

COMPLEX PROJECTS
BERLINER L-BAHN

P5 Presentation
Thomas Brandt
July 2nd, 2024



IMAGINE

Source: List, F. (2020, 20 juli). Urban Air Mobility: Zo zou stedelijk verkeer in drie dimensies er uit kunnen zien. IO. <https://innovationorigins.com/nl/urban-air-mobility-zo-zou-stedelijk-verkeer-in-drie-dimensies-er-uit-kunnen-zien/>



IMAGINE

Source: Baur, S., Schönberg, J., & Hader, M. (2020, 28 april). Cargo Drones: the urban parcel delivery network of tomorrow. Roland Berger. <https://www.rolandberger.com/en/Insights/Publications/Cargo-drones-The-urban-parcel-delivery-network-of-tomorrow.html>

INTRODUCTION



Introduction
BERLIN

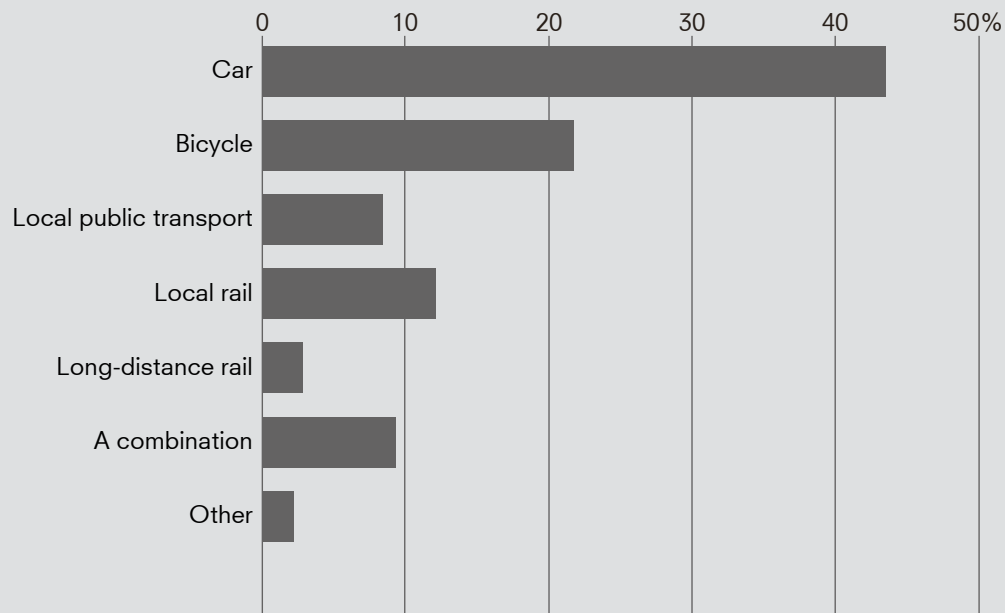


Introduction

MODES OF COMMUTE

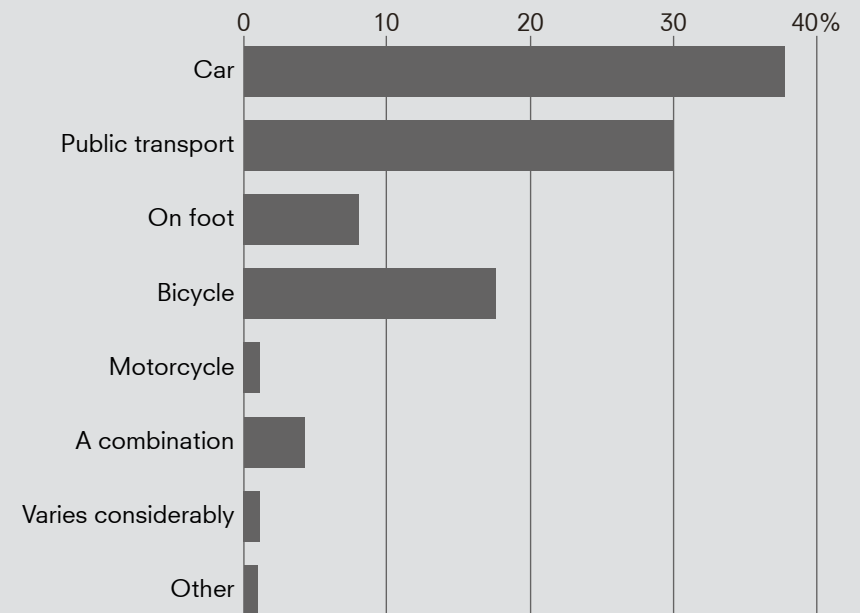
Preferred method of travel

Weighted n in Berlin: 913



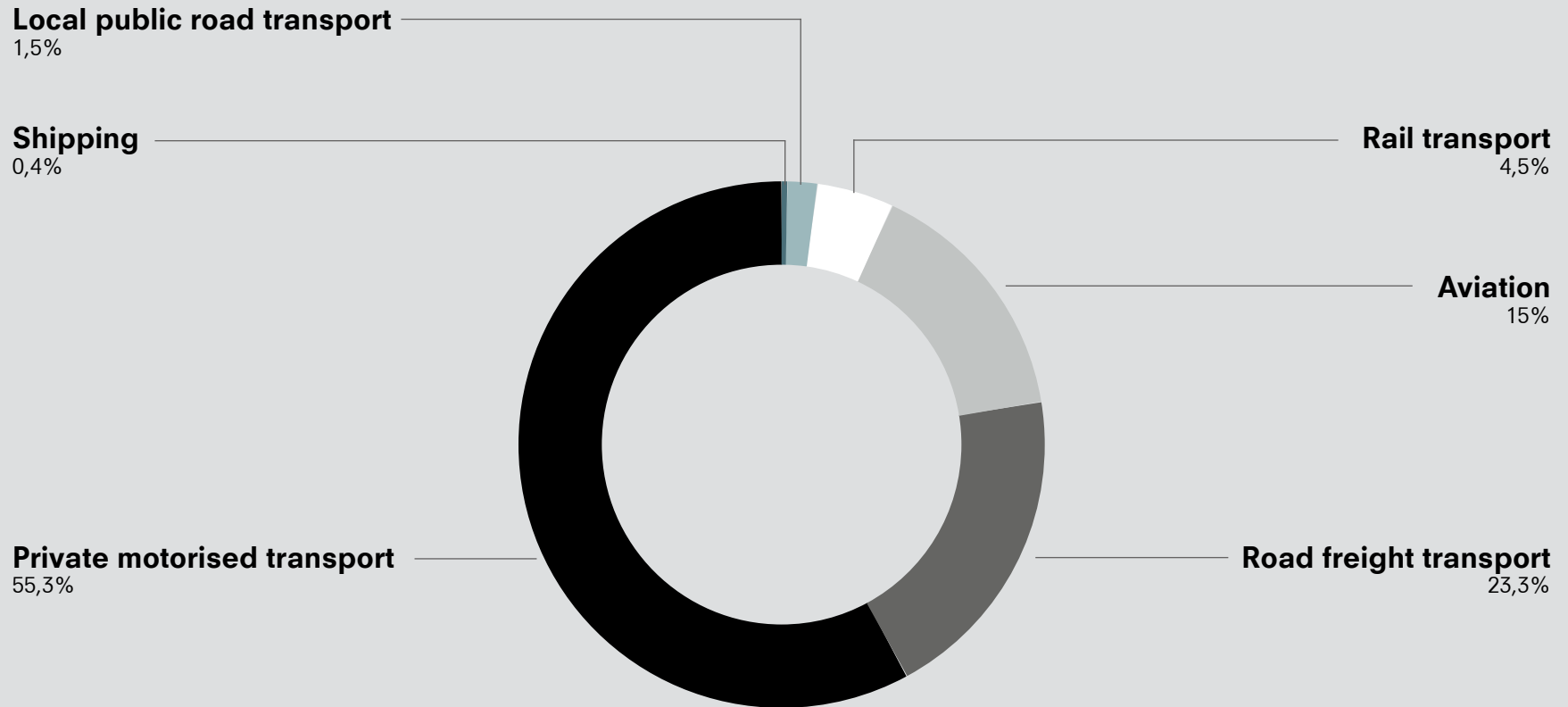
Method of transport used for most daily travel

Weighted n in Berlin: 918



Source: Bloomberg - Are you a robot? (2015, 24 september). <https://www.bloomberg.com/news/articles/2015-09-24/big-european-cities-use-cars-less-but-they-still-have-a-long-way-to-go>

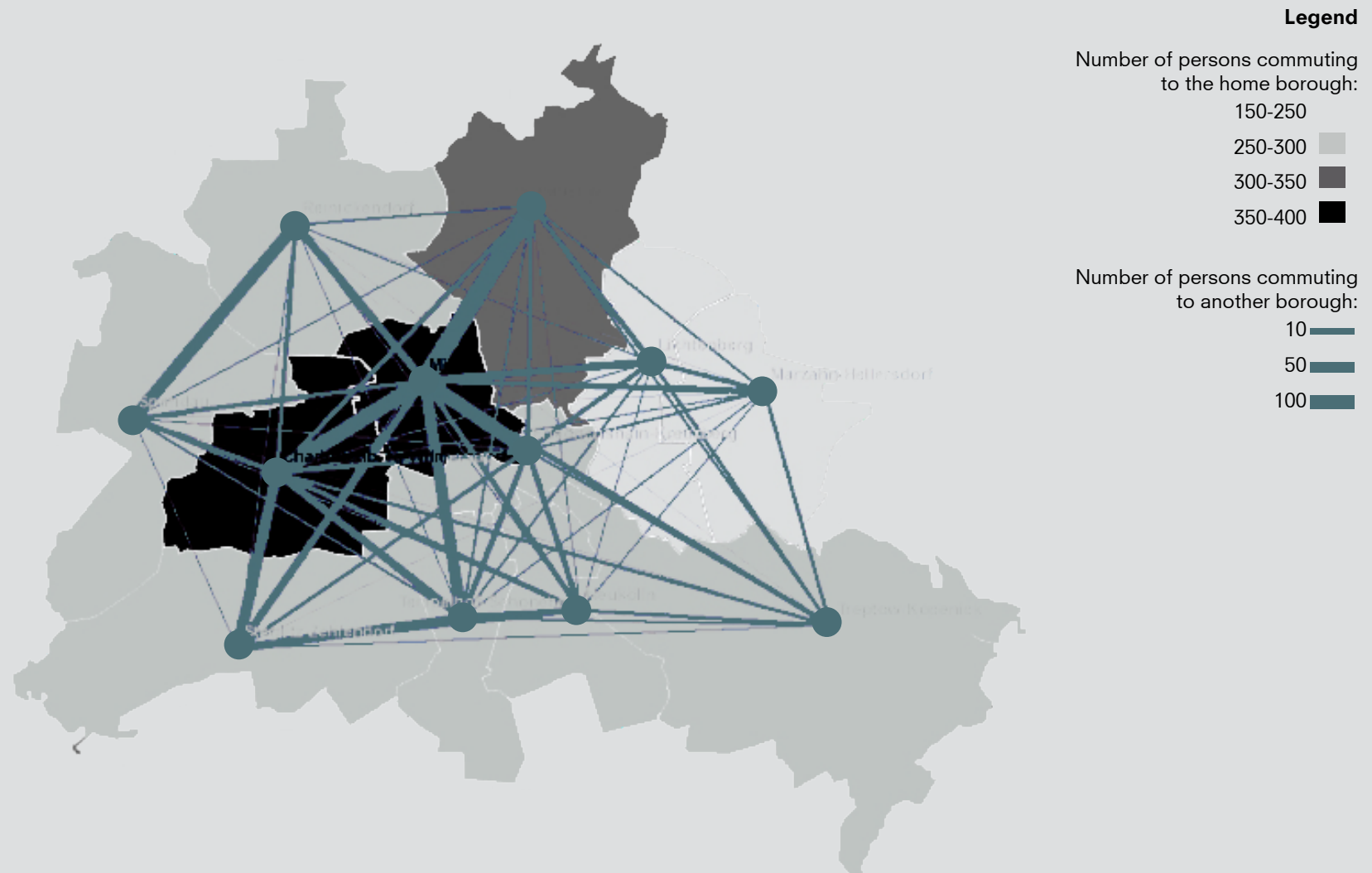
CARBON EMISSIONS BY MODE OF TRANSPORT



Source: VDA - German Association of the Automotive Industry. (2020, 12 augustus). Clean Energy Wire. <https://www.cleanenergywire.org/experts/vda-german-association-automotive-industryautomotive-industry>

Introduction

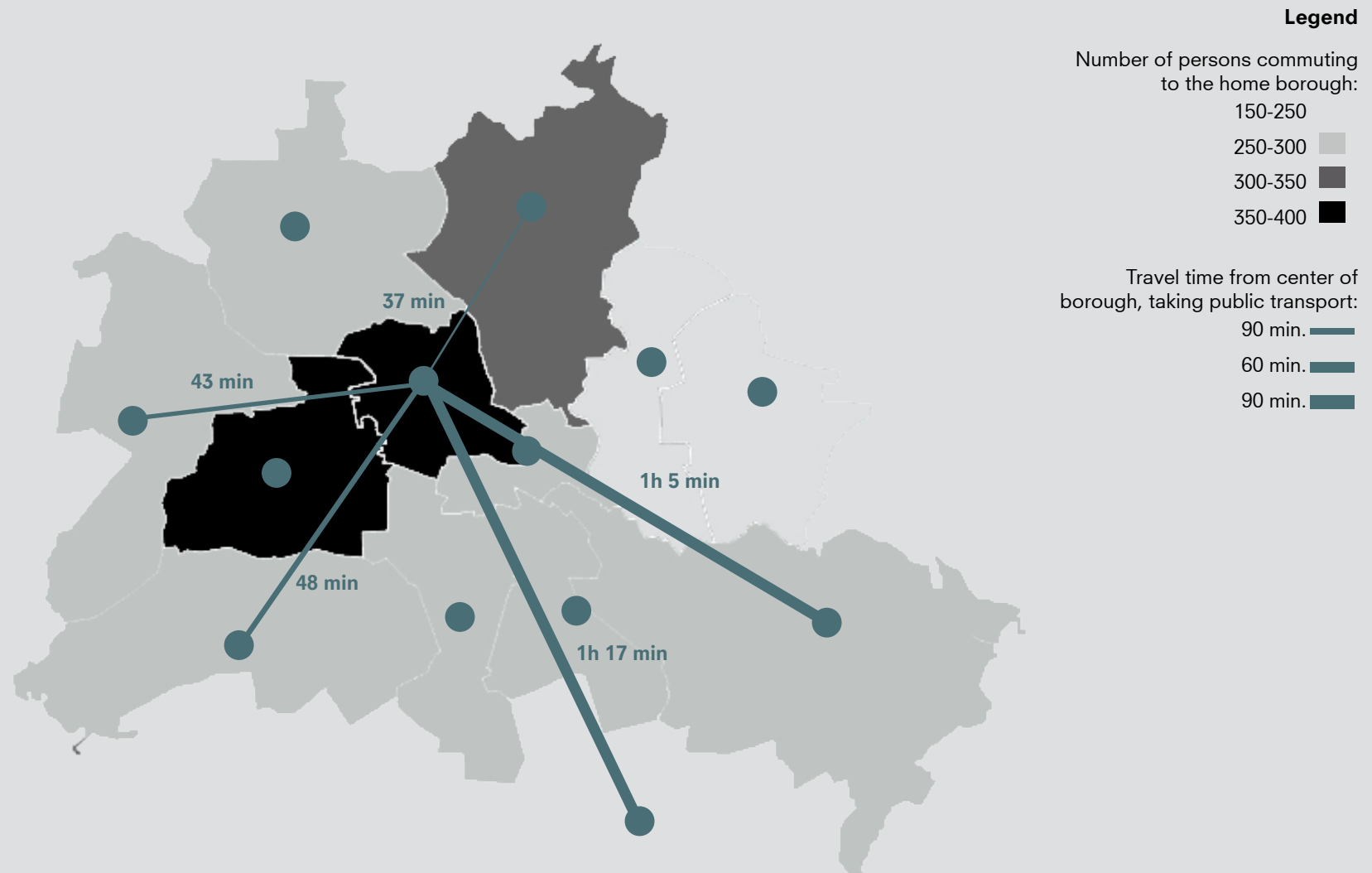
COMMUTE BEHAVIOUR BERLIN



Source: Beige, S. (2012) Analyses of commuting distances and times in the household context: The case of Berlin, paper presented at the 13th International Conference on Travel Behaviour Research, Toronto, July 2012

Introduction

COMMUTE TRAVEL TIMES



Source: Beige, S. (2012) Analyses of commuting distances and times in the household context: The case of Berlin, paper presented at the 13th International Conference on Travel Behaviour Research, Toronto, July 2012

PROBLEM STATEMENT

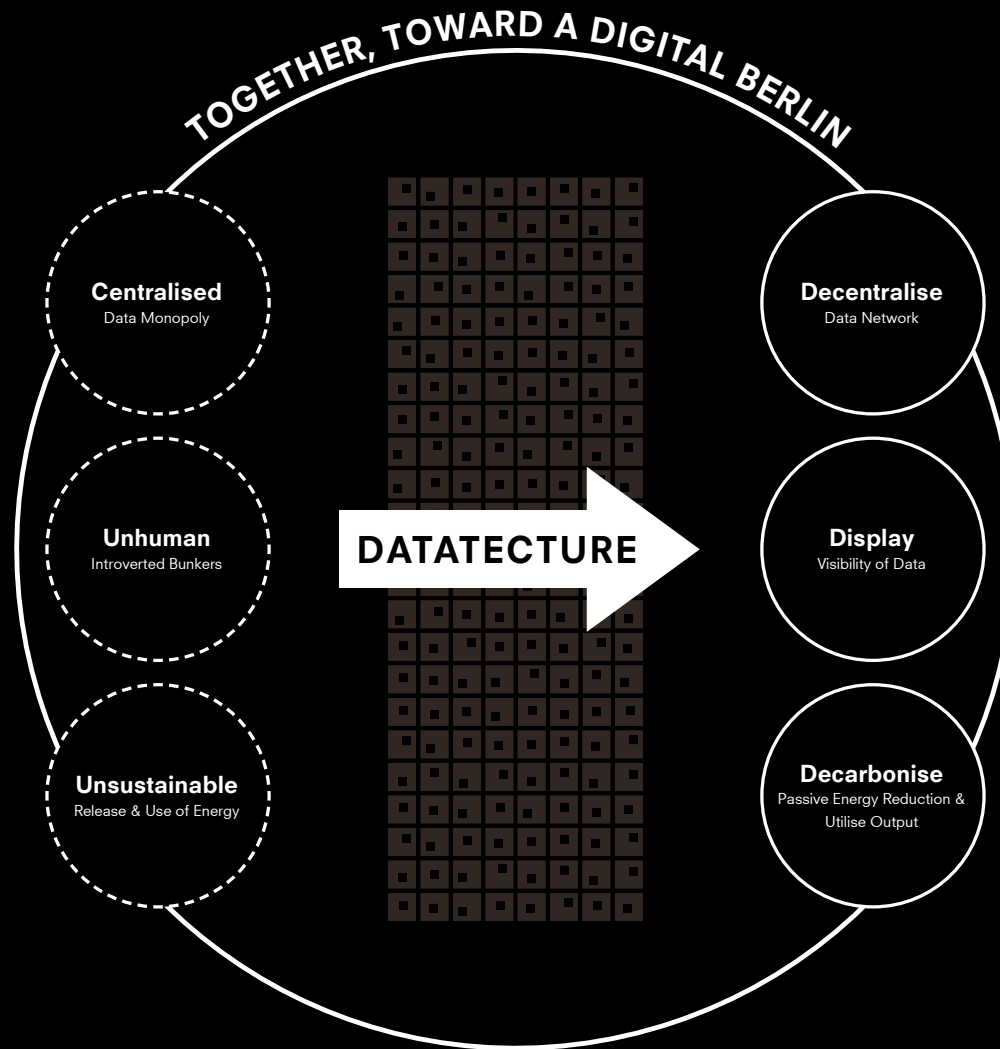


DIGITALIZATION

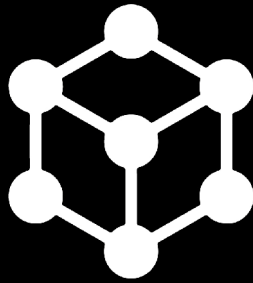


Digitalization

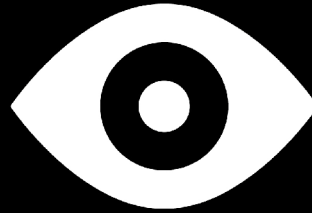
DATAECTURE



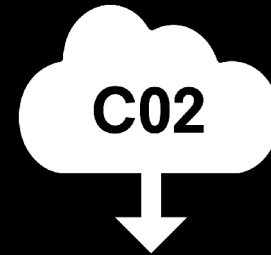
Digitalization
AMBITION



DECENTRALISE



DISPLAY



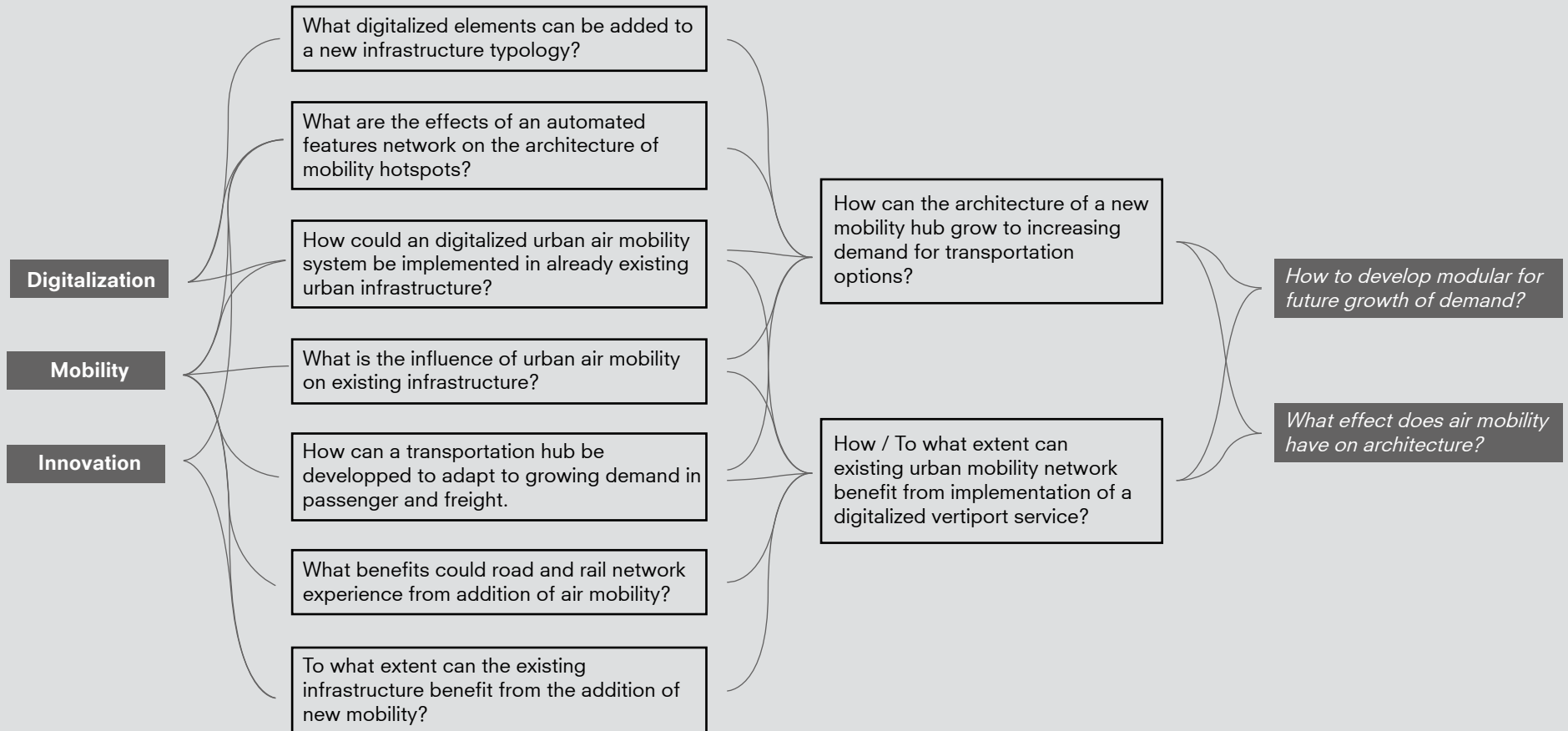
DECARBONISATION



STRATEGY



Strategy RESEARCH PLAN



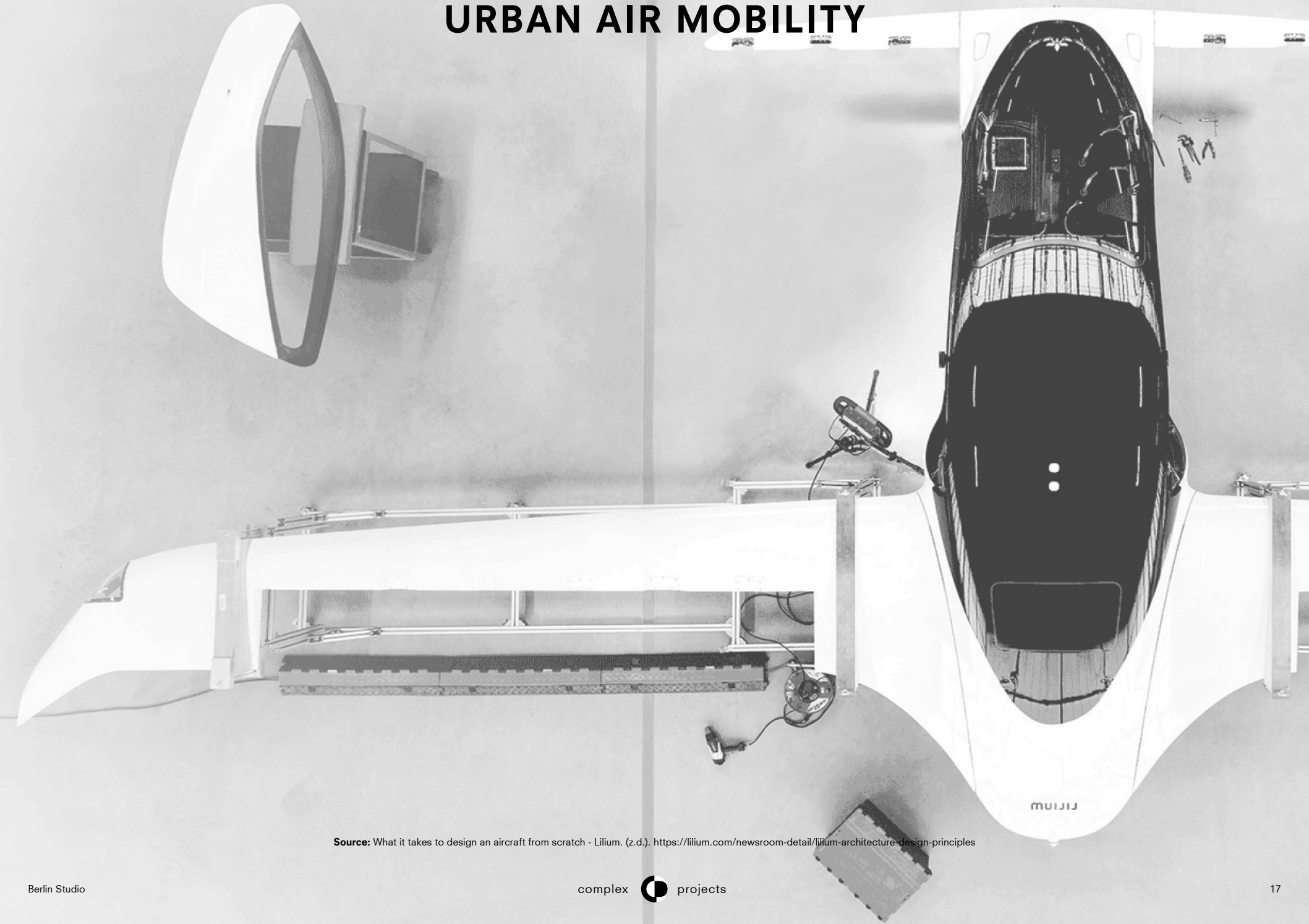
Strategy

RESEARCH QUESTION

How can a new mode of air transportation be designed to facilitate the increasing demand in transportation of people and goods?

Strategy

URBAN AIR MOBILITY



Source: What it takes to design an aircraft from scratch - Lilium. (z.d.). <https://lilium.com/newsroom-detail/lilium-architecture-design-principles>

UTILIZATION EFFICIENCY

Touchdown and Lift-off (TLOF) pads: **2**

192 Passengers / hour

Gates: **12**

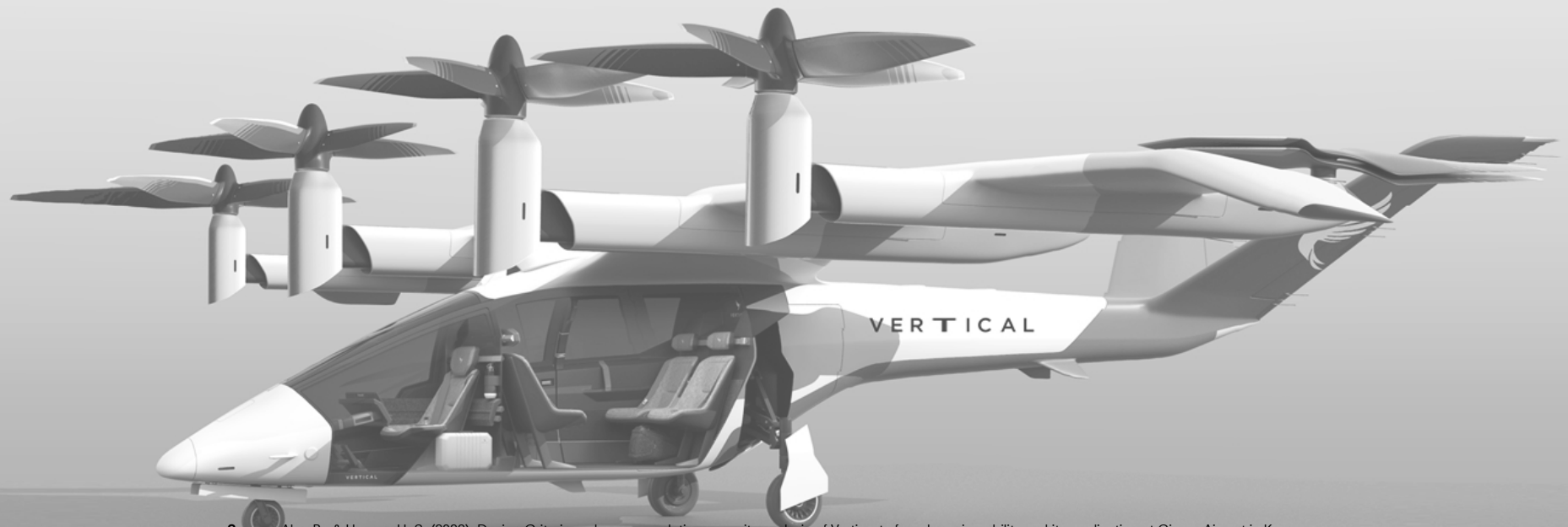
48 Airflights / hour

$$192 \times 16 = 3072$$

Passengers / hour

Operating hours

Passengers / day

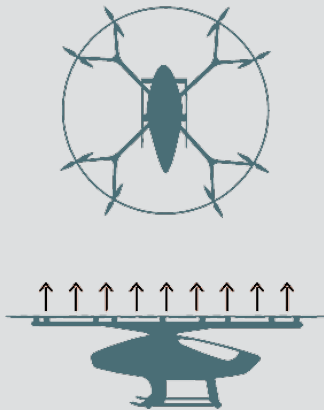


Source: Ahn, B., & Hwang, H. S. (2022). Design Criteria and accommodating capacity analysis of Vertiports for urban air mobility and its application at Gimpo Airport in Korea. Applied sciences, 12(12), 6077. <https://doi.org/10.3390/app12126077>

ELECTRIC VERTICAL TAKEOFF AND LANDING (EVTOL)

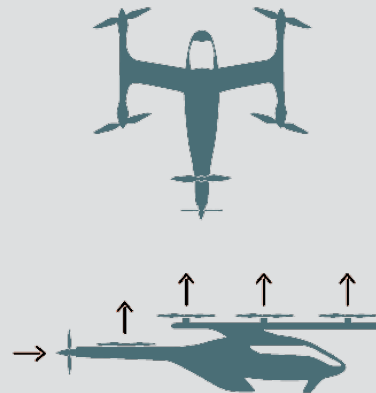
Multicopter

Vertical thrust



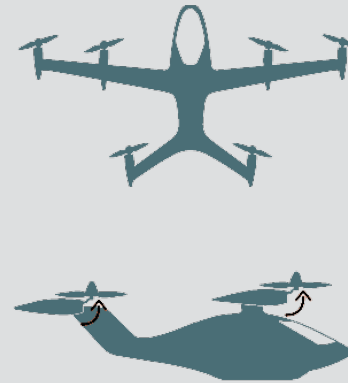
Lift + cruise

Vertical and horizontal thrust



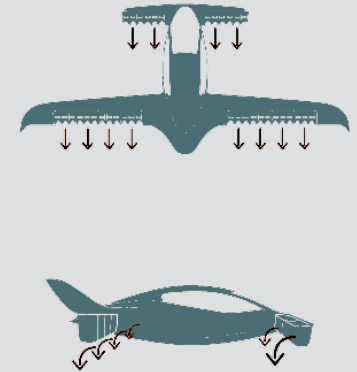
Tilt rotor

Moveable thrust



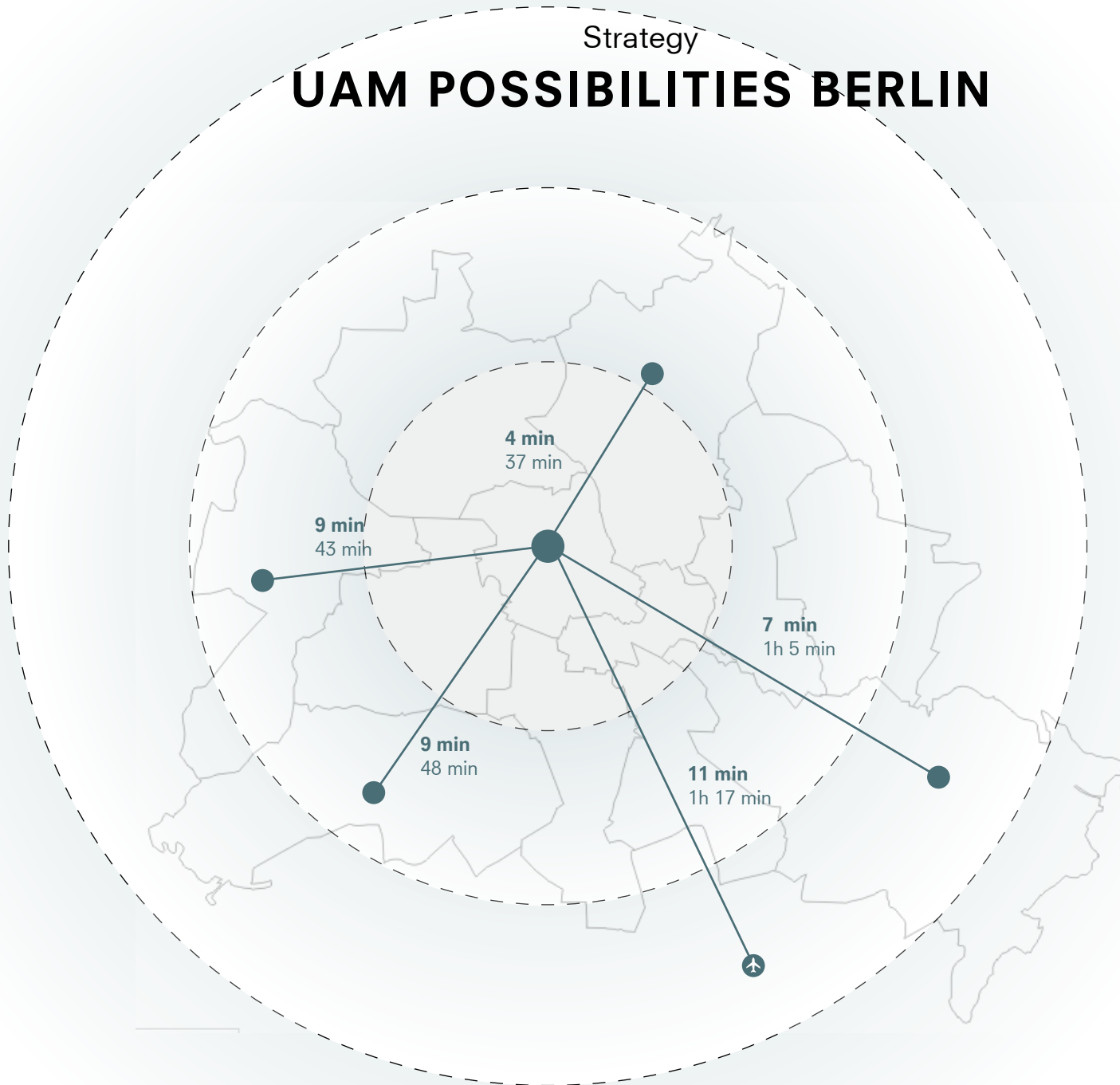
Ducted vector thrust

Moveable thrust



Source: What it takes to design an aircraft from scratch - Lilium. (z.d.). <https://lilium.com/newsroom-detail/lilium-architecture-design-principles>

UAM POSSIBILITIES BERLIN



Legend

Air mobility

Public transport

Source: EHANG 216-S (Production model). (z.d.). [https://evtol.news/ehang-216/#:-:text=Passengers%3A%20%20passengers,km%2Fh%20\(81%20mph\)](https://evtol.news/ehang-216/#:-:text=Passengers%3A%20%20passengers,km%2Fh%20(81%20mph))

