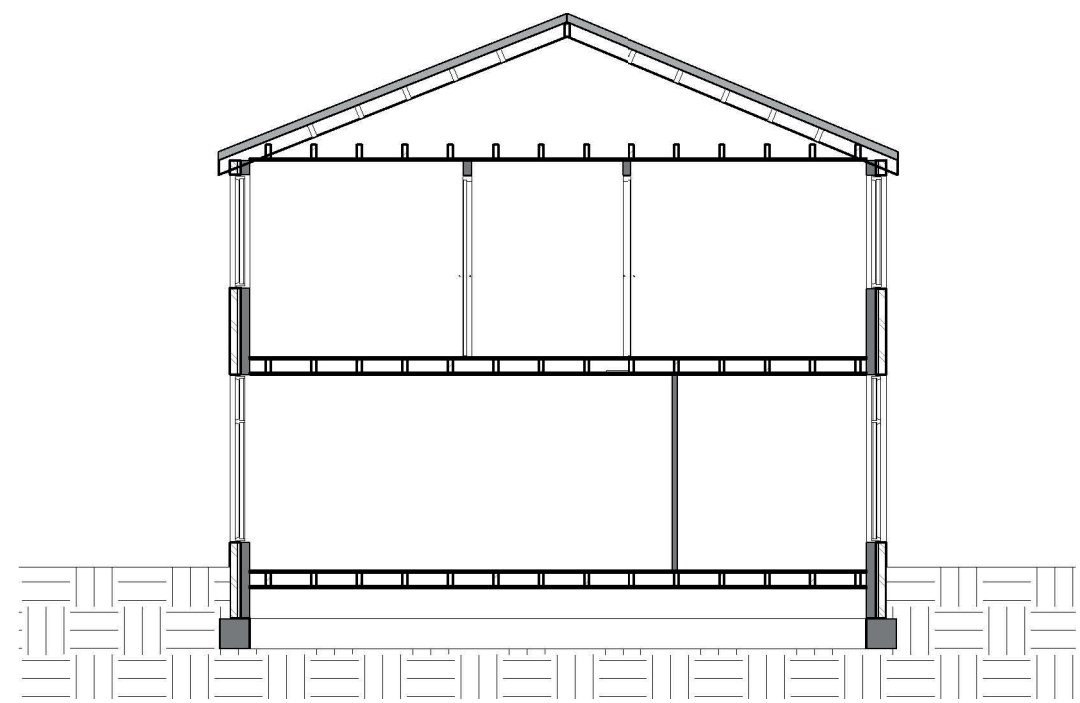


Design | Second floor



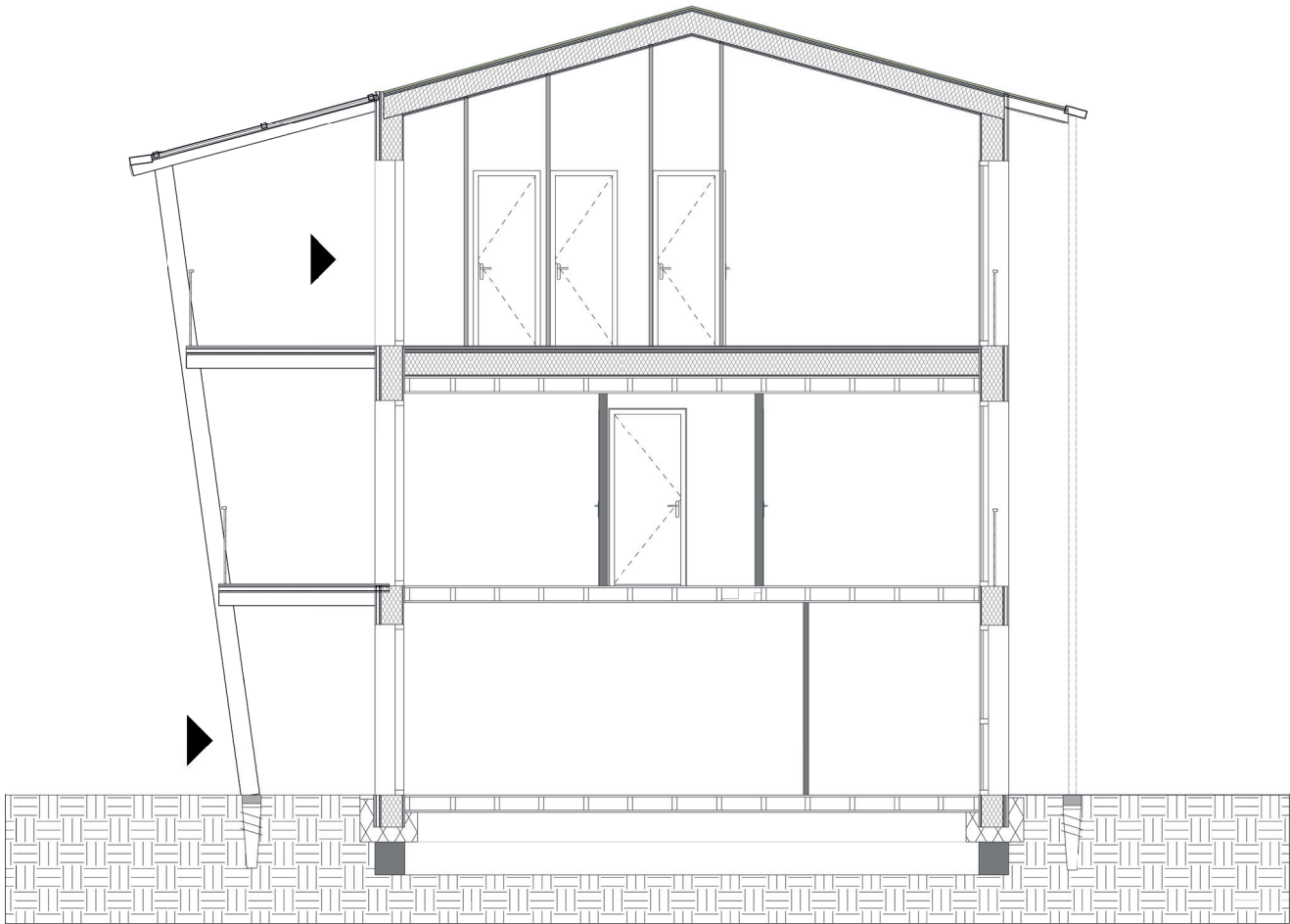
When there is no need for houses anymore,
these spaces can be used as offices or workshop
spaces because of the separated access

Design | **Existing section**



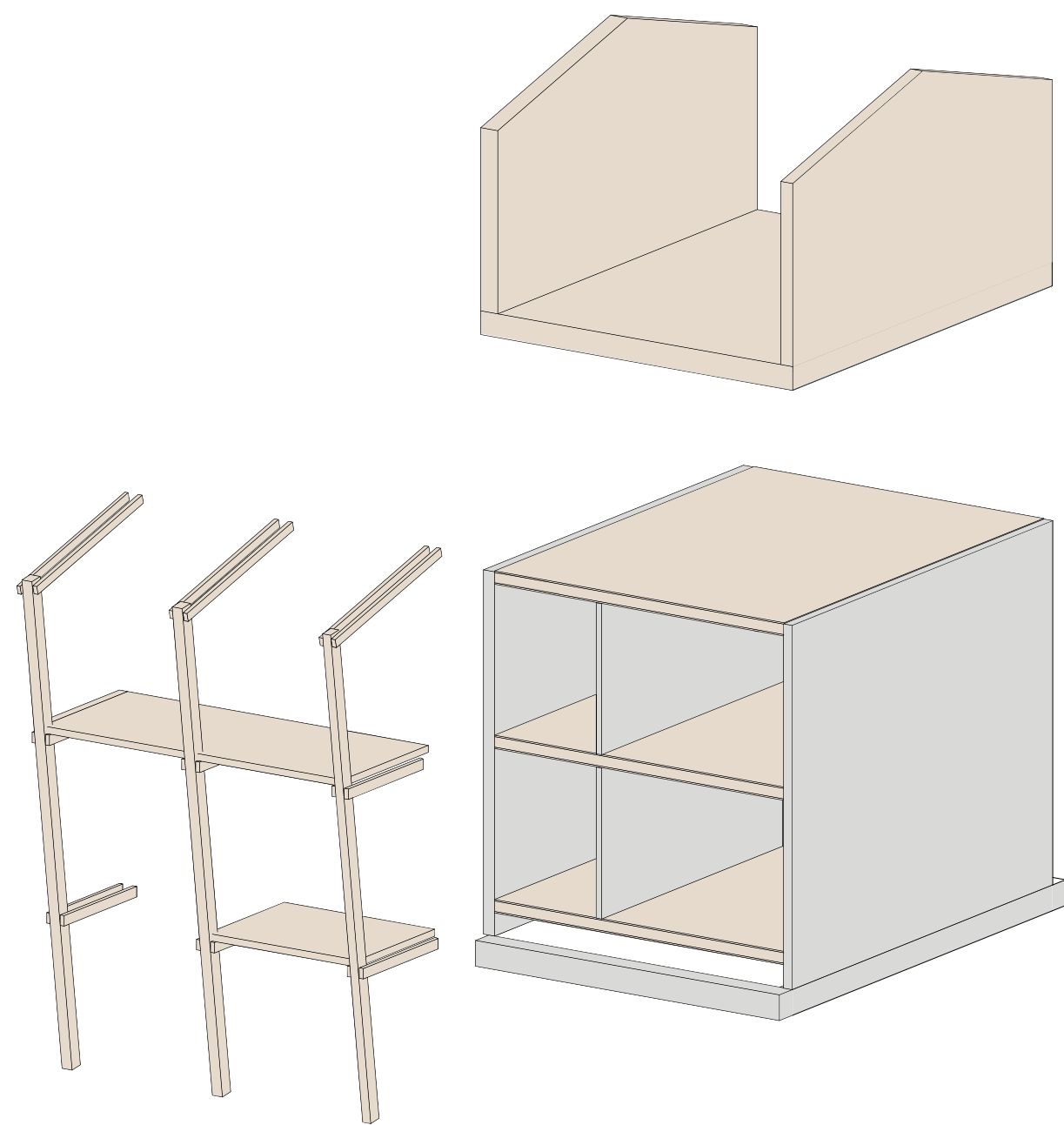
The top up is placed on top of the exsiting construction

Design | **New section**



A new housing unit is placed on top and a gallery
is attached

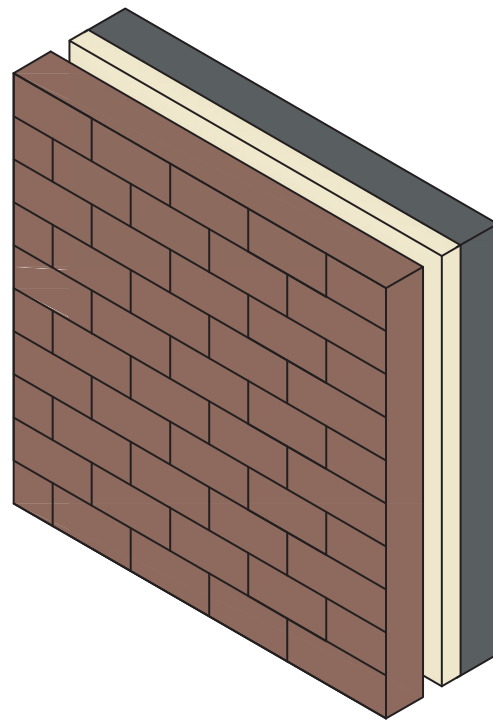
Design | **Construction scheme**



The top up is put up on the existing construction, the extension and galleries rest on a new screw foundation

