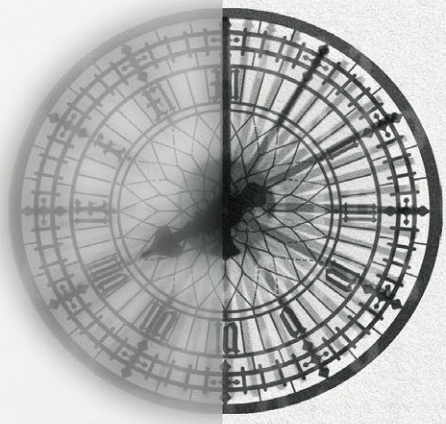
RUSH HOUR

EMOTION-CENTRIC RAILWAY STATION



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Ruben Vos 4465512

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COMPLEX PROJECTS
Berlin studio
AR3CP010

student
Ruben Vos

Berlin Studio
Digitalization

chair
Kees Kaan

Studio coordinator
Hrvoje Smidihen

Studio tutors
Olindo Caso
Martin Grech

email
infocpstudios@gmail.com

Instagram
https://www.instagram.com/
cp.complexprojects/

website
https://www.tudelft.nl/bk/over-faculteit/
afdelingen/architecture/organisatie/disciplines/
complex-projects/

facebook
https://www.facebook.com/CP_Complex-
Projects-422914291241447

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INTRODUCTION

01

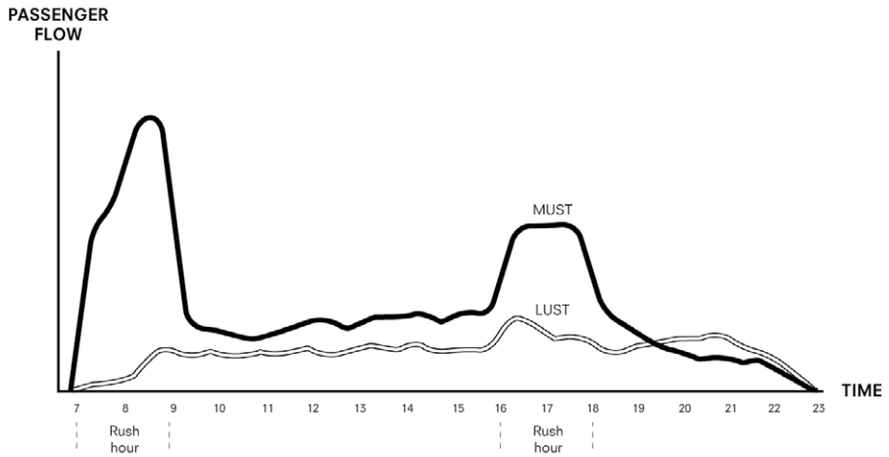
RUSH HOUR: EMOTION-CENTRIC TRAIN STATION

1.1 RUSH HOUR

Rush hour is the ‘break or make’ moment of train station. It determines whether a station is efficient and appreciated by its users. Twice a day, within a time span of two hours, thousands of people flow simultaneously through the building. Time sensitive passengers are rushing on their journey to their destinations, predominatly commuting to work or school. Over time, stations have turned into a true piece of machinery in order to move people efficiently from A to B. Passenger were being treated as machines, shaped by their physical surrounding.

Recent academic research and state-of-the-art stations such as Rotterdam central station show a significant shift by increased incorporation of User Experience (UX) design methods to improve customer satisfaction (Van Hagen, 2014). There is no longer generalization of ‘the passenger’ (Bureau Spoorbouwmeester, 2011). Instead passengers are acknowledged as individuals with their own emotions and well-being. In the era of digitalisation, big data (large amount of information) and digital technology give designers a valuable insight of people’s feeling, behaviour and needs at the train station (Schneider et. al, 2023).

The collected data can inform design decisions such as space optimization, services and overall station lay-out; an iterative proccess of designing from inside-out and outside-in. Analysing user journeys can help explain peak commuting times, popular routes and common pain points. Ultimately, customer satisfaction leads to achieving more customer loyality and higher ridership for railway companies such as the Deutsche Bahn (Germany) (Van Hagen et. al, 2017).



08 Passenger flow throughout average weekday (adapted from Van Hagen, 2014)

03 Rush Hour Alexanderplatz Berlin (Hanschke, 2018)

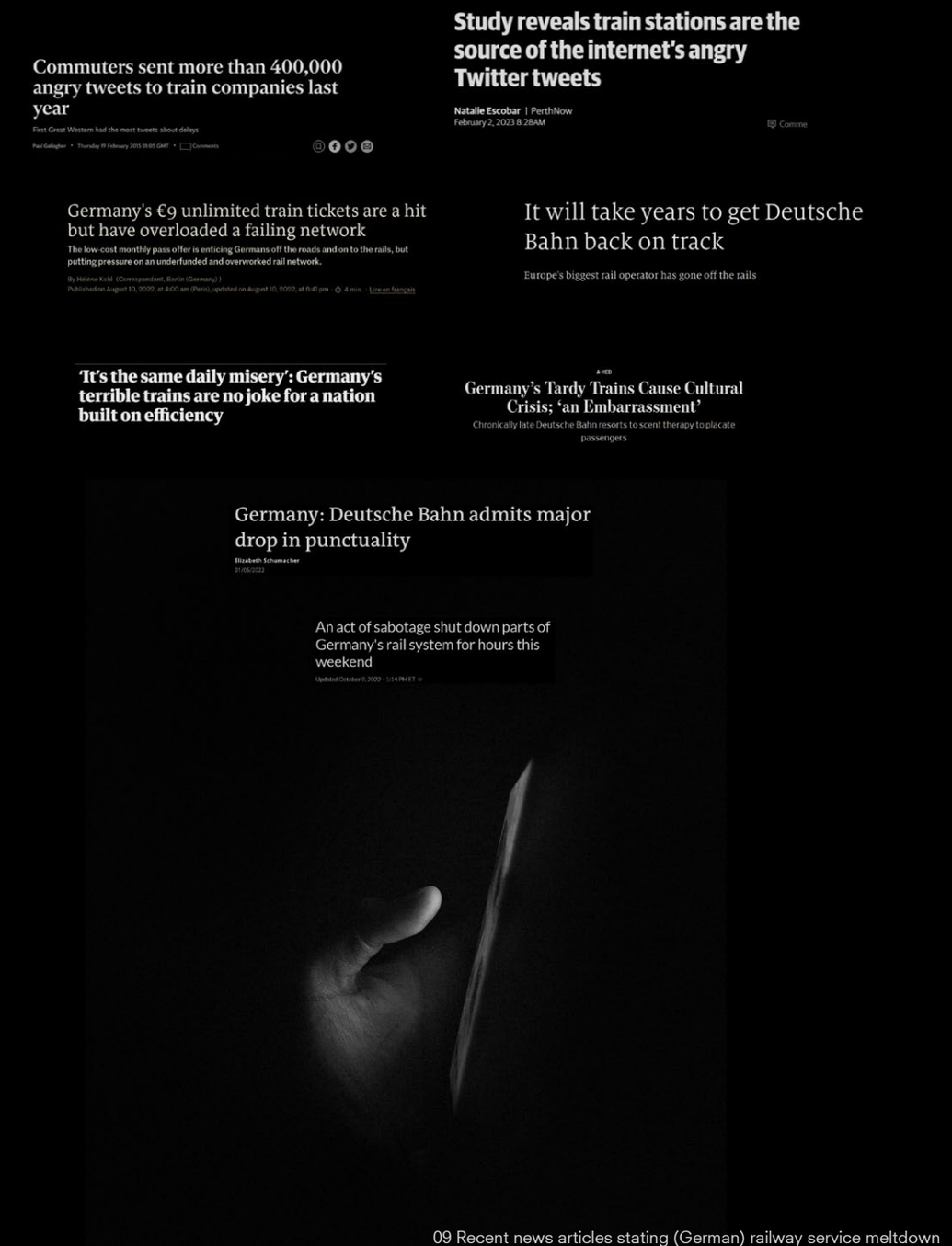
1.2 PROBLEM STATEMENT

With the anticipated surge in population growth and a paradigm shift towards rail in the face of increased urbanization, German cities are projected to accommodate 85% of the population by 2050, up from 75% in 2020 (German Federal Statistical Office, 2020). For instance, Berlin, our studio's city, experiences an annual influx of 65,000 inhabitants, intensifying the pressure on train stations (Berlin, 2023).

A global response to climate change accelerates a significant shift to rail, aligning with the EU's ambition to triple high-speed trains by 2050. Deutsche Bahn aims to double passenger numbers, replacing 5 million car trips and 1/6 of domestic flights by 2050 (DB, 2023). However, existing railway infrastructures in many countries are strained, leading to reduced customer satisfaction and punctuality, especially in long-distance travel.

Last year (2022), 1/3 of the German trains were late wich seems very ungerman, being internationally renowned for its efficieny (Schumacher, 2022). Recent commitment of 40 billion euros by 2027 from the Federal Ministery of Digital and Transport underscores the urgency to modernize train stations and network components (Pamela, 2023).

Unveiling public sentiment through digital platforms like X (Siriaraya et. al, 2023) reveals railway stations as a prime source of online frustration and anger. Negative experiences such as delays, overcrowding, and protracted waiting times significantly impact the overall passenger experience (Van Hagen, 2014). In this context, understanding user behavior and needs is critical for designers. Station designs must proactively address current challenges and anticipate future conditions, ensuring resilience and optimal user experience in the face of escalating demands on railway infrastructure.



09 Recent news articles stating (German) railway service meltdown

1.3 RESEARCH QUESTION

Main research question

How to design a train station for rush hour?

Sub-research questions

How can architectural elements, services and overall station layout improve the emotional wellbeing and needs of the passengers during rush hour? And what can be the role of digitalization?

The primary objective is to comprehensively understand the emotional requirements of individual passengers and investigate how architecture (form, light, materialisation, lay-out, etc.) can evoke positive emotions, particularly during peak times such as morning and afternoon rush hour. The study aims to transition passengers from states of anxiety, frustration and urgency to positive feelings of relaxation, inspiration and excitement. Despite the ultimate goal of achieving an efficient transport system, this research underscores the importance of factoring in emotional well-being in the design and functionality of transportation spaces.

