Housing Affordability in Amsterdam

Mid-income Housing

Graduation Research I MSc4 Architecture, Urbanism and Building Sciences, TU Delft I Dutch Housing

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THE PRESSURE ON THE CITY INCREASES

Main theme:	Middle Income Housing Strategy for Amsterdam
Main problem:	Housing Affordability in Amsterdam
Position:	Affordable and healthy housing for all citizens is a prerequisite for preventing gentrification.
Potential solution:	Housing that is considered affordable “by design” could become a more important part of Amsterdams middle-income housing strategy.
Research question:	What are the requirements for an ‘Affordable by Design strategy’ for mid-income house holds in Amsterdam’s city center?

Project Methodology

PROBLEM RESEARCH

Amsterdam’s challenge in housing affordability

LOCATION

Singelgracht-zone as one of the future development areas

HOUSING AFFORDABILITY

Amsterdam’s challenge in housing affordability

CASE STUDIES

Collection of case studies: innovation in affordable housing design

PROGRAM RESEARCH

Public and residential program research

FRAMEWORK STRATEGY

Future development strategy plan to increase the housing affordability in the city center

PROJECT ARCHITECTURE

Project plan

PROBLEM RESEARCH

Amsterdam’s challenge in housing affordability

THE PRESSURE ON THE CITY INCREASES

The trend towards urbanization is increasing significantly. Inner cities provide a large amount the jobs, facilities and networks for workers. This attracts people and businesses to the city, increasing the pressure on infrastructure, housing and livelihood within the city.

At the same time, the Netherlands is struggling with a population shrinkage in the countryside. Young people tend to leave the place where they grew up move to urban areas to study and find work. A return to the hometown is becoming less realistic due to the decrease of employment (Woodyshousing, 2016). This causes Urban space to become more and more scarce.

Mainly due to the increasing pressure on the city, the tightness in the housing market is becoming a bigger and bigger problem. The offer of decent properties is completely out of balance, causing the housing prices to rise drastically. For the 21st century architect this recent development raises the following question regarding the the future development of the urban environment:

How can we create and sustain a modern existence, while facing the massive growth that is threatening the sustainability of cities and the quality of city life?

THE PROBLEM

The shortage of rental housing in the mid-income segment is becoming more and more of a problem in the Netherlands. Approximately 10 percent of the 3.2 million rental homes in the Netherlands have a rent between 711 and 1000 euros per month. Of this type of housing, and additional 75,000 extra dwellings are required. If no action is taken, rents in the free sector will continue to rise. As a result, it becomes increasingly more difficult to find affordable rental property for the mid-income group.

The main problem nowadays is that due to the lack of national laws and regulations, renters can demand unlimited rent for rental housing in the free sector. An additional problem is that, as a result of the financial crisis, there has been little construction in recent years. During the crisis, the relatively few newly built residential properties consisted of mostly owner-occupied properties, because this was economically more attractive for project developers and municipalities.

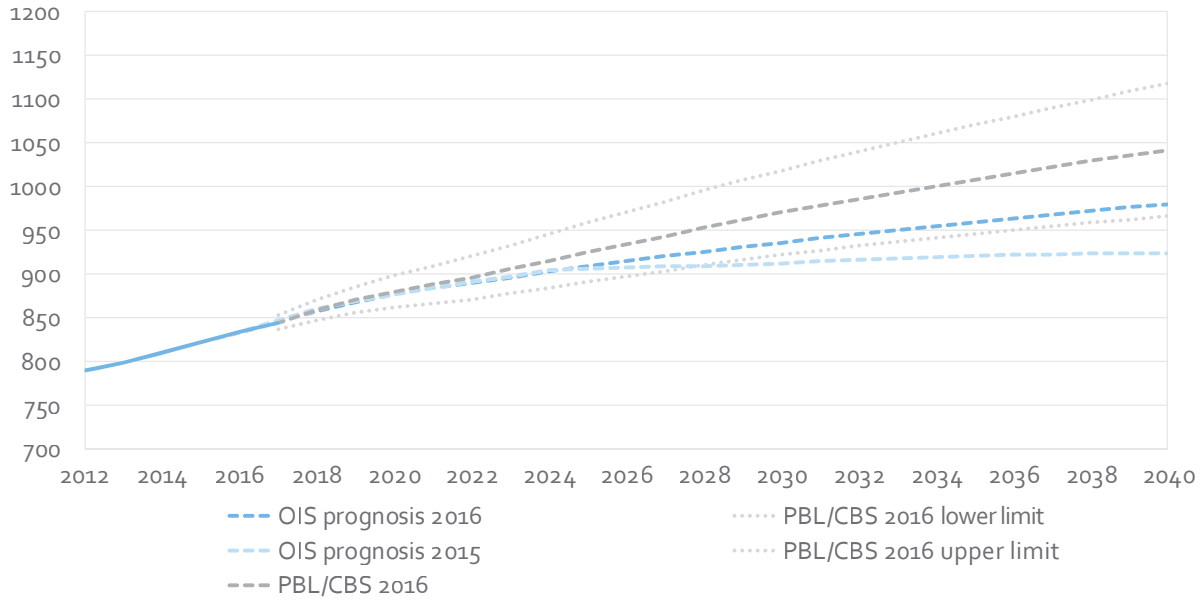
The municipality of Amsterdam has recently presented an action plan for increased rental housing in the mid-income segment for the city. Amsterdam encourages the development of at least 1.500 mid-income rental homes per year until 2025.

Also, the municipality will prescribe additional conditions for new construction projects in the coming years. For the coming 25 years a fixed lease will be agreed with the developers. Only tenants with a certain maximum income may live in mid-income rental properties.

(Source: http://nos.nl/artikel/2172307-betaalbare-huurwoningen-voor-middeninkomens-hardnekkig-probleem.html)

SCENARIO BASED PROBLEM STATEMENT

The prognosed housing stock will not be sufficient to keep everyone in the city on the long term.



Prognosis population and housing in Amsterdam according to OIS and CBS/PBL, 2016-2040

(UN)AFFORDABLE RENTAL HOUSING

In the Netherlands the average price of unfurnished rental property rose by 3.6% in 2016 to € 9.59 per m2 per month. The rental prices for furnished (+ 7.7%) homes increased much more in the same time frame. These numbers are based on a publication by *Pararius*, the largest online platform for rental offers in the Netherlands. Due to the higher price increase in the furnished segments, middle-class rental housing is shifting to a more expensive price range, which significantly increases the demand for middle-class rental housing. As a result, the mid-incomes suffer the most and the gap between supply and demand for affordable housing keeps on growing. This problem especially occurs in regions with the highest WOZ-values per square meter.

“Looking at the demand for private rental housing in the Netherlands, we see that the demand for middle-class rental housing, in the segment between € 711 and € 1,000 per month, is by far the largest.”

- Jasper de Groot, director Pararius

WORKING TOWARDS A SOLUTION

The municipality of Amsterdam is aware of the problem and therefore came up with an action plan. Amsterdam encourages the development of at least 1.500 mid-income rental homes per year until 2025. They do this by making agreements with developers/corporations and often give a discount on the ground price.

Gemeente Amsterdam

SOCIAL HOUSING

- Social housing -> providing accomodation that is affordable to people on low incomes.
- Social housing is owned and managed by housing associations, which are funded by the government
- Limits to rent increases (by law)
- The maximum rent of a social housing dwelling in the Netherlands is € 710.68 per month (price level 2017)
- The total taxable income of a household may not exceed € 36.165 (price level 2017) per year, at the time the property is rented

A point system (Woningwaarderingsstelsel) determines the maximum rent of a social housing unit. The point system does not apply to rental housing in the private sector.

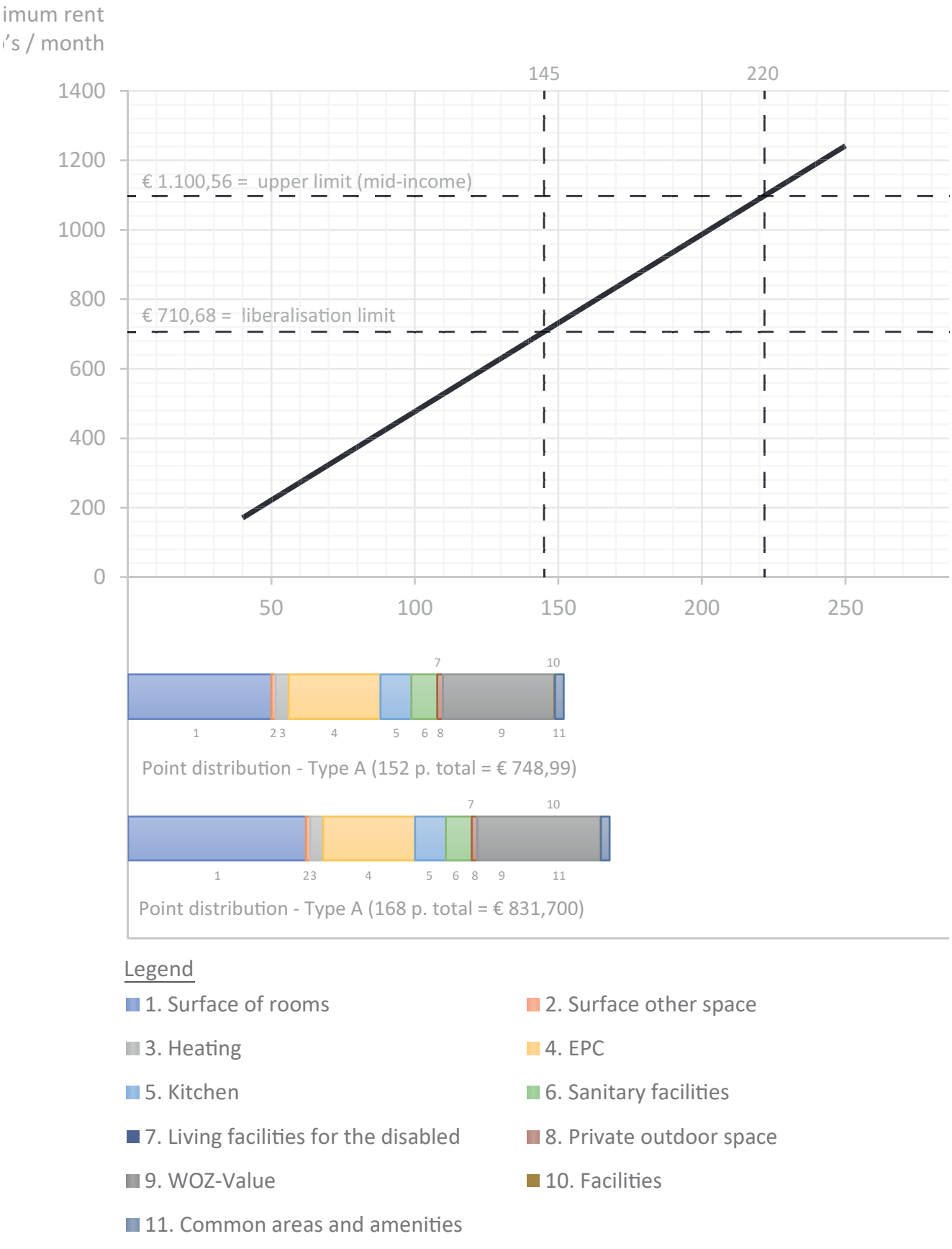
Rental allowance is a contribution to the rental costs. The height of rental allowance depends on a person’s rent, income, age and living situation.

PROPERTY VALUATION SYSTEM

The property valuation system (Woningwaarderingsstelsel - WWS), also known as the point system, is a system used to determine a reasonable rent for a home. The system calculates the points based on the living space and the available facilities. The number of points that a property recieves according to WWS is linked to a maximum rent.

In the point system (Property Valuation System), independent housing units receive points for:

- The surface of the dwelling
- The number of heated rooms
- The energy label
- Kitchen equipment
- Sanitation
- Size of balcony / garden / terrace
- Dwelling type (single-family housing or apartment)
- Disabled facilities
- WOZ-value

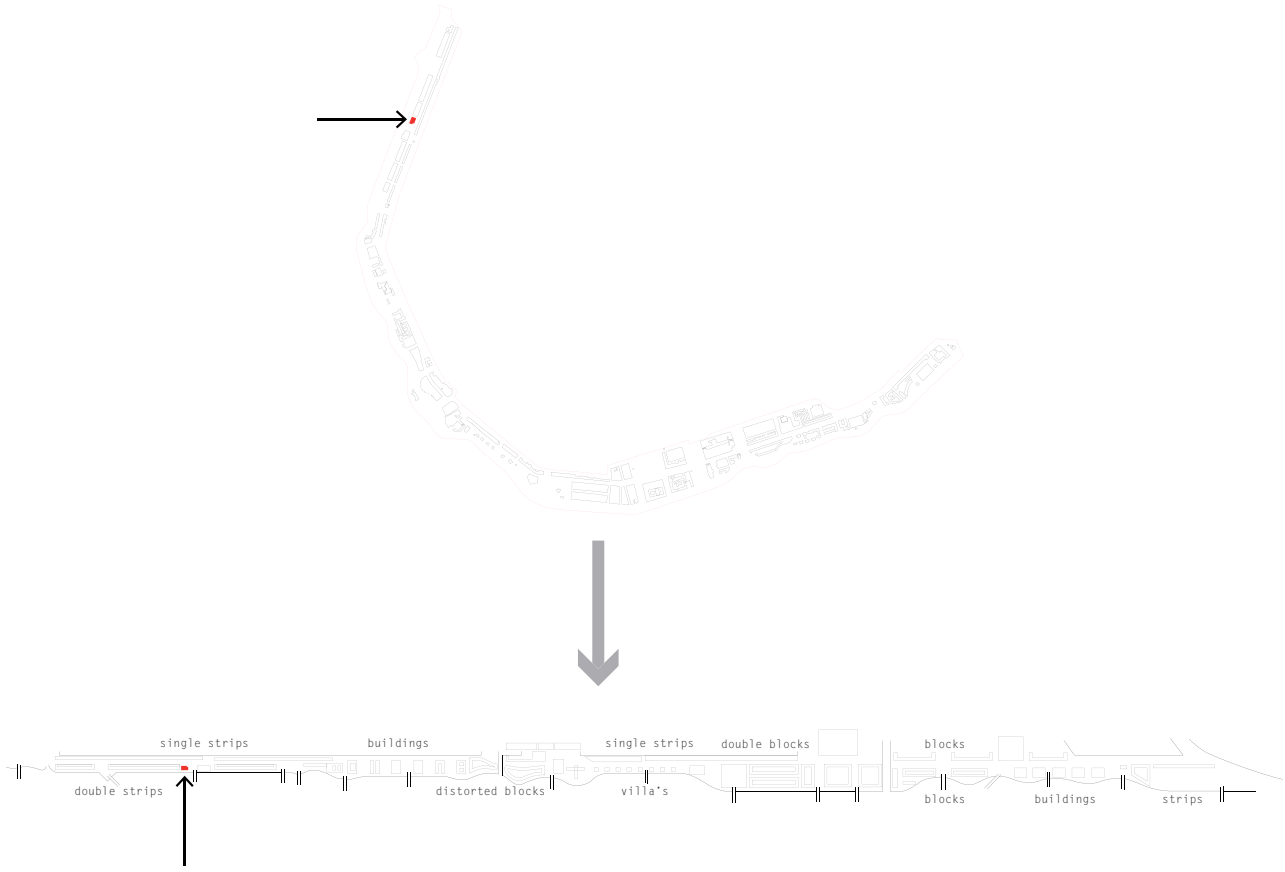

imum rent
's / month
145
220
1400
1200
1000
800
600
400
200
0
€ 1.100,56 = upper limit (mid-income)
€ 710,68 = liberalisation limit
50
100
150
200
250
7
10
1
2 3
4
5
6 8
9
11
Point distribution - Type A (152 p. total = € 748,99)
7
10
1
23
4
5
6 8
9
11
Point distribution - Type A (168 p. total = € 831,700)
Legend
1. Surface of rooms
2. Surface other space
3. Heating
4. EPC
5. Kitchen
6. Sanitary facilities
7. Living facilities for the disabled
8. Private outdoor space
9. WOZ-Value
10. Facilities
11. Common areas and amenities

LOCATION

Singelgracht-zone as one of the future development areas

SINGELGRACHTZONE

The Singelgrachtzone lies around the historic city center of Amsterdam and acts as a transition zone. The intersections are positioned on a strategic location within the belt and give access to the historic city.



HISTORIC ANALYSIS SINGELGRACHT ZONE

Fortifications - 1st Golden Age (1600-1700)

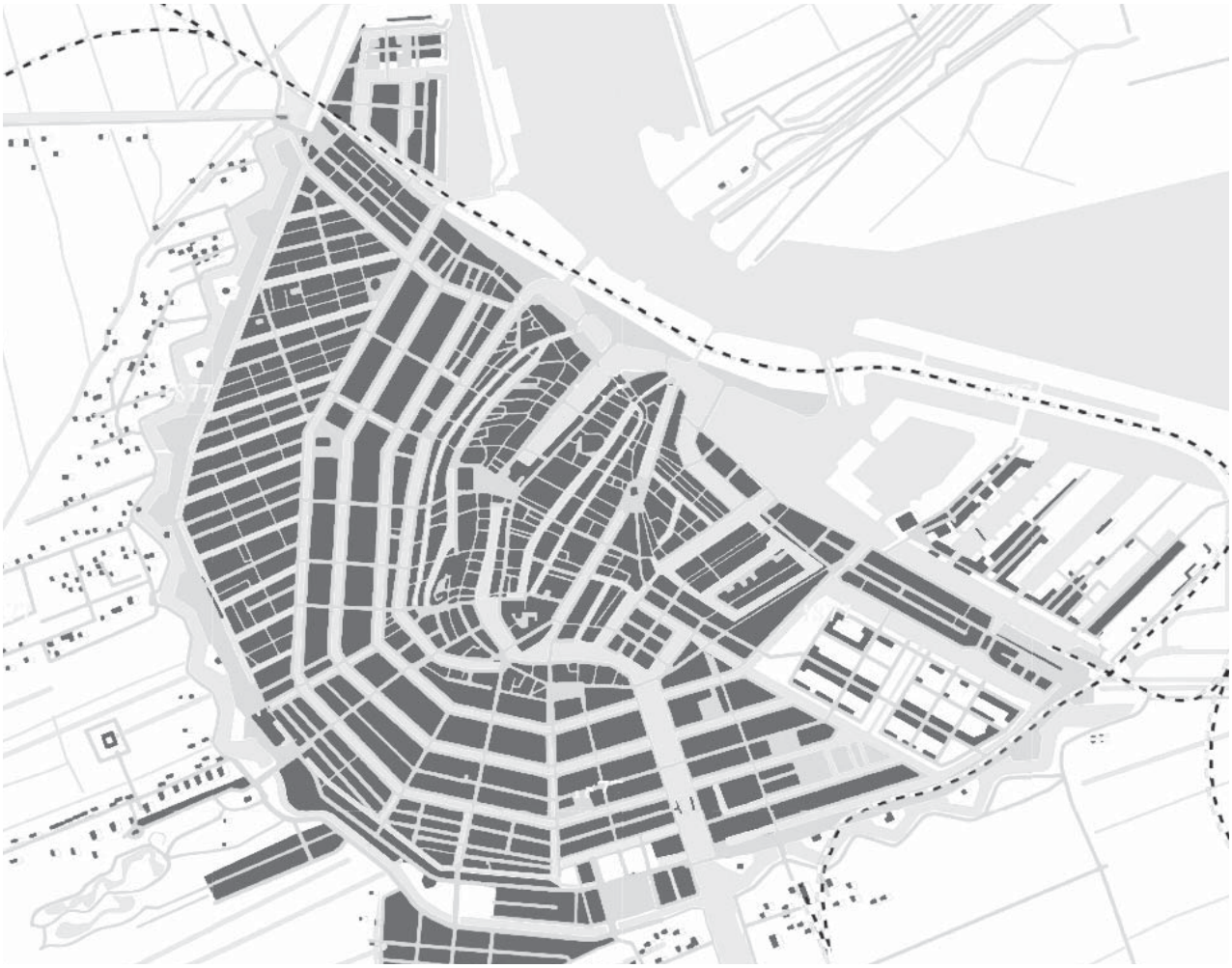
During the first golden age in the 17th century the belt used to be the fortifications of Amsterdam. Due to economic success the city expanded rapidly and therefore the existing fortifications had to be moved. The new fortifications consisted of a sequence of 27 bastions and 9 city gates. On each bastion there was a mill that served for different purposes (sawing/corn). Behind the city walls there were squares that served for logistic purposes.

Industrial Revolution - 2nd Golden Age (1800-1900)

Amsterdam experienced a Second Golden age in the 19th century because of the Industrial Revolutions. In this time the fortifications were no longer needed and therefore demolished and partly replaced by large structures, which were constructed with innovative building materials (glass & steel). The large structures varied from factories to, military buildings, public buildings and hospitals. These buildings were often located close to the intersections that give access to the city.

Industrial Revolution- infill (1800-1900)

Throughout the years the left over space was filled up by mainly serial housing. This is where the factory workers used to live (close to the industry).



Urban Renewal ‘60 (1900-2000)

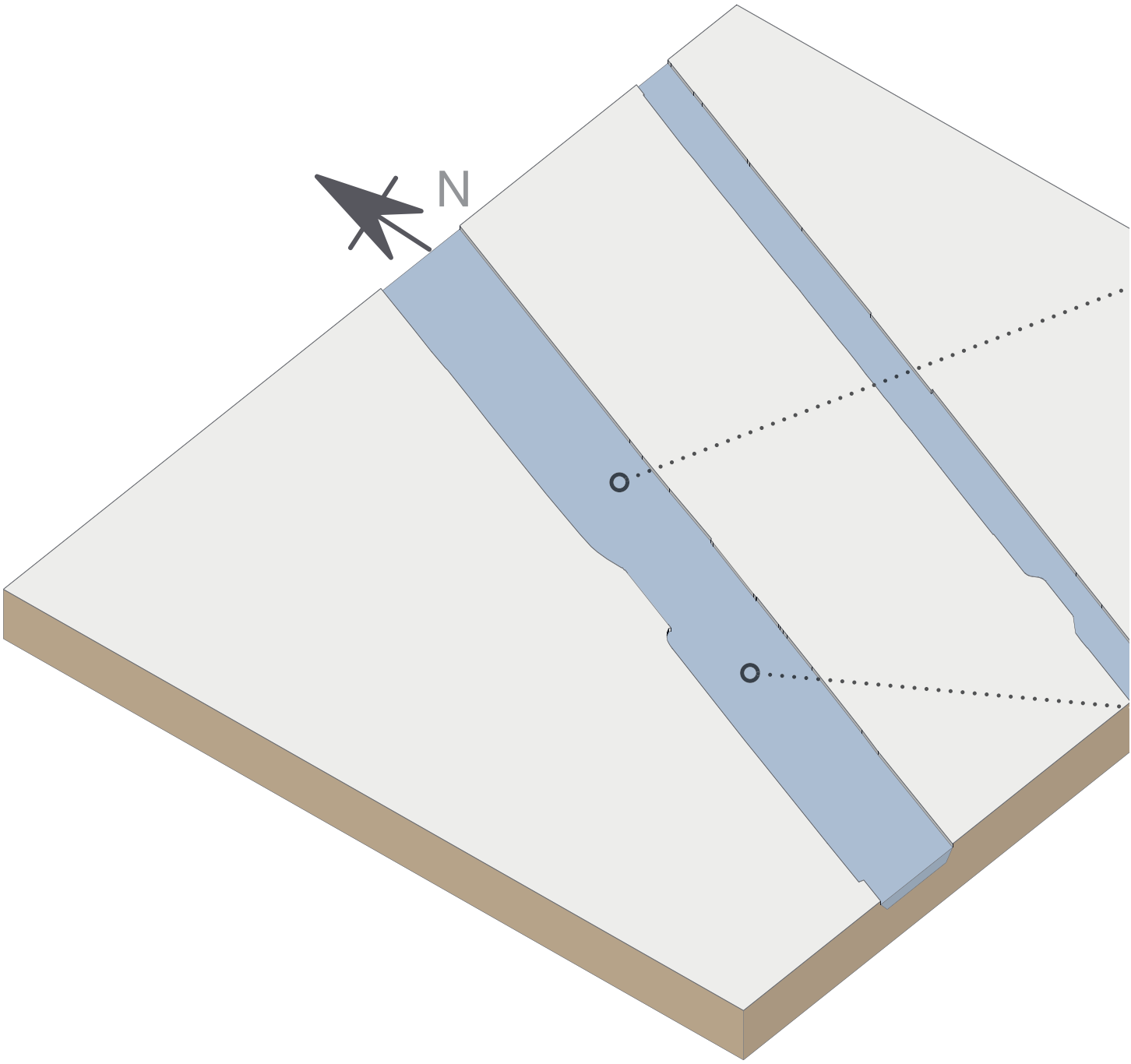
The 20th century is characterized by urban renewal. The city expanded rapidly and industrial and military functions disappeared from the belt and the empty plots were being redeveloped. Often special and public buildings started to appear around the intersections and the quality of living in the belt improved. Also part of the urban renewal was the modernizing of the housing stock in the ’60s.

SITE SELECTION

In order to find a specific site for my project I investigated the potentials of the intersections in the belt. In the first and second golden age, these areas were the first to be redeveloped according to the needs of the time. So as a starting point for the third golden age I propose to redevelop these intersections as well. The idea is to take space and then create an environment for everyone to contribute. In other words, I propose to replace the rotten teeth, and replace them with golden teeth.

I propose to make space by demolishing the existing apartment block because I consider this a rotten tooth. The plinth lacks public qualities and the building does not contribute to the public domain. The apartment block was constructed during the urban renewal of the ‘60s and consists of 35 apartments. The apartment block contains social housing and is owned by one corporation (Ymere). The fact that there is one owner makes it a lot easier to redevelop.

