THE SPACE OF SIGNAL

Hotel New York

complex projects

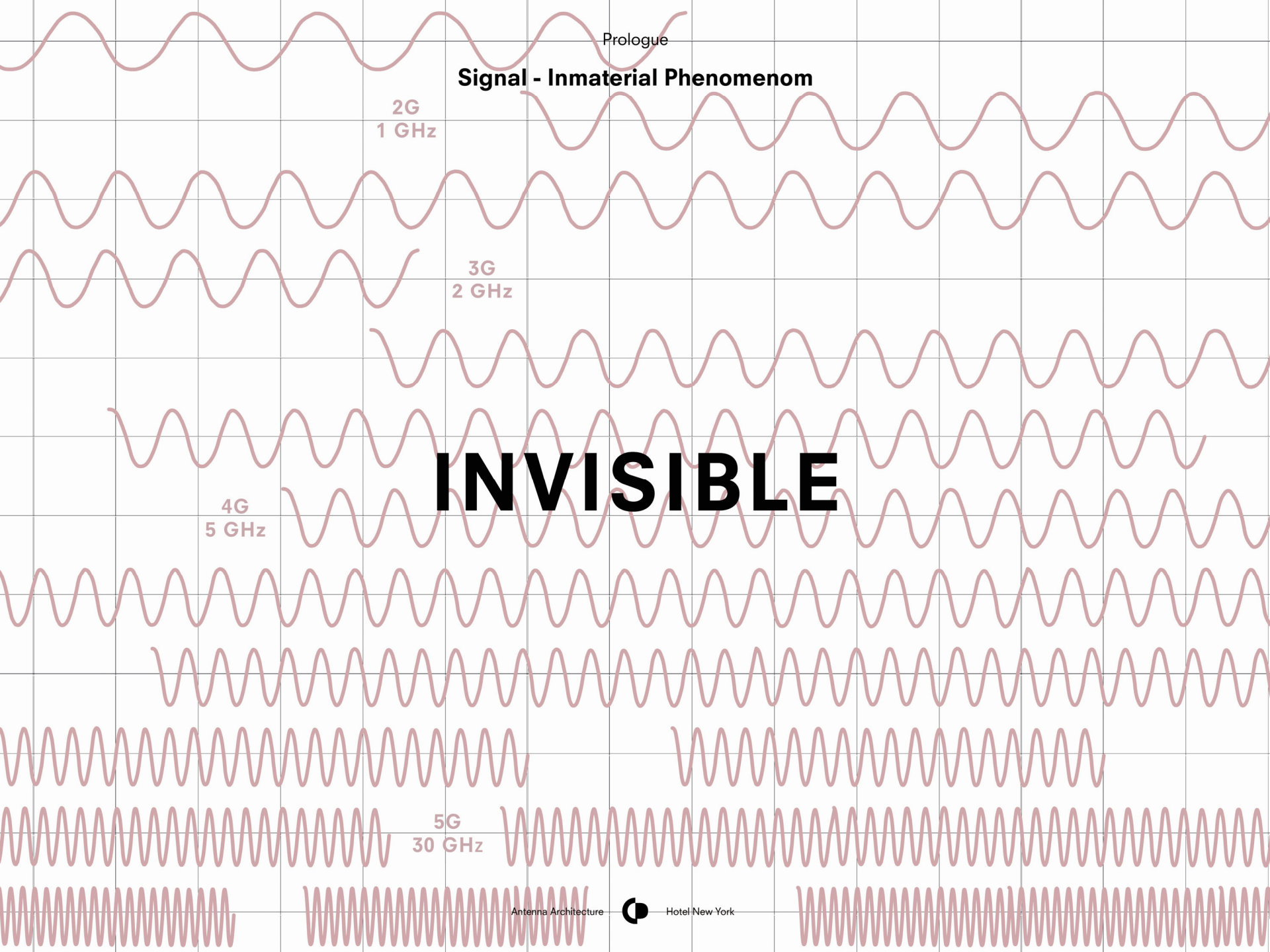
09/07/2021

spring semester

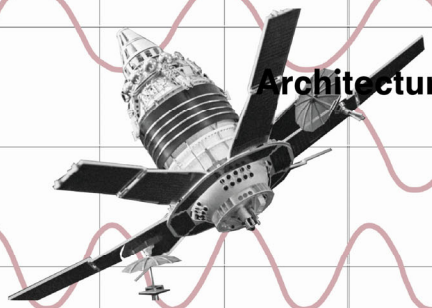
Prologue

Initial Fascination

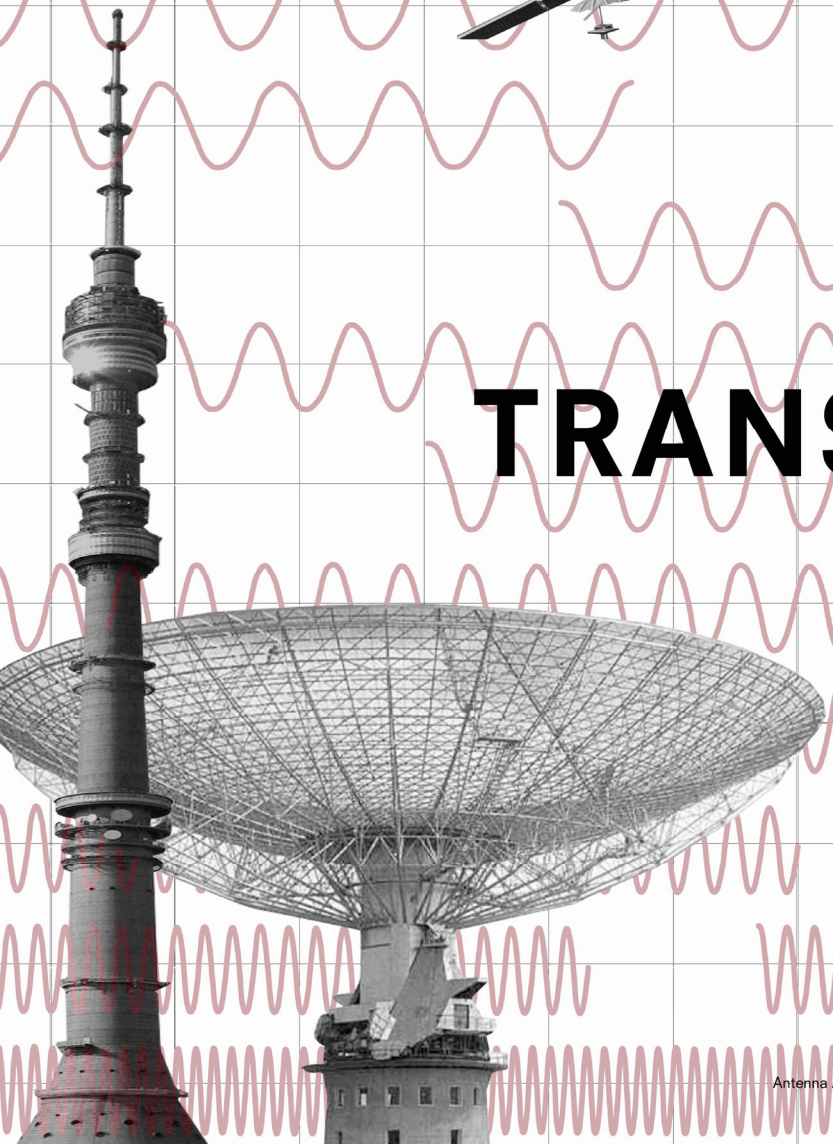
Signal - Inmaterial Phenomenom



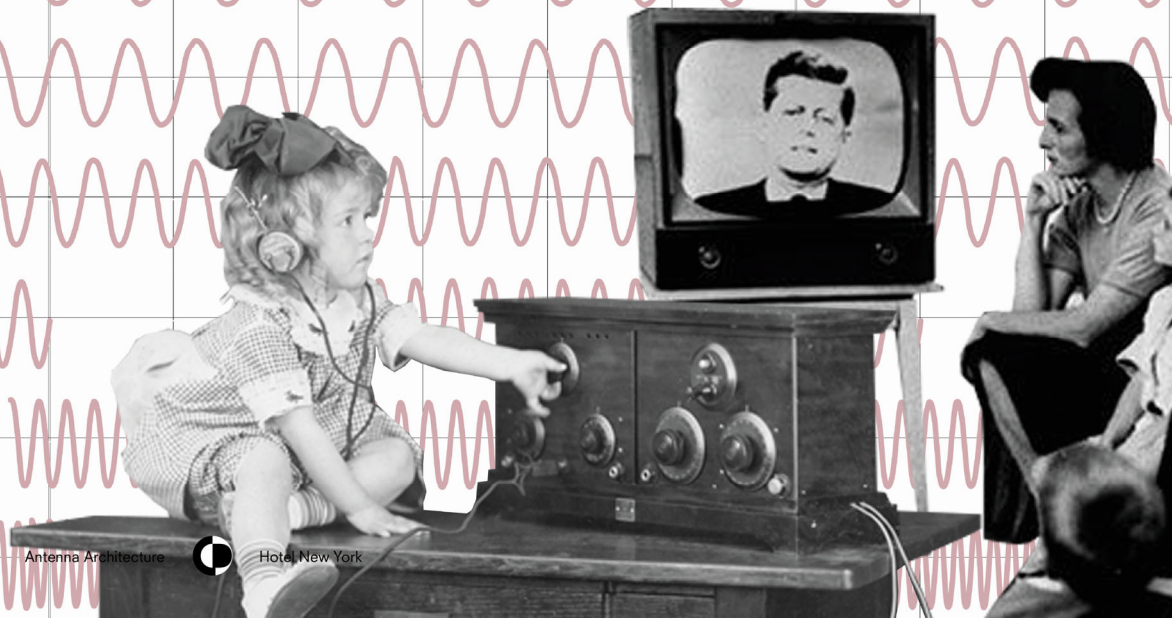
INVISIBLE



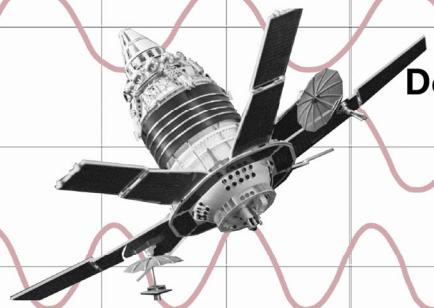
TRANSMITTERS

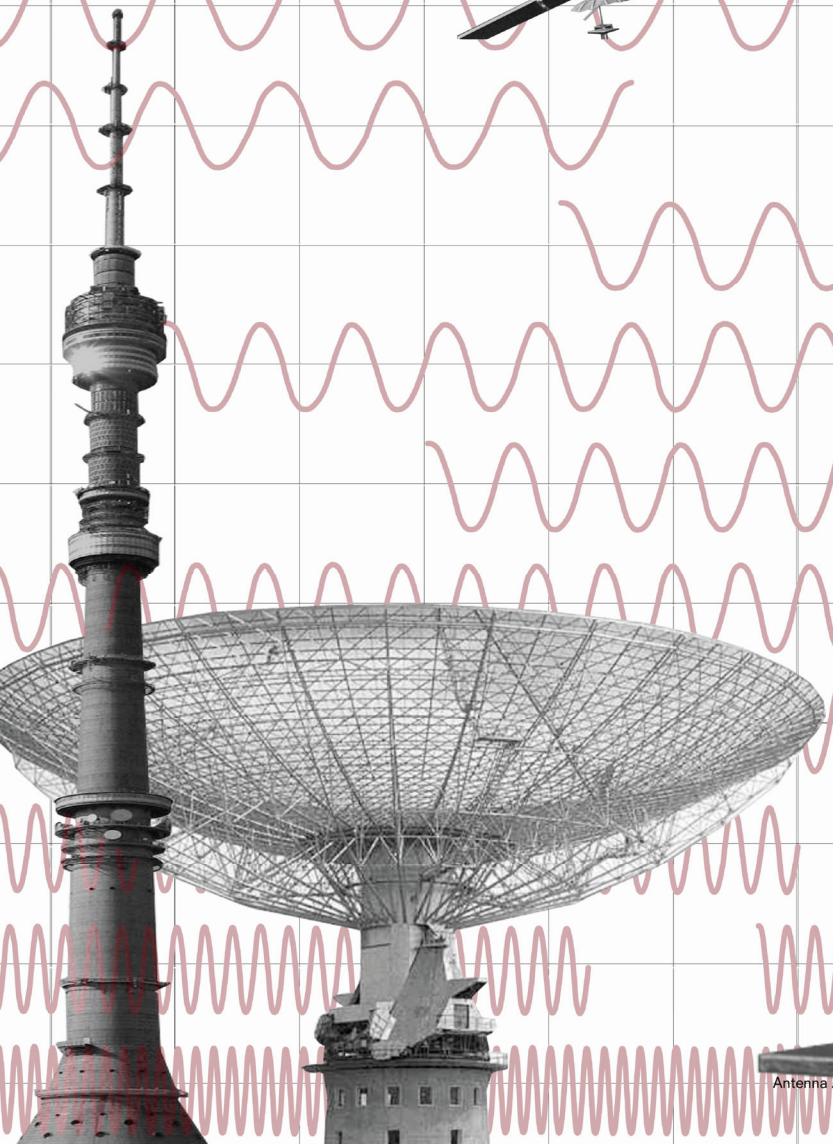


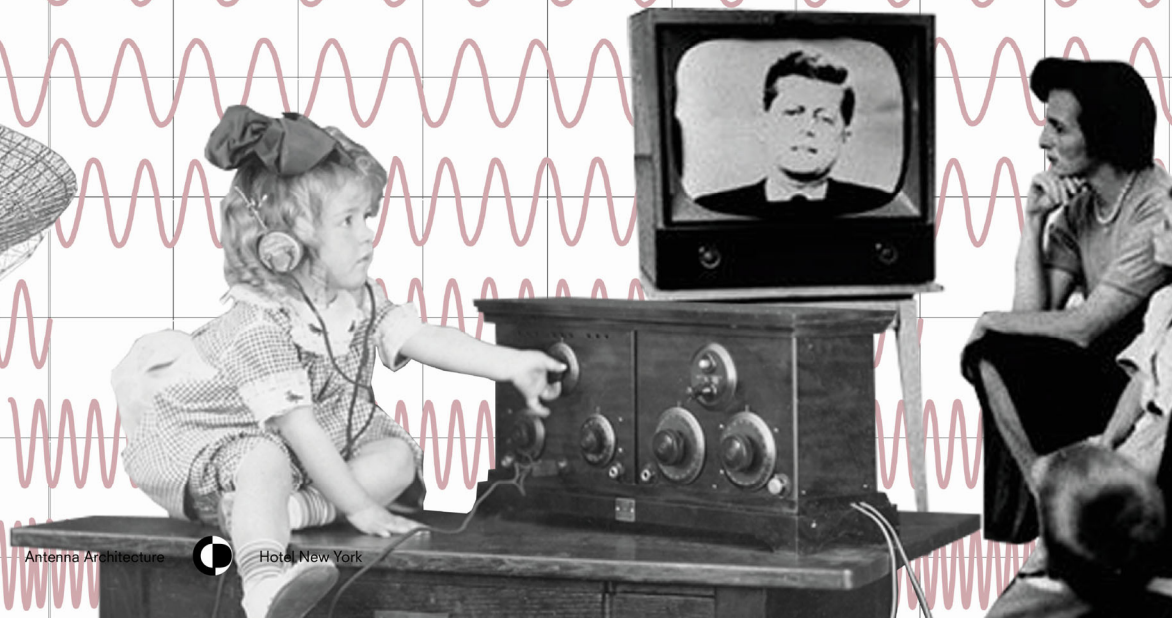
RECEIVERS



Design Topic







Signal Between Transmitter & Receiver

INDEX

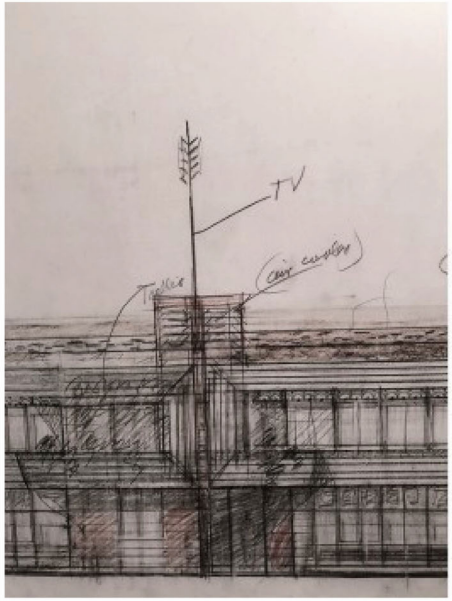
INDEX

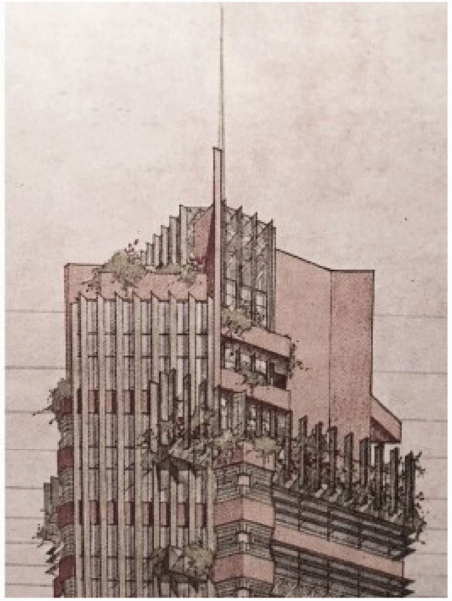
SISO Antenna

Single Input - Single Output (SISO) - one antenna is used as a source (transmitter) and one antenna is used at the destinantion (receiver).

Understanding SISO and MIMO, 2020,
Source: https://www.evercomtech.com/understanding-siso-simo-miso-mimo

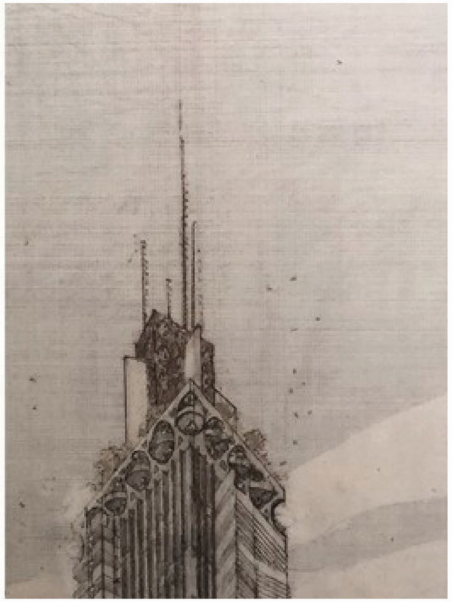
Antenna on Top of Buildings





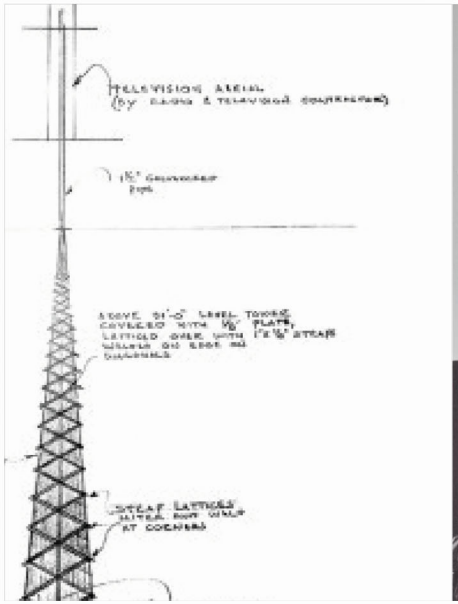
Frank Lloyd Wright sketches - 1921

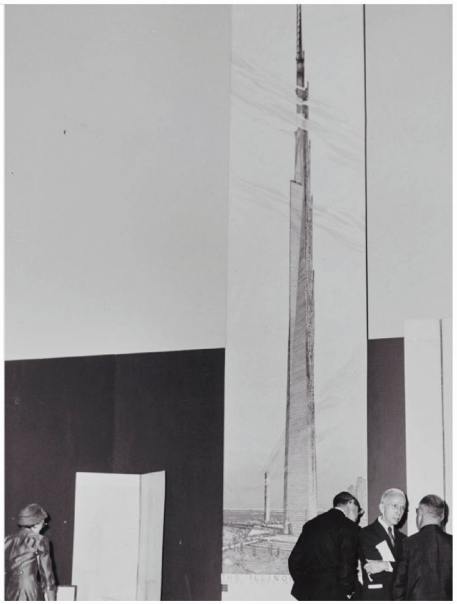
Change in Appearance



Frank Lloyd Wright sketches - 1921

Result of Antenna Invention

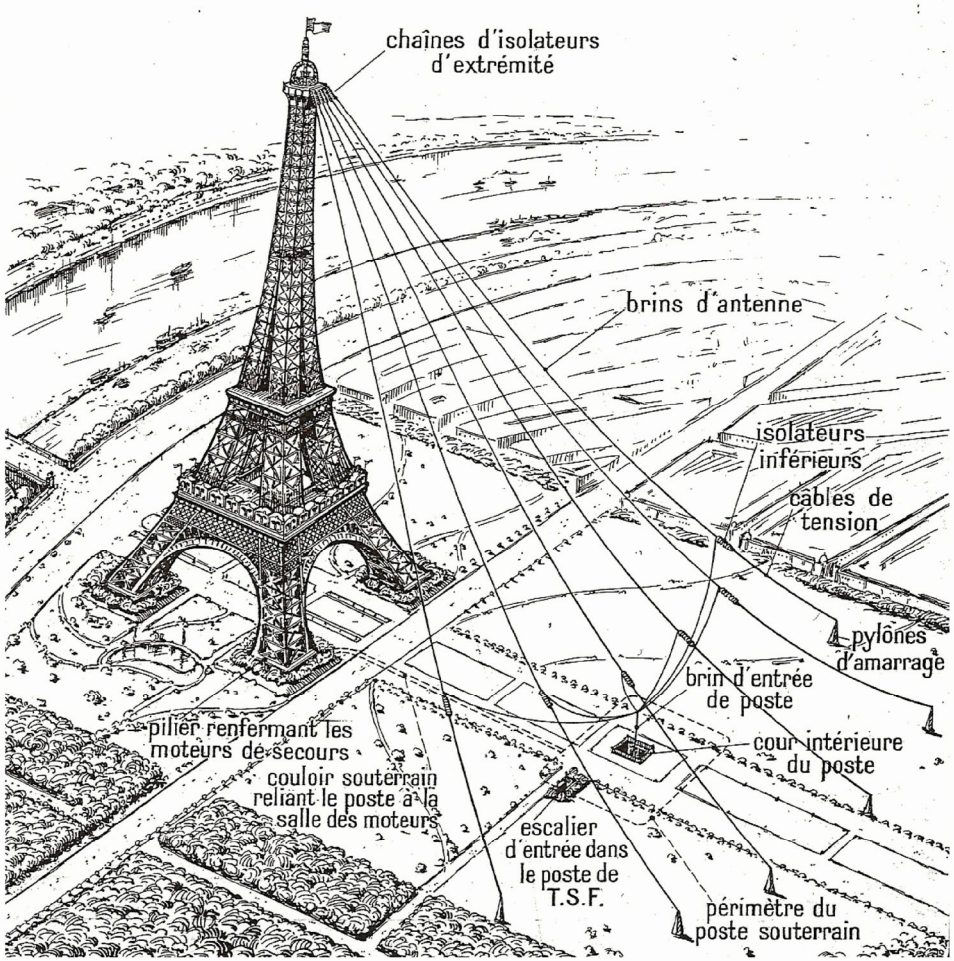




Bahdad Opera House - 1956

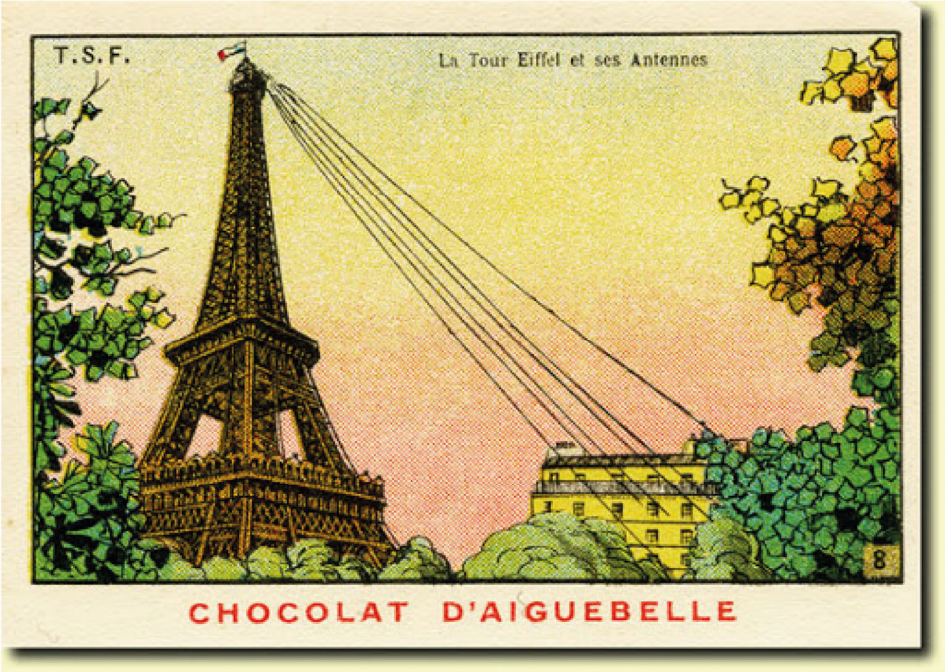
Mile High Skyscraper - 1957

Public Appreciation



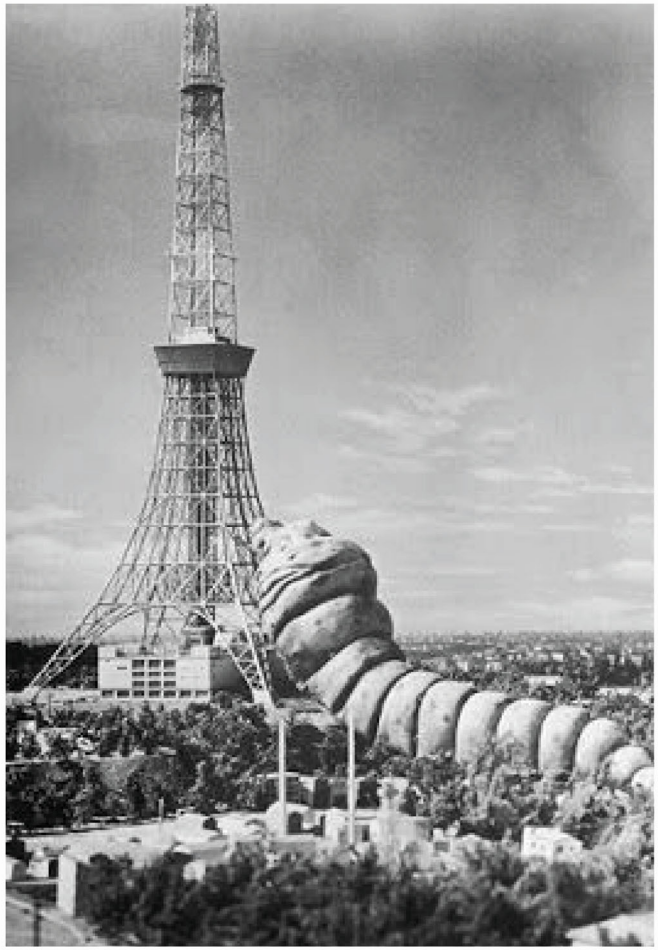
Postcard with Eiffel Tower - 1915

Drawing Connections



Postcard with Eiffel Tower - 1915

Pop Culture



“Mothra” - 1954

Godzilla and Antennas

"Destroy All Monsters" - 1968

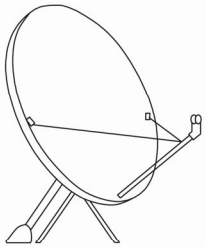
New Building Type

Belgrade 1965

Ostankino 1967

Rotterdam 1960

Satelite Antenna



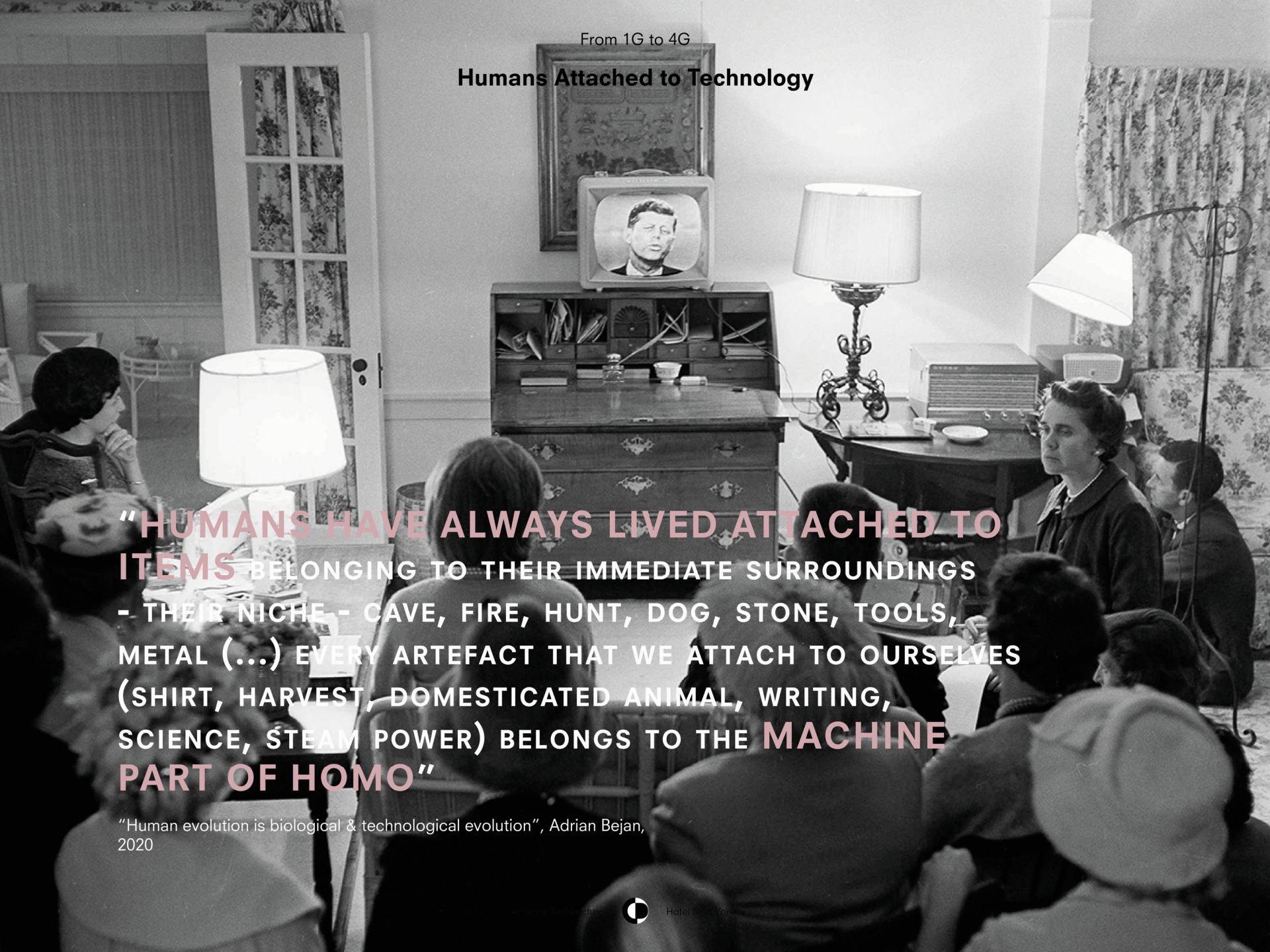
Satelite Antenna
a dish-shaped type of
parabolic antenna designed
to receive or transmit
information by radio waves
to or from a satellite.

Understanding SISO and MIMO, 2020,
Source: https://www.evercomtech.com/understanding-siso-simo-miso-mimo

Disc-Shaped Architecture

Station of Communication Satelite - 1965

Humans Attached to Technology



"HUMANS HAVE ALWAYS LIVED ATTACHED TO ITEMS BELONGING TO THEIR IMMEDIATE SURROUNDINGS - THEIR NICHE - CAVE, FIRE, HUNT, DOG, STONE, TOOLS, METAL (...) EVERY ARTEFACT THAT WE ATTACH TO OURSELVES (SHIRT, HARVEST, DOMESTICATED ANIMAL, WRITING, SCIENCE, STEAM POWER) BELONGS TO THE MACHINE PART OF HOMO"

"Human evolution is biological & technological evolution", Adrian Bejan, 2020

Political Debate - Family Activity

First Presidential Debate - Nixon & Kennedy, 1968

Moon Landing - Public Event

Live Transmission of Moon Landing, 1959

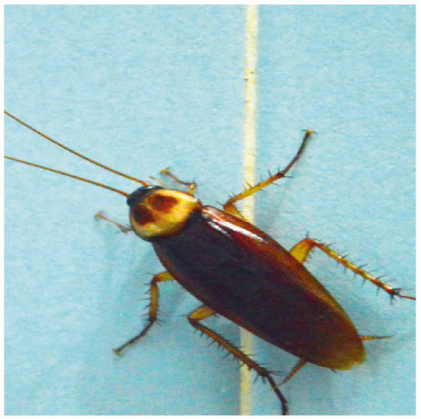
Shared Devices

Wroclaw, 1970-1980

Individual Devices

Tokyo - metro station, 2014

Antenna as Way of Sensing the Wolrd



Antenna are paired appendages used for sensing in arthropods. It is connected directly to insect's brain.

Antenna as the highest point of almost each building - connection to digital, invisible and sky.

Antenna hidden in iPhone becomes an 'extension' of human body, another way of sensing the world.

Invisibility of Infrastructure

"New Trees", Robert Voit, 2019

5G & Protests

5G Protest, Rotterdam, 2020

PROBLEM STATEMENT

5G IS BEING IMPLEMENTED IN CITIES WITHOUT SUFFICIENT STUDIES ON HOW IT WILL INFLUENCE THE BUILT ENVIRONMENT.

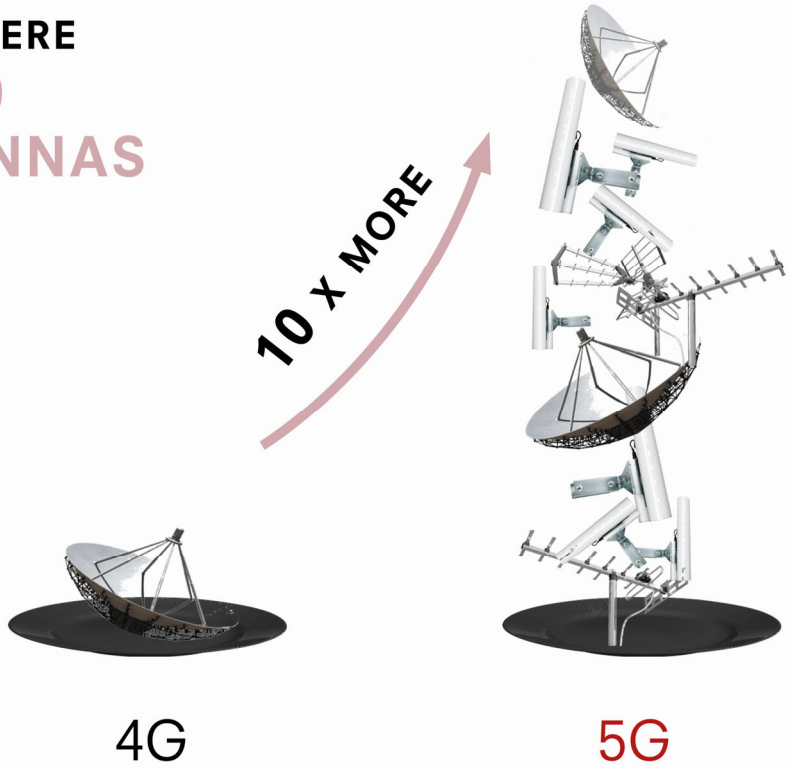
RESEARCH QUESTION

HOW DOES WIRELESS TECHNOLOGY, TOGETHER WITH 5G IMPLEMETATION, PROMOTE FUNCTIONAL AND ESTHETICAL CHANGE IN ARCHITECTURE?

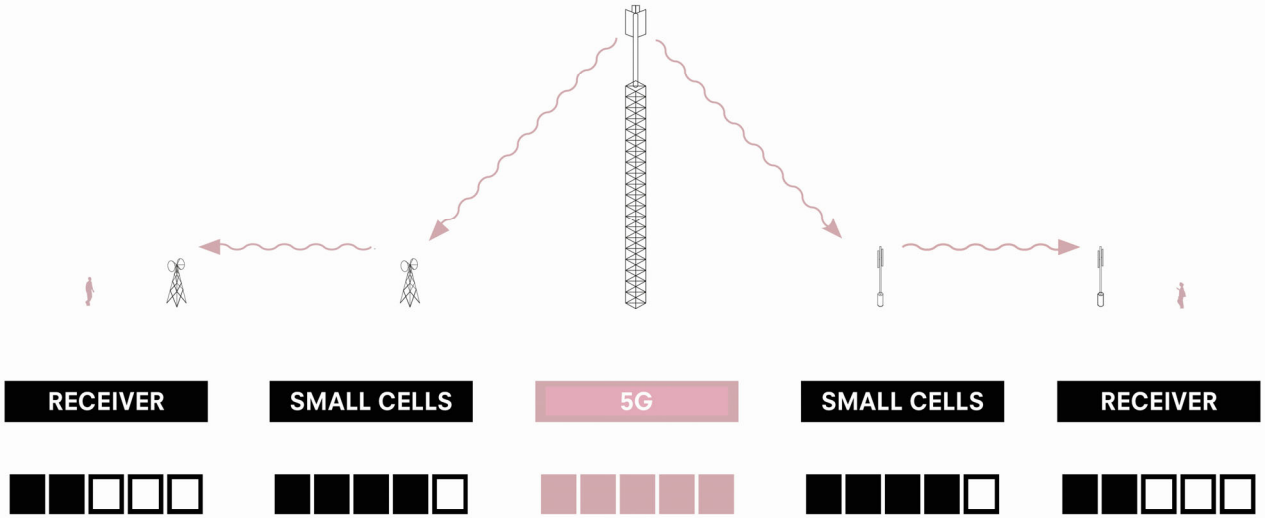
INDEX

More Antennas Than Humans

WITH THE USE OF 5G, THERE WILL BE NEEDED EVEN 10 TIMES MORE ANTENNAS IN THE CITIES.