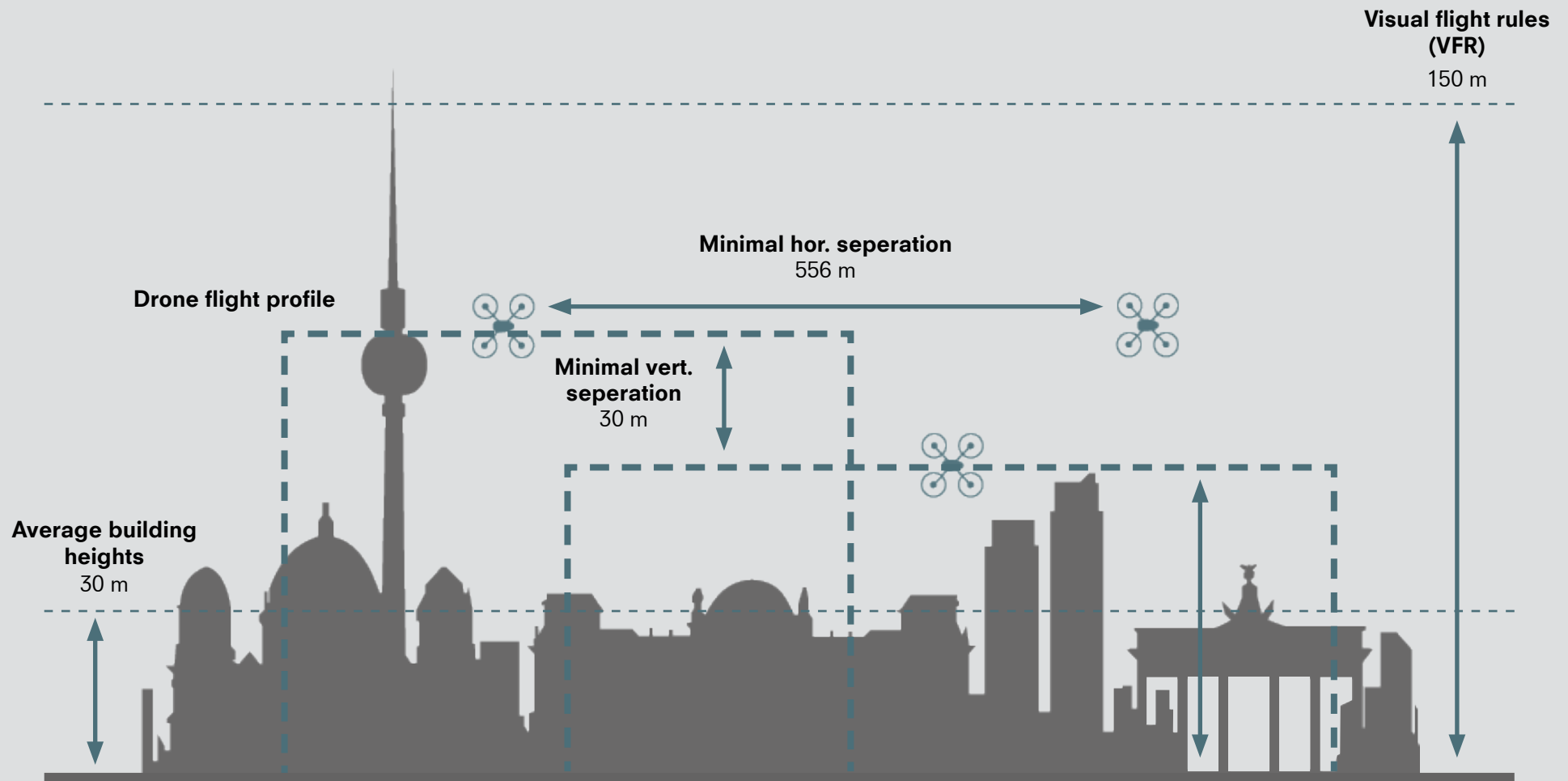
Strategy

URBAN AIR MAIL



Strategy

MUNICIPAL REGULATIONS



Source: Baur, S., Schönberg, T., & Hader, M. (2020, 28 april). Cargo Drones: the urban parcel delivery network of tomorrow. Roland Berger. <https://www.rolandberger.com/en/Insights/Publications/Cargo-drones-The-urban-parcel-delivery-network-of-tomorrow.html>

Strategy

AIR MAIL POSSIBILITIES BERLIN

Factor	Input factors	Roland Berger assumptions	Result	Market size
Regulatory factors	Minimum distances Vertical: 5.500 m Horizontal: 300 m	Scale factor for 10% for minimum distances for drone operations	Airspace for one drone	4.000 drones maximum at the same time
Geographical factors	Berlin area: 892 km² Berlin urban area: 668 km²	60% of urban area useful for drone operations (no fly zones around airports, governmental buildings, downtown areas, etc.) Layer of drones: (from 60m to 150m; each 30m)	Total airspace volume for drones 36.000 x 106 m²	Downscale factor of 30% for smooth operations 1.200 drones flying at the same time
Operational factors	Flight distance: 3 km Flight time2: 5 min Turn-around-time between flights: 15 min	Operating hours per day: 8h Operational days per year: 280 Parcels transported per flight: 1 Flight occupancy rate: 50%	Deliveries per drone per day: 12 parcels and per year: 3.360 parcels	4.000.000 parcels delivered annual

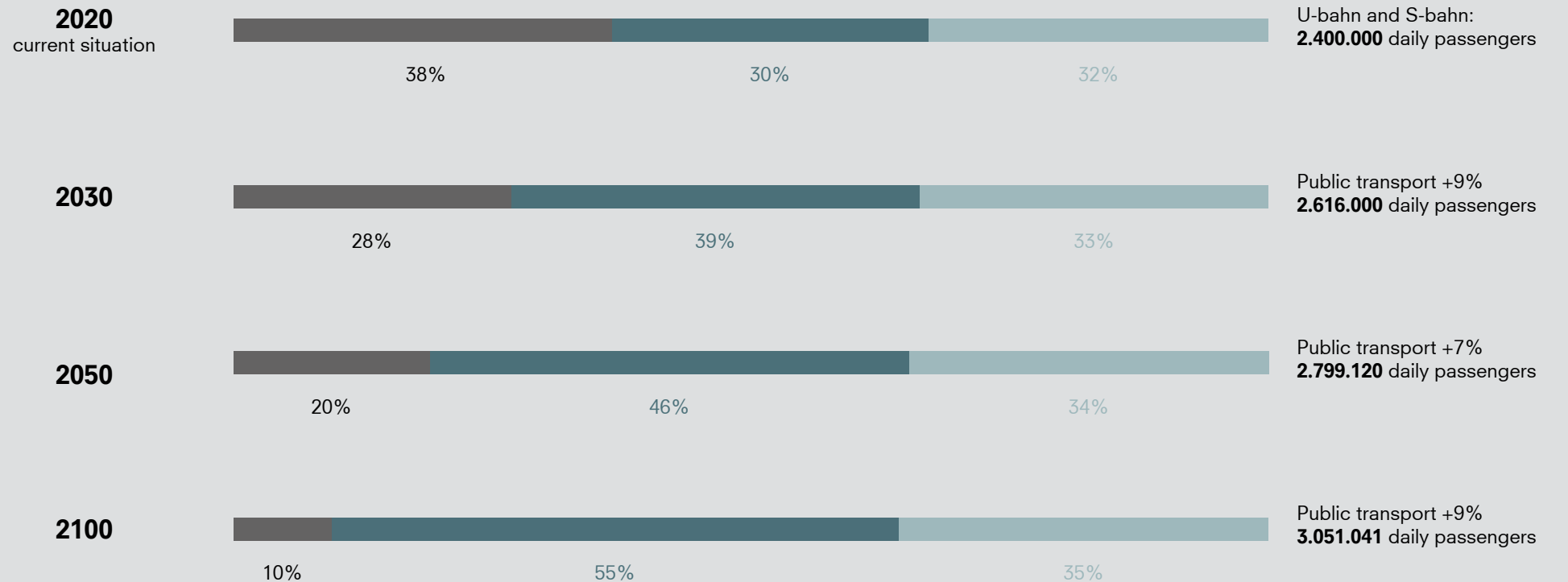
Source: Baur, S., Schönberg, T., & Hader, M. (2020, 28 april). Cargo Drones: the urban parcel delivery network of tomorrow. Roland Berger. <https://www.rolandberger.com/en/Insights/Publications/Cargo-drones-The-urban-parcel-delivery-network-of-tomorrow.html>

HYPOTHESIS



Hypothesis

DAILY METHOD OF TRAVEL GOAL



Source: Bloomberg - Are you a robot? (2015, 24 september). <https://www.bloomberg.com/news/articles/2015-09-24/big-european-cities-use-cars-less-but-they-still-have-a-long-way-to-go>

Hypothesis

MOBILITY SCENARIOS



Scenario 1
Airport shuttle



Scenario 2
Interconnected



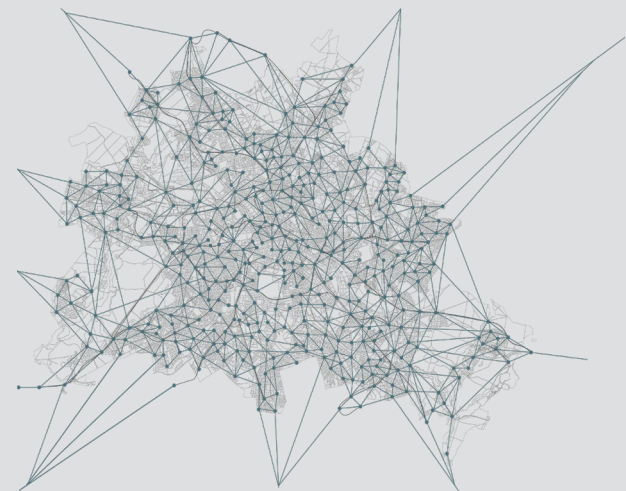
Scenario 3
Across center



Scenario 4
Across outer boroughs



Scenario 5
Platforms network



Scenario 6
City connected

Hypothesis

POLYCENTRIC CITY CENTERS



Source: Main Administration for Urban Development and Environment in Berlin (Publ. Ed.): Urban Development Plan. Central Parts. 3rd Progress Report 2016, 46 p.
Responsible Unit I A: Urban Planning Development, Jens Nijes, Elke Plate, Torsten Tonndor in collaboration with Junker + Kruse, Dortmund. Berlin 2016.

SCENARIO 7: POLYCENTRIC CONNECTED

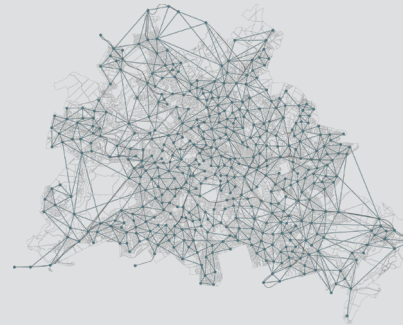


Hypothesis

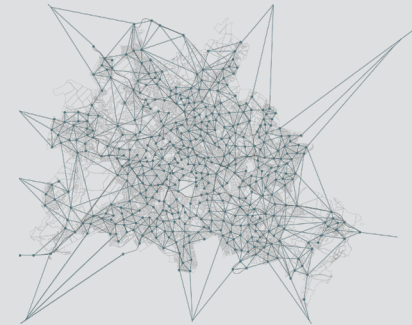
DAILY PASSENGERS VERTIPOINT



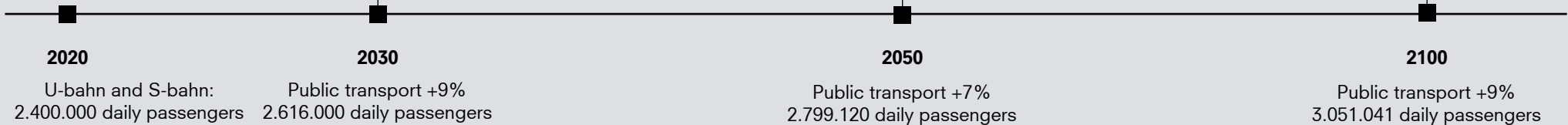
Polycentric scenario
216.000 passengers
72 vertiports



Platform scenario
399.120 passengers
133 vertiports



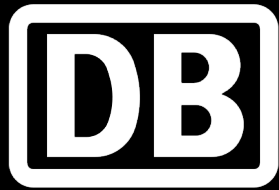
Intercity scenario
651.041+ passengers
217+ vertiports



DESIGN BRIEF

Design brief

CLIENT AMBITION



Deutsche Bahn

Berlin, Germany

1 Grow sustainable

2 Increase reliability

3 Be fully carbon neutral



Berliner Verkehrsbetriebe

Berlin, Germany

1 To be carbon neutral by 2030

2 Reliable urban mobility

3 Accessable property typologies

4 Invest in sustainable infrastructure



Deutsche Post DHL

Bonn, Germany

1 Carbon neutral delivery

2 Experiment transport alternatives

3 Reliable time management

4 Solve last-mile dilemma

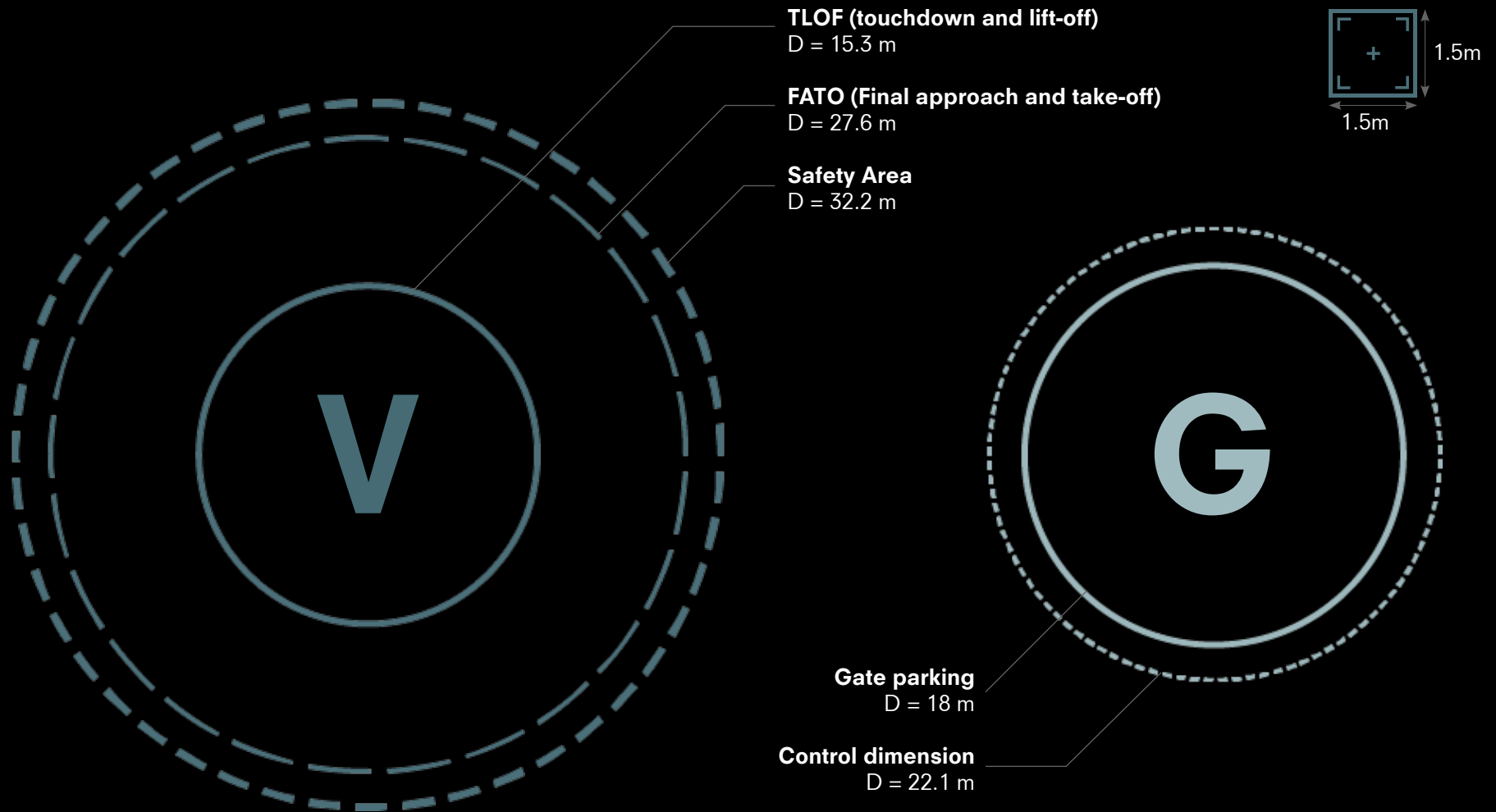
Design brief

STRATEGY



Design brief

GATE SIZES



Source: Ahn, B., & Hwang, H. S. (2022). Design Criteria and accommodating capacity analysis of Vertiports for urban air mobility and its application at Gimpo Airport in Korea. Applied sciences, 12(12), 6077. <https://doi.org/10.3390/app12126077>

Design brief

VERTIPORT APRON LAYOUT

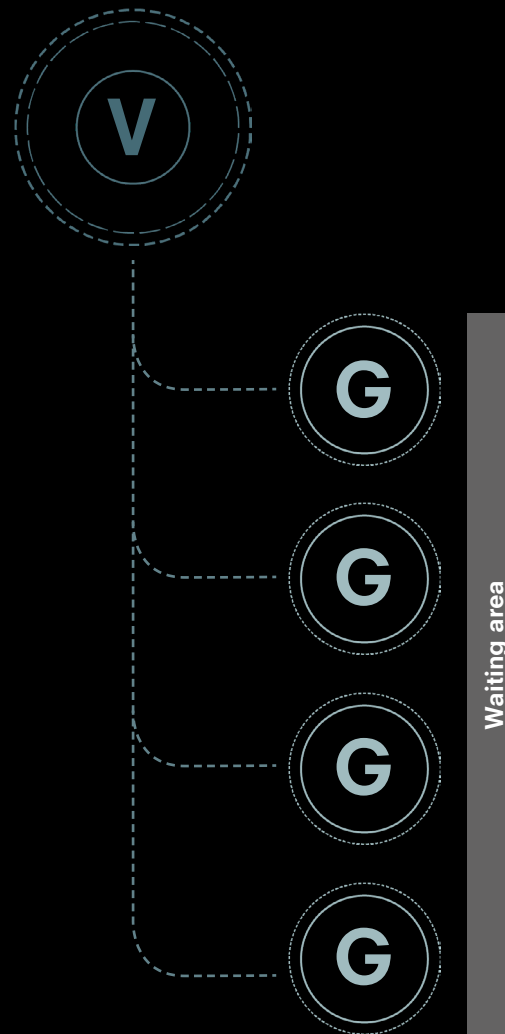
Linear

No gates, direct FATO access



Pier

Taxi to FATO



Satellite

Exclusive gate-to-FATO

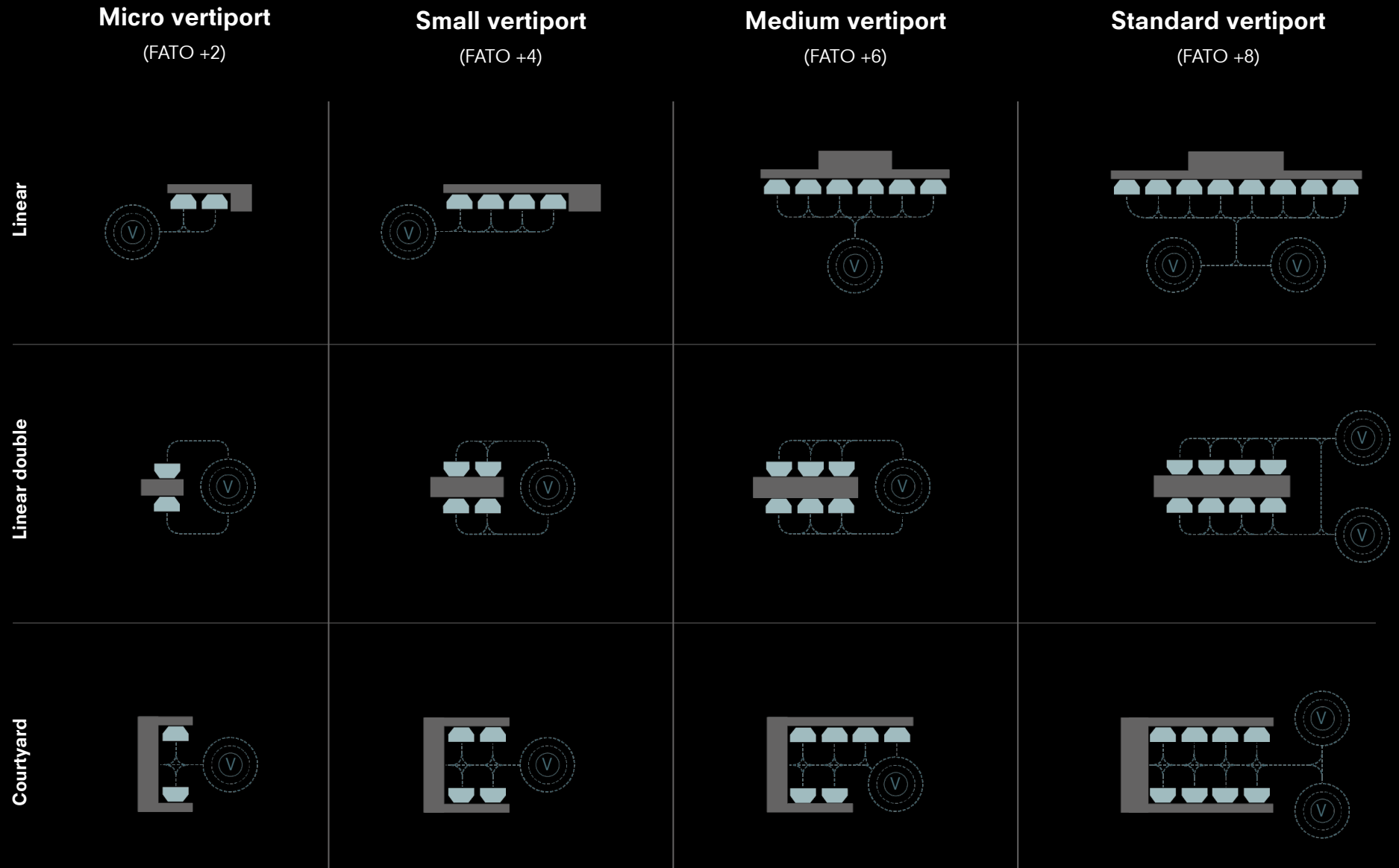


Source: Ahn, B., & Hwang, H. S. (2022). Design Criteria and accommodating capacity analysis of Vertiports for urban air mobility and its application at Gimpo Airport in Korea. Applied sciences, 12(12), 6077. <https://doi.org/10.3390/app12126077>



Design brief

MODULAR GATE STUDY



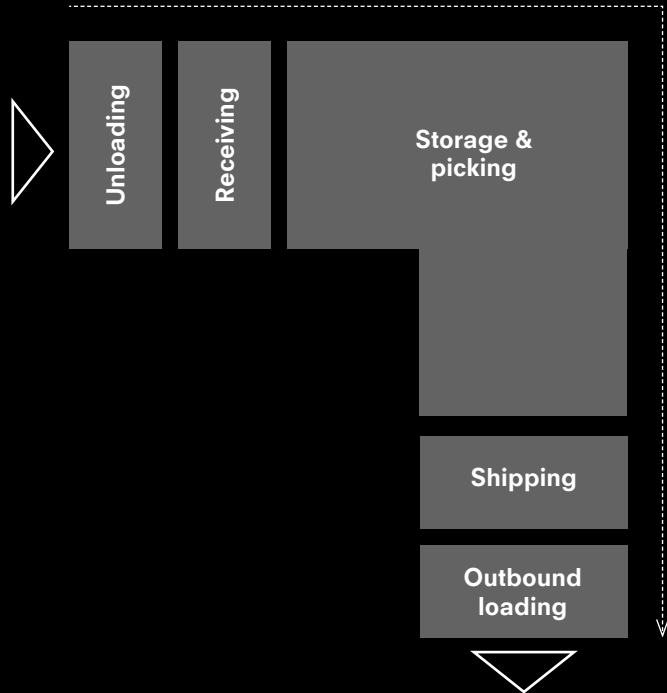
Source: Designing a scalable vertiport - lilium. (2020, 7 februari). <https://lilium.com/newsroom-detail/designing-a-scalable-vertiport>

Design brief

WAREHOUSE LAYOUT

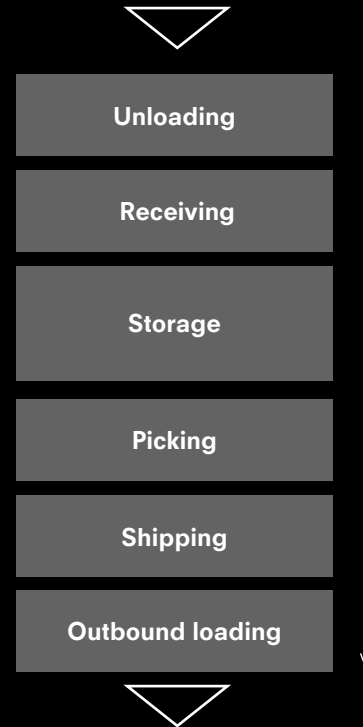
L-shaped inventory flow

For large storage need



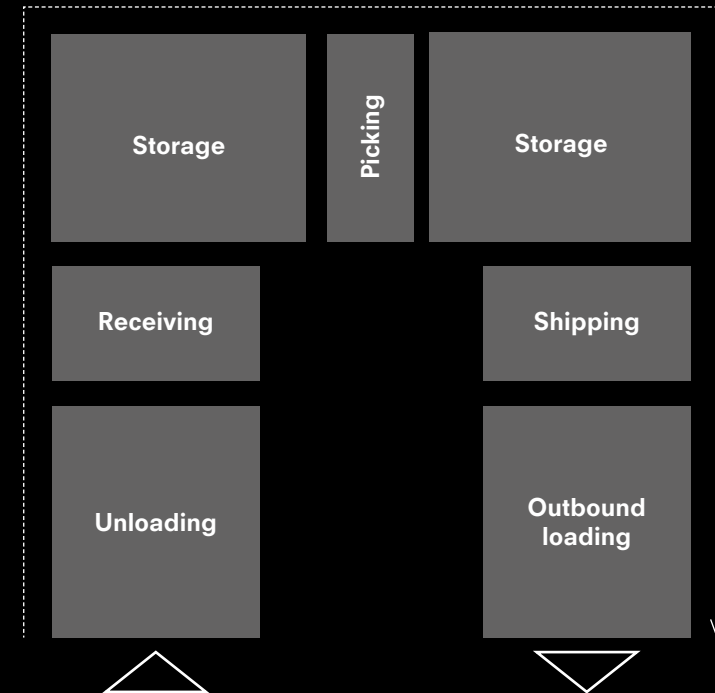
I-shaped inventory flow

Beneficial for large through-flow



U-shaped inventory flow

Most common in warehouse design



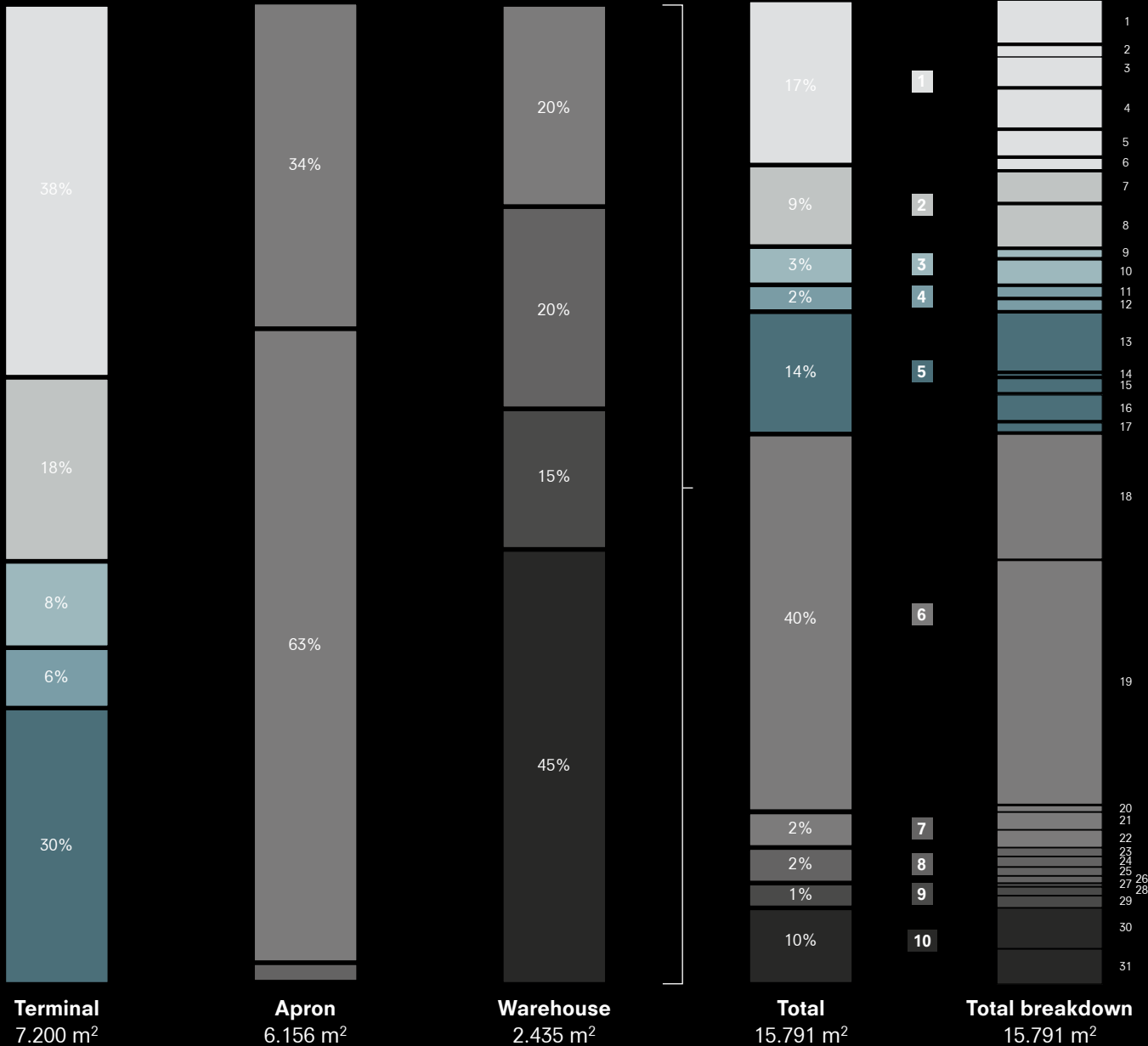
Sources: [1] Brophy, M., & Aviso, A. (2023, 3 maart). Warehouse Layout Design Planning: Steps + Examples. Fit Small Business. <https://fitmallbusiness.com/warehouse-layout/>

[2] Jaimes, W. A., Pineda, M. A. O., Quiñones, T. A. R., & López, L. T. (2012). Optimization of a warehouse layout used for storage of materials used in ship construction and repair. Ciencia y tecnología de buques, 5(10), 59. <https://doi.org/10.25043/19098642.59>



Design brief

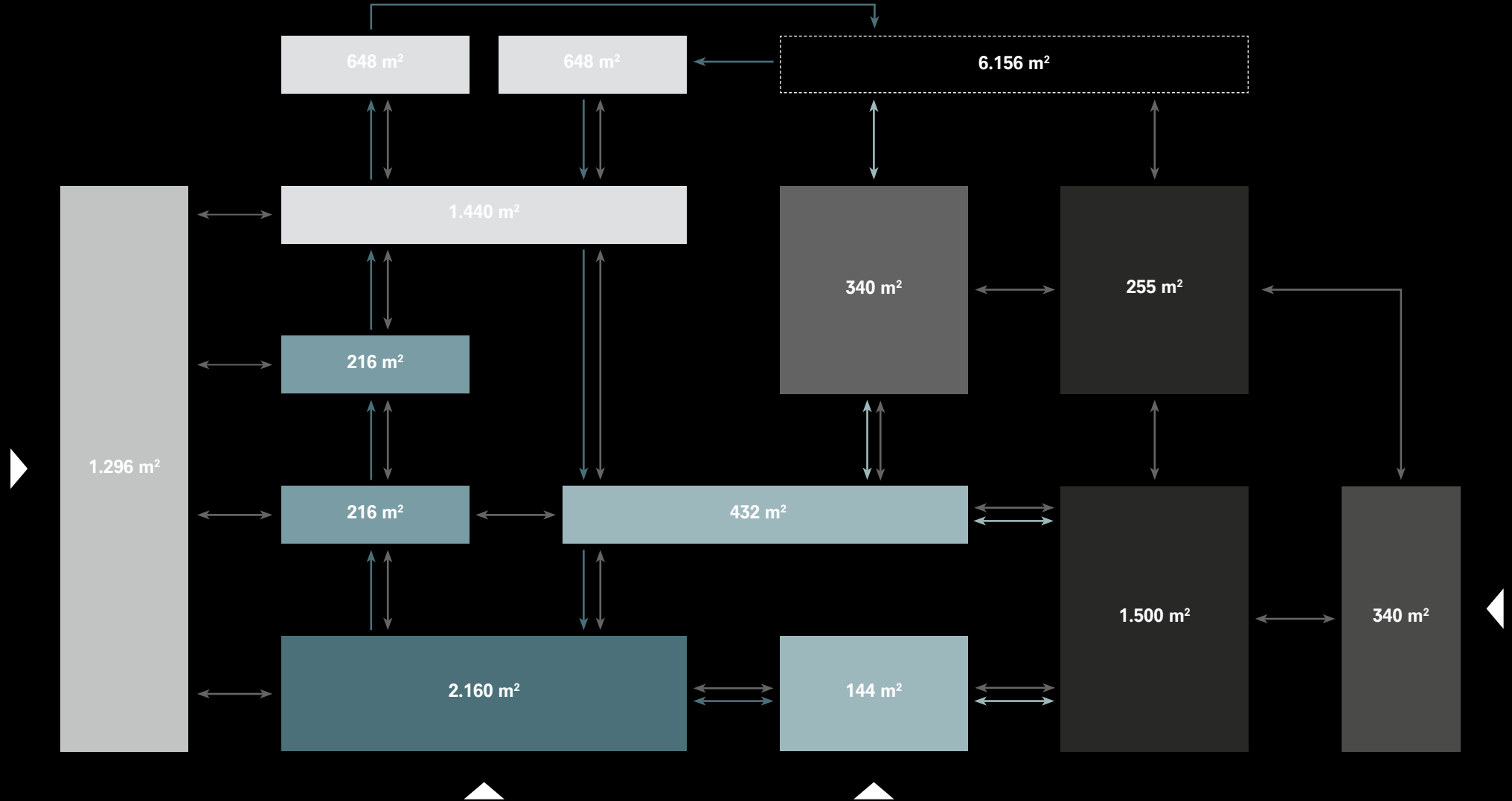
PROGRAM BAR



Departures & arrivals	17%
1. Gates	4,5%
2. Ticketing	0,5%
3. Arrivals area	4%
4. Waiting area	4,5%
5. Shops & restaurants	2,5%
6. Restrooms	1%
Terminal services	9%
7. Offices & other	4%
8. Maintenance	5%
Bagage distribution	3%
9. Ground handling	1%
10. Claim area	2%
Acces procedures	2%
11. Check-in counters	1%
12. Security checkpoints	1%
Main hall	14%
13. Flow space	7%
14. Transfer services	0,5%
15. Information desk	1,5%
16. Retail and dining	3%
17. Restrooms	1%
Apron	40%
18. FATO	13%
19. Vertipads	26%
20. Charging	1%
Delivery apron	2%
21. Loading	1%
22. Unloading	1%
Warehouse office	2%
23. Shipping and receiving	0,5%
24. Security	0,5%
25. Toilets	0,5%
26. Lounge	0,5%
Drone service	1%
27. Charging	0,3%
28. Maintenance and repair	0,3%
29. Drone control center	0,3%
Storage	10%
30. Warehouse racks	5%
31. Data center	5%

