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QUALITATIVE ASSESSMENT OF USABILITY AND ACCESSIBILITY OF HOUSING DESIGN ELEMENTS FOR DISABLED PEOPLE

Hamizah Yakob[1], Syahzanani Afzan Mazlan[2], Yusfida Ayu Abdullah[3], Na'asah Nasrudin[4]

[1,2,3,4] *Faculty of Architecture Planning and Surveying*
[1, 3,4]*Responsive Environmental Development (RED) Research Group*
UNIVERSITI TEKNOLOGI MARA (UiTM)

Abstract

Accessibility has become a challenge in today's societies where everyone has equal rights to live in a barrier-free and accessible environment. A previous study indicated that those living in high-rise residences have limited access to facilities for the disabled that are provided in accordance to the Garis Panduan Reka Bentuk Sejagat (Universal Design). This paper aimed to determine the level of accessibility of selected six (6) design elements such as the ramp, stairs, main entrance, the lift, handrails, and parking space and the usefulness of legislation and standards in PPR Pekan Batu, Kuala Lumpur. Qualitative assessments were applied for the study using content analysis of planning guidelines and site observation. The results demonstrated that the efficiency of legislation and standards was a factor in the accessibility and usability of housing design elements for PWDs. Three (3) design elements- the stair, parking space, and main entrance, had recorded the lowest compliance scores compared to another two (2) elements- ramps and handrails, which recorded the second lowest compliance score. Meanwhile, the lift was recorded as the most compliant element based on its accessibility. The outcome of this study implied that different types of disabilities require varied housing accessibility requirements. This study improves accessible design elements for the disabled, resulting in a better environment.

***Keywords**:* Usability, Accessibility, Design Element, People with Disabilities (PWD)

[1] Senior Lecturer at UiTM, Selangor, Malaysia. Email: hamizahyakob@uitm.edu.my

INTRODUCTION

Disability is any continuing condition that restricts daily life activities (Chai Jing, 2019). People with disabilities are defined as those who cannot participate fully in the community because of physical or mental disabilities that occur at birth or later in life. There are many shortcomings, obstacles, and problems facing persons with disabilities. Walking, listening, working, learning, hearing, and performing manual activities are confined to their everyday lives. In addition, their lives are filled with barriers everywhere they go, in residences, public buildings, and so on. Therefore, to decrease accessibility challenges that are faced by the disabled, architects, engineers, and developers should consider their needs for design and construction infrastructure.

Today's poorly constructed environments remain inaccessible for disabled people (PWD) and older adults. Thus, Malaysia needs to increase accessibility for numerous reasons, one of which is due to the changing demographics. Along with the growing number of people with disabilities, the search for independence and equal rights has also increased (Bashiti, 2015). This situation will also significantly impact how the built environment is planned. Individuals with different disabilities, sizes, and ages should engage freely in the built environment. Various users need different needs when developing. Since some people rely on other skills to build knowledge of their environment, it is necessary to consider all of them. To achieve social justice in all regions, eliminating obstacles and ensuring access are fundamental needs for disabled citizens in Malaysia.

All design requirements are for the making of good designs, as have been demonstrated by human factors. Designers must understand the basic human processing requirements. Universal design has particular challenges as it seeks to improve accessibility for various users. Problems such as the lack of usable and accessible housing and the lack of physical access to user-friendly facilities have resulted in issues that are related to the housing design quality for PWD (Syakir et al., 2018). Universal's design philosophy is a shift towards inclusion that promises better solutions for people with different capabilities. Universal design is necessary for incorporating other groups of users into the design space to support users of all ages with different abilities. In this study, the provision of facilities can be defined as providing uninterrupted facilities or facilities in a residential area where its occupants or others can access at any time. Therefore, public buildings with a barrier-free design should be developed since they promote integration and equal access through a safe and practical method for everyone (Chai Jing, 2019).

