



PROGRAMME IN BUILDING SURVEYING
DEPARTMENT OF BUILT ENVIRONMENT STUDIES AND
TECHNOLOGY
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
PERAK BRANCH
SERI ISKANDAR CAMPUS

**THE WATERPROOFING PROCESS OF REINFORCED
CONCRETE FLAT ROOF ON TERRACE HOUSE AT TELUK
INTAN, PERAK**

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BACHELOR OF BUILDING SURVEYING (HONS.)

PRACTICAL TRAINING REPORT

FEBRUARY 2022

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This practical training report is fulfillment of the practical training course.

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ACKNOWLEDGEMENT



ALHAMDULILAH praise to Allah S.W.T because for HIS bless and mercy, I managed to completed this report within the time given. There are so many knowledge and experiences that are so valuable and I am really appreciated for all of those. In this opportunity, I want to land my huge thanks to: -

MY SUPERVISOR, Mohd Khazli Aswad Khalid that in charge in my presentation and another 3 group members for the marking part. The advice and the tips are so valuable for us to go through four months in the industrial training.

RAZ INTAN DEVELOPMENT SDN BHD STAFF, they are so welcoming and so full of responsibilities in us. All the advice, and the knowledge that they give me and the experience that they share with me are so precious. They are all helping me with knowledge that I can add in my reports.

MY PARENTS, Encik Hj. Hairul Anuar Bin Ramlan and Puan Sa'adah Binti Omar. They help me a lot in financial and for their tireless sacrifice and advices that always become a morale-boosting for me in whatever I do. I am really grateful for them. Lastly, I hope this report give benefits to the reader.

Thank you.

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CHAPTER 1: COMPANY OVERVIEW

1.1 INTRODUCTION

Department Of Built Environment And Technology Perak Branch Seri Iskandar Campus Universiti Teknologi Mara (UiTM) has enlisted the subject Industrial Training (BSR669) in its course outline which will provide pre-professional work experience to all the students taking the subject. The subject requires the students to undergo the training at selected organization and the industrial training period is four months.

Furthermore, during the industrial training, students are encouraged to contribute to the organization by joining activities and carryout the responsibilities given to them professionally. Industrial training is relevant since the students are able to show their skills and prepare for the real working environment in the near future.

During practical internship, I am accepted to do internship at a developer company at Teluk Intan Perak. The name of the company is Raz Intan Development Sdn. Bhd. The scheduled internship period is start from 11th October 2021 until 30th January 2022. This report is the outcomes from my internship in this company.

Table 1:1 Internship schedule

Internship Schedule In Raz Intan Development Sdn Bhd	
Working Days	: Monday – Saturday
Working Hours	: 8.00am (Duty Started) :12.00pm – 1.00pm – Lunch Hour :6.00pm – Off Duty
Industrial Training Period	:16 Weeks (11 th October 2021 – 230 th January 2022)

1.2 COMPANY BACKGROUND



Photo 1:1 Official company logo



Photo 1:2 Front view of office building

The company of RAZ INTAN DEVELOPMENT SDN BHD (Company No:840928-T). It is a company incorporated in Malaysia and licensed accordingly below Real Estate Developers (Controls and License) Act 1966. The company is formally established on December 9th, 2008 as a Private Limited Company (PLC).

It is now a Bumiputera company headed up by two Young Malay Women Entrepreneurs who have full confidence in the housing industry that the majority controlled by non-Malays. It has been actively involved in Real Estate Developers field in 2012 and has successfully completed almost 100 units of houses with individual residential on individual property and four residential housing projects is Raz Intan 1 & 2, Raz Intan Citra and Raz Intan Cassia.

In addition, the company will develop a Shell Petrol Station operated as a Dealer Own Dealer Operate (DODO). It has a Grade G7 construction contractor license, a government employment certificate and a bumiputera worker contractor certificate by CIDB Malaysia.

Table 1:2 Profile corporate company

PROFILE CORPORATE OF RAZ INTAN DEVELOPMENT SDN BHD	
Directors	1. Miss Zulaiha Binti Mohd Azam 2. Miss Nor Hafizah Binti Abdul Hanid
Address	No 65, Lorong Raz Intan 3, Taman Raz Intan Cassia. 36000 Teluk Intan, Perak Darul Ridzuan
Tel	+6013-8466896
Email	ridsb.perak@gmail.com
Website/Facebook	RAZ INTAN DEVELOPMENT – TELUK INTAN, PERAK
Company Registration No	840928-T
Date of establishment	3 rd October 2003
Company registration number	840928-T
Paid up capital	RM 5,000,000.00
Authorized capital	RM 5,000,000.00
Contractor licensed grad level	G7

The company has several of high quality of experienced professional staffs and technical executives which had successfully undertaken various projects in the following services: -

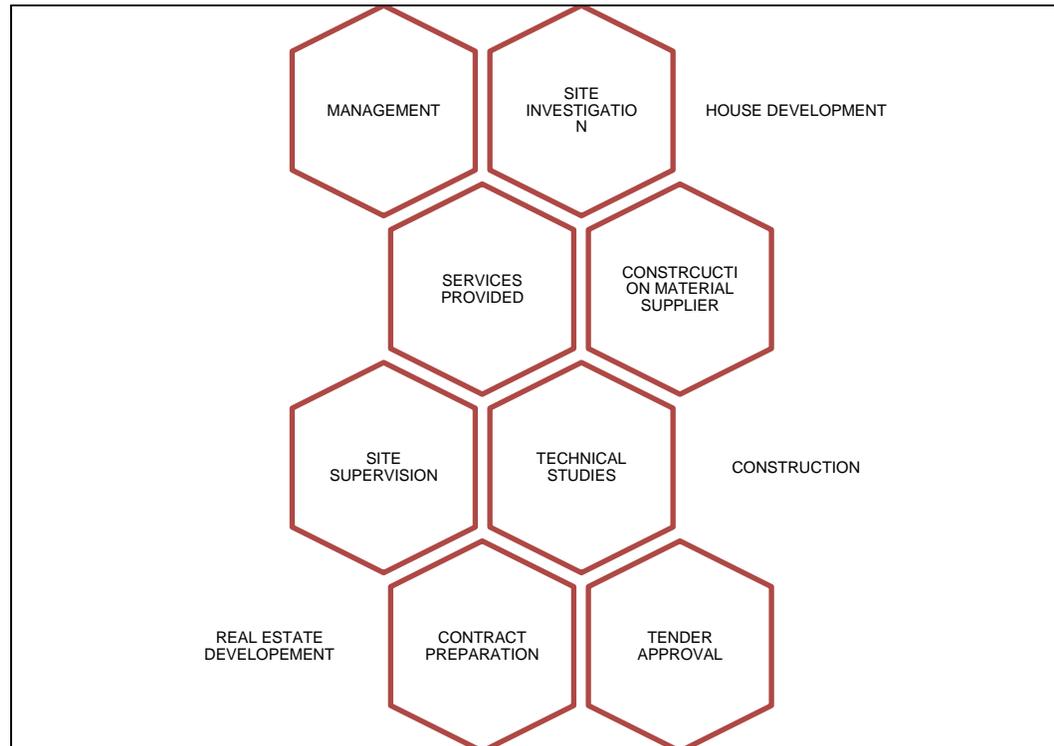


Figure 1:1 Services provided by company

Raz Intan Development Sdn Bhd mainly provide a services that related to housing construction which is from the first step of procedure such as loan until it finish construct and become a house that can be sold. This company mostly provides an experiences and qualified buildings and hardworking employees to ensure all the works can complete perfectly and give good services to our clients or customer. Besides, our architects or plan designer also offer and give a good quality of building plans that regarding to what the client wants.

1.3 HISTORY OF COMPANY

Raz Intan Development Sdn Bhd was established on October 3, 2003. The purpose of this company was established as Housing Developers and Construction Contractors with Bumiputra class A PKK and licensed CIDB Class G7. The vision of the company is to lead, train, develop and nurture the nature of dedication and commitment in the workforce to work as a family. Additionally, they need to combat themselves with challenges and rivals by making new discoveries and ideas in line with today's technology.