Design brief

PROGRAM SCHEME



Legend

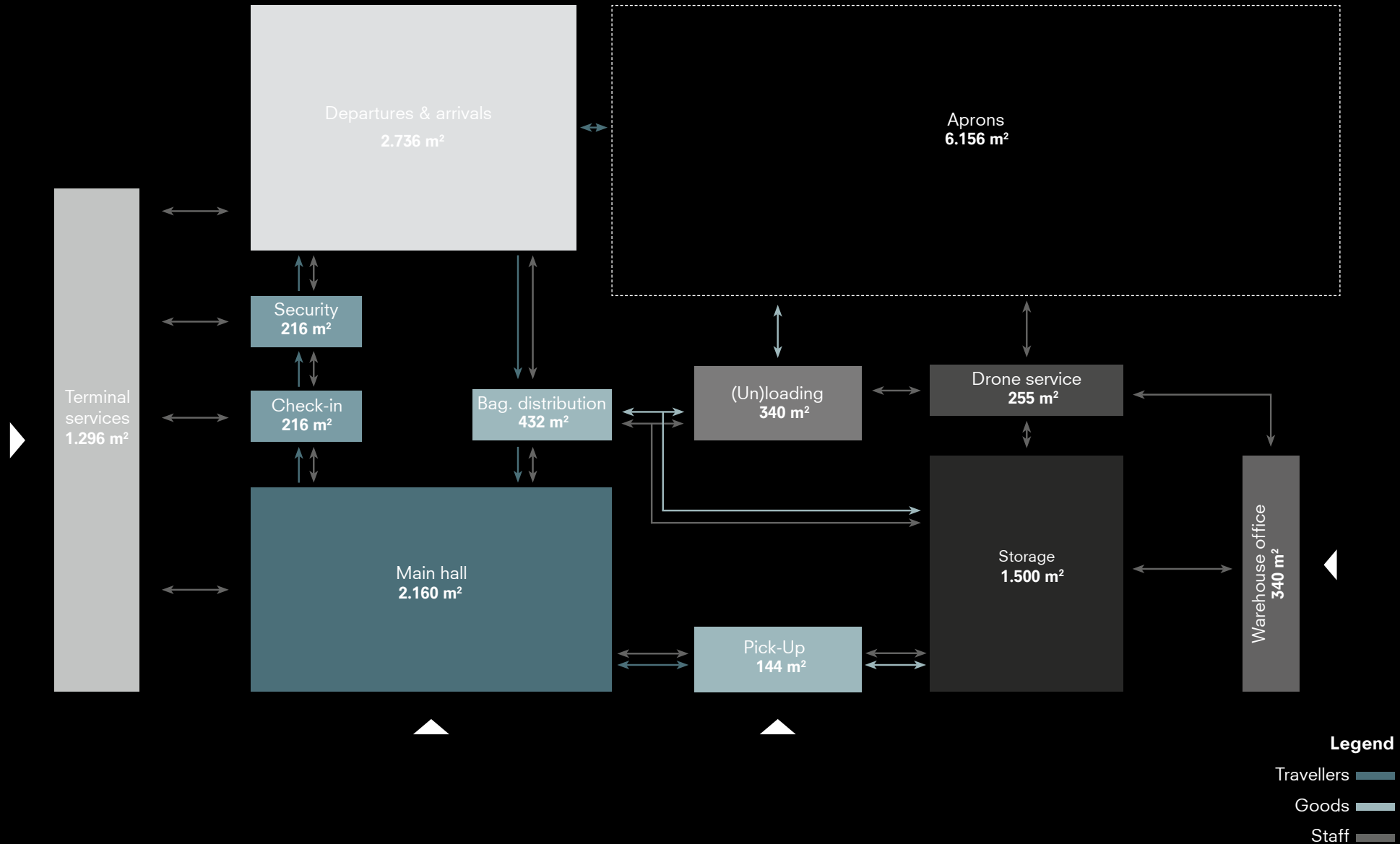
Travellers

Goods

Staff



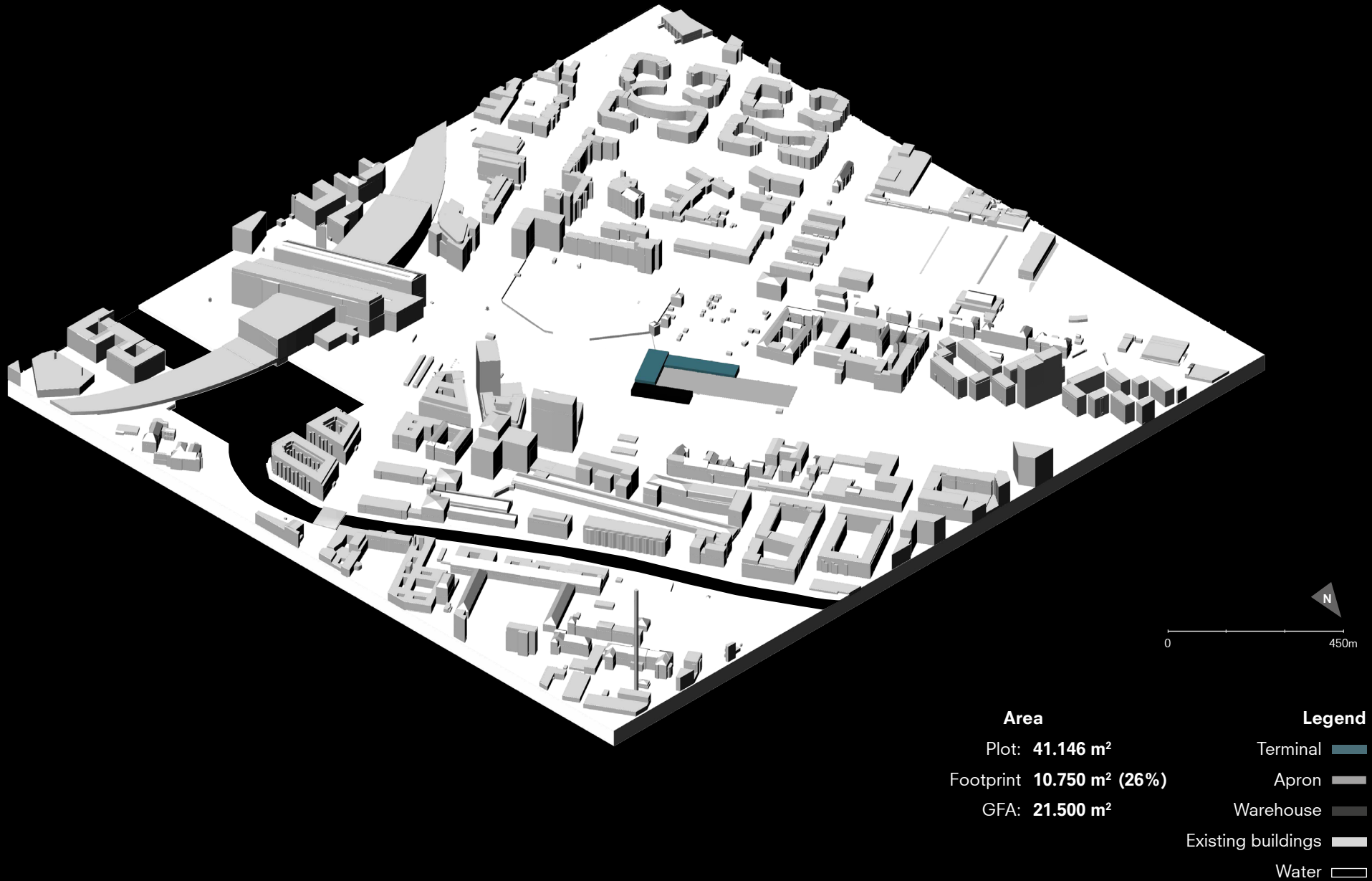
PROGRAM SCHEME SCALED



SITE



PREFERABLE COMPOSITION



DESIGN CONCEPT



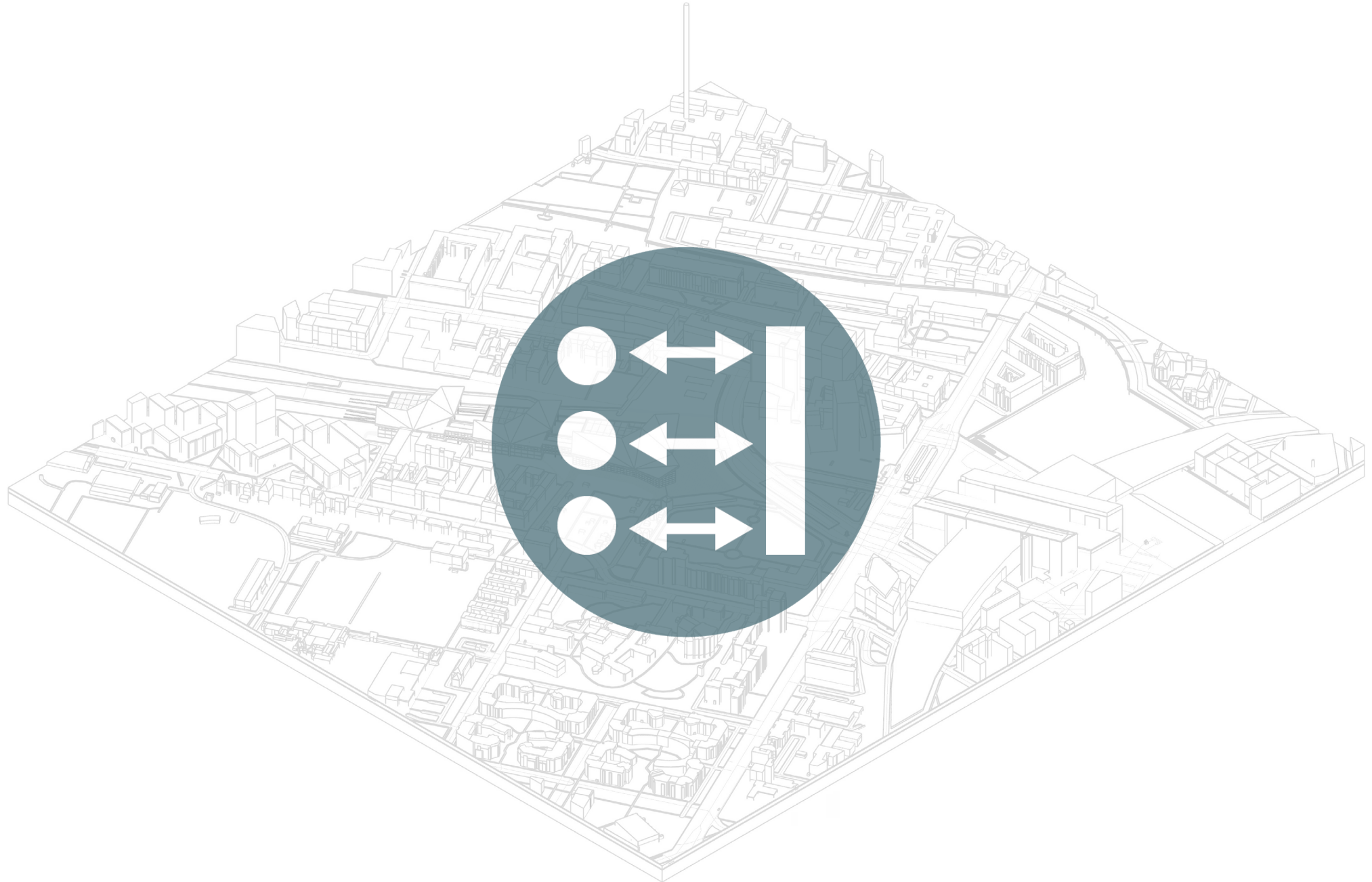
Design concept

TRANSIT CONNECTION



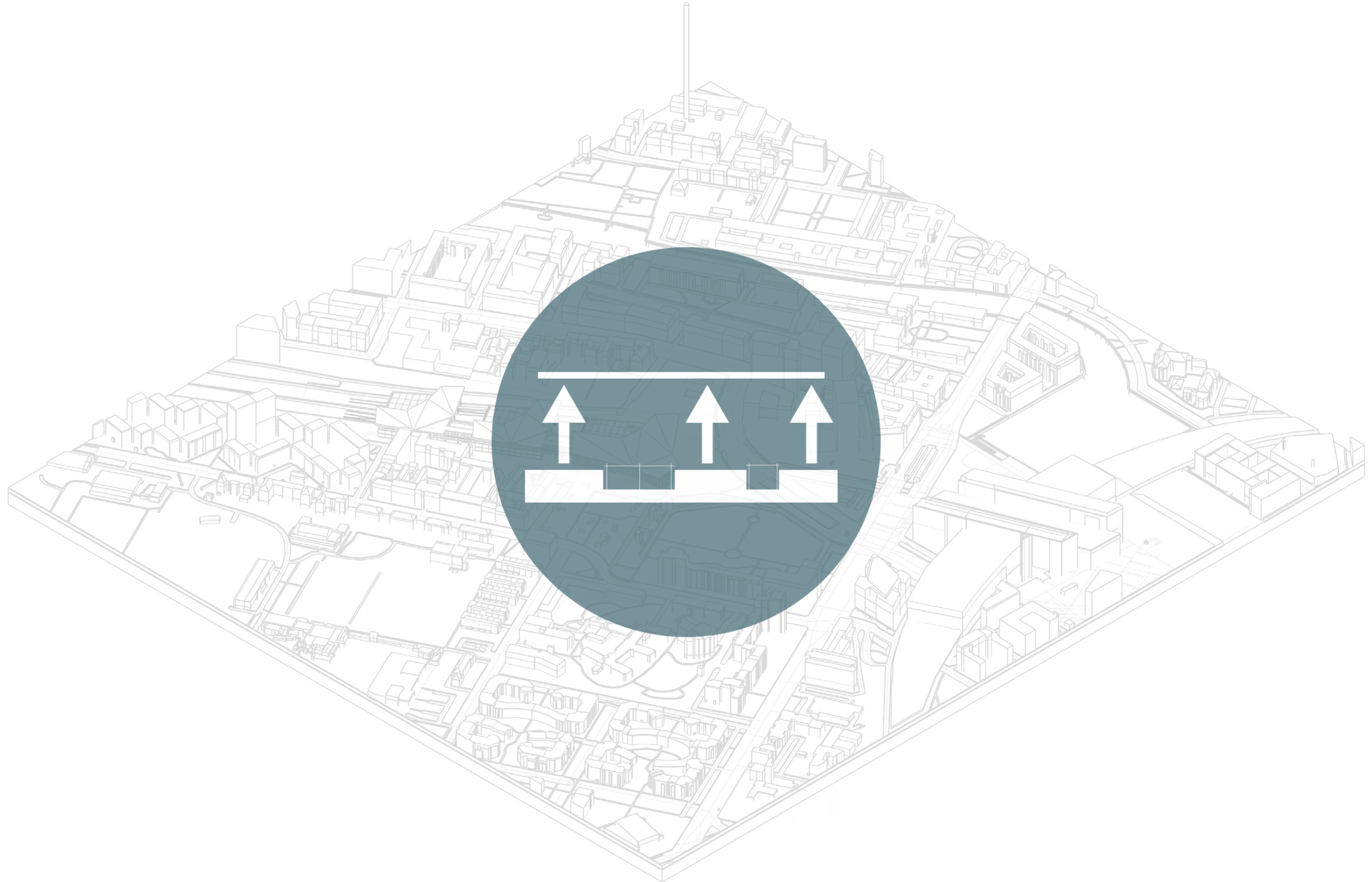
Design concept

GATES ALONG APRON



Design concept

APRON OVER TRACKS



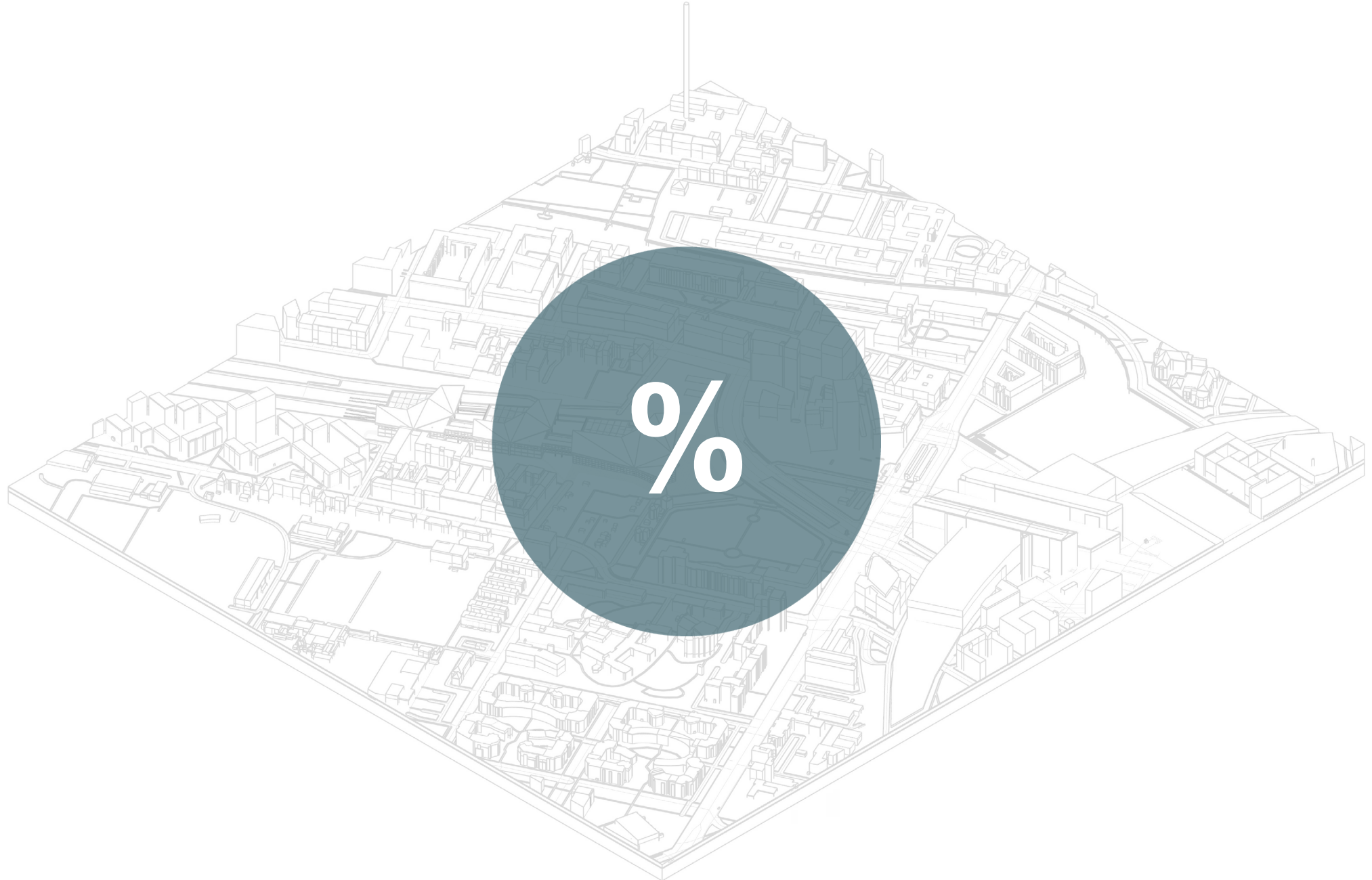
Design concept

MODULAR SYSTEM



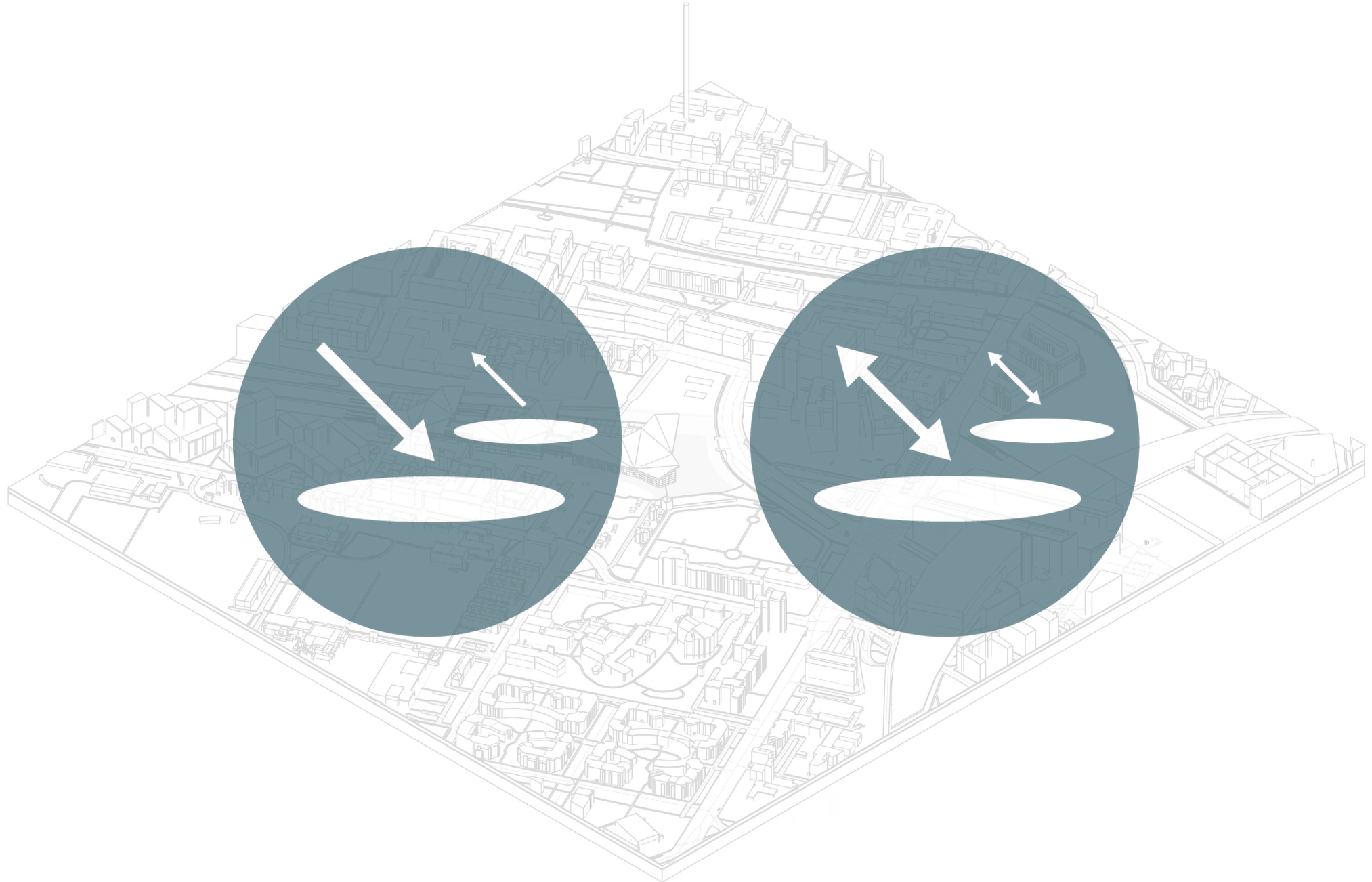
Design concept

DATA INCLUDED



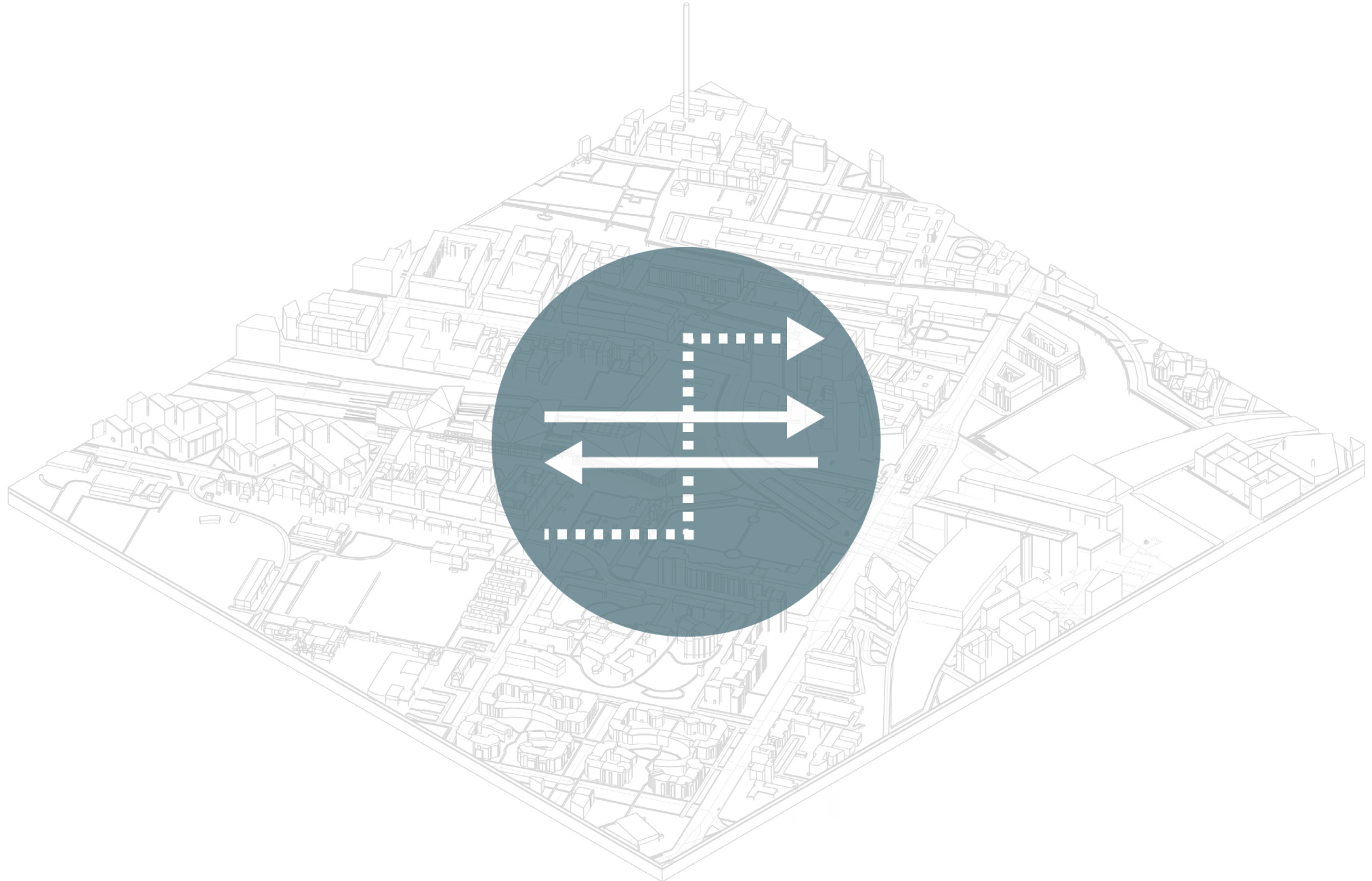
Design concept

FLEXIBLE DRONE NETWORK



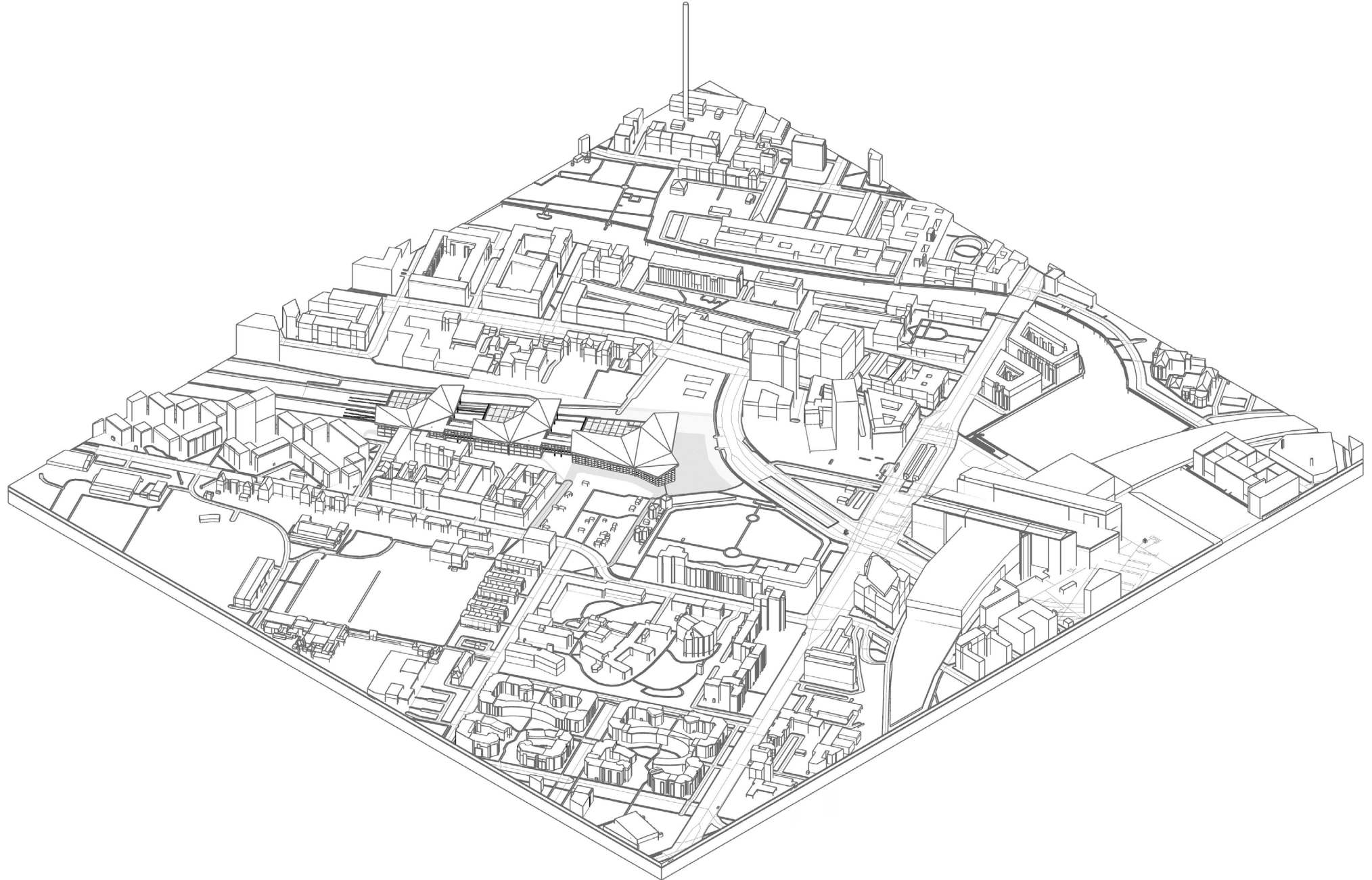
Design concept

INTEGRATED USER FLOWS

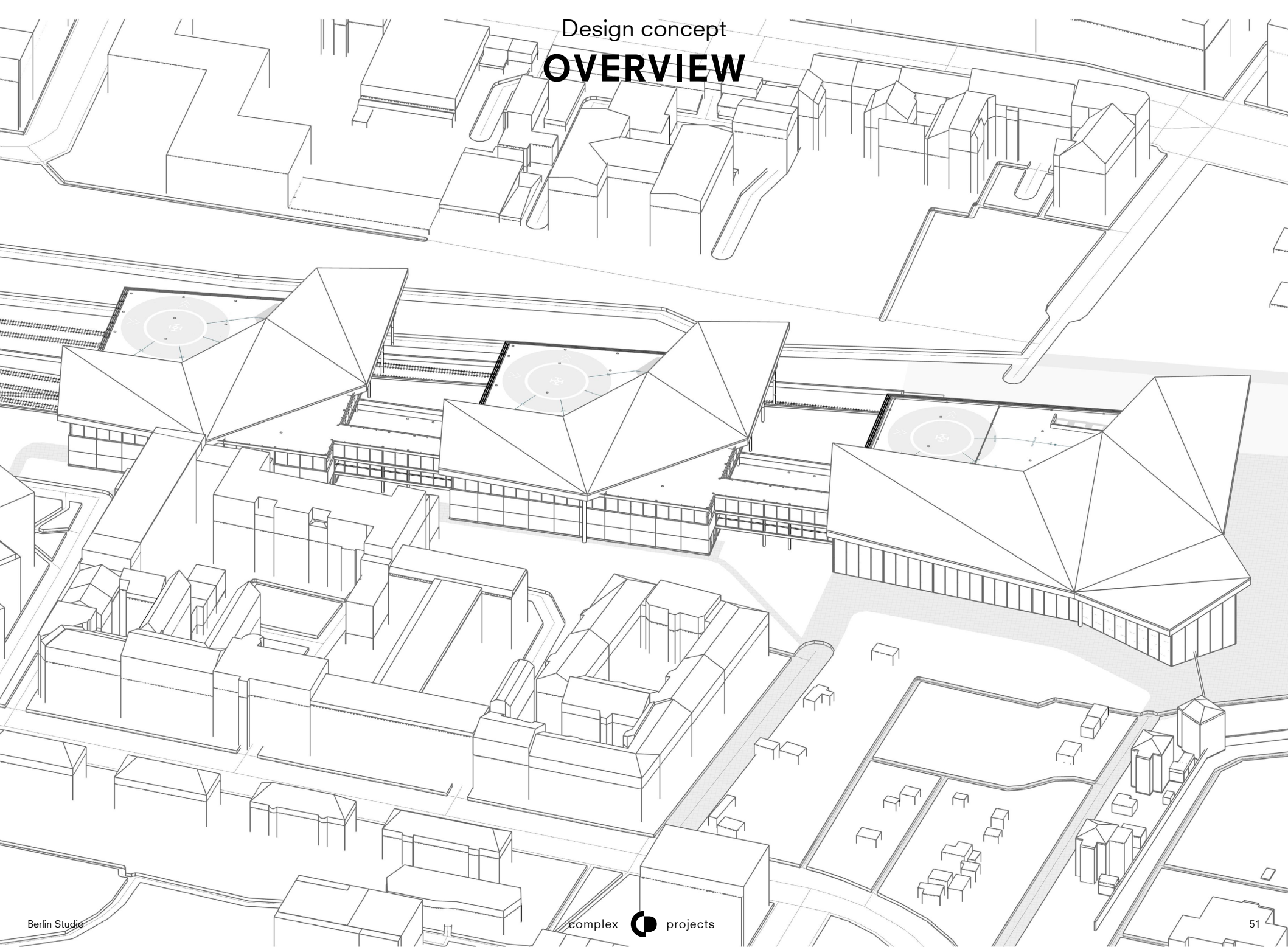


Design concept

URBAN CONCEPT

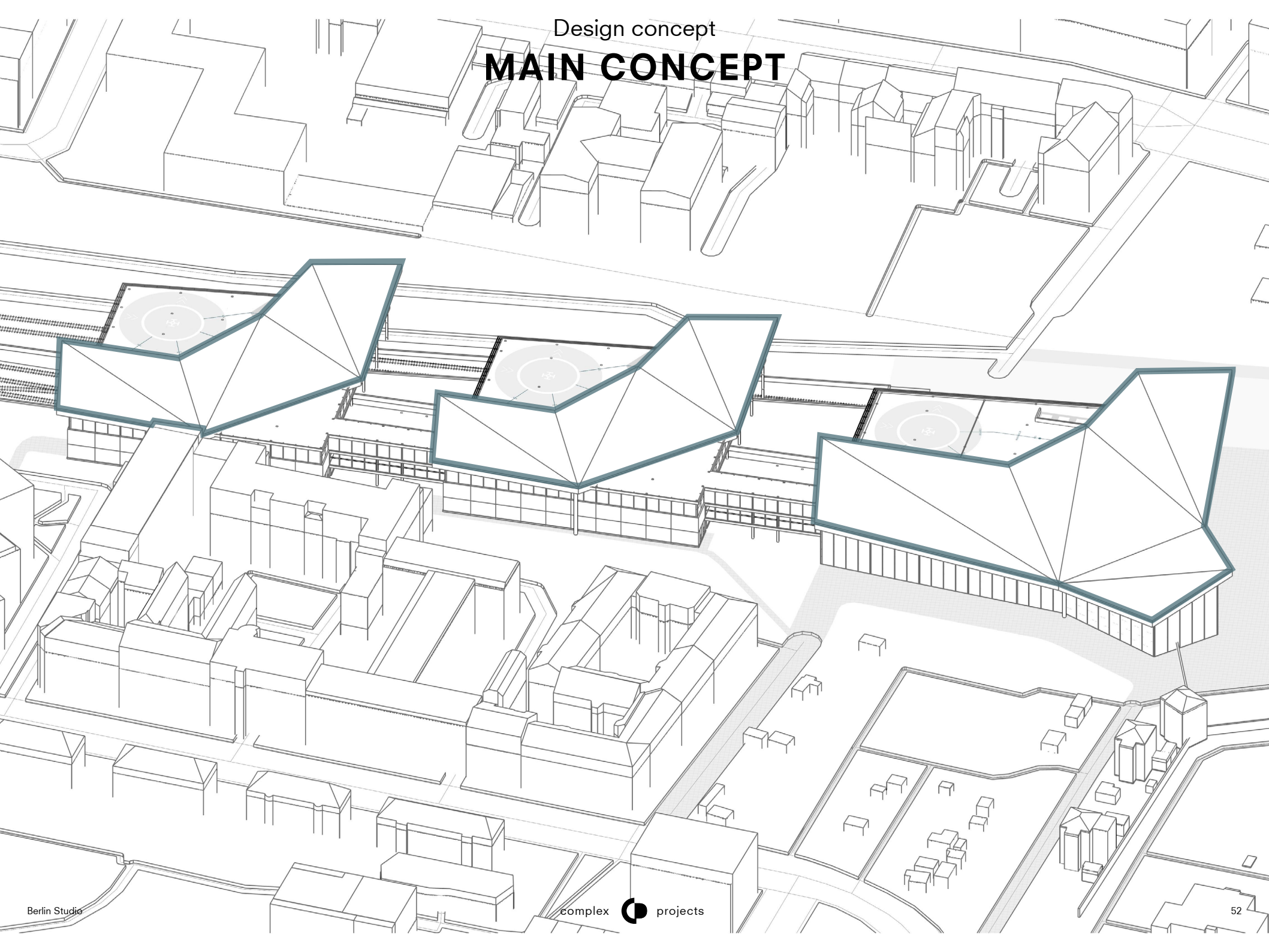


Design concept
OVERVIEW



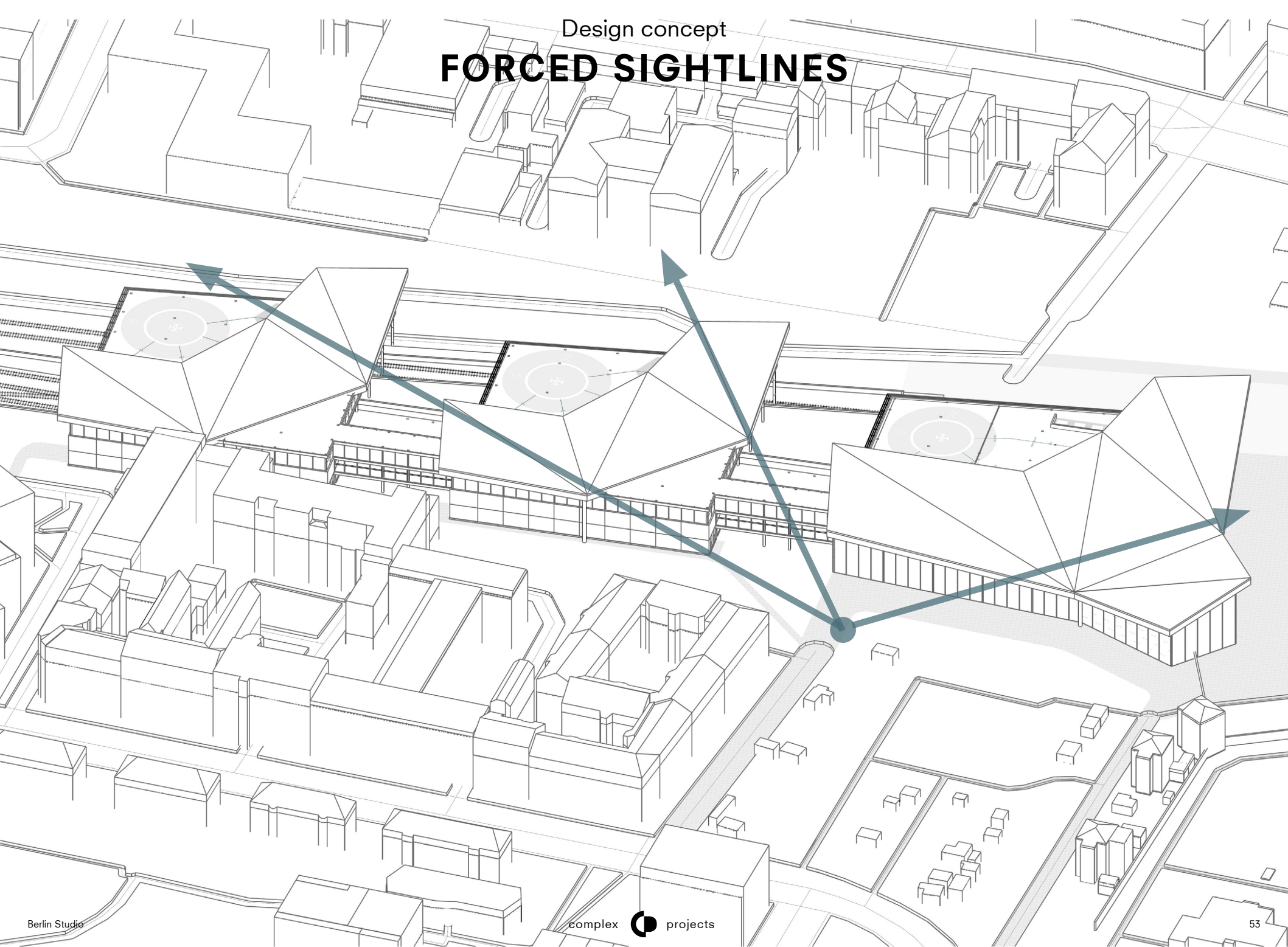
Design concept

MAIN CONCEPT



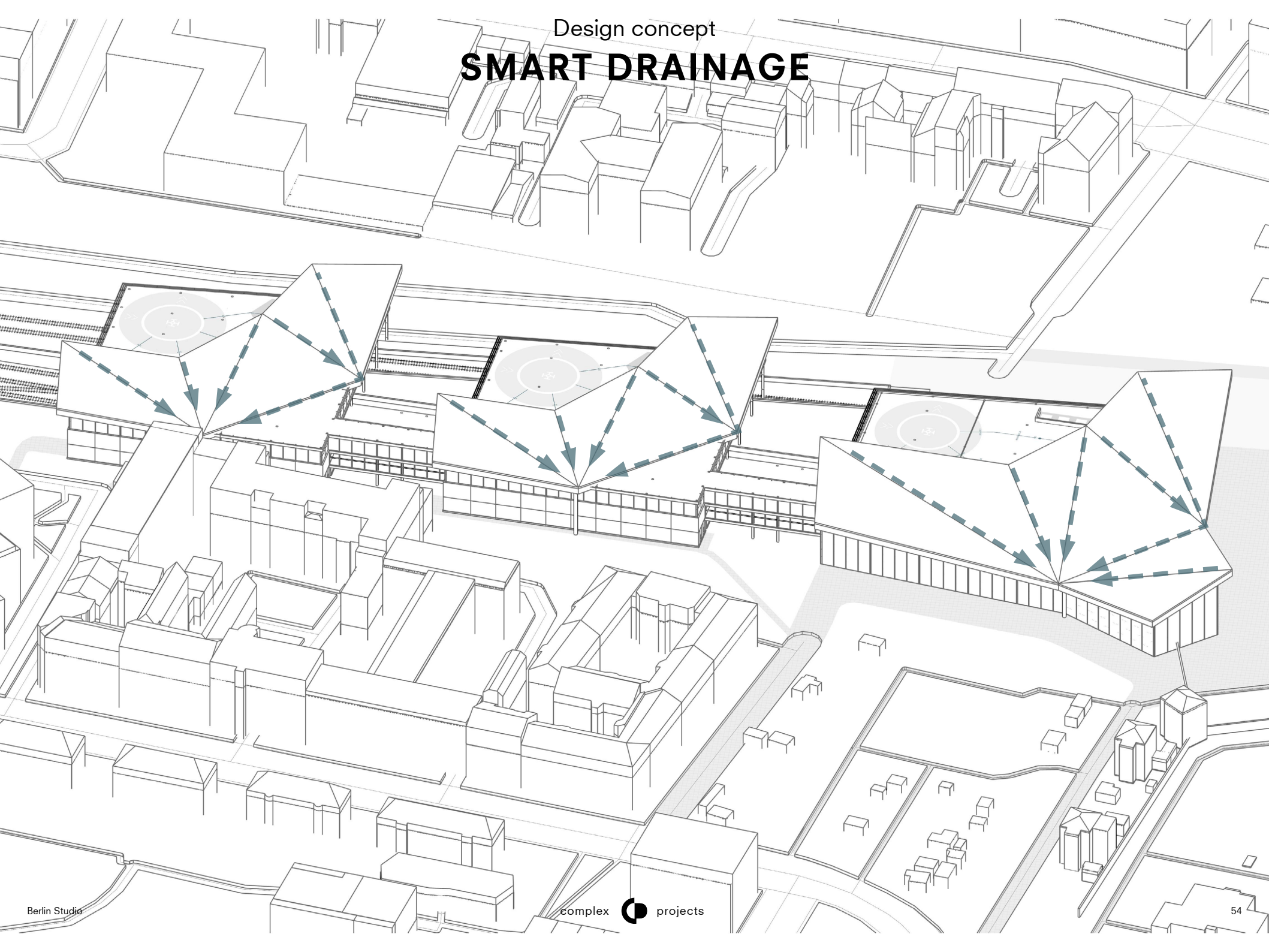
Design concept

FORCED SIGHTLINES



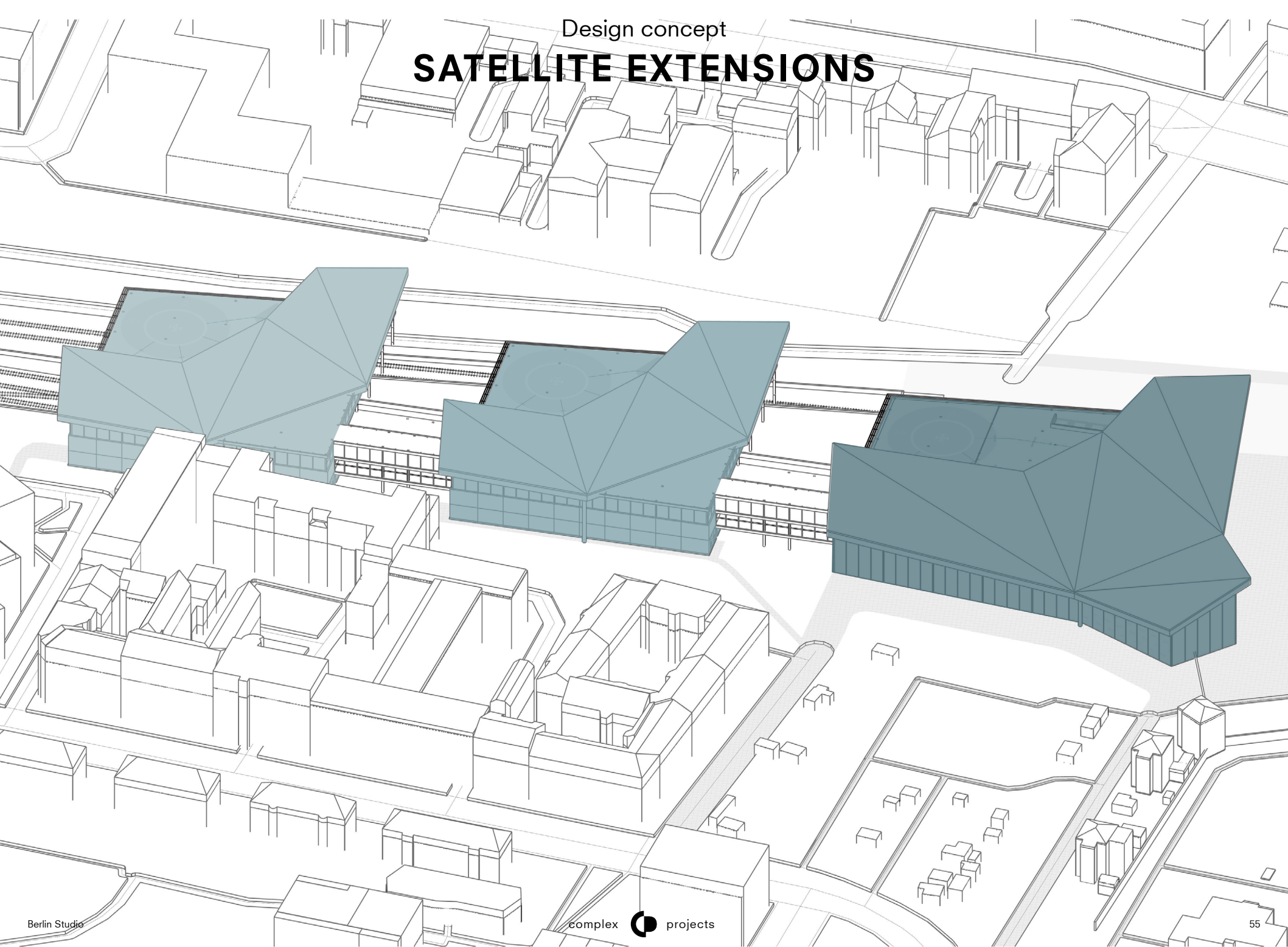
Design concept

SMART DRAINAGE



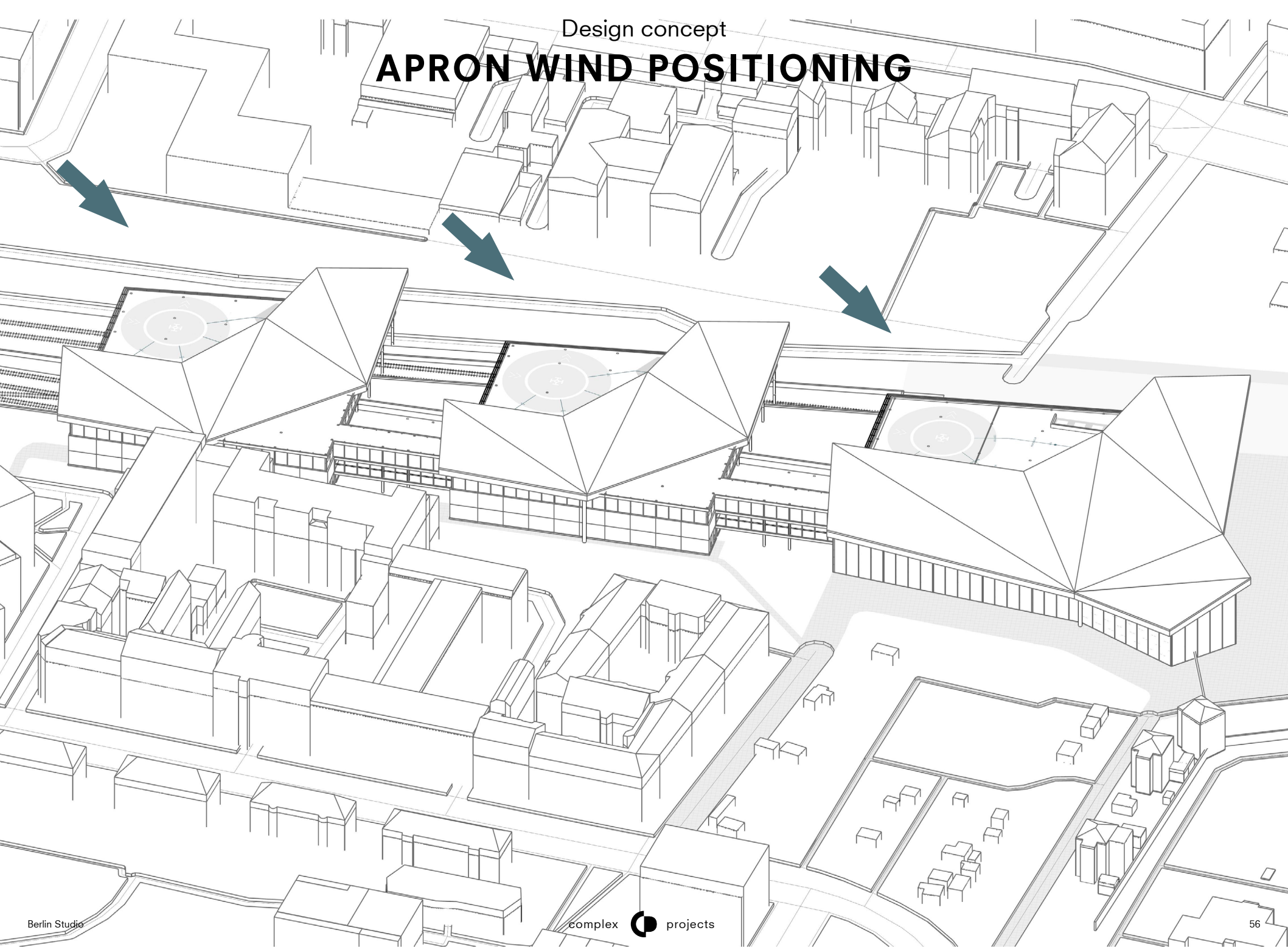
Design concept

SATELLITE EXTENSIONS



Design concept

APRON WIND POSITIONING



VERTIPOINT DESIGN PLANS



Design plans

SITUATION 1:1000

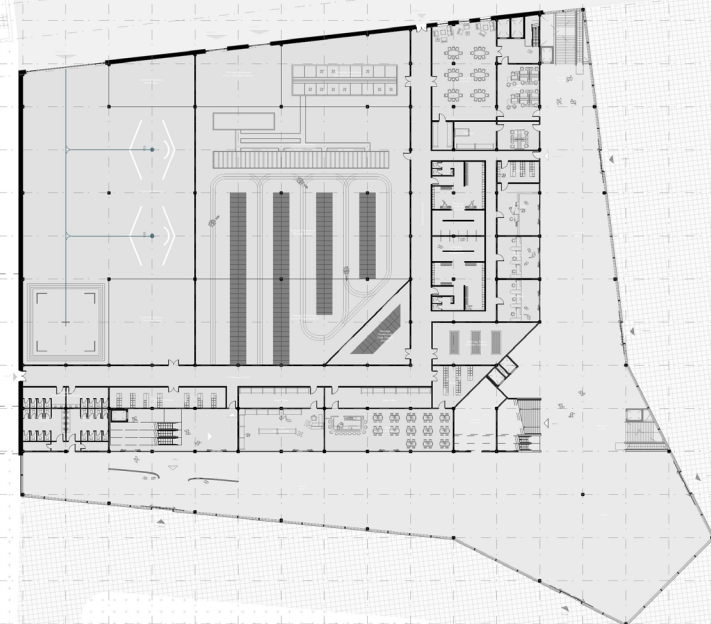
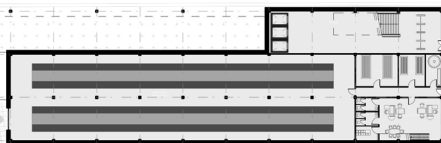
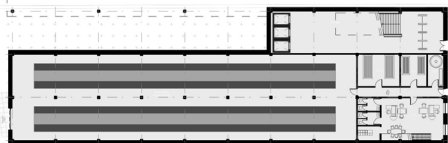


