ACCESSIBILITY COMPLIANCE FOR PERSONS WITH DISABILITIES FOR MALAYSIAN GREEN BUILDINGS

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ACCESSIBILITY COMPLIANCE FOR PERSONS WITH DISABILITIES FOR MALAYSIAN GREEN BUILDINGS

ABSTRACT

In Malaysia, the introduction of the Green Building Index is a reinforcement of the Green building design agenda although compliance is not made mandatory. At the same time, the Persons with Disabilities Act 2008 Malaysia promotes strongly universal design, where accessibility is the major concern in the built environment. Both the Green Building Index and Persons with Disabilities Act support sustainable development in terms of environmental protection and social equity, respectively. The aim of the research is to investigate the accessibility compliance for the Green buildings in Malaysia through the review of the legislation and regulation. The extent of the accessibility of the building is influenced by the whole development process, including planning, design, post-control and management of the building. The study investigates the accessibility of Green buildings in Malaysia, focusing on whether Persons with Disabilities are able to enter, use and exit public buildings. Research method is conducted via multiple site case study visits to conduct the detached observation with persons with disabilities in Green office building, direct observation through access audit checklist, in which the raw data was collected by the researcher to access the compliance of the accessibility (through the review of reports and policy documents). A comprehensive literature review is conducted to identify the building laws regulating access for persons with disabilities within built environment aspect, especially Green building, in order to achieve accessibility. The difficulties in accessing the built environment by different types of users also being investigated. This multiple site case study is valuable because it identifies the inadequacies of current access provisions for people with disabilities and highlights the areas requiring further improvement. Throughout the study, it shows that the Persons with Disabilities' needs are not

accounted for satisfactorily in Malaysian Green buildings. It is hoped that by conducting this research, the solution can be found to improve the architect's skill in space planning and to understand the perception of users, through the usage of the Green Building Index, to rate buildings in everyday life.

Keywords: accessibility; universal design; Green building; built environment; Persons with Disabilities

PEMATUHAN KEBOLEHAKSESAN BAGI ORANG KURANG UPAYA UNTUK BANGUNAN HIJAU MALAYSIA

ABSTRAK

Di Malaysia, pengenalan Indeks Bangunan Hijau adalah pengukuhan agenda Reka Bentuk Bangunan Hijau walaupun pelaksanaan bukan mandatori. Pada masa yang sama, Akta Orang Kurang Upaya 2008 Malaysia menggalakkan Reka Bentuk Sejagat yang kuat, di mana kebolehcapaian adalah kebimbangan utama dalam persekitaran yang dibina. Kedua-dua Indeks Bangunan Hijau dan Akta Orang Kurang Upaya 2008 menyokong Pembangunan Mampan dari segi perlindungan alam sekitar dan ekuiti sosial. Tujuan penyelidikan ini adalah untuk mengkaji pematuhan keboleh-aksesan bangunan Hijau di Malaysia melalui pengajian undang-undang dan peraturan. Tahap aksesibiliti bangunan dipengaruhi oleh keseluruhan proses pembangunan, termasuk perancangan, reka bentuk, kawalan pasca dan pengurusan bangunan. Kajian ini menyiasat kebolehaksesan bangunan Hijau di Malaysia, dengan memberi tumpuan kepada sama ada Orang Kurang Upaya dapat memasuki, menggunakan dan keluar bangunan awam. Kaedah penyelidikan dijalankan melalui beberapa lawatan tapak untuk melakukan pemerhatian berasingan dengan orang kurang upaya di bangunan pejabat Hijau, pemerhatian langsung melalui senarai semak audit akses, di mana data mentah dikumpulkan oleh penyelidik untuk mengakses pematuhan aksesibiliti (melalui kajian laporan dan dokumen dasar). Kajian literatur yang komprehensif dilakukan untuk mengenal pasti undang-undang bangunan yang mengatur akses kepada orang kurang upaya dalam aspek persekitaran yang dibina, terutama bangunan Hijau, untuk mencapai kebolehcapaian. Kesukaran untuk mengakses persekitaran yang dibina oleh pelbagai jenis pengguna juga disiasat. Kajian kes ini adalah sangat berharga kerana ia mengenal pasti kekurangan peruntukan akses semasa bagi orang kurang upaya dan menonjolkan bidang-bidang yang memerlukan penaiktarafan. Sepanjang kajian, ia menunjukkan

bahawa keperluan pengguna kurang upaya tidak dipertimbangkan di bangunan Hijau di Malaysia. Dengan menjalankan kajian ini, diharapkan penyelesaian untuk meningkatkan kemahiran arkitek dalam ruang perancangan dan memahami persepsi pengguna, melalui penggunaan Indeks Bangunan Hijau, untuk menilai bangunan dalam kehidupan seharian.

Keywords: keboleh-aksesan; Reka bentuk sejagat; Bangunan hijau; Persekitaran yang dibina; Orang Kurang Upaya

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Here, I would like to thank all those who have been an inspiration, and who shared insights with me on Accessibility and Green buildings. It is a sign of maturity in Malaysia's nation-building process that more and more aspects have to be studied in order for us to understand the complicated dynamics that are now evident in the country.

I would like to acknowledge the leadership, dedication & supervision of my supervisors Dr. Naziaty Mohd Yaacob and Dr. Hazreena Hussein throughout the dissertation process. Their invaluable expertise, intellect and patience have helped me to build up the required skills as a researcher and have motivated me to accomplish my study.

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LIST OF SYMBOLS AND ABBREVIATIONS

CCC	:	Certificate of Completion and Compliance
CFO	:	Certificate of Fitness For Occupation
COB	:	Commissioner of Buildings
GB	:	Green Building
GBI	:	Green Building Index
GEO	:	Green Energy Office
LEO	:	Low Energy Office
OSC	:	One Stop Center
UD	:	Universal Design
UDI	:	Universal Design Index
PAM	:	Malaysian Institute of Architects
PBT	:	Local authority
PSP	:	Principal Submitting Person
PWD	:	Persons with Disabilities
SD	:	Sustainable Development
SP	:	Submitting Person
VP	:	Vacant Possession

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

With the world's growing concern about the negative impact of human life on the environment, the 1972 Stockholm Declaration at the United Nations Conference on the Human Environment considered the need for the preservation and enhancement of the human environment. This was followed by the 1987 Brundtland Report which suggested the idea of Sustainable Development. In 1992, the RIO Declaration on Environment and Development adopted Agenda 21 & Sustainable Development (Walsh, 2004). The common definition for Sustainable Development based on the above is "*the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*." The most common way to conceptualize Sustainable Development is to elaborate it in three dimensions: environmental, economic and social, as shown in Fig 1.1. However, for more than a few decades, Sustainable Development has subjugated both global environmental and ecosystem protection (Walsh, 2004; EPA, 2008). To be fair, Sustainable Development supposedly does not merely cover environmental protection, but also covers the other aspects such as quality of life, distribution of resources and benefits, interactions between the environment and development, and provisions for the future (Corina J., 2013; Department of The Environment and Local Government, 1995).

In the built environment community, Sustainable Development is interpreted and promoted by the initiatives of the Healthy Building, Green Building Congress, Sustainable Building International Conference and Sustainable City International Conference, where Sustainable Development and human health are the common global development goals, with the consideration of "healthiness" and "comfortability" as the

basis, to create a sense of balance between "sustainability" and a"green" and "healthy" Sustainable Development built environment (Chiang, 2005).

The global and our national sustainable agendas also brought attention to the Green building due to environmental concerns. Buildings in the United States emphasize the importance of the construction industry's role in the national sustainability agenda. Apparently, the motivation exists for owners to build green buildings. The growing demand for Green buildings has generated the need to develop criteria for high-performance Green building construction and design, as well as to assess how "Green" & "high performing" these buildings are. A worldwide building rating system was established to promote eco-efficiency throughout different types of infrastructure (Yudelson, 2008), to develop and explore new ideas related to building environmental assessment (Raymond J. Cole, 2010). Examples of building rating systems in current use are Leadership in Energy and Environmental Design (LEED), Green Globes, Green Star, etc. The great essence of the rating system is a point-based system which allows different measures of Green buildings to be compared with each other through the resulting aggregate score (Yudelson, 2008). Each building was accessed or rated across the categories of concern by using the key environmental attributes in each category. In Malaysia, the launching of the Green Building Index (GBI) – Green building rating system - on 21 May 2009 will undeniably lead changes in the way building owners, professional architects and contractors and/or builders approach the overall design, building construction and maintenance, together with the operation of the building. Under the 10th Malaysian Plan 2011-2015, Prime Minister Dato' Sri Mohd. Najib Bin Tun Abdul Razak announced that the new government buildings would be designed to meet green standards while the existing buildings will be improved through enhancing the energy efficiency to become a showcase for the public. The Prime Minister further

committed that the Prime Minister's office complex would be upgraded to meet the Gold Standard of the Green Building Index (GBI).

It cannot be denied that human beings have spent most of their daily lives in built environments. In the United States, people spent 90 percent of their time indoors (Morton, 2002). The majority of built environments are designed for those of a particular ability range. This will indirectly prevent or limit the activity of others who exist outside the targeted group of inhabitants. A built environment that promotes universal accessibility is tremendously encouraged as it is the natural inclination of a human being to want to be able to access all parts of a building easily. Malaysia, one of the fastest developing countries in the world, has committed to improving the quality of life of its residents and accessibility to the built environment, by signing the 'Proclamation on the Full Participation and Equality of People with Disabilities in the Asia-Pacific Region' in 1994. The signing of the Proclamation provides a strong impetus to meeting the Agenda for Action for the Asian and Pacific Decade of Disabled Persons (1993-2002), covering the 12 policy areas. During an inter-country seminar on Multi-Sectoral Collaborative Action for Persons with Disabilities from December 2-6, 1996, Malaysia drafted and adopted several recommendations to be implemented by the respective governments together with the Action Plans of the other participating countries. One of the main recommendations focused on a Barrier-Free Built Environment for the Disabled (Fong, 2001).

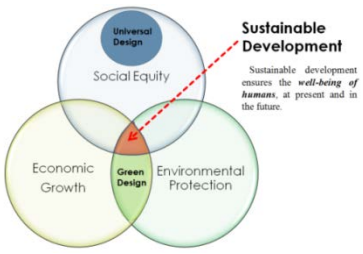


Figure 1.1: Venn diagram of sustainable development

Source: Walsh (2004)

1.1 The Research Problem

Meeting essential human needs in the economic and social dimensions is the principal development challenge. Limited research has been conducted to explore the users' accessibility to built environment, with reference to the objective to achieve Sustainable Development and the social equity, especially in developing countries such as Malaysia. The environmental accessibility is a major issue highlighted in the international platform, with reference to the international disability instruments in achieving Sustainable Development, in the light of its contribution to promoting opportunities for all to participate on the basis of equality in development. Policy concern with accessibility remains, however, elusive in mainstream development strategies, policies and programmes. It is required to recognize that environmental accessibility is a global public good, especially from the environmental friendly green public building, which provides universal benefits, covers multiple groups of countries and all populations. Accessible and usable environments are non-excludable - accessibility benefits all - and non-rivalrous – use by one person does not detract from use by others.

In Malaysia, the introduction of the Green Building Index (GBI) is a reinforcement of Green building design agenda although not mandatory. At the same time, the Persons With Disabilities Act 2008 Malaysia (PWD Act) strongly.promotes universal design. Both the Green Building Index and PWD Act support Sustainable Development with regards to environmental protection and social equity, respectively. After Universal Design was defined in the Persons With Disabilities Act 2008 (Act 685), this, in turn, influenced the policies in Malaysia after the establishment of the PWD Act (Yaacob, Hashim, 2010, 2010a). Before 2008, the use of the word 'access' and 'accessible' is limited in that it was left for interpretation by the architect, and it was stated that "there

are buildings that do not incorporate Malaysian Standards although it has been addressed in the Uniform Building By-law" (UBBL) (Arikisamy, 2007). Also, "existing public buildings that have done modifications as approved by the standard codes are very few" (Chen et al., 2007; Syazwani & Mariam., 2012). The incorporation of universal design in the Persons With Disabilities Act 2008 (Act 685) paved a way to combine and make sustainable development policies in Malaysia to be clearer in the implementation aspects of the 'quality of life for all.' However, most of the built environment in Malaysia is inaccessible resulted the journey/route/connectivity is not seamless (Amirah, 2017). Reason being is that most Architects in Malaysia still considerably deficient towards the implementation of the Act in built environment, according to field research conducted by Yusof et al (2014). The understanding of the accessibility concept in practice is still lacking among Malaysian architects. Altogether, a better insights on the implementation process of accessibility in Green office building is studied. It can be problematic, however, if there is no linkage or relationship between usability & safety in our journey towards a green building with an accessibility factor (Walsh, 2004; Tay, 2011).

Table 1.1: Comparison of the Green building index and Persons with Disabilities Act in Malaysia

Green building index	Persons with Disabilities Act 2008
Reinforcement of Green Building Design agenda	Strongly promotes Universal Design
Compliance is not mandatory	Compliance is mandatory

Source: Laws of Malaysia and author

1.2 Definition of Terms

Studying the integration of accessibility in Green buildings can be approached from various fields of literature and disciplines. Different perspectives entail different strategies that can be followed towards environmental and social improvements. The following represents the current state of knowledge in this industry:-

Accessibility is defined and operationalized in several ways and thus has taken on a variety of meanings …including … "The potential of opportunities for interaction" (Hansen, 1959), "the ease with which any land use activity can be reached from a location using a particular transport system" (Dalvi and Martin, 1976), "the Freedom of individuals to decide whether or not to participate in different activities" (Burns, 1979) and "the benefits provided by a transportation/land use system."(Ben-Akiva and Lerman, 1979).

Barrier Free-Design – Creating environments that are approachable and useable by Persons With Disabilities (Cornell University ILR School, 2007).

A G*reen building* is one that considers and reduces its impact on the environment and human health. A Green building is designed to use less energy and water and consider the life cycle of the materials used. These are achieved through better site development practices, design, construction, operation, maintenance removal and possible reuse of materials (Yudelson, 2008).

Horizontal Circulation is the movement along corridors or open plan areas within a building (Guidelines for Access Auditing of the Built Environment, 2014).

Legislation is a law or a set of laws suggested by a government and made official by a parliament (Cambridge Dictionary).

Persons With Disabilities include those who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society (Laws of Malaysia - Persons with Disabilities Act 2008).

Practice is the actual application or use of an idea, belief, or method, as opposed to theories relating to it (Oxford Dictionary).

Regulatory policy is about achieving government objectives through the use of regulations, laws, and other instruments to deliver better economic and social outcomes and thus enhance the life of citizens and business (http://www.oecd.org/gov/regulatory-policy/ accessed on Dec 2016).

Sustainable Development strives to improve the economy, environment, and society for the current generation, without compromising the ability of future generations to meet their needs (UN, 2003).

Sustainability is the "long term, cultural, economic and environmental health and vitality", "together with the importance of linking our social, financial, and environmental well-being" (http://sustainableseattle.org/, 2016).

A *standard* is a level of quality or attainment or used as a measure, norm, or model in comparative evaluations (Oxford Dictionary).

Universal Design means the design of products, environments, programmes, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design and shall include assistive services for particular groups of persons with disabilities where this is needed (Laws of Malaysia - Persons with Disabilities Act 2008).

Vertical Circulation is the movement through a building via stairs, escalators, lifts and ramps (Guidelines for Access Auditing of the Built Environment, 2014).

Wayfinding is the ability of a person to find his or her way to a given destination. (Guidelines for Access Auditing of the Built Environment, 2014).

1.3 Research Aim

The aim of the research is to investigate the accessibility compliance for the Green buildings in Malaysia through the review of the legislation and regulation. The extent of the accessibility of the building is influenced by the whole development process, including planning, design, post-control and management of the building. And the difficulties in accessing the built environment by different types of users also being investigated. Using multiple site Green office building case studies, the results showed that Persons with Disabilities' needs for accessibility are not accounted for satisfactorily.

1.4 Research Questions and Research Objectives

The topic of this thesis is "Accessibility compliance for Persons with Disabilities for Malaysian Green buildings." The research objectives of this thesis are to gain profound

insights on legislation & regulation, and their influence on the implementation process from the perspective of accessibility for Malaysian Green buildings. To support the realization of research objectives, the basic question that is being posed after the preliminary studies and background research review is:

Is the importance of users' accessibility taken care of in the built environment upon the enforcement of the People with Disabilities Act and the introduction of the Green building index in Malaysia?

The basic question is then developed into three research questions, as follows:-

Research Question 1: What is being considered for users' accessibility in the built environment?

Research Question 2: What is being considered by *legislation and regulation* pertaining to the users' accessibility in Green buildings?

Research Question 3: Do the current Green buildings in Malaysia incorporate with accessibility needs for Persons with Disabilities in Malaysia?

The following research objectives have been derived:

Research Objective 1: To understand the criteria/factors of accessibility in a built environment.

Research Objective 2: To examine the legislation and regulation of users, especially Persons with Disabilities in the Green buildings.

Research Objective 3: To evaluate the accessibility of the Green buildings in Malaysia.

By taking the three research questions, forming assumption statements and creating objectives under each one, the approach is to provide an investigation framework in different scales. Research Question 1 identified the criteria/factors of accessibility in a built environment while Research Question 2 poses a bigger question by reviewing the regulative legislation in built environment, and investigating how the theoretical and philosophical underpinnings of accessibility policies and practice work. Research Question 3 is to evaluate the accessibility of the Green Buildings in Malaysia.

1.5 Methodology

In this study, a theoretical framework is adopted and presented that aims to broaden theoretical insights on the implementation process of sustainable development from the perspectives of two disciplines: accessibility and Green buildings.

The research methods used are reports & policy documents reviewed (secondary data) and multiple site case studies (primary data). Multiple site case studies were selected according to their particular interest & detail of interaction with their contexts. By having a multiple site case study, it is believed that this offer a means of understanding of the policy and program via multiple representations of that phenomenon (Pam, 2012). In other words, by illuminating the experiences, implications, or effects of a phenomenon in more than one setting, wider understandings about a phenomenon can emerge. The research design in multiple site case study is the same across all case study sites. The same unit of phenomenon is studied in light of the same key research questions. In addition, the same data collection, analysis, and reporting approaches are employed across the sites. Hence, multiple site case study enable valid cross-site syntheses and replication claims. In this research, government office buildings are

selected from the list of Green-rated buildings in Malaysia to date i.e. February 2013, listed in Table 3.1. The case study as a research strategy will comprise the all-encompassing method, from the logic of design, data collection techniques, and specific approaches to data analysis (Yin, 2003). Here, the case study is not either an array data tactic or simply a design feature alone (Stoeker, 1991), but a comprehensive research strategy to investigates to answer specific research questions; seeks a range of different kinds of evidence, abstracted and collated to get the best possible answers to the research question; uses a case study is the main method. Different sub-methods are used within it (Gilham, 2000).

The data collection techniques are as follows:-

- Direct methods via multiple site visits to conduct the *detached observation*, which allows the researcher be in direct contact with the subjects and collect data in real time. (See Chapter 3.1.3.2.)
- *Direct observation:- access audit checklist*, in which the raw data was collected by the researcher without interacting with the accessibility during the data collection process. (See Chapter 3.1.3.3.)
- Review of the legislation and regulation in Malaysia together with the currently available critical analysis documentation. (See Chapter 2)

The studies are developed through direct observation – access audit checklists and detached observation – simulation towards the building design. Evidence was collected to allow the clarification of the fulfillment of the research objectives. Observations will be made through the usage of checklists on multiple site case studies. The multiple site case studies are conducted to investigate the accessibility of Green buildings in Malaysia. “Seeing” and “listening” are key to observation. These make the observation

useful to obtain direct information, understand the ongoing behavior, process, unfolding situation or event and also act as physical evidence, products or outcomes that can be readily seen (Ellen & Sara, 1996).

1.6 Significance and Limitations

Direct observation using the access audit checklist provided a standard way of getting data where the researcher tried to obtain reliable data as accurately as possible to examine the research objective. Due to limited costs and time constraints, using real disabled persons would have been a more reliable technique for observation. An actual site simulation exercise was conducted by using people with sensory impairment - using blindfolds and people with physical/mobility impairment i.e. wheelchair users. By having different observation methods, although limited, the findings were able to provide a more varied and/or diverse set of data instead of relying mainly on the access audit checklist.

Another limitation arose when one of the case studies from the list of government office buildings was not cooperative and gave limited access to the researcher, who managed to get access to main areas only and not all areas.

1.7 Organization of the Study

The research design (Fig. 1.2) was conceived and structured to accommodate particular problems arising from research that was conducted in a climate of uncertainty. The study design included preliminary studies that were conducted during the Literature Review stage to form the research question.

Chapter One introduces the research and explains the rest of the thesis document. This chapter includes the research aim and research questions of the thesis. The literature review appears in Chapter Two and explores the theoretical and practical implications of the issue of accessibility to Green buildings, dealing with theory, policy and practice.

Chapter Three describes the methodology used to achieve the stated research goals and objectives, and data collection procedures. Here, the rationale why multiple site case studies were selected was reviewed. Chapter Four describes the qualitative analysis of the collected data as well as the results. The discussion of the analysis of the findings from three selected case studies completes the set of data to be analyzed in this chapter. Chapter Five, the last chapter, presents the results, contributions and limitations of research and recommendations for future studies.

Part I: Theory of Accessibility & Green building

Chapter 01: Introduction

Chapter 02: Literature Review

a) Research Background study on subjects;-

- Accesibility
- Green building
- Universal Design

b) Determine Research Problem

c) Review

- Current legislation and regulation in Malaysia
- Factors of accessibility in Green building

Part II: Description of selected Case Studies

Chapter 03: Research Methodology and its Implementation

a) Research Protocol

- To determine research boundary
- To ascertain research strategy and method

Part III: Analysis of the selected Case Studies

Chapter 04:

Analysis and Findings Discussion

a) Multiple Site Case Studies

- Replication logic to cover different phenomenon and contexts
- Access problems in case study via direct & detached observation

b) Analytic Generalization

Chapter 05: Conclusion and Recommendations } Conclusion of the findings

Figure 1.2: Research structure

1.8 Conclusion

The introduction chapter provides an overview of the rest of the thesis document, outlining the main research questions and research objectives that form the thrust of the research thesis. The primary research question asked will be examined in the subsequent chapters.

The study focuses on the accessibility of the built environment in Green office buildings to achieve the goal of Sustainable Development in Malaysia's National Five-Year Development Plans. The lack of designing for human needs from the accessibility aspect in the design and construction implementation process for Green buildings is identified. The Green buildings studied showed that disabled users' needs are not accounted for satisfactorily. This will be explained further in the summaries of the literature review.

It is hoped that by conducting this research, the solution can be found to improve the architect's skill in space planning and to understand the perception of users, through the usage of the Green building index, to rate buildings in everyday life.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a review of research and existing literature on this research. Continued reference to the existing literature also provided explanations and context in which to discuss research findings. Literature review concentrated primarily on sustainable development, universal design, accessibility, and green buildings. Subsequently, a review of the legislation regulations and standards & practice which lead to the accessibility issue in the built environment.

2.1 Sustainable Development

With the introduction of Sustainable Development, it is clear that different parties have different understandings towards it and this lead to different interpretation. Sustainable Development can also be defined as "*a growing natural and industrial resources which meet the energy need of the present times without settling the ability of next generations for fulfilling their needs in the same manner*" (Hill, 2003). United Nations (1987) explains that world Sustainable Development is a collection of methods to relieve poverty, create the equitable standards of living to satisfy the basic needs of all people and establish sustainable political practices by taking the essential steps to avoid irreversible damages to the long-term natural environment. The *1948 Universal Declaration of Human Rights* (UNOHCHR) noted that sustainability is a measure of how well a particular endeavour can meet the goals and responsible needs of this generation - without stealing the life and living resources from future generations, especially our children and their children.

It is vital to explore the concept of Sustainable Development at the international level before the implications of Sustainable Development in Malaysia. There is a broad range

of interpretations for the idea of Sustainable Development. The standard understanding is that: Sustainable Development ensures the well-being of humans by integrating social equity, economic viability, and environmental conservation and protection, as shown in Figure 2.1. It tries to improve quality of life for current people and future generation (Bossel, 1999). According to Agyeman (2000), Pinfield (1997), Redclift (1987) and Campbell (1996), sustainable development addresses three vital areas:

i. People living today are entitled to justice and equal rights

ii. Environmental degeneration must be eliminated

iii. Future generations must not be impoverished as a result of current actions.

Figure 2.1: Venn diagram of sustainable development

Source: Walsh (2004)

Sustainable Development is on the top of the world agenda. Before the 1992 Rio Earth Summit, the first United Kingdom sustainable development strategy was introduced. Agenda 21 (1992) is to address world's pressing problems and challenges of the foreseeable coming centuries. It highlighted the responsibility of governments to achieve successful implementation via the introduction of national strategies, plans, policies and process. In the world context, the United Nations system has a vital role to play. This lead to the term Sustainable Development becomes an everyday language, especially in the developed countries. Besides, Agenda 21 (1992) also encouraged other international, regional, and sub-regional organisations from the respective country

called upon to contribute this effort. As such, many developed countries begin to take the initiative to draft the national strategy together with the environmental policy to achieve Sustainable Development. Subsequently, most governments over the world had accepted the need for less exploitative forms of development if the world's environment resources are to be protected for the benefit of future generations (Richard et al., 1998). By having this policy, it believed that an integrated and manageable environment reconcile all the Sustainable Development aspects (social, economy and environment) can be achieved. Oldfield & Shaw (2002) however highlighted the worry about the danger in formal commitment at the rhetoric stage to Sustainable Development might be different to the absolute commitment. Table 2.1 listed the overall development timeline for the sustainable development from international and Malaysia's aspects.

Table 2.1: Timeline for sustainable development: International and Malaysia

Year	International Sustainable Development Agenda	Malaysia Sustainable Development Agenda
1972	United Nations Conference on the Human Environment	
1980	United Nations set up the World Commission on Environment and Development	
1987	Brundtland Report on definition and principles of sustainable development	
1992	Rio Summit: World commitment on sustainable development & Agenda 21	• Malaysia National Environmental Policy
1997	Kyoto Declaration on Green House Emission	
2000		• Malaysia (Local Agenda 21) • Planning Doctrine – holistic development for land use planning • Small Renewal Energy Power Program (SREP)
2004		• Ministry of Natural Resources and Environment

Table 2.1 continued

Year	International Sustainable Development Agenda	Malaysia Sustainable Development Agenda
2005		• National Physical Plan 21
2006		• Malaysia Ninth Malaysia Plan: 4th Thrust- Improve Standard and Sustainability of Quality of Life, RE- From waste to energy • National Urbanisation Policy
2007	Roadmap Towards International Agreement on Climate Change, Bali	
2009	COP 15 Copenhagen Accord	• April 2009 Formation of Ministry of Energy, Green Technology and Water • July 2009 National Green Technology Policy, 10th Malaysia Plan
2012		• United Nations Conference on Sustainable Development Rio + 20
2013		• The inaugural meeting of the High-Level Political Forum on Sustainable Development
2014		• UN Conference on Small Island Developing States
2016		• 2030 Agenda for Sustainable Development

Source: Laws of Malaysia and National Policy

2.2 Sustainable Development: Accessibility from Social and Environmental Aspects

In Malaysia, the former prime minister of Malaysia, Tun Dr. Mahathir bin Mohamad introduced Vision 2020 in Sixth Malaysia Plan during the year 1991, with the vision: "*We must ensure that our valuable resources are not wasted. Our land must remain productive and fertile, our water unpolluted, our forest resources capable of regeneration and able to yield the needs of our national development. The beauty of our land should not be desecrated; for its sake and our economic advancement*". The said

vision although do not indicate the term "Sustainable Development," but it implied the importance of Sustainable Development. In the year 1992, the Sustainable Development concept was then officially adopted in Malaysia during the 1992 NGO Forum for RioC10 Malaysia - Chapter of 40 of Agenda 21. In the same year, Malaysia National Environmental Policy was introduced in respond to the Rio Summit: World Commitment on Sustainable Development and Agenda 21. Recently, the new 2030 Agenda for Sustainable Development (see Table 2.1), guided by the Sustainable Development Goals (SDGs) is fully adopted and came into effect in January 2016. These Millennium Development Goals listed 17 goals which include the new areas: climate change, innovation, economic inequality, peace and justice, sustainable consumption, among other priorities. Governments have committed to eradicate poverty, fight *inequalities*, build peaceful, inclusive, and resilient societies, and secure the future of the planet and the well-being of future generations over the next 15 years. The SDGs is prioritized according to national, sub-national and local development needs. It is then be fully integrated into development policies, plans and strategies for effective implementation. The latest five years development plan, i.e. Eleventh Malaysia Plan (2016 – 2020) emphasize on the three pillars of New Economic Model. The theme of 11th Malaysia plan is *"Anchoring Growth on People"* where *people* will be the centerpiece of all development efforts and to ensure that no section of society is left behind in participating and benefiting from the nation's development. Table 2.1 illustrate the timeline for Sustainable Development at both the international level and the agenda introduced in Malaysia. It showed that statutory bodies and agencies follow up closely with the international agenda either by rules and regulations, remits or programs. Since then, Sustainable Development becomes the development concepts in our Malaysian Plan, as shown in Table 2.2 Malaysia's National Five Year Development Plans. Throughout the National Plan, Sustainable

Development became one of the goals in Malaysia. There are several regulatory legislation introduced to achieve the goal of Sustainable Development, which directed in Malaysia's National Five Year Development Plans and others related regulative legislation.

Apparently, from the 2030 Agenda for Sustainable Development, it can be seen that Malaysia is currently focusing on the growth on people, which is tally with the first principle of Agenda 21 (UNCED, 1992) that *'Human beings are at the centre of concerns for sustainable development*'. The 1948 Universal Declaration of Human Rights (UNOHCHR) and United Nations 1987 also emphasize the responsible needs, i.e. the Human & Social Rights, of this generation - without stealing the life and living resources from future generations, especially our children and their children and "sustainable Word development is a collection of methods in order to relieve poverty, create the equitable standards of living, satisfy the essential needs of all peoples, and set up sustainable political practices all while taking the steps essential to avoid irreversible damages to be natural environment in the long-term".

The Preamble to the Charter of the United Nations provides specific direction on accessibility in a broad human rights framework:

> *"…to reaffirm faith in fundamental human rights, the dignity and worth of the the human person, in the equal rights of men and women, …and to promote social progress and better standards of life in larger freedom."*

Article 19 of the Universal Declaration of Human Rights clarify:

> *"Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers."*

UN Sustainable Development identified the Sustainable Development Goals to promote accessibility and inclusion of Persons with Disabilities in the development of the city as a precondition for inclusive development. Accessibility strongly encompasses social dimensions which are critical for urban renewal and sustainability (David, 2016). Accessibility is then viewed as an investment that able to contribute to be effective, sustainable, and equitable development for all, and not merely an issue of cost or compliance, to the public good. Accessibility is not particularly relevant to Persons With Disabilities, it has implications and benefits to all too (UN Sustainable Development, 2016 access via http://www.un.org/sustainabledevelopment/). It is strongly suggested that to allow sustainable development to become a reality, with a certain level of workable compromise between the human's needs and aspire to (Chrisna, 1999). Environmental accessibility is a principal theme of the *World Programme of Action concerning Disabled Persons* which states that accessibility in the general systems of society, such as the physical and cultural environment, housing and transportation, social and health services, educational and work opportunities, cultural and social life, including sports and recreational facilities is essential to furthering its development objective of equalization of opportunities. The *World Programme* states that achieving its goals of "full participation, and equality" is largely determined by environmental factors and that a person is "handicapped when he or she is denied the opportunities generally available in the community that is necessary for the fundamental elements of living." Under the United Nations Standard Rules on the Equalization of Opportunities for Persons with Disabilities: Rule 5 (accessibility) provides: "States should recognize the overall importance of accessibility in the process of the equalization of opportunities in all spheres of society. For Persons With Disabilities of any kind, the state government should (a) introduce programmes of action to make the

physical environment accessible; and (b) undertake measures to provide access to information and communication.

According to article 9 of Convention on the Rights of Persons with Disabilities, accessibility is to enable Persons With Disabilities to live independently and participate fully in all aspects of life. It is state government's responsibility to take appropriate measures to ensure Persons With Disabilities can access to the physical environment, to information and communications, and to other facilities and services open or provide to the public, to transportation, both in urban and in rural areas. All these include the identification and elimination of obstacles and barriers to accessibility: *(a)* Buildings, roads, transportation and other indoor and outdoor facilities; *(b)* Information, communications and other services (Clinton, 2013).

Table 2.2: Malaysia's National Five Year Development Plans to show sustainable development concepts

Malaysian Plan	**Key Emphasis**
Seventh Malaysia Plan (1996-2000)	*Sustainable Development*
Eighth Malaysia Plan (2001-2005)	*Sustainable Development* of energy resources and renewable.
Ninth Malaysia Plan (2006-2010)	*Sustainable Development is* covering social, economic and environmental aspects.
Tenth Malaysia Plan (2011-2015)	Improving the standard and sustainability of *quality of life* through better access to healthcare, public transport, electricity, and water. AFFIRM framework (Awareness, Faculty, Finance, Infrastructure, Research, and Marketing) was established to promote the implementation of *Sustainable Development* in the construction industry. Green building as part of Sustainable Development is the government's consideration to achieve a better future for next generations (Sood et al., 2011).
Eleventh Malaysia Plan (2016 – 2020)	Emphasize the three pillars of New Economic Model. The theme of 11th Malaysia plan is *"Anchoring Growth on People"* where people will be the centrepiece of all development efforts and to ensure that no section of society is left behind in participating and benefiting from the nation's development.

Source: Laws of Malaysia and National Policy

In Malaysia, the importance of accessibility is especially being highlighted in Ninth Malaysia Plan (2006-2010), Tenth Malaysia Plan (2011-2015) and Eleventh Malaysia Plan (2016-2020) that during the Plan period, efforts will be intensified to improve accessibility to and within the country, with the hoping that the entry points of transportation links between gateway cities and resorts as well as access to communication services will be enhanced. The same development plan also emphasizes on the strengthening initiatives for Economic and Environmental aspects, especially in transport, commercial and industrial sectors, and in government buildings. Besides, the social responsibility also was being highlighted in national policy (see Table 2.3). Tenth Malaysian Plan and Eleventh Malaysian Plan (see Table 2.2) introduced accessibility and was referred to 'the quality of life.' In the Ninth Malaysian Plan, accessibility was mentioned only in general, especially the area of infrastructure. Besides, Malaysia's Town and Country Planning Act also included the Sustainable Development factor in the act, as shown in Table 2.6. Every development in Malaysia is required to submit documents of the Development Proposal Report for Planning Permission (Kebenaran Merancang). The layout approval processes are required before construction commencement. The provision in the Act and Related Legislations and regulations that allow these to be carried out are:

- Section 21(1) of Town and Country Planning Act 1976 (Act172) – Planning Permission
- National Land Code Act 1965 (Act 56) - Land matters
  - Section 135 and 136 of Sub-division
  - Section 148 Amalgamation
  - Section 204D Surrender and re-alienation

Tenth Malaysia Plan mainly emphasized on improving the standard and sustainability of quality of life through better *access* to healthcare, public transport,

electricity, and water. AFFIRM framework (Awareness, Faculty, Finance, Infrastructure, Research, and Marketing) was established to promote the implementation of Sustainable Development in the construction industry. Green building as part of Sustainable Development is the government's consideration to achieve a better future for next generations (Sood et al., 2011). Table 2.3 shows that the national policies in a green environment and technology were created and included the agenda to improve the 'quality of life for all.' While Eleventh Malaysia Plan's theme is emphasising the development of people as the centrepiece, complemented by ensuring that no section of society is left behind in participating and benefiting from the nation's development. Through the introduction of the national system, it is clear that sustainability is at the top of the agenda. Thus, the duty to achieve the goal of sustainability has to rely on the professional consultants, especially architects who design the spatial arrangement of the built environment to improve the living standards (Edwards & Hyett, 2001).

Table 2.3: National policy on the environment and technology in Malaysia

National Policy	**Key Emphasis**
National Policy on the Environment (2002)	Economic, social and cultural progress through **Environmentally Sustainable Development**
National Green Technology (2009)	Sustainable Development • Energy: seek to attain energy independence and promote efficient utilisation • Environment: conserve and minimize the impact on the environment • Economy: enhance the national economic development through the use of technology • Social: improve the ***quality of life for all***

Source: National Policy

Table 2.4: Planning legislation that referred to sustainable development in Malaysia

Legal Regulation	Remarks
Town and Country Planning Act 1976 (Act 172)	Section 2A (2) National Physical Planning Council. The functions are to promote the framework of the national policy, town, and country planning as an effective and efficient instrument for the ***improvement of the physical environment*** and towards achieving the ***Sustainable Development***
Town and Country Planning Act 1976 (Act 172)	Section 2A (2) National Physical Planning Council. The functions are to promote the framework of the national policy, town, and country planning as an effective and efficient instrument for the ***improvement of the physical environment*** and towards achieving the ***Sustainable Development*** Section 8 (3) The statement is to formulate the policy and general proposals of the State Authority, to respect the development and use of land, including improvement measures of the physical living environment, communications, traffic management, ***socio-economic well-being*** and the promotion of economic growth, and ***for facilitating Sustainable Development.*** (4) In formulating the policy and general proposals under paragraph (3)(a), the State Director shall secure that the policy and proposals are justified by the results of his survey under section 7 and by any other information that he may obtain, and shall have regards to current policies respecting the ***social and economic planning and development*** and the ***environmental protection of the State and the nation***.

Source: Laws of Malaysia

The strategic thrust 1 of the SDGs & 11MP preamble the following:-

> Enhancing inclusiveness towards an equitable society: *Inclusivity ensures all Malaysians benefit from economic growth regardless of gender, ethnicity, socio-economic status, or geographic location*

The strategic thrust 4 of the SDGs & 11MP: Strategic Thrust 4 preamble the following:-

> Pursuing green growth for sustainability and resilience *Green growth" will be a way of life. This will lead to strengthened food, water, and energy security; lower environmental risks; and ultimately, better wellbeing and quality of life*

It is vital for a building to be green to consider the environmental impact of all its constituent parts and design decisions to be evaluated, as highlighted from the SDGS & 11MP. Olfield and Shaw (2002) also expressed that the notion of Sustainable Development involves the harmony and balance between the overall built environment

together with the community, at an abstract level, it will affect different cultures (Engel and Engel, 1992). Sustainable buildings use energy, water, materials, and land more efficiently than buildings as critical resources to code. However, it appears that the focus of sustainable building is mainly directed at environmental sustainability in practice. The social impact of the built environment affects the way society lives and works. Consequently, the need to build sustainably is vital as what we can provide the built environment of the future and will influence the ability of future generations to meet their needs.

