

COMPLEX PROJECTS

# TWIN ANATOMY

Hospital of a Human Data Twin

Sumeet Joshi  
P5- 02/07/2024

## **Introduction**

Research

Design Brief

Approach

Implementation

Development

Conclusion

Influenza Flu, 1918



Total Deaths: 50 million +  
Deaths in Germany: 0.43 million

Coronavirus, 2019



Total Deaths: 6.9 million +  
Deaths in Germany: 0.18 million

### Influenza Flu, 1918



Total Deaths: 50 million +  
Deaths in Germany: 0.43 million

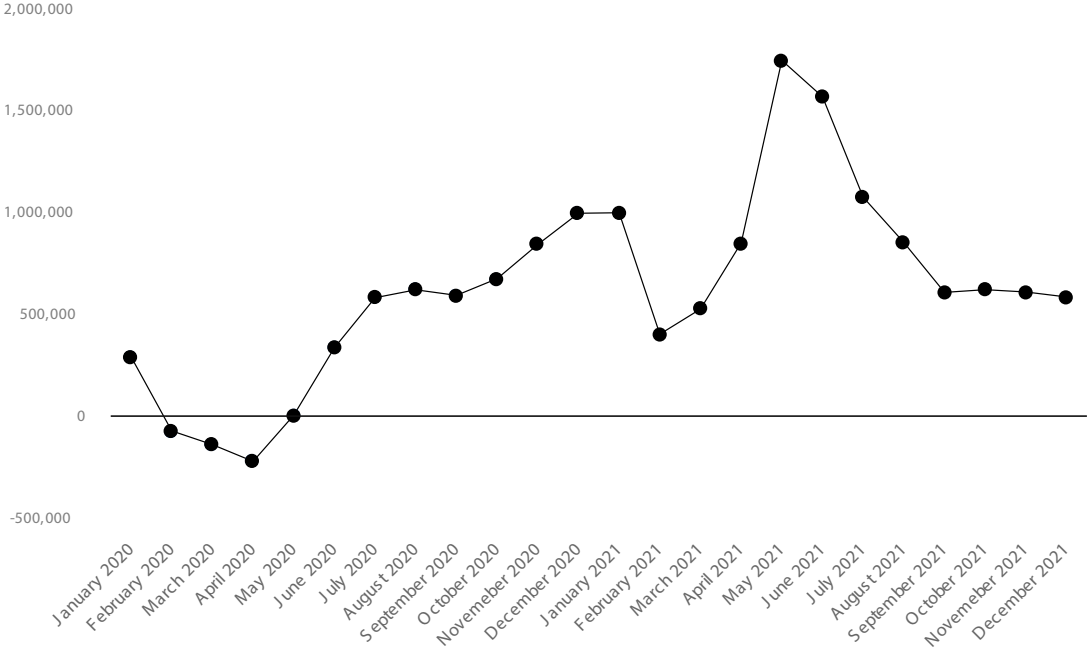
### Coronavirus, 2019



**Cause:**  
virus transmitting on  
the breath, cough and  
sneezes

Total Deaths: 6.9 million +  
Deaths in Germany: 0.18 million

Mean number of excess deaths associated with the COVID-19 pandemic from all-causes worldwide in 2020 and 2021, by month

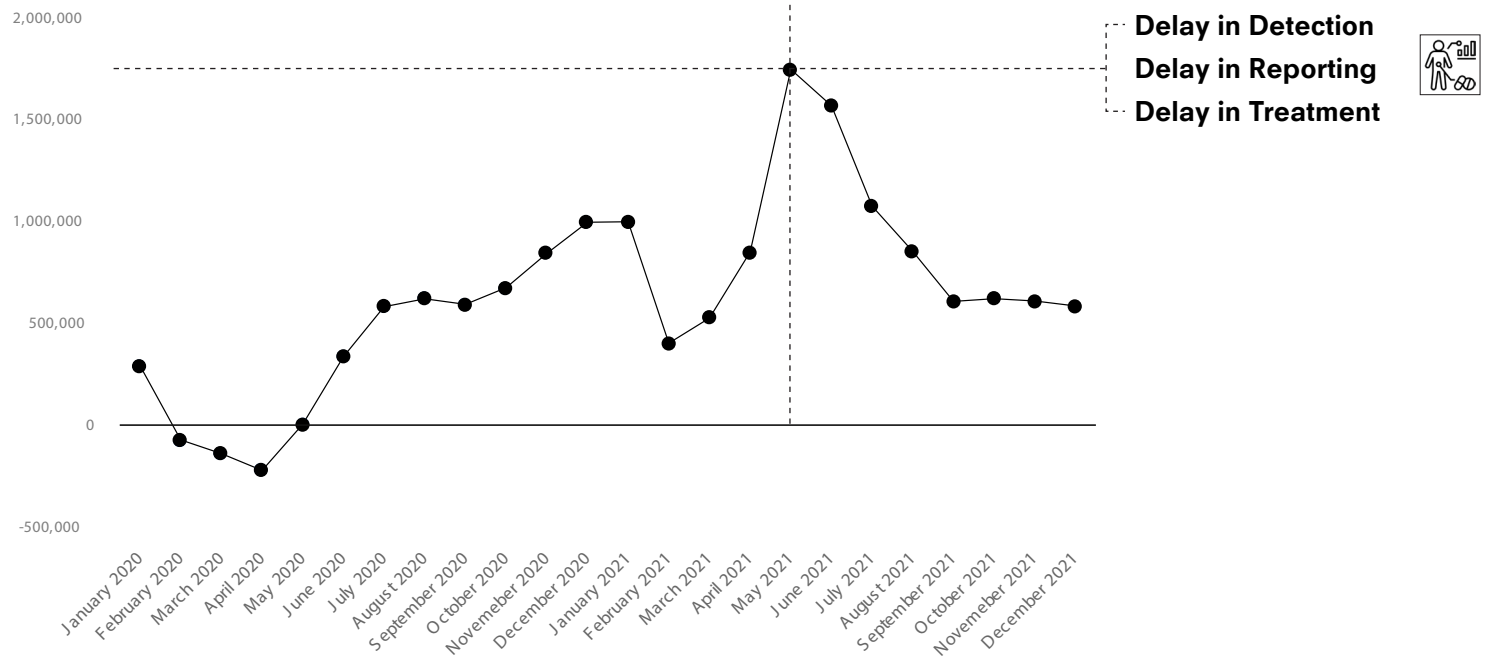


Source  
WHO  
© Statista 2023

Additional Information:  
Worldwide; 2020 and 2021



Mean number of excess deaths associated with the COVID-19 pandemic from all-causes worldwide in 2020 and 2021, by month



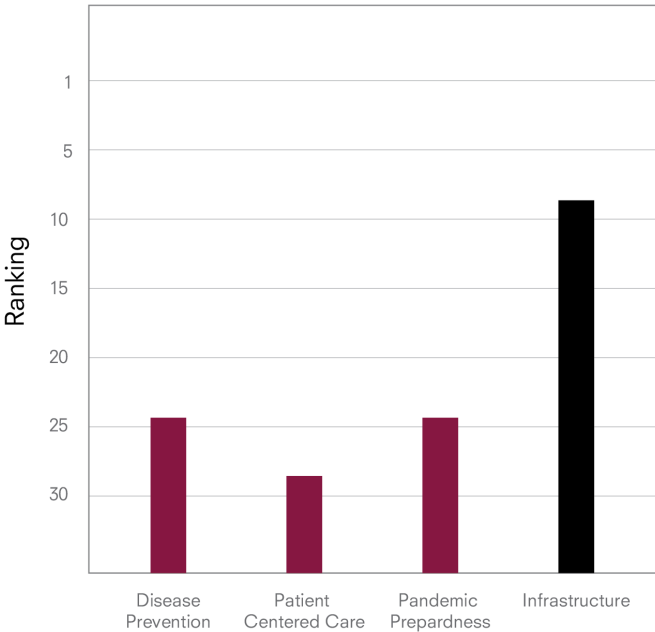
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WHO  
© Statista 2023

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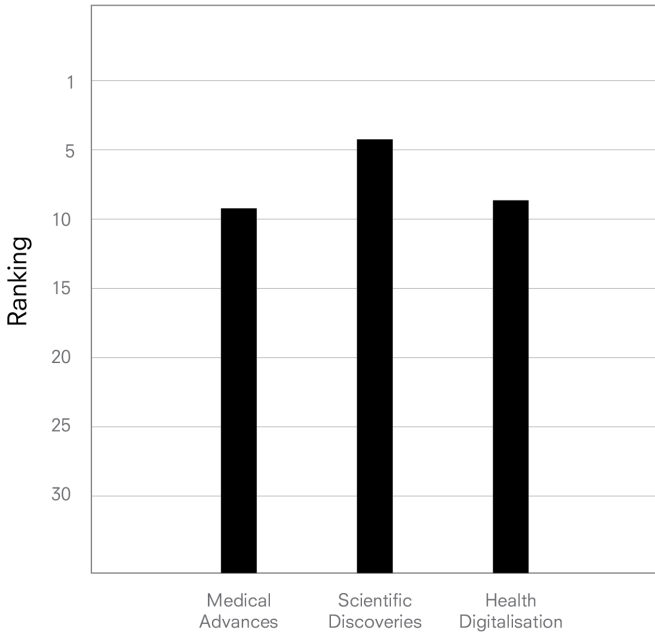


How can our healthcare model be efficient in case of another pandemic?

## Germany Ranks **4th** in 2022 World Index of Healthcare Innovation



Quality

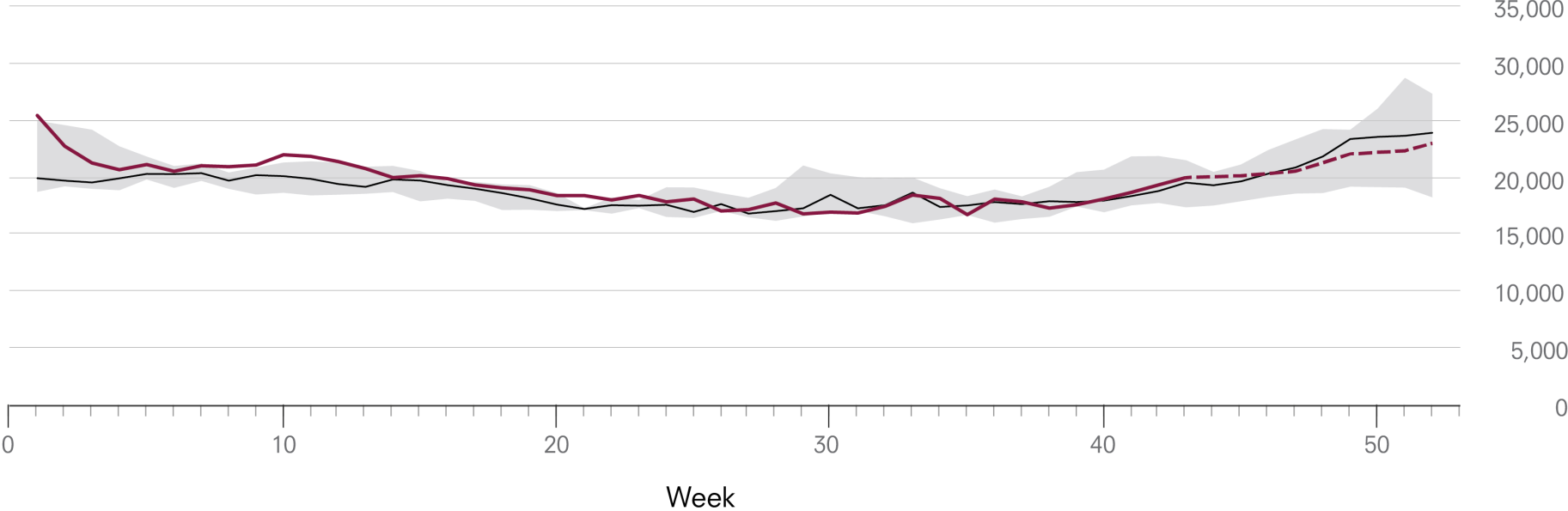


Science & Technology



### 1.02 million deaths in 2023

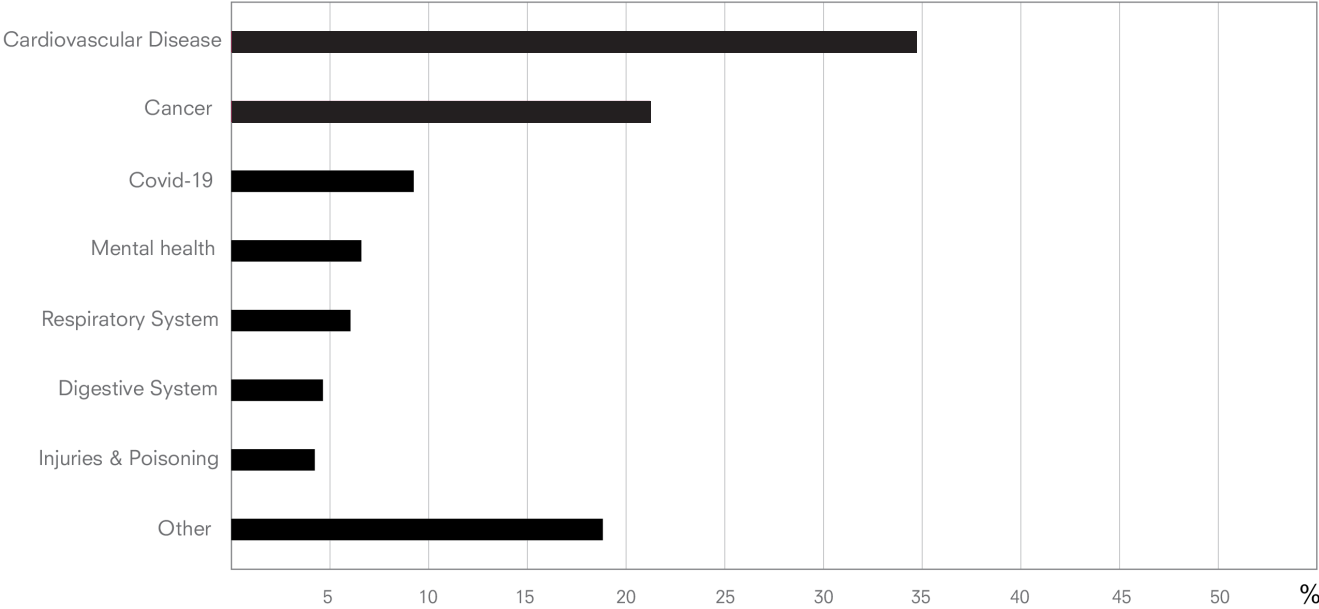
(Dashed lines include estimated proportions.)



© Statistisches Bundesamt (Destatis), 2024

— Median 2019-2022    ■ 2019-2022 (min/max)    — 2023

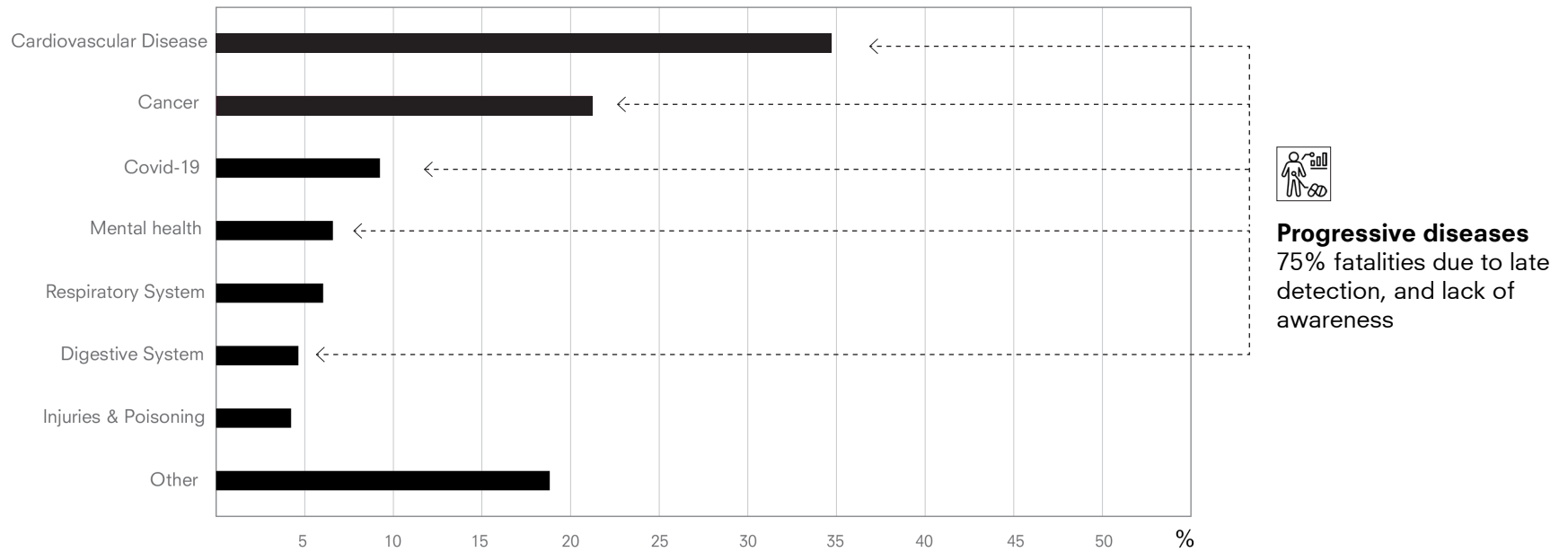
### Causes of Deaths



Deaths by Diseases, 2023

Source: Statistisches Bundesamt (Destatis)

## Causes of Deaths



Deaths by Diseases, 2023

Source: Statistisches Bundesamt (Destatis)

### **Hospital**

an institution providing medical and surgical treatment and nursing care for sick or injured people.

### **historical**

a hospice, especially one run by the Knights Hospitaller

# CURE



## **Hospital**

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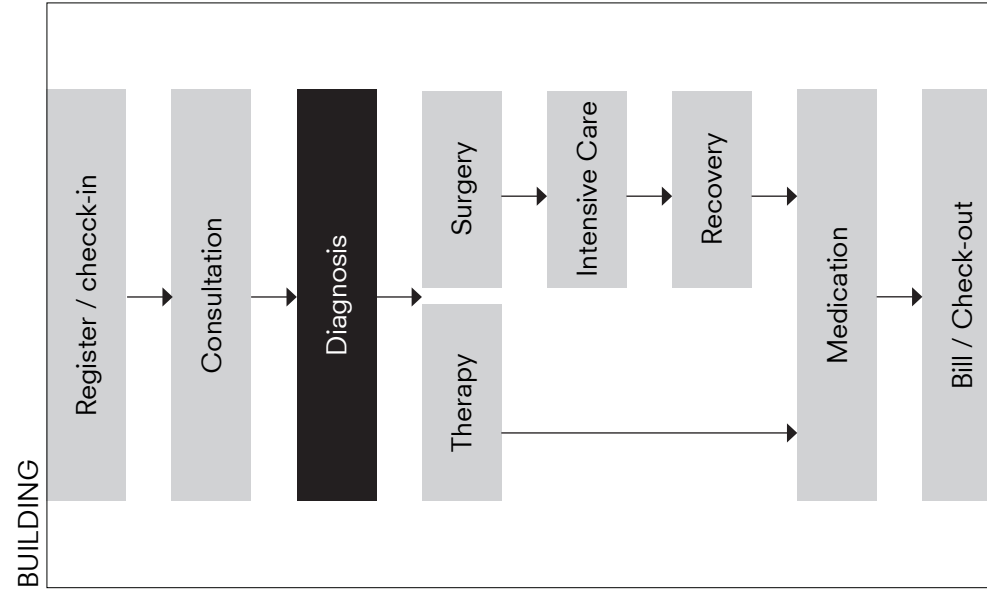
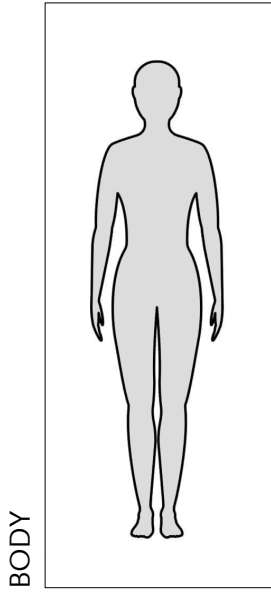
# CURE & CARE

## Hospital

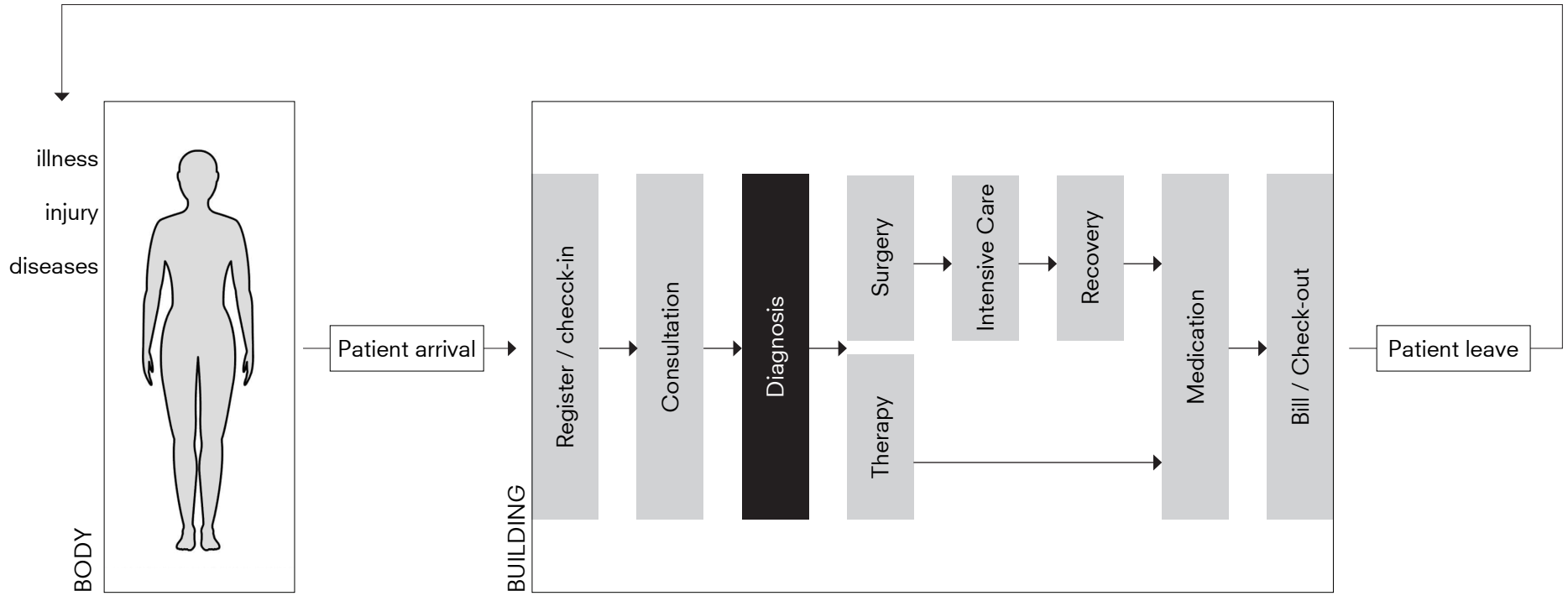
an institution providing medical and surgical **treatment** and nursing **care** for sick or injured people.

## historical

a hospice, especially one run by the Knights Hospitaller

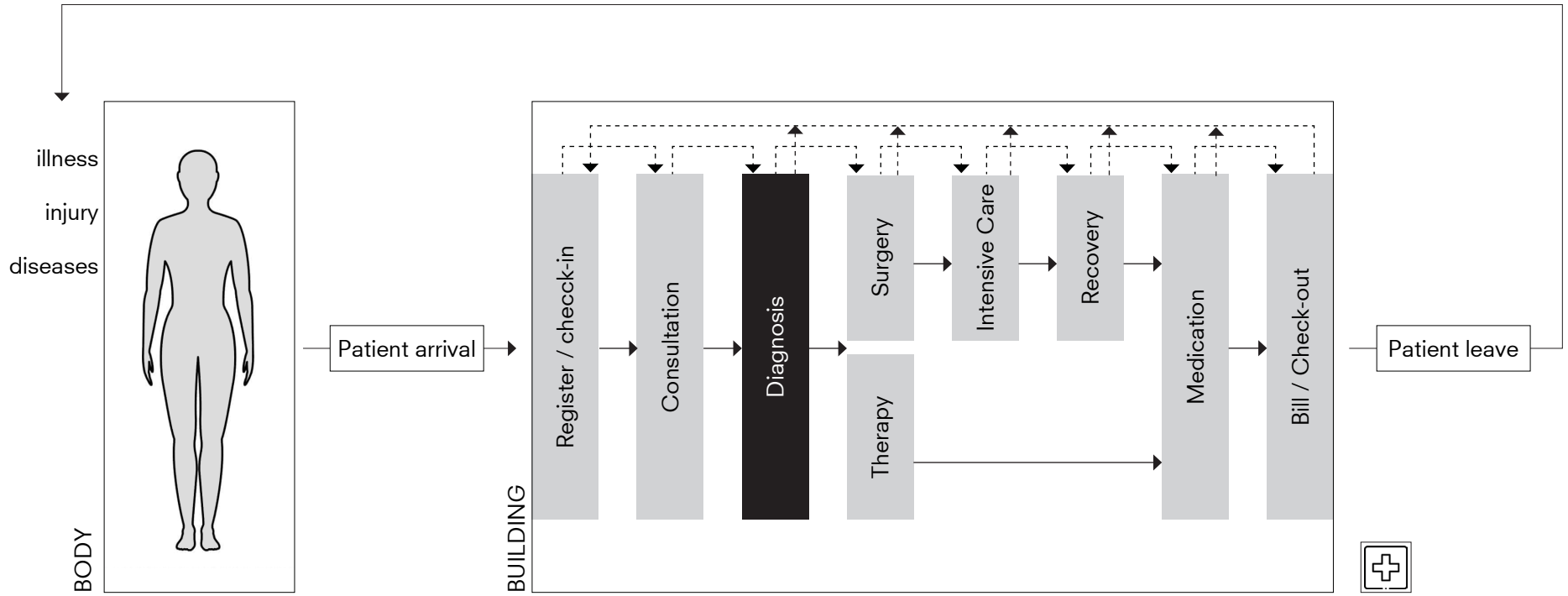


→ Body flow



→ Body flow





-----> Data flow  
———> Body flow



Delay in diagnosis and lack of medical awareness



Hospitals operating within the institutional boundaries

Introduction

**Research**

Design Brief

Approach

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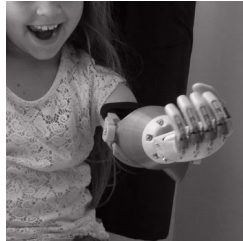
Conclusion

Lens:

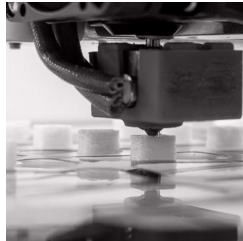
# **DIGITALISATION**

## Digitalisation in Healthcare

### 3D Printing



Prosthetics



Precision Medicine



3D Bioprinting

### Internet of Things

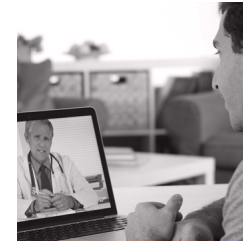


Dialogue device



Wearables

### Diagnosis



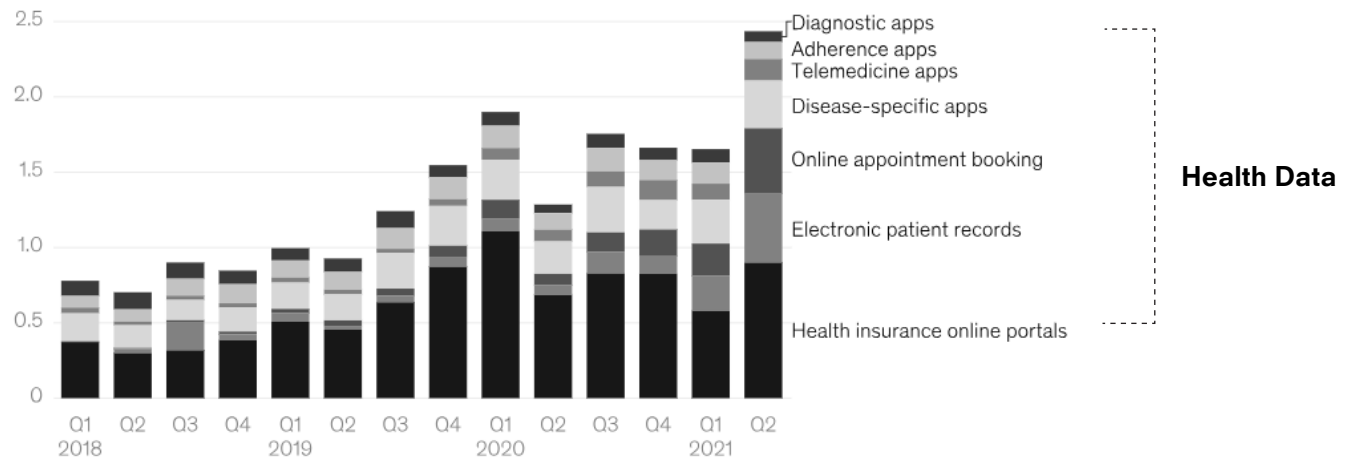
Tele Medicine

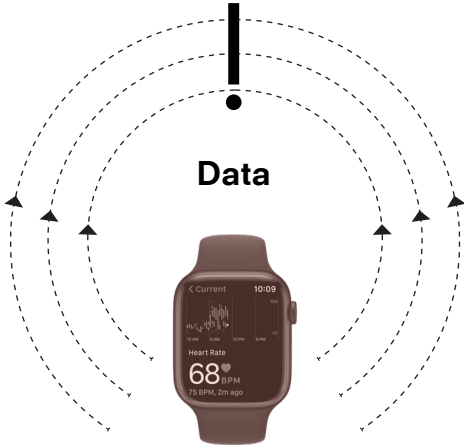
Digitalisation brings  
**Customisation & Personalisation**

## Information Society

**German health apps recently recorded a new high of 2.4 million downloads per quarter, with online appointment booking apps as an important driver.**

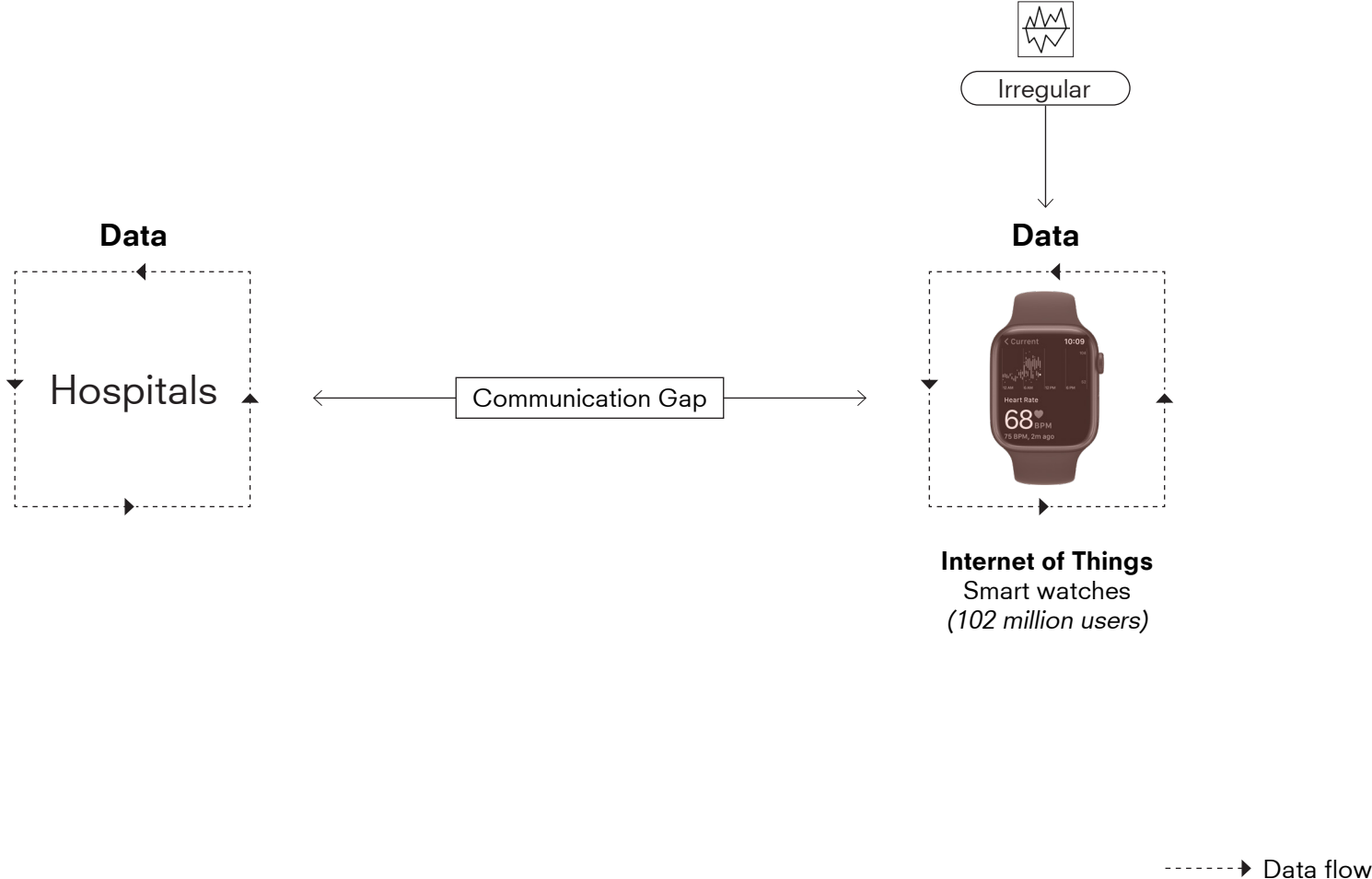
Downloads of the top 40 e-health apps in Germany, by category, million



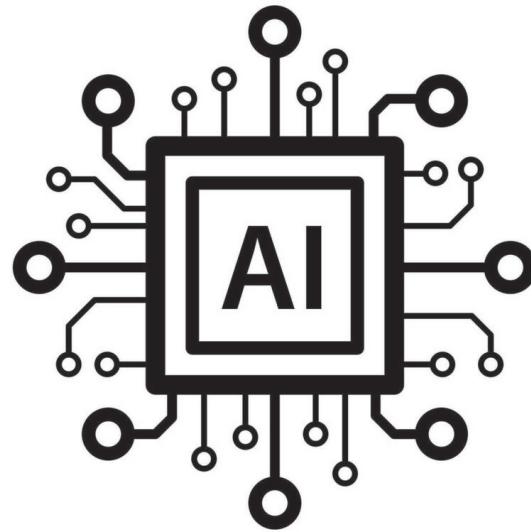


**Internet of Things**  
Smart watches  
*(102 million users)*

-----> Data flow

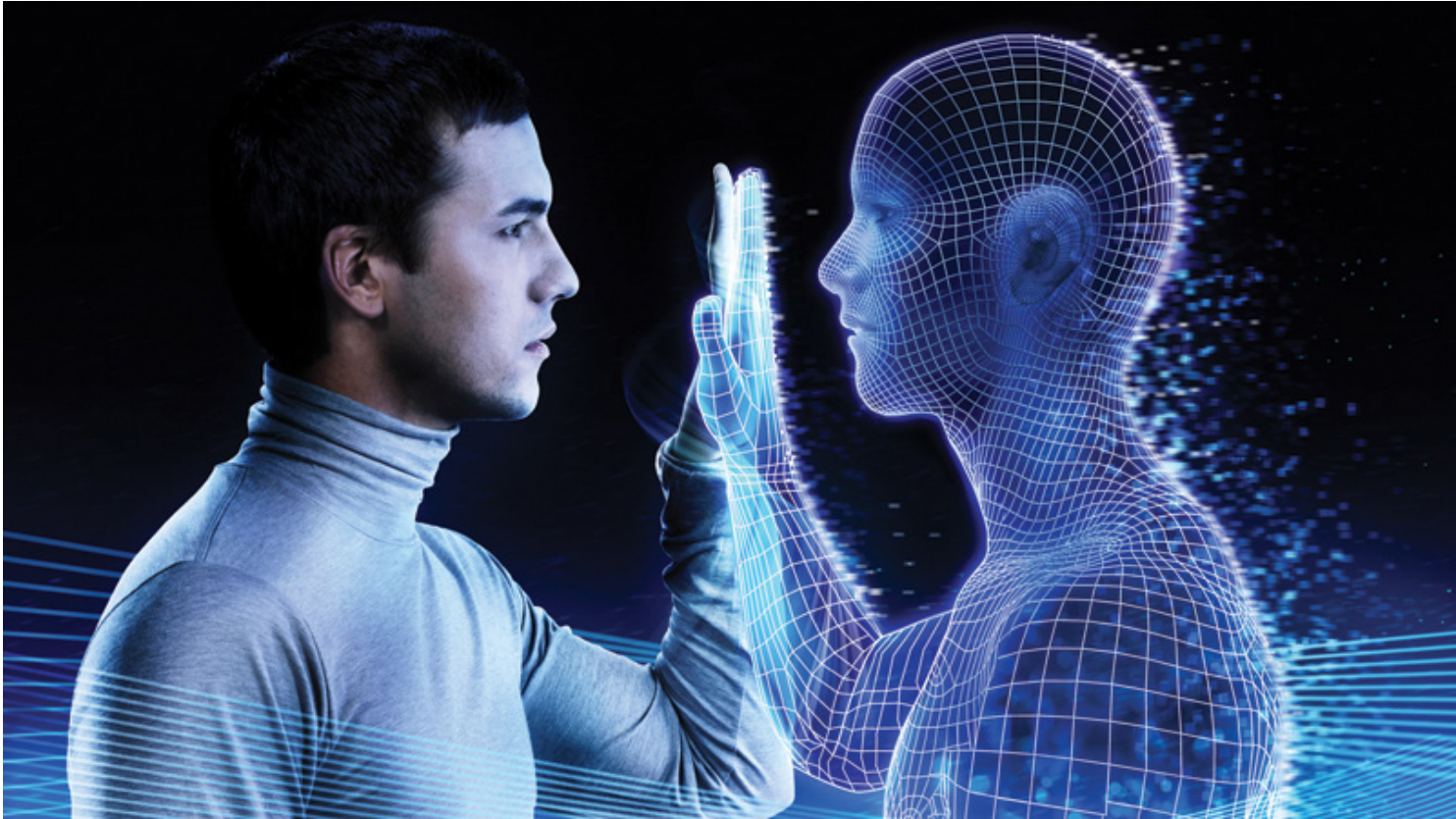




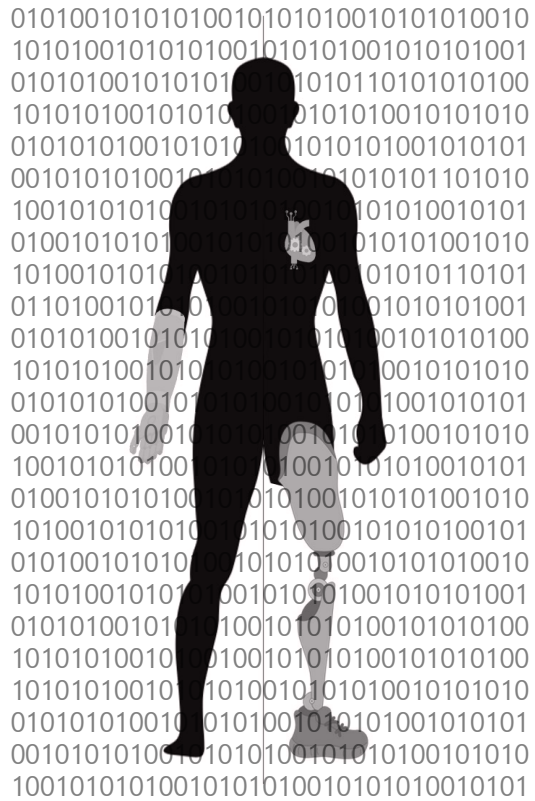


Big Data

# Human Data Twin



**BODY**

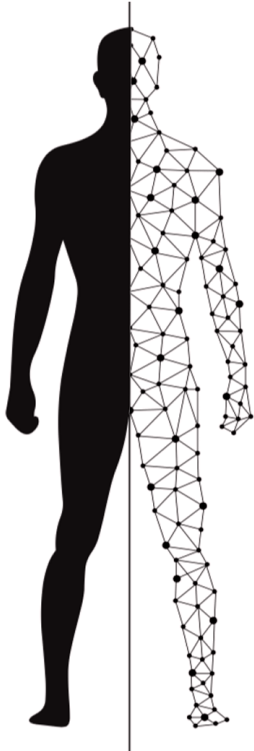


**WITH LARGE DATASETS**

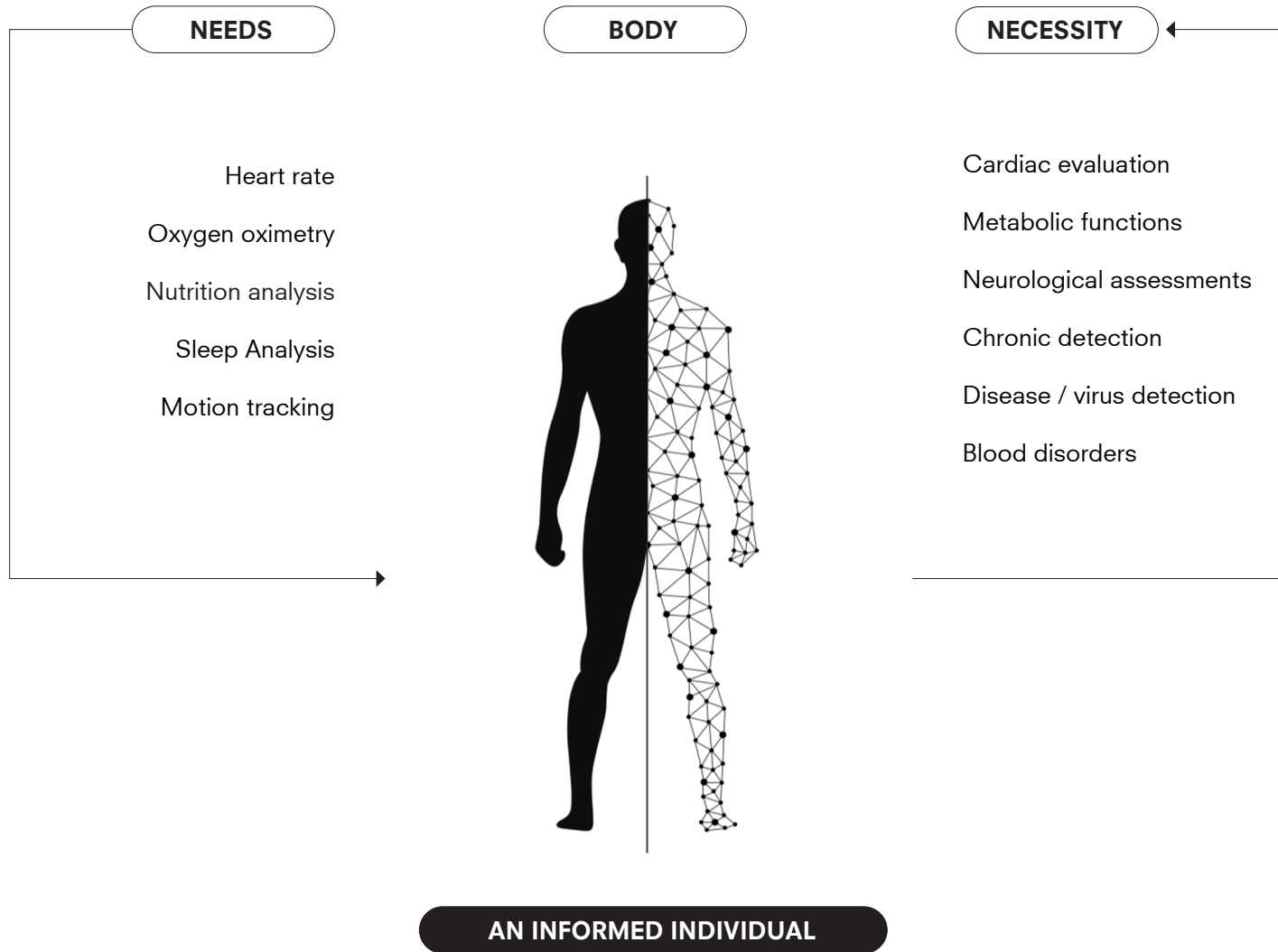
**BODY**

Real World

Cyber Space



**A HUMAN DATA TWIN**



## A new way of Diagnosis

Real-time Diagnosis



DESCRIPTIVE  
ANALYTICS

Summarizing patient data, such as demographics, diagnoses, and treatments, to create reports for healthcare professionals **to review past trends and outcomes.**

DIAGNOSTIC  
ANALYTICS

Analyzing patient data **to identify the root causes** of particular medical conditions or patterns of treatment efficacy.

