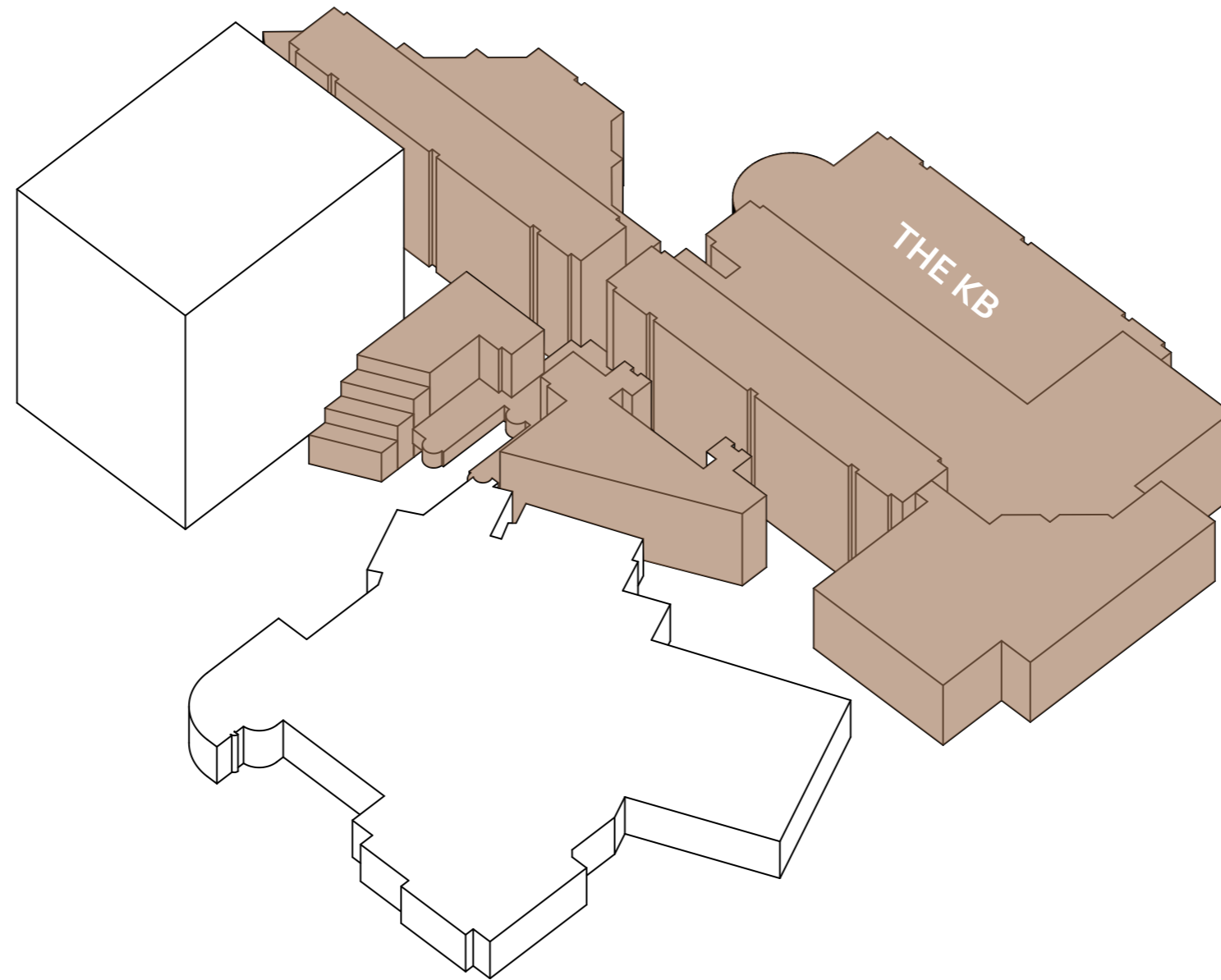


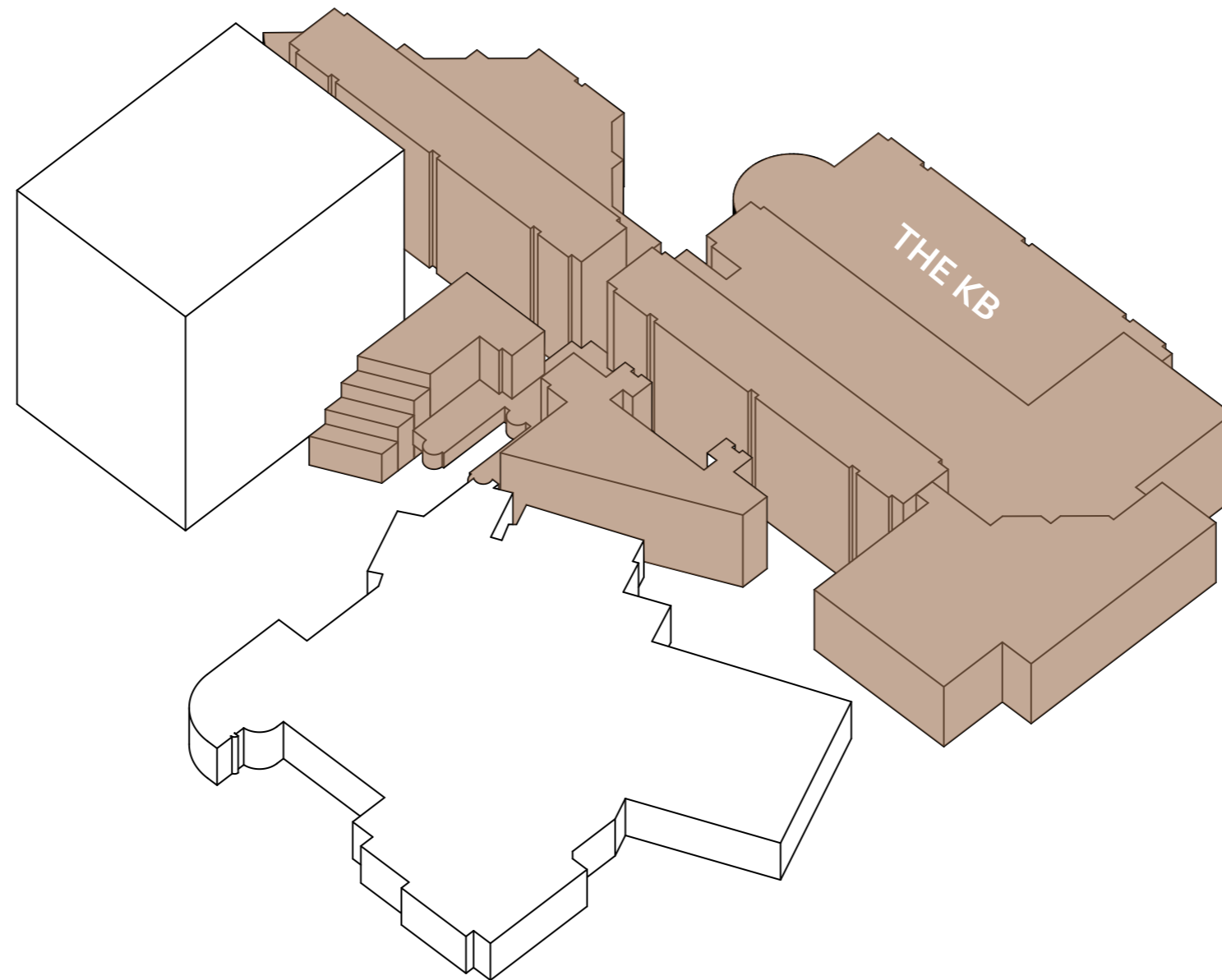
UNIVERSAL INCLUSIVITY

Designing for Senses



The Redesign of The National Library
of the Netherlands (KB), in The Hague

BEYOND SIGHT, BEYOND BARRIERS



Reimagining Library Spaces through **Multisensory Accessibility**

DESIGNING BEYOND SIGHT

*How would you navigate a space if all signs,
labels, and displays were gone?*

SOUND

Navigating a library space through audio-based digital guides, acoustic floor sensors, soundscapes.....



NAVIGATE SPACE THROUGH ORCHESTRATED
SOUNDSCAPES

LE CYLINDRE SONORE
By Bernhard Leitner

TOUCH

*Navigating a library space through textures,
interactive surfaces, embossed signage.....*



PROBLEM FIELD

Observation

Libraries frequently prioritize **visual design**, but what about those who experience the world differently?

PROBLEM FIELD

Observation

Can a library be truly *inclusive* if it only speaks to your *eyes*?

To welcome all users, it must become a space you can *feel*, hear, and move through intuitively.....



PROBLEM FIELD

Literature

“When it comes to the culture of architecture and design, we create and produce almost ***exclusively*** for one sense:the **visual.**”

- Lupton & Lipps (2018)

PROBLEM FIELD

Literature

“We **look** at design, we don’t **feel**, experience or **sense** it”

- Lupton & Lipps (2018)



Lupton, E., & Lipps, A. (Eds.). (2018). The senses: Design beyond vision. Chronicle Books.

RELEVANCE

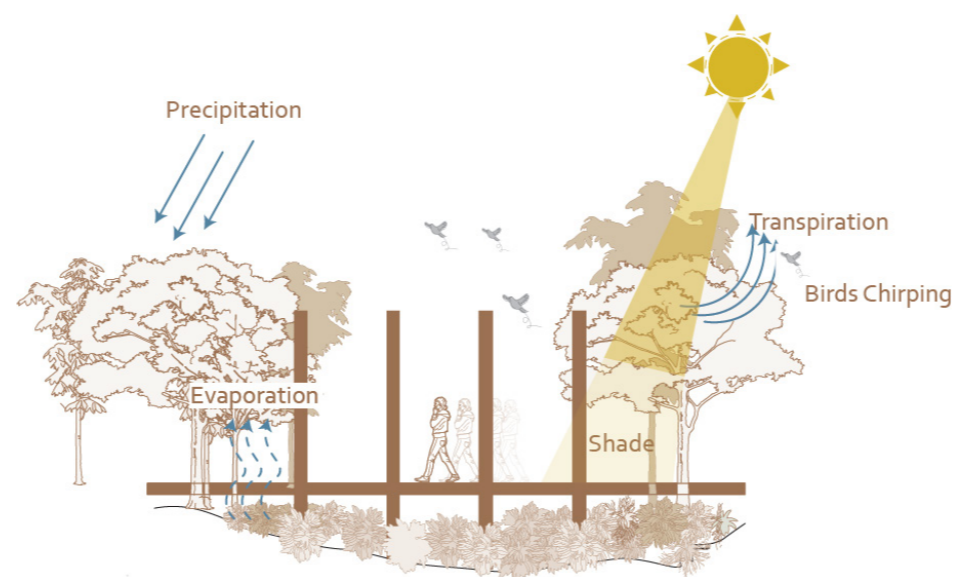
01 RISING NUMBERS



With over **330,000** blind and visually impaired people in the Netherlands, designing for the senses is **not optional, it's necessary** (Koninklijke Visio, n.d.).

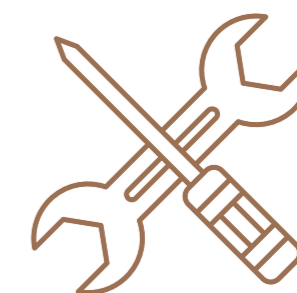
Koninklijke Visio. (n.d.). Over toegankelijkheid. <https://www.visio.org/professional/toegankelijkheid/over-toegankelijkheid/>

02 SENSORY QUALITIES



The **sensory atmosphere** is felt before it is seen: It is fundamental to comfort, well-being, and **spatial quality**.

03 TOOL FOR DESIGN



Inclusivity can be a **design tool**: Inclusive, **multisensory design enhances** comfort and well-being for **all**.

THE NATIONAL LIBRARY?

CONTENT

21. **RESEARCH**
Main question and sub questions
24. **RESEARCH METHODS**
Design framework
27. **OBSERVATIONS**
Barriers Site and Building
37. **RESEARCH TO DESIGN**
Design Concept
41. **HERITAGE VALUES**
Past Informing Present
62. **PROGRAM**
New proposal
66. **MASTERPLAN**
Sensory Spine and Site
73. **ARCHITECTURE IN LAYERS**
Facade, details, comfort & climate

THE NATIONAL LIBRARY (KB)

Building - 1982



Image by: De Architect

THE NATIONAL LIBRARY (KB)

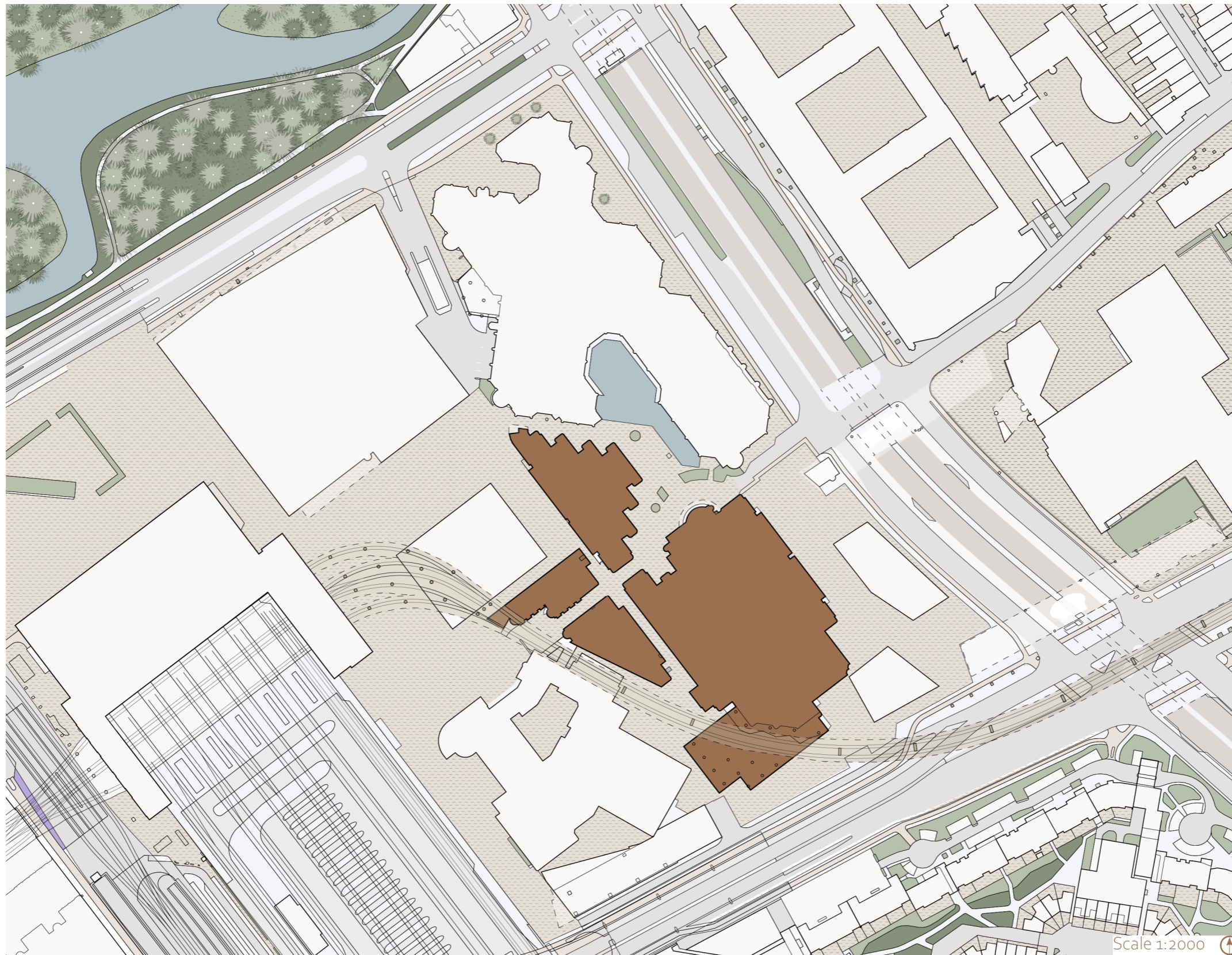
Building - 2018



Image by: Gemeente Den Haag

THE NATIONAL LIBRARY (KB)

Site - Context

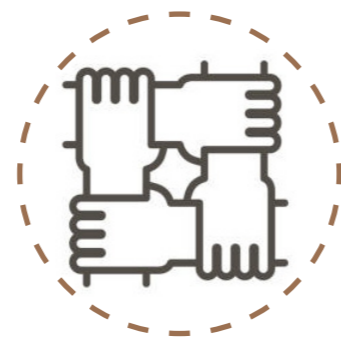


THE NATIONAL LIBRARY (KB)

Core Values



OPEN



UNIFYING



INNOVATIVE



RELIABLE

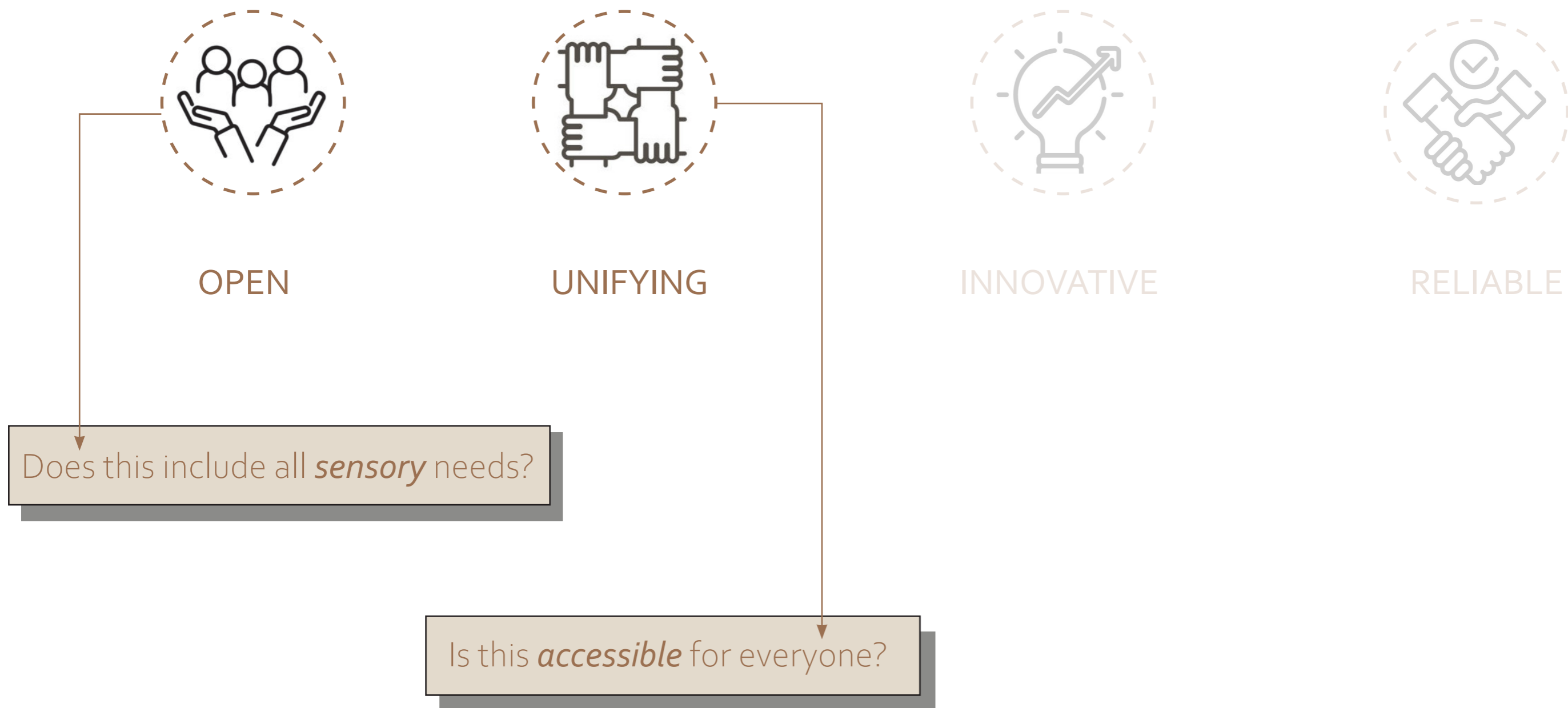
“

“We care for the written word, especially the Dutch publications, and enable *everyone* to read, learn and do research.”

- KB

THE NATIONAL LIBRARY (KB)

Core Values



THE NATIONAL LIBRARY (KB)

Core Values



OPEN



UNIFYING



INNOVATIVE



RELIABLE



INCLUSIVE



ACCESSIBLE

RESEARCH

Main Question

Main question:

“How can libraries be redesigned as resilient environments that foster **social inclusivity** and **user engagement** by integrating **multisensory accessibility** into their physical spaces?”

Sub questions:

1. “What sensory and spatial **accessibility barriers** do visually impaired users face in libraries?”
2. “How can multisensory accessibility be effectively integrated into library environments to enhance **social inclusivity** and **user engagement**?”

MULTISENSORY ACCESSIBILITY

Definition

- **MULTISENSORY =**

mul·ti·sen·so·ry | [məl-tē-sen(t)-sə-rē] *adjective*

“relating to or involving several physiological senses”

- Merriam-Webster Dictionary (n.d.)

- **ACCESSIBLE =**

ac·ces·si·ble | [ik-se-sə-bəl] *adjective*

“easily used or accessed by people with disabilities : adapted for use by people with disabilities”

- Merriam-Webster Dictionary (n.d.)

MULTISENSORY ACCESSIBILITY

Definition - based on research

- **MULTISENSORY ACCESSIBILITY =**

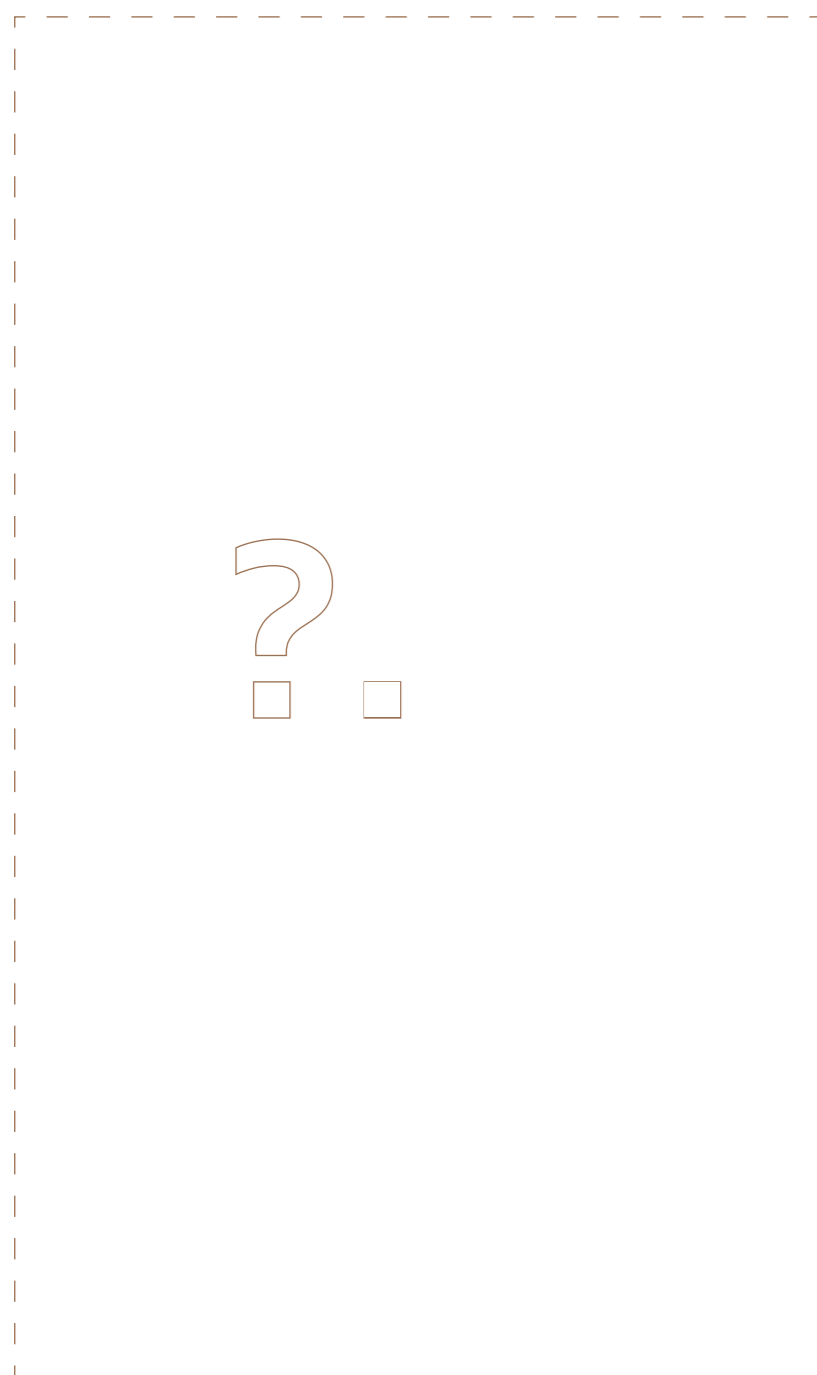
“Multisensory accessibility involves designing environments or experiences that engage **multiple senses**—such as auditory, visual, and tactile—ensuring spaces are **inclusive** and **accessible** to all users, particularly those with **diverse sensory needs**.”

RESEARCH METHODS

Design Framework

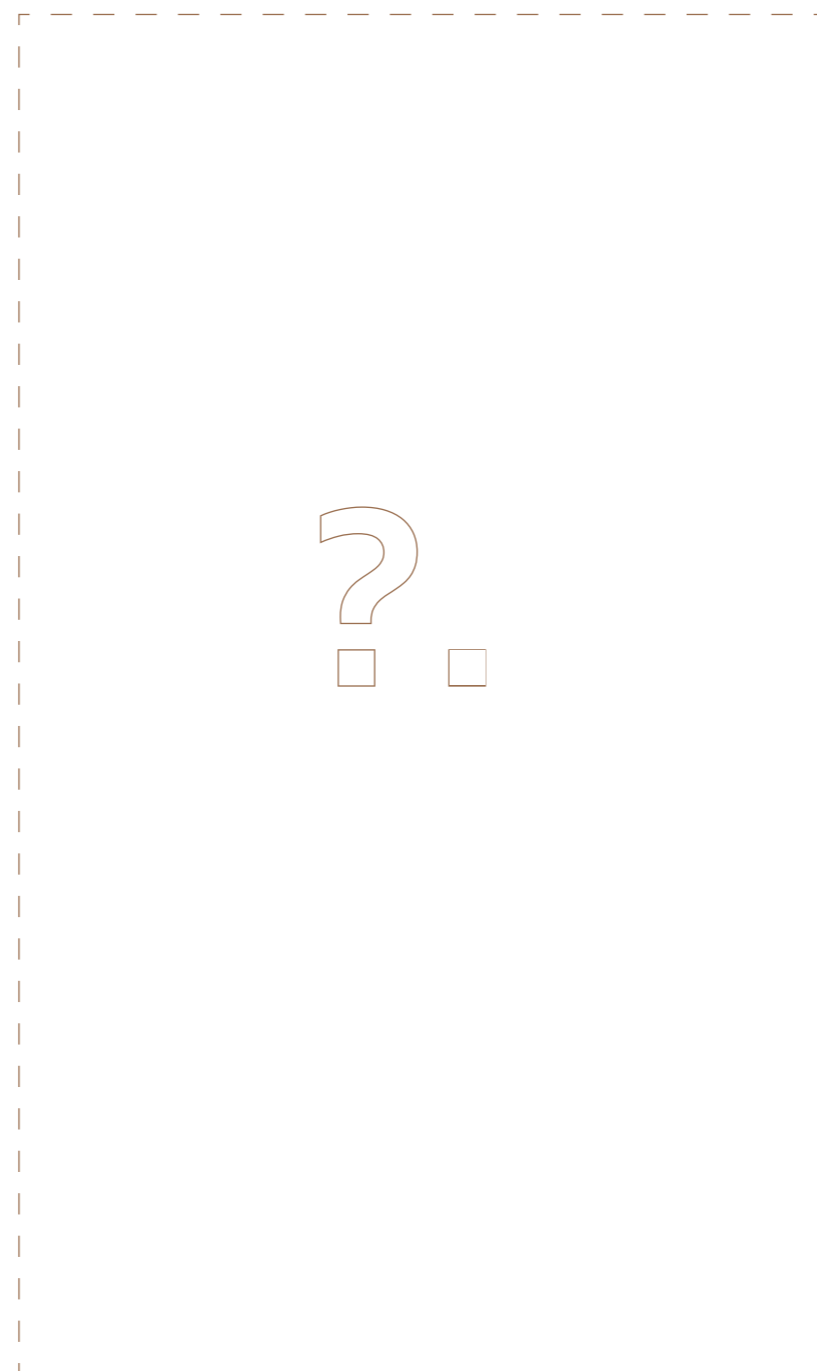
WHAT

Identifying the Problem/Barriers



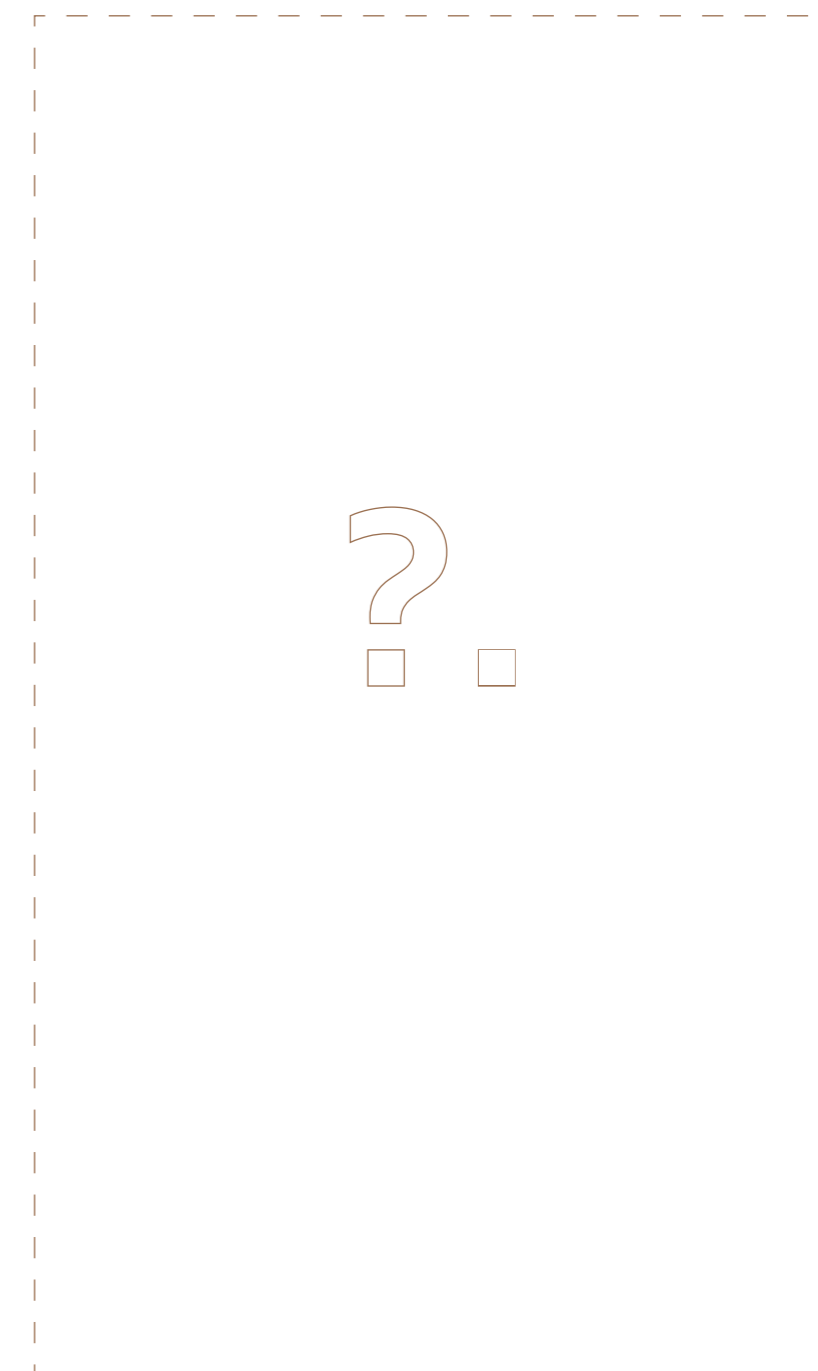
HOW

Proposed Design Solution(s)



WHY

Justifying the Intervention



RESEARCH METHODS

Design Framework

WHAT

Identifying the Problem/Barriers

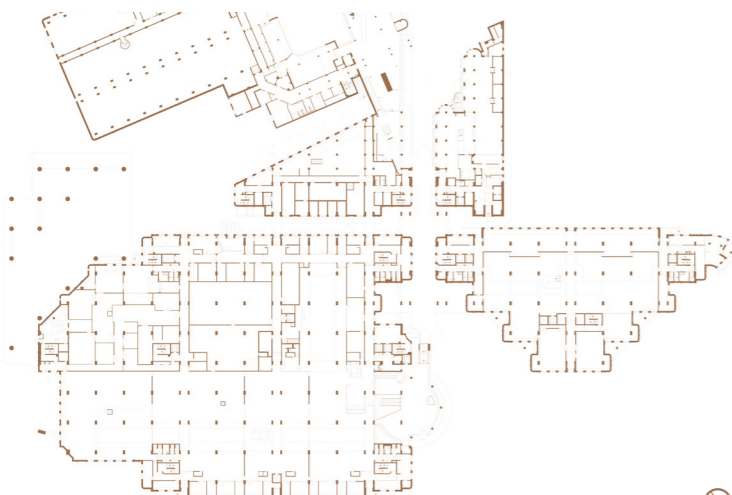
HOW

Proposed Design Solution(s)

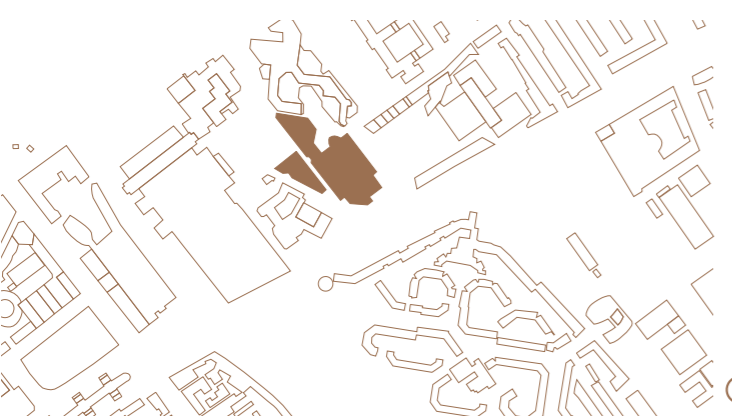
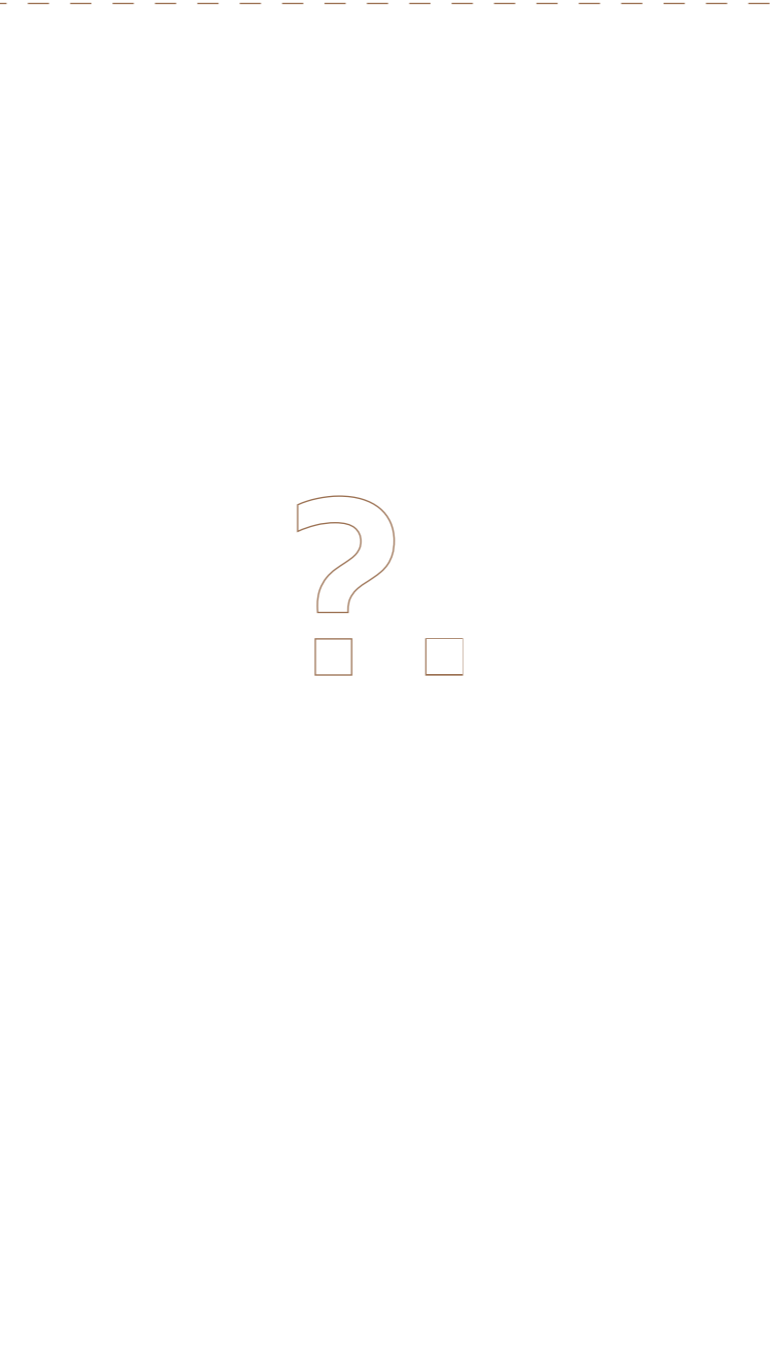
WHY

Justifying the Intervention

1. BUILDING OBSERVATIONS



2. SITE OBSERVATIONS


1. CASE STUDY ANALYSIS

Libraries		
- Multisensory Elements		
- Inclusivity & Accessibility		

+

2. LITERATURE REVIEW

Multisensory	Design
Barriers Visually	Impaired Users
Accessibility in	Libraries



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73. **ARCHITECTURE IN LAYERS**
Facade, details, comfort & climate

RESEARCH METHODS

Design Framework

WHAT

Identifying the Problem/Barriers

HOW

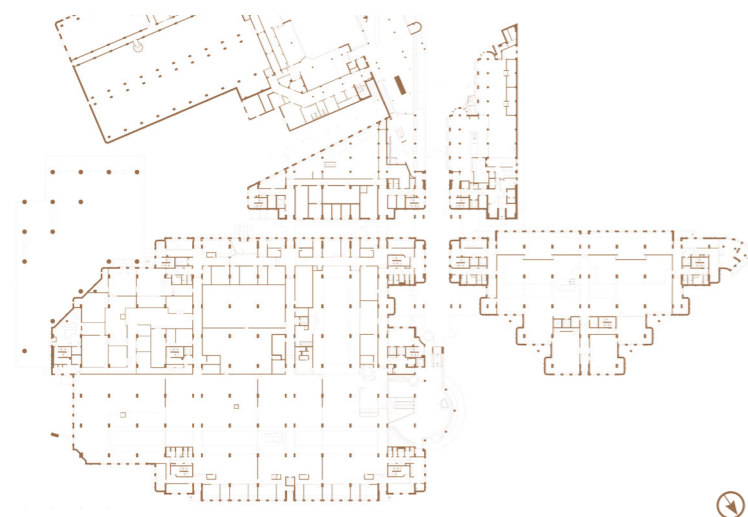
Proposed Design Solution(s)

WHY

Justifying the Intervention

1.

BUILDING OBSERVATIONS



2.

SITE OBSERVATIONS



1.

CASE STUDY ANALYSIS

Libraries		
- Multisensory Elements		
- Inclusivity & Accessibility		



2.

LITERATURE REVIEW





Multisensory	Design
Barriers Visually	Impaired Users
Accessibility in	Libraries

URBAN CONTEXT

Barriers and Pedestrian flows



PEDESTRIAN CIRCULATION

-  Barriers
-  Primary circulation
-  Secondary circulation
-  Pedestrian density

Observational study
 Time: 14:15 - 16:30
 Frequency visits: 5x
 (Weekdays)

Scale: 1 to 1500

BARRIERS SITE

Observations



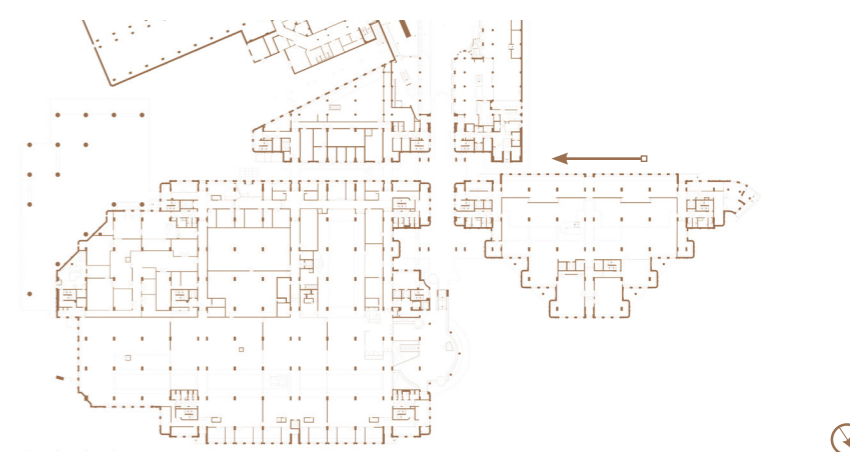
IRREGULAR PAVEMENT CONDITIONS



ABSENCE OF TACTILE PAVEMENT



DARK CORNERS AND ALLEYS



BARRIERS SITE

Observations



CONFUSING ARRIVAL MOMENT



LOW ENTRANCE VISIBILITY



HIDDEN MAIN ENTRANCE



BARRIERS BUILDING

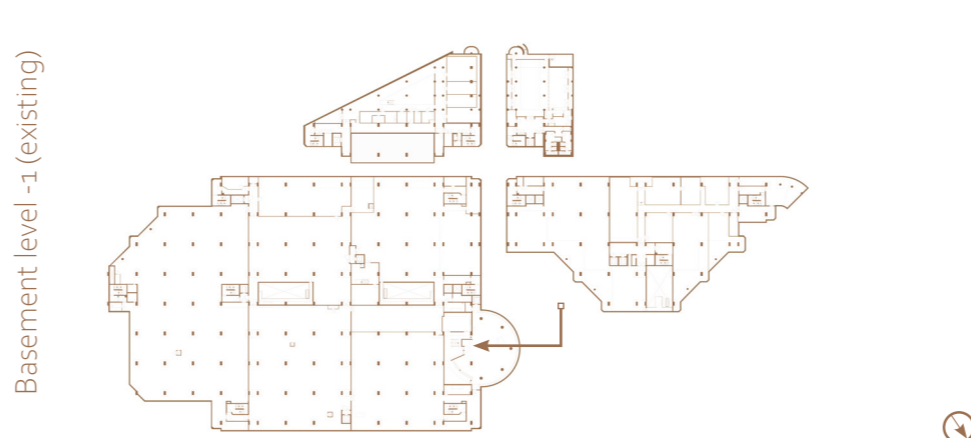
Observations



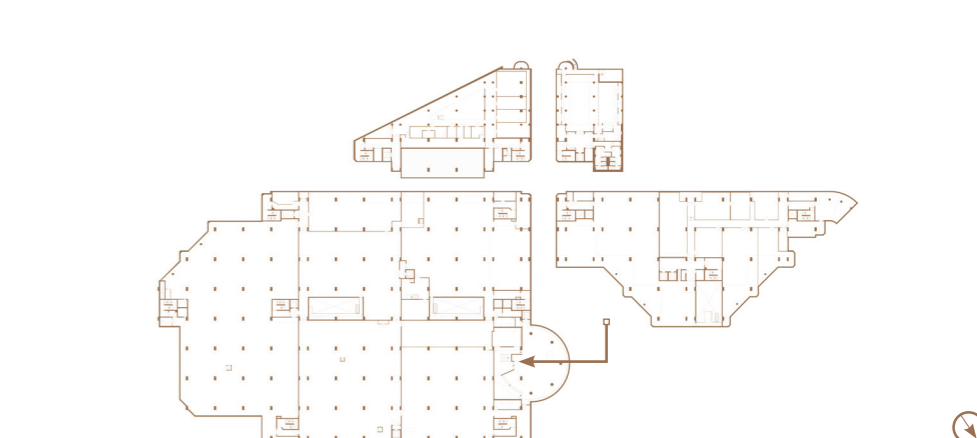
NARROW ENTRYWAYS



LEVEL CHANGES INSIDE



ACCESSIBILITY BARRIERS



RESEARCH METHODS

Conclusion - What

WHAT

Identifying the Problem

Barriers visually impaired:

- Irregular layouts
 - Strong Reliance Visuals
 - Overstimulating Environments
 - Fragmented Circulation patterns
- (Deines-Jones, 2007; Goldsmith, 1997; Visio, n.d.)



Barriers KB:

- Fragmented Zoning and Circulation
- Poor Wayfinding
- Lack of Intuitive Spatial Flow
- Lacks Tactile Cues,
- Lack of Sensory midway-points
- Lack of a Coherent structure

Site

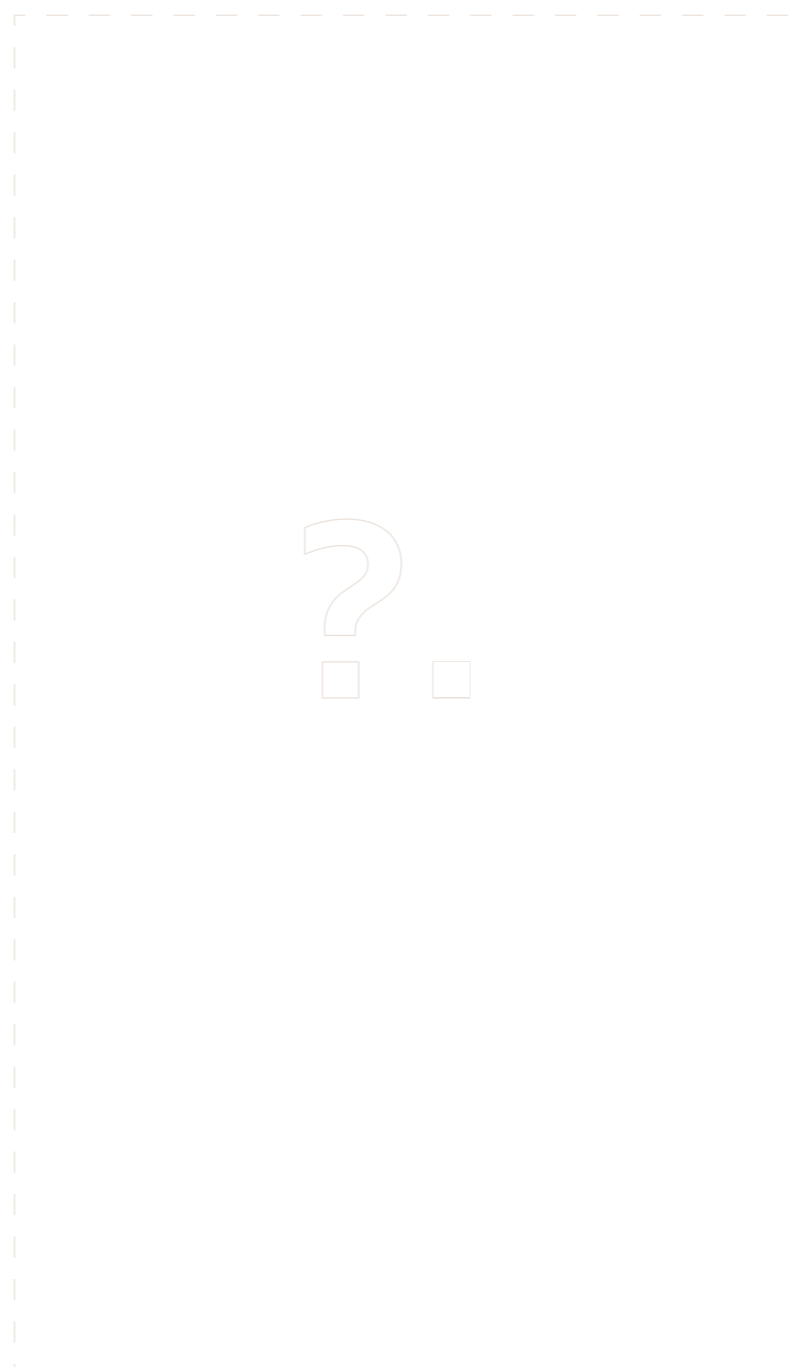
- Irregular Pavement Conditions
- Absence of Tactile Pavements
- Dark Corners and Alleyways
- Entrance not Clear/Visible



-> overall **Disorganized Environment**

HOW

Proposed Design Solution(s)



WHY

Justifying the Intervention

1.

CASE STUDY ANALYSIS

Libraries	
- Multisensory Elements	
- Inclusivity & Accessibility	



2.

LITERATURE REVIEW

Multisensory	Design	
Barriers Visually	Impaired Users	
Accessibility in	Libraries	

Deines-Jones, C. (Ed.). (2007). Improving library services to people with disabilities. Elsevier.
 Goldsmith, S. (1997). Designing for the disabled. London: Architectural Press.
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RESEARCH METHODS

Design Framework

WHAT

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WHY

Justifying the Intervention

1.

CASE STUDY ANALYSIS

Libraries	
- Multisensory Elements	
- Inclusivity & Accessibility	



2.

