DEVELOPMENT OF GUIDELINE FOR BUILDING DEFECTS: CASE STUDY-SHOPPING MALL

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Thesis submitted in fulfillment of the requirements
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ABSTRAK

Kajian ini dijalankan untuk menyiasat kecacatan bangunan dan masalah berkaitan dengan penyelenggaraan bangunan di bangunan komersial terutama pusat membeli-belah. Objektif utama kajian ini adalah untuk mengenalpasti kecacatan bangunan, menganalisis kesedaran dan perspektif responden tentang masalah kecacatan bangunan dan mengadakan garis panduan penyelenggaraan kecacatan bangunan untuk pusat membeli-belah. Kaedah yang digunakan untuk menjalankan kajian ini adalah pemerhatian, kaji selidik dan sesi temubual. Pemerhatian diadakan di pusat membeli-belah untuk mengenal pasti kecacatan bangunan yang ada dan set borang kaji selidik digunakan untuk mengenal pasti dan menganalisis tahap kesedaran dan perspektif terhadap masalah kecacatan bangunan. Sesi temuduga diadakan bersama tiga orang responden yang merupakan Jurutera - Jurutera Profesional dan Pengurus Operasi yang pakar dalam menguruskan hal-hal berkaitan penyelenggaraan bangunan untuk mendapatkan lebih banyak maklumat yang berkaitan dengan penyelidikan ini.

ABSTRACT

This study was conducted to investigate the building defects and problems associate with building maintenance in commercial buildings especially shopping mall centers. The main objective of the study is to identify building defects, analyze people awareness and perspectives on defects problems and develop a defects maintenance guideline for shopping mall building. The method used to conduct this study are observation, questionnaire survey and interview session. Observation of shopping mall conducted to identify defects exist and sets of question form is used to identify and analyze the level of public awareness and perspective towards building defects problem. Interview session held with three respondents which are Professional Engineers and Operation Manager that expert in managing building maintenance matters to gain more information related to this research.

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LIST OF ABBREVIATIONS

TFM	Total Facilities Management
R1	Respondent 1
R2	Respondent 2
R3	Respondent 3

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Malaysia is one of the fastest-growing economies in South East Asia (Bank, 2008). With first class infra-structures, government of Malaysia is really concern about the importance of building maintenance aspect. Even though the concept of building maintenance has already existed in Malaysia since modern buildings were constructed the typical understanding and approaches require changes in order to suit to the current scenarios and demands. To some parties, maintenance of building is a complicated process and costly but if it is carried out wisely it could save money besides potential extended life span of the building (Suffian, 2013).

With new millennium, city development increase building urban development and encouraging some party to dealing with a major problem which is the building defects. Specifically in this research, building defect on shopping mall building was studied involved it causes, effects, maintenance needed. The shopping mall building is under high rise or mega building category as it builds in big size and can hold large capacity of people. The structure has to be able to produce new design include interior or exterior need to be enhance and decrease the problems affected the building itself.

Poor and improper building maintenance will definitely cause more damages and costly repair works if left unattended. In Malaysia, buildings are built in accordance with British Standard and under strict supervision (Ghassan et al, 2010). Unfortunately the maintenance aspects of the building are still weak. Making it worse, sometimes building maintenance is perceived as merely about the mechanical and electrical system in the buildings without

much consideration given to civil and structural elements. This research paper is to discuss the common maintenance problems and building defects on civil and structural elements that require some maintenance works to sustain excellent performance of the building. (Ahmad Suffian, 2013)

Building structure has their own maintenance procedure, but it needs specific reference or skilled person to handle and give information about the issue. This research intend to build a maintenance guideline for defects issues as the outcome to ease the building manager party to execute maintenance work as soon as they get the report of the issue. Delay of work will be avoided and period of the defects occur can be minimize. The guideline includes the people involved, task, period, specification, defects category and cost of such a defect issues. With this guideline, non-skilled people also can get the imaginary and information about things needed to settle defects problem without hoping advises from skilled person.

Building owners have always been aware of the conditions of their building to avoid panic situation to the customers. So with the guideline, it may ease their work to act quickly as it stated the necessary things in managing the defects. Defects not focus on the structural only, but for shopping mall building, defects also come from the mechanical, electrical, water system, thermal condition, doors, windows and glass. Each item will give different effect to the building and affect the value of the building.

1.2 Problem Statement

Development is increasing in this era of globalization but there are various problems involving the structure of the building which causes the value of the building itself to decrease. Building deformities or defects are particularly noticeable directly and clearly then indicating the lack of the building itself. Defect was a main problem at shopping mall. Therefore, the need of maintenance guidance for maintaining the shopping mall performance is very important to solve problem like poor building maintenance, unattended defects and unfamiliarity of authorities with defect requirements. However, people are well versed in observing the defect only but the element involved in the defect maintenance process is difficult to identify.

There are separate resources to find the elements involve in defects management but this research is intended to gather all the references together in one piece of guideline. With this guideline, shopping mall building performance can be improving with zero defects issues. In addition, identification of standard specification of material that suitable to use on shopping mall building also can be list. Not over the structural, the material used to build and operate the building also sometime has defect and not durable to fire emergency such as lift, doors, walkways specification and many more.

1.3 Objectives

The objectives of this research are listed as follow:

1) To identify building defects in shopping mall building.
2) To analyse people awareness and perspective on defects problems of shopping mall building.
3) To develop a maintenance guideline for building defects of shopping mall building.

1.4 Scope of Study

The scope of this study will be focused on defects identification and maintenance operation of commercial building especially the shopping mall building. Shopping mall has been chosen as it is one of commercial building and been expect to have large number of visitors including the respondents.

In this research, researcher do surveys in questionnaires method to the engineers or respondents that has building maintenance or construction background to know their opinion and observation of defect that occur in shopping mall in their area. It helps to identify the obvious defects occur and can be considered as abandoned because of no act is taken to resolve it. An interview with the professional engineer also be held to get information and opinion on how to manage the defects problem and what type documentation is needed for maintenance work execution. The defects observed are include structural, architectural, sewer and mechanical and electrical defects. Defects chose is based on the availability of defect in shopping mall building that can directly observed by the researcher and respondents of interview.

1.5 Limitation of Study

The scope of the study is restricted to only retail area of shopping mall building. All the elements, including the defects solution, defect maintenance and guideline provision could be performed in this study.

1.6 Significance of Study

With this study, various parties will benefit from it, for example this research will highlight defect problems and guide building managers to solve matters by using defects maintenance guideline produce. Technical report also can be produce by referring to the guideline. Building manager can get overall information of the maintenance procedure for the defects so the contractor assigned to solve the defect problem will be under their supervision without hesitation. Contractor assigned to handle the defect problems also can execute the work following the standard and actual procedure. Maintenance party like electrical and mechanical part can get ideas how their work will affect other structure components by getting information from the framework. The guideline will improve the management and operation of the shopping mall building.

The guideline does not for maintenance department user only, but also can be a reference to anybody who intends to know about defect details or procedures as it also can be used for small building like houses and shops. As well as to the researcher, it show the ways to advance and upgrade existing information of engineering knowledge by refer to one piece source only. This effort of research will attract more people on collecting knowledge of defect issues around them. In a nutshell, this research will beneficial to various parties such as the community, organization and researcher.

1.7 Operational Definition

1.7.1 Shopping Mall

Defined as gathering point or group of retail and any commercial establish that was planned, developed, managed and owns as a single property. It also includes the on-site parking space provided. Shopping mall or shopping centre also can be categorized into two categories which are general or special purposes. General purpose range is from small centres that offer groceries and other convenience products to large with significant fashion oriented offering and contain large entertainment component. Special purpose is the enclosed malls that generally have narrower tenant mix, selling similar type of products or related by their concept and purpose. (Sampson, 2012)

1.7.2 Building

Consist of roofed and walled structure built for permanent or long term use. In addition, it is such the art or business of assembling materials into a structure. Building is categorized as several type which are agricultural, civil, residential, medical, educational, government, industrial, military, parking structures, religious, infrastructure and shopping mall is categorized under commercial building. (Markku, 2017)

1.7.3 Operation

Operation fire safety is an initiative to promote fire awareness, prevent fires, and save lives (Cowlard et al, 2013). The fire safety operation and fire emergency plan applies to all premises which are to any extent under the control of the organization as the employer, owner or principal occupier. Its requirements extend to all persons at those premises including staff, visitors and contractors whether permanently or temporarily engaged. (Provisions, 2014)

1.7.4 Building Maintenance

Its combine technical and administrative actions in seeks to ensure the items and elements of a building are in an acceptable standard to perform its required function. Building maintenance in a shopping mall shall include the lighting, electrical, structure, fire system, safety system, infrastructure and facilities. (Chanter, 2007)

1.7.5 Building Defects

Defects is the building flaw or design mistake that results in failure of component part of a building or structure that can cause damage to person or the property itself. It can be found in the design, materials or system. There are minor and major defects where minor is when the building is uninhabitable or likely to collapse. Minor defects is when the defect issue does not threaten entire structure of the building. (Suffian, 2013)

1.7.6 Defects Repair

Process of restoration of a broken, damaged or failed part of property to useable condition or state. Correcting situation either repair or do replacement of such components. Assessing the situation has to be done by the team and determine whether the specific defect is able to repair or not. If it is unable, the component must be replaced and will involve the financial responsible party. (Robert, 2005)

1.7.7 Fire

Fire is a hazard in any part of the premises. Its consequences include the threat to the lives or health and safety of relevant persons, damage to or loss of property and severe interruption to normal business activities or opportunities (Chu & Sun, 2008). Managing the risk of fire demands fire safety precautions based on a combination of appropriate prevention and protection measures depending upon building use and occupancy, the inherent fire risks and the legal obligations laid on organization as the employer, occupier / owner or responsible person. (Cruz, 2011)

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is an introduction to defects element for buildings in general including shopping mall. In this chapter, the definition of each term used is presented. From this chapter also will gather all previous information about case study of previous research.

2.2 Building

The main function of a building is to protect the occupants and contents from the weather, mainly rain, wind and extremes of temperature. It is most important to provide the basic needs which will achieve all of these functions. Features such as windows, pipe, air conditioning system and finishes are only additional. Obviously a building must be structurally safe in order to survive, and the floors must be capable of resisting any normal imposed loads (Poles, 2008). Same goes to shopping mall building where it consist of many facilities features that tend to give comfort ability to customers. There are many aspects that need to consider on maintaining excellent building performance.

2.2.1 Building Operation Management

Operation and maintenance (O&M) is a longest phase in lifecycle of a shopping mall building and involve a sophisticated relation among various stakeholders, facilities, professionals and management activities. The task include is like the scheduling, space planning, emergency managing and repairing (Yang Peng, 2017). Management is the main factor to limit the defect and any building issue in shopping mall. Its involve owner party to take the managing step as a serious thing.

2.2.2 Facilities Management

Facilities of a building also been called as the vital asset that operate the building to the users. To manage the facilities, it combines current technical knowledge on providing effective work environments. It also involves steps in planning, providing and managing a productive building environment for customer conformability. Best facilities management is vital for the success of an organization as numerous people will satisfy.

Facilities management is divided into three aspects which are:

- In-building facilities management
- Contracted or individual traders (package/services-e.g. cleaner)
- Total facilities management (TFM)

Such vendors or traders possibly grab the chance to supply those facilities into the building to seek for broaden their market, raise image and create consistent workloads. Information that are required to maintain facilities are detail of construction, property age, services details, inspection requirements and maintenance history (Barrie Chanter, 2007).

2.3 Maintenance

Maintenance of shopping mall includes all technical and administrative actions include the supervision that to ensure all elements to a condition is fulfil the requirements. Along the building service life, each element should present performance levels that fulfil the user's needs. Before planning maintenance operation for a building, there is some step to be taken first to smooth the planning progress which are analyse the building's elements performance, predicted service life and maintenance needs.

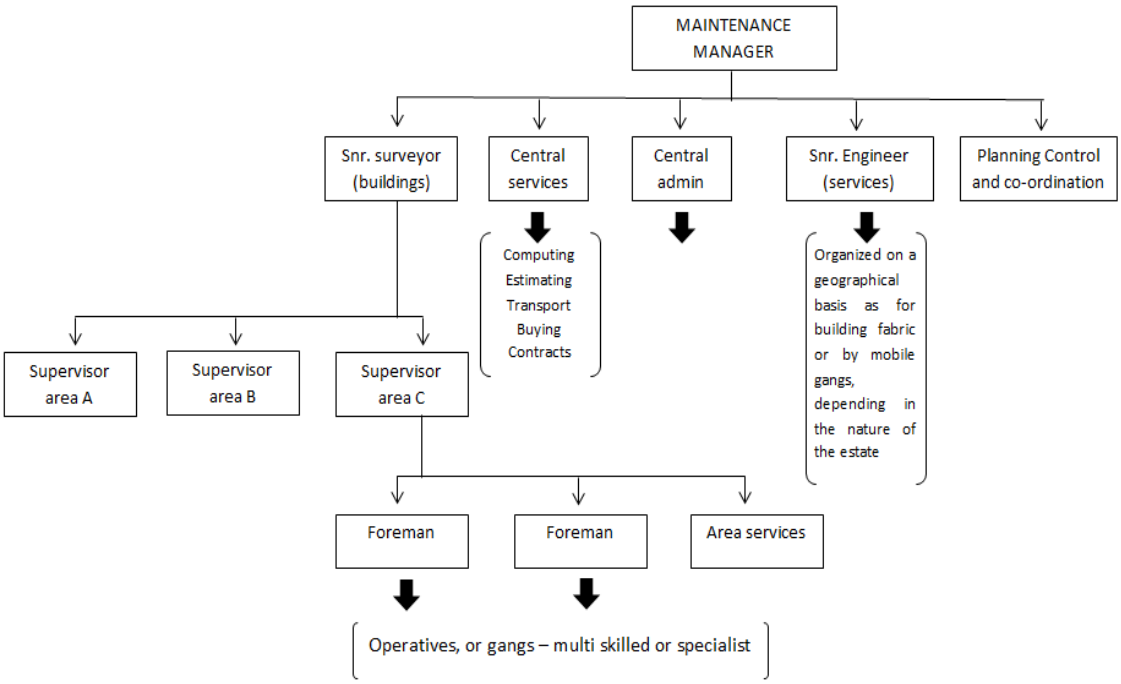

Figure 2.1 Decentralized Maintenance Organizations (Swallow, 2007)

Figure 2.1 shows the hierarchy of person involved in organizing or handling maintenance issue from the work execution start until finish. Maintenance manager are responsible to monitor overall work progress and being help by engineer, surveyor, supervisor and foreman. Each post has to get approval from their higher officer follows the organization structure for making any decision.

