

ADAPTIVE AND INCLUSIVE SEATING DESIGN FOR TRANSIT-ORIENTED INTERIOR

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Abstract

As transit-oriented interiors increasingly evolve into complex commercial and social micro-environments and serve diverse user groups, seating design must respond beyond basic functionality to address the need for adaptation and inclusivity. This study explores adaptive and inclusive design strategies through the development of seating design in such a context. This research follows Liedtka's human-centred, iterative design process comprising stages such as empathy, definition, ideation, and prototyping in developing seating design for a transit-oriented interior at Canabeans Coffee, located within KCIC Halim High-Speed Rail Station, Jakarta.

The design integrates ergonomic, aesthetic, and accessibility considerations while responding to contextual challenges of a high-density transit environment. The design study proposes a circular bench as a form of seating that promotes adaptation and inclusivity for such a context. The bench is conceived as a seating solution that gives a moment of pause for its users in navigating the interior. The circular arrangements are adaptable for various user needs, fostering social interaction. The proportion, details, and materials of the bench support various mobility needs and enhance their spatial experience. This study contributes to the discourse on adaptive and inclusive strategies in public furniture design, emphasising the importance of harmonising function, comfort, and social meaning in transit-oriented interiors.

Keywords: adaptive, inclusive, circular bench, transit-oriented interiors

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Introduction

The design of interior elements within transit-oriented environments has traditionally prioritised material durability and spatial efficiency, often treating seating as infrastructure for capacity management. However, as public transportation hubs evolve into complex commercial and social micro-environments (Pongratz, 2025), seating must transcend basic functionality and embrace adaptive and inclusive design strategies (Sosa et al., 2022). These approaches recognise seating not only as a physical necessity but as a critical determinant of user experience—fostering comfort, accessibility, and cognitive ease for a diverse and temporally pressured user base (Juliá-Nehme et al., 2023; Juliá Nehme et al., 2020; Wu, 2018). This shift reflects an emerging paradigm in interior design, one that moves beyond standardised solutions, toward context-sensitive interventions that respond to the psychological, physical, and socio-cultural dimensions of transit users.

While the built environment's influence on user behaviour is well established, existing literature on transit-oriented interiors tends to focus on operational logistics, architectural spectacle, or aesthetic optimisation. Studies on seating and public furniture often emphasise material durability (Grabiec et al., 2022; Mumcu & Yilmaz, 2016), maintenance efficiency (Moercahyono & Pasaribu, 2023), or ergonomic standards designed for statistically average users (Saha et al., 2024; Sydor & Hitka, 2023). As a result, there remains a significant gap in research addressing how formalised, user-centred design strategies—such as design thinking—can be applied to develop micro-level interventions that respond to user diversity, spatial adaptability, and commercial constraints in high-density transit environments. Bridging this gap is essential for advancing scalable design models that enhance user agency without compromising operational viability.

This study directly responds to the identified gap by applying Liedtka's (2014, 2018) structured prototyping, an empathy-driven design thinking framework, to the development of a circular bench prototype within the Canabeans Coffee at KCIC Halim Station. The research demonstrates how this methodology can translate complex adaptive and inclusive design requirements into a tangible interior element that serves both utilitarian and symbolic functions. The bench is examined not only for its practical roles—such as seating, spatial organisation, and wayfinding—but also for its potential to foster impromptu social interaction, evoke a sense of identity, and cultivate empathy within a transient, high-pressure transit environment.

Adaptive and inclusive furniture design in response to transit-oriented interiors

The urgency to integrate adaptive and inclusive design principles in transit-oriented interiors arises from global trends in increased mobility and urban heterogeneity. Transportation hubs serve as convergence points for individuals with diverse physical abilities, cultural norms, and emotional states—making seating design a critical interface for equitable spatial experience

(Luck, 2017). Inclusive design aims to minimise exclusion and maximise usability across a broad spectrum of users (Rinaldi et al., 2025), while adaptive design enables spatial configurations to respond dynamically to fluctuating demands and varied user groups throughout the day (Luck, 2017; Sipahi & Sipahi, 2024; Tirachini et al., 2013). Implementing adaptive and inclusive strategies is not merely a matter of compliance but a necessary evolution toward human-centred, resilient, and contextually responsive public interiors.