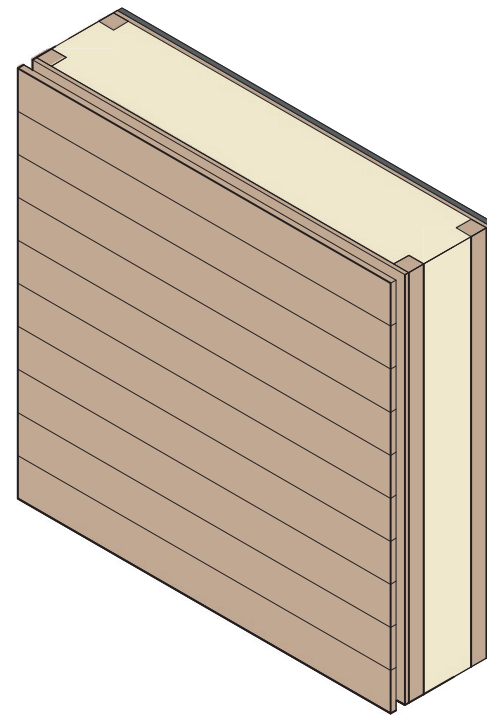
Design | **Weight**

440 kg



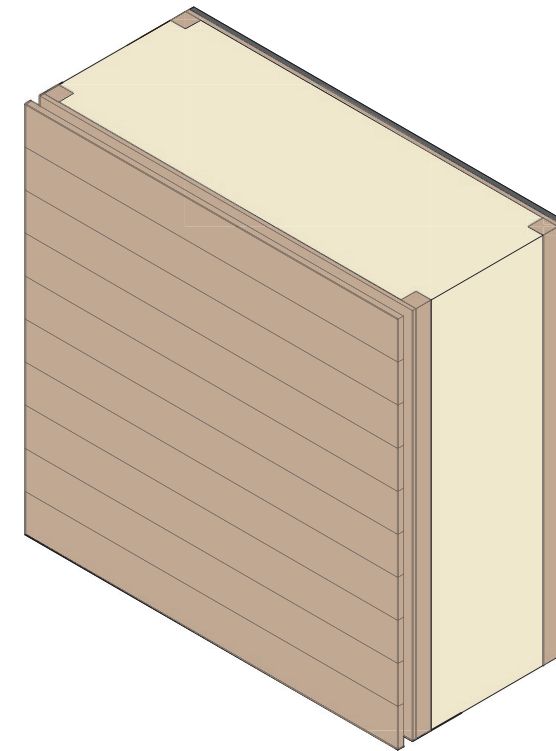
- Concrete inner wall
- PIR insulation
- Brick facade

46 kg



- Timber frame wall
- Flax insulation
- Wooden facade

110 kg

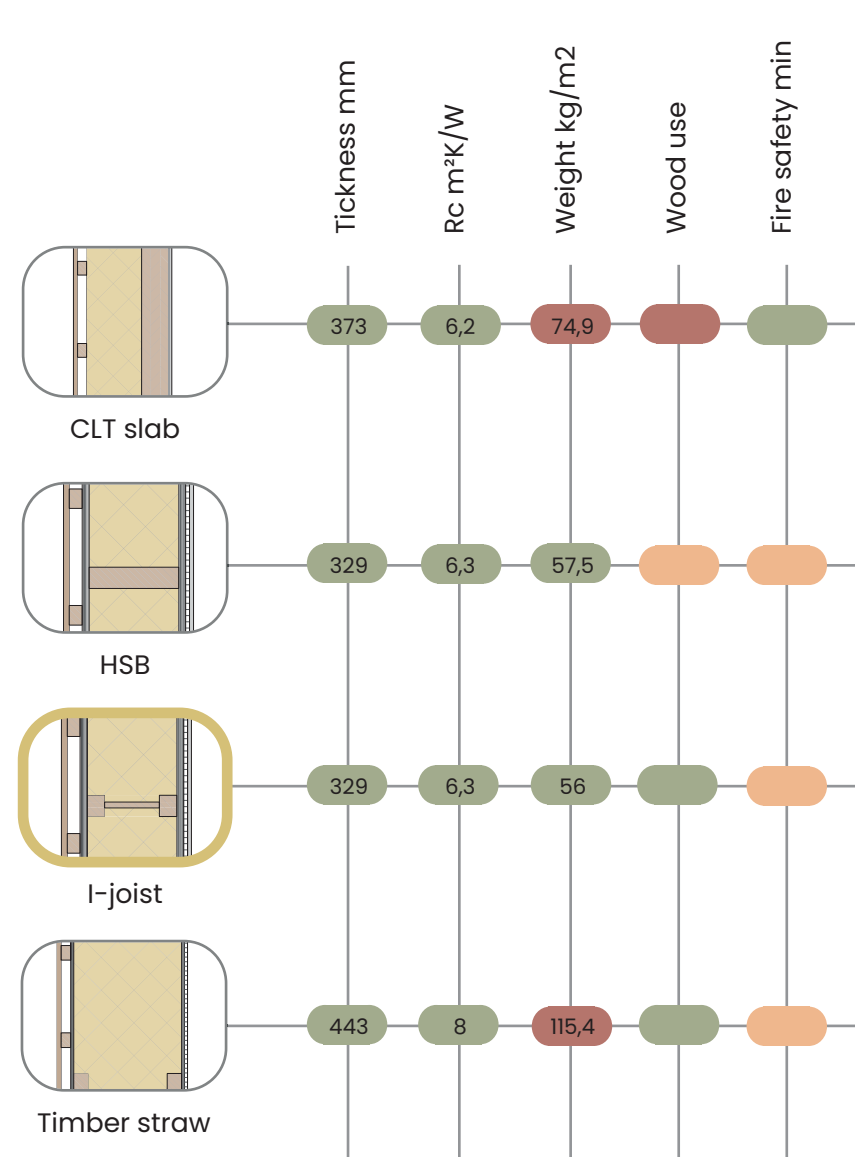


- Ecococon element
- Straw insulation
- Wooden facade

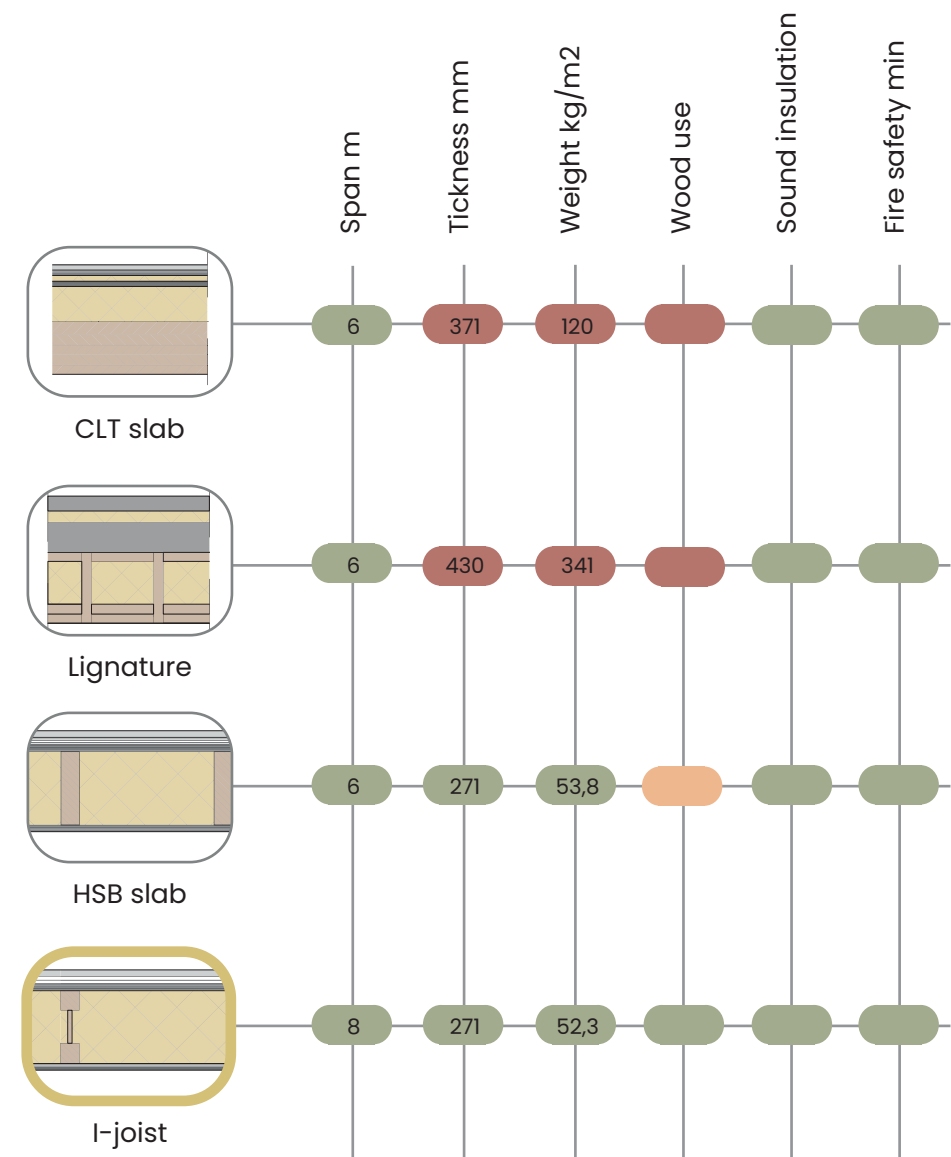
To remove weight from the existing construction
there is looked at different wall structures and
their weight per m²

Design | **Assemblies**

Wall assembly

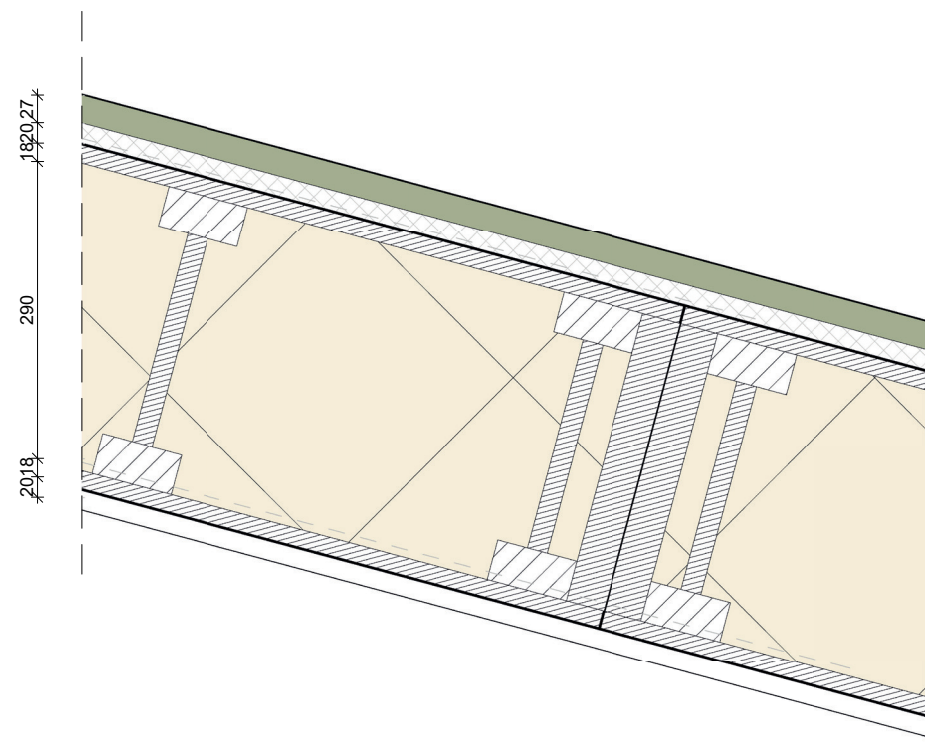


Floor assembly

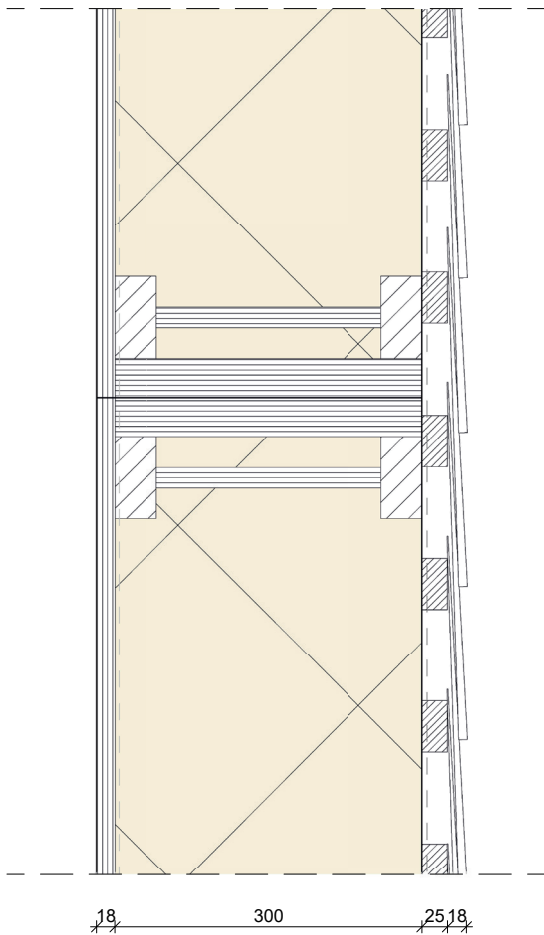


Using the product develop methodology the most efficient wall and floor assemblies where chosen.