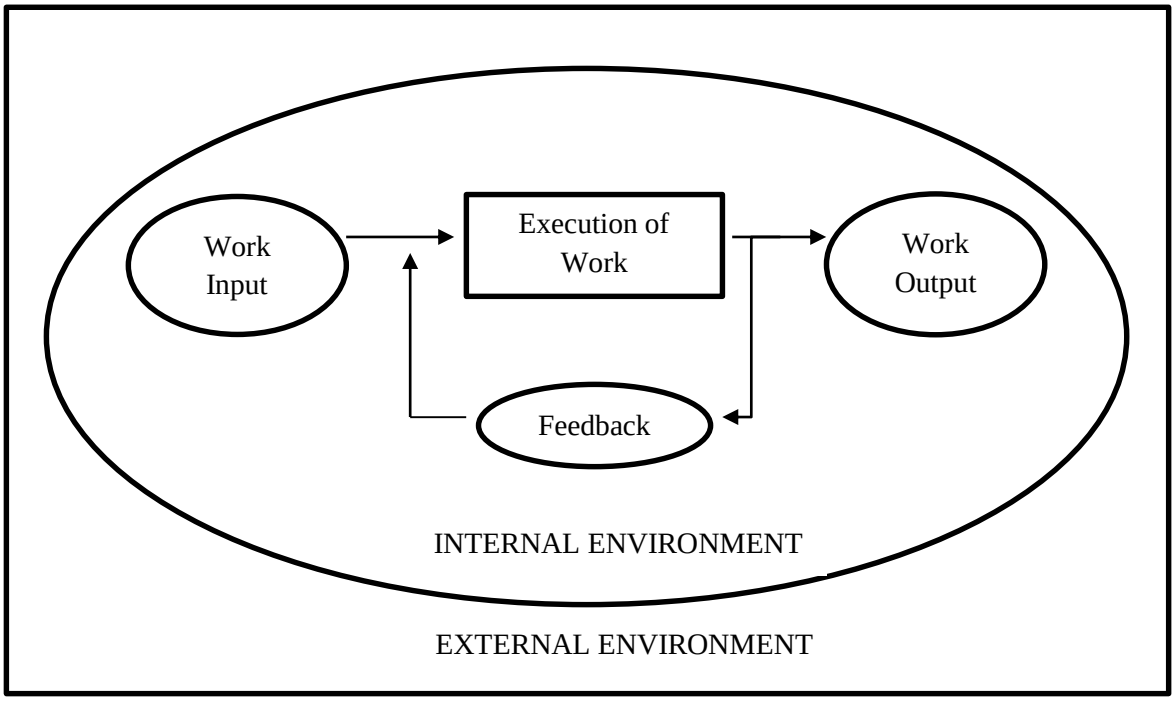

Figure 2.2 Maintenance as Adaptive System (Swallow, 2007)

Maintenance work is an adaptive system which is shown in Figure 2.2. It is a process on execution of work from the work input then manages to produce the work output. From the output, feedback has to be taken into consider if any executed work are still not achieving and comply with standard that has been set. From the feedback, some modification can be made at the work input to produce a better output.

2.3.1 Types of Maintenance

The maintenance process must involve three types of maintenance which are preventive maintenance, predictive maintenance and corrective maintenance (Colen, 2010).

2.3.1.1 Preventive Maintenance

Preventive maintenance is more crucial and those who involve in the development of building must understand the importance right from the beginning of the projects. It involves the degradation signs that come out before any clear physical or functional change on building occurs. (Colen, 2010)

2.3.1.2 Predictive Maintenance

It is based on inspection held to evaluate the maintenance needs of each element. The inspection is planned and maintenance strategy is arranged depends on the inspection results on each elements. In addition, it based on clear number of technical and statistical details about the building's elements behaviour. It requires qualified experts to evaluate functional parameters, symptoms and related causes to provide a mitigation strategy. (Colen, 2010)

2.3.1.3 Corrective Maintenance

This type of maintenance respond on emergency actions, interfere any claims and sometimes putting users integrity in danger. But, corrective maintenance strategy is cheaper in the short-term. It gives benefit to the owners in terms of cost but highly risk. (Colen, 2010)

2.3.2 Maintenance Contractor

Information related to the approved contractor on doing the maintenance work on the facilities should be gather as it useful to refer into the file for variable use. The information need are like name, address, telephone number, code number, type of contractor, hourly rates include overtime rate, tax certificate details and insurance details (Swallow, 2007).

In additional, information like size of job and area which contractor operates can be added. Besides that, sub-file of work or project that undertaken by the contractor should be having that consist of their performance data as the benchmarking exercise.

2.3.3 Maintenance Period Planning

Table 2.1 listed the estimated service life proposal for each façade element in a building that consist of the minimal, maximum, average and proposal of maintenance that should be held for maintaining excellent performance of a building.

Table 2.1 Estimated Service Life Proposal for Each Facade Element (Madureira, 2017)

Elements	**Materials**	**Service life of the building's elements (years)**			
		Minimal	**Maximum**	**Average**	**Proposal**
Claddings	Rendering	20	81	50	40
	Paint	4	40	7	8
	Ceramic	15	57	36	40
	Stone	20	70	45	50
Windows, Doors and Protection Elements	High quality wood	10	69	40	35
	Aluminum	10	58	34	35
	PVC	10	49	30	35
Cornices, Eaves, Door and Window Frames	Stone	20	60	40	50
	Cement/Concrete	20	60	40	50
Joints Seals		3	20	11	10
Discontinuous Claddings Fastening Elements/Doors and Windows Fittings	Galvanized Steel			10	10

Table 2.2 continue the elements from Table 2.1 that describe more detail on claddings elements with it operation task, recommended period and proposal period to maintain most quality performance of the building elements.

Table 2.2 Maintenance Operations Frequency Proposal for Facades Claddings (Madureira, 2017)

Elements	Material	Maintenance Operations	Recommended Periodicity	Proposal
Continuous Cladding	Rendering	Cleaning	Biannual	Every 8 years
			Every 10 years	
			2–5 years intervals	
		Surface treatment	When necessary or after repair works	When necessary or after repair works
		Minor intervention	Every 2 years	Every 10 years
			Every 13 years	
			Every 5 years	
			Every 5 years	
		Major intervention	Every 2 years	After 20 years
			After 26 years	
			After 40 years	
	Paint	Cleaning	It does not apply	It does not apply
		Surface treatment	It does not apply	It does not apply
		Minor intervention	It does not apply	It does not apply
		Replacement	Every 5 years	Every 8 years
			5-10 years intervals	
Discontinuous Cladding	Ceramic Tiles	Cleaning	Every 10 years	Every 10 years
			When necessary	
		Surface treatment	When necessary or after repair works	When necessary or after repair works
		Minor intervention	Every 13 years	Every 13 years
			Every 11 years	
			Every 12 years	
		Major intervention	Every 26 years	Every 26 years
			After 40 years (80 years' service life), or after 20 years (40 years' service life)	
	Stone Tiles	Cleaning	Every 8 years	Every 10 years
			Every 10 years	
			Every 15 years	
		Surface treatment	When necessary or after repair works	When necessary or after repair works
		Minor intervention	Every 20 years	Every 20 years
			Every 15 years	
		Major intervention	Every 18 years	After 30 years or when necessary
			After 40 years	
			When necessary	

2.4 Building Defects

Building defect may be considered to be a failing or shortcoming in the function, performance, statutory or user requirement of a building, and manifests itself within the structure, fabric, services or other facilities of the affected building (Illozor, 2003). Defects cause by many factors such as poor workmanship or rarely maintenance monitoring of the building. Defects can be categorized by two which are defects that affect performance of structure and defects that affect the appearance of structure. In addition, atmospheric pollution also can cause defects especially at interior structure of the building. Defects can be avoid by ensure proper inspection or maintenance schedule are in place.

2.4.1 Building Defects Classification

From ADO Building Inspection 2018, defects can be classified into three categories which are:

2.4.1.1 Major Defect

Defect that require rectification in short term without undue delay to avoid:

- Unsafe conditions, posing a threat to life or serious injury.
- Loss of utility whereby the defect is such that the whole of the relevant part of the property can no longer serve its intended function.
- Further substantial deterioration of the property.

Major defects are typically damp related but may also be serious structural defect. It does not necessarily imply high cost and may be simple.

2.4.1.2 Minor Defect

Classified other type of defects other than major defect. Items of repair and maintenance that do not require urgent repair and are common to properties well maintained or common for a particular type or age of property.

2.4.2 Contribution Factors

There are several factors that contribute to building defects and failure (N. Ahzahar, 2011)

2.4.2.1 Climatic Condition

Climatic condition of Malaysia that has heavy rainfall and warm sunshine along the year are prone to affect the building materials. This is because the external building material are exposed to external climatic such as rain, wind, solar radiation and atmospheric pollution.

2.4.2.2 Building Location

Building that located near the sea or river are tend to have more building defects because water coming from the ground cause dampness penetration and structural instability. Salt that comes from the sea together with polluted atmosphere will cause damage to exterior surface of building.

2.4.2.3 Construction Materials

Most building choose for using materials that easily available and cheaper price. Understanding the nature of the materials is important to predict the problem that might arise and come out with proper technique of preservation of the materials and structures.

2.4.2.4 Maintenance of Building

Regularly maintenance play important role in preventing building defects. Neglecting this task will make the building fall into defects that may lead to structural failures. Inspection carried need to check for any signs of abnormal deterioration, cleaning out of harmful substance and checking lighting conductors.

2.4.2.5 Faulty Design

Design error is made to save the construction cost and lead to uncertainty condition where structure cannot withstand the faulty and finally fails. Faulty design also cause by assumption or decision that are not comply with actual behaviour of the structure.

2.4.3 Defect Inspection

Physical inspection should be done on defect identifies for the following reasons which are to estimate cost and resource needed, arrange access verify information to arranging works order and diagnostic purposes (Barrie Chanter, 2007).

2.4.4 Defect Repairing

It is involving the breakdown of equipment and works undertake to correct the defects in order to return it in effective condition. Simple or soft repairs can be done for guarantee the safely work environment and do not create hazards for people around the work area.

2.4.4.1 Soft Repair

Soft repair is one method on repairing works which develop adaptive strategies to temporarily minimize the fault and large impact of the repairing works until the ultimate physical repair is been done without any other physical intervention. (Woradechjumroen, 2016)

2.4.5 List of Defects in Shopping Mall Building

Professional inspection required to identify defect existing in shopping mall building includes diagnosing the cause of defect and propose suitable repairing work to rectify the problem. These list of defect are defect that obviously can be seen in the shopping mall building.

2.4.5.1 Wall Cracks

Figure 2.3 Wall Crack Defect at Fahrenheit Shopping Mall, Kuala Lumpur (Fieldwork, 2018)

Typical crack of buildings in Malaysia is of non-structural type shrinkage cracks, joint cracks. Surface cracks are commonly found on the floor screed and normally caused by improper curing process. Joint cracks are commonly seen at the joint of different structural elements such as column / brick wall and beam / brick wall. The common causes of such cracks are identified due to the difference thickness of plastering on those structures and insufficient bonding element that holds bricks to the column or beams. Other area of cracks is around the opening such as for windows and doors. These kinds of crack can be repaired easily with straight forward methods such as applying repair mortar / putty onto the affected area (for cracks < 3mm) together with suitable wire meshes provided the surface preparation is carried out in proper ways. In some cases, corrosions of steel reinforcement were detected and these incidents indicated that immediate repair was not carried out at early stage. The measurement of crack progress was carried out using crack gauge to ensure no further crack movement prior to the repair works. (SOCSO, 2011)

2.4.5.2 Tiles Crack

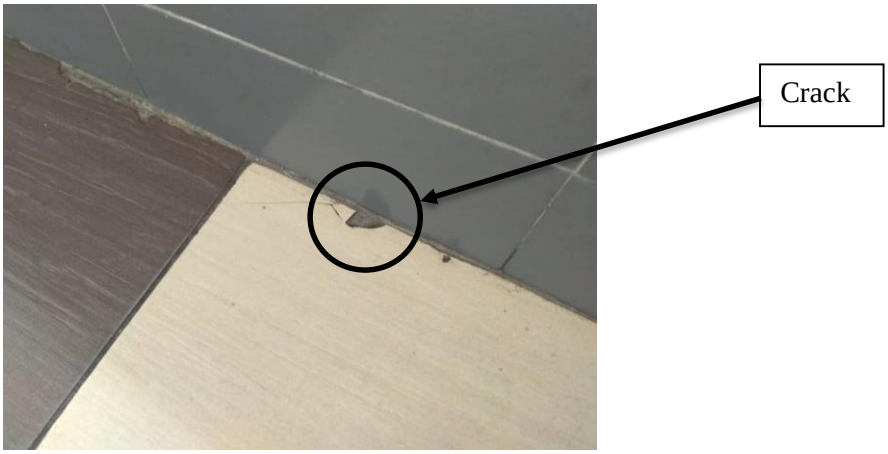

Figure 2.4 Tiles Crack Defect at Mentakab Starmall, Pahang
(Fieldwork, 2018)

Cracked tiles on floors are mostly not cause by the tile itself, but the material below the tile. Because the cause is hidden below tile, it is difficult to investigate the cause or fix it. One of the factor is the thermal effect of the building. The temperature difference between the internal and external tile surfaces is one of the important parameters that control the characteristic of the thermal crack (P. Rajeev, 2016).

