ANALYSIS OF WALKING ACCESSIBILITY TO RAPID PENANG BUS SERVICES (ROUTE 303) IN PENANG ISLAND

WAN NADHIRA SHAQINA BINTI WAN ZAUKI

SCHOOL OF CIVIL ENGINEERING
UNIVERSITI SAINS MALAYSIA
2017

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By

WAN NADHIRA SHAQINA BINTI WAN ZAUKI

This dissertation is submitted to

UNIVERSITI SAINS MALAYSIA

As partial fulfilment of requirement for the degree of

BACHELOR OF ENGINEERING (HONS.)
(CIVIL ENGINEERING)

School of Civil Engineering,
Universiti Sains Malaysia

June 2017

UNIVERSITI SAINS MALAYSIA

SCHOOL OF CIVIL ENGINEERING
ACADEMIC SESSION 2014/2015

FINAL YEAR PROJECT EAA492/6
DISSERTATION ENDORSEMENT FORM

Title: Analysis of Walking Accessibility to Rapid Penang Bus Services (Route 303) in Penang Island.

Name of Student: Wan Nadhira Shaqina binti Wan Zauki

I hereby declare that all corrections and comments made by the supervisor(s) and examiner have been taken into consideration and rectified accordingly.

Signature: Approved by:

_____ _____

(Signature of Supervisor)

Date : Name of Supervisor :

Date :

Approved by:

_____

(Signature of Examiner)

Name of Examiner :

Date :

ACKNOWLEDGEMENT

In the name of Allah S.W.T, the Most Gracious and the Most Merciful. I am truly grateful for the endless amount of strength and guidance been given to me to complete this Final Year Project. Many inspiring people have contributed to the production of my project and for that, I owe them my deepest gratitude for making it possible.

First and foremost, I would like to express my deepest gratitude and appreciation to my wonderful supervisor, Dr. Nur Sabahiah Abdul Sukor for her never ending belief on me and her astounding supervisions, guidance, encouragement and advice through this whole adventurous journey. I am very fortunate to have her as a supervisor because of her strict and perfection way, I manage to finish this project beautifully. Not to forget, the panels involved during the presentation sessions, Professor Dr. Meor Othman Hamzah, Professor Dr. Ahmad Farhan Mohd Sadullah, Associate Professor Ir Dr. Leong Lee Vien and Dr. Mohd Rosli Mohd Hasan, for their constructive comments to improve my work for the better.

Besides that, I would like to thank the team involved in a data collection at the bus stops in Penang Island, Aliff, Azfar, Khuzaimi, Tasha, Noradila, Norazilah, Siti Nabilah, Syazwan, and others of their hard work to successfully complete the task. It was an astonishing experience for me and I hope all of you enjoyed it and gained benefit from it too.

To my motivator, Amirah Nadhrah, you are a true definition of best friend in my life. Thank you for giving me unending strength and motivation to keep me going and finish my project till the end. We may be apart, but you are always there for me through thick and thin of my life. May you be blessed with wondrous life ahead for the endless love you gave me.

Last but not least, the backbone of my life, my reason to live is my family especially my parent, sisters, relatives and friends for their boundless support and understanding toward me. To my parents, Wan Zauki bin Wan Idris and Hasni binti Muhamad, your bountiful love has taken me far in life, your strength made me who I am today, your confidence in me made me believe anything is possible in life and your encouragement inspire me to do great things. Without your love and support, it would have been impossible to do this. From the deepest of my heart, I would like to thank you for always being there for me throughout my whole life.

ABSTRAK

Kajian ini dijalankan bagi mengkaji kebolehsampaian pejalan kaki untuk menggunakan perkhidmatan bas Rapid Penang di Pulau Pinang. Di dalam kajian ini, beberapa parameter seperti sosio-demografi, jarak berjalan, masa berjalan dan tahap kepuasan pegguna dikaji bagi menentukan faktor signifikan yang mempengaruhi kebolehsampaian pejalan kaki berjalan untuk menggunakan servis pengangkutan bas awam. Dalam tempoh masa selama dua minggu, kajian soal selidik terhadap 400 responden telah direkod bagi tujuan kajian ini. Data yang dikumpulkan telah dianalisis menggunakan analisis deskriptif dan analisis statistik melalui *Statistical Package for the Social Science* (SPSS). Analisis berbilang regresi digunakan dalam analisis statistik bagi menentukan faktor yang signifikan mempengaruhi kesanggupan pejalan kaki untuk berjalan bagi mengakses servis pengangkutan bas awam berdasarkan keadaan alam sekitar dan infrasturktur semasa serta keadaan alam sekitar dan infrastruktur yang dibaikpulih pada masa hadapan. Berdasarkan keputusan analisis yang diambil daripada analisis berbilang regresi, jenis perhentian bas, sosio-demografi, jarak berjalan, masa berjalan, tahap kepuasan pengguna dan matlamat perjalanan adalah faktor signifikan yang mempengaruhi kesanggupan pejalan kaki untuk berjalan bagi mengakses servis pengangkutan bas awam. Selain itu, hasil dapatan kajian ini juga telah dapat mengenal pasti jarak maksimum, minimum dan purata perjalanan yang diambil oleh pejalan kaki untuk berjalan ke perhentian bas sebagaimana juga dengan masa yang diambil.

ABSTRACT

This study was conducted to investigate the walking accessibility of pedestrian toward the Rapid Penang bus services in Penang Island. In this study, several parameters such as socio-demographic, walking distance, time travel and satisfaction level of users were examined to determine the significant factors that influence the walking accessibility toward public bus services. Within two weeks period, the questionnaire surveys of 400 respondents were recorded for this study. The collected data were analysed using descriptive analysis and statistical analysis through Statistical Package for the Social Science (SPSS). Multiple regression analysis was used in statistical analysis to determine factors that significantly influenced pedestrian willingness to walk to access the public bus services according to current environmental and infrastructure condition and also the future improvement of the environmental and infrastructure condition. From the results acquired through the multiple regression analysis, type of bus stops, socio-demographic, distance of walking, time of walking, the satisfaction level of users and trip purpose were factors that contribute to pedestrian willingness to walk to access the public bus services. Besides that, the outcome of this study also had identified the maximum, minimum and average distance walked by the pedestrian to reach the bus stops as well as the time travel taken.

