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Universal Design and Accessibility Performance in Public Buildings: Perspectives of Malaysia's Public Works Department

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ABSTRACT

Universal design and accessibility in Malaysia have gone through various improvement and showing a steady progress aligning with Goal 9, 10 and 11 of United Nation's 2030 Agenda for Sustainable Development. However, the accessibility performance of public buildings remained unknown despite the claim. Public Works Department (JKR) as the national technical agency in executing the country's physical development shall ensure public buildings and infrastructure employs sustainable strategy, in particular application of accessibility and universal design. Therefore, the purpose of this article is to evaluate accessibility performance of public buildings in Malaysia. The methodology used is a case study of twelve (12) public buildings of various types located in Peninsular Malaysia. The selected buildings were assessed using the checklist derived from Malaysia Standard MS1184:2014 Universal Design and Accessibility in the Built Environment Code of Practice (Second Revision). The study showed that newly built health facility building obtained the highest score whereas school buildings scored the lowest. The findings from the assessments were further analyzed according to the checklist criteria to propose recommendation on how to provide fully accessible public buildings. In conclusion, although universal design and accessibility have been gazetted as statutory requirements since 2008, public buildings still have a long way to go in ensuring the facilities are inclusive and fully accessible to all. Therefore, synchronization of budget prioritization and stakeholders' awareness will help in accomplishing seamless access and function of public buildings.

1. Introduction (Research Background & Literature Review)

The concept 'Design for All' has been advocated by many since few decades ago and one of the most common application is universal design (UD). Goal 10 and 11 in the Sustainable Development Goals (SDG) are emphasizing on inclusivity with the aim to reduce inequalities and create sustainable

cities and communities. These goals are supported by Goal 9 and 17 in creating sustainable inclusive communities through improving infrastructure and partnerships for the goals. Malaysia is one of the countries that is committed to achieve these SGDs through a collective blue print and initiatives in the 5 years National Development Plan's (NDP) 2021-2025 and NDP 2026-2030. Public Works Department of Malaysia (JKR) is the leading technical government agency in implementing the NDP to provide physical public infrastructure for the country. Thus, it is imperative to the department to deliver the infrastructure and facilities that is inclusive and barrier-free. This action is manifested in the 2021 amendment of the law; The Uniform Building By-Law 1984 (UBBL) [1]. The amendment has included that all buildings must comply with the requirements laid out in Malaysian Standard MS1184: Universal Design and Accessibility in the Built Environment Code of Practice (Second Revision) (MS1184) [2]. Any building that was built before the gazetted amendment are given three years to improve their accessibility features under new by-law of 34A: Building requirements for disabled persons. Failure to comply may result the building owner to penalty as stated in the law.

However, systematic measurements to assess the level of accessibility in public buildings were non-existent. Therefore, the department has come up with initiatives to measure accessibility through an assessment scoring system for public buildings. In 2019, JKR has developed an accessibility checklist adopted from the MS1184. This checklist is intended for JKR designers to evaluate accessibility level of their design pre and post occupancy through a systematic calculation of an accessibility score for the evaluated building. Nevertheless, the benchmark evaluation of accessibility level for public buildings is yet to be established. Therefore, this situation had triggered the objective of this research which is to evaluate the accessibility performance of public buildings in Malaysia.

This research was a case study evaluating accessibility performance of twelve selected public buildings. The instruments used for data collection were on-site access audit and accessibility scoring checklist. This research is filling a gap of benchmark evaluation to the current accessibility level of public buildings. JKR designers will be able to use the findings from this research to evaluate and improve their design in the future. Accessibility scores of ongoing and future projects will be able to be calculated based on this research case study. These scores will be observed and reported in JKR Strategic Plan and eventually, marking the forward steps of the national agenda in achieving the SDGs.

1.1 Literature Review

1.1.1 The importance of universal design

The concept ‘Design for All’ is aimed for the whole community to be able to access and use all places and facilities independently. The misconception of universal design is about providing facilities only for disabled persons shall be debunked. As the name suggest, the concept ‘design for all’ is aimed to everyone, and this includes all vulnerable users such as people with disability, wheelchair user, people with temporary disability, families with small children, pregnant women, school children and elderly. According to Agarwal (2019), data from World Health Organization (WHO) indicated that over one billion people in the world is a person with disability [3]. The number is multiplying greatly when all groups of vulnerable users aforementioned is included. These vulnerable users have specific needs that must be catered for them to independently and equitably use spaces and facilities provided in the community. This can be achieved through the application of universal design. Universal design is commonly known with seven principles; i) equitable use, ii) flexibility in use iii) simple and intuitive use iv) perceptible information v) tolerance for error vi) low physical effort vii) appropriate size and space for approach and use as explained by Center for Universal Design [4]. This concept is aligned with the New Urban Agenda by United Nations and Malaysia is one of the countries ratifying the agenda [5]. Universal design application also supported by Sustainable Development Goals (SDG) 9,

10, 11 and 17 to create sustainable and inclusive communities, cities and infrastructure. This is also agreed by Martínez *et al*, that these goals will be achieved through partnerships and cooperation from all levels of communities [6].