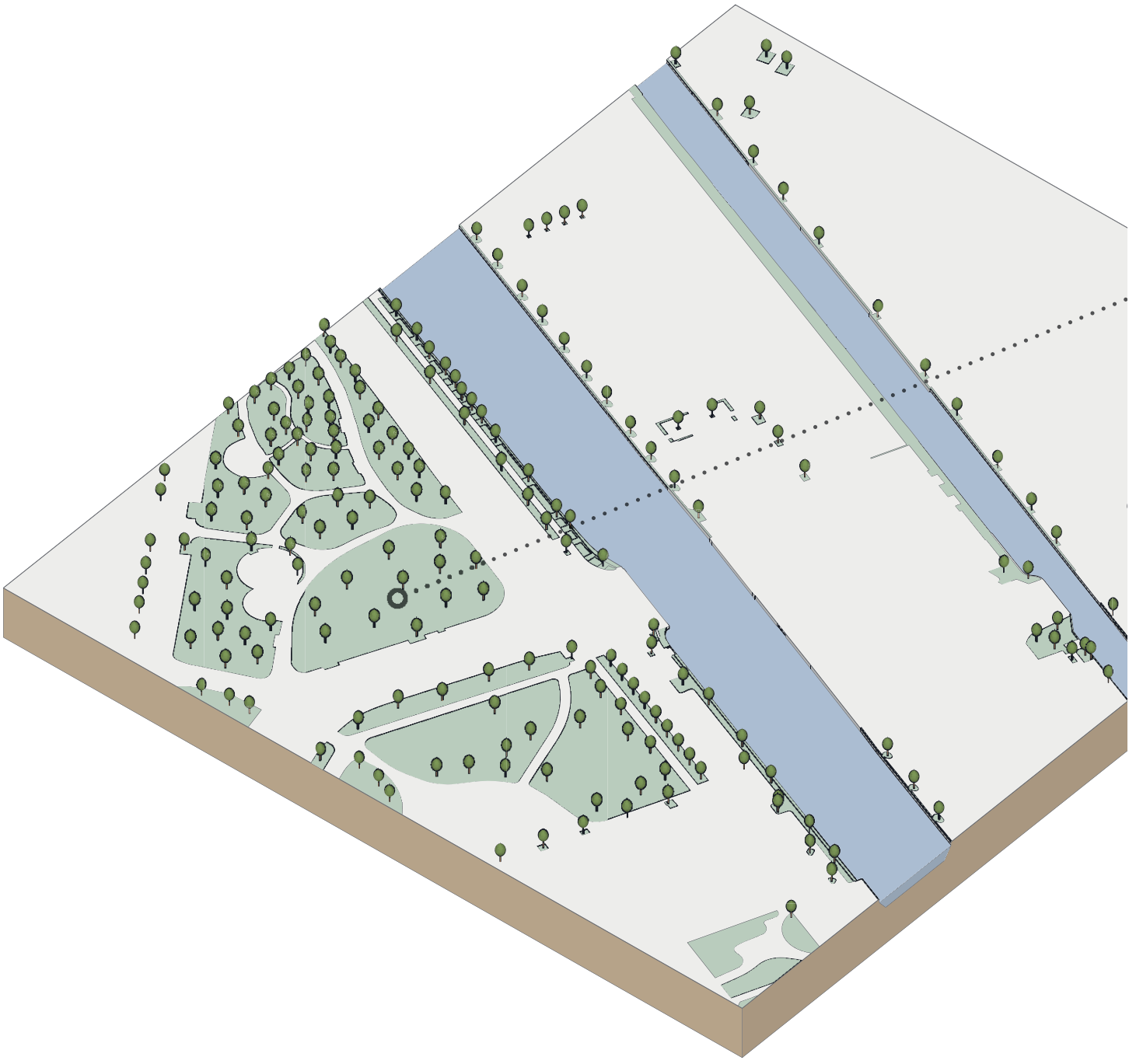
WATER

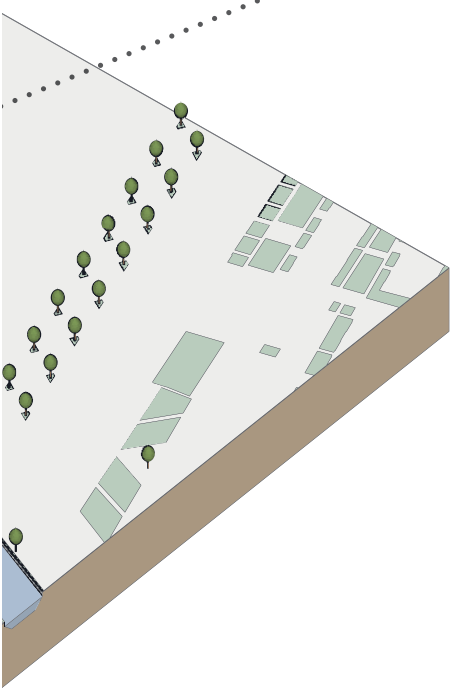


Singelgracht

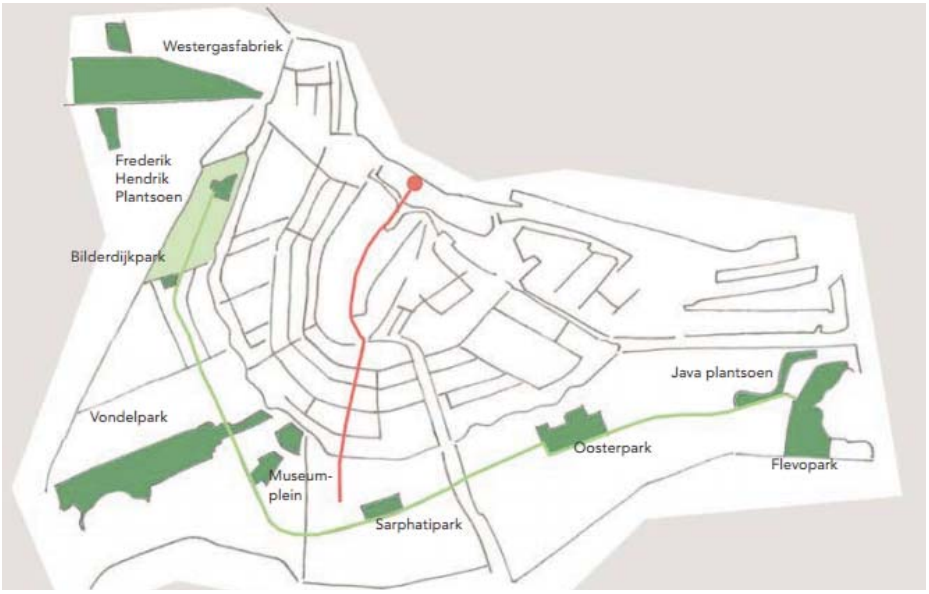
Singelgracht

PUBLIC GREEN SPACE



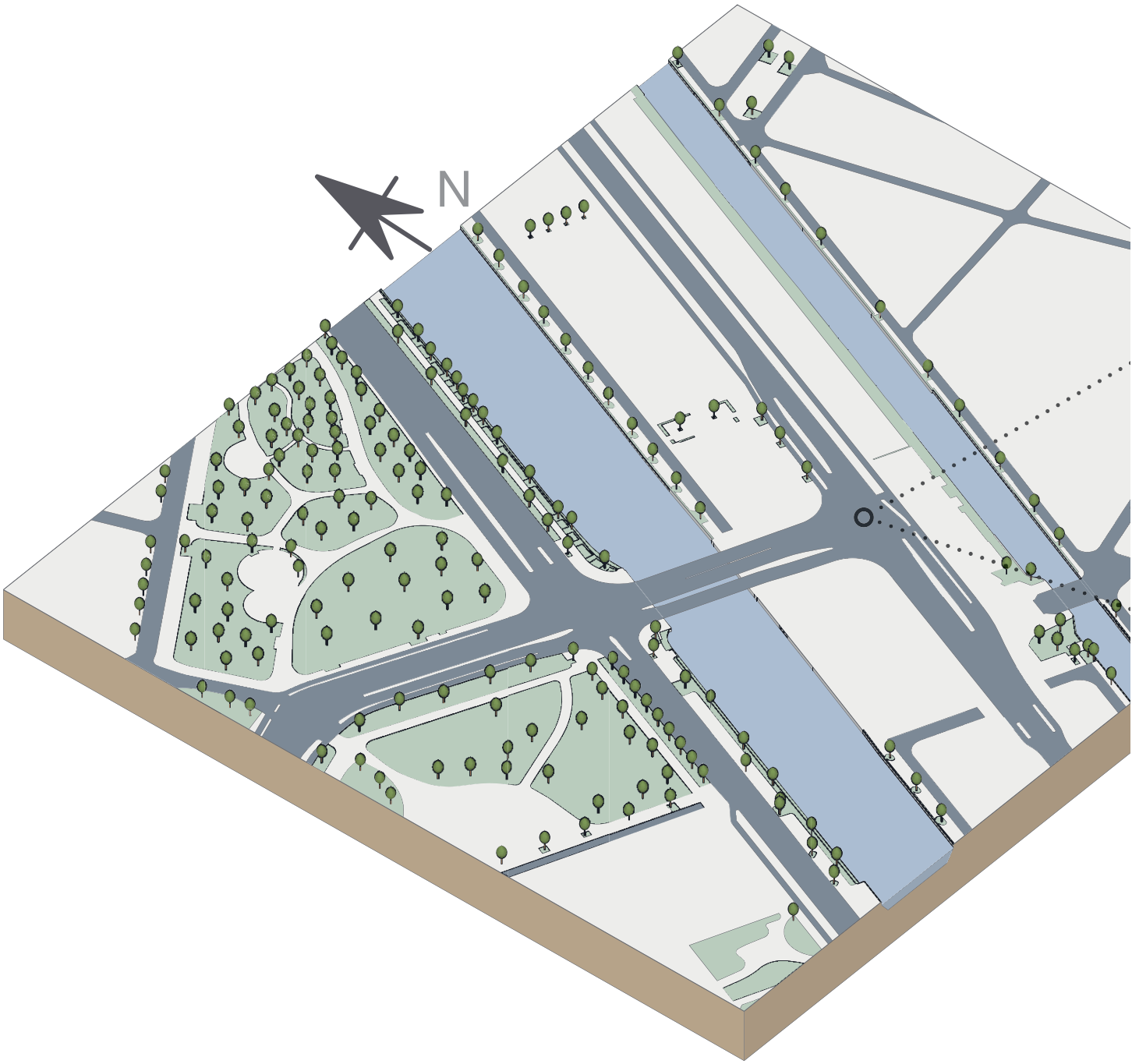


Redevelopment Frederik Hendriksplantsoen

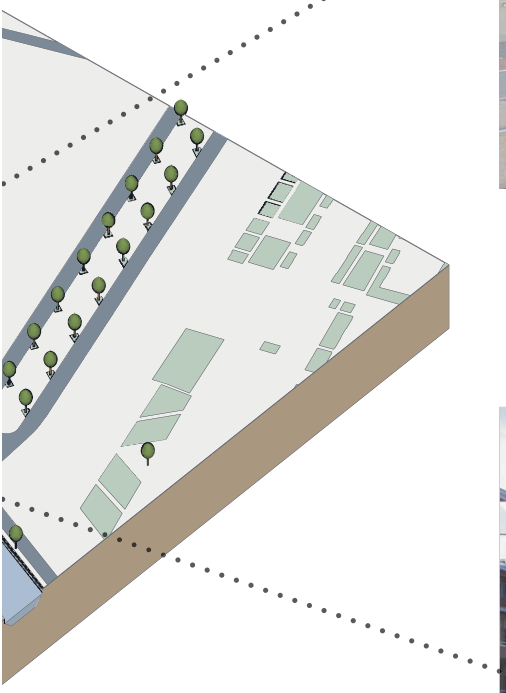


Green-strip around the center of Amsterdam

INFRASTRUCTURE

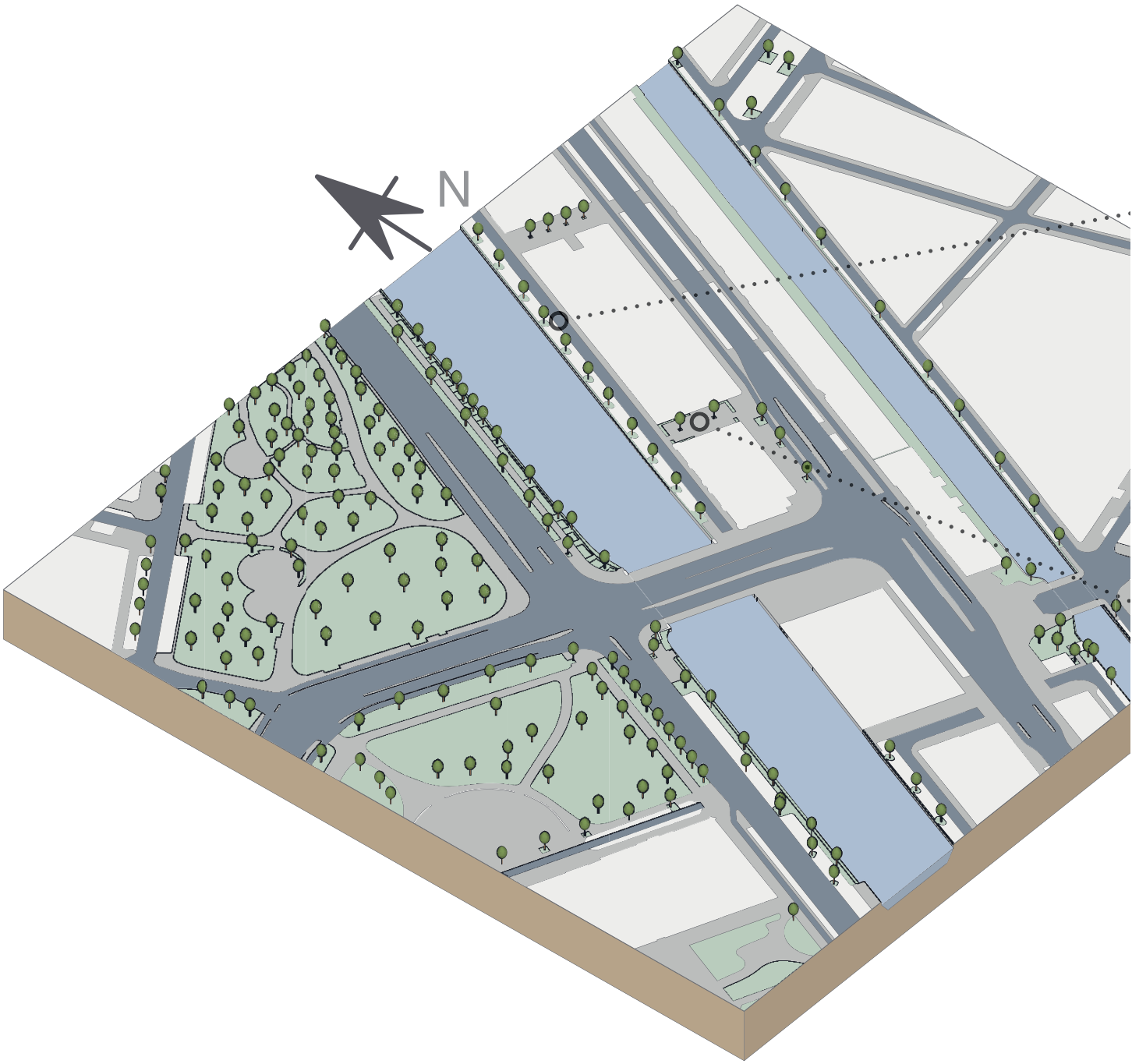


Intersection Marnixplein

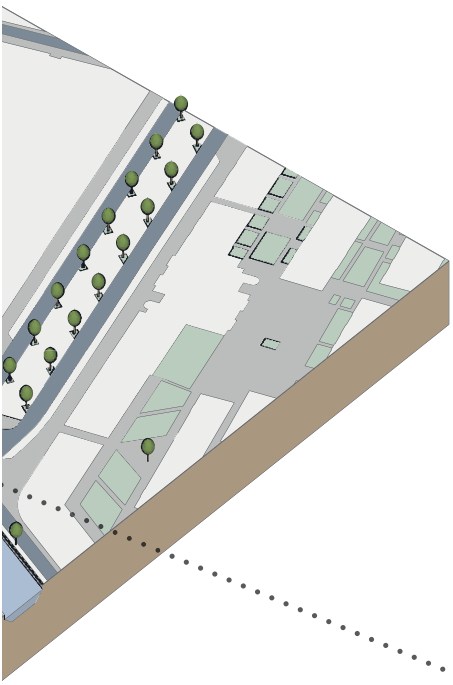


Public-transport node

PEDESTRIAN SPACE

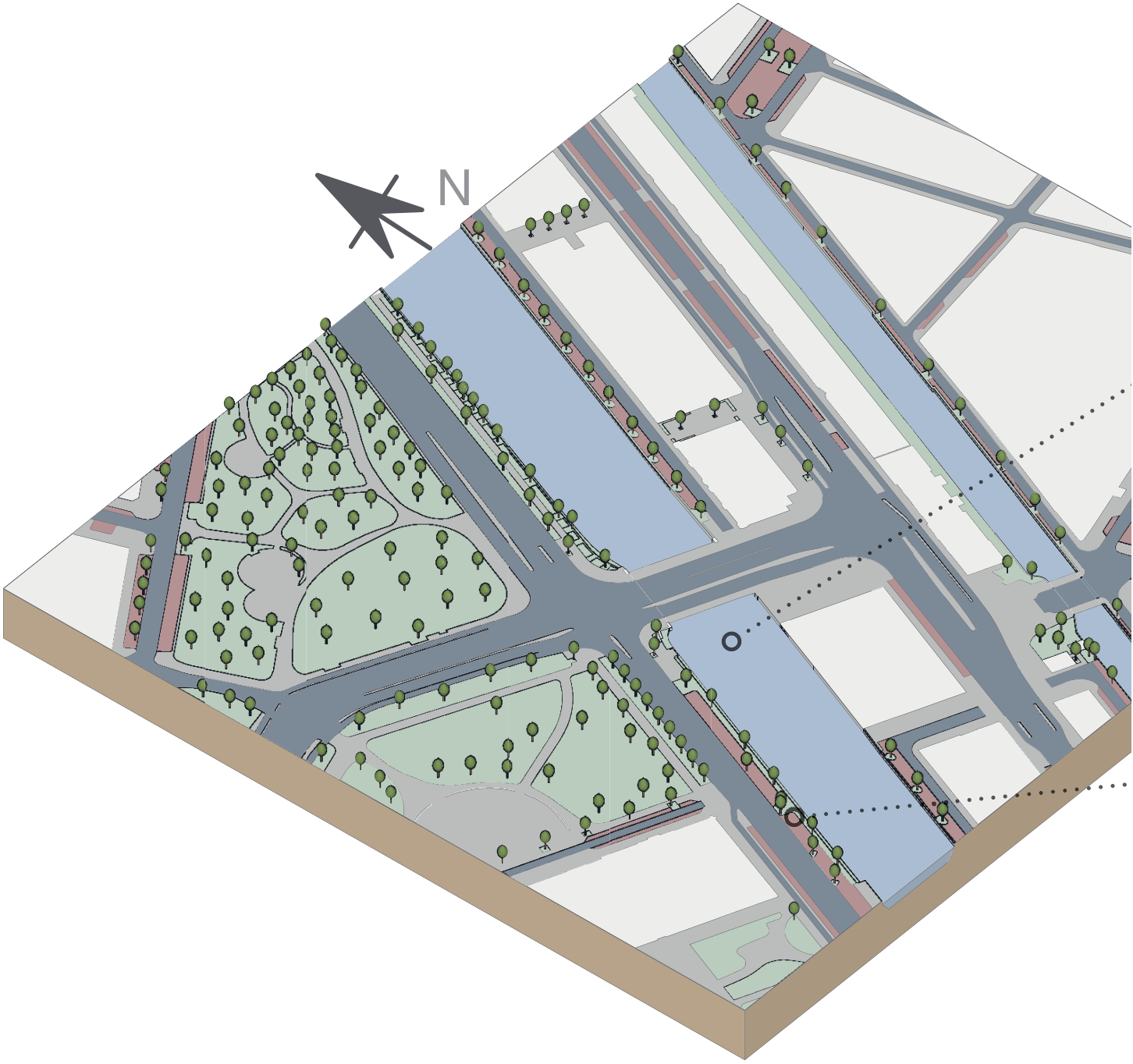


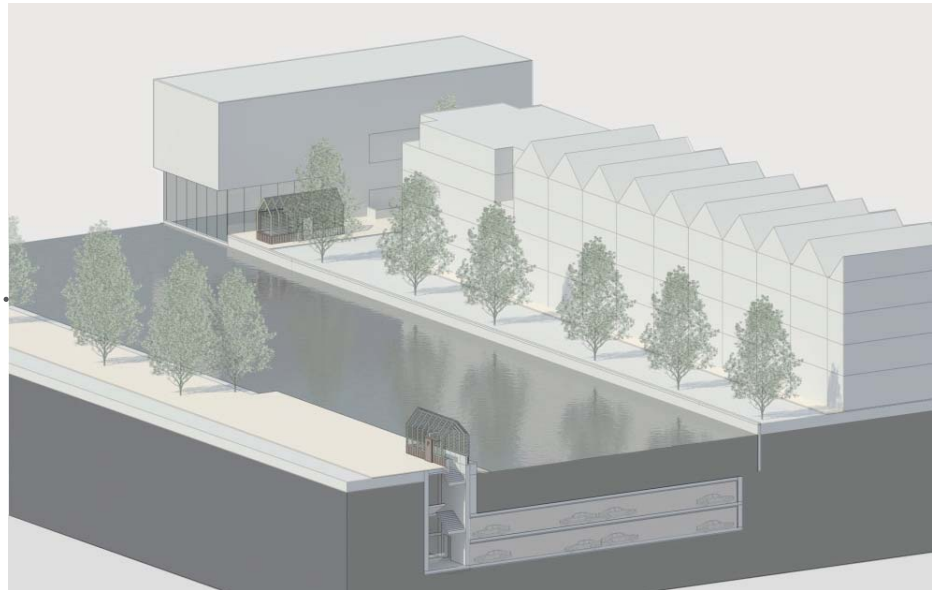
Marnixkade

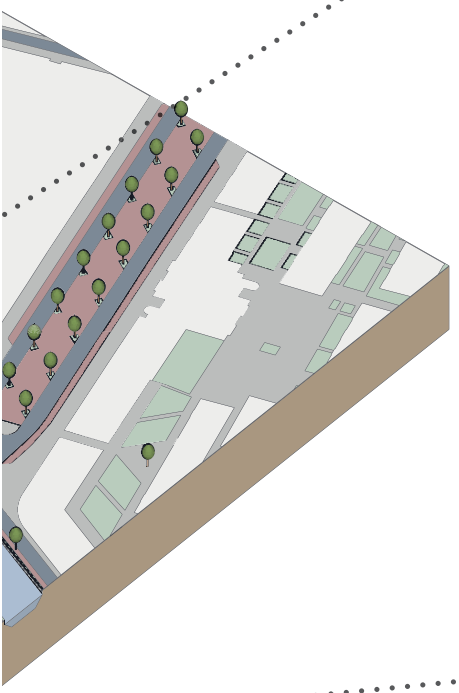


Semi-public pedestrian space

PARKING FACILITIES



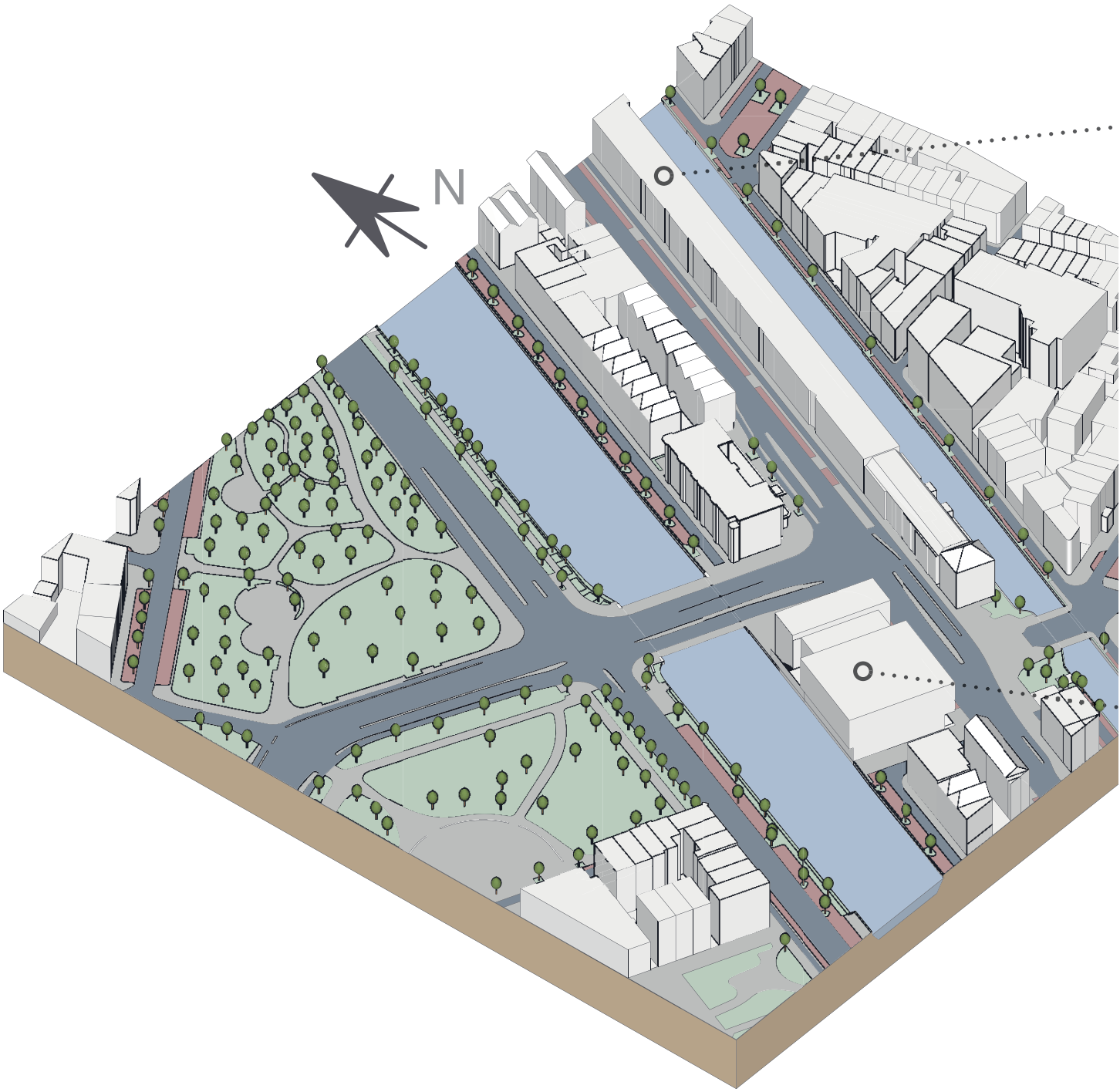




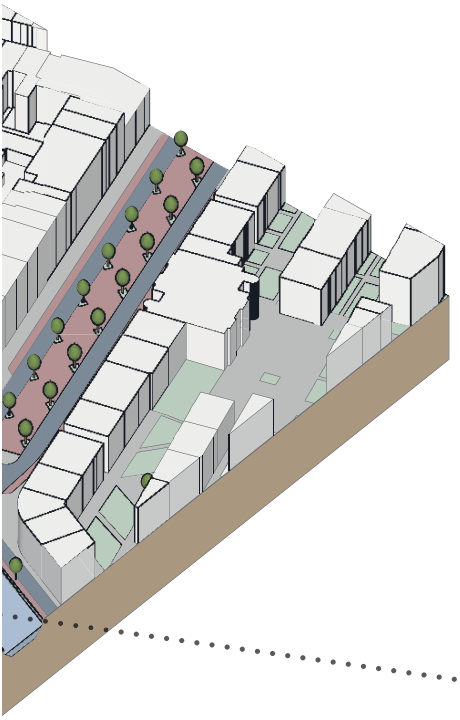
Singelgrachtgarage Marnix (800 spaces)

