KB nationale bibliotheek

UNIVERSAL INCLUSIVITY

Designing for Senses

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

TU Delft

Faculty of Architecture and the Built Environment

Elisabeth Veldkamp
4648056

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REVITALISING HERITAGE
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Supervisor - Research
Dr. M. (Emeline) Lin

Supervisor - Design
Prof. Dr. Uta Pottgiesser

Supervisor - Building Technology
Ir. P.L. Tomesen

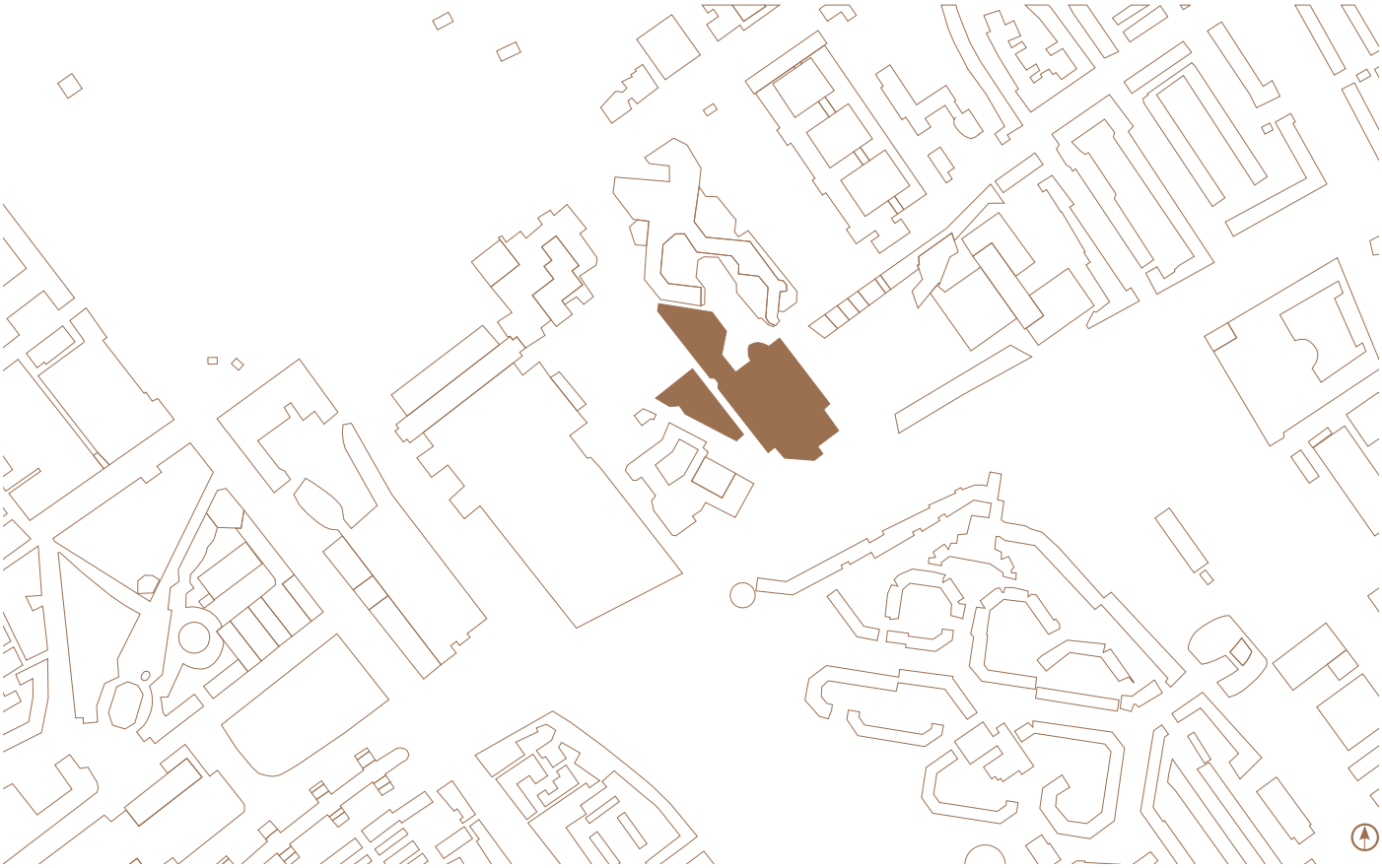


Figure 1. Context Map 1:5000 (reduced 70%). Compiled by author (Veldkamp, 2025).

Image 1. Aerial view of the KB building (Gebouw Koninklijke Bibliotheek | 10-2020).

ABSTRACT

Libraries serve as vital social, cultural, and educational centers; however, their design frequently does not meet the needs of users with sensory impairments. Although ramps and elevators enhance physical accessibility, the overall sensory experience is primarily visual, which restricts engagement for numerous individuals. Libraries must advance beyond primary accessibility to create environments that engage multiple senses, thereby providing a more enriched and inclusive experience. This study investigates the potential of multisensory accessibility to transform the spatial experience of the Koninklijke Bibliotheek (KB) in The Hague, thereby enhancing its significance as an inclusive and socially engaging cultural landmark.

The study asks: "How can libraries be redesigned as resilient environments that foster social inclusivity and user engagement by integrating multisensory accessibility in both physical and digital spaces?" It further examines the sensory and physical barriers neurodiverse and impaired users face and how multisensory design interventions can improve accessibility, wayfinding and user engagement.

A qualitative, comparative case study analysis is employed, analyzing the Openbare Bibliotheek Amsterdam (Netherlands), Helsinki Central Library Oodi (Finland), and Durham County Library (USA), alongside a literature review of existing studies on multisensory accessibility. The hypothesis asserts that the integration of multisensory design within spatial organization and circulation networks can considerably improve the inclusivity, legibility, and user experience of libraries, thereby providing a framework for accessible and inclusive civic architecture.

KEYWORDS: Sensory Engagement, Multisensory Design, Inclusive Design, Accessibility, Barriers, Neurodiversity, Visually Impaired

CONTENT

1 INTRODUCTION

Evolution of Libraries: from Book Lending to Collaborative Spaces

Historically, libraries were long seen as traditional spaces to store and preserve books and information materials (Momoh & Folorunso, 2019). Nevertheless, with the rapid development and changes in technology in the last century, the role and definition of the term 'library' has changed. With the introduction of new reading formats and electronic technologies, Adeniran (2017) as cited in Momoh and Folorunso (2019) defined the term 'library' as:

"a place where information resources are accessed and information services are rendered by professionals who specialize in identifying, collecting, organizing, processing information sources as well as interpreting information needs".

In this respect, libraries have evolved from spaces that focused primarily on book-lending and knowledge preservation to dynamic hubs for immense information retrieval (Deines-Jones, 2007), collaborative learning, meeting and studying. This transition signals profound societal changes, wherein libraries play a pivotal role in community engagement and lifelong learning. Libraries are increasingly recognized as more than repositories of books; they are catalysts for change and facilitators of growth within their communities (Momoh & Folorunso, 2019). Moreover, Deines-Jones (2007) asserts that libraries are evolving to accommodate different user groups by providing environments that facilitate interaction, collaboration, and engagement with information beyond traditional text. The continued provision of this service by libraries depends on their ongoing efforts to remove obstacles that people with impairments encounter while trying to access library materials, as well as any existing resources that may assist them in doing so (Deines-Jones, 2007). This underscores the significance of inclusivity, ensuring that all users, including those with diverse sensory needs, possess equal access to these growing environments.

Barriers in Library Design for Diverse User Groups

Libraries, despite their evolution, still encounter considerable accessibility challenges, particularly for users with visual impairments (Deines-Jones, 2007). An article by Kwafoa (2019) supports this, asserting that individuals with impairments, particularly users with visual impairments, encounter difficulties in accessing library services and information resources. According to the World Health Organization (2023), globally there are at least 2.2 billion people that have near or distance vision. In the Netherlands this amounts to 330,000 visually impaired individuals (Visio, n.d).

Given that visual impairments are among the most prevalent disabilities, creating a pressing need for alternatives to conventional print, libraries must offer information in multiple formats to ensure inclusivity for both current and future users. (Deines-Jones, 2007, p. 3).

The term ***visually impaired***, refers to a variety of conditions that restrict an individual's capacity to see. These impairments can be categorized into mild to moderate vision loss, restricted vision, and total blindness, as outlined in Table 1 (Wiethoff et al., 2008).

The experiences of individuals with visual impairments in modern cultural institutions such as libraries and museums are significantly influenced by the accessibility of the facilities and the effectiveness of the information communication strategies employed (Mesquita and Carneiro, 2016).

Table 1. Categories of Visual Impairments.

1.	Mild or moderate visual impairments	Challenges in reading, recognizing symbols, and transitioning between displays and library environment.
2.	Restricted nocturnal and coloured vision	Challenges in navigating obscurity or comprehending signs and symbols.
3.	Total visual impairment, blindness	No light perception, central visual acuity of 20/200.

Note. Categorization of Visual Impairments. Based on Wiethoff et al. (2008). Compiled by author (Veldkamp, 2025).

Upon entering a cultural institution, individuals with visual impairments encounter ongoing challenges in navigating various spaces, with wayfinding identified as the most critical factor (Mesquita and Carneiro, 2016). This highlights the need for a more inclusive approach to library interiors.

Beyond Sight Design; a Need for a Multisensory Approach

The visually impaired depend heavily on their remaining senses (such as touch, sound and smell), which enhances their appreciation and perception for non-visual spatial attributes and qualities (Bakir et al., 2022). Research shows that inclusive design strategies, which include elements like tactile surfaces, and auditory signals, significantly enhance both the accessibility and safety of environments for visually impaired users (Goldsmith, 1997; Pallasmaa, 1996). This stems from the assertion that architectural design has typically given priority to the visual sense, often at the expense of other senses (Bakir et al., 2022).

Pallasmaa (1996), in The Eyes of the Skin: Architecture and the Senses, reinforces this argument by highlighting how traditional architectural approaches have predominantly emphasized visual aesthetics, frequently overlooking the sensory and spatial requirements of individuals with diverse sensory needs (Pallasmaa, 1996). Despite advancements towards creating more accessible environments, considerable limitations remain, especially in environments that lack a holistic, multisensory approach. The integration of tactile, auditory, and olfactory elements is essential for improving spatial navigation, comfort, and orientation for users with visual impairments (Image 2). This calls for a renewed perspective on libraries — as environments that actively stimulate all senses, rather than predominantly depending on sight. As Lupton and Lipps (2018) assert, multisensory design improves user experience by appealing to our intrinsic, embodied ways of perceiving space while rendering it accessible to people with sensory impairments.

As we interact with the world through all our senses, not solely vision, spatial perception and analysis should not be limited to visual input alone (Bakir et al., 2022). Thus, designing environments that engage multiple senses can enhance the quality of life and create more immersive and meaningful experiences, leading to more lasting and vivid multisensory interactions (Gallace & Spence, 2014, as cited in Bakir et al., 2022). Moreover, multisensory design promotes learning, inclusivity, and social participation by responding to a wide range of cognitive and sensory needs (Cho, 2021). Building on this foundation, ***multisensory accessibility*** extends the concept of multisensory design, by ensuring that environments actively engage various senses —such as auditory, tactile, and visual—to be inclusive and accessible for all individuals, especially those with diverse sensory needs.
Therefore, adopting a multisensory accessibility framework is not only a strategy for enhancing user experience but also to ensure social inclusivity and equitable accessibility in public spaces.

A brief definition is listed below to better understand the terms utilized in this proposal and research question:

Social Inclusivity
Lupton and Lipps (2018) state that inclusive design should embrace all human variations, with design for difference becoming a norm rather than an exception. Building on this, *Social Inclusivity* in library design refers to creating a welcoming environment that represents and enables everyone to engage, regardless of ability, background, or sensory perception. It moves beyond physical accessibility to address users' emotional, sensory, and social experiences within the space.

User Engagement
Lupton and Lipps (2018) underscore the significance of multisensory, embodied interactions in fostering meaningful relationships with a place, proposing that user engagement must transcend sight to incorporate all types of senses. Building on this, *User Engagement* refers to the significant, active interaction between visitors and their surroundings. In the context of library design, it encompasses the interaction between users with spaces, services, and experiences that foster curiosity, learning, and engagement.

Sensory Impairments
Sensory Impairments denote restrictions in one or more senses—such as hearing (Auditory), sight (Vision), touch (Tactile), taste (Gustation), smell (Olfaction), that affect individuals' perception and interaction with their environment. This research concentrates on creating environments that support, but not limited to, visual impairments through the incorporation of multisensory design elements.

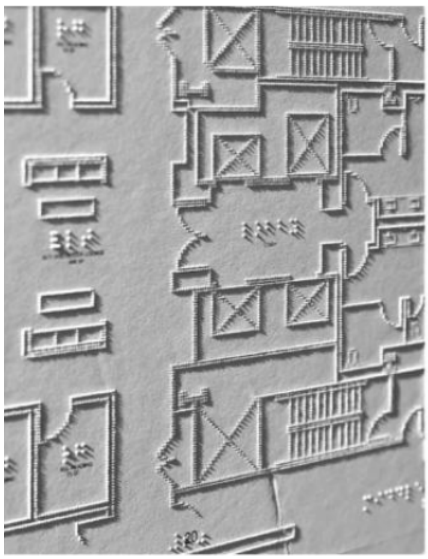


Image 2. Example of a tactile architectural detail drawing, including embossed digital print with ink, raised lines, and braille. Printed by San Francisco Lighthouse for the Blind and Visually Impaired (Photo by Don Fogg as shown in Lupton and Lipps (2018)).

2 PROBLEM STATEMENT

This research explores how multisensory accessibility can be integrated into library design to better accommodate diverse sensory needs. Although libraries have increasingly embraced user-centered design principles in recent years, the focus has predominantly remained on visual elements, often limiting the inclusivity of these environments. Multisensory design strategies— including tactile, auditory, olfactory, and spatial elements—offer valuable opportunities to engage a broader range of users, particularly individuals with sensory impairments. Despite growing interest in this field, a notable gap persists in both academic research and design practice regarding the effective implementation of multisensory experiences in library environments.

In response to this, the study contributes to the future redesign of the Koninklijke Bibliotheek (KB), the National Library of the Netherlands in The Hague, by proposing evidence-based design strategies that integrate multisensory elements to enhance both user experience and accessibility. By fostering an environment that actively engages multiple senses, the KB can evolve into a more accessible, navigable, and socially engaging public space for a wide and diverse audience, with particular attention to the needs of blind and visually impaired users. The research aims to address the existing gap in library design discourse by offering practical frameworks for incorporating multisensory accessibility, ultimately repositioning the KB as an inclusive, and culturally significant landmark within the city of the Hague.

Following this, this study will be guided by the research questions outlined in chapter 3, with an emphasis on how libraries could transform into inclusive environments that promote social inclusivity and user engagement through multisensory accessibility.

3 RESEARCH QUESTIONS

The main research question driving this study is as follows:

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

This is further supported by the following sub questions:

1. What spatial accessibility barriers do visually impaired users face in libraries?

This question aims to identify and understand the obstacles visually impaired users face when accessing libraries.

2. How can multisensory accessibility be effectively integrated into library environments to enhance social inclusivity and user engagement?

This question explores how libraries might promote inclusivity and user engagement by implementing multisensory design strategies that expand beyond the visual sense (Figure 2).

The answers to these questions will be determined by conducting a comprehensive literature review in addition to a case study analysis, as outlined in chapter 4.

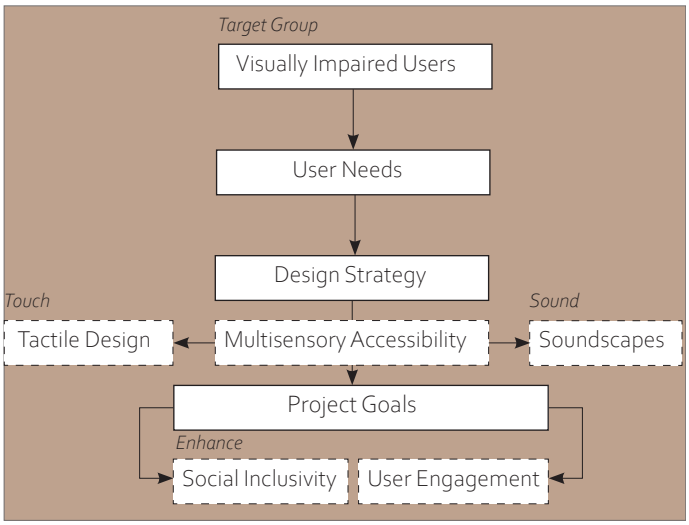


Figure 2. Conceptual diagram highlighting the relationship between the research's main principles of inclusivity, user engagement, and multisensory accessibility. Compiled by author (Veldkamp, 2025).

4 METHODOLOGY

This study will make use of a qualitative methodology, which will include both an analysis of case studies and a comprehensive review of the relevant literature.

Case Study Analysis (Qualitative)

This study will examine three public libraries that have effectively incorporated multisensory design elements into their architectural frameworks:

1. Openbare Bibliotheek (OBA) in Amsterdam, The Netherlands by Jo Coenen & Co Architekten – with emphasis on multisensory accessibility through tactile design features, soundscapes for wayfinding, sensory relief rooms, and interactive multimedia rooms.

2. Helsinki Central Library Oodi in Finland by ALA Architects – with emphasis on multisensory accessibility through sensory installations, tactile surfaces, wayfinding systems, and navigation through textures.

3. Durham County Library in North Carolina, USA by Vines Architecture – with emphasis on multisensory accessibility through multisensory environment rooms, assistive technologies, calming spaces, and flexible usage areas.

4. School for the Blind and Visually Impaired in Ahmedabad, India by SEALAB – with emphasis on inclusive design through tactile pathways, textured surfaces, acoustic zones, sensory pathways, spatial clarity and a sensory-oriented courtyard that supports intuitive wayfinding and spatial orientation for the visually impaired.

This analysis will examine how each selected library incorporates multisensory elements into its physical spaces. Data will be gathered through a combination of site visits, official library documentation, and relevant secondary literature. To ensure a consistent and focused evaluation, a structured analytical framework has been developed to guide the case study analysis (see Appendix A).

Literature Review

The literature review will establish a theoretical framework by examining existing research on multisensory accessibility within cultural institutions, including libraries and museums. Topics include multisensory environments, obstacles faced by people with impairments, and physical and digital accessibility. The primary data will consist of guidelines such as WCAG for digital accessibility, in addition to peer-reviewed journals, articles, books, and policy documents.

Table B1 summarizes the data found in each source, along with a concise overview of its principal points (see Appendix B). Based on this, a checklist matrix has been created to identify the specific keywords and research indicators found in each source, as illustrated in Table C1 (see Appendix C). This matrix will facilitate the categorization and systematic analysis of the literature, ensuring comprehensive capture and alignment with the research focus on multisensory accessibility in libraries.

Alongside the literature review and case study analysis, **observational studies** will be performed at the Koninklijke Bibliotheek and its adjacent urban environment to ascertain barriers to spatial and sensory accessibility. The on-site investigations can offer empirical insights into circulation patterns, architectural barriers, and user movement, thereby anchoring the re-design proposal in real-life spatial conditions. Additionally, a semi-structured interview with digital accessibility expert Kimberly Brinkhuis will be held at the KB for insights on inclusive design and accessibilty barriers.

Research Limitations

There are certain constraints associated with this study. The number of case studies and sites that can be analyzed in depth will be limited by the time and scope of the research. The three selected libraries offer valuable insights; however, they may not completely represent the wide range of library contexts across various regions and scales. Furthermore, restricted access to specific library design documents or internal policies may impact the thoroughness of the analysis.

Additionally, given the limitations in time and scale, it is unrealistic to include the full spectrum of impaired and neurodiverse users in this study or for the proposed library redesign. Thus, those with visual impairments will be the main representation for the user groups, as they represent the most prevalent demographic among people with impairments. This is underlined further in a table based on Ted van der Togt's illustration (Figure 3) on neurodiverse and impaired users, which depicts their various accessibility and sensory needs (Appendix D).

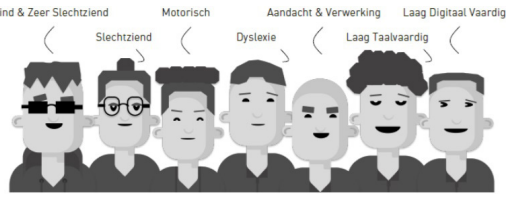


Figure 3. Neurodiverse and impaired users by expert Ted van der Togt, researcher KB.

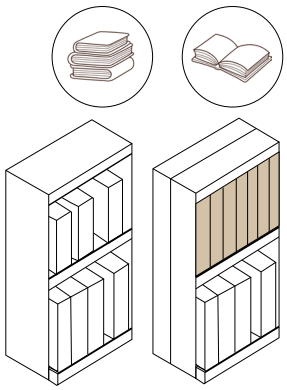
Despite these limitations, the study aims to provide a focused framework for the integration of multisensory accessibility within library settings to enhance social inclusivity and user engagement.

5 RESEARCH AND DESIGN

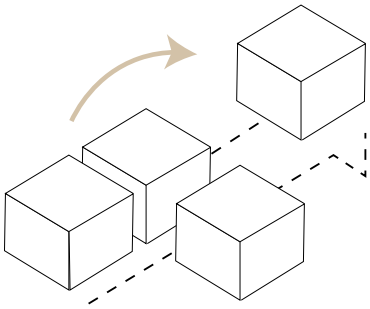
The results of this study will directly inform the spatial and thematic redesign of the Koninklijke Bibliotheek (KB), the National Library of the Netherlands in The Hague. By identifying multisensory design strategies and analyzing precedent libraries, the research will support the integration of tactile, auditory, and spatial features that improve accessibility, intuitive navigation, and overall user experience (Figure 5). The transformed KB can offer a radical change: from a closed, confusing, and visually dominating institution to an open, navigable, and multisensory cultural landmark. This shift is based on the notion that space should communicate not only through sight but also through all senses, providing significant, inclusive experiences for all users, particularly those who are visually impaired, or neurodiverse.

Ultimately, this research will guide the development of a new multisensory-focused program—complementing the existing one—by determining which collections and functions should remain and how they can be spatially reorganized to foster greater social inclusivity (Figure 4).

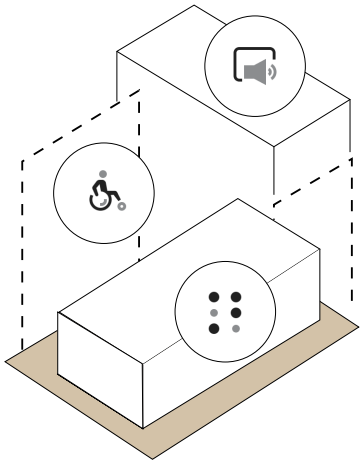
The insights gained will also inform key decisions related to layout, zoning, and circulation, ensuring a clear, comfortable, and equal environment for all visitors particularly, though not exclusively, those with sensory impairments or neurodiverse conditions. In doing so, the KB can evolve into a more adaptable, future-proof library—one that not only preserves its national significance but also sets a precedent for inclusive, user-centered design across public spaces. An environment where inclusivity is no longer a concept, but a lived experience (Figure 6).



1. Identify Collections
Strategic selection and curation of the library's physical and digital collection in the new program



2. Spatial (Re)organization
Altering the spatial layout to facilitate enhanced circulation and accessibility as well as multisensory design elements



3. Multisensory Accessibility Zones
How sensory elements will be included into the library user experience to improve inclusivity and engagement

Figure 4. Research and Design goals. Compiled by author (Veldkamp, 2025).

5 RESEARCH AND DESIGN

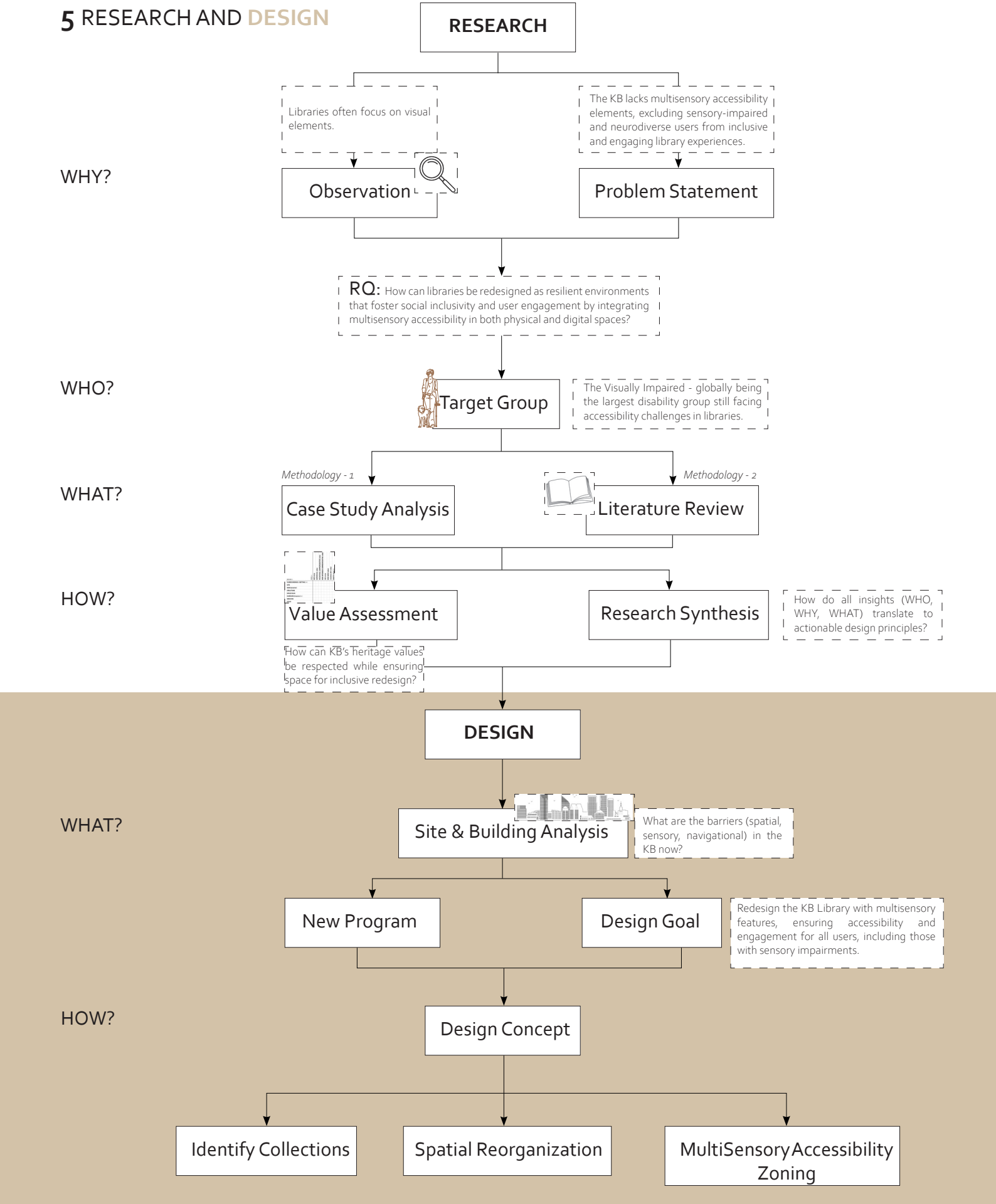


Figure 5. Research-Design diagram. Compiled by author (Veldkamp, 2025).

