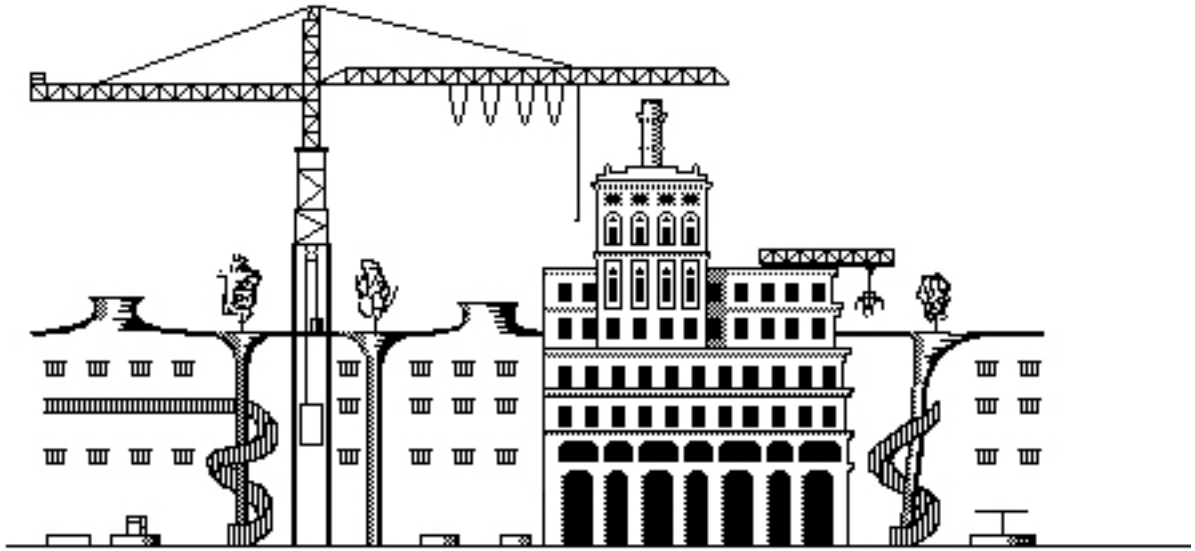
HENNEBIQUE SILOS

HYBRID PREFABRICATED SYSTEM FOR FABRIC FORMWORK FOR CONCRETE SHELLS

The renovation of the Hennebique silos building.



P5
Architectural Engineering
Giuseppe Campo-Antico
4454847

Architectural Engineering
Tutors:
Ir. A. Snijders (Architecture)
Dr. -Ir. M. Bilow (Research & Building Technology)

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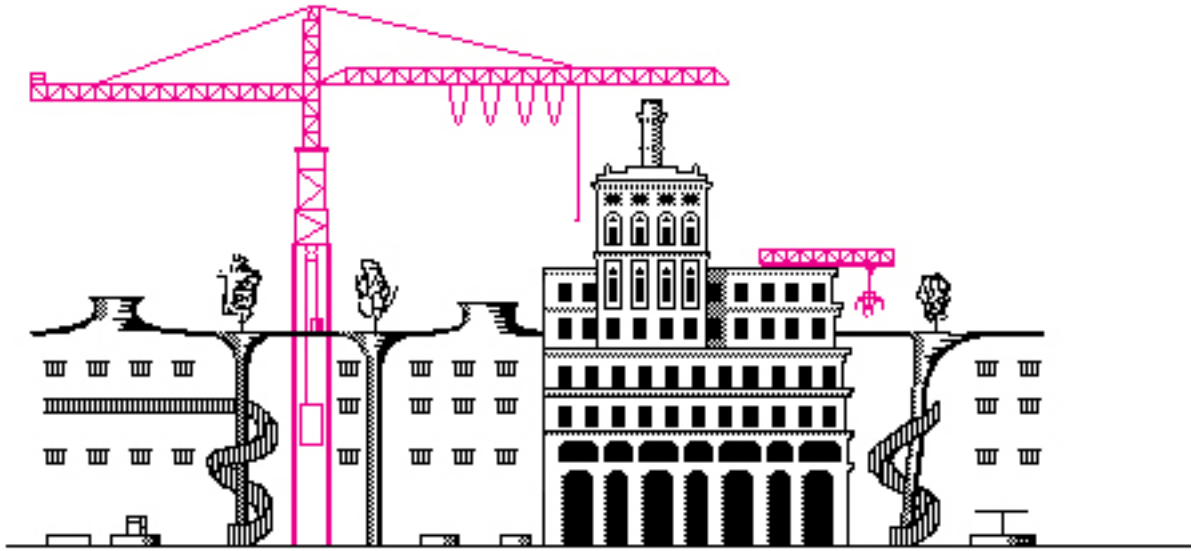
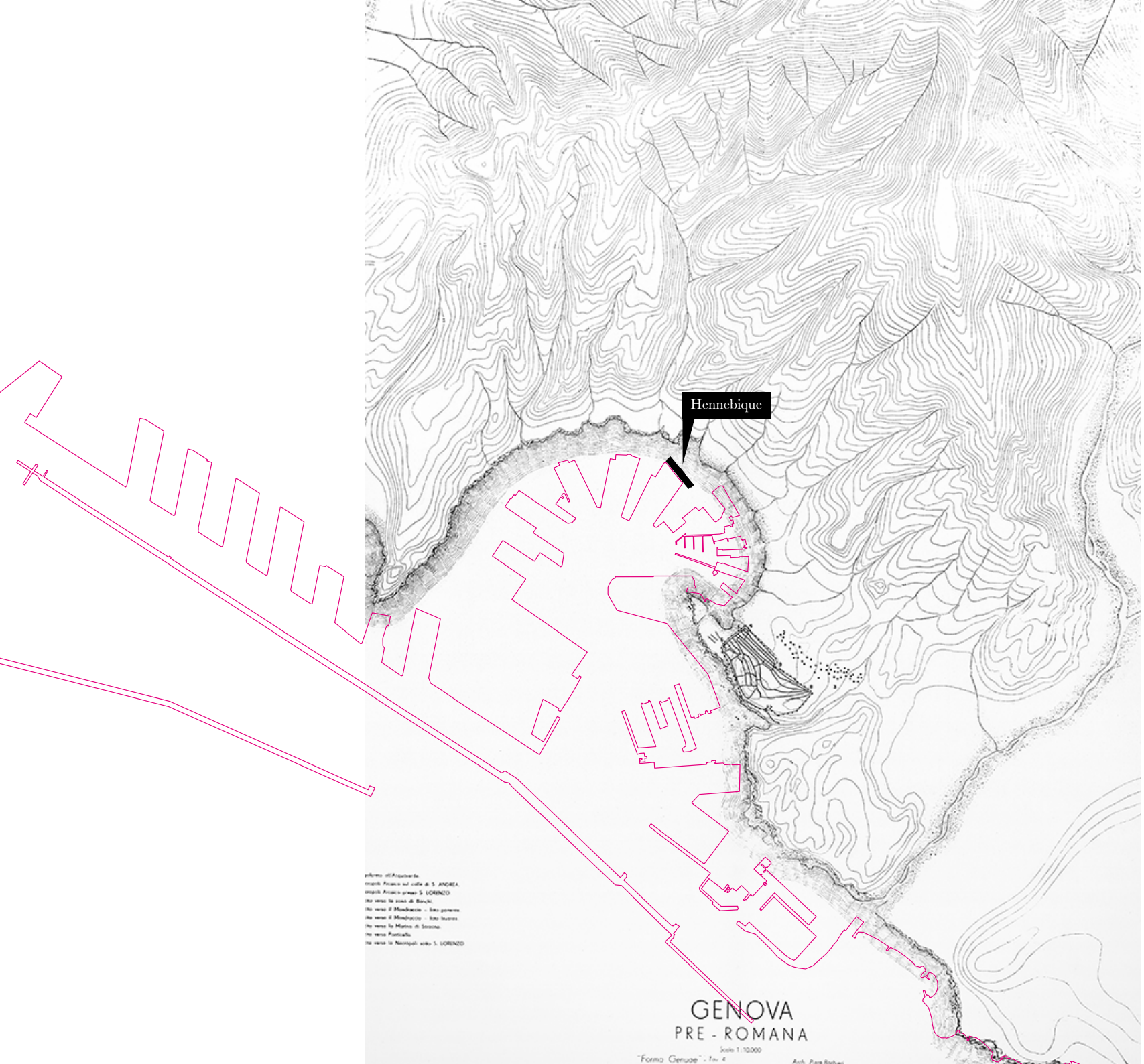
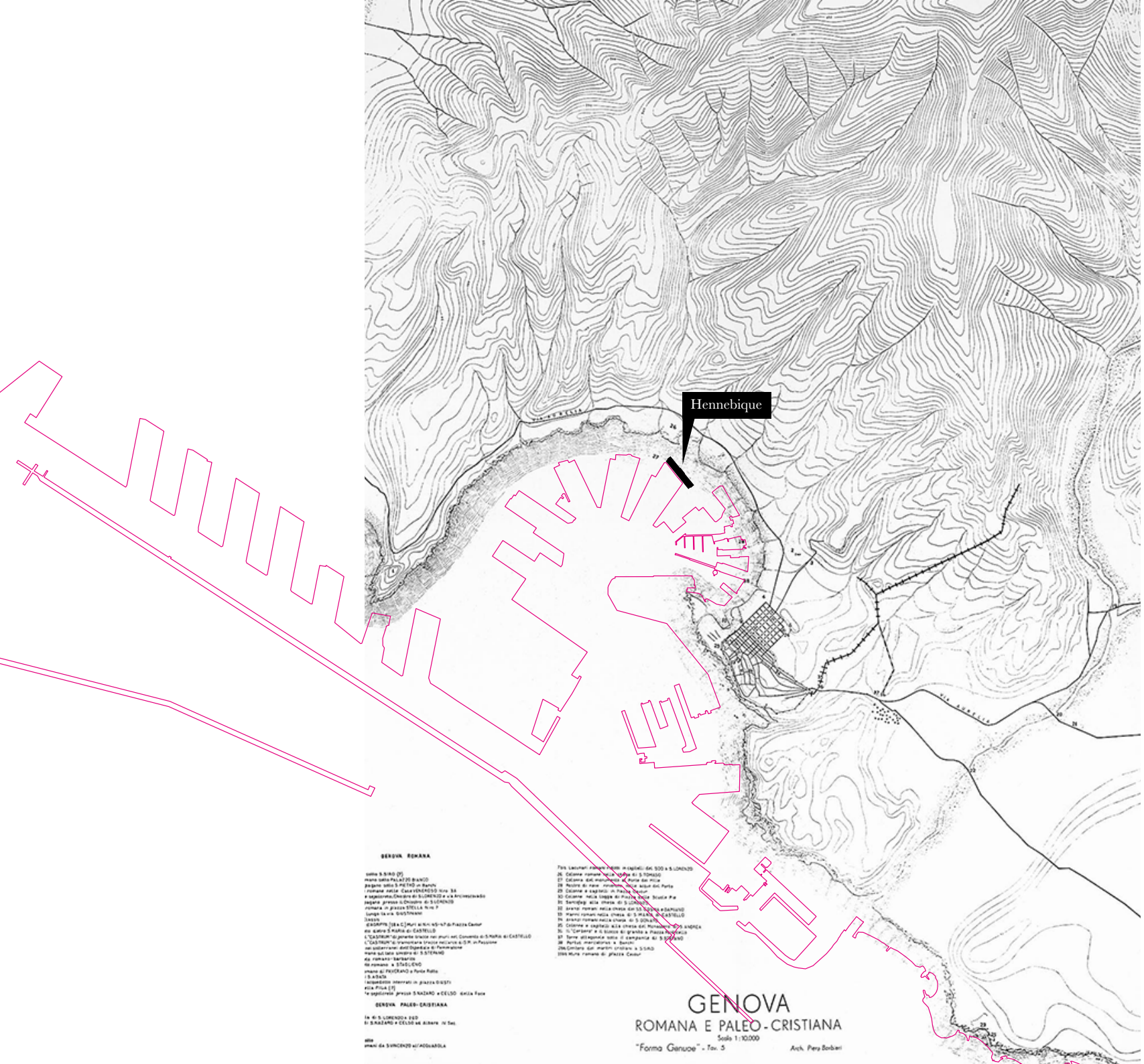
1.CONTEXT

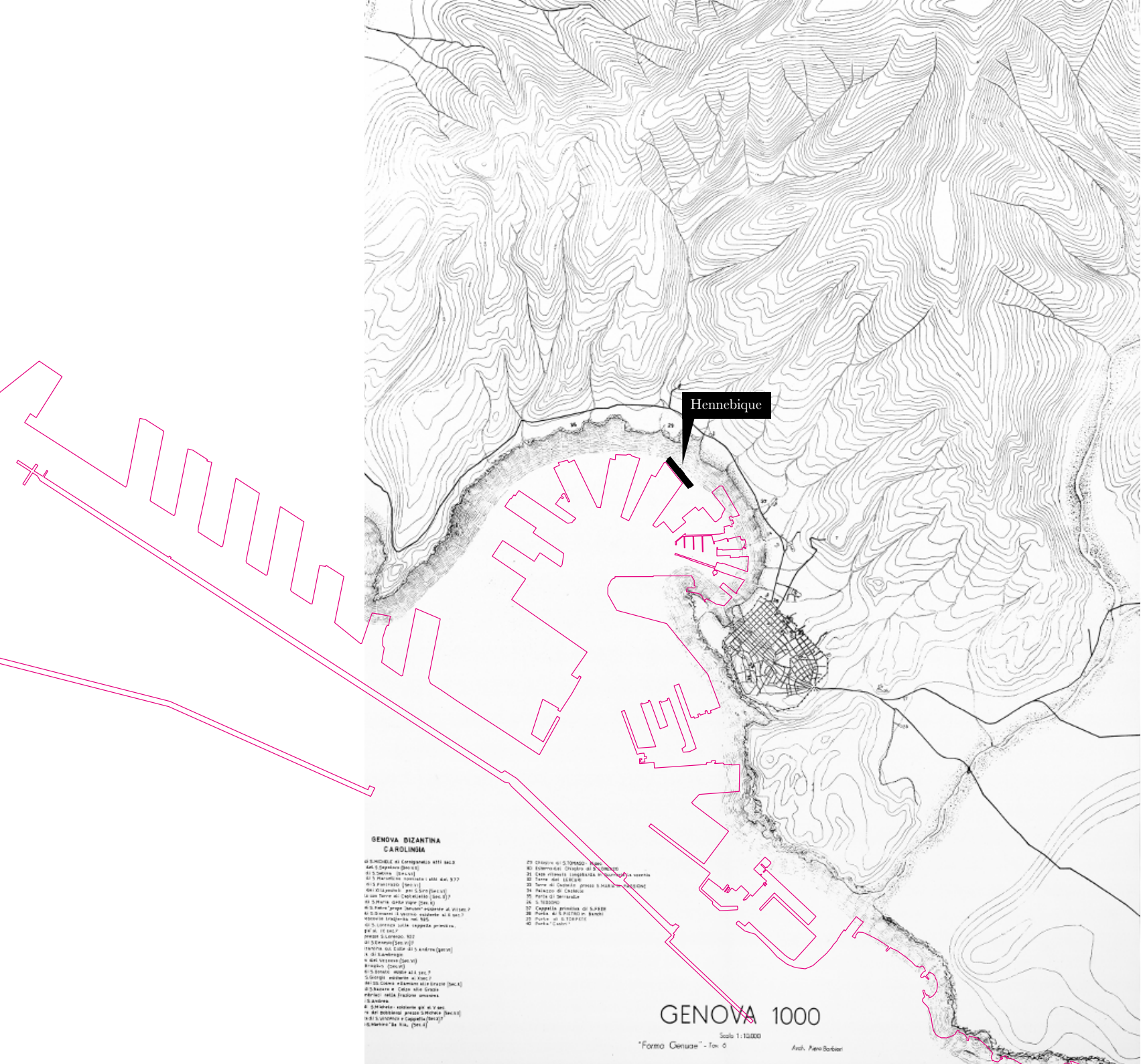


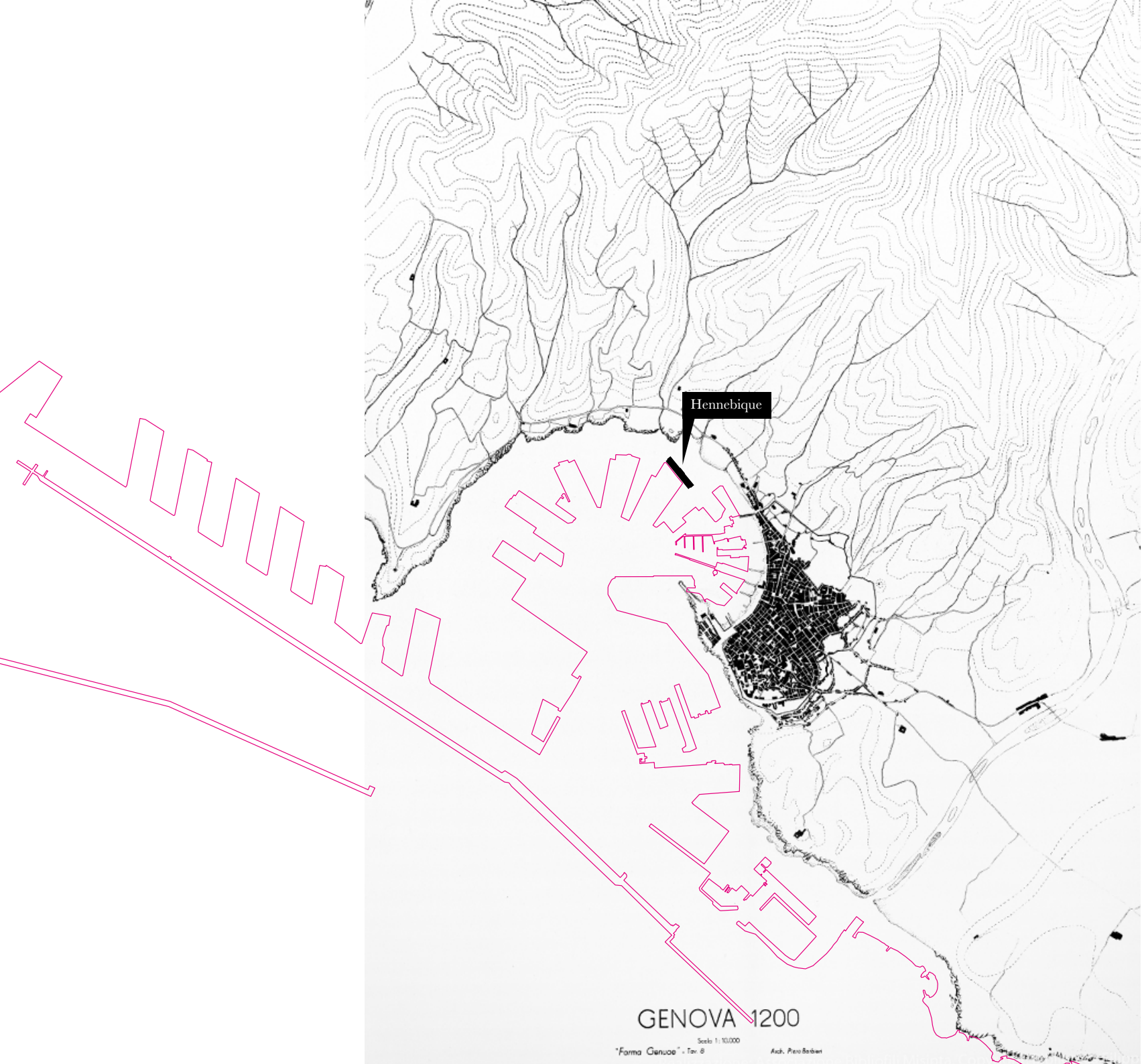

Genova

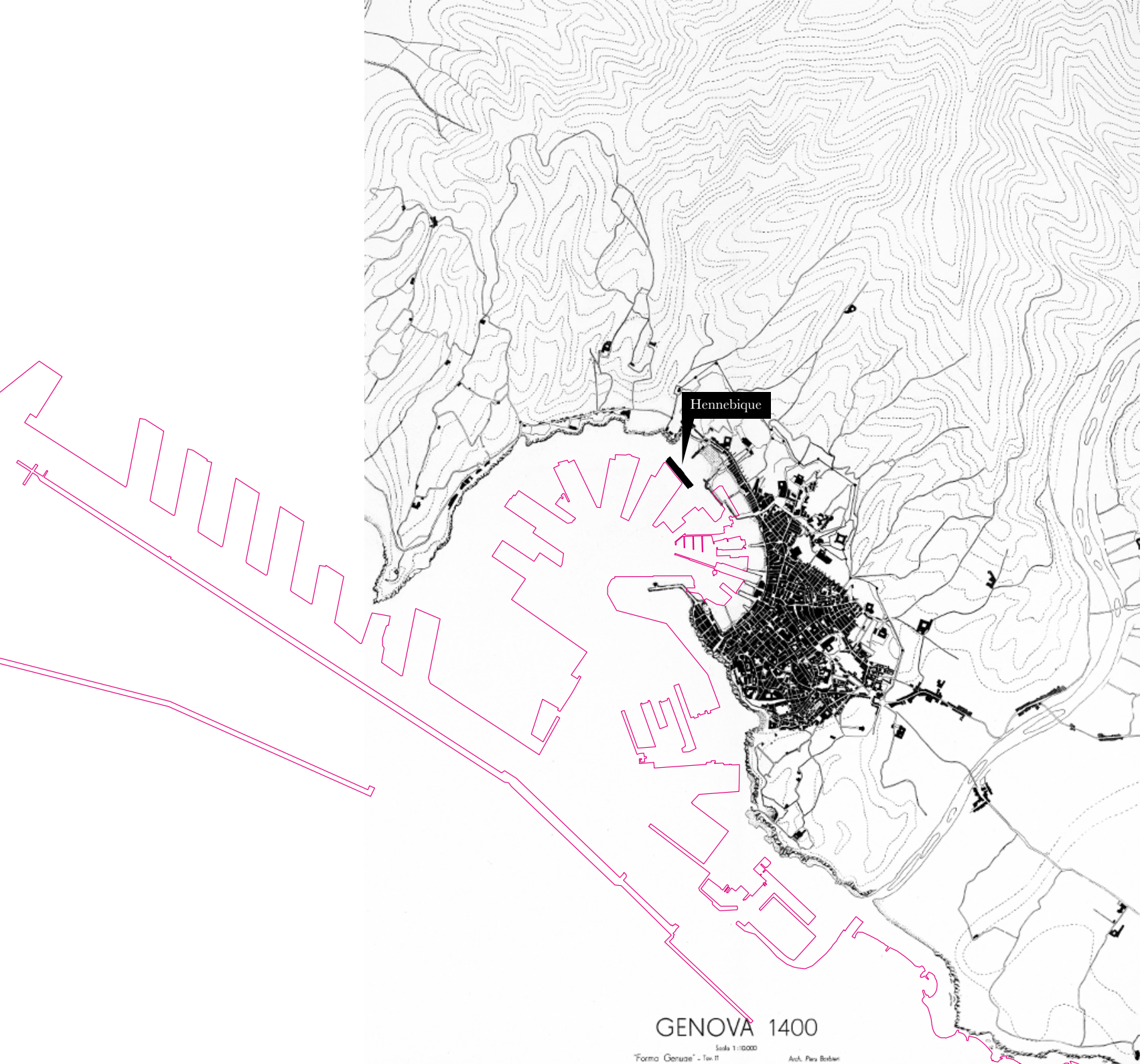

Hennebique
GENOVA: ZERO


Hennebique
GENOVA
PRE - ROMANA

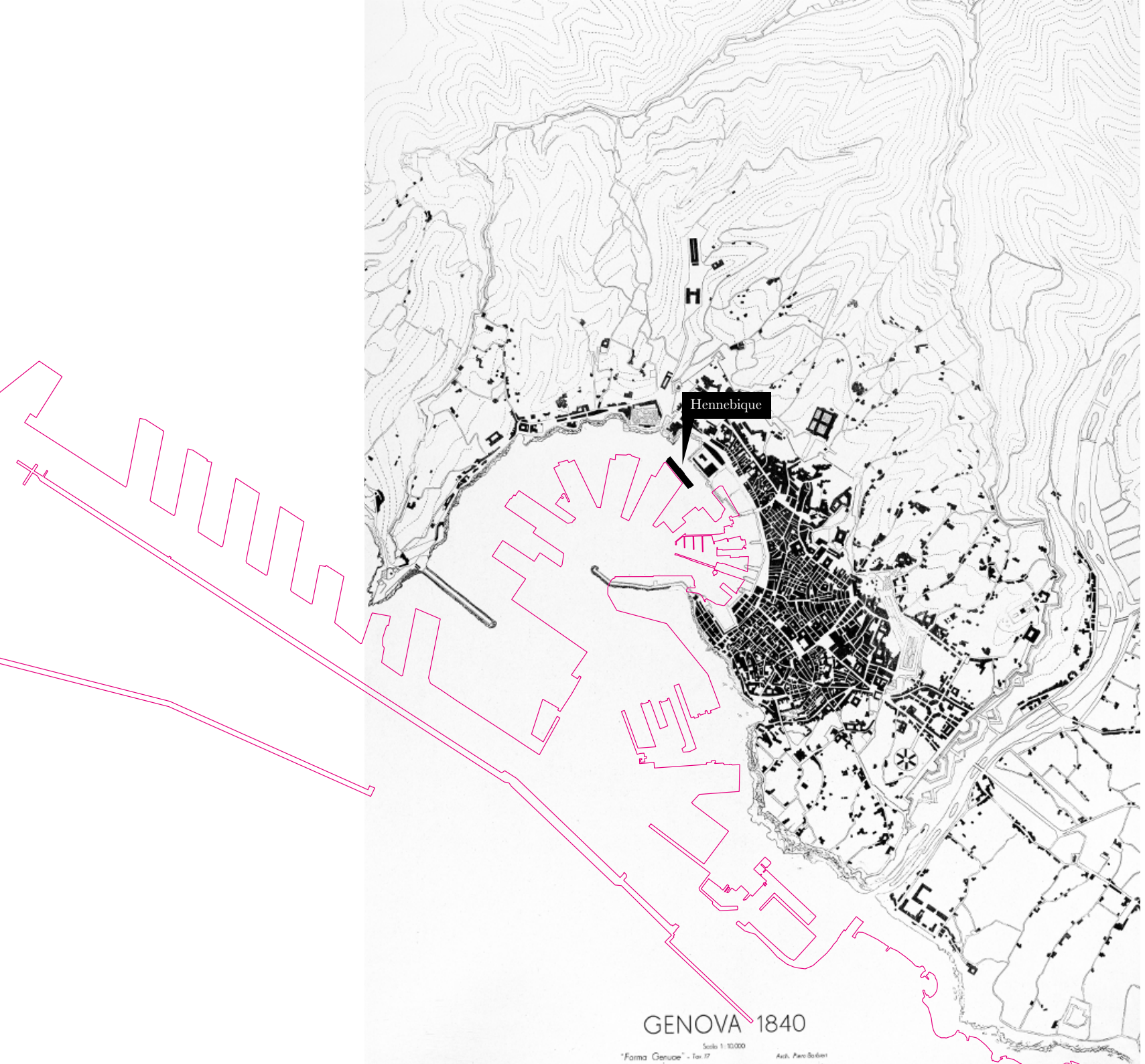

Hennebique
GENOVA
ROMANA E PALEO-CRISTIANA
Scala 1:10.000
"Forma Genuae" - Tav. 5
Arch. Piero Barbieri

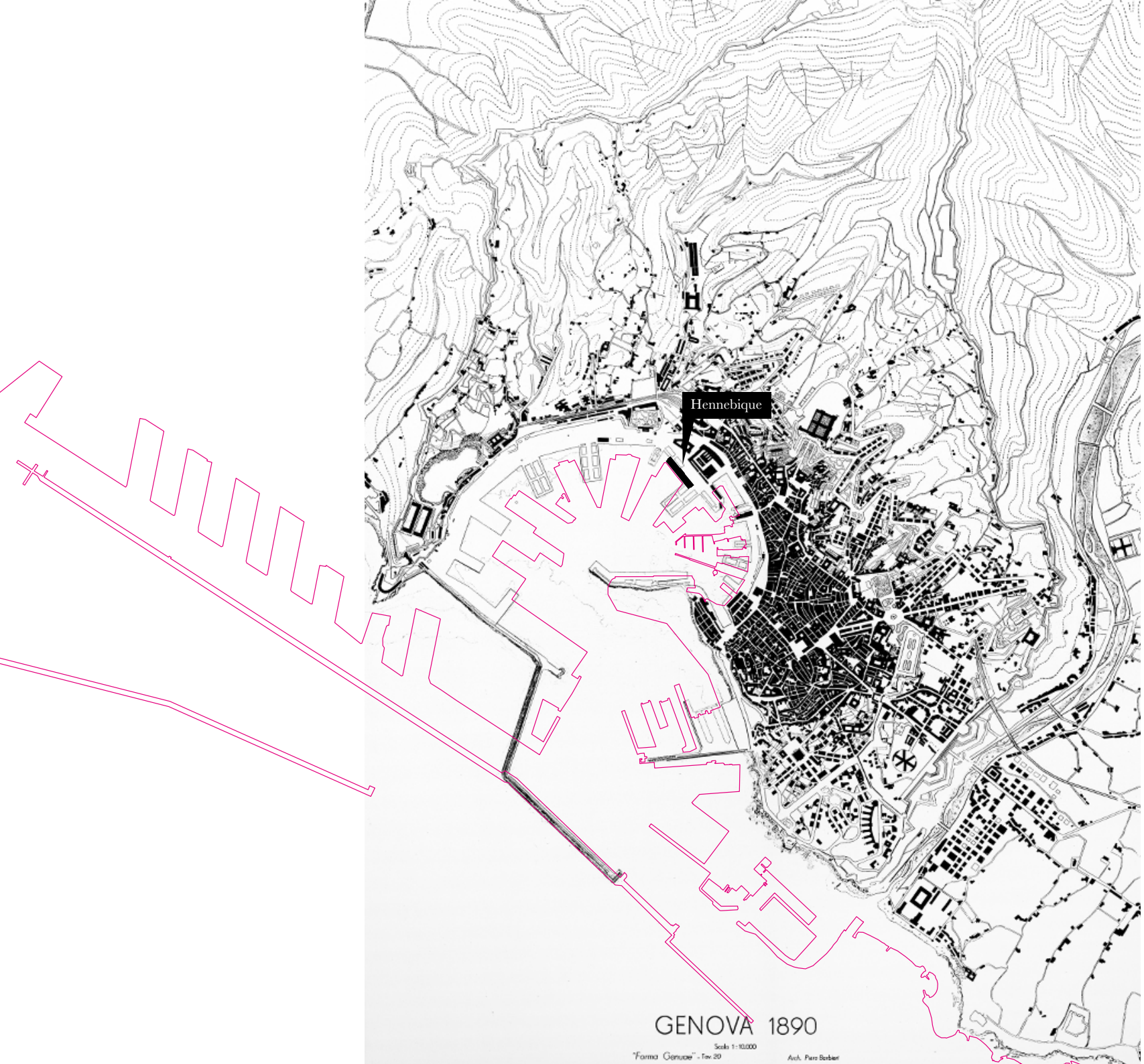

Hennebique
GENOVA BIZANTINA
CAROLINGIA
GENOVA 1000
Scala 1:10.000
"Forma Genuae" - Tav. 6
Arch. Piero Barbieri


Hennebique
GENOVA 1200
Scala 1: 10.000
"Forma Genuae" - Tav. 8
Arch. Piero Barbieri


Hennebique
GENOVA 1400
Scala 1:10.000
"Forma Genuae" - Tav. II
Arch. Piero Barbieri


Hennebique
GENOVA 1656
Scala 1: 10.000
"Forma Genuae" - Tav. 14
Arch. Pino Barbieri


Hennebique
GENOVA 1840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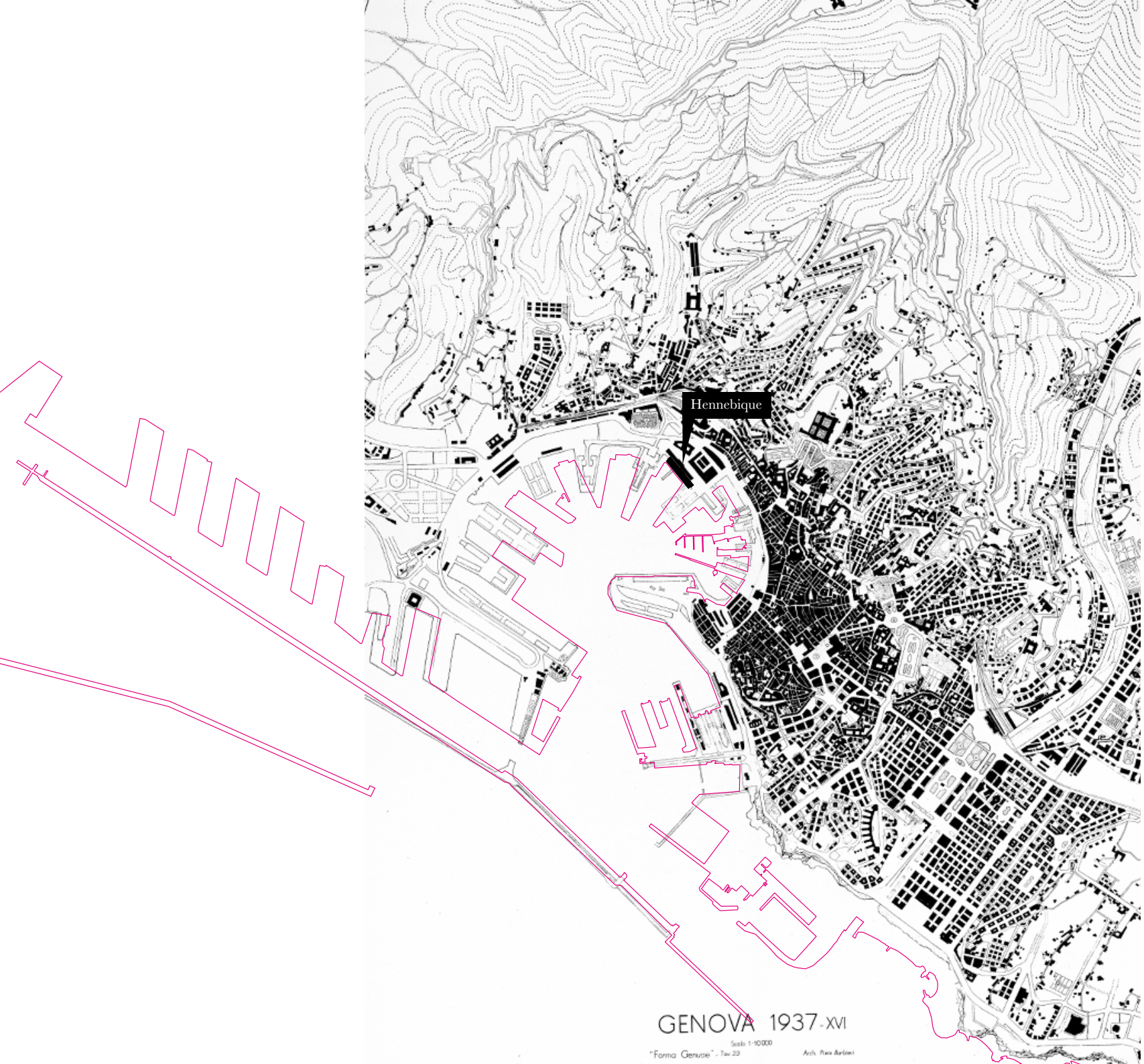
Arch. Pierre Barbieri



