[Designing the Extroverted Library: *An Interactive and Inclusive Hub for the Future*]

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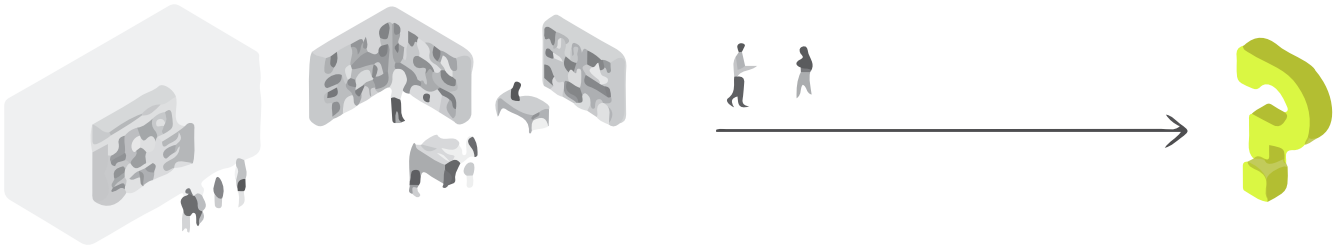
Abstract

This research examines the **KB Library's transformation** in The Hague toward becoming an **extroverted**, **interactive**, and i**nclusive** civic hub that embraces AI and adaptive spatial strategies. This study tackles the challenge of declining library patronage in today's digital landscape by developing spatial and technological framework for future-proof library design.
The project interweaves architectural assessment with **qualitative interview** and **computational analysis**—using DepthMapX as its primary analytical instrument—to reimagine the library's spatial layout. Research methods included field observations, interviews, spatial measurements, and digital modeling to create a comprehensive understanding of current conditions.
Interviews with library staff and patrons, alongside extensive DepthMapX visibility studies and innovative programming proposals, have generated a practical framework that merges AI capabilities with spatial analysis techniques for real-world architectural decisions.
By reconceptualizing national libraries, the study positions these institutions as **active nodes** in the **urban fabric** that foster **learning, inclusivity, and technological access** for diverse populations. Beyond addressing existing spatial limitations, the project aims to deliver sustainable design recommendations capable of evolving alongside changing societal requirements.



1. Introduction

1.1 Problem Field

In recent years, libraries worldwide have hit a critical turning point. They can't just warehouse books anymore – they must become **dynamic, inclusive, and digitally responsive public spaces**. As readers vanish into their screens, physical libraries risk their foot traffic to diminuish.

> *"Many libraries are dealing with a drop in patronage in a world that is becoming more digital."*
> **(Sharma et al., 2024)**

This raises tough questions: **how can libraries remain relevant and vibrant in the digital age?** Beyond

Figure 1, "Timeline of Libraries in the Digital Age", Collage created by the author using excerpts from Emmanuel, Vivien. (2020). History and Development of Libraries.

lending materials, they need to spark civic life – **bringing diverse people together, breaking demographic barriers to learning, and adapting** to our rapidly evolving digital reality.
The Dutch **Koninklijke Bibliotheek (KB)** in The Hague makes a fascinating test case. Despite its importance to national heritage and scholarly access, its layout and visitor patterns feel stuck in the past. Transforming it into a genuinely public forum means **reinventing its spaces, programs, and relationship with technology**.

1.2. Research objective

This research tackles the library evolution through AI and robotics paired with predictive spatial analysis. Indraji's team (2024) found that "automated systems for book sorting and shelving can streamline operations and make more efficient use of library space." Such innovations don't just cut costs – they create **opportunities for reprogramming space toward user-centered activities** that breathe new life into dusty reading rooms.

The project investigates how **spatial adaptability and interactive technology** can be strategically embedded into the design of tomorrow's national libraries, with the KB serving as case study. This research develops **what it is called the "Extroverted Library" – an institution that actively connects with its urban context and plugs into the broader digital ecosystem rather than hiding behind imposing facades.**
After surveying innovations in library architecture and AI integration, this research will dive into the research questions, unusual methodologies, and specialized spatial tools – particularly DepthMapX, which maps visibility patterns and movement flows. **By fusing design, data, and discourse**, this project brings the possibility to bridge the gap between architectural practice and computational research to forge a new vision for civic knowledge spaces.

2. Conceptual Framework / Keywords

This research builds upon three interconnected conceptual frameworks: **Extroverted Spaces, AI-Driven Adaptability, and Future-Proof Design**. These core ideas shape my exploration of spatial approaches and technological tools for reimagining the KB Library as a genuine civic hub.

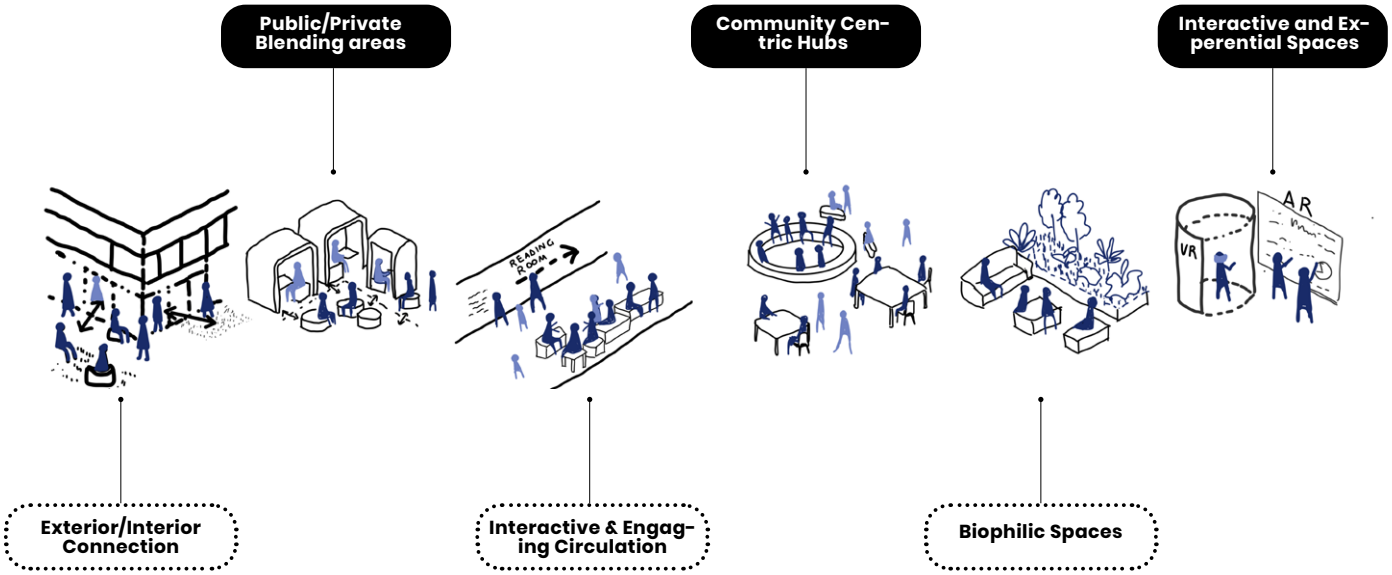


Figure 2, Extroverted Design Strategies: promote openness, interaction, and engagement, made by author

2.1 Extroverted Spaces

Definition: "Extroverted" architectural spaces embody designs that foster openness, visibility, and fluid interaction between interior functions and the surrounding public domain. **Xhambazi (2015, p. 12)** describes this perfectly: "Extroverted architecture is characterized by its centrifugal, outward-looking nature, where 'open spaces [are] extroverted, centrifugal." Unlike traditional inward-facing environments, these spaces break barriers, encouraging social encounters and seamless transitions.
Application in This Research: For the KB Library transformation, extroversion means challenging conventional boundaries: How can this institutional building become more welcoming, transparent, and connected to both urban fabric and diverse user groups? Tactics include (Fig.2) creating permeable ground floors, transparent building edges, mixed civic functions, and intuitive movement pathways.
Design Goal: To develop a library that actively participates in public life—not merely housing books but attracting and engaging communities.

2.2 AI-Driven Adaptability

Definition: This concept harnesses intelligent technologies—robotics, sensor networks, and algorithmic systems—to create responsive environments that optimize library operations and adapt to shifting user

behaviors. It embraces tools like DepthMapX to model and predict spatial performance before physical implementation.
Application in This Research: My work investigates **how automated book management, environmental monitoring, and computational analysis through DepthMapX can transform library experiences while guiding architectural decisions.** The goal isn't technological showmanship but meaningful integration of AI into both physical space and service delivery, by integrating with design those services within the spaces itself.
Design Goal: To craft intelligent, responsive environments capable of evolving alongside changing user demands and technological capabilities.

2.3 Future-Proof Design

Definition: Future-proofing anticipates inevitable shifts in technology, demographics, and cultural practices, creating spaces that accommodate evolution without obsolescence. This demands modular thinking, spatial versatility, programmatic layering, and forward-looking infrastructural planning.
Application in This Research: For the KB Library, this means studying emerging trends in information access, technological advancement, and the building's capacity for physical adaptation. **Key strategies include designing flexible zones, multi-purpose programming, and adaptable technical systems**.
Design Goal: To move beyond quick fixes toward enduring spatial intelligence and architectural adaptability in the library proposal.

3. Research Questions

Main question

What role can technology and design for adaptivity play in shaping the KB Library as a space that promotes openness, interaction, and engagement, using predictive spatial analysis (DepthMapX) to inform adaptability in its design?

Secondary Questions

*What **AI-driven technologies and spatial strategies can enhance user interaction** and support library functions?*

*What are **user expectations and preferences** regarding AI integration and spatial adaptability in the future KB Library?*

*How can the impact of **the new library interventions be informed through a data-driven decision-making tool** (DepthMapX)?*

Main Research Question

What role can technology and design for adaptivity play in shaping the KB Library as a space that promotes openness, interaction, and engagement, using predictive spatial analysis (DepthMapX) to inform adaptability in its design?

This study tackles the transformation of library spaces in the digital age. Looking at KB Library as a test case, it examines how architectural strategies combined with new technologies might create truly public spaces. The research uses computational tools to understand spatial dynamics before physical implementation.

Sub-Questions

The project breaks down into three areas of investigation:
1. *What AI-driven technologies and spatial strategies can enhance user interaction and support library functions?* This part looks at which technologies improve visitor engagement and its influence to the layout and design of the library.
2. *How can these innovations shape the future library experience from a user-centered perspective?* Rather than approaching design from institutional requirements, this question puts visitors first. It examines how various user groups navigate library spaces and their feelings towards the new technological services.
3. *How can DepthMapX inform data-driven decision-making in future library design?* DepthMapX analysis reveals hidden spatial patterns that affect how people move through and use buildings. This section applies these findings to test potential design interventions before construction.

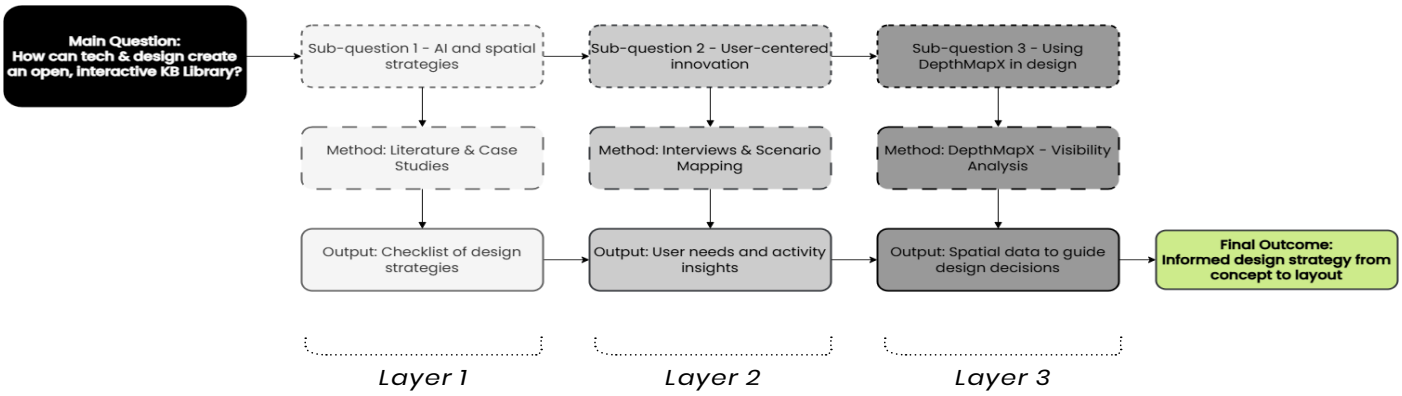


Figure 3, layered methodological approach

4. Methodology

This research is baed on a **layered methodological approach** (Fig.3), blending spatial study, user research, and case analysis. Each method tackles a sub-question while guiding the project from big-picture **concepts to detailed layouts.**

The work unfolds in three parts:

Sub-question 1: **What AI-driven technologies and spatial strategies can enhance user interaction and support library functions?**
Methods Used:
- Literature Review & Technology Scan (Fig.4) Looking at what's happening with AI tools, interactive displays, and smart systems across libraries and civic buildings worldwide.
- Precedent Analysis Studying libraries that have already tried innovative approaches to tech inte-

gration

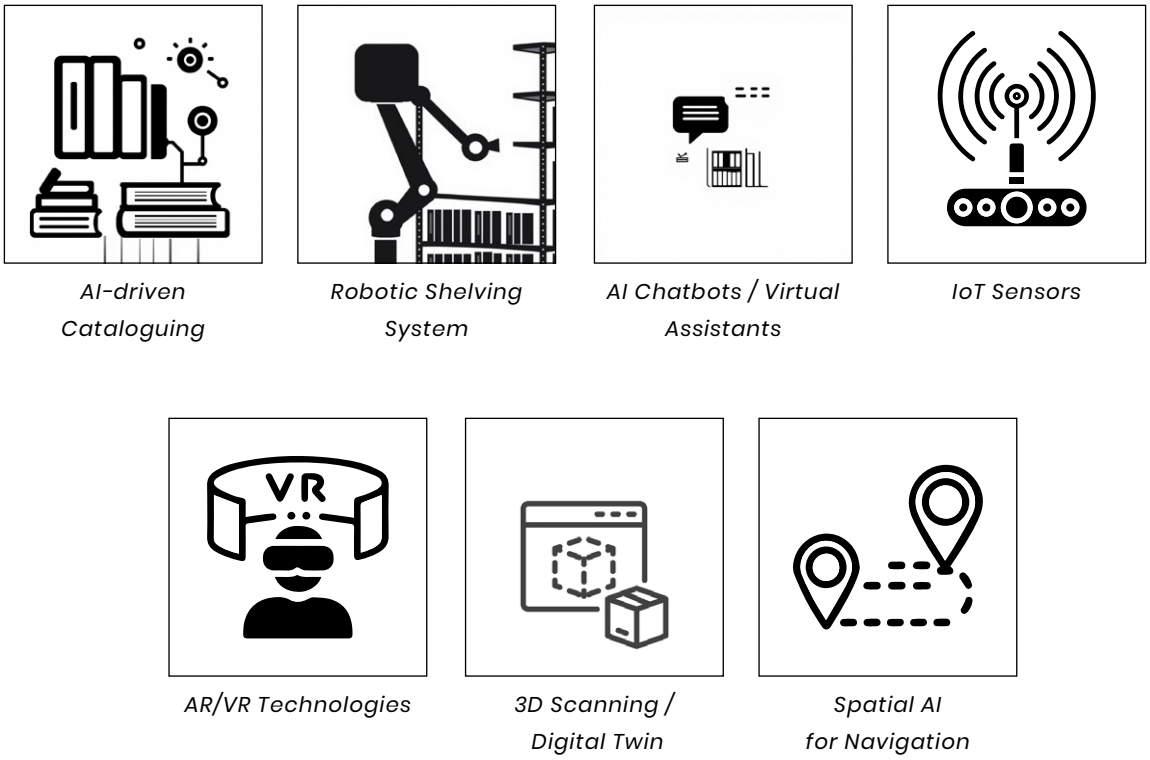


Figure 4, Initial Collected Technologies

What this informs: This groundwork helps to understand both available tools and their spatial implications. Beyond cataloging gadgets, it reveals how technology shapes behavior and experience in public spaces.

Data collection:

- Technology landscape overview
- Design strategies derived from precedents
- A checklist of key values for future libraries (e.g., flexibility, responsiveness, interactivity) (Fig.5)

Sub-question 2: What are user expectations and preferences regarding AI integration and spatial adaptability in the future KB Library?

Methods Used:

- **Interviews** & Focus Groups Talking with actual people who use (or might use) the library to understand their needs.
- **Mock Scenarios / Futurecasting Exercises Asking** "what if" questions to imagine how libraries might evolve.

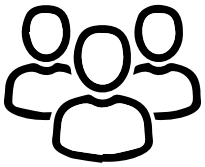
What this informs: This makes abstract concepts concrete. It translates buzzwords like "adaptability" into practical design requirements based on real human needs.

Data collection:

- Needs mapping of user groups
- Behavioral patterns and preferences
- Principles for adaptive programming

Interview protocol: Seven semi-structured interviews (18–30 yrs; students/professionals). Convenience–snowball sampling; 20–30 min each; recorded with consent; rapid thematic coding by two passes; codes: tech comfort, spatial needs, service expectations, concerns.

Students
(5 participants):
Representing regular users from diverse academic backgrounds.



Community Members/Other Users
(5 participants):
Casual visitors, researchers, or individuals who use library spaces for non-academic purposes.

Figure 5, Focus group people

Sub-question 3: How can the impact of the new library interventions be informed through a data-driven decision-making tool (DepthMapX)?

Methods Used:

- Spatial Analysis using DepthMapX Conducting: Visibility Graph Analysis (VGA) (Fig.6), measures visual connectivity and openness in space, mapping potential areas of interaction or isolation.

What this informs: DepthMapX turns intuition into evidence. By modeling the current KB spaces and testing redesigns, we get hard data on how spatial changes affect movement and interaction.

Data Collection:

- VGA maps of current (Fig.8) and redesigned layouts
- Movement potential predictions
- Assessment of spatial openness and program zoning

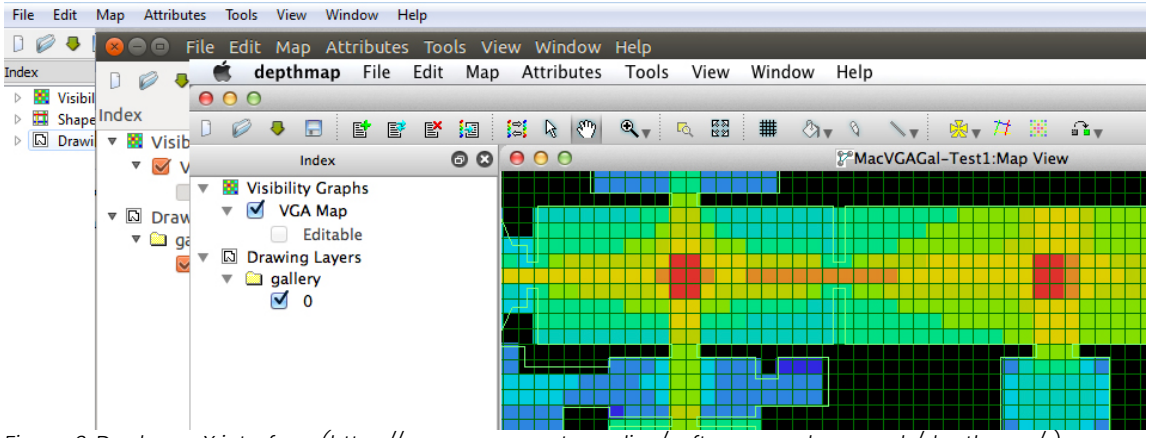


Figure 6, DephmapX interface (https://www.spacesyntax.online/software-and-manuals/depthmap/r)

DepthMapX parameters: VGA grid = 0.5–1.0 m; radius = 'global' and 12–20 m local tests; boundary = wall polygons from CAD; color bins = 7 (blue->red). Output metrics: Connectivity, Integration (Rn), and Visual Control."

5. Initial Research findings

5.1 Sub-Question 1: What AI-driven technologies and spatial strategies can enhance user interaction and support library functions?

To tackle this question, I created a Technology & Spatial Strategy Checklist (Fig.5) after diving deep into literature covering **current and emerging tech applications in library design**, smart buildings, and AI integration. The checklist sorts technological innovations by their spatial and functional effects, creating a hands-on tool for design decision-making during project planning phases.

This checklist works as an analytical framework to:

- **Sort existing and emerging AI and robotics systems relevant to library operations** (cataloging, user navigation, retrieval systems, etc.)
- **Map their spatial impacts** (shifting physical catalogs to digital kiosks, freeing floor area through robotic shelving)
- **Pinpoint design responses like modular zones, AR/VR learning pods, or smart circulation pattern**

Key integrated technologies from the checklist include:

- AI-driven cataloging systems: shrinking desk requirements while expanding digital access points
- RFID & ASRS systems: compact storage that opens up user areas
- AR/VR platforms: demanding flexible, immersive spaces
- IoT & spatial AI: supporting data-informed wayfinding and real-time usage monitoring
- This checklist established the foundation for determining which technologies would deliver the biggest impact or prove most feasible in the KB Library transformation, while structuring the subsequent user research phase.

Technology	Spatial Change	Design Impact	Estimated Space Use
AI-driven Cataloguing	Reduced space for physical catalogues	Digital kiosks replace large reference desks; open lobby flow	**<1–2%** (info desks only)
Robotic Shelving Systems (RFID/ASRS)	Compact vertical storage, fewer open stacks	Robotic corridors behind walls; public stacks reduced	**10–15%** (back-of-house)
AI Chatbots / Virtual Assistants	Less human-manned service points	Self-check terminals, help kiosks, mobile chat zones	**<1%** (dispersed stations)
IoT Sensors	Smart zoning and usage feedback	Dynamic furniture layout, responsive lighting, occupancy tracking	**<1% physical**, pervasive digitally
RFID Technology	Faster inventory and user interaction	Sleek self-checkout areas; secure yet open stacks	**2–3%** (within collection areas)
Automated Storage & Retrieval Systems	High-density, hidden storage	Archive functions relocated to compact areas, freeing up public space	**Up to 10–20%** (if integrated)
Spatial Design Network Analysis (VGA)	Optimized layout planning	Informs zoning and planning; no physical footprint	**0% (methodology tool)**
AR/VR Learning Spaces	Immersive, tech-based zones	Dark rooms, adjustable partitions, AR booths	**3–5%** (can be modular)
3D Scanning / Digital Twin	Real-time digital monitoring	Flexible planning and predictive maintenance; back-end integration	**<1% physical** (software-driven)
Spatial AI for Navigation	Personalized wayfinding	Interactive displays, smart signage, voice-guided access	**<1–2%**, integrated at circulation

Figure 7, The future library check-list, and spatial implications, made by Author

5.2 Sub-Question 2: What are user expectations and preferences regarding AI integration and spatial adaptability in the future KB Library?

Participant Demographics

Age group: All respondents are **between 18–30**

Backgrounds: **Architecture, Finance, Design, Computer Science, International Relations**

Usage Frequency: Mixed (Some regular users, others occasional or non-users)

Technology	User Response Summary
AI-Assisted Search / Smart Lookup	Strong interest across all interviews: faster, more relevant access to archives and books
AR Archives / Visual Browsing	High appeal for making content exploration more intuitive and engaging
Self-Service Tools	Generally positive attitude; helps speed up routine tasks (e.g. check-in/out, navigation)
Chatbots / Virtual Assistants	Mentioned less explicitly, but desire for intelligent assistance is noted
Concerns	One user flagged potential AI bias and accuracy concerns

To address this sub-question, I conducted **seven semi-structured interviews** using a shared interview guide (see Appendix 1). All participants were young adults between 18–30 and represent a range of backgrounds relevant to future library use: architecture and design students, a finance professional, a computer scientist, a medicine student, and a student in international relations and public management. Library use frequency varied from weekly users (e.g. students who regularly visit TU Delft Library or other academic libraries) to occasional users and non-users who mainly rely on digital resources. This mix was intentional, in order to capture both experienced library users and people who could be attracted by a more extroverted, technology-rich KB Library.

The interview guide consisted of eight core questions, organised into four sections:

-**User profile** (4 closed questions) – user group, age range, field of study/profession, and frequency of library use.

-**Technology in libraries** (3 open questions) – preferred digital/smart technologies, interest in AI-assisted research and digital archives, and attitudes toward self-service systems such as check-in/out, scanning and wayfinding.

-**Desired functions and spaces** (3 questions, one multiple-choice, two open) – types of spaces a future library should include, perceptions of current support for collaboration, and what would make them visit more frequently.

-**Perceptions and values** (2 questions, one with tick-boxes, one open) – emotional associations with libraries and opinions on the KB becoming more open, visible, and socially engaging. An additional notes section allowed me to record spontaneous remarks and non-verbal cues immediately after each interview.

Interviews were conducted in **person, online, or by phone** depending on availability, and typically lasted around 20–30 minutes. The semi-structured format allowed me to ask follow-up questions when participants mentioned specific technologies (such as AR archives or AI search tools) or spatial experiences (such as overcrowded study areas or lack of quiet rooms), which later informed the thematic analysis and the user types developed in this chapter.

Space Type	Mention Frequency	Notes
Quiet Study / Reading Areas	★★★★★★ (6/7)	Highly valued. Preference for silent zones, privacy corners, and good acoustics
Co-Working & Group Zones	★★★★★ (5/7)	Desirable for students and young professionals. Sound separation is crucial
Makerspaces / FabLabs	★★★★ (4/7)	Strong interest, especially from architecture and design students
Café / Social Lounge	★★★★★ (5/7)	Seen as attractive, helps libraries serve as "third places"
Outdoor / Green Areas	★★★ (3/7)	Considered a bonus, supports well-being and informal use
Children's Zone	★★★ (3/7)	Mentioned mostly by those who value multi-generational inclusion
Modular / Flexible Workspaces	★★★★★ (5/7)	Desire for convertible areas: silent zones, group rooms, semi-private pods
Exhibition / Cultural Events	★★★ (3/7)	Support for hybrid library programming—talks, exhibitions, etc.

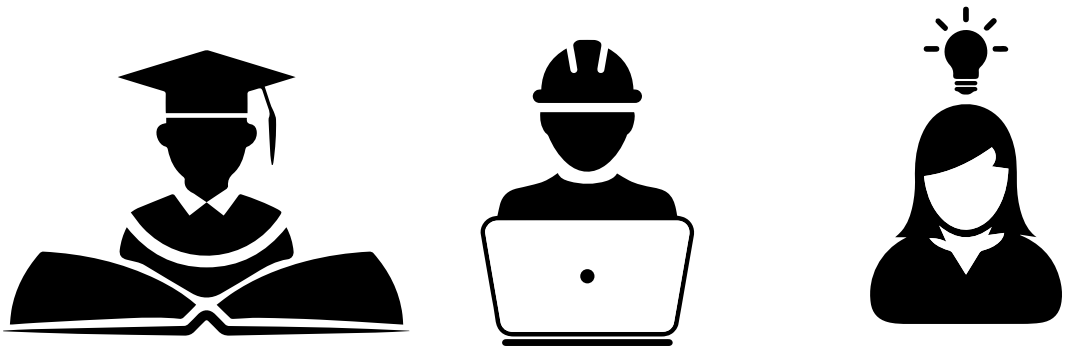
Figure 8, Interviews Results, made by Author

Key findings from current interviews:
1. ***Technological Preferences:***
Strong interest in AI-powered search tools and AR archives that make discovery more intuitive
Users preferred self-service options (check-in/out, navigation) when designed for speed and simplicity
Mixed reactions to chatbots, with some worry about bias and accuracy issues
General preference for technology that enhances rather than dominates the library experience

Theme	Insight
Hybrid Functionality	Libraries should offer spaces for both focus and interaction
Emotional Connection	Libraries seen as inspirational, but also outdated—need modernization
Increased Openness	All respondents welcome a more socially engaging, visible KB Library
Inclusivity Through Zoning	Clear need for both quiet zones and vibrant spaces to support diverse users
Events & Programs	Events, lectures, and exhibitions seen as key to draw in new audiences

Figure 9, Interviews Results, Spatial Behaviour, made by Author

2. Spatial Behavior:
Most participants stressed the importance of quiet, private study areas while also wanting collaborative and group spaces
Strong support for flexible programming that adapts to different needs (pods, movable walls, modular rooms)
Popular features mentioned included green spaces, cultural exhibitions, cafés, and social lounges



The Silent Scholar *The Tech Explorer* *The Creative Maker*

Figure 10, Emerging User Types for Mock Scenarios, made by Author

Emerging user types: (***The Silent Scholar, The Tech Explorer, The Creative Maker***) represent different approaches to library use for later on Mock Scenarios — from quiet focus to hands-on experimentation — and help guide programmatic decisions in the spatial design.

5.3 Sub-Question 3: How can the impact of the new library interventions be informed through a data-driven decision-making tool (DepthMapX)?

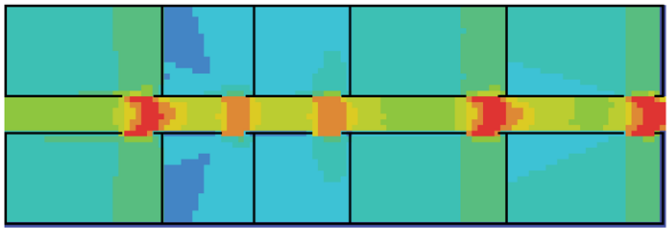
To evaluate and spatially test the interventions proposed through both technological strategies (SubQ1) and user-centered preferences (SubQ2), the software DepthMapX was employed to run Visibility Graph Analyses (VGA). This tool offers a data-driven framework for analyzing movement, visibility, and spatial legibility—core aspects of an extroverted, interactive library environment.

In this phase, DepthMapX was used **exploratively** on the existing KB floorplans rather than on a finalised design proposal. For each test I selected a representative portion of the current building (corridor, entrance zone, reading hall) and then generated a simplified "before–after" scenario by applying one spatial operation to the existing layout (such as opening a corridor, adding a ramp, or reorganising seating). These "after" layouts are **not the final design**, but abstract variations of the current plan used to understand how particular strategies might influence visibility and potential interaction. The aim of these simulations is methodological: to test how a data-driven tool like DepthMapX can support the design process, rather than to evaluate a predetermined architectural solution.

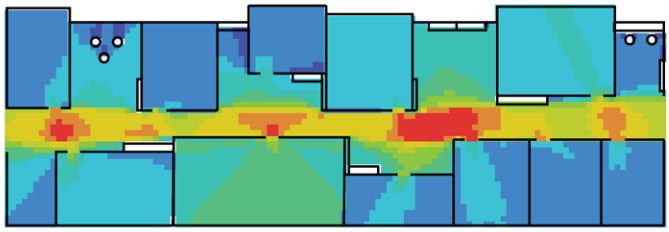
Three spatial scenarios were tested, each selected to reflect a different design condition and user dynamic:

Test 1: Coworking Corridor Transformation

Before:
-Red visibility zones appeared narrow and discontinuous.
-Adjacent rooms had minimal visual connection to the main corridor.
-The corridor functioned more as a transit path than a destination.



BEFORE



AFTER

Figure 11, VGA Test on Corridor Design, made by Author

After:
-Visibility zones expanded and hotzones are more disperesed.
-Adjacent rooms became visually integrated with the corridor.
-The space shifted from linear circulation to a social spine—ideal for collaborative zones.

Design Implications:
-Enhanced visual permeability supports placing pop-up exhibitions, flexible seating, or digital installations.
-Extroverted façades and partial transparency foster interaction and blur inside–outside boundaries.
-Corridor becomes a zone of pause and engagement, not just passage.

Test 2: Hybrid Tech Ramp Zone

Before:
-Visibility concentrated around the stair core—functioned as a transit node.
-Space had linear, directional use with little lateral visual engagement.

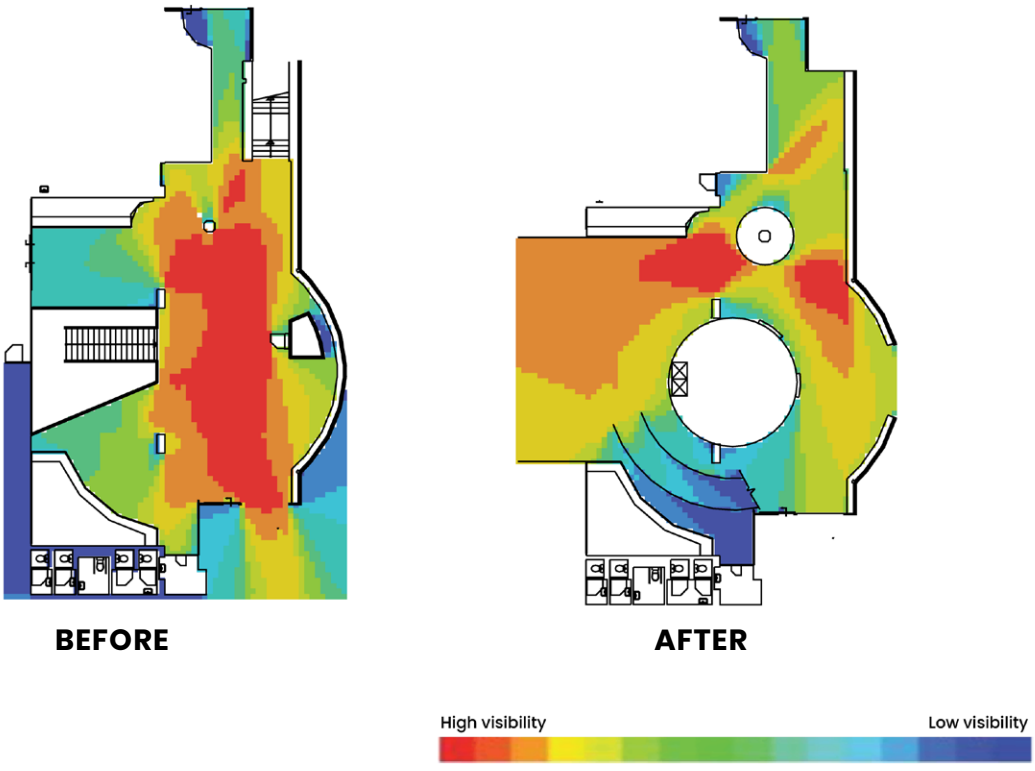


Figure 12, VGA Test on Tech Ramp Entrance, made by Author

After:
-Visibility became distributed along a spiraling ramp, curving around a central “automated” storage core.
-Vertical movement became gradual and explorative, supporting pacing, accessibility, and discovery.
-High visibility points emerged at strategic nodes—ideal for interactive tech features or digital kiosks.

Design Implications:
-The ramp now promotes slower navigation, suited for user exploration.
-The central robotic core becomes a symbolic and spatial attractor—visually prominent, functionally enclosed.
-Zones of engagement can be placed where circulation and visibility converge.

As a conclusion for the second test, a portion of the current entrance floor around the main stair core was taken as a sample. In the "before" model, the layout corresponds to the existing situation, where vertical movement is concentrated in a compact stairwell and the surrounding space mainly functions as a transit node. In the "after" model, I introduced a generic spiralling ramp around this same core, keeping the overall footprint and structural grid of the existing plan.
This modification was not yet a resolved architectural design, but an abstract scenario used to test whether a ramp-based configuration could increase visual continuity, slow down movement, and create more opportunities for interaction compared to the current condition. The resulting visibility patterns indicate how such a strategy could be promising and therefore justify developing it further later in the design phase.