5 DESIGN VISION

An inviting entrance where visual, tactile, and olfactory sensations intersect. Illuminated tactile lettering, aromatic plant beds, and textured pathways foster an inclusive, multisensory experience that directs each visitor to the core of the KB Library. What was once a closed-off and uninviting facade can transform into a light, transparent, and welcoming threshold — a sensory gateway to knowledge, belonging, and shared community space.

Figure 6. A vision for an inclusive and multisensory entrance at the KB Library. This proposal integrates transparent design, tactile wayfinding, illuminated landmarks, and sensory plant indicators to foster an accessible, engaging, and inviting experience for all visitors. Edited by author (Veldkamp, 2025).

Chapter 1

ACCESSIBILITY BARRIERS

1 ACCESSIBILITY BARRIERS

Prior to formulating a significant and contextually grounded design concept for the Koninklijke Bibliotheek (KB) in The Hague, it is essential to understand the barriers that exist in library environments. This chapter discusses the spatial and sensory accessibility obstacles faced by individuals with visual impairments in libraries. It directly responds to the sub-question: **What spatial accessibility barriers do visually impaired users face in libraries?**

The research and analysis is structured according to the WHAT-HOW-WHY framework, as seen in figure 7, guiding the overarching design process. Initial findings from the literature, case studies and observational studies conducted at the Koninklijke Bibliotheek form the basis of a spatial redesign strategy in this chapter.

WHAT: Determines the primary spatial and sensory obstacles that impede independent navigation, spatial orientation, and user engagement.

HOW: Converts these findings into a multisensory design strategy.

WHY: Illustrates the importance of confronting these obstacles in order to cultivate accessible and inclusive library environments.

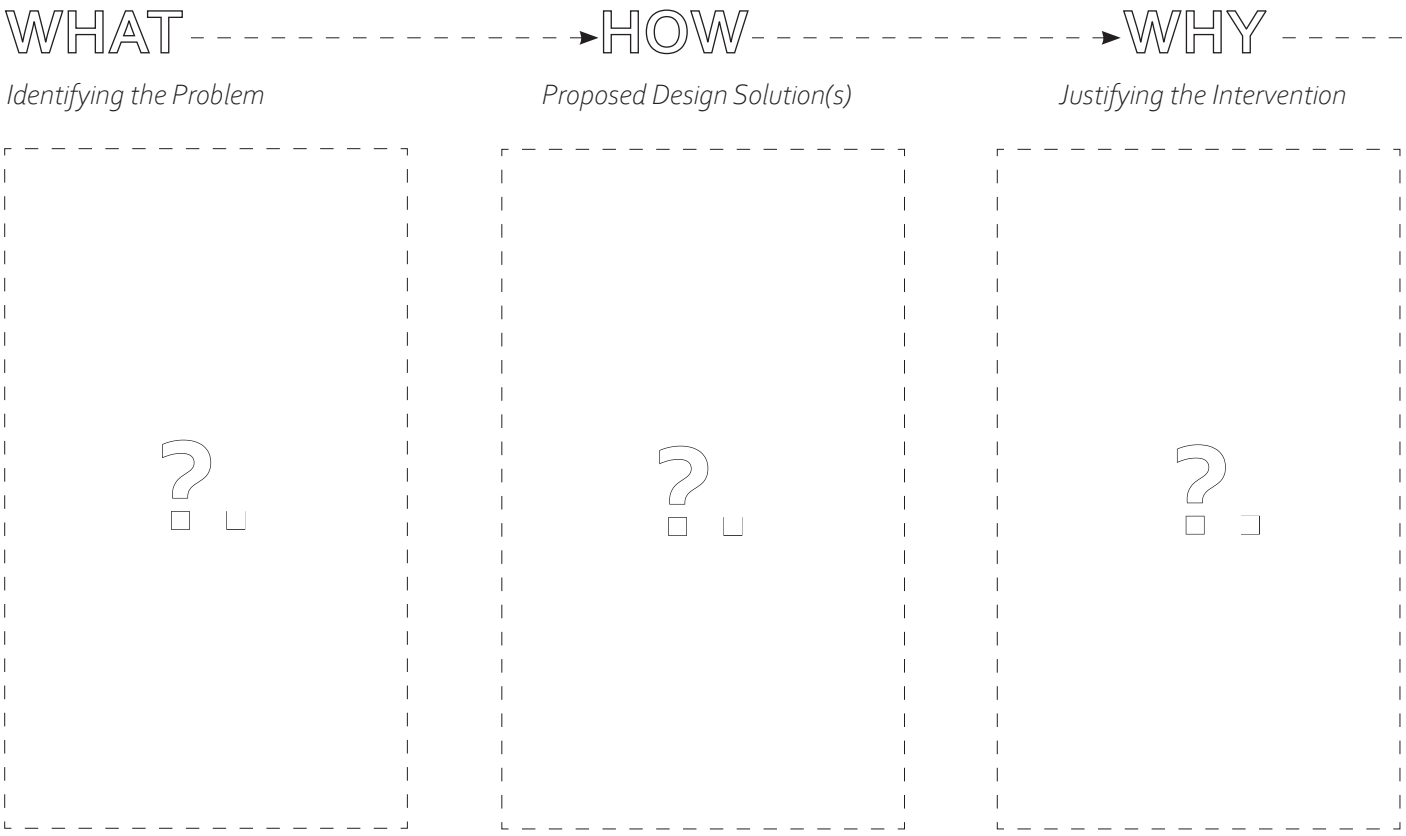


Figure 7. WHAT-HOW-WHY framework. Compiled by author (Veldkamp, 2025).

1.1 ACCESSIBILITY BARRIERS

In the realm of inclusive library design, accessibility barriers and user needs are intricately connected yet conceptually different. Barriers denote the physical, sensory, cognitive, or social constraints that restrict or obstruct equal access to library facilities for those with visual impairments. Conversely, user needs articulate the functional and experiential demands that emerge from these barriers. These needs represent what users necessitate to navigate, interact with, and feel sense of belonging within a space (Lupton & Lipps, 2018) . This chapter specifically addresses those with visual impairments (=users). Though may exist independently of barriers, they are frequently uncovered in design practice through the recognition of barriers. This chapter will first address accessibility barriers as the initial focus, subsequently translating them into relevant user needs (see subchapter 6.1), which can inform inclusive and multisensory design approaches. This framework facilitates a coherent problem-to-solution rationale in comprehending how libraries might enhance service for visually impaired individuals.

Prior to examining the barriers encountered by visually impaired individuals in library settings, it is essential to acknowledge their valuable input in thinking about design more inclusively. As opposed to perceiving impairments exclusively as barriers, their lived experiences underscore the extent of non-visual awareness, accentuating sound, touch, spatial rhythm, and general atmosphere. For individuals with visual impairments it is essential that architects transcend visual elements to create experiences and spaces that are both accessible and inviting through multiple senses. In this way, their very presence serves not as a limitation, but as an incentive for more human centered, multisensory, and socially inclusive spatial design.

Visual Legibility

Lupton and Lipps (2018) assert that the majority of design is visually predominant and "non-sense," crafted to prioritize function over experience.

"We look at design, we don't feel, experience or sense it"
- Lupton & Lipps (2018)

This presents a significant accessibility barrier: library settings frequently lack design considerations for tactile engagement, auditory experience, and navigational accessibility. This explicitly underlines the necessity for alternative navigation methods. Responding to these barriers, Moss (1981) offers practical examples that translate user needs to more inclusive design interventions. He argues that braille descriptions along handrails can assist individuals with visual impairments in locating a library room, emphasizing the need for tactility in spatial orientation and wayfinding (Image 3).

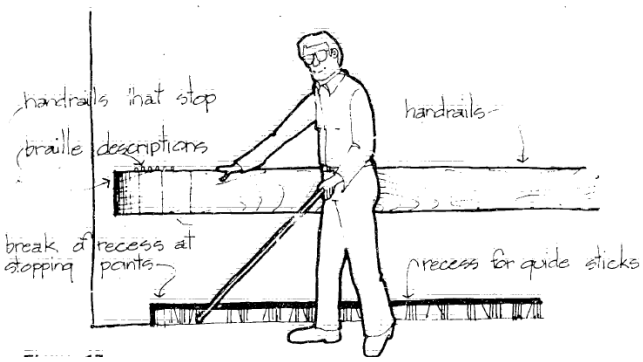


Image 3. Tactile cues for enhancing accessibility and orientation in library design (Moss, 1981, p.35).

Surfaces of Orientation - Warm Materiality

Moreover, the use of automatic sliding doors is favored for accessible entry to the premises. In addition, floor coverings like concrete or wood can serve as subtle tactile cues to assist visually impaired library users in recognizing distinct room boundaries or functional zones (Image 4) These interventions serve as an illustration of how sensory design components directly address accessibility barriers, thereby establishing the groundwork for a more socially inclusive, barrier-free library environment (Moss, 1981, p. 35).

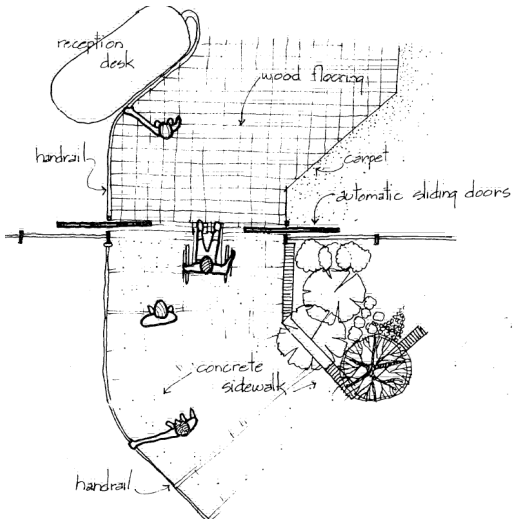


Image 4. Material contrasts highlighting distinct functional zones and spatial transitions, next to sliding doors and handrails leading to reception desks, aiding non-visual navigation (Moss, 1981, p.35).

Surfaces of Movement

A commonly underestimated for visually impaired individuals and those with physical impairments is the dependence on stairs as the primary means of vertical circulation. Libraries frequently exhibit various elevation changes in their spatial configuration, resulting in discontinuity and substantial navigational difficulties for those with visual impairments. This highlights the necessity for more inclusive circulation tactics that facilitate intuitive navigation and spatial orientation. Lupton and Lipps (2018) propose the incorporation of moderately inclined ramps equipped with dual-height railings as a substitute for conventional staircases.

This design improves accessibility for visually impaired individuals and also serves a wider array of users, including wheelchair users, those with children and strollers, and groups moving through the space collectively. In contrast to elevators, which segregate visitors with varying mobility needs, a central ramp promotes collective circulation and a more cohesive, equal library experience for all, including those with visual impairments (Lupton & Lipps, 2018). Image 5 illustrates the notion of a dual-height railing, where the lower section supports individuals in wheelchairs or children, while the upper section benefits individuals with visual impairments, among others.

Image 5. Dual-height railing for children, wheelchair users, and those with (visual) impairments (Lupton & Lipps, 2018, p.12).

Surfaces of Orientation - Tactility

Another accessibility barrier arises not only from the presence of stairs in libraries but also from the materials utilized in their design. The tactile and acoustic characteristics of stair surfaces and handrails play a crucial role in ensuring safe and intuitive spatial navigation and orientation for those who are visually impaired. Lupton and Lipps (2018, pp. 13–16) assert that a visually impaired individual using a handrail might not anticipate a bracket, especially if the staircase is completely carpeted, as it can become indistinguishable when using a mobility cane.

This emphasizes an essential user need: staircases should stimulate various senses, especially touch and sound, to guarantee they are noticeable and easy to navigate (Lupton & Lipps, 2018). An intriguing instance is presented by architect Chris Downey, who, after becoming blind, contributed to the design of the staircase in the LightHouse for the Blind and Visually Impaired in San Francisco, California. The design incorporates a textured wooden front edge, ensuring that each step is easily detectable by a mobility cane, while avoiding the harsh sounds associated with metal materials (Image 6). The hallways that lead to the staircase feature concrete flooring, which amplifies the sound of footsteps and mobility canes. The stairs are made of wood, featuring stainless steel treads at both the top and bottom, providing a tactile and visual contrast for individuals with visual impairments. This design illustrates how the selection of materials effectively tackles accessibility barriers by fostering a multisensory and inclusive user experience (Lupton & Lipps, 2018).

Image 6. Staircase design for the Lighthouse for the Blind and Visually Impaired by Chris Downey and Mark Cavagnero (Image retrieved from Mark Cavagnero Associates Architects).

Surfaces of Rest

Interior furnishings can pose considerable accessibility barriers, especially when sharp corners are visible or when objects are arranged disorderly. Moss (1981, p. 39) argues that furniture with sharp edges presents risks not only to visually impaired individuals but additionally to those with physical impairments. Moreover, disordered or crowded furniture arrangement can impede circulation pathways, obstructing safe and intuitive navigation of the space. To create a more accessible environment, it is crucial that furnishings are chosen and positioned with spatial clarity and circulation in consideration, allowing all users, irrespective of ability, to navigate the library easily and confidently (Image 7).

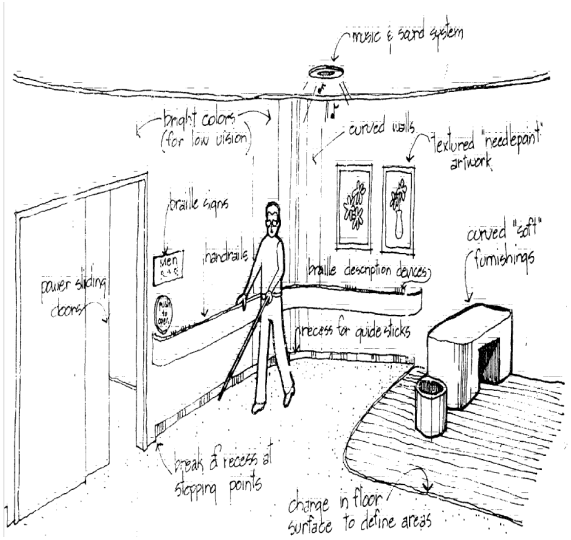


Image 7. Summary accessibility needs for those with visual impairments (Moss, 1981, p. 38).

1.2 CASE STUDY: SCHOOL OF THE BLIND

Addressing Sensory and Spatial Barriers through Inclusive Design: A Case Study of the School for the Blind and Visually Impaired Children in India

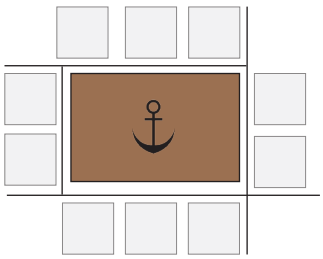
This section analyzes the spatial and sensory obstacles encountered by visually impaired individuals, focusing on the School for Blind and Visually Impaired Children in Ahmedabad, India, constructed by SEALAB (Abdel, 2025). The school, though not a library, offers a spatial typology specifically designed for blind and low-vision individuals, providing significant insights into how architecture might facilitate spatial orientation, wayfinding, and sensory engagement.

The school's design directly addresses the lack of visual clues by meticulously manipulating tactile surfaces, implementing auditory zoning, maintaining constant spatial logic, and creating environmental contrasts (Image 8 and 9). These techniques not only alleviate prevalent obstacles encountered by visually impaired users but also exemplify design methodologies that might guide the development of more inclusive public institutions, such as libraries.

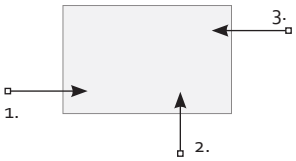
The incorporation of this example in this section aims to better understand accessibility barriers within a setting where these barriers have been effectively addressed, establishing a framework for recognizing deficiencies commonly found in traditional library settings.

The spatial organization of the School for the Blind in India intentionally addresses the sensory and navigational needs of visually impaired individuals. These strategies can be categorized into main spatial planning, as seen in figure 8, and specialized sensory navigation principles.

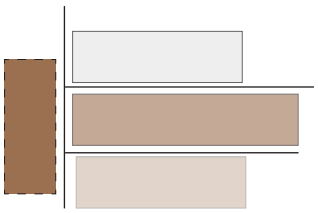
Textured paths and textured (both vertical and horizontal) surfaces are incorporated throughout the building, facilitating user orientation and independent navigation via haptic guidance. Moreover, material contrasts - such as transitions between smooth and rough surfaces - serve to signify important spatial thresholds, like entrances to classrooms, common areas, and recreational zones. The thorough circulation approach prioritizes continuous pathways with minimal directional alterations, hence diminishing spatial complexity and cognitive stress which facilitates intuitive and fluid circulation throughout the building (Abdel, 2025). This **continuous uninterrupted sensory pathway** (Figure 9) enhances wayfinding and spatial orientation, an approach that can be implemented at the Koninklijke Bibliotheek in the Hague.



1. Central Courtyard
Serves as sensory anchor: an orientation point, facilitating circulation.



2. Three Distinct Entrances
For different users (children, visitors and staff): addresses spatial flow and reduces sensory confusion.



3. Zoning
Clear distinction between public, semi-public and private spaces.

Figure 8. Main Spatial Strategies in the School of the Blind, India. Compiled by author (Veldkamp, 2025).

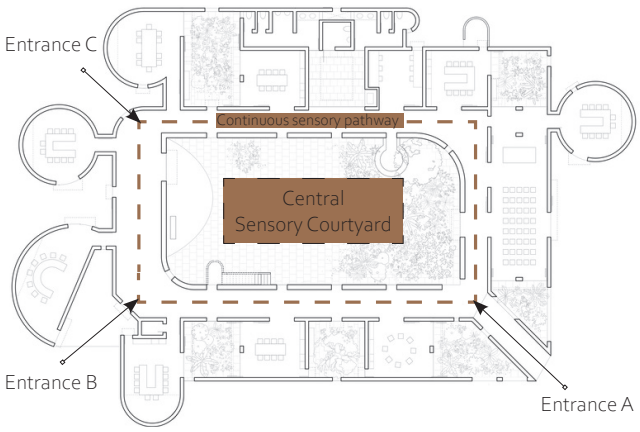


Figure 9. Continuous sensory pathway with distinct entrances in the School of the Blind, India. Edited by author (Veldkamp, 2025).

The school utilizes various secondary sensory strategies alongside spatial layout and circulation to enhance intuitive navigation and spatial awareness. Tactile and textural cues are fundamental, employing various materials (such as brick, wood, and stone) to indicate distinct spatial functions. Walls adjacent to pathways feature textured surfaces that offer continuous haptic feedback, facilitating movement and enhancing spatial orientation (Image 11). Vertical textured wall bands enhance spatial perception by signaling height and aiding users in distinguishing and identifying various zones (Abdel, 2025).

Auditory cues are incorporated into the architectural design, utilizing sound markers like running water in courtyards and wind chimes positioned near thresholds to indicate significant points in the spatial sequence. Natural ventilation and sound-reflective materials enhance spatial legibility by influencing ambient sound. These strategies collectively create a meticulously designed sensory environment, where the internal courtyard functions as both an orientation poiny and a space for sensory relief, incorporating vegetation, varied textures, and natural sounds (Abdel, 2025). An accessible outdoor environment enhances engagement through touch, sound, and smell, thereby reinforcing the building's multisensory accessibility at all levels. These strategies may provide applicable insights for improving sensory orientation and user experience at the Koninklijke Bibliotheek (Figure 10).

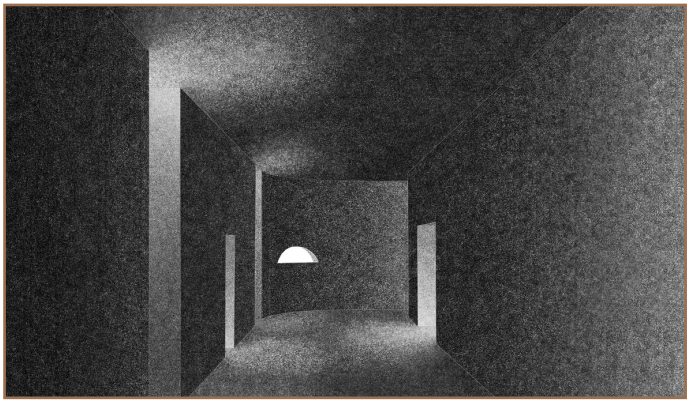


Image 8. A visual of what people with contrast sensitivity impairments see. (Gallery of School for Blind and Visually Impaired Children / SEALAB - 14, n.d.).

Image 9. A visual of what people with no contrast sensitivity impairments see. (Gallery of School for Blind and Visually Impaired Children / SEALAB - 14, n.d.).

Image 10. Tactile model of the School of the Blind and Visually Impaired Children in India. (Image by Dhrupad Shukla, n.d.)

Image 11. Textured wall surfaces, guiding movement throughout the building. (Gallery of School for Blind and Visually Impaired Children / SEALAB - 14, n.d.).

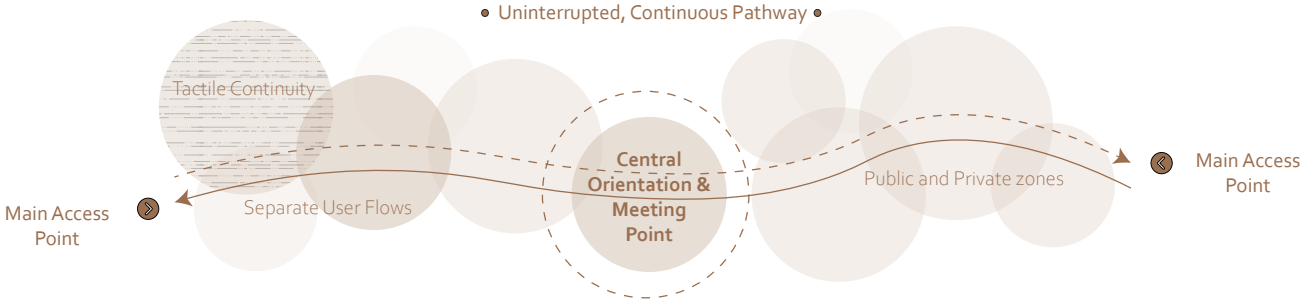


Figure 10. Diagram illustrating main concept of the School of the Blind and Visually Impaired. Compiled by author (Veldkamp, 2025).

1.3 EXPERT INSIGHTS ON ACCESSIBILITY BARRIERS AND INCLUSIVE DESIGN

To further contextualise the accessibility barriers identified in this research, a short expert interview was conducted with Kimberly Brinkhuis, researcher in digital accessibility at the Koninklijke Bibliotheek. The interview took place at the KB on 7 November 2025, in collaboration with fellow peer Sander Groen, and focused on the barriers impaired users face within public institutions, including the KB, along with feedback on the proposed design interventions (Appendix N).

An important finding from the interview with Kimberly Brinkhuis (researcher in digital accessibility at the KB) highlights the critical function of tactile guidance in large public instiutions and wide circulation areas. In these environments, visually impaired individuals cannot depend solely on ambient cues; the absence of continuous tactile reference points severely undermines spatial orientation. Brinkhuis emphasized the necessity of tactile route guidance and warning markers, which include guided planks along extended corridors, tactile floor markers, and material transitions that signify entry into distinct spatial zones. Tactile cues must be supplemented by accessible, multi-height interfaces, including tactile buttons and braille on lift controls, tactile markings on handrails, and raised pictograms positioned at various heights to guarantee accessibility for children, wheelchair users, and individuals using white canes. This is consistent with the findings of Jordans et al. (2012), who emphasize the significance of strong sensory anchors and distinct tactile differentiation in barrier-free environments (p. 352).

Tactility: Surfaces of Orientation

Brinkhuis further emphasized the importance of architectural anchor points: spatially consistent node, such as entrances, exits, the top and bottom of staircases, or a multi-height reception desk, where users can safely pause, gather information, and make navigation decisions. Ensuring a barrier-free route is essential; sharp edges or random objects in the primary circulation route compromise safe movement. Partial mitigation of this risk can be achieved by positioning functions like cloakrooms or storage areas in proximity to the entrance, thus ensuring the primary movement pathway remains unobstructed.

Additionally, the surfaces of orientation must start prior to prior to the building threshold and must consequently direct users seamlessly from the broader urban context, train, tram, and parking areas, toward a distinctly recognizable entrance. This necessitates a continuous tactile guiding line to the main entrance door, clear differentiation between glass walls and actual door openings, and entrance systems designed to minimize ambiguity, such as sliding doors that provide a subtle audible cue and eliminate thresholds. She observed that visually impaired and neurodiverse individuals depend significantly on predictable ground conditions, indicating that consistent underfoot contrast (carpet–stone–wood) and the avoidance of level changes are crucial for safe navigation. Lighting is essential; warm yellow-orange tones enhance sensory comfort, while cold white or glossy reflective surfaces create glare and visual noise that hinder orientation. Clarity is essential: clear naming, explicit notifications regarding out-of-order lifts or floors, and consistent rules (e.g., assistance dogs permitted) collectively enhance a logical, barrier-free pathway that facilitates independent navigation for various user groups.

Visual Legibility

Brinkhuis highlighted that in library settings, where silence is essential, audio-based navigation is inappropriate, as persistent or repetitive sounds lead to distraction and sensory disturbance. She emphasized that orientation should primarily depend on tactile and visual legibility, underpinned by clear contrast logic and predictable material cues. Tactile elements, including detectable lines on stair treads and hand-height pictograms, facilitate intuitive navigation. Additionally, colour selections should adhere to accessibility principles; high-alert colours like yellow are effective, while red is inappropriate due to its comparable luminance value to black. Excessive black-and-white contrasts should be substituted with soft cream tones, and lighting conditions should be modifiable to avoid glare. Brinkhuis emphasized the significance of color-contrast combinations that ensure legibility for color-blind users, such as magenta, cyan, or lime on black; dark green, red, purple, or blue on white; and yellow on black. Functional lighting, exemplified by targeted illumination at the reception desk, along with commonplace items such as black saucers paired with contrasting cups, enhances perceptibility. These measures collectively promote a universally inclusive environment, facilitating safe and independent navigation for users across various ages, abilities, and sensory profiles.

"UNCLEAR ENTRANCES!"

Absence of a Clear Entrance: highlighting a major barrier

Brinkhuis identified entrance recognition as a critical accessibility barrier in public institutions. The larger the building, the more challenging it is to achieve initial orientation, a problem evident in the KB's disjointed arrival sequence from Central Station. The absence of legibility is exacerbated by inconsistent contrast, ambiguous circulation cues, and information positioned at heights that are not accessible to all users.

Utilizing tactile pictograms positioned at eye and hand height, along with distinct spatial cues to facilitate users' navigation from point A to point B, can aid in designing more inclusively.