2.4.5.3 Peeling Paint

Figure 2.5 Peeling Paint Defect at East Coast Mall Kuantan, Pahang
(Fieldwork, 2018)

It is common to see that the wavy surface of plaster due to poor workmanship. Since this problem is common in Malaysia, have the external walls of the new buildings roughen with mortar prior to painting is one of the alternatives. With this kind of finishes, the texture could hide the uneven plastering surface on the large surface. The only problem is that repair of the surface should any defects occur would be a bit more difficult. Another issue with the external wall is an efflorescent (whitish bleeding) spotted on the wall surface which occurred due to chemical reaction of the wall materials and high moisture content on the wall prior to painting process. This problem can be resolved by completely removing the finishes on the affected areas and subsequently repainted it in the suitable condition. (SOCSO, 2011)

2.4.5.4 Ceiling Water Stain/Leak

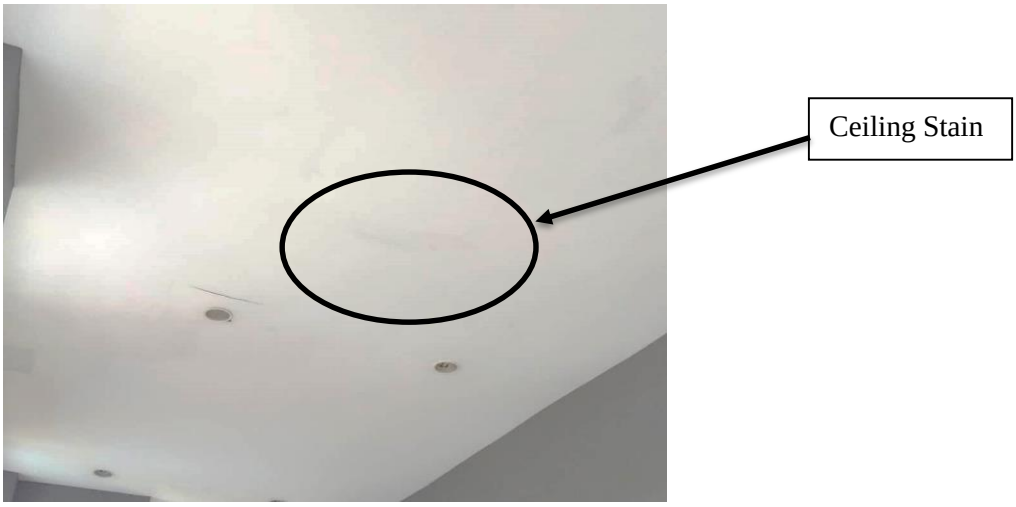

Figure 2.6 Ceiling Stain Defect at Mentakab Starmall, Pahang
(Fieldwork, 2018)

In Malaysia, the problems of leakage at buildings are always happen due to tropical condition, improper design and poor workmanship. For instance, (Ahzahar, 2015) revealed on the roof leakage at the Parliament building and few cases of pipes leakage and ceiling collapse at the government buildings.

There a lot of causes that creates the problems such as environment, poor workmanship improper design and ventilation factors (Ahzahar, A Case Study on Moisture Problems and Building Defects , 2015)

However, the (EPA, 2013) has come out with two recommendations to control the moisture problems that are:

I. Preventing water intrusion and condensation
II. Limited the areas that routinely wet such as bathrooms, kitchen etc. and try to drying them out when it get wet.

The condensation will also lead to mild growth when the dew point of the air is above the temperature of the surface, and then the water vapour will condensate onto that cold surface. In order to control the moisture problem, also recommended it is adequate that the vulnerable materials are in dry condition and if they do get wet, the buildings materials need to be dried out quickly to avoid dampness or any defects. Besides that, (Hassan, 2011) highlighted the issues of moisture problems on the hospitals as example in Malaysia are condensation from the air conditioning due to two attached rooms with different temperature, leakages of pipe, water seepages and surfaces which expose to weather and not resistance to weather.

2.4.5.5 Rusty Iron

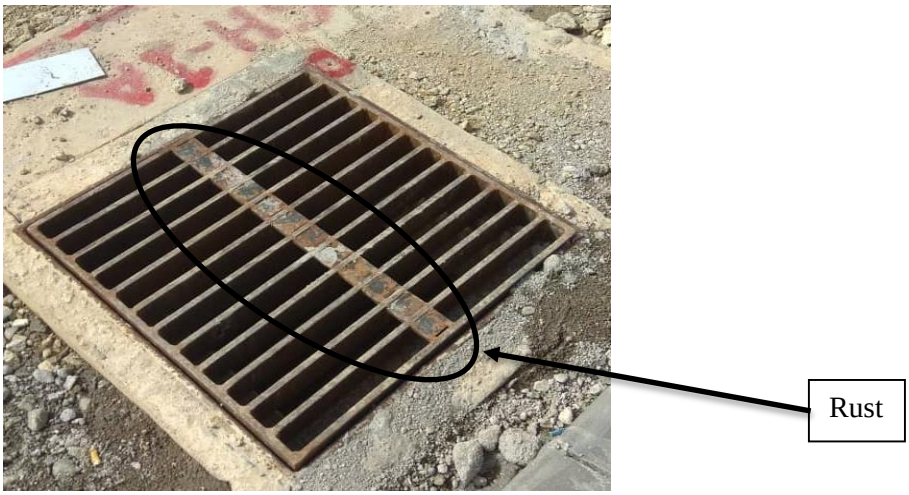

Figure 2.7 Rusty Manhole Cover at Timurbay Site, Kuantan Pahang (Fieldwork, 2018)

Rust is a reddish-brown solid consisting of hydrated iron oxide (predominantly Fe2 O3). It is a special case of corrosion. Traditional rust removal involves use of highly concentrated acids which often have side effects for materials, people and the environment, when the solutions are exhausted they need to be neutralized (Rajendran, 2012). The rusty iron as example the steel pipe will contribute to leakage and other related possibility.

2.4.5.6 Leaking Pipe

Figure 2.8 Water Leaking Defect in Paradigm Mall, Johor Bharu
(Fieldwork, 2018)

Leakage in water supply networks makes up a significant amount, sometimes more than 70% of the total water losses. Leakages are the annual volumes lost through all types of leaks, bursts and overflows up to the point of customer metering. They are caused by lack of active leakage control (ALC), excess pressure, poor operations and maintenance, poor quality of underground assets, vibration and traffic loading and Corrosion. Bursts and background estimates (BABE) philosophy provides a pragmatic and simple approach to the very complex problem of leakage from water distribution system (Nourhan Samir, 2017). In BABE analyses, components of leakage can be categorized into three categories which are:

- Reported breaks and leaks: They typically have high flow rates and short run time before they are reported to the utility either by the general public or the water utility's own staff. They are visibly evident and disruptive.
- Unreported breaks and leaks: They have moderate flow rates and a long run time. They are located by leak detection team as part of their active leakage control (ALC) program.
- Background losses: They are individual events (from joints, fittings, and small cracks) with flow rates too low to be detected by traditional acoustic leak detection techniques. They will continue to flow either detected by chance or until they gradually worsen to a point where they can be detected.

2.4.5.7 Uncovered Electrical Wire

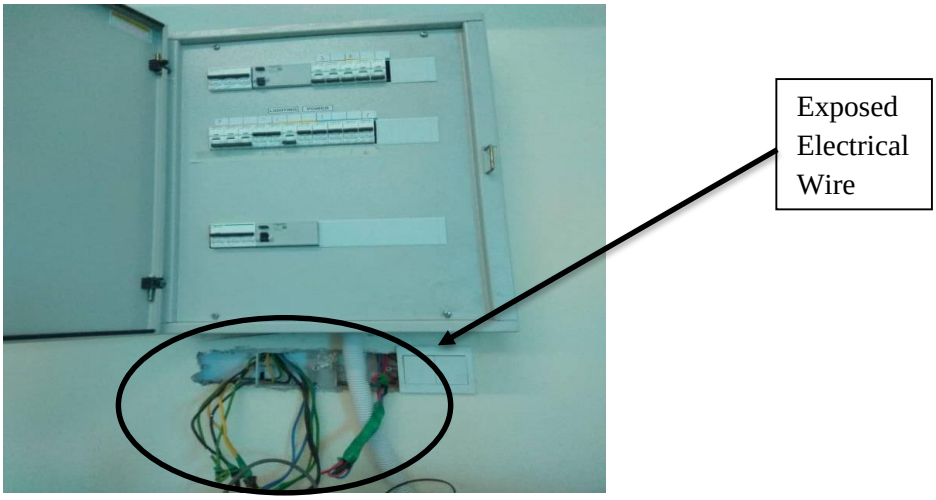

Figure 2.9 Uncovered Electrical Wire at Timurbay Site, Kuantan Pahang (Fieldwork, 2018)

In 2007, an estimate 51,800 home-structure fires reported to fire departments involved some type of electrical failure or malfunction as a factor contributing to ignition. These fires resulted in 450 civilian deaths, 1640 civilian injuries and .2 billion in direct in property damage (Hall, 2007). In shopping mall building also there are observe that at some places, joints in wires are lying uncovered. Residents or visitor feel that these area an open invitation to untoward incidents. It is extremely dangerous for everybody especially young children. Anyone could get injured with the wires exposed and need to be addressed immediately. Junction boxes, pull boxes and fittings must have approved covers. Unused openings in cabinets, boxes and fitting must be closed.

2.5 Shopping Mall

Shopping mall is a building that specially built in strategic area containing shops and restaurants where people can walk between. Shopping mall is divided into certain type that helpful when deciding on the best shopping stop for certain group (Browning, 2017).

Table 2.3 Shopping Mall Type Division (Browning, 2017)

General-Purpose Centers				
Type	**Concepts**	**Typical GLA Range (Sq. Ft.)**	**Typical Number of Tenants**	**Typical type of Anchors**
Neighborhood Center	Convenience	30,000 - 125,000	5-20	Supermarket
Community Center	General merchandise; Convenience	125,000 - 400,000	15-40	Discount department store, supermarket, drug, home improvement, apparel, large specialty discount
Regional Center	General merchandise; fashion	400,000 - 800,000	40-80	Full-line department store, junior department store, mass merchant, discount department store, fashion apparel
Super-Regional Center	Similar to regional center but has more variety and assortment	800,00+	N/A	Full-line department store, junior department store, mass merchant, fashion apparel
Specialize-Purpose Centers				
Type	**Concepts**	**Typical GLA Range (Sq. Ft.)**	**Number of Anchors**	**Typical type of Anchors**
Lifestyle	Upscale stores with dining & entertainment	150,000 - 500,000	0-2	Larger format upscale specialty
Power Center	Category-dominant anchors	250,000 - 600,000	3 or more	Category killers, home improvement, discount department store, warehouse club, off-price
Theme/Festival Center	Leisure, tourist, retail and service-oriented offerings	80,000 - 250,000	N/A	Restaurants, entertainment
Outlet Center	Manufacturers and retailers outlet stores selling brand-name goods at a discount	50,000 - 400,00	N/A	Manufacturers and retailers outlets
Limited-Purpose Centers				
Type	**Concepts**	**Typical GLA Range (Sq. Ft.)**	**Number of Anchors**	**Typical type of Anchors**
Airport Retail	Consolidation of retail stores located within a commercial airport	75,000 – 300,000	N/A	Specialty retail and restaurants with no anchors

Type of centre that indicated in Table 2.3 are explain as below:

Neighbourhood Centre – Designed to provide convenience shopping for the day-to-day needs of consumer in the immediate neighbourhood. A neighbourhood centre is typically a straight line strip with no enclosed walkway or mall area.

Moreover, Community Centre – Offers wide variety of apparel and other goods than a neighbourhood centre. Configuration is a straight line, L-or U-shaped.

Furthermore, Regional Centre – This centre sells a full variety of general merchandise, mostly apparel, in typically enclosed malls with inward facing stores that share a common walkway. Its main attractions are its anchors.

Next, Super-Regional Centre – This centre is similar to the regional centre, but it is larger with more anchors and carries a deeper selection of merchandise. Super-regional centres draw from a larger population base. Typical configuration is enclosed with multi levels.

Besides, Fashion/Specialty Centre – Composed of upscale national-chain specialty stores with dining & entertainment in an outdoor setting. They may not be anchored, but restaurants or entertainment provides the draw of anchors. A sophisticated design emphasizes the rich décor and landscaping.

Additionally, Power Centre – Several large anchors, including discount department stores, off-price stores, warehouses clubs or "category killers" (stores that offer huge selection in particular merchandise categories at low prices) dominate. The centre consists of several freestanding anchors and only a few, small specialty tenants.

Admittedly, Theme/Festival Centre – The centres appeal to tourists, restaurants and entertainment facilities may anchor. Anticipate seeing them in urban areas adapted from older, possibly historic, buildings and part of mixed-use projects.

Lastly, Outlet Centre – Consist of manufacturers and retailers outlet stores selling their brands at a discount. They are found in rural or tourist locations. Outlet centre designs include enclosed malls, a "village" cluster or a strip configuration.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter is proposed for describing and explain he flow of procedures and method that been used to conduct the research. This research method has been developing to achieve the four objectives of this study which are to identify problem that lead to defects in shopping mall building, to analyse defect problems and to develop a guideline for defects repair at shopping mall. Qualitative method is used in conducting this research.