Test 3: Reading Hall Reprogramming into Co-working Hall

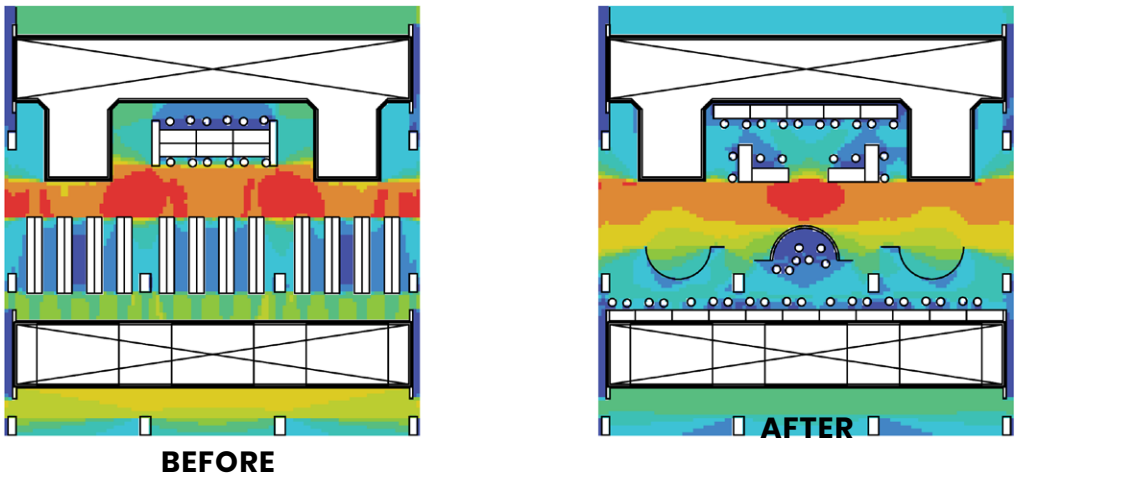


Figure 13, VGA Test on the Reading Hall, made by Author

Before:
-Centralized, symmetrical visibility mirrored traditional reading halls (silent, hierarchical layout).
-Limited spatial variation, strong control over movement and activity.

After:
-Visibility becomes more fragmented and rhythmic, adapting to circular pods and varied program uses.
-Central activity nodes now emerge—supporting AR/VR pods, lounge areas, and informal hubs.
-Peripheral coworking areas provide visual retreat while maintaining openness.

Design Implications:
-Spatial layering supports diverse user rhythms—focus, interaction, and rest.
-Pods offer semi-enclosed activity anchors, boosting informal use.
-The layout no longer enforces silence or control but promotes flexible occupation.

By layering findings from the Technology Checklist (SubQ1) and User Interviews (SubQ2) with spatial simulations via DepthMapX (SubQ3), we now arrive at a robust evidence-based foundation for design. Each method reinforced the others:

5.4 Design Guidelines distilled from Q1–Q3

G1. **Make corridors do more than move**. Maintain continuous **visibility spines with seating, touchpoints, and views** (supports Spatial-AI and lingering).

G2. **Layer privacy**. Place **quiet carrels** in low-visibility perimeters; **pods and collaboration**near—but not on—the visibility spine.

G3. **Expose tech, hide logistics.** Keep **ASRS/robotics visible as attractors**** while back-of-house flows remain off the public path.

G4. **Integrate biophilia where spill-over is high**. Use green pockets to **soften hotspots** and improve comfort.

G5. **Wayfinding = architecture.** Combine **sightlines, thresholds, and interactive markers** so users can read the building without signage overload.

6. Design Translation: From Research to Spatial Intervention

6.1. Hybrid Tech Ramp Zone

Design Summary:

This intervention reimagines the vertical circulation system as an interactive and functional core. The ramp wraps around a central robotic book storage and retrieval system, with AI-driven cataloguing interfaces positioned along the ramp's inner wall. The outer edges host viewing pods, reading spots, or informal gathering zones.

Key Spatial Features:

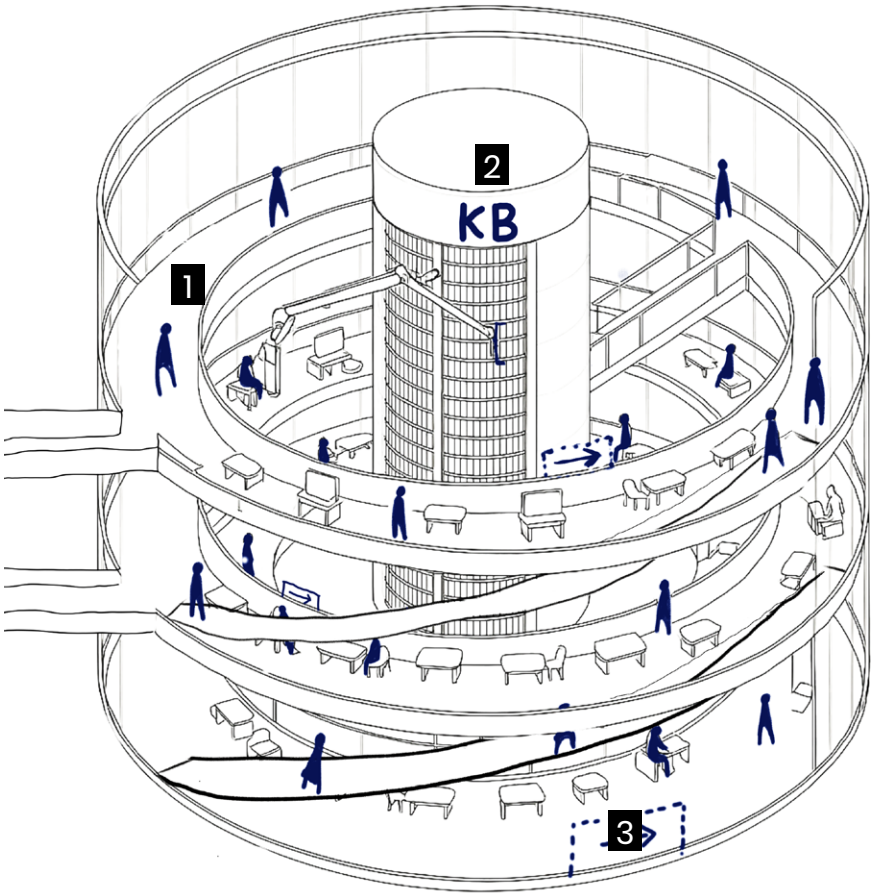


Figure 14, Hybrid Tech Ramp Design , made by Author

1. Gradual spiral ramp supports universal access and spatial pacing
2. Central cylindrical core for automated book logistics (inspired by ASRS)
3. Smart screens for AI-assisted search embedded along the ramp
4. Enhanced visibility and flow, validated through DepthMapX VGA

Technological and conservation considerations

This zone embodies the extroverted library ideal—where movement, exploration, and technology are intertwined to enhance user engagement. The central cylindrical core draws conceptually on recent developments in robotic storage for the KB collections. Boersma, Martens and colleagues describe how the new off-site KB repository is designed as a highly controlled conservation environment: an airtight building with reduced oxygen levels to minimise fire risk and ensure long-term stability for the national collection, organised in 14-metre-high racks accessed by automated systems rather than visitors.

Such a facility is geographically separated from the public library building in The Hague and functions as a dedicated preservation infrastructure rather than a user space.

In contrast, the robotic core in this project is intentionally framed as a working, short-term buffer rather than a full preservation vault. It handles books in transit – recently returned items, requested materials waiting to be picked up, or volumes queued for redistribution in the building – instead of the entire long-term collection. Long-term storage is still assumed to take place in specialised back-of-house or off-site repositories with strict conservation climates, as described in the KB's own plans for the new robotised depot.
The aim here is therefore not to replicate the exact technical and atmospheric conditions of a zero- or low-oxygen archive inside the public library, but to translate part of the robotic work process into spatial form.

By treating the cylinder as an operational node that remains environmentally separated from the ramp yet visually present, the design stays within plausible technical limits while exploring how logistics normally hidden in closed stacks could become legible to users. The Hybrid Tech Ramp thus uses robotic shelving as a future-oriented scenario for day-to-day book circulation, rather than as a literal architectural representation of the KB's off-site archival repository.

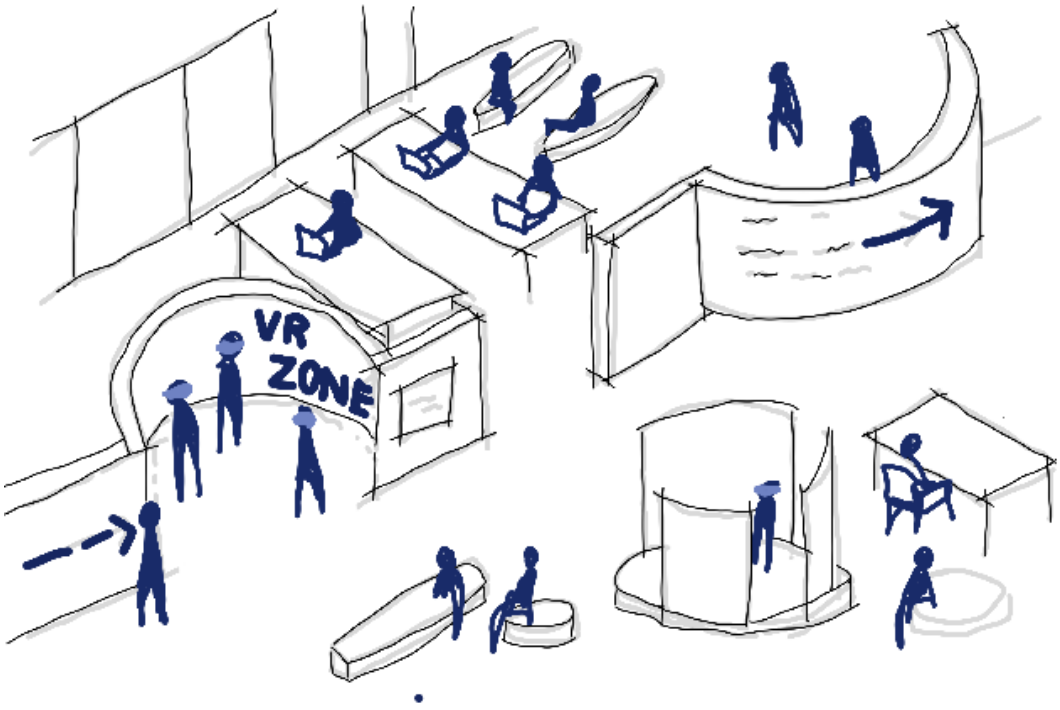


Figure 15, AR/VR Pods + Spatial AI Corridor Design , made by Author

6.2. AR/VR Pods + Spatial AI Corridor

Design Summary:
A multi-purpose corridor designed not only for movement but also interaction and immersion. Along its axis are integrated AR/VR pods—semi-enclosed, screen-lined modules for digital experiences. The corridor walls feature Spatial AI interfaces, providing real-time navigation, content previews, or ambient visual cues.

Key Spatial Features:
-Flexible pods for immersive learning or focus zones
-Transparent corridor walls with integrated spatial navigation aids
-A circulation space designed to support lingering, discovery, and choice
-Designed and refined based on DepthMapX visibility gradients

7. Social scientific impact

This research investigates how libraries can remain relevant spaces in a rapidly changing digital and urban world. By examining the interaction between spatial design, technology and user behaviour, the project explores new paths toward an *extroverted* architecture for civic institutions—one that prioritises openness, accessibility and community engagement over purely archival functions. The design approaches tested aim to support more inclusive and flexible spaces that can adapt to changing needs across different user groups, from silent individual study to collaborative work and technology-rich exploration.

At the same time, the study is necessarily limited in how far it can predict future developments. The technology checklist and design scenarios are based on current trends in AI, robotics and interactive media, but the actual evolution of tools, interfaces and user expectations in the coming decades is highly uncertain. This research therefore focuses on a *few specific directions* in which the KB Library might develop, rather than offering a comprehensive forecast of all possible futures. The robotic storage core, AI-assisted search systems and AR/VR pods are treated as **explorative scenarios** that illustrate how technological infrastructures could be spatialised and made legible, not as fully engineered solutions or fixed blueprints.

There are also methodological limitations. Although DepthMapX provides valuable insights into visibility patterns and potential movement behaviour, it cannot fully capture the social, emotional and cultural dimensions of how people inhabit library spaces. The analyses are restricted to single-floor VGA simulations and static layouts, and do not address temporal aspects such as daily rhythms, seasonal use or long-term patterns of appropriation. In addition, the design outcomes remain speculative and tied to a single case study; their broader applicability to other libraries and cities would need to be tested through implementation, post-occupancy evaluation and comparison with different cultural and institutional contexts.

Despite these constraints, the project establishes a useful foundation for future work that seeks to reimagine public architecture as a dynamic platform for social connection. By linking empirical user insights, computational spatial analysis and design experimentation, it suggests how national libraries like the KB could evolve from inward-looking repositories into extroverted, adaptive hubs embedded in the everyday life of the city.

8. Urban Context and Analysis

The KB stands at a junction point in The Hague where government, culture, and transportation converge. Despite this strategic location beside Den Haag Centraal (Fig.10), the library fails to function as a dynamic

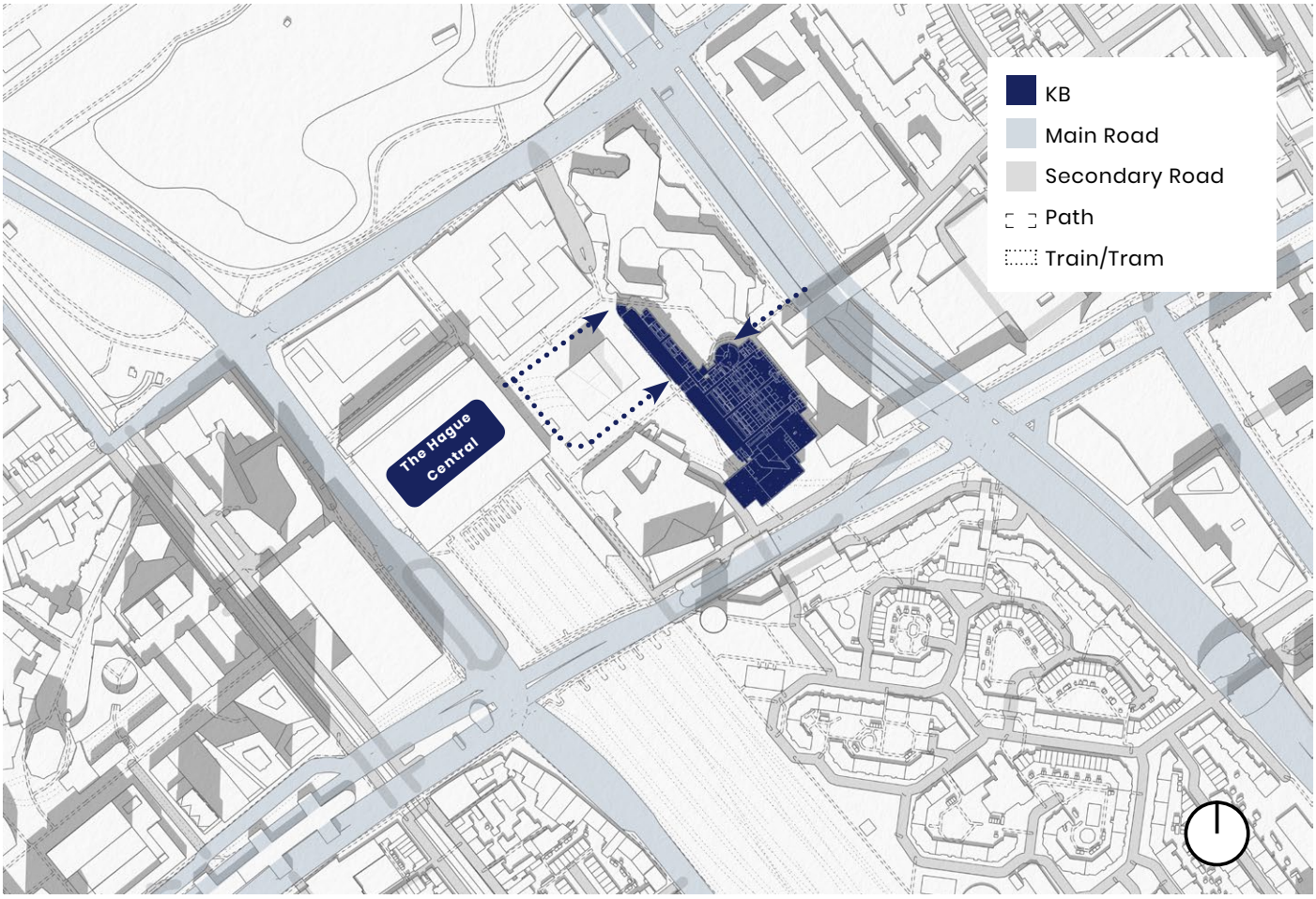


Figure 16, Urban Map

civic interface. Anyone visiting the area can see the problem immediately.
The library sits walled off from pedestrian flow. Glass and concrete physical and visual barriers create an uncomfortable disconnect between the library and the city. While thousands pass by daily, few enter. The building repels rather than attracts.

The solution must prioritize permeability, openness, and integration. Rethinking the KB offers a unique chance to activate its urban surroundings and transform a cultural wallflower into a central player in The

Figure 17, KB Entrance

Figure 18, Ground Floor Passage

Hague's public life.

8.1 Architectural and Functional Background

The building was designed by OD 205 in 1982. Its rational grid system, clear organization, and compartmentalized approach typify a pre-digital library paradigm when collection preservation was the focus instead of user experience.
The building continues functioning as an archive and research center, but these spaces badly serve new civic and technological demands. Modern libraries host maker spaces, provide technology access, and function as community anchors—all needs the rigid KB layout struggles to accommodate.


Figure 18-22, archives from tramway, archives from the road, newspaper room, reading hall, https://www.kb.nl

8.2 Identified Spatial Challenges

- **Introverted Design**: Minimal windows, confusing entrances, and enclosed façades discourage public engagement.
- **Programmatic Rigidity**: The original layout resists flexible re-zoning, limiting the building's capacity to accommodate evolving user needs.
- **Lack of Civic Dialogue**: The architecture fails to engage with the rhythm and diversity of the surrounding city life.

8.3 Potential as a Design Project

These challenges make the KB ideal for testing:
- Applying predictive spatial analytics through DepthMapX to identify high-impact intervention points.
- Exploring adaptive architecture responsive to usage patterns through data-informed systems.
- Prototyping extroverted strategies that transform libraries from book warehouses to public platforms.

9. Spatial Programming

9.1 Introduction: KB Innovation Hub

In line with the KB Library's mission to evolve as a civic knowledge institution, the KB Innovation Hub is proposed as a new anchor program that connects **academia, public knowledge, and entrepreneurship**. Positioned within the northern wing of the existing complex, the incubator will serve as a **collaborative platform for university students, researchers, and creative professionals across the Netherlands**. By inviting stakeholders from institutions such as TU Delft, Leiden University, and professional schools, the hub fosters cross-disciplinary innovation in areas including culture-tech, digital humanities, public policy, and civic technology. Located in The Hague—a strategic international and political capital—the hub aligns innovation with heritage, providing an experimental space at the intersection of education, research, and community engagement.

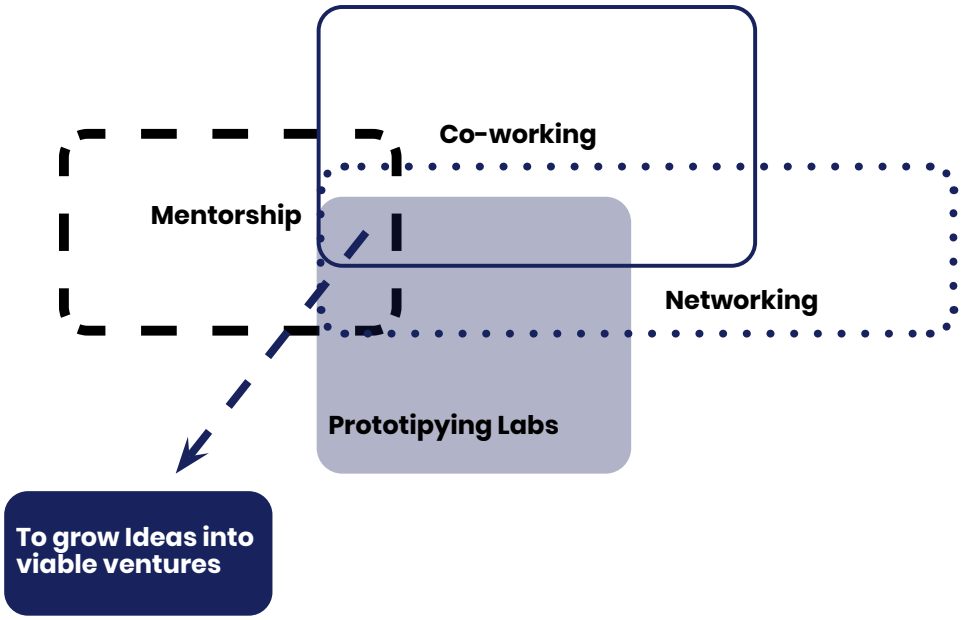


Figure 23, Incubator Diagram

9.2 Gross Floor Area (GFA) Planning and Space Reallocation

A significant reorganization of the KB Library's internal spatial layout has been undertaken to accommodate the updated program. The original total Gross Floor Area (GFA) is approximately 80,000 m², of which a substantial portion was previously allocated to archival storage, museum spaces, and fixed-use administrative areas. With the off-site relocation of the national archives and the departure of the Literature and Children's Museums, the functional space has been reduced by approximately 30%, freeing large zones for reinterpretation and adaptive reuse.

This shift has opened opportunities to restructure the library into a more publicly oriented and flexible institution. The demolished southeastern volume—roughly 10% of the original mass—has made room for a new public plaza, improving urban connectivity and creating a civic threshold into the building. Floors 0 through 2 remain the most active in terms of public programming, while the reduced upper levels host more specialized and institutional functions.

Function	Estimated Area (GFA)	Notes
Reading & Study Areas + quiet Coworking	5,000 m²	Quiet zones, new reading halls
Public Amenities (cafés, restaurants, shop)	2,000 m²	Ground floor extroverted plaza zone
Incubator Hub for Universities	4,000–5,000 m²	Incl. teaching rooms, offices, lab spaces
Office & Admin Spaces	6,000 m²	From Colliers data & document findings
Informal / Coworking / Collaborative Zones	3,500 m²	Converted reading hall
Event / Auditorium / Exhibition	2,000 m²	Flexible public use
AR/VR & Interactive Tech Labs	1,000–1,500 m²	Modular spaces
Archive / Special Collection Access	2,000 m²	Some archives retained onsite
Green & Biophilic Indoor Courtyards	800 m²	Indoor natural integration
Circulation / Vertical Movement / Bridges	6,500 m²	~11% of total floor BVO
Restrooms, Tech support, Services, Storage	4,500 m²	From existing PvE requirements
Total Assigned Area	~42,300 – 44,800 m²	Remaining GFA allows flexibility

9.3 Spatial Plan: Incubator Allocation

The Innovation Hub will occupy the north-eastern wing of the KB building, offering a total of approx. ~4,000–5,000 m² across multiple levels. This program is broken down into:

Space Type	Size Estimate (m²)	Purpose
Co-working Open Area	700–800 m²	Shared hot-desking zone for students, entrepreneurs, researchers
Project/Startup Studios (10–12x)	600–800 m²	Enclosed team rooms (20–30 m² each) for early-stage startups or research
Mentorship / Office Rooms (8–10x)	300–400 m²	Private mentor/staff offices, shared desks for university liaisons
Teaching / Lecture Labs (2–3x)	500–600 m²	Flexible classrooms for workshops, hackathons, guest lectures
Makerspace / Prototype Lab	400–500 m²	Includes light fabrication tools, digital prototyping, 3D printing, etc
Meeting / Breakout Rooms (6–8x)	250–300 m²	Small group rooms (20–40 m² each), enclosed or semi-open
Event & Exhibition Space	400–500 m²	Multipurpose area for launches, demos, pitch events, installations
Kitchenette / Lounge Areas	150–200 m²	Informal social/coffee spaces for mingling and down-time
Storage, Server, and Tech Support	100–150 m²	Back-of-house functions (AV, supplies, tool storage, network)

10. Heritage Intervention Strategy

10.1 Retaining, Opening and Re-valuing the KB

This project treats the KB explicitly as a **heritage building**, not simply as an available structure for reuse. Its transformation is grounded in the value-based assessment developed in the group research Reshaping KB, which translated the official value assessment by Wijnand Galema into a more nuanced framework of eight value categories – social, economic, political, historic, aesthetic, scientific, age and ecological – and mapped them on plans, sections and facades.

Galema's report already concluded that, although the KB is relatively young, it has high cultural-historical significance as a key work of OD205 and as part of the post-war governmental ensemble around The Hague Central Station. The group research did not question this, but unpacked where and how those values are spatially expressed, using the values & attributes framework as a decision-making tool rather than a black box of "significance".

In my project this framework becomes the basis for a heritage strategy of **retention, transformation and subtraction**.

10.1.1 Reading the value maps

On the **ground floor value map** extracted from our group research (fig.24), the highest concentration of heritage values is located in:

- the linear east–west passage and north–south routes to Anna van Buerenplein (social, political and ecological values linked to public access and urban connections);
- the main entrance, lobby and reading-hall sequence (social, historic and aesthetic values);
- the archive plinth and depot extension (scientific and historic values);
- the courtyard and south-east façade with their characteristic aluminium "raincoat" expression (aesthetic and ecological values)

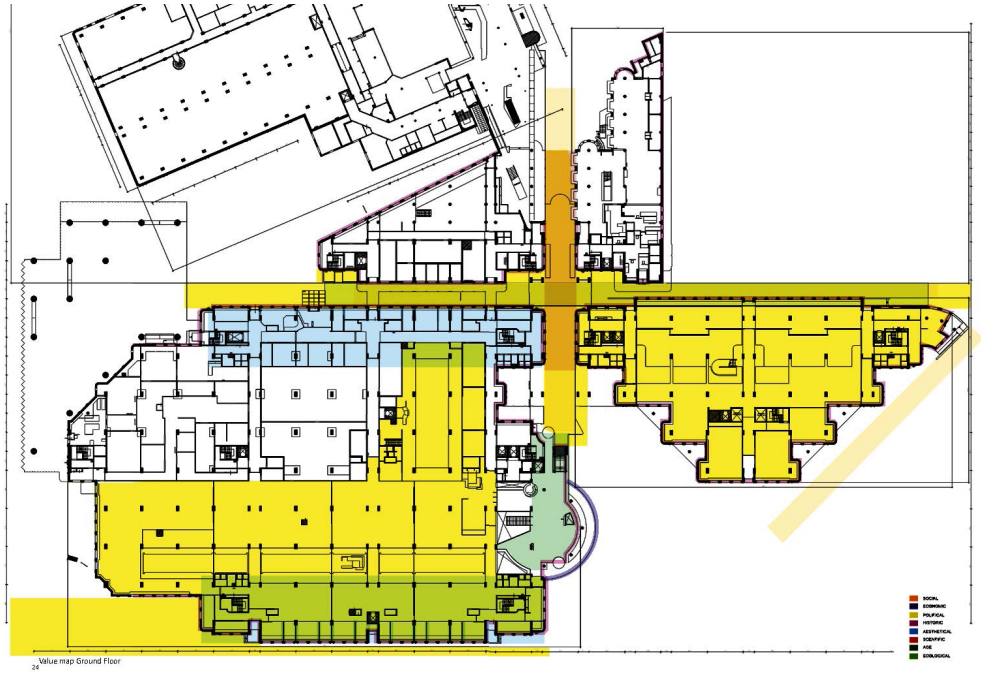


Figure 24, Value map Ground Floor, Made by the Heritage Group, "Reshaping KB" p.22-23

By contrast, the volumes identified in this project as **blocks C and D** (Fig.25) – the narrow bars on the east side of the ensemble – carry r**elatively few articulated values** in the expert assessment and in the user-based mappings. They consist mainly of repetitive office floors and deep internalised corridors, with limited street presence and little contribution to the social life of the ground floor. They are largely valued for functional and economic reasons (floor area and storage), rather than for strong social, architectural or historic qualities.

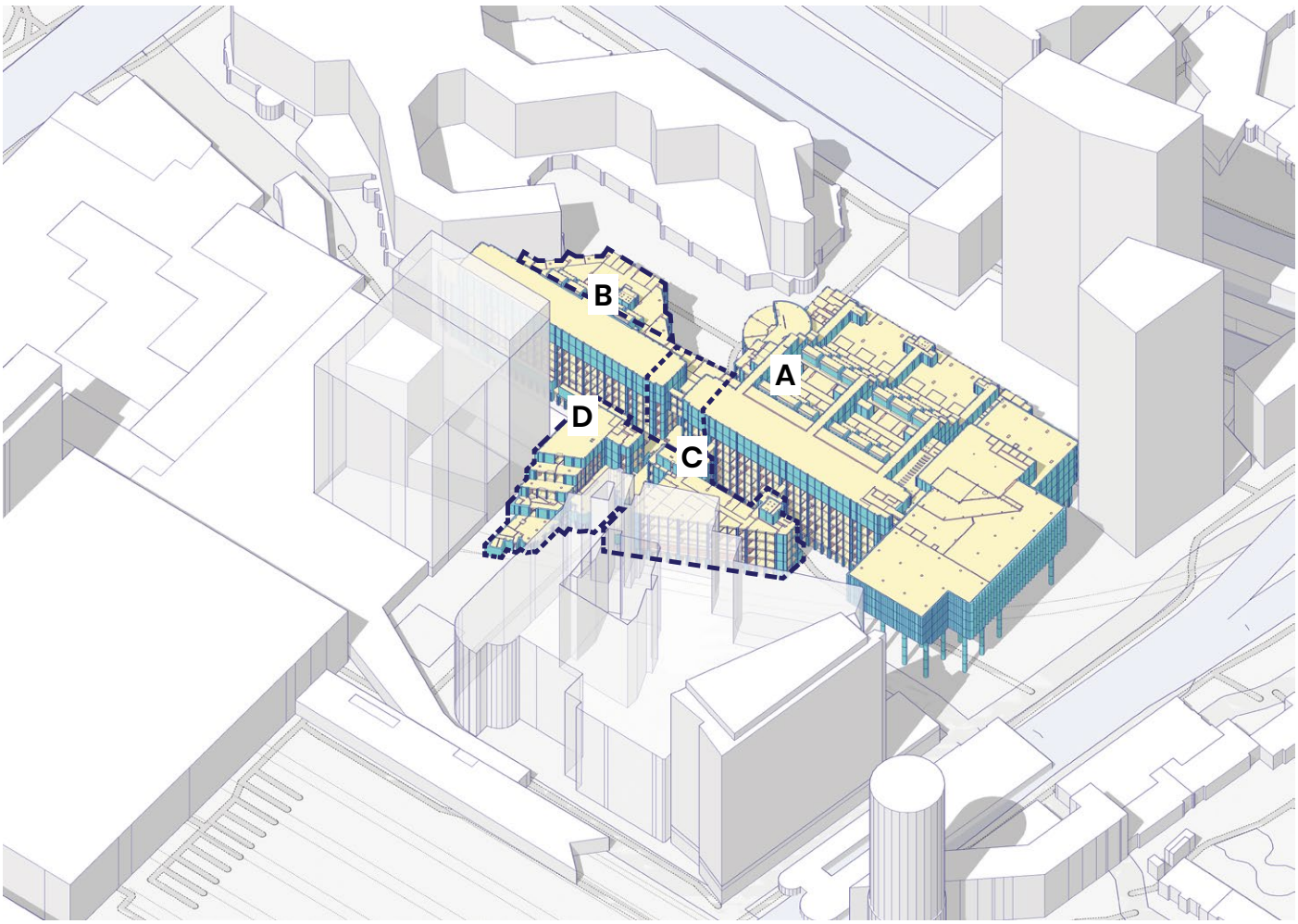


Figure 25, Isometric Diagram of the Blocks, Made by Author

On the basis of this analysis, my strategy is not to treat the KB as a frozen object, but as a **value gradient**:

zones of high **heritage value** (reading hall, archive halls, main structural grid, south and courtyard façades) are retained and carefully upgraded;

zones of **medium value** are reprogrammed and locally adapted;

zones of **low value and high obstruction** (blocks C and D and part of block B) are strategically removed in order to unlock new social and spatial values.

This strategy is summarised in the **heritage retention diagram** (Fig.25), which distinguishes between 0–25–50–75–100% retention for different parts of the complex (Aesthetic South-East Facade, Courtyard, Hybrid Tech Ramp Zone, Incubator / former reading hall, KB Plaza and archive halls).

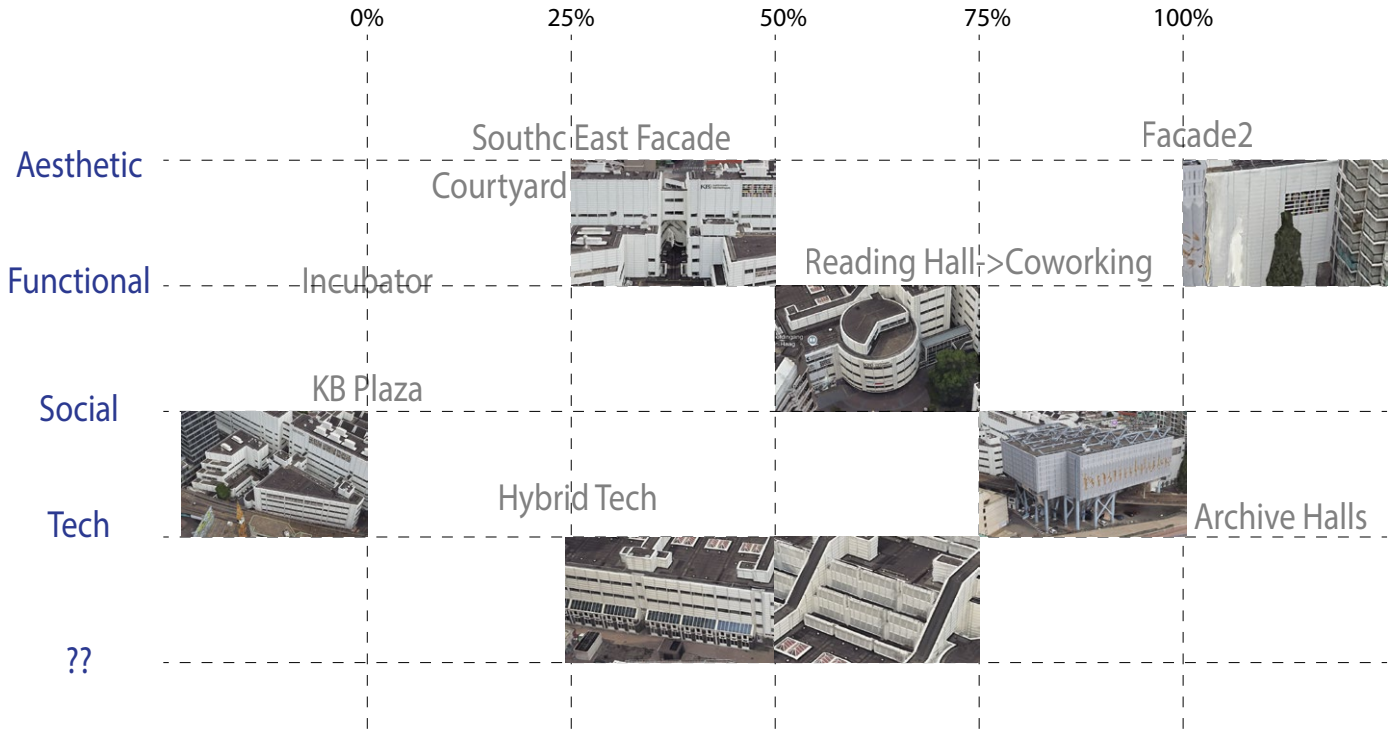


Figure 26, Heritage Retention & Focus Diagram, Made by Author

10.1.2 Subtraction as a heritage tool: the KB Plaza

The most radical intervention is the removal of substantial parts of blocks C and D and a smaller portion of block B – together roughly:

-Block C: ≈ 703 m² × 5 floors
-Block D: (≈ 258 m² + 215 m²) × 5 floors
-Additional fragment: ≈ 327 m² × 5 floors

These volumes are replaced by the new **KB Plaza**, an open, civic forecourt that connects the library directly to the station area and the future developments around Grotiusplaats. Rather than seeing this as a loss of heritage, the design treats it as a **re-programming of value**:

- On the **urban level**, the plaza addresses a long-identified weakness of the KB: despite its cultural importance, the building is almost invisible from the city and difficult to find. Opening the block restores visual and physical permeability and turns the obligatory public passages (already recognised as political and social heritage values in the group report) into a generous, readable public space.
- On the **social level**, the removal of low-value office slabs makes room for new extroverted functions (entrance hall, public program, hybrid tech ramp, incubator spaces) that strengthen the KB as an accessible civic institution. This directly builds on the group research conclusion that social values around the plinth and courtyard are crucial but currently underexploited.
- On the **heritage level**, the intervention clarifies the original structural and volumetric concept of OD205. By cutting away the least specific volumes, the project makes the underlying cross-shaped organisation and the characteristic “raincoat” façade more legible. What is removed are mainly generic infill floors; what is kept and highlighted are the structural grid, the depot extension, and the key spatial sequences that define the identity of the building.