PEOPLE WITH DISABILITIES (PWD) IN MALAYSIA

Table 1 shows the registration of Persons with Disabilities (PWDs) in Malaysia, which has increased from the year 2016 to the year 2021. Based on 592,854

registered PWD in 2021, there was an increasing number of those with disabilities, mainly in Selangor and Kuala Lumpur. The increased number showed that it was necessary to provide them with accessible indoor and outdoor facilities not only in public buildings but also in the place they called home. In this case, seven (7) categories of PWDs can be considered for registration; Hearing Impairment, Visual Impairment, Speech Impairment, Physical Impairment, Learning Disabilities, Mental Disabilities, and Multiple Disabilities.

Table 1: Registration of Person with Disabilities (PWDs), 2016-2021

Year	Total Number (Malaysia)	Total Number (Selangor & Kuala Lumpur)
2016	409,269	88,427
2017	453,258	100,771
2018	497,390	106,875
2019	548,195	126,301
2020	581,265	131,576
2021	592,854	137,189

Source: Jabatan Kebajikan Masyarakat (2021)

LEGAL PROVISION FOR PWDs IN MALAYSIA

In Malaysia, the Person with Disabilities Act 2008 (Act 685) (Malaysia) declared that People with Disabilities have equal rights and chances as ordinary people. According to this Act, there are provisions on the rights of the disabled under Part IV, such as the right to access and use facilities, amenities, services and public buildings (section 26), the right to access and use public transport facilities, amenities and service (section 27), access to education (section 28), and access to employment (section 29). At the same time, the right to access information, communication, and technology is based on equality with the disabled (section 30), the right to access cultural life (section 31), as well as the right to participate in recreational, leisure, and sports activities, is based on equality with the disabled, is also provided subject to the existence of any circumstances that may endanger the safety of the disabled (section 32). Thus, all stakeholders such as the local authorities, developers, contractors, and builders must take an imperative approach to inspire and support services at housing, other facilities, and its surrounding for the disabled. For this study, the scope is focused on section 26 only.

Meanwhile, the Uniform Building by Law (UBBL) is a guide for housing developers, specifically in avoiding discrimination between PWDs from the community. There are also standards or codes of practice on access for disabled persons to public buildings, Malaysian Standard Code on Access for Persons with Disabilities (MS1184:2002) and a code of practice for access of

disabled persons outside the buildings, ms1331:2003, which should be met in all new development including housing. The MS1184 is used to develop universal design facilities as major guidelines by housing developers. In addition, the Universal Design Guideline (*Garis Panduan Reka Bentuk Sejagat*) was provided by PLANMalaysia, which highlighted housing design and surrounding developments of amenities and facilities for PWDs. However, there is a need to review the level of compliance with the provision of facilities and infrastructure requirements for PWDs. Even though the policies on the condition of such needs already exist, their implementation is still not widespread, mainly in the context of high-rise residential buildings.

THE USABILITY OF DESIGN ELEMENTS IN HOUSING

People want to remain in their homes and yet be a part of their communities. People with disabilities and the elderly require freedom, independence, and security to facilitate their mobility around the house. Thus, the house design is critical not only to reduce the risk of trips but also to be easily accessible and effective (Shahrom & Zainol, 2015). Shahrom and Zainol (2015) have described the interaction of the functional status of one person with the physical, cultural, and policy environment as a disability. When an individual cannot use the full range of body functions and cannot effectively collaborate with the accommodation and support, he or she is considered to have disability functional limitation.

People with disabilities have negative aspects of interaction due to their physical impairment, activity limitations, and contextual factors. Hence, as they are housebound and dependent; they need proper housing and habitation, whereby better housing design facilities may aid in their rehabilitation. Notably, this study implies that universal design idea covers the disabled, and considers their different abilities and ages. The universal design in housing is a building concept that has been applied to homes that include features, products, and procedures. All designs that everyone can use can benefit from applying the universal design principles (Dua, 2020). The regulations and guidelines of the universal design are as follows:

i. Equitable - practical, functional, fair and viable to everyone with various types of abilities
ii. Flexibility - the variety of choices for personal preference and skills
iii. Easy, simple and perceptive - easy to grab and understandable
iv. Perceptible information - effective for the user
v. Tolerance for error - minimal dangers and the unpleasant accidents
vi. Low physical effort - efficient and comfy to use with minimum exhaustion

vii. The dimension - size and space which is suitable for reach, manipulation, use and grab

Home design and modification need to meet the requirements of the household. A universal design in housing should provide a ramp, toilet, appropriate space, entrance, handrail, and practical design, as shown in Table 2.