3.2 Research Methodology

A flowchart of the processes involved in this research is shown in Figure 3.1. For the purpose of this study, the research methodology can be briefly divided into five stages, namely:

a) Problem Statement
b) Literature Review
c) Data Collection
d) Results and Analysis
e) Conclusions and Recommendatio

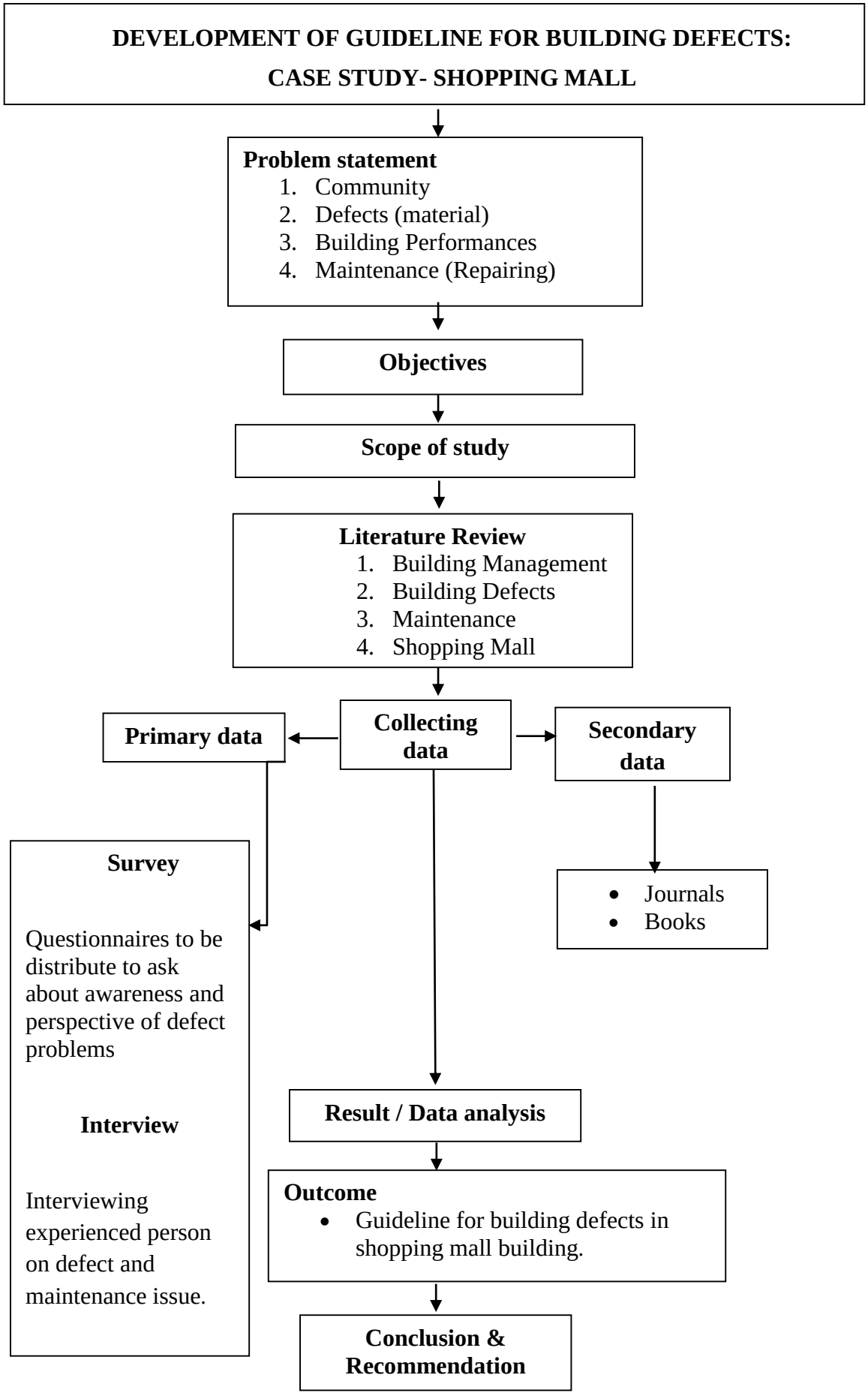

Figure 3.1 Research Methodology Flowchart (Researcher, 2018)

3.3 Problem Statement

It gathers the issues that arise from the topic that make the research valid to continue on solving those problems. The problem statement is look into several sights which are tenants and owner of the building. Building defects will affect the building performance especially shopping mall that load numerous of customers every day. Gather information of building defects repairing requirements will be produce so it will help building owner on solving defects issues in their building by refer to the guideline.

3.4 Literature Review

It is give additional of information fact and theory on research that have been carried out previously. This information can be obtained from books, journals, and article. All sources are gathered and be reviewed to get more information particularly for this research.

3.5 Data Collection

Data collection techniques would be divided into several type to get information orderly. In early stage, a structure work flow to get picture on study journey. This structure will divide into various parts namely:

a) Questionnaires (Part A and Part B)

b) Interviews (3 Participants)

c) Observation of shopping mall defects (Retail area)

3.5.1 Questionnaires

Close-ended questions are choosing in this phase. Questionnaires is important to get data opinion from public either they know or unknown of such fact. Apart from that, it also help in predicting commercial need for conducting this study in the future. The questionnaires will be distribute to engineers or person that have background in building maintenance or construction as they are expected to have more knowledge in the research topic. Questionnaires to be distribute is asking about the awareness of defects, perspective towards building defect and evaluation of defects problems.

3.5.2 Interview

Interview will be carry out by interviewing the professional engineer that have knowledge and experience in managing maintenance of the building to get details and source related to maintenance and repairing works. Some document attachment also can be ask from them to support the research study.

3.5.3 Observation of Shopping Mall Defects

Observation or survey of other benchmark shopping mall also involved to gain more ideas and information to improve the study and make an extravagant outcome. The observation will held randomly or be with competent person that can give advice of defects problems, facilities and design approach that minimize defects problems. Direct observation is done by utilizing a checklist and photograph to document it in phase of analysis data.

3.6 Results and Analysis

All data is collected and analyse as the process involve record and evaluate all the result that got from the primary and secondary data collection. The questionnaires are distributed to 41 respondents of random firm around Malaysia to identify their evaluation on defect level at shopping mall in their area. The result will be recorded and analysed by using table and chart. Result of analysis will come out with chart to be clearer and structure. This results or outcome will answer and comply with objective set which are;

1) To identify building defects in shopping mall building.
2) To analyse people awareness on defects problems of shopping mall building.
3) To develop a defects maintenance guideline for shopping mall building.

Based on the results, it is shown that this defects maintenance guideline will beneficial to many parties such as the building owner as the guideline produce will ease them in solving defects issues in shopping mall building.

3.7 Conclusion and Recommendation

Based on the results, it is shown that this defects maintenance guideline will beneficial to many parties such as the building owner as the guideline produced will ease them in solving defects issues in shopping mall building.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter discuss about the result obtained from the data collection and survey made on study area. All the data has been collected through observation, questionnaires and interviews. The questionnaires are divided into two parts which were Part A about the detail of the respondents, and Part B about the defect awareness and notification in shopping mall building. The questionnaires have been distributed to experience engineers and construction managers as they are more expert on defect issues. The method used for distribution the questionnaire is by email, broadcasting survey link, direct survey and direct interviews. Then, the data are being tabulated by tables and charts.

4.2 Respondent Background

The respondents in this study are engineers or staff in building construction area as their background of study or work scope is on building. So it is expected that they are the right person to evaluate defect issues in shopping mall building around them. There were 41 respondents take part in this survey. Part A of the questionnaires is aimed at obtaining some background detail about the respondents and Part B is survey on research scope. From the survey data collection, the following information has been obtained.

4.2.1 Gender

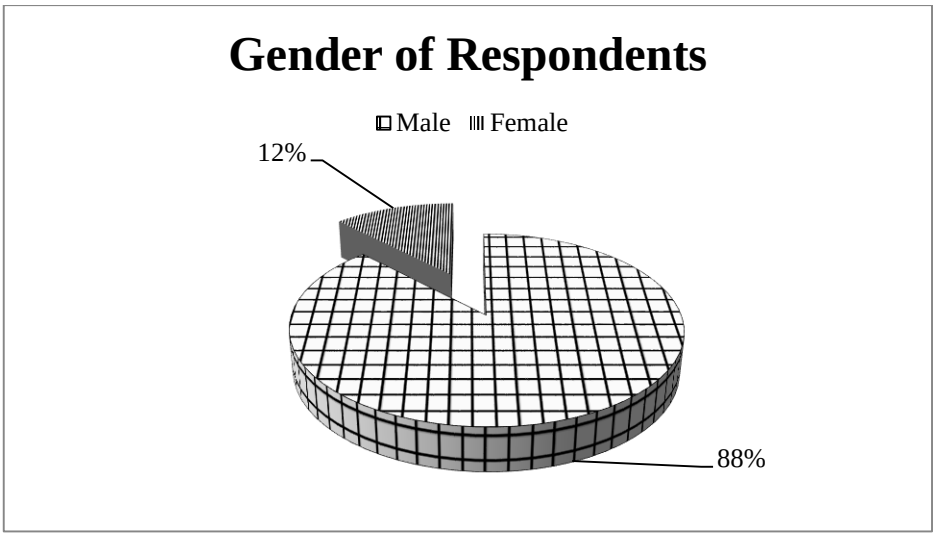

Figure 4.1 Gender of Respondents

From the data collected, it can be observed that the majority of the respondents are male more than female. The percentage of male who involved in this survey was 88% of respondents, and female only 12% of respondents. The data are tabulated as shown in Figure 4.1.

4.2.2 Level of Education

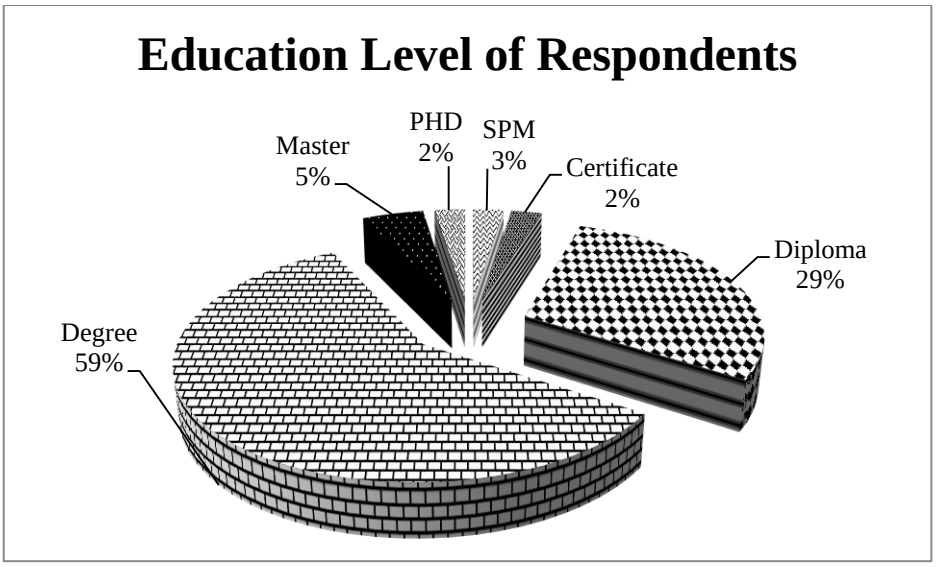

Figure 4.2 Education Level of Respondents

From the data collected, it can be observe that most of the people of the respondent are Degree holders which are 59% of percentage. This is followed by Diploma holders that only 29% of percentage. Respondents possessing Master holders comprised 5% of the overall of respondents and 3% for SPM level. PHD holders are equivalent to certificate holders which are 2% out of overall number of respondents. The data are tabulated as shown in Figure 4.2.

4.2.3 Firm Related

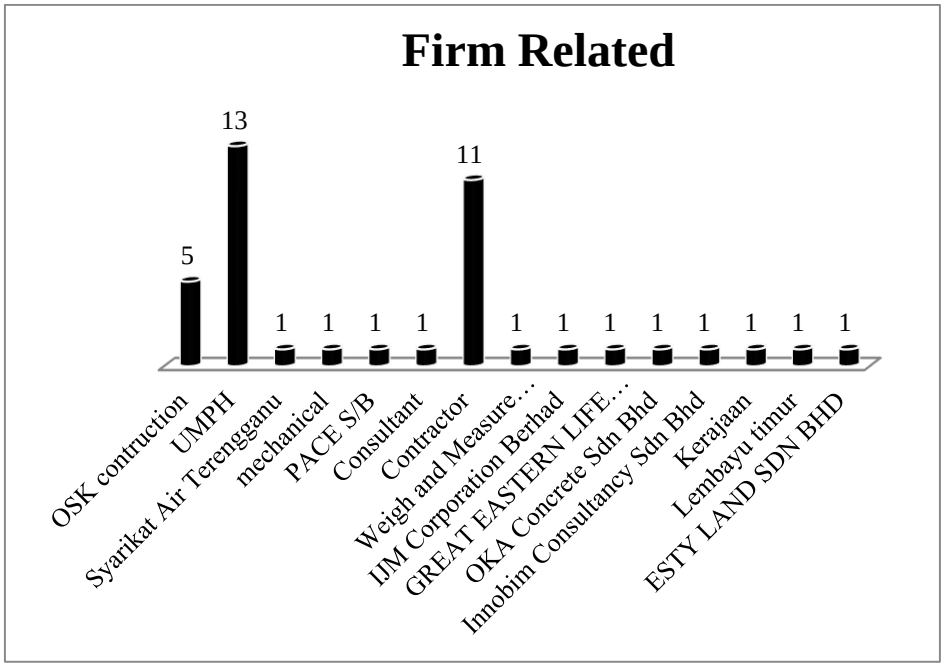

Figure 4.3 Respondent's Firm

The respondents involve in this survey is from both government and non-government firm. It is to ensure the eligible respondent on answering questionnaire answer. Their eligibility is notice by their working experience in certain firm. Most firm that take part on this survey is form UMPH Holding Sdn. Bhd 13 count, general contractor company of 11 count, from OSK Construction on 5 count and 1 count for the rest of different firm. The data are tabulated as shown in Figure 4.3.