Origin

Expansion 1800 - 1850

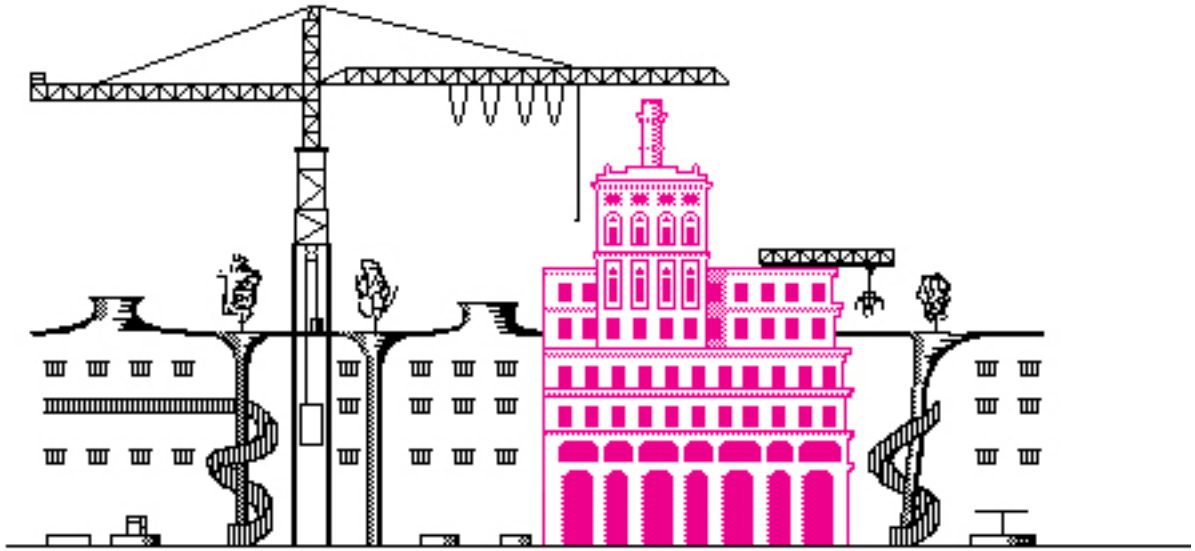
Old port abandonment 1960 - 1980

Waterfront refurbishment 1970 - 1990

Porto Antico, 1950

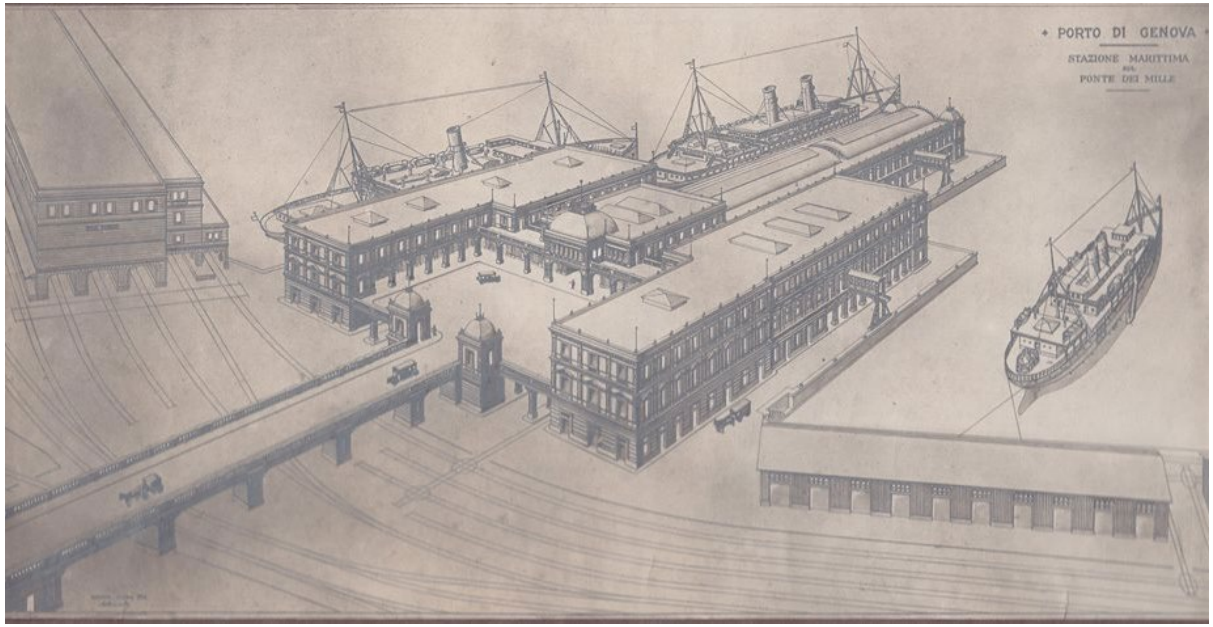
Ponte Parodi, 1910

2.EXISTING SITUATION



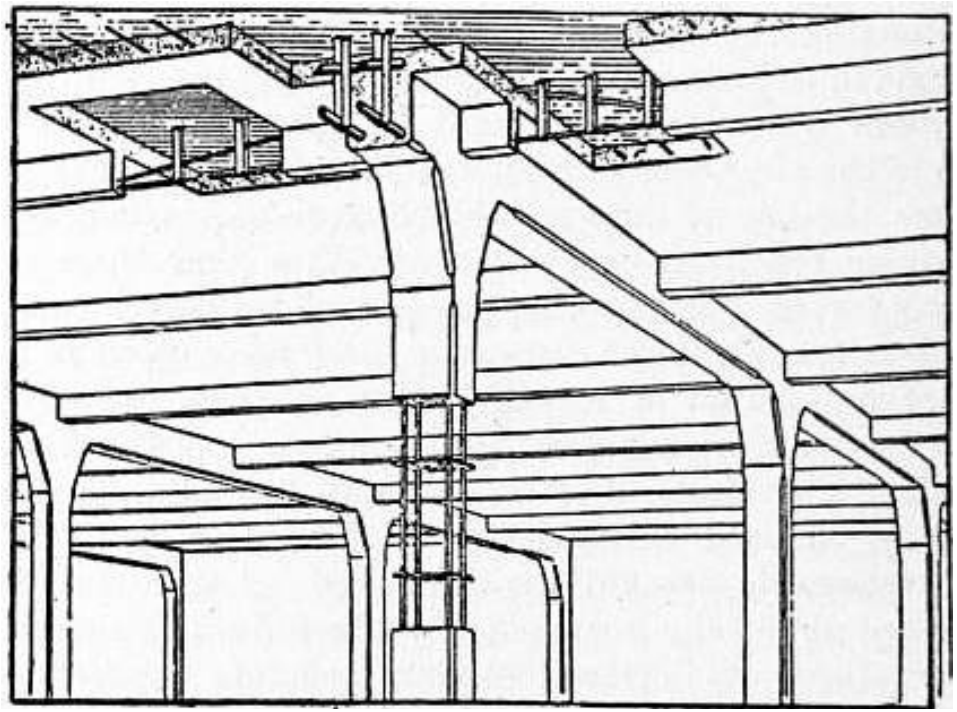
LANDMARK

Postcard, 1918



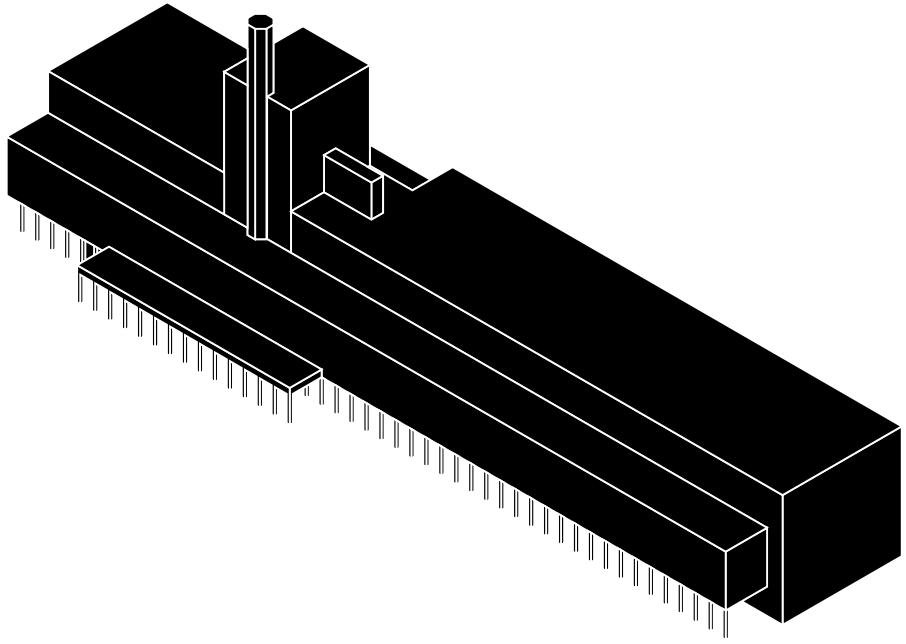
Maritime Station project

INNOVATIVE CONSTRUCTION

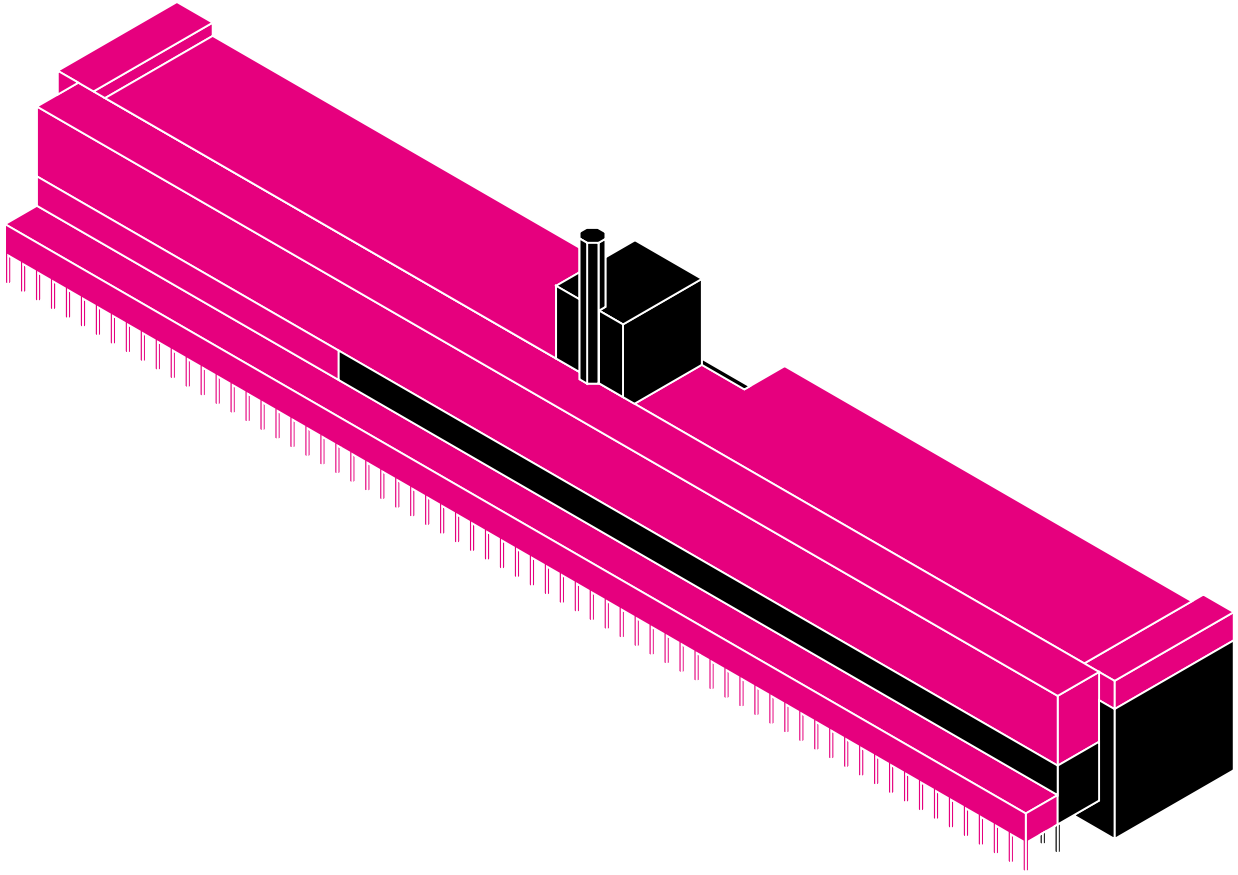


Hennebique construction method

View from the first floor next to the sea



1901



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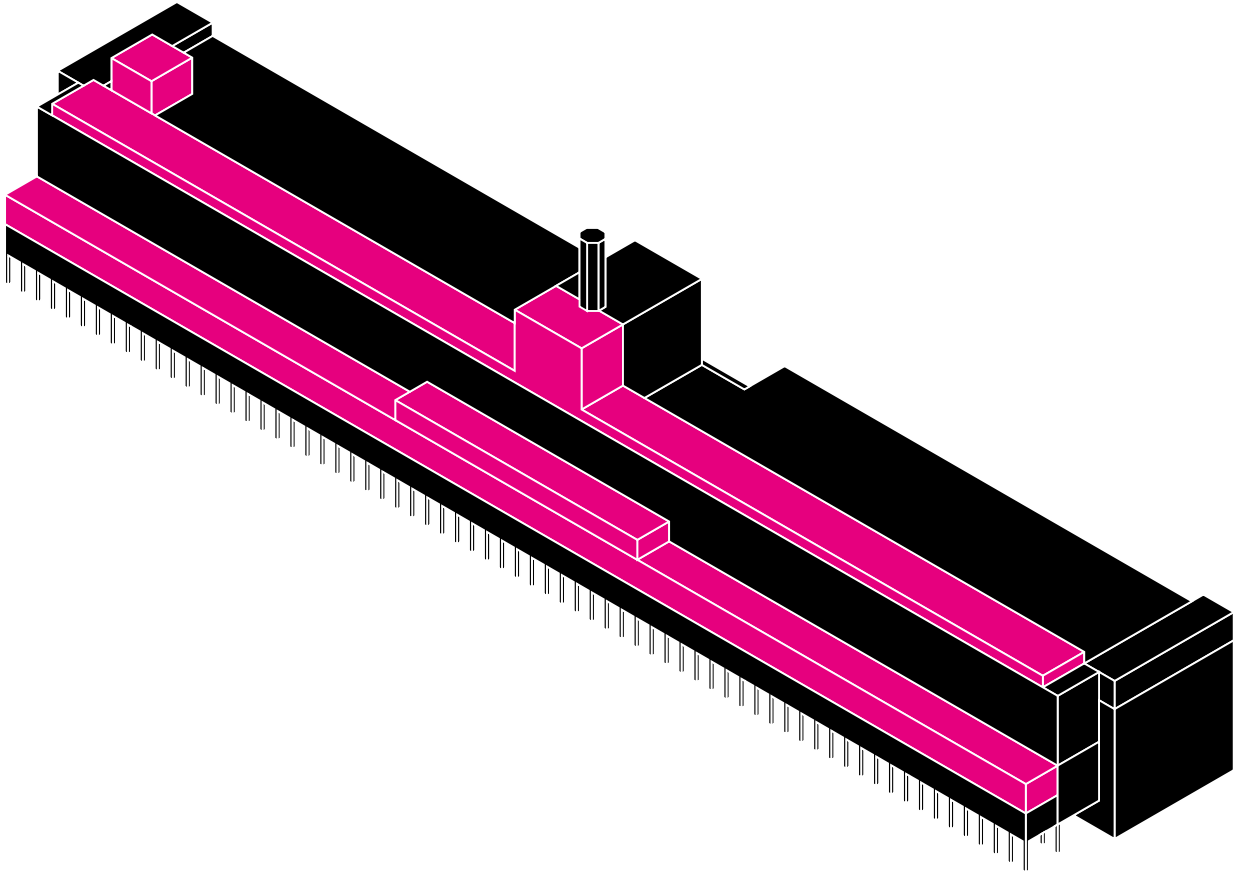
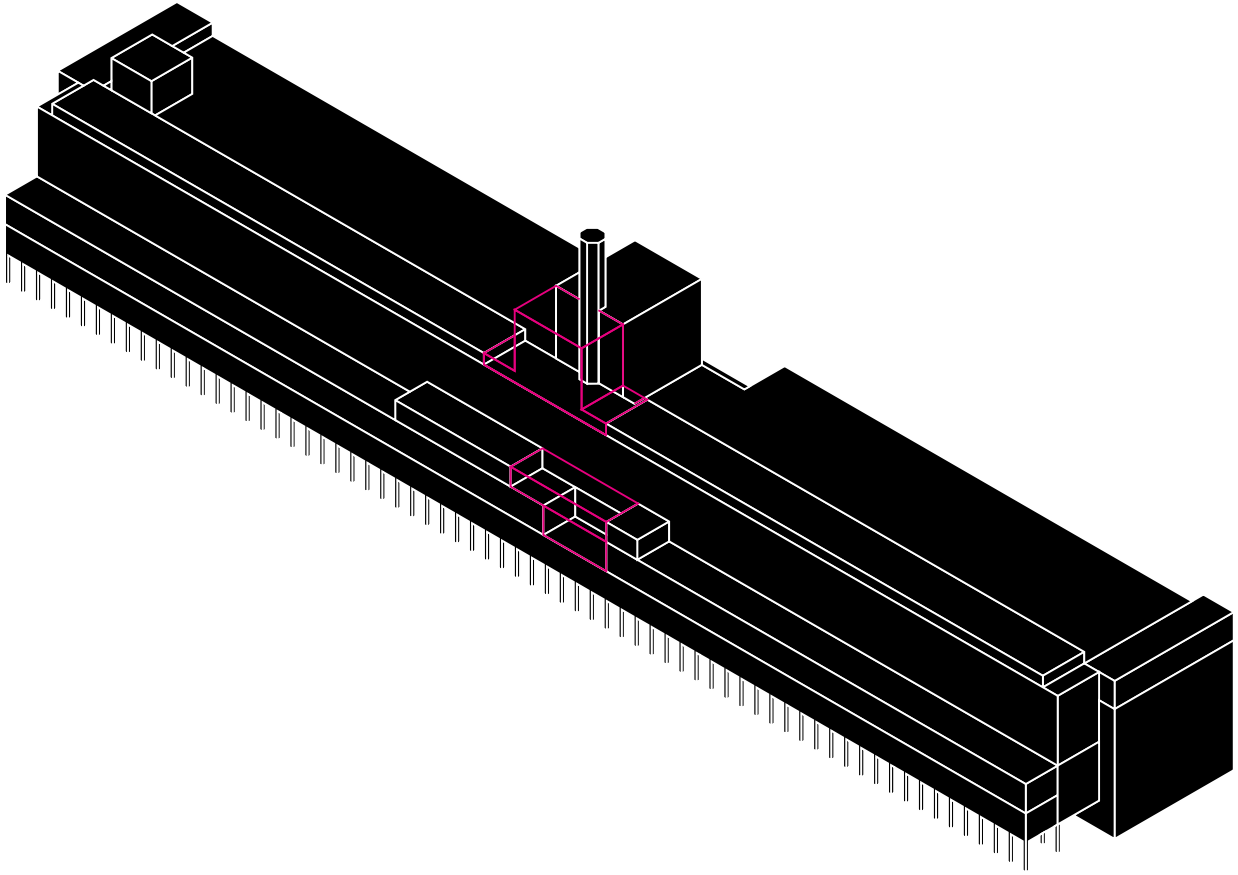
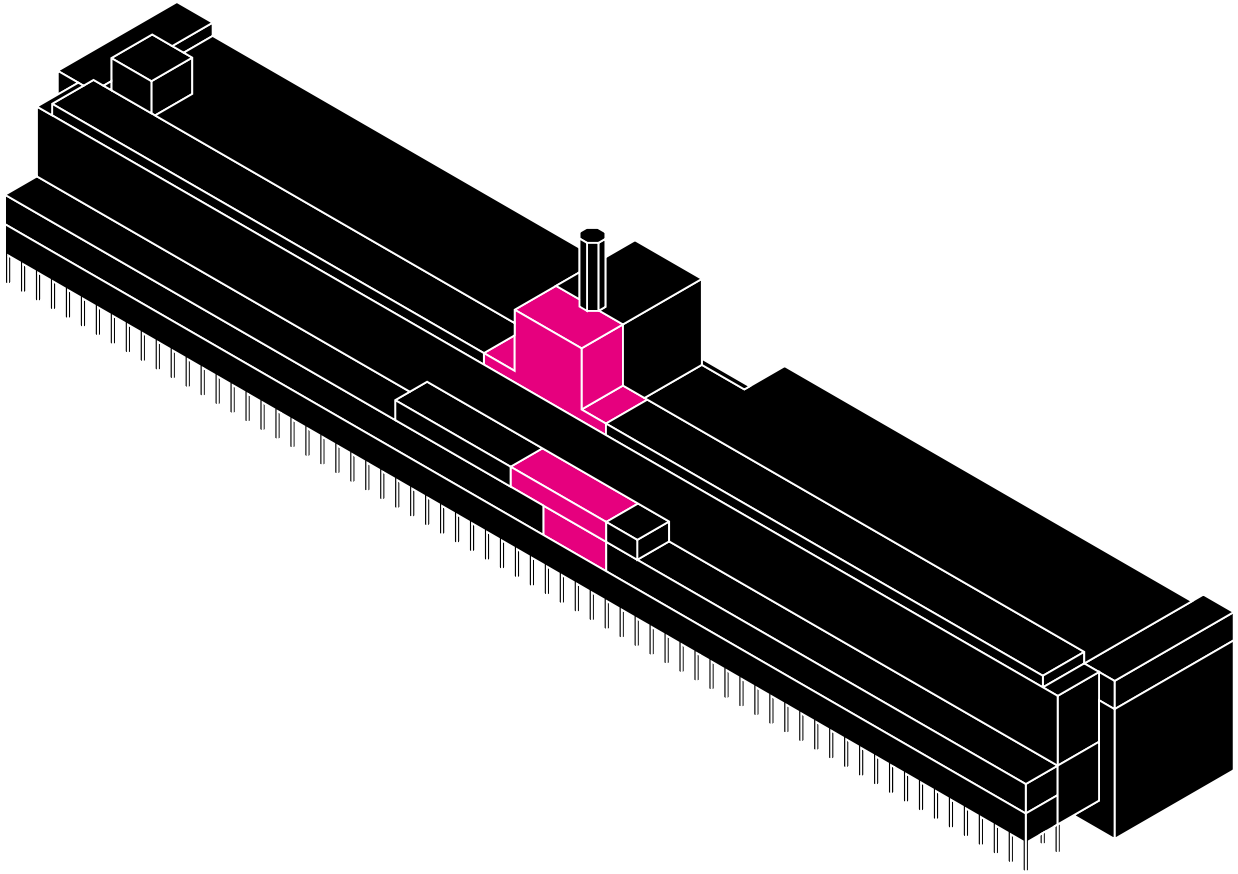


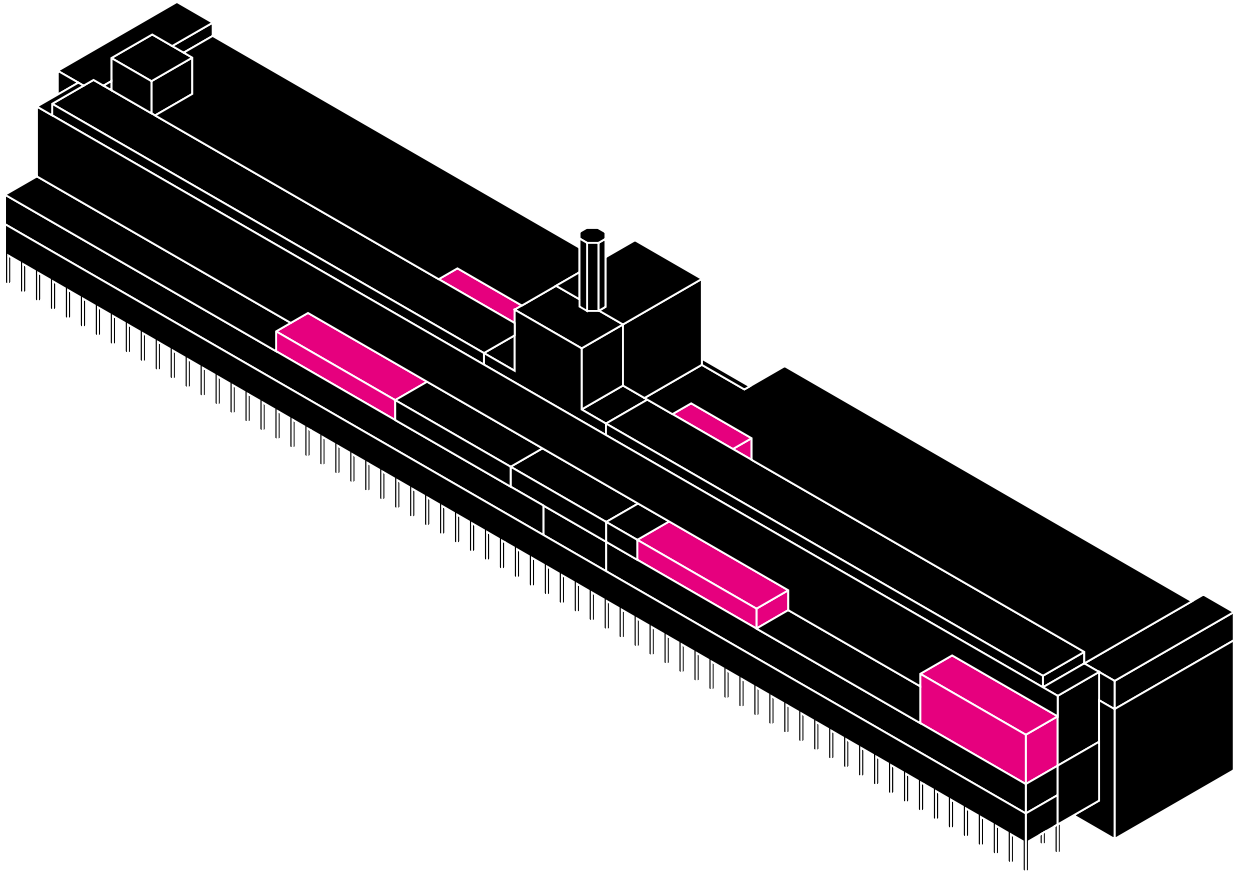
1924



1941



1945

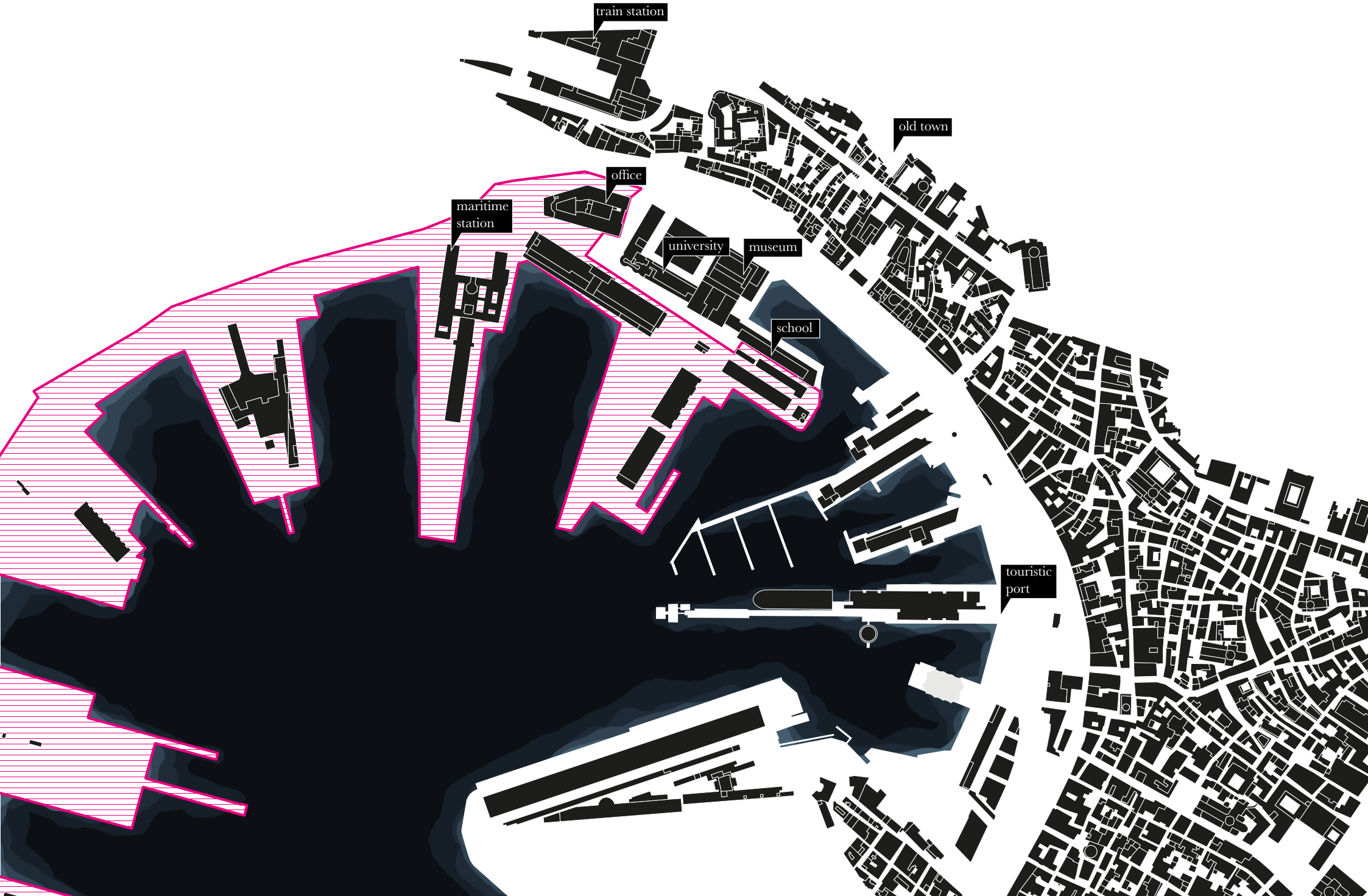


after 1945

Hennebique silos building

SITE | UNEXPRESSED POTENTIAL

SITE | BUFFER ZONE



SITE | VACANT BUILDINGS

The two maritime stations, 1967

Demolished silos building, 2002

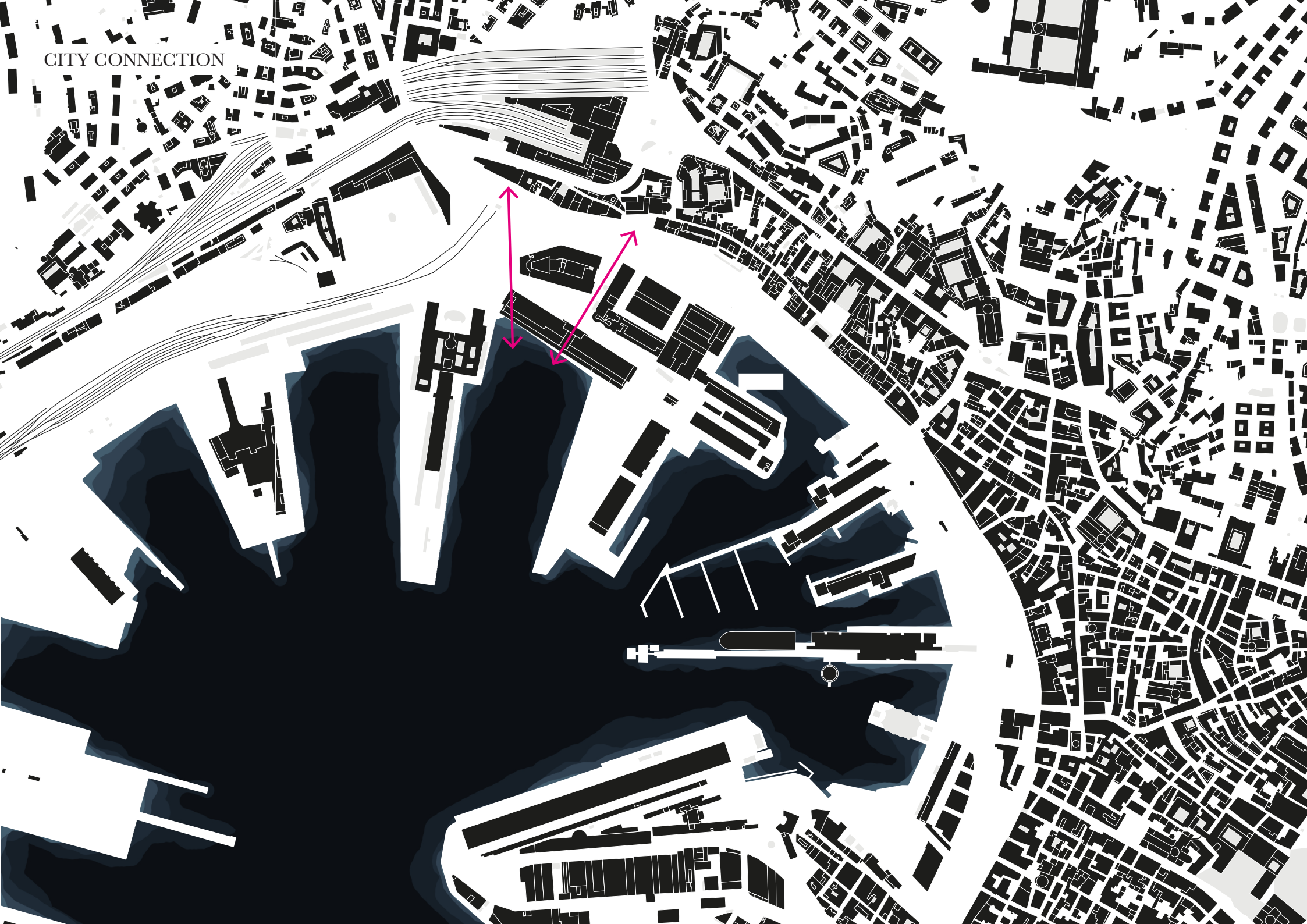
UN Studio, 2001
Winning proposal

MVRDV, 2001

Hennebique silos building

Hennebique silos building

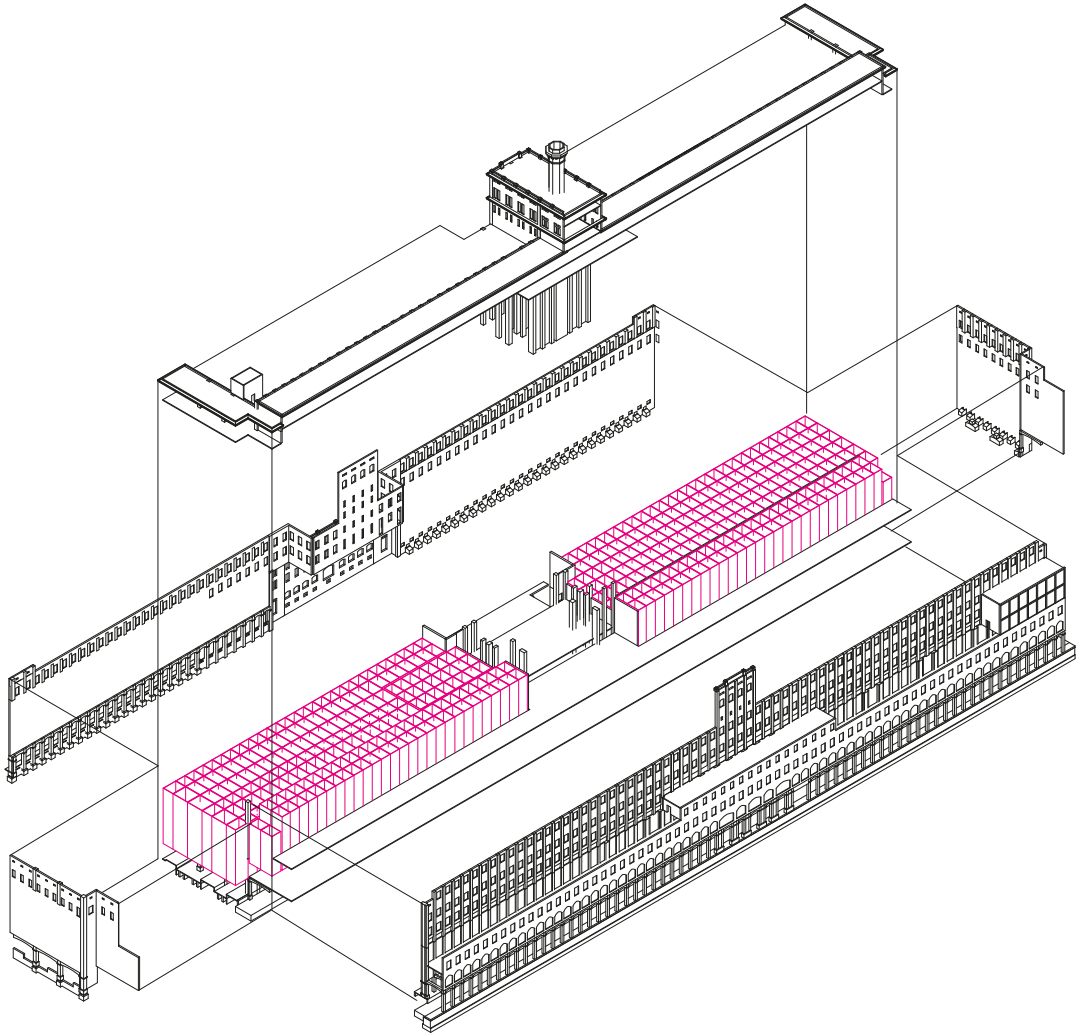

WATERFRONT CONNECTION


CITY CONNECTION

RESTRICTIONS

BUILDING HERITAGE COMMISION

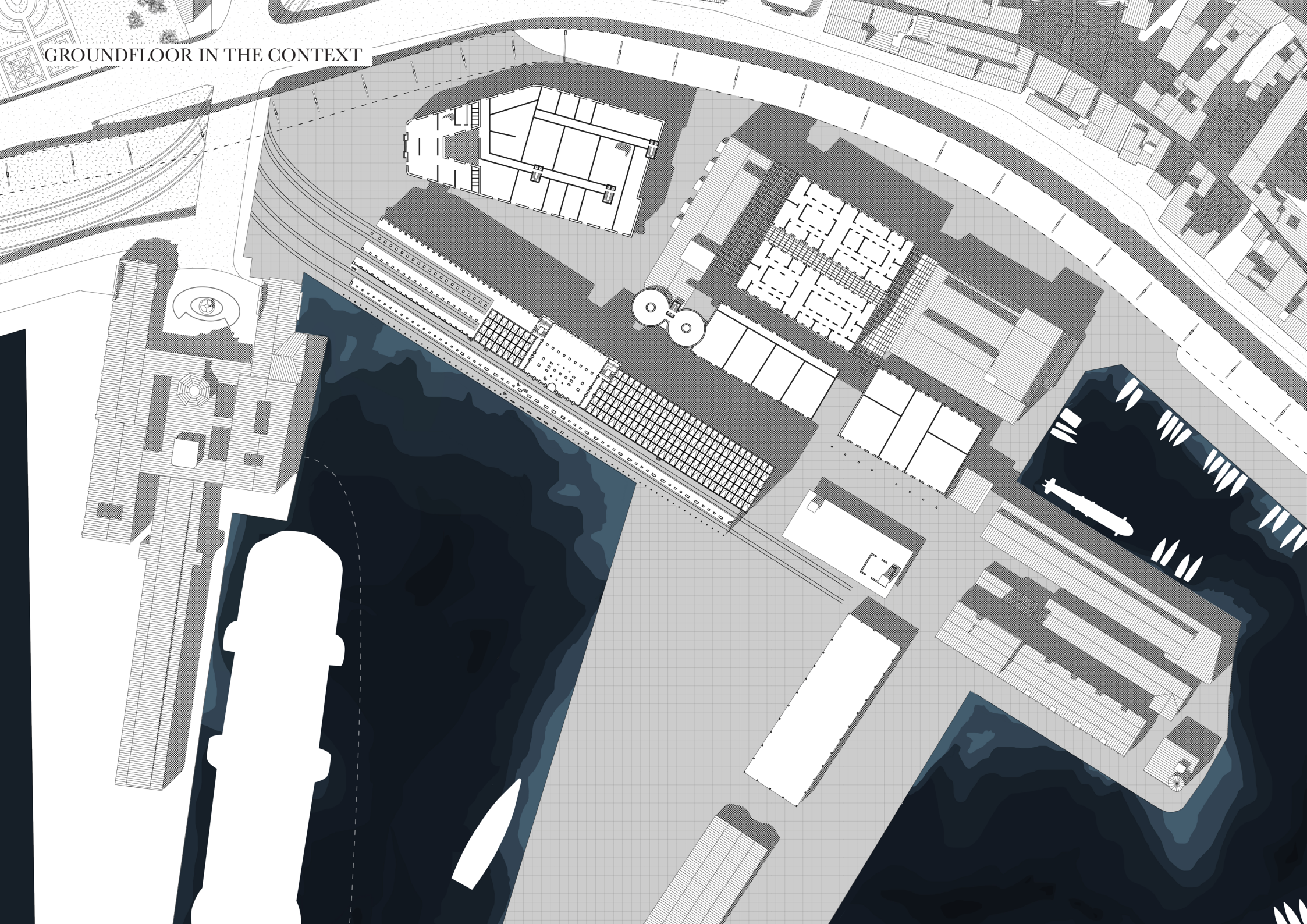
- maintain the facade on the sea side
- keep the central tower as a main characterizing element of the construction
- keep the intervention confined within the existing volume of the building