PREDICTIVE  
ANALYTICS

To **forecast** patient readmission rates, disease outbreaks, or **patient risk scores.** It assists in proactive care management and resource allocation.

PRESCRIPTIVE  
ANALYTICS

**Suggest treatment plans,** interventions, or personalized care for patients based on predictive models. This can **help clinicians make informed decisions** and improve patient outcomes.

DISCOVERY  
ANALYTICS

To **research and exploration** of large datasets to discover patterns, trends, or relationships **that were not previously known.**

Past

Present

Near Future

Far Future

**Source:** Khalifa M. Health Analytics Types, Functions and Levels: A Review of Literature. Stud Health Technol Inform. 2018;251:137-140. PMID: 29968621.

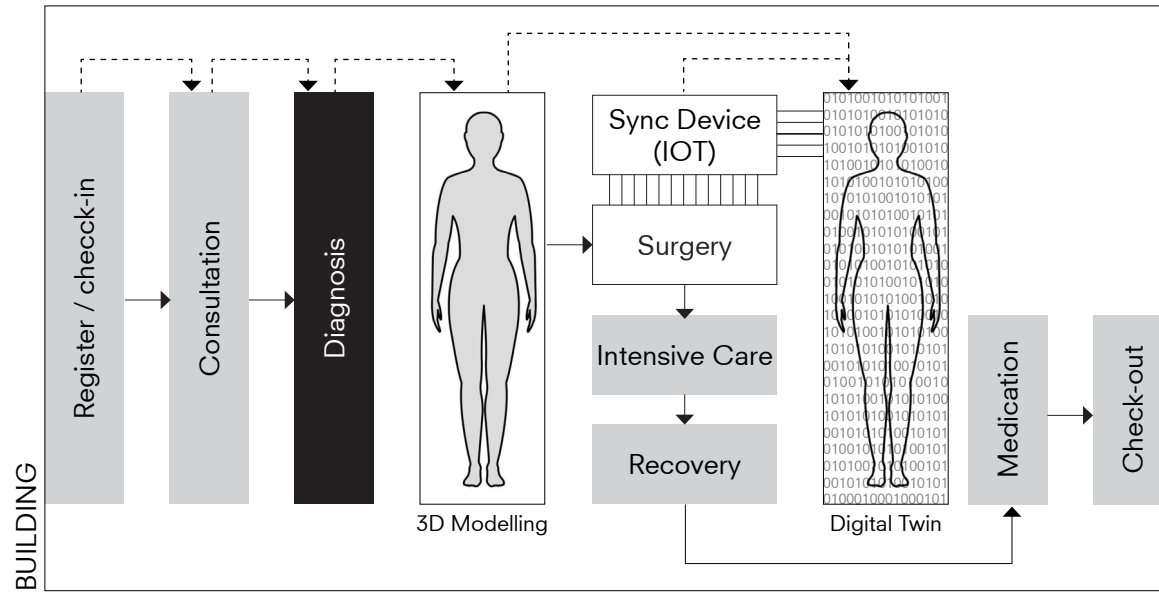
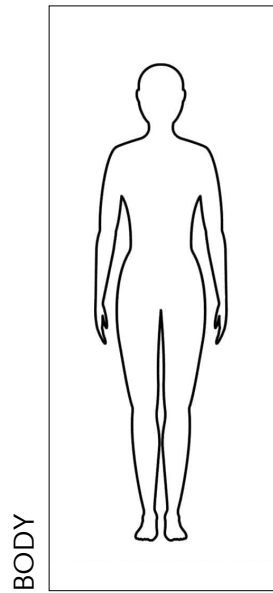
# CURE & CARE



**CARE & CURE & CARE**

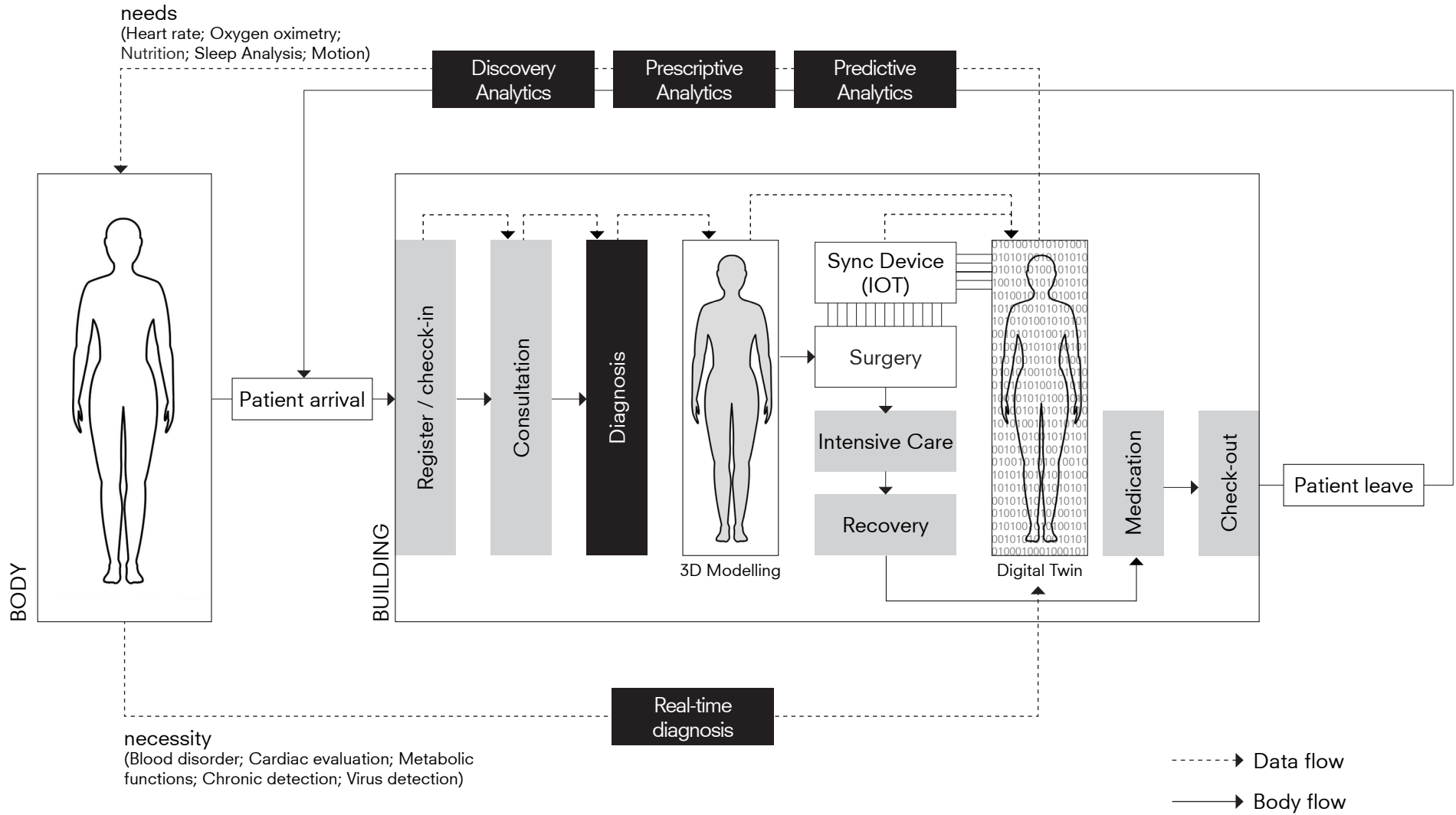
In 2011, Leroy Hood proposed the term “P4 medicine, for cancer treatment, where the four “P’s” stand for **predictive, preventive, personalized, and participatory.**





-----> Data flow  
———> Body flow

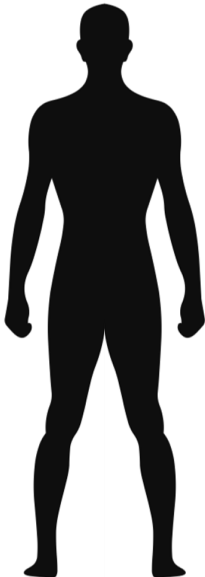
# Data Based Flow



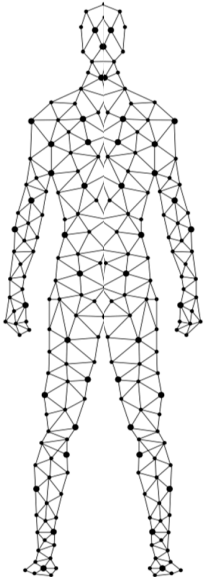
# Project Proposal

HUMAN

TWIN



Facilitate Communication



## Research question:

How does the digitization of the human body in the information society, impact the **architectural** and **spatial** design of hospitals?

Form  
Functions  
Spaces  
Configurations

Process  
Arrangements  
Interactions  
Flows  
Impact of AI

Introduction

Research

**Design Brief**

Approach

Implementation

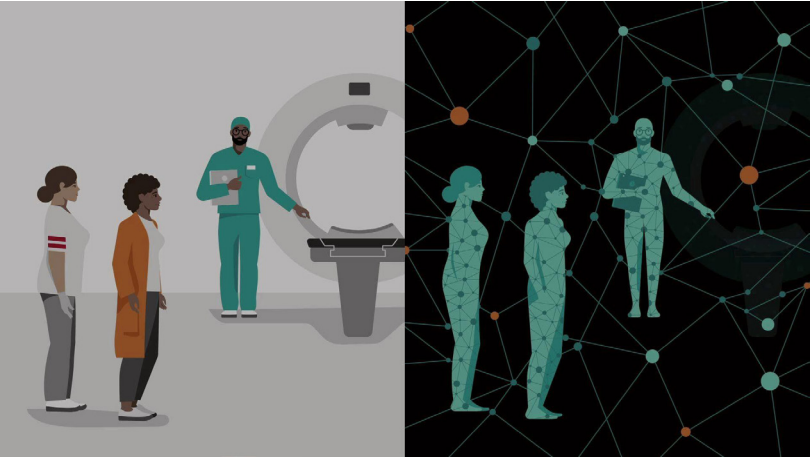
Development

Conclusion

Client

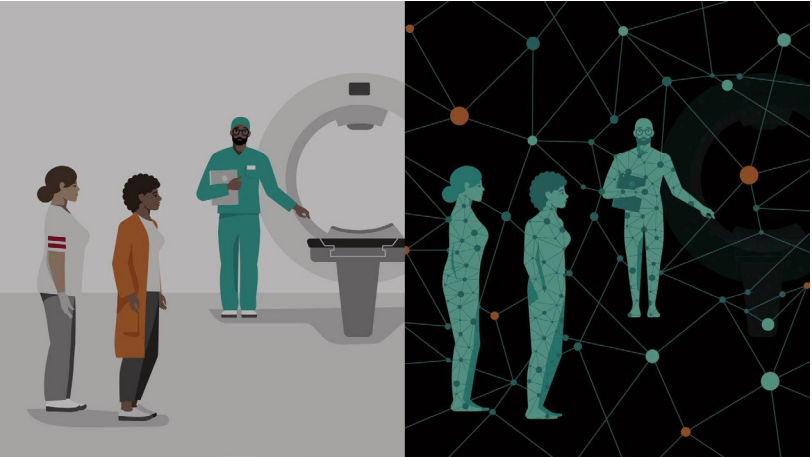
Program

Site



**HUMAN DATA TWIN**





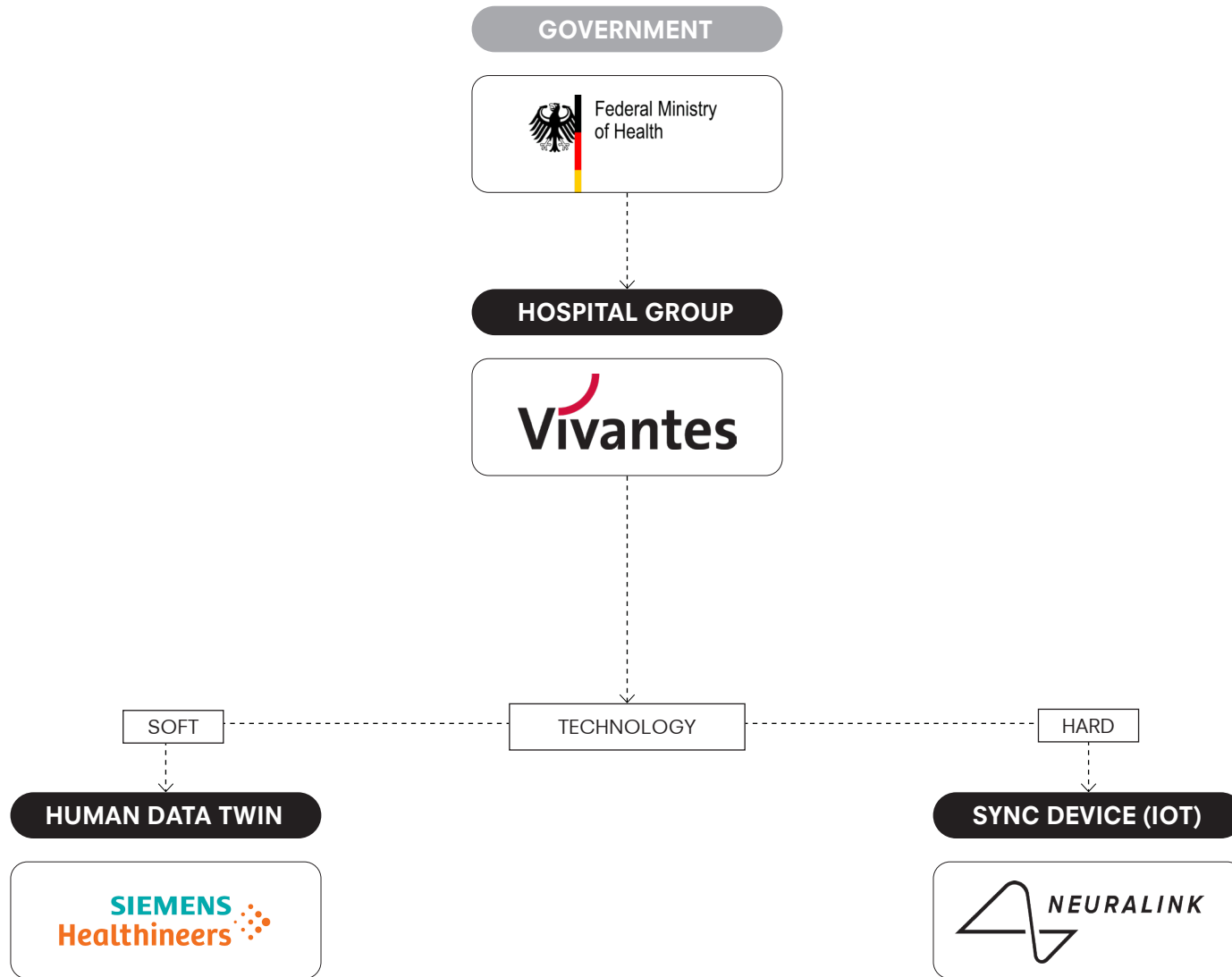
**HUMAN DATA TWIN**



**SYNC DEVICE (IOT)**







## Zaans Medical Center

**Architects:** Mecanoo  
**Location:** Zaandam, Netherlands  
**Client:** Zaans Medisch Centrum  
**Completion:** 2017  
**Floor Area:** 39.000 m<sup>2</sup>  
**Capacity:** 137 Beds



## Centre for Surgical Medicine

**Architects:** Heine Wischer & Partners  
**Location:** Dusseldorf, Germany  
**Client:** University Hospital Dusseldorf  
**Completion:** 2011  
**Floor Area:** 25.886 m<sup>2</sup>  
**Capacity:** 316 Beds

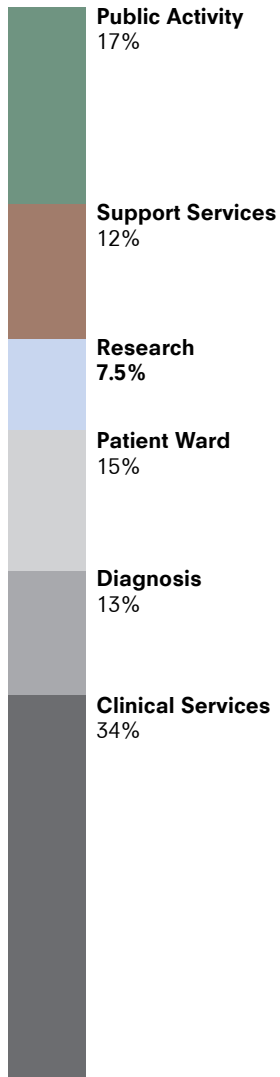


## San Raffaele Emergency Room

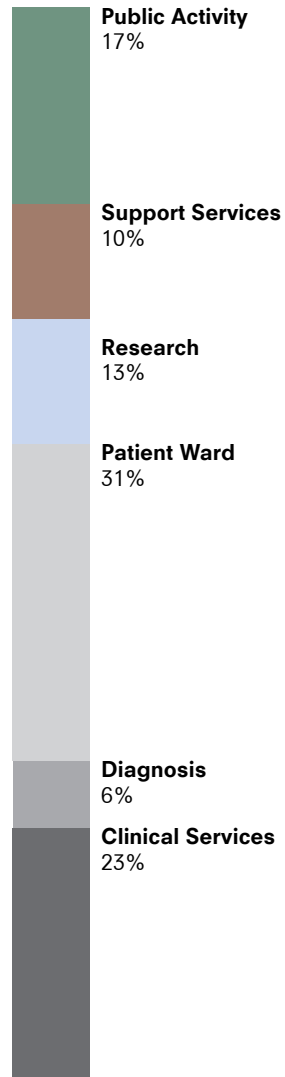
**Architects:** Mario Cucinella Architects  
**Location:** Milan, Italy  
**Client:** San Raffaele university  
**Completion:** 2011  
**Floor Area:** 40.000 m<sup>2</sup>  
**Capacity:** 284 Beds



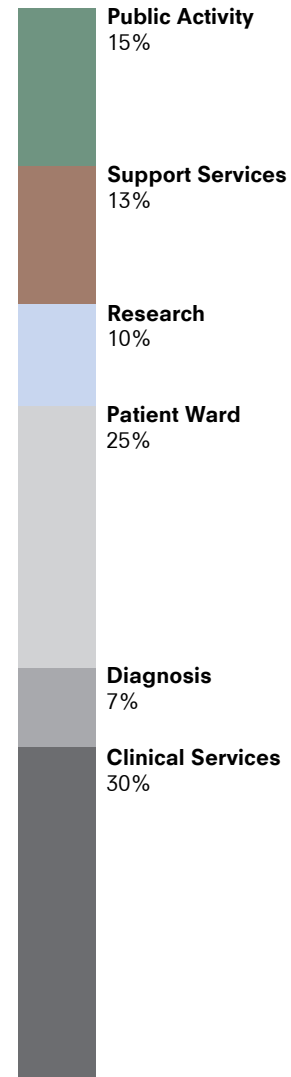
Zaans Medical Center  
39.000 m2



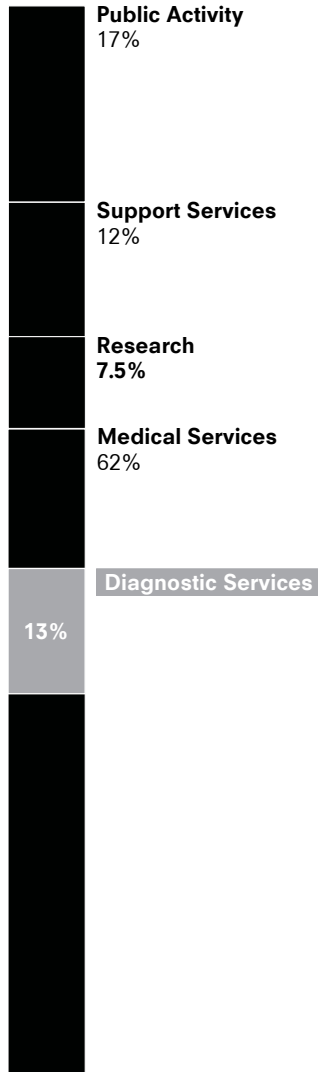
Centre for Surgical medicine  
25.886 m2



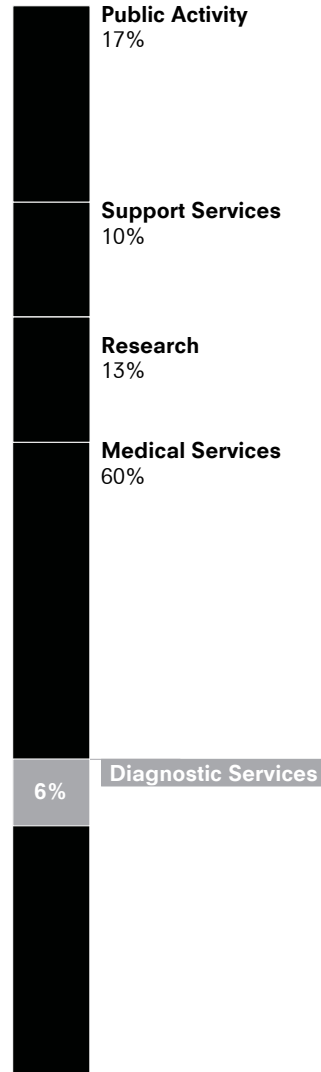
San Raffaele Hospital  
40.000 m2



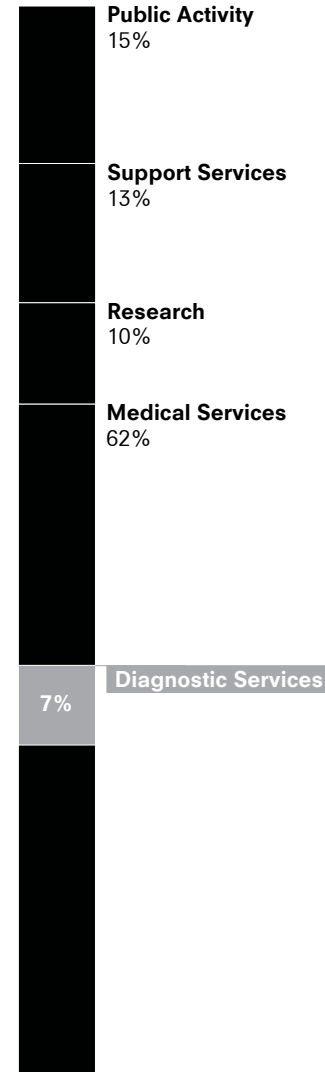
Zaans Medical Center  
39.000 m2



Centre for Surgical medicine  
25.886 m2

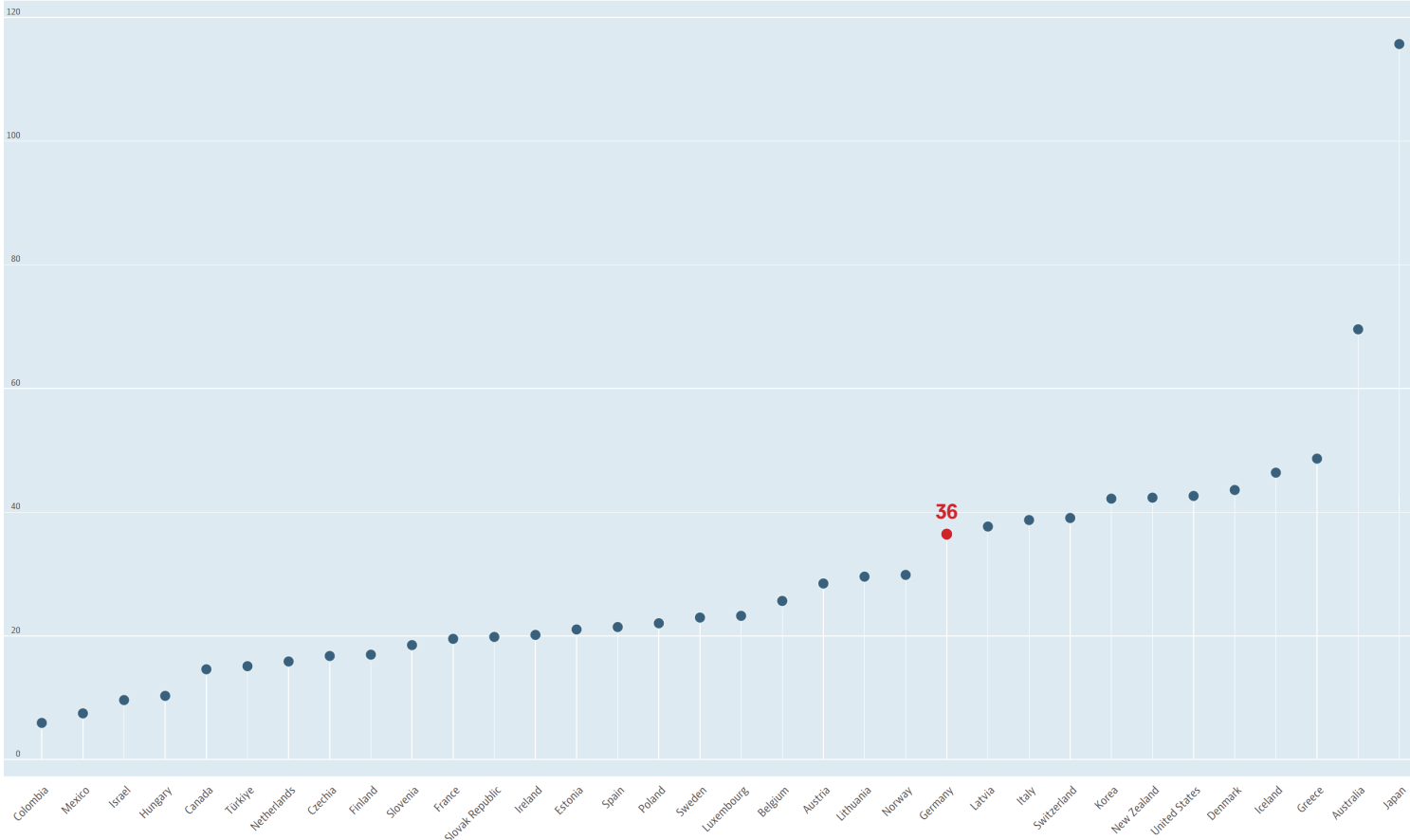


San Raffaele Hospital  
40.000 m2

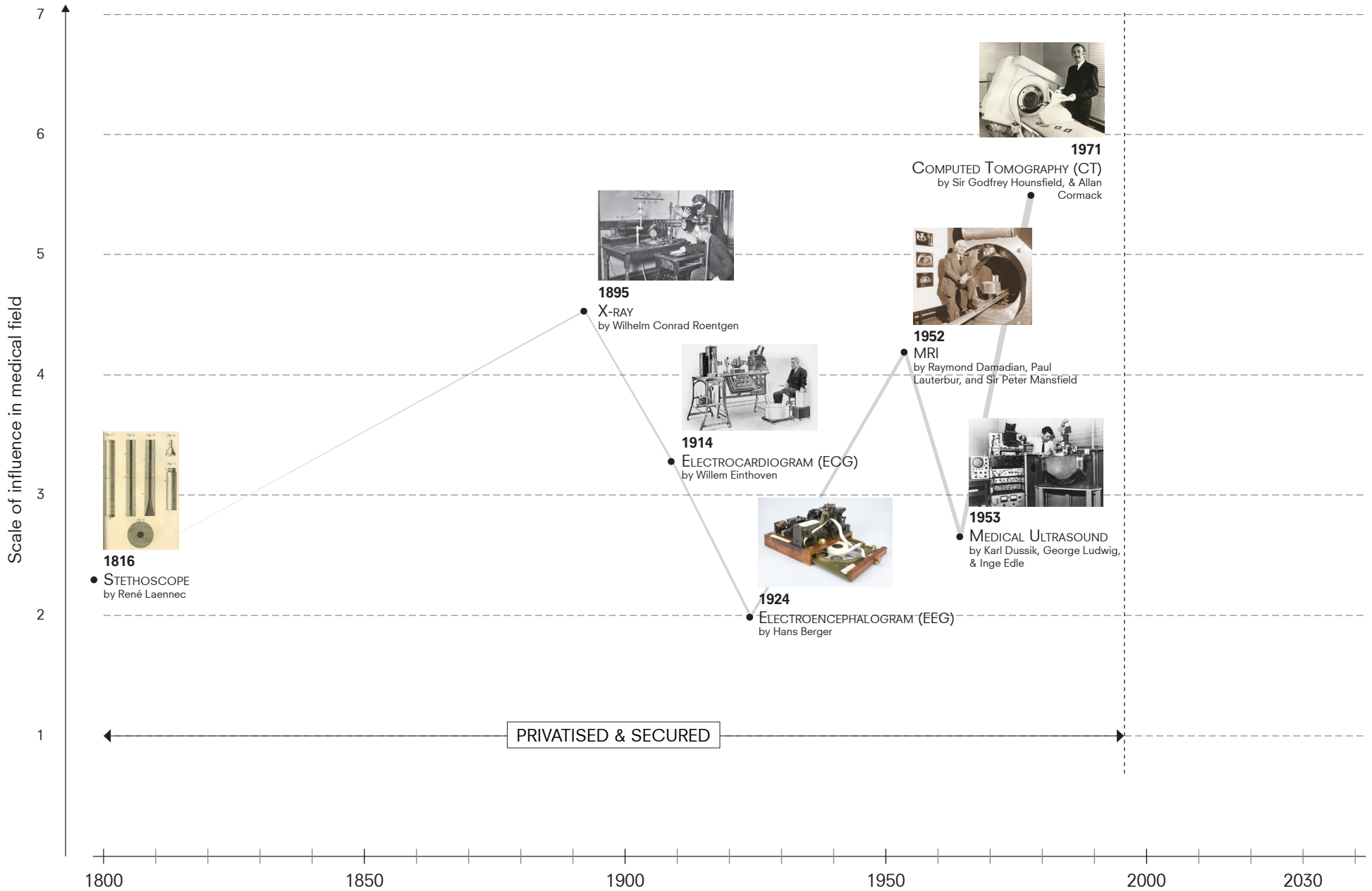


**DIAGNOSTIC SERVICES  
ARE A SMALL PART OF THE  
PROGRAM**

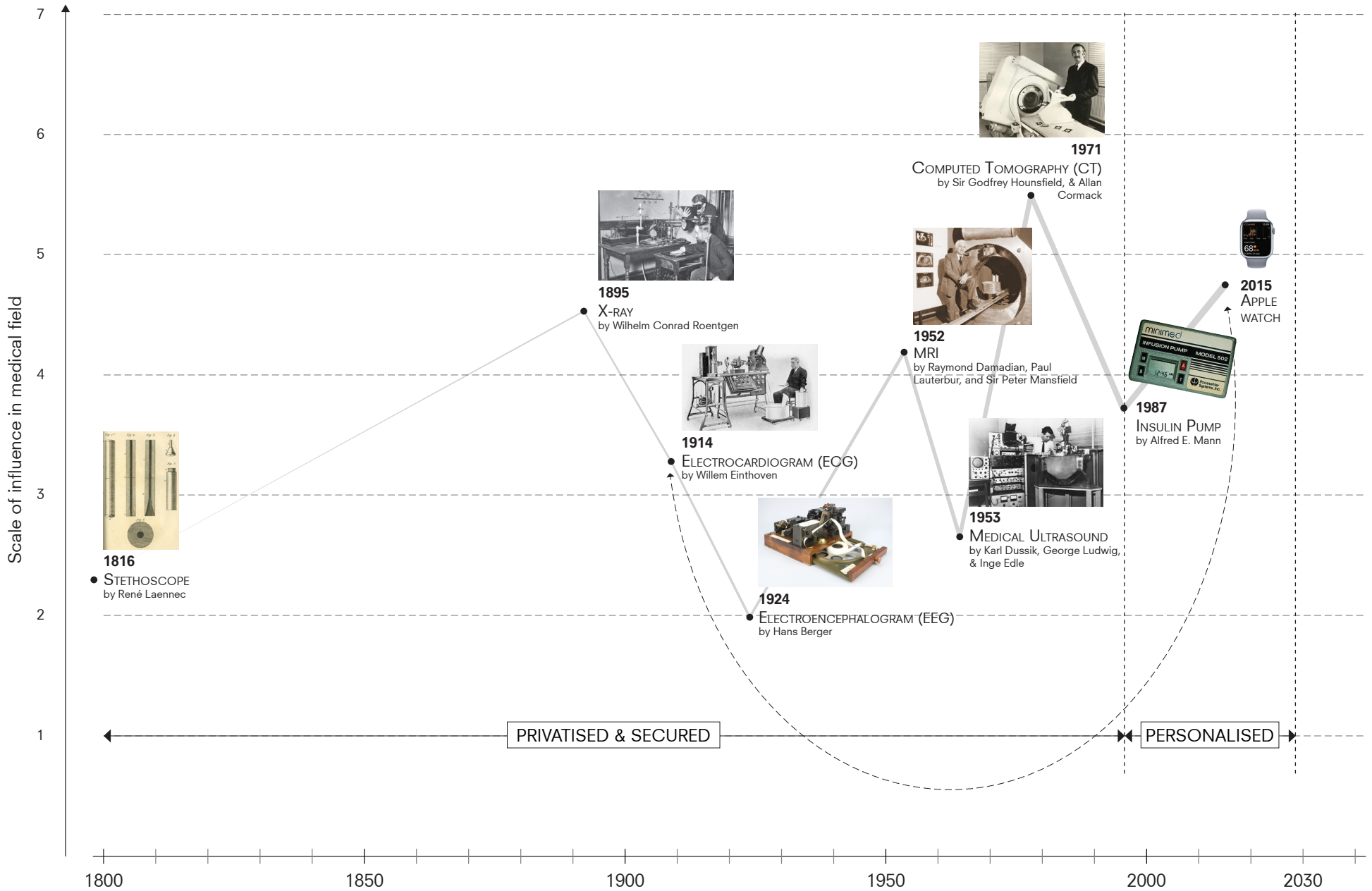
Computed tomography (CT) scanners Total, Per 1 000 000 inhabitants, 2022 or latest available



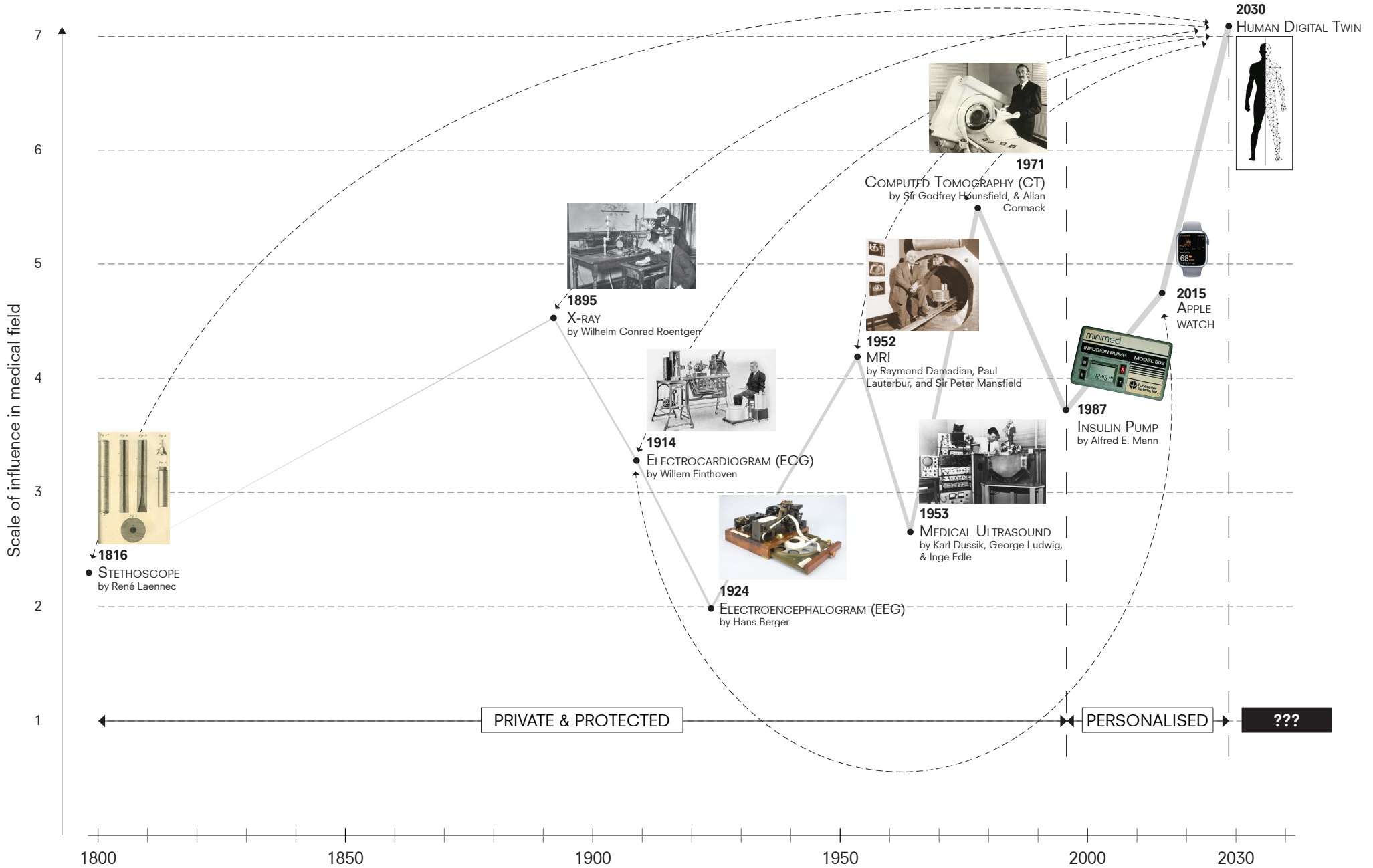
# Medical inventions for diagnosis



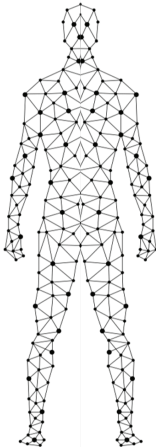
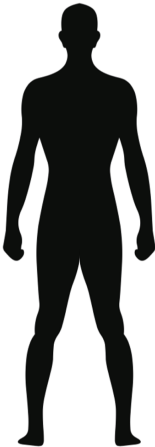
# Medical inventions for diagnosis



