Walkability Analysis in Kauman and Notoprayan Villages, Yogyakarta, Indonesia

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Abstract. This study evaluates the level of walkability in the Kauman and Notoprayan Villages in Yogyakarta to support connectivity between Ngabean parking facilities and major tourist destinations, such as Alun-Alun Utara and Kauman Mosque. Enhancing walkability is crucial to optimize the use of Ngabean Parking, revitalize the historic core through increased pedestrian activity, and generate socio-economic benefits for the local community. The analysis employs six walkability variables: shaped, connected, comfortable, safety, security, and interesting. Data were collected through field observations, measurements, and documentation, and were then quantitatively analyzed using a scoring technique. The findings reveal that the average walkability index of the area is 3.58, indicating good walkability quality. The "shaped" variable recorded the highest score of 4.19, categorized as good. However, the "comfortable" variable received the lowest score of 2.96, reflecting the lack of supporting amenities such as shade, seating, and trash bins. Several outer roads require improvements in comfort, safety, and attractiveness. This research contributes significantly to urban villages planning by providing design- and regulation-based recommendations to enhance the quality of pedestrian pathways, strengthen connectivity, and support a sustainable tourist experience.

Keywords: urban villages, tourism, pedestrian, area planning, walkability

1. Introduction

The North Square (Alun-Alun Utara) of Yogyakarta is one of the city's premier tourist destinations, boasting various attractions. This area offers not only cultural tourism, featuring landmarks such as the Main Gate of the Yogyakarta Palace, Sonobudoyo Museum, Jogja Gallery Museum, and Wahanarata Museum, but also religious tourism with sites like Gedhe Kauman Mosque and Nyai Achmad Dahlan's Mausoleum. At night, the square transforms into a culinary hotspot that draws both local and international visitors. Its strategic location near other tourism hubs, such as Kilometer Zero Point and Malioboro Street, establishes it as the epicenter of tourist activity in Yogyakarta.

With increasing tourist inflow, the demand for supporting facilities, particularly parking areas, has become increasingly urgent. Previous studies revealed that the growing number of tourist vehicles entering this area must be accompanied by sufficient parking facilities (Mahadi & Budiarti, 2016). To address issues like illegal parking on sidewalks and road shoulders, the Yogyakarta City Government has built several parking facilities around the Malioboro, North Square, and Kilometer Zero areas. These facilities include Abu Bakar Ali Parking, Beskalan Parking, Senopati Parking, Taman Pintar Parking, Ketandan Parking, TKP Limaran Parking, and Ngabean Parking.

Among these facilities, Ngabean Parking occupies a unique position but also faces several challenges. Located approximately 1 km or a 15-minute walk from Kilometer Zero Point and 1.2 km or a 17-minute walk from the North Square, its distance is generally manageable. However, a 2019 report highlighted that the facility has not yet fully functioned optimally as a

parking hub to support tourism in Malioboro and its surrounding areas (Dinas Perhubungan Daerah Istimewa Yogyakarta, 2019). One significant challenge is its location at a major intersection prone to traffic congestion and its distance, which some tourists perceive as less convenient.

Previous studies (Ewing & Handy, 2009; Litman, 2011) emphasize that walkability improves pedestrian comfort, connectivity, and urban vitality. In the context of Yogyakarta, Leiwakabessy (2016) assessed walkability in Sosrowijayan Village, but limited studies have explored urban villages routes as strategic pedestrian corridors linked to parking facilities. This research addresses that gap by evaluating the walkability of Kauman and Notoprayan Villages to enhance the productivity of Ngabean Parking, revitalize the historic core area, and generate positive socio-economic impacts for local communities.

