

CONNECTING LOCAL COMMUNITY

WITH TRANSPORTATION NODES

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MASTER THESIS
ARCHITECTURE



Colophon

Graduation report

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05-06-2026
Version A3

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*Parts of this report were supported by OpenAI's ChatGPT for tasks such as text editing, language refinement and condensing text. All final content was critically reviewed and verified by the author to ensure accuracy and originality.

** Unless stated otherwise, all illustrations/images are made by the author.

Foreword

This graduation report researches how station areas can become socially integrated into everyday neighborhood life rather than functioning only as spaces for transit. The project investigates, through research and design, how mobility infrastructure, public space and community interaction can be better connected within a suburban neighborhood in Madrid.

By analysing station areas along the future extended Metro line 11, the research identifies how increasing the mobility intensity can create a disconnection between movement flows and the local community. The findings form a base for the proposed Community Based - Transit Development (CB-TD) framework, which focuses on integrating the existing community structures and public life into mobility environments.

Abstract

Contemporary station areas are shaped by mobility efficiency, accessibility and densification. Within the Transit Oriented Development (TOD) strategy, transportation nodes are primarily approached as infrastructural and economic catalysts. By doing so, their role as socially integrated public spaces often remains underdeveloped. As a result, station environments frequently function as a space of movement rather than a place that supports everyday community life and social interaction.

This research investigates how areas around public transportation nodes can be transformed into community-based public spaces that support social interaction while accommodating mobility flows. The research introduces Community Based - Transit Development (CB-TD) as an alternative approach to the conventional TOD. It focuses on the relationship between movement, staying and everyday use. Through literature research, precedent studies and a comparative station analysis of six stations along Metro line 11 in Madrid, the research examines how increasing the mobility intensity affects spatial conditions for social interaction.

The analysis reveals that community anchors such as schools, parks and local amenities are present in the area, but remain structurally disconnected from the mobility cores. Rather than density, the lack of integration between movement space and lived public space weakens the opportunity for informal encounters and community engagement. Based on these findings, a set of design principles is developed and applied to Comillas in Madrid. The project shows how mobility infrastructure can be interconnected within community life to create a more socially sustainable environment.

01

Introduction

1.1 Problem statement

In the current urban environment, contemporary mobility systems are designed to enable people to move quickly and efficiently from one place to another through the city. This often results in functional zoning and separation of daily activities into clusters such as living, working, leisure and shopping. Because accessibility is often prioritized over proximity, these clusters can be scattered across the city. This emphasis on accessibility and speed leads to an unintended disconnect from people and their urban surroundings. As a result, everyday urban life becomes fragmented and dependent on mobility infrastructures rather than local neighborhoods.

While people travel through stations, transportation nodes, pathways and other means of transport, they tend to stay in their own behavioural 'bubbles'. This disconnection limits their spontaneous social interactions, and with that the opportunity of community engagement. The public spaces linked to or near station areas are visited most regularly in the urban environment but often fail to support interaction between the users.

These spaces are included in the Transit Oriented Design (TOD) approach (TOD Standard – ITDP, n.d.). Although TOD is promoted as a strategy to improve the urban sustainability and transit accessibility, its implementation in practice often focuses on densification, upgrading real estate value and large residential towers around transit hubs. In these cases, mobility efficiency and economic value are prioritised. This focus causes the potential role of public spaces as a catalyst of social interaction and community life to be overlooked, which leads to public realm that acts as a passage instead of a vibrant place that enhances social interaction.

Therefore, the challenge of this problem is to question the dominant TOD framework (TOD Standard – ITDP, n.d.) and to explore how these highly efficient moving places can be reoriented towards the existing neighborhood and its residents. This research asks how movement can be organized in a way to encourage staying and support encounters. Rather than adding new program on top of the neighborhood, this project seeks to build upon social and spatial qualities that already exist in the area close to the station. This research builds on the hypothesis that social interaction in station areas is not based on density, but on the lack of spatial integration between movement and everyday community structures.

1.2 Relevance

This research project is relevant to the urban architecture as it explores how public spaces near station areas can support social interaction. While TOD often prioritizes efficiency and densification, this project investigates a new strategy that connects community life with movement facilities. By focusing on suburban neighborhoods, it aims to provide design approaches that enhance community engagement and create inclusive socially sustainable public spaces for current residents.

1.3 Objective

The objective of this research and design is to develop a spatial design framework which creates spatial conditions that support social interaction and community engagement for existing neighborhoods in the suburban areas of Madrid. Instead of applying TOD as a guiding model, this project proposes an alternative approach: Community Based - Transit Development (CB-TD), in which the needs and social structures of current residents act as a base for the design.

The goal is to identify how mobility infrastructures and public space can be (re)designed so that movement is not only efficient but also socially meaningful. Through research and design, this project aims to create conditions where station areas become a place of everyday use, where local activities, slow movement and social interactions coexist with mobility functions.

The objective therefore is to propose a set of spatial strategies that can be implemented around station areas. These strategies will demonstrate how CB-TD can transform underdeveloped station areas into neighborhood based public spaces. These spatial strategies aim to improve spatial quality for current residents, while critically addressing the impact of new users and future development of the existing social environment.

This topic fascinates me because mobility is more than a technical system for moving people efficiently, instead it alters the way people perceive, use and experience the city. Mobility influences daily routines, social interactions, the formation of community and sense of belonging. I am particularly interested in designing public spaces near transportation nodes in suburban areas that are dominated and rely on mobility infrastructures. I am motivated by the idea that well-designed public spaces near station areas can not only offer efficient way of moving, but can also foster communities, social interaction and more meaningful urban experiences.

1.4 Research questions

How can the area around public transportation nodes be transformed into a community-based public space that supports social interaction, responds to residents' needs, and accommodates mobility flows?

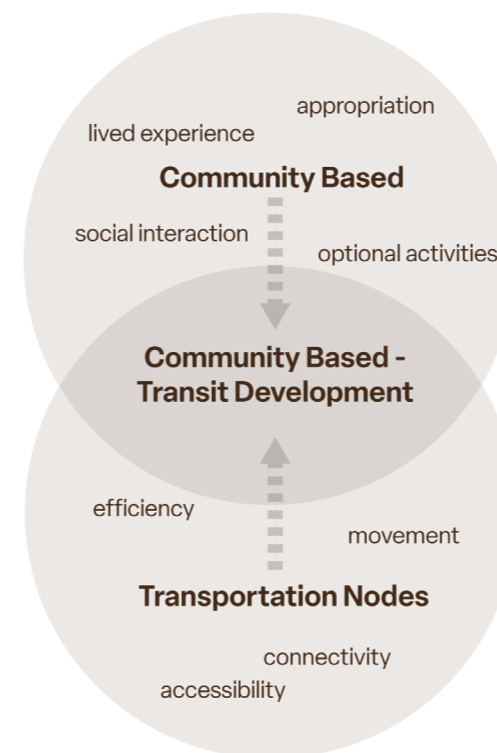


Figure 1: Conceptual framework

Research for design questions

1. How does increasing mobility intensity affect the spatial conditions for staying and social interaction in station areas?
2. How is everyday community life spatially integrated in relation to mobility infrastructure in station areas?

Research through design questions

3. Which spatial conditions support staying, social interaction and everyday use in station areas?
4. How can these conditions be translated into a spatial strategy for Community Based - Transit Development?

Definitions

Public transportation node

A spatial concentration where public transport stops, including public spaces that are directly linked to the mobility system.

Community-based public space

Public space that primarily supports everyday use by local residents and enables social interaction.

Social interaction

Informal and spontaneous encounters between users in public space that contribute to social cohesion and community life.

Mobility flows

Movement patterns of transport users through station areas.

1.5 Scope

The scope of this research focuses on suburban neighborhoods in Madrid where mobility infrastructure plays a dominant role. The urban environment of the chosen neighborhood offers limited social interaction opportunities, mixed-use programming or pedestrian-friendly design. The research and design operates at two scales: the station area itself and the surrounding neighborhood up to residents' final destinations. The result will lead to neighborhood interventions through spatial design of public space and buildings. Therefore the goal is to explore how CB-TD strategies such as walkability, mixed-use at human-scale, community-oriented amenities and inclusive public space can support social interaction and create socially sustainable living environments.

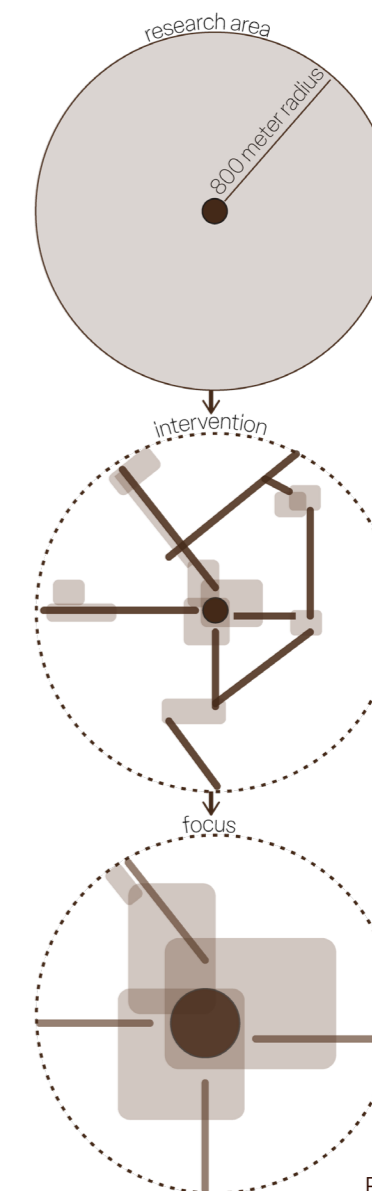


Figure 2: Scope

Part 2. Approach

2.1 Method

The following design/research strategies will be used and combined throughout the process:

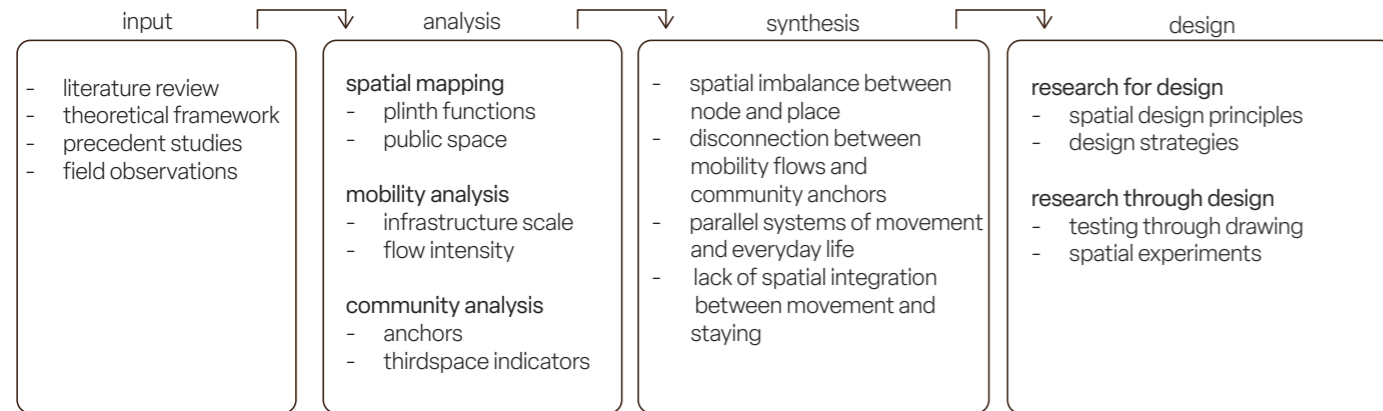


Figure 3: Method

2.2 Timeline

Type	Date	Time
Pre A1 presentation	January 16th	16:00
A1 presentation	January 30th	15:45
Field trip	7 - 12 February	-
A2 presentation	April 14th	10:30
Pre A3 presentation	May 19th	17:00
A3 presentation	June 12th	13:45
A4 presentation	June 26th	13:50

Figure 4: Planning





2.3 **Theoretical Framework**

2.3.1 Node-Place thinking

The research builds on the Node-Place model of Bertolini (1999), which frames station areas along 2 axes: accessibility (node) and spatial and social quality (place), (figure 5). Within this framework, the study focuses on the unsustainable nodes, where the transportation network dominates the surrounding urban environment of which the quality is insufficient. Rather than reducing the node value, this research explores how the place dimension can be strengthened by focusing on community-based public space and program.

The butterfly model (*vliindermodel*) of Vereniging Deltametropool (2013) (figure 6) elaborates on Bertolini's model by providing a measurable method for analyzing station areas. It focuses on the balance between mobility and performance and the spatial quality of the surrounding area. While this study does not apply the model quantitatively, it is used conceptually to distinguish different station areas. This approach allows for a structured analysis on station environments.

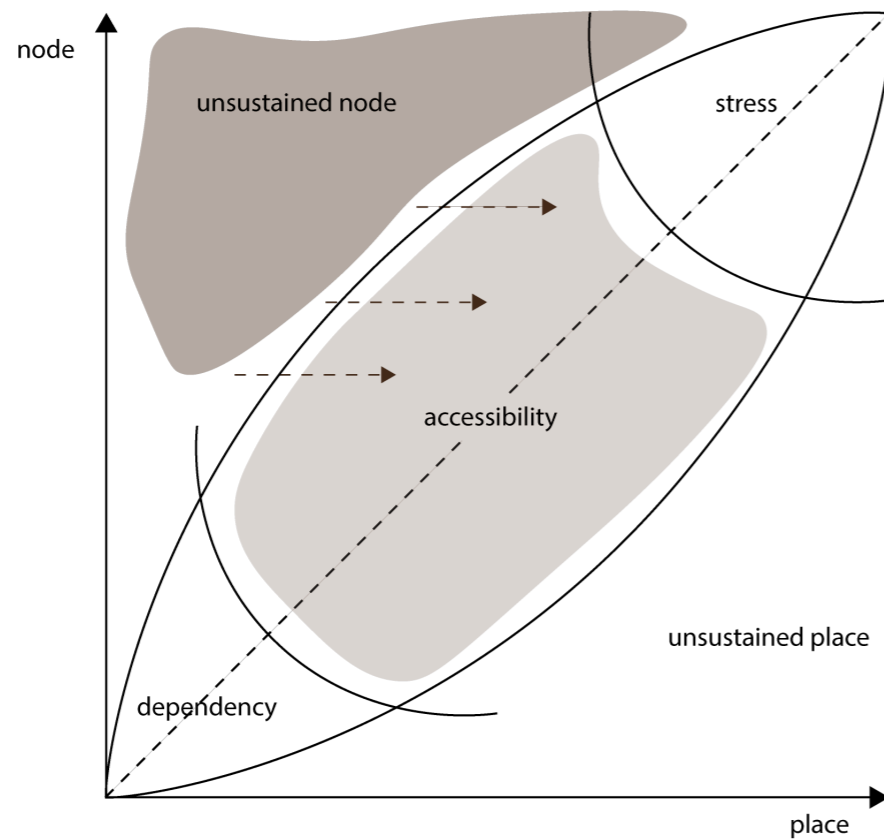


Figure 5: Node-place model

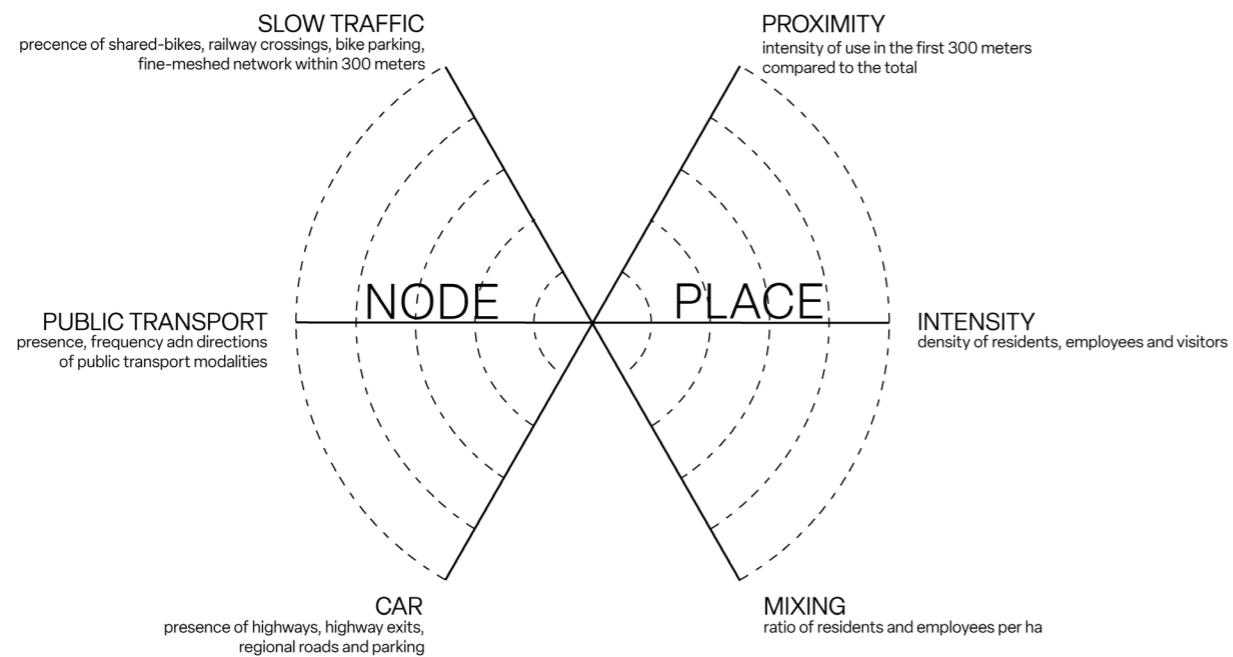


Figure 6: Butterfly model, adapted from Vereniging Deltametropool (2013)



Figure 7: Palos de la Frontera station exit

2.3.2 Life between buildings

The Life between buildings (2011) theory of Jan Gehl provides a human-centered perspective on public space. The theory focuses on the relationship between spatial quality, movement and social interaction. Gehl names three different types of outdoor activities: **necessary activities** (commuting or waiting), **social activities** (sitting or strolling), and **optional activities** (people being present in the same space and therefore depend on optional activities). This distinction in activities is relevant for station areas, which are often designed to support mostly the necessary activities related to mobility. The result of this design approach are spaces that function rather as a passage than places to stay, limiting opportunity of social activity.

In this research, Gehl's framework is applied to analyse different activity types in station areas and to reveal the lack of conditions for optional and social use. Furthermore, the theory is used to explore spatial interventions that shift these environments from movement oriented spaces to places for staying and interaction. The framework supports the critique on Transit Oriented Development and guides towards the shift to Community-Based Transit Development.

	Quality of the physical environment	
	Poor	Good
Necessary activities	●	●
Optional activities	●	●
“Resultant” activities (Social activities)	●	●

Figure 8: *Life between buildings* (p.11), Gehl J. (2011)



Figure 9: *Sidewalk interaction*

2.3.3 Thirdspace and lived experience

Edward Soja's Thirdspace theory (1996) offers a spatial framework that explores beyond the physical and functional understanding of space. Soja distinguishes between Firstspace (the measurable, physical space), secondspace (the conceived or planned space) and thirdspace. These spaces combined include lived experiences, spatial practices and cultural meanings. The theory emphasizes how space is continuously produced through everyday use, interaction, and interpretation by the users of the environment. Station areas are often dominated by first- and secondspace elements such as infrastructure, efficiency and planning ideals. As a result, the lived and social spaces remain underdeveloped. In this research, thirdspace theory is applied as a lens to identify where and how lives space can emerge within station areas. Hereby, it focuses on informal use, everyday activities, and community activities as key drivers of spatial quality. Integrating the thirdspace theory allows to reorient purely functional transit environments and highlights the importance of informal use, in everyday life. Soja's framework supports relocating thirdspace areas near stations, linking them to the user's journey (figure 11).

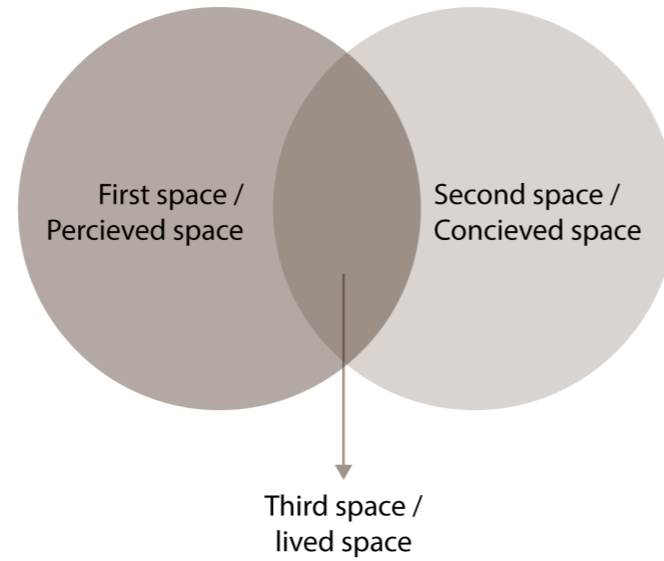


Figure 10: *Third spaces*, adapted from Soja E. (1996)

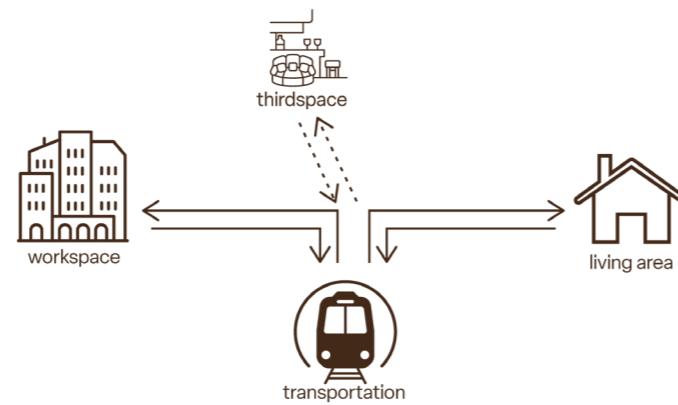


Figure 11a: *Third spaces outside of journey (current)*

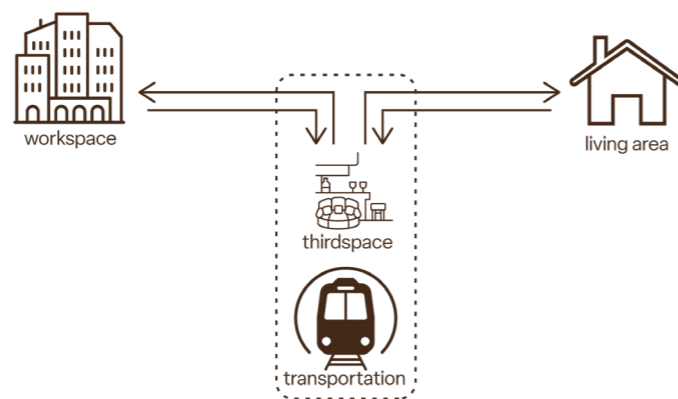


Figure 11b: *Third spaces inside of journey (aimed)*



Figure 12: *Park activity*



2.4

Precedent studies

2.4.1 New Alexandras metro station, Athens - Station as social landscape

XZA architects

Life between buildings

The design of the New Alexandras metro station offers clear staying spaces connected to the station entrances. Instead of just passing through, users can meet in connected seating areas and the park. This approach of station entrance design relates to the life between building theory (2011). Everyday activities such as informal seating and the opportunity for social encounters shape the quality of public space. The station park becomes an area where movement slows down and social interactions are encouraged.

Connecting different scales

The project links multiple spatial scales from metropolitan axis to the local neighborhood and the small station itself. This approach reflects the Butterflymodel (1999), where the transportation node connects the larger urban fabric with local urban life. The station works as a transition zone that connects movement flows with smaller community-oriented spaces.

Station as a Thirdspace

The station surroundings functions as an intermediate space between infrastructure and neighborhood, which can be understood as a form of Thirdspace. The combination of community functions and green spaces with mobility allows the area to be used beyond transportation alone.

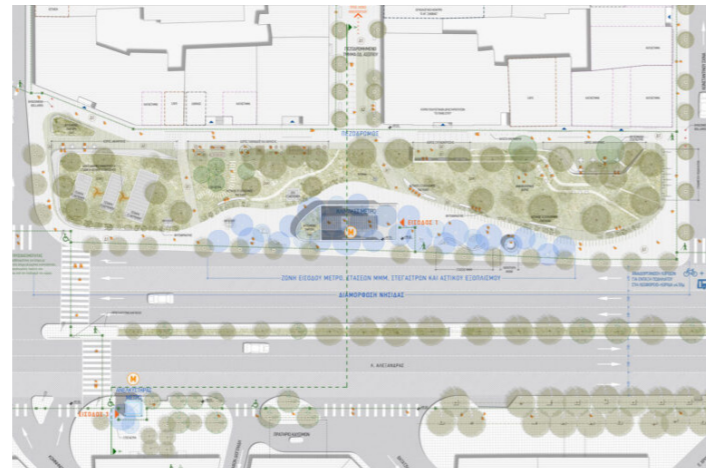


Figure 13: New Alexandras station plan, XZA architects (2023)



Figure 14: New Alexandras station section, XZA architects (2023)

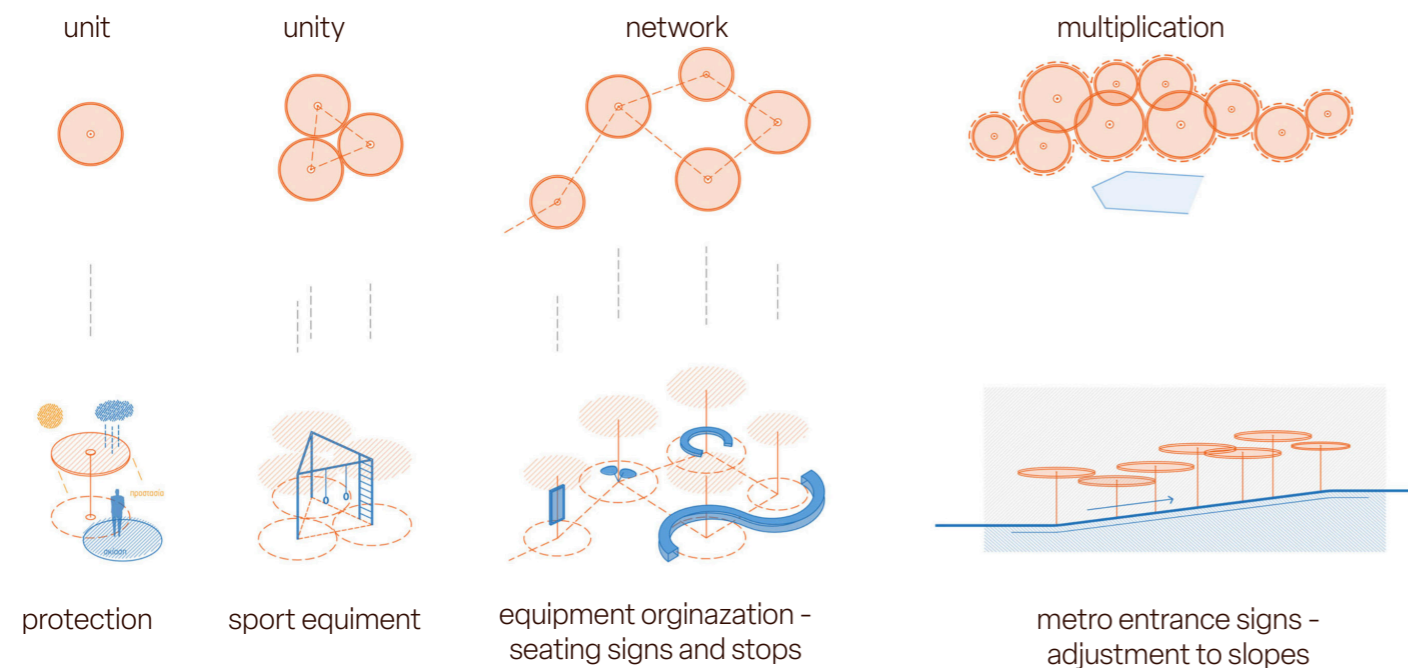


Figure 15: New Alexandras station design diagrams, XZA architects (2023)

2.4.2 Wřätz Spoorzone - Community building through spatial frameworks

MVRDV

Urban integration and functional mix

The redevelopment plans of the Wartz Spoorzone in Zwolle combines housing, workplaces and public amenities together with accessible open spaces near the station. This functional mix strengthens the relationship between the station area and the surrounding community. This is similar to the principles of the Butterfly model, where mobility nodes support both urban accessibility and local activities.

Everyday movement and social interaction

The project emphasizes the importance of everyday movement patterns such as walking and cycling between the neighborhoods and station. Public routes and human-scales spaces create opportunities for short stops and informal encounters along the routes. In line with Life Between Buildings (J.Gehl, 2011), the quality of the area is defined by everyday activities such as passing, waiting or briefly staying.

Community formation

The combination of housing, public routes and collective outdoor spaces support social interaction between residents and visitors. This combination creates a form of Thirdspace, where infrastructure and neighborhood life overlap and where community formation can develop through everyday use.



Figure 16: Wřätz birdview, Spoorzone Zwolle, n.d.



Figure 17: Wřätz public hall, Spoorzone Zwolle, n.d.

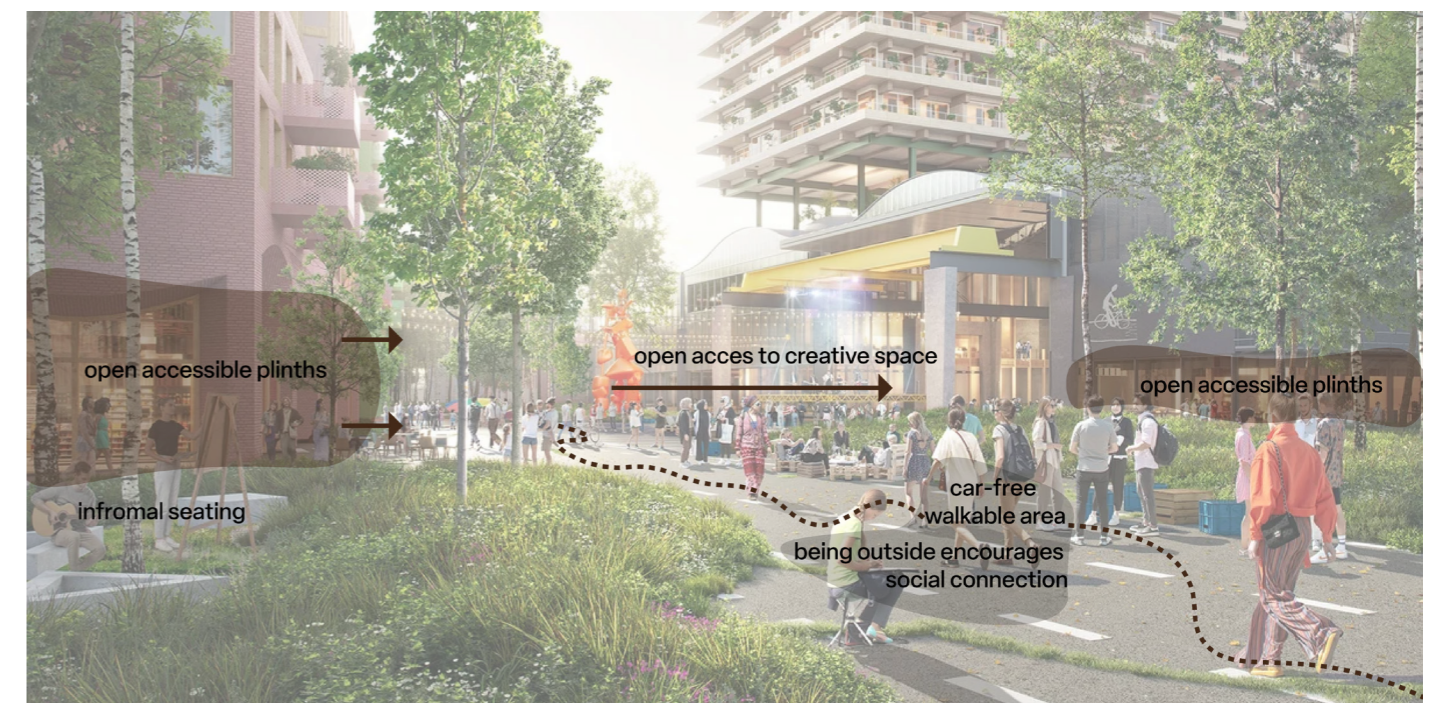


Figure 18: Wřätz outdoor area, Spoorzone Zwolle, n.d.

2.4.3 Pudding Mill

Gort Scott



Figure 19: Pudding Mill, Spocchia (2022)

Key takeaways

- ✓ Pedestrian and cycle connections across barriers
- ✓ Transition between metropolitan and local scale
- ✗ Dominance of large-scale infrastructure over public life
- ✗ Fragmented public realm between housing clusters

2.4.4 Oshawa Ritson school redevelopment

Regional municipality of Durham

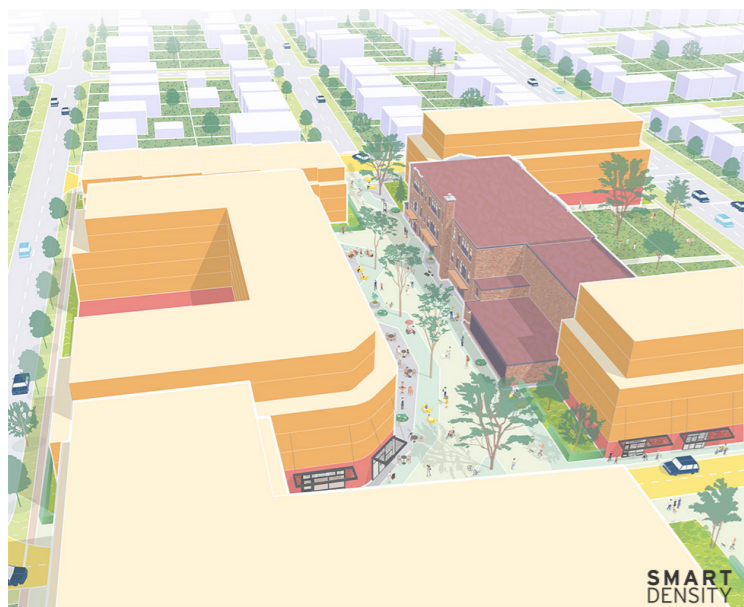


Figure 20: Oshawa Ritson school, Smartdensity. (2023)

Key takeaways

- ✓ Community-driven redevelopment framework
- ✓ Inclusive and barrier-free public space
- ✓ Publicly accessible ground floor
- ✓ Preservation of landmark identity

2.4.5 North Hollywood Metro station

Altitude Design Office



Figure 21: Metro Los Angeles, Curbed LA (2017)

Key takeaways

- ✓ Multimodal transit hub as urban anchor
- ✓ Pedestrian centered public realm
- ✓ Retention of existing creative functions
- ✓ Mixed-use with community-oriented program

2.4.6 Centro Direzionale Subway Station Napels

Miralles Tagliabue EMBT

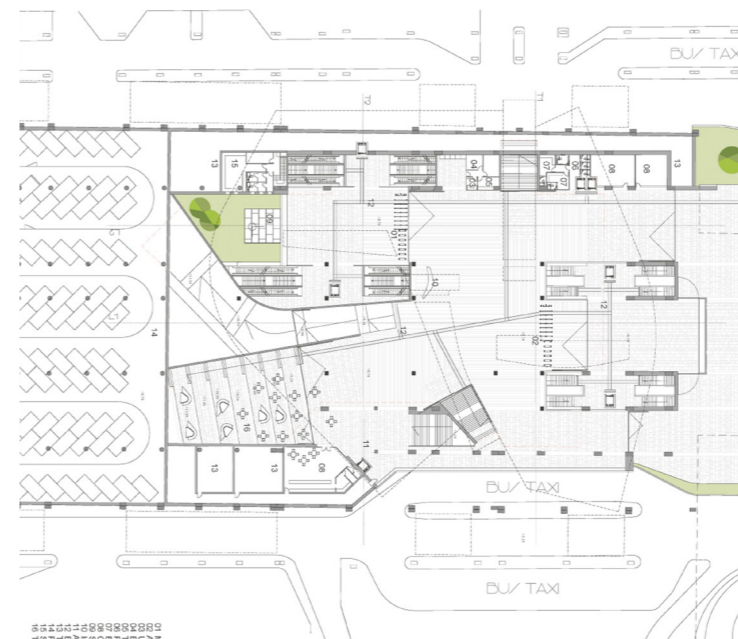


Figure 22: Centro Direzionale Subway station floorplan, Viva (2021)

Key takeaways

- ✓ Vertical movement as spatial sequence
- ✓ Spatial quality encourages optional and social activities
- ✓ Infrastructure can contribute to cultural identity
- ✓ Stations can focus as public spaces rather than transit nodes



2.5

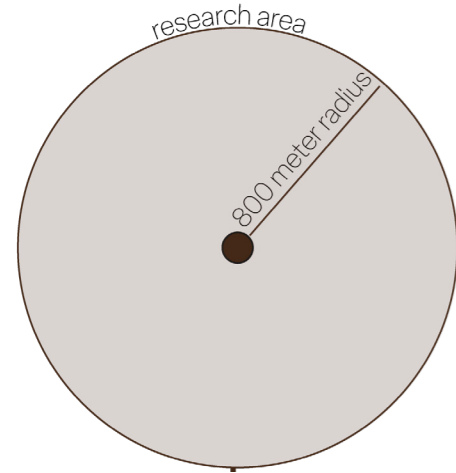
Analytical method & Case selection

2.5.1 Research approach

The comparative station analysis uses the theories mentioned in the theoretical framework as analytical lens to examine the balance between mobility intensity and community intergration. The framework is applied through a comparative station reading of the 6 new stations added to the metro line 11 in Madrid.