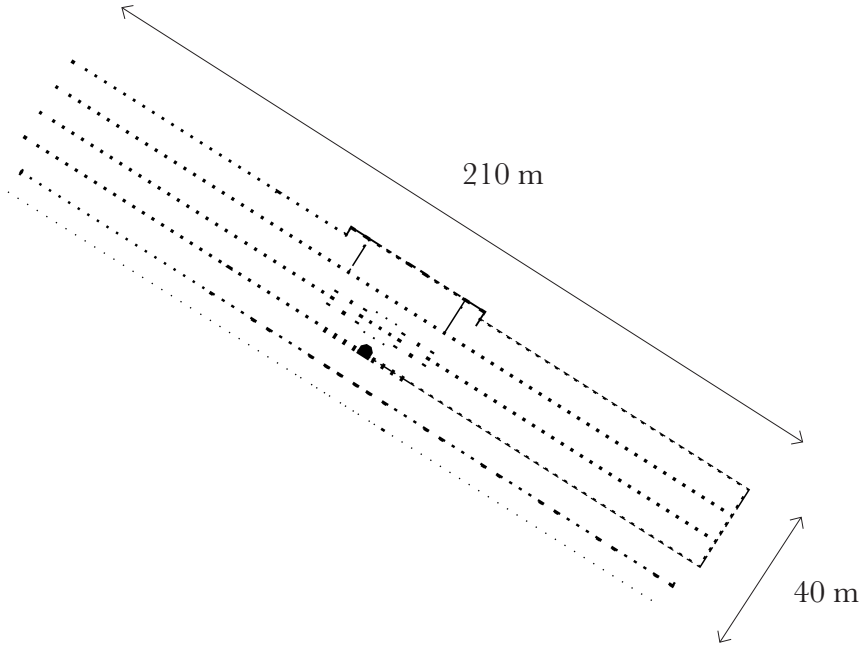
MUNICIPALITY

- public functions must be 51% of the total surface
- proposed main functions:
  public services
  hotel
  market
- proposed secondary functions:
  private services
  shops/retail
  local community spaces (max 10%)
  parkings (not necessarely within the plot)

GROUNDFLOOR IN THE CONTEXT

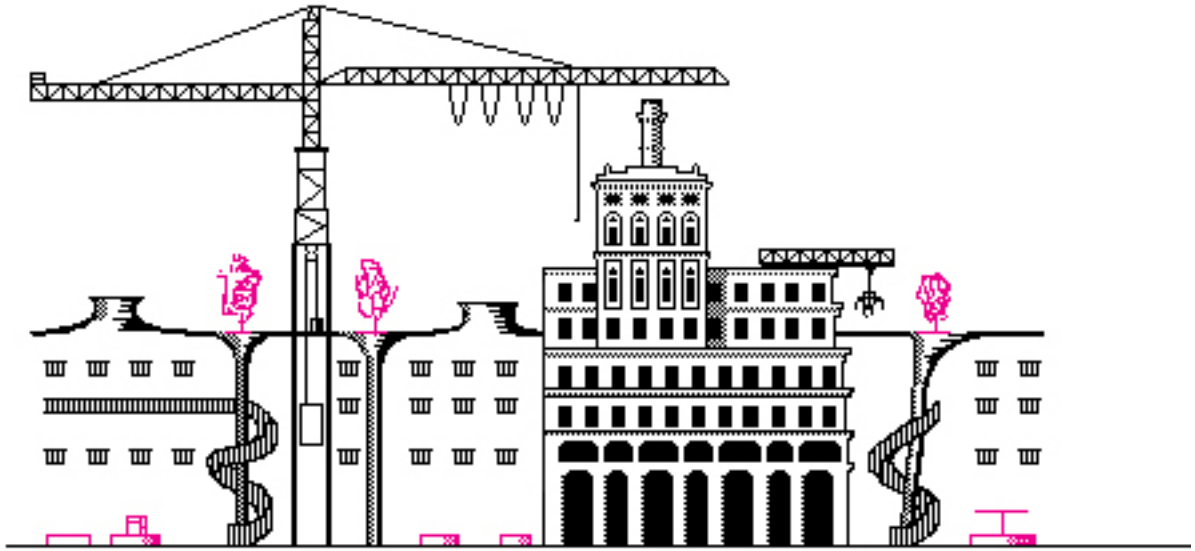


STRUCTURAL LAYOUT



How is it possible to push the boundaries of architecture, while maintaining the greatest possible degree of feasibility and complying with the restrictions?

3.CONCEPT



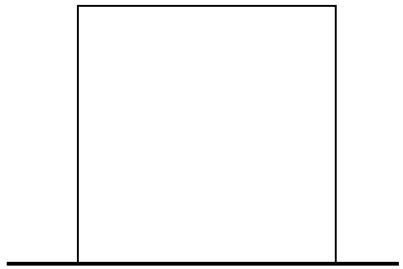
Terrazze di marmo
Ignazio Gardella Sr.
1835 - 1886

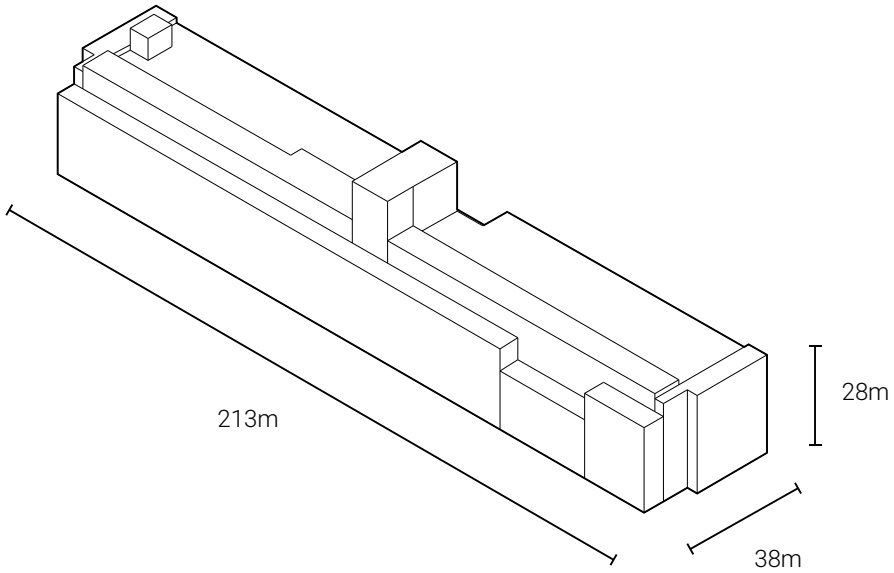
Terrazze di marmo
Ignazio Gardella Sr.
1835 - 1886

CONCEPT

CONCEPT

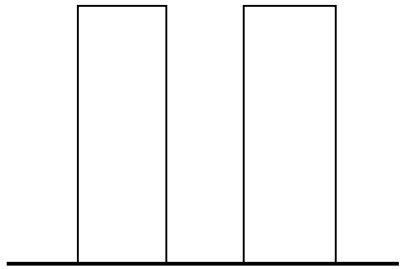
STEP 0

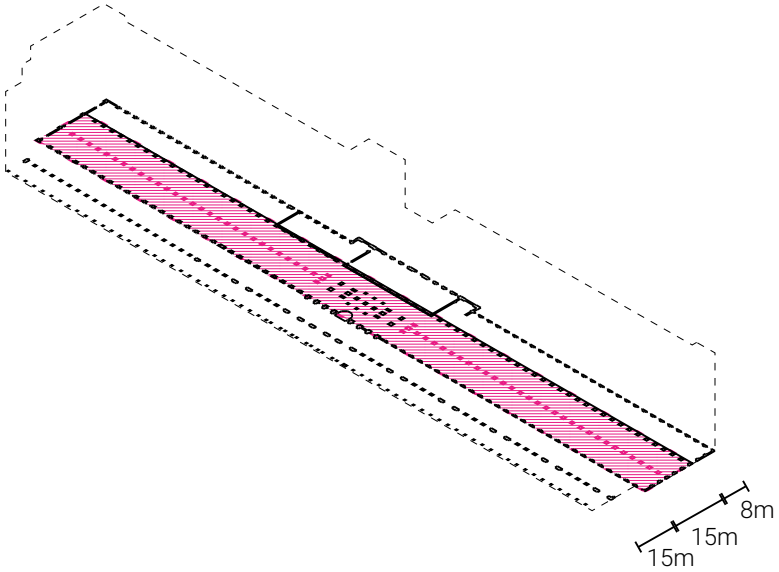




Existing situation

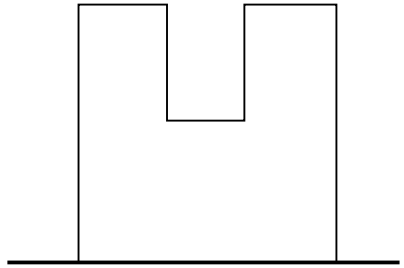
STEP 1

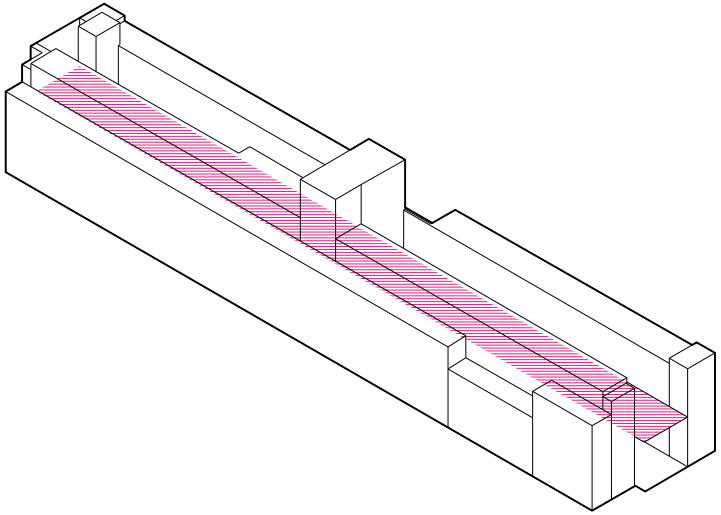




Split

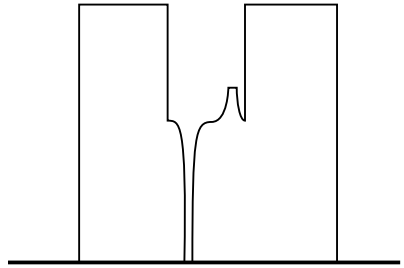
STEP 2

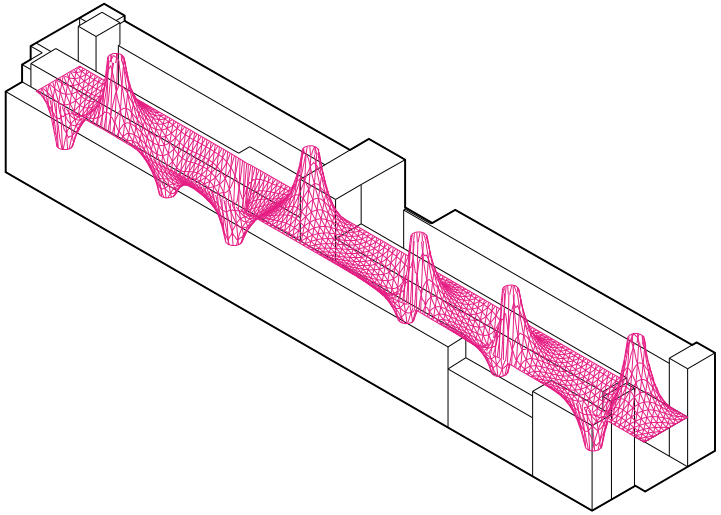




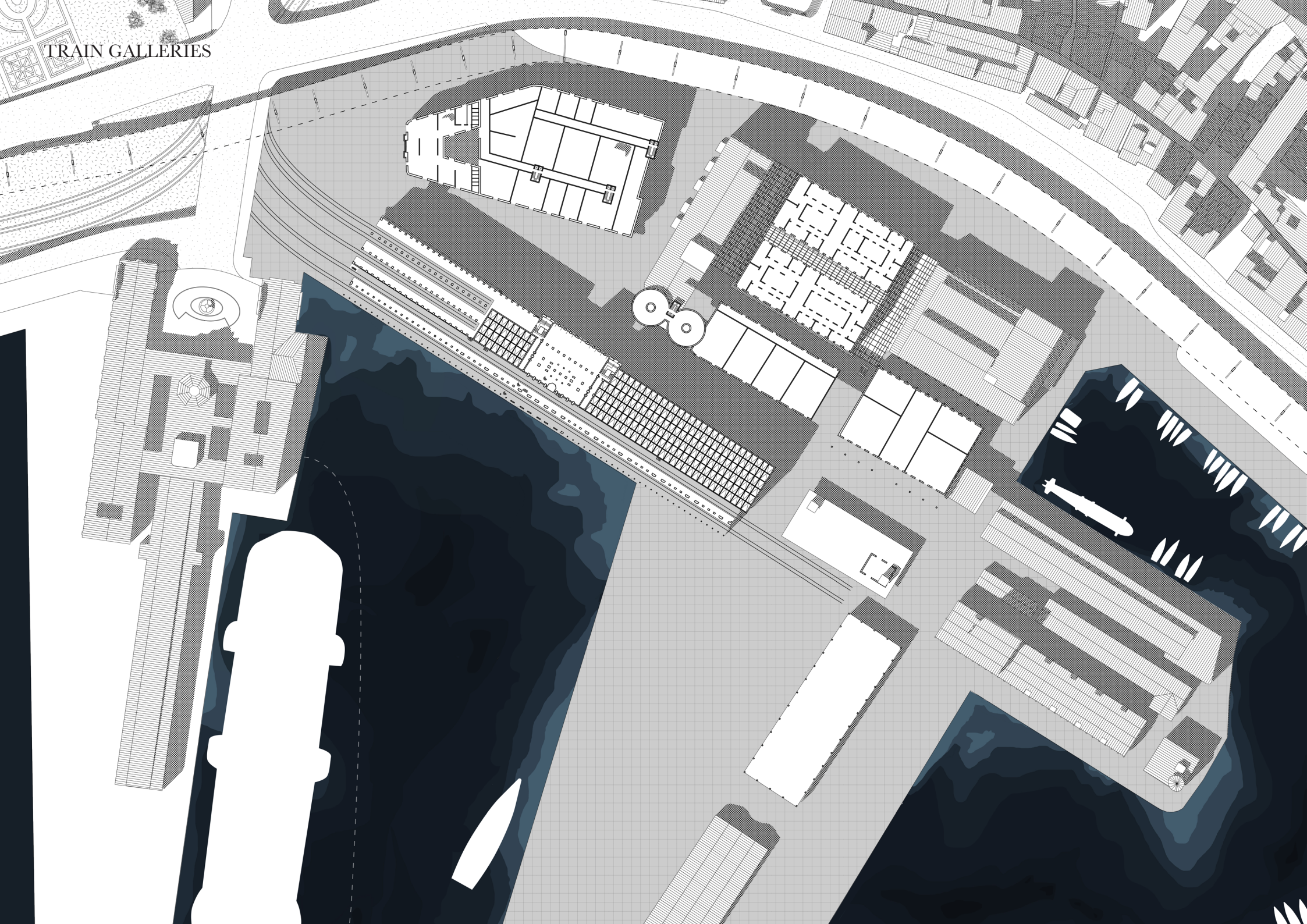
Elevate

STEP 3





Articulate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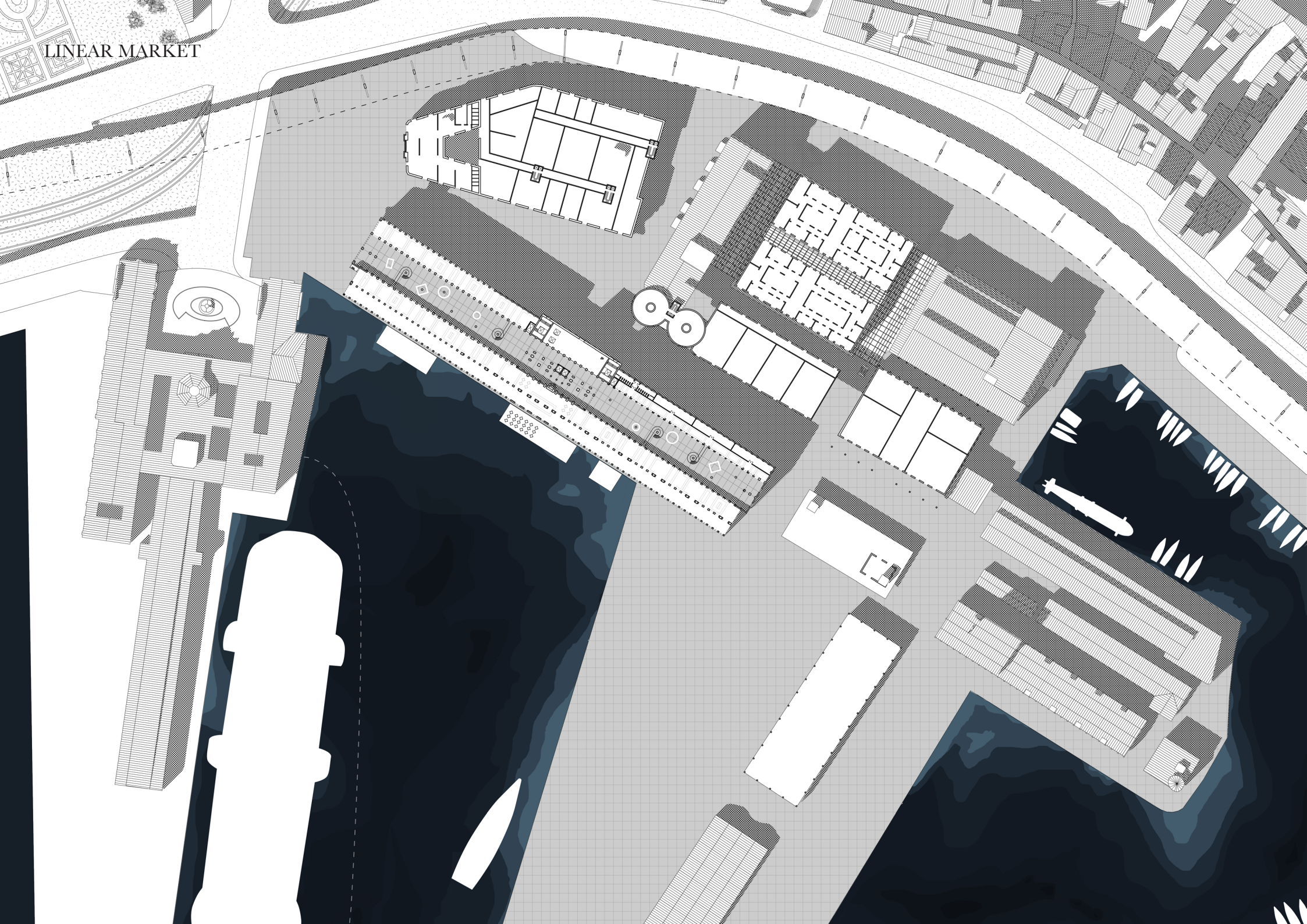
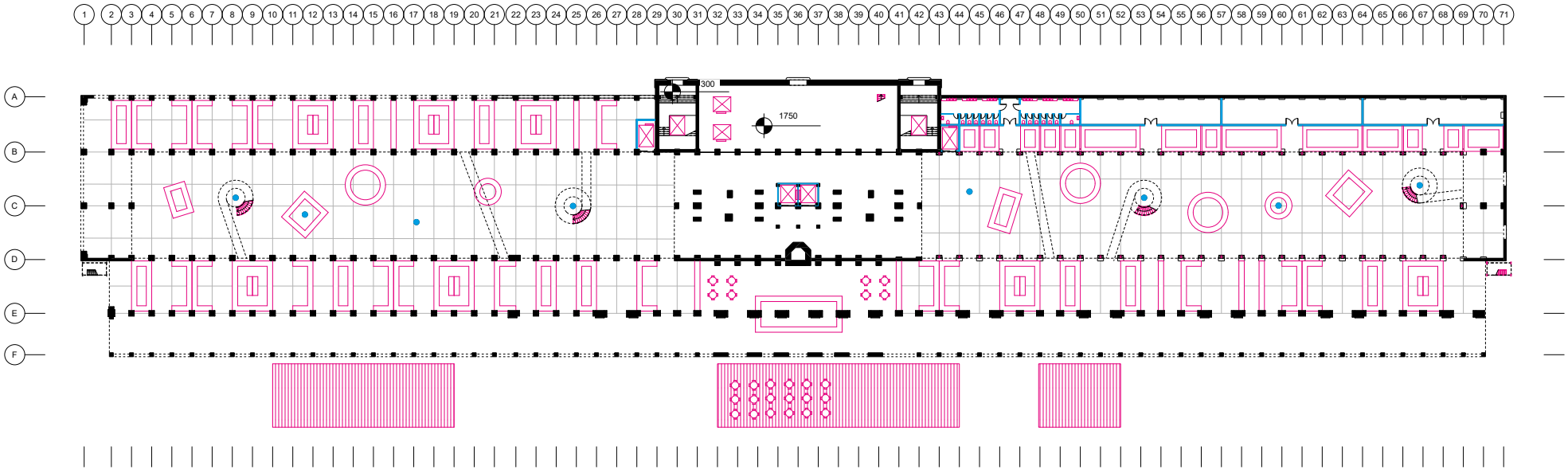
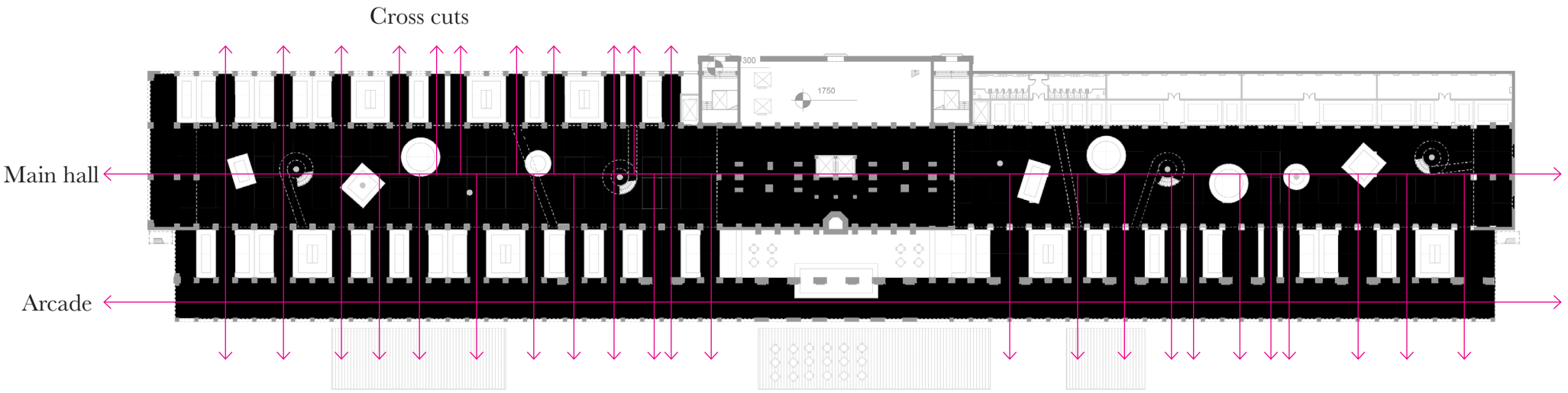