Continuous Circulation Routes

Brinkhuis emphasized the necessity for a clear and continuous circulation route, asserting that users should navigate intuitively "from A to B and from C to D," aided by textured surfaces and relief materials that enhance tactile wayfinding. Multi-height railings as mentioned before, tactile walls, and uniform material transitions serve as orientation anchors, allowing users to identify zones without depending on visual cues. She emphasized the necessity of indirect, glare-free lighting, utilizing roof elements or sun-catchers, and the capability to dim lights during quiet hours to minimize sensory overload. Effective management of crowd flows, prevention of intersecting traffic at reception areas, and the use of high contrast tones instead of bright colors contribute to improved legibility and comfort. Calm, low-stimulation environments, including quiet rooms and sensory reset areas, enhance this approach by maintaining a navigable and supportive circulation spine for various user groups.

Greenery and Scent Expression

In her discussion of multisensory elements, Kimberly Brinkhuis highlighted the importance of considering users who may not be able to perceive scent or who have sensitivities and allergies when integrating aromatic plants. This emphasizes a crucial principle of inclusivity: sensory-rich environments must provide stimulation while avoiding discomfort or exclusion for others. Creating fragrance-free areas, alongside low-odor or non-allergenic plant varieties, ensures that olfactory design enhances, rather than hinders, accessibility. This differentiation acknowledges various sensory thresholds while preserving the microclimatic and physiological advantages of indoor greenery, enhancing a balanced and inclusive multisensory environment within the library.

Guided Walkthrough

During the follow-up tour provided by Brinkhuis at the KB, it was evident that the current configuration does not adhere to inclusive design principles: the lift is inadequately sized and lacks braille indicators, fire doors operate in only one direction, and the existing door handles do not accommodate various modes of use. The building's black flooring may be interpreted by visually impaired individuals as a "black hole," which can induce hesitation and hinder safe movement. The observations supported her previous assertion that accessibility should be integrated into all physical aspects, including circulation systems and material selections, highlighting the necessity of redesigning the KB with a truly inclusive spatial framework.

*Please note: the interview with Kimberly Brinkhuis was conducted in Dutch; all quotations and paraphrased statements presented here have been translated to English by the author, Veldkamp (2025).

1.4 THE KB: ACCESSIBILITY BARRIERS

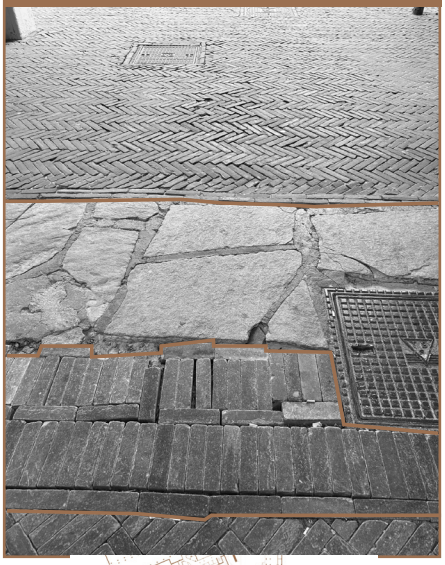
This section presents a series of observations conducted at the Koninklijke Bibliotheek in The Hague, to contextualize accessibility barriers in practice. Site visits and photographic documentation revealed various spatial barriers that impede independent navigation and spatial orientation for visually impaired users. These observations provide particular examples of design limitations in practice and establish a foundation for focused spatial interventions (see page 19) .

These observations highlight that the currect architectural expression of the KB, both externally and internally, fails to reflect and communicate the openness and accessibility the library aims to project. The current internal and external accessibility of the library is extremely fragmented and disorganized. It lacks spatial clarity, inclusive pedestrian walkways and markers, and a clear organizational structure.

Figure 11 illustrates a secondary observational study that outlines the primary pedestrian flows and adjacent circulation routes. The analysis indicates that the main pedestrian flow is directed along the Anna van Buerenplein towards Prins Irenepad, where the KB is situated, likely influenced by the nearby temporary housing of the Dutch Second Chamber. Despite the concentrated flow, the spatial configuration of the KB remains disjointed, characterized by multiple dispersed entrances and an absence of a clearly defined main entrance point. This leads to a fragmented and inconsistent user experience, highlighting the necessity for a cohesive and inclusive design strategy.

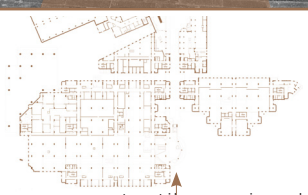
Figure 11. Barriers and Pedestrian flows map. Scale 1:1500 (50% reduced). Compiled by author (Veldkamp, 2025).

IRREGULAR PAVEMENT CONDITIONS



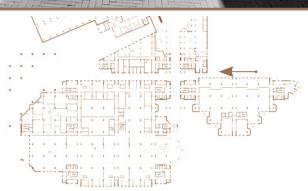
The pavement surrounding the KB has visible gaps, cracks and uneven surfaces - this is a potential tripping hazard for visually impaired individuals and can cause discomfort for those who are physically impaired (weelchair, cane users).

ABSENCE OF TACTILE PAVEMENT



There are no tactile paving leading from the central station or plazas to any of the KB entrances, indicating a noticeable contrast in accessibility priorities, as these pavements can only be seen on the way to the Second Champer.

DARK CORNERS AND ALLEYS



Perceptual and physical obstacles are created by a number of dark corners and unutilized side alleyways. Their presence obstruct sightlines and sensory orientation.

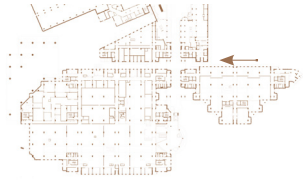
CONFUSING ARRIVAL MOMENT

Surfaces of Orientation
The current entrance sequence lacks clear spatial cues leading towards the main entrance doors, highlighting the abscense of tactile and visual orientation elements.

VISUAL LEGIBILITY (-)

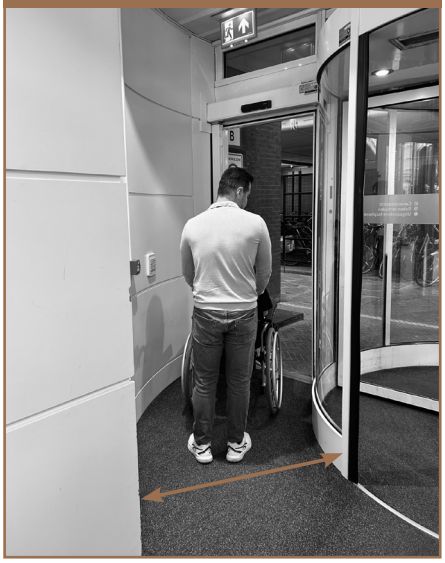
Low Visual Legibility
The east-west alleyway exhibits inadequate visibility and unclear routing. Clear surfaces of movement and visual legibility are crucial for inclusive navigation.

UNCLEAR ENTRANCE



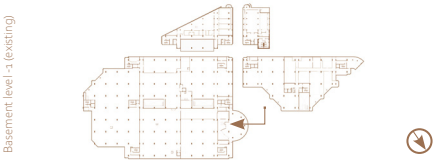
Unclear Entrance
The facade composition facing the Central Station offers no orientation markers that lead you to the main entrance of the KB, marking it spatially disconnected from the entrance sequence.

NARROW ENTRYWAYS



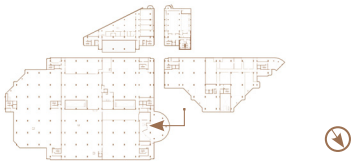
The entrances to the KB consist of narrow rotating doors, not wide enough and difficult to use for people with physical or visual impairments. Not efficient in high-traffic situations.

ORIENTATION: LEVEL CHANGES



On the inside, the KB includes multiple floor level shifts, such as small steps, minor staircases, and raised areas, which lack clear warning indicators, contrasting colors, or tactile floors.

ORIENTATION: LEVEL CHANGES



The absence of accessibility markers presents challenges for visually impaired individuals.

Note. All images taken and edited by author (Veldkamp, 2025).

ASSESSMENT

Chapter 2

VALUE

2 VALUE ASSESSMENT KB - EXISTING SITUATION

In 2017, the Rijksvastgoedbedrijf appointed architectural historian Wijnand Galema to conduct a value assessment for the Koninklijke Bibliotheek (KB) in The Hague. The study determined that the KB possesses significant cultural-historical values, based on its architectural design, spatial arrangement, urban integration, and incorporation of artistic works (Galema, 2017). A significant factor in its aesthetic values is the building's involvement in the percentage scheme for national buildings, a strategy established in 1951 to improve the visual quality of government structures via commissioned artworks.

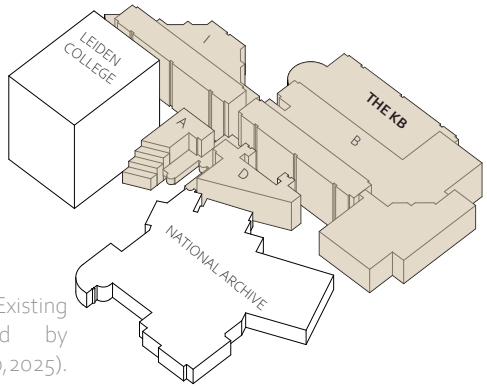


Figure 12. The KB - Existing situation. Compiled by author (Veldkamp, 2025).

This scheme resulted in the integration of several artistic interventions within the KB's architecture, enhancing its internal visual identity and raising its cultural values. A group value assessment was conducted to analyze the KB's larger importance based on this fundamental research utilizing a structured approach adopted from the workshop of Heritage & Design Minor, Architecture and Reuse module in Delft (Pereira Roders et al., 2020). The result affirmed the building's substantial historic, aesthetical, age and ecological values (Figure 13). Yet within this particular research and redesign strategy, special attention will be paid to introducing new social values to the building and its surroundings. Social values denotes the significance of locations within the historic environment as they pertain to modern communities, influencing individuals' sense of identity, belonging, memory, and emotional attachment to a place (Jones, 2017). In this setting, social values are perceived not merely as a facet of heritage significance, but also as a dynamic, lived experience grounded in daily usage and cultural affiliation. Emphasizing this objective fosters a more human-centric design methodology, transcending the building's architectural and historical attributes to enhance its function as an environment for user engagement, social inclusivity, and collective importance. The project aims to reposition the KB as an accessible and socially inclusive public institution by recognizing existing social values through observational studies, social media analysis and the value assessment conducted by architectural historian Wijnand Galema, and suggesting redesign solutions to increase it.

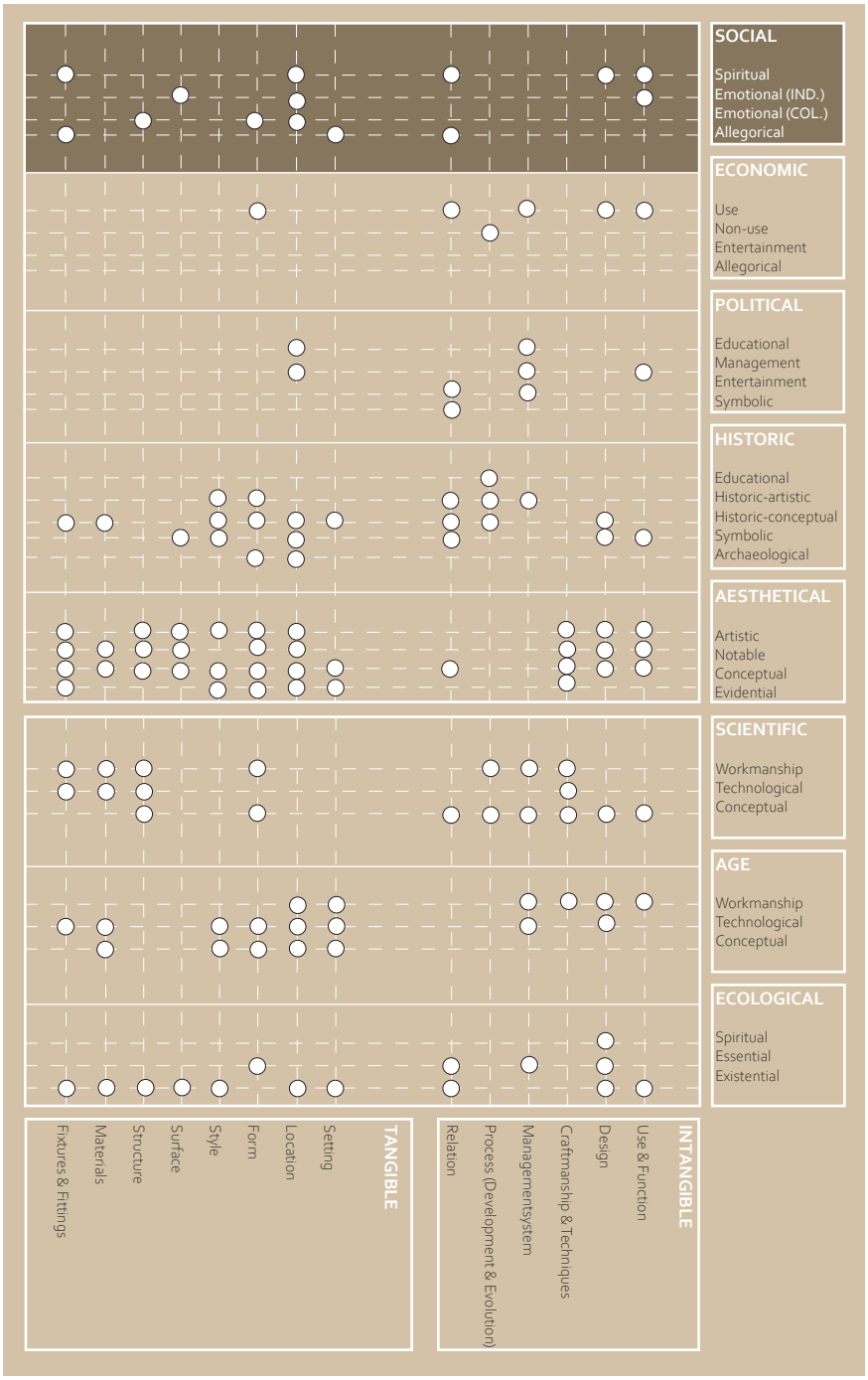


Figure 13. Group Value Assessment. Adopted from the workshop of Heritage & Design Minor – Architecture and Reuse module, Delft, (Pereira Roders et al., 2020). Edited by author (Veldkamp, 2025).

2.1 EXISTING VALUES KB

East-west Alleyway

A pivotal aspect of this redesign is the reconfiguration of the east–west alleyway, which serves as link between the Central Station and the Theresiastraat. According to Galema (2017) the passage enabled the site to be permeable at ground level, dividing the building into four quadrants. However, in doing so, the passage emphasizing transit over interaction: creating a barrier to user engagement and reinforcing the KB's position as merely a passageway instead of a destination. Through the strategic reprogramming of this alleyway, the pass-through circulation space can transform into a space that encourages staying and engaging with what the KB.

It can be argued that the alleyway has a functional role (social values) in providing a daily shortcut and passage for users (Figure 16 and 17). Furthermore, it has a tangible attribute (setting) do to its physical configuration as a spatial void between buildings. While these values highlight urban connectivity, it also signalizes a disengaged relationship with the KB , reducing the library's function from a national destination point into merely a corridor or shortcut.

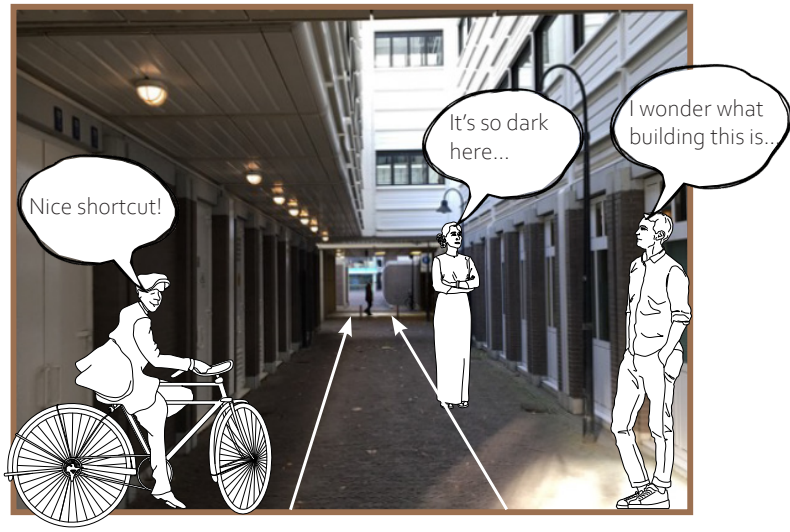


Image 7. View from East-West Alleyway in between building blocks A and D, the KB (Galema, 2016).Edited by author (Veldkamp,2025).

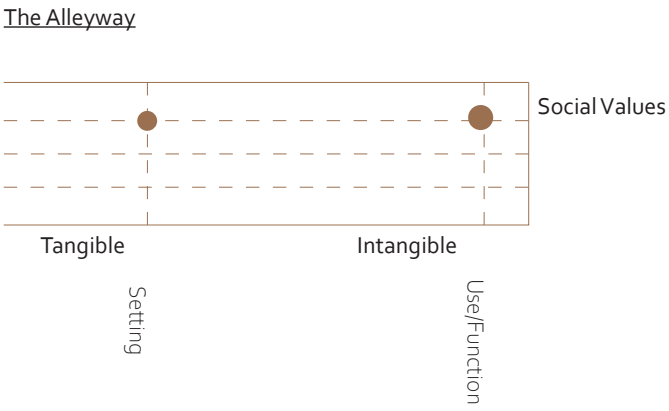


Figure 14. Social Values Alleyway. Adopted from the workshop of Heritage & Design Minor –Architecture and Reuse module, Delft, (Pereira Roders et al., 2020).

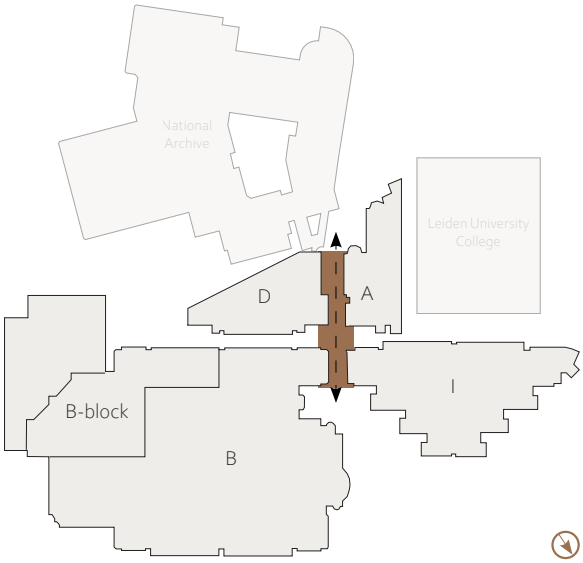
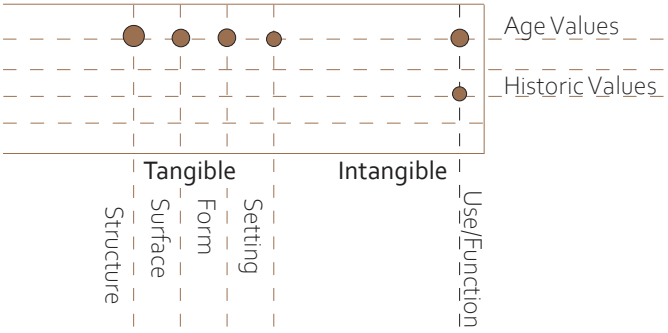


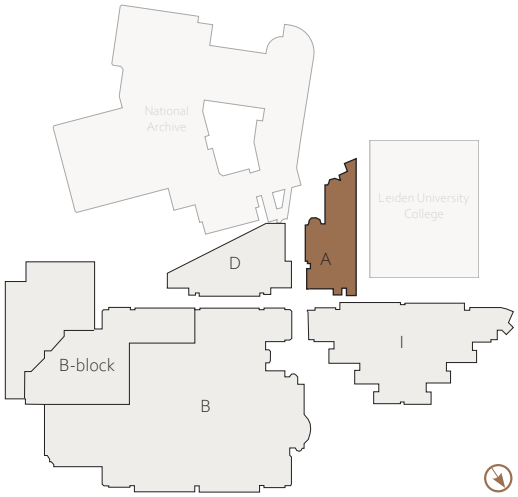
Figure 15. Schematic overview East-West Alleyway in between building blocks A and D, the KB. Compiled by author (Veldkamp,2025).

2.2 EXISTING VALUES KB

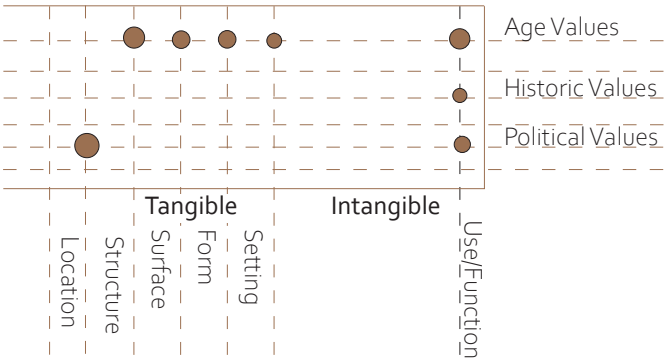
According to KB expert Jani van Kampen, the KB is downscaling substantialy from 80,000m² to 25,000m². Despite the current footprint, numerous rooms are overlooked or underutilized, highlighting the inefficiencies of the existing structure. The relocation of the archives and the majority of physical collections to Delft has reduced the functional necessity for such a large architectural mass. Removing block A and D creates an opportunity, on an urban scale, for a new public space in front of the KB; increasing its visibility, better reflecting its evolving public and national mission. Block D also holds political values due its transitional role connecting the KB and the National Archive (Figure 18). However, its configuration and setting present spatial and perceptual barriers. Although block A and D hold significance, both building blocks lack higher social values.

Block A





Block D



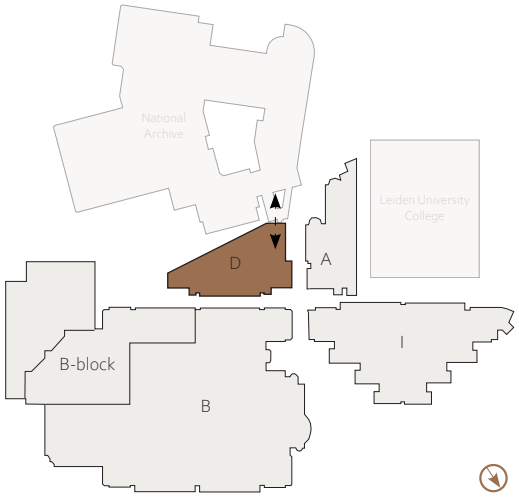


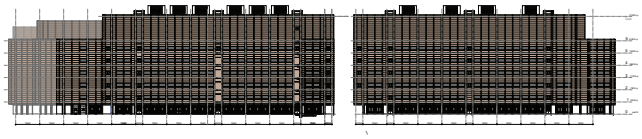
Figure 16. Left: Selected Values Block A and D, the KB. Framework adopted from the workshop of Heritage & Design Minor – Architecture and Reuse module, Delft, (Pereira Roders et al., 2020). Edited by author (Veldkamp,2025). Right: Schematic overview Block A and D. Compiled by author (Veldkamp, 2025).

2.3 Value-Driven Focus Points

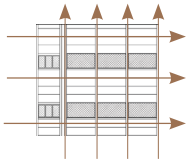
This section identifies the architectural and symbolic elements of the KB with the highest potential for preservation and reinterpretation, based on the outcomes of the group value assessment and the analysis of the east–west alleyway and blocks A and D. The approach views the building fabric not as rigid or solely historic, but as composed of specific components, the modular column grid, the distinctive façade rhythm, and the human-scale brick plinth, that serve as active carriers of value, facilitating an innovative and inclusive transformation. The design concept aims to preserve and enhance these elements while expanding the KB's function from a closed off book repository to an open civic institution, thereby translating heritage values into a unified architectural theme. This framework facilitates the preservation of structural and aesthetical continuity while fostering the emergence of new forms of accessibility, user engagement, and social inclusivity.

Table 2.
Value-Driven Focus Points and Design Themes.

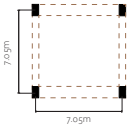
	Heritage component(s)	Why?	Translation into Design Theme
Facade	Facade Design, Materiality & Climate Control	Facade grid based of **modular grid dimensions**, creating both function and structure, and harmony across the building; expressing its modernist identity. Modern appearance supported by bronze, fabric sun protection elements behind facade panels, showcasing attention for climate and function. **Rounded** facade **corners** soften the buildings presence in the surroundings.	Facade is valuable, but risks being seen as closed fortress. Opportunity for further facade strategies that **foster openness and tactility** in possible new added structure. In doing so, the facade becomes part of the sensory journey of future users, not just a structural skin.
Grid	Modular Column System (7.05m x 8,10m, H.O.H)	Modular grid system represents **spatial flexibility**, clarity and **harmony** within the building. Columns and panels define adaptability, rhythm and unity throughout the complex.	**Grid structure retained** as structural **backbone** of the building, sensory spine follows grid rhythm and logic, while columns can be preserved as fragments of the past, showcasing the different layers of history in the redesign.
Human-scale Interaction	Brick base facade	Ground level brick (sub)structure aimed to **enhance human-scale interaction** at eye-level, while softening the building's scale.	Opportunity **to re-establish** the **underrepresented human scale** on ground floor level, enhancing openness and user engagement.
Symbolic meaning	Intangible role as National library	Symbol of **civic identity**, sharing knowledge and cultural memory; beyond its architecture. Shift from closed fortress to open public institution, showcasing intangible social values. Can become irrelevant if social and physical barriers persist.	Central theme: **creating and reinterpreting social values** through multisensory accessibility, inclusivity and public green spaces for user engagement. In doing so the KB can transform in a **socially resilient environment**, strengthening a sense of belonging and identity.



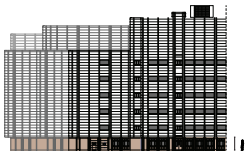
Facade materiality and grid



Facade composition



Column grid system



(Redefine) human-scale base

Note. Compiled by author (Veldkamp, 2025). Value-Driven Focus Points and Design Themes. Building information retrieved from Galema (2017).

ACCESSIBILITY

Chapter 3

MULTISENSORY

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

This chapter examines the second sub question of this research project: **How can multisensory accessibility be effectively integrated into library environments to enhance social inclusivity and user engagement?**

In order to answer this question, three public libraries were selected as case studies, each each exemplifying unique approaches to multisensory accessibility within their architectural frameworks. The Openbare Bibliotheek Amsterdam (OBA) designed by Jo Coenen & Co Architekten, the Helsinki Central Library Oodi by ALA Architects, and the Durham County Library in North Carolina by Vines Architecture are notable examples. Each library highlights various aspects of multisensory accessibility, including tactile wayfinding, acoustic zoning, sensory calming and multisensory environments, and assistive technologies.

The case studies were analyzed through a comparative framework (refer to Appendix A), facilitating the identification of prevalent design strategies that could enhance social inclusivity and user engagement. The findings presented in this initial phase of the case study analysis provide a foundation for the ongoing development of a multisensory accessibility framework. This framework will guide the architectural redesign of the Koninklijke Bibliotheek, with the objective of enhancing social inclusivity and fostering user engagement through a sensory-rich and accessible environment.