In 2014, the facility was renovated into a two-story structure to increase its capacity. However, field observations reveal that its utilization has not been maximized. Figure 1.1. (1) illustrates, the first floor, designated for bus parking, appears underutilized. Meanwhile, the second floor does not function as a tourism-supportive parking area. A large portion of the second floor has been converted into a sports venue managed by a private entity (2), and some car parking spaces are marked for private use by local residents (3). These conditions reflect community adaptation to the reduced utilization of the facility as a tourist parking hub.
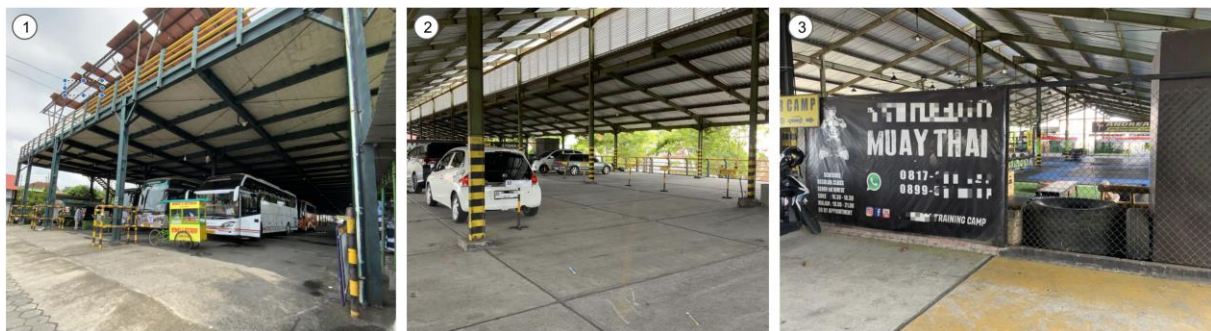

Figure 1.1. Ngabean Parking Existing Condition (Author, 2024)

Ngabean Parking has substantial potential to become one of the optimal supporting facilities for tourism in Yogyakarta. With the availability of public transportation modes such as TransJogja buses and Tole Tourist Buses connecting visitors to various major destinations, along with sufficiently adequate sidewalks along the main roads, Ngabean Parking can be better integrated into the city's tourism ecosystem (Kirana, Rakhmatulloh, & Dewi, 2023). Figure 1.2. illustrates the location of Ngabean Parking (A) in relation to several key tourist attractions, including Ndalem Notoprajan (B), Kauman Mosque (C), the North Square (D), and the Zero Kilometer Point of Yogyakarta (E). The 2.1 figure also shows the spatial delimitation of Notoprajan and Kauman urban villages, which serve as the defined research boundary. However, specific strategies are required to address the various existing challenges to realize this potential.

Figure 1.2. Ngabean Parking Building Location and Tourist Attractions (Author, 2024)

One strategic opportunity lies in utilizing urban village pathways such as those in Notoprayan and Kauman. The term "kampung" originally referred to rural villages in Malay but has evolved to describe urban housing built by migrants, characterized by dense and low-income communities that maintain traditional values, foster strong social cohesion, and adapt to urban environments, while also serving as strategic hubs for productive activities such as home-based businesses (Nugroho, 2009; Nursyahbani & Pigawati, 2015; Setiawan, 2010). By transforming these routes into attractive pedestrian pathways, tourists can enjoy a unique walking experience while immersing themselves in the authentic atmosphere of Yogyakarta's urban villages. Pedestrian pathways are part of the urban spatial structure that connects areas, allowing individuals to walk in either planned or organically formed spaces (Carr, 1992; Jabbari et al., 2023). Pedestrian pathways, such as sidewalks and crosswalks, when well-designed and separated from vehicle traffic, ensure safe and accessible routes for pedestrians (Transport Research Board, 2010; World Health Organization, 2013). This approach not only enhances connectivity between Ngabean Parking and major destinations such as Malioboro and Kilometer Zero Point but also adds value through a deeper cultural tourism experience. Comfortable and safe pedestrian environments are essential components to attract more tourists to use these routes.
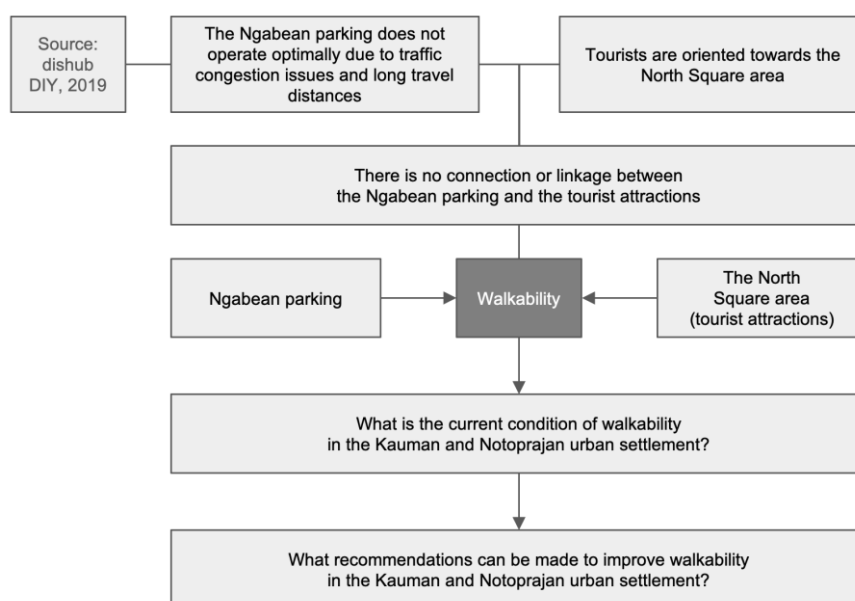