06 Rush hour Franfurt Banhof (Orlowski, 2015)

RESEARCH FRAMEWORK

02

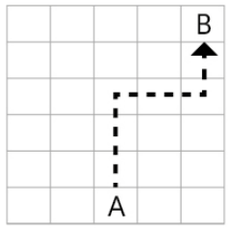
2.1 THEORETICAL FRAMEWORK

In the academic field, the emotional states of train station users during rush hours are significantly influenced by three major research domains: Natural Wayfinding, Crowd Control and Waiting Experience. Satisfying passengers proves challenging, with control over reliable, safe, and seamless transport serving as a benchmark. Minor disturbances can profoundly impact the overall experience, while comfort and additional amenities contribute to satisfaction. Unpleasant waiting experiences before boarding or during delays elongate the perception of time, eliciting anger and frustration (Van Hagen, 2014).

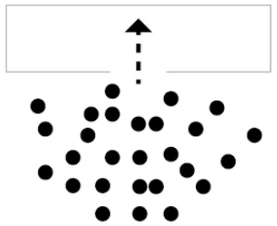
Natural Wayfinding prioritizes an intuitive flow of people through spaces, emphasizing lines of sight, well-articulated spatial flow, and clear legibility (Ferri & Popp, 2022). Crowd control, crucial for efficient flow and spacing, alleviates bottlenecks and congestion, preventing overcrowded conditions (Li, 2019). Train stations face a constant conflict between individuals creating static areas and others requiring dynamic spaces for movement, influencing circulation within the building (Triggianese et. al, 2018).

In the investigation of environmental stimuli's impact on passenger emotions and behaviour, academics commonly employ Mehrabian's Pleasure-Arousal-Dominance (PAD) model of emotions (Russell, 1980) and the Stimuli-Emotion-Response (SER) Model (Mehrabian & Russell, 1974). Rail passengers are broadly categorized into two groups: must and lust travelers (Van Hagen, 2014). Must passengers, such as daily commuters, have high-frequency travel patterns, developing subconscious behaviors. In contrast, lust passengers, including day-trippers, tourists, the elderly, and families, travel less frequently and tend to be more insecure in their travel behavior.

Natural Wayfinding

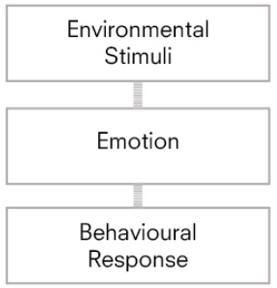


Crowd Control



Waiting Experience

Stimuli-Emotion-Response Model



10 Rush Hour theoretical domains

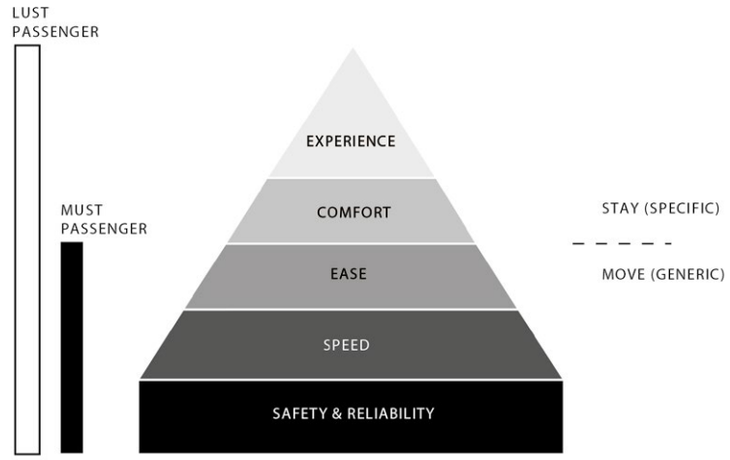
2.2 RELEVANCE

The Rush Hour project aligns with CP Berlin's core principles: Bodies, Building, Berlin.

It seeks to understand the connection between the body (society and individual human) and the building. Architects have a significant responsibility in shaping the lives and sentiments of individuals. Vice Versa, architects are also responsible for translating the societal needs into new design ideas. In response to societal progress and the surge in data and digital means, our 'digitalization' studio group explores how the typology of public buildings can adapt.

Public buildings such as train stations are inherently complex, emphasizing both human and operational flows. Our objective is to devise clear and logical architectural solutions to contemporary and future challenges. This year's overarching research question within CP is centered on determining the balance between generic (primary purpose) and specific (secondary purpose) program elements.

The Rush Hour project adopts a holistic approach, considering human factors alongside global themes such as energy and material efficiency. State-of-the-art stations are set as the benchmarks and as CP studio we strive for incremental advancements.



11 Passenger generic and specific user needs (adapted from Van Hagen, 2014)

RESEARCH METHOD

03

3.1 PROGRAM

The research methodology for designing the ‘rush hour’ train station starts with a programmatic exploration of contemporary state-of-the-art train stations. The focus is on identifying users, figuring out size, programmatic breakdown, key spaces, and essential concepts. Comparative case studies are conducted to draw conclusions. Analytical techniques encompass floorplan analysis, dimensional assessments (height, width, and clear height), area calculations, on scale model-making and functional schemes to establish a benchmark and gain a thorough understanding of the typology. Given the Berlin project location, Berlin Hauptbahnhof will also serve as a primary case study for review and will be visited during our field trip. Throughout the upcomng academic year, as many stations will be visited to make observations from an user perspective.

After the programmatic benchmarking study, the program will be revised from through the lens of future digitalization and by looking at various user journeys during rush hour. Mapping out the sequence of activities and movement through key spaces of various user types (personas) will help to understand how to meet their needs and give them positive state of mind (Bradley et. al, 2021). This will include all steps from arriving at the entrance hall, checking-in, wayfinding through the passage, waiting on the platform, and finally boarding the train. Also researching digitalisation trends will help determine how the train station typology can be impacted.

12 Program Research

13 User Journey Research

3.2 CLIENT

In the research, a suitable client will be chosen. The client’s ambitions and targets will be investigated to ensure alignment with the project objectives. Additionally, research will delve into potential public-private partnership models, considering that crucial big data, essential for comprehending user needs and emotions, is also collected by private entities like Google and T-Mobile. The research methods employed will encompass the examination of their website, relevant news articles, and annual reports containing statements and figures.

14 Client Research

3.3 SITE

The site selection for the train station design is based upon three building typology criteria and three digitalisation strategy group site criteria. Once a suitable site is identified, a comprehensive analysis will help to draw conclusions and inform design decisions. The site analysis includes system mapping on various scales, encompassing mobility, logistics, and urban context. Additionally, opportunity and constraint maps will be generated. A crucial component of the analysis involves a fieldtrip to various potential site locations in Berlin.

15 Site Research

DESIGN BRIEF (DRAFT)

04

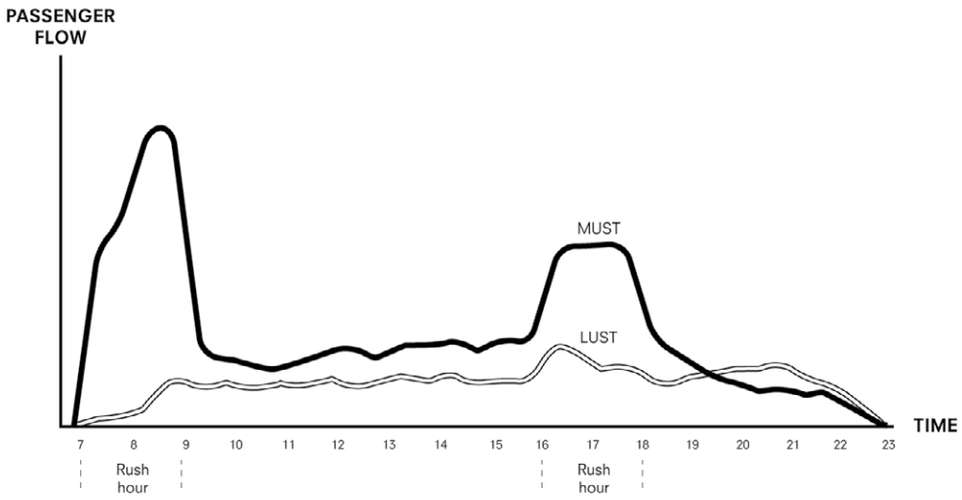
15 Rush Hour Collage

4.1 PROGRAM

The program chapter is organized into several sub-chapters. These include user identification, case study benchmark analysis, ,key spaces catalogue, proposed program with additional elements, program breakdown detailing square meters and required (key) spaces. Eventually, there will be a 3D programmatic building block overview with test-fit studies.

Train Station Users

Train station users can be grouped into three main categories: must travelers (predominant during rush hour), lust travelers, and operational users (Van Hagen, 2014). Each group has specific needs and emotional requirements. Must travelers are often in a hurry, traveling frequently with limited time. Lust travelers have more time but travel less frequently. Operational users play a crucial role in providing seamless service to passengers and include both back-of-house and front-of-house staff, along with office staff from the DB digital department. Understanding the distinct needs of these user groups is vital for designing a station that caters to their specific requirements.

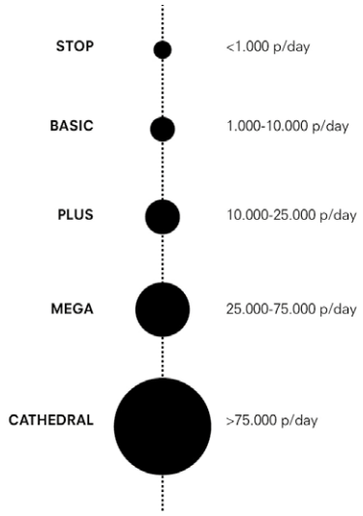


08 Passenger flow throughout average weekday (adapted from Van Hagen, 2014)

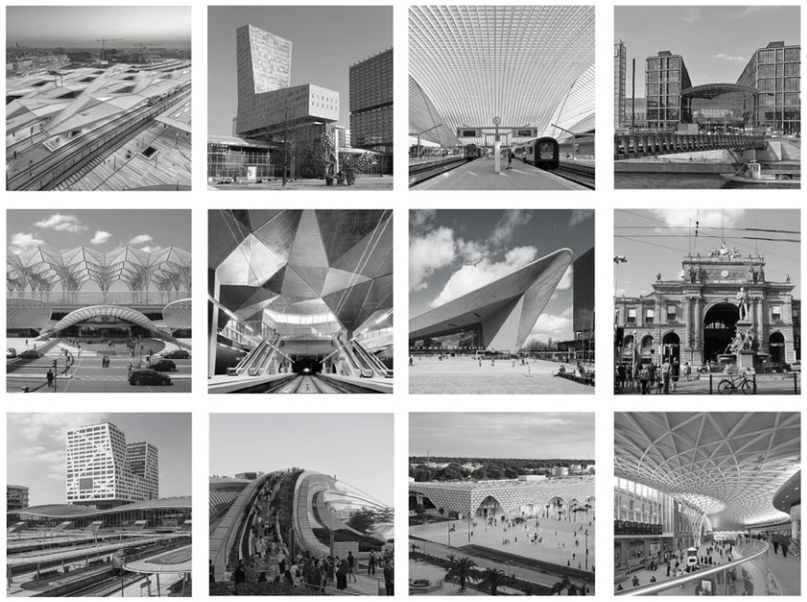
16 Users Identification

Case studies

12 train stations have been thoroughly analysed to understand their qualities, size, overall layout, key spaces, and structure. Most of these stations are considered state-of-the-art and fall into the ‘Mega’ or ‘Catherdral’ scale category, accommodating over 25,000 passengers daily according to Dutch railway classifications (Source). On average, the precedent stations cover about 50,000 m2, with a total area of 122,000 m2. The station programs can be split into two main types: hard (64%) and soft (36%). The hard side includes essential mobility features like platforms, bus stations, and parking, along with operational spaces like logistics and staff facilities. On the soft side are spaces for passengers, including public squares, circulation areas, passenger facilities and commercial spaces. This study provides valuable insights to inform the design of an efficient and innovative train station.