LITERATURE REVIEW



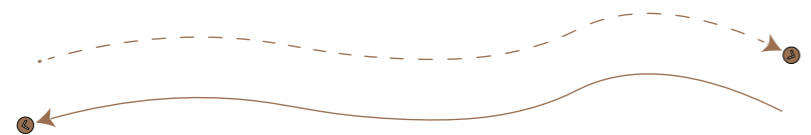
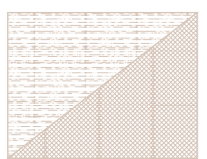
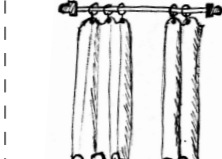
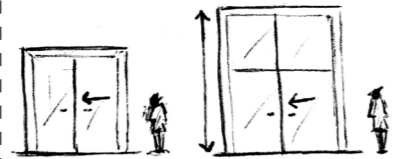
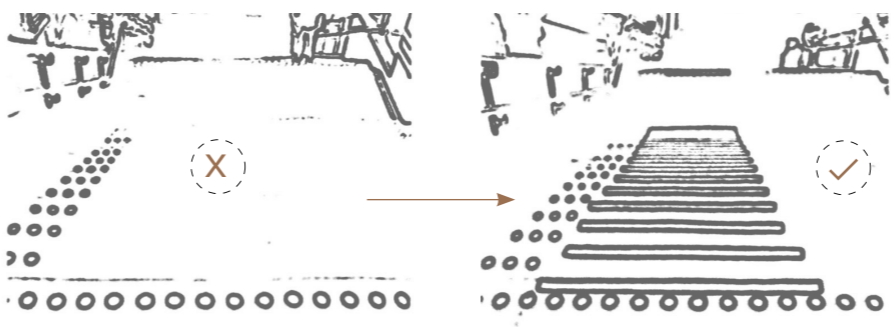

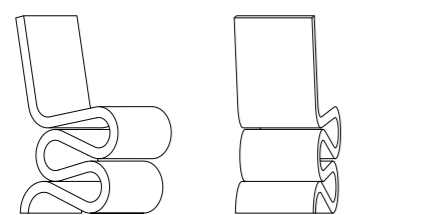
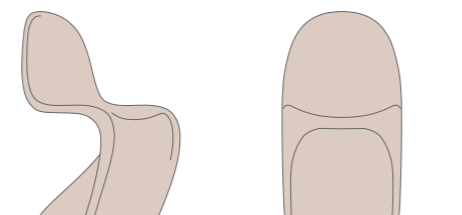
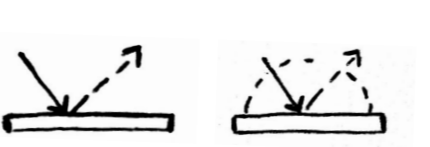
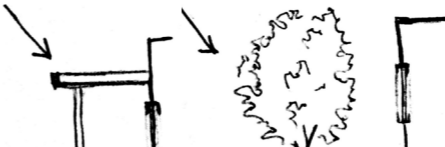
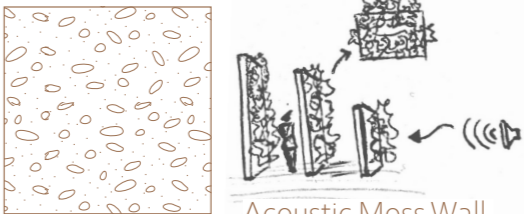

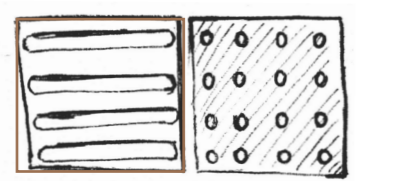
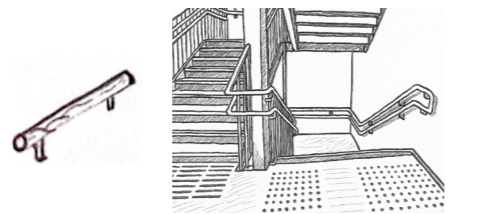


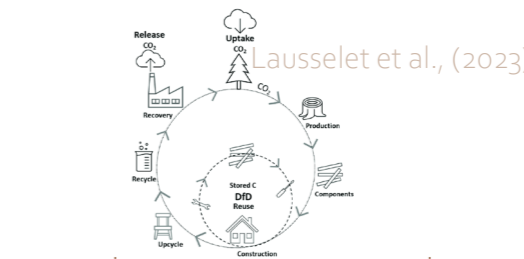
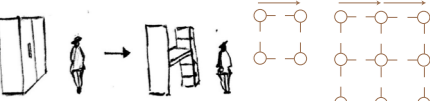
Multisensory	Design
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RESEARCH SUMMARY

Conclusion - Why

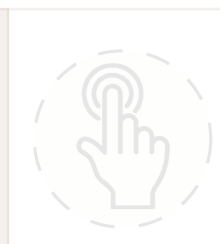
FROM RESEARCH TO DESIGN: STRATEGIES

	<p>Category 1:</p> <h3>Touch - Tactility</h3>		<p>Category 3:</p> <h3>Multisensory Elements</h3>
<p>1.1 Surfaces of Movement</p>  <p>Continuous Uninterrupted Pathways</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="207 850 400 1113">  <p>Material transitions</p> </div> <div data-bbox="445 850 652 1113">  <p>Soft partitions</p> </div> <div data-bbox="712 850 1083 1113">  <p>Higher entrance: spatial anticipation</p> </div> </div>	<p>2.1 Tactile Contrast</p>  <p>Jordans et al., (2012)</p> <p>Continuous tactile markers on stair treads enhance tactile and visual legibility</p>	<p>3.1 Greenery and Scent Expression</p>  <p>Ensure fragrance-free zones for allergies</p> <p>Biodiversity in greenery with subtle aromas enhance sensory richness and microclimate conditions</p> <p>Natural scent sources in materials (e.g., wood, bamboo, soil)</p>	
<p>1.2 Surfaces of Rest</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="207 1249 608 1585">  <p>Soft furnishings with rounded corners</p> </div> <div data-bbox="652 1249 1083 1585">  <p>Warm materials, tactile-friendly finishes</p> </div> </div>	<p>2.2 Controlled Light</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="1142 1270 1543 1585">  <p>Matte/textured surfaces help diffuse reflected light</p> </div> <div data-bbox="1573 1270 1988 1585">  <p>External shading devices help reduce glare</p> </div> </div>	<p>3.2 Sound and Comfort</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="2033 1260 2522 1585">  <p>Acoustic Moss Wall</p> <p>Sound-absorbing materials and surfaces for acoustic comfort</p> </div> <div data-bbox="2552 1260 2953 1585">  <p>Soft rustling of leaves</p> <p>Natural auditory cues to create calm sound layers</p> </div> </div>	
<p>1.3 Surfaces of Orientation</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="222 1711 608 2026">  <p>Tactile floor markers guiding movement</p> </div> <div data-bbox="638 1701 1083 2026">  <p>Continuous rounded railings and tactile wall markers</p> </div> </div>	<p>2.3 Color and Contrast</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="1127 1743 1543 1900">  <p>Secondary doors Main entrances</p> <p>Highlight important areas through controlled use of color, contrast, reflection</p> </div> <div data-bbox="1573 1701 1988 2068"> <p>LRV: 10 (low) LRV: 25-30</p>  <p>Dark, glossy floor = depth confusion Light, matte floor > comfort</p> <p>Matte, light surfaces create clear, comfortable paths</p> </div> </div>	<p>3.3 Materiality and Resilience</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="2033 1701 2522 2068">  <p>Lausanne et al., (2023)</p> <p>Renewable, tactile materials: age gracefully, durable and enhance long-term sensory comfort</p> </div> <div data-bbox="2552 1764 2953 2068">  <p>Modular and demountable system for flexible reconfiguration and reuse</p> </div> </div>	

RESEARCH SUMMARY

Conclusion - Focus point

FROM RESEARCH TO DESIGN: STRATEGIES



Touch - Tactility



Visual Legibility



Multisensory Elements

1.1

Continuous Uninterrupted Pathways

Material transitions

Soft partitions

Higher entrance: spatial anticipation

2.1

Jordans et al., (2012)

Continuous tactile markers on stair treads enhance tactile and visual legibility

3.1

Ensure fragrance-free zones for allergies

Biodiversity in greenery with subtle aromas enhance sensory richness and microclimate conditions

Natural scent sources in materials (e.g., wood, bamboo, soil)

1.2

Soft furnishings with rounded corners

Warm materials, tactile-friendly finishes

2.2

Matte/textured surfaces help diffuse reflected light

External shading devices help reduce glare

3.2

Acoustic Moss Wall

Sound-absorbing materials and surfaces for acoustic comfort

Soft rustling of leaves

Natural auditory cues to create calm sound layers

1.3

Tactile floor markers guiding movement

Continuous rounded railings and tactile wall markers

2.3

Secondary doors Main entrances

Highlight important areas through controlled use of color, contrast, reflection

LRV: 10 (low) Dark, glossy floor = depth confusion

LRV: 25-30 Light, matte floor > comfort

Matte, light surfaces create clear, comfortable paths

3.3

Lausanne et al., (2023)

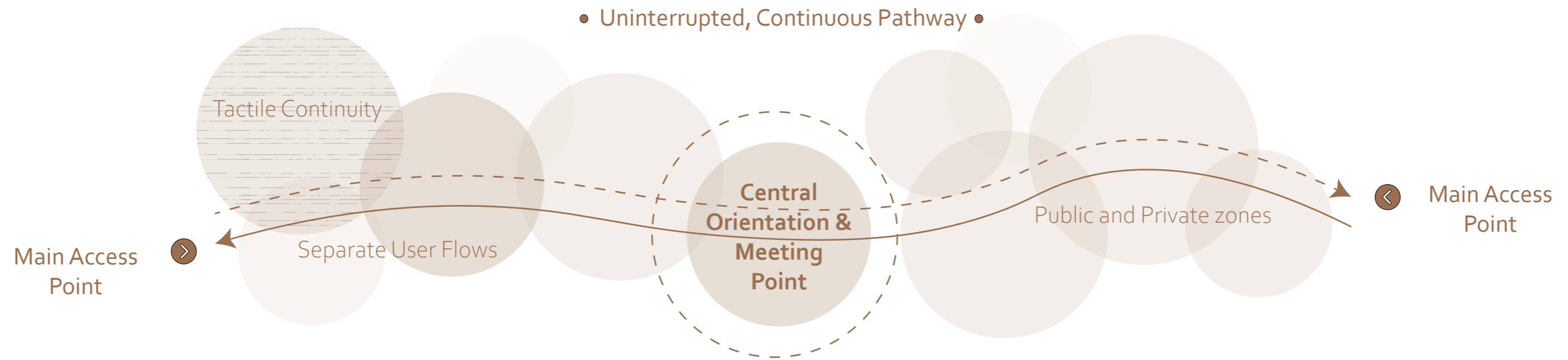
Renewable, tactile materials: age gracefully, durable and enhance long-term sensory comfort

Modular and demountable system for flexible reconfiguration and reuse

DESIGN CONCEPT

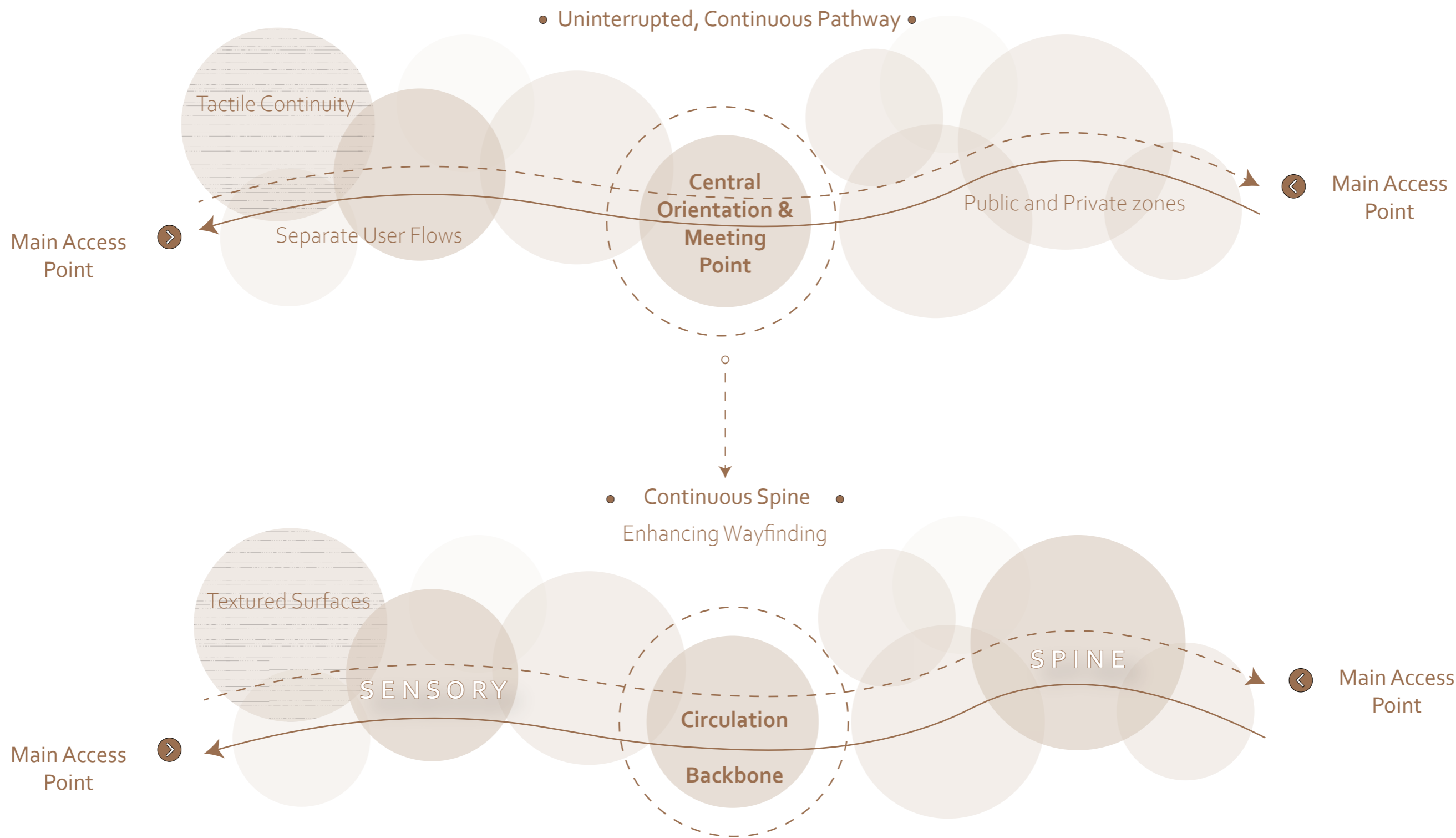
CORE STRATEGY

Derived from Research



CORE STRATEGY

Derived from Research



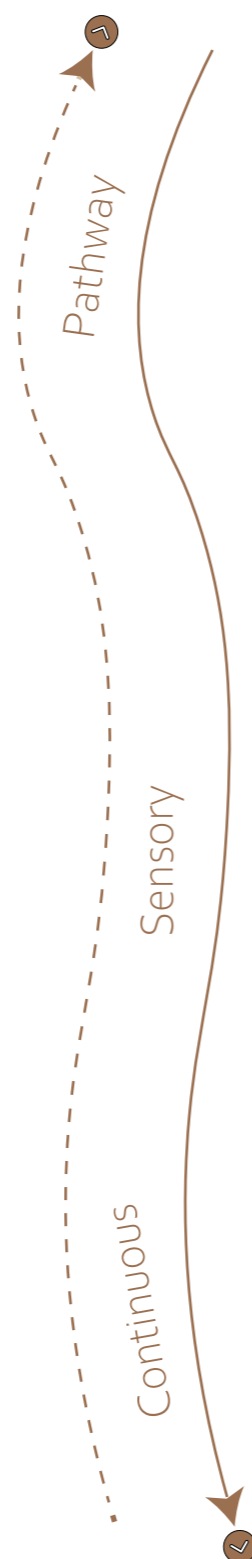
THE SENSORY SPINE

Definition

HUMAN SPINAL CORD



SENSORY SPINE



• THE 'SENSORY SPINE' =

“The Sensory Spine forms the **backbone** of the building. It serves as the main, **uninterrupted circulation route** throughout the building, facilitating intuitive wayfinding and spatial orientation, particularly for - but not limited to - visually impaired individuals. Similar to the spinal cord, that conveys sensory information to the human brain, the Sensory Spine acts as an **architectural core** that regulates sensory experiences.”

HERITAGE VALUES

EXISTING HERITAGE VALUES

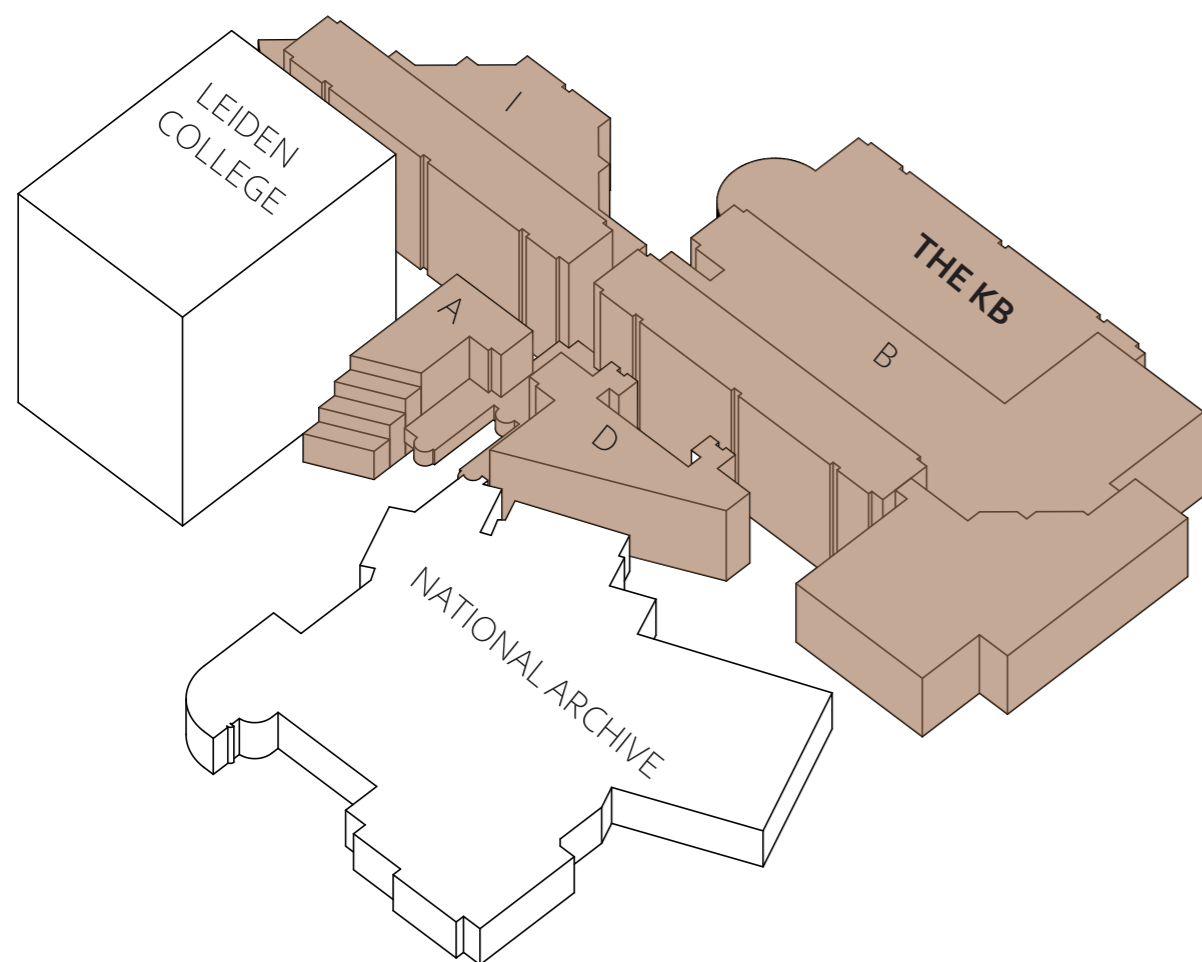
Group Value Assessment

“Our heritage is our inheritance - what the **past** has conceded to us, what we value in the **present** and what we choose to preserve for **future** generations.”

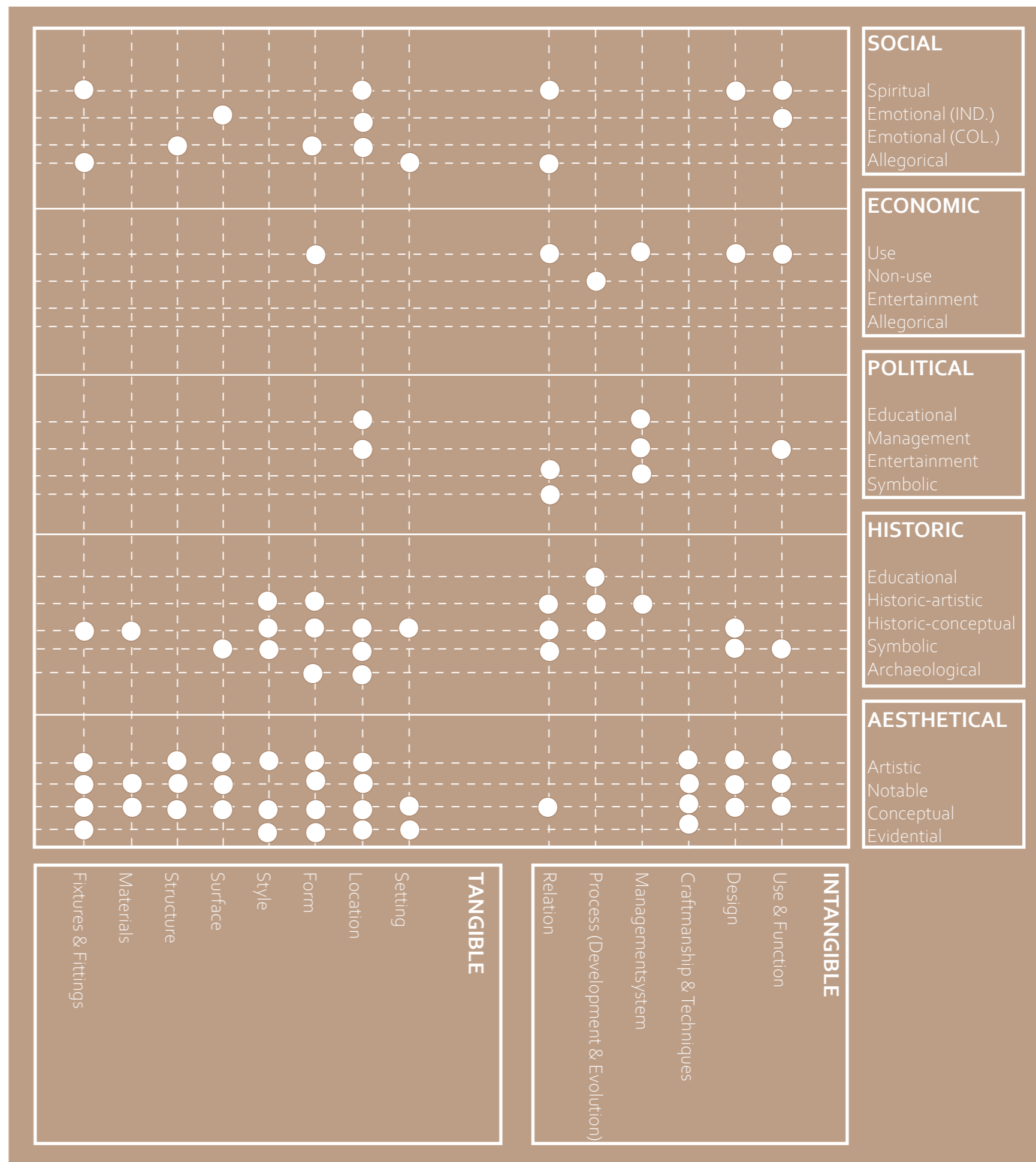
-Heritage Council, IE (2020)

Our heritage:

- **Tangible:** historical sites, buildings, monuments, artefacts.
- **Natural:** landscapes, waterways, wildlife.
- **Intangible:** customs, music, crafts, traditions.



The Heritage Council.(2020). What we do. <https://www.heritagecouncil.ie/about/what-we-do>

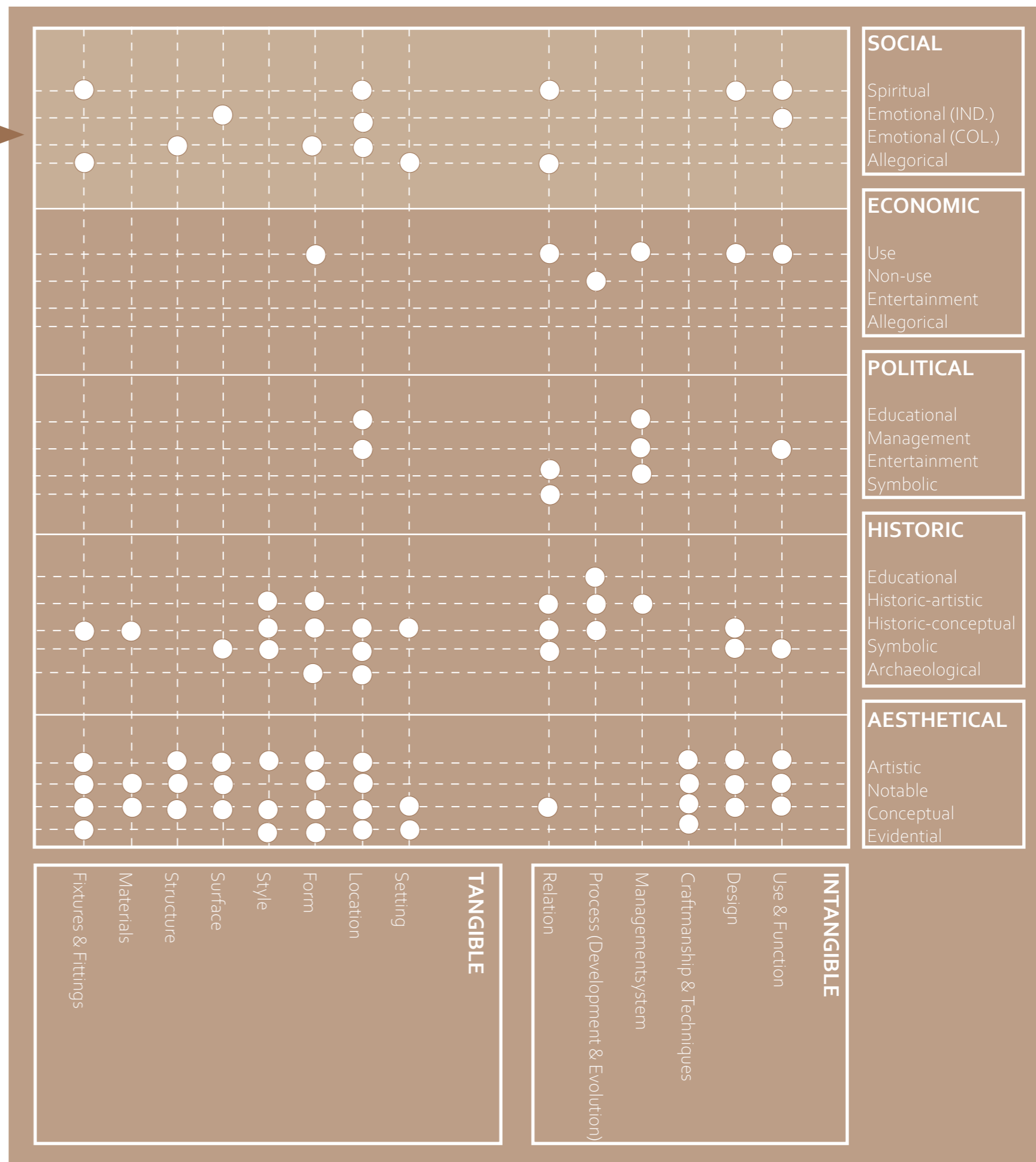
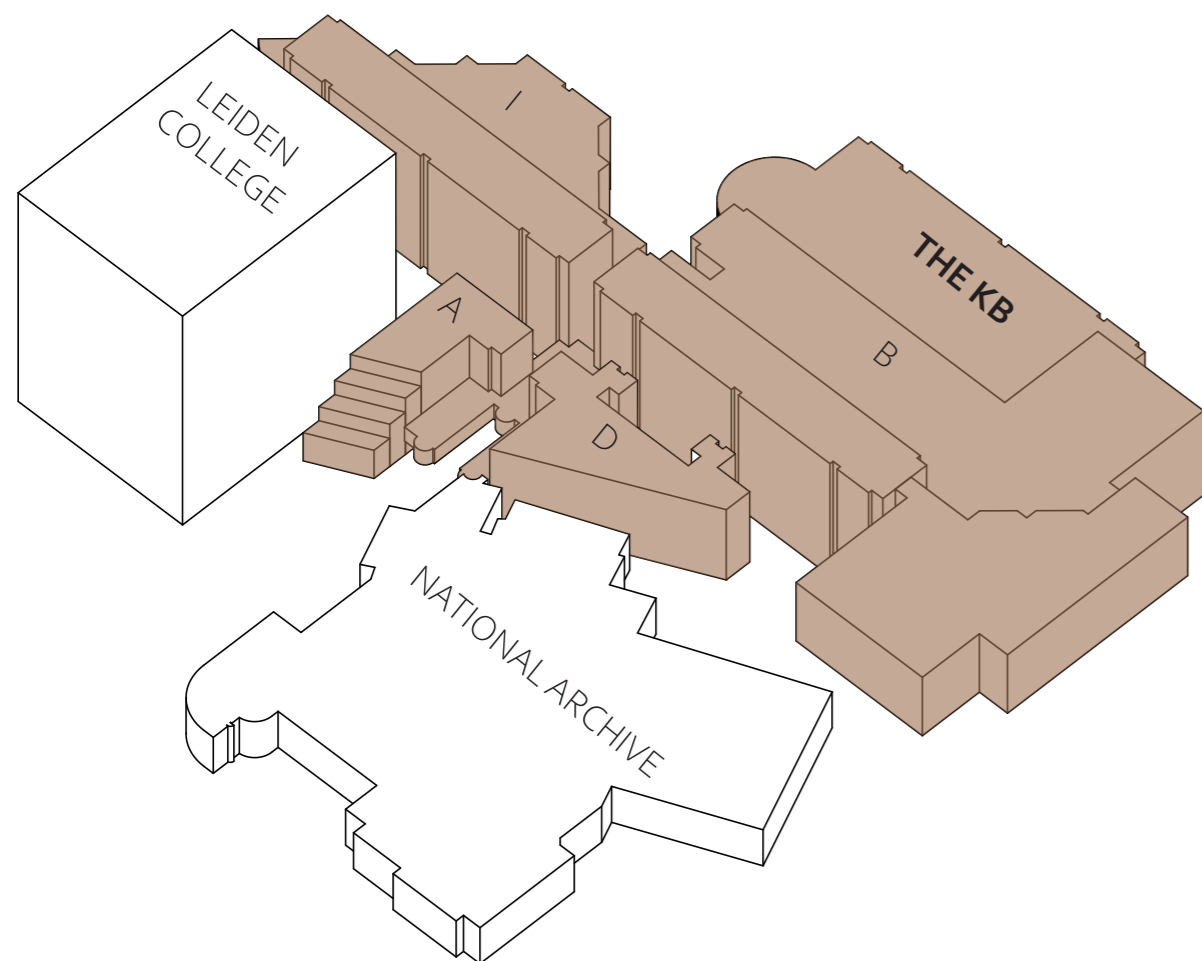


EXISTING HERITAGE VALUES

Focus point

Social Values: the extent to which the KB and its surroundings facilitate inclusivity, collaborative use and civic identity (Jones, 2017).

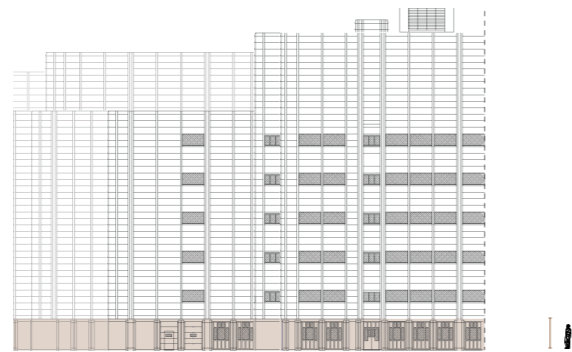
High social values contribute to **inviting environments**, where users can gather and engage with the KB. In doing so the KB is reconceptualized as not merely a building of the past, but as a **socially resilient** place that cultivates **identity, inclusivity** and **sense of belonging** for its future users.



Jones, S. (2017). Wrestling with the social value of heritage: Problems, dilemmas and opportunities. *Journal of community archaeology & heritage*, 4(1), 21-37.

HERITAGE VALUES

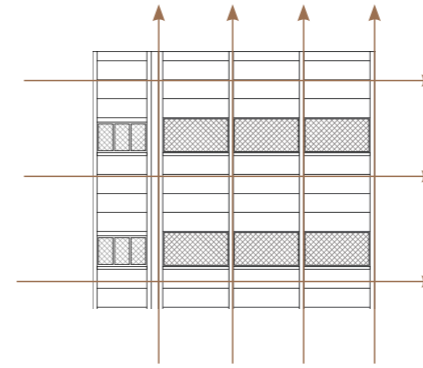
Focus points



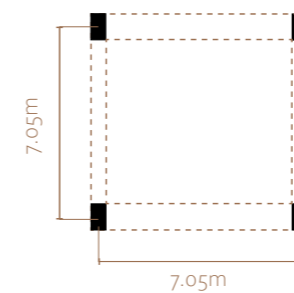
(Redefine) human-scale base



Facade materiality and grid



Facade composition



Column grid system

SOCIAL

Spiritual
Emotional (IND.)
Emotional (COL.)
Allegorical

ECONOMIC

Use
Non-use
Entertainment
Allegorical

POLITICAL

Educational
Management
Entertainment
Symbolic

HISTORIC

Educational
Historic-artistic
Historic-conceptual
Symbolic
Archaeological

AESTHETICAL

Artistic
Notable
Conceptual
Evidential

SCIENTIFIC

Workmanship
Technological
Conceptual

AGE

Workmanship
Technological
Conceptual

ECOLOGICAL

Spiritual
Essential
Existential

SOCIAL

Spiritual
Emotional (IND.)
Emotional (COL.)
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ECONOMIC

Use
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SCIENTIFIC

Workmanship
Technological
Conceptual

AGE

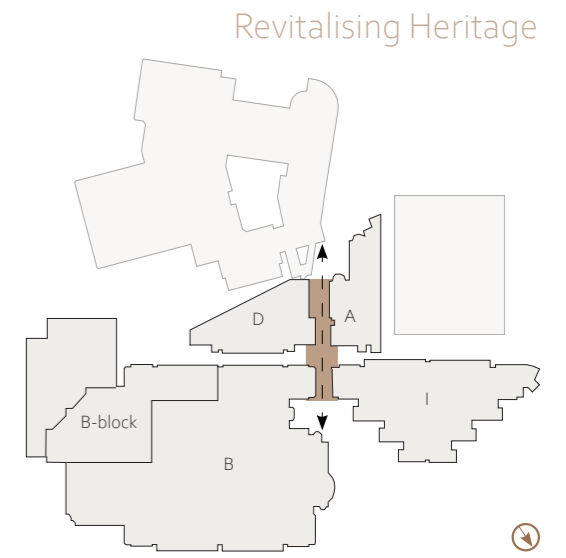
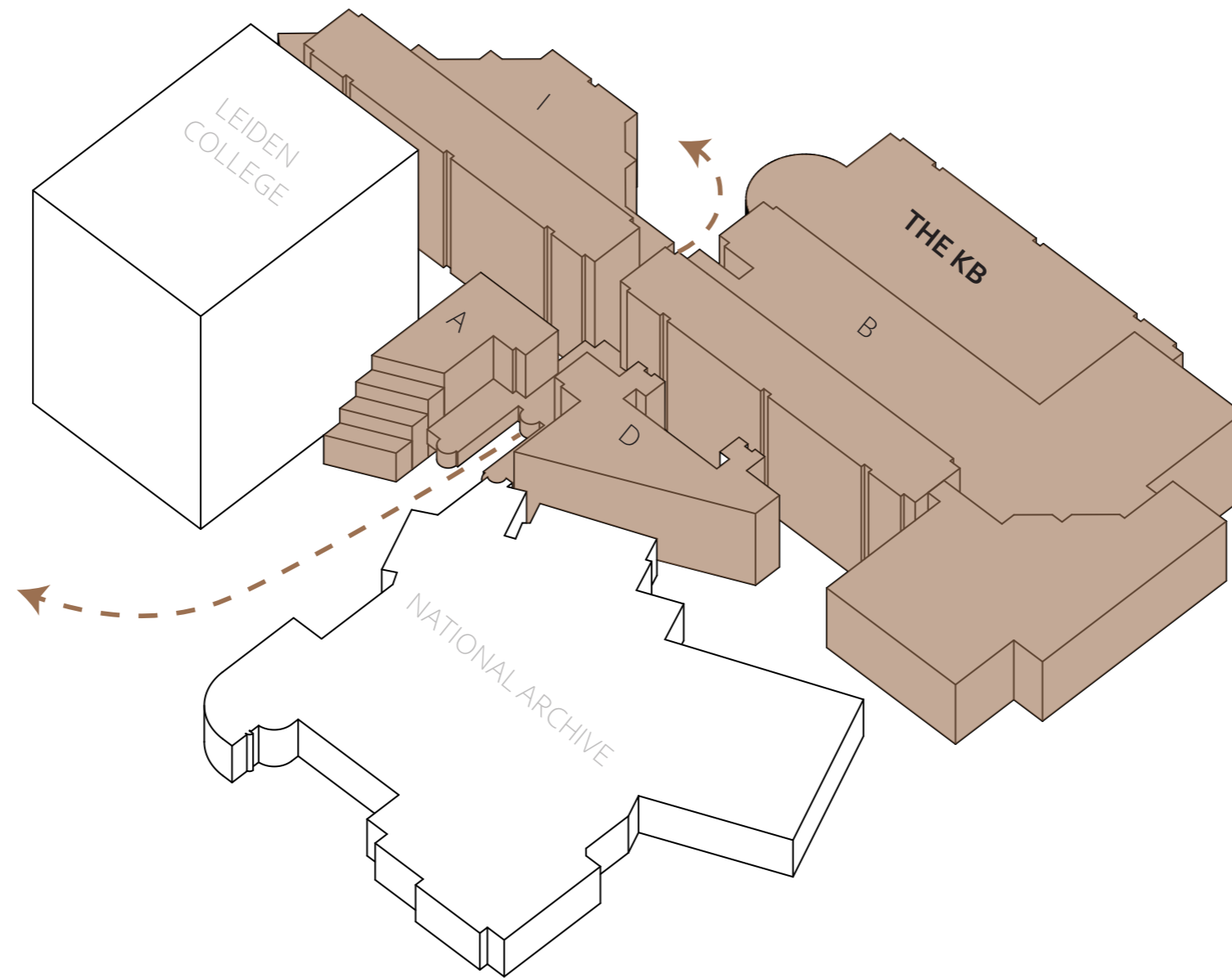
Workmanship
Technological
Conceptual

ECOLOGICAL

Spiritual
Essential
Existential

EXISTING VALUES

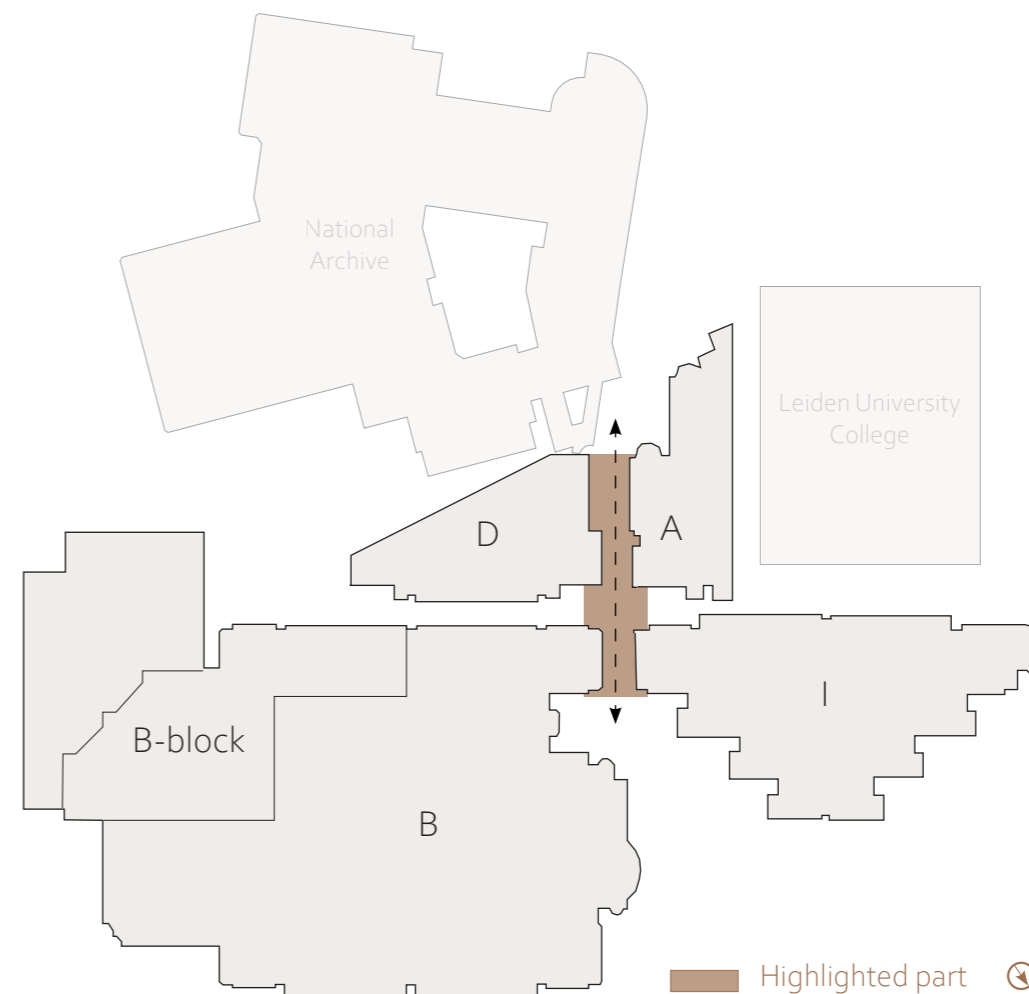
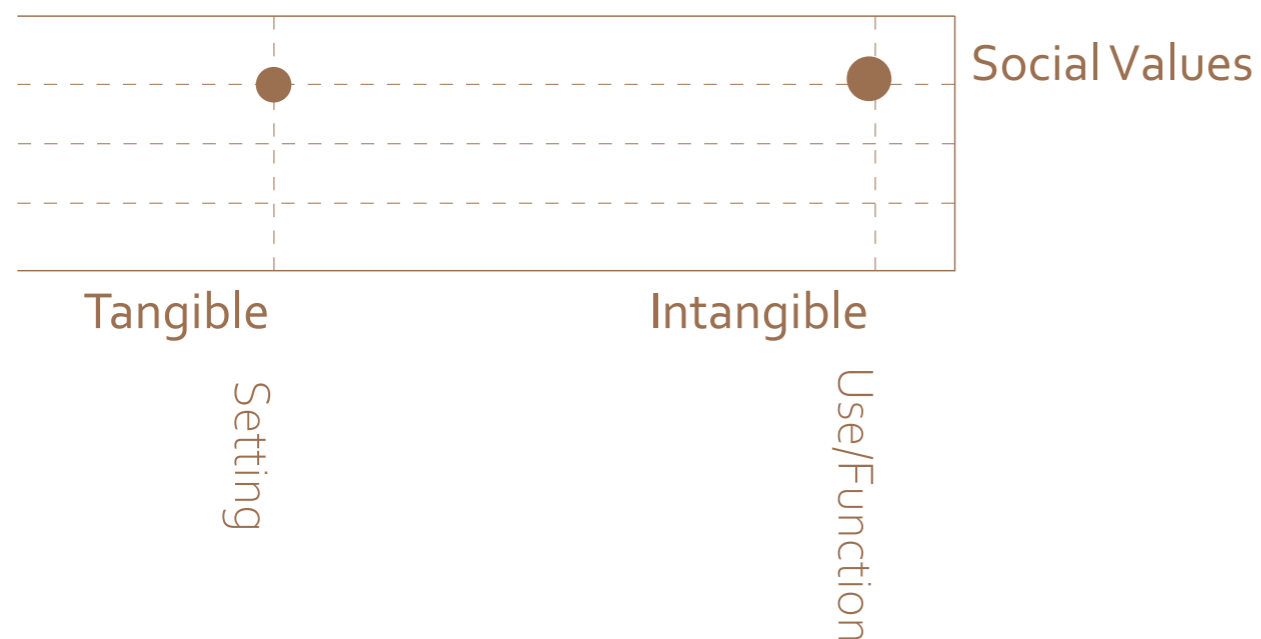
East-west Alleyway



EXISTING VALUES

East-west Alleyway

The Alleyway

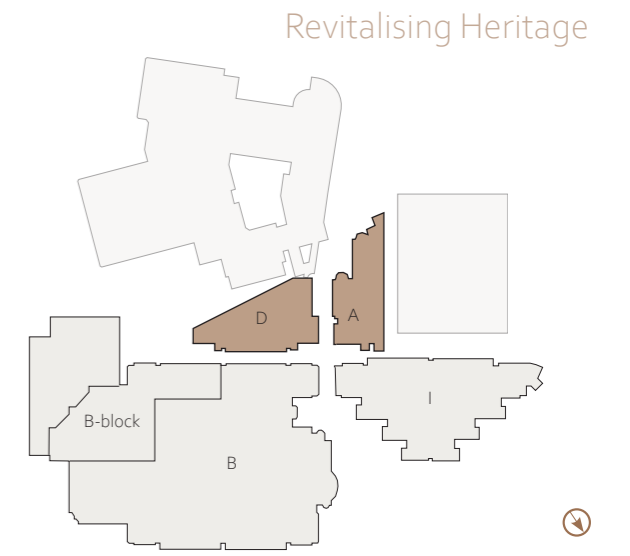
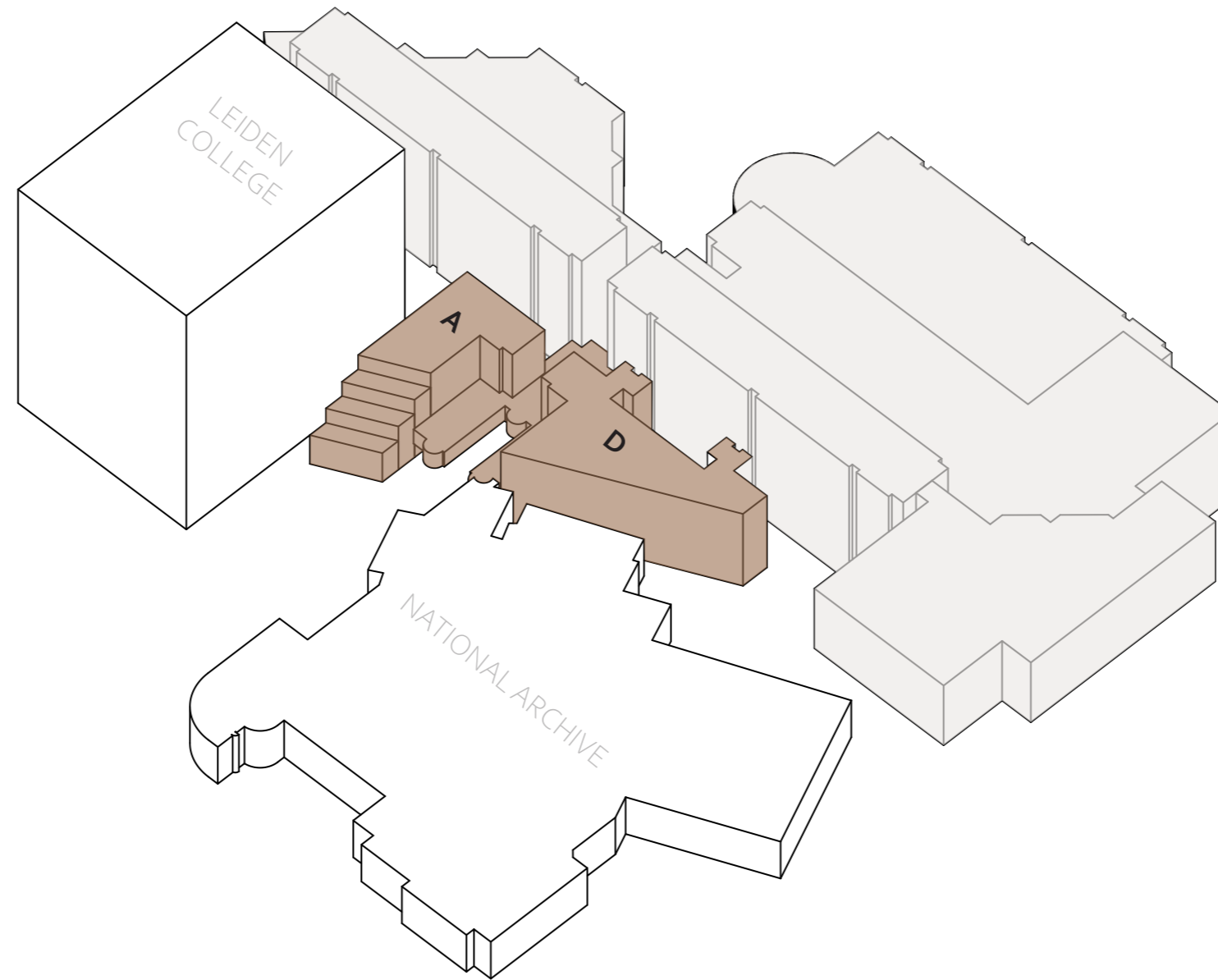


While these values highlight urban connectivity, it also signalizes a disengaged relationship with the KB: reducing the library's function from a national destination point into merely a **corridor/shortcut**.



