

Design of Accessible Toilets for Executive Trains Considering Universal Design Principles and Local Culture

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ABSTRACT

Accessible public transportation is the foundation of inclusive mobility, especially for people with disabilities. Unfortunately, executive train toilets in Indonesia have not fully met the physical and functional accessibility standards. Therefore, toilets that are easily accessible to all users are needed, ones that are not only functionally adequate, but also preserve the local cultural values. This study aims to design an accessible executive train toilet by combining universal design principles with local cultural values for all passengers. This study uses qualitative-quantitative methods and participatory design elements based on the universal design and local culture. The study was conducted in four main stages: collecting data on identifying the needs of the user through an online questionnaire with 84 respondents and a group discussion with seven stakeholders; studying the local culture using ethnographic interviews with 42 Javanese residents and in-depth interviews with cultural experts; quantitative and qualitative data analysis; and the design process, which includes deciding the size of the toilet components, visualization, and identifying alternative designs. The design evaluation stage is based on weighted scoring. The study resulted in a universally accessible executive train toilet design based on the local culture by increasing the width of the door, expanding the size of the toilet room, automating facilities, Braille signs, ergonomic design, emergency calls, and the local Javanese philosophy (color, ornaments, shape, materials, availability of water, bar soap). This study has practical implications for policymakers regarding the transportation policies and infrastructure development toward more inclusive railway services in developing countries.

Keywords- accessible design; local culture; toilet; train; universal design

I. INTRODUCTION

Every community has the right to have easy access to important facilities through public transportation, such as work locations, educational institutions, medical services, social activities, and entertainment venues. With this access, equal opportunities can be created, social inequality can be reduced, and social justice can be encouraged [1]. However, the needs of

persons with disabilities are still insufficiently accommodated, especially in developing countries. Railways are highly favored among various modes of transportation due to the convenient station access, service speed, competitive price, safety [2], ease of ticket purchase, punctuality, and quality of service [3], which shape the passenger preferences. The accessibility to public transportation also positively impacts health by

increasing the physical activity, reducing the obesity, and lowering the accident rates [4]. In contrast, poor accessibility increases the number of private vehicles [5].

Accessibility is a fundamental human right that guarantees the independence and active involvement of people with disabilities in community life. Without an accessible environment—including physical spaces, transportation, information, and communication systems—persons with disabilities lack equal opportunities [6]. First introduced by Hansen in the 1950s, accessibility has evolved from a spatial efficiency focus to one encompassing mobility, justice, and equitable social participation [7-9]. Although the Indonesian Minister of Transportation Regulation No. 98/2017 requires the accessibility of public transportation for people with disabilities, its implementation is still constrained, especially in train toilet facilities. Executive train toilets in Indonesia remain one of the aspects most frequently criticized by passengers. Referring to the results of the 2022 PT KAI (Indonesia's national railway company) passenger satisfaction survey, 27.3% of the respondents complained about unclean toilets, 18.2% cited unpleasant odors, 13.6% mentioned doors that do not close properly, 13.65% reported water flow issues, 9.15% noted the absence of air fresheners, 9.1% mentioned malfunctioning handwashing faucets, and 4.5% criticized the limited space [10]. Field observations of executive train toilets on the Joglosemarkerto and Senja Utama Solo lines were conducted via direct measurement at the Solo Balapan Train Depot. Researchers accessed executive-class toilets and took in-situ measurements using a rolling meter. Each key element—doors, fixtures, and facilities—was measured three times to ensure the data consistency, with the average values recorded. The Joglosemarkerto toilet dimensions were: length 145 cm, width 125 cm, door width 55 cm, sink height 95 cm, and grab bar height 50 cm. The Senja Utama Solo toilet dimensions were: length 130 cm, width 90 cm, room height 190 cm, door width 55 cm, sink height 90 cm, and grab bar 84 cm.