In other words, subtraction is used **selectively and argumentatively**: the blocks with the lowest mapped heritage values are removed to reveal and strengthen the parts of the ensemble that carry the highest values and to generate new, socially significant space.

10.2 Adaptive, water-collecting façade as new ecological heritage

While parts of the volume are removed, the design intensifies and extends the ecological heritage values of the KB through a new adaptive façade. The group research already noted ecological qualities in the existing building – reflective cladding, integrated shading, skylights and voids – but also pointed out shortcomings such as limited daylight, unopenable windows and residual exterior space.

The proposed façade responds directly to these findings:

- It reuses the **existing structural rhythm** and, where possible, the original metal cassette modules, either retaining them, relocating them or substituting them with glazed or planted units (Fig.27).
- **Extruded boxes** create intermediate spaces – balconies, window seats, loggias – that thicken the envelope and allow people to actively inhabit the façade.
- **Green façade modules and planters** are hydraulically connected to an integrated rainwater system: during rainfall, the façade profiles and balcony covers channel water towards gutters and downpipes, which feed storage tanks and redistribute water for façade irrigation and non-potable uses inside the building.
- The façade operates according to a **weather–comfort scenario matrix:** (Fig.28-29) opening for natural ventilation and daylight on mild days, shading and promoting evaporative cooling during heatwaves, sealing and insulating in cold and windy conditions, and switching to “collection mode” in rainy weather to capture and reuse water while still offering protected outdoor or intermediate spaces.

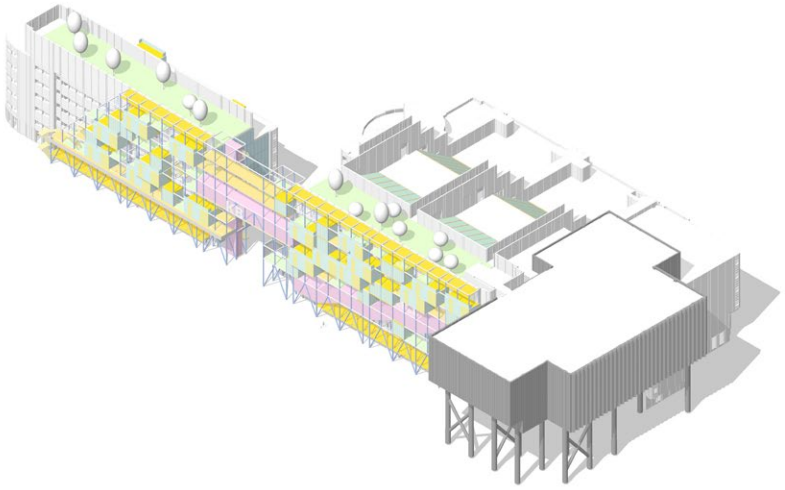


Figure 27, Proposed Facade Design, Made by Author

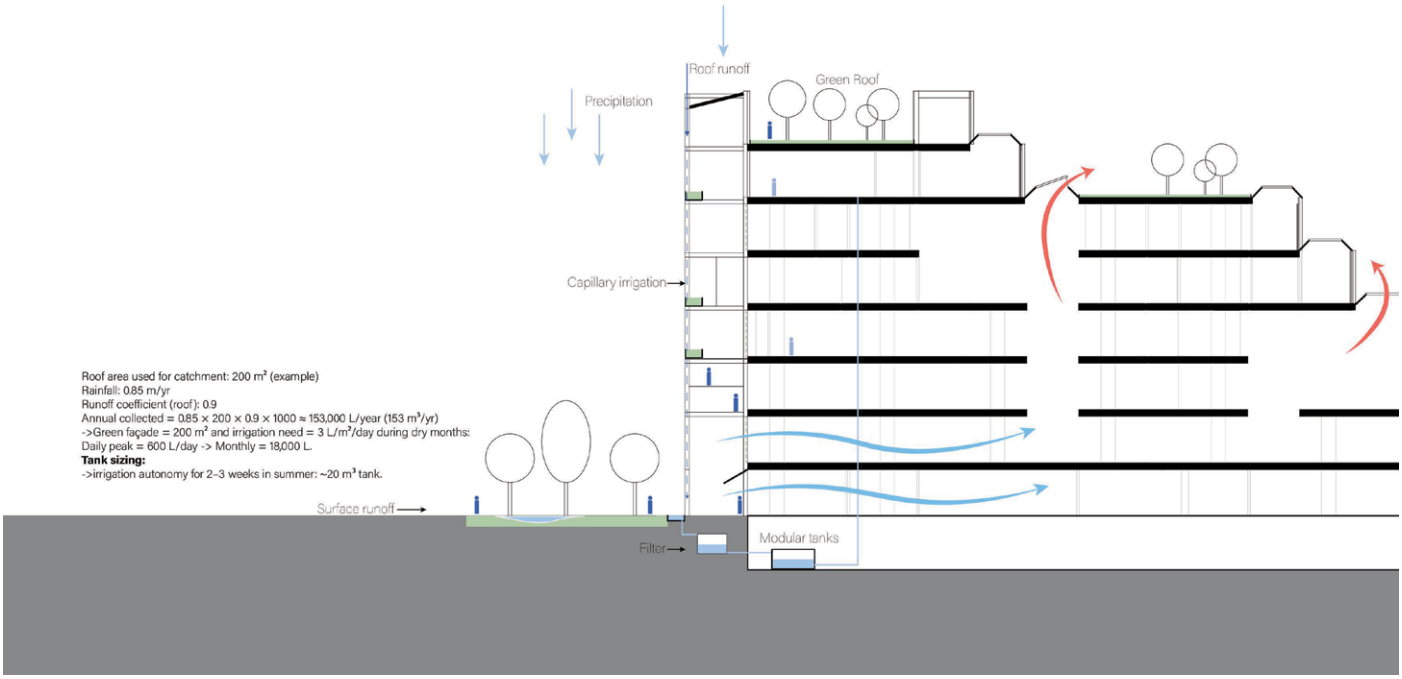


Figure 28, Rainwater Collection Strategy, Made by Author

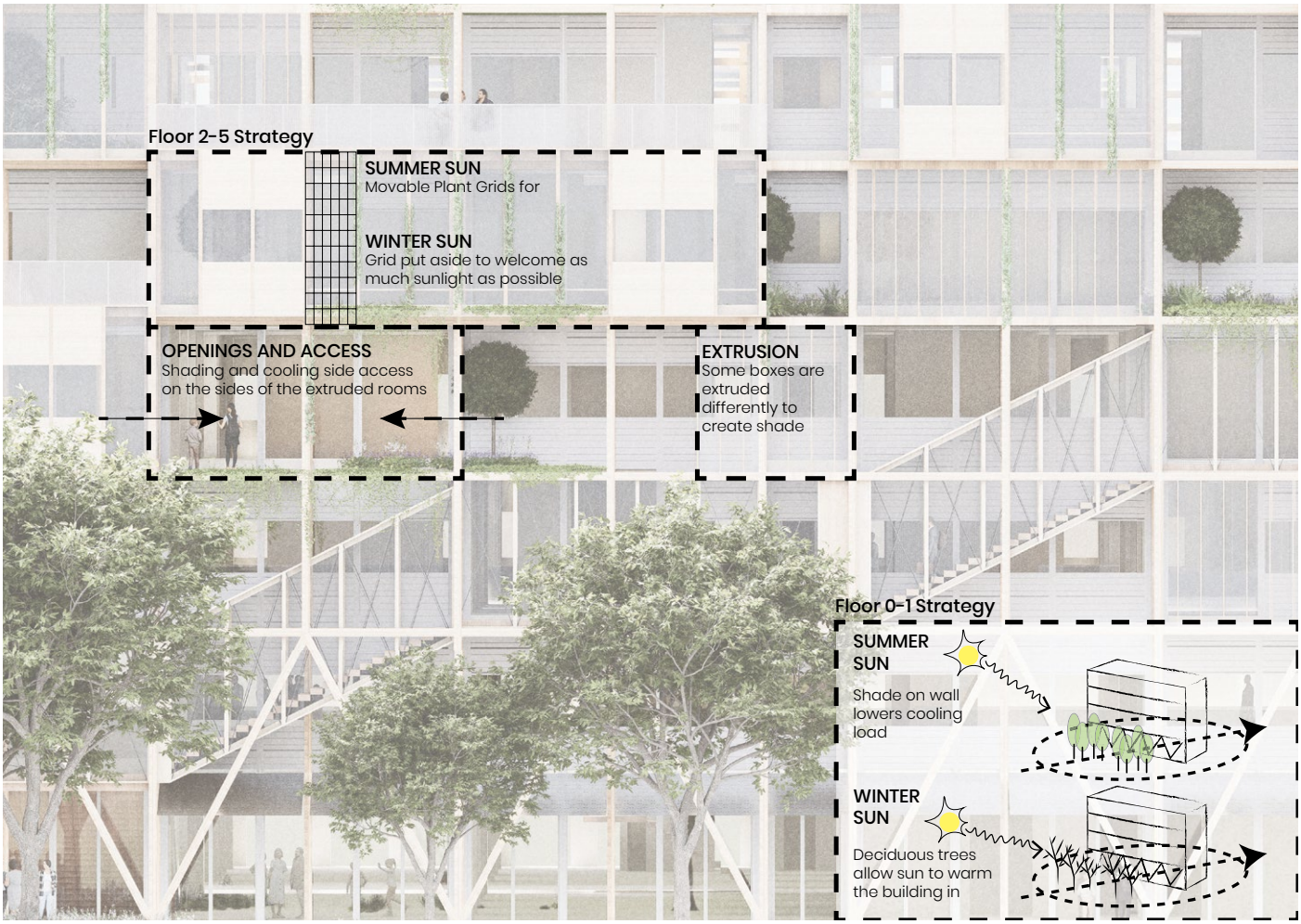


Figure 28, Facade Strategy, Made by Author

In heritage terms, this façade does two things:

- It **preserves and makes legible** key aspects of the original design – the structural grid, the horizontal layering and the idea of a "raincoat" envelope – by keeping the rhythm and partial presence of the aluminium cladding.
- It **adds a new layer of ecological value** that the existing building largely lacked: visible climate adaptation, improved daylight and fresh air, and a direct link between the building and the urban water cycle. Over time, this adaptive, water-collecting façade has the potential to become a recognisable part of the KB's future heritage, in line with contemporary debates on environmental performance as a cultural value.

10.3 Retention, transformation and SDGs

1. Within this project, heritage is understood as a **dynamic balance between existing and emerging values.** Following the value framework, the design choices can be summarised as:

- **Retain and enhance**

1. main concrete structure and column grid;
2. archive and depot halls, as the architectural expression of the KB's national memory function;
3. key façades (especially south-east and courtyard) and interior voids, with improved daylight and access;
4. the reading-hall volume, transformed into an incubator landscape but keeping its spatial proportions.

- **Transform and reinterpret**

1. the plinth and circulation sequences into extroverted, transparent public routes linked to KB Plaza;
2. selected façade bays, where original metal cassettes are combined with new glass or green modules;
3. internal movement systems, extended into the Hybrid Tech Ramp to represent the KB's digital and civic future.

- **Remove and replace**

1. generic office slabs in blocks C and D and a slice of B, which hold low mapped heritage value and block visibility and public access;
2. opaque plinth segments, replaced by glazed and programmable ground-floor spaces.

These decisions are aligned with several **UN Sustainable Development Goals**:

- **SDG 11 – Sustainable Cities and Communities**: protecting and reinterpreting cultural heritage while creating inclusive, accessible public space through KB Plaza.
- **SDG 6 – Clean Water and Sanitation**: integrating rainwater collection and reuse in the façade and planter system.
- **SDG 12 – Responsible Consumption and Production**: retaining the bulk of the existing structure, using modular timber and reusable components, and incorporating recycled concrete aggregate in the new construction.
- **SDG 4 – Quality Education**: enabling the KB to continue as an open, up-to-date knowledge infrastructure.

In sum, the project argues **that preserving the KB's significance means allowing it to change**. By selectively removing low-value volumes, adding climate-adaptive and water-collecting layers, and reprogramming the remaining fabric as an extroverted civic hub, the design aims to respect the building's heritage while actively constructing the values that will make it relevant for future generations.

11. Design Evolution from P2 towards P5

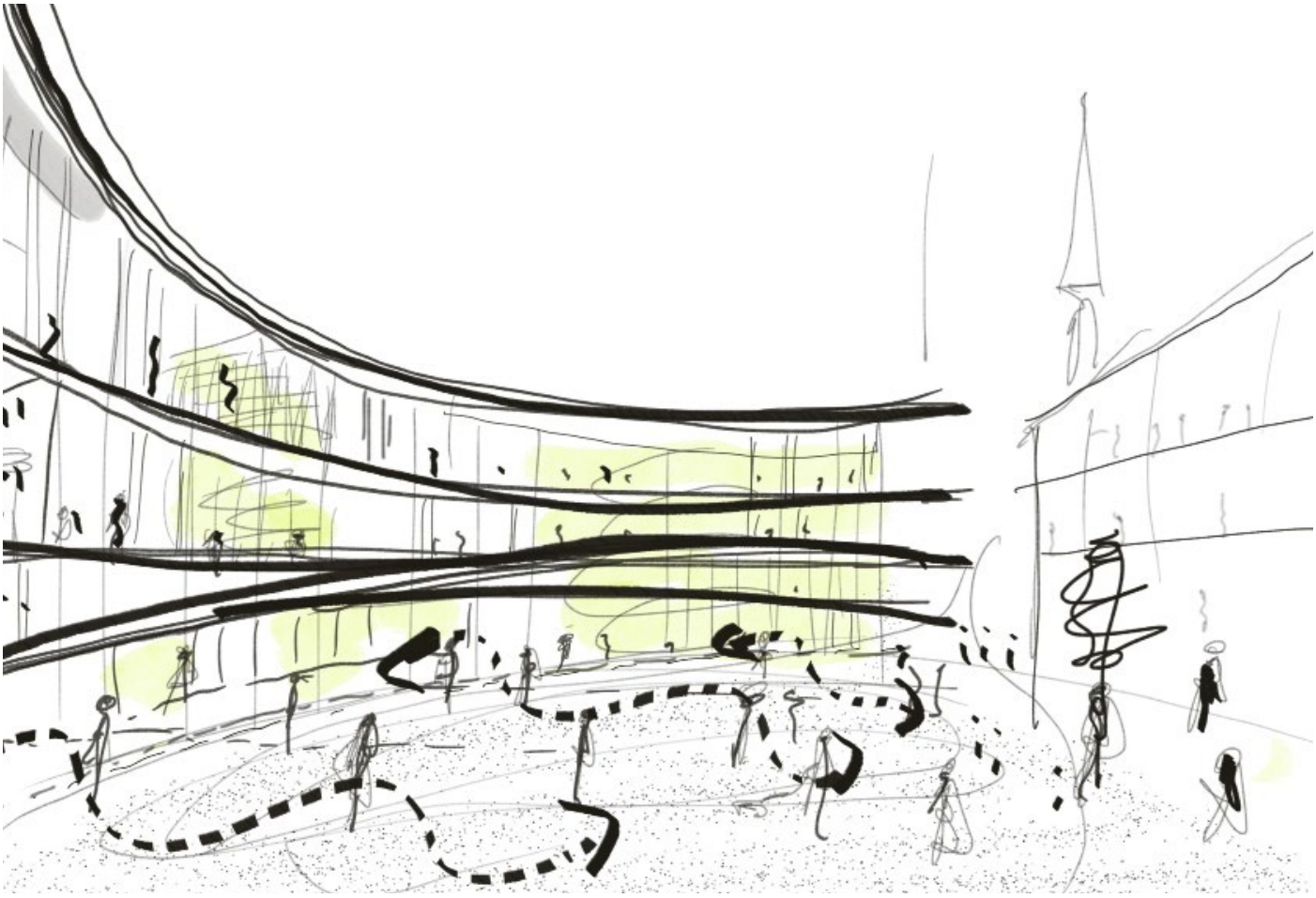


Figure 29, Design Vision P1, Made by Author

P1- First explorations: sketching an extroverted library

The first sketches (P1) start from a conceptual definition of extroverted architecture: a library that no longer hides its activities behind an opaque façade, but performs as a public stage. In this early vision, the building edge is drawn as a continuous, curved line enclosing an active plaza. Interior movement lines spill out into the public space, suggesting that the boundaries between inside and outside are porous.

At this stage, the idea of an “open façade” is mainly spatial and atmospheric rather than technical. The drawings test how people could move along balconies, ramps and terraces overlooking the plaza, and how knowledge-related activities—reading, meeting, performing—could become visible from the square. However, the façade is still treated as a relatively abstract surface; issues of structure, climate performance and heritage integration have not yet been fully addressed.

Figure 30, Design Vision P2, Made by Author

P2- Integrating KB Plaza and first façade extrusions

In P2, the project shifts from conceptual sketches to a first architectural translation of the extroverted idea. The new KB Plaza is introduced by removing low-value volumes on the north side of the complex, opening a direct visual and physical connection between the city and the library entrance. The rendering shows how the building starts to bend around this public void, creating a sheltered urban room.

At the same time, the façade begins to thicken. Extruded boxes appear along the elevation, projecting reading spaces and circulation paths outwards. These boxes mark moments where interior functions actively reach into the public realm—small stages, balconies, viewing platforms. In this phase the extroversion concept becomes more concrete: the library is no longer just open at ground level, but starts to occupy the façade depth. Yet the geometry is still relatively continuous and sculptural; the structural logic and modularity are only partly defined.

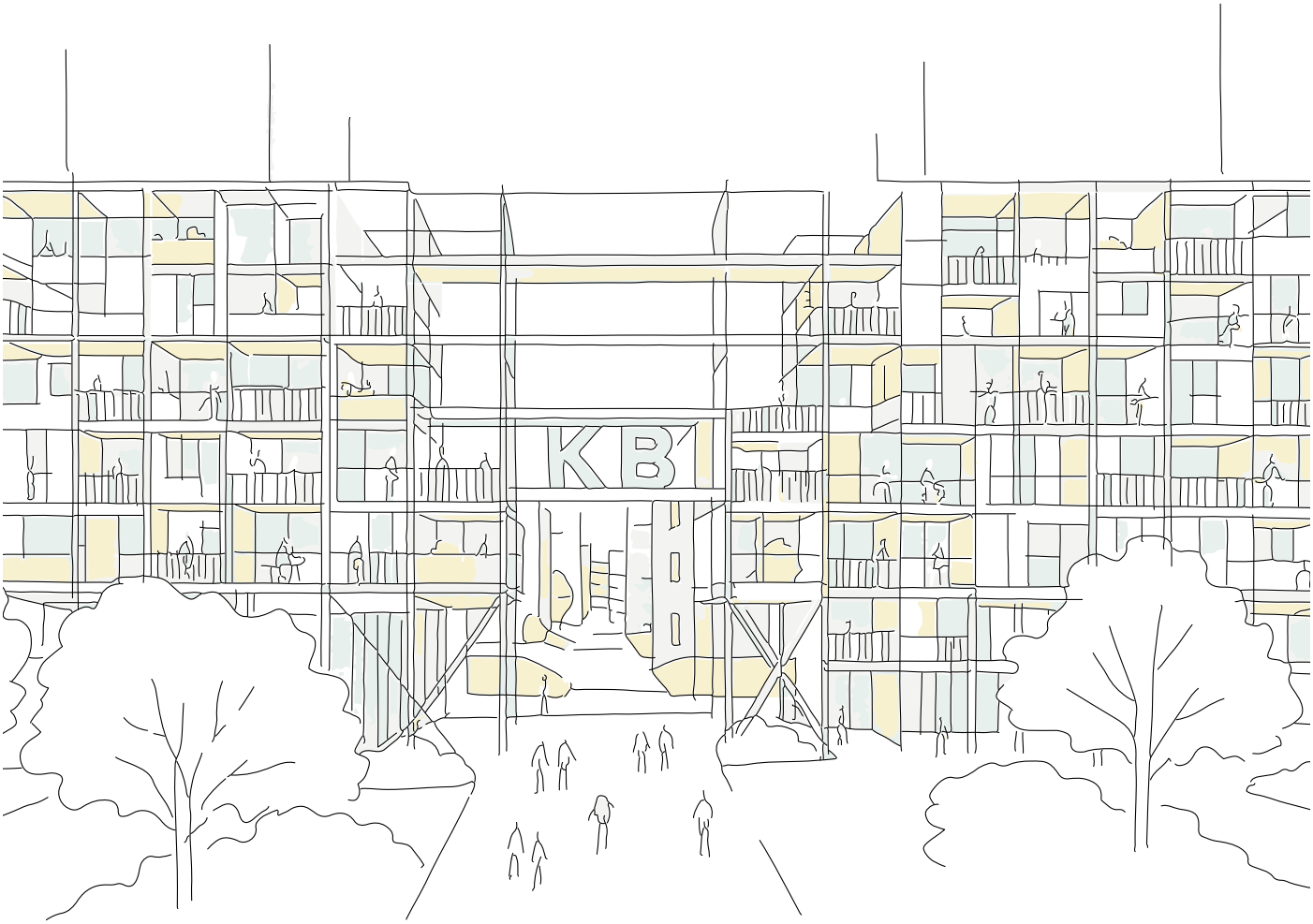


Figure 31, Design Vision P3, Made by Author

P3- Modular structure and the technical extroverted façade

P3 marks a turning point where the extroverted concept is merged with a clear structural and environmental strategy. The façade is re-organised as a modular timber grid that follows the rhythm of the existing concrete frame. Within this grid, different "façade units" can be plugged in:

- glazed reading rooms and collaborative spaces,
- outdoor balconies and loggias,
- planted boxes and rain-collecting planters,
- reused metal panels from the original KB façade.

The sketch and axonometric studies from this phase show how each module combines building technology, comfort and program: occupied boxes receive better daylight and cross-ventilation, green modules support evaporative cooling and biodiversity, and technical units house shading devices or water collection components. The extroverted library becomes not only visually open but also environmentally adaptive, operating according to the weather–comfort scenarios developed in the façade matrix (ventilation on mild days, shading and evaporative cooling in heatwaves, water collection during rain, etc.).

Here, extroversion is no longer just about transparency; it is about a façade that communicates what happens inside while actively regulating climate and resources.

Figure 32, Finalized Design for P4, Made by Author

P4- Final proposal: an open, ecological KB in dialogue with the city

In the final design stage (P4), the different strands of the project—heritage, plaza, modular façade and environmental performance—are brought together into a coherent architectural language. Seen from the tram line, the KB is no longer perceived as a closed technical block but as a layered, permeable structure.

The modular timber grid frames a rich mix of interior and exterior rooms: reading spaces, studios, terraces, planted loggias and circulation bridges. The **activities of the library are legible from the city**—people working by the windows, sitting on window seats, or occupying balconies in the green façade. This visual openness reinforces the KB's public role and makes the building understandable at a glance.

At the same time, the façade operates as a **water-collecting and climate-adaptive skin**. Rainwater is guided through integrated gutters and downpipes into storage tanks, feeding façade planters and reducing potable water demand. Green modules and extruded boxes moderate microclimate along the plaza and the elevated access routes, turning the KB into a visible example of how a heritage structure can be upgraded to respond to contemporary ecological challenges.
The evolution from P1 to P4 therefore charts a clear trajectory:

- from an **intuitive sketch of extroversion** to a precisely located civic plaza,
- from a **generic open façade to a modular structural system** aligned with the existing frame,
- and finally to a **fully developed, adaptive envelope** that expresses library life, collects rainwater and negotiates between the monumental KB and its rapidly densifying urban context.

In this way, the design evolution demonstrates how the concept of the extroverted library is tested, challenged and gradually translated into a robust architectural proposal that is both socially open and environmentally performative.

11. Conclusions

This research set out to explore how the Royal Library of the Netherlands (KB) could evolve from an introverted, technically driven institution into an extroverted, adaptive civic library, and what role emerging technologies and spatial analysis tools might play in that transformation. Working within a value-based heritage framework, the project approached the KB not as a blank slate but as a building with unevenly distributed cultural, architectural and social significance. The central argument of the work is that an extroverted future for the KB is possible without erasing its heritage, if transformation is guided by explicit value choices and by an understanding of how space, technology and user behaviour interact.

The design proposal grows out of a combination of literature and technology review, heritage analysis, interviews and DepthMapX simulations. The group research on KB's heritage values was crucial: it made visible which parts of the building carry strong historic, social or architectural meaning and which are largely generic or obstructive. The transformation strategy therefore treats the complex as a gradient of values. The structural grid, archive halls and characteristic facades are retained and strengthened; medium-value areas are reprogrammed; and low-value office slabs in blocks C and D and part of B are removed. Their demolition is not conceived as a loss of heritage but as a way to unlock new social, urban and ecological values in the form of KB Plaza and clarified public routes. Existing values are thus redistributed: scientific and archival values remain anchored in the depots, while social, political and aesthetic values concentrate around the plaza, the Hybrid Tech Ramp and the new facade.

Within this reconfigured framework, the project tests how technology can support an extroverted library without dominating it. The literature and technology scan led to a critical selection of systems that have meaningful spatial consequences: a robotic working core acting as a short-term logistics buffer, an AI-assisted Hybrid Tech Ramp that turns circulation into a slow, legible social spine, an AR or VR and spatial AI corridor that overlays movement with digital immersion, and a modular facade that combines habitable boxes, reused metal panels, green modules and rainwater collection. These elements treat technology as visible infrastructure rather than invisible background, making processes of storage, search and environmental regulation legible to users and opening them up for debate.

DepthMapX simulations contributed a more objective layer to the design decisions. By analysing visibility and potential co-presence in the existing building and in alternative layouts, they showed how thickening or opening circulation routes can convert purely functional corridors into social spines, and where such moves would clash with the need for silence and concentration. The tool was particularly useful in calibrating the placement of quiet versus active zones, the configuration of the ramp and the fragmentation of the new reading hall. However, the research also confirmed that such analyses provide only one layer of understanding; they must be complemented by architectural judgement, environmental considerations and user feedback.

The resulting proposal frames the KB as a multi-layered extroverted library. At the urban scale, KB Plaza and new entrances transform a hard-to-read backside into a recognisable civic room connected to Den Haag Centraal and surrounding institutions. At building scale, the Hybrid Tech Ramp and reprogrammed corridors structure movement, encounters and access to digital tools. At facade scale, a modular timber grid hosts a mix of glazed rooms, loggias, green planters and reused metal panels, turning the envelope into a stage where the life of the library and its environmental systems become visible. The facade's ability to open, shade, insulate and collect rainwater according to weather scenarios links the project to broader sustainability agendas and redefines ecological performance as part of the KB's future heritage.

At the same time, the research has clear limitations that qualify its conclusions. The interview sample is small and skewed towards young, digitally literate users; perspectives of staff, older visitors and people with different abilities are underrepresented. The spatial analyses rely on two-dimensional visibility graph analysis of single floors and static layouts; they do not account for acoustic conditions, thermal comfort, changing daylight or long-term patterns of appropriation. Many of the proposed technologies, particularly AI inter-

faces and robotic systems, are treated at a conceptual level. Their actual implementation would depend on institutional priorities, budgets and evolving regulations around data, privacy and labour.

There are also non-trivial risks associated with integrating AI into library systems that this project can only outline. Algorithmic bias, opaque recommendation logics, potential surveillance of reading behaviour and the erosion of human-mediated reference work are all widely discussed concerns. While the design responds architecturally, by keeping AI touchpoints visible and optional, combining them with staff presence and providing analogue spaces where no tracking is implied, it does not, and cannot, offer a complete governance framework for AI in the KB. That would require further interdisciplinary research with librarians, legal scholars and ethicists.

Finally, the work is inherently case-specific. The KB's structural logic, its position in The Hague and its existing value constellation are unique; the precise configuration of plaza, ramp and facade cannot simply be copied to other contexts. What is transferable is the combination of methods and the set of principles demonstrated here: treating heritage as a differentiated field of values, using subtraction as a tool to reveal and create value, thickening circulation into social and technological spines, and deploying modular, reversible envelopes that make environmental systems visible.

Within these boundaries, the study shows that the future of a national library like the KB does not lie in preserving a perfect image of the 1980s building, nor in replacing it with a generic co-working complex. Instead, it suggests a third path: recasting the KB as an adaptive civic infrastructure, rooted in its structural and cultural heritage yet open to new forms of public life, digital practice and ecological responsibility. The proposed extroverted library is therefore less a final solution than a worked-through scenario, a demonstrator of how architecture can mediate between continuity and change in the next generation of knowledge spaces.

12. References

- Jogen Sharma. Strategies for Increasing User Engagement in Academic Libraries. International Journal of Sustainability. 2024; 01(02):1-5. Available from: https://journals.stmjournals.com/ijsu/article=2024/view=0
- Indraji C, Satishkumar Naikar, Dominic J (2024) Use of Robotics and Artificial Intelligence for Enhancing Library Services. Library Progress International, 44(3), 3002-3010
- Xhambazi, A. (2015). Thinking Architecture through the Traits of Extroversion and Introversion: Territory as a Question of Environmental Orientation and Autonomy. International Journal of Contemporary Architecture, 2(3), 12.
- Aniwaa. "Using 3D Scanning for Digital Twins and Digital Inventory." Aniwaa, January 4, 2022. https://www.aniwaa.com/insight/3d-scanners/3d-scanning-digital-twins-digital-inventory/
- Aristidou, Andreas, Yiorgos Chrysanthou, and Despina Michael-Grigoriou. "Virtual Library in the Concept of Digital Twin." Accessed March 26, 2025. http://andreasaristidou.com/publications/papers/VR_Library.pdf.
- Bermudez-Contreras, Edgard, Roberto A. Gulli, and Bruce L. McNaughton. "The Neuroscience of Spatial Navigation and the Relationship to Artificial Intelligence." Frontiers in Computational Neuroscience 14 (2020): 63. https://pmc.ncbi.nlm.nih.gov/articles/PMC7399088/.
- Bibliotheca. "RFID In Libraries: Technology That Helps Extend Impact." Bibliotheca, 2024. https://www.bibliotheca.com/rfid-in-libraries-technology-that-helps-extend-impact/.
- IJLSIT. "Applications of the Internet of Things in Library and Data Privacy." International Journal of Library Science and Information Technology, 2024. https://www.ijlsit.org/html-article/19093.
- Kovalcik, Christopher, and Cynthia Villalobos. "Automated Storage & Retrieval System: From Storage to Service." Information Technology and Libraries 38, no. 4 (2019): 114–24. https://doi.org/10.6017/ital.v38i4.11273.
- LIS Education Network. "AI Chatbots in Libraries: Revolutionizing User Experience or Replacing Human Connection?" LIS Education Network, 2025. https://www.lisedunetwork.com/ai-chatbots-in-libraries-revolutionizing-user-experience-or-replacing-human-connection/.
- QGIS Python Plugins Repository. "Spatial Design Network Analysis." QGIS Python Plugins Repository, February 4, 2021. https://plugins.qgis.org/plugins/sdna/.
- Roy, Bijan Kumar, Subal Chandra Biswas, and Parthasarathi Mukhopadhyay. "Artificial Intelligence in Cataloging and Classification: An Overview." DESIDOC Journal of Library & Information Technology 44, no. 1 (2024): 1-11.
- Timoshenko, Igor. "Intelligent Electronic Management of Library by Radio Frequency Identification Technology." Data Science Journal 18, no. 1 (2019): 53. https://datascience.codata.org/articles/10.5334/dsj-2019-053.
- United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations.
- Reshaping KB Studio Group 2025, Reshaping KB: Value-based research on the National Library of the Netherlands, unpublished studio report, TU Delft, Delft.

Appendix 1- Interviews

Future KB Library Design Research

User Interview Template

Interviewee: _____Angela Zhou_____

Date: _____27-05-2025_____

Location/Format: ☐ In-person ☐ Online ☐ Phone

Section 1: User Profile

User Group: (Tick one)

- ☒ Current Library User (e.g., student, researcher)
- ☐ Non-User / Potential User
- ☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

- ☐ Under 18
- ☒ 18–30
- ☐ 31–45
- ☐ 46–60
- ☐ 60+

Profession/Field of Study: _____Design student_____

Frequency of Library Use:

- ☐ Daily
- ☐ Weekly
- ☒ Occasionally
- ☐ Never

Section 2: Technology in Libraries

1. What digital or smart technologies would improve your library experience?

(Examples: smart search systems, interactive tables, AR archives, etc.)

Response:

I would say a smart search system: a system that can make it easier to find the books you need

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?

Response:

Yes, I would be interested. AI-assisted research could save time and help discover sources that I might not find on my own.

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?

Response:

I think self-service is very useful. It make the process faster especially when the library is busy. I like the idea of scanning books myself.

Section 3: Desired Functions and Spaces

4. What type of spaces should a future library include? (Tick all that apply)

- ☒ Quiet reading/study areas
- ☒ Co-working spaces
- ☒ Meeting rooms
- ☐ Makerspace / FabLab
- ☒ Café / Social zones
- ☐ Exhibition space
- ☐ Children's zone
- ☒ Outdoor terraces / green space
- ☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response:

At the school library I usually go to, everyone is mostly silent and focused on studying alone. It doesn't feel like a place designed for collaboration and interaction. I think it is missing some group work areas, maybe with soundproofing , that they can work on projects together without disturbing others.

6. What would make you visit the library more frequently in the future?

Response:

I would visit more often the library if it had more modern and comfortable places. And also, I'm generally someone who prefers to study at home because it's quieter. So, if the library had more completely silent study rooms or spaces where I could really focus without distractions, I would probably go the more often

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- ☒ Traditional and quiet
- ☐ Inclusive and active
- ☐ Boring or outdated
- ☐ Inspiring and creative
- ☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response:

I think making the KB (library) more open and socially engaging is a great idea. It could help attract more people and create a stronger sense of community. Events, exhibitions, and interactive spaces can make the library feel more alive and welcoming. At the same time, it's important that the library continues to offer quiet areas for those who need silence to concentrate. A good balance would make the library more inclusive for everyone.