Design plans

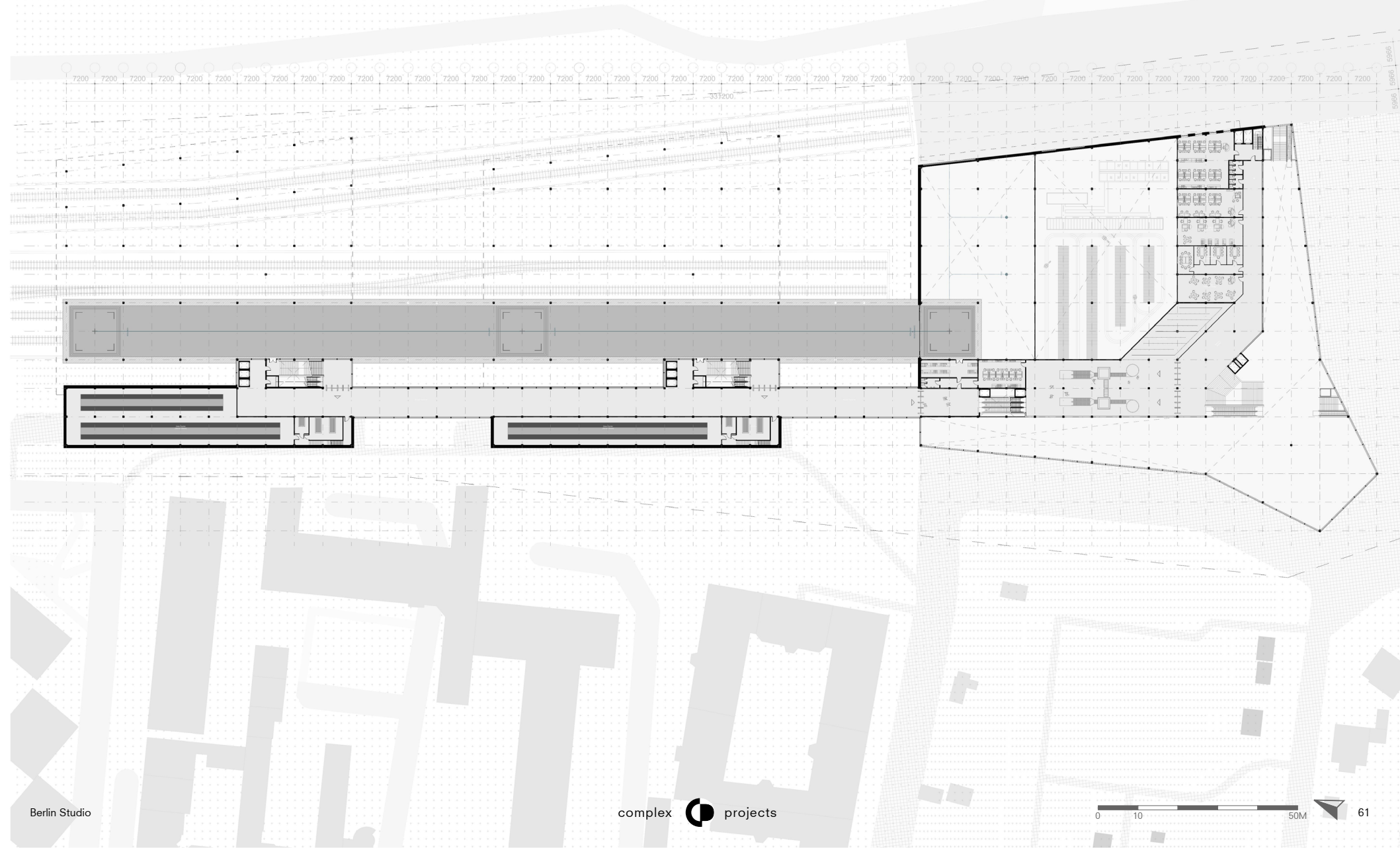
ACCESSIBILITY



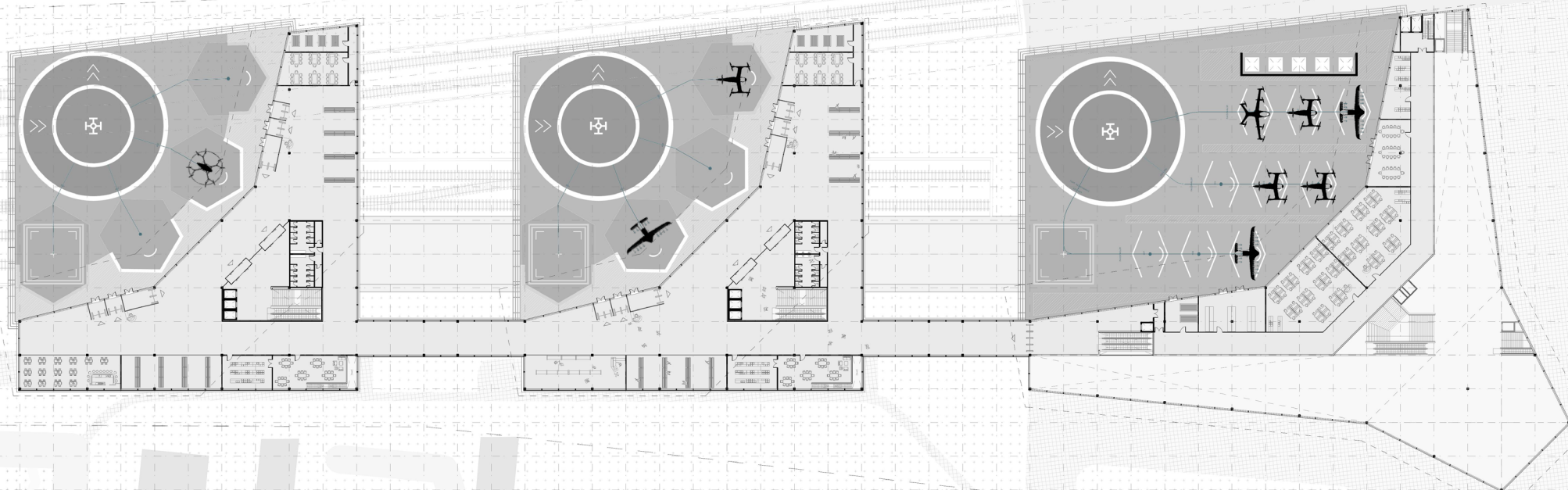
Design plans
LEVEL 0



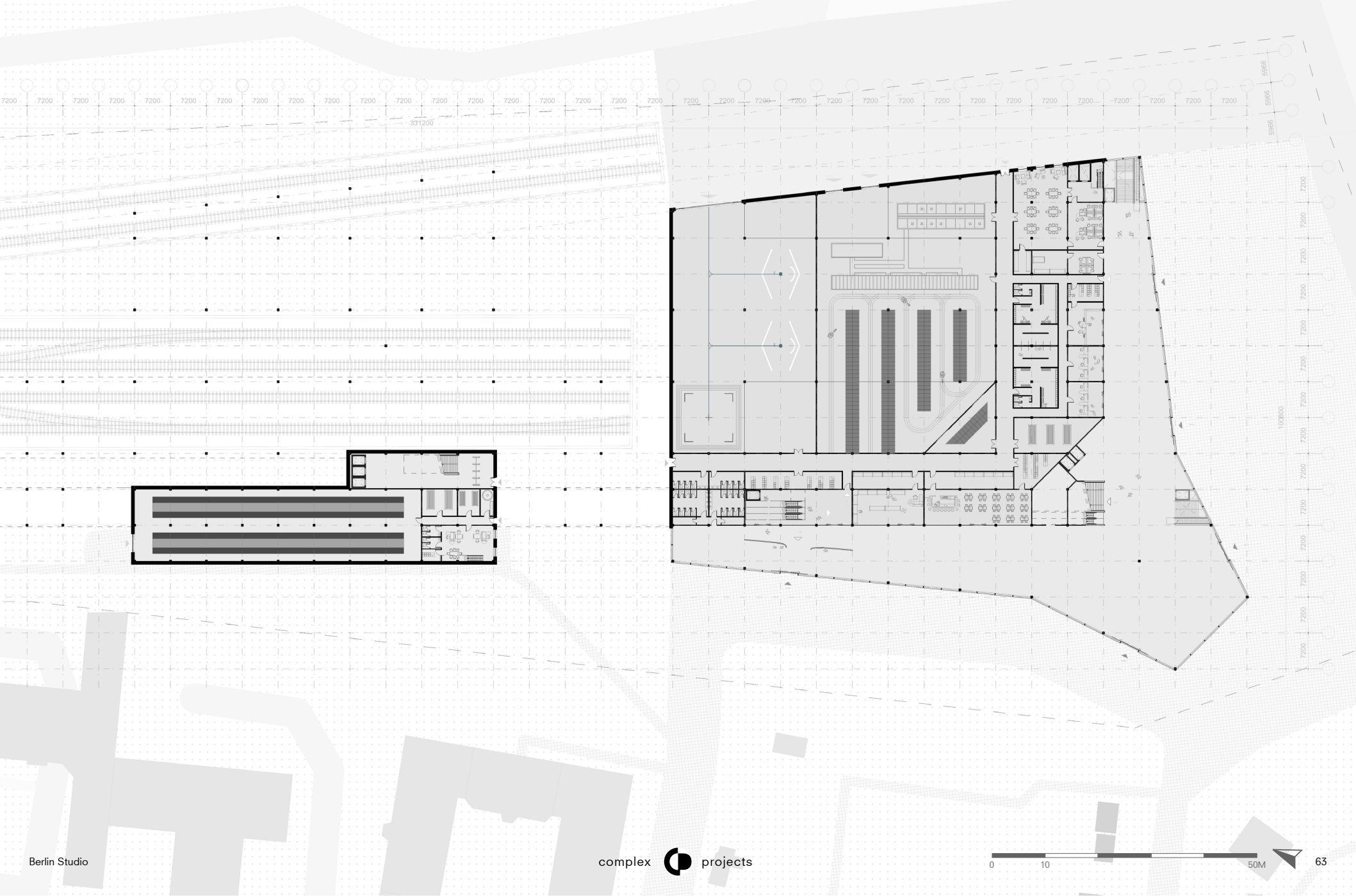
Design plans
LEVEL 1



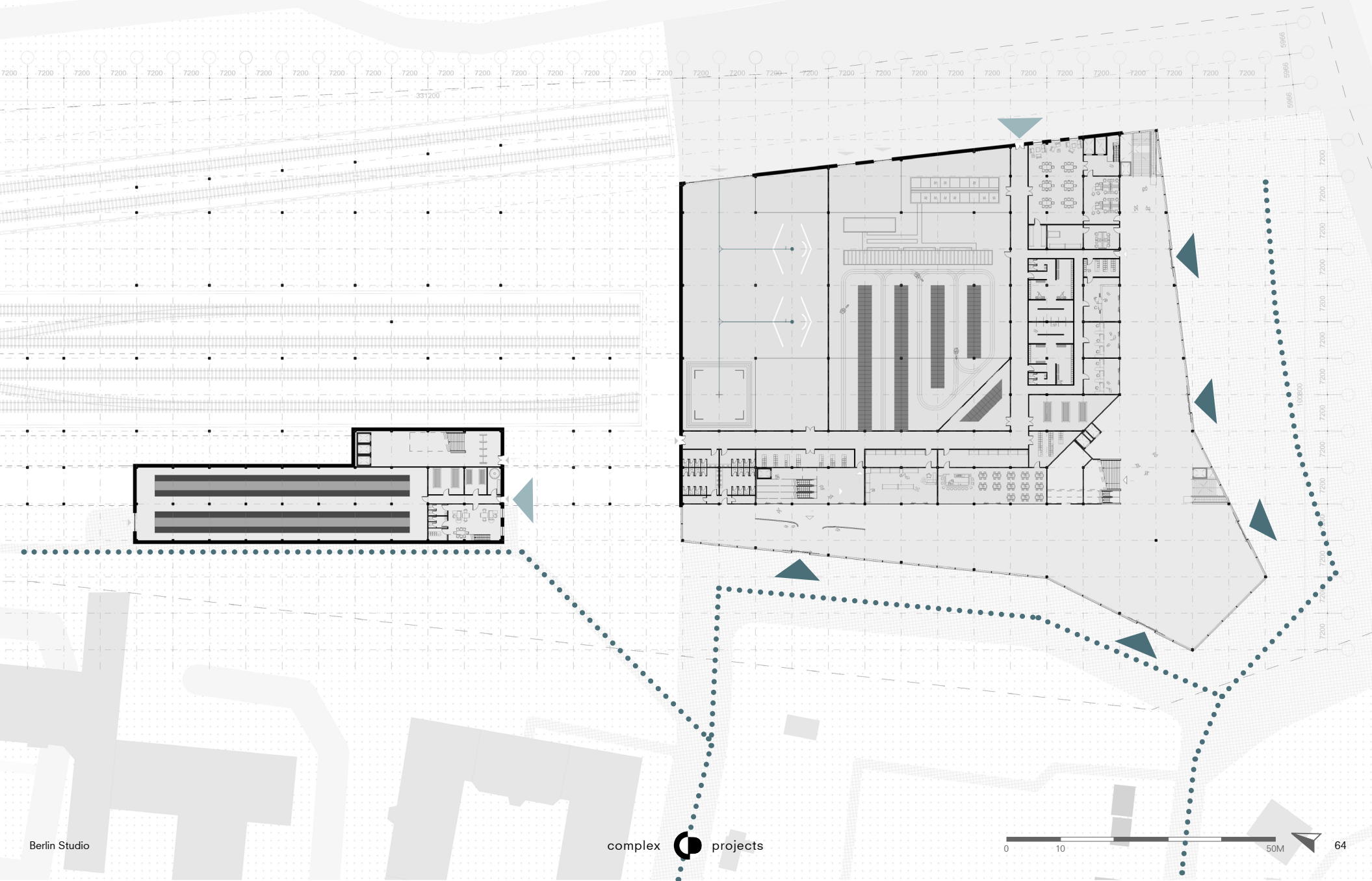
Design plans **LEVEL 2**



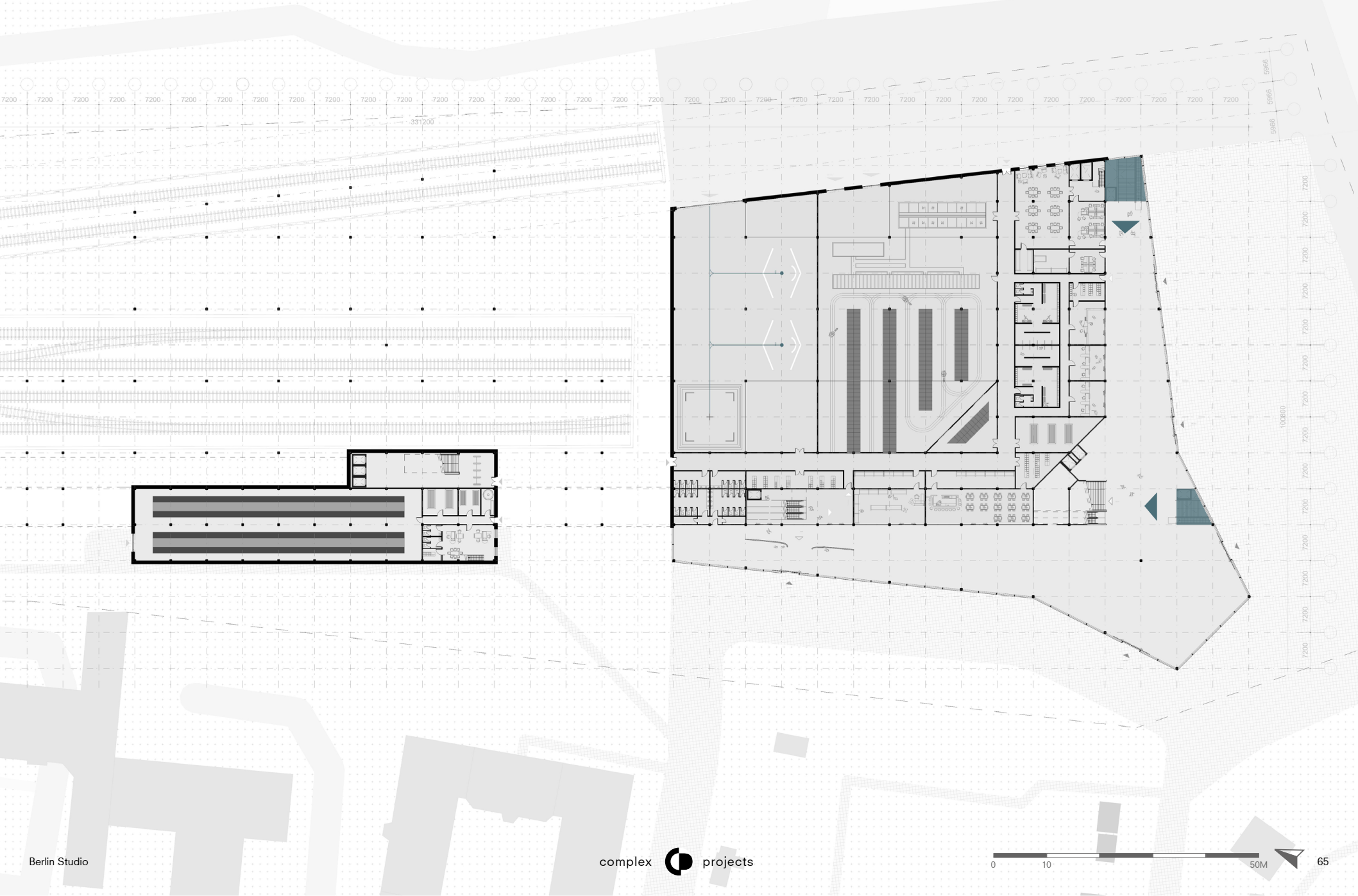
Design plans **LEVEL 0**



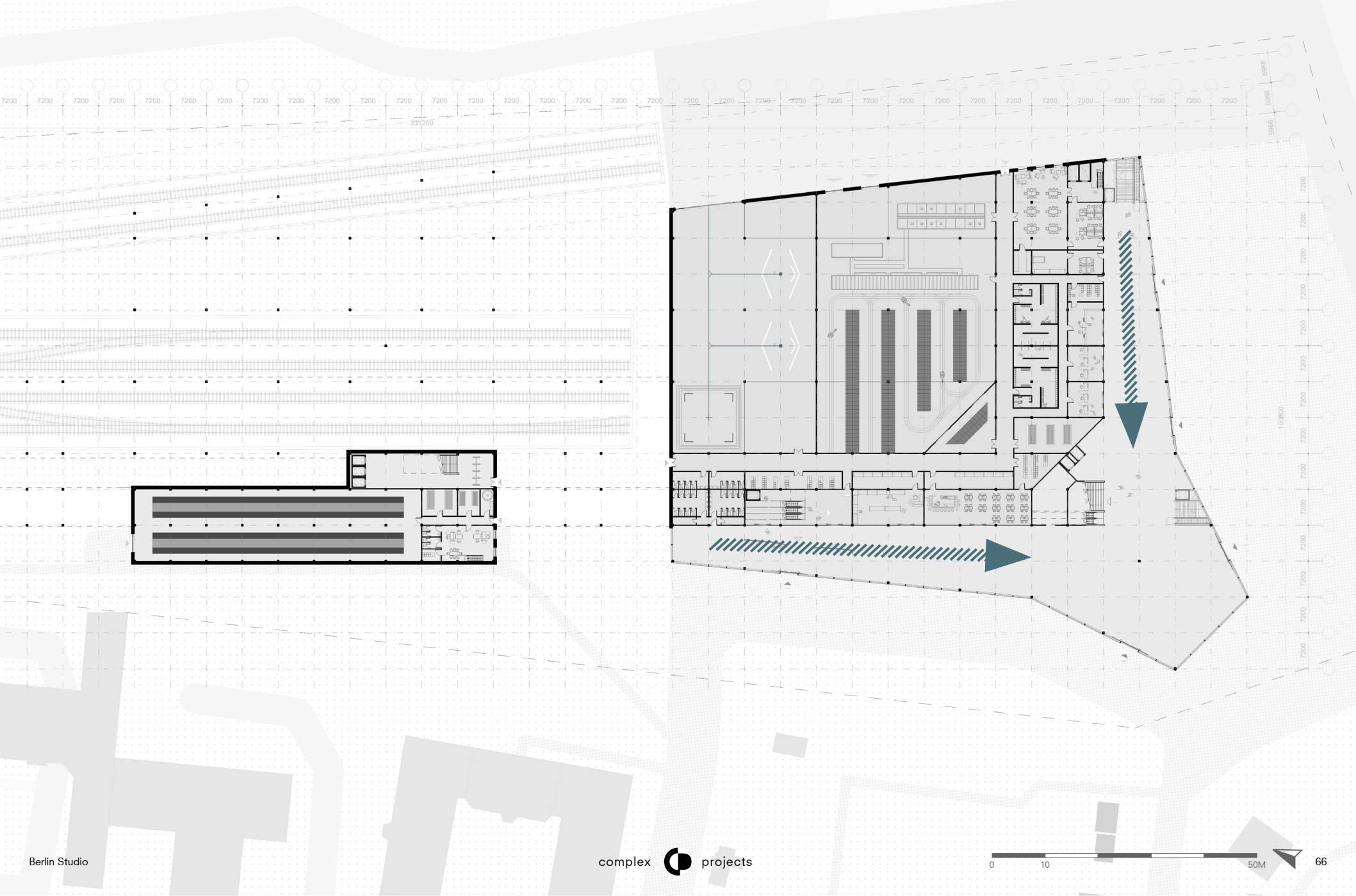
PASSENGER ENTRANCES



HAUPTBAHNHOF CONNECTION

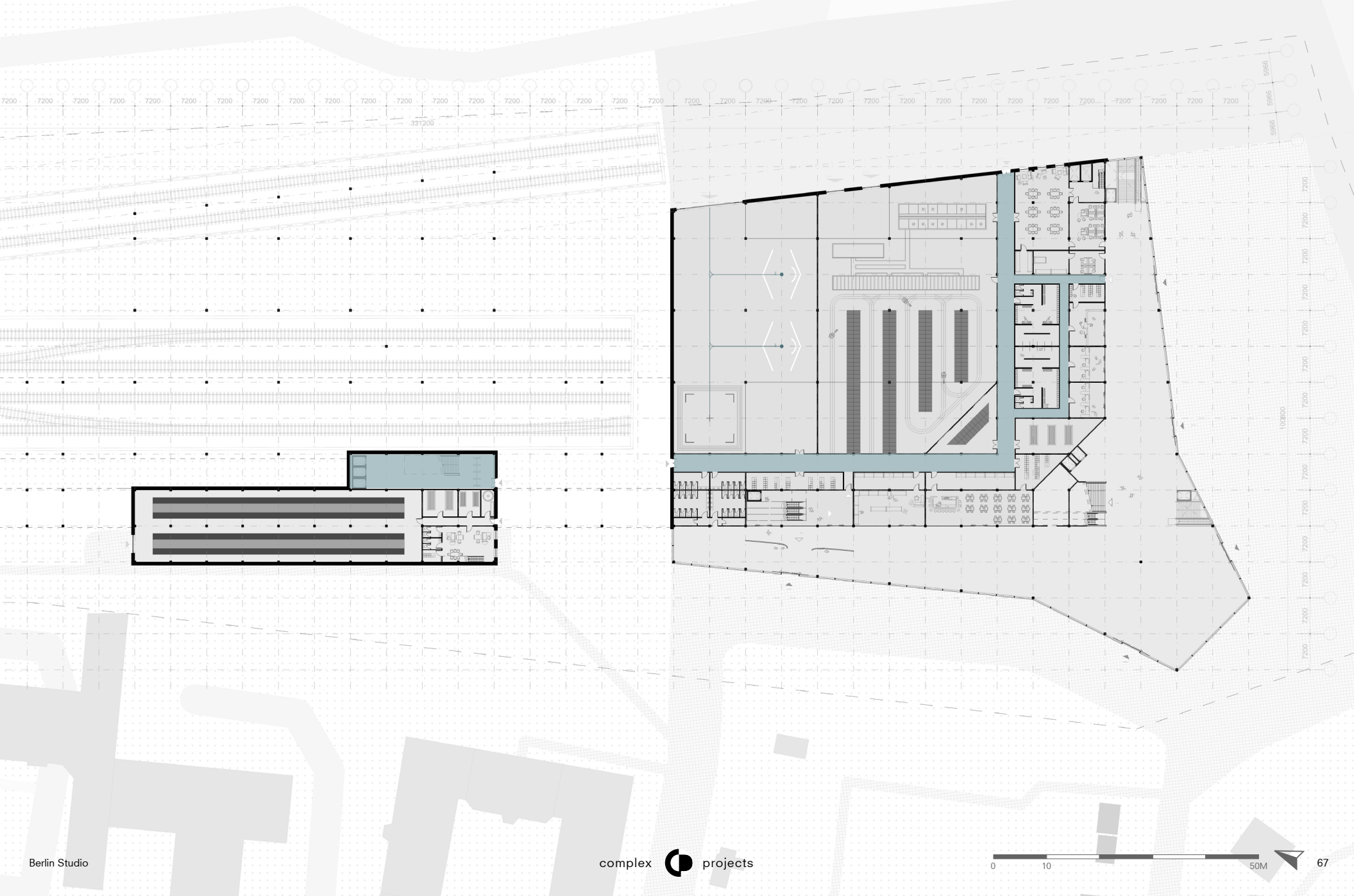


Design plans
ATRIUM



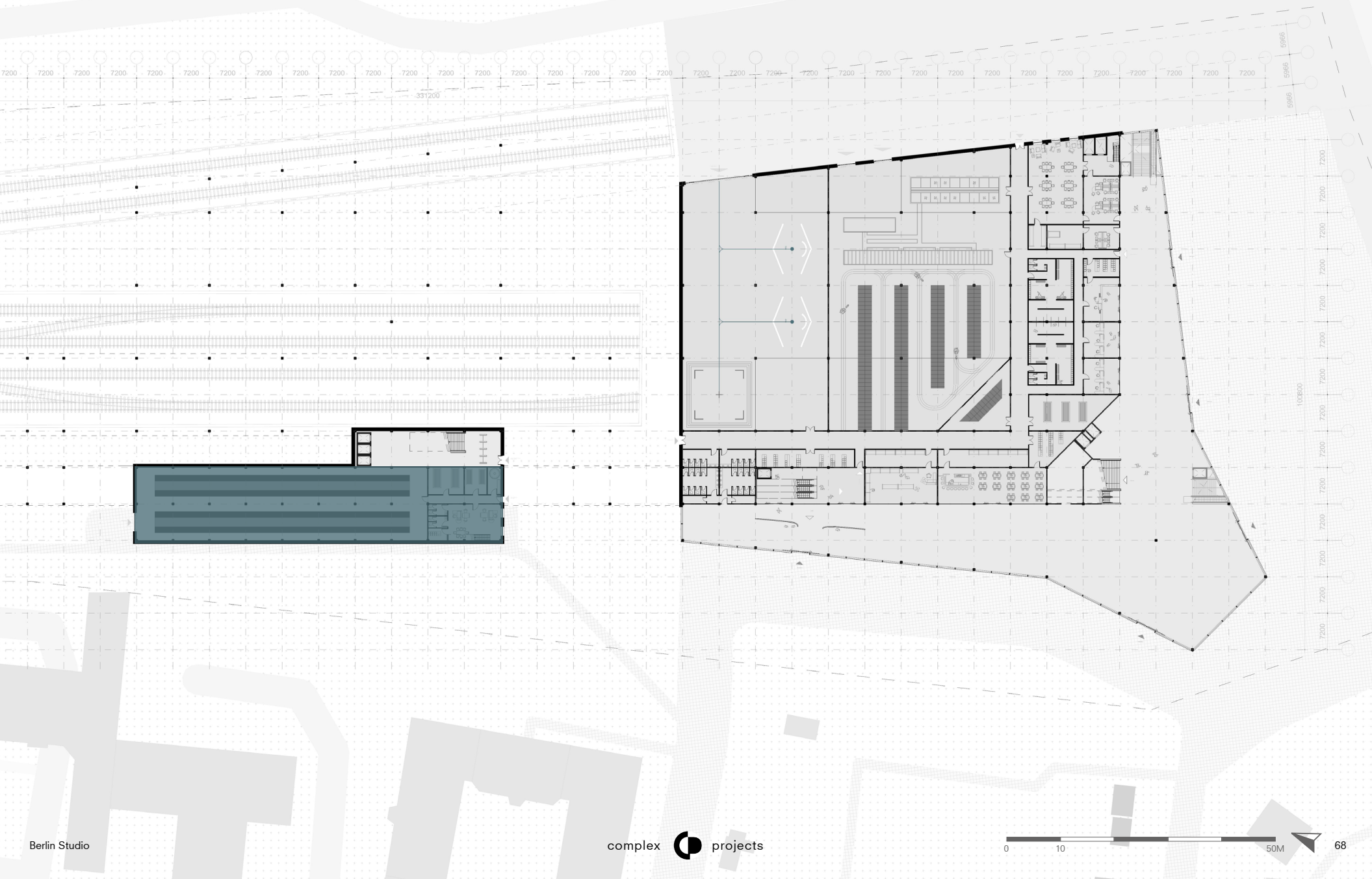
Design plans

STAFF PASSAGE

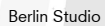


Design plans

DATA CENTER



LEVEL 1



Design plans

PUBLIC CORRIDOR

This architectural site plan illustrates a proposed public corridor project. The plan is overlaid on a grid with horizontal dimensions of 7200 units and vertical dimensions of 5900 and 5965 units. A prominent feature is a large, irregularly shaped plot outlined in black, which contains a detailed building footprint. This building footprint includes a large central hall, several smaller rooms, and a series of rooms along one side. A blue-shaded area, possibly representing a water feature or a specific material, is located within the building footprint. To the left of the main plot, there is a long, narrow rectangular area, also outlined in black, which appears to be a parking lot or a service area. The surrounding area is divided into various zones, some of which are shaded in light gray. The plan includes various lines, dots, and symbols representing different elements of the design, such as walls, doors, windows, and landscaping. A scale bar at the bottom right indicates a distance of 50 meters. The text 'Design plans' and 'PUBLIC CORRIDOR' are prominently displayed at the top. The logos for 'Berlin Studio', 'complex projects', and '70' are located at the bottom.