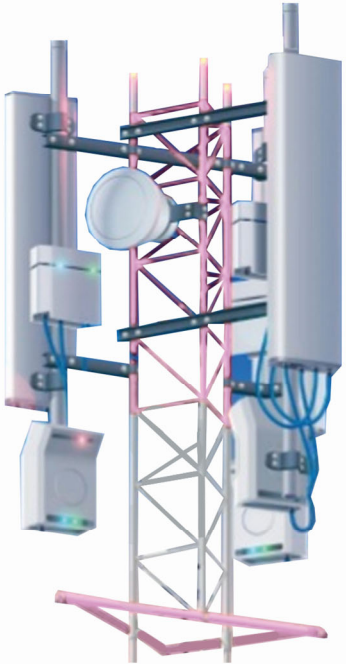
Hierarchy



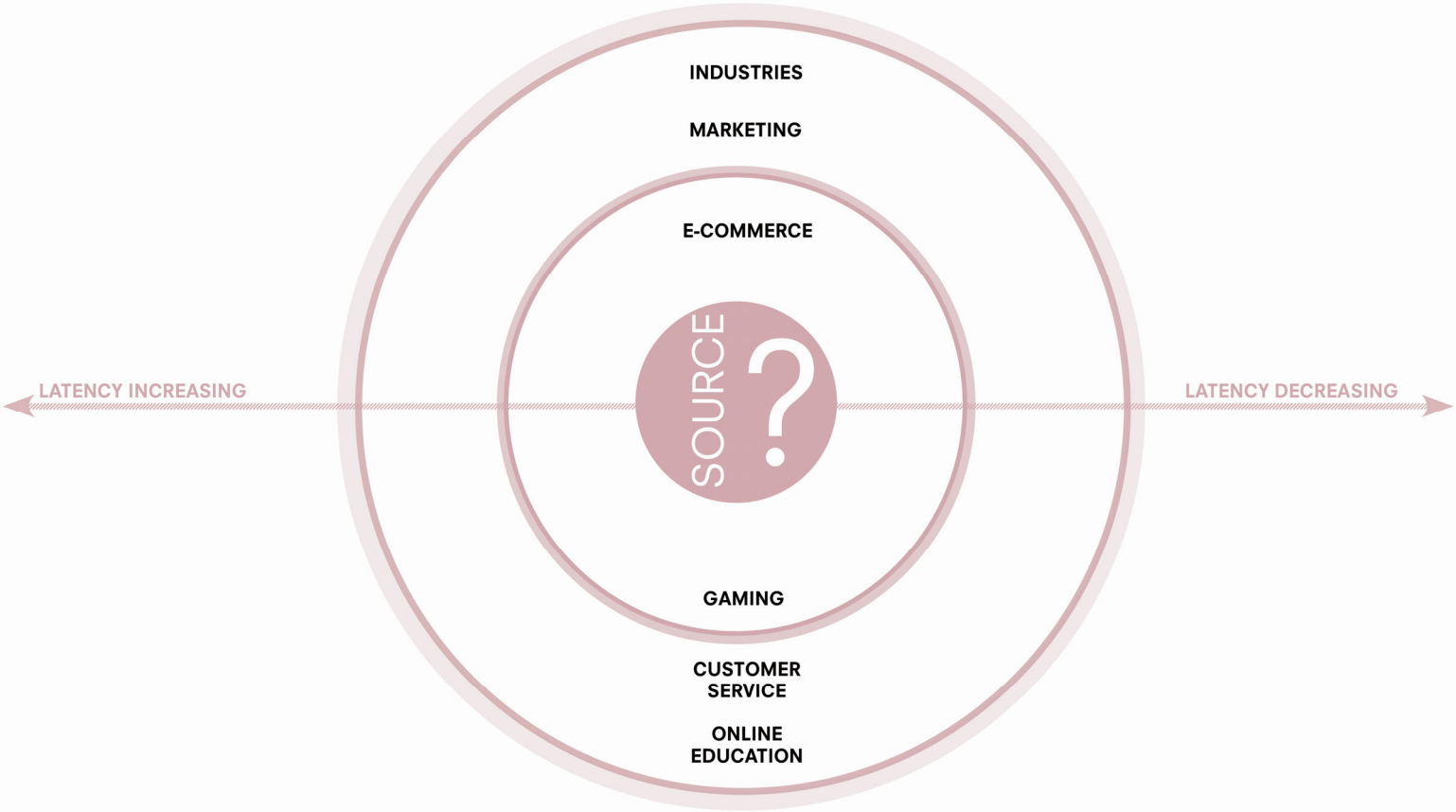
Proximity to Signal

IN ORDER TO QUICKLY SEND AND RECEIVE INFORMATION THE PROXIMITY TO SIGNAL WILL BE CRUCIAL.

"The Importance of Uptime in Digital Businesses", The Foundation of Digital Economy, 2020



Spatial Consequence in City



Healthcare

"5G IS BEING USED TO PERFORM REMOTE SURGERY FROM THOUSANDS OF MILES AWAY, AND IT COULD TRANSFORM THE HEALTHCARE INDUSTRY. (...) 5G SIGNAL LATENCY WILL BE CRUCIAL."

"5G is being used to perform remote surgery from thousands of miles away, and it could transform the healthcare industry", Caroline Frost, 2019

Smart Health Tech Campus

Design Goal

5G IMPLEMENTATION MODEL

5G TRANSMITTER

PUBLIC SOURCE

+

5G RECEIVER

PRIVATE E- BUSINESSES

Erasmus MC
Universitair Medisch Centrum Rotterdam
Czaftung

+

Gemeente Rotterdam

vodafone

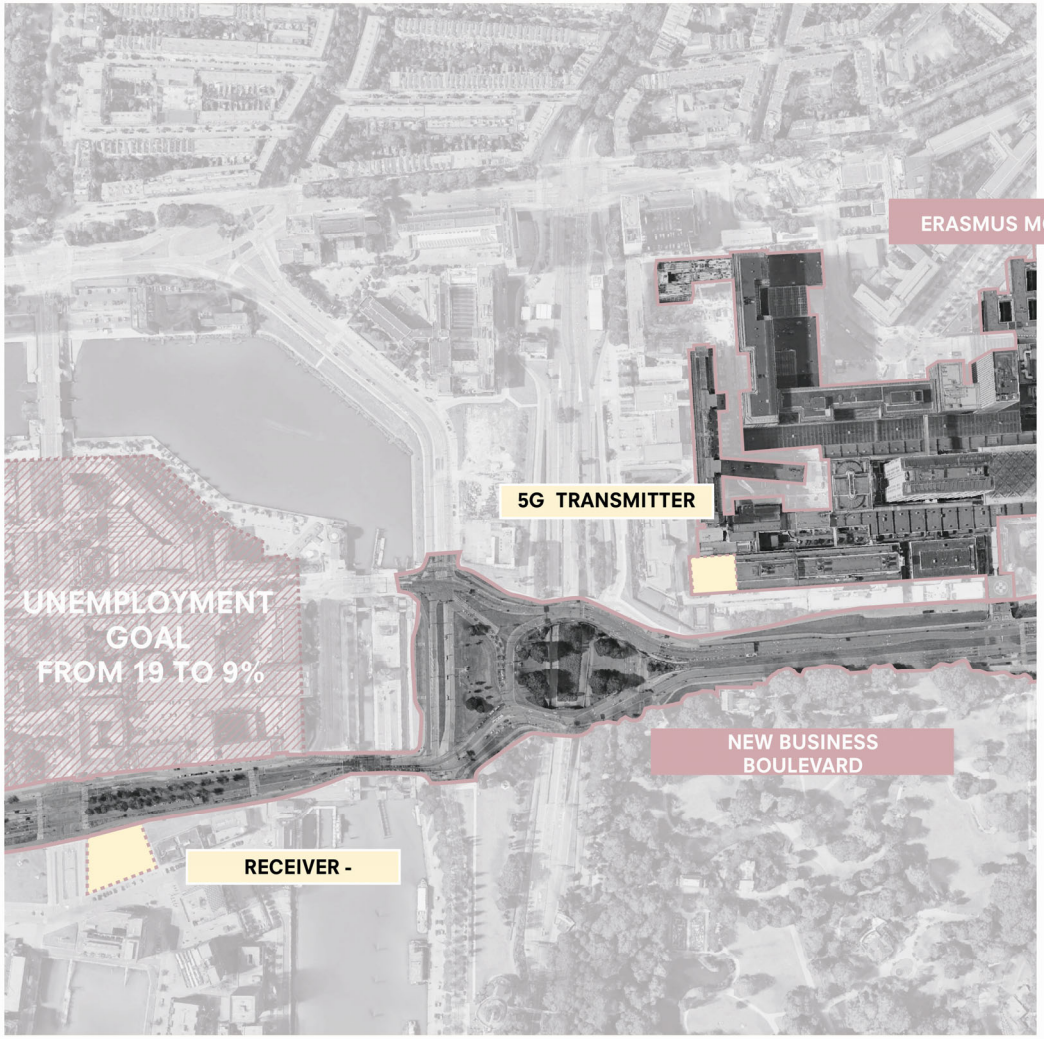
+

T · · Mobile ·

+

kpn

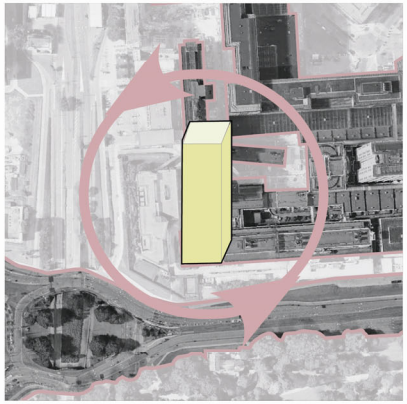
Group Strategy



TOWARDS BOOMPJES

TOWARDS CREATIVE DISTRICT

Urban Consequences



5G Antenna
PROTAGONIST OF CHANGE

Western Archipelago
ECONOMICAL REVIVIAL

Working Prospects
SOCIAL IMPROVEMENT

Transmitter

5G IMPLEMENTATION MODEL

5G TRANSMITTER

PUBLIC SOURCE

Erasmus MC
Universitair Medisch Centrum Rotterdam
Czafung

+

Gemeente Rotterdam

5G RECEIVER

PRIVATE E- BUSINESSES

vodafone

+

T-Mobile

+

kpn

Change In Typology

The Cloud channel is brought to you by CoreSite

DataBank Plans Network of Micro Data Centers at Cell Towers

BY RICH MILLER - SEPTEMBER 6, 2017 — LEAVE A COMMENT

News | Industries | Tech-Talk | Data Center | CIO Wall | ETCISO.In | Brand Solutions

IT News / Latest IT News / Strategy & Management

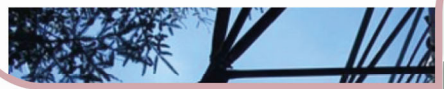
Raritan's innovation edge: Cell towers as next edge data centers

Raritan's Sanjay Motwani on how the company's innovation graph is ... semiconductor machines and routing traffic

All along the cell tower: where to place edge and micro data centers?

Dec 26, 2019 | Chris Burt

CATEGORIES Edge Computing News | Explaining Edge



ABOVE GROUND LEVEL agl Media Group.

AGL MAGAZINE | APPLIED WIRELESS TECH | EDIGEST | CONNECTIONS

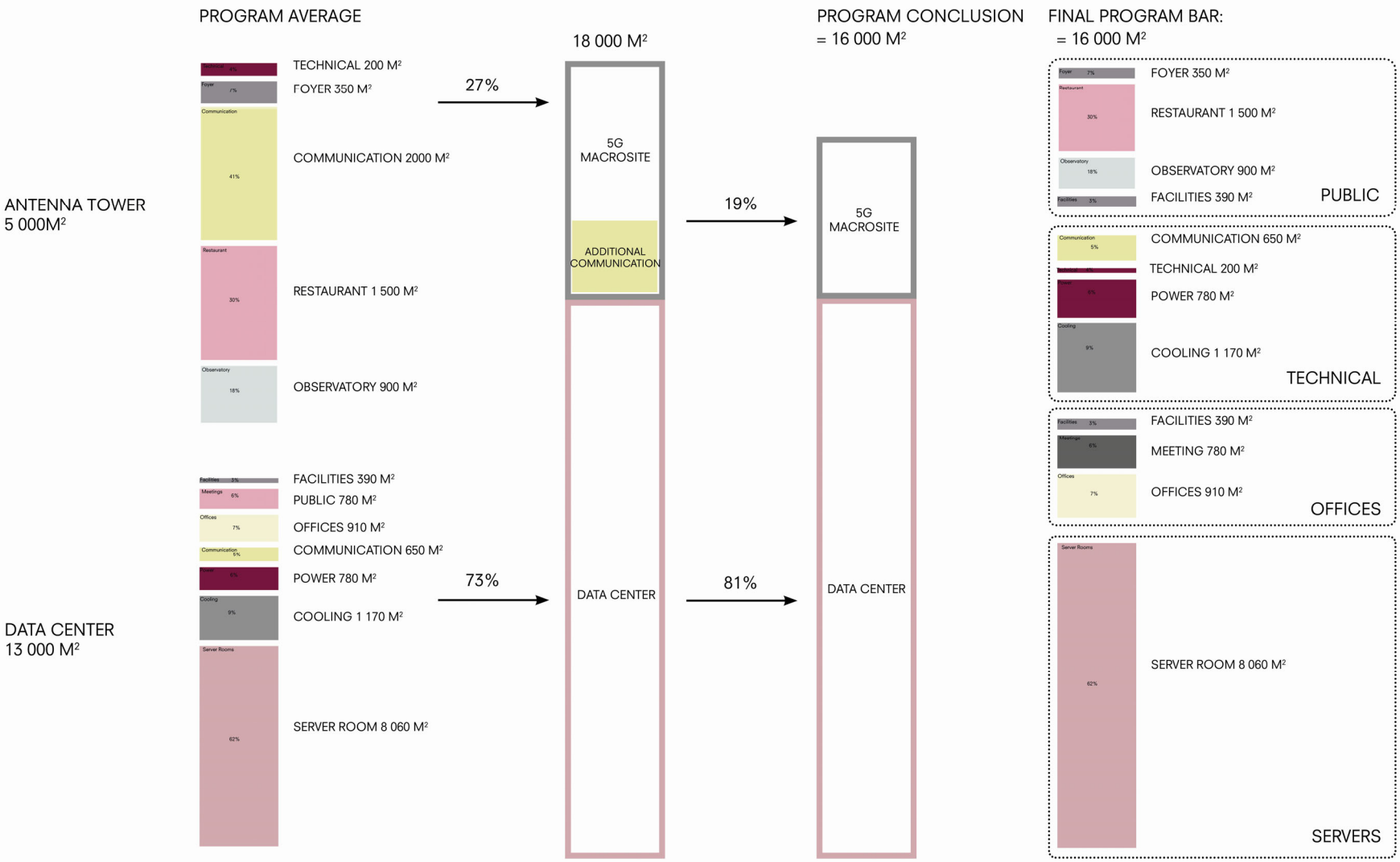
The Tower is the New Data Center

BY COLE CRAWFORD

5G Hybrid

5G HYBRID = DATA CENTER + ANTENNA

Program Bar - Transmitter



Receiver

5G IMPLEMENTATION MODEL

5G
TRANSMITTER

PUBLIC
SOURCE

Erasmus MC
Universitair Medisch Centrum Rotterdam

+

Gemeente Rotterdam

5G
RECEIVER

PRIVATE
E- BUSINESSES

vodafone

+

T · · Mobile ·

+

kpn

Telecomunication Companies - Cooperation

HOME NEWS ARTICLES VIDEOS BLOGS FILES AGENDA EDITIONS SUBSCRIBE

KPN, T-Mobile and Vodafone help each other with major telecom failures

JANUARY 6, 2015

23 April 2019 09:10 AM 5min Coen van Eenbergen INFRASTRUCTURE

KPN, T-Mobile and VodafoneZiggo must jointly build one 5G network

FEATURED

Schiphol will jointly construct an indoor mobile network with providers

Schiphol, in collaboration with KPN, T-Mobile and VodafoneZiggo, will be installing an indoor network for mobile communication. The network at the airport must be ready by 2020. It will be suitable for new techniques such as 5g.

According to the announcement , the network will consist of more than thirty antenna installations and that should result in 'excellent mobile coverage'. The parties do not provide technical details about the network, but the installations would be suitable for 'the latest generation of mobile networks, such as 5g'.

By **Julian Huijbregts**
News editor
Rate this article

08-10-2018 • 11:15

98

KPN, Vodafone and T-Mobile are building a new mobile indoor network in Rotterdam Ahoy

The providers KPN, Vodafone and T-Mobile will be installing a new and future-proof mobile indoor network in Rotterdam Ahoy for an optimal mobile user experience for the visitors of the event

Expo of New Technologies

ITU Telecom, 1971

Expo of New Technologies

ITU Telecom, 1975

Expo of New Technologies

ITU Telecom, 1979

Experience Center

Program Bar - Receiver

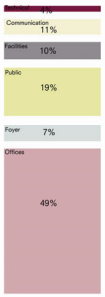
PROGRAM AVERAGE

56 000 M²

T-MOBILE HEADQUARTER 16 000 M²

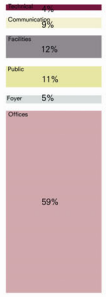
TECHNICAL 640 M²
COMMUNICATION 2
FACILIITES 1440 M²
PUBLIC 1280 M²
FOYER 1 600 M²
OFFICE 8 800 M²

VODAFONE HEADQUARTER 18 000 M²



TECHNICAL 720 M²
COMMUNICATION 1980 M²
FACILIITES 1800 M²
PUBLIC 3 420 M²
FOYER 1260 M²
OFFICE 8 820 M²

KPN HEADQUARTER 22 000 M²



TECHNICAL 880 M²
COMMUNICATION 1980M²
FACILIITES 2640 M²
PUBLIC 2420 M²
FOYER 1 100 M²
OFFICE 12 980 M²

23 % GROWTH →

23 % GROWTH →

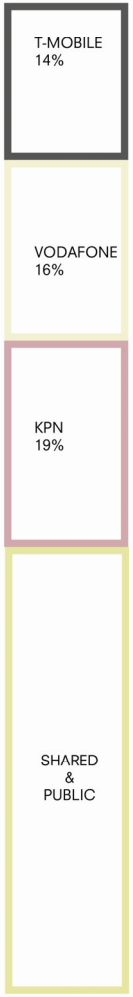
23 % GROWTH →

PROGRAM ADJUSTMENTS

13 000 M²

COOPERATION →

13 000 M²



FINAL PROGRAM BAR

13 000 M²

T-MOBILE

OFFICE 1 560 M²
FACILIITES 260 M²

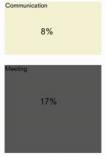
VODAFONE

OFFICE 1 820 M²
FACILIITES 260 M²

KPN

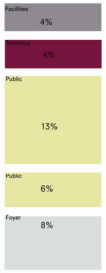
OFFICE 2 100 M²
FACILIITES 260 M²

SHARED



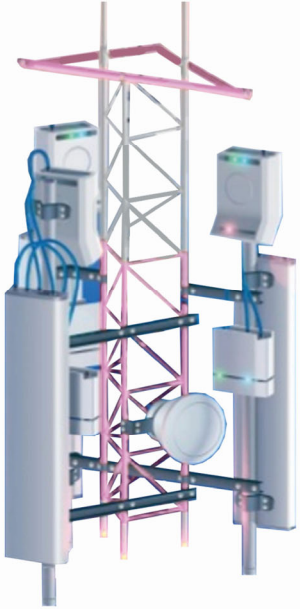
COMMUNICATION 1040 M²
MEETINGS 2 210 M²

PUBLIC



FACILITIES 520 M²
TECHNICAL 520 M²
EXPERIENCE CENTER
RESTAURANT 570 M²
FOYER 1 040 M²

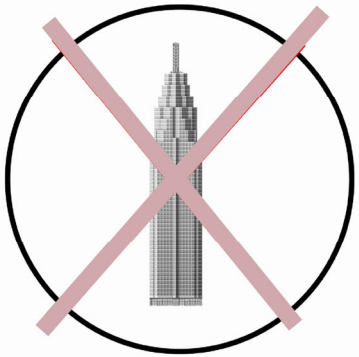
Urban Rules



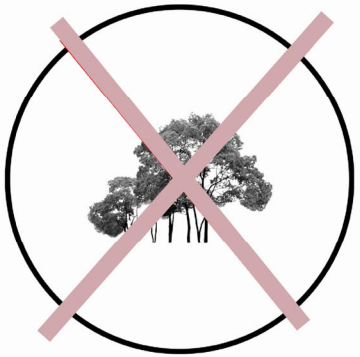
How to define URBAN RULES in order to assure RELIABLE SIGNAL CONNECTION?

Physical Barrier

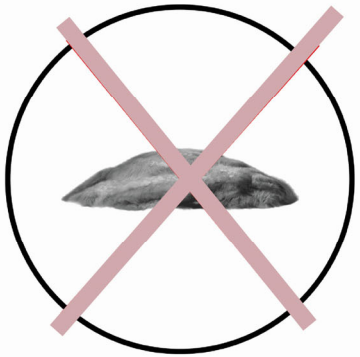
"4G WAVELENGTHS HAVE A RANGE OF ABOUT 10 MILES, WHEREAS 5G HAS A RANGE OF JUST 1,000 FEET. DUE TO THIS, 5G SIGNALS CAN BE BLOCKED BY PHYSICAL BARRIERS."



High-rise Buildings

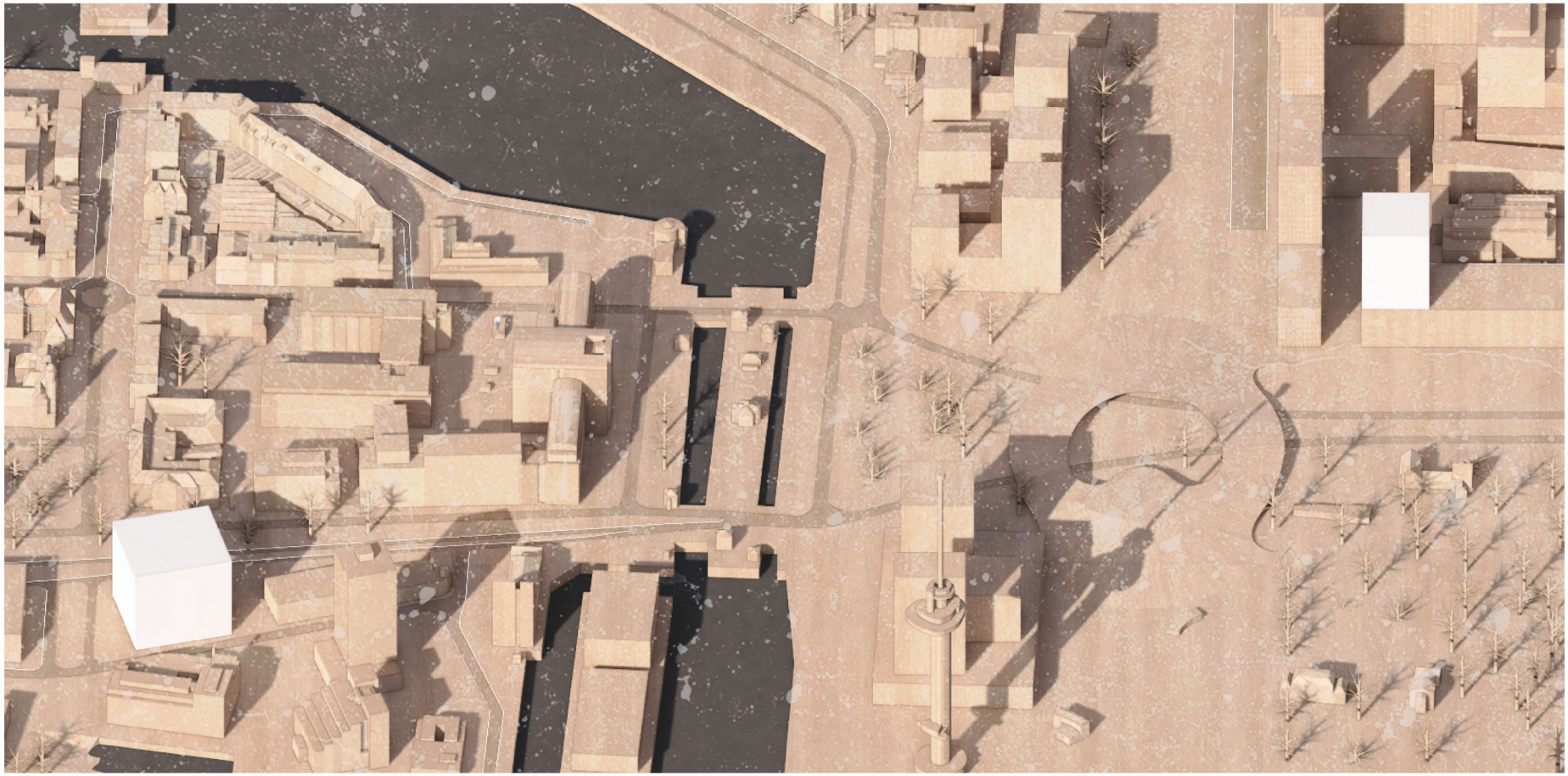


Large Tree Formations



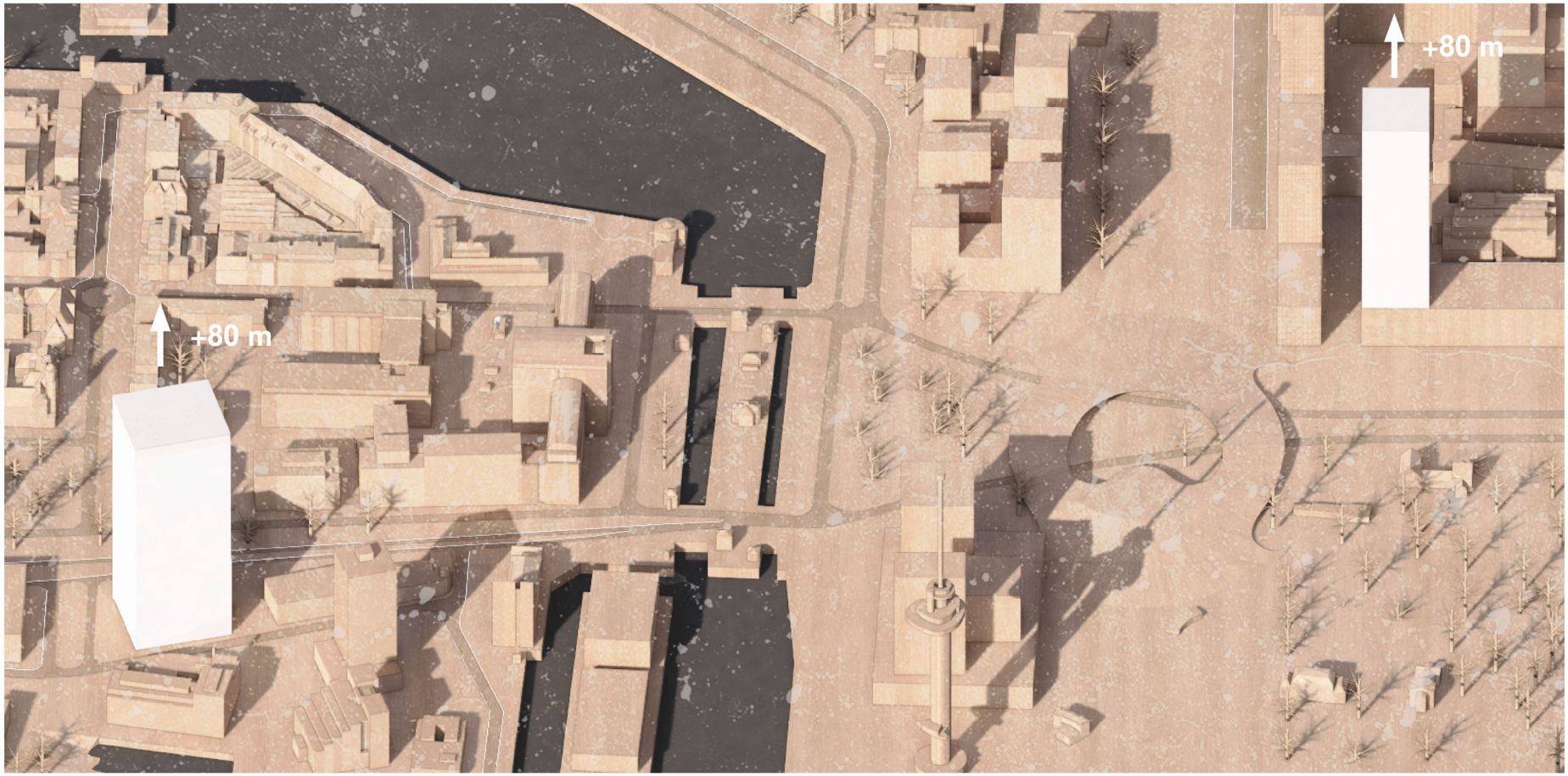
Natural Landscape Formations

Massing 1 - Same Height



Massing 1 - Unsucessful Signal Transmission

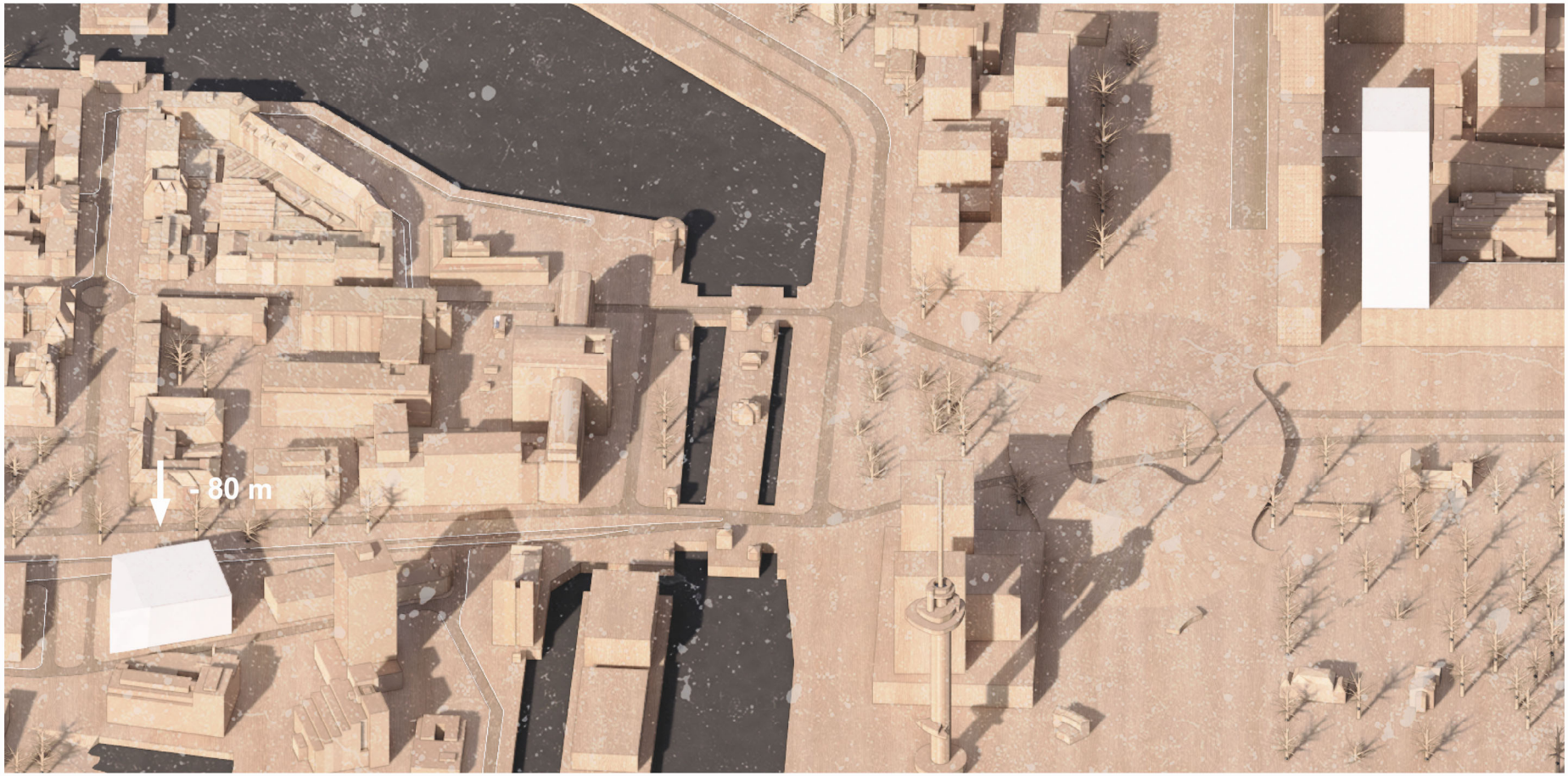
Massing 2 - Highrise



Massing 2 - Signal Blocked for Business Boulevard

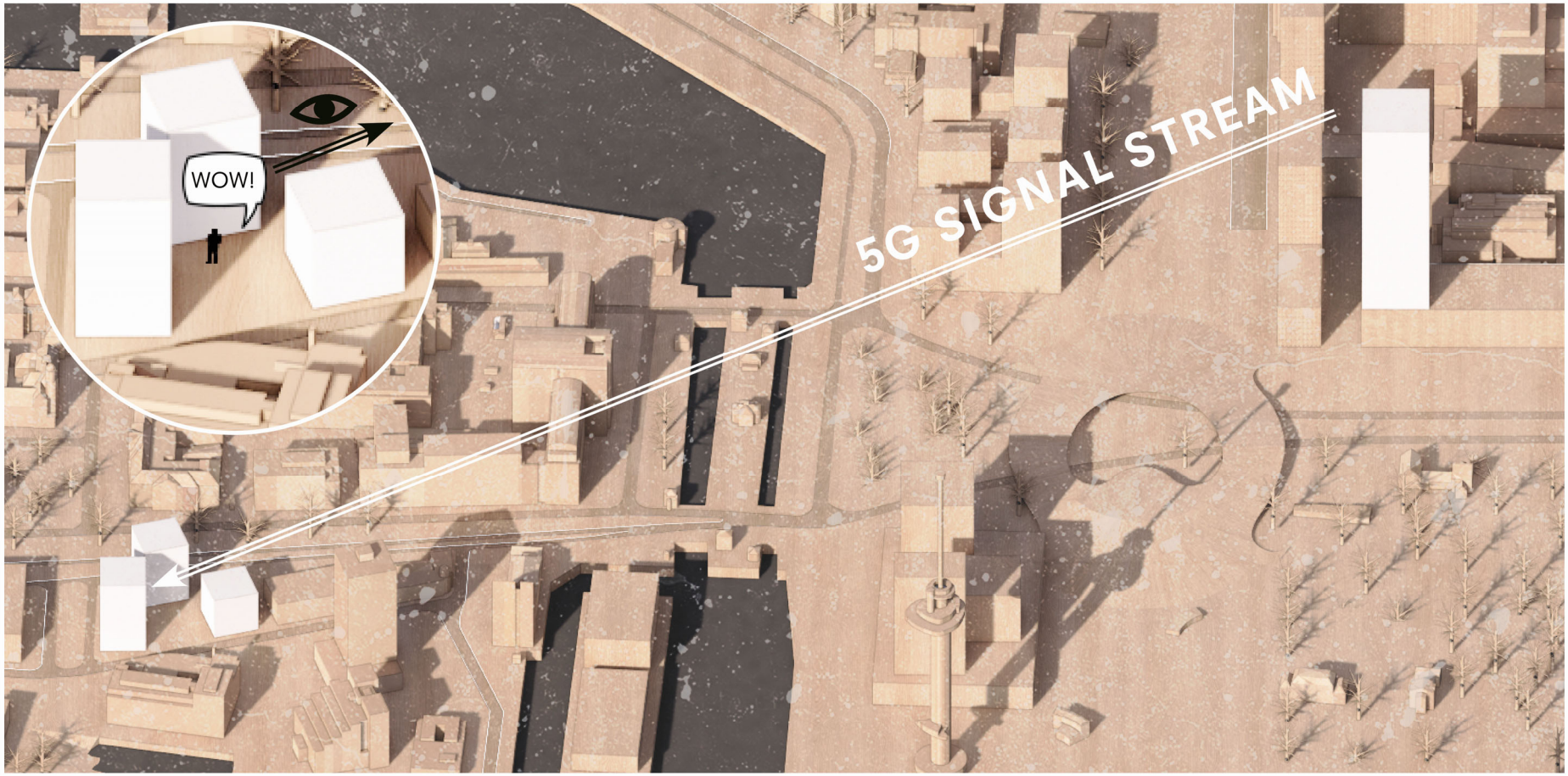
5G SIGNAL BLOCAKDE

Massing 3 - Height Difference



Massing 3 - Signal Not Able to Reach Entire Depth

Massing 4 - Separation of Volumes

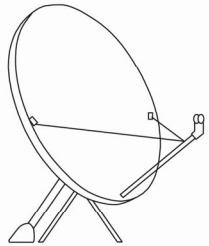


Step 2: Antenna Placement

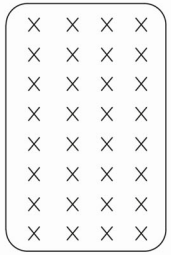
- [x] URBAN RELATION & MASSING
- [ ] ANTENNA PLACEMENT
- [ ] DESIGN

Architectural Equation

Single Input - Single Output



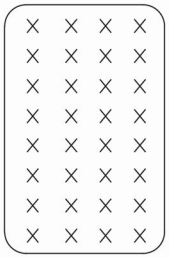
Satelite Antenna



Massive MIMO

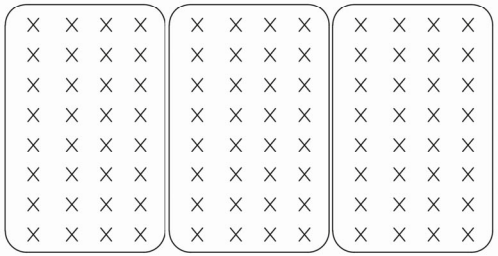
?