A Green building is the one "that uses a careful integrated design strategy that minimizes energy use, maximizes daylight, has a high degree of indoor air quality and thermal comfort, conserves water, reuses materials and uses materials with recycled content, minimizes site disruptions, and generally provides a high degree of occupant comfort" (Kozlowski, 2003). Internationally, a few commercial standards are commonly utilized for green rated buildings. The most popular green ratings available for buildings are the U.S. Green Council's Leadership in Energy and Environmental Design (LEED) certification, the U.S. Department of Energy's Energy Star certification, and the Green Globes certification. Green buildings are evaluated based on the overall performance, which relies on the functionality, flexibility, and accessibility, as well as economic and environmental performance (including social performances such as comfort, health, and social compatibility) of the building (Mona et al., 2013). The essence of greenness is mainly directed towards various sustainable orientations by focusing on the economic, environmental and social variability. However, according to Reza et al. (2011), Malaysia is still much lacking behind pertaining the development of green buildings than other Asia-Pacific countries such as Australia, Japan, and Singapore.

2.3 Implementation Method of Government Strategies

With reference to the United Nations Secretariat, it is the state parties' responsibility to develop, publicize and monitor the implementation of legislation, regulations, standards and guidelines for the accessibility in relate to the facilities and services open or provided to the public within the built environment; to ensure that private entities take into account all aspects of accessibility for PWD; to provide training for stakeholders on accessibility issues facing by PWD; to provide public signage in Braille and in easy to read and understand forms; to provide forms of live assistance and intermediaries, including guides, readers and professional sign language interpreters, to facilitate accessibility to buildings and other facilities open to the public; to promote other appropriate forms of assistance and support to PWD to ensure their access to information; to promote access for PWD to new information and communications technologies and systems. The States Parties shall take all appropriate measures to ensure that PWD can exercise their right to freedom of expression and opinion, including the freedom to seek, receive and impart information and ideas on an equal basis with others and through all forms of communication of their choice by providing information intended for the general public to PWD in accessible formats and technologies appropriate to different kinds of disabilities in a timely manner and without additional cost.

Malaysia had adopted a federal system of government with an administration geared towards three tiers of government at the Federal, State and Local levels, or called as "top-down" approach. This approach act as the guiding national legislation on accessibility, which would be supplemented by regulations and timelines for implementation, including formulation of norms, standards and specification of benchmarks to carry out required activities at local and sub-national levels. Under the

Constitution, there are express provisions of jurisdiction at varying levels under both Federal and State governments. The country administration is divided into multiple local authority areas and is directly under the Ministry of Housing & Local Government. Under the provisions of the Local Government Act (Act 171) of 1976, a local authority can be declared as such by the Ministry of Housing & Local Government, after due consultation with the State Authority and the Election Commission. The State Authority in this instance is the Ruler-in-Council or the Governor-in-Council.

As Sustainable Development was adopted in Malaysia effective from 1992 NGO Forum, the driver for Malaysia's economy is then becoming construction industry (Abdullah, 2004). The planning development in Malaysia begins with the national mission which listed in Vision 2020 and National Five Year Development Plan, stipulated the mission of the nation. Town and Country Planning Act 1976 (Act 172) was subsequently be introduced & implemented in Peninsular Malaysia effective from the year 1976 to provide proper control and regulation of town and country planning in Malaysia by ensuring the uniformity of law and policy. National Physical Plan reviewed the National Five Year Development Plans till the year 2020, by securing the objective of the national physical plan can be achieved by both the federal and state government. State Authority implemented the policy via structure plan which considers various aspects of the area, particularly the land use, physical living environment, communications, traffic flow, socio-economy, and any other elements to facilitate Sustainable Development. State director must ensure all the policies (all three aspects: social, economic and environmental) being implemented and protected from the state and subsequently nation.

At the structure plan level, when survey is being instituted, and general policies are being formulated, the architect performs a useful role by participating in critical review and analysis of survey information and structure plan proposals, related in particular to issues pertaining to the built environment, and in offering constructive suggestions to complement, supplement or modify the recommendations in the Draft Structure Plan. Active contribution to the profession at this stage would most likely be in the form of collective or group representations by professional institutes, public interest groups or similar organisations. At the draft local plan stage, when detailed proposals are exhibited, the architect could contribute his expert views and suggestions on elements affecting the townscape, urban form, and the built environment within the local plan area.

Table 2.5: Timeline for sustainable development in Malaysia

Year	Malaysia Sustainable Development
1992	National Environment Policy
1995	Amendment to Town and Country Planning Act 1976 (Act 172): the introduction of public participation in the development plan
2000	• Local Agenda 21 • Planning Guidelines. • Focus group discussions in planning • 5th Fuel Policy • 8th Malaysia Plan • Small Renewable Energy Power Program
2004	• Strategic Environmental Assessment (SEA) • Social Impact Assessment (SIA) • MURNInet – Urban Sustainable Indicators • Ministry of Natural Resources and Environment
2005	National Physical Plan • Selangor Sustainable Development and Agenda 21
2006	Sustainability Assessment: Plans drove by Sustainability Objectives • National Urbanisation Policy
2009	• Ministry of Energy, Technology, and Water • National Green Technology Policy
2010	• National Physical Plan 2 Planning Guideline Review
2011	MURNInet review study (sustainable development indicators) • Development plans – structure plan, local plan, special area plans
2016	2030 Agenda for Sustainable Development

Source: Malaysian Institute of Planners

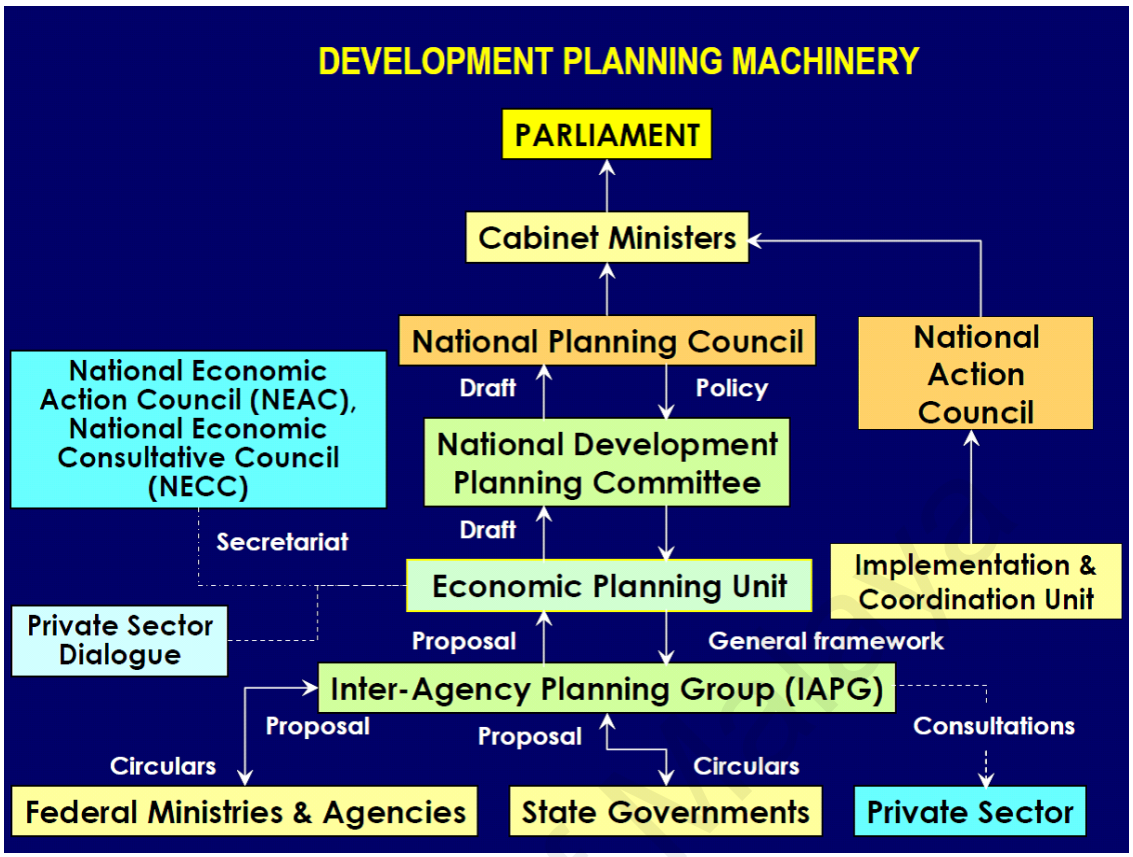


Figure 2.2: Planning Development in Malaysia

Source: Town and Country Planning Act

The national strategies and plans in Malaysia are in many other respects very different creatures. National environmental policy programs, on the one hand, are different from national strategies for sustainable development on the other in conceptual terms. A much broader range of issues at social visioning are required to address rather than the only associated with environmental policy plans. Matters of international development assistance, for example, are integral to Agenda 21, but might not be considered within the remit of a national environmental policy plan (Meadowcroft, 1999). It cannot be denied that long-term national environmental plans and sustainable development strategies reflect a change in the way how the advanced countries management system function (Meadowcroft, 1999). Regional planning became the focus of the developed countries before establishing the new regional architecture. Most of the time, planning's role is being overlooked or under-emphasized; however, their

role in the statutory regulation implementation showed that it should be strictly implemented instead of being casually dismissed (Haughton & Counsell, 2004). These required a continuous adjustment and long-term review to form mature governance.

2.4 Accessibility: Legislation & Regulation Compliance

Cities should be accessible in all their diversity, without obstacles (Mari, 2013). Clinton (2013) stated that accessibility benefits all: once provided, none can be excluded from accessible environments for a cause – although capacity constraints can result in temporary reductions in services access but not accessibility. The advantage that one person can aknowledge from accessibility in the physical environment and information and communication technologies does not diminish opportunities for others to enjoy the "ease and flexibility" of using an accessible good or service at national, regional or global levels. Accessibility can thus be identified as a member of the set of "global public goods" and not a defined benefit for a particular group. The concept of global public good is important to advancing environmental accessibility in the context of mainstream development since it redefines resource allocation questions from a matter of compliance to investments that contribute to improved societal well-being. Recovering equalization of opportunities for development participation by all will involve a shift in focus on environmental accessibility from an issue of compliance and social protection to an essential element in development planning, technology, institutional setting and investment decision making at all levels. As a global public good, this presupposes international commitment, including development finance, to actions that promote progressive removal of barriers of a physical, technological or institutional nature, and the agreement of governments to identify functional requirements for accessible environments, to develop minimum technical specifications

related to those requirements, and to institute systems and procedures to promote, implement and monitor environmental accessibility provision for all (Clinton, 2013).

2.4.1 International Practice

Under international law, States must agree to accede to international obligations. Accessibility are reflected in actions by governments, international community to adopt, reaffirm commitments to promote the environmental accessibility. By recognizing accessibility as a global public good rather than a compliance issue would afford it a central place in international development policy analyses, budgeting decisions, and implementation management (Clinton, 2013). For this reason, these statutory requirements should be formulated clearly and coherently. Standards and minimum dimensions must be stated. Architects, engineers and builders well trained on the different aspects of accessibility are a prerequisite for implementing statutory requirements consistently (Mari, 2013). According to Jim S. (2001), at a broad social level, the major challenges facing by accessibility are to create a legal framework, establish practical rules of engagement, which will encourage easy access and promote awareness of the real opportunities. The legislation compliance pertaining the environmental accessibility in developed countries which also adopting the similar "top-down" approach as Malaysia are as follows:-

1. Australia

Disability Discrimination Act 1992 (DDA) provides the elimination, discrimination against persons by their disabilities in various ranges, and in particular access to premises, work, accommodation and the provision of facilities, services and land. The enforcement of Disability (Access to Premises - Buildings) Standards 2010 (Premises Standards Act) in May 2011 aimed to ensure that buildings are accessible to people with disability and meet the requirements of discrimination law (DDA). Through the

introduction of Standards, it is envisaged that the Standards will ensure the buildings in Australia become more accessible and useful to an ageing population as well. Premises Standards prescribe national requirements for new buildings and where new building work is undertaken in existing buildings to comply with DDA in these areas and for the buildings covered by these Standards.

2. Canada

The *National Building Code (2010*) provides the base document for provincial building codes for regulating construction. Under the Constitution of Canada, provinces can adopt supplemental legislation or administrative guidance to the Code to meet local conditions.

3. United Kingdom of Great Britain & Northern Ireland

It was the United Kingdom that had led the field covering most aspects of accessibility such as in housing, transport, employment, education and so forth, starting in 1944. In the *UK*, the Part M of the Building Regulations sets out legal minimum requirements for promoting access to and use of built environment. Previous versions of the Regulations focused on the specific needs of disabled people, while the 2004 edition of Approved Document M promotes an approach to inclusive design that reflects the needs of all people. Accessibility in the built environment in England and Wales is governed by the Building Regulations, which are enacted by the government under the Building Act 1984. BS 8300: 2009 *Design of buildings and their approaches to meet the needs of disabled people - Code of Practice*,62 which provides guidance in the design of new buildings to make them more accessible; and recommendations can be applied to existing buildings their improved accessibility and usability. BS 8300: 2009 applies to a wide range of public buildings and offers recommendations on the

accessibility of features both around and within a building, including access to lifts, wall surfaces, signage, wheelchair spaces in audience seating, the arrangement of seating, reading carrels in libraries and accessible washbasins. Recommendations address a wide range of disabilities and consider usage by persons with disabilities as residents, visitors, spectators, customers, employees, or participants in sports events, performances and conferences.

4. United States of America

Accessibility in the built environment is covered by the Americans with Disabilities Act of 1990 (ADA) as amended and the Architectural Barriers Act of 1968 (ABA) as amended. ADA standards govern construction and alteration of places of public accommodation, commercial facilities, and state and local government facilities; and separate standards, developed in cooperation with the U.S. Department of Transportation, address construction and alteration of transportation facilities covered by the Americans with Disabilities Act. US Federal facilities are covered by standards consistent with those of the ADA issued under the Architectural Barriers Act (ABA).

Apart than the four countries above which also implementing the “top-down” approach as Malaysia, in Europe, they approach the accessibility issue via standardization by introducing tools, instead of a compulsory legal requirement. The European Commission makes use of mandates to the European standardisation bodies CEN, CENELEC and ETSI to develop standards that play a vital role in making non-legal requirements of producers of goods and services, to ensure the inclusion of accessibility aspects. Mandate 420: Accessibility requirements for public procurement in the built environment (including transport infrastructures). The inventory covered building elements; internal environments, transport facilities and specific building use

as well as outdoor areas. All countries reported gaps in the combined coverage of user requirements (Mari, 2013).

In developed countries, there are well-developed codes and standards for a multitude of design elements related to accessibility and accommodation, but an understanding and knowledge about sustainable Universal Design practices is still lacking (Mari, 2013). In developing countries and countries in transition, there are very few codes or standards for the built environments, accessible ICTs, provision of accessible services, etc. and there is little to no knowledge or understanding of the principles of Universal Design and the development of sustainable environments, services and products. Our neighbouring country, Singapore, referring Americans with Disabilities Act as the basis, admitted that people should be viewed as equal, as having similar rights and obligations, and as deserving of equal opportunity in every facet of society. The Building and Construction Authority (BCA) enforced the implementation of Universal Design Guidelines in 2007. The introduction of Universal Design add a new dimension to the accessibility and has a significant influence towards the field of design. BCA recognised that the designer and developer/building owner to create an environment and allowing people with different levels of physical/mobility/vision/learning impaired to move independently to integrate into the mainstream of their daily life.

Throughout the study above, the interplay between international norms and standards in the field of disability and developments in national policy, law and administrative guidance, mainly as this pertains to provision of social and rehabilitation services, prevention of discrimination due to a condition or functional limitation, drives much research, development, testing and dissemination of accessibility standards and technical guidelines. The international policy framework on the advancement of persons

with disabilities in the context of development provides normative guidance on issues, trends and priorities for actions that governments, which have not already done so, can use in formulating strategies and policy options concerning persons with disabilities. Governments should promote the full realisation of human rights and fundamental freedoms for all without discrimination of any kind. Governments should also recognise the responsibility to undertake and support the implementation of accessible solutions, to evaluate and follow-up (Mari, 2013). A legislative approach would be to make compulsory the purchase of accessible goods and services; decide on one or two framework directives with general accessibility obligations on manufacturers to improve goods and services; a regulation with similar accessibility requirements and a combination of the above with an Action Plan (Mari, 2013). Therefore, the task will be to continue changing public buildings and spaces so that they can be used by everyone independently, naturally, intuitively and comfortably. The principles of Design for All remain a challenge that will determine the quality of the city (Mari, 2013).

2.4.2 Universal Design Principles and Criteria

In Malaysia, the introduction of Persons with Disabilities Act Malaysia in year 2008 is an act to provide for the registration, protection, rehabilitation, development and wellbeing of persons with disabilities, the establishment of the National Council for Persons with Disabilities, and for matters connected therewith, in which recognizing that disability is an evolving concept and that disability results from the interaction between persons with disabilities and attitudinal and environmental barriers that hinders their full and active participation in society on an equal basis with persons without disabilities; the importance of accessibility to the physical, social, economic and cultural environment, to health and education and to information and communication, in enabling persons with disabilities to fully and effectively participate in society; and also

recognizing that persons with disabilities are entitled to equal opportunity and protection and assistance in all circumstances and subject only to such limitations, restrictions and the protection of rights as provided by the Federal Constitution.

> *"Universal Design must be present in standards, legislation and regulations for the building industry and industrial design. However, regular people are the ones that can make a real change. …bring Universal Design to the masses, to make them aware of the potential, the beauty and the usefulness of a well thought out design. The Universal Design philosophy must permeate a country's whole education system, from basic to higher education."* Andres Balcazar, *GAATES* Communications and Project Coordinator, Mexico. 2012.

In Malaysia, the majority of the built environments are designed for those of a specific ability range. This will indirectly prevent or limit the activity of others which exist outside of the targeted group of inhabitants, especially Persons with Disabilities (PWD). PWDs are persons who have long-term physical, mental, intellectual or sensory impairments, which in interaction with various barriers may hinder their full participation in society. A built environment which promotes universal accessibility is tremendously encouraged as it is a natural inclination of the human being to desire and experience ability in certain extents and specific ways. The seven principles of Universal Design as described in Table 2.6 below. The core message is that Universal Design concept is embedded in the content of the technical standards, but its practice requires clear and straightforward information that shows the best examples of technical solutions for user satisfaction and full social participation within the structure of Persons With Disability accessible buildings. The objective of universal design is not to demystify people's impairment, avoid impairment attention and 'social ostracism' attention by the public (Imrie and Hall, 2001). Universal Design is a comprehensive concept that can benefit all users and enrich the lives of people who are less mobile, to the greatest extent possible, without adaptation or specialised design. It is acknowledged that by increasing the width of the walkway and select the appropriate, suitable walkway finishes, can improve the convenience for all people, including people with

physical / mobility impaired and people with sensory impaired. It is essential to adopt universal design principles in Malaysian accessibility system so that our nation is on par with the accessibility technology which caters all range of users in another developed country. Malaysia's Persons with Disabilities Act 2008 define accessibility that persons with disabilities shall have the right to access to and use of, public facilities, amenities, services and buildings open or provided to the public on equal basis with persons without disabilities, but subject to the existence or emergence of such situations that may endanger the safety of persons with disabilities (see Table 2.7).

Table 2.6: Universal design principles

Principle	Description
Equitable use	The design is useful and marketable to people with diverse abilities.
Flexibility in use	The design accommodates a wide range of individual preferences and abilities.
Simple and intuitive use	Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
Perceptible information	The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for error	The design minimizes hazards and the adverse consequences of accidental or unintended actions.
Low physical effort	The design can be used efficiently, comfortably, and with a minimum of fatigue.
Size and space for approach and use	Appropriate size and space are provided for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility.

Source: Center for Universal Design, North Carolina State University (1997)

Table 2.7: Implementation of Green building index and Persons' with Disabilities Act in Malaysia

Green Building Index	Persons' With Disabilities Act
Reinforcement of Green Building Design agenda	Promotes strongly Universal Design
Not mandatory to comply	Mandatory to Comply

Source: Author

Equally important is the contribution of Universal Design concepts and principles in promoting accessible, functional and usable solutions for all. This has moved accessible design discourse beyond a concern with the provision of accessibility in the public arena for specific groups to consideration of options that reduce barriers to choice and use and produce solutions that are intuitive, easy to use and require minimum effort for all to enjoy in a range of environments – public and private – and in services and consumer goods. The enforcement of Persons With Disability Act in the year 2008 means that the developers, designers, and owners of buildings have the responsibility to ensure that the built environment is accessible to everyone. This includes the understanding of various disability types and their physical limitations. This framework is started with understanding types of disabilities to be attended in the access auditing. Each type of disability will have its physical limitation and different potential barriers in the built environment. They are categorized into various physical disabilities. As characterized by Martin (1999), disabilities can group into wheelchair users, mobility impaired, hand or armed impaired, visually impaired and hearing impaired.

1. *Wheelchair users:* those individuals who are unable to move about except with the use of the wheelchair.
2. *Mobility impaired:* those individuals who cannot move about without the aids of walkers, crutches, or a cane. They include those who lack the stamina to walk the long distance, climb stairs, or demonstrate a prevalence of fainting or poor balance.
3. *Hand or armed impaired:* those individuals who have been limited in their ability to use their hand or arm, such as at those missing a limb or with lack or coordination or strength.

4. *Visually impaired:* those individuals who have a great deal of difficulty or are unable to read ordinary newspaper print with the aid of eyeglasses and those individuals who have total loss of vision (blind).
5. *Hearing impaired:* those individuals who have a great deal of difficulty or are unable to interpret speech with or without amplification (Martin, 2000).

2.4.3 Universal Design: Legislation and Regulation

Universal design is a conceptual theory that extends beyond the issues of compliance with accessibility standards for persons with disabilities and offers a powerful rationale for responding to the broad diversity of users who have to interact with the built environment. In Malaysia, the government has introduced certain legislation and regulation to be complied with in building construction by both the private and government agencies to ensure that the development is disabled friendly. Universal design is not a design style but an orientation. It is based on the premise that design processes must be inclusive, produce equitable benefits, and be appropriate to human functioning, gender, demographic group and social, economic and cultural settings and historical development experience. The followings are the prevailing legislation and regulations in Malaysia:

a) Street, Drainage and Building Act 1974 (Act 133), 1991

Section 3 of the Act clarified that "frontage" means the owner of premises fronting on, adjoining, abutting on, or adjacent or *accessible* to a street or back lane has the *right to use* as a means of *access* to or drainage from the premises. Section 9 (7b) – Private persons making new streets required to ensure the means of access from the street and make the relevant application

to the local authority. Section 12 clarified that public street works have to be *accessible* to the building's frontage.

b) Town and Country Planning Act 1976 (Act 172) amended Act 1995 (Act A 933), 1995

Section 21 (3). Application for planning permission is required by the developer when it involves the erection of a building, the local planning authority may give written directions to the applicant in respect of any of the following matters, that is to say the owner of the premises by himself or his tenant has the *right to use* or commonly does use the street or back-lane as a means of *access* to or drainage from the premises.

c) Persons with Disabilities Act 2008 (Act 685), 2008

Section 2 interpreted that ***"Universal Design"*** means the design of products, environments, programs, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design and shall include assistive devices for particular groups of PWD where this is needed. Part IV. Promotion and development of the quality of life and wellbeing of PWD. Chapter 1 *Accessibility* Section 26 –*Access* to public facilities, amenities and services and buildings highlighted that PWD shall have the *right to access* to and use of, public facilities, amenities, services and buildings open or provided to the public on equal basis with persons without disabilities, but subject to the existence or emergence of such situations that may endanger the safety of PWD. The Government and the providers of such public facilities, amenities, services, and buildings shall give appropriate consideration and take necessary measures to ensure

that such public facilities, amenities, services and buildings and the improvement of the equipment related to it conform to *universal design* to facilitate their *access* and use by PWD.

d) Uniform Building By-Law 1984 By-Law 34A(1) Amended in 1991

By-Law 34A(1) stipulated that all public buildings shall provide with access to enable disabled persons to get into, out of and within the building & be designed with facilities for used by disabled persons. The requirements of this by-law shall comply with MS 1184 and MS 1183.

e) Uniform Building By-Law 1984 By-Law 34A(1) Amended in 2005

By-Law 35. *Access* from a street: Every building to be erected on a site which does not front a street shall have *access* from a street, and the means, nature, and extent of the *access* shall be by a layout plan approved by the competent planning authority or the local authority.

f) Uniform Building By-Law 1984 By-Law 34A(1) gazetted in 27th Dec 2012

By-Law 140 104. (1) *Access way* shall be provided on the site of a building to enable fire appliances to gain access to the building. Access openings shall also be provided along the external walls of buildings fronting the access way to provide access to the building for firefighting and rescue operations.

An analysis of the building regulations and legislation against the general Persons with Disabilities Act showed some similarities regarding the definitions, where the word 'access' and 'accessible' is used, however, only in 2008 the Persons with Disabilities Act expanded and included Universal Design as the definition for 'access.' Policy

development was a key tool used in various municipalities to remove barriers to corporate and departmental programs and services. Policy development occurs in collaboration with Persons With Disabilities. The involvement of Persons With Disabilities ranges from consultative to policy development committee membership. Corporate policy to address the needs of persons with hearing, visual or other disabilities was addressed by the implementation of municipal guideline and policies. Department specific policy specifies the needs of Persons With Disabilities were also being used to provide greater access to specific municipal departments. Noticeably absent from the realm of the corporate policy was the use by municipalities of an overriding or global corporate-wide "Accessibility Policy" or guiding statement to enable access to municipal services by Persons With Disabilities.

The enactment of Persons' with Disabilities Act directly affected building occupants entitlement, especially on the issues of accessibility and its implementation under Uniform Building By-Law and compliance to guidelines by all relevant party. However, there are buildings that do not incorporate Malaysian Standards although it has been addressed in Uniform Building By-Law (Arikisamy, 2007). Also, the number of existing public buildings that have done modifications as approved by the standard codes is very few (Chen et al., 2007; Syazwani & Mariam., 2012). Several Malaysian Standard is regulated to ensure the technical compliance with the legislation and regulation. The followings are the prevailing standards for accessibility in the built environment:

a) Malaysian Standard **MS 1183: Part 8: 1990 (P) Code of practice for means of escape for disabled people** requiring special standards to be

complied with in providing fire precautions in designing public buildings to make it safe for the use of disabled persons.

b) Malaysian Standard **MS 1184: 1991 & 2002: Code of practice for *access* for disabled people to public buildings** issued by SIRIM in 1991 requiring special standards to be complied with in designing public buildings so that its safe for to be used by disabled persons

c) Malaysian Standard **MS 1331: 1993 & 2003: Code of practice for *access* to disabled people outside buildings** issued in 1993 and subsequently 2003 is the Malaysian Standard about the provisions on designing of special facilities outside buildings for disabled people to ensure accessibility and usable by disabled persons.

d) Malaysian Standard **MS 1184: 2014: Universal Design and *Accessibility* in the built environment: - Code of Practice** is the revised and updated Malaysian Standard for MS 1184: 1991.

e) JKT: AM/B/BIL.19/19 **"Guidelines on building requirements for disabled persons**" issued by Ministry of Housing & Local Government in 1999.

f) **Building requirement for disabled** developed by Federal Department of Town and Country Planning Peninsular Malaysia in the year 2000.

g) Federal government Malaysia signed on 16th May 1994 the full Participation and equity of people with disabilities in Asia & Pacific Region.

h) **"Asian and Pacific Decade of Disabled Persons 1993 – 2002"** aimed at systematically improving the living conditions of disabled persons and helping them to achieve their full development potential.

i) **Biwako Millenium Framework for Action from 2003-2012** aims to allow disabled persons to be in the main stream of society with the aim to create an inclusive, barrier-free & rights-based society for people with disabilities.

This Malaysian Standard provides a range of requirements for the elements of construction and fittings which comprise the built environment. These requirements relate to the constructional aspects of access to buildings, to circulation within buildings, to egress from buildings in the normal course of events and evacuation in the event of an emergency. Based on the Malaysian Standard, facilities that need to be planned by universal design concept includes pedestrian walkways, pedestrian crossings, parking space, bus stops, stairs, elevators, escalator, street furnitures such as public telephones, seating, post box, litter bins, and safety fence. Other facilities are supporting facilities such as guiding blocks, step ramp/dropped kerb, ramp, handrails, signages and indicators, as well as ATM.

Key accessibility issues in accordance with Malaysian Standard 2014 concerning the Universal Design principles are:-

- Equitable approach to a building, e.g. designated parking, clear pedestrian routes separate from vehicles and cyclists, no steps or obstacles, short distances from parking and public transport, good signage, good lighting and good contrast.
- Equitable entry via the same entrances, e.g. easy to locate main entrances, no steps or obstacles, wide openings, adequate manoeuvring space in front of the door, low operating forces, good signage, good lighting and good visual contrast.
- Equitable use of the paths in horizontal circulation, e.g. no steps or obstacles, adequate manoeuvring space, wide door openings, easy to operate doors, resting places, clear layout, good signage, good lighting and good visual contrast.

- Equitable access to the paths in vertical circulation, e.g. safe stairs, spacious lifts with easy operation, good signage, good lighting and good visual contrast.
- Equitable use of the same rooms, e.g. ample circulation space and different seating possibilities, good acoustics and hearing enhancement systems, good lighting and good visual contrast.
- Equitable use of the equipment and facilities, e.g. easy to understand and operate, adequate manoeuvring space and operating height, information via two senses.
- Equitable use of toilet and sanitary facilities, e.g. good signage, adequate manoeuvring space, good transfer options, well-placed equipment, easy operation.
- Equitable exit and evacuation routes, concepts for emergency planning, e.g. no steps or obstacles, fire protected lifts, good signage, good lighting, good visual contrast, good fire safety, protection and evacuation, accessible evacuation routes.
- Important information via two senses or more, e.g. visual, audible and tactile.

2.4.4 Factors Affecting Accessibility

Constructing an accessible barrier-free environment is often better achieved if approached incrementally and can focus on building a 'culture of accessibility' and removing basic environmental barriers. As the concept of accessibility becomes more ingrained and familiar, it becomes easier to raise standards and attain higher levels of mainstream disability inclusion. The four design requirement for the users' accessibility in the built environment are (i) sensory, including tactile warnings, guide ways and information; (ii) outdoor environments, including obstructions, signage, street furniture, pathways, kerb ramps, pedestrian crossings, parking and children's playgrounds; (iii) horizontal areas, including doors, entrance areas and lobbies, corridors, handrails and

railings, bathrooms and toilets; (iv) vertical areas, including ramps, lifts and stairs. Upon considering the four factors, it is believed that this will result in a secure and accessible environment within and between buildings and in outdoor environments and promote opportunities for greater mobility and result in increased social and economic independence.

In brief, the four design requirements for the users' accessibility required accessible information and communications is important for everyone, including people with low vision and blindness to navigate physical spaces. This involves consistent and continuous guiding system that includes tactile: warnings, guide ways and information. Lighting and good signage is an important aspect in providing a safe and secure environment, particularly for people with disability. Obstacles, protruding elements and anything else obstructing the path of travel should be removed or relocated. This includes: a) overhanging obstructions, such as electric cables, light fixtures, shop awnings, signs and vegetation; b)fixed objects on pathway surfaces, such as bollards, garbage bins, poles, trees and other street furniture; c)unfixed objects on pathway surfaces, such as A-frame signs, commercial street furniture, planting tubs, retail and food carts, and stalls; d) spaces below ramps and stairs. Signage includes direction signs, emergency and hazard warnings, information notice boards and location signs. It must be clear, easy to read and understand, properly lit at night, visible and well located. Examples of horizontal building elements are doors, entrance areas and lobbies, corridors, handrails and railings, as well as bathrooms and toilets. Accessible doors include doors a person can operate in a single motion with little effort. Entrance areas and lobbies should be accessible, easy to find, well lit and supported with clear and consistent signage. Vertical accessibility, which covers building elements enabling people to negotiate changes in level and reach upper floors in the built environment,

allow the components that make for an accessible environment and comply with universal design principles are covered in this section, including: a)multi-level building provisions; b)avoiding unnecessary level changes; c)installing ramps; d)installing lifts; e) installing emergency stairs. Stairs should provide safe access into buildings and between levels within buildings for all users. This is particularly important for those with low vision and blindness, as well as those with mobility disability. Poor staircase design is a common problem in many buildings in developing countries and it can lead to injuries.

2.4.4.1 Safety and Usability

According to the principle of accessibility, being able to "physically get into a room" is not sufficient. More than that, it must be possible for people to use this room for what it is intended for in the way that is common, without additional effort or assistance. Thus, in a workshop, for instance, it must be possible to use a workbench. This requires its adjustability to allow wheelchairs underneath and maybe also grab bars and fixation devices. Moreover, in all accessibility-related solutions based on the universal design approach, safety aspects – the aim of a quick, complete and safe evacuation of all types of users. For the most part, both aspects, that of safety and that of usability, are strongly connected: For instance, the corridors in the office building need to be wide enough and must not be obstructed by objects so that people with physical/mobility impaired can use these areas without assistance. At the same time, sufficiently sized corridor not obstructed by objects provide the necessary prerequisite for evacuation in case of emergency. Similarly, step edge markings are not just indispensable for people with visual impairments, but also helpful to reduce the number of accidents on stairs as a whole.

Architects should follow the principal listed under 'Universal Design' from the start of the design process. They should design the building to meet the needs of everybody who will be using it, regardless of their age, size or abilities. Consultation with a broad range of users should be considered throughout the design process. When architects are estimating the time required to evacuate a building, they should keep in mind that many people have particular needs during evacuations. Some people use wheelchairs or crutches to move around and may be slower than others. Some people will have some degree of hearing loss or vision impairment. Older people may be slower to move around, and some people may have young children with them. In short, the building design should cater for everyone, regardless of their age, size or abilities (NDA, 2008).

2.4.4.2 Access Audit

Accessibility audit checklist has been commonly used by access auditors undertaking access audit of public buildings in most countries. The access audit checklist is used as a basic tool and can be further developed and innovated by the researcher depending on the type of building or service been audited. The checklist goes beyond the physical accessibility and address issues of making the service provided in the building accessible. Audit of the physical facilities of the building is divided into two sections - external environment and internal environment. See Table 2.8 for the physical features for both external and internal environment. The 'Handbook on Barrier Free and Accessibility' may be referred to while providing recommendations. Some elements in any public space have to be considered and evaluated for every area. Therefore, the auditor must keep these elements in mind throughout the audit. These elements include signage, illumination, colour contrast and flooring.

Table 2.8: Physical features

Features	Description
External environment	Including approaches, parking, transport, links, routes, street furniture and external ramps and steps.
Entrance	Including visibility layout, entry controls, doors, thresholds and lobbies.
Internal environment:-	
Reception area	Including layout, reception desk, waiting area, signs, visual and acoustic factors.
Horizontal circulation	Including ease of navigation, corridors, doors, direcitonal information, internal surfaces
Vertical circulation	The provision of lift, stairs and escalator.
WC's	The general provision, WC's for ambulant disabled people, accessible WC's and baby changing facilities.
Specific Facilities	Changing areas, bathrooms and showers, bedrooms, storage, refreshment areas, service desks, waiting area and assembly areas
Controls and equipment	Coin and card operated devices, building services controls, window controls, alarms, entry phones
Communication systems	Telephones/text phones, lift voice announcers and audio visual displays
Emergency egress	Including escape routes, refuges, alarms, fire protected lifts, emergency lighting
Signs and way finding	Including overall layout of building, sign type and location, use of landmarks features, maps and guides, visual contrast, audible features and olfactory feature
Lighting	General and workplace
Acoustic environment	Including background noise, hearing environment systems, acoustic conditions suitable for the intended use

Source: Ann Sawyer (2007)

In this research, the access audit checklist is developed based on all the technical requirements in compliance to the Malaysian Standard 1183 and 1184 as mentioned in the Uniform Building By-Law 1984 (Yaacob, Omar, Rahim et.al. (2011); Yaacob, Hashim, Hashim 2009) to assess the fit between the building users and the built environment. This can help to identify workplace design factors that might be barriers to users with disabilities, and users who have not yet experienced a disability. The areas assessed are divided into two sections: external environment (pedestrian walkway, disabled car park, external ramp, external step ramp, general obstruction and external staircase) and internal environment (building entrance foyer, doors, room & spaces, barrier-free toilet, barrier-free shower area, urinal area, fire escape, corridors, internal

step ramp, internal ramp, staircase, lift, special telephone, ATM, directional sign & symbol, guiding block, restaurant & cafeteria and others), as listed under Table 3.4.

Throughout a review to the accessible building design elements using accessibility audit checklist by Clinton (2013) reveals that no standard is available in the code under review for the particular design element - although it may be addressed in a code revision. There also is observed variation in technical specifications among codes, which reflects different ways in which jurisdictions specify accessibility provisions in response to local conditions, regulatory experience and end-user preferences. Variation in coverage and level of technical specification in building codes and accessibility standards would suggest: (1) not all accessibility standards may be applicable to all development settings, which strengths the case for specifying performance requirements rather than technical minimums for environmental accessibility; (2) accessibility norms and standards are always under development; or (3) authorities may be employing a "best possible solution"86 approach to promoting accessibility in built environments in the light of available technical and financial resources, personnel and institutional capacities and enduser interests, needs and capacities. The report notes that while the benefits of environmental accessibility are well known, there are examples in currently built environments where buildings and spaces – public and private - do not provide appropriate levels of accessibility. It addresses the question through review and analysis of national accessibility regulations and standards of European Union member countries and internationally and examines how their presence and enforcement assist or hinder the provision of accessibility in built environments. The review found that a substantial body of legislation, regulations, standards and practice are available – as at November 2010 - to guide design and provision of accessible built environments. Some gaps and weaknesses in national documents concerning functional accessibility requirements,

which were either not specified or incompletely developed, and technical specifications of building types and elements, which mainly involved users with certain impairments, such as mental health, learning disability, cognitive abilities, and allergies. To address identified issues, the report recommends the introduction of common European Union-level approaches to the definition of functional requirements, minimum technical standards and conformity assessment (in public procurements), and improved training of environmental design professionals. The joint report, "Accessibility in the built environment," provides important lessons on the role of policy and legislation, institutional arrangements and systematic consultations in developing performance requirements and technical standards on environmental accessibility (Clinton, 2013).