EXISTING VALUES

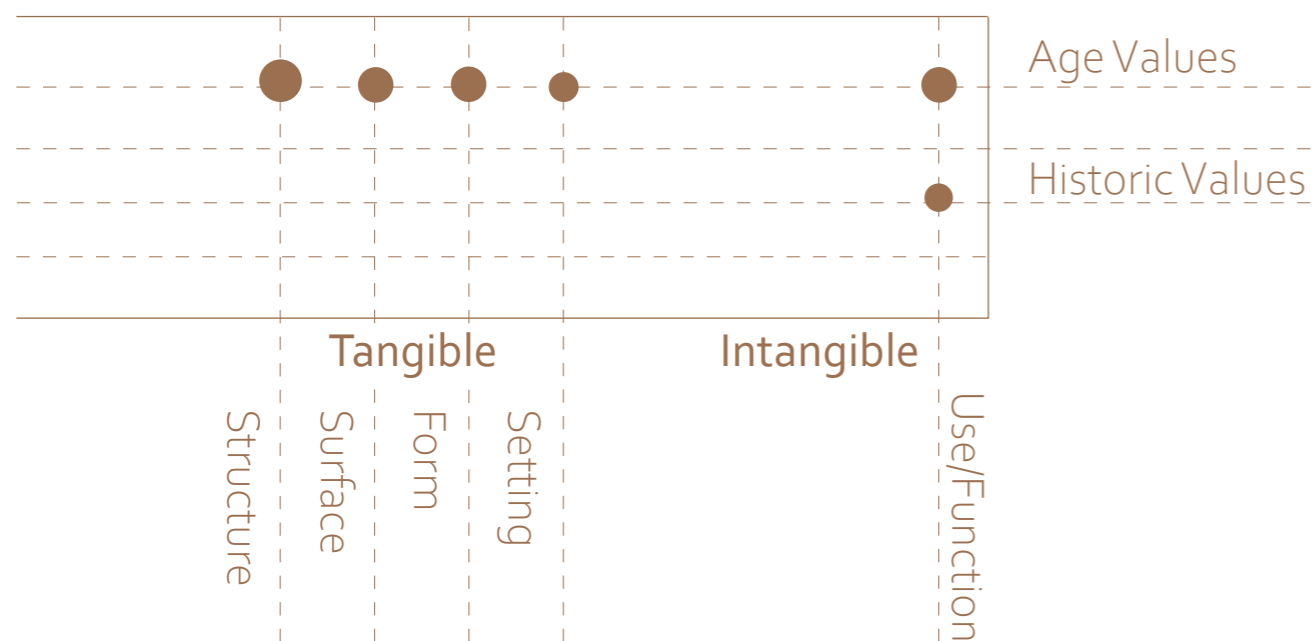
Block A and D



EXISTING VALUES

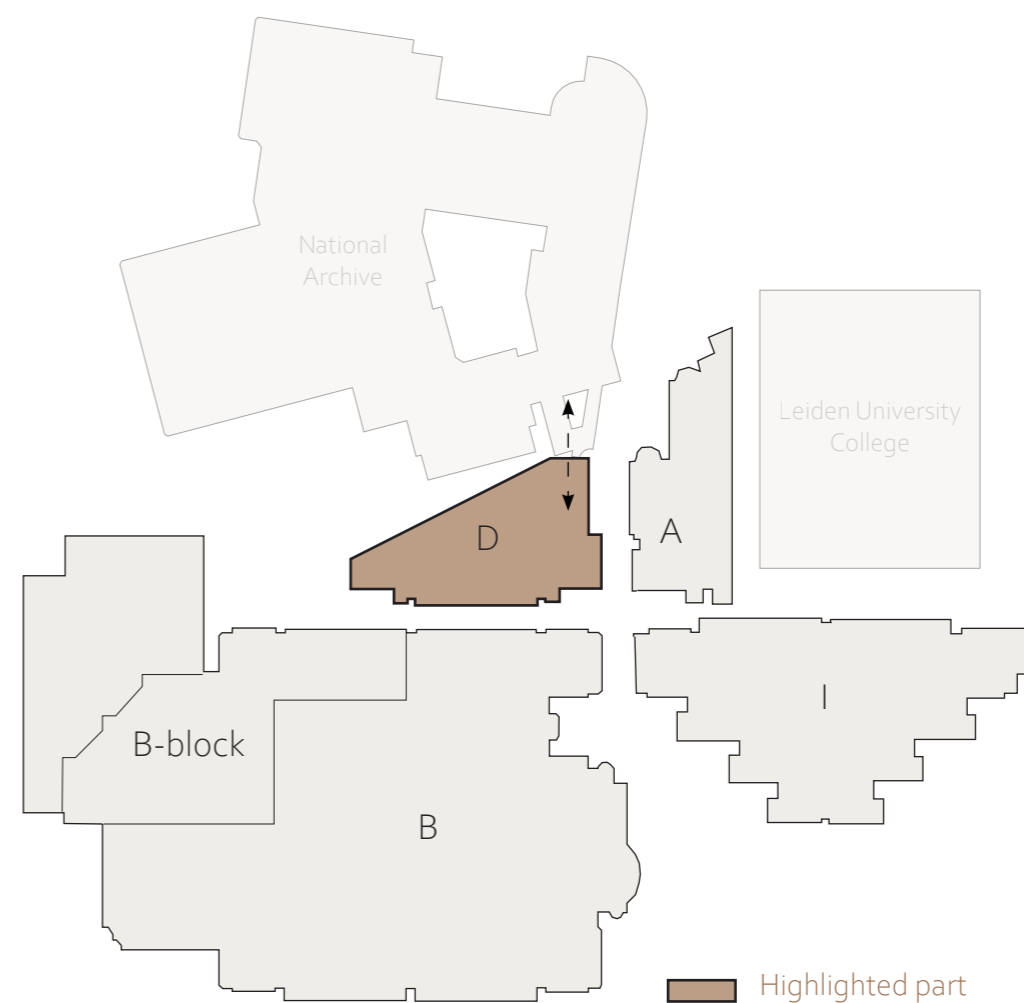
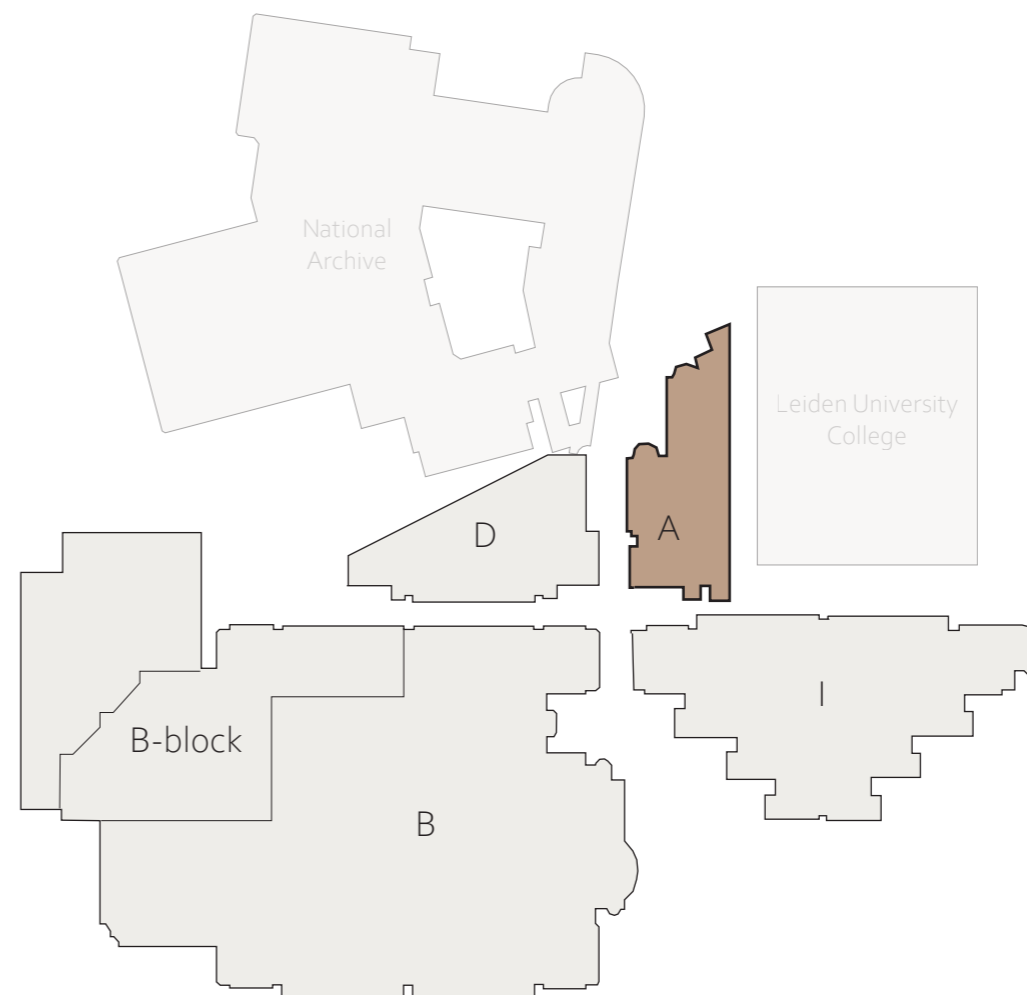
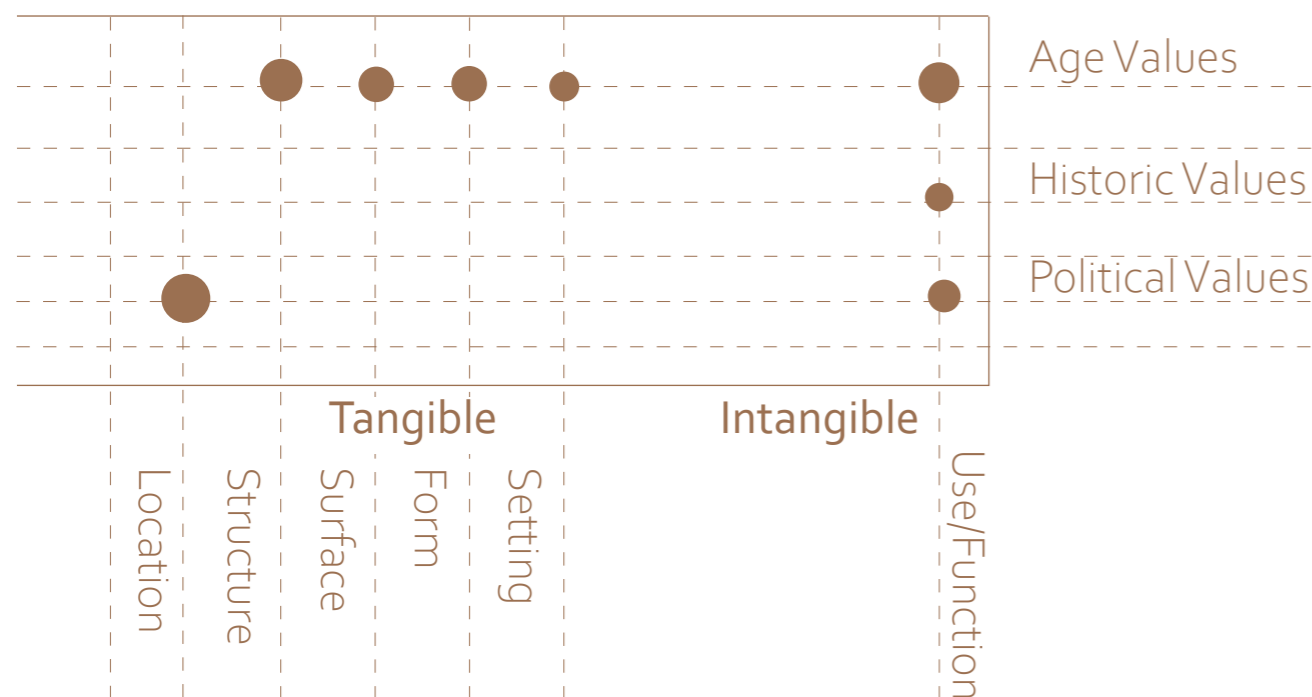
Block A and D

Block A



Although block A and D hold significance, both building blocks **lack** higher **social values**.

Block D



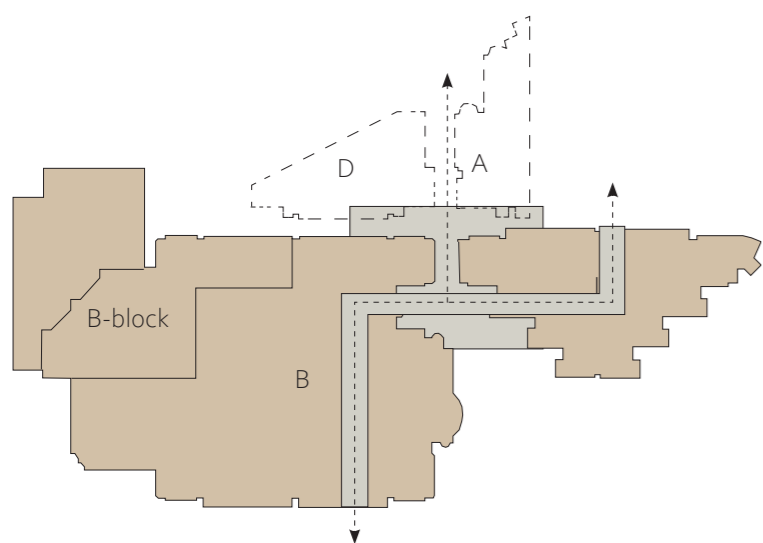
SCENARIOS

Potential Redesign Strategies

B.

REMOVE BLOCK A & D

+ Add new pathway

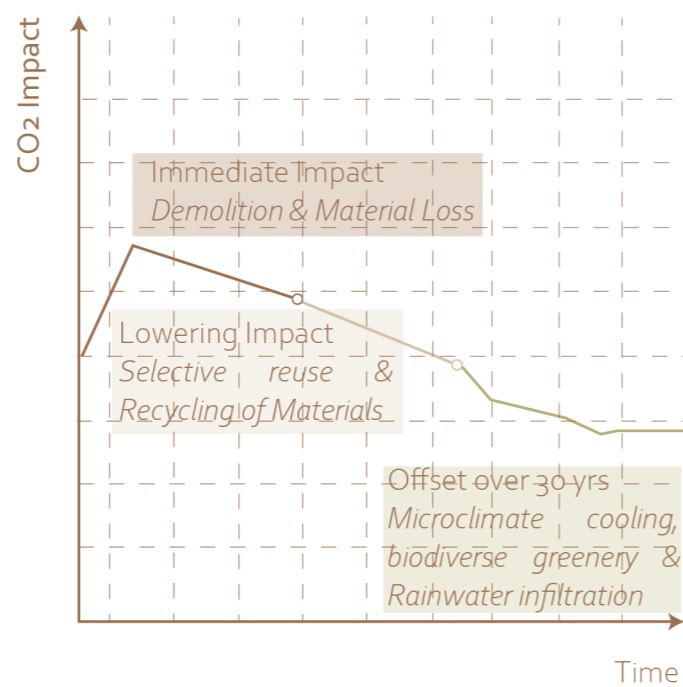


GFA

Building Block	Approximate GFA [m ²]
A	2,600 m ²
D	4,120 m ²
Total	6,720 m²



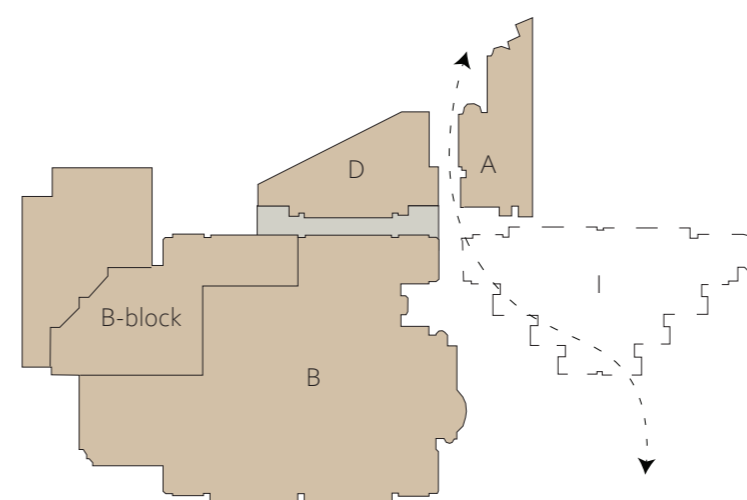
CO₂ IMPACT



C.

REMOVE BLOCK I

+ Connect block B and D

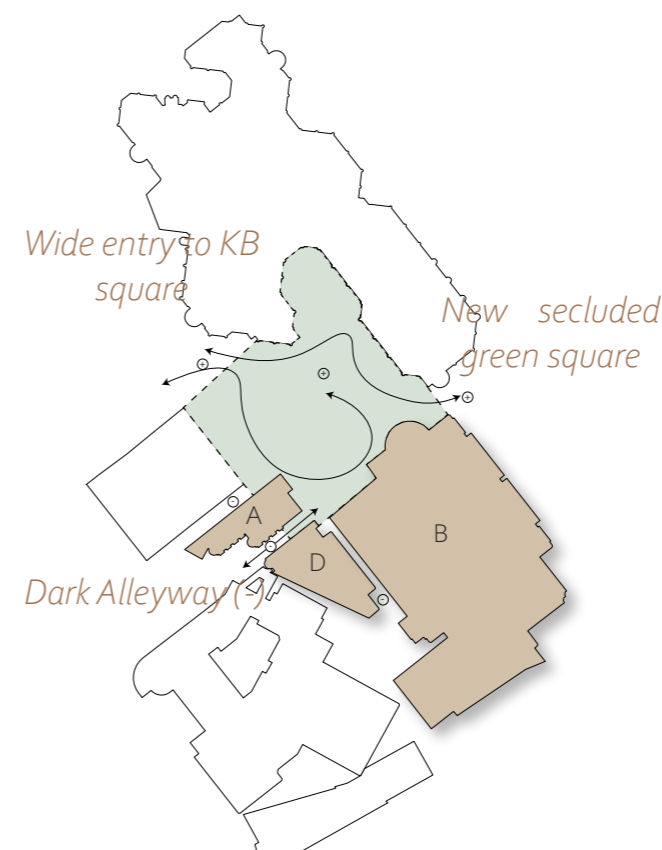
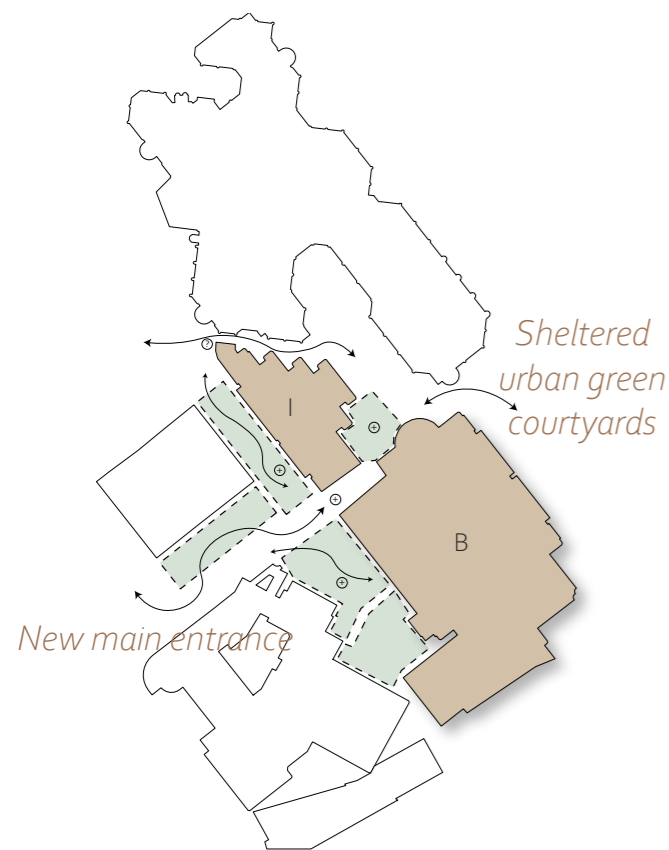
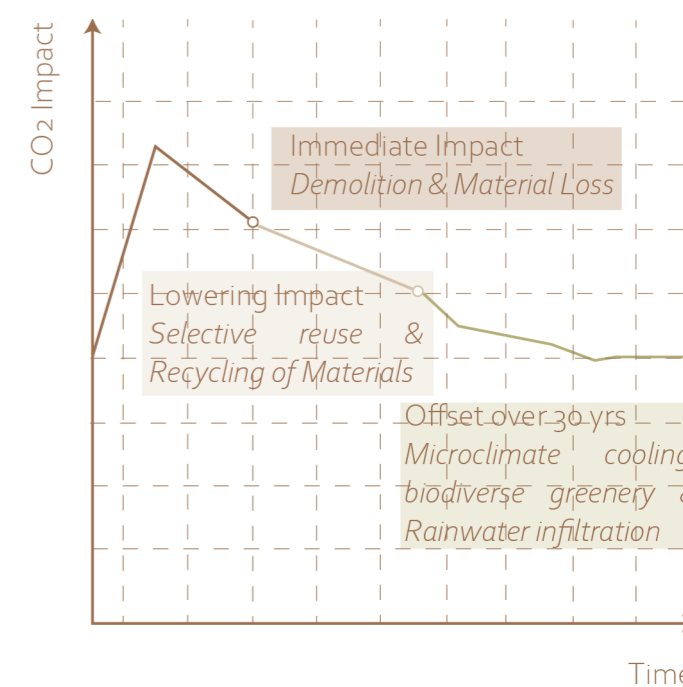


GFA

Building Block	Approximate GFA [m ²]
I	12,400 m ²
-	-
Total	12,400 m²



CO₂ IMPACT



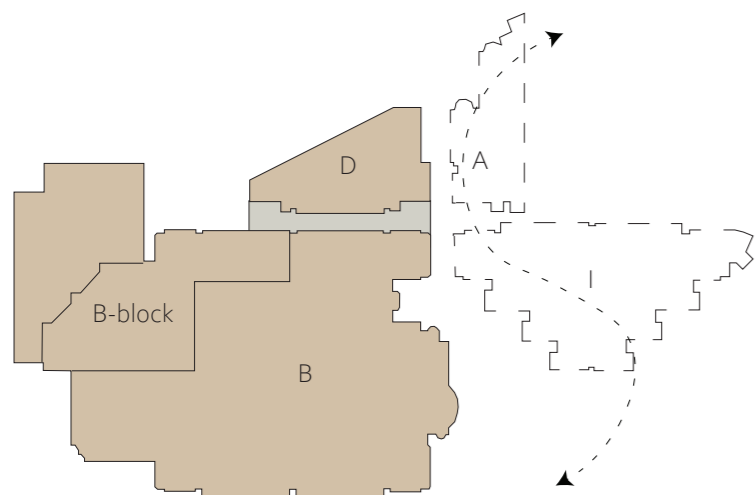
SCENARIOS

Potential Redesign Strategies

D.

REMOVE BLOCK A & I

+ Connect B and D

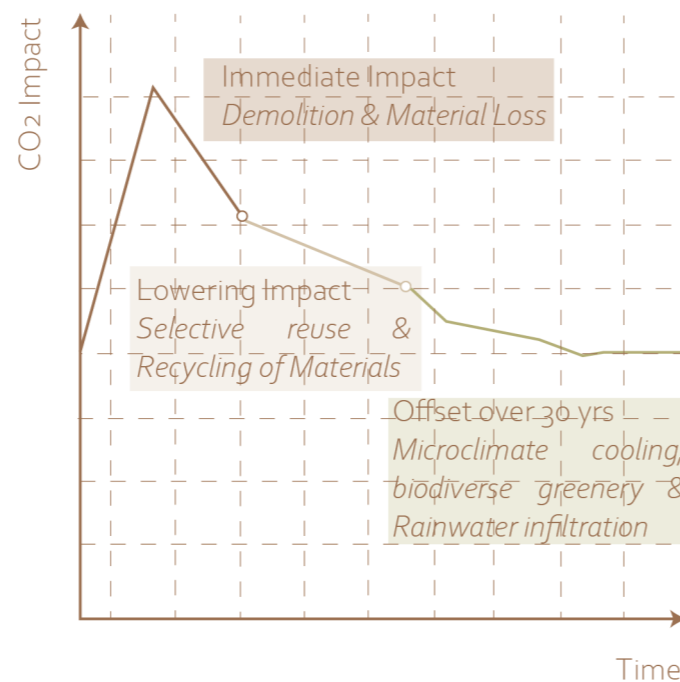


GFA

Building Block	Approximate GFA [m ²]
A	2,600 m ²
I	12,400 m ²
Total	15,000 m²

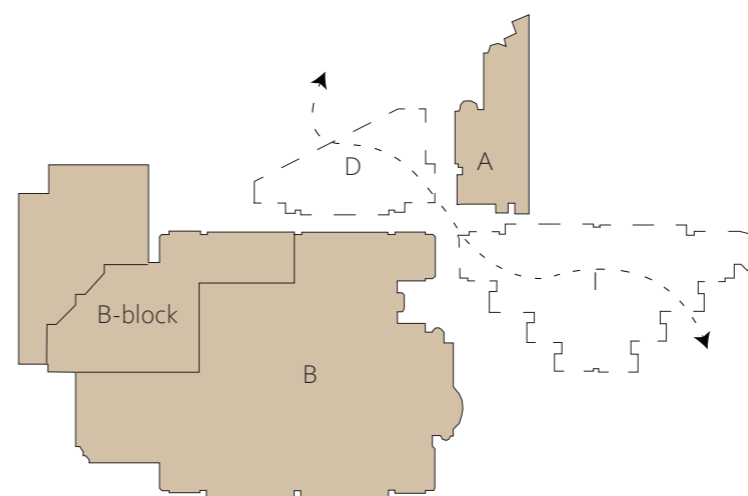


CO₂ IMPACT



E.

REMOVE BLOCK A & I

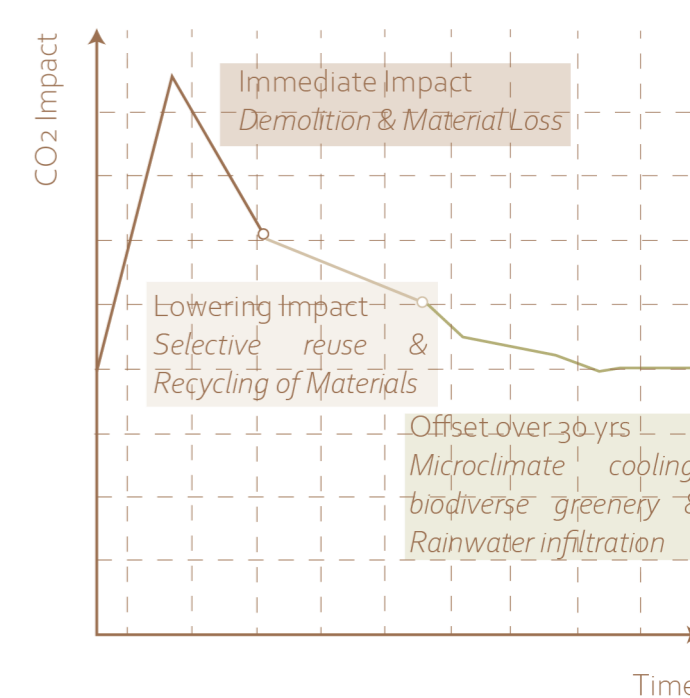


GFA

Building Block	Approximate GFA [m ²]
D	4,120 m ²
I	12,400 m ²
Total	16,520 m²



CO₂ IMPACT



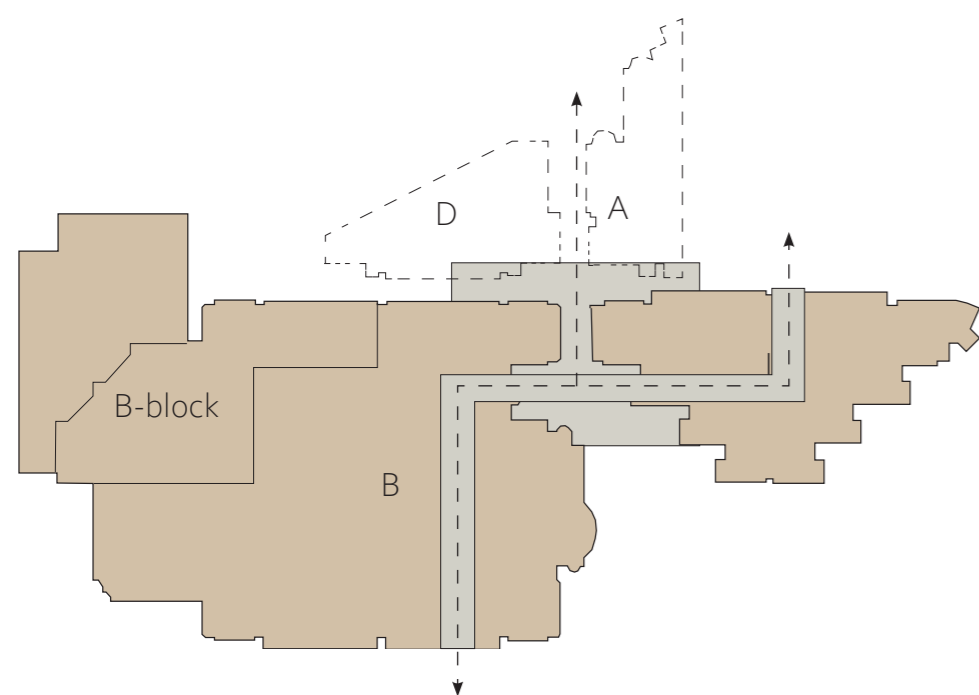
SCENARIOS

Potential Redesign Strategies

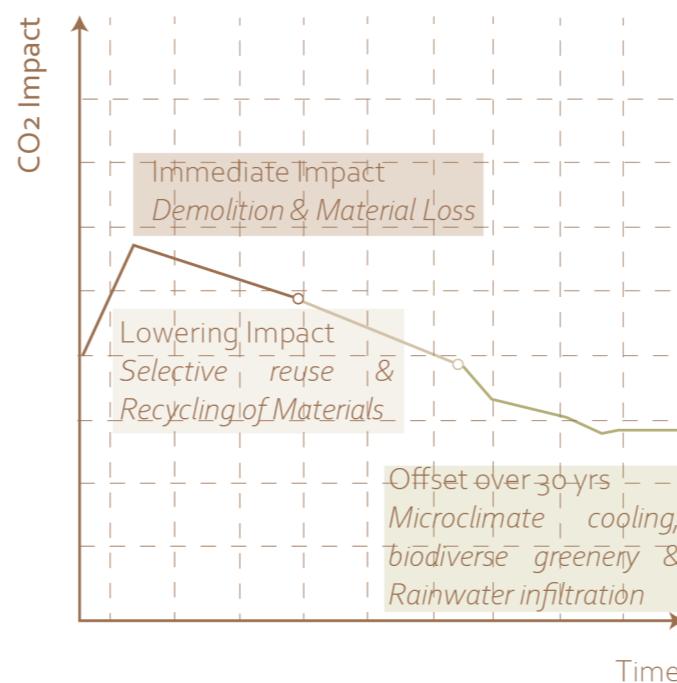
B.

REMOVE BLOCK A & D

+ Add new pathway



- Keep
- Remove
- Add



Removing Blocks D and A **restores connectivity between city and library**, transforming a closed-off fortress into an **open civic threshold**, while allowing daylight, vegetation and public life to enter the heart of the complex. This rebalances the KB's **fragmented structure into a coherent and permeable ensemble**.

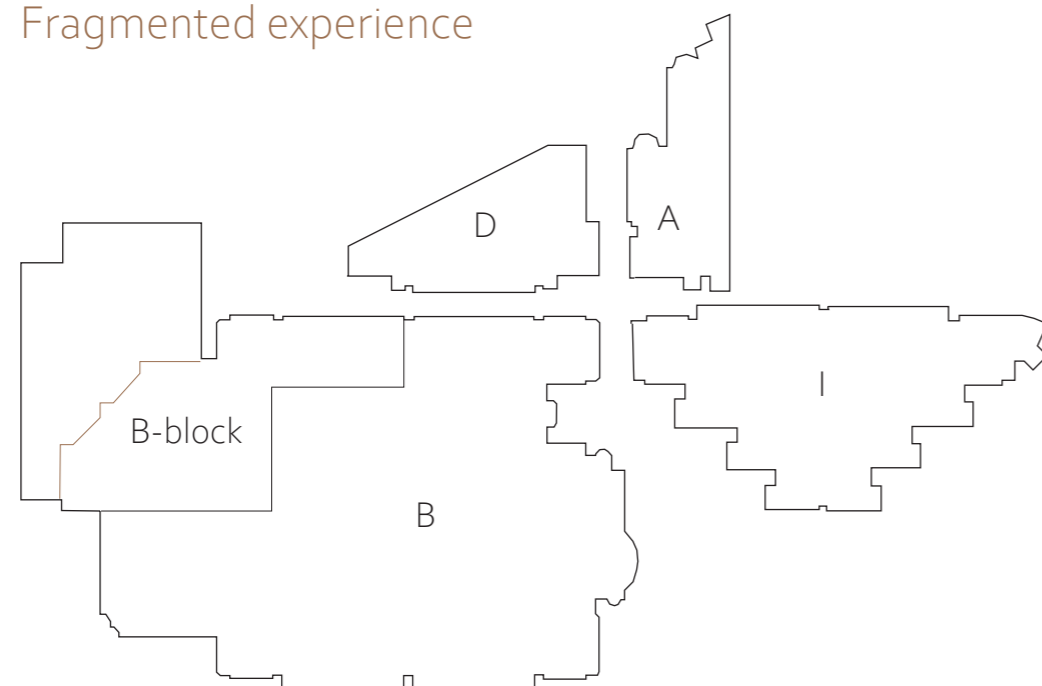
DESIGN CONCEPT

Strategy B

01

CURRENT SITUATION

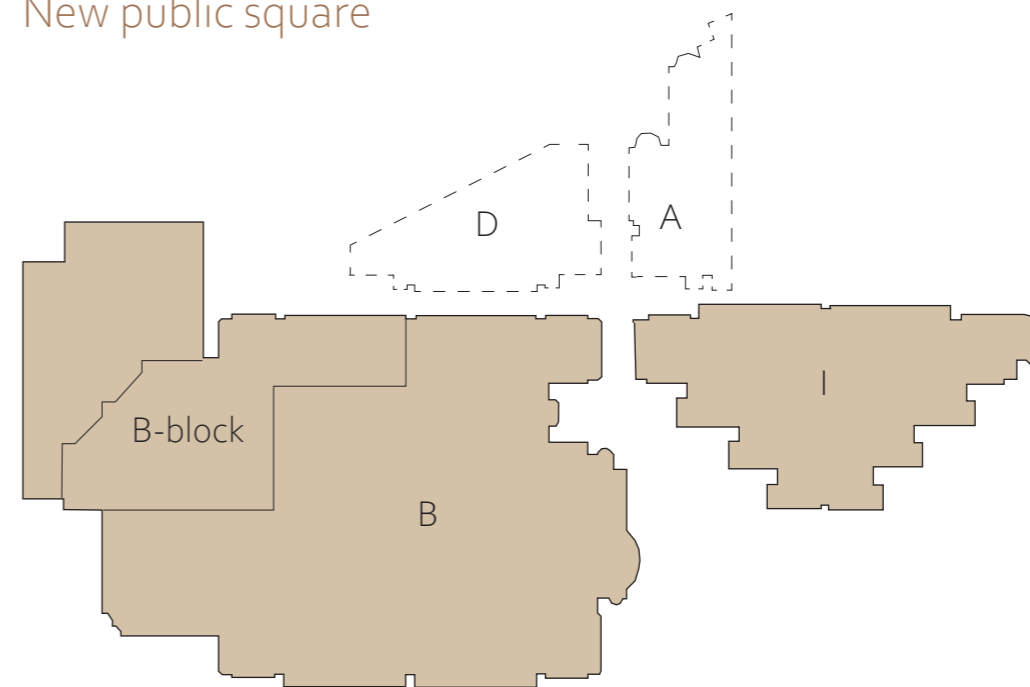
Fragmented experience



02

REMOVE BLOCK A AND D

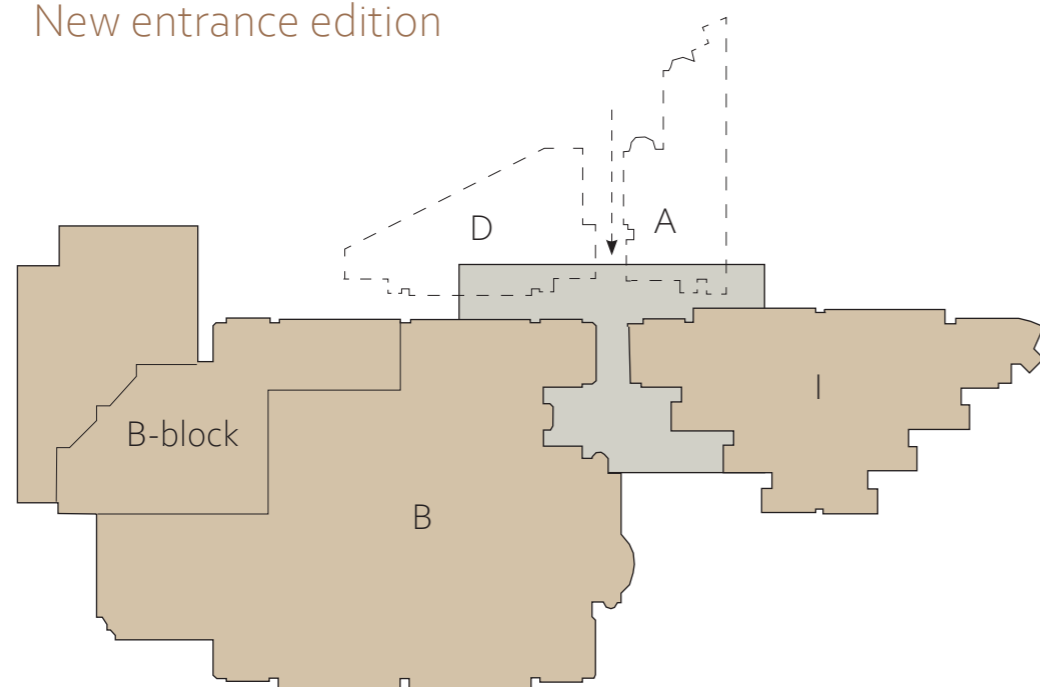
New public square



03

CLOSE OFF ALLEYWAY

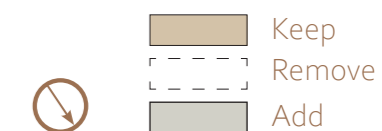
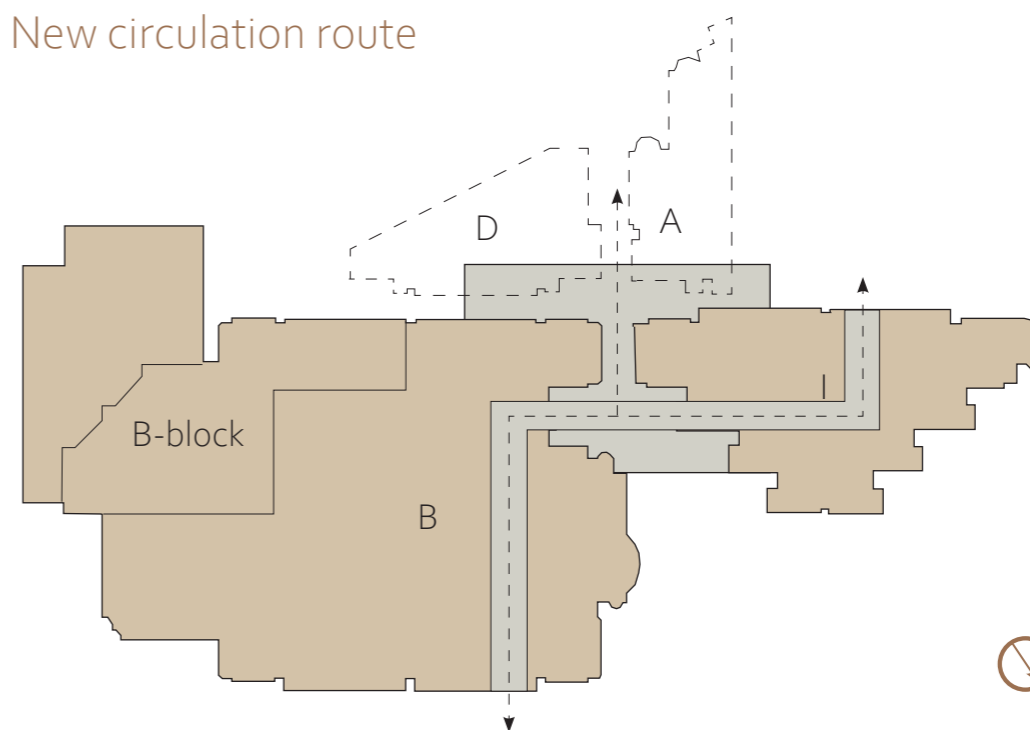
New entrance edition



04

INTRODUCE NEW PATHWAY

New circulation route

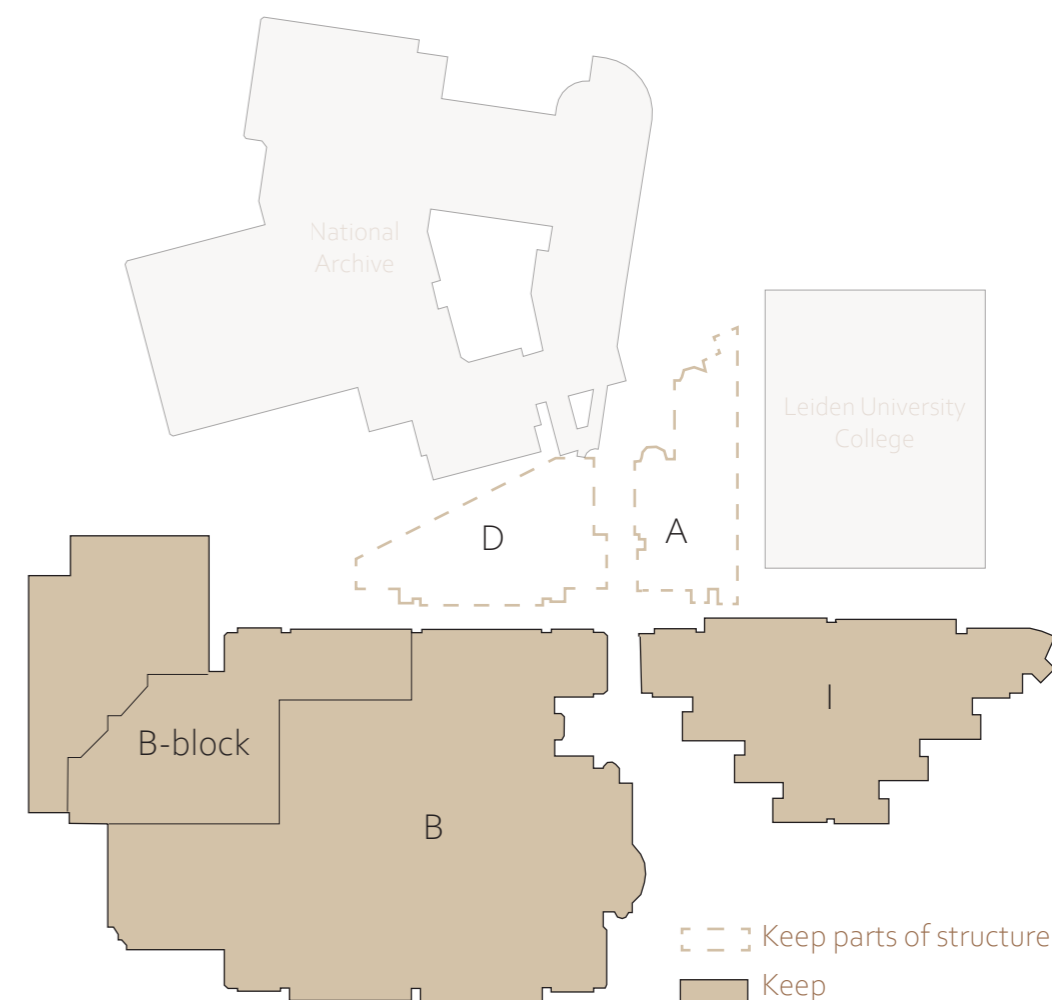
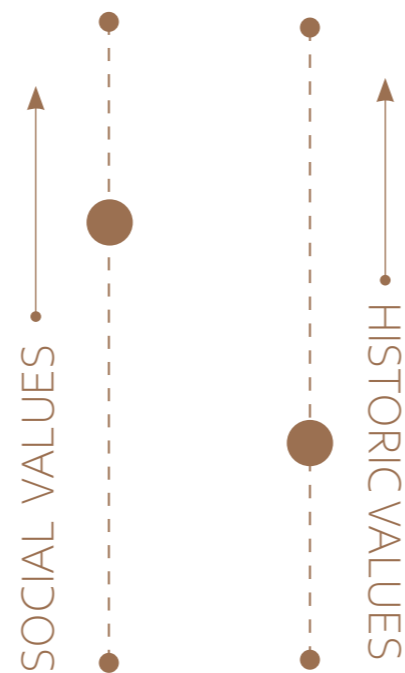
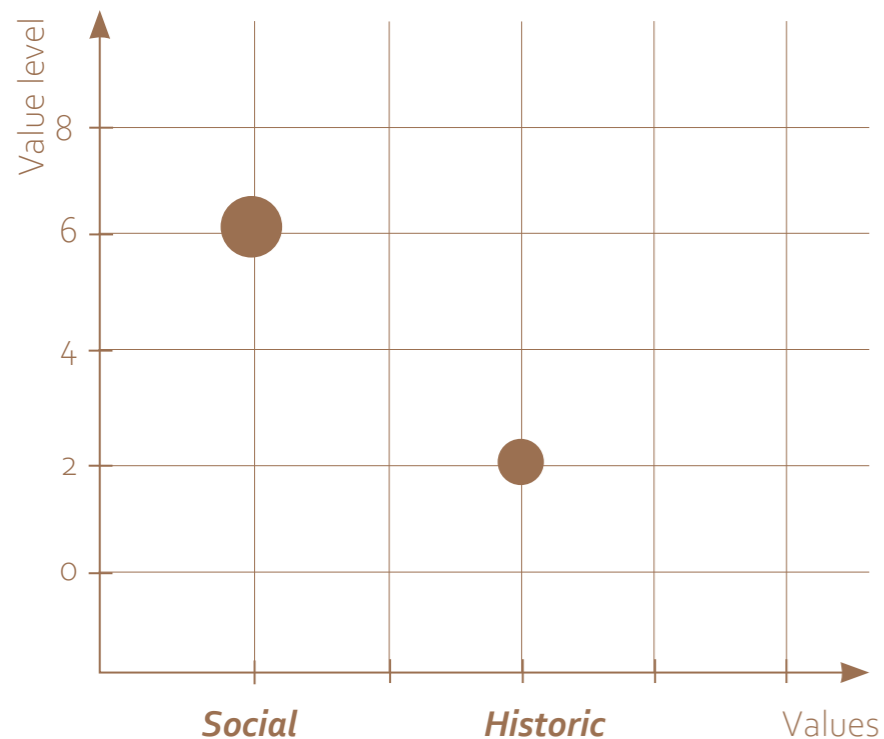


DESIGN CONCEPT

Heritage Strategy

Keeping parts of the structure:

Introduces new social values and preserves parts of the existing historic values.