Design plans

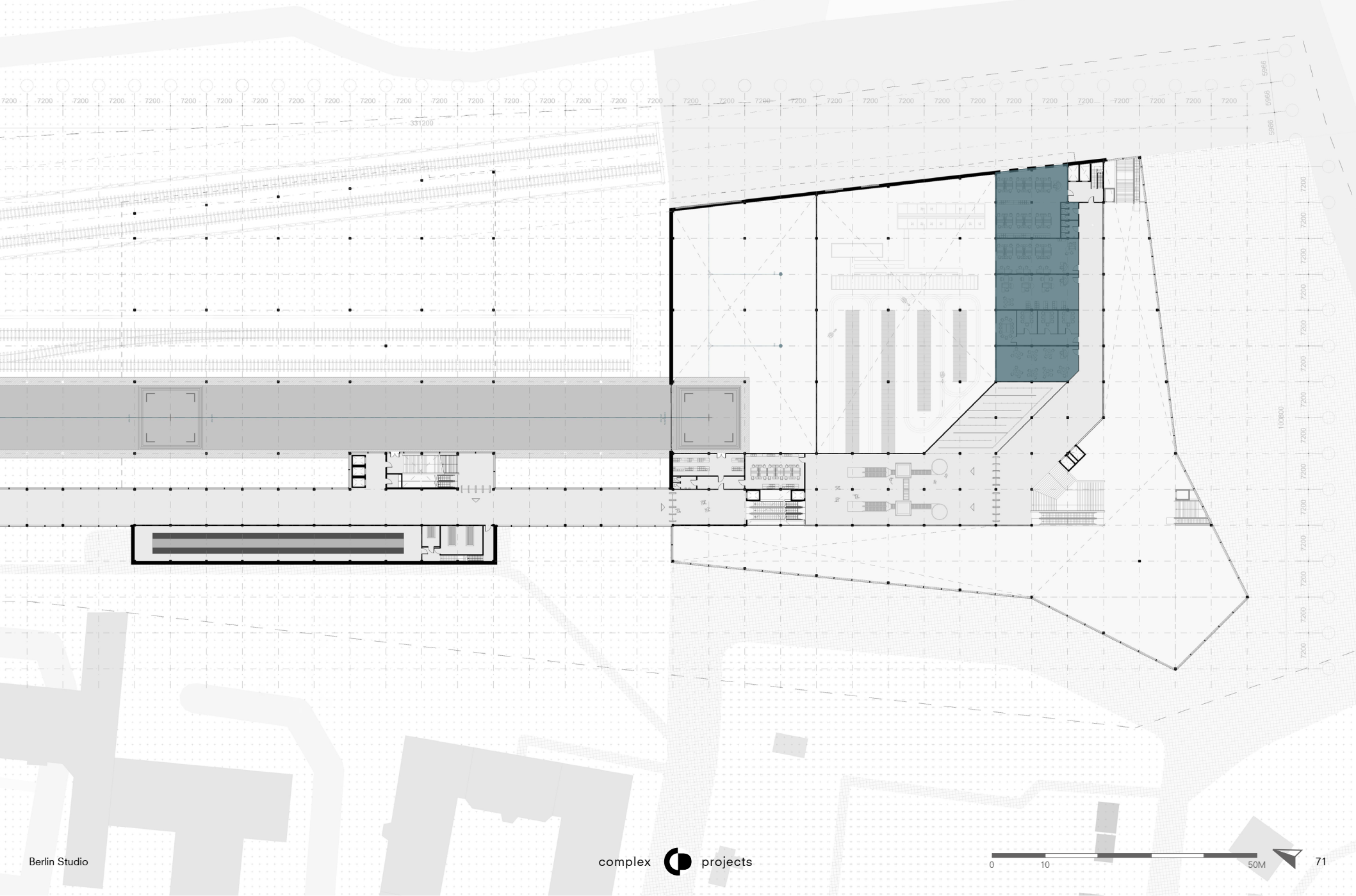
PUBLIC CORRIDOR

Berlin Studio

complex projects

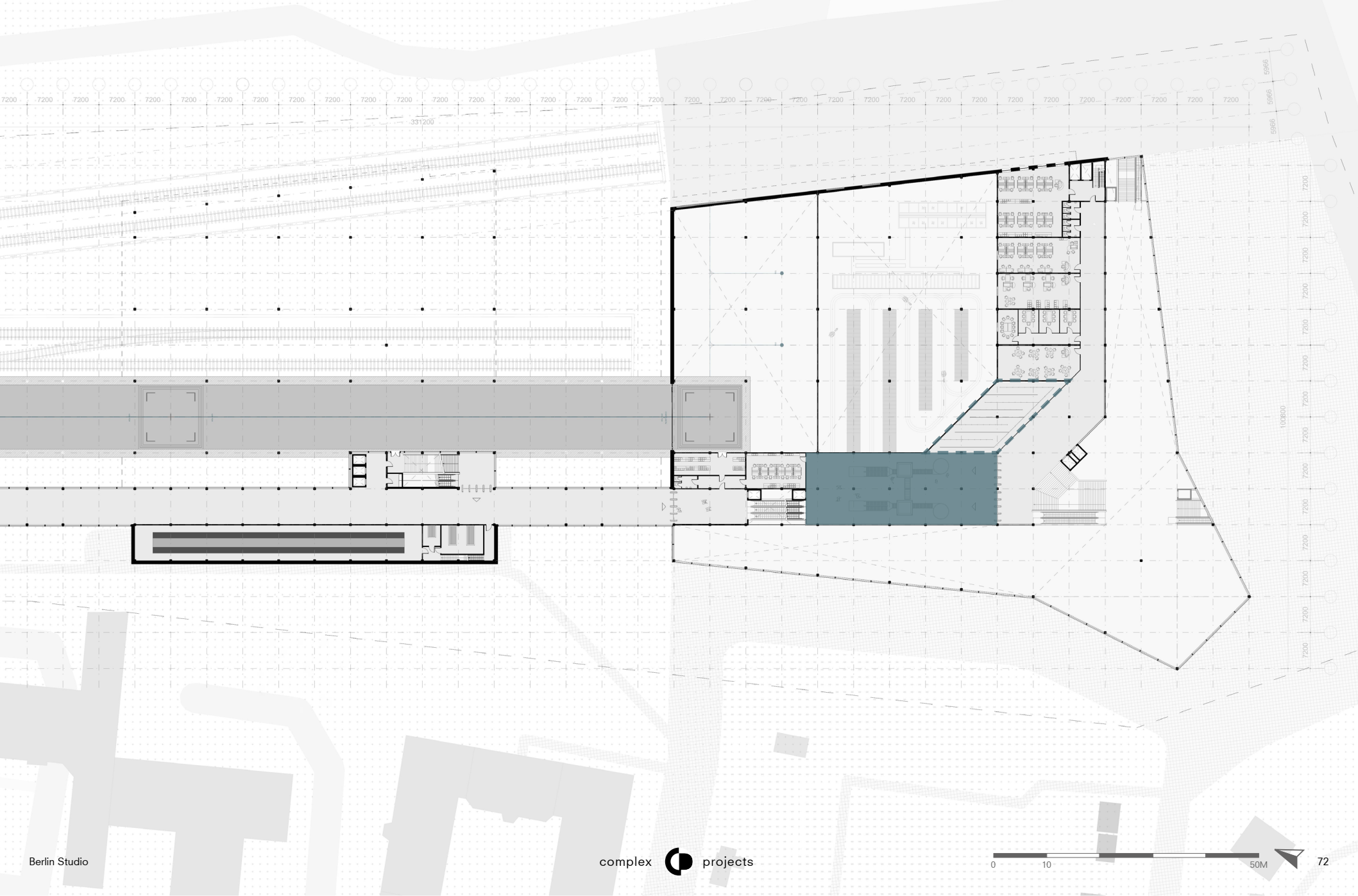
0 10 50M 70

Design plans **WORK SPACES**



Design plans

SECURITY CHECK



Design plans

DRONE HIGHWAY

Design plans

DRONE HIGHWAY

Berlin Studio

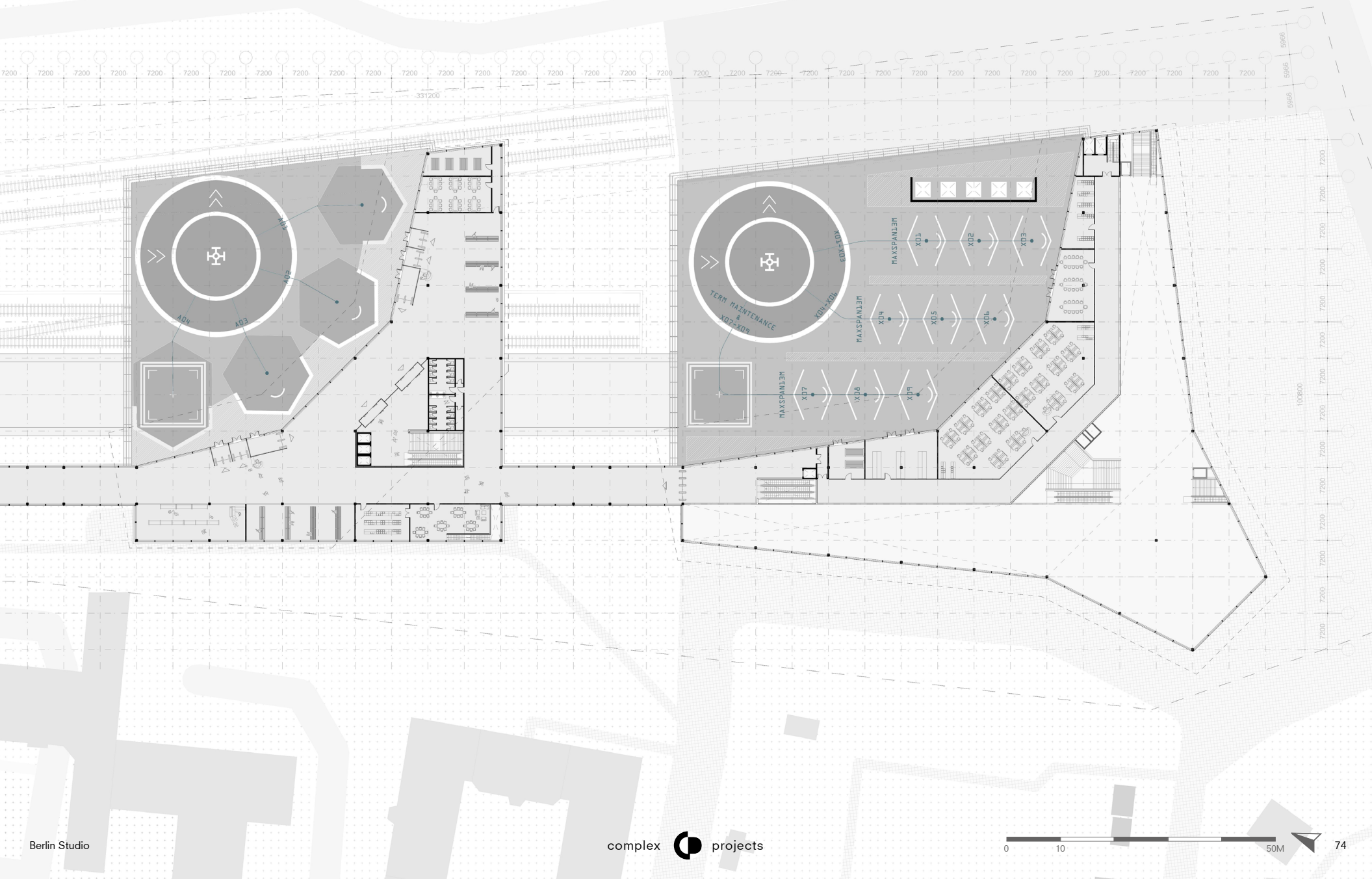
complex projects

0 10 50M

73

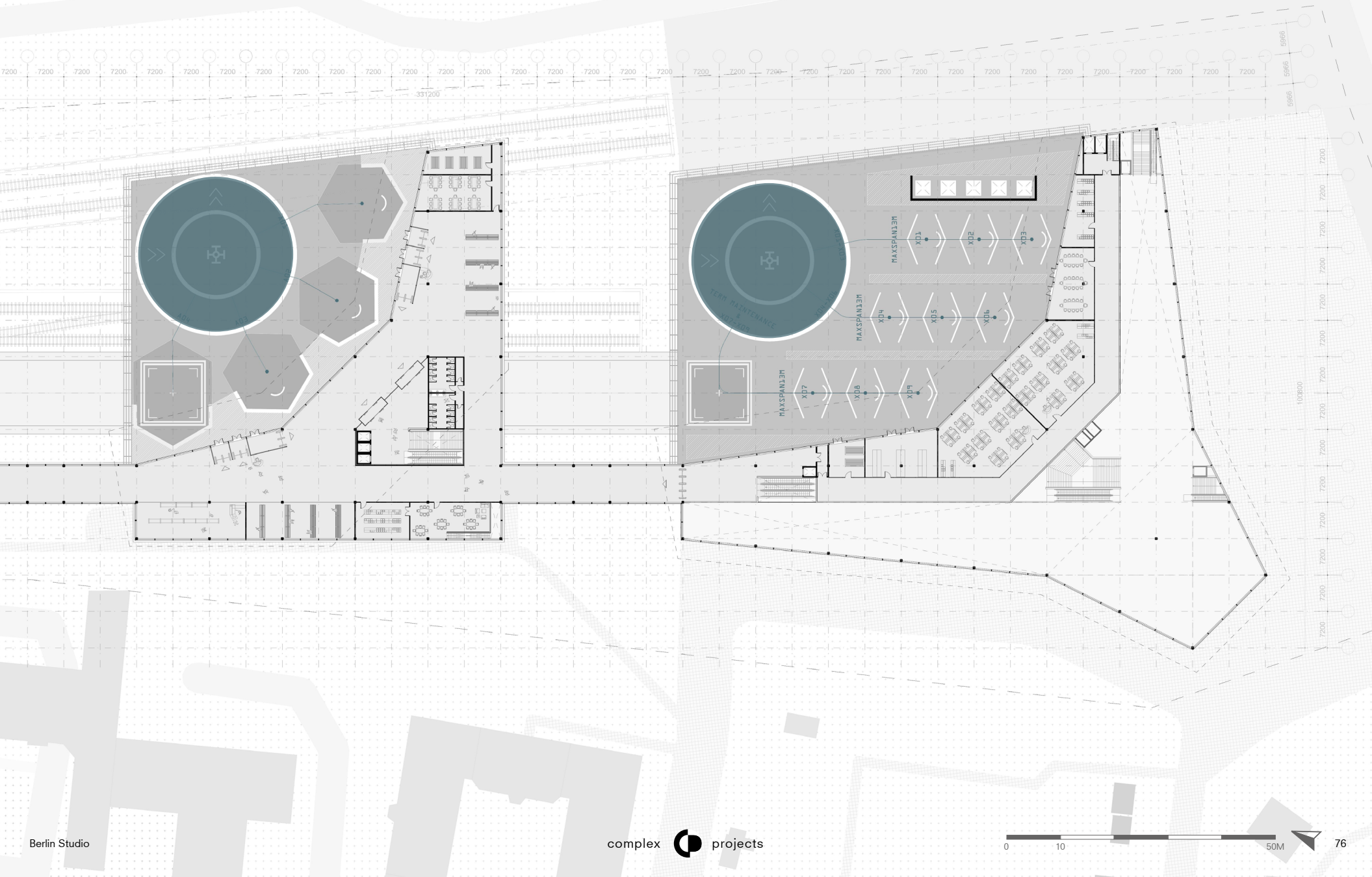
Design plans

LEVEL 2



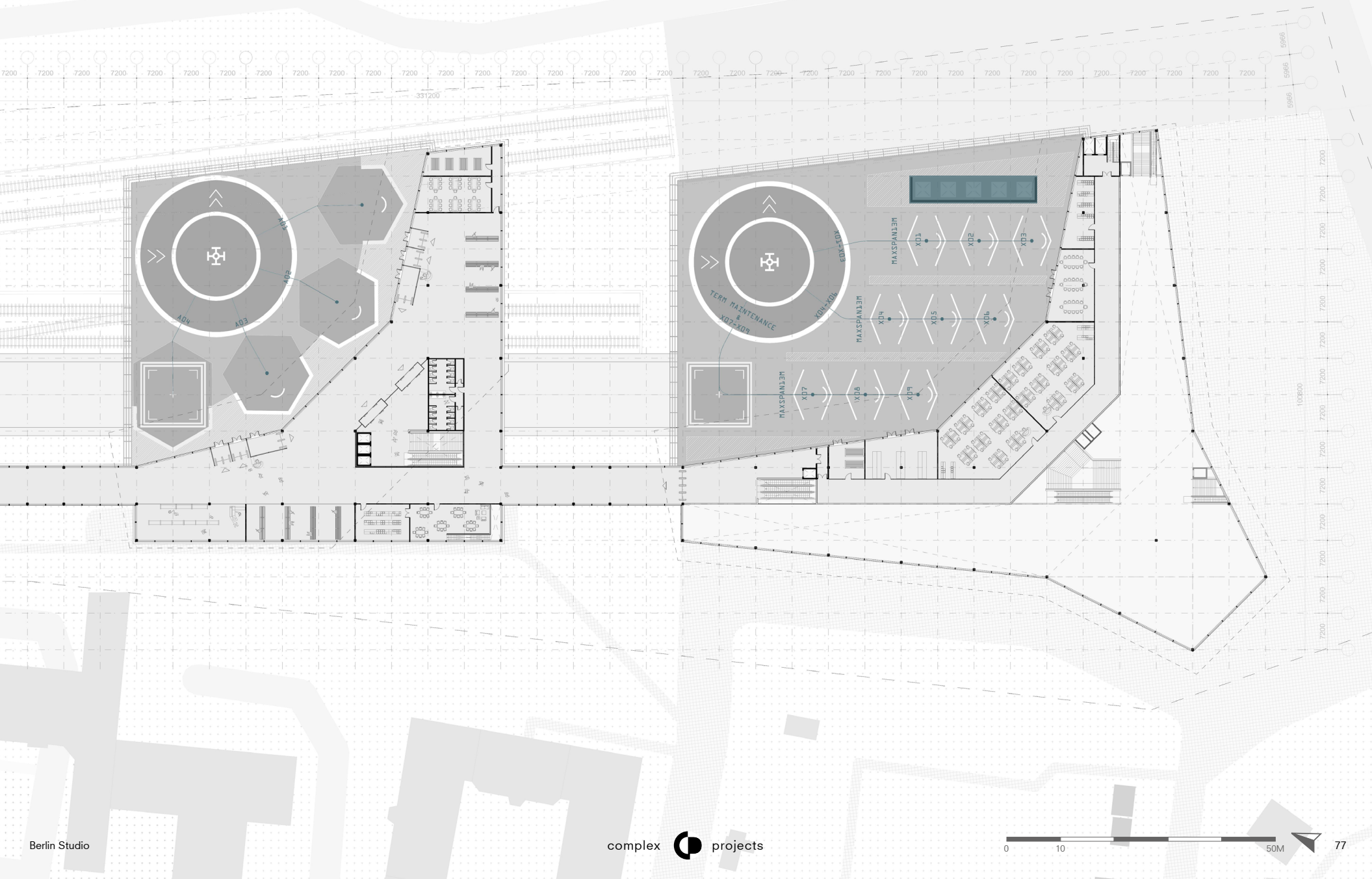
Design plans

TAKE OFF AND LANDING PADS



Design plans

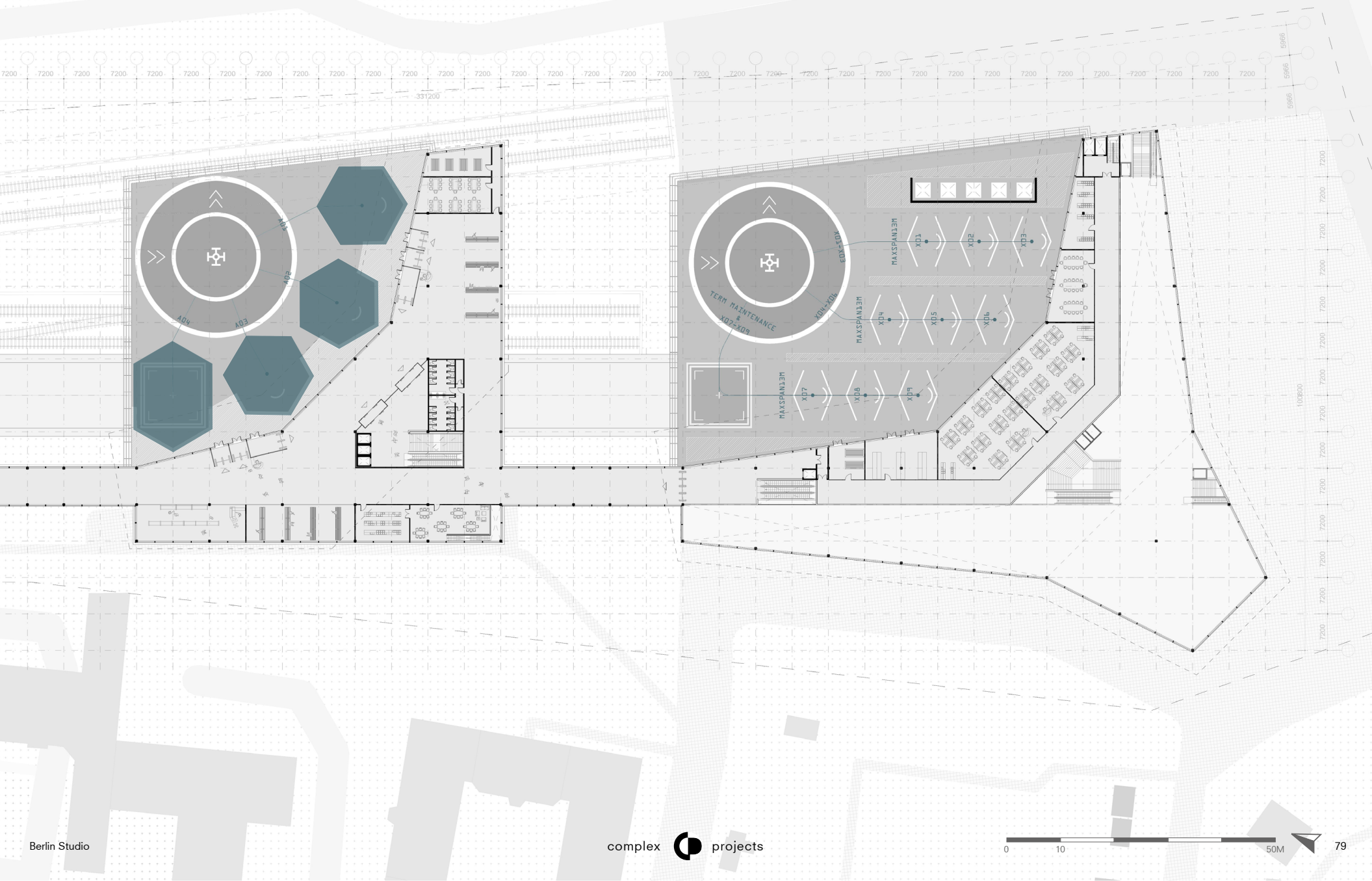
PARCEL PORTS



8 9 9

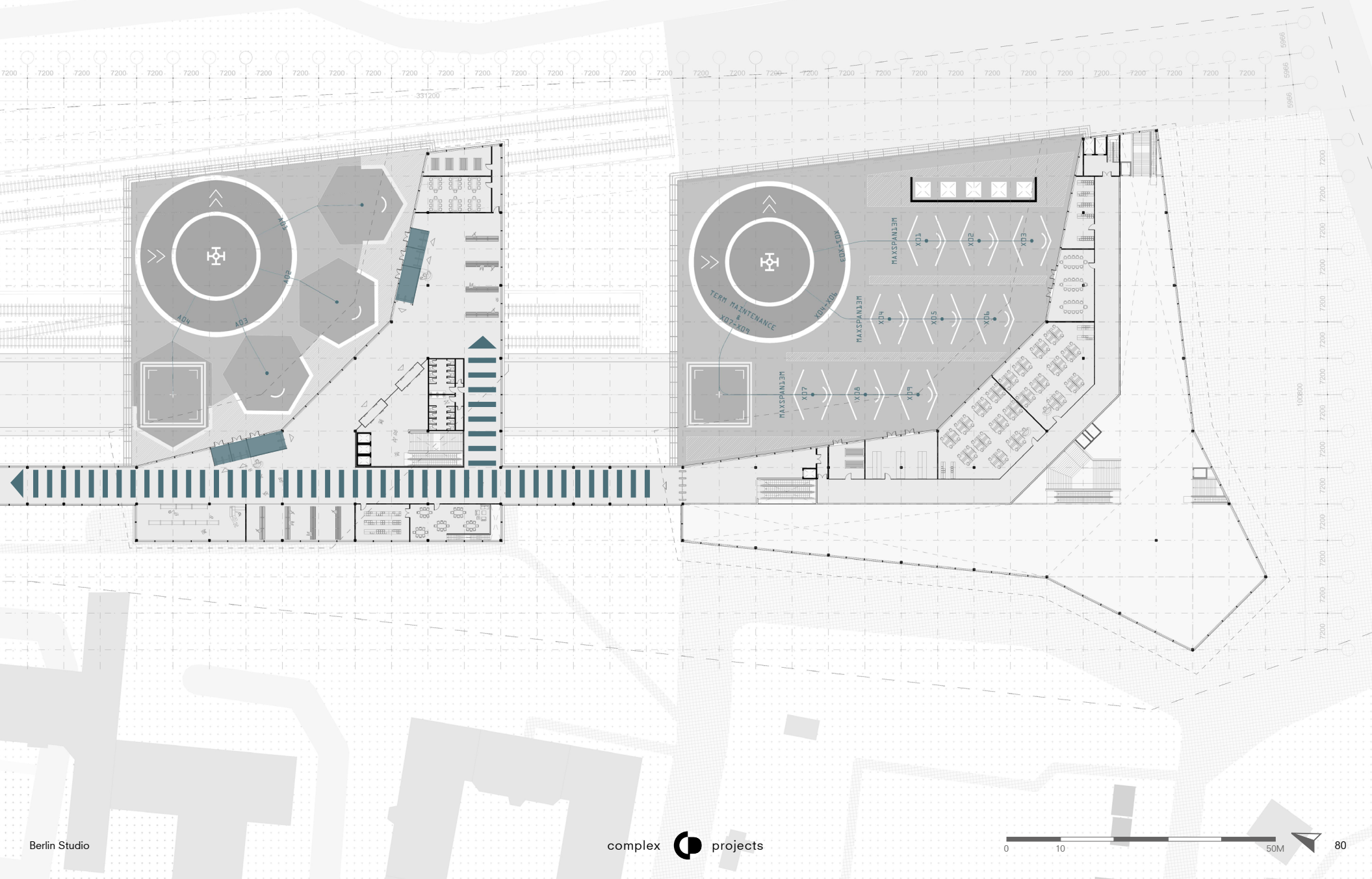
Design plans

GATE PLATFORM



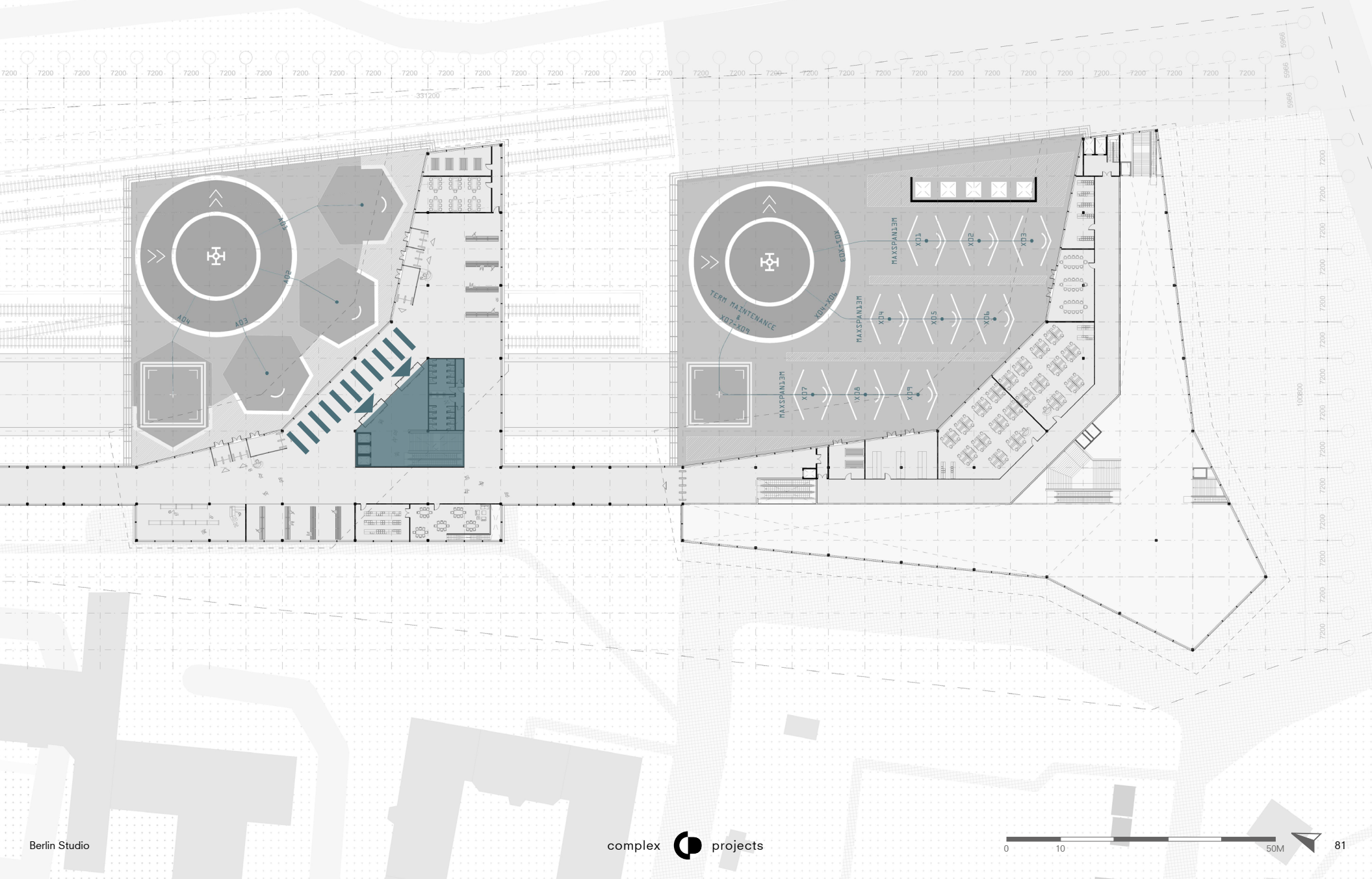
Design plans

DEPARTURE GATES



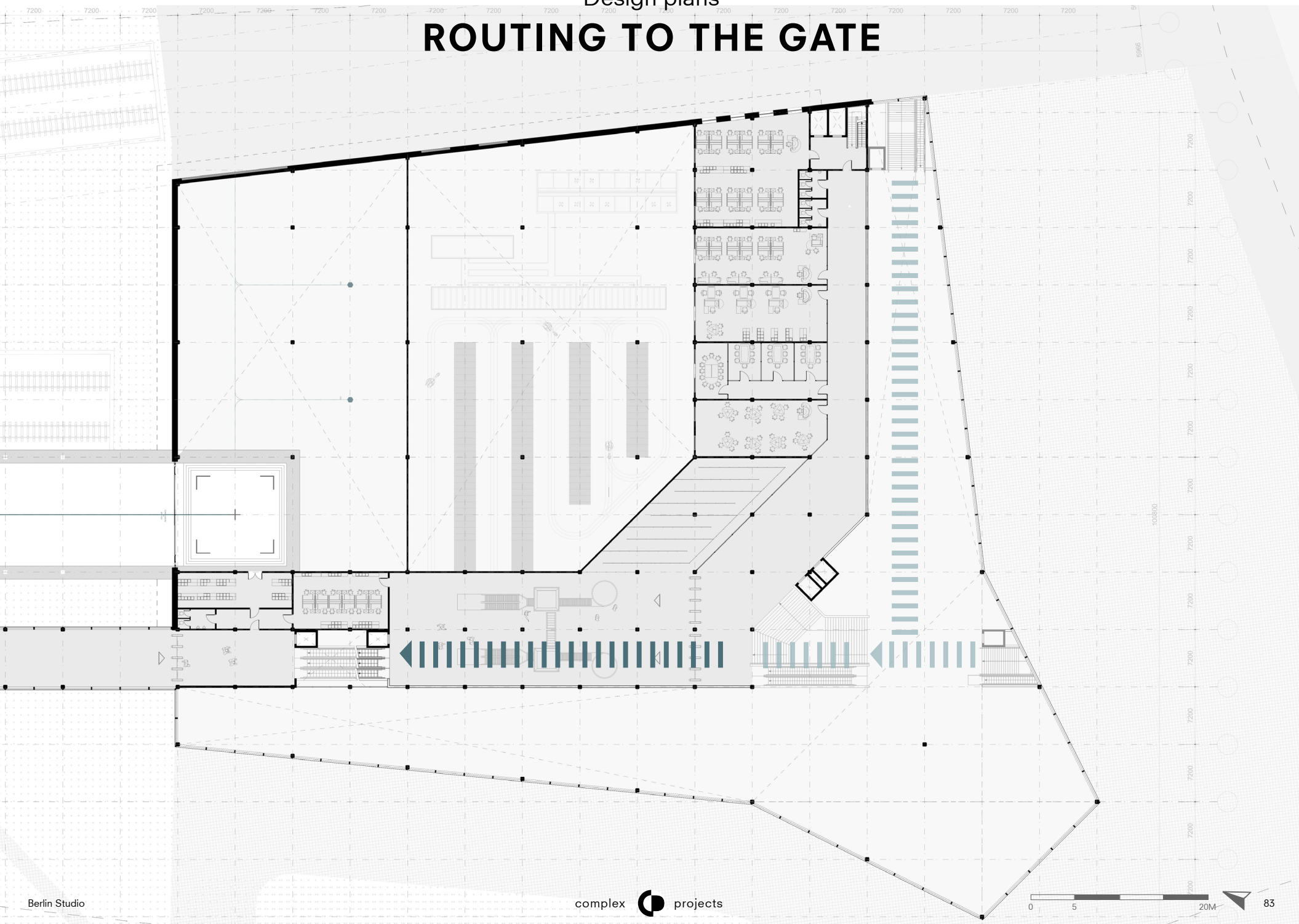
Design plans

ARRIVALS





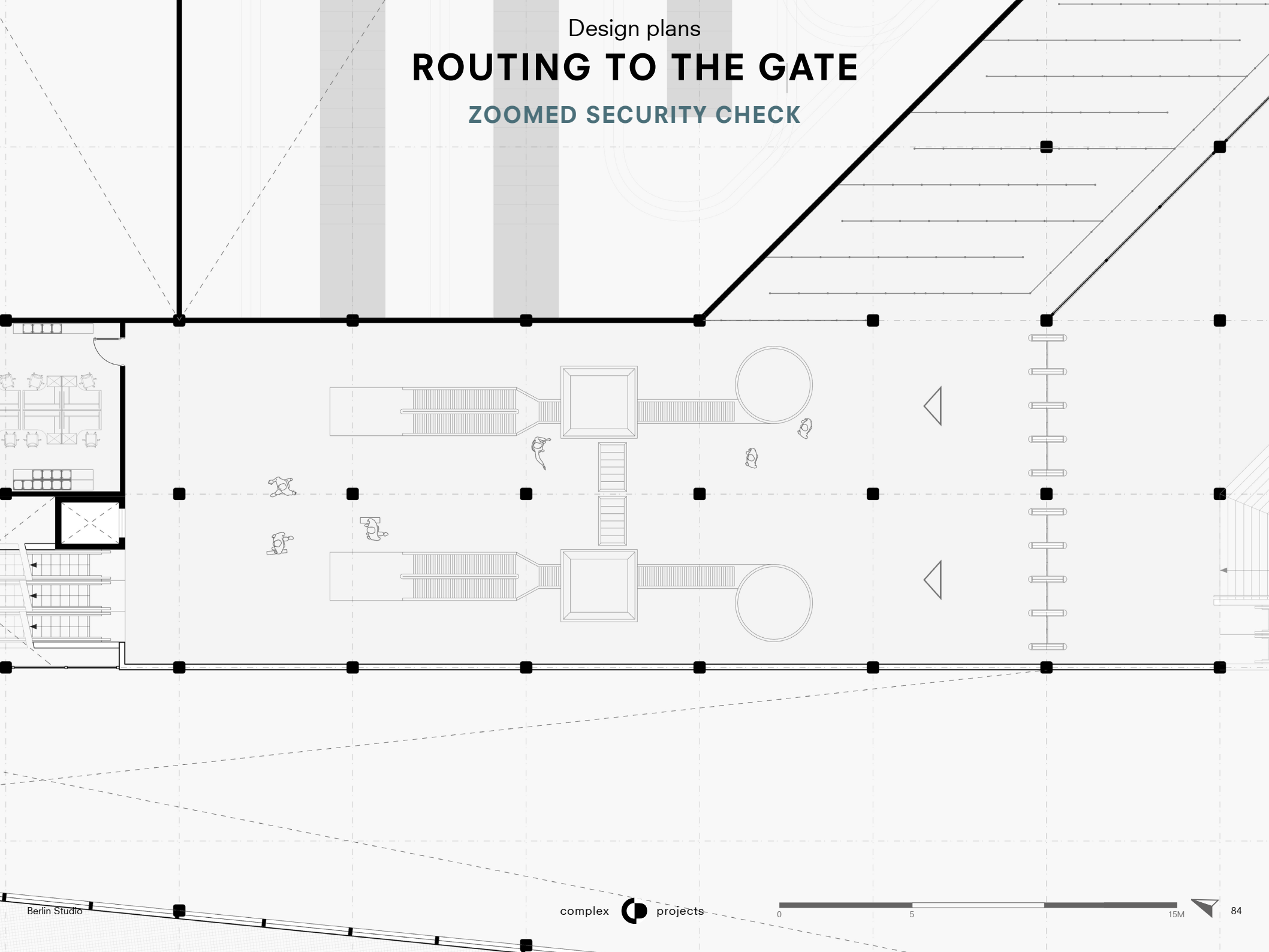