2.5 Accessibility: Green Building Legislation & Regulation Compliance in Malaysia

Environmental accessibility plays a not inconsiderable role in development: an estimated 25% of the world's population can benefit from environmental accessibility measures and progressive removal of barriers to their full and effective participation in social life and development. A recent study by the World Health Organization, in collaboration with the World Bank Group, estimated that as at 2010 there are more than one billion persons (approximately 15% of the global population) living with disabilities. The Madrid Plan of Action on Ageing (2002) noted that accessibility is an important factor in furthering the goal of a "society for all ages." However, the built environment nowadays tend to focus on building 'green' with the consideration of environmental consideration and have tended to give less attention to users' requirement. It is important for users to be able to access/enter in a built environment and spaces inside, yet to enjoy all the facilities contained in any building. Universal design means that we have to pay greater attention to sustainability and the quality of the natural environment.

It imposes a whole new moral tone and synergy to our daily activities. Universal design is an important tool in this continuous and stupendous process of living.–A building/ built environment shall be designed for an equal-accessibility not only for those who are able-bodied but also to people with vision impaired, people with physical/mobility impaired, people with hearing impaired, who, might be unable to access signs and information or negotiate the environment satisfactorily, and operate the fixtures and furnishings in buildings, such as doors and door handles (Sanjoy & Gilbert, 2001). There is increasing recognition of users' needs in the built environment, which goes beyond sustainable development, to focus on accessibility of public office building.

Persons' with Disabilities Act which promotes strongly Universal Design is mandatory to comply while the reinforcement of Green Building Index design agenda is not mandatory to comply as shown in Table 2.7. Among all the regulative legislation implemented in Malaysia, it can be concluded that users' equitability right, which is universal design, was introduced in Persons' With Disability Act while green building requirement is introduced in GBI. Apart than that, there is an introduction of universal design index according to Abdul Rahim (2012). Universal Design Index is based on the principles of (i)Connectivity, (ii)Accessibility, (iii)Usability, (iv)Safety, (v)Integrated Design and; (vi)Operations and Maintenance, which further elaborated each component in Appendix H. By taking into account the basic three aspects of Accessibility, Usability, and Safety, which scores 65%, a building will be rated a "passing" evaluation if these three principles are fulfilled.

In Malaysia, a government has introduced few National policies to adopted the broad course of action in pursuits to its objectives. The followings are the prevailing National policy:

a) **National Policy on the Environment (2002)** with the key emphasis on ensuring the economic, social and cultural progress through environmentally sustainable development

b) **National Green Technology (2009)** that emphasise Sustainable Development. The four pillars of National Green Technology Policy include:

i) Energy: seek to attain energy independence and promote efficient utilization;

ii)Environment: conserve and minimize the impact on the environment;

iii) Economy: enhance the national economic development through the use of technology;

iv) *Social*: improve the quality of life for all.

In the launching of the Green Technology Policy (GTP) in July 2009 by Prime Minister, Dato' Sri Mohd Najib bin Tun Haji Abdul Razak informed the approach aims to increase the *quality of life and a better environment for the people*. In achieving this national mission, buildings *shall comply with all green design features* that contribute to energy performance and simultaneously *accomplish user comfort*. National Green Technology Policy 2009 is launched to promote Green Technology (GT) as a driver to accelerate the national economy and to promote *sustainable development*: i). Strengthen Institutional Frameworks; ii) Provide A *Conducive Environment* For Green Technology Development; iii) Intensify *Human Capital Development* In Green Technology; iv) Intensify Green Technology Research And Innovations; v) Promotion And Public Awareness. Besides, our government had allocated RM20 billion to intensify *green and sustainability* awareness in budget 2010, tabled on 24th October 2009. Public Works Department Malaysia (PWD) also has taken steps progressively to create, adapt and apply a sustainable building project management throughout building lifecycle;

planning, design, construction, monitoring, and maintenance as to achieve a *green nation by 2020*. Tenth Malaysia Plan (2011 – 2015) Thrust 4 stipulated that to improving the Standard and *Sustainability of Quality of Life* through better access to healthcare, public transport, electricity, and water. Measures were also taken to create a caring society and promote community well-being. Eleventh Malaysia Plan (2016-2020) reinstated the importance of people, by having the theme of *"Anchoring Growth on People"* where people will be the centrepiece of all development efforts and to ensure that no section of society is left behind in participating and benefiting from the nation's development. Interestingly, Jabatan Kerja Raya Framework also launched their JKR in-house Green Index – developed by CAST which stipulated that 80% of new building projects comply to JKR Green Index and 70% of the projects to be healthy projects. The Green Building rating system - Green Building Index (GBI) was launched in May 2009 by private sector Pertubuhan Arkitek Malaysia, in line with the National Policies on the environment and technology. The GBI was designed based on other international rating systems such as BREEAM (Building Research Establishment Environmental Assessment Method) and the USA's LEED (Leadership in Energy and Environmental Design). The GBI providees it's own definition of what constitutes a Green Building, which is "focuses on increasing the efficiency of resource use – energy, water, and materials – while reducing building impact on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal". The GBI further clarifies that Green Buildings should be operated and designed to reduce the overall impact of the built environment on its surroundings. Through the definition, it is not obvious that all of the users' rights will be protected by the Green Building. This is because the Green Building design and construction mainly address the following aspects: sustainable site planning, energy

efficiency, indoor environmental quality, conservation of materials and resources, and safeguarding water and water efficiency (see Table 2.9).

Table 2.9: GBI tools criteria

GBI Tools Criteria	Remarks
Energy Efficiency (EE)	Improve energy consumption by optimising building orientation, minimising solar heat gain through the building envelope, harvesting natural lighting, adopting the best practices in building services including use of renewable energy, and ensuring proper testing, commissioning and regular maintenance.
Indoor Environment Quality (EQ)	Achieve good quality performance in indoor air quality, acoustics, visual and thermal comfort. These will involve the use of low volatile organic compound materials, application of quality air filtration, proper control of air temperature, movement, and humidity.
Sustainable Site Planning & Management (SM)	Selecting appropriate sites with planned access to public transportation, community services, open spaces, and landscaping. Avoiding and conserving environmentally sensitive areas through the redevelopment of existing sites and brownfields. Implementing proper construction management, storm water management and reducing the strain on existing infrastructure capacity.
Materials & Resources (MR)	Promote the use of environment-friendly materials sourced from sustainable sources and recycling. Implement proper construction waste management with storage, collection, and re-use of recyclables and construction formwork and waste.
Water Efficiency (WE)	Rainwater harvesting, water recycling, and water-saving fittings.
Innovation (IN)	Innovative design and initiatives that meet the objectives of the GBI.

Source: Green Building Index Malaysia (2010)

The government of Malaysia has taken several pro-active actions in promoting energy efficiency through demonstration buildings that could encourage the private sector also to construct and design low energy buildings. Users' requirement in the built environment is mostly being ignored during the planning stage. As such, the built environment should be designed to cater for Persons with Disabilities to promote universal accessibility. Persons with Disabilities are individuals who have long-term physical, mental, intellectual or sensory impairments, in which various barriers may

hinder their full participation in society. The disability-related from built environment is the relation between the human and environment, various aspects of culture, society, politic, climate topography, technology and architecture (Meyers et al., 2002). It is evident that barrier in architecture is one of the significant factors that contribute to disability situation of persons with impairments. However, Imrie and Hall (2001) argue that policies, practices, and values of professionals who create the built environment are the main contributors to the barriers in architecture.

Not all buildings can talk about everything encompassing green, but they can be sustainable on to themselves (Selina Hijjas). Table 2.9 compared the different countries objectives focusing on the 'energy efficiency' agenda, however, move towards 'renewable energy' and 'social justice' has only been recently addressed in many countries. However, Malaysia, the emphasis is still on 'energy efficiency.'

Office buildings were the initial focus for the development of strategies and tools to support environmentally responsible design and construction based on their overall contribution to the building stock (Kim & Osmand, 2013). This can be seen from the development of BREEAM (see Table 2.10), first released in 1990, provides environmental performance labels suitable for marketing purposes. BREEAM has claimed to capture over 25% of the new office building market in the United Kingdom, but versions for other building types and existing office buildings remain less influential.

Table 2.10: Breakdown of different categories in the rating systems

Name of Rating Tools	BREEAM	LEED	Green Star	Green Mark	GBI
Origin & years introduced	UK, 1990	US, 1993	Australia, 2003	Singapore, 2005	Malaysia, 2009

Table 2.10 continued

Name of Rating Tools	BREEAM	LEED	Green Star	Green Mark	GBI
Categories	Energy use Transportation Water Ecology Land Use Materials Pollution Health and well-being	Energy and atmosphere Water efficiency Sustainable Sites Materials and resources Indoor environmental quality (IEQ) Innovation	Energy Transport Water	Energy efficiency Water efficiency Environmental protection Indoor environmental quality (IEQ) Innovation	Energy efficiency Indoor environmental quality (IEQ) Sustainable Site and management Materials and resources Water efficiency
Developer	Building Research Establishment (BRE)	United States Green Building Council (USGBC)	Green Building Council of Australia (GBCA)	Building and Construction Authority (BCA)	Green Building Index Sdn Bhd

Currently, the Malaysian example could be contrasted with the City of Columbus and Franklin (USA), where the establishment of the AWARE Manual for Sustainable Accessible Living incorporated green building and universal design in Sustainable Rating System (the City of Columbus and Franklin County, 2013). Another universal design and Green Home Survey Checklist developed by Sandler (2010) are designed for building livable, energy-efficient homes and apartments that people of all ages and abilities can use, enjoy and adapt to suit their changing needs. Other countries may still lag behind in this endeavour, due to legislation, attitudinal, professional conducts (Samari et al., 2013), which arguably includes Malaysia.

Experience suggests that development, provision and maintenance of accessible goods and services on an efficient and sustainable basis are more complex processes than compliance-based decisions alone. Some actors are involved – representing public, academic, professional, private and voluntary sectors – in the design, development and

provision of goods and services that provide accessibility with “reasonable accommodation” for all (Clinton, 2013).

2.6 The role of parties involved in the implementation

Through the introduction of both SDSs and 11MP, an institutional and governance framework involving all stakeholders will be in place to plan and monitor the goal of the Sustainable Development. All stakeholders’ contribution is required to ensure the successful implementation of SDGs. There are some pieces of legislation that place responsibility on government bodies (authority), building owners and employers to ensure the safety, health and welfare of anyone using a particular building. These responsibilities are in addition to the moral duty of care to building users. The statutory requirements on accessibility will only become more comprehensive and demand for architects to expand their design abilities. Unsatisfactory solutions will create if the architect take the direct and literal application of the requirements into the built environment’s design. As such, innovative design is required while applying the unversal design approach, by putting the human accessibility factor in the foremost and right place during the design stage, then the built environment is then just can be considered satisfactorily done.

In Malaysia, effective from 12th April 2007, Malaysia Prime Minister officially announced the introduction and implementation of Certificate of Completion and Compliance (CCC), One Stop Centre (OSC), Commissioner of Buildings (COB) and Built and Sell (10:90), in conjunction with the implementation, relevant Acts and Regulations had made certain amendments. The CCC replaces the Certificate of Fitness For Occupation (CFO) previously issued by the local authority. The CCC is at this moment released by the project's Principal Submitting Person (PSP) who is either a

Professional Architect, Professional Engineer or a Registered Building Draughtsman (allowed by the Architects Act to issue a CCC for buildings not exceeding two stories and an area less than 300 square meters). The overall procedure before the CCC approval is illustrated in Fig. 2.3.

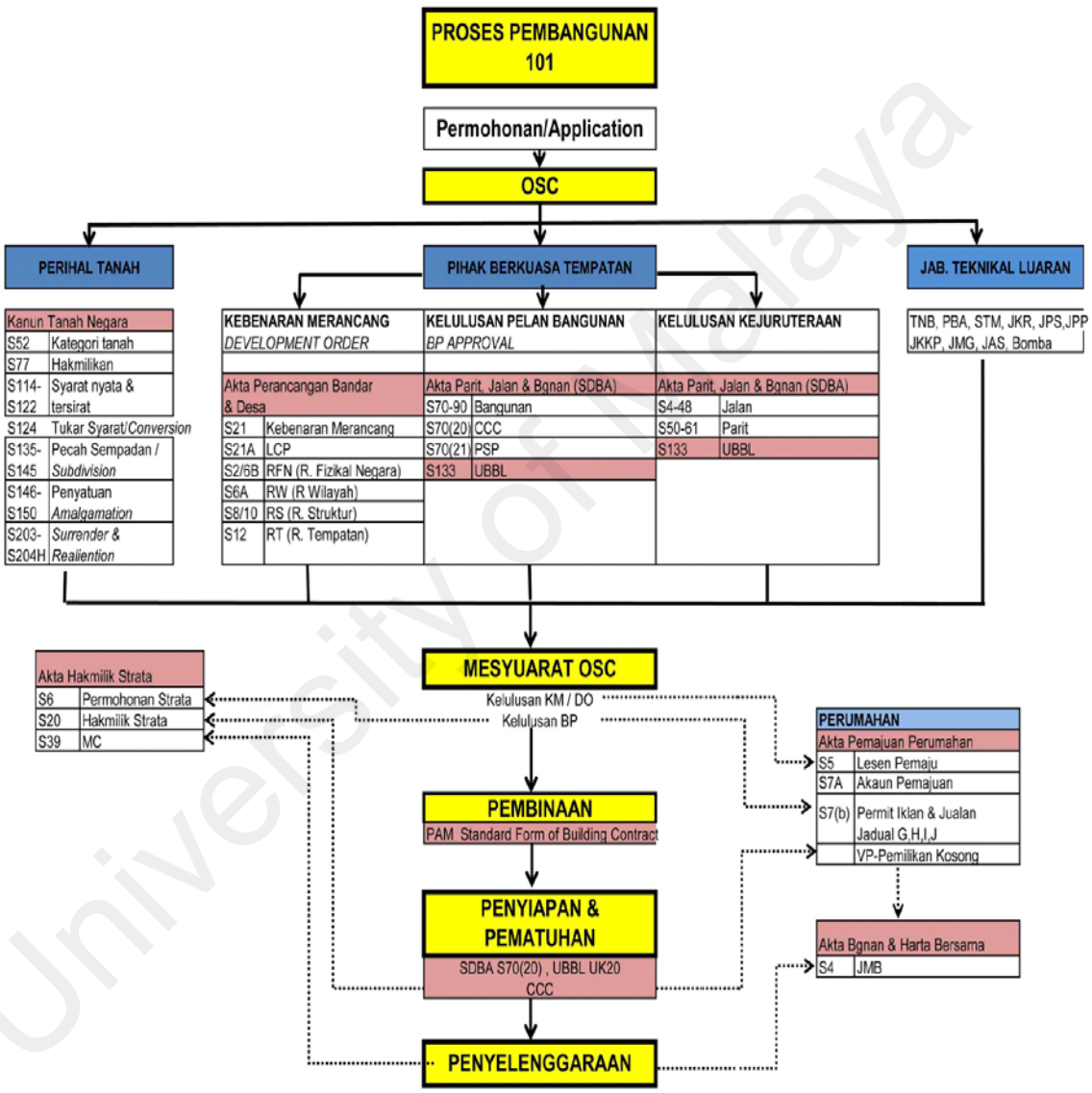


Figure 2.3: Local Authority Submission Procedure

Source: One Stop Center (2013)

It is the government’s view that CCC will cut down on red-tape and ensure that building owners able to move in without compromising the safety. This is consistent with the government’s desire to encourage self-regulation, which was introduced in the National Economy Growth Planning strategy to continuously enhance the delivery system. The local authority act as a role to receive all the planning and building plan submission, and review it before issuing the appropriate approval letter before all the site work commencement. Besides, the local authority can initiate site inspection or act on behalf while receiving any complaints from the public to check the current site work progress. Notice or stop work order will be issued if there is a breach / not complying the approved regulations. Under the new CCC system, a matrix responsibility process is introduced. Each construction process is required to be verified by relevant professionals and contractors or trade contractors. Malaysia's government believed that it would be an improvement in the accountability and responsibility aspect and, thus, work quality.

2.7 Conclusion

In Malaysia, the consideration of better future of next generations is always governments' primary focus regarding green building design (Sood et al., 2011). The governments' role in promoting green building design is always compelling and undeniable according to both Atsusaka (2003) and Samari (2012). However, different researchers and or specialist have different opinion towards the effective way of giving incentives. Same believed market-based incentive is more effective to address the market failure than non-market problems to improve the green buildings development (Dennis, 2006).

Principal Submitting Person (PSP) and Qualified Person (QP), whether Professional Architect, Professional Engineer or building draughtsman should always put accessibility on the agenda if he/she wants to achieve the objective of the sustainable built environment when adopting the green construction design and concept. The fundamentals of sustainable built environment regarding accessibility should go beyond green construction as principles because the universal design is universal for all categories of buildings, especially for people with disabilities who will face the difficulties in accessing the building. Design and development of accessibility guidelines and issuance of technical standards generally were initiated in connection with national legislation mandating accessibility in public facilities and services, public accommodations and government-funded infrastructure. However, designs that aimed to comply with legal provisions on accessibility often would result in solutions that placed "accessible" facilities separate – and thus unequal -from principal service facilities and entryways. This was especially the case in requirements to retrofit existing facilities to meet contemporary standards on accessibility and usability.

Moving from a compliance model to viewing accessibility as a global public good would encourage solutions that are holistic, provide accessibility with reasonable accommodation and are sustainable. These issues will be considered in the select review of current practices. The focus is on examples that provide benchmarks for specifying functional requirements and defining minimum standards to assist the governments that have ratified the Convention on the Rights of Persons with Disabilities, as at December 2011, but have not yet instituted measures and guidelines to promote and implement its accessibility provisions for the built environment, transport services, public facilities and safe and secure pedestrian movement.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter explains the rationale behind the thesis's research methodology, describing the theory and analysis of how the research should proceed (Harding, 1991). List of the research objectives are as follows:-

1. To understand the criteria/factors of accessibility in a built environment.

2. To examine the legislation and regulation of users, especially Persons with Disabilities in the Green buildings.

3. To evaluate the accessibility of the Green buildings in Malaysia

3.1 Implementation of Methods

In brief, the study was conducted in the order presented below.

Phase 1: The study first identified the legislation, regulation, and standards in Malaysia pertaining the built environment and Green buildings.

Phase 2: The study then selected two Green buildings with performance ranking in the top during the year 2013, from two respective categories, i.e. non-residential existing building (NREB) and non-residential new construction (NRNC) to evaluate the effectiveness of the said implementation.

Phase 3: An in-depth multiple site case study of the Green office buildings was then conducted. Data was collected through multiple day visits, direct observation and detached observation.

Phase 4: The data was then analysed for differences in advancement practices between the built environment, ranging from Green certified non-residential existing building to Green certified non-residential new construction.

3.1.1 Phase 1 of the Study:

Identifying the legislation and regulation, standards and practice in Malaysia.

Phase 1 of the study represents the process utilized to identify the legislation, regulation, and standards in Malaysia. Through the literature review process, some architectural building elements and way-finding elements were identified as affecting factor in accessibility among built environment. Insufficient studies had been done explicitly evaluating universal design accessibility to the Green building. It is vital to note that through this research, the author sought to clarify the association of accessibility within the built environment. Analysis of the data collected involved the data reviewed and analytical method. The data were reviewed for consistency and reasonableness. The actual outcome of the implementation of the legislation and regulation were then compared against the data collected.

3.1.2 Phase 2 of the Study:

Selection of multiple site case study in Green building to evaluate the effectiveness of Phase 1

3.1.2.1 Multiple Site Case Study as Research Method

Eisenhardt (1989) indicates that case study research is suitable to be used when one aims to understand the current single settings' dynamics. The objective of the selection of case study as a research method is for more like a focus point which evolves during the study (Andersson et al., 2007b). It is conducted to investigate contemporary phenomena in their natural context, in which focus can be controlled (Per, 2008). The use of the case study method rather than other research strategies because there was a need to find out "what" based on the formation of the research question; as there was no

control for the researcher over actual behavioral events and the degree of focus is on contemporary events (Yin, 1994). The good planning of case study is crucial in obtaining a good data collection and the subsequent success of research method. There are several issues need to be planned, from the case study selection, to the framework theory, research questions, research methods and finally the selection strategy. In this research, accessibility compliance is the being studied. The case study research is purely observational and conducted in real-world settings, and thus have a high degree of realism, mostly at the expense of the level of control (Per, 2008). The case study contain elements of other research methods, e.g. access audit conducted within the case study, literature search often precede a case study and archival analyses may be a part of its data collection. Ethnographic methods, like interviews and observations are mostly used for data collection in case studies. The data collected in an empirical study is qualitative which involves words, descriptions, pictures, diagrams etc. Qualitative data is analyzed using categorization and sorting in which provide a richer and deeper description. The conclusions of the case study are based on a clear chain of evidence collected from multiple sources in a consistent and planned manner, and it adds to existing knowledge by being based on previously established theory (Per, 2008).

A single setting within this study is defined as an office building that is going through the process of accessibility criteria after the Vacant Possession of the building. This single setting forms the context and is the core of the study. Yin (2003) describes this core of the phenomenon that gets explored in a bounded context as the unit of analysis. This is typically a system or action, rather than an individual, a group of persons or entity (Tellis, 1997). These evaluation methods have been developed and implemented by researchers, design educators, and practitioners (Preiser, 1988,1994,1996; Zeisel, 1981; Bailey, 1987; Baird et al., 1996 and Shauna, 2001).

Case studies typically combine data collection methods such as filmed visual representations like video, photographic exercises; observations such as facility walk through using a checklist, whereby the evidence can be qualitative or quantitative (Eisenhardt, 1989; Yin, 2003).

In Malaysia's context, Persons with Disability have become the driving forces on development and construction of government buildings such as offices, schools, police stations, hospitals, and clinics. Government's office building is categorised under the public building which able to gain the regular public visits within working hours. The study shows that previous government's office building design did not optimise universal design strategies in its building layout and building design. Government buildings and facilities are the nation's assets that must be well managed. Failing to provide proper maintenance to the government offices will give an impact on government's efficiency in running the country. Thus, it is vital for all to stress on usability facility in the public sector as to ensure a more quality life for all. This study investigates current government office design layout towards an understanding of accessible and sustainable buildings. The last criteria for the case study selection are building users. Among the various building typology, government office buildings were able to address all types of users. The sustainable office building is designed by using an integrated approach to address critical issues with optimal solution (Ng, 2007).

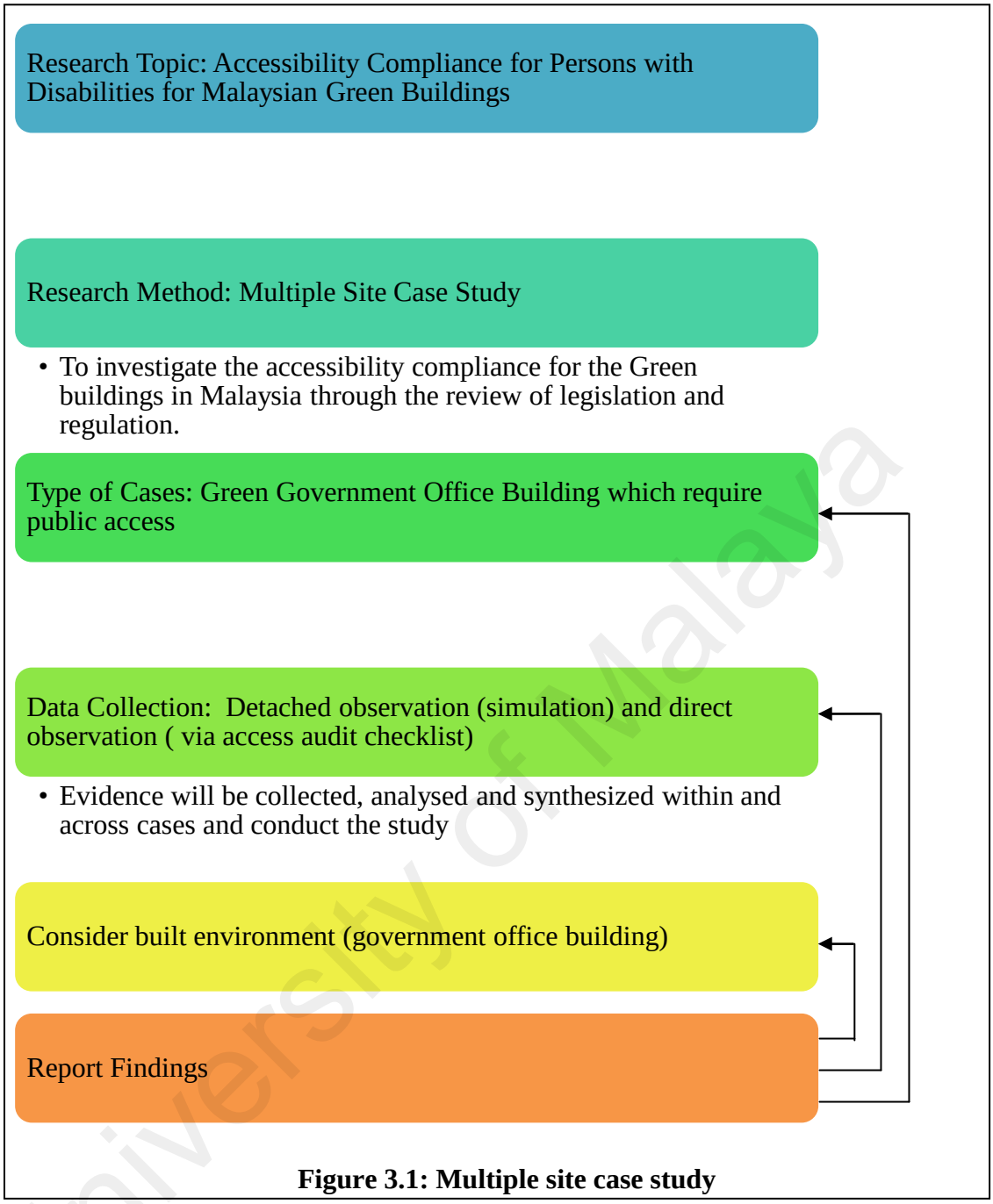


Figure 3.1: Multiple site case study

Source: author

In this research, case studies are selected according to its particular interest & detail of interaction with its contexts. Case study is the study of the particularity and complexity of a single case, coming to understand its activity within exigent circumstances. The case study building is selected to become the contrast case to the two Green-rated building. Building typology of government office building which required public access is then set to be the primary criteria. Selection of case studies

needs not be a haphazard activity (Yin, 1994). The case study selection and evaluation process needs to be justified and fully documented (Maha, 2002). In this research, which is a multiple site case design, was conducted to allow the researcher to understand the similarities and differences between the cases. The evidence generated through multiple site case study is strong and reliable (Baxter and Jack, 2008). According to Yin (2003), multiple site case study can be used when augur contrasting result for expected reasons. It can allow for a wider discovery of theoretical evolution to create a more convincing theory. The selection of cases is driven by two issues of appropriateness and adequacy (Kuzel, 1999). Appropriateness is related to demonstrating a fit to both the purpose of research and the phenomenon of inquiry; relevance is concerned with how many cases (Kuzel, 1999; Miles and Huberman, 1994; Patton, 1990).

The exploration framework for the study was designed to examine the organizational and advancement legislation, regulation, standards, and practices within the case study set. Consistent with qualitative research methodology, review of the existing literature related to advancement program practice helped focus data collection during the research study. The level of provision and functional of the facilities in the case studies building is evaluated. To achieve this objective, the factors involved are classified as users and regulative legislation. This is to answer the research question as to how effective the implementation of the legislation, regulation, standards and practice influences the users' accessibility in public office building.

3.1.2.2 Sampling Strategy

This study was designed in response to research in the field for a qualitative study evaluating the differences in practice pertaining accessibility. Typically, building

assessment uses the performance benchmarks as the basis to measure or indicate how well or how weak a cases study building is performing. Therefore, each performance benchmark is assigned some points so that the overall performance score can be calculated. The case study will show that the implementation of the legislation and regulation, which would allow for accessibility within Green building to be implemented resulting in the office building being able to operate and provide services to the public that would be accessible. To compare the effectiveness of the implementation of Phase 1, multiple site case study methodology was utilised (see Fig. 3.1) by the replication logic. Two site buildings are selected, with the basis that both are Green office public building, fully complete the construction and currently under operation to serve the public. It is assumed that both cases turn out as predicted then there is substantial evidence for the initial set of propositions.

Before the performance benchmark can be assessed, it is essential to determine the applicable phases towards the case study. There are five phases involved prior to the completion of the built environment, namely: 1) Schematic Design Phase, which explores the initial design brief of the built environment; 2) Design Development Phase, which develops the design brief into the detailed drawing; 3) Contract Documentation Phase, which building contract documents are prepared; 4) Contract Implementation and Management Phase, which built environment is being constructed; 5) Final Completion Phase, which built environment is being handed over/vacant possession to client for their onward building operation & management. It is recommended that the assessment of the case study should be upon the completion of the project and it is currently operating with the involvement of the public visitors.

Green building certificates are awarded according to a few categories: non-residential new construction, non-residential existing buildings, residential new construction, industrial new construction, industrial existing building, and township. Provisional certificates will be issued for the buildings' vacant possession. Final certification issued indicated that the building was accredited according to the Green building index rating requirements. The list of Green-rated buildings in Malaysia as to date, February 2013 is listed in Table 3.1. To date, only five buildings have received their final certification (Green building index, 2013). A significant increase in the construction of Green office building was recorded until March 2013 with 61 buildings obtaining the GBI provisional certification (Green building index, 2013).

Field audits took place within the listed Green Rated Building with the GBI accreditation, under Pertubuhan Arkitek Malaysia (Refer Table 3.1). Since the building typology was set to be the government office building which allows the access from the public, only two category out of four categories from the GBI-Green-rated Building is relevant, i.e. non-residential existing building and non-residential new construction (see Table 3.1). The other two non-relevant categories are provisional certified existing building and provisional certified new building, means submission for applying the Green-rated building is completed but pending of actual site commencement. From the non-residential existing building category, only one certified building is completed, i.e. Ketha Leo Building (LEO). For the non-residential new construction category, four buildings are completed, with two of them is a government building, and the other two are from the private sector. The two government non-residential new construction Green-rated certified buildings are PTM Geo building and Bangunan Suruhanjaya Tenaga. The study then selected two Green buildings with performance ranking in the top during the year 2011, from two respective categories, i.e. non-residential existing building (NREB) and non-residential new construction (NRNC). PTM Geo building is

then selected under the non-residential new construction as it was the first new government building in the country receiving the recognition, and with the purpose-built – provide a diverse range of participation possibilities. To best illuminate the legislation, regulation, standards, and practices contributing to differences in accessibility performance, two site from different categories were selected, i.e. Kettha Low Energy Office (LEO) in Putrajaya and PTM Green Energy Office (GEO) in Bangi.

Table 3.1: List of Green-rated buildings in Malaysia

Non-residential existing building(NREB)	**Non-residential new construction(NRNC)**
Certified buildings(CVA)	Certified buildings (CVA)
Ketha Leo building (gov)	PTM Geo building (gov)
	Bangunan Suruhanjaya Tenaga (gov)
	1 First Avenue
	Digi technology operation centre, Malaysia
Provisional certified buildings (DA)	Provisional certified buildings (DA)
Bangunan Perdana Putra	KRC sales gallery
Menara Citibank	Menara Worldwide
ASR padu existing building redevelopment	The horizon phase 2 (tower block 1, 2, 3, 4,7,8,9,10)
	CSF computer exchange 5 (CX5)
	Office tower on plot z10
	3-star hotel on plot z10
	Menara Binjai
	Menara Felda
	G Tower
	Hotel penaga
	Elken distribution centre
	The sage
	Sarawak Energy Berhad
	The office building at lot 2c2
	S P Setia Berhad Corporate HQ
	Point 92 office
	Menara LGB
	Lot E, Platinum Sentral, KL Sentral park, corporate office suite
	Rehda headquarter
	NTT MSC technology centre
	Setia City Mall
	Mytelehaus CJI

Source: Green building index Sdn Bhd

Figure 3.2: Selected multiple site case study

Source: author

3.1.3 Phase 3 of the Study:

An in-depth multiple site case study of the Green buildings was then conducted. Data were collected through direct observation and detached observation.

Multiple site case study for this research in a way that produces more generalizable knowledge about the legislation & regulation and standards & practices in Malaysia, whether they work or fail to work. Multiple site case studies emphasize comparisons within and across contexts. It is important to use several data sources in a case study to limit the effects of one interpretation of one single data source. If the same conclusion can be drawn from several sources of information, i.e. triangulation, this conclusion is stronger than a conclusion based on a single source. In a case study, it is also important to take into account viewpoints of different roles, and to investigate differences, for example, between different projects and products. Commonly, conclusions are drawn by analyzing differences between data sources (Per, 2008).

According to Lethbridge et al. (2005), data collection techniques can be divided into three levels:

- First degree: Direct methods means that the researcher is in direct contact with the subjects and collect data in real time. This is the case with, for example, interviews, focus groups, Delphi surveys (Dalkey et al., 1963), and observations with "think aloud protocols".
- Second degree: Indirect methods where the researcher directly collects raw data without actually interacting with the subjects during the data collection. This approach is, for example, taken in Software Project Telemetry (Johnson et al. 2005) where the usage of software engineering tools is automatically monitored, and observed through video recording.
- Third degree: Independent analysis of work artefacts were available and sometimes compiled data is used. This is, for example, the case when documents such as requirements specifications and failure reports from an organization are analyzed or when data from organizational databases such as time accounting is analyzed.

In-depth multiple site case study of the Green buildings was then conducted. In this research, the data collection techniques are as follows:-

- First Degree: Direct methods via multiple site visits to conduct the *detached observation*, which allows the researcher be in direct contact with the subjects and collect data in real time. (See Chapter 3.1.3.2.)
- Second Degree: *Direct observation:- access audit checklist*, in which the raw data was collected by the researcher without interacting with the accessibility during the data collection process. (See Chapter 3.1.3.3.)

- Third Degree: Review of the legislation and regulation in Malaysia together with the currently available critical analysis documentation. (See Chapter 2)

The findings of the first degree, second degree and third degree are valuable in tailoring interventions to support the achievement of intended outcomes. The findings will be reviewed and analyzed using data triangulation via the data collected based on the case studies. These lead to the determination of the best practice of office design to achieve the accessible built environment. The outcome of the research is expected to have a better understanding and subsequently establish a model/guideline for government office building design that must be responsive to the accessibility, safety, and usability of the building in wayfinding independently without relying on others.

3.1.3.1 Observation

When you observe a space, you learn how it is used rather than how you think it is used. Observation enables the researcher to quantify what would otherwise be regarded as intuition or option (Madden, 2000). “Seeing” and “listening” are crucial to observation. This allows the researcher to observe what people do or say, rather than what they say they do, as people always not willing to tell a stranger what they think of interview or questionnaire. This makes a comment useful to obtain direct information, understand the ongoing behaviour, process, unfolding situation or event and also act as physical evidence, products or outcomes that can be readily seen (Ellen et al., 1996). The advantages of having observational research are observation allow the access to situations and persons where questionnaires and interviews are inappropriate to use; able to access to real-life situations; useful for explaining the meaning, and context & can be strong on validity and in-depth understanding. The disadvantages of having

observational research are it can be viewed as too subjective; time-consuming; depends on the role of the researcher; may affect the situation and thus the validity of findings; ethical principles contravened & high potential for the role conflict for practitioner-researcher. This, however, is noted that it produces a substantial amount of data which makes the analysis time consuming (Per, 2008). Thus, observations could yield valuable insights on an issue.

3.1.3.2 Detached Observation (Site Simulation)

Detached Observation: Observations and building walk through are useful hands-on methods that allow the researcher to see and experience the problems in a given space (Shauna, 2001). A hidden observer documents are unrehearsed and natural patterns of behaviour. Taking notes or diagramming use patterns are essential parts of observations. Walk-through can be casual evaluations based on general satisfaction, or they can be more formal regarding a detailed checklist. Building checklists developed for all aspects of the facility enabled the researchers to quantify the problems. According to Baird et al. (1996), checklists assisted researchers to identify the perceived satisfaction such as space usage, privacy, user-friendliness, facility image, way finding, quality of maintenance and aesthetics. Walk through cover the entire facility, and observer uses different methods such as photography and direct observation to document conditions (Preiser in Baird et al., 1996). A casual walk through can identify unexpected issues (Shauna, 2001). “During a walkthrough, we observed things like persons with their hand up to their ear when talking on the phone," found by Katherine Klass, project manager for an interior design firm in Boston (Tarricone, 1999; Shauna, 2001). This implied the necessity of buildings’ acoustic in noise management. One of the primary methods to evaluate accessibility is to study the architectural design elements and way-finding elements. With that aim, the detached observation was used to identify and

document design element of the case study building and determine their functionality in context.

Audit timing: The audit took place between October 2012 until April 2013, within the selected multiple site case study buildings.

Observational Method: Generally, this framework is started with understanding types of disabilities and their physical limitations to be attended in the access auditing. Each type of disability will have its physical limitation and different potential barriers in the built environment. They are categorized into various physical disabilities. As characterized by Martin (1999), disabilities can group into wheelchair users, mobility impaired, hand or armed impaired, visually impaired and hearing impaired. Independent observer was used in each case study. While walking at the audit location, the auditors would document certain aspects by taking photographs according to each audit point location. All photographs were collected for research purpose only; no images are made public. A detached observation method was used to observe the building's accessibility factor. This method was selected for this research to record visually and commented using the checklist as mentioned above. The advantage of using this method is the setting is natural, flexible and unstructured. The data generated relevant and quantifiable, and the data collected can be combined with other variety of data collection method. The disadvantage of using this method is the simulator might lose their objectivity while involving the activity. However, this can be overcome by giving the relevant training before the observation being conducted. The detail of the access audit methodology is as follows:-

Stage 1: - Preparatory Stage: training research assistants on the conduct of access audit, including simulations. All simulators are trained in accessibility concepts before the beginning of the simulation. Data obtained were analysed before final compilation. The equipment to carry out the audit includes a measuring tape (to measure the dimension for the facilities, for example, door width, risers, landings etc. and subsequently check the comply-ability of the facilities); a digital camera; a light meter; and an induction loop tester. An audit is a journey through the building in a logical sequence.