New Antenna Type



MASSIVE MIMO

Large Number of Devices
on Cell Towers

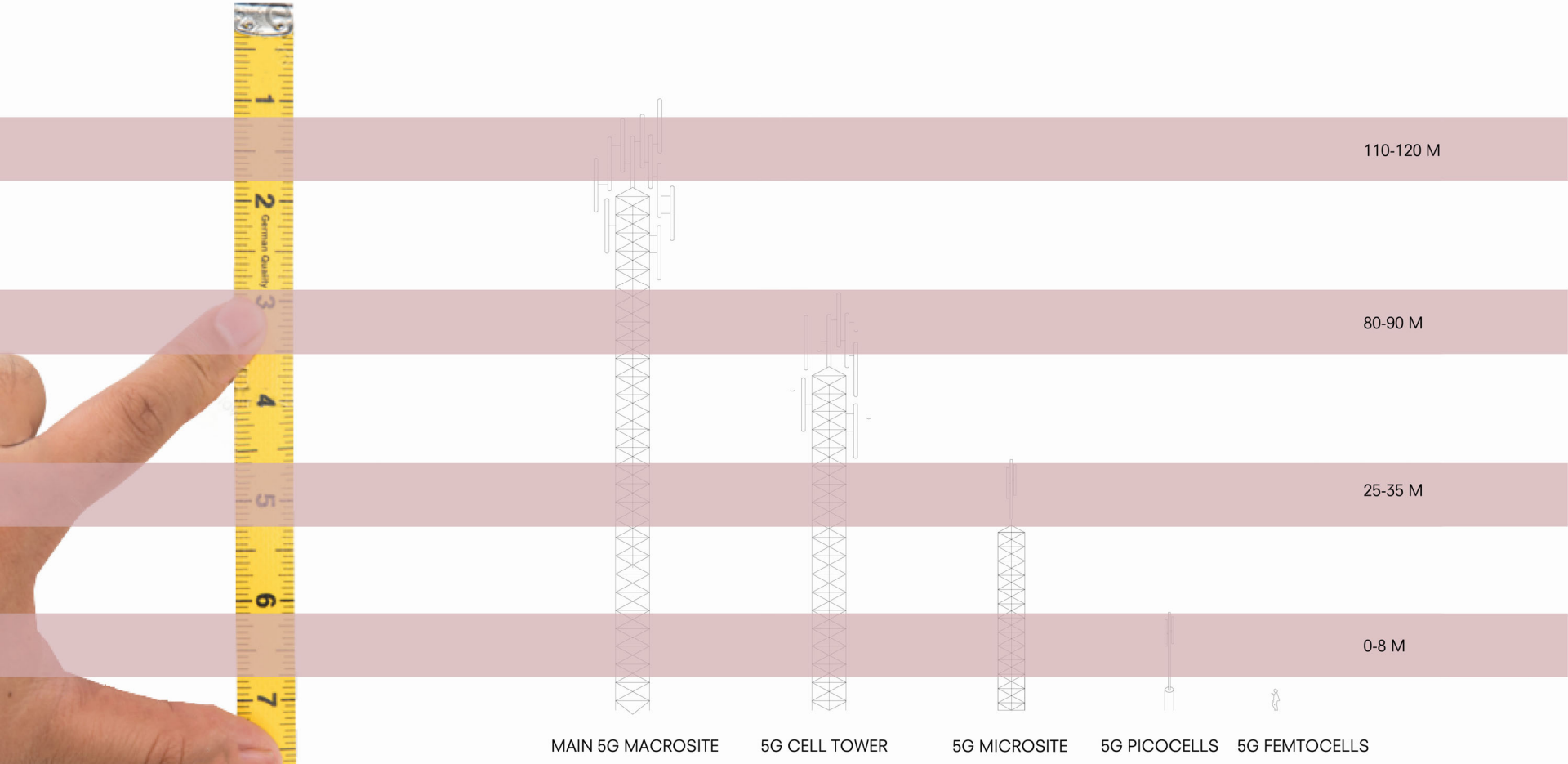


More Antennas Than Users

30 000 users = 300 devices

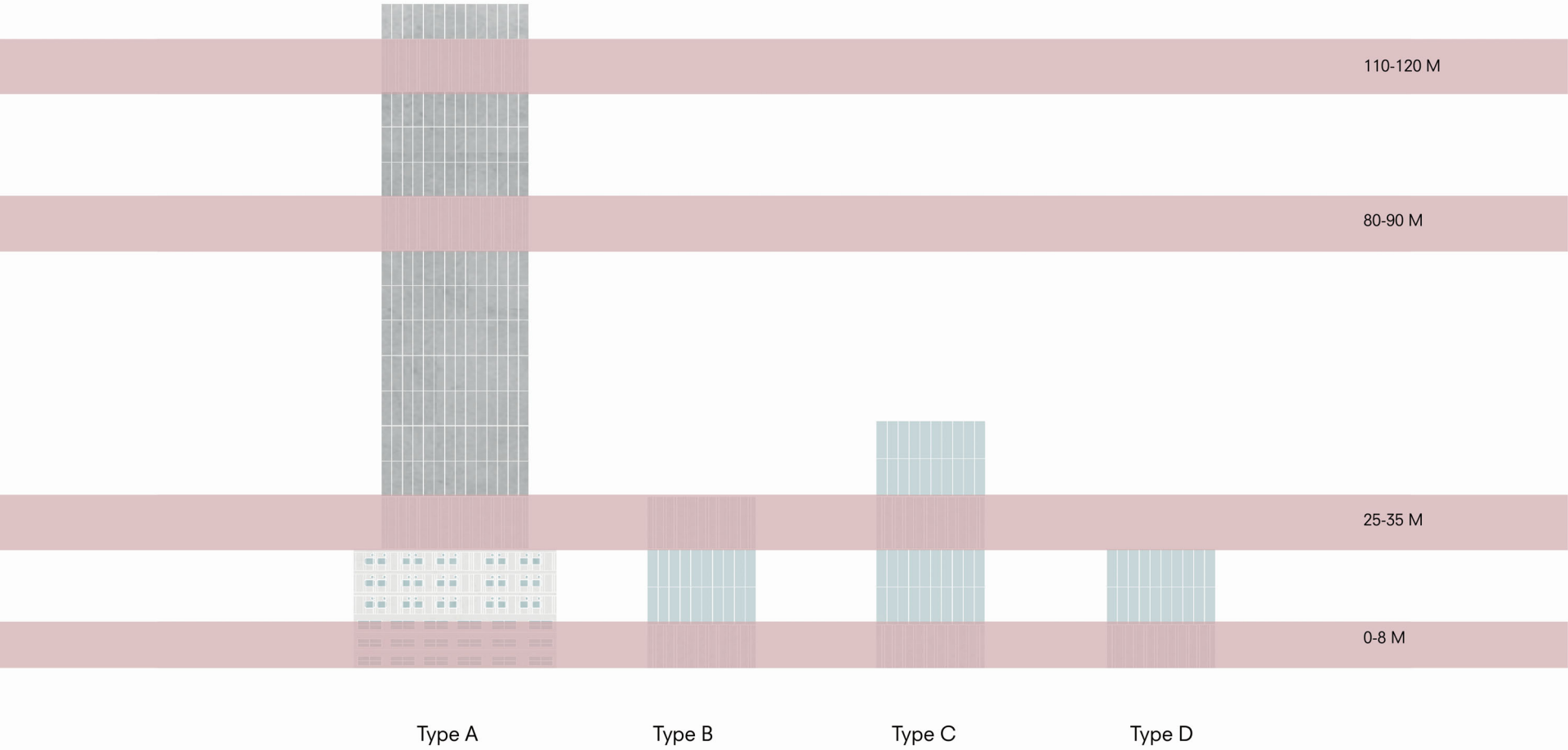
Understanding SISO and MIMO, 2020,
Source: https://www.evercomtech.com/understanding-siso-simo-miso-mimo

5G Placement Regulations

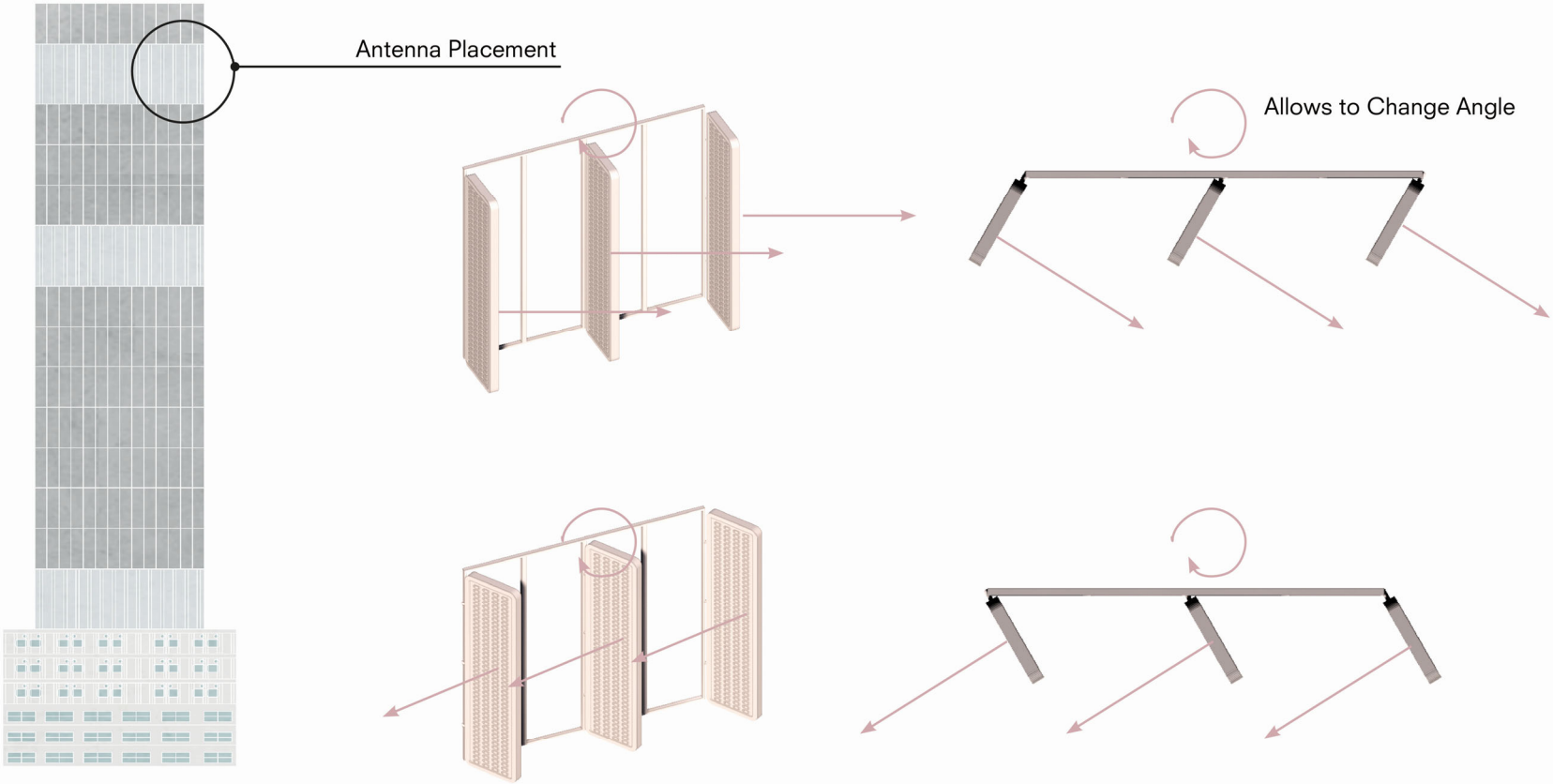


City in Stripes

CITY IN STRIPES



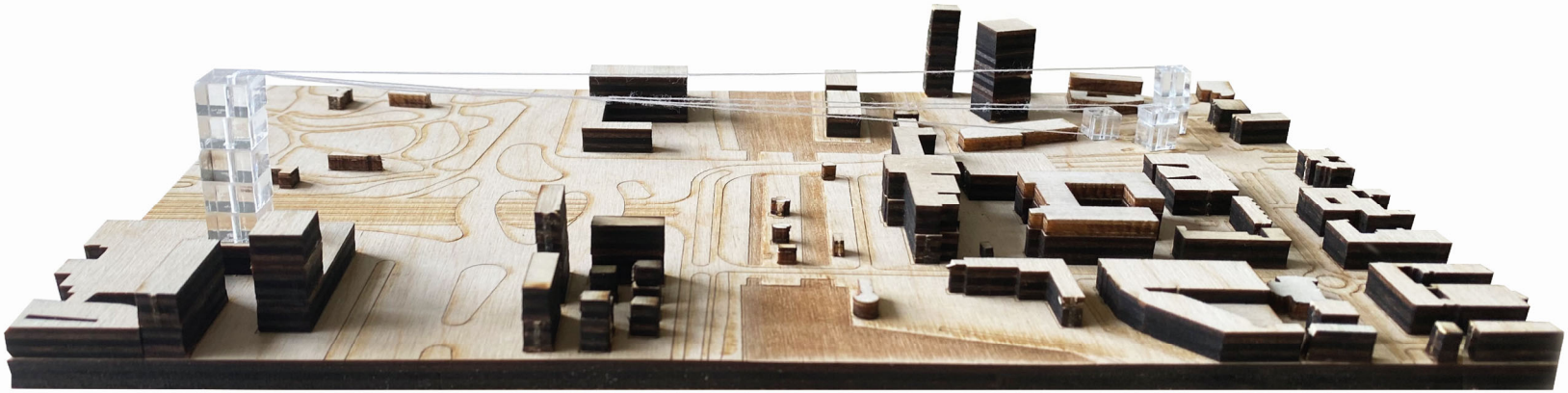
Panelling System



Step 3: Design

- [x] URBAN RELATION & MASSING
- [x] ANTENNA PLACEMENT
- [ ] DESIGN

Transmitter & Receiver



Transmitter

INDEX

To Expose Technology

Pompidou Center, 1977

Change of Approach

1987

1992

1998

2000

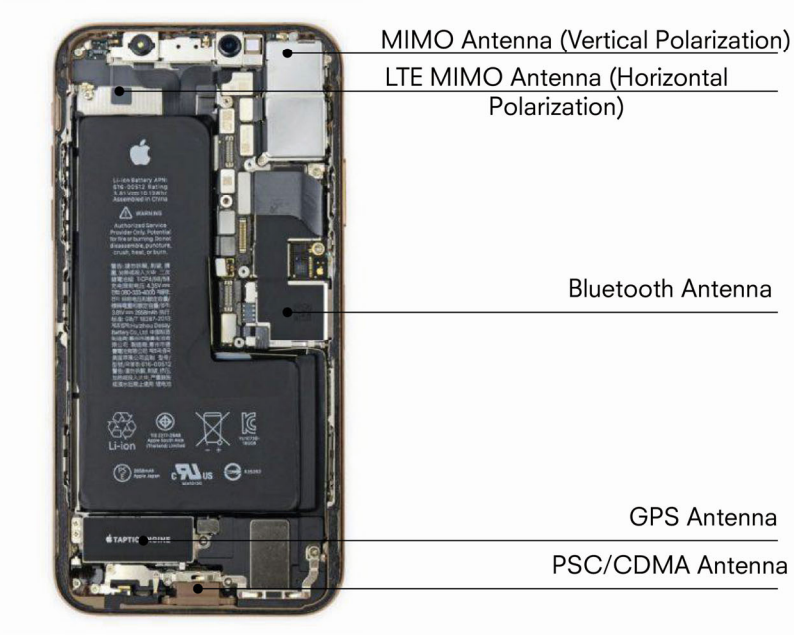
2005

2020

FROM CELEBRATING TECHNOLOGY → **TO HIDING TECHNOLOGY**

Current Trend

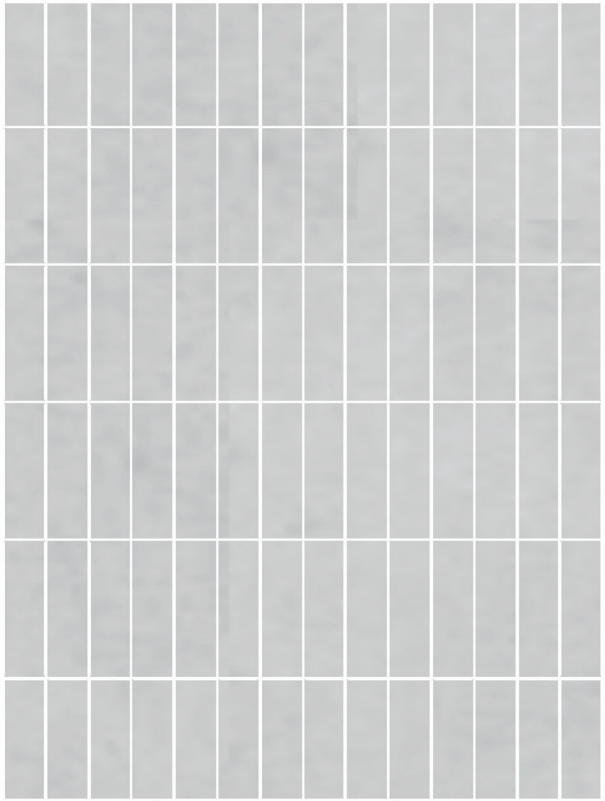
Simplified Exterior



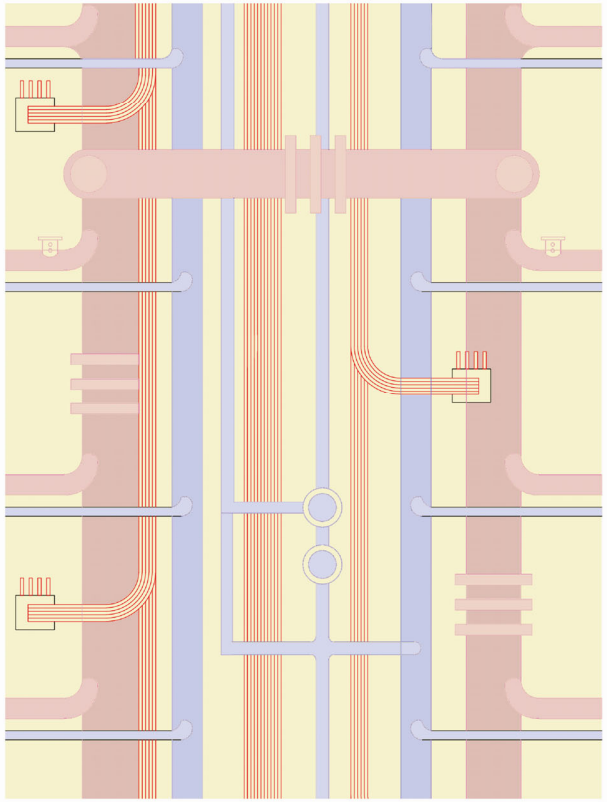
Complex Technology - Interior

"What's Inside My Smartphone? — An In-Depth Look At Different Components Of A Smartphone" by Fossbytes Staff, June 2017

Architectural Topic

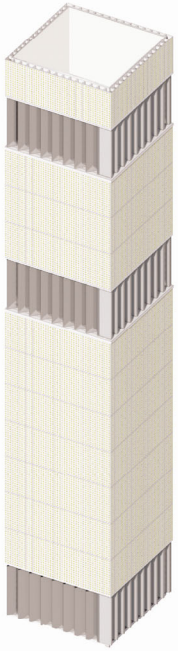


Exterior - Box



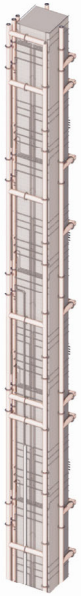
Interior - Machine

Spatial Concept



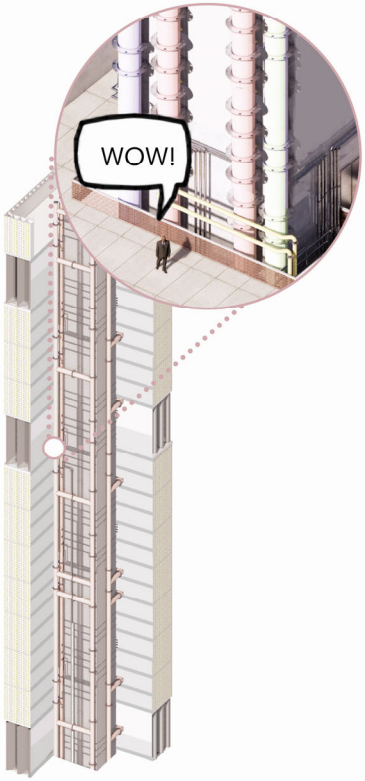
Enigmatic Skin

+



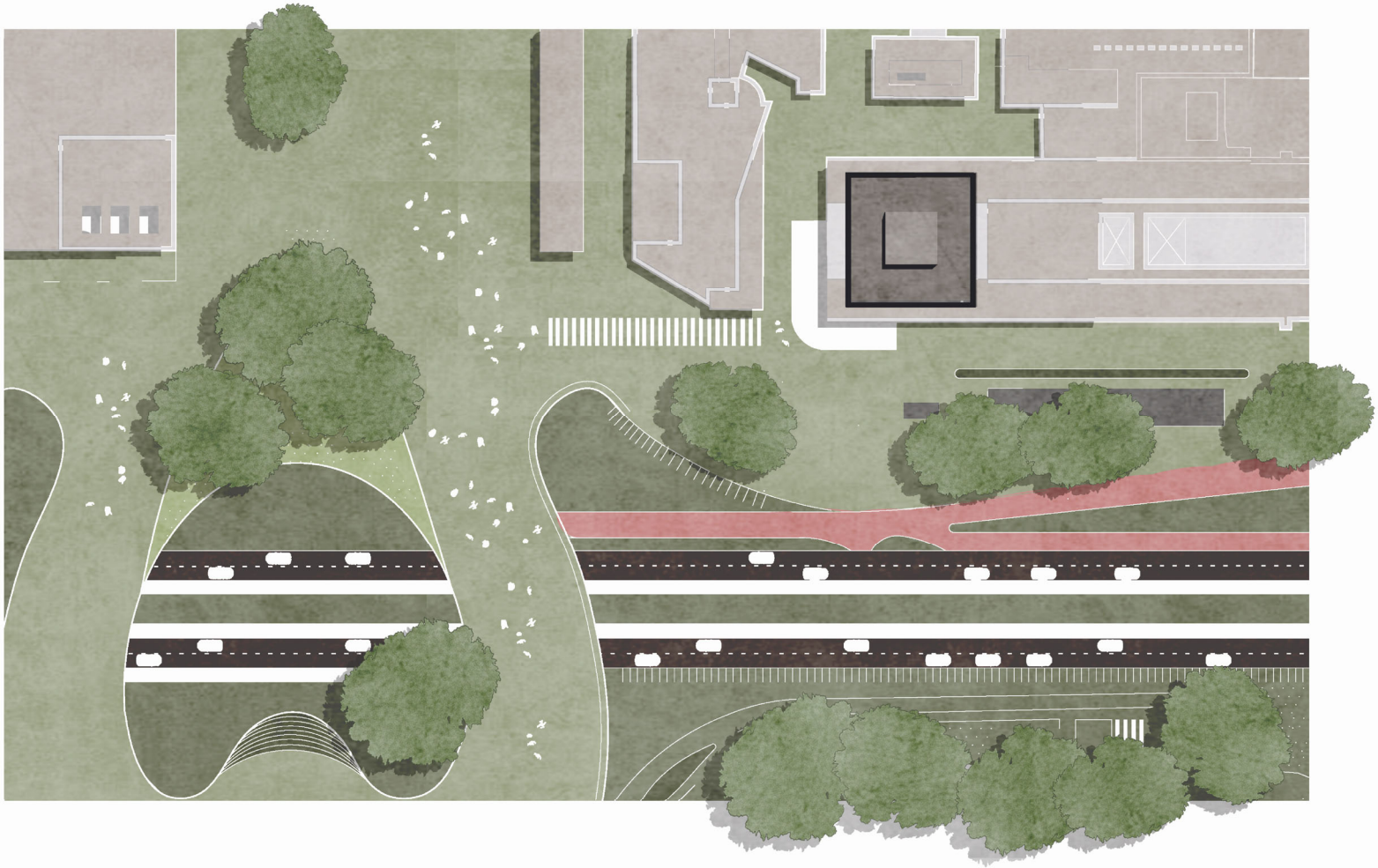
Core as Technical Space

=



Contrast & User's Experience

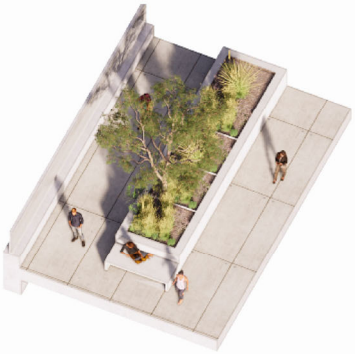
Accessibility



Entrance from Public Terrace

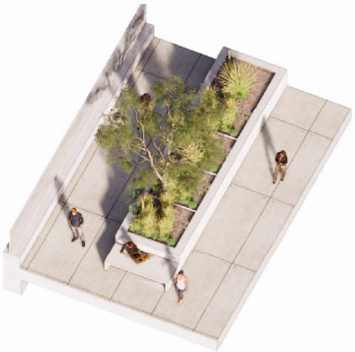
Entrance

Program Explanation

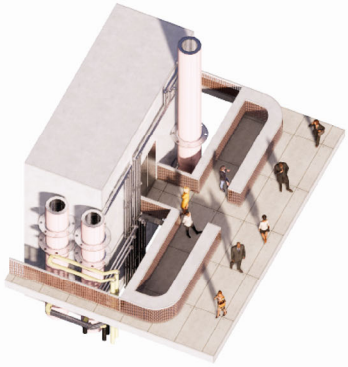


Public Plaza

Program Explanation

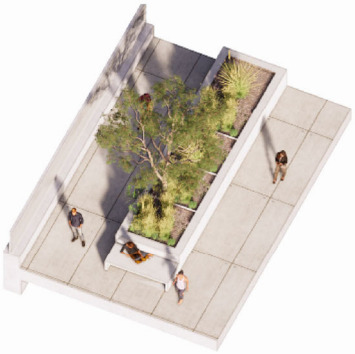


Public Plaza

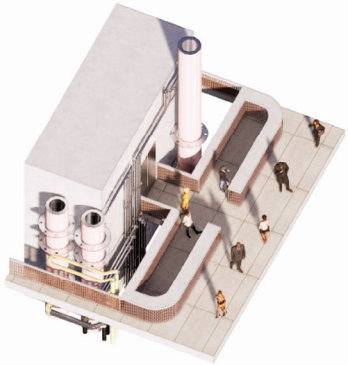


Entrance / Foyer

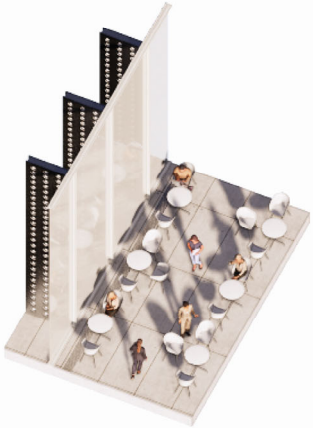
Program Explanation



Public Plaza

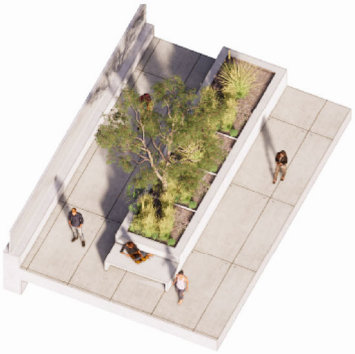


Entrance / Foyer

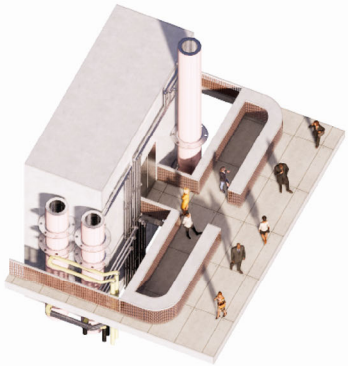


'Sky' Restaurant

Program Explanation



Public Plaza



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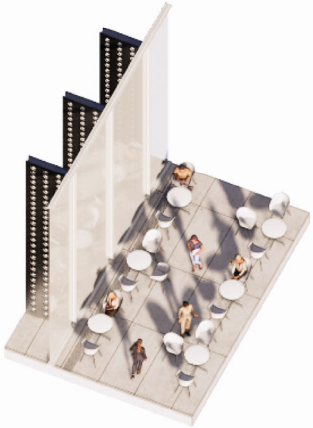
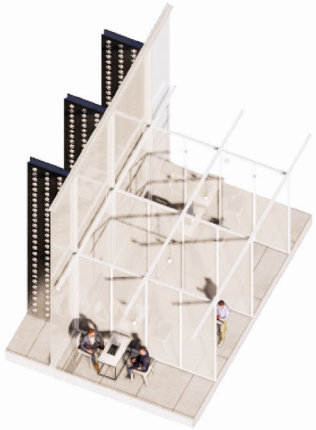
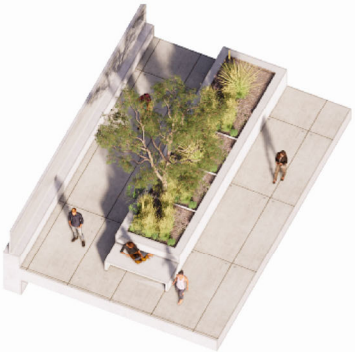


'Sky' Restaurant

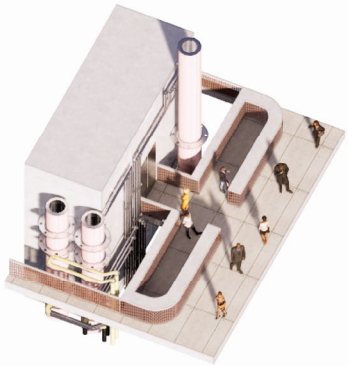


Offices & Technicians

Program Explanation



Public Plaza



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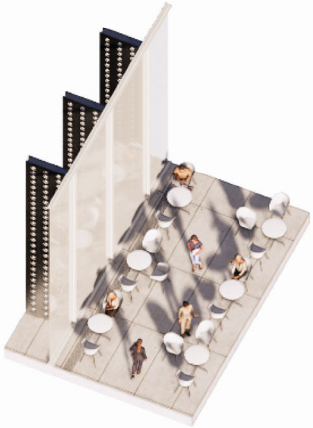

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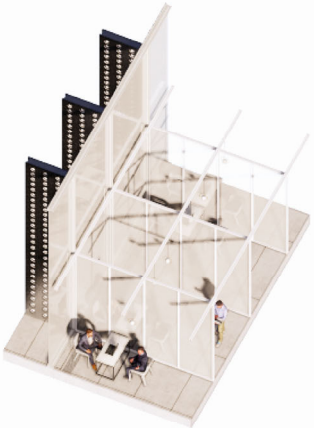

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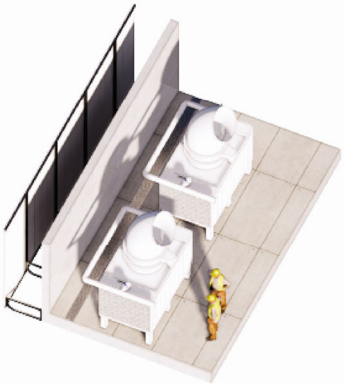
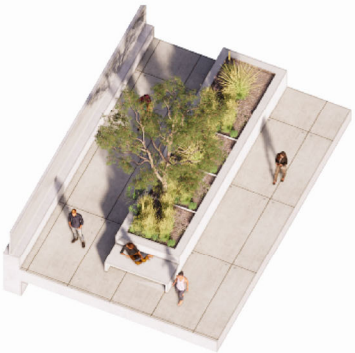
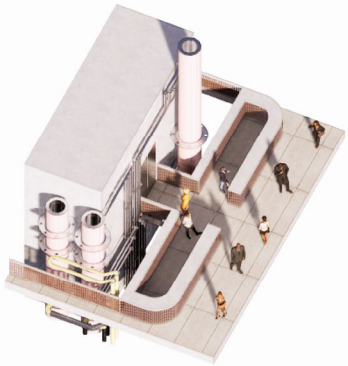


Technical Roof

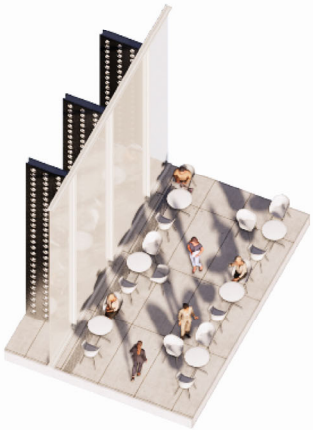
Program Explanation



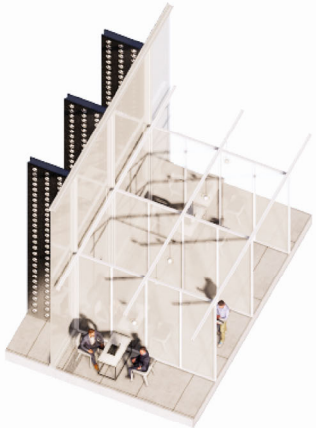
Public Plaza



Entrance / Foyer



'Sky' Restaurant



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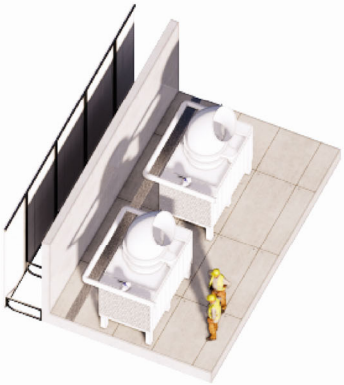

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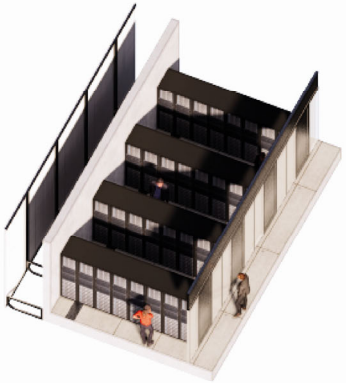
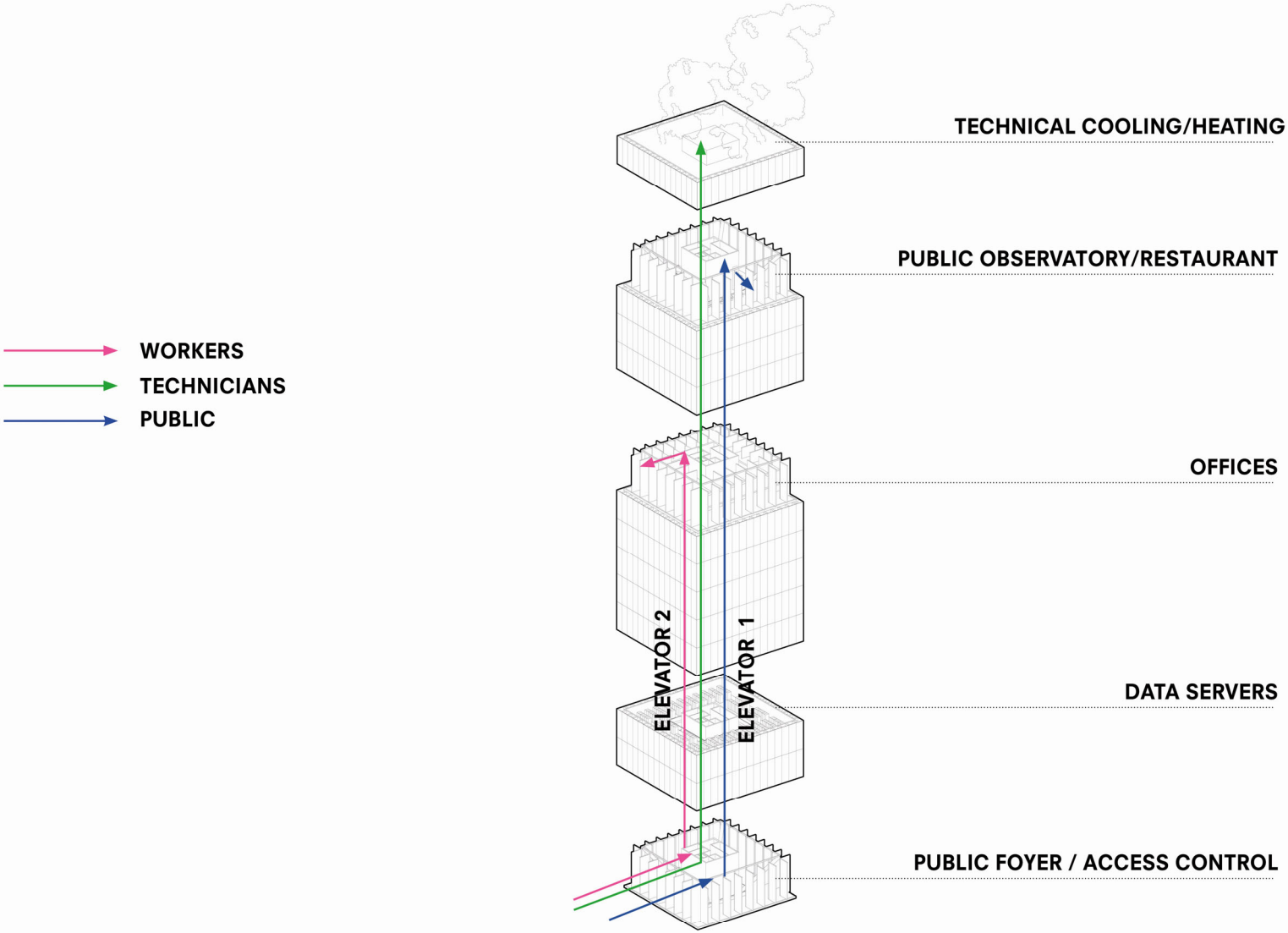