Figure 1.3. Research Questions (Author, 2024)

This study aims to evaluate the level of walkability or pedestrian comfort in Notoprayan and Kauman Villages, which are potential pathways connecting Ngabean Parking with major tourist hubs (Figure 3.1). The research questions formulated include assessing the current walkability conditions of the Kauman and Notoprayan Village areas and identifying recommendations to improve walkability in these areas.

This study evaluates the walkability of Kauman and Notoprayan Villages, which serve as potential pedestrian corridors linking Ngabean Parking with major tourist hubs. It examines the current walkability conditions and proposes design and policy recommendations to improve pedestrian comfort and connectivity. Building on existing walkability studies, this research introduces a localized framework tailored to the dense and heritage-rich character of urban villages, incorporating socio-cultural and spatial dimensions. This approach not only addresses the functional needs of urban tourism but also enriches the theoretical discourse on walkability in historic urban settings.

2. Methods

In conducting this research, two research questions were formulated to examine the walkability conditions in the study area and propose recommendations to enhance the walkability index. Walkability is a concept that measures the quality of an area in supporting pedestrian activities based on aspects of design, individual perception, and infrastructure elements. This concept encompasses comfort, safety, connectivity, and accessibility of spaces designed to enhance the quality of the walking experience. Various theories suggest that walkability is influenced by individual reactions to the benefits, enjoyment, and comfort of an area (Ewing & Handy, 2009), micro-elements of urban design (Park, 2008). as well as quantitative and qualitative assessments of the integration of built environments (Hess & Fornow, 2011a; Litman, 2011). Thus, walkability serves as an important indicator in creating pedestrian-friendly urban areas that support various human activities.

Figure 2.1 presents the conceptual framework and outlines the research methodology used to derive the findings. The research area is limited to the urban villages of Notoprayan and Kauman in the Ngampilan District, Yogyakarta City (Figure 1.2.). These two villages separate Ngabean Parking from the North Square, serving as potential pathways to connect the parking facility with key tourist destinations.
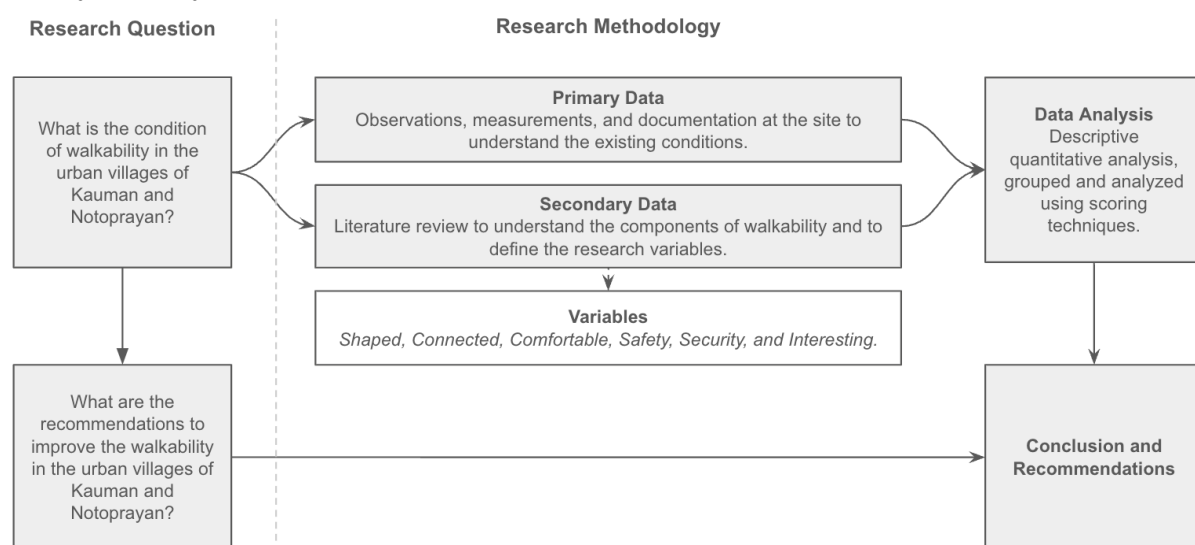