4.2.4 Respondent's Post

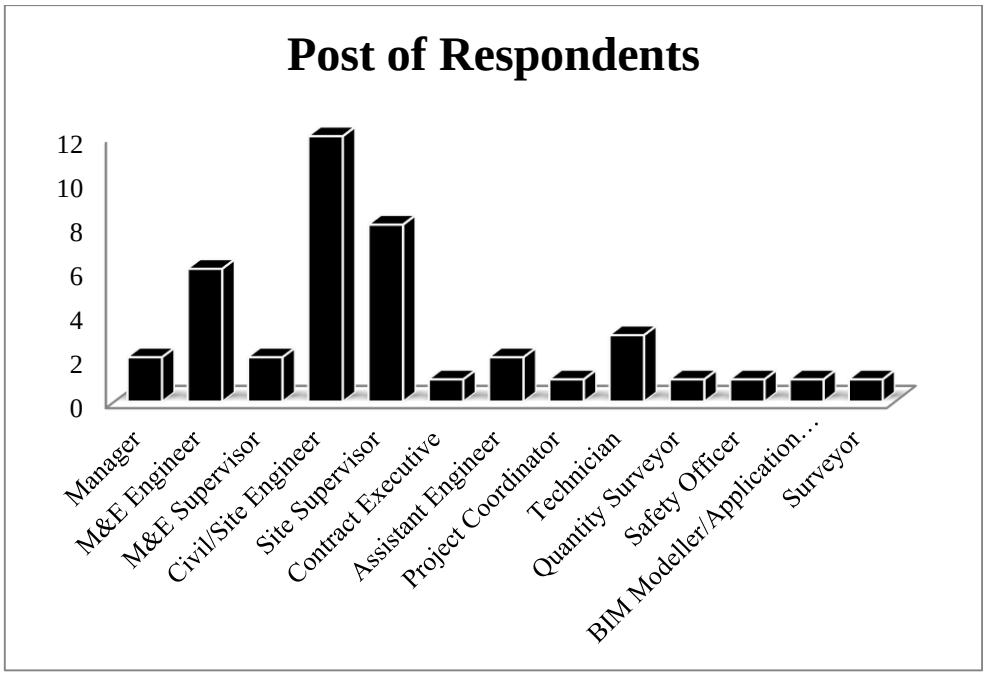

Figure 4.4 Post of Respondents

Respondent position determines their expertise and experience in assessing defect condition that stated in survey question. Top management in building management was preferred in taking part of this survey. Highest post of respondents is Civil/Site Engineer 12 count, Site Supervisor 8 count, Mechanical and Electrical Engineer 6 count, Technician 3 count. The rest is followed by Manager, Mechanical and Electrical Supervisor and Assistant Engineer for 2 counts each. Also there are other related post to building involve in this survey which are Contract Executive, Project Coordinator, Quantity Surveyor, Safety Officer, Application Engineer and Surveyor. The data are tabulated as shown in Figure 4.4.

4.2.5 Respondent's Residence

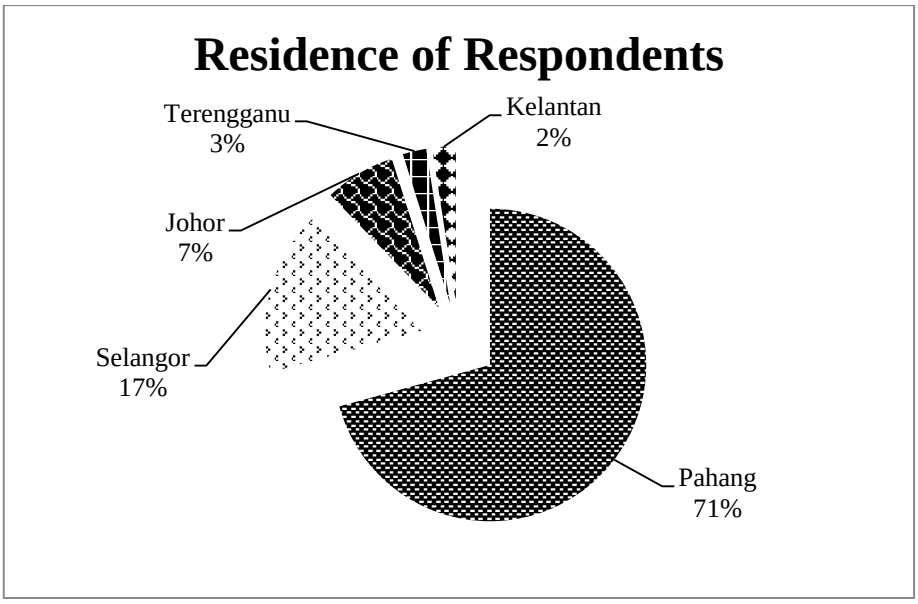

Figure 4.5 Residence of Respondents

This research is mostly held in Pahang area but also involve respondents in other state as to observe their valuation on shopping mall building in their area. 71% of respondents from Pahang, 17% from Selangor, &% from Johor, 3% form Terengganu and 2% from Kelantan.

4.3 Findings of Questionnaires Survey

This is the Part B of the questionnaires. In this section, it is consisting of 8 questions. This section attempts to identify and evaluate the defect awareness and evaluation in shopping mall building. The respondents answer are based on likert scale of 5 ordinal measure form (1) to (5) according to respondent's preference answer so it ease on identifying the majority of the answer. The data are then tabulated in figure. Each scale means

5 = Very High
4 = High
3 = Medium
2 = Low
1 = Very Low

4.3.1 Defect Awareness in Shopping Mall Building

The purpose of this question is to determine the defect awareness of respondents of shopping mall building in their area. Their awareness are define by their valuation through the agreement scale list from 1 to 5 where 1 shows very low, 2 low, 3 medium, 4 high and 5 very high. This agreement can be observed by tabulated data and determine the majority results from the survey.

4.3.1.1 Frequency on Visiting Shopping Mall Building in Respondent Area

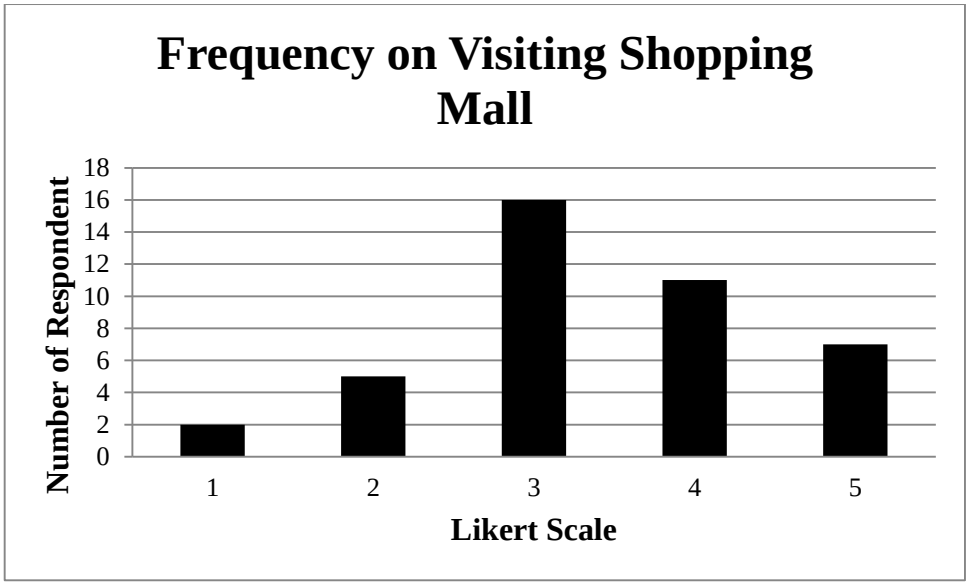

Figure 4.6 Frequency on Visiting Shopping Mall

Shopping mall was chosen as the area of study as shopping mall can be consider as most visited place by targeted respondents. This tabulated graph shows that high number of respondents are often visiting shopping mall as most of the answer are at 3, 4 and 5 scale which present medium, high and very high respectively. So their observation of shopping mall in their area can be valid as they aware of the building condition.

4.3.1.2 ‘Defect in Building’ Term Understanding

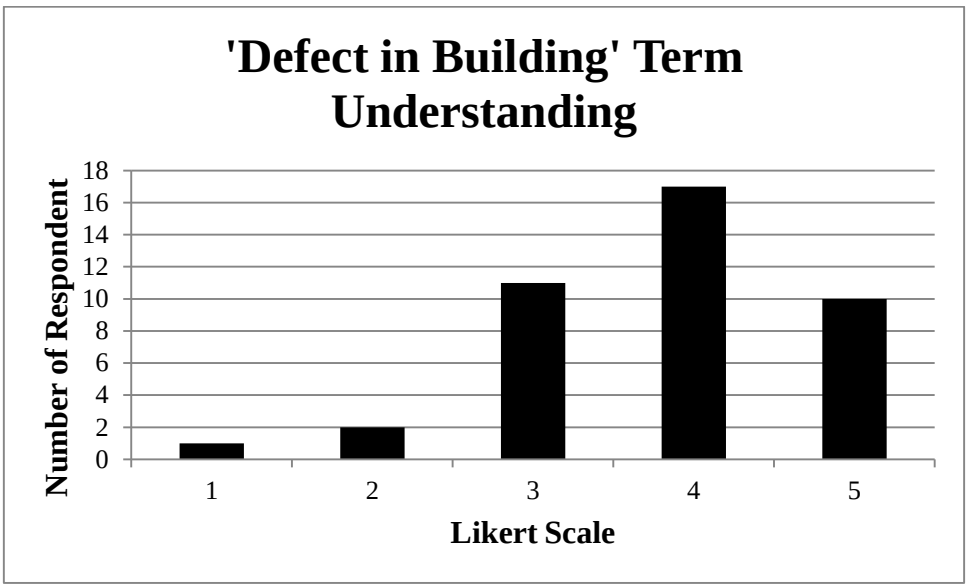

Figure 4.7 ‘Defect in Building’ Term Understanding

Defect can bring many meaning on imperfections of material or structure. For defect in building, it means all imperfection or elements that affect the building performance value. The targeted respondents are in structure engineering background so they are expected to have well understanding in building defect term, so their observation on this case study can be accepted. They rate their understanding of ‘building defect term’ themselves so from the tabulated graph it shows most of respondents have well understanding of the term.

4.3.1.3 Awareness on Existing Defect in Shopping Mall Building

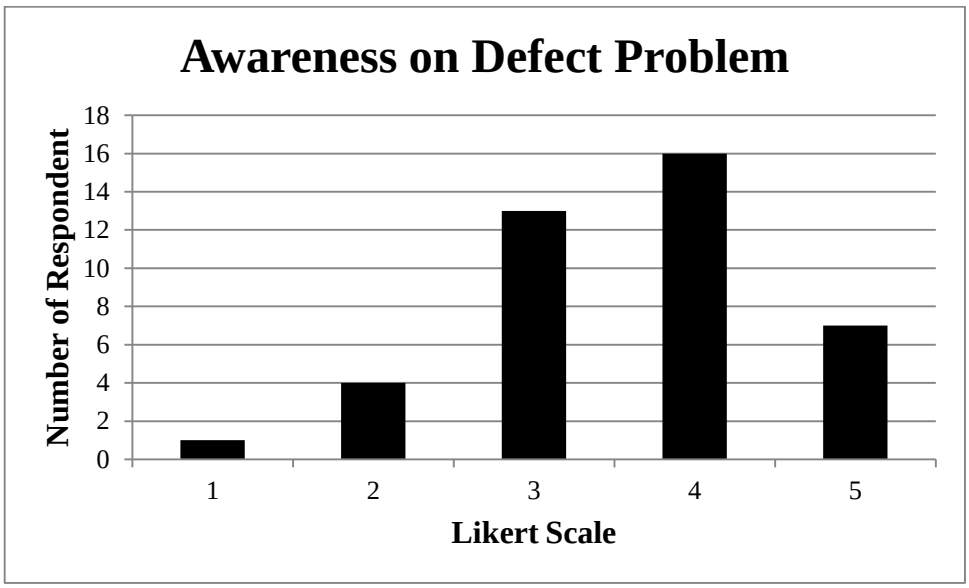

Figure 4.8 Awareness on Defect Problem

There are rarely found a building with no defect in Malaysia as defect occur without expectation of building management team even periodically maintenance check was done. It is either the defect are clearly shown of sheltered from view. Respondents rate high of their awareness on existing defect problem in the building which also show their concern about the building performance.