Universal design application for the community is vital as the number of vulnerable users in the country is very significant. According to Malaysia's Welfare Department (JKM) [7], as at January 2023, the number of persons with disability currently registered is 637537, and these number does not reflect the real situation which is estimated to double due to reluctance of disabled persons to register with the official body. These findings also supported by Department of Statistics Malaysia (DOSM) [8] which predicted that by 2050, the number of elderlies in the country will be more than 15% of the country's population. In 2022, The Malaysia Reserve mentioned that this country was officially declared as ageing nation once elderly of 65 years old and above reached 7.3% of the total population [9]. However, the reality is more alarming than the declared numbers. The National Morbidity Survey revealed that one in four adults in the country experience functional difficulties in one or more of the following domains; seeing, hearing, remembering, walking, self-care and communicating [10]. Therefore, this situation calls for a more rampant action as the need of universal design implementation goes beyond the common perception. Rahim [11] also mentioned that universal design requirements cover every aspect in the daily lives of a user from the womb to the tomb. Technology, communication, built environment, clothing, furniture and even stationeries are some aspects in life that must consider the needs of the universal users.

1.1.2 Universal design in the built environment

Universal design in the built environment is one of the most vital aspect that need more attention from all. The built environment plays a very big role in the life of a user. Housing, transportation, offices, public service buildings, parks, hospitals, schools are examples of places and spaces that need universal design implementation. Building and Construction Authority Singapore [12] mentioned that universal design application covers external and internal aspect of buildings and spaces, including accessibility, circulation, connectivity, usability and safety. Furthermore, as explained by Bianco (2020), having systematic developments of universal design guidelines for architectural and urban projects will lead to a fully accessible built environment [13]. Developed countries such as United Kingdom, Ireland and Australia had put emphasis on accessibility to the built environment since early 90s with gazettement of disabled acts in respective countries [14]. However, the situation is still demeaning in Malaysia, as related acts were only gazetted in 2008 and enforcement of the act is still lacking. The comparison of acts and guidelines in the country to other developed nations related to universal design is shown in Table 1. Currently, some universal design aspects can be found in newer buildings yet very limited in existing and older buildings.

Table 1
Comparison of acts and guidelines in Malaysia to other developed countries related to universal design

No	Country	Universal Design Act & Guidelines
1	Malaysia	Act 685 MS1185 & MS1184 Universal Design Guidelines for the Built Environment
2	Singapore	Code on Accessibility in the Built Environment 2019 (BCA) Universal Design Mark Certification
3	Ireland	Building for Everyone: A Universal Design Approach (National Disability Authority)
4	United Kingdom	Equality Act 2010
5	Australia	Disability Discrimination Act 1993

1.1.3 Universal design application in Malaysia's public buildings

The history of universal design application in Malaysia's public buildings dated back to few decades ago with the gazettement of Person with Disability Act 2008 (Act 685). Act 685 [15] outlines the provision of the registration, protection, rehabilitation, development and well-being of person with disabilities and other matters connected to all aspects mentioned. The recent amendment of UBBL in 2021 further emphasizes on the improvement of universal design application in the built environment based on the MS1184. The requirements and details of universal design application is comprehensively explained in this document. However, although various documents have highlighted the needs to implement universal design in the built environment, the reality is far from perfect. Kadir *et al* [16] mentioned that complaints and requests from end users are endless specifically for public buildings that are used by all community groups on daily basis. This is agreed by Hussein *et al* [17] where public buildings such as schools, mosques, public services places, parks, and so on are lacking on universal design implementation, especially older buildings. Therefore, the finding of this research is crucial to evaluate the accessibility performance and implementation of universal design in public buildings in the country.

2. Methodology

2.1 Research Design

This paper started with a review of universal design application in the built environment and current situation in Malaysia. The situation in Malaysia is further investigated specifically to public buildings as per objective of the paper. This research aimed to find the current status or benchmark of public buildings accessibility and thus improve its' design and accessibility performance. The methodology adopted for this research is a case study of 12 public buildings located in Peninsular Malaysia, with accessibility assessment done over 2022 and 2023 by an access audit team of JKR architects and staff. These buildings were JKR projects and assessed using the accessibility checklist adopted from MS1184. The data collected from the case studies were further analyzed using a marking system based on the criteria from the checklists to achieve the objective of the paper which is to evaluate accessibility performance of public buildings in Malaysia.