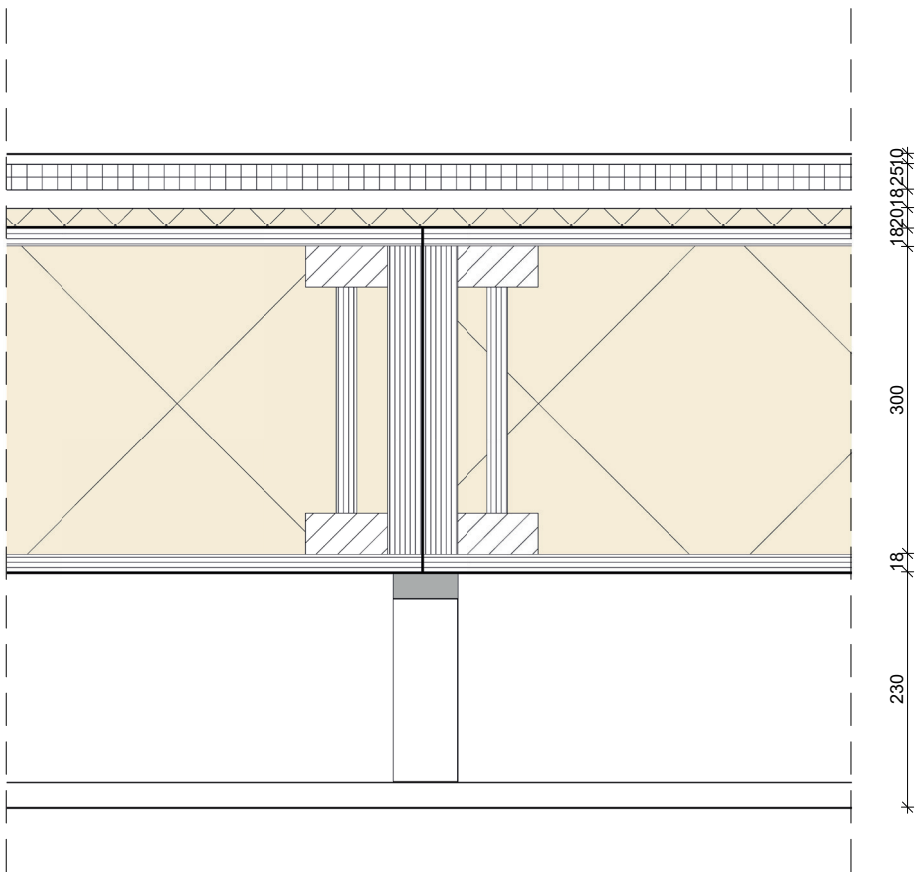
Design | **Assemblies**



Roof assembly
50 kg per m2



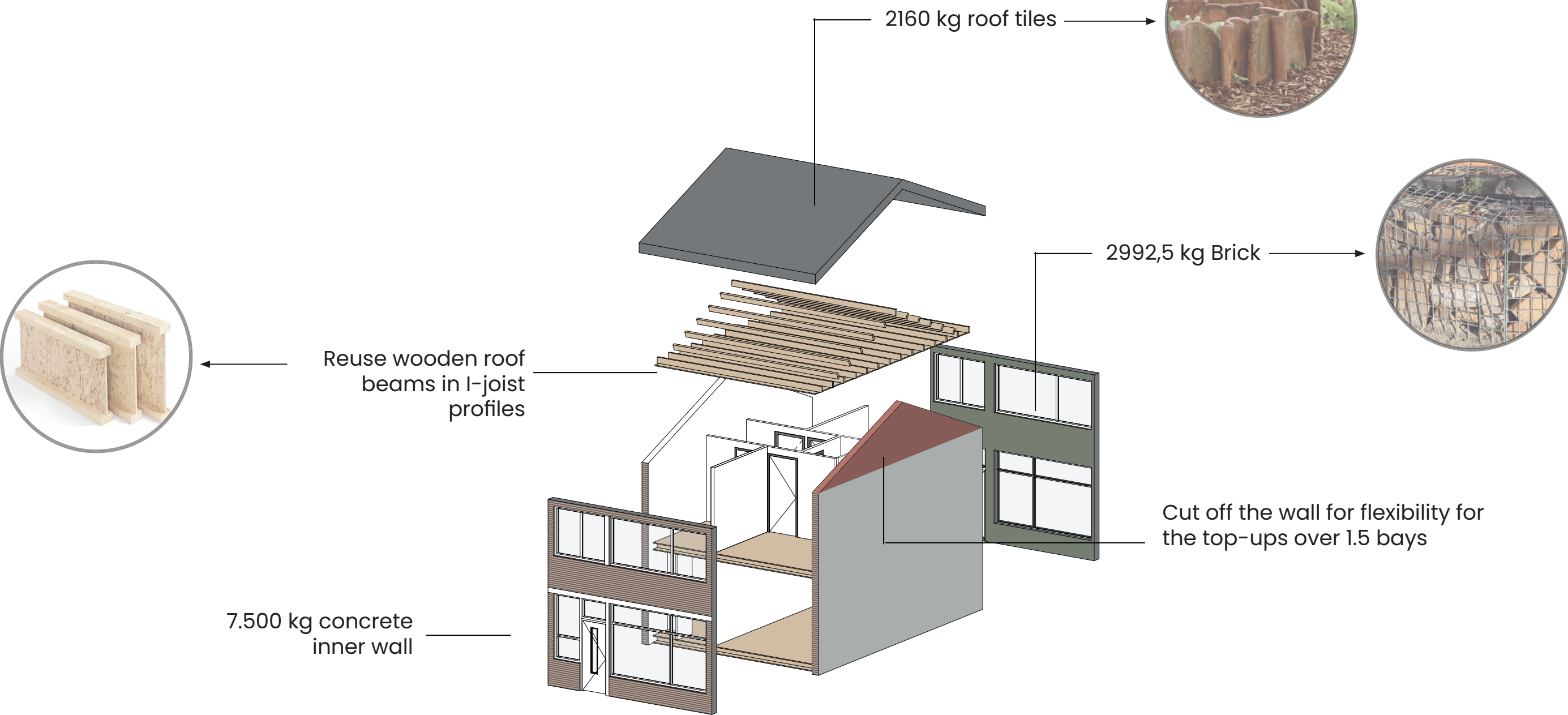
Facade assembly
46 kg per m2



Floor assembly
100 kg per m2

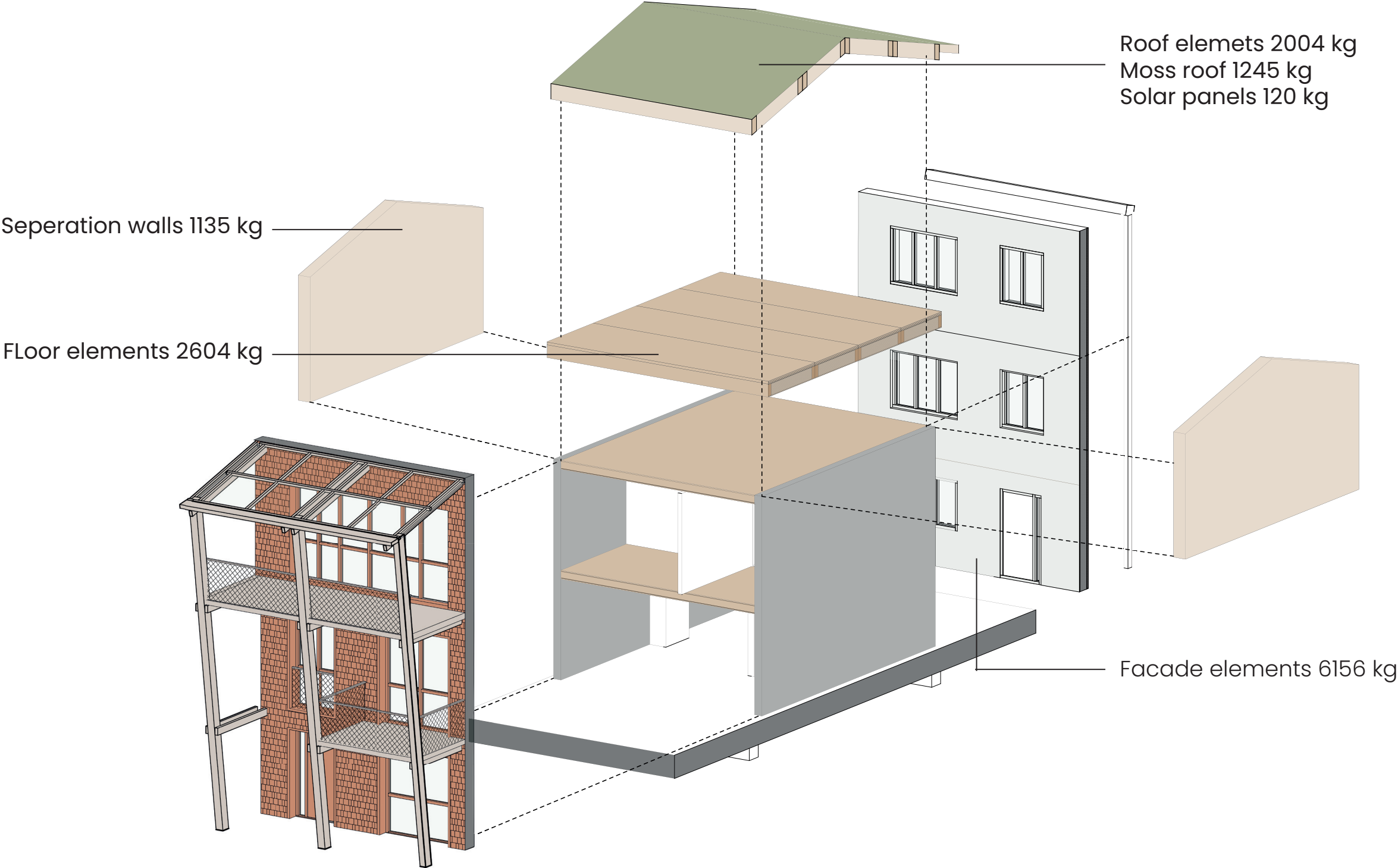
i-joint profiles with flax insulation, due to the efficient use of wood and the light weight