The Oodi Helsinki Central Library

The Oodi Helsinki Central Library, designed by ALA Architects in 2018, exemplifies a contemporary approach to public libraries as inclusive civic spaces (Figure 17 and 19). Designated as Helsinki's Civic Heart, Oodi integrates openness, participatory culture, and spatial adaptability to accommodate a diverse range of user requirements.The vertically layered design, from an active ground floor level to the reflective "Book Heaven" on the upper floor, provides both sensory engagement and solace (Figure 18). The majority of spaces facilitate public-oriented creative and participatory activities, rather than passive exhibitions. This deliberate allocation enhances transparency, adaptability, and social inclusivity. Oodi illustrates how spatial programming, transparency, and multisensory design components (such as tactile materials, visual clarity, and acoustic zoning) can encourage inclusive user engagement and spatial adaptability (Oodi Helsinki, n.d.; ArchDaily, 2019). Table 3 shows initial findings of the case study framework used to analyze multisensory accessibility in the Oodi Helsinki library. Page 33 shows a photo gallery of the library.

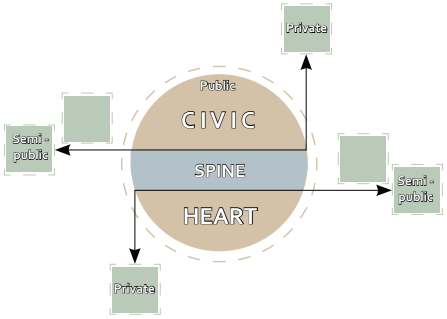


Figure 17. Space distribution - high focus on public use space. Compiled by author (Veldkamp, 2025).

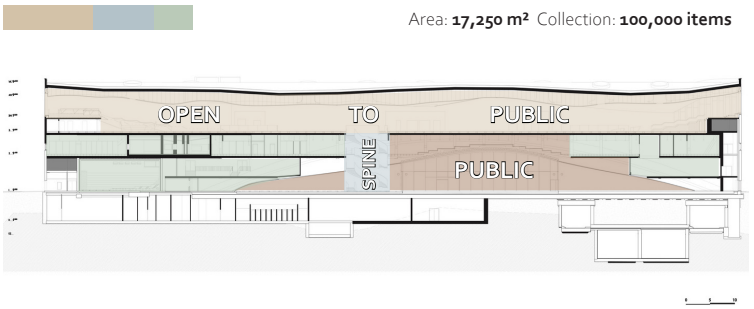


Figure 18. Spatial organization. Adapted by author from building section (Veldkamp, 2025; Archdaily, 2019).

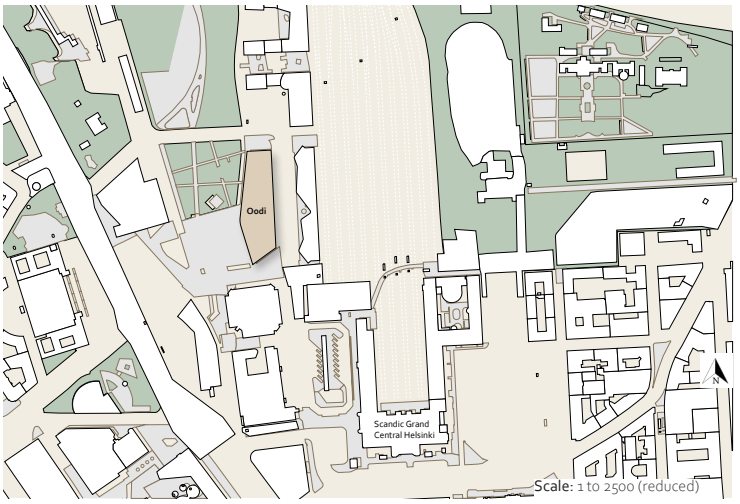


Figure 19. Situation map Oodi Helsinki Central Library Compiled by author (Veldkamp, 2025).

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Table 3.
Framework for Case Study Analysis

CATEGORY	FOCUS POINTS	SUMMARY
Narrative and Identity	Mission and public identity of the library	The Oodi Library is a "living meeting place", offering users knowledge, new abilities, and narratives, thus serving as an accessible place for learning, storytelling, work, and relaxation (Oodi Helsinki, n.d.). The spatial characteristics, including its openness, wooden façade, and transparency, represent democracy, freedom of expression, and accessibility (ArchDaily, 2019).
Spatial Organization	Centralised, Linear, Radial, Cluster, or Grid lay-out, Transition Spaces, Openness vs Enclosure	The design is linear and vertically organized: active services occupy the bottom level, creative and communal areas are situated on the middle level and calming, serene open-plan reading spaces are located on the upper level beneath a curved, cloud-like roof. Featuring, in-between, an enclosed intermediary space that houses rooms for supplementary services and facilities within the library. The central open lobby serves as a nexus. Transition zones mitigate sound between public loud and private silent areas (ArchDaily, 2019).
Program and Functions	Building Services, Functional Spaces and overall Program	Oodi contains a cinema, café, maker spaces, (audio-visual) studios, reading lounges, game rooms, and event halls. It integrates traditional and digital functionalities, providing services for diverse age demographics and requirements, encompassing immigrants, children, and artists. Adaptable furniture and multifunctional spaces facilitate adaptability (Oodi Helsinki, n.d.; ArchDaily, 2019).
Zoning and Circulation	Space division, User Flow, Hierarchy of Spaces, Relationship between Public, Private and Semi-public zones	Zones are organized vertically: Ground (public, noisy, active), Second (semi-public, productive), Third (quite/serene, private). Translucent materials and nuanced textures guide users through the building. Spacious staircases and elevators facilitate accessible movement vertically. Wayfinding is facilitated by sightlines and open layouts (Archello, n.d.).
Multisensory Design Elements	Integration of Tactile, Auditory, Olfactory, and Visual elements in the design	Focus on visual and tactile aesthetics. The incorporation of natural materials, such as wood, augments tactile warmth, while diverse lighting improves atmosphere and navigation. The open rooftop patio facilitates sensory interaction with the exterior environment. Acoustic panels enhance auditory comfort (ArchDaily, 2019).
Accessibility Strategies	Design features addressing sensory and physical impairments	Oodi incorporates accessibility at every level. Elevators, ramps, signage, and adjustable furniture take into account physical demands. The inclusive structure of the program, such as language cafés and sensory-friendly zones, stimulates user engagement, yet is not explicitly multisensory (Oodi Helsinki, n.d.).

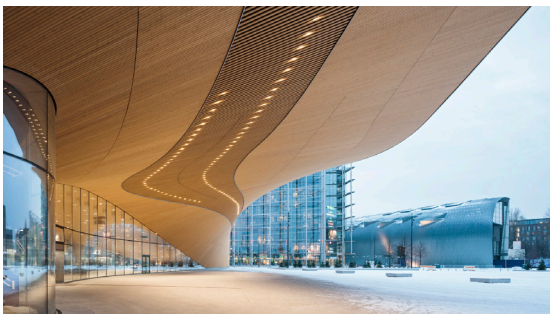
Note. Compiled by author (Veldkamp, 2025). Framework for Case Studies: Summary analysis.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Active ground floor level with primary circulation

Enclosed sensory reading rooms.

Main staircase - spine of the building.



Ground floor level extends to the outdoor public square.

Open plan reading areas surrounded by natural (wood) materials.

The in-between transition spaces for user interaction.

The "Book Heaven" on the top floor of the Oodi Library.

Cloud-like, organic shaped roof.

Open plan reading areas.

Escalators leading to study areas.

Note. Images retrieved from: ArchDaily. (2019, January 4). Oodi Helsinki Central Library / ALA Architects. https://www.archdaily.com/907675/oodi-helsinki-central-library-ala-architects.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

The Openbare Bibliotheek Amsterdam (OBA)

The Openbare Bibliotheek Amsterdam (OBA), designed by Jo Coenen & Co Architekten in 2007, serves as a Civic Heart that integrates culture, education, and public engagement throughout seven vertically arranged levels (Figures 20, 21 and 22). The library promotes openness, accessibility, and urban interaction with dynamic public areas on both the ground and upper floors, featuring a panoramic restaurant and terrace. Anchored in its goal to be "from, for, and by Amsterdammers," the OBA functions as an essential public building, providing secure, inviting, and accessible spaces for knowledge, culture, and community.

The curved pathway alongside Oosterdokseiland, natural stone entrance, orchestrated rhythm of escalators, illuminated the atrium, and visual layers all characterize the spatial experience of the library. The architecture provides a sensory sense of openness and enclosure, rapid and gradual rhythms, and contrasts between light and dark materials. All centered around a central spine leading you to different places. Additionally, natural light infiltrates the structure through vertical perforations and segmented volumes, guiding movement through the building, while accentuating material textures and facilitating wayfinding. It renders the library tactile and visible (ArchDaily, 2014; Openbare Bibliotheek Amsterdam, n.d.). Table 4 shows initial findings of the case study framework used to analyze multisensory accessibility in the OBA. Page 36 shows a photo gallery of the library.

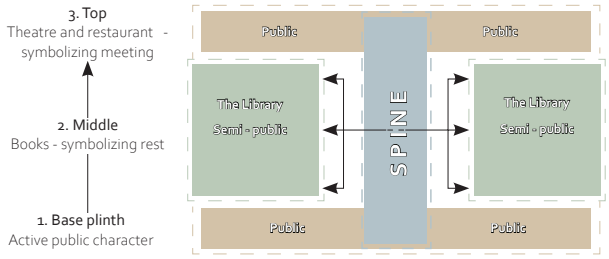


Figure 20. Space distribution - Program connected through central Spine. Compiled by author (Veldkamp, 2025).

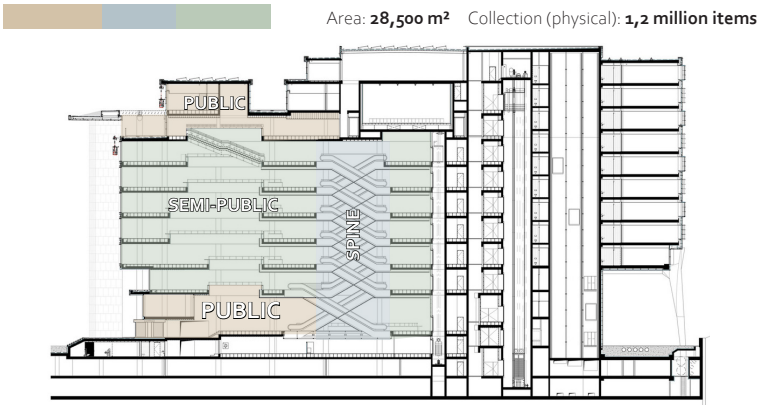


Figure 21. Spatial organization. Adapted by author from building section (Veldkamp, 2025; Archdaily, 2019).

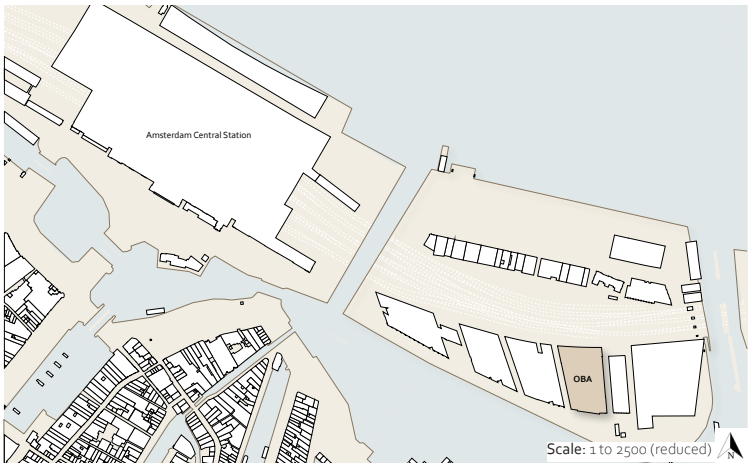


Figure 22. Situation map OBA Compiled by author (Veldkamp, 2025).

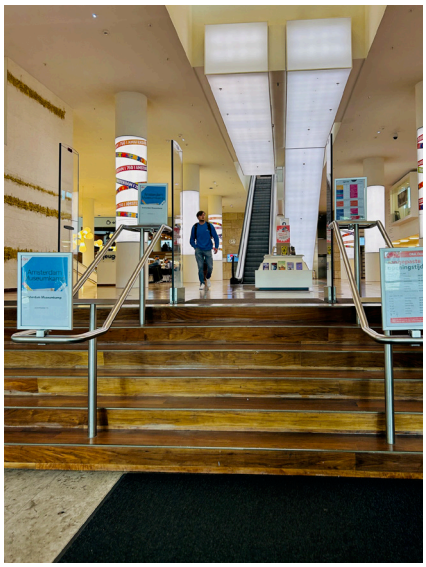
3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

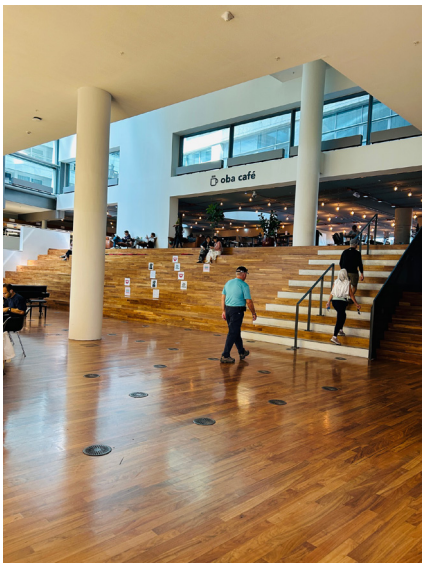
Table 4.
Framework for Case Study Analysis

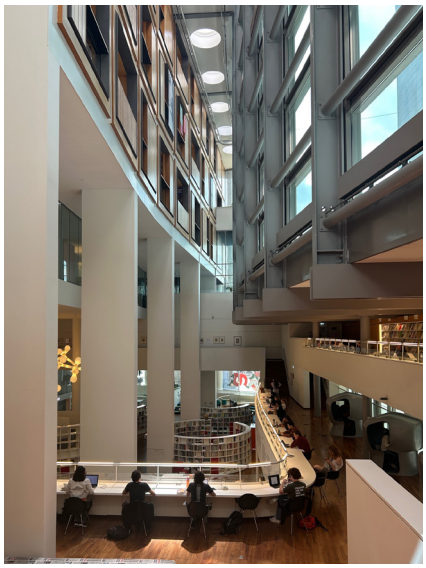
CATEGORY	FOCUS POINTS	SUMMARY
Narrative and Identity	Mission and public identity of the library	The OBA establishes itself as a significant social and cultural institution in Amsterdam, with 29 locations that function as accessible, inviting, and secure public places throughout the city. Its objective is to offer free and unrestricted access to knowledge, information, and culture for all citizens, promoting community engagement and lifelong learning (OBA, n.d.).
Spatial Organization	Centralised, Linear, Radial, Cluster, or Grid lay-out, Transition Spaces, Openness vs Enclosure	The library consists of seven levels, organized into three distinct layers: an active ground floor plinth designated for public functions; a middle section featuring serene reading and study areas; and an upper level accommodating a restaurant and theatre, facilitating cultural events and social interactions (ArchDaily, 2014). A central atrium featuring escalators links all floors and offers visual clarity and openness.
Program and Functions	Building Services, Functional Spaces and overall Program	The OBA contains book collections, exhibition spaces, auditoriums, workspaces, study areas, a children's library, a theater, media laboratories, as well as a café and rooftop restaurant. The spectrum of functions encompasses several user groups, including families, students, tourists, artists, and specialists (OBA, n.d.).
Zoning and Circulation	Space division, User Flow, Hierarchy of Spaces, Relationship between Public, Private and Semi-public zones	The library is vertically zoned: public and dynamic functions (café, events, children's area) occupy the lower level; semi-public creative spaces, calmer study areas and workshops are situated in the middle, and a theater, restaurant and terrace are located on top. Unobstructed sightlines and wide atrium facilitate both horizontal and vertical movement. Circulation primarily occurs via escalators, elevators, and open staircases (ArchDaily, 2014).
Multisensory Design Elements	Integration of Tactile, Auditory, Olfactory, and Visual elements in the design	Natural daylight and material transparency underscore visual openness. The children's library section and exhibition spaces feature tactile installations and interactive displays. The central atrium enhances auditory spaciousness; however, acoustic comfort differs across floors (OBA, n.d.).
Accessibility Strategies	Design features addressing sensory and physical impairments	Elevators, spacious corridors, diverse seating options, and accessible restrooms facilitate mobility for individuals with impairments. Nevertheless, multisensory elements are not systematically integrated. The limitations of tactile design and auditory navigation indicate a need for enhancements in sensory-inclusive infrastructure.

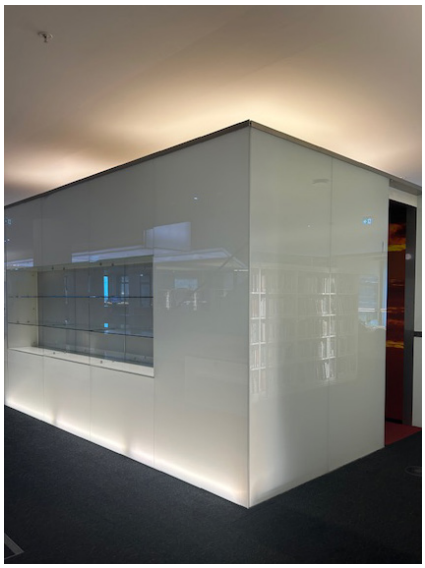
Note. Compiled by author (Veldkamp, 2025). Framework for Case Studies: Summary analysis.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN









Note. Images taken by author (Veldkamp, 2025).

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

The Durham County Main Library

The Durham County Main Library, renovated by Vines Architecture and Skanska in 2020, serves as a Civic Heart, integrating information retrieval, innovation, and technology within a transparent and interconnected spatial framework. The design exhibits two overlapping spatial principles rather than fixed public, semi-public, or private areas: one for conventional physical collection and another for interactive, technology-enhanced content creation (Figures 23, 24 and 25). These elements are integrated through a central atrium that facilitates both vertical and horizontal movement (Vines Architecture, n.d.).

The library shows a significant example for multisensory accessibility. The inclusive design incorporates tactile play areas, acoustic zoning, a sensory calming room and multisensory environment, visual wayfinding, adaptable lighting, and textured flooring to meet the needs of neurodiverse and sensory-impaired individuals (Jamsky & Alverson, 2024; Durham County Library, n.d.). The library, built through interaction with the community, provides an accessible and inclusive environment for all, serving as a model for reevaluating sensory-inclusive public libraries for the Koninklijke Bibliotheek in The Hague. Table 5 shows initial findings of the case study framework used to analyze multisensory accessibility in the Durham County Library. Pages 39 and 40 show a photo gallery of the library.

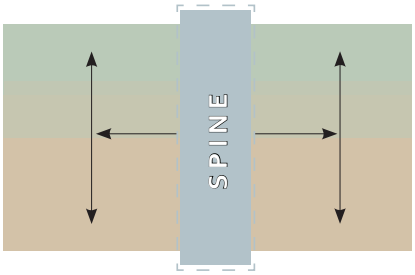


Figure 23. Space distribution - Program connected through central Spine. Compiled by author (Veldkamp, 2025).

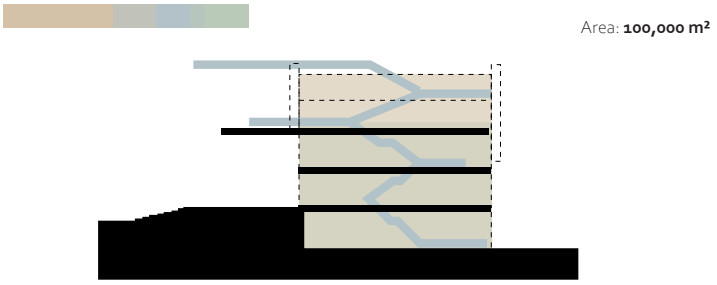


Figure 24. Spatial organization - public and private zone flow into each other connected through central spine. Compiled by author (Veldkamp, 2025).

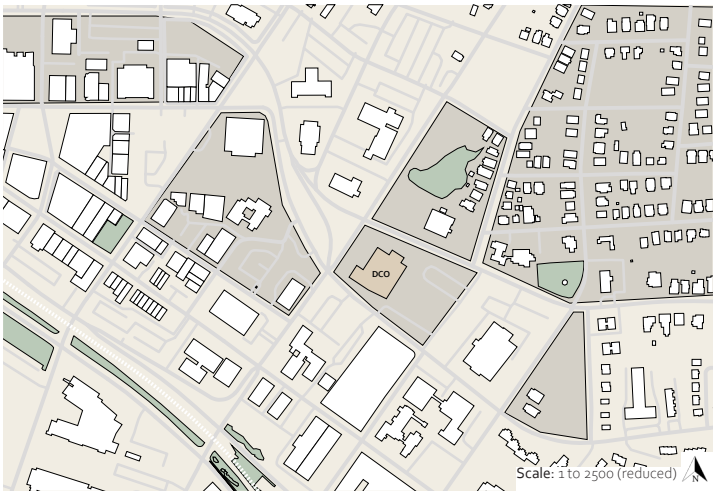


Figure 25. Situation map Durham County Library. Compiled by author (Veldkamp, 2025).

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Table 5.
Framework for Case Study Analysis

CATEGORY	FOCUS POINTS	SUMMARY
Narrative and Identity	Mission and public identity of the library	The library's aim is to promote research, unite the community, and excel in literacy. Its aim is to inspire lives and transform Durham. It provides comprehensive, community-focused services and programs to empower and enhance the Durham community (Durham County Library, n.d.).
Spatial Organization	Centralised, Linear, Radial, Cluster, or Grid lay-out, Transition Spaces, Openness vs Enclosure	The architectural design integrates two spatial systems, one for traditional collections and another for digital collaboration, into a versatile plan designed around a skylit atrium. This radial and clustered structure fosters transparency, continuity, and engagement among diverse age groups and learning methods (Vines Architecture, n.d.).
Program and Functions	Building Services, Functional Spaces and overall Program	The library contains a sensory-inclusive children's section, a teenager zone, a maker lab, a digital media studio, STEAM zones, study rooms, spaces for small businesses and public gathering facilities alongside multisensory zones. Programs are created with input from the community to guarantee cultural and demographic inclusion.
Zoning and Circulation	Space division, User Flow, Hierarchy of Spaces, Relationship between Public, Private and Semi-public zones	Spaces are visibly interconnected through distinct transitions assisted through unobstructed sightlines, translucent barriers, color indicators, and auditory variation. The center atrium serves as a spatial anchor, facilitating both vertical and horizontal circulation (Vines Architecture, n.d.).
Multisensory Design Elements	Integration of Tactile, Auditory, Olfactory, and Visual elements in the design	The design incorporates sensory walls, textured flooring, serene sensory chambers, acoustic zoning, lighting regulation, and visual wayfinding. These components foster an inclusive environment for neurodiverse and sensory-impaired individuals (Jamsky & Alverson, 2024).
Accessibility Strategies	Design features addressing sensory and physical impairments	Accessibility encompasses more than just conformity, integrating inclusive programming, personnel skilled in sensory assistance, and physical attributes such as wide paths, adjustable furniture, and sensory packages. The library highly advocates for inclusive sensory engagement (Jamsky & Alverson, 2024).

Note. Compiled by author (Veldkamp, 2025). Framework for Case Studies: Summary analysis.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Main entrance and outdoor amphitheater for events.

Light and inviting entrance with monumental staircase.

Seperation between library zone and main circulation zone.

'The Incubator': dedicated to small businesses.

Natural daylight penetrating through the building.

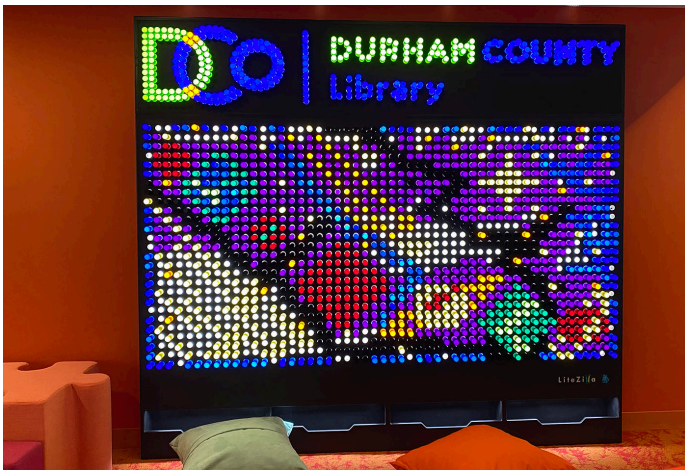
Modern open floorplan with wide oak-stained wooden staircase.

Note. Images retrieved from: Durham County Library. (n.d.). Main Library. https://durhamcountylibrary.org/location/main-library/.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Inspiring auditorium space filled with natural light.

Gaming area for teens .



Inclusive play area with tactile light wall.

Comfortable study booths (first come, first serve).

The Multisensory Environment for sensory stimulation.

Outdoor rooftop terrace open for events and programming.

Note. Images retrieved from: Durham County Library. (n.d.). Main Library. https://durhamcountylibrary.org/location/main-library/.

3 MULTISENSORY ACCESSIBILITY FOR INCLUSIVE DESIGN

Summary Analysis

The initial findings from the three case studies highlight the opportunity of multisensory accessibility to foster more inclusive and engaging library environments (Figure 26). Each example illustrates the significance of spatial design strategies, such as tactile surfaces, soundscapes, assistive technologies, and sensory calming zones, in enhancing accessibility, social inclusivity and enriching users' experience. Building on these findings, the next chapters will further explore the integration of multisensory accessibility in the spatial redesign of the KB. This encompasses the integration of specific sensory design elements and a thoughtful awareness of the valuable input that visually impaired users offer to the design process. The objective is to create an inherently inclusive environment that fosters spatial orientation, user engagement, and social inclusivity for all individuals, irrespective of their abilities, rather than potentially creating a divide between majority and minority user groups.

Please refer to appendix M for the new program proposal.

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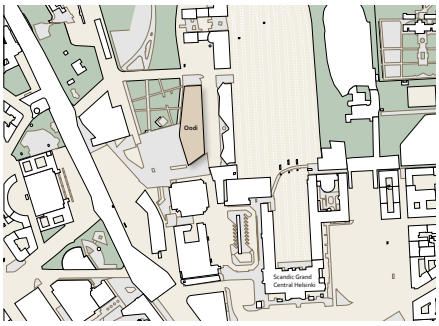
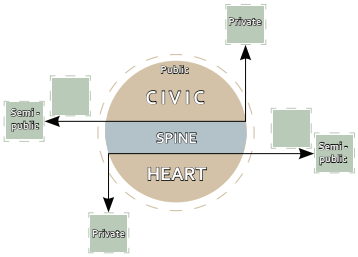


The Helsinki Central Library Oodi in Finland:

Architects: ALA Architects

Area: **17,250 m²**

Year: 2018



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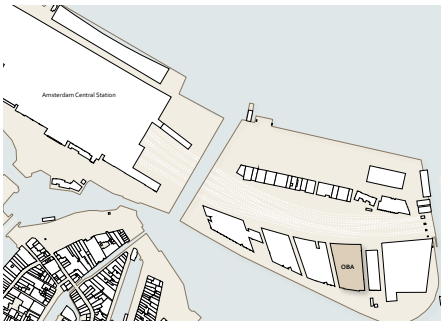
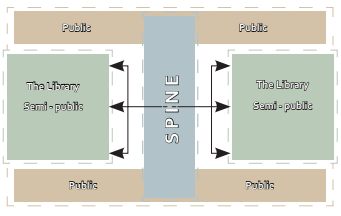


Openbare Bibliotheek (OBA) in Amsterdam:

Architects: Jo Coenen & Co Architekten

Area: **28,500 m²**

Year: 2007



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Durham County Library in North Carolina, USA:

Architects: Vines Architecture

Area: **100,000 m²**

Year: 2020

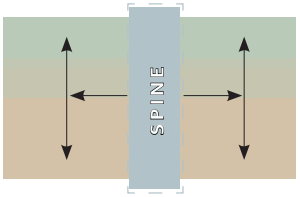


Figure 26. Summary Case Study Analysis. Compiled by author (Veldkamp, 2025).