Stage 2: - On-site survey by using a checklist, conduct simulation of access audit using wheelchairs and blind cane. During the detached observation, persons (refer Table 3.2 for the category of users' group), activities, or physical aspects that naturally exist, are being recorded, especially to those items related to my evaluation questions. It seeks to be inclusive and to see things within the context- full situation, everything that is going on in the setting and does not limit the observations to pre-identified areas. It is trusted that by having an open-ended, unstructured format observation, the author can pick up things which might not have thought about in advance, and resulted in less structured observations which produce qualitative data.

Table 3.2: Category of users' group

Persons with sensory impaired	Persons with physical/mobility impaired
- Vision Impaired - Hearing Impaired	- Physical/mobility impaired - Learning Impaired - Abled

Source: author

The access audit simulation is systematically approached through the use of a prepared layout plan to identify the routes that can be used for the simulation process. Detached observation of each segment began by walking from the accessible car park area towards the building entrance and other internal spaces of the building and documenting its design elements. The case study building was recorded photographically to highlight the positive and negative issues contributing to the experience of walkability and accessibility. Spots were chosen in each segment for observing these elements and their functional descriptions. All observations, measurements and other forms of assessments were made about the Malaysian Standard (MS 1331:2003, MS 1184:2002). Each point has been analyzed and measured to identify the level of accessibility of the marked area. After the compilation and checklist were made with the available sources of secondary information, the level of accessibility was determined for each area. Based on the overall aspects measured, conclusions were made on each of the study area about its overall accessibility level. A detailed description of the components was noted with systematic site visits. The data collected from detached observation was charted. The results of the observations are detailed in Chapter four (4).

3.1.3.3 Direct Observation (Access Audit Checklist)

Direct observation provides the opportunity for bias to be reduced. Since the author is collecting empirical data, the author herself can introduce bias without sufficient rigour in questioning, observation and documentation methods. For this reason, it is important to structure the data collection. Objective and probing questions with rigorous documentation yield high-quality qualitative data. The potential weaknesses of individual data sources will be managed by using a critical approach to the review of existing data. In sum, the shortcomings of each source of data will be accomplished by

collecting data from other sources using triangulation, a traditional method for controlling bias in data collection (Yin, 2003).

An access audit rates an existing building against given criteria for usability and accessibility. It involves not only the issue of ready movement to and around the building but also the use by persons with sensory or intellectual disabilities of the services, which the building provides (NDA, 2002). The purpose of an access audit is to establish how well a building performs access and ease of use by a wide range of potential users, including persons with physical mobility and sensory impairments. It lists out the accessibility requirements in detail and would prove more useful to compare with multiple site case studies. It identifies good and bad practice, design and layout regarding disabled access, identifying obstacles to persons with mobility and sensory impairments. The access audit of a building and its setting is the starting point for a planned programme of access improvements. Access auditing involves an inspection of a building or environment to appraise its accessibility - judged against predetermined criteria (http://www.cae.org.uk/access.html).

An access audit can provide the basis for an access improvement plan or strategy. According to Sawyer and Bright (2004), there are some reasons for carrying out an audit including: to gather data on buildings for comparison or analysis; to check compliance with specific standards and regulations; to review the policy on equal opportunities; and awareness of some particular issues. Carrying out an access audit can identify a number of features including: a) the current accessibility of the built environment; b) areas for improvement (e.g. no accessible car spaces in the car park or the door in the accessible toilet on the ground floor is incorrectly located and therefore the WC is inaccessible); c) good/bad practice in relation to facilities management; d)

positive accessibility features (e.g. counter loop at reception, proper use of lighting and colour throughout building, signage). The access audit will consider the needs of all users, and potential users, of a building or environment and assess the factors affecting independent use and access to services (Ann Sawyer, 2007). Ann Sawyer (2007) described the audits should take place when the buildings are occupied as this gives an opportunities to observe procedures and assess the building in use. The audit should cover both physical features and issues of management and use. The physical features usually include items listed under Table 3.3. By doing this, it could contribute to improvements that will eliminate the problems recurrence where an ad-hoc approach would result in.

Table 3.3: Physical features

Features	**Description**
External environment	Including approaches, parking, transport, links, routes, street furniture and external ramps and steps.
Entrance	Including visibility layout, entry controls, doors, thresholds and lobbies.
Internal environment:-	
Reception area	Including layout, reception desk, waiting area, signs, visual and acoustic factors.
Horizontal circulation	Including ease of navigation, corridors, doors, direcitonal information, internal surfaces
Vertical circulation	The provision of lift, stairs and escalator.
WC's	The general provision, WC's for ambulant disabled persons, accessible WC's and baby changing facilities.
Specific Facilities	Changing areas, bathrooms and showers, bedrooms, storage, refreshment areas, service desks, waiting area and assembly areas
Controls and equipment	Coin and card operated devices, building services controls, window controls, alarms, entry phones
Communication systems	Telephones/text phones, lift voice announcers and audio visual displays
Emergency egress	Including escape routes, refuges, alarms, fire protected lifts, emergency lighting
Signs and way finding	Including overall layout of building, sign type and location, use of landmarks features, maps and guides, visual contrast, audible features and olfactory feature
Lighting	General and workplace
Acoustic environment	Including background noise, hearing environment systems, acoustic conditions suitable for the intended use

Source: Ann Sawyer (2007)

In this research, the access audit checklist is developed based on all the technical requirements in compliance to the Malaysian Standard 1183 and 1184 as mentioned in the Uniform Building By-Law 1984 (Yaacob, Omar, Rahim et.al. (2011); Yaacob, Hashim, Hashim 2009) to assess the fit between the building users and the built environment. This can help to identify workplace design factors that might be barriers to users with disabilities, and users who have not yet experienced a disability. The areas assessed are divided into two sections: external environment (pedestrian walkway, disabled car park, external ramp, external step ramp, general obstruction and external staircase) and internal environment (building entrance foyer, doors, room & spaces, barrier-free toilet, barrier-free shower area, urinal area, fire escape, corridors, internal step ramp, internal ramp, staircase, lift, special telephone, ATM, directional sign & symbol, guiding block, restaurant & cafeteria and others), as listed under Table 3.4. Video recording and photos are taken for further qualitative analysis of the current facilities condition.

3.1.3.3.1 Scoring Method

The scoring method for the assessed areas are divided into five categories, i.e. all requirements are not met/facility is not provided even though it is necessary (equivalent to 1 score); 25% of the requirements met (equivalent to 2 scores); 50% of the requirements met (equivalent to 3 scores); 75% of the requirements met (equivalent to 4 scores); and all requirements met/facility is not provided, but it is not necessary (equivalent to 5 scores). The scoring calculation process is as follows:

1. Determine the number of scores achieved in each category;
2. Calculate the percentage of the credits achieved for each category;
3. Add all the category scores together to give the overall Accessibility score.

The assessment was done, recorded, counted and reported (types of usability problems) according to the scoring method, The data were then evaluated in accordance to the access audit checklist, developed under technical criteria listed under Malaysian Standard 1184:2014 Code of Practice for Universal Design and Accessibility in Built Environment. The percentage is calculated based on the compliance of the technical items based on the access audit checklist (refer Appendix 'O'). The area accessed must meet the technical requirement to be counted as scored/complied. There are noted to be some of the access audit checklists are related to the persons with mobility impaired, while persons with sensory impaired and persons with vision impaired are infrequently addressed. The checklist addressed the seven universal design principles as specified under the Malaysian Standard, especially the flexibility in use and equitable in use of the facilities within the built environment and is vital to check on the standard and anthropometric of the existing physical access features. It encompasses all the technical requirements for all building elements, related facilities and external areas approaching the building. Generally, the elements of auditing can be grouped into two principles of Barrier Free Design Principles accordingly as shown in Table 3.5. The whole exercise of data collection was guided by the listed elements or areas in the checklist solely. Then it technically identified problems on standards of provision or anthropometric measurement on each building elements of case study. The quantitative data from this study was used to review the accessibility of Green buildings in Malaysia.

Table 3.4: Access audit section

	Internal Environment		**External Environment**
a	External barrier-free pedestrian walkway	f	Building entrance foyer
b	Disabled car park	g	Door
c	External step ramps	h	Room & spaces
d	External ramp	i	Barrier-free toilet
e	External staircase	j	Barrier-free shower area

Table 3.4 continued

	Internal Environment		External Environment
		k	Urinal area
		l	Fire escape
		m	Internal step ramp
		n	Ramp (interior)
		o	Staircase (interior)
		p	Lift
		q	Special phone
		r	ATM
		s	Directional signage & symbol
		t	Guiding block
		u	Restaurant & Cafeteria
		v	Bus & taxi station

Table 3.5: Keywords for accessibility and usability

Accessibility	Usability
- Environmental context connectivity a) Vertical circulation: staircase, lift b) Horizontal circulation: walkway, ramp, pedestrian ramp, entrance drop off area	- Overall design fit for purpose a) Person's ability to operate b) Way-finding

Source: author

3.1.3.4 Legislation Review

Review of the legislation and regulation in Malaysia together with the currently available critical analysis documentation, as discussed in Chapter 2.3, 2.4 & 2.5.

3.1.4 Phase 4 of the Study:

Data Analysis and Data Triangulation

The data was then analysed for differences in advancement practices between the built environment, ranking from Green certified non-residential existing building and Green certified non-residential new construction. This so-called triangulation arises

from the need to confirm the validity of the research process (Tellis, 1997) and increase the precision of the empirical research (Per, 2008). Combining different data sources towards the studied object thereby reduces the likelihood of misinterpretation by considering various perceptions to clarify meaning and to verify repeatability of observation or interpretation (Denzin and Lincoln, 1994) yet clarify based on users' needs and facility type. This study has been kept limited to qualitative data from sets of data sources. The need for triangulation is obvious when relying primarily on qualitative data, which is broader and more vibrant, but less precise than quantitative data (Per, 2008). Triangulation is defined as an "attempt to map out or explain more fully the richness and complexity of human behaviour by studying it from more than one standpoint" (Coben and Manion, 1986). The four basic types of triangulation are data triangulation (using more than one data source or collecting the same data at different occasions), investigator triangulation (using more than one observer in the study), theory triangulation (using alternative theories or viewpoints) and methodological triangulation (combining different types of data collection methods,e.g. qualitative and quantitative methods) (Denzin, 1978; Stake, 1995). Data triangulation is commonly used and involves time, space and persons, entails gathering data through several sampling strategies, sot that slices of data at different times and social situations as well as on a variety of persons are gathered.

The data obtained from these sources (direct observation and detached observation) were triangulated using the data triangulation technique to provide an in-depth evaluation of the accessibility of the office building. Triangulation is used to indicate that more than two methods are utilized in a study to (or "intending to") double or triple-check results. This also is called "cross-examination". Researchers will be more confident with a result if different methods lead to the same result. By using three

methods to get the answer to one question, the hope is that two of the three methods will produce similar answer; if three chasing answers are presented, the researcher realize that the question needs to be reframed, methods reconsidered or both. Triangulation is a powerful technique that facilitates the researcher invalidating data through cross-verification from more than two sources (Coben and Manion, 1986). The conclusion of the research are based on the results of the research methods.

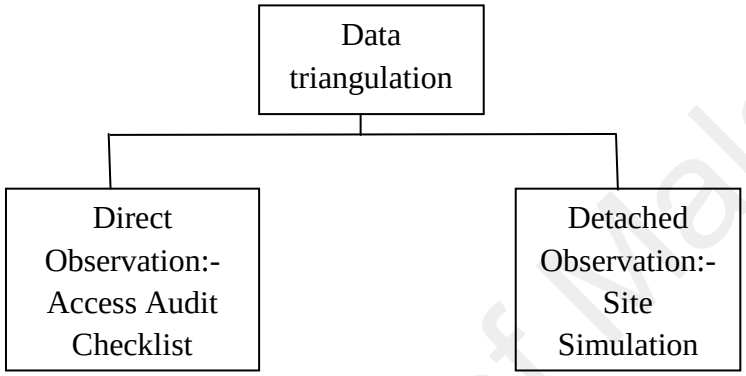


Figure 3.3: Relationships between data triangulation and the research methods

Source: author

Miles and Huberman (1994) see the analysis as a 3-step process: 1) data reduction 2) data display and 3) conclusion drawing and interpretation. Denzin and Lincoln (1994) distinguish two levels of understanding during this research stages. The first tier is descriptive, in which the questions of what is going on and how things are proceeding call for a reasonable accounting of the phenomena observed. The second level is explanatory, in which, e.g. causal relations got observed and defined, and propositions get supported or rejected. Questions concern why to form the central part of this step within the analysis.

In the exploratory study of this thesis, the analysis of the empirical data was mainly focused on the first level of understanding, whereby the analysis is made in three steps.

The rationale behind this is that in this phase of the study, it was not the aim to find causal relations. The three stages of analysis are sorting of the data according to central themes, description of the multiple site case study and interpretation of the results. In the primary case study research of this thesis, the analysis of the empirical data includes both levels of understanding. It entails five stages of analysis. The five steps are coding a clustering of the data according to the constructs description of the phenomenon under study, i.e. the different constructs between the different sites and identifying cross-construct relationships. A more detailed description of the analysis of the exploratory and explanatory case study is given in the corresponding chapter.

The validity of qualitative case study research refers to the strength of the conclusions, inferences, and propositions made. Cook and Campbell (1979) define it as the best available approximation to the truth or falsity of a given assumption, proposition or conclusion (Yin, 2003).

3.2. Problems Encountered in the Data Collection Process

The researcher observed several drawbacks during the data collection process that decreased the response rate and caused no- responded question within the surveys:

- Lack of a publicly accessible database in the Green construction community other than ease study based websites that present the contact information for Green building project participants;
- The high turnover rate in the construction industry and the difficulty to reach the individuals that have worked on focus projects;
- Confidentiality concerns about some of the types of data such as design and construction information result in an unwillingness to share them even for research purposes.

3.3 Prescriptive Summaries of the Multiple Site Case Study

3.3.1 Green Energy Office Building

Green Energy Office (GEO), headquarters of Malaysia Energy Centre (Pusat Tenaga Malaysia - PTM), is a showcase project by the Energy, Water and Communications Ministry, coordinated by Danish consultancy IEN, and executed by local architects and engineers to promote and to demonstrate most energy efficient office building in Malaysia. The general objective of this project was to achieve zero energy consumption in response to the global warming issue. Green Energy Office is the first completed Green-rated office building in Malaysia under non-residential new construction category with "Certified" Green building rating received on 24 July 2009 (www.greenbuildingindex.org.my).

GEO was located in Bandar Baru Bangi, Selangor, Malaysia and completed in October 2007 (see Figure 3.4 & 3.5). It is a 3-storey office building with a sub-basement, comprising 3,175 square meters of usable floor area with a gross floor area of 5,000 square meters, built on a 5.02 acres site. The said building was designed when the awareness of building green is still infancy in the country. The project team that made GEO building success is as shown in Table 3.6 project team.

The GEO building has placed Malaysia on the regional map as the first utterly self-sustainable building in Southeast Asia. GEO operates on the dynamics of both passive and active techniques and onsite renewable energy generations. GEO function as a showcase building to facilitate and explore the concept of sustainability in buildings, while assisting to create opportunities for the involvement of other relevant industries. The building is exemplifying the use of energy efficiency, with solar BIPV setting a

new standard for sustainable building in the Association of Southeast Asian Nation (ASEAN) region (see Figure 3.5, 3.6 & 3.7).

Table 3.6: GEO project team

Project Team		**Name**
Client / Developer	:	Pusat Tenaga Malaysia (PTM)
Project Manager	:	KLCC Project
Energy Consultant	:	IEN Consultants
Architect	:	Ruslan Khalid Associates
Civil & Structure	:	Arup Jururunding
Mechanical & Electrical	:	Five-H Associates
Quantity Surveyor	:	Jurukur Bahan Majubina
Interior Designer	:	Onion Design Consultants
Landscape Architect	:	Laguna Associates
Photovoltaic Expert	:	PTM-MBIPV Project
International Consultants (Energy)	:	Transsolar of Germany and International Centre for Indoor Environment & Energy of Denmark
ZEO Test Cell	:	National University of Malaysia (UKM)
Contractor Package 2 – Building Works	:	Putra Perdana Construction
Contractor Package A	:	Mitsubishi Electric
Contractor Package B	:	IBC Solar AG
Contractor Package C	:	PJ Indah
Contractor Package D	:	SFG Technology

Figure 3.4: Location plan

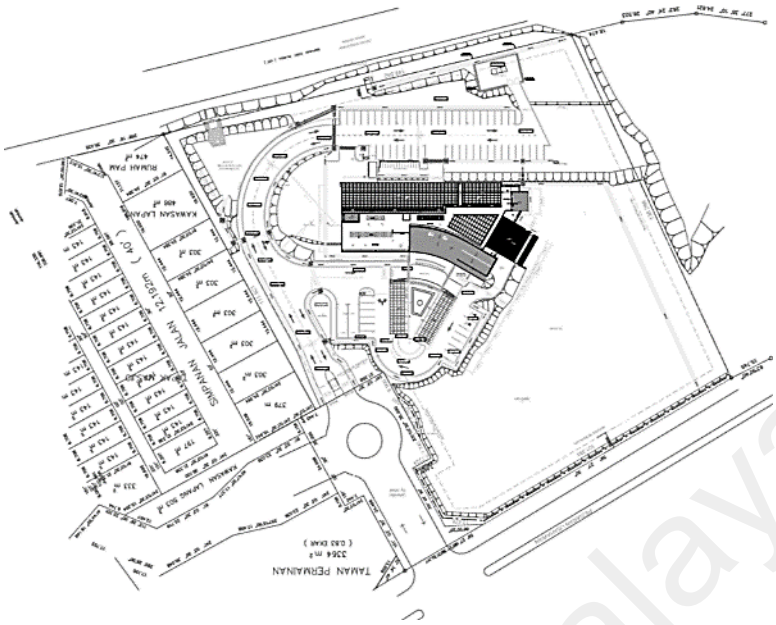


Figure 3.5: Site plan

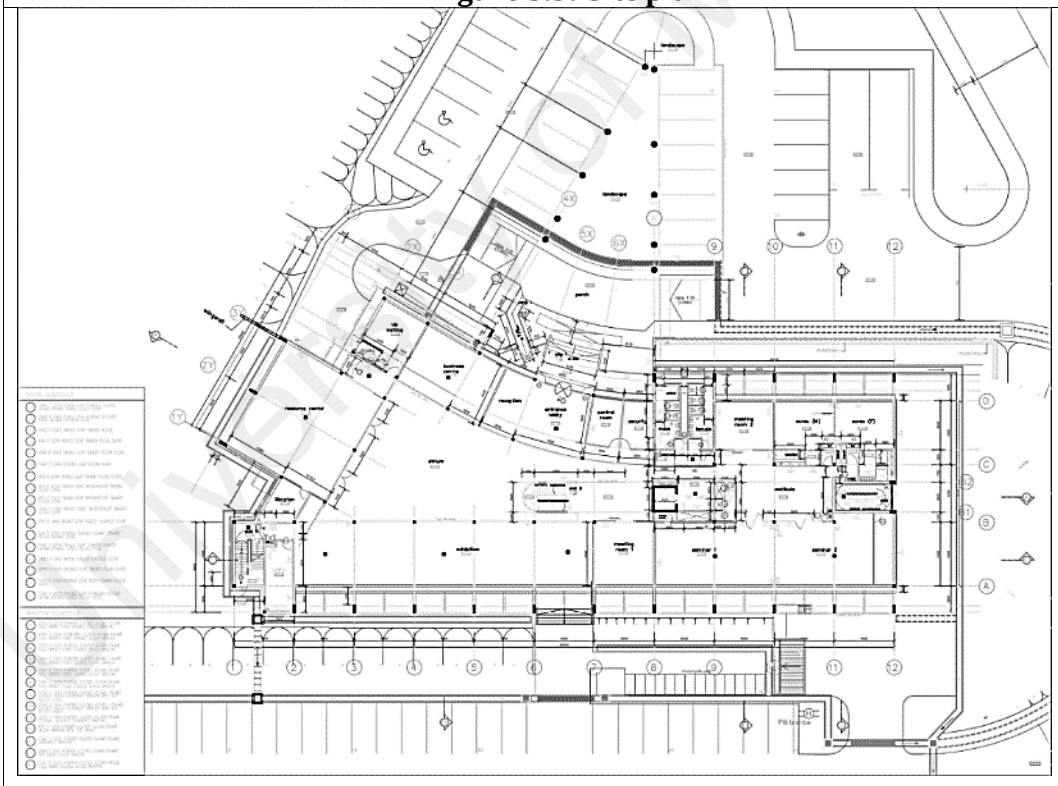


Figure 3.6: Upper ground floor plan

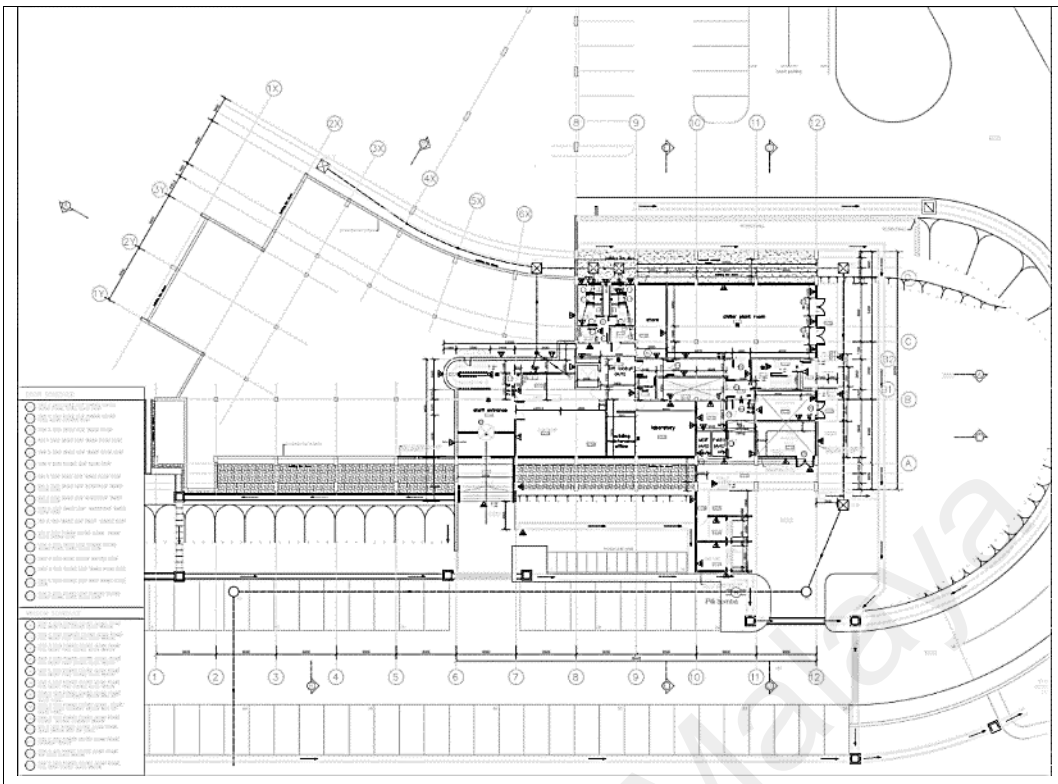


Figure 3.7: Lower ground floor plan

3.3.2 Low Energy Office (LEO) Building

Low Energy Office (LEO) of the Ministry of Energy, Water and Communications in Putrajaya is the first government building to be designed with *combined architectural, engineering, site planning and landscape (multidisciplinary) approach* with integrated energy efficient design with combined passive and active measures. It was conceived as a showcase building to demonstrate energy efficient and cost useful features so that other public and private sector buildings can replicate such actions.

The Danish and local experts commenced work in January 2001, in cooperation with Malaysian architects and engineers, focusing on optimising the overall design of the building and its energy systems for minimum power consumption. In August 2002, Putra Perdana Construction Sdn. Bhd. was appointed as the turnkey contractor to undertake the construction works. Low Energy Office is the first completed Green-rated office building in Malaysia under non-residential existing building category with “Silver” Green building rating received on 01 December 2011 (www.greenbuildingindex.org.my).

LEO was located in Putrajaya, Malaysia and completed in September 2004. It is a 6-storey office building, comprising a gross floor area of 38,606 square meters, with an 8,602 square meter car park area. The project team that made Green Energy Office building a success being is shown in Table 3.7 Project Team.

The primary target is to minimize the energy consumption and running cost, but without sacrificing aesthetics and occupants' comfort. Thus, several critical decisions were made in the building design, construction and operation about the architecture,

mechanical and electrical systems, lighting, air-conditioning, office equipment, and landscaping, together with the implementation of an energy management system.

The Low Energy Office (LEO) building, as it is now known, has demonstrated the integration of the best energy efficiency measures, optimized towards achieving the best overall cost-effective solutions.

Table 3.7: LEO project team

Project Team		**Name**
Client / Developer	:	Putrajaya Holdings Sdn Bhd. (PJH)
Architect	:	SNO Architect
Turnkey Contractor	:	Putra Perdana Construction Sdn Bhd
Consultant for EE design	:	Danish International Development Agency (DANIDA)
Construction Period	:	21/2/2002 – 18/2/2004 (104 weeks)