4.3.1.4 Defect as Injury Factor

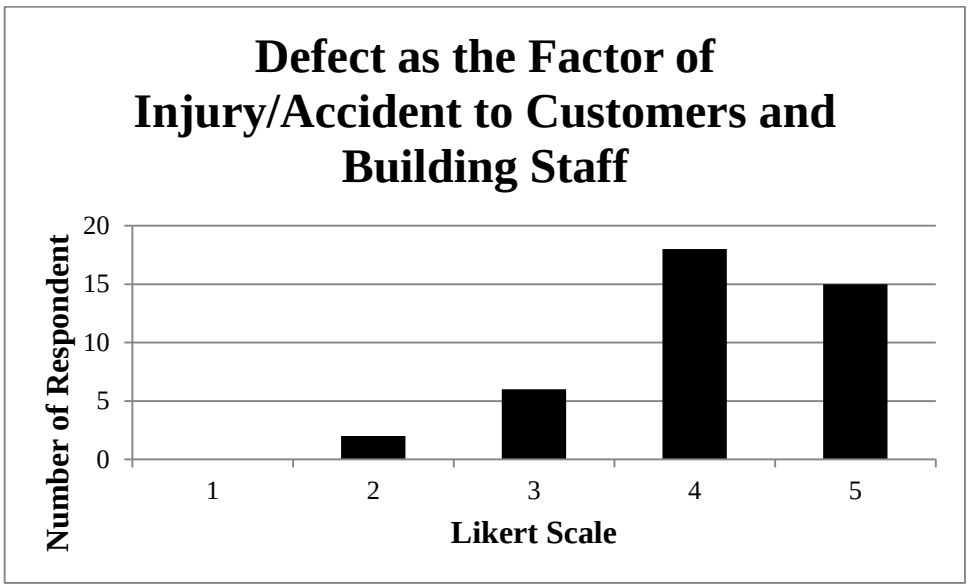

Figure 4.9 Defect as the Factor of Injury/Accident to Customers and Building Staff

Most of respondent agree on statement building defect can cause injury or accident to customers or building staff as high number of respondents tick high and very high scale on the survey. This validity are supported by a lawsuit that can be made by a person that injured caused by building flaw. An architect, engineer, general contractor, or subcontractor may find themselves being sued for negligent construction and cause the injured person suffered harm caused by that failure.

4.3.1.5 Defect as Building Performance Value Indicator

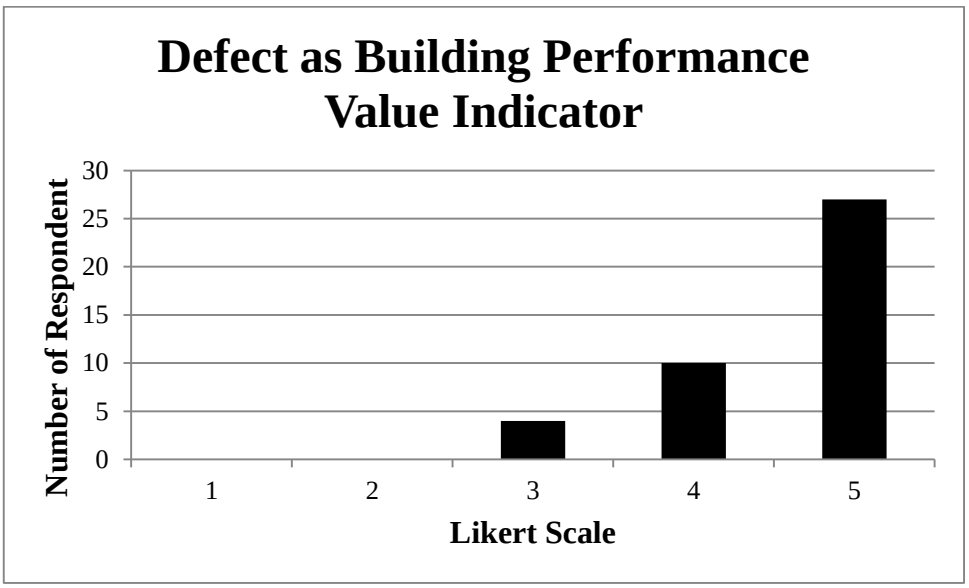

Figure 4.10 Defect as Building Performance Value Indicator

From the survey, it shows large number of respondent agree that building defect will affect building performance value. It became a factor for a person on choosing the most pleasure place to visit especially the shopping mall as it is the place to get enjoyable time. So if many defect observed, the building performance will get low rate.

4.3.2 Observed Defect in Shopping Mall Building

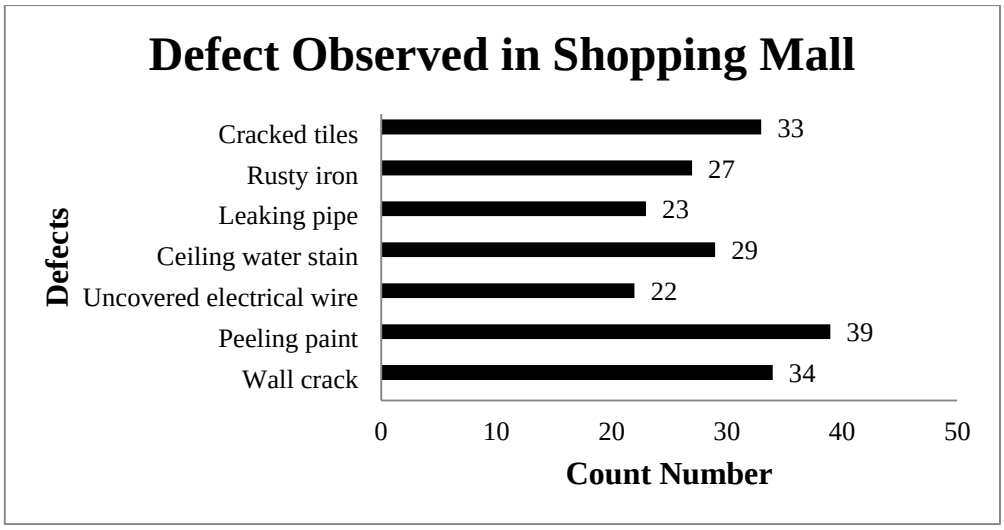

Figure 4.11 Defect Observed in Shopping Mall

The tabulated graph shows the vote of most observed defect in shopping mall building. The highest defect was the peeling paint with 39 counts, followed by wall crack 34 count, crack tiles 33 count, ceiling water stain 29 count rusty iron for 27 counts, leaking pipe 23 counts, and the least is uncovered electrical wire 22 counts. These existing defect can damage the integrity of building or structure.

4.3.3 Level of Defect Problem

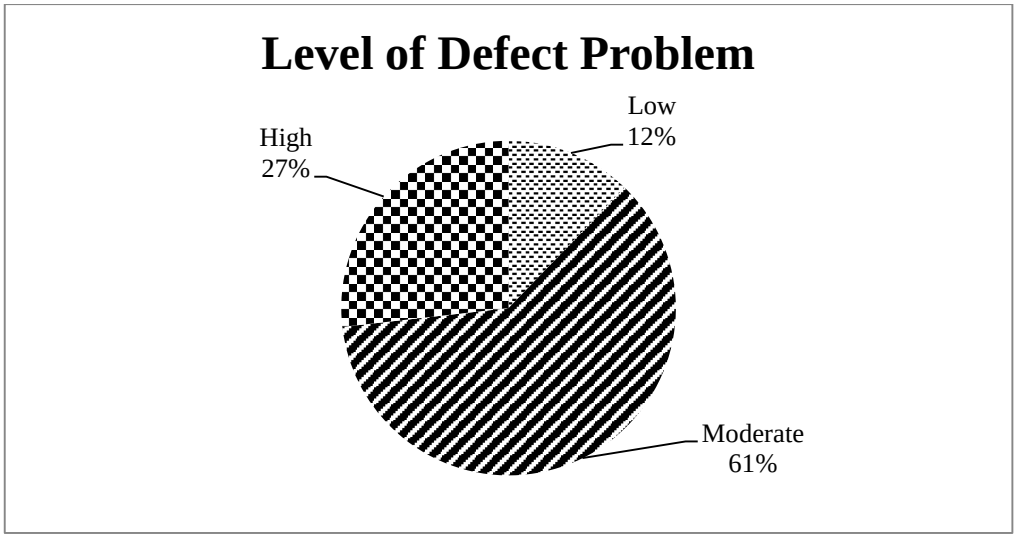

Figure 4.12 Level of Defect Problem

Defect problem in existing operating building can be classified under 3 levels which are low, moderate and high. From the data collected, respondents evaluate the defect problems that exist in shopping mall building are in moderate level with 61 percent. It is not giving high risk to users but still proper management of maintenance work has to be done to improve the building performance value.

4.3.4 Need of Guideline Development for Proper Maintenance

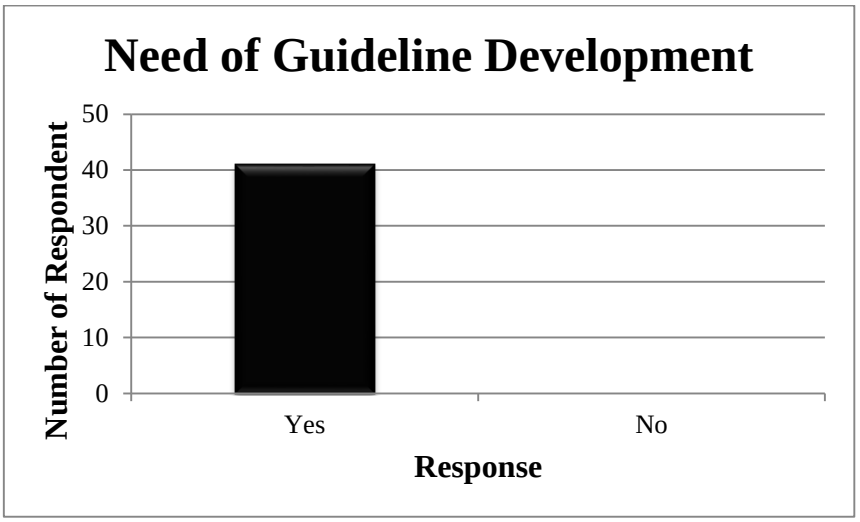

Figure 4.13 Need of Guideline Development

All of respondents agreed that there is really need of guideline development for proper maintenance at shopping mall. The guideline may ease the building management or contractor assign on doing maintenance work. Besides of using expertise skill and experience, the guideline can be one of source of reference.

4.4 Interview Data

Other than distribute the survey form for data collection, there are also held interviews with experience person in maintenance or building construction field to gain more opinion and perspective towards research study.

Table 4.1 Interview Data from R1

Respondent 1 : Mechanical & Electrical Engineer at OSK Construction	
Question	**Answer**
1. As industrial person, can you explain more on 'defect in building' term?	Defect in building includes all elements like structure, architectural, mechanical and electrical. Example of architectural defects are like the problem on skim coat or painting. For structure defects consist of wall cracks and honeycomb. Uncovered trunking also one of example of defect problem for mechanical and electrical.
2. Can you help in classifying level of defect that may harm and cause danger to customer or building staff?	Minor – architectural defect which is simple and not involve safety issue like peeling of surface painting. Major – involve safety issue and structure failure and a bit complicated to repair/replace. As example, water excess from concrete, injection method has to be applying to identify the sources. Fail structure can cause building collapse.
3. How defect can affect building performance value?	By observation of visitors and identification of uncomforting view. People will choose better shopping mall to go and spend their quality time. The better one will valued by tidiness and nice coordination of building.
4. What are the most factors that lead to defect problem? Maintenance/material/not according to specification	All are main the factor in this problem which are maintenance, material and specification that have pro and contrast with each other. As example, if the contractor uses better material but not following dimension requirement, the structure will pass. Vice versa, if wrong material use but following exactly the requirement, it also can be okay.
5. Who is in charge for taking care of defect problems in a shopping mall building?	Structure supervisor/mechanical and electrical supervisor/maintenance department.
6. What are the references or guideline uses on maintenance work for building? Books/Guideline/Expert	Guideline – Qlassic, expertise or experience person.

Table 4.2 Interview Data from R2

Respondent 2 : Operation Manager Kuantan Medical Centre	
Question	**Answer**
1. As industrial person, can you explain more on 'defect in building' term?	Defects are something that build by contractor but not following specification stated. It involves specification like material, measurement and other specification in bill of quantity.
2. Can you help in classifying level of defect that may harm and cause danger to customer or building staff?	Major – cannot be accepted. When have handover either defect not complies with requirement. It involves engineer and architecture. Minor – defect still can be accepted but not comprise statutory requirement.
3. How defect can affect building performance value?	Choose more safe and well place to go without obvious defect problem in the building.
4. What are the most factors that lead to defect problem? Maintenance/material/not according to specification	Material use, attitude of contractor where like to cut cost, use cheaper alternatives, negligence, lack of supervision and not follow structure requirement.
5. Who is in charge for taking care of defect problems in a shopping mall building?	Facility manager on receiving complaints.
6. What are the references or guideline uses on maintenance work for building? Books/Guideline/Expert	Major – statutory requirements, Bomba, local council, association of architect, JKKP, PAM Minor – evaluation form facility department, repair hand claim, general evaluation

Table 4.3 Interview Data from R3

Respondent 3 : Professional Engineer at Perunding RJA	
Question	**Answer**
1. As industrial person, can you explain more on 'defect in building' term?	In general, defects involve civil, structural, mechanical and electrical and also sewerage. Structural defect is like crack, mechanical and electrical defect include the lamp, wiring, air conditioning system and firefighting system. Sewer part includes water and supply, sewage and drainage. There are also aesthetic defect like the pale of painting. We cannot predict defect like crack, if that happen suddenly it become more critical and cause by design failure like wrong piling design that cause settlement. The crack problems may come from design stage as they are not using correct concrete specification or lower cement grade. As example for crack issue, it might be at plaster, painting or moving structure. it can be avoid by well prepare in design and construction stage
2. Can you help in classifying level of defect that may harm and cause danger to customer or building staff?	Major – safety defect, involve public safety, need repairing work. Minor – does not affect people safety.
3. How defect can affect building performance value?	Effect customer's psychology as they are expecting nice place that value for their money.
4. What are the most factors that lead to defect problem? Maintenance/material/not according to specification	Design problem. Contractor not following design specification of dimension and material for getting more profit from the project. Other factor also is genuine mistake by the worker with less knowledge and experience.
5. Who is in charge for taking care of defect problems in a shopping mall building?	Property manager
6. What are the references or guideline uses on maintenance work for building? Books/Guideline/Expert	Inspection by local authority.