LINEAR MARKET



Groundfloor

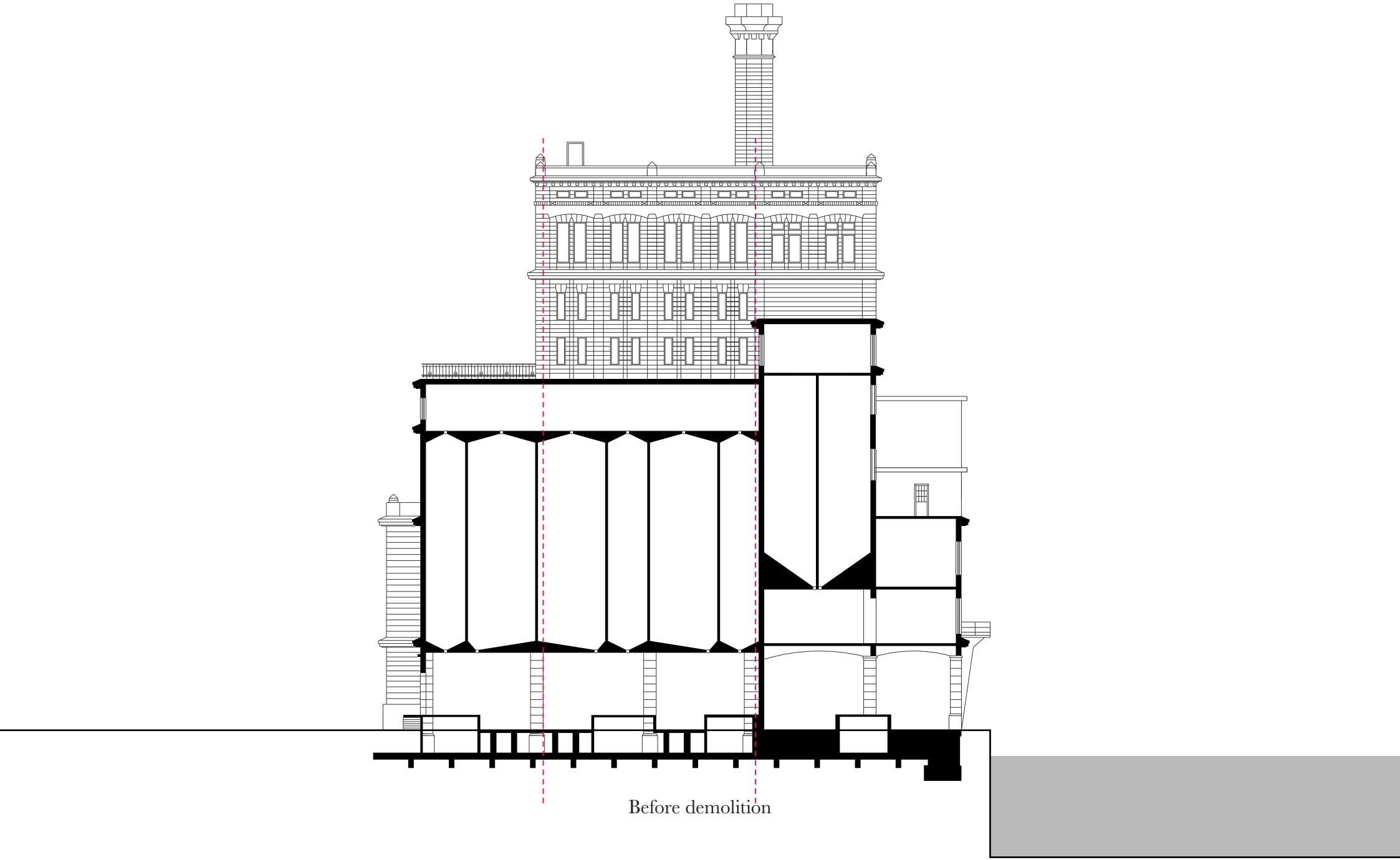
POROSITY



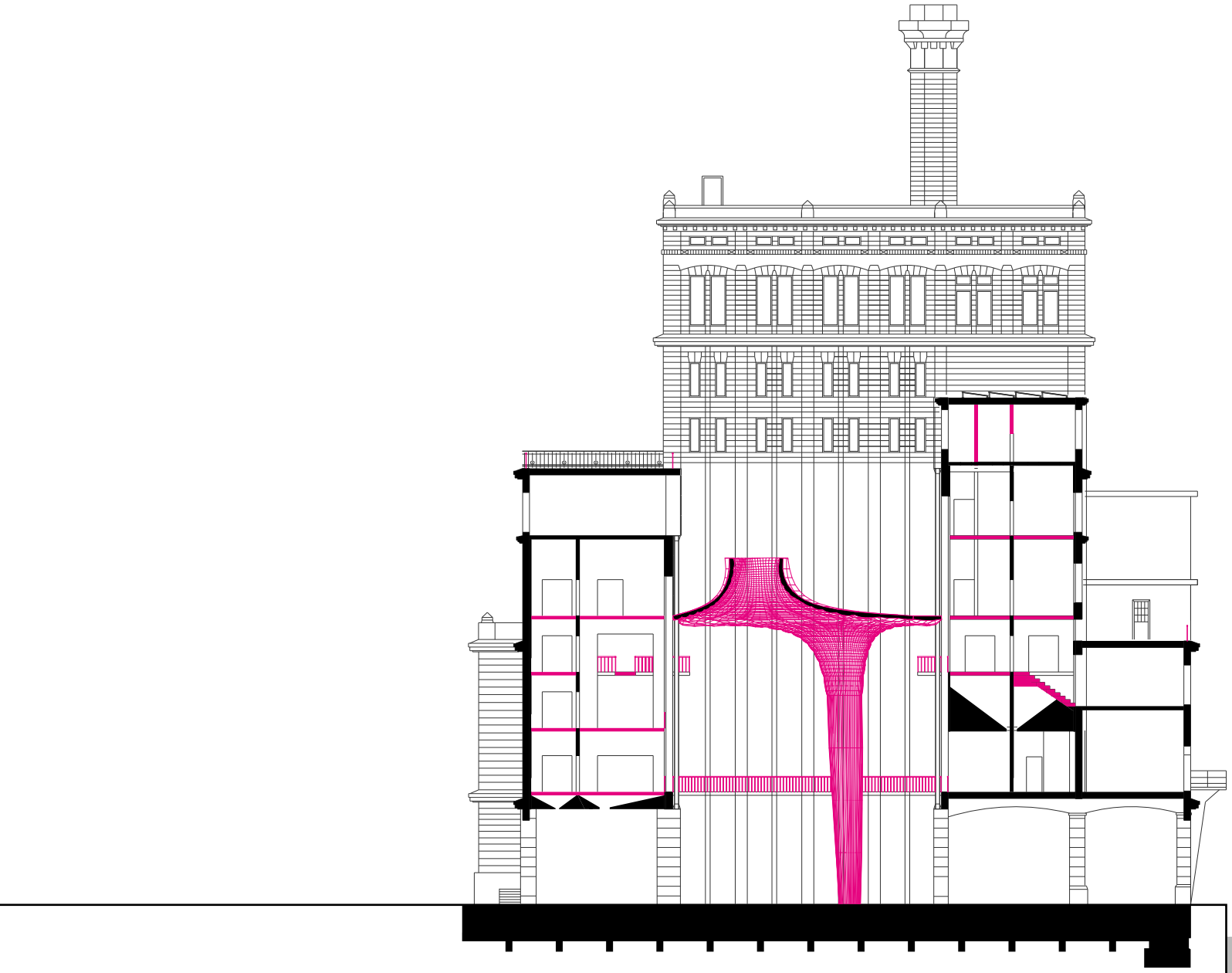
Groundfloor

The arcade

Cross cut towards the sea

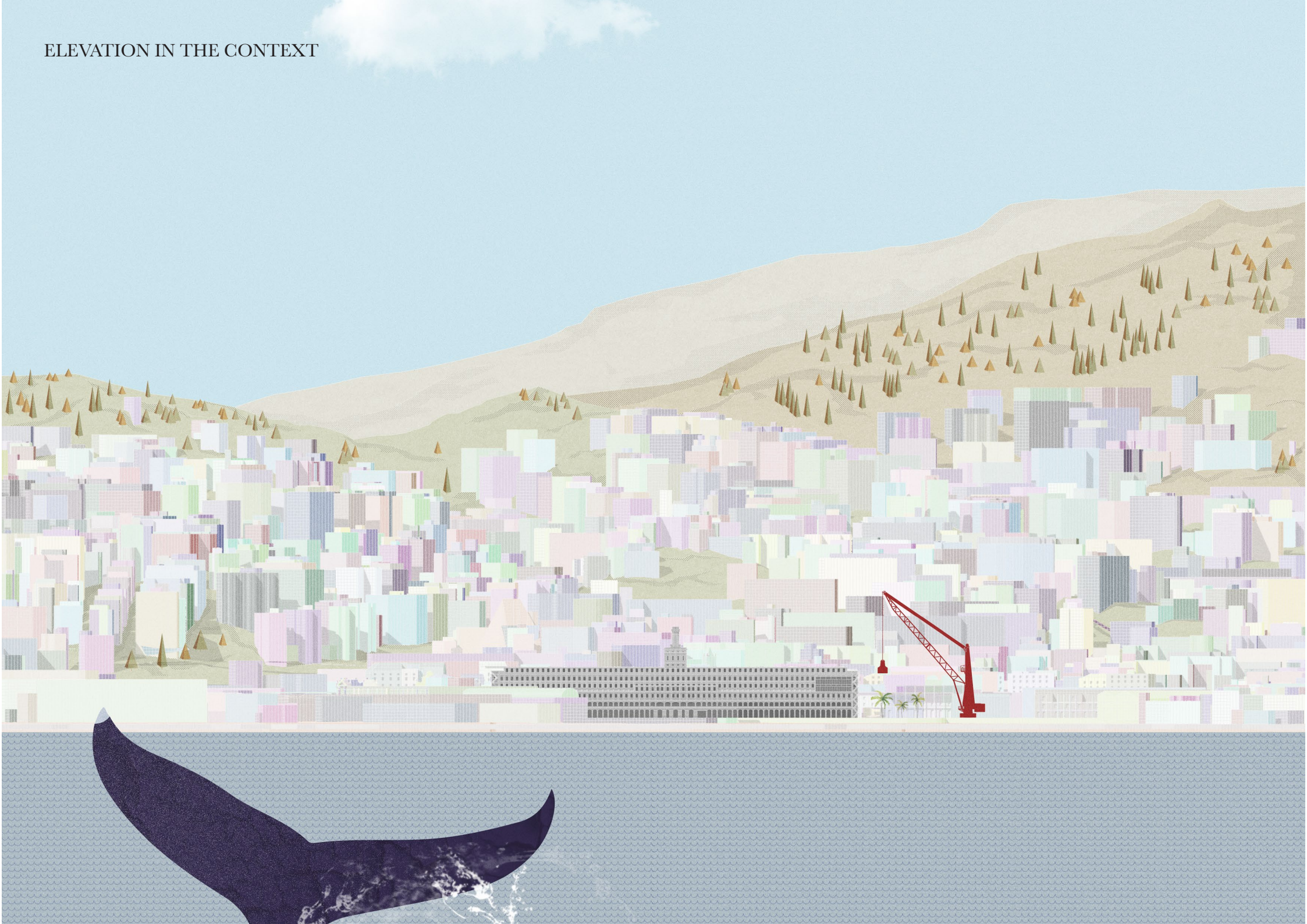


Before demolition

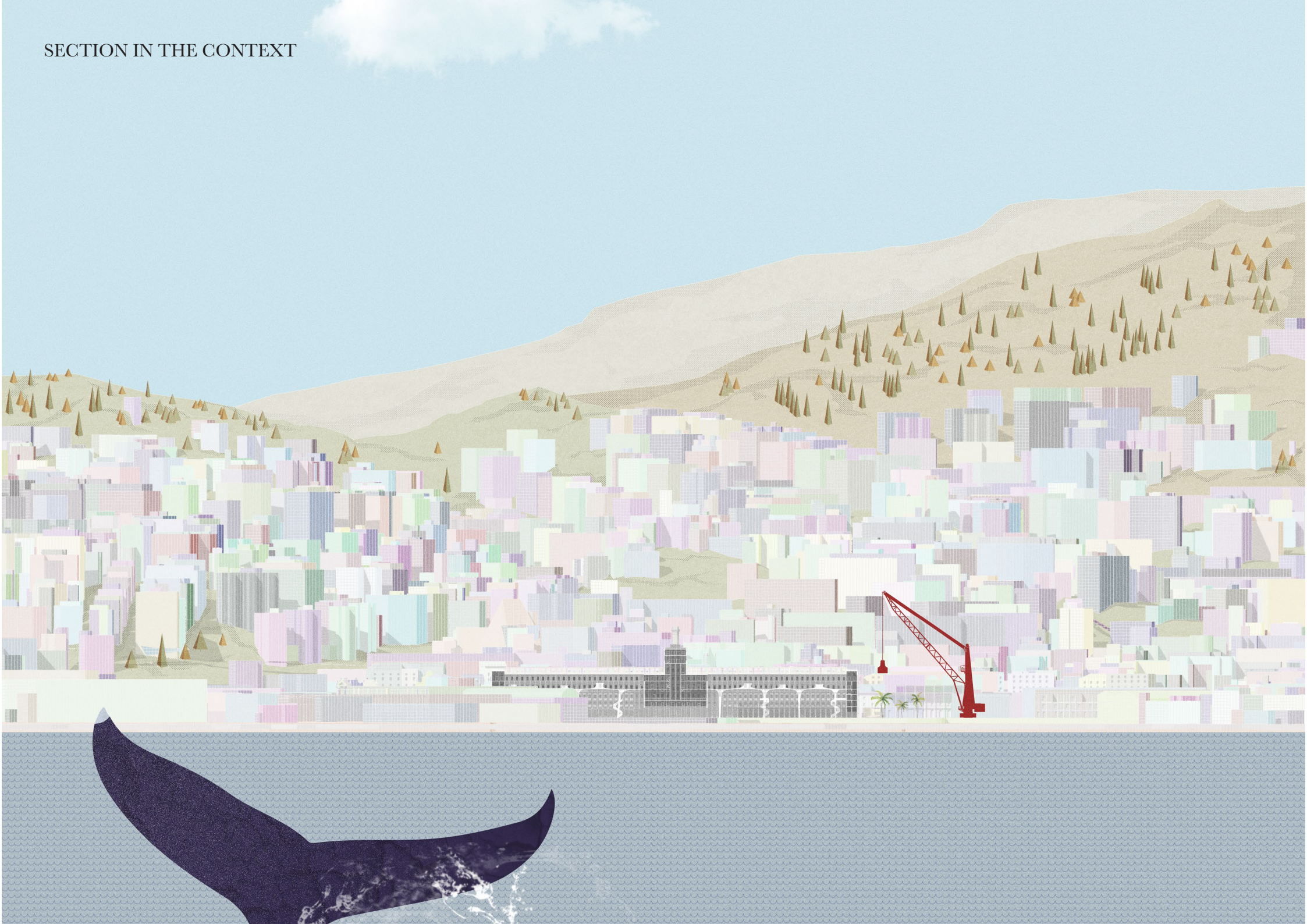


After demolition

ELEVATION IN THE CONTEXT



SECTION IN THE CONTEXT



PROGRAM

hotel

- Rooms and service spaces
- Spa and gym

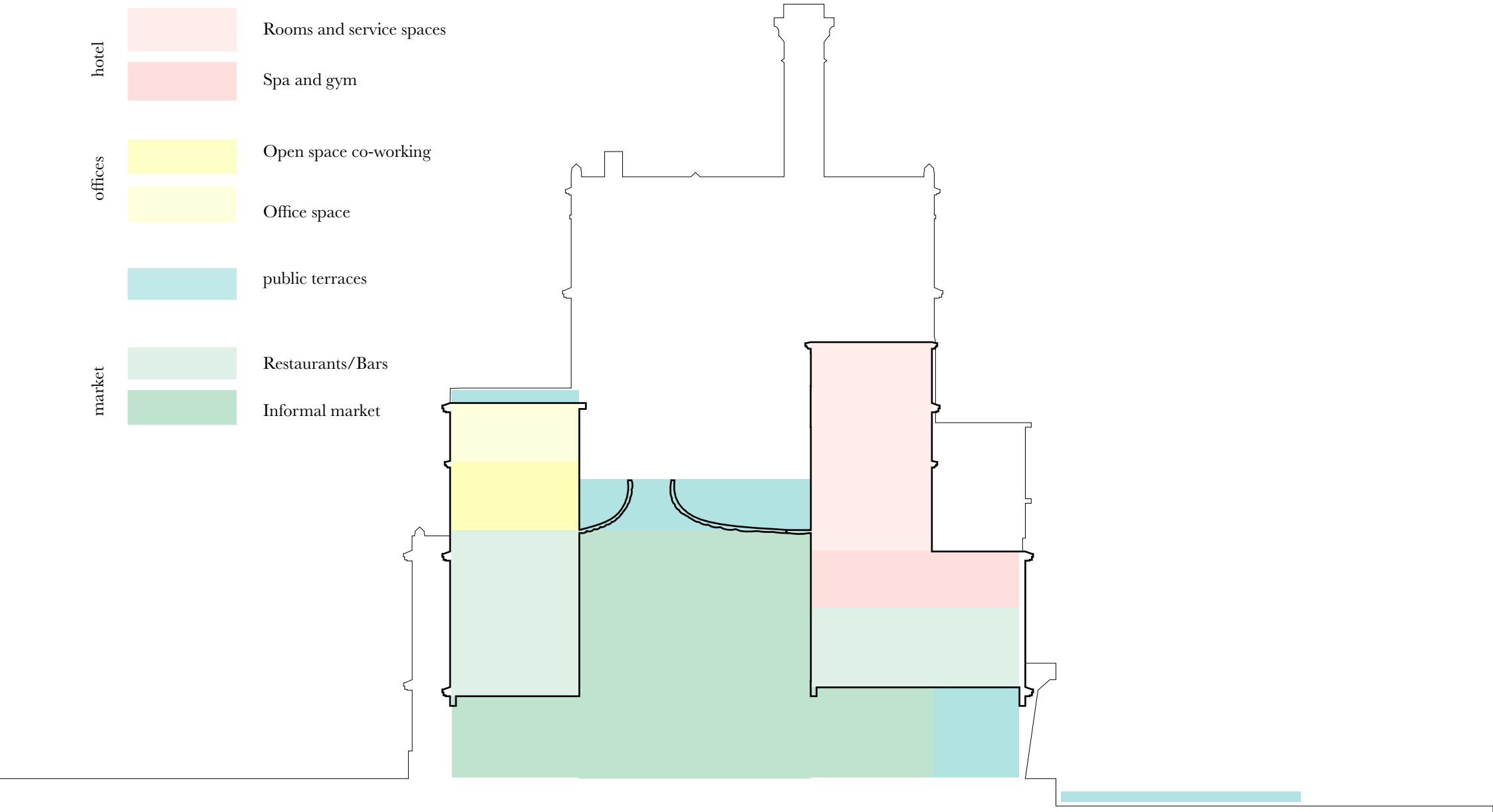
offices

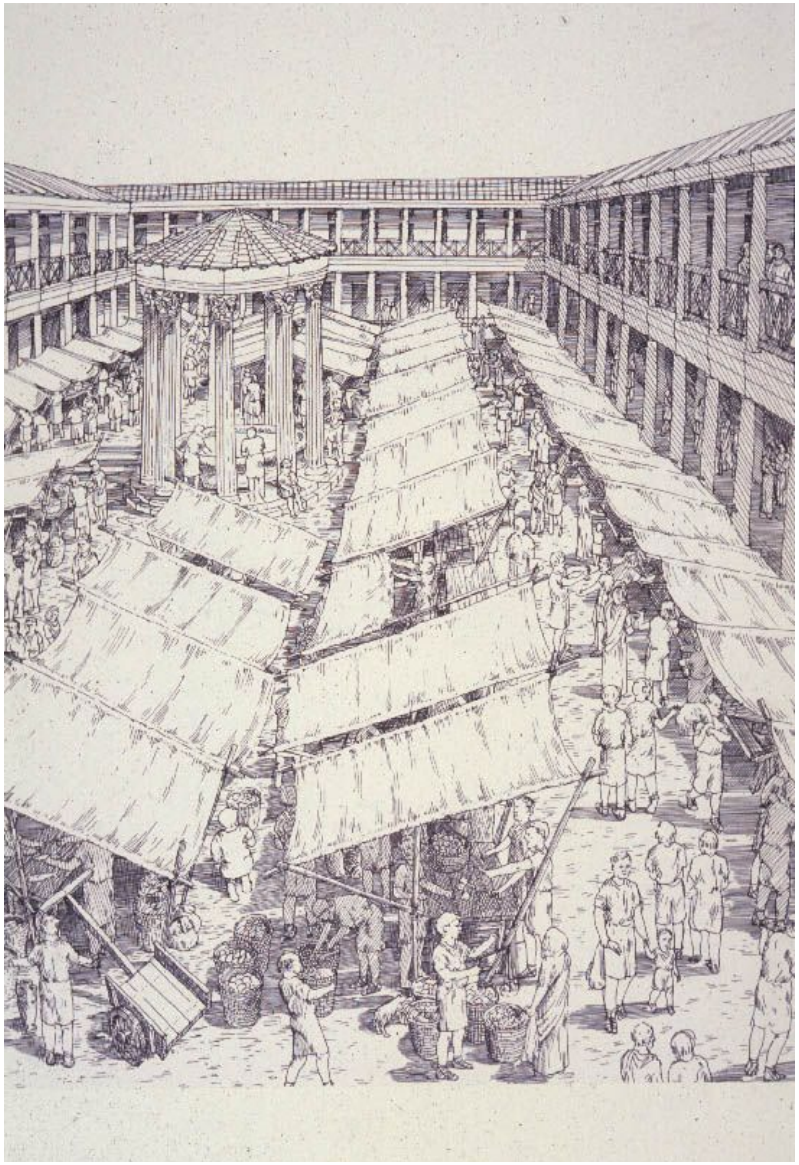
- Open space co-working
- Office space

- public terraces

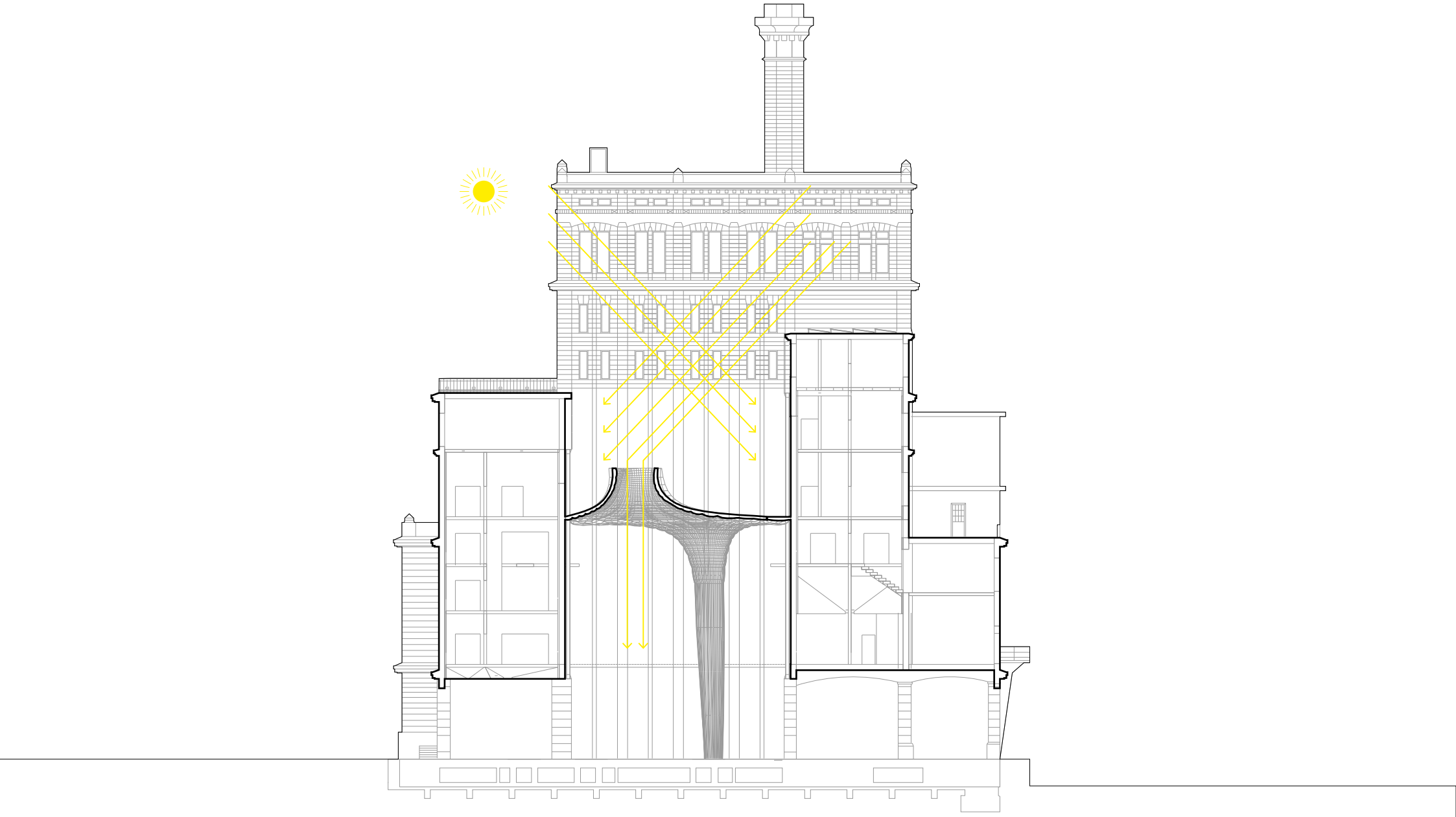
market

- Restaurants/Bars
- Informal market

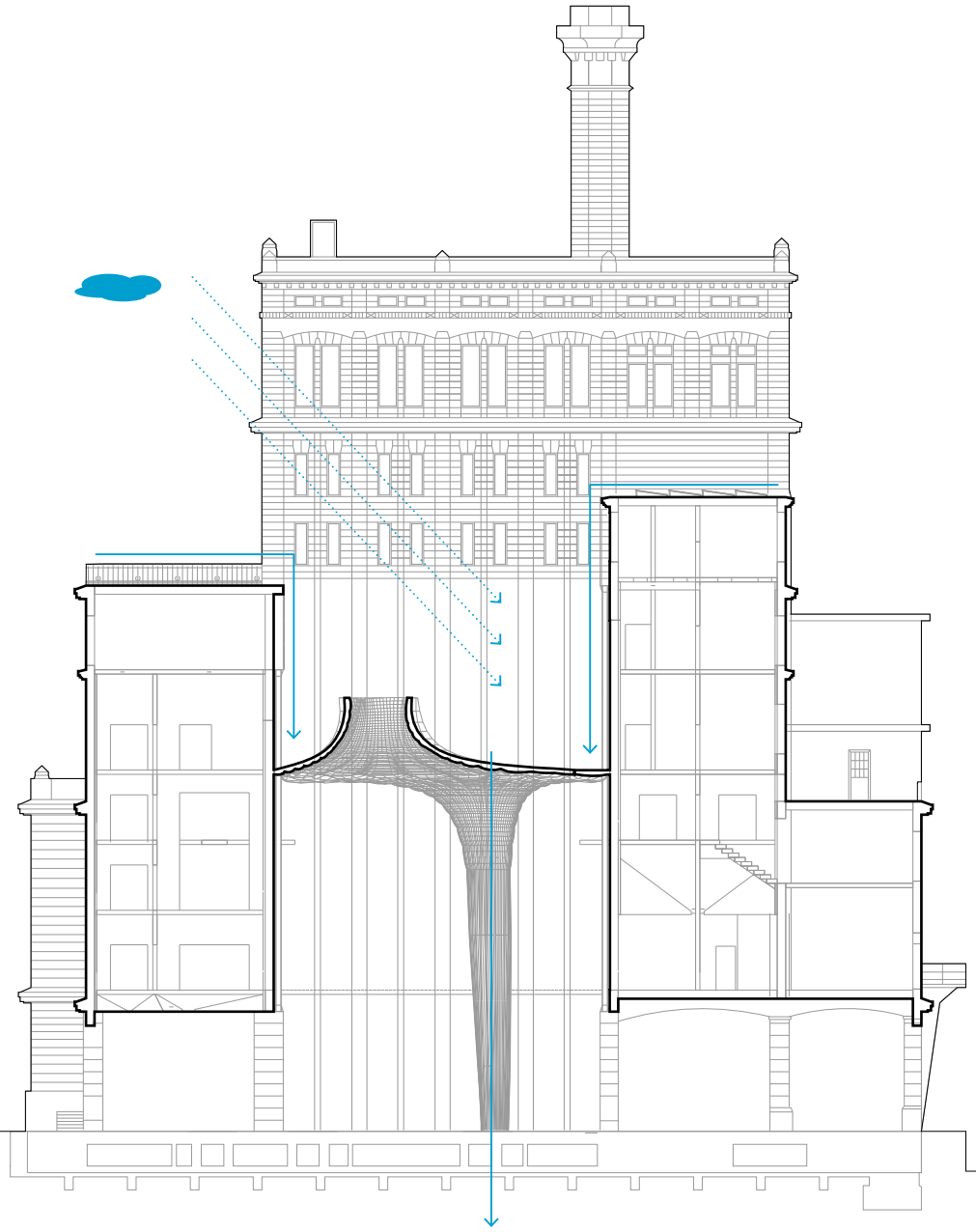




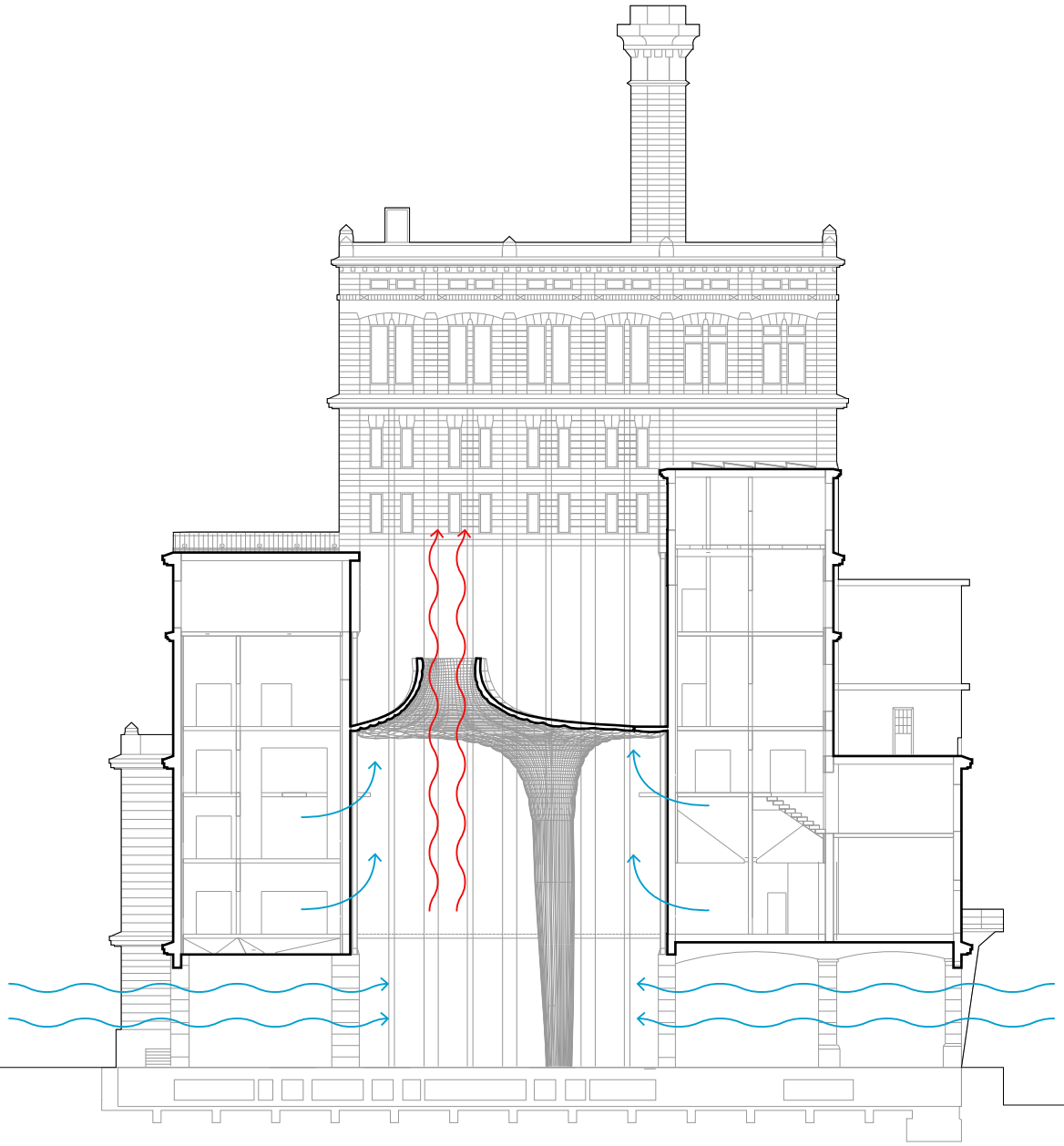
Organization and layout



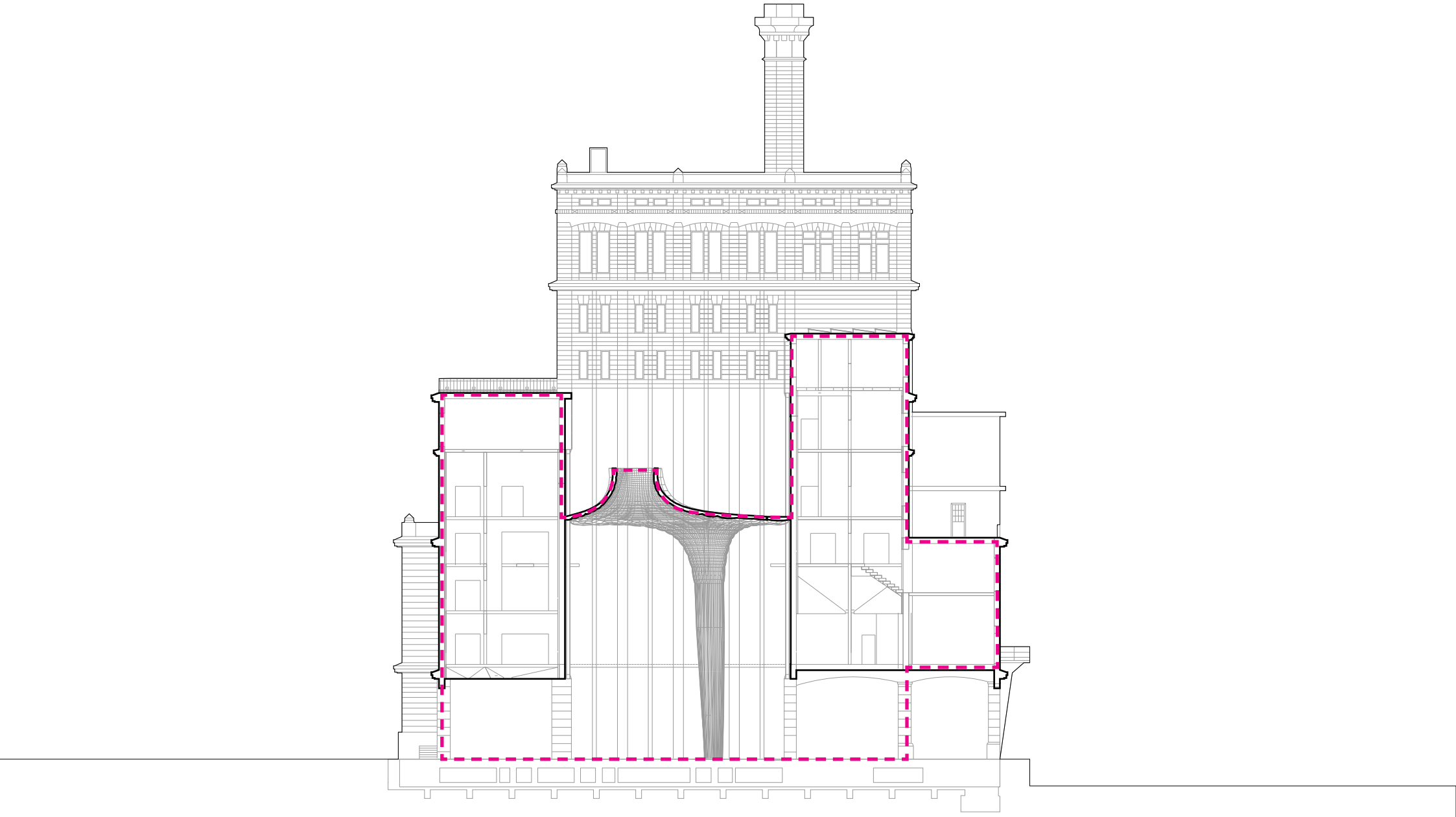
light diagram



Water management

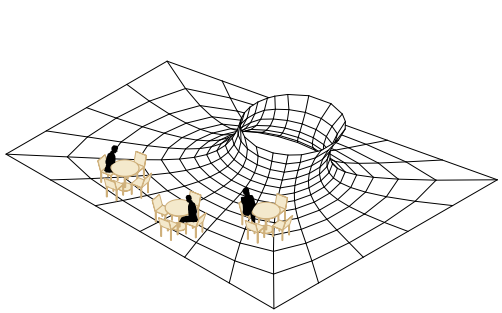


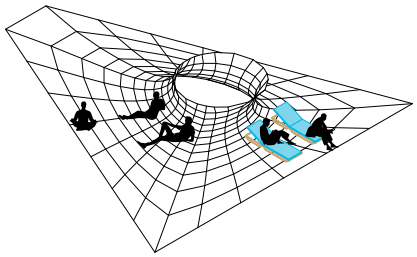
Climate and air flow

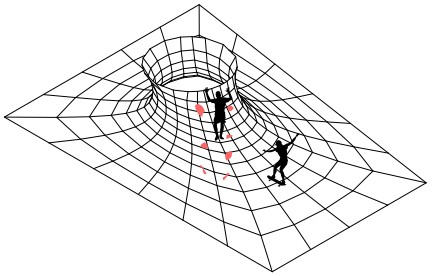


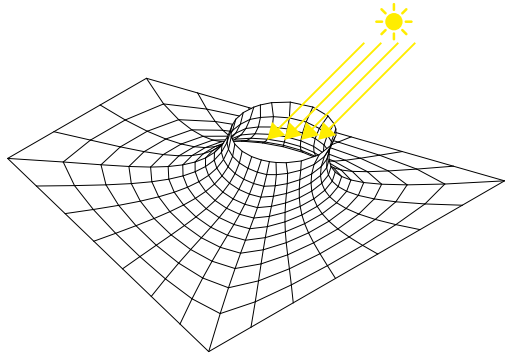
Thermal line

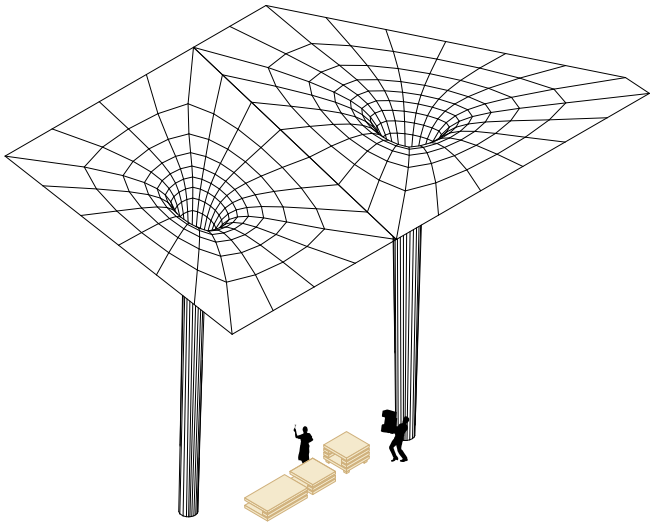
USES OF THE SPACE

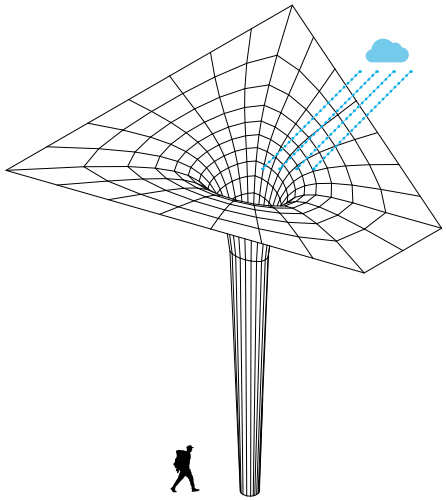


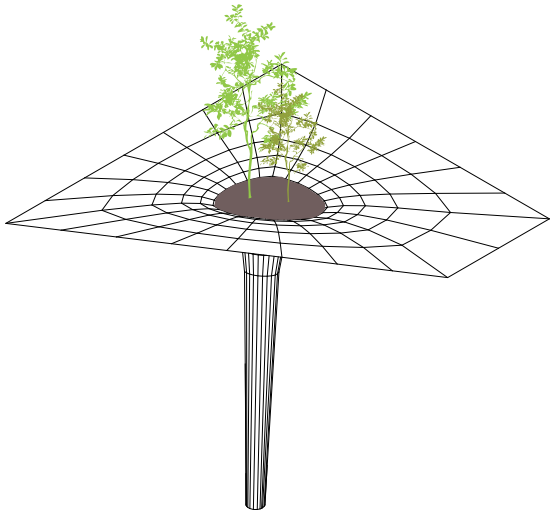


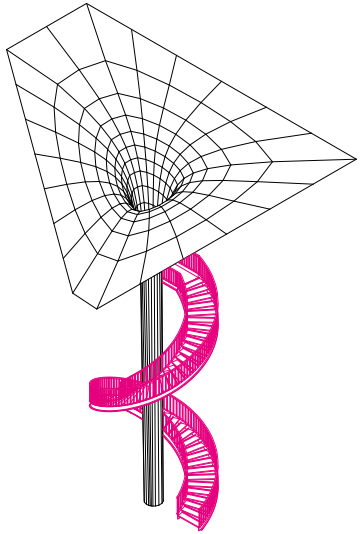




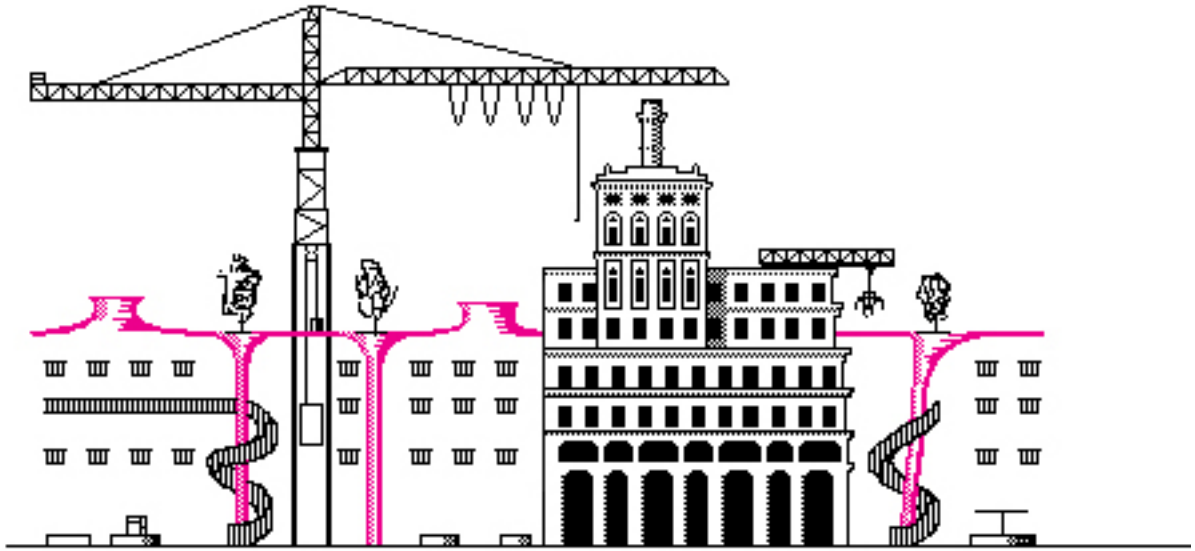


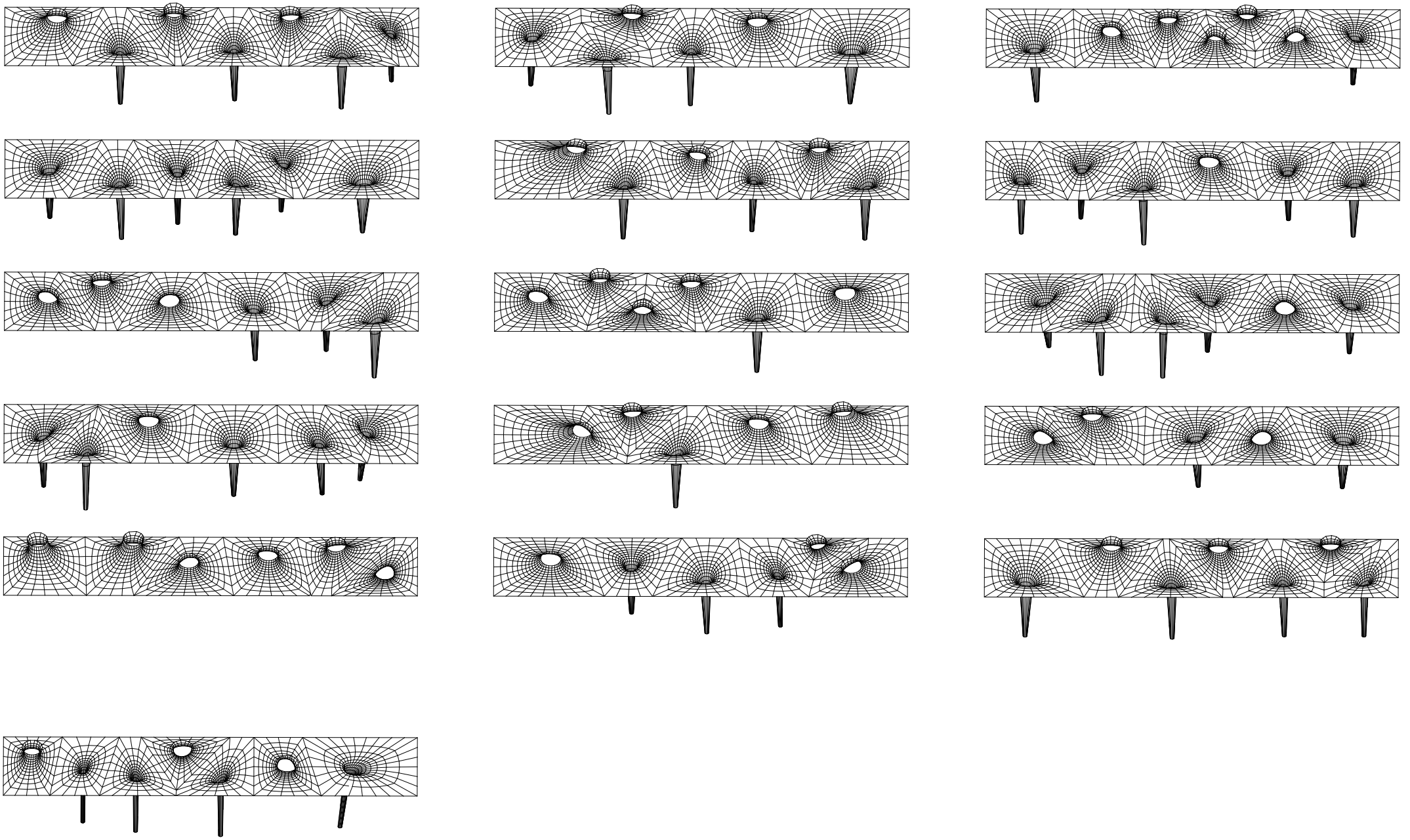






4.RESEARCH





Form studies

Table 2.1: Comparison of various formwork methods

method	amount of manual labour needed	machining and tooling	costs	speed of shaping	freedom of form	surface quality	reuse of shaped elements	recycling of raw material
timber formwork	large, usually on-site	high-tech only if complex shape	high	low	large, but complex shapes require CNC	medium (shuttering generally visible)	limited, and if same shape	yes
steel formwork	limited, due to repetition	high-tech only if complex shape	high	low	limited (double- curved is expensive)	high	often, if same shape	yes
CNC-milling	average, mainly finishing	high-tech	high	medium	practically unlimited	high, if finished properly	only in mould banks	partially
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fabric formwork (air)	limited, during erection of inflatable shape	cutting patterns / sewing	medium	high	limited to controllable pneumatics	high, depending on fabric	yes, if same shape	partially
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3D-printing	limited, set-up of installation	high-tech, presently not on full building scale	high	low	large, but limited resolution	low (at present, but improving rapidly)	not applicable	not applicable
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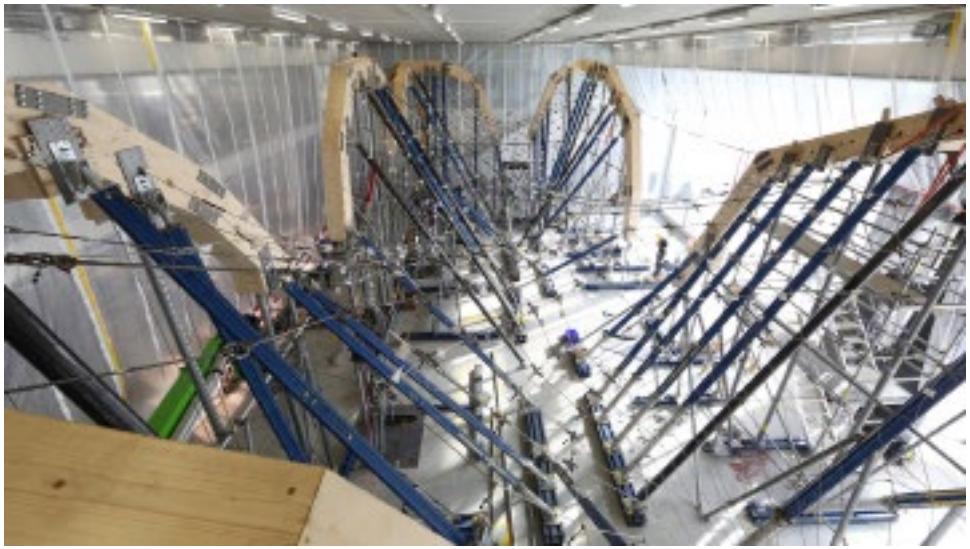
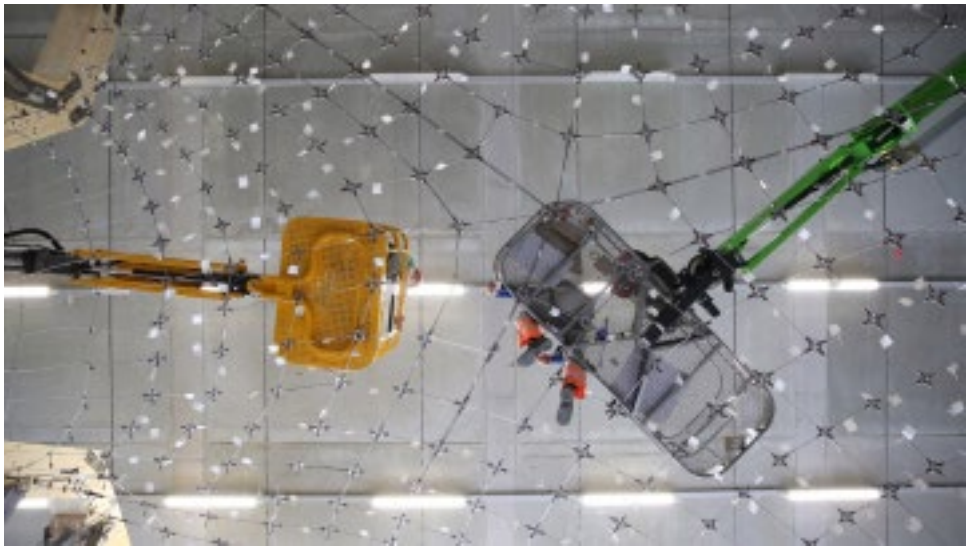
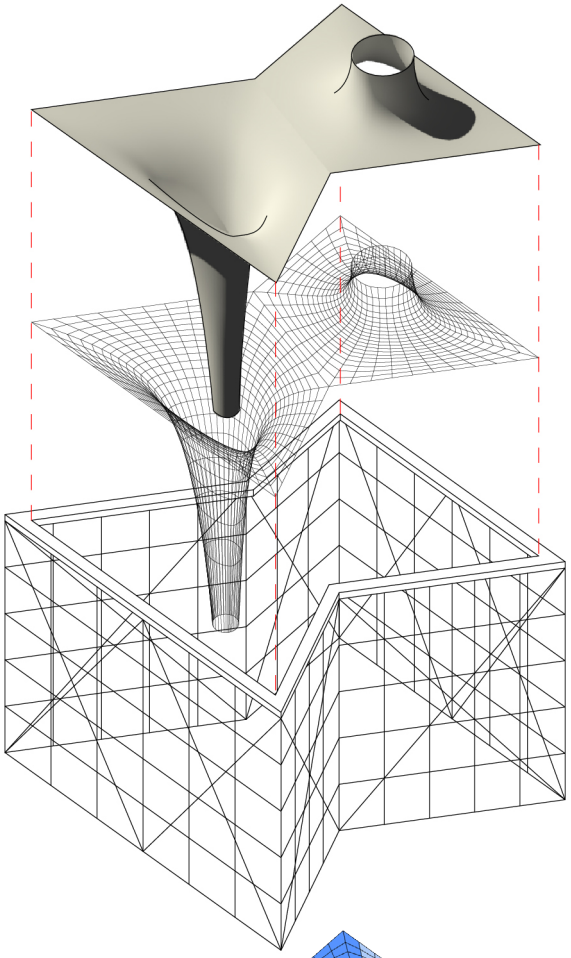
Schipper, H. R. (2015). Double-curved precast concrete elements: Research into technical viability of the flexible mould method.