ROUTING TO THE GATE



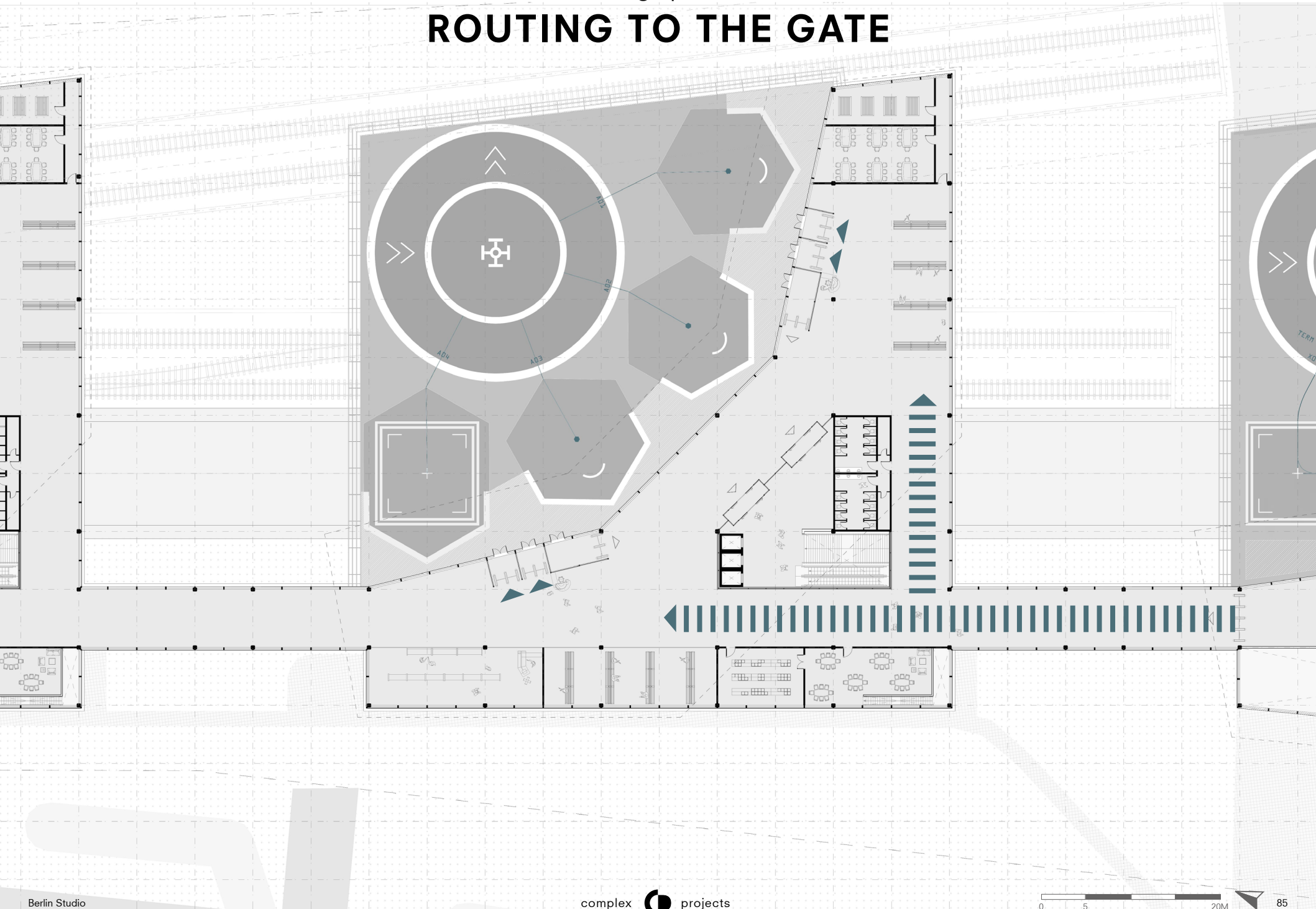
Design plans

ROUTING TO THE GATE

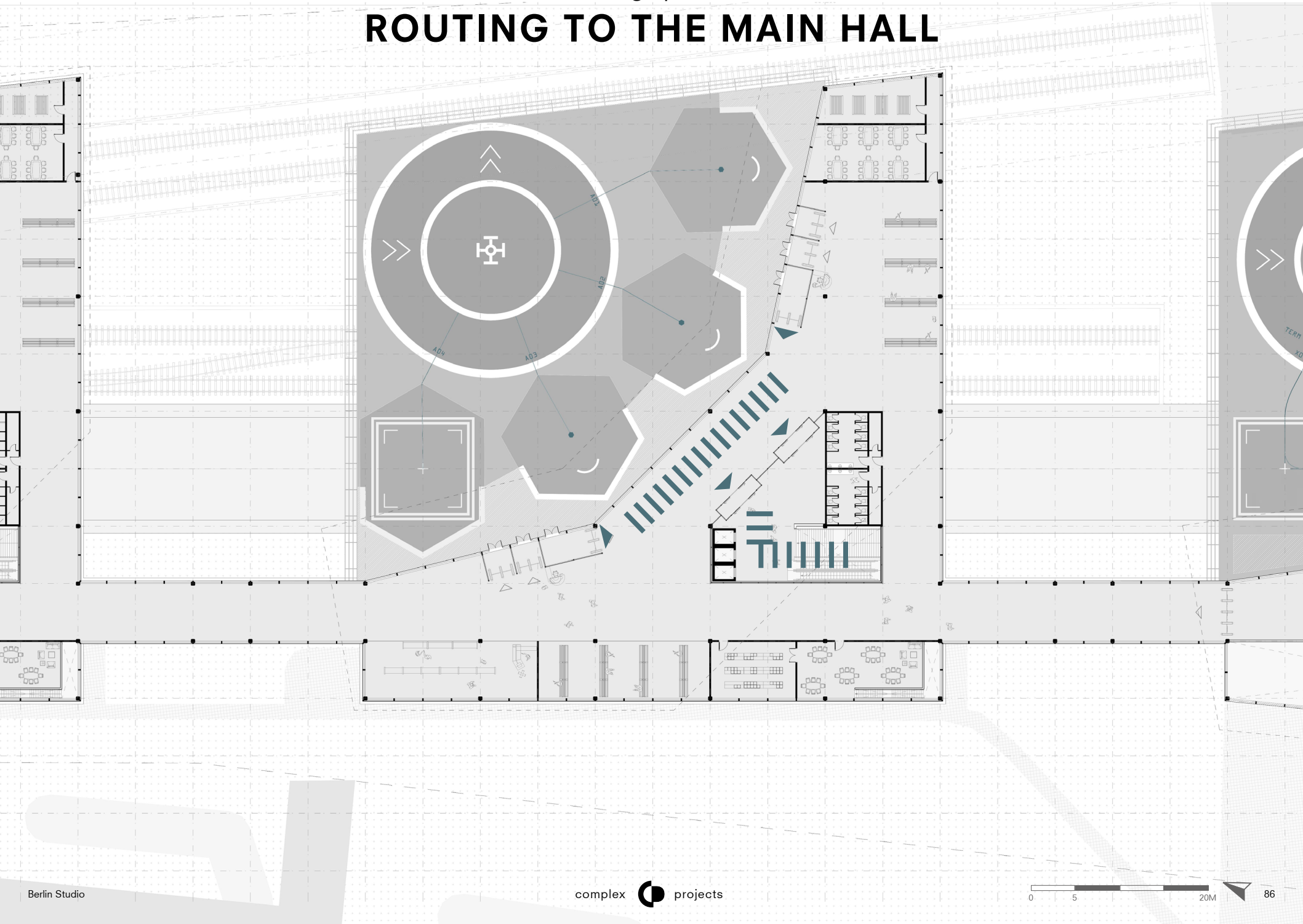
ZOOMED SECURITY CHECK



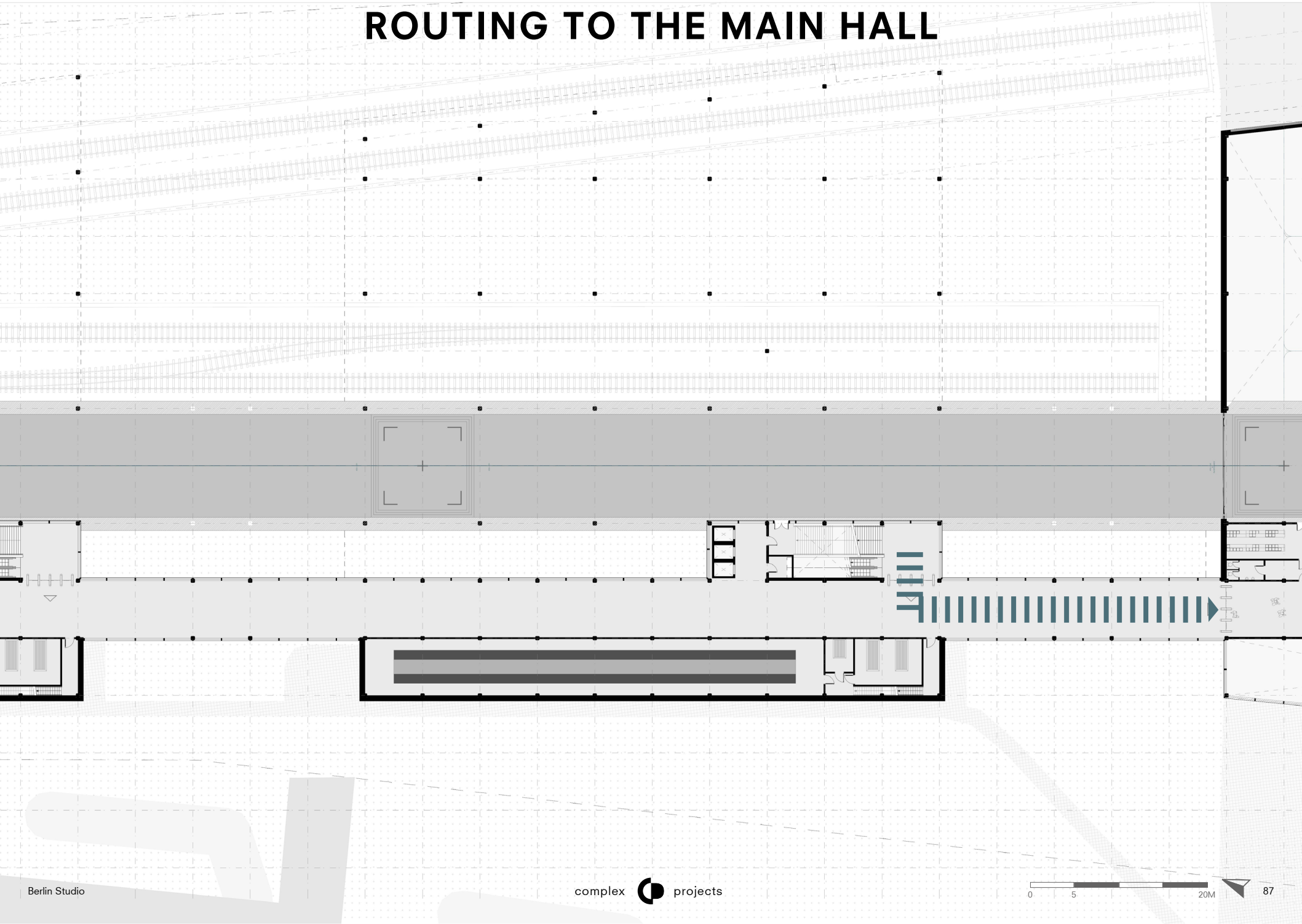
ROUTING TO THE GATE



ROUTING TO THE MAIN HALL

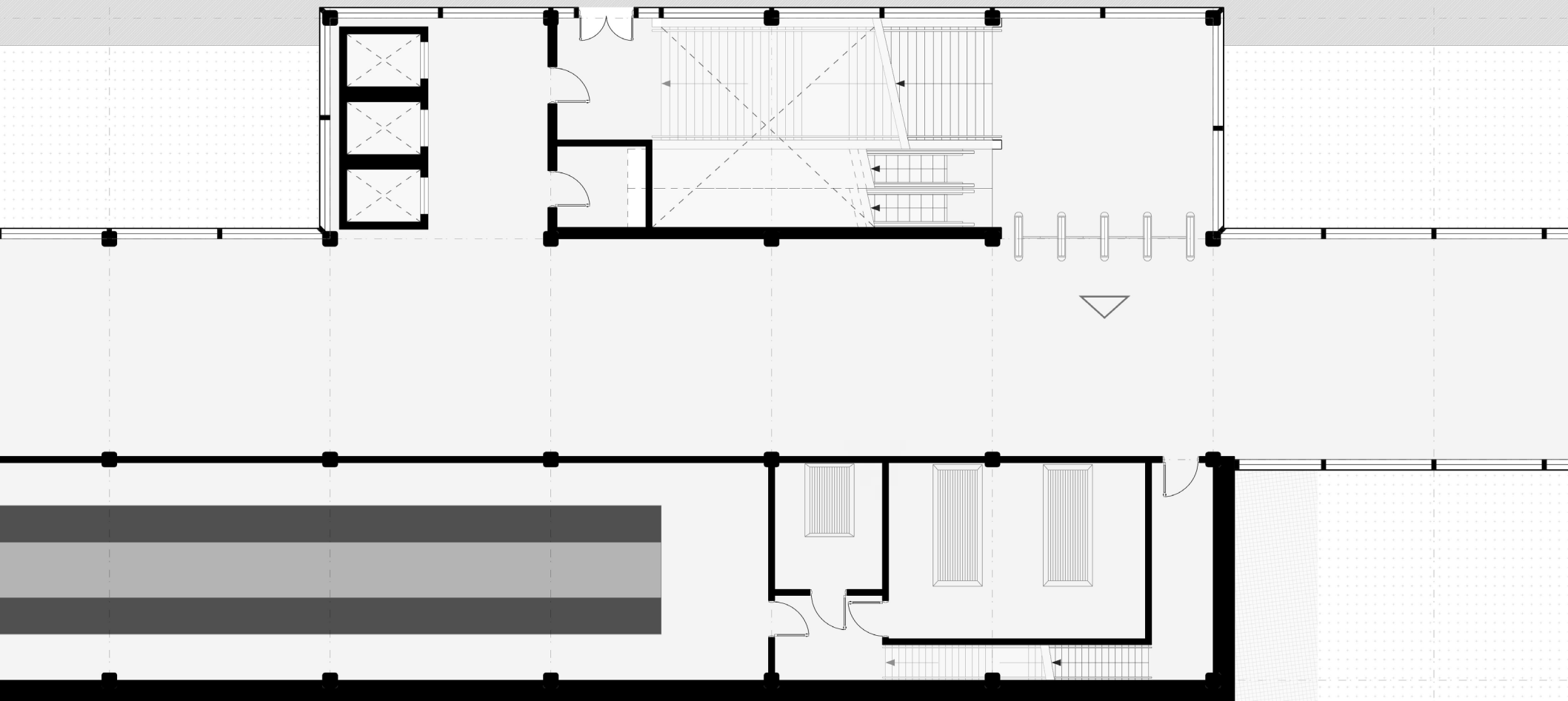


ROUTING TO THE MAIN HALL

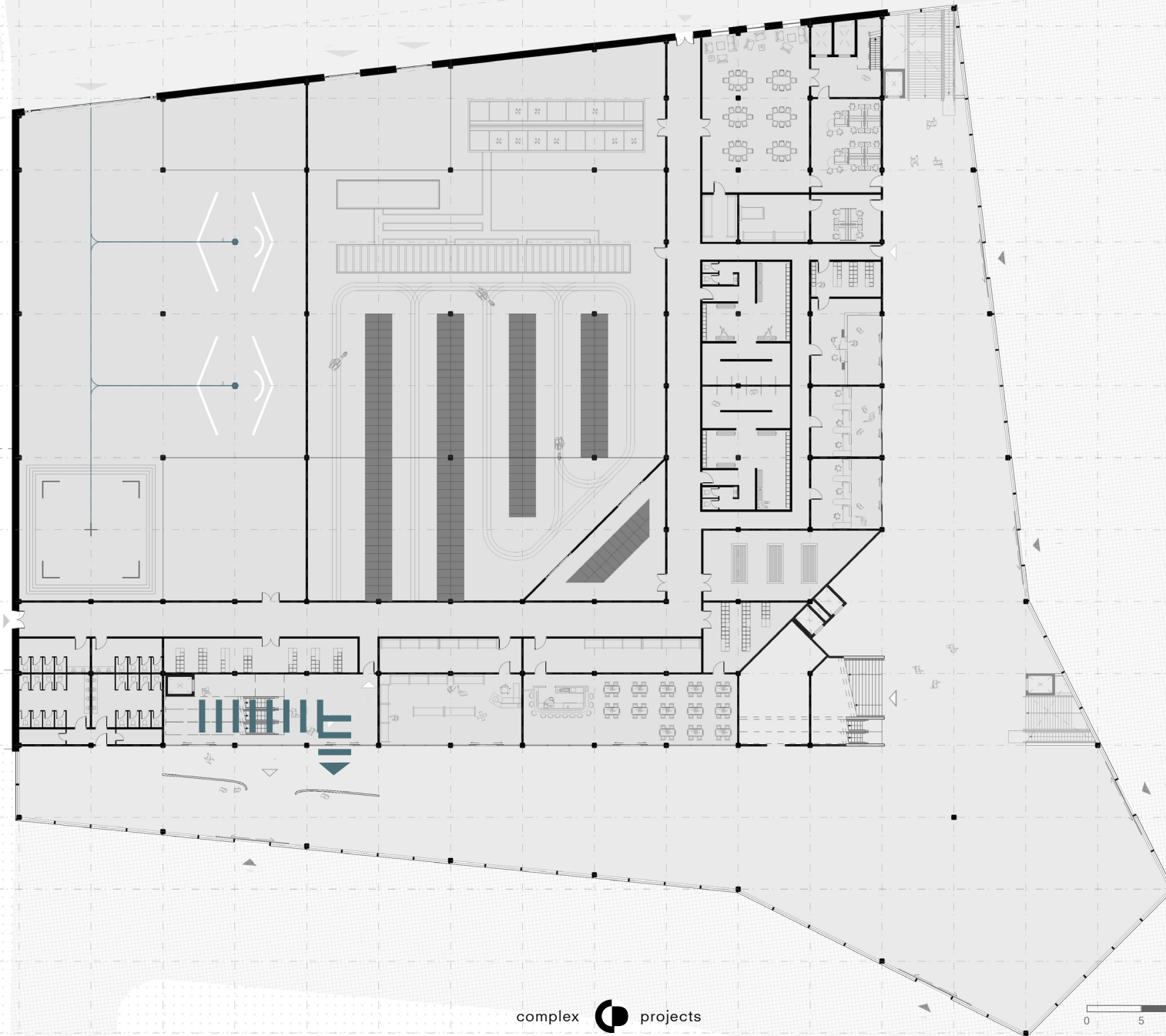


ROUTING TO THE MAIN HALL

ZOOMED ARRIVALS CORRIDOR

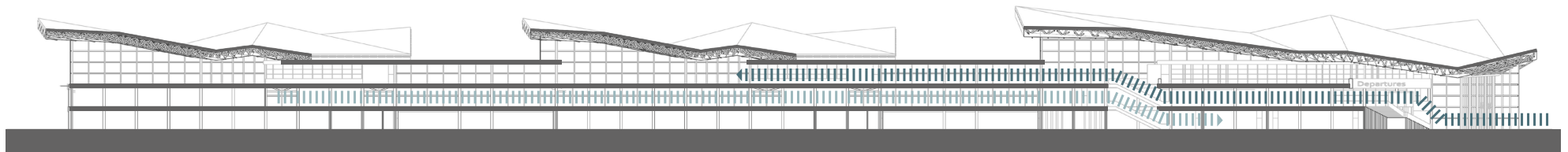


ROUTING TO THE MAIN HALL



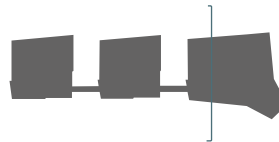
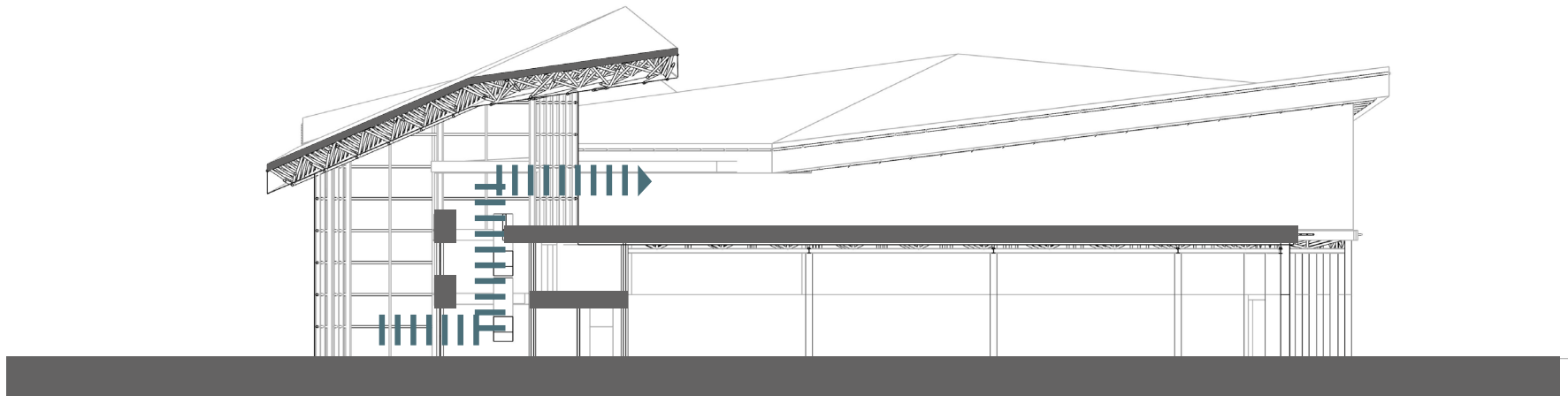
Design plans

INTEGRATED FLOWS



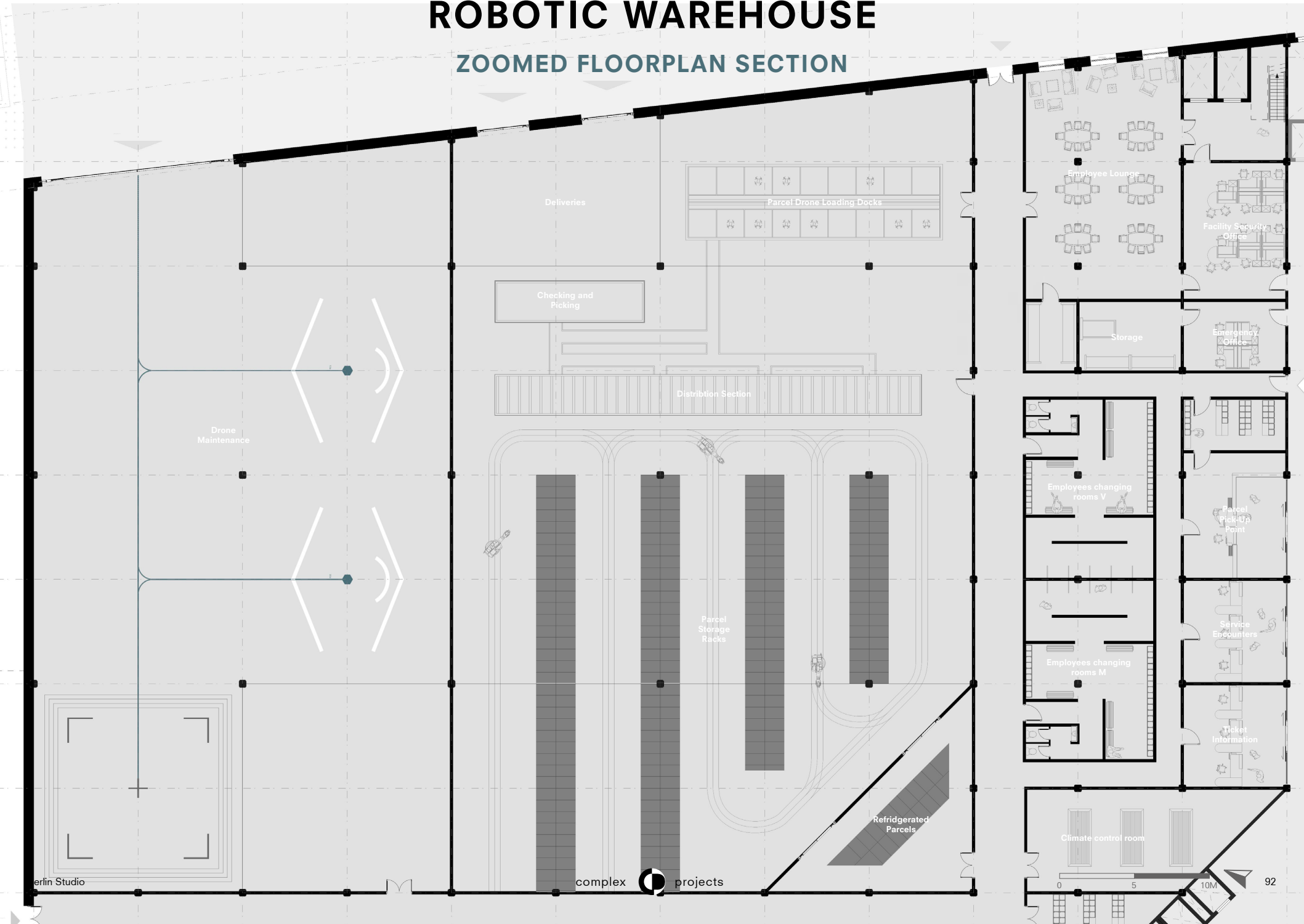
Design plans

SEPERATED AIRSIDE



ROBOTIC WAREHOUSE

ZOOMED FLOORPLAN SECTION



Design plans
TERMINAL
ZOOMED FLOORPLAN SECTION

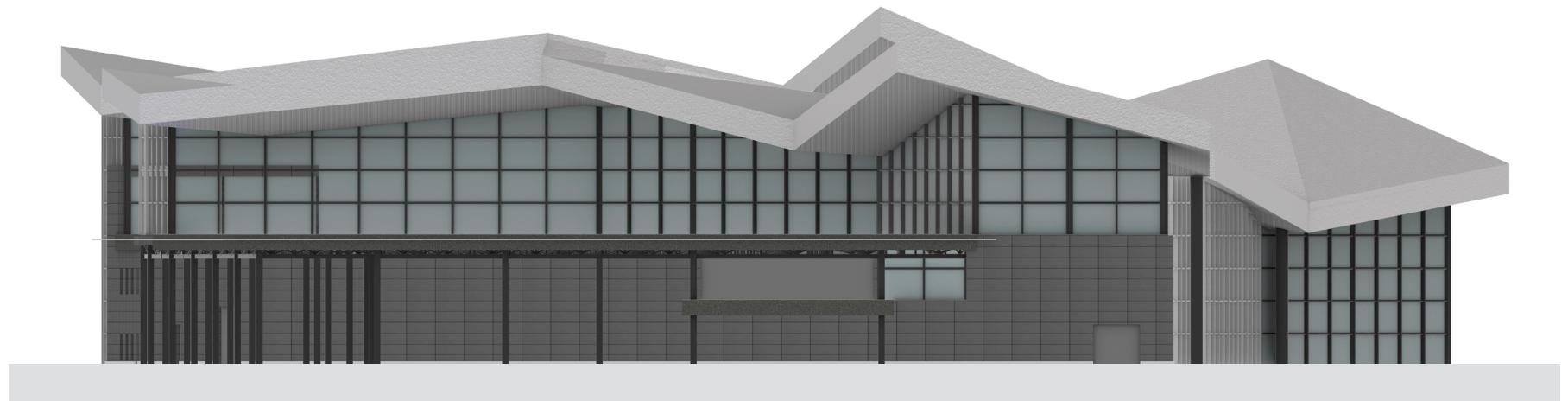
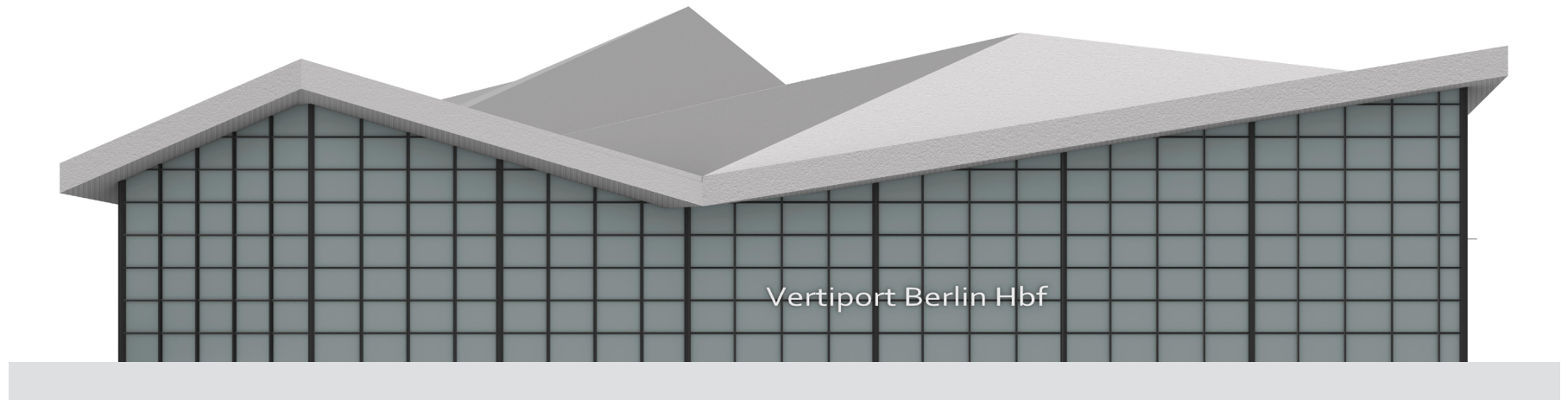