Among the projects that have been completed are the construction of 22 units of single-storey terrace houses and 11 units of bungalows at Teluk Intan. The project is worth RM 5,000,000.00. The project has been completely handed over to customers. The current project is the construction of 16 units of single-storey house at Langkap and 1 unit of bungalow at Tanjong Karang.

Raz Intan Development Sdn Bhd has five subsidiaries of which the company is a subsidiary of Raz Intan Development Sdn Bhd. It also trains the staff here to have leadership qualities and to manage their own company. These subsidiaries include DNBR Construction Sdn Bhd, DNBR Security Sdn Bhd, PMV Energy Sdn Bhd, Sheiks Construct (M) Sdn Bhd and Dynamic Networking Business Resources. Each of these subsidiaries has different tasks and activities.

The main thrust of the Raz Intan Development Sdn Bhd is Mr. Mohd Rezal Bin Ayub. He was assisted by the managing director, Ms. Zulaiha Binti Mohd Azam and the director, Ms. Nor Hafizah Binti Abdul Hanid. Among the other staff of this company is Mrs. Nurul Huda Binti Abdul Rahman as legal advisor, Ms. Jamelah Binti Mohd Azam as marketing manager and Mrs. Sakinah Binti Zakaria as the site supervisor.

1.4 OBJECTIVES, VISION AND MISSION OF COMPANY

a) OBJECTIVES

The objectives of the company mainly is become a credible Bumiputera developer company to deliver quality and affordable homes to buyers in an innovative design as time goes by

b) VISION

To be a Bumiputera developer company that reliable to give houses that have good quality and able to belong house for buyer in innovative architecture within time to time.

To inspire trust through demonstrated dedication to honesty, integrity, and transparency.

c) MISSIONS

To ensure construction work is carried out by skilled personnel, to achieve specified specifications as well as ensuring that the work is implemented in a timely manner.

To provide top quality professional services and support to a wide range of residential real estate owns and investors in effort to help many individual communities in our portfolio is sought after places to live.

1.5 ORGANIZATION CHART

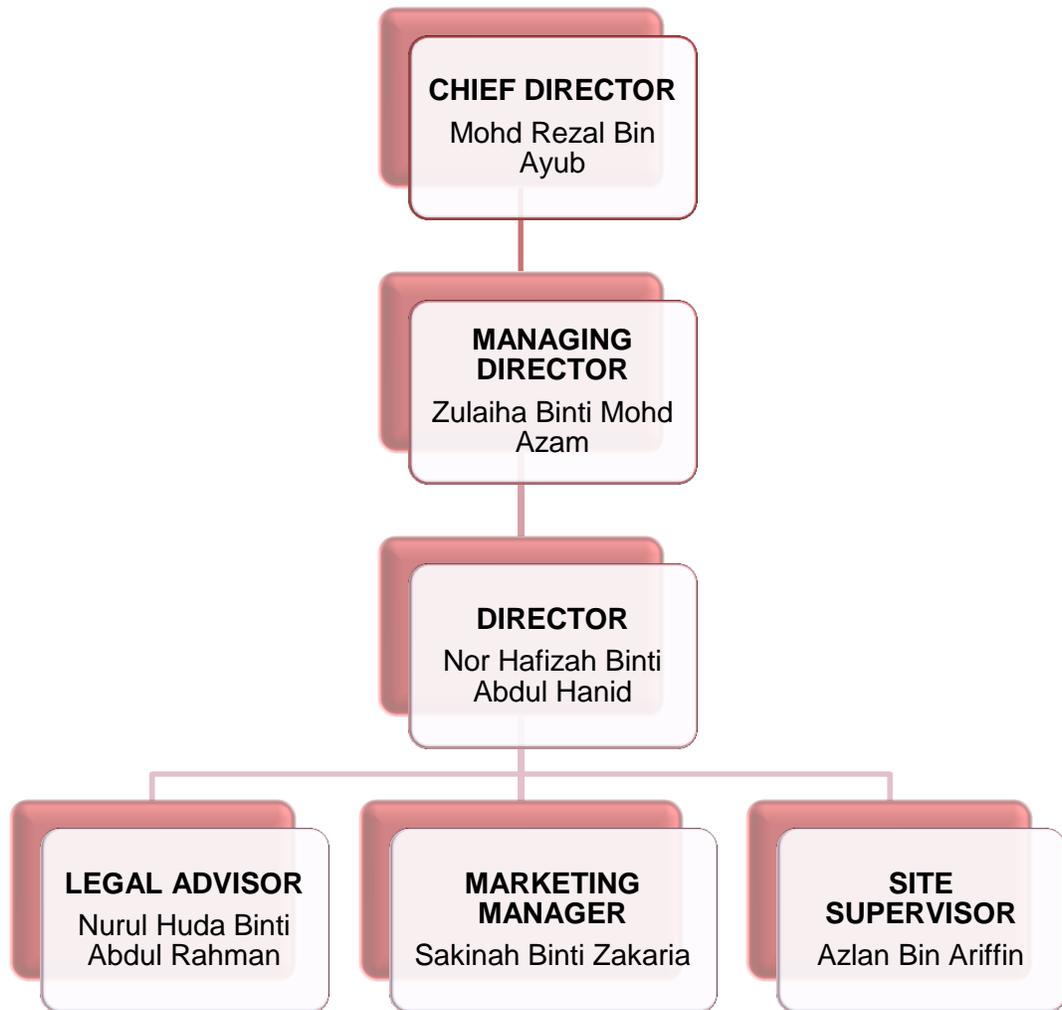


Figure 1:2 Organization charts of company

The organization of Raz Intan Development Sdn Bhd, for Teluk Intan Branch, there is only 5 permanent workers or staff here. The highest position in this company is Chief Director following by Managing Director and Director. The rest of position is the lawyer, marketing manager as well as site supervisor to monitoring the works on the site. All of them are working in a good environment and positivity throughout my internship period.

1.6 LOCATION OF COMPANY

This company is located in Teluk Intan, Perak. The office is located in the address of No 65, Lorong Raz Intan 3, Taman Raz Intan Cassia, 36000 Teluk Intan, Perak.

a) KEY PLAN

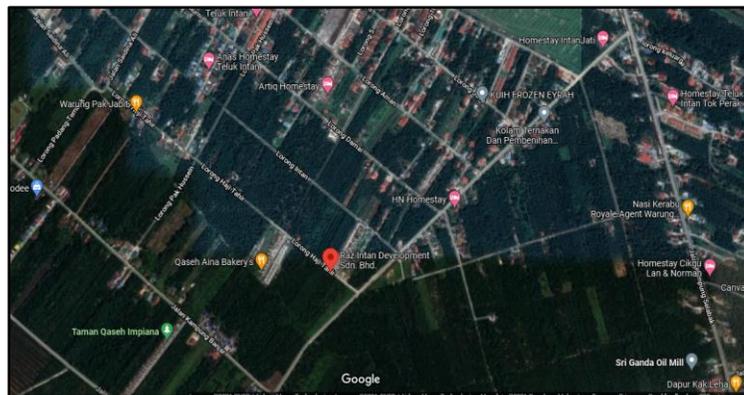


Photo 1:3 Key plan of company

Teluk Intan is located in the state of Perak. This town has been developed from time to time and in the area of the company is surrounded by many projects of housing development. Raz Intan Development Sdn Bhd is located near the town. The office located here due to surrounding area also having current projects such as bungalow and other two units of Semi-D house.