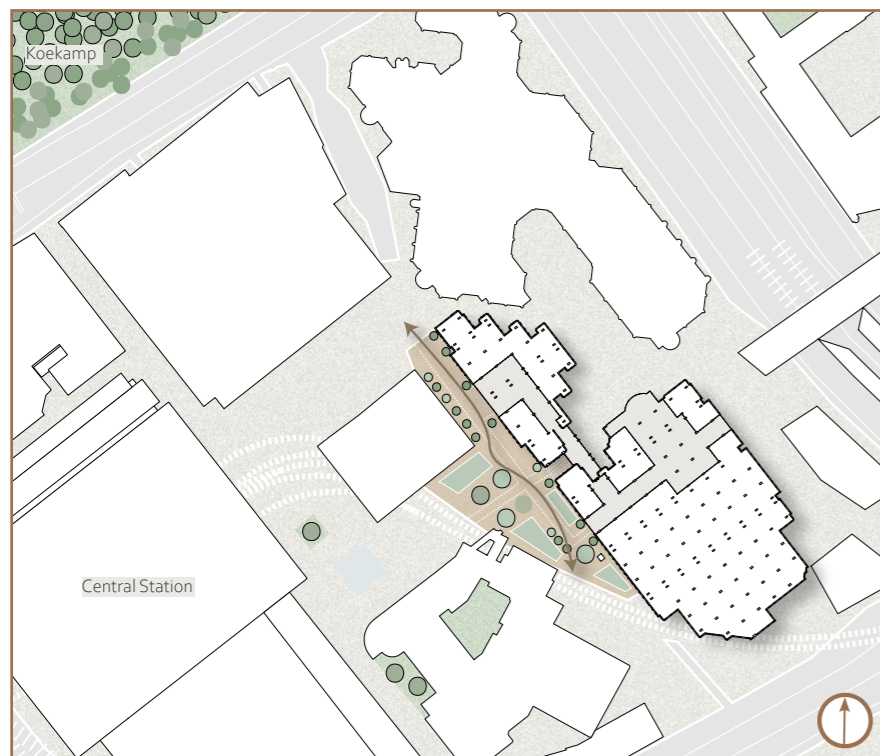
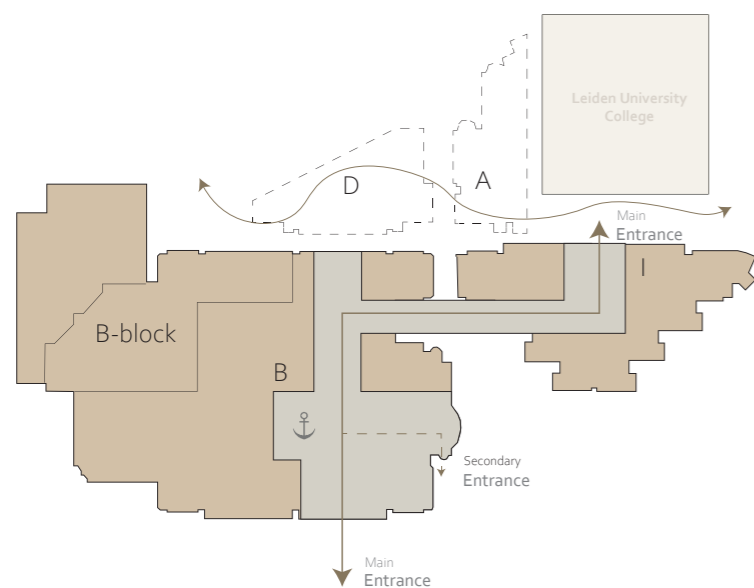


The preserved building fragments can serve as a **visual landmark**, drawing attention to the new entrance of the KB

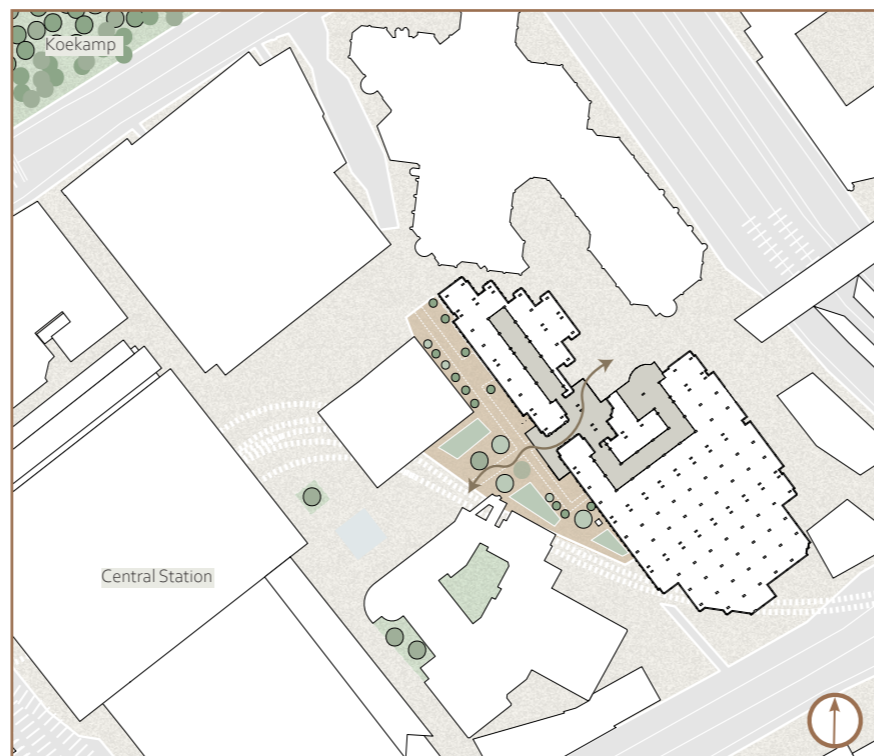
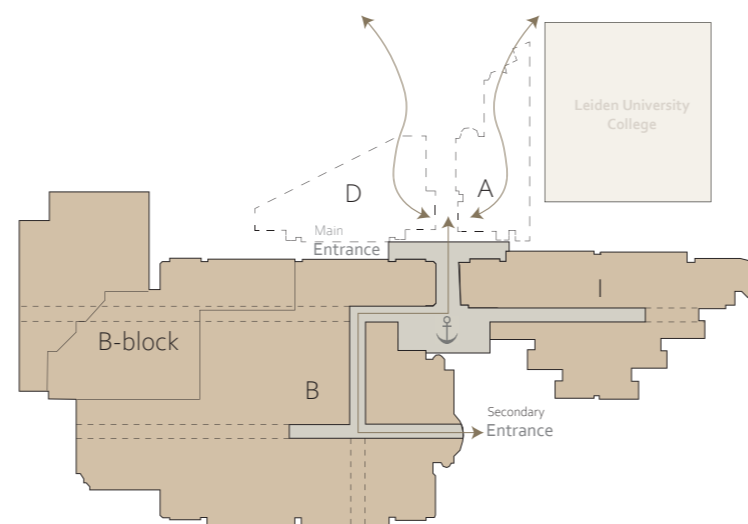
THE SENSORY SPINE

Entrance Strategies

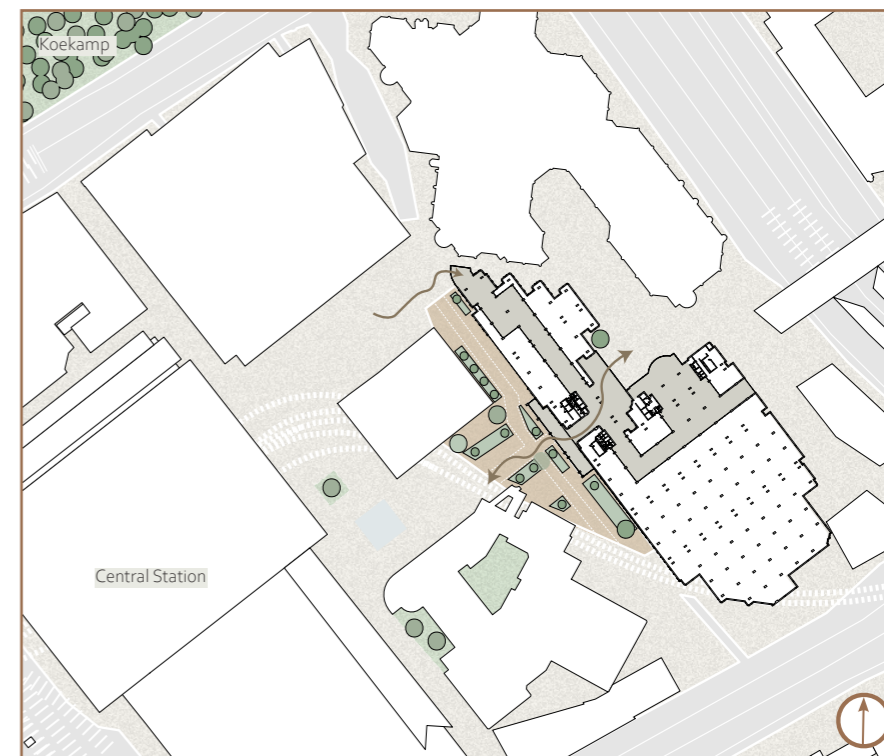
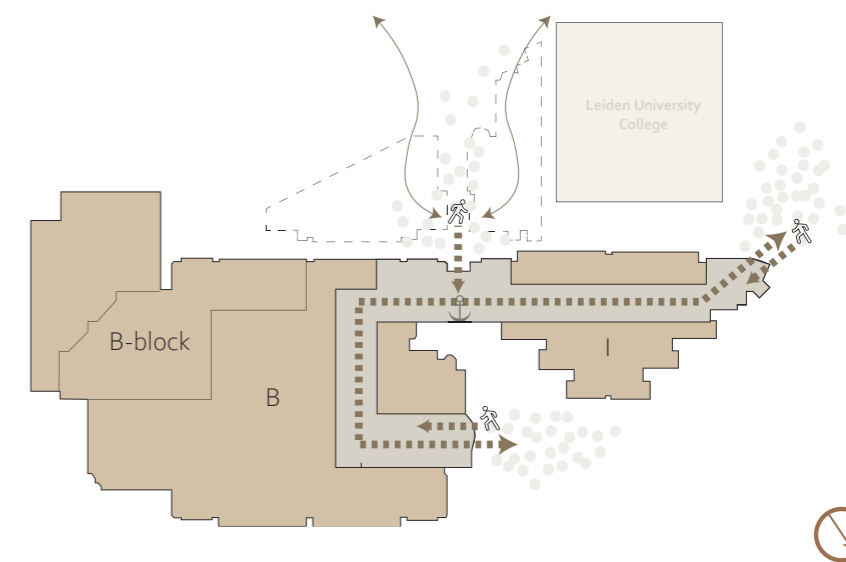
01
OFF-CENTERED ENTRANCE



02
CENTERED ENTRANCE



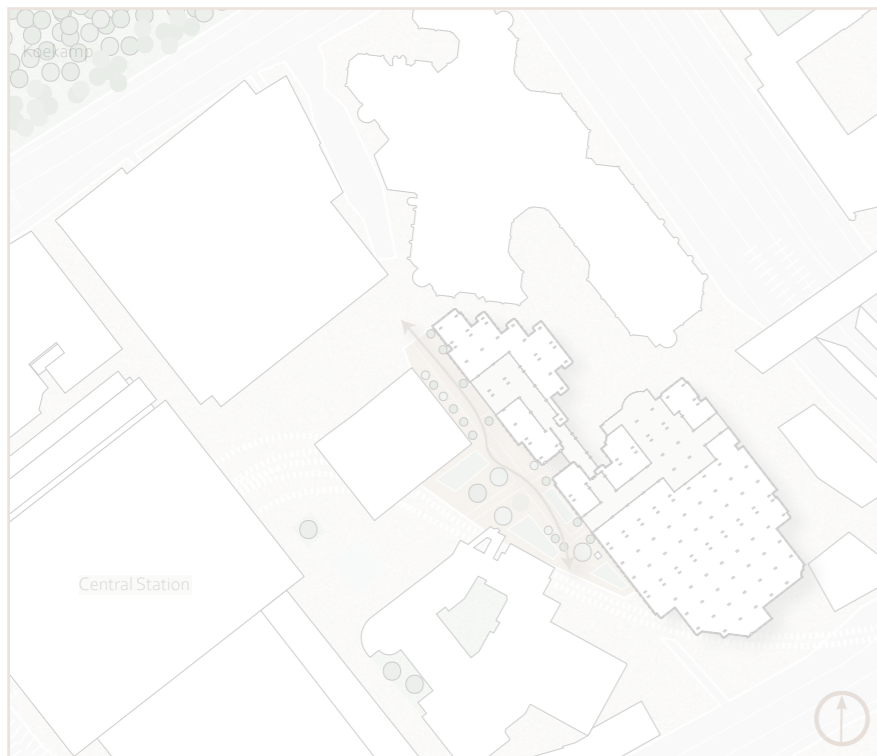
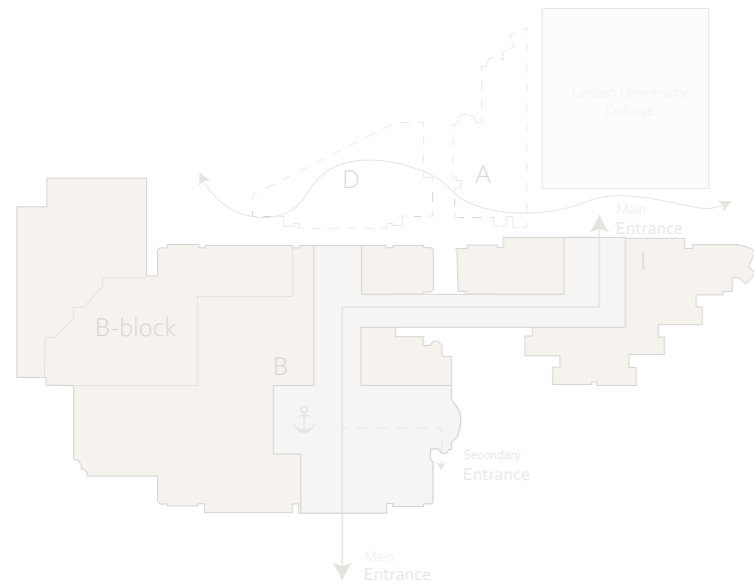
03
CENTERED AND CORNER ENTRANCE



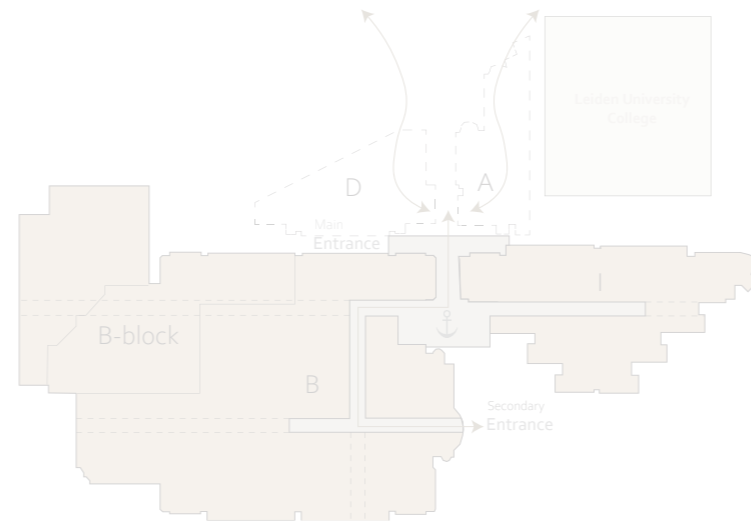
THE SENSORY SPINE

Entrance Strategies

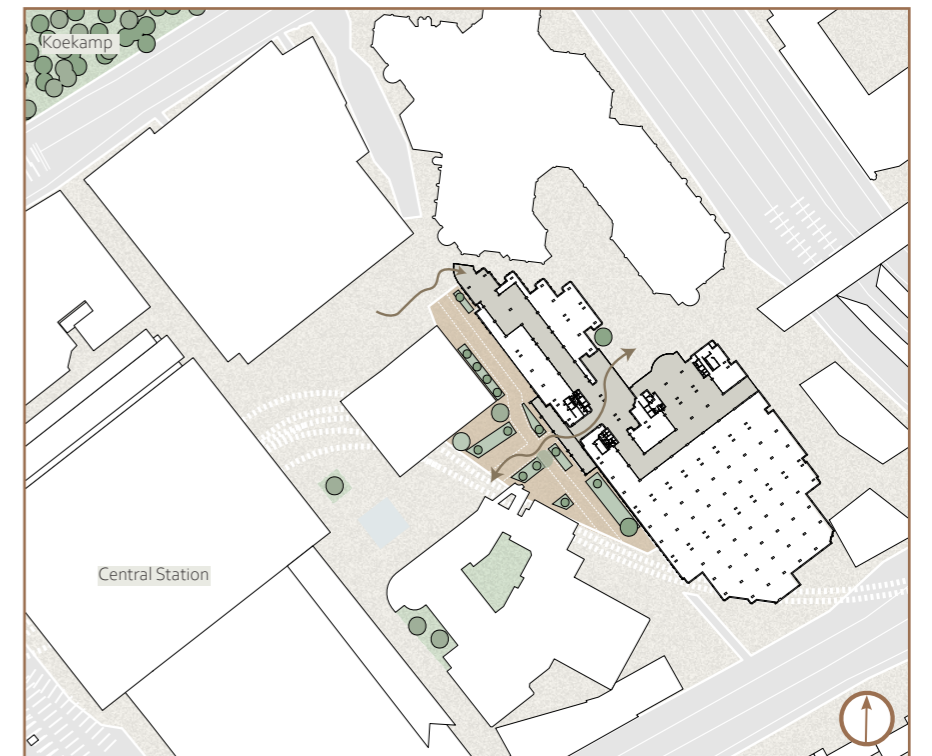
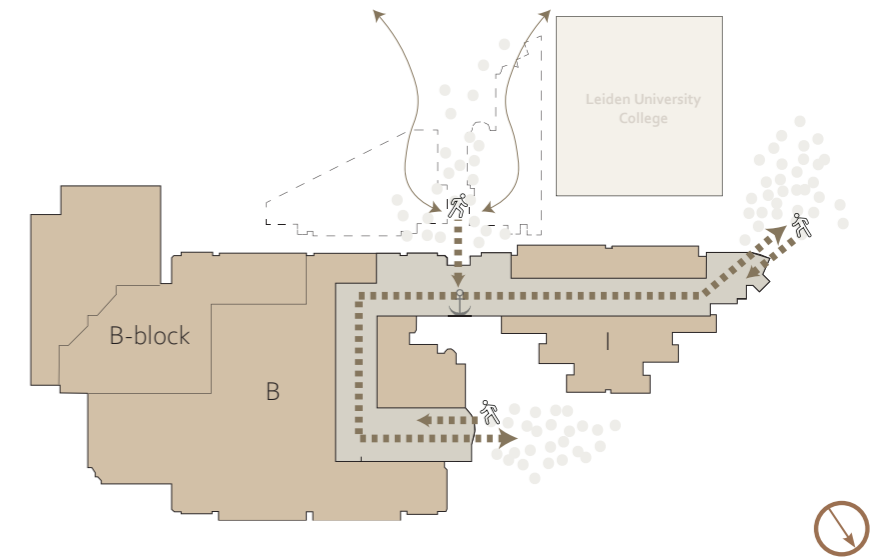
01
OFF-CENTERED ENTRANCE



02
CENTERED ENTRANCE

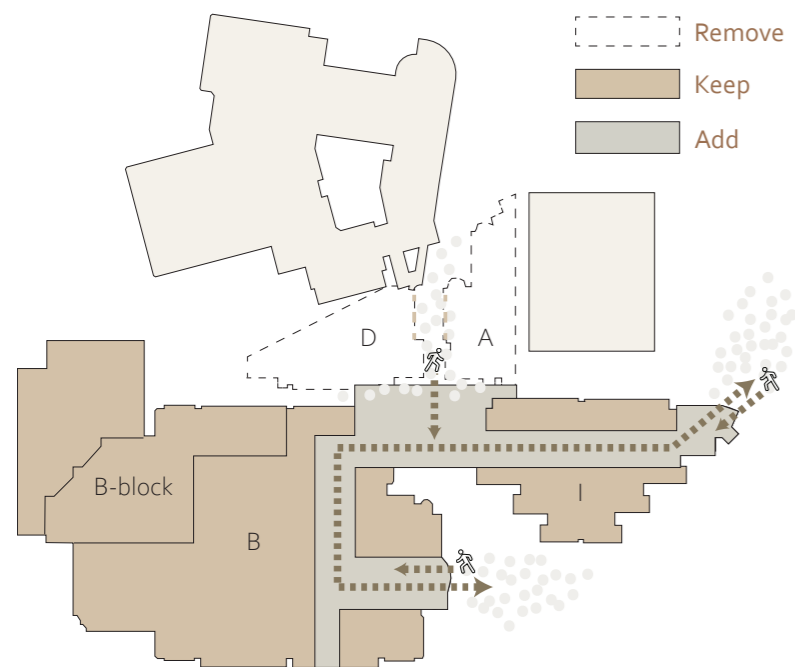


03
CENTERED AND CORNER ENTRANCE

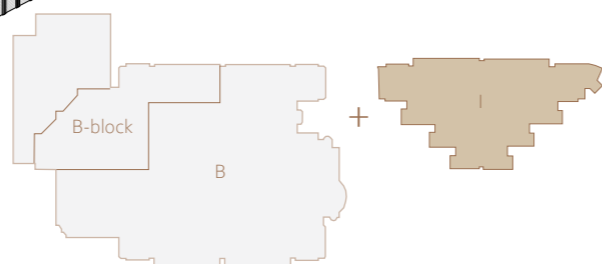
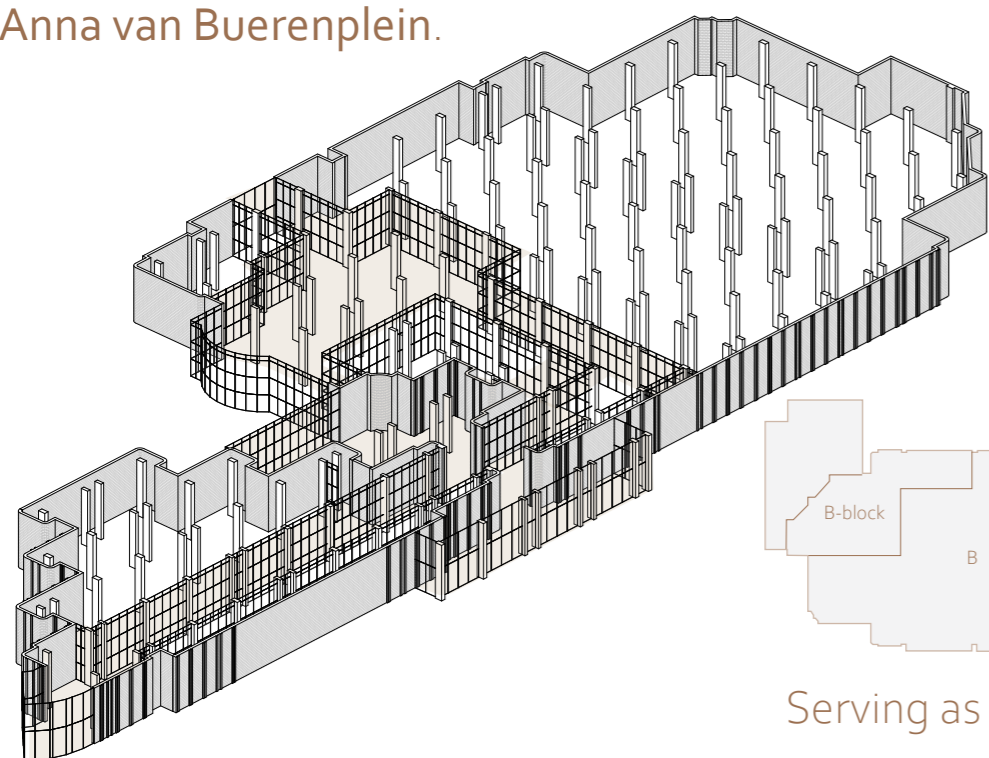
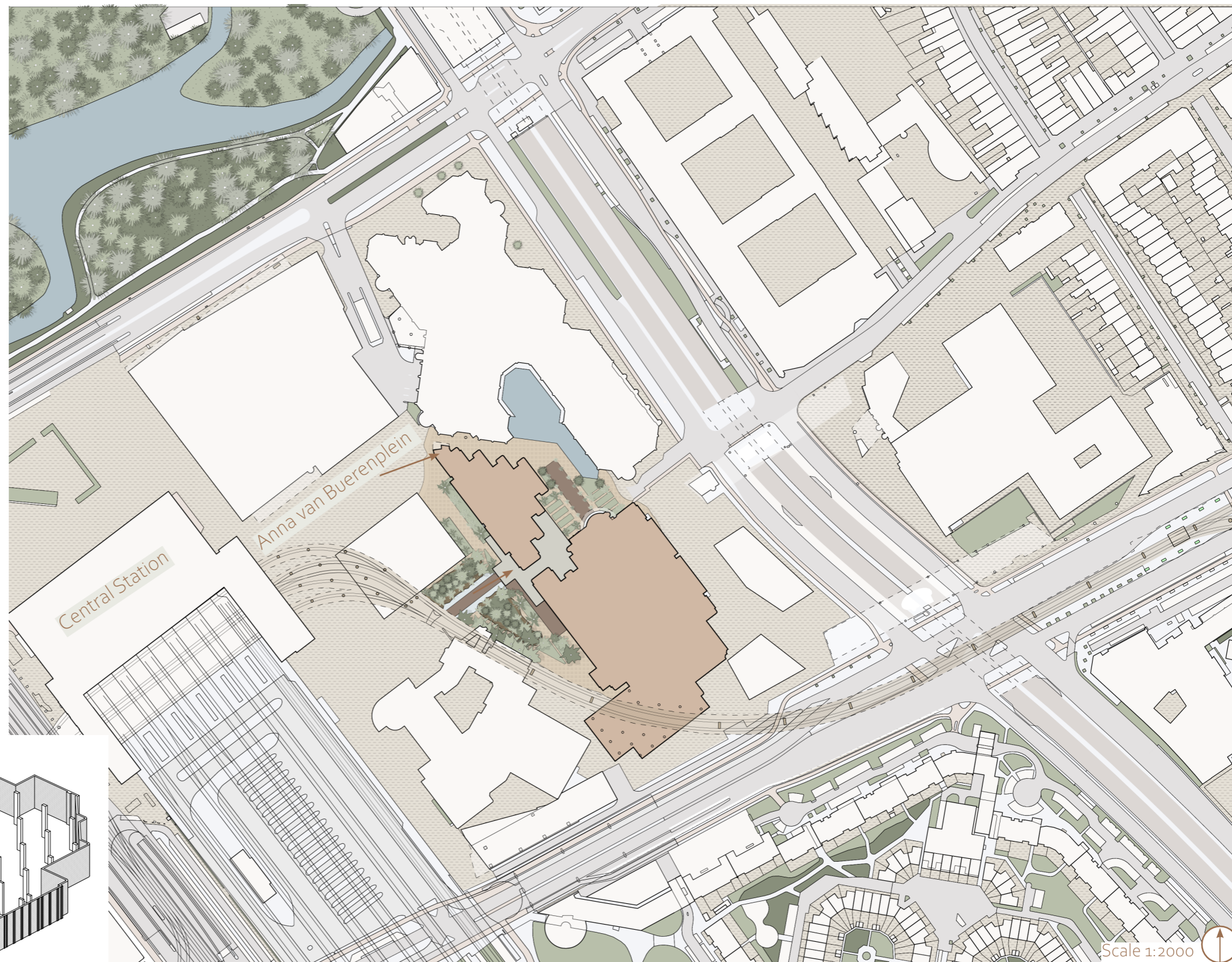


THE SENSORY SPINE

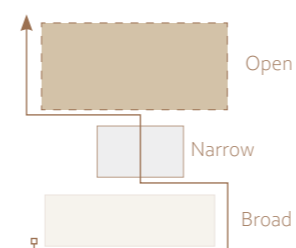
Variant 3



The new sensory spine is rooted in the original modular grid system (7.05m, and 8.10m H.O.H distance between columns). Variant 3 synchronizes entrances with pedestrian movement by incorporating a corner entrance at the Anna van Buerenplein.



Serving as a **Connector**



Following a **Dynamic Rhythm**

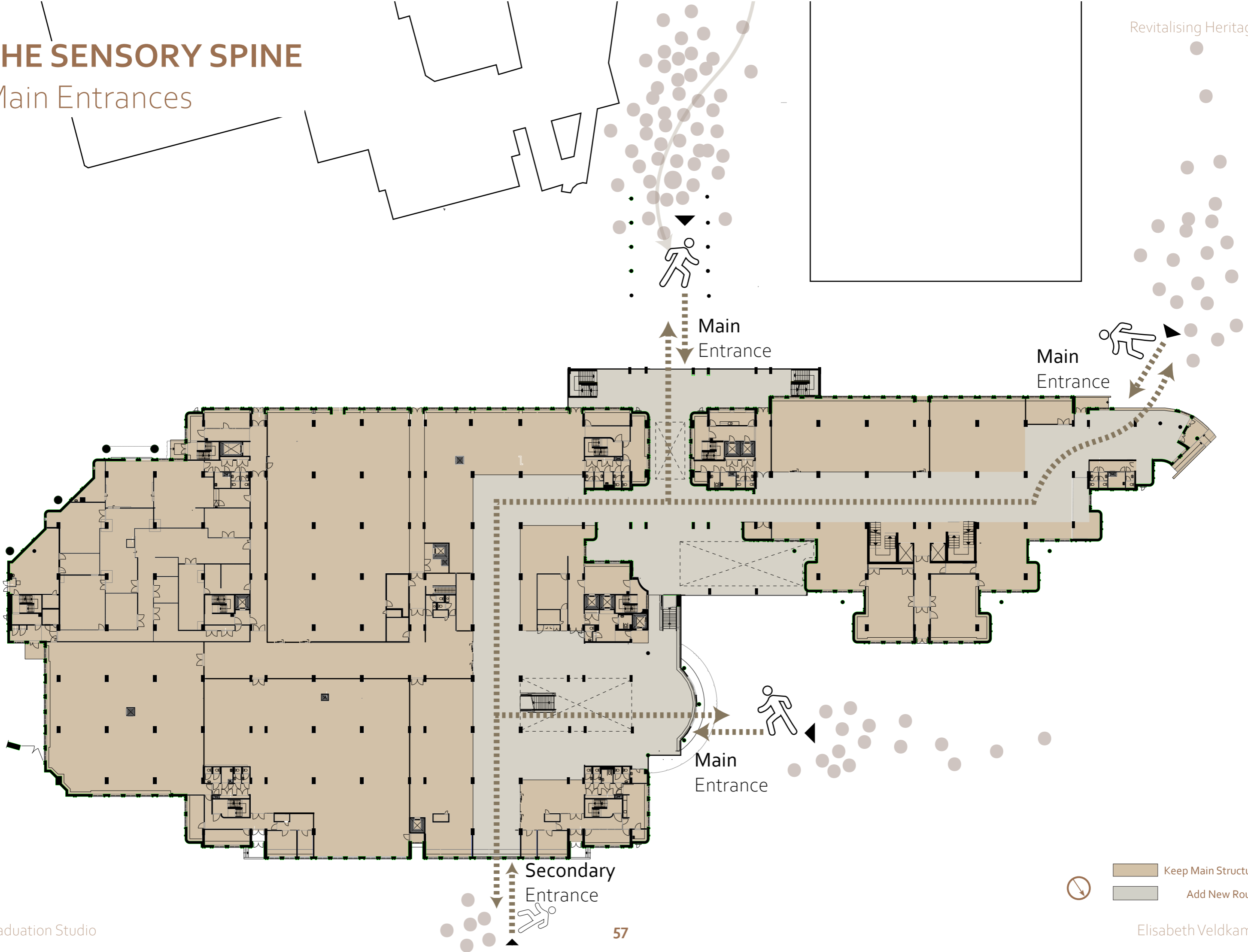


Using **Tactile Materials**

THE SENSORY SPINE

Main Entrances

Revitalising Heritage

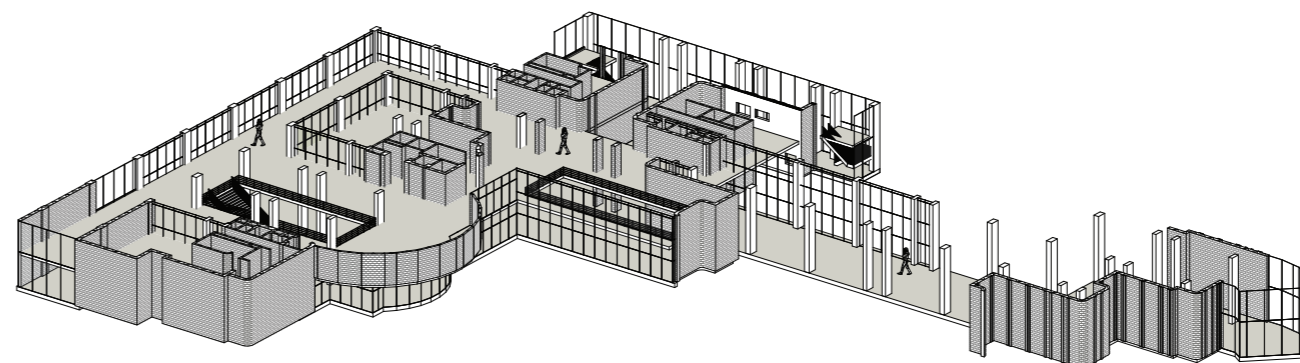


THE SENSORY SPINE

Main Circulation System

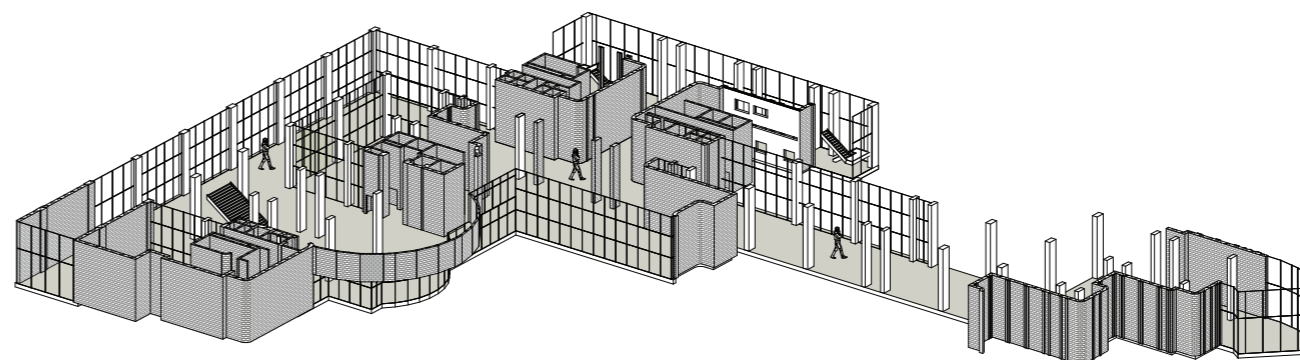
01 SENSORY SPINE Upper Connections

Upper and circulation floor system openings



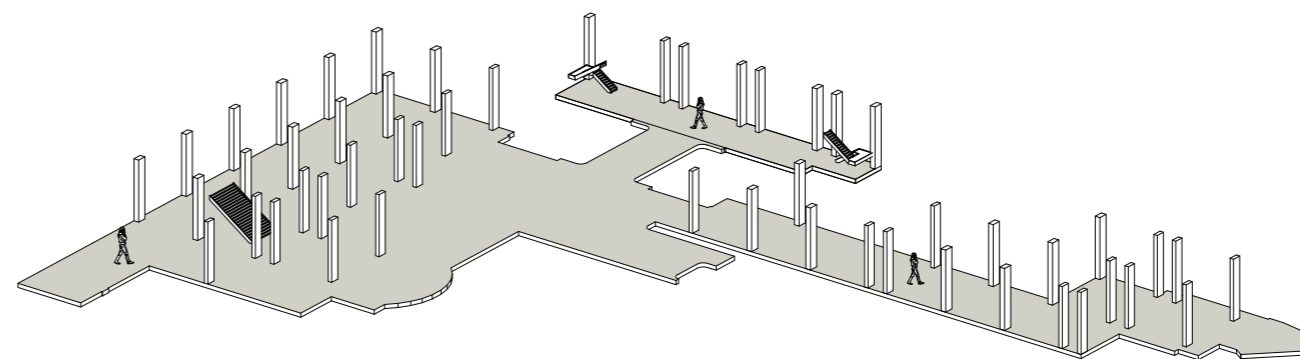
00 SENSORY SPINE Walls & Columns

Main circulation system through existing structural core



00 SENSORY SPINE Columns

Spine rooted in the existing grid system revealed, new circulation route



OVERVIEW

What, How and Why

WHAT

Identifying the Problem

Barriers visually impaired:

- Irregular layouts
 - Strong Reliance Visuals
 - Overstimulating Environments
 - Fragmented Circulation patterns
- (Deines-Jones, 2007; Goldsmith, 1997; Visio, n.d.)



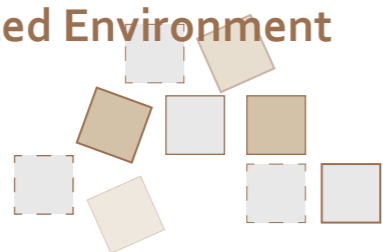
Barriers KB:

- Fragmented Zoning and Circulation
- Poor Wayfinding

Site

- Irregular Pavement Conditions
- Absence of Tactile Pavements
- Dark Corners and Alleyways
- Entrance not Clear/Visible

-> overall **Disorganized Environment**

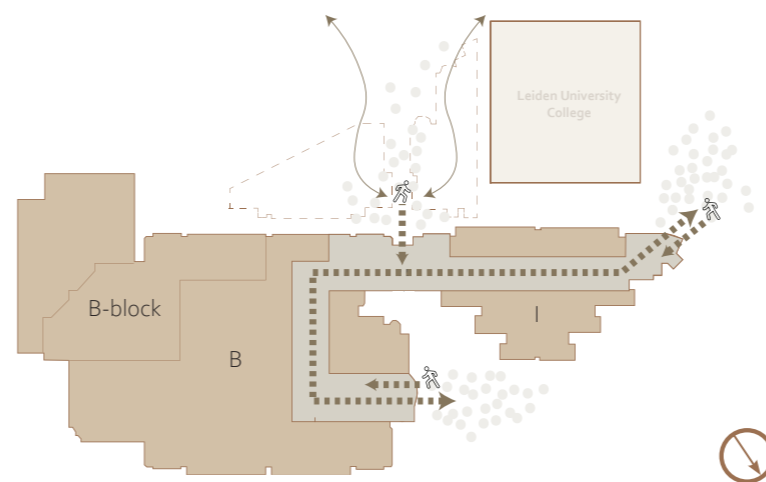


HOW

Proposed Design Solution(s)

The redesign aims to tackle these barriers by introducing a continuous pathway, known as the **Sensory Spine**, serving as the **backbone** of the building and site: improving wayfinding and orientation.

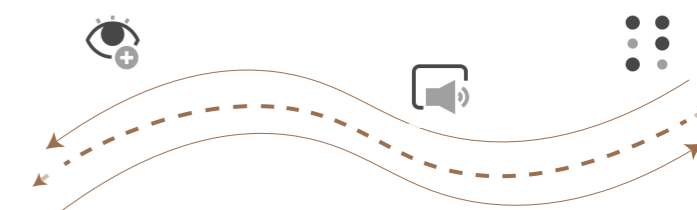
THE SENSORY SPINE



WHY

Justifying the Intervention

Academic literature asserts that inclusive design must include the entire sensory spectrum. **Continuous uninterrupted pathways** enhanced by sensory stimuli promote spatial memory and orientation, especially for those with visual impairments (Goldsmith, 1997).



Deines-Jones, C. (Ed.). (2007). Improving library services to people with disabilities. Elsevier.
 Goldsmith, S. (1997). Designing for the disabled. London: Architectural Press.
 Koninklijke Visio. (n.d.). Over toegankelijkheid. <https://www.visio.org/professional/toegankelijkheid/over-toegankelijkheid/>

CONTENT

21. **RESEARCH**
Main question and sub questions
24. **RESEARCH METHODS**
Design framework
27. **OBSERVATIONS**
Barriers Site and Building
37. **RESEARCH TO DESIGN**
Design Concept
41. **HERITAGE VALUES**
Past Informing Present
62. **PROGRAM**
New proposal
67. **MASTERPLAN**
Sensory Spine
73. **ARCHITECTURE IN LAYERS**
Facade, details, comfort & climate

PROGRAM PROPOSAL

PROGRAM

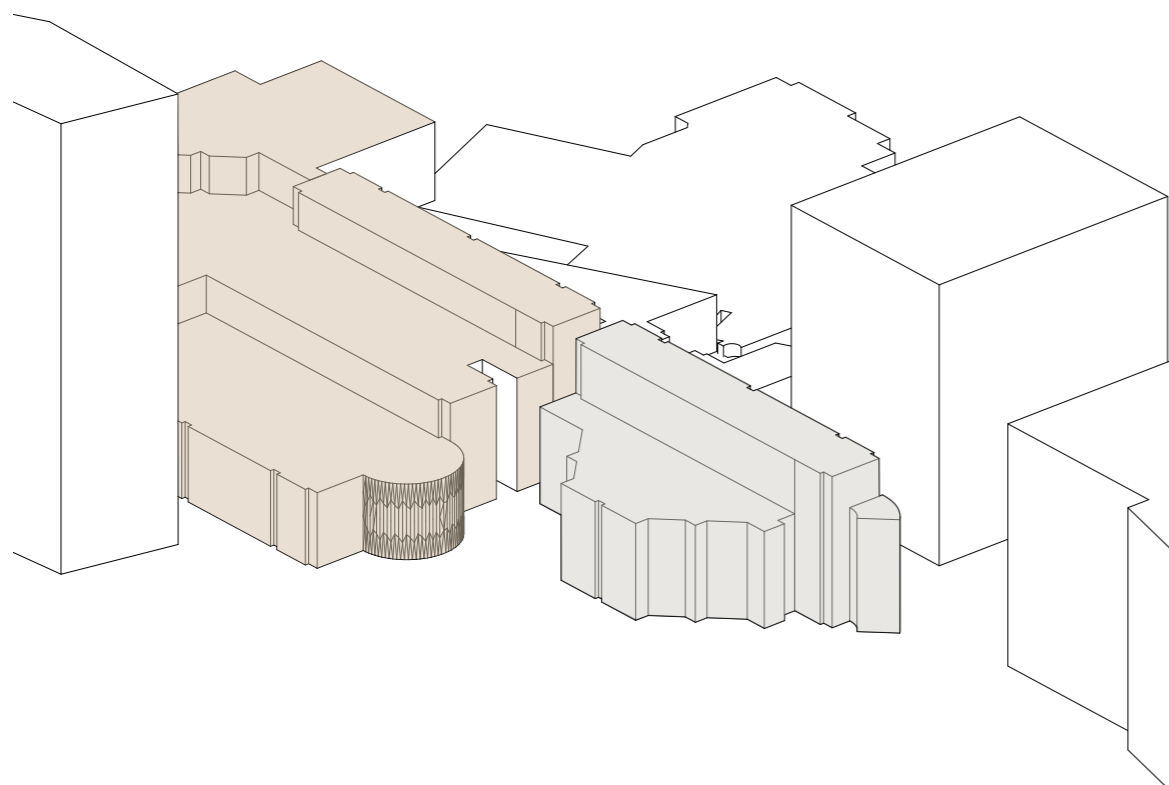
Proposal

1.

KONINKLIJKE BIBLIOTHEEK (THE KB)

Mission:

Unite people and knowledge by preserving the written **cultural heritage** of the **Netherlands** and fostering reading, research, and lifelong learning (Koninklijke Bibliotheek, n.d.)



2.

'THE HOUSE OF SENSES AND STORIES'

Mission:

Connect visitors, through an **inclusive** and immersive experience, with **Dutch cultural heritage** through a **multisensory** approach: touch, sound, scent *and* sight.

Visitors do not just **read** history, they *feel* it.

Why?:

Transforms cultural content into **sensory experiences**, while introducing a program that **enhances the KB's role** beyond conventional reading and doing research.

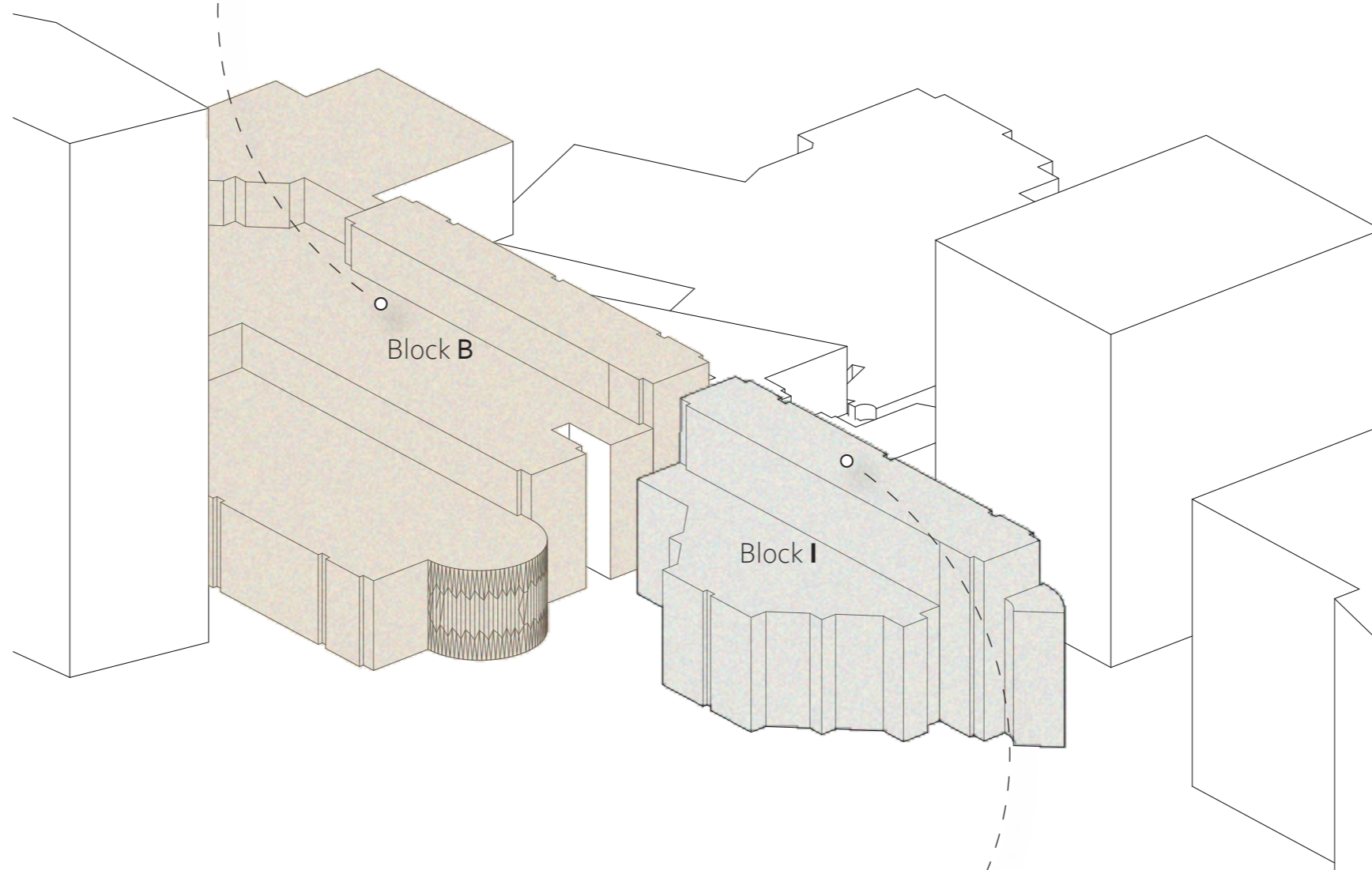
Inspired by:

Taalhuis Amsterdam (Nederland in Zintuigen), ARTIS-Groote Museum: Geurtunnel.

PROGRAM

Proposal

KONINKLIJKE BIBLIOTHEEK (THE KB)
National Library of the Netherlands



THE HOUSE OF SENSES AND STORIES
A Multisensory Museum of Dutch Culture

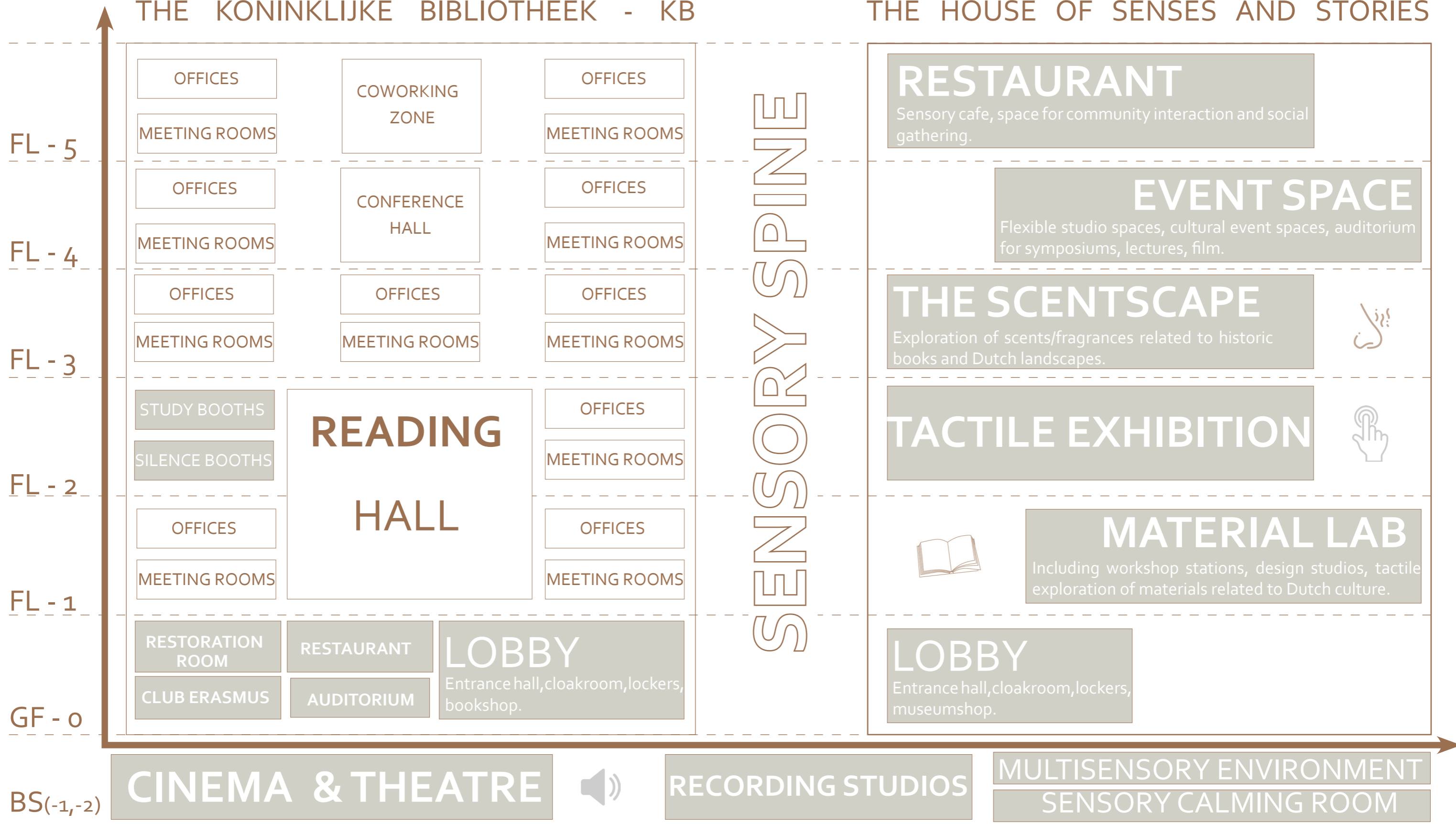
Total square meters:	
Block B:	+/- 38,900 m ²
Block I:	+/- 12,400 m ²
Total:	51,300 m²

PROGRAM

Proposal

THE KONINKLIJKE BIBLIOTHEEK - KB

THE HOUSE OF SENSES AND STORIES



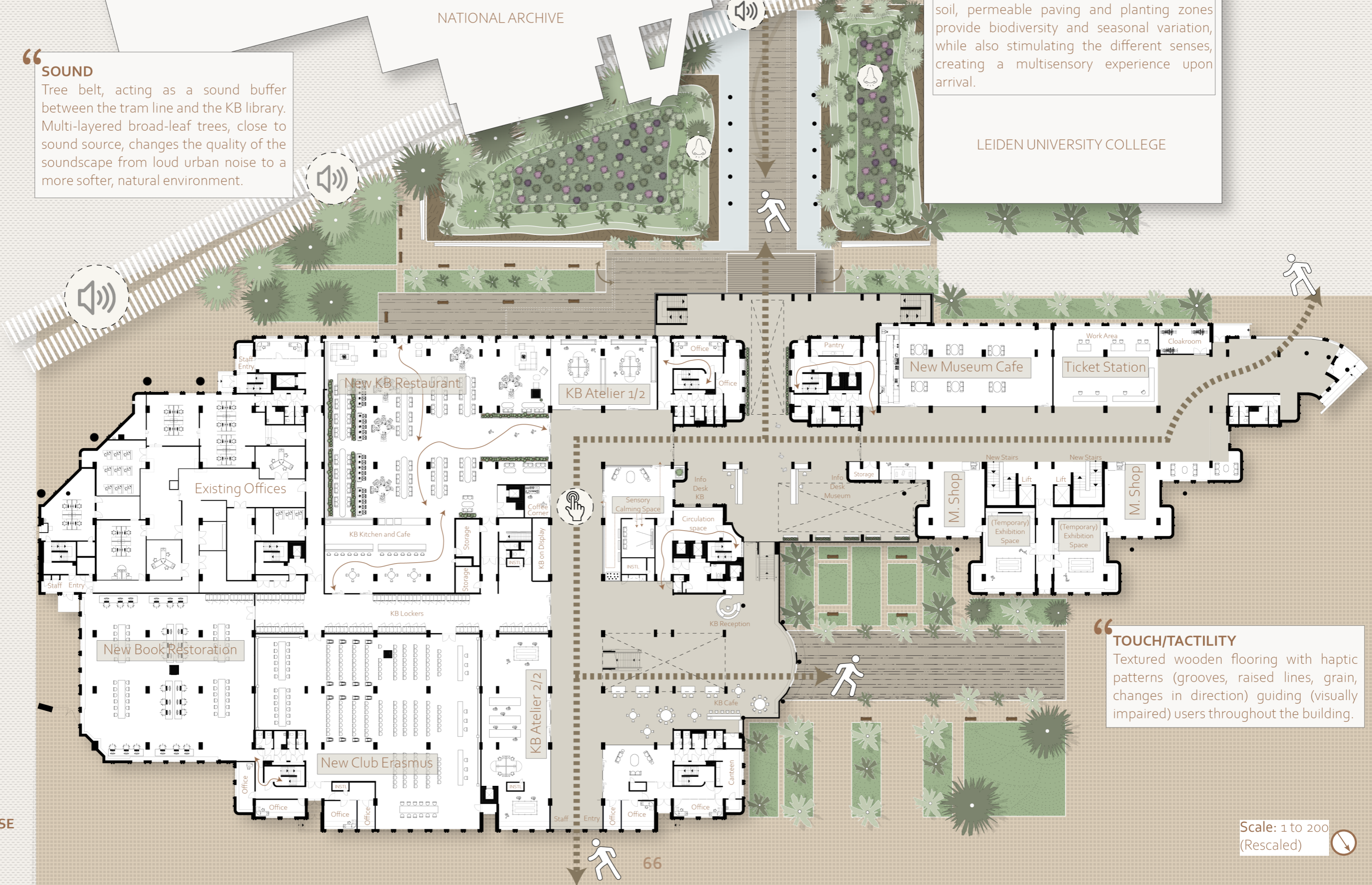
MASTERPLAN

MASTERPLAN

Ground Floor

SOUND
Tree belt, acting as a sound buffer between the tram line and the KB library. Multi-layered broad-leaf trees, close to sound source, changes the quality of the soundscape from loud urban noise to a more softer, natural environment.