Referring to the provisions of the Indonesian Ministry of Public Works and Public Housing in Regulation Number 14 of 2017, the Ministry identified the inconsistency of the train toilet design with the accessibility principles, especially in terms of the room size, door width, and equipment height. These facilities play a crucial role in determining the comfort and safety of people with disabilities. Therefore, inclusive and flexible design innovation is an urgent need. This study proposes applying universal design principles to address the accessibility barriers. Developed by Ronald Mace in the 1970s, the universal design emphasizes the creation of inclusive environments that everyone can use without requiring any special adaptation [11]. This approach has been recognized globally for increasing the comfort and minimizing the environmental barriers. The seven core principles of the universal design—such as equity in use, flexibility of use, and tolerance for error—have been shown not only to expand the accessibility, but also to provide social and economic benefits [12, 13]. By adopting the universal design principles, public transport systems can contribute to achieving the Sustainable Development Goals (SDGs), especially in realizing inclusive societies (Goal 10) and sustainable urban development (Goal

11). Furthermore, universal design encourages the end-user participation, especially from persons with disabilities, in the design process. This participatory approach is essential, as the design is intrinsically linked to disability, as evidenced in theoretical frameworks and practices, such as co-design and participatory action research [14].

Previous studies have explored the application of universal design in toilet facilities. Authors in [15] proposed improvements to railway station amenities in Thailand, including toilets, using a universal design approach. Authors in [16] identified a lack of universal design implementation in public transportation toilets in Jakarta. In [17], the impact of barrier-free certification on user satisfaction in train toilet facilities was examined. Authors in [18] analyzed accessibility barriers for the elderly and persons with disabilities at Beijing Daxing International Airport [18]. Authors in [19] explored emerging challenges for people with psychosocial disabilities using toilets post-COVID-19, applying universal design. Authors in [20] addressed the accessibility in train station facilities, including toilets, through a universal design perspective.

Beyond accessibility, the local culture has increasingly been recognized as an essential component in design. Local culture refers to the moral and traditional values that evolve from communities and shape the social norms and spatial arrangements [21]. In Javanese culture, values such as simplicity, privacy, and using natural materials like bamboo and wood reflect the sustainability and aesthetic harmony [22]. These cultural values can enrich the architectural design through environmental compatibility and identity reinforcement [23]. The need to combine local materials, adaptive approaches to tropical climates, and regional decorative elements in toilet design has been highlighted [24-26]. This cultural aspect is highly relevant in Indonesia's multiethnic public infrastructure. Applying local cultural values within the framework of universal design creates transportation solutions that are beautiful, functional, and full of cultural meaning. This combination addresses practical needs while preserving the local character, making it more acceptable to the community and sustainable. While the toilet accessibility at stations and airports has been examined [15, 18], there is a noticeable lack of studies focusing on executive train toilets in Indonesia. More importantly, few studies have attempted to combine the universal design with the local cultural values.

Therefore, this study aims to design an accessible toilet in Indonesian executive trains through an integrative approach based on the universal design principles and the local culture. Integrating functional and cultural aspects in this design framework is expected to provide theoretical and applied contributions to developing a sustainable public transportation system that covers all levels of society in developing countries. The results of this study are expected to fill the research gap in [27], where it was concluded that the exterior and interior design of high-speed trains can adopt forms, patterns, or philosophies from the traditional Chinese culture, and draft policies and technical standards for accessible facilities, while enriching the academic literature on culturally responsive and inclusive infrastructure.

II. METHOD

This study uses a mixed-method approach with a dominant qualitative-quantitative approach combined with the elements of participatory design and universal design to develop a train toilet design model that is accessible, inclusive, and based on the local culture. The research stages are carried out in four main phases.

A. Data Collection

Data collection was conducted using quantitative and qualitative approaches to gain an understanding of the needs of toilet users on executive trains, both in terms of functionality, ergonomics, and local cultural values. The methods used are:

- **Identification of User Needs:** Data were collected using an online questionnaire involving 84 respondents, 59 non-disabled users, and 25 users with special needs: 2 elderly and one pregnant woman. The purposive sampling technique was utilized, with respondents elected based on having used the executive train at least once in the past 12 months and being willing to provide information about their toilet usage experience during the journey. The main objective of this survey is to collect data that describe users' perceptions of comfort, safety, and accessibility aspects in executive train toilets as a basis for designing accessible facilities to meet users' needs.
- **Understanding Local Culture:** Ethnographic methods were used to interview 42 Javanese people (including people with disabilities) to explore toilet-related practices and customs in Javanese culture, to explore the local customs, values, and norms related to toilet use that can inform culturally rooted toilet designs. The snowball sampling technique was used, starting from community leaders and representatives of disability organizations, who then recommended other informants, who were expected to have an understanding or experience related to toilet activities. In addition, this interview aims to identify the local elements that can be symbolically or functionally adapted into the train toilet design while still being rooted in the local culture.
- **Interviews with Cultural Experts:** In-depth interviews were conducted with cultural experts who possess extensive knowledge of the local toilet practices among Javanese people. Purposive sampling was used to select experts based on their expertise and track record in Javanese culture. The selection criteria included academic and/or practical background in Javanese cultural studies, active involvement in cultural preservation, and authorship in books related to Javanese culture. Data were collected through semi-structured interviews, using a flexible guide to allow for a deeper exploration of the cultural narratives. The interviews were recorded with permission and then transcribed for qualitative (thematic) analysis. The interviews were of exploratory nature, aimed at understanding the symbolic meanings, philosophical values, and history of the toilets in Javanese culture, as well as normative-conceptual, which means to obtain input from

experts as a basis for designing toilets that are not only functional and ergonomic, but also rich in educational and local cultural values.

B. Data Analysis

Statistical analysis was used to quantify the user needs, while qualitative data from cultural expert interviews were analyzed using thematic analysis with MAXQDA software. The thematic analysis was conducted to identify relevant local values.

C. Design Process

Based on the results of the analysis, an initial concept for designing an accessible toilet was developed by integrating the universal design principles (7 principles) and the local cultural values of the Javanese people in toilet use. The steps in the design process are:

- Mapping the relationships between the toilet components
- Mapping the integration of local culture in toilet design
- Mapping the integration of universal design principles in toilet design
- Mapping of toilet component dimensions
- Visualization design

D. Design Evaluation

The evaluation of the design proposals is necessary to help designers choose the best alternative using weighted criteria based on the level of importance, expert opinion, and stakeholders' needs [28]. Nine stakeholders, including ergonomics experts, PT INKA representatives, representatives of people with disabilities (wheelchair users, crutches users, deaf people), representatives of the elderly, representatives of pregnant women, and representatives of the train user community, provided their assessments on the initial criterion. Each assessor/stakeholder was free to provide a weight value of 20 criteria, with the total weight being 100% of the 20 criteria.

It is worth noting that the cultural elements used in the study are limited to Javanese Indonesian society.

III. RESULT

A. User Needs Data

User need data for the toilet facilities were obtained from an online Likert scale questionnaire with 84 respondents who had used executive class train toilets, including respondents with special needs. This questionnaire was designed to identify the key variables related to the toilet design requirements. The results of the user need identification are presented in Figure 1.

B. Local Culture Element Data

Local culture element data of Javanese people when doing toilet activities were obtained using an ethnographic approach by interviewing 39 informants (9 people with special needs) from Surakarta, Yogyakarta, and Kudus. The results of ethnography (interviews) regarding Javanese people's toilet activities can be seen in Table I.

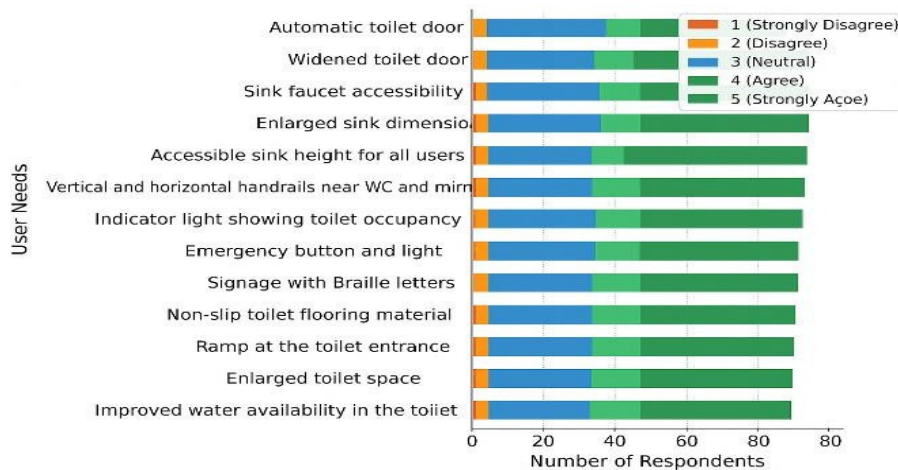


Fig. 1. User needs identification.