b) SITE PLAN

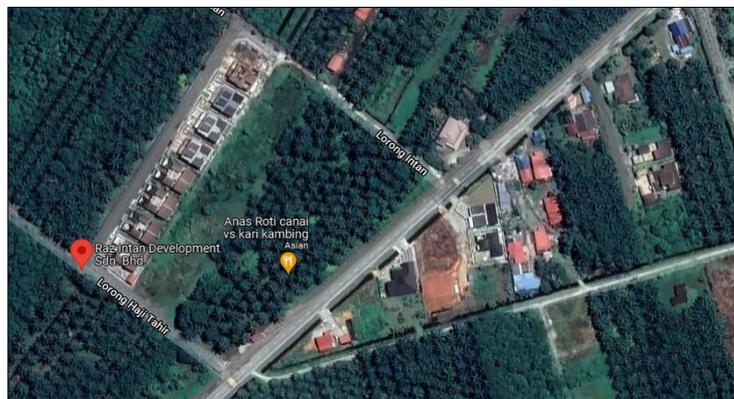


Photo 1:4 Site plan of company

Raz Intan Development Sdn Bhd is located at Taman Raz Intan Cassia, Teluk Intan. The building is in the centre of units 2-storey Semi-D Housing development. The building is taking 14 minutes to Bandar Baru Teluk Intan.

c) LOCATION PLAN

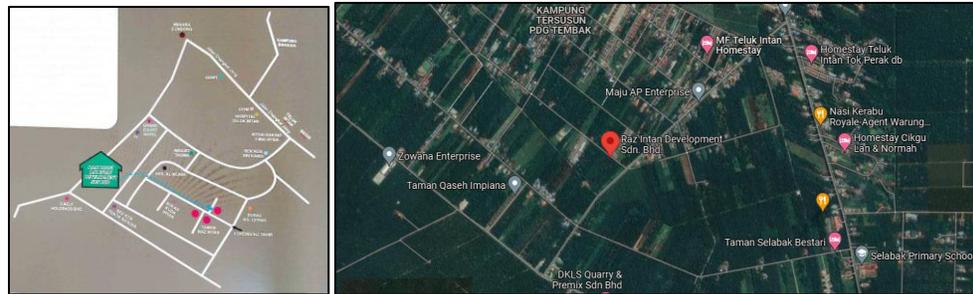


Photo 1:5 Location plan of company

Others facilities building that are nearest is At-Taubah Mosque, Al-Khairiah Mosque, Teluk Intan Police Station, Teluk Intan Hospital and Mat Frozen Fresh Market. The office building also near two highways which are Sungkai Highway and West Coast Expressway (WCE) Highway.

d) BUILDING VIEW OF MY COMPANY

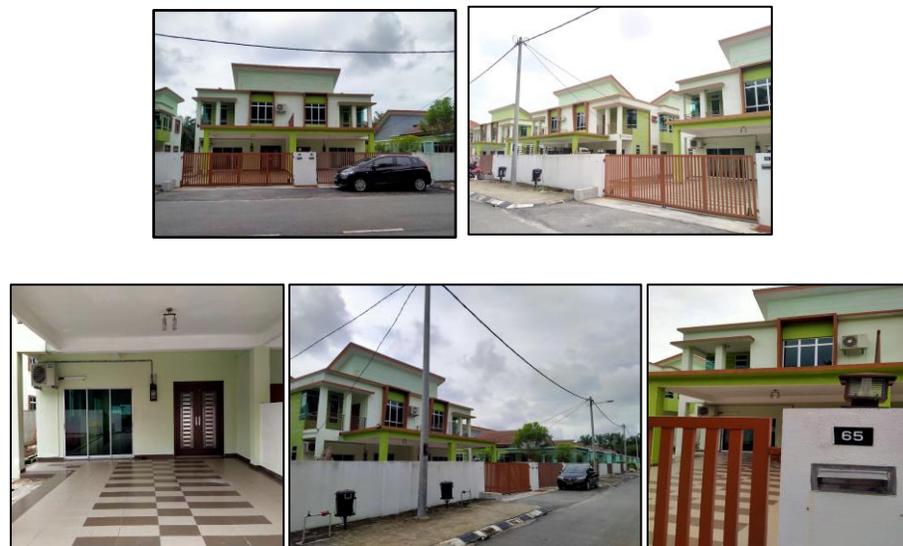


Photo 1:6 View of office building

1.7 LIST OF COMPANY PROJECTS

Since its establishment, there were many projects completed and in progress showing that RIDSB has shown its capabilities in their services provided according to their services and divisions respectively. However, due to the company policy, the value of the projects remains confidential and legally privileged.

a) LIST OF COMPLETED PROJECT

Table 1:3 List completed company project

NO	PROJECT TITLE	START DATE	COMPLETION DATE	PROJECT DURATION
1.	Built 2 units of a single storey house on PT 21526 and PT 21527, Mukim Durian Sebatang, Perak.	27/02/2012	4/7/2013	1 Year, 4 Months, 7 Days
2.	Built 1 unit of a 1 1/2 storey house on PT 24480, Kampung Cerah, Mukim Durian Sebatang,Perak.	10/07/2013	11/11/2014	1 Year, 4 Months, 1 Day
3.	Built 1 unit of a single storey house on PT 24479, Kampung Cerah, Mukim Durian Sebatang, Perak.	19/12/2013	19/03/2015	1 Year, 3 Months,
4.	Built 1 unit of a single storey house on PT 1289, Mukim Sungai Manik, Perak.	11/12/2013	01/06/2015	1 Year, 5 Month, 21 Days

5.	Built 1 unit of a 1 1/2 storey house on LOT 34518, Mukim Durian Sebatang, Perak.	31/07/2013	19/02/2016	2 Years, 6 Months, 19 Days
6.	Built 11 units of a single storey house on PT 24477 - PT 24487, Mukim Durian Sebatang, Perak.	31/10/2012	11/08/2016	3 Years, 9 Months, 11 Days
7.	Built 1 unit of a single storey house on PLOT 8, LOT 8648, Mukim Durian Sebatang, Perak.	12/05/2016	05/10/2016	4 Months, 23 Days
8.	Built 1 unit of a single storey house on PLOT 7, LOT 8648, Mukim Durian Sebatang, Perak.	12/05/2016	07/11/2016	5 Months, 26 Days
9.	Built 1 unit of a single storey house on PLOT 6, LOT 8648, Mukim Durian Sebatang, Perak.	12/05/2016	24/02/2017	9 Months, 12 Days
10.	Built 1 unit of a single storey house on PLOT 5, LOT 8648, Mukim Durian Sebatang, Perak.	12/05/2016	21/03/2017	10 Months, 9 Days
11.	Built 22 units of a single storey terrace	08/10/2013	12/11/2018	5 Years,

	houses on PLOT 01 - PLOT 22 (LOT 8577), Mukim Durian Sebatang, Perak.			1 Months, 4 Days
12.	Built 8 units of a single storey house and 4 units of double storey house on PLOT 01 - PLOT 12 (LOT 8573), Mukim Durian Sebatang, Perak.	03/07/2013	10/02/2020	6 Years, 7 Months, 7 Days
13.	Built 2 units of double storey Semi-D house on LOT 60212 GM 8530 and LOT 60211 GM 8531,Mukim Durian Sebatang, Perak.		20/12/2021	

b) LIST OF ONGOING PROJECT

Table 1:4 List of ongoing company project

NO.	PROJECT TITLE	ESTIMATED OF COMPLETION DATE
1.	Built 1 unit of a single storey house on LOT 34519, Mukim Durian Sebatang, Perak.	2022
2.	Built 2 units of double storey Semi-D house on LOT60210 HSM8532 & LOT 60209 HSM8533, Mukim Durian Sebatang, Daerah Hilir Perak,	2022

1.8 SCOPE OF WORK & RESPONSIBILITIES GIVEN DURING INTERNSHIP PROGRAMMED

During intern at Raz Intan Development Sdn Bhd, there were a few scopes of works that have been given that related to the building surveyor scope. During this internship period, the scopes given are mostly is related to the construction site. The numerous works need to be covered also including site visit in order to update the progress report of daily works on site. Table below shows the scope of works given during internship programed.

Table 1:5 Scope of work

NO	SCOPE OF WORKS
1	Monitor finishing work of two-storey semi-D houses including mosaic, lamp and fan wiring as well as bathroom fitting.
2	Monitoring repairing work of flat roof of three terrace house due to leaking defects by waterproofing remedial
3	Inspection works for two units of terrace house before handover process. This is to avoid problems or dispute between contractor and client after handover process.
4	Repairing defects on a bungalow at Tanjung Karang, Selangor. The defects have been reported by house owner during Defect Liability Period (DLP).
5	Inspection works for a bungalow that still under construction. This is due to avoid further mistake from the beginning on house frame especially.