The analysis identifies spatial imbalances between node and place, leading to a comparative positioning and argueded site selection for CB-TD implementation.

2.5.2 Method



800 meter radius
to define walkable neighborhood scale

plinth analysis
to assess functional diversity

demographic data
to understand community structure

field observation
to detect thirdspace indicators

Analytical concepts

- The mobility (node) intensity is evaluated through the number of transit connections, scale of infrastructure and the expected increase in accessibility.
- Place quality is assessed through functional diversity, public green and pedestrian connections
- Community integration is analysed through the presence of community anchors, third space indicators and the spatial relation between anchors and station.

Mobility intensity profile

The mobility intensity is assessed per station using the infrastructural scale and flow dominance. The infrastructural scale reflects the physical size of the station (low; medium; high), the flow dominance describes the continuity of passenger movement (fragmented; moderate; continuous). These two factors combined, deliver the overall intensity of the mobility infrastructure in the station area, categorized by low, medium and high. The categories are not based on numerical data, but function as indicative factors to support the comparative spatial analysis. The mobility intensity factor is used in combination with the community intergration analysis to introduce a social dimension to the framework (figure 39).

Station	Infrastructure scale	Flow dominance	Overall intensity
Plaza Eliptica	Medium	Moderate	Medium
Comillas	Low	Fragmented	Low
Madrid Rio	Low	Fragmented-moderate	Low - medium
La Frontera	Low-medium	Moderate	Medium - low
Atocha	High	Continuous	High
Conde de Casal	Medium	Fragmented	Medium - low

2.5.3 Case study: Madrid Line 11



The site research focuses on the Line 11 extension in Madrid, which is being extended with six new stations. This extension provides a condition in which mobility intensity will increase allowing potential for future node-place imbalances. For each station, a radius of 800 meters is defined, which is about a 12-15 minute walk. Within these areas, a plinth function analysis and an analysis of public spaces are performed. In addition, demographic data is collected to identify social patterns. Based on these findings, there will be concluded whether each station area functions as a sustained or unsustainable node/place. Lastly the risk of implementing a new station in the areas will be identified.

Figure 23: Line 11 extension, 1:50 000



Figure 24: Line 11 new connections, 1:20 000



2.6

Comparative reading of station areas

Plaza Eliptica

Spatial and functional analysis

The station is connected to a large public park, surrounded by numerous educational institutions and sport facilities. The mix of residential, commercial, institutional and recreational functions form a high diversity and cause for continuous flows throughout the day.

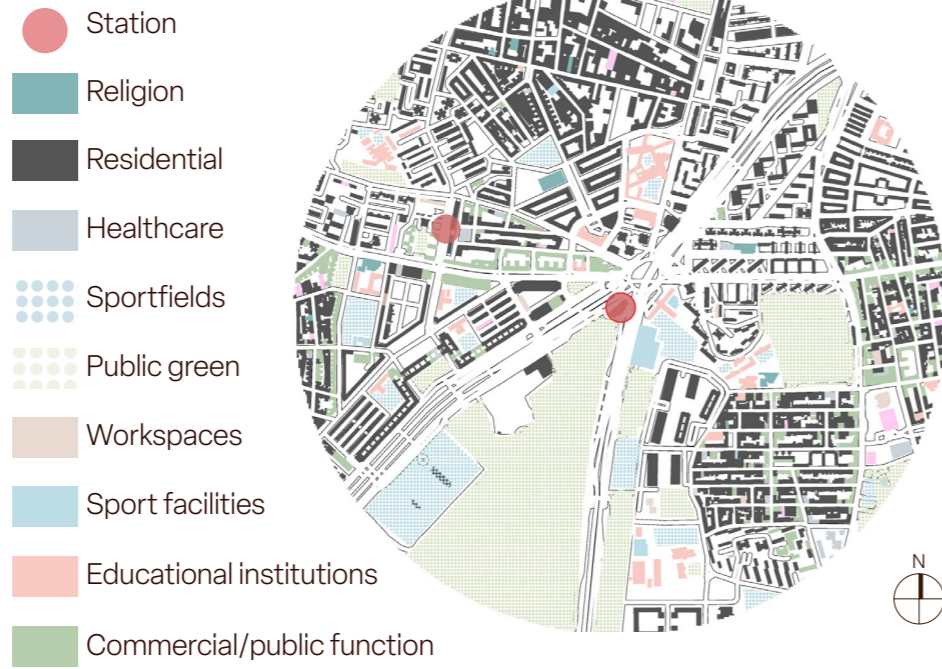


Figure 25: Plinth functions 800 meters around Plaza Eliptica, 1:10 000

Community analysis

Monday 11:00 - 12:00

Weather: slightly cloudy

The area contains a residential feeling with a comfortable scale for its users. however, cars dominate the street with many street parking facilities and wide street profiles. Typical users of the area include teenagers, elderly, commuters and local workers which showcase a typical Monday morning mix. Thirdspace indicators in the area are benches, playgrounds, informal seating and local shops. Social activities mostly happen at the park and sidewalks. The community anchors in the area are the schools, playgrounds, parks and sport facilities.

Conclusion

Minor unsustained node

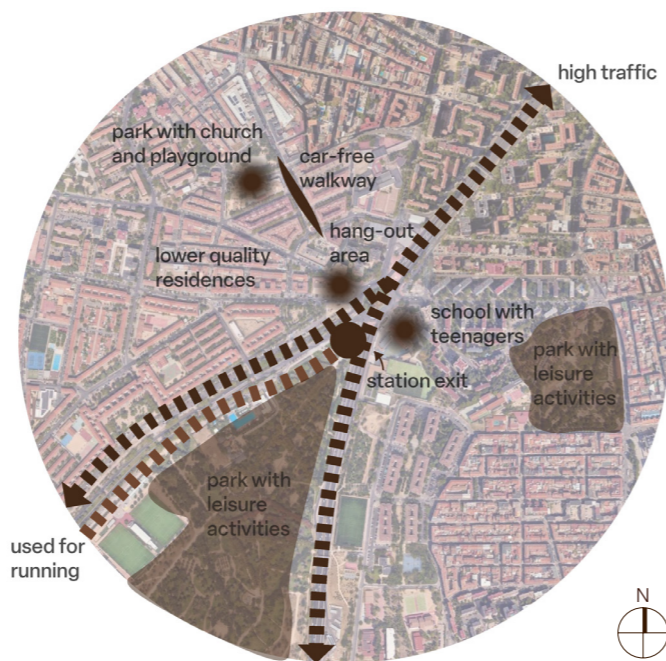
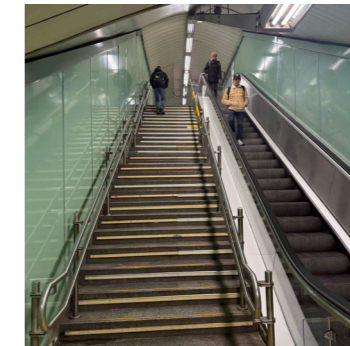


Figure 26: Community analyses Plaza Eliptica, 1:10 000

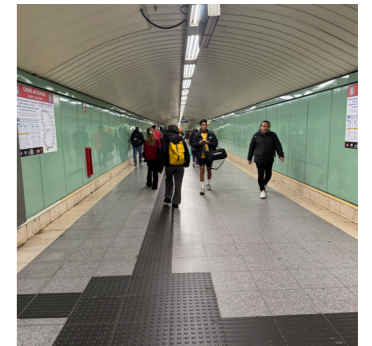
Sequence of station spaces



platform



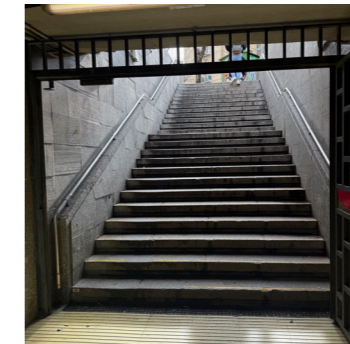
staircase



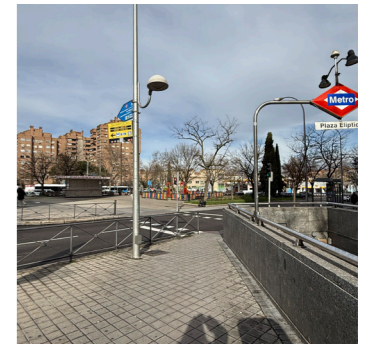
hall



ticket gates

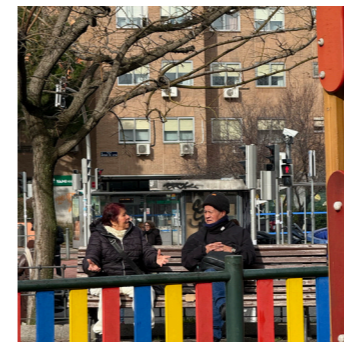


staircase outside

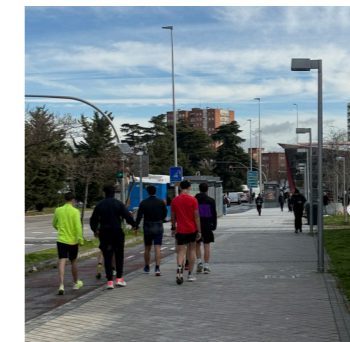


outside

Communal spaces



(bench at) playground



park edge walkway



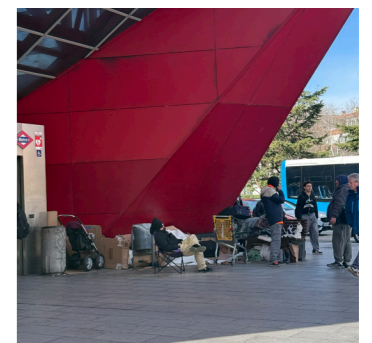
wide car-free street



park benches



park cycling benches



benches outside station

Comillas

Spatial and functional analysis

The area surrounding the station is planned as a medium-density residential neighborhood. The new station is located in the former park, next to a public school. Housing dominates the functional mix with a limited diversity in program.

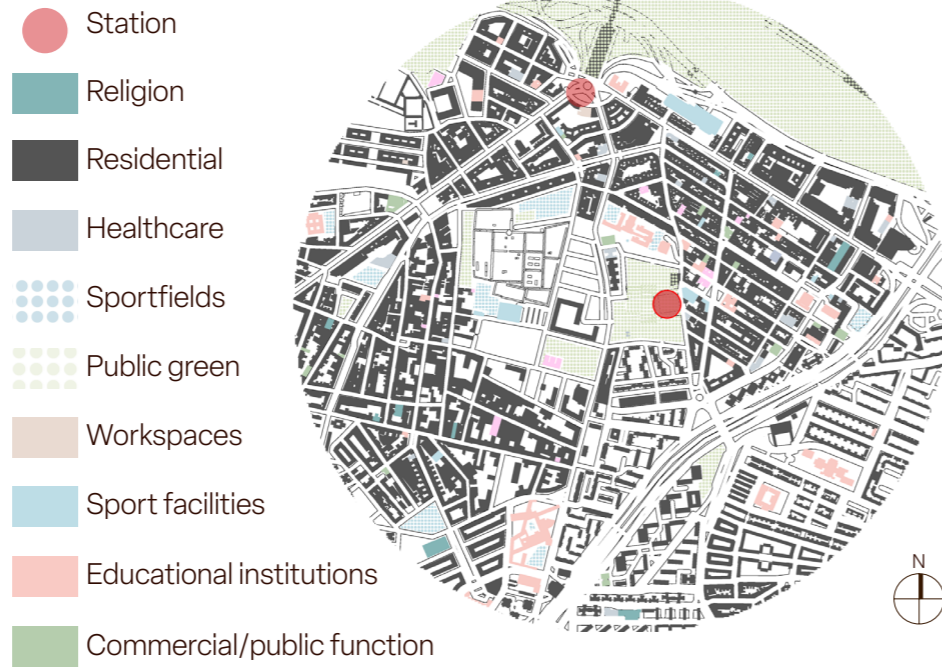


Figure 27: Plinth functions 800 meters around Comillas, 1:10 000

Community analysis

Monday 12:00 - 13:30
Wednesday 12:00 - 17:00
Weather: overcast

The neighborhood is characterized by a relatively high number of elderly residents. The existing green spaces in the area are small and of low quality. The school functions as one of the active nodes in the neighborhood. Thirdspace indicators are benches, playgrounds, a vegetable market, and informal seating spaces where much of the local life takes place. The cultural center offers events in the weekend, other community anchors are the school, playgrounds and the sport facility. However, strong anchors are missing for an active public life.

Conclusion:

(Future) unsustainable place

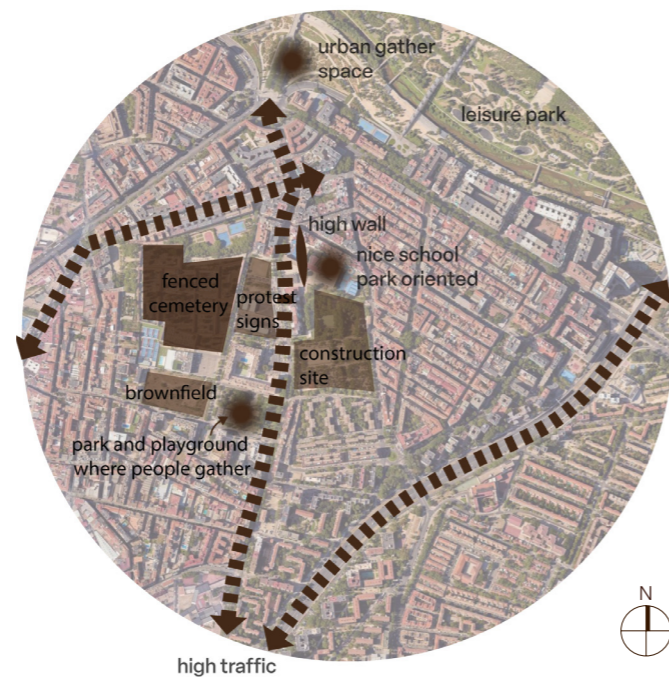


Figure 28: Community analyses Comillas, 1:10 000

Communal spaces



public school



outside north metro



playground



communal benches



communal benches



communal benches



open sport facilities



wide sidewalk



community center



school walls



benches near playground



protest signs

Madrid Rio

Spatial and functional analysis

The station is located in Parque Madrid Rio, which provides a large space for leisure activities. The surrounding neighborhood offers a sufficient mix of amenities. As a result, the station attracts mainly park visitors.

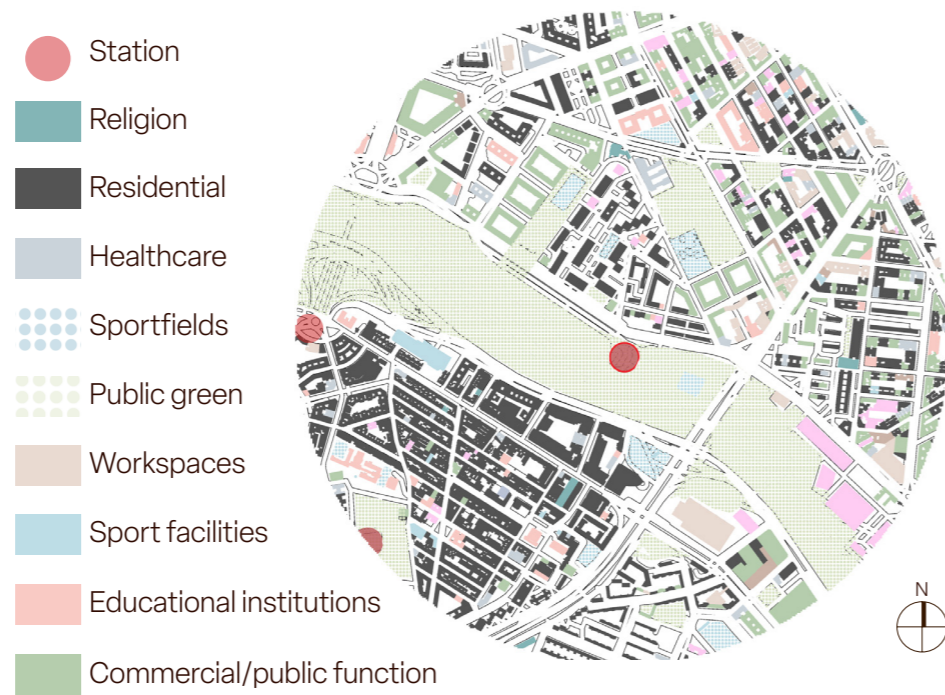


Figure 29: Plinth functions 800 meters around Madrid Rio, 1:10 000

Community analysis

Monday 14:30 - 15:30

Weather: rain

The area is primarily residential and organized around the large park. Wide streets surrounding the park form a physical barrier, which limits the connection with the residential area. The main users of the area are families and tourists. Local community life take place around leisure activities located in the park. Thirdspace indicators are benches, playgrounds, and public sportfields which are used by different age groups. The new station attracts visitors who only use the park, which may overshadow local neighborhood use.

Conclusion

(Future) sustained node place

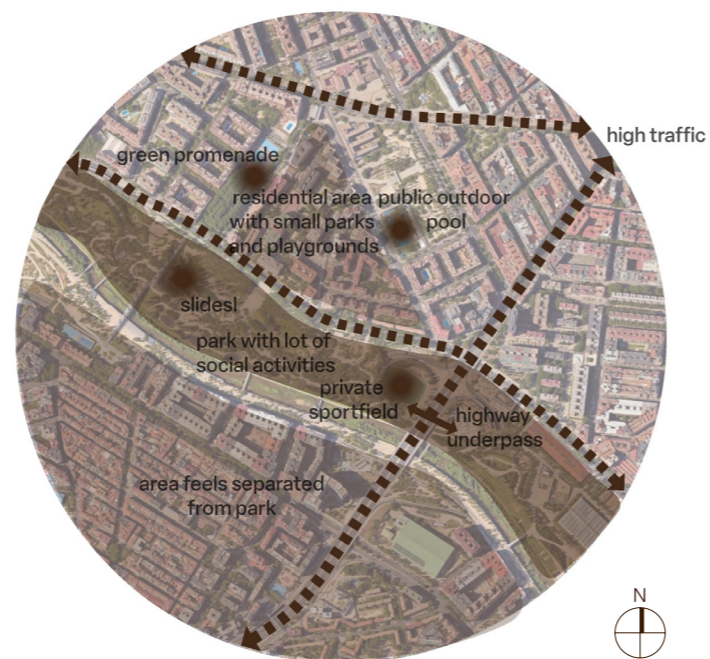
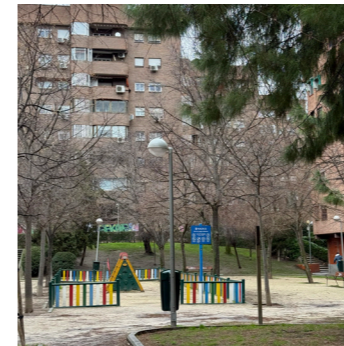


Figure 30: Community analyses Madrid Rio, 1:10 000

Communal spaces



playground near residence



playground near residence



small park functions



communal garden



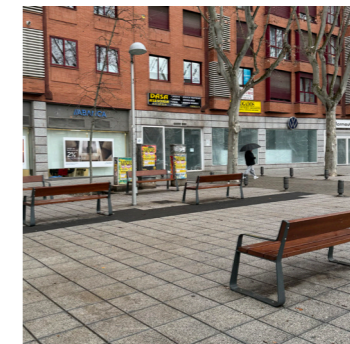
public sportfield



playground in park



informal seating



informal seating



private sportfield

La Frontera

Spatial and functional analysis

The station is part of a dense network of stations in the surrounding area, including Atocha station. While there is a high diversity in functions public green space is limited.

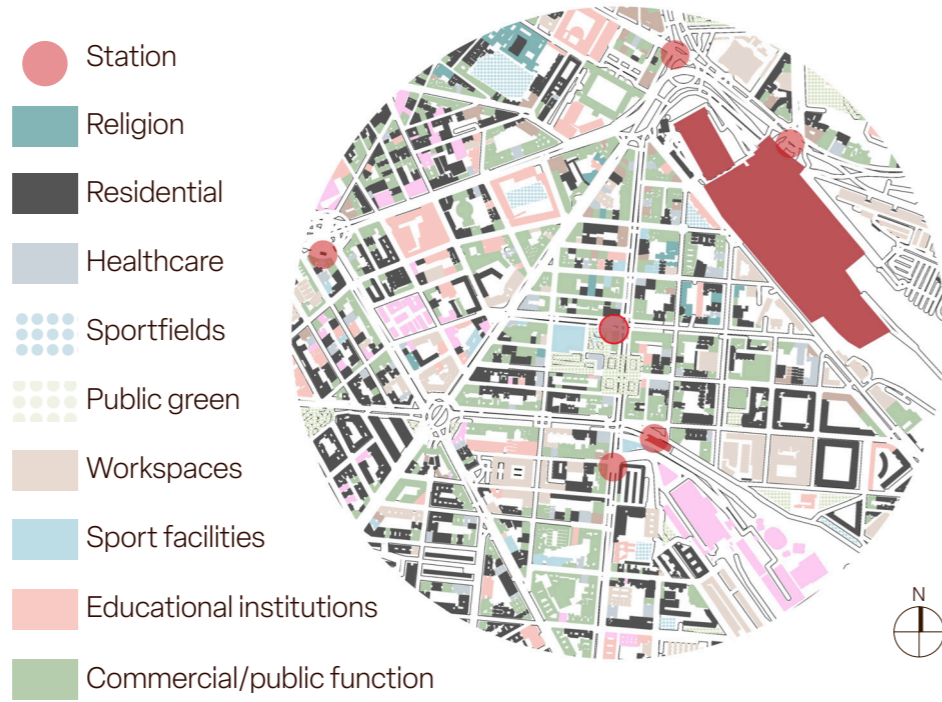
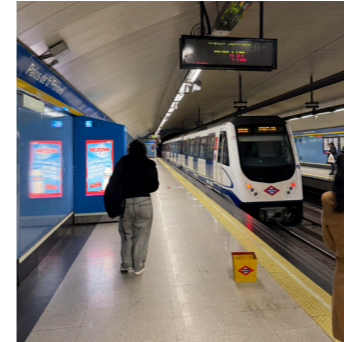


Figure 31: Plinth functions 800 meters around La Frontera, 1:10 000

Sequence of station spaces



platform



staircase



tickets



doors



outside

Community analysis

Monday 15:30 - 17:00

Weather: rain

The plinths in the area are active and offer a diverse range of functions. The neighborhood accommodates a wide range of age groups. However, infrastructure plays a dominant role in the streetscape. The community center, located near the station, is used by different age groups, and acts together with the small park as a key community anchor. Thirdspace indicators in the neighborhood include cafe's and bars, local shops and small green spaces.

Conclusion

Unsustained place



Figure 32: Community analyses La Frontera, 1:10 000

Communal spaces



community center



inside community center



homeless in park

Atocha

Spatial and functional analysis

The station functions as a multimodal hub and is within walking distance of Retiro park. The high density of amenities, together with numerous hotels, give the neighborhood a strong touristic character. The ratio of residents compared to the amenities is imbalanced, favoring visitors over residents.

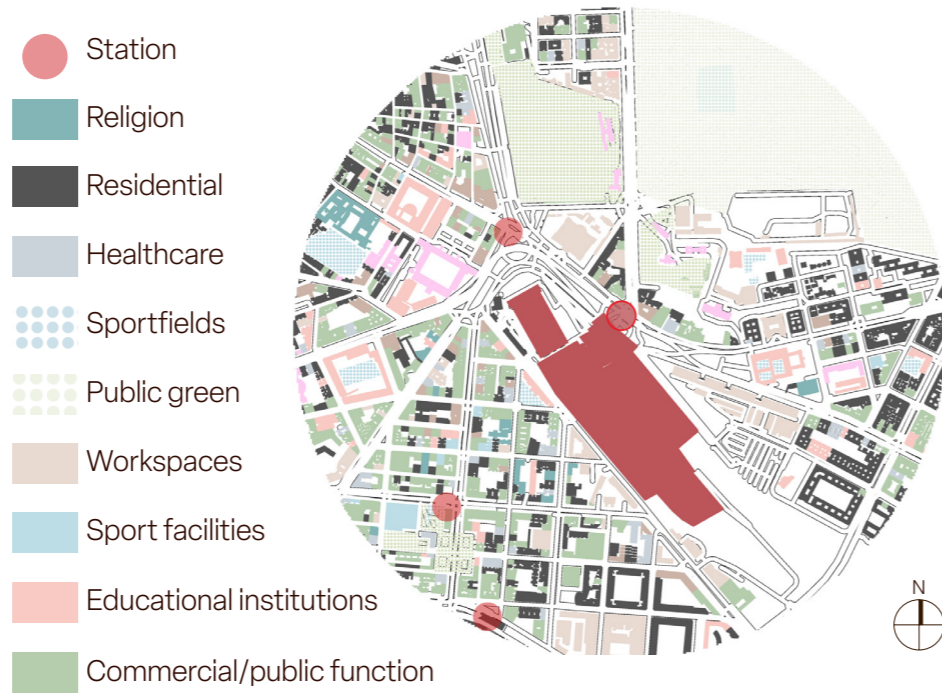


Figure 33: Plinth functions 800 meters around Atocha, 1:10 000

Community analysis

Tuesday 12:30 - 14:00

Weather: overcast

The area features mixed functions, however, is primarily dominated by infrastructure and large scale facilities, giving a strong touristic character. The population is diverse, including, children, elderly, local workers, commuters and tourists. Thirdspace indicators are cafes and bars, the park commercial spaces within the station and the market street. Local community life mainly takes place in Retiro park, therefore it functions as the key community anchor together with the market street.

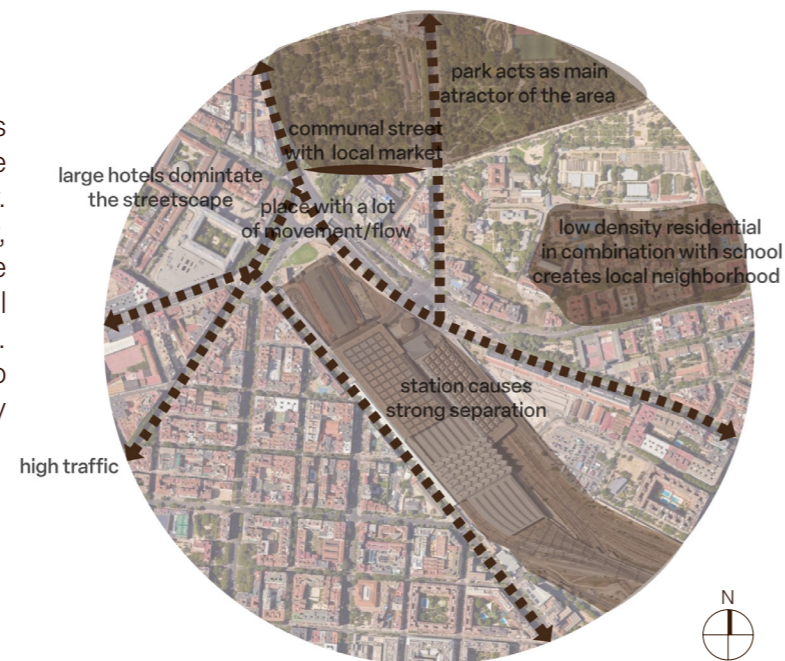
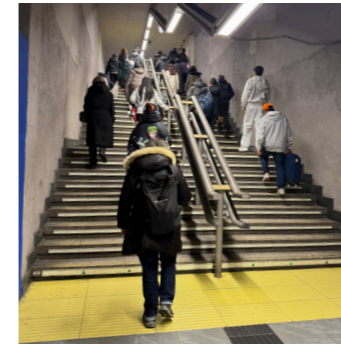


Figure 34: Community analyses Atocha, 1:10 000

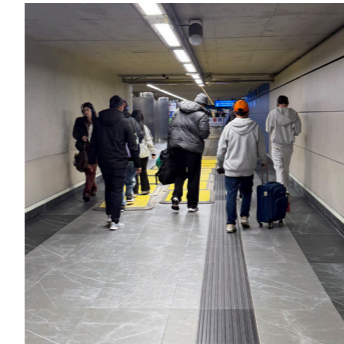
Conclusion

Sustained node and place

Sequence of station spaces



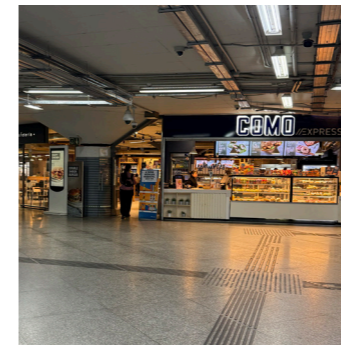
platform/stairs



hall



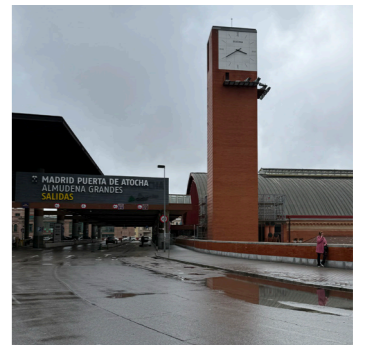
ticket gates



hall with shops/restaurants



exit/entrance



outside bus platform

Communal spaces



sidewalk social interaction



informal seating



local market

Conde de Casal

Spatial and functional analysis

The area offers a mix of different housing typologies and multiple transportation possibilities. Wide road infrastructure dominates the area, complicating the walkability in the neighborhood. The neighborhood offers a mix of amenities.

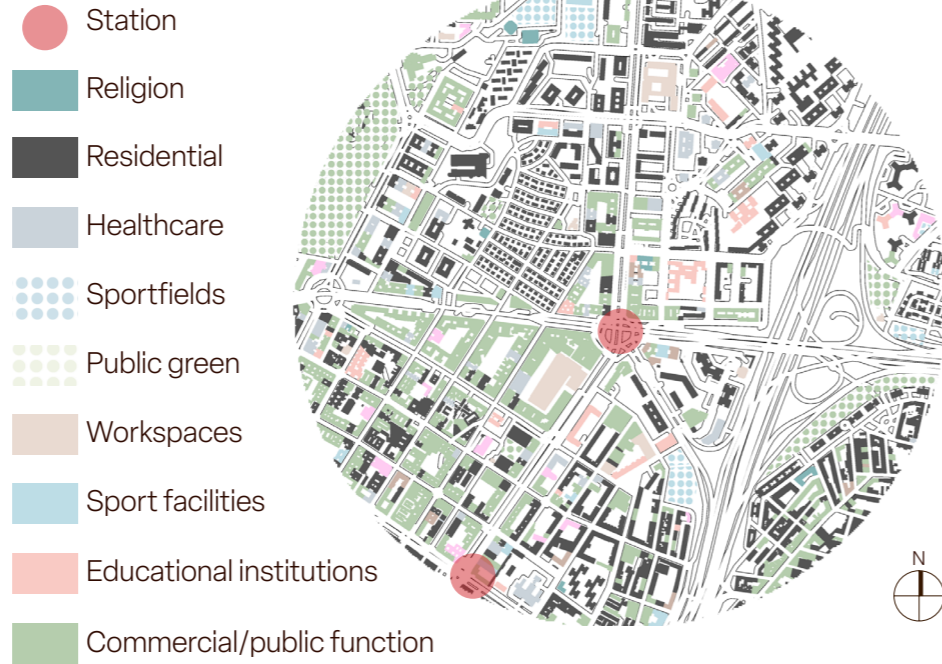


Figure 35: Plinth functions 800 meters around Conde de Casal, 1:10 000

Community analysis

Tuesday 14:00 - 16:00

Weather: overcast

The neighborhood has a local feeling, with a diverse mix of amenities used by the community. Thirdspace indicators in the neighborhood are benches, playgrounds, cafe's and schools. Local life primarily exists at the schools and playgrounds, the church and sport fields. the neighborhood accommodates largely younger age groups. Wide streetscapes troubles the walkability, and therefore a cause a slight loss of social connection.

Conclusion

Minor unsustainable node

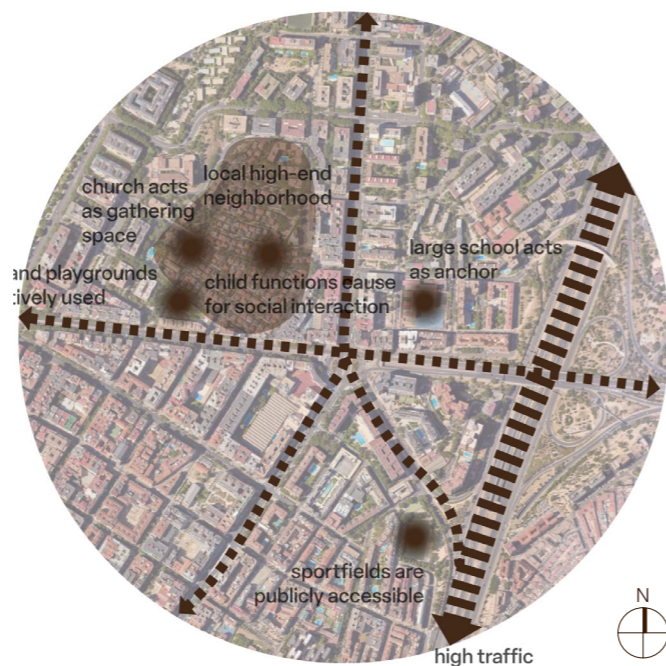


Figure 36: Community analyses Conde de Casal, 1:10 000

Communal spaces



church



informal seating



informal seating in park



benches near station



formal seating near station



kindergarden pick-up



playground



school area



local fair

Comparative positioning of station areas

Node-Place model

The node-place model (figure 37) evaluates the balance between the six new stations on metro line 11 and their surrounding urban environments. Both Atocha and Madrid Rio function as sustained node-places, though for different reasons. Atocha operates as a multimodal mobility hub, supported by an active urban environment shaped by tourism and metropolitan functions. Madrid Rio, in contrast, benefits from its large park with leisure activities, where strong spatial quality compensates the node intensity. La Frontera, due to its proximity to Atocha, does not match its node performance with the surrounding spatial quality. Plaza Elíptica and Conde de Casal are positioned near the edge of a sustainable condition. Infrastructural barriers and spatial discontinuities weaken the relationship between node and place. Comillas station is identified as a future risk of becoming an unsustainable node. The planned increase in accessibility is not matched by the spatial and programmatic diversity. Without intervention, this imbalance may encourage residents to seek their daily activity elsewhere in the city.