Table 2: List of housing design features with the description of universal design in housing

Design Features	Description
Entrance	• Stepless entrance • Sloping walks at 1:20 max • Min 5'x5' level clear space inside and outside the door • The light doorbell at a reachable height
Circulation	• Interior and vertical circulation - 30"x48" clear floor space • Improve circulation • Easy access • Accessible for wheelchair users
Bathroom and Toilets	• Provide clear floor space • Curbless shower • Provide handrails - easy to grab and move. • Handle, faucet, control - single lever handles
Kitchen	• Space between a face of cabinets and walls - 30"x48" clear floor space • Clear knee space under the table and sink • Adjustable height in wall cabinet - max reach controls 24"x46" • Allow a person to work while sitting
Switches and Controls	• Reachable height - 15"-48" • Accessible to children and wheelchair users • Easy-touch or hands-free switch • Portable battery powered/ using the remote control • Easier to reach with hands full (e.g. with elbow)
Windows	• Windows for viewing, 36" max sill height • Can look out from the seat • Reachable to open, close and lock
Doors	• Clear opening. The open door should extend 2' min or more 90 degrees • Accessible • Outside open-loop handles • Latches are operable without grasping or twisting • Max 48" height and easy to open
Floor	• Non-slip floor surface - 30"x48" clear floor space • Avoid slippery surfaces

	• Easy to move
Stairs	• Provide handrails - to grab and for the barrier
	• Provide ramp, 1:2 max
	• Accessible to all people
Ramp/Curb	• The slope of 1:2 max
	• Easy for mobility impairment and stroller.

Source: Shahrom & Zainol (2015)

The design of a person's home can support engagement both inside the house and in the community if it considers their functional needs. This is supported by Rangga et al. (2020) who have claimed that to enhance usability, easy access to design features is highly recommended. Easily recognisable entrances enable access to the community and neighbourhood. People may feel more energised or motivated to engage in community activities if their homes have bathrooms that make bathing simple and comfortable, kitchens that are designed to support meal preparation, and bedrooms that permit safe transfers and are suitable for getting enough rest (Greiman, Koon, Schulz, & Nary, 2022). For the purpose of this paper, only six (6) design elements concerning accessibility and usability were covered as the focus of the study. In addition, they were only measured within the surrounding access, and not inside the individual's house unit.

ACCESSIBILITY OF DESIGN ELEMENTS IN HOUSING

According to Shahrom and Zainol (2015), there were six (6) aspects of Universal Design Index (UDI) to rate housing accessibility: 1) connectivity, 2) usability, 3) safety, 4) accessibility, 5) integrated design, and 6) operation and maintenance. Their study also claimed that they had thought that universal design in housing only cared about accessibility, however the concept of universal itself showed that it is usable for everyone. Figure 1 shows the terminology that is related to the Universal Design Concept. In the context of housing, there was no correlation between universal housing and barrier-free or disabled housing. Universal housing is designed to be usable for most individuals for a lifetime without considerable change.

Meanwhile, Shobri et al. (2018) have claimed that accessible design only benefits the PWD. Individuals with multiple disabilities have distinct accommodation, support and facility requirements from the general population. Thus, accessibility is the most significant aspect of housing for the disabled. Jin et al. (2018) has stated that accessibility is always associated with spatial relations or topology; these connections between spaces have suggested spatial integration in a building and spatial depth, and is one of the representative concepts. This statement is supported by Syakir Amir et al. (2018), who has claimed that housing locations that are far from direct access result in the disabled not owning or

buying their own houses. In addition, Ng (2019) stated that accessibility was necessary to measure the effectiveness and efficiency of the Malaysia Standard and Universal Design in terms of its compliance. Meanwhile, Adriana et al. (2020) in their study suggested the notion of accessibility for high-rise residential buildings including the possibility for PWDs to have their house unit on the ground floor of the block. Also, Cornelia et al. (2022) has claimed that the inclusion of housing features in the future will provide additional insights into the accessibility needs of different populations including PWDs.