1.9 SUMMARY

As summary, industrial training or internship is a guided practice based on a knowledge theory that students learned and gained earlier. During industrial training, students can use this opportunity to gain some experience that they never have in class. Students also need to apply and develop soft skill such as communication skills, teamwork, work ethics and management.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Roof is part of a buildings outer skin, and fulfills a range of functions which first it protects the space below it, open or closed, from the weather. Different roof structures can be used according to functional requirements or the design approach (Abu Awwad, Suliman and Safran, 2018). There are a huge number of roof types, all serving a different purpose and more suitable to certain weather conditions and building styles (jtc roofing contractors, 2019).

Around the world, many modern commercial buildings have flat roofs. Flat roofs exist all over the world, and each area has its own tradition or preference for materials used. Flat roofs are characteristic of the Egyptian, Persian, and Arabian styles of architecture. Flat roofs have been built a long time before the Modern Movement appeared in architecture (Urbanik & Tomaszewicz, 2020). Flat roof, as we understand it today, is the last floor's ceiling functioning as the building's roof. It was widely used in construction since the 1920s. In fact, in 19th century residential buildings flat roofs were commonly used, mainly in urban environment until now (Ulubeyli et al., 2014) .

This chapter will basically explain the literature review about flat roof and mainly in waterproofing topics. It is an overview before entering the case study chapter that will be focus only in part of repairing & waterproofing flat roof. All sub-topics in chapter 2 are the knowledge that needs to be known to all parties that are related to the scope of works. Therefore, this chapter is an important and significant chapter to this report.

2.2 DEFINITION OF REINFORCED CONCRETE FLAT ROOF AND WATERPROOFING OF FLAT ROOF

a) Definition Of Reinforced Concrete Flat Roof

A concrete slab flat roof is normally made up of a structural layer of concrete finished with a smooth screed onto which a water proof layer such as a membrane is laid. The roof should incorporate insulation and usually a vapor control layer to protect from interstitial condensation (Kvande & Lohne, 2018).

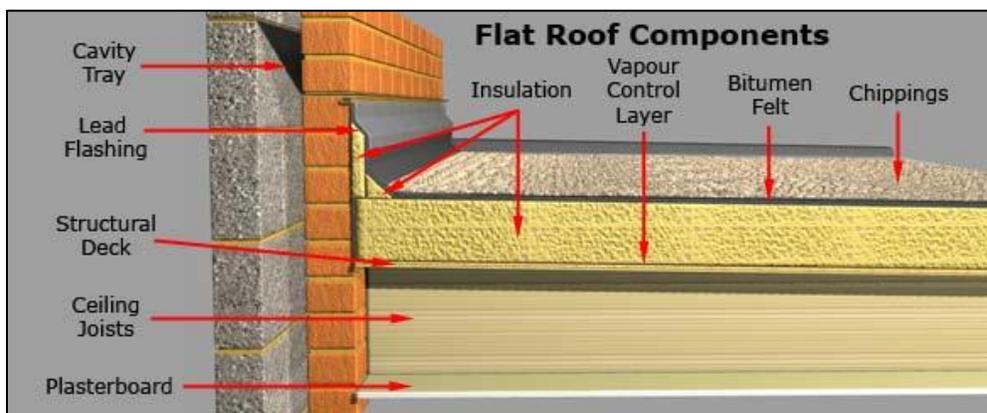


Figure 2:1 Flat roof components

b) Definition of Waterproofing

Waterproofing is the process of making an object or structure waterproof or water-resistant so that it remains relatively unaffected by water or resisting the ingress of water under specified conditions.



Photo 2:1 Illustration of waterproofing

2.3 DESIGN AND CONSTRUCTION OF REINFORCED CONCRETE FLAT ROOF

Most flat roofs nowadays are constructed using reinforced concrete which is known to have pores or capillary tracts. Depending on the designed strength density and installation techniques, the number of pores can vary. These pores are interconnected within the concrete and water will penetrate through such capillary tracts aided by osmotic effect. Concrete is known to be inherently weak in tension, cracks and voids can also form due to thermal expansion, contraction and shrinkage. As a result, water will seep through these voids. Therefore, waterproofing is required to keep the roof water-tight since they are exposed to the weather (Roofing, 2019)

The proper design of falls in a flat roof is an essential consideration in the overall drainage of the roof. Falls create flow paths to direct the drainage of rain-water away from the roof to suitable discharge points. To be effective, it is essential to clear surface water as rapidly as possible from the flat roof to avoid ponding or stagnation of water on the roof itself. Water ponding on a flat roof is a prime cause of deterioration because variations in temperature between wet and dry areas of the roof can cause differential thermal movement. Together with the accumulation of acids left by evaporating rain, this would cause a breakdown on the roof surface. In general, a minimum fall of 1 in 80 will help to prevent ponding of water (Abu Awwad et al., 2018).

During construction, precautions must be taken to prevent excessive moisture from being trapped between the reinforced concrete roof structure and membrane. This is one of the common causes of flat roof waterproofing failure. Therefore, proper design of falls in reinforced concrete flat roofs is most important in creating flow paths to suitable discharge points. For a roof to be effective surface water should be discharged quickly without ponding or stagnation since it is the earliest sign of the presence of defects on the flat roof.

2.4 COMMON CAUSES OF LEAKING DEFECT FOR REINFORCED CONCRETE FLAT ROOF

There are many causes of flat roof leaks. Roofs are among the most susceptible areas of your home or office to water leakages. This is because they are exposed to the full blunt of both rain and wind. Furthermore, water is a highly mobile substance, capable of finding even the smallest of holes in your structure to enter through. This even includes gaps that are too small for the naked eye to see.

Depending on the quality of the initial designed strength, density and technique, the concrete material may have a varying number of pores. These pores are connected within the concrete roof, allowing water to travel with ease from one pore to another. This is also known as the osmotic effect where water flows with the help of capillary tracts. As such, while water may only be able to enter through a single small gap, it can quickly full up internal spaces in the concrete. The common sources include the following(*Renovation of Modern Movement Architecture , the Twenties*, 2014):

CAUSES OF FLAT ROOF LEAKS	ILLUSTRATION
<p>a) <u>Inadequate drainage.</u> If your roof can't properly drain water, it will pool. Over time, standing water can destroy roofing materials that make the roof susceptible to leaks.</p>	 <p>Photo 2:2 Example of inadequate drainage</p>
<p>b) <u>An old roof.</u> Older roofs are more prone to leaks as years of heat, sun, rain, and wind destroy the roofing material.</p>	 <p>Photo 2:3 Example an old roof</p>

<p>c) <u>Damaged flashing.</u> Improperly installed or damaged flashing leaves the corners of the roof exposed to the elements, including rain. Poor flashing can allow water to penetrate the roofing system.</p>	 <p>Photo 2:4 Example of damage flashing</p>
<p>d) <u>Problematic roof membrane.</u> Tears, cracks, punctures, shrinking, and blistering of the roof membrane leave the interior of the roof vulnerable to water damage and leaks.</p>	 <p>Photo 2:5 Example of problematic roof membrane</p>
<p>e) <u>Standing water.</u> Water is heavy and a small puddle of standing water can cause excessive strain, wear, and tear on flat roof. These factors ultimately weaken the roof to the point where it can no longer stand up against leaks.</p>	 <p>Photo 2:6 Example of standing water</p>
<p>f) <u>Open roof penetrations.</u> Holes must be made in the roof membrane to accommodate vents, pipes, drains, and HVAC units. Over time, the gaps in these holes are no longer watertight. Water can seep into the membrane and the roofing system and cause leaks.</p>	 <p>Photo 2:7 Example of open roof penetration</p>

2.5 ADVANTAGE AND DISADVANTAGE OF REINFORCED CONCRETE FLAT ROOF

Flat roofs are among the most controversial roofs of all the types of roofs for buildings and homes. They are most commonly used on outbuildings and large structures. Flat roofs have a unique set of challenges and needs. Therefore, these are the list of advantages and disadvantages of flat roof application towards buildings.