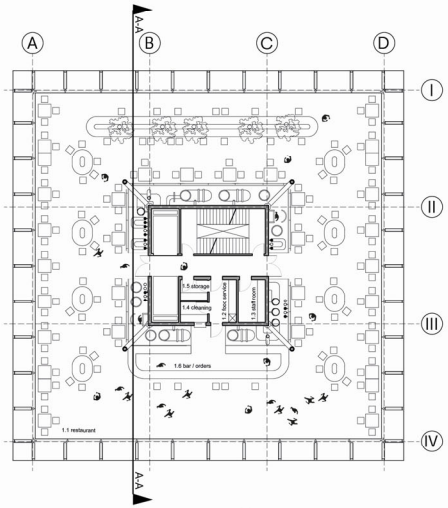
Server Rooms

Transmitter

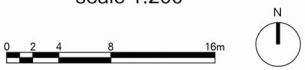
Routing

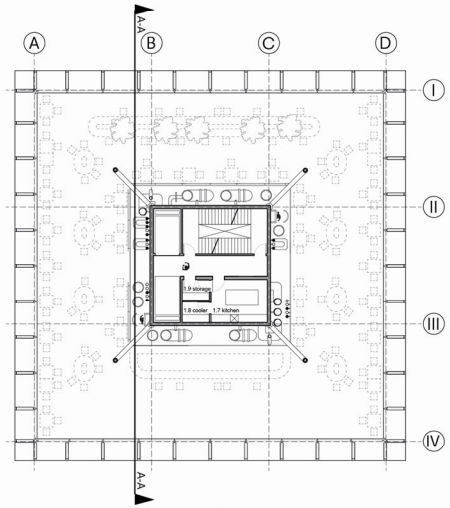


Elevator 1 - Accessible Floors

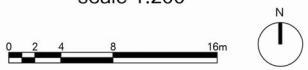


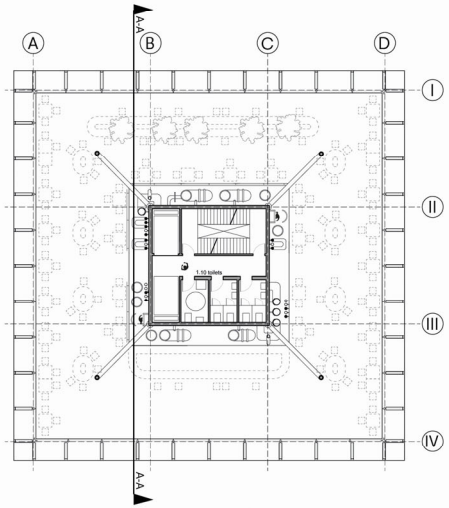
Restaurant Floor
scale 1:200



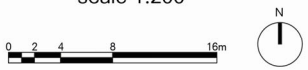


Kitchen Floor
scale 1:200

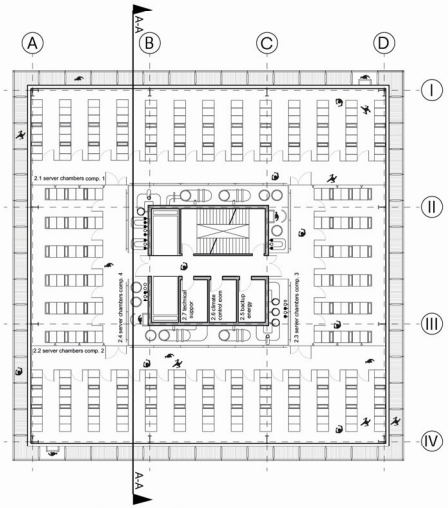




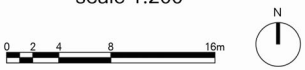
Customer's Toilets
scale 1:200

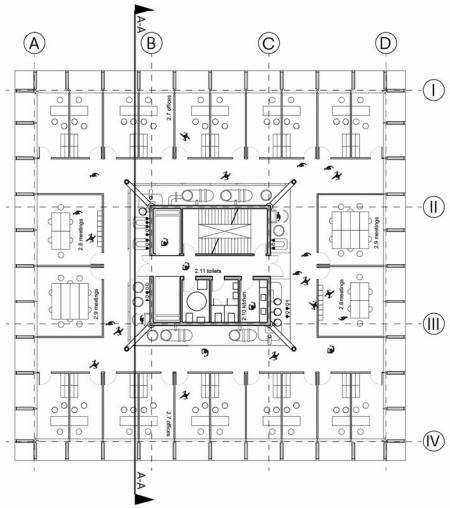


Elevator 2 - Accessible Floors

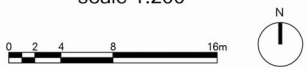


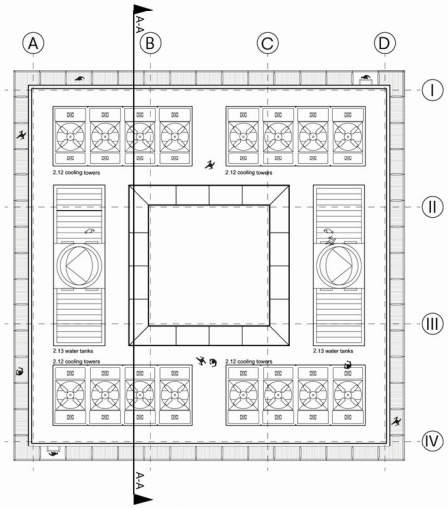
Server Chambers Floor
scale 1:200



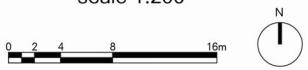


Office Floor
scale 1:200



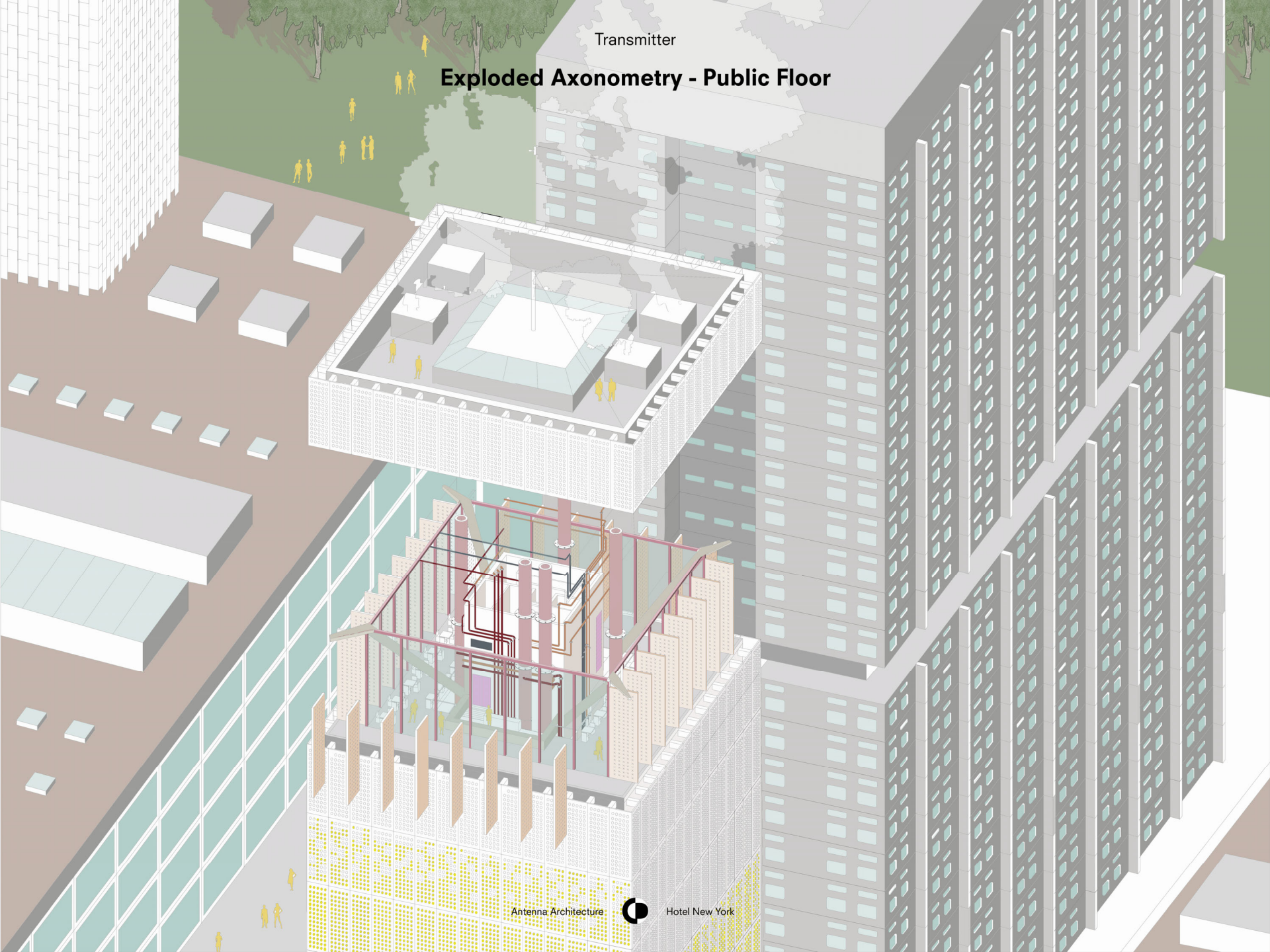


Technical Roof
scale 1:200



Transmitter

Exploded Axonometry - Public Floor



Transmitter

Section

Section A-A - Transmitter
scale 1:200

0 4 8 16 32m

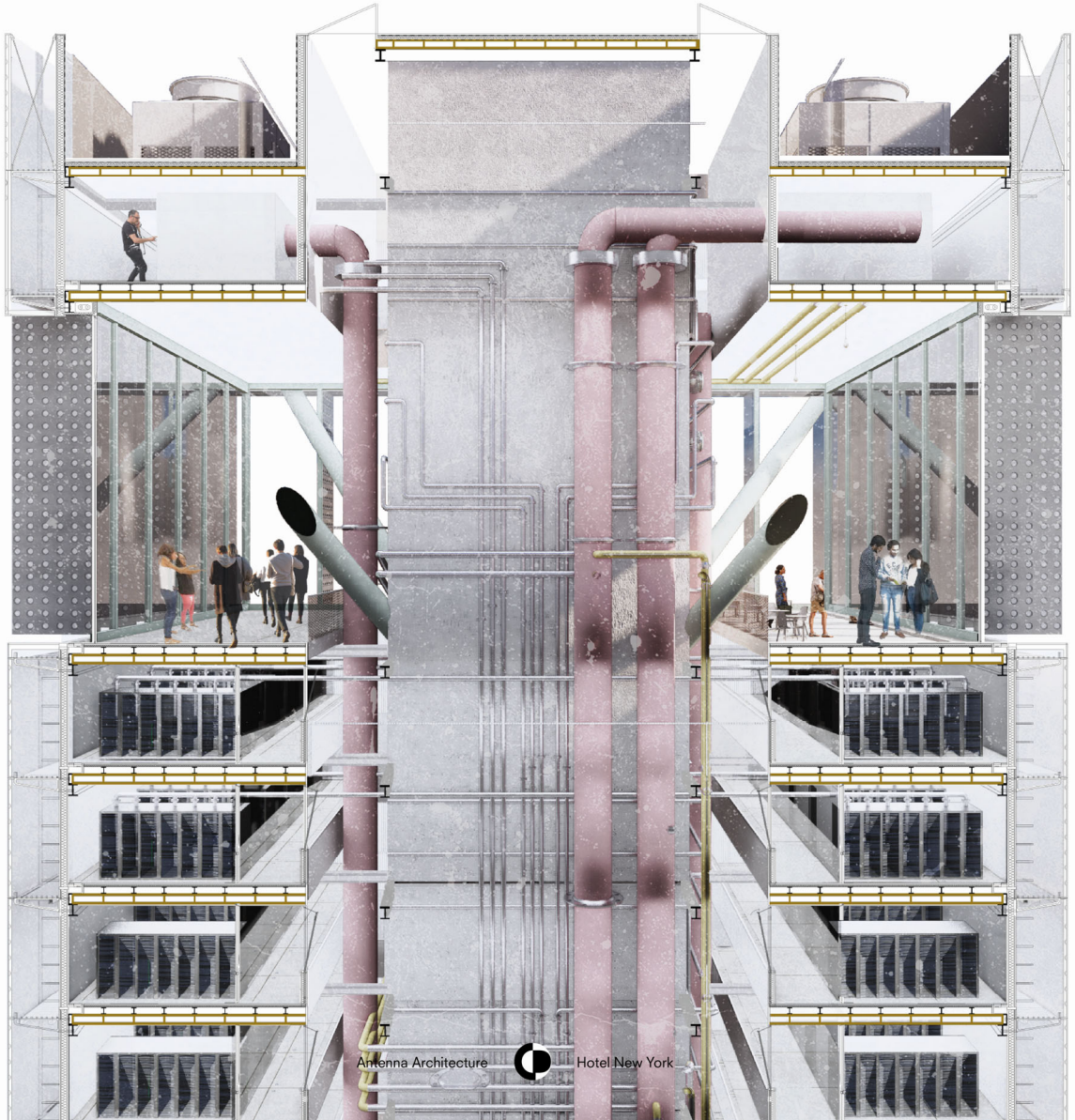
Antenna Architecture Hotel New York

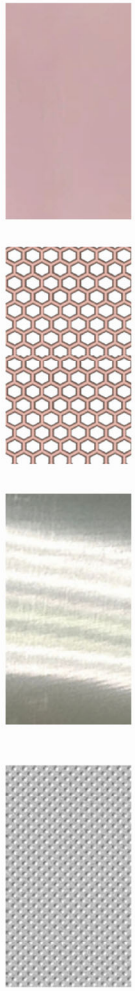
Sky Restaurant View

View Towards Euromast

Transmitter

1:50 Public Space



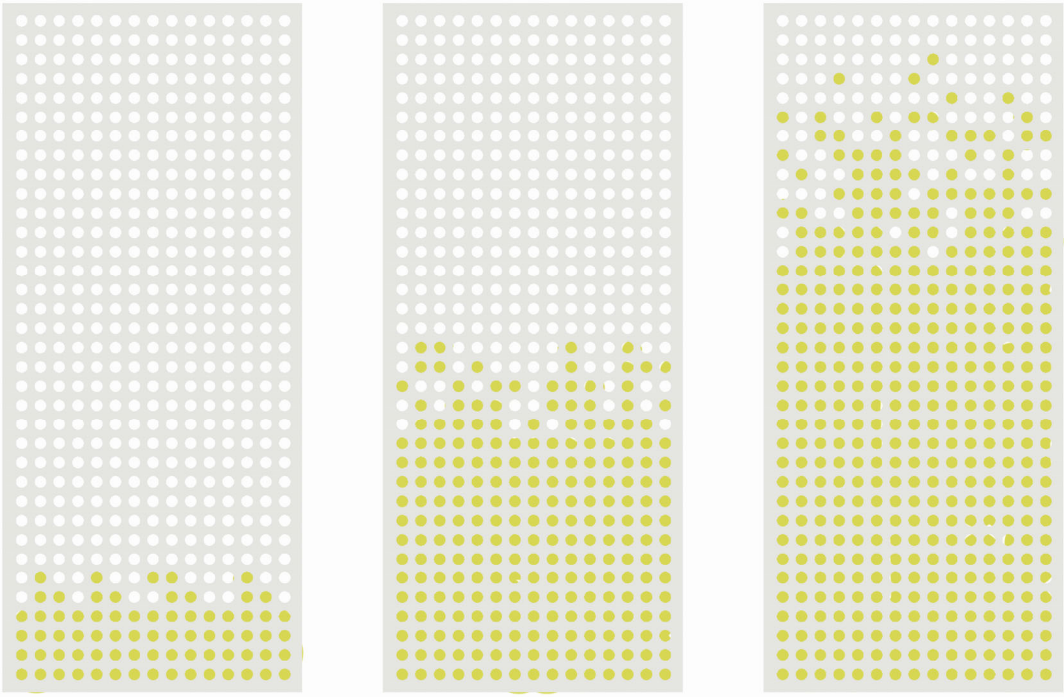


Visual Relation Between Public & Technical Floors

HOW TO CONVINCE TO APPRECIATE 5G?

Transmitter

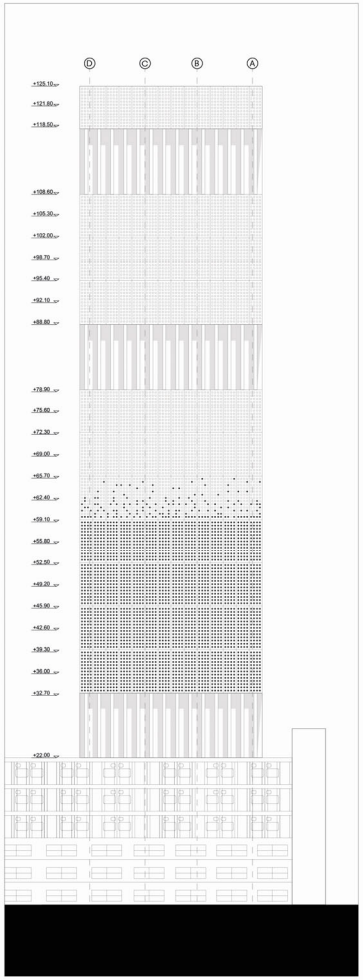
5G Informative Facade



Number of Devices Connected to 5G Antenna

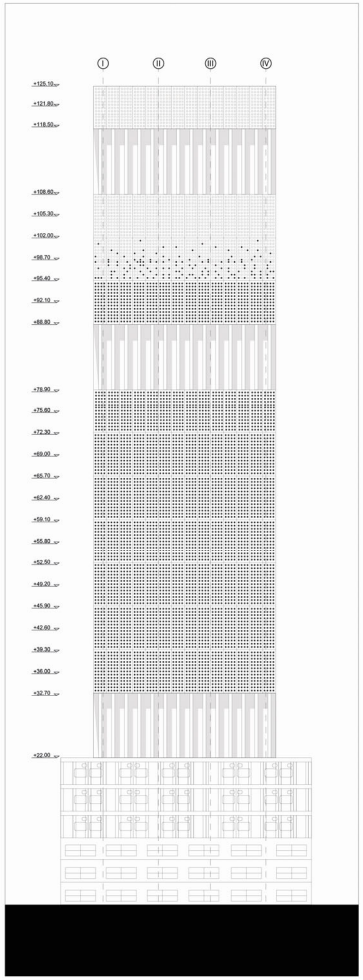
Informative Facade -
Growing Use of 5G Antennas

Facades



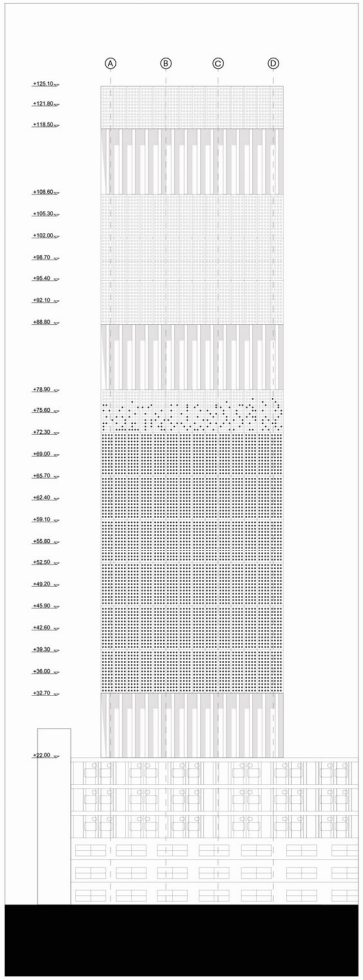
Facade North - Transmitter
scale 1:200

0 4 8 16 32m



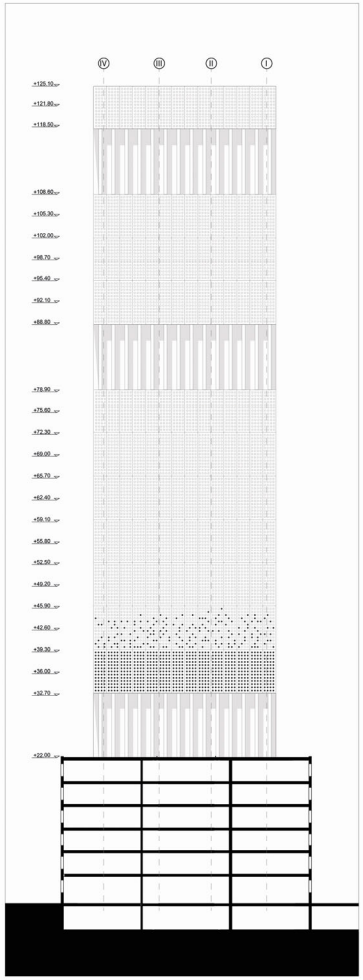
Facade East - Transmitter
scale 1:200

0 4 8 16 32m



Facade South - Transmitter
scale 1:200

0 4 8 16 32m



Facade West - Transmitter
scale 1:200

0 4 8 16 32m

Overview

Roof

Main Body

Ground

Elements

1 Steel Bracing
2 Maintenance Path
3 Facade Support System Steel Profile
4 Maitenance Ladder
5 LED Reflectors
6 Supporting Steel Frame
7 Lignatur Panel
8 Steel Joint
9 Steel I-Beam 300mm
10 Service Distribution Area/Wooden I-Beams
11 Antenna Palelling Control Unit
12 5G Massive MIMO Antenna
13 Double Glass Window
14 Mullion
15 Aluminium Roof Profile
16 Server Cooling System
17 Prefabricated Facade Panel
18 Anchor Bolt
19 Mineral Wood 150 mm
20 Reiforced Concrete Beam
21 Suspended Ceiling System
22 Air Handling Unit
23 Aluminium Roof Profile

61 Facade Skin
Aluminium Frame 160 mm
Panels with LED Lights

62 Attic Wall
Fiber Cement Panel 30 mm
Water Isulation th. 0,5mm
Gypsum Board th. 20 mm
Mineral Wool th. 150 mm
Gypsum Board th. 20 mm
Water Isulation th. 0,5mm

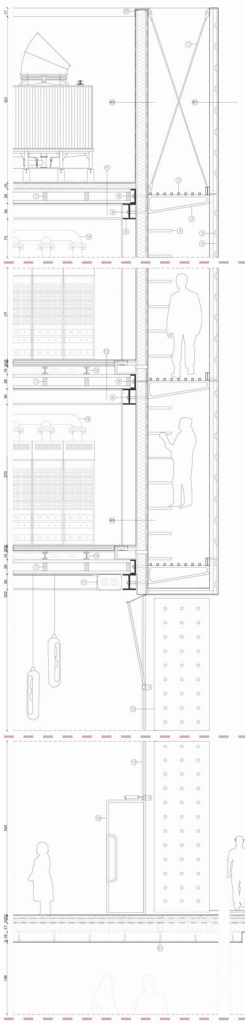
63 External Wall
Fiber Cement Panel 30 mm
Water Isulation th. 0,5mm
Gypsum Board th. 20 mm
Mineral Wool th. 150 mm
Gypsum Board th. 20 mm

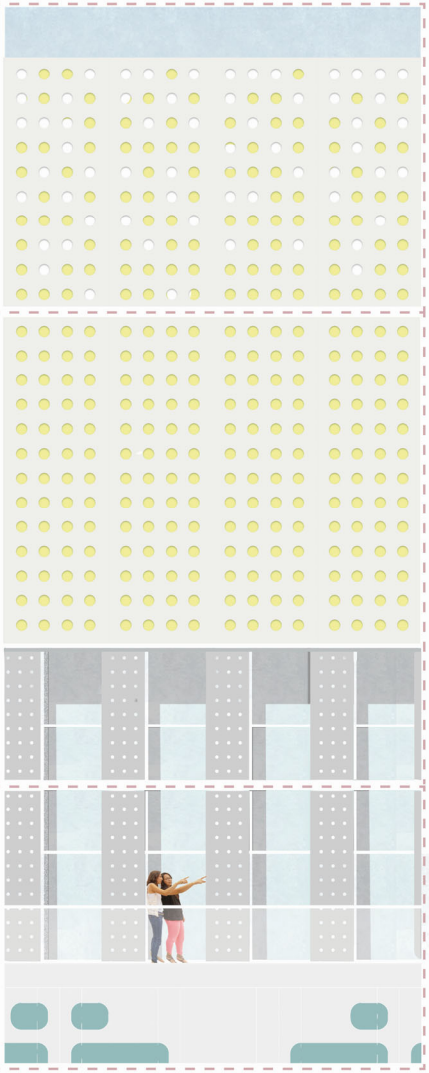
71 Roof
Gravel th. 30mm
Water Isulation th. 0,5mm
Thermal Insulation - mineral wool th. 10 cm
Lignature Floor Panel th 280 mm

72 Middle Floor
Floor FInish th. 20 mm
Gypsum Board th. 20 mm
Service Distribution Space th. 250 mm
Hard Fiber Insulation 100 mm
Lignature Floor Panel th 300 mm

73 Existing Floor
Floor FInish th. 20 mm
Concrete th. 40 mm
Hydro Insulation th. 0,5 mm
Mineral Wool th. 150mm
Hydro Insulation th. 0,5 mm
Concrete Slabs Floor th. 250 mm