Figure 2.1. Conceptual Framework (Author, 2024)

Data collection in this study utilized both primary and secondary sources. Primary data were obtained through direct observation, measurement, and documentation conducted on Sunday, November 9, 2024, at Ngabean Parking and along pedestrian pathways within the urban villages of Notoprayan and Kauman (Figure 1.2.). These activities aimed to assess the actual conditions of parking facilities and pedestrian pathways, including factors influencing pedestrian comfort and safety. Secondary data were acquired through a literature review of relevant prior studies.

Data were processed using a descriptive quantitative approach, grouped, and analyzed through a scoring technique to understand social phenomena and narrate the findings with insights into the urban environment (Aitken & Michel, 2018; Mühlfeld, 2016). Findings were categorized into predefined parameters based on the boundaries of the study area and the types of pedestrian pathways. The assessment employed an index scale from 1 to 5 for each parameter (Likert, 1932), where the scores represented the quality of pedestrian pathways based on the defined variables.

Table 2.1. Variabel, Parameter, and Sub-Parameter (Author, 2024)

Variabels	Parameter	Sub-Parameter	Scale				
			1	2	3	4	5
Shaped	Availability of pedestrian paths	*Floor* (path material)	Not defined	Partially defined	Moderately defined	Largely defined	Fully defined
		Wall (enclosure)					
Connected	Connectivity of pedestrian paths	Condition of the path	Not connected	Poorly cpnnected	Moderately connected	Largely connected	Fully connected
		Presence of obstructions					
Comfortable	Availability of shade	Vegetation arrangement, arcade, or awning	No shade	Minimal shade	Moderate shade	Largely shaded	Fully shaded
	Dimensions and accessibility of paths	Lebar jalur pedestrian	Inaccessible	Poorly accessible	Moderately accessible	Largely accessible	Fully accessible
		Ease of access to destinations					
		Guidance paths (e.g., tactile paving)					
	Availability of signage and amenities	*Signage (e.g., building functions, warnings, direction signs)*	None	Minimal shade	Moderate	Extensive	Fully available
		Amenities (e.g., benches, lighting, trash bins)					
Safety	Conflict with other modes	Conflict with motorbikes, bicycles, and street vendors	Conflict throughout	Conflict in most areas	Moderate conflict	Minimal conflict	No conflict
Security	Availability of lighting	Path lighting settings	No lighting	Minimal lighting	Moderate lighting	Extensive lighting	Fully lit
	Activity duration	*Timing of activities along the paths (busy times and quiet times)*	No activities	Activities only at spesific times	Activities in some areas	Frequent activities	Continuous activities
	Orientation of building walls	Entrance placement of adjacent buildings	No entrances near the path	Fre entrances	Moderate number of entrance	Many entrances	All entrances near the path
Interesting	Entrance placement of adjacent buildings	Activities and building functions that are appealing	Not attractive	Poorly attractive	Moderately attractive	Largely attractive	Fully attractive
	Index Scape Description:		0 - 1,00 Very poor	1,01 - 2,00 Poor	2,01 - 3,00 Fair	3,01 - 4,00 Good	4,01 - 5,00 Very Good

The six key walkability variables are shaped, connected, comfortable, safety, security, and interesting, were selected because they represent the physical, functional, and experiential dimensions crucial for urban villages, where pathways are often informal and intertwined with residential areas. "Shaped" and "connected" assess the clarity and linkage of pedestrian routes, ensuring efficient access between Ngabean Parking and tourist destinations. "Comfortable" focuses on shading, seating, and pathway dimensions, which are vital in Yogyakarta's tropical climate, while "safety" and "security" address potential conflicts with vehicles, lighting, and visibility to enhance pedestrian protection. Finally, "interesting" highlights the cultural and visual elements, such as traditional architecture and murals, that enrich walking experiences and promote tourism value (Leiwakabessy, 2016; Ewing & Handy, 2009; Litman, 2011).