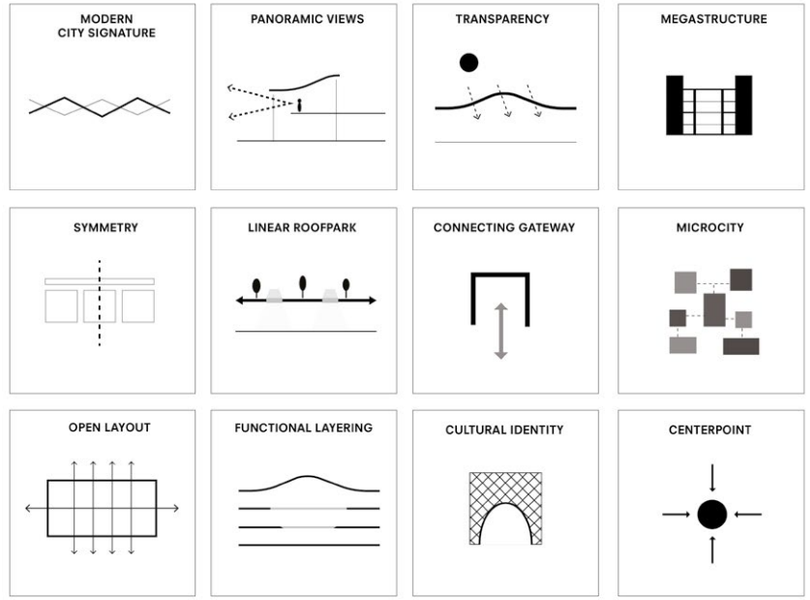


17 Railway Station Classification (adapted from NS, 2022)



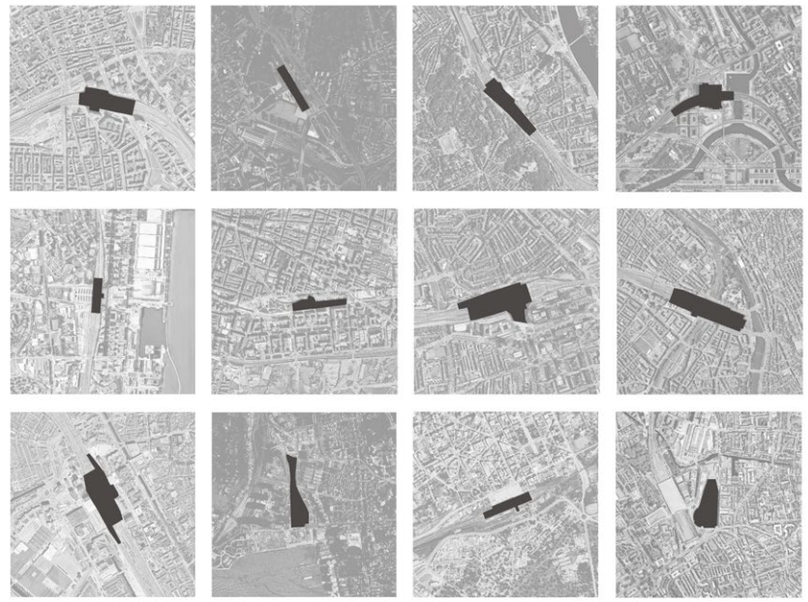
18 Benchmark case study train stations

Case studies Key Qualities



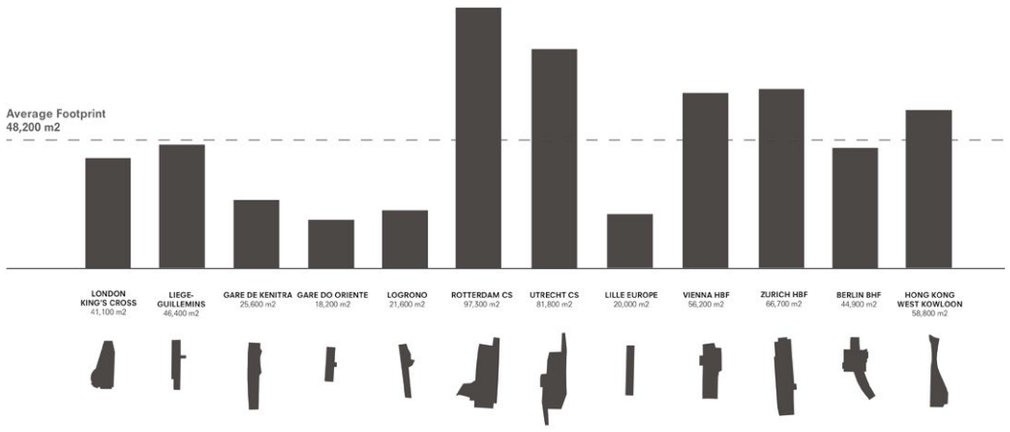
19 Case study train station key qualities