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Interviewer's Initial Reflection:

- Key needs expressed: -Quiet, silent study spaces are essential for focused work. -Separate zones for collaboration and individual study would improve the library experience. -More support for group work and interactive learning environments is needed.

- Tech expectations: -Interest in smart search systems to find books more efficiently. -Positive attitude toward AI-assisted research and access to digital archives. -Self-service tools like check-in/check-out systems and digital wayfinding are seen as useful and time-saving.

- Spatial preferences: - Prefers studying at home due to the quiet environment. -Would consider using the library more if silent study rooms were improved. -Values a balance between social/interactive spaces and calm, focused ones.

- Potential barriers: -Current library environment may not fully support either focused study or group collaboration. -Lack of dedicated silent rooms could discourage frequent visits. -Overly social or noisy spaces might reduce the library's appeal for those who need silence.

To be included in post-analysis matrix.

Future KB Library Design Research
User Interview Template

Interviewee: Emilee Chen
Date: 05/05/2025
Location/Format: ✓In-person ☐ Online ☐ Phone

Section 1: User Profile
User Group: (Tick one)

- ☐✓ Current Library User (e.g., student, researcher)
- ☐ Non-User / Potential User
- ☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

- ☐ Under 18
- ☐✓ 18–30
- ☐ 31–45
- ☐ 46–60
- ☐ 60+

Profession/Field of Study: __student - architecture_____
Frequency of Library Use:

- ☐ Daily
- ☐✓ Weekly
- ☐ Occasionally
- ☐ Never

Section 2: Technology in Libraries
1. What digital or smart technologies would improve your library experience?
(Examples: smart search systems, interactive tables, AR archives, etc.)
Response:
Smart search for books/ concepts. Media Libraries where you can use VR sets etc

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2. Would you be interested in using AI-assisted research or digital archives? Why or why not?
Response:
Yes, I believe it would help with research especially in archives in different languages.

---

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?
Response:
Preferred

Section 3: Desired Functions and Spaces
4. What type of spaces should a future library include? (Tick all that apply)

- ☐✓ Quiet reading/study areas
- ☐✓ Co-working spaces
- ☐ Meeting rooms
- ☐✓ Makerspace / FabLab
- ☐✓ Café / Social zones

- ☐✓ Exhibition space
- ☐✓ Children's zone
- ☐✓ Outdoor terraces / green space
- ☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response:

Yes, especially those with lots of smaller meeting and study rooms. Also enjoy those which host public events.

---

6. What would make you visit the library more frequently in the future?

Response:

Nicely designed spaces. Libraries that can act as a 3rd space.

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- ☐ Traditional and quiet
- ☐ Inclusive and active
- ☐ Boring or outdated
- ☐ ✓Inspiring and creative
- ☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response:

Very good !

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Most frequently visited library recently is the TU Delft main library. Good tech integration, but overall a little too open. Good libraries should have a mix between open and more private quiet spaces. There's no corners to read alone in. If you pull a book off the shelf to quickly flip through, you're pretty much exposed to the entire open area.

Interviewer's Initial Reflection:

- Key needs expressed:
- Tech expectations:
- Spatial preferences:
- Potential barriers:

To be included in post-analysis matrix.

Future KB Library Design Research

User Interview Template

Interviewee: Tzu-Shou Huang

Date: 06.05.2025

Location/Format: ☐ In-person ☐ Online ☐ Phone

Section 1: User Profile

User Group: (Tick one)

- ☐ Current Library User (e.g., student, researcher)
- ☐ Non-User / Potential User
- ☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

- ☐ Under 18
- ☐ 18–30
- ☐ 31–45
- ☐ 46–60
- ☐ 60+

Profession/Field of Study: Masters student- Architecture

Frequency of Library Use:

- ☐ Daily
- ☐ Weekly
- ☐ Occasionally
- ☐ Never

Section 2: Technology in Libraries

1. What digital or smart technologies would improve your library experience?

(Examples: smart search systems, interactive tables, AR archives, etc.)

Response:

I am imagining a smart, interactive digital archive that makes using the library way more fun and easy. Picture walking through a digital map of the library's knowledge — with cool AR layers, personalized recommendations, and archives that actually adapt to what you're interested in. An AI-powered search could help you explore and see collections in a whole new way, making learning way more accessible and exciting.

---

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?

Response:

Yes, because AI-assisted research and digital archives SAVES TIME, discover relevant materials faster, and connections I might otherwise miss.

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?

Response:

Self-service for routine stuff is awesome—it speeds things up and cuts down wait times. OMA Seattle Library does a great job spreading out self-service options! For things like finding your way around, smart tools or digital guides could make it way easier to navigate without needing as much help.

Section 3: Desired Functions and Spaces

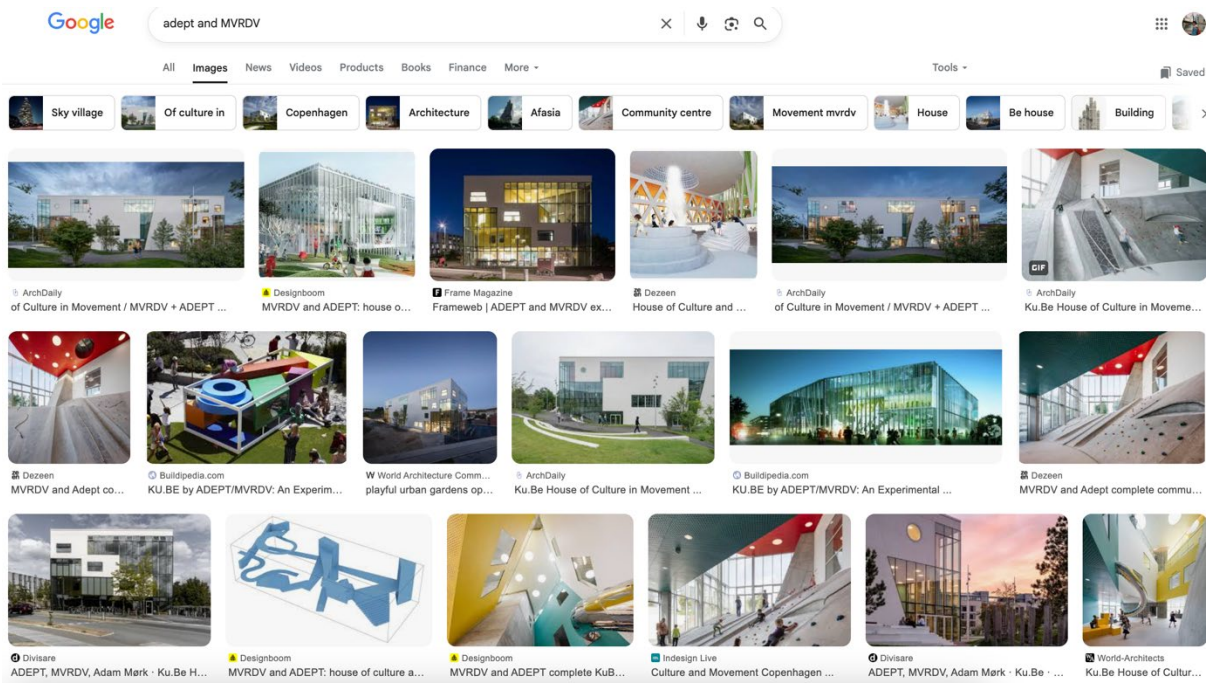
4. What type of spaces should a future library include? (Tick all that apply)

- ☐ Quiet reading/study areas
- ☐ Co-working spaces
- ☐ Meeting rooms
- ☐ Makerspace / FabLab
- ☐ Café / Social zones
- ☐ Exhibition space
- ☐ Children's zone
- ☐ Outdoor terraces / green space
- ☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response:

Traditional libraries weren't really built for teamwork or fun group hangouts… BUTT modern libraries are shaking things up with cozy group rooms, open layouts, and handy tech to make working together easier. PLAY/ LEARNING doesn't just mean for kids — think playful for adults, grandparents, and everyone in between? The more adaptable and tech-friendly these spaces get, the better for all generations to learn, create, and connect.



6. What would make you visit the library more frequently in the future?

Response:

Regular talks, workshops, or exhibitions relevant to my research interests would give me more reason to visit regularly.

Somewhere quiet for studying but also somewhere lively to visit during my study breaks

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- ☐ Traditional and quiet
- ☐ Inclusive and active
- ☐ Boring or outdated
- ☐ Inspiring and creative
- ☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response:

Would be nice to include both quiet and lively as well. Maybe during daytime, its targeting quieter study programmed but nighttime, it becomes louder holding public events, bars etc. Think about how the space can be hybrid.

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Moderns Library should be a hybrid of different functions

Interviewer's Initial Reflection:

- Key needs expressed:
- Tech expectations:
- Spatial preferences:
- Potential barriers:

To be included in post-analysis matrix.

Future KB Library Design Research
User Interview Template

Interviewee: Julian Wu
Date: 27/05/2025
Location/Format: □ In-person x Online □ Phone

Section 1: User Profile
User Group: (Tick one)

- □ Current Library User (e.g., student, researcher)
- x Non-User / Potential User
- □ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

- □ Under 18
- x 18–30
- □ 31–45
- □ 46–60
- □ 60+

Profession/Field of Study: Computer Scientist
Frequency of Library Use:

- □ Daily
- □ Weekly
- x Occasionally
- □ Never

Section 2: Technology in Libraries
1. What digital or smart technologies would improve your library experience?
(Examples: smart search systems, interactive tables, AR archives, etc.)
Response:
A smart lookup system would be very beneficial. I imagine being able to type in a few keywords or a couple short sentences, and the system will be able to match research papers or books that are immediately relevant and useful.

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?
Response:
I think the term AI-assisted research or digital archives is pretty vague, but using AI to help in doing research seems helpful. Especially if it helps researchers cut down the time looking for sources and pointing researchers towards the right material. I think the downside is that AI may create implicit biases and potentially recommend different archive information disproportionately.

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?
Response:
Having the option for self-service in a library is great and convenient, but there is also value in having a librarian who can answer questions, help you check-in/check-out, recommend books, and provide insight. Would love to have both options.

Section 3: Desired Functions and Spaces
4. What type of spaces should a future library include? (Tick all that apply)

- x Quiet reading/study areas
- x Co-working spaces
- □ Meeting rooms
- x Makerspace / FabLab

- x Café / Social zones
- x Exhibition space
- x Children's zone
- □ Outdoor terraces / green space
- □ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response:

I feel that current libraries don't support that much collaboration or interaction. The idea of looking for and checking out books has diminished significantly due to the rise of the digital world and people are just less inclined to have in-person interactions at libraries anymore. Having planned events that draw people towards libraries may help.

6. What would make you visit the library more frequently in the future?

Response:

If there was something to do at the library with friends or having a cafe and a nice comfortable workspace would make the library more valuable.

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- x Traditional and quiet
- □ Inclusive and active
- □ Boring or outdated
- □ Inspiring and creative
- □ Other: Immersive but solitary

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response:

I think it would be great, especially having events that are diverse and inclusive of everyone. That being said, it is still important to have a quiet workspace somewhere in the library.

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Interviewer's Initial Reflection:

- Key needs expressed:
- Tech expectations:
- Spatial preferences:
- Potential barriers:

To be included in post-analysis matrix.

Future KB Library Design ResearchUser Interview Template

Interviewee: Marina Lin

Date: 15/05/2025

Location/Format: ☐ In-person ☐ Online x Phone

Section 1: User Profile

User Group: (Tick one)

☐ Current Library User (e.g., student, researcher)

☐ Non-User / Potential User

☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

☐ Under 18

☐ 18–30

☐ 31–45

☐ 46–60

☐ 60+

Profession/Field of Study: __Medicine study_____

Frequency of Library Use:

☐ Daily

☐ Weekly

☐ Occasionally

☐ Never

Section 2: Technology in Libraries

1. What digital or smart technologies would improve your library experience?(Examples: smart search systems, interactive tables, AR archives, etc.)

Response:

Interactive tables. AI. Smart search

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?

Response:

Yes, it would be more simple to find information, more practical

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?

Response:

I'm positive. It wold be faster and sometimes easier to find information by myself.

Section 3: Desired Functions and Spaces

4. What type of spaces should a future library include? (Tick all that apply)

- ☐ Quiet reading/study areas
- ☐ Co-working spaces
- ☐ Meeting rooms
- ☐ Makerspace / FabLab
- ☐ Café / Social zones
- ☐ Exhibition space
- ☐ Children's zone
- ☐ Outdoor terraces / green space
- ☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response:

Not really, I think is more a silent place where you can read and study alone.

6. What would make you visit the library more frequently in the future?

Response:

The quality of the library. The design. If the space is comfortable

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- ☐ Traditional and quiet
- ☐ Inclusive and active
- ☐ Boring or outdated
- ☐ Inspiring and creative
- ☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response:

It is a possibility. But first you need to change the perspective of people. A lot of people associates KB more like some quiet place where you can only read and study.

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Interviewer's Initial Reflection:

Key needs expressed:

Tech expectations:

Spatial preferences:

Potential barriers:

To be included in post-analysis matrix.

Future KB Library Design Research

User Interview Template

Interviewee: Annamariya Velizarova

Date: 16.05.2025

Location/Format: ☐ In-person ☑ Online ☐ Phone

Section 1: User Profile

User Group: (Tick one)

☑ Current Library User (e.g., student, researcher)

☐ Non-User / Potential User

☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

☐ Under 18

☑ 18–30

☐ 31–45

☐ 46–60

☐ 60+

Profession/Field of Study: International Relation; Public Management/ Public Policy

Frequency of Library Use:

☐ Daily

☑ Weekly

☐ Occasionally

☐ Never

Section 2: Technology in Libraries

1. What digital or smart technologies would improve your library experience?

(Examples: smart search systems, interactive tables, AR archives, etc.)

Response: AR archives

---

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?

Response: Yes, I would be interested, because it will make the search for sources more convenient and feasible.

---

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?

Response: I have mixed feelings about it. On one hand, they can significantly improve convenience by making it easier to find a spot, access services, or print documents quickly. On the other hand, it's important to ensure that technical support is available in case something goes wrong.

Section 3: Desired Functions and Spaces

4. What type of spaces should a future library include? (Tick all that apply)

☑ Quiet reading/study areas

☑ Co-working spaces

☑ Meeting rooms

☐ Makerspace / FabLab

☑ Café / Social zones

☐ Exhibition space

☐ Children's zone

☑ Outdoor terraces / green space

☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response: I think they do.

---

6. What would make you visit the library more frequently in the future?

Response: I would visit the library more frequently if there were more space available. The main reason I don't go often is that the libraries are usually overcrowded, and I often feel like there's no room for me.

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

☑ Traditional and quiet

☐ Inclusive and active

☐ Boring or outdated

☑ Inspiring and creative

☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response: I think making the KB more visible and connected would be beneficial. If it's easier to find both physically and online, like through social media or a well-designed website, it could attract more people and make the services more

accessible. Also, being connected to other platforms, digital tools, or even other libraries would provide users with more resources and options.

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Interviewer's Initial Reflection:

Key needs expressed:

Tech expectations:

Spatial preferences:

Potential barriers:

To be included in post-analysis matrix.

Future KB Library Design Research

User Interview Template

Interviewee: Tina Lai

Date:10/05/2025

Location/Format: ☐ In-person ☐ Online x Phone

Section 1: User Profile

User Group: (Tick one)

- ☐ Current Library User (e.g., student, researcher)
- X Non-User / Potential User
- ☐ Cultural/Creative Professional (e.g., artist, curator)

Age Group:

- ☐ Under 18
- X 18–30
- ☐ 31–45
- ☐ 46–60
- ☐ 60+

Profession/Field of Study: finance_____

Frequency of Library Use:

- ☐ Daily
- ☐ Weekly
- X Occasionally
- ☐ Never

Section 2: Technology in Libraries

1. What digital or smart technologies would improve your library experience?

(Examples: smart search systems, interactive tables, AR archives, etc.)

Response: smart search and recommendations, with reviews. previews

---

---

2. Would you be interested in using AI-assisted research or digital archives? Why or why not?

Response: yes! So many books to rifle through that AI can be efficient in finding exact subtopics that I need

---

---

3. What is your attitude toward self-service (check-in/check-out, scanning, wayfinding)?

Response: fine, but for community purposes enjoy real live librarians.

Section 3: Desired Functions and Spaces

4. What type of spaces should a future library include? (Tick all that apply)

- X Quiet reading/study areas
- X Co-working spaces

- X Meeting rooms
- X Makerspace / FabLab
- X Café / Social zones
- ☐ Exhibition space
- X Children's zone
- X Outdoor terraces / green space
- ☐ Other: _____

5. Do you feel current libraries support collaboration and interaction? If not, what's missing?

Response: missing flexible working spaces for different age groups/formats (group work, social chatty, meeting room etc)

---

6. What would make you visit the library more frequently in the future?

Response: if it catered to my working needs and was aesthetically pretty without the cost and crowd of popular cafés

---

Section 4: Perceptions & Values

7. What emotions or associations do you have with libraries?

- ☐ Traditional and quiet
- ☐ Inclusive and active
- X Boring or outdated
- ☐ Inspiring and creative
- ☐ Other: _____

8. How do you feel about the KB becoming more open and publicly engaging (e.g., visible, social, connected)?

Response: great - libraries are community spaces for free learning and dialogue

---

Section 5: Notes & Observations

(Use this area to record additional impressions, ideas, or quotes)

Interviewer's Initial Reflection:

- Key needs expressed:
- Tech expectations:
- Spatial preferences:
- Potential barriers:

To be included in post-analysis matrix.

Appendix 2- P4 presentation/ Drawings

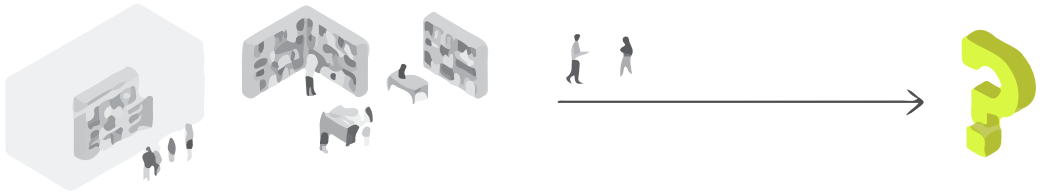
TU Delft
2025 Fall - Revitalizing Heritage
By Giada Zhou

[Designing the Extroverted Library: *An Interactive and Inclusive Hub for the Future*]

Designing the Extroverted Library: An Interactive and Inclusive Hub for the Future

*"Many libraries are dealing with a **drop in patronage** in a world that is **becoming more digital**." (Sharma et al., 2024)*

With the rise of online resources, libraries **risk becoming static spaces**, lacking the **adaptability** needed for future technological and social shifts. Conventional library layouts often do not support interactive or dynamic user experiences, limiting their potential as **vibrant community hubs**.



300 BCE – Library of Alexandria -> *Center of Learning*
A hub for scholars to collect, translate, and advance global knowledge.

15th Century – Printing Press (Gutenberg) -> *Democratization of Knowledge*
Books became more

20th Century – Institutional & Academic Libraries -> *Knowledge Infrastructure*
University and research libraries became essential for scientific and technological progress.

Now

21st Century – The Internet & AI Era -> *From Storage to Interaction*
Libraries evolve into social, interactive, and adaptive learning spaces, integrating AI and digital tools.

2600 BCE – Ancient Libraries ->*Knowledge as Power*
Libraries stored administrative records, religious texts, and laws for rulers and priests.

8th-14th Century – Islamic Golden Age -> *Libraries as Innovation Hubs*
Preserved and expanded knowledge in science, medicine, and philosophy.

17th-19th Century – Enlightenment & Public Libraries -> *Libraries for the People*
Public and national libraries promoted education, civic engagement, and intellectual freedom.

Late 20th Century – Digital Revolution Begins -> *Information Explosion*
Libraries expanded into digital collections, online databases, and multimedia resources.

Ancient -> Modern -> Digital

What is the Extroverted Architecture?

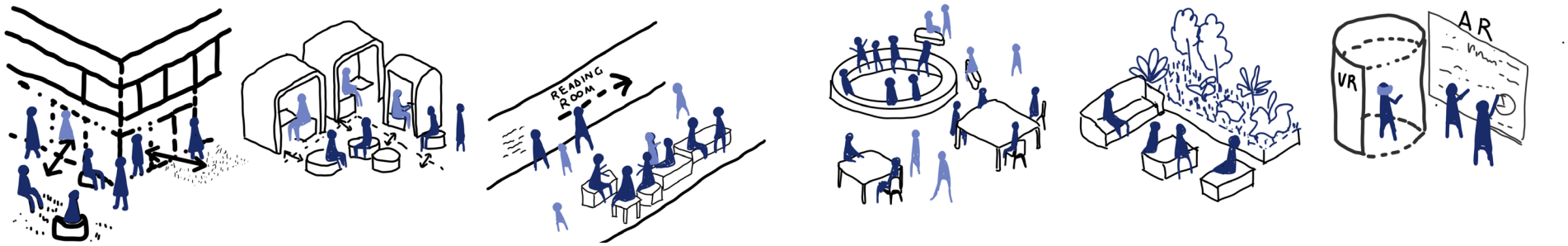
"Extroverted architecture is characterized by its **centrifugal, outward-looking nature**, where 'open spaces [are] extroverted, **centrifugal**" (Xhambazi, 2015, p. 12)

Extroverted architecture refers to design strategies that promote **openness, interaction, and engagement** with the surrounding environment and users.

Public/Private Blending areas

Community Centric Hubs

Interactive and Experential Spaces

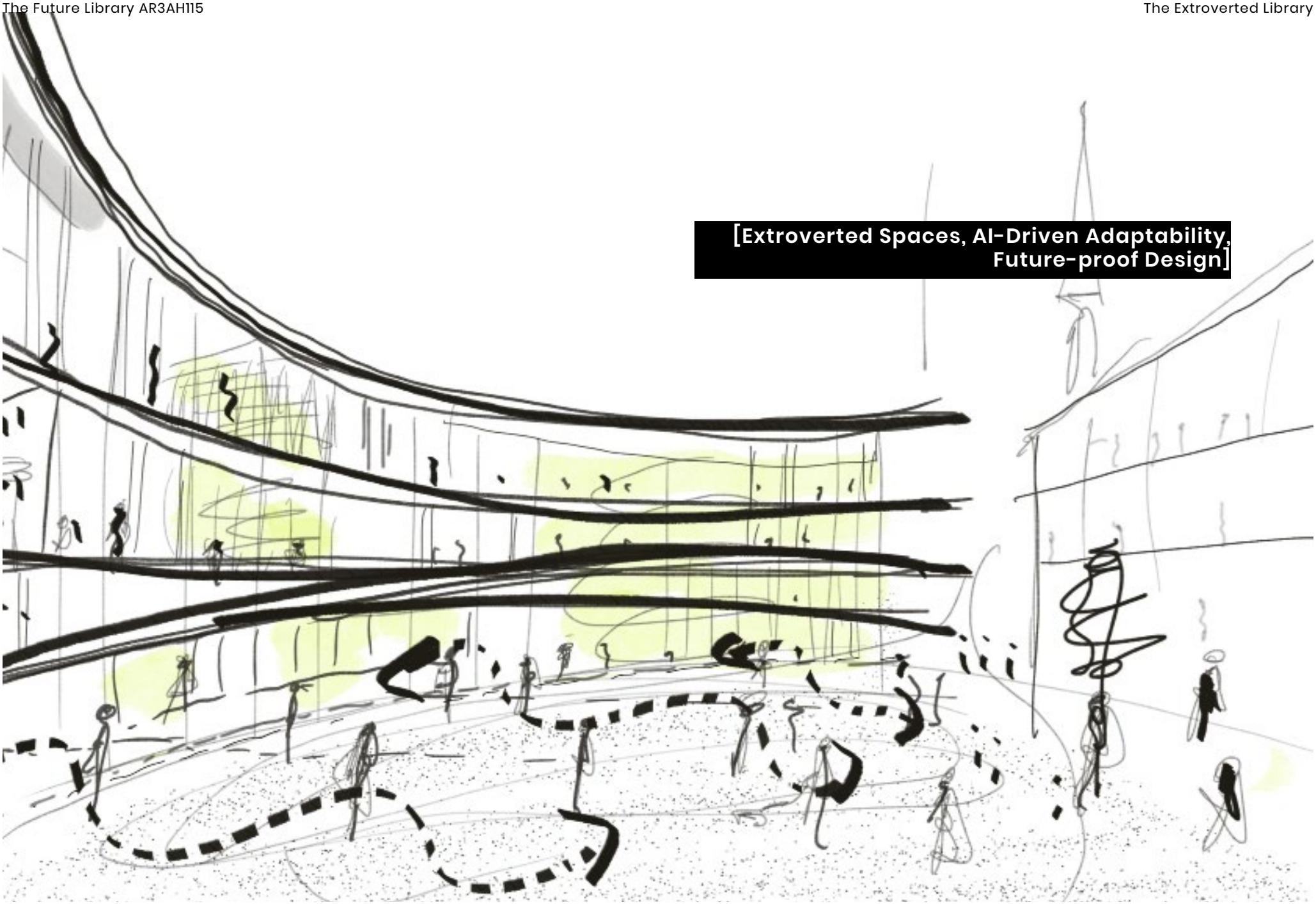


Exterior/Interior Connection

Interactive & Engaging Circulation

Biophilic Spaces

Extroverted Design Strategies:
promote **openness, interaction, and engagement**

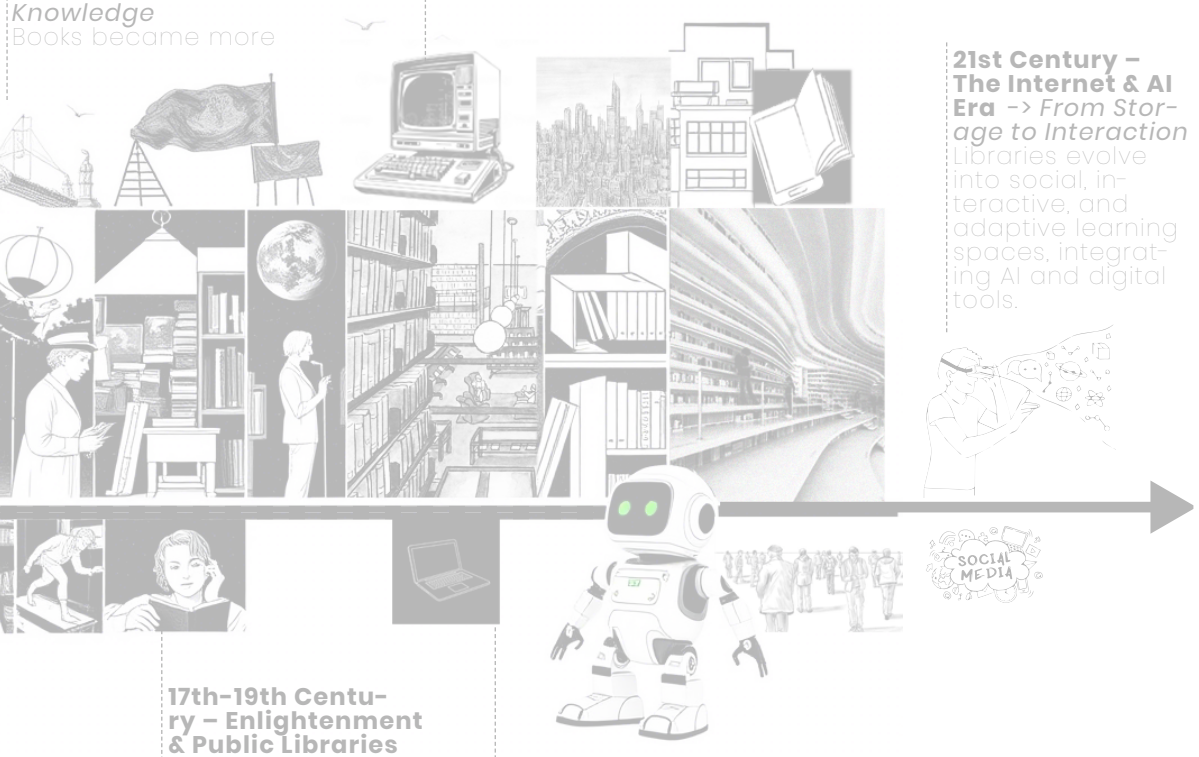

[Extroverted Spaces, AI-Driven Adaptability,
Future-proof Design]

15th Century – Printing Press (Gutenberg) -> *Democratization of Knowledge*
Books became more

20th Century – Institutional & Academic Libraries -> *Knowledge Infrastructure*
University and research libraries became essential for scientific and technological progress.

Now

21st Century – The Internet & AI Era -> *From Storage to Interaction*
Libraries evolve into social, interactive, and adaptive learning spaces, integrating AI and digital tools.



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Modern -> Digital

What will be next?
Building for future scenarios

Research & findings

RESEARCH QUESTIONS

Main question

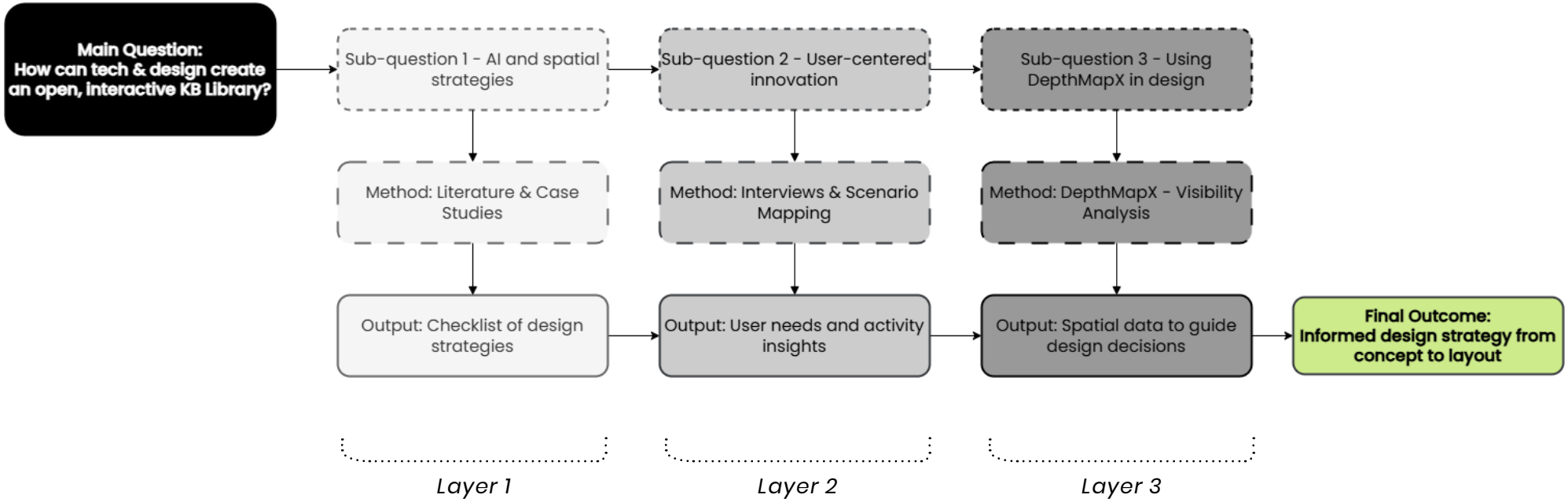
What role can technology and design for adaptivity play in shaping the KB Library as a space that promotes openness, interaction, and engagement, using predictive spatial analysis (DepthMapX) to inform adaptability in its design?

Secondary Questions

*What **AI-driven technologies and spatial strategies can enhance user interaction** and support library functions?*

*What are **user expectations and preferences** regarding AI integration and spatial adaptability in the future KB Library?*

*How can the impact of the new library interventions be **informed through a data-driven decision-making tool** (DepthMapX)?*



METHODOLOGY+OBJECTIVES

Layered Method

The future library check-list

Technology	Spatial Change	Design Impact	Estimated Space Use
AI-driven Cataloguing	Reduced space for physical catalogues	Digital kiosks replace large reference desks; open lobby flow	**<1–2%** (info desks only)
Robotic Shelving Systems (RFID/ASRS)	Compact vertical storage, fewer open stacks	Robotic corridors behind walls; public stacks reduced	**10–15%** (back-of-house)
AI Chatbots / Virtual Assistants	Less human-manned service points	Self-check terminals, help kiosks, mobile chat zones	**<1%** (dispersed stations)
IoT Sensors	Smart zoning and usage feedback	Dynamic furniture layout, responsive lighting, occupancy tracking	**<1% physical**, pervasive digitally
RFID Technology	Faster inventory and user interaction	Sleek self-checkout areas; secure yet open stacks	**2–3%** (within collection areas)
Automated Storage & Retrieval Systems	High-density, hidden storage	Archive functions relocated to compact areas, freeing up public space	**Up to 10–20%** (if integrated)
Spatial Design Network Analysis (VGA)	Optimized layout planning	Informs zoning and planning; no physical footprint	**0% (methodology tool)**
AR/VR Learning Spaces	Immersive, tech-based zones	Dark rooms, adjustable partitions, AR booths	**3–5%** (can be modular)
3D Scanning / Digital Twin	Real-time digital monitoring	Flexible planning and predictive maintenance; back-end integration	**<1% physical** (software-driven)
Spatial AI for Navigation	Personalized wayfinding	Interactive displays, smart signage, voice-guided access	**<1–2%**, integrated at circulation

Participant Demographics

Age group: All respondents are **between 18–30**

Backgrounds: **Architecture, Finance, Design, Computer Science, International Relations**

Usage Frequency: Mixed (Some regular users, others occasional or non-users)

Technology	User Response Summary
AI-Assisted Search / Smart Lookup	Strong interest across all interviews: faster, more relevant access to archives and books
AR Archives / Visual Browsing	High appeal for making content exploration more intuitive and engaging
Self-Service Tools	Generally positive attitude; helps speed up routine tasks (e.g. check-in/out, navigation)
Chatbots / Virtual Assistants	Mentioned less explicitly, but desire for intelligent assistance is noted
Concerns	One user flagged potential AI bias and accuracy concerns

RESEARCH FINDINGS

Spatial Preferences

Space Type	Mention Frequency	Notes
Quiet Study / Reading Areas	⭐⭐⭐⭐⭐⭐ (6/7)	Highly valued. Preference for silent zones, privacy corners, and good acoustics
Co-Working & Group Zones	⭐⭐⭐⭐⭐ (5/7)	Desirable for students and young professionals. Sound separation is crucial
Makerspaces / FabLabs	⭐⭐⭐⭐ (4/7)	Strong interest, especially from architecture and design students
Café / Social Lounge	⭐⭐⭐⭐⭐ (5/7)	Seen as attractive, helps libraries serve as “third places”
Outdoor / Green Areas	⭐⭐⭐ (3/7)	Considered a bonus, supports well-being and informal use
Children’s Zone	⭐⭐⭐ (3/7)	Mentioned mostly by those who value multi-generational inclusion
Modular / Flexible Workspaces	⭐⭐⭐⭐⭐ (5/7)	Desire for convertible areas: silent zones, group rooms, semi-private pods
Exhibition / Cultural Events	⭐⭐⭐ (3/7)	Support for hybrid library programming—talks, exhibitions, etc.