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LIST OF ABBREVIATIONS

SPSS	Science Package for the Social Science
SPAD	Suruhanjaya Pengangkutan Awam Darat
PTMP	Penang Transport Master Plan
JPJ	Jabatan Pengangkutan Jalan Raya
LRT	Light Rail Transit
NCIA	Northern Corridor Implementation Authority
KMRT	Kaohsiung Mass Rapid Transit
GPS	Global Positioning System
NHTS	National Household Travel Survey
PTWAI	Public Transit and Walking Accessibility Index

CHAPTER 1

INTRODUCTION

1.1 Background

It is crucial to provide public transport services within close proximity that connect people to the desired activities' location. Hence, transport and land use planning have a significant role in promoting accessibility toward public transport services and developing a sustainable city. In most developing countries, effective provision of a first class public transportation is a means for making journeys to work, school, shops and other daily activities. It is also a means of providing greater freedom, access, opportunity, employment, education and choice for those 'financially challenged' living in these urban areas and those who simply cannot afford to have their own private vehicles (lles, 2005).

According to National Public Transport Masterplan Malaysia (SPAD, 2012), a series of actions and interventions were laid out to increase the usage of public transport by the community across geographic and income dimensions. Its objective is to achieve a 40% public transport modal share in urban areas, improving access to underserved rural areas and increasing the connectivity between geographies.

In Penang, the Penang State Government has identified three major concerns that need to be addressed – Crime, Cleanliness and Traffic Congestion (Lim, n.d.). Through continuous effort, an outstanding progress is achieved in reducing crime that improves the public safety, and in providing a clean and comfortable environment. However, issues on traffic congestion remains a primary concern to the Penang State Government intensified by the dynamics economic growth and increasing number of tourist into the heritage city. With an aim to improve the situation of traffic congestion in Penang, the

State commissioned a Penang Transport Master Plan (PTMP) Strategy Report. PTMP strategy report collaborated with Northern Corridor Implementation Authority (NCIA) conducted by Halcrow was published in 2013 (Recommended Transport Master Plan Strategy, 2013). It offered transport improvement to be implemented in three terms; short term, medium term and long term.

SRS Consortium had outlined an integrated transit network with the appropriate long-term capacity to increase public transport adaptation in Penang. The proposed transit lines are; Bayan Lepas LRT, Ayer Itam monorail, Tanjung Tokong monorail and tram services in Georgetown heritage area, these transit networks are portrayed as shown in Figure 1.1 below.

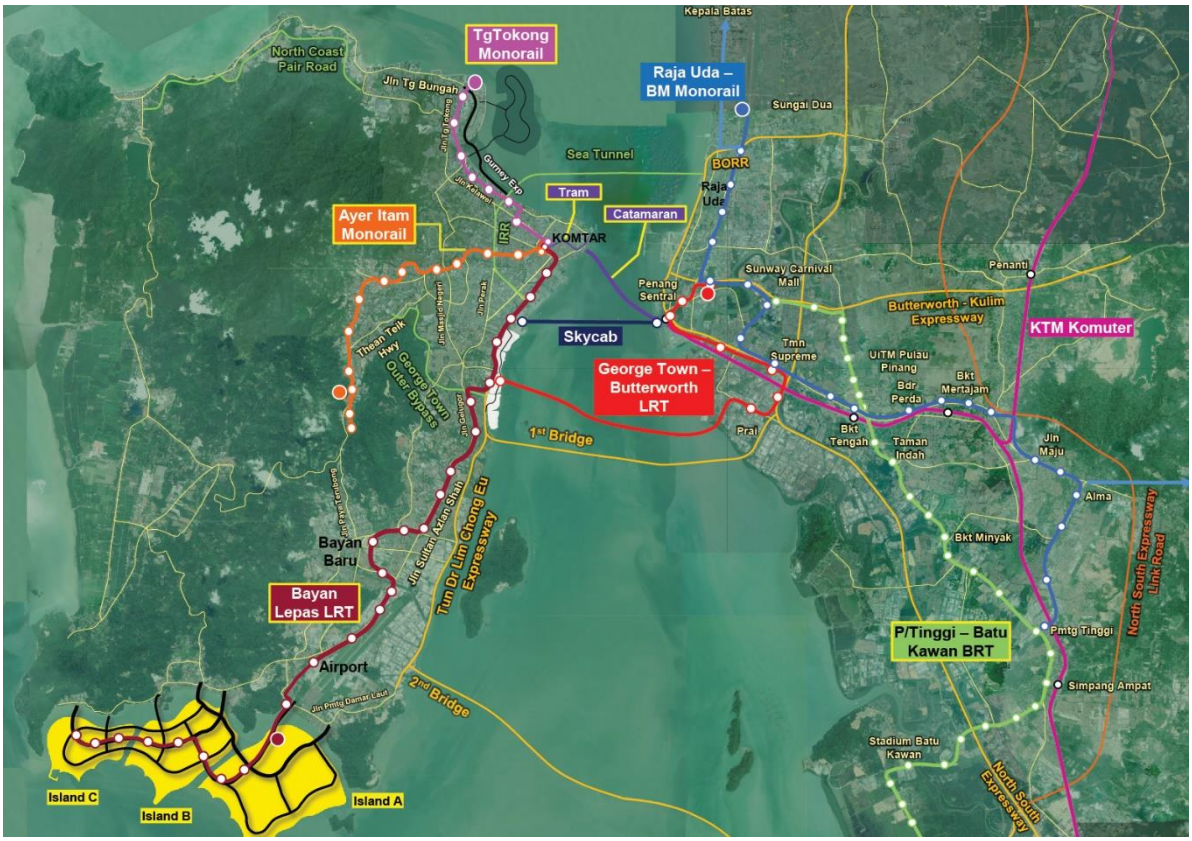

Figure 1.1: Proposed Public Transport Network in Penang by SRS Consortium (Source: Penang Transport Master Plan, 2013)

The main focus of this study is only on the Bayan Lepas LRT network from Komtar to the future reclaimed islands in the south made up of 27 stations along a 30 km length network as shown in Figure 1.2. Parallel links between the future development of Bayan Lepas LRT and Rapid Penang bus routes are investigated and the most parallel route is route 303 from Weld Quay Port to Persiaran Mayang Pasir. Hence, the study of walking accessibility to public transport was done on route 303.