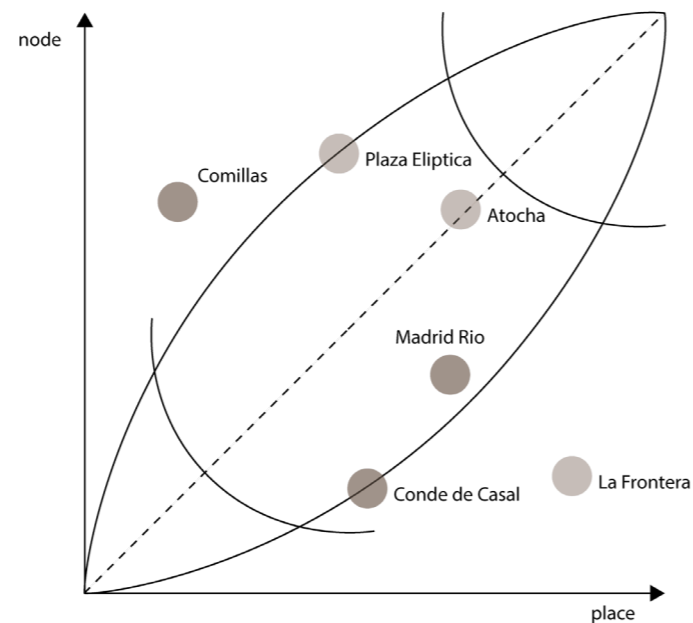


Figure 37: Node-place positioning

Community-mobility positioning

While the node-place model evaluates node and place performance, the community-mobility positioning introduces a social dimension. It assesses the degree to which everyday community life is integrated within mobility structures. Atocha represents a condition of high mobility intensity, combined with a relatively low community integration. Social interaction is largely shaped by transport flows and tourism rather than stable neighborhood structures. Madrid Rio demonstrates a strong community integration with its supporting park. Plaza Elíptica is with an intermediate position accessible and supported by mixed-use functions. Conde de Casal shows a relatively strong community integration despite moderate mobility intensity. La Frontera is characterized by medium mobility intensity and moderate community integration. Comillas, again, emerges as a future condition in which mobility intensity will increase without a corresponding strengthening of community integration. Existing social anchors are present but remain spatially disconnected from the future station environment.

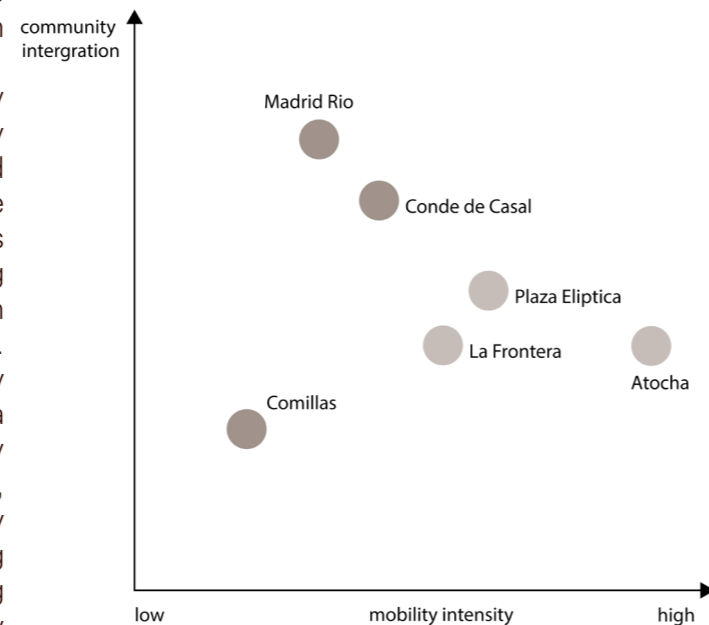


Figure 38: Community-mobility positioning

Selection of Comillas for CB-TD implementation

Comillas represents a future condition of increased accessibility combined with limited spatial integration of community structures. The station area is predominantly residential, with identifiable social anchors such as schools and playgrounds, yet these remain weakly connected to the emerging mobility framework.

Unlike Atocha or La Frontera, Comillas offers a stable local context in which intervention can operate on neighborhood scale. The imbalance is not the result of overdevelopment, but of under-integration.

For this reason, Comillas offers an appropriate testing ground for Community Based - Transit Development (CB-TD). The primary design challenge is not densification, but the spatial integration of existing community anchors into the mobility framework.

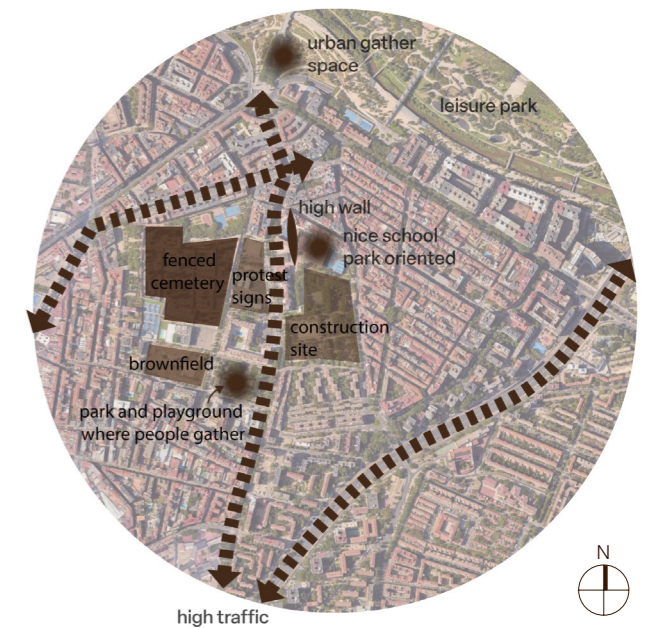


Figure 39: Park activity



3.1 Results

Synthesis 1 & discussion

1. How does increasing mobility intensity affect the spatial conditions for staying and social interaction in station areas?

Through Bertollini's node place model, increasing the mobility intensity strengthens the node. However, comparative station analysis demonstrates in several cases that mobility intensification often remains only infrastructural rather than spatially embedded, resulting in an imbalance between node and place.

Gehl's distinction between necessary and optional activities clarify the underlying reason behind this condition. High flows emerging from the high intensity of the node cause pressure on the spatial and perceptual conditions that are required for optional and social activities. New Alexandras metro station (XZA architects) and the Wartz spoorzone (MVRDV) show that when transitional zones, mixed ground floors and human scale thresholds are introduced into the mobility sequence, this pressure can be undermined.

In high-intensity station areas, space is predominantly organised as conceived and measurable infrastructure (first- and secondspace), while lived space is displaced to parks, edges or interior commercial zones. The examined station areas in Madrid confirm that without spatial mediation, social interaction becomes secondary.

When mobility flows remain uninterrupted and monofunctional, they weaken the overlap between node and place. The mobility intensity will affect social interaction not by scale but through its spatial articulation. When spatially layered, flows are interrupted and encounters can support community life and social interaction.

2. How is everyday community life spatially integrated in relation to mobility infrastructure in station areas?

When combining the mobility intensity profiles with community indicators, a consistent spatial pattern is revealed: community anchors are present in the station areas, but remain structurally disconnected from the mobility cores.

The line 11 analysis show this condition clearly, where mobility and community operate as parallel spatial layers with limited overlap. In contrast, New Alexandras metro station (XZA architects) shows that integration becomes possible when mobility environments are treated as part of the neighborhood fabric.

According to Gehl, social interaction concentrates, where spatial comfort, visibility and informal occupation are present. These conditions are typically found in parks, school surroundings and small-scale streets rather than within infrastructural corridors.

The Thirdspace concept of Soja, further reveals that everyday life exists in spaces that offer stopping and repetition, while mobility infrastructure remains efficiency driven.

As a result, a structural gap exists between node and lived space. Everyday community life is positioned within reach of mobility infrastructure, however, rarely within the spatial logic. The key challenge emerging from this synthesis is redirecting this relation, enabling areas to operate not only as transit nodes, but socially embedded in urban environments.

Discussion

The comparative station analysis shows that the mobility intensity factor alone does not create station environments that offer opportunities for social interaction. While Transit Oriented Development often prioritizes accessibility and densification, this research reveals that community life depends on the spatial integration between movement and everyday use. The most recurring conclusion is that mobility infrastructures and community structures operate as parallel systems rather than one. This research therefore questions the assumption that densification around transportation nodes automatically creates socially sustainable environments. From this perspective, the research suggests that the quality of these environments depend less on the mobility intensity by itself, but more on how movement is spatially embedded within the urban fabric.

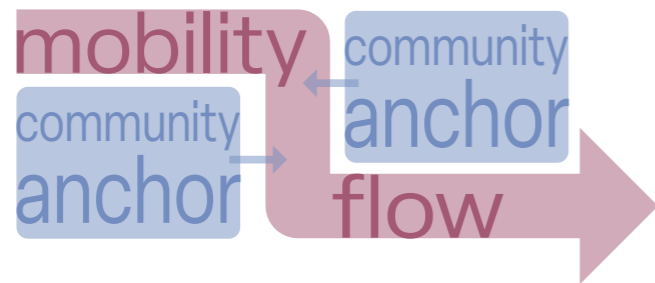
However, the research remains primarily spatial in its approach. The comparative station analysis focuses on spatial conditions, mapping and theoretical interpretation, while social behavior and long-term community dynamics are observed only indirectly. As a result, the research cannot fully predict how future users of the new stations will react to the transforming environment. Nevertheless, the spatial patterns emerging from the analysis shows that when community anchors and opportunities for optional activities are integrated within the mobility sequence, stronger conditions for social interaction can emerge.

The introduction of Community Based – Transit Development should not be interpreted as a rejection of mobility infrastructure, but as an attempt to reposition within the everyday life of the neighborhood users. Rather than treating station areas as isolated transit machines this research argues for station environments that can both accommodate mobility flows and support community life simultaneously.



3.2 Design principles

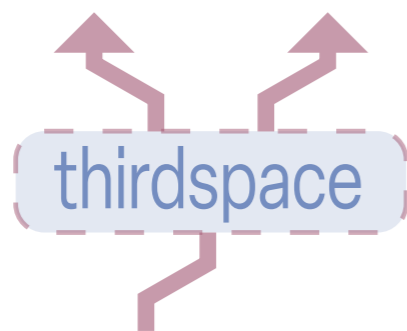
1 Anchoring community functions to mobility flows



2 Overlapping movement and staying



3 Integrating thirdspaces in the journey



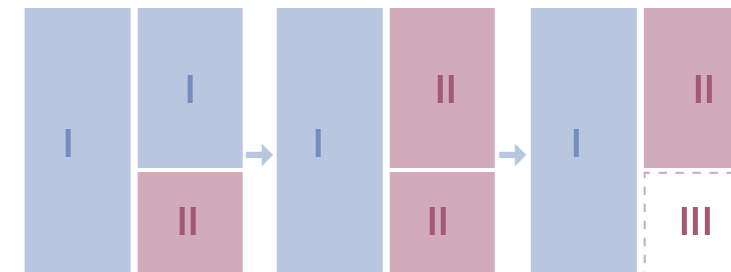
4 Creating thresholds instead of boundaries



5 Layering of different flow speeds



6 Temporal layering of use





3.3

Mapping comillas

Windrose

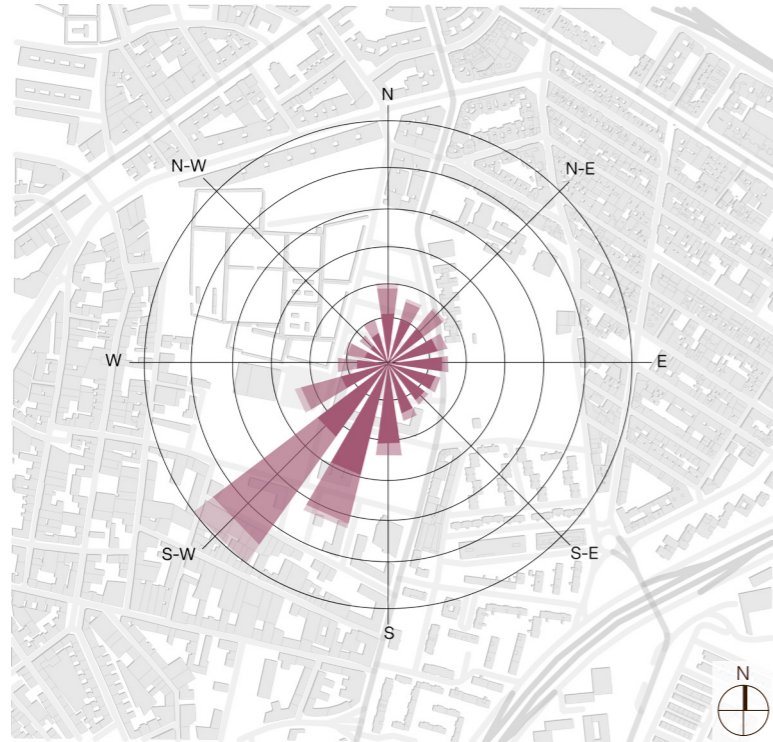


Figure 40: Windrose

Staying



Figure 42: Staying

Sun path

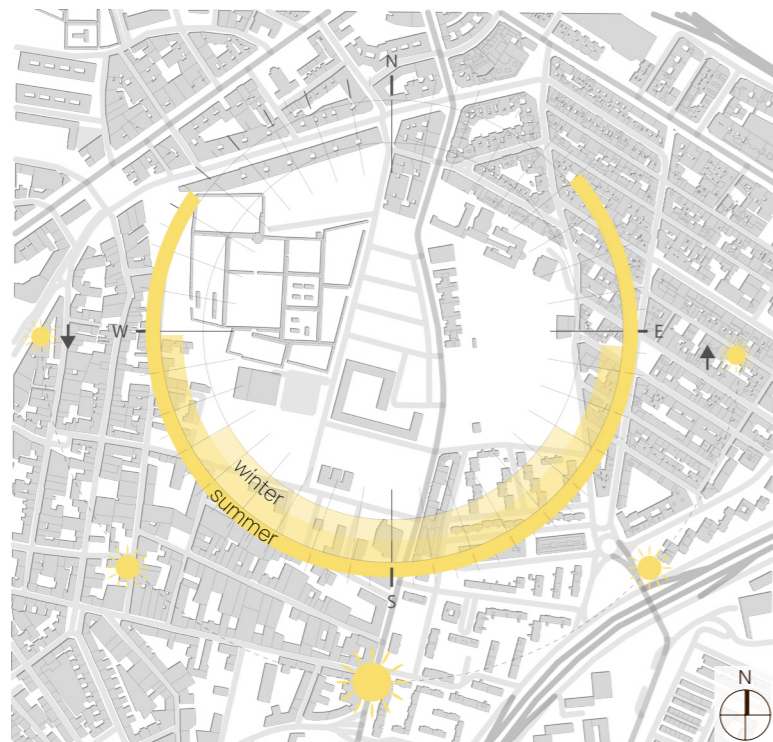


Figure 41: Sun path

Walking routes



Figure 43: Walking

Motorized traffic

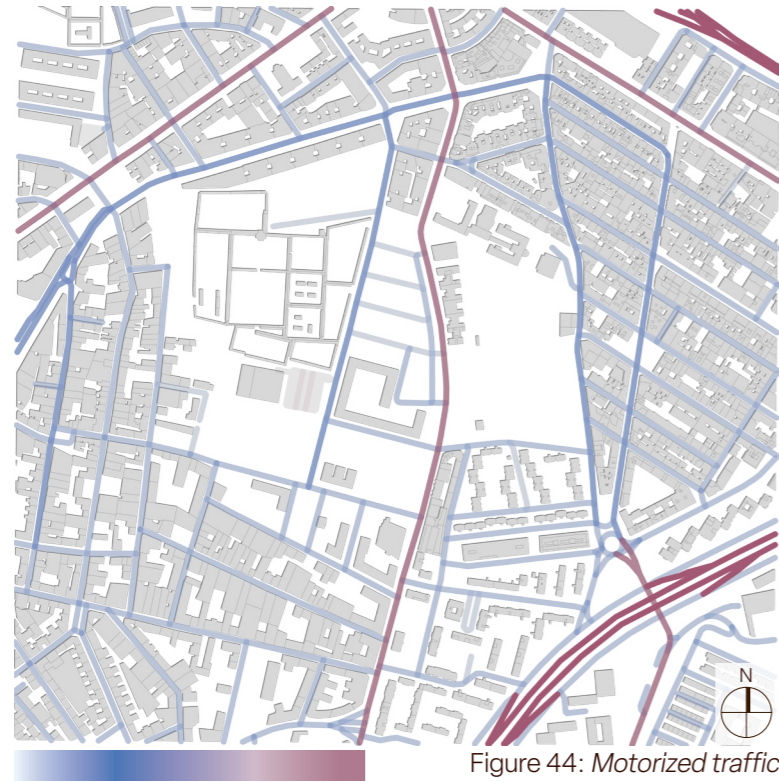


Figure 44: Motorized traffic

Historic photos of area



Figure 46: Historic photos, Comunidad de Madrid (2023)