Design | **Exsiting construction**



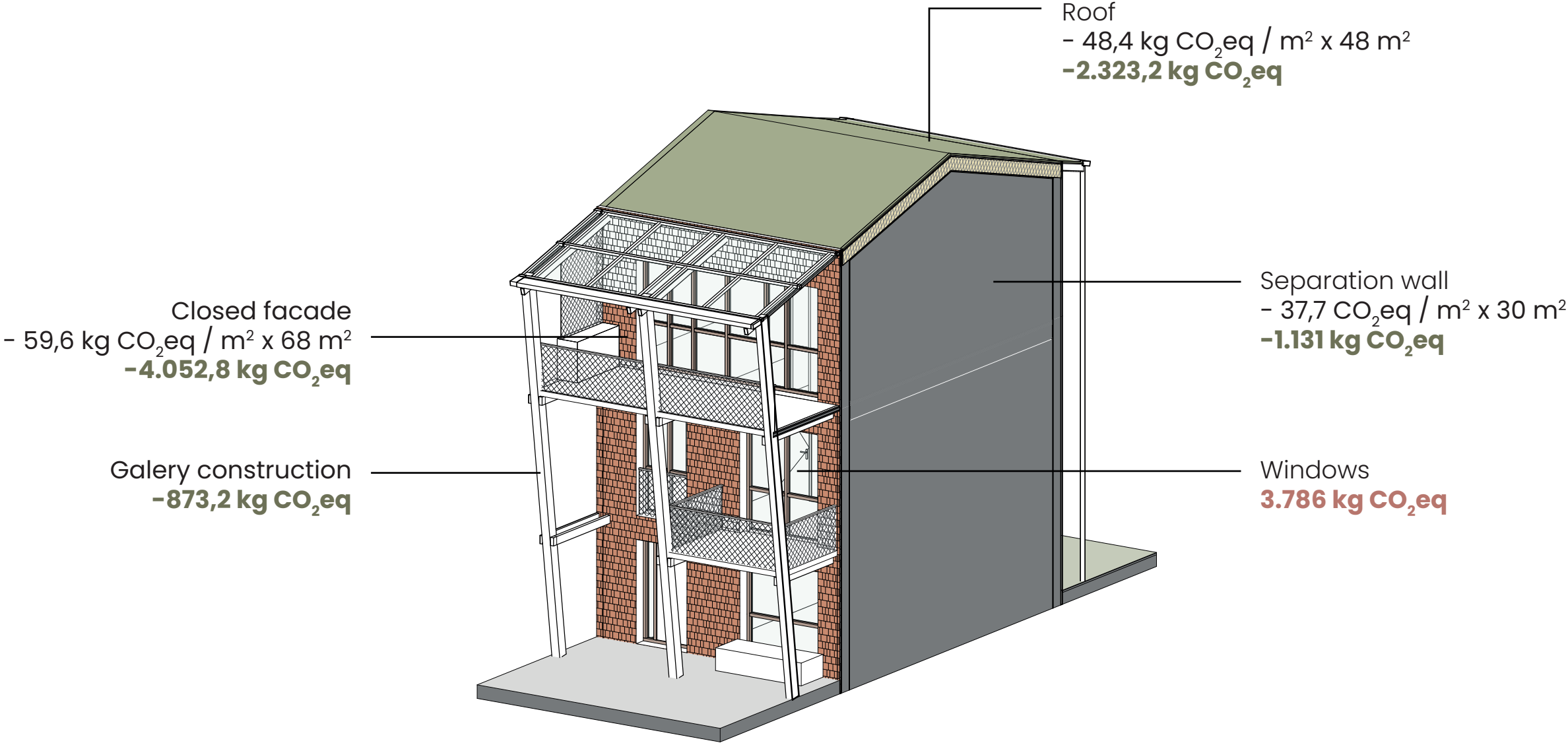
Total weight that can be removed from the house
12.660 kg

Design | **New elements**



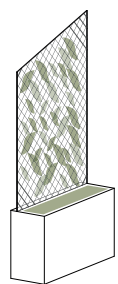
Total weight added
13.264 kg

Design | **New elements**

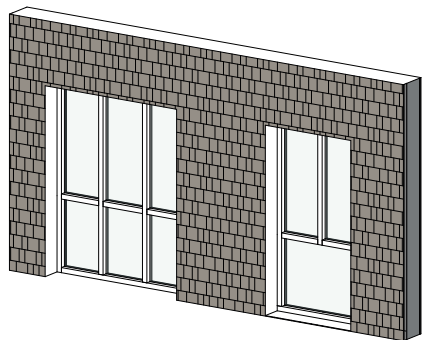


The materials have a GWP of **-4594 CO₂eq** which means CO₂ is acctually stored in the construction (CINARK)

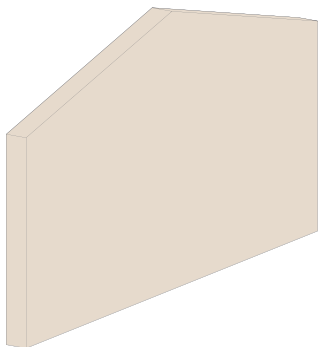
Design | **Building elements**



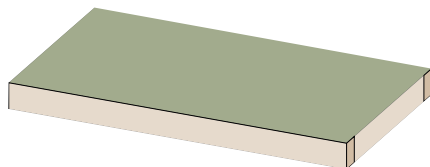
Separation planter



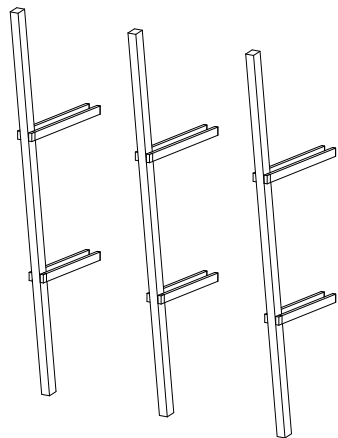
Facade element



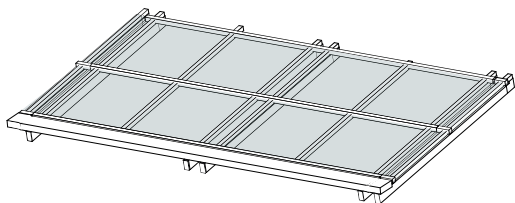
Separation wall



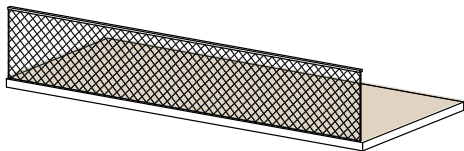
Roof element



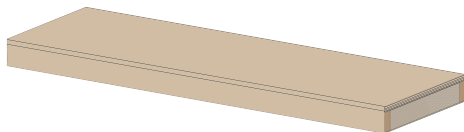
Beams and columns



Gallery roof



Gallery



Floor element

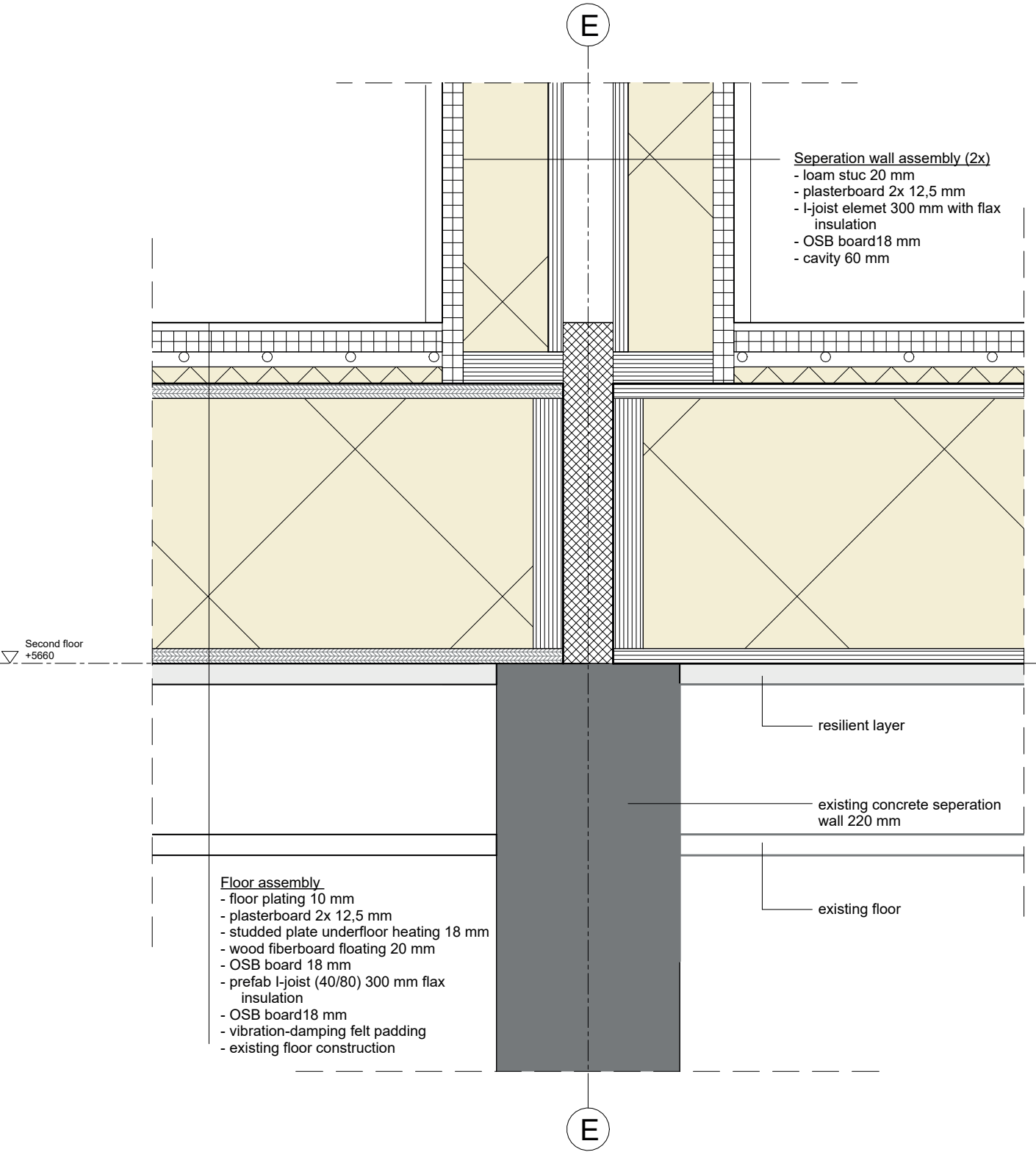
The new construction consists of prefabricated
1D en 2D elements that ensure a fast construction
time

Design | **Fragment**



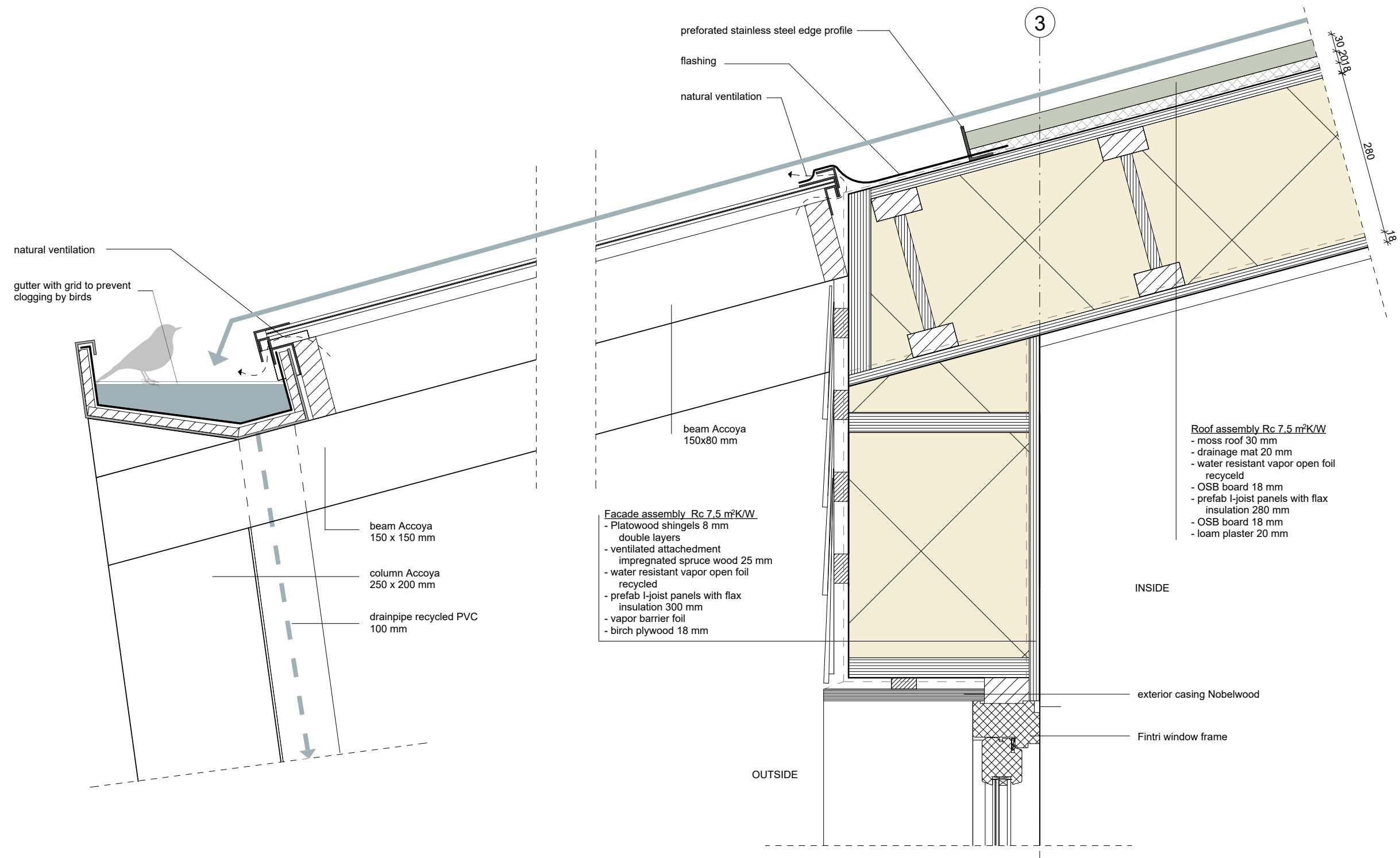
For the extentions new screw foundations are used