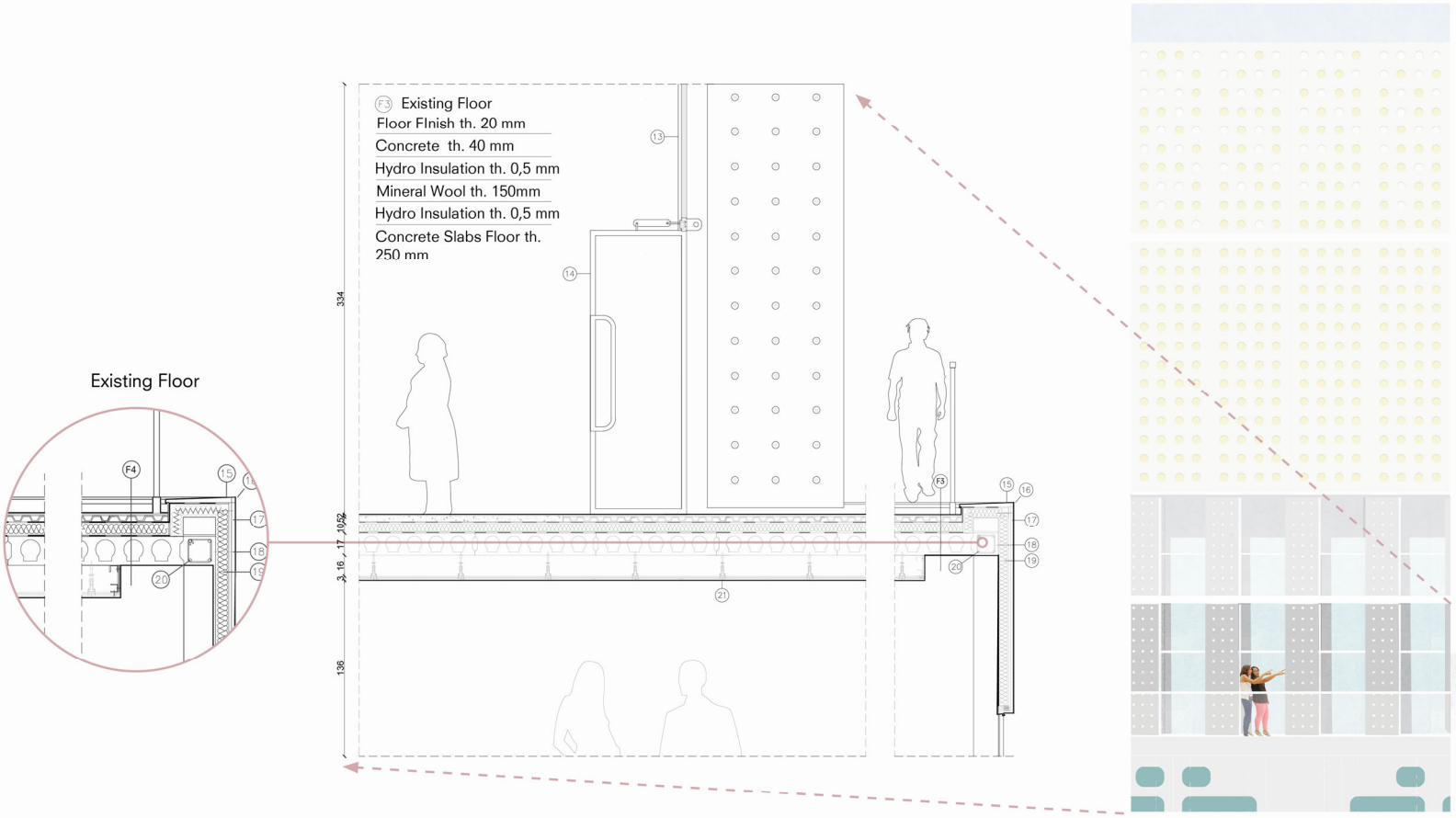
Transmitter Facade Section





Transmitter

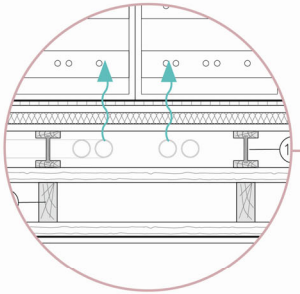
Ground



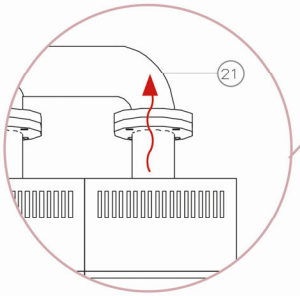
Transmitter

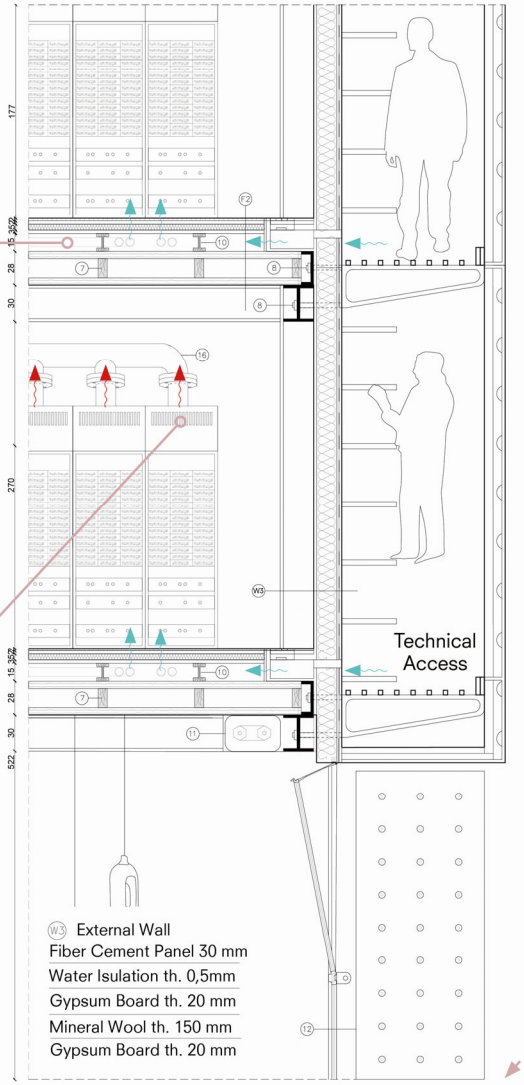
Main Body

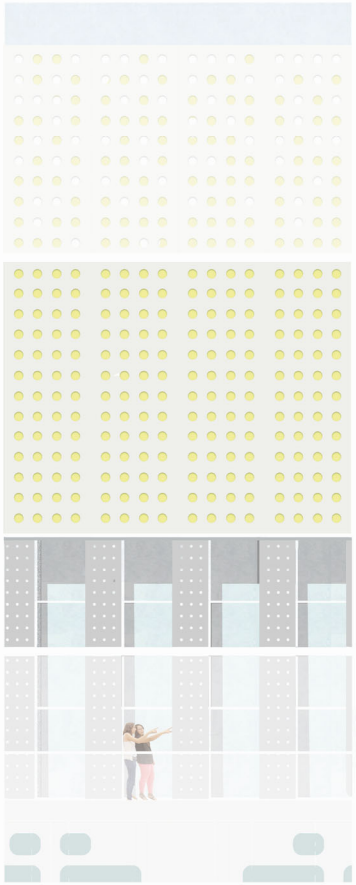
Service Distribution Floor



Hot Air Exhaust



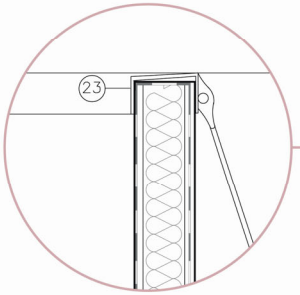




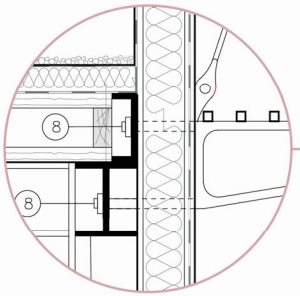
Transmitter

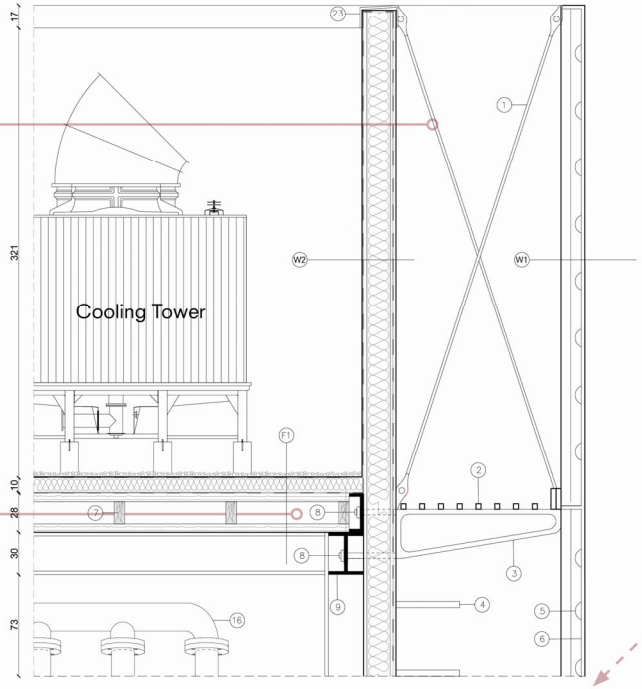
Roof

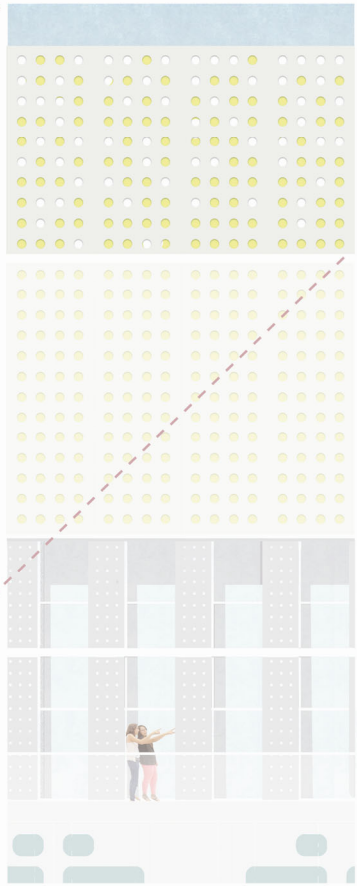
Steel Bracing



External Wall Connection

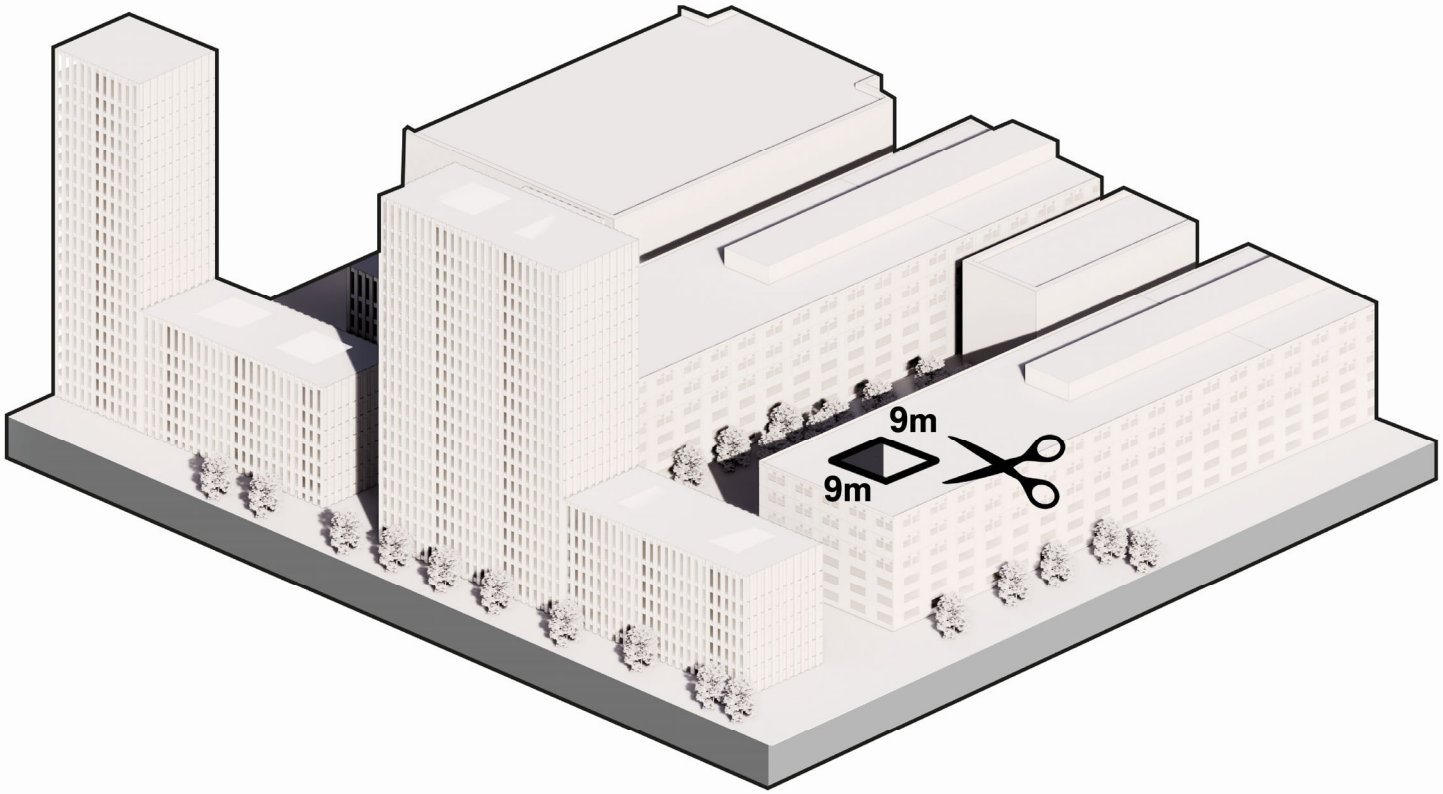




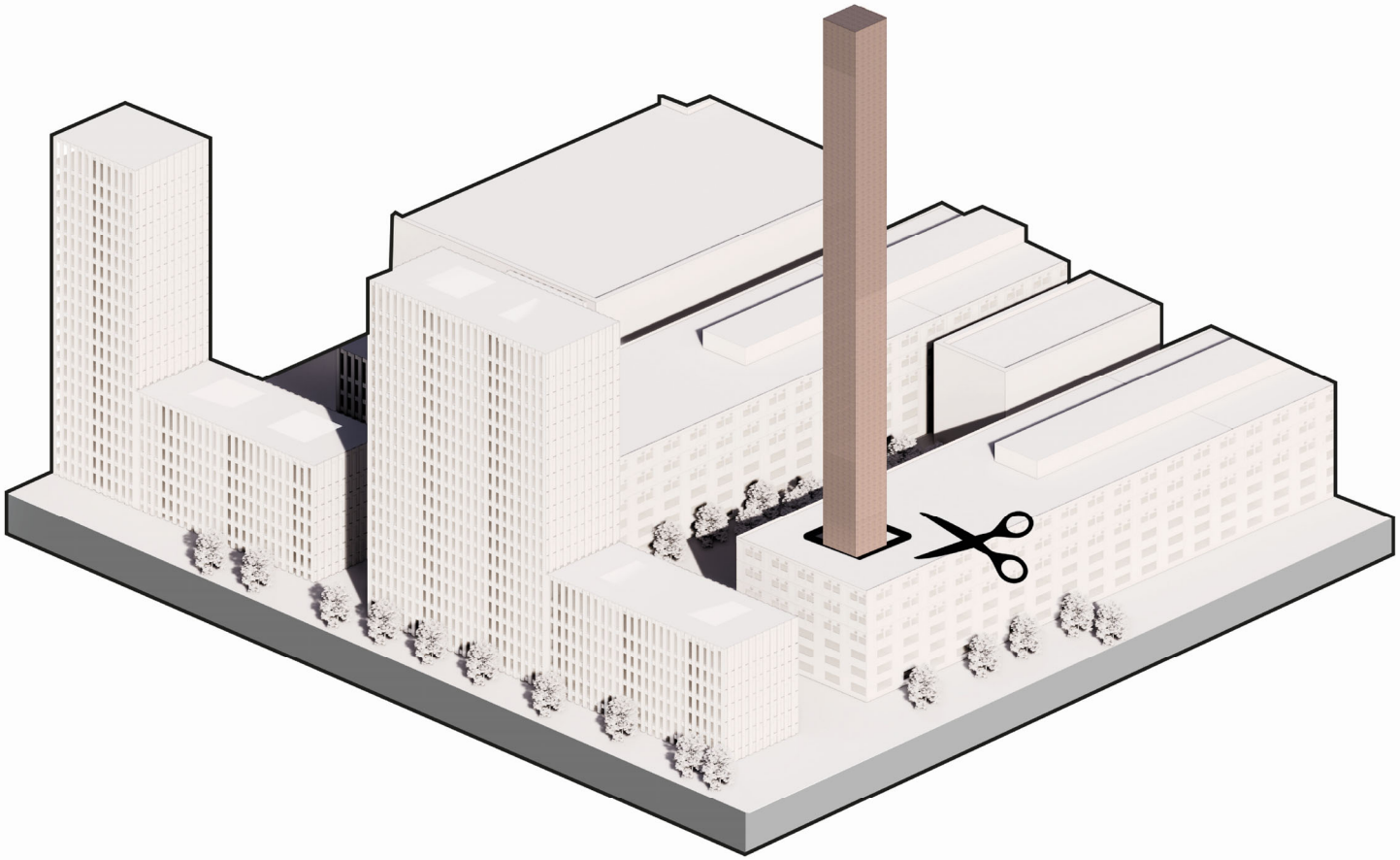


New Smart Health-Tech Campus

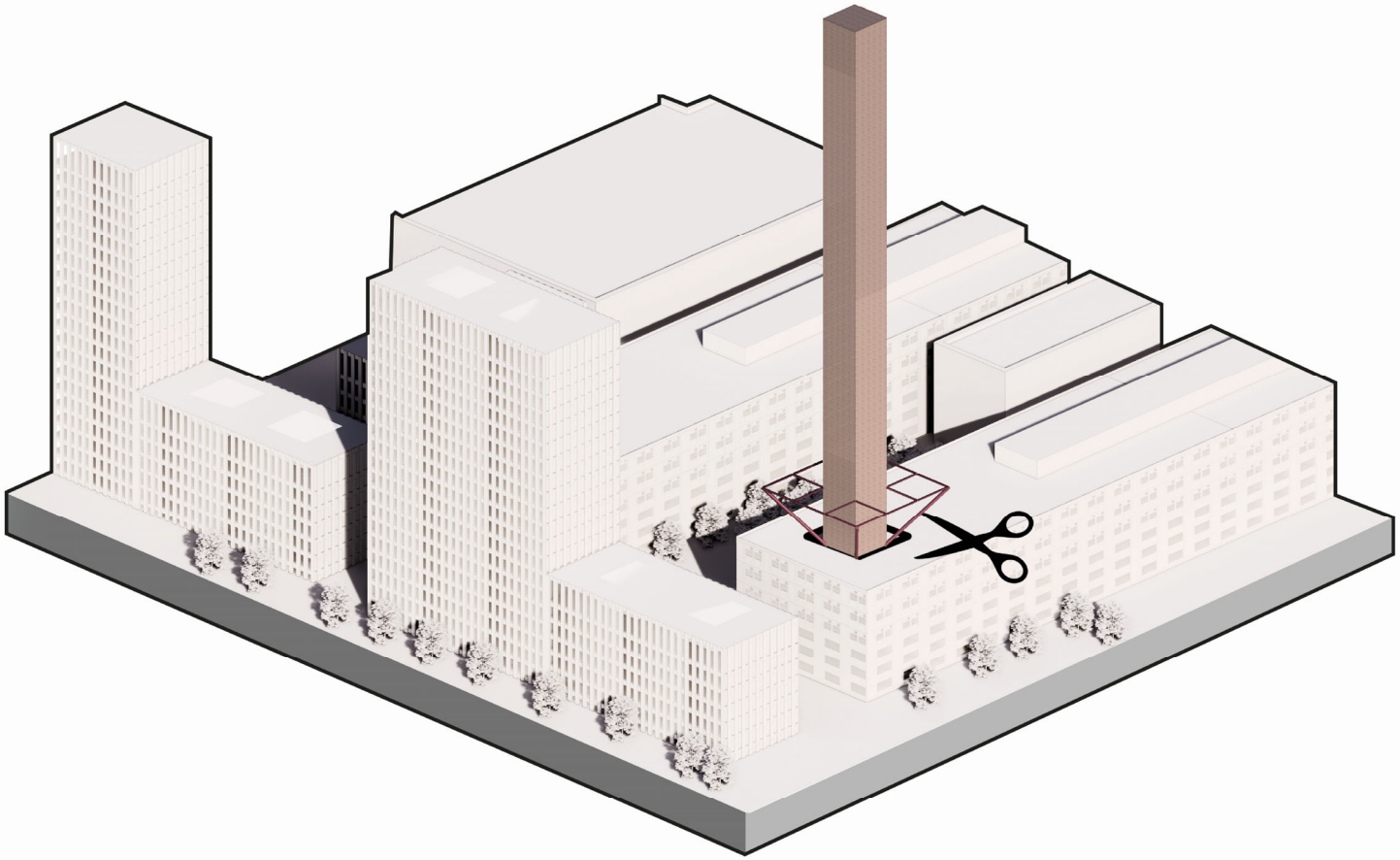
Extension of Exisitng Building



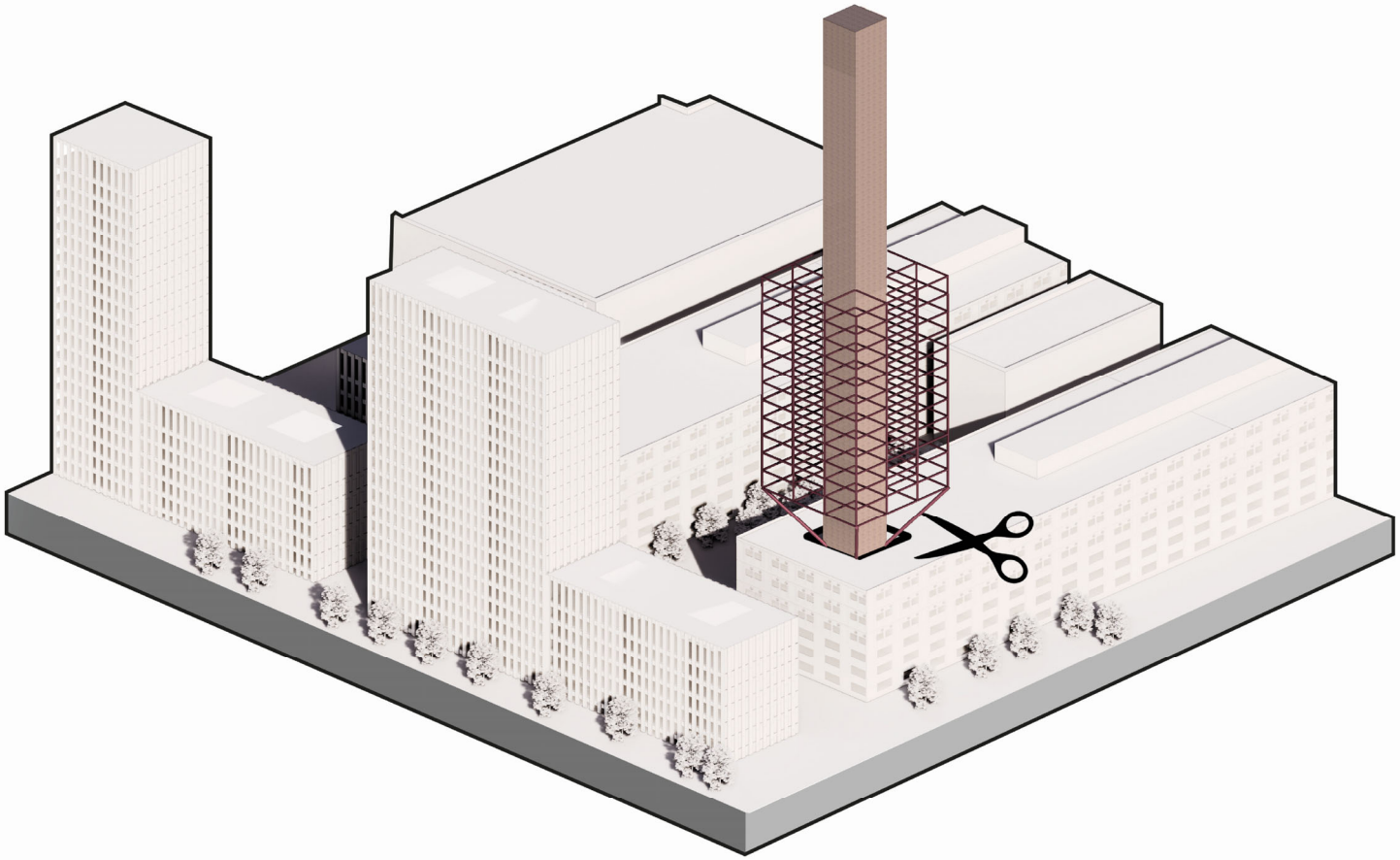
Reinforced Conrete Core with New Foundations



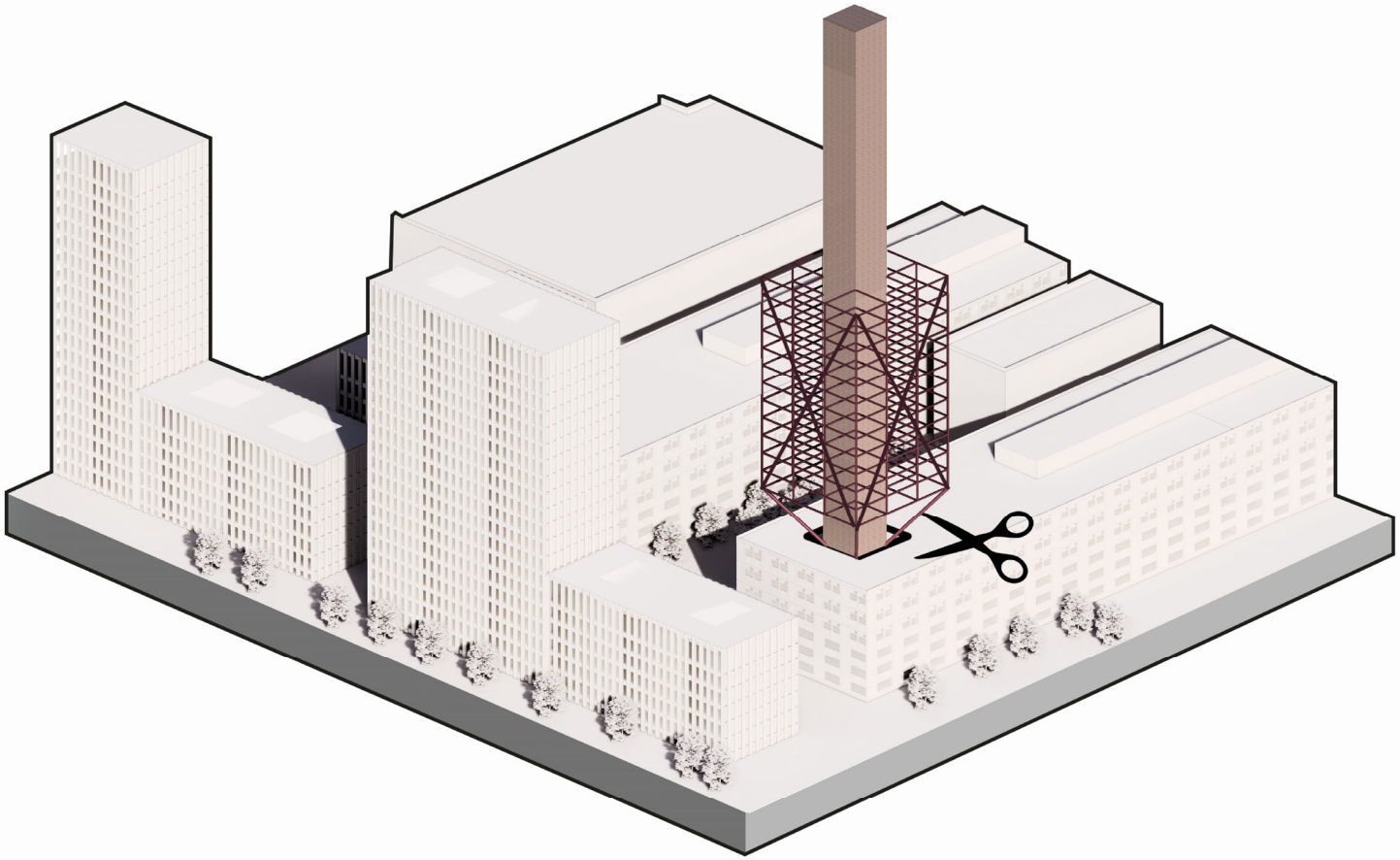
Steel Beams Support



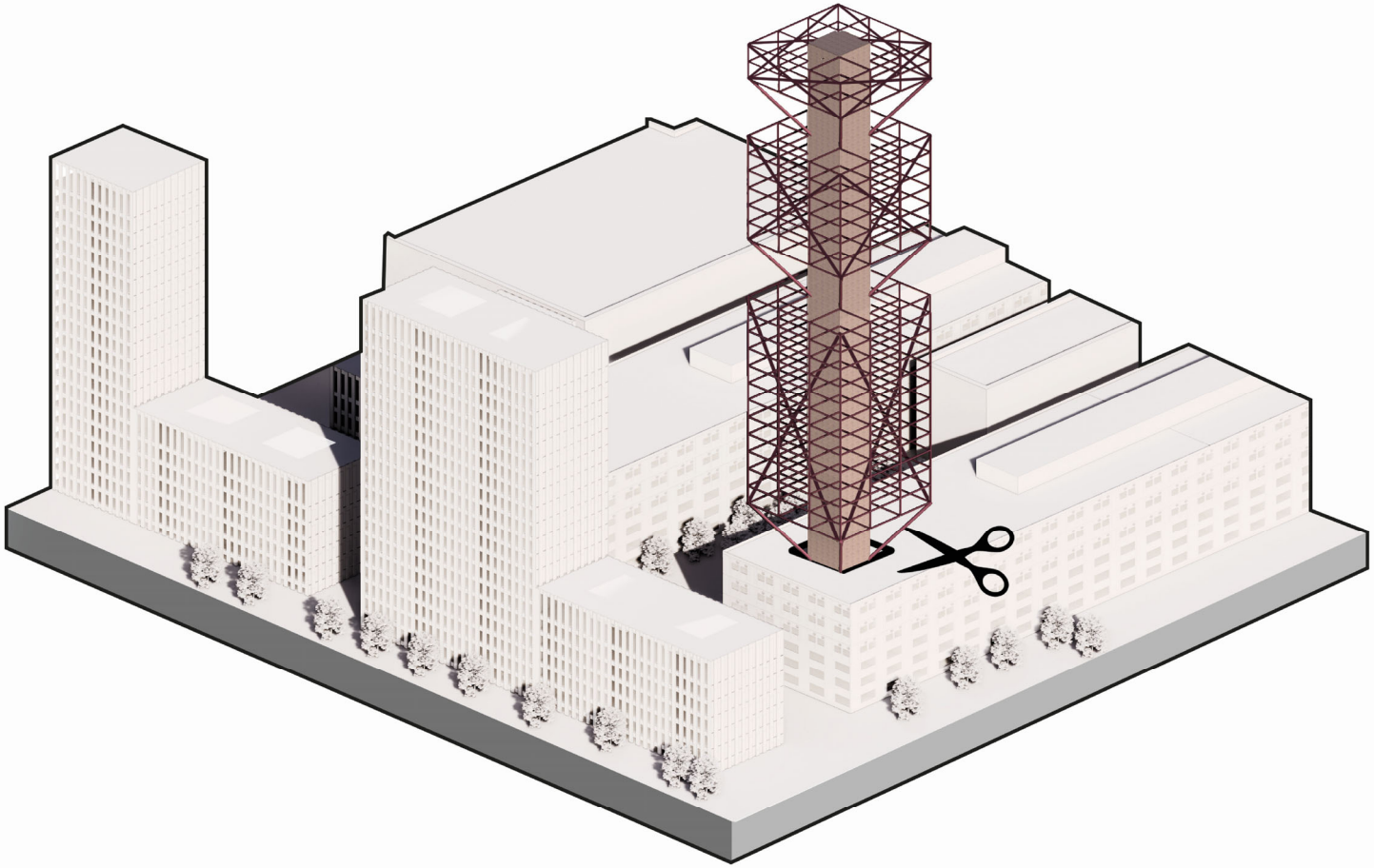
Prefabricated Steel Frames



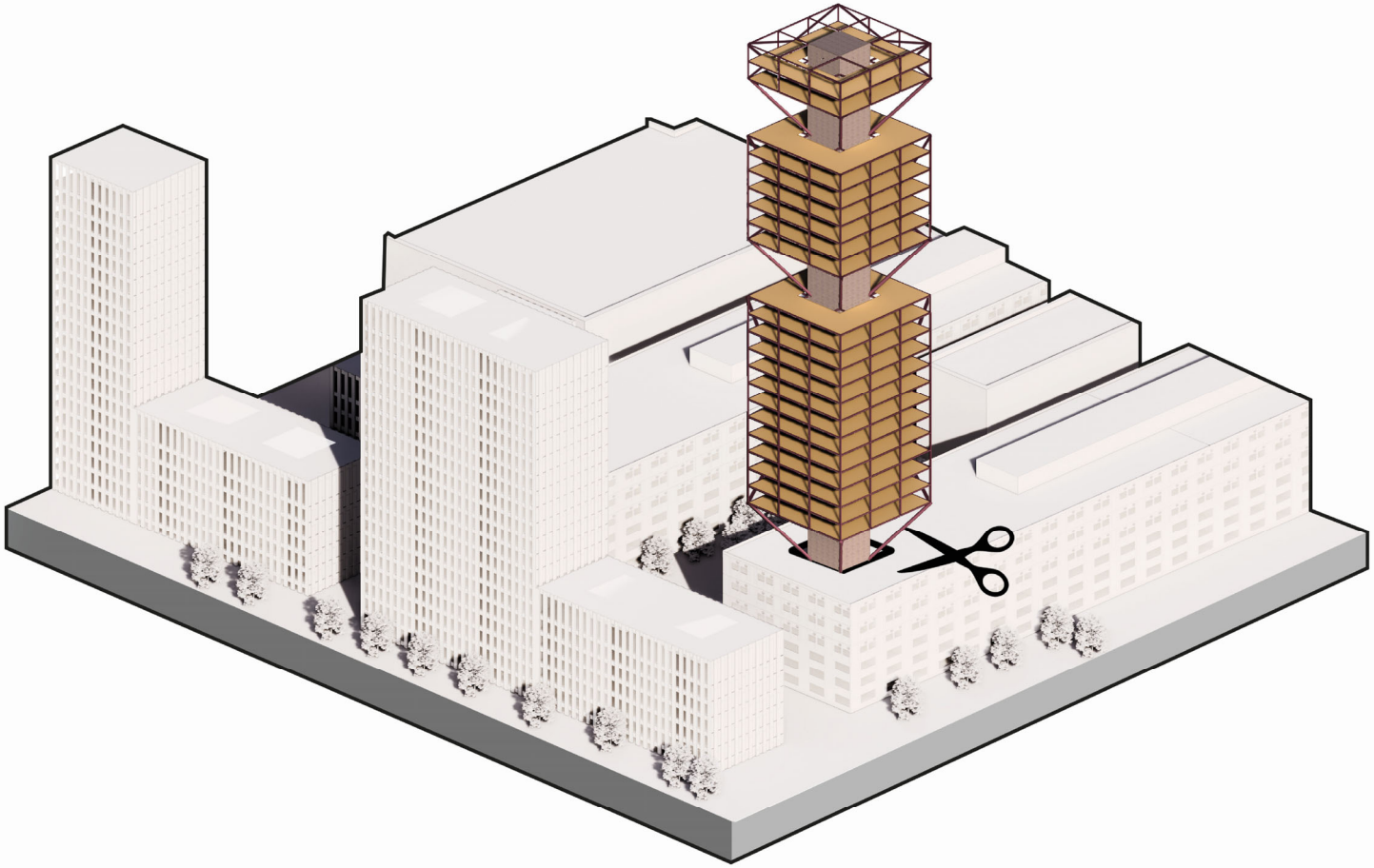
Steel Bracing



Complete Steel Structure



Light Wooden Floors

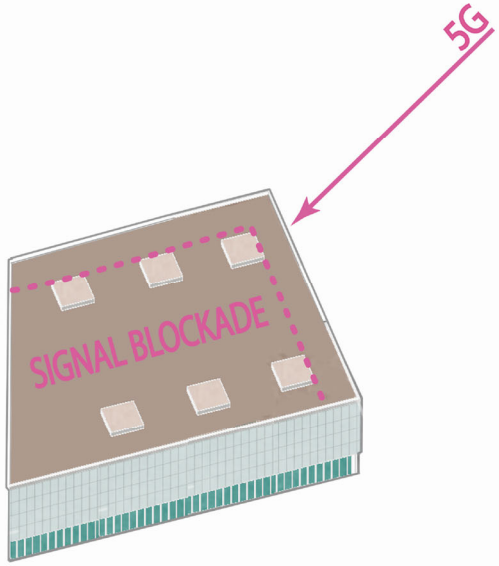


View Towards New Campus

INDEX

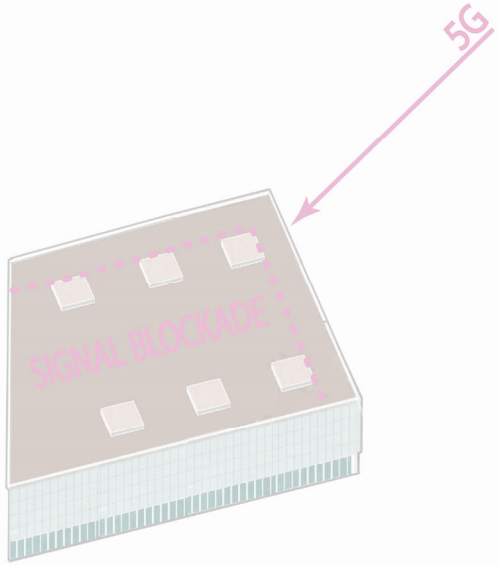
Receiving Facility

Volume Studies

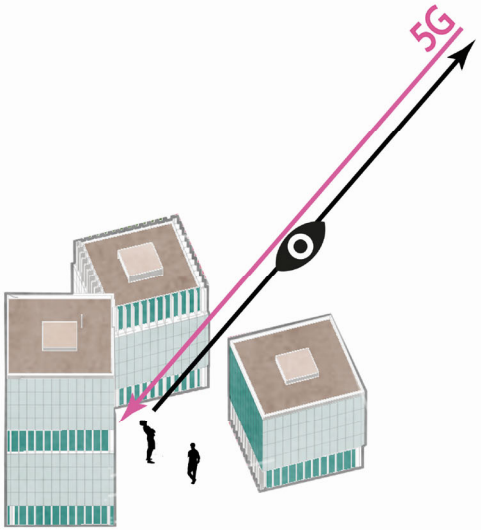


Initial Volume
- Signal Blocked

Signal Transmission & View Towards Transmitter

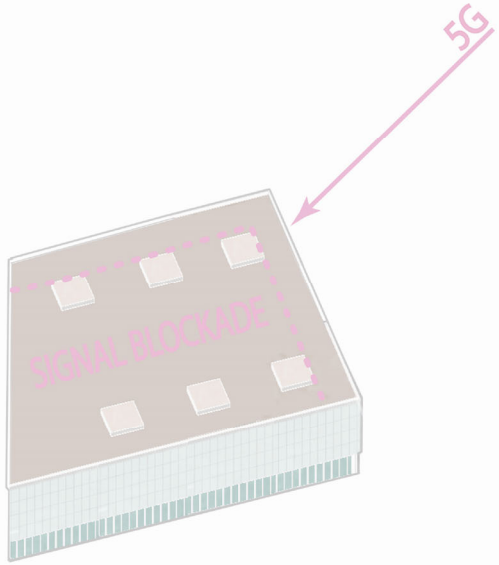


Initial Volume
- Signal Blocked

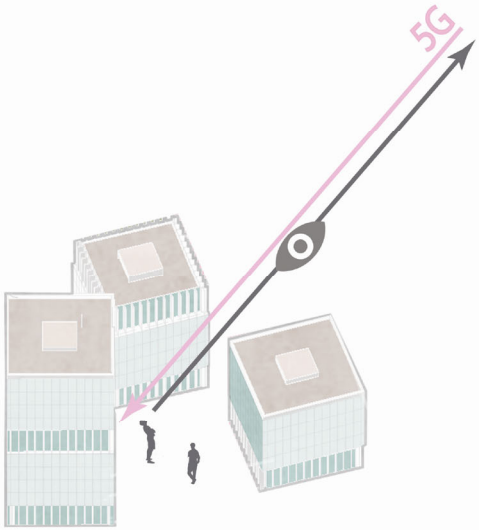


Signal Transmission and View
Towards Transmitter

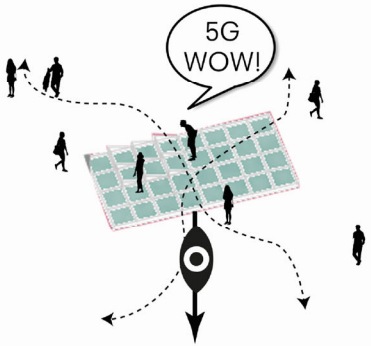
Experience Center & Glass Ceiling



Initial Volume
- Signal Blocked



Signal Transmission and View
Towards Transmitter



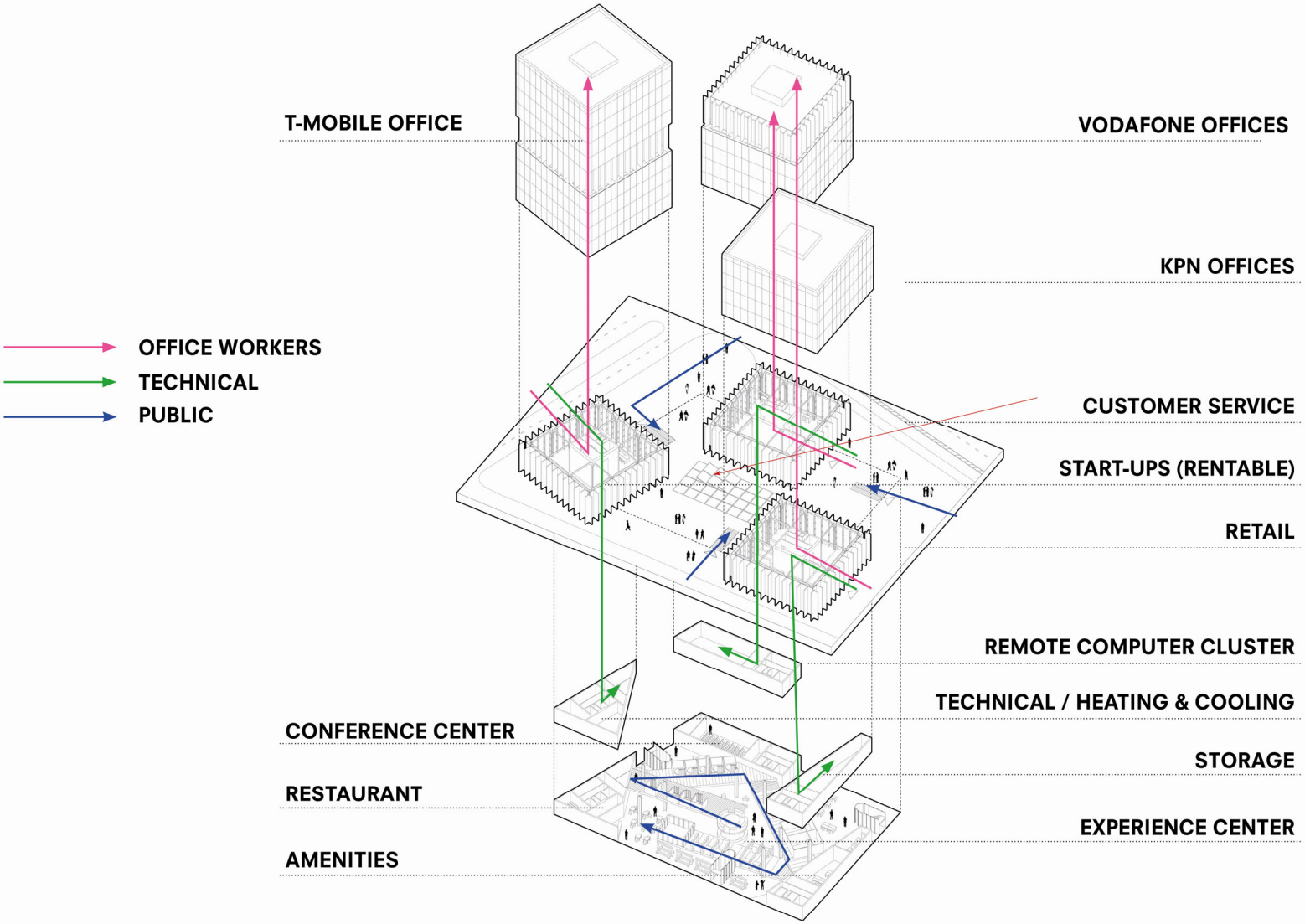
Experience Center
Below Glass Ceiling

Receiver

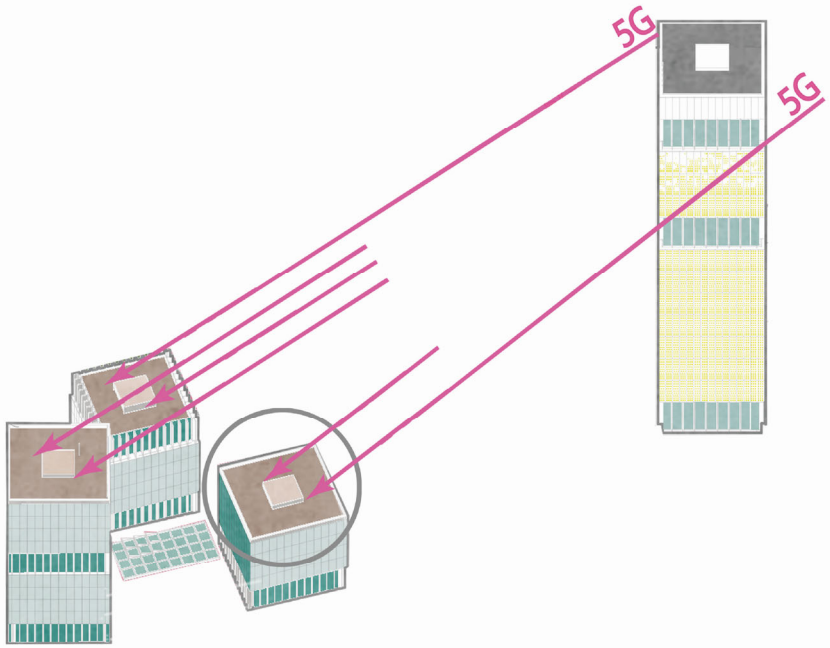
Massing Overview

Receiver

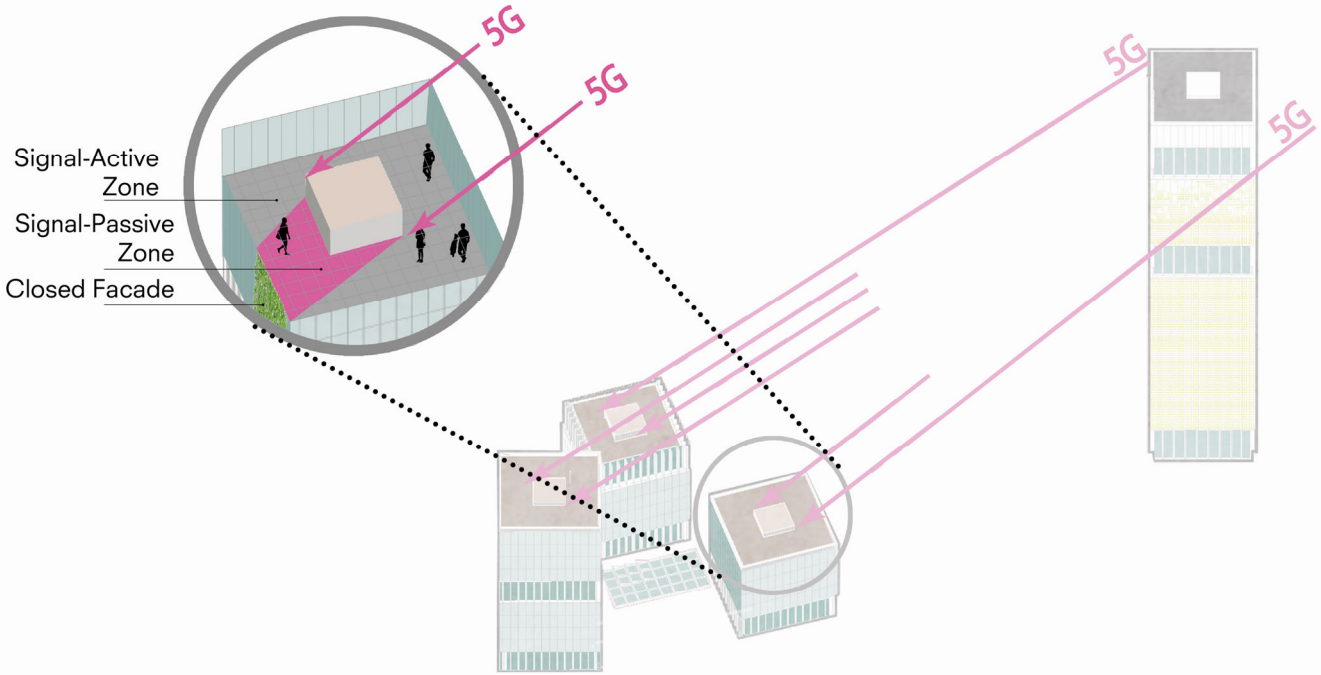
Routing



Signal-Passive and -Active Zones

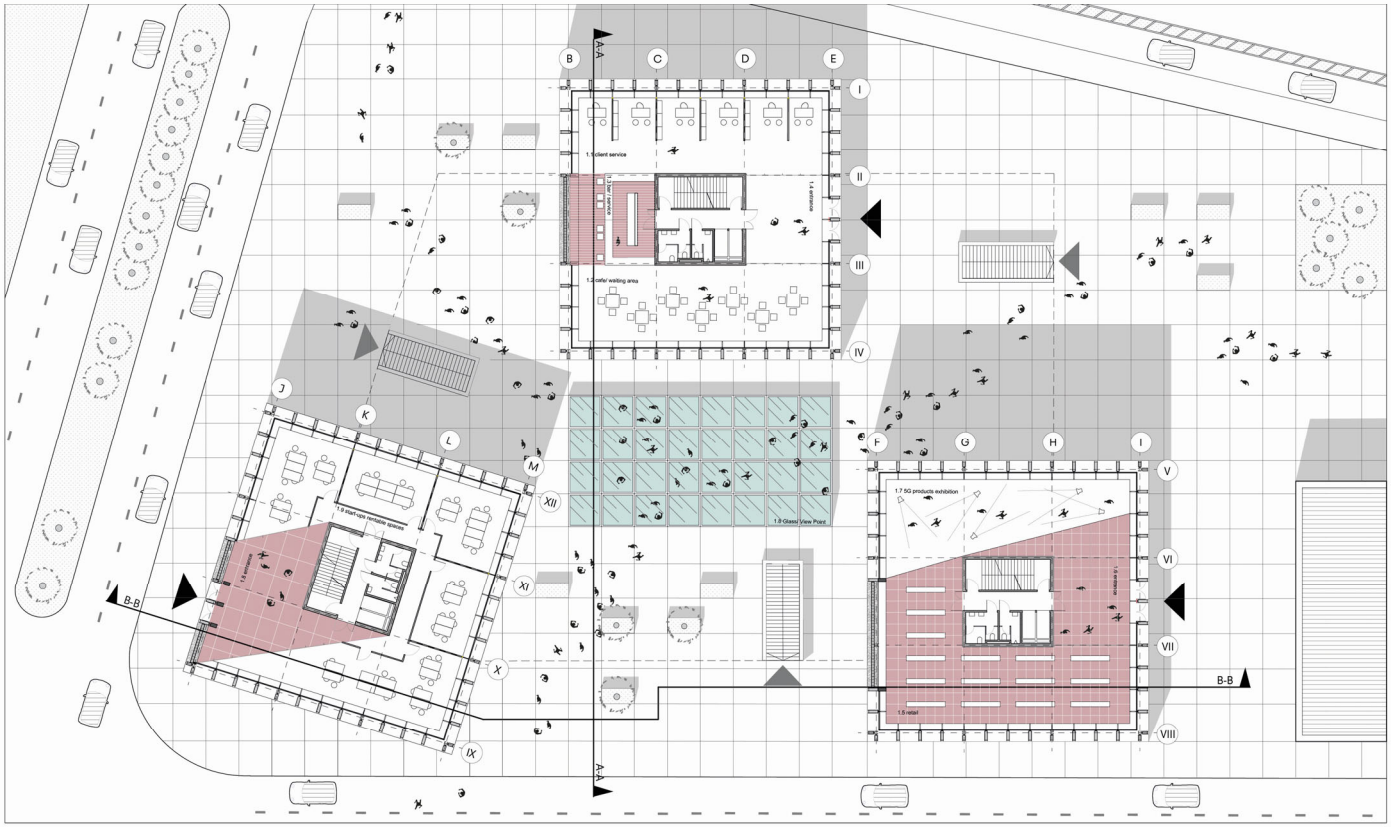


Signal-Passive and -Active Zones



Receiver

Ground Floor Plan



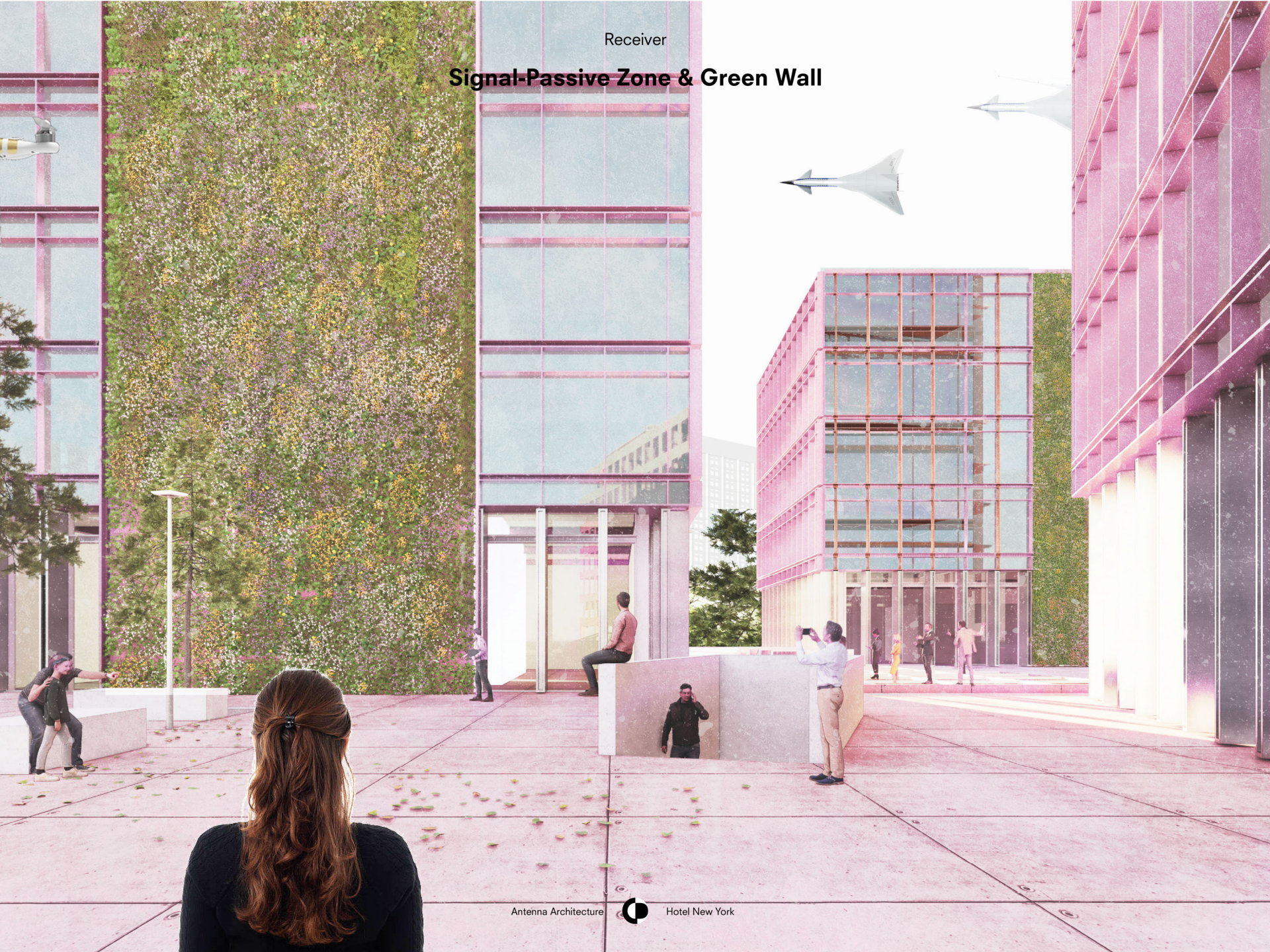
Ground Floor - Receiver
scale 1:200

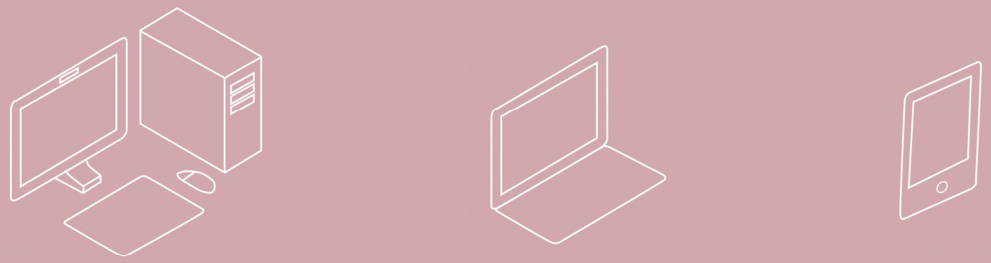
0 2 4 8 16m

N

Receiver

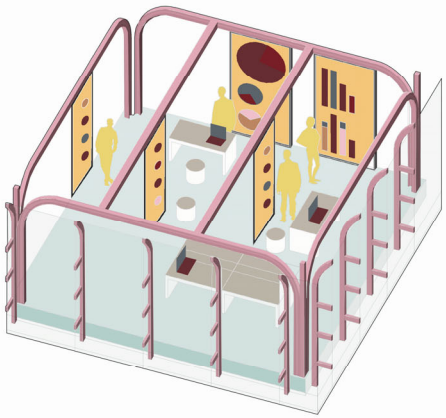
Signal-Passive Zone & Green Wall





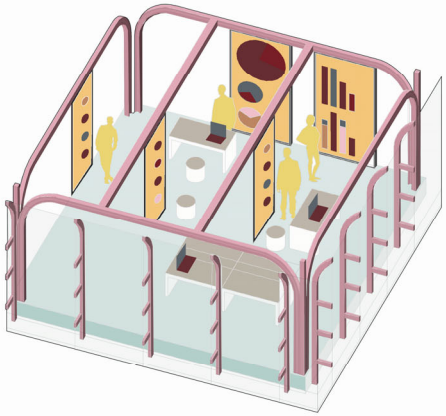
HOW WILL 5G CHANGE THE ARCHITECTURE OF REGULAR OFFICE SPACE?