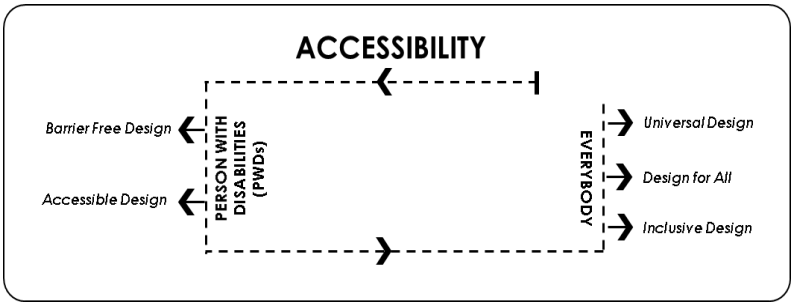


Figure 1: Terms related to Universal Design Concept
Source: Yusof & Jones (2014)

Based on previous studies, it was found that there was a lack in terms of analysis concerning supporting facilities for PWDs in residential areas. Previous studies have only examined the housing needs of PWDs, such as the interior design of the home, satisfaction and preferences of the disabled regarding housing design elements, factors that are influencing the disabled daily mobility in residential facilities, availability and access to physical facilities, universal design assessment and house accessibility using *Garis Panduan Reka Bentuk Sejagat.* Thus, the relationship between accessibility and usability of design elements for PWDs in residential areas was studied to fulfil the research gap.

METHODOLOGY

Study Area

PPR Pekan Batu is a low-cost condominium in Kuala Lumpur's Batu Caves district (Figure 2). The government completed the project in 2000 as part of the People's Housing Project. The project is situated on leasehold land and is strata titled. The government has been striving to upgrade the property's facilities. PPR Pekan Batu comprises two (2) blocks, namely Block A and Block B. The complex contains a high-rise apartment building with a total of 496 units and an estimated population of 2,480. There are 18 storeys, each with 16 units. Each block is equipped with three (3) elevators or lifts. There was only one (1) layout, consisting of three (3) bedrooms and two (2) bathrooms, with a total built-up area

of 650 square feet. This area was selected as a case study as it was designed as the primary residential area surrounded by other residential properties such as 99 residences and Seri Wahyu Residence. It was also located near the public transportation (MRT Taman Wahyu, MRT Kampung Batu, MRT Batu Caves), public amenities and accessible facilities that provide additional services to the residents, including the PWDs. Apart from that, this PPR was a government project under an affordable housing scheme that aimed to assist mainly the B40 group to purchase their home at affordable prices with adequate facilities.