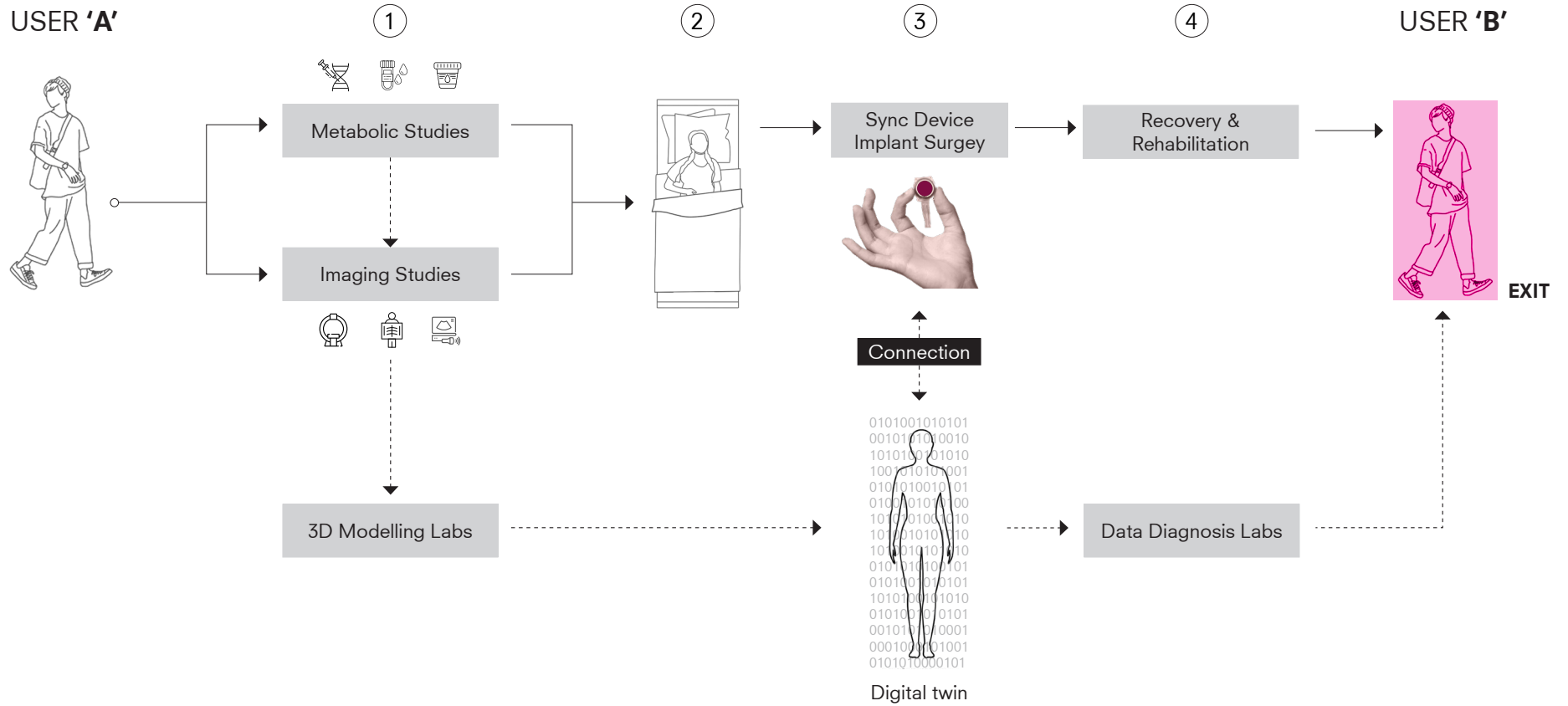
# Medical inventions for diagnosis

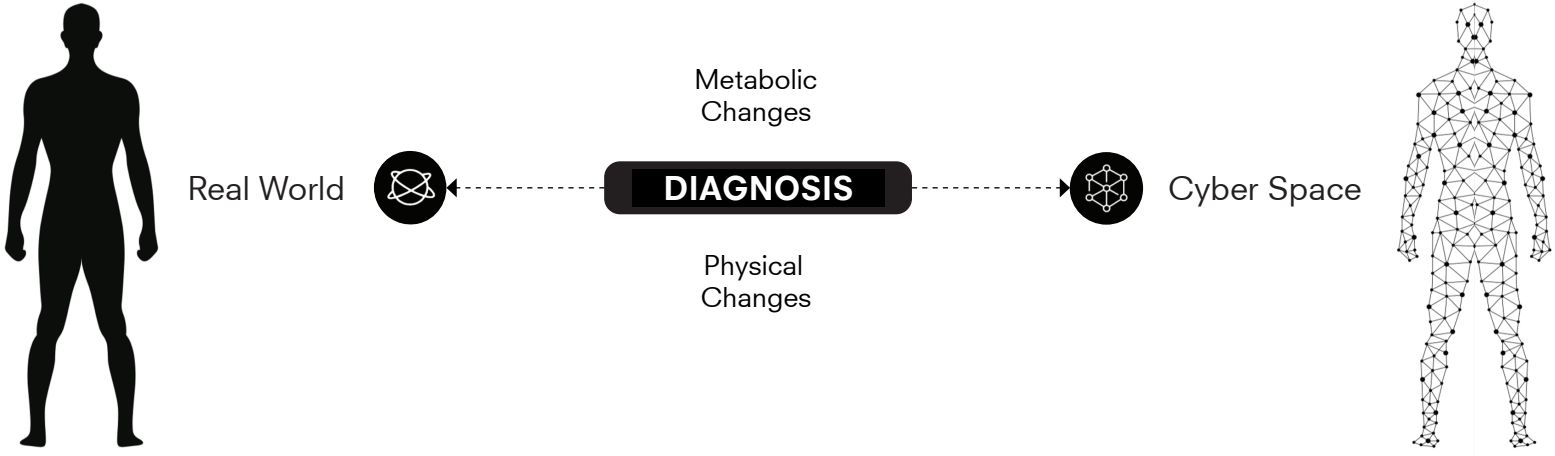


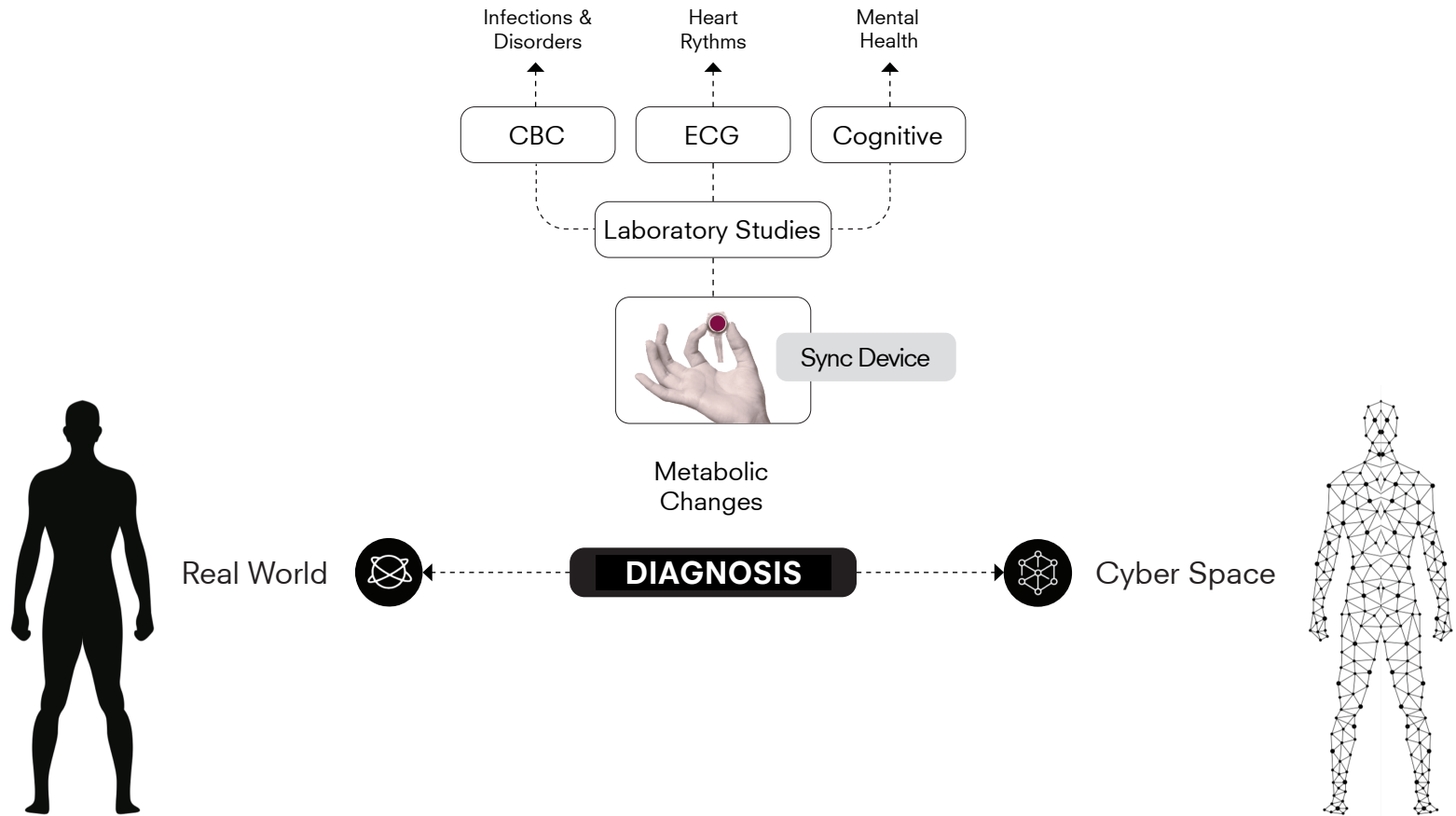


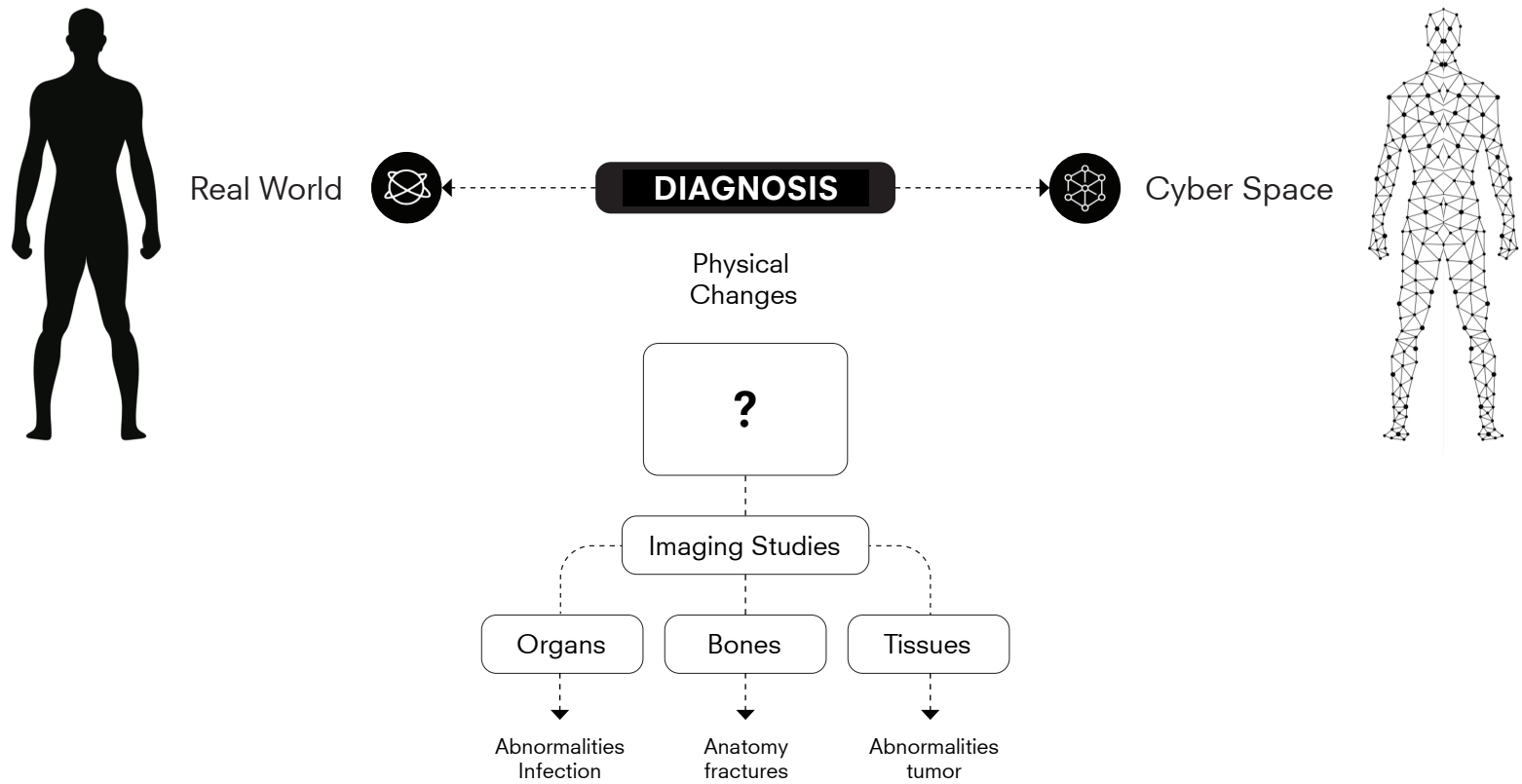


# Process







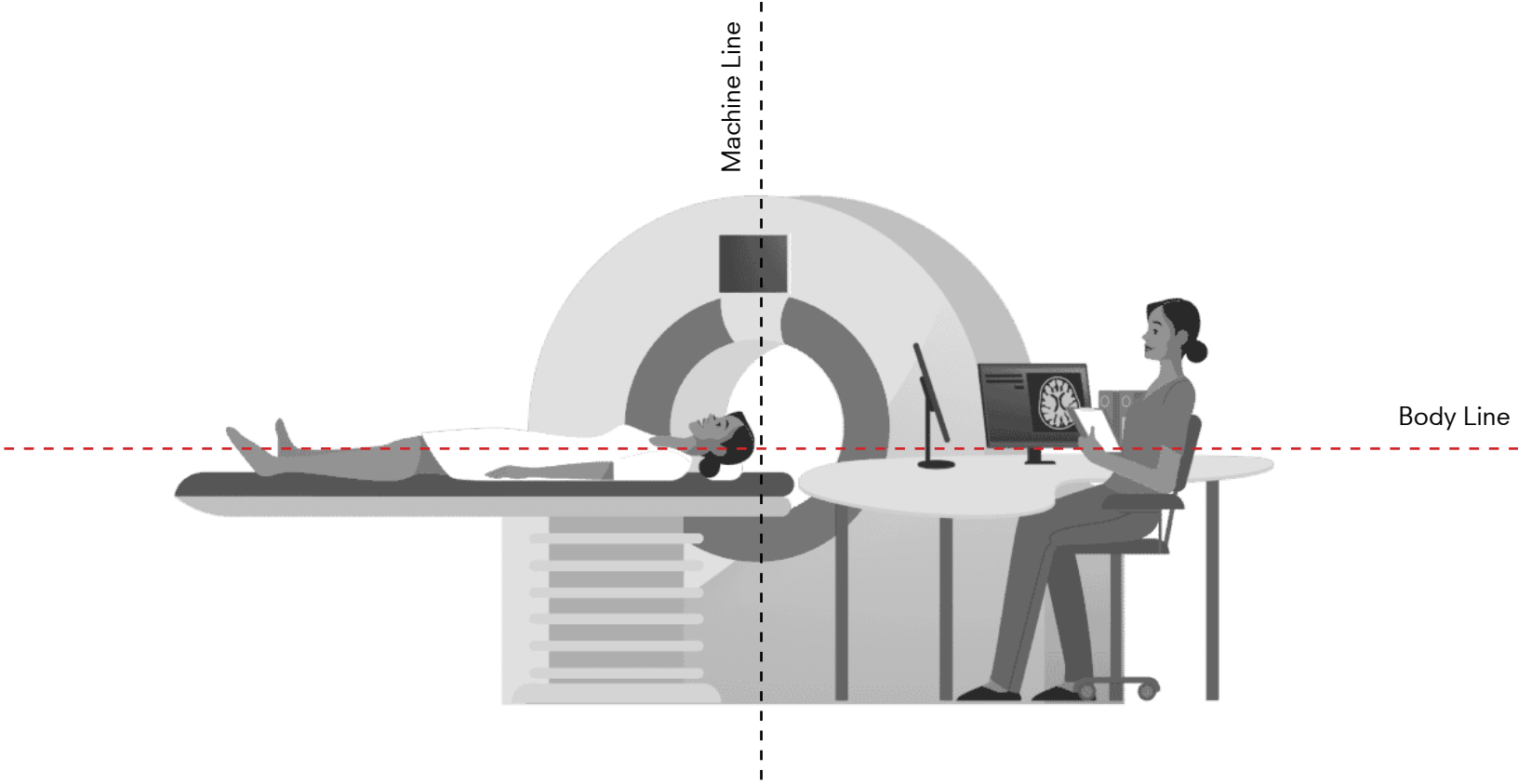


## USER 'B'

the one who already posses a Data twin, needs to  
update its physcal changes regularly

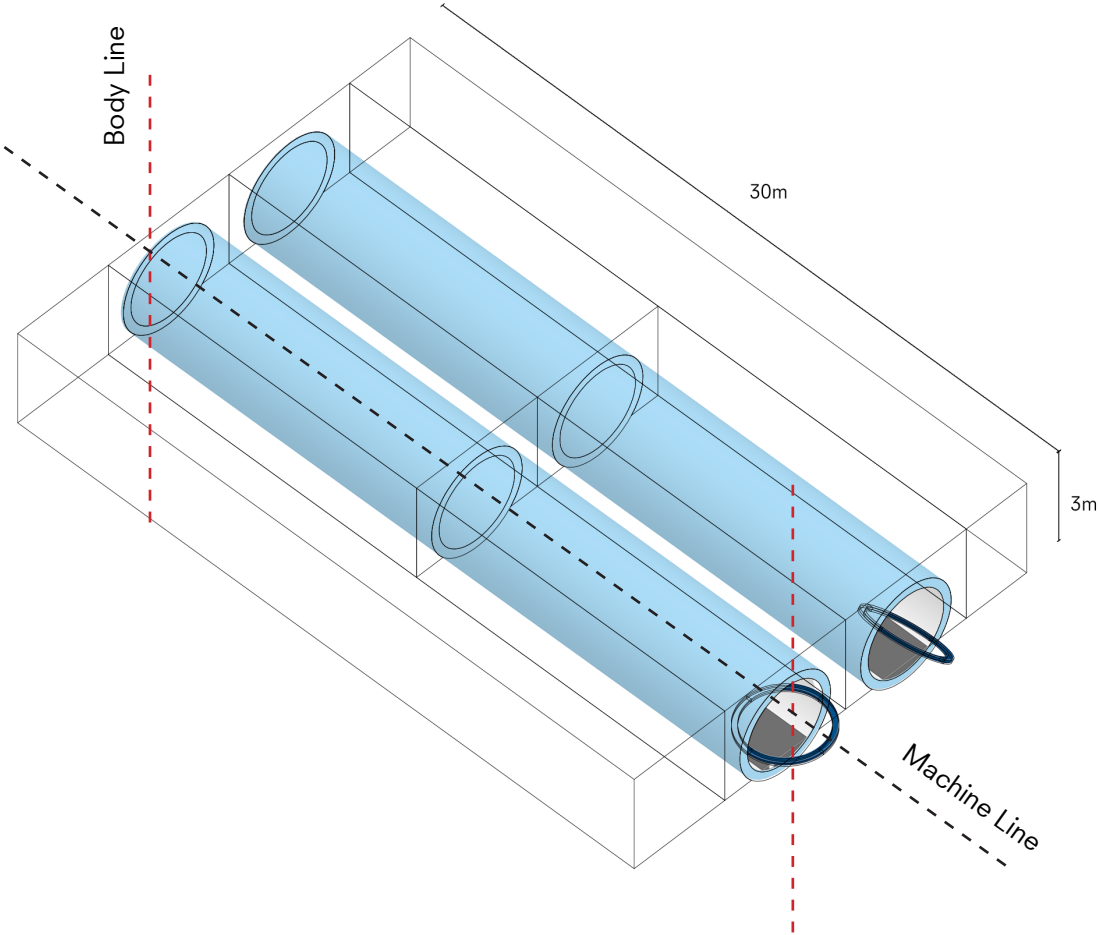


it prompts the need to make diagnosis easily  
accessible and available in the public domain



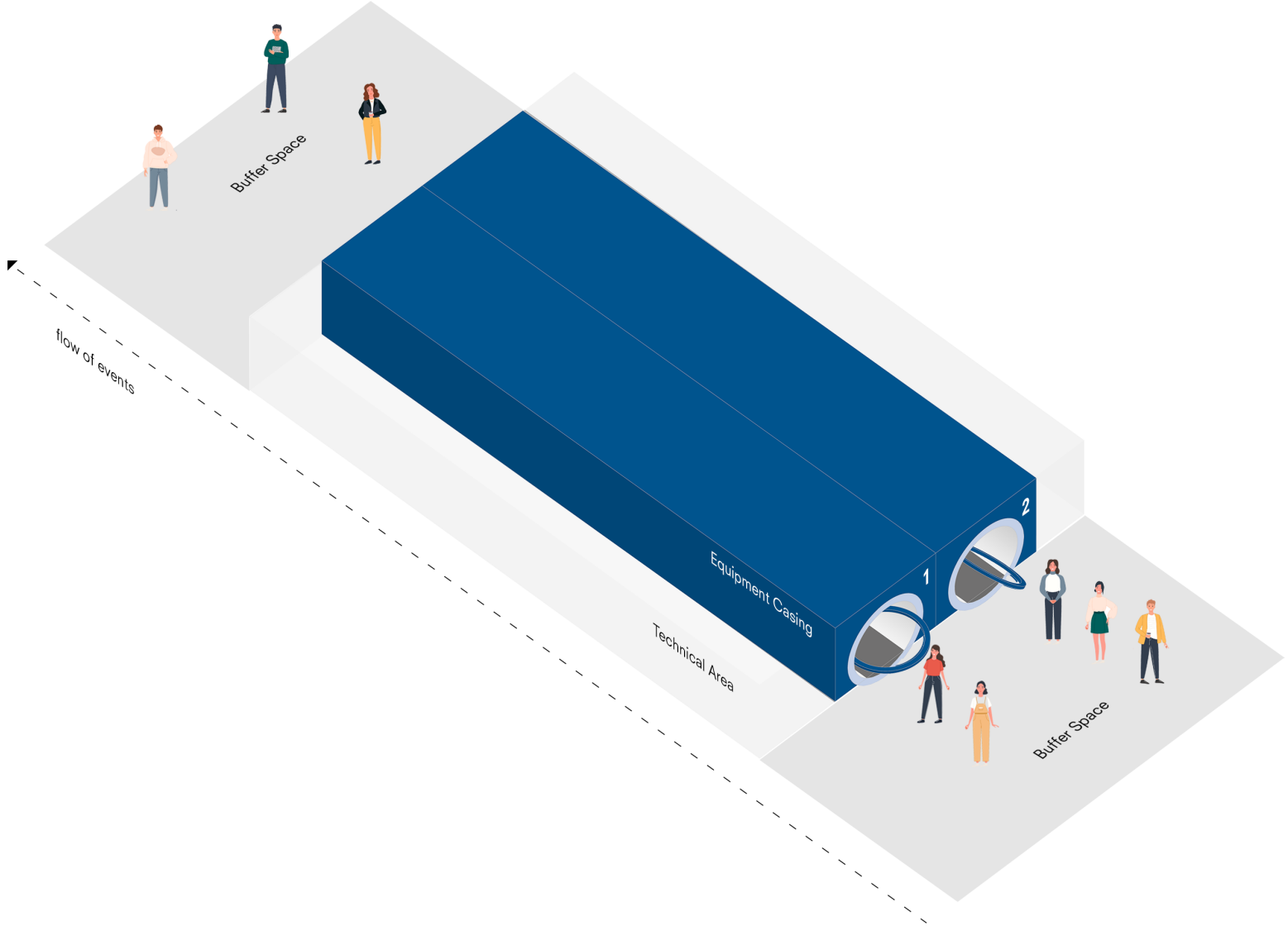
Computed Tomography Scan

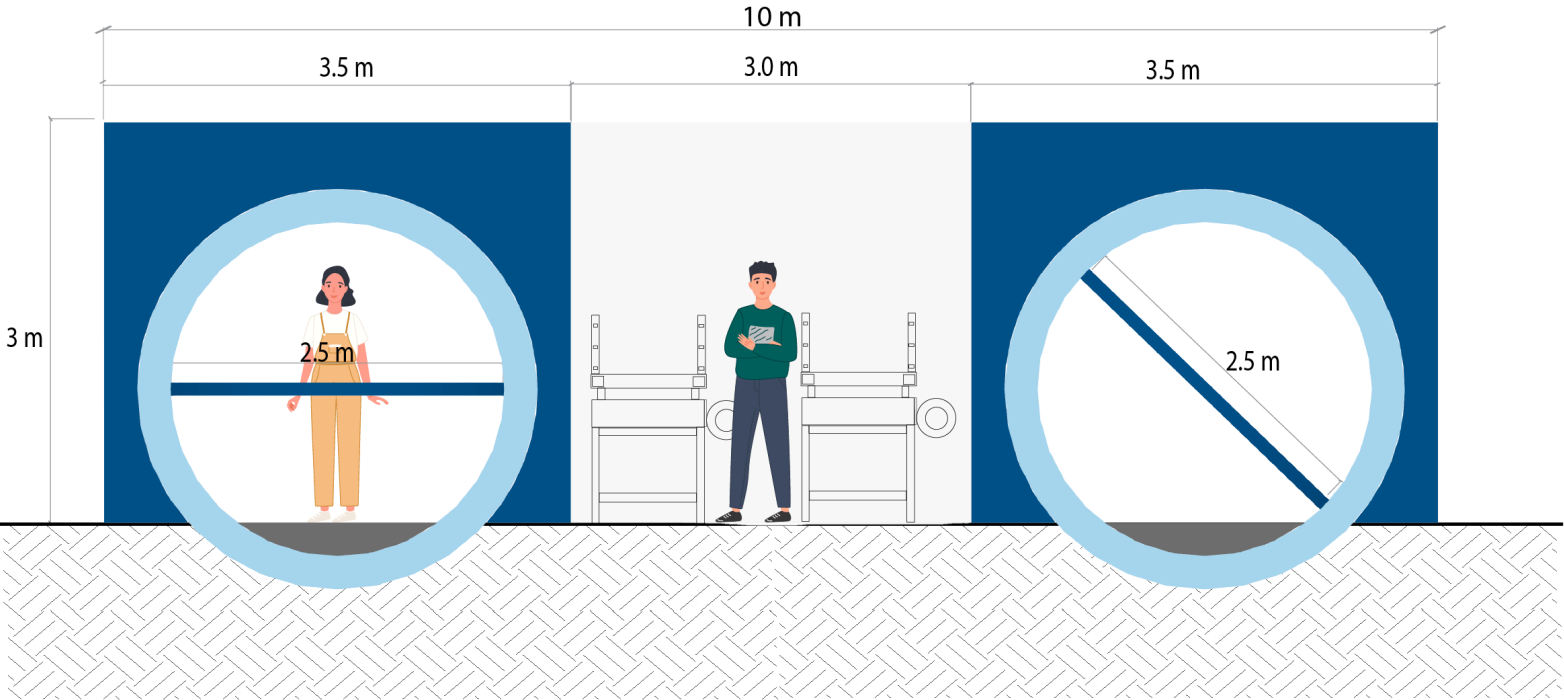
# Imaging Walkways

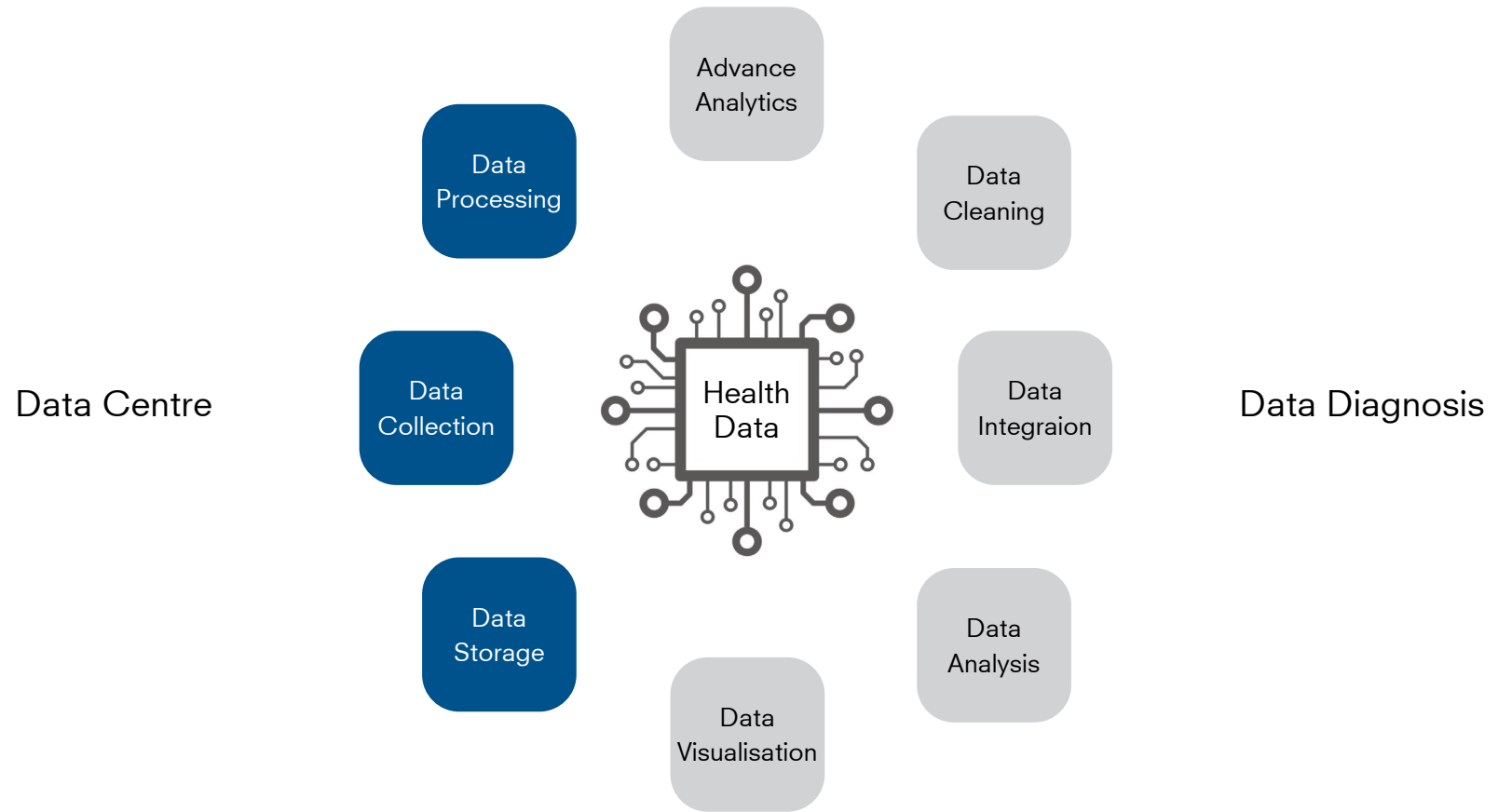


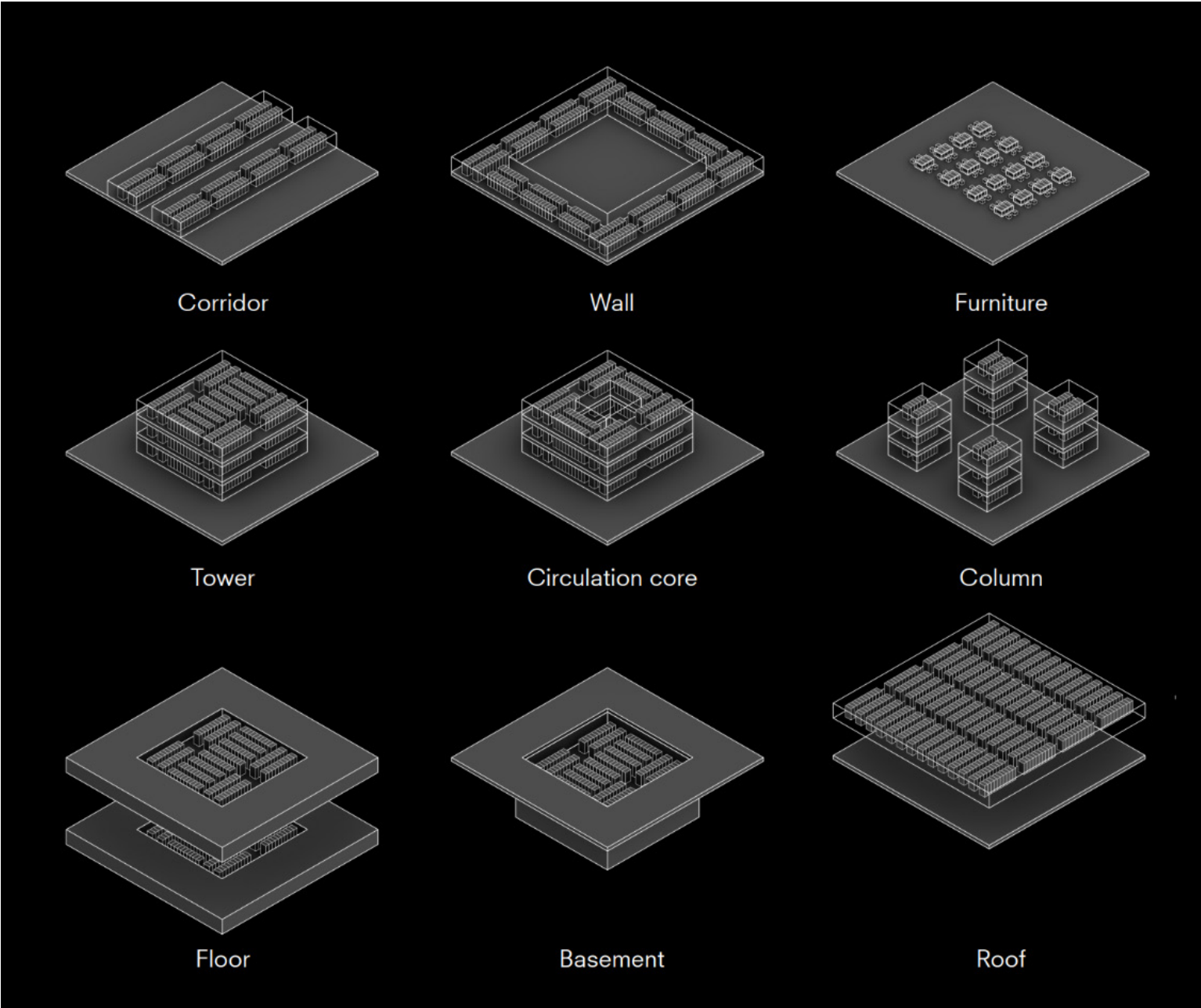


# Imaging Walkways

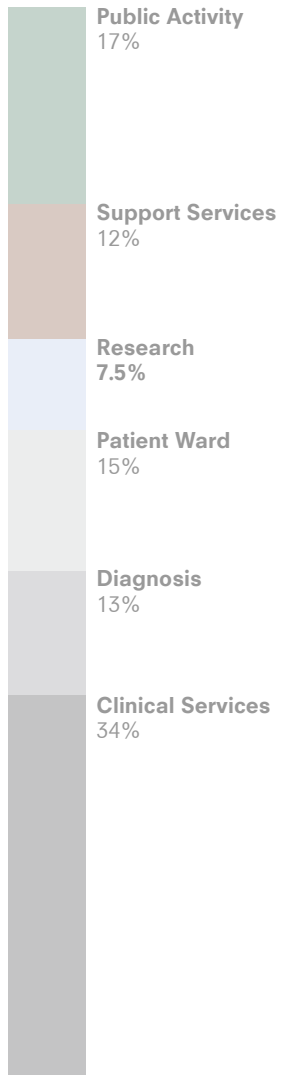




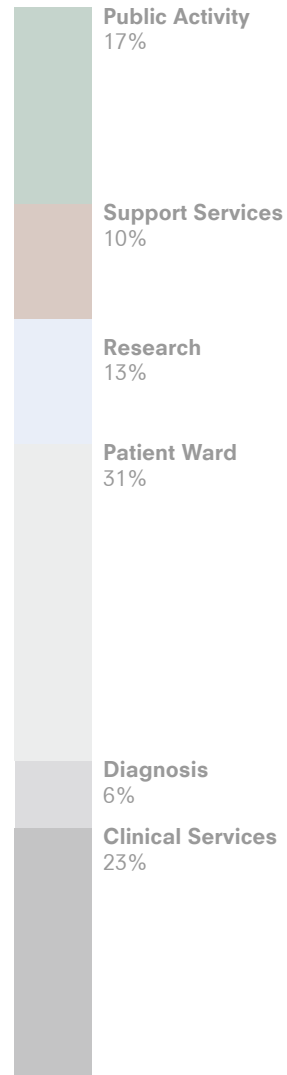




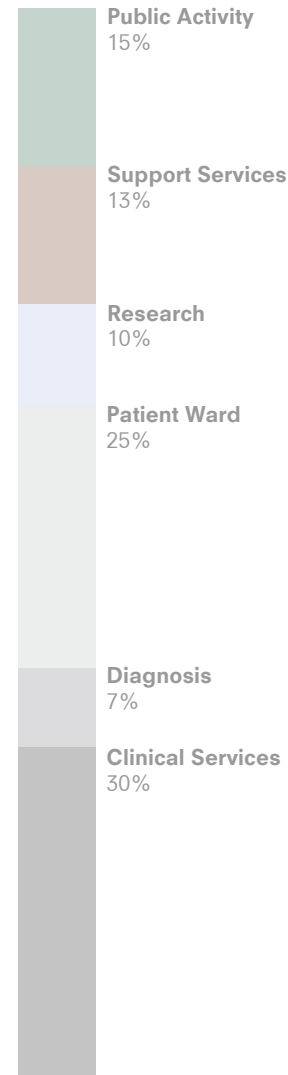
Zaans Medical Center  
39.000 m2



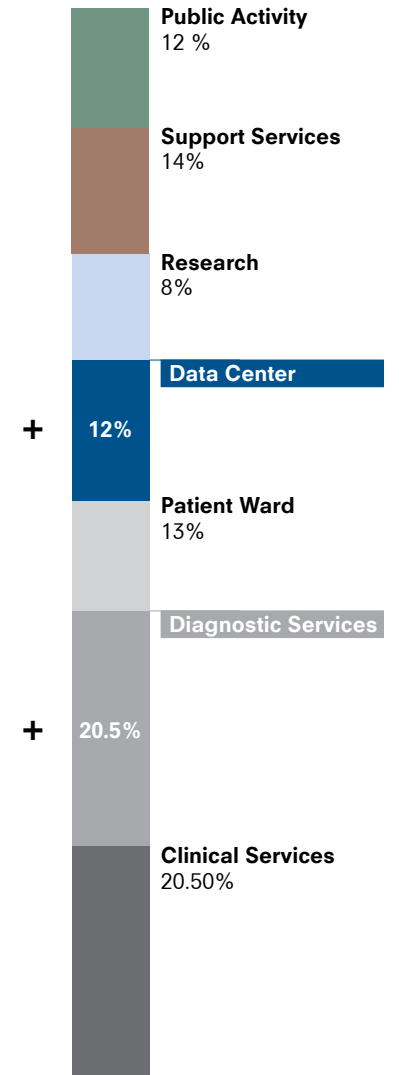
Centre for Surgical medicine  
25.886 m2