Portable Devices & Screen Sharing

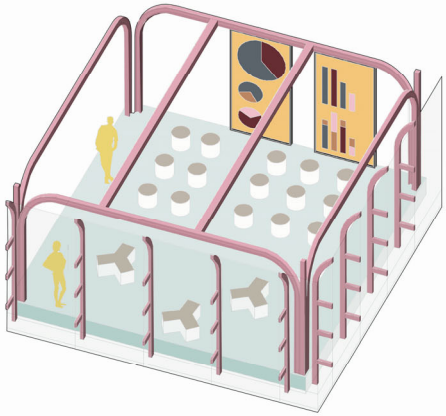


Portable Devices & Large Screens

Online Meetings

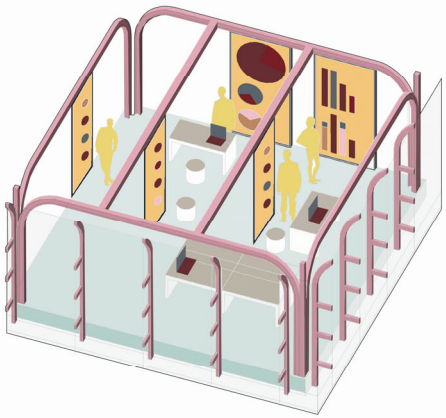


Portable Devices & Large Screens

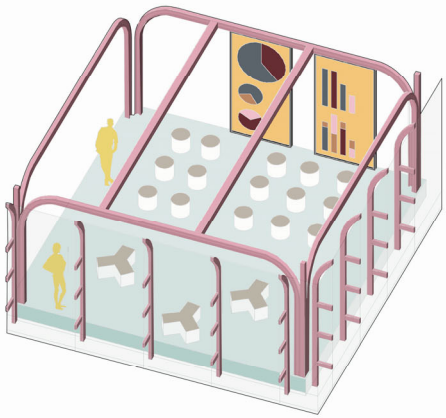


Online Meetings Between Companies

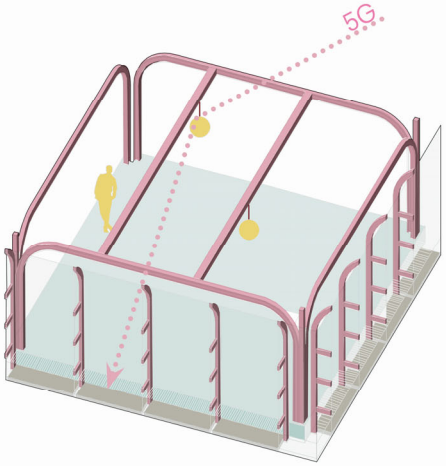
5G ‘Smart’ Facade



Portable Devices & Large Screens

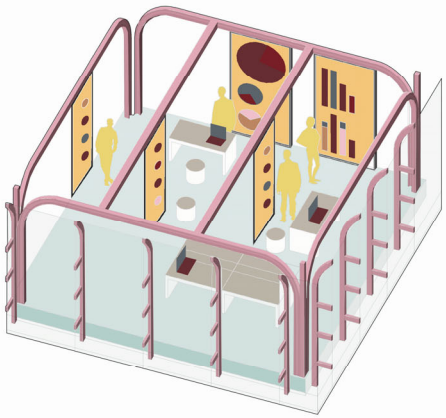


Online Meetings Between Companies

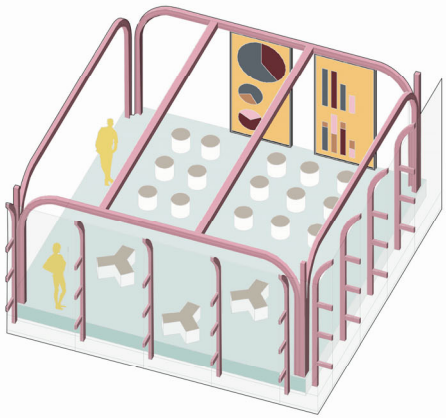


Smart ‘5G’ Facade

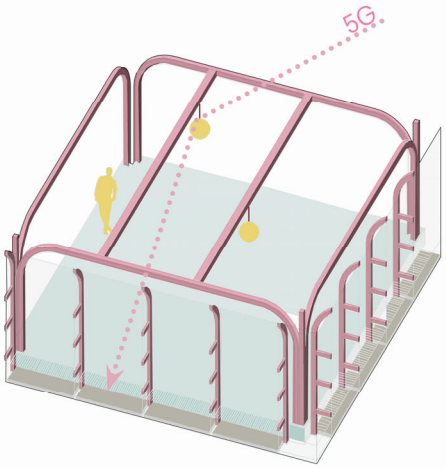
Adaptability between 5G & 6G



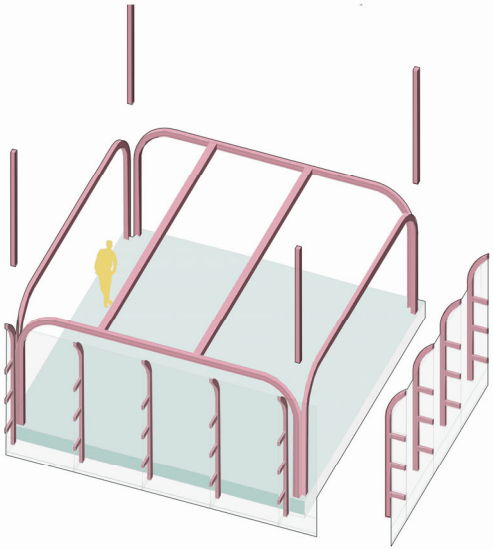
Portable Devices & Large Screens



Online Meetings Between Companies



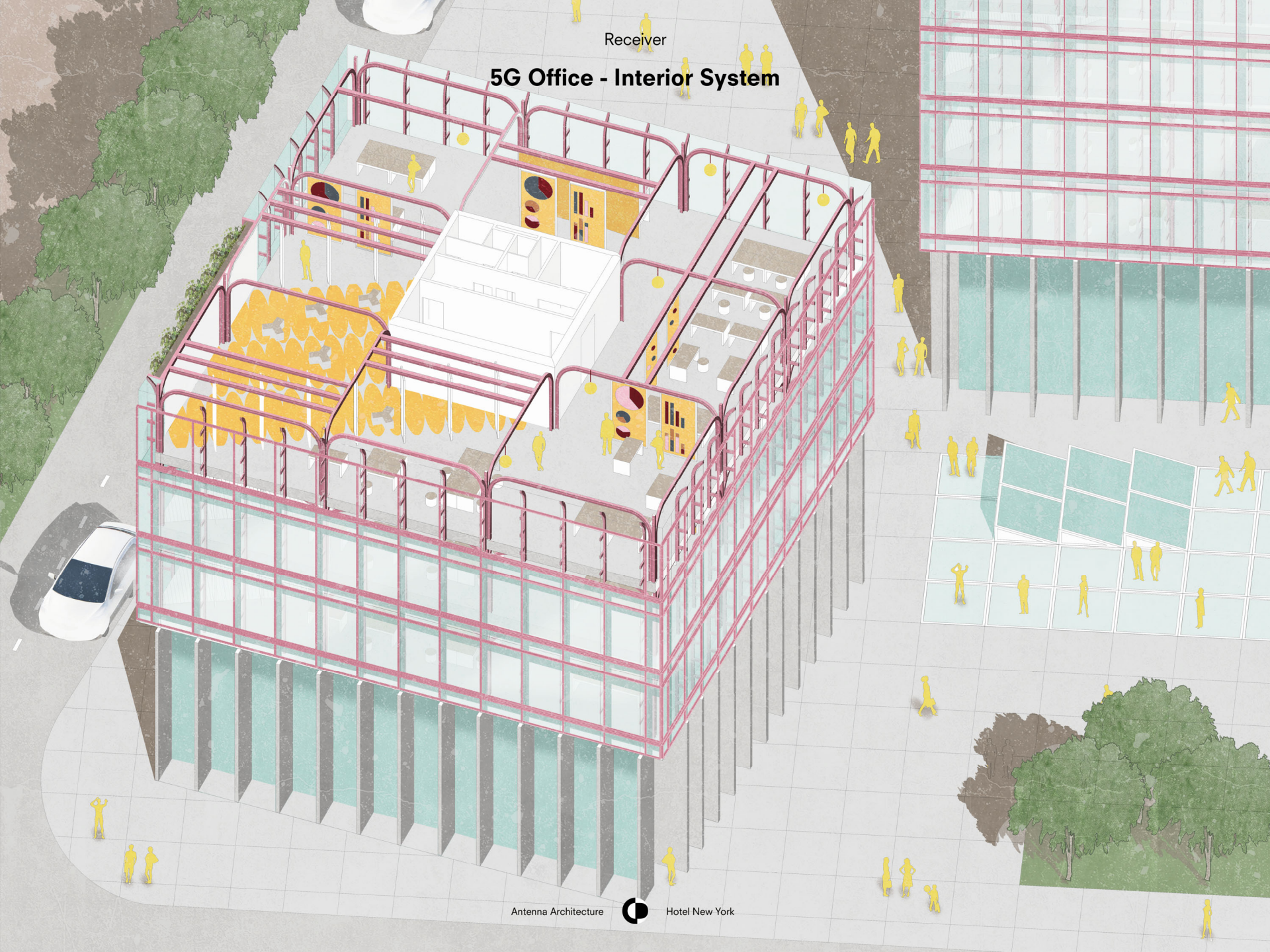
Smart '5G' Facade



Adaptability Between 5G & 6G

Receiver

5G Office - Interior System



Receiver

Office Floor - Plan

+2 Floor (Typical Office Floor) - Receiver
scale 1:200

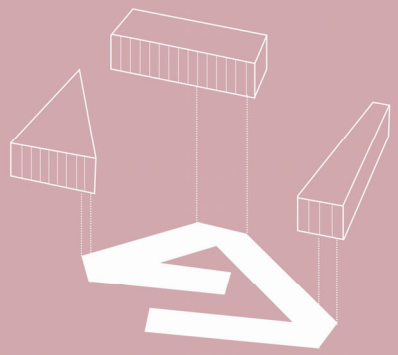
0 2 4 8 16m

N

Signal-Active Zone

Signal-Passive and -Active Zones

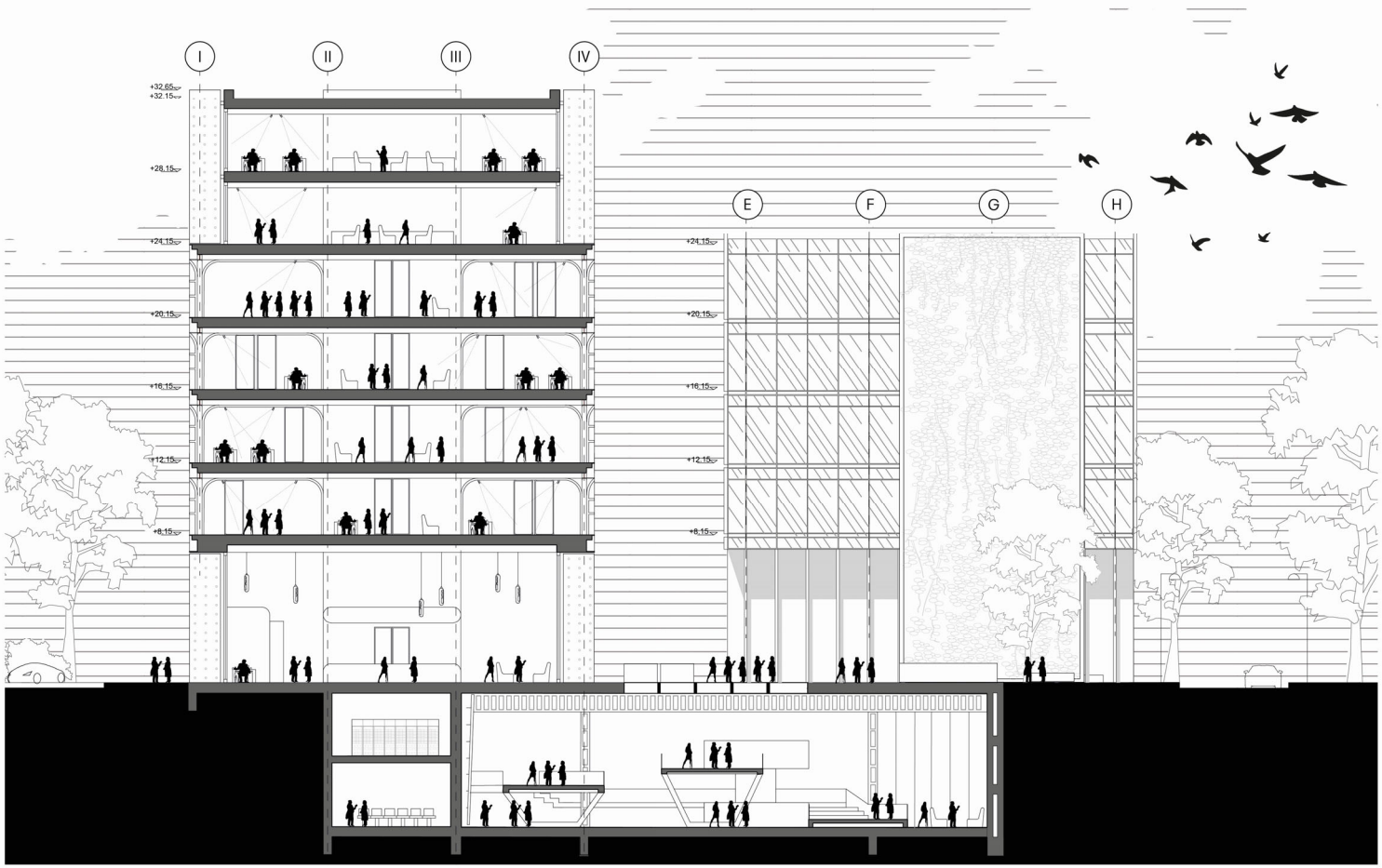
Signal-Passive Zone - Office



THE DESIGN OF 5G EXPERIENCE CENTER

Receiver

Section



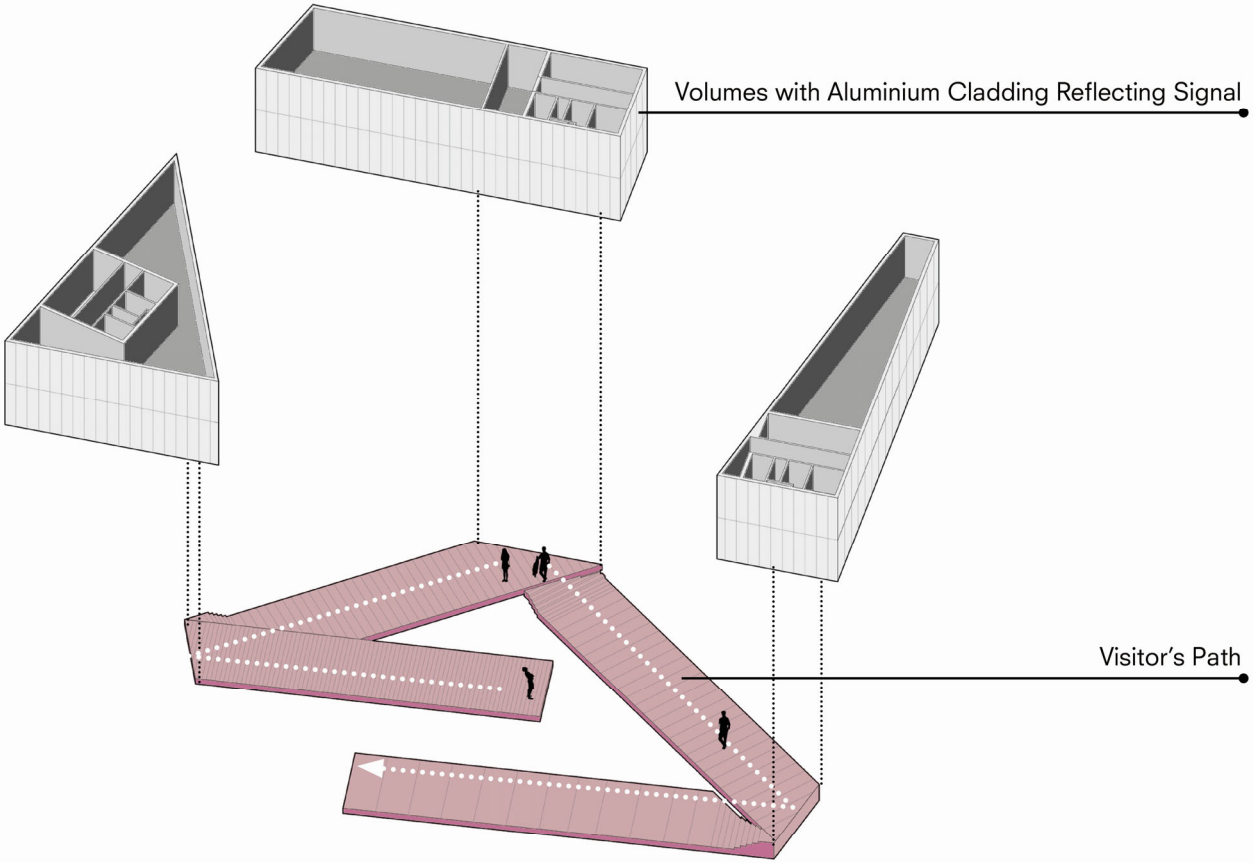
Section AA - Receiver
scale 1:200

0 2 4 8 16m

Receiver

View From the Top

Experience Center - Concept



Receiver

Experience Center - Plan

-2 Floor (Experience Center)- Receiver
scale 1:200

0 2 4 8 16m

N

Receiver

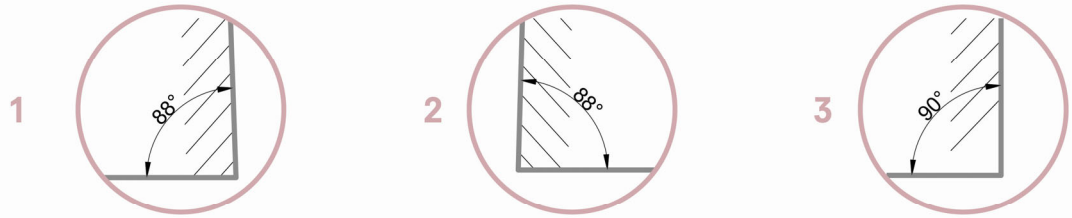
Experience Center - Plan

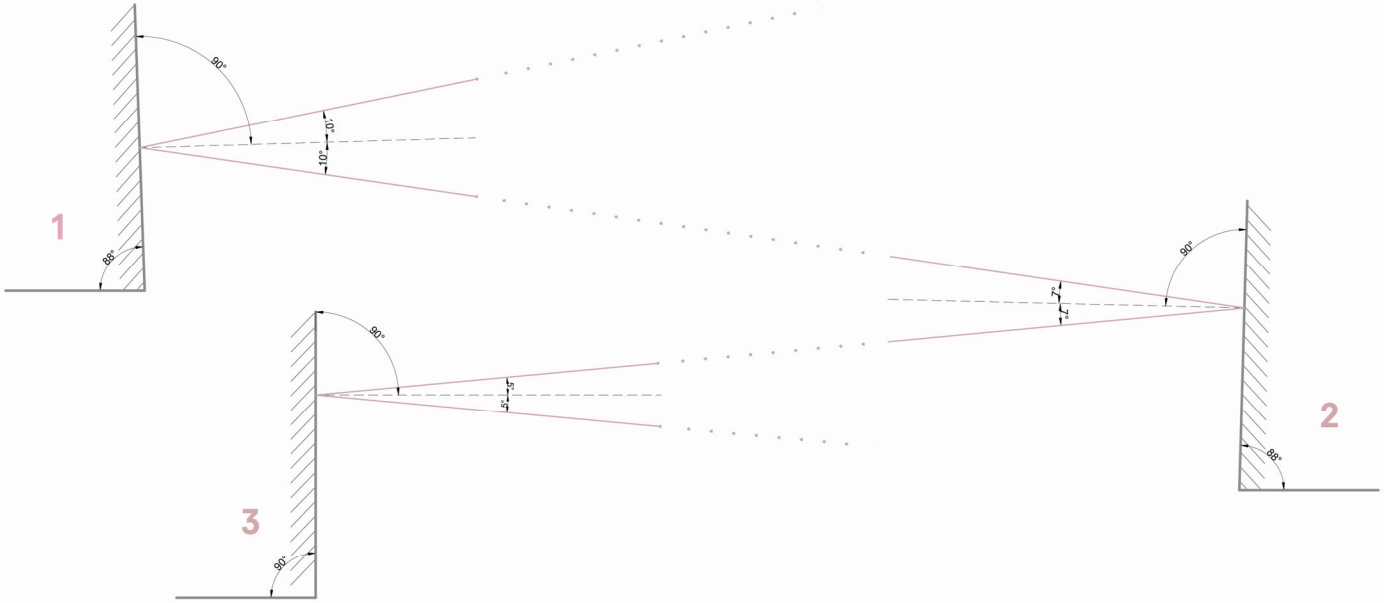
-1 Floor (Technical Floor) - Receiver
scale 1:200

0 2 4 8 16m

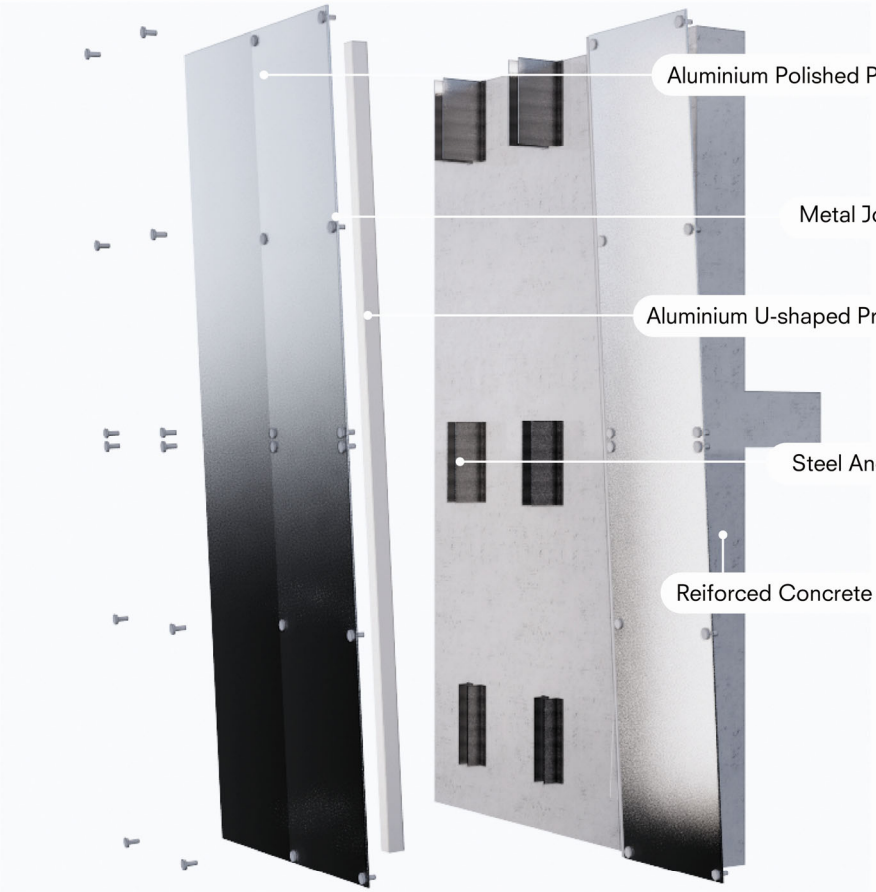
N

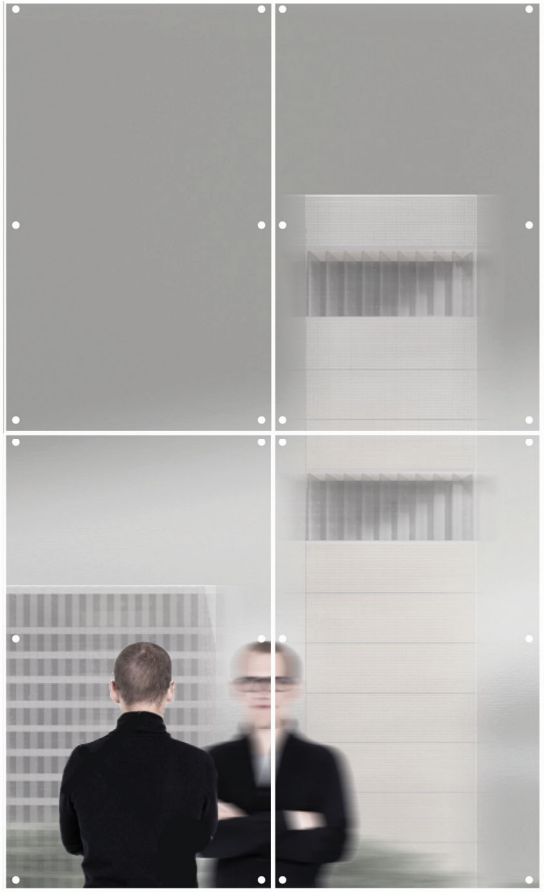
Signal Path Design





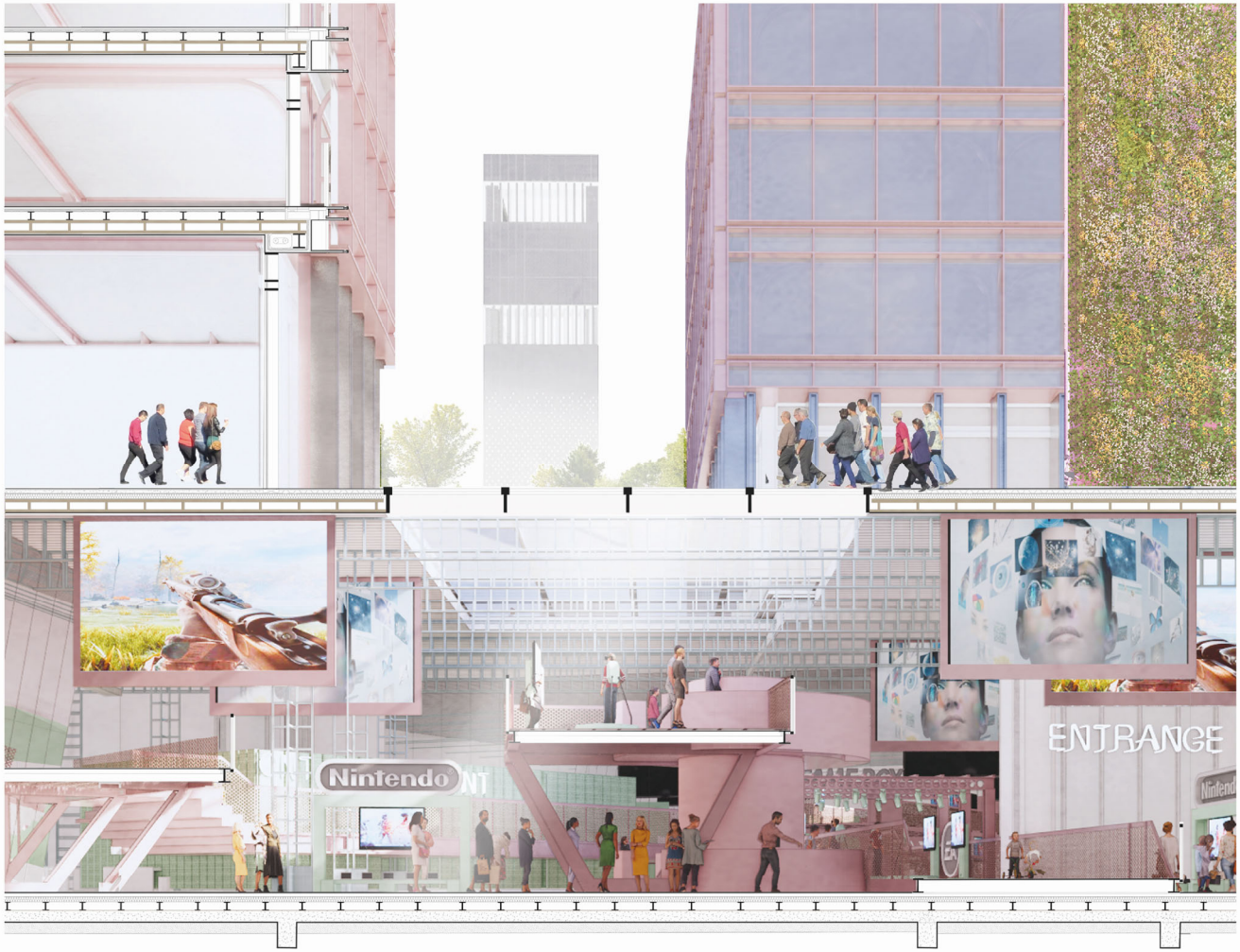
Interior Cladding System



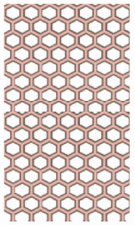


Receiver

1:50 Experience Center

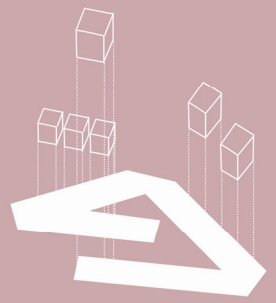



Anodized


Perforated


Polished


Brushed



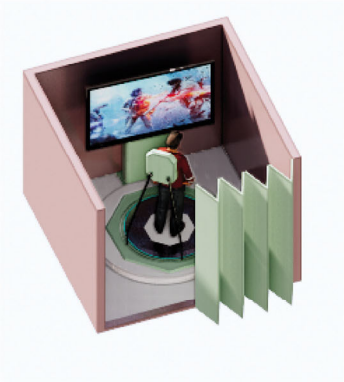
PROGRAM EXPLANATION

Program Explanation

9D Cinema

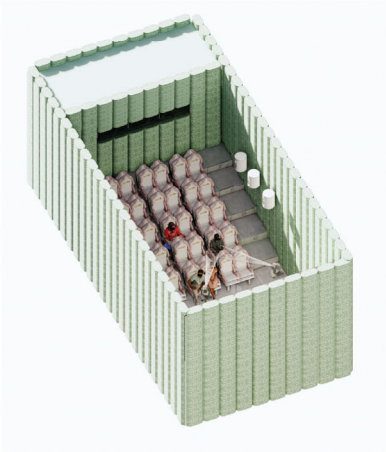
Program Explanation

9D Cinema

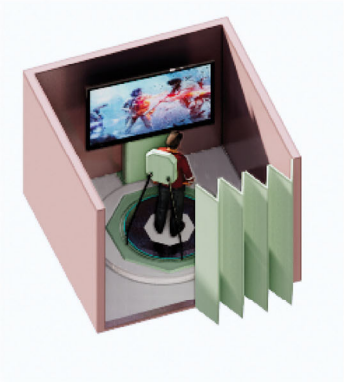


VR Training Cabins

Program Explanation



9D Cinema

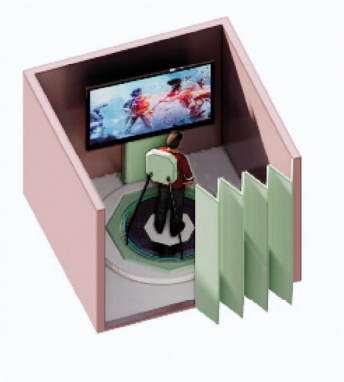


VR Training Cabins

Ticket Check Point / Entrance

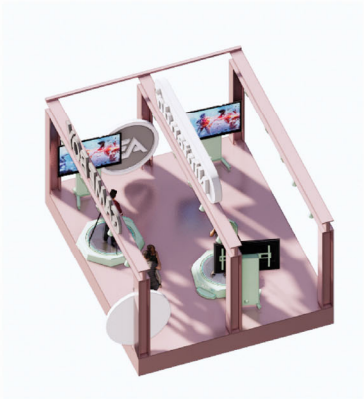
Program Explanation

9D Cinema



VR Training Cabins

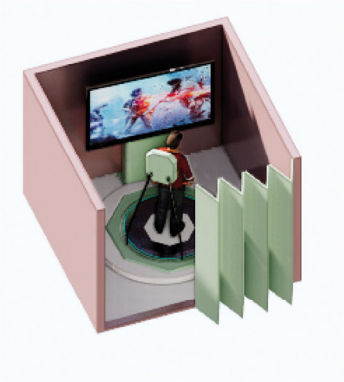
Ticket Check Point / Entrance



Gaming Platform

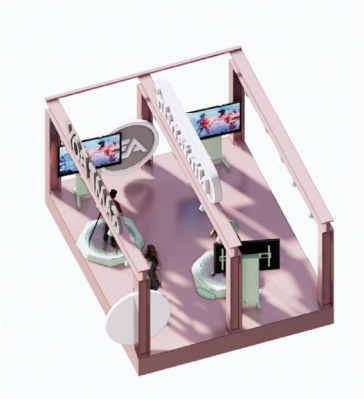
Program Explanation

9D Cinema



VR Training Cabins

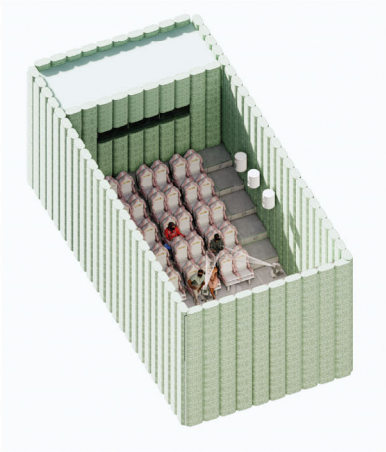
Ticket Check Point / Entrance



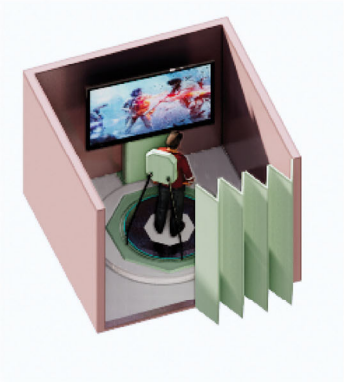
Gaming Platform

VR Playground

Program Explanation

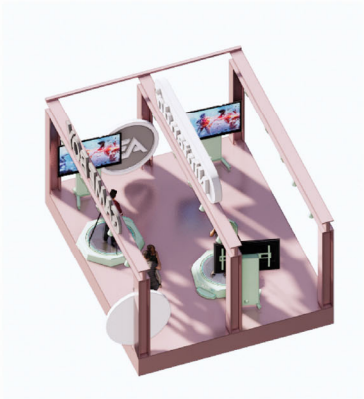


9D Cinema



VR Training Cabins

Ticket Check Point / Entrance



Gaming Platform

VR Playground

5G Products Selling Point

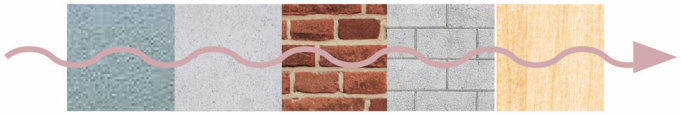
9D Cinema

Gaming Platform

VR Playground

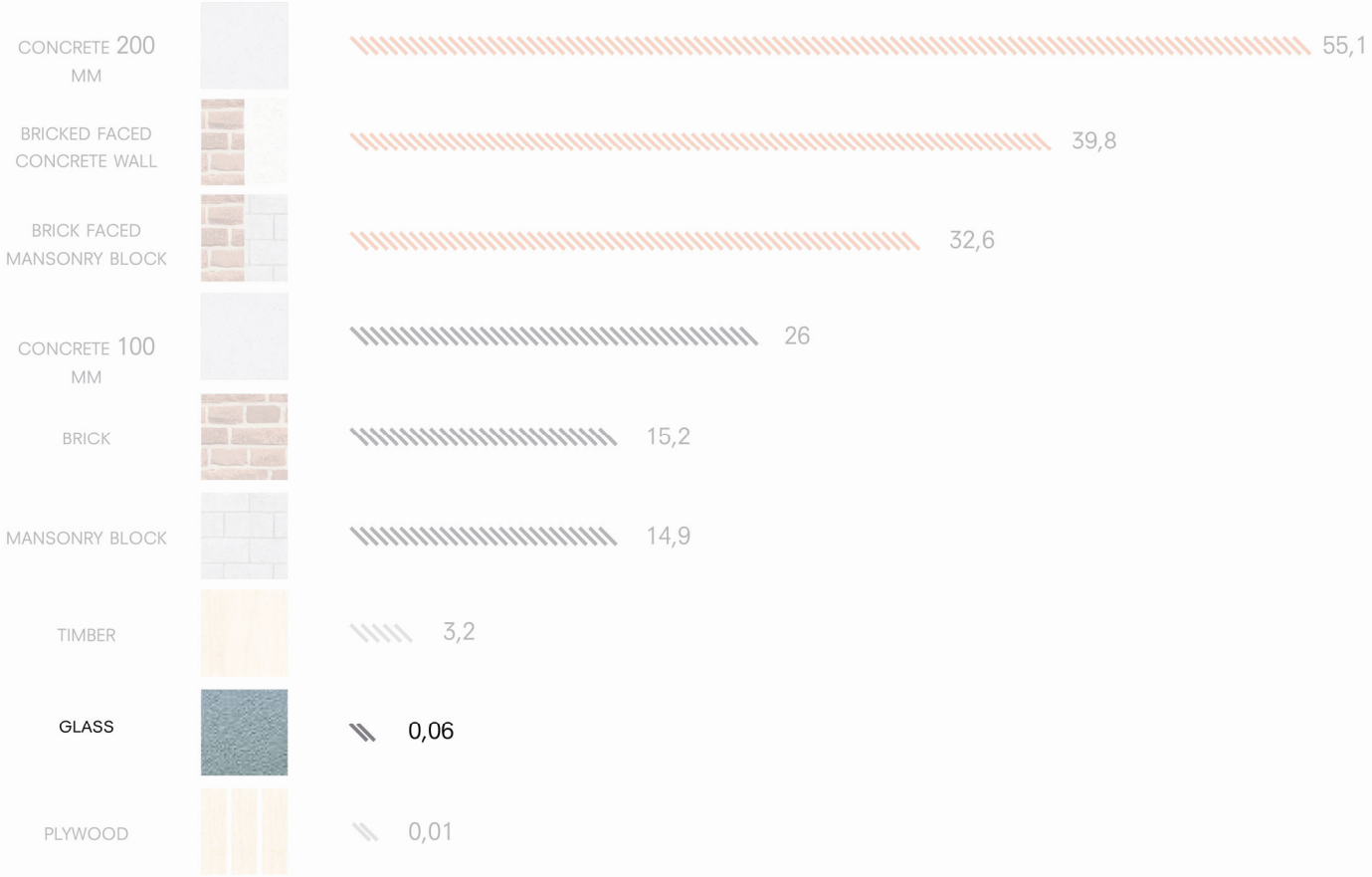
5G Products Selling Points

Material Choice



WHICH MATERIAL WILL CAUSE THE LEAST SIGNIFICANT SIGNAL LOSS?