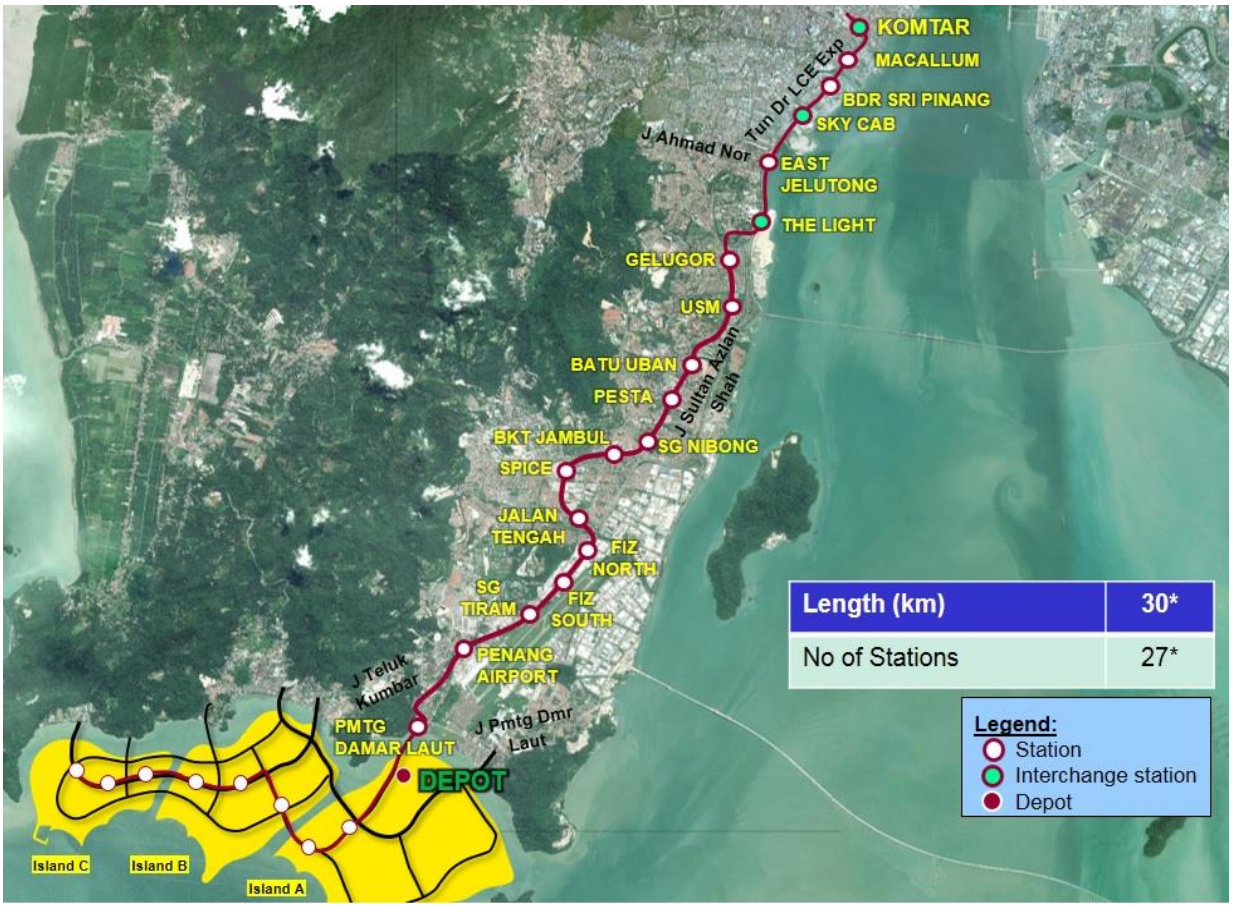

Figure 1.2: Proposed Network of Bayan Lepas LRT line
(Source: Penang Transport Master Plan, 2013)

1.2 Problem Statement

The number of registered vehicles in Penang Island are increasing at an alarming rate. The number of vehicles registered in Penang is more than 2 million compared with the number of residents who have reached 1.6 million that gave a ratio of 1:1.25 between the populations in Penang with the registered vehicles. It is justified by the statistic of registered motor vehicles in Penang archived from Jabatan Pengangkutan Jalan (JPJ) Penang as shown in Table 1.1 below. The Penang state needs to reduce the number of motor vehicles on road by providing a suitable infrastructure that suits the people need.

Besides that, the new development project on public tranportation network by SRS Consortium is proposed. This is to help reduce the number of private vehicles on the road in Penang Island. Hence, to encourage the society of Penang to use the future public transport services, the authority needs to identify factors that influenced them to use the public transport services and also ascertain the problems experienced by the users of the current public transportation in Penang.

Table 1.1: Number of Vehicle Registered in Penang, 2008 – March 2014
(Source: Jabatan Pengangkutan Jalan Malaysia (JPJ))

TYPE	YEARS						
	2008	2009	2010	2011	2012	2013	2014
Motorcycles	1,033,025	1,076,409	1,124,476	1,172,311	1,226,223	1,264,046	1.278.908
Cars	780,519	830,678	890,652	945,444	1,000,131	1,024,197	1,037,770
Buses	5,232	5,511	5,781	5,960	6,131	4,739	4,794
Taxis/Rental Cars	3,387	3,545	3,701	3,841	3,931	3,512	3,546
Hired Cars	479	500	529	517	499	1,620	1,640
Goods Vehicles	57,462	59,744	62,952	65,603	68,381	72,391	73,050
Others	17,648	18,271	19,140	20,071	20,920	38,210	38,408
TOTAL	**1,897,752**	**1,994,658**	**2,107,231**	**2,213,747**	**2,326,216**	**2,408,715**	**2,438,116**

This situation leads to extreme traffic congestion in Penang Island as well as environmental pollution such as air pollution and noise pollution. To overcome this issues, a study on walking accessibility to public transport in Penang is carried out to identify factors that affect the willingness to walk to access public transport in Penang that is Rapid Penang buses and to determine the level of satisfaction of public bus users toward current public bus services. This will help Penang State Government to develop a sustainable and greener lifestyle besides providing an effective transportation system in Penang Island.