Entrance Singelgrachtgarage Marnix

BUILDINGS

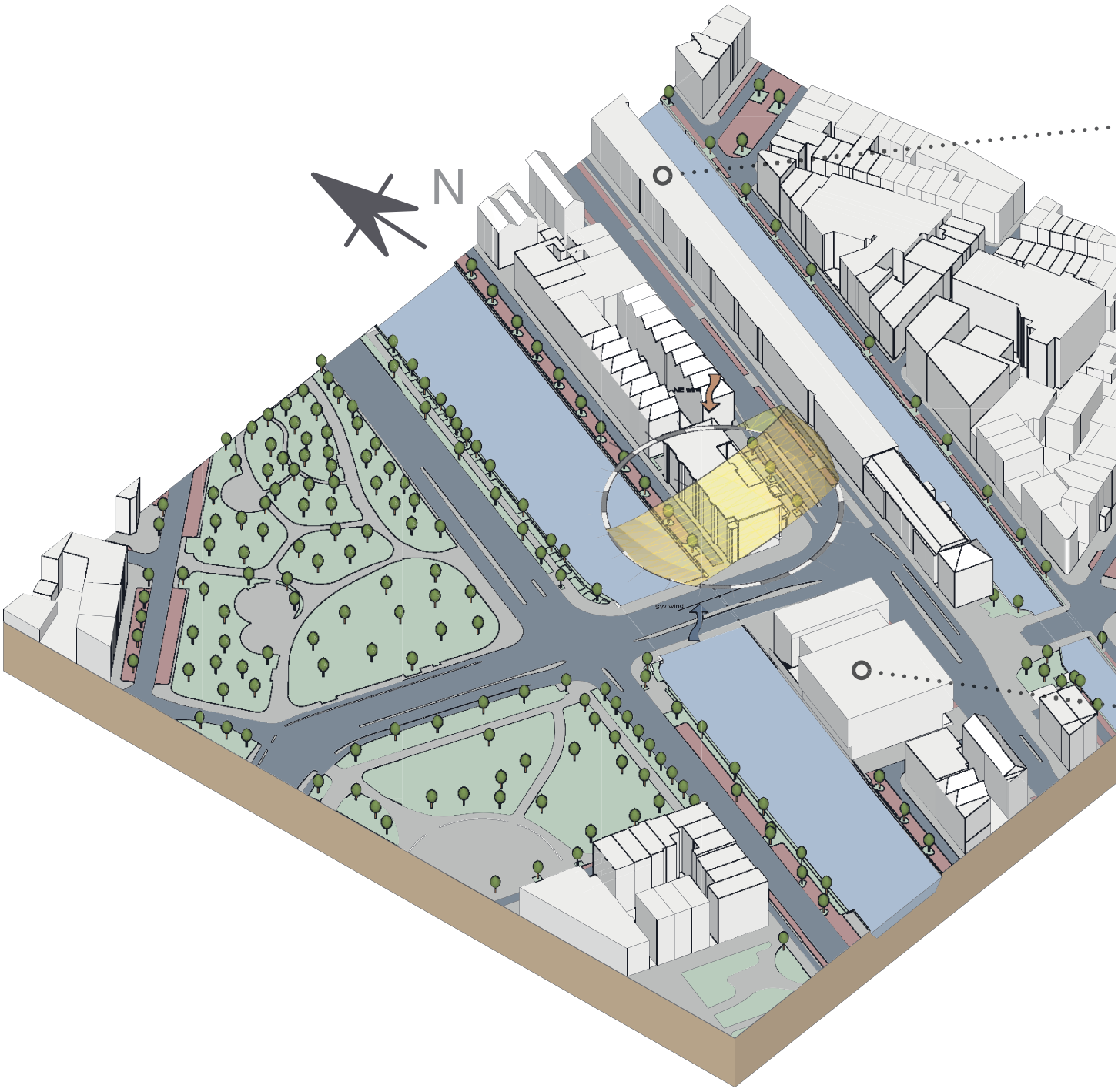


Marnixstraat

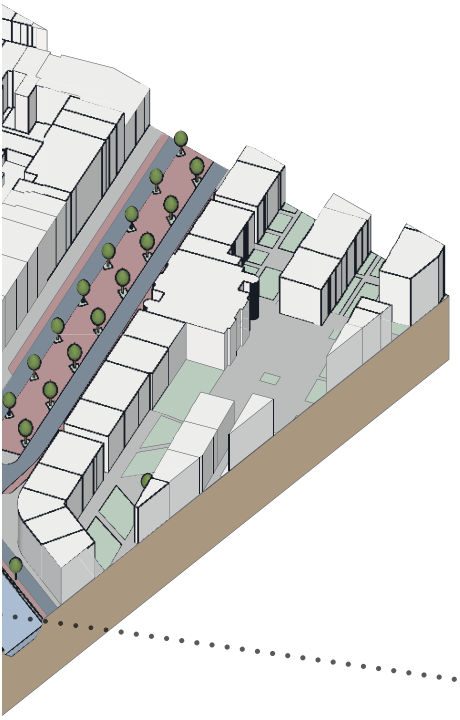


Het Marnix Sports Center 2006

SUN ORIENTATION



Marnixstraat 1960’s



Het Marnix Sports Center 2006

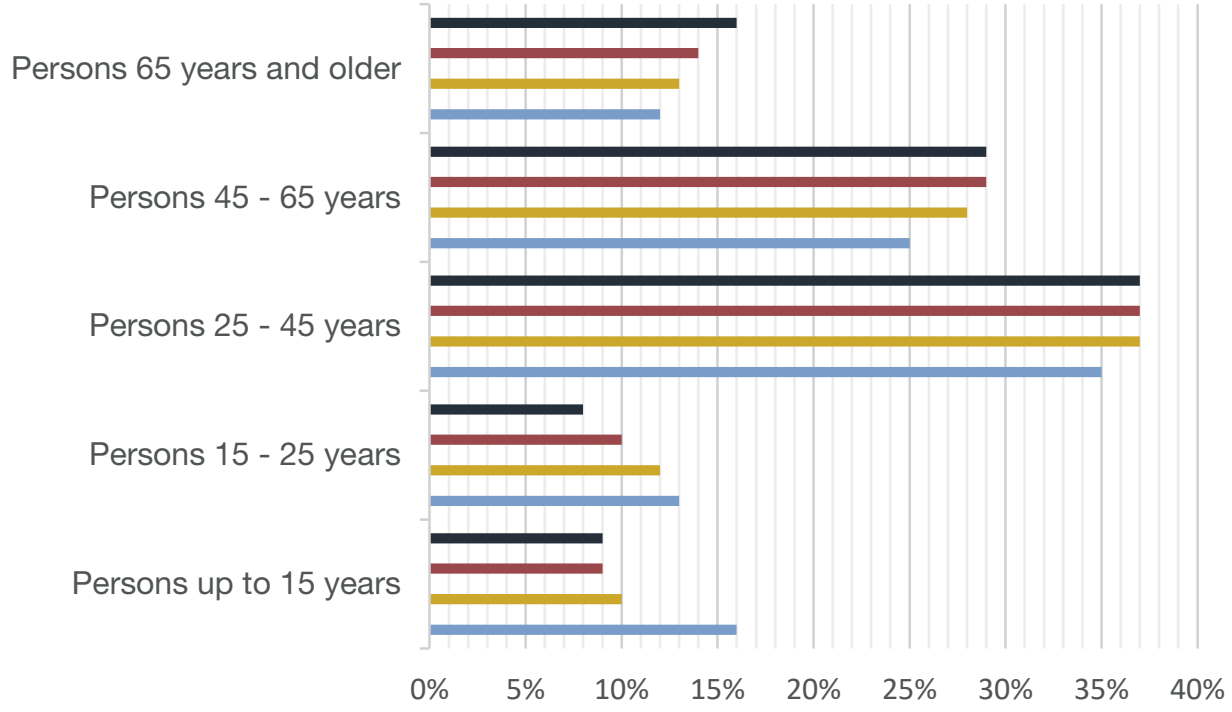
KEY FIGURES

	Amsterdam
Total surface:	21.949 ha
Land surface:	16.589 ha
Population:	821.752 pers.
Population density:	4.954 pers./km^2
Number of households:	449.209
Household size:	1,8 pers.
Number of dwellings:	416.966
Density of dwellings:	5.968 /km^2
WOZ-value:	232.000 euro

City Center	Jordaan	Marnixbuurt-N.
804 ha	96 ha	7 ha
628 ha	84 ha	6 ha
86.360 pers.	19.390 pers.	1.480 pers.
13.754 pers. /km^2	23.195 pers. /km^2	26.796 pers. /km^2
55.915	13.020	980
1,5	1,5	1,5
53.937	12.934	Data unknown
8.791 /km^2	11.201 /km^2	10.774 /km^2
319.000 euro	281.000 euro	271.000 euro

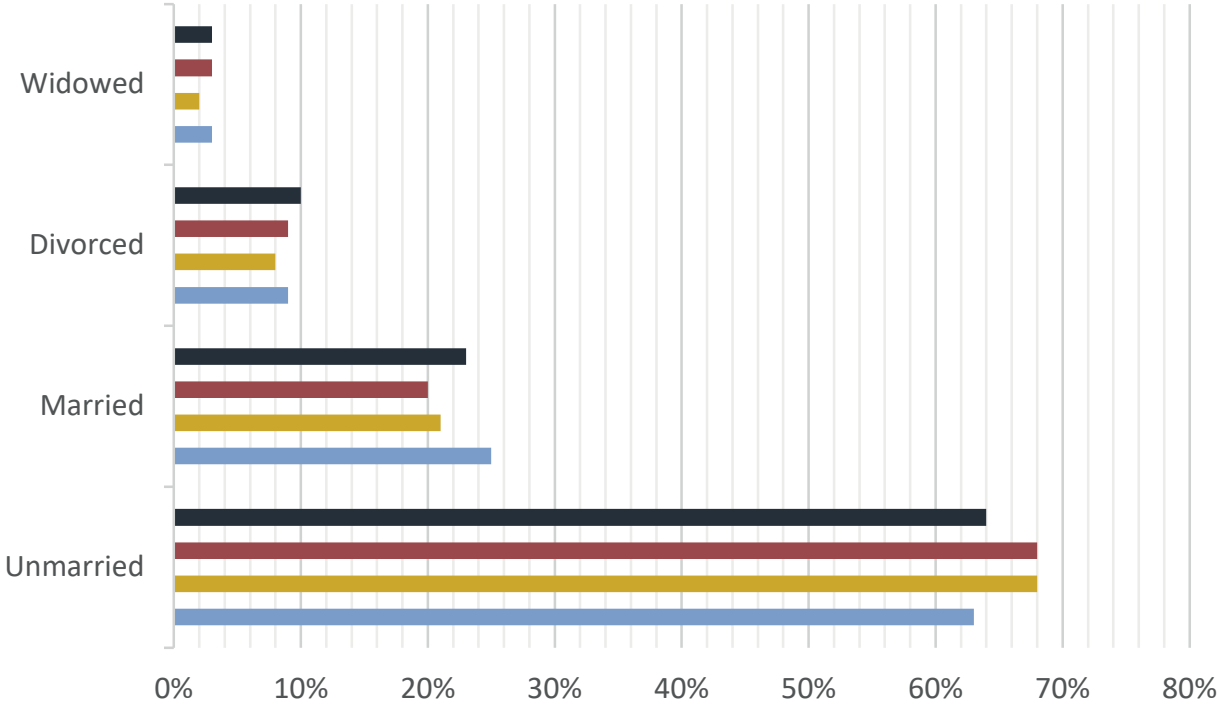
Age differences

From the graph below we may conclude that the group of ‘65 years and older’ is well represented in Marnixbuurt-Noord. The age groups ‘15-25 years’ and ‘up to 15 years’ are to a lesser extent present in the neighborhood.



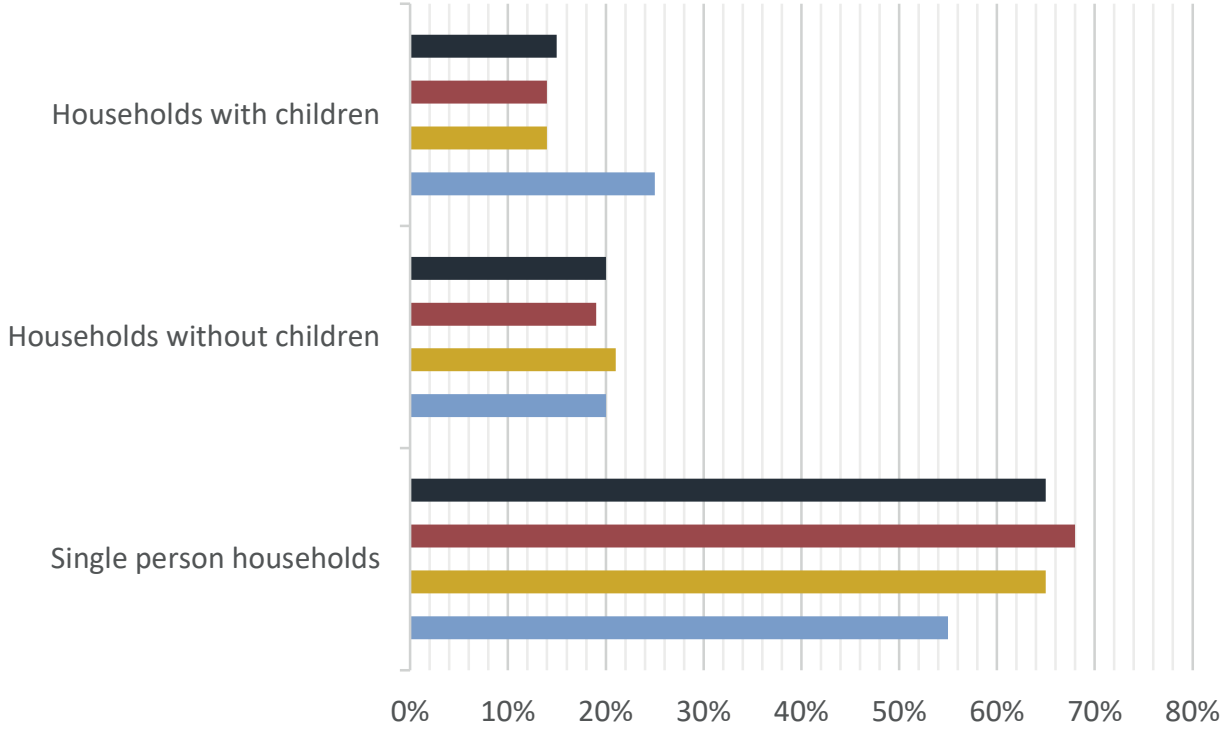
Marital status

Overall the category ‘unmarried’ is the most present in all different scales of the city.



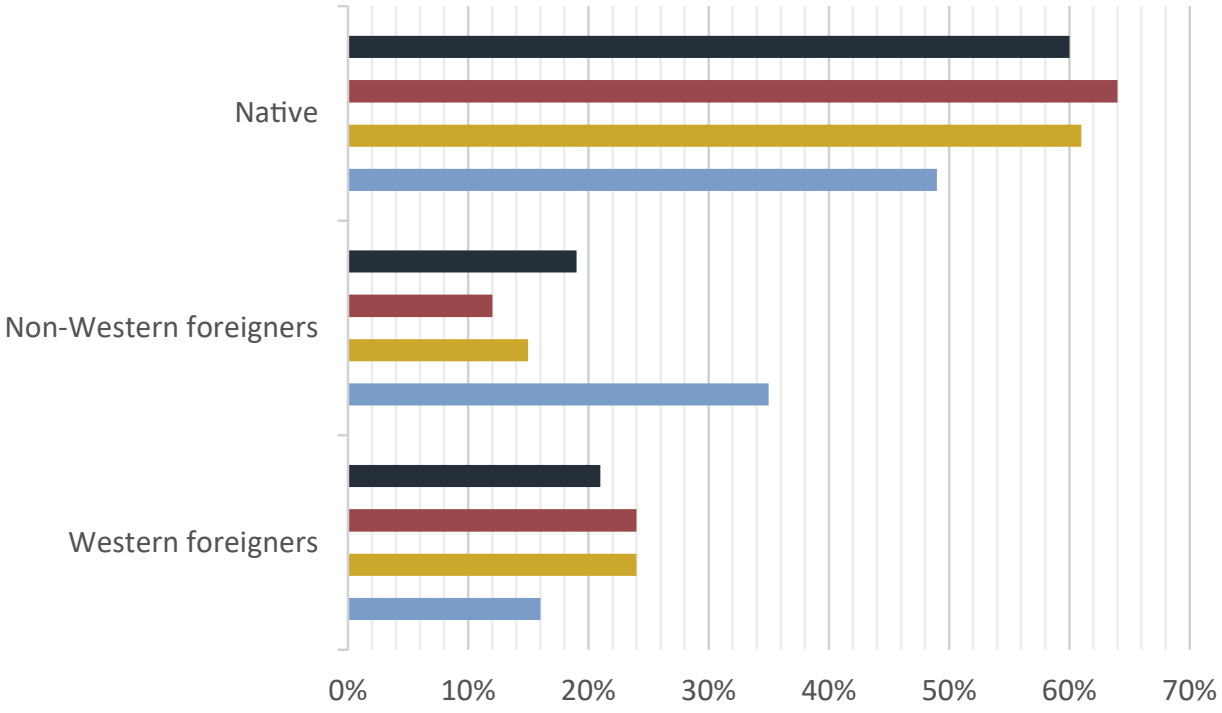
Household configuration

From the graph below we may conclude that the group of ‘65 years and older’ is well represented in Marnixbuurt-Noord. The age groups ‘15-25 years’ and ‘up to 15 years’ are to a lesser extent present in the neighborhood.



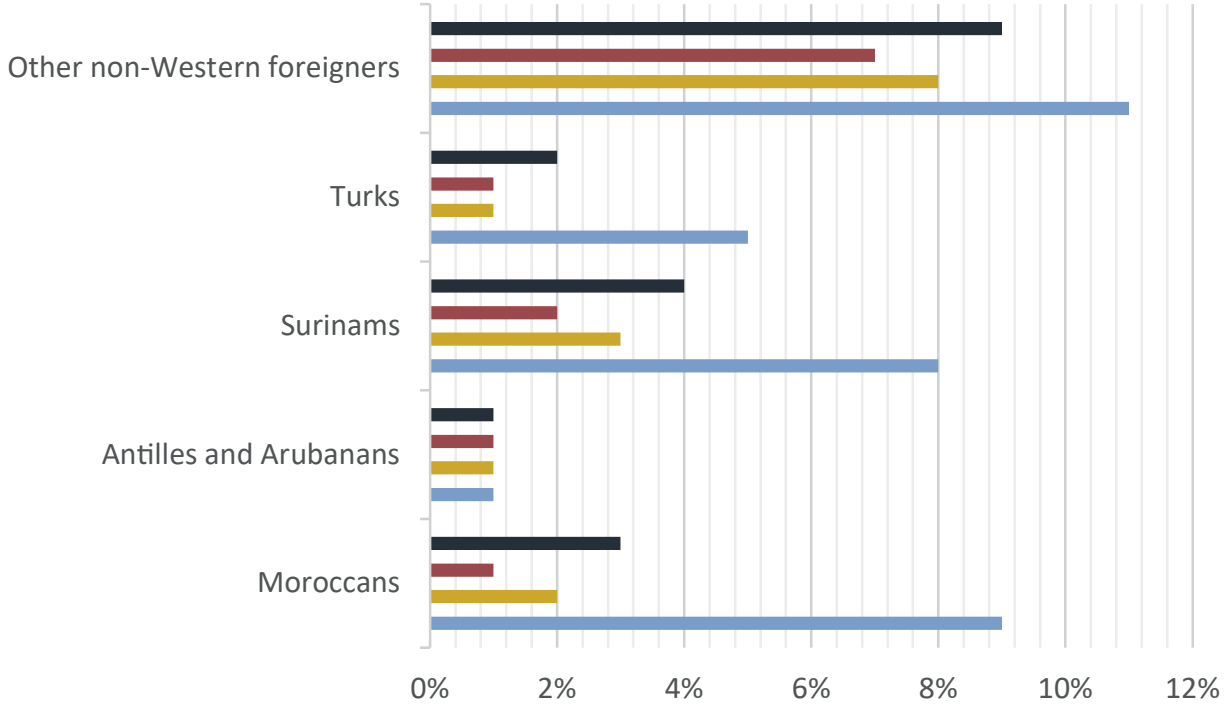
Origin

Overall the category ‘native’ is the most present in all different scales of the city with a percentage of around 60 percent of the population.



Nationality

The gap between the Non-Western foreigners in the different scale levels is the smallest.



HOUSING AFFORDABILITY

Amsterdam’s challenge in housing affordability

Wonam

An example of a qualitative research interview that I have conducted was the interview with the director of Wonam, a housing corporation that is settled in Amsterdam. Wonam focusses on the development of affordable housing with a rent ranging from 725 and 1100 per month. By 2020 Wonam realizes approximately 2500 rental homes in Amsterdam, serving the mid-income group. The housing complexes are built in own management or in collaboration with a developer or contractor.

wonam...

... is a housing corporation that focuses specifically on the development of affordable urban apartments with a rent ranging from €725 to €1.100 per month suitable for the middle income.

... realizes 2.500 rental properties for the mid-range by 2020

... realizes housing in own management or in collaboration with a developer / contractor.

Gerard Kohsiek, Director Wonam

Location:	Close to transportation nodes
Dwelling typologies:	Studio <50 m2 2-room 50-60 m2 3-room 60-70 m2 4-room 80-100 m2
Target groups:	Mid income households: ‘Young pro fessional’ (median income) & ‘City dweller’ (1.5-2 x median income)
Construction method:	Traditional construction
Shared facilities:	Only practical shared facilities (e.g. bike storage)
Sustainability: I	EPC according to Bouwbesluit, energy abel A
Quality level:	Dwellings are provided with standard kitchen and bathroom

CASE STUDIES

Innovation in affordable housing design

CASE STUDIES

Wonam case studies (mid-income housing):

Coubertin Zeeburg - Zeeburgereiland, Amsterdam
Steltloper - Ertskade, Amsterdam Sporenburg
Poort van Toorop - Jan Tooropstraat, Amsterdam Nieuw-W.
Sandebak - Jan Tooropstraat, Amsterdam Nieuw-West

Other case studies:

Huize Kerklingh - Haarlemmerplein, Amsterdam
Stadthaus - 24 Murray Grove, London
THE STACK - Manhattan, New York
The Colville Estate Phase 3 - Hackney, London
Carmel Place - Manhattan New York

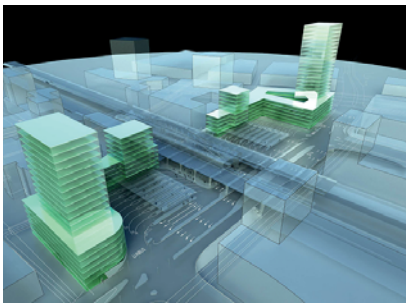
WONAM - PROJECTS

1. COUBERTIN ZEEBURG

2. STELTLOPER

3. POORT VAN TOOROP

4. SANDEBAK



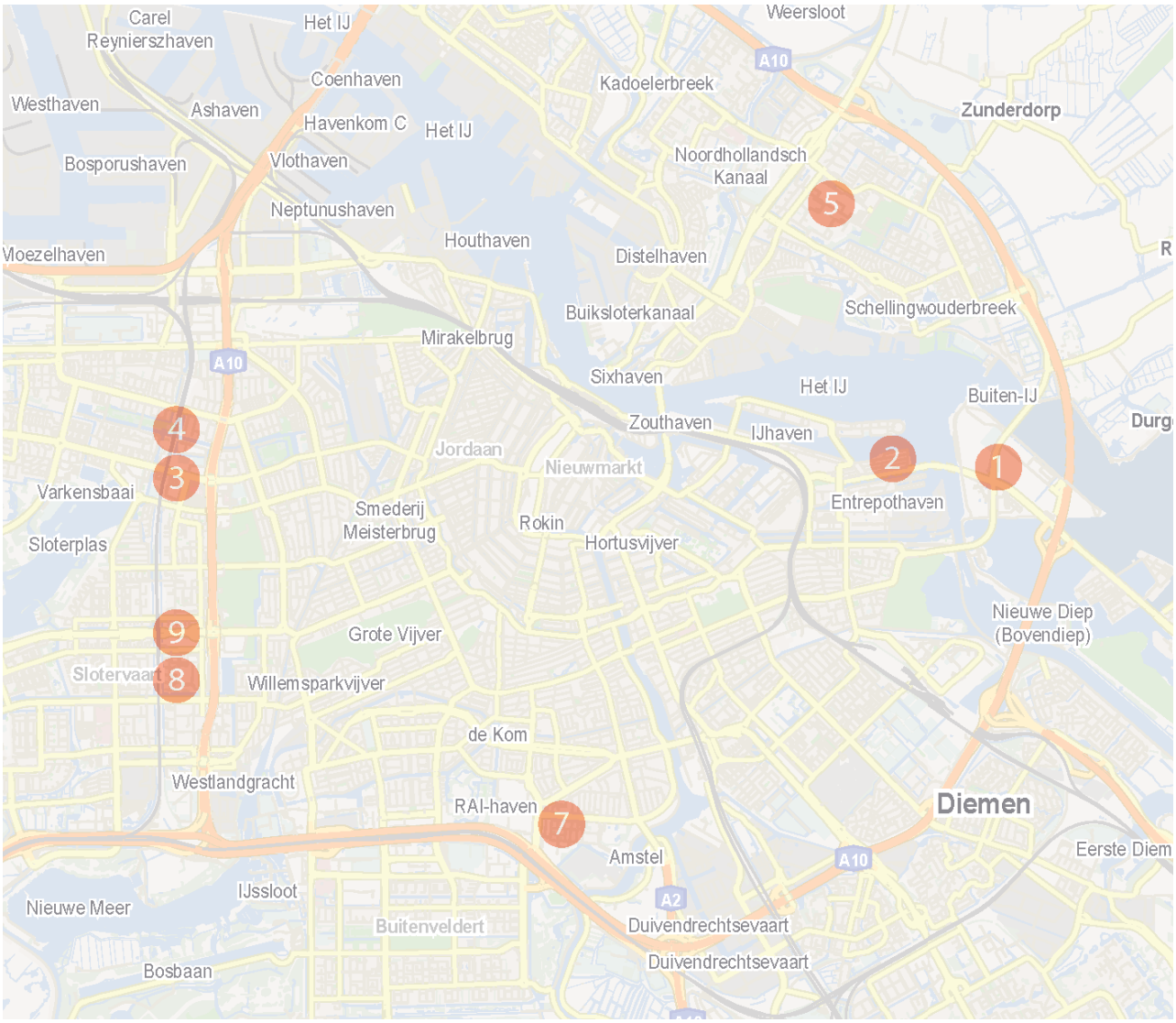
5. 3N4

6. TOON TERWIJDE

7. SQUARE

8. KING

9. QUEEN


Carel
Reynierszhaven
Het IJ
Weersloot
A10
Coenhaven
Kadoelerbreek
Westhaven
Ashaven
Havenkom C
Het IJ
Zunderdorp
Bosporushaven
Vlothaven
Noordhollandsch
Kanaal
5
Neptunushaven
Houthaven
Distelhaven
Moezelhaven
Buiksloterkanaal
Schellingwouderbreek
Mirakelbrug
A10
Sixhaven
Het IJ
Buiten-IJ
4
Zouthaven
IJhaven
3
Jordaan
Nieuwmarkt
2
1
Varkensbaai
Entrepothaven
Smederij
Meisterbrug
Rokin
Sloterplas
Hortusvijver
Nieuwe Diep
(Bovendiep)
9
Grote Vijver
Slotervaart
8
Willemsparkvijver
de Kom
Westlandgracht
RAI-haven
7
Diemen
Amstel
A10
Eerste Diem
IJssloot
Nieuwe Meer
A2
Buitenveldert
Duivendrechtsevaart
Bosbaan
Duivendrechtsevaart

Coubertin Zeeburg - Zeeburgereiland, Amsterdam

In Coubertin Zeeburg there are a total of 89, mainly mid-range, rental apartments. The building has a shared bicycle storage room and a semi-detached garage with 58 parking spaces. In Coubertin Zeeburg it is possible to live on your own, as a couple, as a family with children, or even with two friends. The building has many variations in dweling types. It consists of 25 two-room apartments, 36 three-room apartments and 28 four-room apartments. There are a number of multi-storey dwellings that contain a void. The homes have an outdoor space and are provided with a bathroom and full kitchen.

Figure 1 - Exterior Coubertin Zeeburg

Project Details

Completion date:	2019
Building type:	Multi-storey apartment blocks
Location:	Zeeburgereiland, Amsterdam
Architect:	Leeuwenkamp Architecten
Tenure:	Singles, couples, families
Budget:	-
Construction method:	
Construction material:	
Number of storeys:	9
Number of apartments:	89
Apartment size:	75 m2 - 100 m2
Public quality:	Commercial plinth

Steltloper - Ertskade, Amsterdam Sporenburg

The Steltloper building is a slim residential tower with 126 free sector rental apartments and 88 parking spaces in the parking lot. The building is partly standing in the water. On the land, Steltloper rests on 12 meter high columns. On the ground floor is the entrance and a common room. The individual dwellings are situated on the floors. The building has a total of 18 floors.

Figure 1 - Exterior Steltloper

Project Details

Completion date:	2018
Building type:	Residential tower
Location:	Ertskade, Amsterdam Sporenburg
Architect:	Dam & Partners
Tenure:	Singles, couples, families
Budget:	-
Construction method:	
Construction material:	
Number of storeys:	18
Number of apartments:	126
Apartment size:	55 m2 - 75 m2
Public quality:	Common room

Poort van Toorop - Jan Tooropstraat, Amsterdam Nieuw-West

In Amsterdam-West, Wonam realizes 176 new rental properties, of which 2- and 3-room apartments and some studios. Located on the corner of Jan Tooropstraat and Jan van Galenstraat, situated around a unique inner courtyard. Rental rates are from € 750, -. All houses have a full kitchen, a bathroom and a balcony. The residents also have their own storage in the basement of the building. Under the building there are also 56 parking spaces.

Figure 1 - Exterior Poort van Toorop

Project Details

Completion date:	2017
Building type:	Multi-storey apartment block
Location:	Jan Tooropstraat, Amsterdam Nieuw-West
Architect:	Dam & Partners
Tenure:	Singles, couples, families
Budget:	-
Construction method:	
Construction material:	
Number of storeys:	10
Number of apartments:	176
Apartment size:	43 m2 - 83 m2
Public quality:	

Sandebak - Jan Tooropstraat, Amsterdam Nieuw-West

Next to the apartment block ‘Poort van Toorop’, Wonam develops the Sandebak with 106 apartments, all two-room apartments of approximately 50 m2, all with an outside space. Rental rates from about € 750 per month. Under the building, 28 parking spaces are also realized.

Figure 1 - Exterior Sandebak

Project Details

Completion date:	2017
Building type:	Multi-storey apartment block
Location:	Jan Tooropstraat, Amsterdam Nieuw-West
Architect:	INBO
Tenure:	Singles, couples
Budget:	-
Construction method:	
Construction material:	
Number of storeys:	9
Number of apartments:	106
Apartment size:	50 m2
Public quality:	

CASE STUDY I

Huize Kerklingh - Haarlemmerplein, Amsterdam

The plan Huize Kerklingh is part of an initiative from the housing corporation Woodyshousing and is specifically designed to accommodate students in the city center of Amsterdam. The housing complex consists of a lower (commercial) and an upper structure (student housing) and accommodates 48 units. The project is located on a piece of land that has been empty for 40 years, and therefore made available by the municipality for the 'Huize Kerklingh' initiative for a period of 10 years.