Closed building blocks



Figure 45: Closed building blocks

Green structures

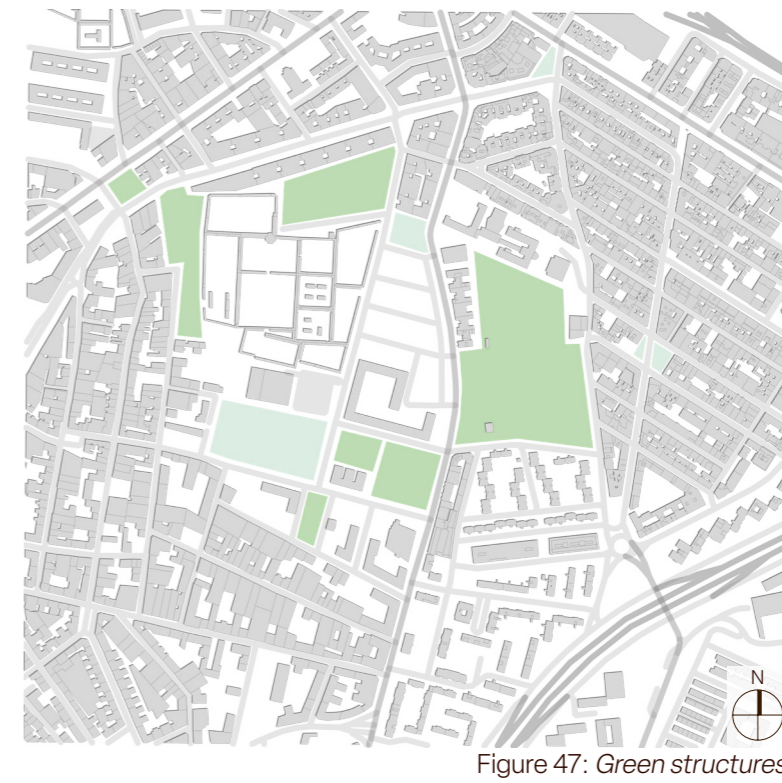


Figure 47: Green structures

Public transport

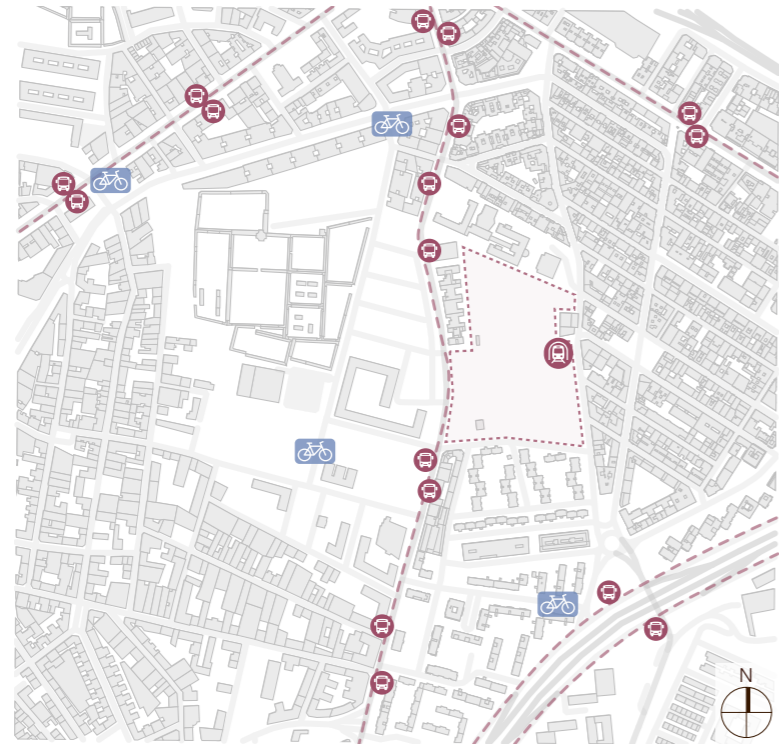


Figure 48: Public transport

Fieldwork hotspots



Figure 49: Fieldwork hotspots

Fieldwork findings



Figure 50: Fieldwork collage

Section A

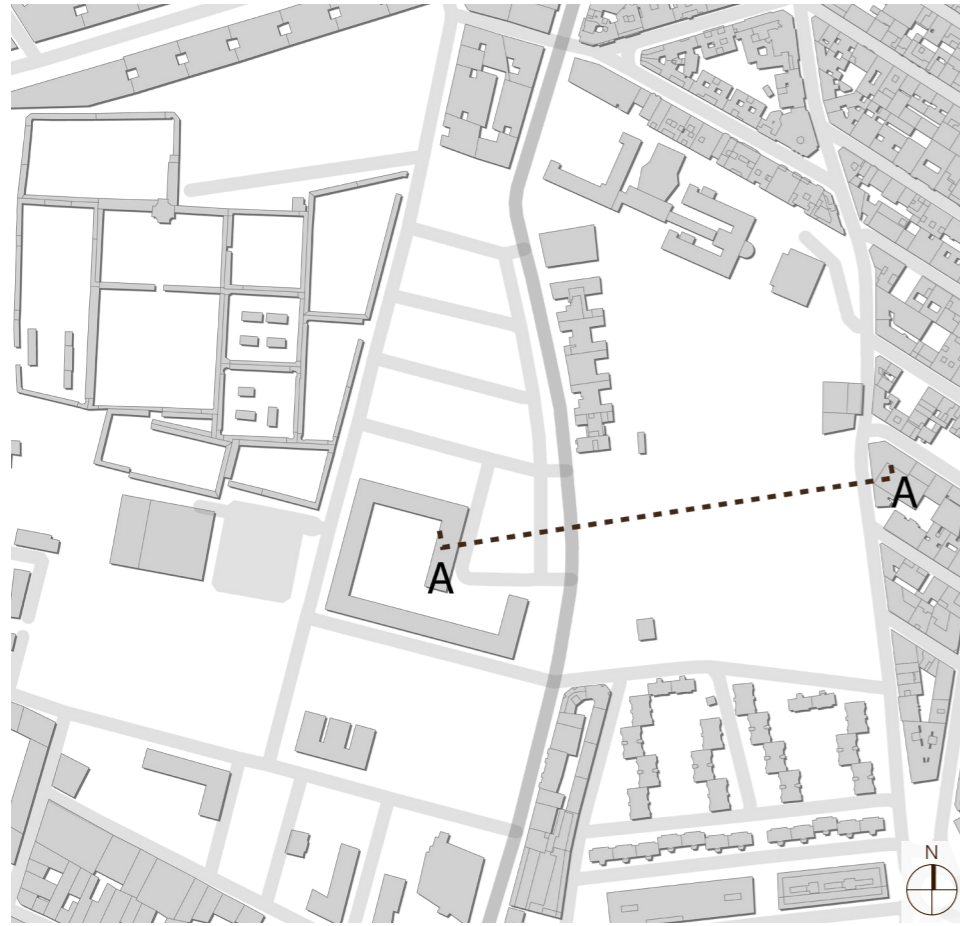


Figure 51: Section line A-A

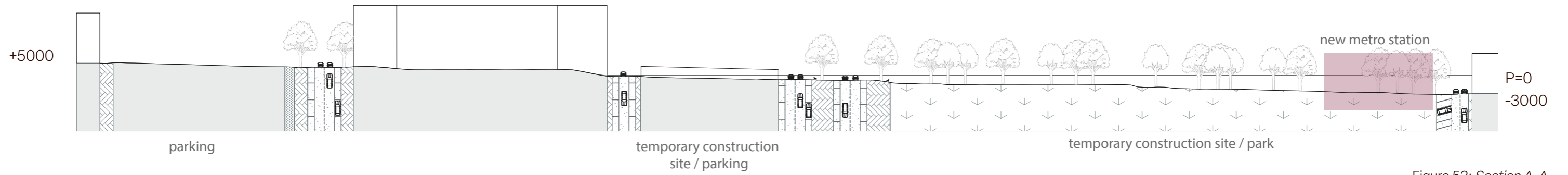


Figure 52: Section A-A

Section B

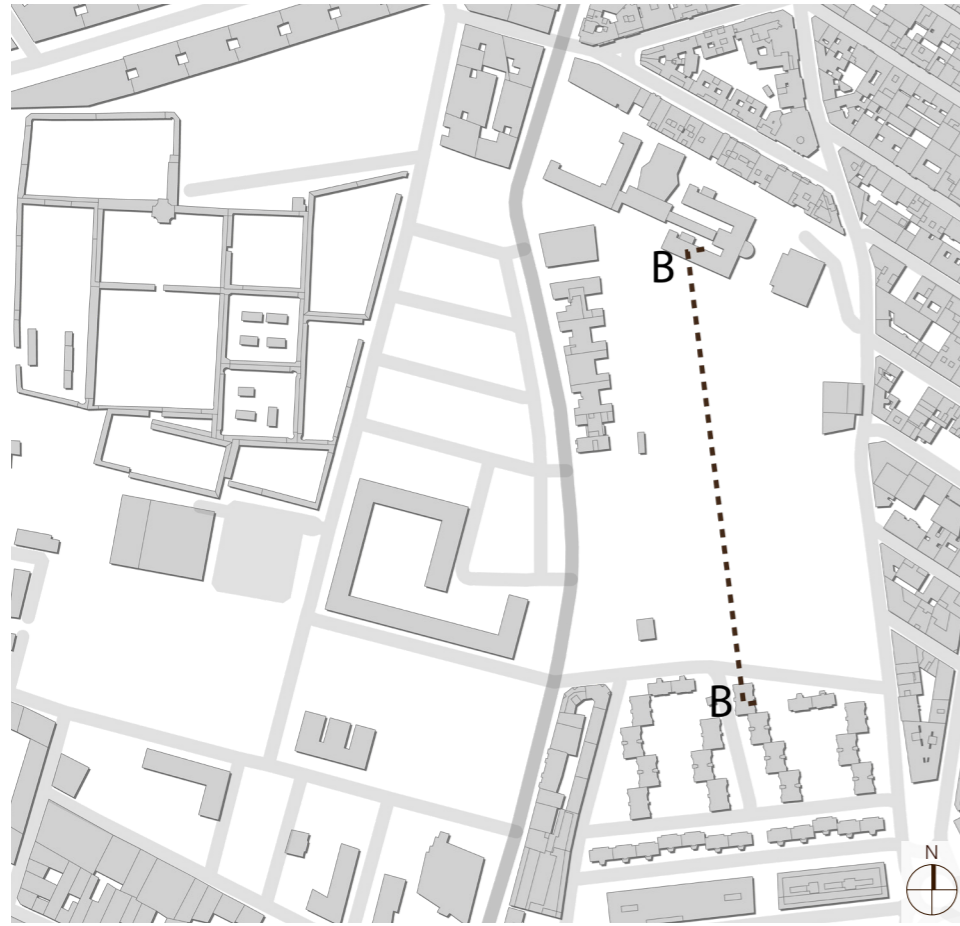


Figure 53: Section line B-B

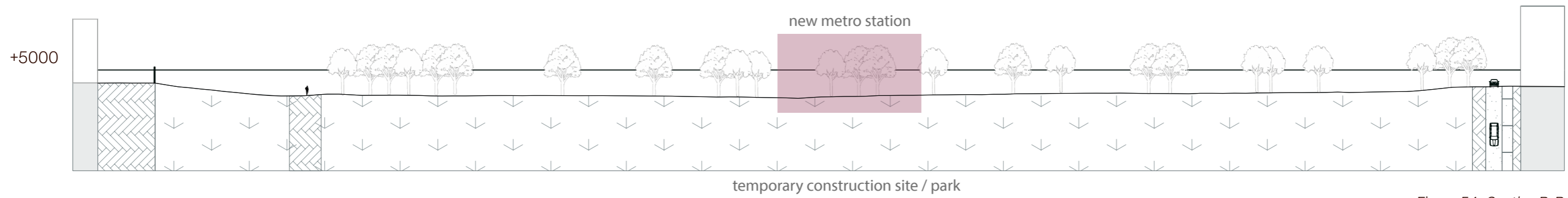


Figure 54: Section B-B

Section C

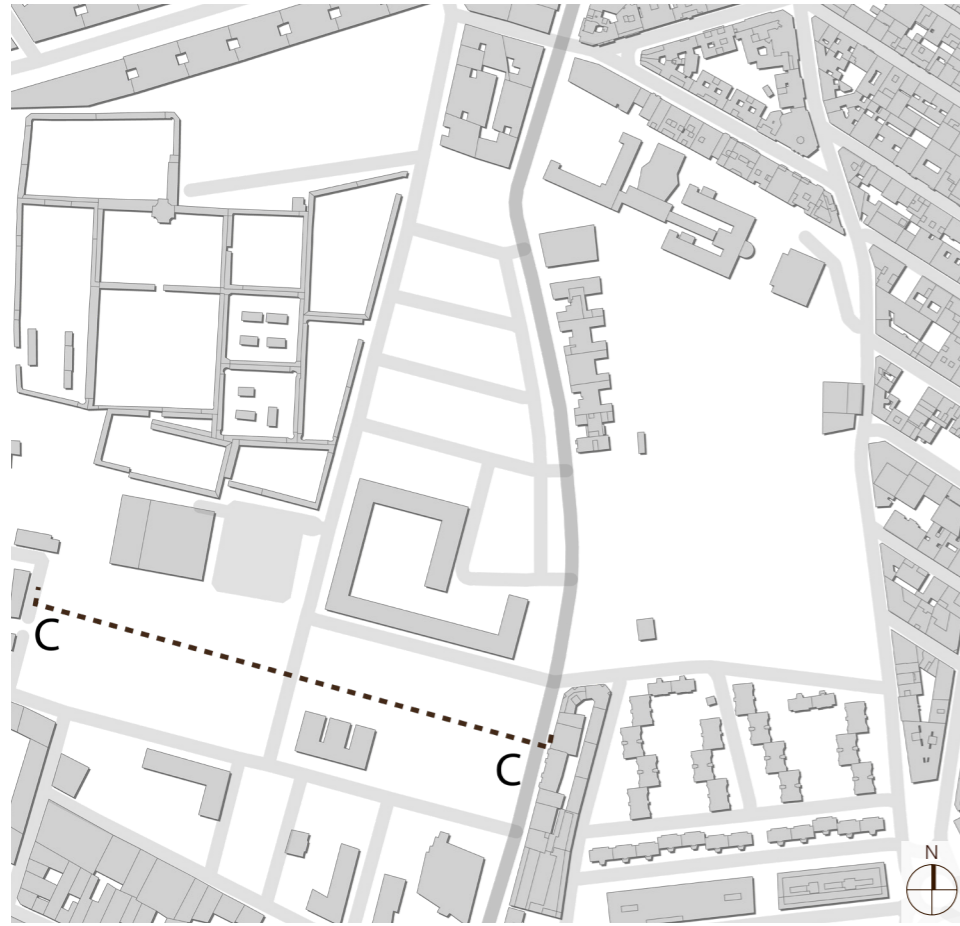


Figure 55: Section line C-C

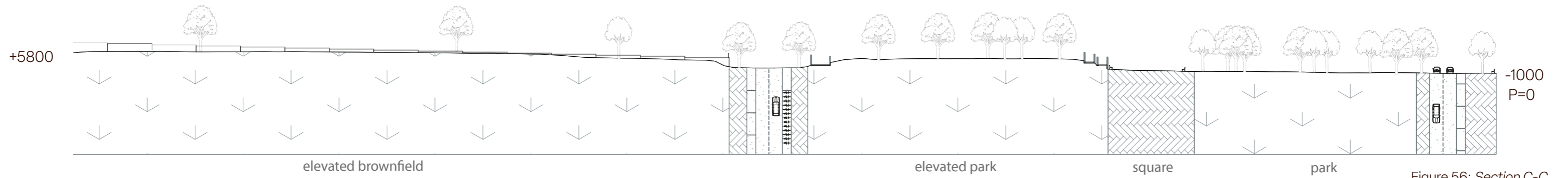


Figure 56: Section C-C

Routing personas

Children

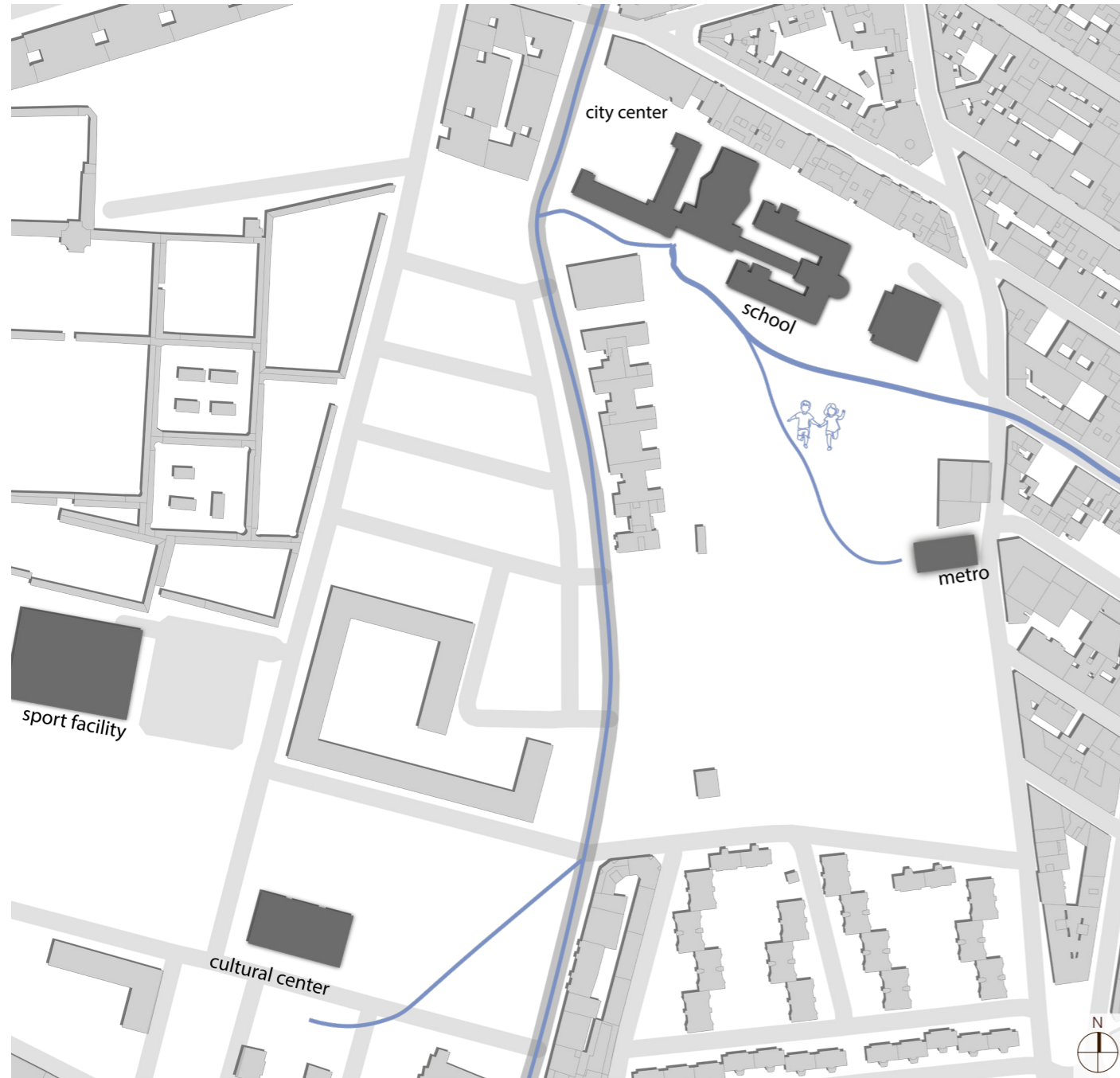


Figure 57: Routing children

Middle aged

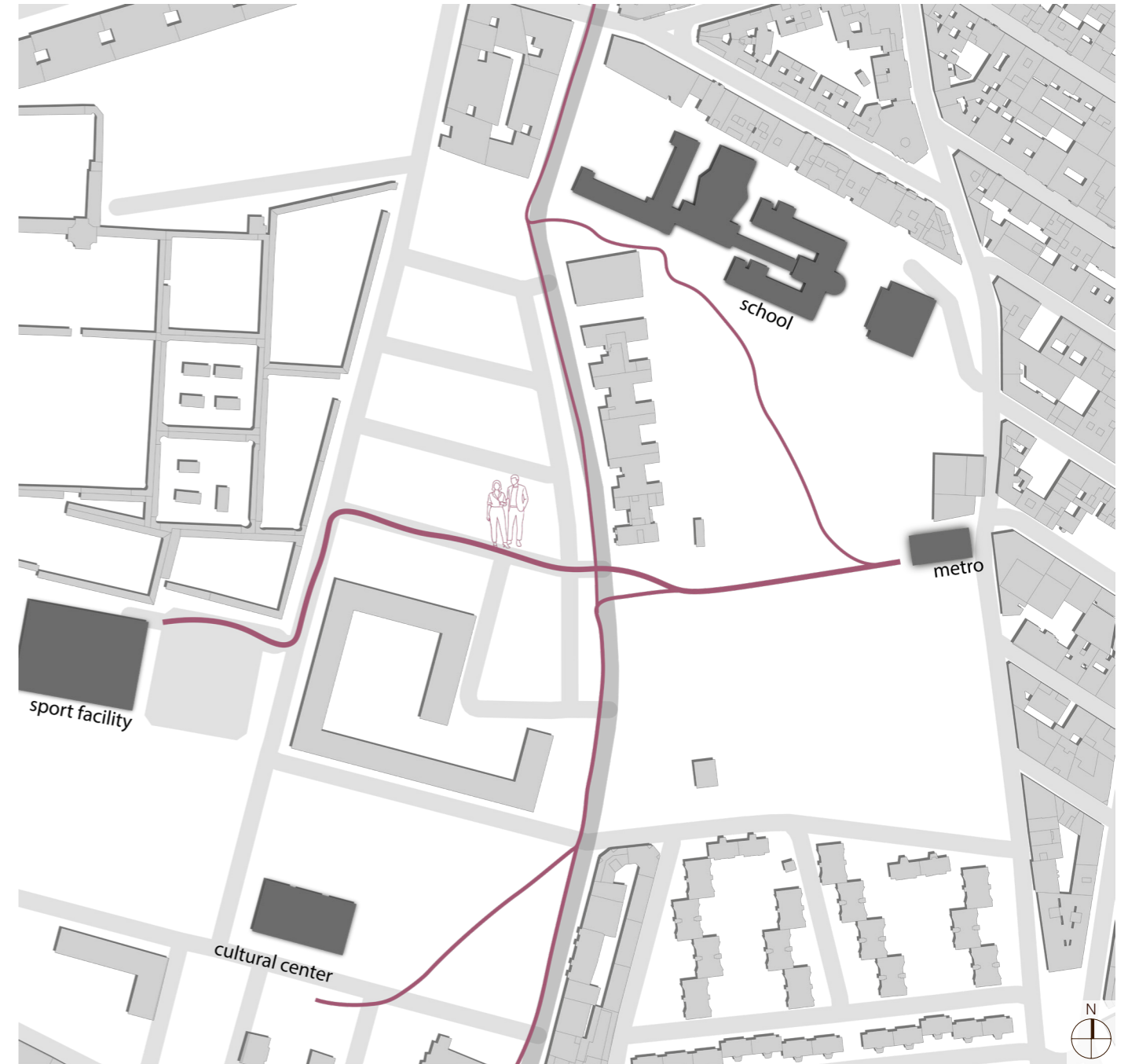


Figure 58: Routing middle aged

Elderly

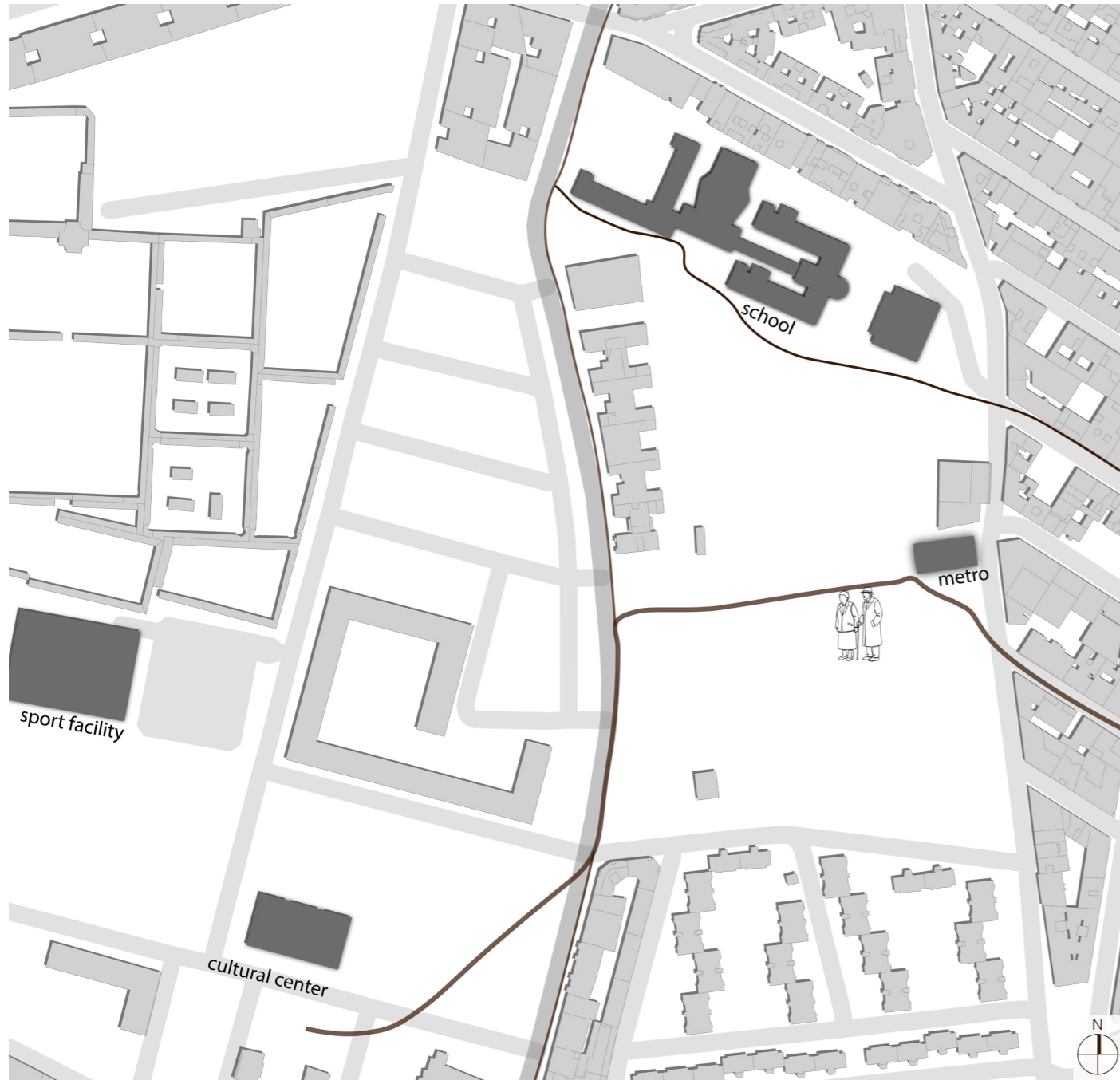


Figure 59: Routing elderly

Combined

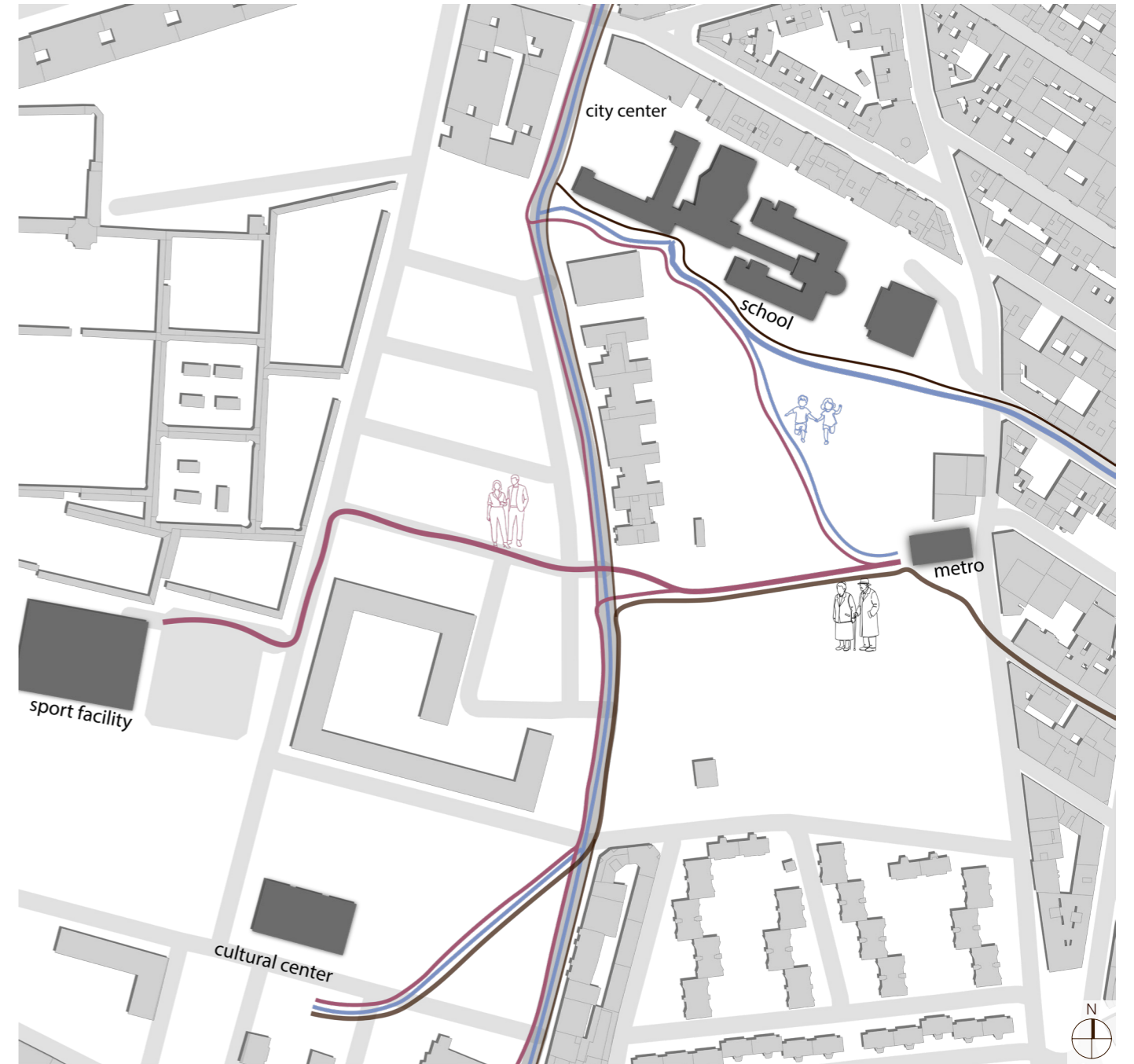


Figure 60: Routing combined



3.4 **Design**

CB-TD strategy - program of requirements

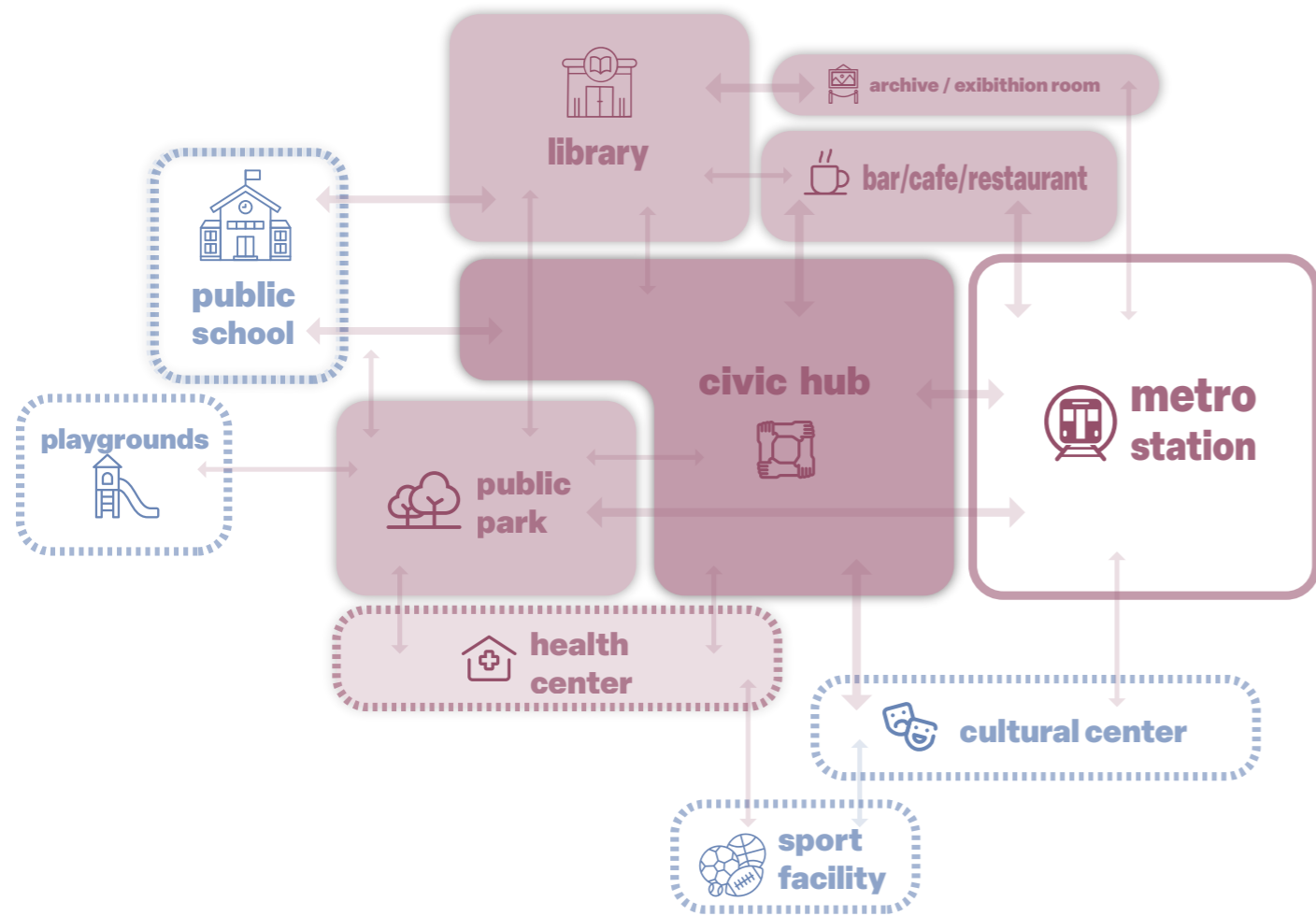






Figure 61: Program of requirements

-  existing program
-  node
-  planned program
-  new program

CB-TD strategy - programatic zoning

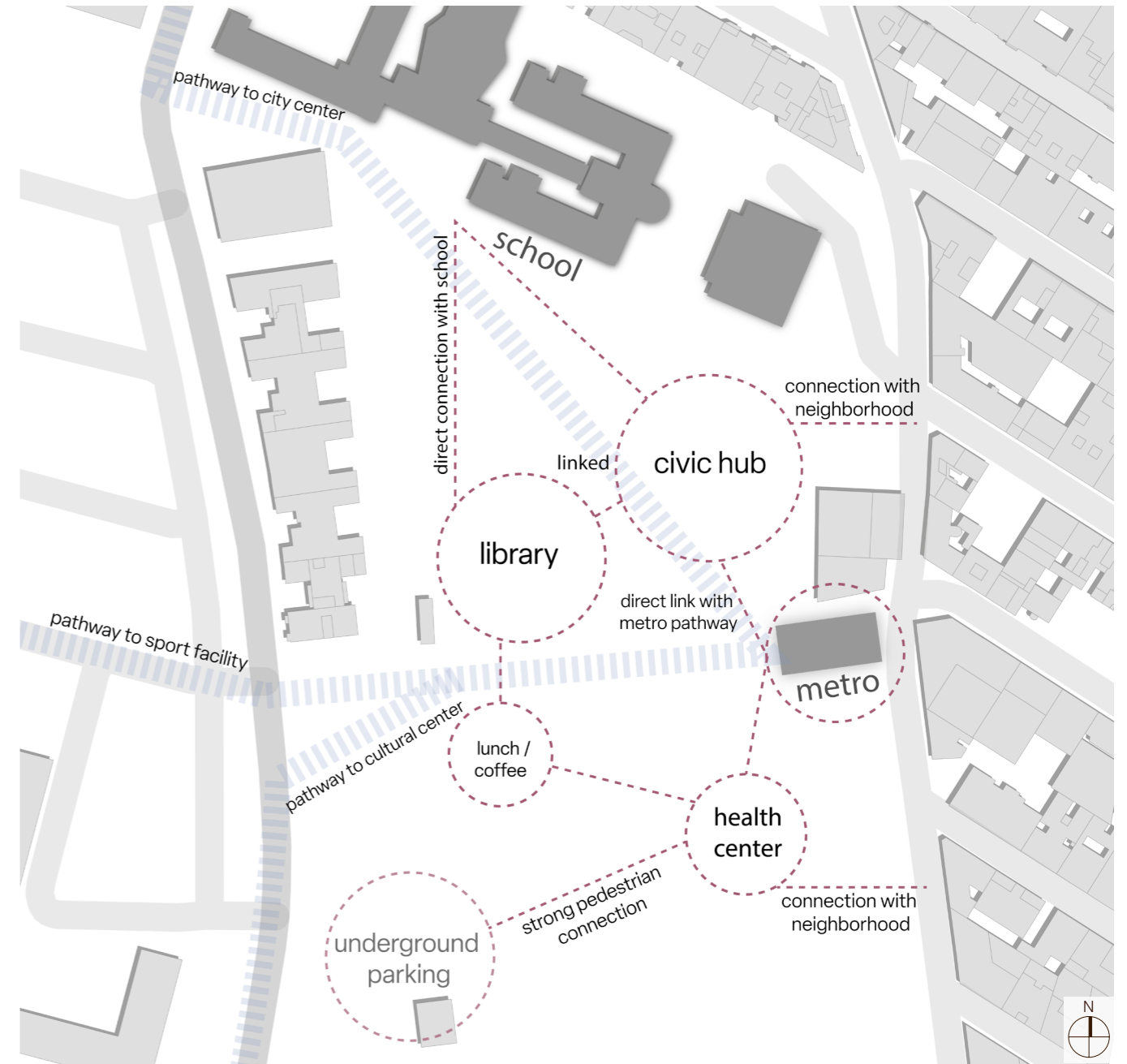


Figure 62: programatic zoning

CB-TD strategy - massing according to design principles

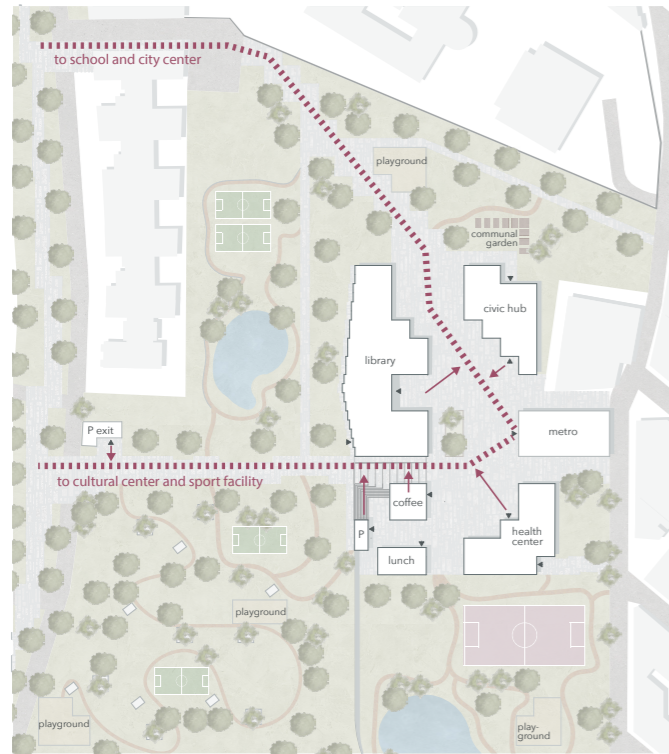


Figure 63: Massing step 1

1
Anchoring community functions to mobility flows

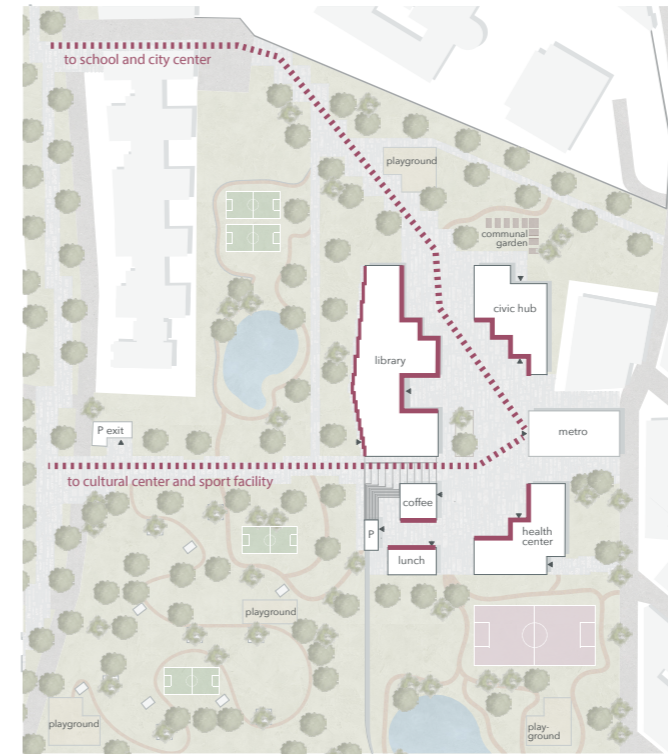
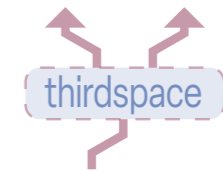


Figure 65: Massing step 3

3
Intergrating thirdspaces in the journey



4
Creating thresholds instead of boundaries

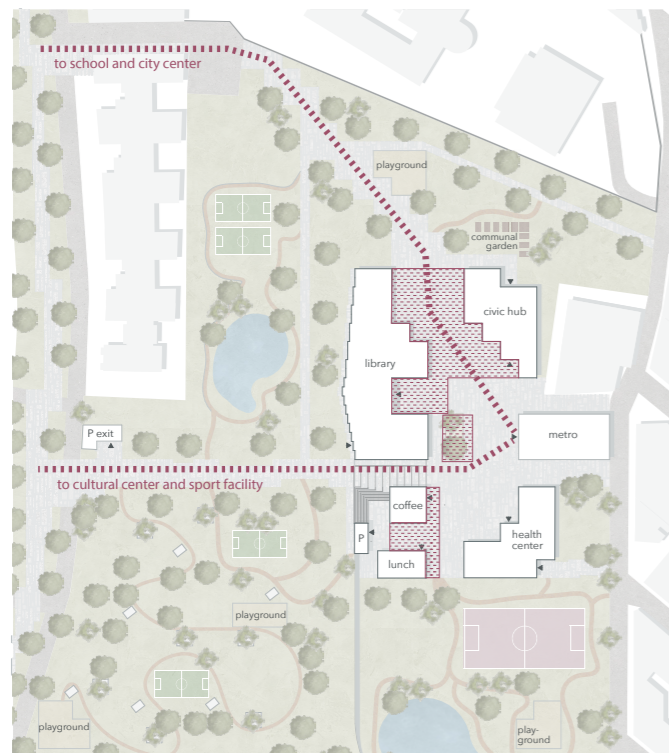


Figure 64: Massing step 2

2
Overlapping movement and staying



5
Layering different flow speeds

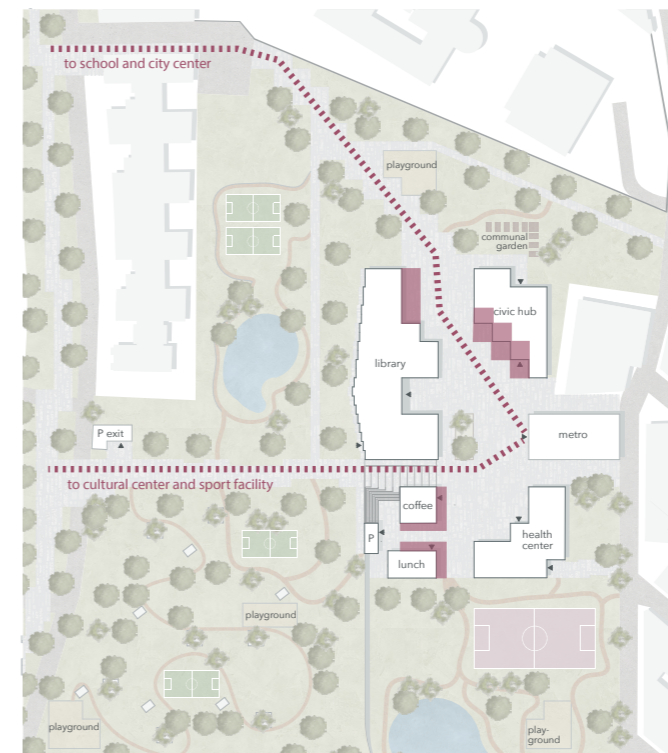
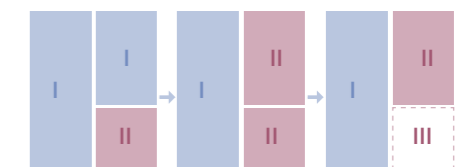


Figure 66: Massing step 4

6
Temporal layering of use



Site plan 1: 1500

Figure 67: Site plan 1:1500



Floor plan 1: 200 - scaled to 1:500

Figure 68: Floor plan 1:200



Movement and spatial experience - street profile

Current profile

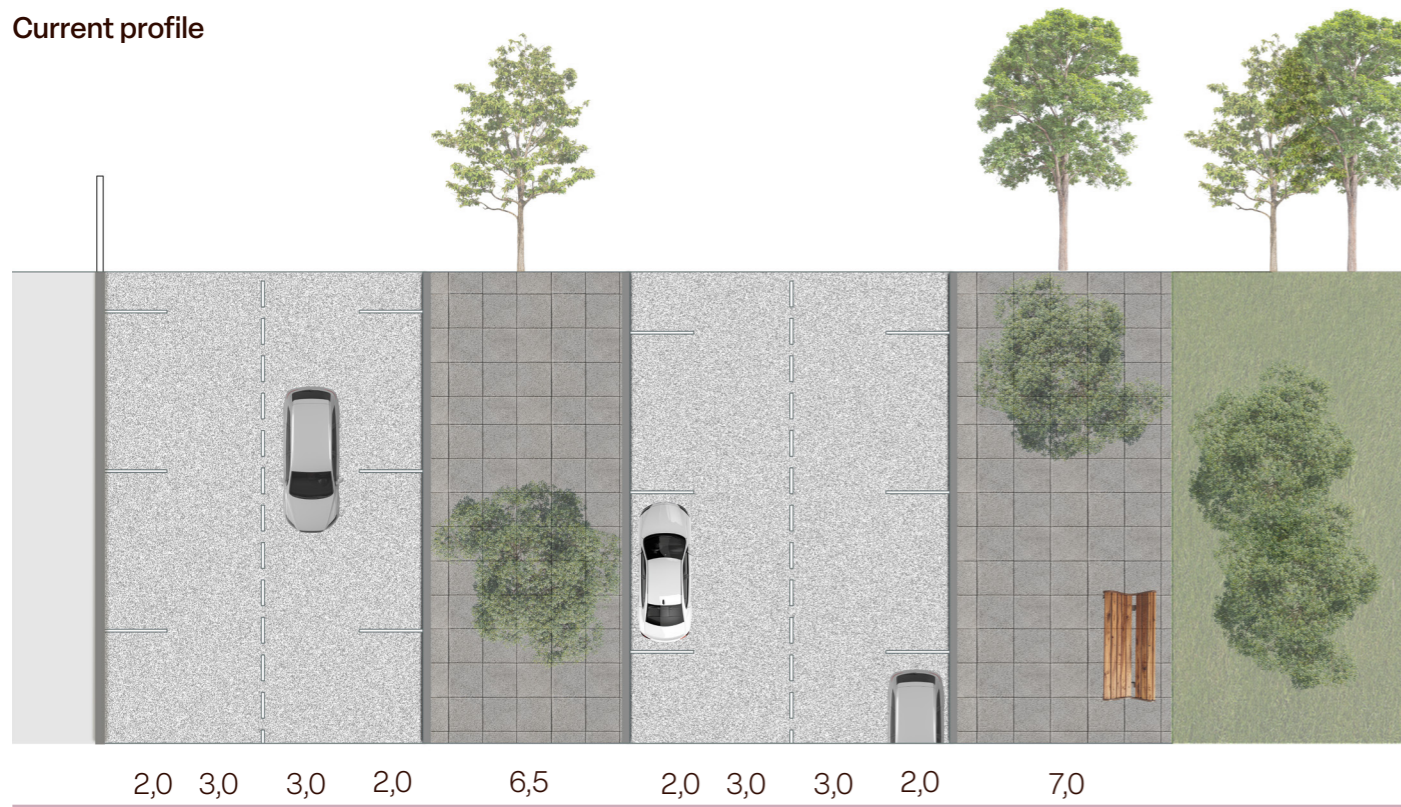


Figure 69: Street profile existing

New profile

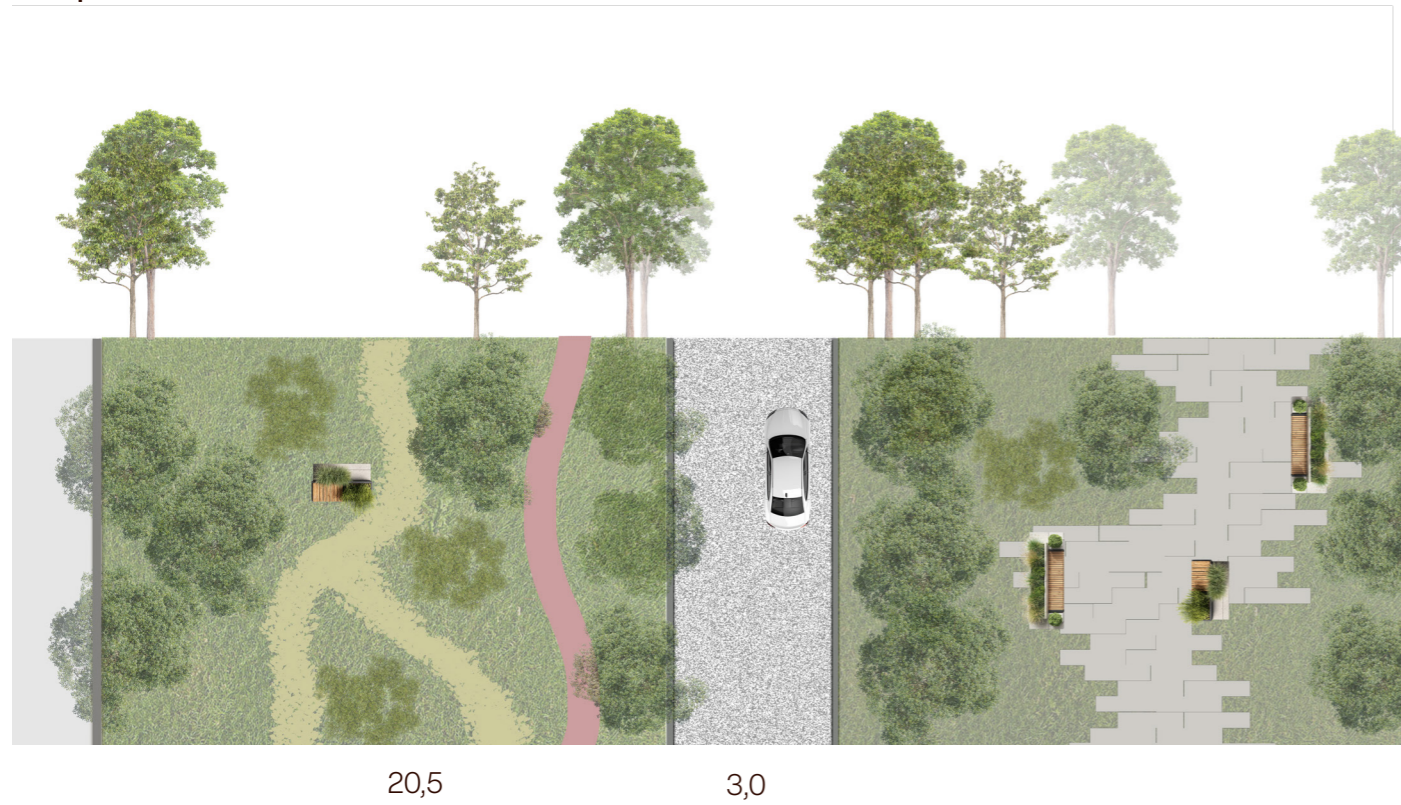


Figure 70: Street profile new

Calle de Antonio de Leyva is in the current situation dominated by four car lanes and excessive paving, resulting in a wide and difficult to cross street. The new design reduces to two car lanes, introduces a separate cycling route, and limits paved surfaces. The leftover space is transformed into green areas. Crossing conditions are improved by slowing down traffic and introducing crossing plazas where the car becomes a guest. With the new design meeting and slowing down is encouraged by overlapping movement and staying.

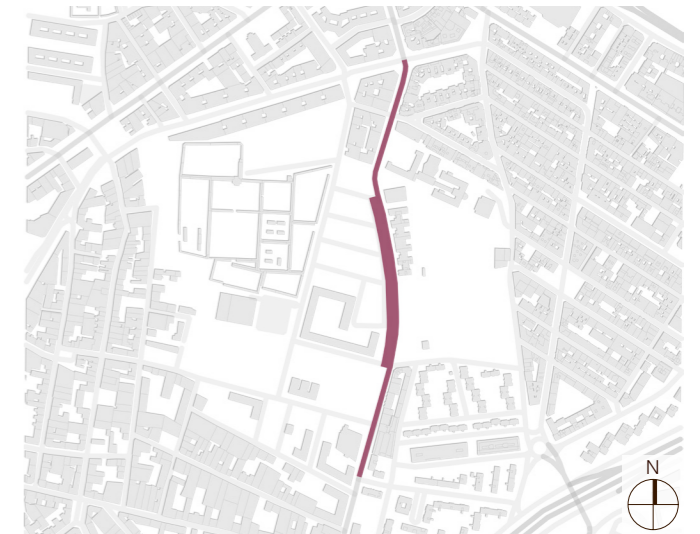


Figure 71: street intervention



Figure 72: Crossing plaza reference 1, (Gallery of Morumbi Corporate Arquitetos, n.d.)



Figure 73: Crossing plaza reference 2 (Miramare Square – NFO, n.d.)