Figure 3.8: Exterior of LEO building

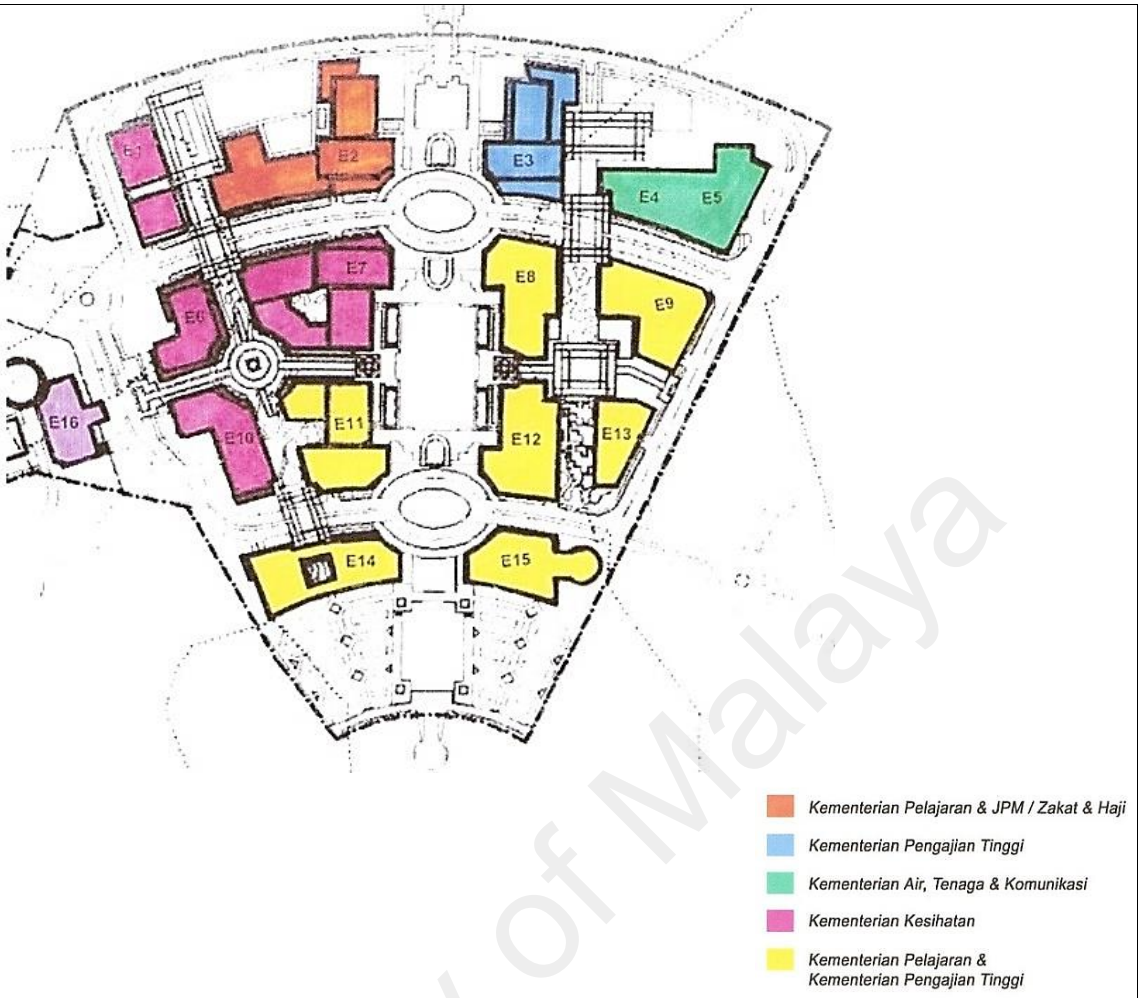


Figure 3.9: Site plan: Location plan indicating designated ministries

Source: SNO Architect

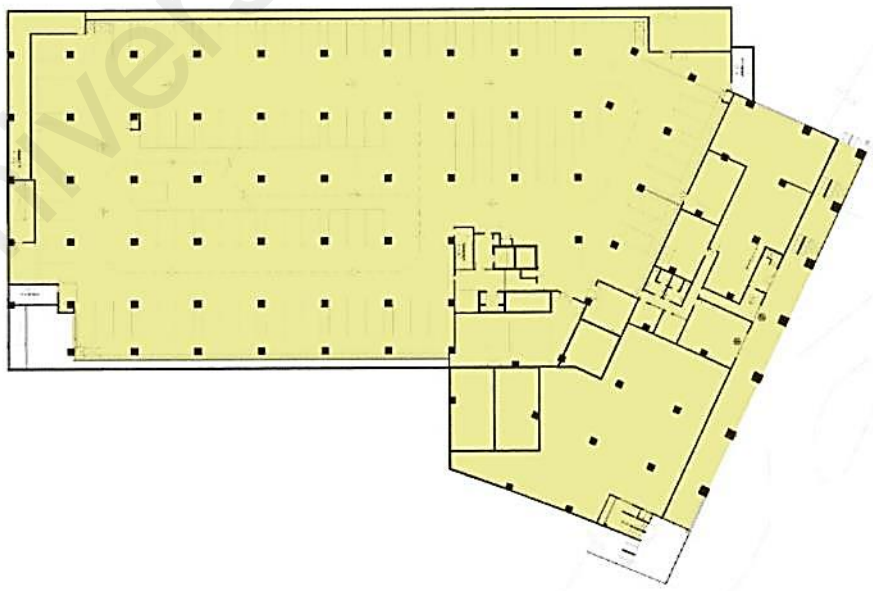


Figure 3.10: Basement plan

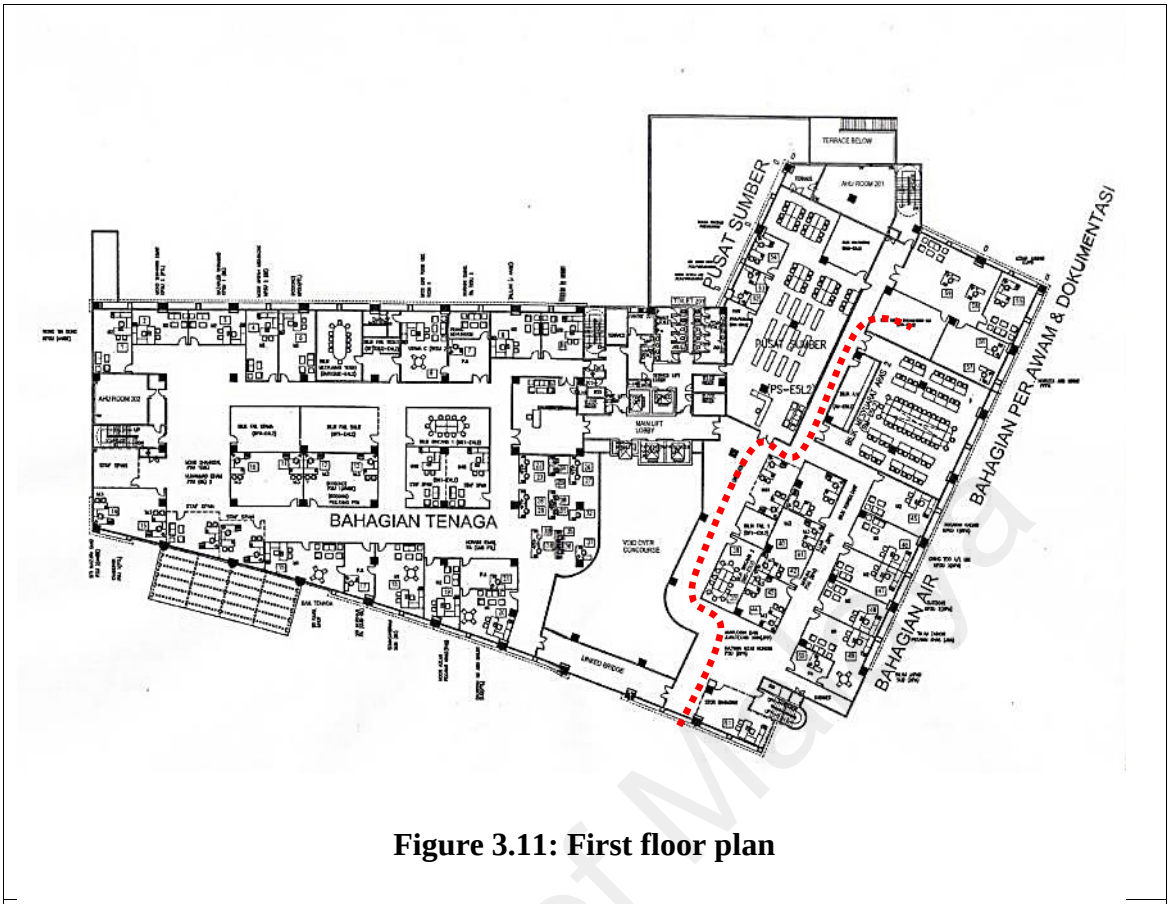


Figure 3.11: First floor plan

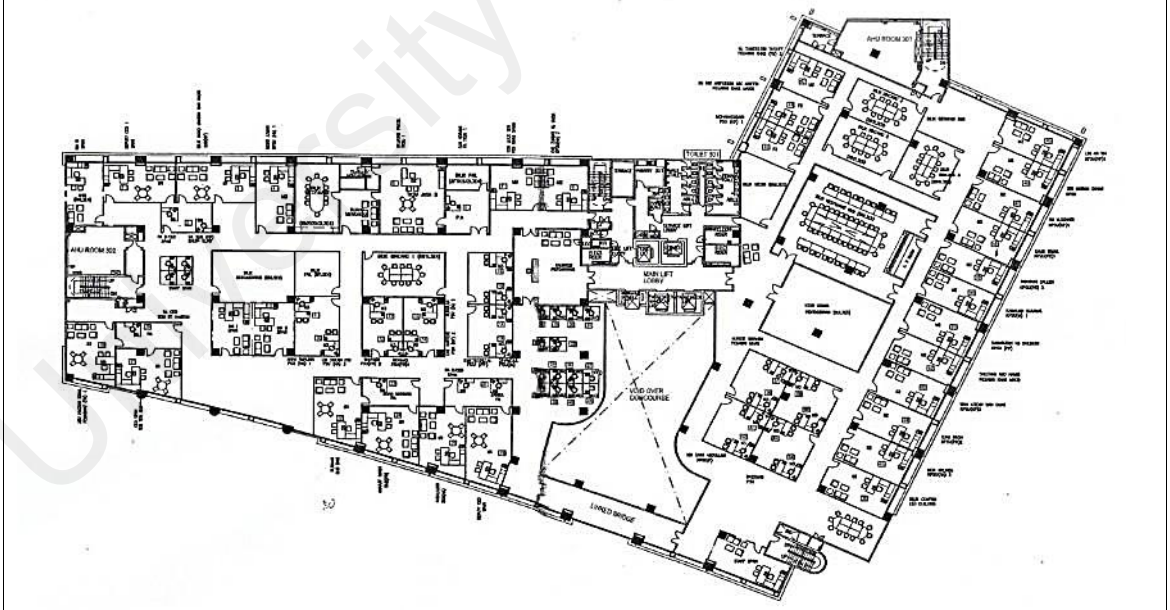


Figure 3.12: Second floor plan

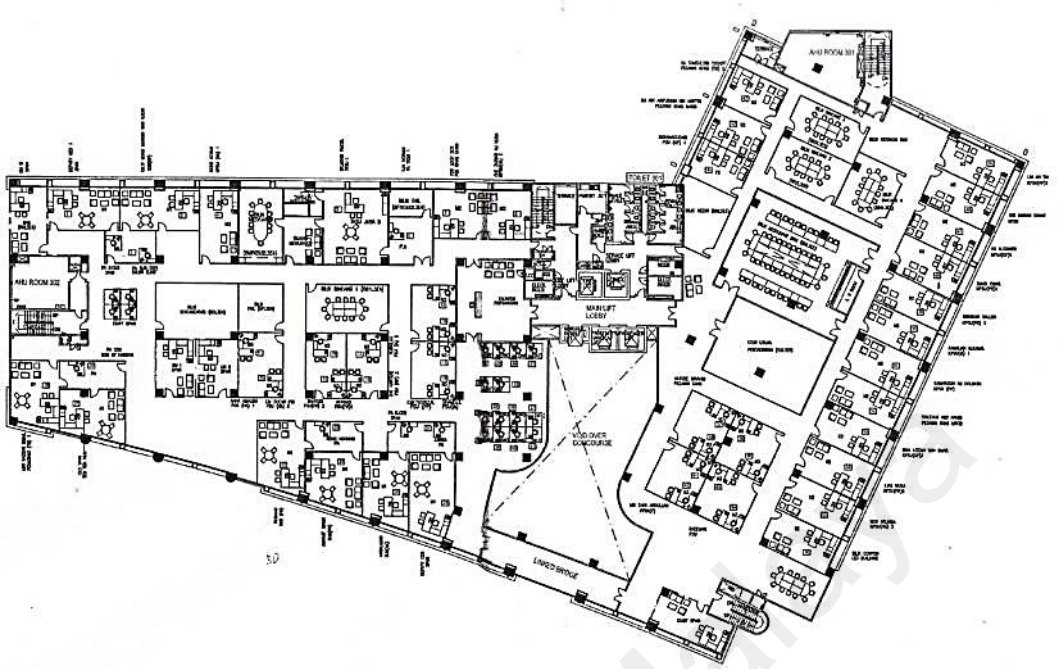


Figure 3.13: Third floor plan

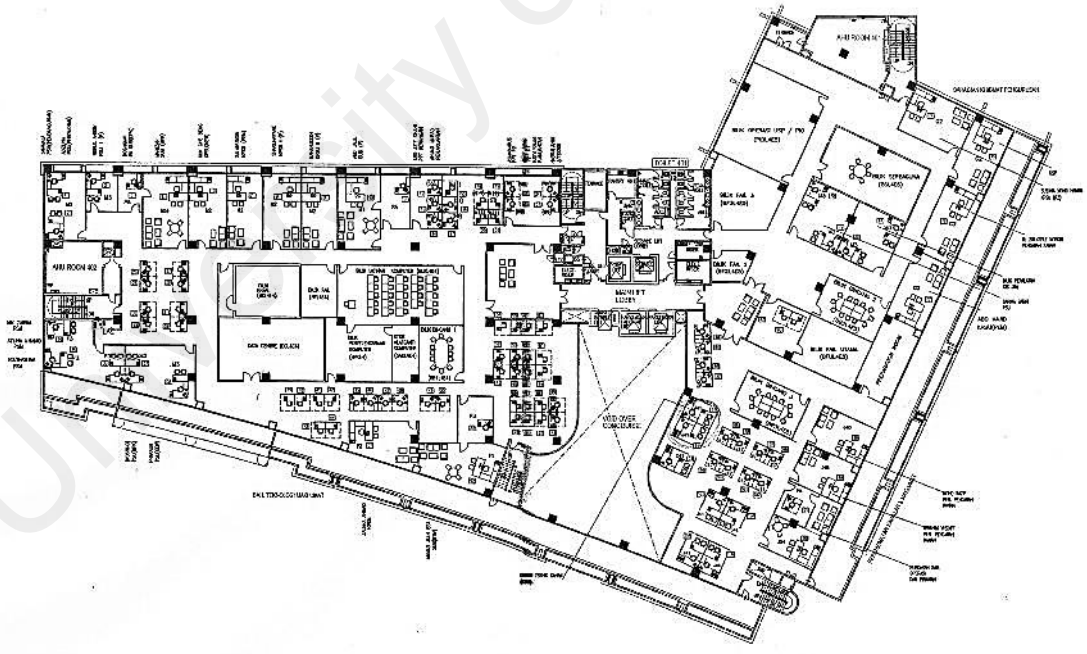


Figure 3.14: Forth floor plan

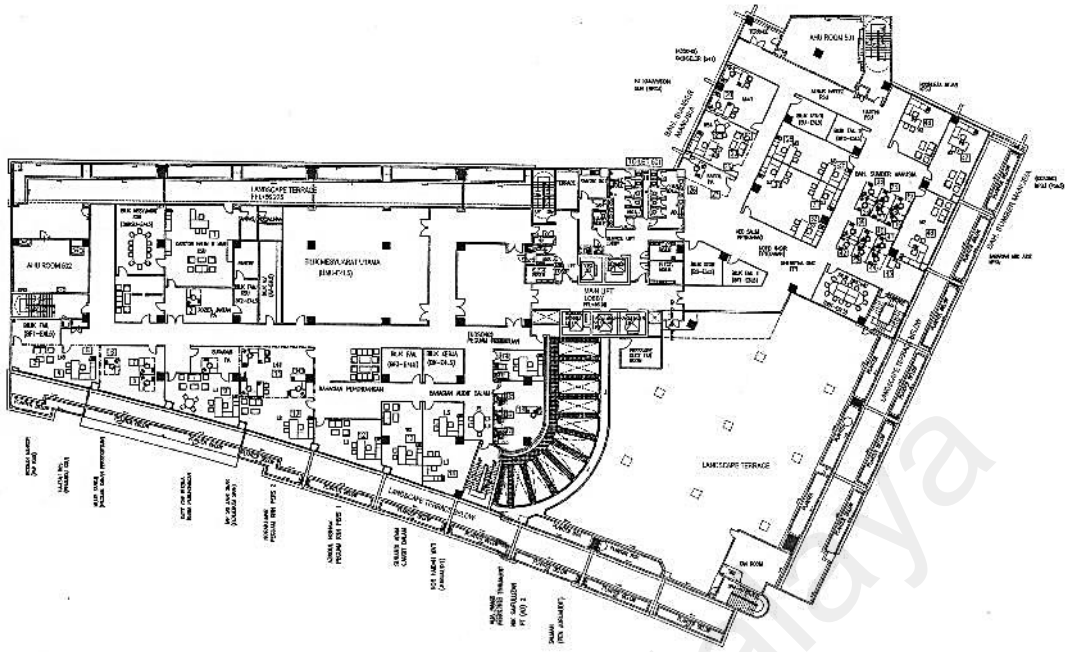


Figure 3.15: Fifth floor plan

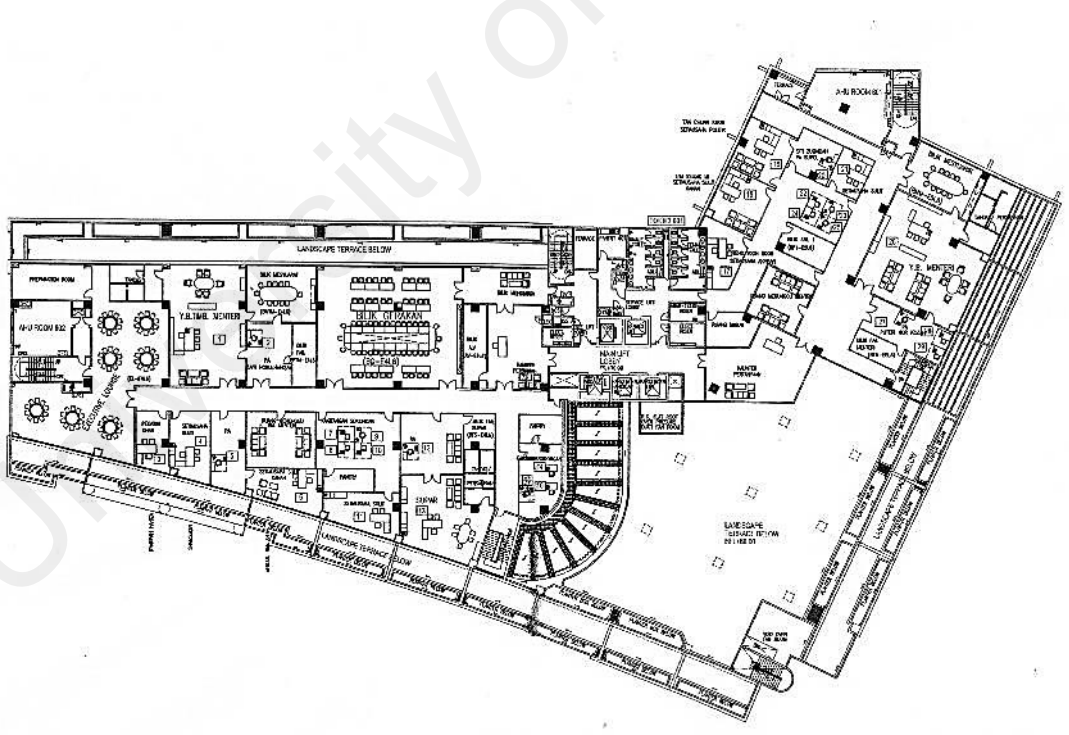


Figure 3.16: Sixth floor plan

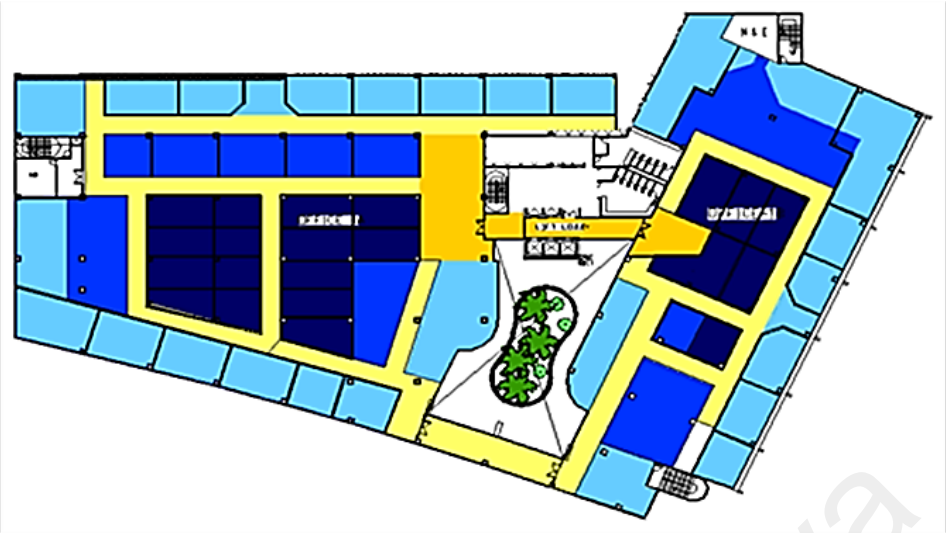


Figure 3.17: Typical office layout plan

Source: SNO Architect

3.4 Research Limitations

Direct observations using the access audit checklist provides a standard way of getting data where the researcher tried to obtain as close as possible reliable data to examine the research objective. Due to time and costs constraints, participant observation techniques, using a real disabled person would have been a more reliable method. A simulation exercise using wheelchairs and blindfold of a researcher was conducted instead. Although limited, it was able to give a more diverse set of data rather than just ticking boxes on the access audit checklist.

Another limitation is one of the multiple site case study of the government office buildings was not cooperative and gave limited access for the researcher, who managed to, however, got access to main areas but not all areas.

3.5 Conclusion

This chapter described the data collection procedures and steps undertaken to satisfy data uniformity and quality for this research: - direct observation, detached observation, and review of the legislation and regulation. The data obtained from the research are triangulated using the data triangulation method. The findings and analysis of the research are explained in Chapter 4 with the conclusions in Chapter 5.

CHAPTER 4: RESEARCH FINDINGS

This chapter reveals the findings from the research via the methodology as discussed in Chapter three. The findings will be analyzed and discussed too, in this chapter. All these will be concluded in Chapter Five.

The purpose of this research is to analyze and discuss within the following research objectives:

- *R.O.1: To understand the criteria/factors of accessibility in a built environment.*
- *R.O.2: To examine the legislation and regulation of users, especially Persons with Disabilities in the Green buildings.*
- *R.O.3: To evaluate the accessibility of the Green buildings in Malaysia.*

Results will determine the degree of effectiveness in implementing accessibility to green building by illustrating the scoring of the accessibility. This investigation will answer research questions as listed in Chapter One.

4.1 Research Findings for Research Objective 1

Following to the literature review in Chapter Two, this sub-chapter sets out to understand the criteria/factors of accessibility in the built environment. It is assumed that the users' accessibility, especially for the Persons with Disabilities in the built environment is seldom being considered. It was anticipated that different groups would have different views about the criteria/factors of accessibility in the built environment. Therefore, these views were being identified and then analysed pertaining the accessibility in Green buildings. In doing so, this sub-chapter is being divided into three sections, namely methods, findings and analysis.

4.1.1 Method

There are currently no sufficient data on the accessibility in Green building, therefore this study is new and exploratory. As such, the secondary data review is deemed appropriated to synthesis and analyse all relevant information from different sources. This can projected with reasonable degree of accuracy by following a systematic and multi-disciplinary approach. It can be further be used to inform the detailed sector specific information. The objective of this is to verify the information that serve as baseline and present the assessment of the situation. The benefits of having secondary data review is it provides higher-quality baseline information than does primary data in emergemcy. It add depths to the primary data findings and broaden the database & allow wider generalization of ideas. Lastly, it can be carried out quickly and remotely by the researcher.

4.1.2 Findings

The definition of Universal Design shares a common aim: to improve the accessibility and usability in the built environment by including everyone in the context

(Yusof, 2014). To understand the factors of accessibility in built environment, especially Green building, prior to achieving Sustainable Development, two important aspects we need to review, i.e. Green building from the environment aspects and Universal Design from social aspects. The goal of Green building index in Malaysia are the built environment need to be designed to save *energy and resources*, and minimize the emission of toxic substances; *harmonize* with the local climate, traditions, *culture and the surrounding environment; sustain and improve the quality of human life* while to maintain the capacity of the ecosystem at local and global levels; and to make efficient use of resources, have significant *operational* savings and *increases workplace productivity.*While the goal of Universal Design in Malaysia are body fit (able to accommodate a wide range of body sizes and abilities); comfort (within desirable limits of body function); awareness (ensure the critical information for use is easily perceived); understanding (methods of operation); wellness (contribute to health promotion); social integration (treating all groups with dignity and respect); personalization (incorporating opportunies for choices) and cultural appropriateness (respecting and reinforcing cultural values and the *social and environmental context* of any design project). The similarities for both the goal of Universal Design and Green Building are to improve the quality of human life and abilities; design in respond to cultural, social and environmental context and operation method (See Appendix F for the comparison tabulation). The building operation method is mainly related to economic aspects. The importance of quality of human life and abilities reinstate the importance of social aspects under Sustainable Development, while in built environment context, this refer to the accessibility. The understanding of human abilities within the building provides invaluable information on its likely impacts and helps to ensure its effective implementation. The qualitative and multi-criteria nature of such information is likely to be particularly relevant for large projects which tend to have significant impacts on

communities, and which have traditionally relied on more expert-driven analytical approaches. If the sustainable development is to address social imperative, the projects should have to plan actively how to keep the built environment to be accessible to a diverse range of human, from adults to children.

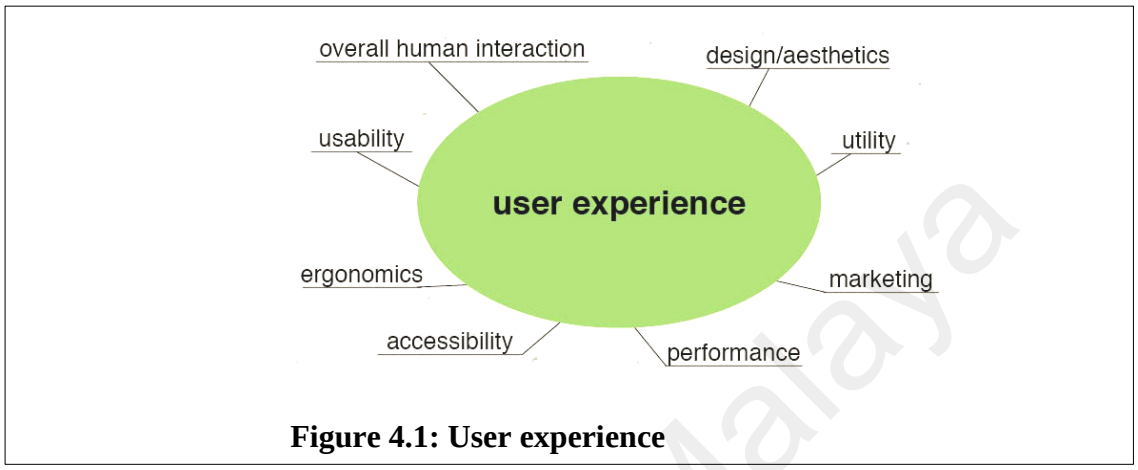


Figure 4.1: User experience

Source: Carrie (2013)

The Green building principles by Green Star – Green building council promotes the livability of a place, create opportunities for economic prosperity, foster environmental quality by enhancing accessible design excellence. While universal design principles promote equitable use, flexibility in use, simple & intuitive use, perceptible information, tolerance for error, low physical effort and size and space for approach and use. The common key words for both Green building principles and universal design principles are users and design (See Appendix G for the integration tabulation). Users' experience in respect to the built environment's design is the major goal prior to achieving Sustainable Development. Users' experience is how the human feels when interacting with surrounding facilities/built environment. Varies factors controlled how the user experience the space, from designers' aesthetic and functional point of view, utility, marketing, performance, accessibility, ergonomics, usability to overall human interaction (see Fig. 4.1). *Usability* is the key components of the overall user experience. Users' experience is important because it can create the momentum that propels the

environment forward. Users can determine their usability and accessibility within few seconds the moment they reached the built environment. Besides, research by Kim & Osmond (2013) stated that Green building rating system should deal with user experience, focusing on user needs and satisfaction. This proves that green building performance could also benefit from a user-centered approach, focusing on user needs and satisfaction, accordingly.

Table 4.1: Integration of Green building index criteria and `universal design index principle in Malaysia

Green building index	Universal design index
Indoor environmental quality	- Connectivity - Accessibility
Sustainable Site and management	
Materials and resources	- Usability - Safety - Integrated Design - Operations and Maintenance
Water efficiency	
Energy efficiency	

Source: author

Users' comfort level in the building upon occupant is the similarity for UDI – usability and GBI- Energy efficiency and indoor environmental quality principle (See Appendix M). Through the integration of the green building index criteria (developed by Malaysian Institute of Architects) and universal design index (Abdul Rahim, 2012), it can be concluded that the common goal is: accessibility and usability (see Table 4.2). This implied that building should be designed to provide access and enjoyment satisfactorily to all, yet usability and safety are equally important not only for able-bodied but also for persons with vision impaired, persons with physical/mobility impaired, persons with hearing impaired and persons with learning difficulties. The accessibility of the building was accessed by observing how the users find their ways.

The types of users are categorised according to persons with vision impaired, persons with physical/mobility impaired, persons with learning difficulties, persons with hearing impaired and abled persons. The draft report to Ministry of Transport, Malaysia pertaining the Universal Design Index Principle listed the criteria required towards the environment in respect to the seven principles proposed by Center for Universal Design, North Carolina State University in the year 1997. Six criteria are included in the Universal Design Index Principles, including connectivity (15%), accessibility (25%), usability (20%), safety (20%), integrated design (10%) and operations and maintenance (10%) (See Appendix H & I for the details of Universal Design Index Principles definition and index ranking). Among the six criteria, accessibility is the most important factor and thus carried the heaviest percentage. This is followed by usability and safety. Accessibility highlighted the availability and convenience of provisions such as safe and sheltered accessible alighting and boarding points, conspicuously accessible parking lots located near main or lift lobbies, family friendly facilities like family room, seats, and child-friendly sanitary facilities. Other amenities such as accessible information counter, friendly drinking fountain, vending machine, friendly multimedia kiosk, ATM, WiFi access, friendly directory, electric carts, AED (automated external defibrillator), PA system with an induction loop. Usability required the provision of signage and wayfinding cues such as audible information, tactile directional indicators, and colour or visual themes at main circulation spaces & leading to public transport nodes and facilities. It also includes the degree to which the design of signage and way-finding cues that are easy to read, understand and intuitive regardless of the user's experience, knowledge, language skills or current concentration level. Safety ensure the design of the facilities are made safe and secure with attention to details such as choice of materials, design without gratings, free of obstacles and dangerous overhangs, provision of adequate lighting and handrails/trailing bars, contrasting colour, the design

clearly distinguishing floors and walls, stairs & landings, provision of tactile warning indicators near the edge of potentially hazardous areas.

4.1.3 Analysis

From the above study, it is noticed the difference of the goal is Green Building Index considered the implications towards the future generation, with every decision made towards the built environment. While the goal of Universal Design is mainly focused on human's experience. Building Index goal collaborates with 1992 Rio Declaration on Environment and Development Principle 1 & 3: - human beings are entitled to a healthy and productive life in harmony with nature and that "the right to development must be fulfilled to meet equitably developmental and environmental needs of present and future generations. The said goal will have significant implication towards the future sustainable development, in which it can increase the countries' ability to attack poverty, protect and repair the environment, and build the base with the consideration of future population growth. The transition to stabilisation levels can have a considerable positive impact on quality of life. If the country's development is accompanied by social and economic policies, has been shown to increase economic growth and help propel countries out of poverty. It also helps in making the necessary investments for a future with higher proportions of older persons.

Through the findings above (see Appendix N for the details comparison), the keywords for both universal design and Green building are Accessibility and Usability. Accessibility describes a site, building, facility, pedestrian path and interconnection that can be approached, enter and used by persons via the accessible route. An accessible route is the continuous unobstructed path connecting all accessible elements and spaces in a building or facility that can be negotiated safely, which can be categorised to be

vertically accessible route and horizontally accessible route. Examples of vertically accessible routes are a lift, staircase, fire escape etc., while the horizontally accessible route is a ramp, step ramp, walkway, corridor etc. Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. In the built environment, it is about the design of the facilities to fit for its purpose by the users to find their way. As usability refers to the part of the broader term from the user experience, allowing persons to move from the present location to the final destination, without the guidance of the third party, but with the guidance of the information required (commonly known as signage) to fulfil his required information. This can normally be achieved via creating an identity at each location, use landmark to provide orientation cues, create a well-structured path, provide signage at decision-making location, and provide sight lines to show what's ahead. The breakdown of the items for both accessibility and usability are as per listed in Table 4.3.

Table 4.2: Common goal of Green building index criteria and universal design principle in Malaysia

Green Building Index	Universal Design Principle	Common Goal
- Indoor environmental quality	- Flexibility in use	Accessibility
- Sustainable Site and management	- Size and space for approach and use	
- Materials and resources	- Equitable use	Usability
- Water efficiency	- Simple and intuitive use	
- Energy efficiency	- Perceptible information	
	- Low physical effort	
	- Tolerance for error	

Source: author

Table 4.3. Keywords for accessibility and usability

Accessibility	Usability
- Environmental context connectivity 1. Horizontal circulation: walkway, ramp, pedestrian ramp, entrance drop off area 2. Vertical circulation: staircase, lift	- Overall design fit for purpose 1. Persons'/users' ability to operate 2. Way-finding

Source: author

4.2 Research Findings for Research Objective 2

This study sought to inform the industry and academicians the legislation, regulations, standards and practice in Malaysia impacting significantly on accessibility in the built environment and green buildings. The findings for this sub-topic are in respond to Research Question 2. Accordingly, the Research Objective guided the research findings.

4.2.1 Method

An overview of the legislation, regulation, standards and practice in Malaysia has been provided in Chapter Two. This section more elaborated on the analysis of the findings. The secondary data review on the enforced legislation, regulation, standards and practice are deemed appropriated to synthesis and analyse.

4.2.2 Findings

As listed in Chapter Two.

4.2.3 Analysis

Governments in the majority-world countries are pre-occupied with the basic issues facing persons, such as poverty alleviation, literacy, better infrastructure, roads,

drinking water, sanitation, and so on. Most of these efforts concern average persons, and there is hardly any time and resources left for the needs of the persons who are the elderly, disabled and another persons who is not average and who is presently a voiceless minority in comparison. The government, however, make policies and laws in the interest of the persons who are disabled. Practical application through policy, design, construction, and facilities management will not only improve the quality of life of those in new settings but will provide further research sites. Regulations in all sorts explicitly and implicitly influence the character of most settings – among these are requirements for fire safety, locks, signage, privacy, and physical accessibility, and are applied to almost all settings that are designed and constructed.

In Malaysia, the combination of the data analysis, review of existing policies, and access audit checklist formed the basis for the recommendations as listed below:

1. **Decentralized System**

   Malaysia, through the study, is designed to work in a federation of states, is almost decentralized entirely, with the final design responsibility for upholding the legislation, regulation, standards compliance being left to the professional, especially architect. The technical specifications for accessibility are contained in several Malaysian Standard discussed. This norm applies to all the states in Malaysia. Selected local authority body (e.g. Dewan Bandaraya Kuala Lumpur, Majlis Perbandaran Petaling Jaya, etc.) have an additional barrier-free technical guideline for compliance purpose to cater for their special population requirements. However, most of the local authority does not have the additional technical barrier-free requirements. Central building code and regulations exist, but the statutory local authority requirements might have the marginal effect on

the public building. This resulted and required the professional body, especially architect, to timely update the technical requirements at a different area. Conflict among the professional might raised in the future for the statutory legal compliance. It is recommended that a set of the standardized guideline can be established.

2. Barrier Free Planning

From the research, the legislation, regulation, standards and practice provided in Malaysia make up a framework for the implementation of the barrier-free design. The introduction of Green incentives in Green building stated clearly the form of technical performance criteria from the economy and environmental aspects. It is recommended that a guidebook with the consideration of accessibility in Green building can be established to provide better understanding and compliance.

3. Government/legislative drivers

These study results reveal that several factors can influence the implementation of regulative legislation and policies during the building design process. These are categorised as government and legislative drivers, education, communication and training. Although most of the respondents are aware of the global need to address climate change, most of them are unsure about the requirements of legislation and policies in their entirety. User-specific documents such as a practical guide for clients, architects and engineers could also be useful.

4.3 Research Findings for Research Objective 3

The aim of this sub-chapter is to assess how the legislation is being applied in real life, and consequently addressing the Research Question 3: "Do the current green buildings in Malaysia incorporate with accessibility needs for Persons with Disabilities in Malaysia?" This research will focus on the result of the data presented the implemented Persons with Disabilities Act 2008, Uniform Building By-Law 1984 and the standards and practice in the built environment. Analysis of the data revealed the effectiveness of the implementation of Uniform Building By-Law 34A in green building. Case study selection is discussed in Chapter 3.

4.3.1 Method

Primary data was collected through multiple day visits through direct observation (site simulation) and detached observation (access audit checklist). The detailed method is discussed in Chapter 3.1.3.

4.3.2 Findings

4.3.2.1 Green Energy Office (GEO)

The results of the Research Question 3 for the Green Energy Office are presented in the summary format (see Appendix Z4, Z5, Z6, Z7, Z8 & Z9). Data Review based on observation and access audit checklist (see Appendix P ~ Z1) are as follows:-

4.3.2.1.1 Detached Observation (Site Simulation)

From the detached observation (site simulation) for horizontal accessibility, the persons with sensory impaired simulator felt that she could not find the reception on her own and the whole journey is being hit a something. The office entrance door was not a simple "push and pull door" but a rotating door, which required others' assistance to get

through. Same goes for the journey to the toilet, and other office spaces. Besides, persons with sensory impaired simulator felt that the quietness of lobby caused her did not become aware of the presence of the lobby, as there is no guiding block or any other elements to guide her way.

Different problems arise for the persons with physical/mobility impaired (wheelchair, crutches, learning disability) within the built environment. For GEO, the persons with physical/mobility impaired simulator faced the problem of a steep ramp, and thus extraordinary effort was required to move herself to reach the entrance foyer. She had to hold the railing tightly to avoid falling. The planter boxes at the landing area obstructed the wheelchair circulation. Besides, the building entrance door was designed to limit the public entrance by using access card. Thus, other person's assistance was required to enter the building. The height of the information counter is too high & it is challenging to register.

From the vertical accessibility direct observation (access audit) aspect, the internal staircase within the Green Energy Office have the issues of visual contrast for persons with sensory impaired, as the surface of landing and floor level are having the same tiles. The internal staircase has the similar issues as the external staircase that is lacking 300mm horizontal handrail extension parallel to the floor at the top and bottom of the riser, and guiding block. The external staircase (see Table 4.4) at the Green Energy Office building's main entrance have similar problems as the external ramp for the persons with sensory impaired, i.e. the 1000mm height of the handrail exceeded the 900mm allowable height above the stairs surface, and there is no 300mm horizontal handrail extension parallel to the floor at the top riser. The placement of planter box at the staircase risers obstructed the flow of the pedestrian. It is lacking guiding blocks from the staircase to other facilities and spaces within the building.

The fire escape staircase is lacking the provision of red phone & visual and audible signal for two-way communication, especially rescue assistance instruction during an emergency posted adjacent to the communication system. Besides, the lift within the building provides the lift door with sufficient width, i.e. 800mm. This caused those wheelchair users just have sufficient space to enter the lift, without any extra provision. Also, handrails are not provided in the said lift too.

From the vertical accessibility site simulation aspect, the findings of detached observation by using site simulation in vertical accessibility for persons with sensory impaired (vision and hearing impaired) are: The GEO building are accessible for persons with sensory impaired, except the lift lobby design which is very confusing and required others' assistance to look for lift button panel and lift the car. The floor and wall finish design within the lift car is also very confusing for persons with sensory impaired. The building's design (architectural elements) cannot assist in directing the way & difficult for them to access. GEO has many obstructions in the circulation area, which confused persons with sensory impaired's mind, they are struggling the way from the lift to the office when it was reached the first floor. It takes simulator a long time to feel the surrounding using the stick but still lost. As there was no signage, guiding block, tactile map and Braille for the simulator to study the buildings' space before came into the building to reach the stipulated spaces.

4.3.2.1.2 Direct Observation (Access Audit)

With careful attention to detail, most of the technical requirements partially complied to the Malaysian Standards 1184:2014 for the GEO. From the usability (way-finding) access audit aspect, the persons with physical/mobility impaired who are looking for way-finding in Green Energy Office, they faced the difficulties that the characters on

the signage cannot be viewed from a distance, lack of directory to the provided signage and lack of equivalent verbal description for the accompanying symbol. The findings for the usability-way-finding site simulation aspect, the signage (see Table 4.5) provided within the building are lacking information board with letters, Braille, tactile map and a push-button audio system results in the persons with vision impaired simulator faced difficulties to understand the information of the building in order to access to their designated space. The spaces lacking the said information are entrance lobby, information counter, staircase, library, office, restaurant, and meeting area. Persons with sensory impaired simulator and persons with physical/mobility impaired simulator faced the difficulties to identify the door location as most doors are a lack of distinguishable colour contrast strip and subsequently how to operate the door as it is a lack of Braille information at the doorknob pertaining the method of the door opening (see Table 4.5).

From the horizontal accessibility aspects via access checklist, the external pedestrian walkway surrounded the Green Energy Office building is unable to connect to the main building entrance, car park area and public streets. Step ramp is not provided at the pedestrian crossing points, junctions along the pedestrian walkway. Guiding block is not provided for the connection in between the pedestrian areas and vehicular areas. There are 600mm diameter round reinforced concrete column and planter boxes at the centre of the pedestrian walkway which can obstruct the flow of pedestrian. The gradient of the accessible footpath is very steep, and it is less than the gradient of 1:20, which does not comply the requirement of the ramps. Some of the change of level between the footpath and adjacent level is 11mm and more, which does not comply the maximum limit 10mm. The gratings opening is 60mm wide, and it is not comply with the maximum allowable limit of 13mm. There is one external ramp located in front of

the main entrance lobby. However, the width of the external ramp (see Table 4.4) in front of the main entrance lobby is 1000mm, and it does not comply the minimum 1200mm clear width requirement. Same goes to the gradient of the ramp, it is very steep, and lack of landing at the top and bottom of the ramp. The 960mm height of the handrail is slightly higher than the maximum allowable height, i.e. 900mm, and do not have the 300mm horizontal extension at bottom and top of the ramp. Apart than that, the said external ramp are lacking guiding blocks to connect to other facilities/space, visual contrast and raised marking.

Table 4.4: Summary of the problems faced by GEO's external environment

Problems faced at GEO's External Environment via Detached Observation, simulation		Problems Faced at GEO's External Environment via Access Audit Checklist	
a	**External barrier-free pedestrian walkway**  *"Protruding manhole."*  *"No provision of a disabled path for linkage."*  *"Bulky columns at the pedestrian walkway."*	i)	Accessible Footpath Site - Public Transportation: Missing of accessible footpath within the boundary of the site linking to the public transportation stops, and sidewalks.
		ii)	Accessible Footpath – Missing of accessible footpath connecting accessible car parking area to the main entrance.
		iii)	Protruding Objects: 600mm round column & planter boxes around at the centre of the walkway.
		iv)	Gradient: The gradient of the accessible footpath and ramp is less than 1:20.
		v)	Covers and Gratings: width of the grating opening is too wide, i.e. 60mm instead of 13mm.
		vi)	Drain or Other Steep Drop-off: There is no guard rail available for the drains or another steep drop-off adjacent to the accessible footpaths.
		vii)	Directional Signs: Missing of directional signs indicating accessible footpath to the nearest accessible entrance.

Table 4.4 continued

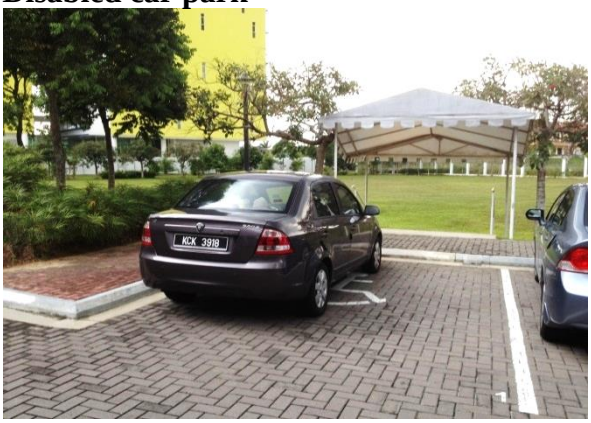
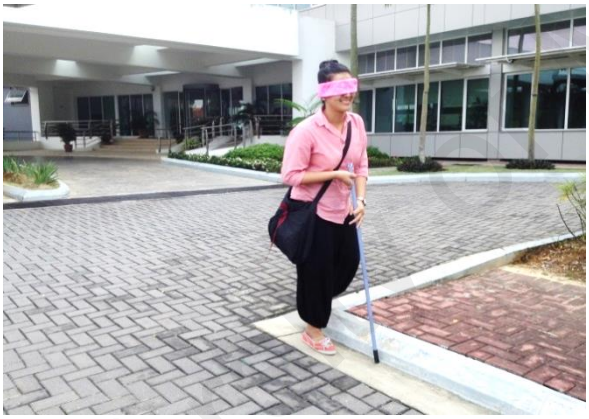
	Problems faced at GEO's External Environment via *Detached Observation, simulation*	**Problems Faced at GEO's External Environment via Access Audit Checklist**
b	**Disabled car park**  *"No proper pathway linking from the disabled car park to the main building entrance."*	i) Flat Access: Do not have flat access marked with yellow diagonal lines and it is not connected directly to the accessible footpath.
c	 **External step ramps** *"No proper pathway linkage for the persons with vision impaired."*	Not available
d	**External staircase**  *"Planter box obstructing the accessible path."*	i) Handrail: Height for the tops of handrails is 1000mm instead of 840mm ~ 900mm. ii) Risers/Treads: tread width is 420mm instead of 265mm ~ 280mm depth iii) Obstruction: Planter box iv) Guiding block: Not available

Table 4.4 continued

Problems faced at GEO's External Environment via *Detached Observation, simulation*		**Problems Faced at GEO's External Environment via Access Audit Checklist**
e	**External ramp**  *"Planter boxes blocking the turning radius for the wheelchair users."*	i) Clear Width: the clear width between handrails is 1000mm instead of 1200mm. ii) Gradient: The gradient of ramps is less than 1:12, very steep. i) Landing: There is planter box located at the landing of the ramp. ii) Intervals: Missing of level landing provided at regular intervals of **not** more than 6000mm of every horizontal run. iii) Size of landing is 1080mm instead of 1500mm long. iv) Height: height of the railing, i.e. 960mm instead of 840~900mm.

Source: author

Table 4.5 Summary of the problems faced at GEO's internal environment

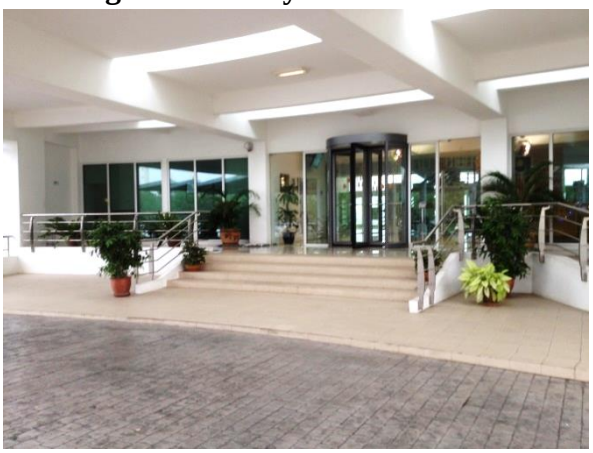
Problems faced at GEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at GEO's Internal Environment via Access Audit Checklist**
f	**Building entrance foyer**  *"No proper linking path guiding to the entrance."*	i) Directional signage: missing of adequate signage to assist in locating the accessible entrance.
g	**Door**  *"Confusing door for persons with vision impaired."*  *"Locked Fire Door, inaccessible to the fire staircase."*	i) Doors: swing door located at the accessible entrance to a building is locked. ii) Opening Force - Fire Doors: All fire doors are locked.

Table 4.5 continued

Problems faced at GEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at GEO's Internal Environment via Access Audit Checklist**	
h	**Room & spaces**    *"Obstructing objects along the pathways create confusion during the journey."* *"Difficult to access due to the height of level difference."*	i) ii) iii) iv)	Protruding Objects: For the objects mounted to the wall have leading edges between 500mm and 2000mm from the floor, it is protruding 360mm out from the wall instead of less than 100mm into the accessible space. Level Changes: the vertical difference is 25mm instead of 10mm when there is a level difference. Controls - Power Outlets: The general power outlets, dispensers, and similar devices are located at 300mm from the floor instead of 500mm ~ 1200mm. Light Switches: light switches horizontally aligned with door handles at 1500mm instead of 900mm to 1200mm

Table 4.5 continued

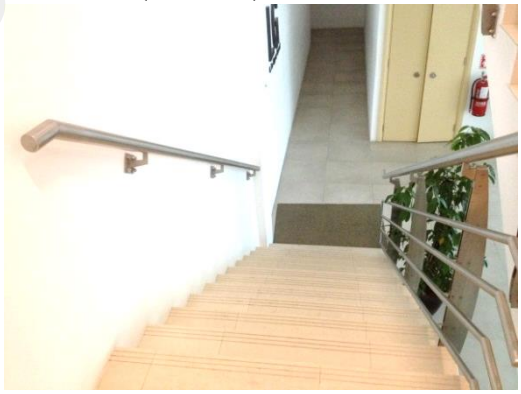
Problems faced at GEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at GEO's Internal Environment via Access Audit Checklist**
i	**Barrier-free toilet**	Not available
j	**Barrier-free shower area**	Not applicable
k	**Urinal area**  *"Facing difficulty to open the toilet door within the very tight washroom."*	i) Grab Rails: not available
l	**Fire escape**  *"The entrance of fire staircase is full of obstruction."*	i) Exit Door Sign & Emergency intercom: The character of the signage is not accompanied by Braille. ii) Emergency Procedure Posters: no display of emergency procedure posters
m	**Internal step ramp**	Not applicable
n	**Ramp (interior)**	Not applicable
o	**Staircase (interior)**  *"Feel lost with the continuous handrail"- persons with vision impaired.*	i) Visual Contrast: the surface of landing and floor level do not have contrast in colour or texture from stairs (Same tiles) ii) The height of handrails is 980mm instead of 840mm ~ 900mm above the stairs surface iii) Guiding block: Not available

Table 4.5 continued

Problems faced at GEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at GEO's Internal Environment via Access Audit Checklist**
p	**Lift**  *"Cannot find the control buttons" – persons with vision impaired.*	i) Lift Controls: No raised controls. Do not have the contrast for the numbers with the background (light-on-dark or dark-on-light). ii) Handrails, raised marking & guiding block: not available
q	**Special phone**	Not applicable
r	**ATM**	Not applicable
s	**Directional signage & symbol**  *"Hanging hook due to missing of fire hydrant obstruct passers-by."*  *"Signage location slightly higher than eye level of the wheelchair user and the font is too small."*	i) Character Size: Size of signage does not comply with Clause 28.6 & too small from a distance. ii) Raised and Braille Characters: missing of raised sign and accompanied by Braille. iii) Symbols: missing of the directory to the signs provided.