Figure 1 - Exterior Huize Kerklingh - Student housing with a commercial plinth

Project Details

Completion date:	t.b.a
Building type:	Multi-storey apartment block
Location:	Haarlemmerplein, Amsterdam
Architect:	Woodyshousing
Tenure:	Student housing
Budget:	-
Construction method:	Standardized pre-fabricated home modules (plug & play)
Construction material:	Timber elements (solid wood panels for floors, roof, internal and external walls
Number of storeys:	5
Number of apartments:	48
Apartment size:	21 m2 - 62 m2
Public quality:	Commercial plinth

Construction Principle

The base of Woodyshousing's construction principle is the solid wood, stackable, plug & play module: the WOODY. In a temporary factory near the location, the modules are assembled in a short time and equipped with a bathroom and kitchen and all facilities. From there they are transported to the location and then placed and stacked. The entire production and assembly process of the modules and the building will take up to a couple of weeks. As simple as a Woodys building can be placed on a temporary location, as simple it can be moved to a new destination - partly or completely.

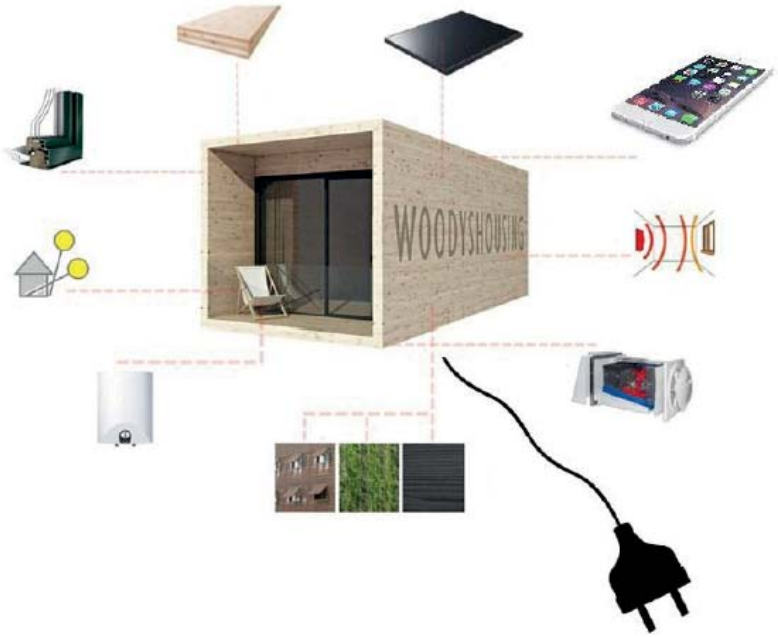


Figure 1 - The WOODY - Plug & play module

WOODY 41 - Module

Dimensions:	w 3.40m x d 7.20m x h 2.90m
Net floor area:	21 m2
Number of modules:	1
Estimated WOZ-value*:	€ 4.000 x 21m2 = € 84.000

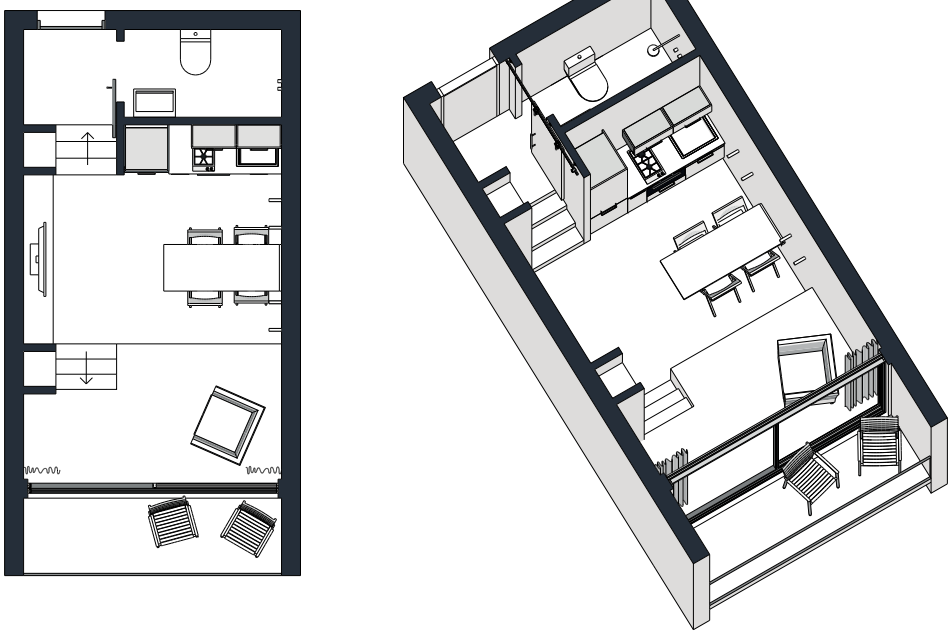


Figure 1 - Woody 41 - Module: folding table

* Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

WOODY 41 - Module

Each standard WOODY 41 is provided with its own kitchen block and bathroom. Due to the height of the modules, the student studios are equipped with a raised sleeper or a trundle bed. Shared facilities for cleaning, washer / dryer are located in the common areas.

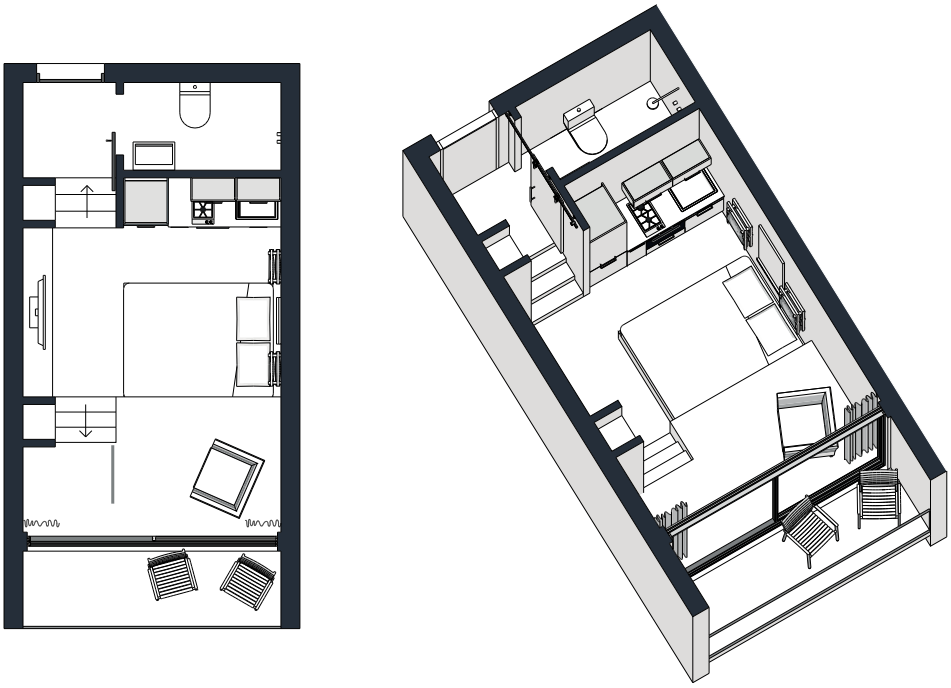


Figure 1 - Woody 41 - Module: trundle bed

WOODY 41 - Property Valuation System

Section	Points
Energy performance (A)	36
The counter is between 1 and 2 meters	4
Facilities living room with open kitchen	4
Toilets	3
Washbasins	1
Sanitary	4
Separate shower only	4
Facilities bathroom with toilet	4
Surface area 20,00 m²	20
Surface area 4,00 m²	2
Heating leave	6
Heating other rooms	1
WOZ value	93
Maximum rental price (flat rent)	€ 844,59
Total points	170

WOODY 41 - Conclusion

Conclusion

The points awarded according to the Property Valuation System show an extremely high rental price per square meter (€ 844,59 / 21 m2 = € 40,22 m2), compared to the average m2 rental price in Amsterdam. The average rent in Amsterdam rose 10.4% to € 22.28 per square meter per month last year (https://www.pararius.nl/nieuws/randstad-drukt-stempel-op-landelijke-huurprijs/NI0000000233).

The high rental price is caused by the recently changed regulations concerning the Property Valuation System. For small houses in the so-called COROP regions around Amsterdam and Utrecht, a higher score for the WOZ value applies for the same amount of square meters. This regulation only applies to houses up to 40 m2, which will be built between 2018 to 2022.

When the Woody 41 - module is applied outside the COROP regions, the property would be awarded with 120 points (€ 585,31).

WOODY 41 - Property Valuation System

Section	Points
Energy performance (A)	36
The counter is between 1 and 2 meters	4
Facilities living room with open kitchen	4
Toilets	3
Washbasins	1
Sanitary	4
Separate shower only	4
Facilities bathroom with toilet	4
Surface area 20,00 m²	20
Surface area 4,00 m²	2
Heating leave	6
Heating other rooms	1
WOZ value	93
Maximum rental price (flat rent)	€ 844,59
Total points	170

CASE STUDY I

WOODY 42 - Module

Dimensions:	w 6.80m x d 7.20m x h 2.90m
Net floor area:	43 m2
Number of modules:	2
Estimated WOZ-value*:	€ 4.000 x 43 m2 = € 172.000

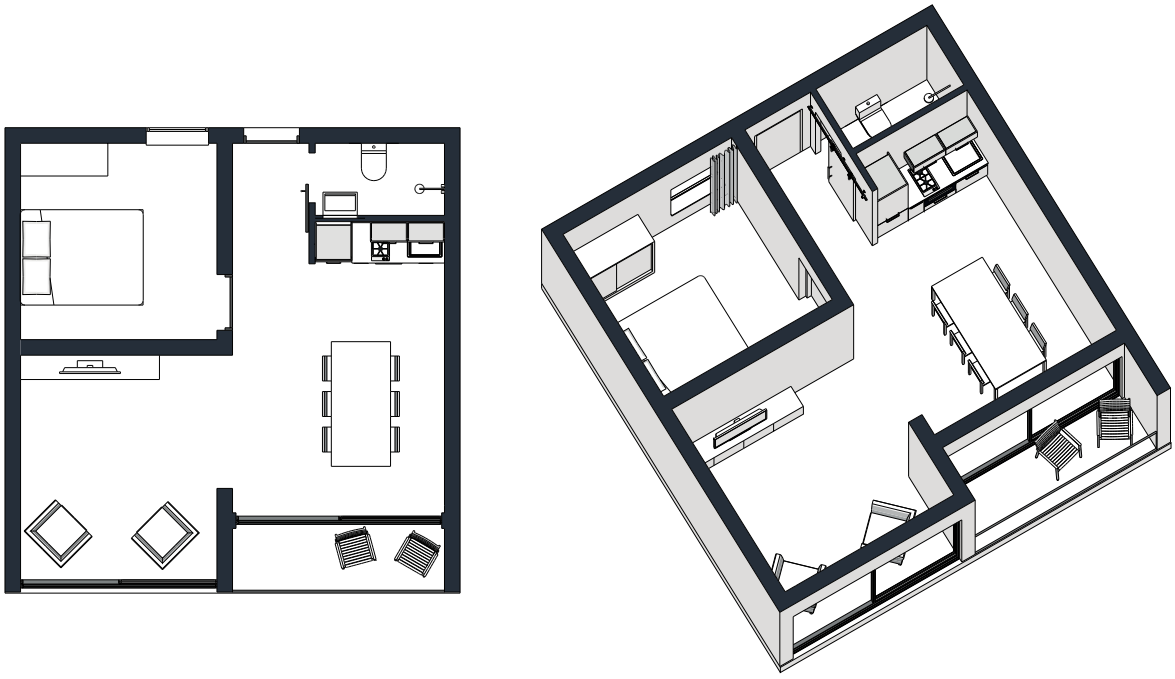


Figure 1 - Woody 42 - module: closed bedroom

* Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

WOODY 42 - Module

Two interconnected WOODY’s are suitable for two people and includes a bathroom, living kitchen, living room, bedroom and balcony. The Woody 42 - module comes in two variations. The first variation contains a closed bedroom and the second variation a raised sleeper, which can be accesed by stairs.

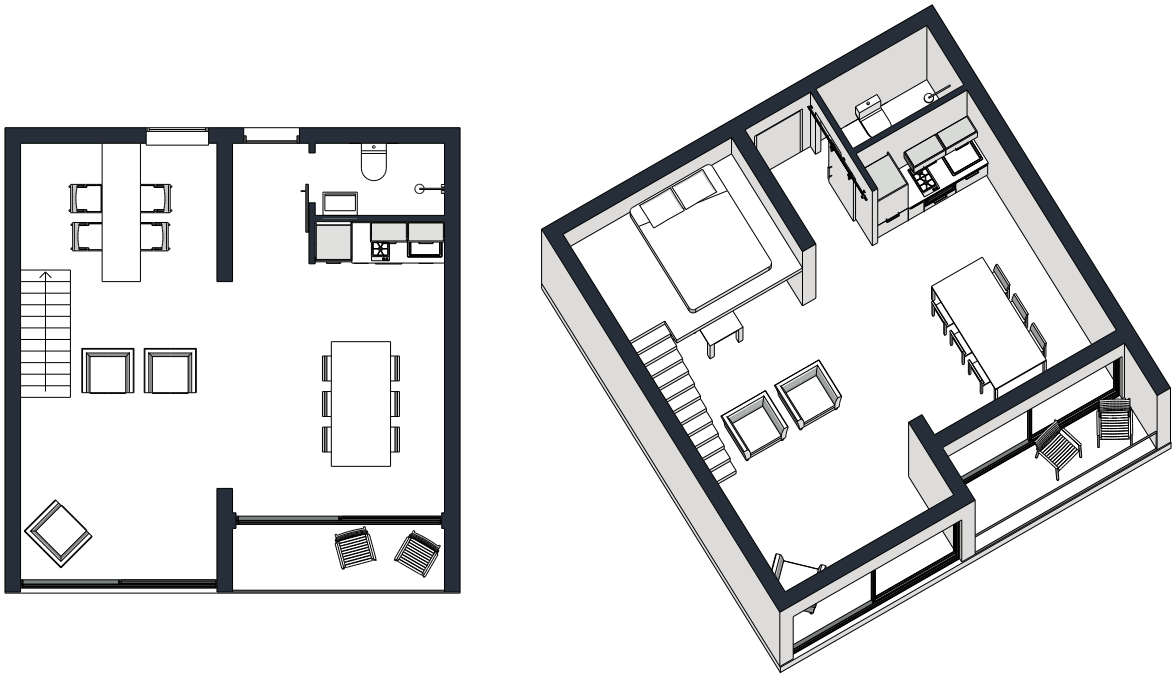


Figure 1 - Woody 42 - module: raised sleeper

CASE STUDY I

WOODY 44 - Module

Dimensions:	w 10.20m x d 7.20m x h 2.90m
Net floor area:	62 m2
Modules:	3
Estimated WOZ-value*:	€ 4.000 x 62 m2 = € 248.000

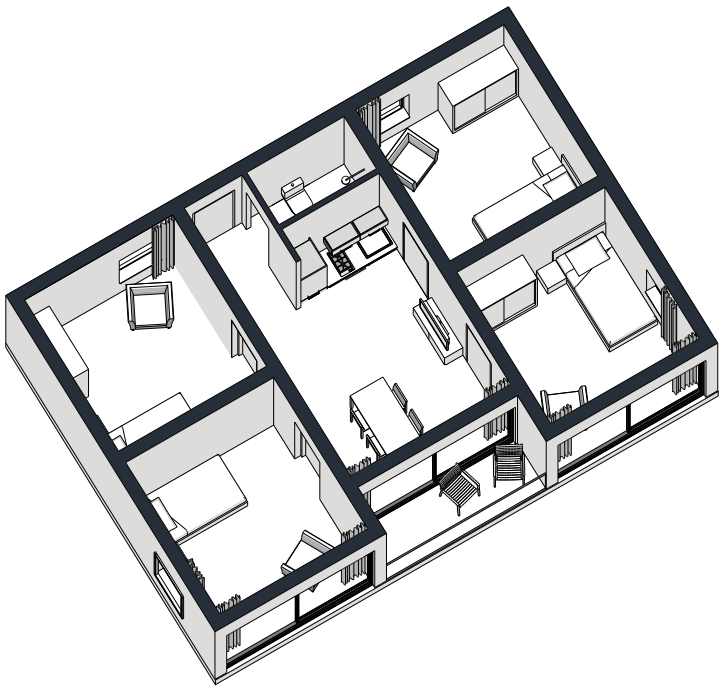


Figure 1 - Woody 44 - module:

* Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

WOODY 44 - Module

The WOODY 44 - module makes common living become easier for young tennants or families living together, by connecting three WOODYs. Three to four bedrooms with shared living space, balcony and shared facilities of bath and kitchen make an ideal combination for common living.

Figure 1 - Woody 44 - module:

CASE STUDY I

WOODY 44 - Module

Section	Points
Energy performance (A)	36
The counter is between 1 and 2 meters	4
Facilities living room with open kitchen	4
Toilets	3
Washbasins	1
Sanitary	4
Separate shower only	4
Facilities bathroom with toilet	4
Surface area 43,00 m²	61
Surface area 4,00 m²	2
Heating leave	14
Heating other rooms	1
WOZ value	62
Maximum rental price (flat rent)	€ 937,93
Total points	188

WOODY 44 - Module

The WOODY 44 - module makes common living become easier for young tennants or families living together, by connecting three WOODYs. Three to four bedrooms with shared living space, balcony and shared facilities of bath and kitchen make an ideal combination for common living.

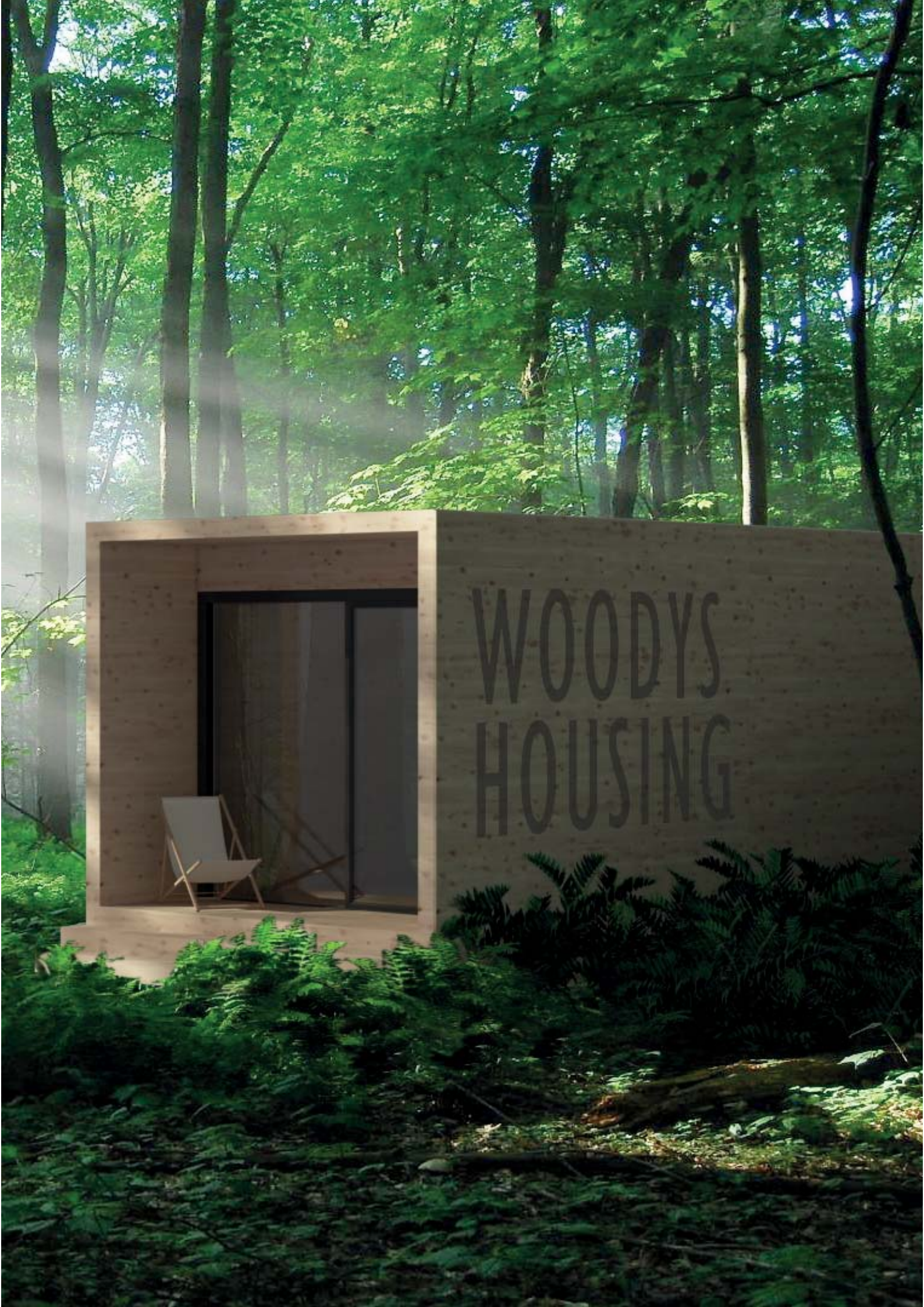
Figure 1 - Woody 44 - module:

Conclusion

The points awarded according to the Property Valuation System show an extremely high rental price per square meter (€ 844,59 / 21 m2 = € 40,22 m2), compared to the average m2 rental price in Amsterdam. The average rent in Amsterdam rose 10.4% to € 22.28 per square meter per month last year (https://www.pararius.nl/nieuws/randstad-drukt-stempel-op-landelijke-huurprijs/NI0000000233).

The high rental price is caused by the recently changed regulations concerning the Property Valuation System. For small houses in the so-called COROP regions around Amsterdam and Utrecht, a higher score for the WOZ value applies for the same amount of square meters. This regulation only applies to houses up to 40 m2, which will be built between 2018 to 2022.

When the Woody 41 - module is applied outside the COROP regions, the property would be awarded with 120 points (€ 585,31).


WOODYS
HOUSING

CASE STUDY II

Stadthaus, 24 Murray Grove, London

Stadthaus is a high-density multi-storey apartment block, completely constructed from pre-fabricated cross-laminated timber panels. The building compromises 29 private and affordable housing units (1, 2, 3 and 4-bedroom apartments) and is divided into two independantly owned sections. The gound floor provides office space for the local residents association and the Metropolitan Housing Trust owns (social housing) apartments on levels 1, 2 and 3. Levels 4-8 feature private apartments.

Figure 1 - Exterior view - Stadthaus, 24 Murray Grove, London.

Project Details

Completion date:	2009
Building type:	Multi-storey apartment block
Location:	Hackney, London
Architect:	Waugh Thistleton Architects
Housing Type:	Social housing, private housing
Budget:	£ 3.5 million (€ 4,2 million)
Construction method:	Pre-fabricated cross-laminated timber panels
Timber elements:	Solid wood panels for floors, roof, internal and external walls, lift
Number of storeys:	9
Number of apartments:	29
Apartment size:	45 m2 - 73 m2

Third Floor Plan

The building consists of two sections that are independently owned, accessed and serviced. The three lower storeys are designed for social housing and owned by the Metropolitan Housing Trust. The Housing Association required a separate ground floor entrance for the affordable units.

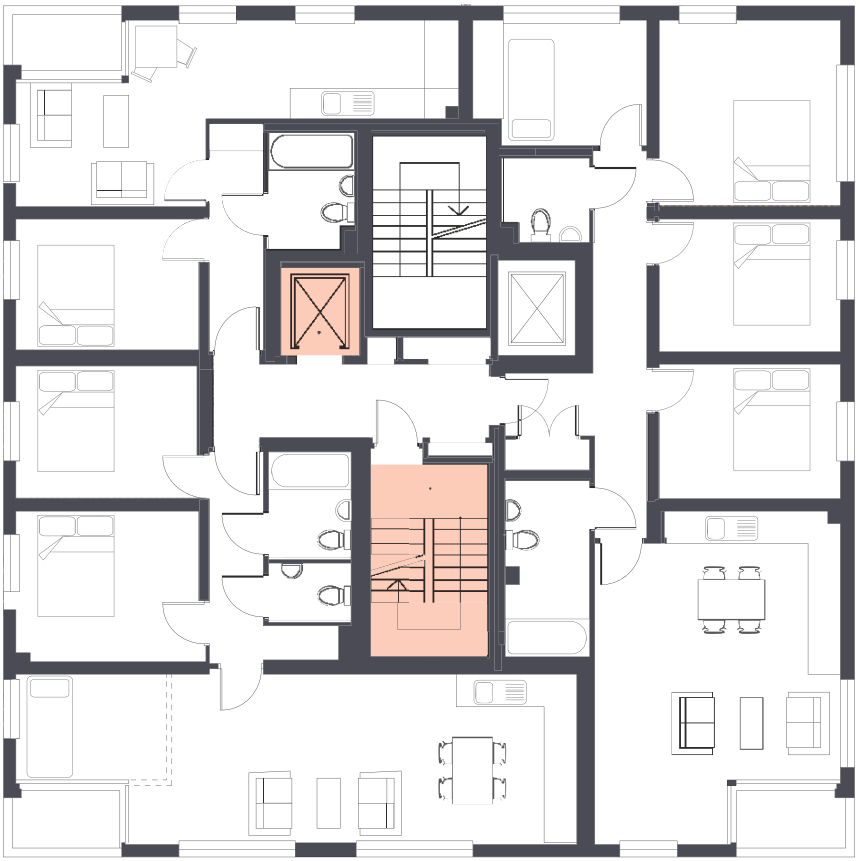


Figure 1 - Three lower storeys are provided with separate lift and stairs.