One of action to minimize defect is by providing proper maintenance such as repairing works and periodically monitoring. Each interview respondent also been asked about suitable period on checking each possible defect element and repairing work detail like its procedure, manpower, material, equipment and time taken. The data were summarised in Table 4.4.

4.5 Word Frequency Query Analysis using NVivo Software

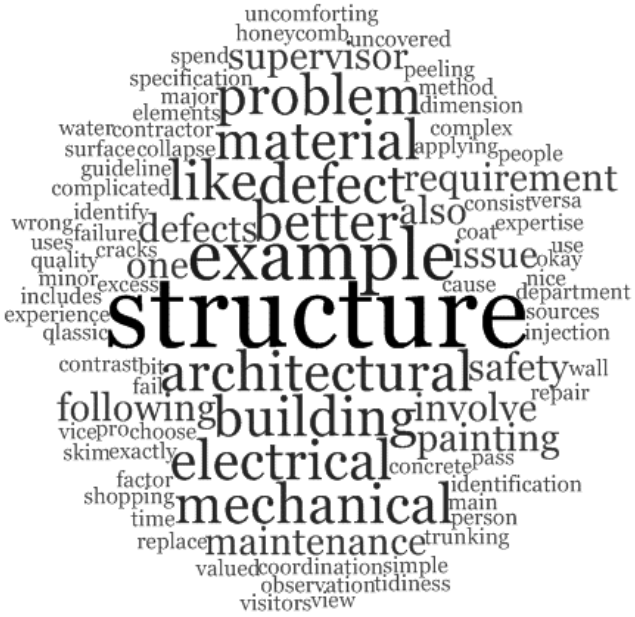

Figure 4.14 NVivo Word Frequency Query from R1

Figure 4.15 NVivo Word Frequency Query from R2

Figure 4.16 NVivo Word Frequency Query from R3

NVivo is a qualitative data analysis (QDA) computer software package produced by QSR International. It has been designed for qualitative researchers working with rich text-based or multimedia information, where deep levels of analysis on small or large volumes of data are required. In this research, researcher analyse word frequency query data from 3 respondents that take part in this research interview. From the interview session, their answer on every question is noted and recorded the browse into NVivo software to get the results on the word frequent analysis. The most frequent word was analysed as the most emphasized issue in this research topic. From all respondents R1, R2 and R3, it can be seen most emphasized word are structure, specification, defect, requirement, design and safety. All of these elements are related to research topic and respondents indeed giving opinion based on their experience related to this research.

4.6 Summary of Findings

From the interview, the details of defect management information has been gathered such as the suitable maintenance checking period, repairing work list, manpower, material, equipment and time taken to complete the defect repairing work. It helps in provide a guideline table that consist detail of defects problems.

Table 4.4 Maintenance Information Details

No.	Defect	Defect Classification	Causes	Repairing Task	Equipment	Material	Number of Worker Needed	Completion Time	Maintenance Checking Period
1	Peeling Paint	Minor	1. Different Coatings in the Same Surface 2. Poor Application Method 3. High Humidity and Excessive Condensation	1. Repaint Surface	1. Roller Paint Brush	1. Paint	2	1 Day	3 Month
2	Wall Crack	Minor/Major	1. Poor Initial Design 2. Degradation of Building Materials 3. Natural Settling	1. Identify causes 2. Hacking the crack line 3. Clearing Debris 4. Patch the crack line 5. Paint	1. Roller Paint Brush 2. Hacking tools	1. Plastering Cement	2	3 Day	3 Month
3	Cracked Tiles	Minor/Major	1. Loads Dropped 2. Installed Improperly Spaced Joist 3. Hollowness 4. Cracks in Concrete Substrate	1. Remove crack tile and screed 2. Screeding hacked area 3. Install tile	1. Hacking tools 2. Tile cutter 3. Trowel 4. Rubber hammer 5. Spirit level	1. Cement 2. Tile	2	3 Day	3 Month

4	Ceiling Water Stain / Leak	Minor/Major	1. Leak of Plumbing Water Supply Line	1. Cut ceiling 2. Inspect piping 3. Remove damage Section 4. Install new pipe section 5. Patch ceiling	1. Pipe Cutter 2. Scrapper	1. Pipe * Cast iron/PVC/Galvanized Steel/ Stoneware/AC/Concrete 2. Pipe glue	2	1 Day	3 Month
5	Rusty Iron	Minor	1. Expose to moisture/acid 2. Aging	1. Remove rusty 2. Coating/Painting anti rust (grease/galvanization) 3. Repaint	1. Sand paper 2. Paint brush	1. Anti-rust paint	2	1 Day	3 Month
6	Leaking Pipe	Major	1. Excess Water Pressure 2. Degraded Seals 3. Advanced Corrosion 4. Untreated clogs	1. Inspect Piping 2. Remove damage Section 3. Install New Pipe Section	1. Pipe Cutter 2. Saw 3. Scout	1. Pipe * Cast iron/PVC/Galvanized Steel/ Stoneware/AC/Concrete 2. Pipe glue	2	1 Day	3 Month
7	Uncovered Electrical Wire	Major	1. Worker negligence 2. Damage of Electrical Box	1. Provide cord cover	1. Screwdriver 2. Gloves	1. Trunking/Conduit	2	1 Day	3 Month

As an overall overview of the results collected, it can be analyse that defect in building term are includes all elements in construction such as structural, architectural, mechanical, electrical, sewer and also aesthetic defect. It is some failure or unpleasant condition of structure or material that occur due several factors from the initial design stage or during operational stage. The factor leading due design stage are like inaccurate calculation, incomplete drawing or specification, poor designing or misunderstanding of the design. Factors that may contribute during operational stage are negligence of management or constructor parties, poor maintenance schedule and also age of property. Defects can be classified into two classifications which are major defect and minor defect. Major defect are when safety issue is include where it involves public safety likes the structure failure and defects that cannot be suspend for too long time while minor defect are classify on defect that not involving safety issue and does not required emergency actions.

With existing of defects, it can give effect to the visitors psychological to evaluate the building performance value. By observation made of visitors and identification of unpleasant view, they might choose another shopping mall with safer condition and better coordination to spend their time. The factors that lead to defect problems is the design problem where contractor might not follow the design specification and make the structure showing defect in less time period. This problem arise when attitude of contractor to cut cost by using cheaper alternatives to gain more profit from the project. Other factor is negligence and lack of supervision by management on doing maintenance check periodically. Person who is responsible for defect and maintenance issue for shopping mall building are either facility manager, property manager or maintenance department. To conduct maintenance work, reference or guideline that can be referring to is the Qlassic guideline or advisory by expertise person.

4.7 Propose Guideline for Defect Maintenance

The guideline was proposed based on data analysis and data collected from interview session with experience people on managing defects maintenance issue in buildings.

Table 4.5 Propose Maintenance Guideline

Maintenance	Preventive	Predictive	Corrective
Peeling Paint	Check wall surface every 3 months	Make sure wall surface are presentable.	Scraping wall using hand tools and repaint.
Wall Crack	Check wall condition every 3 months to check if any crack pop out.	Checking nearby wall structure after repairing work that involve vibrate elements is done.	Major crack lead to demolition of wall and reconstruction
Cracked Tiles	Inspect all tiles in building every months.	Ensure tiles grout are cleaned and free from damaging material.	Cracked tiles lead to unconscious injury and need to be replace immediately.
Ceiling Water Stain	Inspect ceiling surface condition every 3 months	Make sure ceiling are in good condition without any dampness or water stain.	Cut ceiling to replace any pipe section that cause the water stain then installed new ceiling part.
Rusty Iron	Check iron material condition every 3 months	Make sure rusty iron are not being exposed to protect it from affecting customers.	Coat the iron with rust-proof coatings material
Pipe Leaking	Inspect pipe section every 3 months to check if any leaking or joint problems occur.	Pipes are ensured to connect tightly with each other and no damaging material enters the pipe section.	Replacement of pipe.
Uncovered Electrical Wire	Inspection of electrical box condition after any electrical work has be done.	Make sure all wire or electrical component covered.	Install new electrical box/cover

Maintenance guideline proposed base on the 3 types of maintenance to protect and maintain each defects elements that mostly occur in shopping mall building. It is preventive maintenance which is as an early step to avoid defect from directly happen, predictive maintenance as preparing such defect requirement as notice the statistical record of defect and corrective defect where replace and repair the defects.

Table 4.6 Maintenance Checking Period Guideline

Architecture Defect	**Service Defect**	**Interior Repairing**
Monthly	**Monthly**	**Weekly**
3 to 5	5	1
6 to 9	9	2
9 to 12	12	4
Preventive	**Predictive**	**Corrective**

Table 4.6 show the guideline for suitable maintenance checking period that can be apply to prevent defects from occurring rapidly. From the inspection, predictive maintenance or mitigation strategy can be planned to reduce the defects issue.

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter concludes the study by summarizing the results of the analysis. Some recommendations for further studies are also included. Based on the literature review, observation, interviews, data from the questionnaires survey, and analysis of the result, the three main objectives of this study have been achieved.

5.2 Conclusions

As a conclusion, this study has successfully identified and met three objectives that were previously stated. All task required to perform the research are successfully run to gain more information related to this study.

5.2.1 Objective 1

The first objective is to identify building defects in shopping mall building. Defects in shopping mall building are mostly observed by rough observation that can be made by visitors or building tenants itself. Observer may not able to classify the building defect type but know if there are unpleasant views of some structure or material. Involving of engineers on this research help to classify the name and type of building defects. In this research, 7 number of defect were identified that often occur in shopping mall building. The defects identified are peeling paint, wall crack, tile crack, ceiling water stain, rusty iron, leaking pipe and uncovered electrical wire. These defects are belong under structural, mechanical and aesthetic defects. The defects list are been classified under two category which are major or minor defects. Major defects are defect that involved safety aspect to visitors or building staff that need immediate repair or action while minor defects are defect that not involve safety issue towards visitor and do not need immediate actions. Researcher also gathered information from the interview session with experience engineers on defects details that help many party such as building management to analyse the source of problem and action that need to be taken to handle such defect problems. The details include the cause of defects, repairing task, equipment and material needed, number of worker involved, completion time estimation and suitable maintenance checking period. With these information, it easier management party to analyse and plan the maintenance work of the building.

5.2.2 Objective 2

Second objective is to analyse people awareness on defects problems of shopping mall building. Most of visitors come to shopping mall to get their quality time with family and friends. Somehow, there are some people will choose the best coordination and condition shopping mall building to fill their leisure time. With their concern, it also helps in motivating management party on ensuring their building are well perform to attract more visitors. So in this research, there are list of question for visitors in evaluating their awareness and perspective on shopping mall building in their area. Respondents involved are consist of experience people in structural or building maintenance field where they are engineers from various company are approach on completing this survey. They are seems as the right person to evaluate the defects problems in their area as they have experience in the field and expected to understand more on defect in building term. Most of them are

aware on existing defect in shopping mall in their area with identification of defects element in the building. Most of respondents also agreed that defect as one of the factor of injury to customers and building staff so it important to focus on defect maintenance aspect. Besides that, defect also seen as a building performance value indicator because most of respondent agreed that they value a building based on the condition and coordination of the building itself. Respondents also have rate the level of defect problem in shopping mall in their area is in moderate level with existing minor and major defect and agreed that there is really need of guideline for proper defects maintenance at shopping mall. It can be concluded that majority of respondents did aware of defect issue in shopping mall building.

5.2.3 Objective 3

Third objective is to develop a defects maintenance guideline for shopping mall buildings. There is still existing of defects in shopping mall building that will affect the building performance value. So by developing this maintenance guideline, it helps management party on practicing defect maintenance work efficiently. Due to this partial research, only 7 defects were studied in shopping mall building as it seen as most identified defects by the visitors. So the guideline proposed is based on these identified defects that consist of preventive, predictive and corrective maintenance. Preventive maintenance are crucial in early stage of development as person who involve in the development process must understand the long term effect of such building elements. It helps in identify degradation sign that can come out before clear physical change happen. Predictive maintenance is based on inspection held and technical staff have notice on the building's element behaviour from the statistical details of the functional parameters of the building elements. Mitigation strategy need to be proposed in handling the defects problems. Corrective maintenance is classified when emergency actions are needed to settle such a defect problems. It required immediate response but sometimes putting users in danger. But corrective maintenance is cheaper as it does not required long term plan or early mitigation strategy.

5.3 Recommendations

Maintenance is an important aspect in ensuring well performance of a building especially a commercial building like a shopping mall building. There are many effect arise when building are not maintain well until abandoning such defects. There were several recommendation that can be applied in term to have well maintain building and minimizing the defect problems.

5.3.1 Recommendation 1

Management party especially maintenance department or property manager should give strict supervision on maintenance checking and any construction done in the building so one element repaired will not affecting another element. regular supervision should be carried out so that workmanship problem also can be identified and the remedy work can be executed immediately. Besides, when executing the supervision, supervisory staff must possess the knowledge, expertise, and capabilities to administer the defects and maintenance issue.

5.3.2 Recommendation 2

Proper management in classifying defects. Repairing works involve extra cost consumption and most avoided by building owner. Minor defect are not require immediate action but major defect need urgent repairs. It will more costly in managing major defect compared to minor defect so inspection has to be done properly on identify type of defect exist. It needs to identify earlier the source of problems, resources needed and cost involve in managing them.