1.3 Objectives

The objectives of this research are as follows:

1. To identify the acceptable walking distance to the bus stops.
2. To evaluate the walking accessibility to the bus stops including the surrounding environment of the bus stops and the pedestrian walkway.
3. To analyse the factors that are affecting bus users' willingness to walk to the bus stops.

1.4 Scope of Work

The purpose of this study is to identify the acceptable walking distance to the bus stops of respondents living in Penang Island. The walked distances were measured from origin location of respondents to their destination. For an instance a trip from home to workplace or home to school.

Other than that, this study is conducted to evaluate the walking accessibility for public bus users to the bus stops. The evaluation is based on the condition of bus stops whether the bus stops are shaded and benched or unshaded and no bench provided. Type

of pedestrian walkways such as roofed and paved walkway is observed as well as its surrounding environment either the pedestrian walkway is shaded with trees, away from busy traffic, safe from robbery or in a crowded area like residential or shops.

Lastly, the factors affecting bus users' willingness to walk to the bus stops are analysed based on observation and evaluation conducted. The factors are socio-demographic of respondents such as age, gender, and income, the trip purpose of respondents and level of satisfaction of respondents toward condition of bus stops and pedestrian walkway.

To fulfil the objectives of this study, a set of questionnaire survey was prepared for the purpose of data collection on bus users of Rapid Penang on route 303. The data collection was conducted during weekdays of Tuesday, Wednesday, and Thursdays within working hour from 8 o'clock in the morning until 6 o'clock in the evening.

From the data collection via questionnaire survey, socio-demographic information of public bus users such as gender, age, nationality, race, and income were gathered. Besides that, the questionnaire was designed to determine the willingness to walk of public bus users to the nearest bus stop in term of distance travel and time travel. The respondents were also asked about their perception toward the condition of bus stops and the pedestrian walkway that they took to arrive at the bus stop. The data collected were computed into Microsoft Excel and analysed using SPSS software.

1.5 Organization of Thesis

This thesis comprised of 5 chapters that thoroughly describes the study of 'Analysis of walking accessibility to Rapid Penang bus services (Route 303) in Penang Island'. Chapter 1 is the introduction of the study that consists of background of study, problem statement, objectives, and scope of work involved.

While in Chapter 2 discussed on literature review consist of the definition of accessibility and factors affecting accessibility to public transport. These factors are discussed based on previous related studies. Site observation, the method of data collection and data analysis are explained in Chapter 3.

Next is Chapter 4 that shows the result and discussion of data analysis from collected data. Lastly, the thesis is entirely concluded in Chapter 5 with recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the 21st century, Malaysia has grown tremendously and become a more developed country over the years. It has evolved into a high technology nation with many outstanding skyscrapers like the Petronas Twin Towers and experienced a stable economic progression along with rapid infrastructural development. However, according to Din et al. (2009) traffic congestion has become an increasingly rampant problem throughout Kuala Lumpur parallel with current development in Malaysia, thus to reduce traffic congestion from getting severe, fellow Malaysians are encouraged to use more public transport.

Penang is a rapidly developing island located on the northwest coast of Peninsular Malaysia. As the development in Penang increases so does the number of vehicles on the road of Penang that leads to major traffic congestion in Penang especially during peak hours at industrial area of Penang especially.

Hence to overcome this issues, the Penang State Government had collaborated with NCIA and come up with PTMP that was published in 2013. Simply put, the purpose of this strategy is to promote the public transportation in Penang and encourage the society to use these abundant services provided for them. There are plenty of convenient, reliable and affordable forms of public transportation in Penang including buses, taxis, and ferries. Thus, we must fully utilize these accommodations for a better lifestyle in the future.

2.2 Accessibility

Accessibility refers to the ability of every individual to access, use and gain benefits from everything within their surrounding environment, regardless of their disability or special needs. In the context of accessibility to public transport, it is defined as how effective for people to reach public transport stops based on respective parameters. According to Litman (2012), accessibility is referred in terms of potential or in terms of activity.

Moreover, accessibility characteristic holds a significant impact on transport planning, urban planning and geography of an area. According to Din et al. (2009), characteristic of pedestrian walk influenced the accessibility to public transport terminals as users would prefer a safer mode walking environment no matter how short the distances are. However, researchers have quickly discovered that pedestrian behaviour is highly complex and difficult to study, and the existing body of research points to few consistent findings.

Albacete et al. (2015) has measured accessibility through Structural Accessibility Layer (SAL) and Public Transport Walking Access Index (PTWAI) methods. These methods are selected by four criteria which are the location-based measures, public transport accessibility in urban areas, the required data from different sources and the sequentially developed methods.

Due to lack of data on availability to public transport and complicated journey that could be taken by users to access the public transport services (Martin et al. 2002) the research regarding the accessibility to public transport is relatively small.

2.3 Factors affecting accessibility to public transport

There are several factors that greatly influence the walking accessibility such as socio – demographics, walking distance, time travel, trip purpose and condition of infrastructures like pedestrian walkway and the bus stops as well as the level of satisfaction of users. These factors are briefly explained in the paragraphs below.

2.3.1 Socio – demographics

Socio-demographic of Rapid Penang bus users is one of the factors that affect the mode choice. Daniels and Mulley (2013) claimed that the impact of socio-demographic factors has mostly been studied in the context of differentiating factor in the choice of travel behaviour. Gender, age, marital status, income, the level of education and vehicle ownership are the factors included in socio-demographic. Corpuz et al. (2005) found that in Sydney females walk more than male, older and younger age groups walk more and people with low car ownership walk more.