Movement and spatial experience - routing

Facility routing

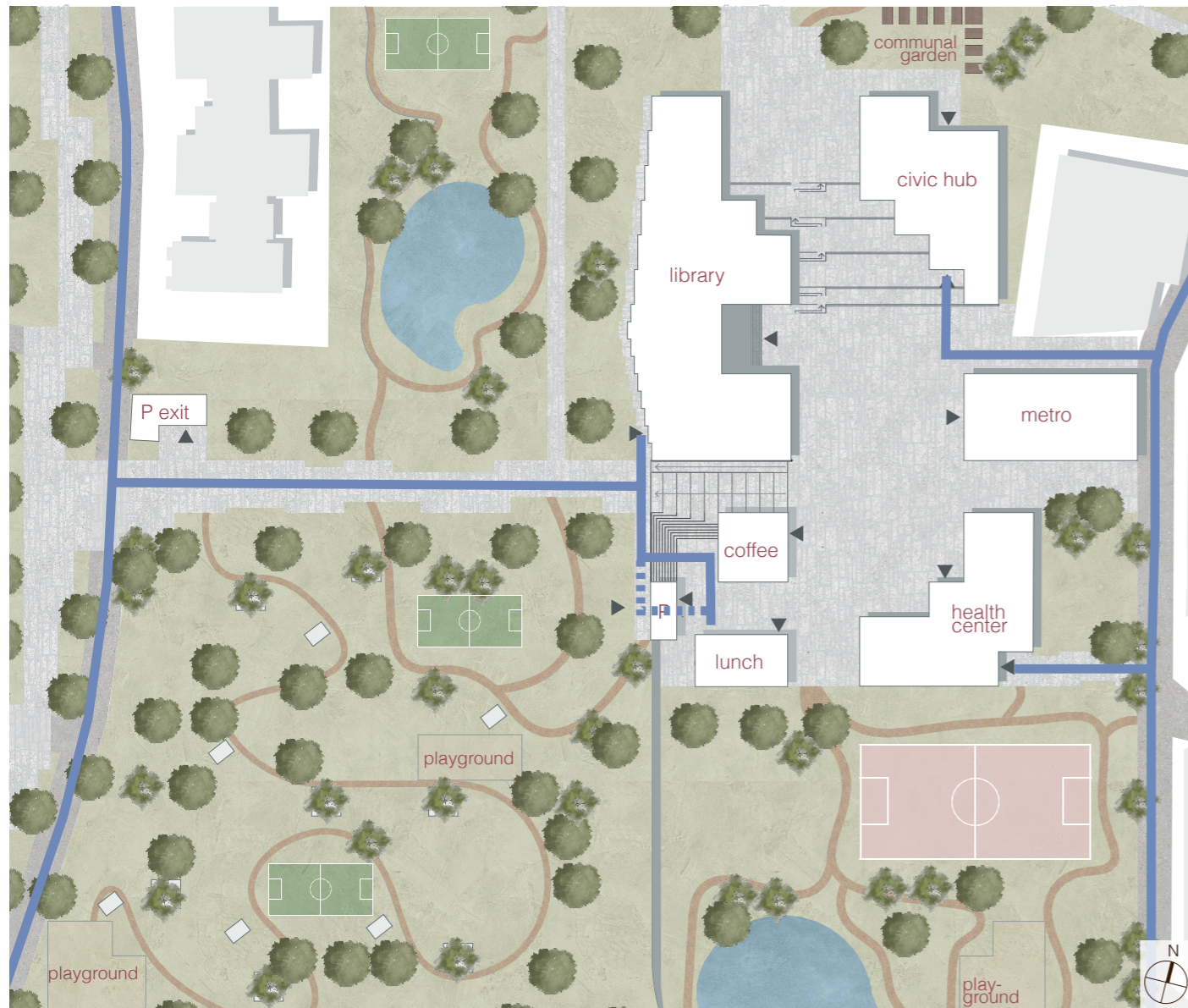


Figure 74: Facility routing

The blue lines above indicate the routes of motorized traffic through the site to service functions or give access in case of emergency. These routes are organized along the paved pathways and are positioned as close to the facilities as possible.

Pedestrian routes, shown on the right side, primarily connect to the metro station, civic hub, library and neighborhood community anchors. Secondary paths form connection throughout the landscape with the parking, coffee and lunch place. By overlapping movement with spaces for staying and public activity, movement becomes part of the social and spatial experience of the project.

Pedestrian flow map

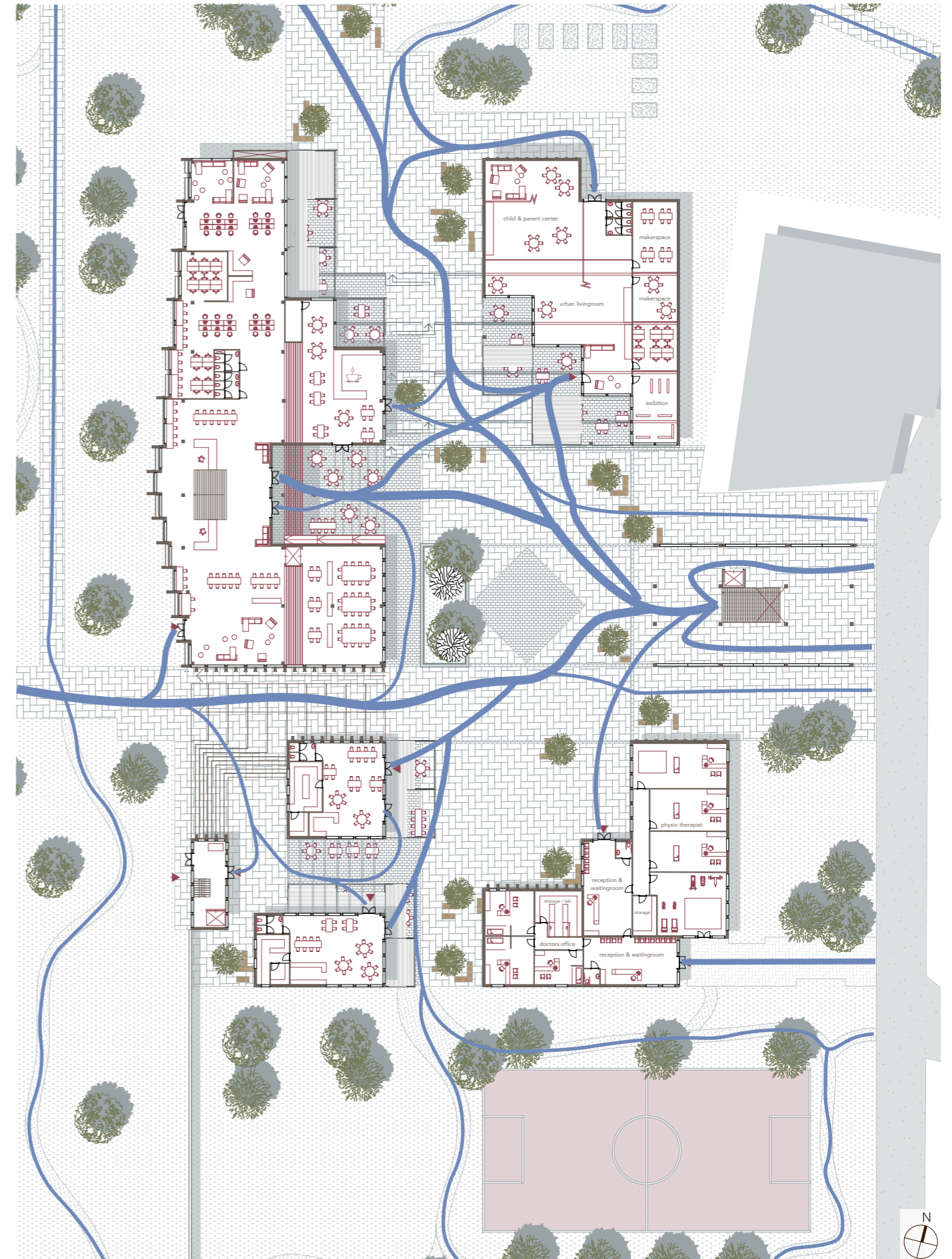


Figure 75: Pedestrian routing

Movement and spatial experience - height differences

The total height difference that is bridged in the site is 3.5 meters. The mobility square is shaped by subtle height differences that create spatial diversity while maintaining openness and accessibility. The first 1.5 meter is therefore resolved with lazy stairs.

The tactical positioning of the rising areas forces people to slow down, overlook the area provide places for gathering.

The remaining 2 meters is resolved with gradual landscaping that organizes the transition between the public park and the program.



Figure 76: Height differences

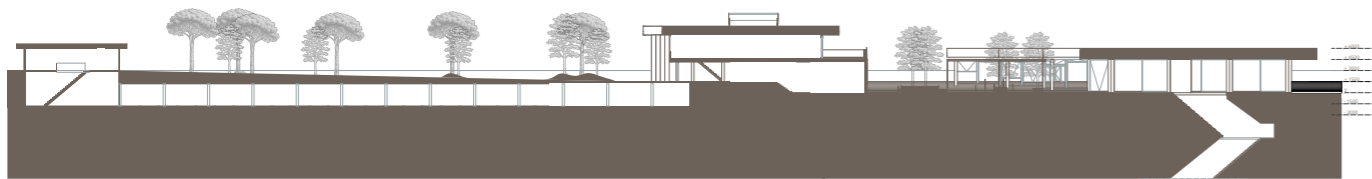


Figure 77: Site section

Movement and spatial experience - mobility square

The two configurations of the section below illustrate how the mobility square functions in everyday use and when temporary collective events take place. During daily use, the space functions as a public environment where movement and informal staying overlap and interact with each other. The threshold between the library and civic hub creates a gradual transition between private and public spaces.

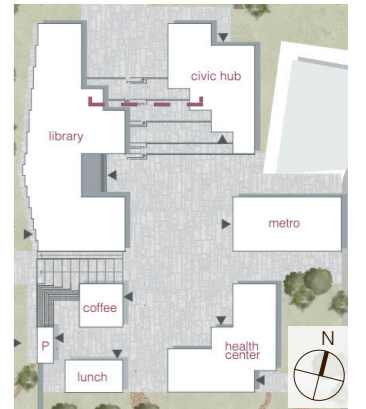
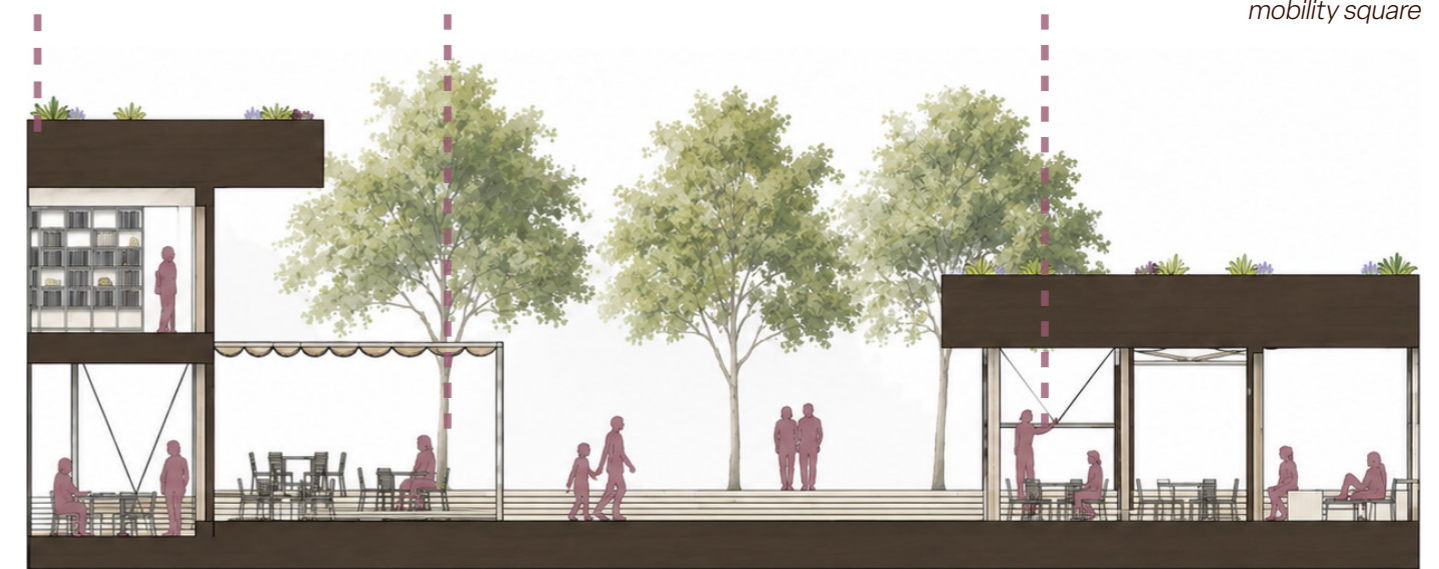


Figure 78: Section line mobility square



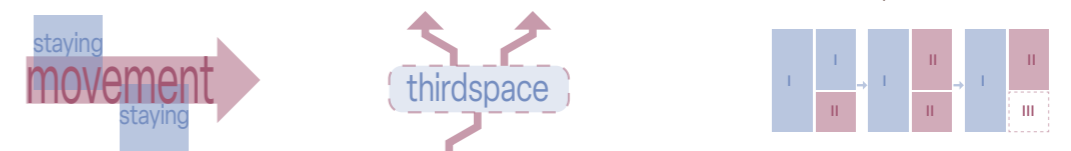
Daily use

Figure 79: Section mobility square - daily use



Festival occasion

Figure 80: Section mobility square - festival occasion



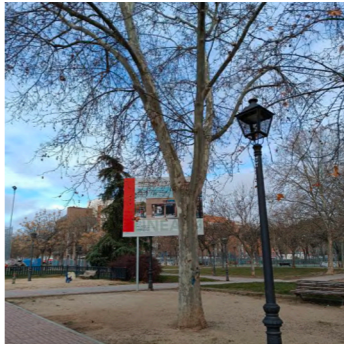


Environmental and climate strategy - tree inventory

Existing trees are reintegrated to preserve neighborhood identity, provide shading along routes and reduce heat stress within the mobility environment.



Stone pine 74x



Spanish plane 47x



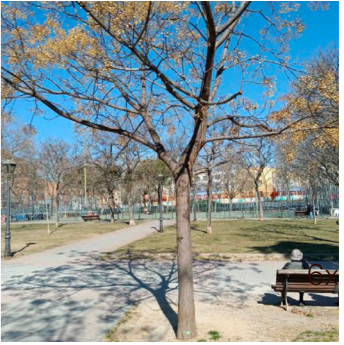
Japanese pagoda tree 40x



Black locust 17x



Deodar cedar 9x



Chinaberry tree



Siberian elm 2x



Arizona cypress 1x



Common privet



White poplar 1x



Tree of heaven 1x



Horse chestnut 1x

Environmental and climate strategy - natural ventilation parking garage



Figure 81: Floorplan parking, 1:1500

Windrose

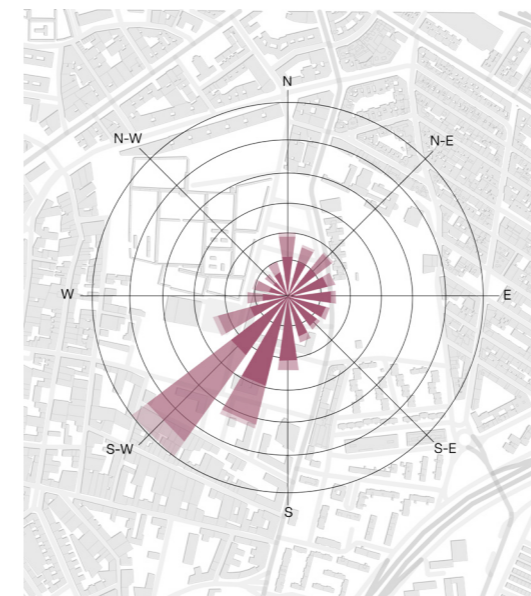


Figure 40: Windrose

The project uses the natural height differences across the site strategically by positioning the parking garage in the south-west corner of the site. As a result the parking garage is maintained at only 1.5 meters below ground level (0 = metro), reducing excavation.

The windcatcher principle is used to capture the dominant wind flow and guide the air downward into the parking garage. This use of natural wind enhances natural air circulation and thermal comfort. The design of the windcatchers with integrates benches offer places for staying in the park to increase social interaction.

Openings in the parking roof slab introduce daylight, vegetation and natural ventilation into the parking level. These openings improve spatial quality and contribute to the natural ventilation of the parking.

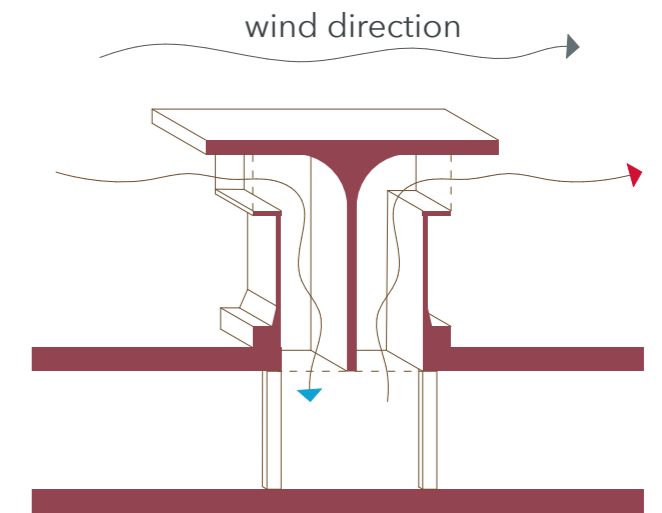


Figure 82: Windcatcher design

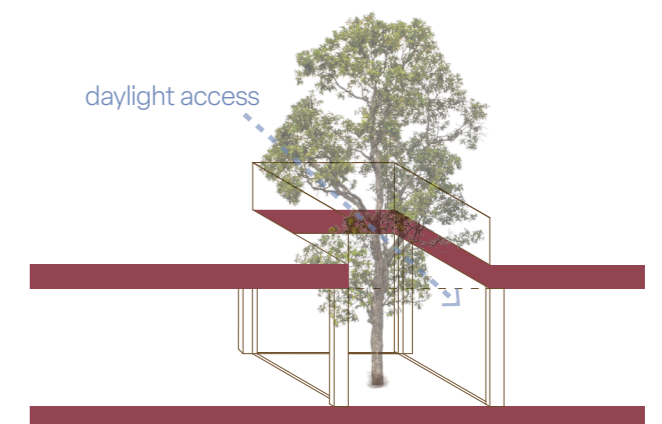


Figure 83: Daylight access

Environmental and climate strategy - passive metro ventilation strategy

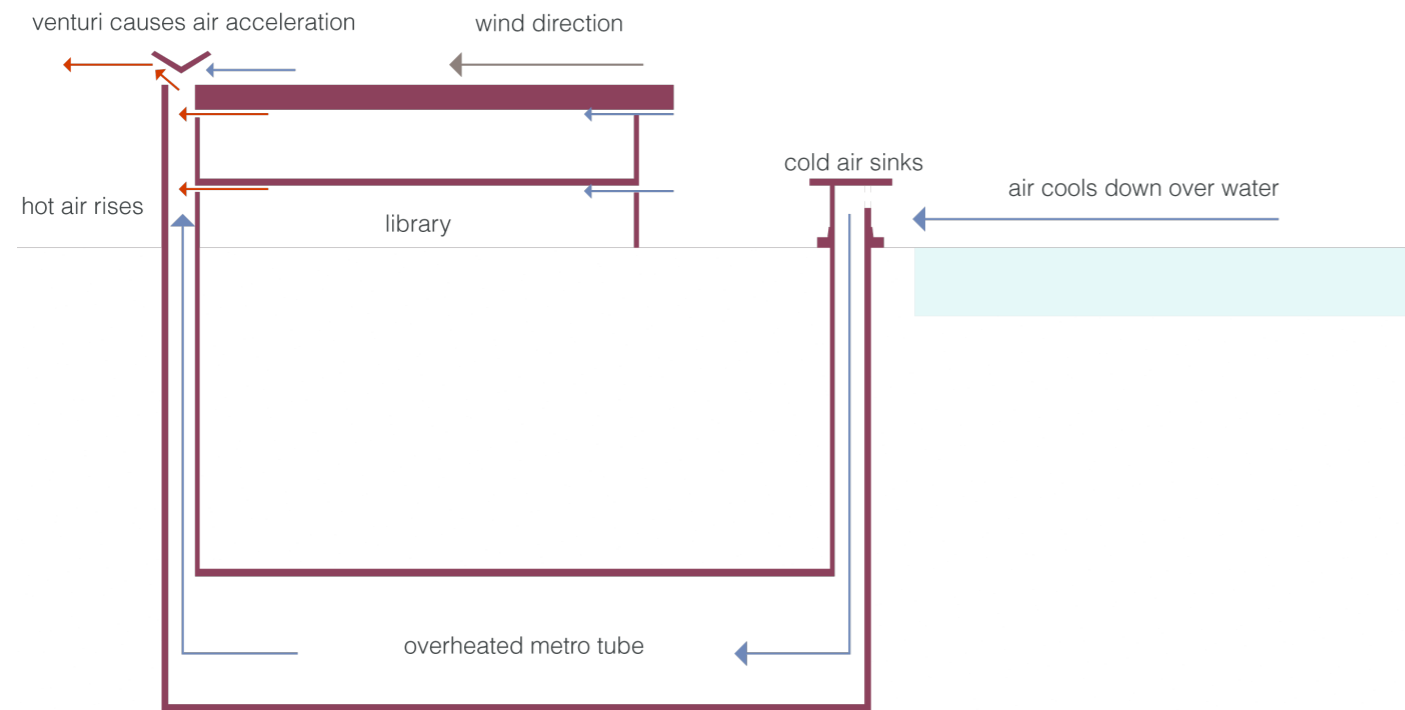


Figure 84: Metro ventilation strategy section

The design uses the thermal conditions of the underground metro as a part of a passive ventilation strategy. The dominant wind from the south-west is guided across a water landscape. Here, air is naturally cooled before entering the ventilation shaft, where it moves down into the metro system. Warm air in the metro tube rises due to the stack-effect through the ventilation shaft in the leeward side.

Openings in the library facade, connected to the shaft, ventilate the air out of the library. The venturi shaped roof causes the wind to accelerate and extract the air out of the shaft, creating continuous natural airflow without relying entirely on mechanical ventilation.

By combining the wind direction, water cooling and vertical air movement, the system contributes to a more energy-efficient and climate responsive environment.



Figure 85: Venturi roof

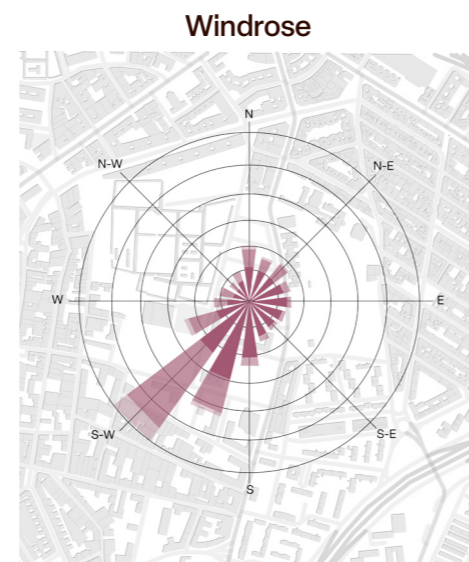


Figure 40: Windrose

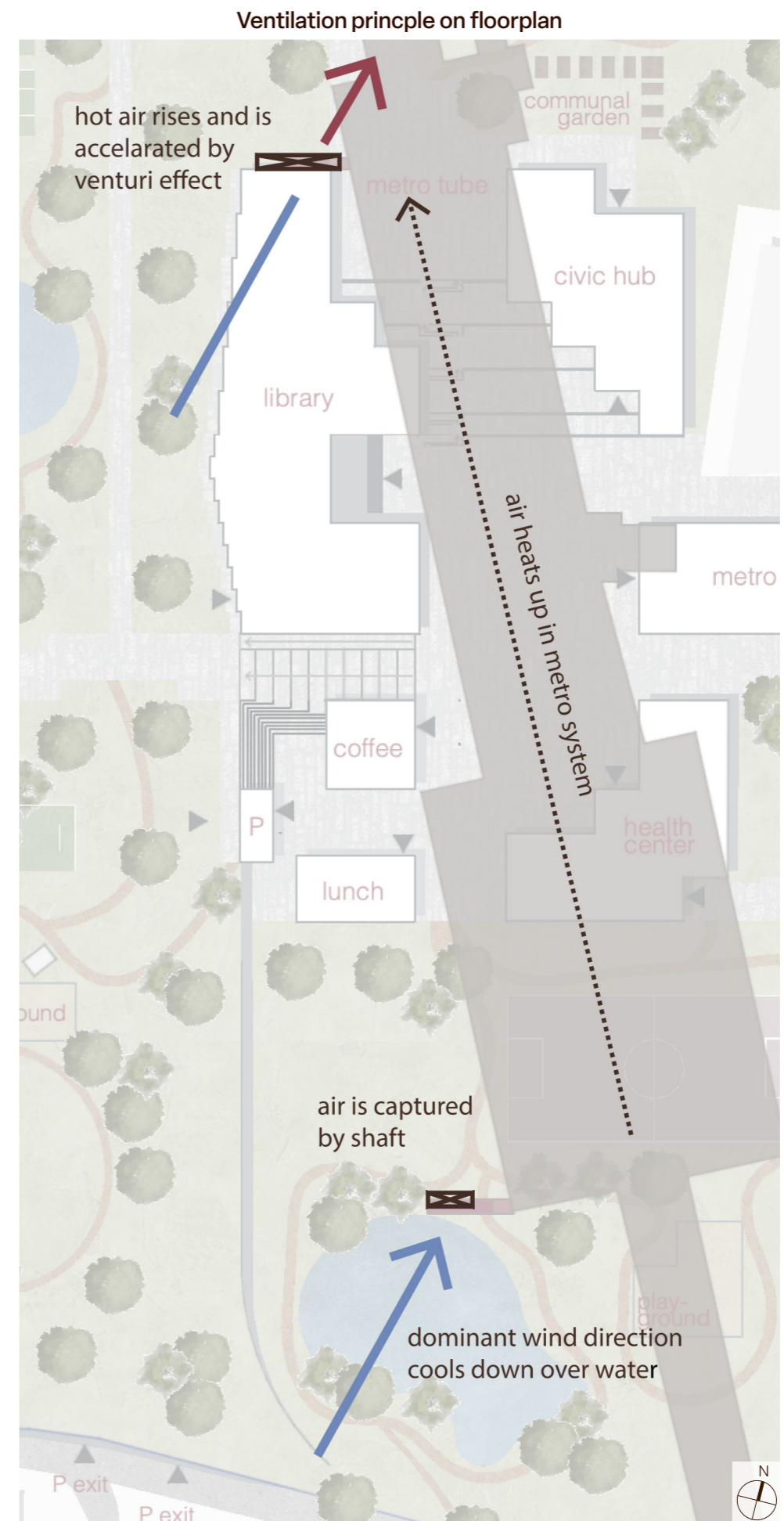
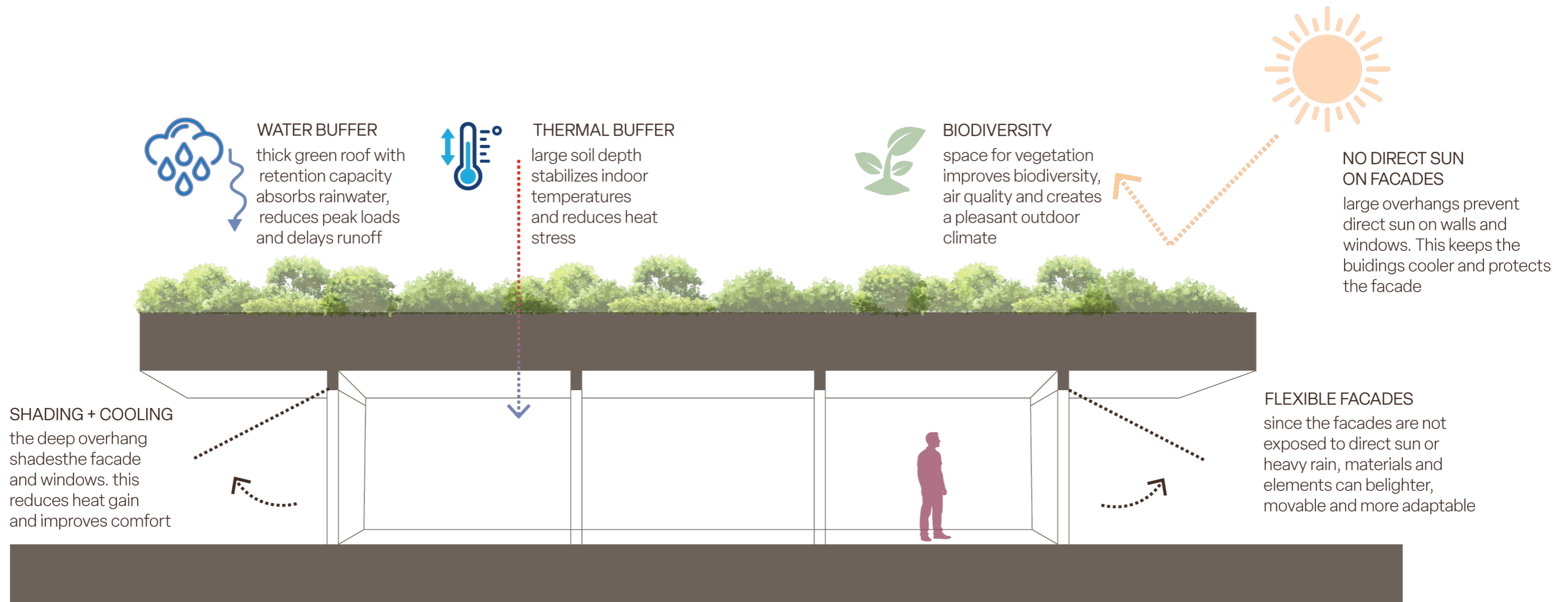


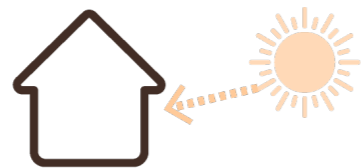
Figure 86: Metro ventilation strategy floor plan

Environmental and climate strategy - climate buffering



PRINCIPLE

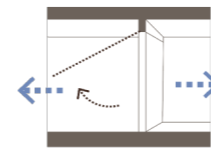
the overdimensioned roof and overhangs take on the climate challenges so the facade can be light, open and adaptable



without overdimensioning
direct sun on the facade = high heat loads, less flexibility



overdimensioned roof
thick green roof + large overhangs = climate shields



result
comfortable indoor climate + flexible, adaptable facades

BENEFITS

- lower energy demands
- better indoor comfort
- resilient to climate change
- design freedom

Figure 87: Climate section

Materiality and adaptability - mobility square elements

Flooring

Primary routes, in-between areas and staying zones on the mobility square are defined by different types of pavement. Granite is used as main paving material due to its availability in Madrid and durable character. The in-between areas are finished with semi-pavement grass tiles to minimize hard surfaces while maintaining the flexibility and public use of the square.



Figure 88: *Granite light* Figure 89: *Granite grey* Figure 90: *semi-pavement*

Shading with flexible textile shutters

Shading is provided with textile shutters that are adjustable throughout the day to improve outdoor comfort during warmer periods and create semi-public spaces for staying. This shading system creates a more gentle microclimate while maintaining visibility within the square. The shutters are located along the library, civic hub and coffee and lunch place.



Figure 91: *Textile shutter* Figure 92: *Textile shutters impression*

Movable planters and water fountains

To accommodate flexible use of the mobility square, movable planters and seating areas are provided. These elements allow the public space to adapt to different activities and seasonal conditions, while also providing informal social interaction biodiversity and shading.

Interactive water fountains enhance the climate comfort and reduce heat stress on the square, while also providing opportunity for play.

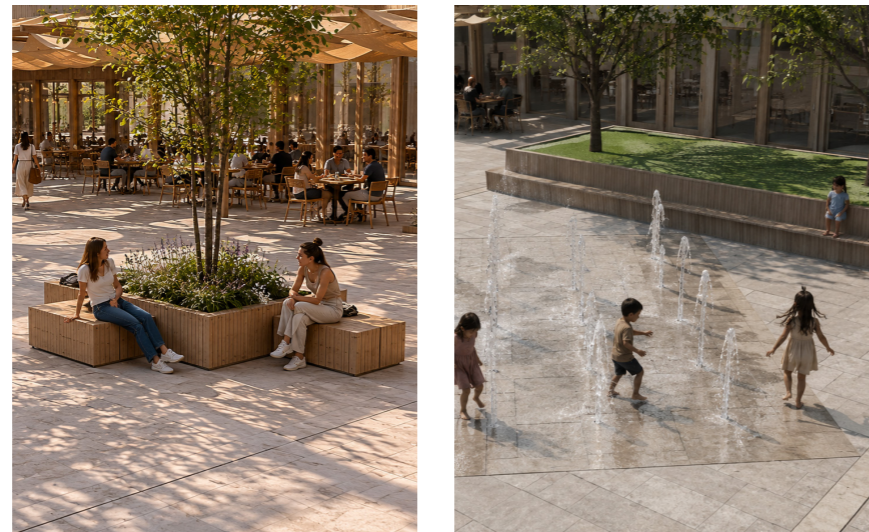


Figure 93: *Movable planters* Figure 94: *Water fountains*

Materiality and adaptability - materiality



Figure 95: *Accoya wood*

Facade

The facade is finished with Accoya wood to create a warm and natural atmosphere. The wood cladding is originated from the northern region of Spain, Galicia. Due to its treatment it is graded in the first category for sustainability. The material softens the transition between architecture and landscape while contributing to an inviting atmosphere around the mobility square.

Roof trim and first floor facade

Berroqueña granite is used for the roof trim and the first floor facade of the library, facing the mobility square. The granite is originated from the quarry in Sierra de Guadarrama, near Madrid. The lighter color stone reflects heat. In addition, the granite references the monumental architecture that is commonly found throughout Madrid, giving the building a durable, civic character.



Figure 96: *Berroqueña granite*

Roof

The roof structure is built up out of a CLT slab with an overdimensioned substrate layer and intensive greenery. This allows the roof to function as both a climate buffer and a landscaping element that supports biodiversity. Together with a flexible facade and wall system, the building can adapt over time to changing needs.

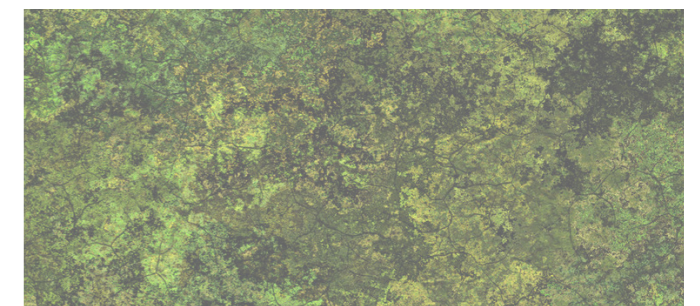


Figure 97: *Green roof*

Materiality and adaptability - civic hub facade function

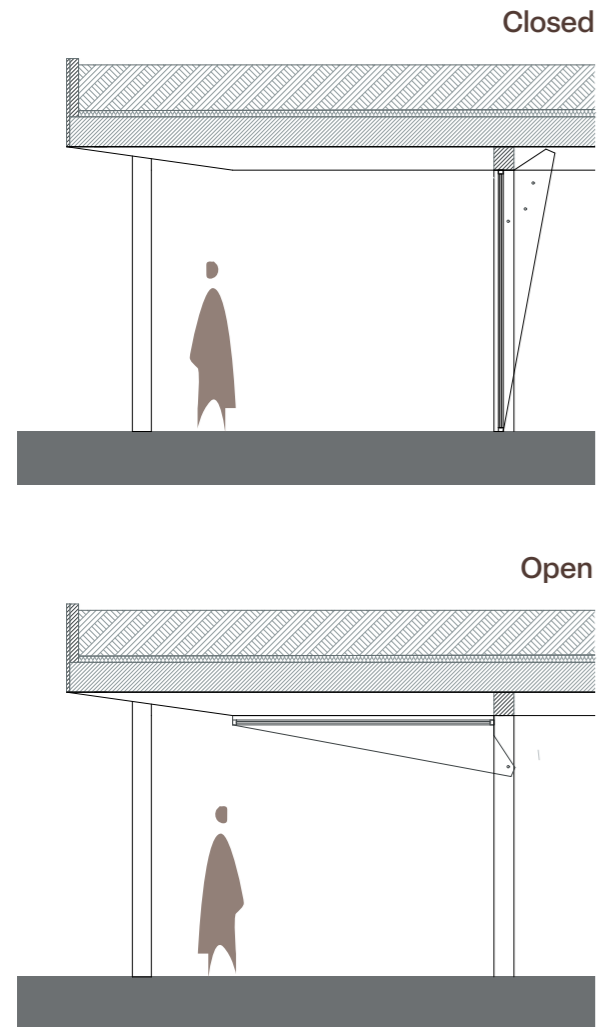


Figure 98: Civic hub facade function

The adaptive facade system enables the civic hub to transform between daily use and open public events. The hinging wooden frame panels create a flexible transition between exterior and interior space, adjusting to climate conditions and public activities.