SOUND/SMELL/SIGHT
Shallow planted wadi planted in front of the new wood-framed facade, capturing rainwater and creating a cooler microclimate and evaporative cooling during summer. Diverse soil, permeable paving and planting zones provide biodiversity and seasonal variation, while also stimulating the different senses, creating a multisensory experience upon arrival.



TOUCH/TACTILITY
Textured wooden flooring with haptic patterns (grooves, raised lines, grain, changes in direction) guiding (visually impaired) users throughout the building.

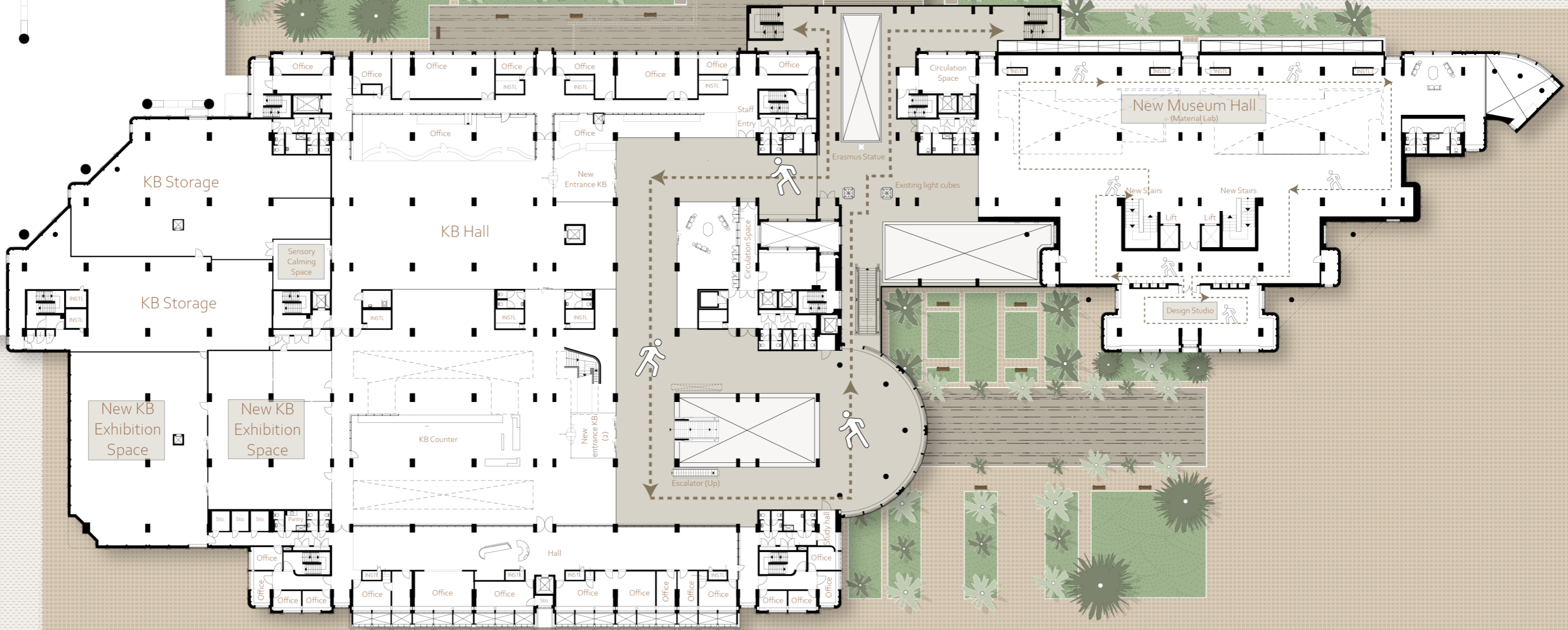
-  R1 RETHINK
-  R7 REPURPOSE
-  R8 RECYCLE

Scale: 1 to 200
(Rescaled)

FIRST FLOOR

NATIONAL ARCHIVE

LEIDEN UNIVERSITY COLLEGE

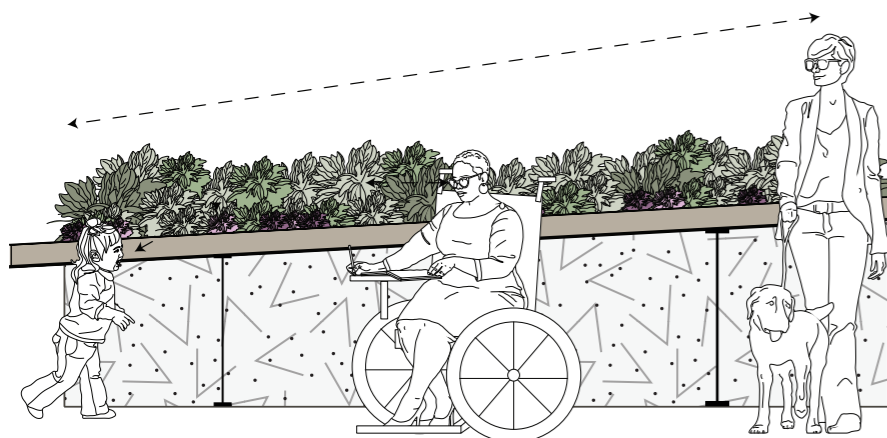


Scale: 1 to 200
(Rescaled)



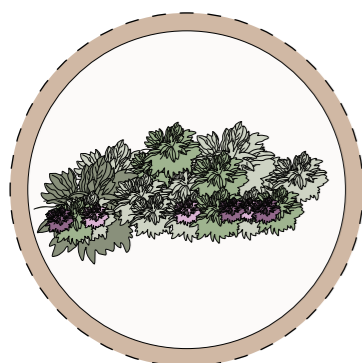
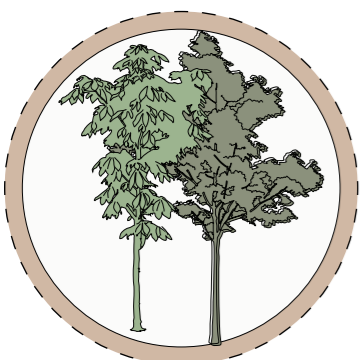
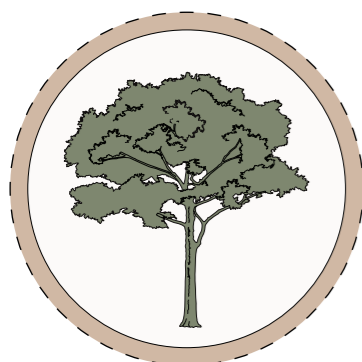
MASTERPLAN

Site



TOUCH/SMELL

An integrated planter made from recycled concrete rubble (a rough porous material) creates a tactile and sensory edge along the wadi. Varying in height it invites all users - regardless of impairment - to touch, smell and taste aromatic plants, fostering inclusivity, biodiversity and community interaction.



SIGHT/SOUND

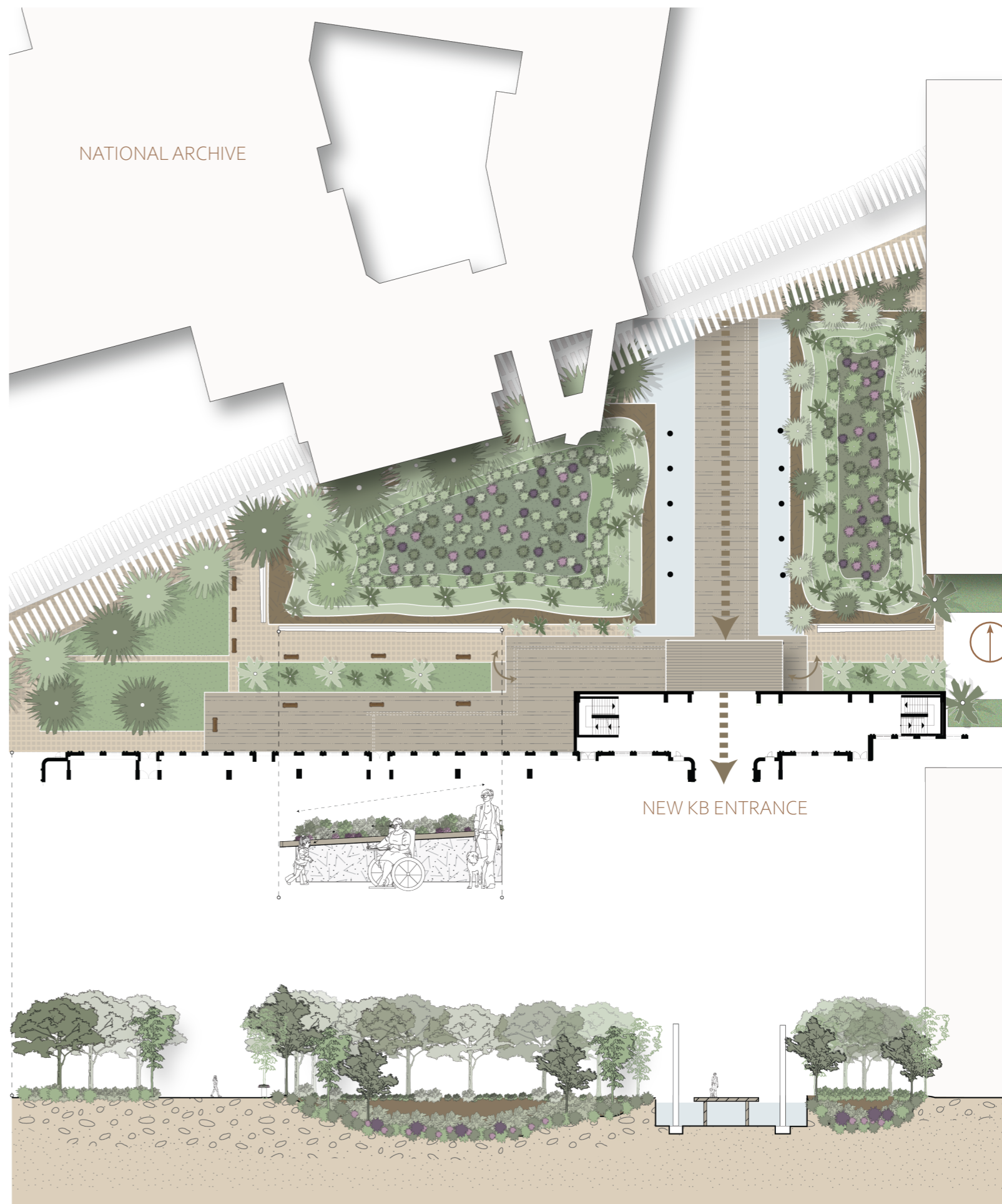
Medium height, broadleaf trees acting as partial acoustic and visual buffers, contributing to a calmer perception and sensory quality of the KB site.

SIGHT/SOUND

Medium height, smaller broadleaf deciduous trees (wide, flat leaves), shedding annually during the fall with colors shifting every season, rustling in the wind, offering shade and filtering light.

SIGHT/SOUND/SMELL

Dense low shrubs and aromatic plants, with textured foliage, scents activated by sun, year-round greenery with drought resistance. Grasses and aromatic herbs, releasing subtle scents when wet, gentle swaying in the wind, tolerating flooding and attracting different insects and birds.

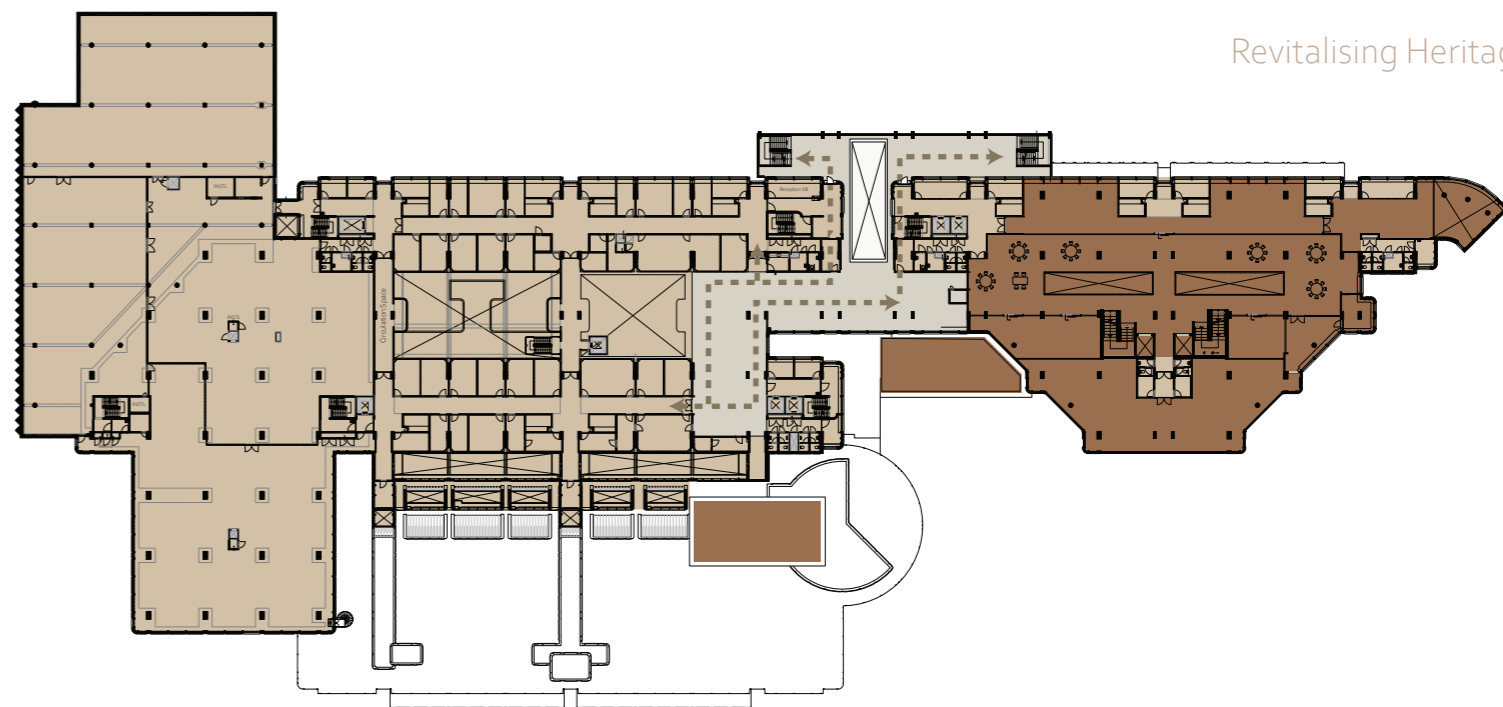


INTERVENTIONS

Old - New

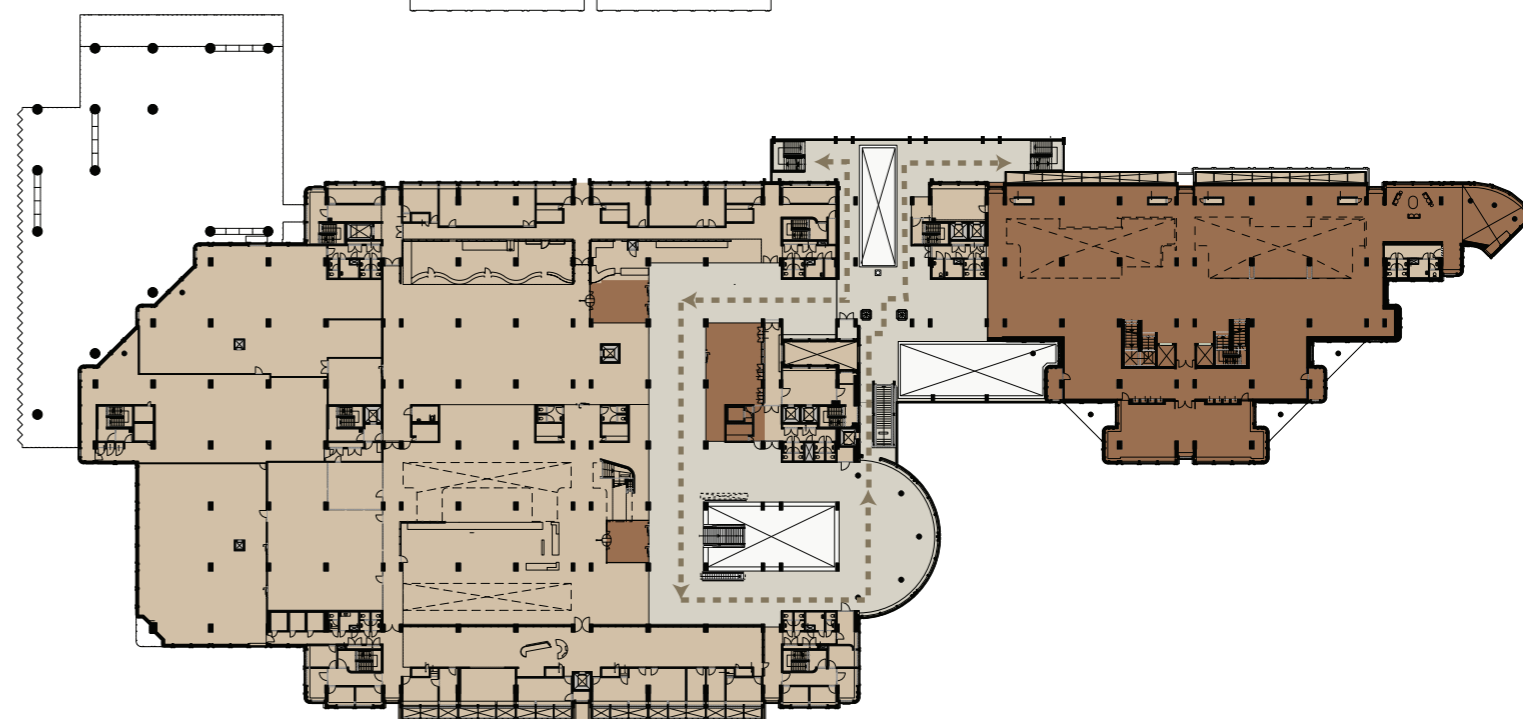
FIFTH FLOOR

(Level 5)



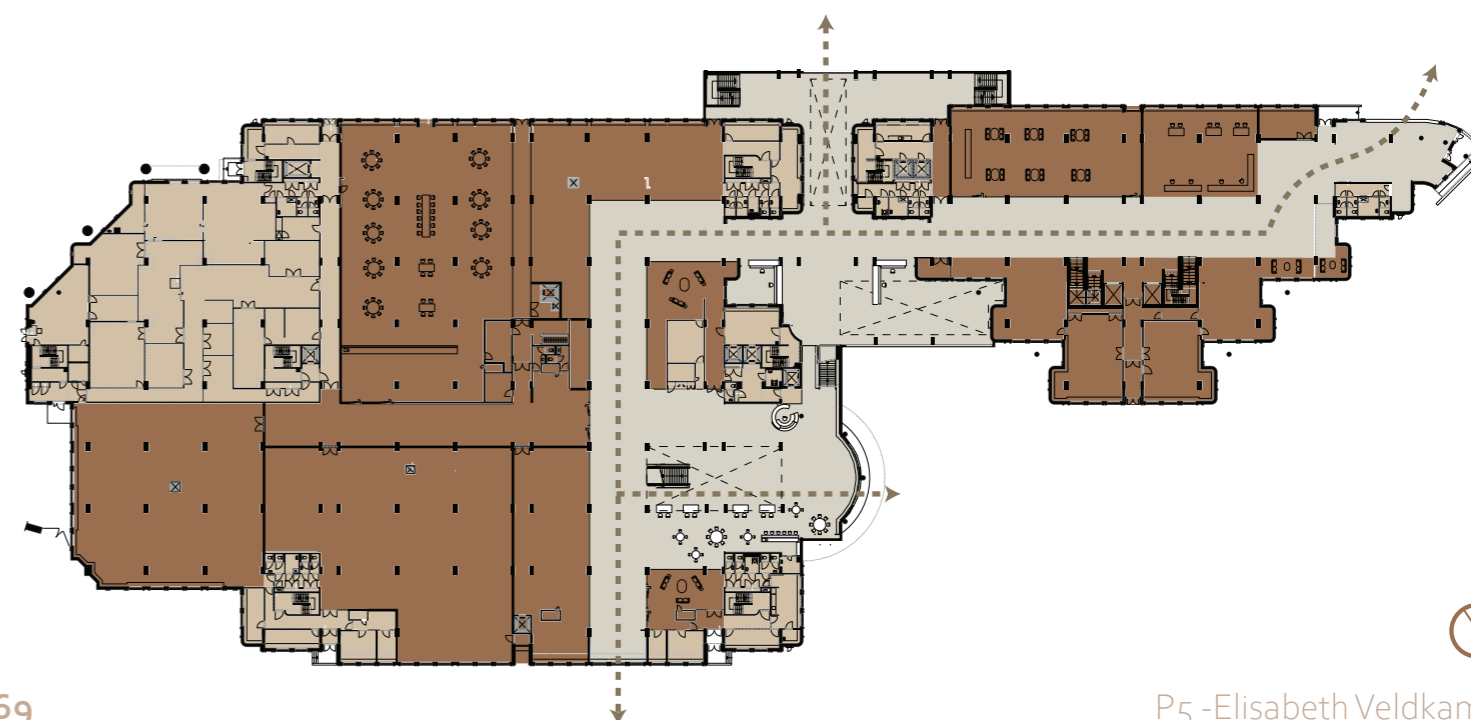
FIRST FLOOR

(Level 1)



GROUND FLOOR

(Level 0)

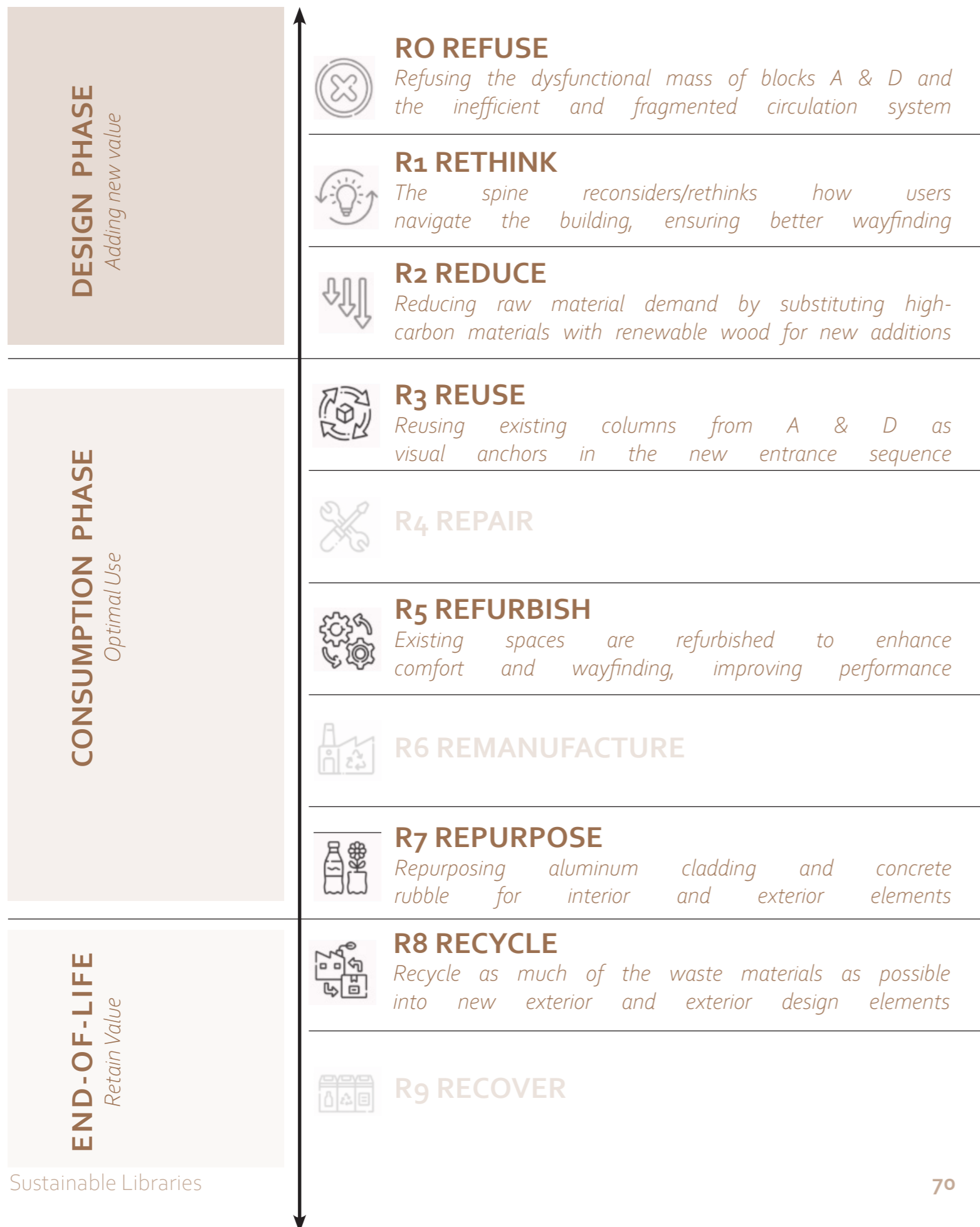


- NEW
- EXISTING
- SPINE (New)



R-STRATEGIES

Design Hierarchy



SDGs

Design Contribution



CONTENT

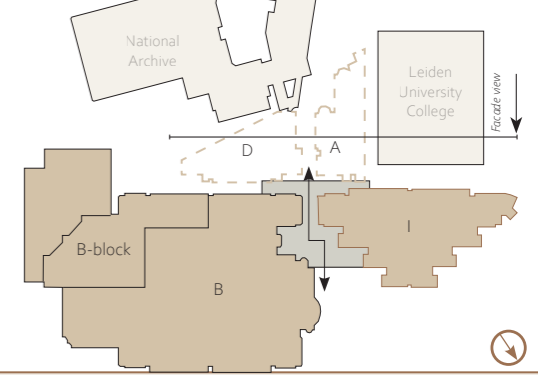
21. **RESEARCH**
Main question and sub questions
24. **RESEARCH METHODS**
Design framework
27. **OBSERVATIONS**
Barriers Site and Building
37. **RESEARCH TO DESIGN**
Design Concept
41. **HERITAGE VALUES**
Past Informing Present
62. **PROGRAM**
New proposal
66. **MASTERPLAN**
Sensory Spine
73. **ARCHITECTURE IN LAYERS**
Facade, details, comfort & climate

ARCHITECTURE IN LAYERS

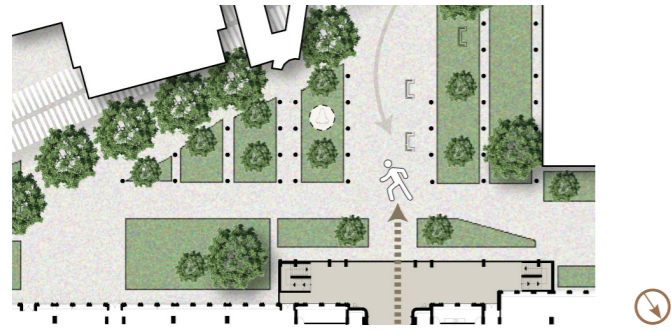
MATRIX

Facade Scenarios - BT

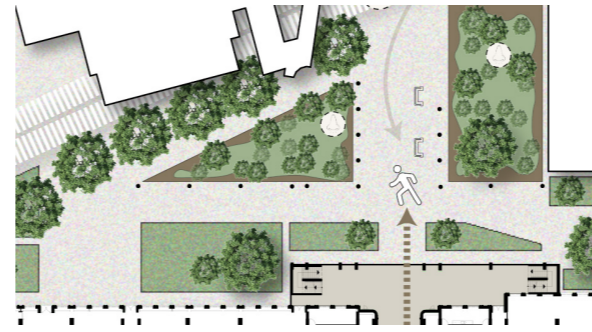
Keep parts of structure
 Keep
 Add



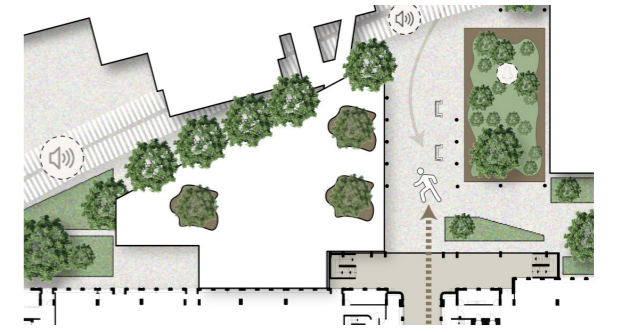
Scenario B *plan strategy*



Scenario B.1 *plan strategy*



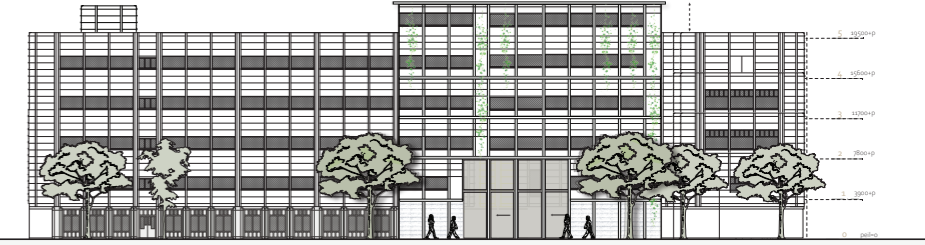
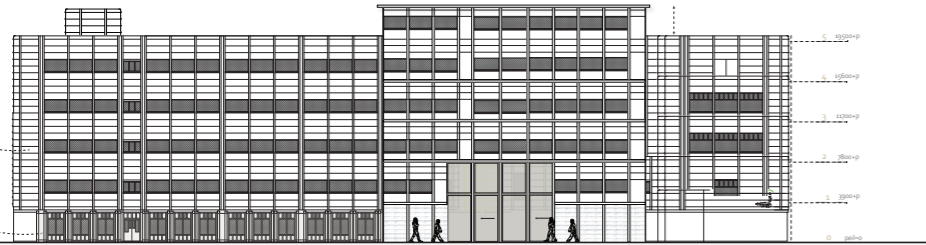
Scenario B.2 *plan strategy*



Scenario B *recycled aluminum cladding*

Scenario B.1 *new wooden structure*

Scenario B.2 *recycled aluminum cladding + green planters*



THE SENSES

Touch



Cold, metallic, less tactile



Warm, textured, comfortable microclimate



Natural shading, pleasant airflow



Smell



Limited sensory richness



Scents released through variation in vegetation, aromatic plants, wet soil and wood



Earthy, organic, seasonal fragrances



Sound



Green belts buffer noise



Natural calm soundscape from water and biodiverse vegetation



Wind, rain, muffled tram noise



Sight



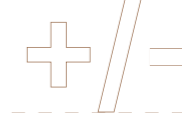
Rigid, closed, fortress-like appearance



Warm wood tones, balanced rhythm of cold and warm, inviting facade





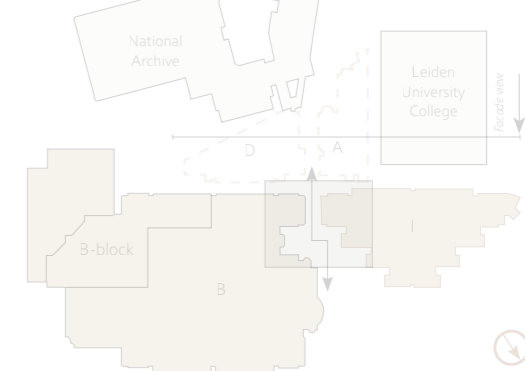
Dynamic green facade, light and shadow play - takes a while for plants to grow



MATRIX

Facade Scenarios - BT

-  Keep parts of structure
-  Keep
-  Add



Scenario B *plan strategy*



Scenario B.1 *plan strategy*



Scenario B.2 *plan strategy*



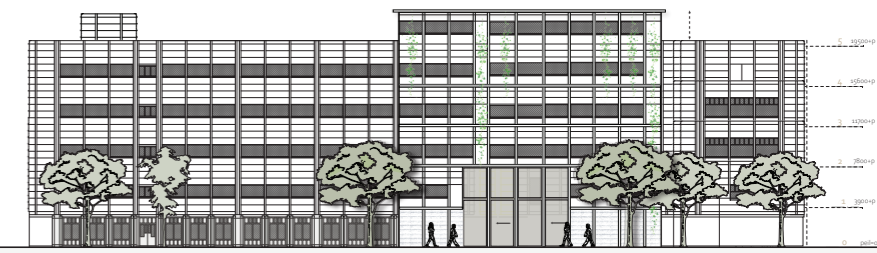
Scenario B *recycled aluminum cladding*



Scenario B.1 *new wooden structure*



Scenario B.2 *recycled aluminum cladding + green planters*



THE SENSES

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Rigid, closed, fortress-like appearance



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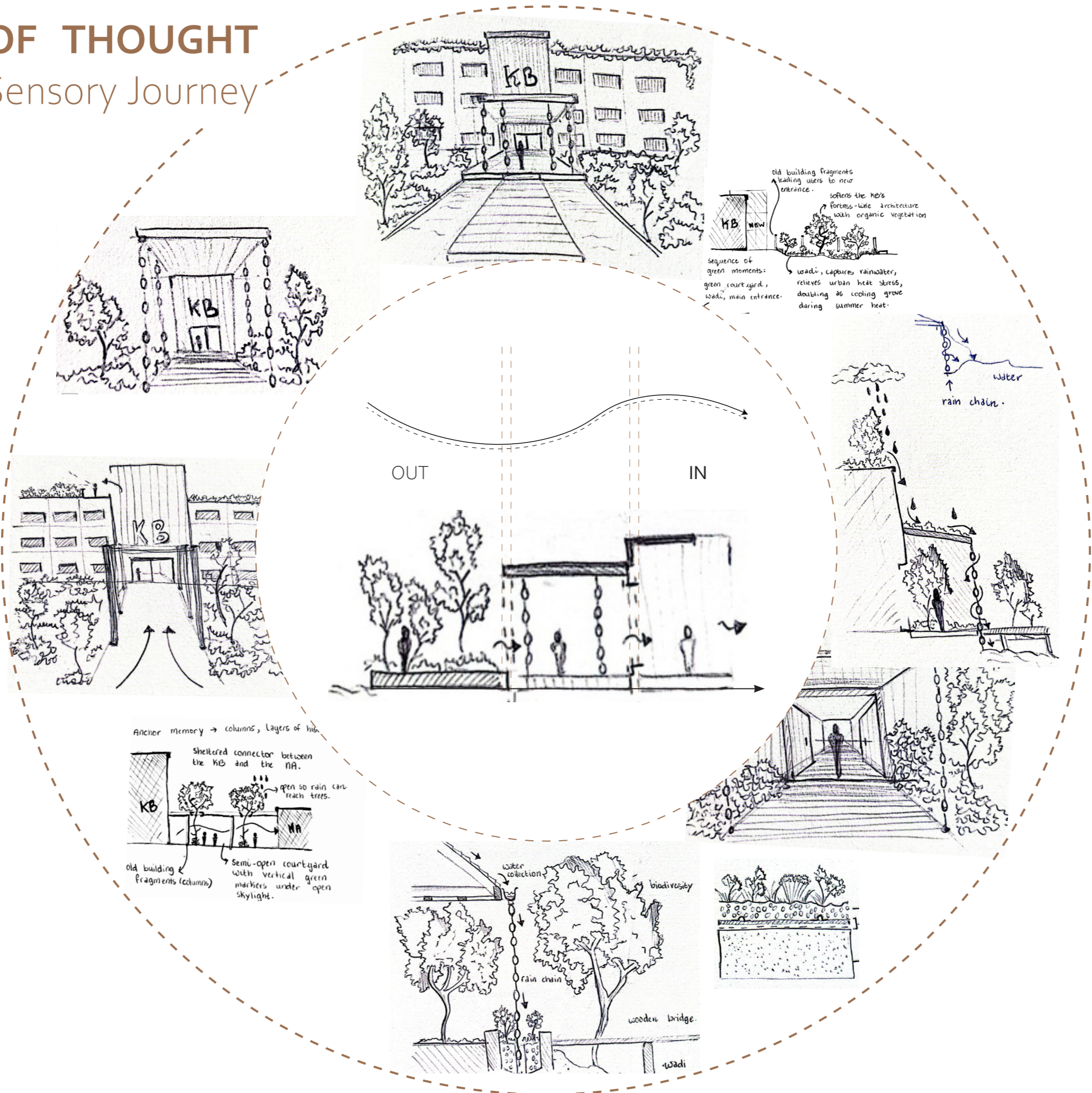


Dynamic green facade, light and shadow play - takes a while for plants to grow



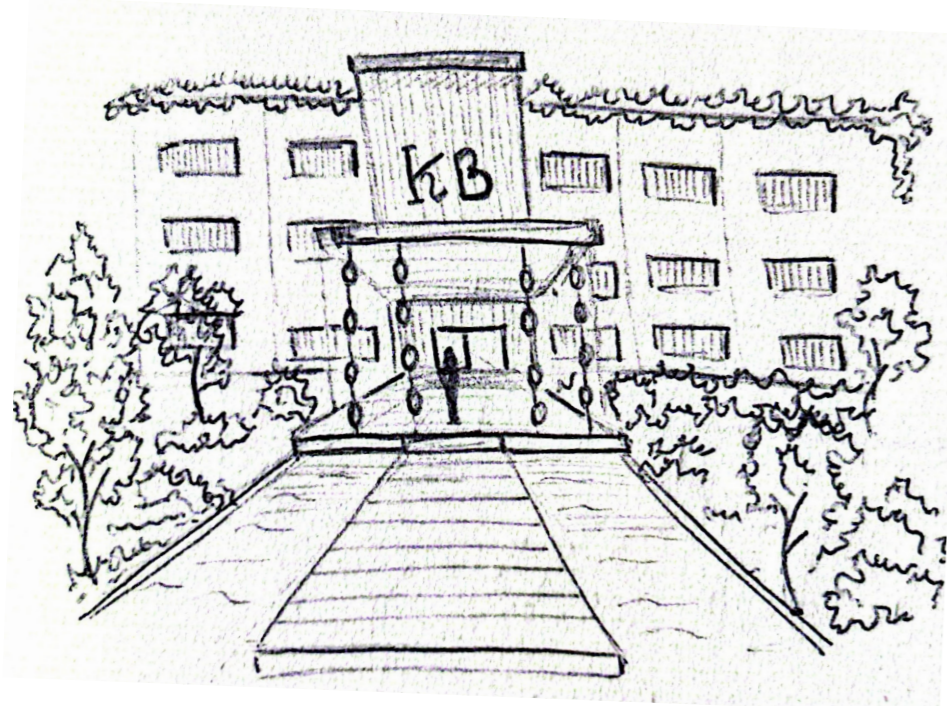
SKETCHES OF THOUGHT

Mapping the Sensory Journey



MATRIX

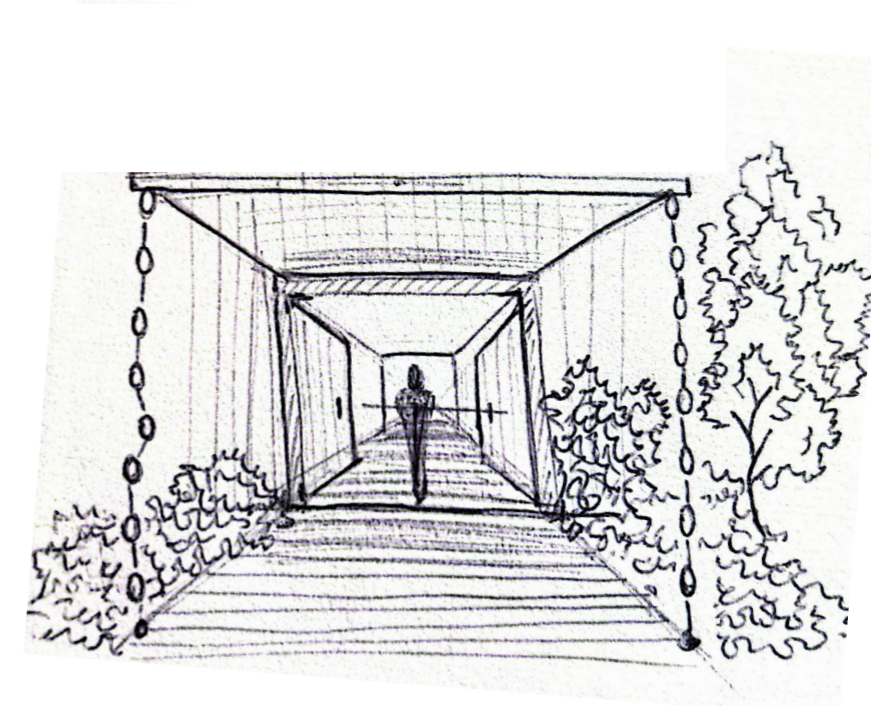
Related Senses



01. THE APPROACH



02. THE THRESHOLD



03. THE ARRIVAL

THE SENSES

Touch



Leaving the 'outside world'. Users arrive at the new green square in front of the KB entrance, and come across the **elevated wooden bridge** above the wadi. Users sense the **haptic wooden floors** when walking on the bridge.

Smell



Fresh, earthy scents arise from the biodiverse and aromatic vegetation alongside the wadi and bridge.

Sound



When it rains, the **soft sounds of water rippling** through the **rain chains** into the wadi, while the **wooden planks** slightly **creak** when users step onto it and enrich the transition from the outside world to the new entrance of the KB.

Sight



When users approach the new square, they can see the **soft reflections** of the sky and new facade in the water alongside the bridge, **framed by greenery**, creating a moment of **sensory relief** and calmness before entering the KB.

After rain, the mist from the rain chains gently brushes against the skin, as droplets slowly flow down to the water basin.

Scents intensify when **rainwater interacts with soil** and aromatic plants in the wadi.

The **rhythmic sound of trickling water** under the canopy contrasts with the loudness of the city.

Rain chains catch incoming sunlight, while they sway among climbing plants, vines and biodiverse vegetation surrounding the green square. Oversized tactile 'KB' letters serve as a visual & tactile landmark, illuminated for night-time security and low vision wayfinding.

Textured double doors framed by the wooden facade fins lead users deeper into the building, while a **textured path** serves as an intuitive, non-visual navigation tool.

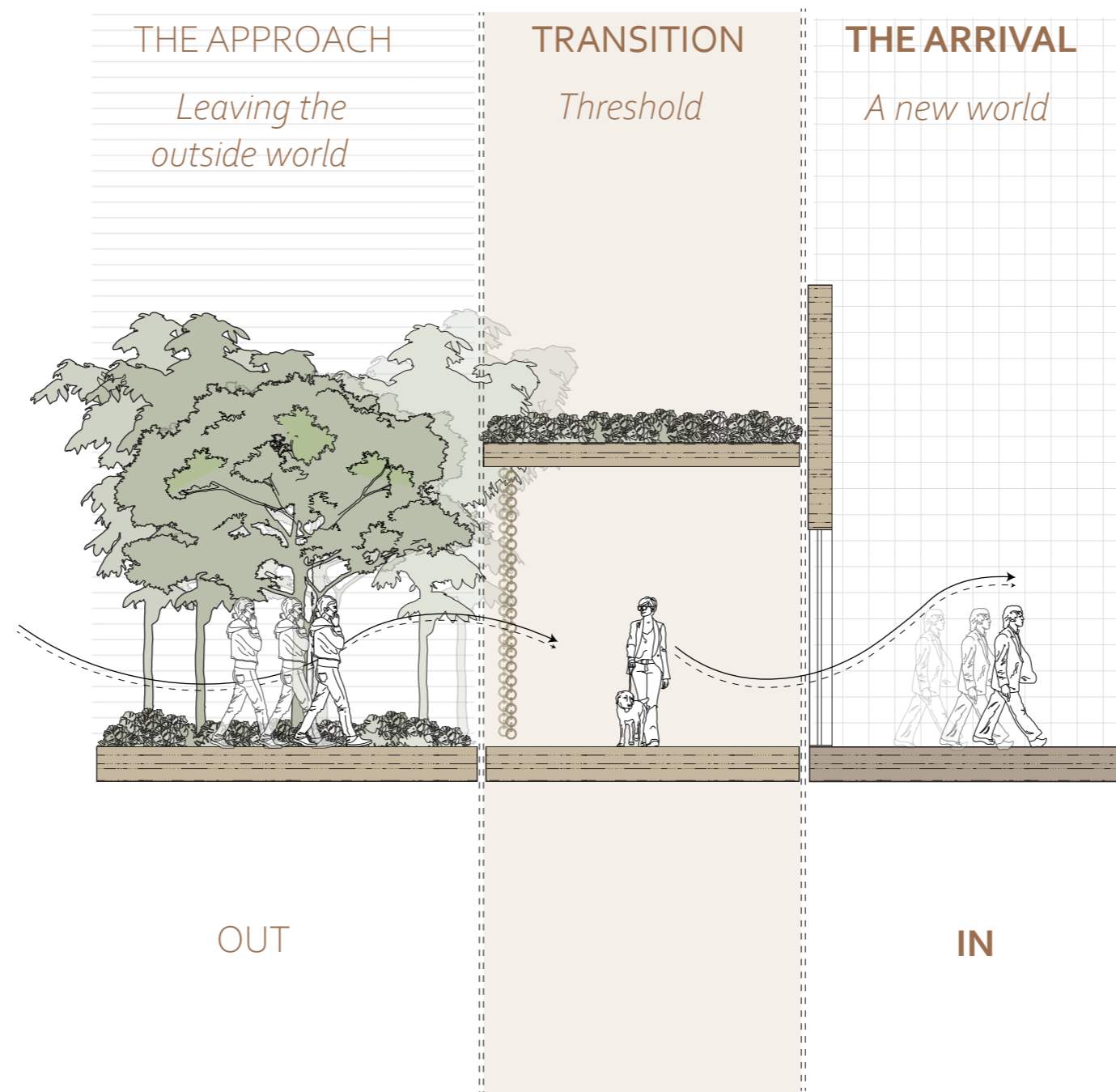
The presence of seasonal plants and vines surrounding the entrance canopy release **subtle fragrances**, marking different seasons.

Slowly the outside sounds fades, replaced by softer indoor tones as users enter the sensory spine.

Vertical facade fins possibly shifting and showing the KB letters, biodiverse vegetation surrounding the entrance: a **lively gateway** into the **sensory realm** inside.