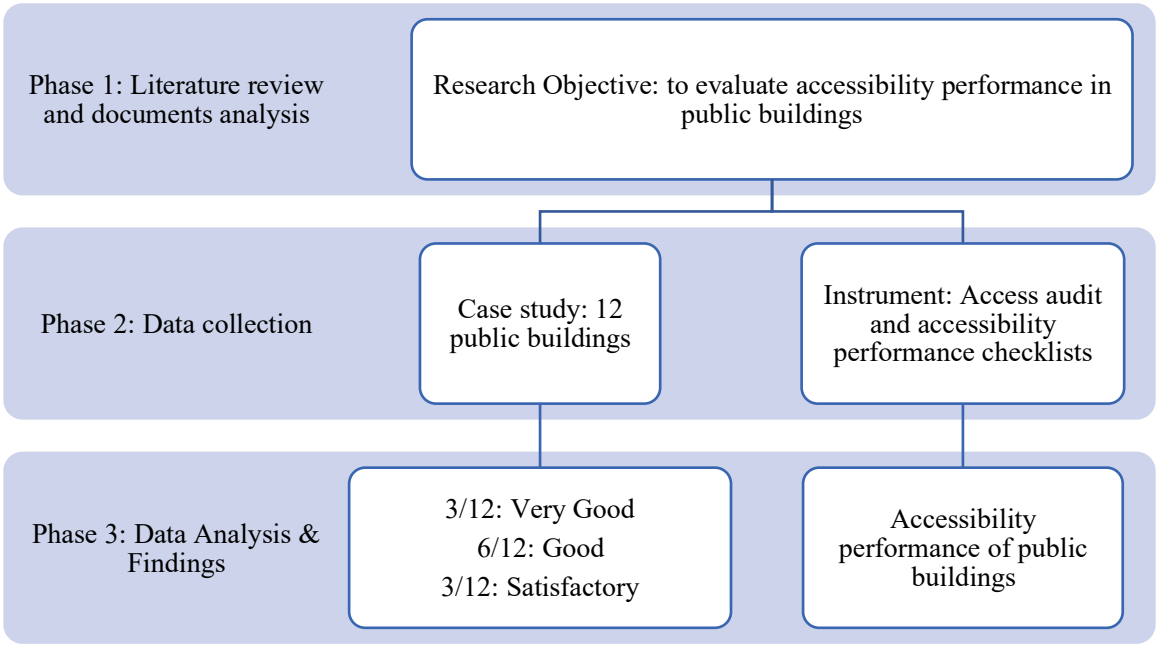


Fig. 1. Research Design

2.2 Case Study Criteria Selection

The data collection was conducted through access audits in 12 public buildings over the year 2022 and 2023. The basic characteristics listed for the case study were 1) sample buildings were completed JKR projects and 2) the buildings have been occupied for a minimum duration of 6 months or have had at least 60% occupancy. These two characteristics were vital to create a baseline to the results and further generalized in future research. The result analyzed from the data collection will be used as the baseline for public buildings' accessibility performance. The selection of buildings used for the access audits was a variation of building types to eliminate any skewed result towards certain types of buildings. This process is significant to produce an unbiased result for the research. The selection process was done thoroughly to produce a relevant and applicable result to their users. Minimum occupancy and usage period were needed to ensure these buildings have been used by all types of communities, especially vulnerable users such as person with disability, person with temporary disability, pregnant women, school children, families with small children and elderlies. Observations and feedbacks were also collected from the end users, and these impressions were crucial to evaluate preliminary findings regarding accessibility performance of these buildings.

During the audit, the sample buildings were assessed using specific listed criteria to measure their accessibility performance using a systematic marking system. The sample were categorized according to certain criteria as follows:

Table 2
Categorization of public buildings used for the case study

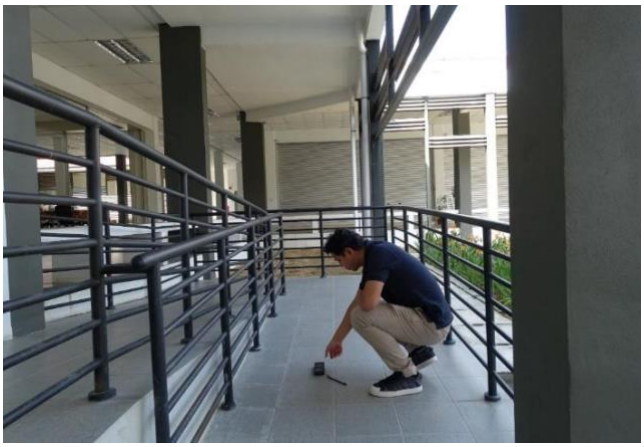
No	Name of building	Building Type	Single/ Multi Blocks	Completion Year	Assessment Year
1	CREaTE JKR, Melaka	Training Centre	Multi Blocks	2016	2023
2	Hospital Pendang	Hospital	Multi Blocks	2022	2023
3	KPDN Kuala Pilah	Public Services	Multi Blocks	2021	2023
4	Orang Asli One Stop Centre, Kampung Bawong, Sungai Siput, Perak	Public Services	Multi Blocks	2020	2023
5	Hospital Sultan Ismail Petra (HSIP), Kuala Krai, Kelantan	Hospital	Multi Blocks	2018	2022
6	Masjid Tareq Bin Ziyad, Kempadang Perdana, Kuantan, Pahang	Mosque	Single block	2021	2022
7	Bangunan IPJKR BLOK A,B,C,D, E	Government office	Multi Blocks	1955	2022
8	Blok F, IPJKR	Government office	Single block	1955	2022
9	Blok G, Menara Kerja Raya	Government office	Single block	2016	2022
10	Lembaga Pelabuhan Johor	Government office	Single block	2014	2022
11	Jabatan Pendaftaran Negara, Daerah Jasin, Melaka	Public Services	Multi Blocks	2016	2022
12	Sekolah Menengah Kebangsaan Agama (SMKA) Jerlun, Kedah	School	Multi Blocks	2019	2022

Source: JKR database

2.3 Procedure of Assessment

The assessment session was conducted through two main phases which is the preparation prior to on-site access audit and conducting the access audit on-site. During the first phase prior audit preparation is forming the assessment team consisted of six persons; one lead assessor, two note taker, one measurer, and two access evaluator (roleplay). Then, the lead assessor will inform the building owner about the schedule of assessment sessions meanwhile the team will ensure all documents were available prior to the actual on-site session which are as-built drawings, site plans, visitors' feedback or complaints form and pictures of the buildings. These documents were used to establish preliminary evaluation to the buildings. These documents were identified and marked according to their criteria; vertical and horizontal circulation, public access, private access, disabled toilets, main spaces, supporting facilities, gathering spaces and many more. Phase two involved conducting the on-site access audit. The assessment sessions typically took 3 to 4 days, according to complexity and location of the buildings. During the assessment, the building owner will appoint two persons in charge to facilitate the assessment process. Apart from evaluating the accessibility features, the team also measure the space and element of the building according to criteria laid out in the checklists. This activity requires equipment such as measuring tape, digital leveler, wheelchair, long cane, and blindfold. The photos of the spaces and design criteria such as width and depth of stairs, height and gradient of ramps were also captured and recorded. The findings (in score) were calculated and included in the final report shared with the building owner. This report may be used by the building owner to bid for budget from the government for further improvement of their buildings. The examples of on-site assessment are shown in Figure 2 below:

(a) Assessors taking measurements of parking spaces



(b) Assessor taking measurements of ramp slopes

(c) Assessor taking measurements of level difference

(d) Simulation of wheelchair user accessing PWD toilet

Fig. 2. Examples of assessment session

2.4 Assessment Checklist Attributes

According to (Ireland National Disability Authority's Centre of Excellence in Universal Design, 2012) [18], universal design is elaborated using nine characteristics, explained in its Building for Everyone Booklet Series; 1) External environment and approach 2) Entrances and horizontal circulation 3) Vertical circulation 4) Internal environment and services 5) Sanitary facilities 6) Facilities in buildings 7) Building types 8) Building management and 9) Planning and policy. Similar characteristics and concept can be found in Singapore's Guide to Universal Design Index published by Building and Construction Authority in 2022 explaining how these characteristics are targeted for a bigger user groups of disabled persons, elderlies, families with young children and expectant mothers to ease independent usage in the built environment. It is observed that these characteristics are aligned with the criteria and attributes listed in the checklist derived from MS1184 used in this research. All

building sample in the case study were assessed using this accessibility checklist with a systematic marking system. The checklist has 15 criteria and 142 attributes as depicted in Table 2 as follows:

Table 3
Checklist of assessment criteria

Form	Criteria	No of Attributes
Form A	Checklist of Designated Accessible Parking	8
Form B	Checklist of Paths to the building	12
Form C	Checklist of Ramp	6
Form D	Checklist of Doors and Windows	13
Form E	Checklist of Toilet, Shower and Ablution	28
Form F	Checklist of Emergency Route	7
Form G	Checklist of Fire Fighting System	4
Form H	Checklist of Staircase	5
Form I	Checklist of Handrails	10
Form J	Checklist of Lift and Escalator	15
Form K	Checklist Door Handle	7
Form L	Checklist Reception, Counter and Auditorium	4
Form M	Checklist Directional Signage and Wayfinding	15
Form N	Checklist Drainage System	3
Form O	External roads	5
	Total	**142**