Design | **Detail top up**



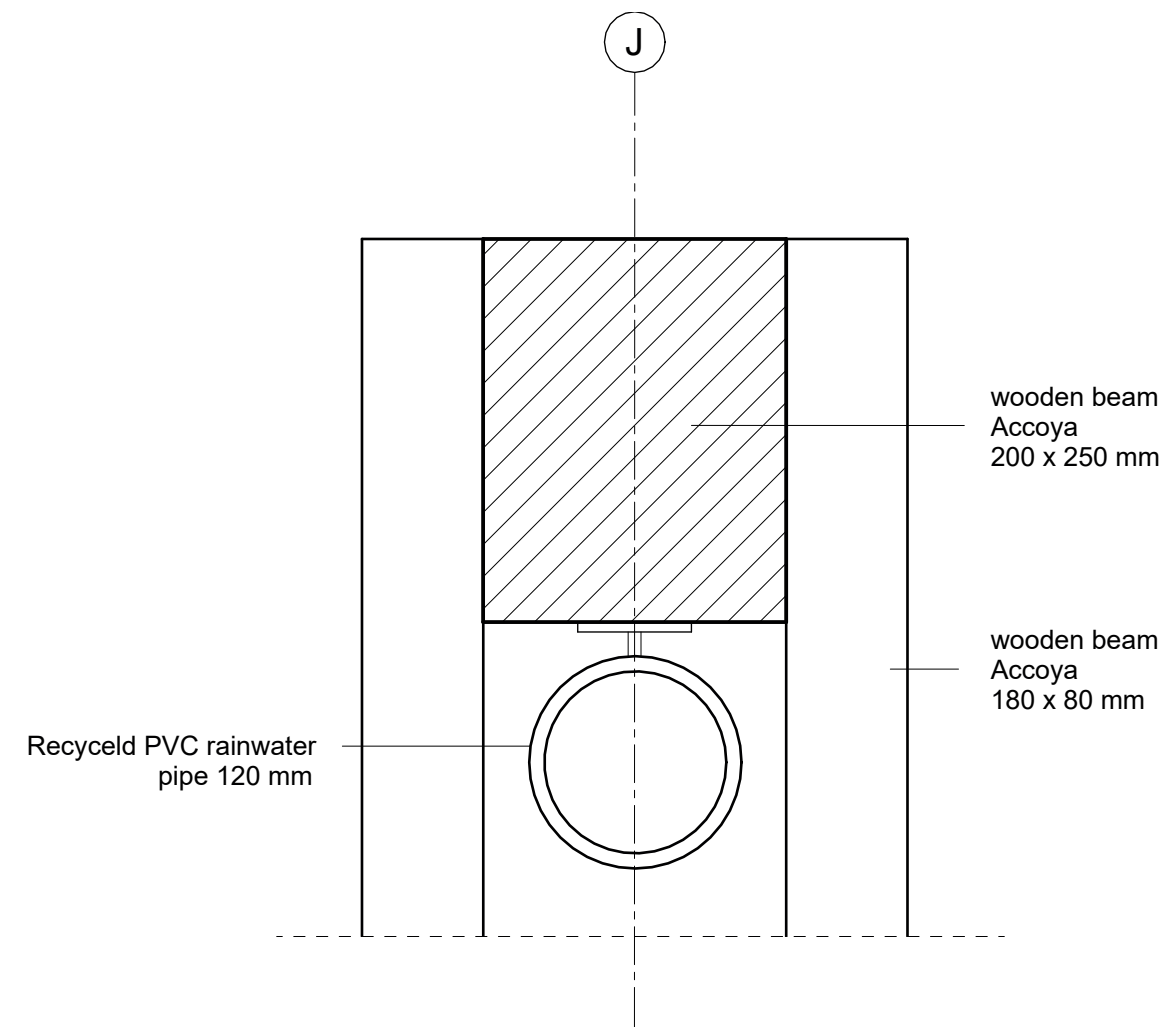
Existing floor functions as an air cavity for
additional noise insulation

Design | **Detail rainwater drainage**



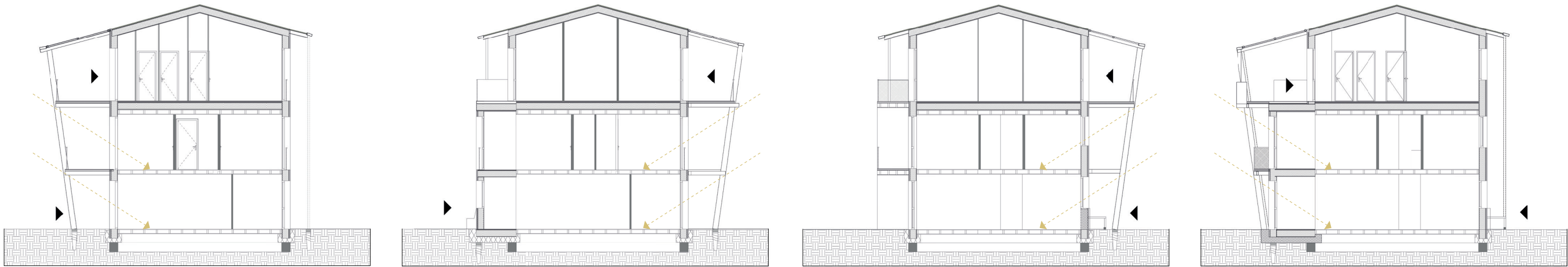
The water drainage goes over the green roof and the glass of the gallery to a gutter that can also be used for birds to bathe in

Design | **Detail rainwater drainage**



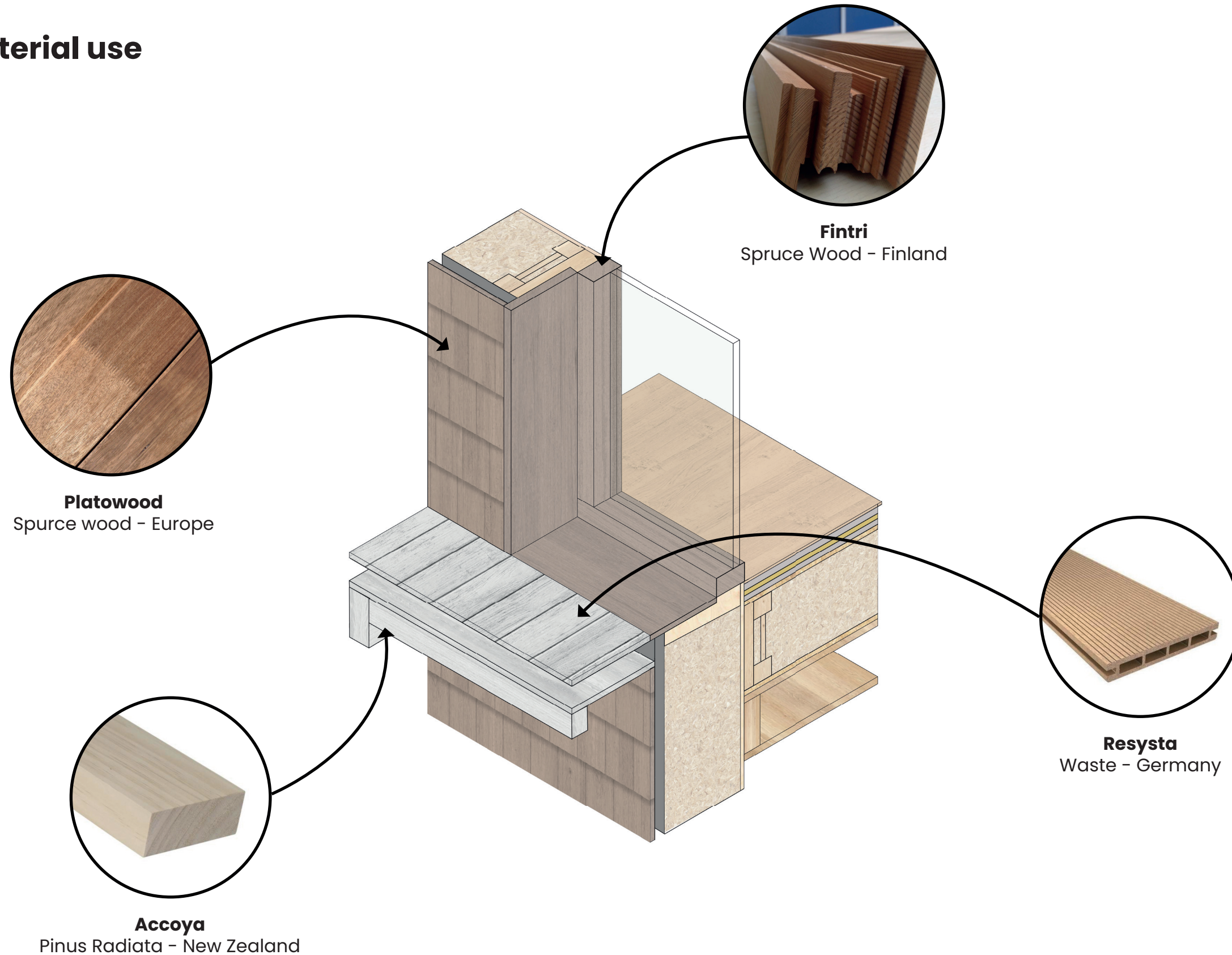
The waterpipe of recycled PVC is hidden behind the column between two small beams

Design | **Sections**



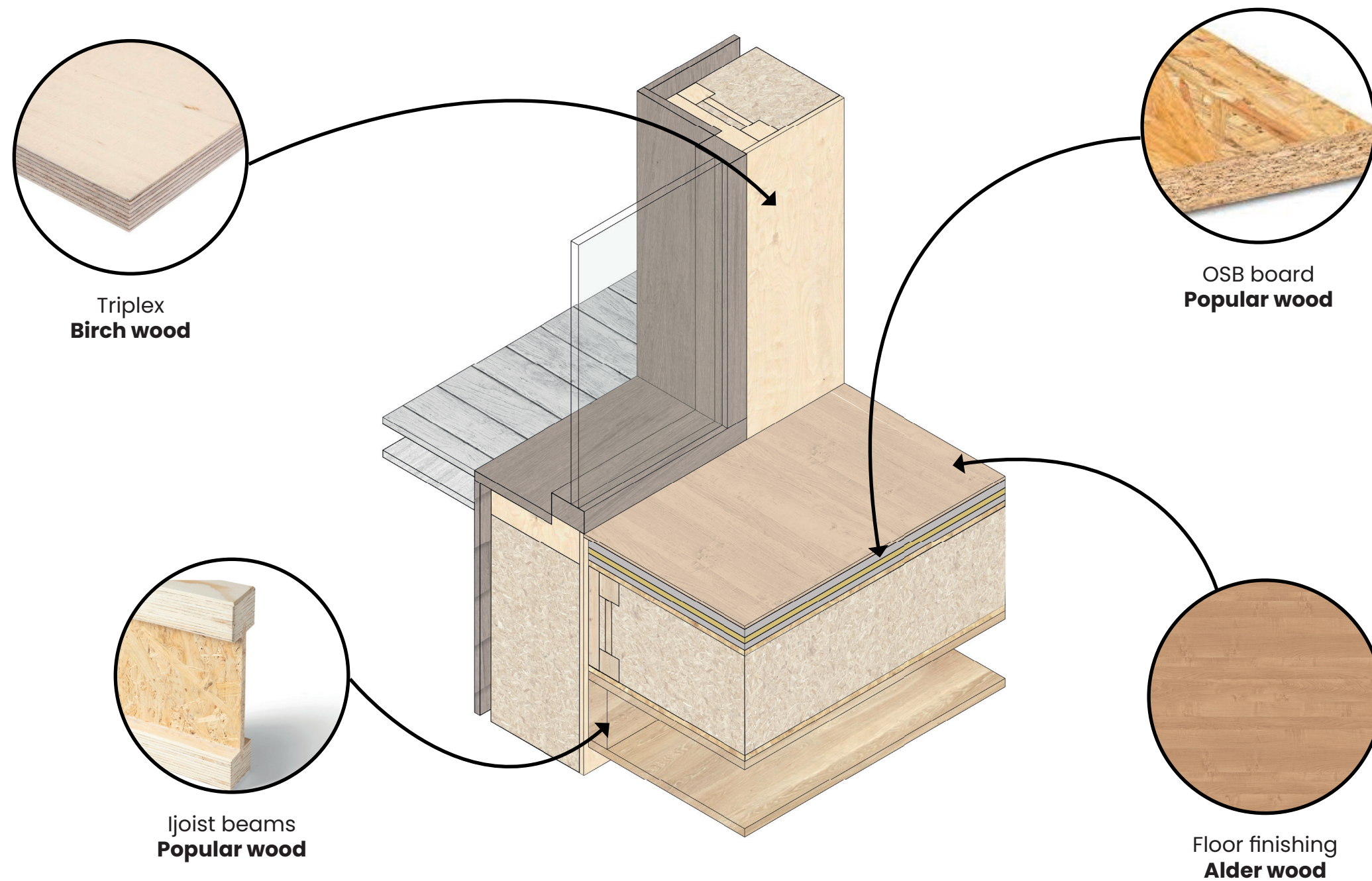
Different sections, all with overhang to protect the biobased facade, columns are placed in an angle to generate more daylight on the ground floor

Design | **Material use**



Despite the overhang, processed materials with a long lifespan are used, chosen according to the research, to withstand various weather conditions effectively.