HiLo roof, ETH Zurich, 2017

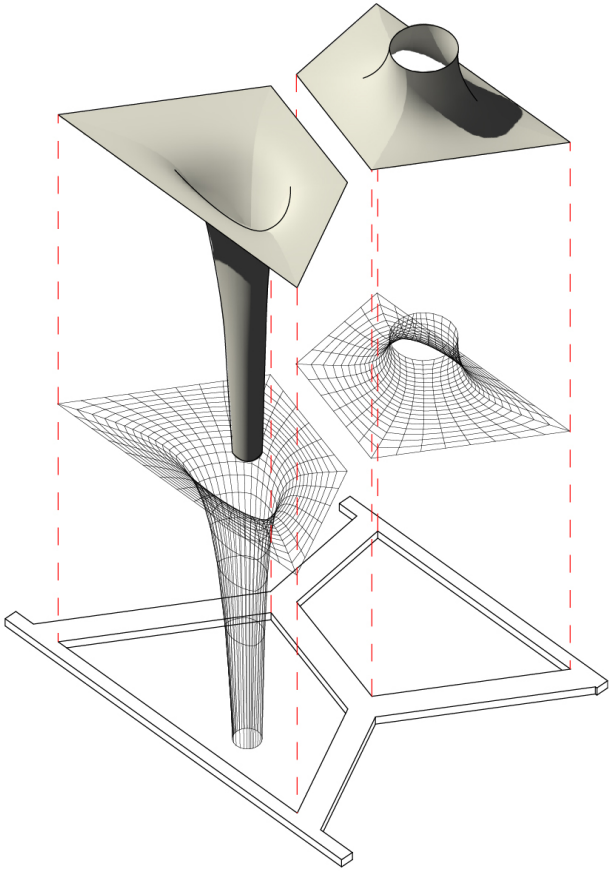
cost breakdown
150/300 €/m²

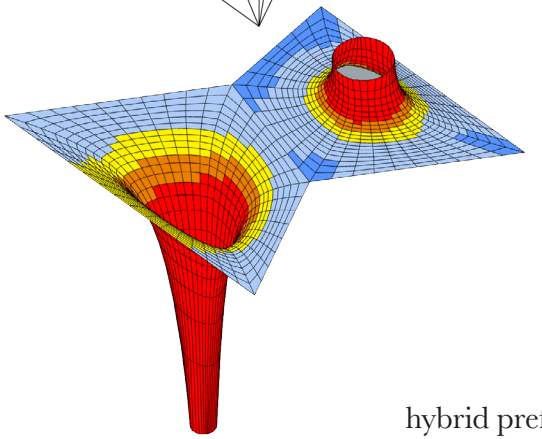


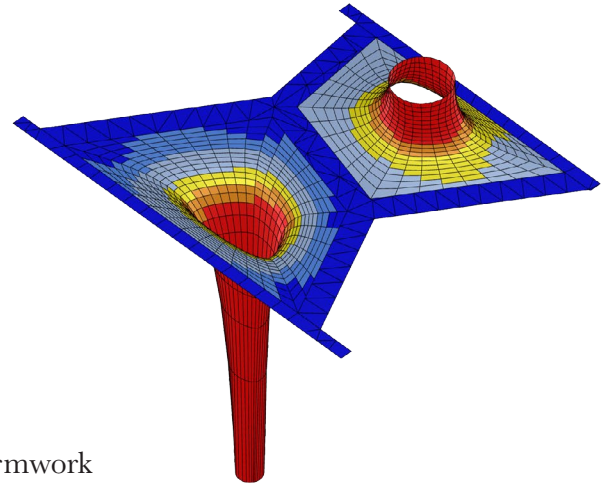
33%
textile

12%
cable mesh

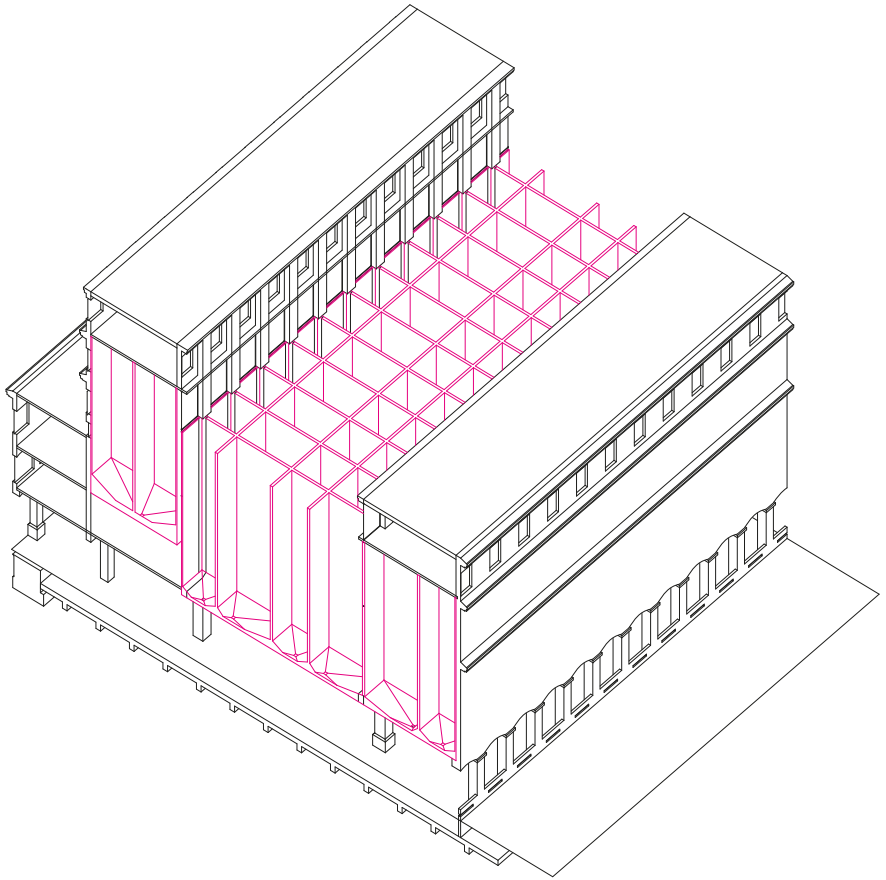
55%
support structure



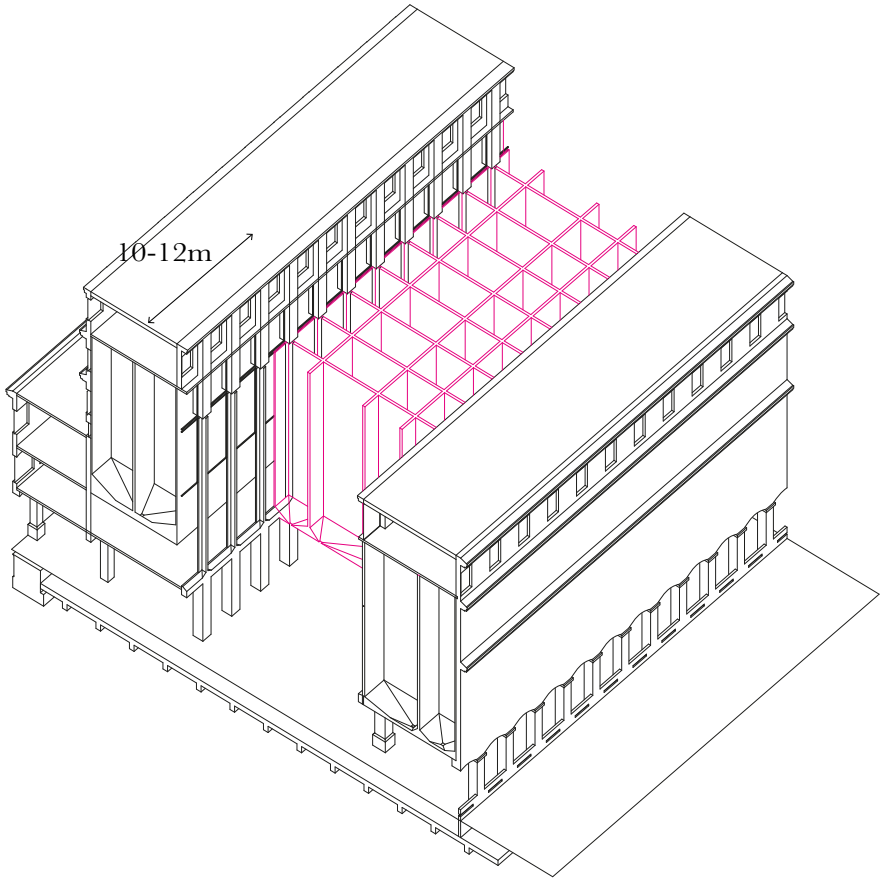




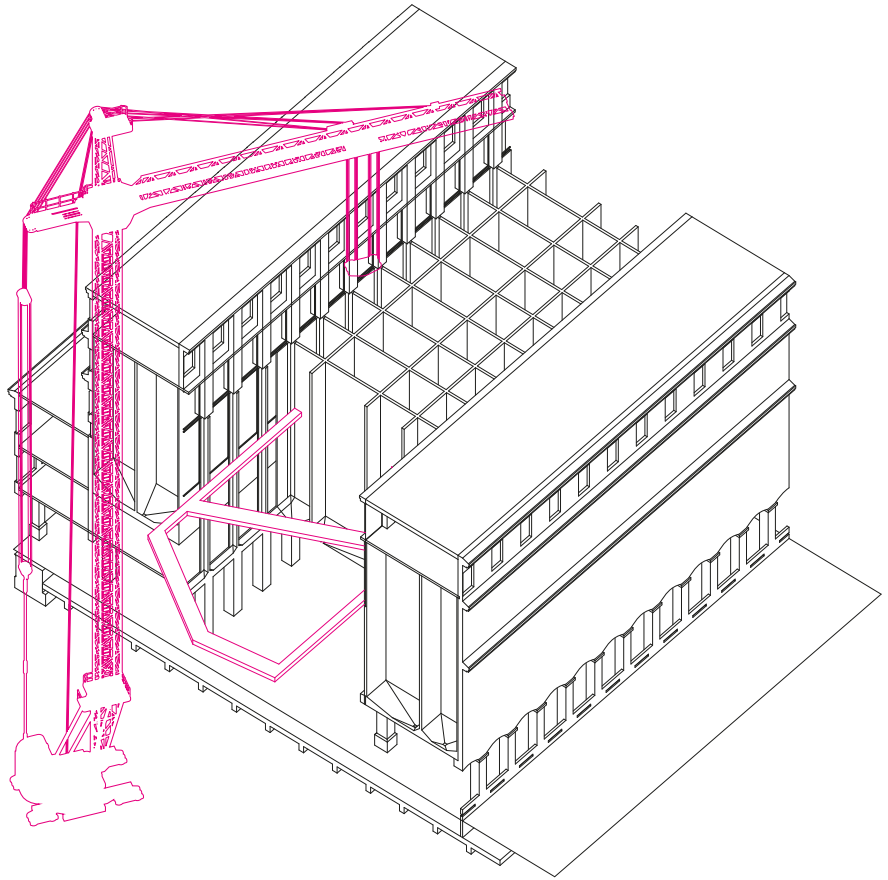
Classic fabric formwork
vs
hybrid prefabricated system for fabric formwork