Case studies Footprint



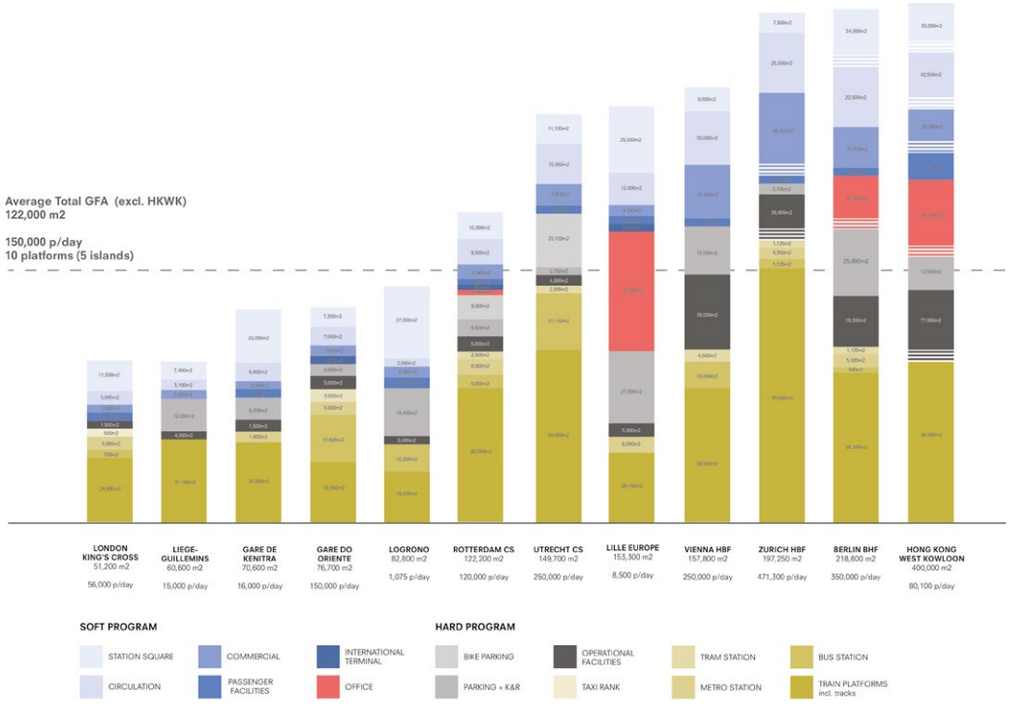
20 Case study train station footprints

Benchmark Footprint Comparison



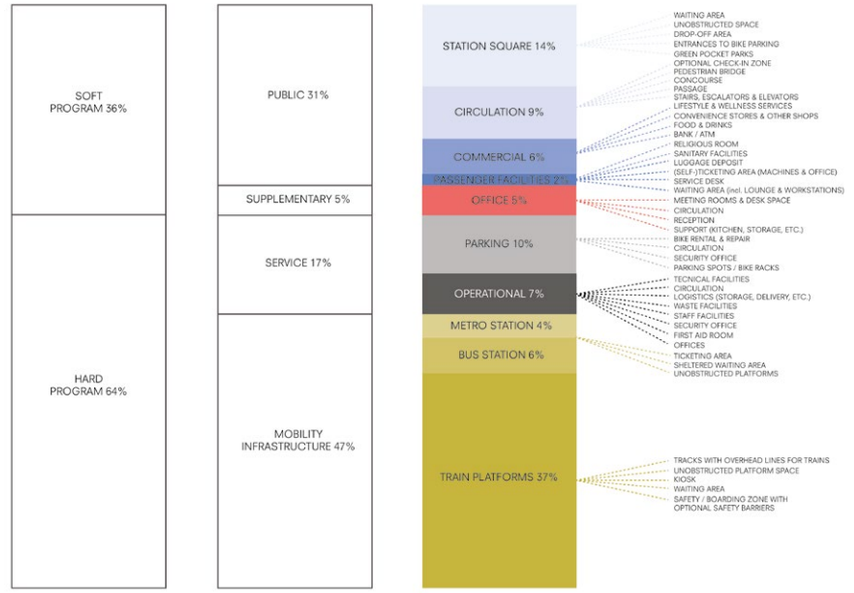
21 Benchmark Footprint Comparison

Benchmark Program Bar Comparison



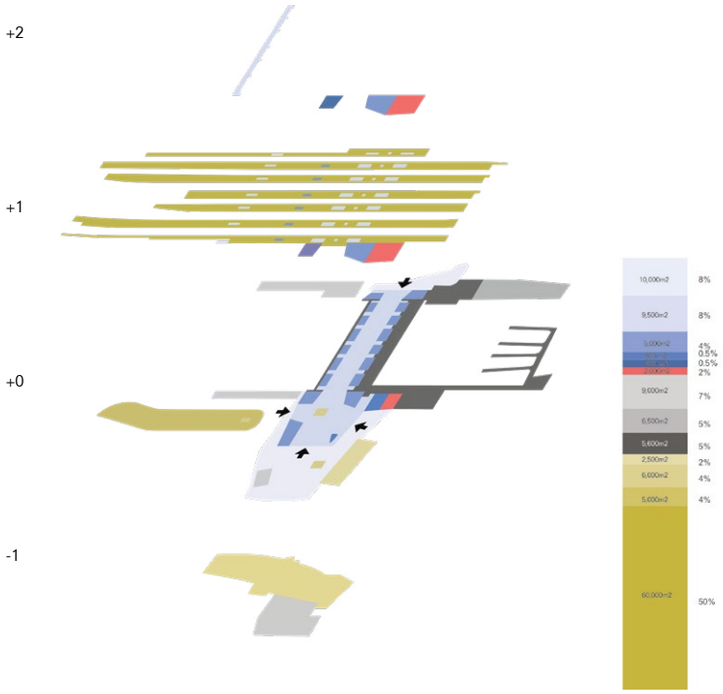
22 Benchmark Program Bar Comparison

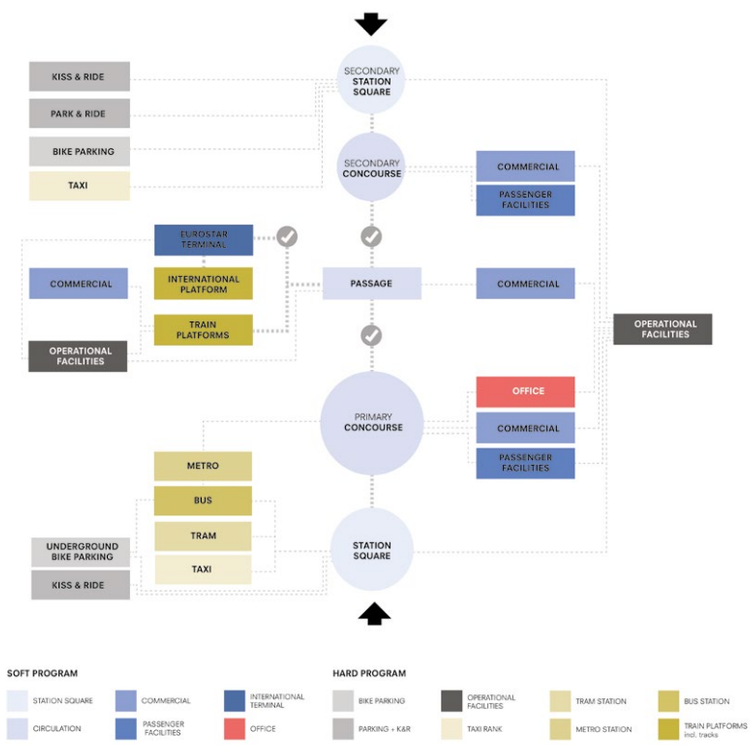
Benchmark Program Bar



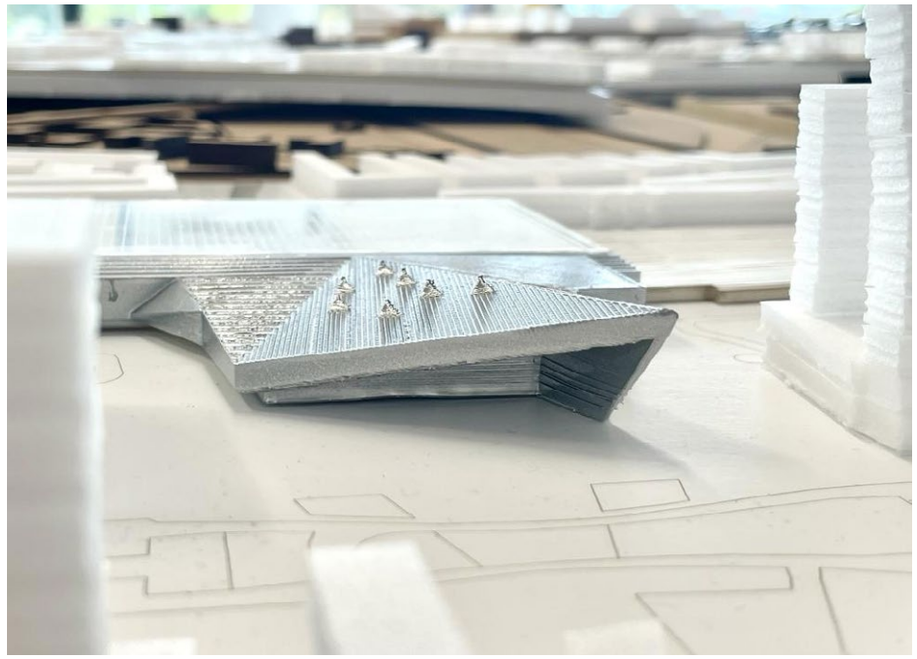
23 Benchmark Program Bar

Seminar Dutch Case-study: Rotterdam CS





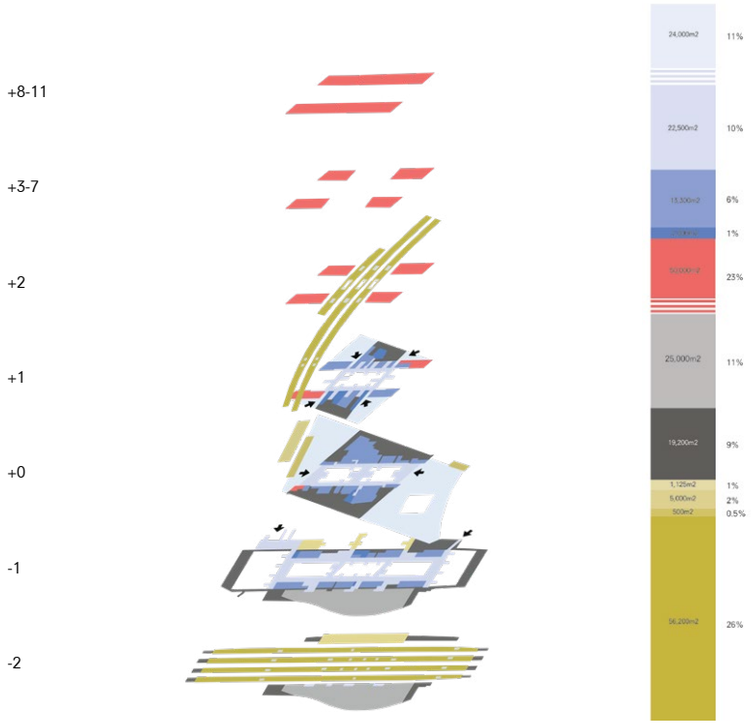
24 Rotterdam CS Program Analysis

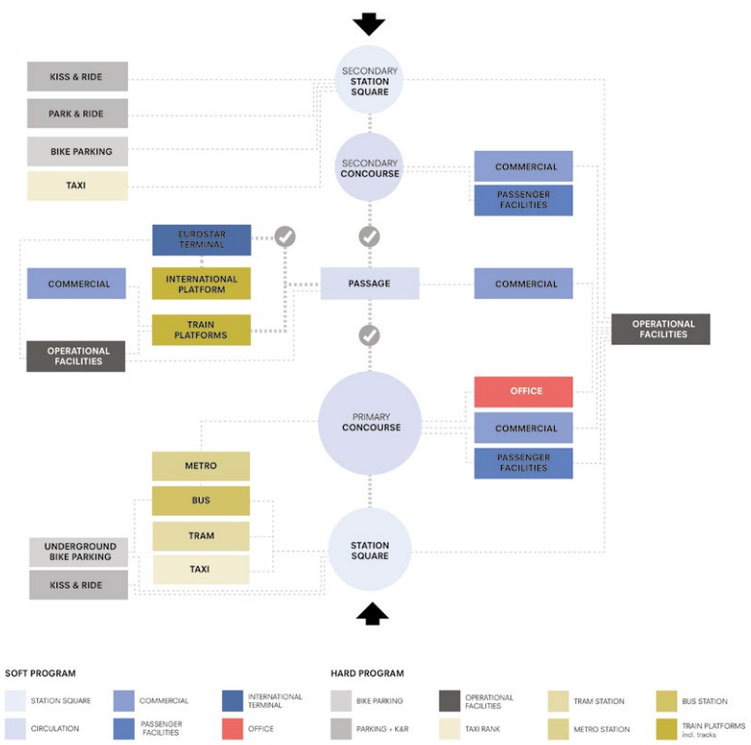


25 Rotterdam CS Model (Author)

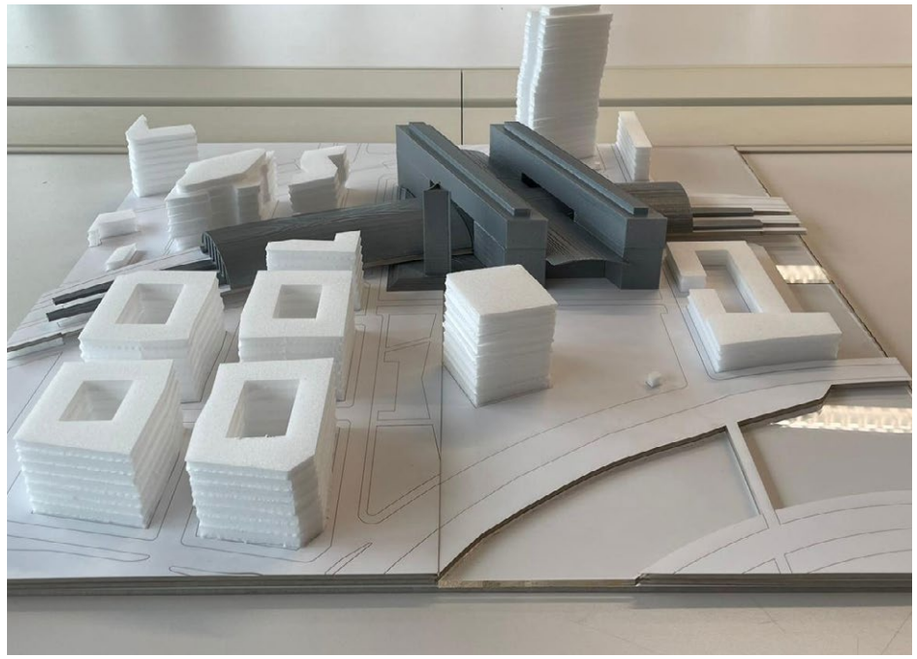
05 Rotterdam CS (Linders, 2014)