5.3.3 Recommendation 3

In previous it is a bit hard to find type of guideline that can be refer for all type of defect maintenance. Even this research also only focus on general defect that can be clearly observed in shopping mall building. Defect also can be in electrical or mechanical part which is other than structure and architecture defect. So it is recommended for other researcher to continue on proposing defect maintenance guideline as it will help a lot in solving all unpleasant condition of building especially shopping mall building which accommodate lot of people.

5.4 Contribution to Research

This research are valuable as it contribute advantages to the society. Previous or existing guideline may not enough and hard to apply as the information are not be put into one resource sheet. With guideline developed from this research, it provide easier way for every party that have similar problems to solve the issues by refer to this guideline. It can be a reference to anybody who intends to know about defect details as it also can be used for small building like houses and shops.

Local authority may beneficial by using this guideline as a new approach besides previous guideline or reference that may difficult to refer because of the incompletely information for every detail needed. With this guideline also, it listed the most popular defects that occur in shopping mall so local authority can straight refer to this guideline if any requirement needed for shopping mall issue. It is straight forward and easily apply.

In addition, the information gathered in this research can be used in academic field where can be a reference for tutors to provide teaching material on related field. Not only for builders or contractors has to know on defects maintenance knowledge, but it also can be add into learning plan to students that under related courses. As this study was conduct, it gathers many information that relate to the topic.

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APPENDIX A
QUESTIONNAIRE FORM

CASE STUDY: DEVELOPMENT OF GUIDELINE FOR DEFECT MAINTENANCE AT SHOPPING COMPLEX

Thank you for agreeing to take part in this important survey measuring user satisfaction for building defect evaluation at shopping complex. Today we will be gaining your thoughts and opinions in order come out with better alternative in providing guideline for defect maintenance at shopping complex. This survey should only take 4-5 minutes to complete. Thank You.

Terima kasih kerana bersetuju untuk mengambil bahagian dalam kaji selidik ini yang bertujuan mengukur kepuasan pengguna untuk penilaian kecacatan bagunan di kompleks membeli-belah. Kaji selidik ini akan mengumpul pendapat dan pandangan anda bagi menghasilkan alternatif yang lebih baik dalam menyediakan garis panduan bagi penyelenggaraan kecacatan bangunan di kompleks membeli-belah. Kajian ini hanya mengambil masa selama 4-5 minit untuk disiapkan. Anda boleh menjawab sama ada dalam bahasa Inggeris atau Melayu. Terima kasih.

PART A

Email Address / Alamat Email

Gender /Jantina

8 **Male (Lelaki)**
Female (Perempuan)

Level of Education / Tahap Pelajaran

Firm / Firma (Company)

Position / Jawatan

Residence / Tempat Tinggal

PART B

Defect awareness in Shopping Complex Building / Kesedaran kecacatan bangunan di pusat membeli belah

How often You visit Shopping Complex in your area? / Bagaimanakah kekerapan anda melawati pusat membeli belah di kawasan anda?

☐ 1(very low) ☐ 2(low) ☐ 3(Medium) ☐ 4(High) ☐ 5(Very High)

Do You understand 'defect in building' term? / Adakah anda faham istilah 'kecacatan bangunan'?

☐ 1(very low) ☐ 2(low) ☐ 3(Medium) ☐ 4(High) ☐ 5(Very High)

Scale your awareness on exisiting defect problem in shopping complex in your area. / Nyatakan skala kesedaran anda tentang kecacatan bangunan yang sedia ada di pusat membeli belah di kawasan anda.

☐ 1(very low) ☐ 2(low) ☐ 3(Medium) ☐ 4(High) ☐ 5(Very High)

Do You think building defect can cause injury/accident to customers or building staff? / Adakah anda rasa kecacatan bangunan boleh mengakibatkan kecederaan/ kemalangan kepada pelanggan atau pekerja bangunan?

☐ 1(very low) ☐ 2(low) ☐ 3(Medium) ☐ 4(High) ☐ 5(Very High)

Do You agree building defect will affect building performance value? / Adakah anda bersetuju bahawa kecacatan bangunan boleh menjejaskan nilai prestasi bangunan?

☐ 1(very low) ☐ 2(low) ☐ 3(Medium) ☐ 4(High) ☐ 5(Very High)

Tick (more than 1) on defect problems that You most observe in Shopping Complex / Tandakan kecacatan bangunan (lebih daripada 1) yang sering anda lihat di pusat membeli belah.

☐ Wall Crack / Dinding retak

☐ Peeling Paint / Pengupasan cat

☐ Uncovered Electrical Wire / Wayar elektrik yang tidak ditutup

☐ Ceiling Water Stain / Kesan air pada siling

☐ Hollow Mosaic / Mozek berongga

☐ Leaking Pipe / Paip bocor

☐ Switch Socket Not Aligned / Suis soket tidak sejajar

☐ Ceiling Leak / Siling bocor

☐ Rusty Iron / Besi berkarat

☐ Structure Damp / Kelembapan struktur

☐ Cracked Tiles / Jubin retak

In what scale You measure level of defect problem in shopping complex in your area? / Dalam skala berapa anda meletakkan tahap kecacatan bangunan di pusat membeli belah di kawasan anda?

○ Low (Rendah)
○ Medium (Sederhana)
○ High (Tinggi**)**

Do you think proper guideline of defect maintenance need to be produce? State reason for your answer / Adakah anda berpendapat bahawa garis panduan penyelenggaraan bangunan perlu dihasilkan? Nyatakan sebab bagi jawapan anda

----

APPENDIX B
INTERVIEW QUESTIONS

Interview questions

1. As industrial person, can you explain more on ‘defect in building’ term?
Sebagai orang perindustrian, bolehkah anda menjelaskan lebih lanjut tentang istilah 'kecacatan dalam bangunan'?

2. Can you help in classifying level of defect that may harm and cause danger to customer or building staff?
Bolehkah anda membantu dalam mengelaskan tahap kecacatan bangunan yang mungkin menyebabkan bahaya kepada pelanggan atau kakitangan bangunan?

3. How defect can affect building performance value?
Bagaimana kecacatan bangunan boleh menjejaskan nilai prestasi bangunan?

4. What are the most factors that lead to defect problem? Maintenance/material/not according to specification
Apakah faktor utama yang boleh menyebabkan masalah kecacatan bangunan? Penyelenggaraan / bahan / tidak mengikut spesifikasi

5. Who is in charge for taking care of defect problems in a shopping complex building?
Siapa yang bertanggungjawab untuk menjaga masalah kecacatan bangunan pusat membeli belah?

6. One of action to minimize defect is by provide proper maintenance of defect cases such as repairing works or periodically monitoring. Can you please suggest the suitable period on checking each possible defect element so it can be avoid from repairing works.
Salah satu tindakan yang boleh diambil untuk meminimumkan kecacatan bangunan adalah dengan memastikan penyelenggaraan yang baik seperti kerja-kerja pembaikan atau pemantauan secara berkala. Bolehkah anda mencadangkan tempoh yang sesuai untuk memeriksa setiap elemen bangunan yang mungkin mengalami kecacatan supaya dapat mengelakkan daripada kerja pembaikan.

7. Can you please explain more on repairing work detail such as cost needed, procedure, manpower, material, equipment and time taken?
Bolehkah anda menerangkan dengan lebih terperinci tentang kerja-kerja pembaikan kecacatan bangunan seperti kos yang diperlukan, prosedur, tenaga kerja, bahan, peralatan dan waktu yang diambil?

8. What are the references or guideline uses on maintenance work for building? Books/guideline/expert
Apakah sumber rujukan atau garis panduan yang digunakan bagi kerja-kerja penyelenggaraan bangunan? Buku / garis panduan / pakar

End of interview

APPENDIX C
FORMAL LETTER

Universiti Malaysia PAHANG
Engineering • Technology • Creativity

Universiti Malaysia Pahang
Lebuhraya Tun Razak, 26300 Gambang
Kuantan, Pahang Darul Makmur
Tel: +609-549 2688 I Faks/Fax: +609-549 2689
Website : http://ftek.ump.edu.my

Fakulti Teknologi Kejuruteraan
Faculty of Engineering Technology

Ruj. Kami : UMP.31.02/13.16/1 Jld 13 (135)
Tarikh : 4 Oktober 2018

OSK CONSTRUCTION SDN. BHD.
Lot No. 1705-1708
Level 17 Tower 2 Faber Towers
Jalan Desa Bahagia
Taman Desa
58100 Kuala Lumpur

Tuan/Puan,

PERMOHONAN PENGISIAN BORANG KAJI SELIDIK BAGI PROJEK TAHUN AKHIR

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Adalah disahkan bahawa penama berikut merupakan pelajar Tahun 4 di Fakulti Teknologi Kejuruteraan Universiti Malaysia Pahang. Pelajar ini dikehendaki menyiapkan tugasan kerja kursus ***Final Year Project 2 (BET4783)*** di organisasi luar yang merupakan salah satu keperluan dalam aktiviti pembelajaran bagi kursus tersebut di mana pelajar dikehendaki melaksanakan kaji selidik ke organisasi tuan/puan bagi tujuan untuk mendapatkan data berkaitan kajian yang dijalankan. Maklumat pelajar adalah seperti berikut:

Nama Pelajar	**: Nur Farah Huda binti Mohd Zaimi (TE15060)**
Program	**: Program Ijazah Sarjana Muda Teknologi Kejuruteraan (Pengurusan Infrastruktur) Dengan Kepujian**

3. Sehubungan dengan itu, jasabaik pihak tuan/puan dipohon agar dapat mempertimbangkan permohonan daripada pelajar berkenaan. Sekiranya pihak tuan/puan memerlukan maklumat lebih lanjut, sila Ts. Mohammad Affendy bin Omardin (Pensyarah) di talian 09-5492286 atau emel affemdi@u,p.edu.my

Kerjasama puan dalam perkara ini sangatlah dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"Memasyarakatkan Teknologi"

Saya yang menjalankan amanah,

ABD RAZAK BIN JA'AFAR
Eksekutif Kanan
NDFD/Akademik/AktivitiPelajar

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0 8 OCT 2018
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Fakulti Teknologi Kejuruteraan
Faculty of Engineering Technology

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Tarikh : 4 Oktober 2018

UMP HOLDINGS SDN. BHD.
Universiti Malaysia Pahang,
26300 Gambang,
Pahang Darul Makmur.

Tuan/Puan,

PERMOHONAN PENGISIAN BORANG KAJI SELIDIK BAGI PROJEK TAHUN AKHIR

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Adalah disahkan bahawa penama berikut merupakan pelajar Tahun 4 di Fakulti Teknologi Kejuruteraan Universiti Malaysia Pahang. Pelajar ini dikehendaki menyiapkan tugasan kerja kursus ***Final Year Project 2 (BET4783)*** di organisasi luar yang merupakan salah satu keperluan dalam aktiviti pembelajaran bagi kursus tersebut di mana pelajar dikehendaki melaksanakan kaji selidik ke organisasi tuan/puan bagi tujuan untuk mendapatkan data berkaitan kajian yang dijalankan. Maklumat pelajar adalah seperti berikut:

Nama Pelajar : Nur Farah Huda binti Mohd Zaimi (TE15060)
Program : Program Ijazah Sarjana Muda Teknologi Kejuruteraan (Pengurusan Infrastruktur) Dengan Kepujian

3. Sehubungan dengan itu, jasabaik pihak tuan/puan dipohon agar dapat mempertimbangkan permohonan daripada pelajar berkenaan. Sekiranya pihak tuan/puan memerlukan maklumat lebih lanjut, sila Ts. Mohammad Affendy bin Omardin (Pensyarah) di talian 09-5492286 atau emel affemdi@u,p.edu.my

Kerjasama puan dalam perkara ini sangatlah dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"Memasyarakatkan Teknologi"

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Tarikh : 26 September 2018

YS PENGARAH
Ibu Pejabat
Jabatan Bomba & Penyelamat
Jalan Persiaran Abu Bakar
Bandar Baru Indera Mahkota,
25200 Kuantan,
Pahang Darul Makmur.

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11 OCT 2018
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KEBENTARAN

YS Tuan

PERMOHONAN MENGADAKAN LAWATAN BAGI MENYIAPKAN TUGASAN KERJA KURSUS PELAJAR

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Adalah disahkan bahawa penama berikut merupakan pelajar Tahun 4 di Fakulti Teknologi Kejuruteraan Universiti Malaysia Pahang. Pelajar ini dikehendaki menyiapkan tugasan kerja kursus *Final Year Project 2* (BET4783) di organisasi luar yang merupakan salah satu keperluan dalam aktiviti pembelajaran bagi kursus tersebut. Maklumat pelajar adalah seperti berikut:

Nama Pelajar	: 6 Orang Pelajar (Seperti Di Lampiran)
Program	: Program Ijazah Sarjana Muda Teknologi Kejuruteraan (Pengurusan Infrastruktur) Dengan Kepujian

3. Untuk makluman YS Tuan, antara skop analisa data dan ideology adalah terkandung perkara seperti berikut:

3.1 Akta Perkhidmatan Bomba 341 & UBBL
3.2 Kecacatan bangunan (civil, mekanikal & infrastruktur)
3.3 Operasi dan penyelenggaraan keselamatan kebakaran di bangunan hospital
3.4 Operasi keselamatan system pakir
3.5 Edaran boring kaji selidik

4. Sehubungan dengan itu, jasabaik pihak YS Tuan dipohon agar dapat mempertimbangkan permohonan daripada pelajar berkenaan. Sekiranya pihak YS Tuan memerlukan maklumat lebih lanjut, sila hubungi Ts. Mohammad Affendy bin Omardin (Pensyarah) di talian 09-5492296 atau emel affendi@ump.edu.my.