TABLE I. ETHNOGRAPHIC DATA RESULT

Question	Options and Respondents
Water vs Tissue	Water (36), Tissue (0), Water and Tissue (3)
Type of Soap	Bar Soap (31), Liquid Soap (4), Bar Soap and Liquid Soap (4)
Toilet Posture	Sitting (11), Squatting (25), Sitting and Squatting (3)
Water Use Tool	Dipper (29), Water Spray (3), Dipper and Water Spray (7)
Water Storage	Bucket (33), Large Jar (2), Pool (4)
Ventilation	Window (7), Ventilation Hole (23), Window and Ventilation Hole (9)
Wall Material	Bamboo Weaving (24), Wood (10), Brick Wall (5)
Wall Color	Brown (28), Brick Red (2), White (9)
Door Lock Type	Sliding Lock (10), Slot Lock (24), No Lock (5)
Flooring Material	Red Brick (21), Cement (14), Tile (4)

C. Data from In-Depth Interviews with Cultural Experts

Data collection on the elements of the local culture of the Javanese people regarding the defecation activities was also carried out through in-depth interviews with local culture experts. The interview results are summarized in Table II.

TABLE II. DATA FROM IN-DEPTH INTERVIEW WITH CULTURAL EXPERT

Toilet design element	Local Javanese cultural elements
Wall Material	Wood or Bamboo
Color	Brown symbolizes a return to nature or the color of the earth.
Ornament	Jepara carvings with floral, leaf, and vine motifs or Batik motifs from Solo or Yogyakarta (parang, kawung)
Floor	Tile patterns influenced by palace floors
Room Shape	Square or rectangular, influenced by the Javanese Joglo house, symbolizing the four cardinal directions
Door	Slot-shaped door
Water Availability	Water in the toilet is essential for Javanese society.
Hand Cleaner	Bar soap

D. User Need Data Analysis

A descriptive test was conducted to collect user need data. The test results show that the most prioritized features in accessible toilet design are the emergency buttons and lights,

occupancy indicators, water availability, and the toilet area. However, respondents' perceptions of these features are very diverse. Features, such as handrails, sink height, and automatic doors have a slightly lower level of need but with a more uniform perception. Features with high mean and low Standard Deviation (SD) values, as depicted in Table III, are the primary focus of development.

TABLE III. DESCRIPTIVE STATISTICAL USER NEED DATA

Accessibility needs	Mean	SD
Emergency button and light	26.07	25.84
Toilet occupancy indicator light	25.80	23.90
Improved water availability	25.80	24.20
Non-slip flooring material	25.47	23.93
Enlarged toilet space	25.07	19.99
Enlarged sink dimensions	24.87	19.73
Ramp at toilet entrance	24.87	19.85
Braille signage	24.73	19.23
Widened toilet door	24.47	19.37
Sink faucet accessibility	24.33	17.76
Accessible sink height	24.20	17.17
Handrails near the WC and mirror	24.20	15.80
Automatic toilet door	22.67	13.62

E. Local Culture Element Data Analysis

Data analysis of the local culture elements was carried out deploying an ethnographic approach, including validity, reliability, and descriptive tests. The validity test was conducted by comparing the $r_{calculated}$ with the r_{table} using a significance level of 5% ($N = 39$, $d_f = 37$, $r_{table} = 0.316$). The results of all questionnaire items showed that all items (V1–V10) had a $r_{calculated}$ value greater than the r_{table} value, indicating that all items were valid and acceptable, as presented in Table IV.

The reliability test results, as portrayed in Table V, show a Cronbach's α value of 0.723, which exceeds the limit value 0.60, indicating acceptable internal consistency, and is considered reliable for further analysis [28].