CONCLUSION

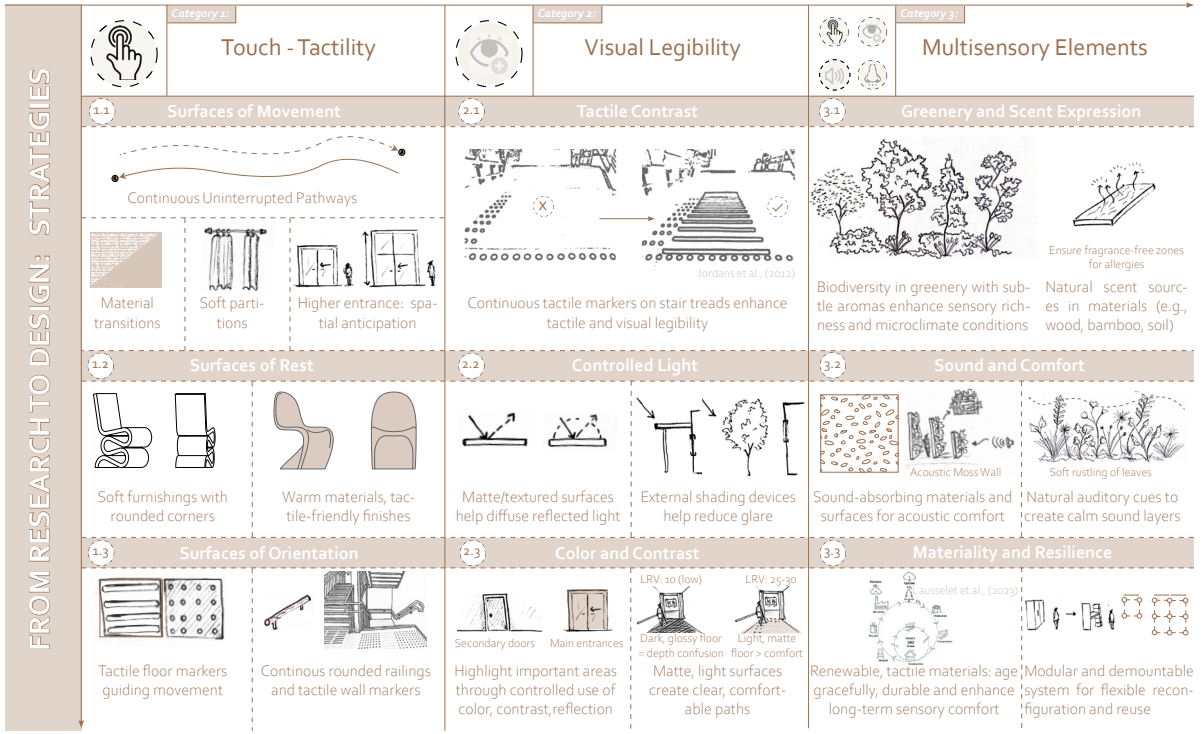
Chapter 4
RESEARCH

4 CONCLUSION

This research addressed the question: **How can libraries be redesigned as resilient environments that foster social inclusivity and user engagement by integrating multisensory accessibility into their physical spaces?.** While the design phase continues, and true inclusivity can only be thoroughly assessed after interventions are put into practice and experienced in real-world settings, the research findings indicate that multisensory strategies possess considerable potential to expand inclusivity and improve user engagement. The pursuit of universal inclusivity is an ongoing objective, one that goes beyond the time frame and practical limits of this research. Nevertheless, the research approach indicated that prioritizing touch as a primary sensory topic could have offered a more concentrated framework, especially considering its universal perceptibility and its status as the second-most relied-upon sense after vision. The study initially examined accessibility from a comprehensive multisensory perspective, but the hierarchy of the senses became more evident over time, indicating that a touch-centric approach could have enhanced the coherence of the design strategy. Even so, the results of this research indicate that designing beyond the sense of sight can be accomplished through various sensory modalities, each offering unique kinds of inclusivity and engagement within the library setting.

This research utilized a combined methodology that included a comprehensive literature review, site observations, case study analysis, and an expert interview with Kimberly Brinkhuis, resulting in a multisensory design toolbox focused on tactility, visual legibility, and multisensory elements (Table 6). This toolbox brings together essential principles, material transitions, tactile guidance, shading and contrast, controlled lighting, greenery, soundscapes, and material expression, that interact in order to foster the development of sensory rich, perceptually accessible, and socially inclusive library spaces. Although the complete effects of these measures can only be validated through future implementation and post-occupancy evaluation, the research indicates that incorporating multisensory accessibility provides a strong approach to libraries that not only support inclusivity but also encourage various forms of user engagement and a sense of belonging.

Table 6.
Toolbox for Redesign



Note. Compiled by author (Veldkamp, 2025). Summary Research Findings into possible Design Strategies.

The multisensory toolbox that served as a framework for the redesign of the KB, proved effective in this context, offering a transferable set of principles that can be tailored to different public institutions to meet context-specific sensory requirements and social dynamics. A significant personal insight gained from this project is the significance of inclusive design, especially considering that more than 330,000 individuals in the Netherlands experience visual impairments. Designing beyond sight addresses specific user needs while also reflecting a wider commitment to creating environments that foster autonomy, comfort, and accessibility for everyone. Design enhancements, like ongoing tactile pathways or more distinct spatial transitions, show that initiatives aimed at assisting visually impaired individuals ultimately improve comfort, confidence, spatial orientation and ease of movement for ***all users***, regardless of impairment.

CONCEPT

Chapter 5
DESIGN

5 DESIGN IMPLICATIONS: RESEARCH TO DESIGN

A significant spatial strategy identified in the case study analysis was the implementation of a continuous sensory pathway, characterized by an organized and uninterrupted circulation route that facilitates intuitive navigation, spatial orientation and wayfinding through tactile, auditory, and spatial cues. This method allows individuals with visual impairments to navigate independently by relying on sensory input instead of solely on visual cues. Building on this notion, the proposal for the Koninklijke Bibliotheek transforms this route into a similar spatial intervention titled the *Sensory Spine* (Figure 27).
The following interpretation and definition of the Sensory Spine is formulated as a component of the current research and design initiative:

Sensory Spine

The Sensory Spine forms the backbone of the building. It serves as the main, uninterrupted circulation route throughout the building. Although it is particularly sensitive to the needs of visually impaired library users, it is intended to be beneficial to all visitors by facilitating multisensory navigation. Similar to the spinal cord, that conveys sensory information to the human brian, the Sensory Spine acts as a spatial core that regulates sensory experiences throughout the building.

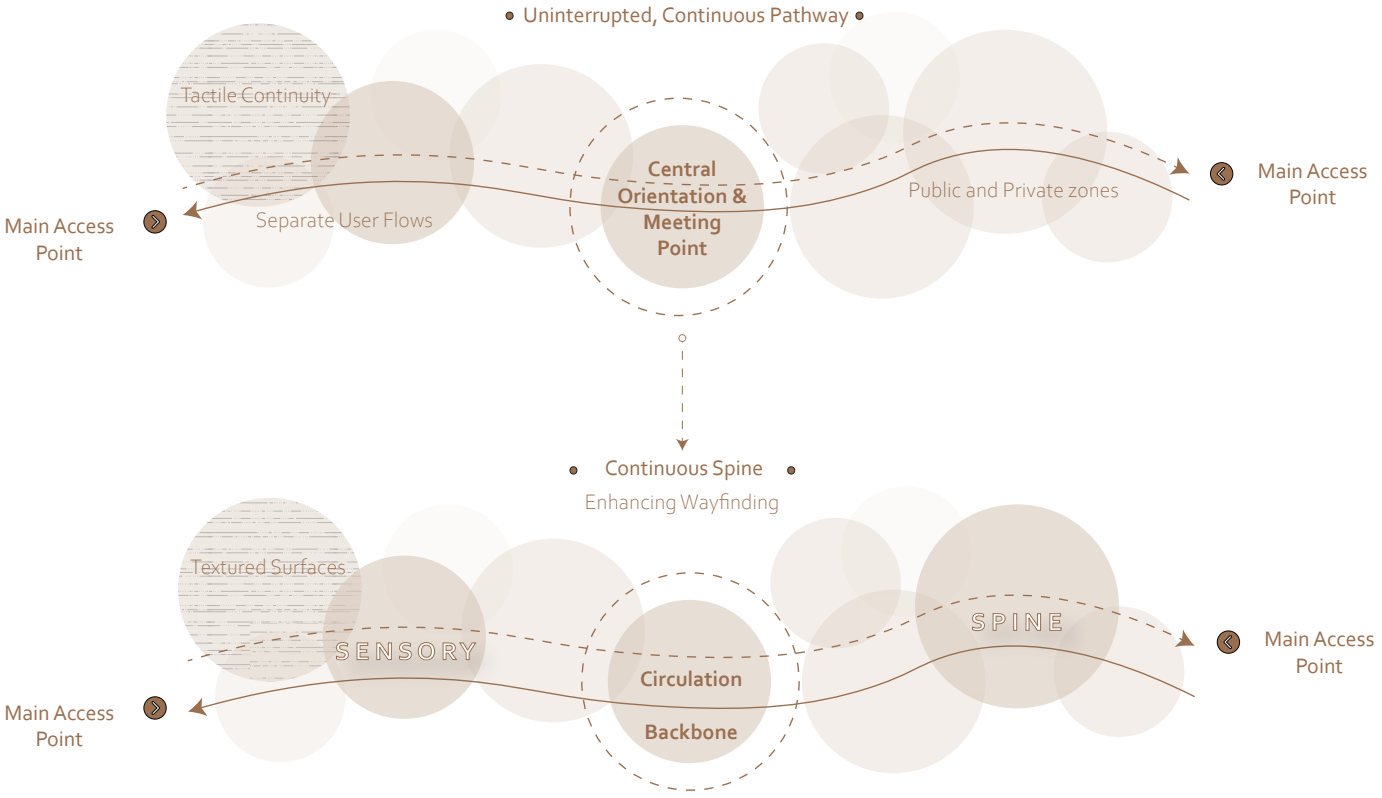


Figure 27. Research Synthesis: translation Sensory Pathway into the Sensory Spine, a continuous multisensory pathway. Compiled by author (Veldkamp, 2025).

5.1 DESIGN IMPLICATIONS: RESEARCH TO DESIGN

The spatial strategy for the KB, known as the sensory spine, informed by precedent analysis and on-site observations, addresses specific barriers identified in earlier sections, including fragmented circulation patterns, lack of spatial clarity, and absence of tactile guidance and intuitive spatial flow. The WHAT–HOW–WHY framework synthesizes findings by identifying the problem (WHAT), defining the proposed spatial reaction (HOW), and establishing its relevance within academic literature on inclusive and multisensory design (WHY). This framework illustrates the emergence of the Sensory Spine as a spatial and sensory-accessible solution in the redesign of the KB (Figure 28).

WHAT → HOW → WHY

Identifying the Problem

Barriers visually impaired:

- Irregular and obstructive layouts
- Sight-Dependent Design
- Level Changes and Unequal Access
- Fragmented Circulation patterns

(Deines-Jones, 2007; Lupton & Lipps, 2018; Moss, 1981)

Barriers KB:

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

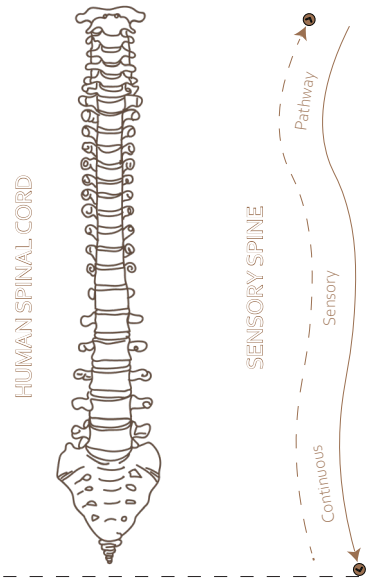
Barriers KB Site:

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

Overall **Disorganized Environment**

Proposed Design Solution(s)

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



Justifying the Intervention

Academic literature asserts that inclusive design must include the entire sensory spectrum (Lupton and Lipps, 2018). Continuous uninterrupted pathways enhanced by sensory stimuli promote spatial memory and orientation, especially for those with visual impairments (Goldsmith, 1997).

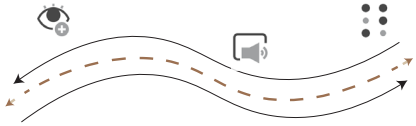


Figure 28. WHAT-HOW-WHY framework. Compiled by author (Veldkamp, 2025).

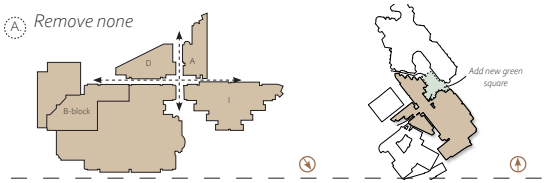
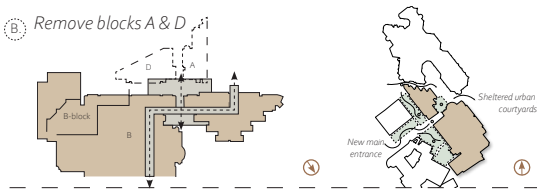
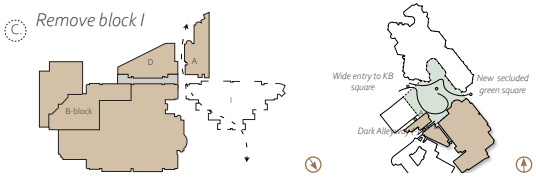
5.2 POTENTIAL REDESIGN SCENARIOS

This chapter outlines the iterative method employed in developing a spatial transformation strategy for the Koninklijke Bibliotheek. Following the site analysis and research conclusions on accessibility barriers and multisensory accessibility, multiple redevelopment scenarios were evaluated to ascertain their effects on carbon footprint, historic and social values. This comparative analysis showcased the advantages and disadvantages of each alternative, thereby identifying the attributes that most effectively contribute to an inclusive, future-oriented redesign of the KB.

While the CO_2 analysis underscored the environmental impact of removing and potentially reusing certain structural elements, the historic and social values proved to be critical comparative factors as well. While social values, characterized by the degree to which the KB fosters inclusivity, civic identity and collaborative use (Jones, 2017), preserving historic values of the building help maintain the KB's architectural identity and continuity.

Ultimately, scenario B was selected, removing blocks A and D, as this does not outright dismiss the KB's legacy; rather, it presents an opportunity to enhance it. The justification for this decision is further elaborated in the next section.

Table 7.
Scenarios for Redesign

SCENARIOS		① Historic Values	② Social Values	③ Functions removed	④ CO_2 impact	⑤ Pros	⑥ Cons
Ⓐ *Remove none*		**High** - all blocks preserved and reused.	**Neutral:** building parts preserved but (hidden) barriers can persist: hidden entrances, dark corners and alleys, closed fortress.	None.	**Low:** no demolition, room for renovations/ refurbishments.	Maximum heritage retention, least amount of demolition (exterior).	Current site and partial interior barriers persist. Overscaled unused spaces, closed fortress, accessibility barriers.
Ⓑ *Remove blocks A & D*		**Medium-low:** partial loss of heritage values. Keeping structural parts of building (A+D) fragments can help reinterpret their historic values.	**High:** opportunity for new public green squares for public engagement, a new main entrance enhancing the KB's visibility.	6,720m² important functions including: Club Erasmus, Auditorium, Exhibition spaces, BK atelier, Book restoration room, connection NA.	**Medium:** 8% of the building demolished. Materials can be recycled for interior furniture, new building additions.	-New green square for interaction and gathering. -Improves permeability and daylight conditions. -Enhances the KB's visibility. -Open civic space.	Demolition of block A & D, causing nuisance and pollution.
Ⓒ *Remove block I*		**Low:** major loss of building part.	**Low:** civic memory weakened, however opportunity for public engagement with new secluded green square.	+/- 12,400m² space demolished: KB offices (literature museum and archives already moving)	**High:** 15.5% of the building demolished.	Unused space resolved with removal of block I, enclosed green square, permeability and daylight on the eastside.	Major demolition with higher CO_2 impact, loss of partial cultural identity. Significant part of architect's work eliminated.
Ⓓ *Remove blocks A & I*		**Low:** major loss of building parts, strong alteration of building's layout.	**Medium:** Wide new main entrance, with green public square and improved circulation.	+/- 15,000m² space demolished: KB offices, restaurant employees, auditorium.	**High:** 19% of the building demolished.	Opens up the KB to the city of the Hague, new green square, better integrated within the urban fabric.	Large-scale demolition with higher CO_2 impact, important functions lost, heritage fragments gone.
Ⓔ *Remove blocks D & I*		**Low:** major loss of building parts, strong alteration of building's layout.	**Medium-high:** two secluded green courtyards foster intimacy and belonging, with public engagement.	+/- 16,520m² space demolished: KB offices, restoration room, BK atelier, Club Erasmus, connection NA.	**High:** 21% of the building demolished.	New intimate green spaces for public gathering and engagement. Unused space solved.	Large-scale demolition with higher CO_2 impact, loss of connection with NA, fragmented building experience.

High: significant heritage values are preserved and/or strengthened.
Medium: some heritage values and attributes are lost, other elements remain.
Low: major heritage values and attributes are lost, compromising

Note. Compiled by author (Veldkamp, 2025). Redesign scenarios with associated pros and cons.

5.3 PROPOSED INTERVENTION

This section presents the spatial transformation strategy formulated to address the accessibility barriers identified through the case study analysis, literature, and location-specific observations at the Koninklijke Bibliotheek. The design process converts the initial research findings into architectural solutions that emphasize multisensory accessibility. Figure 29 illustrates that the strategy entails the removal of building blocks A and D, the closure of the existing alleyway, and the integration of a continuous internal sensory pathway. This spatial reconfiguration forms the basis for the Sensory Spine, a redesign intervention that enhances wayfinding, spatial orientation, while reconnecting fragmented user flows and redefining the spatial logic of the library.

Removing blocks A and D enhances the KB's visibility and accessibility, converting it from a closed archival fortress into a recognizable public space. This presents an opportunity to create a new green square in front of the building, substituting the closed off frontage with a communal outdoor area stimulating interaction, activities and gathering.

As KB expert Jani van Kampen mentioned, the architectural language of the building fails to reflect the new mission of the KB to be open and accessible to the public.

Furthermore, closing off the alleyway removes the disconnect between block B and I, transforming the space into a spatial connection point. These actions are not a mere act of erasure but rather an intentional and strategic transformation. The design facilitates the integration of a central sensory spine, which can bring together the fragmented layout of the KB into a coherent, welcoming, and accessible civic space.

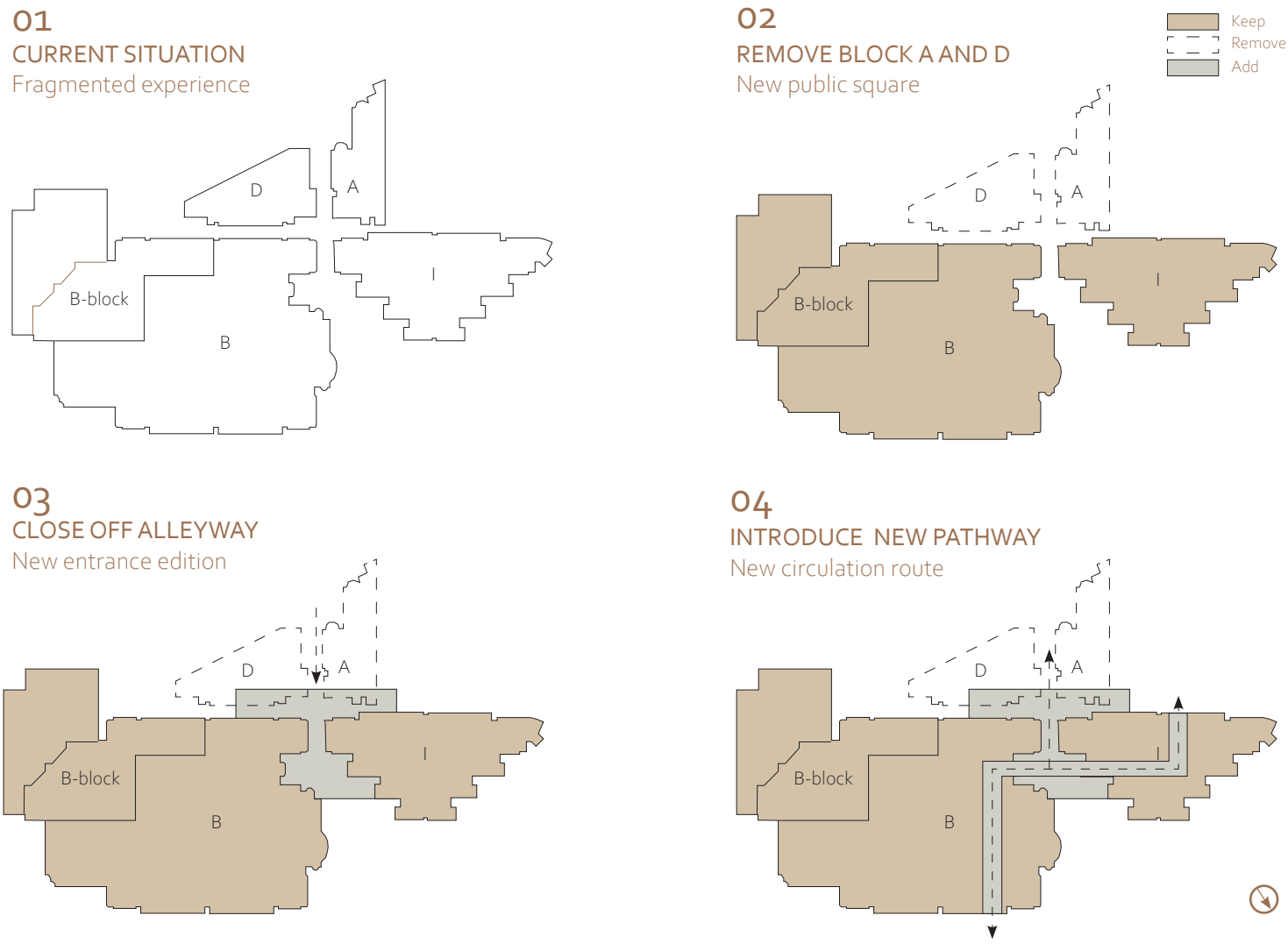


Figure 29. Phased spatial transformation strategy for the KB. Compiled by author (Veldkamp, 2025).

5.4 POTENTIAL NEW VALUES KB

While the removal of Blocks A and D modifies elements of the original architectural design and removes certain historic values, this action should be contextualized within the overarching goal of enhancing the KB's social function. This section assesses how this design choice, albeit impacting certain historic values, generates substantial opportunity to improve social values, inclusivity, and user engagement within and surrounding the revitalized KB library. The resulting open square, through removing blocks A and D, might foster more community interaction, improve spatial orientation, and significantly increase the visibility and public presence of the KB. Two proposals have been formulated in response to this spatial scenario: proposal 1 entails the total removal of blocks A and D to enhance openness and accessibility (Figure 30).

In contrast, proposal 2 preserves certain structural elements of these blocks, facilitating a reinterpretation of their historical significance while promoting social interaction (Figure 31). In this second scenario, keeping select elements of the original structure of blocks A and D can help preserve and reinterpret their historic values, while also introducing new social values. This approach reveals multiple historical layers, allowing the public to visually engage with the building's architectural evolution. Moreover, these preserved fragments can serve as a spatial or visual landmark, drawing attention to the new entrance of the KB and reinforcing its identity within the

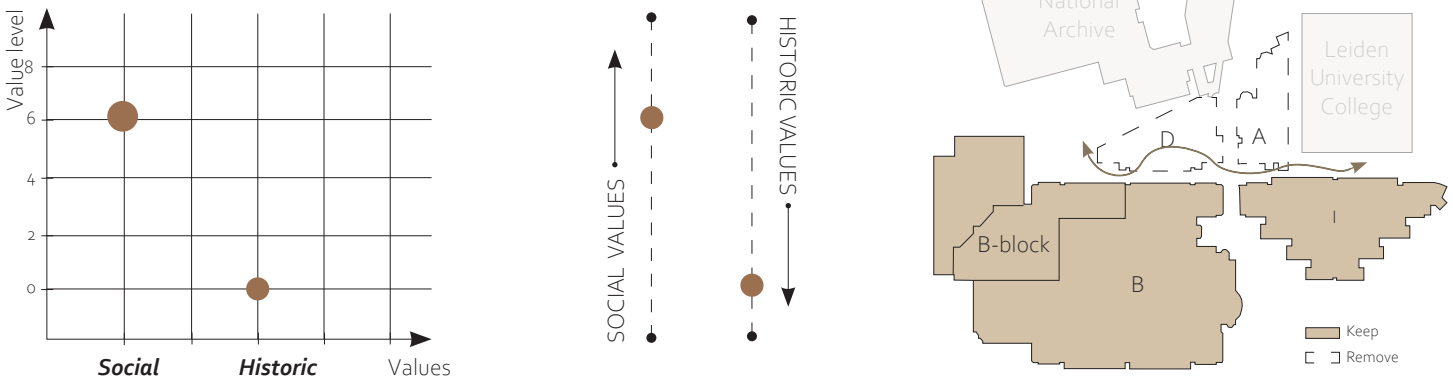


Figure 30. Option 1: overview removing block A & D: Introduces new social values but removes the existing historic values. Compiled by author (Veldkamp, 2025).