DESIGN IMPLEMENTATION



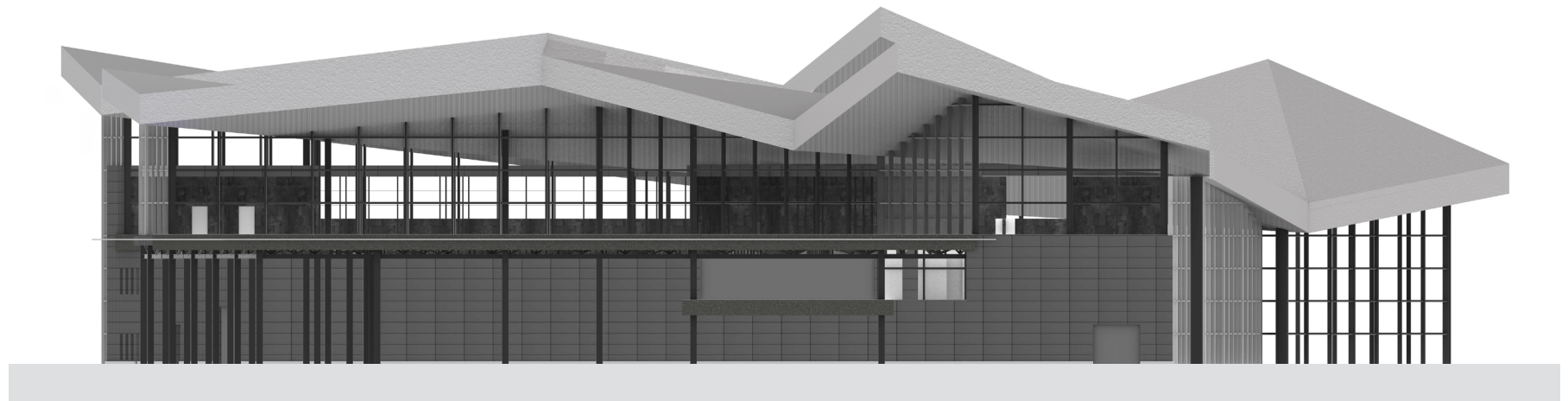
Design implementation

ELEVATIONS SE & NW



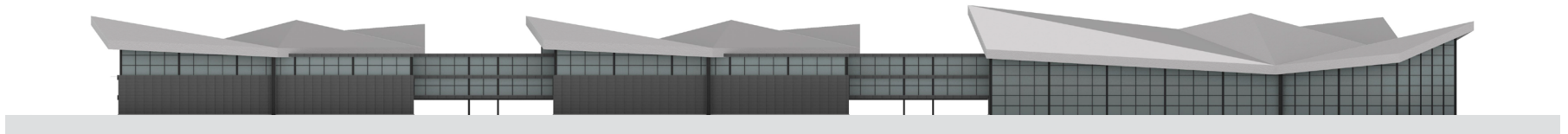
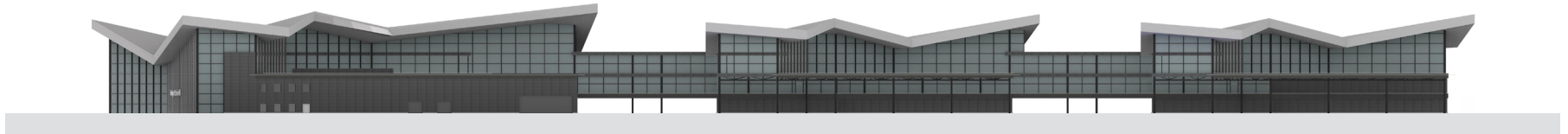
Design implementation

ELEVATIONS TRANSPARENT



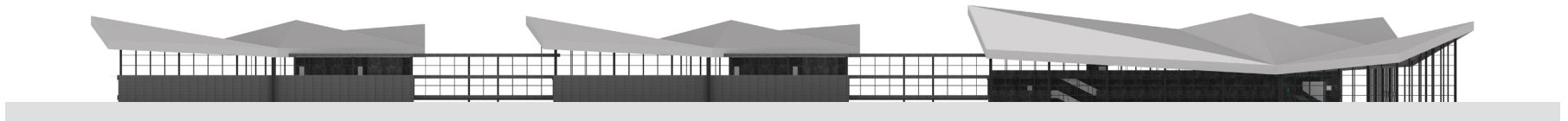
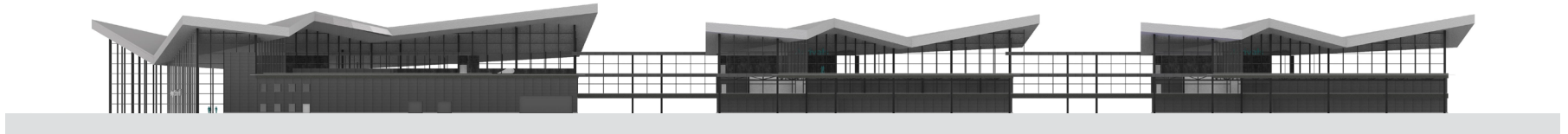
Design implementation

ELEVATION NE & SW



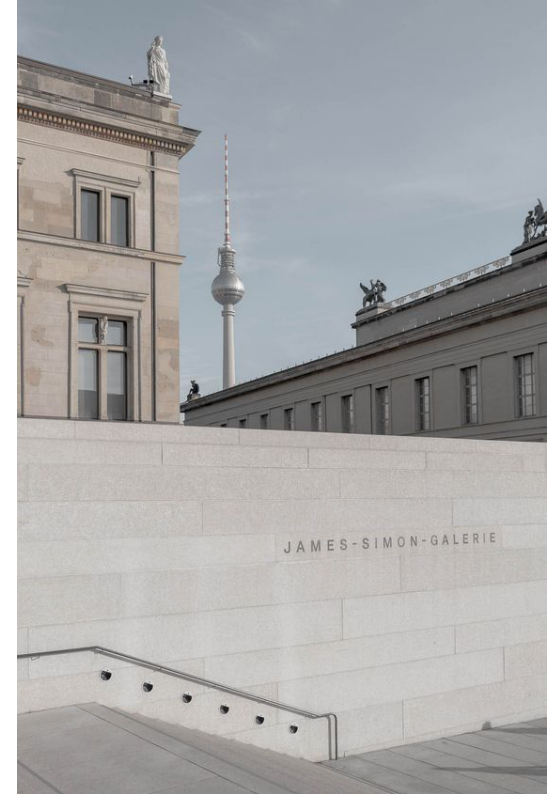
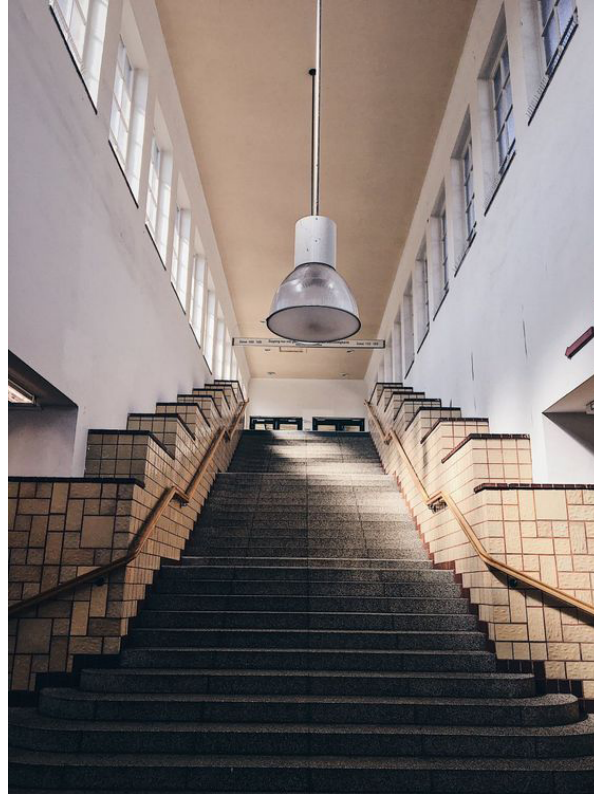
Design implementation

ELEVATIONS TRANSPARENT



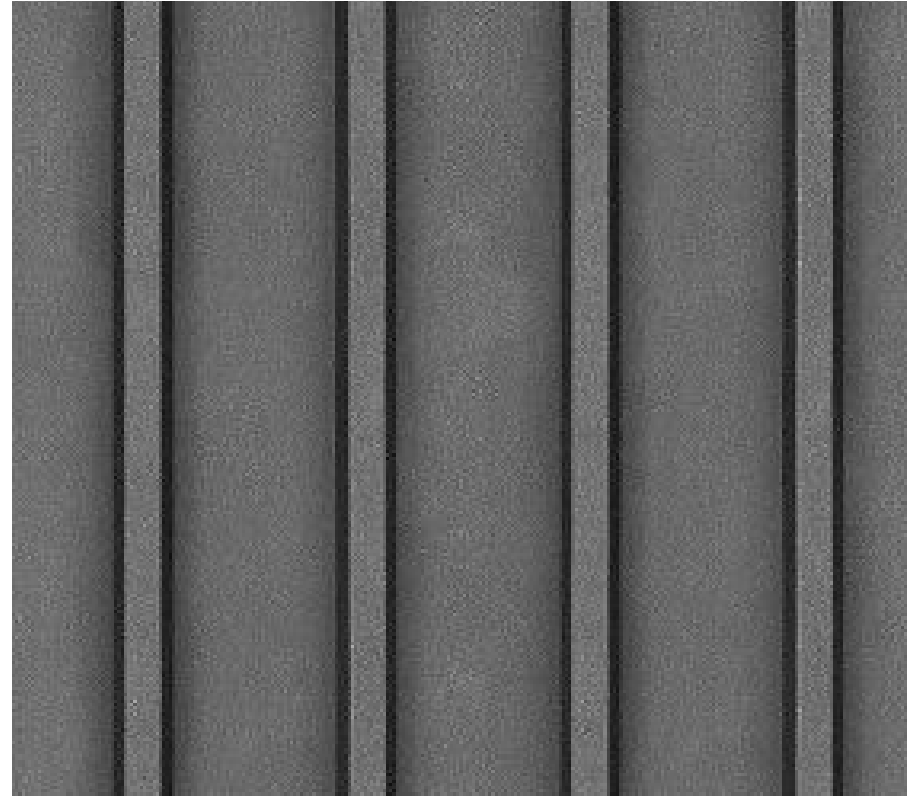
Design implementation

BERLIN CONTEMPORARY



Design implementation

METALIC ROOF COATING



Design implementation

GLASS CURTAIN FACADE



Design implementation

SOLID FACADE



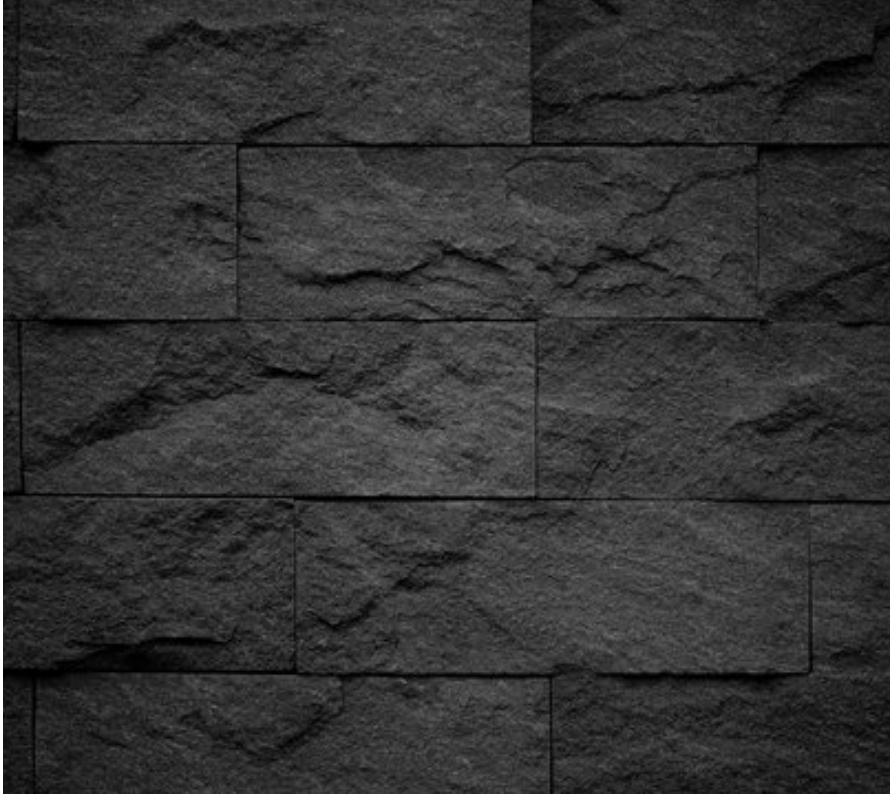
Design implementation

INTERIOR FLOOR



Design implementation

INTERIOR WALLS

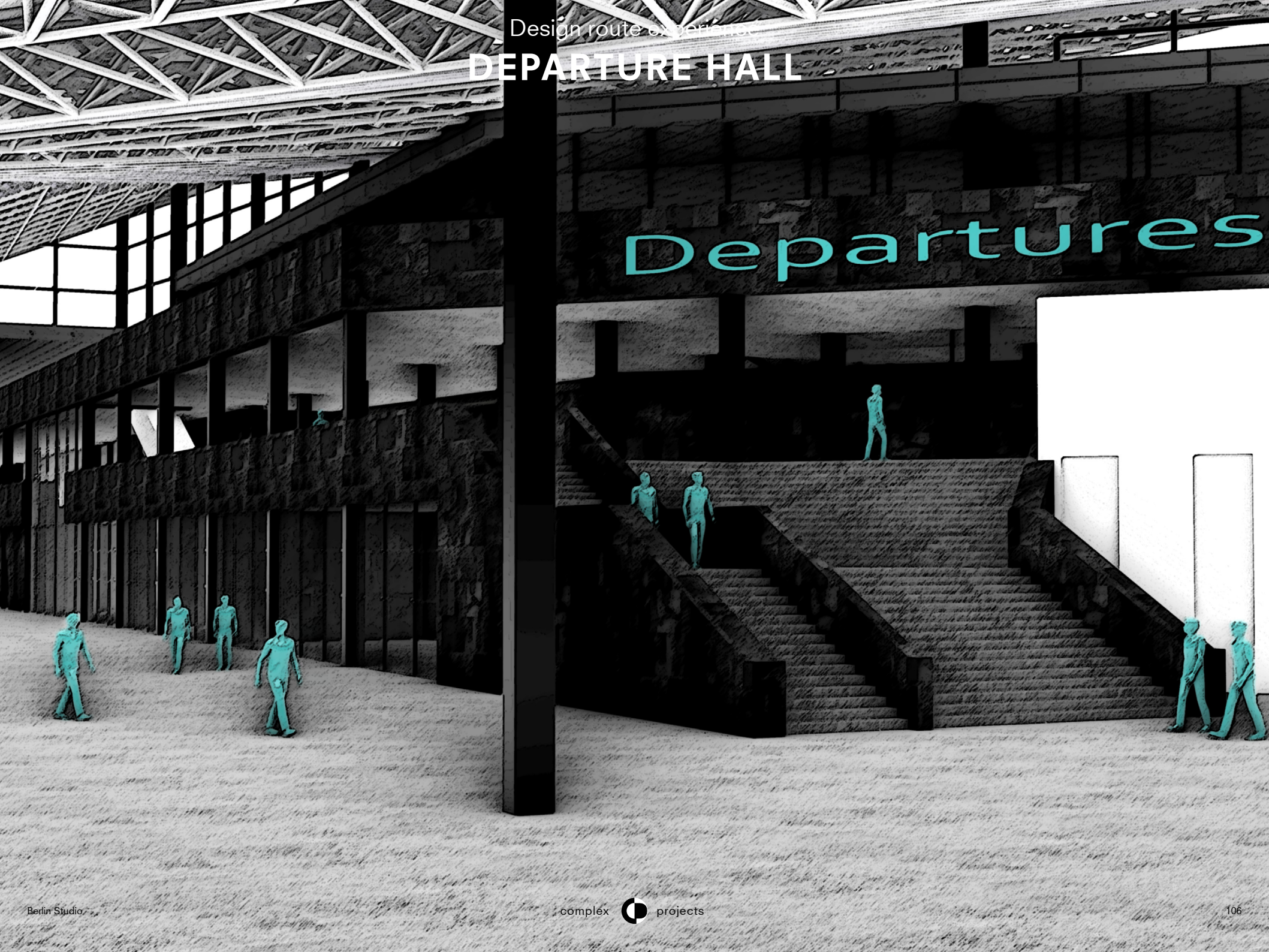


DESIGN ROUTE EXPERIENCE



Design route experience

DEPARTURE HALL

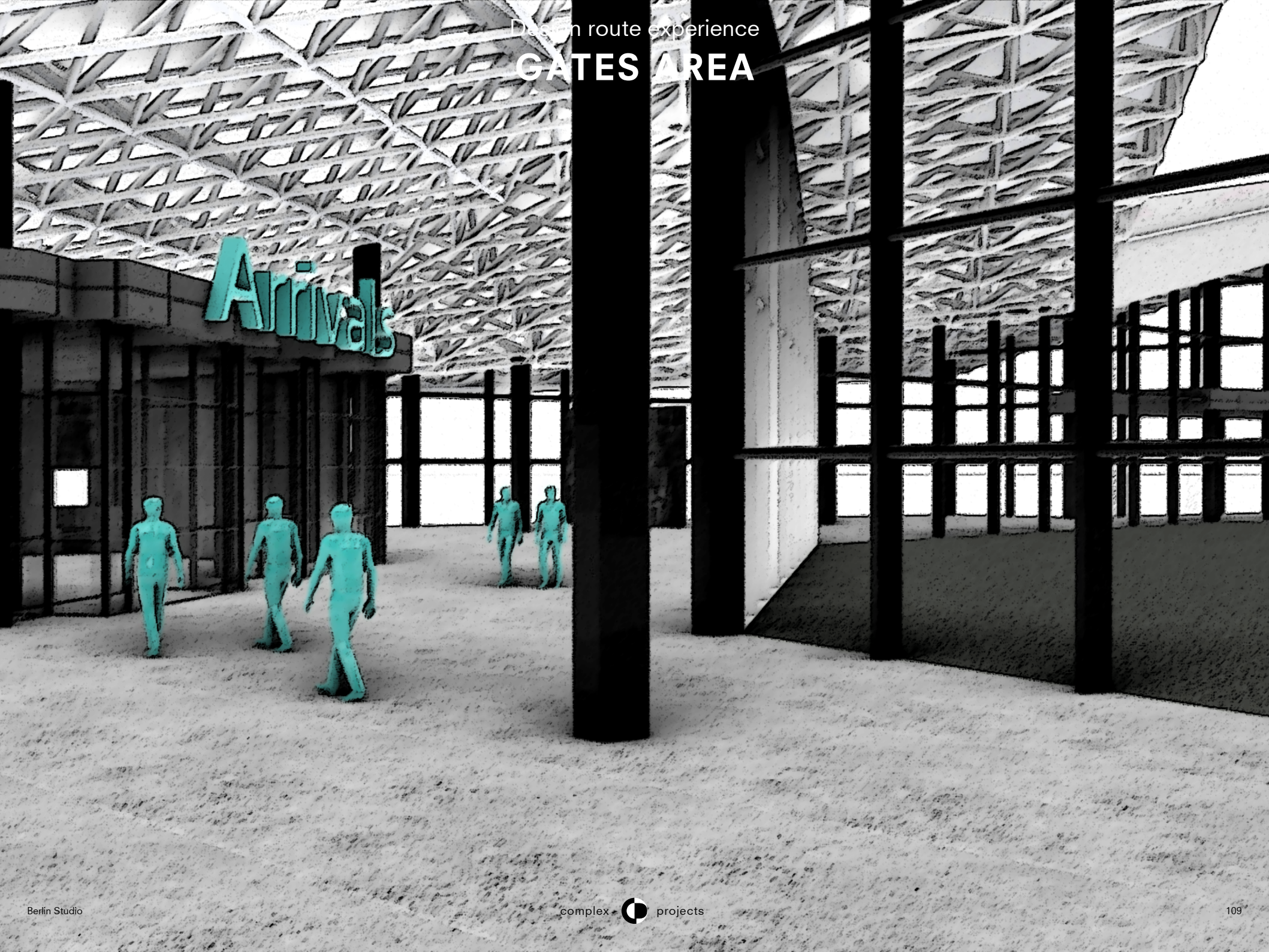


Designing a
TERMINAL BRIDGES

Design route experi

DEPARTURE CORRIDOR



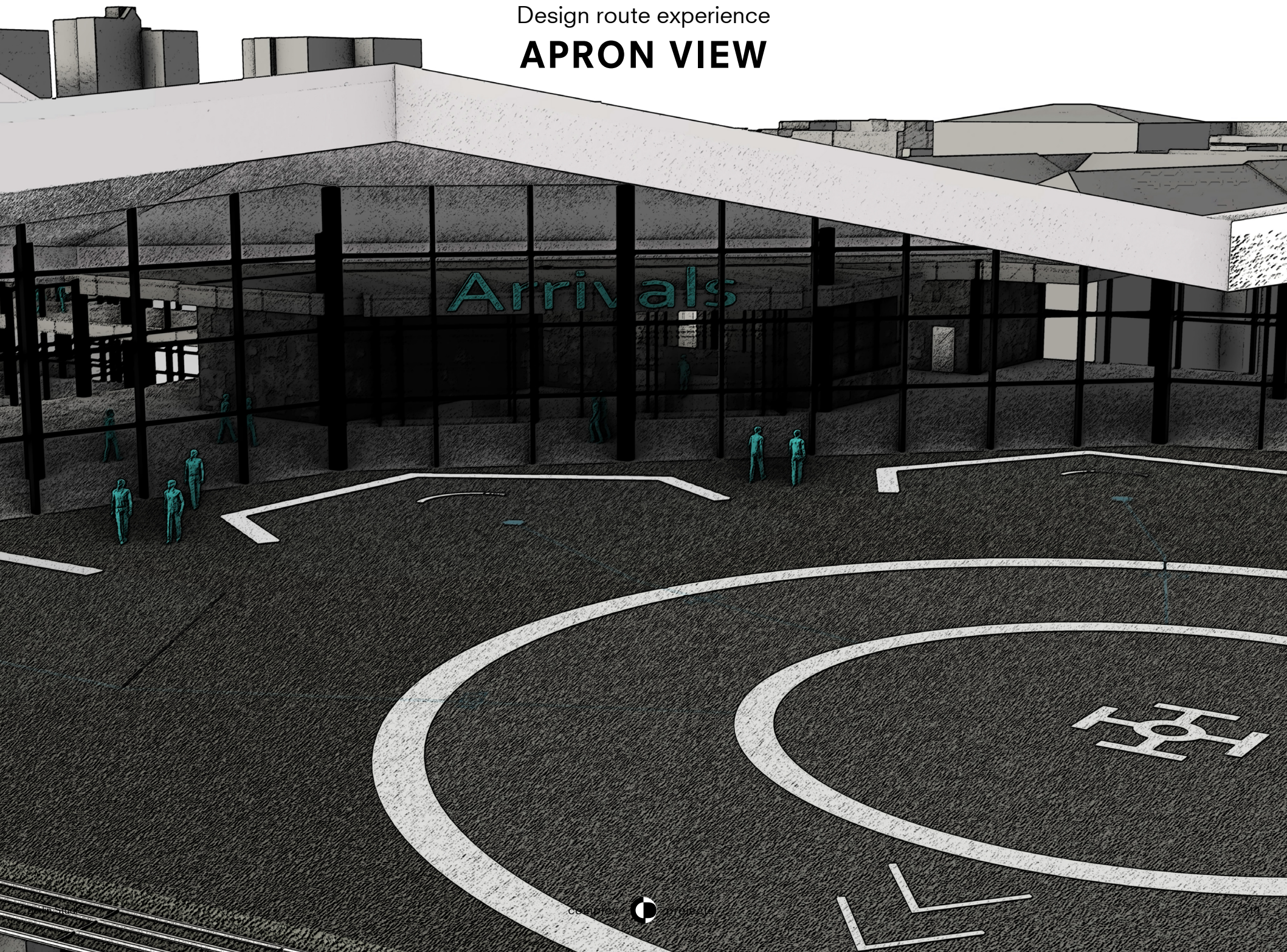


Design route experience

GATES AREA

Design route experience

APRON VIEW



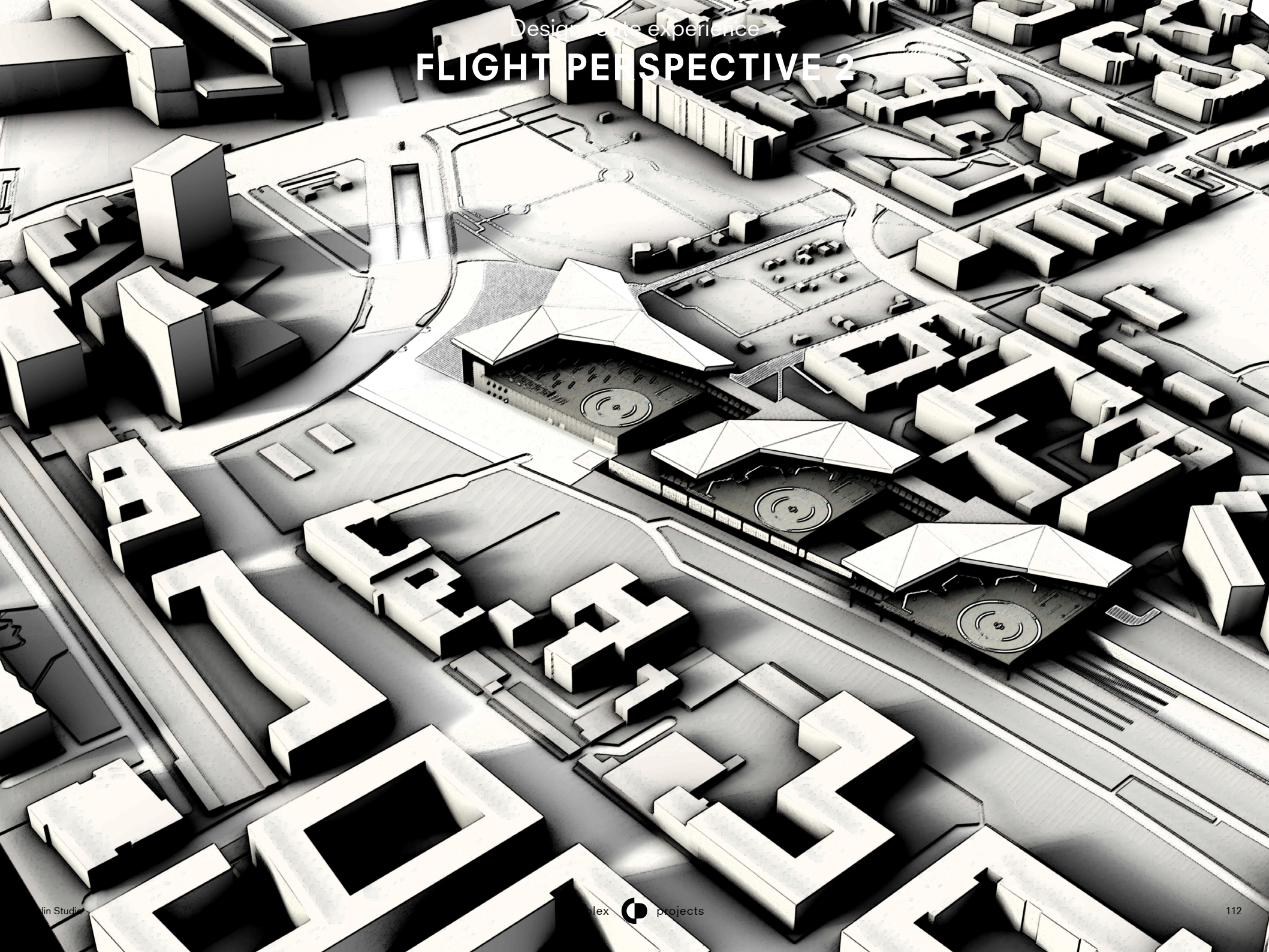
Design route experience

FLIGHT PERSPECTIVE 1

Arrivals

Design Centre experience

FLIGHT PERSPECTIVE 2

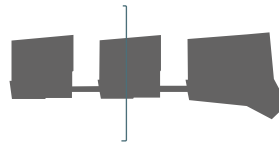
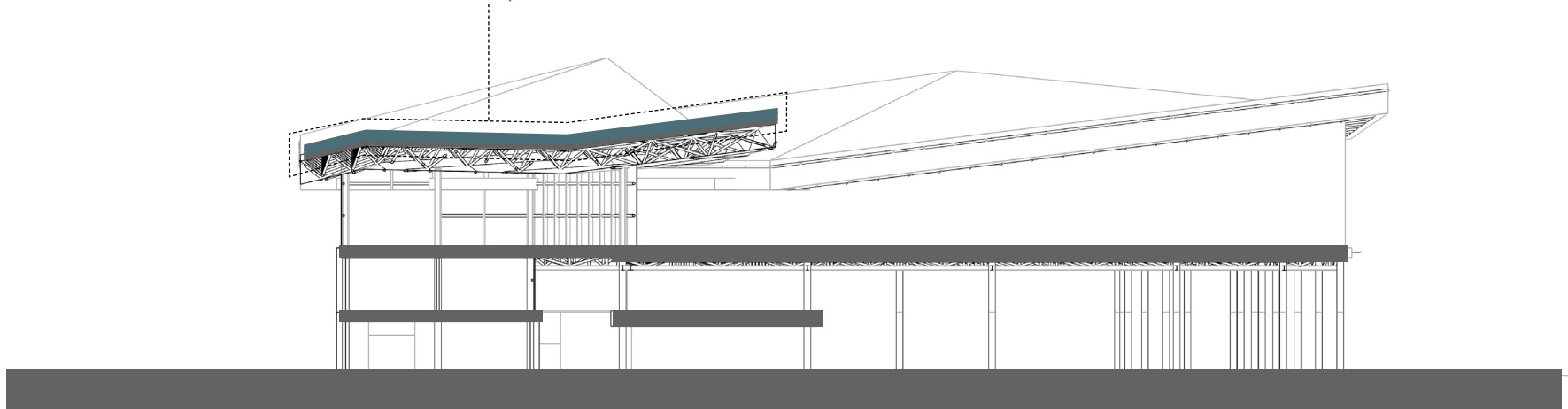