Table 4.5 continued

	Problems faced at GEO's Internal Environment via *Detached Observation, simulation*	Problems Faced at GEO's Internal Environment via Access Audit Checklist
t	**Guiding block**	Not available
u	**Restaurant & Cafeteria**  *"Signage of the cafeteria is too small and very difficult to notice; facing difficulty to swing the heavy glass panel independently without the help of others."*	acceptable
v	**Bus & taxi station**	Not applicable

Source: author

4.3.2.1.3 Analysis

Green Energy Office building is partially accessible for persons with physical/mobility impaired, based on the simulation process, as the way heading to fire escape staircase was obstructed and the door of fire escape staircase is locked. Also, the lift for GEO also brings difficulties to a wheelchair user, as the lift buttons panel are located beside the lift door. No provision of lift buttons panels for wheelchair users. The location of the lift buttons panel makes me felt that there is an insufficient turning area within the lift car.

4.3.2.2 Low Energy Office (LEO)

The results of the research question 3 for the Low Energy Office are presented in the summary format (see Appendix Z4, Z5, Z6, Z7, Z8 & Z9). Data Review based on observation and access audit checklist (see Appendix P ~ Z1):-

4.3.2.2.1 Detached Observation (Site Simulation)

From the usability – wayfinding access audit aspect, the signage in Low Energy Office (see Table 4.7) is mounted at varies height instead of complying 1500mm above the floor surface. The findings for the usability-way-finding site simulation aspect, the signage provided within the building lack information board with letters, Braille, tactile map and a push-button audio system results in the persons with vision impaired simulator faced difficulties to understand the information of the building in order to access to their designated space. The spaces lacking of the said information is entrance lobby, information counter, staircase, library, office, restaurant, and meeting area. Persons with the sensory impaired simulator and persons with physical/mobility impaired simulator faced the difficulties to identify the door location as most doors are a lack of distinguishable colour contrast strip and subsequently how to operate the door as it is a lack of Braille information at the door knob pertaining the method of the door opening.

From the horizontal site simulation aspect, the persons with sensory impaired simulator felt that there are a lot of protruding objects (see Table 4.7) and windows which create confusion. They required others' assistance to get through. Same goes for the journey to the toilet, and other office spaces. Besides, persons with sensory impaired simulator felt that the quietness of the lobby (see Table 4.7) caused her did not become

aware of the presence of the lobby, as there is no guiding block or any other elements to guide her way.

From the vertical accessibility (see Table 4.6) site simulation aspect, regarding overall, it is accessible. Despite that, there is one standing fan without the lid cover located at the perimeter staircase surrounded the building and caused the simulation process ended immediately, as this is a major risk factor in accessibility.

4.3.2.2.2 Direct Observation (Access Audit)

For the horizontal accessibility access audit aspect, the external pedestrian walkway surrounded the Low Energy Office (LEO) building is having the following problems: 1200mm width with the planter box at the centre of the pedestrian walkway does not fulfil the minimum 1500mm width requirement, and it is inaccessible to the building, facilities, elements and spaces of the building. Directional signage located at 2100mm above the floor level and some of the signages are dropped on the floor resulted in a confusing image.

From the vertical accessibility access audit aspect, the limited width of landing at the entrance ramp caused the persons with physical/mobility impaired required to move/adjust the wheelchair few times to reach the accessible path. However, the gentle ramp at the Low Energy Office allowed the wheelchair simulator access the ramp quickly.

Table 4.6: Summary of Access Audit Report of LEO at the external environment

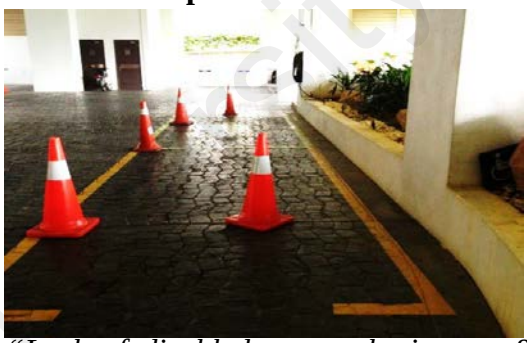
	Problems faced at LEO's External Environment via *Detached Observation, simulation*	**Problems Faced at LEO's External Environment via Access Audit Checklist**
a	**External barrier-free pedestrian walkway**  *"Confusing floor pattern"& lack of guiding block."*	i) Accessible Footpath Site - Public Transportation: Missing of accessible footpath within the boundary of the site linking to the public transportation stops, and sidewalks. ii) Accessible Footpath – Missing of accessible footpath connecting accessible car parking area to the main entrance. iii) Clear Width: footpath clear width 1200mm c/w planter box, i.e. 600mm instead of 1500mm iv) Gradient: The gradient of the accessible footpath and ramp is less than 1:20. v) Covers and Gratings: width of the grating opening is too wide, i.e. 40mm instead of 13mm.
b	**Disabled car park**  *"Lack of disabled car park signage & human assistance."*	i) Inadequate number of the disabled car park. ii) The width of Parking Space is 2400mm instead of 3600mm.
c	**External step ramps**  *"Confusing floor patter & without proper guiding block."*	i) Gradient: the gradient of step ramps is less than greater than 1:12 ii) Minimum Width: the step ramp is 1200mm width instead of 1800mm wide, exclusive of the flared edges. iii) Guiding Blocks & raised marking: not available

Table 4.6 continued

Problems faced at LEO's External Environment via *Detached Observation, simulation*		**Problems Faced at LEO's External Environment via Access Audit Checklist**
d	**External ramp**  *"Signage cannot be noticed as it is being blocked by the planter."*	i) Size of landing is 1200mm instead of 1500mm long. ii) Height: height of the railing, i.e. 950mm instead of 840~900mm.
e	**External staircase**  *"Bulky columns blocking the access and very misleading."*	i) Risers/Treads: uneven riser height. ii) Visual contrast: the surface of landing and floor level do not have contrast in colour or texture from stairs(Landing & floor level same colour) iii) Guiding block: Not available

Source: author

Table 4.7: Summary of Access Audit Report of LEO at the internal environment

Problems faced at LEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at LEO's Internal Environment via Access Audit Checklist**
f	**Building entrance foyer**  *"Lack of guiding block."*	i) Directional signage: missing of adequate signage to assist in locating the accessible entrance. ii) Level Change: lack of step ramp at the entrance iii) Glass Door or Wall: Missing of the distinguishable colour contrasting strip across the full width at 800-1000mm above the floor. iv) Disembarkation Space: missing of disembarkation space for disabled persons at the entrance. v) Guiding block: not available
g	**Door** 	Glass Door or Wall: The glazed door is distinguishable colour contrasting strip across the full width is at 1130-1250mm high instead of 800-1000mm above the floor.
i	**Barrier-free toilet** 	i) Grab Rails: the grab railed horizontal and mounted at 730mm instead of 800mm above the floor level ii) Wall Clearance: the space between the grab rail and the wall exactly is 40mm instead of 115mm. iii) Washbasin: the washbasin located at 500mm instead of minimum 600mm away from end water closet.

Table 4.7 continued

Problems faced at LEO's Internal Environment via *Detached Observation, simulation*		**Problems Faced at LEO's Internal Environment via Access Audit Checklist**
h	**Room & spaces** 	i) Protruding Objects: For the objects mounted to the wall have leading edges between 500mm and 2000mm from the floor, it is protruding 400mm out from the wall instead of less than 100mm into the accessible space. ii) Level Changes: the vertical difference is 40mm instead of 10mm when there is a level difference. iii) Work Surfaces: The top of the table or counter IS 1150mm instead of not more than 840mm above the floor. iv) Controls - Power Outlets: The general power outlets, dispensers, and similar devices are located at 300mm from the floor instead of 500mm ~ 1200mm. v) Light Switches: light switches horizontally aligned with door handles at 1500mm instead of 900mm to 1200mm vi) Window and Doors: all windows and doors are locked
j	**Barrier-free shower area**	Not applicable
k	**Urinal area**	Acceptable
l	**Fire escape**	Exit Door Sign & Emergency intercom: The character of the signage is not accompanied by Braille.
m	**Internal step ramp**	Not applicable
n	**Ramp (interior)**	Not applicable
o	**Staircase (interior)** 	i) Single side handrail ii) Visual Contrast: the surface of landing and floor level do not have contrast in colour or texture from stairs (Same tiles) iii) The height of handrails is 1000mm instead of 840mm ~ 900mm above the stairs surface iv) Guiding block: Not available

Table 4.7 continued

Problems faced at LEO's Internal Environment via *Detached Observation, simulation*		Problems Faced at LEO's Internal Environment via Access Audit Checklist
p	**Lift** 	Handrails, raised marking & guiding block: not available
q	**Special phone**	Not applicable
r	**ATM**	Not applicable
s	**Directional signage & symbol**  *"Signage is too small & not easy to notice."*	Raised and Braille Characters: missing of raised sign and accompanied by Braille.
t	**Guiding block**	Not available
u	**Restaurant & Cafeteria**	acceptable
v	**Bus & taxi station**	Not applicable

Source: author

4.3.2.2.3 Analysis

LEO building provides moderate usability for the facilities provision, especially pathway, staircase, ramp and internal way-finding. The LEO building overall is accessible to abled persons but inaccessible to persons with vision impaired. Both personswith hearing and learning will find difficult to assess this building.

4.3.3 Multiple Site Case Study Analysis and Discussion

Green buildings were chosen as case studies which have apparent accessibility problems. Each site is in respond to the needs in their interpretation and context. To study in detail, there are common key access problems occur in the green buildings (see Table 4.8. In fact, both green buildings are partially accessible, i.e. where persons with reduced capacities, especially persons with physical/mobility/vision impaired have limited access to all of its parts and uses the spaces and equipment. As explained under Chapter 3.1.3. Pg. 82 for the scoring method, each research sampling unit is being evaluated based on the following process:

a) Location to be evaluated in the built environment, from external environment (external barrier free pedestrian walkway, disabled car park, external step ramp, external ramp, external staircase) towards internal environment (building entrance foyer, door, room & spaces, barrier free toilet, barrier free shower area, urinal area, fire escape, internal step ramp, ramp, staircase, lift, special phone, ATM, directional signage & symbol, guiding block, restaurant & cafeteria and bus & taxi station) based on the access audit checklist (see Appendix Q-Z2) which developed under Malaysian Standard 1184:2014 Code of Practice for Universal Design and Accessibility in Built Environment.

b) The level of accessibility is then being evaluated and categorized into three category: 1) *total accessibility / complied* (where Persons with Disabilities can travel within the area, easily enter and gain access to all of its parts, and use spaces and equipment in conditions of independence and safety); 2) *partial accessibility* (where persons with reduced capacities, especially persons with vision impaired have limited access to all of its parts, and uses

spaces and equipment); 3) *Deferred accessibility* (where the built environment can be modified with limited costs in order to allow use by Persons with Disabilities). See Appendix P.

c) Findings of the access audit are being tabulated under Appendix 'Q' till Appendix 'Z2'. Each building element is being evaluated based on the numbers of comply-ability in each aspect, i.e. all requirements are not met/facility is not provided even though it is necessary (equivalent to 1 score); 25% of the requirements met (equivalent to 2 scores); 50% of the requirements met (equivalent to 3 scores); 75% of the requirements met (equivalent to 4 scores); and all requirements met/facility is not provided, but it is not necessary (equivalent to 5 scores).

Among the cases, the research sampling unit, LEO building (score of 51 of 90) provides better accessibility to building users, followed by GEO (score of 44 of 90) (see Table 4.8). This means the majority of the facilities provided in the LEO meets 5% of the requirements while less than 50% for the facilities in GEO building. The analysis and discussion of this study are divided into two: 1. accessibility and 2. usability. The issues of way finding elements like signages, guiding block and Braille information and user's ability to operate are parked under usability category while horizontal and vertical circulation are parked under accessibility category.

Table 4.8: Findings of multiple site case study

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	Total Score
LEO										-			-	-				-					51/90
GEO										-			-	-				-					44/90

Legends for Score

	Score	Description
	1	All requirements are not met / facility is not provided even though it is necessary
	2	25% of the requirements met
	3	50% of the requirements met
	4	75% of the requirements met
	5	All requirements met / facility is not provided, but it is not necessary

Legends for Environments

	External Environment		Internal Environment
a	External barrier-free pedestrian walkway	f	Building entrance foyer
b	Disabled car park	g	Door
c	External step ramps	h	Room & spaces
d	External ramp	i	Barrier-free toilet
e	External staircase	j	Barrier-free shower area
		k	Urinal area
		l	Fire escape
		m	Internal step ramp
		n	Ramp (interior)
		o	Staircase (interior)
		p	Lift
		q	Special phone
		r	ATM
		s	Directional signage & symbol
		t	Guiding block
		u	Restaurant & cafeteria
		v	Bus & taxi station

Source: author

Based on the findings of the factors affecting the accessibility are horizontal accessibility, vertical accessibility and usability. Throughout the findings from the case studies, both GEO and LEO building are generally accessible to abled persons, difficult

to access to persons with physical/mobility impaired, persons with learning impaired and persons with hearing impaired from the aspect of accessibility. From the aspect of usability, LEO provides moderate usability compare to GEO building, where most facilities are difficult to utilize. See Table 4.9. The analysis of the findings is categorized into four aspects: horizontal accessibility, vertical accessibility, usability – way-finding and recommendations.

Table 4.9: Summary of findings for multiple site case study

	PTM Green Energy Office (GEO), Bangi	Kettha Low Energy Office (LEO), Putrajaya
Accessibility:		
Persons with Vision Impaired:	Inaccessible	Inaccessible
Persons with physical/mobility impaired	Difficult to access	Moderate access
Persons with Learning Difficulties	Difficult to access	Difficult to access
Persons with Hearing Impaired	Difficult to access	Difficult to access
Able Persons	Accessible	Accessible
Usability		
	Difficult External ramp, footpath, driveway & signages are not by UBBL & Malaysian Standard. Savings are seen in both energy and water.	Moderate Pathway, staircase, ramp and internal way-finding

Source: author

1. **<u>Horizontal Accessibility</u>**

1a) Entrance Foyer and sidewalks

The common keywords findings for the horizontal accessibility via site simulation in three case study buildings for persons with sensory impaired are: “nothing to assist in

directing the way". Different problems arise for the persons with physical/mobility impaired (wheelchair, crutches, learning disability) at three case study buildings. From the public sidewalks entering towards the building entrance foyer, it is obvious that all the case study buildings lack connectivity and accessibility by users. In fact, the public sidewalks need to be designed with safety, continuity, and comfort in mind. None of them is providing the main sidewalk covered, as such cannot provide protection from rain and other inclement weather conditions to the users. In addition, guiding block and appropriate voice-guidance systems need to be installed to help persons with visual impaired to get around easily and safely, as these are lacking in both green case study buildings. To help persons with vision and hearing impaired, pictograms, voice-guidance systems and electric illumination indicators should integrated into signs used at intersections and on sidewalks. This is the standard requirement as mentioned in Malaysian Standards. The signs include directions to facilities, office information and event information. These help the office building to become more accessible to all. Besides, both the LEO and GEO do not provide railing at both side of the sidewalks. The supporting handrails / railing is particularly important to fit with a supportive element for persons to lean on, thus providing relief while standing up. This is very useful for older persons, or for persons who have had accidents.

1b) Bus shelters

All the case study buildings have a bus shelter nearby the building. However, all the case buildings are lacking of comfortable walkway to used by everyone, and should not have any architectural barriers. Nevertheless, the particular shapes and sizes of these elements can turn them into real physical barriers which can prevent possible intrusions of motorcycles into pedestrian areas.

2. Vertical Accessibility:

2a) Staircase & Lift

Based on the detached observation (site simulation) for vertical accessibility in three case studies, persons with physical/mobility impaired (wheelchair, crutches, learning disability). It is partially accessible to both LEO and GEO. Based on the direct observation (access audit checklist) for vertical accessibility, the similarities of all the case study buildings are lacking the provision of guiding block and raised marking; Besides, the dimension for the green buildings' risers/ treads/handrail for internal or fire escape staircase also do not comply with the requirement, with uneven riser/thread size, height of handrail differed, etc. It is found to be philosophically safe that providing an even staircase can assist the users in protecting the joint movement capability and balance. With step dimensions not easily retrofitted, this need to get right during the construction stage. Handrails are also crucial for both usability and safety. By adopting the recommended size of handrail, persons with physical disability especially crutch user can enjoy the sufficient stability provided.

For the fire escape staircase, all the case study buildings do not provide the exit door sign in front of the escape staircase; their emergency intercom is not identified by Braille and raised letters within the fire escape staircase; and the lift controls are not raised and not contrast with the lift car background for Green Energy Office. In case of emergency, persons with disabilities are usually unable to quickly leave the built environment. So their only chance is to promptly reach a static safe place. A flight of stairs or notably staircase landing is a haven to allow persons who are unable to move quickly to stop and wait, without creating impediments to the orderly movement of those who want to use the stairs to go up or down and to exit from places that can be potentially dangerous.

All the architectural design issues highlighted can be improved via design changes to make it more usable. A proper handrail section at the staircase will allow greater forces and moments to be exerted to help arrest a fall and to help pull oneself up a stair when leg muscles lose some of their capability. Similarly, improvements to stairway lighting and guiding block marking will be appreciated with every use as well as reducing the chance of a misstep.

3. Usability – Wayfinding

3a) Guiding Block

Both GEO and LEO do not provide guiding block within the building. Persons with vision impaired are the complainants when access rights are enforced, on occasion their dissatisfaction perhaps being caused by a lack of guiding block and tactile pavings to help them get into and around the building concerned. To achieve accessibility for persons with vision impaired, guiding block should run continuously through the main sidewalk leading from the entrance to the relevant facility. As listed in the Malaysian Standard, yellow is the most recognisable colour for persons with vision impaired, and it is needed to be select for guiding block since luminance contrast between the pavers and the flooring material as it is vital for persons who are embryonic to walk safely. It is apparent that such pavings can be troublesome, uncomfortable, and sometimes hazardous for other users. However, generally, the Malaysian Association of Blind recognized that the guiding block and tactile pavings are essential for persons with vision impaired and it is immaterial how tiny the number of persons who are vision impaired in the total population may be.

3b) Signage

The findings for the direct observation (access audit checklist) for persons with sensory impaired (vision and hearing impaired) wayfinding in both Green Energy Office and Low Energy Office are without the provision of signage with Braille information and guiding block.

The lacking the tactile guiding block in both GEO and LEO caused the persons with sensory impaired simulator lost the way in the wayfinding journey. This restricted the simulator to access the building independently without relying on others, as shown in areas: drop off area towards the entrance of the building, and internal of the building. The odd design of the architectural space next to staircase area and locking of swing door beside the turnstile door increase the confusing level of the persons with vision impaired and they take time to understand turnstile door mechanism to enter the building. This can overcome by providing a magnetic sensor which able to transmit and receive communication with the use of a portable device was mounted onto the normal voice-guidance system. It can be activated within a 15m to the 20m radius of the voice-guidance sign and indicates the individual's current location. On the main guidance signboard, a three-dimensional map and Braille directions need to be included for both GEO and LEO building.

3c) Socket Outlet

Besides, both the GEO and LEO faced the very common problems for the socket outlet. Most persons with physical disability, especially wheelchair user, and many persons who find it difficult to bend and stretch, particularly appreciate the convenience of switches and socket outlets that are easy to reach. During the site simulation, the simulator mentioned: "I have never been able to change a fuse because the fuse box

always seems to be situated about 300mm above the ground". It is ideal if both green buildings can comply the Malaysian Standard requirements, i.e. power socket and light fitting outlets to be 450mm ~ 1200mm from the floor.

4. Recommendations

Based on the observation above, both LEO and GEO ignore the importance of the technical assistance in the built environment (see Table 4.9). Technical assistance can assist persons to continue living independently, with the help of technical assistance. Technical assistance for building entrance is walking supports/handgrips or collapsible wheelchair; the staircase is handrails, and chair lift/walking supports; toilet and bathroom are grab bars, handrails, tub seats, shower seats and cranes. By providing the technical assistance in the built environment, with the reasonable cost implications, the built environment can be more accessible, yet with the consideration of safety and usability.

4.4 Discussions – Data Triangulation

Throughout the review of the literature review of Chapter 2 in this study, researchers and practitioners within the advancement field noted the importance of accessibility in the built environment. Primary data collected from the case study and secondary data from external sources were analysed to justify the accordingly. The results from the different approaches were then compared thematically, to assess the extent of the accessibility in the Green building. Previously, a case study reported on the outcome of access auditing and indicated the access provisions being in place based on respective contents. Departure from research sampling unit to access auditing was justified in due course. Current legislation, regulation, standards, practice and green building aspects in Malaysia was discovered in the study. Besides, research ascertained the core access elements in green buildings and indicated prevalent access problems in practice.

4.5 Conclusion

This study as a whole has very little sense of accessibility for the persons with vision impaired, and no sense of connectivity at all as it is difficult for the vision impaired to navigate their way around the building independently due to the absent of sensory designs such as Braille information and guiding block. This might be partly linked with the clientelism which means developing countries and marginalized groups tend to get ignored. *Accessibility* would be better served than currently is the case if there were greater use of ergonomics or human factors knowledge and approached problem-solving in design, construction, management, and regulation of buildings. Rather than leave tasks as important as these largely to manufacturers and builders, who lack the training in and sensitivity to human factors, there needs to be a broadened involvement of professionals with education, training, and experience dealing with the interaction of persons and their environments. It is critical to focus more on making the

environment fit for persons than expecting persons to adjust to the shortcomings of the built environment. The good quality of accessibility solutions must be treated differently from the conventional approach to partially grant civil rights to minority groups including Persons with Disabilities even though the industrial framework of ideas remains untouched in every new edition.

Mandatory compliance is still depending on the local authority and their level of enforcement. Moreover, it is common in Malaysia that many buildings are approved and constructed without the consideration of accessibility, including Green building.

The Green office building was commonly being understood that “energy efficiency”, “water efficiency”, “operation and maintenance” and “materials” and “sustainable site and management” criteria are being achieved. “Indoor environment quality” is ranked as the first criteria to achieve the good building. It is sensible as a Green building should be considered as a good building, and yet able to cater the accessibility of all parties within the built environment. The aspects highlighted under the Universal design index principle marking scheme are important to ensure the accessibility compliance in Green building, i.e. connectivity: accessibility: usability: safety: integrated design and operation & maintenance.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion on the Research Questions

The holistic approach taken by most Green building rating systems is based on a collection of fragmented technical criteria, which are somehow disconnected from each other and disconnected from the expected real human behaviour in the building. As a result, Green building performance is not consistent with Green building certification levels and expectations regarding the concept of accessibility. In this research, understanding of the end-users' true accessibility, especially Persons with Disabilities in Green buildings, is studied.

This chapter discusses the research questions and conclusion, which is based on the research methods of the entire research investigation. The chapter ends with suggestions to improve the research methodology, recommendations, and conclusion. The three research questions that make up the backbone of this thesis are as follows:

Research Question 1 –

What is being considered for users' accessibility in the built environment?

Research Question 2 –

What is being considered by *legislation and regulation* about the users' accessibility in Green buildings?

Research Question 3 –

Do the current Green buildings in Malaysia incorporate with accessibility needs for Persons with Disabilities in Malaysia?

5.1.1 Conclusion for Research Question 1

In Malaysia, it was evident that there is no legislation and regulation specifically for Persons with Disabilities in Green buildings. This is true also for standards and practice. However, based on the research conducted in Chapter 2 & 4, both accessibility and Green buildings are a part of the aspects of sustainable development. The critical words for sustainable development that considers users' needs in the built environment are usability and accessibility (way-finding). The comparison of the similarities of the goal, principles, and Index for both universal design (the social aspect of sustainable development) and the Green building (the environmental aspect of sustainable development) are shown in Appendix N. Therefore, it can be concluded that a built environment can be utilized by various types of users (including both persons with vision/sensory impairment and persons with physical/mobility impairment) to assist in achieving the connectivity of elements and spaces within the Green buildings, and can be considered as being in full compliance with all the three sustainable development aspects (social, environmental and economic). Sustainable development, to date, greatly emphasises on optimising energy and resource efficiency. A successful built environment which fully complies with the three vital areas of sustainable development (social, economic and environmental) has to more than efficiently utilise the natural resources within the budget allowed (economic means) by considering the users' comfort in accessing the building. Unfortunately, too many of the public spaces and the built environment in our nation have been designed based on the criteria that are appropriate only for the able-bodied or non-handicapped portion of the population. It is encouraging to be in areas, especially in public spaces and the built environment, that can balance Green design features with an accessible physical environment.

Research has shown that there are methods to improve the degree of accessibility within the built environment concerning current guidelines and practice. The degree of accessibility can be improved within the two scopes, namely additional assistive devices and the removal of identifiable barriers or obstructions. To be more specific, ‘reasonable accommodation' is the means of gauging the degree of accessibility as stated in the Persons with Disabilities Act. It states that appropriate modification and adjustment without any undue burden should be proportionately allowable on a case-by-case basis. Notwithstanding that, all the businesspersons and professionals, such as architects, play the leading role in providing accessibility. Architects, though they may prefer otherwise, can live with a design mandate if it does not overly interfere with aesthetic concerns. Professionals, particularly architects, rarely like to admit their ignorance about the many issues involved (e.g. the relevance of technical considerations, information access, usability, safety and accessibility). It is a paradox that at one level the design professionals pride themselves on their professionalism, but they are unable to admit that these require a complicated approach to solve this.

However, the expectation now is that the approach currently being applied universally to new buildings will have an impact on the aspirations and attitudes of existing property owners. Gradually, as properties are improved, modernised, and extended, it is hoped that the owners & government representatives will incorporate many accessibility features. Furthermore, government and local authorities will increasingly ensure that wherever modernisation takes place, accessibility is a priority in public buildings.

It is hoped that a research-scrutinised framework determining the provisions for reasonable access and identifying the significance of the built environment will be

essential in encouraging comprehensive planning. Access planning should be adopted in Green building practice to develop access strategy on a case-by-case basis. There is never a fixed standard to follow in proposing accessible public office buildings nor can one standard be derived and applied to all. Instead, comprehensive planning progress is the answer and forms the fundamental basis for implementation.

5.1.2 Conclusion for Research Question 2

As discussed in Chapter 4.1.3, the legislation for Persons with Disabilities in the built environment is the Persons with Disabilities Act 2008 while regulation for Persons with Disabilities in the built environment are Uniform Building By-Law 1984 By_Law 34A, Malaysian Standards MS 1183:1990, MS 1184:1991, MS 1331:1993, MS 1184:2014, "guidelines on building requirements for disabled persons" issued by the Ministry of Housing & Local Government and several frameworks (see Table 4.1.2 Legislation and Regulation of accessibility in Malaysia). The intention of the Persons with Disabilities Act 2008 was to end discrimination against Persons with Disabilities and to ensure that the individuals with the stipulated disabilities are entitled to equal opportunity and protection by the Federal Constitution and would be able to adequately and efficiently move into the mainstream of social and business life. The Uniform Building By-Law was gazetted in 1991, seventeen (17) years before the introduction of the Persons with Disabilities Act 2008, and enforced the requirement that all public buildings shall provide access to disabled persons to get into, out of and be within the building and be designed with facilities for use by disabled persons. The requirements of this by-law are covered by Malaysian Standards MS 1184 and MS 1183. It is a real breakthrough resulting from the government's decision to regulate universal change for accessibility, affecting all new buildings. Of course, the vast majority of buildings in Malaysia have already been constructed, and the new measures do not apply to existing property. It

will take many years for genuinely accessible institutional buildings to represent the majority of the Malaysian workplaces.

Based on the findings from RQ2, it is noted that the built environment today is not constructed with full compliance to the relevant Acts and by-laws. Parties involved from the initial conceptual design phase till the final completion phase, i.e. (i) the local authorities, (ii) professional bodies (architect, engineer, quantity surveyor), (iii) client/developer, (iv) project manager, and (v) contractor have played the main roles in this process.

(i) **Local Authority:** According to the Town and Country Planning Act which has fundamentally instituted a uniform planning legislation covering all the states, the local authority must assume an essential role in ensuring that the development plans, and planning and building submissions are entirely complaint with the Uniform Building By-Law and subsequent Malaysian Standards, in considering the needs of Persons with Disabilities. It is the local authority's responsibility to formulate and set the planned structure and policies on social, economic and environmental criteria within its jurisdiction. The power of the local authority also includes inspecting any building works at any stage; calling attention to any deviation from the approved plan or non-compliance with any of the Uniform Building By-Laws which the inspector may observe; and giving relevant notice in writing, thus ordering such deviation to be rectified as per the Uniform Building By-Laws 1984 BL 25(2).

(ii) **Professional bodies:** According to the Uniform Building By-Laws 1984, Professional Bodies, especially the Principal Submitting Persons and Submitting Persons, in accordance with Uniform Building By-Law BL 25A, shall supervise the erection and completion of the building in accordance with the By-Laws, comply with all the conditions imposed by the local authority, and accept full responsibility for the building. Failure to comply with this by-law is an offence under the Act and shall render the person(s) liable to prosecution under the Act, as highlighted under UBBL BL 28.

(iii) **Client/developer/project manager:** The Client/developer/project manager should be advised and guided by their appointed professional bodies (architect, engineers and quantity surveyor) for all the enforced Acts in Malaysia and the necessity to comply, which makes safety and health the main priorities for whoever takes vacant possession of the building.

(iv) **Contractor:** A contractor is appointed by the Client during the construction phase. They must have the skills, knowledge, experience, where relevant, to carry out the works. They should register themselves with the Construction Industry Development Board (CIDB), established under the and responsibilities are contained in Section 4, subsection (1) of the Act. It is CIDB's corporate objective to strive "to develop the capacity and capability of the Construction Industry through the enhancement of quality and productivity, by placing great emphasis on professionalism, innovation, and knowledge, in the endeavour to improve the quality of life." As such, all the construction works carried

out by the Contractor shall be monitored and governed by the Construction Industry Development Board Act 1994 (Act 520).

Apart from the imposition of legislation and regulation in Malaysia, problems may arise due to insufficient knowledge caused by the lack of exposure, the lack of training/education in the industry, the lack of awareness, ignorance and a negative attitude towards sustainability, and the lack of interest and enthusiasm of all the parties involved. Legislators often do not possess the detailed knowledge required, the level of expertise necessary, or the foresight or premonition of potential issues that may arise to address them effectively. If the local authority also fails to do its job correctly, then the level of uncertainty will inevitably prompt lawsuits and judicial vexation. Malaysia's federal government has overcome the issues mentioned above by introducing the Matrix of Responsibility for the Certificate of Completion and Compliance (CCC) in 2007. According to the requirements, the completed constructed building had to be delivered under vacant possession and accessed only upon compliance with the statutory legislation; the Principal Submitting Person is responsible for the issuance of the Certificate of Completion and Compliance (CCC). The CCC can only be issued by the Principal Submitting Person (PSP) after the following have been secured: 1. all the certifications by the respective parties (professionals, contractors and licensed tradesmen) based on the prescribed 'Form Gs' under the Matrix of Responsibility (Forms G1 – G21); and 2. clearances from the following authorities : • Tenaga Nasional Berhad (TNB) • Water Authority •Sewerage Services Department (JPP) • Fire and Rescue Department (except for residential buildings of not more than 18 meters high) • Department of Safety and Health (where applicable), • Relevant authorities/Public Works on Roads and Drainage. These CCC systems hold everyone responsible (i.e. all

the parties involved, including the professionals, contractors and licensed tradesmen) in undertaking the project and minimising the subsequent possible failure.

Besides, from the study of the legislation covering Green buildings in Malaysia, there are the National Policy on the Environment (2002) and National Green Technology (2009), as listed in Appendix C. These emphasise the importance of sustainable development and thus the Green building/environment; while Green buildings are regulated by the Green Building Index by the private sector, i.e. Pertubuhan Arkitek Malaysia, in 2009. Based on the research findings, Green technology and economic implications are the primary focus of the policy while the Green Building Index is restricted to the environmental concern of sustainability. Both the legislation and regulation focus attention on technical sustainability, the root of any environment crisis. Parties involved in project development have proposed that the government should play a proactive role in successfully introducing a financial reward for implementing Green technology in the built environment. This indirectly also implies that the industry players lack knowledge in selecting the relevant technology to enjoy the economic benefits of sustainability.

As such, all these suggest that the development of both legislation and regulation are still in the premature stage, i.e. without the full consideration of the social, environmental, energy and economic aspects. These aspects should be prioritized, set up and adopted as soon as possible to bring Green Buildings to the next level.

5.1.3 Conclusion for Research Question 3

Multiple site case study in Malaysia of the main Green buildings show the emergence of accessibility needs for Persons with Disabilities in current practice. Nevertheless, the study encountered a lack of information on current practices relating to access problems in Malaysia. About sustainable development, significant attributes of Green buildings were identified in the multiple site case study while inappropriate access core elements were audited.

From both direct observations using the access audit checklist and detached observation using site simulation, the Malaysian Standard can be regarded as either not referred to or deemed not applicable from the design development to the completion stages. These findings suggested that the Malaysian Standard is a guide rather than a procedure with legal influence. The Malaysian Standard is not suitable or has unclear requirements for persons with vision impairment, or persons with hearing impairment. The Malaysian Standard is particularly meant for those using larger varieties of wheelchairs which require bigger turning circles. By accommodating these wheelchair users, this allows not just access but the permanent occupation of the property.

From both of the site, the LEO and GEO buildings were designed for persons who do not have sensory problems, whereas persons lacking sensory abilities were not designed for. It is highly advisable for building managements to plan and provide solutions and facilities for accessibility, communication and information formats in visual, auditory and tactile form. The expectation is that the users of the buildings were provided with a firm endorsement for accessibility. It seems to be unclear whether the management/government should decide to what extent it was taking responsibility for ensuring that the accessibility requirement was fully utilized by all users. However, this

can be overcome by paying careful attention to the standards which can be achieved in all built environments, including both Green-rated and non-Green-rated buildings.

5.2 Recommendations

As a result of this research, this study would like to make the following recommendations to Green building designers, and stakeholders: Green building designers, especially architects, should consider users' feedback from previous Green building case studies and post-occupancy evaluations. They should consider using critical thinking about their perspectives on accessibility, and develop awareness of the issue in the wider arena of determining Green buildings through appraisal of the Built Environment. Also, to achieve higher-performing Green buildings, anticipated users, especially Persons with Disabilities, should be highly engaged in the early design proposal stage. The innovation and knowledge presented in legislation, regulation, standards and practice require clear statements about Accessibility in each of technical recommendations and requirements. Building a database for post-occupancy evaluations of Green buildings will be a helpful resource for designing future Green buildings that can embrace the bottom line of sustainability and introduce a better experience for building users.

5.3 Limitations

The results of this research are subject to some limitations. The general limitations are related to the method of data collection, which relied on self-reporting by participants. Self-reported data can contain several potential sources of bias, such as selective memory and exaggeration. In selective memory, there is a possibility that participants remember or do not remember experiences that occurred at some point in the past. In exaggeration, respondents may present some experiences or perceptions as

being more significant than they were. Thus, a categorization approach has been taken in this research to reduce the effect of possible biases that may come from self-reporting.

The research has been limited by the small number of green buildings in Malaysia during the year the research data was collected. Sites were selected with the goal of providing examples with the strongest possible influences on Green building and accessibility theory during 2012 to help to identify any variables which may have been left out. The ground theory of accessible Green buildings has yet to be defined and is under-researched academically.

5.4 Further Research

The effectiveness of the Persons with Disability Act 2008 could be further investigated, where reasonable adjustments in the legislative implementation by building owners and the consultant team can be made to enable equal participation of all users in enjoying the built environment. This is essential to understand better how policies in legislation can be translated into practice.

Another research focus that would be valuable is the drawing up of a checklist incorporating both the essential requirements of Green buildings with universal design to achieve Sustainable Development. Other building typology, e.g. sports arenas and stadia, should be studied because they provide not only the usual concerns related to access and usability but also include considerations of lines of sight, dispersal, integration, and general seating. Even though they deal primarily with persons using wheelchairs and do not address other forms of disability, this building typology is a valuable example.

5.5 Conclusion

The government need to put concentration on better access to all new buildings, especially Green buildings, should increase all parties' understanding of the issues and heighten demand for better accessibility in existing buildings before achieving the goal of Sustainable Development. Positive steps have been taken towards improving access for various types of users in the built environment, especially Persons with Disabilities, including both Green buildings and non-Green-rated buildings. Legislation, regulations, guidelines, and standards for public buildings have evolved over the years. Public buildings were the first to be subjected to accessibility regulations. Through the research, legislation, regulation, guidelines, standards and requirements for accessibility have been drawn up in such a way that accessible spaces can be created within the constraints of an accepted framework. The multiple site case study selected for this study are representative of current office building trends in Malaysia, and they show that new, accessible solutions can conform to long-established national traditions. This holds true for most aspects of the designs, including the building typology, layout, plan form, dimensions and the use of space. It may, therefore, be surmised that accessibility that has come about is the result of a pragmatic approach. The architects have to work within a field where tradition dominates and where solutions to new requirements are sought within the confines of established norms.

Green buildings should be fully accessible to fully comply with the goals of the National Five Year Development Plans. Sustainable Development includes 'social equity' apart from 'economic viability' and 'environmental sustainability', thus requiring continuous changes to achieve development and redress the imbalance of Green-certified building objectives. It is recommended that Government interventions be put in place regarding regulatory and monitoring support, including incentives and proper

guidelines. To ensure the successful implementation of Sustainable Development, the introduction of Green building compliance to the regulatory requirements, including accessibility standards for all different and diverse needs, are very necessary to achieve the aim stipulated in the PWD Act Malaysia, i.e. that equal opportunities are given to all in all areas of life. Based on the results of this study, future studies recommended are qualitative research using case studies obtained by interviewing disabled persons (including those with sensory impairment) regarding the use of Green-certified buildings from the perspective of employment.