Fifth Floor Plan

The upper five storeys contain apartments for private owners. The Lift and stairs for levels 4-8 run over the full height of the building, but don’t have access to levels 1-3. Level 4 marks a change in floor layouts

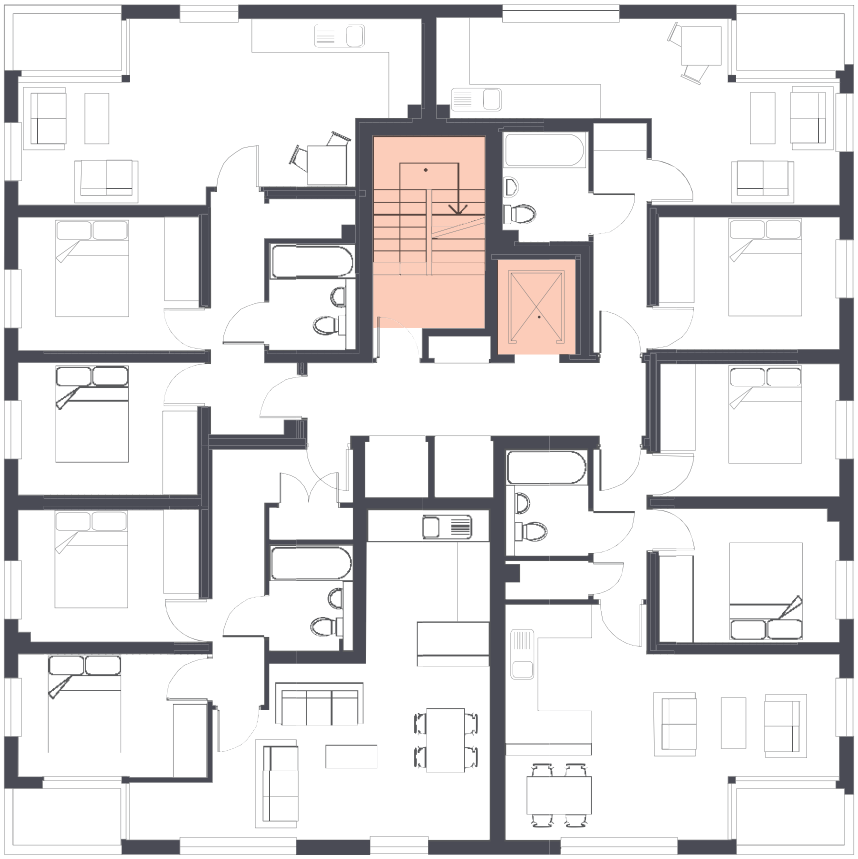
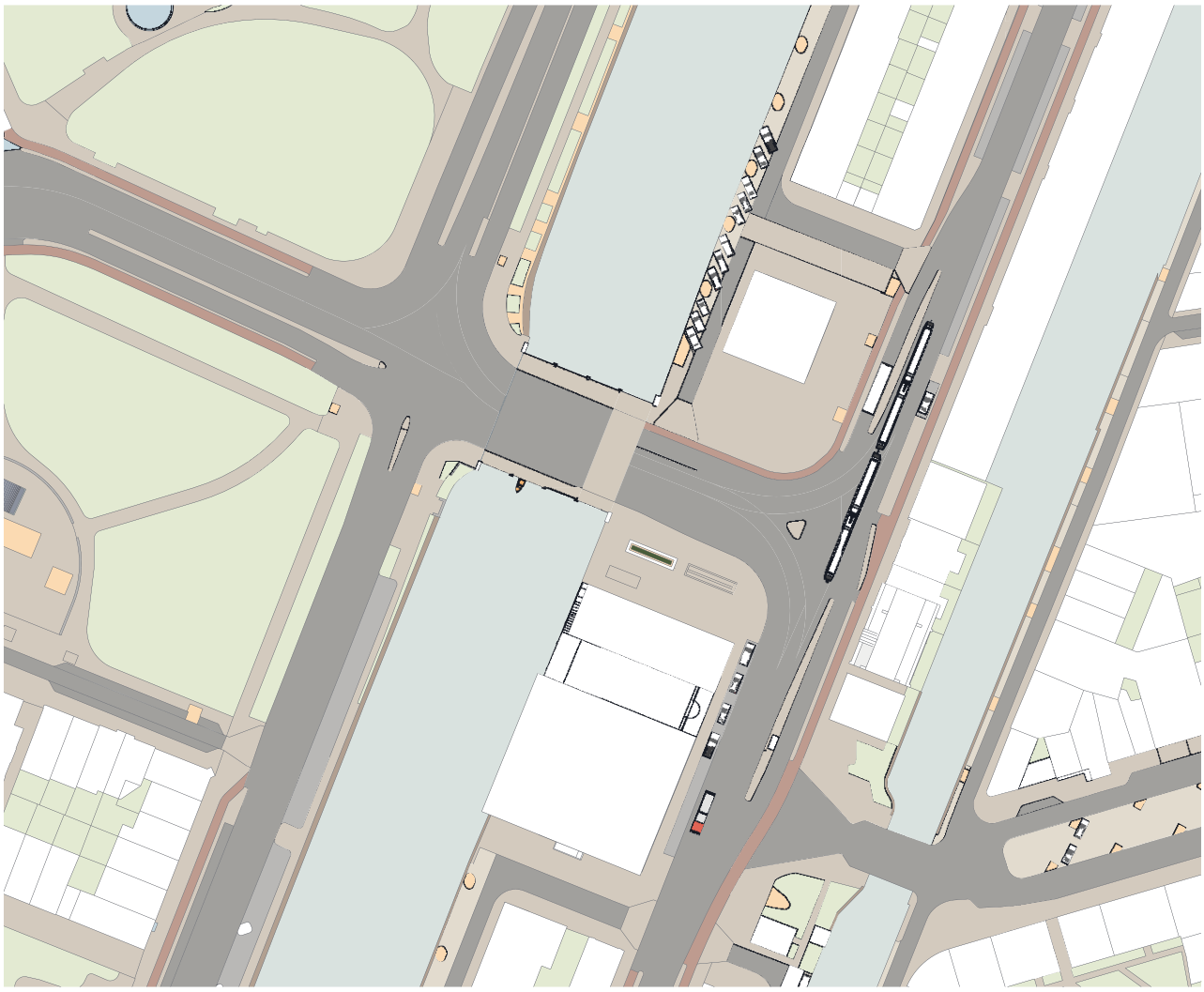


Figure 1 - Upper five storeys - designed for private housing.

Stadthaus, 24 Murray Grove, London - Building transfer



CASE STUDY II

Net floor area:	45 m2
Bedrooms:	1
Estimated WOZ-value*:	€ 4.000 x 45 m2 = € 180.000
Net floor area:	66 m2
Bedrooms:	2
Estimated WOZ-value*:	€ 4.000 x 62 m2 = € 264.000
Net floor area:	62 m2
Bedrooms:	2
Estimated WOZ-value*:	€ 4.000 x 62 m2 = € 248.000
Net floor area:	73 m2
Bedrooms:	2
Estimated WOZ-value*:	€ 4.000 x 62 m2 = € 292.000

* Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

CASE STUDY III

THE STACK, Manhattan, New York

THE STACK is a good example of project that focusses on the need for moderate-income housing in Manhattan. THE STACK is considered to be a pilot project for developing a quality and economically viable housing solution. Part of the strategy is the rebuilding and filling gaps in outmoded housing urban infrastructure. THE STACK is constructed on a small urban site and built up out of 56 pre-fabricated modules. Due to the offsite modular construction, the assembly only took 19 days.

Figure 1 - Exterior view - THE STACK

Project Details

Completion date:	2013
Building type:	Multi-storey apartment block
Location:	Manhattan, New York
Architect:	Gluck+
Tenure:	Moderate-income housing
Budget:	$ 7 million (€ 6,4 million)
Construction method:	Pre-fabricated, off-site con struction of the modules
Construction material:	Steel and concrete
Number of storeys:	7
Dwelling types:	Studio, 1 bedroom, 2 bedroom and 3 bedroom apartments
Number of apartments:	28
Apartment size:	30 m2 - 95 m2
Public quality:	4,000 square feet of ground floor commercial space

CASE STUDY III

Off-site Modular Construction

Modular construction was chosen for this project because it shortened the construction t imeline by as much as half and cut the building budget by nearly 20 percent. The Stack's developer estimates he saved 6 to 8 months of construction time and 15 to 20 percent of the approximately $7 million in construction costs.
Any mechanical, electrical, and plumbing was already in place, with only connections between the modules left to be completed.

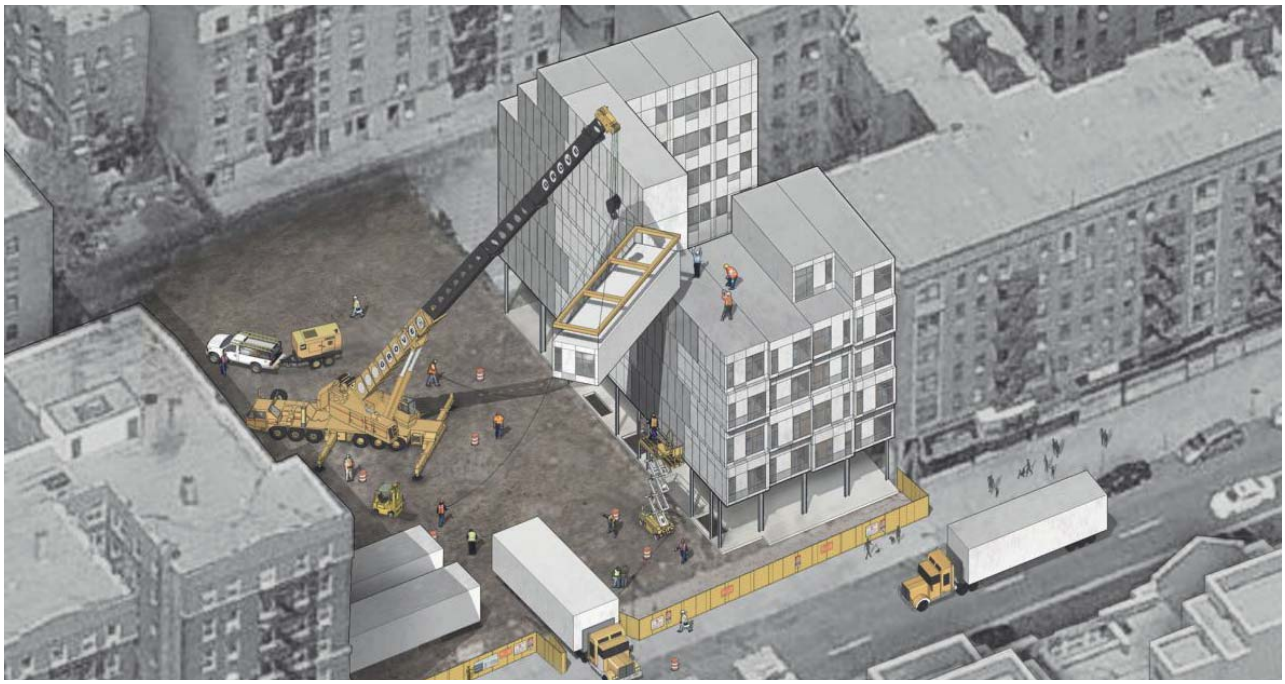


Figure 1 - Installation of the module took 19 days, an eight person crew and a crane

Project Details

Each individual unit is legible but also reads as part of a knit-together whole. Inside, different combinations of units provide structural integrity, as well as a diverse selection in the kinds of layouts for tenants. The Stack contains studio, 1, 2 and 3 bedroom homes.

Figure 1 - Great variety in appartment layout

CASE STUDY III

Net floor area:	85 m2
Bedrooms:	3
Modules	3
Estimated WOZ-value*:	€ 4.000 x 88 m2 = € 352.000

Net floor area:	30 m2
Bedrooms:	0
Modules:	1
Estimated WOZ-value*:	€ 4.000 x 30 m2 = € 120.000

Figure 1 - Fifth floor - A studio and a 3-bedroom apartment

* Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

Section	Points #1	#2
Energy performance (A)	36	36
The counter is longer than 2 meters	7	7
Facilities living room with open kitchen	7	7
Toilets	3	3
Washbasins	1	1
Sanitary	4	4
Bathroom with bath-shower and toilet	6	4
Facilities bathroom with bath-shower and toilet	6	6
Bathroom with bath-shower and toilet	6	-
Facilities bathroom with bath-shower and toilet	6	-
Surface area	88	29
Surface outdoor space	2	2
Surface other space	1	-
Heating leave	14	6
Heating other rooms	1	1
WOZ value	74	96
Maximum rental price (flat rent)	€ 1.197,17	€ 932,73
Total points	238	187

CASE STUDY IV

The Colville Estate Phase 3, Hackney

The two towers accommodate a mix of studios, one and two bed apartments and three bed penthouses. On the first and second floors, studios are combined with one and two bed units, with studios facing East/South/West only. Typical floors provide six alternating 1 and 2 bed apartments per floor. This vertical arrangement and central ‘service zone’ allows services to stack vertically and to follow the line of the vault to transfer to the core at ground floor level.

Figure 1 - Two towers of 16 and 20 storeys

Project Details

Completion date:	2016
Building type:	Multi-storey apartment towers
Location:	Hackney, London
Architect:	Karakusevic Carson Architects
Tenure:	100% market sale (partly subsidised)
Budget:	-
Construction method:	On-site construction
Construction material:	Concrete
Number of storeys:	16 and 20 storey towers
Number of apartments:	198 in two towers
Apartment size:	45 m2 - 73 m2
Public quality:	225 sqm café, pedestrian space

Typical Floor Plans

The buildings are shaped to minimise loss of light to neighbours and provide a series of elegant elevation profiles. The hexagonal footprint and orientation maximises daylight to surrounding buildings and enables a layout of generous double-oriented apartments. The floor plans have the option of 4-6 units per floor, maximising views over the park and the canal.

Figure 1 - The hexagonal footprint and orientation maximises daylight.

~~Affordability~~

The buildings form Phase 3 of Hackney Council's redevelopment of the Colville Estate - part of their borough wide Estate Regeneration Programme and will accommodate 198 private tenure apartments which will partly cross-subsidise the construction of 450 affordable homes across the new Colville neighbourhood. Income generated by the sale of private flats in the new towers will be funnelled back into the estate to subsidise social housing.

Figure 1 - Towers are facing Shoreditch Park

CASE STUDY IV

Net floor area:	67 m2
Bedrooms:	1
Estimated WOZ-value*:	€ 4.000 x 67 m2 = € 268.000

Net floor area:	88 m2
Bedrooms:	2
Estimated WOZ-value*:	€ 4.000 x 88 m2 = € 352.000

Figure 1 - Typical floors provide six alternating 1 and 2 bed apartments per floor.

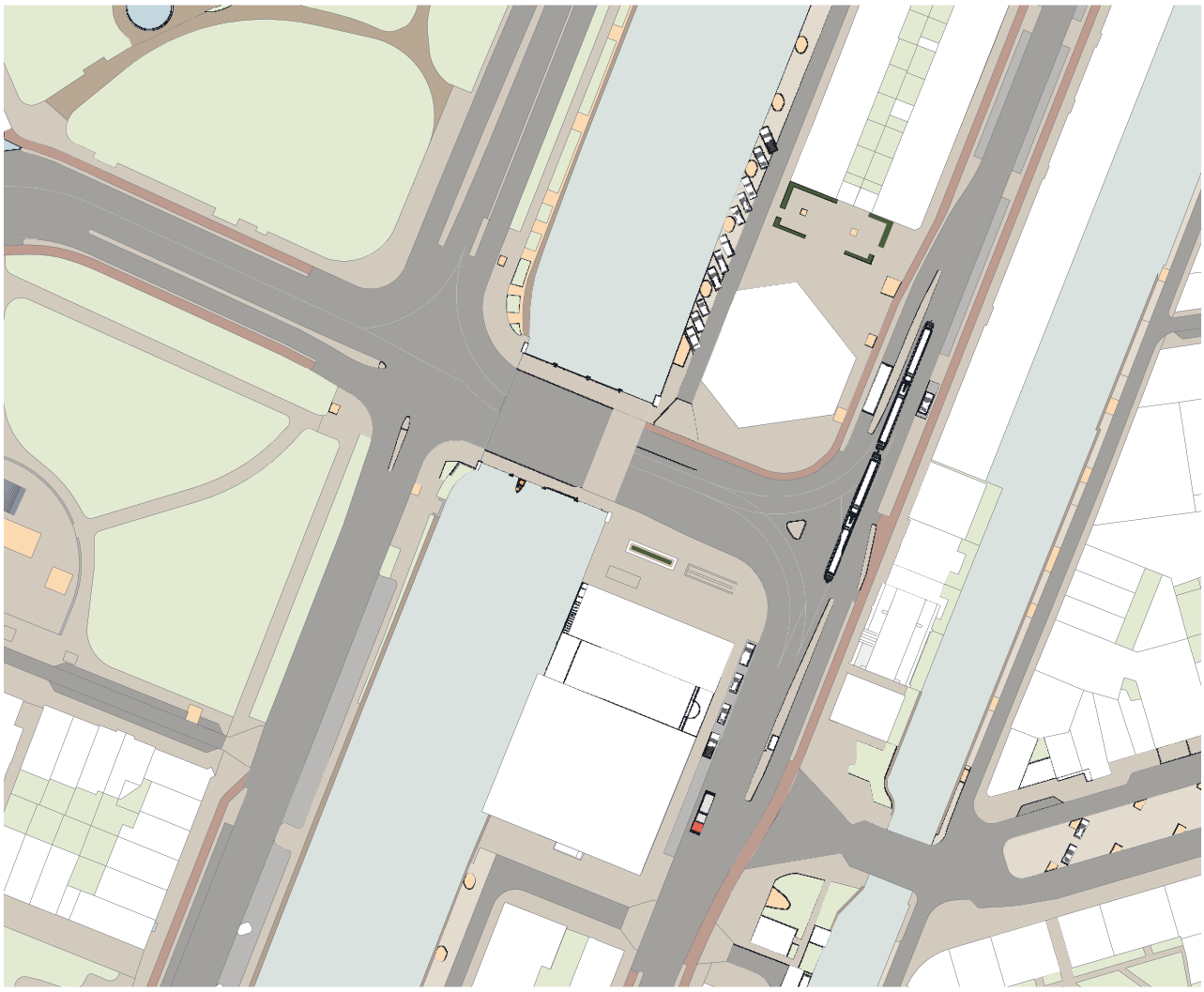
*

Based on current existing WOZ-values of the neighborhood Jordaan, Amsterdam (2016)

Property Valuation System

Section	Points #1	#2
Energy performance (A)	36	36
The counter is longer than 2 meters	7	7
Facilities living room with open kitchen	7	7
Toilets	3	6
Washbasins	1	2
Sanitary	4	8
Bathroom with shower and toilet	4	4
Facilities bathroom with shower and toilet	4	4
Bathroom with bath and toilet	-	6
Facilities bathroom with bath and toilet	-	6
Surface area	67	86
Surface outdoor space	2	2
Surface other space	-	-
Heating leave	8	8
Heating other rooms	1	1
WOZ value	67	75
Maximum rental price (flat rent)	€ 948,29	€ 1171,26

The Colville Estate Phase 3, Hackney - Building transfer

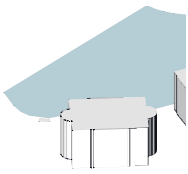


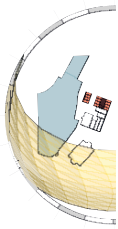
HUIZE KERKLINGH

Haarlemmerplein, Amsterdam

The plan Huize Kerklingh is part of an initiative from the housing corporation Woodyshousing and is specifically designed to accommodate students in the city center of Amsterdam. The housing complex consists of a lower (commercial) and an upper structure (student housing) and accommodates 48 units. The project is located on a piece of land that has been empty for 40 years, and therefore made available by the municipality for the 'Huize Kerklingh' initiative for a period of 10 years.

Completion date:	t.b.a
Building type:	Multi-storey apartment block
Location:	Haarlemmerplein, Amsterdam
Architect:	Woodyshousing
Tenure:	Student housing
Budget:	-
Construction method:	Standardized pre-fabricated modules
Construction material:	Timber elements
Number of storeys:	5
Number of apartments:	48
Apartment size:	21 - 62 m2
Rental price:	€24 per m2 per month
Building amenities:	Commercial plinth (220m2), laundry room, living room restaurant





THE STACK - Inwood, Manhattan, New York

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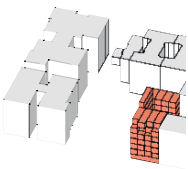
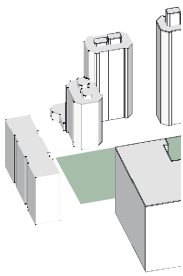
Completion date:	2013
Building type:	Multi-storey apartment block
Location:	Manhattan, New York
Architect:	Gluck+
Tenure:	Moderate-income
Budget:	$ 7 million (€ 6,4 million)
Construction method:	Pre-fabricated, off-site construction
Construction material:	Steel and concrete
Number of storeys:	7
Dwelling types:	Studio, 1-, 2-, 3-bedroom apartments
Number of apartments:	28
Apartment size:	30 - 95 m2
Rental price:	€34 per m2 per month
Building amenities:	4,000 square feet of ground floor commercial space

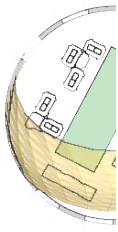


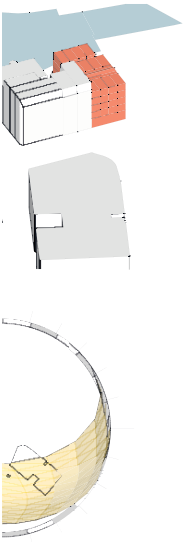
CARMEL PLACE - Kips Bay, Manhattan, New York

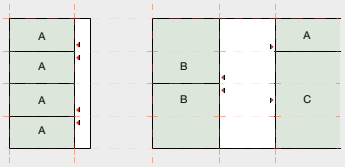
<Description>

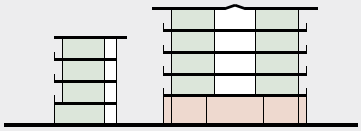
Completion date:	2016
Building type:	Residential Tower
Location:	Kips Bay, Manhattan, New York
Architect:	nARCHITECTS
Tenure:	High-income
Budget:	$ 17 million (€ 15,1 million)
Construction method:	Pre-fabricated, off-site construction
Construction material:	Steel framed modules
Number of storeys:	9
Dwelling types:	Studio (micro) apartments
Number of apartments:	55
Apartment size:	30 - 95 m2
Rental price:	€96 per m2 per month
Building amenities:	Laundry room, fitness room, (bike) storage, retail, study room, roof terrace, community room

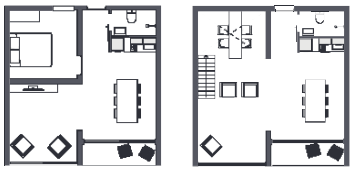


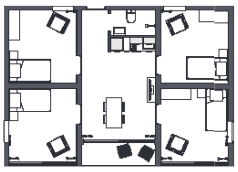




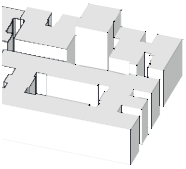


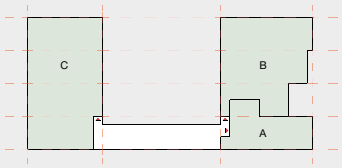


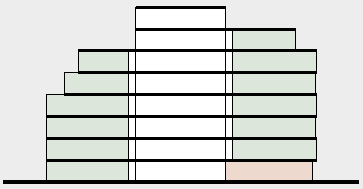


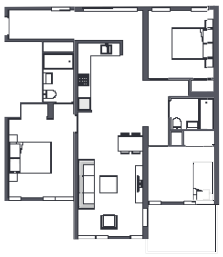


The rental price for an individual module is based on the property valuation system and is estimated to be around € 500

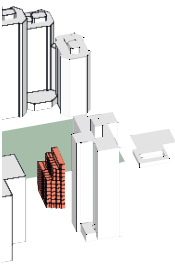


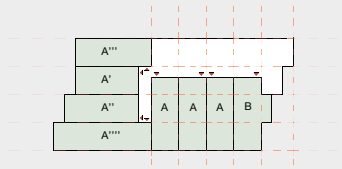


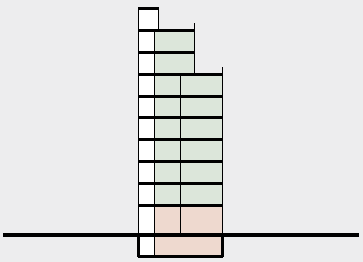


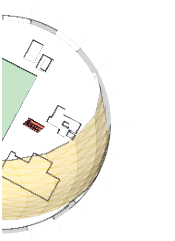


Modular construction was chosen for this project because it shortened the construction t imeline by as much as half and cut the building budget by nearly 20 percent. The Stack's developer estimates he saved 6 to 8 months of construction time and 15 to 20 percent of the approximately $7 million in construction costs. Any mechanical, electrical, and plumbing was already in place, with only connections between the modules left to be completed.









The 55-unit project formally known as My Micro NY will offer market-rate rents ranging from $2,650 (€2,350) to $3,150 (€2,800) for apartments with an average of 28 sqm. A 750-sqm one-bedroom apartment in New York City currently rents for approximately $3,400 (€3,000). At about €3,660 to €3,875 per square meter to construct, Oriwol (Monadnock Construction) said this particular project hasn't provided major costs savings compared to traditional construction. But he said it has saved time and improved quality since a major chunk of the work is done in a warehouse that is cleaner than a construction site and less crowded.

PROGRAM RESEARCH

Public and residential program research

RESIDENTIAL PROGRAM

This chapter describes the functional and spatial requirements for affordable (mid-income) residential buildings with individual apartments, storage rooms, common (circulation) spaces, bicycle parking facilities and storage units.

Market & Program

For the new affordable rental apartments, spacial-, technical- and esthetical requirements are formulated in this program of requirements. The studios and two-, three- and four-bedroom apartments are classified in three quality levels, namely Standard, Plus and Extra. In general, dwellings in a residential building are all in the same quality level. The target group for rental housing is mid-income group, including the “Young Professional” and the “City Dweller” (1.5-2x modal income). The apartment’s floor areas can range from 40m^2 to 100m^2. The rental rates range from € 725 to € 1100 per month. The table “Surfaces per Quality Level and Type” indicates the area at which quality level is indicative.

Floor area per quality level and type	Standard	Plus	Extra
	Area m^2	Area m^2	Area m^2
Studio	<50	<50	<50
1 room	50-60	50-60	50-60
2 room	60-70	60-75	60-80
3 room	80-100	80-100	80-100

PROGRAM DESCRIPTION

The aim of this project is to develop housing for the free market rental segment with a rent between € 710 and € 1,100. The project mainly focusses on housing young professionals (people in their 20s and 30s who are employed in a profession), by providing affordable studios and two or three room apartments. To achieve this, the (economic) benefits and limitations of two construction methods (modular prefab construction vs. traditional construction) will be further explored. Each individual dwelling is provided with adequate outdoor space (suitable for dining and directly accessible from living/dining area) and contains a complete bathroom and kitchen.

Proposed program:

Residential tower block that consists of a basement (max. storey), lower structure (max. 5 storeys) and upper structure (max. 10 storeys). The ground-floor areas are conceived as an extension of the street (permeability) and contains public functions. The building's design should correspond and interact with the existing spatial and urban structure and its dimensioning relates to pre-existing structures. To meet the desired density and to ensure the affordability of rental housing, the lower structure enables the construction of a residential tower on top of it. The high-rise should act as a catalyst of urban development and may exceed 45 meters in height. The overall project shout contribute to the sustainable development of the city and enrich the urban qualities of the direct and indirect surroundings

- The building is sufficiently accessible for wheelchair users.
- The entrance hall is the showpiece of the residential building and is therefore very important. This means: a lot of attention has to be paid to the quality of the entrance space (height and floor area), light (day and energy efficient artificial light), finishing level, safety and functionality.
- No freely accessible public spaces and niches. Any fences can be locked and equipped with a card reader system or similar.
- Correct signposting, naming and numbering so that routing of the building has been made explicit.
- Bike storage for visitors near the entrance and subtly from sight.
- Waste collection is carried out by the municipality in the public domain.
- Mailboxes are provided with house number and residents name and are accessible from outside for delivery providers and from inside by residents.
- At the entrance door a well lit place to stand dry, in sight of public domain (avoid hangout place)
- Prevent residents from cycling through entrance to the storage space.
- Prevent placement of bicycles in front of the main entrance.
- If there is a height difference between ground level and access level of the residential building, cross this height difference with stairs and a slope according to the requirements of 'Woonkeur'.
- A closed communal circulation space provides access to living accommodations (interior gallery, a core/hall and porch).
- Commercial premises located under residential buildings should contribute to the appearance of a project and should not cause any harm to residents. (Facility level: suitable for middle income).

- Passenger lifts take as little space as possible. An optimal balance is sought between the space fitting and the cost of the lifts.
- The elevator is located on a logical place in the building and is easily found both on the ground floor and on the upper floors.

Façades

- The architecture of the possible different plans are designed in conjunction with each other.
- The installations, lighting and measures against wind, etc. are integrally designed in the building
- The design of the plinth fits well with the public space. For commercial purposes, depending on the function, the plinth has a higher floor height and glazing ranging from the top of the ground floor to the bottom of the ceiling.
- The building is designed to create a good (urban)climate at the ground level.
- Starting point is that the applied (facade) materials have an attractive appearance and have a lasting/ durable and maintenance-friendly character.

General points of interest

- Possibility of applying curtains, attention to the inward rotating tilt-and-turn windows.
- Preventing unwanted warming of the living space by the sun.
- Window cleaning of dwellings on higher floors requires a facade maintenance facility.
- The floorplans must be designed in such a way that a flexible layout of the furniture by the occupant is possible within the living spaces.
- The resident must be able to identify with the entrance hall outside the front door of the dwelling (if present). The entrance is very important and it belongs sensitively to the home.
- All dwellings contain a storage room in the dwelling, provided with a washer- and dryer connection. In case additional external storage units are provided, the minimun requirements conceirning these units are stated in 'Bouwbrief 2015-130' (included in attachment). The concideration of external storage facilities is dependant on factors such as the building envelope and the site allocation plan.
- For dwellings under 50m^2 there are no minimum requirements regarding the storage facilities (both internally and externally in the building)
- Each property is provided with individual outdoor space. The minimum size for the outside space is: for a studio aprox. 6m^2, for a two-bedroom appartment 6-8m^2 and for three-bedroom apartment 8-10m^2.

Requirements per quality level		Standard	Plus	Extra	Remarks
Free height living space	Minimum 2,60 m (bouwbesluit)	v	v		Floor height of the plinth must be 'connected' to the surroundings and may be higher than the upper floors.
	Minimum 2,80 m			v	
Window frames living room	Parapet under window frames	v			
	Storey high		v	v	No radiator in front of window. Plinth convector is allowed.
Outdoor space	Outdoor space (balcony or loggia)	v	v	v	Studio's >40 m^2 and 1-bedroom: 6m^2, 2-bedroom: 6-8m^2, 3-bedroom: 8-10m^2.
	Rotating door to outdoor space	v			
	Sliding doors to outdoor space		v	v	
Dwelling entrance	Videophone	v	v	v	For contact and safety reasons.
	Spaceous entrance hall			v	Plenty of room for hanging coats and a 'rich' entrance.
Living room	Open kitchen	v	v	v	Open kitchen in living room.
Kitchen	Open kitchen	v	v	v	
	Worktop HPL	v	v		
	Worktop Hardstone			v	
	Kitchen cabinet doors	v	v	v	Light colors, modern handles.
	Combi hot water tap			v	
	Built-in fridge freezer	v			Table model refrigerator (120 l.) with freezer compartment (20 l.).
	Built-in fridge freezer		v		Ratio 40 liter freezer compartment underneath,180 liter refrigerator above.
	Built-in fridge and built-in freezer			v	180 liter refrigerator bottom, 40 liter freezer compartment above.
	Built-in dishwasher	v	v	v	Width 60cm.

