ASSESSMENT OF WALKABILITY AND PUBLIC TRANSPORT SERVICES IN LUYANG, KOTA KINABALU

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UNIVERSITI MALAYSIA SABAH
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ASSESSMENT OF WALKABILITY AND PUBLIC TRANSPORT SERVICES IN LUYANG, KOTA KINABALU

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELOR OF CIVIL ENGINEERING

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ABSTRACT

Excessive carbon dioxide emission is becoming one of the main concerns of the world in recent years. To reduce adverse impacts, walking is the best method as it greatly aids in the reduction of carbon emission released from motorized vehicles. Walkability has always been related to the environmental issues around the world. This study investigates the improvement indicators of walkability and public transport service at Luyang, Kota Kinabalu as it has a high concentration of pedestrian especially during morning market. The study was conducted via field observtion and questionaire distribution and then analysed by using Analytical Hierarchy Process to determine the safety, connectivity and comfortability indicators with their respective weightages and ranking. It has been found that the most concerned and bothersome factor is comfortability as there are lack of comfortability aspects in Luyang. It was found that the most concerned issue regarding the services of bus in Luyang was the amount of bus stops within 800m radius of the boundary area, followed by the frequency of bus and lastly the comfort aspects of public transport services. Along with that, the walkability index in Luyang achieves satisfactory as they are higher than 0.5, with the highest walkability index of 0.758 at road segment 1, followed by road segment 2 and finally road segment 3 with the lowest walkability index at bus stop 5 (0.499). Therefore, it can be concluded that the walkability of Luyang and the public transport services is satisfactory since the walkability index found are mostly exceeding 0.5, but further improvement can be done to improve the built environment in Luyang, especially in the aspect of comfort.

ABSTRAK

PENILAIAN KEBOLEHJALAN DAN PERKHIDMATAN PENGANGKUTAN AWAM DI LUYANG, KOTA KINABALU

Pelepasan karbon dioksida yang berlebihan menjadi salah satu kebimbangan utama dunia sejak beberapa tahun kebelakangan ini. Untuk mengurangkan kesan buruk, berjalan kaki adalah kaedah terbaik kerana ia sangat membantu dalam pengurangan pelepasan karbon yang dikeluarkan daripada kenderaan bermotor. Kebolehjalan kaki sentiasa dikaitkan dengan isu alam sekitar di seluruh dunia. Kajian ini menyiasat petunjuk penambahbaikan kebolehjalan kaki dan perkhidmatan pengangkutan awam di Luyang, Kota Kinabalu kerana ia mempunyai tumpuan pejalan kaki yang tinggi terutamanya semasa pasar pagi. Kajian telah dijalankan melalui pemerhatian lapangan dan pengedaran soal selidik dan kemudian dianalisis menggunakan Proses Hierarki Analitik untuk menentukan petunjuk keselamatan, ketersambungan dan keselesaan dengan wajaran dan kedudukan masing-masing. Telah didapati bahawa faktor yang paling membimbangkan dan menyusahkan ialah keselesaan kerana terdapat kekurangan aspek keselesaan di Luyang. Didapati isu yang paling membimbangkan mengenai perkhidmatan bas di Luyang ialah jumlah perhentian bas dalam radius 800m dari kawasan sempadan, diikuti dengan kekerapan bas dan terakhir aspek keselesaan perkhidmatan pengangkutan awam. Seiring dengan itu, indeks kebolehjalan kaki di Luyang mencapai memuaskan kerana ia lebih tinggi daripada 0.5, dengan indeks kebolehjalan kaki tertinggi 0.758 di bahagian jalan 1, diikuti oleh bahagian jalan 2 dan akhirnya segmen jalan 3 dengan indeks kebolehjalan kaki terendah di perhentian bas 5 (0.499). Oleh itu, dapat disimpulkan bahawa kebolehjalan kaki Luyang dan perkhidmatan pengangkutan awam adalah memuaskan memandangkan indeks kebolehjalan kaki yang didapati kebanyakannya melebihi 0.5, namun penambahbaikan selanjutnya boleh dilakukan untuk menambah baik persekitaran binaan di Luyang khususnya dalam aspek keselesaan.