Seminar German Case-study: Berlin Hauptbanhof

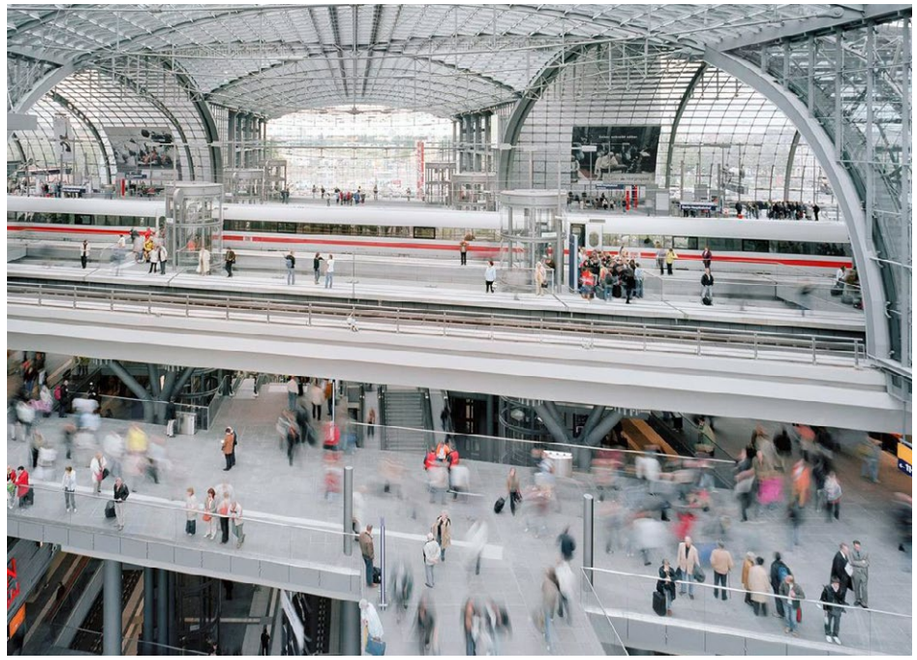




26 Berlin Hbf Program Analysis

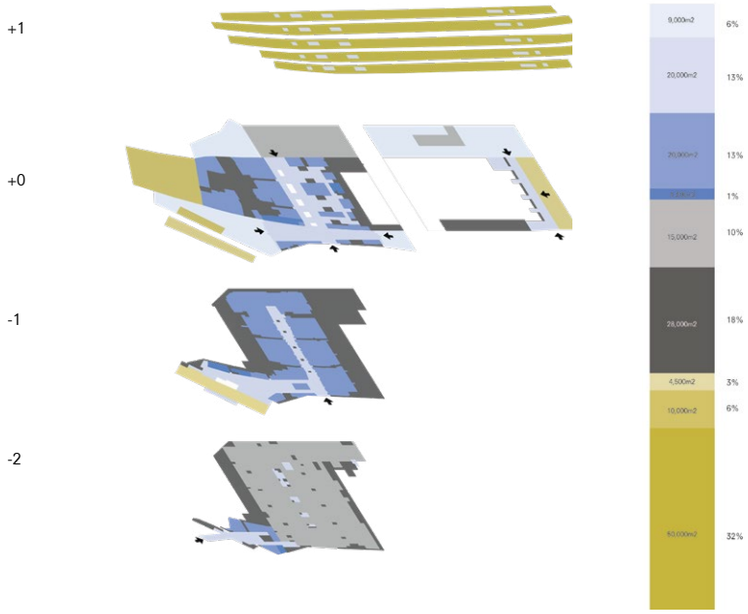


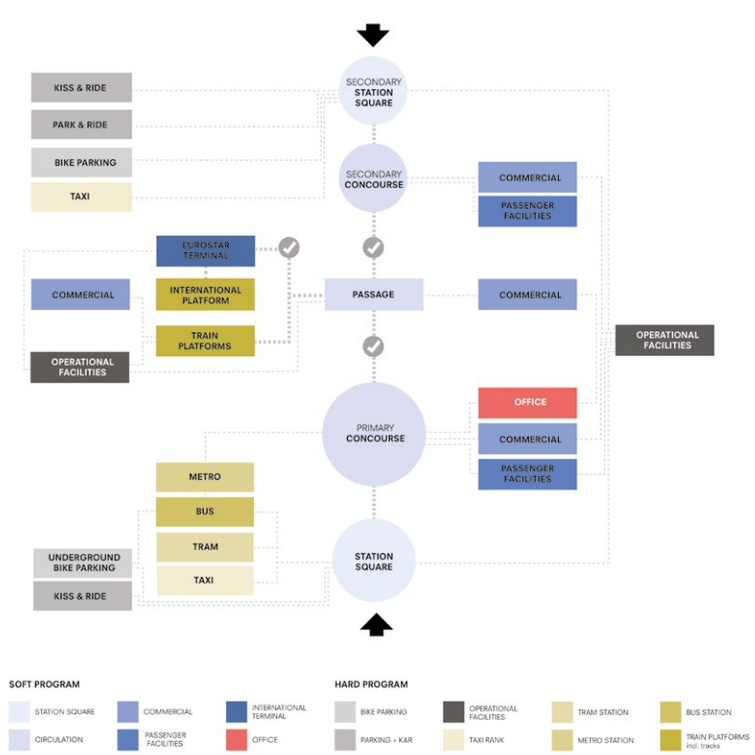
27 Hauptbanhof Berlin Model (Author)



01 Hauptbanhof Berlin (Bredt, 2022)

Seminar International Case-study: Vienna Hauptbanhof



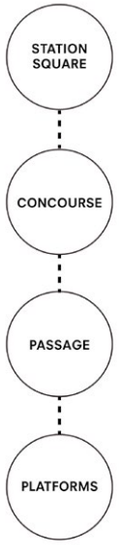


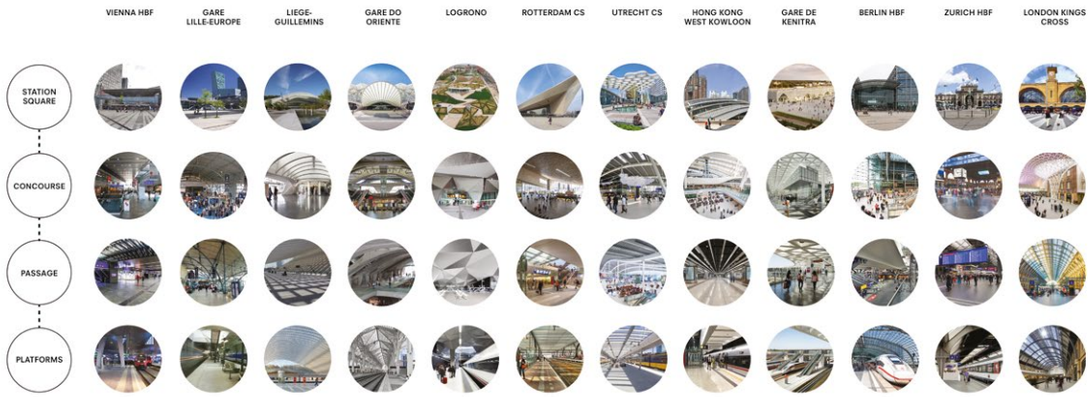
28 Vienna Hbf Program Analysis

02 Vienna Hauptbanhof Roof Berlin (Del Missier, 2014)

Catalogue of key spaces

The case studies train stations all have common key spaces, including the station square, concourse (entrance hall), passage, and platforms. To fully grasp their size and spatial qualities, these spaces are systematically compare, considering aspects such as width, height, clear height, and accessibility. This catalog will serve as a valuable resource in shaping the design brief.





Catalogue of key spaces

	VIENNA HBF	GARE LILLE-EUROPE	LIEGE-GUILLEMINS	GARE DO ORIENTE	LOGRONO	ROTTERDAM CS	UTRECHT CS	HONG KONG WEST KOWLOON	GARE DE KENITRA	BERLIN HBF	ZURICH HBF	LONDON KINGS CROSS
SQUARE												
AREA (m2)	7200	25000	7400	7300	36000	10500	11100	30800	36000	24000	7500	11500
LENGTH x WIDTH (m)	110 x 65	180 x 140	108 x 68	162 x 45	300 x 120	125 x 85	160 x 70	255 x 120	290 x 124	162 x 148	135 x 55	230 x 50
MAIN PEDESTRIAN ENTRANCES	2	2	1	1	1	2	2	2	1	2	2	2
CONCOURSE												
AREA (m2)	2950	180 - 900	500	2370	1500	3900	3050	4500	2600	4050	3500 - 5900	2550
LENGTH x WIDTH (m)	130 x 23	9-45 x 20	17 x 29.5	80 x 29	47 x 32	67 x 58	69 x 44	144 x 32	177 x 15	155 x 53	44 x 79-134	133 x 19
CLEAR HEIGHT (m)	10.6	4.6 - 9	3.5	11.5	5.5 - 11	17 - 22	9 - 15.4	16 - 30	8 - 13	9 - 26	9 - 18	20
BARRIER CHECK-IN	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	YES
PASSAGES												
WIDTH RANGE (m)	24	19	17 - 20	22	23	24.5	56	50	17	53 (22 eff.)	14 - 40	9.5 - 21.5
LENGTH RANGE (m)	114	305	82	80	23	153	175	90 - 136	90	84 - 216	144	64
CLEAR HEIGHT RANGE (m)	3.7	4.6 - 9	3.5	3.5	5 - 9	3.5 - 4.5	9 - 15.4	6	5	5.5 - 9	4 - 4.8	5 - 22
TUNNEL / BRIDGE / TRACK LEVEL	TUNNEL	BRIDGE	TUNNEL/ BRIDGE	TUNNEL	BRIDGE	TUNNEL	BRIDGE	BRIDGE	BRIDGE	BRIDGE	TUNNEL /TRACK LEVEL	TRACK LEVEL
PLATFORMS												
WIDTH RANGE (m)	11 - 12	7.5	7	9	10	11.5 - 12	9 - 12	9 - 12.5	8 - 10	12	9.5 - 15	7.5
LENGTH RANGE (m)	394 - 430	322	373 - 511	302	370	318 - 425	335 - 445	313 - 514	457 - 560	166 - 434	270 - 567	251 - 328
CLEAR HEIGHT RANGE (m)	6.4 -10.6	4.3 - 10	7 - 38	19	5.6 - 15.8	10.3	5.4	6	9	10.5 - 16.7	4 - 7	5 - 22
SPACING (m)	8.3 - 13	14.8	8.3	9	7.4	8 - 12.3	7.6 - 11.2	9.5	7.8	8.2	8.2	6.7
TRAIN SERVICES	INTERNATIONAL NATIONAL REGIONAL LOCAL	INTERNATIONAL NATIONAL REGIONAL	INTERNATIONAL NATIONAL REGIONAL	NATIONAL REGIONAL	NATIONAL REGIONAL	INTERNATIONAL NATIONAL REGIONAL LOCAL	INTERNATIONAL NATIONAL REGIONAL LOCAL	INTERNATIONAL NATIONAL REGIONAL	NATIONAL REGIONAL LOCAL	INTERNATIONAL NATIONAL REGIONAL LOCAL	INTERNATIONAL NATIONAL REGIONAL LOCAL	NATIONAL REGIONAL
ACCESS PLATFORM	3 ELEVATORS 3 ESCALATORS 2 WIDE STAIRS	1 ELEVATOR 4 ESCALATORS 4 NARROW STAIRS	1 ELEVATOR 6 ESCALATORS 3 WIDE STAIR	2 ELEVATORS 4 ESCALATORS 2 NARROW STAIRS 2 WIDE STAIRS	1 ELEVATOR 2 ESCALATORS	1 ELEVATOR 3 ESCALATORS 1 NARROW STAIRS 2 WIDE STAIRS	1 ELEVATOR 4 ESCALATORS 2 WIDE STAIRS	6 ELEVATORS 8 ESCALATORS	2 ELEVATORS 3 ESCALATORS 1 NARROW STAIR	3 ELEVATORS 4 ESCALATORS 2 NARROW STAIRS	1 ELEVATOR 4 ESCALATORS 3 WIDE STAIRS	1 ELEVATOR 1 ESCALATOR