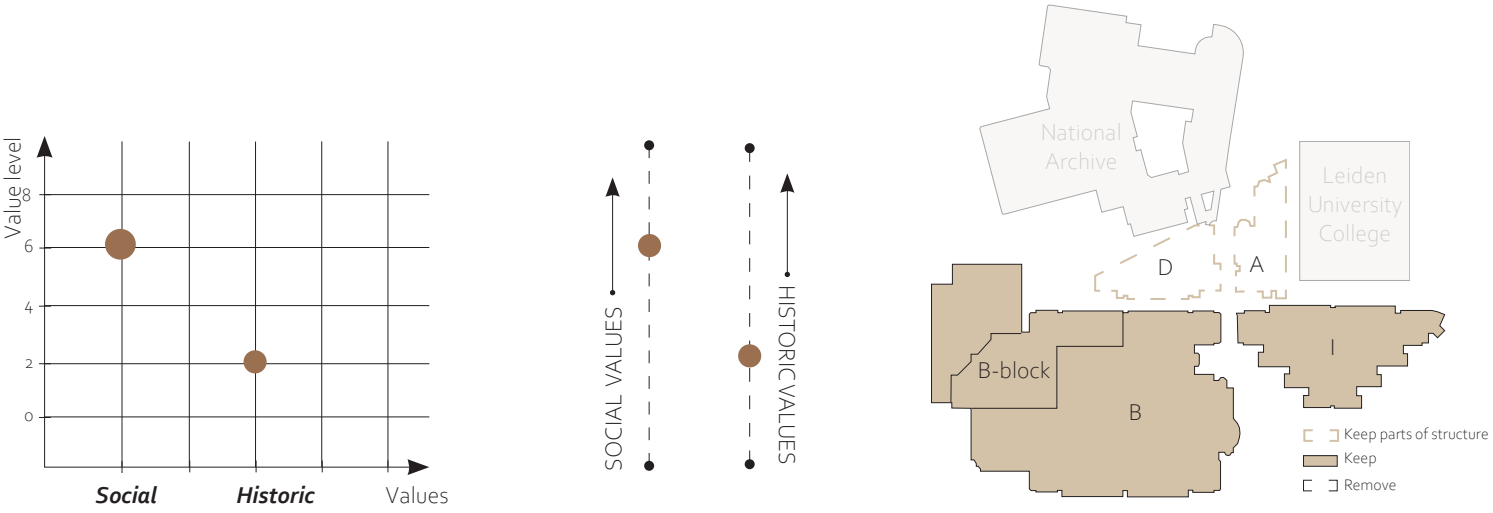


Figure 31. Option 2: overview keeping parts of the structure: Introduces new social values and preserves parts of the existing historic values. Compiled by author (Veldkamp, 2025).

5.5 CONCEPT VARIANTS

In this section the design process transitions to investigating spatial strategies that try to integrate the sensory spine in the existing library. The suggested elimination of Blocks A and D, along with the deliberate preservation of some structural elements, presents a significant architectural opportunity: to reimagine the KB's spatial logic while enhancing its significance as an accessible cultural institution. This subchapter provides three design options that propose distinct arrangements of the Sensory Spine within the KB (Figure 32). Although varying in focus and approach, all three techniques seek to convert the KB into an inclusive, easily navigable and accessible space, grounded in multisensory accessibility and influenced by the site's architectural essence.

Variant one integrates the new sensory spine in the original modular grid system (7.05m, and 8.10m H.O.H distance between columns) designed by architect Arie Hagoort. Honoring this, ensures the intervention is seen as a natural progression rather than a imposition. However, the second entrance is positioned opposite the Leiden University, reducing the visual legibility of the entrance when coming from the Central Station (Appendix E).

Variant two employs the newly established central entry, resulting from the removal of blocks A and D. This arrangement directly addresses the existing main pedestrian flow, removes spatial obstacles, and promotes the central courtyard as the focal point of movement and experience. It can transform a formerly divided structure into a cohesive, accessible, and inclusive cultural institution. Although the entrance is centrally aligned, it does not follow the main pedestrian flow from the Anna van Buerenplein creating a discontinuity in the primary surface of movement outside(Appendix F).

Lastly, variant three responds to pedestrian movement patterns from various access points, incorporating a corner entrance from the Anna van Buerenplein, a central entrance, while preserving and reimagining the existing main entrance. This layered entry strategy enhances permeability, fortifies the KB's presence within the urban fabric, and improves accessibility for all users, including those with diverse sensory needs.

The three variants examine distinct spatial narratives that facilitate the integration of the Sensory Spine within the KB. Option three was chosen as the preferred strategy because it directly responds to the primary pedestrian flows shown in subchapter 1.3, aligning the new entrances and the sensory spine in line with the existing circulation patterns around the library (Appendix G).

01
OFF-CENTERED ENTRANCE

02
CENTERED ENTRANCE

03
CENTERED AND CORNER ENTRANCE

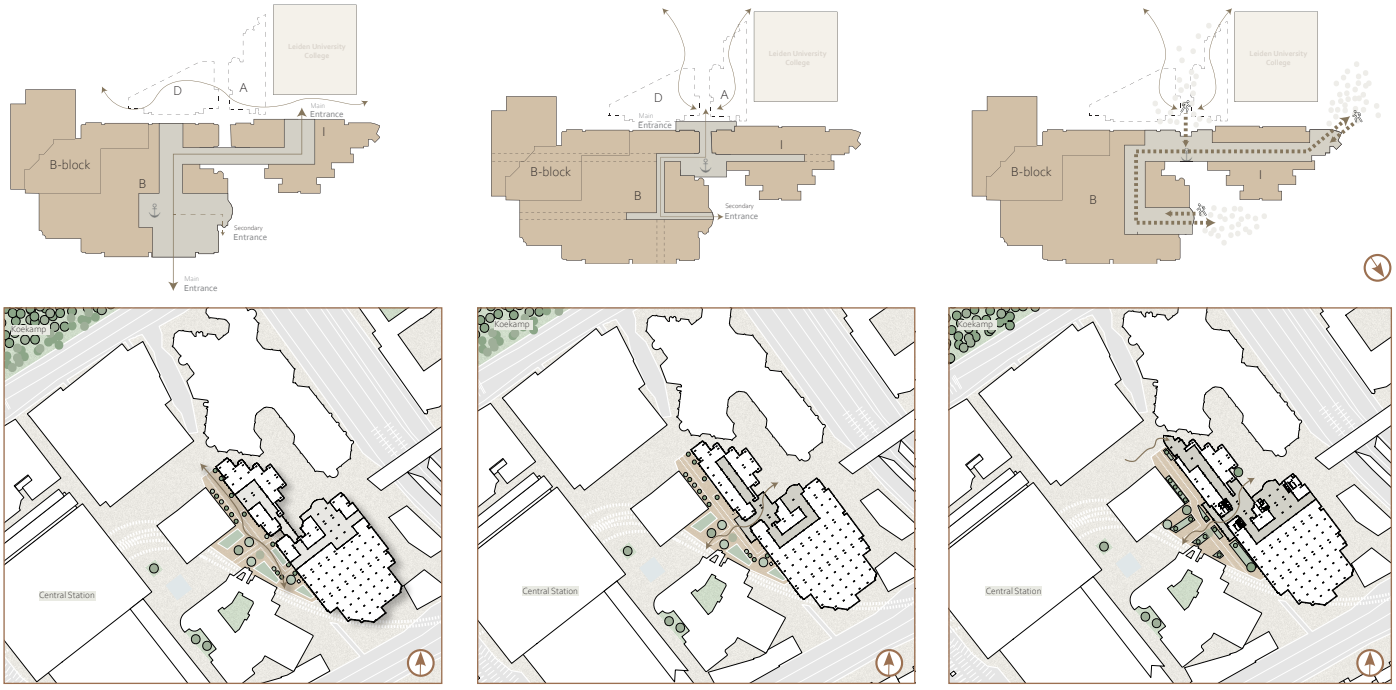


Figure 32. Unfolding the Spine: Three Visions for the integration of the sensory spine in the KB library. Compiled by author (Veldkamp, 2025).

5.6 FACADE AND SITE STRATEGIES

Having identified scenario three as the most spatially coherent entrance configuration, aligning with the main pedestrian flows coming from the Anna van Buerenplein and enhancing exterior surfaces of movement through the introduction of a clear pathway leading to the new main entrances, the subsequent step is to investigate how the new facade edition and site can bolster a sensory-inclusive design. Each site strategy emphasizes the new centered entrance by using the preserved structural columns of Blocks A and D to frame the approach towards the building and establish strong spatial orientation points along the new exterior pathway. This exterior pathway leading towards the centered entrance acts as an extension of the interior sensory spine, opening up the opportunity to bring the sensory qualities into the outdoor realm. The three strategies below explore how various material and environmental strategies can improve comfort, visual legibility, and sensory richness at the threshold of the redesigned KB, focusing on the arrival sequence of the southwest facade.

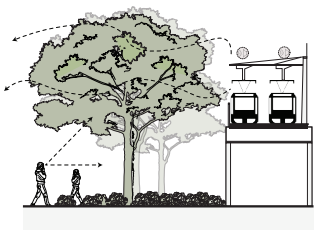
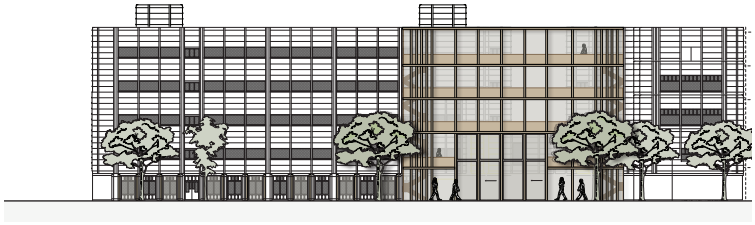


Figure 33.
Facade, Reuse: New facade composed of recycled white aluminum panels from building blocks A and D, heightened for ventilation purposes. Site: Trees acting as partial acoustic and visual buffers, contributing to a calmer perception and sensory quality of the KB site. Compiled by author (Veldkamp, 2025).



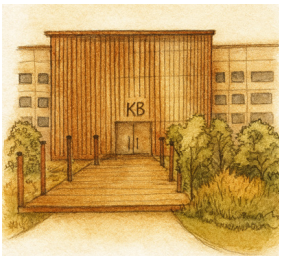


Figure 34.
New wood-framed facade (using Accoya wood) follows the rhythm and lines of the existing aluminum panels, while replacing harsh reflectivity with a warm, non-glary, tactile surface. Its softer visual transition, durability and long lifespan enhances user comfort and ages gracefully. Compiled by author (Veldkamp, 2025).

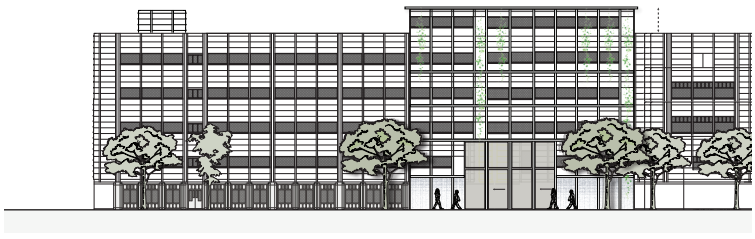


Figure 35.
The new green facade overlays climping plants on a stainless steel Webnet trellis over the existing aluminum panels that have been salvaged from the removal of blocks D and (partially) A. Site: The new canopy roof structure with openings for trees preserves the connection with the NA, while offering a sheltered transition to the new KB entrance. Compiled by author (Veldkamp, 2025).

Strategy 1

This strategy explores how the reuse of the white aluminum cladding from building blocks A and D for the new facade edition can ensure aesthetical continuity with the existing KB structure, honoring its original modular facade design (Figure 33). Nonetheless, their elevated reflectance, white aluminum reflects around 80% of solar radiation (Galema, 2017), produces significant glare, stark contrast, and irregular light reflections, all of which impede visual clarity and establish sensory obstacles for visually impaired individuals outside. Numerous reflections between the KB and the Leiden University College in front of the building exacerbate localized heat, while the contrast between the reflective cladding and underlying warmer brick plinth intensifies the material perception of the building. While this option could ensure heritage continuity with the reuse of existing aluminum cladding, it can lead to several technical and visual limitations. Concerning the site, the introduction of medium-height broadleaved trees can serve as acoustic and visual buffers between the existing tramline and the new KB site, alleviating sensory overstimulation by offering filtered views, subtle audio cues through the soft rustling of the trees, and softer shadows, yet this intervention alone cannot completely address all accessibility barriers.

Strategy 2

The second strategy involves the introduction of a warm, non-reflective wooden facade, creating a softer visual transition between city and building, enriching surfaces of orientation through tactile markers on the pathway leading to the new centered entrance. By adhering to the KB's established horizontal facade lines and grid rhythm, the intervention is anchored in the building's structural frame-

work while mitigating excessive glare. The addition of vertical wooden fins mitigate low-angle afternoon sunlight and enhance light regulation (Figure 34). The choice of materiality for the new facade addition extends to the materiality of the exterior pathway leading to the entrance, facilitating tactile navigations through its warmth, material texture and small vibrations of the wood which can be sensed, in accordance with research on tactile cognitive sensibility (Lupton & Lipps, 2018). Furthermore, warm-toned materials like fragrant wood enhance the sensory experience upon arrival by stimulating the sense of smell ((Jordans et al., 2012, p. 398). For the site, a new wadi initiates a series of "green moments," featuring multilayered vegetation, subtle fragrances of aromatic plants, subtle rustling of the leaves. This ensures a smooth transition from the external urban landscape to the internal sensory core.

Strategy 2

The last strategy focuses on a new green facade that overlays climping plants on a stainless steel Webnet trellis over the existing aluminum panels that have been salvaged from the removal of blocks D and (partially) A. This creates a living layer that minimizes late-afternoon glare and heat, increases the sensory experience (sound of leaves rustling in the wind, seasonal change of the facade, earthy plant smell after rain, changing patterns of growing leaves for visual engagement), improves air quality and offers partial protection of facade materials. Early stages will not give much shading, due to vines needing years to fully develop: a good planting base is needed for fast-growing vegetation, while initial shading solutions can be used until plants mature and grow (Figure 35).
For the site a new canopy roof structure with openings for trees is introduced, preserving the connection with the NA, while offering a sheltered transition to the new KB entrance. Users are welcomed by diffused light coming from the roof openings, the sounds of the trees when the wind passes by, shade and coolness and the rich aroma of wood and vegetation - enhancing the sequence of green moments. If technically well designed, the structure can offer protection from glare, enhanced comfort and shading, and weather protection for the KB's users.

Conclusion

To choose the most beneficial strategy for the redesign of the KB, aligning with the project's goal and findings, a comparative matrix has been developed that evaluates the sensory implication per strategy (See table 8). When assessed through the perspectives of tactility, visual legibility, and heritage continuity, the integrated approach of wood and greenery demonstrates the most favorable strategy. The new wooden facade offers a warm tactile surface, while the wooden bridge with tactile markers guides movement and orientation. The new sensory wadi with diverse greenery and aromatic plants contributes to sensory depth and improves microclimate conditions, enhancing user comfort. This method transforms the KB's previously rigid nature, establishing a welcoming entrance sequence, and aligns with the project's primary objective of evolving the KB into a socially resilient and multisensory public space.

5.6 FACADE AND SITE STRATEGIES - SUMMARY

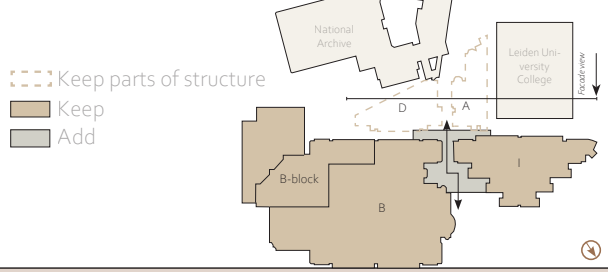
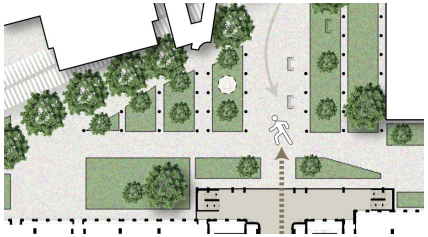
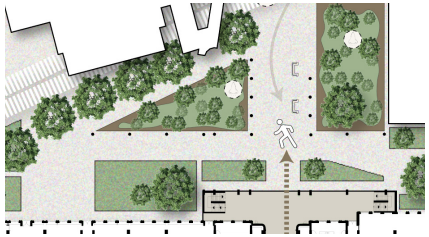
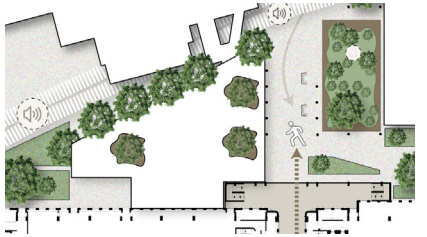
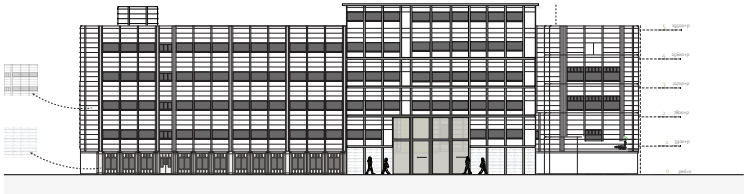


Table 8.
Comparative analysis

	Scenario B *plan strategy*	Scenario B.1 *plan strategy*	Scenario B.2 *plan strategy*
			
	Scenario B *facade strategy*	**Scenario B.1** *facade strategy*	**Scenario B.2** *facade strategy*
			
THE SENSES — *Touch*	The new facade surface feels cool and smooth rather than warm, reflecting incoming sunflight. The brick plinth feels warm, in a more human-scaled way.	The textured warmth of the wood-framed facade contrasts with the cold aluminum surfaces, while evaporative cooling from the wade creates a welcoming and comfortable microclimate before the new entrance.	Roof canopy with tree openings can provide shade during hot summer month, reducing un exposure and leading to a cooler climate. Early morning sunlight can feel soft through the canopy openings. Biodiverse facade evolves over the seasons, while reducing heat and glare, and enhacing sensory engagement.
THE SENSES — *Smell*	The metallic aluminum surface does not add sensory richness, the brick plinth could release an earthy smell when wet, yet leaving smell primarily tied to the surrounding greenery.	Variation of vegetation and aromatic plants surrounding the wadi release subtle scents , especially after rainfall, with the natural fragrance of wet soil and wood.	The air can carry an earthy and organic smell, especially after rainfall, with occasional flowery scents depening on the vegetation planted.
THE SENSES — *Sound*	The new green belts can function as a sound (and visual) buffer, enhancing user experience when approaching the new KB entrance.	The presence of the wadi with varied vegetation can attract different kinds of birds and insects, creating a natural and calm soundscape.	Users can hear the rustling of leaves in the wind, with pleasant sounds of rain trickling through the greenery and webnet, while the green belt muffles part of the tram noise nearby.
THE SENSES — *Sight*	The recycled aluminum panels preserve the KB's material identity, creating a horizontal rhythm of lines and grooves. While the new green belt offers a visual buffer between the tram tracks and the KB's square.	The warm wood-framed facade reduces glare while following the existing lines and rhythm of the aluminum facade, in a more inviting form, complemented by the new green square in the foreground.	The climbing plants on the new facade soften the existing rigid aluminum rhythm of the facade panels with a living layer of vegetation, changing through every season, while offering a vibrant play of light and shadows throughout the day.

Note. Compiled by author (Veldkamp, 2025). Comparative analysis on facade and site strategies.

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Openbare Bibliotheek Amsterdam. (n.d.). OBA – Home. https://www.oba.nl/

Pallasmaa, J. (1996). The eyes of the skin: Architecture and the senses (3rd ed.). Wiley. [ISBN 978-1-1199-4128-6].

Vines Architecture. (n.d.). Durham Main Library. https://www.vinesarc.com/mobile/projects/durham-main-library-2

Wiethoff, M., Sommer, S., Valjakka, S., Van Isacker, K., Kehagias, D., & Tzovaras, D. (2008). User needs for mobility improvement for people with functional limitations. In S. Pinder (Ed.), Advances in human-computer interaction (pp. 595–604). I-Tech Education and Publishing. https://repository.tudelft.nl/islandora/object/uuid%3A8b8d9e99-d456-4b44-906b-1eaa6be4b481

7 FIGURES

7 FIGURES

APPENDIX **A**

Table A1.
Framework for Case Study Analysis

CATEGORY	FOCUS POINTS	GUIDING QUESTIONS
Narrative and Identity	Mission and public identity of the library	What is the narrative or ambition of the library, and how is this communicated spatially?
Spatial Organization	Centralised, Linear, Radial, Cluster, or Grid lay-out, Transition Spaces, Openness vs Enclosure	Is the library structured around a central atrium/hub? How is the space organized? Are there buffer zones between quiet and nosy areas? Is there a relationship between public and private zones?
Program and Functions	Building Services, Functional Spaces and overall Program	What kind of functions are housed in the library infrastructure? Are the functions responsive to diverse user groups? Are there any multi-functional spaces available to meet changing needs?
Zoning and Circulation	Space division, User Flow, Hierarchy of Spaces, Relationship between Public, Private and Semi-public zones	How are different zones (public, private, semi-public) distributed and connected in the spatial lay-out? And what differentiates these zones (visuals, acoustics, texts)? Vertical circulation: How are stairs, elevators, and ramps organized? Horizontal circulation: How are the corridors designed and connected? Wayfinding: Are there any sightlines, tactile or auditory elements guiding the movement?
Multisensory Design Elements	Integration of Tactile, Auditory, Olfactory, and Visual elements in the design	Are there any multisensory design elements integrated in the spatial organization and program of the building?
Accessibility Strategies	Design features addressing sensory and physical impairments	How does the library provide inclusive access to its collections, programs, and services through multisensory strategies? To what degree do the library's design elements cater to various sensory and physical capabilities, and how are these integrated into both the physical and digital environments?

Note. Compiled by author (Veldkamp, 2025). Framework for Case Studies: guiding questions for analyses.

APPENDIX **B**

Table B1.
Literature Overview with Short Summary

Title:	Type:	Content:	Reference:
Accessibility and provision of digital library resources to the visually impaired students in academic libraries: A case study of University of Oslo Library.	Master thesis	The research highlights significant obstacles consisting of insufficient assistive devices, absence of accessible digital content, and a lack of awareness among librarians concerning the requirements of visually impaired users, using the University of Oslo Library as a case study.	Agabirwe, P. (2019). Accessibility and provision of digital library resources to visually impaired students in academic libraries: A case study of University of Oslo Library (Master's thesis, Oslo Metropolitan University). Retrieved from https://oda.oslomet.no/odaxmlui/handle/10642/6922
The spatial experience of visually impaired and blind: an approach to understanding the importance of multisensory perception	Article	Bakir et al. (2022) investigate the spatial experiences of visually impaired and blind individuals through multisensory perception. The research highlights the significance of non-visual sensory stimuli—such as auditory, tactile, and spatial memory—in navigation and spatial cognition.	Bakir, D., Mansour, Y., Kamel, S., Moustafa, Y., & Khalil, M. H. (2022). The spatial experience of visually impaired and blind: an approach to understanding the importance of multisensory perception. *Civ Eng Archit*, *10*(2), 644-58.
Spaces speak, are you listening?	Book	Blesser and Salter investigate the often-overlooked role of sound in architectural design. They think that rooms have innate acoustic properties that influence how individuals perceive and experience their surroundings. The book investigates the sensory influence of sound, highlighting its role in producing immersive and meaningful experiences. The authors investigate how sound influences emotional responses and social interactions in physical settings, as well as how spatial architecture might engage aural senses in ways that complement visual and tactile experiences.	Blesser, B., & Salter, L.-R. (2007). *Spaces speak, are you listening? : experiencing aural architecture*. MIT Press. http://site.ebrary.com/id/10173546
Multi-sensory interaction for blind and visually impaired people	Article	Cho (2021) investigates the significance of multisensory interaction in improving accessibility for those who are blind or visually impaired. The research examines the enhancement of digital and physical navigation experiences through the integration of tactile, auditory, and spatial interactions.	Cho, J. D. (2021). Multi-sensory interaction for blind and visually impaired people. *Electronics*, *10*(24), 3170.
Improving library services to people with disabilities	Book	Deines-Jones (2007) examines methods for improving library services to cater to people with impairments.	Deines-Jones, C. (Ed.). (2007). *Improving library services to people with disabilities*. Elsevier.
Designing for the disabled	Book	Goldsmith focuses on the ideas of creating environments that are accessible to people with disabilities. The book emphasizes the significance of recognizing and meeting the different needs of impaired users via thoughtful and inclusive design. It offers practical recommendations for designing spaces that are not only functional, but also visually pleasant and inspiring for people with a variety of disabilities.	Goldsmith, S. (1997). *Designing for the disabled.* London: Architectural Press.
Assessment of accessibility and inclusivity in the design of public library in Lagos.	Article	The article explores the challenges of accessibility and inclusivity within public libraries, focusing on Lagos as a case study. It emphasizes the ways in which physical and sensory obstacles restrict access for individuals with disabilities, especially those who are visually impaired.	Itoroabasi, U., George, O., & Daniel, A. C. (2024). Assessment of accessibility and inclusivity in the design of public library in Lagos. *International Journal of Multidisciplinary Research and Growth Evaluation*, 5(2), 594–599.
Multi-sensory environments and inclusive sensory engagement at Durham County Library	Article	This article by Jamsky and Alverson outlines Durham County Library's innovative initiatives in creating specialized Multi-Sensory Environments (MSEs) to improve accessibility for users of all ages, especially individuals with different sensory needs	Jamsky, J., & Alverson, S. (2024). Multi-sensory environments and inclusive sensory engagement at Durham County Library. *North Carolina Libraries*, *82*(1). 10.3776/ncl.v82i1.5435
Conceptualising benefits of user-centred design for digital library services	Article	Kautonen and Nieminen analyze the implementation and assessment of user-centered design (UCD) in the implementation of digital library services in this article.	Kautonen, H., & Nieminen, M. (2018). Conceptualising benefits of user-centred design for digital library services. LIBER Quarterly, 27(1), 1–28. https://doi.org/10.18352/lq.10173
Visually impaired access to library services: The role of library infrastructure.	Article	Kwafoa (2019) examines the influence of library infrastructure on the accessibility of services for visually impaired individuals. The research underscores the significance of physical and digital infrastructure in either promoting or obstructing access to knowledge.	Kwafoa, P. N. Y. (2019). Visually impaired access to library services: The role of library infrastructure. Library Philosophy and Practice, (e-journal), 1–19.

Note. Compiled by author (Veldkamp, 2025). This table presents a concise overview of the selected literature, including a summary relevant to the study.