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LIST OF ABBREVIATIONS

AHP	-	Analytic Hierarchy Process
AHP-OS	-	Analytic Hierarchy Process- Online Software
CIDB	-	Construction Industry Development Board
CI	-	Consistency Index
PCM	-	Pairwise Comparison Matrices
SOP	-	Standard Operating Procedure

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CHAPTER 1

INTRODUCTION

1.1 Overview

Chapter 1 presents the overall view of the whole study in the assessment of walkability. This chapter contains a few subtopics to further define the study in a more specific aspect. The first subchapter presents the definition of keywords used in the research. The second subchapter presents the background of study which includes some history of the research. The third subchapter presents the problem statement of the study. The fourth subchapter shows the objectives of the research, while the last subchapter in chapter 1 presents the scope of work of this research.

1.2 Definition

Connectivity: A state in which one is connected or being connective to a surface (Source: Merriam-Webster dictionary)
Comfortability: A state of pleasantness in terms of psychological, physiological and harmony between the humans and their surrounding (Source: Malone et al., 2017).

Pedestrians: Someone who is walking (Source: Cambridge dictionary)

Safety: A state in which one is in no risk of danger and is safe (Source: Cambridge dictionary)

Walkability: The capacity of an environment that has been built in means of supporting and encouraging pedestrians to walk, in return of providing them with safety, connectivity of people to places within a reasonable distance and making sure the view throughout the journey is pleasing (Source: Southworth, 2005).

1.3 Background of Study

Walkability has always been an important yet hard concept to be grasped and maintained. Walking is an ancient method of transportation and existed historically since ancient times and had slowly developed due to the mass innovation and rapid modernization of areas in the world, slowly decreasing in implementation as cars were massively introduced back in the 1950s (Baobeid et al.,2021). Despite being the most eco-friendly method of transportation, that is; having no need of fuel combustion, it is one of the dreaded ways to go from one place to another since it requires effort and energy, along with other factors that affect one to avoid walking. However, walkability is gaining more attention due to the benefit of it and is being researched more to help reduce the inclining usage of private vehicles, which increases the rate of carbon dioxide emission due to the traffic density (Arslan et al., 2018).

Excessive carbon dioxide emission is becoming one of the main concerns of the world in recent years. Being around for many years, this issue has been tackled by many researchers to help in reducing the high carbon dioxide emission, reducing traffic congestions, and increasing awareness on the environmental impact on highly used motorized private vehicles (Baobeid et al., 2021). Therefore, the concept of walkability needs to be fully understood to ensure a road is improved or made based on certain elements to make it "walkable". Walkability and walking are closely related to each other as walkability can be defined as the capacity of built environment that supports and encourages walking by providing pedestrian comfort and safety (Li et al., 2020). Therefore, a road is considered to have a high level of walkability if it offers enough comfort and safety.

Comfort, connectivity, and safety are three of the factors that are important in making a place pedestrian-friendly or "walkable". To encourage walkability, the aim is to make the environment good, which comprises of several factors that make up for it (Sukor and Fisar, 2020). Creating a good environment could begin with making sure the comfortability of pedestrians is in its maximum to promote or encourage walking as most of us prefer walking only if a certain walkway is comfortable. The comfort of pedestrians could be provided with means of building comfortable pathways with enough spaces and with excellent walking surfaces (Sukor and Fisar, 2020). Comfortability could also be shown by the walkable distances from one location to another. According to Almahdy, climate conditions and weather, along with pollutions and bad air quality disrupts the walkability and causes discomfort in walking for pedestrians (Almahdy, 2020). This shows that the relation between the high usage of motorized vehicle is related to the pollution, and affecting the walkability. Thermal comfort is also being issued as one of the problems that could affect civilian's decisions to walk, as mentioned by Manifesty in one of his research projects in Indonesia, walkability is reduced in the streets during dry season as there are not many greens and trees as shades (Manifesty, 2021). Therefore, the importance of comfortability in promoting walkability is being emphasised as people will not consider walking as options for commuting especially during the afternoon (Almahdy, 2020).