Adaptive design in transit-oriented interiors emphasises flexibility, multifunctionality, and responsiveness to the diverse user needs and environmental conditions. While traditional seating often targets average ergonomic standards, recent studies highlight the need for furniture that accommodates varied postures, fluctuating user density, and dynamic spatial configurations (Atmodiwirjo & Yatmo, 2022; Postell, 2012; Pramantha et al., 2022). Adaptive public furniture must respond not only functionally and spatially, but also temporally—serving different purposes across time and user groups (Gómez-Carmona et al., 2022; Grabiec et al., 2022; Şatir & Korkmaz, 2005; Siu & Wong, 2015; Sosa et al., 2022). These insights underscore the urgency of embedding adaptive strategies into furniture design to ensure resilience, inclusivity, and contextual relevance in high-density public interiors.

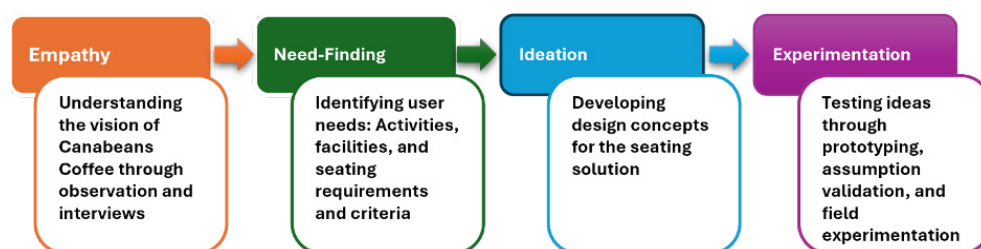
On the other hand, inclusive design in transit-oriented interiors seeks to create environments that are accessible, intuitive, and socially engaging for users of all ages, abilities, and backgrounds. Foundational principles such as equity, flexibility, clarity, and perceptibility (Clarkson et al., 2013) guide the development of seating that accommodates diverse physical needs, including optimal seat height, backrest angle, and mobility support (Wang et al., 2025). Beyond physical accessibility, inclusive furniture also fosters social interaction through spatial configurations that reduce hierarchy and promote openness (Rinaldi et al., 2025; Sawyer & Bright, 2014).

Inclusive furniture becomes a strategic element in transit-oriented interiors—dissolving boundaries between public and private space (Mumcu & Yilmaz, 2016; Ryerson, 2015; Sawyer & Bright, 2014; Stanco & Tanasi, 2012)—and serves as a narrative medium that conveys social and cultural meaning (Hurdley, 2007). Psychologically, public seating needs to offer choice, protection, and connection to surrounding activity (van Hagen et al., 2014). The form of the seating may influence such needs. For example, circular forms evoke the feeling of unity and equality, despite creating challenges in circulation and privacy (Lima, 2017). These insights affirm that there are tangible and intangible dimensions of user experience in dynamic public settings (Sosa et al., 2022), of which inclusive design must address. It can be argued that while adaptive design allows flexibility in furniture arrangements for different times, inclusive design responds to different physical needs and provides for social and cultural contexts. The following design exploration aims to apply these strategies in developing the seating needs for transit-oriented interiors.

Method

This article outlines the design process of a bench for Canabeans Coffee at KCIC Halim Station. The methodology of this design study comprises three core stages: need-finding, ideation, and experimentation through prototyping (Liedtka, 2014, 2018). In practice, the design thinking approach was applied flexibly, with a primary focus on generating design solutions through collaboration and digital exploration. To gain a deeper understanding of spatial needs, contextual analysis was first conducted based on observations of user behaviour and the environmental characteristics of the station. The diagram presented in this article illustrates the stages of the design thinking process employed in the development of seating for Canabeans Coffee (Figure 1).

The study began with the need-finding stage, which consists of the process of empathising and understanding user experiences to articulate design needs (Figure 1). The designer seeks to understand the users' vision and needs through direct observation and interviews with relevant stakeholders. The design problem is formulated based on user activities and existing facilities, and the criteria for appropriate seating design are established. The next stage is ideation, which is aimed at exploring alternative solutions to address the identified needs. The design process follows by experimentation and prototyping, which entails the creation of a presentation model of the selected seating concept, serving as an initial visualisation and ideas testing prior to implementation.