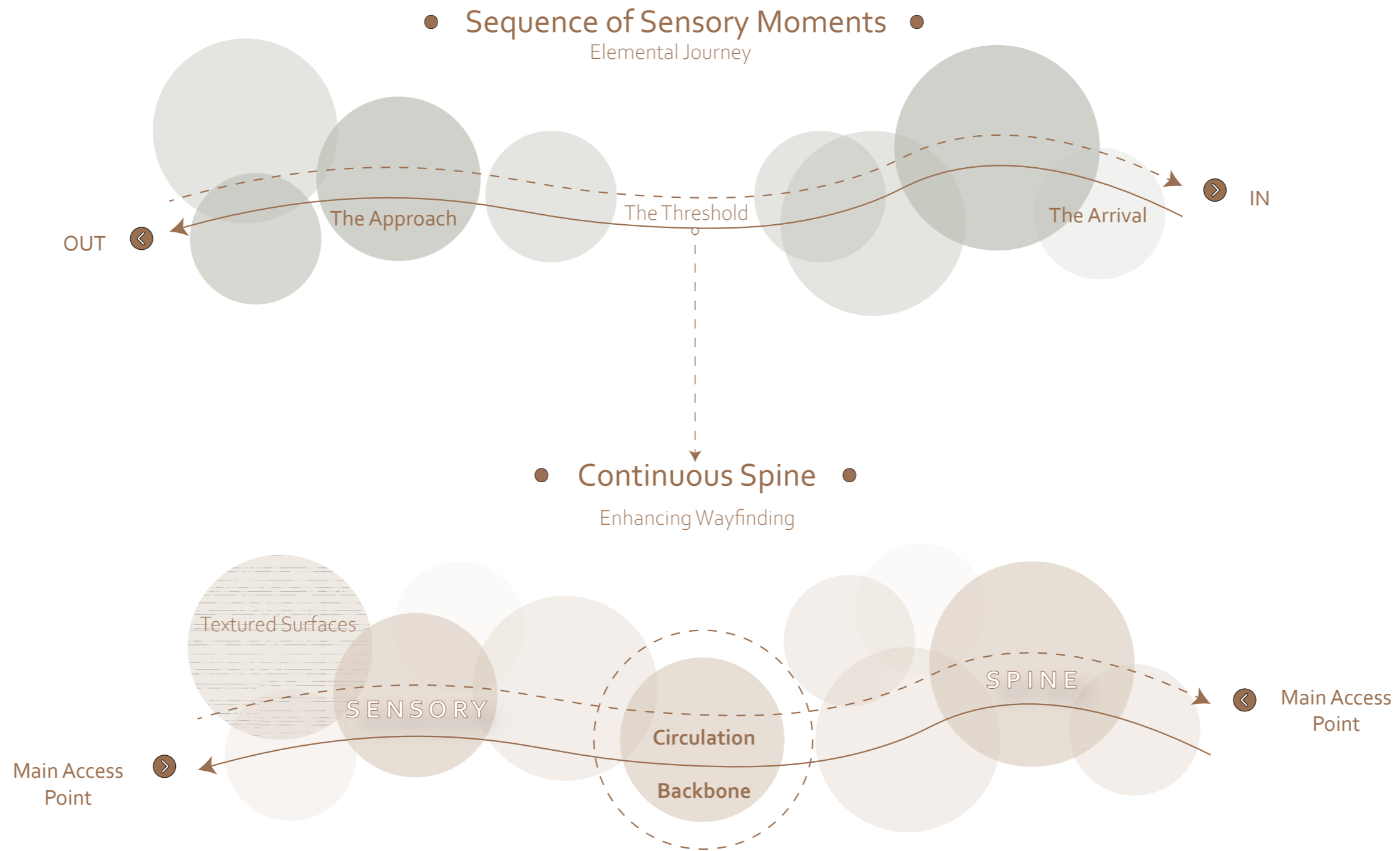
SEQUENCE OF MOMENTS

Approach, Transition, Arrival



SEQUENCE OF MOMENTS

Green to Spine, City to Library



Elements to Spine: A sequence of **sensory moments** passes across the **threshold** and flows inward as a continuous **Sensory Spine**.

CONTEXT

Impact on Urban Level

CURRENT

Urban Heat Trap



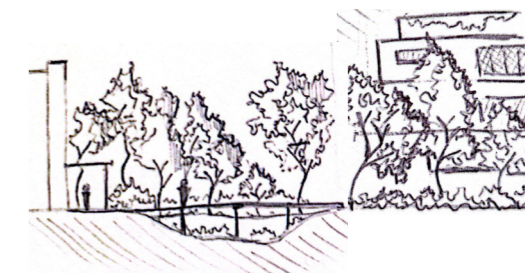
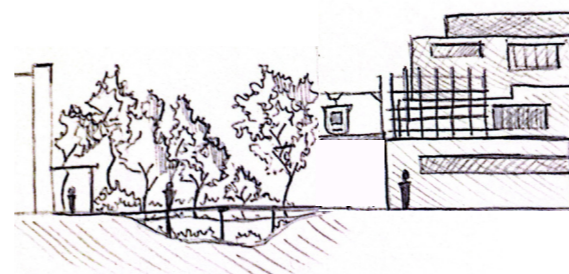
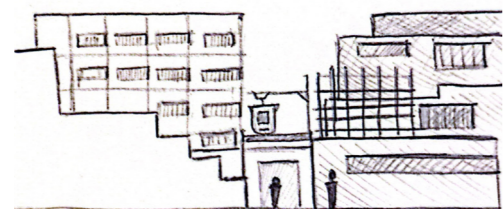
FUTURE

Emerging Green square



FAR FUTURE

Urban Habitat



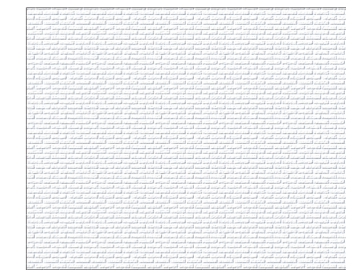
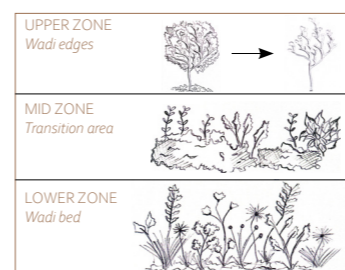
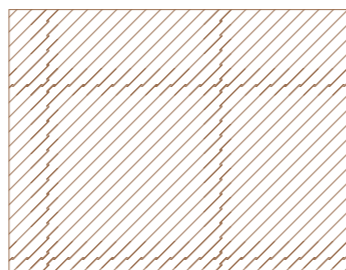
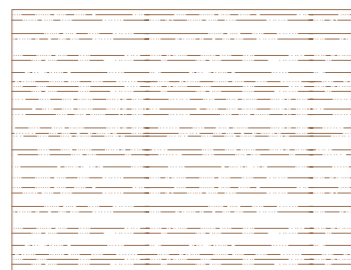
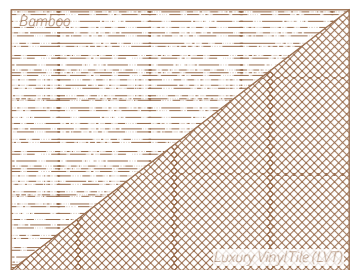
LETS GO ON A JOURNEY...

SECTION AA'

Sequence of Moments

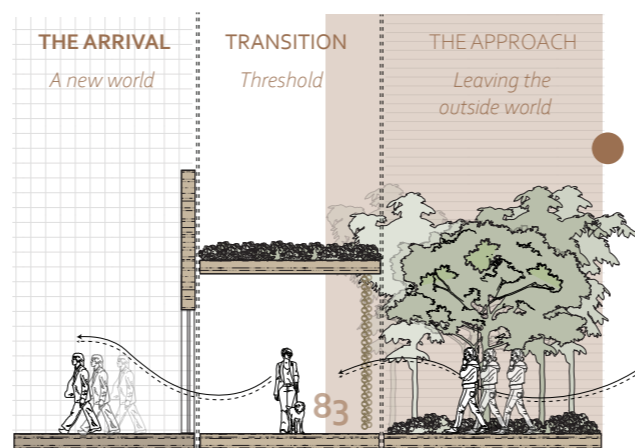


BAMBOO / LVT ← WARM WOODEN ELEMENTS ← METAL RAIN CHAINS ← BIODIVERSE GREEN - WADI ← (ACCOYA) WOODEN BRIDGE ← CLICKER BRICK PAVEMENT



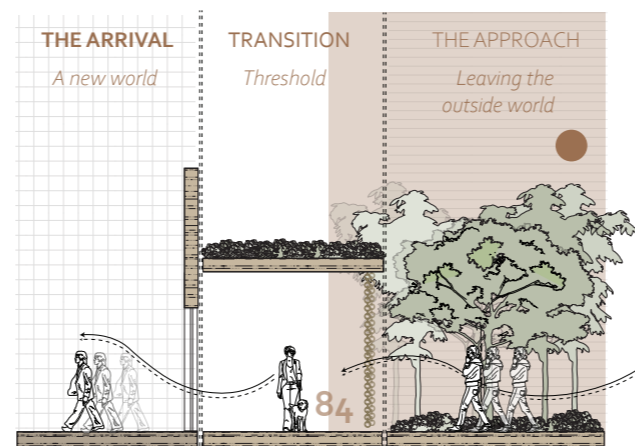
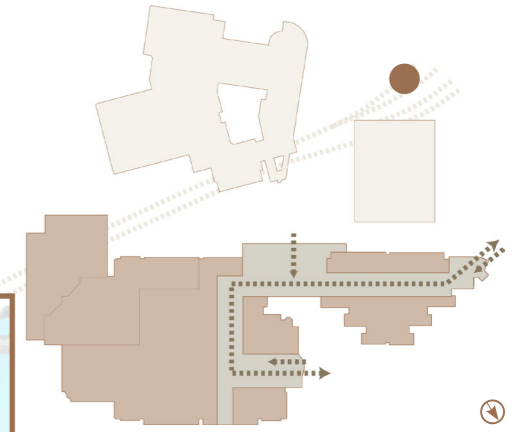
THE APPROACH (1/4)

Hard, Loud, Paved



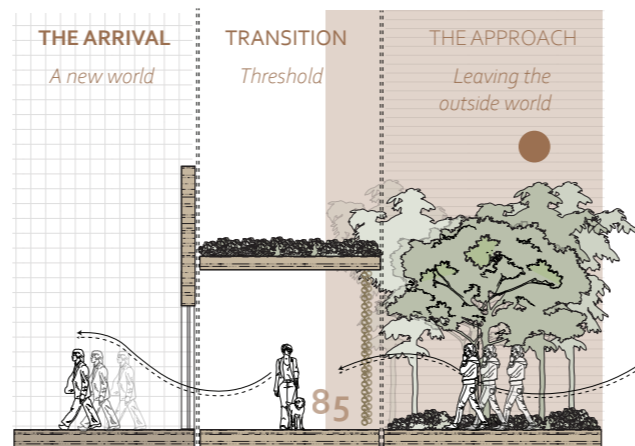
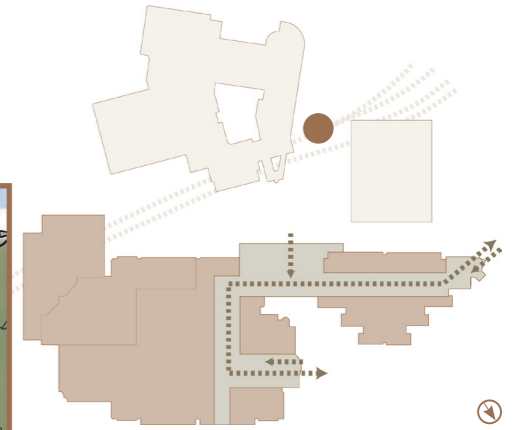
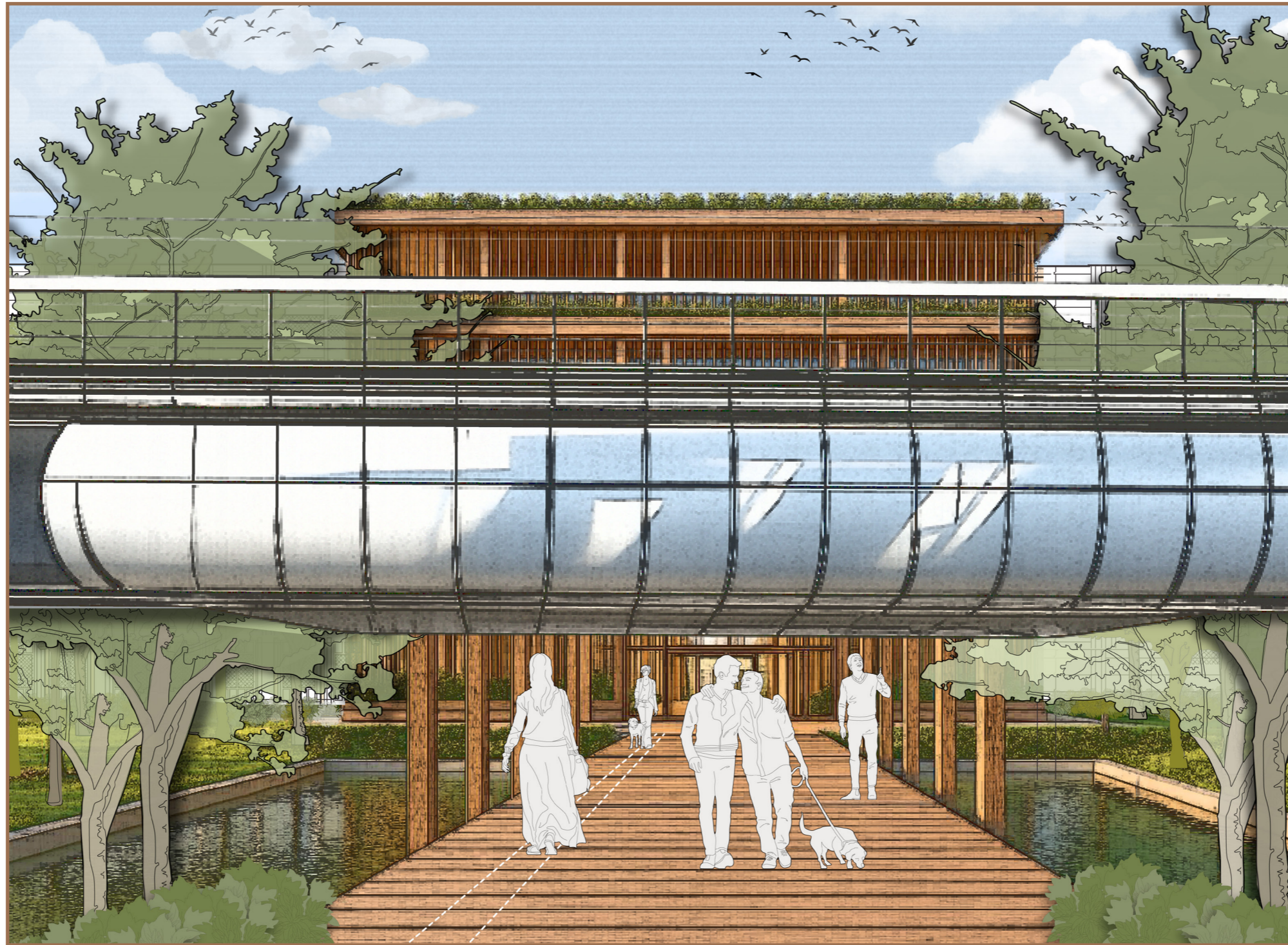
THE APPROACH (2/4)

Urban Forecourt



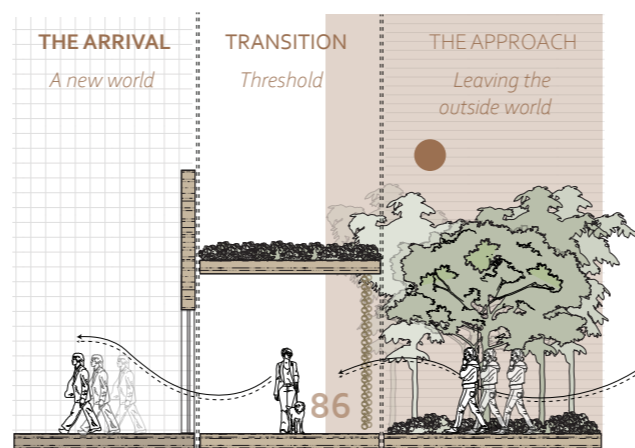
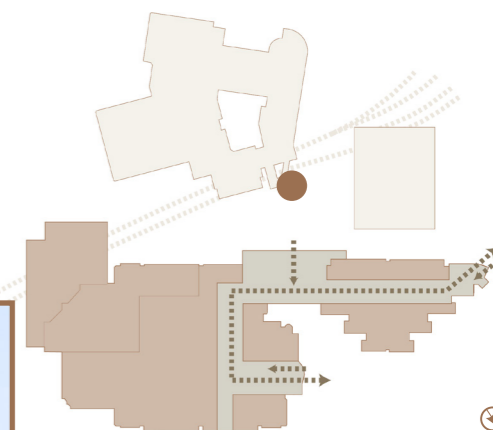
THE APPROACH (3/4)

Threshold Beneath Transit



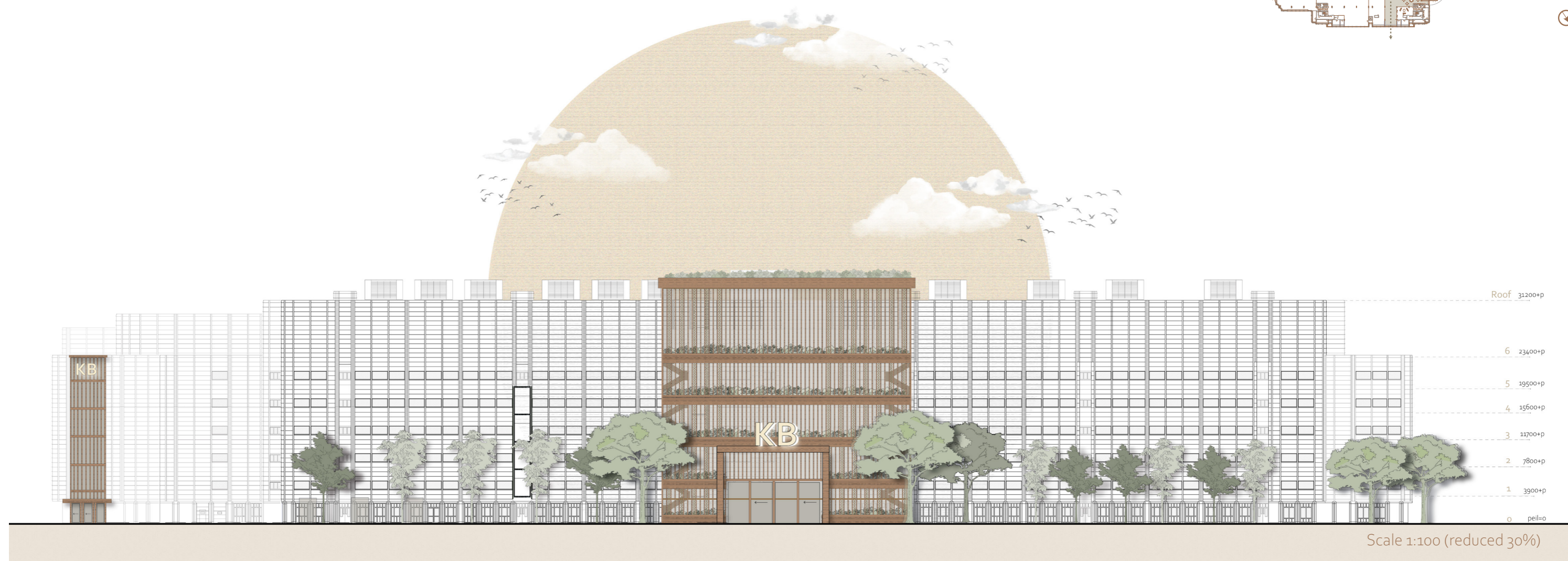
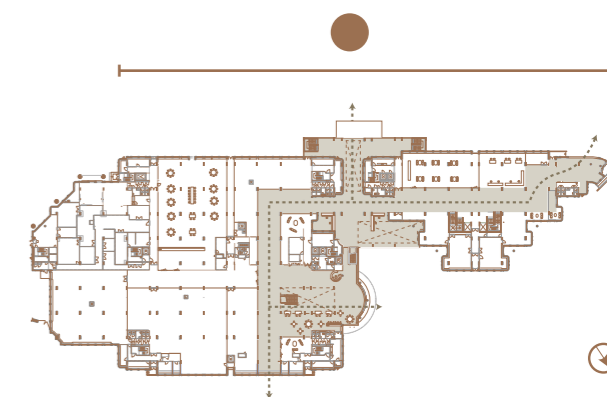
THE APPROACH (4/4)

Green, Tactility, Calm

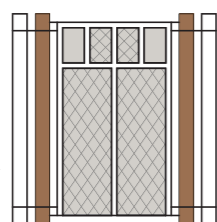


SOUTHWEST ELEVATION

Strategies



1. Opening up the Plinth
Opening up the former door zones, allowing natural light to penetrate into the sensory spine.



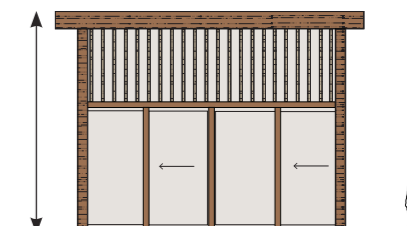
2. New greenery
(Aromatic) plants that reduce urban heat island effect, increases biodiversity, and provides sensory relief outdoors.



3. Living Facade
Integrated planters, rain chains, wooden fins, enhance microclimate, shading and sensory experience along the facade.



4. Threshold Emphasis
Increased entrance height enhancing orientation and spatial anticipation, guiding users towards the inside.



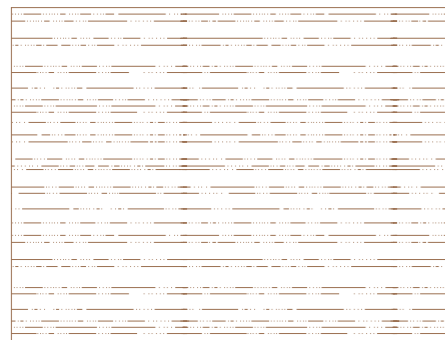
SOUTHWEST ELEVATION

New Facade Fragment

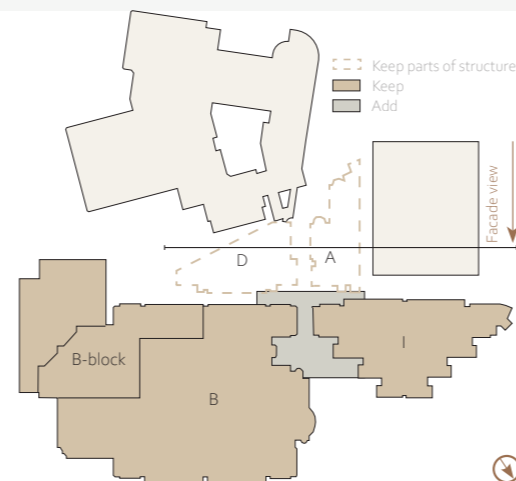
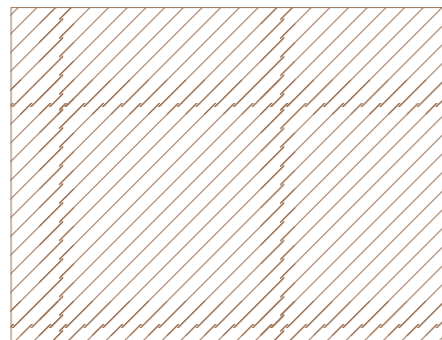


Southwest elevation refined 1:200

Accoya Wood
Vertical fins, planters, canopy

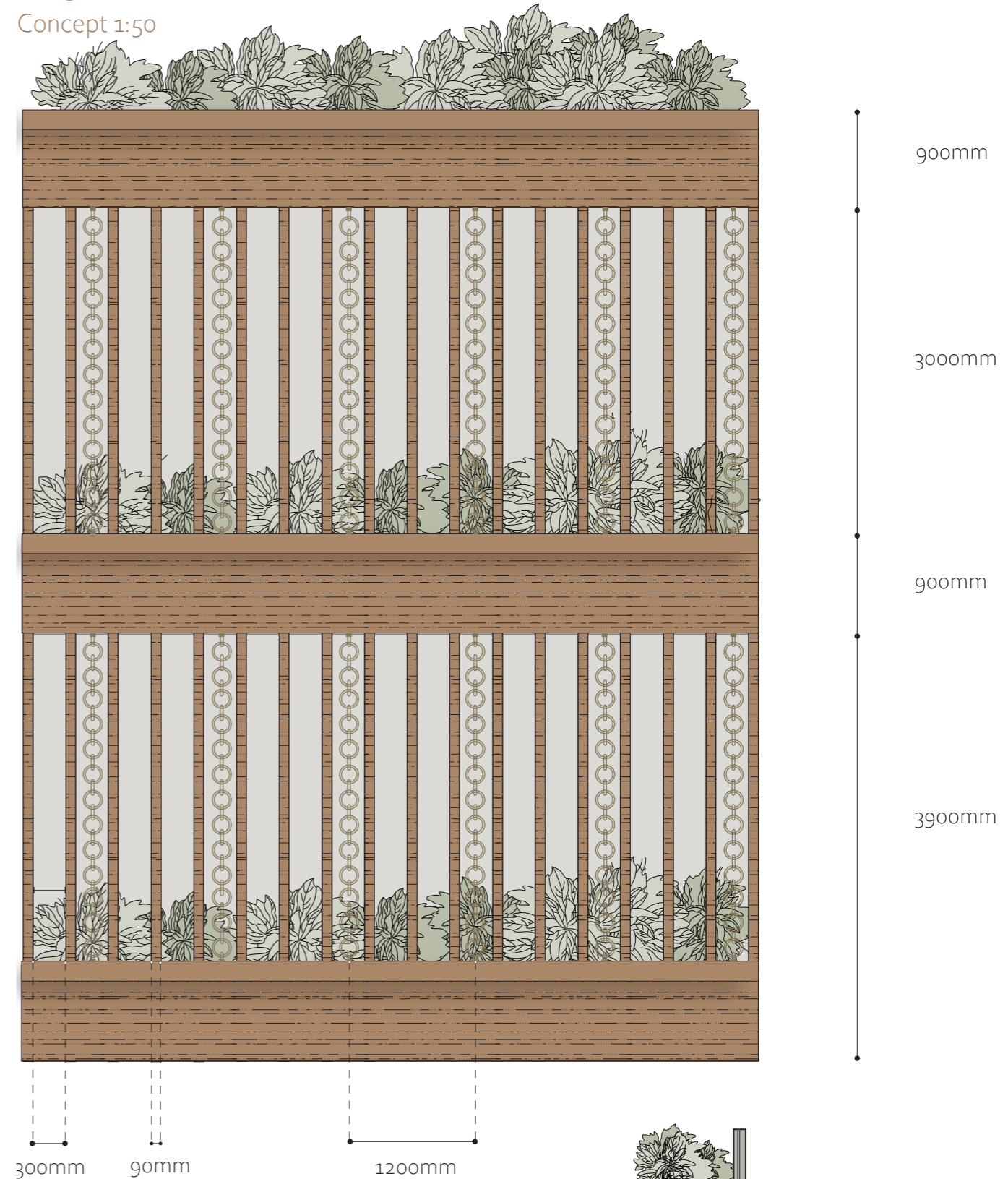


Copper/Stainless Steel
Brushed/matte rain chains



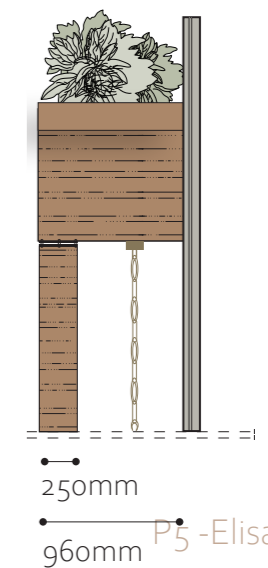
FRONT VIEW

Concept 1:50



SIDE VIEW

Concept



DESIGN STATEMENT

The new façade follows the **horizontal grid** of Arie Hagoort's **modular system**, ensuring structural and aesthetic continuity (Galema, 2017). In contrast, the **vertical Accoya/Cedar fins** introduce a **new rhythm**, enhancing shading, depth, and tactile perception, while maintaining harmony with the building's horizontal order. Together with integrated wooden planters and a renewed palette of wood, metal, glass, and vegetation, the design **softens the aluminum rigidity** and **creates a climate-responsive, multisensory façade**. This approach extends the KB's architectural rationale through sensory and technical innovation, reinforcing its heritage values and **enhancing user comfort and engagement**.

Galema, W. (2017). Waarderend Onderzoek Koninklijke Bibliotheek Prins Willem Alexanderhof 1, Den Haag.

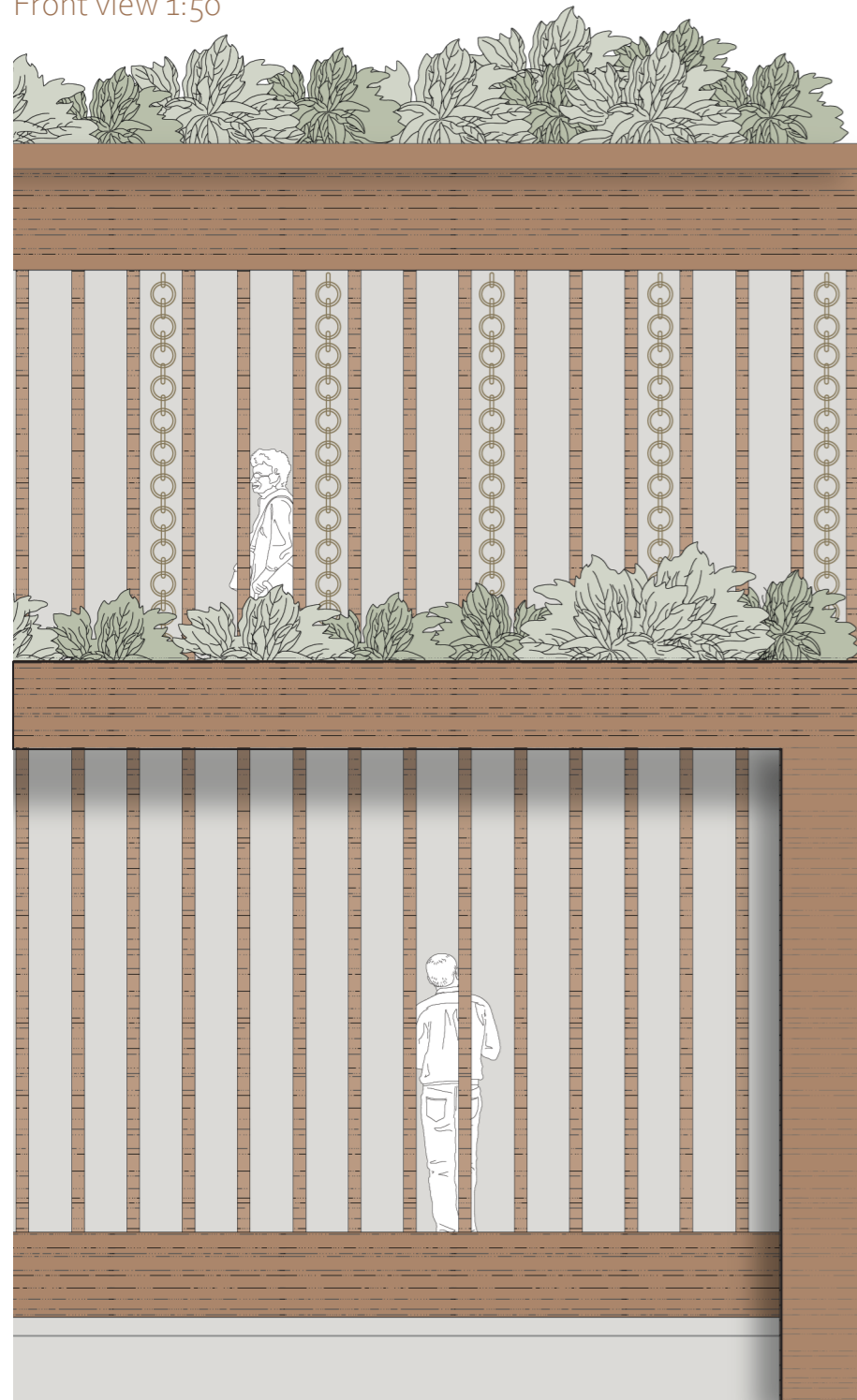
DETAILS

SOUTHWEST FRAGMENT

Cross Section

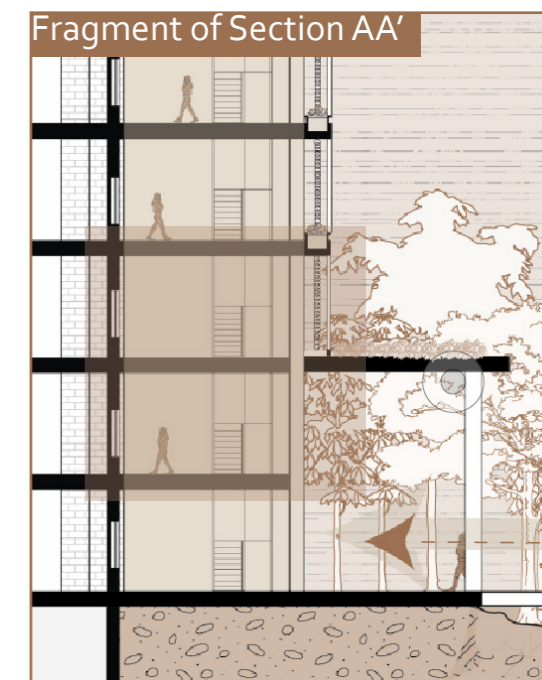
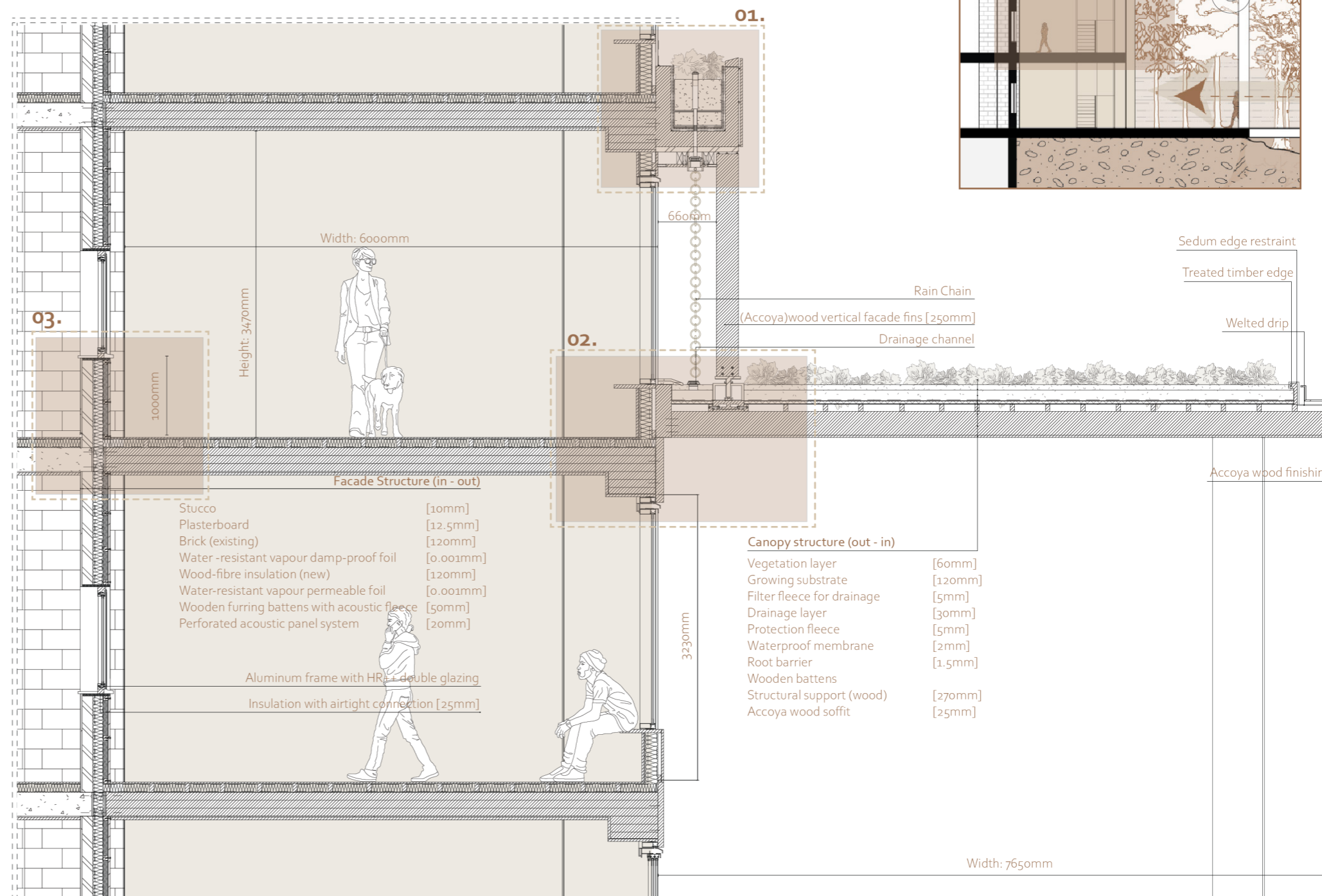
FACADE FRAGMENT

Front view 1:50



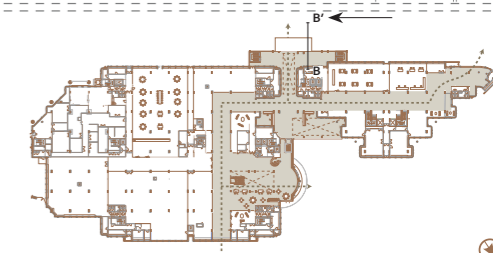
CROSS SECTION BB'

Side section 1:50



Further research on facade materials illustrated that the user of a darker toned cedar wood would enrich the sensory experience even further, by enhancing contrast and rhythm against the existing white aluminum panels. The distinct warm fragrance of cedar (especially when wet) evokes the sense of smell on arrival, while its tone ages gracefully over-time, creating a dynamic, tactile, warm and sensory rich new facade edition.

■ New

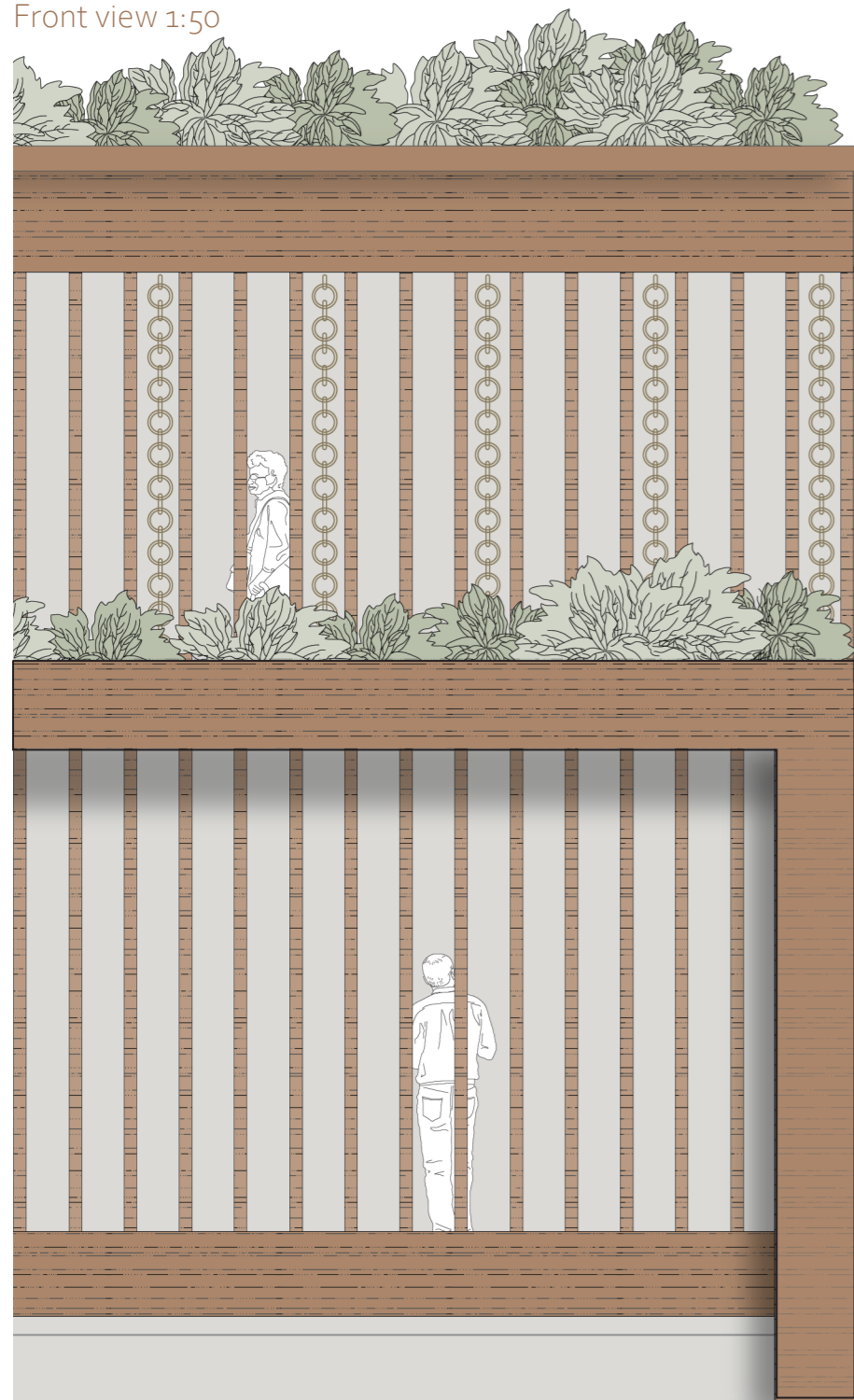


SOUTHWEST FRAGMENT

Cross Section

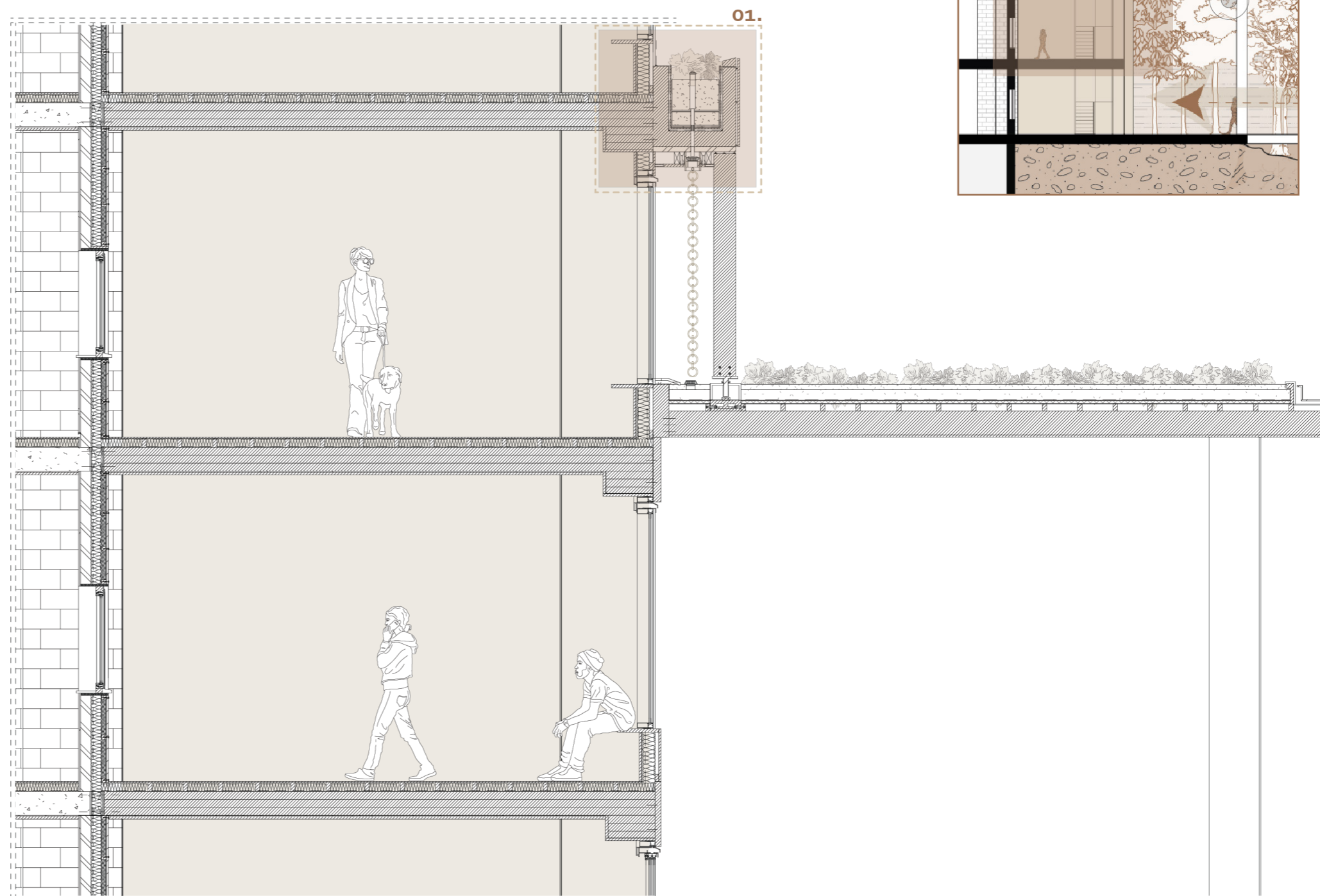
FACADE FRAGMENT

Front view 1:50



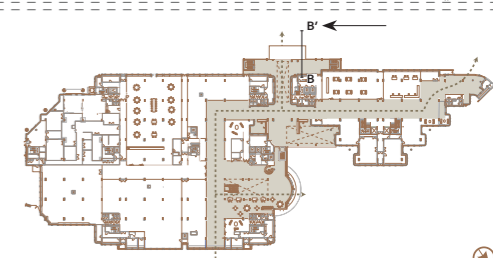
CROSS SECTION BB'

Side section 1:50



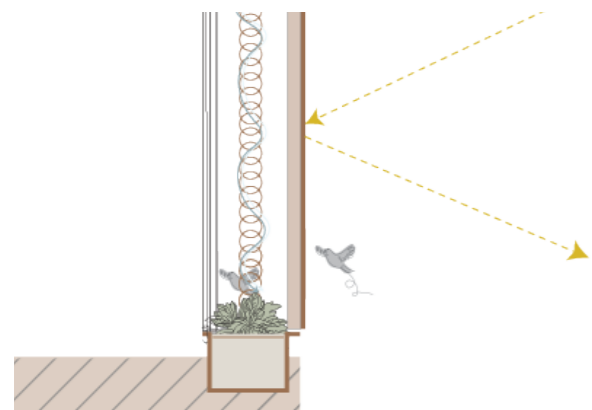
■ New

Fragment of Section AA'



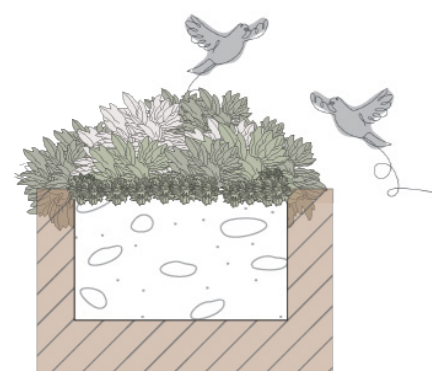
DETAIL 01

Integrated Facade Planter



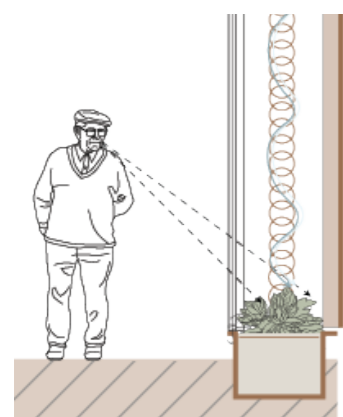
OUT - SENSORY EXPERIENCE

The integrated rain chains, wooden facade fins and planters create a gentle soundscape and enhance microclimatic comfort outside, while reducing glare and enhancing biodiversity through gradual water flow and evaporation.



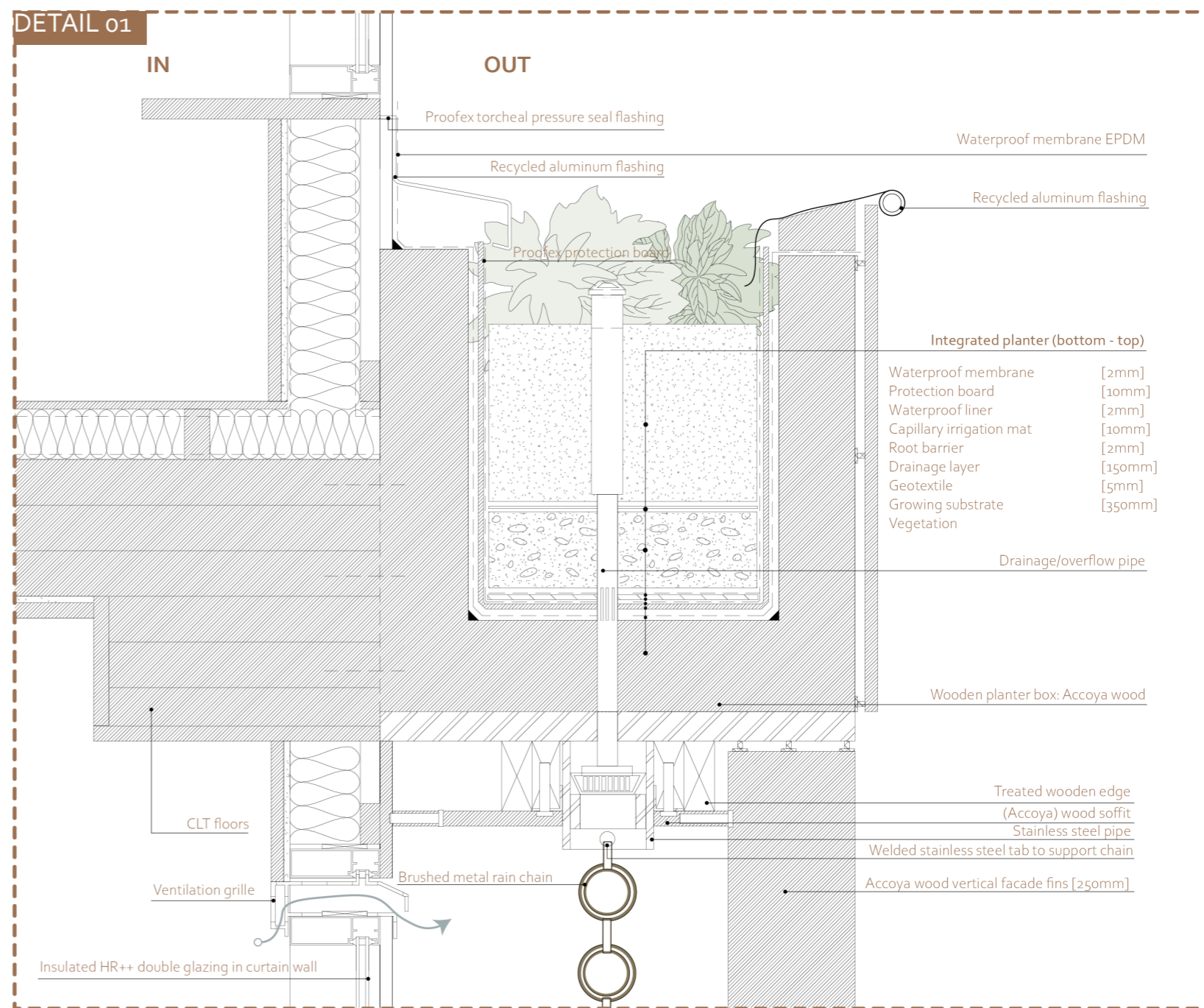
OUT - MICROHABITAT - LIVING SOUNDSCAPE

The cedar wooden facade planters provide visual rhythm and tactile warmth, while rain chains gradually guide water into the planters a microhabitat is created for birds and insects, while aromatic vegetation enhances the sense of smell.