Table 2:1 Advantage of flat roof

a) Advantage of flat roof
i. The expenses - From building and installing to the materials commonly used for flat roofs, they are relatively cheap. It makes a flat roof very affordable for both installation and upkeep and maintenance. Labor is cheaper due to less risk while installing a flat roof. Installation of flat roofs is quicker and easier. There are fewer damage and repair costs over the lifespan of the roof.
ii. Good Long-Term Investment - Concrete roofing can stay intact and sturdy for more than 50 years. Some properties built with concrete even last for up to a century. It's one of the most long-lasting roofing materials available in the market. To reach its maximum performance, a professional is needed to ensure that the installation is done correctly and according to the industry's standard.
iii. Hassle-Free Maintenance - Flat concrete roofs are generally low maintenance, meaning it is easy to clean and aren't too difficult to access. Like any other roofing, debris and dirt can pile up over time. However, roofers can easily remove these from the surface without damaging the roof itself.

Table 2:2 Disadvantage of flat roof

b) Disadvantage of flat roof	
i.	Leakage Problems - Concrete isn't waterproof. While it can protect the property from storms, snow, hail, and other natural phenomena, it has the tendency to absorb water. And when this happens, it cannot be deny the fact that unwanted water damages could follow through (particularly leakage and moisture retention). The problem with leaks is that it can worsen over time. There are instances when leaks aren't even visible to normal eyes. Thus, the water damage proliferates and spreads throughout the property. When these things happen, the structural integrity goes down to a critical level.
ii.	Plant Growth - Plant growth is a common issue among surfaces that retain moisture. Since concrete cannot repel water, there's a tendency for water to stick around especially if nobody don't notice it. When there's water, plants like fungi, molds, and mildew can easily proliferate.
iii.	Debris and Dirt Can Build Up - Water are not the only things that can cause problems on a flat roof. Leaves, twigs, dirt and other debris can also clog up the drain, and this leads to water not draining properly.

2.6 TYPE OF COVERING FLAT ROOF OR WATERPROOFING

Table 2:3 Type of flat coverings

TYPE OF COVERING FLAT ROOF	
<p>i. Asphalt</p> <p>Asphalt is made up of multiple layers of reinforcing plies and asphalt forming a redundancy of waterproofing layers.</p>	 <p>Photo 2:8 Example of asphalt</p>
<p>ii. EPDM</p> <p>Ethylene propylene diene monomer rubber (EPDM) is a synthetic rubber most commonly used in single-ply roofing because it is simple to apply.</p>	 <p>Photo 2:9 Example of EPDM</p>
<p>iii. CPE AND CSPE</p> <p>Chlorosulfonated polyethylene (CSPE) and chlorinated polyethylene (CPE) are non-vulcanized synthetic rubber roofing materials that were used for roofing materials.</p>	 <p>Photo 2:10 Example of CPE & CSPE</p>
<p>iv. Modified bitumen</p> <p>Modified bitumen membranes are hybrid roof systems that combine the high technology formulation and prefabrication benefits of single-ply with the traditional roofing installation techniques used in built-up roofing.</p>	 <p>Photo 2:11 Example of modified bitumen</p>
<p>v. Cold-applied liquid membranes</p> <p>This type of a roof membrane is generally referred to as liquid roofing and involves the application of a cold liquid roof coating.</p>	 <p>Photo 2:12 Example cold-applied liquid membranes</p>

<p>vi. PVC (vinyl) membrane roofing Polyvinyl chloride (PVC) membrane roofing is also known as vinyl roofing.</p>	 <p>Photo 2:13 Example of PVC membrane</p>
<p>vii. Flexible thermo polyolefin Flexible thermo polyolefin is the exact physical and chemical name given to the product commonly known in the industry as TPO (thermoplastic olefin).</p>	 <p>Photo 2:14 Example of flexible thermo polyolefin membrane</p>
<p>viii. TPO Thermoplastic polyolefin (TPO) single-ply roofing. This roofing material can be fully adhered, mechanically fastened, or ballasted.</p>	 <p>Photo 2:15 Example of TPO roofing</p>
<p>ix. Coal-tar pitch built-up roof It ages very slowly through volatilization and is an excellent waterproofing and oil resistant product.</p>	 <p>Photo 2:16 Example of coal-tar built-up roof</p>
<p>x. Glass-reinforced plastic A glass-reinforced plastic (GRP) roof is a single-ply GRP laminate applied in situ over good-quality conditioned plywood or oriented strand board (OSB) deck..</p>	 <p>Photo 2:17 Example of glass-reinforced plastic</p>
<p>xi. Metal flat roofing Metal can be used for both pitched roofs and flat roofs. Flat or low-slope roofs can be covered with steel, aluminum, zinc, or copper just like pitched roofs.</p>	 <p>Photo 2:18 Example of metal flat roofing</p>

2.7 IMPORTANCE OF WATERPROOFING FOR REINFORCED CONCRETE FLAT ROOF

A building or structure needs waterproofing as concrete itself will not be watertight on its own. All the flat roofs in the modern age are generally constructed of reinforced cement concrete. This material removes all the problems of flat roofs except that the roof should be made water proof by employing any of the various methods available for moisture proofing (Us & Waterproofing, 2020).

- i. Building regulations. Waterproofing is one of the important requirements for many construction works.
- ii. Risk prevention. For any construction it is important to have the right waterproofing solutions to protect the building. If the waterproofing is done poorly, it can lead to damage of property and valuables, and to risk for human health.
- iii. Prevent unnecessary costs. It is wiser to invest in preventive risk measures than to pay for damage repairs. Any building requires regular maintenance to protect it from damage caused by water and roof waterproofing is an effective preventive measure.

Typically, extensive waterproofing measures are applied during construction to ensure that moisture is controlled at the initial stage. Waterproofing can also be done after a building has been built to solve problems as they arise. Waterproofing is crucial for a number of reasons.

2.8 SUMMARY

Roof is the important structure in a house and if there is any problem related to it is a huge problem. Waterproofing is essential because it ensures your flat roof has a longer life span and prevents damage to your house's interior parts. Ultimately, it assures you comfortable and stress-free living since you do not have to worry about constant roof repair and maintenance.

CHAPTER 3: CASE STUDY

3.1 INTRODUCTION

In this internship training, a student must present a topic title for submission report. I choose flat roof as my main topic since it is the site that I am supervise fully in the months of internship training. I need to do a simple report for this site's job to be submitted to the company. It is on the appendices of this report. I understand the works and that is the main reason why I choose flat roof as my main topic for my internship report.

3.2 DESCRIPTION OF CASE STUDY

The project of terrace house named on project file as *“cadangan pindaan kepada pelan 22 unit rumah teres satu tingkat di atas plot 01 sehingga plot 22 (lot asal 8577) yang telah diluluskan (mpti (b) sp 03-2013) mukim durian sebatang daerah hilir perak”* . There are three houses that involved in the repairing work before deliver the house to their respective owner. These are the list of details about the involved house.



Photo 3:1 View of case study building

Table 0:1 Information about case study

No	Buyers name	Lot number	Address properties	Type of building
1	Nor Fazilah Binti Abdul Hanid	Pt 255568	No 36, Lorong Raz Intan 2, Taman Raz Intan, Padang Tembak, 36000 Teluk Intan, Perak Darul Ridzuan	Housing scheme
2	Abdul Rahaman Bin Shaari	Pt 255569	No 37, Lorong Raz Intan 2, Taman Raz Intan, Padang Tembak, 36000 Teluk Intan, Perak Darul Ridzuan	Housing scheme
3	Abdul Rahaman Bin Shaari	Pt 255570	No 38, Lorong Raz Intan 2, Taman Raz Intan, Padang Tembak, 36000 Teluk Intan, Perak Darul Ridzuan	Housing scheme

a) CASE STUDY PROJECT

Terrace is the most crucial segment of a building, and it is exposed to direct climatic variations, extremes of rainfall and structural movements caused thereby. So every effort should be taken at the design stage itself to ensure that a proper protection system has been incorporated.