Proposed Program

The proposed program is an interchange station between local S-bahn rail and long distance IC rail services. The program is dimensioned for a flow of ca. 100,000 passengers per day. There is a future possibility of upscaling to 125,000 p/day with 2 additional plaforms. With the digitalized future in mind, the additional program incorporates an autonomous pod station (ca. 3000m2), an edge data center (ca. 5000m2), and the new headquarters for DB's Digital Headquarter (ca. 10,000m2). Another major difference compared to the benchmark involves a substantial reduction in car parking space. Anticipating the rise of autonomous vehicles and the paradigm of Mobility as a Service (e.g. Uber), permanent car parking becomes less imperative.

Additional Program

Autonomous Pod Station

+4,000 m2

Docking area (incl. platforms)
Waiting area
Ticketing area

Edge Data Centre

+5,000 m2

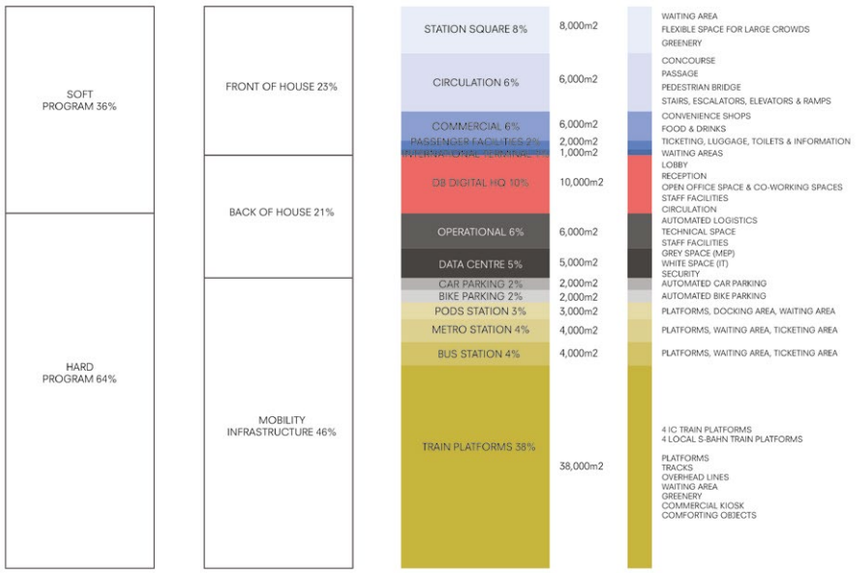
White Space (IT equipment)
Grey Space (MEP)
High level security

DB Digital HQ

+10,000 m2

Workplace for ca. 750 employees from DB digital business unit
Co-working space for ca. 250 external tech staff
Atriums
Staff facilities

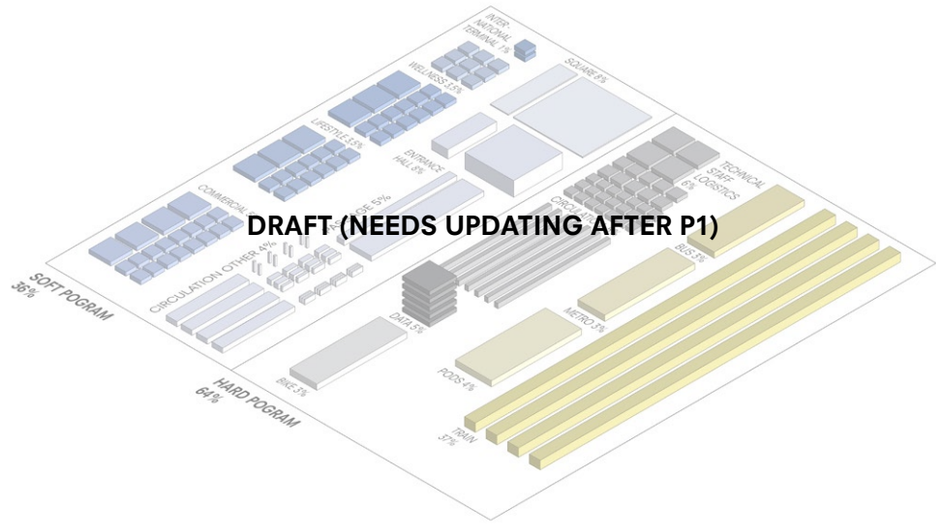
Program Bar Proposal



100,000 m2 GFA
100,000 - 125,000 p/day
8 PLATFORMS

29 Program Bar

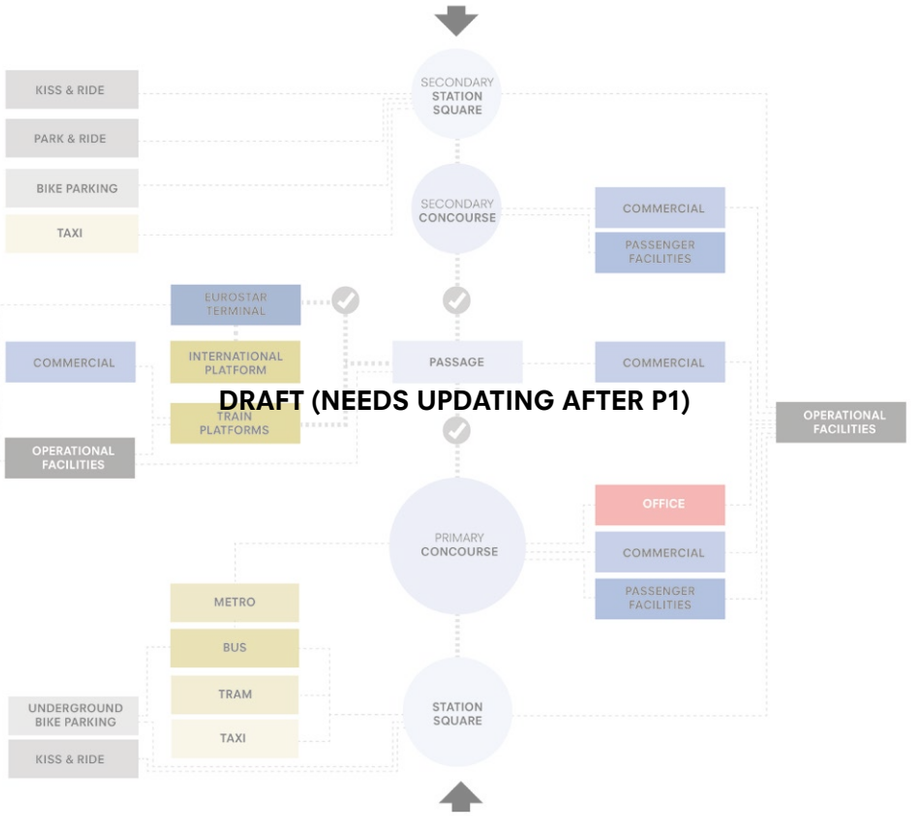
Programmatic Blocks



DRAFT (NEEDS UPDATING AFTER P1)