TABLE IV. VALIDITY TEST RESULTS OF THE USER NEED DATA

Variable	<i>r_{calculated}</i>	<i>r_{table}</i>	Validity
V1	0.70	0.41	Valid
V2	0.41	0.32	Valid
V3	0.38	0.32	Valid
V4	0.78	0.41	Valid
V5	0.65	0.41	Valid
V6	0.60	0.41	Valid
V7	0.44	0.41	Valid
V8	0.43	0.41	Valid
V9	0.54	0.41	Valid
V10	0.46	0.41	Valid

TABLE V. RELIABILITY TEST RESULTS OF USER NEED DATA

Number of Items	Cronbach's <i>α</i>	Acceptable Threshold	Interpretation
10	0.723	0.60	Reliable

F. Qualitative Analysis of In-Depth Interview Data with Local Culture Experts

Qualitative testing was conducted on in-depth interview data with local culture experts using MAXQDA software to identify the key themes and cultural meanings in Javanese toilet use. This analysis strengthens the contextual understanding based on the local values. Figure 2 illustrates the contribution of the number of words in an interview.

Speaker	Focus Group	% Contribution	Words	% Words	Characters	% Characters
INTERVIEWER	Transcript Interview	55.56%	450	40.00%	2966	42.08%
INFORMANT	Transcript Interview	44.44%	675	60.00%	4082	57.92%

Fig. 2. Percentage of words in interview.

Figure 3 shows the results of the qualitative test presented in the form of word clouds, which highlight keywords related to the integration of Javanese local wisdom in toilet use and toilet design activities.



Fig. 3. Word cloud integration of local wisdom into toilet design.

G. Design Process

The design process consists of the following five stages:

1) Mapping the Relationships between the Elements in the Toilet

Relationship mapping was conducted to create an integrated and efficient system, where each element supports the others to

achieve optimal functionality. This mapping also facilitates accessible and ergonomic spatial planning and supports accessibility for all groups, including people with disabilities. There were 24 toilet elements, namely: Element 1 (Room); Element 2 (Door); Element 3 (Toilet Bowl); Element 4 (Washbasin); Element 5 (Tissue Holder); Element 6 (Clothes' Hook); Element 7 (Soap Dispenser); Element 8 (Handrail); Element 9 (Mirror); Element 10 (Baby Changing Table); Element 11 (Panic Button); Element 12 (Panic Lamp); Element 13 (Hand Dryer); Element 14 (Air Freshener); Element 15 (Storage Rack); Element 16. Labels and Signage Toilet flush button; Element 17 (Labels and Signage Washbasin); Element 18 (Labels and Signage Soap Dispenser); Element 19 (Labels and Signage Panic Button); Element 20 (Labels and Signage Hand Dryer); Element 21 (Labels and Signage Wheelchair Straps); Element 22 (Wheelchair Straps); Element 23 (Ventilation); Element 24 (Lighting). Figure 3 displays the relationship matrix between the toilet elements.

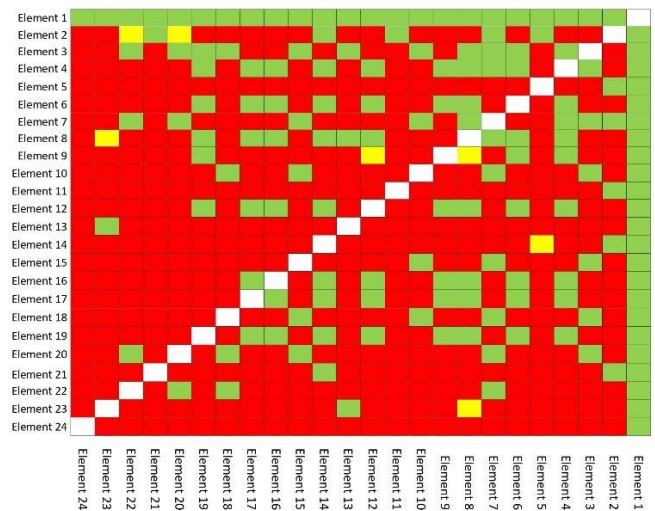


Fig. 4. Matrix of toilet components.

2) Mapping of Integration of Javanese Local Culture in Toilet Design

Based on ethnographic and interview data, themes and the categorization of local culture elements that can be integrated into the design were developed. Table VI shows the development of the themes and their categorization.