In terms of safety, one of the factors affecting the preferences of pedestrians to walk is for their own safety, where there is a risk of accidents to happen. This is often associated with the built or environment of the road that ensures the safety of pedestrian, which will become a huge issue to the walkability if the surrounding is unsafe (Pongprasert and Kubota, 2017). According to research by Canu, Congiu and Fancello, some of the major concerns regarding safety of pedestrians are the speed of vehicles and the traffic volume, in which intersections with high-speed vehicles possess difficulty and great danger for pedestrians to cross and causing a delay in crossing time since there are a high number of vehicles with high-speed (Canu et al., 2018). A pedestrian is killed in every two hours as stated in research done in United States (Yin and Zhang, 2021). Therefore, this emphasises a lot about why safety is a huge concern in affecting walkability and should be focused on more to avoid risks of injury or fatalities.

Connectivity plays a huge role in encouraging walking, and its often associated with routes and alternative paths of walking. In connectivity basis, intersections that are dense gives options for pedestrians to have different route choices in a shorter distance (Nasution, 2020). More options give rooms for more road links, resulting in connectivity of roads to various locations, in which will provide a much better environment as all roads are directing to a lot of different places. Based on research done in Singapore, the connection of pedestrian streets with its residential areas, commercial areas and institutional areas (Manifesty, 2021). Singapore being the most developed country in Southeast Asia, its government has made walking as one of the agendas and improved its pedestrian environment (Manifesty, 2021). Some road elements that are important in increasing connectivity or the road or walkway are the intersections and influence the walkability greatly (Canu et al., 2018).

In an effort of promoting walkability, the safety, comfortability, and safety of pedestrians all linked to another attempt of reducing private motorised vehicles usage, public transportation. The use of public transport such as the bus holds numerous advantages than what using private vehicles could offer, such as the economic impact and positive change in the environment (Ojo, 2019). The increase of public transport usage could help in reducing carbon dioxide emission as it promotes the concept of carpooling and preventing traffic congestion by reducing the number of private vehicles on road. However, the lack of awareness of using public services is shown as the number of private vehicles increases globally. According to Du, Zhang and Mora, public transportation plays a huge role by allowing a large capacity of mobility and providing an improvement in the quality of life in means of public transit networks that are accessible for pedestrians in walkable distances (Du et al., 2021). Although public services are not as fast as private vehicles, they cover a huge amount of location around the city. In terms of walkability, public services are studied to investigate the relation on whether its safety, connectivity and comfortability is associated with the walkability of the area.

1.4 Problem Statement

Walkability has always been related to the environmental issues around the world. The overuse and over-dependency towards using motorized vehicle encourages the release of dangerous gas to the environment, causing adverse effects to the surrounding and human population (Abastante et al., 2020). It has become an important issue to promote and find ways to enhance and encourage walkability in response to reducing negative output and finding solutions in the implementation of sustainable development (Baobei et al., 2021).

To measure walkability, several important aspects need to be analysed to create a sustainable urban space. In past studies, there are several terms being emphasised in the assessment of walkability and mostly on the built environment such as the pathways, the surrounding environment and existing buildings (Shammas and Escobar, 2019). Some studies conducted in the past had also investigated the effect of density of area with the walkability (Frank et al., 2021), while some had also measured walkability relating it to the health of humans and pedestrians (Baobeid et al., 2021). In addition, other studies had also mentioned the effect of nearby public services and distance of walking to the walkability (Sukor and Fisal, 2020). For this research, the case study is done to assess whether there are other factors that could affect their willingness to walk in Luyang.

The conductance of this research is done in Luyang, Kota Kinabalu, where numerous shops, restaurants and residential area is located, especially in the study area as shown in figure 1.1. Along the shops, there are commercial activities held every morning and mostly, the locals residing in Luyang completes their shopping for necessities on a daily basis as shown in figure 2.0. It is one of the main attractions of pedestrians living near the area and most of the buyers head to the location by walking.