The terrace house is leaking until the ceiling plaster is falling down. It is dangerous to the owner of the house and immediately action is needed. The area of the leaking for each house is same which is toilet near the kitchen and room 3. After the defects on the flat roof have been diagnosed and observe, the process of repair flat roof began. There is one terrace house have been occupied while the other two terrace house will be occupied after the handover phase/process. This report will showing and describe the process of repairing flat roof of the terrace house involved.



Table 3:2 The situation problem

b) OBJECTIVES OF CASE STUDY PROJECT

The objectives of the project report is to prepare a complete report as developer in make sure the condition of the house is in a best condition before handover process. The report will be act as guidance for future reference if the same defect happen again and as a proof that the developer have give its best to the house before handover process. This procedure and documentation are important for next argumentation if happen between developers and owner of the house. This report have been submitted to the company developer and I choose this report to be submitted towards my university since this scope of work are related to the course as well as my main project that I handled myself as intern student during my internship. From this case study project, knowledge on flat roof that I got is:

- i. To identify the defect that act upon the flat roof
- ii. To know the right method and procedure of repairing flat roof houses by waterproofing
- iii. To find out the best materials and tools in repairing leaking flat roof by waterproofing

c) SCOPE OF WORK CASE STUDY PROJECT

My scope of work in the small project is to monitoring the whole process starting observation towards defects and cleaning the site. After the site work completed, I need to do a details report about the work on the site and submitted to my supervisor to taking the next action of procedure in documentation.

3.3 LOCATION OF CASE STUDY

a) KEY PLAN

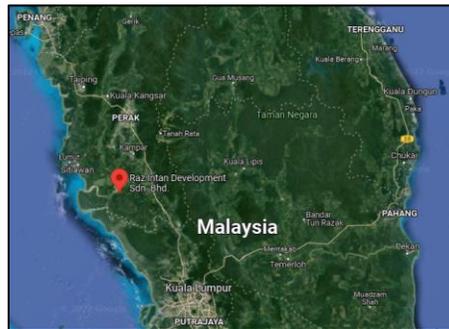


Photo 3:2 Key plan of case study

The location of three unit terrace houses is located in Perak state nearest Office Company. The terrace house is in a scheme project house development of terrace house in Perak.

b) LOCATION PLAN

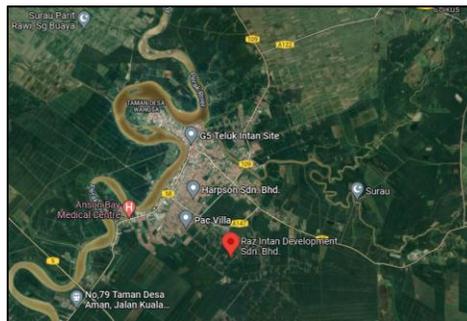


Photo 3:3 Location plan of case study

The terrace house is located in Teluk Intan, Perak. The location is near to the primary schools and secondary schools. There also others facilities and amenities that are near the terrace house area including mosques and hospital. It can be said that the area of the terrace house is quite strategic for a home.

c) SITE PLAN



Photo 3:4 Site plan of case study

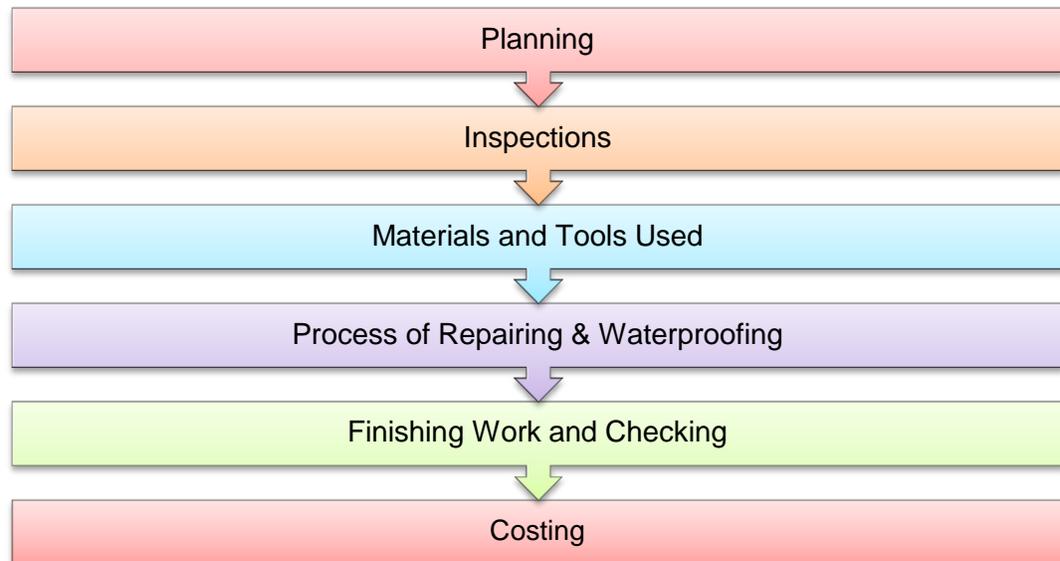
The detail and accurate location of the terrace house or case study is in Lorong Haji Tahir, Teluk Intan, Perak. Although the case study location is quite in village area with minor road access, but surrounding the location, there are so many construction project of house development that will expand the surrounding area becoming a huge residential area with many types of houses such as terrace house, Semi-D house and bungalow house. Its taking less than 15 minutes to arrive town and city.

d) SURROUNDING BUILDING OF CASE STUDY



Photo 3:5 surrounding building of case study

3.4 PROCESS OF WATERPROOFING FLAT ROOF



3.4.1 PLANNING

In this project, the immediate repair is needed due to the defects report that our company received as developer, there is falling plaster ceiling in the three unit of terrace house. This situation has reached dangerous level and immediate action is needed. There are owners from the three unit terrace house are forced to move out from their new house since they reported that the falling plaster ceiling is nearest to falling on their kids. They move from the house and our company is taking all the responsibility towards the situation.

The first action that my company takes is planning the work. This time, a good planning is needed due to they did not the situation repeated again. The worker that involve to this work project is three people and one supervisor as well as one assistant supervisor. The meeting planning is only one day to and mostly about method and materials as well list of tools need by the worker.

On 24th October 2021, the worker and supervisor visit the terrace house to discussing about the best method as well as the wages needed. Detail planning is needed so that the client or owner of the house did not complain and the house is ready to be livered through agreement by legal lawyer.

3.4.2 INSPECTION & IDENTIFYING DEFECTS

On 24th October 2021 also, the workers have identifying defects on inside the terrace house as well as on the flat roof itself. During observation, they found the cause of the leaking flat roof. During phase of identifying defects, the involve workers as well as the supervisor found many cracks and vegetation growing on the waterproofing membrane. Some cracks were more than 5mm in width. These are the defects found on the flat roof and inside the terrace house. Disintegration led to thinning and affected the durability and service life of the waterproofing system. The poor past remedial treatments were caused by the low quality of workmanship and could be identified based on their application defects.