Moreover, in research conducted by Freeland et al. (2013) in the United States, people are more likely to transit walk if they are from lower income households, are non-White, and live in large urban areas with access to rail systems. In this research, transit walker is defined as a person who travelled to or from public transport by walking and they are stratified by household income, age, education, race, gender, urban size, household car ownership and employment status based on National Household Travel Survey (NHTS) administered by the United States Department of Transportation.

2.3.2 Walking distance

To this day, there has been little information on an accurate method of measuring distance walked by pedestrians. From Agrawal et al. (2008) study, a self-reported

distances method is used to gather data on walking distance of pedestrians by asking how far they had walked in both miles and blocks. However, the accuracy of the distances recorded was questionable as each individual has a different view of estimating distance.

Meanwhile, Burke and Brown (2007) analysed that the average distance walked from home to all public transport is 600m. In their study located in Brisbane, Australia through collective data of travel diaries by respondents and the *South East Queensland Travel Survey* (SEQTS) data, a statistical analysis was conducted on distances walked for single-stage walk trips. These trips include school, workplace, and shops and the results based on percentages were tabulated into bar graph as shown Figure 2.1. The farthest distances walked for single-stage walk trips were from home to primary school with an average distance of 920m, while the average distances for trips from home to shops was 810m.

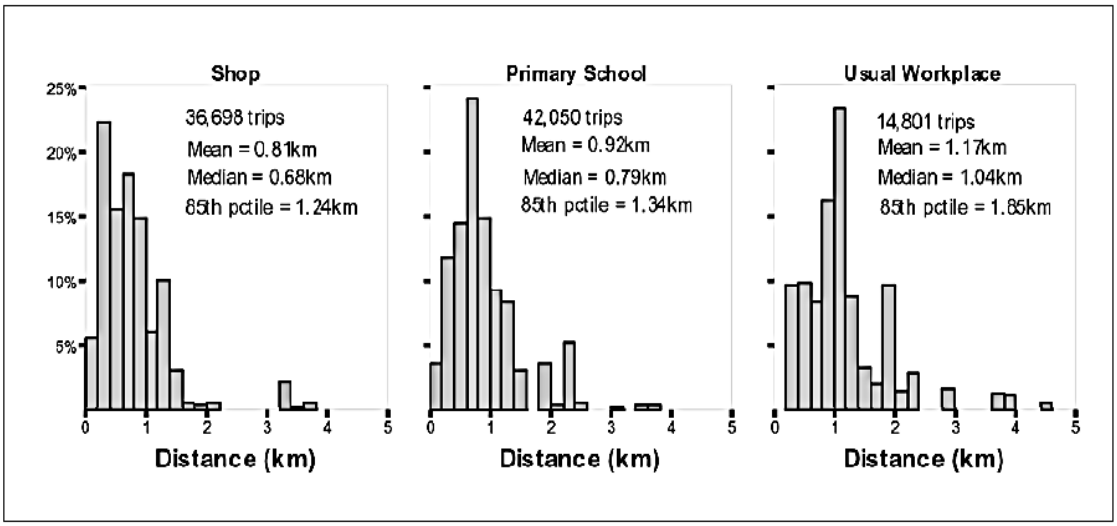

Figure 2.1: Distances Walked for Single-Stage Trips from Home to Shops, Primary School and Workplaces. (Burke and Brown 2007)

In Sydney, it was analysed that bus users only accredited to walk for 50m to access the bus services, while the train users willing to walk longer than 100m to access the train services. Hence, it shows a large difference in average walking distance to the train compared to the bus (Daniels and Mulley, 2013). The distributions of walking

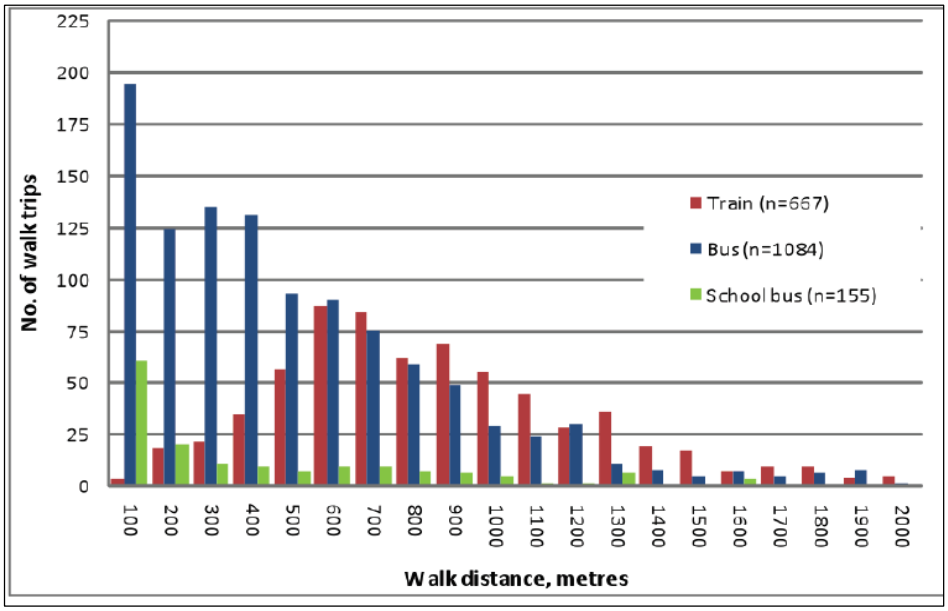

Figure 2.2: Distribution of Walking Distances by Public Transport Mode (Daniels ad Mulley,2013)

distance by public transport mode were shown in the graph of a number of walk trips against walk distances in meters as shown in Figure 2.2.

The graph represented the number of walk trips made to access the public transport services and the distances walked by the users. It can be concluded that for train services, users are willing to walk till 2000m to access the services while users only willing to walk up to 1900m to access the bus services.