3. Discussion

3.1. Pedestrian Pathways in the Urban Villages of Kauman and Notoprayan

Figure 3.1. illustrates the pedestrian pathways in the urban villages of Kauman and Notoprayan, based on the shortest distance coverage. These routes are considered the most effective and potential options for walking from the Ngabean Parking Building to the North Square of Yogyakarta and Gedhe Kauman Mosque, and vice versa. The selected routes are labeled J1–J16 for each street segment (Figure 3.1.). These 16 segments showcase the unique characteristics of Yogyakarta's urban villages, passing through several historic and cultural landmarks such as Ndalem Notoprayan and Kauman Mosque.
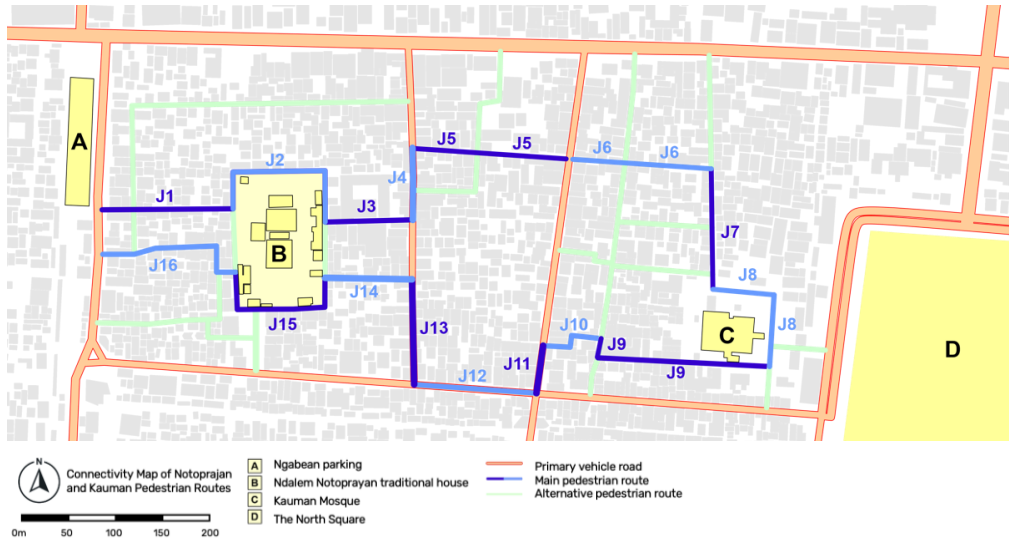

Figure 3.1. Connectivity Map of Notoprajan and Kauman Pedestrian Routes (Author, 2024)

3.2. Assessment of Pedestrian Pathways Based on Parameters

The walkability analysis in the Notoprayan-Kauman area encompasses six main variables: shaped, connected, comfortable, safety, security, and interesting, which represent the quality of pedestrian pathways in the area. Each variable is evaluated to determine the extent to which the pathways support a comfortable, safe, and engaging walking experience (Ewing & Handy, 2009). The average score for all variables is 3.58, indicating that the walkability in this area falls into the "good" category. This result is consistent with the findings of Leiwakabessy (2016), who identified similar walkability scores in Sosrowijayan Village, suggesting that urban villages environments often share comparable challenges, particularly regarding pedestrian comfort and safety. While the overall quality is good, each component contributes differently to the index, with some aspects demonstrating superior performance while others require further improvement. The following is a detailed analysis of each walkability variable (Table 3.1.).