Research Guidelines



Receiver

Overview

Roof

Elements

1. Glass Fiber Isulation
2. Mullion
3. Spectrally Selective Double Glass
4. Air Inflow Floor System
5. Aluminium C Profile 100 mm
6. Steel I-Column 300mm
7. Aluminium Profile
8. Lignatur Panel
9. Steel Joint
10. Steel I-Beam 300mm
11. Roller Blinds System
12. Blinds
13. Air Handling Unit
14. Aluminium Facade System
15. 5G Sensors
16. Screens
18. Antenna Palelling Control Unit
19. 5G Massive MIMO Antenna
20. Double Glass Window
21. Automatic Doors 220x90
22. Water Drainage System
23. Reinforced Concrete Foundation
24. Drainage Water Pipe o 100mm
25. Ceiling Cooling Panels
26. Wood I-Beam 150 mm

W1 Glazed Facade
Double Glazed Curtain Wall th. 20 mm

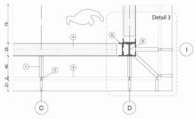
W2 Attic Wall
Gypsum Board th. 20 mm
Water Isulation th. 0,5mm
Fiber Glass th. 10 cm
Panel Cladding th. 10 mm

F1 Roof
Gravel th. 30mm
Water Isulation th. 0,5mm
Thermal Insulation - mineral wool th. 10 cm
Lignature Floor Panel th 280 mm

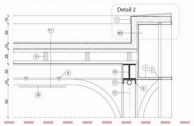
F2 Middle Floor
Floor FInish th. 20 mm
Gypsum Board th. 20 mm
Hard Fiber Insulation 50 mm
MDF Board 30 mm
Service Distribution Space th. 150 mm
Lignature Floor Panel th 280 mm

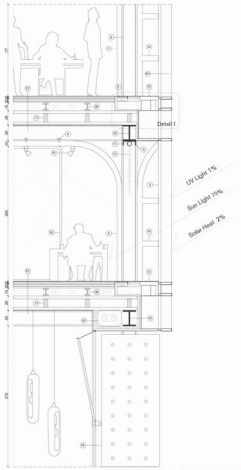
F3 Foundation Floor
Floor FInish th. 20 mm
Concrete th. 40 mm
Hydro Insulation th. 0,5 mm
Thermal Insulation - Mineral Wool th. 100mm
Hydro Insulation th. 0,5 mm
Reinforced Concrete Floor th. 250 mm
Sand 200 mm

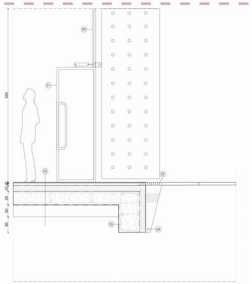
Receiver Facade Plan

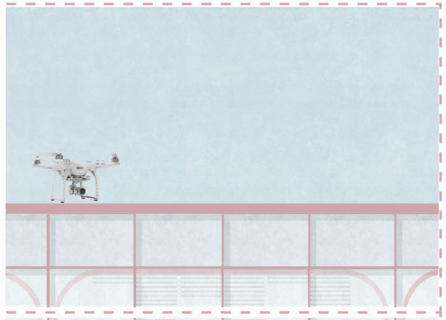


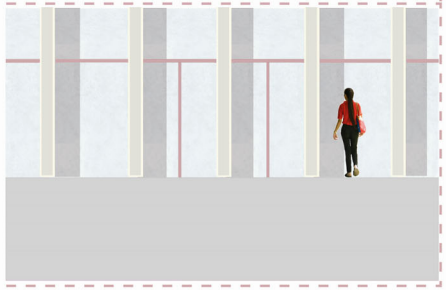
Receiver Facade Section











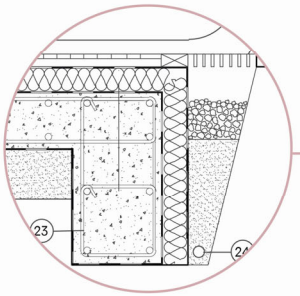
Main Body

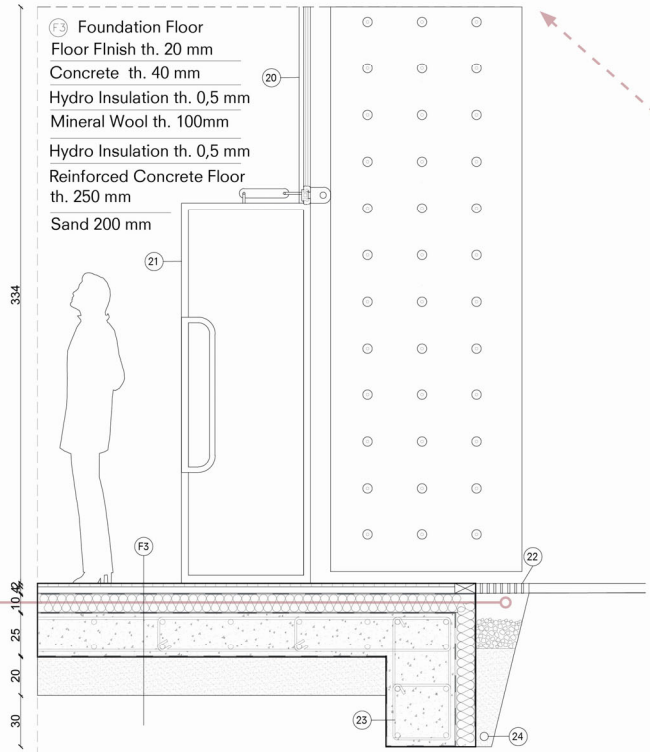
Ground

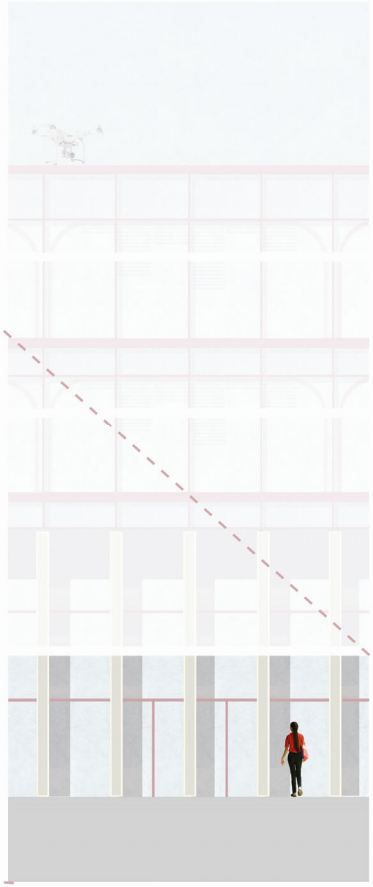
Receiver

Ground

Drainage & Water Collection

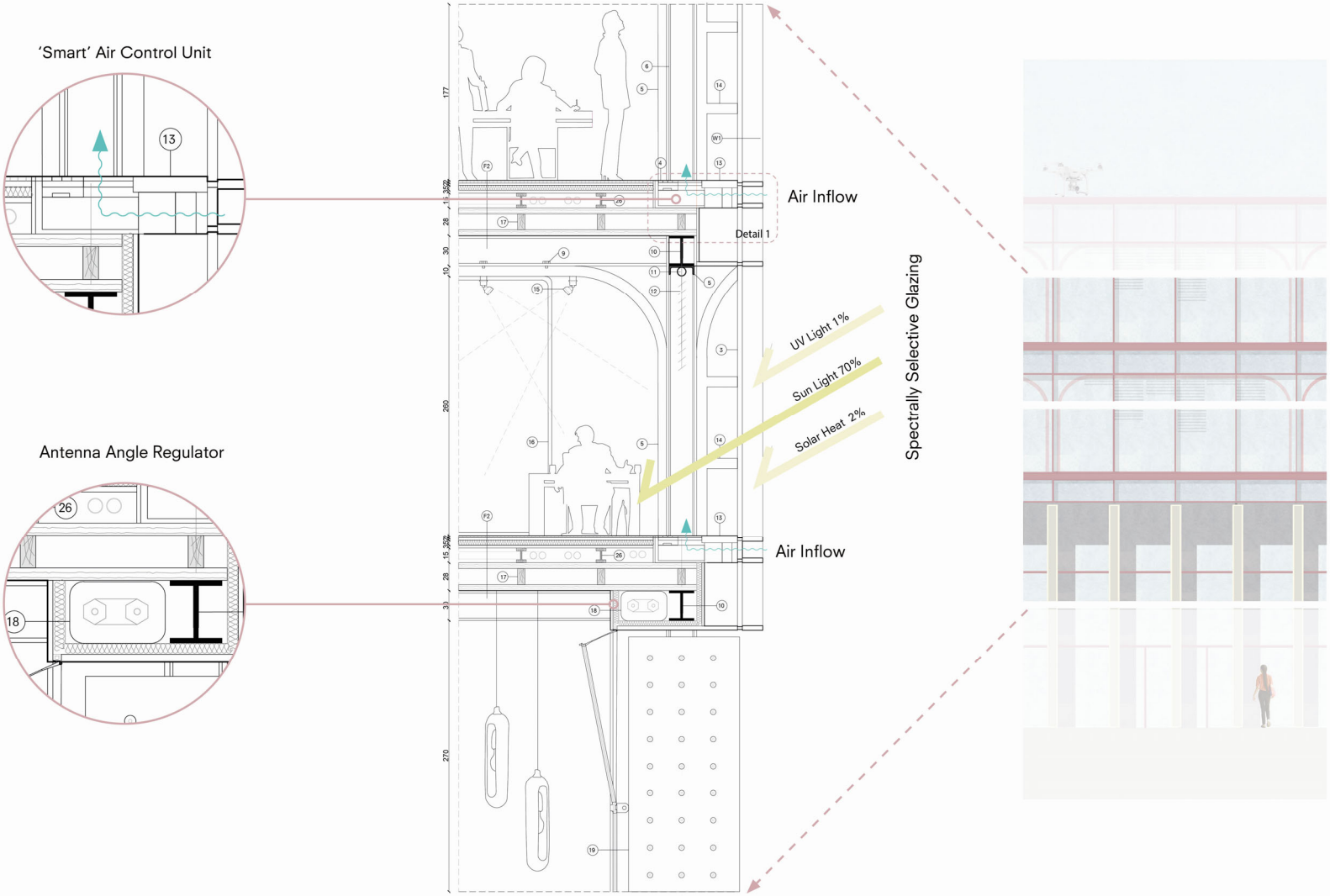






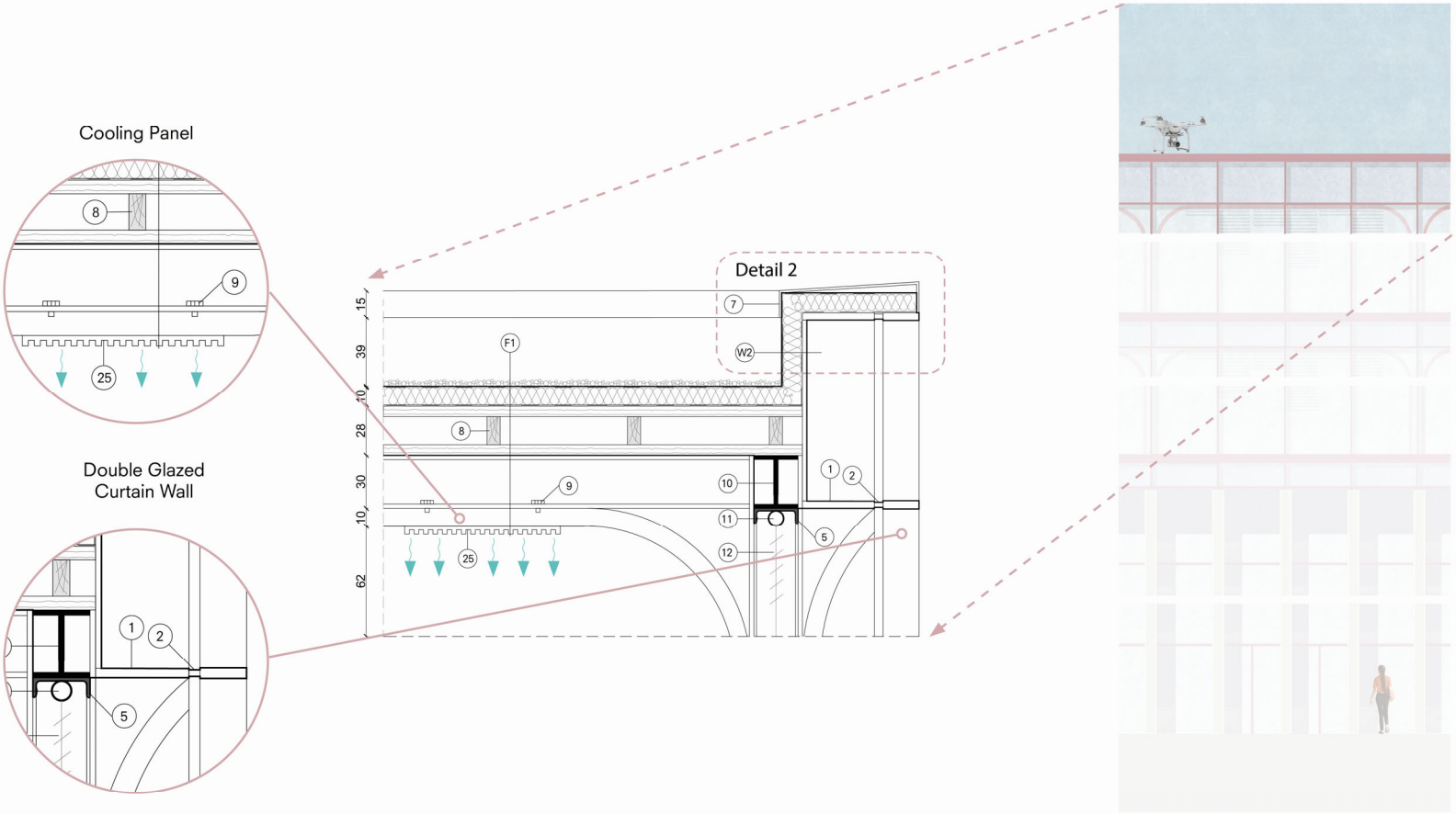
Receiver

Main Body



Receiver

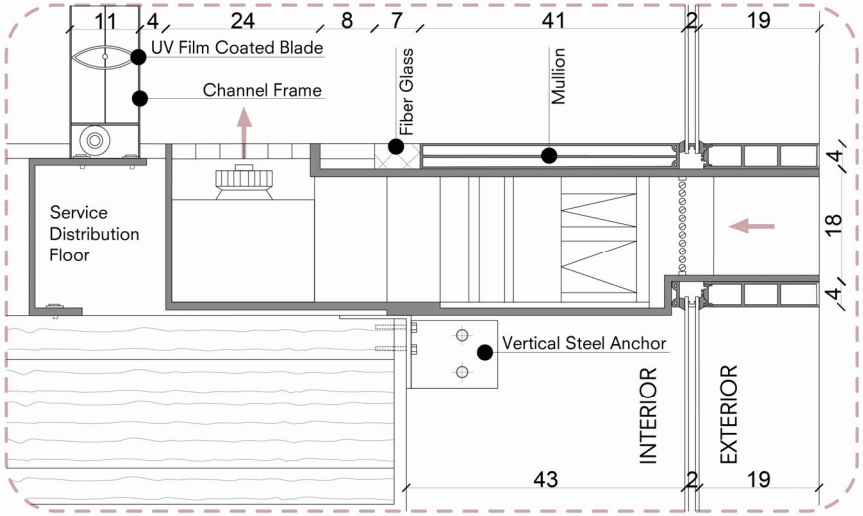
Roof



View Towards Plaza

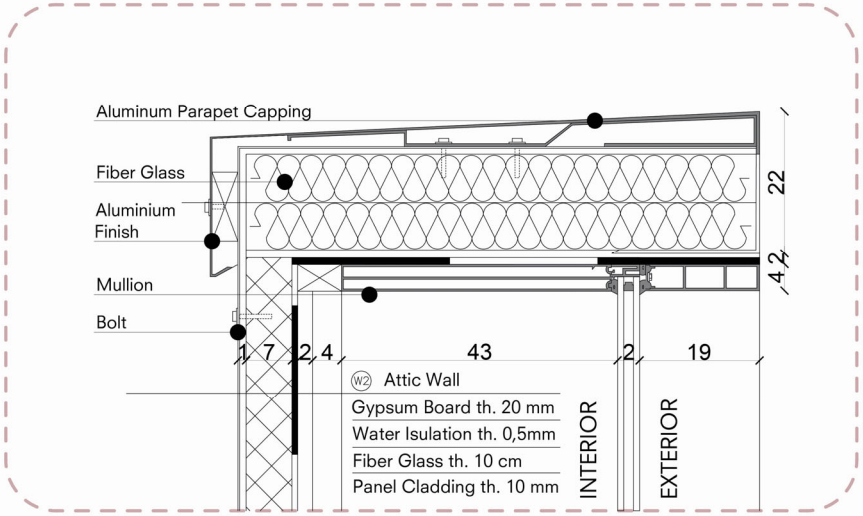
Details

Air Handling Unit 1:5



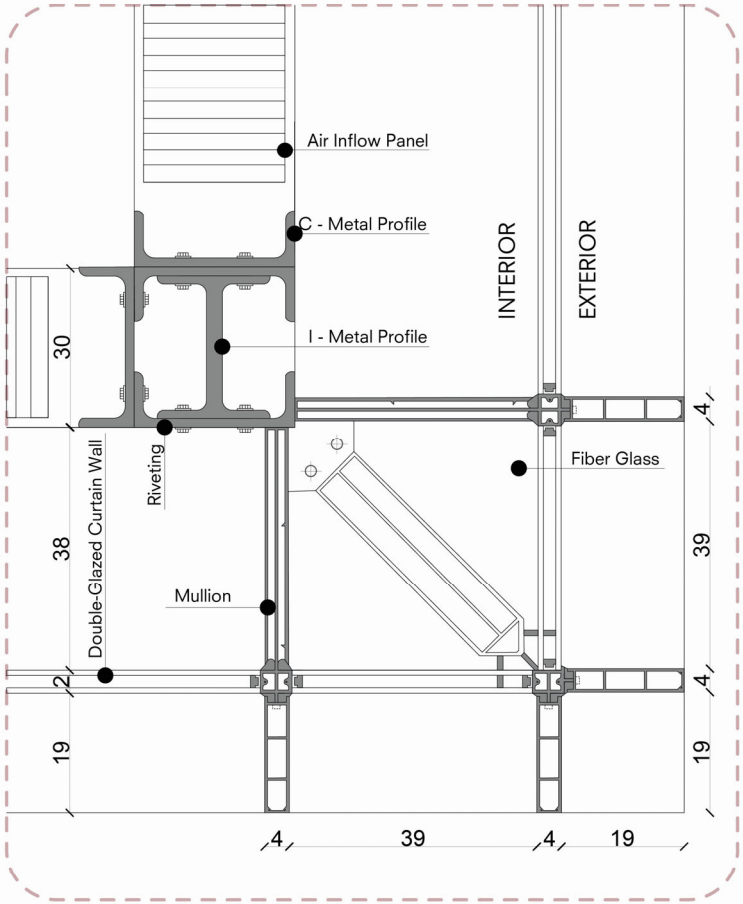
Details

Roof Top 1:5



Details

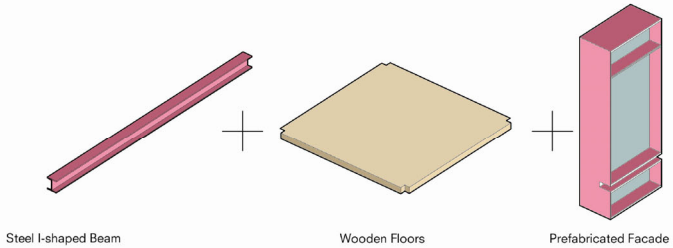
Corner - Curtain Wall System 1:5



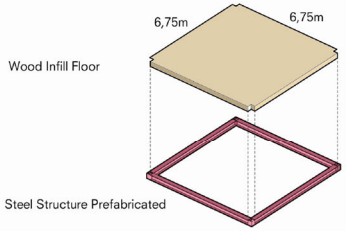
4G 5G ?

FROM 5G TOWARDS 6G & 7G ...