These four stages reflect a systematic and user-centred approach to design, aimed at producing solutions that are relevant, functional, and contextually attuned to the spatial characteristics and user needs of Canabeans Coffee. This approach enabled the design to evolve adaptively and responsively to the needs of users in public spaces.

Figure 1. Elaboration on the design thinking process in developing the seating concept (Image by authors)

Adaptive and inclusive seating design of Canabeans Coffee

The study focuses on creating a bench design for Canabeans Coffee at KCIC Halim Station. Situated within a bustling station environment characterised by high foot traffic and rapid movement rhythms, the coffee shop presents a unique context for design intervention. Discussion about user needs indicates that there are several key criteria for seating in public waiting areas: safety for maintaining social distance, use of materials that are easy to clean, minimal contact surfaces, physical and cognitive comfort, and visual aesthetic value.

Both physical and cognitive comfort are central concerns for users. Physical comfort relates to the need for bodily ease while seated—particularly when consuming food and beverages in a transit setting—whereas cognitive or psychological comfort reflects a sense of safety and calm in relation to public intimacy and health considerations. These dual dimensions of comfort underscore the importance of designing seating that not only meets functional requirements but also supports emotional well-being in high-mobility environments. As part of empathising with the emotional well-being of the users, the design of Canabeans Coffee at KCIC Halim Station began with an immersive exploration of the spatial atmosphere. Other than analysing the layout and circulation patterns, the design process sought to experience the rhythm of life within the space—observing how people arrive and depart, how they navigate their surroundings, and where they tend to pause.

These observations led to a deeper understanding of the importance of creating a recognisable and comfortable point of pause through seating design, both visually and functionally. The design process further formulates the requirements and conditions for the seating facility in collaboration with the client, based on the actual activities of visitors within the Canabeans Coffee space and the existing conditions of the space (Figure 2). Different patterns of sitting, movement, and interaction inform the standard dimensions of chairs and tables—ensuring not only comfort but also smooth circulation and safe mobility for users. These different aspects were carefully designed to allow visitors to move freely without feeling constrained or obstructed. Beyond functional considerations, this phase also addressed aesthetic elements such as material selection and colour schemes, which were aligned with the visual identity of Canabeans Coffee. Colour and texture were not only used to reinforce brand character but also to foster visual engagement with visitors. Through these observations, the design becomes responsive to real-world needs while simultaneously conveying meaningful visual values to enhance the user experience.



Figure 2.
Documentation of the
existing conditions
at Canabeans Coffee,
KCIC Halim Station
(Photographs by
authors)

The ideation phase of the design process involved exploring a range of conceptual seating possibilities to address the spatial needs of Canabeans Coffee at KCIC Halim Station (Figure 3). This design study highlights that circular seating arrangements can be beneficial in transit café environments. Within the proposed interior setting, the circular bench serves as a moment of pause—

both physically and visually—for visitors seeking rest, awaiting departure, or simply wishing to enjoy the ambience. Circular benches serve as functional seating but also as a spatial anchor that fosters openness, equality, and togetherness (Rinaldi et al., 2025; Sawyer & Bright, 2014).

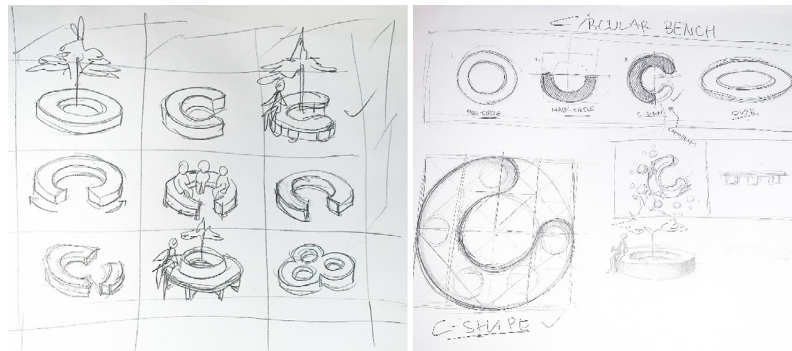


Figure 3. Illustrations of the furniture ideation of circular benches (Illustrations by authors)

By eliminating hierarchical seating positions, the design encourages equitable social interaction and supports diverse user experiences. Circular seating arrangements support community life in open spaces, creating welcoming and inclusive environments for diverse users (Ryerson, 2015). This approach aligns with the principles of inclusive design, which emphasise the importance of creating spaces that are accessible and usable by everyone, regardless of background, age, or physical ability (Sosa et al., 2022).