Photo 1.1 : Morning market at Foh Sang commercial centre, Luyang

The assessment of determining walkability have not been done much in Malaysia, especially in the East part of Malaysia. In addition, despite having some necessary infrastructures and pedestrian amenities (pedestrian crossings) existing in the study area, motorized vehicles are still actively used at the Luyang area. Therefore, this study aims to determine what issues are faced by pedestrians that affects their willingness to walk. While the stated past studies had fully addressed the computation and analysis of walkability factor focusing on the aspects objectively (ie; width of pathway) and subjectively, there is still a gap in knowledge on how these factors (comfort of pedestrians) correlate with each other (Abastante et al., 2020). In addition to that, in past studies, there is a lack of research done in the field of public transport services. Most studies had emphasised on the distance towards transit and railway stations instead of bus stations (Jeffrey et al., 2019).

Other studies conducted in Malaysia had also measured the walkability of distances to public services (Sukor and Fisal., 2020). This however, is focusing more on the walking facilities rather than other aspects that can be considered in terms of walkability since bus services are commonly used with the provisions of bus stops at the nearby area. However, this study aims to determine how the bus services in Luyang affects the walkability of pedestrians in Luyang in terms of their safety, comfortability and connectivity to bus stops. This study aims to fill the gap by focusing more on the aspect of distance and preferred and desirable walking

distance of pedestrians to bus stops. The role of bus services is evaluated to determine whether usage of bus and existing bus stops affects walkability in Luyang and determining whether all the bus stops is highly accessible based on the amenities and availability of bus provided in the area.

While doing that, this study is also aiming to fill the density gap, as the area of study is located near the street of activities where morning markets are available and is the centre of the city. Considering the peak hour, analysis is being made by conducting two forms of analysis, where two type of data will be obtained which is from secondary sources and distribution of questionnaire to compare information for better results.

1.5 Objectives of Study

The objectives of this research are:

a) To analyse the factors affecting the walkability in Luyang, Kota Kinabalu in terms of safety and comfortability of pedestrians
b) To assess the connectivity and accessibility of pedestrians to bus stations.
c) To determine and evaluate the walkability index in Luyang, Kota Kinabalu

1.6 Scope of Work

The parameters of the walkability assessment are in terms of the safety, connectivity and comfortability of pedestrians in Luyang, Kota Kinabalu, Sabah. By distributing survey questionnaire, factors affecting walkability will be analysed in regard to the three conditions mentioned above. The research is conducted during peak hour and is focused on the radius between bus stations at the surrounding area and how it affects the walkability. Walkability index is determined in this research by applying the Analytical Hierarchy Process (AHP) by comparing studied criteria. This research will be focusing on the pedestrians or people that lives in

Luyang, Kota Kinabalu as the targeted audience. A survey will be conducted, and questionnaires will be distributed to increase accuracy of results. The usage of Google Form to reduce contact will be considered due to the pandemic but will only be implemented if there are less respondents available for physical meet up in that area.

Only three elements are being studied in this research out of the nine from the General Theory of Wakability (Gorrini & Bertini, 2018). The purpose for this is to clarify how the three investigated issues regarding the comfortability, connectivity and safety is closely related to the bus stations or services located in the Luyang area will affect the walkability greatly. This research could be used as a guideline for the implementation of safer and much more accessible public transport services to engage pedestrians in walking and thus improving walkability.