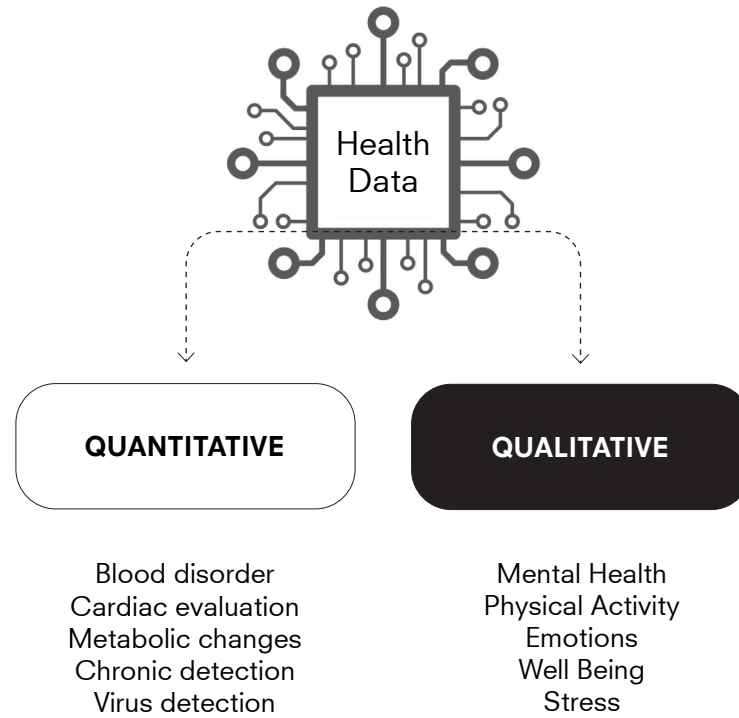


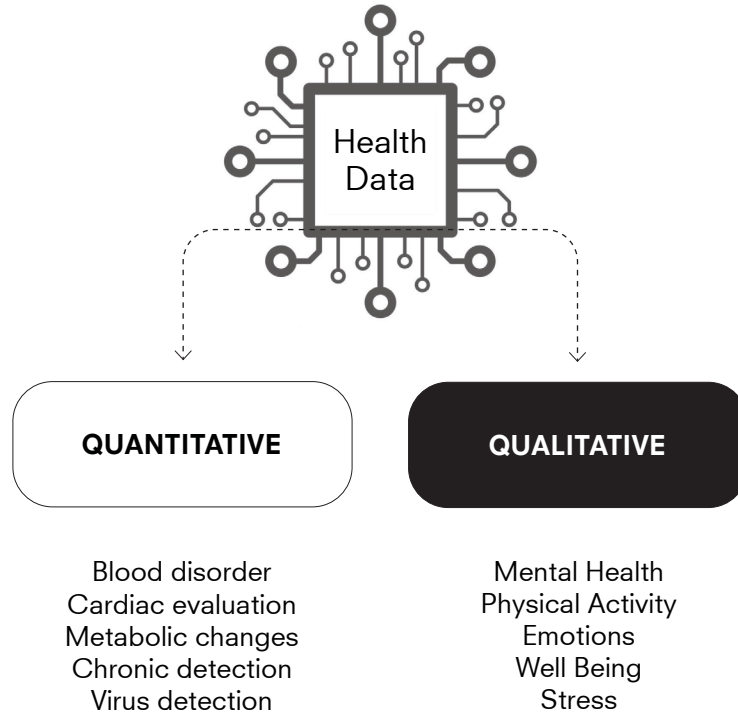
San Raffaele Hospital  
40.000 m2



Twin Anatomy MC  
30.000 m2

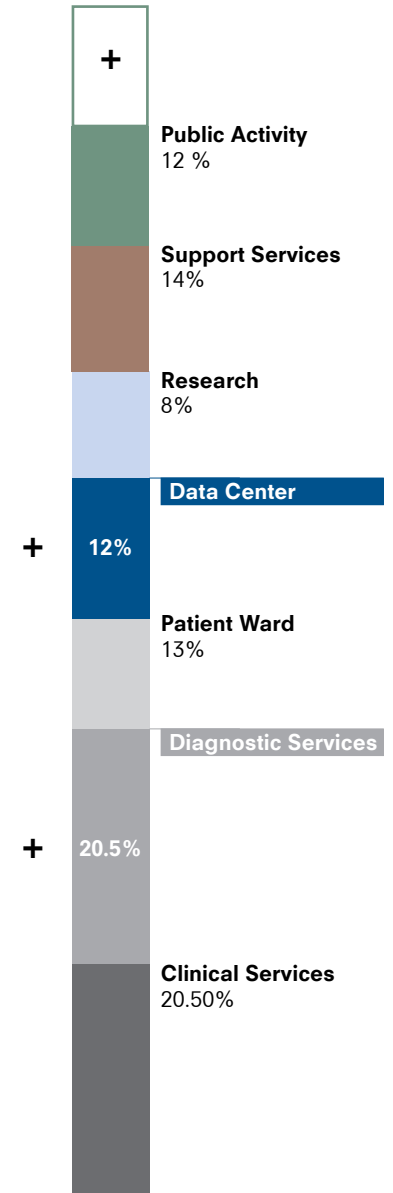


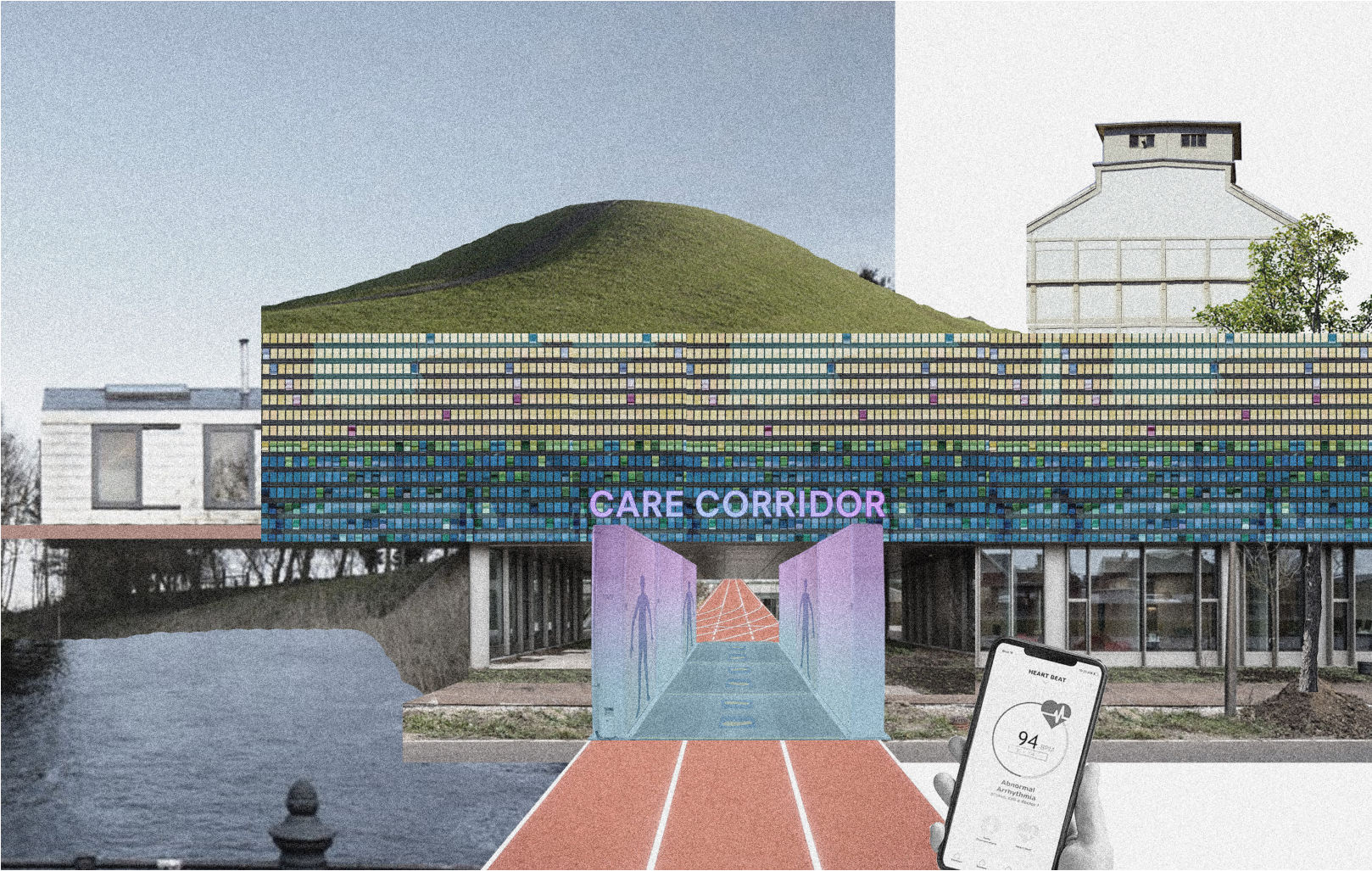




Can hospital facilitate health and well-being through their architecture?

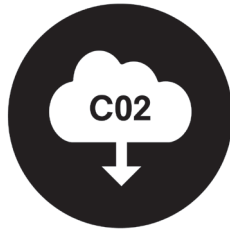
Twin Anatomy MC  
30.000 m2







## Data Centre Criteria



### **Decarbonisation**

water and wind as medium for  
reducing footprint



### **Display**

within 1km from major  
public transport node for  
accessibility & visibility



### **Decentralisation**

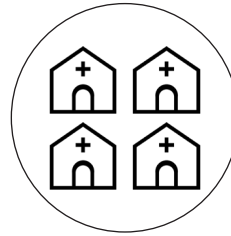
buildings at least 1.5 km  
distance apart from old data  
centers & each other

## Typology Criteria



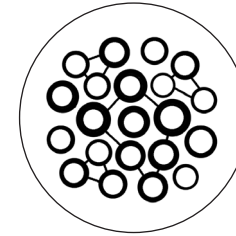
### **Healing Landscapes**

a comforting environment that  
enhances healing



### **Hospital Nexus**

within an ambulance radius  
of 10 mins to other speciality  
hospitals

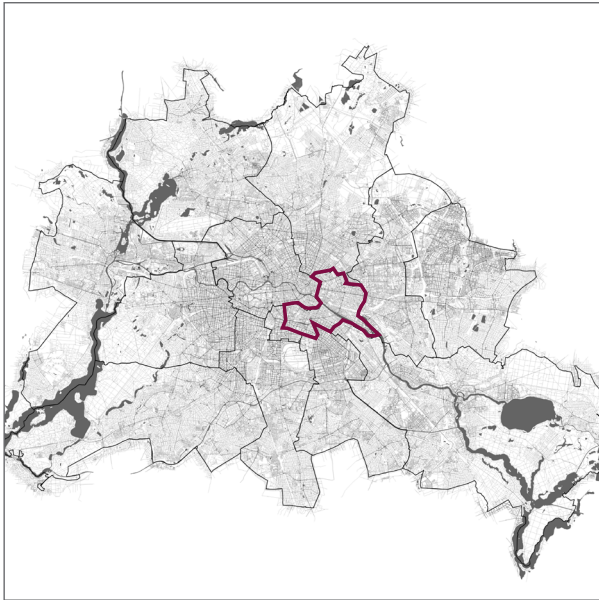


### **Diverse Datasets**

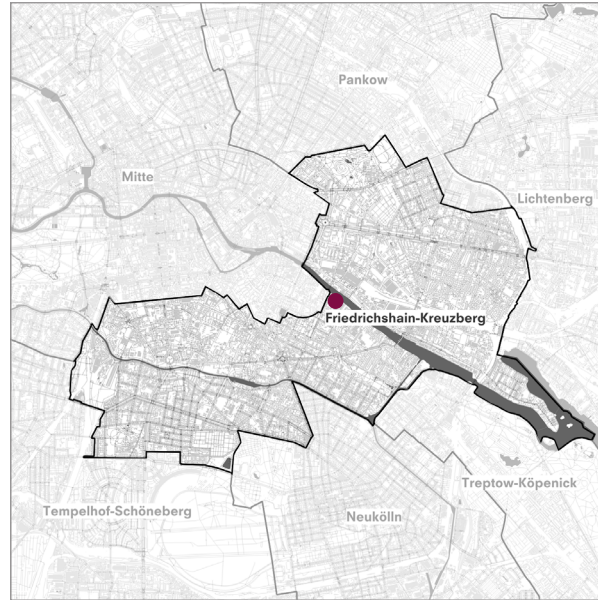
diverse neighbourhoods,  
cultural spaces, hotspot areas  
and leisure

## Location

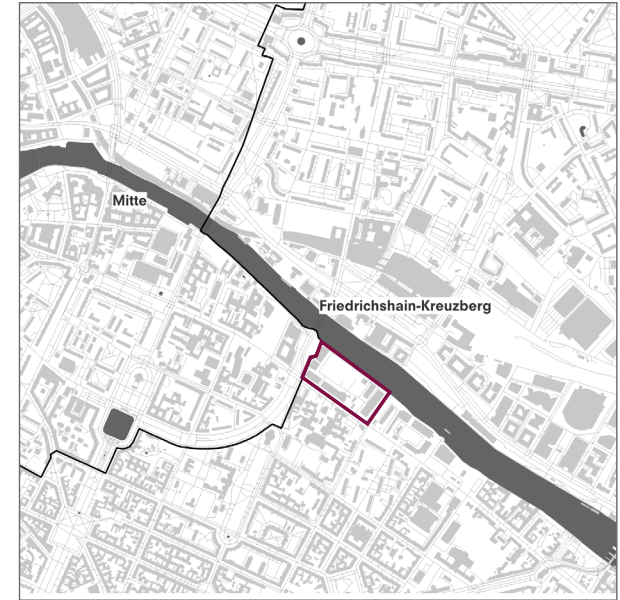
L



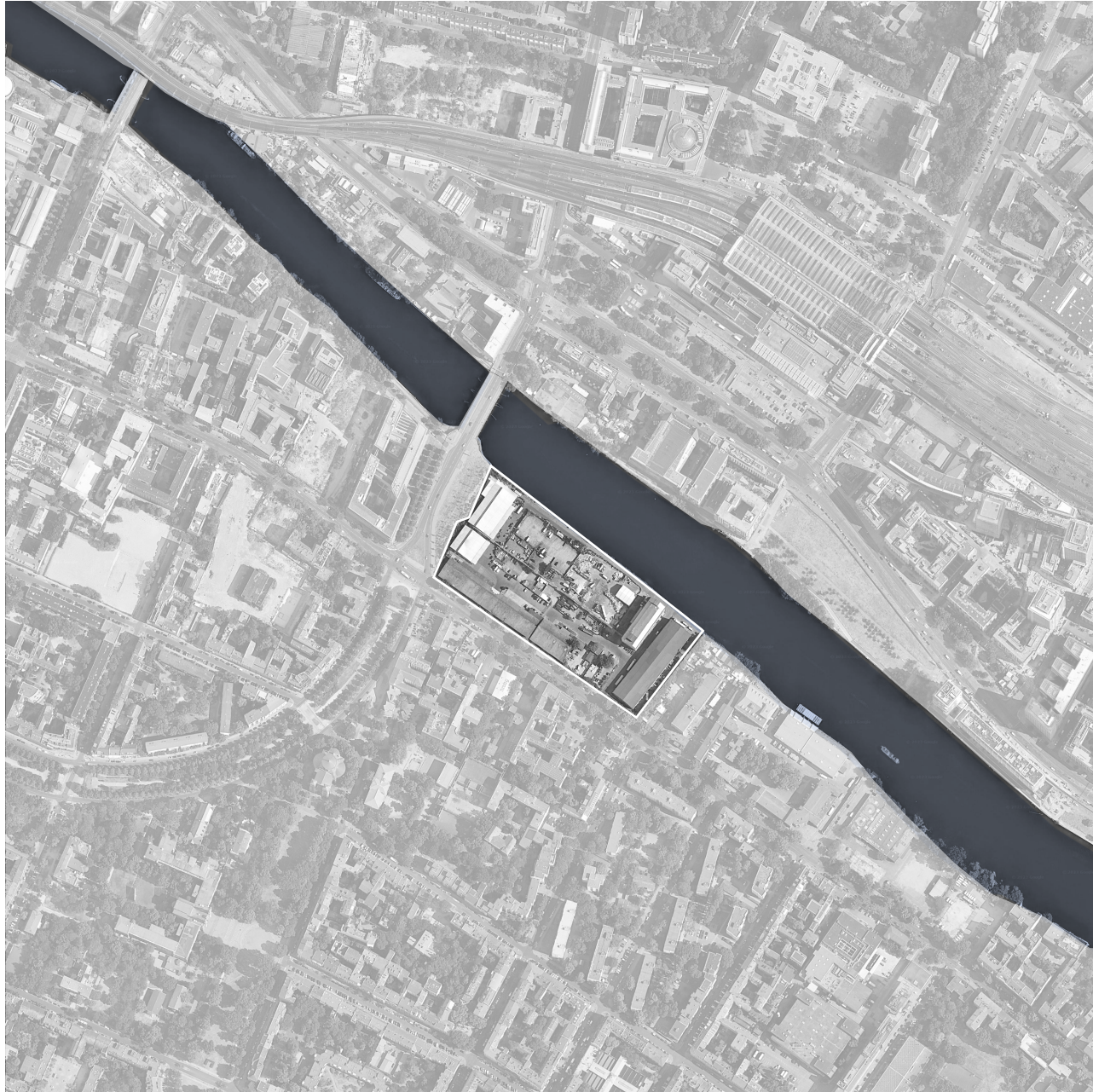
M



S



Viktoria Speicher  
Kreuzberg



**Data Decarbonisation**

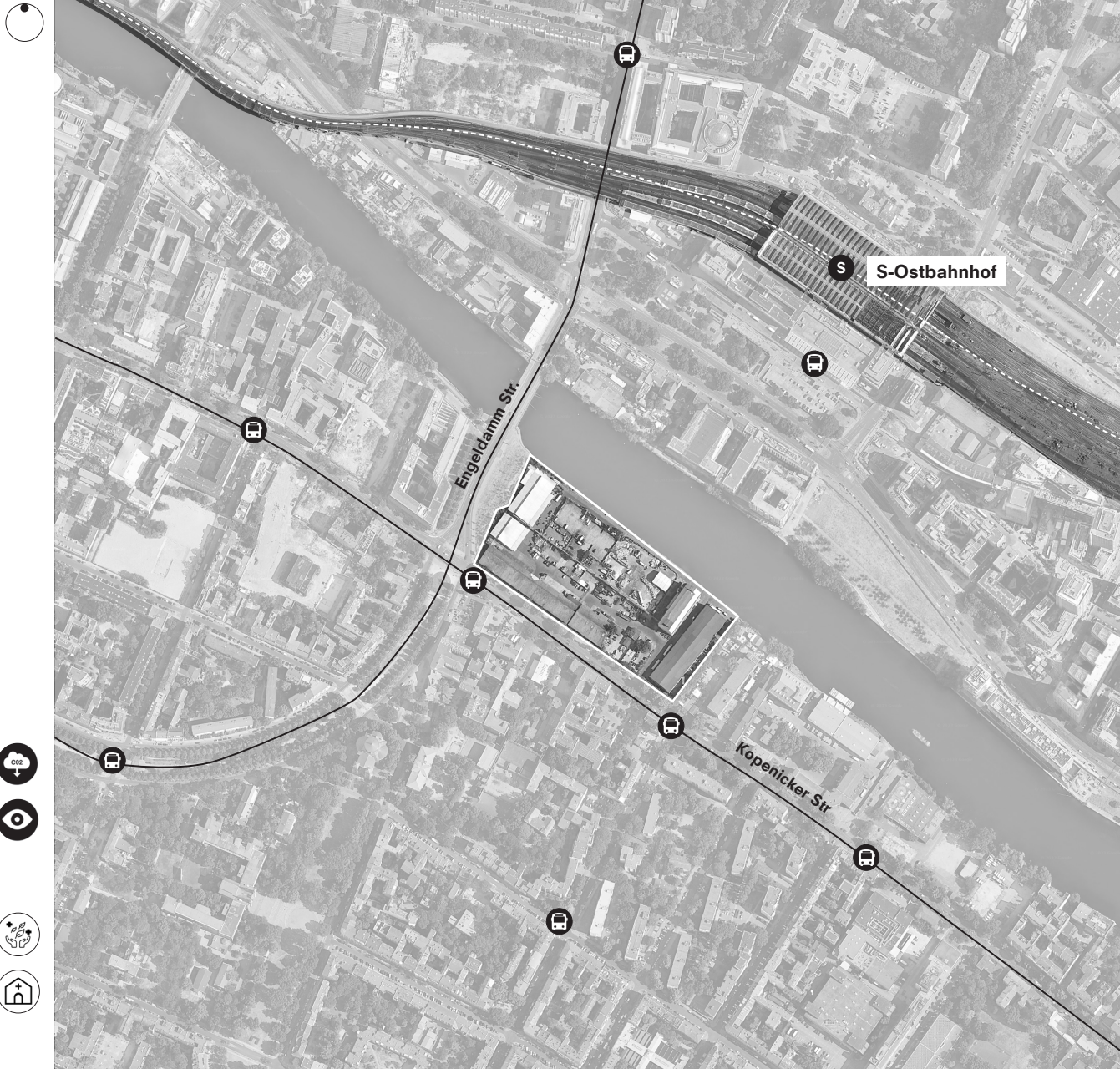
Close to river to be able to use natural conditions for data center cooling



**Healing Landscapes**

Location is close to the river to adopt privacy and enhance healing





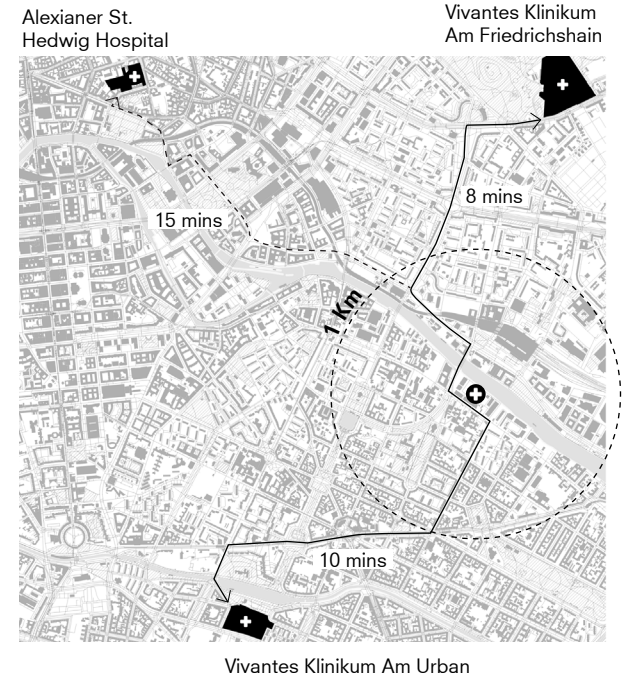
**Data Display**

Located in a prominent area, with walking radius to S-Ostbahnhof, to be able to create data awareness.



**Hospital Nexus**

Travel time of 10 mins to nearby hospitals by an Ambulance





Introduction

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Implementation

Development

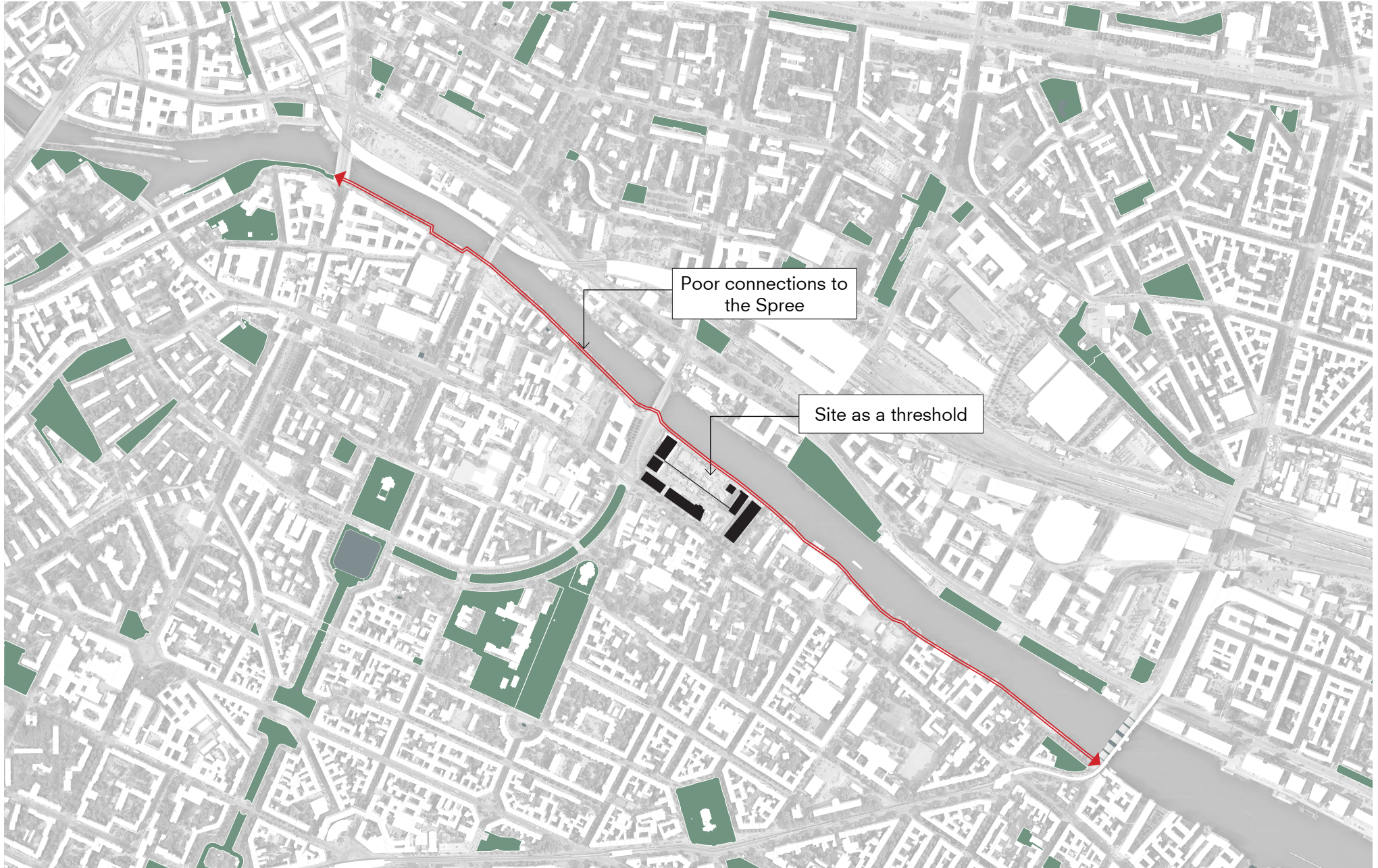
Conclusion

# Green Spaces

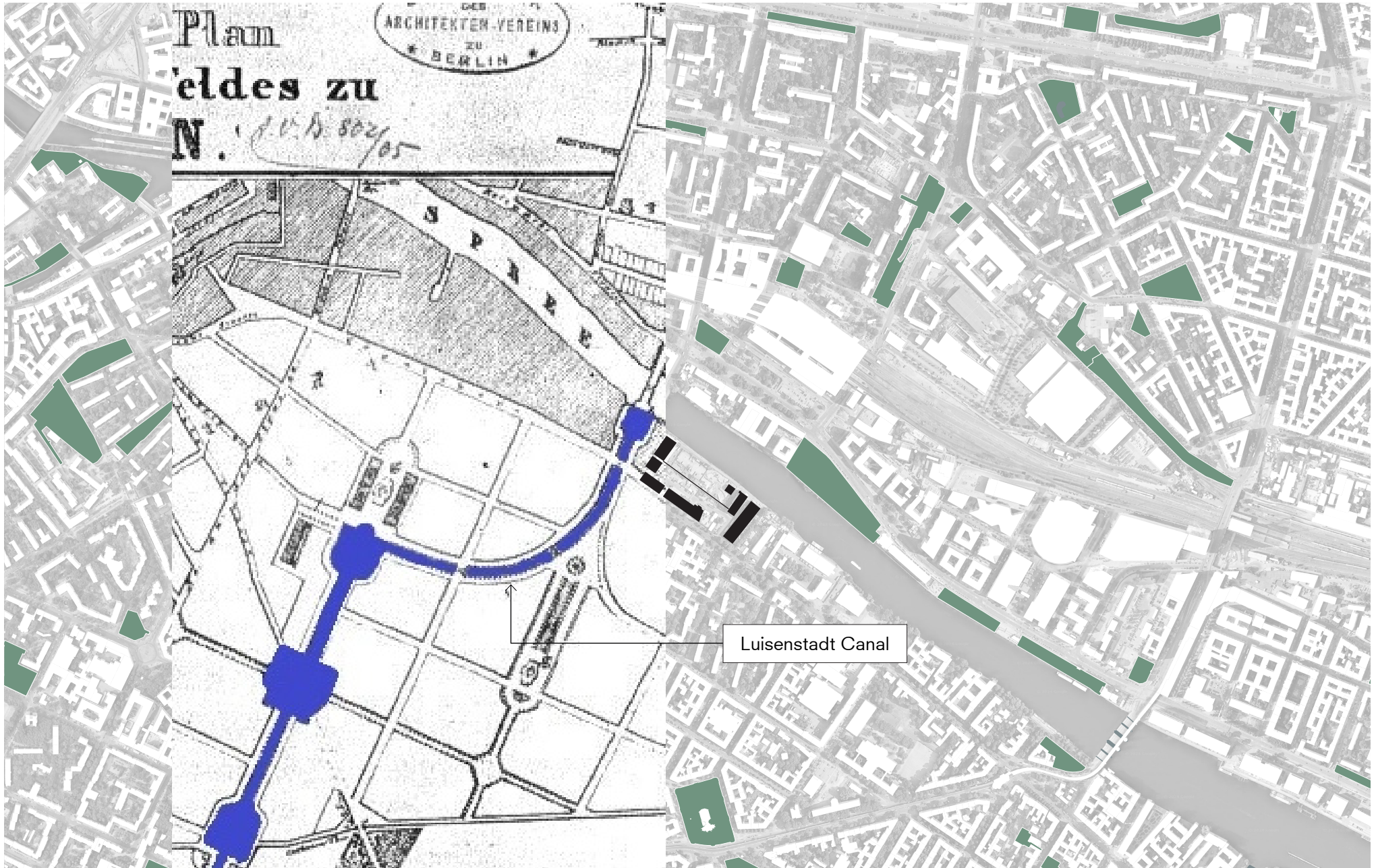




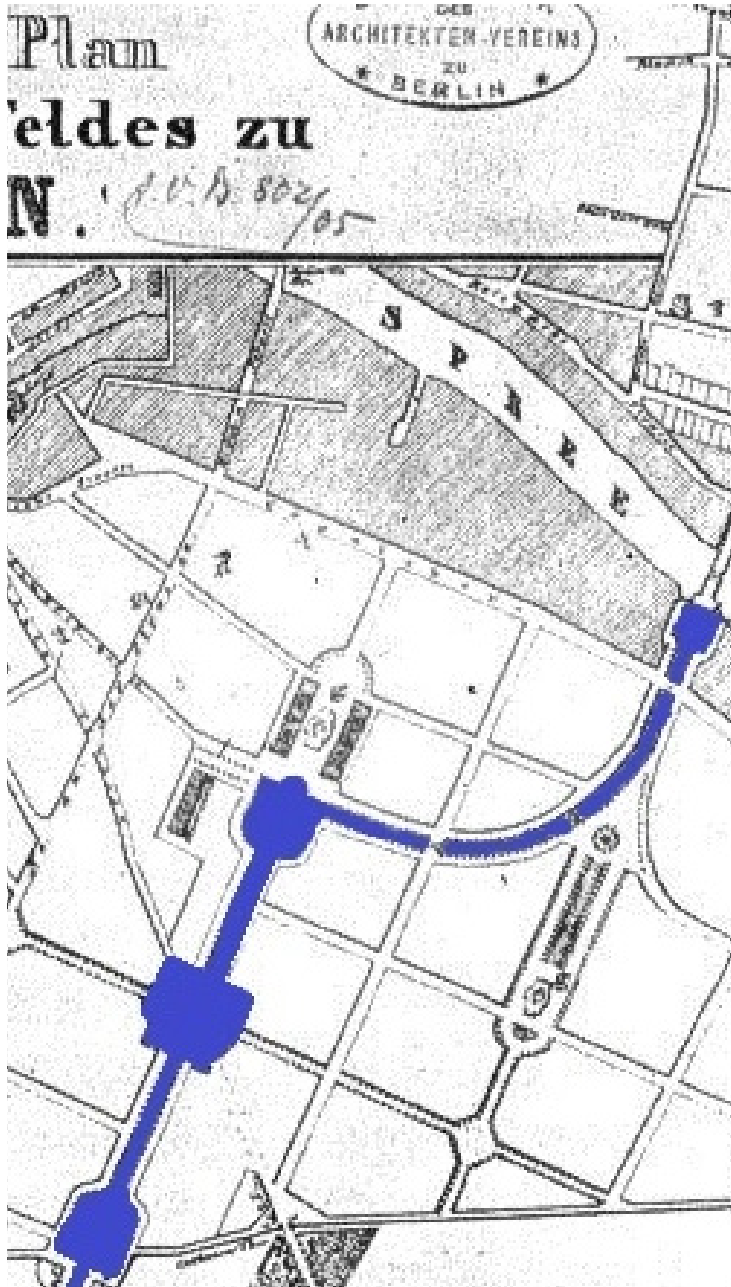
## Accessibility to River



1852 to 1926



## Berlin and Public Parks



then: Luisenstadt Canal

now: Engelbecken Park

# Berlin and Public Parks



then: railway hub

now: Park am Gleisdreieck



then: Luisenstadt Canal

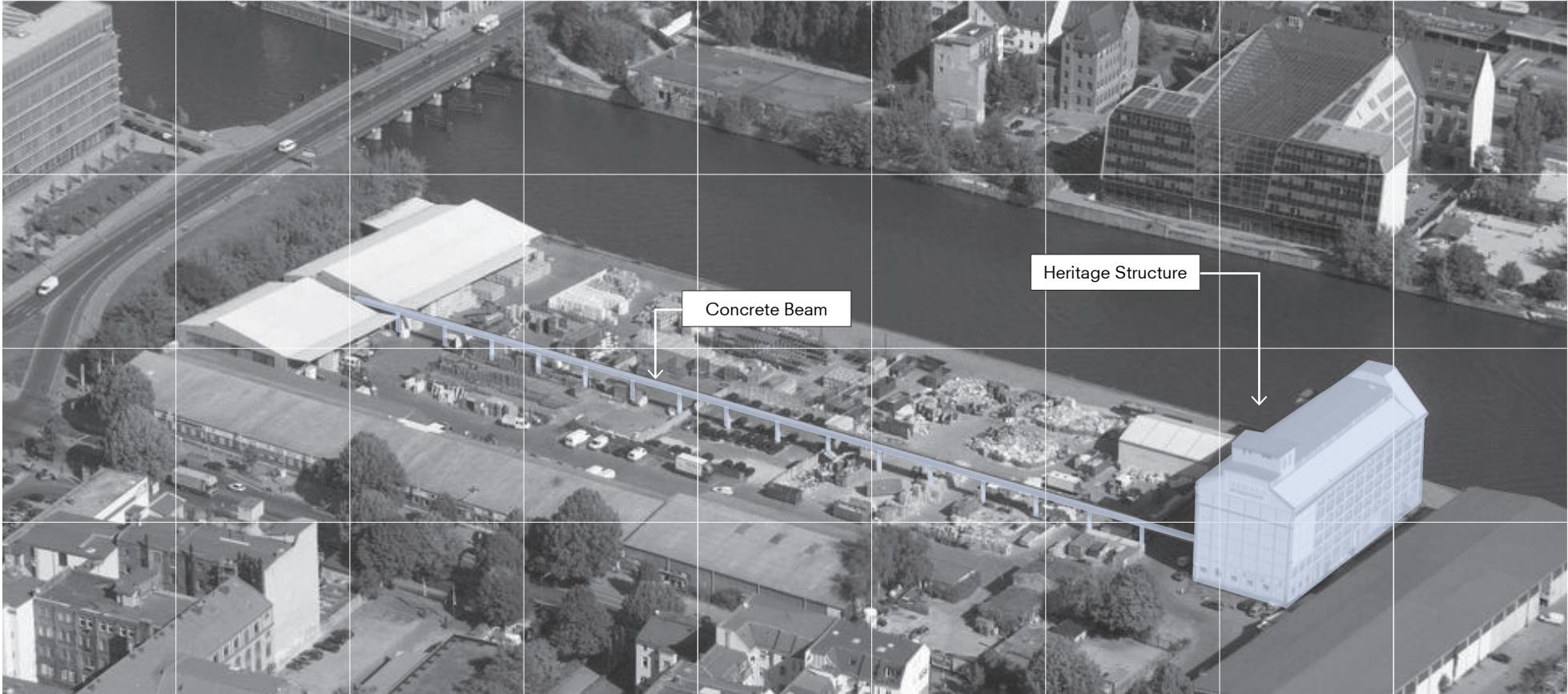
now: Engelbecken Park

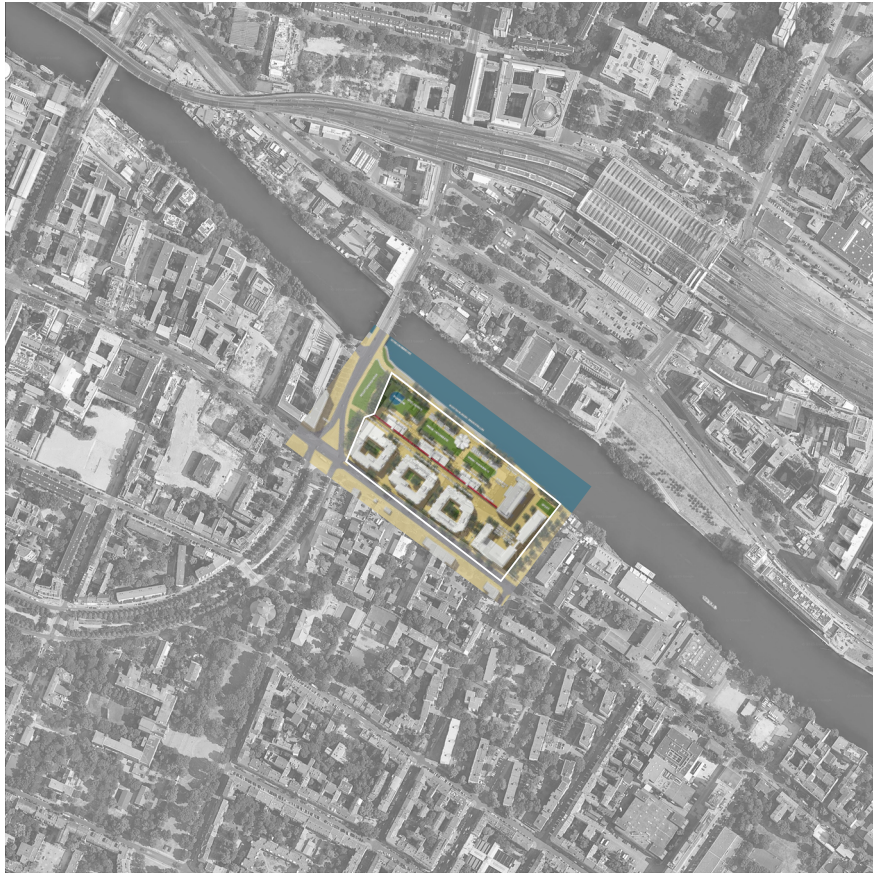


then: airport

now: Tempelhof park

# Existing conditions





2008

## Public Referendum

The referendum under "Spreeufer Fur alle" aims to "Sink Mediaspree development" characterized by dense office space and limited free space.

- Space for riverfront
- Less densely built

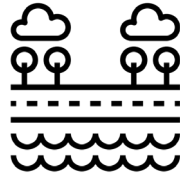


## Site ambitions



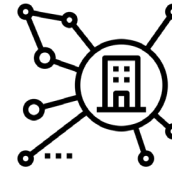
### Heritage:

Building not higher than heritage structure.