Figure 4. 3D modelling of the furniture design (left) and the proposed spatial ambience (right) (Images by authors)

Multiple forms of circular benches are proposed and evaluated based on their potential to serve as a visual anchor, their alignment with the Canabeans brand identity, and their feasibility in terms of production and on-site implementation (Figure 3). However, the implementation of circular seating must be carefully calibrated. Some of the alternatives emphasised enclosed seating aligned with circulation flow. Another alternative explored modular arrangements for adaptive occupancy, where the circular seating could be broken down into multiple parts flexibly. While the enclosed form promotes inclusivity and symbolic unity, it may present limitations in seating capacity and spatial efficiency, particularly in confined areas. Overly enclosed configurations can affect the dynamics of social interaction, potentially causing discomfort for users who prefer more open or linear arrangements. These considerations highlight the importance of balancing symbolic intent with ergonomic and contextual realities.

The third alternative—which is the one ultimately selected—proposed an open circular bench encircling a tree planter as a spatial focal point (Figure 4, right). The existence of a tree planter inside the bench reflects the integration of biophilic elements within a high-traffic interior setting. In outdoor environments, benches are placed around large trees to provide shade and encourage face-to-face interaction (Mumcu & Yilmaz, 2016). The integration of environmental considerations within the design introduces and promotes ecological awareness, encouraging environmentally conscious attitudes (Aulia et al., 2023; Utomo & Setiawan, 2022). This approach reflects a shift toward more human-centred and environmentally responsive design strategies in transit interiors. Such biophilic integration not only enhances the aesthetic and emotional quality of the space but also aligns with broader sustainability goals in public interior design.

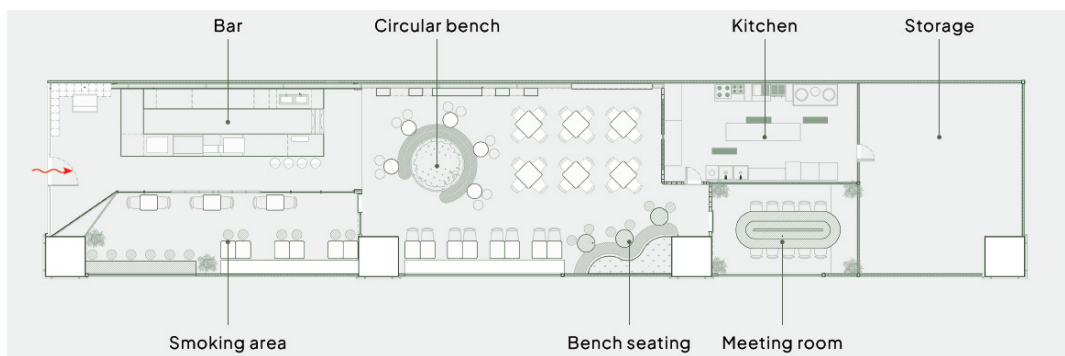


Figure 5. The selected floor plan of Canabeans Coffee, KCIC Halim Station (Image by authors)

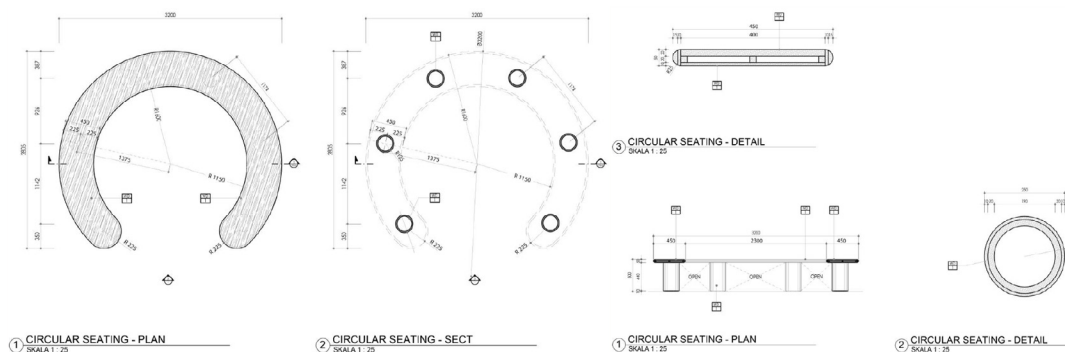


Figure 6. The details of the circular bench that show the distance between the support column and the seating height for different user needs (Images by authors)