The open configuration extends the civic function into the mobility square and strengthens interaction between the building and its surroundings.

FORUM PAVILION / GIONA BIERENS DE HAAN ARCHITECTURES



Figure 90: Facade function reference

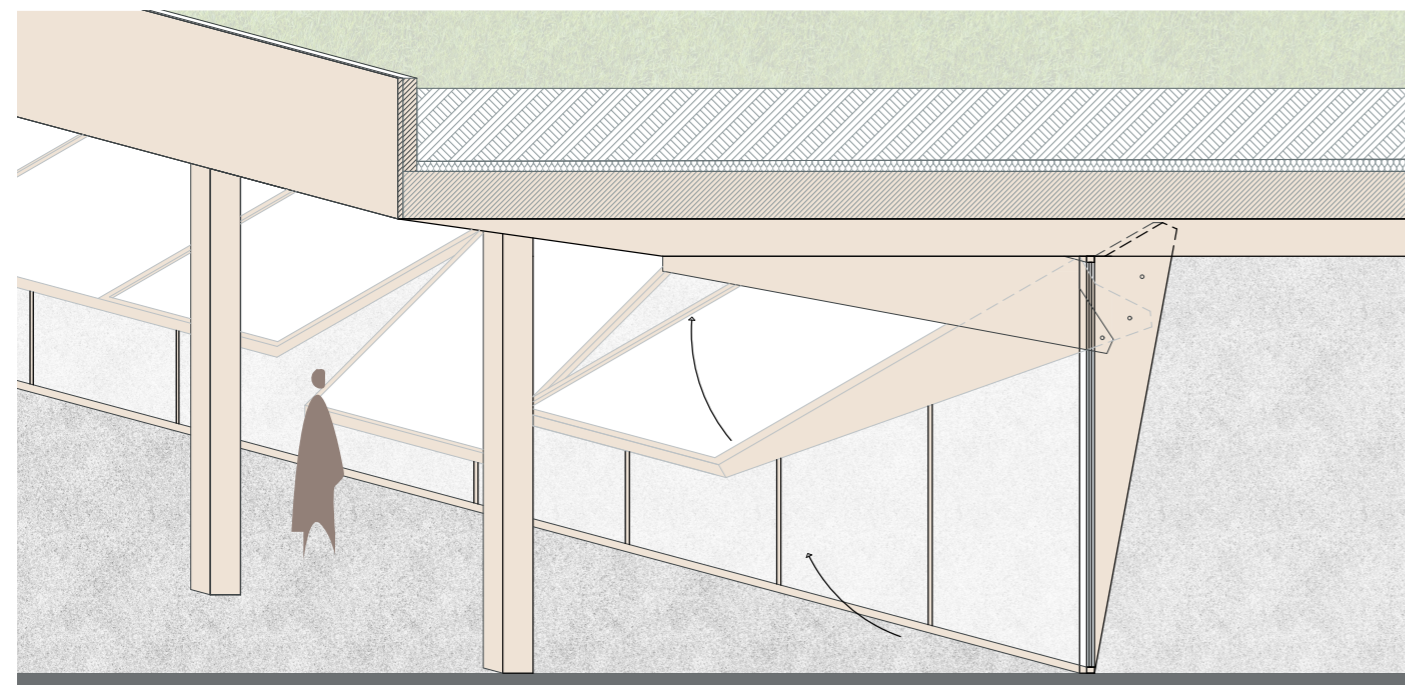
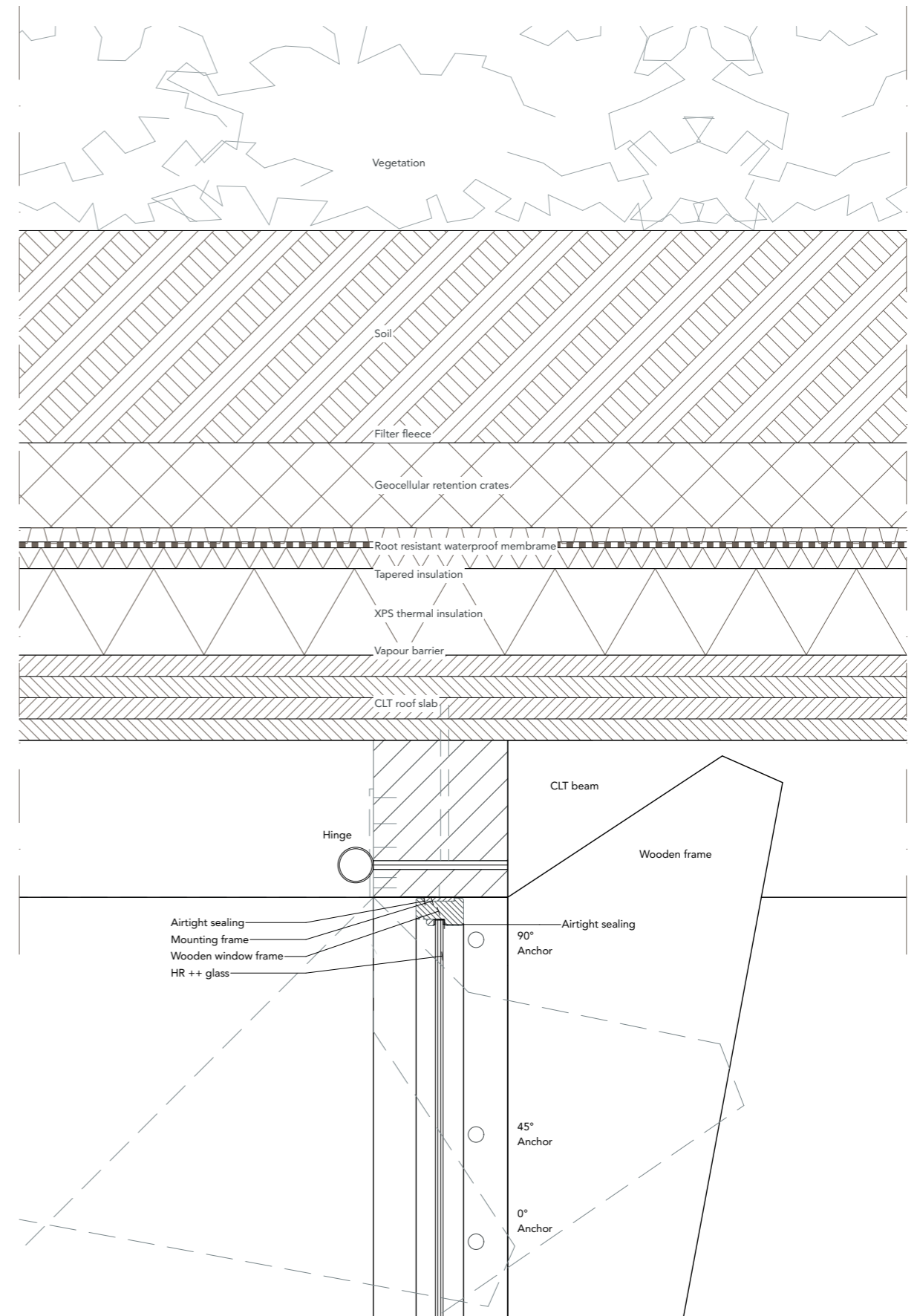


Figure 100: Civic hub facade function axo 1:50

Materiality and adaptability - facade-roof connection 1:10

Figure 101: Civic hub facade detail 1:10



Materiality and adaptability - library fragment

1:20 - scaled to 1:50

The facade fragment shows how the library park facade functions as an interactive threshold between inside and outside. It offers places for staying, while maintaining a close connection to the park.

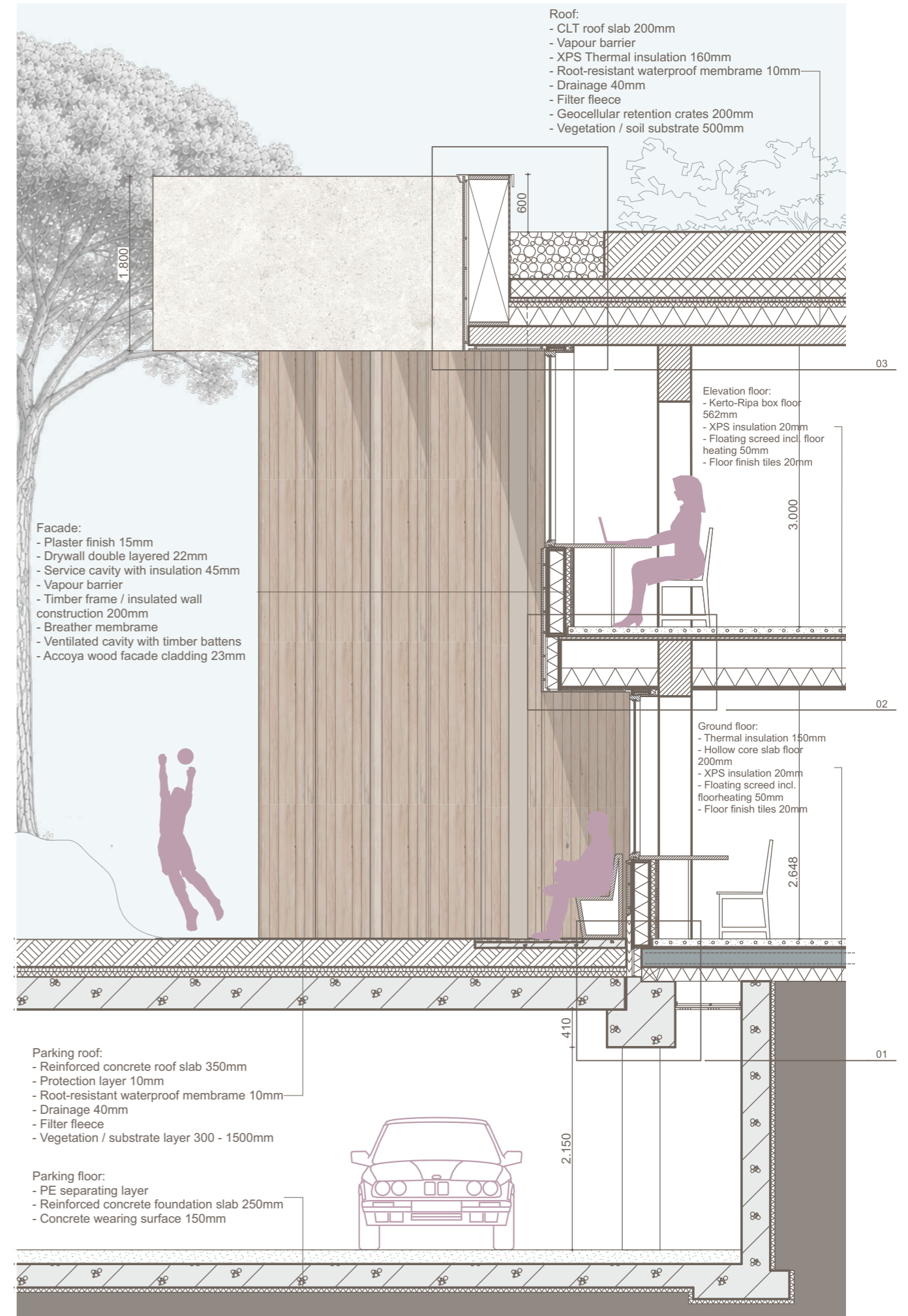
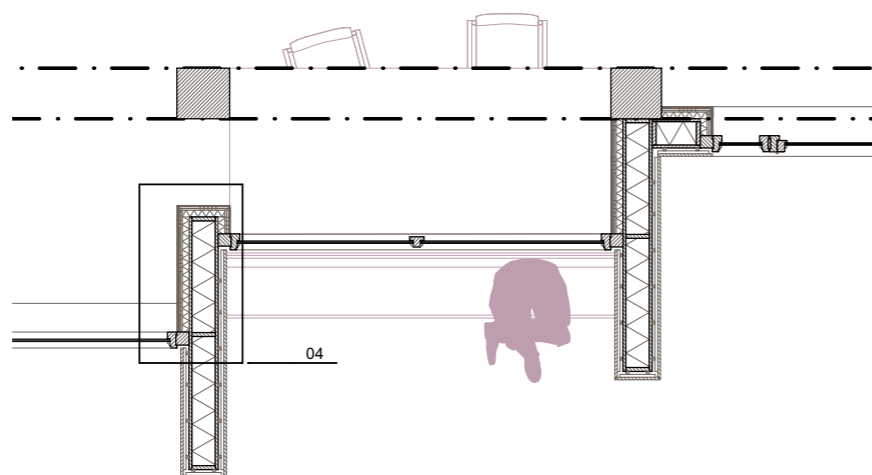
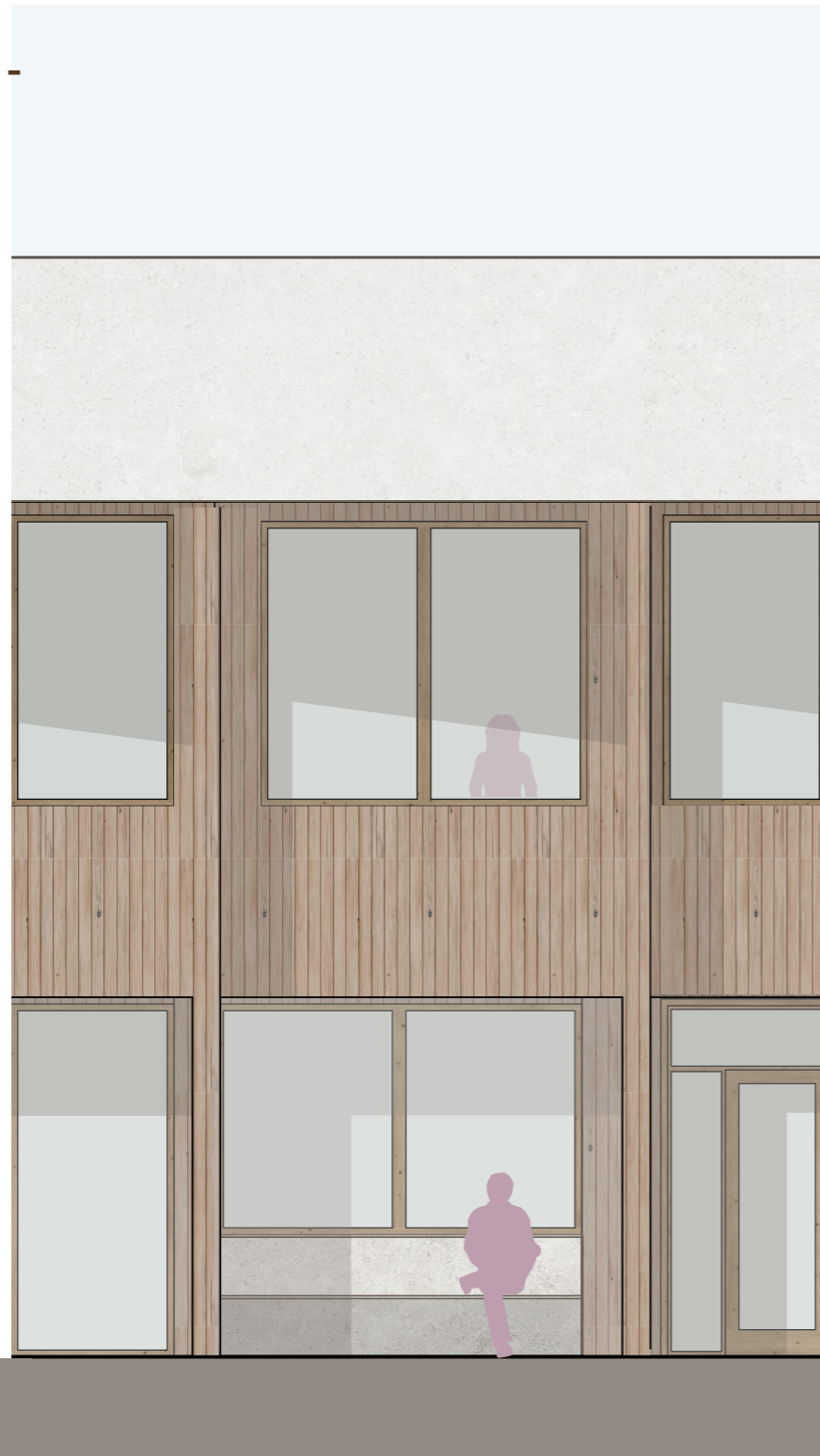


Figure 102: Library facade fragment 1:20

Structural and spatial integration - civic hub section C-C
1:200

The systemic section shows the transition from private to public spaces towards the metro.

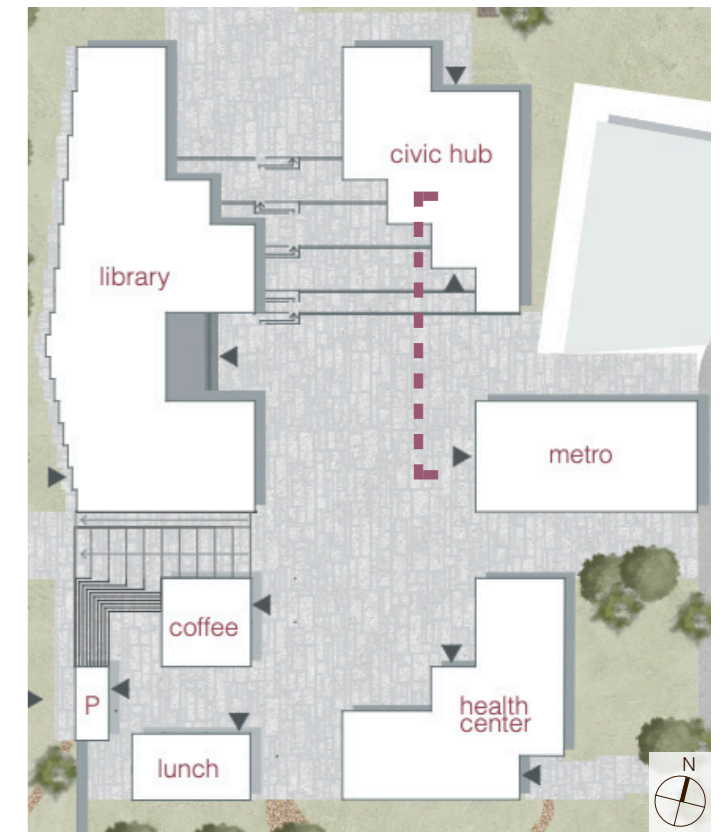


Figure 103: Section line A-A Civic hub



Figure 104: Section A-A Civic hub 1:200

Structural and spatial integration - library section B-B
1:100

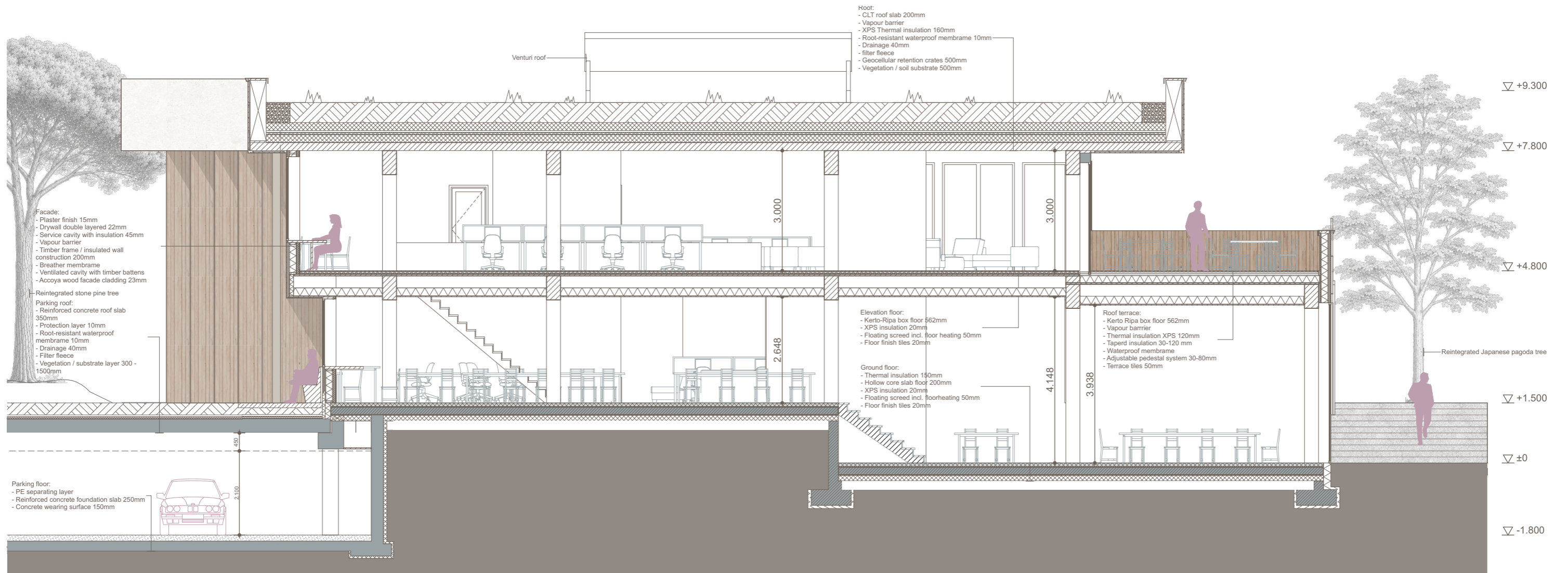
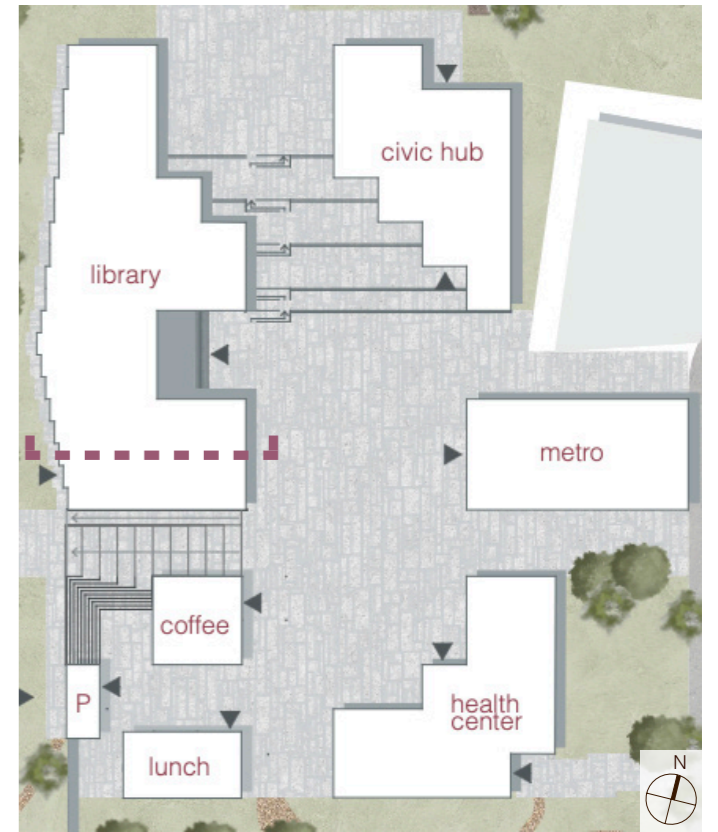


Figure 106: Section B-B Library 1:100

Structural and spatial integration - construction

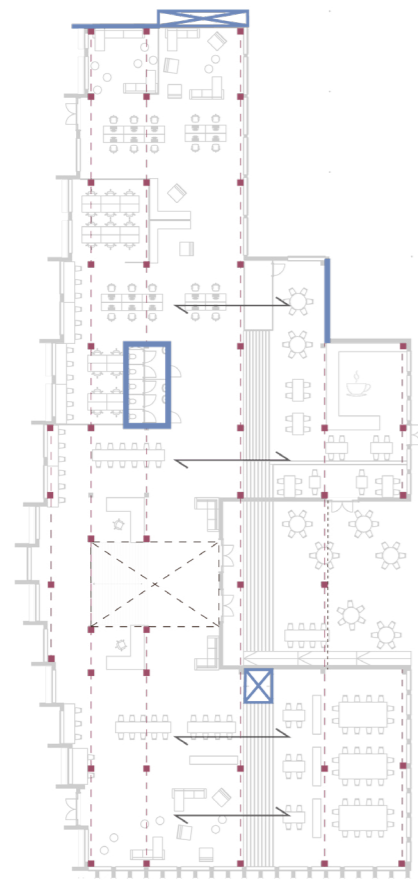


Figure 107: Ground floor construction

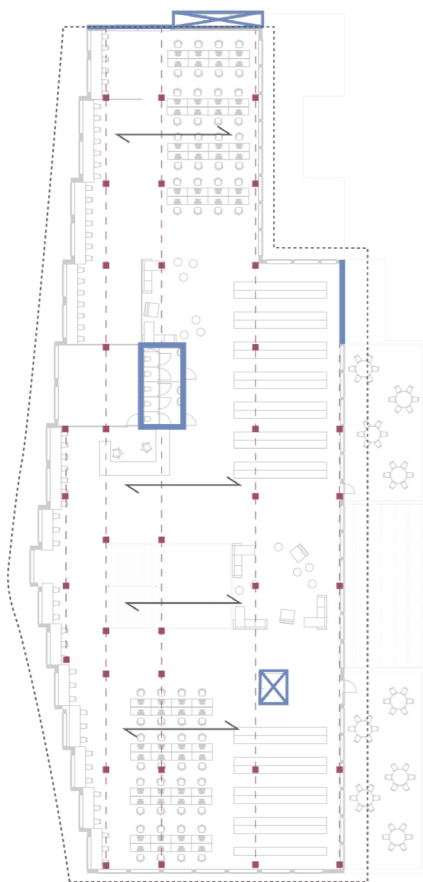


Figure 108: first floor construction



Figure 109: CLT roof

CLT roof
200mm CLT roof slab supporting the extensive green roof and roof overhangs.



Figure 110: Kerto Ripa Box

Kerto Ripa Box slab
The first floor is constructed with Kerto Ripa Box slabs. The used type is: *KRB-2400x37-5x57x450-2400x25* maximum span: 10.3 meters.



Figure 111: CLT beam

CLT beam
To support the CLT roof and Kerto Ripa first floor, CLT beams are used.



Figure 112: GLT column

GLT column
To support the CLT beams, GLT columns are used.

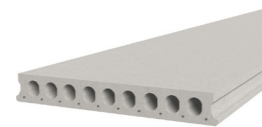







Figure 113: Hollow-core slab

Hollow-core concrete slab
The ground floor is constructed with concrete hollow core slabs.

Legend

-  span direction
-  column
-  beam
-  stability core
-  floor opening





3.5 **Impressions**



Figure 114: *View from park*



Figure 115: *View from metro*



Figure 114: Civic hub



3.6

Synthesis & discussion 2

3. Which spatial conditions support staying, social interaction and everyday use in station areas?

The comparative station analysis together with the case study in Comillas, shows that social encounters in station areas depend on the spatial integration of mobility infrastructure with everyday community life. During the design process, it was revealed that spaces for interaction mainly emerge where pedestrian routes are connected to the existing community anchors such as schools and local public programs.

The case study demonstrates that when station areas combine movement and staying spatially instead of separated, the environment supports everyday use. Public seating, informal meeting spaces and small-scale public programs slow down movement flows and offer place where users temporarily occupy space. The integration of thirdspaces within the pedestrian routes strengthens daily use and informal encounters in the neighborhood.

The design exploration also showed that gradual transitions between public and private spaces enhances the communication between functions and public areas. Instead of functioning as a mobility system, station areas support social interaction when it becomes part of the existing neighborhood structure and daily routines of residents.

4. How can these conditions be translated into a spatial strategy for Community Based - Transit Development?

The design of Comillas translates the design principles and spatial conditions of the Community - Based transit development approach by integrating the mobility system as part of everyday neighborhood life. Instead of approaching the station area as an isolated transit node, the strategy aims to integrate staying and community functions within the movement sequence in the station environment.

The strategy is implemented through three spatial interventions. First, pedestrian routes are reconnected, by linking the future metro station to existing everyday functions such as schools and community programs. Simultaneously, public space is used as the connecting framework between these elements, reinforcing the neighborhood structure around the station. In addition, the proposal introduces layered public spaces that combine movement and staying, rather than introducing mobility efficiency alone. Gradual transitions between public and private realm, integrated green structures and human scale pedestrian environments reduce the infrastructural character of station environments.

Through these spatial interventions, the station is embedded within daily routines of residents and is integrated as a community-oriented public environment. The strategy focuses not on densification alone, but on spatially integrating movement, community anchors and public space within the existing neighborhood structure.

Discussion

The design case study in Comillas builds upon the conclusion emerging from the comparative station analysis. This is carried out by spatially testing how Community - Based Transit Development principles can operate within the urban context. While the first part of the research identified a structural separation between mobility infrastructure and everyday community life, the design exploration investigates how these two systems can be spatially reorganized through design interventions. The case study therefore not only functions as a proposal, but also as a method for translating the theoretical findings into a spatial strategy.

At the same time, the findings remain speculative due to the research by design method. Unlike the comparative station analysis, which is based on observed spatial conditions, the design proposal cannot fully predict how users will occupy these future spaces over time. Social interaction and community formation remain dependent on cultural, economic and behavioural factors that are beyond spatial design alone.

Nevertheless, this case study design illustrates the potential of Community Based - Transit development as an alternative approach to Transit Oriented Development. Rather than prioritizing mobility efficiency and densification, the research advocates to integrate public space and community life within mobility infrastructure. This way the systems become spatially connected within the existing urban fabric.





4 Conclusion

4.1 Conclusion

The research investigated how station areas can be transformed into community based public environments that support social interaction while accommodating increasing mobility flows. Through the comparative station analysis, theoretical research and the design case study in Comillas, the research demonstrates that the quality of station environments does not only depend on mobility intensity or densification, but on spatial integration between movement, public space and everyday community life.

The analysis reveals that many contemporary station areas are designed as an infrastructural system to accommodate only the mobility flows. As a result, opportunities for staying, informal encounters and optional activities become fragmented and displaced from the mobility sequence. In line with Gehl's understanding of optional activities, the analysis shows that social interaction emerges where mobility flows are integrated spatially through human scale public space, gradual transitions, mixed use environments and connections to existing community anchors such as schools, parks and local programs.

The design case study in Comillas translates these findings into a spatial strategy through the six principles of Community Based - Transit development (CB-TD). Rather than approaching the station as an isolated transit node, the proposal integrates pedestrian routes, public space and neighborhood functions within one continuous spatial framework. Through layered public environments, integrated climatization principles and spaces for staying within the movement sequence. The station area becomes part of the daily routines and social life.

The research therefore argues that station areas can support mobility and community life when movement infrastructure is embedded within the existing community fabric. Community Based - Transit Development (CB-TD) proposes an alternative perspective on Transit Oriented Development (TOD) by redirecting the position of transportation nodes as places of transit towards socially integrated public spaces that contribute to neighborhood identity, everyday use and social interaction.

How can the area around public transportation nodes be transformed into a community-based public space that supports social interaction, responds to residents' needs, and accommodates mobility flows?



4.2 Implications

This research contributes to the architecture profession by proposing the Community Based - Transit Development (CB-TD) approach as an alternative perspective on station area design. Rather than treating the station environment primarily as an infrastructural system, the research investigates how mobility, public space and community life can be spatially integrated within the urban environment.

The research focuses on the development of a new station area with a relatively undeveloped place. Future research could therefore investigate how existing station areas, transformed by the typical TOD standard, can be redirected towards the new CB-TD approach to strengthen social interaction and community life.

4.3 Reflection

For the first time, I independently created and executed a complete design assignment, from defining the research topic to translating the findings into a spatial proposal. The Crossovers graduation studio introduced me to a design approach new to me, where self-conducted research forms the foundation and guidelines of the design assignment, which proved to be a very valuable approach. The project also shifted my understanding of architecture from designing isolated objects, towards a focus on the relation between movement, public space and community within and between the build environment. It allowed me to think more critically on the public realm and in how spatial design can either separate or connect social life within the city.

Throughout the process, I learned how literature research, reflection and design exploration strengthen the architectural design in a deeper way than before. It helped me develop a more critical and structured design process, where decisions are grounded. The weekly supervision sessions also played an important role by creating clear moments of reflection and kept me working consistently towards milestones.