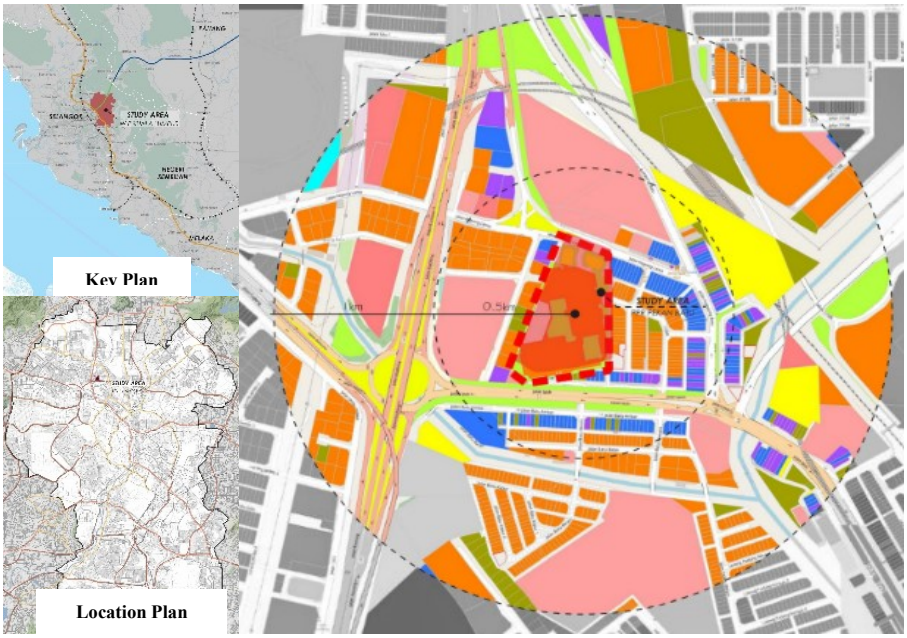


Figure 2: Study Area and its Adjacent Land Use within 1 km Radius
Source: Draf Pelan Strategik Kuala Lumpur (2020)

Method

As this study had focused on the qualitative method, the observation and content analysis of documents were applied. The design of a research method was formed following the research topic and objectives. The study used a qualitative approach with observation, measurement, photography and document review to determine the usability and accessibility of the selected six (6) housing design elements for PWDs.

Site Observation and Content Analysis

The study was to understand the essential characteristics of a person, group, or environment in observational research, nothing had been monitored or

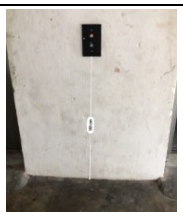
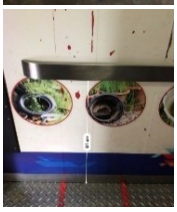
manipulated, as such it was not experimental. Therefore, it was conducted using a structured observation that involved a detailed explanation of the categories to be documented. The observation form design approach was used visually and precisely to compile qualitative data by identifying issues related to accessibility and usability. This approach was also applied to determine the usability or functionality of all the design elements or indicators, which had included parking space, walkways, ramp, handrails, stairs, lifts, and connectivity from one point to another. The characteristic, as referred to in the guidelines, had been defined in the survey form, in which the usability and accessibility of the design elements for disabled people were determined. Observation using a checklist was supported by photography, which was conducted between June 2021 till July 2021, whereby each observation had taken three (3) hours to complete. Content analysis was performed to review and analyse the compliance with *Garis Panduan Reka Bentuk Sejagat*. The Rank Matrix on level of accessibility and usability as well as observation were applied in the form of a Table, using Radar value (which was generated manually from Excel) as an outcome of the study.

RESULTS AND DISCUSSION

This study has used structured observation, which typically renders the observation material all the more inflexible than an unstructured observation. It has been performed to determine the usability or functionality of the design elements, including parking spaces, walkways, ramps, handrails, stairs, lifts, and connectivity. The characteristic referred to the universal design requirements of the *Garis Panduan Reka Bentuk Sejagat*, in which the usability for disabled individuals and accessibility were also determined. The result from the compliance checklist for the listed design elements was summarised (Table 3). The content analysis was made by analysing six (6) design facilities referring to the *Garis Panduan Reka Bentuk Sejagat*.

Table 3: Analysis of Selected Design Elements for Accessibility in Compliance to *Garis Panduan Reka Bentuk Sejagat*