TABLE VI. JAVANESE LOCAL CULTURE ELEMENTS IN TOILET DESIGN INTEGRATION

Category	Local Culture Elements
Material	Use of wood (wood vinyl stickers)
Color	Brown
Ornament	The design combines Jebara carvings or Javanese batik motifs.
Flooring	Featuring a stone-inspired tile pattern
Spatial Form	It adopts the square or rectangular forms of traditional Javanese Joglo houses.
Sanitation System	Water and bar soap must be available.

3) Mapping the Integration of Universal Design Principles in the Toilet Design

The seven universal design principles were mapped to assess the extent to which the design elements of the train toilets meet inclusive accessibility standards. These principles include fair use, flexibility, simplicity, information comprehension, fault tolerance, physical efficiency, and adequate space to ensure that the design meets the comfort and safety of all users, including people with disabilities. Table VII presents the integration of the universal design principles into the toilet design.

4) Mapping the Dimensions of the Toilet Components

In this stage, the size specifications of each component in the train carriage toilet were determined. The mapping of the toilet components refers to national and international standards and the ergonomic (percentile) approach, as portrayed in Table VIII.

TABLE VII. INTEGRATION OF UNIVERSAL DESIGN PRINCIPLES INTO THE TOILET DESIGN

Universal Design Principles	Application in Toilet Design
Equitable use	Three handrails available (vertical next to the mirror, vertical and horizontal next to the toilet); Door equipped with automatic opening button; Mirror tilts down; Washbasin height: 75 cm for wheelchair access; Emergency light above the door; Emergency sound button available inside the toilet.
Flexibility in use	The toilet is integrated with the main room; The flush button is easy to reach (next to the toilet); The door operates with a sensor or automatic button.
Simple and intuitive use	Toilet components (shelves, doors, toilets, sinks) are easy to use; an Automatic flushing system or easy-to-push buttons. Sink placement is easily accessible for wheelchair users; Automatic faucets for ease of use; Soap placement is easily accessible and located near the sink.
Perceptible information	Door buttons have a tactile design and high-contrast colors for people with disabilities; Instructions on the flush button are available in Braille symbols and letters; Braille symbols and instructions are available for door buttons, faucets, soap dispensers, and hand dryers; Occupancy indicators are available on restroom doors.
Tolerance for error	The toilet floor is made of textured and non-slip material; The toilet floor slope is at least 1% for drainage; Emergency lights are installed above the door; The walls are waterproof; The handles and joints are rust-proof and not sharp; The toilet meets standard specifications.
Low physical effort	The toilet is equipped with a light-flush system and shower jet; The faucet operates with a sensor system for ease of use; The door is automatic, requiring no physical effort to open or close.
Size and space for approach and use	Accessible toilet room dimensions: 175 cm × 200 cm; Minimum free space of 150 cm × 150 cm for wheelchair maneuvering; Minimum open space of 60 cm in front of the sink; Door width: 85 cm, accessible for everyone, including wheelchair users.

5) Design Visualization

This section presents a 2D and 3D view of an accessible train toilet design with a universal design approach and Javanese local culture, illustrating accessibility features and ergonomic considerations. Two alternative toilet designs were

developed: Design A and Design B. Various views of these designs are illustrated in Figures 5-11.

TABLE VIII. TOILET COMPONENT DIMENSIONS

Toilet Components	Dimension
Room	Length: 200 cm; Width: 175 cm; Height: 220 cm
Door	Width: 85 cm; Height: 195 cm
Toilet bowl	Height: 45 cm; Width: 33.12 cm
Washbasin	Width: 45 cm, Length: 60 cm; Height: 75 cm
Tissue holder	Height: 60 cm
Clothes hook	Height: 151.98 cm
Soap dispenser	Height: 93.22 cm
Handrail	Horizontal Length: 95 cm; Vertical Length: 60 cm; Diameter: 3.6 cm; Height from floor: 70 cm
Mirror	Length & Width: 90 cm; Height from floor: 90 cm
Baby changing table	Length: 72 cm; Width: 53 cm; Max height: 85 cm
Panic button	Height: 24.26 cm
Panic lamp	Height: 185 cm
Hand dryer	Height: 66.31 cm
Air freshener	Height: 143.71 cm
Storage rack	Height: 73.39 cm; Width: 43.41 cm
Labels and toilet flush button signage	Height: 24.26 cm
Labels and Signage Washbasin	Height: 66.31 cm
Labels and Signage Soap dispenser	Height: 66.31 cm
Labels and Signage Panic button	Height: 24, 26 cm
Labels and Signage Hand dryer	Height: 66.31 cm
Labels and Signage Wheelchair Straps	Height: 80 cm
Wheelchair straps	Height: 70 cm
Ventilation	Height: 150 cm
Lighting	Height: 220 cm