CLIMATE CONTROL



Climate control **POWER**

PV panels on flat surfaces facing south
384 m² of panels



Climate control

INDOOR CLIMATE

Smart climate
Digitalized auto control settings

Ventilation

Mechanically controlled. Airpipes through space frame truss and lowered ceiling

Overhang

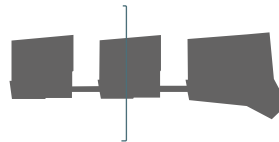
Minimize direct sunlight

Heating

Via floor and wall elements

Cooling

Ceiling, wall and floor elements



Climate control

SUSTAINABILITY

Smart water drainage system

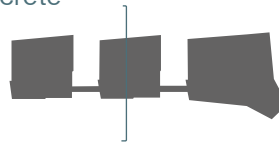
Retain and reuse

Steel column and (cross) beam elements

Full demountable and recyclable

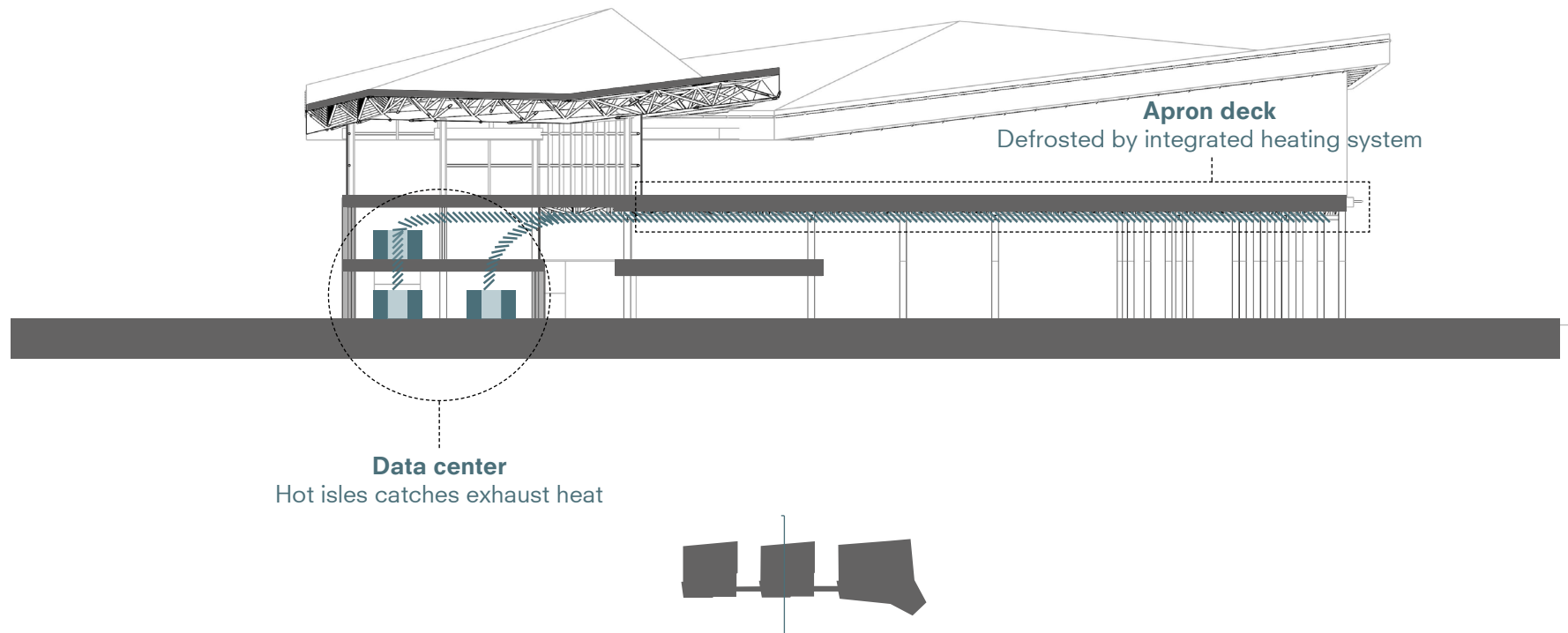
Prefab wooden floor elements

Saving 9.433 m³ of concrete



Climate control

DATA EXHAUST HEAT

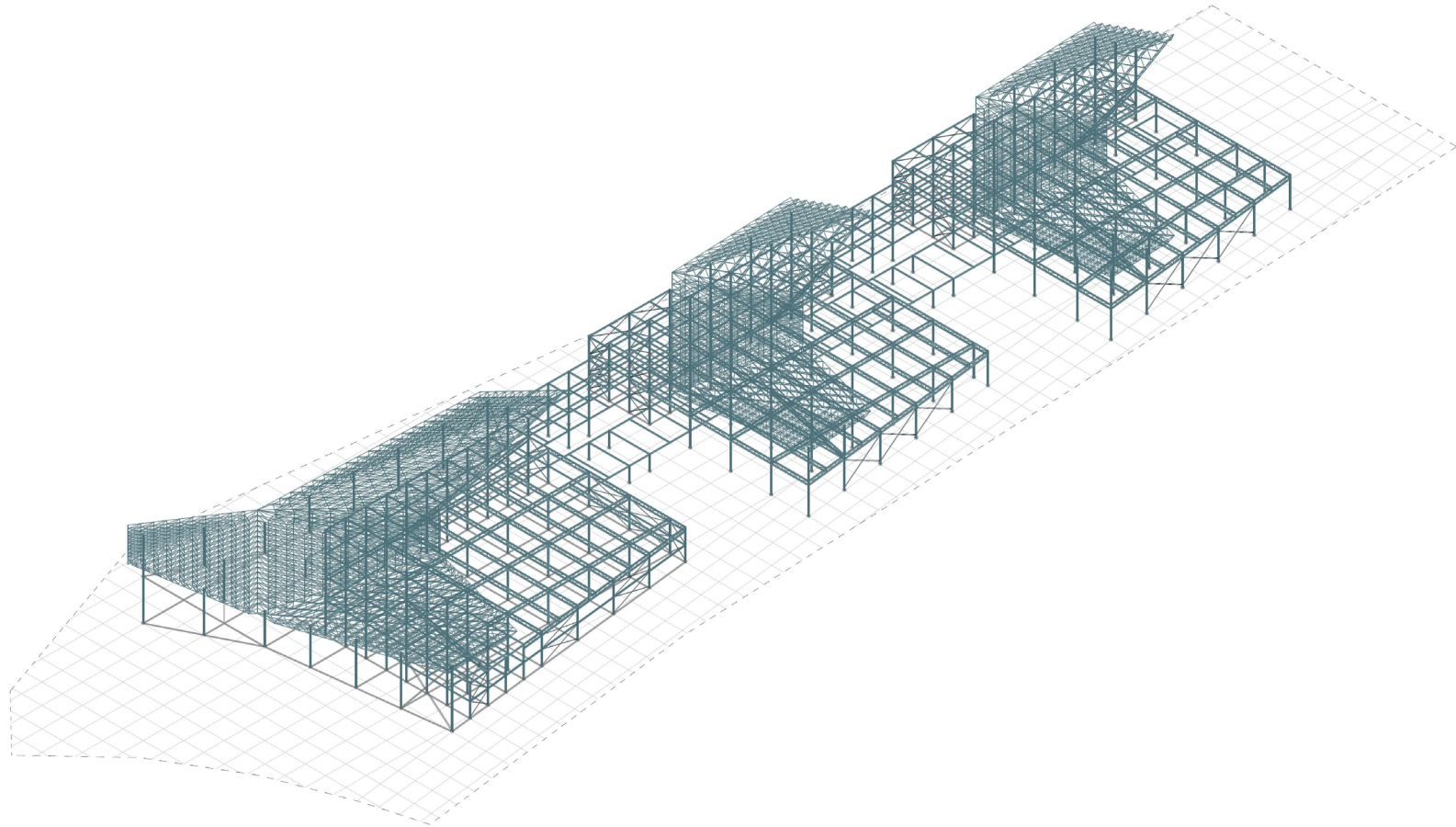


CONSTRUCTION



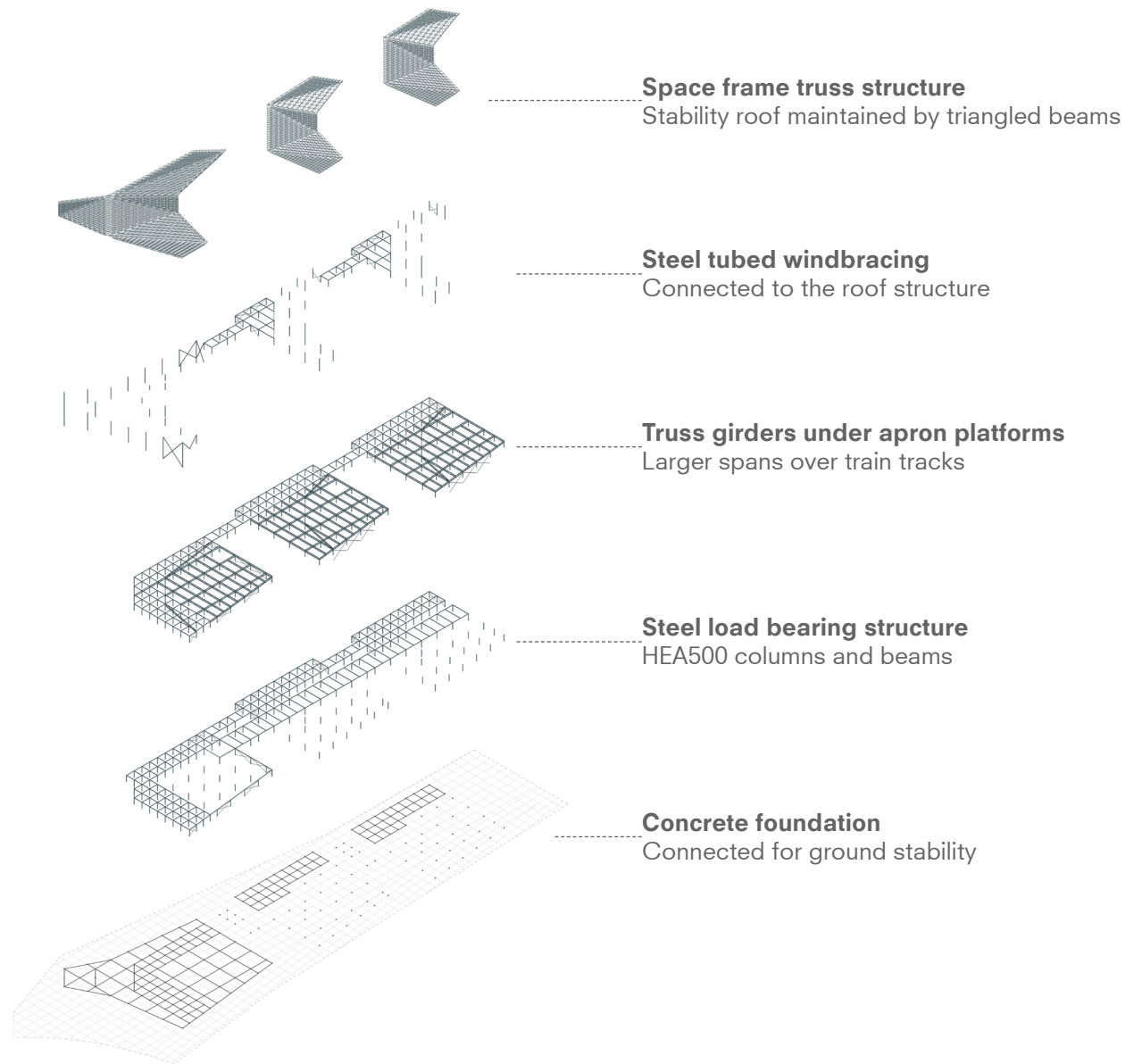
Construction

STRUCTURE AXONOMETRIC

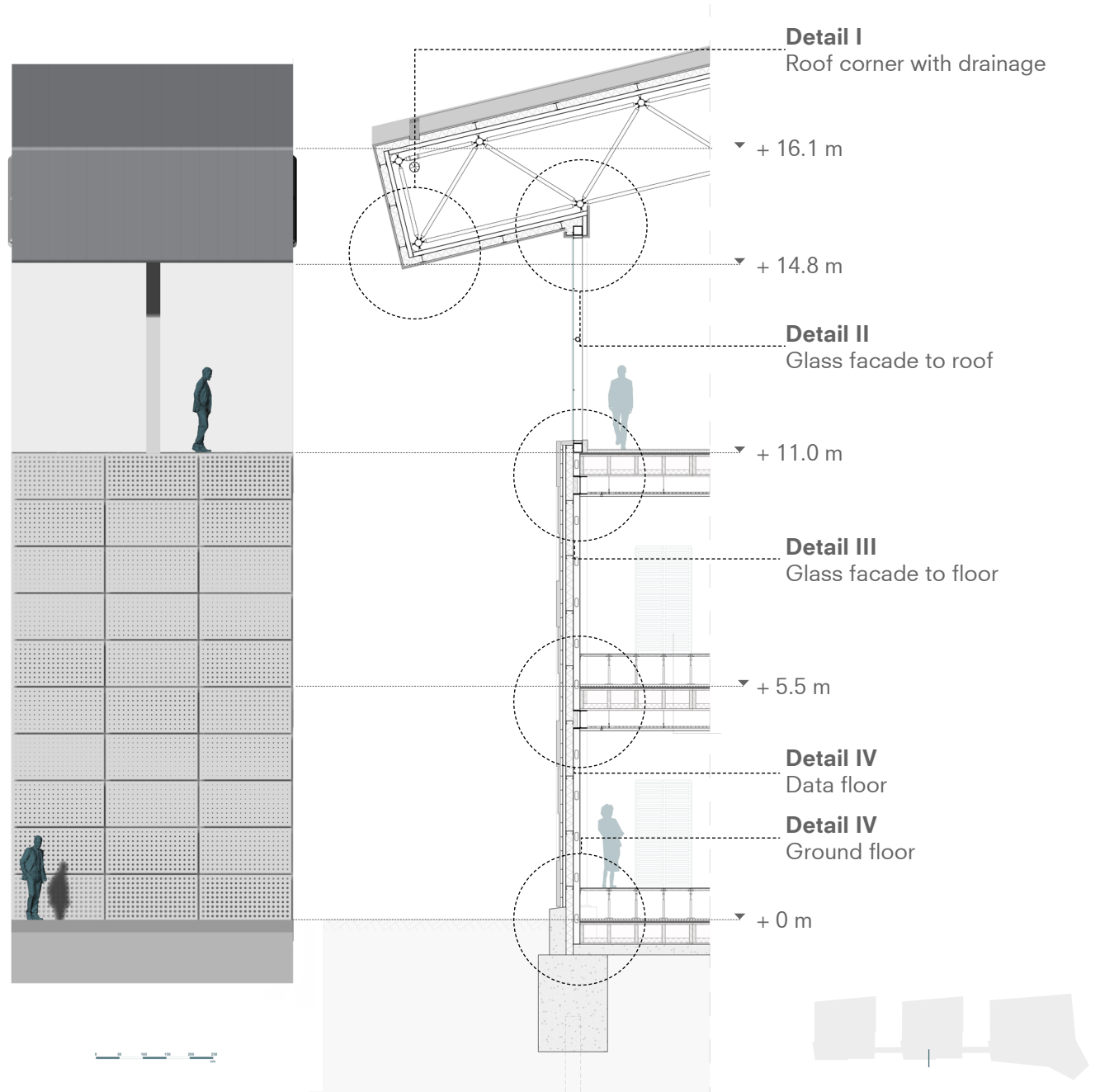
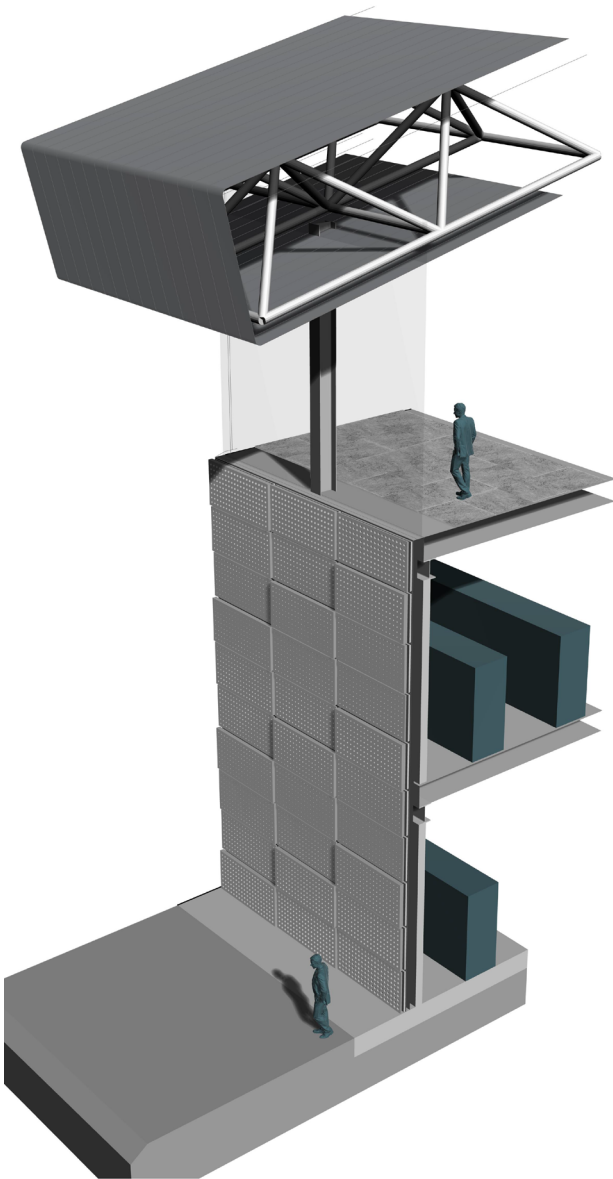


Construction

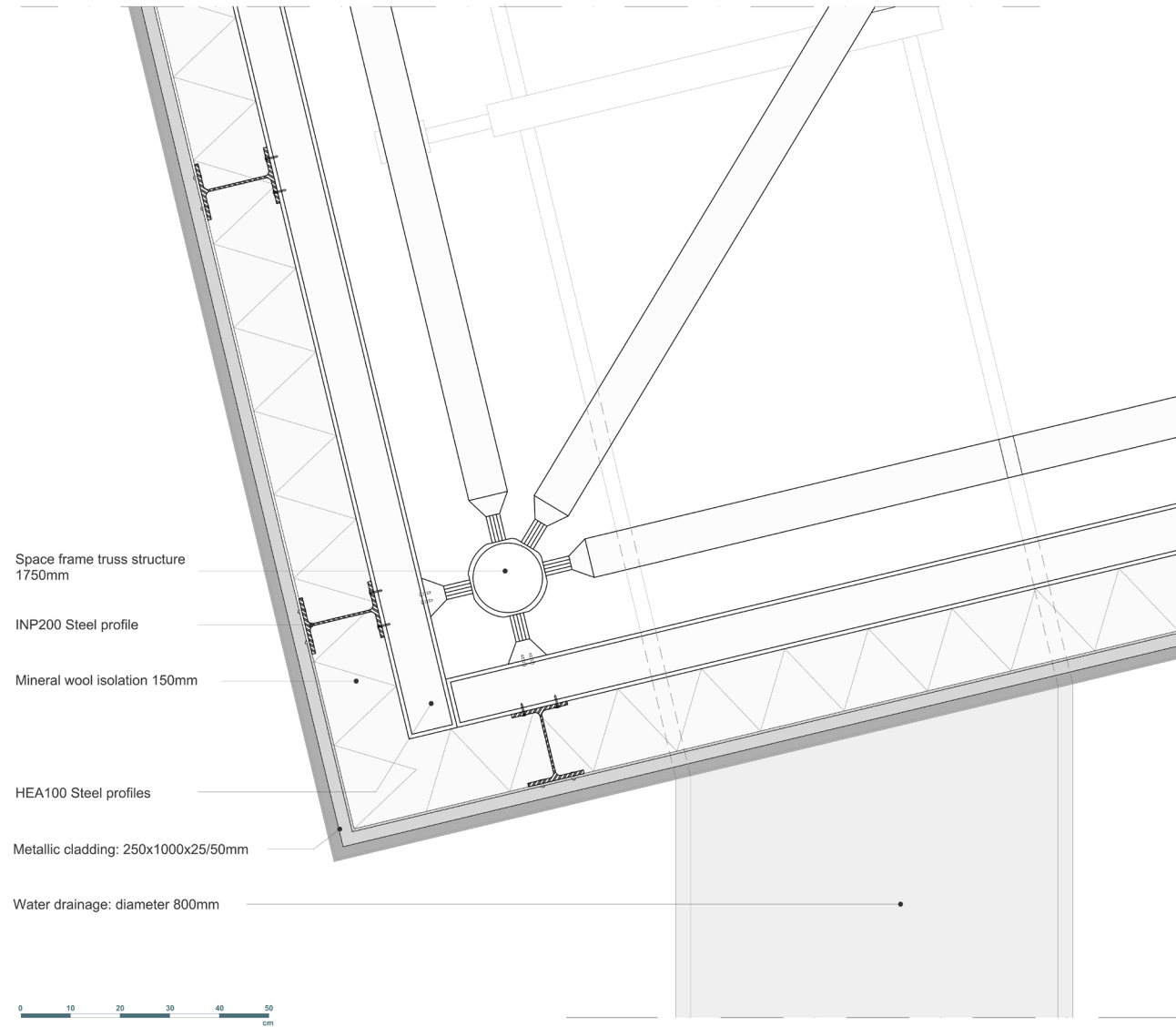
EXPLODED AXONOMETRIC



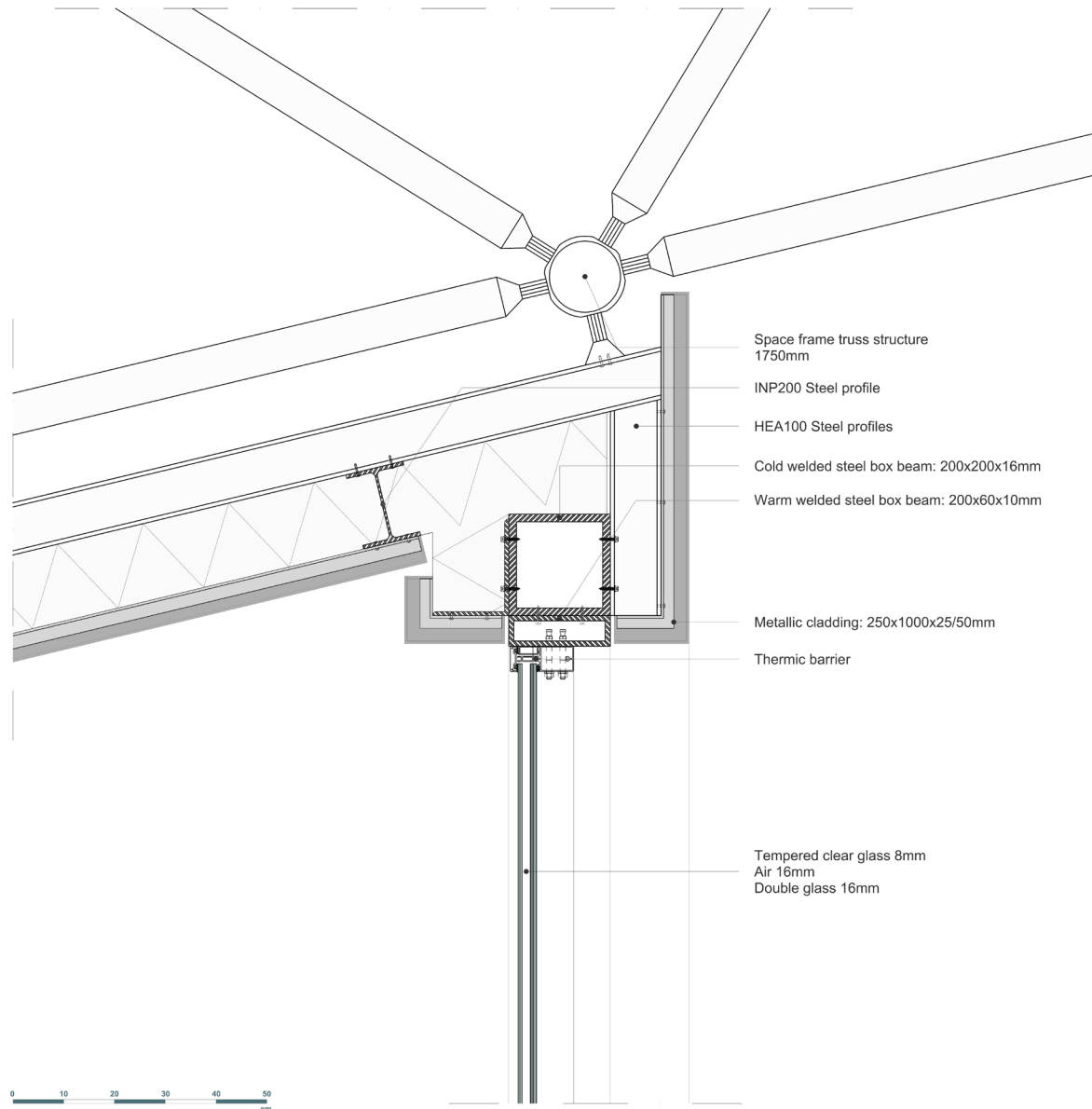
Construction FACADE SECTION



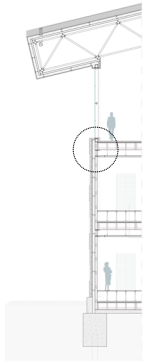
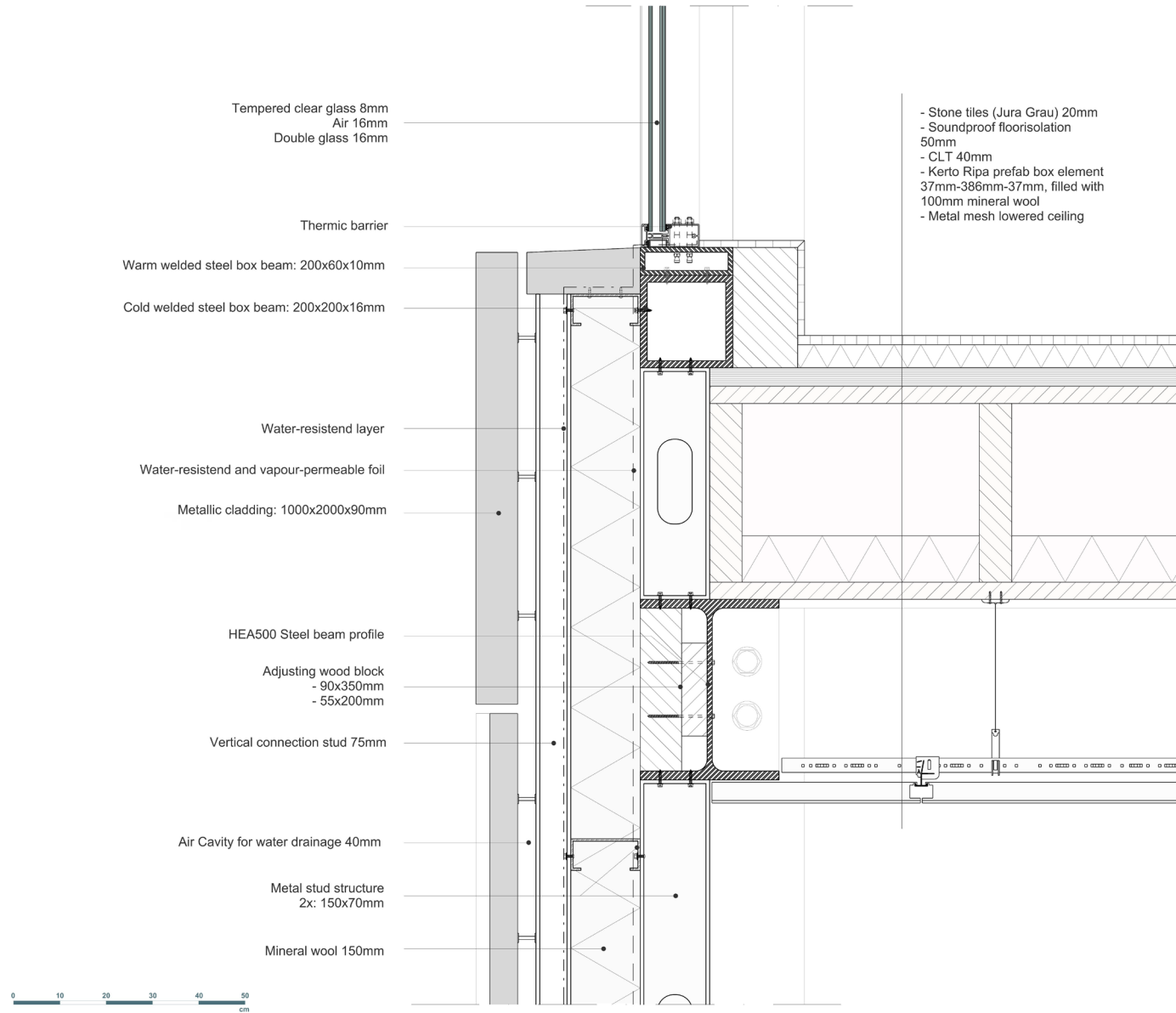
Construction DETAIL I



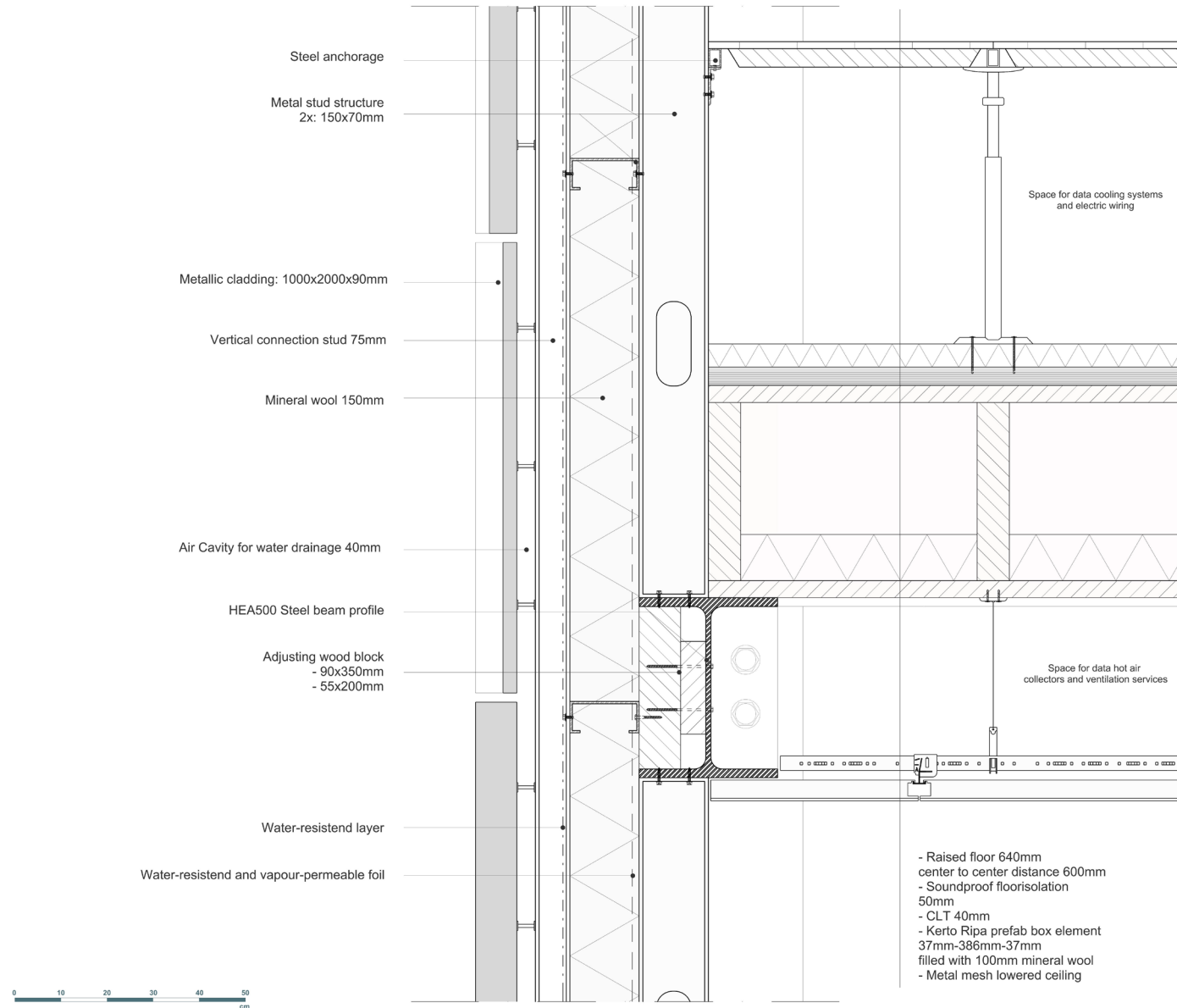
Construction DETAIL II



Construction DETAIL III



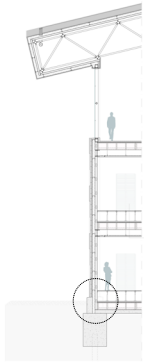
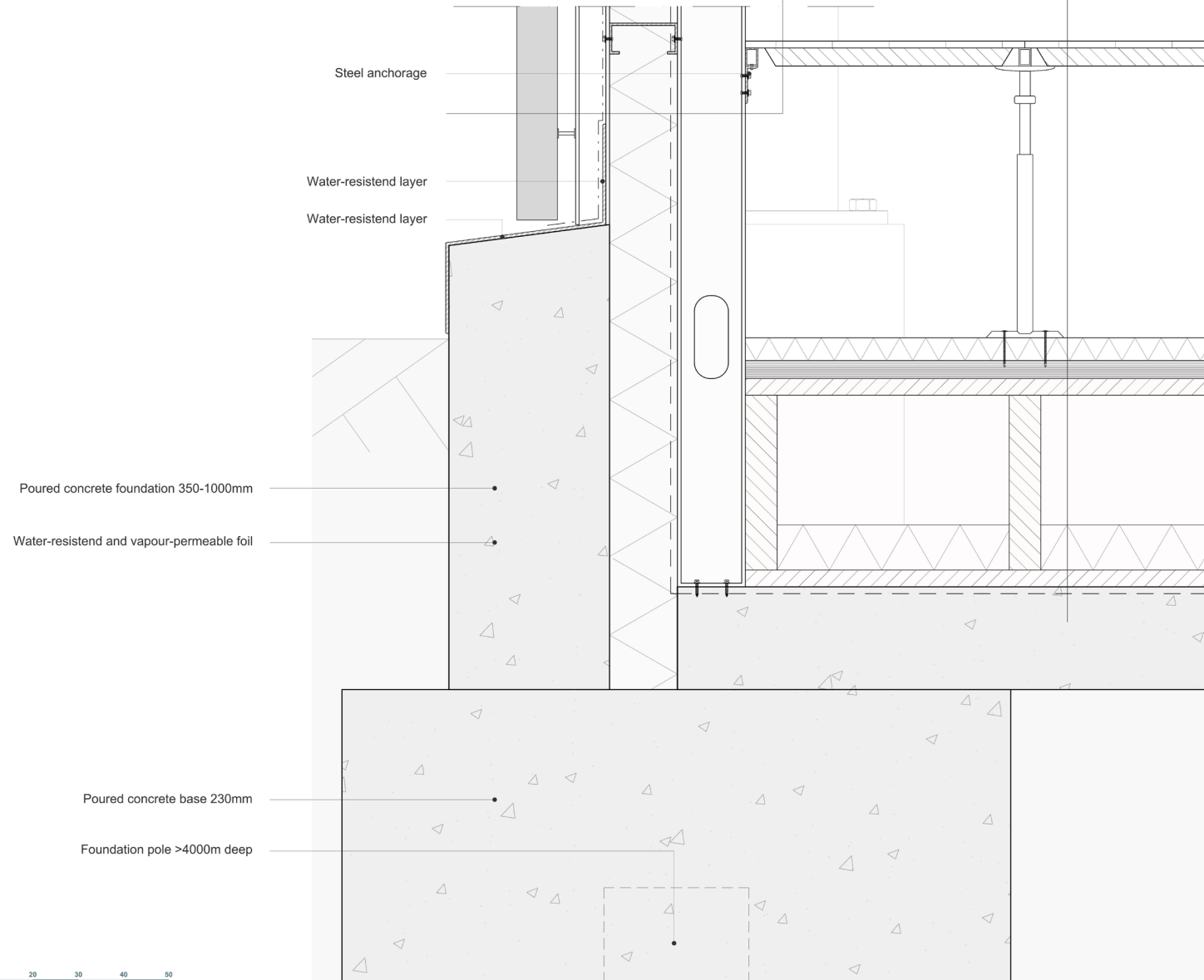
Construction DETAIL IV



Construction DETAIL V

- Metallic cladding:
1000x2000x90mm
- Air cavity for water drainage
and ventilation
- Vertical connection stud 75mm
- Mineral wool 150mm
- Metal stud structure 150x70mm

- Raised floor 640mm
center to center distance 600mm
- Soundproof floorisolation
50mm
- CLT 40mm
- Kerto Ripa prefab box element
37mm-386mm-37mm
filled with 100mm mineral wool



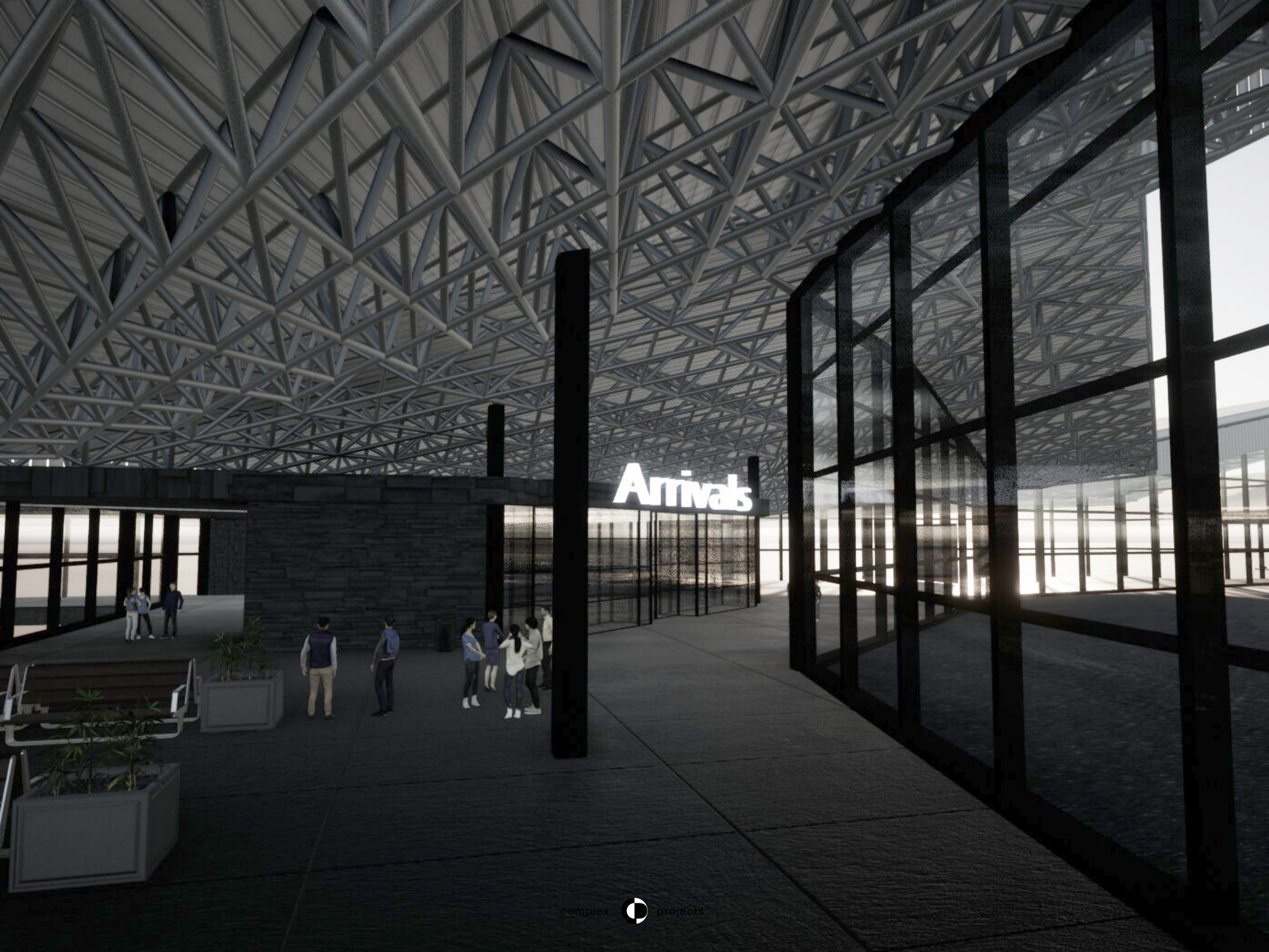
ARCHITECTURAL EXPERIENCE





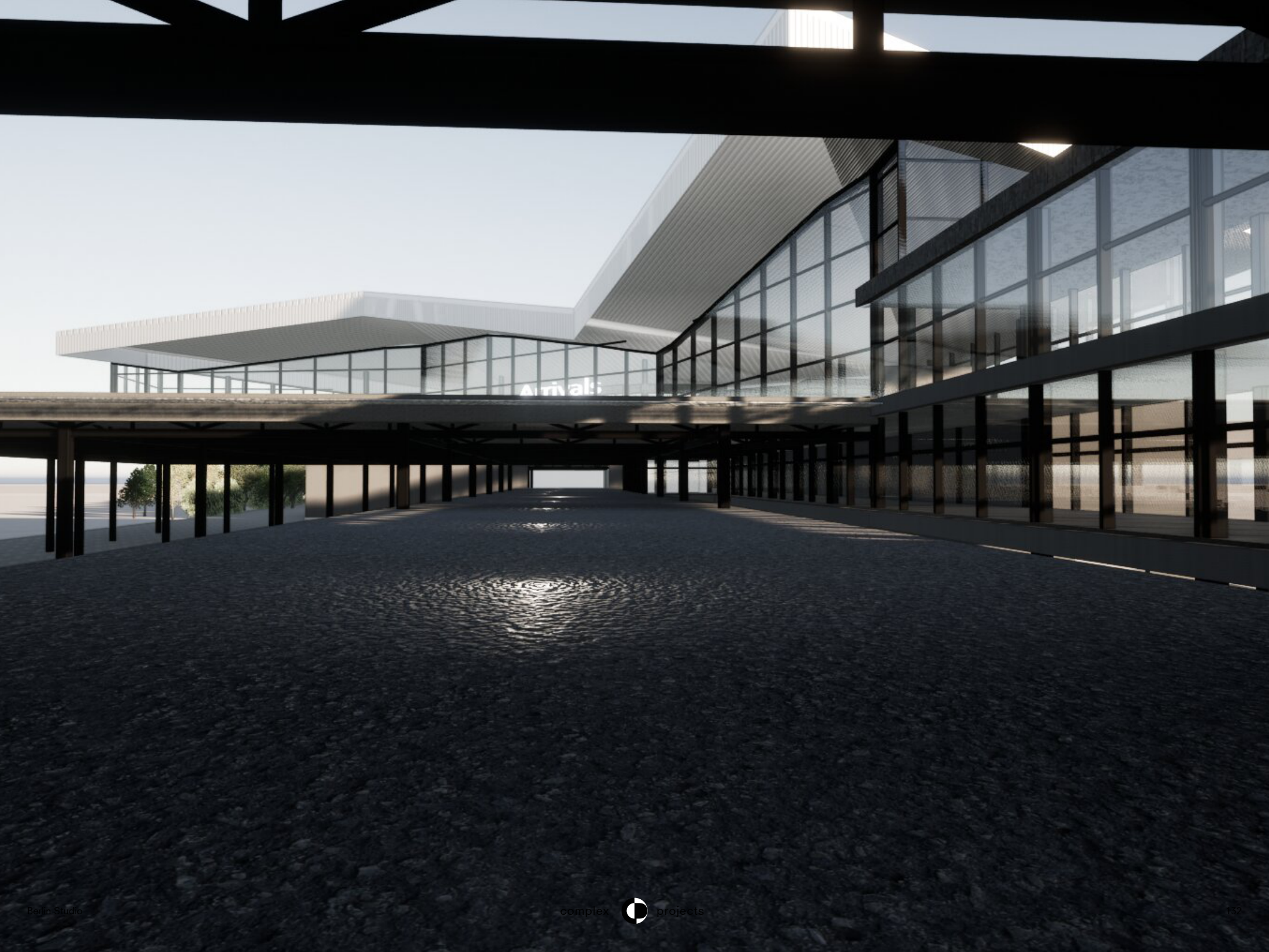


Departures



Arrivals





Arrivals

THANK YOU