Design Elements	Standards	Compliance			Remark
		1	2	3	
Ramps	Ramps shall be provided outside and inside all public and commercial buildings, public transport terminals, car parks, multi-story residences and recreational areas to connect pedestrian walkways.			/	
	Unrestricted ramp on the left and right shall be provided with a curb with a minimum height of 100 mm for the safety of wheelchair users and crutch users	/			
	Guiding blocks / tactile blocks should be provided at the beginning and end of the ramp gradient to warn and guide the visually impaired.	/			
	The maximum for the ramp slope must be 1:12 with a minimum width of 1500 mm.		/		
	The surface of the ramp must be of a non-slip and suitable material			/	
Stairs	Stairs, elevators and escalators shall be provided to provide access to individuals in multi-story buildings.	/			
	Guiding blocks / tactile blocks shall be provided on stairs, elevators and escalators as a guide to physical barriers or warning.	/			
	Width of the stairs not less than 900 mm			/	
	Tread between 260 mm - 300 mm			/	
	Riser of the stairs 180 mm maximum		/		
	The landing of the stairs not less than 1200 mm		/		
	Handrail provides each side of stairs		/		
	Floor finishes use non-slip material			/	
	Texture and colour of the stairs are distinguished from landing and floor level			/	
Handrail	Handrail shall be provided on sidewalks, building corridors, ramps and building stairs		/		
	Handrail shall be installed at a minimum of 840 mm and a maximum of 900 mm from the floor level			/	
	Handrail shall have a minimum distance of 50 mm and a maximum of 100 mm from the walls of the building		/		
	Handrail shall have a minimum circumference / width of 40 mm and a maximum of 60 mm and shall be non-slip and safe to grasp		/		
Doorway and main entrance	All main entrances to the building shall provide access to wheelchair users to enter the building	/			
	Guiding blocks / tactile blocks shall be provided at the entrance and exit of the building			/	
	The floor surface shall use contrasting materials and			/	

	colour for the purpose of warning signs for the visually impaired.				
	The entrance of the building must have a minimum width of 900 mm. However, the minimum width for hospital entrances and sports complexes is 1000 mm	/			
	Space for twisting (turning radius) for wheelchair users shall be provided with a minimum diameter 1200 mm	/			
Lift	Lifts shall be provided to provide access to individuals in multi-story buildings	/			
	Guiding blocks / tactile blocks shall be provided on stairs, elevators and escalators as a guide to physical barriers or warning			/	
	A minimum of 1 elevator near the main entrance of the building should be accessible to wheelchair users and have space to rotate 180 degrees	/			
Parking	Parking for wheelchair users shall be provided outside and inside all public	/			
	Provide near the main entrance		/		
	Parking should be provided on a flat surface		/		
	A step ramp / dropped curb with a minimum width of 1200 mm shall be provided as access to the pedestrian walkway outside the building.			/	
	For Indoors, the parking space should be level with the surrounding walkway. Step ramps or dropped curbs with a minimum width of 1000 mm and a maximum of 1050 mm shall be provided if uneven.			/	
	Parking symbols for wheelchair users must be provided and visible when entering the parking area.	/			
	Parking symbols for wheelchair users should also be provided on the surface of the parking space	/			
	A building must have a minimum of 1 wheelchair parking space for every 25 public parking spaces, or 1 space for every 2 public parking spaces if there are only 2.	/			
	The minimum size of right-angle parking is 3600 mm wide x 4800 mm long. If the parking facility is parallel to the road, the minimum size is 3600 mm wide x 6600 mm long.	/			

Note: 1 - All requirements are not met/ facility is not provided even though it is necessary
2- Partially met the requirement
3- All requirement met/ facility is provided but it is not necessary

Meanwhile, the Rank Matrix was used to evaluate and to summarise the compliance according to the required guideline, as in Table 4. Results on the level of accessibility in Figure 3 showed that three (3) design elements- the stair, parking space, and main entrance, had recorded the lowest compliance scores (Rank 3) compared to another two (2) elements- the ramps and handrails, which had recorded the second lowest compliance score (Rank 4). Meanwhile, the lift was recorded as the most compliant component of the study area based on its accessibility (Rank 5).

Table 4: Rank Matrix for Evaluation on Level of Accessibility Compliance for Selected Housing Design Elements.