APPENDIX **B**

Table B2.
Continuation of table B1: Literature Overview with Short Summary

The multisensory museum: Cross-disciplinary perspectives on touch, sound, smell, memory, and space	Book	Levent and Pascual-Leone (2014) examine how museums might captivate visitors beyond visual stimuli by integrating multimodal experiences, encompassing touch, sound, olfaction, and spatial memory.	Levent, N., & Pascual-Leone, A. (Eds.). (2014). *The multisensory museum: Cross-disciplinary perspectives on touch, sound, smell, memory, and space*. Rowman & Littlefield.
Blindness and low vision in The Netherlands from 2000 to 2020—modeling as a tool for focused intervention	Article	This study focuses on estimating the causes and magnitude of severe visual impairments (blindness) and mild visual impairments (low vision) in the Netherlands, from the year 2000 up to 2020.	Limburg, H., & Keunen, J. E. E. (2009). Blindness and low vision in The Netherlands from 2000 to 2020—modeling as a tool for focused intervention. *Ophthalmic Epidemiology*, *16*(6), 362–369. https://doi.org/10.3109/09286580903312251
The senses: Design beyond vision	Book	This book examines why we should design beyond sight, while examining how this can enhance accessibility and inclusivity. It includes case studies, articles, and design projects that incorporate sensory stimulation through tactile surfaces, sound, olfaction, and motion.	Lupton, E., & Lipps, A. (Eds.). (2018). *The senses: Design beyond vision*. Chronicle Books.
Accessibility of European museums to visitors with visual impairments	Article	In this study, Mesquita & Carneiro (2016) examine the accessibility of European museums for individuals with visual impairments, assessing current obstacles and inclusive approaches. The research underscores that museums frequently depend on visually oriented exhibitions, hence restricting interaction for visually challenged users.	Mesquita, S., & Carneiro, M. J. (2016). Accessibility of European museums to visitors with visual impairments. *Disability & Society*, *31*(3), 373–388. https://doi.org/10.1080/09687599.2016.1167671
The evolving roles of libraries and librarians in the 21st century	E-journal	Momoh and Folorunso (2019) examine the evolving purpose of libraries and the shifting duties of librarians within a digital and user-centered context. The article examines the evolution of libraries to meet changing societal demands, highlighting the significance of technological integration, user engagement, and inclusive design.	Momoh, E. O., & Folorunso, A. L. (2019). The evolving roles of libraries and librarians in the 21st century. *Library Philosophy and Practice (e-journal)*, *2867*.
The Eyes of The Skin: Architecture and the Senses (3rd Edition)	Book	Pallasmaa underscores the significance of multisensory design in architecture, notably in how surroundings may stimulate all senses beyond mere sight. He claims that contemporary architecture has grown excessively preoccupied with visual stimuli, disregarding the other senses that enhance a comprehensive perception of space.	Pallasmaa, J. (1996). *The eyes of the skin: Architecture and the senses* (3rd ed.). Wiley. [ISBN 978-1-1199-4128-6].
The multisensory experience of handling and reading books.	Article	In this study, Charles Spence examines the multisensory dimensions of engaging with physical books, especially classic and historical texts. He examines how the tactile experience of using a book, the aesthetic allure of its design, the unique aroma of old paper, and the auditory effect of page turning enhance a profound, multisensory reading experience.	Spence, C. (2020). The multisensory experience of handling and reading books. *Multisensory Research*, 33(8), 902–928. https://doi.org/10.1163/22134808-bja10015
On making libraries and museums more accessible for autistic people	Article	This article examines measures to improve the accessibility and inclusivity of libraries and museums for individuals with autism.	Svaler, T. B. (2023). On making libraries and museums more accessible for autistic people. *IFLA Journal*, *50*(1), 42–52. https://doi.org/10.1177/03400352231202516
Perspectives of Visually Impaired Visitors on Museums: Towards an Integrative and Multisensory Framework to Enhance the Museum Experience.	Article	The research underscores the shortcomings of conventional museum designs, which predominantly rely on visual stimuli, and examines how tactile, auditory, and interactive components can enhance visitor engagement. Vaz, Freitas, and Coelho (2021) suggest a multisensory framework to improve accessibility and inclusivity.	Vaz, R., Freitas, D., & Coelho, A. (2021). Perspectives of visually impaired visitors on museums: Towards an integrative and multisensory framework to enhance the museum experience. Proceedings of the 18th International Conference on Digital Accessibility, 343-350. https://doi.org/10.1145/3439231.3439272
User needs for mobility improvement for people with functional limitations	Book chapter	This chapter by Wiethoff et al. examines the mobility requirements of individuals with functional limitations, investigating how technology and design might enhance their mobility and mitigate obstacles.	Wiethoff, M., Sommer, S., Valjakka, S., Van Isacker, K., Kehagias, D., & Tzovaras, D. (2008). User needs for mobility improvement for people with functional limitations. In S. Pinder (Ed.), Advances in human-computer interaction (pp. 595–604). I-Tech Education and Publishing. https://repository.tudelft.nl/islandora/object/uuid%3A8b8d9e99-d456-4b44-906b-1eaa6be4b481

Note. Compiled by author (Veldkamp, 2025). This table presents a concise overview of the selected literature, including a summary relevant to the study.

APPENDIX **B**

Table B3.
Continuation of table B1: Literature Overview with Short Summary

Enhancing usability of digital libraries: Designing help features to support blind and visually impaired users.	Article	Xie et al. (2020) investigate the potential of digital libraries to improve usability for blind and visually impaired individuals through the development of efficient assistance features. The research examines the difficulties encountered by users in navigating digital library interfaces and assesses assistive technologies that enhance accessibility.	Xie, I., Babu, R., Lee, T. H., Castillo, M. D., You, S., & Hanlon, A. M. (2020). Enhancing usability of digital libraries: Designing help features to support blind and visually impaired users. Information Processing & Management, 57(3), 102110. https://doi.org/10.1016/j.ipm.2019.102110
Multisensory reading promotion in academic libraries	Article	In this study, Yu et al. examine the execution of multisensory reading promotion in academic libraries, concentrating on the Reading Together with Library Echo (RTLE) initiative at Zhejiang University of Technology Library. The RTLE software integrates auditory and visual components to foster an immersive reading experience, with the objective of augmenting user engagement and facilitating comprehensive reading.	Yu, W., Jiang, Y., Wu, Y., & Cheng, Y. (2023). Multisensory reading promotion in academic libraries. *Frontiers in Psychology*, 13, 987180. https://doi.org/10.3389/fpsyg.2022.987180

Note. Compiled by author (Veldkamp, 2025). This table presents a concise overview of the selected literature, including a summary relevant to the study.

APPENDIX **C**

Table C3.
Multisensory Accessibility in Libraries: A Literature Review Matrix

REFERENCES	Multisensory Accessibility				Accessibility & Inclusivity				Accessibility for the Visually Impaired				User Experience and Engagement			
	Sensory Design	Multisensory	Beyond Sight Design	Embodied Interaction	Barriers	User needs	Inclusivity	General Accessibility	Assistive Technologies	Sound	Wayfinding	Tactile Design	Sensory Stimulation	User Engagement	User Experience	User Satisfaction
Agabirwe, P. (2019)					■	■	■		■						■	
Bakir et al. (2022)		■	■				■			■	■	■			■	
Blesser, B., & Salter, L. (2009) [Book]	■		■			■			■	■				■	■	
Cho, J. D. (2021)		■	■						■	■		■		■	■	
Deines-Jones, C. (Ed.). (2007)					■	■	■		■		■					■
Goldsmith, S. (1997) [Book]	■				■	■	■		■		■	■				■
Itoroabasi et al. (2024)					■	■	■		■	■		■				
Jamsky, J., & Alverson, S. (2024)	■	■				■	■		■					■		
Kautonen, H., & Nieminen, M. (2018)						■	■		■					■	■	
Kwafoa, P. N. Y. (2019)			■		■	■	■		■		■	■			■	
Levent et al. (2014) [Book]		■	■	■			■			■		■	■		■	
Lupton, E., & Lipps, A. (Eds.). (2018).	■	■	■	■			■			■		■	■			
Mesquita, S., & Carneiro, M. J. (2016)		■	■		■		■		■			■		■		
Momoh, E. O., & Folorunso, A. L. (2019)		■					■		■					■	■	
Pallasmaa, J. (1996) [Book]	■	■	■	■			■					■	■			
Spence, C. (2020)	■	■													■	
Svaler, T. B. (2023)	■					■	■	■						■	■	
Vaz, Freitas, & Coelho (2021)		■	■	■			■			■		■	■	■	■	
Wiethoff et al. (2008)	■					■	■		■		■					
Xie et al. (2020)			■		■	■			■		■				■	■
Yu et al. (2023)	■	■				■								■	■	

Note. Compiled by the author (Veldkamp, 2025). This matrix presents a checklist derived from the literature overview in Table 2, illustrating the research indications found in each source.

APPENDIX **D**

Table D1.
Accessibility needs for Neurodiverse and Impaired User Groups

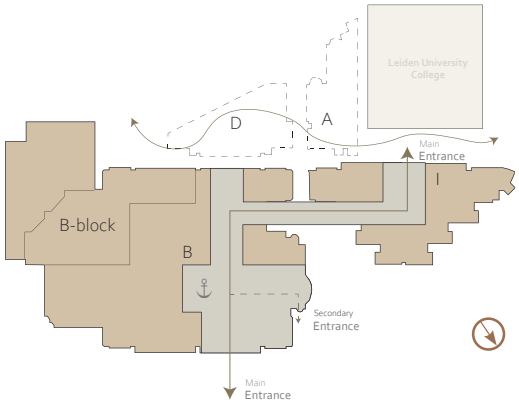
Group	Characteristics	Inclusive Design through	
Visually Impaired	Impaired visual perception, dependence on non-visual senses (e.g., auditory – sound, tactile - touch).	*Physical*	*Digital*
		More accessible environment through soundscapes, tactile surfaces, non-visual navigation.	Incorporation of braille and auditory technology (European Accessibility Act, EAA).
Mobility Impairments	Challenges with fine or gross motor abilities, restricted mobility, and the necessity for assistance devices such as wheelchairs.	Physical spaces that are accessible (e.g., ramps, elevators, widened paths and ergonomic design).	
Dyslexic	Challenges with text comprehension and letter reversal; difficulty with penmanship, reading, and writing.	Modifications to text-based design (e.g., streamlined typefaces, text-to-speech functionality, visual indicators). Transparent arrangement for information distribution.	
Attention Span Disorders (ADHD)	Challenges in concentration, frequent attentional shifts, inattention, hyperactivity, and impulsivity (NIMH, n.d.).	Engaging design elements (e.g., audio or visual stimuli), information presented in a clear and direct matter.	
Low Literacy	Restricted proficiency in reading and writing, dependence on visual aids, frequently constrained vocabulary.	Multimedia support, literacy programs.	
Low Digital Skills	Insufficient knowledge or comfort with digital technology may hinder effective navigation of interfaces.	Clear digital interfaces, detailed technology usage instructions, and user-friendly designs.	

Categorization based on sketch by Ted van der Togt, researcher KB, European Digital Reading Lab and Future Libraries Lab.
Design strategies based on: European Parliament. (2018). Assistive technologies for people with disabilities. European Parliamentary Research Service. https://europarl.europa.eu
Attention-Deficit/Hyperactivity Disorder (ADHD). (n.d.). National Institute of Mental Health (NIMH). https://www.nimh.nih.gov/health/topics/attention-deficit-hyperactivity-disorder-adhd

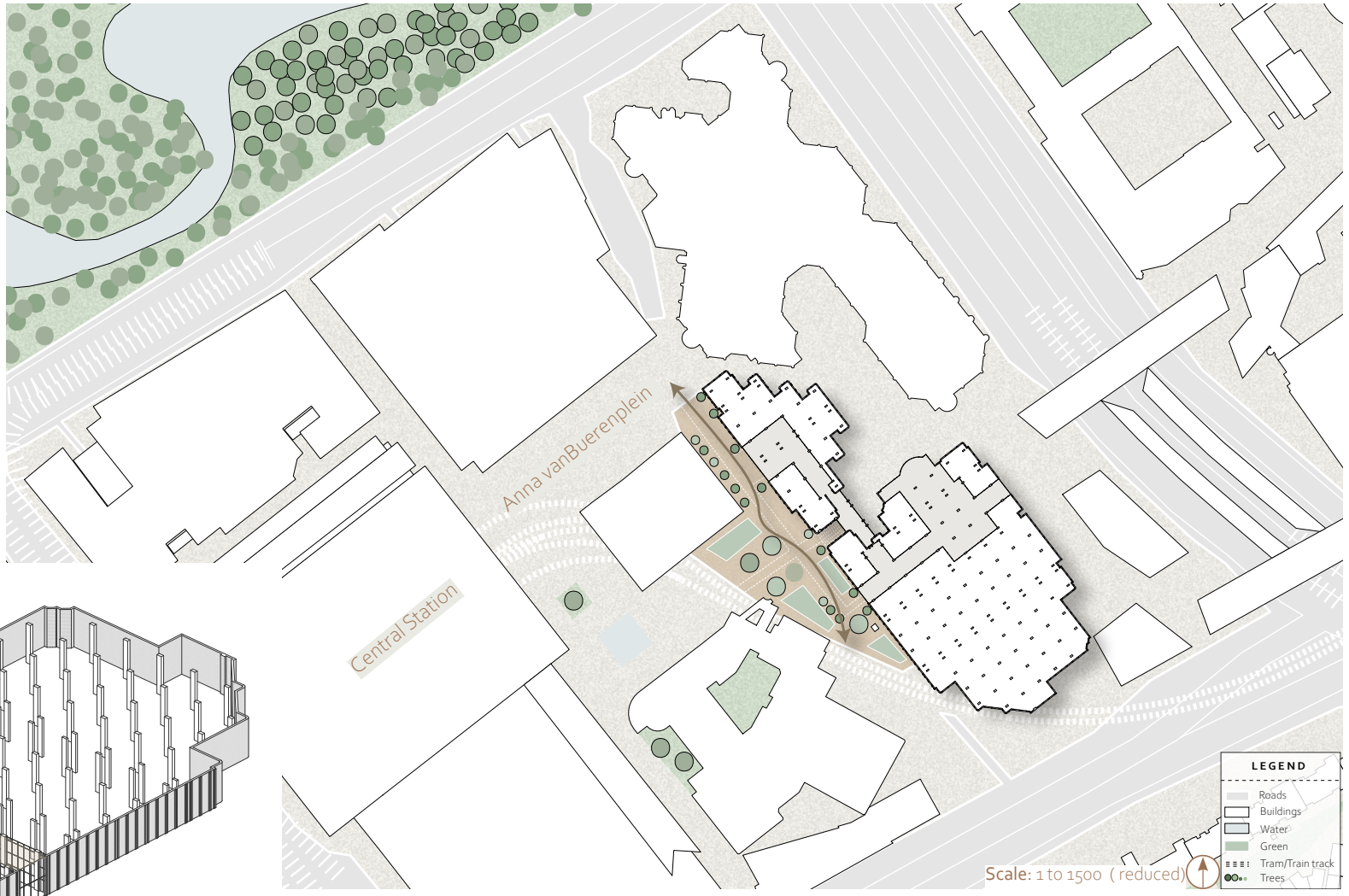
Note. Compiled by author (Veldkamp, 2025). Categorization based on Ted van der Togt, researcher KB, European Digital Reading Lab and Future Libraries Lab.

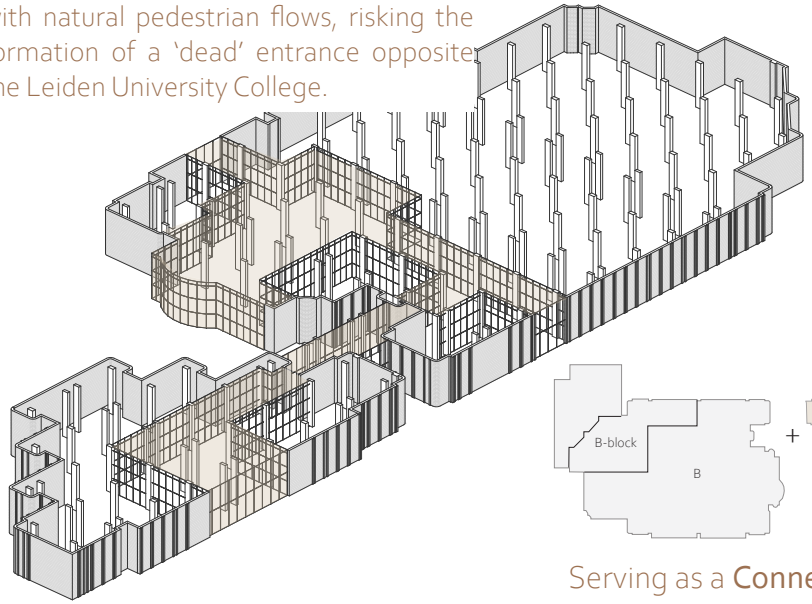
APPENDIX **E**

Variant One: Off-centered Entrance

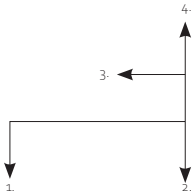


The new sensory spine is rooted in the original modular grid system (7.05m, and 8.10m H.O.H distance between columns) designed by architect Arie Hagoort. Honoring this, ensures the intervention is seen as a natural progression rather than a imposition. Yet, entrance 1 does not align with natural pedestrian flows, risking the formation of a 'dead' entrance opposite the Leiden University College.

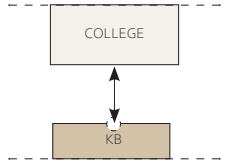




Serving as a **Connector**



Four different **Entrances**

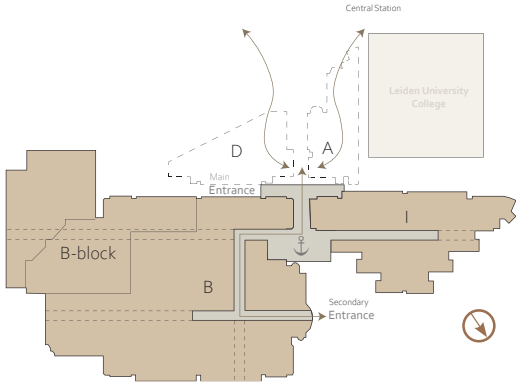


Risk of **'Dead' Entrance** opposite College

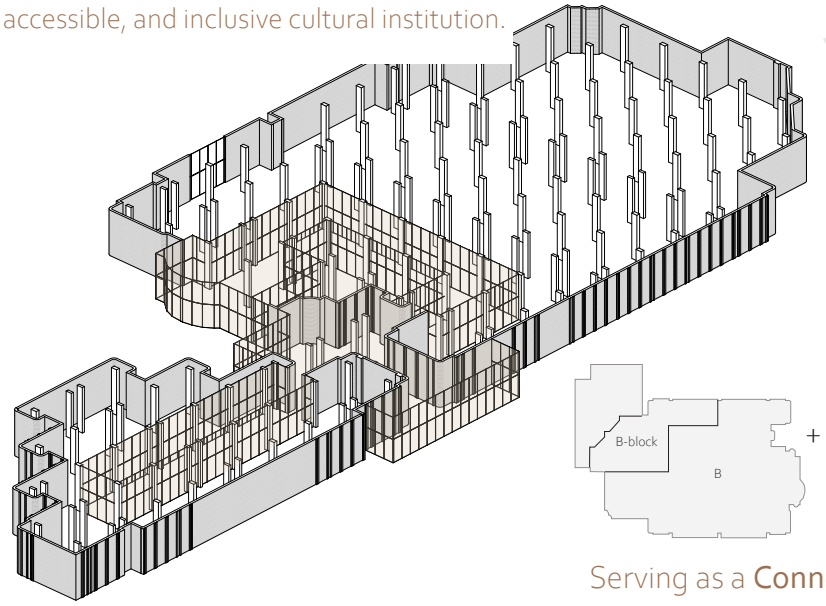
Elisabeth Veldkamp 4648056

APPENDIX **F**

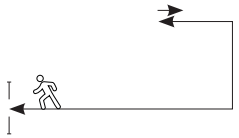
Variant Two: Centered Entrance



The newly established central entry, created by the removal of Blocks A and D, directly addresses the existing main pedestrian flow, removes spatial obstacles, and promotes the central courtyard as the focal point of movement and experience. It transforms a formerly divided structure into a cohesive, accessible, and inclusive cultural institution.



Serving as a **Connector**



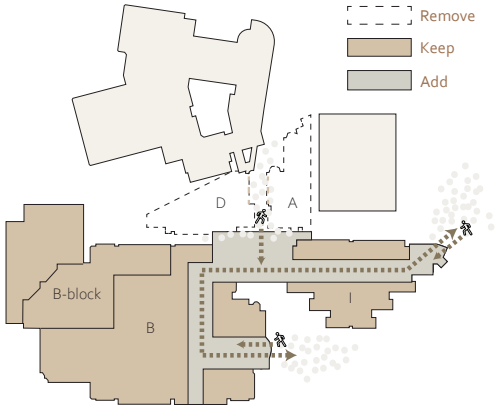
⊖ Spine leads to **Dead End** inside

⊖ Does **not** follow main **pedestrian flows**

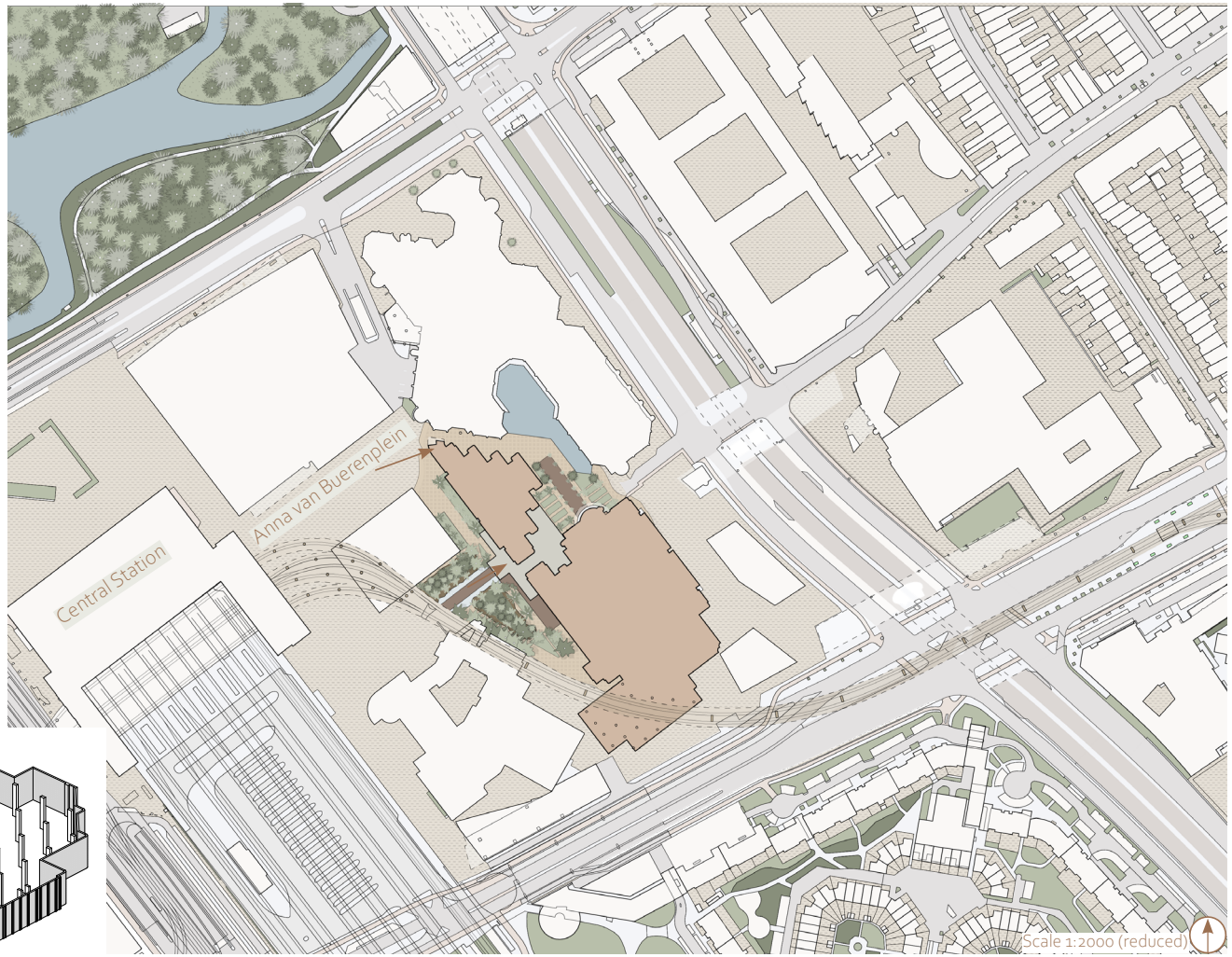
Elisabeth Veldkamp 4648056

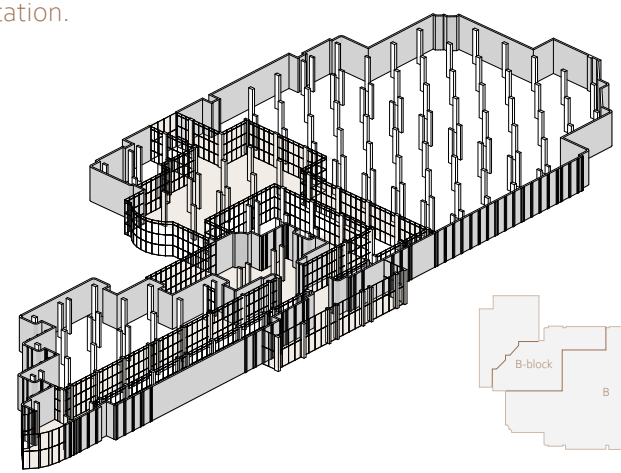
APPENDIX G

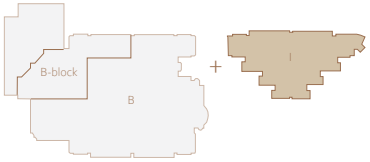
Variant three: integration of the Sensory Spine within the KB



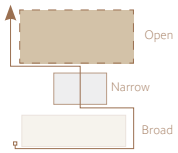
The new sensory spine is rooted in the **original modular grid system** (7.05m, and 8.10m H.O.H distance between columns). Variant 3 synchronizes entrances with pedestrian movement by incorporating a corner entrance at the **Anna van Buerenplein**. The extended corner entrance ensures stronger visual legibility when arriving from the Central Station.