### Spree for ALL:

Building with an offset of 30 m from the river front



### Urban Connections:

Extension of the Engelbecken Park

# Massing 3x3

Site

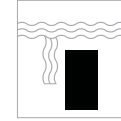
Free ground space



Large open space



Water as healing element



Program

Double terrace morphology



Imaging Walkway Flow



Active design strategies



Client

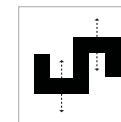
Iconic + Introvert



Iconic + Extrovert



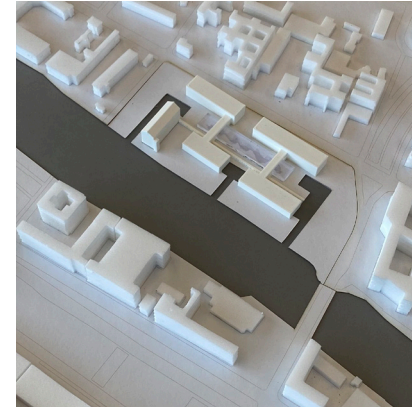
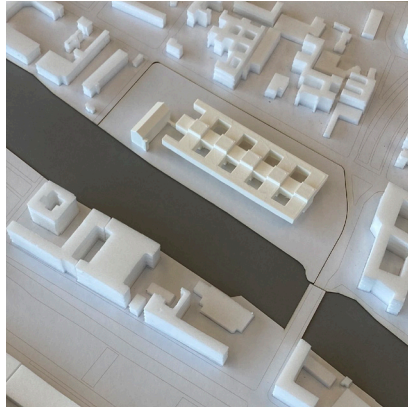
Introvert & Extrovert



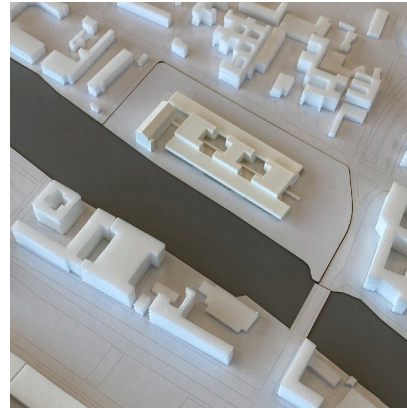
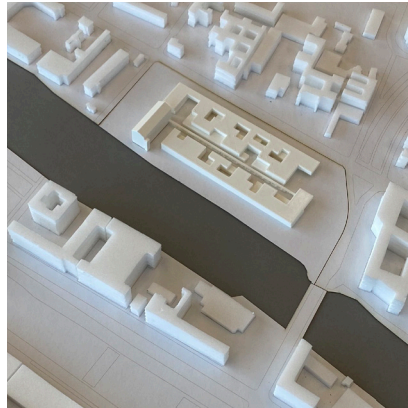


# Massing 3x3

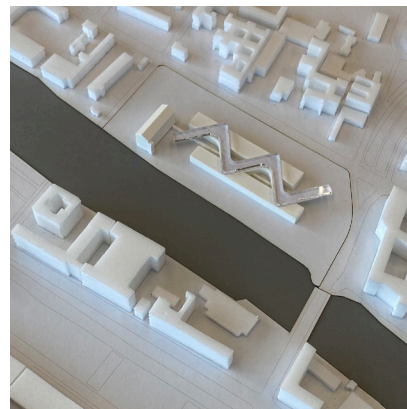
Site



Program

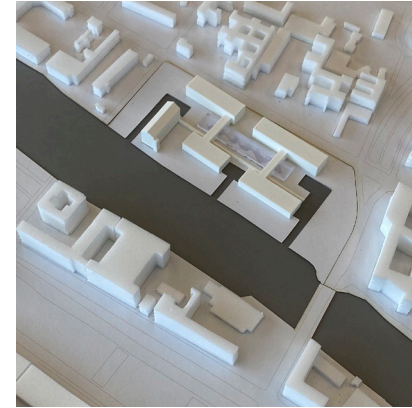
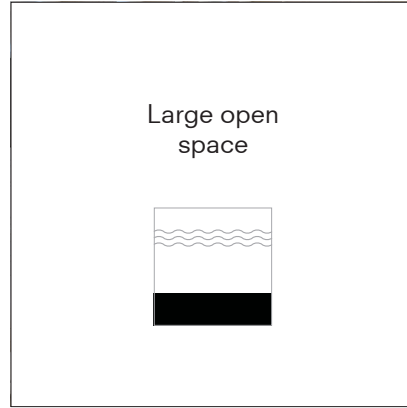
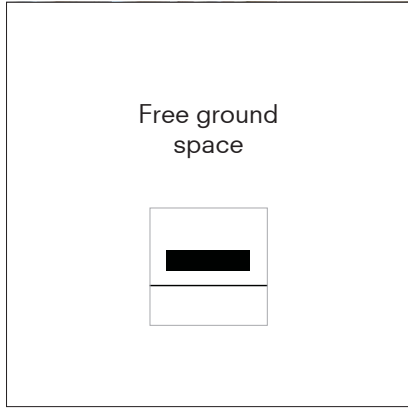


Client

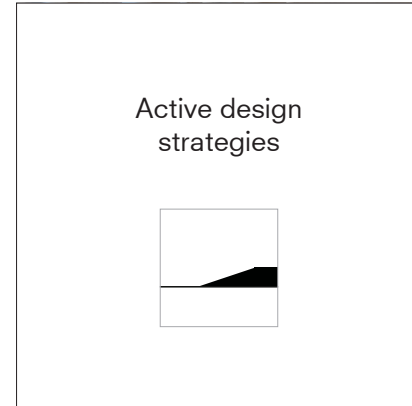
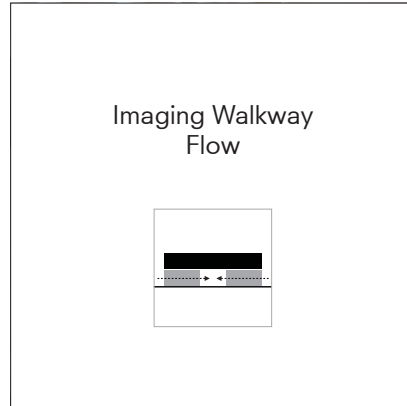


# Massing 3x3

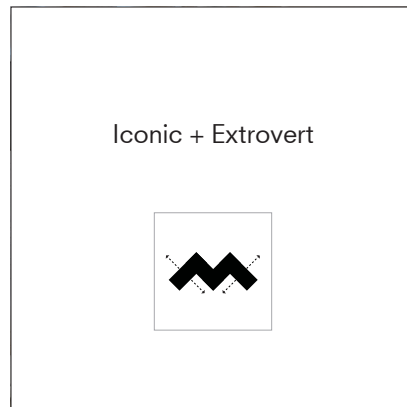
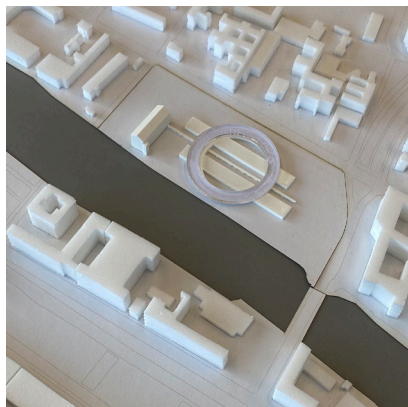
Site



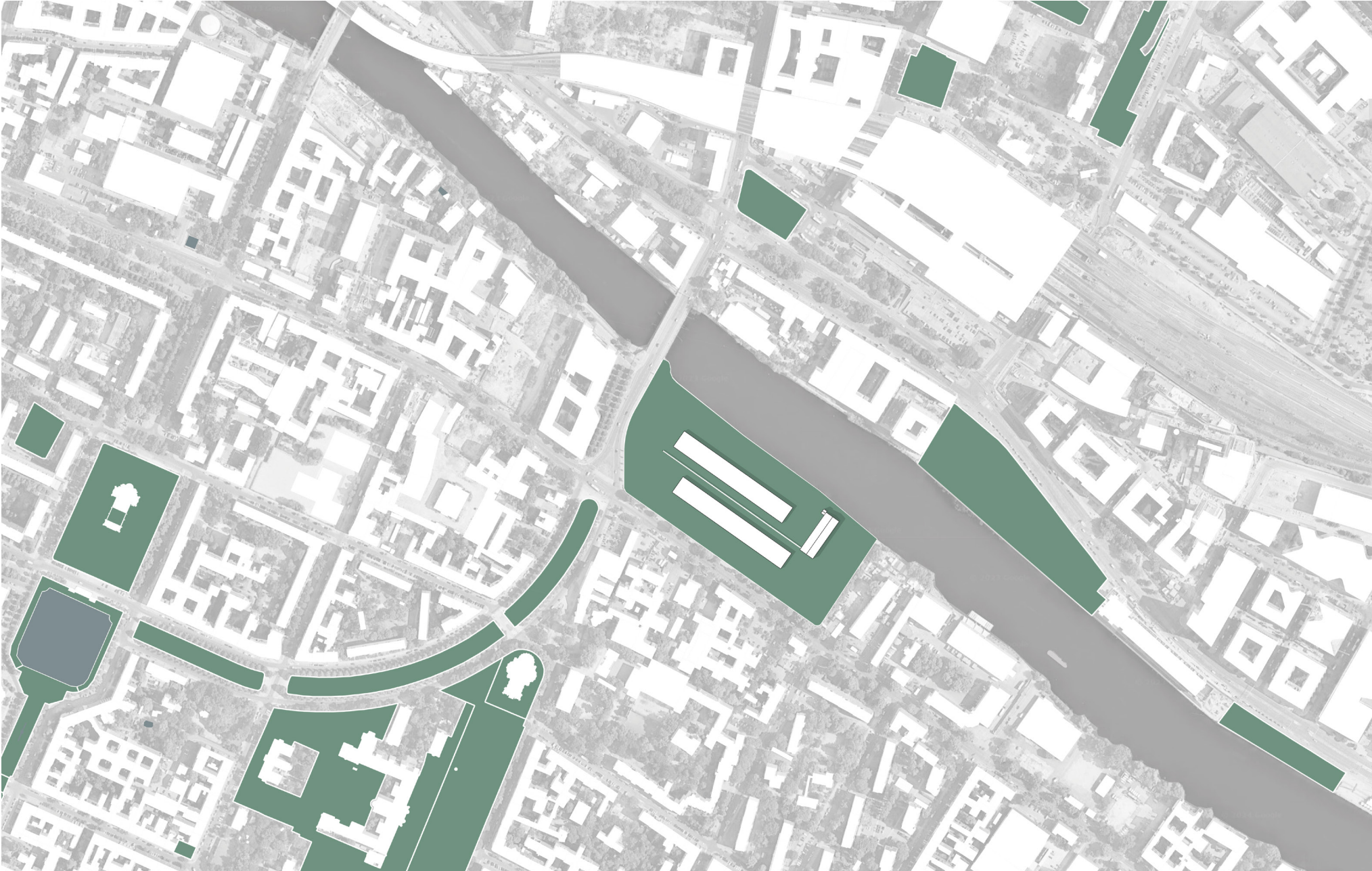
Program



Client



# Twin Massing



## A point of reference from the history

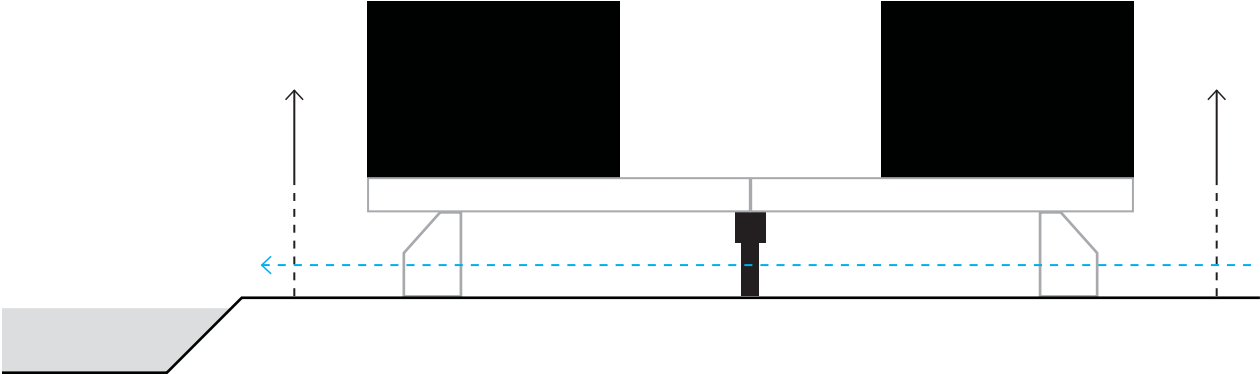


Source and author credit: © ddrbildarchiv.de/Manfred Uhlenhut

an opportunity



an opportunity

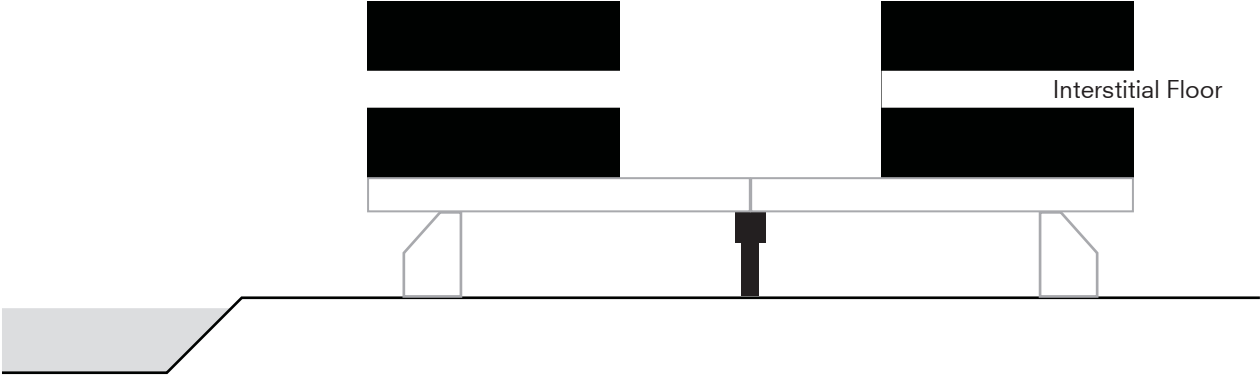


“a place in the shade”

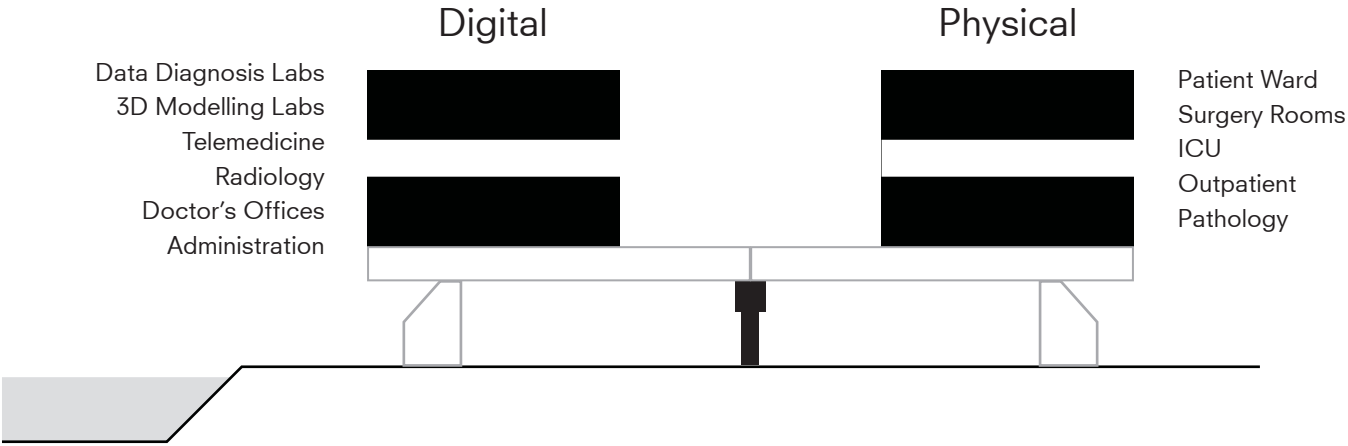
Art Museum of São Paulo, Lina Bo Bardi

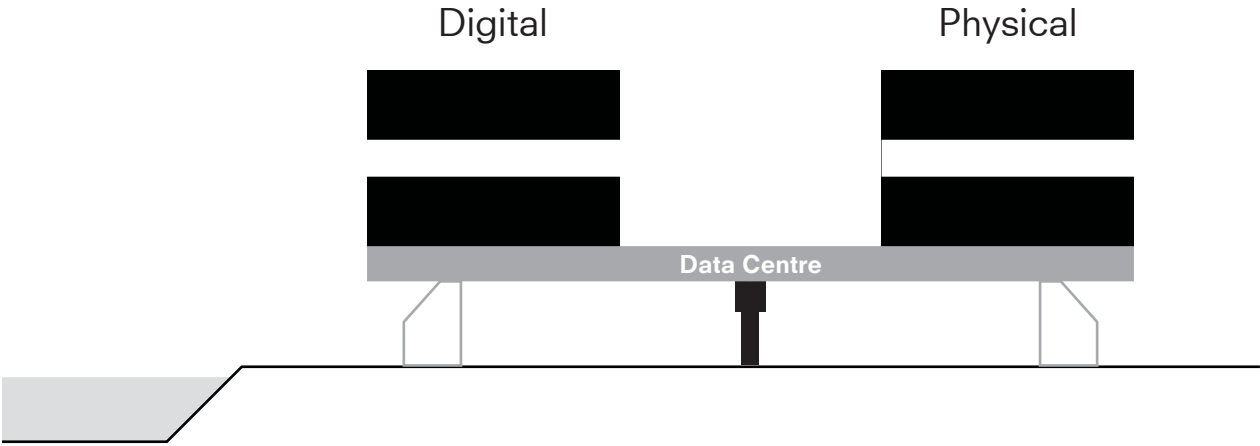


A refuge from the city's pace,  
A place for all to be, to explore.









Introduction

Research

Design Brief

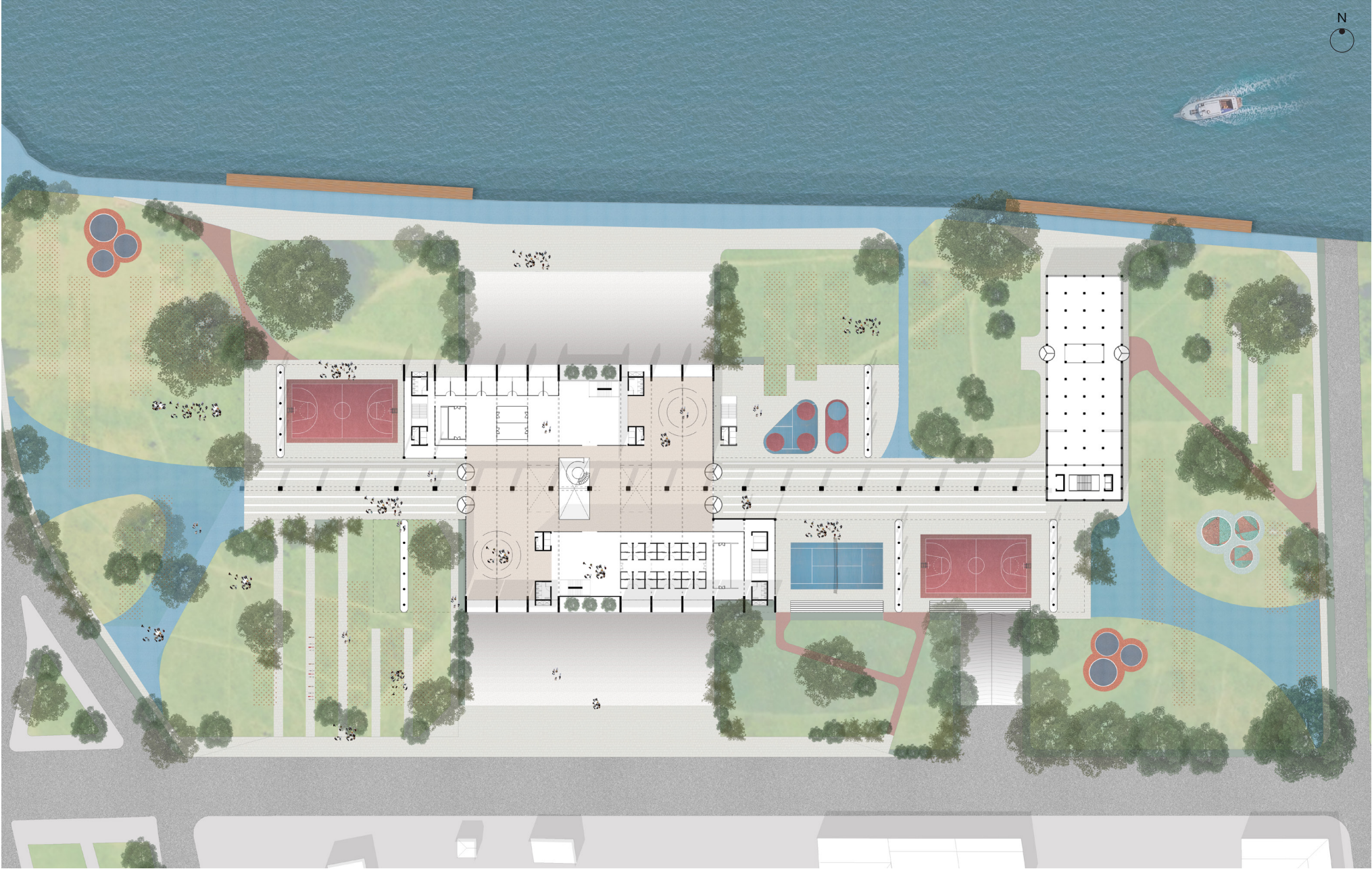
Approach

**Implementation**

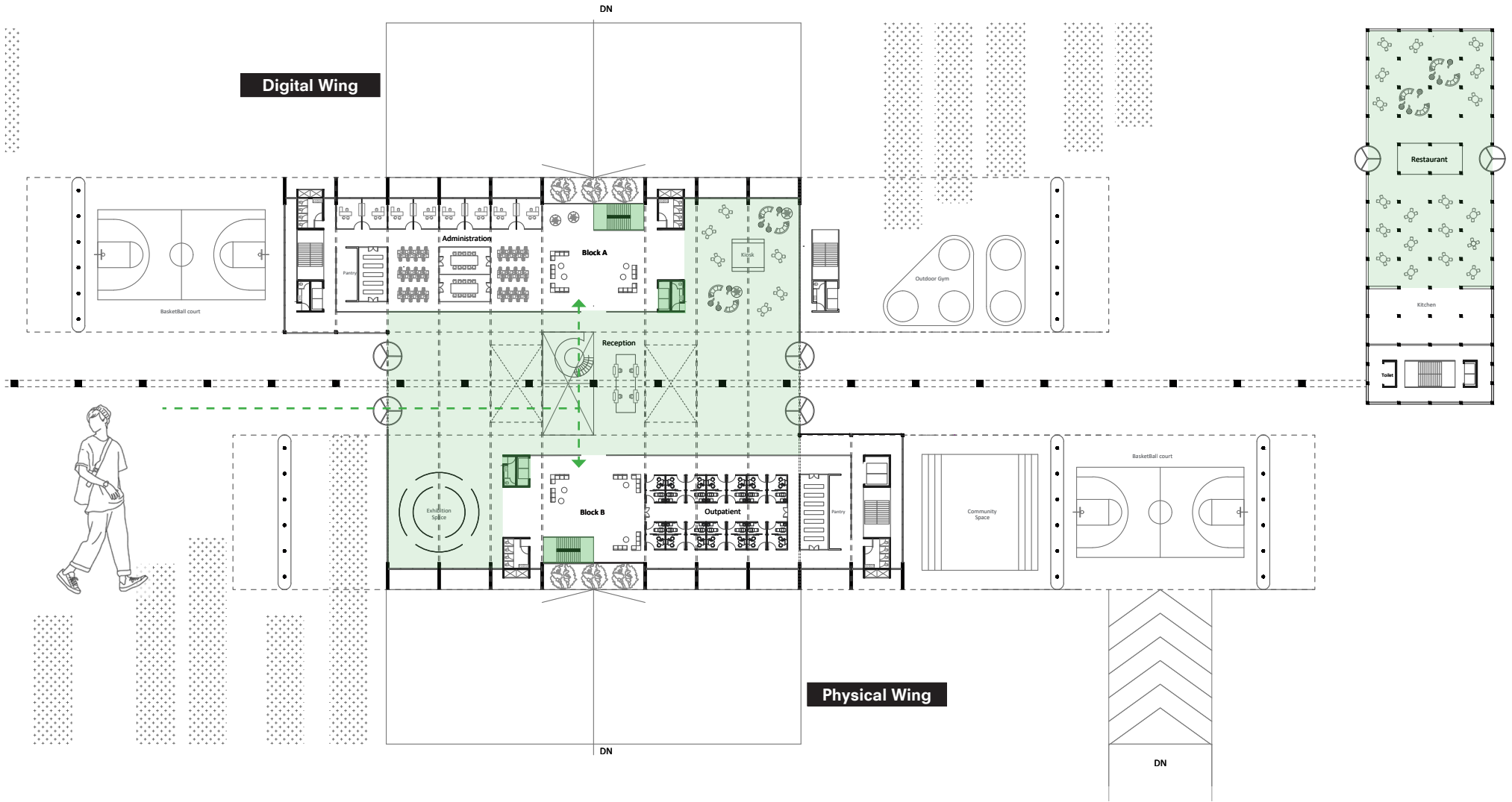
Development

Conclusion





# L 0

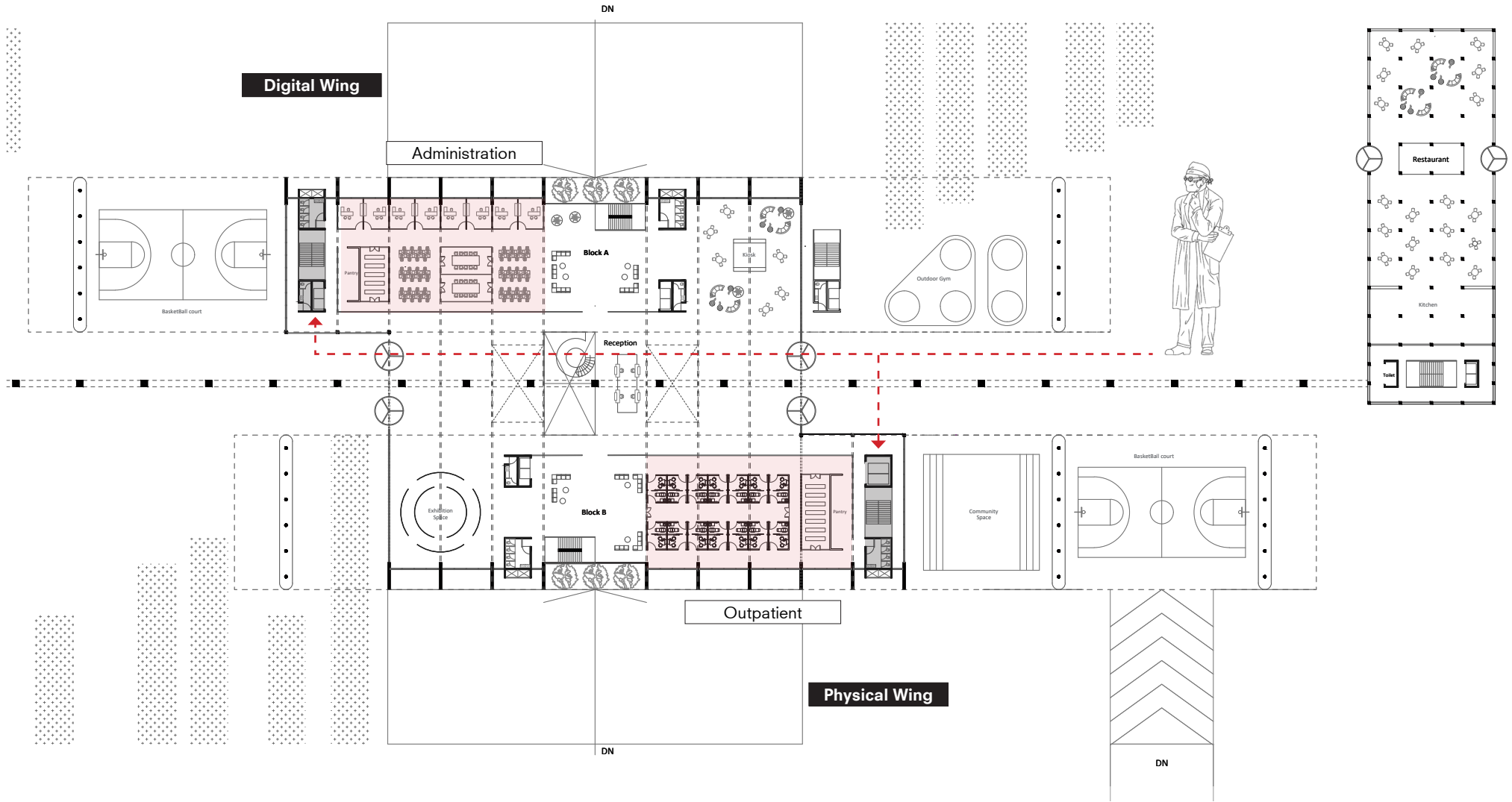


# L 0

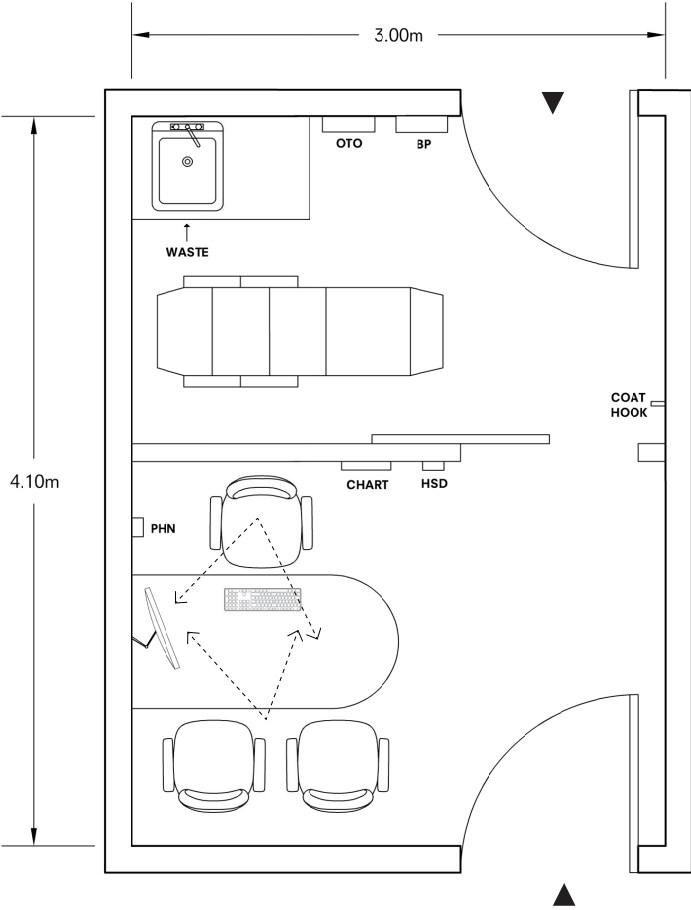


Entrance Lobby

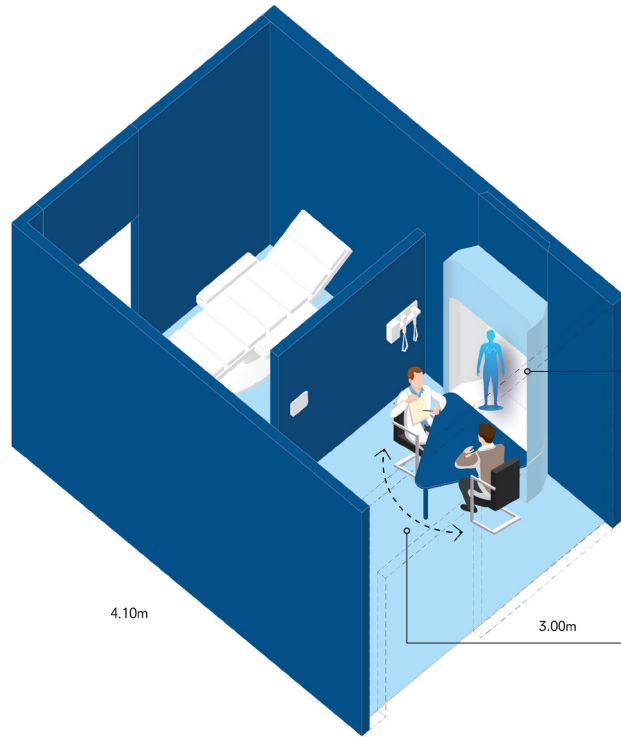
# L 0







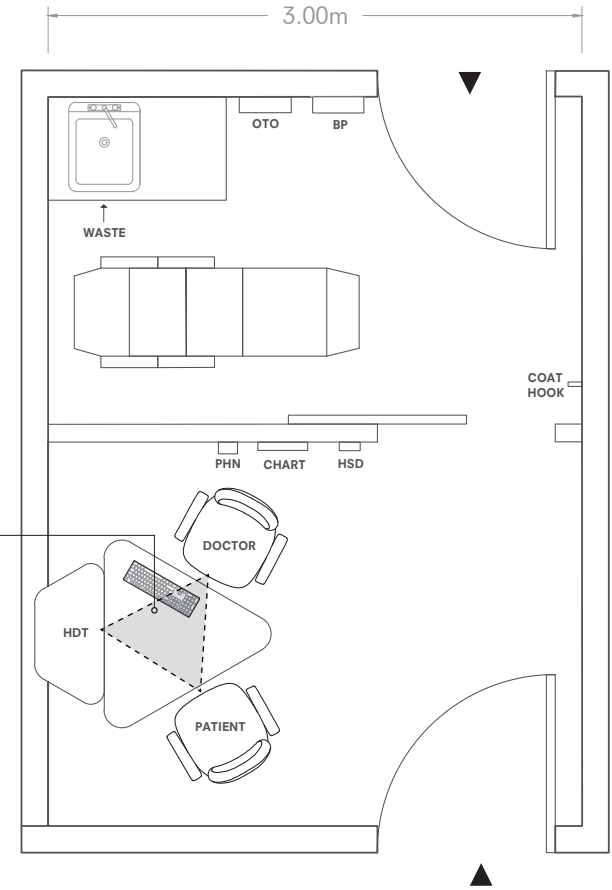
Examination Room



Human Digital Twin

A NEW TRIAD

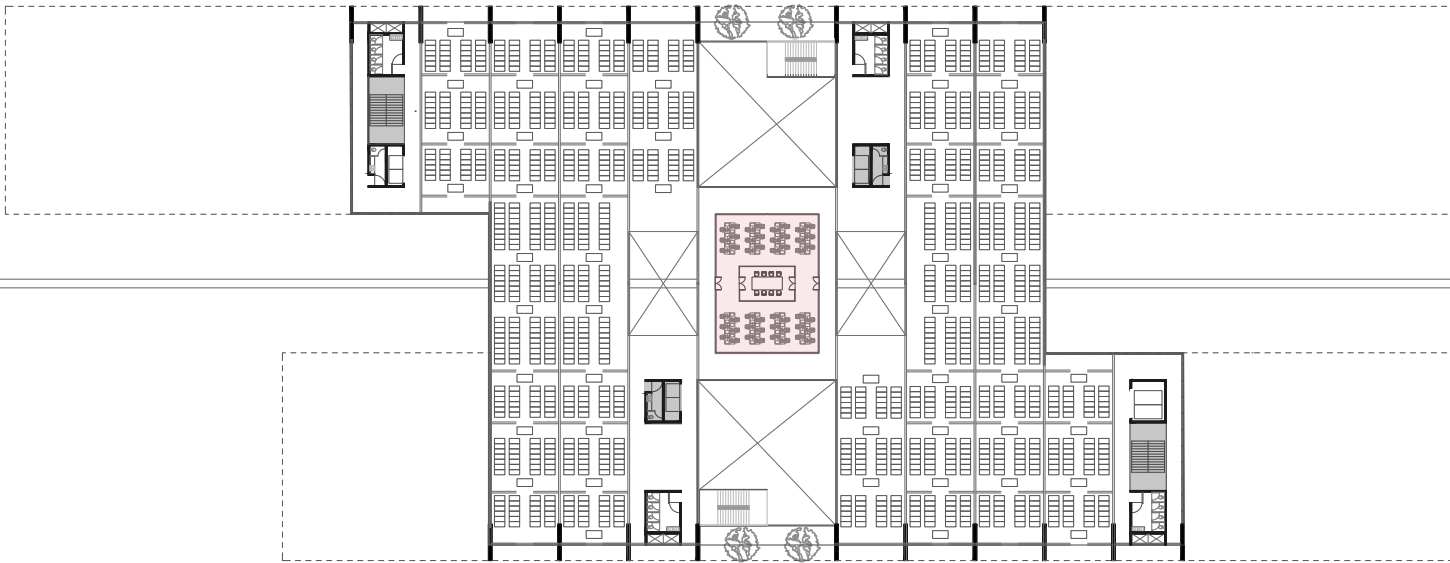
Seating arrangement enhances the human connection



Examination Room

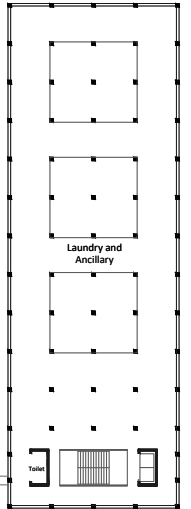
# L 0.5

**Digital Wing**



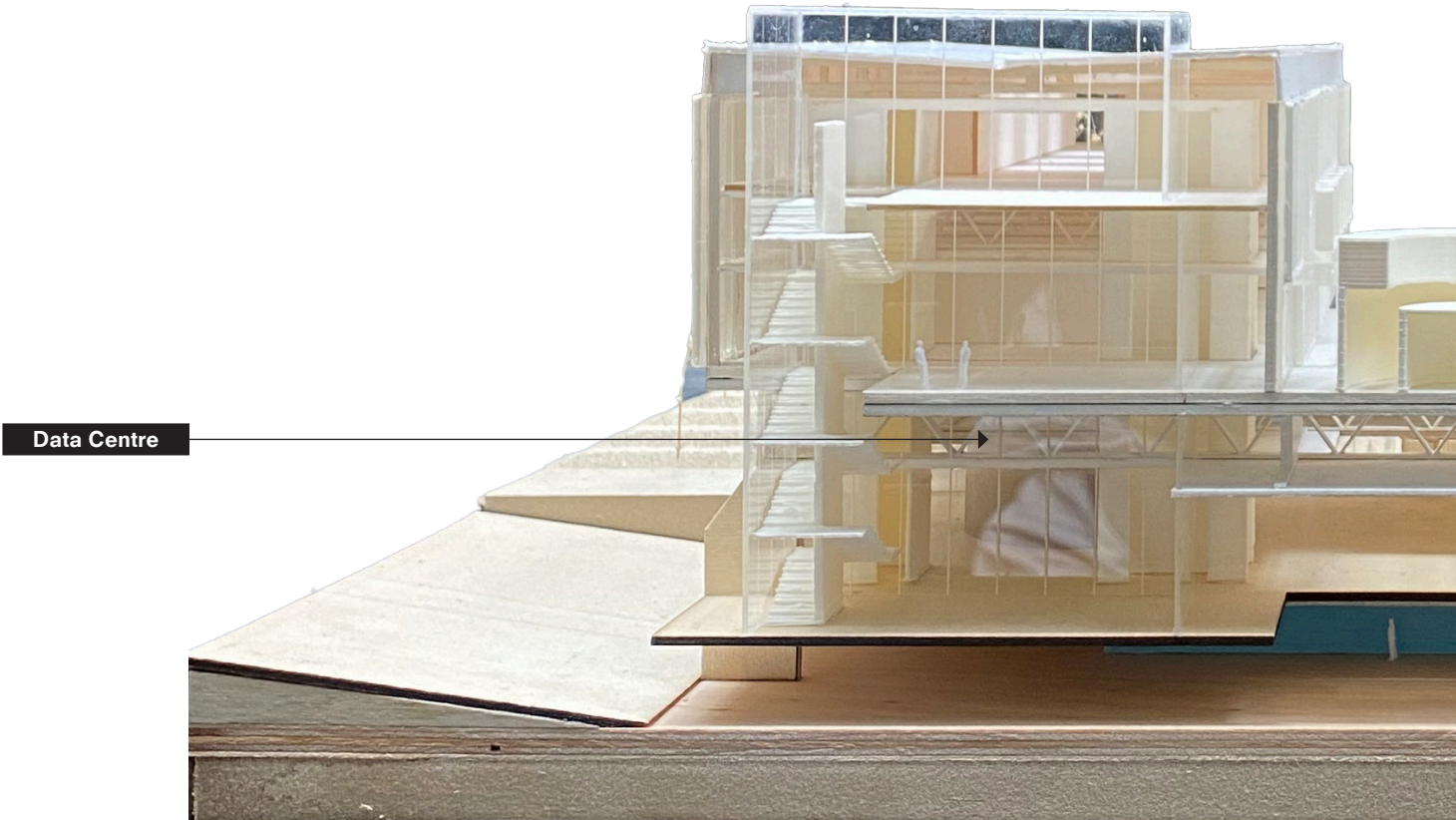
Data Centre

**Physical Wing**

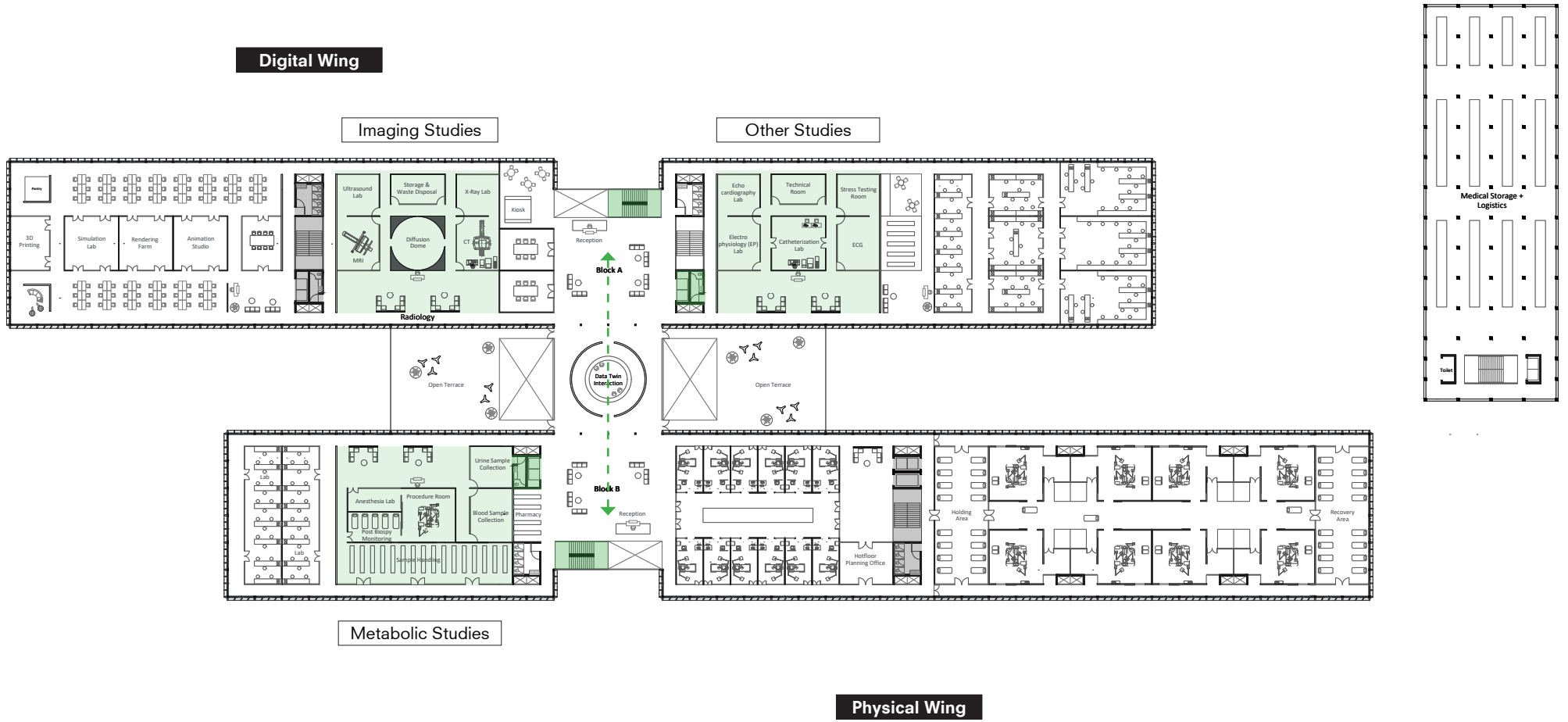


Laundry and Ancillary





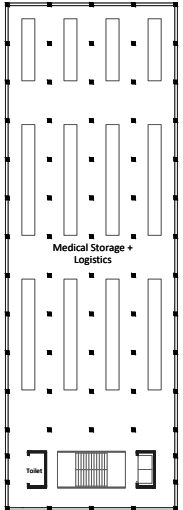
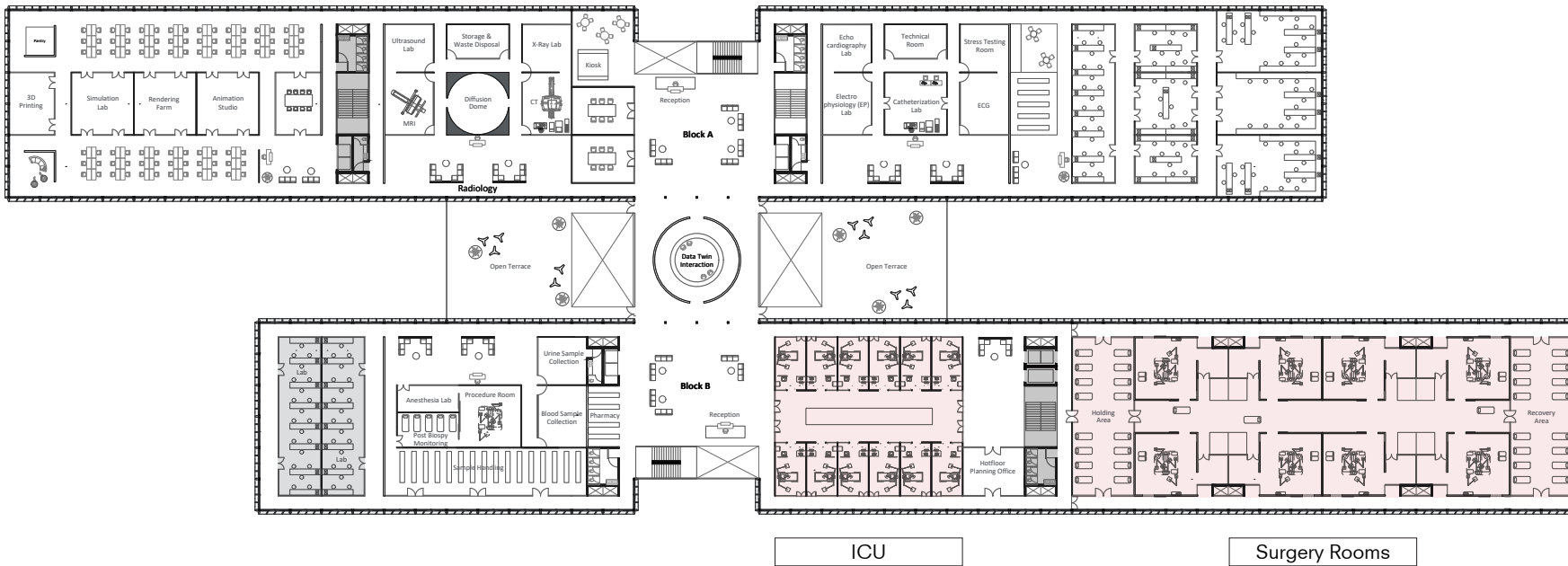
# L 1