2.3.3 Time Travel

Mavoa et al. (2012) has conducted a study in the Auckland region, the North Island of New Zealand to measure the walking modes of travel to public transport. The travel time of users walking to the transit station of public transport was calculated through accessibility score. The accessibility score was calculated by averaging the accessibility scores for all destination in Auckland prior to calculating the PTWAI. The PTWAI scores description is as shown in Table 2.1.

Table 2.1: PTWAI scores descriptions (Mavoa et al. 2012)

PTWAI score	Label	Description
0 – 4	Very low	Accessible within a travel time >60 min on average
5 – 8	Low	Accessible within a travel time 40 – 60 min on average
9 – 12	Medium	Accessible within a travel time 20 and 40 min on average
13 – 16	High	Accessible within a travel time 10 – 20 min on average
17 – 20	Very high	Accessible within a travel time <10 min on average

2.3.4 Condition of Infrastructures

Wee and Mitchell (2010) observed that car and motorcycle users parked their vehicles in the existing accessible footways. This behaviour not only causing damage to the infrastructures such as safe rail guard, paved walkways and raised kerb but also inflicting nuisance for the pedestrian to walk on the provided paved footways. During the study, it was discussed that good quality infrastructure, vehicles and staff are not enough to provide a proper and comfortable walking environment for the pedestrian if road users behaviour is not enforced and if the infrastructures are not inspected and maintained and bus drivers positioned the bus very close to the kerb at the bus stops.

An overview of environmental attributes that associated with particular types of walking was discussed by Owen et al. (2004). There were three types of walking, walking for exercise, walking to get to and from places, and total walking. These types of walking had environmental attributes that encourage people to walk the pedestrian path is aesthetically pleasant, convenient facilities, safe and walkable neighbourhood, have access to public open spaces, stores are within walking distance and no issues concerning

traffic. Overall, understanding environmental influences on physical activity such as walking is important to encourage people to enjoy walking.

2.4 Level of Satisfaction

Satisfaction level of users is an important characteristic to determine the quality of certain services from a different perspective (Brons et at.,2009). Evaluation of public transport satisfaction can be done from a different point of view like bus stops infrastructure such as benches, drivers' behaviour, frequency of bus arrival and cleanliness of bus stops.

In a recent study of Kaohsiung Mass Rapid Transit (KMRT) in Kaohsiung City, Taiwan, a questionnaire survey of KMRT passengers was conducted to collect data on perceived value and overall satisfaction of KMRT services (Lai and Chen, 2011). The result attained from the study involving the relationship between service quality, perceived value, overall satisfaction, and behavioural intentions propose important implications for public transit companies. Vehicle safety, facility cleanliness, and complaint handling are important services attribute to obtain passenger satisfaction.

A study conducted in Greece by Efthymiou and Constantinos (2017) factors that affect the users' satisfaction are comfort, staff, system and safety. Besides that, the study showed that the users' environmental consciousness and improved public transport services also influenced the users' satisfaction level.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter presents the methodology carried out for the study of accessibility to public transport in Penang, Malaysia. The focus of the study is to examine the condition of the pedestrian walkway, the condition of the bus stops and its connectivity. In order to gather the necessary data, both quantitative and qualitative approaches are utilized by the researcher to produce an effective outcome. These approaches help to describe, define and determine significant factors that affect the accessibility to public transport in Penang. Site observation, questionnaire survey and data analysis using IBM SPSS (Statistical Package for the Social Science) are methods applied to gather and analyse data obtained from this study.

The methodology of this study was divided into two parts, Part I and Part II. Part I was the early stage of research to identify required elements of this study. Whereas Part II focused on designing questionnaire form to be used for data collection from respondents. From collected data, SPSS analysis was done for descriptive analysis and regression analysis. These analyses were explained further in this chapter. Lastly, the final stage of the methodology was the result obtained from the SPSS analysis. Thus the research methodology for the study of accessibility to public transport in Penang is accomplished. The work progress of this study was illustrated as shown in Figure 3.1.