From Q1–Q3 to Design Guidelines

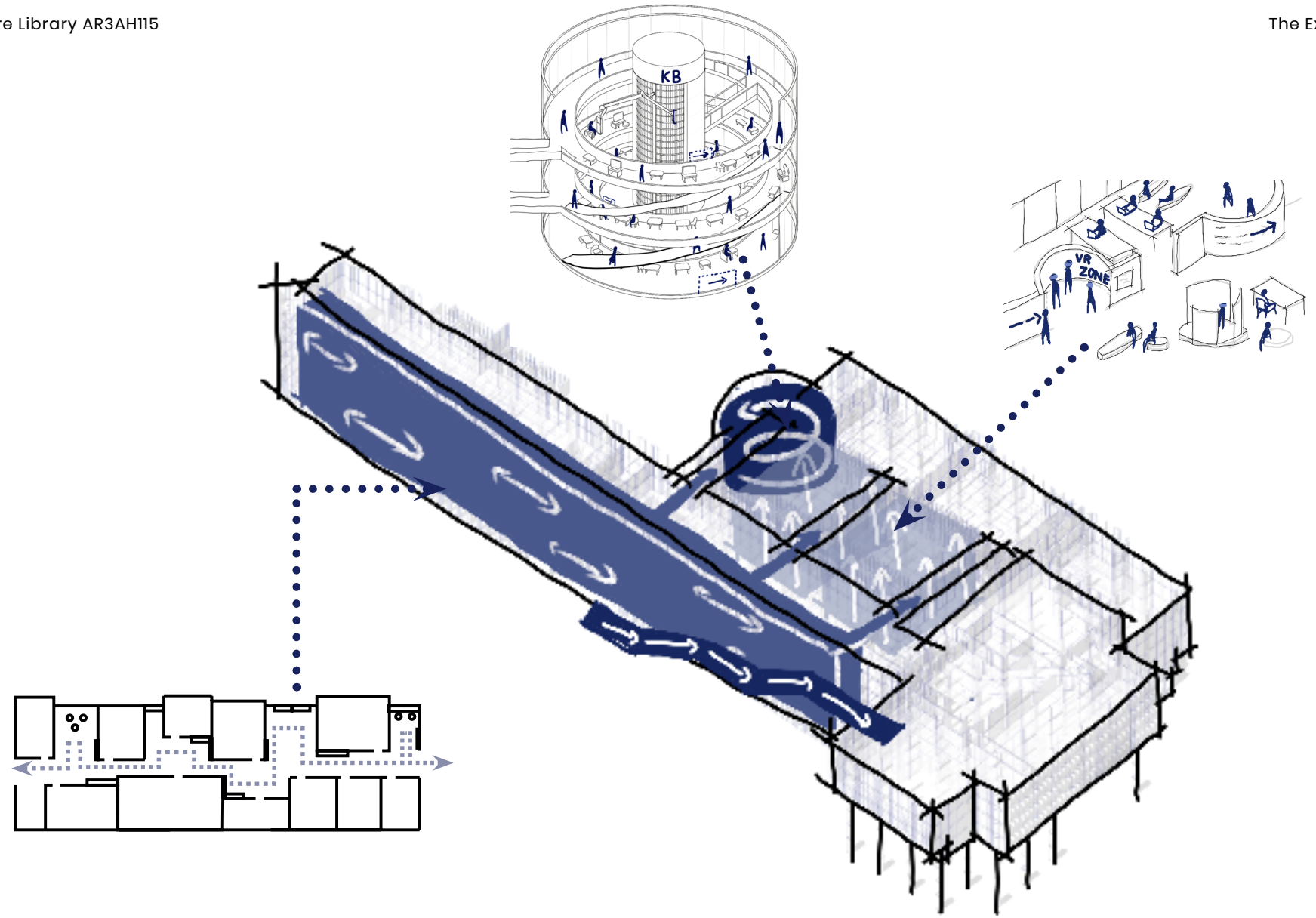
G1 – Corridors as social spines
Research showed desire for encounter and clear visibility.
->***Turn main corridors into continuous visibility spines with seating, AI touchpoints and framed views.***

G2 – Layered privacy
Interviews and VGA revealed conflict between exposure and focus.
->***Place quiet carrels in low-visibility perimeters, keep pods and collaboration near, but not on, the spine.***

G3 – Tech as legible infrastructure
Technology scan and heritage stance call for visible but bounded innovation.
-> ***Keep ASRS and digital tools visible from public areas, while logistics routes stay off the main path.***

G4 – Green at spill-over zones
Comfort issues cluster where flows and noise are highest.
-> ***Insert green pockets and planters at ramps, nodes and balconies to soften hotspots and cool micro-climate.***

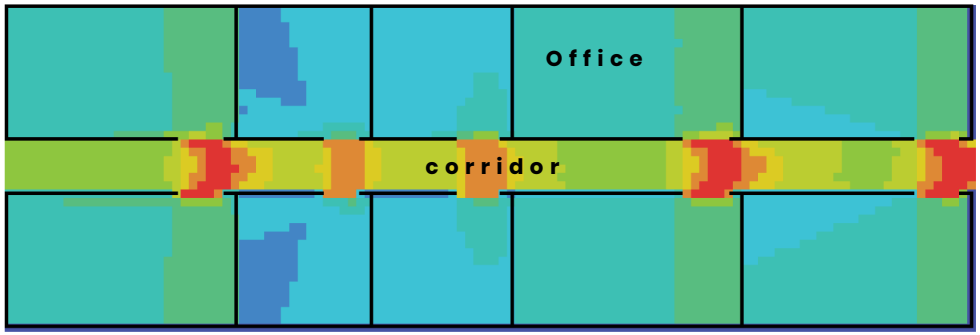
G5 – Wayfinding through space, not signage
Users experience the KB as confusing and opaque.
->***Use sightlines, thresholds, level changes and a few interactive markers so the building itself guides orientation.***



DESIGN TRANSLATION
Location

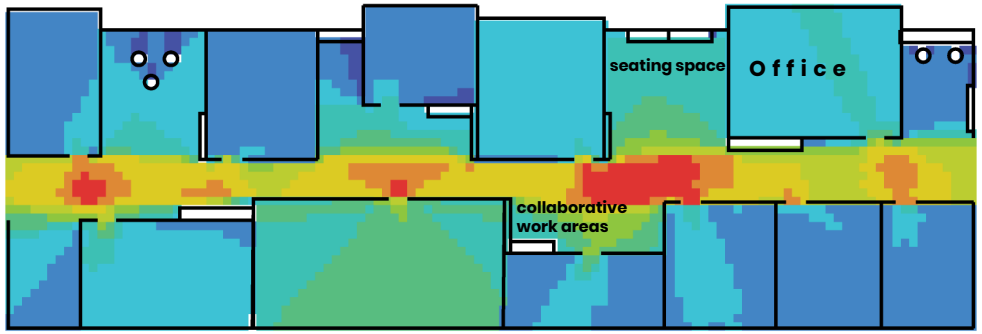
-Corridors acted as linear, highly visible passageways.

-Strong directionality (clear axis), but limited spatial interaction.



BEFORE

GOAL: not just a passage, but a destination



AFTER

-Visibility becomes more spread/dynamic.

-Corridors support activity with facade-facing openings and fun zones.

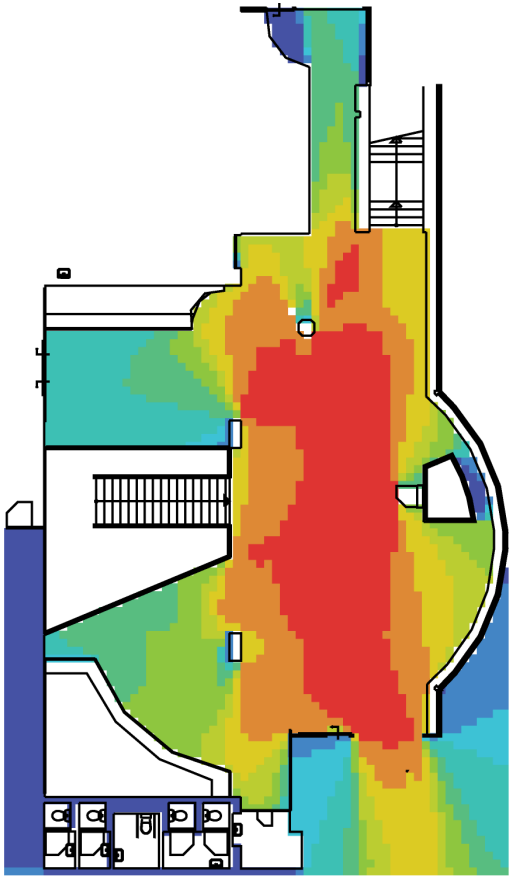
-Acts as a connective, socially active spine of the library.partial walls, or larger portals.

RESEARCH FINDINGS
VGA Test 1- Corridor Design

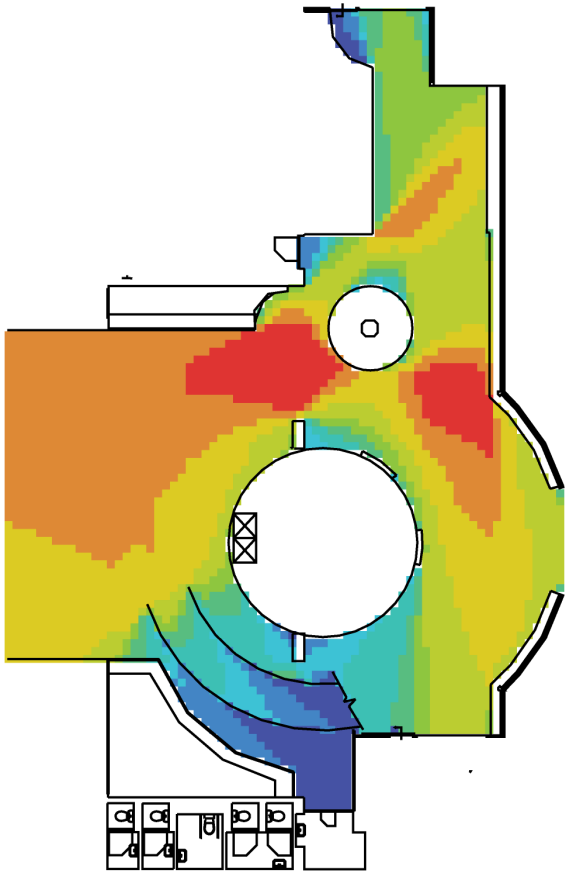
High visibility — Low visibility

-Direct route to stairs with **high visibility in a single central band**.

-Functioned more like a transit zone, **lacking spatial engagement**.



BEFORE



AFTER

-Entrance repositioned to **de-emphasize** the stair axis.

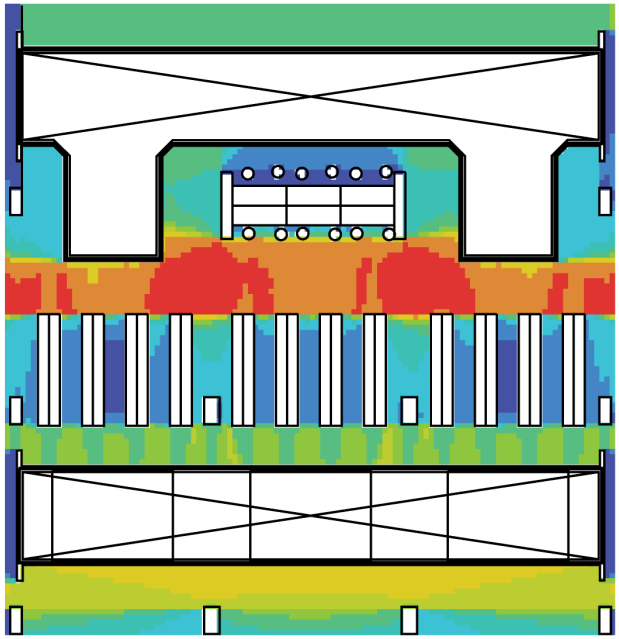
-Introduction of **ramp and interactive library shelving** diversifies circulation.

-Visibility is more **dispersed, creating potential for lingering and engagement**.

High visibility — Low visibility

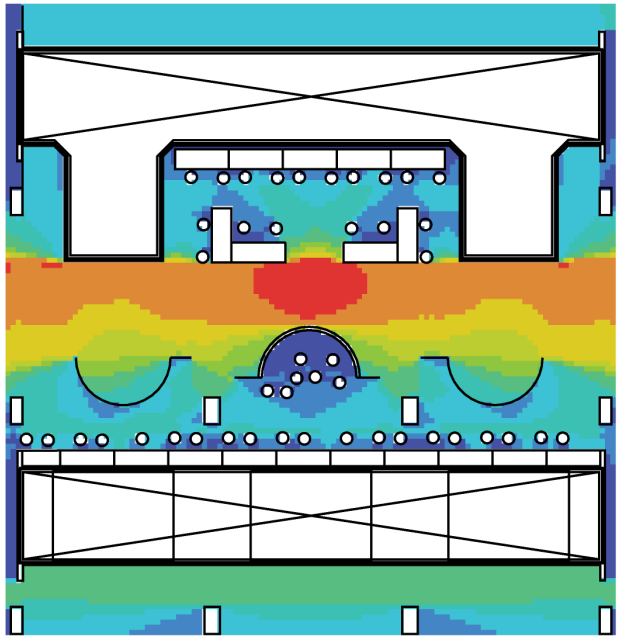
RESEARCH FINDINGS
VGA Test 2- Secondary Entrance Ramp

-Strong central axis with two red visibility hotspots.
-**Rigid, linear layout** encourages silent reading and focused behavior.
-Visual control is **centralized**.



BEFORE

-Visibility is more dispersed and dynamic.
-New curved VR/resting pods soften the layout.
-A central node remains, but directionality fades..
-Corridors and pod placement create **multiple interaction points**.

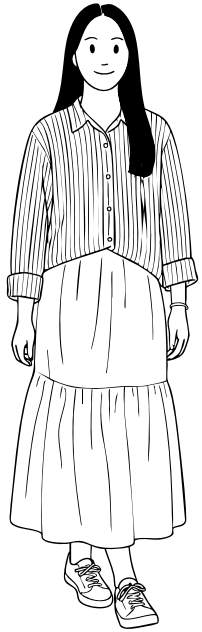


AFTER

RESEARCH FINDINGS
VGA Test 3- Reading Hall->Co-working Hall

Julian (The Tech Explorer):

- 27, Digital Nomad, data-oriented
- uses AI search, AR previews
- loves clear wayfinding
- wants flexible co-working tools and quick access to digital collections

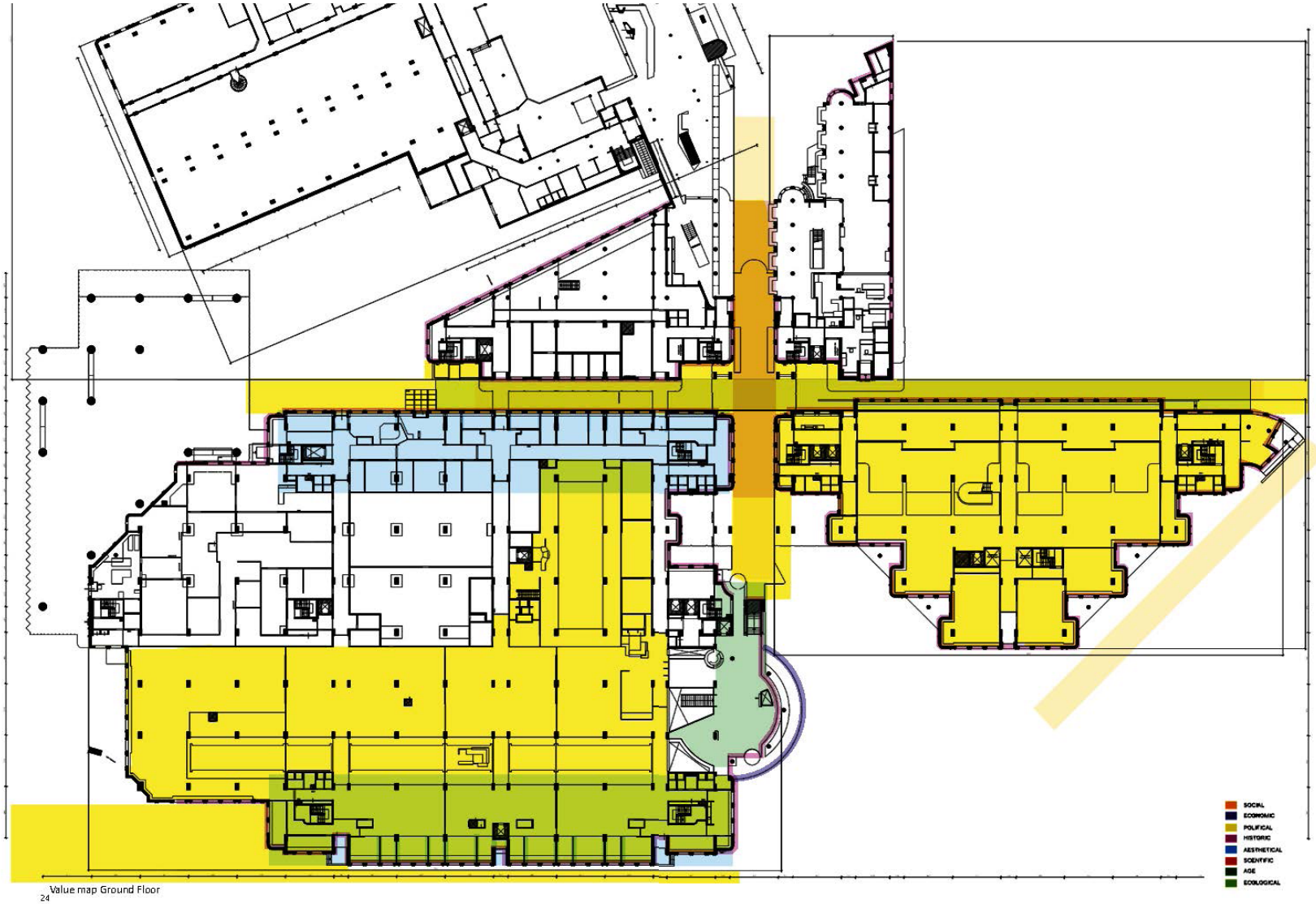


Angela (The Creative Maker):

- 21, Product Designer
- values making, mentoring, tangible workshops
- seeks hybrid zones to present, learn, and collaborate
- curious about how the building performs

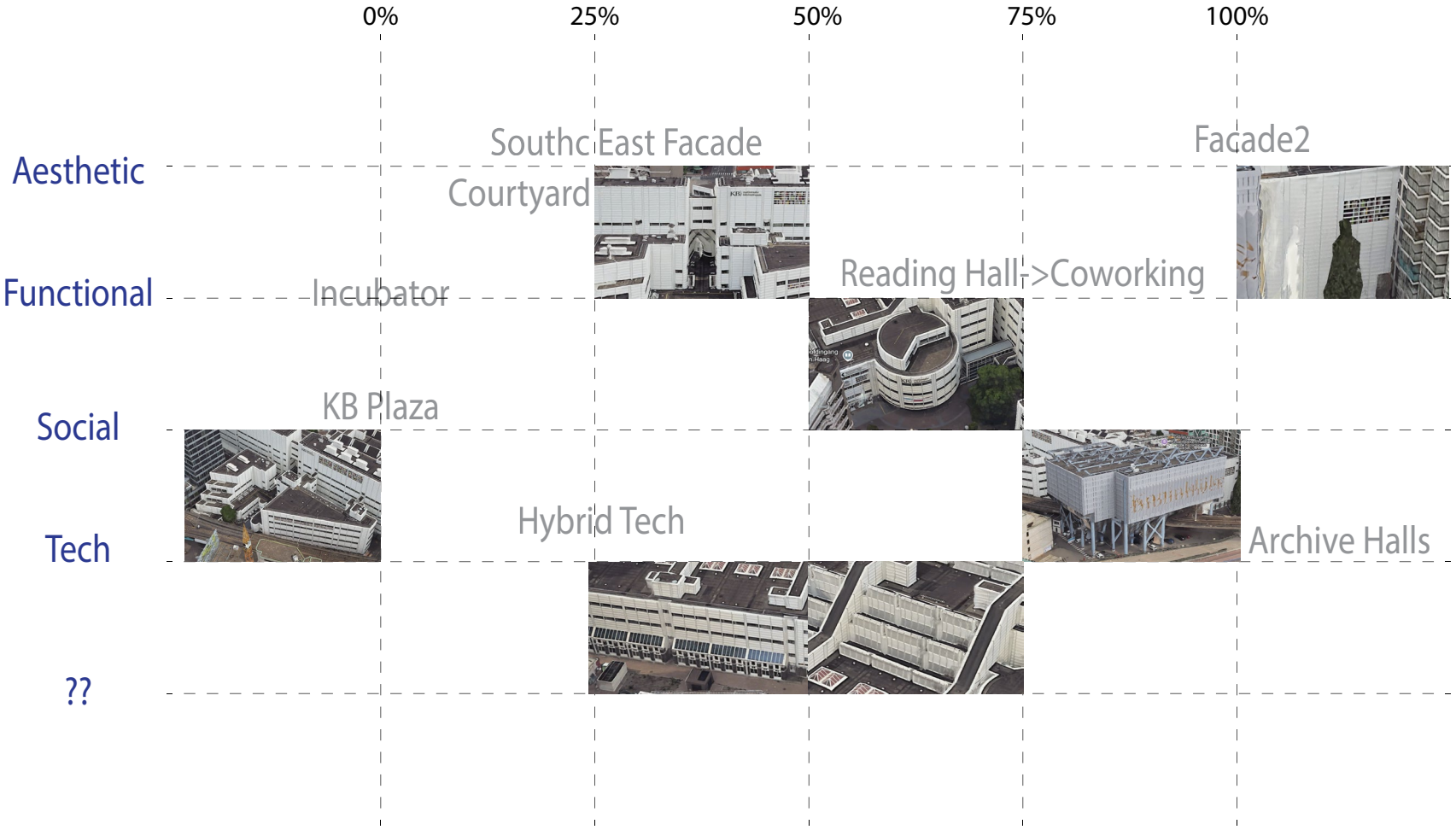
A KB JOURNEY THROUGH USER EXPERIENCE

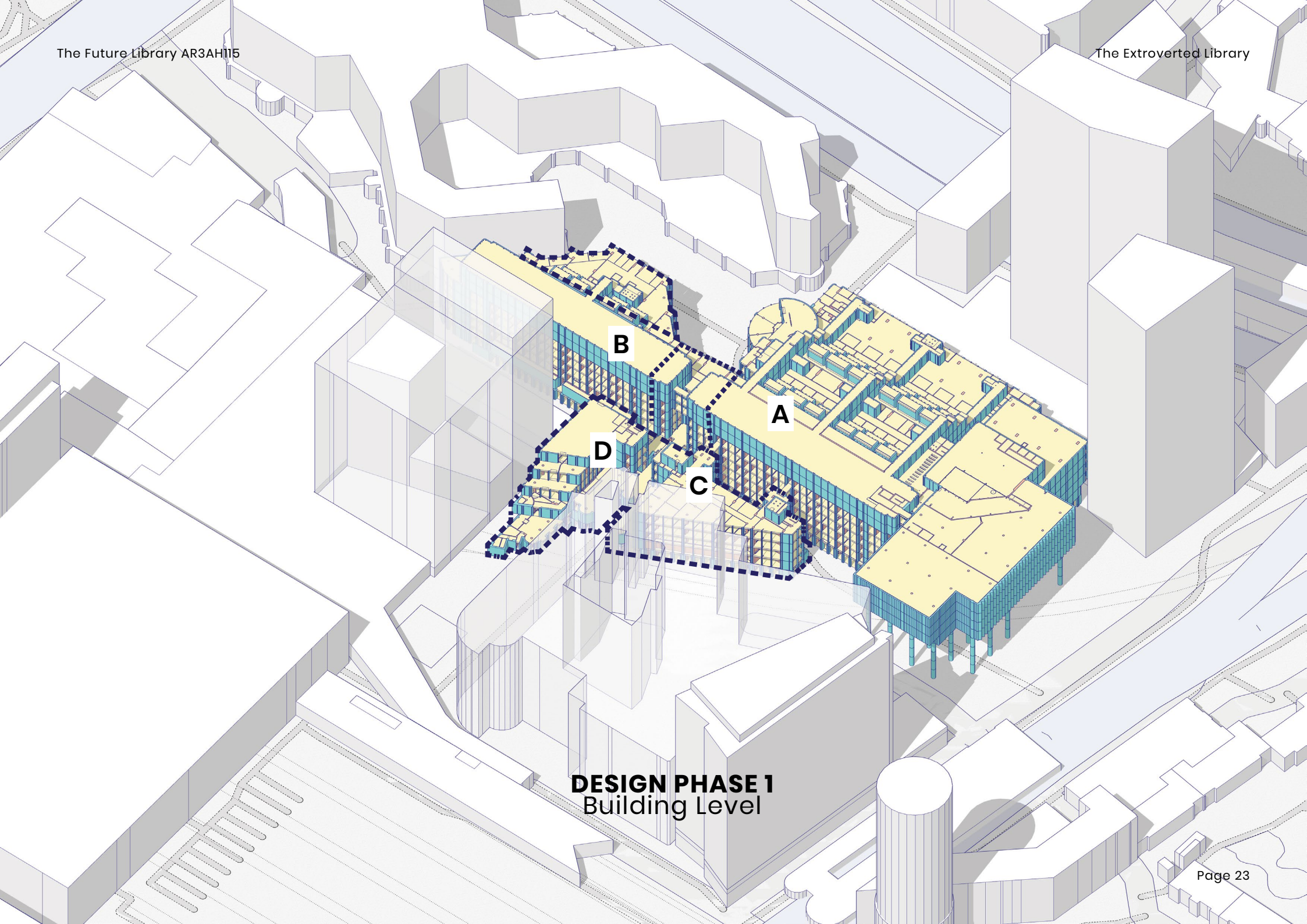
But before this journey starts...



Value map Ground Floor, Made by the Heritage Group, "Reshaping KB" p.22-23

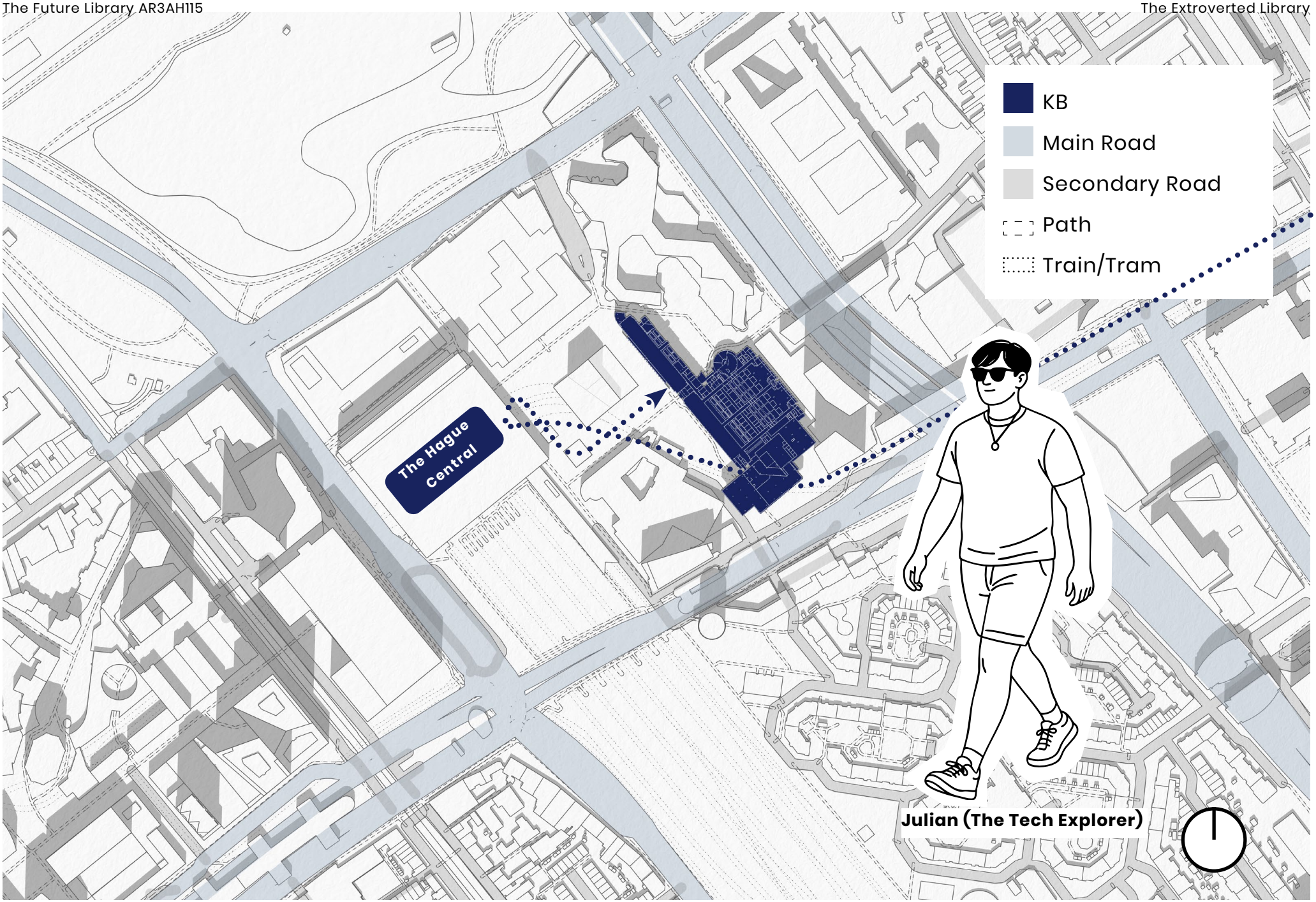
HERITAGE RETENTION %

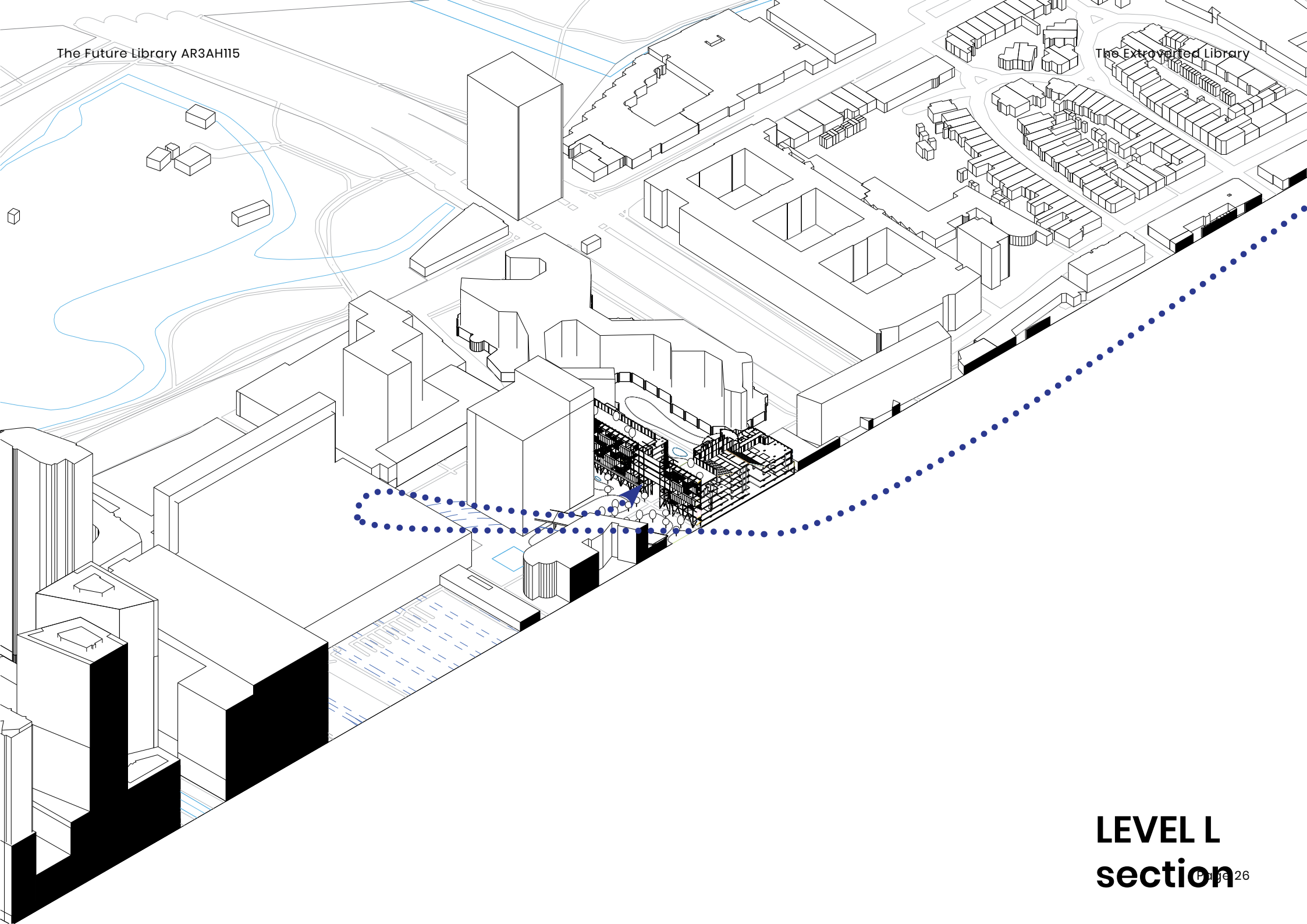




DESIGN PHASE 1
Building Level

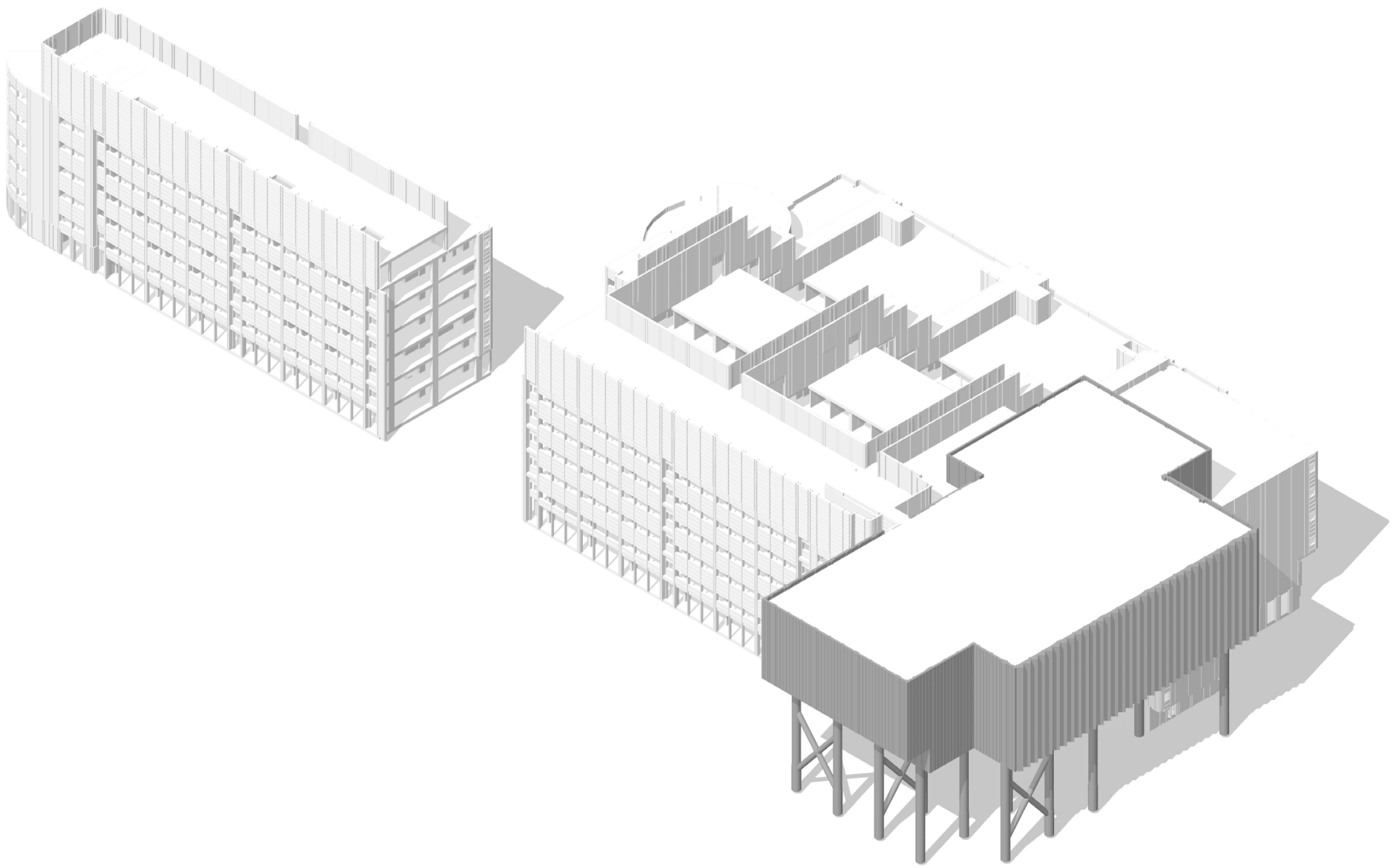
Let’s start **the Journey!**


KB
Main Road
Secondary Road
Path
Train/Tram
The Hague Central
Julian (The Tech Explorer)