Table 3.1. Variable Assessment on Road Segments (Author, 2024)

Variabel		J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	Average	Index
Shaped	Availability of pedestrian paths	4,00	4,00	4,00	4,00	4,00	4,00	5,00	5,00	4,00	4,00	5,00	4,00	4,00	4,00	4,00	4,00	4,19	Very good
Connected	Connectivity of pedestrian paths	3,00	4,00	4,00	4,00	4,00	4,00	5,00	5,00	4,00	3,00	5,00	3,00	4,00	5,00	5,00	3,00	3,94	Good
Comfortable	Availability of shade	2,00	2,00	2,00	2,00	3,00	3,00	3,00	5,00	4,00	3,00	3,00	3,00	2,00	3,00	3,00	2,00	2,96	Fair
	Dimensions and accessibility of paths	2,00	3,00	3,00	4,00	4,00	3,00	5,00	5,00	4,00	3,00	3,00	3,00	3,00	2,00	4,00	2,00		
	Availability of signage and amenities	2,00	2,00	3,00	3,00	3,00	4,00	3,00	5,00	3,00	3,00	2,00	3,00	2,00	2,00	2,00	2,00		
Safety	Conflict with other modes	2,00	3,00	4,00	4,00	3,00	3,00	5,00	5,00	3,00	3,00	3,00	3,00	2,00	4,00	5,00	3,00	3,38	Good
Security	Availability of lighting	3,00	3,00	3,00	3,00	3,00	3,00	4,00	5,00	4,00	3,00	4,00	5,00	3,00	3,00	3,00	3,00	3,58	Good
	Activity duration	2,00	3,00	3,00	4,00	4,00	4,00	4,00	4,00	4,00	3,00	4,00	5,00	3,00	3,00	4,00	2,00		
	Orientation of building walls	3,00	3,00	4,00	5,00	4,00	4,00	5,00	5,00	4,00	4,00	4,00	5,00	3,00	4,00	3,00	3,00		
Interesting	Entrance placement of adjacent	2,00	3,00	3,00	3,00	4,00	5,00	5,00	5,00	5,00	3,00	3,00	3,00	3,00	3,00	2,00		3,44	Good
	Average	2,61	3,22	3,33	3,67	3,67	3,83	4,67	4,94	3,94	3,22	3,78	3,50	3,06	3,28	3,78	2,78	3,58	Good
	Index	Fair	Good	Good	Good	Good	Good	Very good	Very good	Good	Good	Good	Good	Good	Good	Good	Fair		

Index Scape Descriptiions	0 - 1,00 Very poor	1,01 - 2,00 Poor	2,01 - 3,00 Fair	3,01 - 4,00 Good	4,01 - 5,00 Ver good

The shaped variable has an average score of 4.19, the highest among all walkability variables. This indicates that pedestrian pathways in the Notoprayan-Kauman area are very well-defined. Most pathways use adequate pavement, providing clear boundaries for pedestrians. The use of paving blocks serves as a key element in supporting the sustainability of the pathway structure, enhancing comfort, and improving the quality of pedestrian infrastructure design. According to Litman (2011), well-maintained pavement and clear spatial boundaries are crucial for ensuring both the safety and comfort of pedestrians.

The connected component has an average score of 3.94, indicating that most pathways have good connectivity. These pathways are effectively linked without many obstacles, facilitating easy mobility between road segments. The availability of well-connected pathways is a crucial factor in enabling pedestrians to smoothly reach destinations around the area, although some areas still require improvements in directional signage to reduce disorientation. This is consistent with Hess & Fornow (2011), who argue that street connectivity significantly enhances pedestrian route efficiency and accessibility.

The comfortable component has an average score of 2.96, the lowest among all variables. This indicates that the comfort aspect of pedestrian pathways still needs improvement. Shade is not evenly distributed along the pathways, leaving pedestrians unprotected from the sun. Additionally, pathway dimensions vary greatly, and supporting facilities such as benches and trash bins are still limited. These findings echo the conclusions of Park (2008), who highlights that thermal comfort, shading, and urban furniture are primary determinants of pedestrian satisfaction.

The safety component has an average score of 3.38, indicating that pedestrian pathways generally function well. Most pathways are free from conflicts with other modes of transportation, although there are still some areas where motorcycles use pedestrian pathways for traffic or parking. The pedestrian pathways are generally free of motorized vehicles, minimizing the risk of accidents. However, further monitoring is needed to ensure that all pathways remain safe for users. This aligns with World Health Organization (2013), which underscores that the physical separation of pedestrian and vehicular spaces is essential for reducing accident risks.