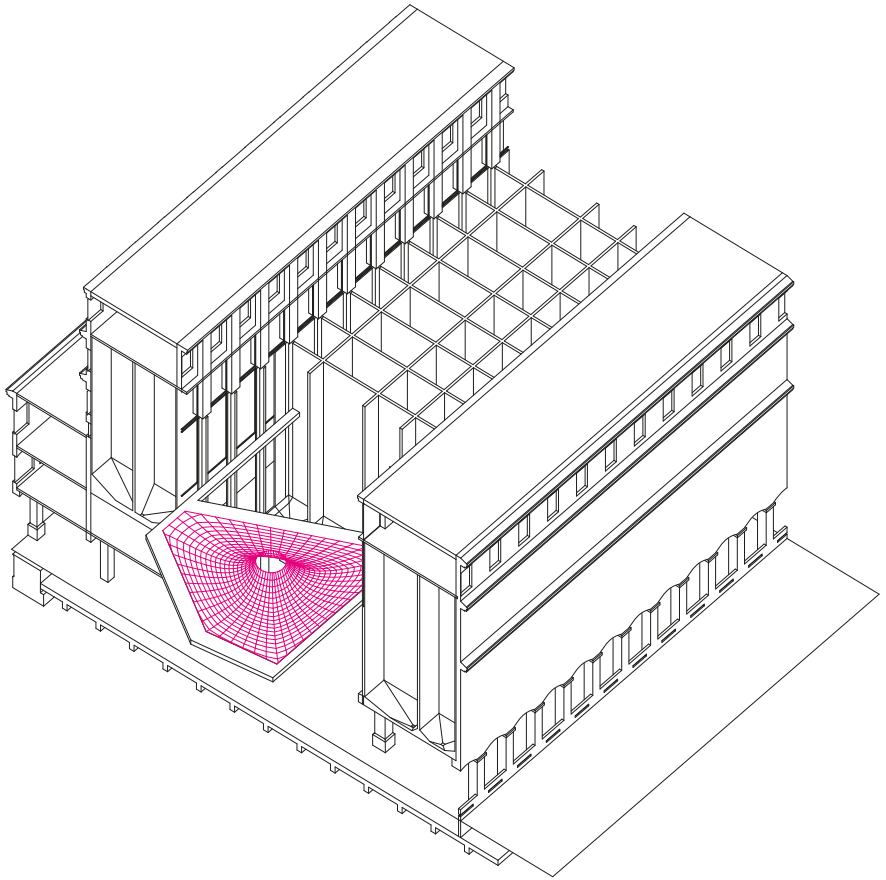
Existing situation



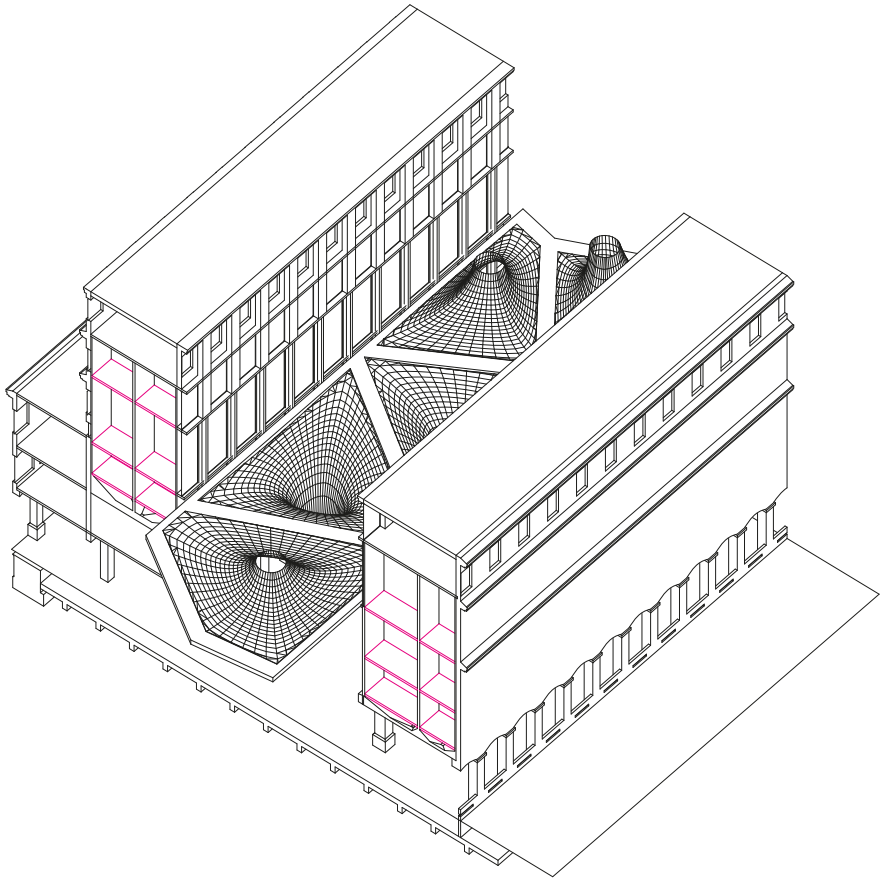
Partial demolition



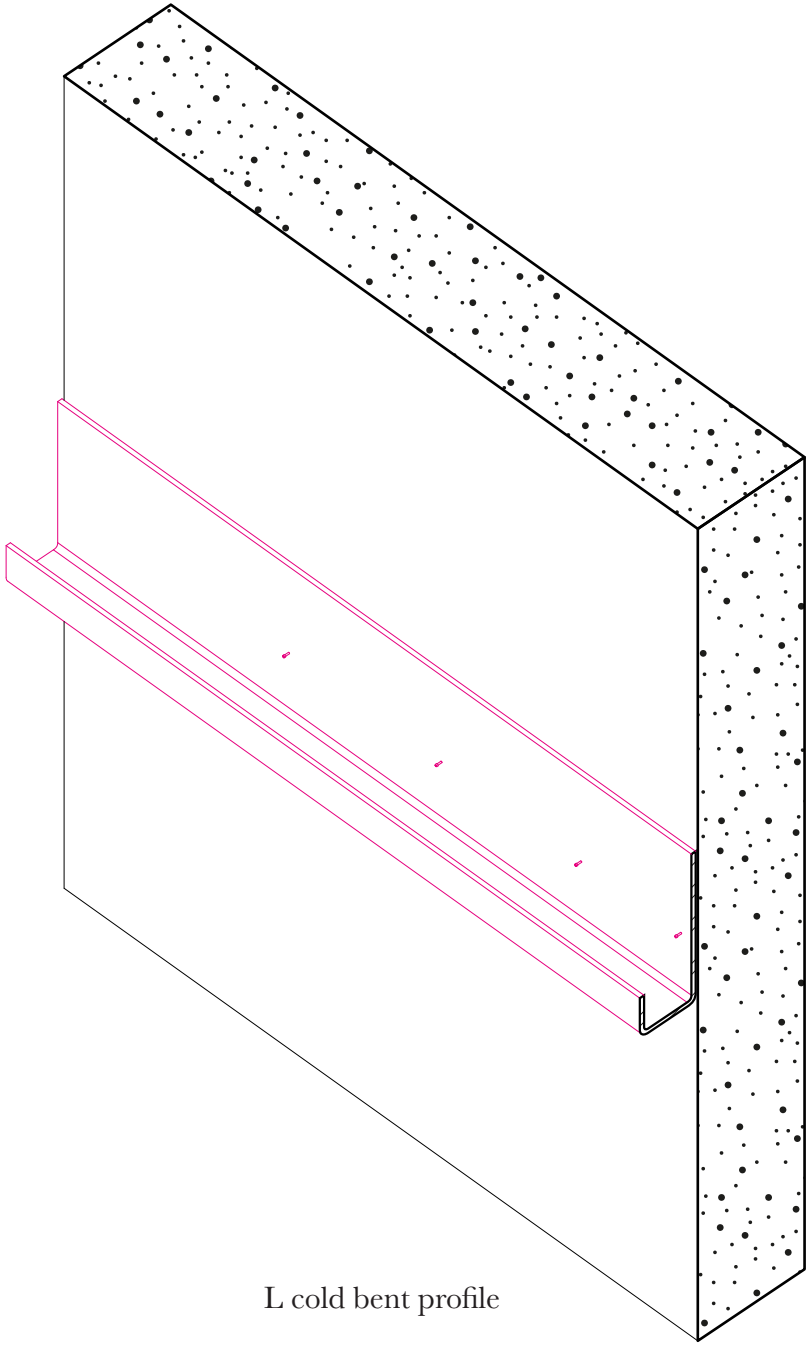
Prefabricated beam



Wire mesh + fabric

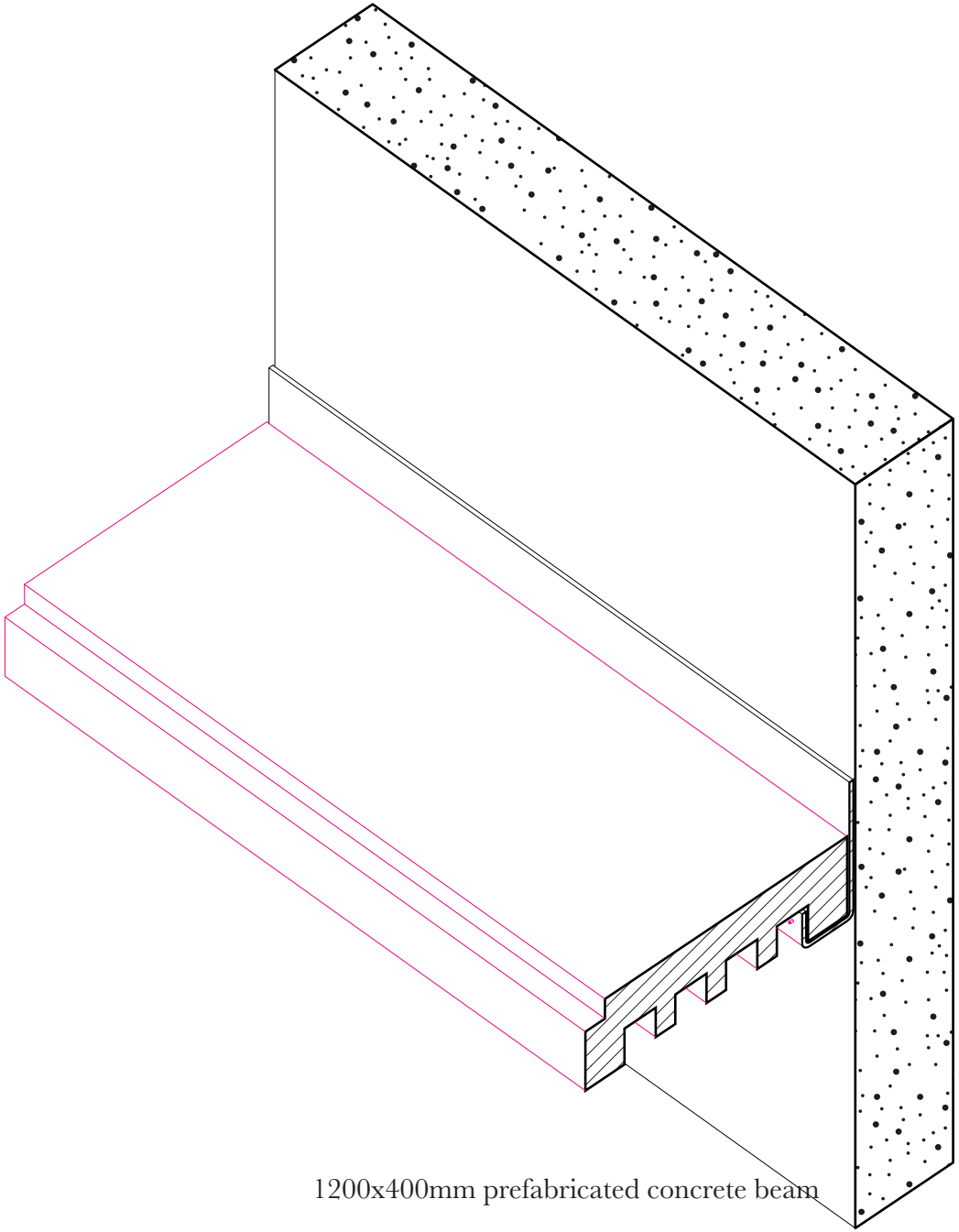


Completed roof structure

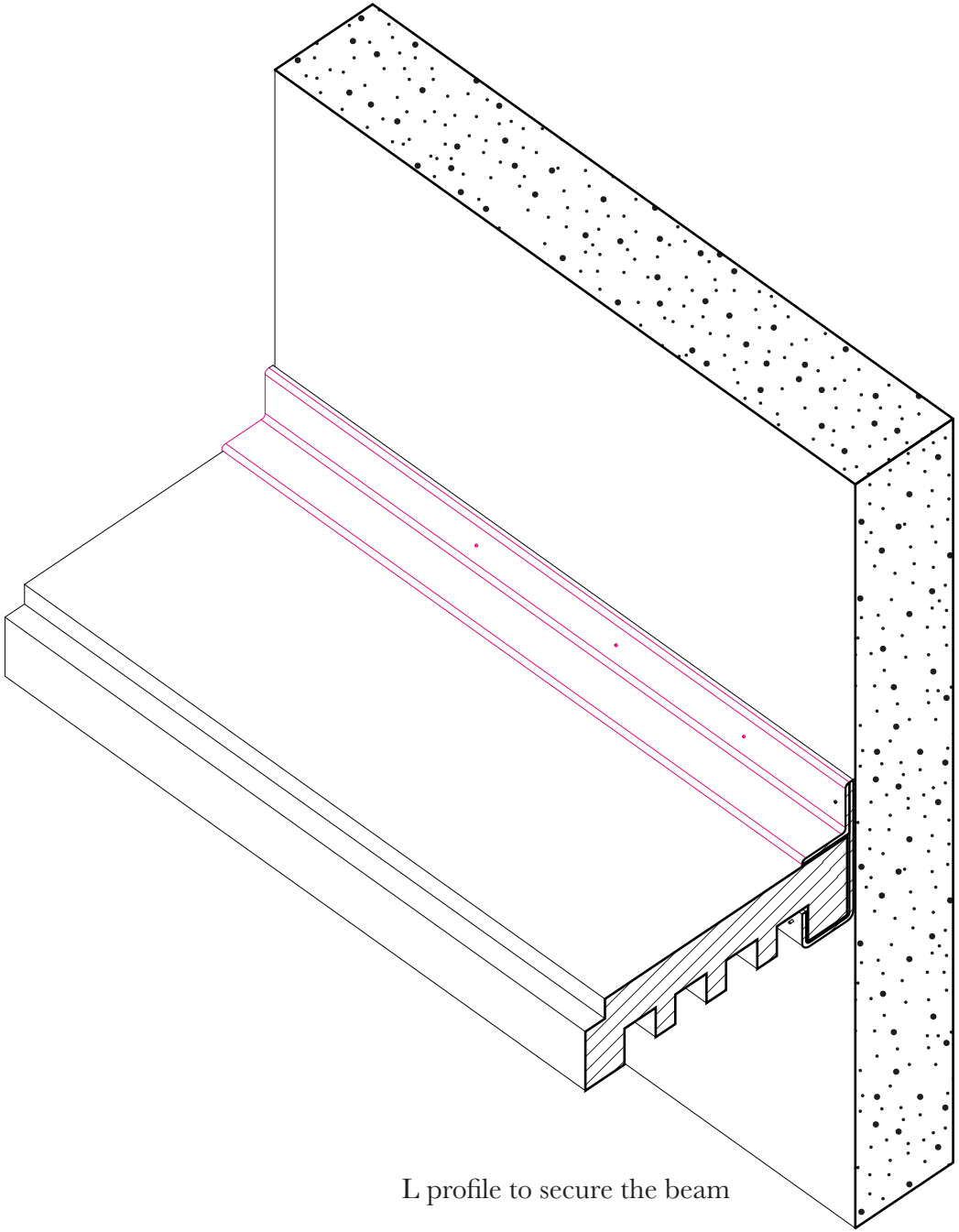


L cold bent profile

CONSTRUCTION PROCESS

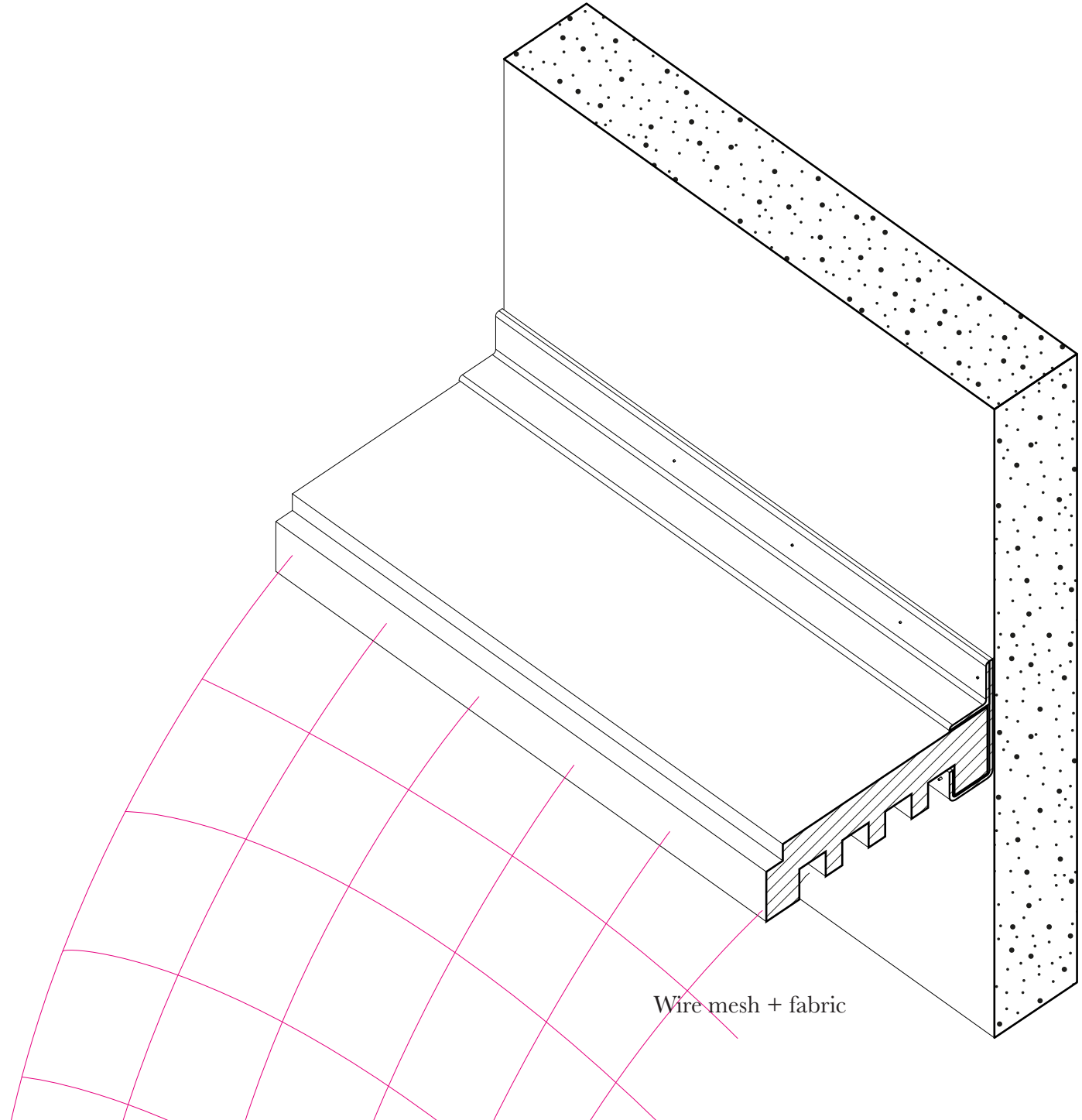


1200x400mm prefabricated concrete beam

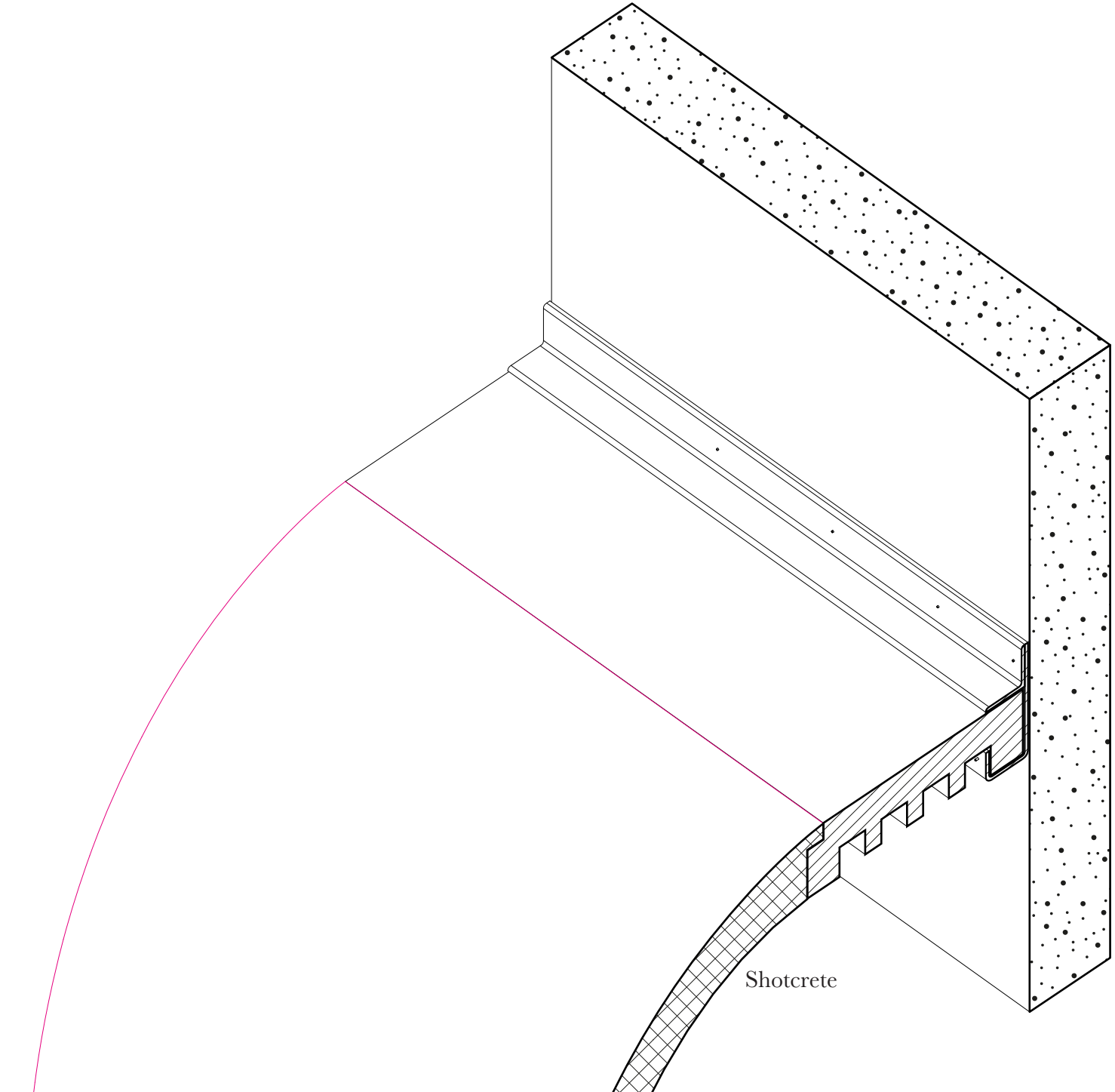


L profile to secure the beam

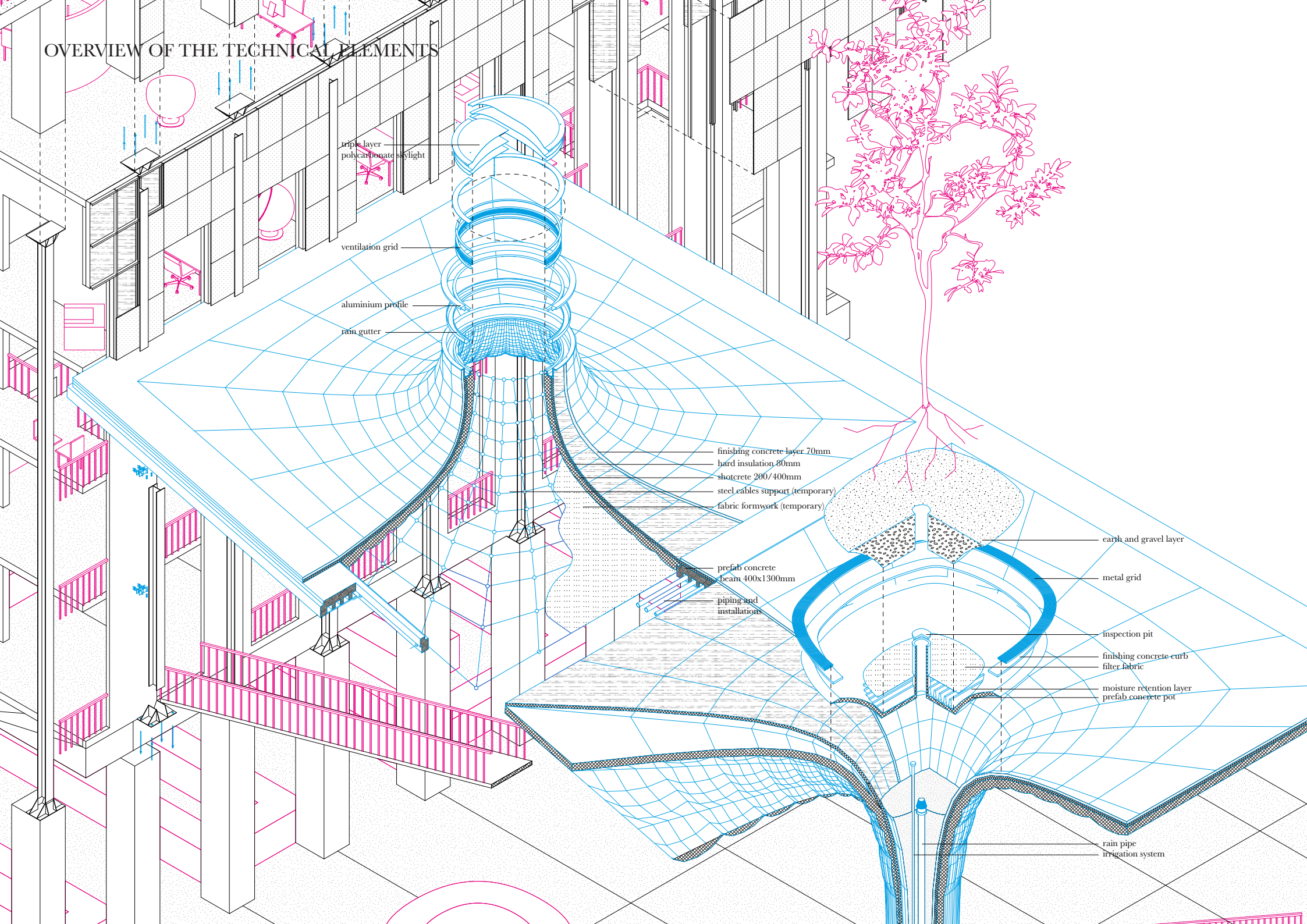
CONSTRUCTION PROCESS



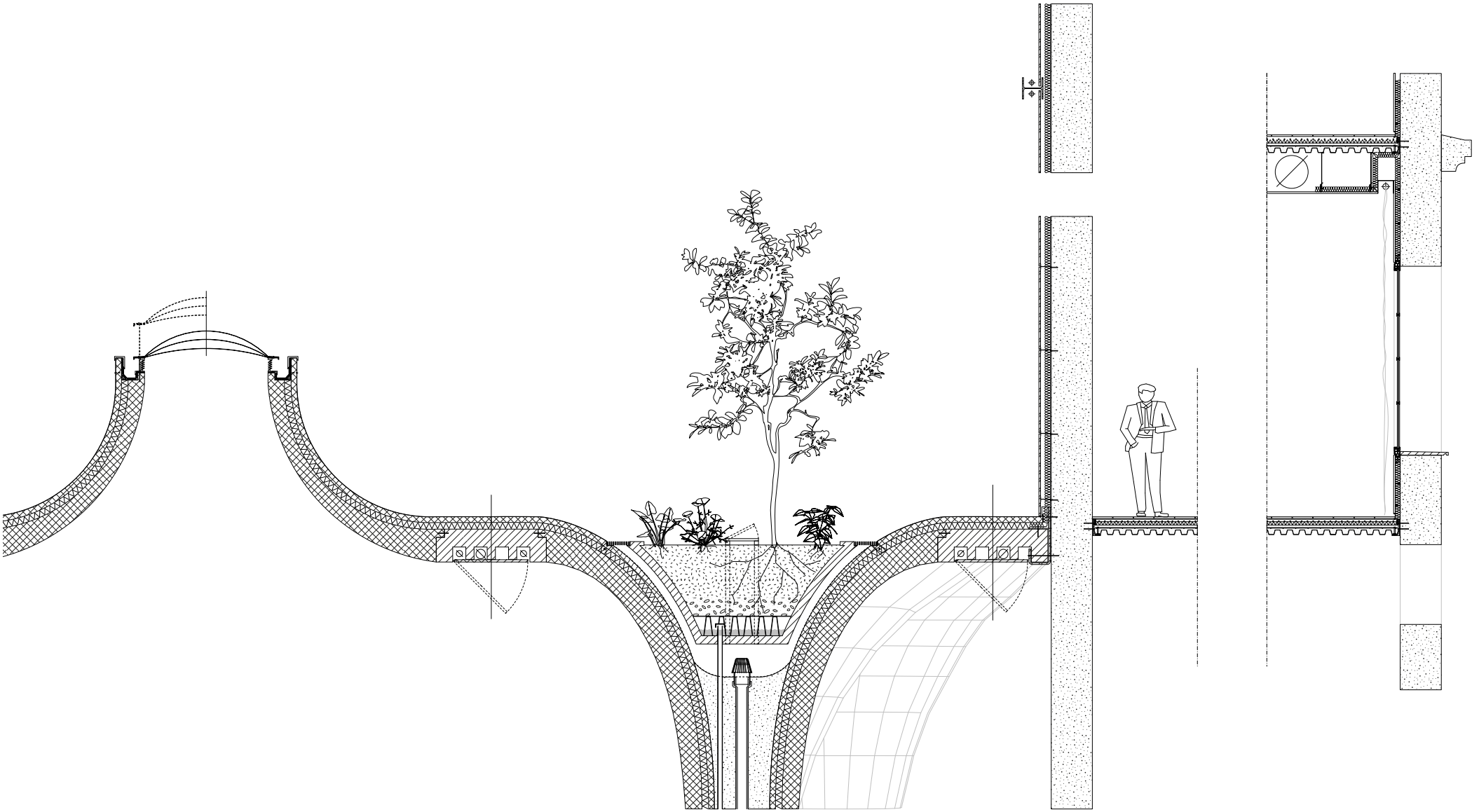
CONSTRUCTION PROCESS



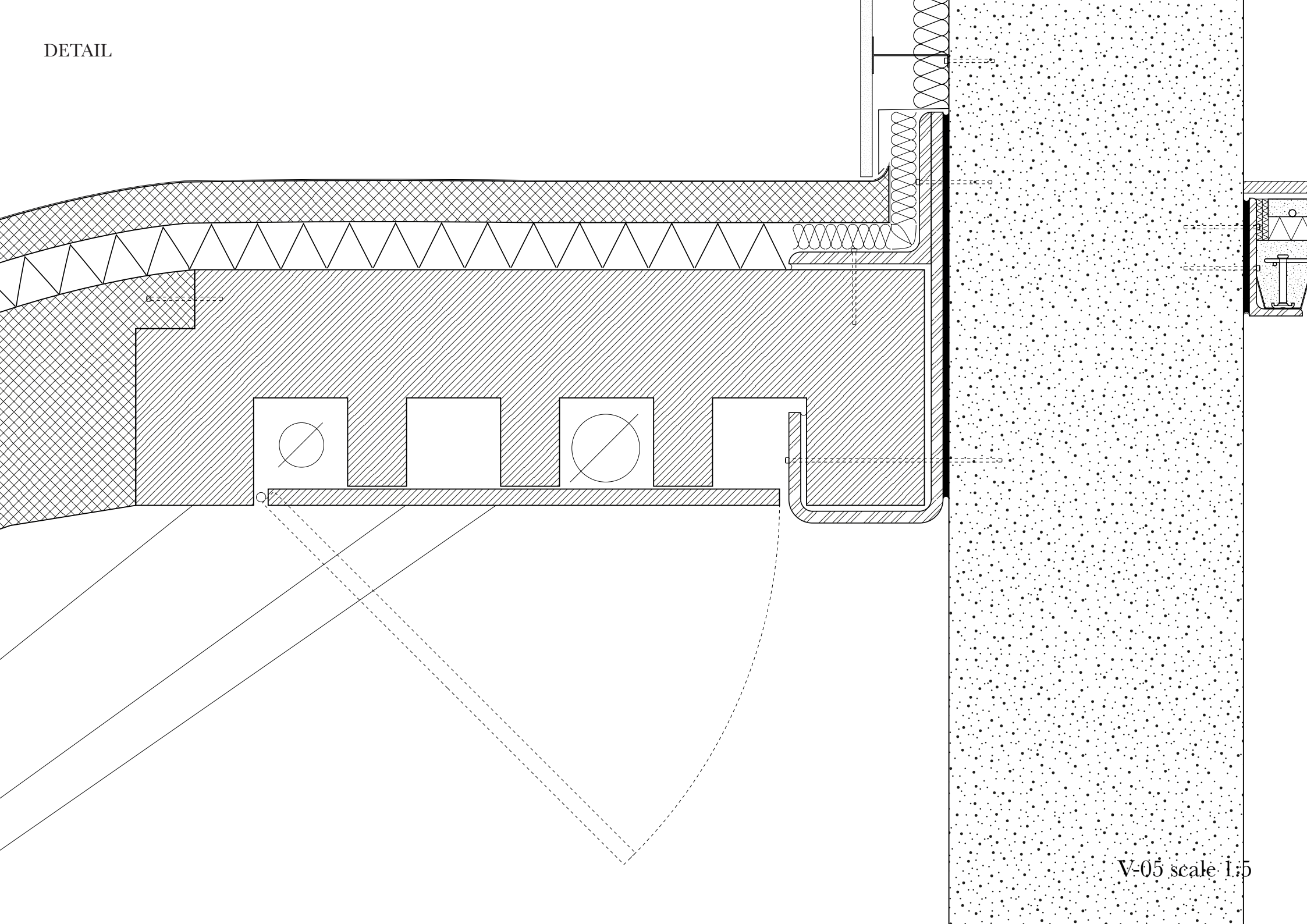
OVERVIEW OF THE TECHNICAL ELEMENTS



OVERVIEW OF THE TECHNICAL ELEMENTS



DETAIL



V-05 scale 1:5

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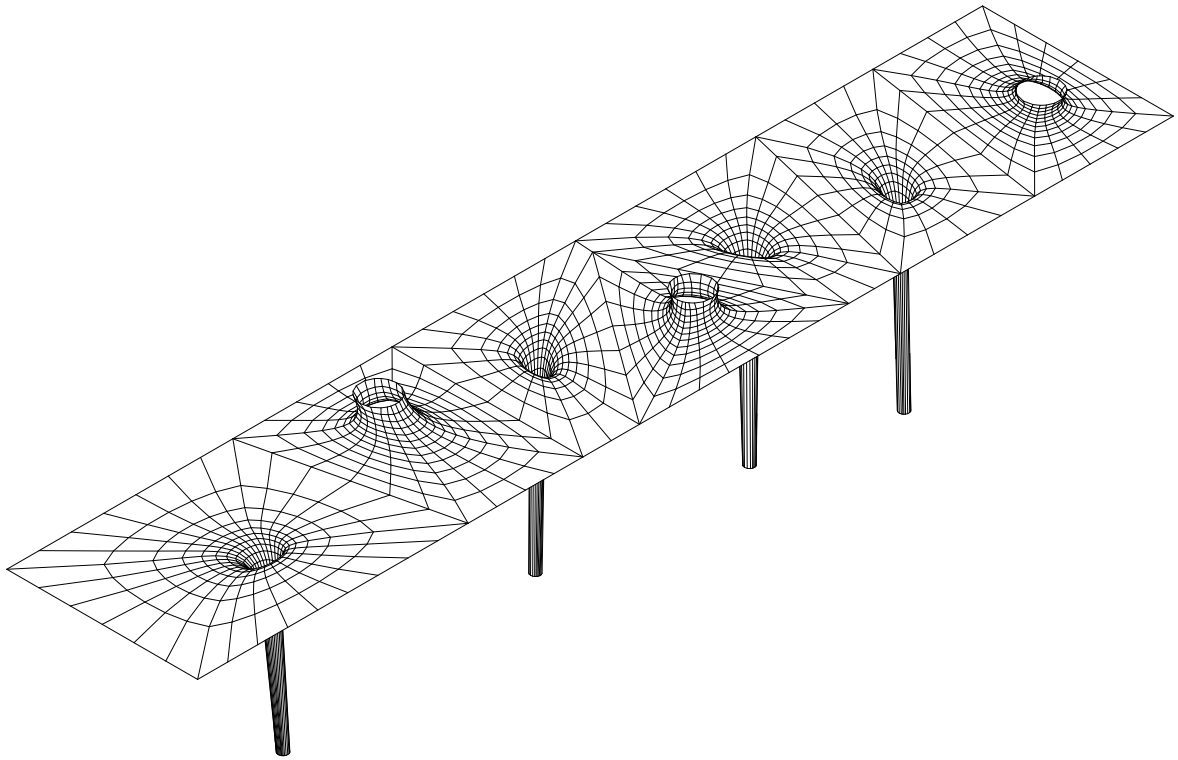
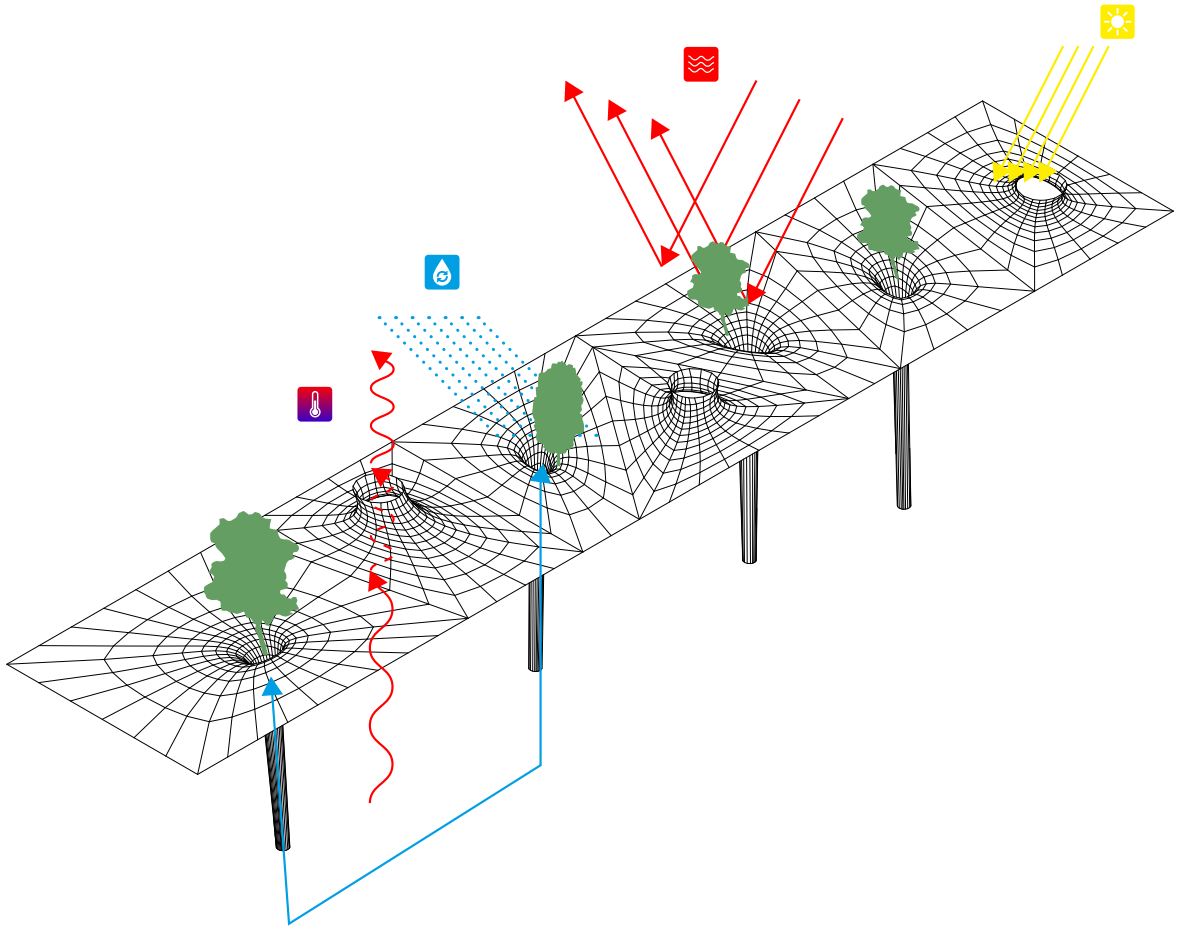
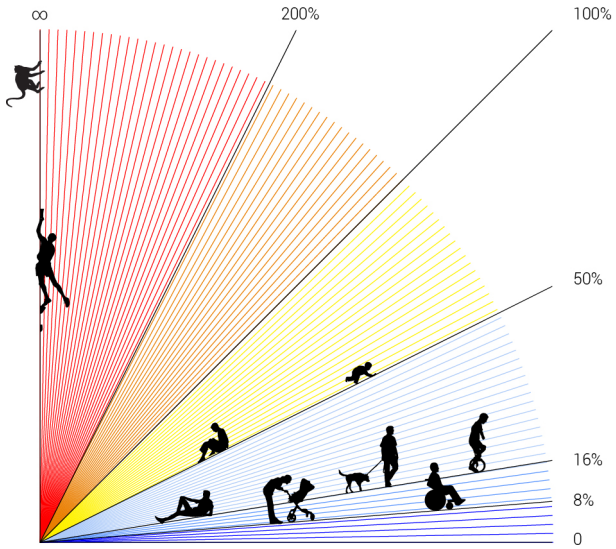
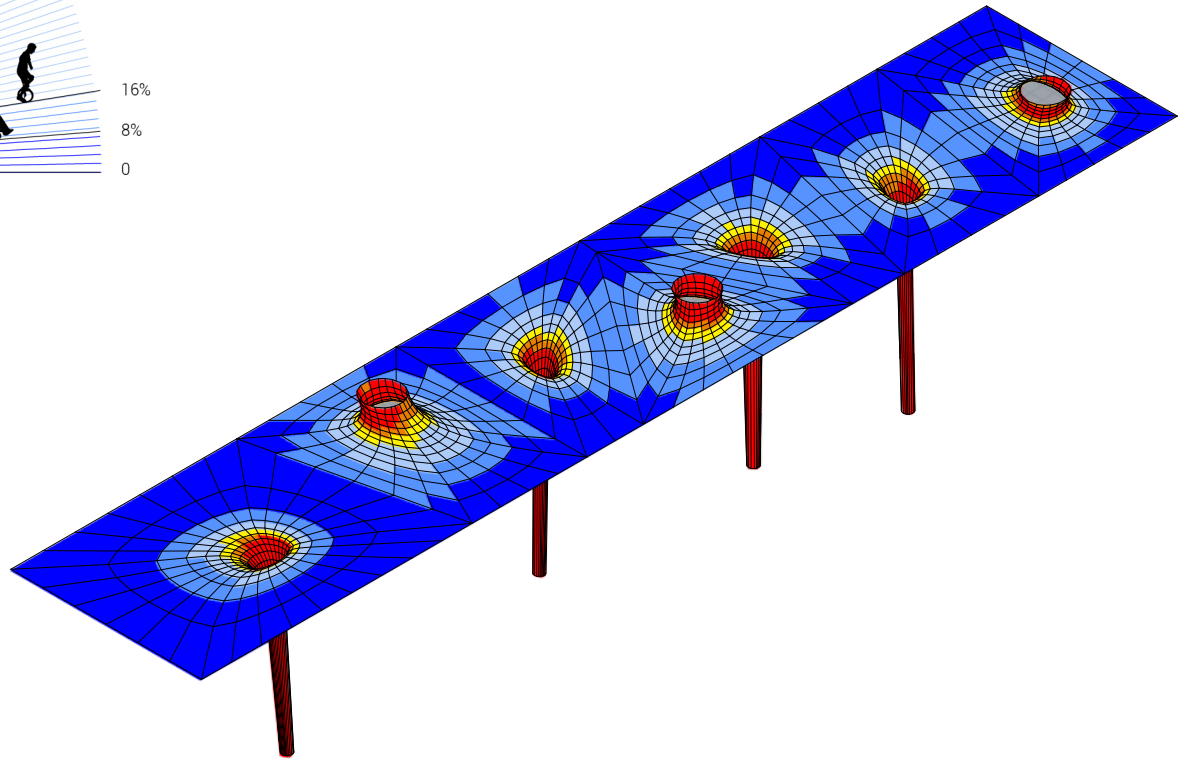
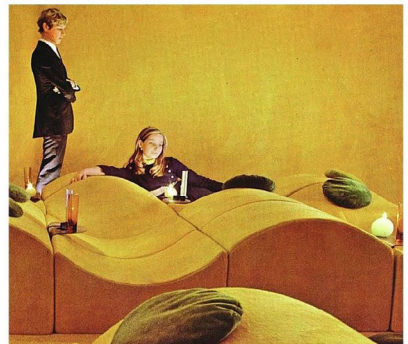