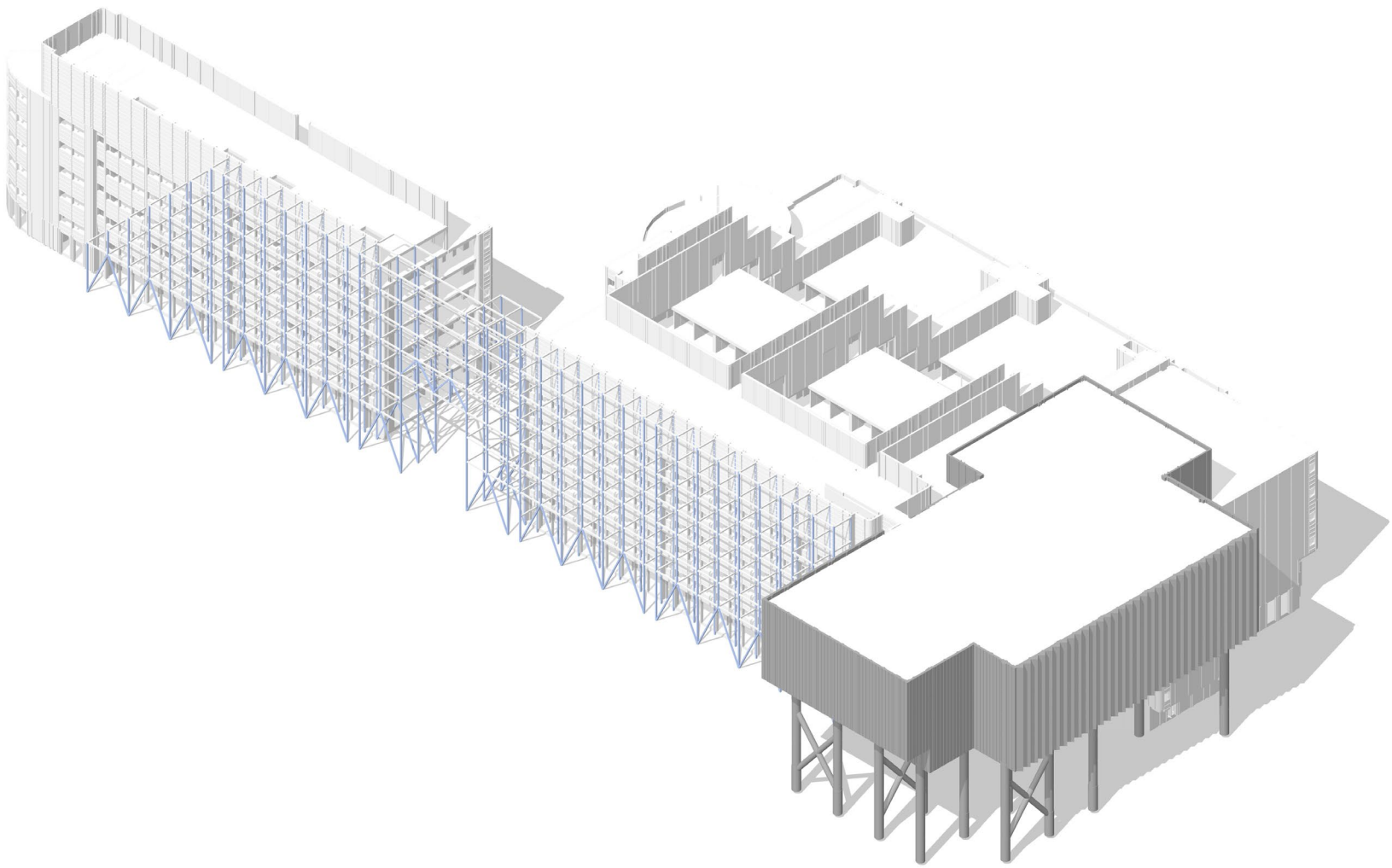


LEVEL L section

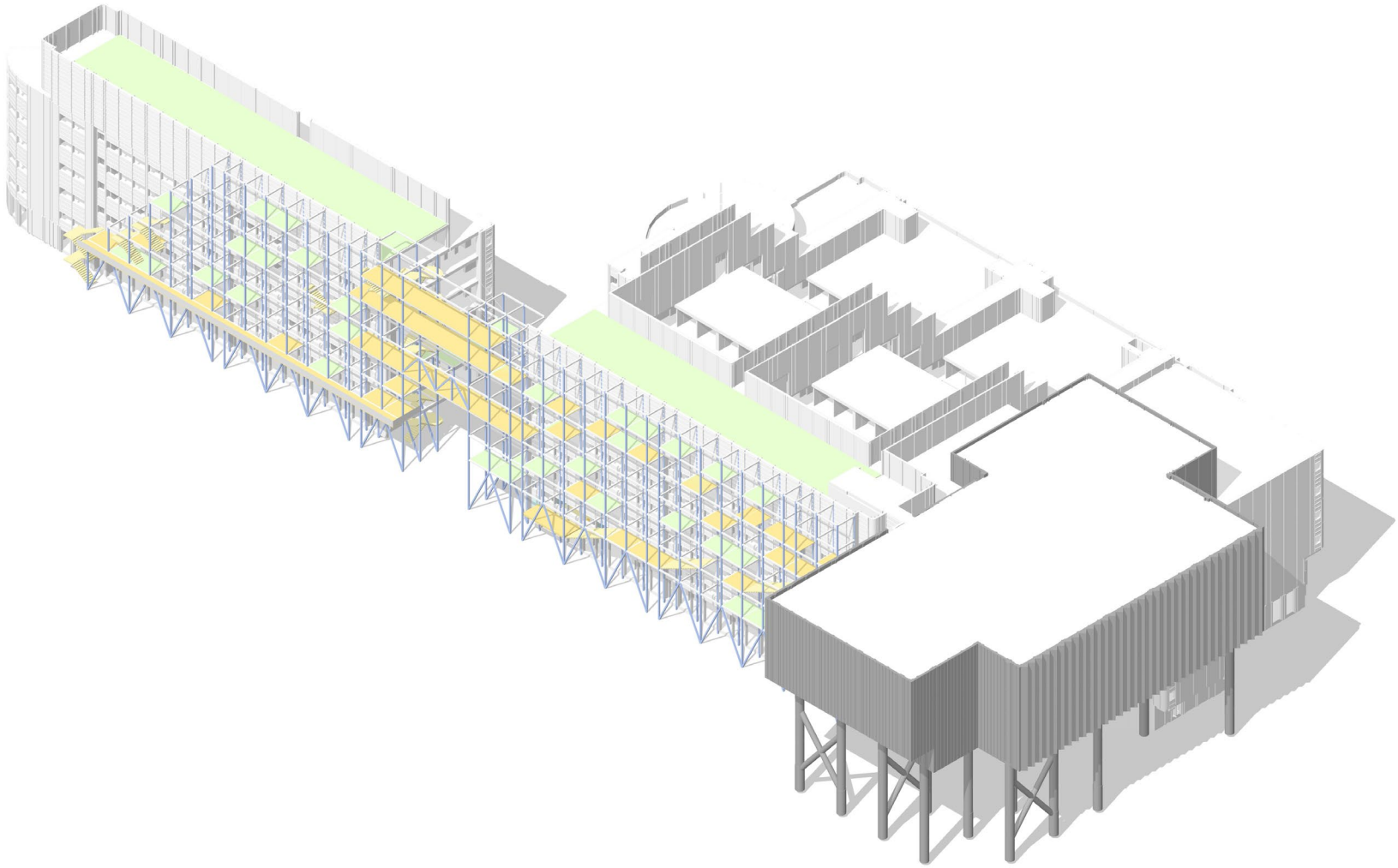
The Extroverted Facade



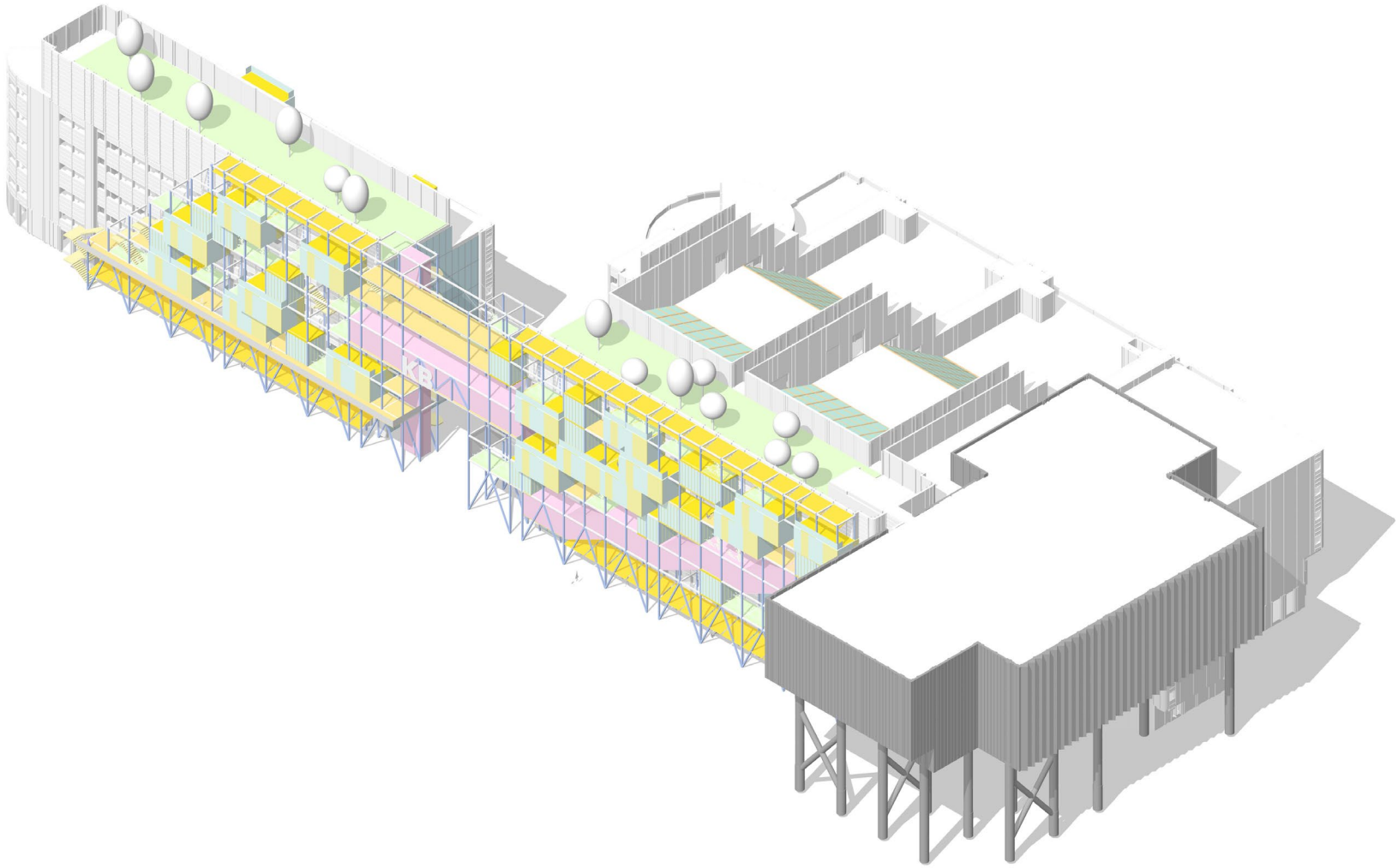
Original Building



Structure

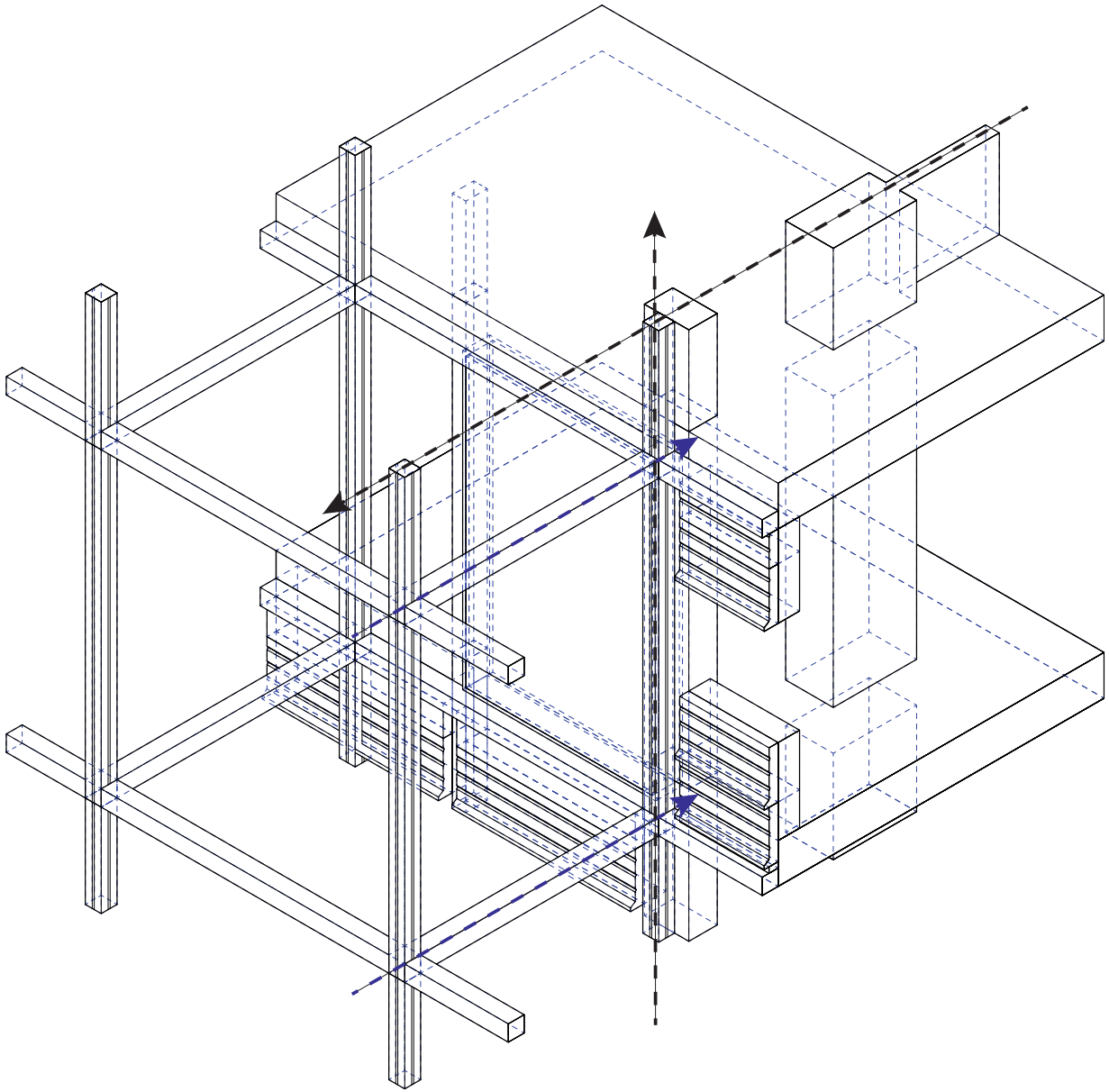


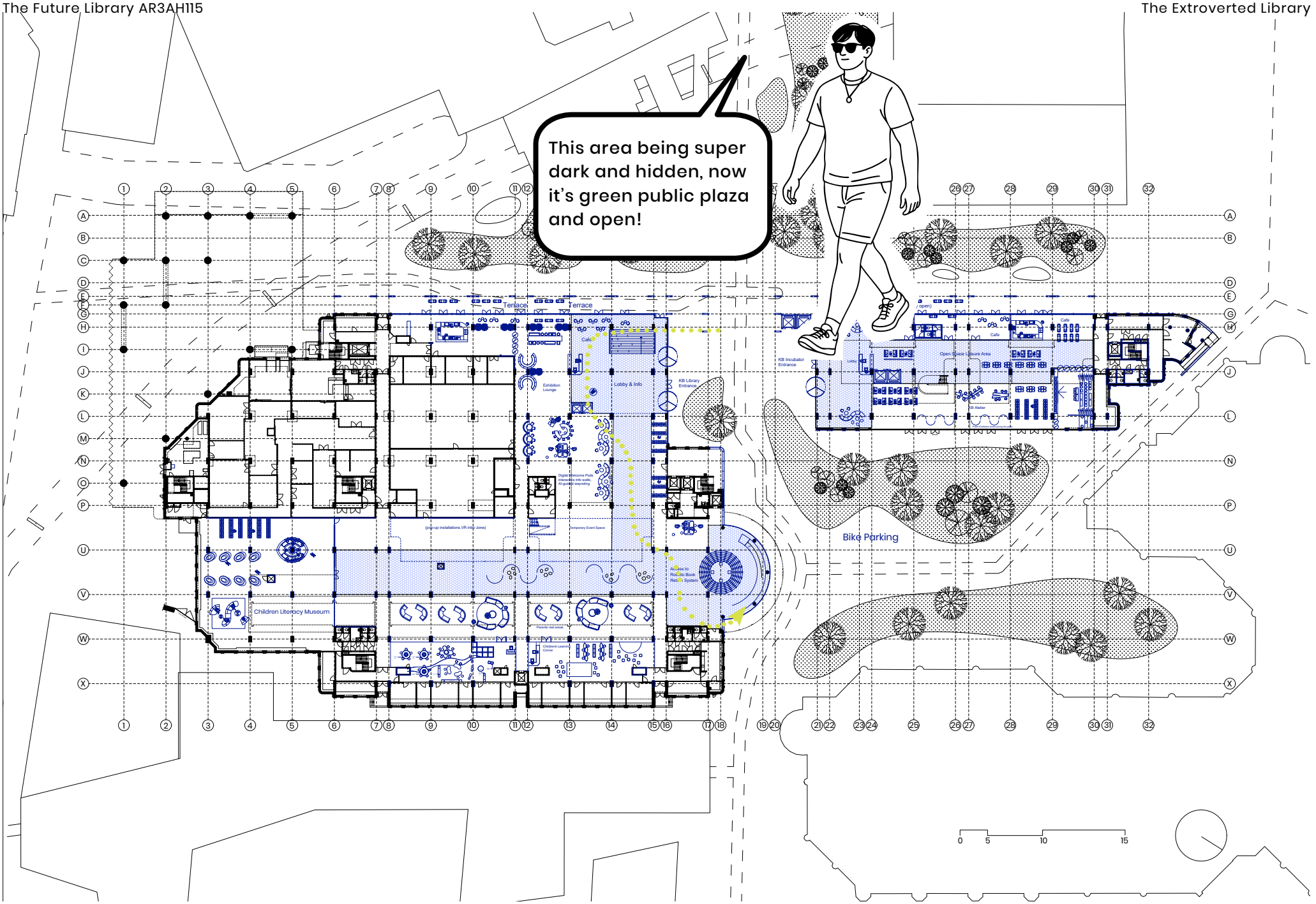
Access Points



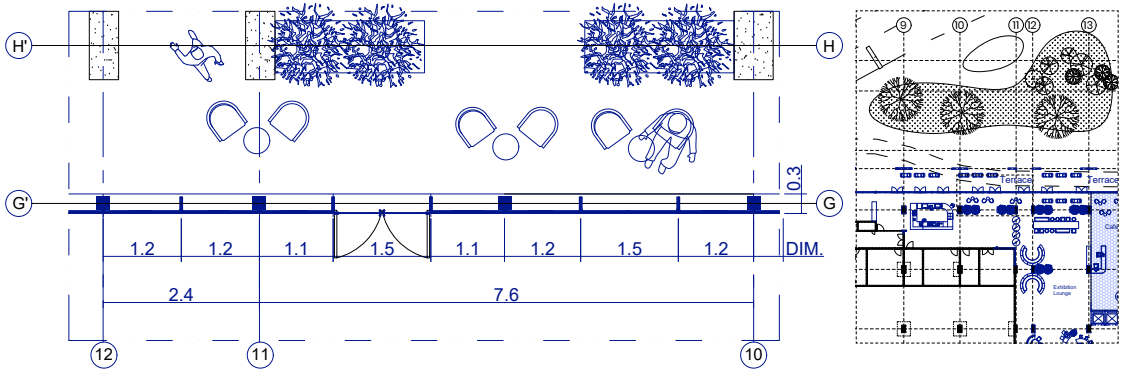
Indoor/Outdoor &Staircase

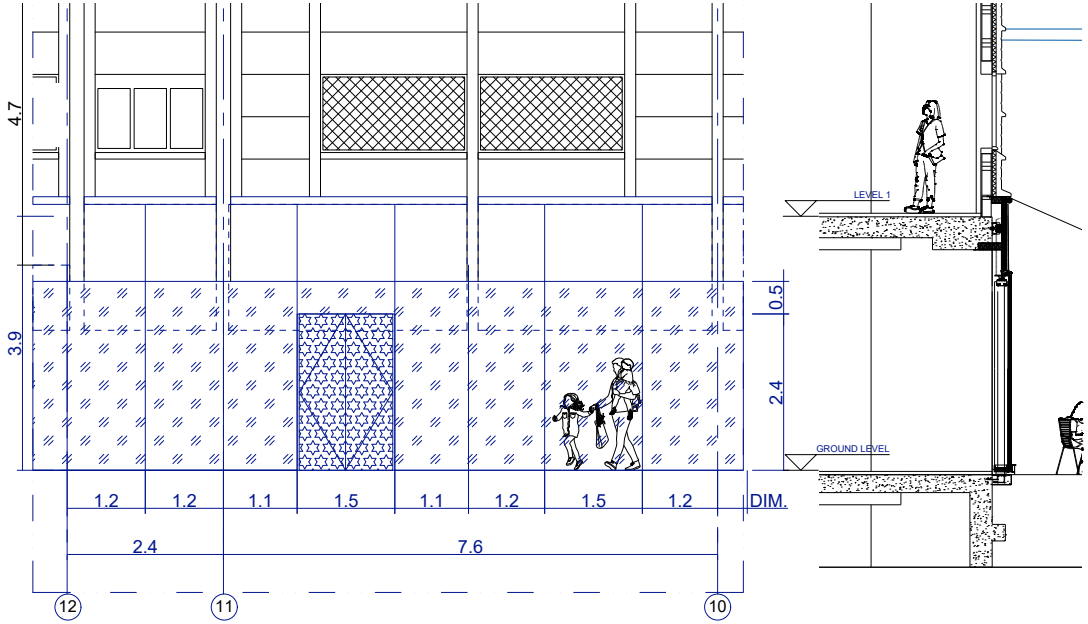
New Facade+Landscape

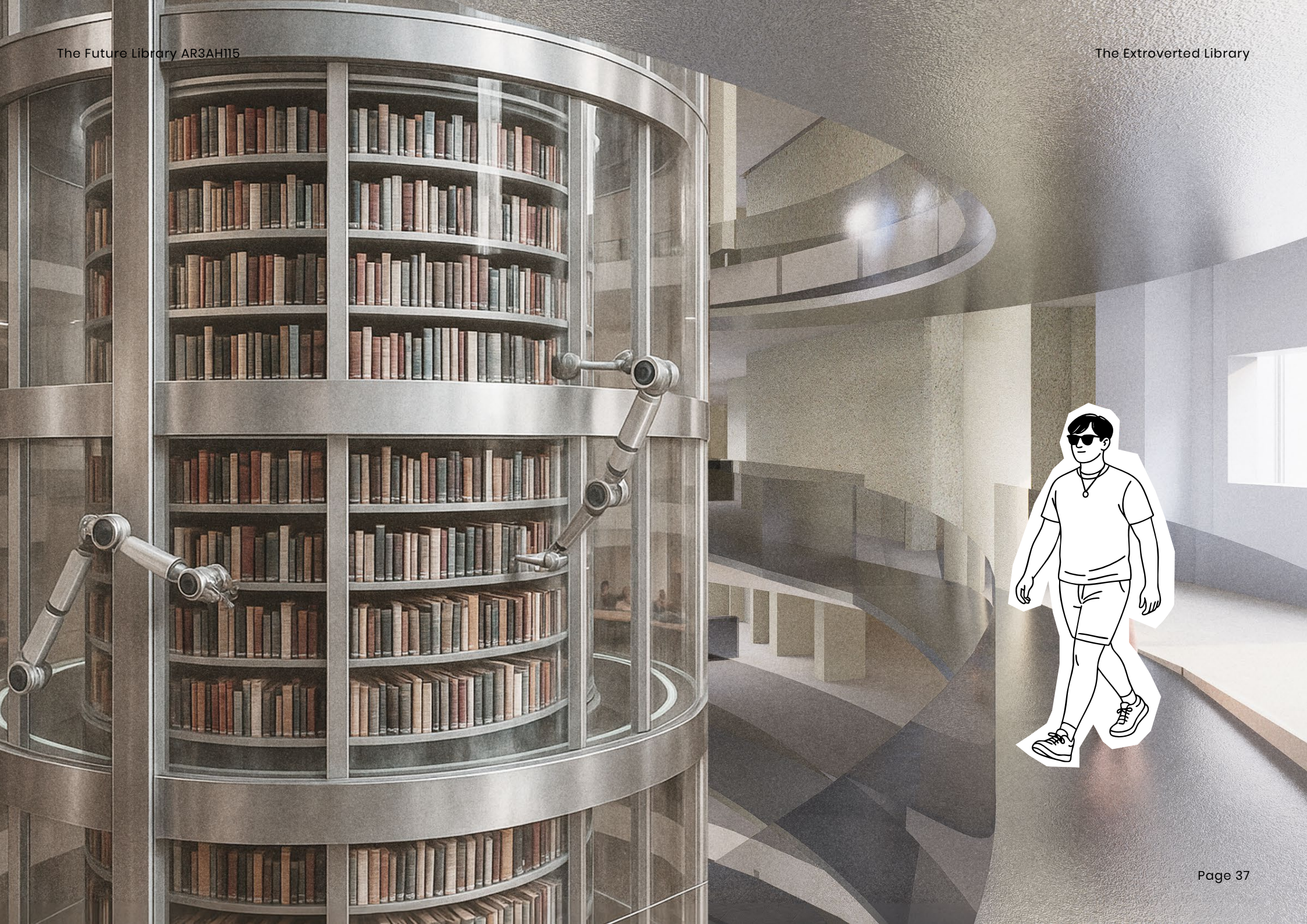


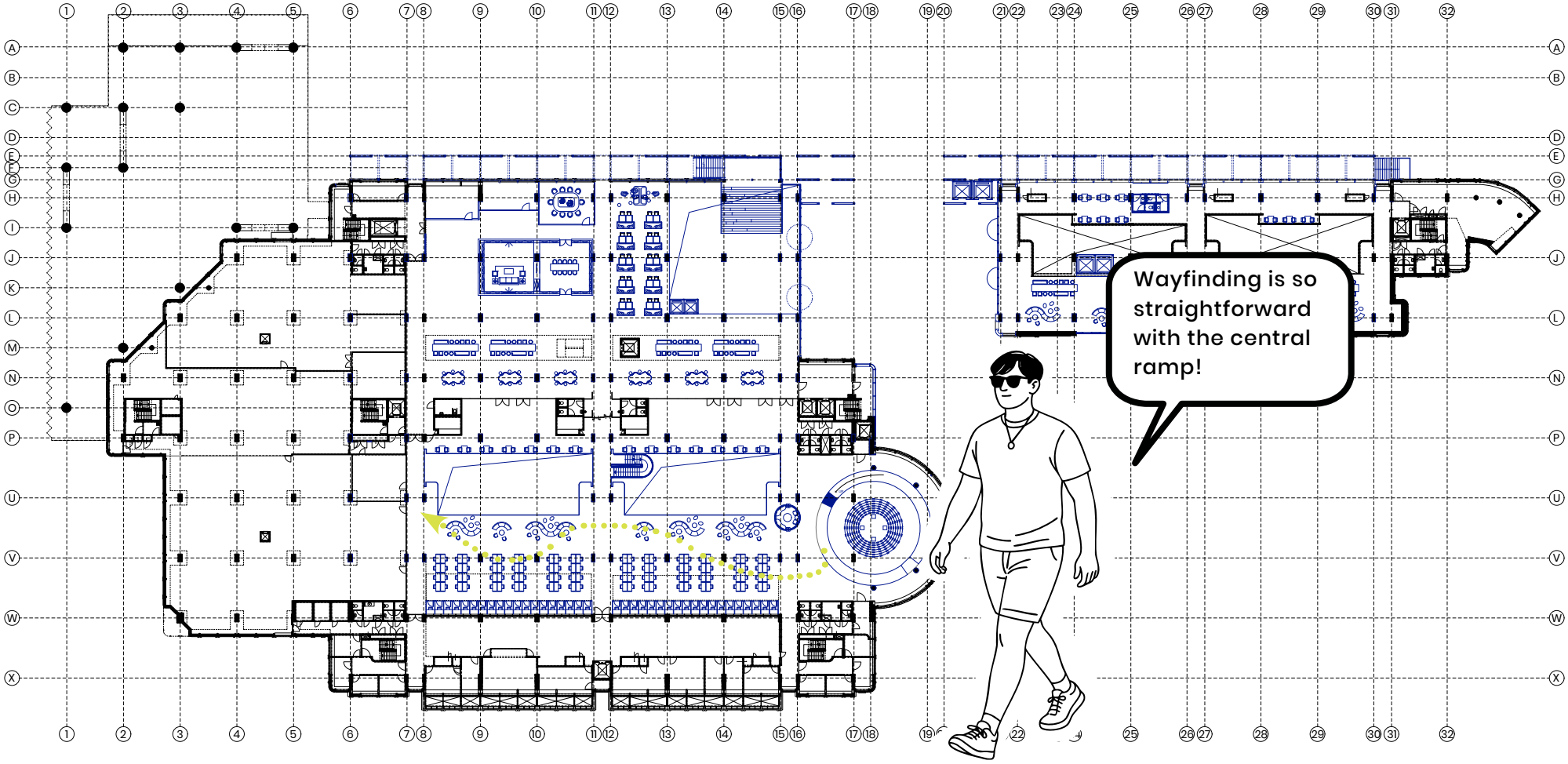

This area being super dark and hidden, now it's green public plaza and open!
Terrace
Terrace
Cafe
Exhibition Lounge
Lobby & Info
KB Library Entrance
Digital Welcome Pods interactive info walls, Augmented wayfinding
Temporary Event Space
Access to Robotic Book Retrieval System
Children Literacy Museum
Children's Learning Corner
KB Incubator Entrance
Open Space Leisure Area
KB Atelier
Bike Parking
0
5
10
15

Groundfloor Exterior/Interior Connection

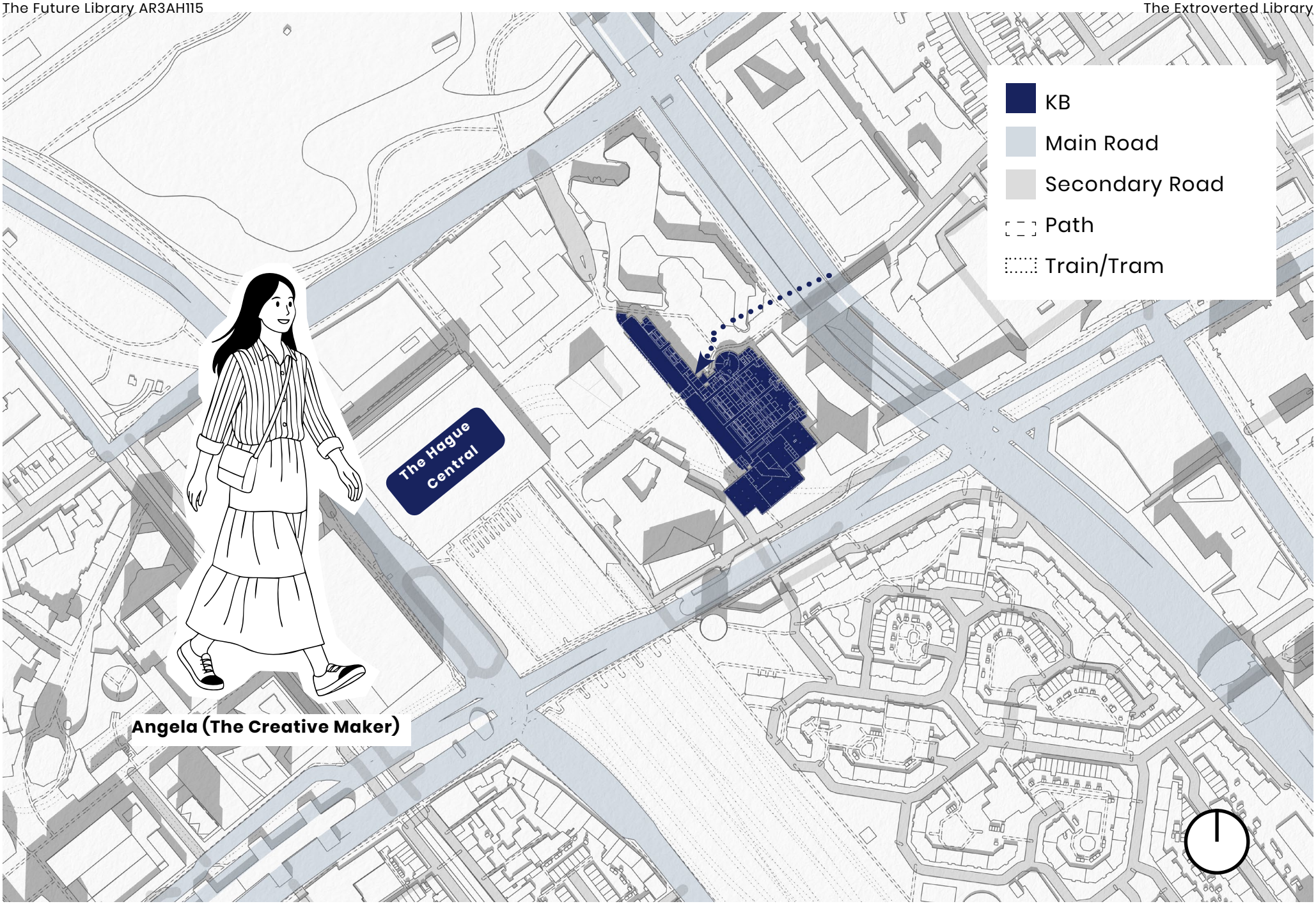

H'
H
G'
G
0.3
1.2
1.2
1.1
1.5
1.1
1.2
1.5
1.2
DIM.
2.4
7.6
12
11
10
9
10
11
12
13
Terrace
Terrace
Exhibition Lounge


4.7
3.9
0.5
2.4
LEVEL 1
GROUND LEVEL
1.2
1.2
1.1
1.5
1.1
1.2
1.5
1.2
DIM.
2.4
7.6
12
11
10




Wayfinding is so straightforward with the central ramp!