Rank	Remark
1	Poor/ 0% all requirements are not met/ facility is not provided even though it is necessary
2	Satisfactory/ 25% of the requirements met
3	Fair/ 50% of the requirements met
4	Good/ 75% of the requirements met
5	Excellent/ 100% all requirements met

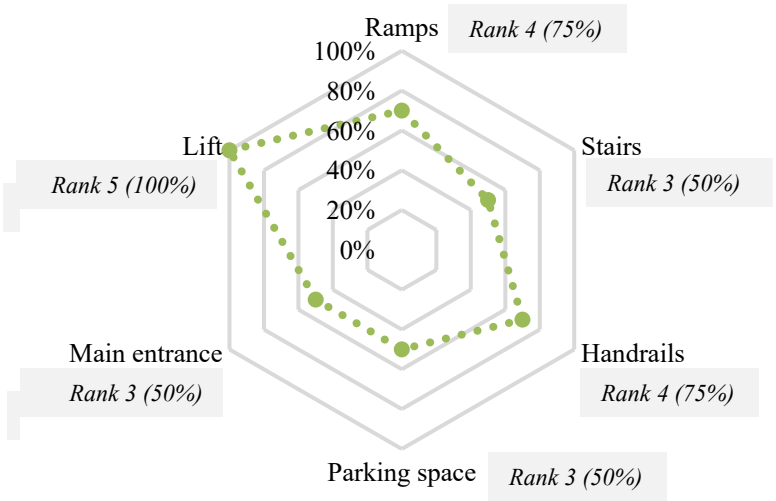


Figure 3: Rank Matrix on Level of Accessibility for Selected Housing Design Elements.

Regarding usability, six (6) evaluation indicators were used in a checklist during site observation, where a scale has been applied (Table 5). From

the results, it was found that the tread and riser of the stairs in the provided study area were accessible. However, the top and bottom of the stairs seemed to lack tactile surfaces. There is neither signage nor walkways directing visitors to the building; the only signage indicating the accessible areas was installed in the parking lot for the disabled user. The width of existing corridors in specified areas is frequently sufficient for the wheelchair users to pass through and turn. In addition, wheelchair users have access to the existing corridors. The lift is accessible due to the provision of an assistive lighting system. Additionally, the size of the lift holds enough space. It can be deduced that the equipped lift facilities do not cause unnecessary difficulty for the disabled. The existing ramps make it easier for the disabled users to enter and exit the building. Also, the slope of the ramp was ideal for use.

Table 5: Evaluation Criteria on Usability When Entering the Building (Housing Block)

Evaluation Criteria	Rank	Note
Are tread depth and riser height of stairs enough? Are there any tactile surfaces at the top and bottom of the stairs?	1.5	*1: Yes/ There is no obstacle or deficiency to restrict accessibility* *1.5: Medium / there are several obstacles or deficiencies to restricting accessibility* *2: No/ There are obstacles or deficiencies in terms of accessibility*
Are there any signage and wayfinding in places?	2	
Is the width of corridors enough? Is there enough area for a wheelchair to pass and turn?	1.5	
Are there any assistive listening systems in elevators?	1	
Are the width of lift enough for wheelchair?	1	
Are there any ramps to make passing easier? If exists, are their slopes appropriate?	1	

CONCLUSION

The results of the study indicated that some obstacles and challenges must be addressed regarding universal design, specifically on accessibility and usability aspects. These issues were due to a lack of accessible housing design elements as well as the lack of understanding of the existing legislation and standards. Thus, the results have indicated that Malaysian developers need to be better informed regarding universal design and its benefits and issues that are connected with the adopting of the principle in the housing environment. Additionally, government initiatives and community awareness should be improvised to implement universal design elements in compliance with the related guidelines.

As this study examined the accessibility and usability of PWD's facilities by assessing the efficiency of regulations and standards, some recommendations may be considered in the future. Firstly, future studies on the related topic may use a quantitative or mixed method for data collection. In addition, the study may be focused on landed property in an urban area, and *Garis*

Panduan Reka Bentuk may be introduced to ensure accessibility for PWDs in raising their awareness. Expert interviews among the stakeholders such as the local government, policymakers, and developers may be approached as respondents for future research. Moreover, other design elements excluding these six (6) elements may be used as the focus of the study, which covers the inside of the housing unit such as access to the kitchen, access to the bathroom, and so on.

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