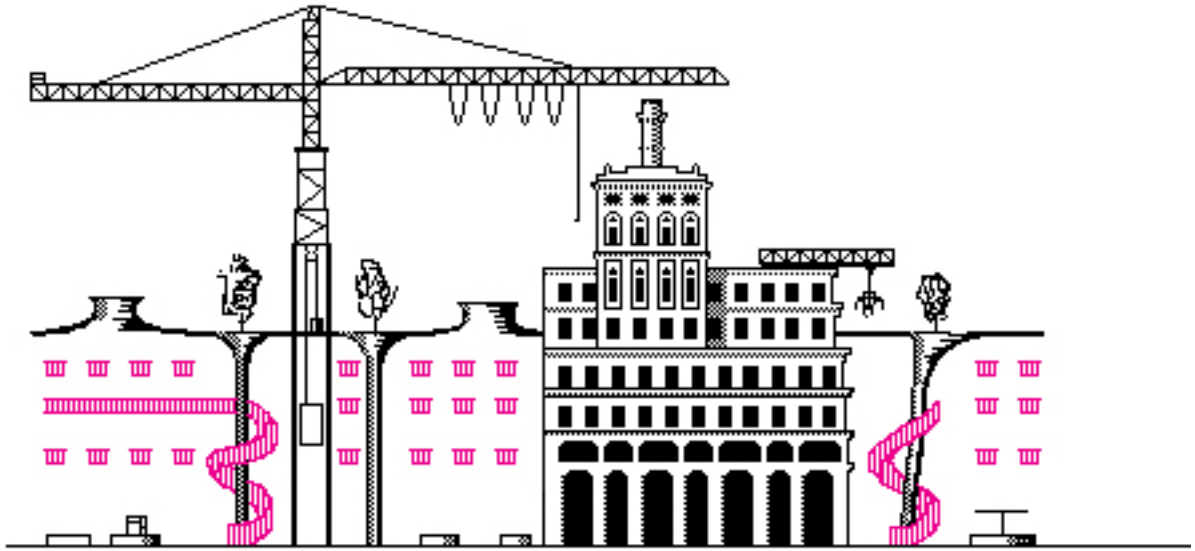

∞
200%
100%
50%
16%
8%
0

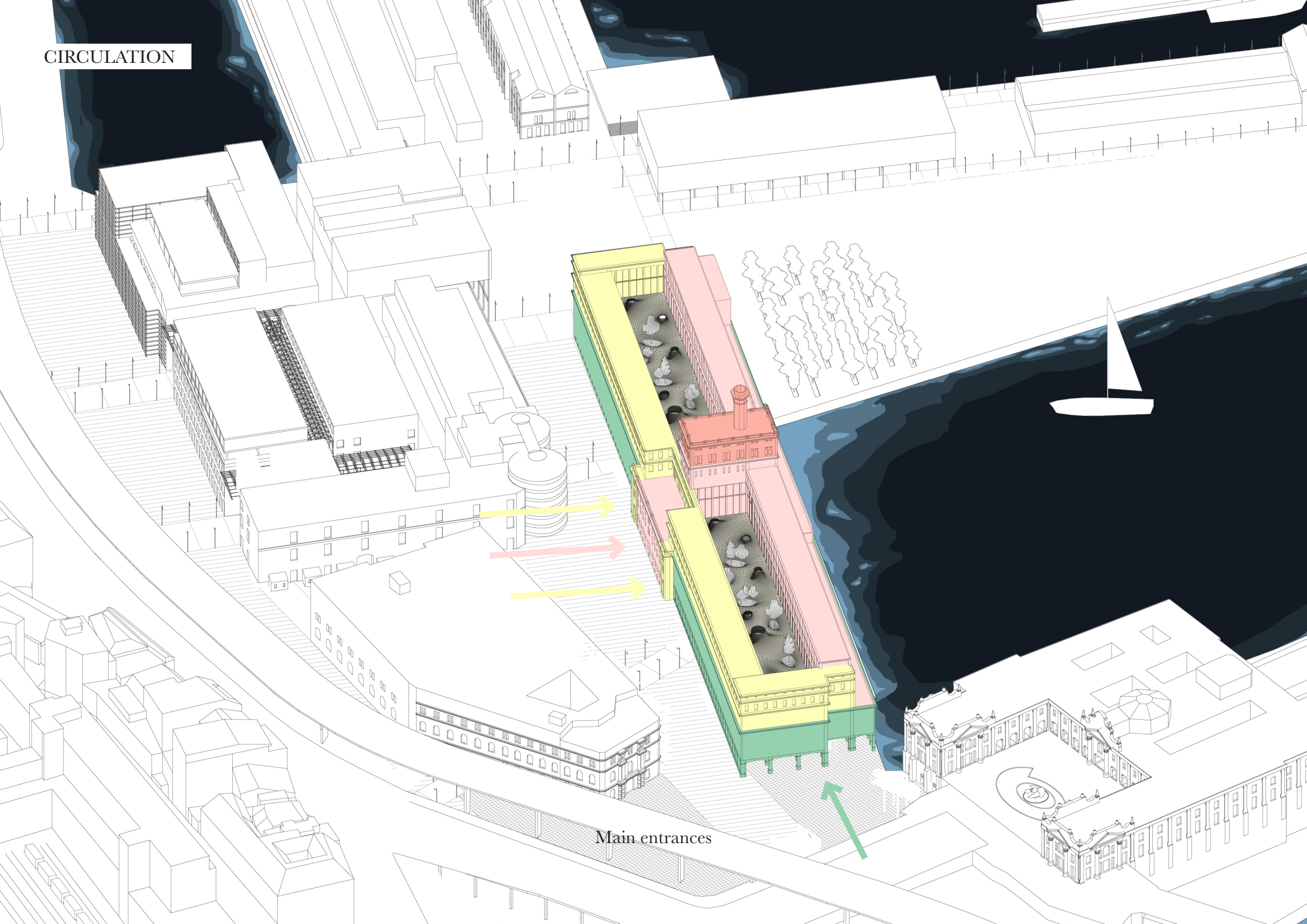




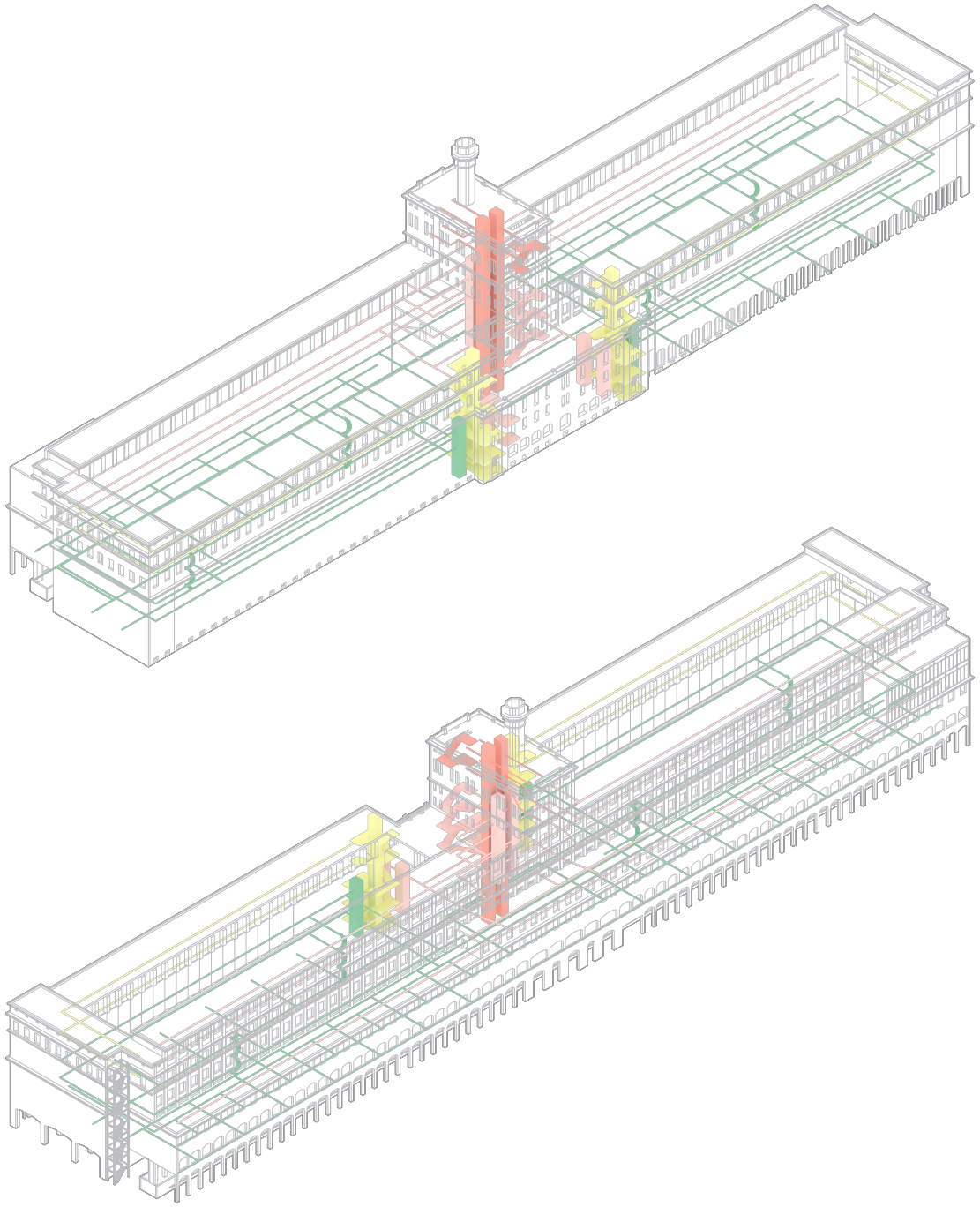
Public space as a playground

5.DESIGN




CIRCULATION
Main entrances

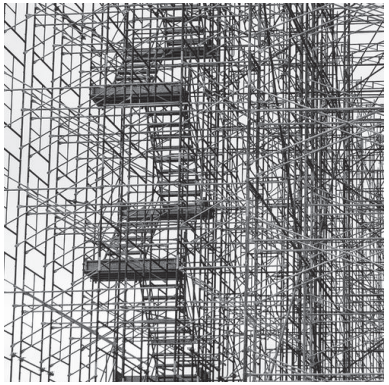
CIRCULATION



EXISTING/
CONCRETE

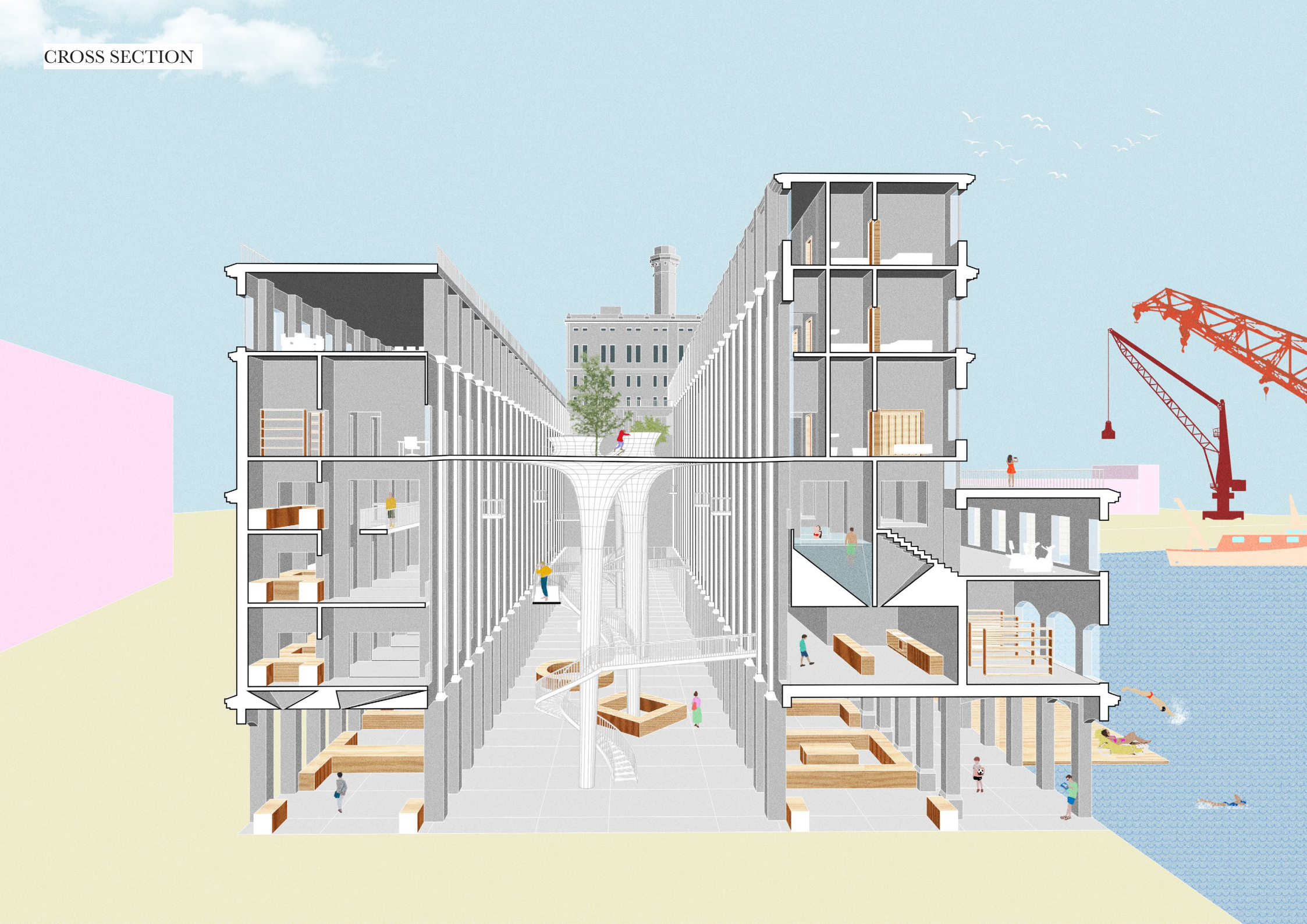
NOT FIXED ELEMENTS/
WOOD

INTEGRATIONS/
STEEL



NEW/
CONCRETE

CROSS SECTION



PROCESS READABILITY

Bumpy white concrete

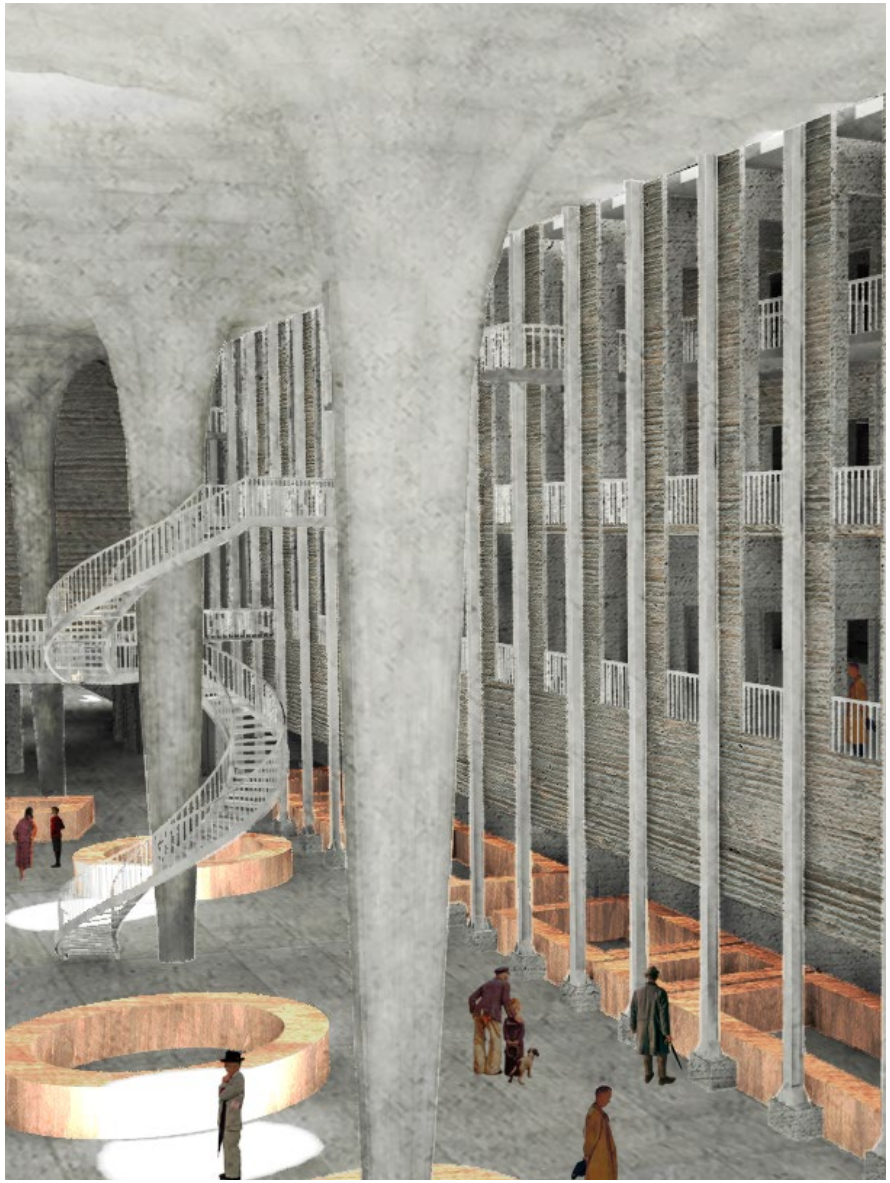
Rough concrete post-demolition

Casted in-situ concrete

Prefab concrete tiles

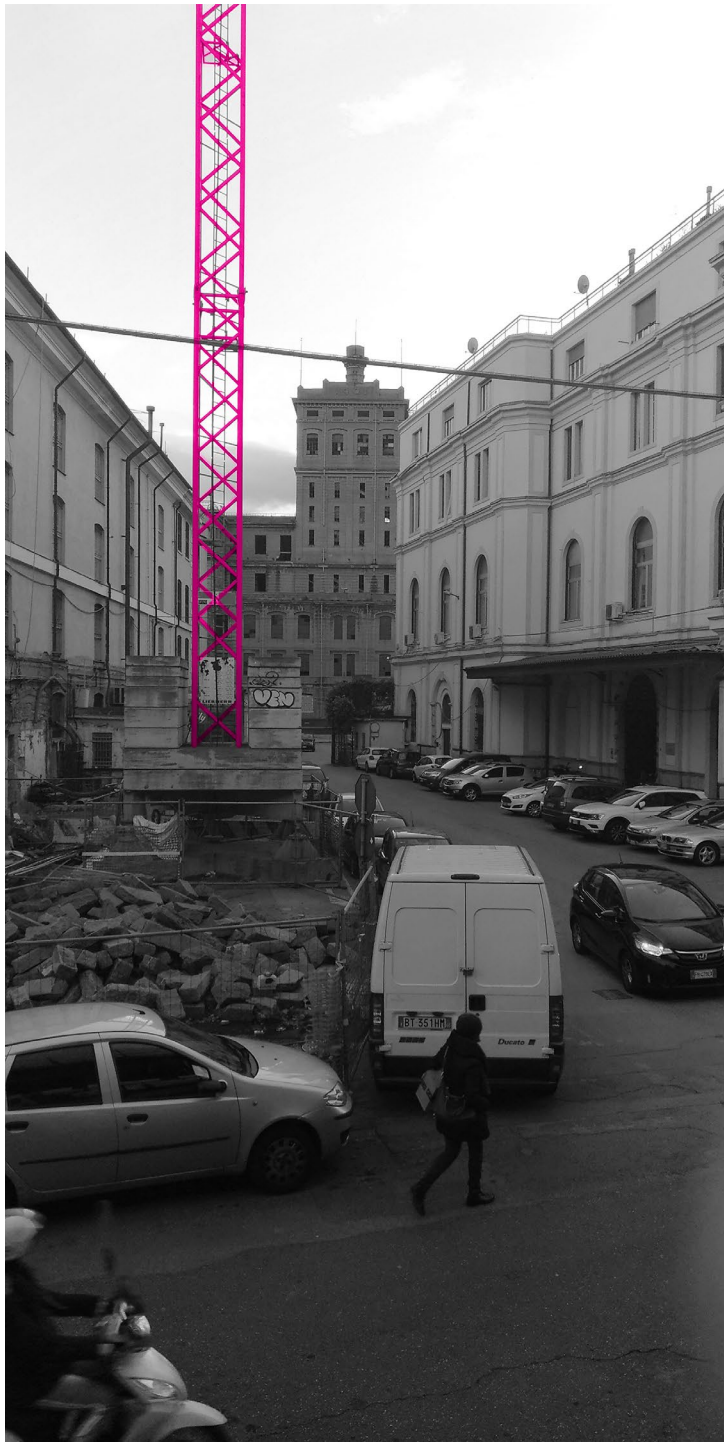
Main market hall

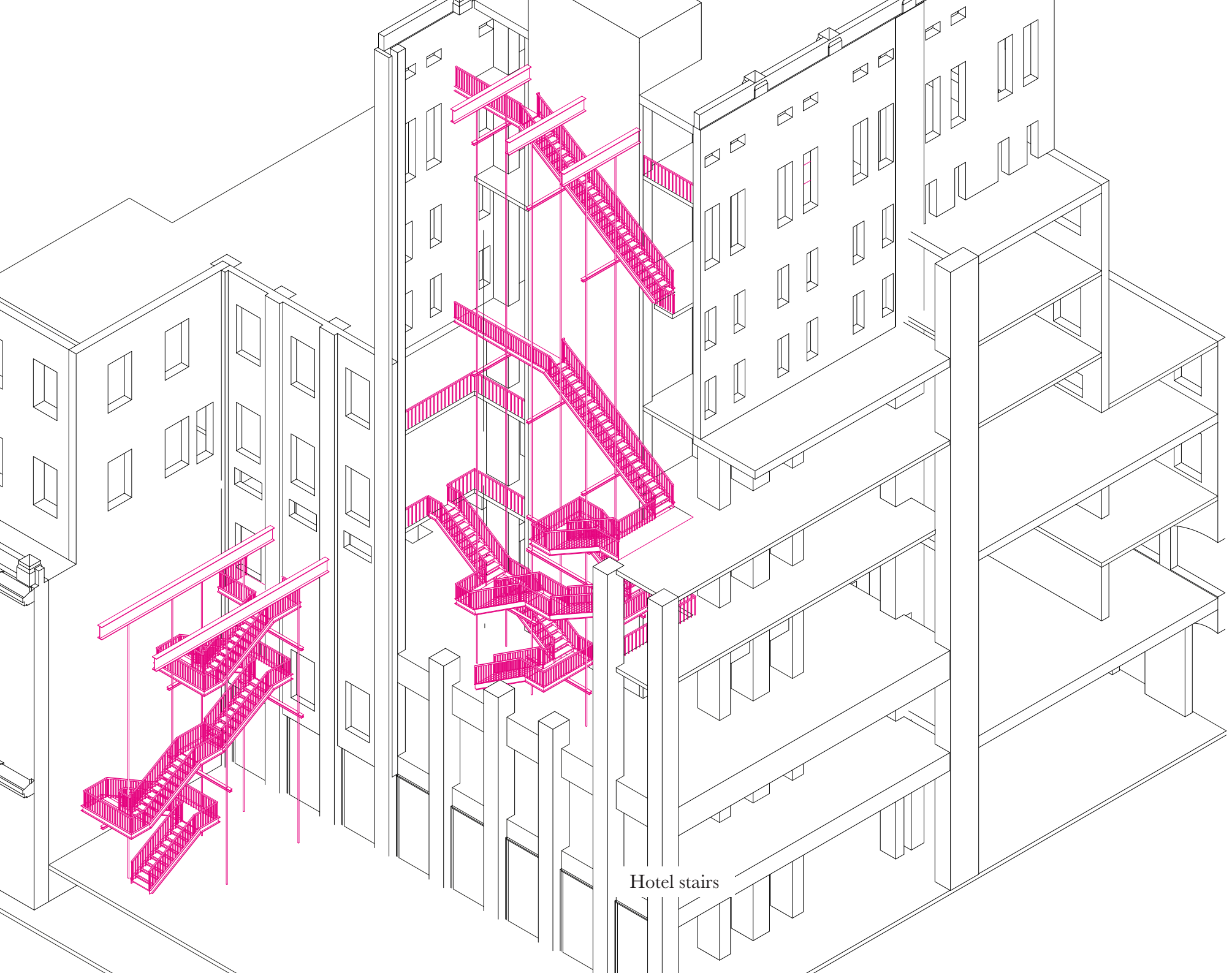
Zenital light

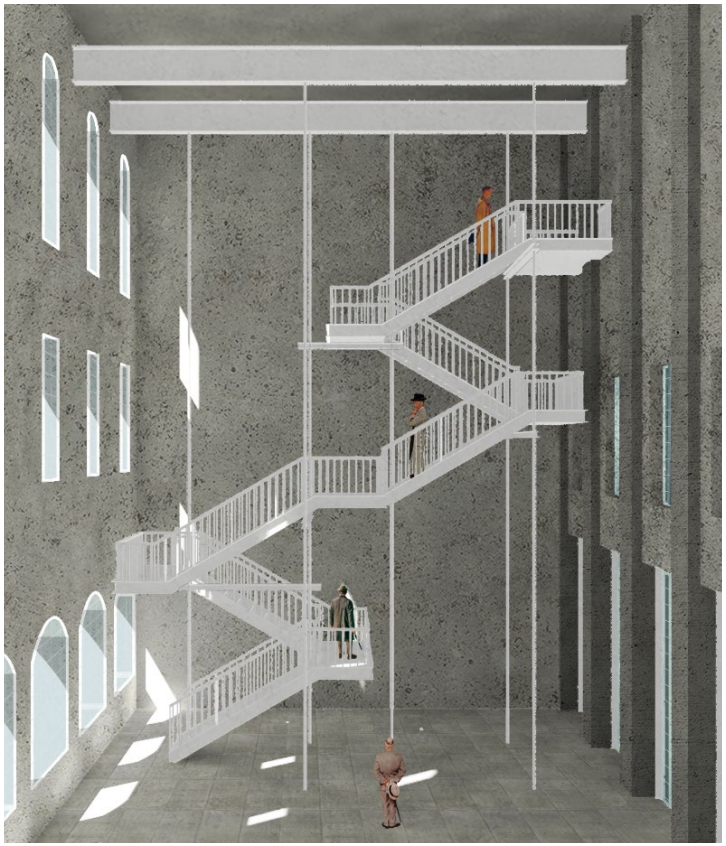


Sense of scale

SORROUNDINGS

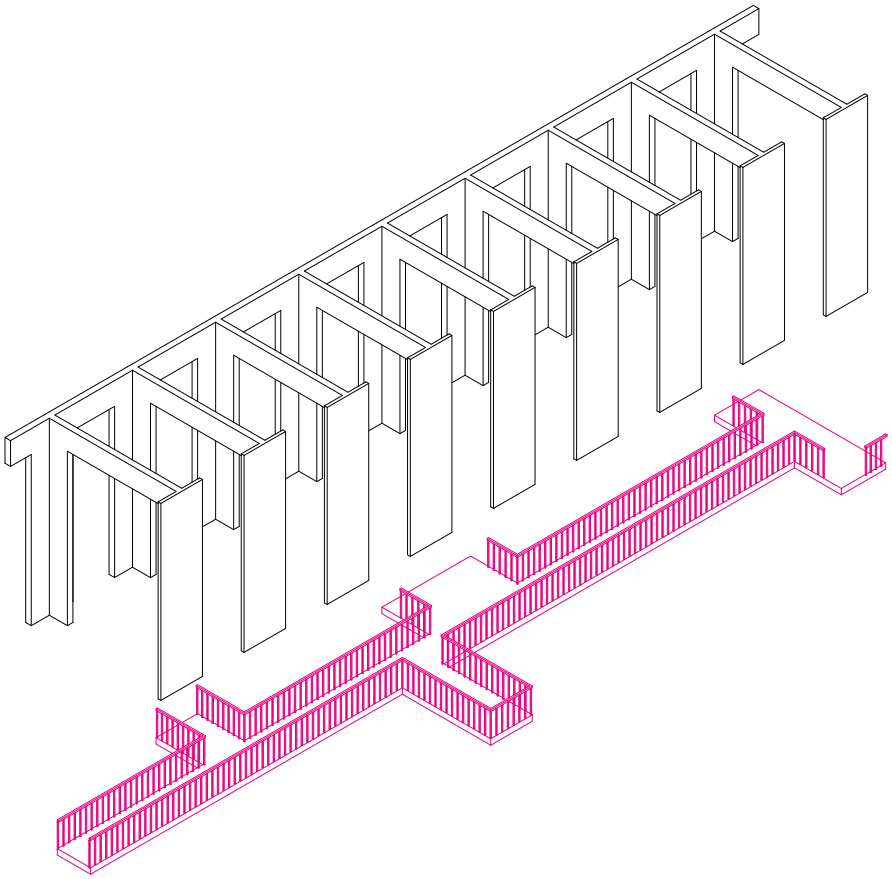


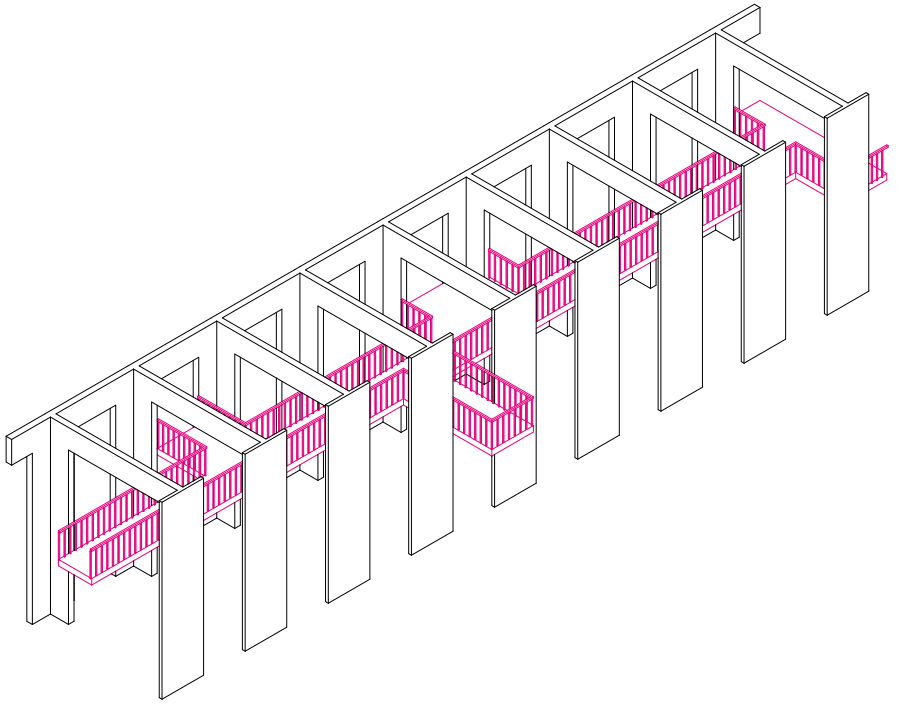

Hotel stairs



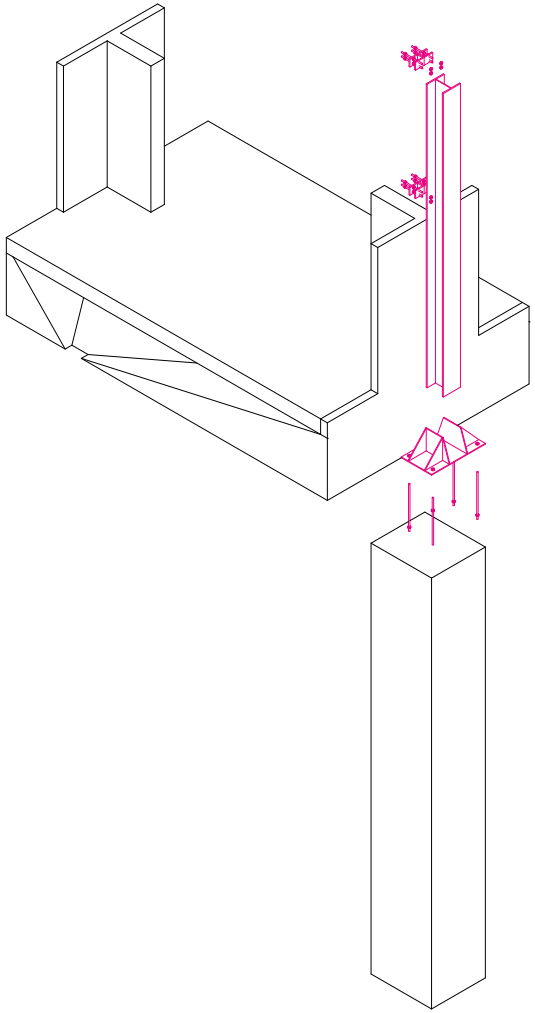
Routing

Hotel stairs

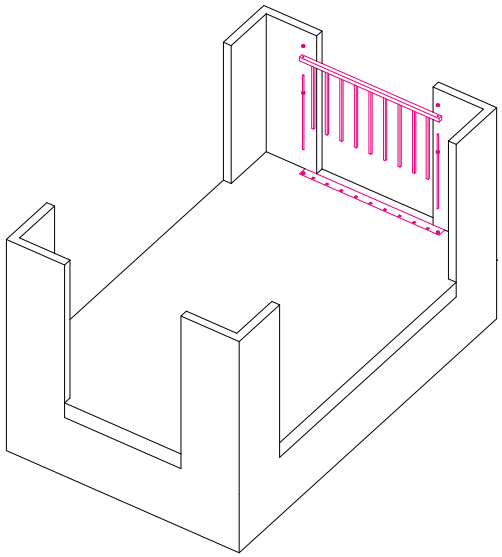




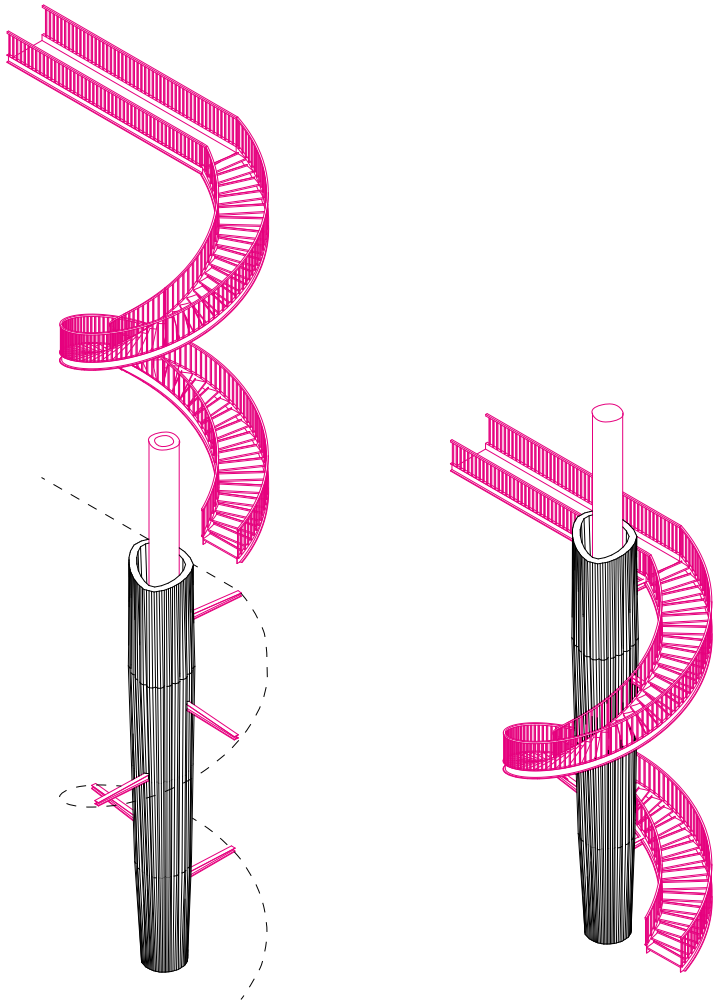
Market mezzanine



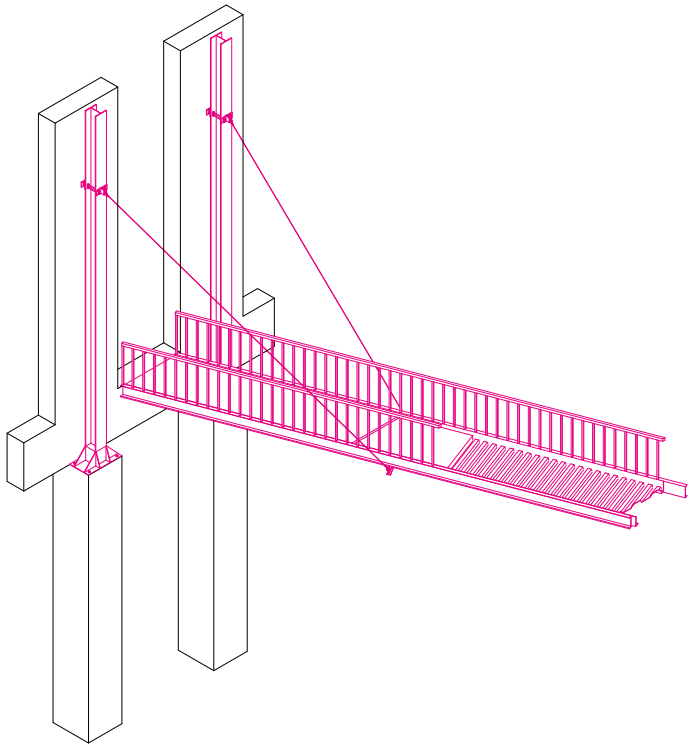
Support column in the main market hall



Handrail detail



Helicoidal stair in the main hall

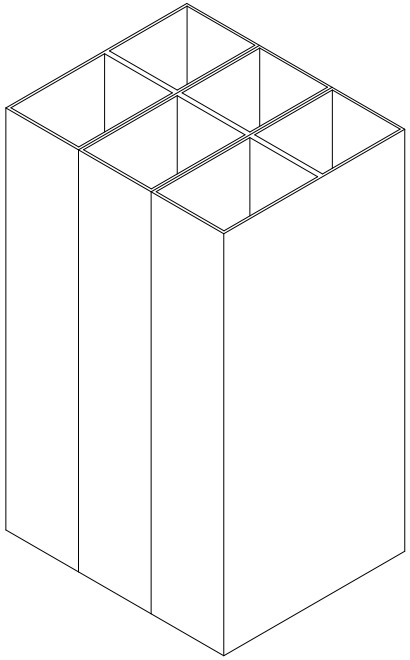


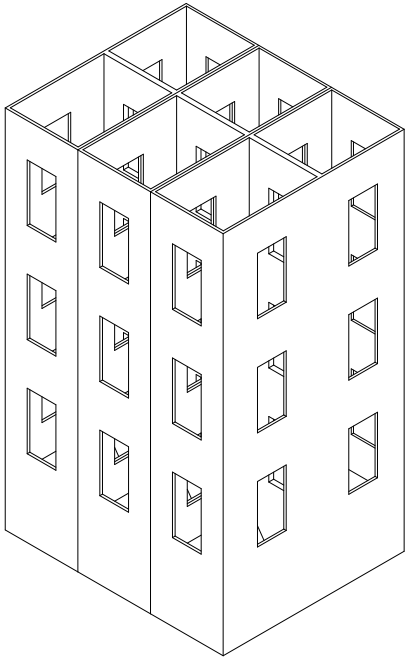
Bridge in the main hall

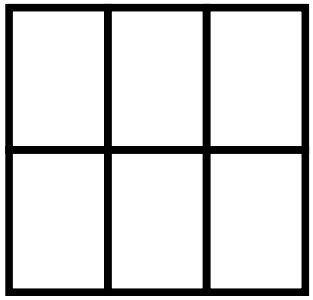
Material contrast

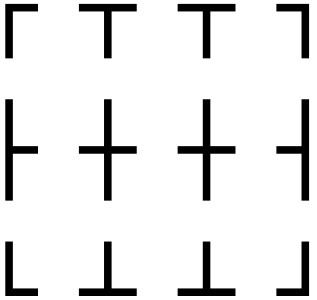
STRATEGY

Demolition area <30% than the total area of the wall