Source: JKR

The attributes in each form varies from 3 to 28 items, with a total mark of 142, indicating 142 attributes to be assessed for each building. One mark is given for compliance and nil for non-compliance. However, for situations where certain items were not applicable, the total score will be recalculated to eliminate the non-applicable items. Total score will be presented in percentage and categorized as indicated in Table 3 below:

Table 4
Categorization of accessibility marks

SCORE (%)	CATEGORY
80 - 100	Very Good
60 - 79	Good
40 - 59	Satisfactory
0 - 39	Unsatisfactory

Source: JKR

According to the targeted scoring of accessibility in JKR Strategic Plan 2021-2025, public buildings must achieve at least 60% marks or otherwise considered as not achieving the intended accessibility level and need to undergo upgrading works immediately. The target was set according to the baseline of the essential requirements in ensuring accessibility in public infrastructure.

3. Results and Discussion

3.1 Results and Findings

3.1.1 Accessibility score

According to the findings, three buildings are in the Very Good category, meanwhile six buildings are categorized as Good, and the remainder are in the Satisfactory category. The buildings under Very Good category are B2, B9 and B11, with marks of 87.60%, 80.18% and 80.22% respectively,

meanwhile the buildings with Good marks are B1 (71.42%), B3 (70.64%), B4 (73.21%), B5 (74.62%), B6 (65.96%), B10 (67.89%) and B11 (72.22%). The three buildings categorized under Satisfactory are B7, B8 & B12 with marks 47.14%, 51.22% and 54.98% each. The result of the assessment for each building is described in Table 5 as below:

Table 5
Accessibility marks for each building

No	Name of building	Building Type	Mark (%)	Category
B1	CREaTE JKR, Melaka	Training Centre	71.42	Good
B2	Hospital Pendang	Hospital	87.60	Very Good
B3	KPDN Kuala Pilah	Public Services	70.64	Good
B4	Orang Asli One Stop Centre, Kampung Bawong, Sungai Siput, Perak	Public Services	73.21	Good
B5	Hospital Sultan Ismail Petra (HSIP), Kuala Krai, Kelantan	Hospital	74.62	Good
B6	Masjid Tareq Bin Ziyad, Kempadang Perdana, Kuantan, Pahang	Mosque	65.96	Good
B7	Bangunan IPJKR BLOK A, B, C, D, E	Government office	47.82	Satisfactory
B8	Blok F, IPJKR	Government office	51.22	Satisfactory
B9	Blok G, Menara Kerja Raya	Government office	80.18	Very Good
B10	Lembaga Pelabuhan Johor	Government office	67.89	Good
B11	Jabatan Pendaftaran Negara, Daerah Jasin, Melaka	Public Services	80.22	Very Good
B12	Sekolah Menengah Kebangsaan Agama (SMKA) Jerlun, Kedah	School	46.15	Satisfactory

Source: JKR database

Referring to targeted scoring of accessibility in JKR Strategic Plan 2021-2025, there are nine buildings with minimum 60 marks and above. Among these, top of the chart is the B2, the most recently finished hospital in the year 2022 with marks of 87.6%. B11 is at second place earning 80.22%, which is a public service building. B9 at third place followed very closely at 80.18%. Previously, it was assumed that recently built buildings were able to achieve better accessibility marks, however both buildings with second and third highest marks were completed in 2016. In contrast, two buildings finished in 2021, B3 and B6 only gained 70.64% and 65.96% respectively. However, both achievements were still acceptable and met the targeted score. According to the data collected, there were only three buildings with marks under 60%. B7 and B8 earned 47.82% and 51.22% respectively were not a surprise as they were the oldest among the samples, which were completed almost seven decades ago in 1955. Surprisingly, B12 that placed last with 46.15% was completed in 2019. Therefore, it is concluded that the buildings' year of completion does not determine accessibility performance despite our initial assumption of newer buildings have better accessibility. However, the data concurs the accessibility performance of public buildings are far from perfectly designed. The comparison marks according to the buildings' year of completion is shown as follows in Figure 3.