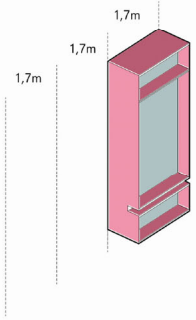
Structure Concept



DEMOUNTABLE SYSTEM STEEL+WOOD



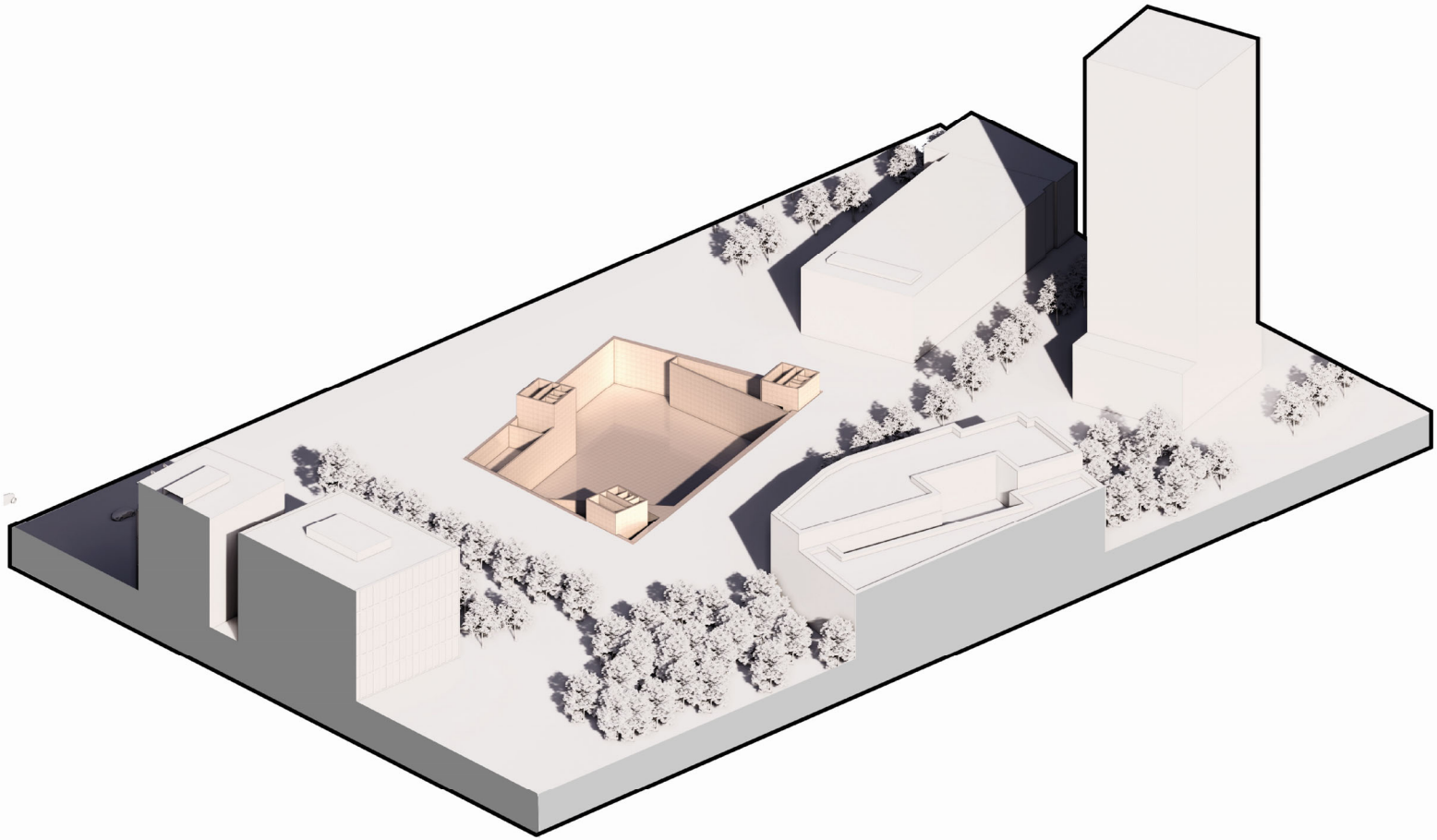
ADAPTABILITY FOR NEW TECHNOLOGIES



MODULARITY

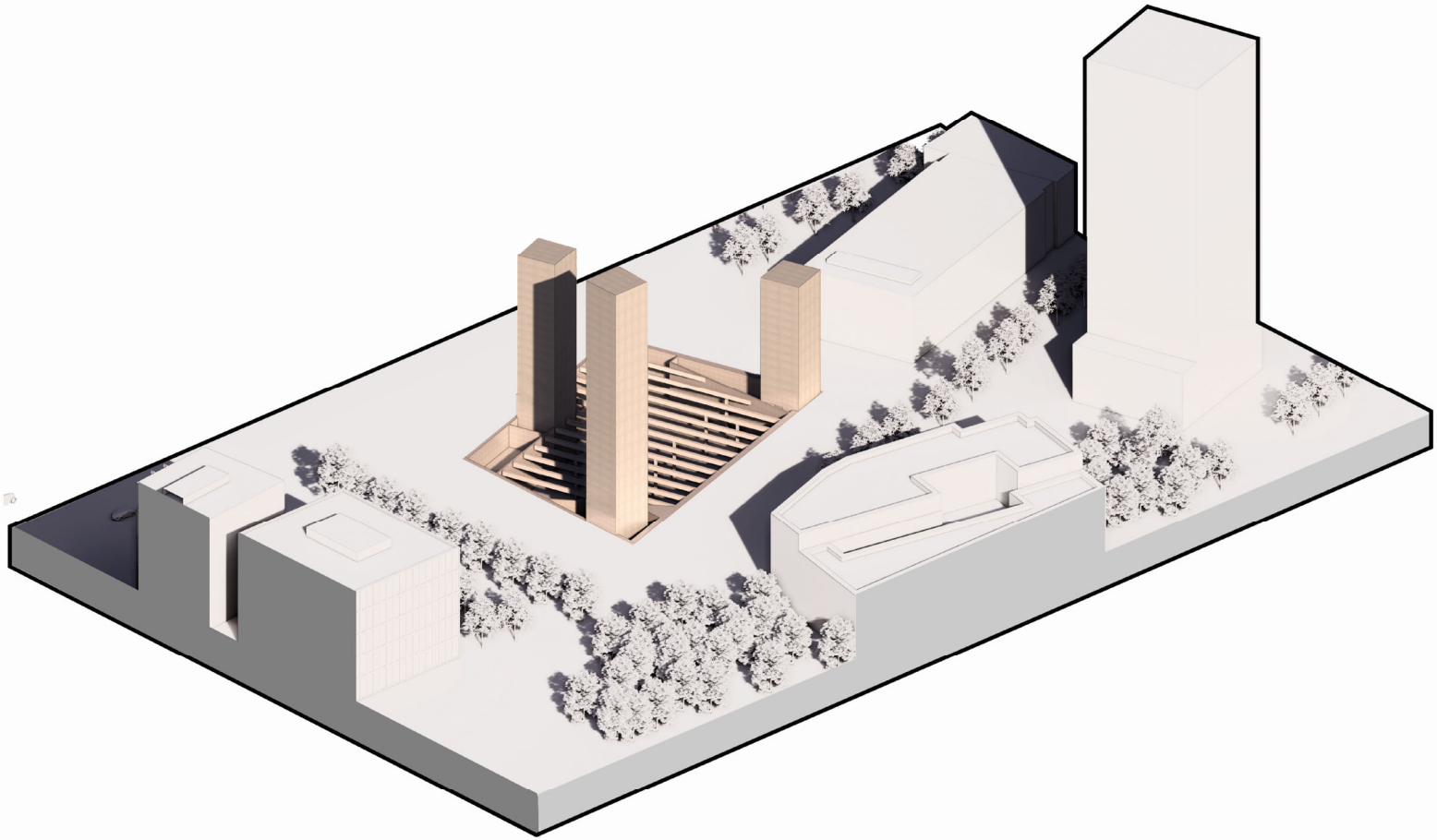
Receiver

Concrete Base

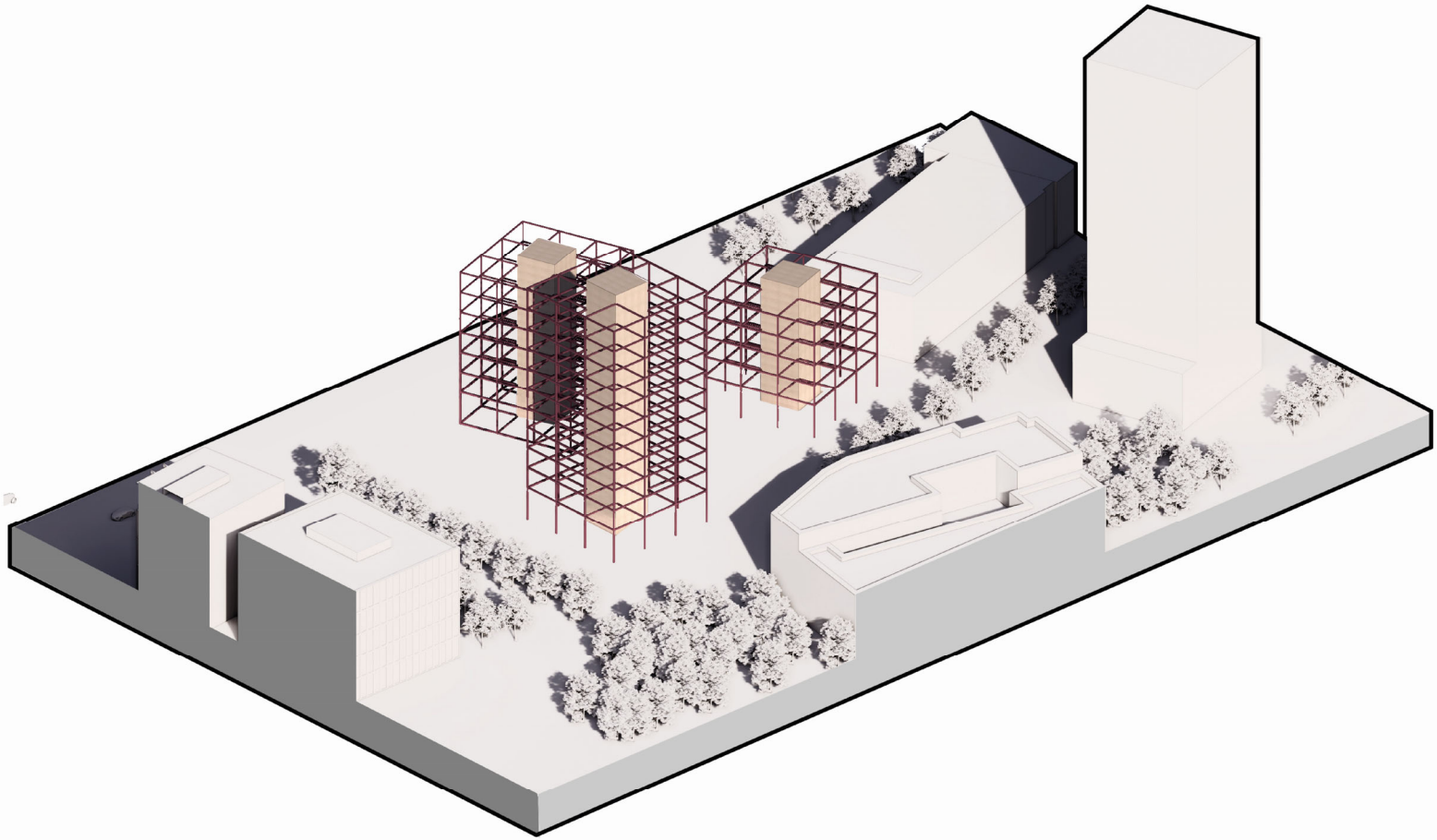


Receiver

Concrete Cores

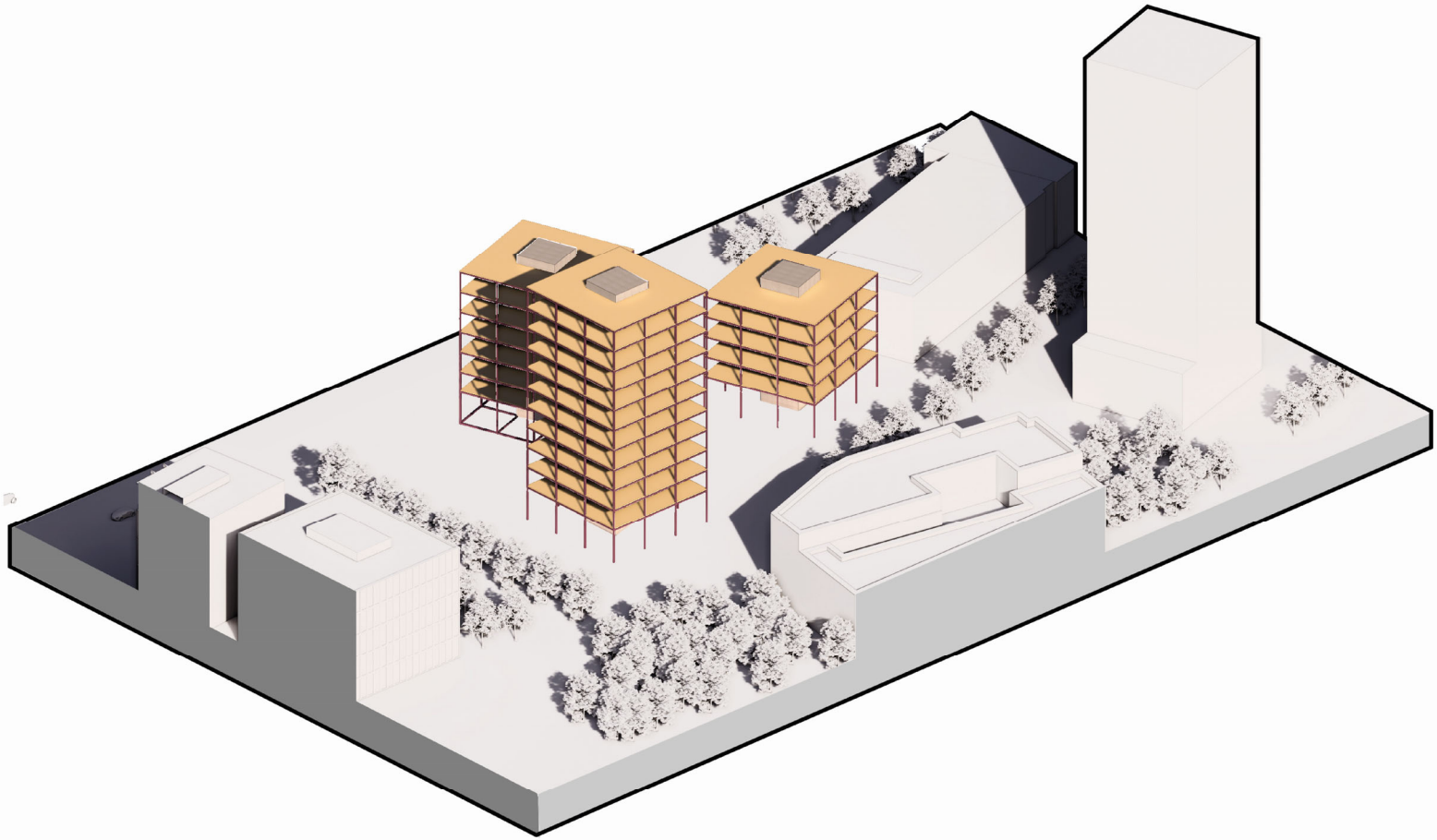


Steel Frames

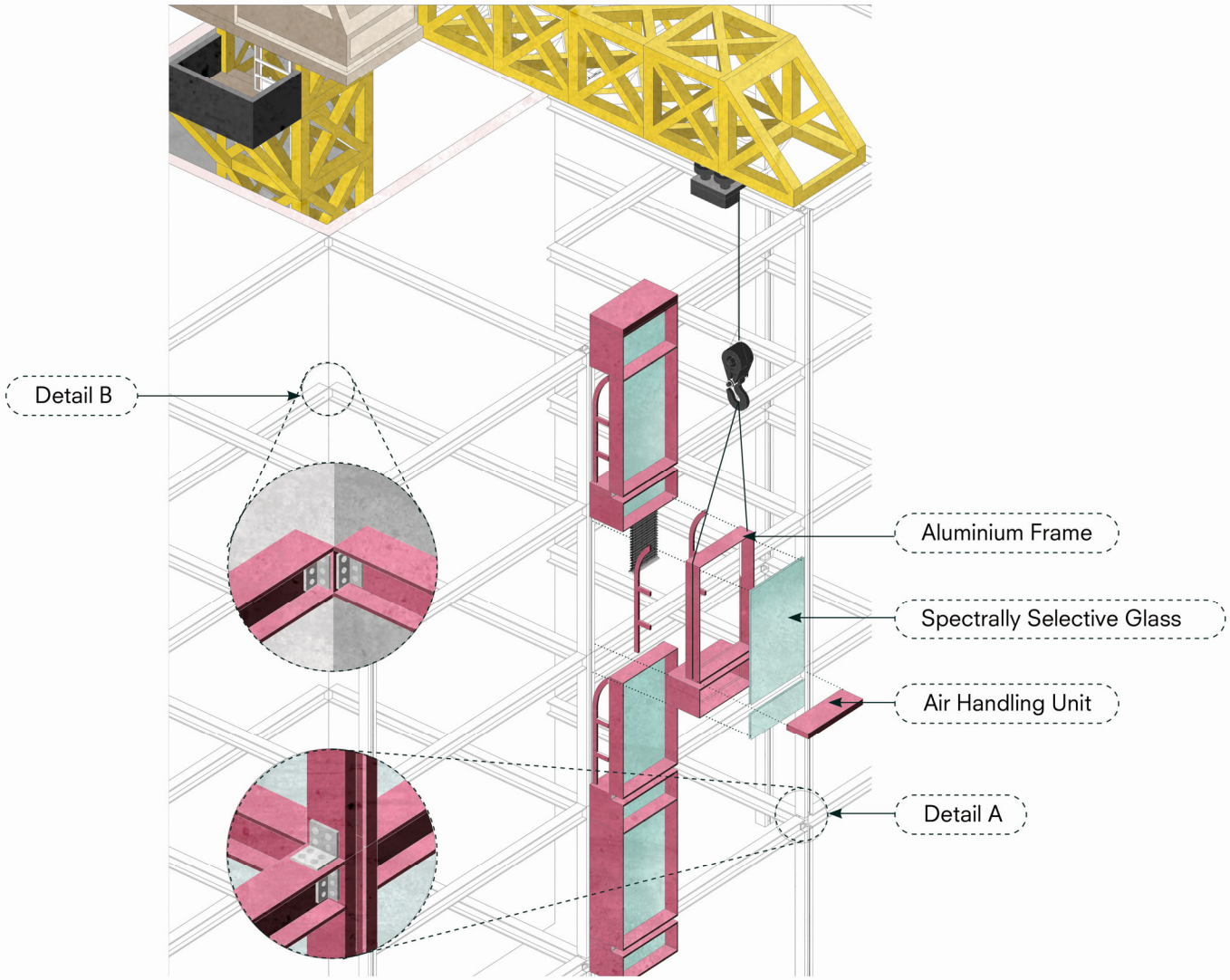


Receiver

Light Wooden Floors



Demountable Structure & Fast Assembly



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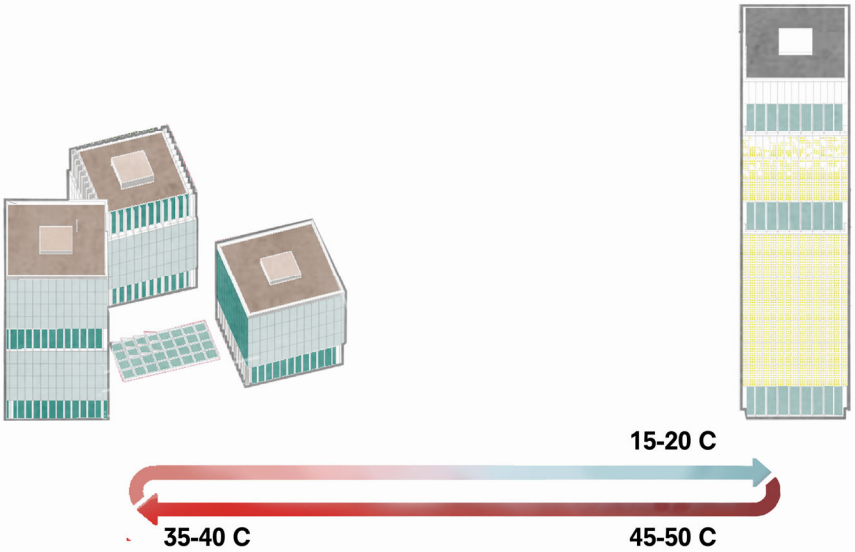
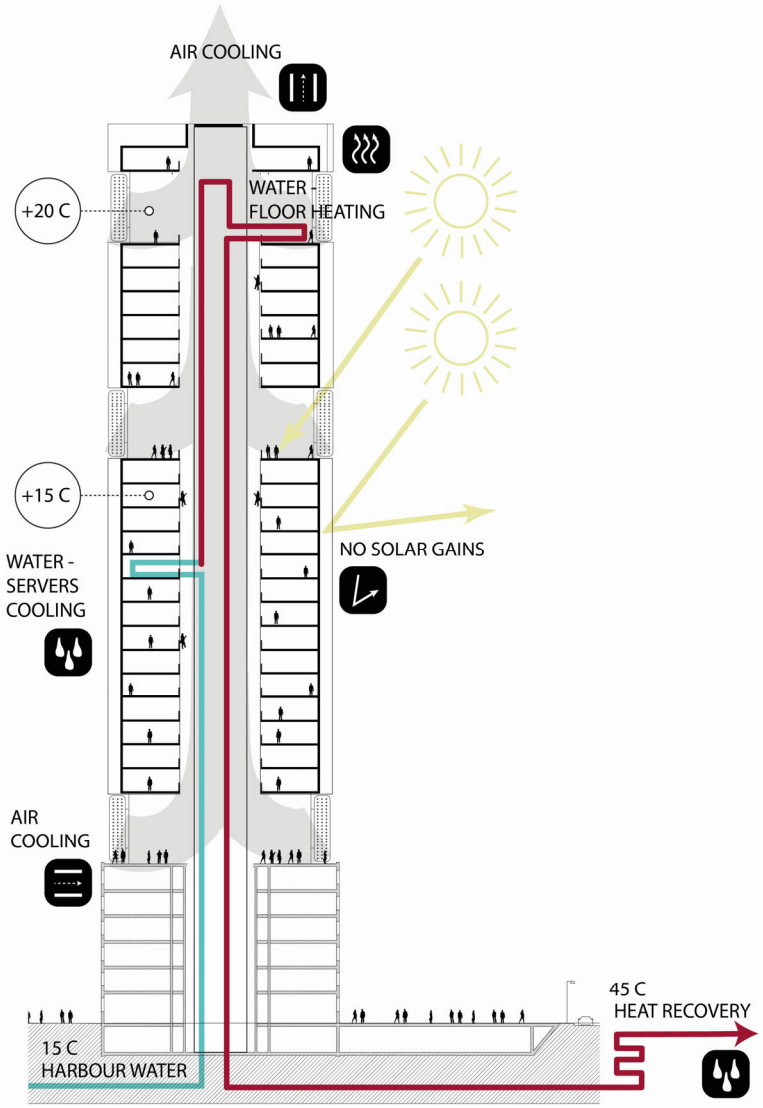
Heat Exchange

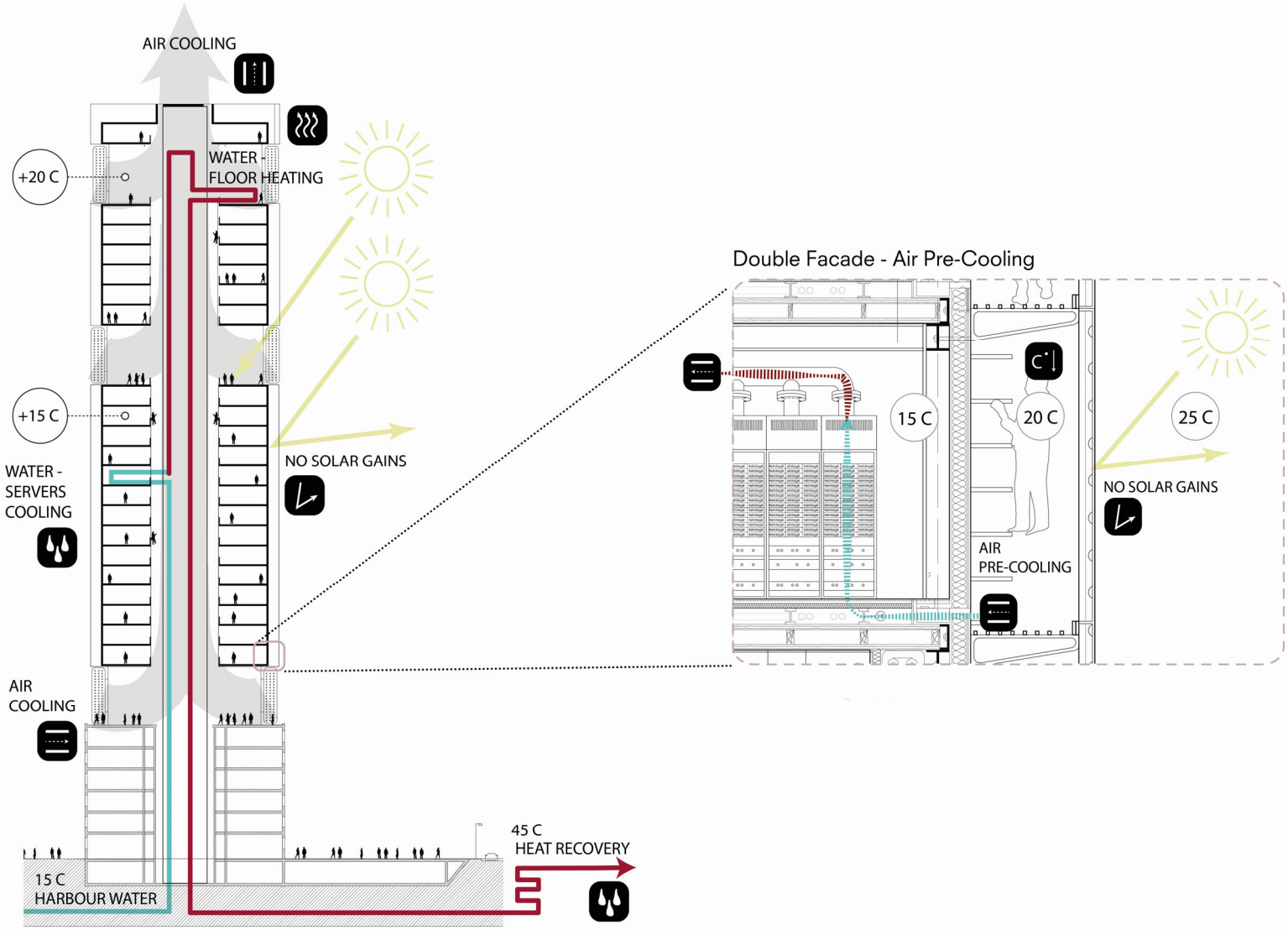


Source: Snohetta, Spark Model

Transmitter - Hybrid Cooling System

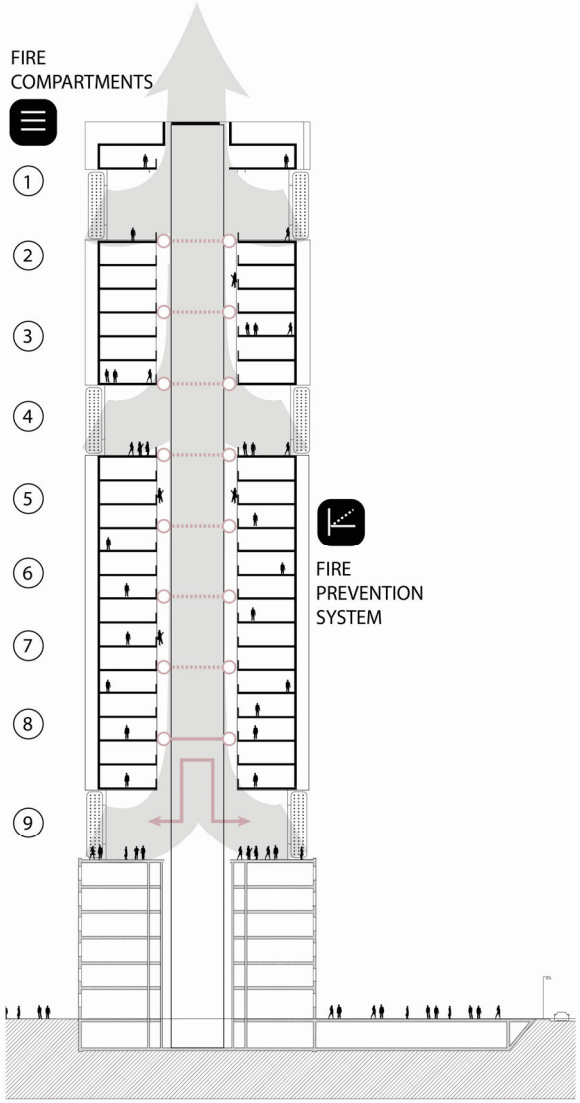


Envelope Concept

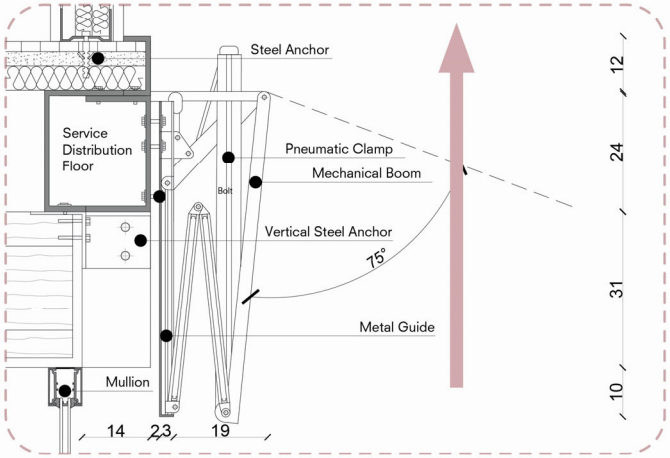


Envelope Concept

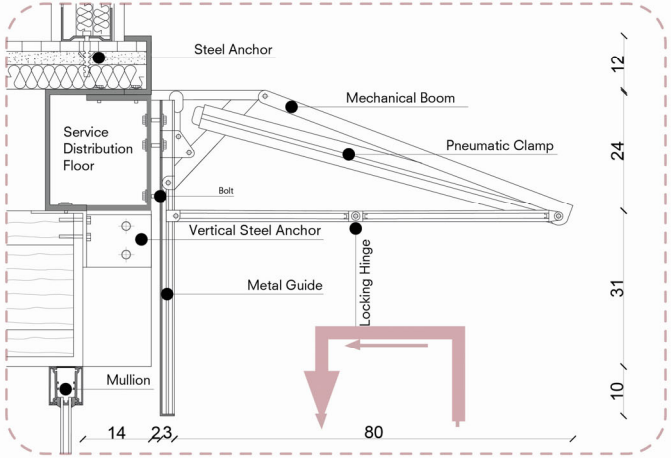
Fire Prevention System



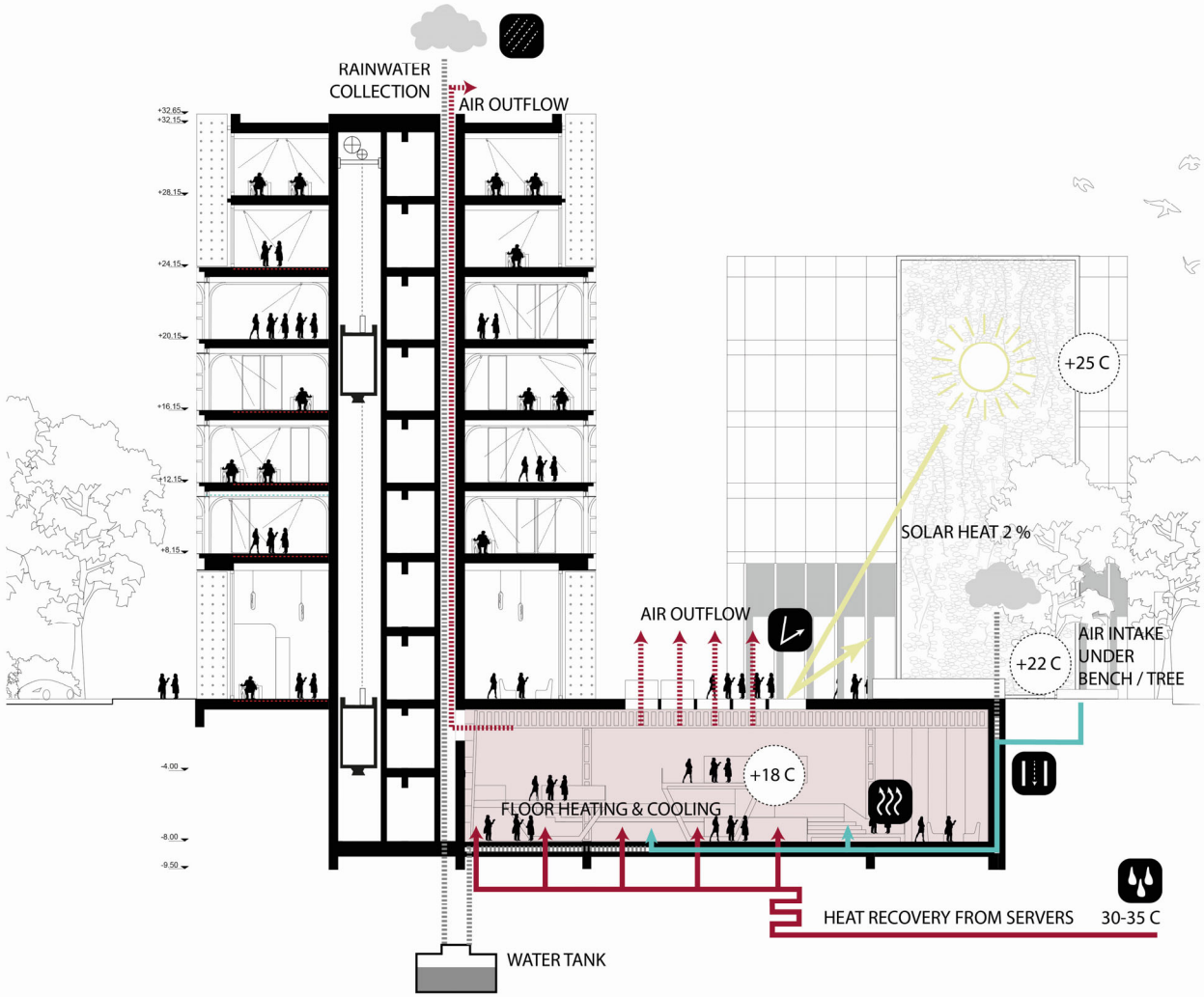
Fire Prevention System (regular time) 1:5



Fire Prevention System (during fire) 1:5

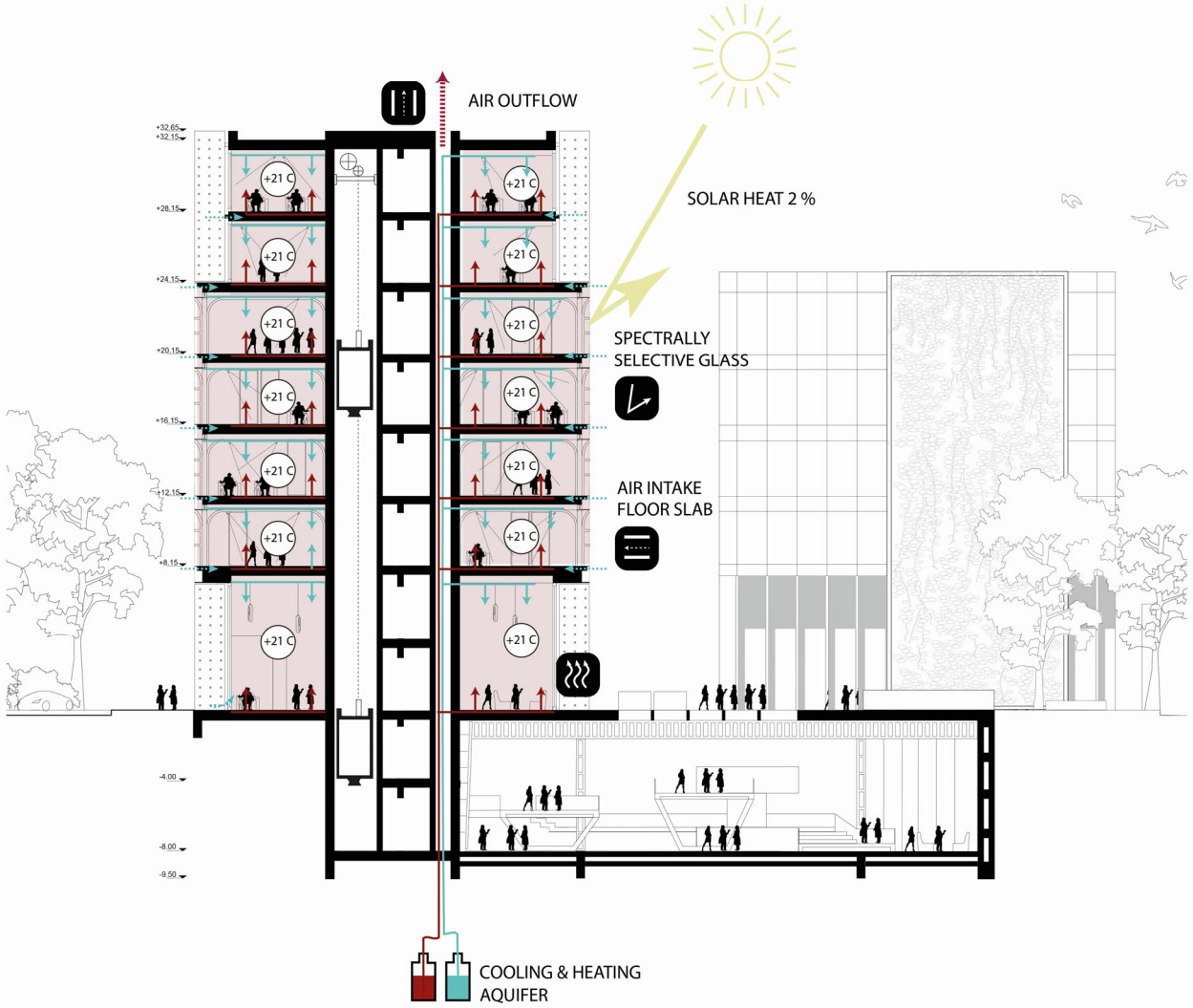


Receiver - Climate Zone 1 (Experience Center)



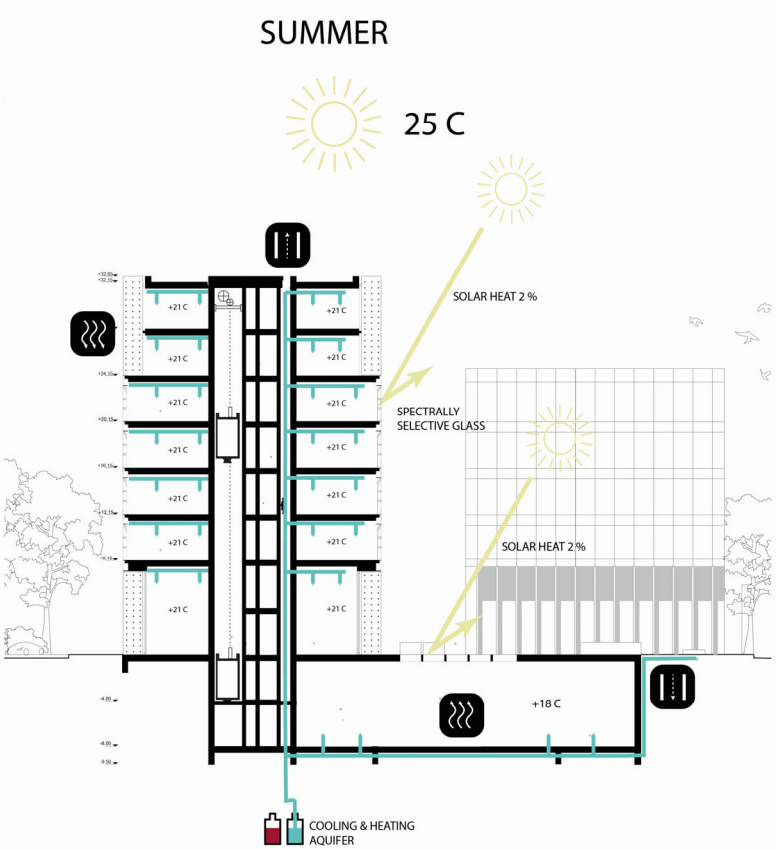
Receiver - Climate and Public Space Design

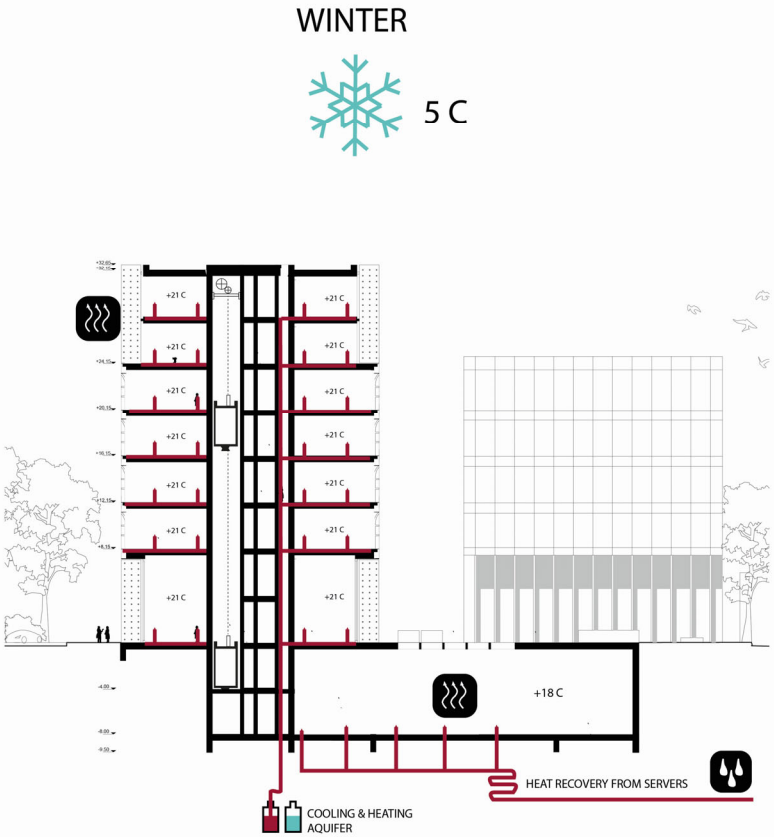
Receiver - Climate Zone 2 (Offices)



Receiver - Internal Shading System

Receiver - Summer & Winter





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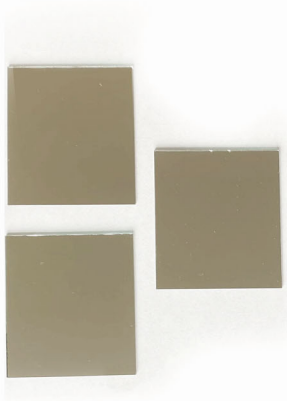
Study Model

Study Elements



3 x mirrors

experience center model

transmitter

Experience Center - Physical Model

Experience Center - User’s Perspective

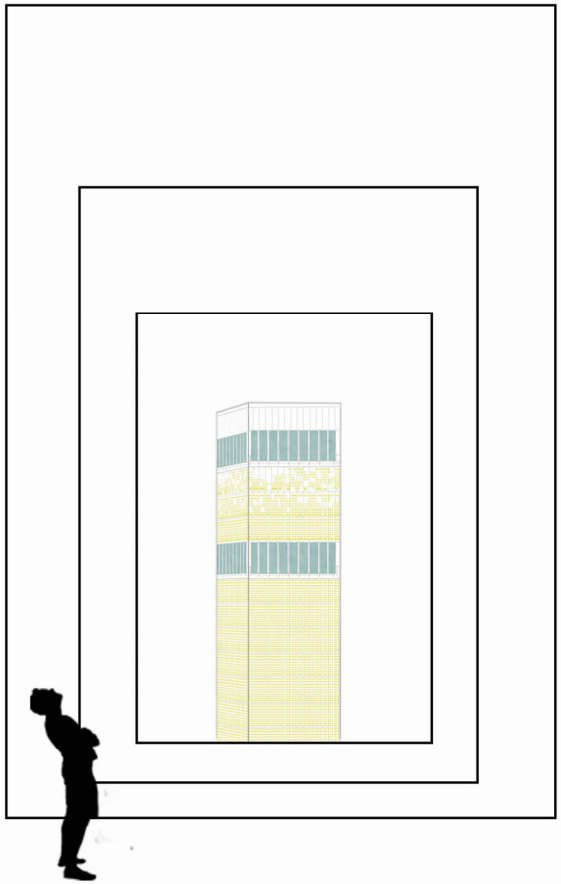
Mirrors & Reflection of Transmitter

Mirror #1

Mirror #2

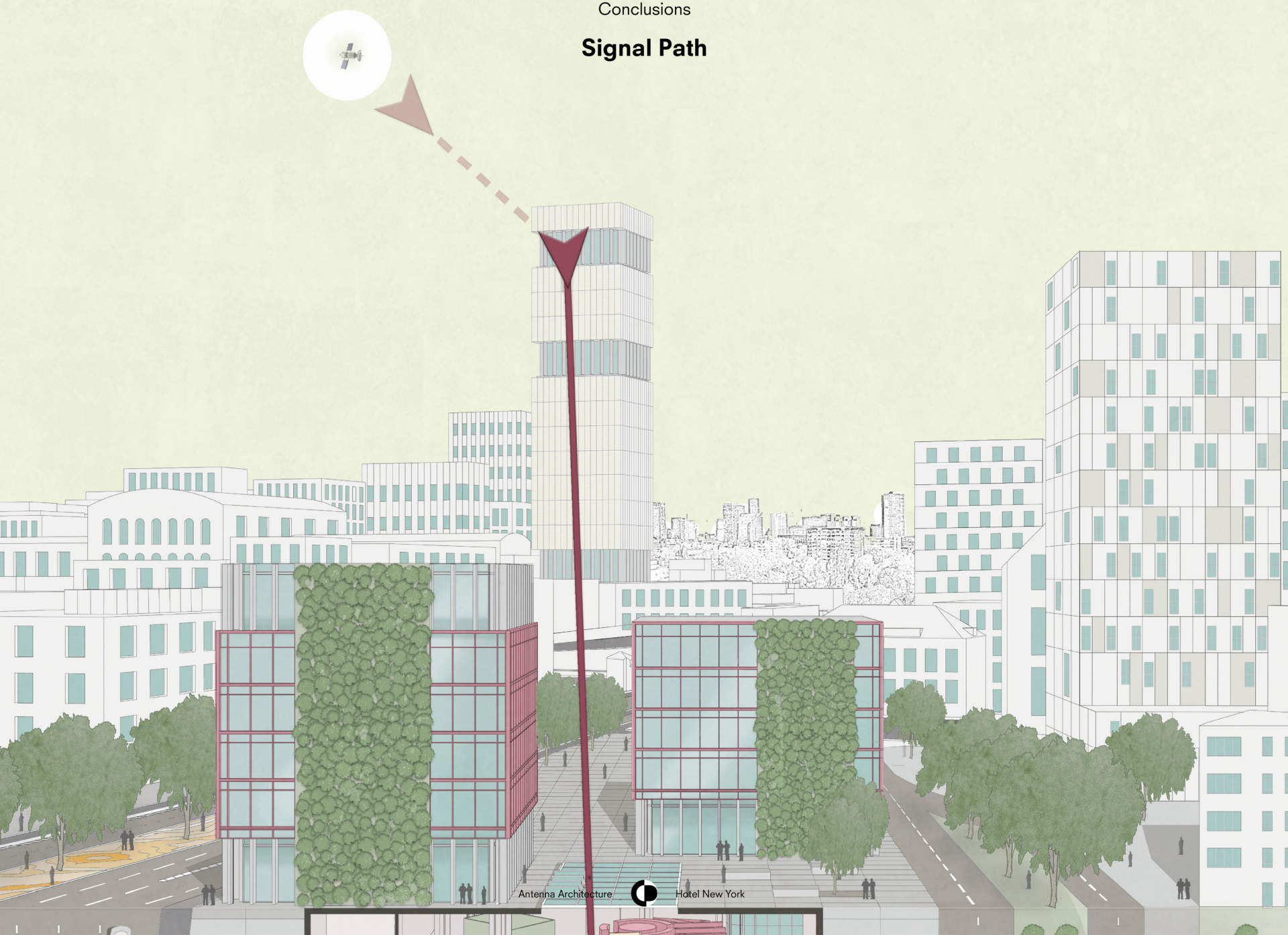
Mirror #3

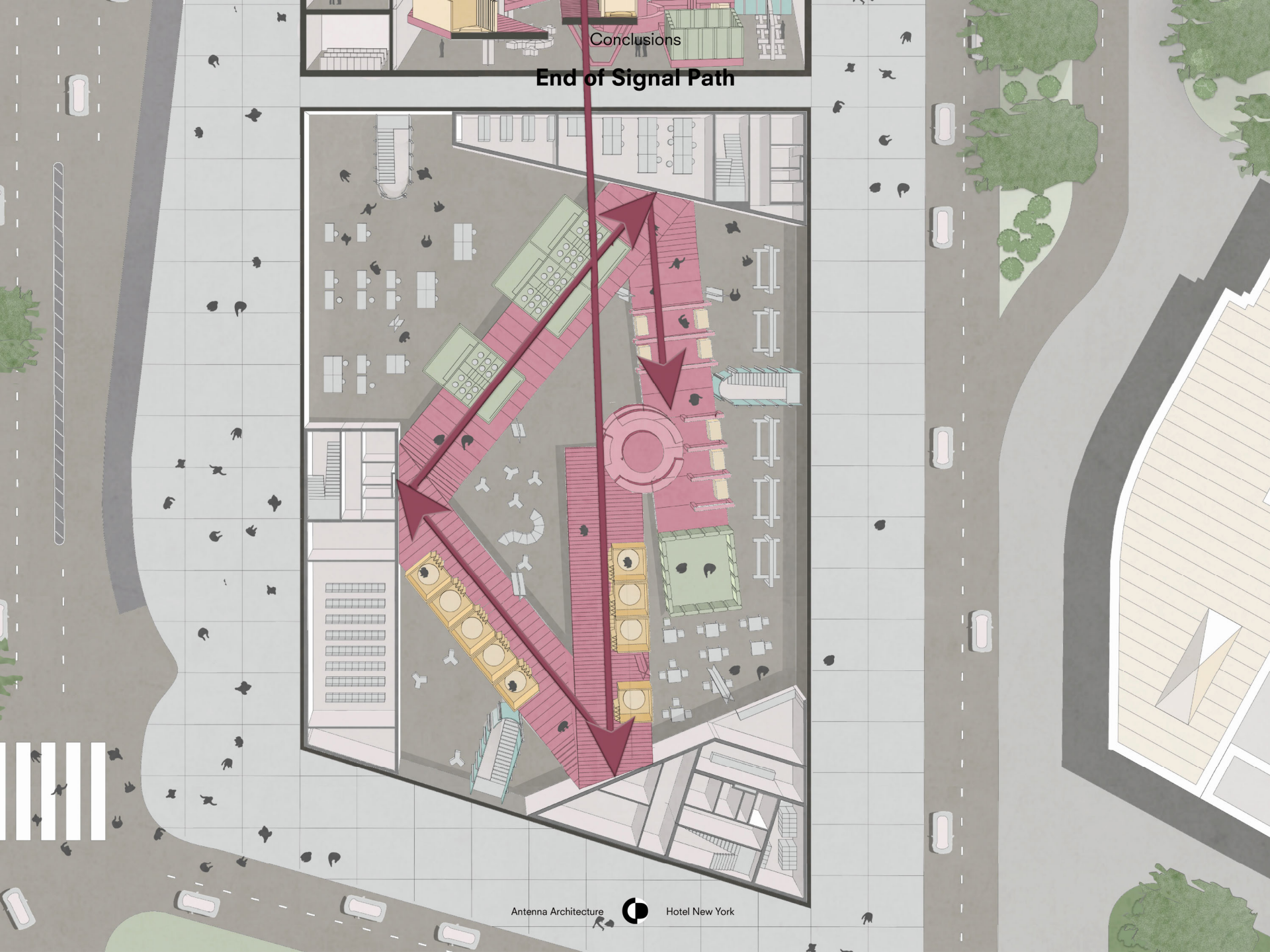
Promenade Architecturale



User's Experience

Signal Path




Conclusions
End of Signal Path
Antenna Architecture
Hotel New York

Research Result

(IN)VISIBLE

Research Result

(IN)VISIBLE

URBAN RELATION

Research Result

(IN)VISIBLE

URBAN RELATION

DISTRIBUTION OF FUNCTIONS

Research Result

(IN)VISIBLE

URBAN RELATION

DISTRIBUTION OF FUNCTIONS

MATERIAL REQUIREMENTS

Research Result

(IN)VISIBLE

URBAN RELATION

DISTRIBUTION OF FUNCTIONS

MATERIAL REQUIREMENTS

NEW TYPES OF ACTIVITIES & PROGRAM

THANK YOU.

complex projects