It’s nice to have a good balance of enclosed/open zones to work!


KB
Main Road
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Train/Tram
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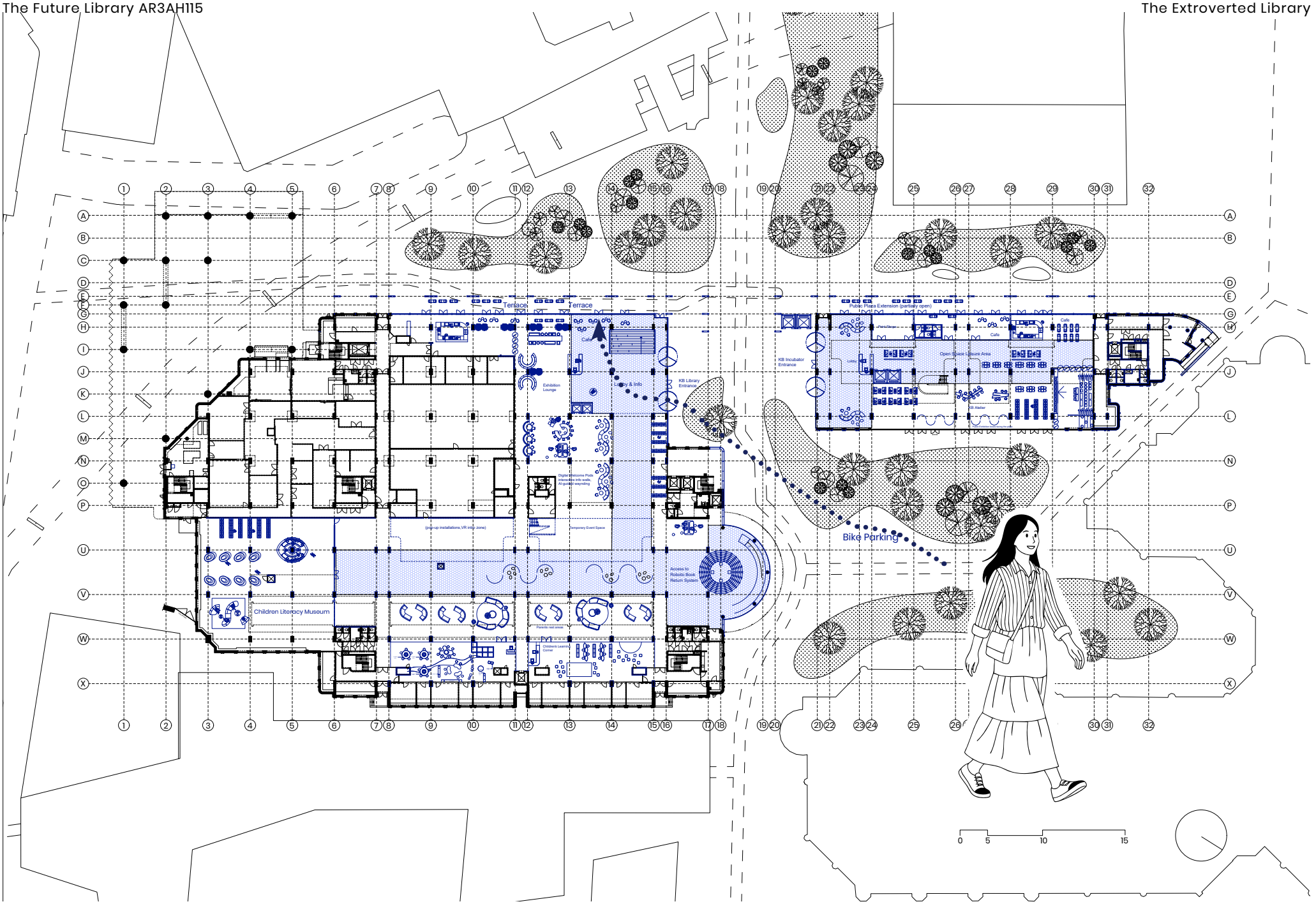
Angela (The Creative Maker)


Terrace
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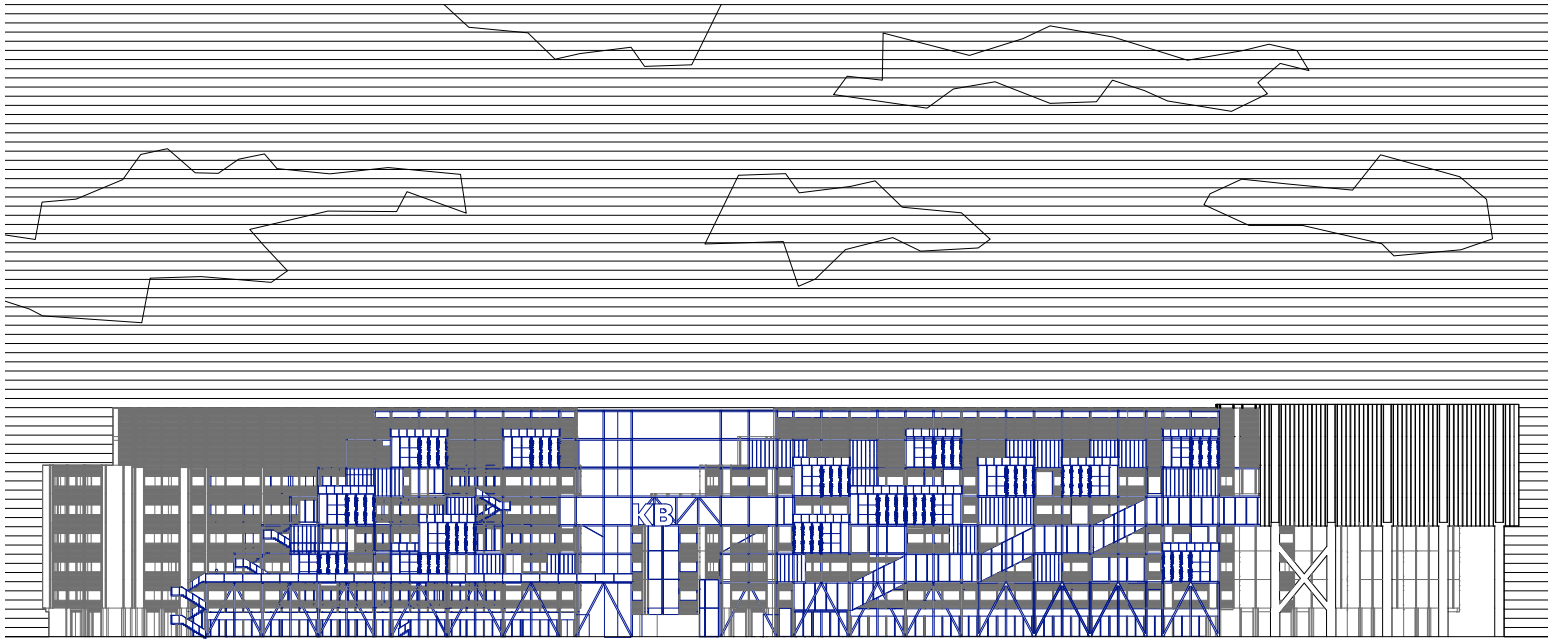
KB Library Entrance
Digital Welcome Pods interactive info walls, AI-guided wayfinding
(pop-up installations, VR intro zone)
Temporary Event Space
Access to Robotic Book Return System
Children Literacy Museum
Children's Learning Corner
Public Plaza Extension (partially open)
Cafe
Cafe
KB Incubator Entrance
Open Space Leisure Area
KB Atelier
Bike Parking
0
5
10
15

Main Entrance




0
5
10
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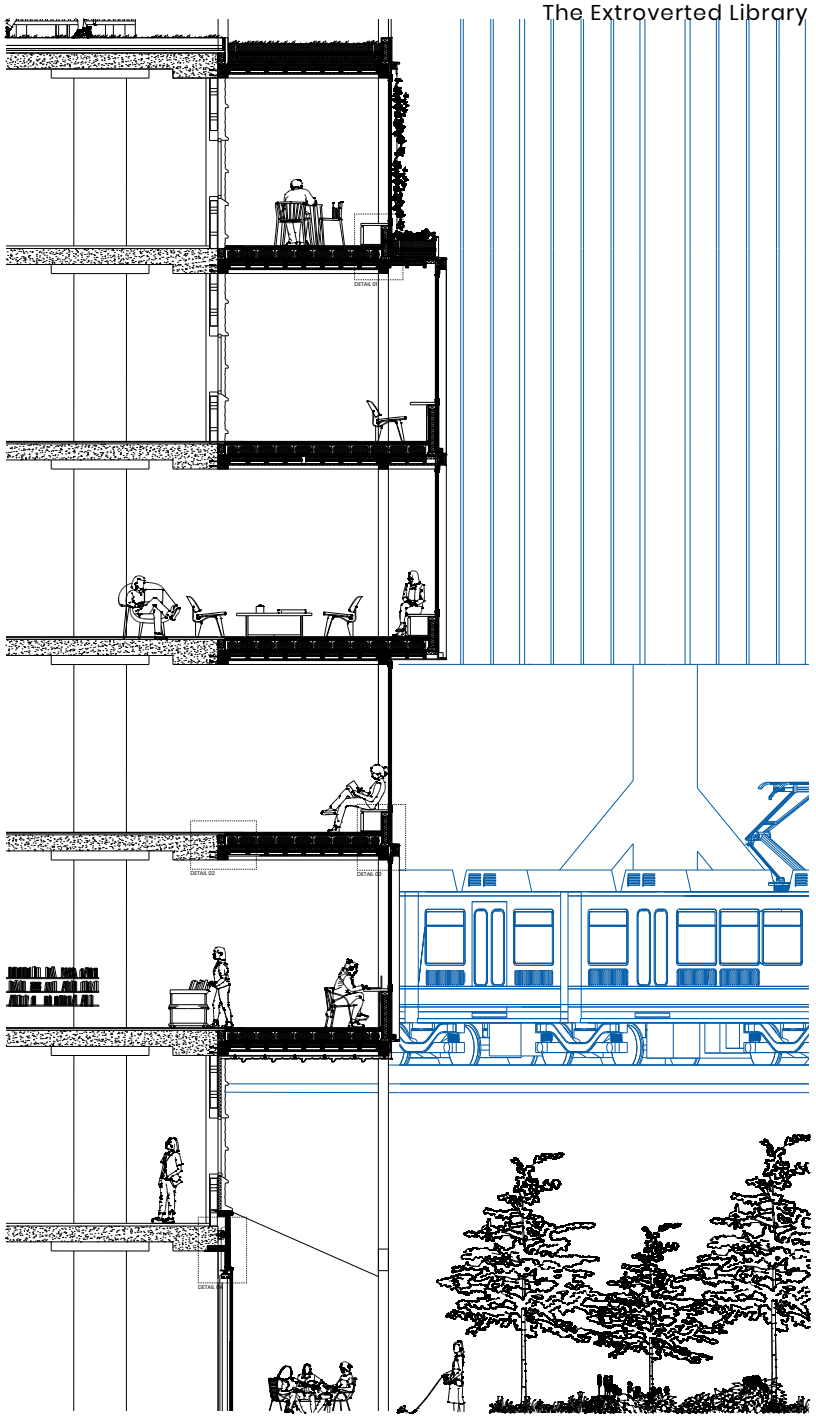
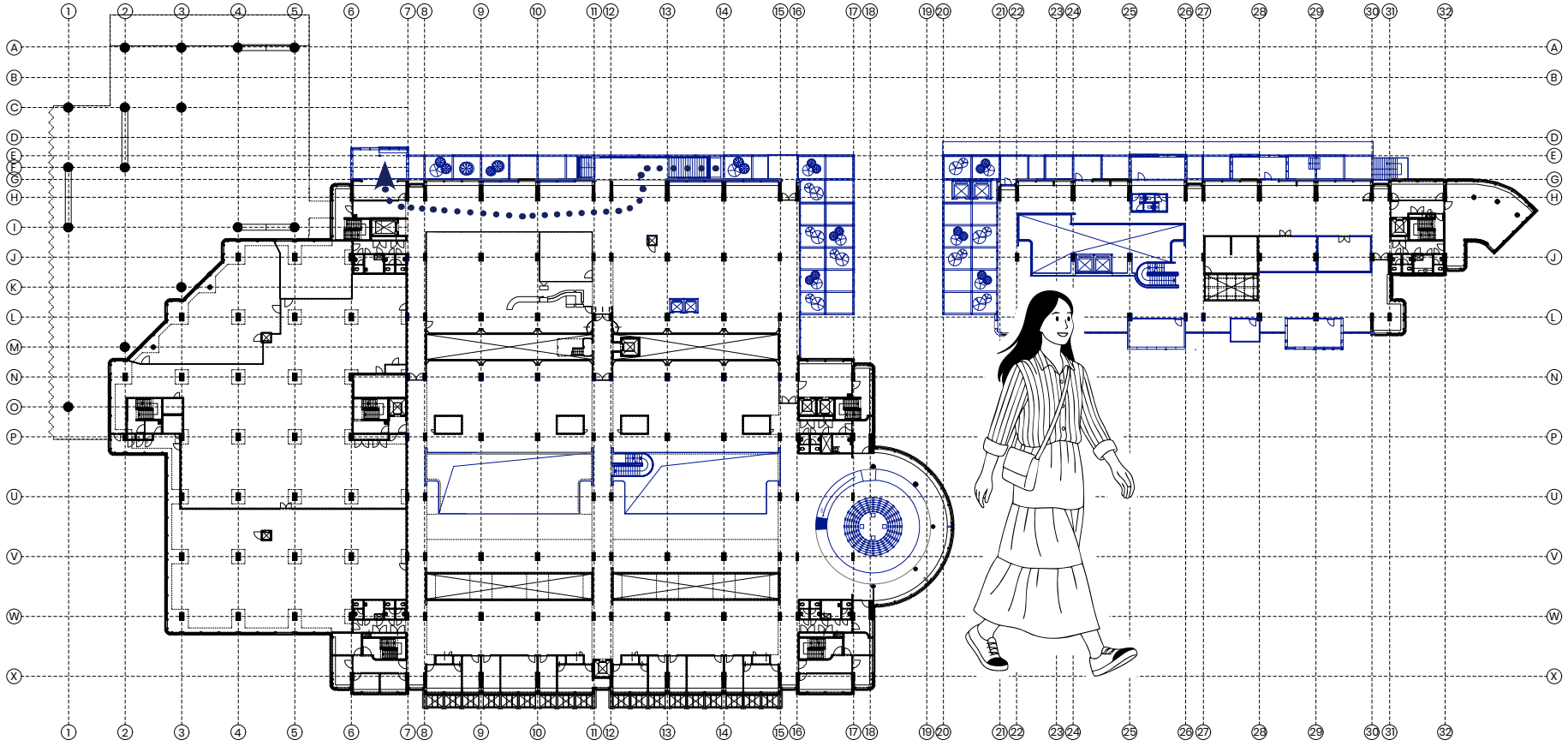
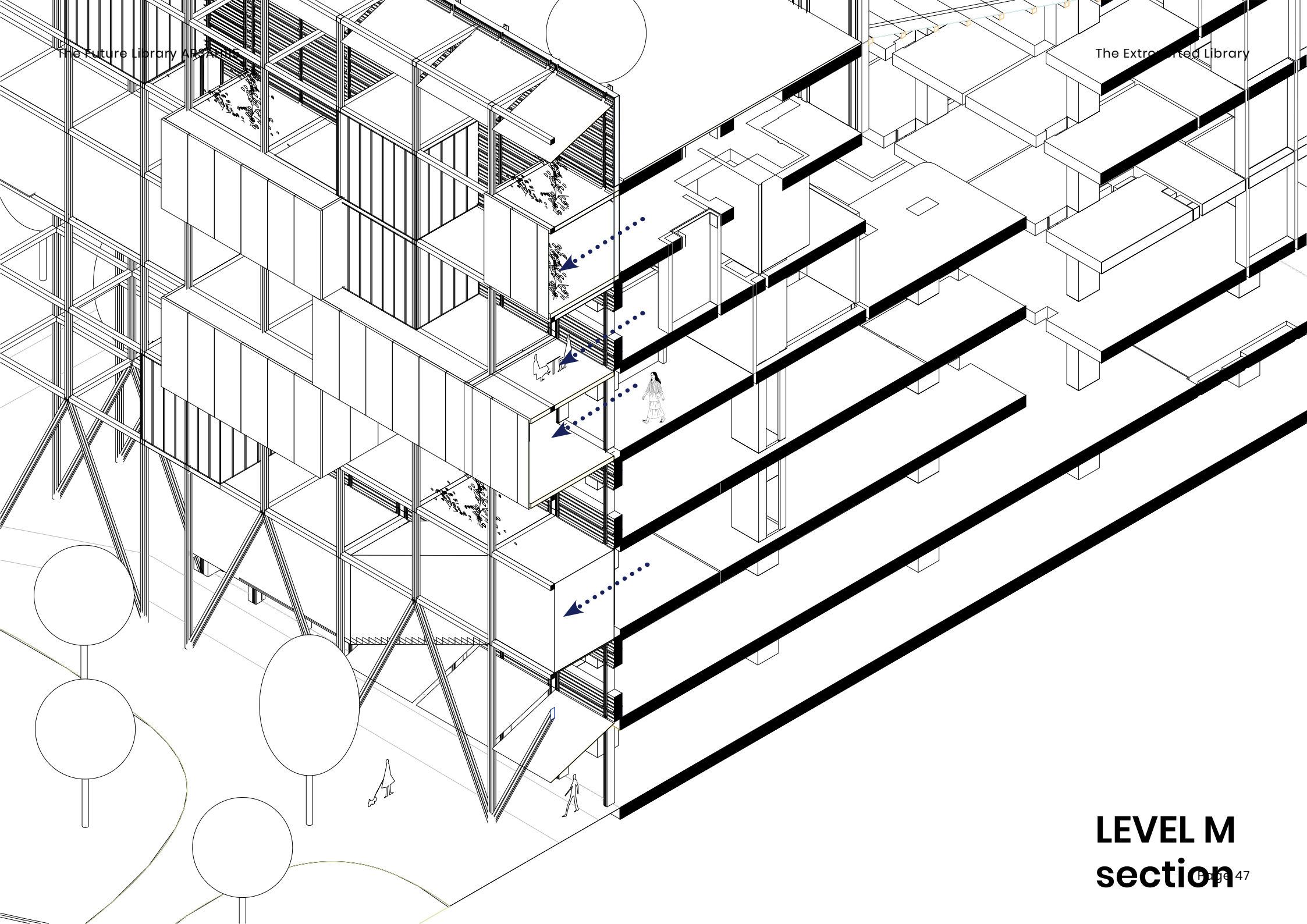
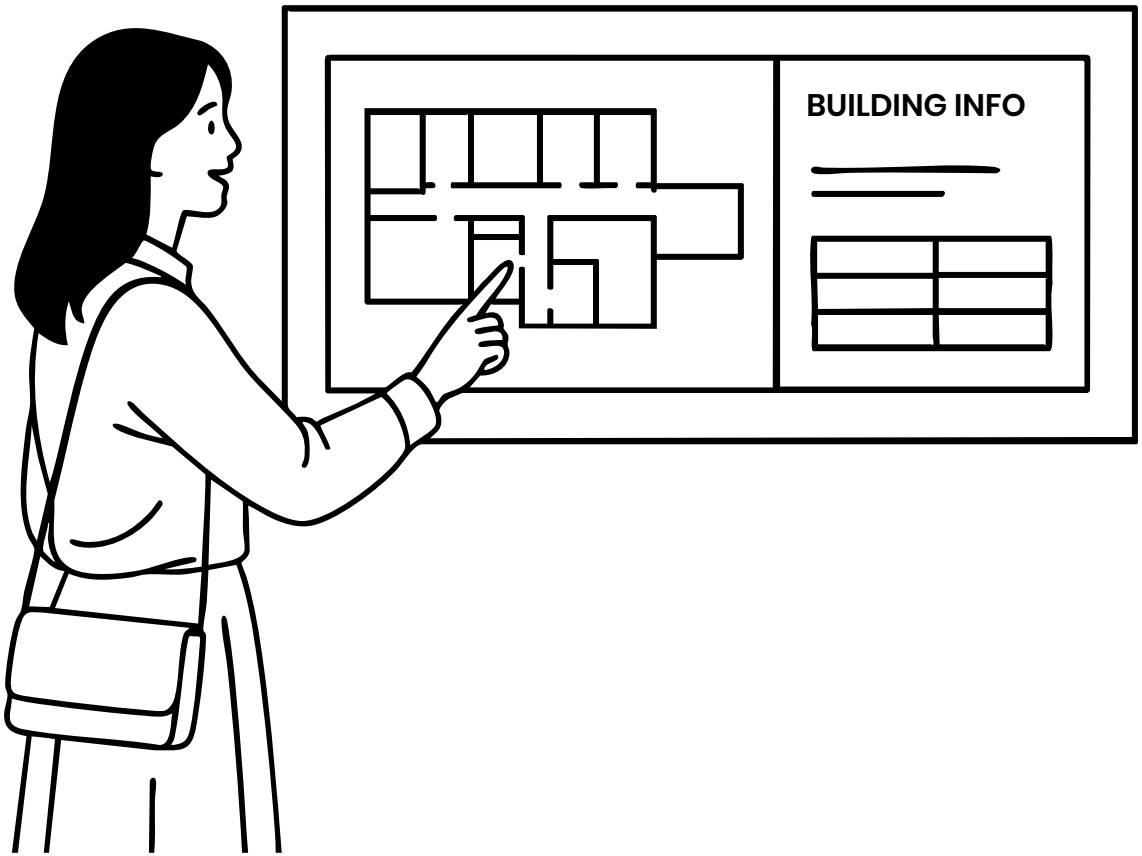






LEVEL M section



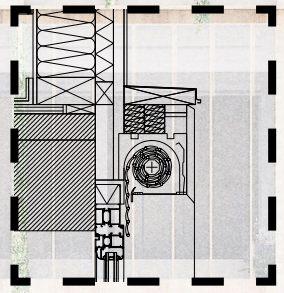
Digital Walls

Floor 2-5 Strategy

SUMMER SUN
Movable Plant Grids for

WINTER SUN
Grid put aside to welcome as much sunlight as possible

Rolling Shading devices
On the Extruded Rooms



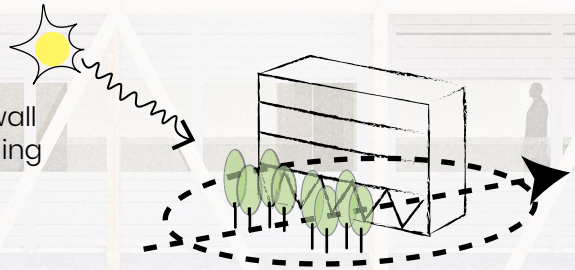
OPENINGS AND ACCESS
Shading and cooling side access on the sides of the extruded rooms

EXTRUSION
Some boxes are extruded differently to create shade

Floor 0-1 Strategy

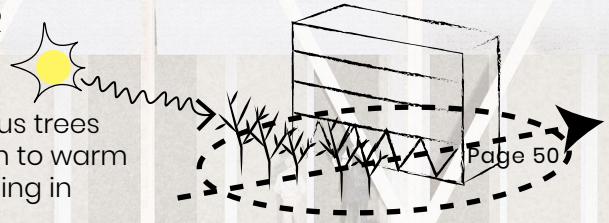
SUMMER SUN

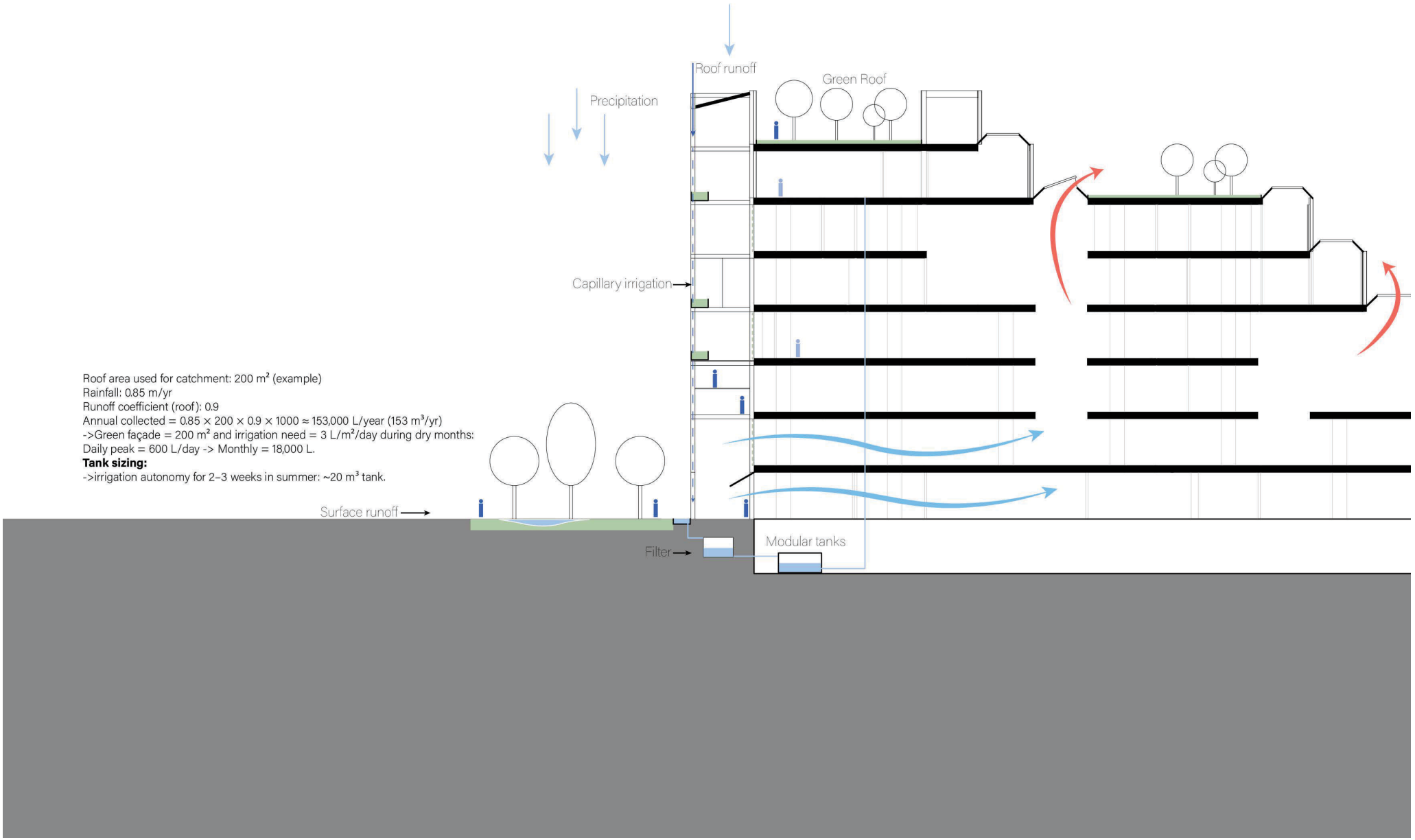
Shade on wall lowers cooling load



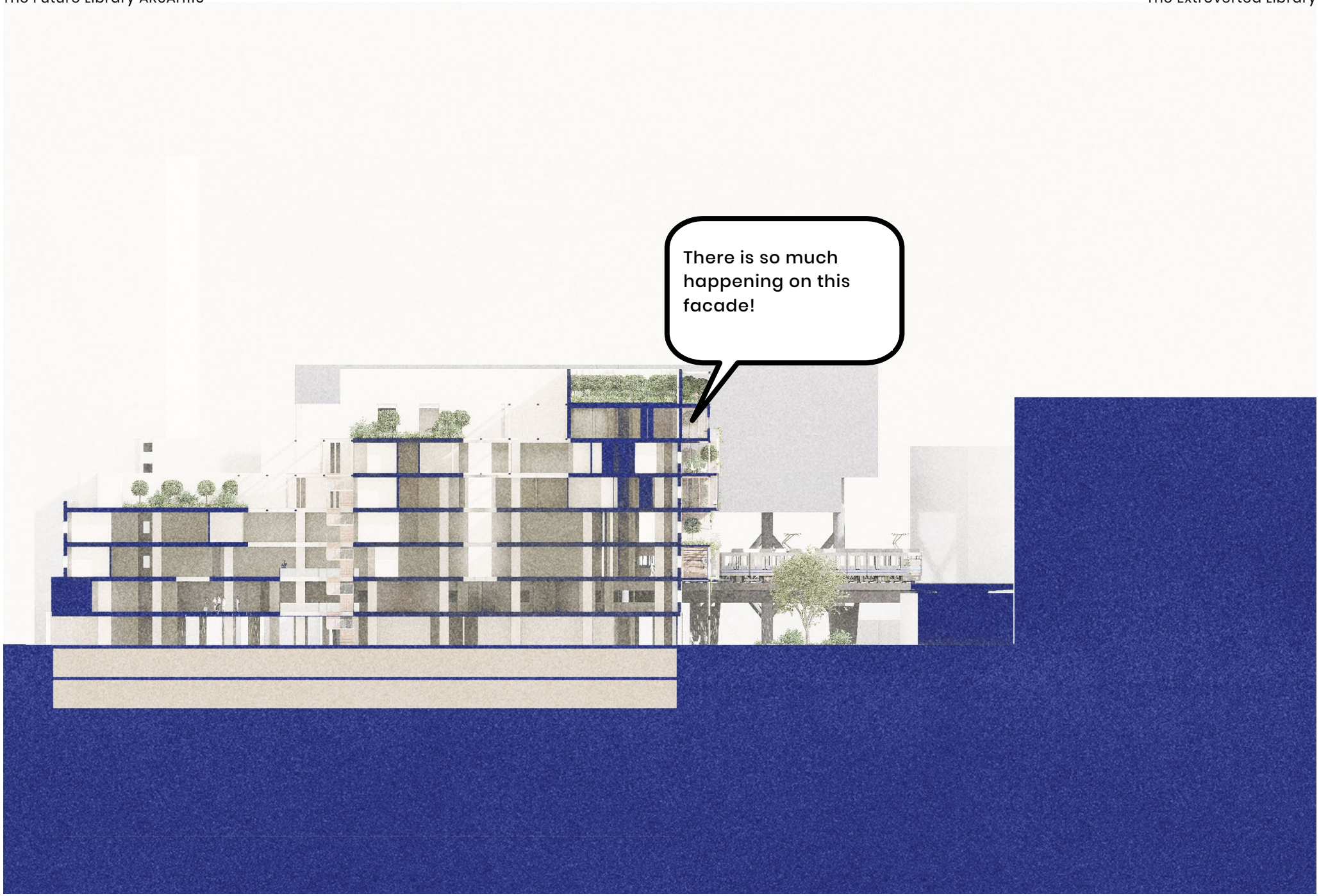
WINTER SUN

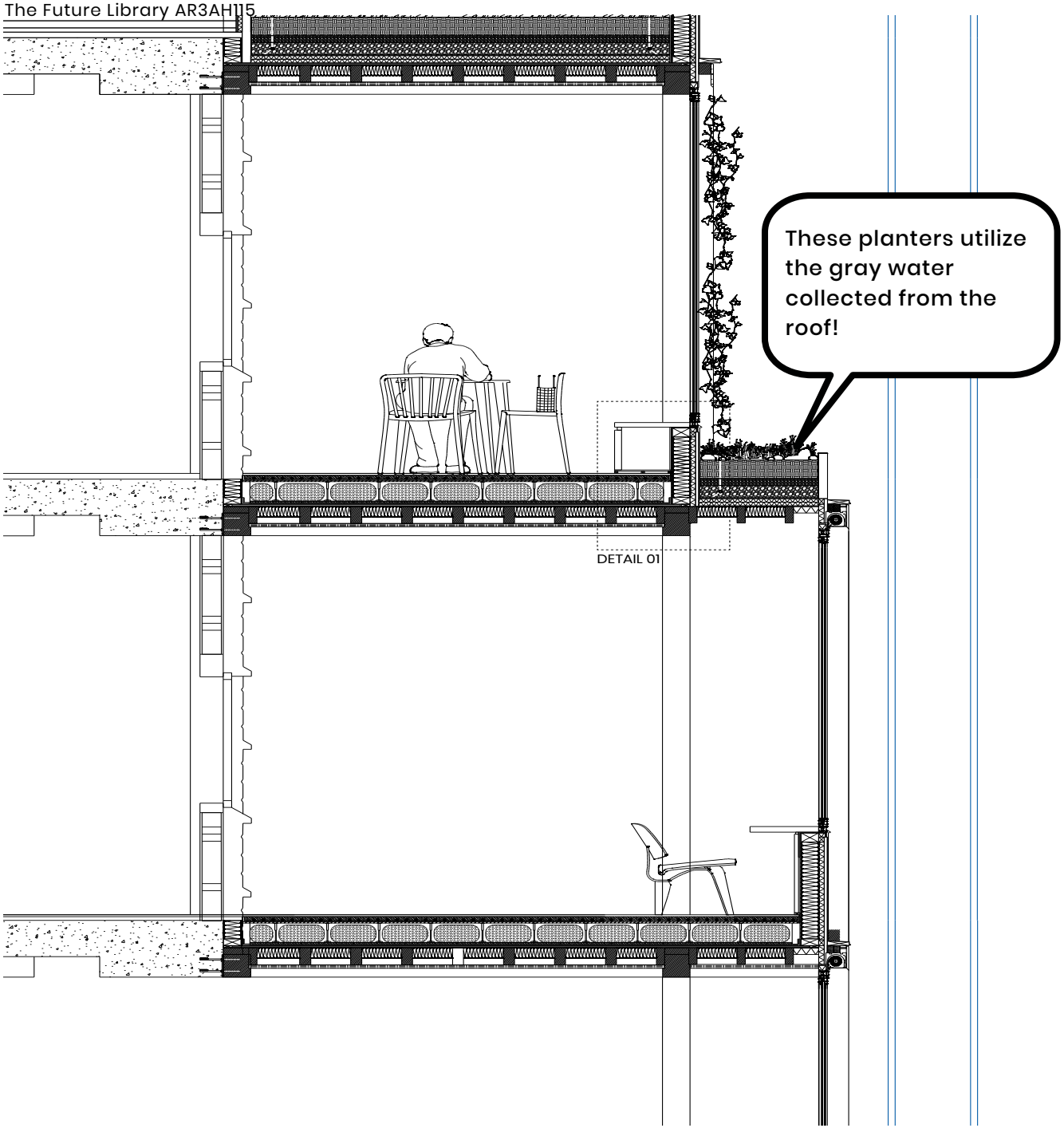
Deciduous trees allow sun to warm the building in

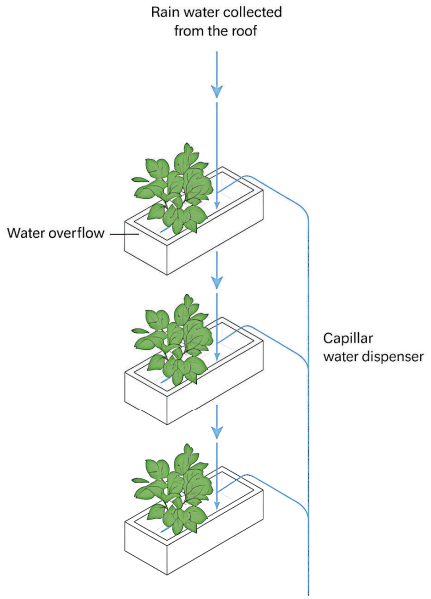


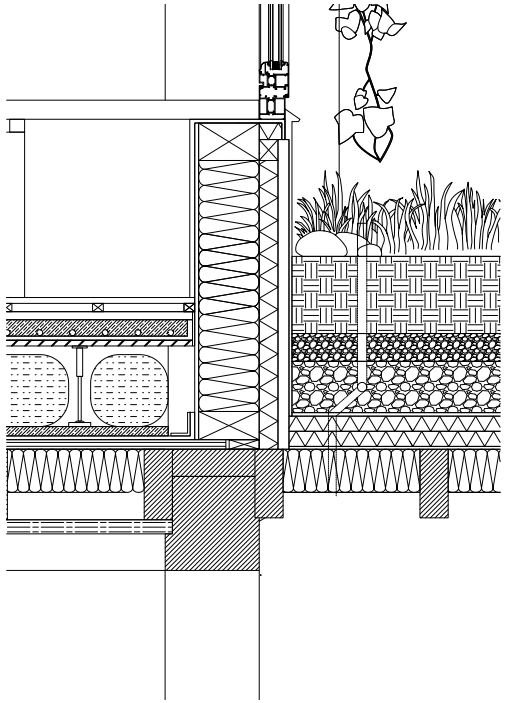


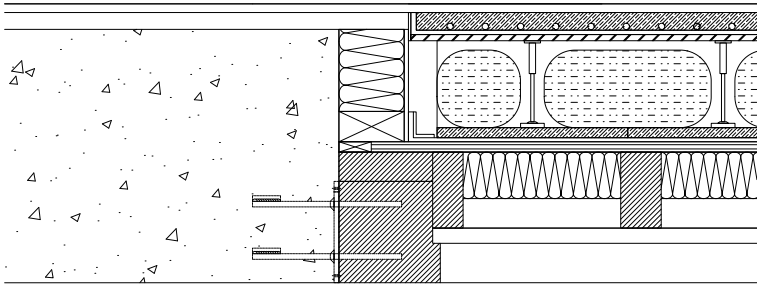
Roof area used for catchment: 200 m² (example)
Rainfall: 0.85 m/yr
Runoff coefficient (roof): 0.9
Annual collected = 0.85 × 200 × 0.9 × 1000 ≈ 153,000 L/year (153 m³/yr)
->Green façade = 200 m² and irrigation need = 3 L/m²/day during dry months:
Daily peak = 600 L/day -> Monthly = 18,000 L.
Tank sizing:
->irrigation autonomy for 2–3 weeks in summer: ~20 m³ tank.