Design | **Material use**



Inside the home, materials with a lower durability class are used, with wooden finishing which can be customized according to the residents' preferences.

Design | **Architecture**



The existing houses have flat façades, do not have a south or north side and look messy due to their own additions over the years.



Deep ledges



Shingles



Sloped roof



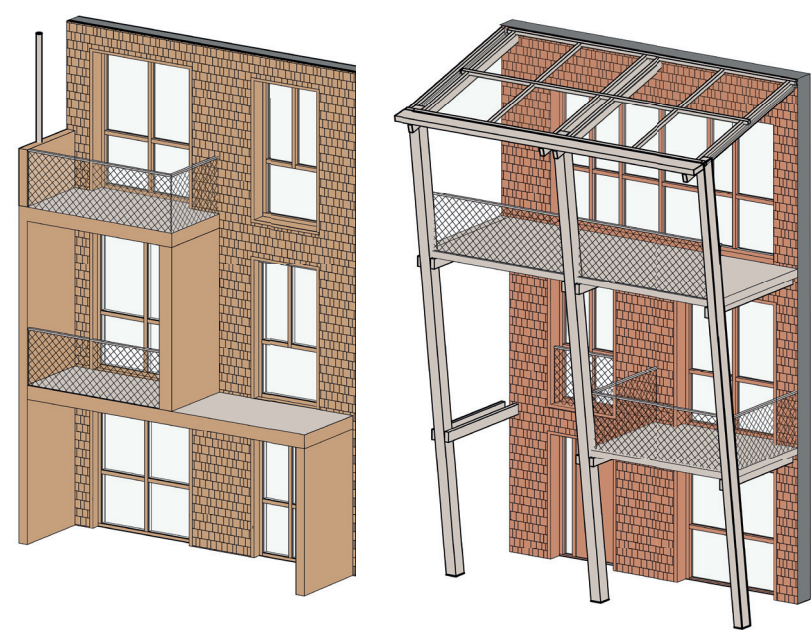
Window frame division



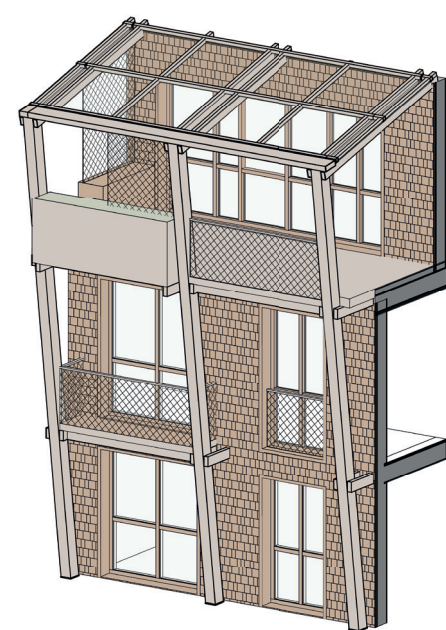
Subtle gallery structure

The new architecture creates a new biobased layer using shingles match the scale of the bricks element deep ledges and window frame divisions create privacy

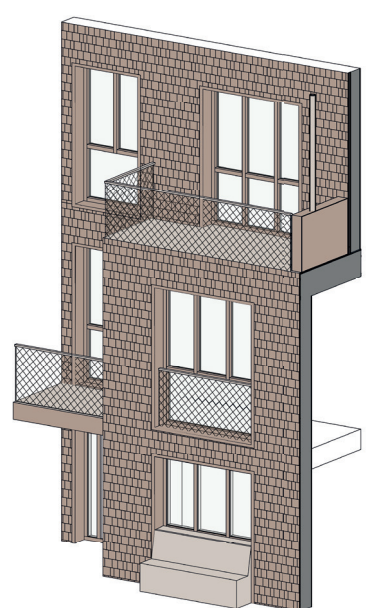
Design | **Facade options**



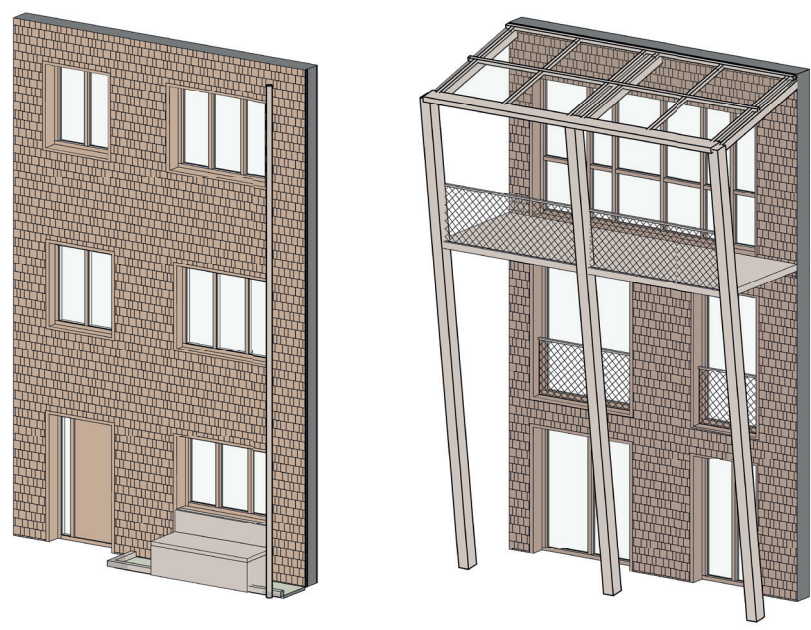
Private outside space



Extension



Only gallery



Whit these principles different facade configurations are made

Design | **Facades**



North facade front 1:200



South facade courtyard 1:200



South facade front 1:200



North facade courtyard 1:200

Configurations create diversity in facade, different colours stained woods recognisable and protect the wood

Design | **Facade**



The facade consists of wooden shingles and recessed frames in the same shade of wood, the structure in front of the facade is made of accoya wood

Design | **Facades**



This wood will gray within a few months, the facade and window frames will be stained to retain their color, easy and not frequent, and protects the wood

Design | **Facades**



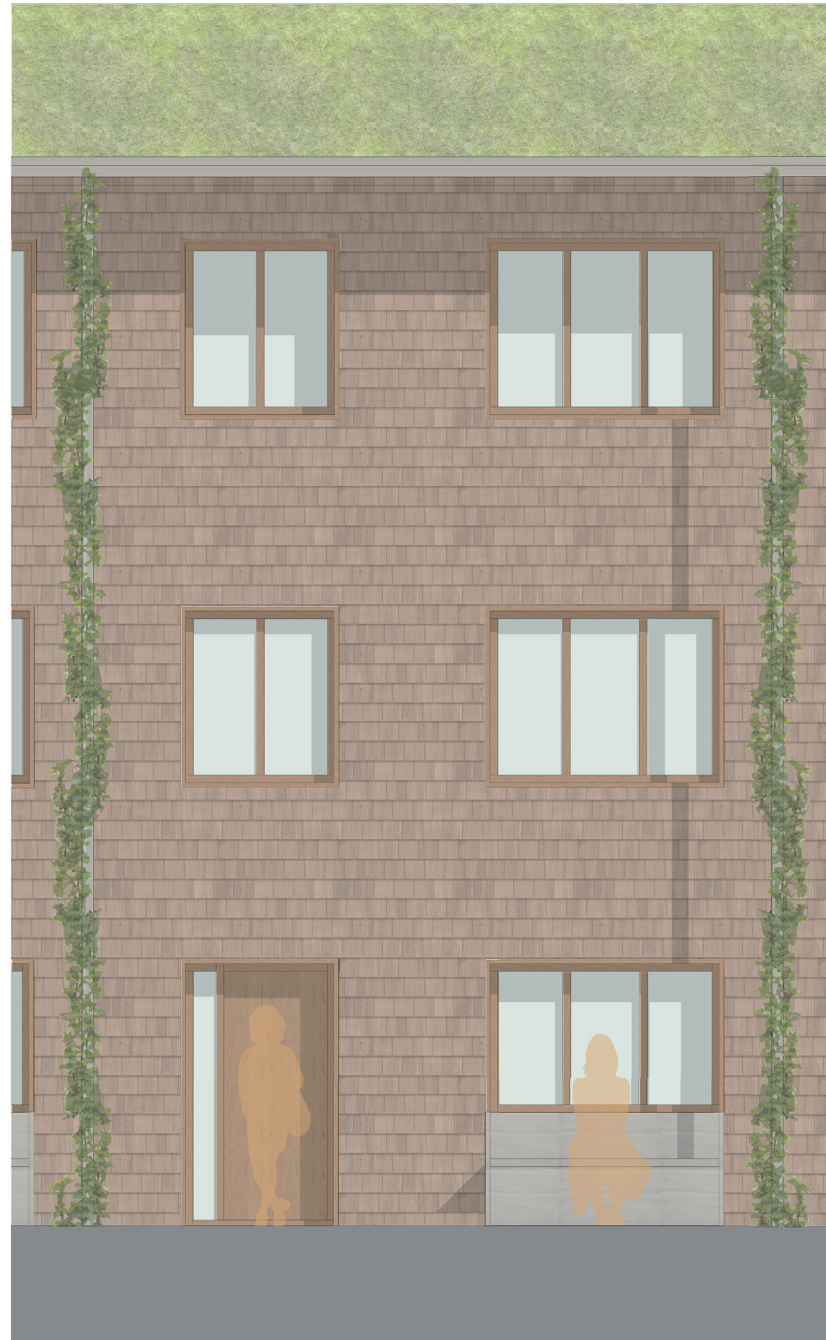
South façades have planters on galleries that block out the sun.
Option to place extra planters or pergula blocking the sun and
creating more privacy

Design | **Facades**



In winter, the plants in the planter do not bloom and more light enters the gallery and living room

Design | **Facades**



Northern façades have smaller frames for less heat loss and a shorter overhang,

Design | **Facades**



On the street side residents can choose whether they want a bench or a planter in front of the door, to possibly encourage meetings.