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Achieving Sustainable Development: Accessibility of green buildings in Malaysia

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Abstract

Both Universal Design (UD) and Green Building Design (GBD) aim to achieve sustainability in the built environment. In Malaysia, the introduction of Green Building Index (GBI) is a reinforcement of GBD agenda although not made mandatory to comply. At the same time, the Persons With Disabilities Act 2008 Malaysia (PWD Act) promotes strongly UD. Both the GBI and PWD Act are in support of Sustainable Development (SD) in terms of environmental protection and social equity, respectively. This study provides a critical analysis of how these two SD instruments are either being corroborated or compromised or complemented through the practice of providing accessibility to PWDs in green buildings.

Keywords: Accessibility; green building; sustainable development; universal design

1. Introduction

For more than forty years, SD has dominated the global environmental discourse and guiding ecosystem protection (Walsh, 2004; EPA, 2008). SD is interpreted and promoted by the initiatives of Health Building, Green Building Congress, Sustainable Building International Conference and Sustainable City International Conference, where SD and human health are the global development goal, with the consideration of "healthiness" and "comfortability", to constructa balance between"sustainability","green" and"healthy" SDenvironment (Chiang, 2005). It can be problematic, however, if there is no connection between a sustainable building and its accessibility, including safety

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and usability by all people (Walsh, 2004; Tay, 2011). The study focuses on the accessibility of the built environment in green buildings in order to achieve the goal of SD in Malaysia's National Five-Year Development Plans. A review of Malaysia legislative, regulative mechanisms and policies in the literature review showed gaps identifying the lack of designing and constructing accessibility for human needs and an imbalance in adopting policies separating accessibility from sustainability. Using case studies, the results showed that disabled users' needs are not accounted for satisfactorily.

2. Literature review

2.1. Sustainable Development (SD): national plans, legislation and policies

SD ensures the well-being of humans by integrating social equity, economic viability, and environmental conservation and protection.According Agyeman (200),Pinfield (1997),Redclift(1987) andCampbell(1996), SD addresses three vital areas:

- People living today are entitled to justice and equal rights
- Environmental degeneration must be eliminated
- Future generations must not be impoverished as a result of current actions

SDconcept was adoptedin Malaysia during the 1992 NGO Forum for RioC10 Malaysia - Chapter of 40 of Agenda 21. Planning byMalaysia constitutes a National Plan where SD was outlined as one of the goals (see Tables 1 and 2).Table 1 shows that accessibility was introduced much later in the Tenth Malaysian Plan where it refers to 'the quality of life'. In the Ninth Malaysian Plan accessibility was mentioned only in general regarding infrastructure. The Town and Country Planning Act included sustainable development as shown in Table 2.

Table 1. Malaysia's National Five Year Development Plans showing SD concepts

Malaysian Plan	Key Emphasis
Seventh Malaysia Plan (1996-2000)	SD
Eighth Malaysia Plan (2001-2005)	SD of energy resources and renewable.
Ninth Malaysia Plan (2006-2010)	SD covering social, economic and environmental aspects. Improving*accessibility* to and within the country, enhancing transportation links and communication services and internet at entry points.
Tenth Malaysia Plan (2011-2015)	Improving the standard and sustainability of quality of life through better *access* to healthcare, public transport, electricity and water. AFFIRM framework (Awareness, Faculty, Finance, Infrastructure, Research and Marketing) was established to promote the implementation of SD in the construction industry. Green building as part of SD is government's consideration to achieve a better future for next generations (Sood et al., 2011).

Table 2. Planning legislation that referred to SD in Malaysia

Legal Regulation	Remarks
Town and Country Planning Act 1976 (Act 172)	Section 2A (2) National Physical Planning Council. The functions are to promote the framework of the national policy, town and country planning as an effective and efficient instrument for the *improvement of the physical environment* and towards achieving the*SD* Section 8 (3) The statement is to formulatethe policy and general proposals of the State Authority, respecting the development and use of land, including improvement measures of the physical living environment, communications, traffic management, *socio-economic well-being* and the promotion of economic growth, and *for facilitating SD.* (4) In formulating the policy and general proposals under paragraph (3)(a), the State Director shall secure that the policy and proposals are justified by the results of his survey under section 7 and by any other information that he may obtain, and shall have regards to current policies respecting the *social and economic planning and development* and the *environmental protection of the State and the nation*.

Table 3. National policy on the environment and technology in Malaysia

National Policy	Key Emphasis
National Policy on the Environment (2002)	Economic, social and cultural progress through environmentally SD
National Green Technology (2009)	SD
	Energy: seek to attain energy independence and promote efficient utilization
	Environment: conserve and minimize the impact on the environment
	Economy: enhance the national economic development through the use of technology
	Social: improve the quality of life for all

Table 3 shows that the national policies in green environment and technology was created and included the agenda to improve the 'quality of life for all'.

2.2. Green Building (GB)

US Green Building Council states the function of GB is to significantly reduce or eliminate the negative impact of buildings on the environment and the building occupants (LEED, 2004). Golstein (2011) further elaborated that GB is designed for economic and environmental performance, considering the local climate and cultural needs, and providing for the health, safety and productivity of its occupants.

In Malaysia, the Green Building rating system - Green Building Index (GBI) was launched in May 2009, corresponding to the national policies on the environment and technology (Table 3). The GBI was designed based on other international rating systems such as BREEAM (Building Research Establishment Environmental Assessment Method) and the USA's LEED (Leadership in Energy and Environmental Design). The GBI defines GB as to focus on increasing the efficiency of resource use (energy, water and materials) while reducing building impact on human health and the environment through better sitting, design, construction, operation, maintenance and removal . Table 4 compared the different countries objectives focusing on the 'energy efficiency' agenda, however move towards 'renewable energy' and 'social justice' has only been recently addressed in many countries. However, in Malaysia in 2005, the emphasis is still on 'energy efficiency'.

Table 4. Breakdown of different categories in therating systems

Name of Rating Tools	BREEAM	LEED	Green Star	Green Mark	GBI
Origin & years introduced	UK, 1990	US, 1993	Australia, 2003	Singapore, 2005	Malaysia, 2009
Categories	Energy use Transportation Water Ecology Land Use Materials Pollution Health and well being	Energy and atmosphere Water efficiency Sustainable Sites Materials and resources Indoor environmental quality (IEQ) Innovation	Energy Transport Water	Energy efficiency Water efficiency Environmental protection Indoor environmental quality (IEQ) Innovation	Energy efficiency Indoor environmental quality (IEQ) Sustainable Site and management Materials and resources Water efficiency
Developer	Building Research Establishment (BRE)	United States Green Building Council (USGBC)	Green Building Council of Australia (GBCA)	Building and Construction Authority (BCA)	Green Building Index SdnBhd

2.3. Accessibility and Universal Design (UD): definitions and building regulations

The built environment should be designed to cater for Persons with Disabilities (PWD) to promote universal accessibility. PWDs are persons who have long term physical, mental, intellectual or sensory impairments, which in interaction with various barriers may hinder their full participation in society. The seven principles of UD (see Table 5):

Table 5. UD Principles (Center for Universal Design, North Carolina State University, 1997)

Principle	Design description
Equitable use	Useful and marketable to people with diverse abilities
Flexibility in use	Accommodates a wide range of individual preferences and abilities
Simple and intuitive use	Easy to understand, regardless of the user's experience, knowledge, language skills, or concentration level
Perceptible information	Communicates information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
Tolerance for error	Minimizes hazards and the adverse consequences of unintended actions.
Low physical effort	Used efficiently, comfortably and with a minimum of fatigue.
Size and space for approach and use	Appropriate size and space for approach, reach, manipulation and use regardless of the user's body size, posture or mobility.

Table 6. Regulative instruments of accessibility in Malaysia.

Legal Regulation	Year	Key words / phrases quoted
Act:		
Street, Drainage and Building Act 1974 (Act 133)	1991	Section 3 – Interpretation "frontage" means the owner of premises fronting on, adjoining, abutting on, or adjacent or accessible to a street or back lane or where the owner of the premises by himself or his tenant has the right to use or commonly does use the street or back-lane as a means of access to or drainage from the premises. Section 9 (7b) – Private persons making new streets Any person without the permission in writing of the local authority plants any hedge in such manner that any part thereon is in any direction less than twenty feet from the centre of the carriageway of any street, not being a public street, or less than forty feet from the opposite side of any road or path which is used or intended to be used as the means of access to two or more houses exclusive of the width of any footway which the local authority requires should be liable on conviction to a fine not exceeding two thousand ringgit, and a Magistrate's Court shall, on the application of the local authority, make a mandatory order against the offender. Section 12 – Declaration of public streets Where street works have been executed to the satisfaction of the local authority under this Part in respect of a private street, which is not less than forty feet wide, then on the request in any other case, of the several frontagers of such private street or part of a private street as together have an annual value of more than fifty per centum of the total annual value of the premises fronting on, adjoining, abutting on or adjacent or accessible to such private street or part of the private street, as the case may be.
Town and Country Planning Act 1976 (Act 172) amended act 1995 (Act A 933)	1995	Section 21. Application for planning permission (3) Where the developer involves the erection of a building, the local planning authority may give written directions to the applicant in respect of any of the following matters, that is to say the owner of the premises by himself or his tenant has the right to use or commonly does use the street or back-lane as a means of access to or drainage from the premises.
PWD Act 2008 (Act 685)	2008	Section 2. Interpretation "Universal Design" means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design and shall include assistive devices for particular groups of PWD where this is needed. Part IV. Promotion and development of the quality of life and wellbeing of PWD. Chapter 1 Accessibility. Section 26 – Access to public facilities, amenities and services and buildings. PWD shall have the right to access to and use of, public facilities, amenities, services and buildings open or provided to the public on equal basis with persons without disabilities, but subject to the existence or emergence of such situations that may endanger the safety of PWD For the purposes of subsection (1), the Government and the providers of such public facilities, amenities, services and buildings shall give appropriate consideration and take necessary measures to ensure that such public facilities, amenities, services and buildings and the improvement of the equipment related thereto conform to universal design in order to facilitate their access and use by PWD Section 27 – Access to public transport facilities Section 28 – Access to education Section 29 – Access to employment Section 30 – Access to information, communication and technology Section 31 – Access to cultural life Section 32 – Access to recreation, leisure and sport
Rule:		
Uniform Building By-Law 1984 By Law 34A(1) Amended in 1991	1991	By-Law 34A(1) All public buildings shall provide with access to enable disable persons to get into, out of and within the building & be designed with facilities for used by disabled persons. The requirements of this by-law shall be complied with MS 1184 and MS 1183.
	2005	By-Law 35. Access from a street. Every building to be erected on a site which does not front a street shall have access from a street and the means, nature and extent of the access shall be in accordance with a layout plan approved by the competent planning authority or the local authority.

In Malaysia, regulative instruments that promote UD and accessibility for PWDs have existed since 1990 with the adoption of Malaysian Standards, and in 2008, the PWD Act was enacted (Table 6). A comparative analysis of the building regulations and legislation against the general PWD Act showed some similarities regarding the definitions, where the word 'access' and 'accessible' is used, however, only in 2008 the PWD Act expanded and included UD as the definition for 'access'.

After UD was defined in the PWD Act in 2008, this in turn influenced the policies in Malaysia after the establishment of the PWD Act (Yaacob, Hashim, 2010, 2010a). Before 2008, the use of the word 'access' and 'accessible' is limited in that it was left for interpretation by the architect, and it was stated that, "there are buildings that do not incorporate MS although it has been addressed in the Uniform Building By-law" (UBBL) (Arikisamy, 2007). In addition, "existing public buildings that have done modifications as approved by the standard codes are very few" (Chen et al., 2007; Syazwani et al., 2012).

The incorporation of UD in the PWD Act paved a way to combine and make SD policies in Malaysia to be clearer in the implementation aspects for the 'quality of life for all'. Currently, the Malaysian example could be contrasted with the City of Columbus and Franklin (USA), where the establishment of the AWARE Manual for Sustainable Accessible Living incorporated GB and UD in Sustainable Rating System (City of Columbus and Franklin County, 2013). Another UD and Green Home Survey Checklist developed by Sandler (2010) are designed for building livable, energy-efficient homes and apartments that people of all ages and abilities can use, enjoy and adapt to suit their changing needs. Other countries may still lag behind in this endeavor, due to legislational, attitudinal, professional conducts (Samari et al., 2013), which arguably includes Malaysia.

3. Case study

The objectives are to examine the condition of the facilities provided and to examine the compliance to the requirement of UD in MS prior to achieving the goal of SD in MalaysiaNational Five Year Development Plans. The level of provision and functional of the facilities in the case studies building is evaluated.

3.1. Methods

Data collection was made via direct observation using access audit checklist. The access audit checklist was created to be based on the Malaysian standards and the UBBL(Yaacob, Omar, Rahim et.al. (2011); Yaacob, Hashim, Hashim 2009) to assess the fit between the building users and the built environment.This can helped to identify workplace design factors that might be barriers to users with disabilities, as well as users not yet experiencing a disability. The area assessedare divided into two sections: external environment (pedestrian walkway, disabled car park, external ramp, external step ramp, general obstruction and external staircase) and internal environment (building entrance foyer, doors, room & spaces, barrier free toilet, barrier free shower area, urinal area, fire escape, corridors, internal step ramp, internal ramp, staircase, lift, special telephone,ATM, directional sign & symbol, guiding block, restaurant &cafeteria and others). Video recording and photos are taken for further qualitative analysis of the current facilities condition.Three government office buildings were assessed:

- Kettha Low Energy Office (LEO) in Putrajaya and PTM Green Energy Office (GEO)in Bangiare two green certified government office buildings, located in non-residential existing building (NREB) category and non-residential new construction (NRNC) category, respectively.
- The Ministry of Women, Family and Community Development (KPKWM) in Putrajayais a non-green certified building, chosen according to the consideration of UD and accessibility of PWD during pre-construction stage.

3.2. Analysis and findings

The results showed that KPWKM building (score of 65 of 90) provides better accessibility to building users, followed by LEO(score of 51 of 90)and GEO (score of 44 of 90) (see Table 7).This means, the majority of the facilities provided in the KPWKM meets 75% of the requirements while less than 50% for the facilities in GEO building. The best practice facility provided is barrier free toilet, while the worst practice is lacking installation of guiding block and special phone.

The findings are divided in two: Firstly, way-finding and secondly, architectural design elements. The issues of way finding elements like signages, guiding block and Braille information are found in three buildings. Signage and signals are a problem to recognize accessibility signs for building users. Both the LEO and GEO buildingssignages' size are too small and are not installed at 'decision-making' location. The fire staircase at latter building is not accompanied with a pictogram or fire escape plan for building users. Voice announcement and tactile signs are not installed for users who are vision impaired. The signages installed at KPWKM are easily identified and Braille information are accompanied at certain signages if necessary. In addition, the importance of the guiding block in enhancing the accessibility of people with vision impaired andpeople with learning disability were neglected in three buildings.

Table 7. Findings of direct observation using access audit checklist

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	Total Score
LEO										-			-	-				-					51/90
GEO										-			-	-				-					44/90
KPWKM										-			-	-				-					65/90

Legends for score:

	Score	Description
	1	All requirements are not met / facility is not provided even though it is necessary
	2	25% of the requirements met
	3	50% of the requirements met
	4	75% of the requirements met
	5	All requirements met / facility is not provided, but it is not necessary

Legends for environments:

	Internal Environment		External Environment
a	External barrier free pedestrian walkway	f	Building entrance foyer
b	Disabled car park	g	Door
c	External step ramps	h	Room & spaces
d	External ramp	i	Barrier free toilet
e	External staircase	j	Barrier free shower area
		k	Urinal area
		l	Fire escape
		m	Internal step ramp
		n	Ramp (interior)
		o	Staircase (interior)
		p	Lift
		q	Special phone
		r	ATM
		s	Directional signage & symbol
		t	Guiding block
		u	Restaurant & cafeteria
		v	Bus & taxi station

Table 8. Summary of findings

	GEO	LEO	KPWKM
Accessibility:			
Vision Impaired:	Inaccessible	Inaccessible	Moderate access for people with vision impaired. Lacking of connecting guiding block & information Braille from one space to another.
People with physical / mobility impaired	Difficult to access	Moderate access	Accessible
Learning Difficulties	Difficult to access	Difficult to access	Accessible
Hearing Impaired	Difficult to access	Difficult to access	Accessible
Able People	Accessible	Accessible	Accessible
Safety:			
	Difficult All fire staircases were locked due to security reason. Certain fire extinguishers are not installed at the designated area.	Moderate Lacking of safety curb at external pathway.	Acceptable
Usability:			
	Difficult External ramp, footpath, driveway &signages are not in accordance to UBBL & M.S. Savings are seen in both energy and water.	Moderate Pathway, staircase, ramp and internal way-finding	Acceptable

Both LEO and GEO did not install any guiding block while it is provided at KPWKM's drop off area. However, theconnectivity was not properly done and is missing between the drop off area to the lobby's entrance and adjacent bus station at KPWKM building. In terms of architectural design elements, many problems are identified at the staircase and ramp. The staircase posed major 'usability' problems for persons with mobility impairment, visions impairment and learning difficulties. The fire escape staircases at GEO were locked due to security reasons and this is useless for the purpose of fire escape. Other issues found in both LEO and GEO staircases were the handrails that did not provide accurate tactile and sensory cues to show the presence and locations of steps / landing. Building users might not be able to grab the handrails if they lose their balance momentarily at the landing as the handrails of the staircase were lacking with the required 300mm horizon extension parallel to the floor at the top and bottom risers. The sloped walking surface at both LEO and GEO buildingsproved difficult for wheelchair users to use when approaching the pedestrian walkway. In addition, extra efforts were required to access the external ramp by the wheelchair users as the gradient of the ramp is not in accordance to the MS's requirement.

4. Limitations of the study

Direct observations using the access audit checklist provides a standard way of getting data where the researcher tried to obtain as close as possible reliable data to truly examine the research objective. Due to time and costs constraints, participant observation technique, using real disabled persons would have been a more reliable technique. A simulation exercise using wheelchairs and blindfold of a researcher was conducted instead. Although limited, it was able to give a more diverse set of data rather than just ticking boxes for the access audit checklist.Another limitation is one of the case study government office buildings was not cooperative and gave limited access for the researcher, who managed to however got access to main areas and not all areas.

5. Recommendations and conclusion

GB should be fully accessible in order to fully compliant to the goal of the National Five Year Development Plans. Both LEO and GEO buildings were designed for persons who do not have sensory problems whereas persons lacking sensory abilities were not designed for. It is highly advisable for both building managements to plan and provide solutions and facilities for accessibility, communication and information formats in visual, auditory and tactile form. KPWKM building was designed, in comparison to the green-certified buildings to be more accessible to all users but still not accessible for vision-impaired persons, especially for the connectivity aspects to the surrounding environment. SD includes 'social equity' apart from 'economic viability' and 'environmental sustainability' thus requiring continuous changes to achieve development and redress the imbalance of green-certified buildings objectives. It is recommended that Government interventions be in placed in terms of regulatory and monitoring support including incentives and proper guidelines is also encouraged. To ensure successful implementation of SD, the introduction of GB compliance to the regulatory requirements including accessibility standards for all different and diverse needs are very necessary to achieve the aim stipulated in the PWD Act Malaysia for equal opportunities to be given for all in all areas of life.Future studies recommended based on the results of this study is to perform a qualitative research using case studies by interviewing disabled persons including those with sensory impairment in terms of using green-certified buildings, from the perspective of employment.

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APPENDIX A

Uniform Building (Amendment) By Law 1991

In exercise of the powers conferred by section 133 of the Street, Drainage and Building Act 1974, the State. Authority Makes the following By-laws:

1. These By-laws may be cited as the Uniform Building (Amendment), By-laws 1991.
2. By-law 2 of the Uniform Building By-laws 1984 which in this By-laws is referred to as "the principal By-laws" is amended by inserting immediately after interpretation “detached building” the following interpretation.
   "disabled persons" means people; with a physical, hearing or sight impairment which affects their mobility or their use of buildings as referred to under by-law 34A;".
3. The principal By-laws is amended by inserting immediately after by-law 34, the following new by-law 34A:
   (1) Any building or part thereof to which this by-law applies shall
      (a) be provided with access to enable disabled persons to get into, out of and within the: building except for any part of the building for which access is provided wholly or mainly for the inspection, maintenance or repair of the building, its services or fixed plant or machinery; and
      (b) be designed with facilities for used by disabled persons.
   (2) The requirements of this by-law shall be deemed to be satisfied by compliance with Malaysian Standard MS 1184 and MS 1183.
   (3) Buildings to which this by-law applies and which on .the date of commencement of this by-law have been erected, are being erected or have not been erected but plans have been submitted and approved shall be modified or altered to comply with this by-laws within 3 years from the date of commencement of this by-law.
   (4) Notwithstanding paragraph (3) the local authority may where it is satisfied that it is justifiable to do so-
      (a) allow an extension or further extensions of the period within which the requirements of this by-law are to be complied with: or
      (b) allow, variations, deviations, or exemptions as it may specify from any provisions of: this by-law.
   (5) Any persons aggrieved by the decision of the local authority under paragraph (4) may within 30 days of the receipt of the decision appeal in writing to the State Authority whose decisions shall be final.

(6) The requirements of this by-law shall apply to any of the following buildings or any part thereof –

(a) offices, banks, post offices, shops, department stores, supermarkets and other administrative anti commercial buildings. except shop-houses existing, at the commencement of this by-law;

(b) rail, road, sea ad air travel buildings and associated concourses, car parking, buildings and factories;

(c) hospitals, medical centers, clinic, and other health and welfare buildings;

(d) restaurants, concert halls, theatres, cinemas, conference buildings, community buildings, swimming pools, sports buildings and other refreshment, entertainment and recreation buildings;

APPENDIX B

Descriptive for Legislation of accessibility in Malaysia

Legal Regulation	Year	Key words/phrases quoted
Act:		
Street, Drainage and Building Act 1974 (Act 133)	1991	Section 3 – Interpretation "frontage" means the owner of premises fronting on, adjoining, abutting on, or adjacent or ***accessible*** to a street or back lane or where the owner of the premises by himself or his tenant has the ***right to use*** or commonly does use the street or back-lane as a means of ***access*** to or drainage from the premises. Section 9 (7b) – Private persons making new streets Any person without the permission in writing of the local authority plants any hedge in such manner that any part thereon is in any direction less than twenty feet from the centre of the carriageway of any street, not being a public street, or less than forty feet from the opposite side of any road or path which is used or intended to be used as the means of ***access*** to two or more houses exclusive of the width of any footway which the local authority requires should be liable on conviction to a fine not exceeding two thousand ringgit, and a Magistrate's Court shall, on the application of the local authority, make a mandatory order against the offender. Section 12 – Declaration of public streets Where street works have been executed to the satisfaction of the local authority under this Part in respect of a private street, which is not less than forty feet wide, then on the request in any other case, of the several frontagers of such private street or part of a private street as together have an annual value of more than fifty per centum of the total annual value of the premises fronting on, adjoining, abutting on or adjacent or ***accessible*** to such private street or part of the private street, as the case may be.

APPENDIX B continued

Legal Regulation	Year	Key words/phrases quoted
Town and Country Planning Act 1976 (Act 172) amended Act 1995 (Act A 933)	1995	Section 21. Application for planning permission (3) Where the developer involves the erection of a building, the local planning authority may give written directions to the applicant in respect of any of the following matters, that is to say the owner of the premises by himself or his tenant has the ***right to use*** or commonly does use the street or back-lane as a means of ***access*** to or drainage from the premises.
Persons with Disabilities Act 2008 (Act 685)	2008	Section 2. Interpretation ***"Universal Design"*** means the design of products, environments, programs and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design and shall include assistive devices for particular groups of PWD where this is needed. Part IV. Promotion and development of the quality of life and wellbeing of PWD. Chapter 1 ***Accessibility***. Section 26 – ***Access*** to public facilities, amenities and services and buildings. • PWD shall have the ***right to access*** to and use of, public facilities, amenities, services and buildings open or provided to the public on equal basis with persons without disabilities, but subject to the existence or emergence of such situations that may endanger the safety of PWD • For the purposes of subsection (1), the Government and the providers of such public facilities, amenities, services and buildings shall give appropriate consideration and take necessary measures to ensure that such public facilities, amenities, services and buildings and the improvement of the equipment related thereto conform to ***universal design*** in order to facilitate their ***access*** and use by PWD

APPENDIX B continued

Legal Regulation	Year	Key words/phrases quoted
		Section 27 – ***Access*** to public transport facilities Section 28 – ***Access*** to education Section 29 – ***Access*** to employment Section 30 – ***Access*** to information, communication, and technology Section 31 – ***Access*** to cultural life Section 32 – ***Access*** to recreation, leisure, and sport
Rule:		
Uniform Building By-Law 1984 By-Law 34A(1) Amended in 1991	1991	By-Law 34A(1) All public buildings shall provide with access to enable disable persons to get into, out of and within the building & be designed with facilities for used by disabled persons. The requirements of this by-law shall comply with MS 1184 and MS 1183.
	2005	By-Law 35. ***Access*** from a street. Every building to be erected on a site which does not front a street shall have ***access*** from a street and the means, nature, and extent of the ***access*** shall be by a layout plan approved by the competent planning authority or the local authority.
Uniform Building By-Law 1984 Selangor	Gazetted in 27 Dec 2012	By-Law 140 (revised & addition) 104. (1) ***Access way*** shall be provided within the site of a building to enable fire appliances to gain access to the building. Access openings shall also be provided along the external walls of buildings fronting the access way to provide access into the building for firefighting and rescue operations. (2) The requirements of ***access way*** shall be as follows: (a) ***access*** way shall have a minimum width of 6 meters throughout its entire length and shall be able to accommodate the entry and maneuvering of the fire engine, extended ladders pumping appliances, turntable, and hydraulic platforms;

APPENDIX B continued

Legal Regulation	Year	Key words/phrases quoted
		(b) ***access*** way shall be metalled or paved or laid with strengthened perforated slabs to withstand the loading capacity of stationary 30 tons fire appliance; (c) ***access*** way shall be positioned so that the nearer edge shall be not less than 2 meters or more than 10 meters from the center position of the access opening, measured horizontally; (d) ***access*** way shall be laid on a level platform or if on an incline; the gradient shall not exceed 1:15. The access road shall be laid on an incline not exceeding a slope of 1:8.3; (e) dead-end ***access*** way and fire engine access road shall not exceed 46 meters in length or if exceeding 46 meters, be provided with turning facilities; (f) outer radius for turning off ***access*** way and fire engine access road shall comply with the requirements of the Fire Authority; (g) overhead clearance of fire engine ***access*** road shall be at least 4.5 meters for passage of fire appliances; (h) public roads may serve as ***access*** way provided that the location of such public roads is in compliance with the requirements of distance from access openings as the Fire Authority may specify; and (i) ***access*** way and the fire engine access road shall be kept clear of obstructions and others parts of the building, plants, trees or other fixtures shall not obstruct the path of the access way and the access openings. (3) All corners of the ***access*** way shall be marked as follows: (b) ***access*** way provided on turfed area shall be marked with a different object (preferably reflective) that is visible at night. The markings are to be at an interval, not more than 3 meters apart and shall be provided on both sides of the access way;

Source: Laws of Malaysia and author

APPENDIX C

National policy on the green technology policy in Malaysia

Year	Event
July 2009	**National Green Technology Policy 2009** The Green Technology Policy (GTP) that was launched in July 2009 by Prime Minister, Dato' Sri MohdNajib bin Tun Haji Abdul Razak is one of the approaches that purposely aims to increase the ***quality of life and a better environment for the people***. In achieving this national mission, buildings ***shall comply with all green design features*** that contribute to energy performance and simultaneously ***accomplish user comfort***. National Green Technology Policy 2009 is launched to promote Green Technology (GT) as a driver to accelerate the national economy and to promote ***sustainable development*:** 1.Strengthen Institutional Frameworks 2.Provide A ***Conducive Environment*** For Green Technology Development 3.Intensify***Human Capital Development*** In Green Technology 4.Intensify Green Technology Research And Innovations 5.Promotion And Public Awareness <u>Objectives</u> under National Green Technology Policy 2009 include: (1) To reduce the energy usage rate at the same time increasing the economic growth. (2) To facilitate the growth of the Green Technology industry and to enhance its contribution to the national economy. (3) To increase the national capability& capacity for innovation in GT development and enhancing Malaysia competitiveness in GT in the global arena. (4) To ***ensure sustainability development*** and conserving the ***environment for future generation***. (5) To enhance public education and awareness in GT and to encourage its widespread use.

Appendix C continued

Year	Event
	The Four Pillars of National Green Technology Policy include: (1) Energy: Seek to attain energy independence and promote efficient utilization. (2) Environment: Conserve and minimize the impact on the environment. (3) Economy: Enhance the national economic development through the use of technology. (4) ***Social: Improve the quality of life for all.***
Oct 2009	In Budget 2010 (Tabled on 24th October 2009) – Government allocated RM 20 billion to intensify ***green and sustainability*** awareness.
Dec 2009	**Public Works Department Malaysia (PWD)** Public Works Department Malaysia (PWD) has taken steps progressively to create, adapt and apply a sustainable building project management throughout building lifecycle; planning, design, construction, monitoring and maintenance as to achieve a ***green nation by 2020***.
Year	**Event**
2011 – 2015	**Tenth Malaysia Plan (2011 – 2015)** Thrust 4: Improving the Standard and ***Sustainability of Quality of Life*** The quality of life for Malaysians improved through better access to healthcare, public transport, electricity, and water. Measures were also taken to create a caring society and promote community well-being. Policy and an action plan on PWDs were formulated in 2007 with the aim of integrating PWDs into the mainstream of society. The Government established the NKRAs and Ministerial Key Performance Indicators (KPIs) to move towards an outcome-based approach for planning, monitoring and evaluating public sector programs.
June 2011	**Green Technology Financial Scheme (GTFS)** There are four sectors of which companies could apply for which are: (i)building; (ii)energy; (iii)waste and water, and (iv)transport.
2012-2015	**Jabatan Kerja Raya Framework** JKR in-house Green Index – developed by CAST 80% of new building projects comply to JKR Green Index 70% healthy projects

Source: Laws of Malaysia and author

APPENDIX D

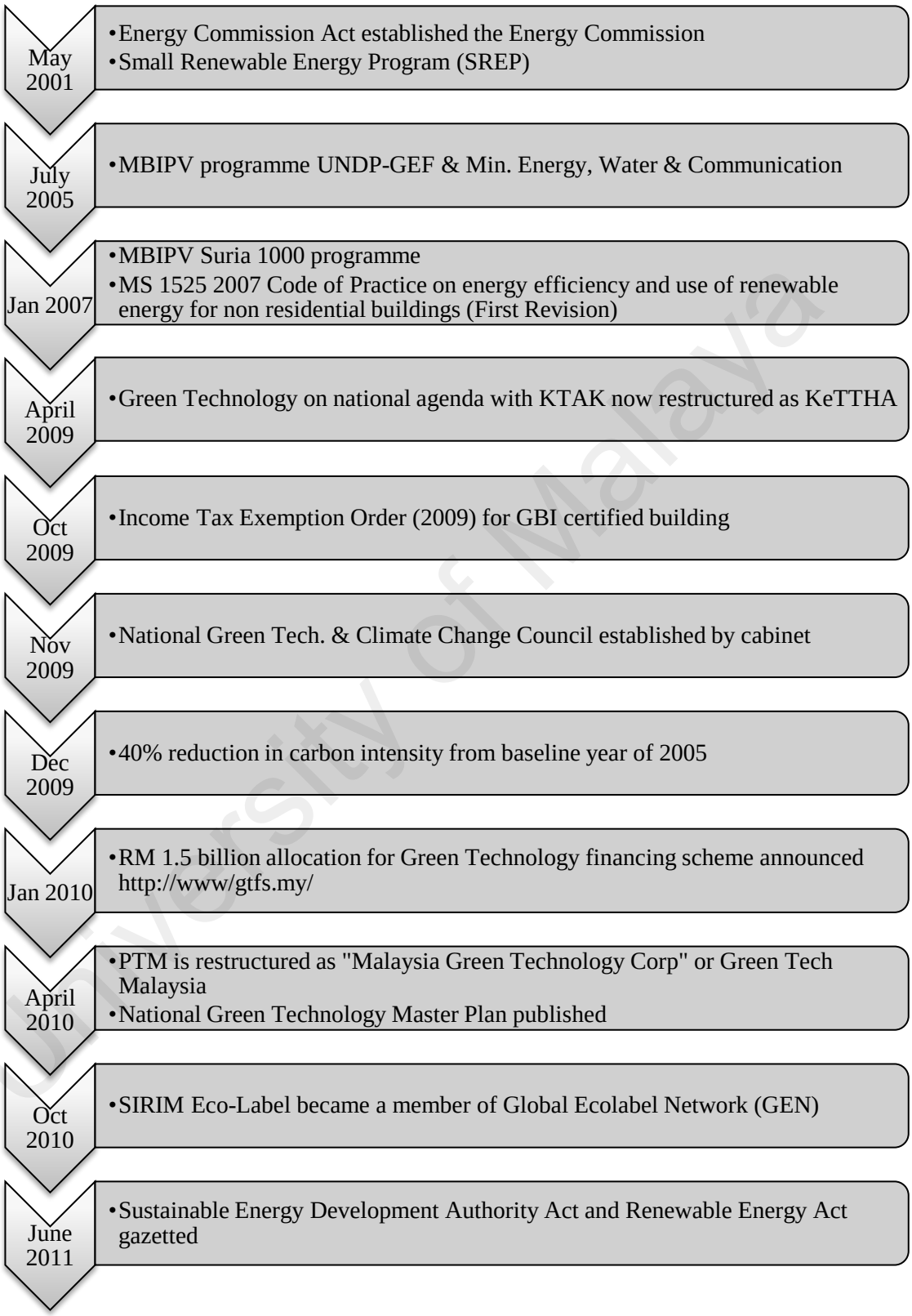
Standards and practice for PWD in Malaysia

Legal Regulation	**Year**	**Remarks**
Malaysian Standards / Guidelines		
MS 1183: Part 8: 1990 (P)	1990	Code of practice for means of escape for disable people
MS 1184: 1991	1991, 2002	Code of practice for *access* for disabled people to public buildings
MS 1331: 1993	1993, 2003	Code of practice for *access* of disabled people outside buildings
MS 1184: 2014	2014	Universal Design and *Accessibility* in the built environment: - Code of Practice (Second Revision)
JKT: AM/B/BIL.19/19	1999	"Guidelines on building requirements for disabled persons" issued by Ministry of Housing & Local Government.
Building requirement for disable	2000	Developed by Federal Department of Town and Country Planning Peninsular Malaysia
Framework		
Full Participation and equity of people with disabilities in Asia & Pacific Region	1994	Malaysia signed on 16th May 1994.
"Asian and Pacific Decade of Disabled Persons 1993 – 2002	1993	Aim at systematically improving the living conditions of disabled persons and helping them to achieve their full development potential.
Biwako Millenium Framework for Action from 2003-2012	2003	To allow disabled persons to be in the main stream of society with the aim to create an inclusive, barrier-free & rights based society for people with disabilities.

Source: Laws of Malaysia and author

APPENDIX E

Timeline for green policies in Malaysia



Source: Kettha

APPENDIX F

Comparison of the goal for both Green building index and Universal Design

Goal of Green Building Index in Malaysia	**Goal of Universal Design**	**Common goal of GBI & UD**	**Difference goals**
1. Green buildings are designed to *save energy and resources*, recycle materials and minimize the emission of toxic substances throughout its *life cycle*.	1. Body fit: *accommodating* a wide *range* of body sizes and *abilities*	Improve the quality of human life & abilities (GBI – 3 & U.D. 1)	GBI – aim for future (GBI 1 & 5)
2. Green buildings *harmonize* with the local climate, traditions, *culture and the surrounding environment.*	2. *Comfort*: Keeping demands within desirable limits of body function	Cultural, social and environmental context (GBI-2 & U.D.-6 & 8)	UD. – focus on body ability (U.D. 1, 2, 7)
3. Green buildings can *sustain and improve the quality of human life* while to maintain the capacity of the ecosystem at local and global levels.	3. *Awareness*: ensuring that critical information for use is easily perceived		
4. Green buildings make efficient use of resources, have significant *operational* savings and *increases workplace productivity*.	4. Understanding: making *methods of operation* and use intuitive, clear and unambiguous	Operation (G.B.I.-4 & U.D. 4)	

APPENDIX F continued

Goal of Green Building Index in Malaysia	**Goal of Universal Design**	**Common goal of GBI & UD**	**Difference goals**
	5. *Social integration*: treating all groups with dignity and respect		
	6. Personalization: incorporating opportunities for choice and the expression of *individual preferences*		
	7. Cultural appropriateness: respecting and reinforcing cultural values and the *social and environmental context* of any design project		

Source: author

APPENDIX G

Integration of Green building principle and Universal Design principle

Universal Design Principles	**Green Building Principles**	**Common Key Words**
U1. Equitable Use - Diverse abilities	G1. Enhance Liveability - Affordable - Inclusive - Healthy - Social interaction - Safe - Caring - People's well-being	User / People (similarities between U1, U2, U3, U4 & U7 and G1)
U2. Flexibility in use - Individual preferences and abilities	G2. Create Opportunities for Economic prosperity - Diversity - Innovation - Economic development	Design (Similarities between U5, U6 & G4)
U3. Simple and intuitive use - User experience	G3. Foster environmental quality - Promote infrastructure - Transport - buildings	
U4. Perceptible Information - user's sensory abilities	G4. Enhance Design excellence - desirable - accessible - adaptable	
U5. Tolerance for error - design minimize hazards	G5. Demonstrate visionary leadership and strong Governance - transparent - accountable - adaptable	
U6. Low physical effort - design usage		
U7. Size and space for approach and use - size and space provide for users		

Source: Author

APPENDIX H
Universal Design index principles

Universal Design Index Principles	Definition
Connectivity	The degree to which the development is designed in a holistic manner to allow for: • seamless connection to public transport nodes, streets, sidewalks and adjacent buildings, etc • seamless movement within the buildings with provisions such as wide circulation paths and doorways • access to all levels of building by ramps and/ accessible lifts and/ ambulant friendly stairs. (Singapore Code of Accessibility)
Accessibility:	The availability and convenience of provisions such as safe and sheltered accessible alighting and boarding points, conspicuously accessible parking lots located near main or lift lobbies, family friendly facilities like family room, seats, and child-friendly sanitary facilities. Other amenities such as accessible information counter, friendly drinking fountain, vending machine, friendly multimedia kiosk, ATM, WiFi access, friendly directory, electric carts, AED (automated external defibrillator), PA system with an induction loop.
Usability	The provision of signage and way finding cues such as audible information, tactile directional indicators, and color or visual themes at main circulation spaces & leading to public transport nodes and facilities. It also includes the degree to which the design of signage and way-finding cues that are easy to read, understand and intuitive regardless of the user's experience, knowledge, language skills or current concentration level.