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Back matter



1 Drawing set



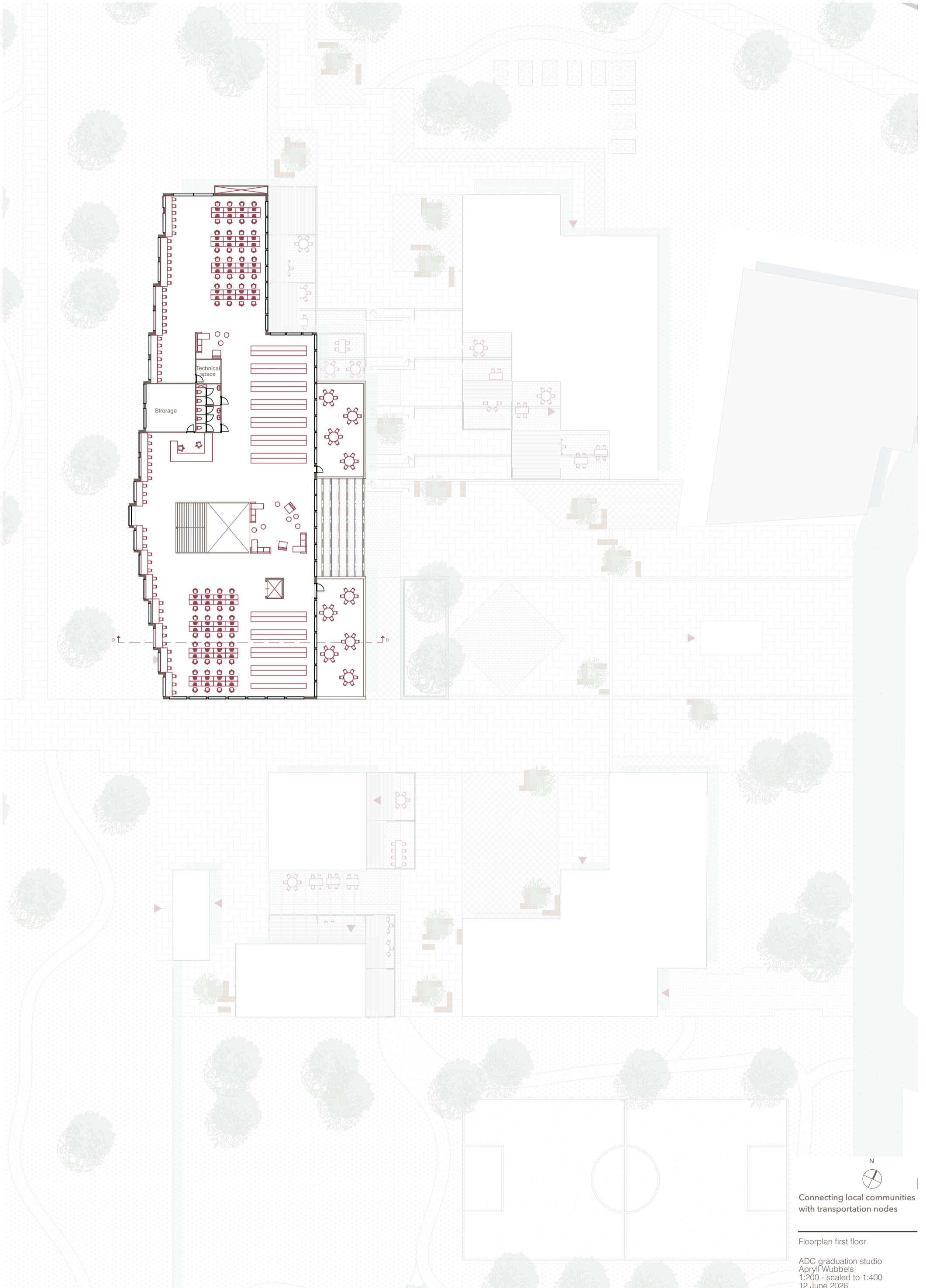


- Legend**
- Grass 
 - Pavement - moving 
 - Pavement - staying 
 - Semi-pavement 
 - Asphalt 
 - Textile shading 
 - Communal garden 
 - Gravel path 
- N


Connecting local communities with transportation nodes

Floorplan groundfloor

ADC graduation studio
 April Wubbels
 1:200 - scaled to 1:400
 12 June 2026



Connecting local communities
with transportation nodes

Floorplan first floor

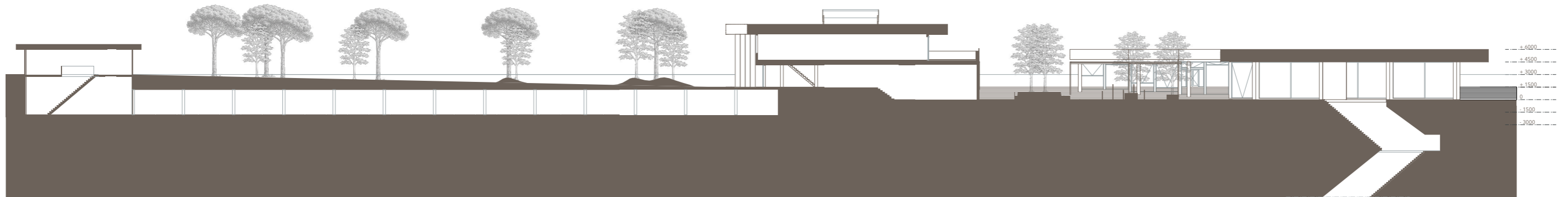
ADC graduation studio
Apryll Wubbels
1:200 - scaled to 1:400
12 June 2026



West facade



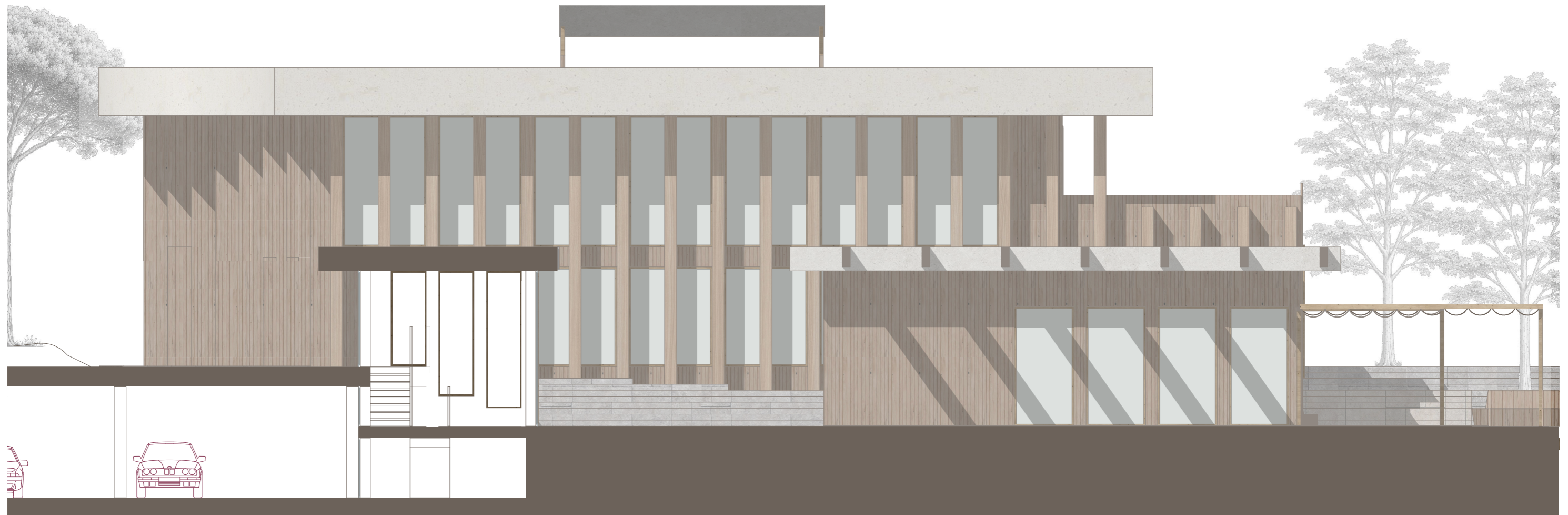
East facade



Connecting local communities
with transportation nodes

Section A site

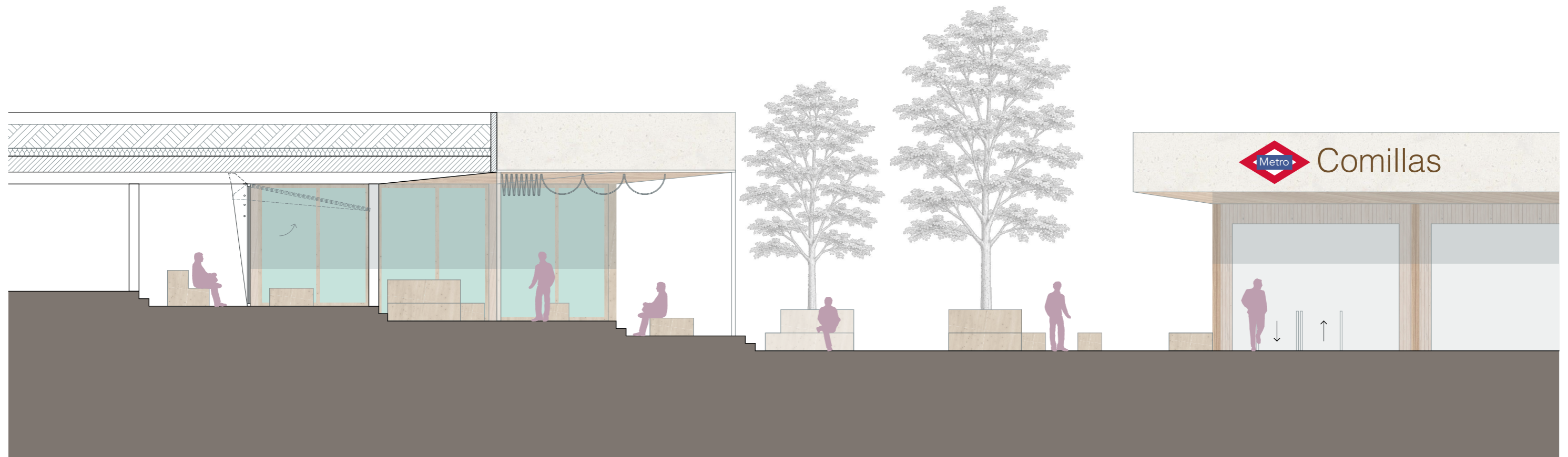
ADC graduation studio
Apyll Wubbels
1:500
12 June 2026



Connecting local communities
with transportation nodes

Section B parking exit

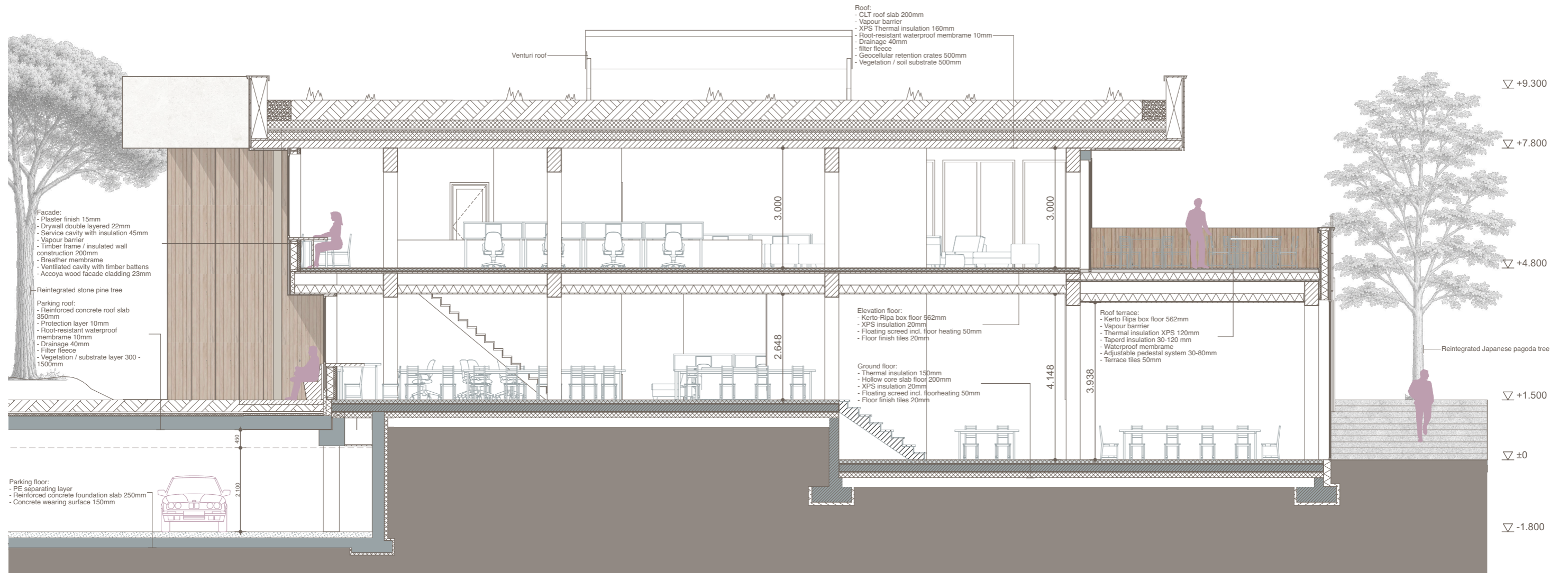
ADC graduation studio
Apryll Wubbels
1:200
12 June 2026



Connecting local communities
with transportation nodes

Section C civic hub

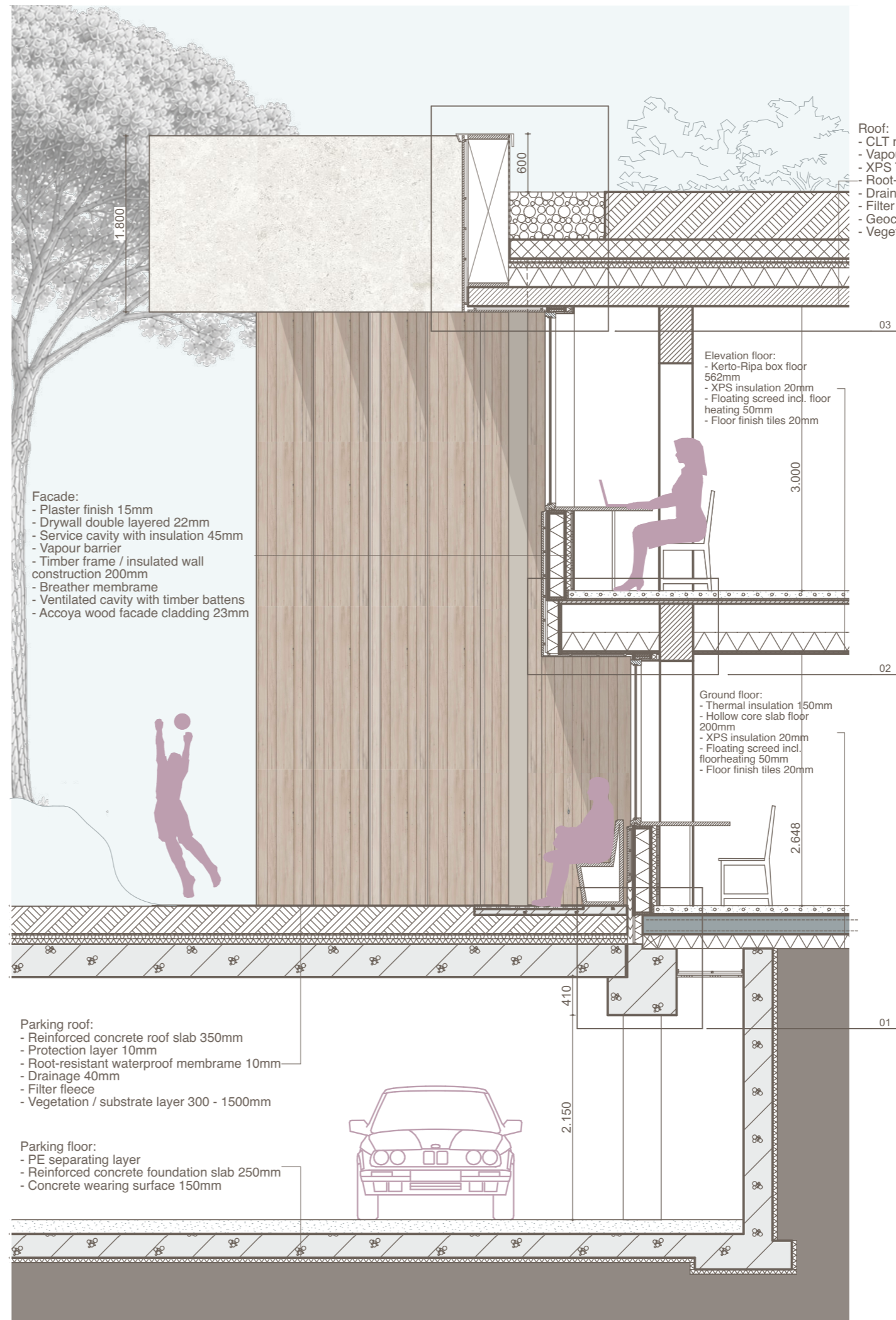
ADC graduation studio
Apyll Wubbels
1:200
12 June 2026



Connecting local communities
with transportation nodes

Section D library

ADC graduation studio
Apryll Wubbels
1:100
12 June 2026



- Roof:
- CLT roof slab 200mm
 - Vapour barrier
 - XPS Thermal insulation 160mm
 - Root-resistant waterproof membrane 10mm
 - Drainage 40mm
 - Filter fleece
 - Geocellular retention crates 200mm
 - Vegetation / soil substrate 500mm

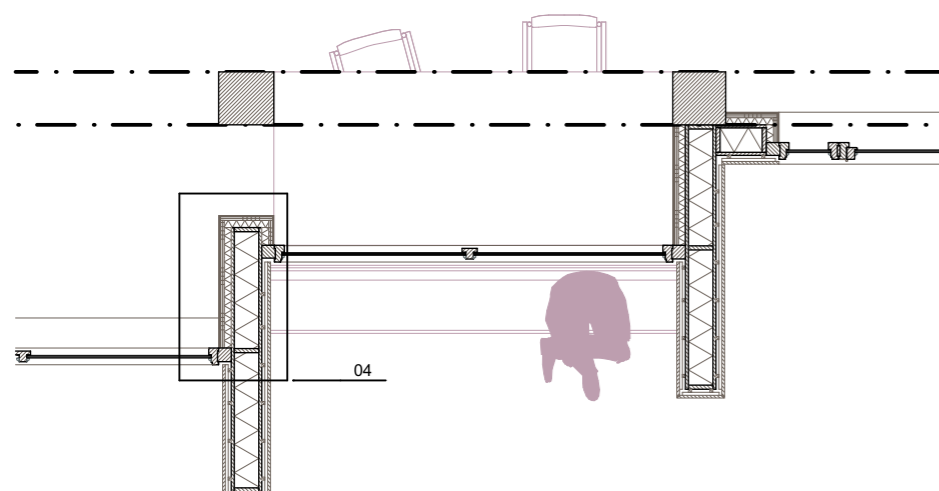
- Facade:
- Plaster finish 15mm
 - Drywall double layered 22mm
 - Service cavity with insulation 45mm
 - Vapour barrier
 - Timber frame / insulated wall construction 200mm
 - Breather membrane
 - Ventilated cavity with timber battens
 - Accoya wood facade cladding 23mm

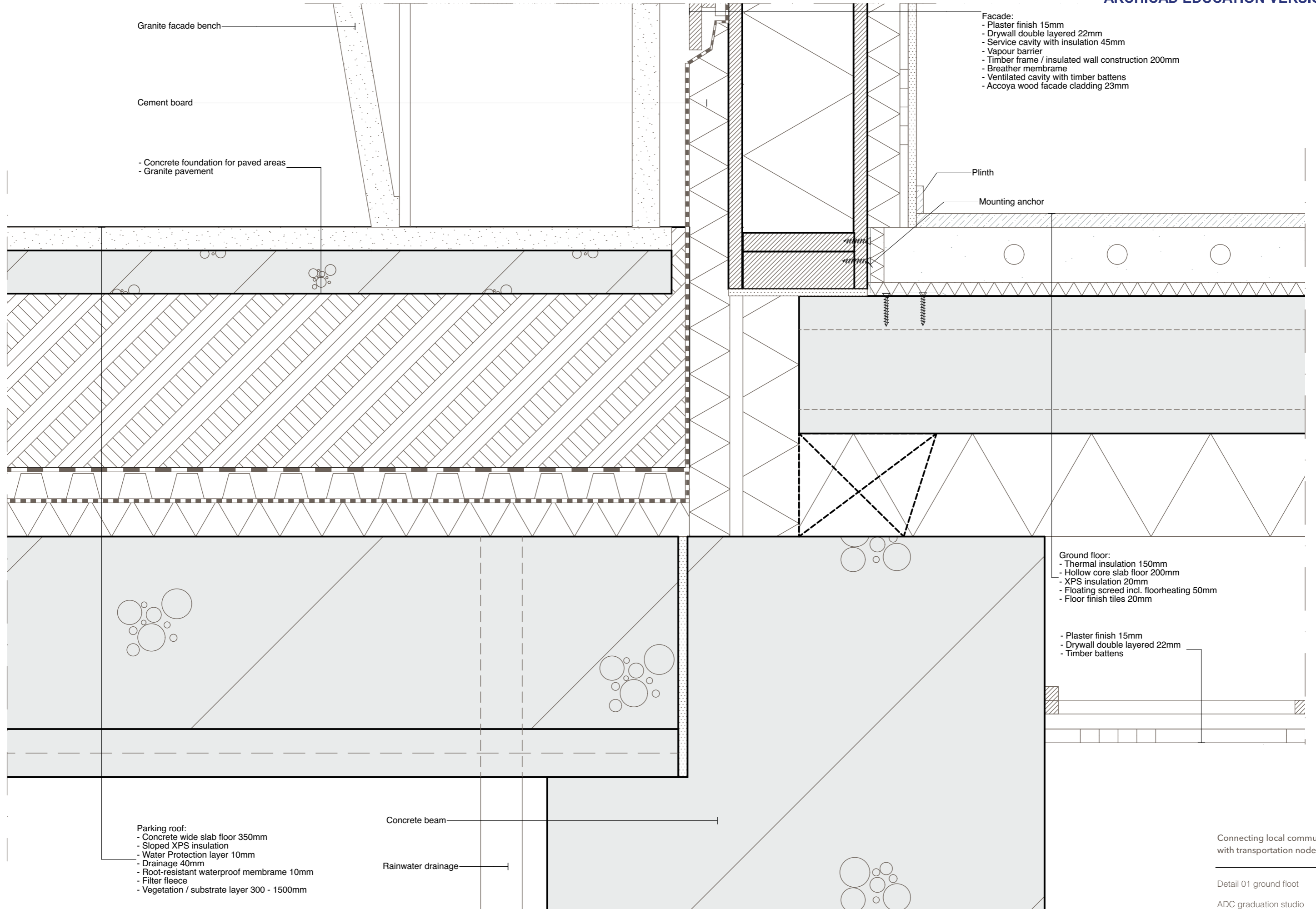
- Elevation floor:
- Kerto-Ripa box floor 562mm
 - XPS insulation 20mm
 - Floating screed incl. floor heating 50mm
 - Floor finish tiles 20mm

- Ground floor:
- Thermal insulation 150mm
 - Hollow core slab floor 200mm
 - XPS insulation 20mm
 - Floating screed incl. floor heating 50mm
 - Floor finish tiles 20mm

- Parking roof:
- Reinforced concrete roof slab 350mm
 - Protection layer 10mm
 - Root-resistant waterproof membrane 10mm
 - Drainage 40mm
 - Filter fleece
 - Vegetation / substrate layer 300 - 1500mm

- Parking floor:
- PE separating layer
 - Reinforced concrete foundation slab 250mm
 - Concrete wearing surface 150mm





- Facade:
- Plaster finish 15mm
 - Drywall double layered 22mm
 - Service cavity with insulation 45mm
 - Vapour barrier
 - Timber frame / insulated wall construction 200mm
 - Breather membrane
 - Ventilated cavity with timber battens
 - Accoya wood facade cladding 23mm

Granite facade bench

Cement board

- Concrete foundation for paved areas
- Granite pavement

Plinth

Mounting anchor

- Ground floor:
- Thermal insulation 150mm
 - Hollow core slab floor 200mm
 - XPS insulation 20mm
 - Floating screed incl. floorheating 50mm
 - Floor finish tiles 20mm

- Plaster finish 15mm
- Drywall double layered 22mm
- Timber battens

- Parking roof:
- Concrete wide slab floor 350mm
 - Sloped XPS insulation
 - Water Protection layer 10mm
 - Drainage 40mm
 - Root-resistant waterproof membrane 10mm
 - Filter fleece
 - Vegetation / substrate layer 300 - 1500mm

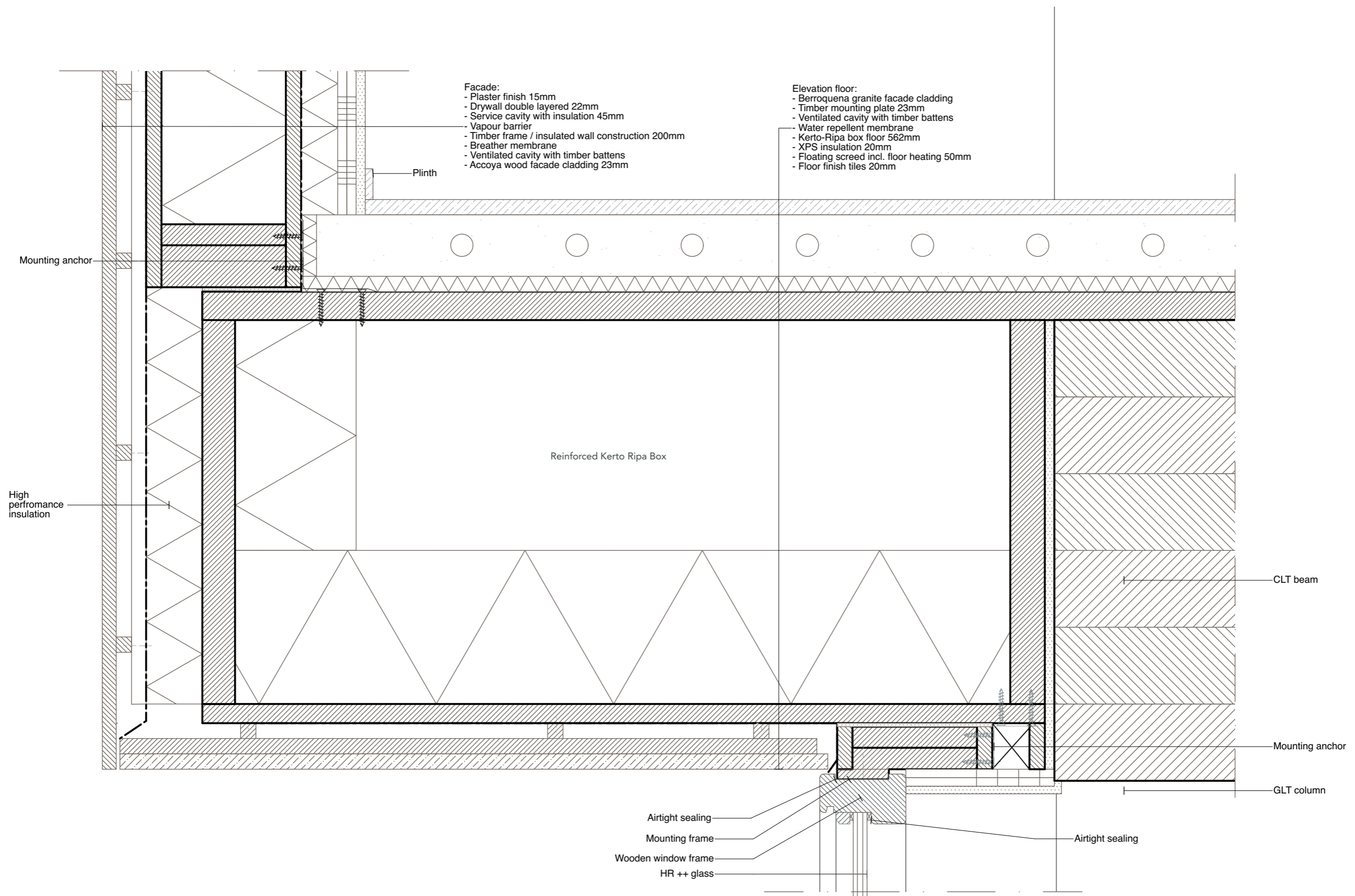
Concrete beam

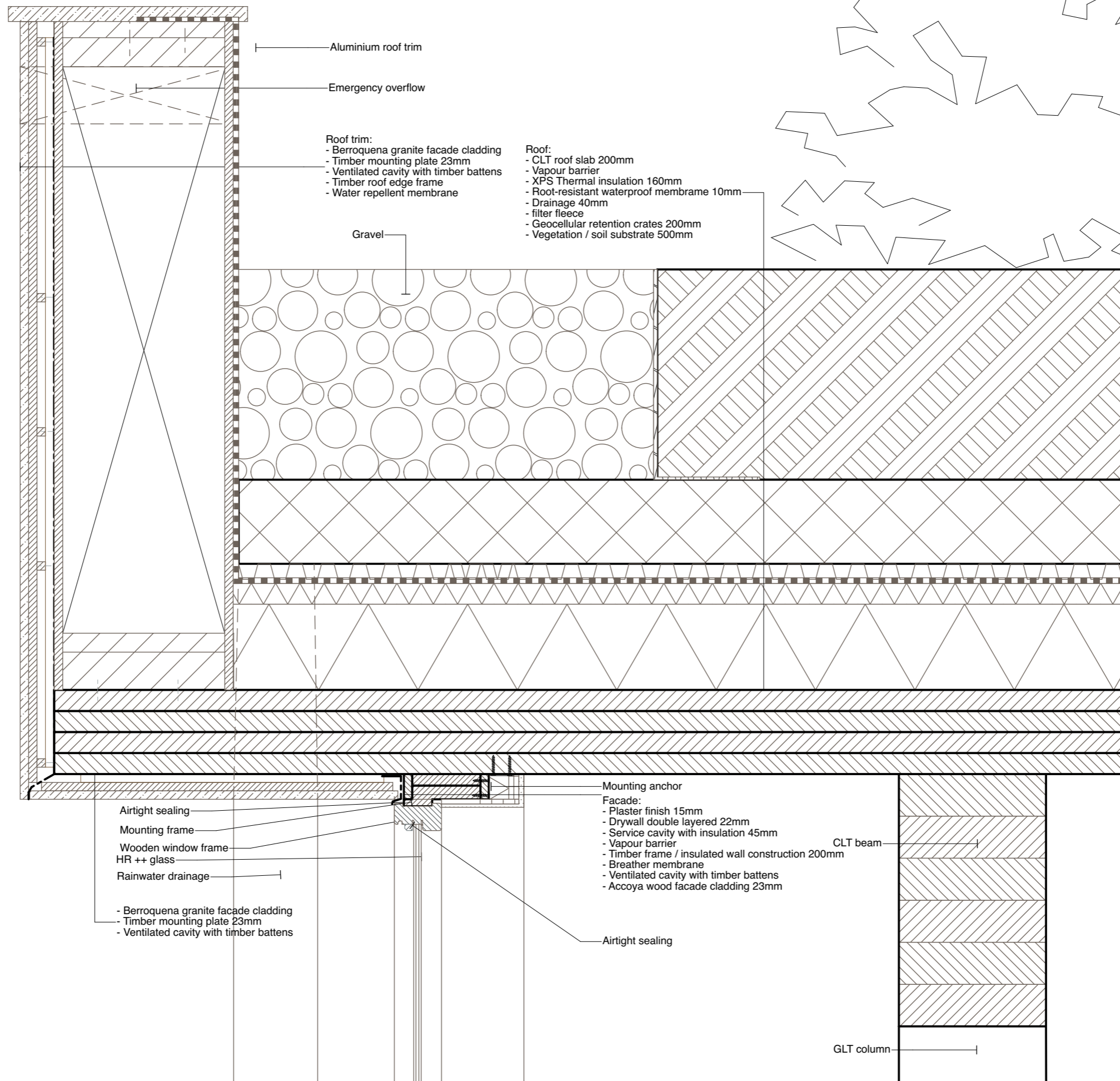
Rainwater drainage

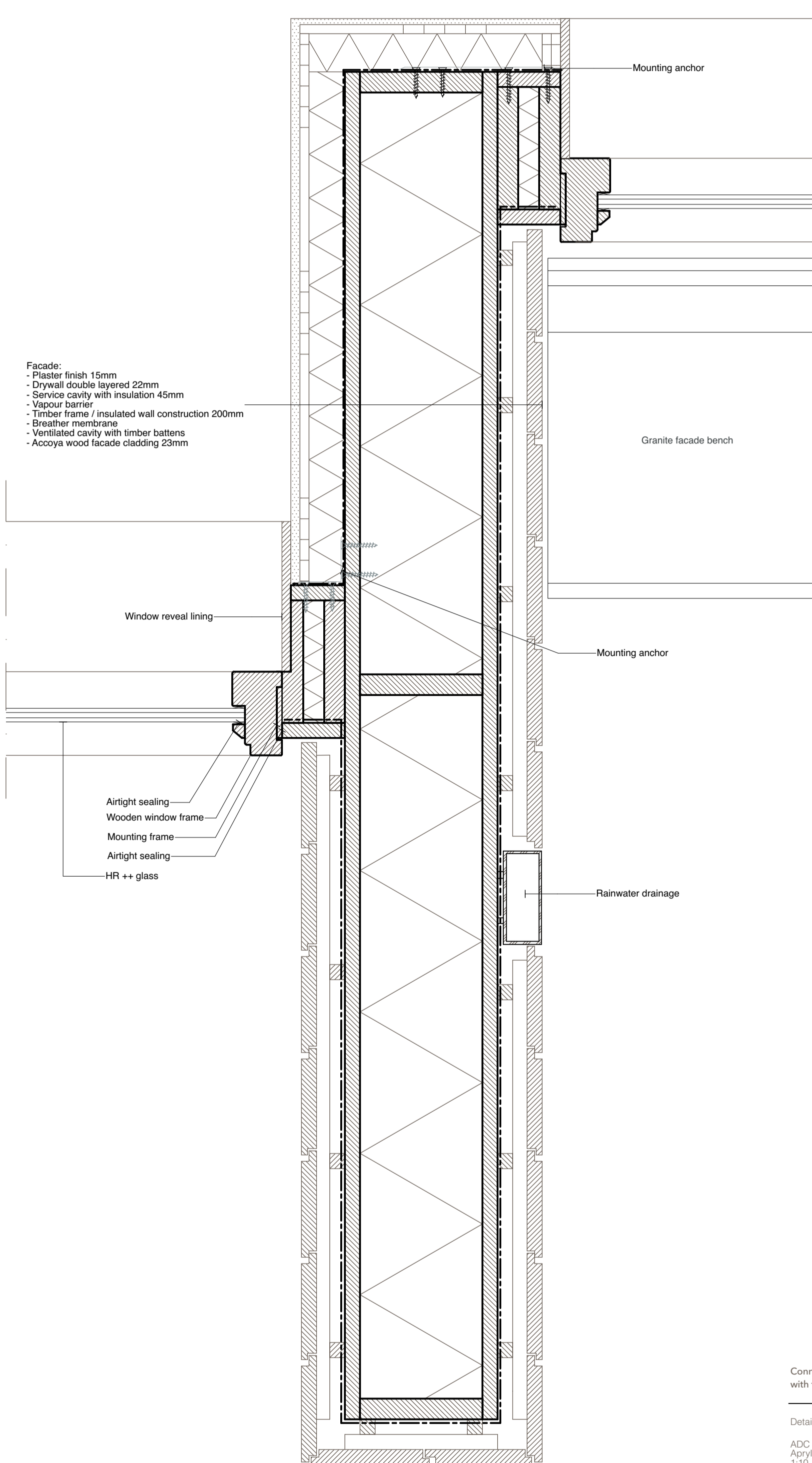
Connecting local communities with transportation nodes

Detail 01 ground floor

ADC graduation studio
 Apryll Wubbels
 1:5
 12 June 2026







- Facade:
- Plaster finish 15mm
 - Drywall double layered 22mm
 - Service cavity with insulation 45mm
 - Vapour barrier
 - Timber frame / insulated wall construction 200mm
 - Breather membrane
 - Ventilated cavity with timber battens
 - Accoya wood facade cladding 23mm

Window reveal lining

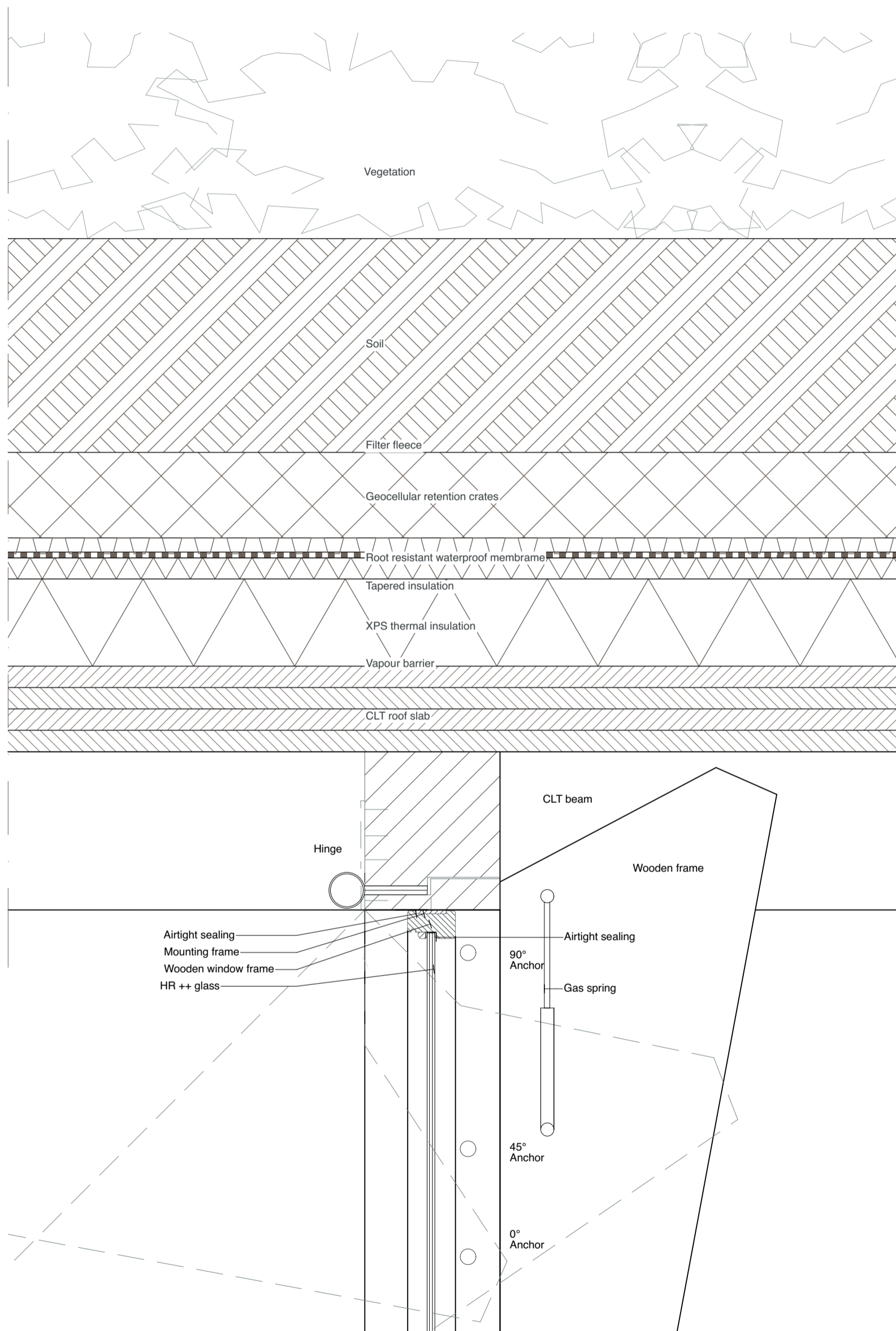
- Airtight sealing
- Wooden window frame
- Mounting frame
- Airtight sealing
- HR ++ glass

Mounting anchor

Granite facade bench

Mounting anchor

Rainwater drainage





2 Appendix

Attachment 1.1: Demographic data analysis of 6 station areas

Demographic analysis Plaza Eliptica (Indicadores Poblacion, n.d.)