# L 1

## Digital Wing



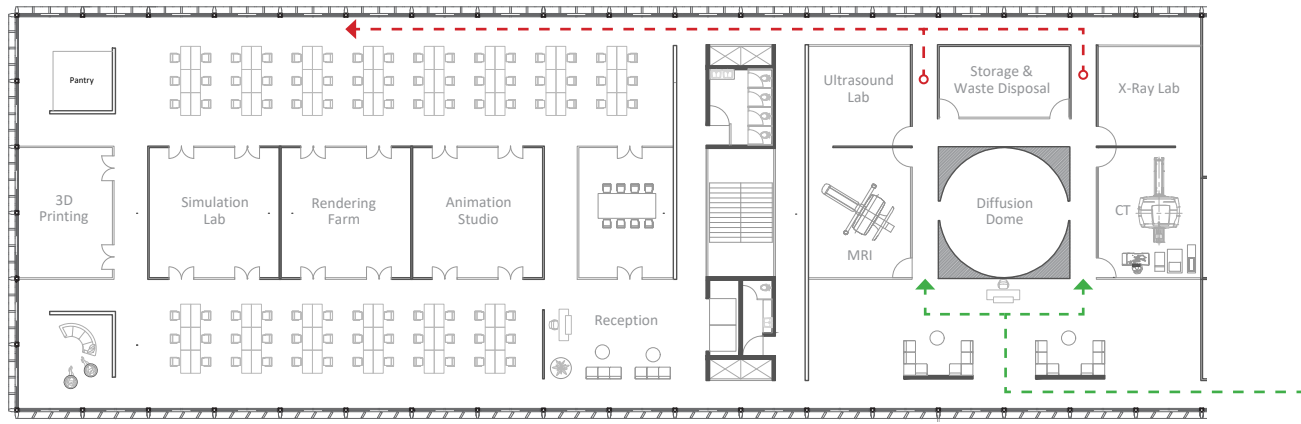
## Physical Wing





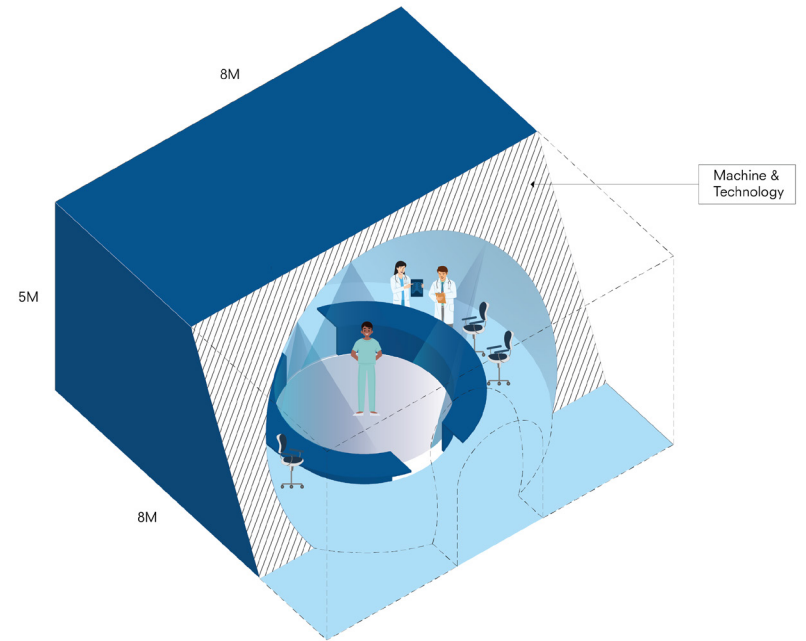
Entrance Lobby



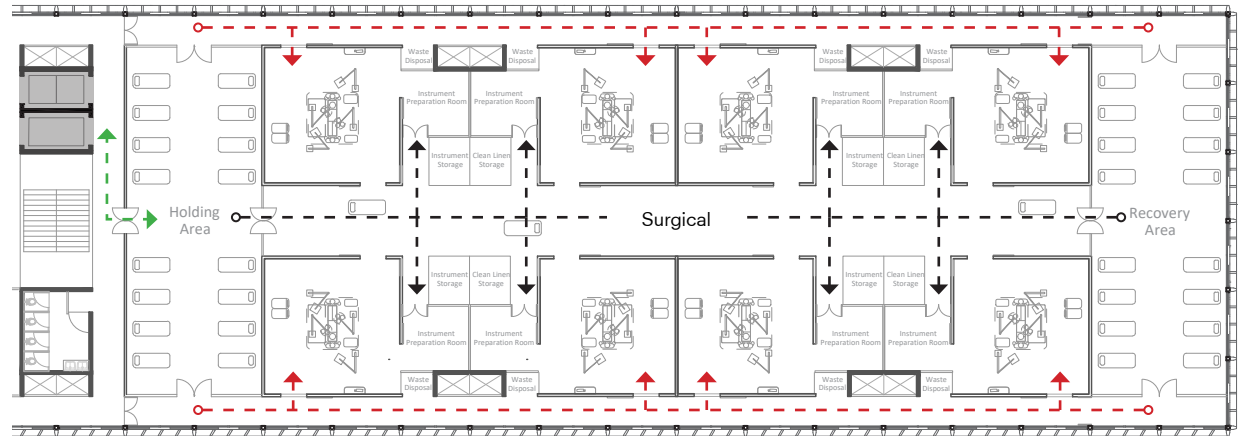


3D Modelling Lab

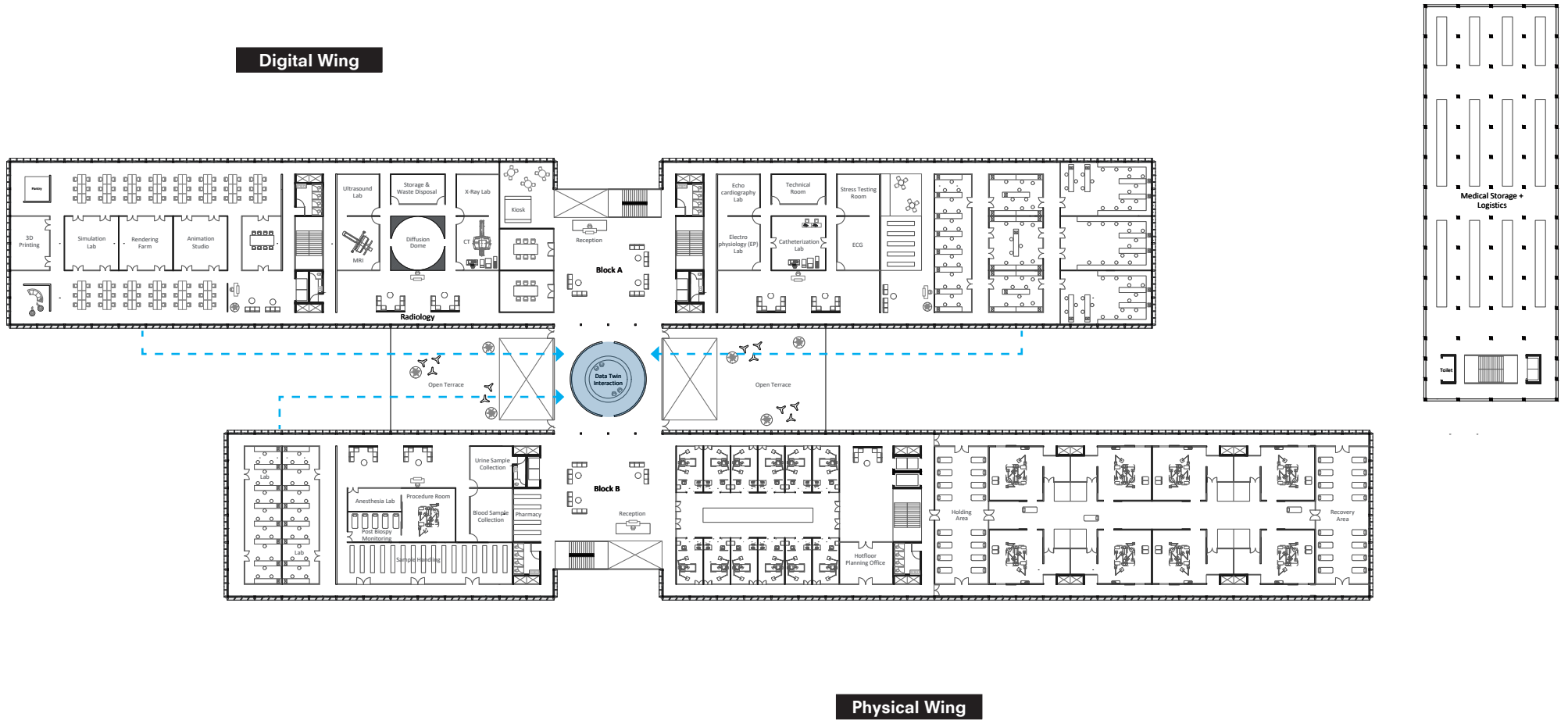
Radiology

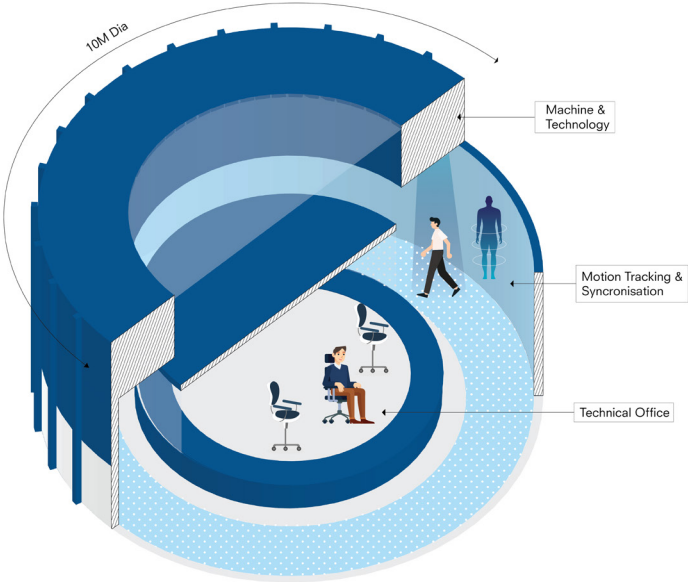


Diffusion Dome

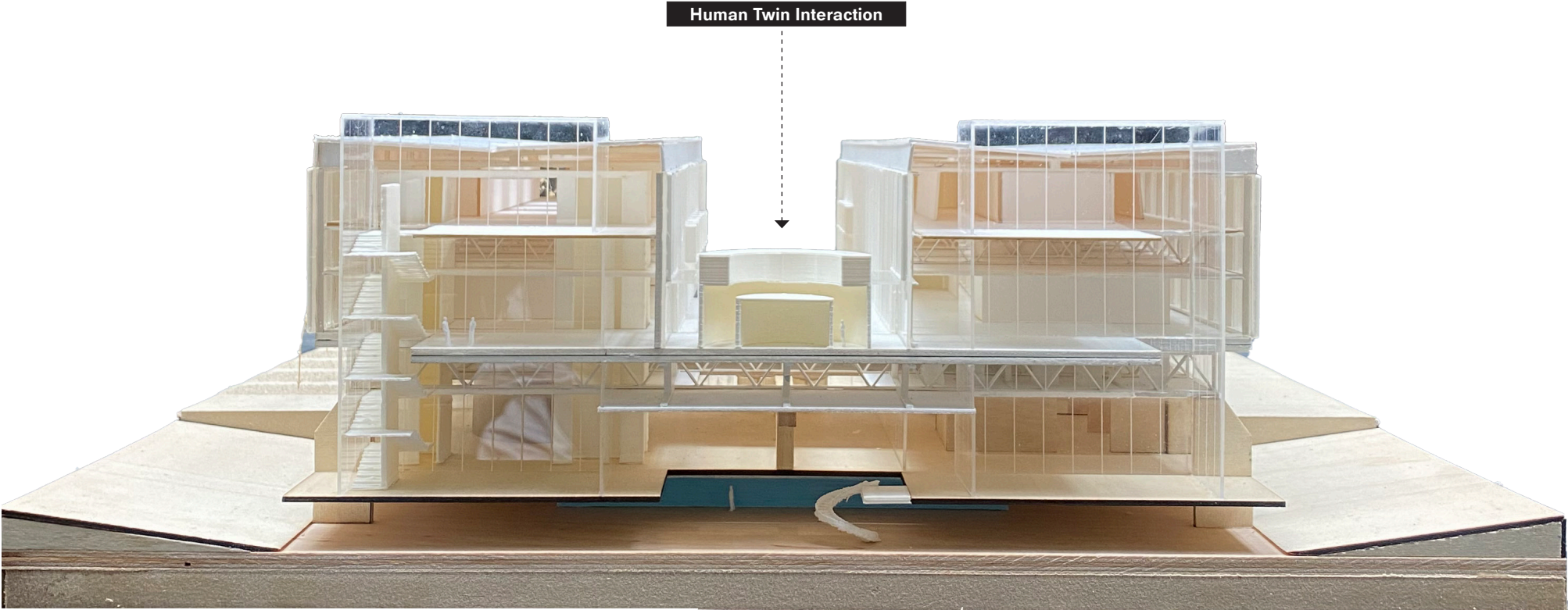


# L 1





Human - Twin Interaction



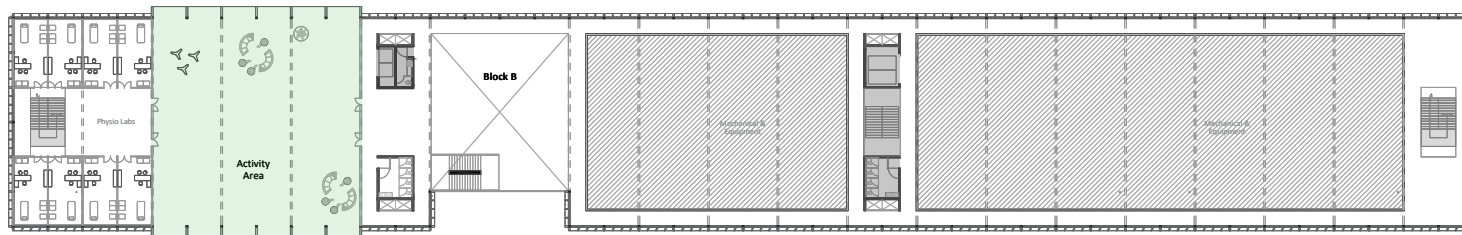
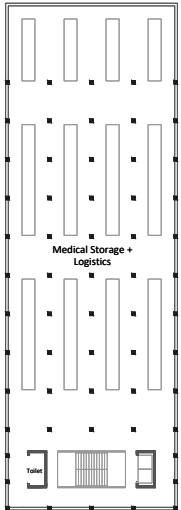
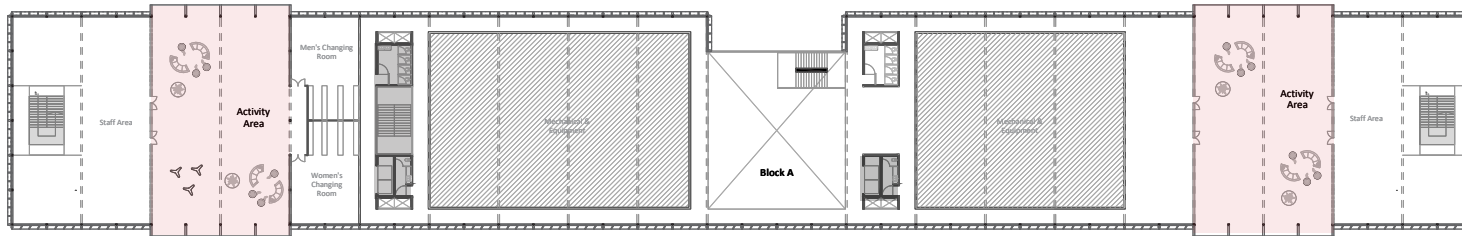
Cross Section



Human -Twin Interaction

# L 1.5

## Digital Wing

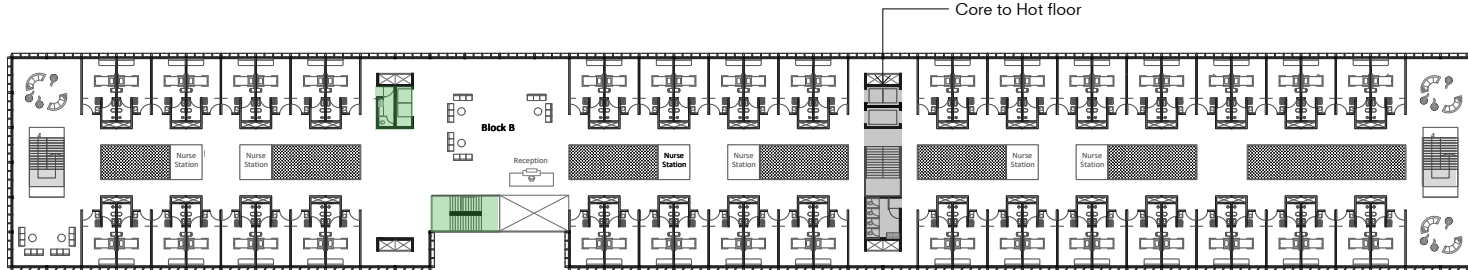
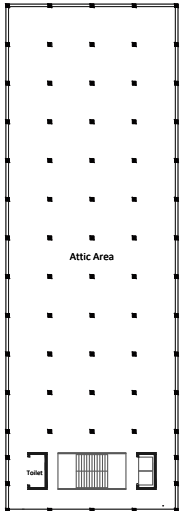
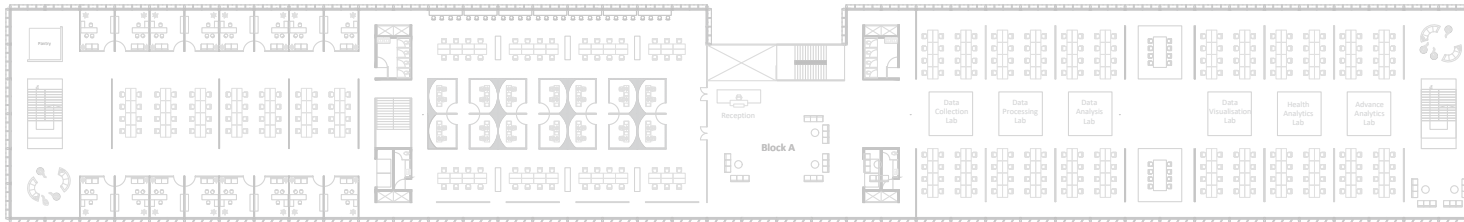