IN - VISUAL FACADE EXPERIENCE

The warm wooden tones and layered greenery from the planters create a calming visual experience from a inside perspective, engaging the sense of sight. This interplay of wood tones, greenery and water blurs the boundary between architecture and nature, while heightening the visual and auditory sensory experiences.



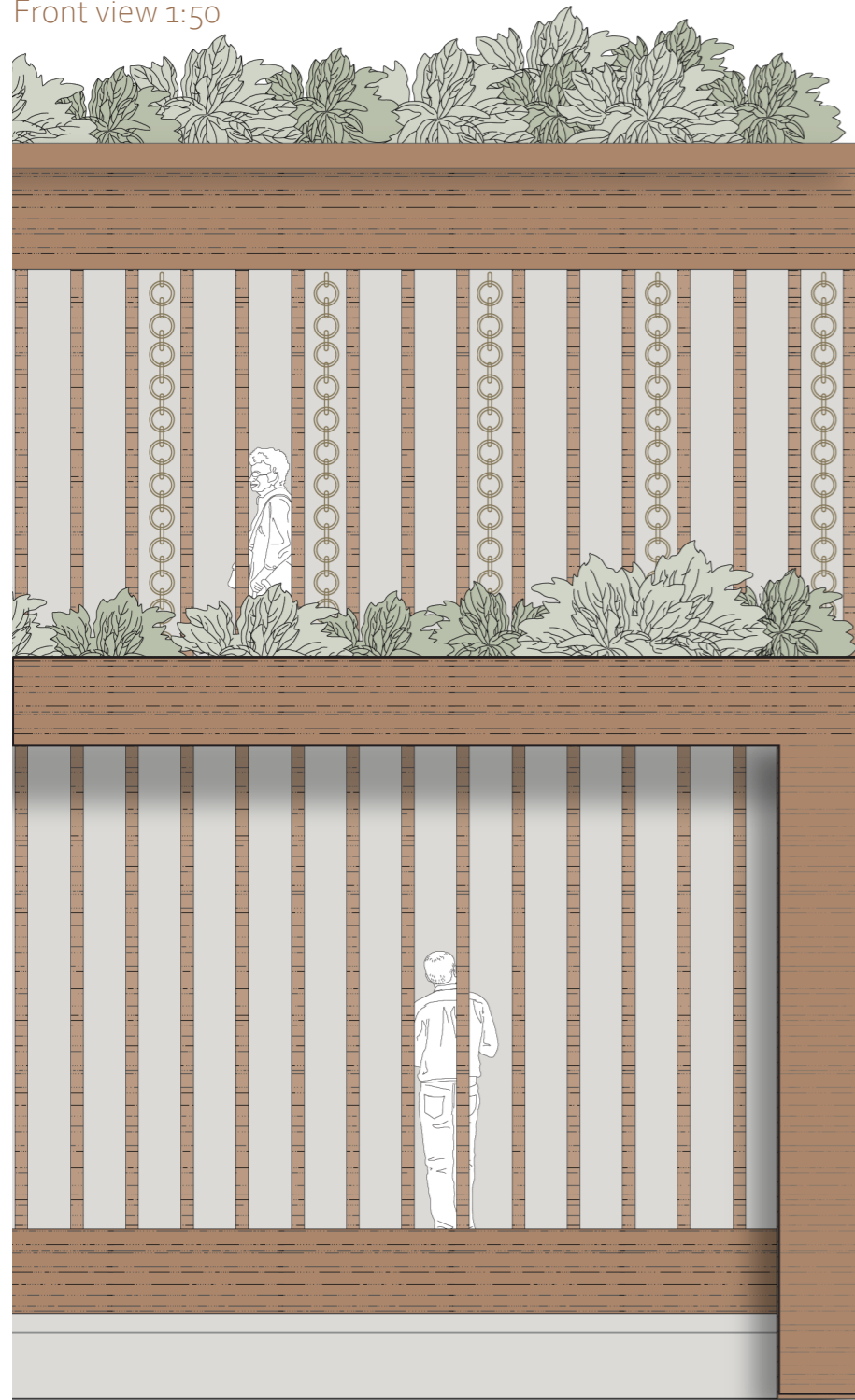
Scale 1:10

SOUTHWEST FRAGMENT

Cross Section

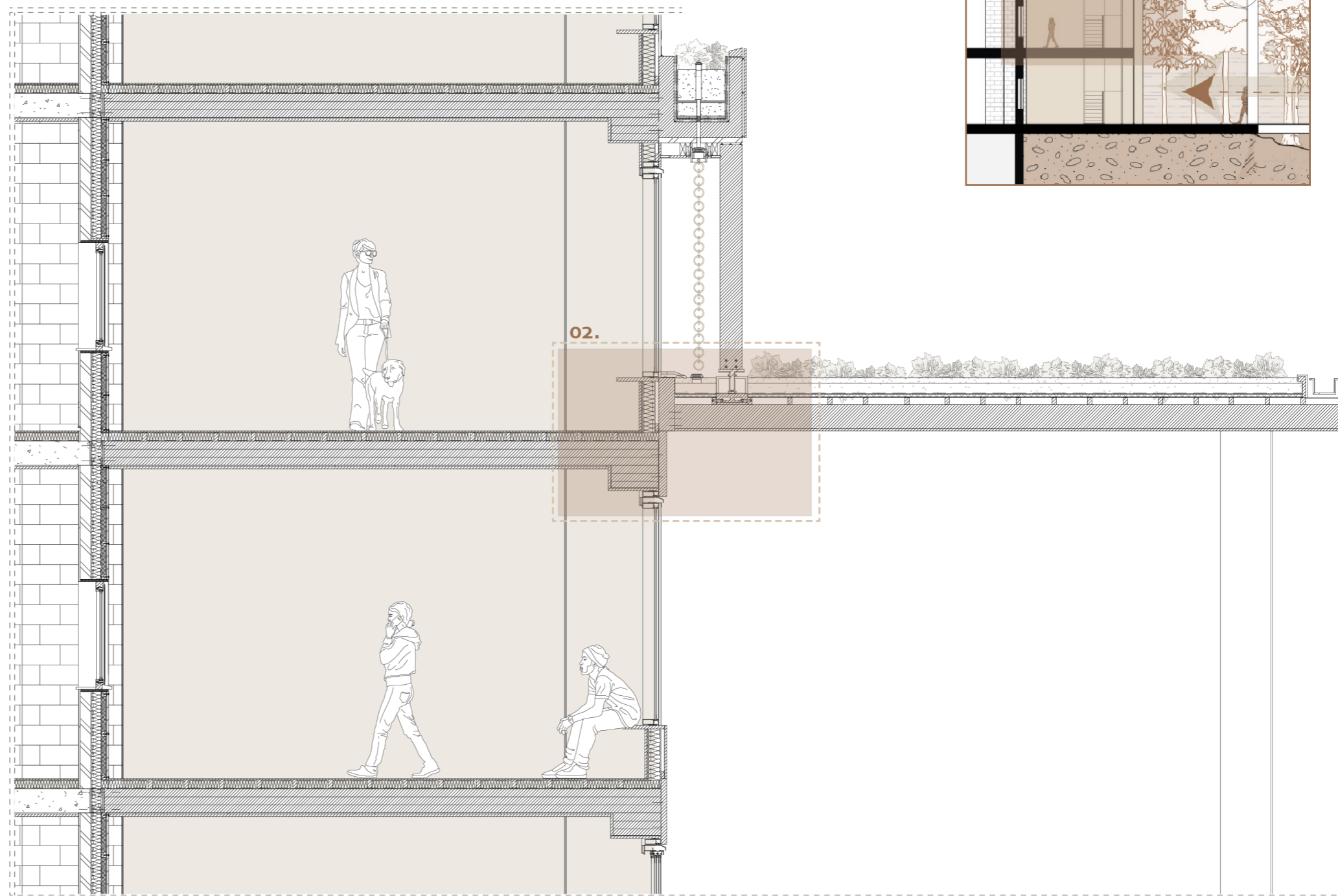
FACADE FRAGMENT

Front view 1:50



CROSS SECTION BB'

Side section 1:50

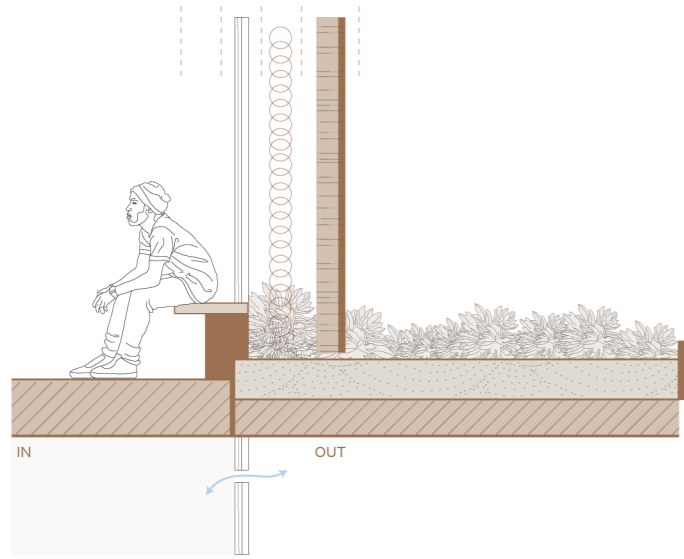


Fragment of Section AA'



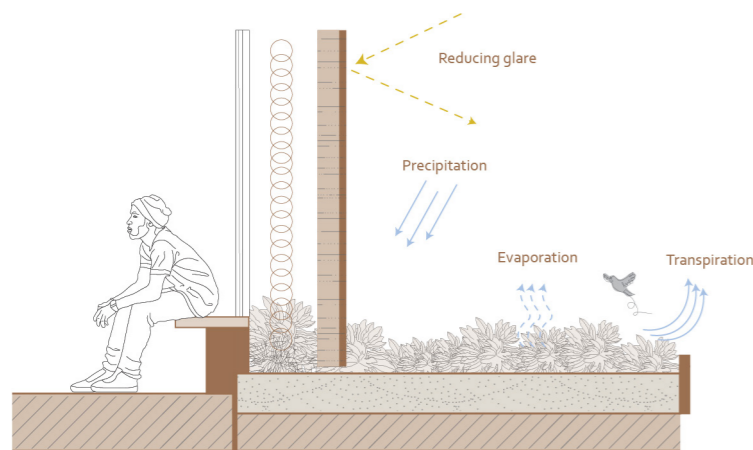
DETAIL 02

Canopy Connection



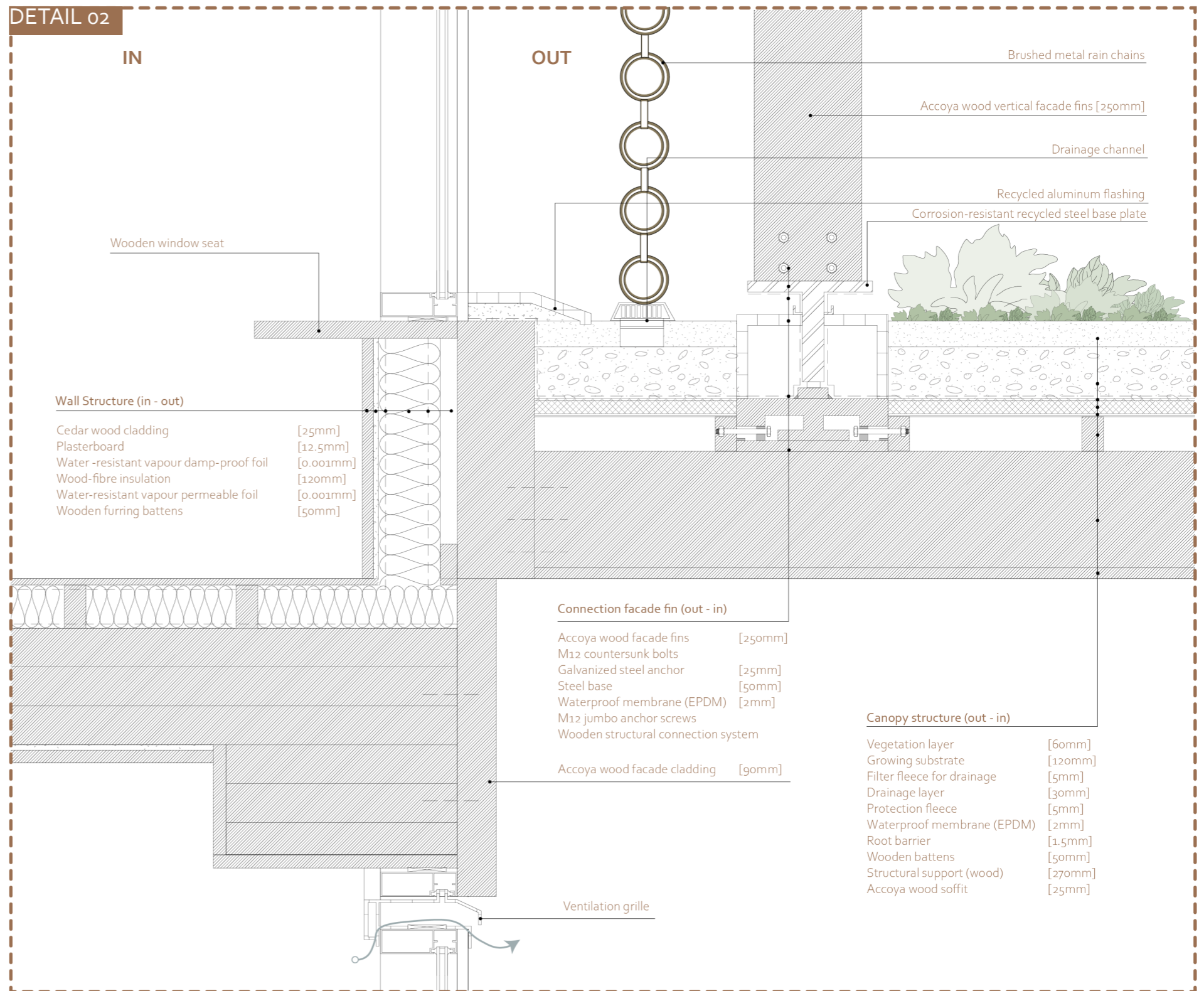
IN - VISUAL & TACTILE COMFORT

The combination of different wood tones and textures introduce warmth and tactility, while the cedar window seat serves as a sensory edge inviting users to sit, rest and engage with light, textures and layered views to the outside. The ventilation grille allows heat to escape during hot summer months, enhancing thermal comfort inside. The window seat, glass, rain chains, facade fins create a multisensory frame from the inside.



OUT - MICROHABITAT - LIVING SOUNDSCAPE

The combination of the integrated rain chains, vertical facade fins and vegetated canopy roof create soft auditory sensory experience outside, while gradually guiding and capturing rainwater, and enhancing microclimate conditions through evaporation and transpiration.



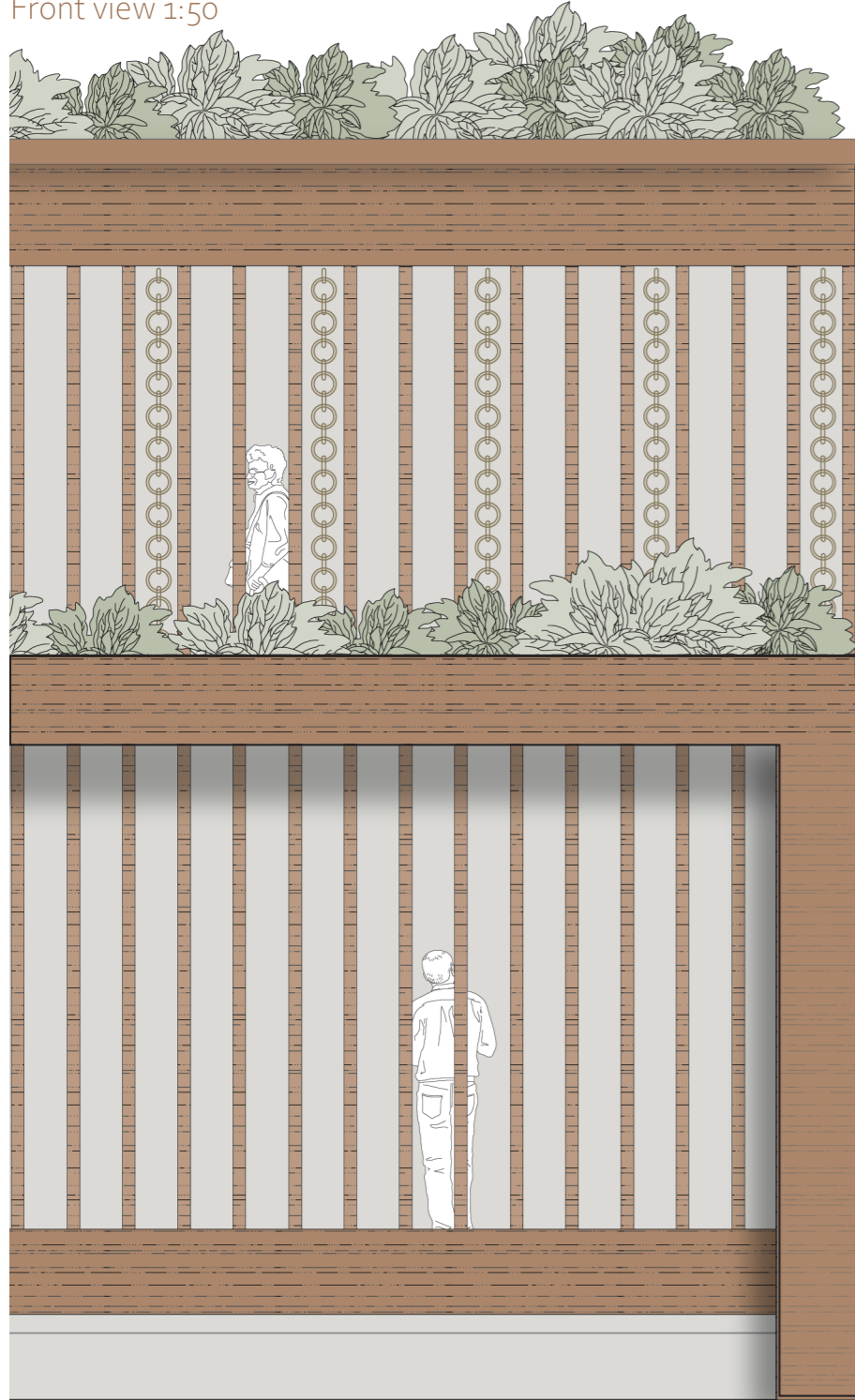
Scale 1:10

SOUTHWEST FRAGMENT

Cross Section

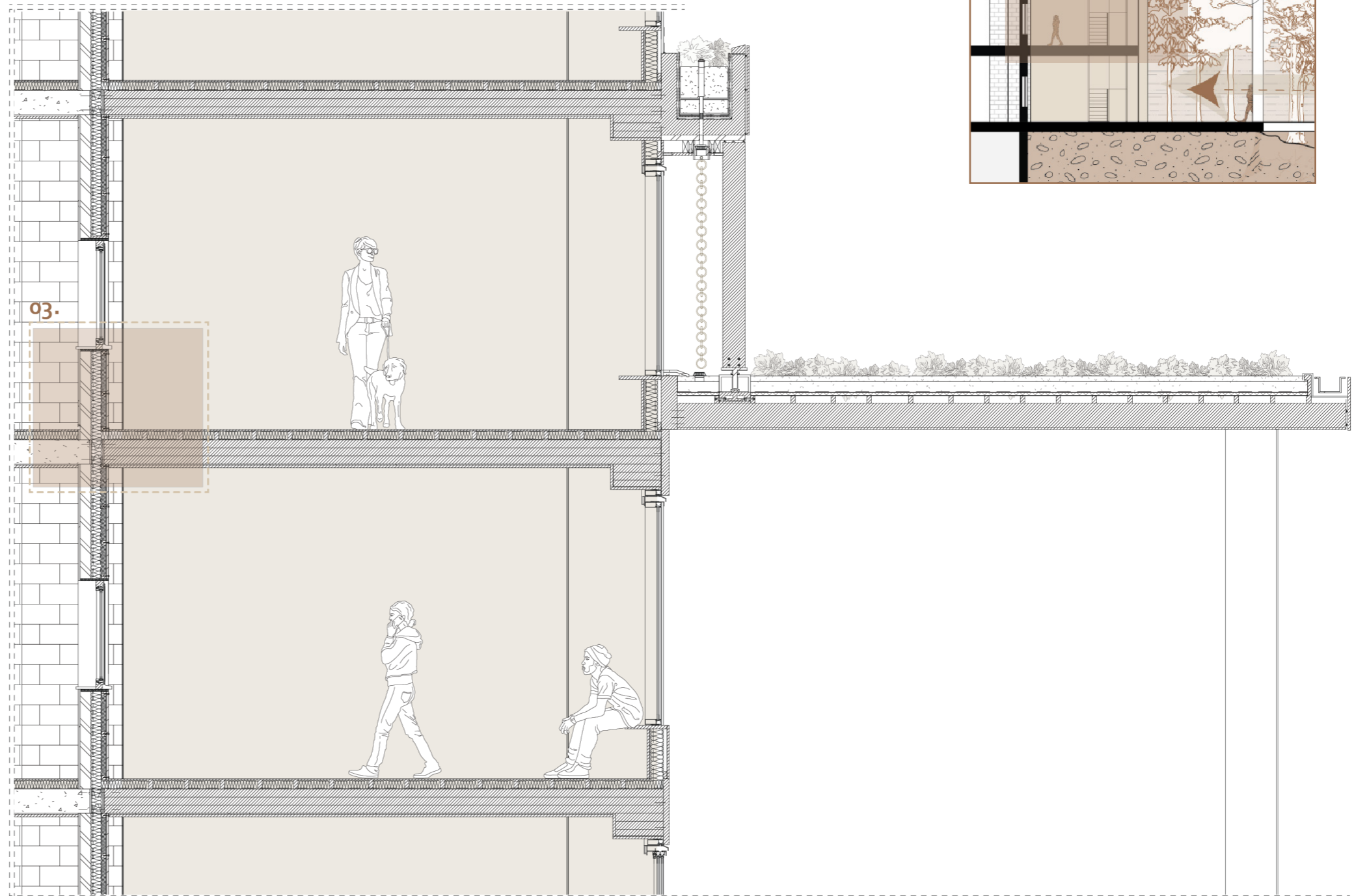
FACADE FRAGMENT

Front view 1:50



CROSS SECTION BB'

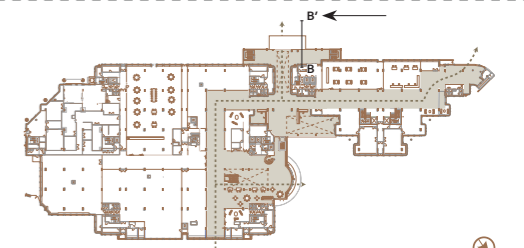
Side section 1:50



03.

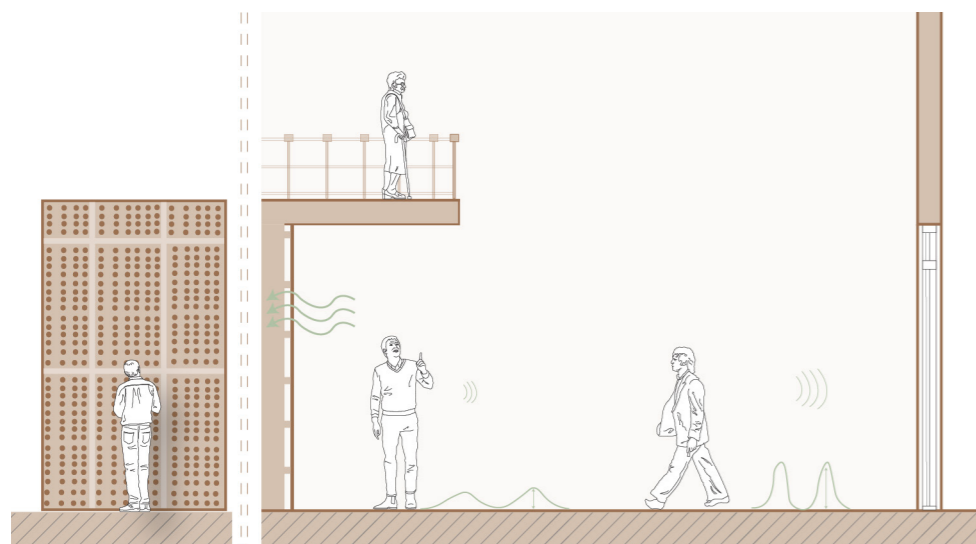
New

Fragment of Section AA'



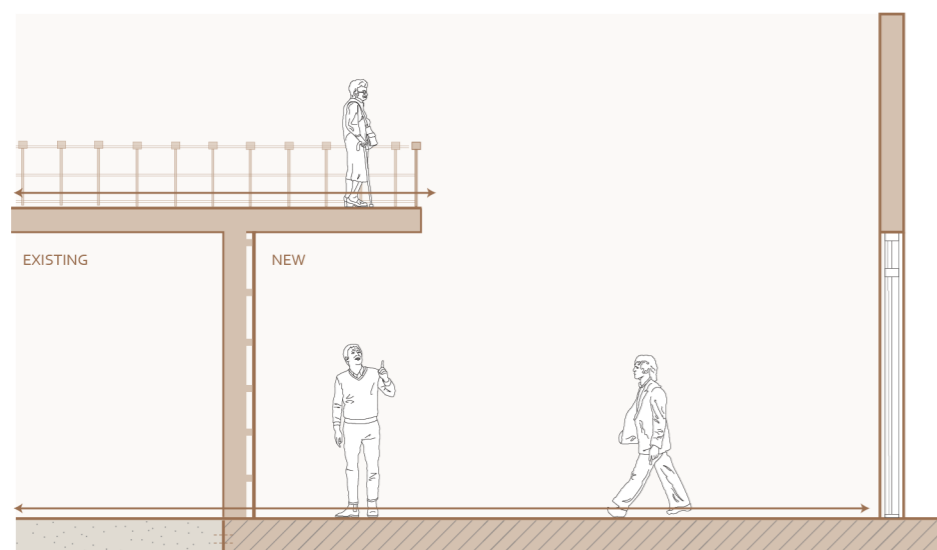
DETAIL 03

Connection Existing and New



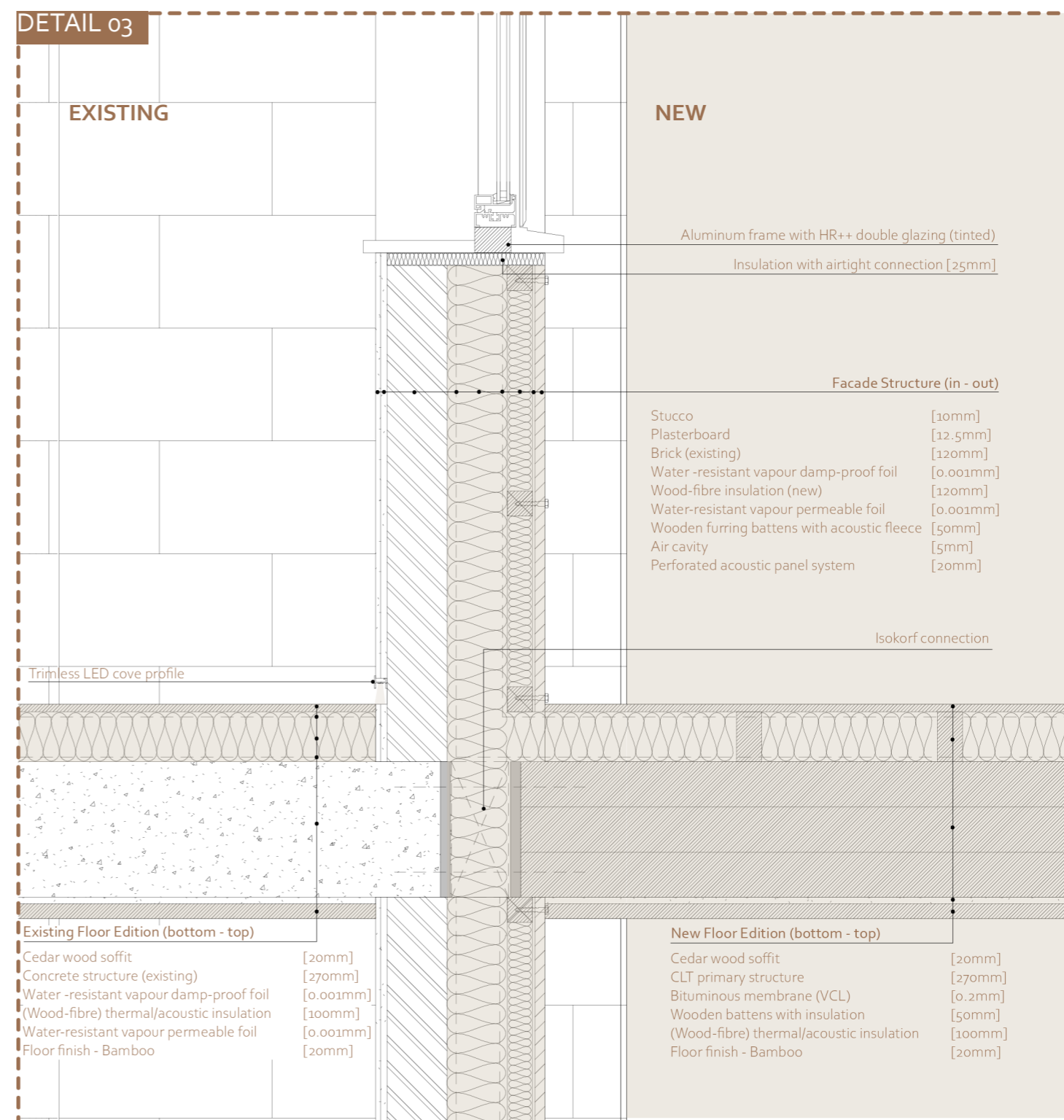
IN - ACOUSTIC COMFORT

In addition to the usage of different wood tones, the added insulation above the floors and new perforated wooden acoustic facade absorb echo, softening footsteps, stabilising temperatures and thus allowing users to sense/perceive a calmer soundscape upon arrival. These interventions all contribute to a smooth transition into the new sensory spine.



IN - CONTINUITY

The new structural CLT floors align with the existing concrete slabs, creating a continuous barrier-free transition between the new edition and the existing volume. This continuity preserves the original rhythm while also adding warmer, tactile floor surfaces, improving spatial flow and wayfinding.



NEW

Scale 1:10

INTERIOR DESIGN

ARRIVAL

From City to Library

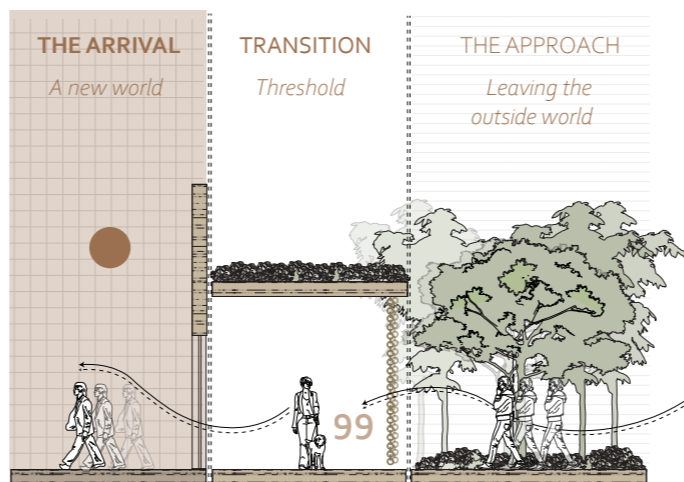
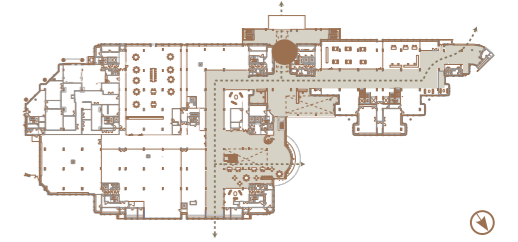
NATIONAL ARCHIVE

LEIDEN UNIVERSITY COLLEGE



ARRIVAL

From City to Library

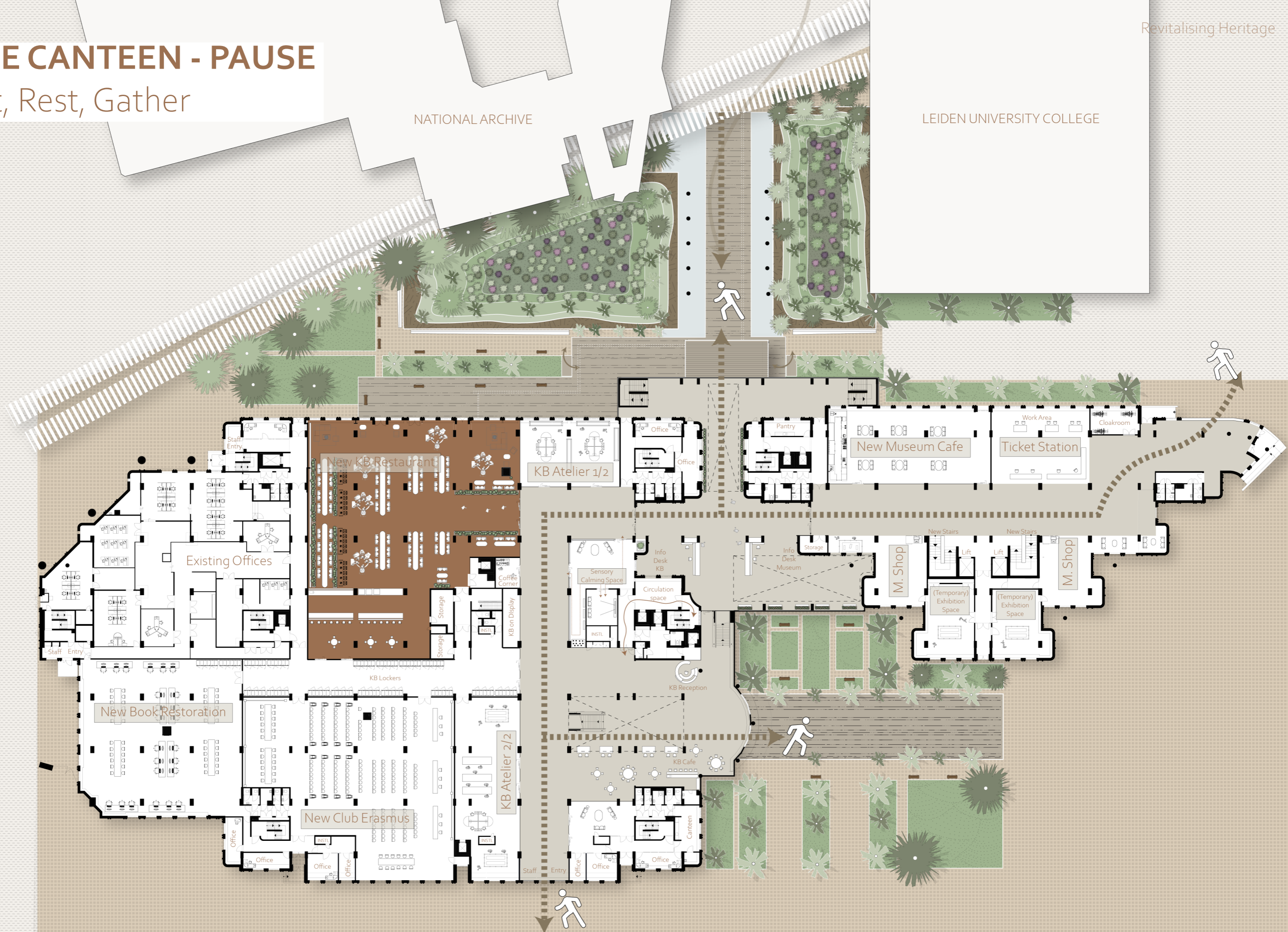


THE CANTEEN - PAUSE

Eat, Rest, Gather

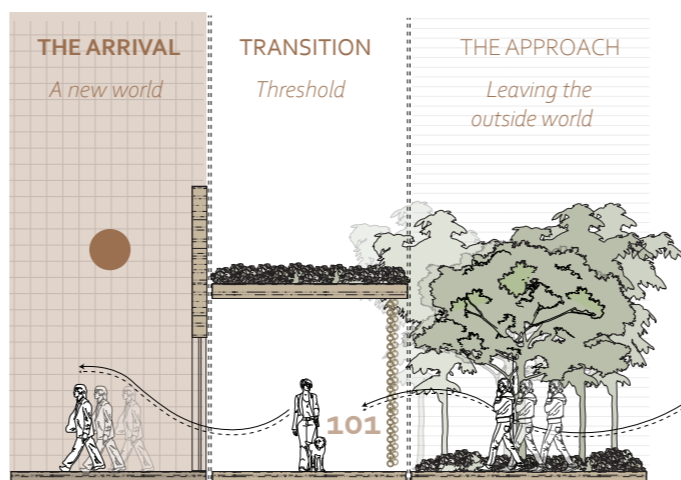
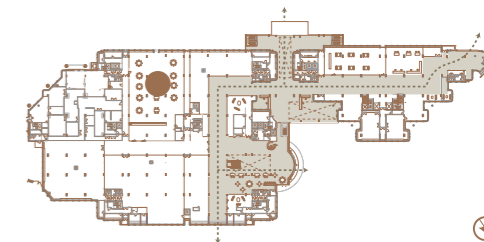
NATIONAL ARCHIVE

LEIDEN UNIVERSITY COLLEGE



THE CANTEEN - PAUSE

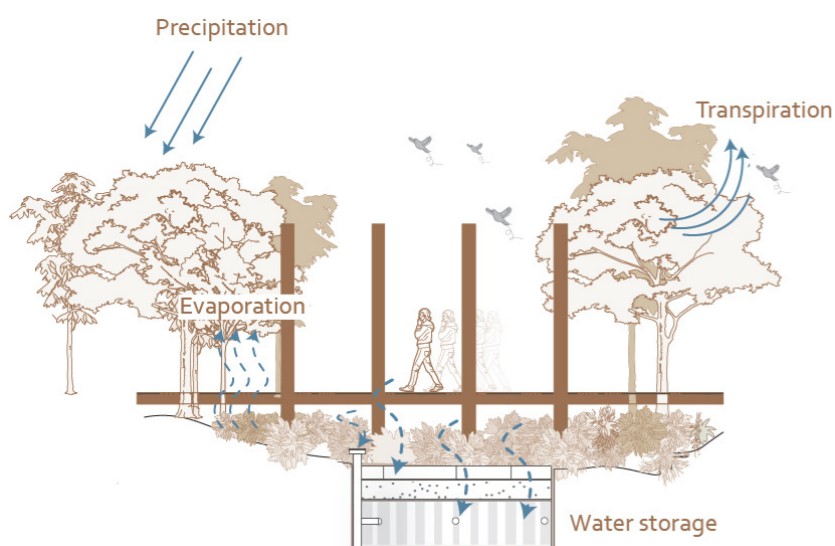
Eat, Rest, Gather



CLIMATE?

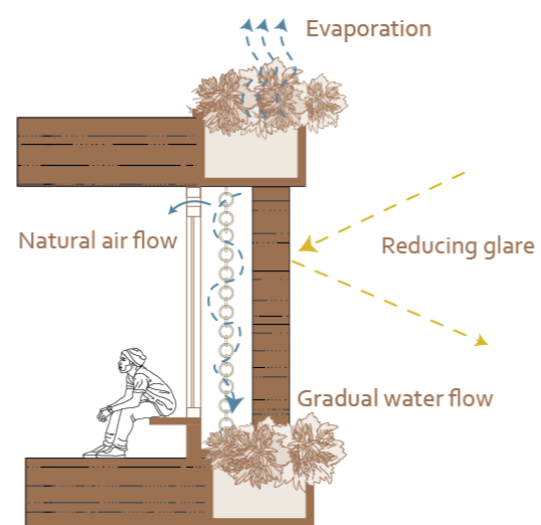
CLIMATE PRINCIPLES

Main Strategies



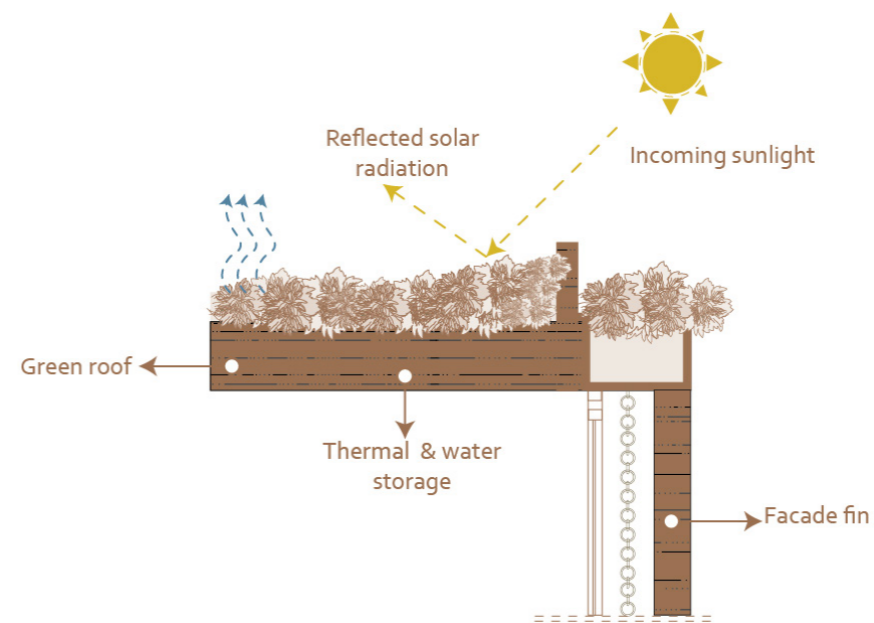
THE SENSORY WADI

The wadi stores excessive rainwater, while the presence of water and green stabilizes microclimate conditions while creating natural evaporative cooling.



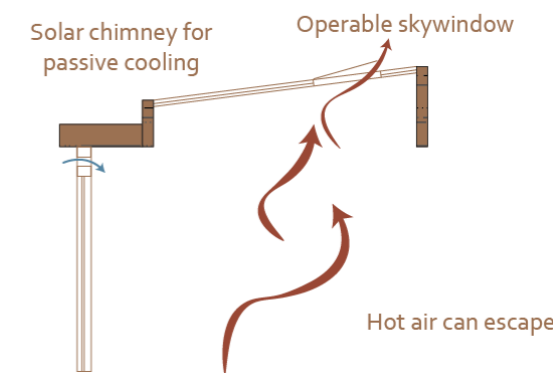
INTEGRATED FACADE DESIGN

Vertical wooden fins, integrated planters and ventilation grilles create a calm and comfortable indoor climate, while rain chains gradually guide water downwards creating a living facade experience.



GREEN ROOF - GREEN CONTINUUM

The facade greenery extends upwards to the green roof enhancing cooling, stabilizing roof temperatures, temporarily storing water and reflecting sunlight.

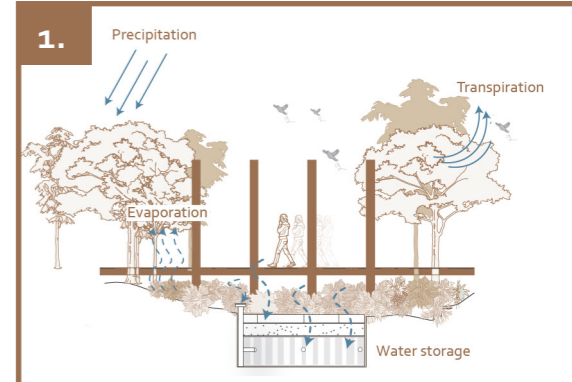
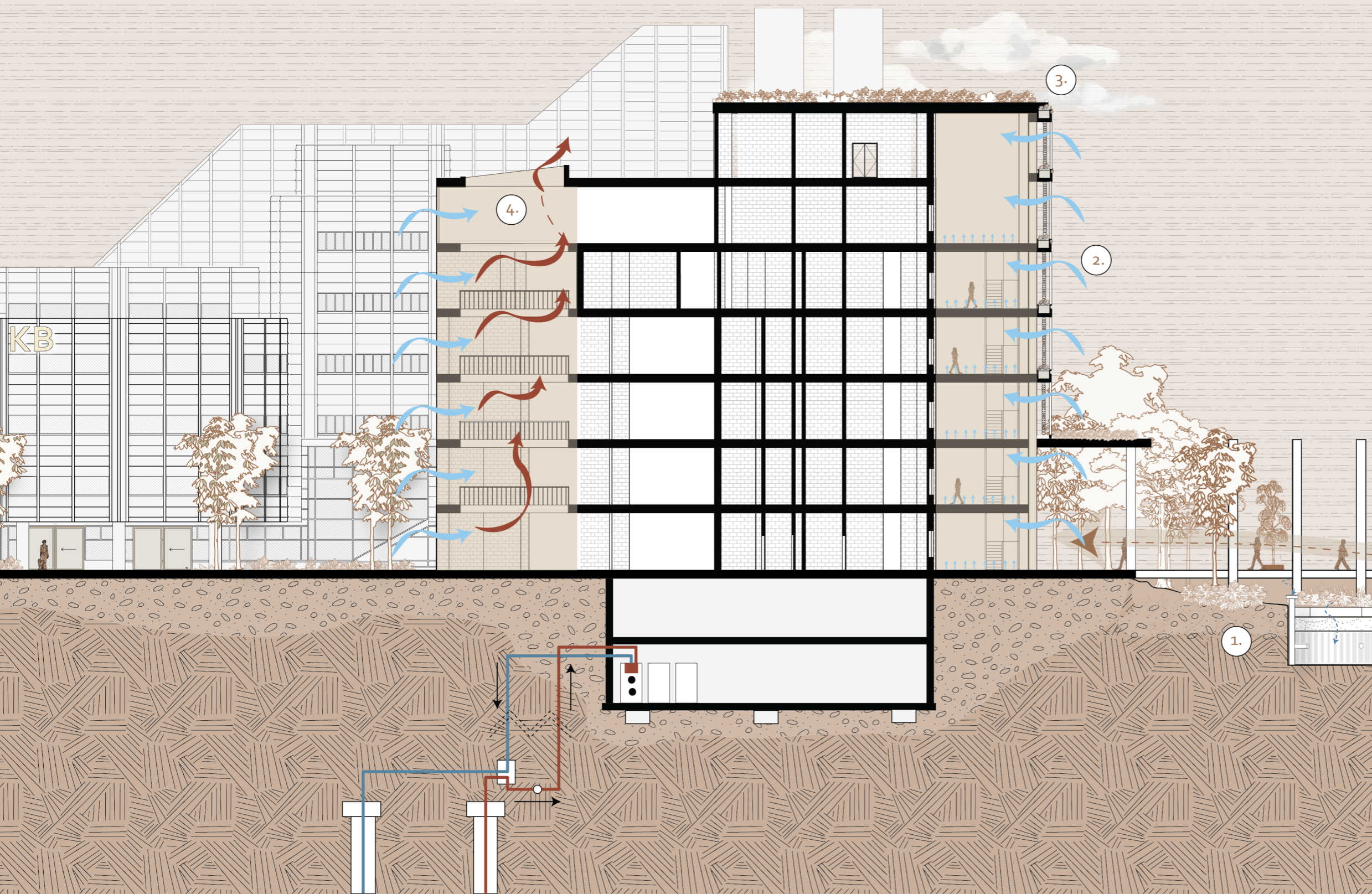
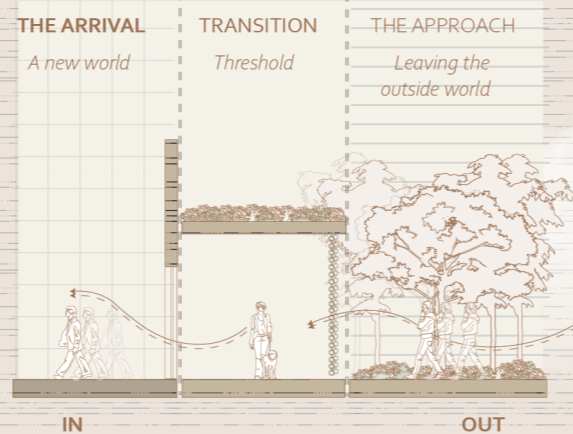


STACK VENTILATION - SOLAR CHIMNEY

New atrium acts as a solar-chimney, warm air escapes through top vents, drawing in cooler air via lower ventilation grilles. This passive system enhances indoor comfort and reduces the need for mechanical energy.