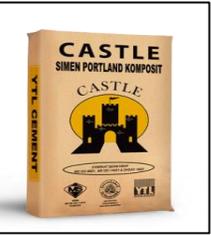
No	a) Defects found on the flat roof of three unit of terrace house	
1	 <p data-bbox="495 1304 826 1329">Photo 3:6 Stain defect on flat roof</p>	<ul style="list-style-type: none"> • There are excessive ponding water on the flat roof visible during after rain • There are no visible curb and drain on the flat roof • There are also no slope on the surface of the flat roof • Fine crack in the concrete flat roof as a start • Fracture and failure • Stained slab
2	 <p data-bbox="488 1850 833 1875">Photo 3:7 Mould defect on flat roof</p>	<ul style="list-style-type: none"> • Weeds growing under roof • Defects in the tail-ends • Defects in the fastening • Cracking defects • Improper roofing • Surface wear • Creasing and bulging

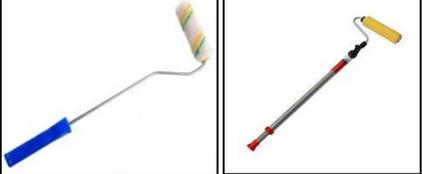
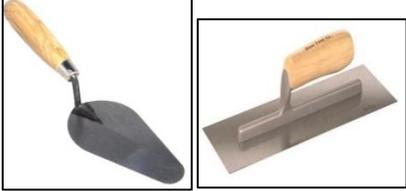
<p>3</p>	 <p>Photo 3:8 Vegetation defects on flat roof</p>	<ul style="list-style-type: none"> • Having sign of early stage of corrosion • Vegetation or biological growth • Corrosion
<p>4</p>	 <p>Photo 3:9 Debris accumulation defects on flat roof</p>	<ul style="list-style-type: none"> • Inadequate downspout design • Defects in the coping • Inadequate lap joints design • Insufficient coverage • Debris accumulation
<p>5</p>	 <p>Photo 3:10 Fine crack defects on flat roof</p>	<ul style="list-style-type: none"> • Membrane problems due to roof with no blister • Drainage problem and sufficient number of drain • Water retention on roof surface due to improper slope • Ponding water in several areas due to ineffective falls on flat • Disintegration defects found • Insufficient surrounding heights • Presence of water penetration due to the waterproofing covering is not intact • Ridging and cockles on roofing membrane

b) Defects found inside the three unit of terrace house		
1	 <p>Photo 3:11 Moist defect on ceiling</p>	<ul style="list-style-type: none"> • Cracking • Moisture stain of condensation and leaks • The board is on the verge of falling since there is continuous presence of water element and dampness
2	 <p>Photo 3:12 Board ceiling falling defect</p>	<ul style="list-style-type: none"> • Mossy and rotting ceiling • Without immediate action, this defect could lead to fatality or injury to the user
3	 <p>Photo 3:13 Mossy defect on wall</p>	<ul style="list-style-type: none"> • Mossy and moldy plaster wall surface due to the continuous presence of water and dampness • Proper treatment of the water and dampness source could prevent this defect
4	 <p>Photo 3:14 Stain ceiling defect</p>	<ul style="list-style-type: none"> • Stained ceiling • Mossy and moldy plaster wall surface due to the continuous presence of water and dampness
5	 <p>Photo 3:15 Fine crack on wall defect</p>	<ul style="list-style-type: none"> • Fine crack in the concrete flat roof as a start • Rusty from aged metal roof let water seep through due to weather impact-harsh tropical

3.4.3 MATERIALS AND TOOLS USED

a) List of materials that have been used and its function

		<p>Waterproofing cement compound for interior and exterior waterproofing and damp-proofing of concrete, cementations rendering, brickwork and block work.</p>
<p>Photo 3:16 Waterproofing cement compound</p>		
		<p>Sand helps to prevent mortar shrinkage. It also prevents cracking of mortar during setting. Well-graded sand increases the density of mortar.</p>
<p>Photo 3:17 Sand</p>		
		<p>Castle is versatile blended cement for general purpose usage and can be used for bricklaying, plastering, screeding and concreting application.</p>
<p>Photo 3:18 ompound cement</p>		
		<p>Bonding Latex K-996 is a multipurpose high quality Latex admixture specially formulated for use with cement based including Tile Adhesive, Tile Grout.</p>
<p>Photo 3:19 Latex admixture</p>		
		<p>6” White PVC Pressure Pipe 3m Length is to blocking the hole of down water pipe on the flat roof.</p>
<p>Photo 3:20 White PVC pressure pipe</p>		

b) List of tools that have been used	
 <p data-bbox="513 583 760 611">Photo 3:21 Blue PE Sheet</p>	<p data-bbox="919 344 1438 575">Blue Polyethylene Sheet (Blue PE Sheet) used in construction as vapor retarders, window films, flooring and counter top protection, and even in roofing.</p>
 <p data-bbox="548 869 727 894">Photo 3:22 Shovel</p>	<p data-bbox="919 617 1438 743">Wooden Handle Shovel And Shovel Square Steel for digging, lifting, and moving bulk materials.</p>
 <p data-bbox="526 1108 750 1129">Photo 3:23 Paint roller</p>	<p data-bbox="919 905 1438 1031">Long Handle Brush Paint Roller tool used for painting large flat surfaces rapidly and efficiently.</p>
 <p data-bbox="545 1356 730 1377">Photo 3:24 Trowel</p>	<p data-bbox="919 1140 1438 1314">Brick Laying Trowel & Hand Concrete Trowel used in brickwork or stonework for leveling, spreading and shaping mortar or concrete</p>
 <p data-bbox="493 1587 782 1608">Photo 3:25 Single step ladder</p>	<p data-bbox="919 1388 1438 1461">8 feet aluminum single step ladder for reinforced feet for a steady climb</p>
 <p data-bbox="532 1843 740 1862">Photo 3:26 Water jet</p>	<p data-bbox="919 1619 1438 1839">Water jet, is an industrial tool capable of cutting a wide variety of materials using an extremely high-pressure jet of water, or a mixture of water and an abrasive substance.</p>

3.4.5 PROCESS OF REPAIRING & WATERPROOFING

In this section are the description work activity of the repairing leaking flat roof and the chronology of the project until waterproofing as well as finishing works.



Photo 3:27 Process of hacking work

For the earlier work, the worker doing hacking job. The area of the hacking is all flat roof of the three unit of terrace house that have been affected of the leaking defects. The terrace house using terms house 3, house 4 and house 5. This is because the three units are attached and count in order to easier all involved worker to have a same code site. Hacking work is done on the flat roof of house no 3, 4 & 5. Hacking work is done as deep as 8 inches because the waterproofing must be done on the flat roof slab. The 8 inch depth was due to old flat roof repair work and did not succeed because the flat roof had leaked again. Hacking work was done for 8 days for 3 houses. Hacking works include cement plaster slope of house no 6 for the installation of beams in that section.



Photo 3:28 Process of claning flat roof

Next is the flat roof cleaning work before sweeping waterproofing work to slab roof. Washing works include sweeping sand residue due to hacking and leveling flat roof using water jet to remove old rendered cement left behind. This is to make sure that the surface of the flat roof is really clean from any debris before waterproofing works being done and applied to the flat roof slab. The weather for the rest of week are sunny day making the progress of work are quite fast than expected.



Photo 3:29 Process of waterproofing

After that, the waterproofing work on the flat roof started with house no 3, no 4 and no 5. The part of the flat roof that is suspected to be leaking has been waterproofed twice and has been tested. Next, all parts of the flat roof are waterproofed, including the corners of the slope roof. Waterproofing is applied evenly in hot weather in all areas and left to dry. Before the waterproofing work, the weather is rainy for two days straight. Waterproofing only is done in a hot weather. Waterproofing membranes must be cautiously selected based on environmental conditions such as rain, temperature variations, usage conditions, durability, and desired aesthetics. It is imperative to go through product literature to understand the benefits and limitations of a waterproofing system.



Photo 3:30 Process of testing water

Then, after the waterproofing work is done and left to dry for a day, all three area of the flat roof are allowed to hold water for several hours to ensure effective waterproofing sweep before the rendering work is done. The pipelines of rain water downpipe in each flat roof hole are closed during the water reservoir test using 6" white PVC pressure pipe 3 meter length. During the flat roof testing, it was found that there were no leaks on the roof slab in the house. The water used to retain water is clean water from the tank.



Photo 3:31 Process of create divider beam

Further work continued by barrier beam making work is done on all three parts of the flat roof. A total of three beams are made as a divider between

houses no 3, no 4 and no 5. The beam measuring 6 inches high and wide and the beam steel also was inserted into each beam formwork prior to concrete. The beam between house no 3 and no 4 is close to the bricks of house no 4. There is no space for stagnant water between the beams of house no 3 and the bricks of house no 4.