6) Design Evaluation

The design evaluation used the weighted scoring method involving twenty assessment criteria to determine the optimal design alternative. The evaluation's success is determined based on the highest score of the two design options, which is obtained by calculating each criterion's value multiplied by the weight set's percentage. The statistical comparison between Design A and B is presented in Table IX.



Fig. 5. 3D front view of toilet design A.



Fig. 6. 3D left side view of toilet design A.



Fig. 10. 3D right side view of toilet design B.



Fig. 7. 3D right side view of toilet design A.



Fig. 8. 3D front view of toilet design B.



Fig. 9. 3D left side view of toilet design B.

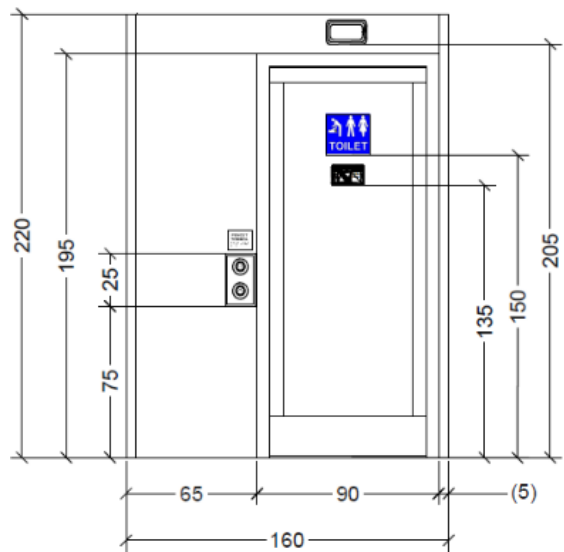


Fig. 11. 2D door view of toilet design A and B.

Based on the assessment results of 20 criteria, Design B shows superiority in accessibility, ease of use, automation, and representation of local cultural values and ornaments, with assessments that tend to be more consistent (indicated by a lower SD value). Design B scored higher on 11 criteria, indicating a strong preference from the assessors for this design. However, Toilet Design A still excels in several important technical aspects, such as material durability, visual comfort, lighting, and ventilation, contributing to user comfort and safety. The results of the toilet design validation assessment carried out by nine stakeholders can be seen in Table X.

The assessment demonstrated that Design B had a slightly higher average score (5.33) than Design A (5.28). Although the differences were relatively small, most raters rated Design B better, especially cane users, wheelchair users, and the general public. However, some assessors, such as industry representatives and seniors, gave higher scores to Design A. This suggests that both designs have their advantages, with Design B tending to be superior overall in terms of inclusivity and perceived comfort, although this was not statistically significant.