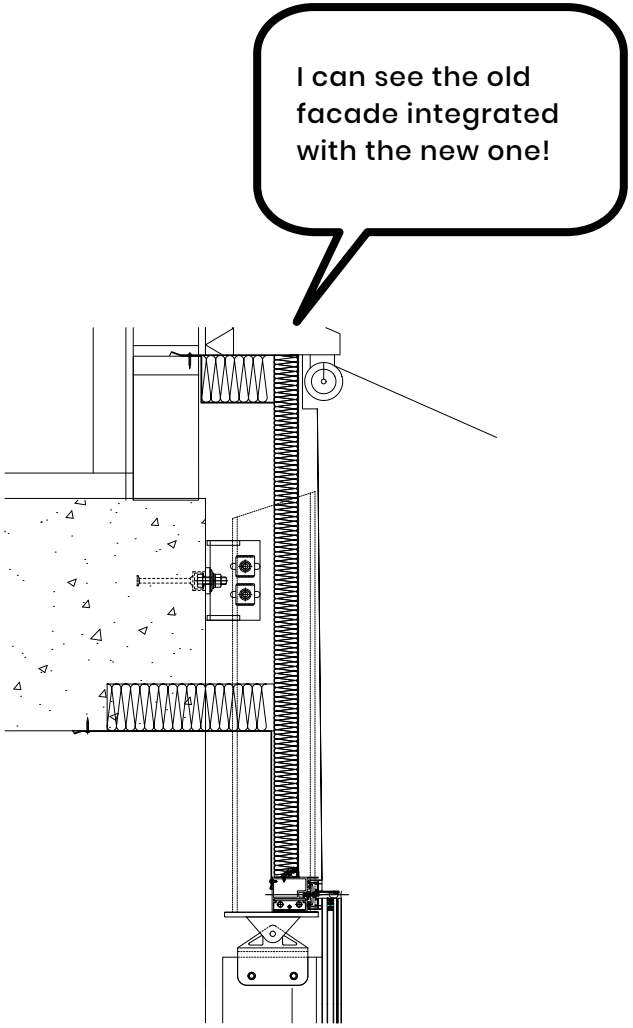

There is so much happening on this facade!


These planters utilize the gray water collected from the roof!
DETAIL 01

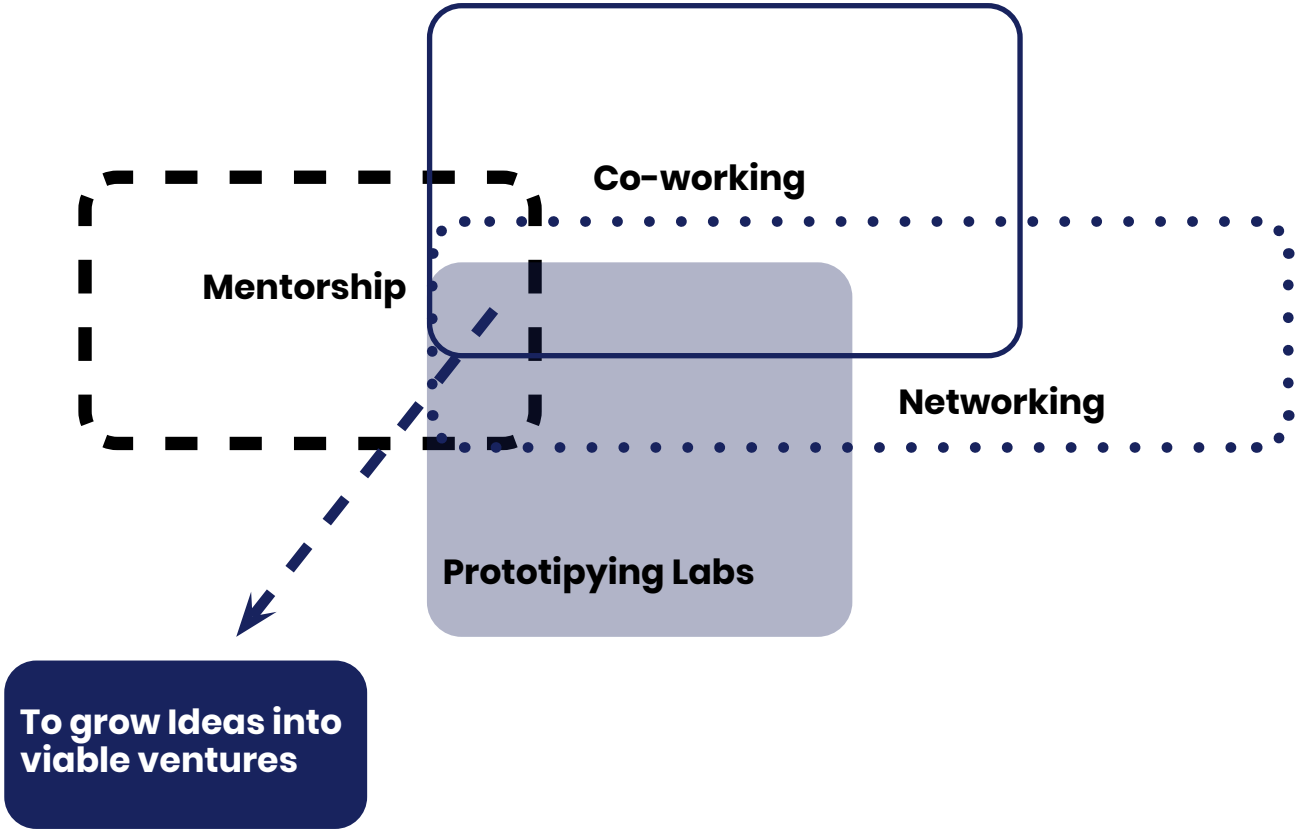

Rain water collected from the roof
Water overflow
Capillar water dispenser



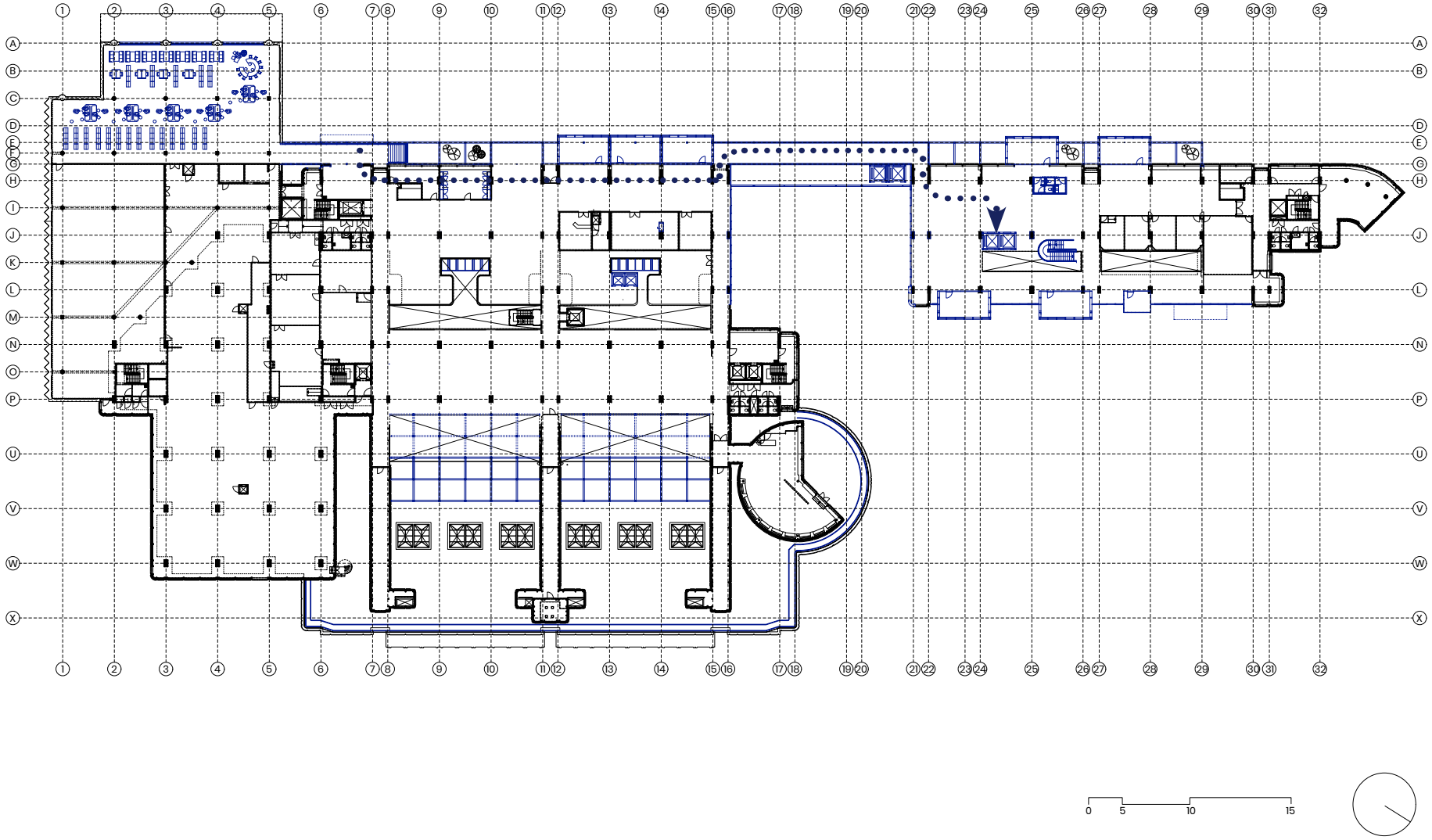



I can see the old facade integrated with the new one!


Oh! I'ts time to go to my 3D printing class at the **KB Incubator**
BEEP



THE KB INCUBATOR
What?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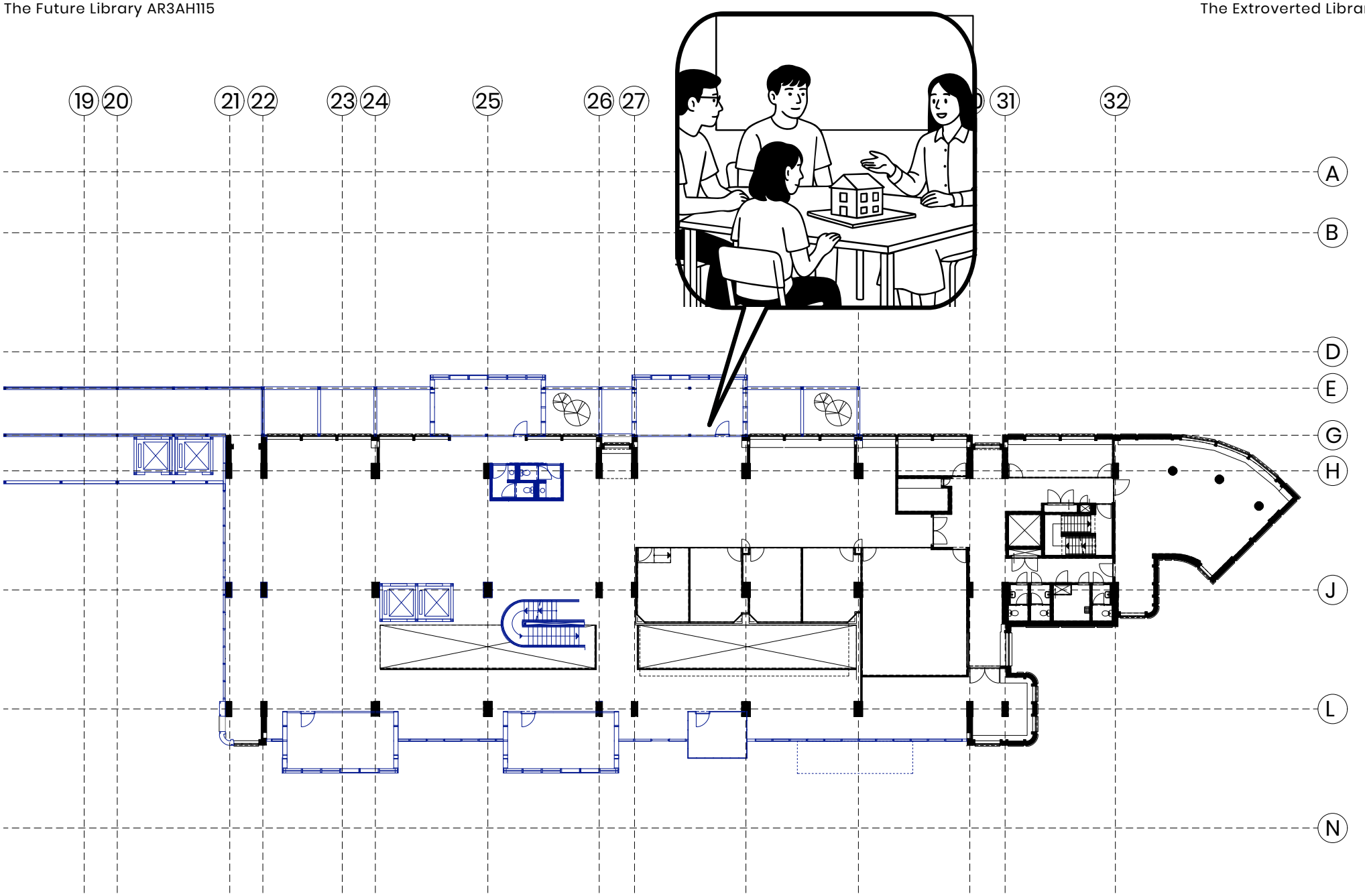
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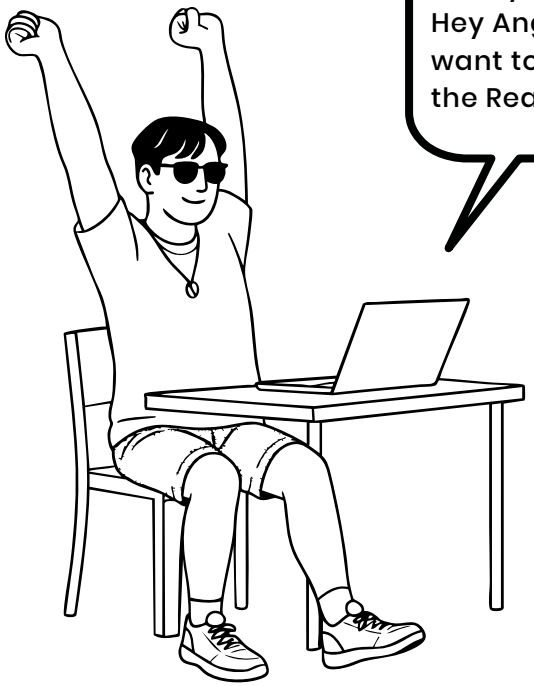
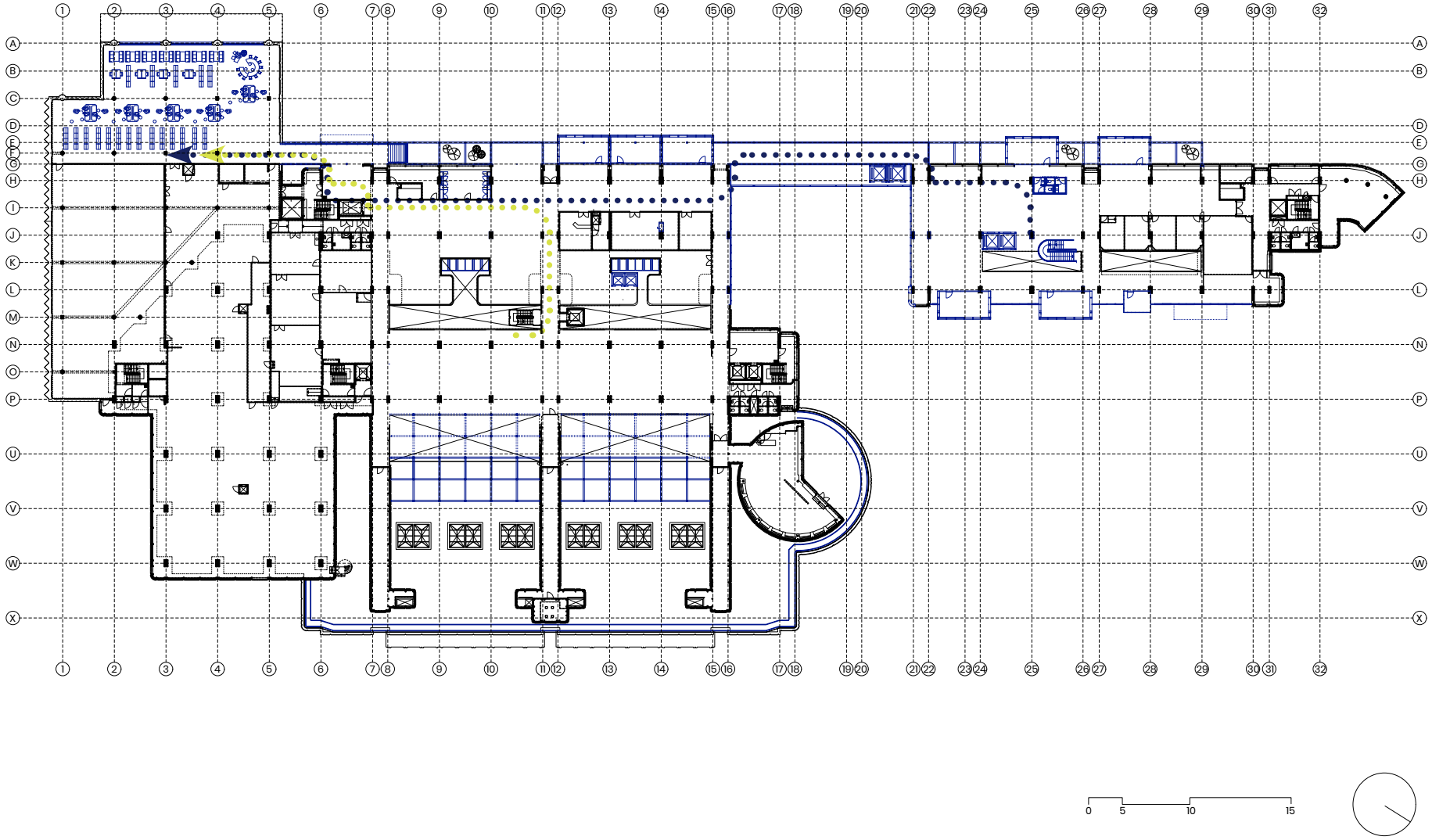
Julian (The Tech Explorer)

Finally done with work! Hey Angela! Do you want to go check out the Reading Hall?



Angela (The Creative Maker)

Yes, just done with class. See you there! I got recommended a very fun book by my AI assitant!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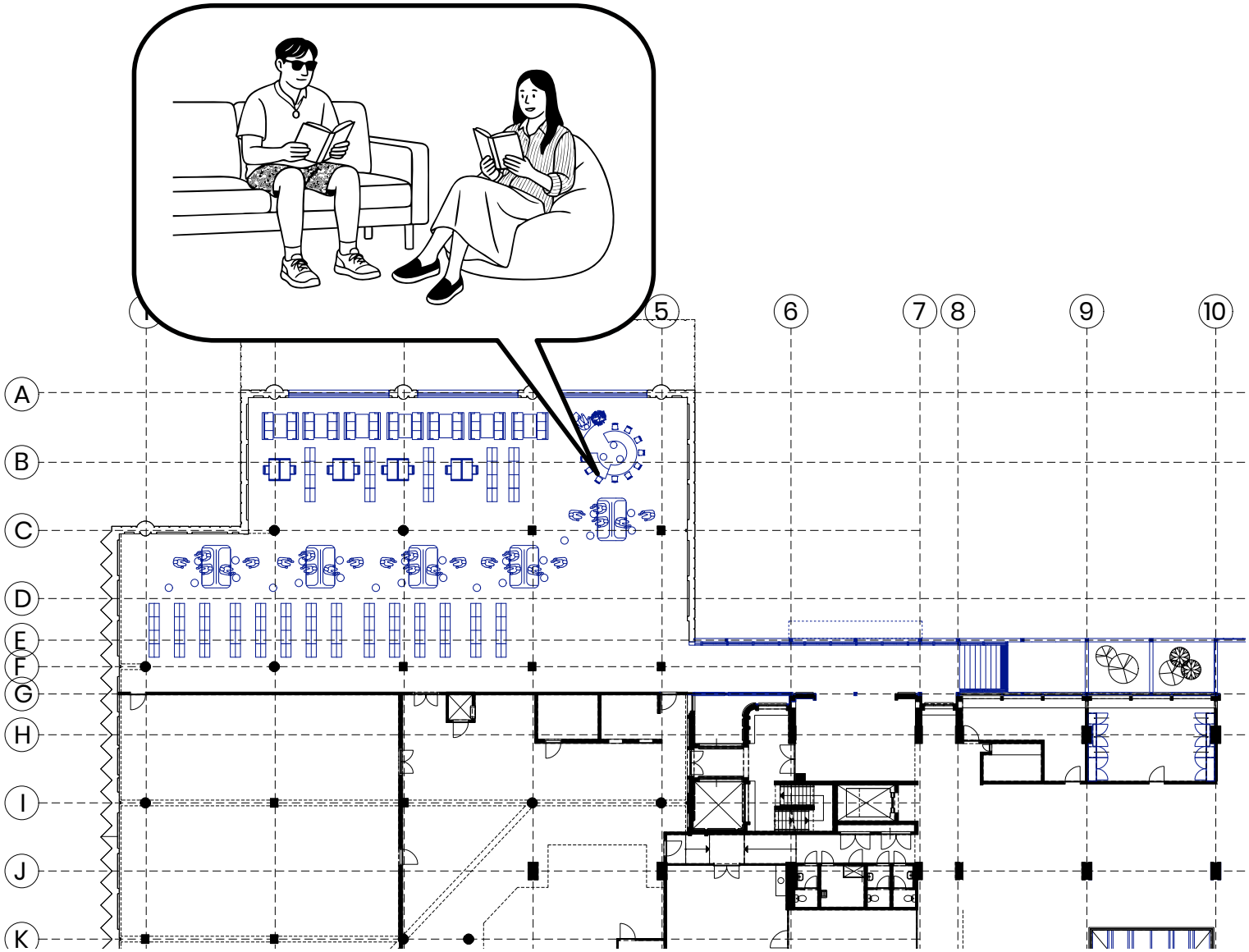
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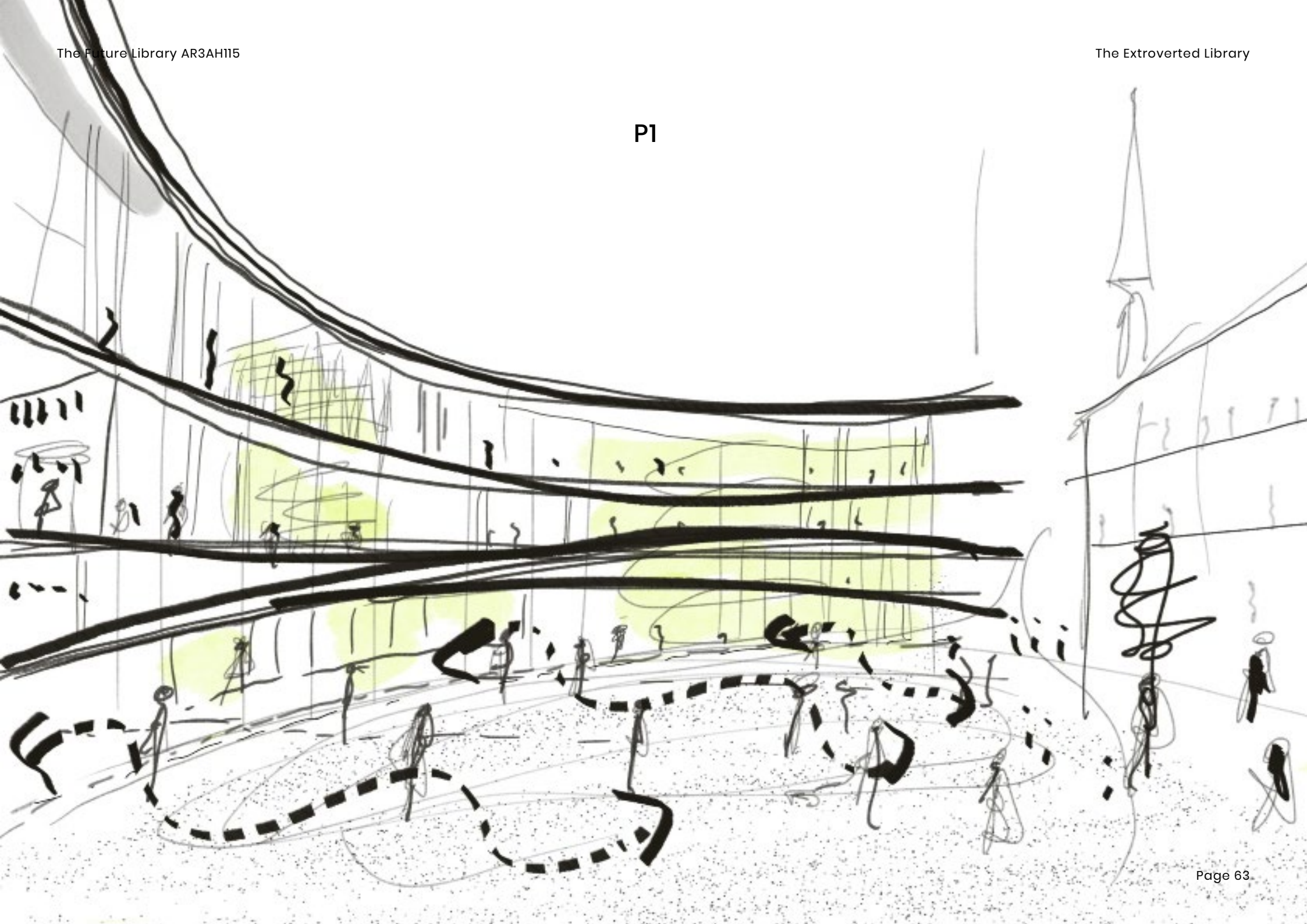
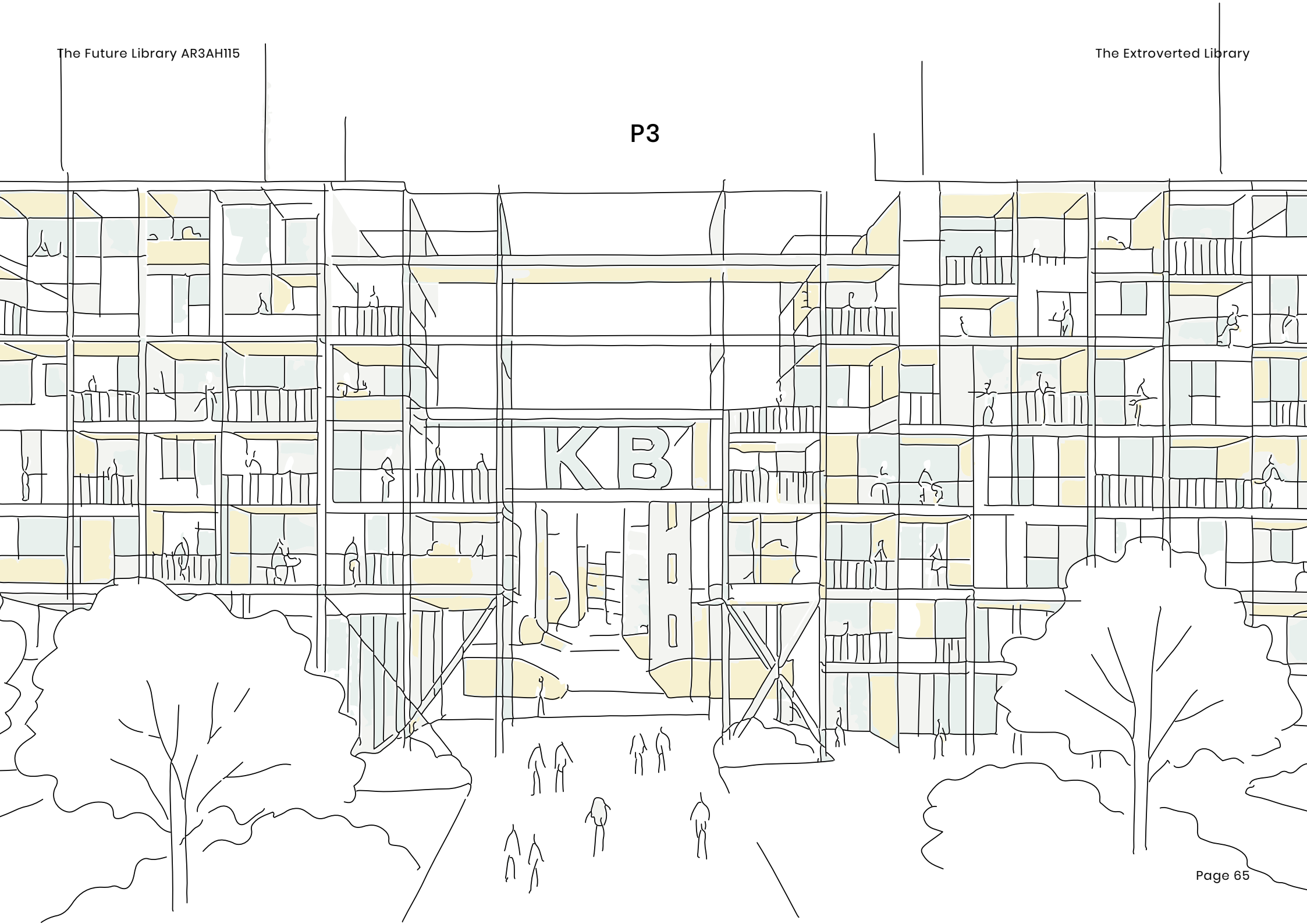
Design from P1 to P4

P1



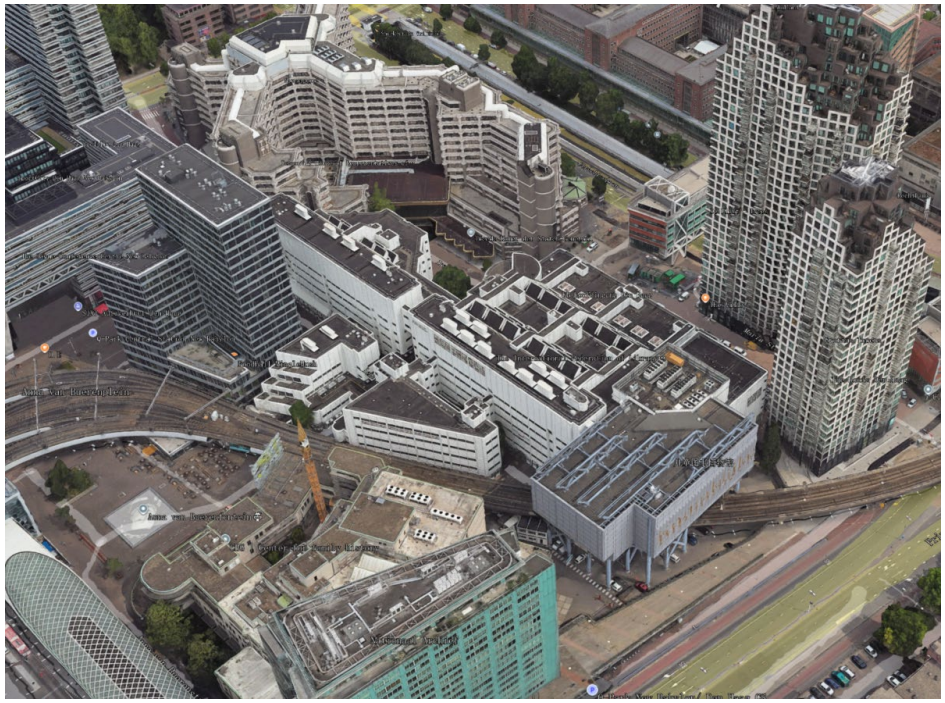
P2

P3



P4

BEFORE



The KB's core mandate — **stewardship of collections**, **legal deposit**, **research services**, and **conservation** — remains spatially protected, while **the new plaza, co-working, incubator, and extroverted façade act as connective tissue** that amplifies **access, participation, and production.** In this arrangement, heritage and innovation work together.

AFTER

The **original KB anchors authority and memory**, and the new program widens its public, updates its tools, and keeps the institution future-relevant.


READING ROOM
Thank you!
VR
AR