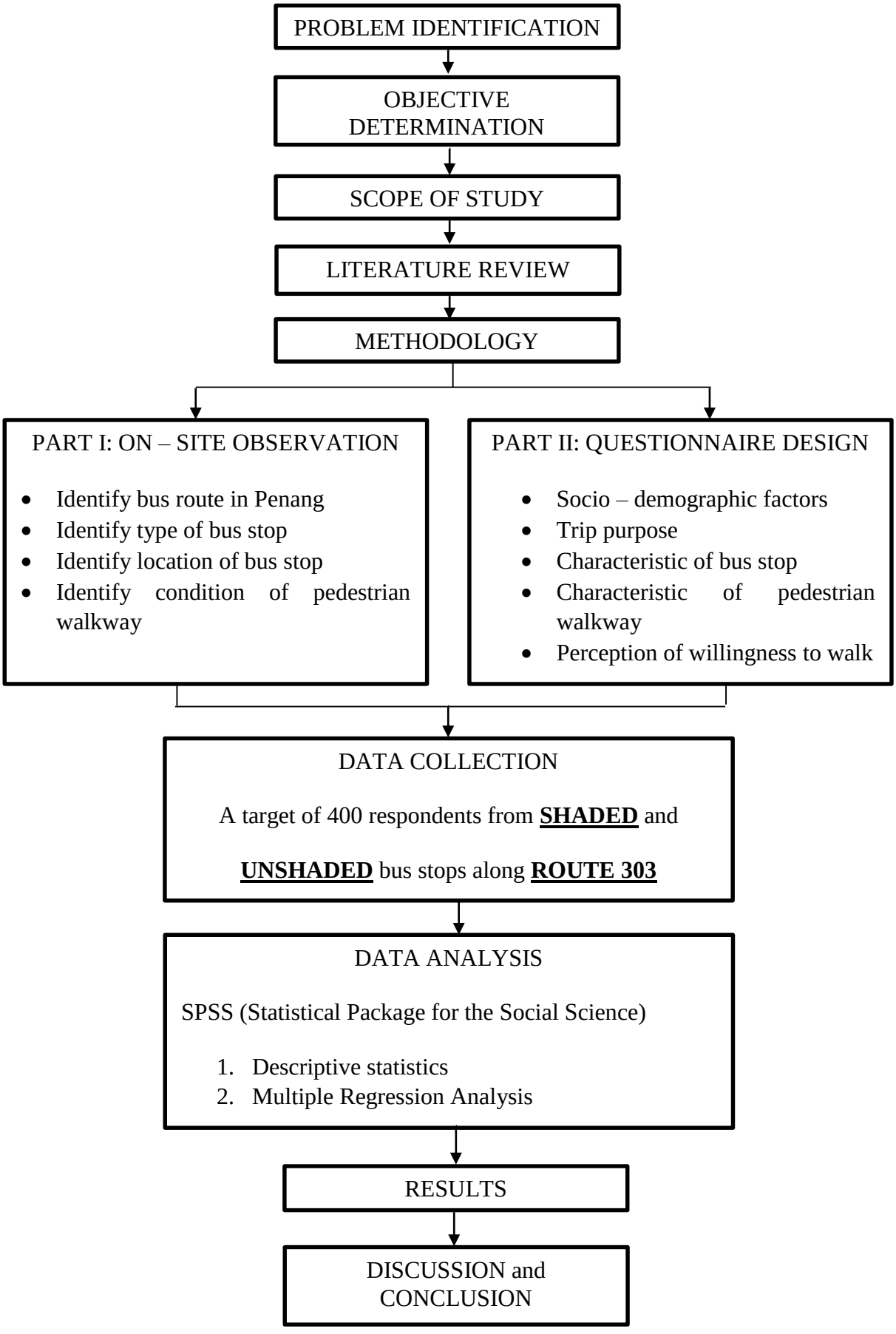

Figure 3.1: Flow Chart of The Study

3.2 Site Observation

In this study of accessibility to public transport in Penang, site observation was piloted to identify bus route of Rapid Penang buses, type of bus stops, the location of bus stops and condition of the pedestrian walkway. On October of 2016, the site observation was carried out from Weld Quay bus terminal located in Georgetown. Route 303, 401 and 401E were observed based on the route taken along the journey to decide which route is suitable for this study.

3.2.1 Bus Route

Currently, there are a total of 28 bus routes of Rapid Penang in Penang Island including route 10, 11, 12, 13, CAT, 101, 102, 103, 104, 201, 202, 203, 204, 206, 301, 302, 303, 304,305, 306, 307, 208, 401, 401E, 403, 404, 501 and 502. The bus route is defined as maps of the bus journey from one location to another. It helps bus user to plan their journey and time of travelling. For this study, the primary criteria for selecting the bus route was to find a route that was aligned almost parallel to the train routes of future development of Light Rail Transport (LRT) in Penang. This approach presumably would help to increase public transport usage among Penang's locals and promote sustainable lifestyle by providing more option for users to commute in Penang Island. Hence, from site observation, it was found that route 303 was the most aligned bus route with the future LRT routes. Route 303 started its journey from Weld Quay bus terminal and ended at Taman Sri Tunas Jalan Mayang Pasir. The detailed area covered for bus route 303 is shown in Figure 3.2 and Figure 3.3 shows the details location along route 303. Besides that, a map of bus stops location along Route 303 is included in Appendix B.