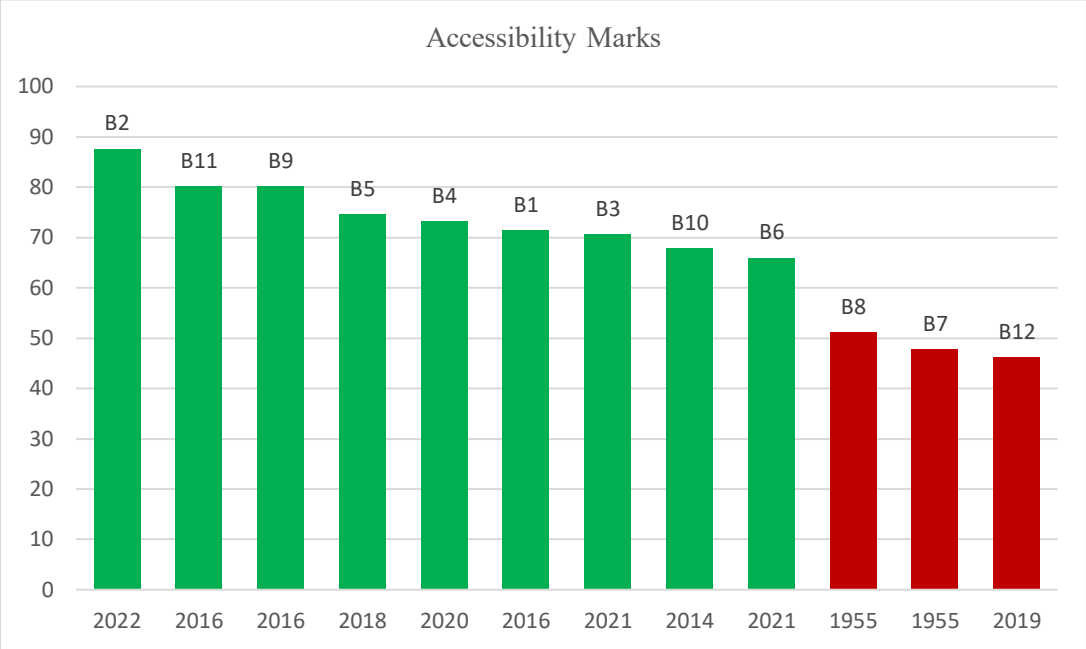


Fig. 3. Accessibility marks and assessed buildings' year of completion

Table 3 previously depicted number of attributes for all criteria which reflected defaulted maximum marks could be attained according to the forms and criteria in the accessibility checklist. The accessibility assessment gave one mark for every attribute fulfilled. However, attributes that were not applicable (na) to the buildings were not considered and eliminated from the marking system calculation. Further analysis of the data collected for every form and criteria is presented in Table 6 below:

Table 6
Highest and lowest accessibility marks according to criteria

Form	Criteria	Defaulted Marks	Lowest Marks	Highest Marks
Form A	Checklist of Designated Accessible Parking	8	3/7	8/8
Form B	Checklist of Paths to the building	12	4/8	9/9
Form C	Checklist of Ramp	6	0/4	6/6
Form D	Checklist of Doors and Windows	13	0/6	11/11
Form E	Checklist of Toilet, Shower and Ablution	28	10/27	20/21
Form F	Checklist of Emergency Route	7	2/7	6/7
Form G	Checklist of Fire Fighting System	4	1/4	4/4
Form H	Checklist of Staircase	5	3/5	4/4
Form I	Checklist of Handrails	10	4/8	10/10
Form J	Checklist of Lift and Escalator	15	0/15	14/14
Form K	Checklist Door Handle	7	1/6	6/6
Form L	Checklist Reception, Counter and Auditorium	4	0/4	4/4
Form M	Checklist Directional Signage and Wayfinding	15	2/15	10/15
Form N	Checklist Drainage System	3	0/1	3/3
Form O	External roads	5	1/5	3/5
	Total marks	**142**		

Source: JKR database

The findings showed a significant number of criteria gained full marks after eliminating all non-applicable items where necessary. Non applicable items were the items that is not provided in the design due to typology of the respective buildings. This finding showed that a number of buildings were designed in full compliance of certain requirements of universal design as stated in MS1184. In contrary, there were five criteria that gained nil mark even after eliminating all non-applicable items. This finding indicated that the scoring of each assessment attribute is depending on the building types and functions. For example, B2 has scored full marks for Form C, whereas B1 were unable to get any score for the same particular criteria.

3.1.2 Accessibility attributes

Further observation was performed to analyse each criteria applicable in all assessed building to gain better understanding of their accessibility performance. The assessment result for each criteria in all buildings were presented through this compliance marks of each attribute as shown in Table 7.

Table 7
Comparison of marks for each assessment attribute.