30 Programmatic Blocks

Functional Scheme



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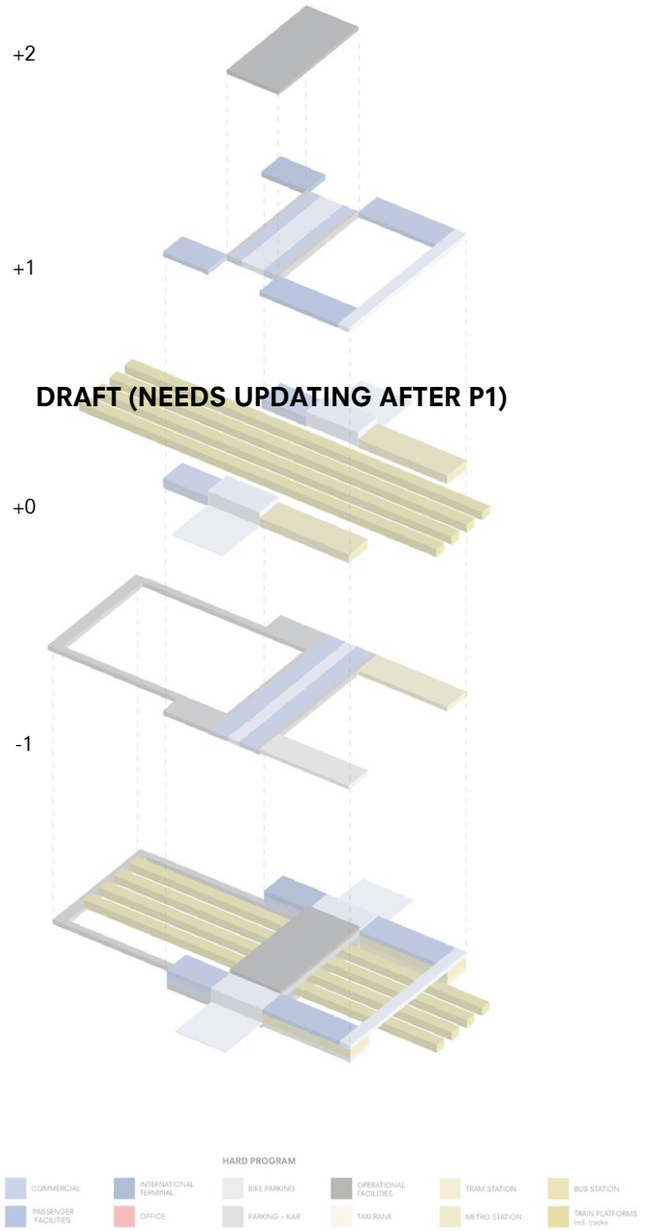
31 Functional Scheme

Programmatic Test-Fit



DRAFT (NEEDS UPDATING AFTER P1)

32 Programmatic Test-fit

4.2 CLIENT

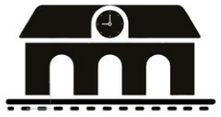
The main client for the train station design is Deutsche Bahn (DB), Germany's national railway company, functioning as a state-owned enterprise under the control of the German government. Situated in Berlin, DB's aspirations and objectives will be examined to ensure alignment with the project's overarching goals. As the largest railway operator and infrastructure owner in Europe, boasting over 300,000 employees, DB oversees trains, cargo, train stations, and the railway network, placing the user at the core of its operations.

In the context of our interconnected world and the technological landscape, a public-private partnership emerges as an opportunity. This collaboration can provide intelligent solutions to solve rush hour overcrowdedness, enhance passenger flow, train punctuality, and improve overall user satisfaction. Data and technology companies can serve the role of service providers, while the German Federal Government and the EU function as regulators and initiators, collectively shaping the trajectory of the project.

DB Organisational Units

DB
Passenger Traffic

DB
Cargo Traffic



DB
Train Stations

DB
Rail network

DB ambitions

FOR CLIMATE

To reduce carbon emissions by 10.5 milion metric tons each year by shifting to rail

FOR PEOPLE

To double patronage in long distance passenger transport, and reduce the number of car trips in Germany by 5 million and domestic flights by 14,000 every day

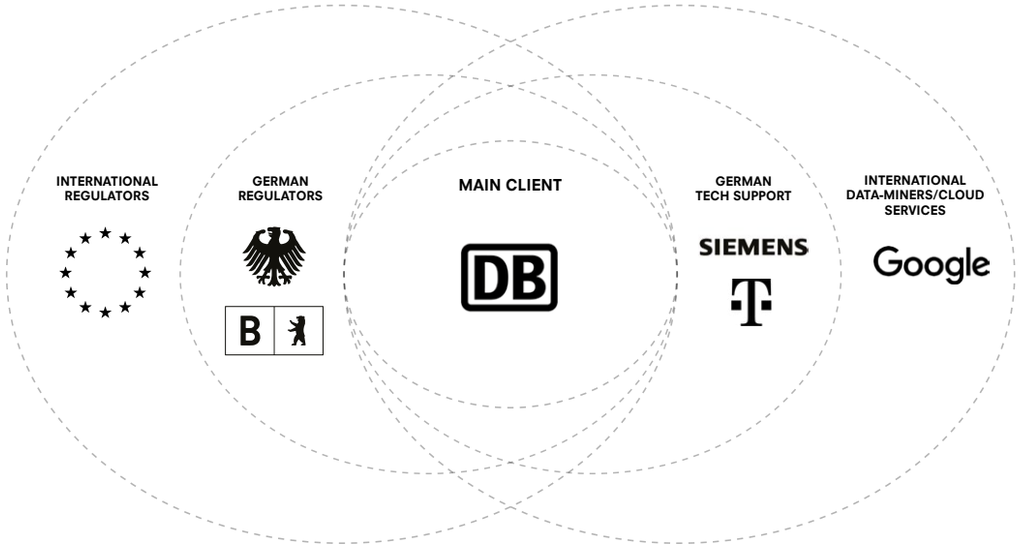
FOR ECONOMY

To raise the market share of rail freight transport from 18% to 25% – the equivalent of 13 million fewer truck trips per year in Germany

FOR EUROPE

To achieve a connected Europe by fostering a strong rail network

Public-Private Partnership



33 Public-Private Partnership Framework

Rush Hour Data Flow

DRAFT (NEEDS UPDATING AFTER P1)

34 Data Flow Framework

4.3 SITE

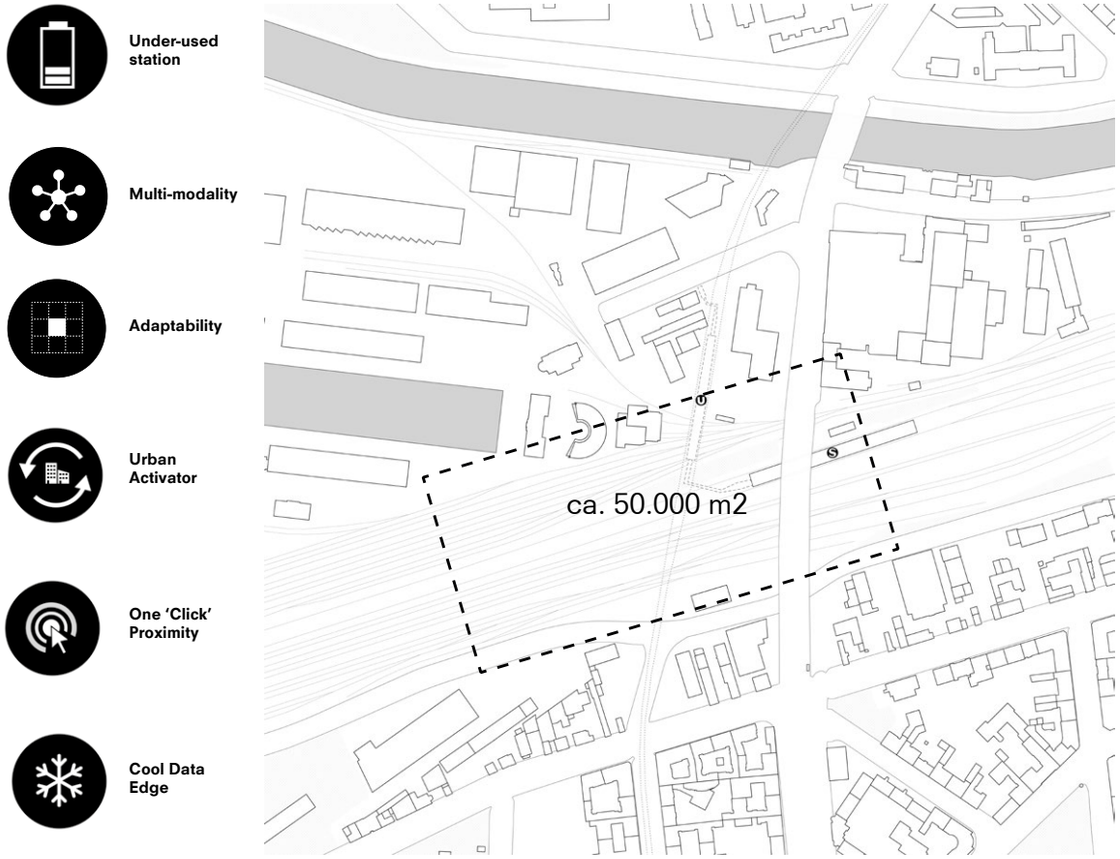
The selection of the Westhafen site for the train station design is underpinned by specific building typology and group strategy site criteria:

1.Under-used Station:
Strategicaly positioned along a significant Inter-City rail corridor, the underused station at Westhafen holds the potential to serve as an anchor and catalyst for urban development.

2.Multi-modality:
Functioning as an intermodal node, the site boasts a metro station and traffic artery integration, enhancing its connectivity within the city's wider urban fabric.

3.Adaptability:
The site is future-proof, offering adaptability and sufficient space for potential expansion, accommodating additional platforms in response to increasing passenger demand and flow.

4.Integrated Data Centre:
In line with the group's digitalization strategy for Berlin, the site incorporates an integrated edge data centre, embracing contemporary trends in data management. It also serves to increase data awareness among the Berlin society. The vision for Westhafen transcends its industrial past, evolving into a data-driven district. Improved accessibility is envisioned to spur land-use development, fostering both social and economic activities.