TABLE IX. DESCRIPTIVE STATISTICAL COMPARISON TEST OF TOILET DESIGN A AND TOILET DESIGN B

Criteria	Toilet Design A		Toilet Design B	
	Mean	SD	Mean	SD
The toilet design can be accessed by all users	4.67	0.50	4.89	0.33
The toilet design can be used by both right-handed and left-handed users	4.78	0.44	4.89	0.33
The toilet facilities are easy to understand and operate	4.22	0.67	4.44	0.53
The toilet design includes information in pictograms/symbols and Braille	4.56	0.73	4.67	0.71
The toilet design minimizes hazards	4.78	0.44	4.89	0.33
The toilet includes automatic buttons/sensors in its facilities	4.67	0.50	4.78	0.44
The toilet space accommodates user dimensions	4.44	0.53	4.44	0.73
The toilet design features a visual or symbolic ornaments representing the local culture	4.00	0.50	4.56	0.53
The toilet design uses colors representing Javanese cultural identity	4.22	0.67	4.33	0.87
The toilet design reflects the local values such as the square layout of traditional Yogyakarta houses	4.56	0.53	4.78	0.44
The toilet includes bar soap	4.56	0.53	4.56	0.73
The toilet incorporates or resembles local materials	3.78	0.67	3.56	0.73
The toilet design aligns with international/national standards and user ergonomics	4.67	0.71	4.78	0.67
The materials used in the toilet are durable and easy to clean	4.11	0.60	3.78	0.67
The toilet is safe to use while maintaining	4.33	0.71	4.33	0.50
The toilet has a modular design	4.33	0.87	4.67	0.71
The toilet uses corrosion-resistant and fire-retardant materials	4.11	0.60	3.89	0.78
The toilet includes wheelchair anchor features	4.67	0.71	4.67	0.71
The toilet aesthetics provide users with comfort and calm	4.22	0.44	4.11	0.33
The toilet has adequate lighting and good air circulation	4.56	0.53	4.33	0.50

TABLE X. STAKEHOLDER ASSESSMENT RESULTS

Stakeholder/Assessors	Toilet A Score	Toilet B Score
Ergonomics design experts	4.27	4.42
Representatives of PT INKA,	4.55	4.45
Representatives of disabled wheelchair users	4.52	4.35
Representatives of disabled crutch users	3.75	4.23
Representatives of deaf disabled people	4.26	4.23
Representatives of visually impaired disabled people	4.52	4.56
Representatives of the elderly	3.92	3.90
Representatives of pregnant women	4.21	4.17
Representatives of the train passenger community	2.97	3.02
Average	5.28	5.33

IV. DISCUSSION

The survey results, identifying the needs of executive train toilet users, show that features, such as emergency buttons,

occupancy indicators, water availability, and more expansive toilet space received the highest priority scores. This indicates users' urgent need for accessibility, safety, comfort, and cleanliness. These findings are in line with previous studies that emphasize the importance of accessibility [29], safety [30, 31], and cleanliness [32] features of disabled-friendly public toilet facilities. The results of group discussions highlighted the diverse needs of vulnerable groups, such as wheelchair users, the elderly, and pregnant women. Inputs included larger toilet spaces, tactile indicators, and handrails around mirrors and toilets. This reflects universal design principles, such as "equitable use" and "simple and intuitive use", which are in line with international standards, such as ISO 21542:2021 and WHO recommendations for inclusive transport [30].

The ethnographic insights emphasize the importance of Javanese cultural preferences, such as using natural materials (bamboo, wood), natural colors (brown), cleaning oneself using water, and symbolic ornaments, such as Jepara carvings and batik motifs. The integration of these values not only increases the user comfort, but also supports the cultural preservation. This approach is similar to the public design practices in Japan [33], China [34, 35], and Scandinavia [36] that incorporate the local cultural aspects into functional design.

This study provides methodological contributions through a mixed approach that combines participatory design, ethnographic methods, and universal design principles. This approach strengthens the validity of the design model and can be replicated for other inclusive transportation infrastructure projects in multicultural societies. The findings also have policy implications, and there is an urgent need to revise the standard Indonesian public transportation design with an inclusive approach that considers the local culture. For further development, it is proposed that an evaluation study of design implementation and cross-cultural comparative research be conducted to achieve a holistic national transportation system that embraces all community groups.

V. CONCLUSION

This study develops a toilet design model for executive trains in Indonesia that combines universal design principles with local cultural values of the Javanese community to support the accessibility and inclusion for disabled users. Using a mixed-method approach that includes identifying the user needs, ethnographic studies, and direct involvement in the design process, the resulting design can respond to functional needs while considering cultural aspects. The research findings show that key elements, such as expanding the toilet space, using non-slip floors, providing emergency systems, and using local materials and ornaments, improve the user comfort and emotional experience. The evaluation results show that assessors prefer toilet Design B more than toilet Design A. This study contributes to designing culturally adaptive and friendly public transportation facilities for all groups. Further research is needed to evaluate the implementation in the field, aspects of sustainability of use, and potential application in other cultural contexts.

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