The data from neighborhoods Abrantes, Zofio and 50% of Opanel are used for the 800m radius

Key data:

Resident: 67 855
Age average: 43,2 years
Households: 23 992
Average householdsize: 2,75

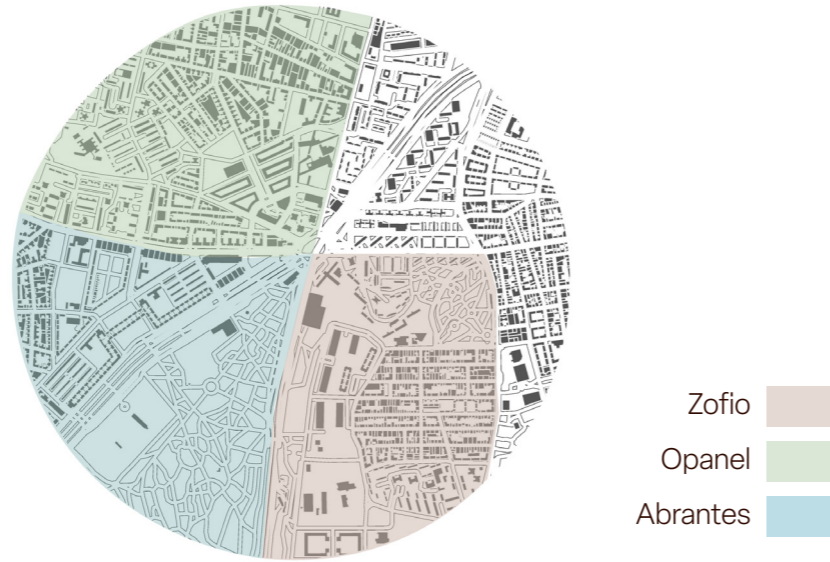


Figure 1: Neighborhoods around Plaza Eliptica, +-1:20 000

Demographic analysis Comillas (Indicadores Poblacion, n.d.)

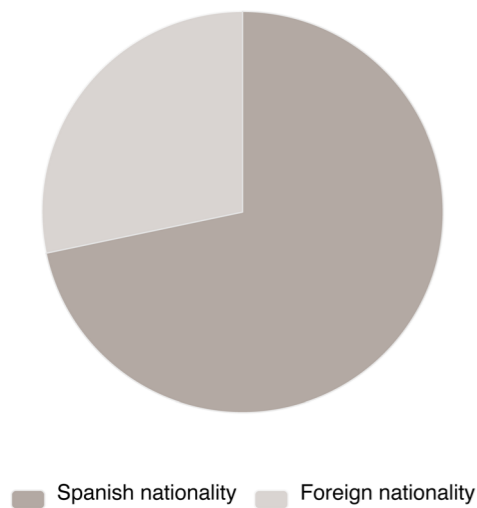
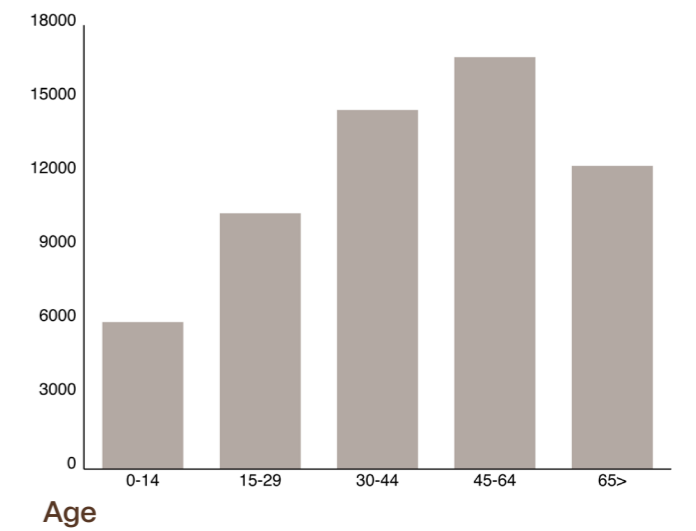
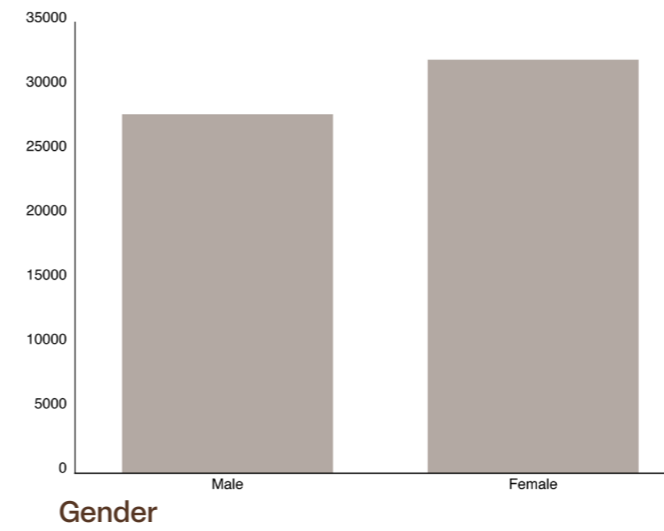
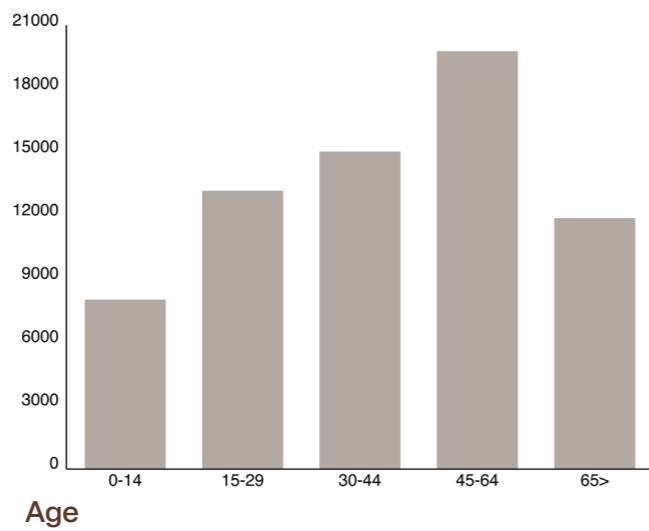
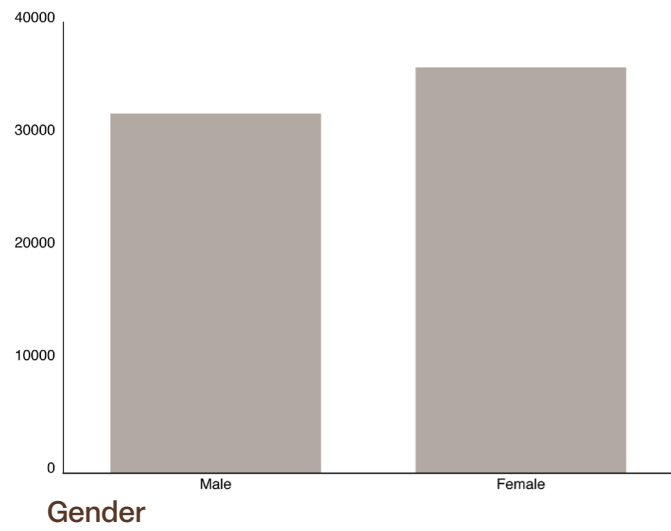
The data from neighborhoods Comillas and Opanel are used for the 800m radius.

Key data:

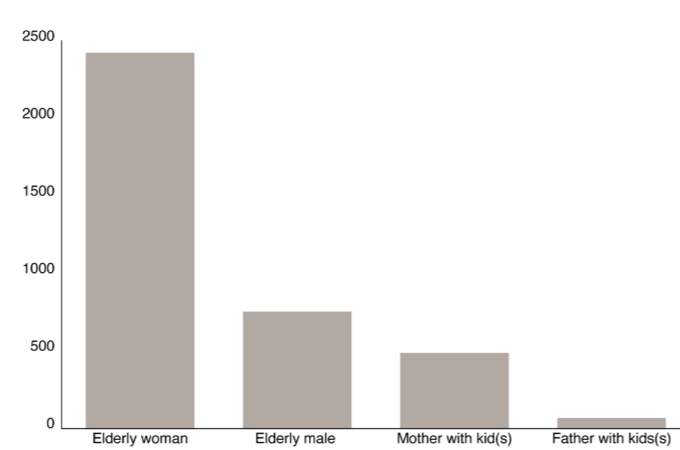
Resident: 59 907
Age average: 44,2 years
Households: 24 061
Average householdsize: 2,44



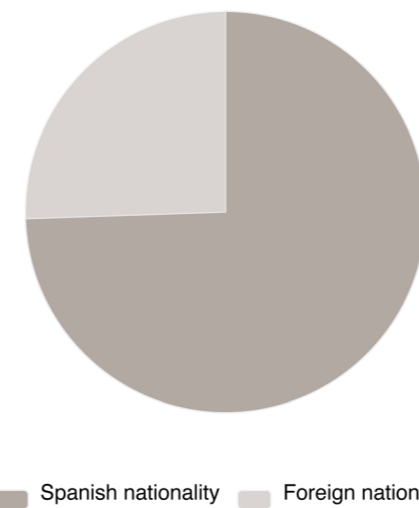
Figure 2: Neighborhoods around Comillas station, +-1:20 000



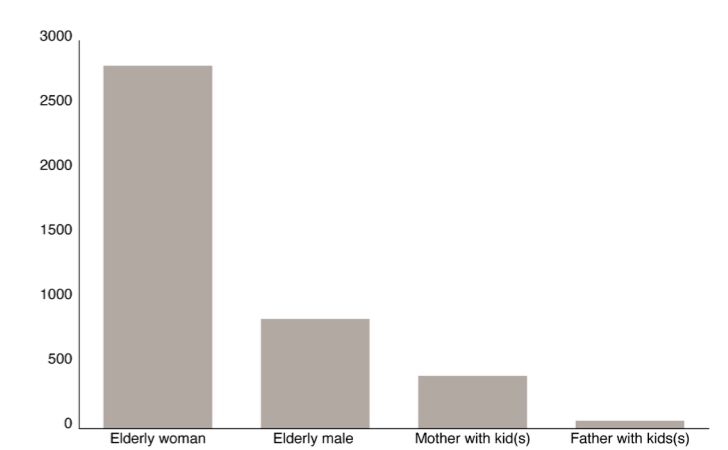
Nationality



Household



Nationality



Household

Demographic analysis Madrid Rio
(Indicadores Poblacion, n.d.)

The data from neighborhoods Acacias Comillas and Chopera are used for the 800m radius

Key data:
Resident: 80 791
Age average: 46,7 years
Households: 35 186
Average householdsize: 2,28



Figure 3: Neighborhoods around Madrid Rio, +-1:20 000

Demographic analysis La Frontera
(Indicadores Poblacion, n.d.)

The data from neighborhoods Palos de la Frontera, Atocha Delicias and 50% of Embajadores are used for the 800m radius.

Key data:
Resident: 82 730
Age average: 42,8 years
Households: 37 839
Average householdsize: 2,25

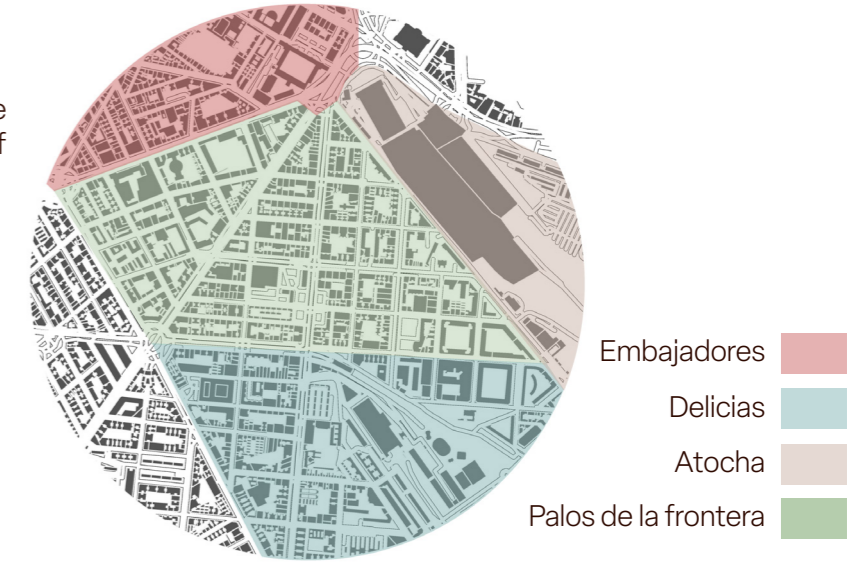
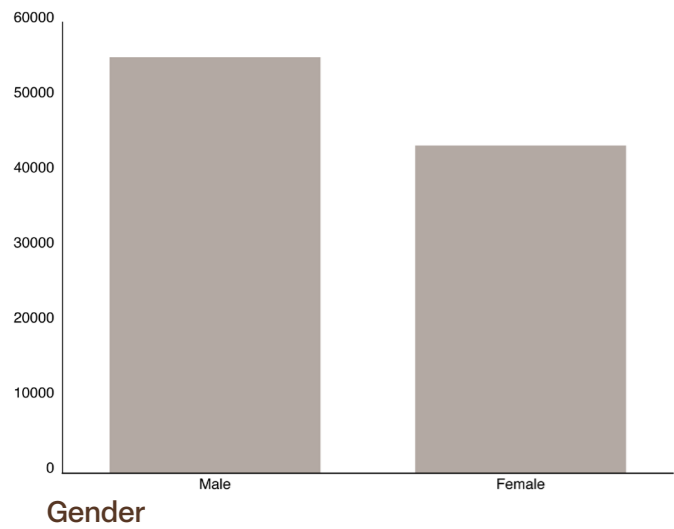
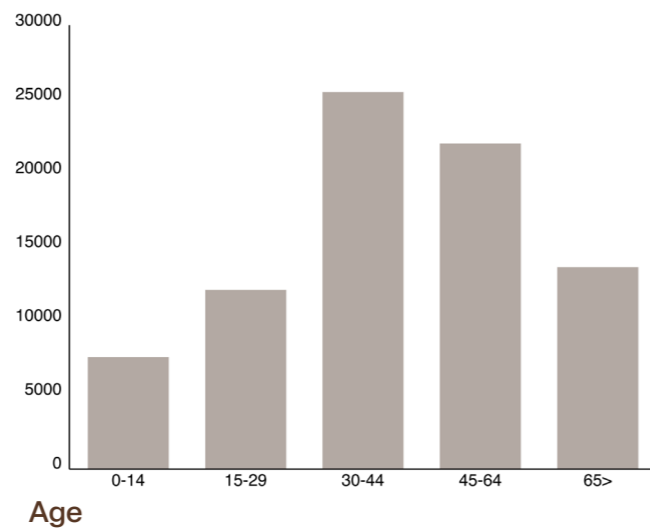


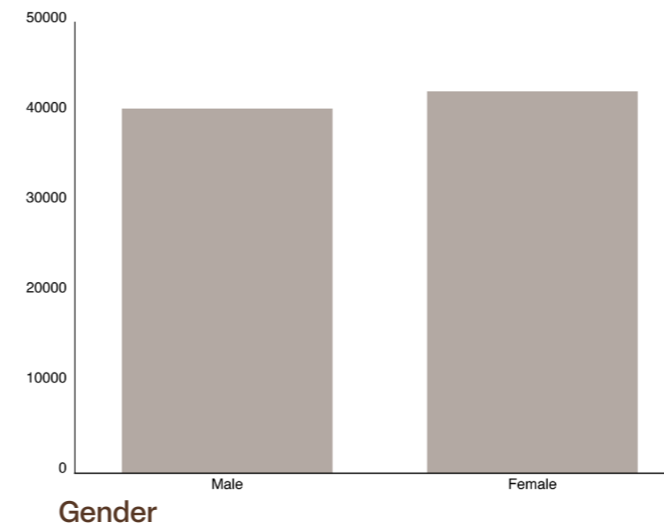
Figure 4: Neighborhoods around La Frontera, +-1:20 000



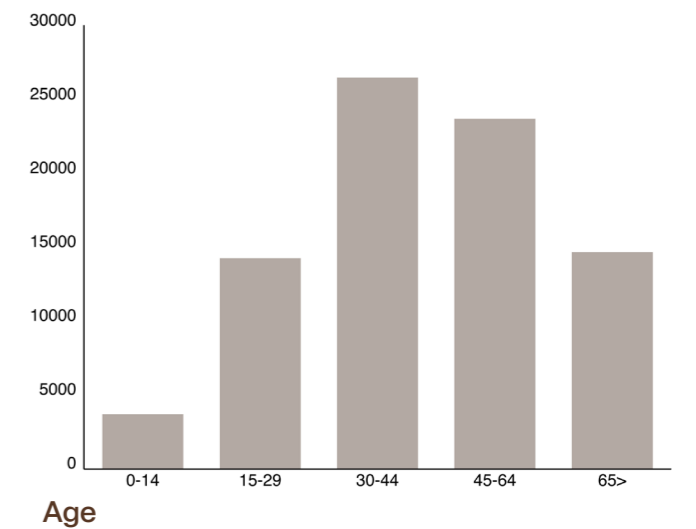
Gender



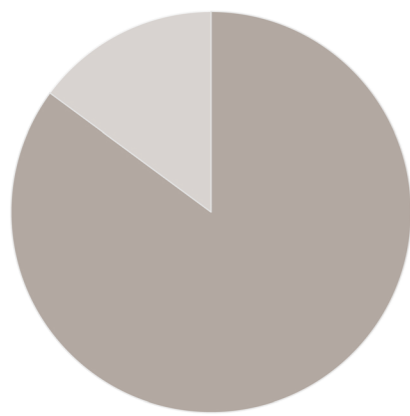
Age



Gender

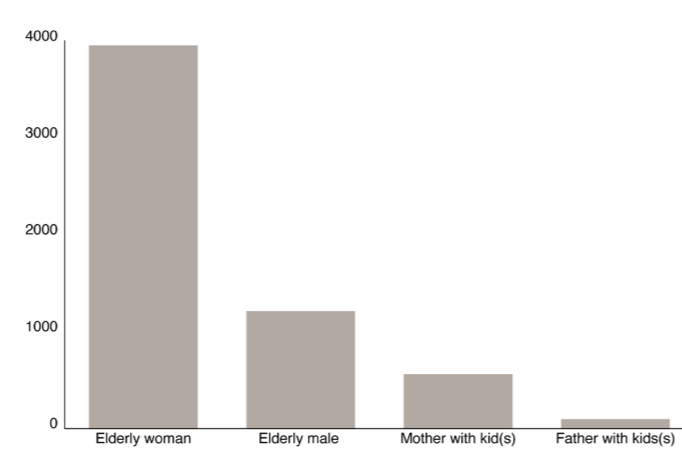


Age

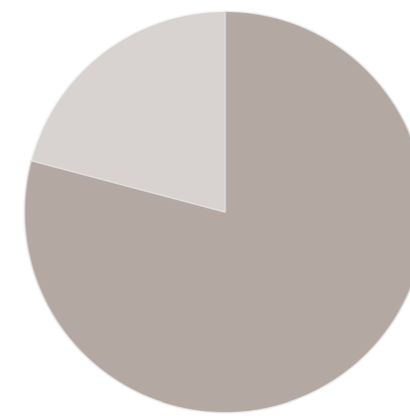


Spanish nationality Foreign nationality

Nationality

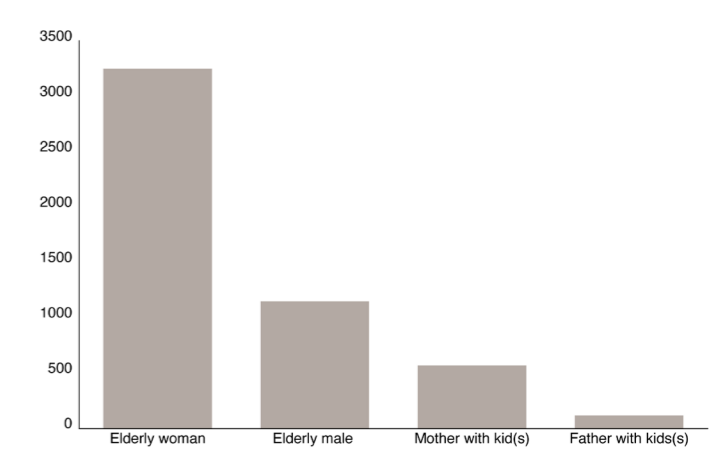


Household



Spanish nationality Foreign nationality

Nationality



Household

Demographic analysis Atocha
(Indicadores Poblacion, n.d.)

The data from neighborhoods Palos de la Frontera, Atocha, Pacifico and Los Jeronimos are used for the 800m radius.

Key data:
Resident: 69 339
Age average: 45,2 years
Households: 31 258
Average householdsiz: 2,33

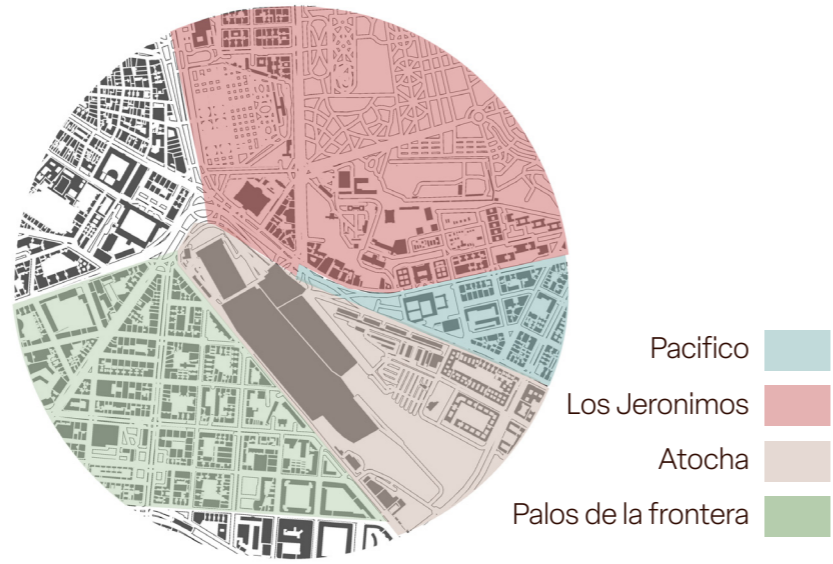


Figure 5: Neighborhoods around Atocha, +-1:20 000

Demographic analysis Conde de Casal
(Indicadores Poblacion, n.d.)

The data from neighborhoods Estrella, Adelfas, Pacifico and Nino Jesus divided by 2 are used for the 800m radius

Key data:
Resident: 45 727
Age average: 47,55 years
Households: 19 140
Average householdsiz: 2,42

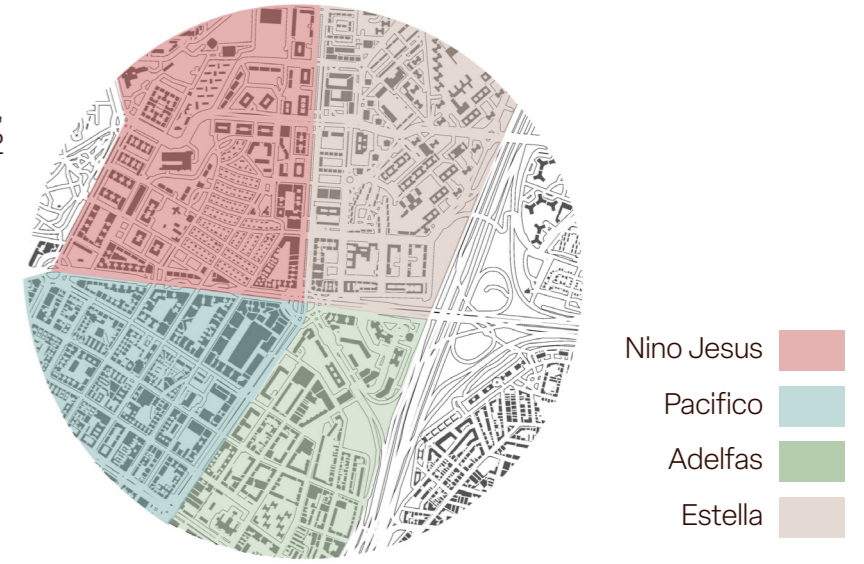
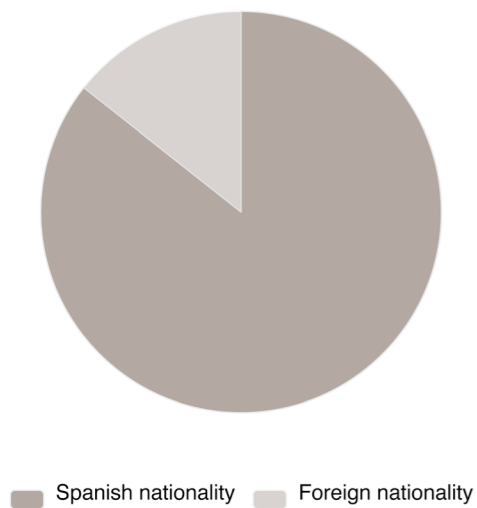
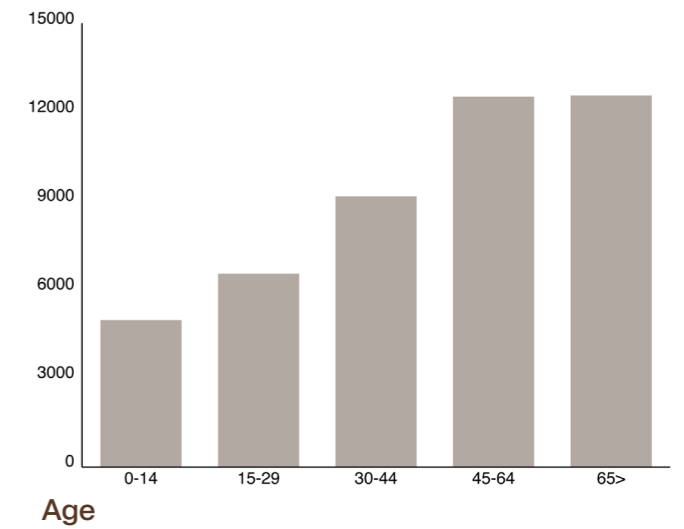
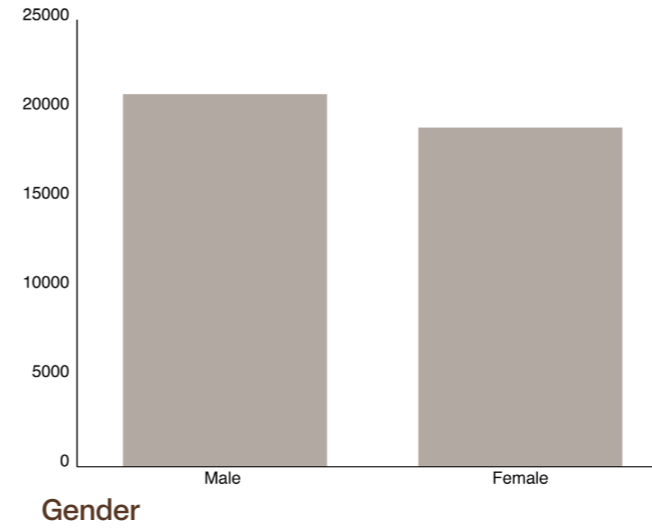
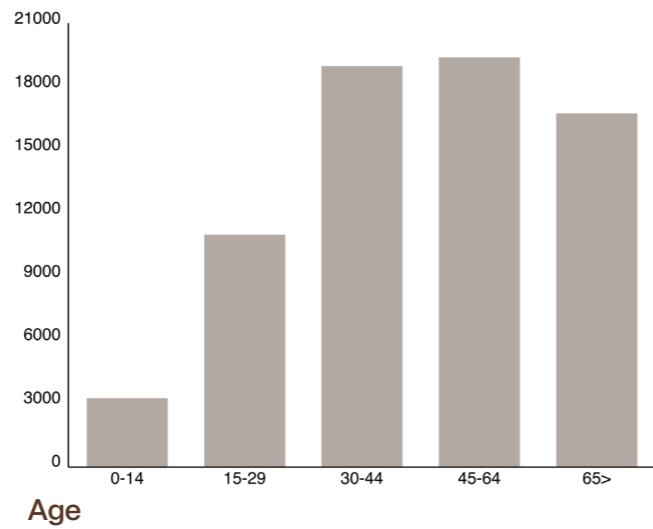
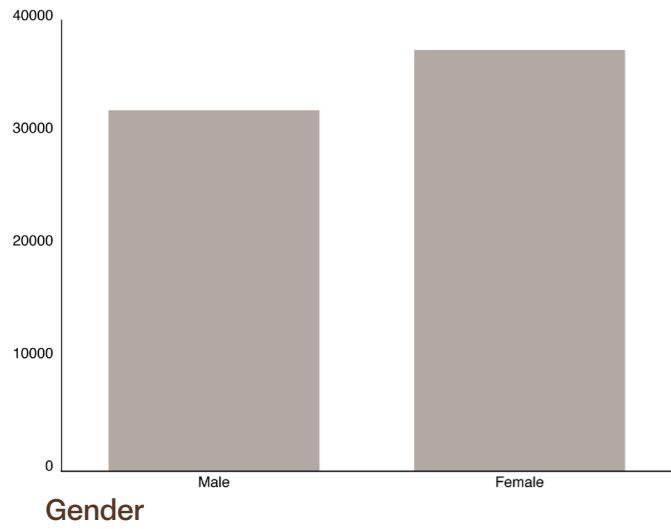
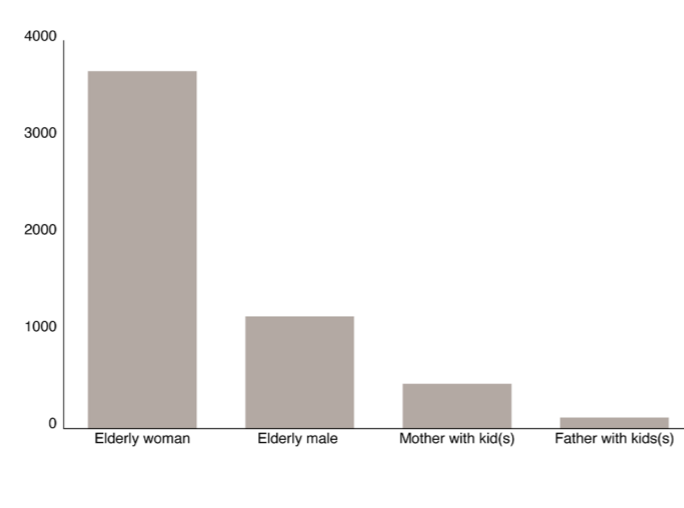


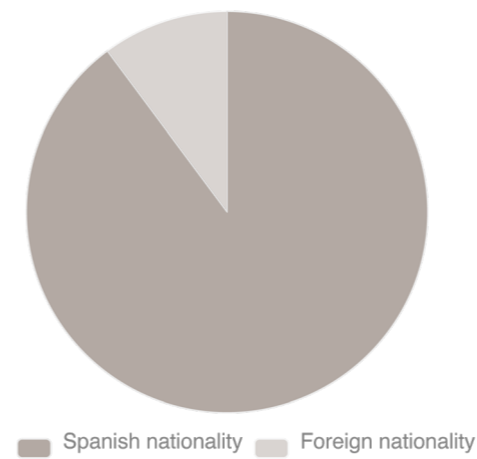
Figure 6: Neighborhoods around Conde de Casal, +-1:20 000



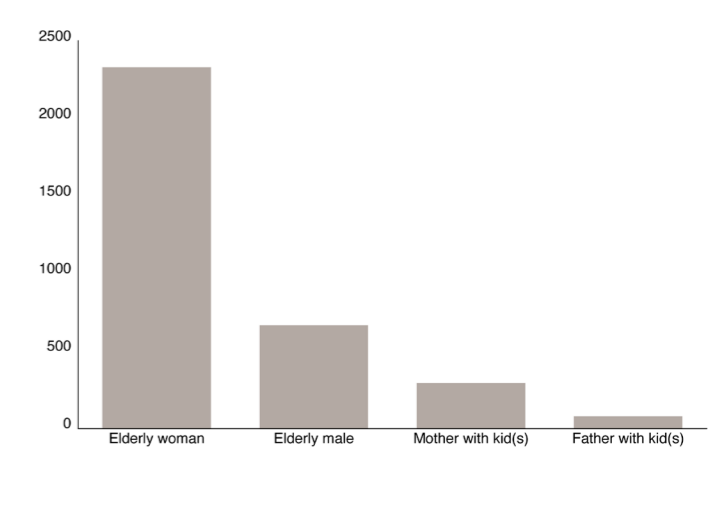
Nationality



Household



Nationality



Household

Attachment 1.2: Raw demographic data

	Plaza Elíptica	Comillas	Madrid Río	La Frontera	Atocha	Conde de Casal
Residents	67855	59907	80791	82730	69339	45727
Males	31887	27832	55326	40411	31990	20848
Females	35981	32075	43564	42319	37349	18971
Age average	43,2	44,2	46,7	42,8	45,2	47,5
0-14	8010	5950	7549	3678	3233	4956
15-29	13171	10374	12098	14233	10980	6529
30-44	15023	14567	25499	26481	18981	9147
45-64	19782	16714	22005	23685	19397	12527
65>	11869	12302	13640	14653	16748	12568
Spanish nat.	47560	43920	68259	64649	58672	36296
Foreign nat.	18763	15059	11938	17047	9842	4110
Households	23992	24061	35186	37839	31258	19140
Average size	2,75	2,44	2,28	2,25	2,33	2,42
Elderly (women)	2422	2806	3952	3247	3685	2328
Elderly (male)	751	845	1208	1144	1153	664
Mother with kid(s)	458	404	557	567	458	291
Father with kid(s)	65	57	93	115	109	76

Attachment 2: Fieldwork planning and actions

date (Feb.)	activity
7	flight Amsterdam - Madrid
8	exploring madrid
9	Plaza elíptica, Comillas & Madrid Río station area observation
10	University lectures, La Frontera, Atocha & Conde de Casal station area observation
11	Comillas station area deeper observation
12	flight Madrid - Amsterdam

Attachment 3: Data management checklist

Selection A. General considerations	yes	no
<p>1. Is the graduation project conducted as part of an internship (at a company), or as part of a research project at TU Delft?</p> <p>If a student's graduation project is conducted at a company or as part of a research project at the university, questions of data ownership and intellectual property rights need to be addressed in a written graduation or internship agreement before the project begins. Student and supervisor should consult the Intellectual Property Rights of Students webpage. Additional information can also be found in the Extended Personal Research Data Workflow. If applicable, complete the Confidentiality Agreement.</p>		X
<p>2. Does the project involve conducting (part of) the research outside the Netherlands?</p> <p>Students who intend to travel abroad (even to other EU countries) for study, exchange, research, internship, or graduation project purposes need to follow the Travel Safety Protocol. This includes attending a mandatory Travel Safety Training Session: see the Disclaimer.</p>	X	
<p>3. Will the research involve processing data from humans, such as running a survey, conducting interviews or workshops, collecting data through social media or internet forums, or re-using existing datasets about humans provided by a third party? (If 'yes', see follow-up questions 4 to 13 in Checklist B.)</p> <p>Students who work with data from human participants must complete the next section and apply for and receive ethical approval from the Human Research Ethics Committee (HREC) before conducting the research.</p>		X