35 Selected Site

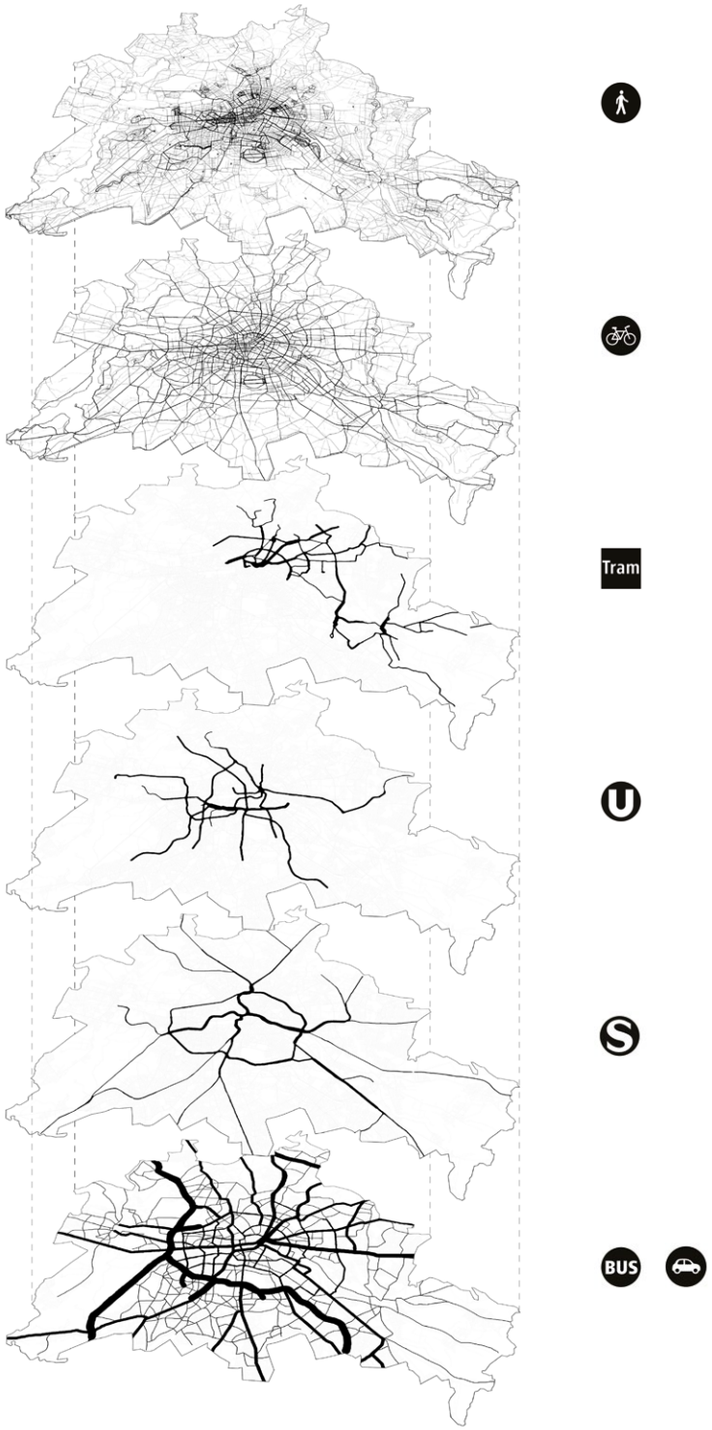
Westhafen aerial photo

36 Westhafen Aerial (Google Earth, n.d.)

Westhafen site photo

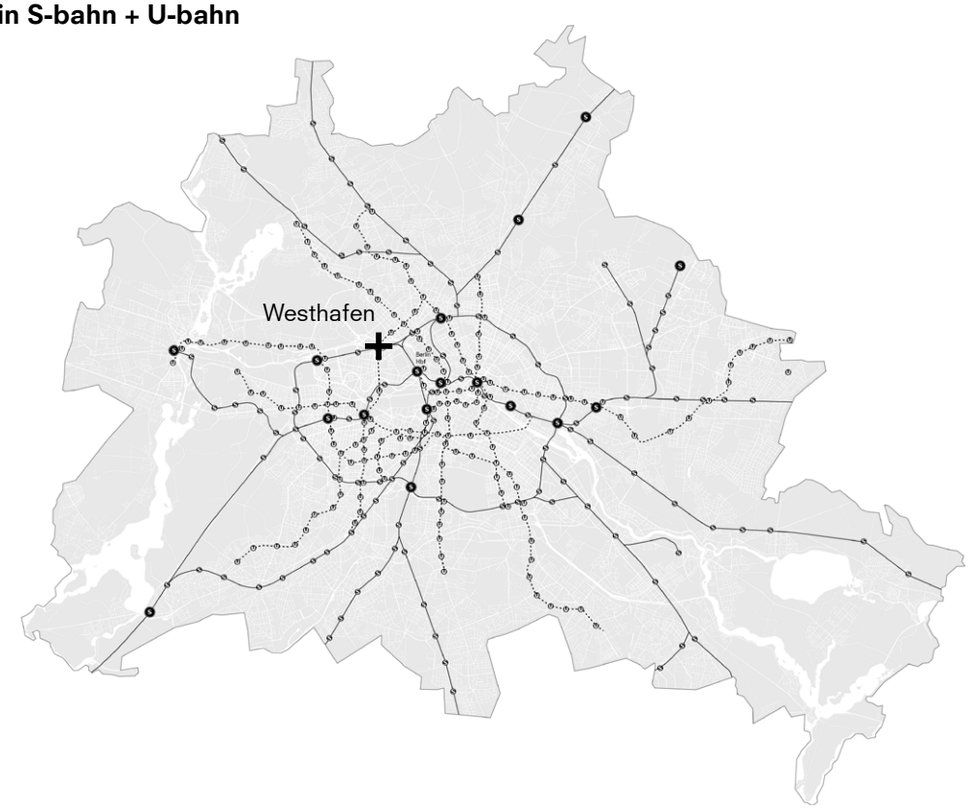
37 Westhafen site photo (Land, n.d.)

Berlin Mobility Stack

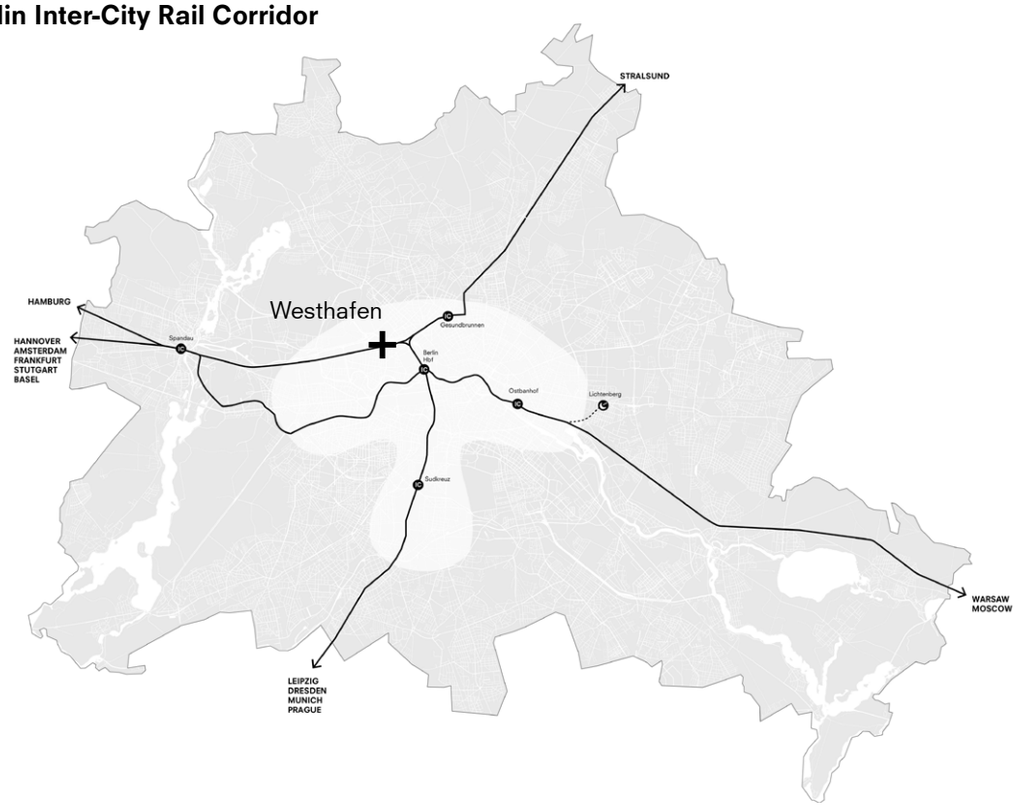


38 Berlin Mobility System Analysis Maps

Berlin S-bahn + U-bahn



Berlin Inter-City Rail Corridor

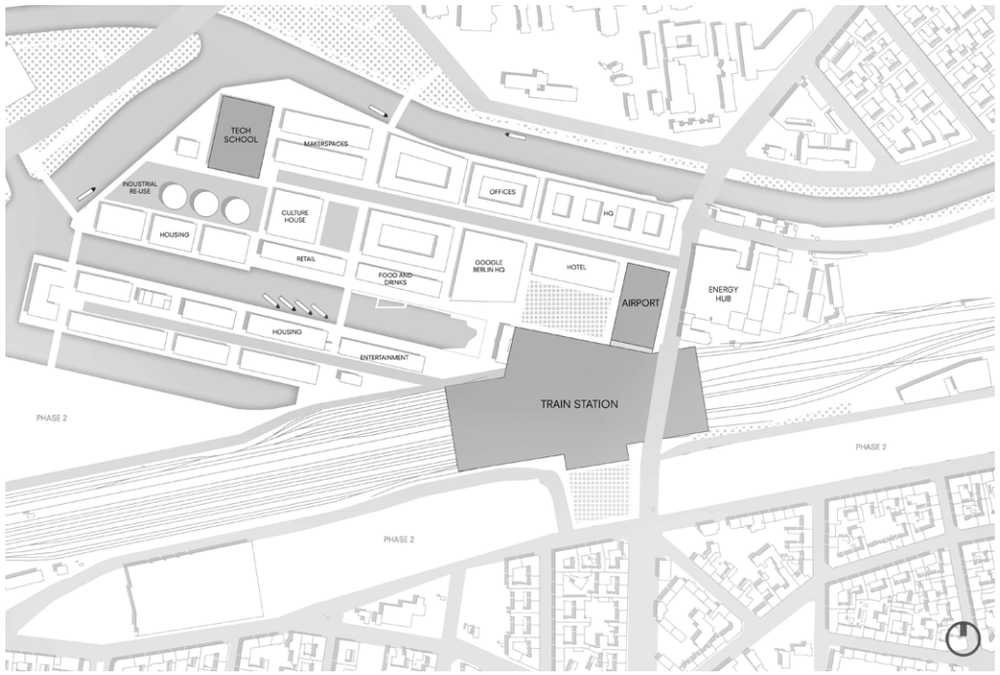


Urban Plan

The proposed new train station at Westhafen holds the potential to catalyze future development in the surrounding area. By bridging the urban neighborhoods on both the north and south sides of the Westhafen canal, the station aims to overcome the current barrier and enhance accessibility. Drawing inspiration from case studies in London Kings Cross and Sheffield, it is evident that industrial rail yard sites adjacent to railways can evolve into dynamic mixed-use neighborhoods. These areas, characterized by 24/7 living, recreational spaces, and workplaces, feature high-density programs such as offices, retail establishments, educational institutions, and residential areas, all within close ‘walking distance’ proximity to each other.

Conceptual Masterplan

Conceptual Masterplan



39 Conceptual Masterplan: Station as urban activator

Site Case-Study: London Kings Cross

40 Coal Drop Yards Kings Cross Aerial (Google Earth, n.d.)

41 Coal Drop Yards Kings Cross Aerial (Google Earth, n.d.)

07 Coal Drop Yards Kings Cross (Sturrock, 2019)

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