## Physical Wing



# L 2

## Digital Wing



## Patient Ward

## Physical Wing

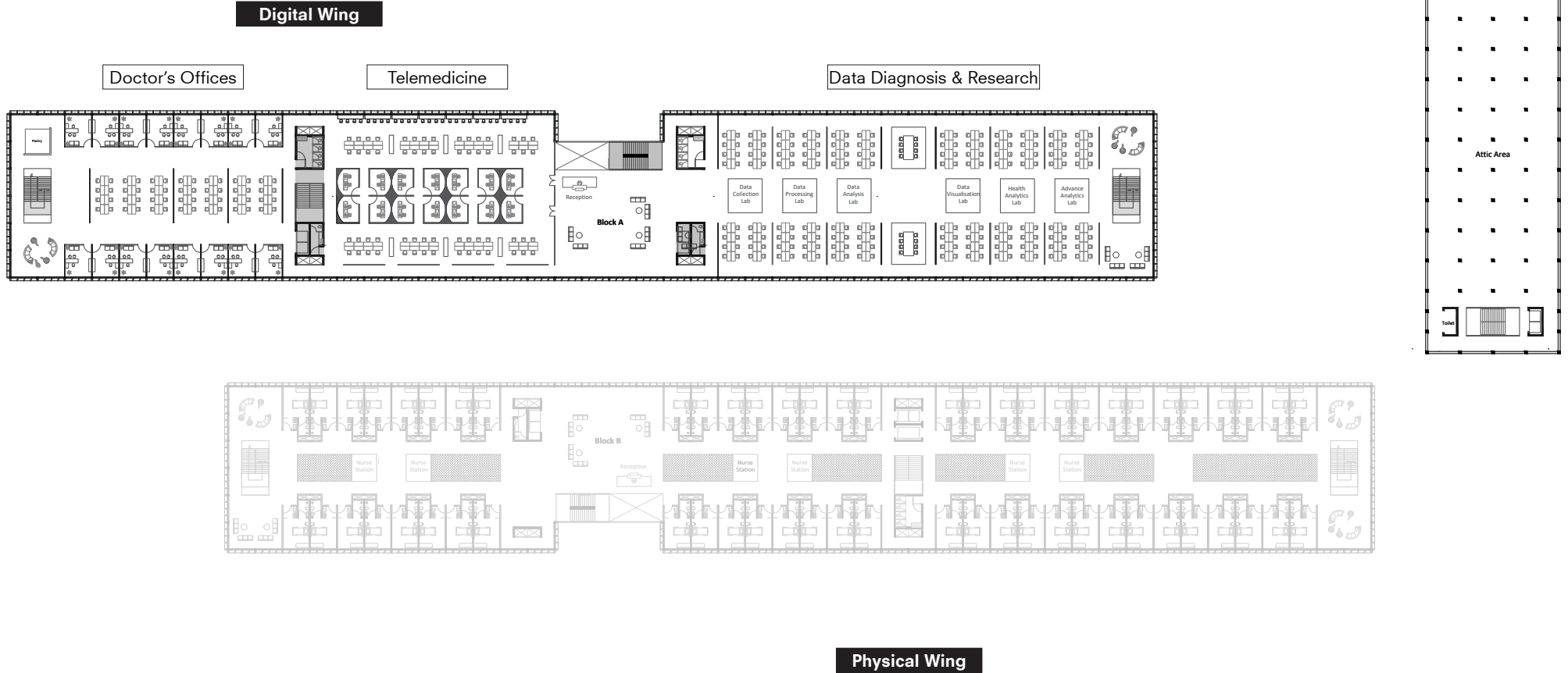


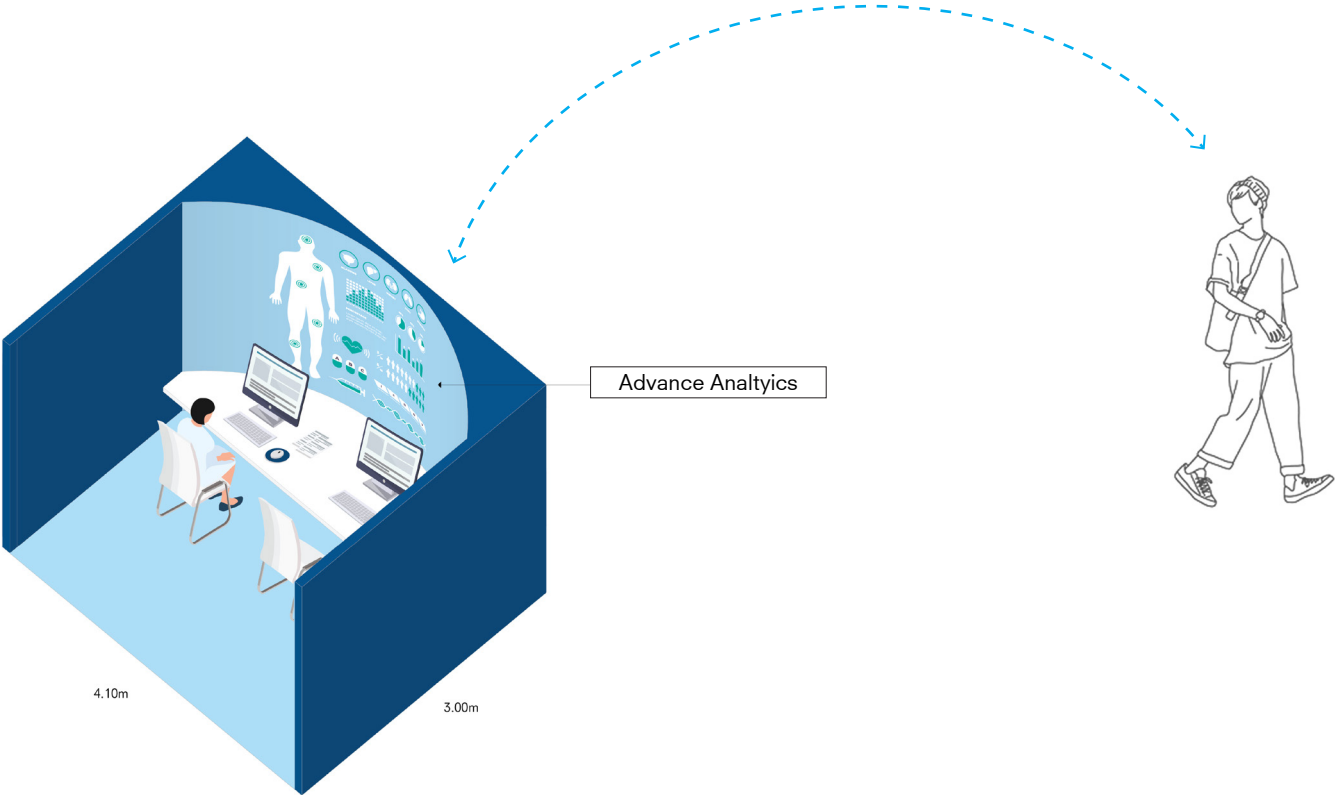




Patient Ward

# L 2



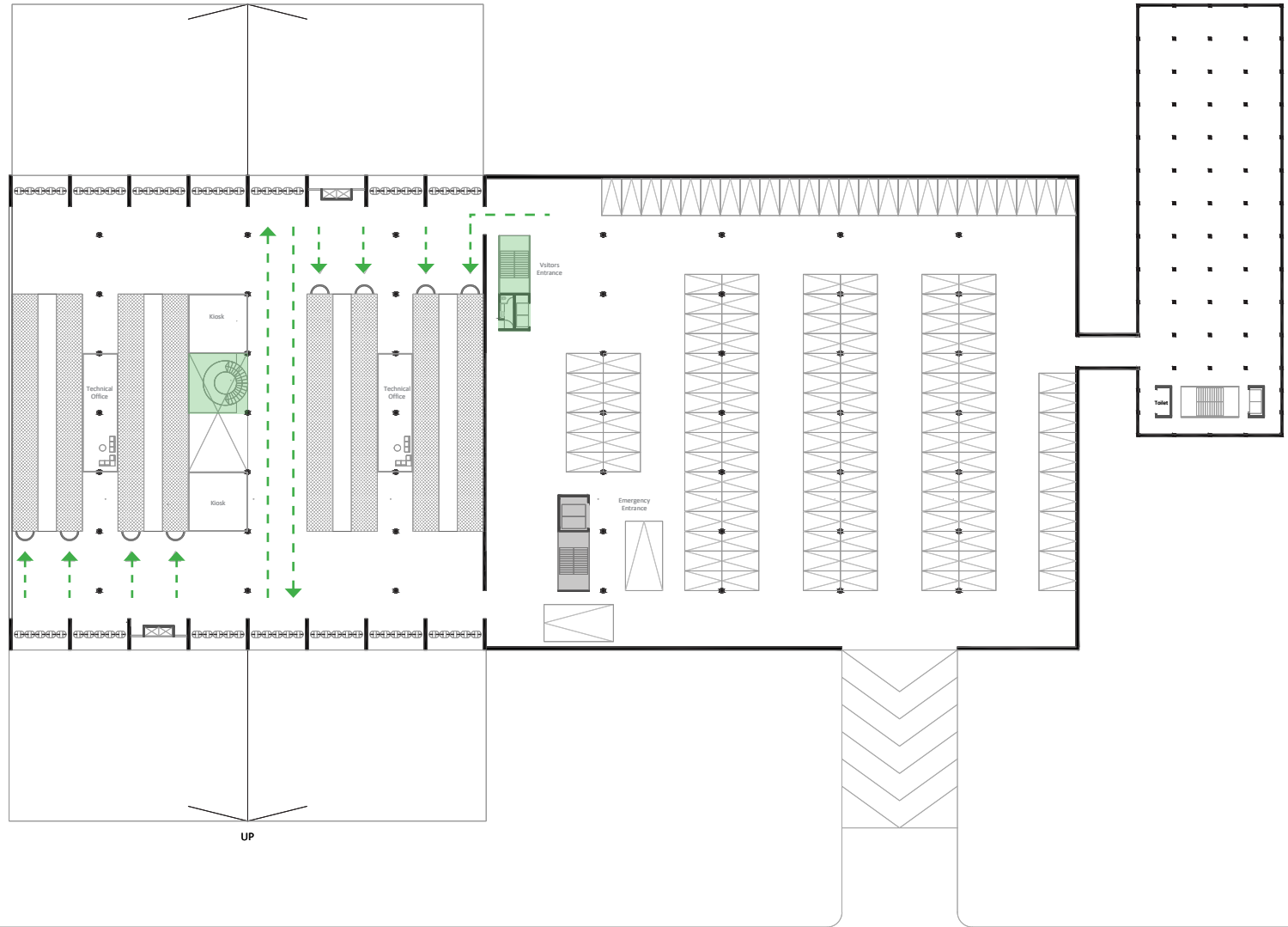


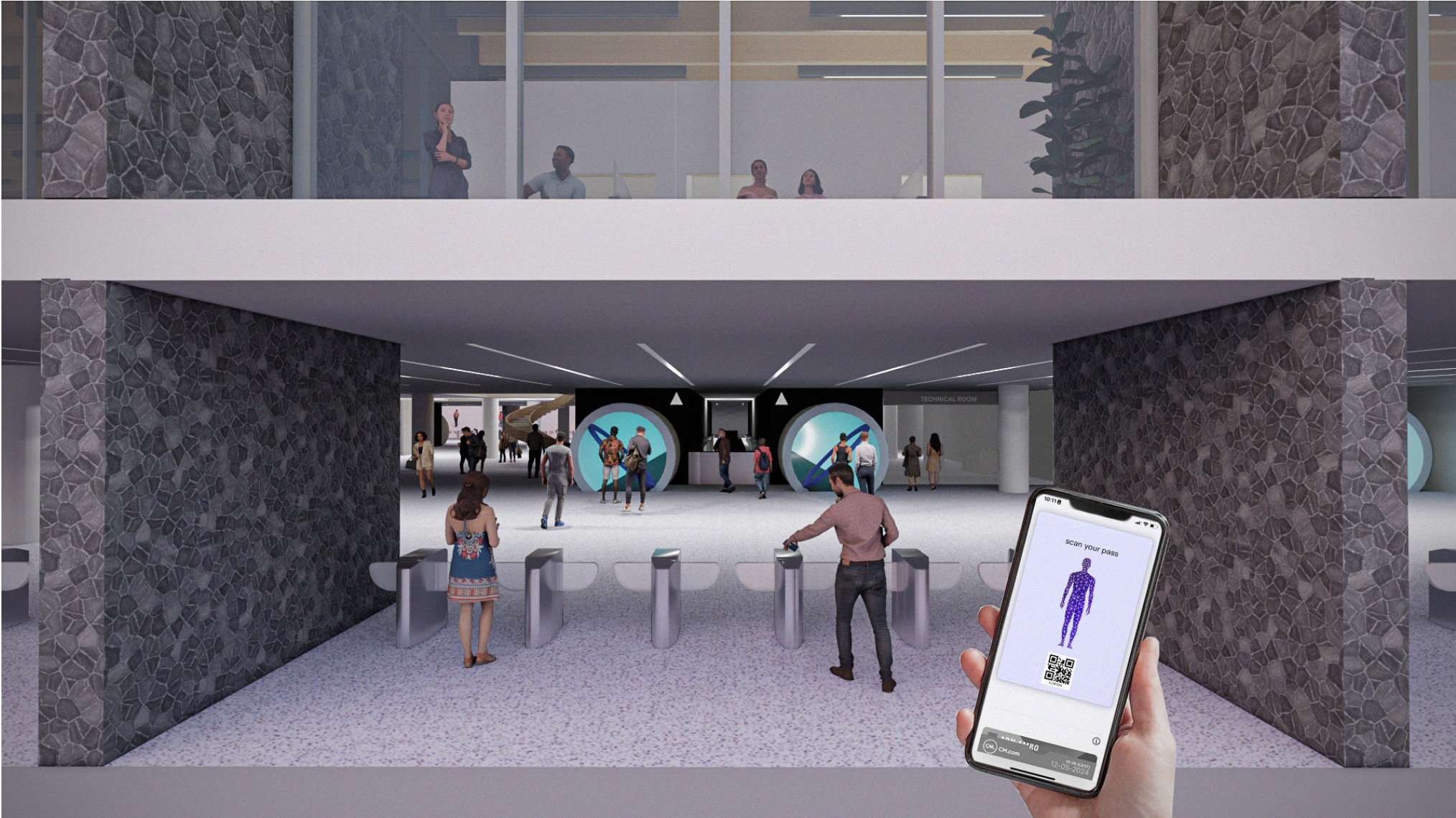


Data Diagnosis Labs

# L -0.5

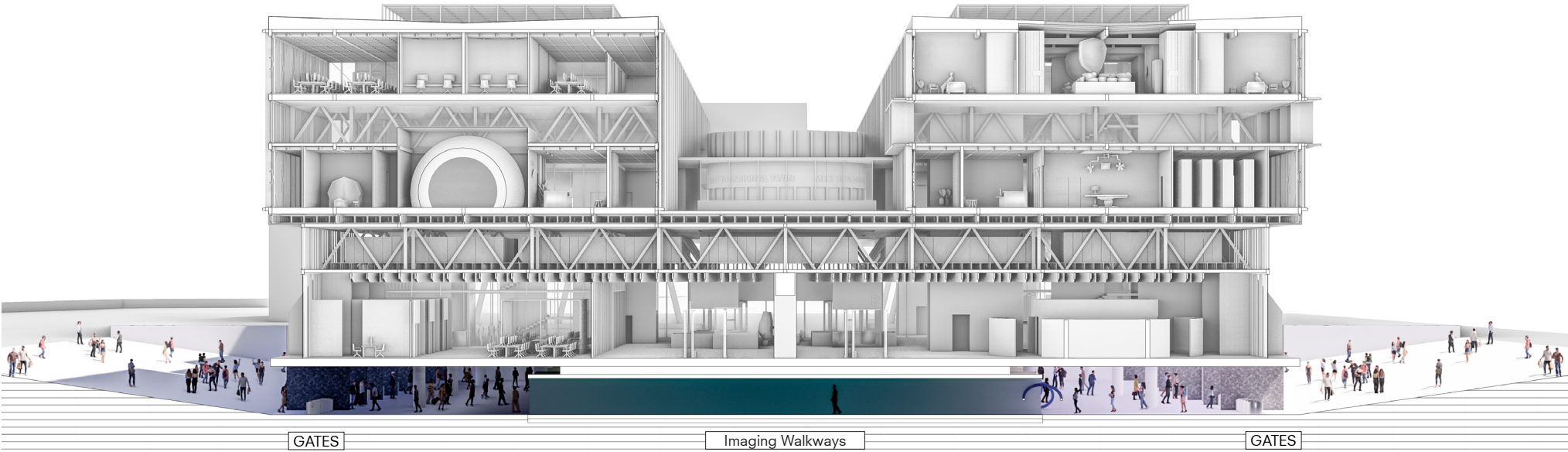
Imaging Walkways

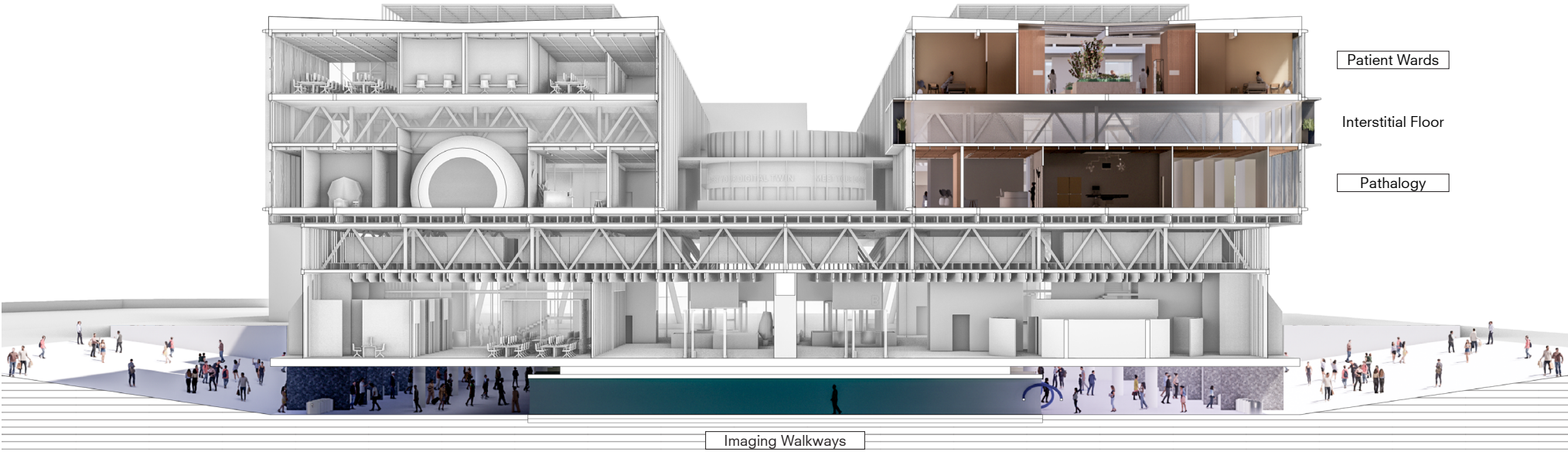




Imaging Walkways

# Key Space





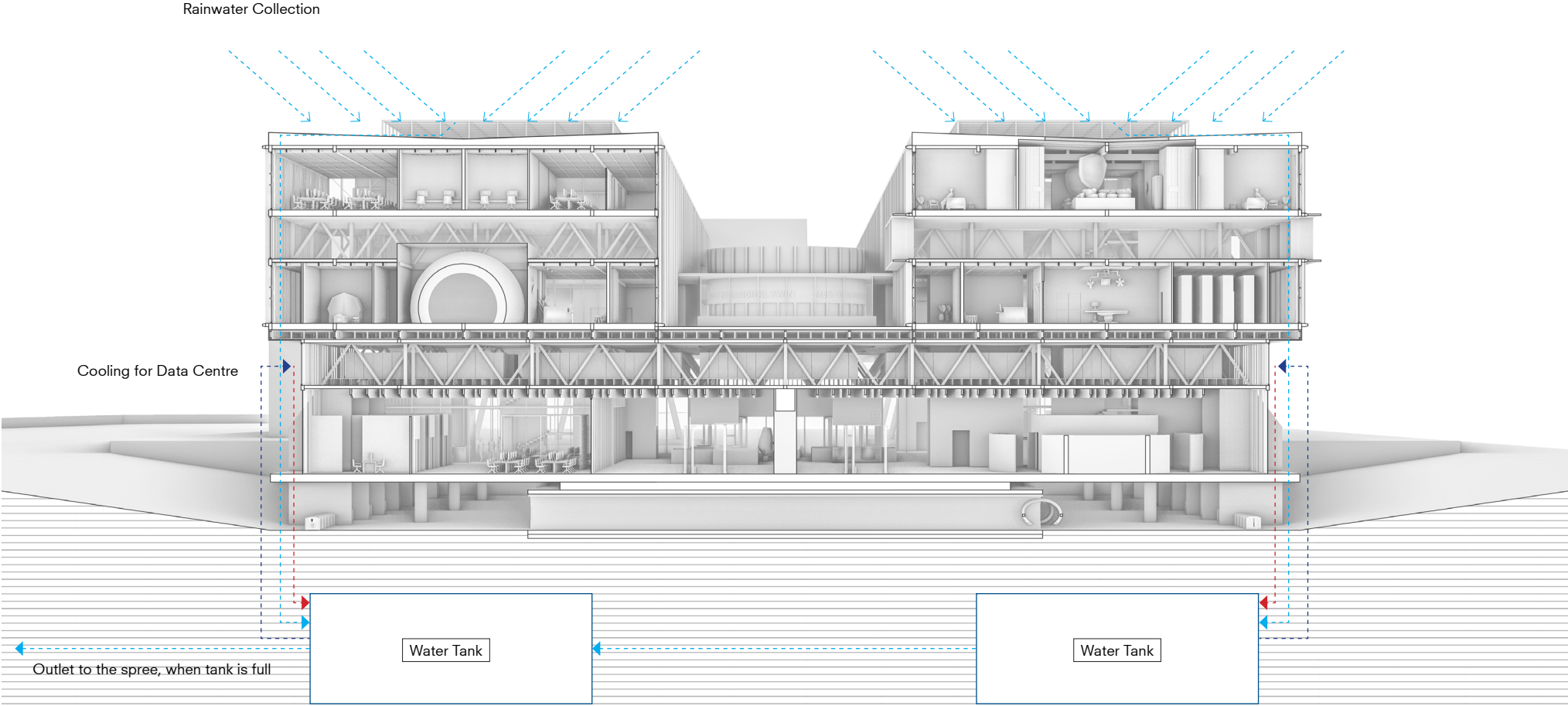






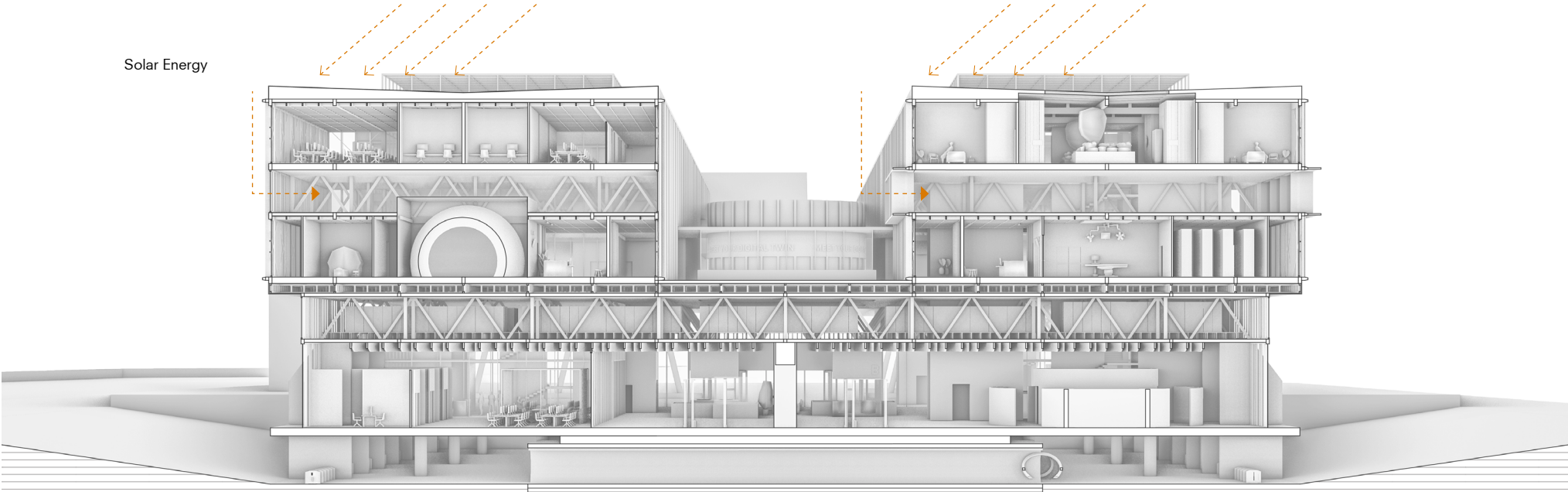


# Climate Strategy



# Climate Strategy

Solar Energy



Introduction

Research

Design Brief

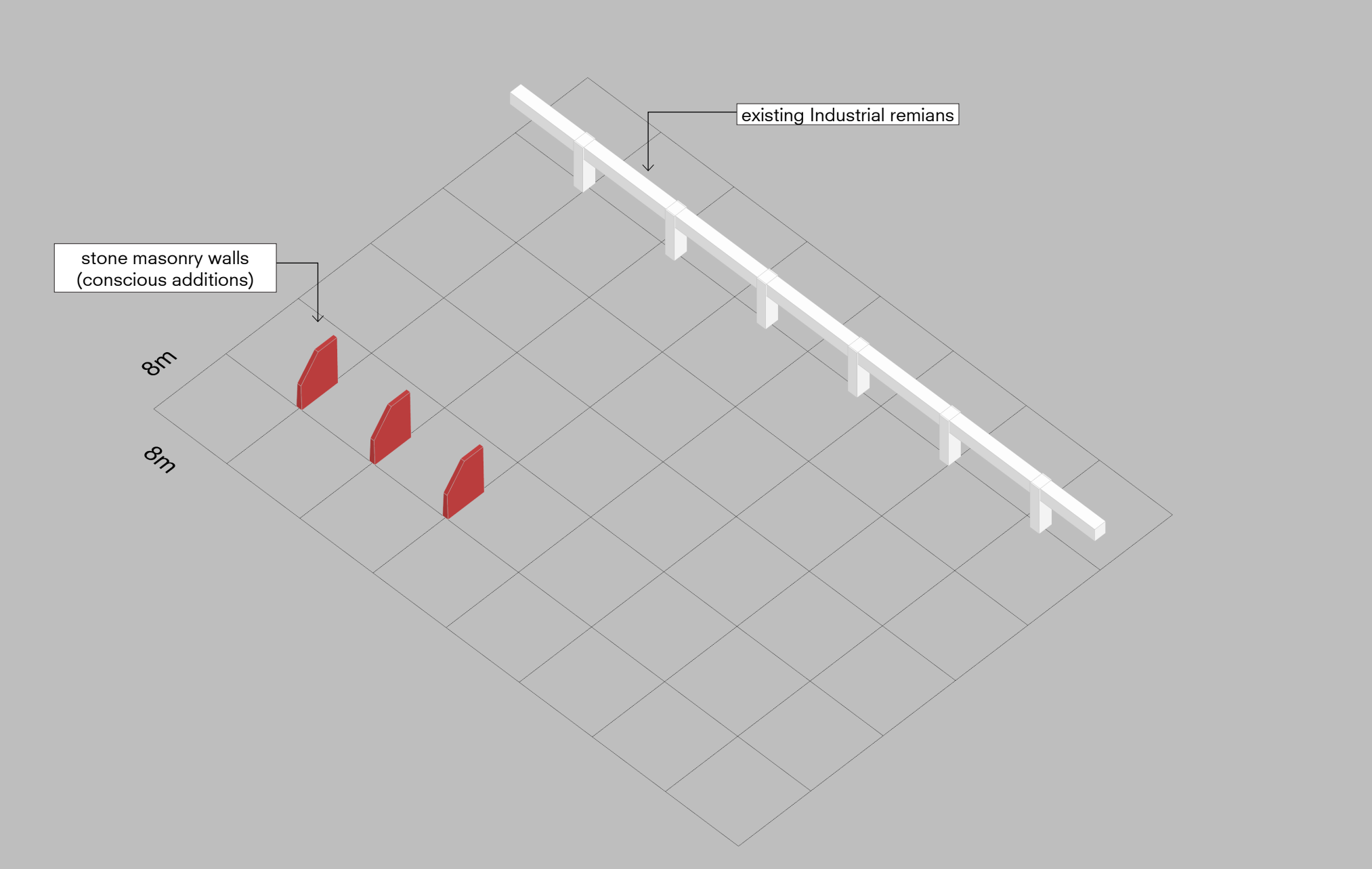
Concept

Implementation

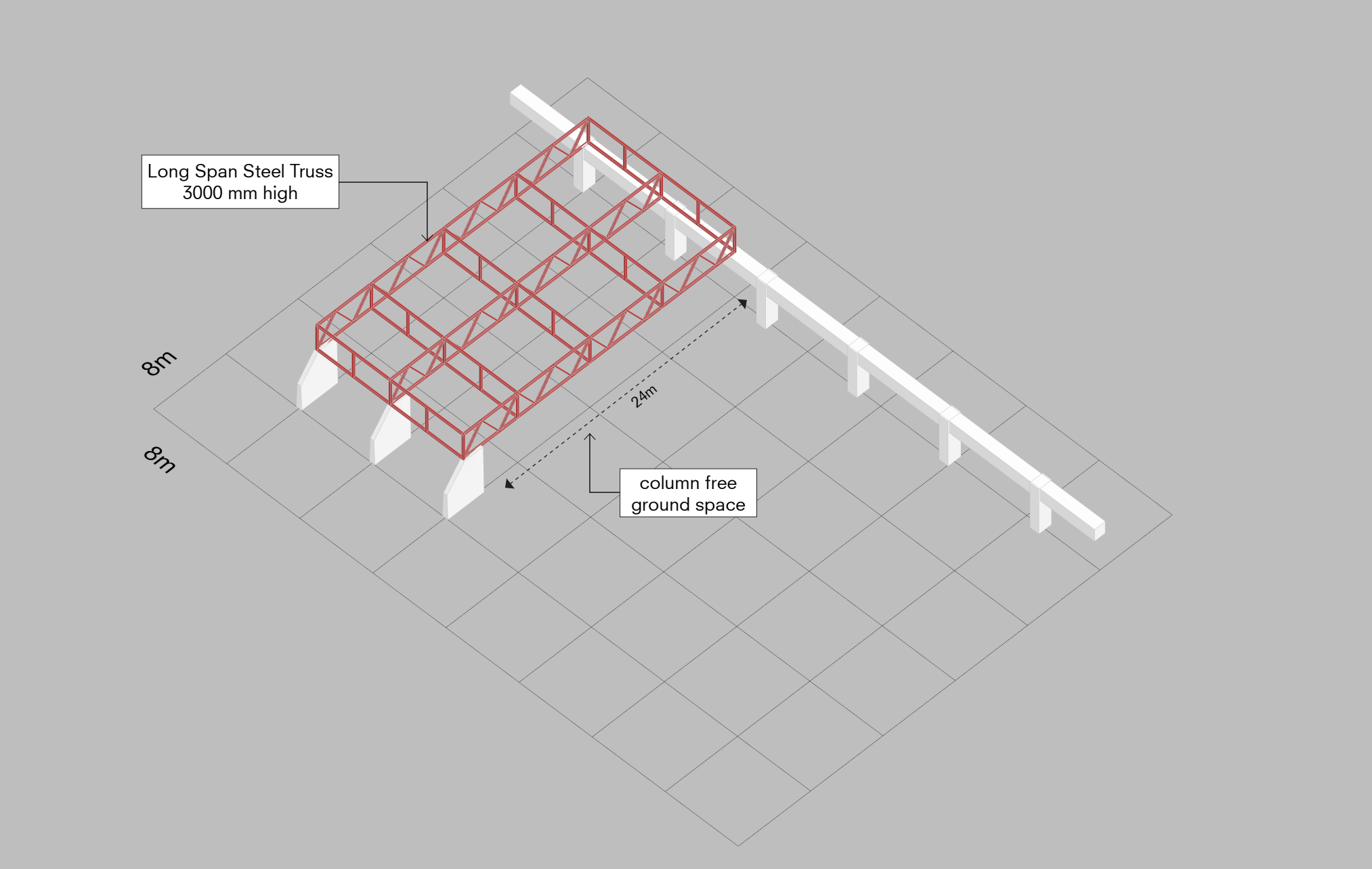
**Development**

Reflection

# Structure

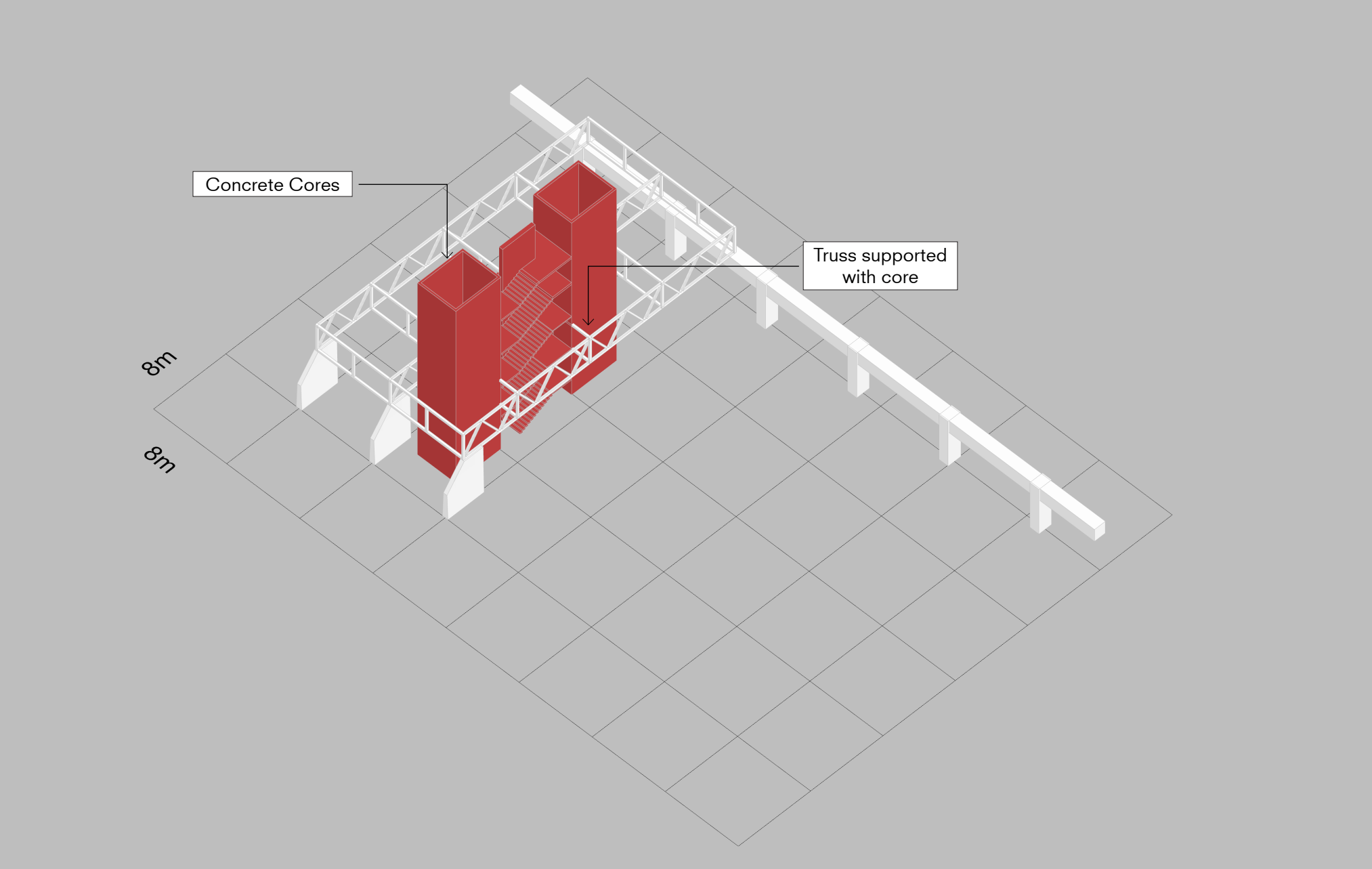


# Structure

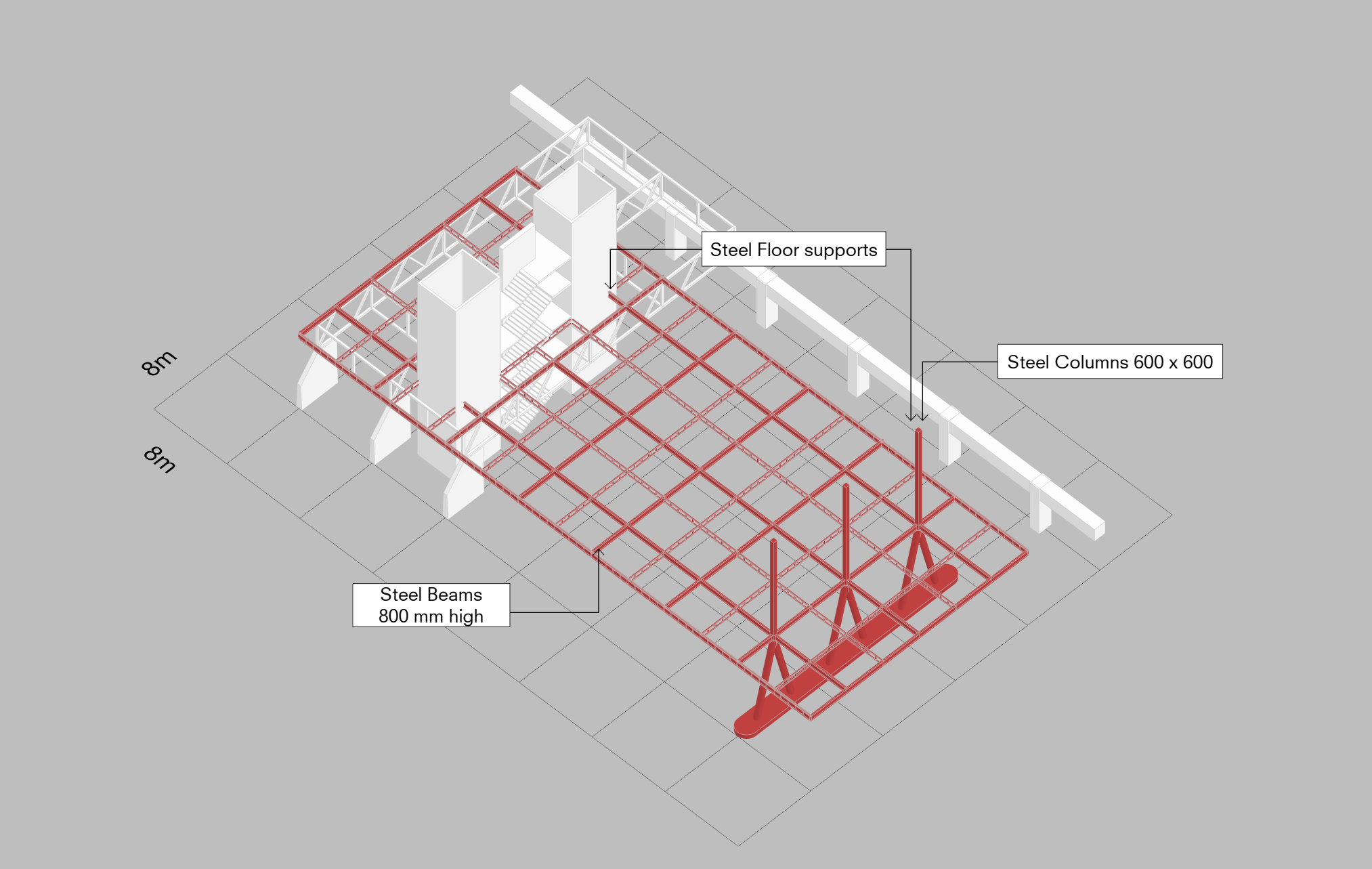




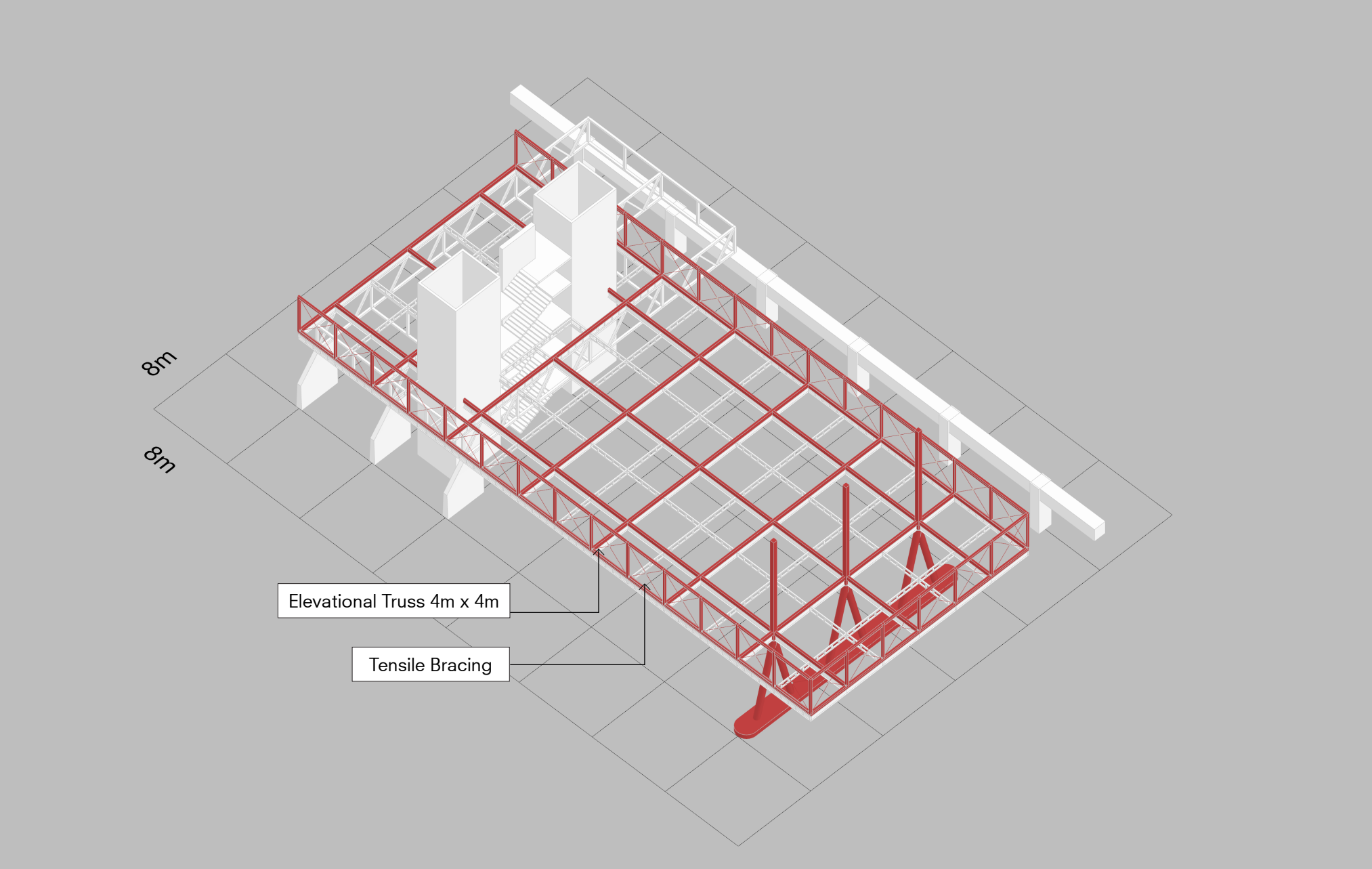
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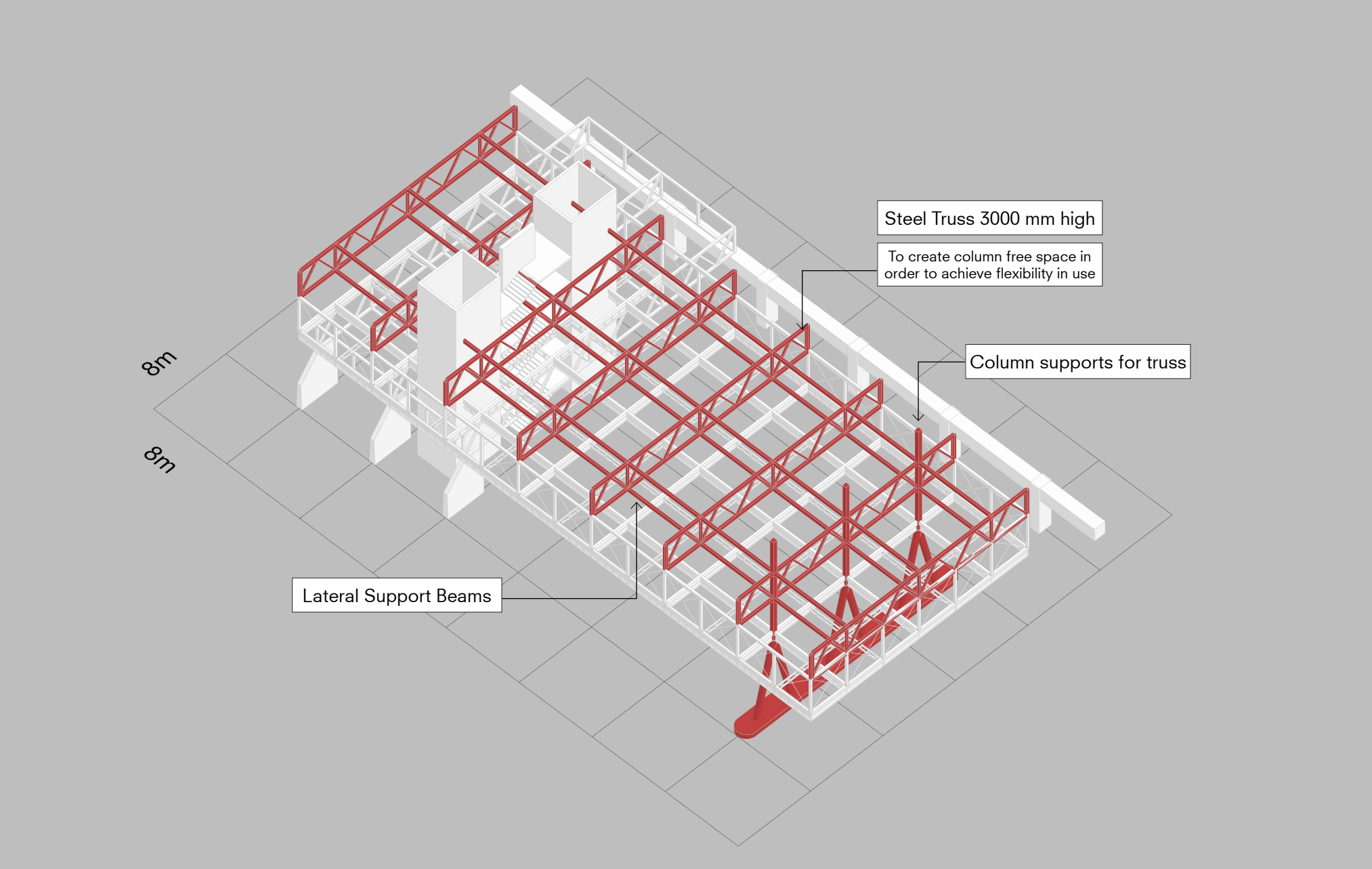
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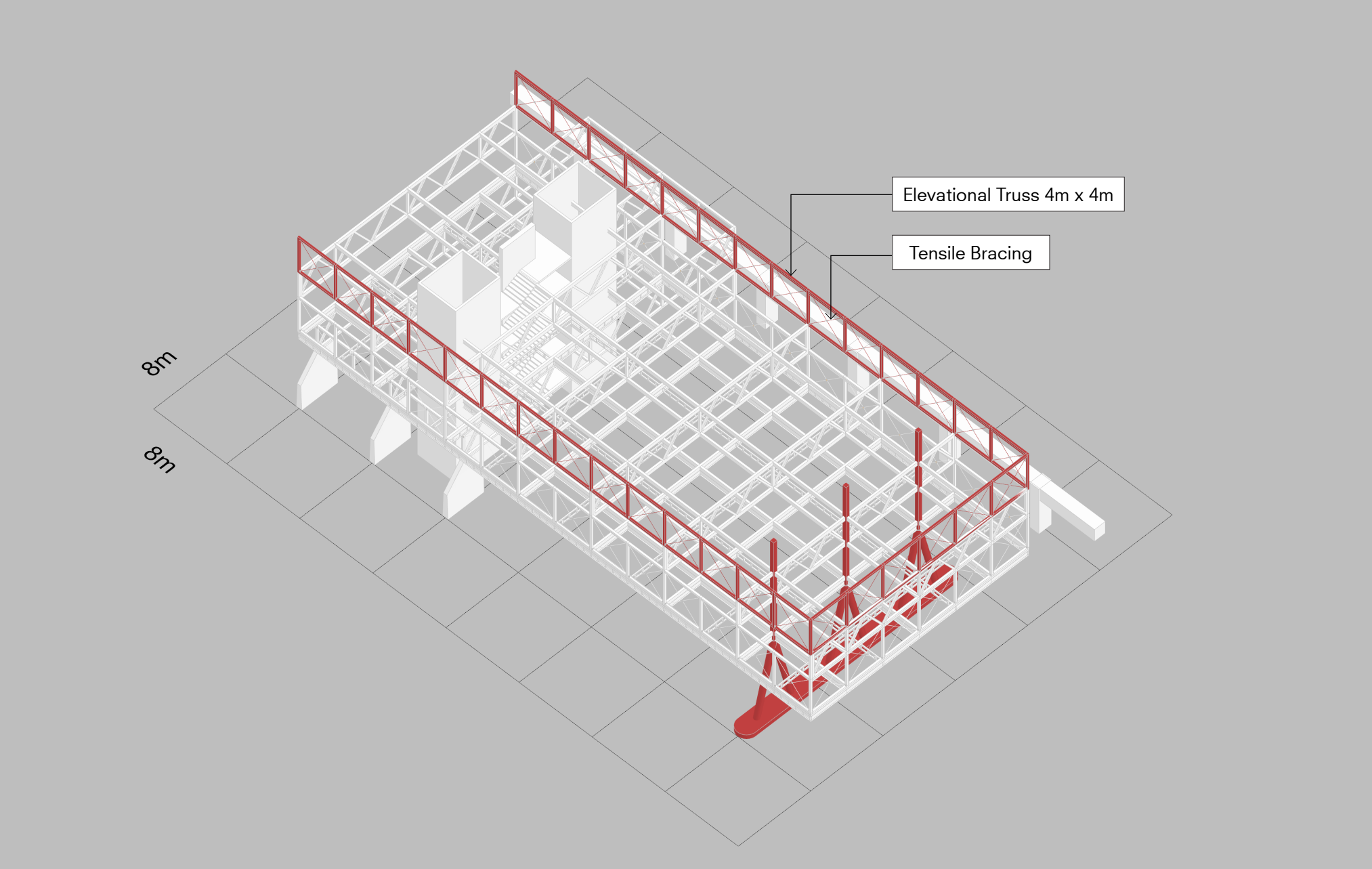
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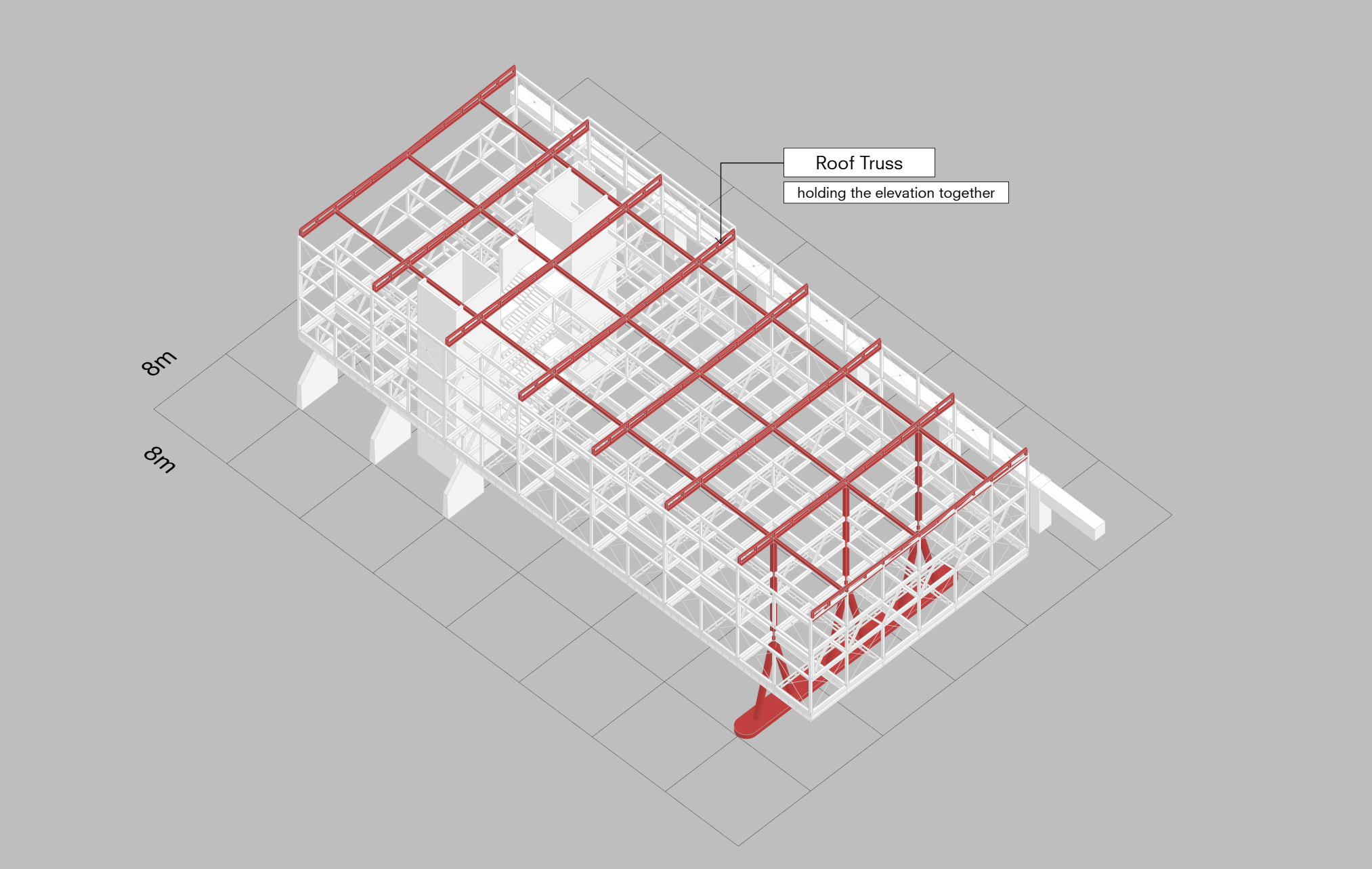
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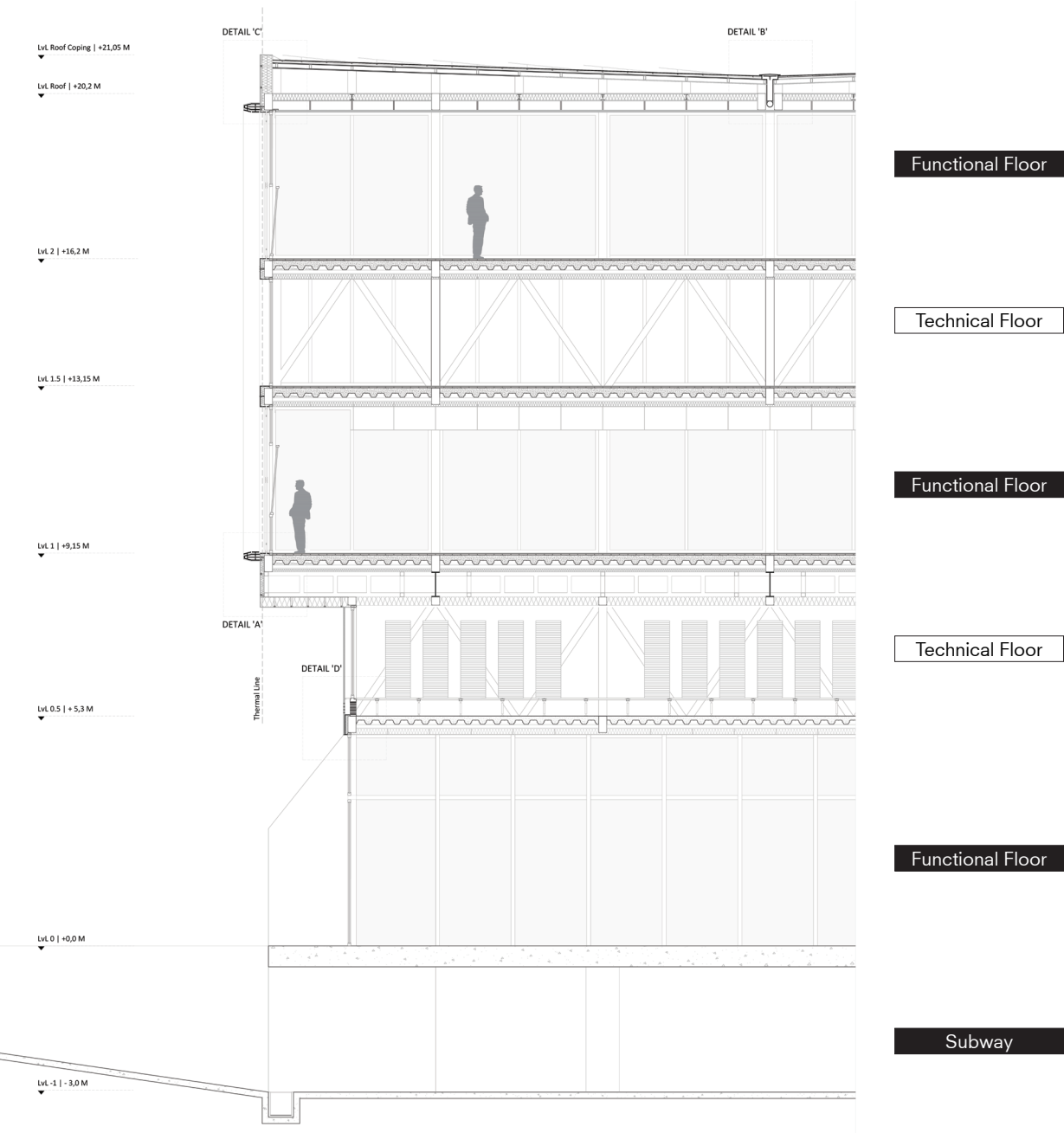
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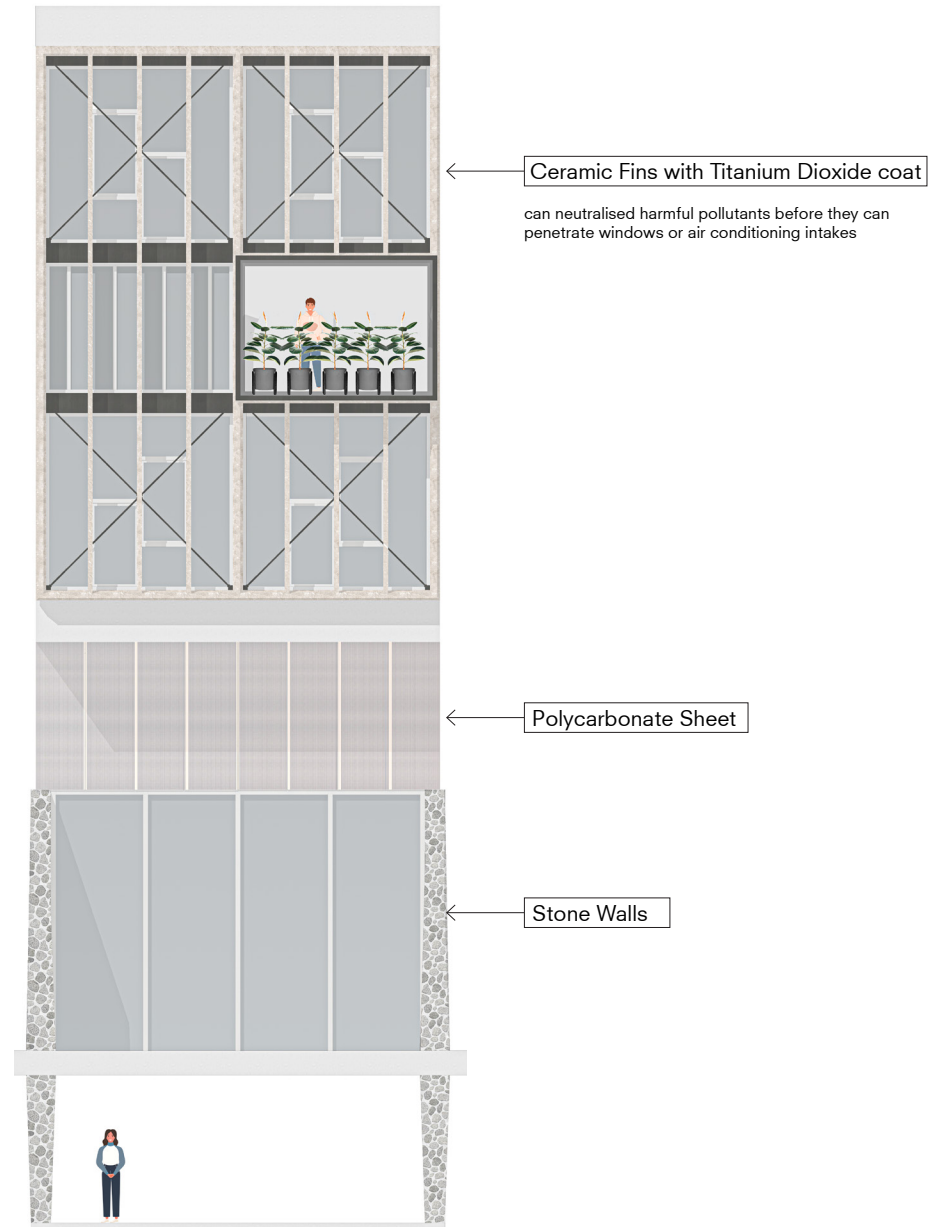
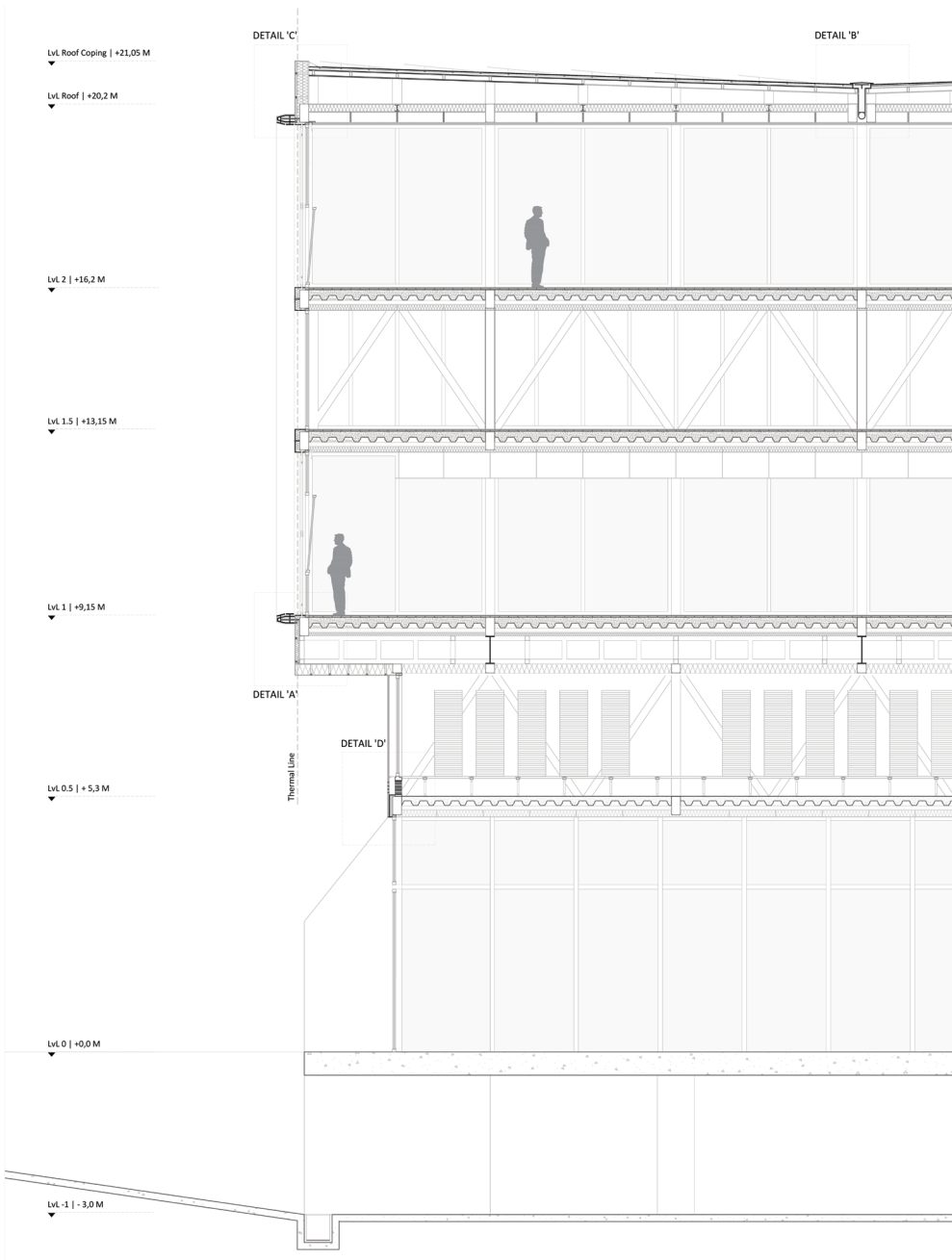
# Structure