Form	**Def.**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**	**B11**	**B12**
Form A	8	6/7	8/8	6/7	7/8	4/7	4/6	4/6	3/7	5/6	4/6	6/7	5/5
Form B	12	6/10	9/9	7/11	9/12	9/11	9/9	5/9	6/11	7/8	7/8	4/8	4/8
Form C	6	0/4	4/4	5/6	5/6	2/5	4/5	4/6	5/6	0/0	5/5	6/6	1/6
Form D	13	6/8	8/9	7/7	7/7	12/13	8/9	6/7	0/6	11/11	5/7	7/9	4/7
Form E	28	13/22	18/22	18/22	17/21	21/28	16/22	0/0	14/28	20/21	16/25	17/22	10/27
Form F	7	6/7	6/7	4/7	5/7	5/6	1/1	5/7	2/2	2/7	2/2	3/3	0/1
Form G	4	1/ 4	4/4	1/4	1/3	4/4	2/4	3/3	1/4	3 /4	1/4	3/3	1/1
Form H	5	4/4	3/4	4/5	4/4	3/4	2/3	3/5	3/5	3/5	3/5	0/0	2/4
Form I	10	10/10	10/10	8/10	8/10	8/9	4/8	8/8	8/10	9/9	8/10	7/7	4/7
Form J	15	11/13	12/13	0/0	0/0	14/14	0/0	0/15	8/12	10/12	11/12	0/0	0/0
Form K	7	6/6	6/6	6/6	5/7	5/5	1/6	2/7	3/3	7/7	3/3	6/6	4/6
Form L	4	3/3	4/4	4/4	4/4	3/4	4/4	0/4	4/5	2/3	2/3	4/4	1/4
Form M	15	9/15	10/15	6/15	4/15	6/14	5/15	2/15	2/14	9/15	6/14	9/15	4/10
Form N	3	1/1	1/1	0/0	3/3	0/1	2/2	1/2	0/1	1/1	0/1	1/1	1/1
Form O	5	3/5	3/5	1/5	3/5	1/5	0/0	1/3	1/4	0/0	1/4	0/0	1/4
Total Marks	142	85/ 119	106/ 121	77/ 109	82/ 112	97/ 130	62/ 94	44/ 92	63/ 123	89/ 111	74/ 109	73/ 91	42/ 91
Percent (%)	**100**	**71.42**	**87.6**	**70.64**	**73.21**	**74.62**	**65.96**	**47.82**	**51.22**	**80.18**	**67.89**	**80.22**	**46.15**

Source: JKR database

Defaulted marks (Def.) indicate the total score of the attributes. However, as certain attributes were not applicable to certain types of buildings, the items identified were excluded in the total mark calculation. The mark is shown in fraction, with the numerator (x) is the number of attributes complied and the denominator (y) is the total attributes applicable to the building after all non-applicable items is excluded.

$$\frac{x}{y} = \ marks\ for\ each\ criteria\ (\%)$$

Analysis has shown only one number of building (B2) complied with all attributes in Form A (Parking). The scoring of the other buildings has shown at least half of the attributes complied except for B8 that only scored 3/8 marks. There were two numbers of building, which is B2 and B6 were complied with all applicable attributes for Form B (Paths to Building) where all other buildings have

complied with at least half of the attributes listed. However, for Form B (Ramp), there is one building (B1) has not scored any marks in complying the requirements for ramp. Three other buildings scored full marks for similar criteria which are B2, B10 & B11. B3, B4, and B9 have scored full marks for Form D (Door and Windows) while B8 on the other hand did not gain any marks. On the other hand, Form E (Toilet, shower and ablution) has indicated as the most score attributes. However, these criteria were excluded in B7 due to its age and era it was built. Four buildings (B6, B8, B10 & B11) complied with all applicable attributes as listed in Form F (Emergency Route) and only B12 scored zero mark. Five buildings complied with all applicable attributes in Form G (Fire Fighting System) and none of the building scored zero mark. Examples of assessment sessions are shown in Figure 4.

a) Assessors taking measurements of attributes in Form A: Checklist of Designated Accessible Parking

b) Simulation of wheelchair user navigating from one building to another

Fig. 4. Assessment session for Checklist Form A (Parking) and Form B (Path to Building)

Form H (Staircases) has recorded two numbers of buildings (B1 and B4) scored full marks. There was similar case in Form I (Handrails) where none scored zero mark, and five buildings has complied with all applicable attributes for this criteria. However, Form J (Lift and escalator) has shown that this criteria is mostly not applicable to most of the buildings. In contrary, Form K (Door handle) and Form L (Reception, counter and auditorium) has shown otherwise. Although Form M (Signage and wayfinding) is among the criteria with the most attributes (15), eight buildings has shown less score in half of the attributes. Form N (Drainage) has recorded the least attributes to be assessed (three items) yet three numbers of buildings scored zero mark. The same situation also applied to Form O (External roads) where six buildings recorded only one mark. Figure 5 showed the roleplay done by assessors.