The security component received an average score of 3.58, showing that the pathways have a good level of security. These pathways generally have sufficient lighting, although it is not evenly distributed across all areas. The activity duration on the pathways is quite good but was influenced by the observation time on Sunday afternoon, which tends to be quieter compared to nighttime activities. The proximity of building entrances to the pathways also provides a sense of safety for pedestrians, as the street wall orientation maintains a visual connection between pathway users and the surrounding environment. As Ewing and Handy (2009) note, environmental surveillance and proper lighting are integral to perceived pedestrian security.

The interesting component recorded an average score of 3.44, indicating that the pedestrian pathways are visually and experientially appealing. In Kauman, the appeal comes from authentic buildings that reflect local cultural character, while in Notoprayan, unique elements such as Ndalem Notoprayan offer further development potential. Murals or distinctive architectural elements along these pathways can provide a more immersive experience while enhancing the pathways' attractiveness for tourists and local users alike. This aligns with Carr (1992), who asserts that the aesthetic and cultural qualities of public spaces significantly contribute to their walkability and user engagement.
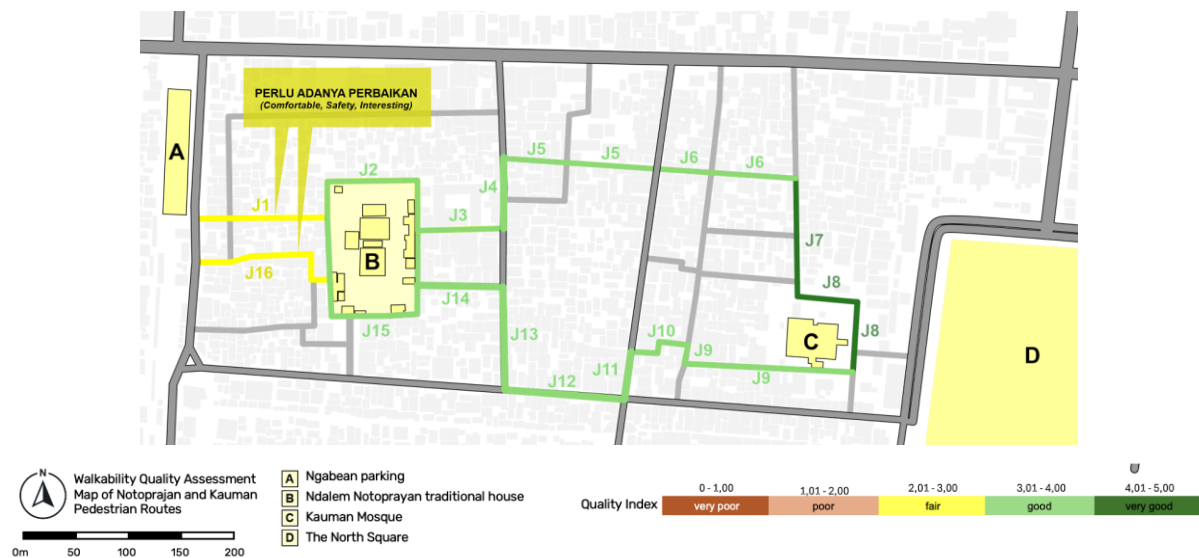
Figure 3.2. Mapping of Variable Assessment on Road Segments (Author, 2024)

Figure 3.2. illustrates the walkability assessment of road segments in the Notoprayan-Kauman area based on their quality index, categorized as very good, good, and fairly good. Road segments with a very good index are represented by dark green, such as J7 and J8. These pathways are located near the center of religious and tourist activities at Kauman Mosque, where infrastructure quality, connectivity, and visual appeal are highly prioritized. According to Ewing & Handy (2009), pedestrian infrastructure that is visually appealing and well-connected significantly enhances walkability perception. Community awareness in maintaining these pedestrian pathways as alternative access to the mosque is well-preserved. Additionally, government-led revitalization efforts, including improvements to paving blocks, have significantly enhanced the quality of these pathways. Litman (2011) also emphasizes that infrastructure upgrades such as paving and wayfinding signage are key to sustaining pedestrian-friendly environments.