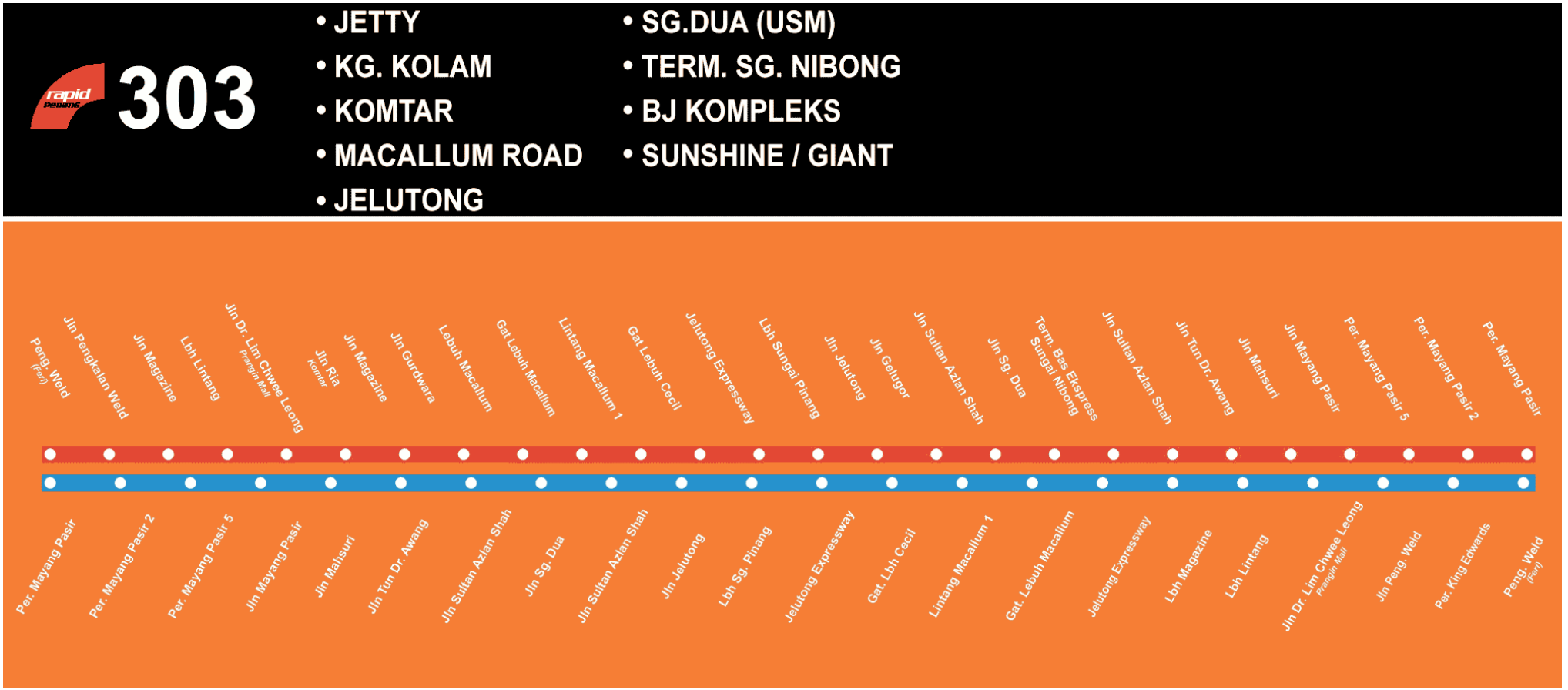

Figure 3.2: Rapid Penang Bus Route 303. (Reprinted from Journey Planner Route in *Rapid Penang*, n.d.,Accessed on October 28, 2016)

Figure 3.3: Route 303 on Map (Retrieved from Google Maps on October 28, 2016)

3.2.2 Type of Bus Stops

From observation of bus route 303, it was identified that there were two types of bus stop located within the area covered in route 303. One type of the bus stop was roofed and shaded bus stops as shown in Figure 3.4 taken during site observation. It was assumed that roofed and shaded bus stops were provided at locations that have the highest number of bus users. These bus stops offered the bus users comfortability in waiting for buses by equipping the bus stop with benches for them to sit and sheltered them from hot sunny weather or rain weather.

Another type of bus stop provided by Rapid Penang for its user was unroofed and unshaded bus stop as shown in Figure 3.5 at which only the bus stop sign was provided. These bus stops were not equipped with any facilities such as bench or roof probably because it was not accessed as often as the roofed and shaded bus stops. Moreover, it was usually provided near to residential area due to the limited area to build a bus stop there.

Figure 3.4: Shaded Bus Stop

Figure 3.5: Unshaded Bus Stop

3.2.3 Location of Bus Stops

From observation, there was two primary location of bus stop within route 303. The bus stops were either located near to residential area or near to city centre area. These two areas were significantly different from one another. The users' demand for buses near to the residential area were high in the morning and in the evening because that duration of time was identified as peak hour for people to go to work and to return home after work. Whereas the demand for buses near to the city centre were high during the afternoon as people were going out for lunch or students had finished their schooling session.

For bus stop located near to residential area, it was typically surrounded by apartments, houses, and condos. The existence of these bus stop offers easy access for the housing residents to commute using public transport, buses especially. Meanwhile, the bus stop located near to city centre area was usually surrounded by offices, schools, malls, restaurants and shop lots.

3.2.4 Pedestrian Walkway

Pedestrian walkway is an infrastructure facility built to provide connectivity to bus stop from residential area or city centre area. The pedestrian walkway also ensures the safety of bus user that walk to bus stop. In Penang, the pedestrian walkway was provided at almost every area that has a bus stop. Besides that, Penang authority also accommodates the pedestrian walkway with safety precaution by installing safe rail guard and increase the height of kerb. These infrastructures can be observed while site observation was conducted as shown in Figure 3.6 and Figure 3.7. For a rapidly developing state, it is great to observe that Penang government pay their attention to issues regarding the safety of its community.

Figure 3.6: Safe Rail Guard along Pedestrian Walkway

Figure 3.7: High/Raised Kerb along Pedestrian Walkway

3.3 Questionnaire

Questionnaire is a mechanism or tools to obtain information and opinion from people. It is designed to get unbiased accounts of people's experiences with regard to specific issues or topic. The questionnaire helps the researcher to have a better understanding of the study conducted. It is suitable for studies that require much information from a large amount of respondents.

For this study, a particular questionnaire was designed accordingly with the identified significant factors. It is divided into two parts, Part A and Part B.

Part A of the questionnaire asked on the socio-demographics of the respondents such as age, gender, race, nationality, the level of education, status and monthly income. Besides, in this part of the questionnaire, the respondents were asked on how far and how long it took for them to walk to the nearest bus stop and their frequency of using the public bus services in a month.

Meanwhile, Part B focused on the perception of respondents toward the existence of infrastructure provided such as bus stops and pedestrian walkway. A scale of 1 to 5, where 1 is very bad, 2 is bad, 3 is neutral, 4 is good and 5 is very good, were used to rate the level of satisfaction of respondents. Lastly, questions on respondents' willingness to walk were asked to determine factors that influence respondents to walk to bus stops to access public bus services (Appendix A).

3.4 Respondents

The category of respondents needed for this study was pedestrian that used the public bus as means of transportation in Penang. The number of respondents aimed in this study was 400 pedestrians that used public bus services as a mode of transport. Information from respondents were obtained from the questionnaire prepared that was

related to accessibility to public transport. The questionnaire contained 21 questions for respondents to fill. Later, the completed data from the questionnaire were collected to proceed for analysis.

3.5 Data Analysis

3.5.1 Statistical Analysis using SPSS

SPSS is a Windows-based program that can be used to perform data entry and analysis which then able it to create graphs and tables. It is also largely used for statistical analysis. In this study of accessibility to public transport in Penang, three type of analysis using SPSS were generated. The analyses were descriptive analysis and multiple regression analysis. The characteristic of respondents who were pedestrians walking to the bus stop to commute using bus was analysed in descriptive analysis. Perception of the pedestrian on the willingness to walk to access public transport by distance travel and time travel were analysed using multiple regression analysis. Each analysis was established using SPSS.

3.5.2 Descriptive Analysis

Descriptive statistics are used to describe the basic features of the data in a study that provides simple summaries about the collected samples and data. Based on the questionnaire achieved, descriptive analysis was done where independent variables were distinguished. The independent variables were gender, age, nationality, race, marital status, monthly income, the level of education, vehicle ownership, the frequency of using bus, walking distance and time taken to reach the nearest bus stop. These variables were sorted using Microsoft Office Excel before being computed into SPSS for analysis. The