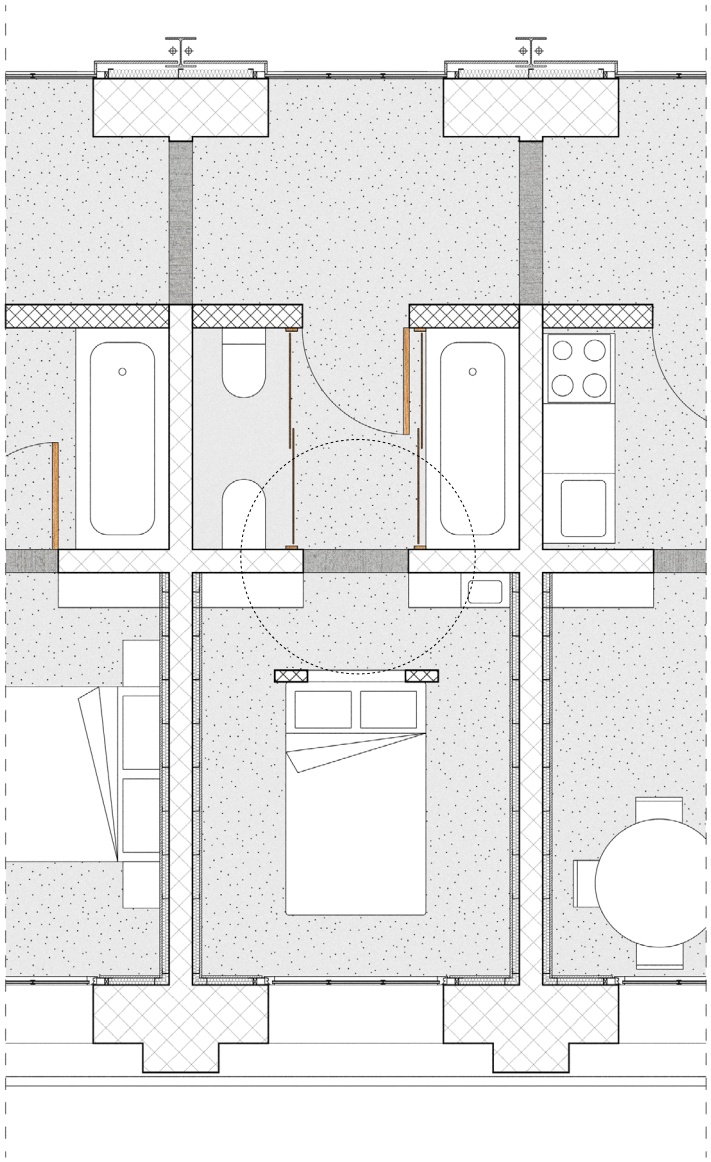


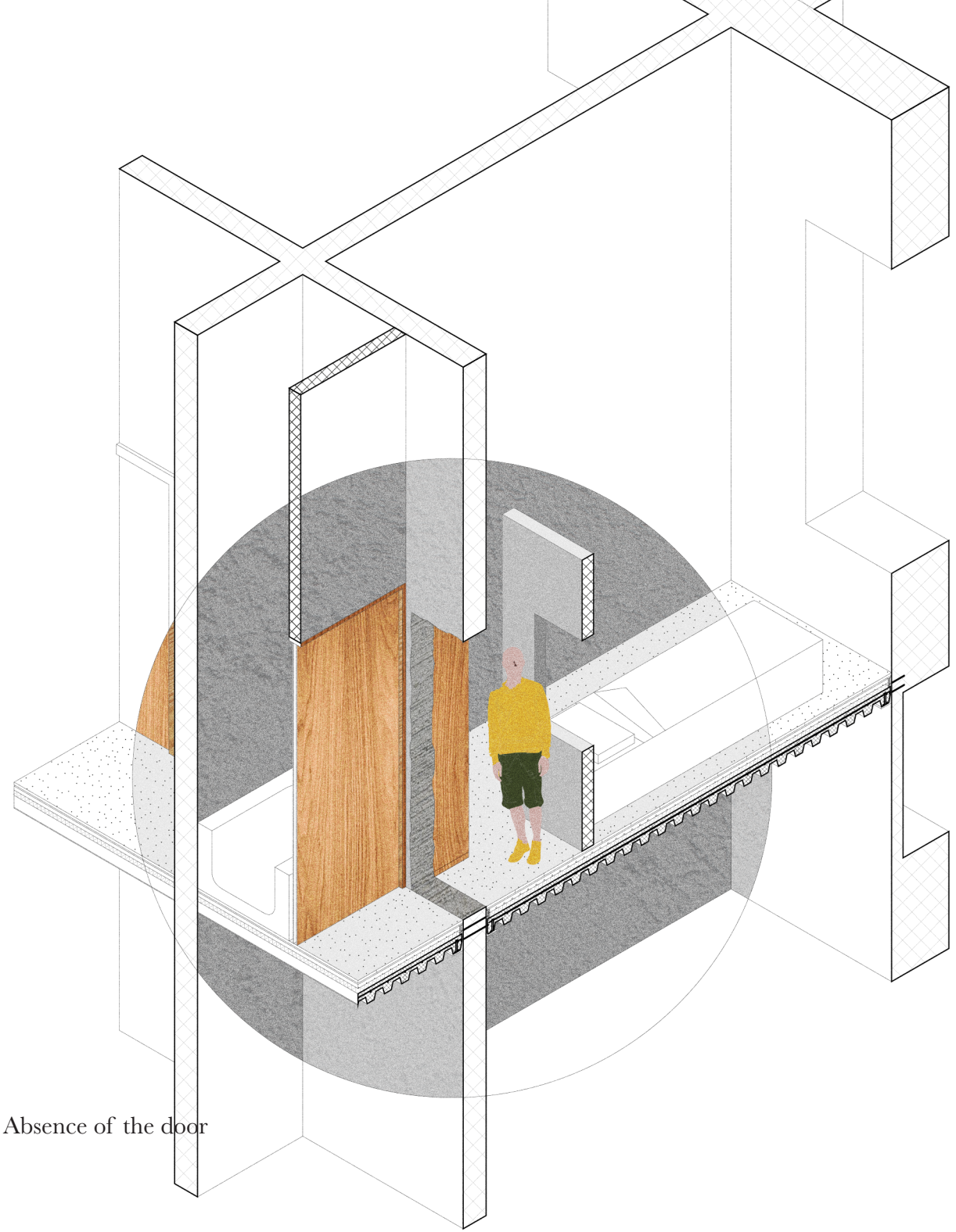




Intervention evidence

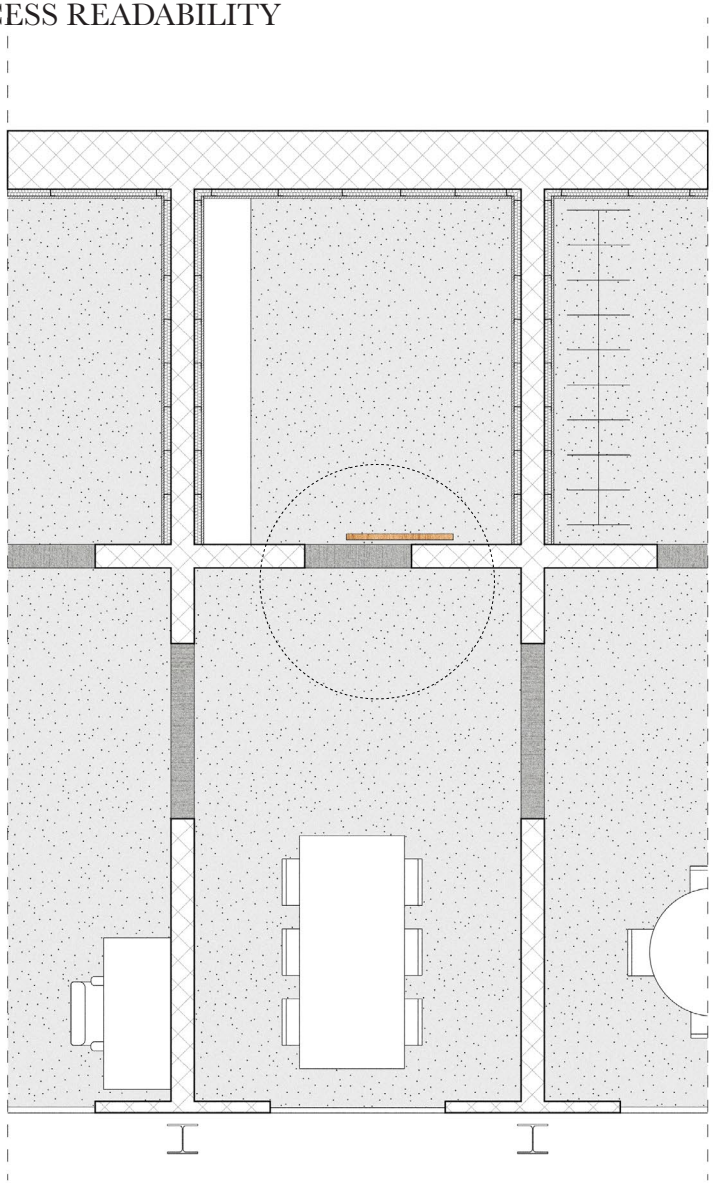
PROCESS READABILITY

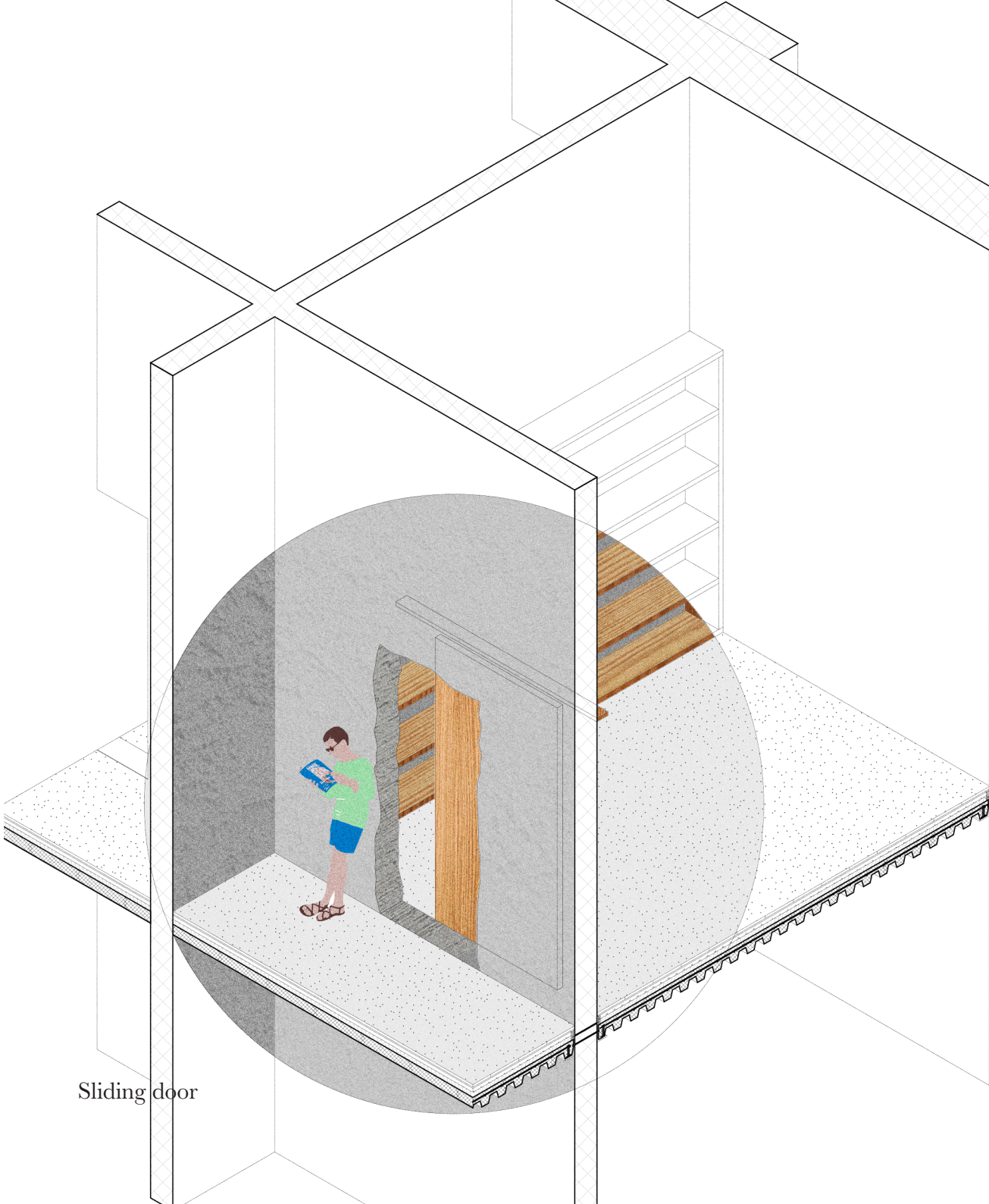




Absence of the door

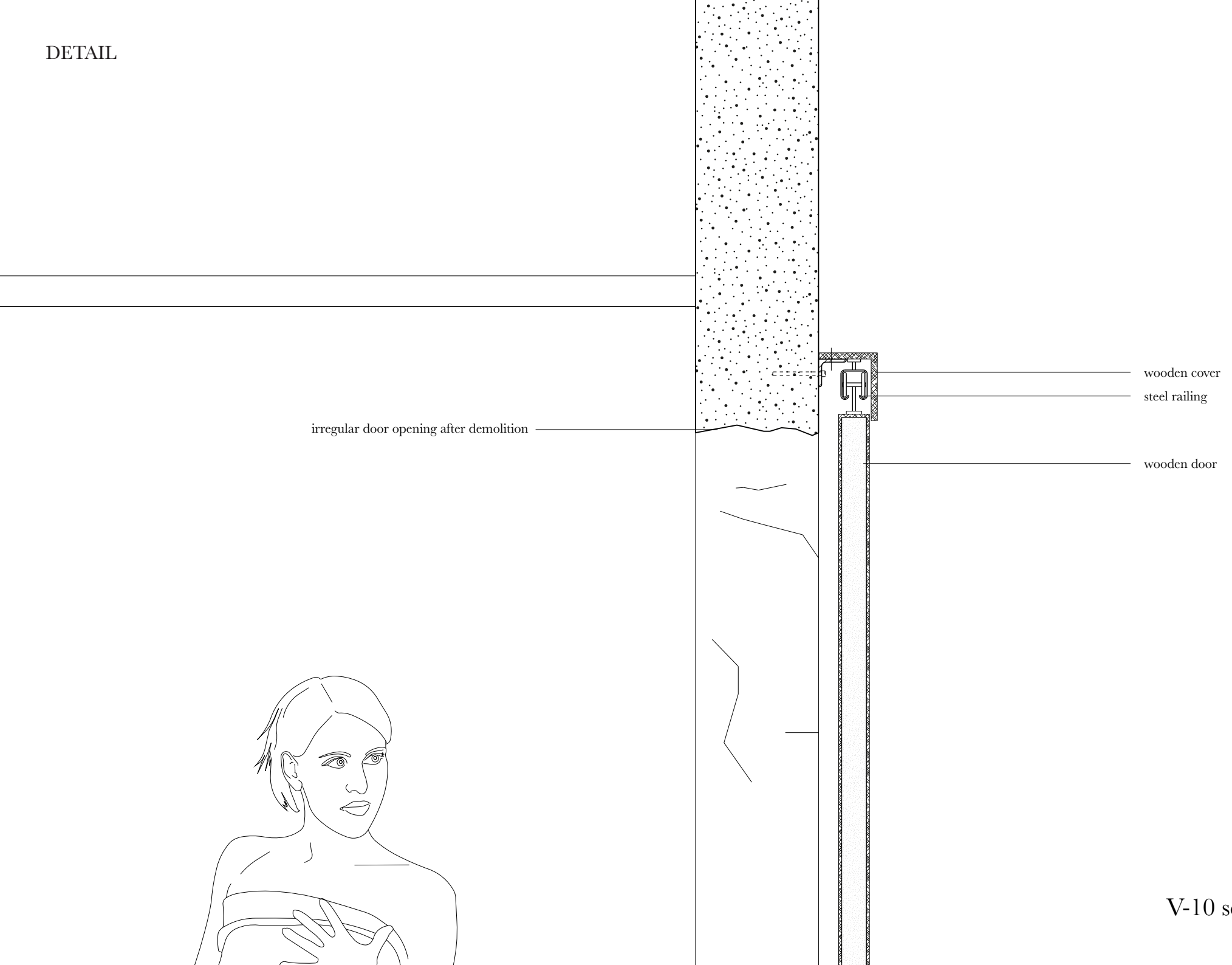
PROCESS READABILITY





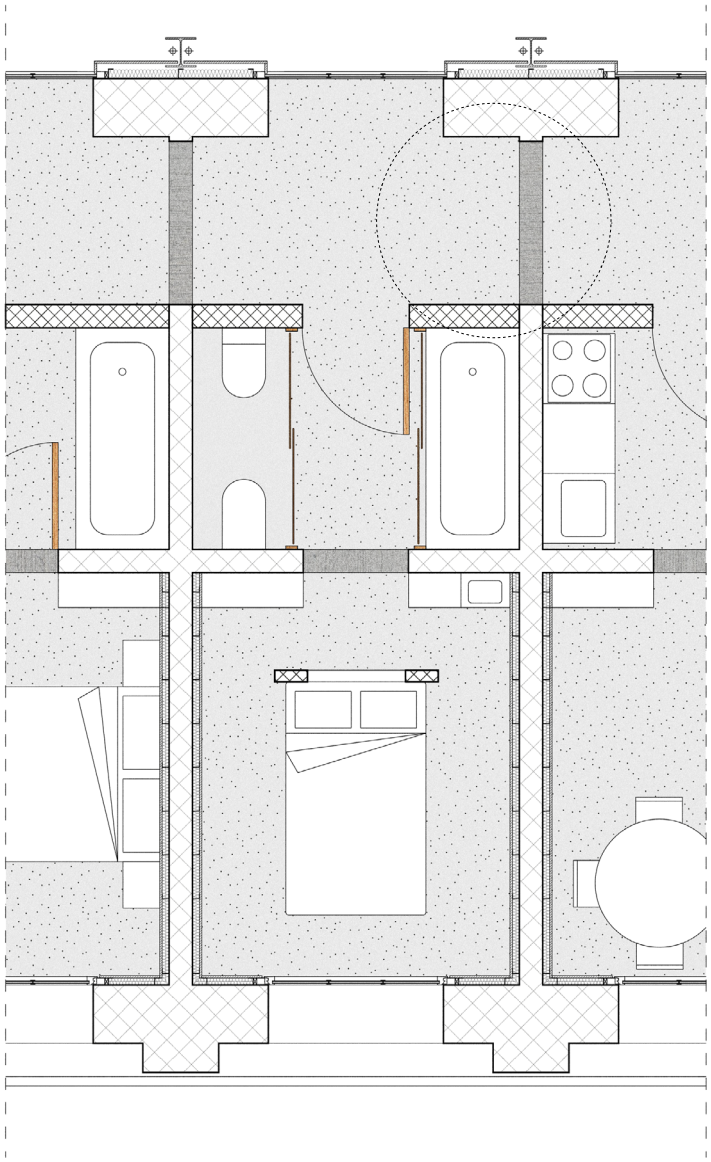
Sliding door

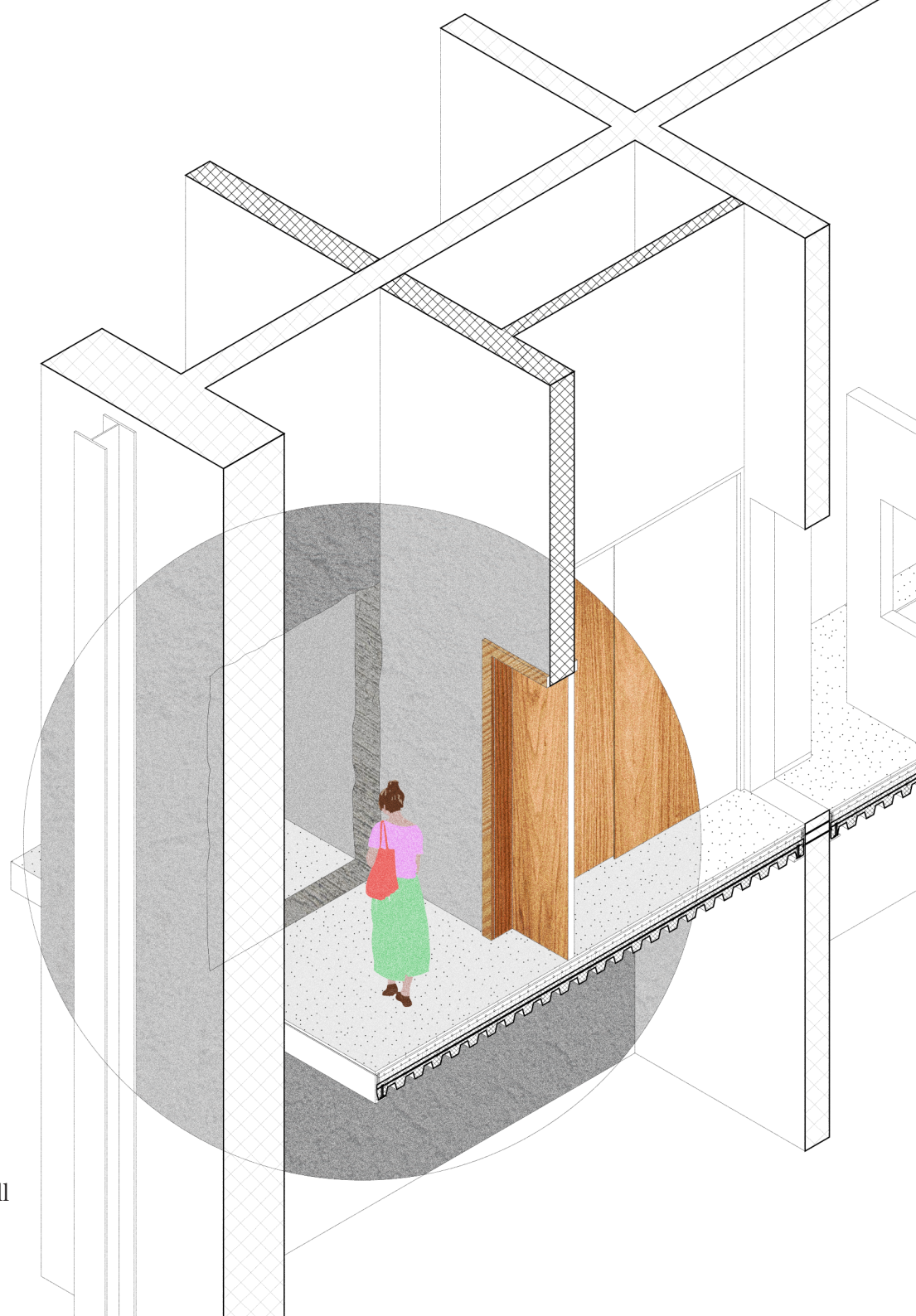
DETAIL



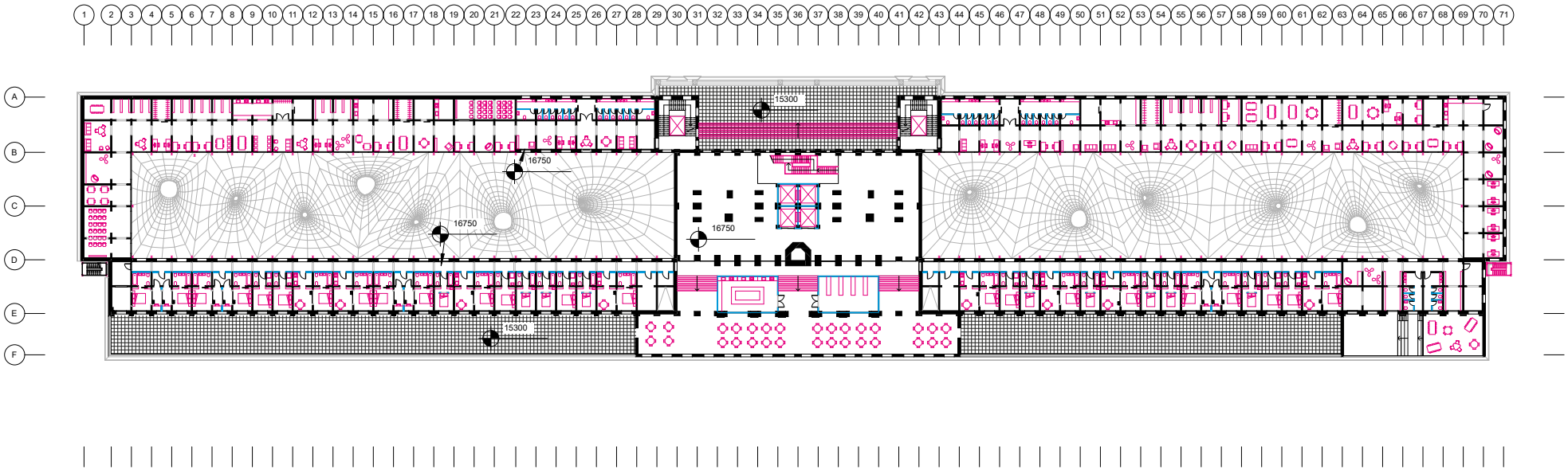
V-10 scale 1:5

PROCESS READABILITY



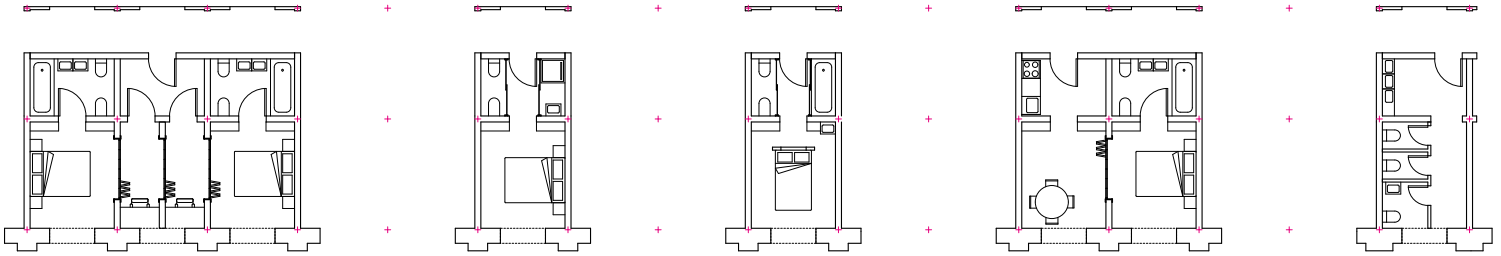


Wall

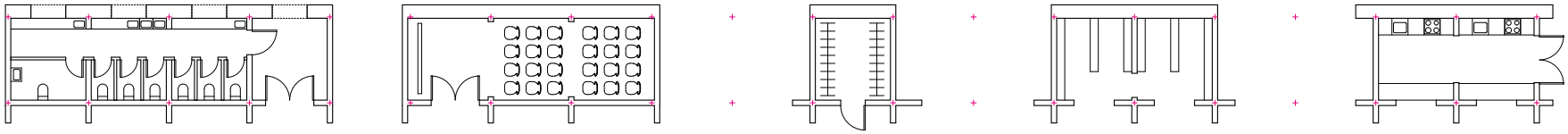


Level 7 (+16,75m)

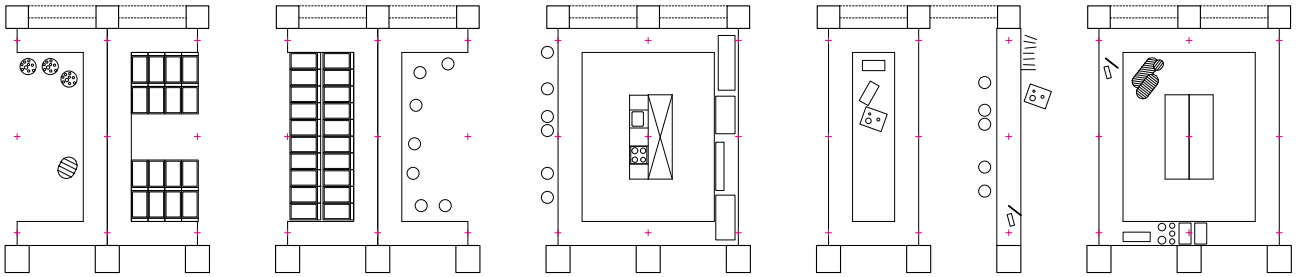
PROGRAMMATIC FLEXIBILITY THROUGH MODULARITY



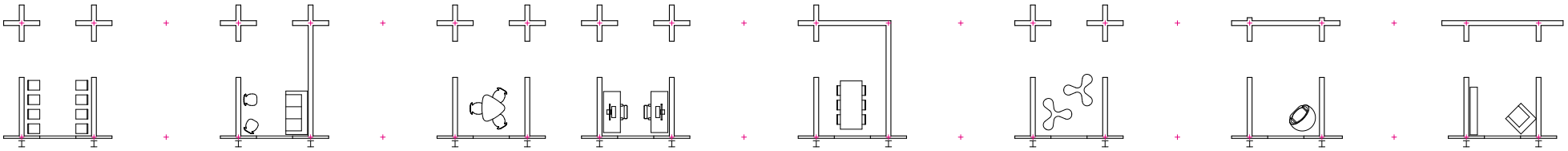
Hotel



Services

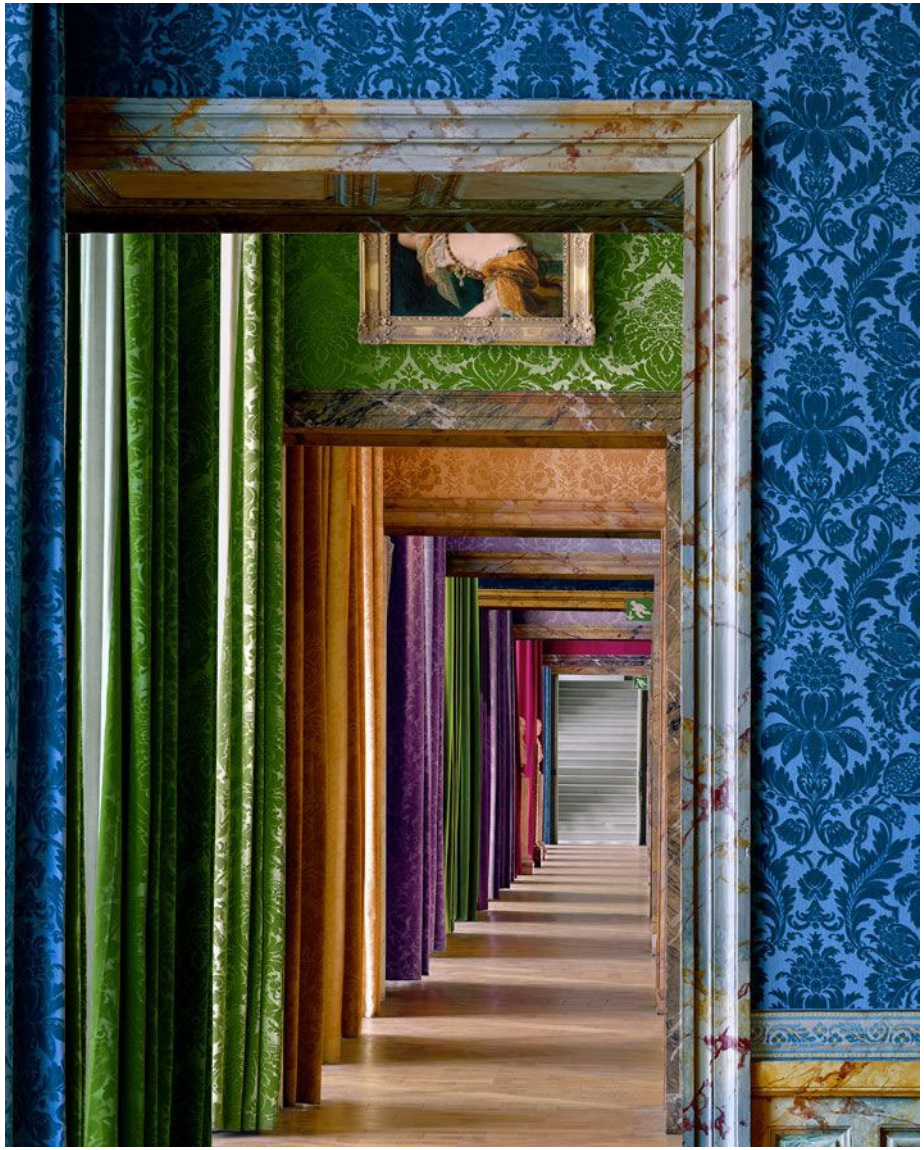


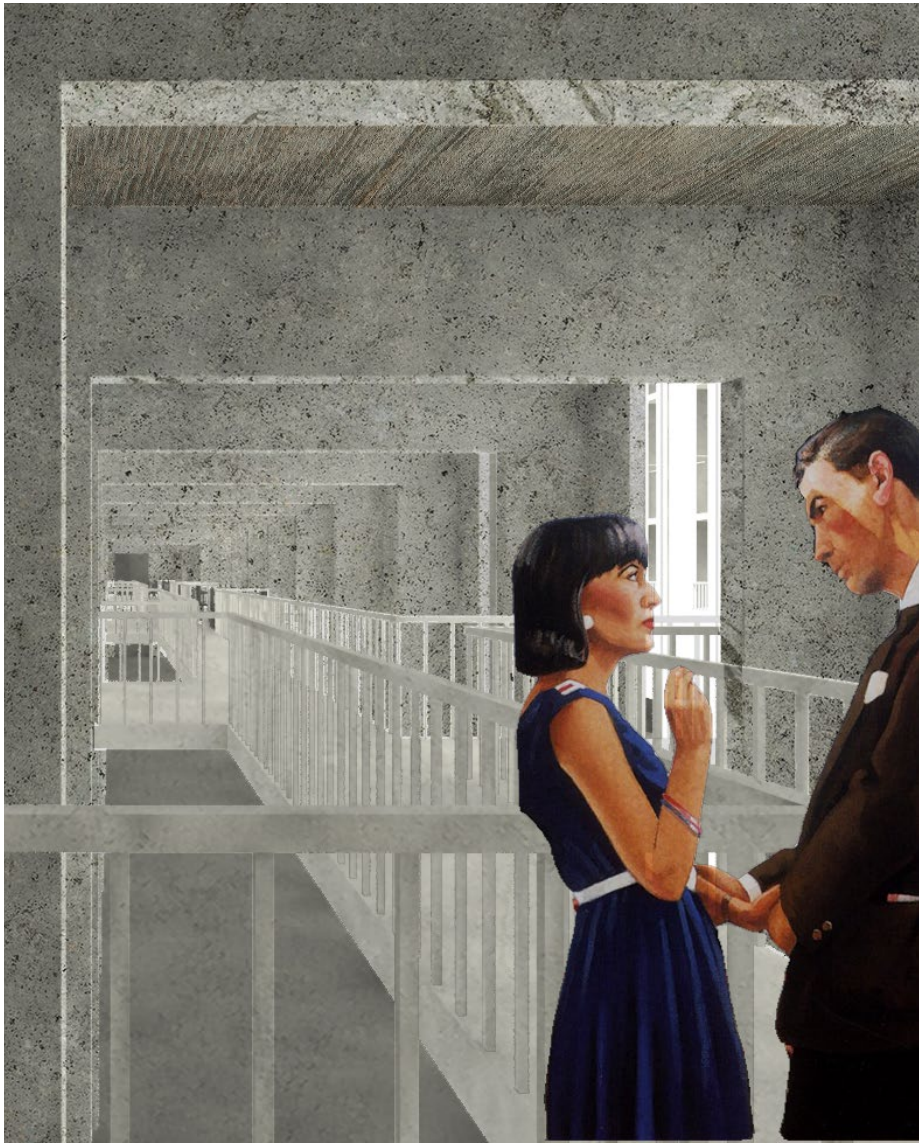
Market



Office

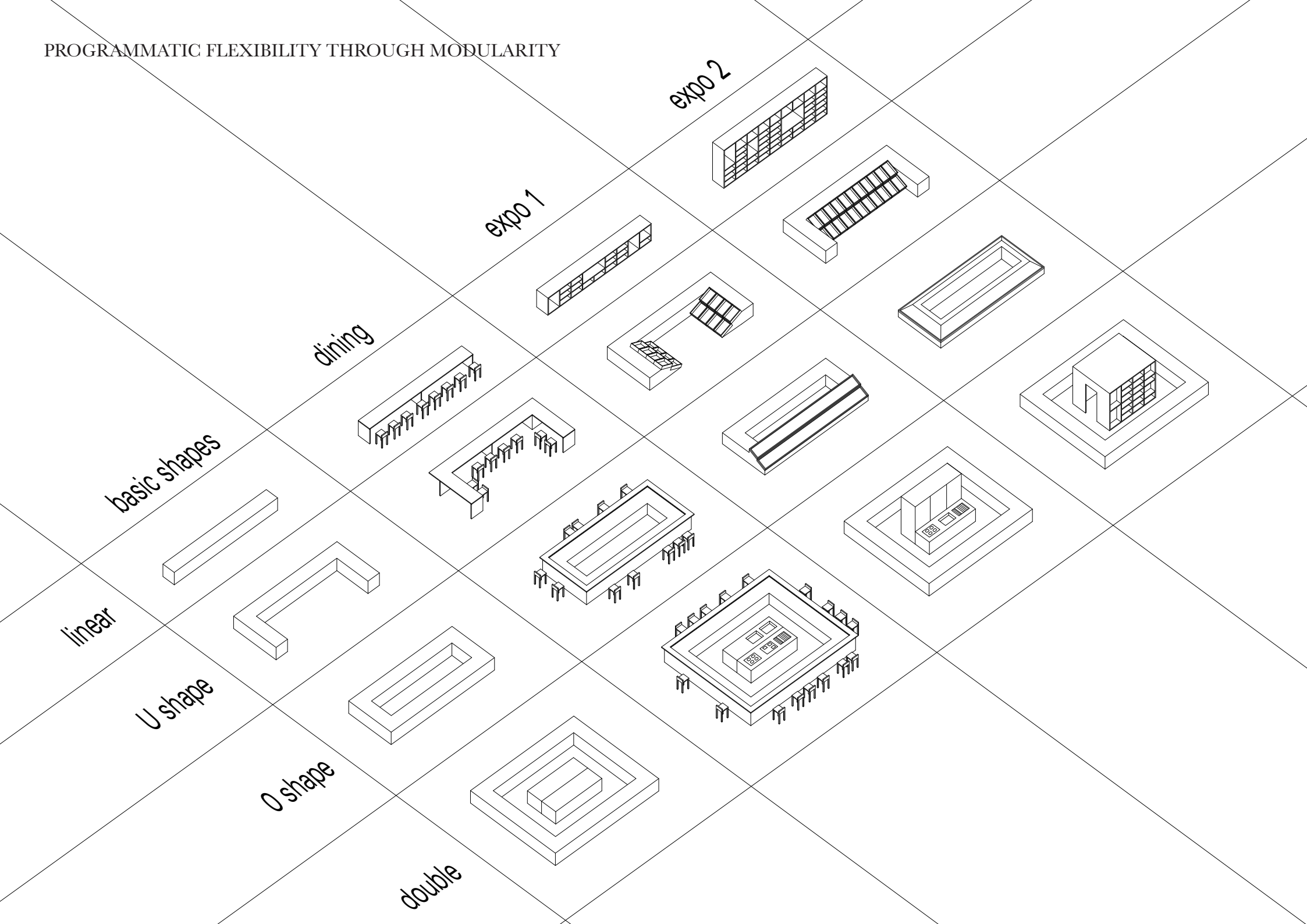
Co-working spaces

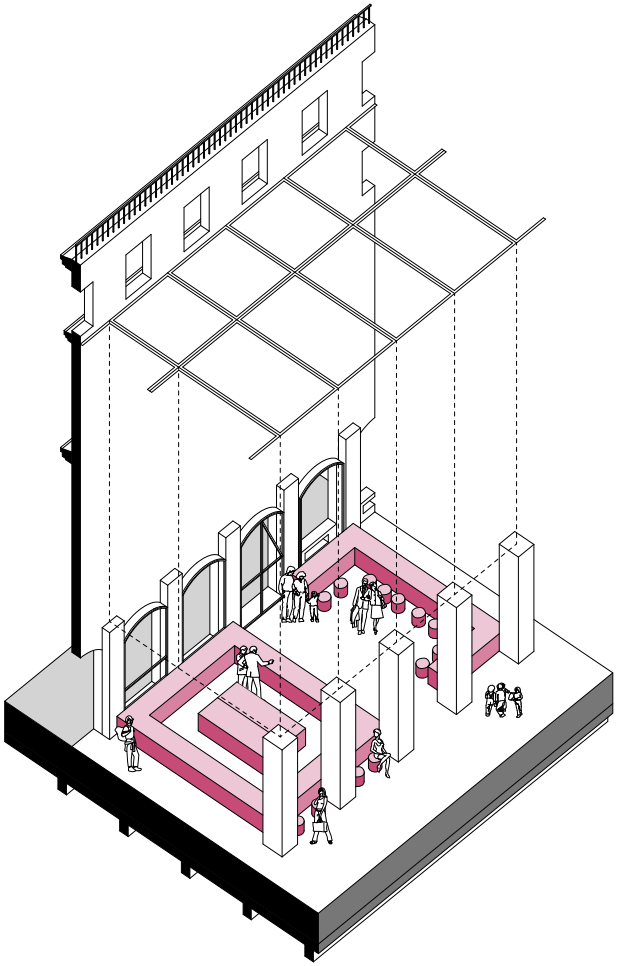


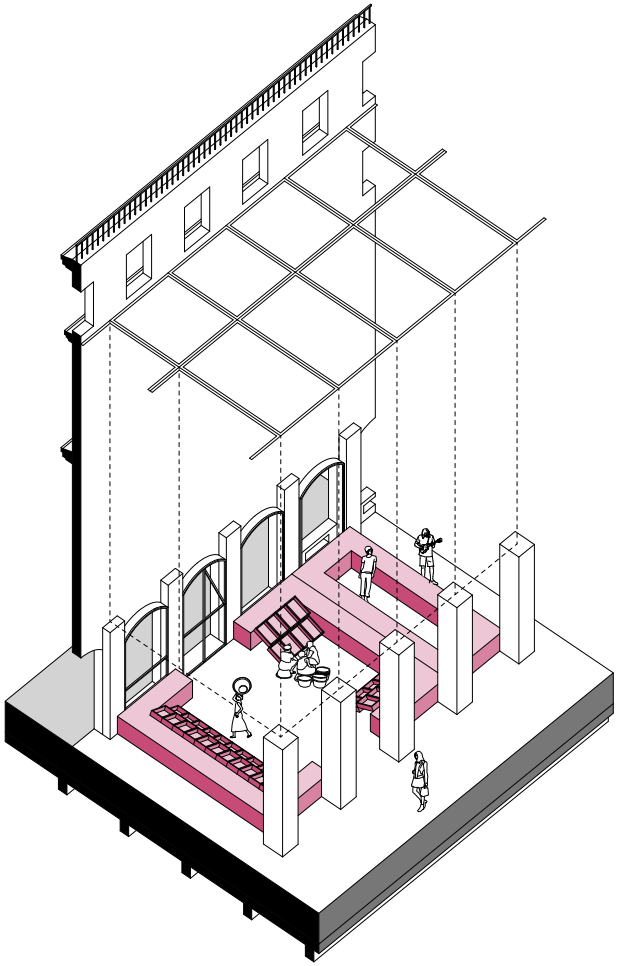


Sense of perspective

PROGRAMMATIC FLEXIBILITY THROUGH MODULARITY

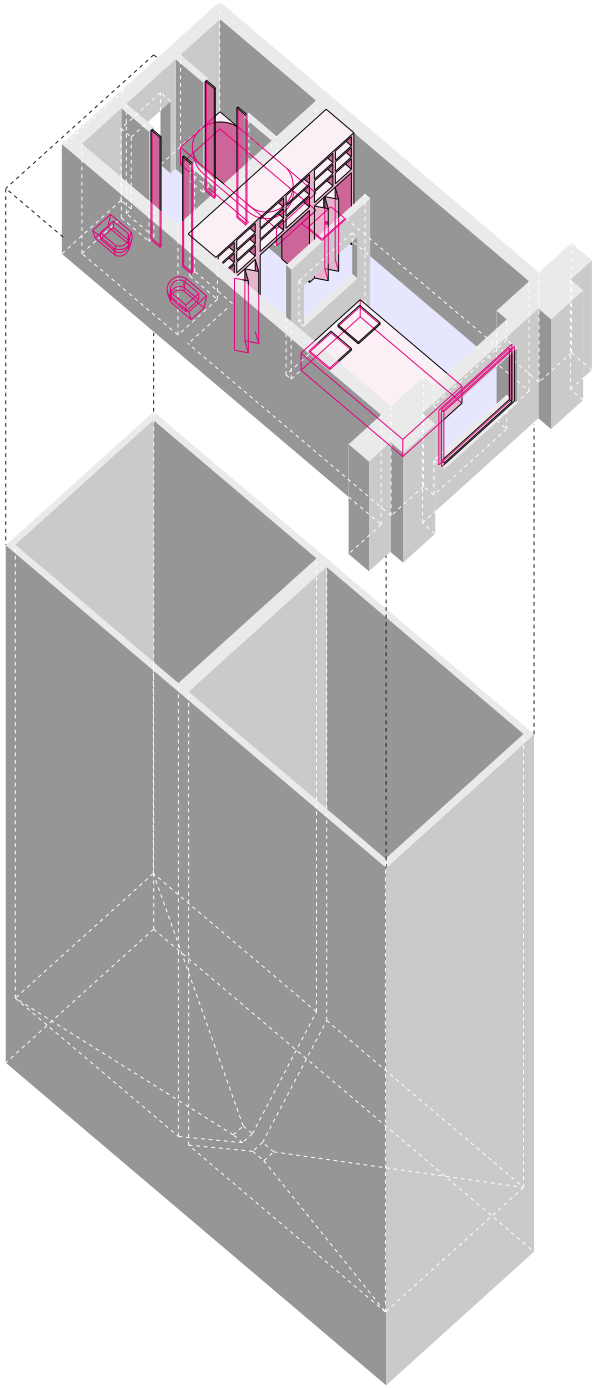


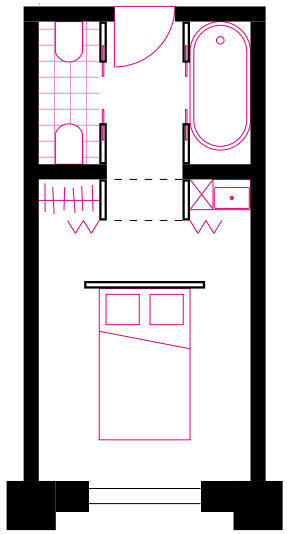




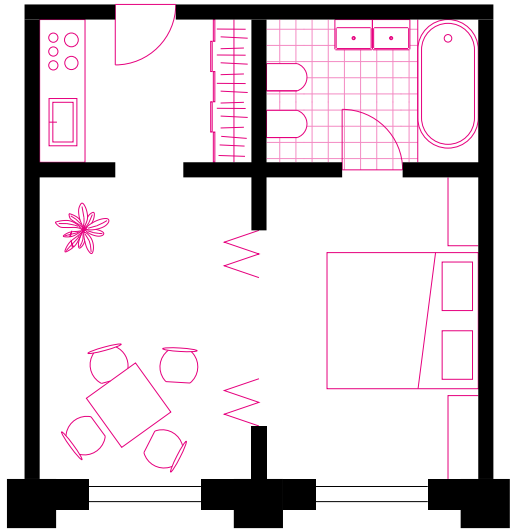
Market stalls

Market stall

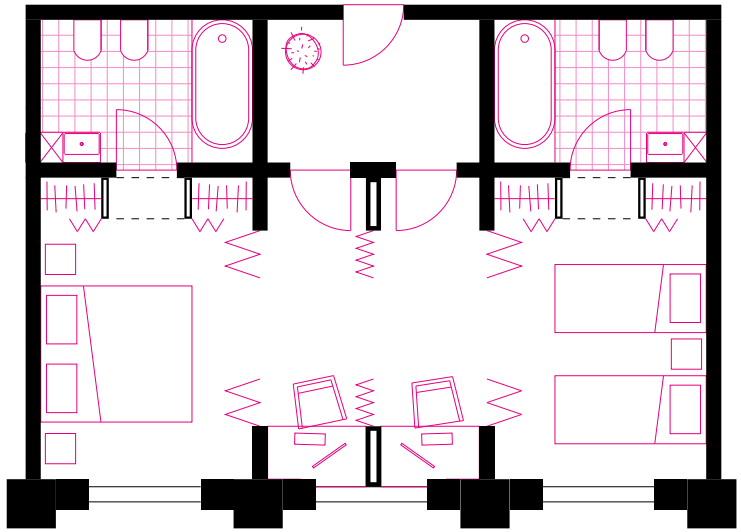




single/double
room
1-unit



suite
room
2-unit



communicating
room
3-unit

Hotel units

scale 1:100

Single unit room - closed

Single unit room - open

Thank you