a) Simulation of wheelchair user using counter and lift (b) Assessing compliance of signage

Fig. 5. Roleplay done for assessment sessions for Form L: Checklist Reception, Counter and Auditorium, Form J: Checklist of Lift and Escalator & Form J: Checklist Directional Signage and Wayfinding

Form N (drainage) recorded three buildings with zero marks, meanwhile Form C, D, F, J and L encountered similar situation for one building. Meanwhile Form M (signage and wayfinding) recorded seven buildings that scored less than half. Similar situation can be seen in Form O (external roads) with six buildings, Form G (Fire Fighting System) with five buildings, Form C recorded two buildings and one building each for Form A (Parking), Form E (Toilet), Form F (Emergency route), Form K (Door handle) and Form L (Reception). On the other hand, Form B (Path to building), Form H (Staircase), and Form I (Handrails) recorded score of more than half for all the buildings assessed. Therefore, it is observed that drainage, signage and wayfinding, fire system, and ramp are the elements that need critical attention meanwhile path to buildings, staircases, and handrails are quite excellent in complying to MS1184.

3.2 Discussion

3.2.1 Accessibility performance of public buildings in Malaysia

The accessibility performance of public buildings in Malaysia is considered infancy despite all requirements for universal design were laid out in the acts and regulations since 2008. The action taken to cater the issue is slowly progressing. Building with the highest marks is a hospital, the newest building among the samples, built in 2022. The data also showed majority of buildings constructed in 2014 and later adhere to most of universal design requirements and are categorized as Very Good (80

- 100%) in the score. Meanwhile the buildings constructed in earlier years only scored 40 - 60% marks, considered as Satisfactory. It is safe to mention that better accessibility marks are earned in newer buildings as awareness among designers and building owners are improving along the years. Stricter requirements and guidelines for universal design are also being implemented properly in the country. JKR as the leading technical agency played a vital role to include universal design elements in public buildings to ensure better accessibility for all.

However, it is also found that one of the assessed building built in 2019 gained the lowest mark. According to discussion with the designers and end users, this happened due to lack of universal design elements implied during design development stage and limitation in construction cost further worsen the situation. Therefore, it is concluded that recent year of completion does show improvements in accessibility performance yet it is not the only determinant for accessibility performance in public buildings. Additionally, there are some universal design elements in a number of buildings that were commendable as they were exemplary. It was observed that certain elements provided is better than the requirement listed in MS1184. One of the buildings assessed provided a dedicated counter for person with disability and elderly at one of the blocks in B3, meanwhile B4 provided standing signages for disabled parking spaces. Furthermore, it was also observed that seamless level for accessing check in counter was provided at B1. These examples are shown in Figure 6.

(a) Dedicated counter for person with disability and elderly

(b) Standing signage for disabled parking spaces

(c) Seamless level accessing check in counter

Fig. 6. Exemplary elements adopted by assessed buildings

4. Conclusion

The findings of this research have met the objective of the paper which is to evaluate accessibility performance of public buildings. Although most of the sample scored above 60%, more data from diverse sample buildings is required to produce a solid conclusion of accessibility performance in public buildings. Accessibility assessment shall be conducted in buildings with various typologies and age. It is also suggested that certain improvements shall be done to the accessibility checklist used for this assessment for better reporting and clarity. Additional criteria can be incorporated in the existing forms for commonly found items in built environment such as cafeteria, landscaping, seating area, and street furniture. These aspects were currently overlooked despite their importance to gain better analysis and solid conclusion of accessibility performance for public buildings in Malaysia.

This research revealed buildings completed in recent years (less than 10 years) showed a better score in accessibility as compared to older buildings. This finding concurs the establishment of acts and regulation related to accessibility in built environment may contribute in the improvement. However, the study concluded that there are multi factors that contribute to accessibility performance of public buildings. Other than building typology and year of completion, other external factors also contribute to accessibility performance. Location, history, age, context and most common, lack of budget continuously being the reason for building accessibility issues. However, universal design application in public buildings in Malaysia is align with SDGs in achieving social sustainability. Awareness among designers and building owners have significantly increased the accessibility performance in public buildings. The accessibility assessment shall become an obligation in all projects implemented by JKR, including infrastructure projects such as road and transportation facilities as well. Synchronization of budget prioritization and stakeholders' awareness will help in accomplishing seamless access and function of public buildings. Finally, this exercise is crucial to ensure all public buildings and infrastructure adhere to the requirement laid out in UBBL and MS1184 as the implementation of universal design in public buildings in Malaysia, is still far from perfect.

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