# Building Fragment

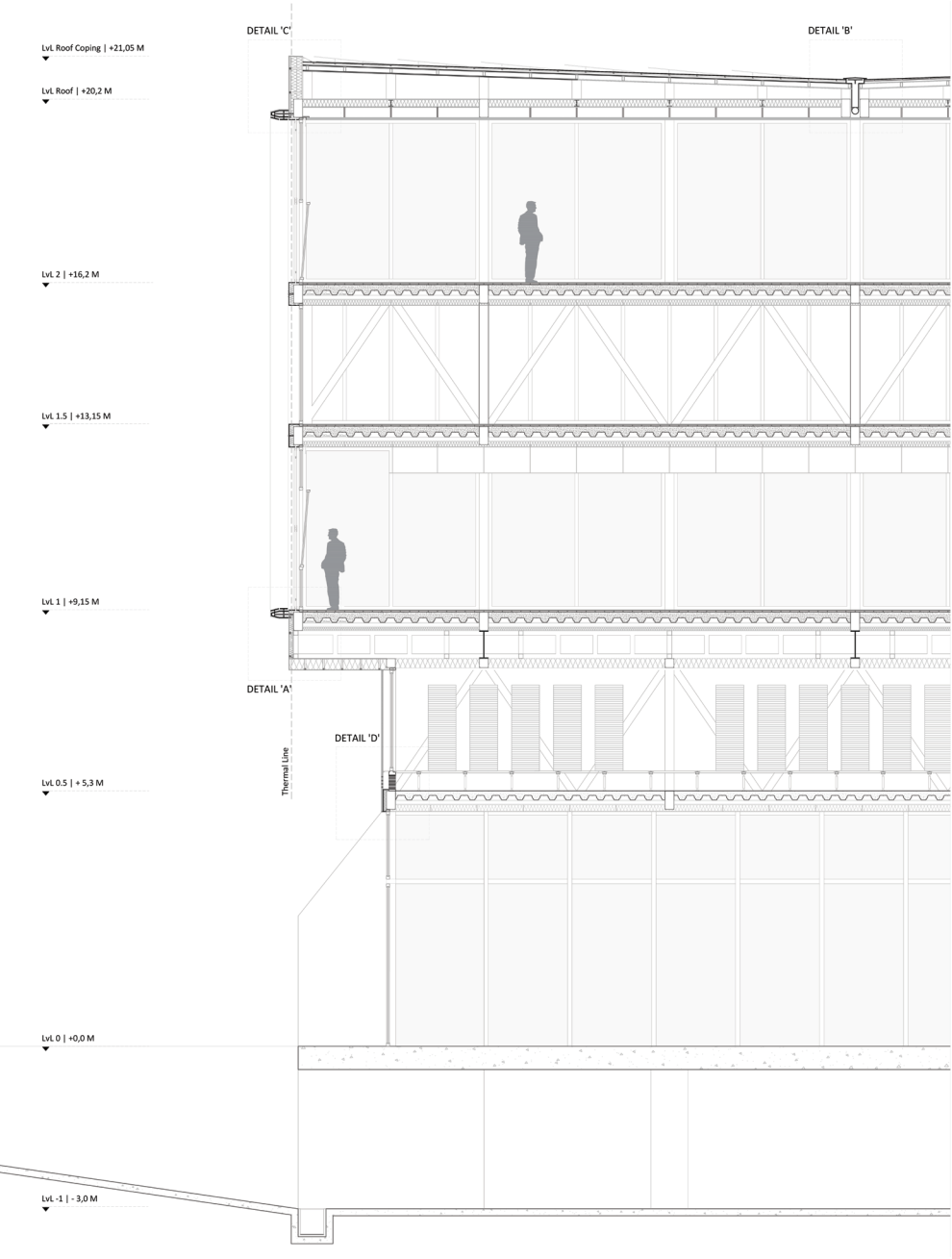


Elevation

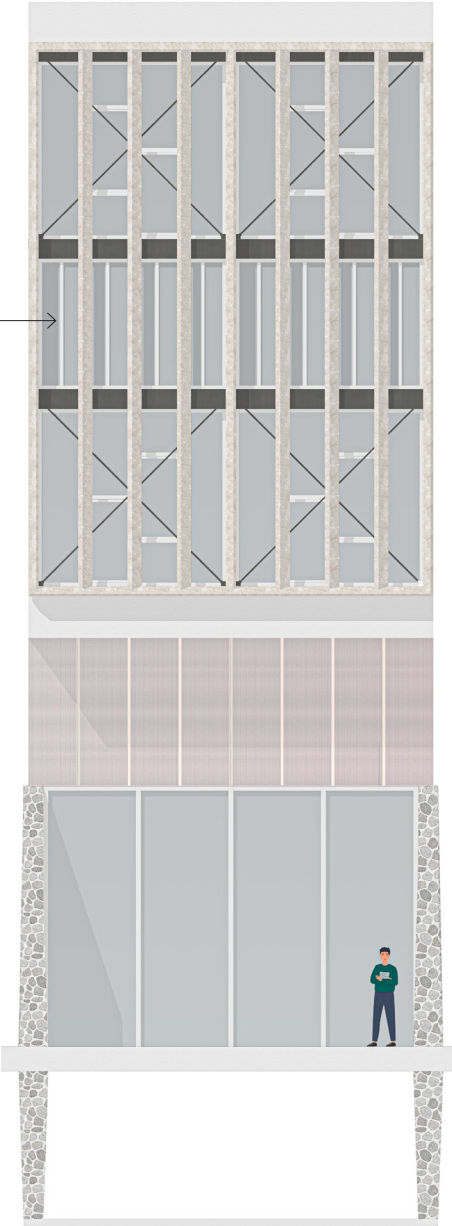


North Facade

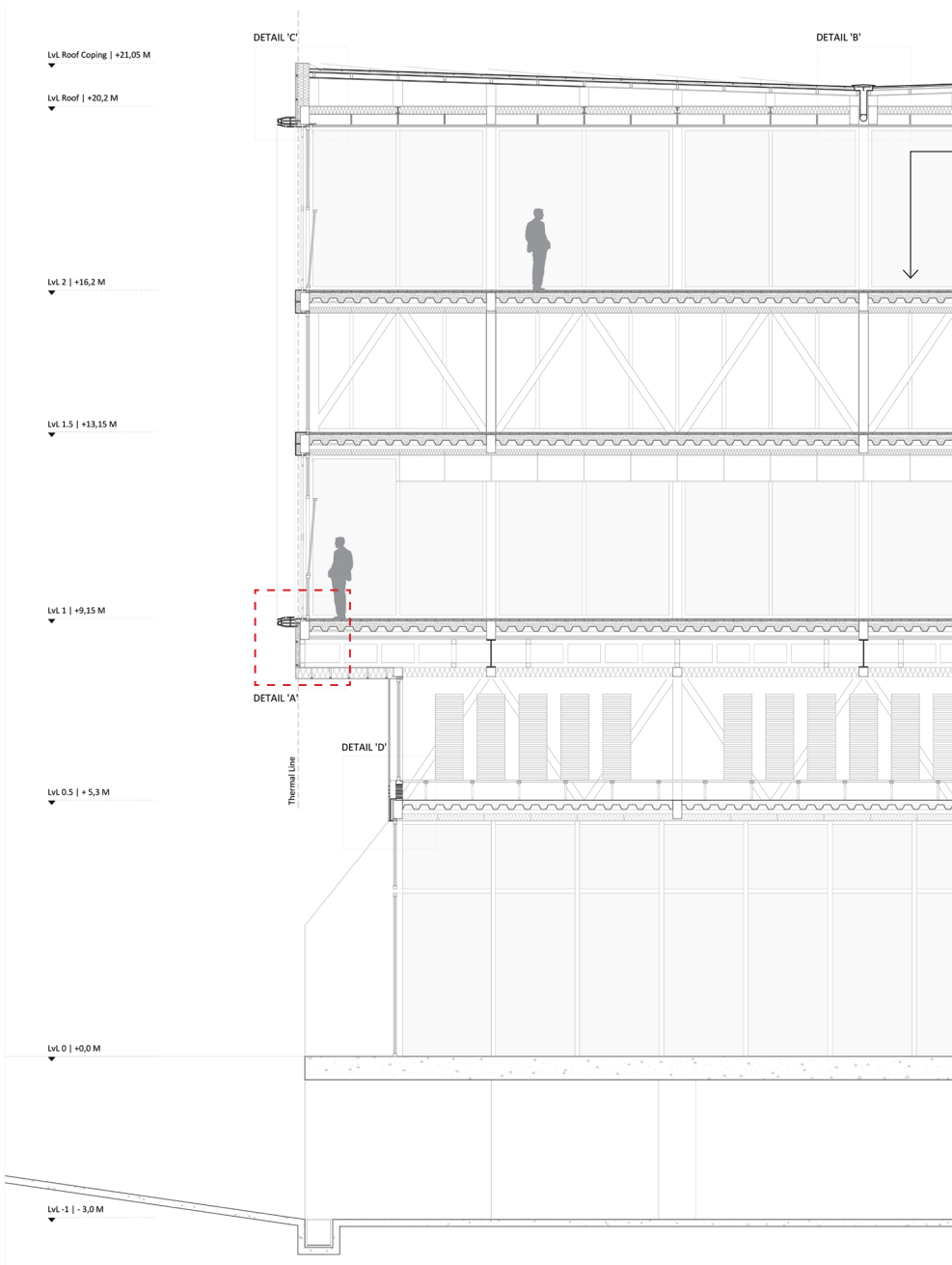




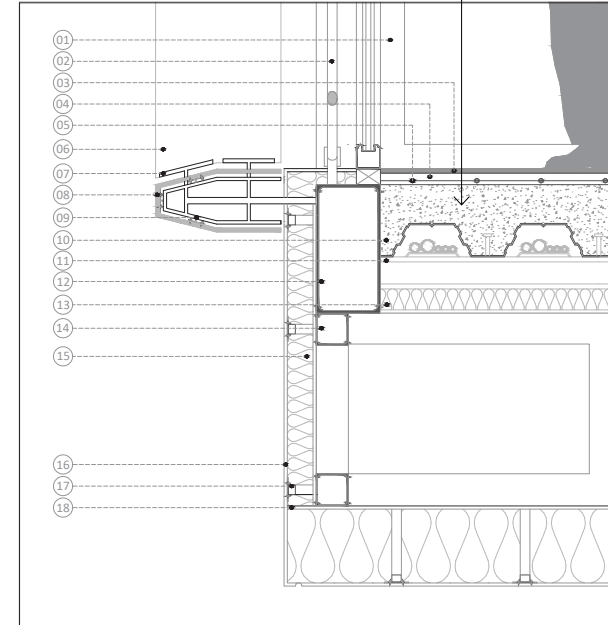
Fins at an angle



South Facade

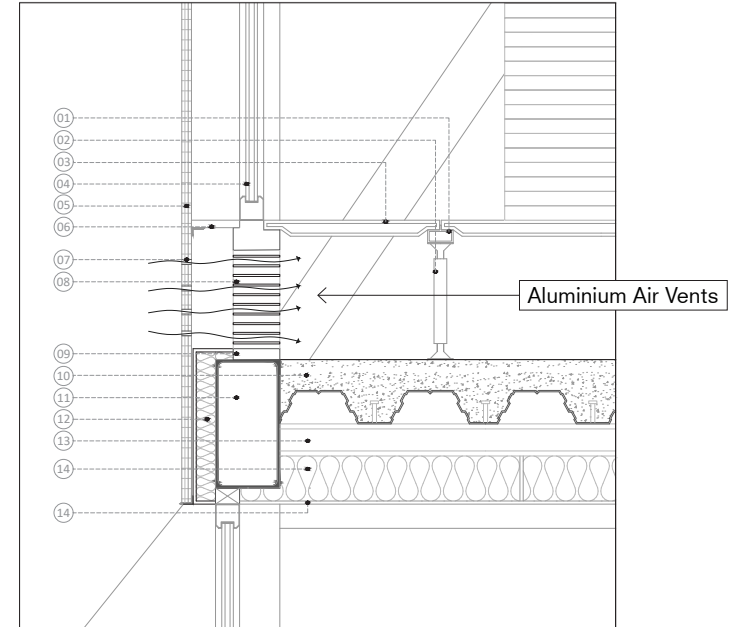
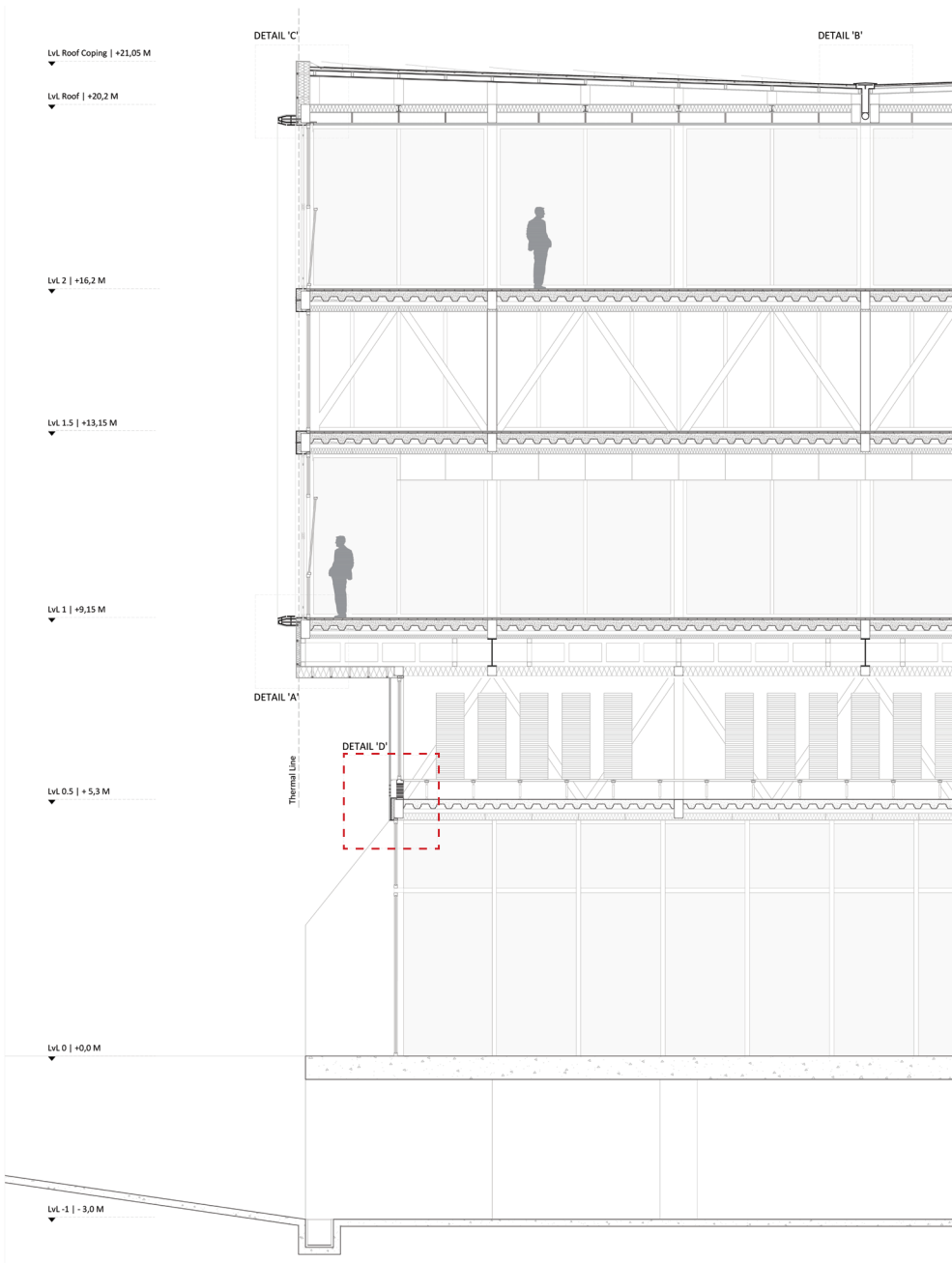


Composite Steel Deck Floor



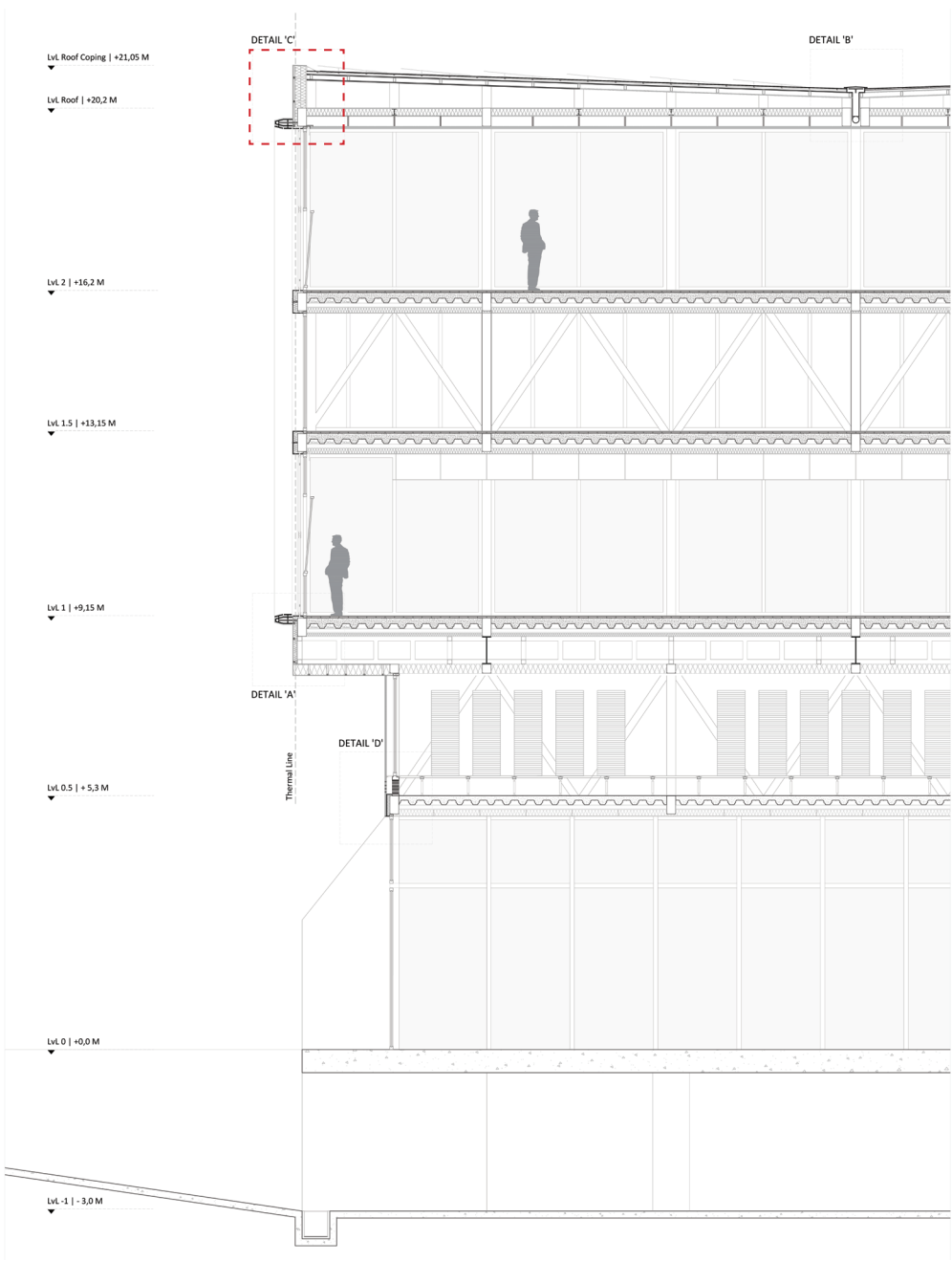
DETAIL 'A' (1:10)

- 01 TILT & TURN 12MM DOUBLE GLAZING WINDOW
- 02 60MM DIA STEEL CABLES, CROSS BRACING
- 03 14MM THICK LINOLEUM FLOORING
- 04 36MM SANDWICH THERMAL BOARDS
- 05 RADIENT FLOOR HEATING PIPES
- 06 30CM WIDE CERAMIC SUN SCREENS (FINS)
- 07 METAL CLAMPS FOR FINS
- 08 12MM CERAMIC PANELS
- 09 12MM STEEL PROFILE
- 10 125MM THICK COMPOSITE CONCRETE SLAB
- 11 100mm MS FLOOR BEAM (I SECTION)
- 12 200\*400MM MS BOX SECTION
- 13 64MM THICK EPS INSULATION WITH 10MM FIBER BOARD
- 14 100\*100 MM MS BOX SECTION (SPACE FRAME)
- 15 80MM THICK EPS INSULATION WITH 10MM FIBER BOARD
- 16 10MM THICK EXTERIOR CERAMIC WALL PANELING
- 17 METAL CLAMPS FOR EXTERIOR CLADDING
- 18 10MM FIBER BOARD

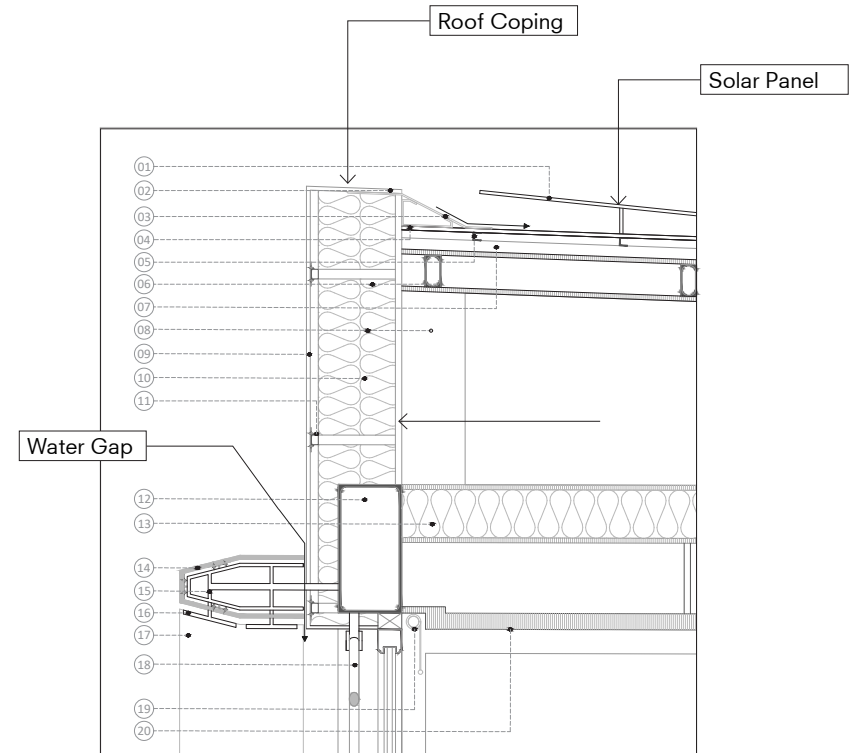


DETAIL 'D' (1:10)

- |  |  |
|--|--|
| 01 80*40MM MS STRINGER                   | 09 145MM ALUMINIUM PROFILE FOR AIR VENTS           |
| 02 350MM HIGH STEEL PEDESTAL             | 10 125MM THICK COMPOSITE CONCRETE SLAB             |
| 03 50MM THICK DECK FLOORING              | 11 200*400MM MS BOX SECTION                        |
| 04 DOUBLE GLAZING 12MM REINFORCED GLASS  | 12 80MM THICK EPS INSULATION WITH 10MM FIBER BOARD |
| 05 30MM THICK THREE LAYER POLY-CARBONATE | 13 100mm MS FLOOR BEAM (I SECTION)                 |
| 06 30MM THICK BOARD AS AIR LOCK          | 14 150MM UNDER-DECK EPS INSULATION                 |
| 07 20MM WIDE VENTILATION HOLES           | 15 10MM GYPSUM FALSE CEILING                       |
| 08 ALUMINIUM AIR VENTS (FIXED LOUVERS)   |  |

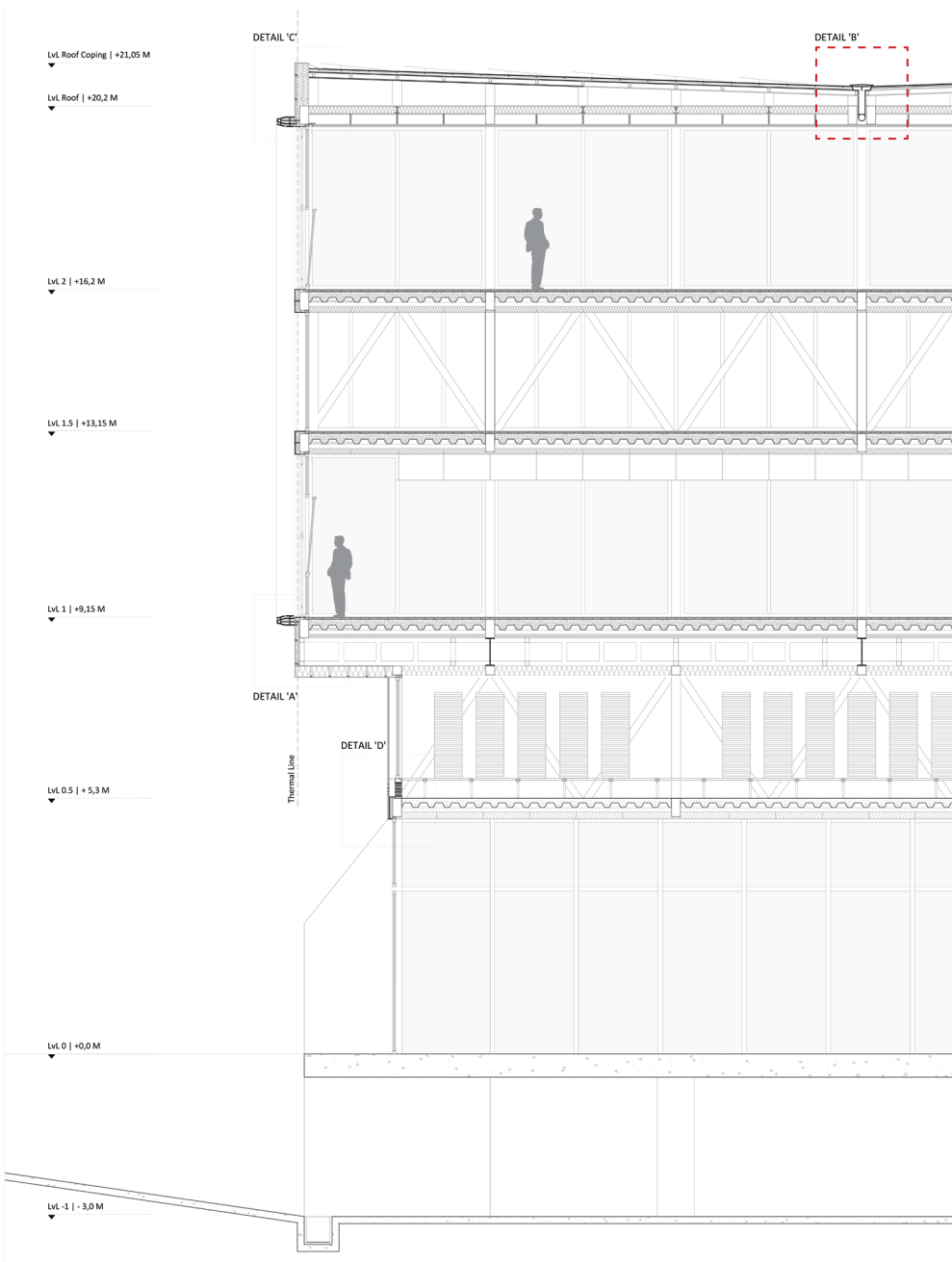


Details

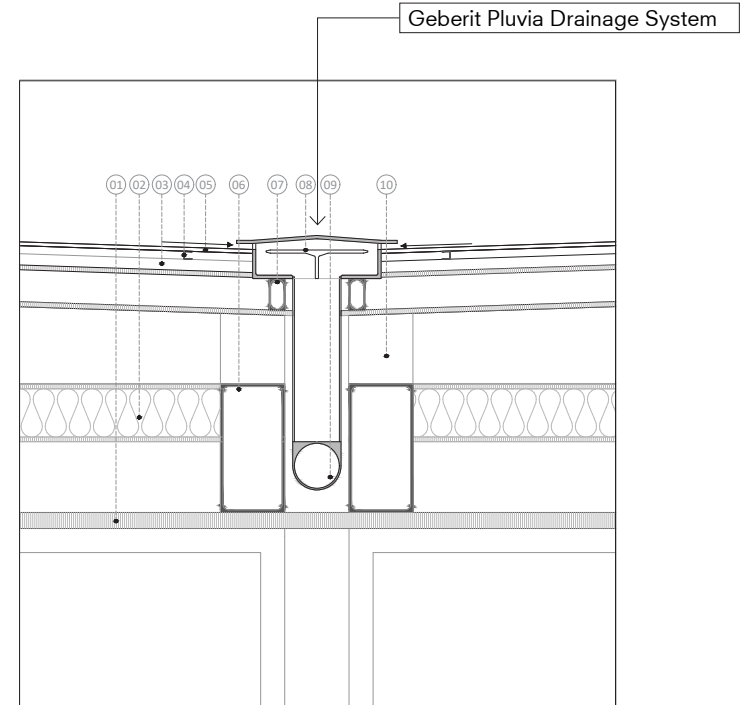


DETAIL 'C' (1:10)

- |  |   |
|--|---|
| 01 SOLAR PANEL                             | 11 METAL CLAMPS FOR EXTERIOR CLADDING               |
| 02 10MM CERAMIC EXTERIOR CLADDING          | 12 200*400MM MS BOX SECTION                         |
| 03 ALUMINIUM LEDGE PROFILE                 | 13 160MM THICK EPS INSULATION WITH 10MM FIBER BOARD |
| 04 ROOFING WITH WATERPROOFING MEMBRANE     | 14 12MM CERAMIC PANELS                              |
| 05 METAL ROOFING CLAMPS                    | 15 12MM STEEL PROFILE                               |
| 06 50*100MM MS BOX SECTION RAFTERS         | 16 METAL CLAMPS FOR FINS                            |
| 07 60*35MM MS BOX SECTION PURLINS          | 17 30CM WIDE CERAMIC SUN SCREENS (FINS)             |
| 08 100*100 MM MS BOX SECTION (SPACE FRAME) | 18 60MM DIA STEEL CABLES, CROSS BRACING             |
| 09 12MM CERAMIC PANELS                     | 19 ROLLER BLINDS                                    |
| 10 260MM THICK EPS INSULATION              | 20 50MM GYPSUM FALSE CEILING                        |



Details



DETAIL 'B' (1:10)

- 01 50MM GYPSUM FALSE CEILING
- 02 160MM THICK EPS INSULATION WITH 10MM FIBER BOARD
- 03 60\*35MM MS BOX SECTION PURLINS
- 04 METAL ROOFING CLAMPS
- 05 ROOFING WITH WATERPROOFING MEMBRANE
- 06 200\*400MM MS BOX SECTION
- 07 50\*100MM MS BOX SECTION RAFTERS
- 08 GEBERIT PLUVIA RAINWATER DRAINAGE
- 09 RAINWATER GUTTER
- 10 100\*100 MM MS BOX SECTION (SPACE FRAME)

Introduction

Research

Design Brief

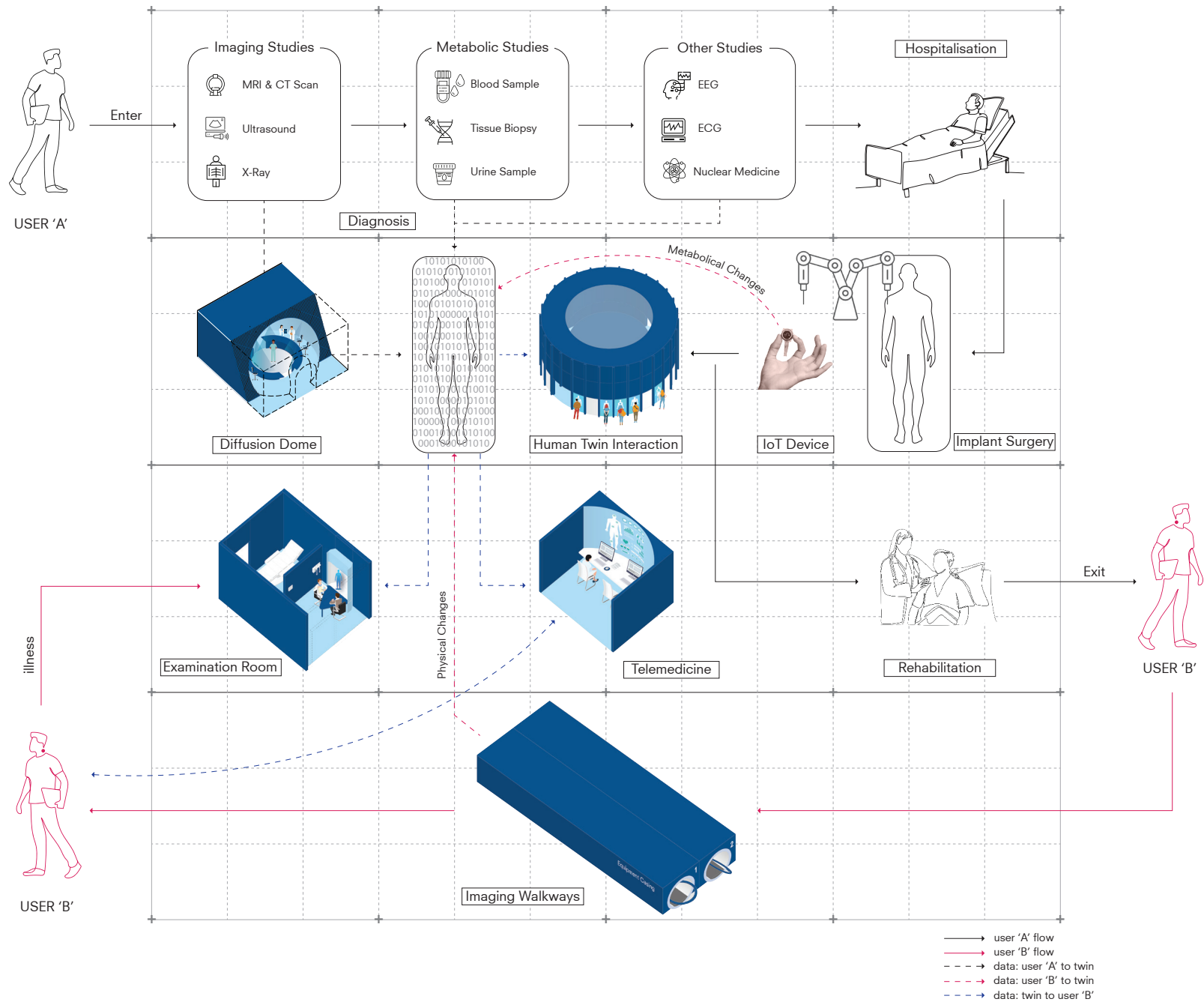
Approach

Implementation

Development

**Conclusion**

# Elements of Digitalisation







thank you