Requirements per quality level		Standard	Plus	Extra	Remarks
	Ceramic cooker	v			
	Induction cooker		v	v	
	Built-in microwave with oven function	v			
	Built-in oven, microwave function		v	v	
	HR-extractor hood	v	v	v	Connectable to the central air extraction system of the house, motorless.
Bedroom(s)	Space for wardrobe	v	v	v	
Bathroom	Walk-in shower	v	v	v	Flat floor with shower cubicle, glass shower screen.
	Bath	v	v	v	Note: only applies to 3 room apartments or larger.
	Single sink	v	v	v	
	Double sink	v	v	v	Note: only applies to 3 room apartments or larger.
	Mirror	v			Width equal to sink.
	Mirror		v	v	Width equal to sink, with built-in lighting.
	Tiling 1.50 m high	v			Shower tiles up to 2.10 high.
	Tiling to ceiling		v	v	
Toilet	Separate toilet	v	v	v	
	Sink	v	v	v	
	Tiling	v	v	v	Up to 1.50 m high.
Storage	In dwelling, or internally in building	2,70 m³	2,70 m³	2,70 m³	See attachment: Bouwbrief (2015-130)
	washer and dryer setup	v	v	v	
Parking	Parking standard	0,2-0,7	0,2-0,7	0,5-1,0	Indoor parking. Standard dependent on targt group
	Indoor bicycle parking	v	v	v	Shared bicycle parking. See attachment: Bouwbrief (2015-130)

Sustainability

In terms of sustainability, the living experience of the final occupant is important. Sustainability is based on the long-term operation of the building. The requirements regarding durability and safety are as follows:

- Market and target-oriented development and design appropriate to the DNA of the neighbourhood of the building.
- Particular attention has to be paid to the operation, management and maintenance of apartments, building and environment, aimed at the long term in relation to own-interest (investment).
- All wood to be used must be certified with an FSC approval mark
- Focus on energy saving and reduction of CO2 emissions. EPC according to Bouwbesluit, taking into account any additional requirements.
- Achieving energy label A

Exploitation & Management

The property is managed by a manager. Per project is determined whether a complete management space is required, or a simple management space. A property is provided with a complete management space, unless a property in the vicinity is already provided with a complete management space (indicative: over 200 homes a complete management space). In the latter case, a simple administrative space in the property is sufficient.

Complete management space:

- Counter, internet connection, pantry with warm and cold water, toilet with sink, heated, storage closet

Simple management space:

STRATEGY

FRAMEWORK STRATEGY

Future development strategy plan

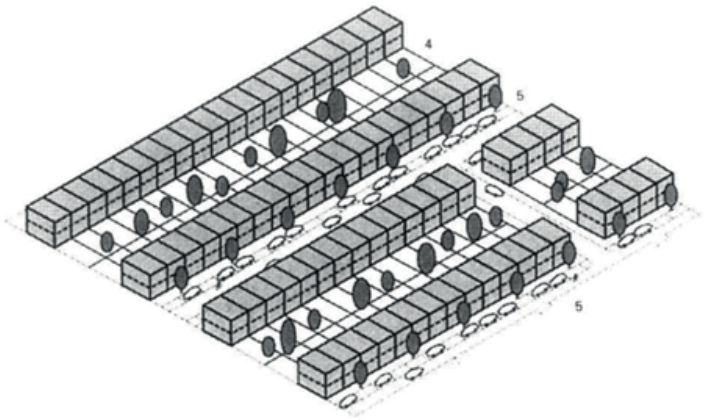


Figure 1 - Low rise - High site coverage (75 units/ha)

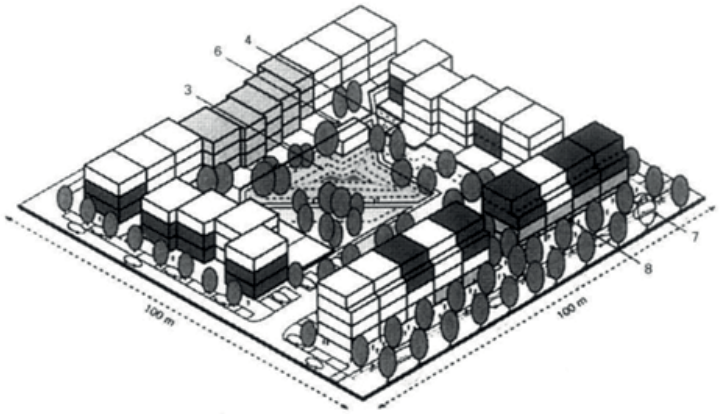


Figure 1 - Medium rise - Medium site coverage (75 units/ha)

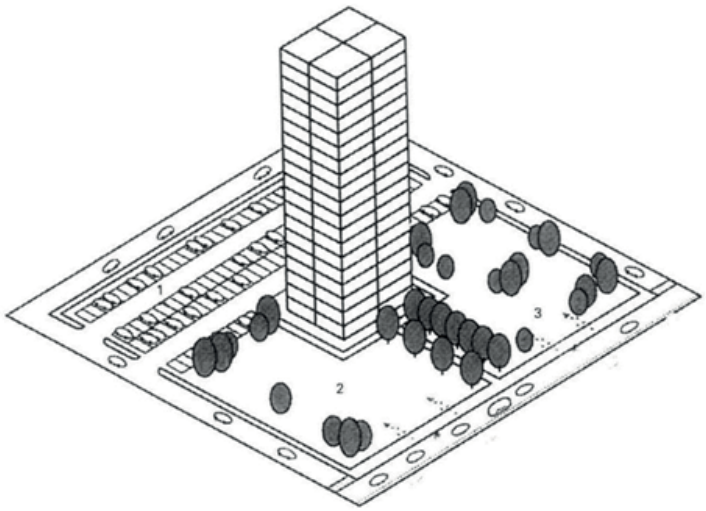
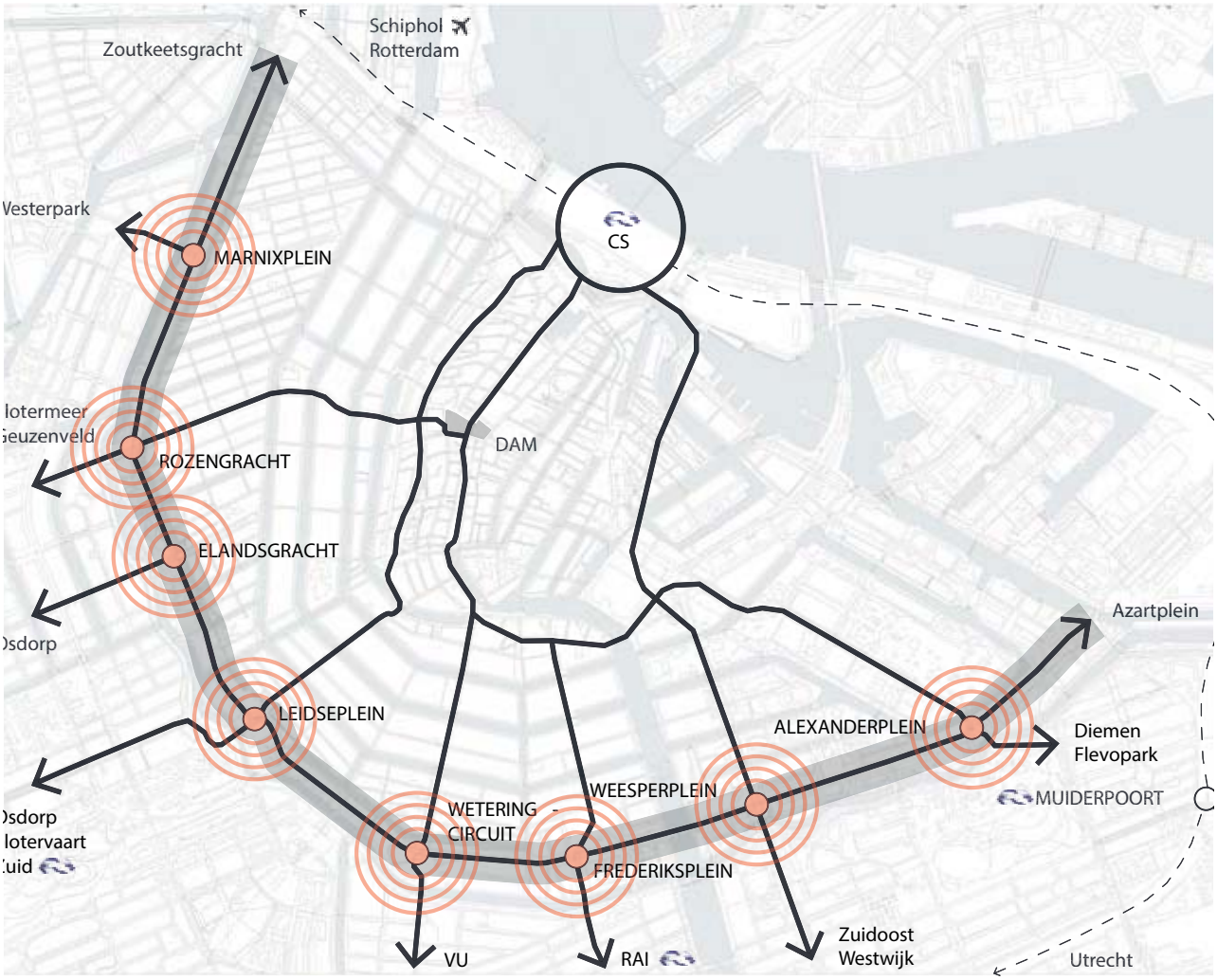


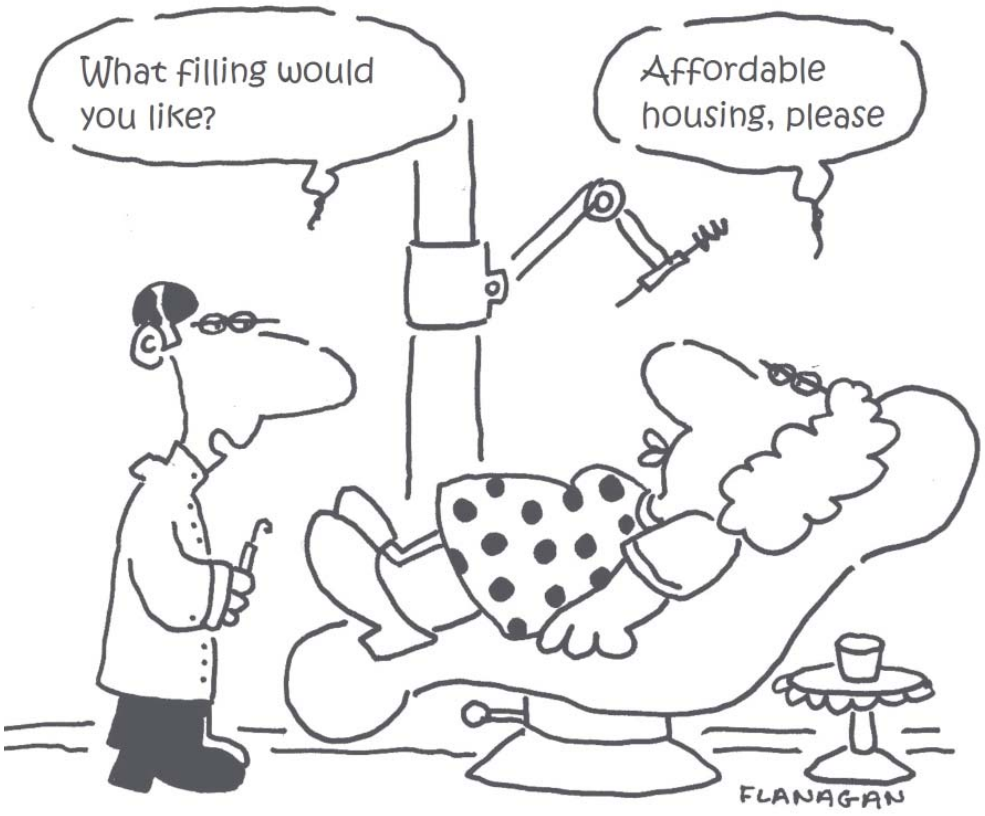
Figure 1 - High rise - Low site coverage (75 units/ha)

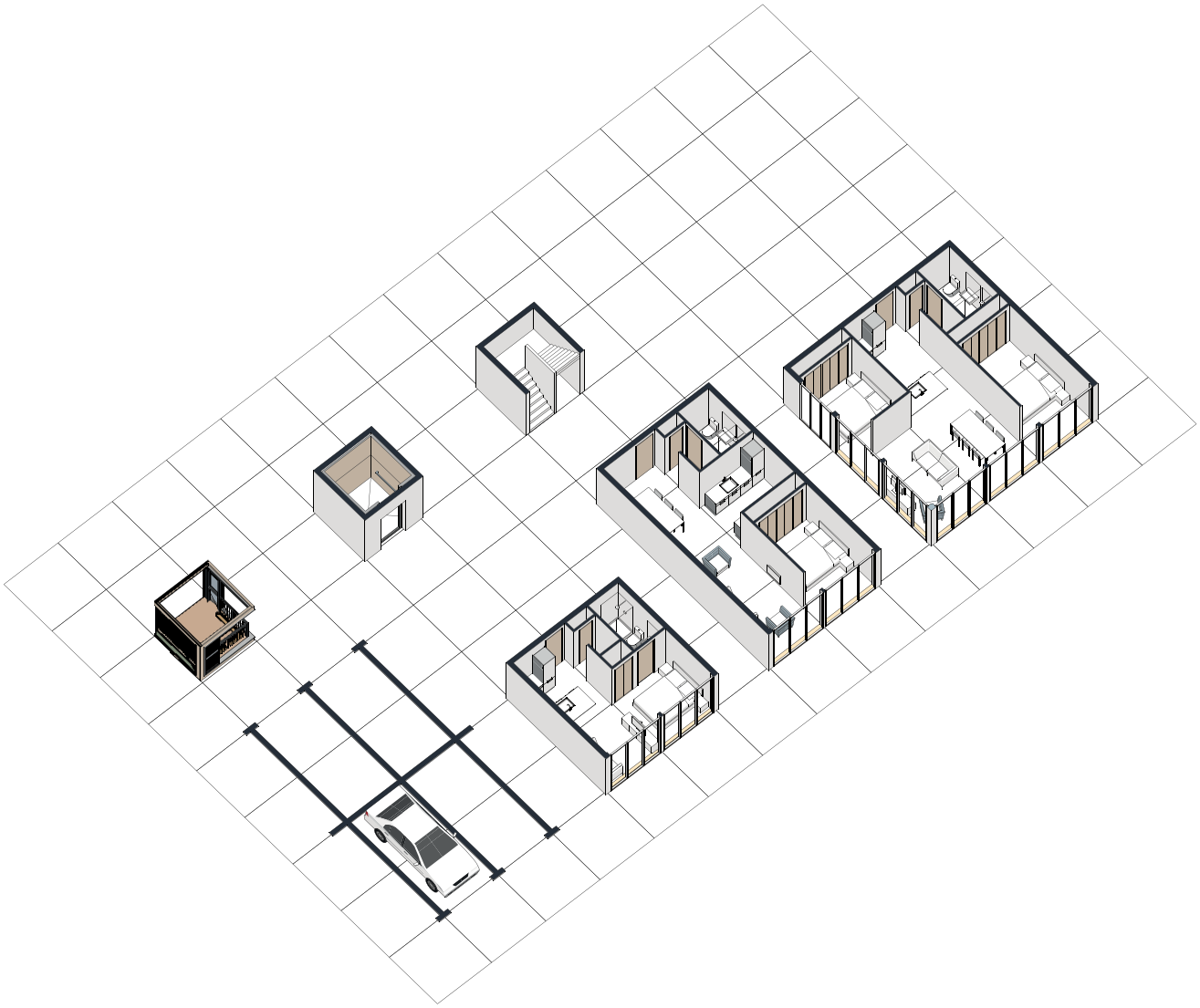
THE PRESSURE ON THE CITY INCREASES

Part of the overall strategy is to gradually start introducing highrise in the Singelgracht-zone. The intersections are considered strategic locations for this new development.



The trend towards urbanization is increasing significantly. Inner cities provide a large amount the jobs, facilities and networks for workers. This attracts people and businesses to the city, increasing the pressure on infrastructure, housing and livelihood within the city.





SINGELGRACHTZONE

The trend towards urbanization is increasing significantly. Inner cities provide a large amount the jobs, facilities and networks for workers. This attracts people and businesses to the city, increasing the pressure on infrastructure, housing and livelihood within the city.

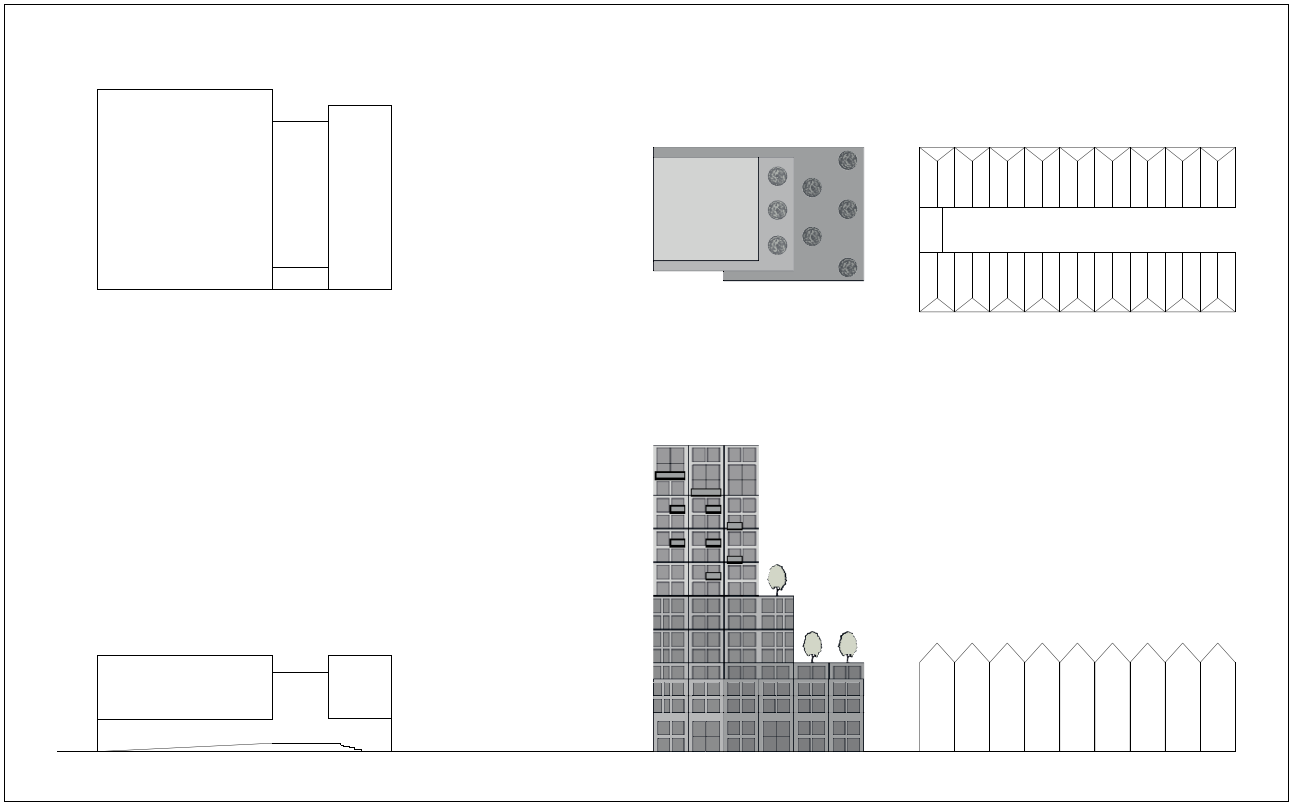
At the same time, the Netherlands is struggling with a population shrinkage in the countryside. Young people tend to leave the place where they grew up move to urban areas to study and find work. A return to the hometown is becoming less realistic due to the decrease of employment (Woodyshousing, 2016). This causes Urban space to become more and more scarce.

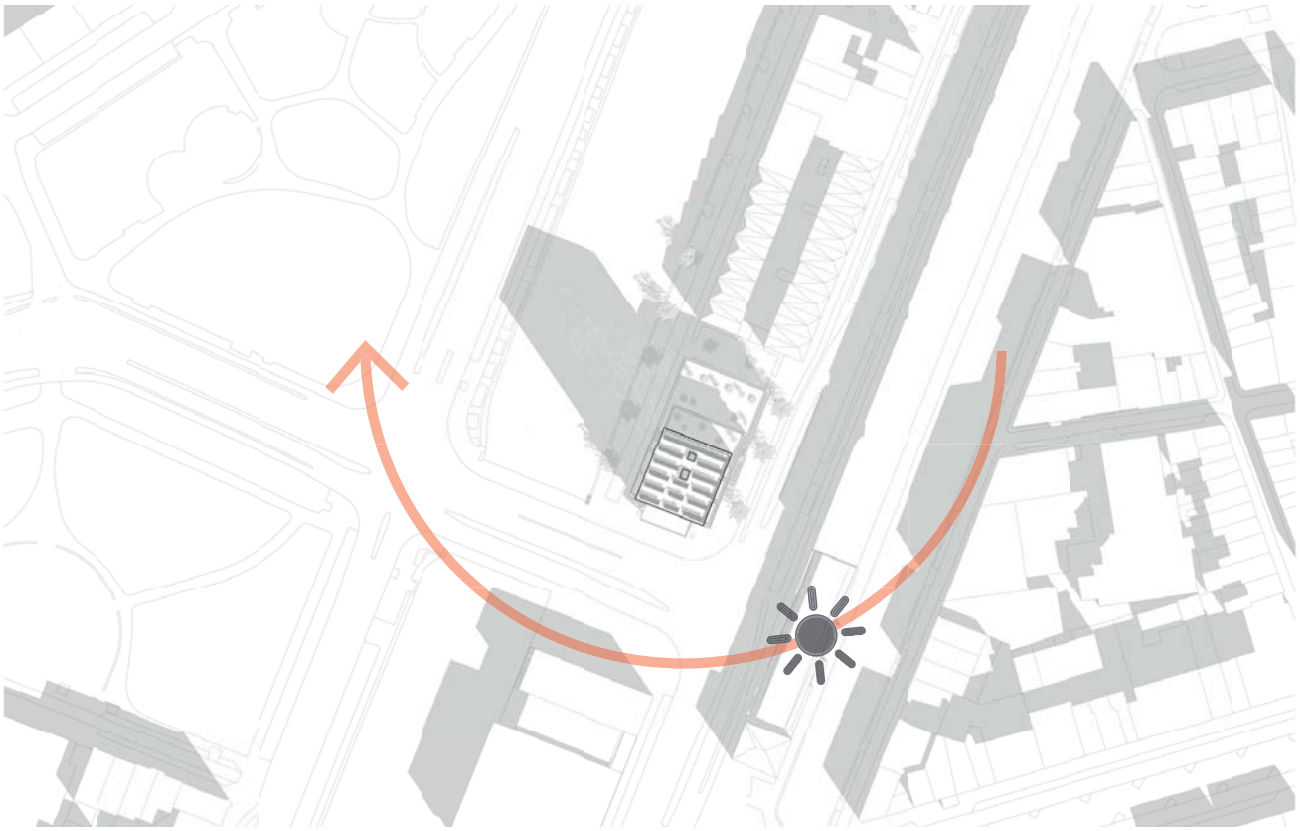
Mainly due to the increasing pressure on the city, the tightness in the housing market is becoming a bigger and bigger problem. The offer of decent properties is completely out of balance, causing the housing prices to rise drastically. For the 21st century architect this recent development raises the following question regarding the the future development of the urban environment:

PROJECT ARCHITECTURE

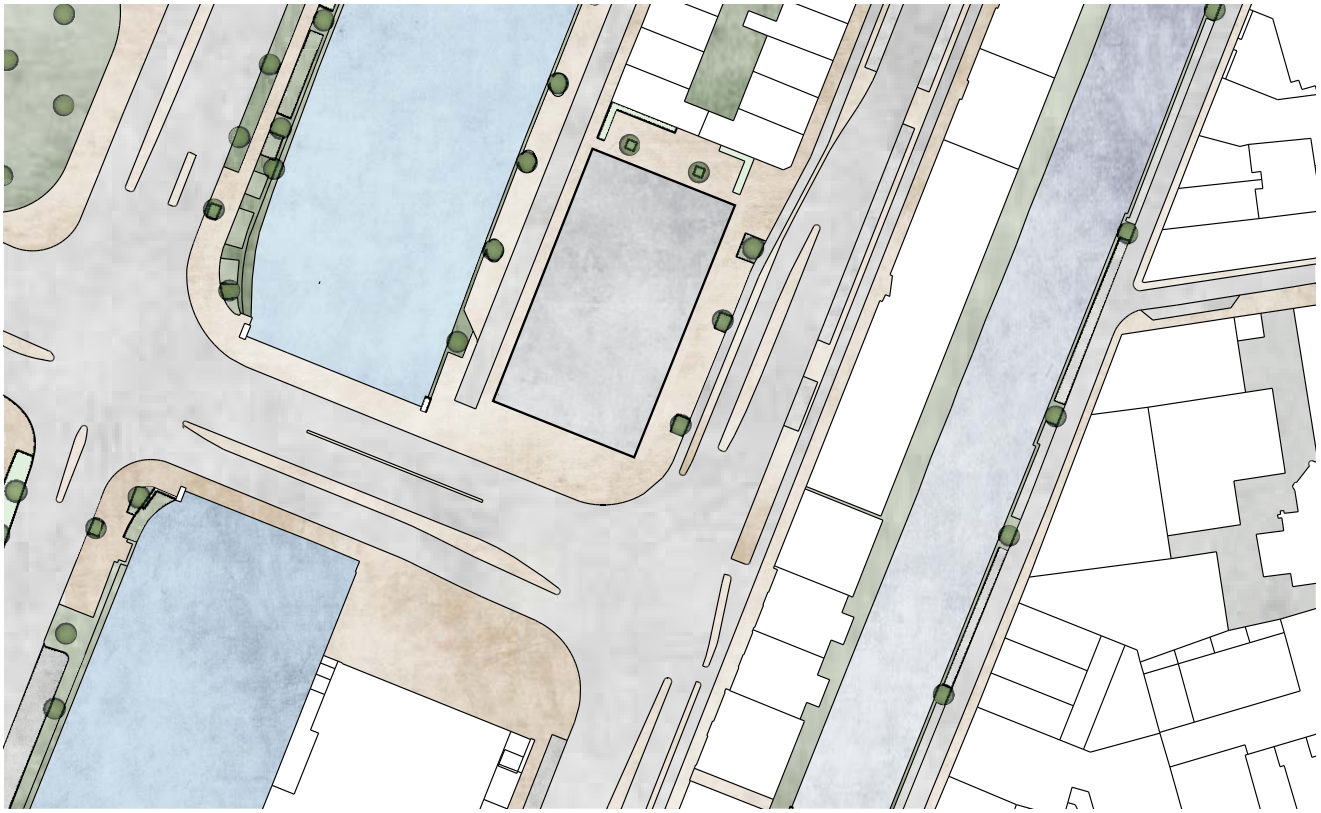
Project plan

SINGELGRACHTZONE

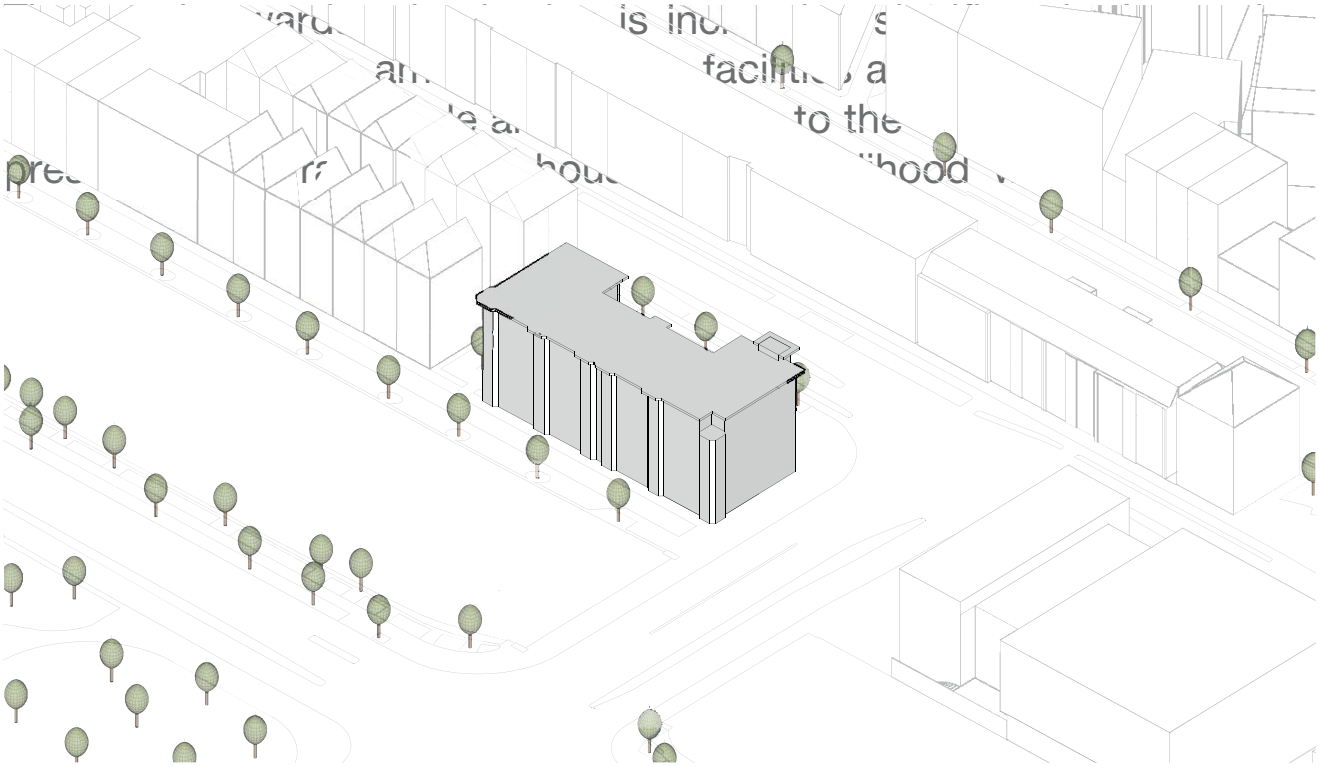




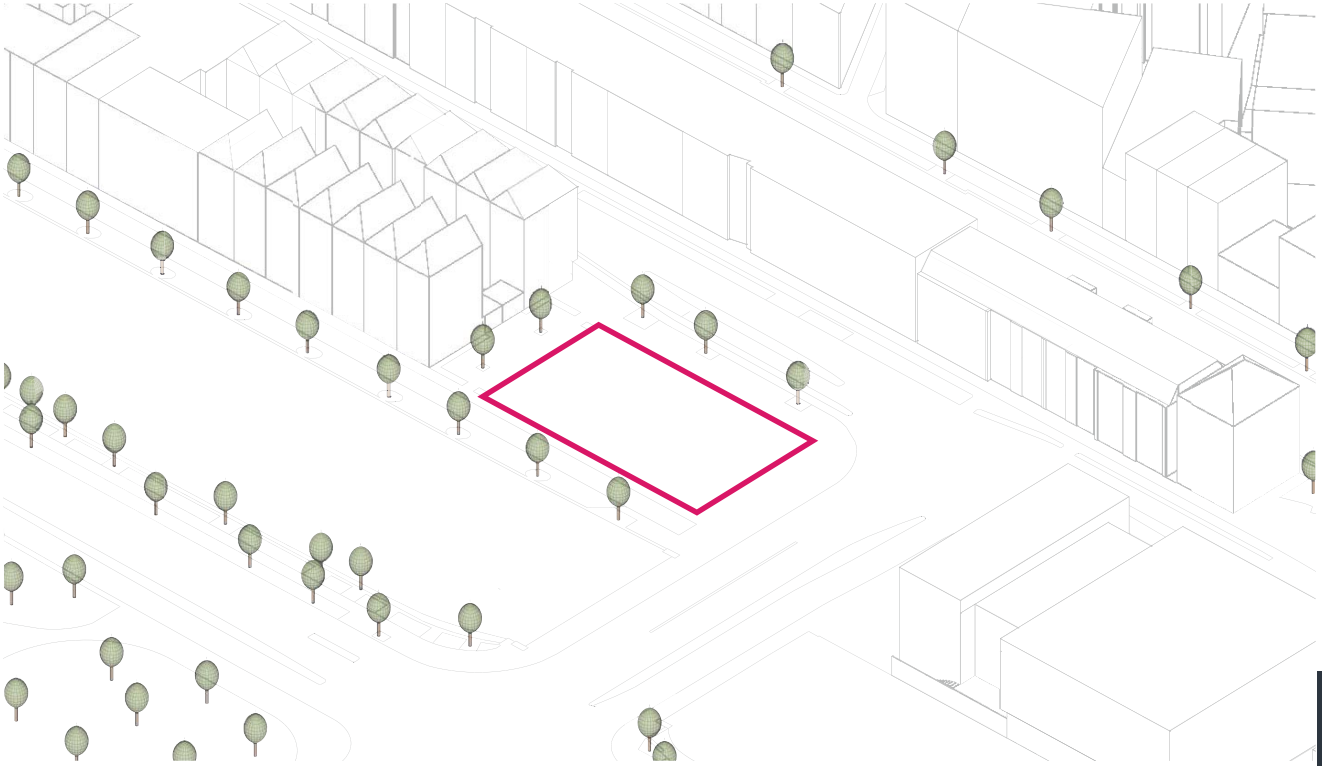
URBAN DESIGN



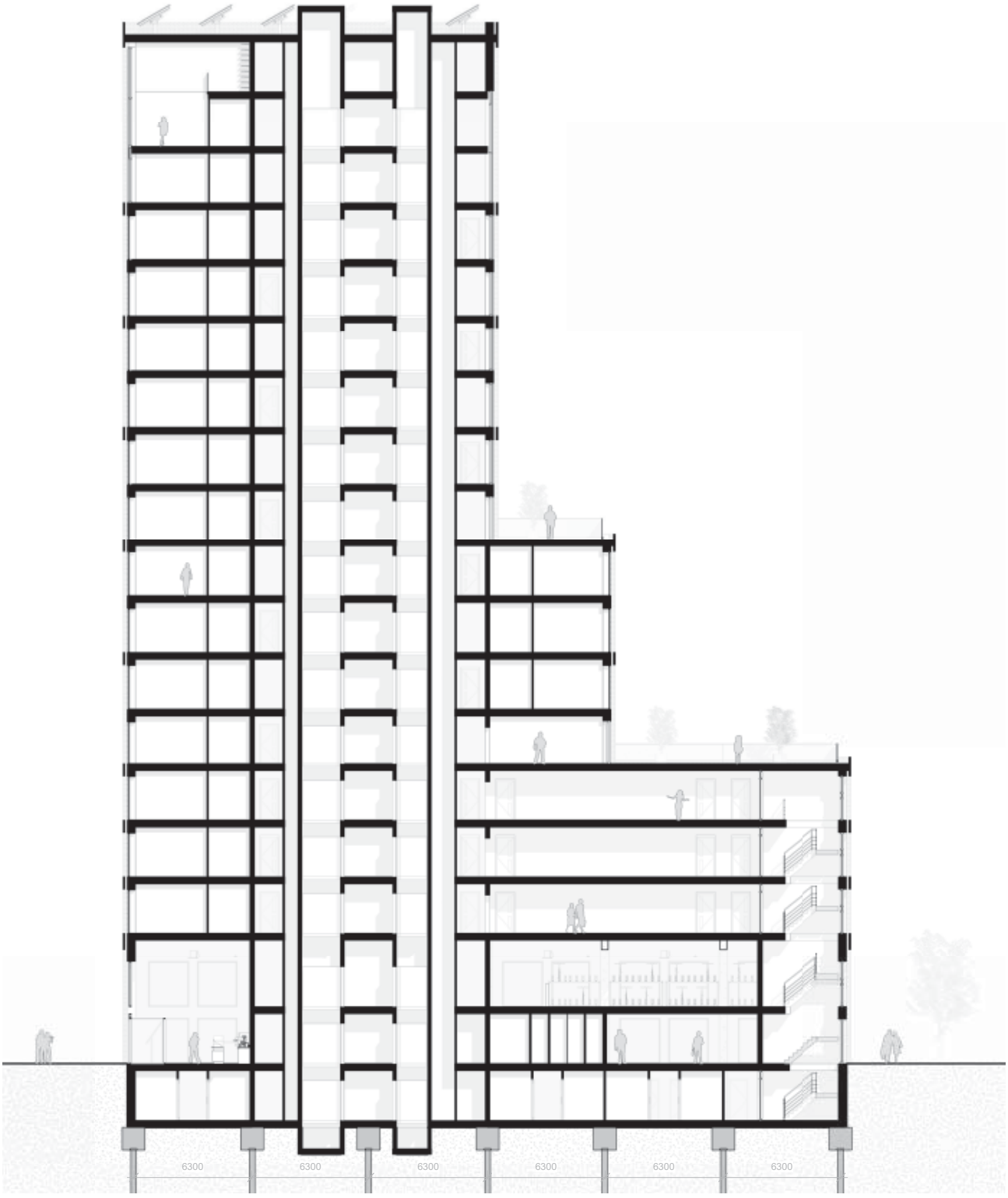
EXISTING SITUATION



Existing apartment blok



Empty plot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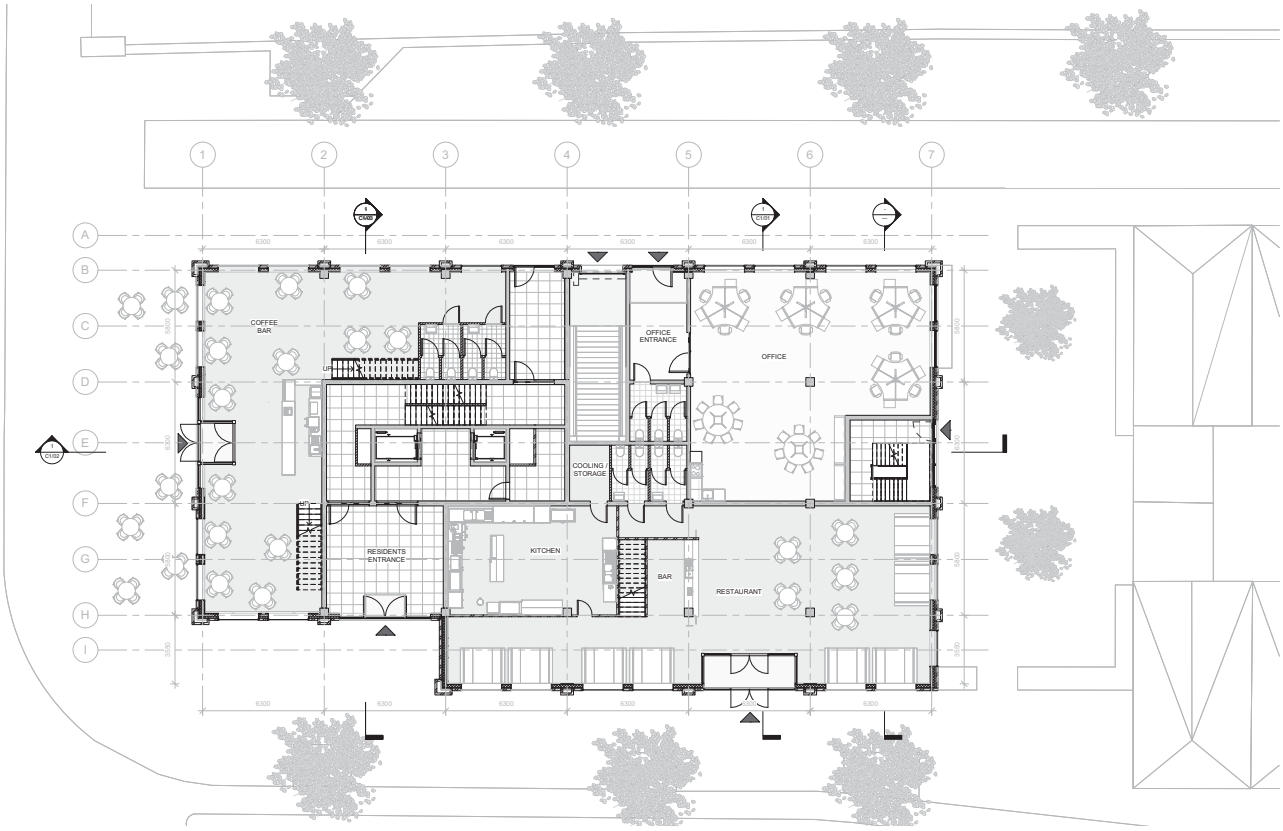
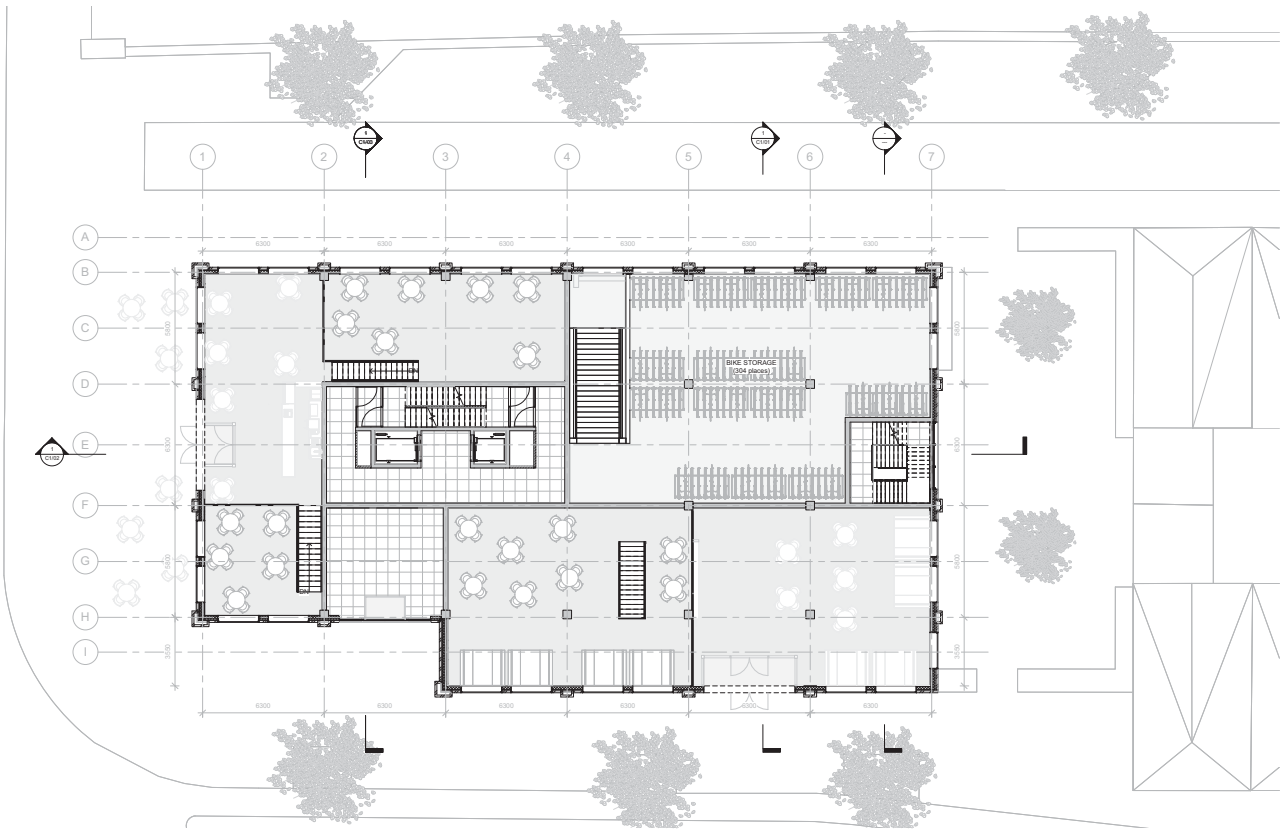
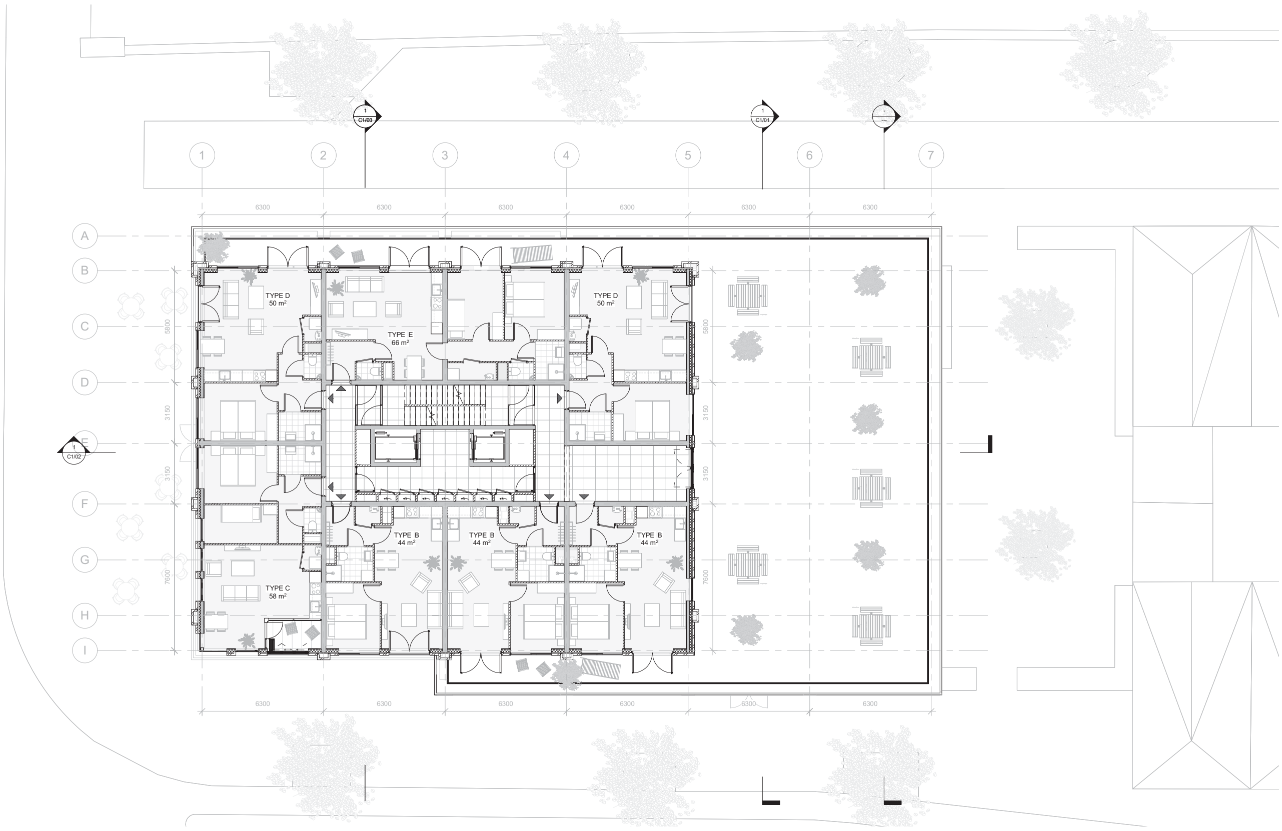

COFFEE BAR
UP
OFFICE ENTRANCE
OFFICE
COOLING / STORAGE
RESIDENTS ENTRANCE
KITCHEN
BAR
RESTAURANT


BIKE STORAGE
(304 places)


TYPE D
50 m²
TYPE E
66 m²
TYPE D
50 m²
TYPE B
44 m²
TYPE B
44 m²
TYPE B
44 m²
TYPE C
58 m²
6300
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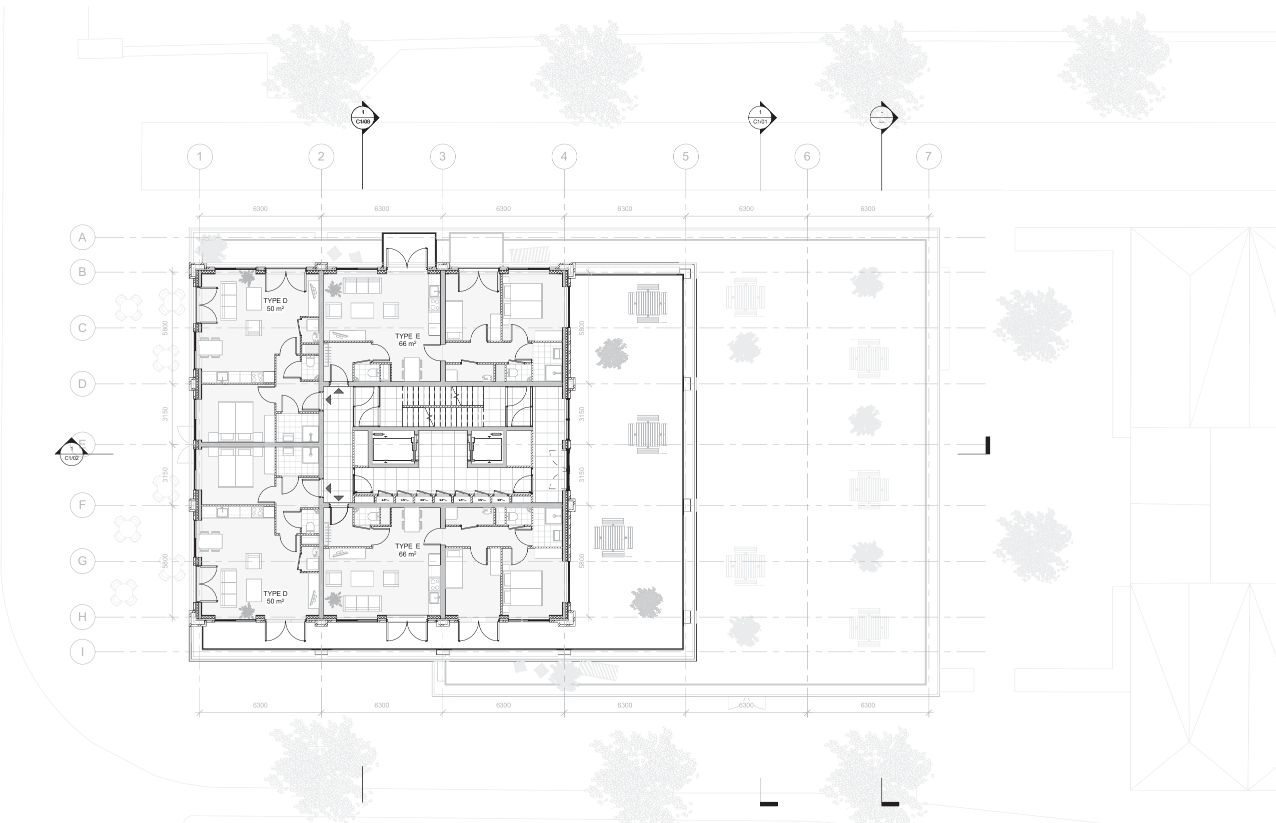
TYPE D
50 m²
TYPE E
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TYPE E
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TYPE D
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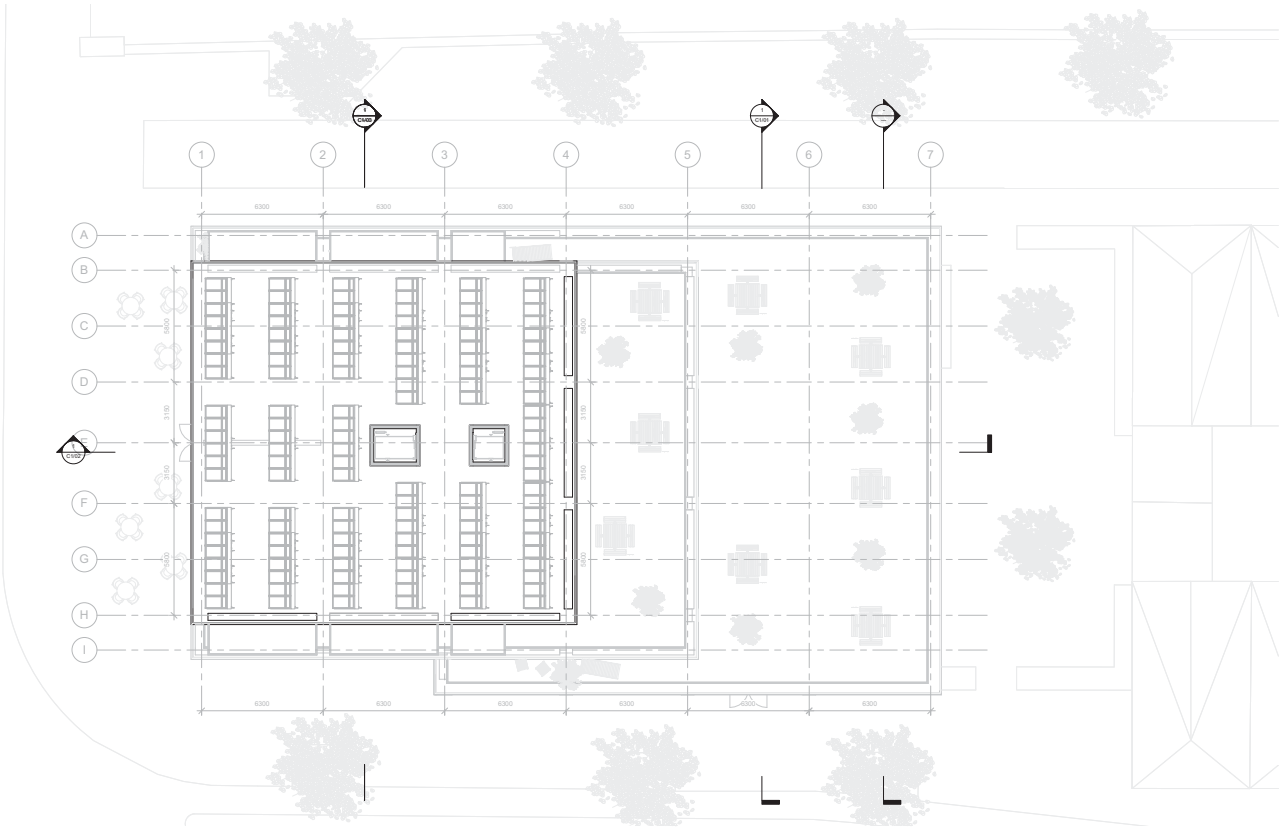
C1/03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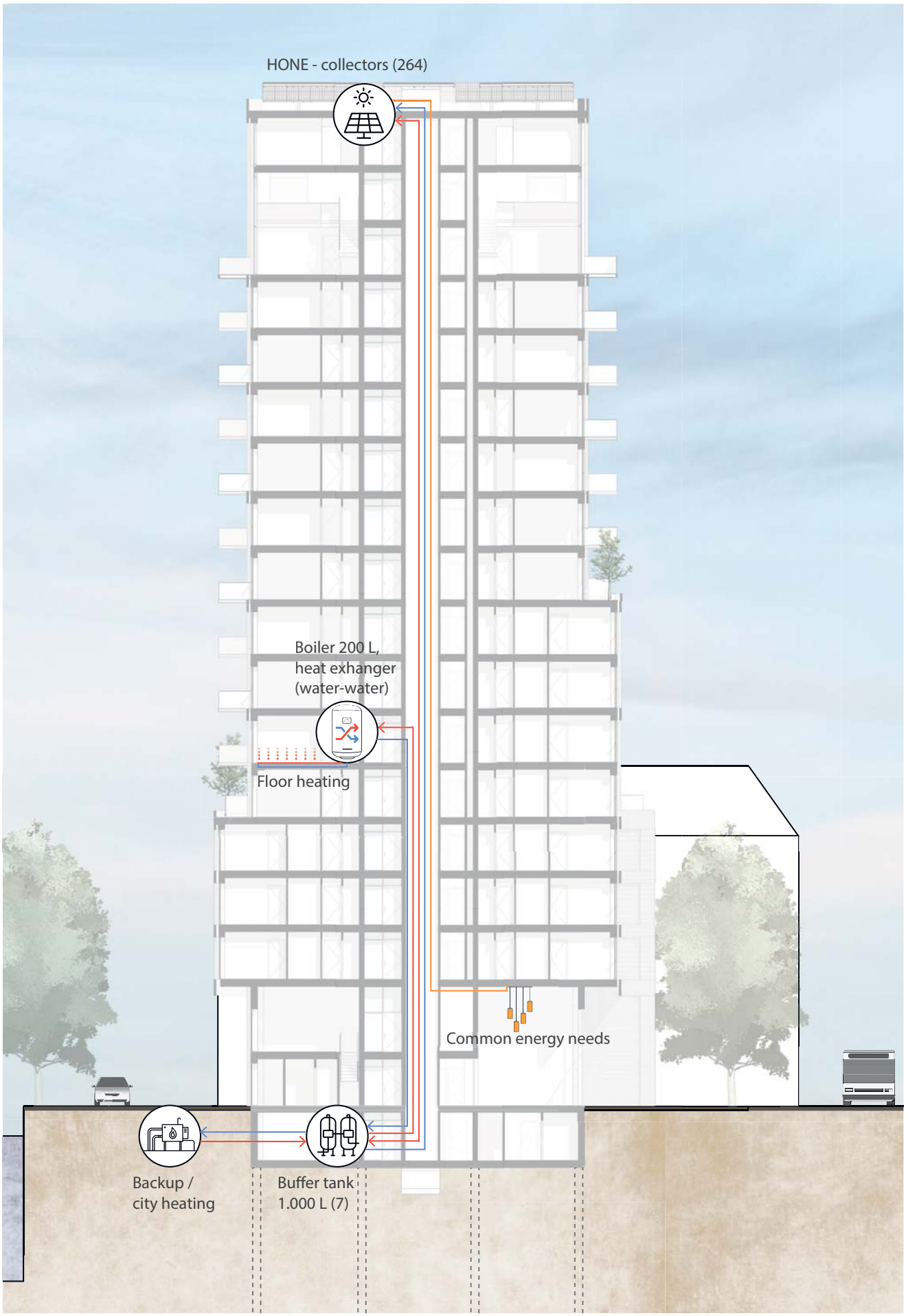
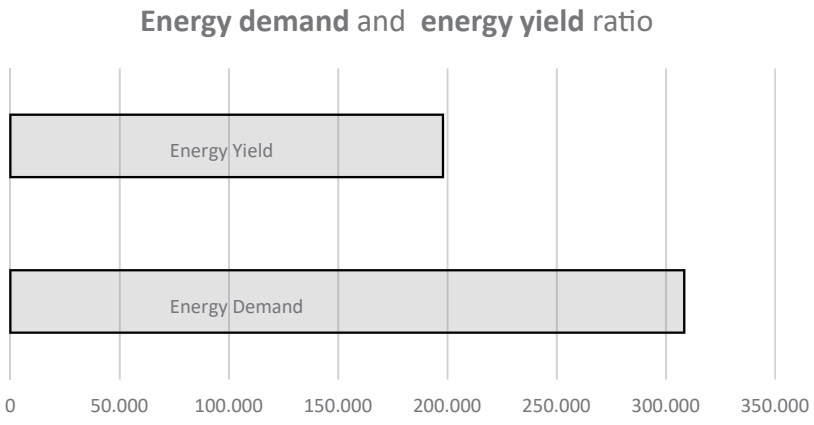
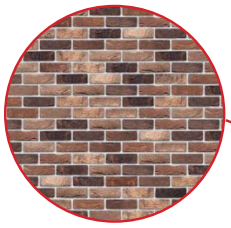
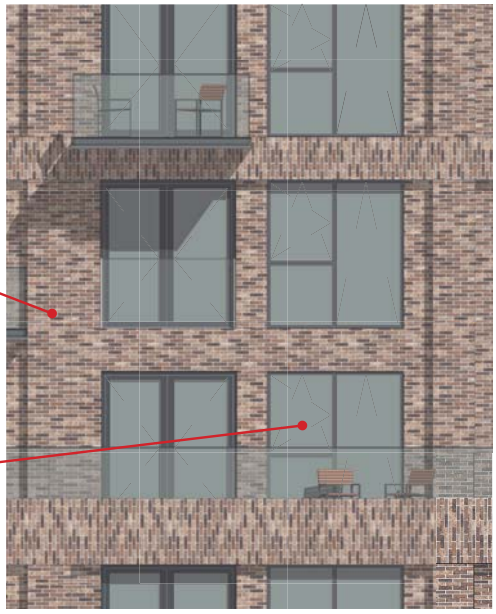