The design incorporates a range of adaptive and inclusive strategies that respond to both functional and symbolic needs of transit interior use in multiple scales. The circular form supports multi-directional access, supporting inclusive use by individuals with varied mobility levels. Open circulation paths with a 3.2 metre diameter are deemed optimal for user capacity and spatial balance, and ensure the navigability for wheelchairs and strollers around the bench (Figure 5). In addition, the bench can also be adaptively used together with multiple sets of additional tables and chairs around it, encouraging social interaction for various needs in a flexible way.

The seat height is calibrated lower to accommodate elderly users and those with mobility aids (Figure 6). The absence of a backrest subtly regulates the duration of use, allowing for

rotational occupancy—particularly relevant in transit contexts where passengers are waiting for departure. Minimal signage for social distancing is embedded discreetly into the bench and surrounding floor, maintaining aesthetic clarity while supporting public health protocols. These aspects collectively demonstrate how adaptive and inclusive principles can be embedded into everyday public furniture, enhancing its usability in transit-oriented interiors.



Figure 7. Moodboard ideation showing proposed material and ambience (Image by authors)



Figure 8. The bench installation at the site (Photographs by authors)

The design study highlights that the bench functions not only as seating but also as a spatial marker that gives opportunity to pause as well as reinforces the café's visual and atmospheric identity (Figure 7). The circular bench uses solid teak wood as the primary material, selected for its durability, warm tactile quality, and ease of maintenance in high-traffic environments. Supported by warm lighting and natural textures, the circular form invites pause and interaction, offering a moment of respite within a high-mobility setting (Figure 8). This approach harmoniously integrates seating and natural elements, creating a connection between visitors, space, and environment.

It can be concluded that the design contributes to adaptive and inclusive design principles by addressing the needs of users with varied physical abilities. The application of appropriate design principles can strengthen the aesthetic appeal and visual prominence of an object within its spatial context (Hu et al., 2022; Wang et al., 2025), making the space more meaningful

that conveys social and cultural meaning (Hurdley, 2007). In the context of KCIC Halim Station, the circular bench serves as a spatial narrative that reinforces the café's brand identity while responding to the behavioural patterns of transit passengers. Strategically placed at the centre of the interior, the bench clarifies zoning, guides circulation, and establishes visual balance—creating a calming atmosphere that contrasts with the typically hurried nature of transit environments (Lima, 2017).

Ultimately, the design offers a meaningful contribution to the discourse on inclusive public interiors by demonstrating how spatial form, materiality, and symbolic elements can be orchestrated to support diverse user needs. It exemplifies how thoughtful design can transform a utilitarian waiting area into a socially engaging and visually distinctive environment.

Conclusion

This study demonstrates that adaptive and inclusive design strategies can significantly enhance the quality of spatial experience in transit-oriented interiors. It outlines the design process of a circular bench for Canabeans Coffee at KCIC Halim Station, which serves not only as a seating facility but also as a visual anchor that creates a form of pause in the interior space. This study reveals that circular seating arrangements promote adaptability and inclusivity. It creates various seating arrangements to meet flexible needs, but requires careful calibration to address limitations in seating capacity and interaction dynamics. The integration of biophilic elements and minimal signage further supports emotional comfort and public health protocols, demonstrating how everyday public furniture can embody adaptive and inclusive principles. The design responds holistically to the varied user needs by integrating ergonomic comfort, accessibility, material durability, and spatial identity.

This research contributes to the broader discourse on adaptive urban interiors by offering a scalable model for designing contextually responsive furniture in high-density public environments. Future studies may explore comparative evaluations between circular and linear seating configurations, as well as observational analyses of user behaviour and communication patterns. By adopting a multidisciplinary approach—combining design, spatial psychology, and user experience research—future work can advance more inclusive, resilient, and socially attuned public interior design practices.

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process. The author has made limited use of AI tools such as Deepl Translator, M365 Copilot, and Gemini solely for grammar refinement and sentence clarity, without affecting the substance or originality of this scholarly work.

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