APPENDIX H continued

Universal Design Index Principles	Definition
Safety	The degree to which walking surfaces are made safe and secure with attention to details such as: • choice of materials, • design without gratings, • free of obstacles and dangerous overhangs, • provision of adequate lighting and handrails/ trailing bars, • contrasting colour • the design clearly distinguishing floors and walls, stairs & landings • provision of tactile warning indicators near the edge of potentially hazardous areas.
Integrated Design	The demonstration of total design approach for targeted user groups in: • the layout design and the integration of all designed aspects • equitable use facilities and features with the overall architecture • the interior design of the building
Operations and Maintenance	The degree to which the organization is committed to creating and maintaining an inclusive built environment through the establishment of corporate policy which is clearly communicated to employees, mandating regular inspections to ensure good working condition of facilities, equipping employees in Universal Design through training, and providing avenues for users to give feedback and authority for employees to render assistance to feedback givers. The use of Disabilities Equality Training and Awareness Programmes and incorporating disabled people's needs in Fire Drills for example.

Source: Draft report to Minister of Transport

APPENDIX I

Universal Design index principle marking Scheme

Item	Percentage (100%)
Connectivity	15%
Accessibility	25%
Usability	20%
Safety	20%
Integrated Design	10%
Operation & Maintanance	10%
Total	100%

Source: Draft report to Minister of Transport

APPENDIX J

Universal Design index classification

Range of percentage	Index
10-20%	1
21-40%	2
41-60%	3
61-80%	4
81-100%	5

Source: Draft report to Minister of Transport

APPENDIX K

Non-Residential New Construction (NRNC) points allocation

Item	Percentage (100%)	Index
Energy Efficiency (EE)	35%	1
Indoor Environment Quality (EQ)	21%	2
Sustainable Site Planning & Management (SM)	16%	3
Materials & Resources (MR)	11%	4
Water Efficiency (WE)	10%	5
Innovation (IN)	7%	6
Total	100%	

Source: http://www.greenbuildingindex.org/

APPENDIX L

Integration of Green building index criteria and `Universal Design index principle in Malaysia

Green Building Index	Universal Design Index
Indoor environmental quality	- Connectivity - Accessibility
Sustainable Site and Management	
Materials and resources	- Usability - Safety - Integrated Design - Operations and Maintenance
Water efficiency	
Energy efficiency	

Source: author

APPENDIX M

Similarities of Universal Design index & Green building index

Universal Design Index Principle	Green Building Index Criteria	Common Key Words
Connectivity The degree to which the development is designed in a holistic manner to allow for: • seamless connection to public transport nodes, streets, sidewalks and adjacent buildings, etc • seamless movement within the buildings with provisions such as wide circulation paths and doorways • access to all levels of building by ramps and/ accessible lifts and/ ambulant friendly stairs. (Singapore Code of Accessibility)	Sustainable Site and management SM8 Public Transport Access: Locate project within 1km of an existing, or planned and funded, commuter rail, light rail or subway station OR within 500m of at least one bus stop.	• Public Transport Access: Locate project to ***connect*** to public transport nodes, streets, sidewalks and adjacent buildings, etc
Accessibility The availability and convenience of provisions such as safe and sheltered accessible alighting and boarding points, conspicuously accessible parking lots located near main or lift lobbies, family friendly facilities like family room, seats, and child-friendly sanitary facilities. Other amenities such as accessible information counter, friendly drinking fountain, vending	Sustainable Site and management SM3 Development Density & Community Connectivity: construct a new building or renovate an existing building on a previously developed site with pedestrian access between the building and the services.	• ***Accessibility/ Connectivity:*** pedestrian access between the building and the services.

APPENDIX M continued

Universal Design Index Principle	Green Building Index Criteria	Common Key Words
machine, friendly multimedia kiosk, ATM, WiFi access, friendly directory, electric carts, AED (automated external defibrillator), PA system with an induction loop.		
Usability The provision of signage and way finding cues such as audible information, tactile directional indicators, and color or visual themes at main circulation spaces & leading to public transport nodes and facilities. It also includes the degree to which the design of signage and way-finding cues that are easy to read, understand and intuitive regardless of the user's experience, knowledge, language skills or current concentration level.	Energy Efficiency EE2 Lighting Zoning: provide flexible lighting controls to optimize energy savings Indoor Environmental Quality EQ15 Post Occupancy Comfort Survey: Verification – provide for the assessment of comfort of the building occupants within 12 months after occupancy which covers thermal comfort, visual comfort and acoustic comfort aspects of the building.	• ***Lighting*** controls to assist ***way finding*** and ***signage*** locating. • ***Assessment of*** comfort of the building occupants after occupancy to justify the degree to usability.
Safety The degree to which walking surfaces are made safe and secure with attention to details such as: • choice of materials, • design without gratings, • free of obstacles and dangerous overhangs,	Energy Efficiency EE2 Lighting Zoning: provide flexible lighting controls to optimize energy savings. Indoor Environmental Quality EQ2 Environmental Tobacco Smoke Control: Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution	• ***Safety and health*** towards building occupants with the attention to details such as: - choice of materials - adequate lighting - obstacles free - indoor

APPENDIX M continued

Universal Design Index Principle	Green Building Index Criteria	Common Key Words
• provision of adequate lighting and handrails/ trailing bars, • contrasting colour • Design clearly distinguishing floors and walls, stairs &landings • Provision of tactile warning indicators near the edge of potentially hazardous areas.	systems to Environmental Tobacco Smoke. EQ4 Indoor Air Pollutants: Reduce detrimental impact on occupant health from finishes that emit internal air pollutants. EQ8 Daylighting: provide good levels of daylighting for building occupants. EQ9 Daylight glares control EQ10 Electric lighting levels EQ11 High-frequency ballasts EQ12 External views <u>Materials and Resources</u> MR1 Material Reuse and Selection MR2 Recycled Content Materials MR3 Regional Materials MR4 Sustainable Timber MR5 Storage and collection or recyclables MR6 Construction Waste Management	surfaces & tactile warning indicators

APPENDIX M continued

Universal Design Index Principle	Green Building Index Criteria	Common Key Words
<u>Integrated Design</u> The demonstration of total design approach for targeted user groups in: • the layout design and the integration of all designed aspects • equitable use facilities and features with the overall architecture • the interior design of the building	<u>Energy Efficiency</u> EE7 Post Occupancy Commissioning: - Carry out post-occupancy commissioning for all tenancy areas after fit out changes are completed: 1. Design Engineer shall review all tenancy fit-out plans to ensure original design intent is not compromised and upon completion of the fit-out works, verify and fine tune the installations to suit. <u>Indoor Environmental Quality</u> EQ1 Minimum IAQ Performance: establish minimum air quality performance to enhance indoor air quality in the building, thus contributing to the comfort and well-being of the occupants. EQ5 Mould Prevention: design systems which reduce the risk of mold growth and its associated detrimental impact on occupant health. <u>Materials and Resources</u> MR1 Material Reuse and Selection	• to ensure original design intent which had integrated all designed aspects ***fit for purpose***.

APPENDIX M continued

Universal Design Index Principle	Green Building Index Criteria	Common Key Words
	MR2 Recycled Content Materials MR3 Regional Materials MR4 Sustainable Timber MR5 Storage and collection or recyclables MR6 Construction Waste Management <u>Water Efficiency</u> WE1 Rainwater Harvesting WE2 Water Recycling WE3 Water efficient – irrigation/landscaping WE4 Water Efficient fittings WE5 Metering & Leak detection system <u>Innovation</u> IN1 Innovation in design & environmental design initiatives	

Source: author

APPENDIX N

Common key words for goal, principle, and index of Green building and Universal Design

Goal	**Principles**	**Index**	**Common Key words for goal, principles and Index**
CG1. Improve the quality of human life & abilities (GBI – 3 & U.D. 1)	CP1. User / People (similarities between U1, U2, U3, U4 & U7 and G1)	CI1. Public Transport Access: Locate project to ***connect*** to public transport nodes, streets, sidewalks and adjacent buildings, etc	**Usability (CG1, CG3, CP1, CP2, CI3, CI4, CI5)**
CG2. Cultural, social and environmental context (GBI-2 & U.D.-6 & 8)	CP2. Design (Similarities between U5, U6 & G4)	CI2. *Accessibility/Connectivity:* pedestrian access between the building and the services.	**Accessibility (CG2, CP2, CI1, CI2, CI6)**
CG3. Operation (G.B.I.-4 & U.D. 4)		CI3. *Lighting* controls to assist *way finding* and *signage* locating. *Assessment of* comfort of the building occupants after occupancy to justify the degree to usability.	
		CI4. *Safety and health* towards building occupants with the attention to details such as: - choice of materials - adequate lighting - obstacles free indoor surfaces & tactile warning indicators	

APPENDIX N continued

Goal	Principles	Index	Common Key words for goal, principles and Index
		CI5. To ensure original design intent which had integrated all designed aspects *fit for purpose*.	

Source: author

APPENDIX P

Legend clarification for the Access Audit Checklist

Legend	Remarks
/	**Total accessibility / complied** Where persons with disabilities can travel within the area, easily enter and gain access to all of its parts, and use spaces and equipment in conditions of independence and safety.
Δ	**Partial accessibility** Where persons with reduced capacities, especially persons with vision impaired have limited access to all of its parts, and uses spaces and equipment.
○	**Deferred accessibility** Where the built environment can be modified with limited costs in order to allow use by persons with disabilities.

Source: author

APPENDIX Q

Summary of access audit checklist finding for *Vertical Accessibility: Internal Staircase* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
9.1	Clear Width	Is the clear width between handrails at least 900mm?	/ 1275mm	/ 1100mm
9.4(a)	Risers/ Treads	In any one flight of stairs, do all the steps have uniform riser heights and tread widths?	/	/
9.4(e)		Are the risers closed and plain faced?	/	/
		Are the riser heights no more than 180mm?	/ 180mm	/ 160mm
		Are the tread width uniform and 265mm to 280mm depth?	○ 260mm	○ 260mm
9.4(d)	Nosing	Is the radius of the nosing between 10mm to 15mm?	/	/
		Do the nosing project no more than 25mm?	/	/
9.4(c)	Surface	Do treads have a non-slip surface?	/	/
	Visual Contrast	Do the surface of landing and floor level contrast in color or texture from stairs?	○ Same tiles	/
9.9	Handrails	Do stairways have continuous handrails on both sides?	/	○ Single side
9.9	Height	Are the tops of handrails is between 840mm and 900mm above the stairs surface?	○ 980mm	○ 1000mm
12.2	Diameter	Is the grip diameter of the handrail between 40mm and 50mm?	/ 55mm diameter	/ 40mm diameter
12.5	Clearance	Is the clearance between walls and handrails between 50mm and 100mm?	/ 70mm	/ 50mm
12.1	Extension	Do handrails have a 300mm horizontal extension parallel to the floor at top riser?	○ 280mm	○ 250mm

APPENDIX Q continued

Clause	Element	Technical Requirement	GEO	LEO
		Do handrails have a 300mm horizontal extension parallel to the floor at bottom riser?	○ 280mm	○ 220mm
12.4	Obstruct-ion	Is the gripping surface uninterrupted by newel posts or other obstructions?	/	/
12.3		Are the ends of handrails rounded or returned smoothly to the floor, wall or post?	/	/
12.3		Are handrails fixed so that they do not rotate within their fittings?	/	/
12.7	Color Contrast	Are handrails contrasts in colour with the supporting walls?	/ Handrail: Grey Wall: White	/ Handrail: Grey Wall: White
15.5	Guiding Blocks	Are the guiding blocks 300mm wide extending the full width, and 300mm away from the edge of top and bottom of step?	NA	NA
15.2(d)		Do guiding blocks contrast visually with adjoining surfaces (light-on-dark or dark-on-light)?	NA	NA
15.4	Raised Marking	Do guiding blocks detectable underfoot and have raised truncated domes of 5 – 6mm above the floor level finish??	NA	NA
29.4	Illuminat-ion Level	Is the illumination level at stairways at least 150 lux?	/	/

Source: author

APPENDIX R

Summary of access audit checklist finding for *Vertical Accessibility: Fire Escape* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
	Fire Exits	Are fire exits clearly marked and easily identifiable?	/	/
		Are fire exits free from obstruction?	○ locked	/
	Exit Door Signs	Are the characters on such signs raised and accompanied by Braille?	○	○
		Do the characters and background on such signs have a non-glare finish?	/	/
		Do the characters on such signs contrast with their background (light-on-dark or dark-on-light)?	/	/
11.2.2 (h)		Are door signs posted at about eye level?	/	/
11.2.2 (i)	Fire Door	Are fire rated doors equipped with self-closing devices, latching hardware?	○ locked	/
		Is all door hardware operable without tight grasping, pinching, or twisting of the wrist? (U-shaped handles, levers, and push type mechanisms are acceptable designs)	/	/
	Emergency Lighting	Is there an emergency lighting system that is adequately maintained?	/	/
	Fire Extinguishers	Are fire extinguishers available?	/	/
		Are the fire extinguishers suitable to the type of fire that may occur?	/	/
		Are fire extinguishers serviced regularly?	/	/
	Hose Reels	Are hose reels available and connected to water supply?	/	/
		Is access to the hose reels unobstructed?	/	/

APPENDIX R continued

Clause	Element	Technical Requirement	GEO	LEO
	Red Phones	Are phones in working order?	○	/
		Are phones obstructed from view?	○	○
6.2(e)	Wheelchair Spaces in Areas of Rescue - Size	Does each area of rescue-protected area provide with at least one space that does not obstruct the flow of persons escaping?	/	/
	Two-Way Communication	If emergency systems are provided, do they have both visual and audible signals?	○ Bell	/
		Is the emergency intercom identified by Braille and raised letters?	○	○
	Instructions for Use	Are there instructions for the use of the area of rescue assistance during an emergency posted adjacent to the communication system?	○	/
	Identification Signs	Is each area of rescue assistance identified by a sign which states "Area of Rescue Assistance", and which also displays the International Symbol of Accessibility?	○	/
		Is the sign illuminated when/where exit signs are required to be illuminated?	○	/
	Directional Signs	Is there directional signage posted at all inaccessible exits indicating the direction to areas of rescue assistance?	○	/
		Are directions to exits posted on all floors?	○	/
	Emergency Procedure Posters	Are emergency procedure posters displayed?	NA	/
		Are posters in a prominent position and easy to understand?	NA	/
		Are posters available in other languages as necessary?	NA	○
		Are posters adequately maintained?	NA	/

Source: author

APPENDIX S

Summary of access audit checklist finding for *Vertical Accessibility: Lift* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
10.1	Lobby	Is the clear depth in front of the lift door (lobby) not less than 1800mm?	/ 3450mm	/ 2200mm
10.2	Floor Tolerance	Does the floor of lift car level within 10mm tolerance with the lobby floor level?	/ 3mm	/ 3mm
	Visual Indicators	Is the button designating the "up" direction above the "down" button?	/	/
		Are the buttons raised?	/	/
		Is there a visible and audible signal at each hoistway entrance to indicate which car is answering a call?	/	/
	Audible Signals	Do audible signals sound once for "up" and twice for "down," or do they have verbal annunciators that say "up" or "down"?	/ Verbal	/ Verbal
10.5(b)	Doors	Is the clear door opening width more than 800mm?	○ 800mm	/ 1100mm
10.5(d)		Does the door stay open at least 5 seconds?	/	/ 10 sec
10.5(c)		Is sensing device provided to ensure that lift car door will open while the opening is obstructed?	/	/
29.4	Illuminati on Levels	Is the illumination level inside the car and the lobby at least 150 lux?	/	/
10.6	Lift Controls	Are the controls raised?	○	/
10.6(d)		Do the controls also have Braille?	/	/
		Do the numbers and characters contrast with the background (light-on-dark or dark-on-light)?	○	/
10.6(b)		Are the control buttons at least 20mm in diameter?	/	/ 30mm diameter

APPENDIX S continued

Clause	Element	Technical Requirement	GEO	LEO
10.6(c)	Height of Controls	Are the floor buttons, alarm buttons, and door control buttons placed no higher than 1400 mm from the floor level?	/ 975mm	/ 1150mm
10.3	Handrails	Is the handrail placed at a height of 1000mm from the floor and fixed adjacent to the control panel?	NA	/ 1000mm
		Is the handrail length not less than 600mm?	NA	/
15.5	Guiding Blocks	Are the guiding blocks 300mm wide extending the full width, and 300mm away from the lift door?	NA	NA
15.2(d)		Do guiding blocks contrast visually with adjoining surfaces (light-on-dark or dark-on-light)?	NA	NA
15.4	Raised Marking	Do guiding blocks detectable underfoot and have raised truncated domes of 5 – 6mm above the floor level finish??	NA	NA

Source: author

APPENDIX T

Summary of access audit checklist finding for *Horizontal Accessibility: Entrance Foyer* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
6.1	Ground Floor Entrance	Is there at least one accessible entrance on the ground floor?	/	/
6.3	Direction-al Signs	Are signs adequate to assist in locating the accessible entrance?	○	○
		If an entrance is **not** accessible, are there directional signs indicating the location of the nearest accessible entrance?	○	○
		Do the directional signs comply with Clause 28? (Use Form 19: Sign and Symbol)	○	○
3.1	Accessible Footpath	Within the boundaries of the site, is the accessible entrance connected by an accessible footpath to existing public transportation stops, accessible parking and passenger loading zones, and to public streets or sidewalks?	○	/
		Is the accessible entrance connected by an accessible footpath to all accessible elements or spaces within the building or facility?	○	○
7.1 (a)	Level Change	Is there a step ramp at the entrance?	○	○
8.1	Doors	At each accessible entrance to a building or facility is there at least one accessible door comply with Clause 8?	○	/
8.7	Turnstiles	If turnstiles or revolving doors are used on an accessible route, is there an accessible gate or door provided adjacent to the turnstile or revolving door to facilitate the same use pattern?	/	○
	Gates	Do all gates, including ticket gates, comply with the applicable specifications of Clause 8.4? (Use Form 15: Doors and Doorways)	-	-

APPENDIX T continued

Clause	Element	Technical Requirement	GEO	LEO
8.9	Glass Door or Wall	If glazed door / wall are used, is a clearly distinguishable colour contrasting strip across the full width at 800-1000mm above floor?	○	○
4.6	Disembarkation Space	Is provided disembarkation space for disabled persons at the entrance?	○	○
6.4	Guiding Block	Is provided guiding blocks leading to the main entrance?	○	○

Source: author

APPENDIX U

Summary of access audit checklist finding for *Usability: Door* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
8.1	Doors - Accessible Entrances	Is there at least one accessible door complying with applicable specifications below at each accessible entrance to the building or facility?	/	/
8.2	Egress Door and Areas of Rescue Assistance	Does each door that is an element of an accessible means of egress or that connects to an area of rescue assistance comply with applicable specifications below?	/	/
8.2.1	Open Direction	Does the door open in the exit direction?	/	/
		Does the door acting as double swing open?	/	/
8.3	Revolving Doors and Turnstiles	If a revolving door or turnstile is used on an accessible route, is an accessible door or gate provided adjacent to it?	/	○
8.4	Gates	Do gates, including ticket gates, meet the applicable specifications below?	○	○
8.5	Clear Opening	When a door is open 90 degrees, is there a clear opening width at least 900mm measured between the face of the door and the door stop on the latch side?	○ 900mm	/ 1100mm
8.6	Double Leaf Doors	If the doorway has two independently operated door leaves, does at least one active leaf provide at least a 900mm clear opening width?	- N/A	○ 650mm
8.7	Thresholds	Is the threshold at doorways no higher than 10mm?	/ 3mm	/ 2mm
8.8	Hardware	Are all handles, locks, and latches or other operative devices operable with one hand?	/	/

APPENDIX U continued

Clause	Element	Technical Requirement	GEO	LEO
8.8.1		Are they operable without tight grasping, pinching, or twisting of the wrist? (U-shaped handles, levers, and push type mechanisms are acceptable designs.)	/	/
8.8.2		If there are sliding doors, is the operating hardware exposed and usable from both sides when the doors are fully open?	/	/
8.8.3		Is the operating device or handle mounted between 900mm and 1200mm above the floor?	/	/
8.8.4		Is the clearance between the handles and the back plate not less than 50mm?	/ 55mm	/ 60mm
8.9	Door Closers – External Door.	Is the force required to operate the controls no greater than 36N?	/	/
		Is the force required to operate the controls no greater than 22N?	/	/
8.10	Opening Force - Fire Doors	Do fire doors have the minimum opening force allowable by the appropriate local authority?	○ All fire door are locked	/

Source: author

APPENDIX V

Summary of access audit checklist finding for *Usability: Restaurant and Cafetaria* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
	Accessible Tables	Does at least 5% (but **not** less than 1%) of all fixed tables comply with applicable specifications below?	-	/
	Clear Floor Space - Seating	Do seating spaces for wheelchair users have at least a 900mm by 1200mm clear floor space that adjoins or overlaps an accessible route?	/	○ 700mm
	Knee Space	Is the knee space at least 750 mm high, 750mm wide and 450 mm deep?	/	○ 700mm high, 320mm deep, 700mm wide
	Table/Counter Height	Is the top of the table or counter **not** more than 800mm?	/	/ 700mm high
	Accessible Route	Are all accessible routes between accessible fixed tables at least 900mm wide?	/	/ 1050mm wide
	Food Service Lines	Do food service lines have circulation path of at least 1200mm clear width?	/	/
	Tray Slide	Are tray slides **no** more than 800mm above the floor?	/	○ 900mm
	Vending Machines	Are spaces for vending machines located on an accessible route?	NA	/ Drink vending machine
	Sign	Is the symbol for disabled placed on the table reserved for people with disabilities?	NA	NA

Source: author

APPENDIX W

Summary of access audit checklist finding for *Usability: Room & Spaces* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
8.1	Doors	Do the doors comply with Clause 8? (Use Form 15: Door and Doorways)	/	/
8.9	Glass Door or Wall	If a glazed door / wall is used, is a clearly distinguishable colour contrasting strip across the full width at 800-1000mm above floor?	○ 950-1220 mm	○ 1130-1250m m
8.10	Threshold	Is the threshold less than 10mm or beveled at gradient 1:2 or less?	/ 3mm	NA
14.1	Aisles	Are aisles between permanently built-in case work or partitions at least 1200mm wide?	/	/
25.1	Protruding Objects	If objects mounted to the wall have leading edges between 500mm and 2000mm from the floor, do they project less than 100mm into the accessible space?	○ 360mm protrude out from wall	○ 400mm
		Do free-standing objects, mounted on posts with leading edges between 500mm and 2000mm (such as drinking fountains or telephones) project **not** more than 300mm into the perpendicular route of travel?	○ Drinking fountain: 320mm	○ 400mm
26.1	Floors	Are the floor surfaces in all accessible rooms and spaces stable, firm, and slip-resistant?	/	/
5.1(c)	Level Changes	When walkway levels change, is the vertical difference less than 10mm?	○ 25mm	○ 40mm
26.1	Carpet	If carpet or carpet tile is used on the floor, is it securely attached?	/	○ detached

APPENDIX W continued

Clause	Element	Technical Requirement	GEO	LEO
28.5	Sign and Symbols	Do signs, which provide direction to, or information about, functional spaces of the building comply with Clause 28? (Use Form 14: Sign and Symbols)	/	/
28.4	Room Identification Signage	Do signs, which designate permanent rooms and spaces, comply with Clause 28? (Use Form 14: Sign and Symbols)	/	/
24.3	Work Surfaces	Is the top of the table or counter **not** more than 840mm above the floor?	/ 750mm	○1150mm
24.1	Knee Space	Is the knee space at least 750mm high, 750mm wide and 540mm deep?	/	/
27.4	Controls – Telephone, Vending	Are all telephones, vending machines, and other such facilities, their buttons **no** higher than 1000mm above the ground and face forwards?	/	NA
27.3	Controls - Power Outlets	Are general power outlets, dispensers, and similar devices between 500mm to 1200mm from the floor, and 500mm from corners?	○ 300mm from the floor	○ 300mm from the floor
27.3	Light Switches	Are light switches horizontally aligned with door handles at between 900mm to 1200mm?	○ 1500mm	○
27.1; 27.7	Window and Doors	Are locking and opening controls for windows and doors accessible?	/ Sliding doors	○ Locked
29.1	Alarms	Where alarms are provided, do they comply with Clause 29?	/	/
27.4	Public Telephones	If public telephones are located in a room or space, do they comply with Clauses27.4? (Use Form 16: Telephones)	○	○
	Exit Door Signs	Are exit doors all marked with the International Symbol of Accessibility?	○	/

Source: author

APPENDIX X

Summary of access audit checklist finding for *Usability: Urinal Area* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
18(a)	Wall-hung Urinal	If provided, is at least one wall hung urinal having a rim located 400mm above the floor?	/ 570mm	/ 500mm
18(b)	Floor-mounted Urinal	Is provided floor-mounted urinals with size **not** less than 760mm wide?	NA	NA
18(a)	Step Free	Is constructed step or hob free?	○ Level difference: 90mm	○ Level difference: 45mm
18(c)	Grab Rails	Are there grab rails installed on both side of the urinal?	○	NA
		Are grab rails vertically mounted and 1200mm above the floor?	○	/

Source: author

APPENDIX Y

Summary of access audit checklist finding for *Usability: Bus and Taxi Station* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
	Taxi / Bus Stop	Is the taxi stand located nearest to an accessible entrance?	NA	○
	Clear Passageway	Are the clear passageway between seating and handrail at least 900mm wide?	NA	/
	Guiding Blocks	Do hazard warning (dot-type guiding blocks) provided at 600mm - 900mm from hazard or dangerous drop-off?	NA	○
	Guard Rails	Are guard rails provided at height of 900mm from the floor level?	NA	/
	Step Ramps	Where a taxi stand is **not** on the same level with the walkway or pathway, does provided two separate step ramps for boarding and alighting?	NA	○
		Is the minimum width for each step ramp 1000mm?	NA	○ 900mm
	Seating	Do seating provided for users between 420mm and 450mm above walking surface?	NA	/
	Floor Surface	Is the taxi stand floor surface even and slip resistant?	NA	/

Source: author

APPENDIX Z

Summary of access audit checklist finding for *Way Finding: Signage and Symbol* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
	Directional and Information-al Signs	Do signs that provide direction to, or information about, functional spaces of the building comply with Clauses 28.1, 28.2, and 28.6?	/	/
	Room and Space Identificati-on Signs	Do signs that designate permanent rooms and spaces comply with Clauses 28.1, 28.2, and 28.6?	/	/
28.1	Contrast	Do the characters contrast with their background (light-on-dark or dark-on-light)?	/	/
	Finish	Do the characters and backgrounds on such signs have a non-glare finish?	/	/
28.2	Symbol Size:	Is the symbol on such signs sized according to viewing distance and comply with Clause 28.2?	/	/
28.6	Character Size	Are the characters on such signs sized according to viewing distance and comply with Clause 28.6?	○	/
28.7	Raised and Braille Characters	Are the characters on such signs raised and accompanied by Braille?	○	○
28.5	Symbols	Is a directory to such signs provided?	○	/
		If a symbol is used, is the symbol accompanied by the equivalent verbal description?	○	/
	Mounting Location	Are such signs mounted on the wall adjacent to the latch side of the door? (At double leaf doors, are the signs placed on the nearest adjacent wall?)	/	/
	Mounting Height	Are such signs mounted 1500mm above the floor surface?	/	/ 1650mm

Source: author

APPENDIX Z1

Summary of access audit checklist finding for *Way Finding: Guiding Block* for the multiple site case study

Clause	Element	Technical Requirement	GEO	LEO
15.5	Entry Points: Doors, Stairs, Ramps, Lifts, etc.	Do entry points on a site have a dot-type guiding blocks complying with Clause 15.4, i.e. extending the full width and 300mm before the entry point?	NA	NA
15.5	Hazardous Vehicular Way	Are the boundaries of pedestrian areas and vehicular areas defined by a continuous dot-type guiding blocks with Clause 15.4, i.e. 600mm away from the edge of the pedestrian area?	NA	NA
15.5	Dangerous Drop-Off	Are the edges of pedestrian area defined by a continuous dot-type guiding block complying with Clause 15.4, i.e. 900mm away from the edge?	NA	NA
15.4	Guiding Blocks	Do guiding blocks consist of raised truncated domes with a nominal diameter of 25 – 35mm, a nominal height of 5 – 6mm, and a nominal center-to-center spacing of 50 – 70mm apart?	NA	NA
15.2	Color Contrast	Do guiding blocks contrast in colour with adjoining surfaces (light-on-dark or dark-on-light)?	NA	NA
15.2		Do guiding blocks detectable underfoot or with cane?	NA	NA
15.6	Raised Marking	Do the guiding blocks raised truncated domes stand out above the upper surface of adjacent surfaces?	NA	NA

Source: author

APPENDIX Z2

Summary of access audit checklist finding for *common items* for the multiple site case study

Both GEO and LEO do not have the following facilities:

a) Special phone
b) Atm machine
c) Internal ramp
d) Internal step ramp

APPENDIX Z3

Result of detached observation Green Energy Office

(Person with sensory impaired)

"I hate this place especially at the moment you drop me at the drop off area of the building. There was ***nothing to assist me in directing my way*** *towards the entrance of the building, even though I have my cane with me. I couldn't find the reception on my own.*

After I look a few steps up from the pedestrian walkway and ***hit by a few things****, I reach the foyer of the building. I found out that it was not a simple "push and pull door" just like any other office building but it is instead a rotating door which normally used at shopping mall, after seeking for a manual help from someone directed me to the building. I didn't expect there will be a rotating welcoming me as I couldn't feel the cylindrical glass door surrounding me. The entrance of the building is not so welcoming as there is nothing to direct me and providing information or either to the receptionist counter. In addition, there is nobody greeting me and asked me where I was going to. I had to find my way to the toilet by* ***seeking someone's help*** *based on the noise I heard when I feel that someone is crossed by. I hate this kind of feeling, as I felt I'm going to fall anytime by walking endlessly and keep on turning around finding the space.*

The lobby is not very helpful because it is very very quiet until I didn't even know I was at the lobby. It was very empty and I could go round and round, ***finding myself lost****. I cannot sense the wall or any other thing giving me direction and guiding block on the ground.*

"On my way heading to toilet, I can sense through my cane that there was a drop and I manage to enter the toilet without falling to use the water closet and sink. I felt the wall and the space at the moment I enter the toilet, that is the main reason I manage to go out from the toilet. But, there is nothing to direct me from toilet to the lift. I have to ask for others' manual help. I was on my own to the lift by "reading" / sensing the Braille sign at the lift buttons. I can sense the material of lift which is colder than other building material as it is colder. The moment I was inside the lift, with the help of audio which told me which floor I was at. I was ***struggling the way*** *from the lift to office when it was reached first floor. It takes me a long time to feel the surrounding using my cane but I was lost. As there was no signage, guiding block, tactile map and Braille for me to study the buildings' space before I came in to the building in order to reach to the stipulated spaces."*

*"It was pretty **difficult for me to access** from the office to the staircase because there are a lot of fusses, for example, plants obstructing my way and I keep on hitting them. I found that the **railing was helpful** by hinting me there was steps and landing, especially the handrail of the landing didn't stop immediately when there was a landing. I feel more safe."*

*"I was trying to find my way to the library but I cannot reach. I **keep on hitting** bunting, panels, signage placing on the wall without even realize me myself was actually at the middle of the exhibition area in the lobby. I keep on finding my way back and forth, but still couldn't find the library. I keep on walking around and sensing the space using my cane until I reach a space where the floor finishes material is different than others, i.e. carpet instead of tiles at lobby area. Immediately after that, I sense a stack of papers, newspapers and subsequently sofa seating area, table and partition of vertical shelves with the books arrangement, which make me concluded that it is a library. I, however, feel the position of the bunting and panels are not in proper places because I kept on hitting them which always disturb me. I not sure about the location of the wall and the space arrangement, but I feel unbalance to walk and it is dizzy for me, especially when I keep on hitting plants. In addition, there was no indication at all where I was, and I didn't know how the overall building work as there was no map and others to assist me in my way finding journey.After leaving the library area, I coincidently reach another sofa seating area which allow me to rest.*

*In order to survive in this building, I think to **seek for the help from others is necessary**. I feel that the building is silence and very empty, which make me feel that I'm the only one using the building. I feel lost without direction given and people's assistance.*

APPENDIX Z4

Findings of direct observation: Horizontal Accessibility

	GEO	LEO
Persons with sensory impaired		
Entrance Foyer	- Without provision of guiding block leading to the main entrance	- Lack of accessible gate or door for accessible route
Persons with physical/mobility impaired		
Entrance Foyer	- Lack of directional signage - Accessible footpath is not connecting to the entrance foyer - Entrance door is inaccessible (touch card required) - Lack of clear distinguishable colour contrasting strips across the full width at 800- 1000mm above floor for all glass door or wall - Disembarkation place for disabled persons at entrance is not provided	- Lack of directional signage - Accessible entrance cannot connect the accessible footpath with other accessible elements or spaces within the building or facility - Lack of clear distinguishable colour contrasting strips across the full width at 800- 1000mm above floor for all glass door or wall - Disembarkation place for disabled persons at entrance is not provided

Source: author

APPENDIX Z5

Findings of Direct Observation: Vertical Accessibility

	GEO	**LEO**
Persons with sensory impaired		
Internal Staircase	- Width of tread does not comply to the UBBL requirement, 260mm provided instead of 265mm; - Visual contrast: same tiles for both landing and staircase; - Height of handrail over provided, 980mm instead of 840-900mm; - Extension of the handrail (parallel to the floor) too short, 280mm instead of 300mm - Without the provision of guiding block and raised marking	- Width of tread does not comply with the UBBL requirement, 260mm provided instead of 265mm - Only single side handrail being provided, instead of both sides - Height of handrail over provided, 1,000mm instead of 840-900mm; - Extension of the handrail (parallel to the floor) too short, 250mm instead of 300mm - Without the provision of guiding block and raised marking
Fire escape staircase	- Fire escape door is locked - Without the provision of exit door signs - Emergency intercom is not identified by Braille and raised letters	- Without the provision of exit door signs - Emergency intercom is not identified by Braille and raised letters
Lift	- Lift controls are not raised & the number and characters are not contrast with the background - Without the provision of guiding block and raised marking	- Without the provision of guiding block and raised marking

APPENDIX Z5 continued

	GEO	**LEO**
Persons with physical/mobility impaired		
Internal Staircase	- N/A	- N/A
Fire Escape	- Without the provision of red phone & visual and audible signal for two way communication - Lack of rescue assistance instruction during an emergency posted adjacent to the communication system - Lack of directional signs - Without provision of emergency procedure posters	- Emergency poster provided not available in other language
Lift	- Clear door opening just sufficient, i.e. 800mm - Handrails are not provided	-

Source: author

APPENDIX Z6
Problems identified for detached observation (site simulation):
Vertical Accessibility

	GEO	LEO
Persons with sensory impaired (vision & hearing impaired)		
Total issues raised by simulator for ***Staircase***	2 Nothing to assist Difficult to access	1 Nothing to assist
Total issues raised by simulator for ***Fire escape staircase***	1 Nothing to assist	1 No signage
Total issues raised by simulator for ***Lift***	1 No signage	1 No signage
Persons with physical / mobility impaired (wheelchair, crutches, learning disability & abled persons)		
Total issues raised by simulator for ***Staircase***	0	1 Very dangerous
Total issues raised by simulator for ***Fire escape staircase***	1 Door of fire escape	0
Total issues raised by simulator for ***Lift***	1 Too small	0

APPENDIX Z7
Problems identified for detached observation (site simulation):
Horizontal Accessibility

	GEO	LEO
Persons with sensory impaired (vision & hearing Impaired)		
Total issues raised by simulator for ***Entrance foyer***	3 Nothing to assist Lobby feeling empty	2 Nothing to assist Entrance very confused
Persons with physical/mobility impaired (wheelchair, crutches, learning disability & abled people)		
Total issues raised by simulator for ***Entrance foyer***	1 Ramp is very steep	2 Difficult to change the wheelchair direction

APPENDIX Z8
Problems identified for detached observation (site simulation): Usability

	GEO	LEO
Persons with sensory impaired (vision & hearing impaired)		
Total issues raised by simulator for ***Door***	1 Foyer	0
Total issues raised by simulator for ***Restaurant & cafeteria***	1 Circulation	0
Total issues raised by simulator for ***Room & space***	1 Lobby	0
Total issues raised by simulator for ***Urinal area***	1 Water closet & sink	0
Total issues raised by simulator for ***Bus & Taxi station***	1 Too far away	1 Too far away
Persons with physical/mobility impaired (wheelchair, crutches, learning disability & abled persons)		
Total issues raised by simulator for ***Door***	3 - Entrance - Door too heavy for OKU - Door swing difficult for OKU	0
Total issues raised by simulator for ***Restaurant & cafeteria***	1 Table too high	0
Total issues raised by simulator for ***Room & space***	1 Counter is too high	0
Total issues raised by simulator for ***Urinal area & surau***	1 Sink too high	0
Total issues raised by simulator for ***Bus & Taxi station***	0	0

APPENDIX Z9
Problems identified for detached observation (site simulation): Way finding

	GEO	LEO
Persons with sensory impaired (vision & hearing impaired)		
Total issues raised by simulator for ***signage and symbol***	26	4
Affected Areas	- Open car park - Cafetaria - Lift - Toilet - Surau - Circulation - Fire Staircase	- Lobby - Toilet - Circulation - Fire staircase - Entrance
Total issues raised by simulator for ***guiding block***	Not provided	Not provided
Persons with physical/mobility impaired (wheelchair, crutches, learning disability & abled persons)		
Total issues raised by simulator for ***signage and symbol***	-	2 Disabled car park
Total issues raised by simulator for ***guiding block***	-	-