Design | **Facades**



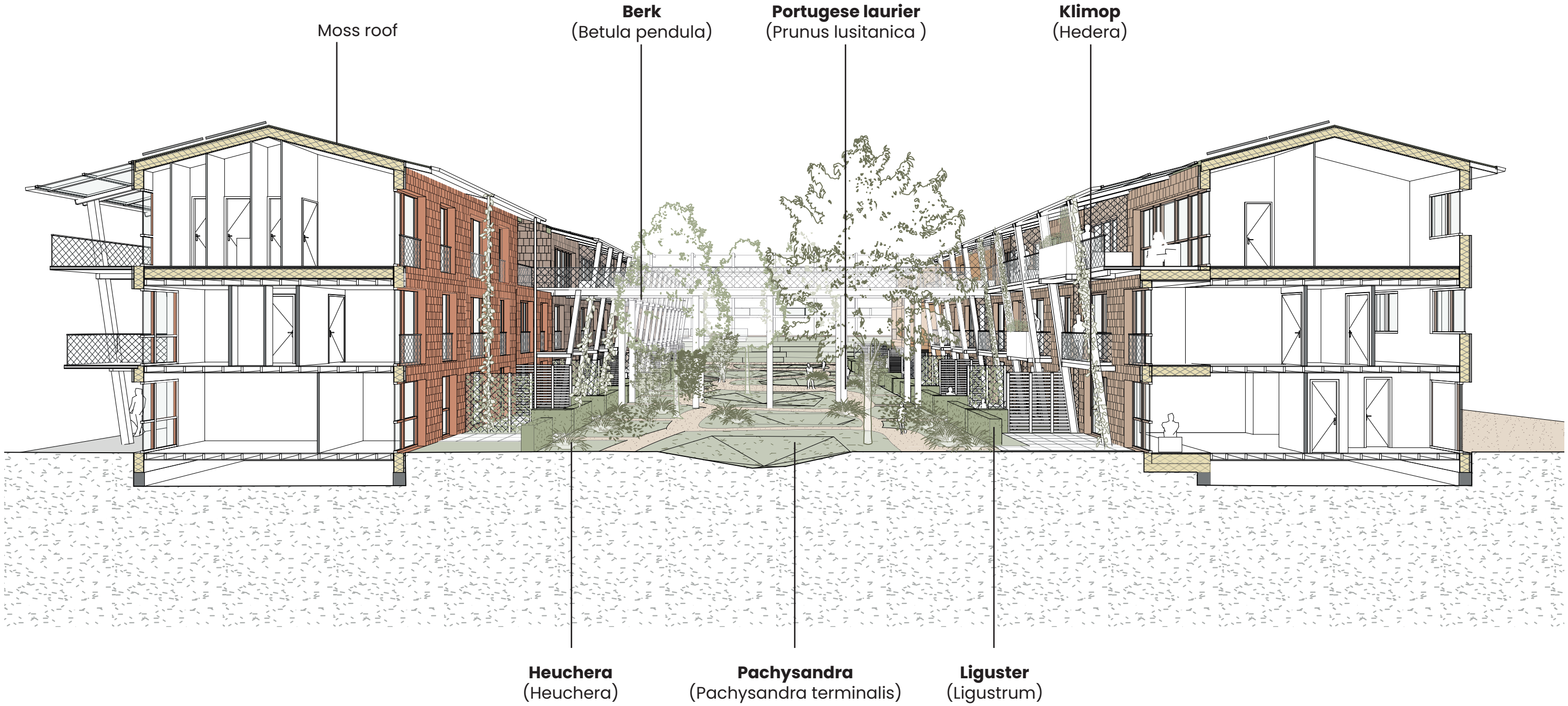
North facades facing the collective garden do have larger frames with French balconies, to strengthen the connection with the garden

Design | **Facades**



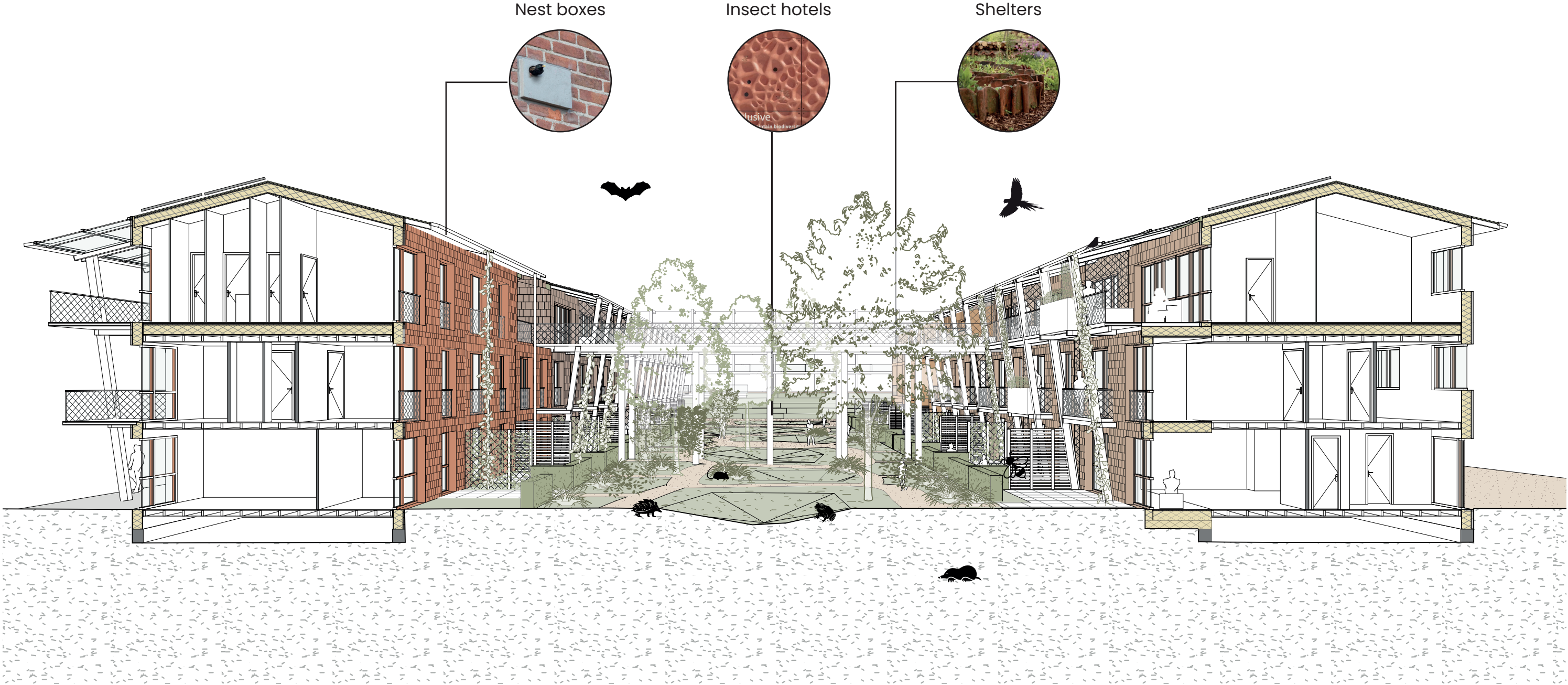
But residents can also choose to add a planter here,
for more privacy

Design | **Biodiversity**

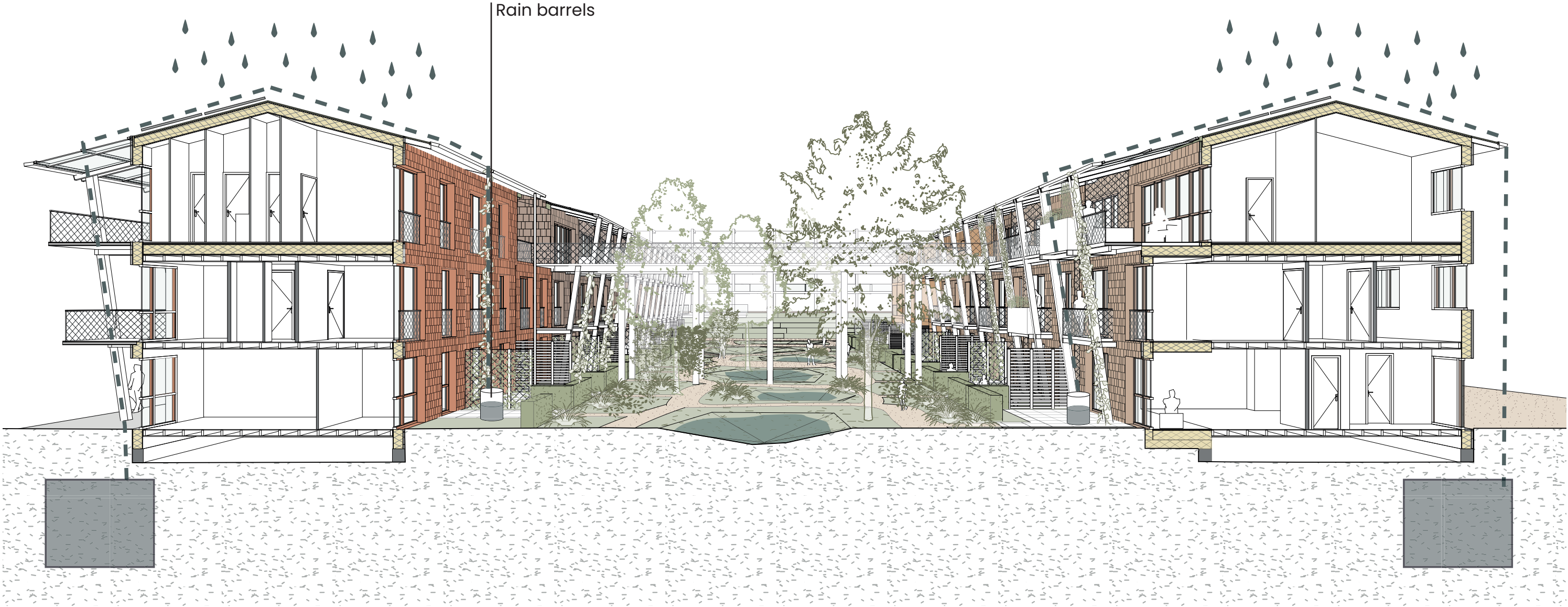


Different trees and plant in de garden also creat privacy for the residents, species that together are green all year round

Design | **Biodiversity**



These, together with the nest boxes, attract small animals and insects

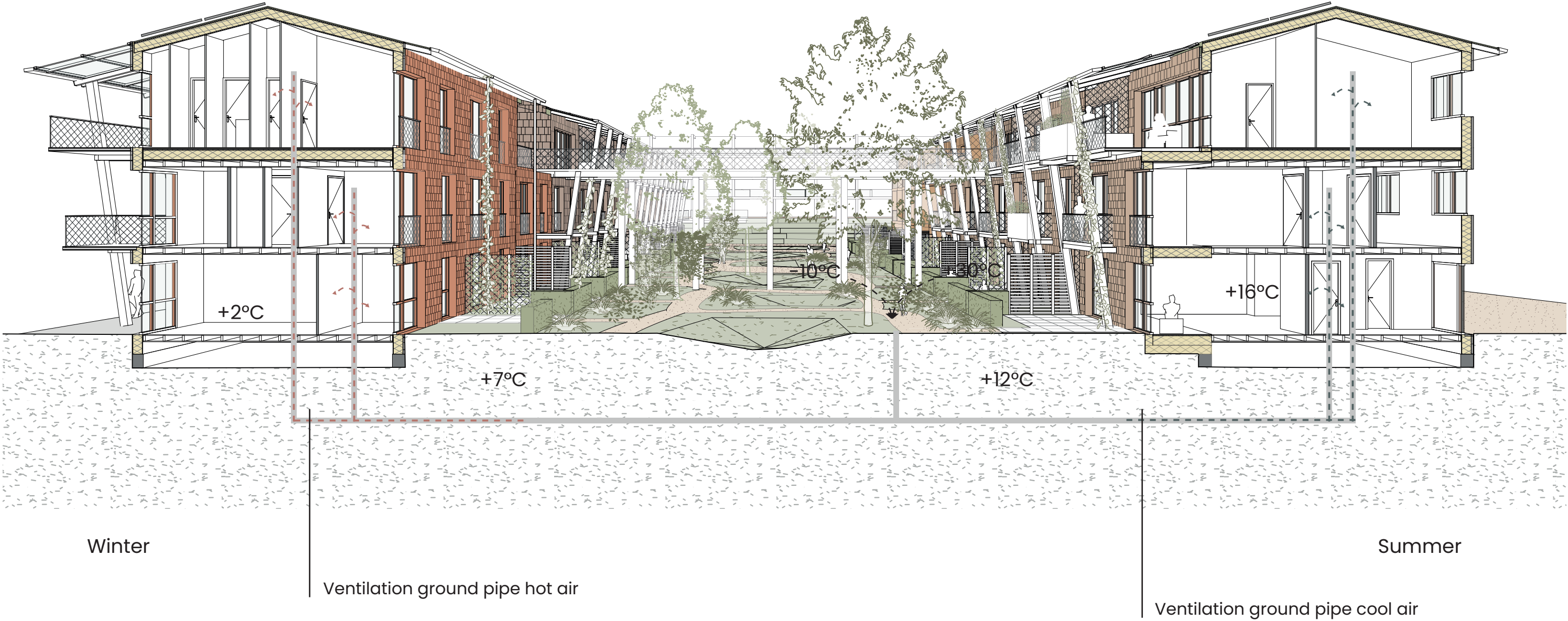


Rainwatertanks in the garden for watering plants.
Wadi's create a water buffer

Design | **Passive climate principles**



Design | **Passive climate principles**



Together with an automated ventilation system

Design | **Active climate principles**



Design | Context



The design can eventually be copied to a lot of similar stamps within the neighborhood