Most of the other road segments, such as J4, J5, J6, J10, and J11, fall into the good category, with an index ranging from 3.01 to 4.00. These pathways exhibit adequate connectivity and comfort, although there is still room for further improvements. Meanwhile, road segments with a fairly good index, such as J1 and J16, are represented by yellow. These segments are located on the outer edges of the main activity centers of the North Square and Kauman Mosque. Despite this, these segments hold strategic potential as primary entry points for beginning pedestrian exploration in the urban village area. Therefore, improvements focusing on enhancing comfort, safety, and attractiveness are required to optimize these pathways' function as part of an integrated tourism experience. When compared with findings from Leiwakabessy (2016) in Sosrowijayan Village, which reported similar walkability indices ranging from 3.2 to 3.9, the results of this study indicate that Kauman and Notoprayan share typical challenges of urban kampungs, particularly in the areas of shading and pedestrian amenities. Moreover, the current scores are still below the walkability benchmarks proposed by Ewing & Handy (2009), which suggest that highly walkable urban spaces generally achieve indices closer to 4.5 or higher. These comparisons highlight the need for targeted interventions to raise the overall quality of pedestrian routes to align with best practices and international walkability standards.

3.3. Recommendations

Design recommendations can be made based on the defined components and parameters of walkability (Table 3.2.). The proposed design recommendations are general in nature and can be further developed into more specific solutions based on these guidelines.

Table 1.2. Recommendation Design (Author, 2024)

Component	Parameter	Design Recommendations
Shaped	Availability of Pathways	Clarify boundaries between roads and buildings through differences in elevation or materials.
		Use contrasting colors to differentiate pathways from roads.
Connected	Pathway Connectivity	Add directional signage at every road intersection.
Comfortable	Availability of Shade	Encourage tree planting (small–medium trees) and use pergola-like shading inspired by successful tropical cities (e.g., Singapore)
		Design light-permeable shading structures that maintain ventilation and prevent damp corridors.
	Dimensions and Accessibility of Pathways	Avoid excessive fencing designs that make corridor spaces feel narrow.
		Apply guiding blocks on main pedestrian pathways.
	Signage & Amenities	Design attractive and efficient signage that includes ornamental elements reflecting the identity of Yogyakarta.
		Create more varied signage content, providing information on nearby facilities or attractions.
		Integrate seating areas with existing structures, such as fences or planter boxes, for space efficiency.
Safety	Conflicts with Other Modes	Map abandoned buildings with the potential to be converted into communal parking for motorized or non-motorized vehicles.
Security	Availability of Lighting	Adapt lighting models to match the street's character, using lamp poles, garden lights, or canopy-mounted lights.
		Ensure a minimum distance of 10-15 meters between lighting installations.
		Design ornamental lighting that reflects Yogyakarta's identity.
	Activity Duration	Identify public buildings, such as community halls (Balai RT/RW), that can serve as communal activity spaces.
	Orientation of Street Walls	Use blank wall spaces along corridors to add murals.
		Design attractive murals to promote or represent Kauman or Yogyakarta areas.
Interesting	Attractiveness of Activities and Spatial Form	Maximize the use of empty roadside spaces with potted plants to create a more pleasant atmosphere.
		Encourage preservation efforts during renovations to ensure buildings maintain their cultural identity, especially in the Kauman area.
		Map wide roadside spaces that can be converted into facilities for tourists, such as souvenir kiosks or rest areas.
		Utilize the exterior walls of Ndalem Notoprayan as visually attractive spaces through temporary art installations that avoid damaging the structure.

4. Conclusion

This study identified the walkability level in the Notoprayan and Kauman urban villages of Yogyakarta using six main variables: shaped, connected, comfortable, safety, security, and interesting. The analysis results show that the average walkability index in this area falls into the "good" category, with a score of 3.58 out of 5. These findings indicate that the pedestrian pathways in the area are mostly well-defined and well-connected, particularly in segments near major tourist activity centers such as the North Square and Kauman Mosque. Among the six aspects evaluated, the comfortable variable recorded the lowest score, highlighting the need for improved supporting facilities such as shading, benches, and trash bins to enhance the pedestrian experience.

Although the overall walkability in this area is good, some outer road segments, such as J1 and J16, require improvements in comfort, safety, and attractiveness. These improvements are crucial to support the area as a primary gateway to tourist destinations and to create pedestrian pathways that are more inclusive while fostering social and cultural interaction. Design-based and regulation-based development recommendations have been formulated to enhance the functionality and appeal of this area.

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