HONE - collectors (264)
Boiler 200 L,
heat exhanger
(water-water)
Floor heating
Common energy needs
Backup /
city heating
Buffer tank
1.000 L (7)

TYPE	FLOOR AREA	RENTAL PRICE	NUMBER OF UNITS	PERSONS PER UNIT	ENERGY CONSUMPTION	TOTAL ENERGY DEMAND
A	52 m2	€ 844,59	21	2	2.950 kWh / year	61.950 kWh / year
B	44 m2	€ 813,46	18	2	2.950 kWh / year	53.100 kWh / year
C	58 m2	€ 974,23	13	3	4.000 kWh / year	52.000 kWh / year
D	50 m2	€ 865,31	20	2	2.950 kWh / year	59.000 kWh / year
E	66 m2	€ 984,58	16	3	4.000 kWh / year	64.000 kWh / year
F	… m2	-	2	4	4.600 kWh / year	9.200 kWh / year
G	… m2	-	2	4	4.600 kWh / year	9.200 kWh / year
TOTAL			92	221		308.450 kWh / year

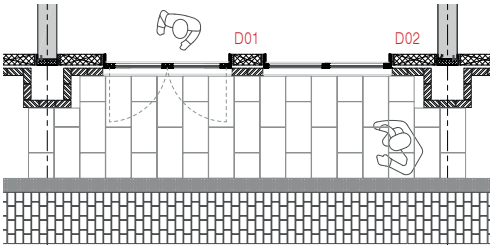
		TOTAL YIELD
Thermal yield per panel	750 kWh / year	198.000 kWh / year
Electricity yield per panel	95,5 kWh / year	25.212 kWh / year
Number of panels	264	
Number of buffer tanks (1000 liter)	7	
Pump units	7	
Individual boilers (200 liter)	92	
Water-water heat pump	92	

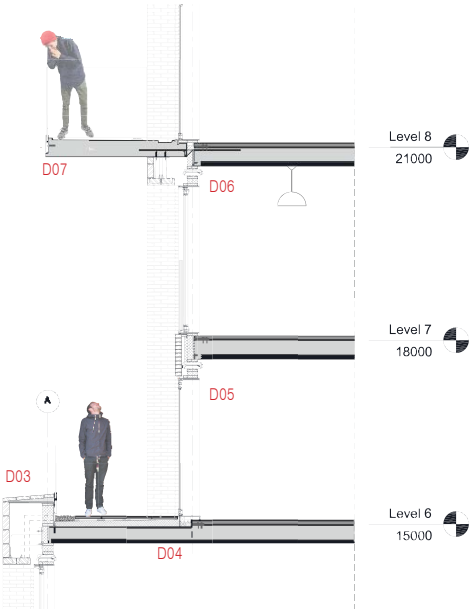


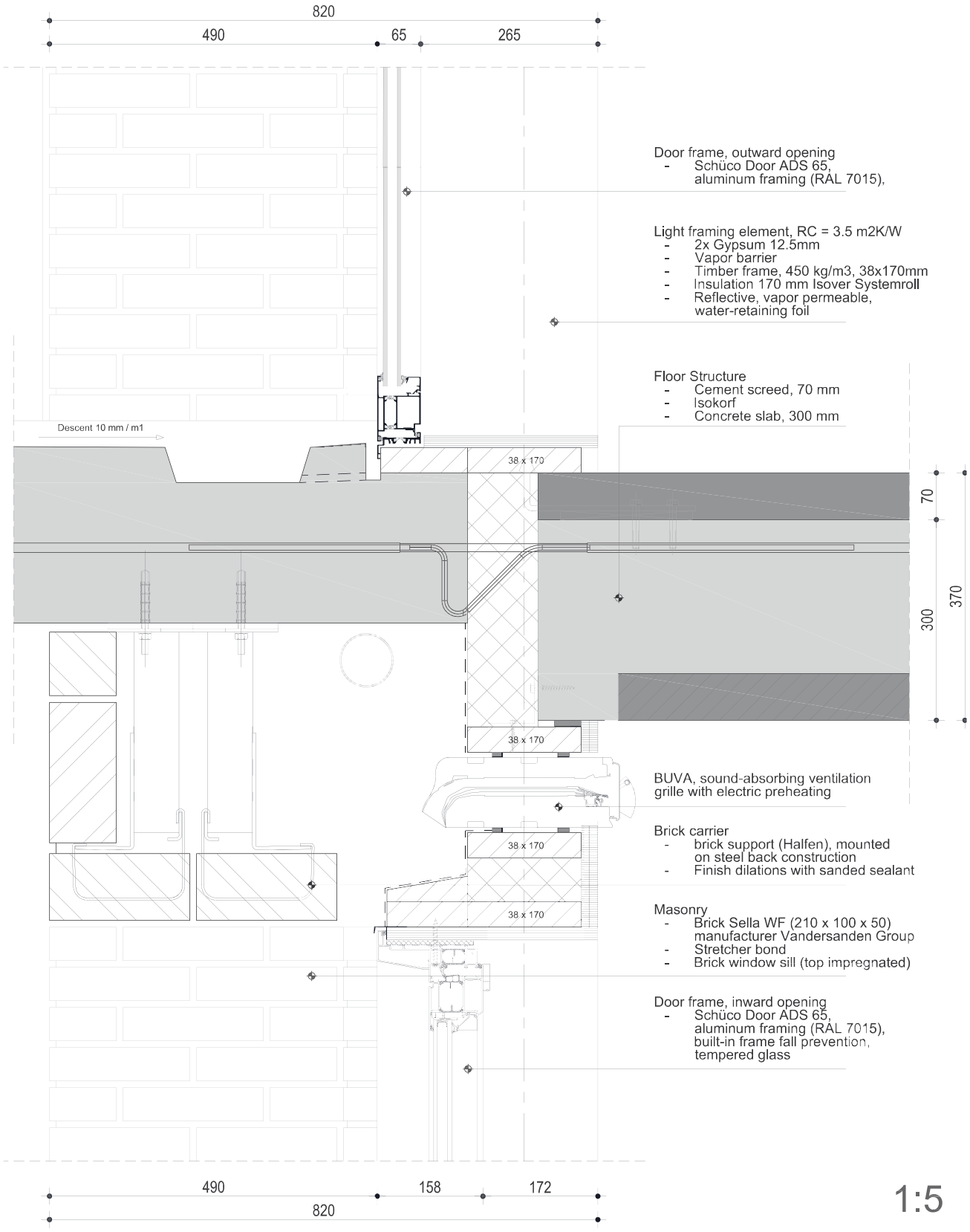




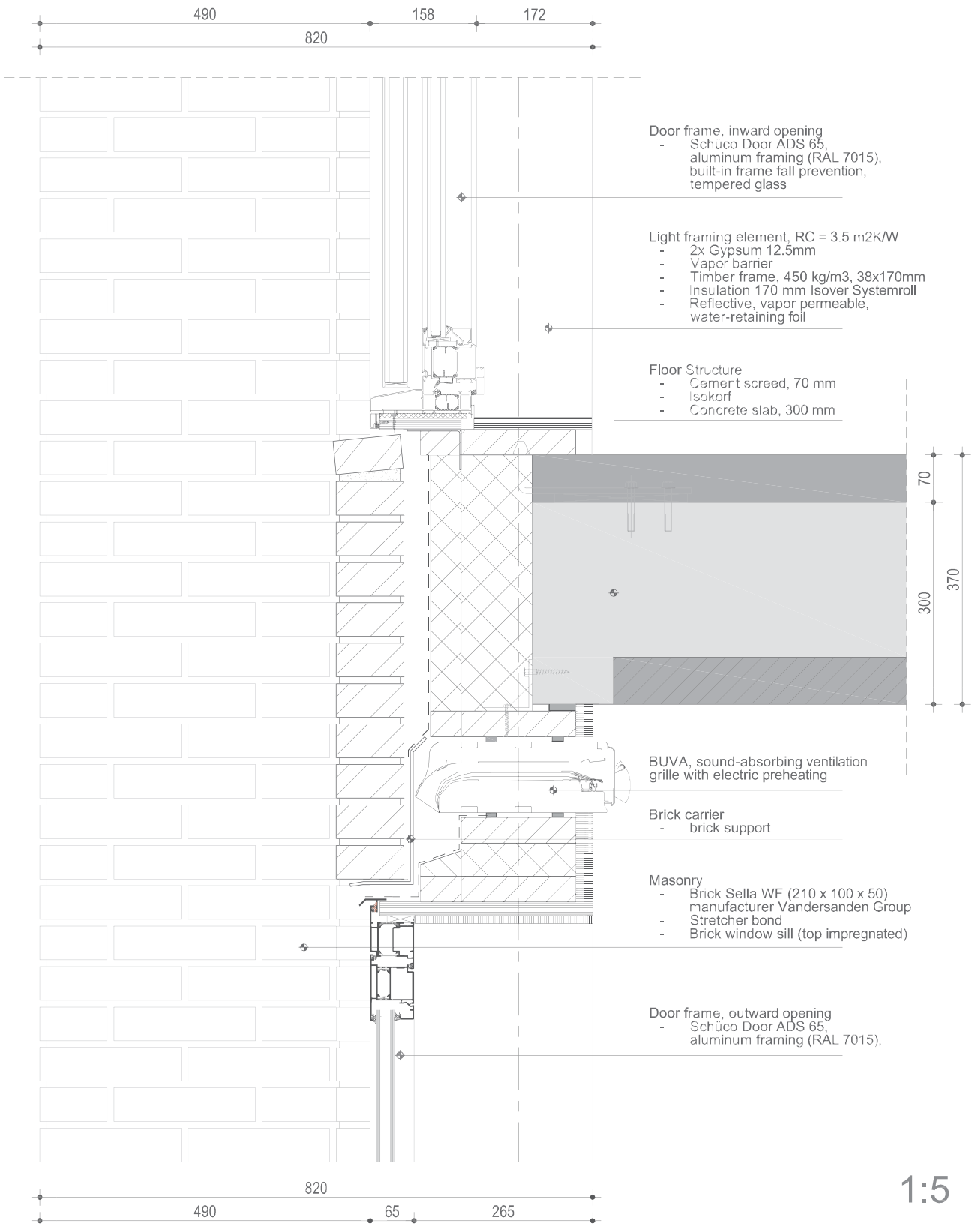
FACADE FRAGMENT 1:25



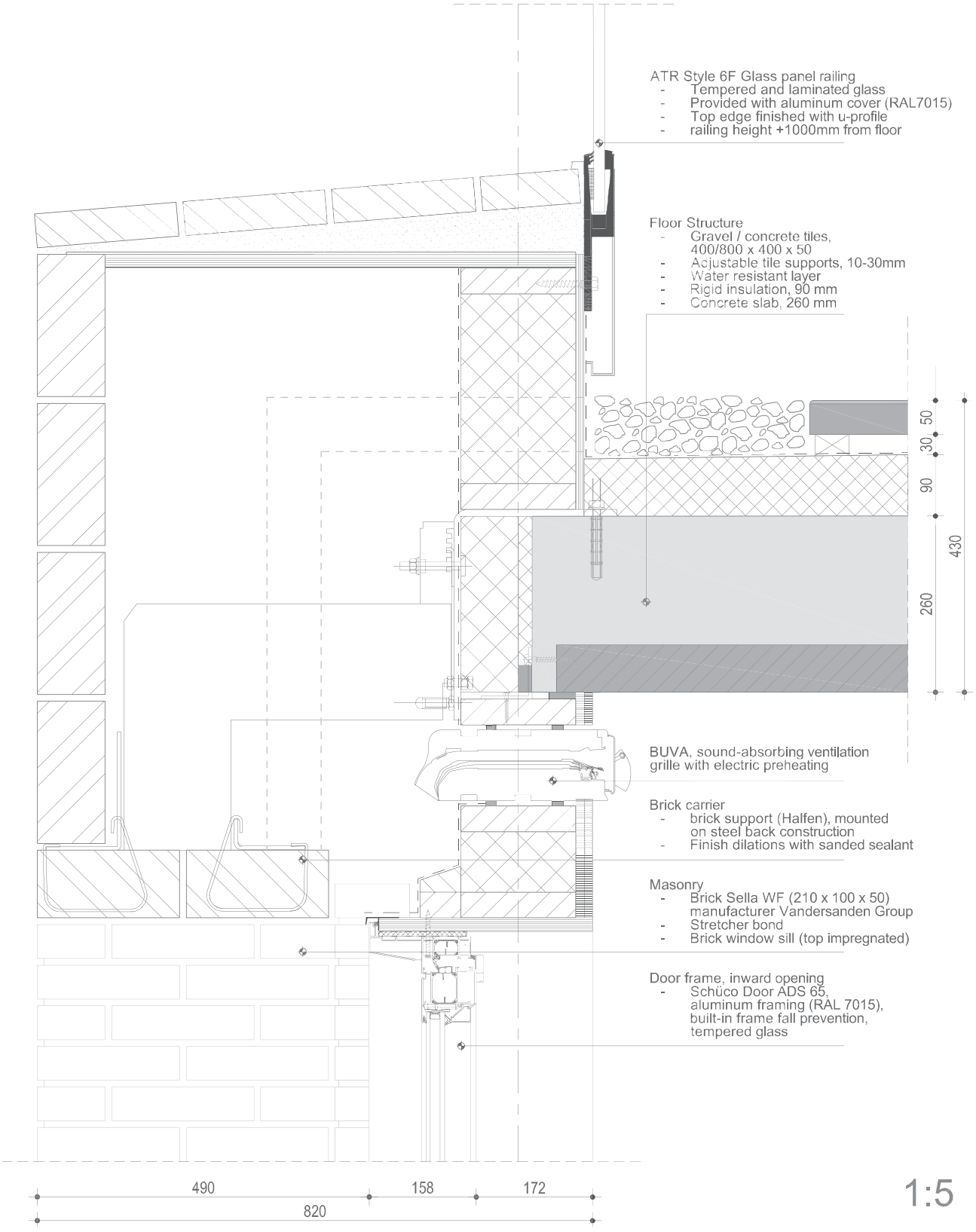



820
490
65
265
Door frame, outward opening
- Schüco Door ADS 65, aluminum framing (RAL 7015),
Light framing element, RC = 3.5 m2K/W
- 2x Gypsum 12.5mm
- Vapor barrier
- Timber frame, 450 kg/m3, 38x170mm
- Insulation 170 mm Isover Systemroll
- Reflective, vapor permeable, water-retaining foil
Floor Structure
- Cement screed, 70 mm
- Isokorf
- Concrete slab, 300 mm
Descent 10 mm / m1
38 x 170
38 x 170
38 x 170
38 x 170
70
300
370
BUVA, sound-absorbing ventilation grille with electric preheating
Brick carrier
- brick support (Halfen), mounted on steel back construction
- Finish dilations with sanded sealant
Masonry
- Brick Sella WF (210 x 100 x 50) manufacturer Vandersanden Group
- Stretcher bond
- Brick window sill (top impregnated)
Door frame, inward opening
- Schüco Door ADS 65, aluminum framing (RAL 7015), built-in frame fall prevention, tempered glass
490
158
172
820

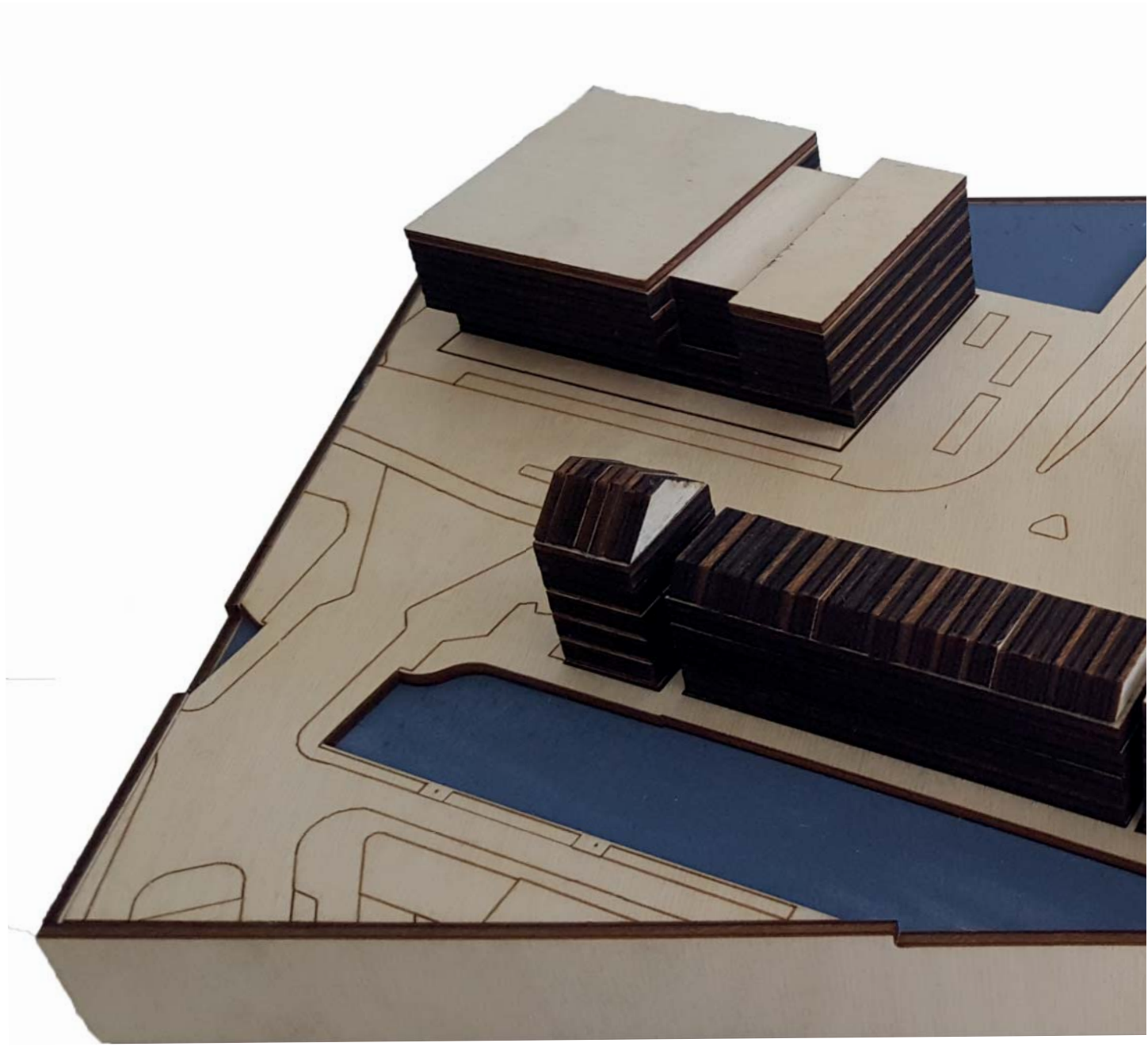
1:5

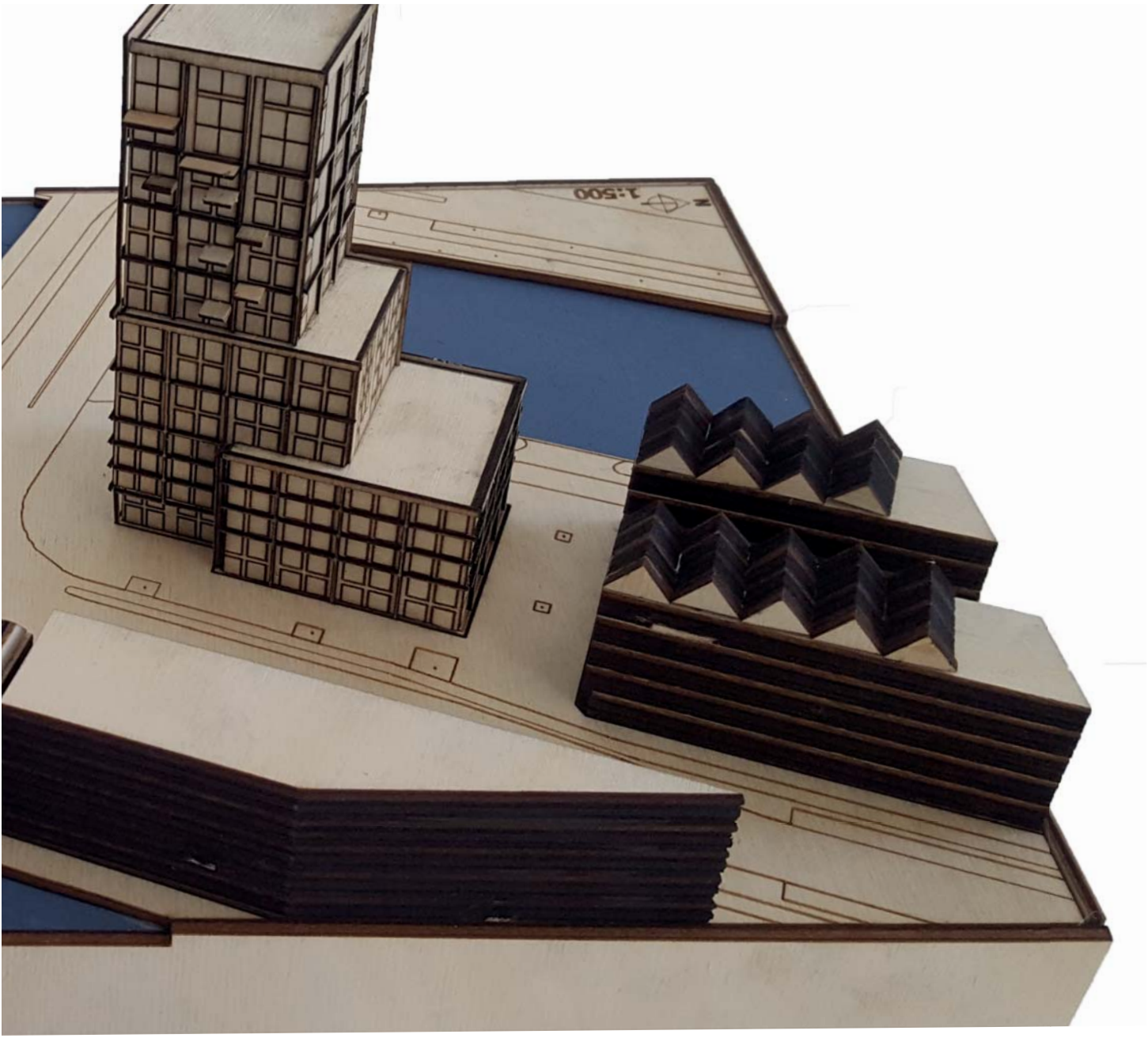

490
158
172
820
Door frame, inward opening
- Schüco Door ADS 65, aluminum framing (RAL 7015), built-in frame fall prevention, tempered glass
Light framing element, RC = 3.5 m2K/W
- 2x Gypsum 12.5mm
- Vapor barrier
- Timber frame, 450 kg/m3, 38x170mm
- Insulation 170 mm Isover Systemroll
- Reflective, vapor permeable, water-retaining foil
Floor Structure
- Cement screed, 70 mm
- Isokorf
- Concrete slab, 300 mm
70
300
370
BUVA, sound-absorbing ventilation grille with electric preheating
Brick carrier
- brick support
Masonry
- Brick Sella WF (210 x 100 x 50) manufacturer Vandersanden Group
- Stretcher bond
- Brick window sill (top impregnated)
Door frame, outward opening
- Schüco Door ADS 65, aluminum framing (RAL 7015),
820
490
65
265

1:5


ATR Style 6F Glass panel railing
- Tempered and laminated glass
- Provided with aluminum cover (RAL7015)
- Top edge finished with u-profile
- railing height +1000mm from floor
Floor Structure
- Gravel / concrete tiles, 400/800 x 400 x 50
- Adjustable tile supports, 10-30mm
- Water resistant layer
- Rigid insulation, 90 mm
- Concrete slab, 260 mm
50
30
90
260
430
BUVA, sound-absorbing ventilation grille with electric preheating
Brick carrier
- brick support (Halfen), mounted on steel back construction
- Finish dilations with sanded sealant
Masonry
- Brick Sella WF (210 x 100 x 50) manufacturer Vandersanden Group
- Stretcher bond
- Brick window sill (top impregnated)
Door frame, inward opening
- Schüco Door ADS 65, aluminum framing (RAL 7015), built-in frame fall prevention, tempered glass
490
158
172
820

1:5

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