Serving as a **Connector**



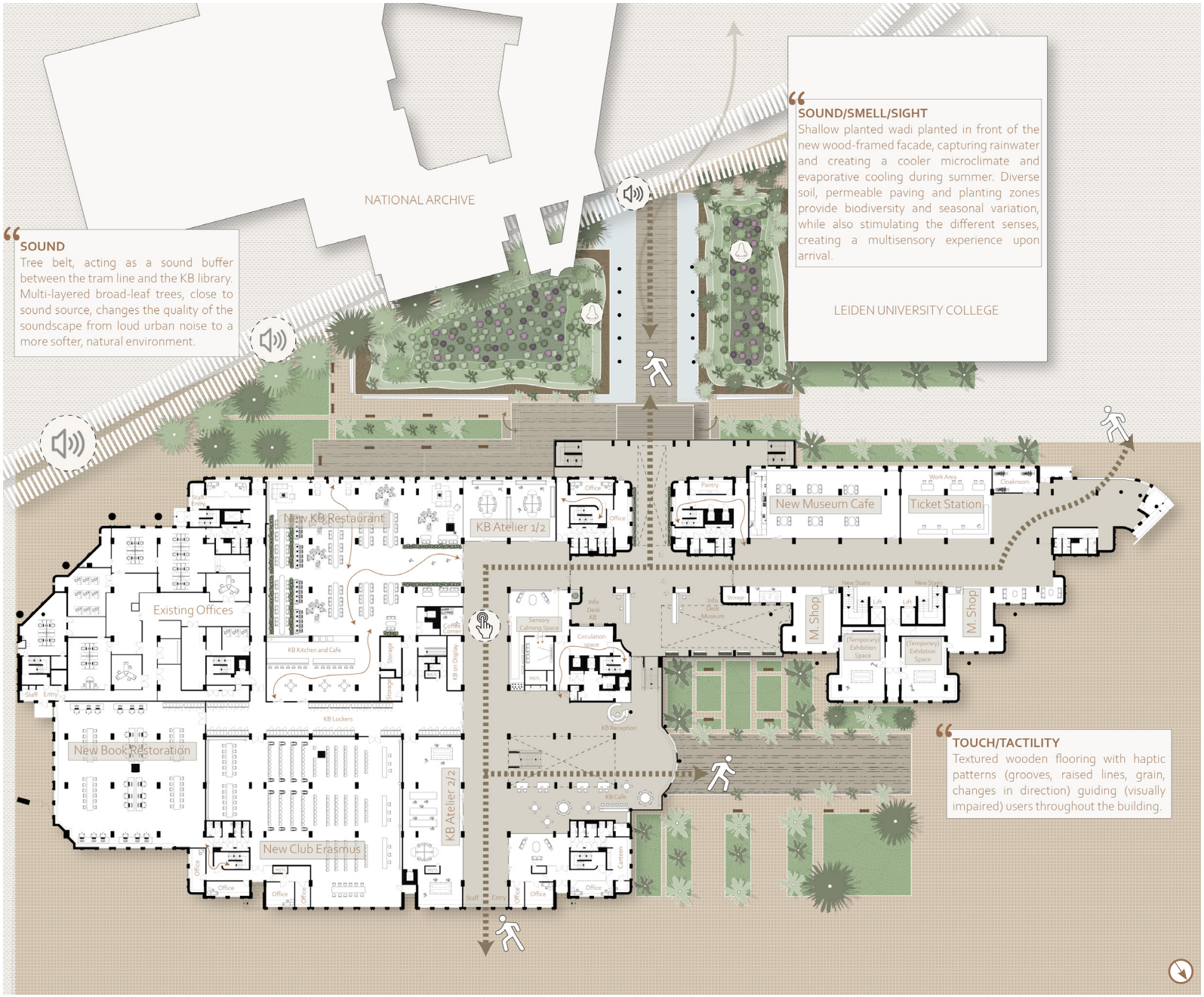
Following a **Dynamic Rhythm**

Using **Tactile Materials**

Elisabeth Veldkamp 4648056

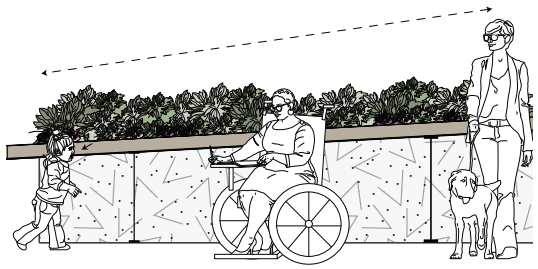
APPENDIX **H**

Masterplan Ground floor - scale 1:200 (reduced)



APPENDIX I

Masterplan Context

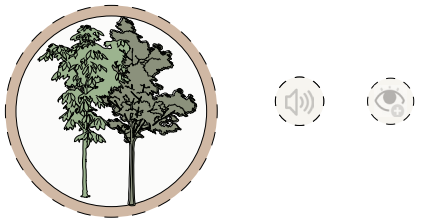


TOUCH/SMELL

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

SIGHT/SOUND

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

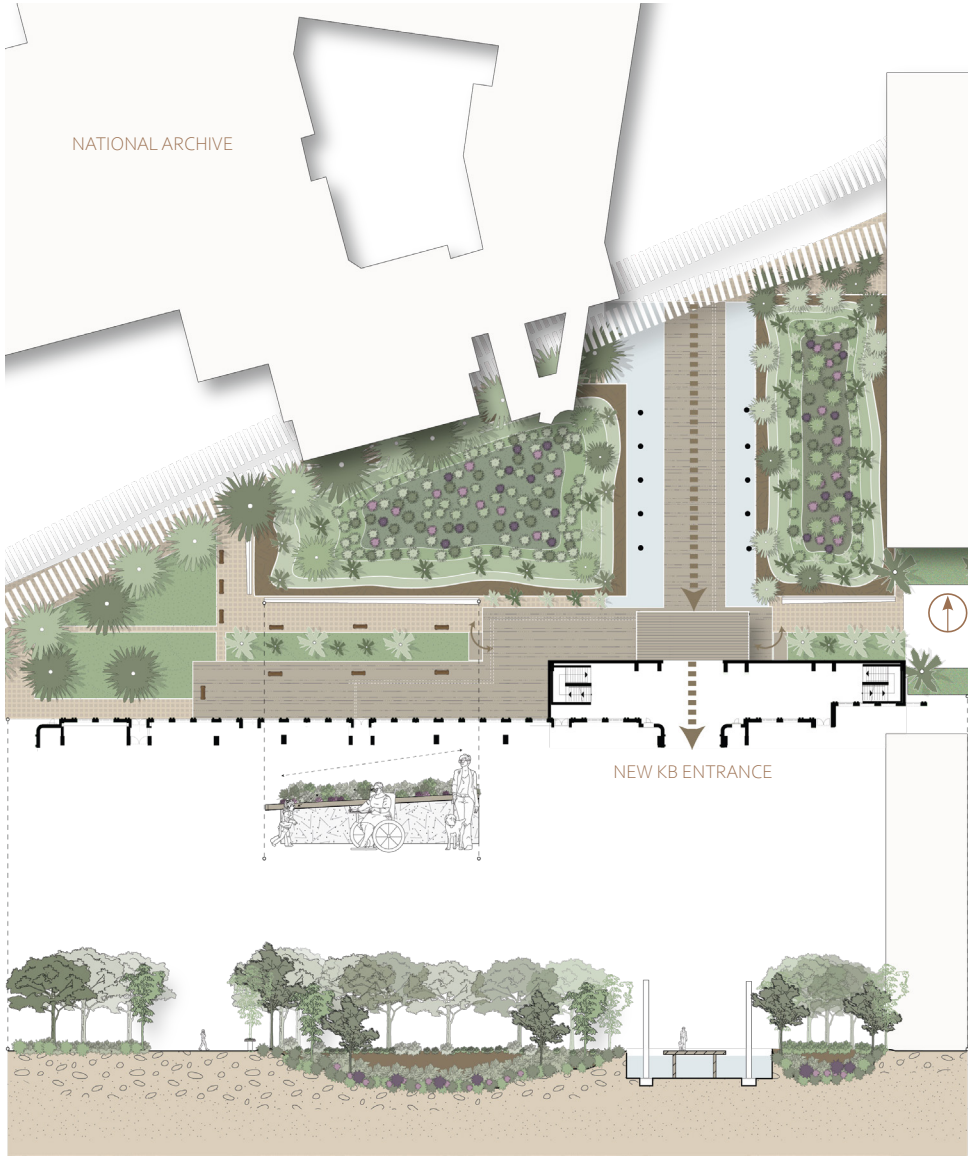


SIGHT/SOUND

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

SIGHT/SOUND/SMELL

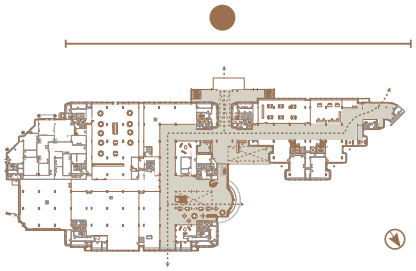
Dense low shrubs and aromatic plants, with textured foliage, scents activated by sun, year-round greenery with drought resistance. Grasses and aromatic herbs, releasing subtle scents when wet, gentle swaying in the wind, tolerating flooding and attracting different insects and birds.

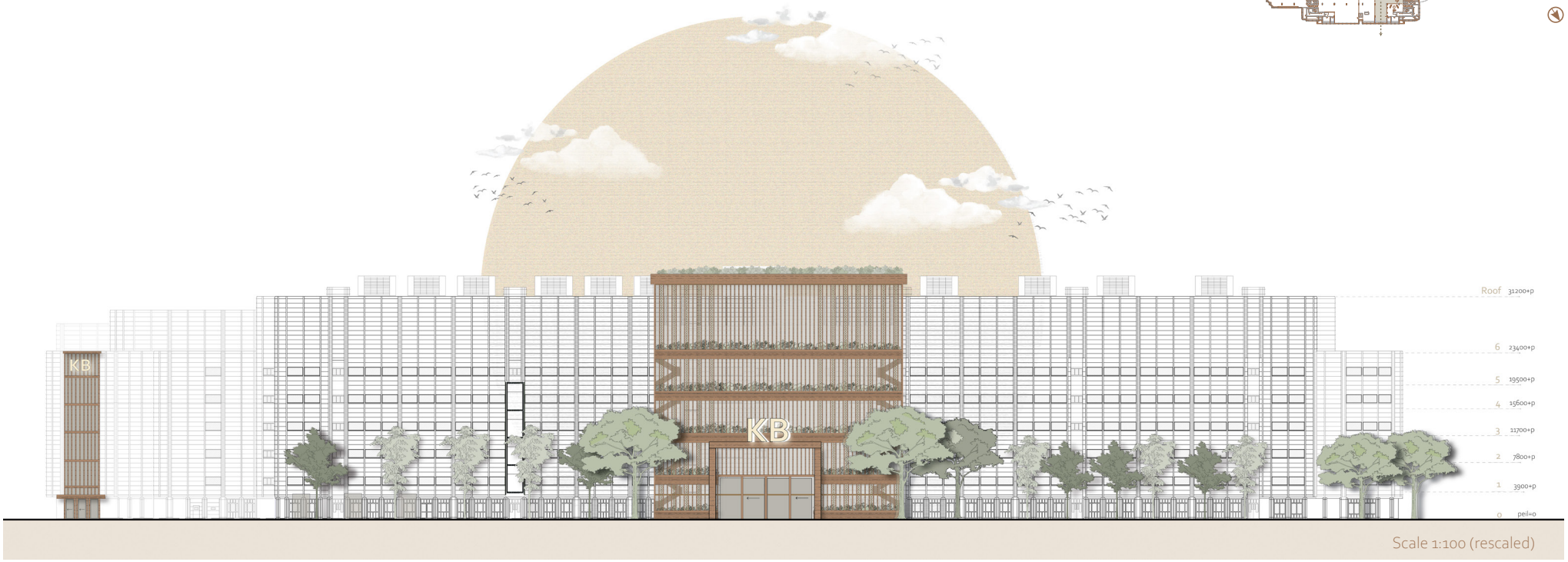


Section and Plan
Scale 1:500 (reduced)

APPENDIX J

Masterplan SW Elevation





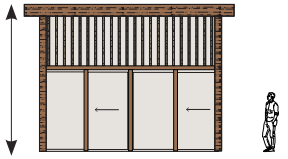
Scale 1:100 (rescaled)

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

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

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

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



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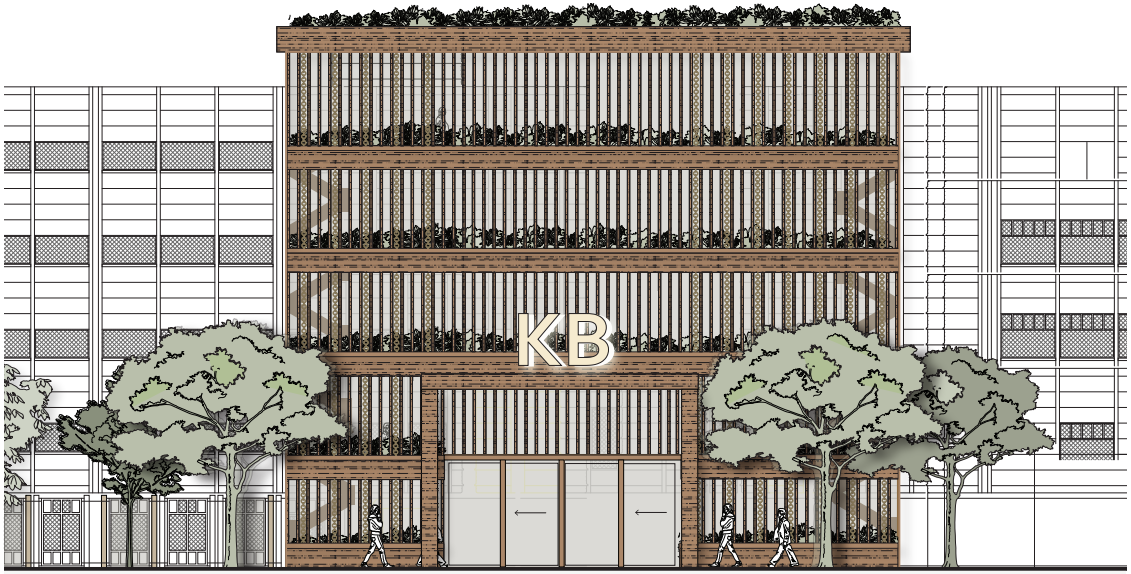
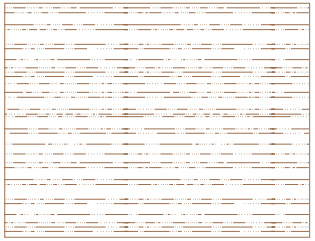
APPENDIX **K**

Facade Composition

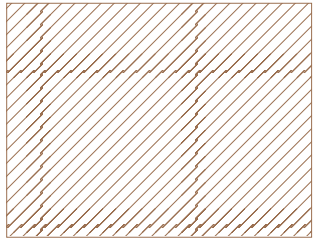


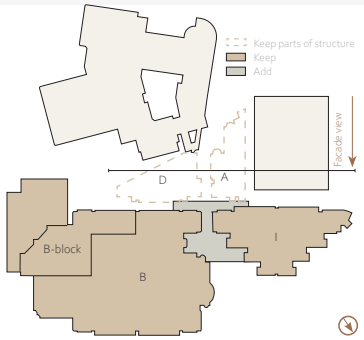
Southwest elevation refined 1:200

Accoya Wood
Vertical fins, planters, canopy



Copper/Stainless Steel
Brushed/matte rain chains





DESIGN STATEMENT

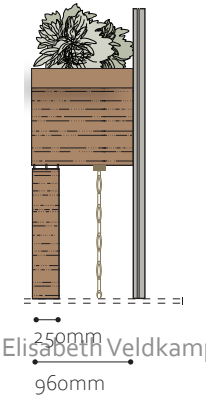
The new façade follows the **horizontal grid** of Arie Hagoort's **modular system**, ensuring structural and aesthetic continuity (Galema, 2017). In contrast, the **vertical Accoya/Cedar fins introduce a new rhythm**, enhancing shading, depth, and tactile perception, while maintaining harmony with the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

FRONT VIEW

Concept 1:50

SIDE VIEW

Concept



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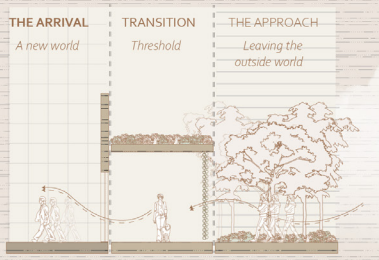
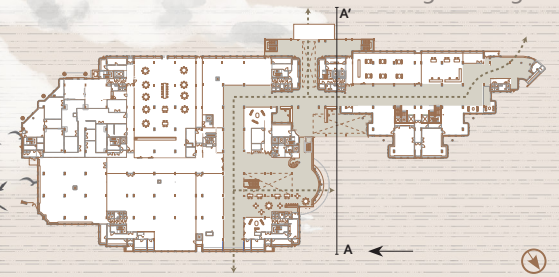
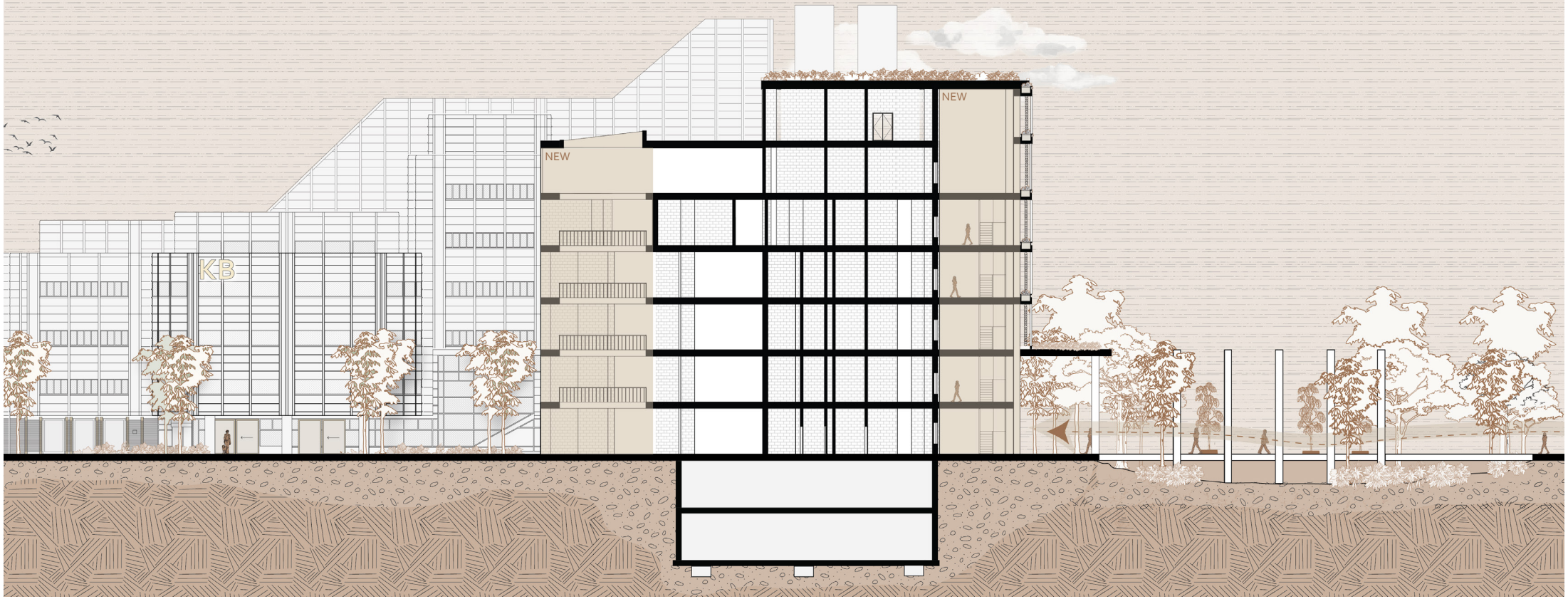
APPENDIX L

NW Section AA'

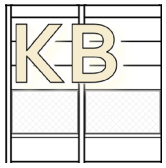




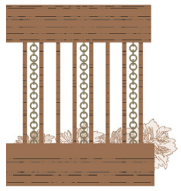


Subtle ground-level openings

New Green Square – Climate Buffer



Oversized illuminated KB letters for low vision wayfinding



Rain Chains & Planters – Gradual Water Flow

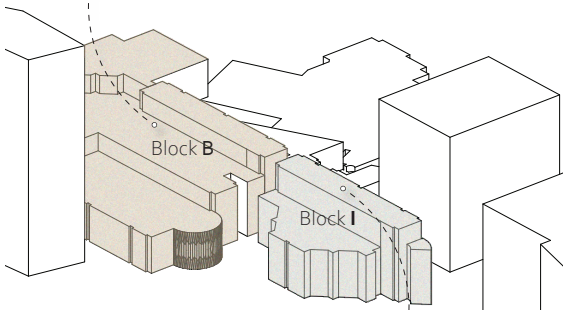
Biodiverse green and wadi form a climatic threshold framed by retained columns

Trees acting as a visual and sound buffer

APPENDIX **M**

Program Proposal

KONINKLIJKE BIBLIOTHEEK (THE KB)
National Library of the Netherlands



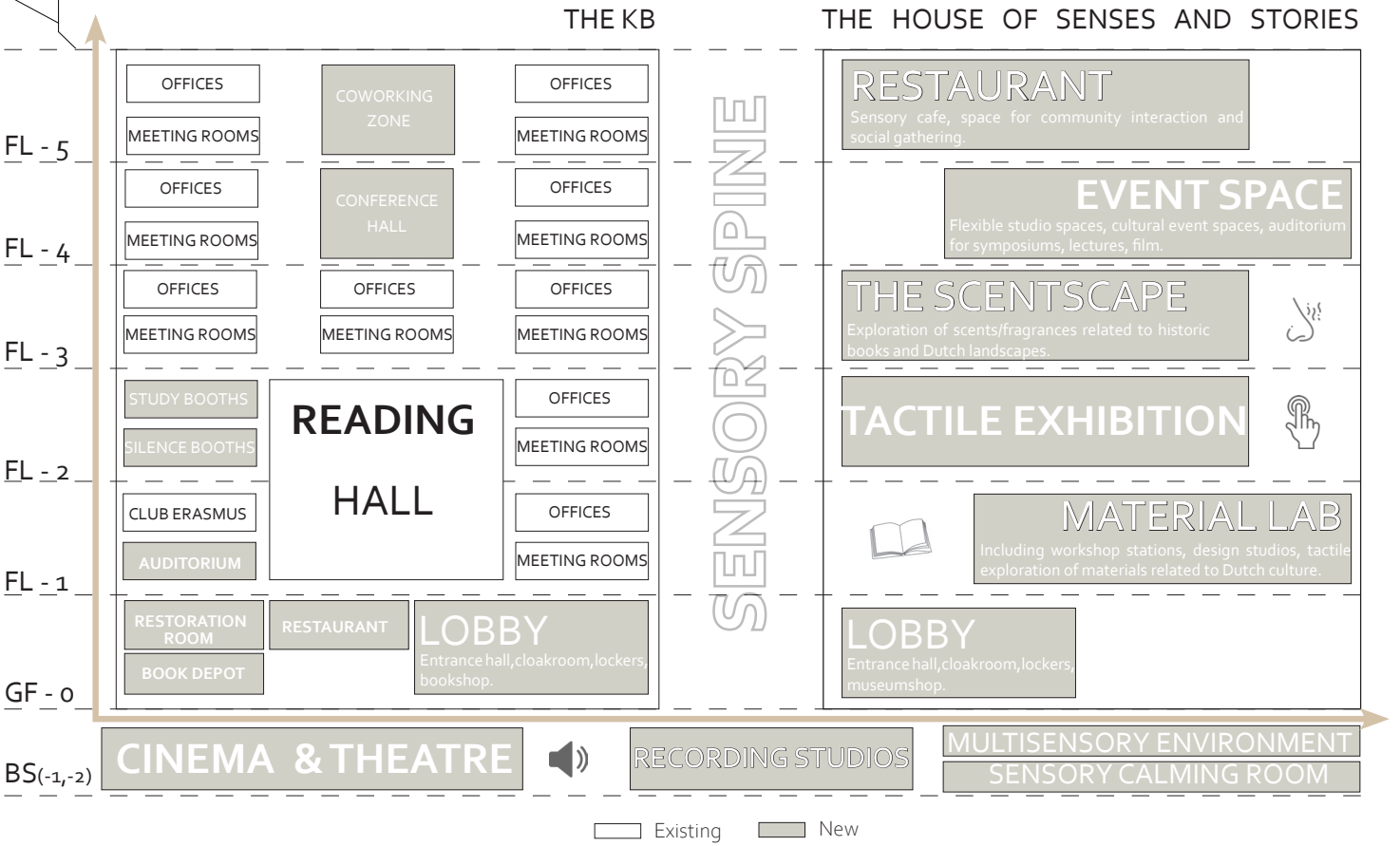
THE HOUSE OF SENSES AND STORIES
A Multisensory Museum of Dutch Culture

THE HOUSE OF SENSES AND STORIES

The mission of the museum is to connect visitors, through an inclusive and immersive experience, with Dutch cultural heritage through a multisensory approach: touch, sound, scent and sight.

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

The multisensory museum transforms cultural content into sensory experiences, while introducing a program that enhances the KB's role beyond conventional reading and doing research. This program proposal was inspired by Taalhuis Amsterdam (The Netherlands in Senses), and the ARTIS-Groote Museum: Scent Tunnel.



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APPENDIX **N**

Interview Questions for Kimberly Brinkhuis (Digital Accessibility Researcher, KB)

In collaboration with fellow peer Sander Groen, the following questions were used to guide the semi-structured interview conducted with Kimberly Brinkhuis, researcher in digital accessibility at the Koninklijke Bibliotheek, on 7 November 2025 (K. Brinkhuis, personal communication, November 7, 2025). The aim of the interview was to gain insight into accessibility barriers for impaired users and to discuss the implications for the proposed Sensory Spine design concept.

1. General Experience & Starting Points

- How do you usually experience large public buildings such as libraries or museums? What often goes well, and what often goes wrong?
- What are the most important conditions for you to move independently and safely through a building?
- Are there examples of buildings (libraries) that you think perform well in terms of accessibility for blind and visually impaired users?

2. Orientation & Entering the KB

- When you enter a new building, what do you need first in order to orient yourself?
- How important is a clear "main direction" or spine in the building (such as a spiral or linear route)? What should we pay particular attention to in that case?

3. Questions on the Spiral Route

- A spiral is a continuous route through the building. Does this sound clear to you (one clear route), or could it become confusing (because of the turning movement)?
- The sensory spine is a continuous circulation route throughout the building, facilitating wayfinding and spatial orientation. What design elements can be introduced to further enhance spatial memory and orientation?
- How do you prefer to notice that you are changing "levels" (floor, height), especially when this happens through a ramp rather than stairs?(sound, material, smell, acoustics)?
- What is comfortable for you in terms of ramp inclination: can you clearly feel the difference between a "comfortable" slope and one that is too steep? Where do things often go wrong in other buildings?
- What would you need in order to feel, along the spiral/sensory spine:

o Where you are (e.g., middle of the route, nearly at the top),

o Which functions are around you (reading rooms, exhibition areas, makerspace),

o Whether clear "anchors" would help—places where the space feels recognisably different (sound, material, smell, acoustics)?

4. Tactile and Auditory Elements

- Which tactile and audible elements do you use most in other buildings (tactile tiles, handrails, tactile floor plans, acoustics, echo, announcements)?
- If one continuous handrail runs along the spiral, what would you like to be integrated into that handrail?
- For example: tactile markers for floors/sections, braille at important points, vibration/feedback?
- How can material differences in floors and walls be used to help you feel when entering another zone (e.g., study area vs. exhibition space)?
- To what extent does sound help you orient yourself (openness, busy places, quiet, voices)? Should the design create more "acoustic landmarks" or prioritise sound dampening?

5. Safety, Calm & Crowds

- What do you need to feel safe on a ramp or spiral (edges, handrails, height differences, balustrades)?
- How can we best signal that the spiral is ending or that you have reached a specific floor?
- How do you navigate crowds and traffic flows in buildings? What can be done to reduce collisions and chaotic movement?

6. Digital Tools & Wayfinding

- Do you use apps or technologies (e.g., NaviLens, Soundscape-like tools) to orient yourself in buildings?
- What would you like an accessibility policy to include regarding digital tools? And how could this be translated into architectural design?

KB nationale bibliotheek

UNIVERSAL INCLUSIVITY

Designing for Senses

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