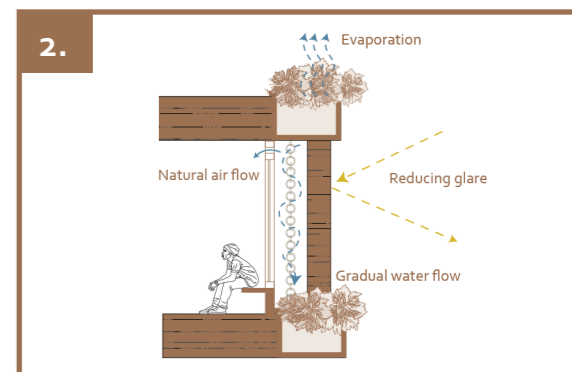
CLIMATE PRINCIPLE

Summer



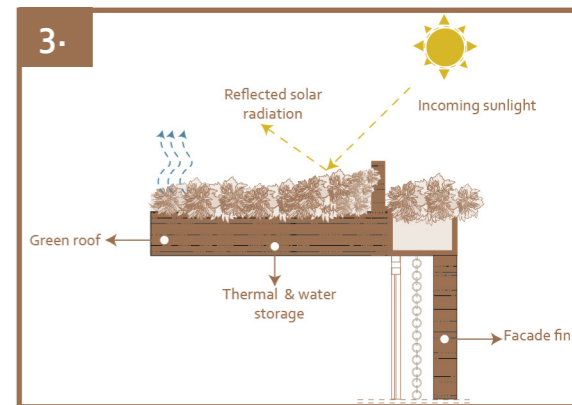
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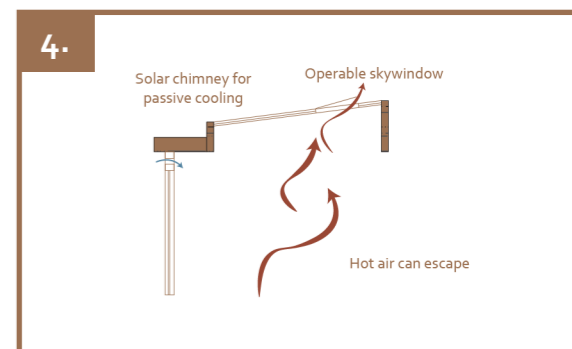
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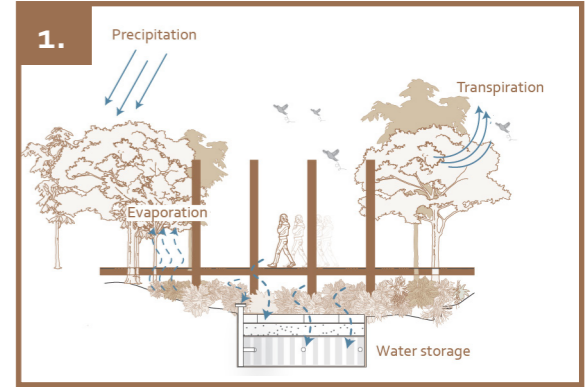
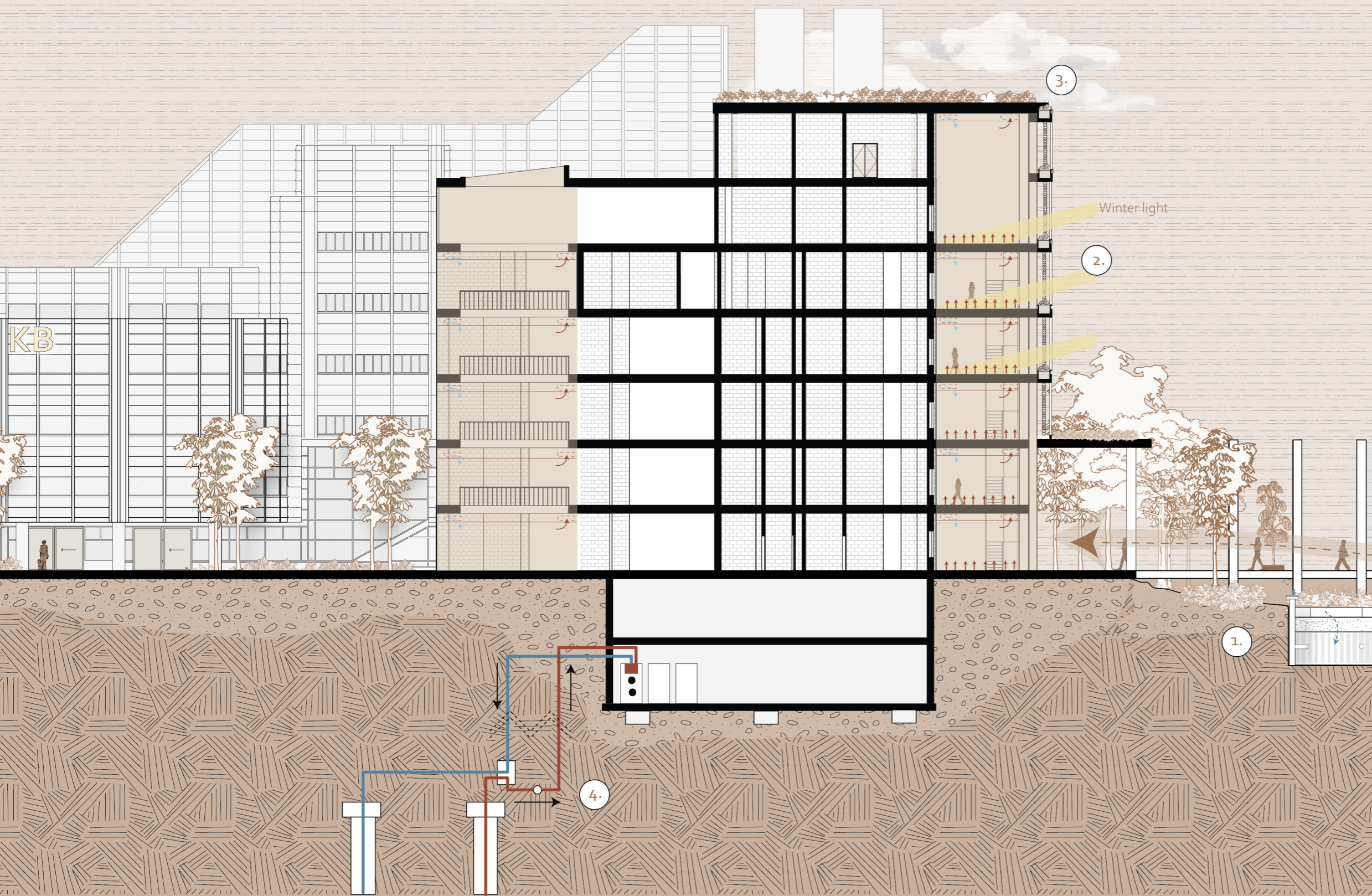
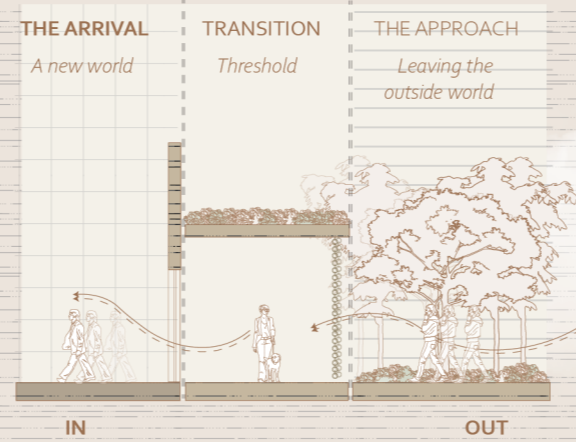


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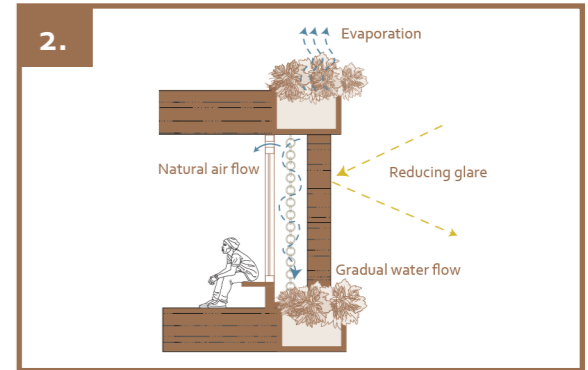
CLIMATE PRINCIPLE

Winter



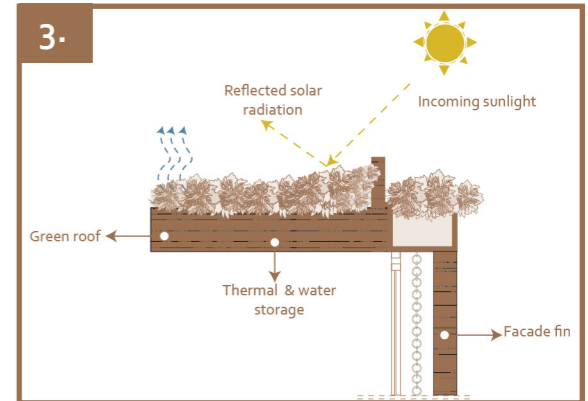
THE SENSORY WADI

The wadi stores excessive rainwater, while the presence of water and green stabilizes microclimate conditions while creating natural evaporative cooling.



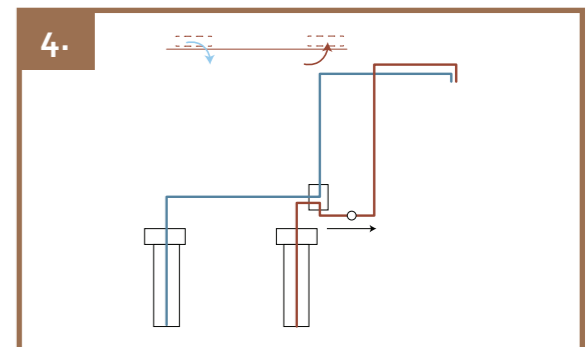
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GREEN ROOF - GREEN CONTINUUM

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GROUND SOURCE HEAT PUMP (WKO) & MVHR

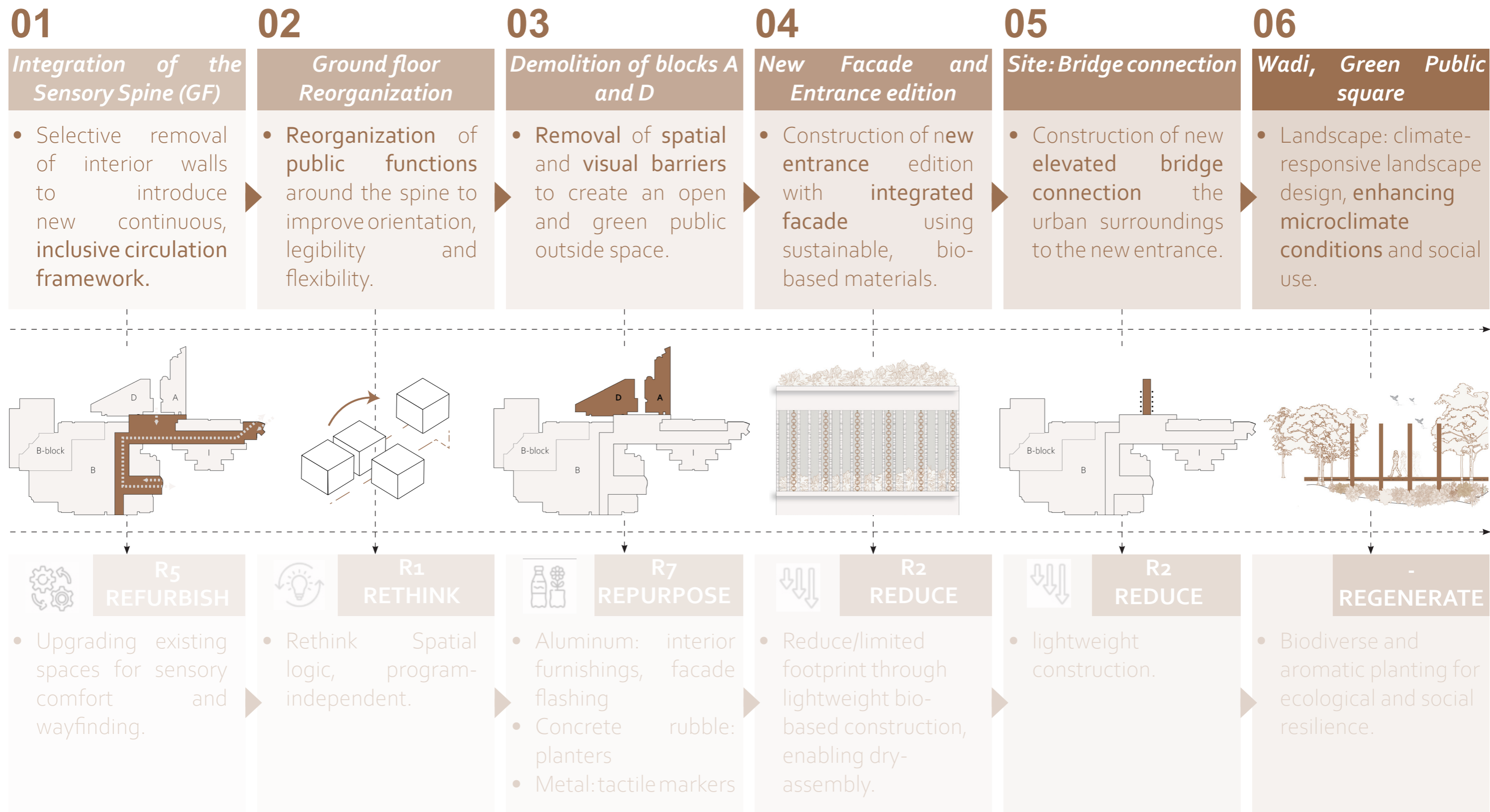
Activated only when passive measures (green roof, solar chimney, shading fins, wadi) and existing systems can no longer maintain comfort, while reusing indoor heat and enhancing thermal comfort year-round.

PHASED IMPLEMENTATION

PHASED IMPLEMENTATION

A Stepwise Transformation

PHASED SPATIAL TRANSFORMATION



SUMMARY

SUMMARY

What, How and Why

WHAT

Identifying the Problem

Barriers visually impaired:

- Irregular layouts
 - Strong Reliance Visuals
 - Overstimulating Environments
 - Fragmented Circulation patterns
- (Deines-Jones, 2007; Goldsmith, 1997; Visio, n.d.)



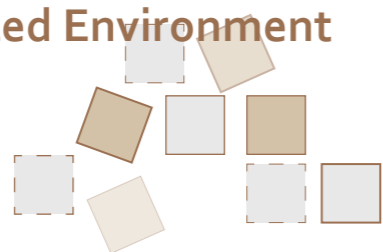
Barriers KB:

- Fragmented Zoning and Circulation
- Poor Wayfinding

Site

- Irregular Pavement Conditions
- Absence of Tactile Pavements
- Dark Corners and Alleyways
- Entrance not Clear/Visible

-> overall **Disorganized Environment**

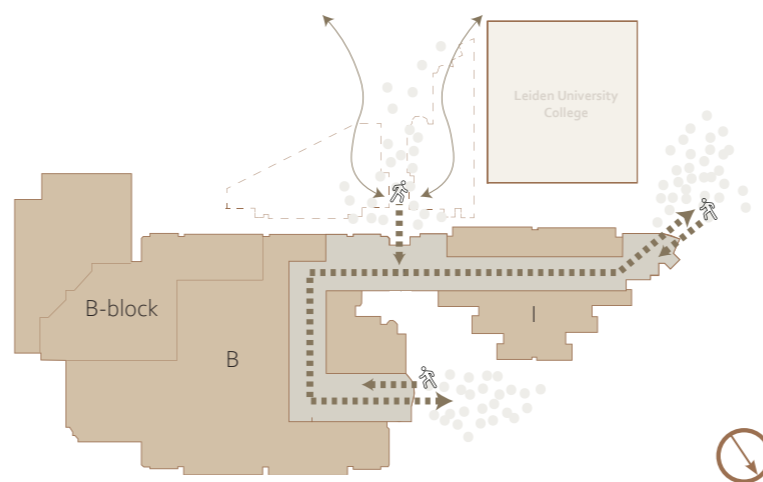


HOW

Proposed Design Solution(s)

The redesign aims to tackle these barriers by introducing a continuous pathway, known as the **Sensory Spine**, serving as the **backbone** of the **building** and **site**, improving wayfinding and orientation.

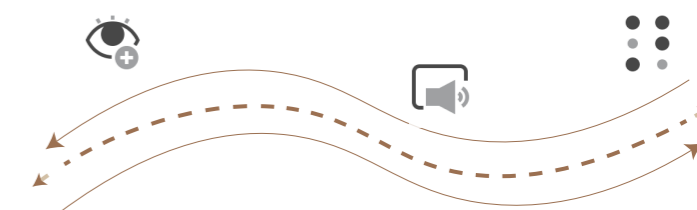
THE SENSORY SPINE



WHY

Justifying the Intervention

Academic literature asserts that inclusive design must include the entire sensory spectrum. **Continuous uninterrupted pathways** enhanced by sensory stimuli promote spatial memory and orientation, especially for those with visual impairments (Goldsmith, 1997).

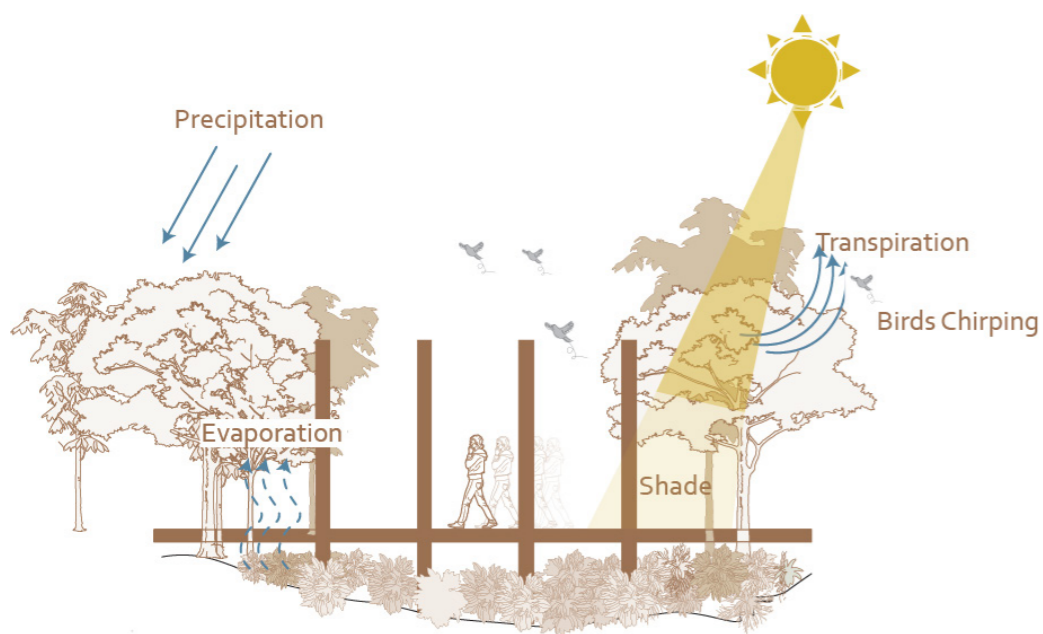


Deines-Jones, C. (Ed.). (2007). Improving library services to people with disabilities. Elsevier.
 Goldsmith, S. (1997). Designing for the disabled. London: Architectural Press.
 Koninklijke Visio. (n.d.). Over toegankelijkheid. <https://www.visio.org/professional/toegankelijkheid/over-toegankelijkheid/>

REFLECTION

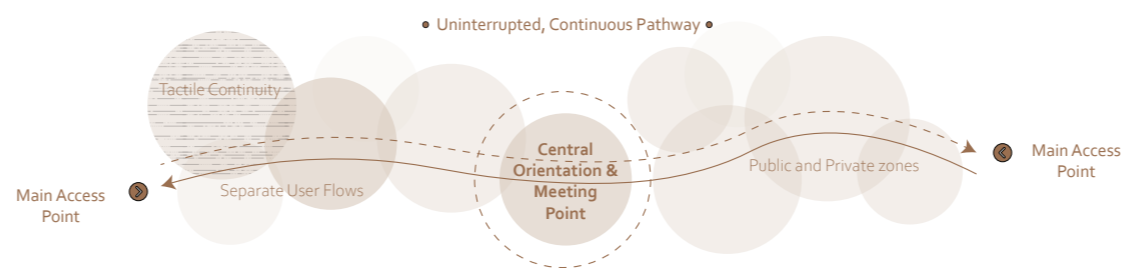
Research & Design

SENSORY QUALITIES



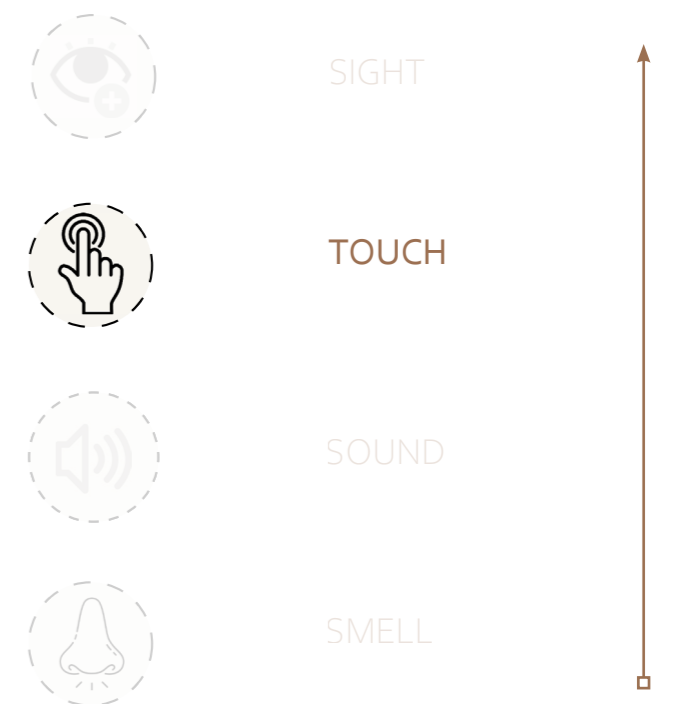
Sensory experiences are not a luxury but a **fundamental component of spatial quality**.

TRANSFERABILITY



The sensory spine demonstrates resilience through **continuous circulation** adaptable to any public program or function.

HIERARCHY IN SENSES



A more **focused emphasis on tactility** from the outset could have strengthened both conceptual precision and spatial coherence.

At night...



During cold winter days...





THANK YOU!
Questions?



BEYOND SIGHT, BEYOND BARRIERS:
Reimagining Library Spaces through MultiSensory Accessibility

EXTRA INFO

MATERIAL EXPRESSION

Warm Tactility

The Psychiatric Institution GGZ-Nijmegen

4.4 kilometres of Copper Coloured Accoya

Image credits: www.accoya.com



ACCOYA WOOD

Coloured/Stained

- Exceptional dimensional stability
- Durable and long lifespan (50-year above-ground warranty)
- Sourced from FSC certified forests (Cradle to Cradle Gold certification)
- **Tactile warmth and sensory richness**

Sustainable Libraries

Cross-laminated Timber Construction

Cross-laminated layers

Image credits: Jack Hobhouse



CROSS-LAMINATED TIMBER

Coloured/Stained

- Excellent structural strength
- Good thermal and acoustic performance
- Lightweight construction, faster build-times
- **(-)**Sustainability limitations (energy-intensive production, end-of-life challenges)
- **Acoustic softness, visible textures, warmth**

Kengo Kuma's Layered Cedar Wood Facade

Grounded in transience, weathering and warmth

Image credits: www.architizer.com



CEDAR WOOD

Sourced from Well-managed Forests

- Recyclable and biodegradable
- Natural resistance to decay and insects
- Dimensional stability & weather performance
- **Sensory richness: distinctive warm fragrance, tactile warmth and ageing gracefully** (ages to a soft grey patina)

P5 -Elisabeth Veldkamp

MATERIAL EXPRESSION

Overview

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- Recyclable and biodegradable
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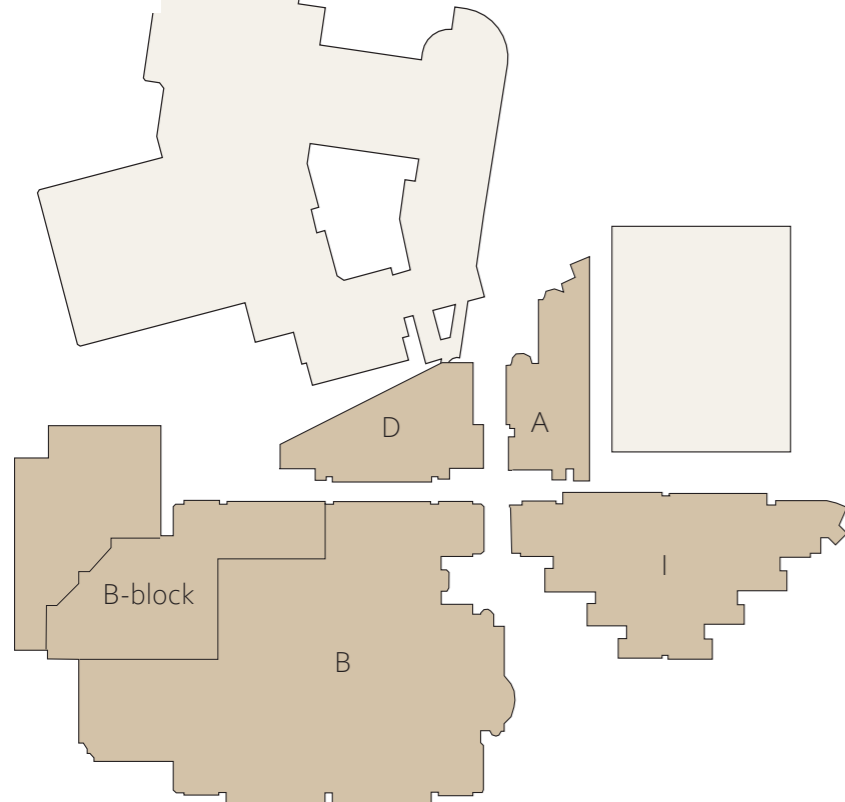
ASPECT	ACCOYA WOOD	CEDAR WOOD	CLT
<i>Durability</i>	Class 1 - Sourced from FSC certified forests (Cradle to Cradle Gold certification).	Class 2 - Recyclable and biodegradable. Natural resistance to decay and insects.	Class 1/2 - Sustainability limitations (energy-intensive production, end-of-life challenges).
<i>Dimensional Stability</i>	Exceptional dimensional stability (less shrinkage and swelling), durable and long lifespan (50-year above-ground warranty).	Western Red Cedar – high stability due to its low density, shrinkage factors, with superior resistance to warping, cupping and twisting.	Cross-layered structure minimizes warping and shrinkage, yet moisture build up could lead to swelling.
<i>Sensory Qualities</i>	Tactile warmth and sensory richness.	Sensory richness: distinctive warm fragrance, tactile warmth and ageing gracefully.	Acoustic softness, visible textures (only if kept dry inside, warmth).
<i>Weathering/Sun</i>	Stable under sun exposure, but coating needed for weathering conditions.	Ages gracefully overtime to a soft grey patina, may lead to a rougher texture when wet attracting mold and bacteria. Over time, sun exposure may cause shrinking/splitting.	Better protected behind a watertight envelope. Sun exposure can cause discoloration, cracking and surface degradation.
<i>Advised Usage</i>	Accoya wood is the best choice for facade fins, planter boxes (frequent wetting tolerant), bridge decking and canopy primary structure	Cedar wood is not recommended for frequent soil/wet exposure, better suited for soffits, handrails, facade fins if kept off wetting.	Better fit for (interior) floor, roof and loadbearing walls assemblies. CLT is not suitable exposed, only if fully weather protected.
<i>Choice</i>	Planter boxes, canopy primary structure and bridge decking.	Facade fins, interior and exterior soffits, handrails.	Interior loadbearing structure for entrance extension (beams, floors, columns).

Table 1. Overview types of wood and advised usage (Veldkamp, 2025).

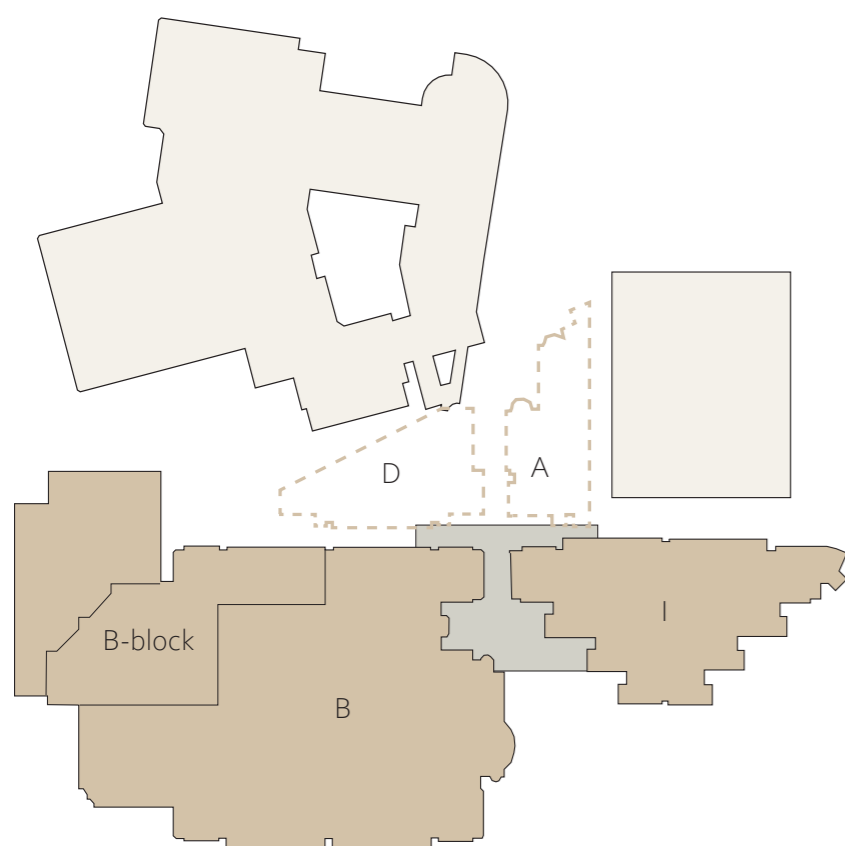
MAIN INTERVENTION

CO₂ Impact

BEFORE :



AFTER:



Sustainable Libraries

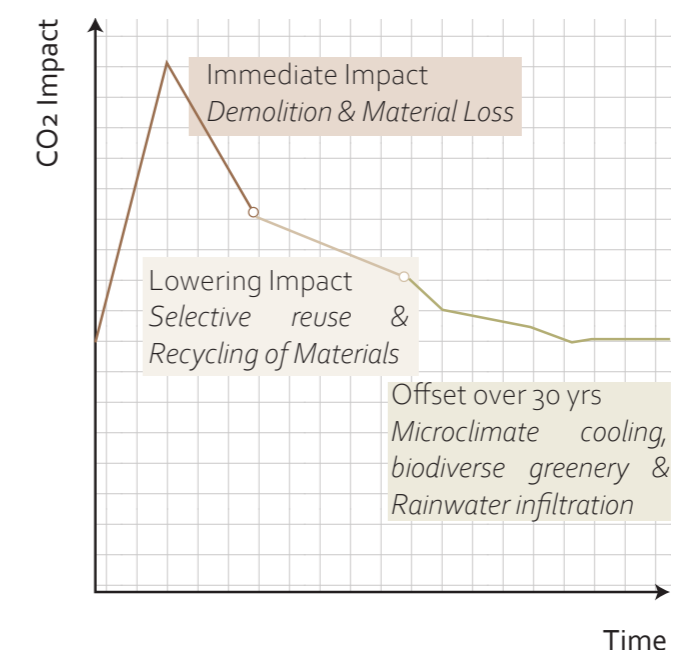
Building Block	Approximate GFA [m ²]
A	2,600 m ²
D	4,120 m ²
Total	6,720 m²

Material Component	Approximate share of total Floor Area [%]
Reinforced concrete (Slabs, beams and columns)	~ 75%
Reinforced steel (Rebar)	-
Brick (Substructure)	~ 15%
Aluminum cladding panels	~ 15%
Demolition process (waste + transport)	~ 100%

For the combined 6 720 m² of Blocks A and D, the carbon footprint results in ≈ 659 t CO₂e for the concrete alone. This is based on the NMD dataset for Doorgaand Gewapend Beton C_{30/37} CEM III/B, as it represents typical numbers and calculations used for reinforced concrete. Please note that the immediate actual carbon footprint/embodied carbon risk is higher due to other materials (Including the aluminum panels, finishings and brick substructure). This can be compensated through selective reuse of the aluminum panels, concrete and brick rubble, and the introduction of a new green square/wadi. Over time, the new wadi and biodiverse greenery can aid in lowering urban heat stress through evaporative cooling, reduced local air temperatures, improving soil quality and capturing and infiltrating rainwater.

Climate Change [kg CO ₂]		
Continuously Reinforced Concrete C _{30/37} CEM III/B		
Phase A <i>Production & Build</i>	Phase C <i>Demolition and Processing</i>	Phase D <i>Outside Life Cycle</i>
= 3,264 · 10 ²	= 2,165 · 10 ¹	= -1,984 · 10 ¹
Embodied CO ₂ for 1 m ³ [kg CO ₂ / m ³]		
= 326.4	= 21.65	= 19.84
Total Embodied CO ₂ :		
326.4 + 21.65 - 19.84 = ~ 328 kg CO ₂ / m ³		
Total Concrete Volume [m ³ per m ² GFA]		
Following material-intensity benchmarks typical for Institutions/Libraries		
= ~ 0.30 m ³ per m ² GFA (Including walls, columns, beams and slabs)		
Total Embodied CO ₂ [per m ² GFA]		
328 kg CO ₂ /m ³ × 0.30m ³ /m ² GFA ≈ 98 kg CO ₂ /m ² GFA		
Total CO ₂ impact/ carbon footprint [kg CO ₂]		
98 × 6720 ≈ 659000 kg CO ₂ = 659 t CO ₂ e (concrete only)		

Numbers and Values retrieved from Nationale Milieudatabase (2023). Figure by author (Veldkamp, Elisabeth)



Nationale Milieudatabase (NMD). (2023). Milieudata v3.0: Productkaart Doorgaand Gewapend Beton C_{30/37} CEM III/B[Data set]. Retrieved from https://milieudatabase.nl/nl/viewer/milieuverklaring/nmd_53768/

SDGs

Design Contribution



The **acoustic detailing** (perforated wooden walls, added floor insulation, wooden columns) and **sensory zoning** reduce echo, stress, and sensory overload, while the **green square and water buffer** moderate heat and provide calmer, restorative environments, **supporting mental well-being and comfort** in line with SDG 3's emphasis on reducing health risks and promoting well-being.



By transforming the KB into an **inclusive, multisensory learning environment**, with tactile wayfinding, dual-height railings, inclusive-height desks, and **accessible routes**, this design directly supports SDG 4 target 4.a on safe, disability-sensitive education facilities and **lifelong learning access for all**.



The wadi, rain chains, and integrated planters form a small-scale **water-sensitive system that buffers, guides, and reuses rainwater on site**, contributing to more **sustainable local water management** and helping to protect water-related ecosystems, in line with targets on water-use efficiency and water-related ecosystems in SDG 6.



The use of WKO (ground source heat pump), mechanical ventilation with heat recovery, and reliance on **passive measures** (stack/solar chimney ventilation, shading fins, microclimate from greenery) aligns with SDG 7's focus on **energy efficiency** and modern, **low-carbon energy services** at building scale.



Adaptive reuse of the KB structure, combined with CLT floors/columns, timber/wooden additions, and circular connections (e.g., detachable facade fins, recycled concrete planters), contributes to "**upgrading infrastructure to be sustainable**" with higher resource efficiency and cleaner technologies, as formulated in SDG 9 target 9.4.



The sensory spine, continuous tactile flooring with markers, contrasting non-glossy surfaces, multi-height railings, indirect sunlight and inclusive counters explicitly **promote social inclusion of visually impaired and neurodiverse users**. This responds directly to SDG 10 target 10.2 on social inclusion irrespective of disability or age.



The **new green square**, accessible bridges, sensory spaces, and opening up of the plinth create safe, **inclusive public spaces**, while protecting and re-valuing the KB as cultural heritage. This is strongly aligned with SDG 11 targets 11.4 (cultural heritage) and 11.7 (universal access to safe, inclusive, accessible green and public spaces).



The 10R-based strategy, demolishing only parts (A and D), **selectively reusing concrete rubble in furnishings, reusing or recycling aluminum panels**, and choosing **biobased materials** like CLT, cedar, and bamboo, fits SDG 12 targets 12.2 and 12.5 on efficient resource use and **waste reduction** through prevention, recycling, and reuse.

SDGs

Design Contribution



The combination of green roofs, wadi, integrated planters, shading fins, passive cooling (stack effect, solar chimney) and **reduced operational energy demand** means the building contributes at local scale to climate adaptation (urban heat mitigation, stormwater buffering) and mitigation (less operational CO₂), aligning with SDG 13's focus on **strengthening resilience** and adaptive capacity to climate-related hazards.

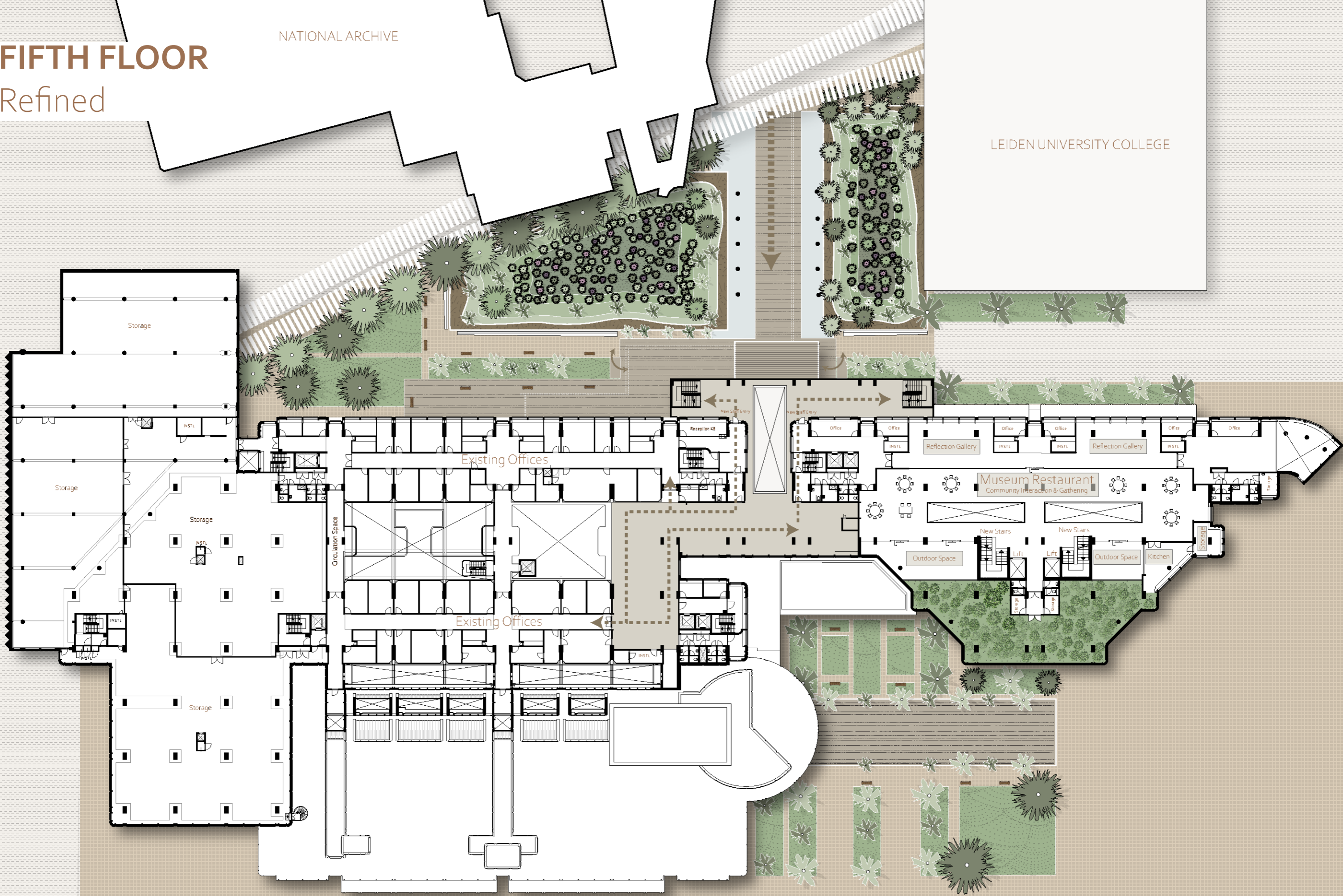


The wadi planting, trees, vertical planters, and rooftop greenery enhance urban biodiversity, create **small habitats for insects and birds**, and improve soil and **microclimate conditions**, echoing SDG 15 goals on **protecting terrestrial ecosystems** and restoring degraded land at the micro-urban scale.

FIFTH FLOOR

Refined

LEIDEN UNIVERSITY COLLEGE



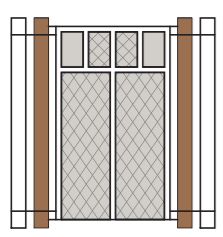
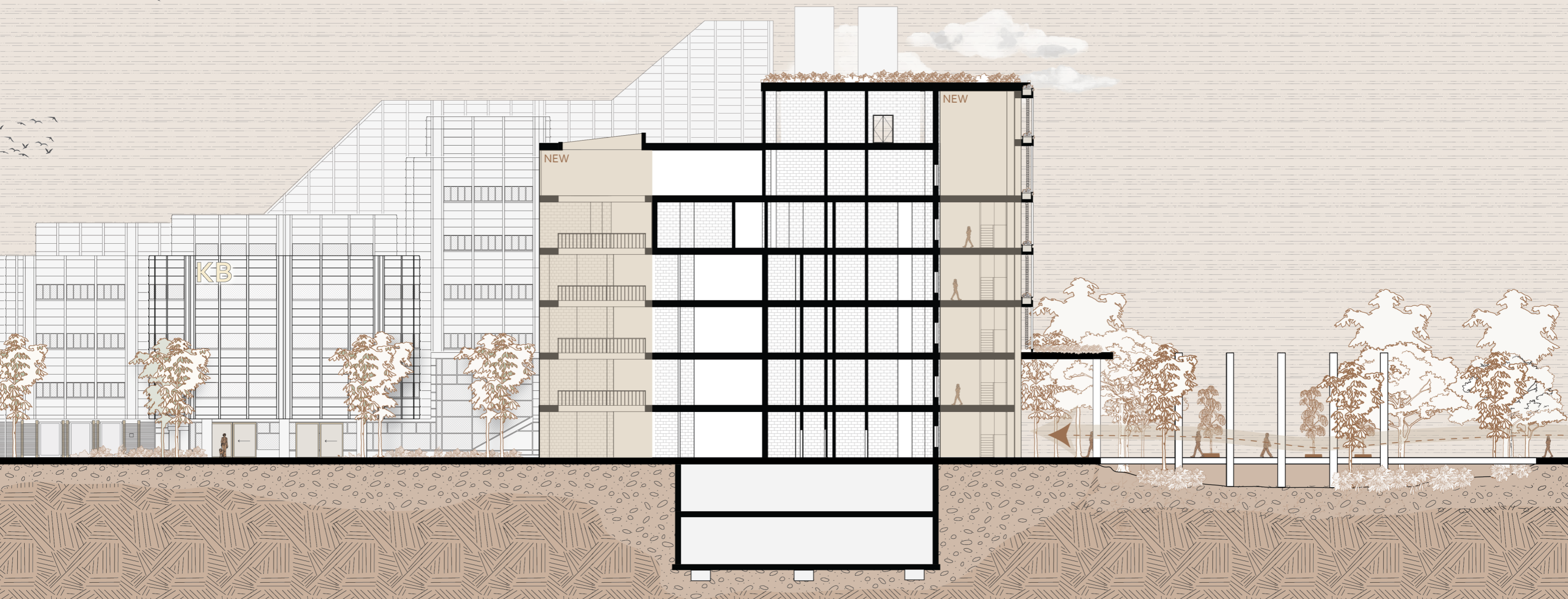
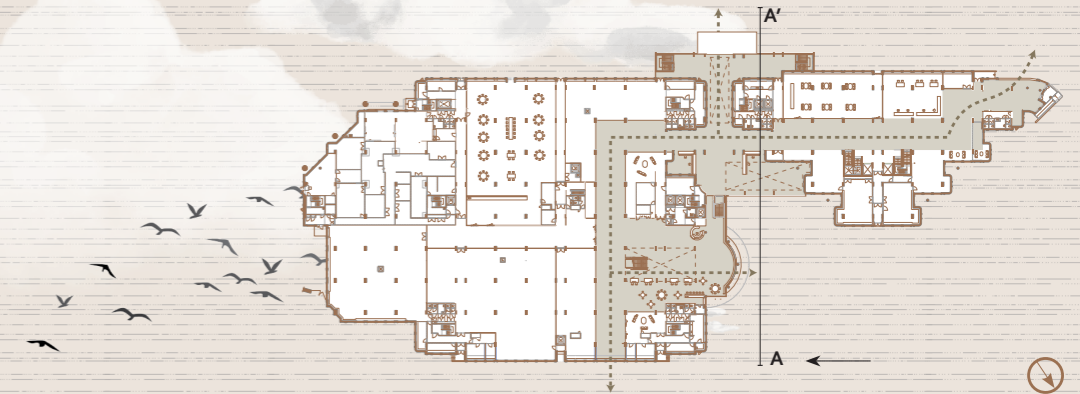
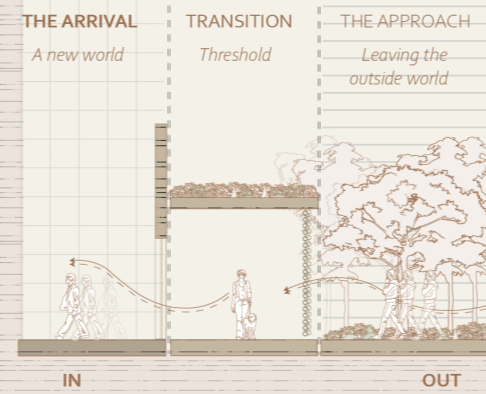
SCENARIOS

	1. Historic Values	2. Social Values	3. Functions removed	4. CO2 impact	5. Pros	6. Cons
<p>A Remove none</p>	<p>High - all blocks preserved and reused.</p>	<p>Neutral: building parts preserved but (hidden) barriers can persist: hidden entrances, dark corners and alleys, closed fortress.</p>	<p>None.</p>	<p>Low: no demolition, room for renovations/refurbishments.</p>	<p>Maximum heritage retention, least amount of demolition (exterior).</p>	<p>Current site and partial interior barriers persist. Overscaled unused spaces, closed fortress, accessibility barriers.</p>
<p>B Remove blocks A & D</p>	<p>Medium-low: partial loss of heritage values. Keeping structural parts of building (A+D) fragments can help reinterpret their historic values.</p>	<p>High: opportunity for new public green squares for public engagement, a new main entrance enhancing the KB's visibility.</p>	<p>6,720m² important functions including: Club Erasmus, Auditorium, Exhibition spaces, BK atelier, Book restoration room, connection NA.</p>	<p>Medium: 8% of the building demolished. Materials can be recycled for interior furniture, new building additions.</p>	<p>-New green square for interaction and gathering. -Improves permeability and daylight conditions. -Enhances the KB's visibility. -Open civic space.</p>	<p>Demolition of block A & D, causing nuisance and pollution.</p>
<p>C Remove block I</p>	<p>Low: major loss of building part.</p>	<p>Low: civic memory weakened, however opportunity for public engagement with new secluded green square.</p>	<p>+/- 12,400m² space demolished: KB offices (literature museum and archives already moving)</p>	<p>High: 15.5% of the building demolished.</p>	<p>Unused space resolved with removal of block I, enclosed green square, permeability and daylight on the eastside.</p>	<p>Major demolition with higher CO2 impact, loss of partial cultural identity. Significant part of architect's work eliminated.</p>
<p>D Remove blocks A & I</p>	<p>Low: major loss of building parts, strong alteration of building's layout.</p>	<p>Medium: Wide new main entrance, with green square and improved circulation.</p>	<p>+/- 15,000m² space demolished: KB offices, restaurant employees, auditorium.</p>	<p>High: 19% of the building demolished.</p>	<p>Opens up the KB to the city of the Hague, new green square, better integrated within the urban fabric.</p>	<p>Large-scale demolition with higher CO2 impact, important functions lost, heritage fragments gone.</p>
<p>E Remove blocks D & I</p>	<p>Low: major loss of building parts, strong alteration of building's layout.</p>	<p>Medium-high: two secluded green courtyards foster intimacy and belonging, with public engagement.</p>	<p>+/- 16,520m² space demolished: KB offices, restoration room, BK atelier, Club Erasmus, connection NA.</p>	<p>High: 21% of the building demolished.</p>	<p>New intimate green spaces for public gathering and engagement. Unused space solved.</p>	<p>Large-scale demolition with higher CO2 impact, loss of connection with NA, fragmented building experience.</p>

High: significant heritage values are preserved and/or strengthened.
Medium: some heritage values and attributes are lost, other elements remain.
Low: major heritage values and attributes are lost, compromising the KB's identity and the architect's intent for the building composition.

SECTION AA'

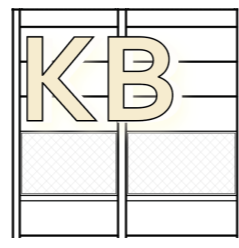
Northwest view



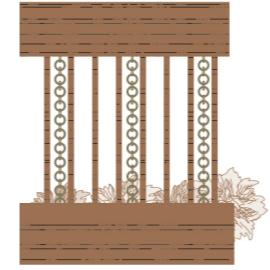
Subtle ground-level openings
Sustainable Libraries



New Green Climate Square Buffer



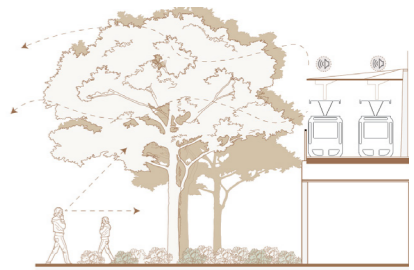
Oversized illuminated KB letters for low vision wayfinding



Rain Chains & Planters – Gradual Water Flow



Biodiverse green and wadi form a climatic threshold framed by retained columns



Trees acting as a visual and sound buffer