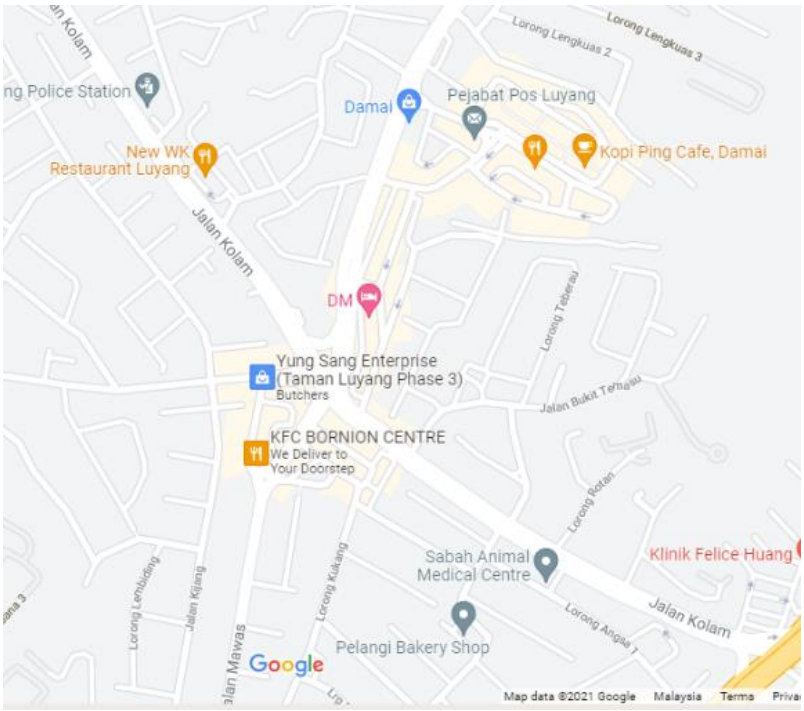

Figure 1.1 : Area of study at Luyang, Kota Kinabalu, Sabah

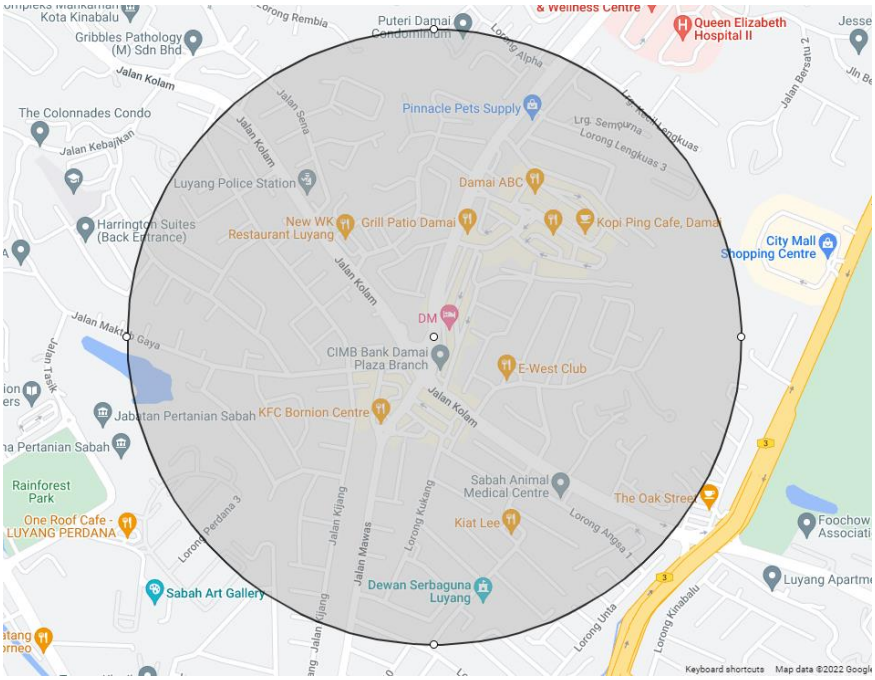

Figure 1.2 : Boundary of area of study

1.7 Significance of Study

The data and information produced in this study can be used and applied in the improvement of walkability in Luyang area and to determine which existing and non-existing structures that could be enhanced in terms of its functionality and usage with hopes to promote walking. In addition to that, the knowledge of Walkability Index for the study area could help in observing pedestrians' patterns and to analyse what factors affect their decision-making to overall improve the street walkability and induce a car-free environment. Aside from that, determination of walkability index in Luyang could become a stepping stone in developing the walkability index for Malaysia as there are not enough study regarding this issue.

Aligned with the goals of reducing accidents while promoting walking since there is an estimation of all of two-thirds world population will be living in the city by the year 2050 as stated by the United Nations (https://www.un.org, 2018), an effort of reducing motorized vehicle usage needs to be done. To induce walking, factors are to be analyse, especially in Malaysia and in Sabah, which are developing state