Design | **Context**



Nijmegen



Leeuwarden

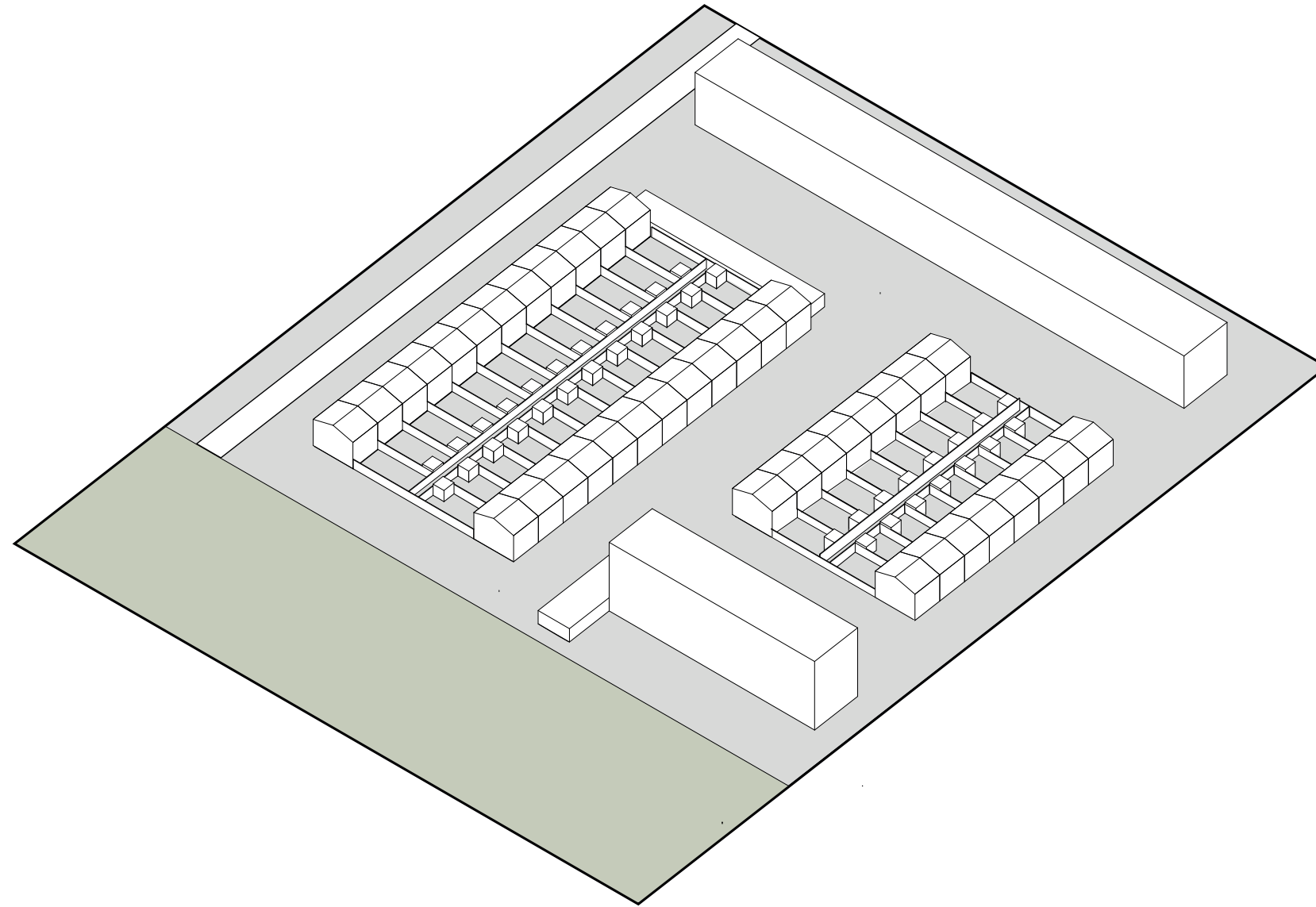


Eindhoven



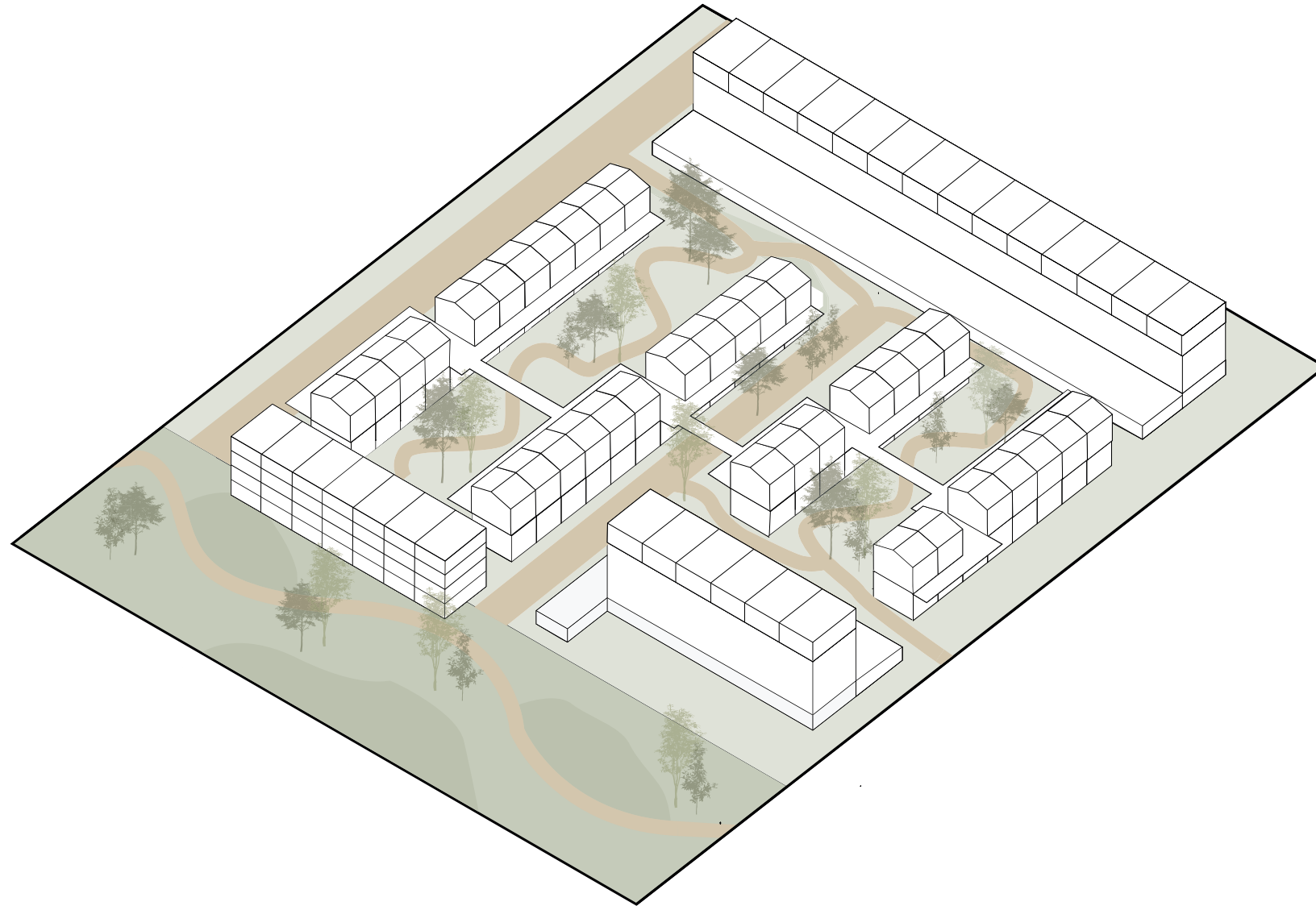
Rotterdam

These types of houses can be found all
over the Netherlands



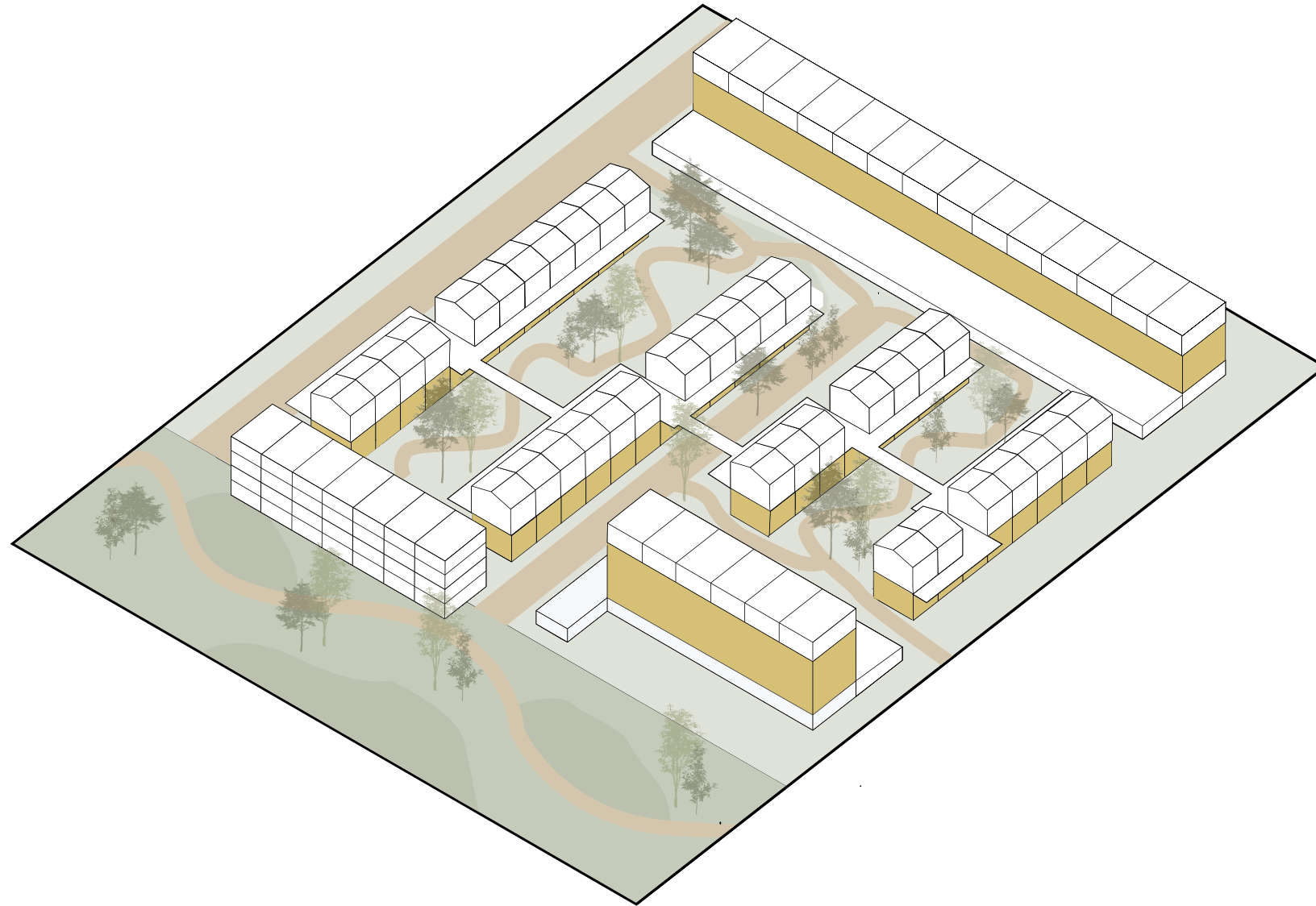
1.8 million typical post-war houses in the Netherlands, spread over 1,800 neighborhoods

Design | **Context**



If these neighborhoods are densified in a similar way by 65%, 760,000 homes can be added.

Design | **Context**



While the existing houses will undergo sustainable improvements, while there is CO₂ stored in the houses

Design | **Context**



While the neighborhood is transformed in to a
revitalized and liveable place