Photo 3:32 Process of rendering work

Next is sweeping work on waterproofing beams and leaking parts area. The slab roof has been rendered as high as 3 inches as well as finishing work such as sweeping smooth cement on slab roof area. The drains also are made and added towards the water pipes as well as have been waterproofed.



Photo 3:33 Process of smoothing work

Moreover, the slopes around the flat roof have been made including the left and right beams. The slope has also been waterproofed after drying. The flat roof smoothing works include sweeping the flat roof from sand and smoothing the corners of old rendered cement at the bottom of the water tank in houses 4 and it

is being call tidying work to making the whole area of flat area is nice. The area around the old rendered cement has been built a drain.



Photo 3:34 Process offsite cleaning

The last task and work on site is the cleaning work is done in the backyard of house no 4 and no 5. This is due to the hacking work at the earlier stage of work done making it need to be cleared to avoid any complaining from the owner and buyers. The cleaning work was done by 2 workers and a help of backhoe. The cleaning process taking one week due to rain heavily for straight 4 days. The help of backhoe is needed for two days since all the hacked concrete are pile up in the backyard. All fragments of old flat roof rendering cement have been removed to appropriate areas. The remaining fragments of old rendered cement are leveled in the backyard of house no 4.

3.4.6 FINISHING WORK AND CHECKING



Photo 3:35 Process of ceiling installation

Finally, it is time for the ceiling plaster installation work and it is done for 2 days starting from house no 4, no 5 and no 3. Prior to the ceiling installation

work, the roof slab has been ensured that there are no leaks and the company decide to called plaster ceiling installation experts to install the plaster ceiling towards the three units of terrace house. All old and rusty ceiling plaster irons have been replaced with new ones. Installation of plaster ceilings is in good condition after the scheme finishing is done.

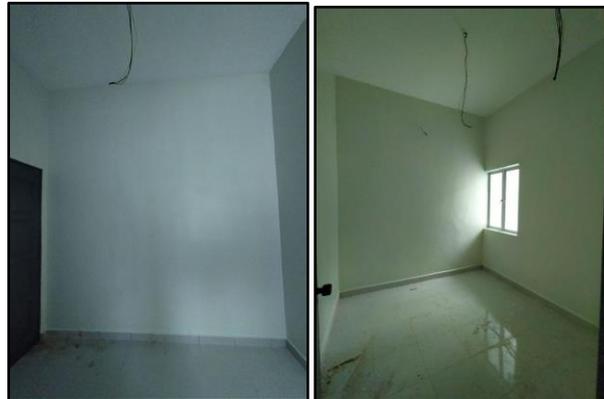


Photo 3:36 Process of painting work

Lastly, the painting works on house no 3, no 4 & no 5. The area to be repainted is room 2 in house 3, 4 and 5 as well as the outer wall of the room from room 2 to the back wall of the kitchen door. The paint used is the same paint color code. The ceiling of the rear toilet and the ceiling of room 2 of houses 3, 4 and 5 have also been painted since the area also is affected due to rusty door as well as blistering paint defects. The condition of the painting work after completion is in good condition.



Photo 3:37 Process of cleaning work

Additionally, since the house will be in shortly noticed that it will be delivered by legal agreement later, the cleaning works on terrace houses No. 4 and No. 5 is done too. It is because all the old board plaster ceiling that is falling down are presence with the dust making the room affected are in mess and needed to be cleaned before delivery process. The cleaning area is all room space including living room, kitchen, toilet and porch. All areas have been swept and cleaned. The indoor area is in good condition after cleaning. Ceiling condition of terrace house 4 & 5 which has been repaired and painted - Kitchen toilet and room 3.



Photo 3:38 Ceiling plaster installation

3.5 SUMMARY

Concrete flat roofs are one of the building components that are most prone to degradation. Remedial treatments are necessary to extend the service life of concrete flat roofs. However, the workmanship is highly related to the quality of remedial treatments. Waterproofing is essential because it ensures your flat roof has a longer life span and prevents damage to your house's interior parts. Ultimately, it assures you comfortable and stress-free living since you do not have to worry about constant roof repair and maintenance.

CHAPTER 4: PROBLEMS & RECOMMENDATIONS

4.1 INTRODUCTION

Almost every construction project, no matter how big or small, encounters and resolves challenges relating to craftsmanship, materials, machines, and other factors. Many challenges were faced during the creation of this case study's development project. Following the outbreak of the COVID-19 epidemic, this occurred. The construction business has been going through an exciting period in its life, developing at a breakneck pace while also confronting numerous problems. Some of these issues are relatively new, while others have existed since the beginning of the industry.

4.2 ANALYZING PROBLEMS AND RECOMMENDATION

All the problems and recommendation in this section is from the observation that has been made by me and all of it is related to the site work and project. The problems will affect to the related parties if there is no other immediate action has been done. The first one is on safety precaution, secondly is due to the lack of expertise and experience to the job scope of project while lastly is the whole of project management making the project having a others outside problems. It delayed the project. Therefore, in this section, all the problems arises have been describe in details including the recommendation action that should be take into consideration by involved parties.

4.2.1 PROBLEM 1: SITE SAFETY AT CONSTRUCTION

Based on observation, most of the workers during inspection are not wearing the Personal Protective Equipment's (PPE) at most of the time. They are only wearing common caps which not protecting their head at all. They are wearing the caps claiming that they only want to protect from sun but not because of the safety. This may and can be risk in getting injuries or casualties getting higher. Especially during project waterproofing on the flat roof which is at the high place need more safety concerned.



Photo 4:1 No application of safety

4.2.2 RECOMMENDATION 1:

To overcome this problem, the company should provide their workers with safety equipment's (PPE) like gloves and safety helmet. The company also need to make them used this regulation such as the safety officer must take an action on the staff. Instruments are compulsory during work progress. If the staff cannot follow the safety, harsh action should be taken. Because construction work has a high level of danger, PPE will always be a critical safety measure, even with all of the other controls in place to protect you from these risks.



Figure 0:1 PPE equipments

4.2.3 PROBLEM 2: LACK OF EXPERTISE AND EXPERIENCES

Shortage and difficulties in obtaining manpower resources will definitely affect the project productivity. Lack of local expertise that is has the knowledge and experiences in the field of roof and waterproofing job experience. The employees who handled the projects have not enough experiences in order to monitor the progress of the projects. Therefore, they are lack of quality in doing the job. The workers have repaired the flat roof for two times and there is still leaking happened making the company are loss money doing repair work only.



Figure 4:2 Unskilled worker doing work on flat roof

4.2.4 RECOMMENDATION 2: HIRED SPECIALIST

As recommendation, the company should hire a roofing specialist to seeking advice about the repairing work. There is because there is no at least one specialist of roofing making the repair work are being done more than once due to the same problem. The loss of repair work is so much than rather loss to hire a roofing specialist. From specialist, the knowledge about the good materials and right tools are being observed by them making the method procedure of the repair defect and waterproofing are on the right track and can be long last the maintenance for it.



Figure 4:3 Specialist working on flat roof

4.2.5 PROBLEM 3: NO SYSTEM OF EFFECTIVE MANAGEMENT

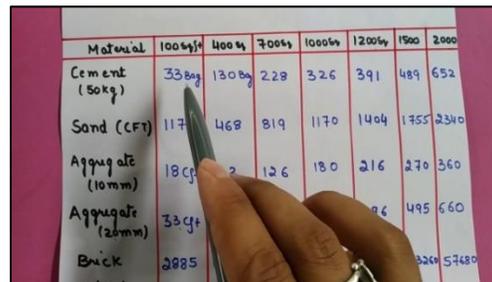
The problems that have been detected on the site are, the work at the project site is not running properly and systematically. There is no system of effective management of the construction site causing delay in the completion of the repaired project. There are also the waste of raw materials, labor and time during work or activities at the construction site. Waste of materials is due to the order of sand that is too much at the end and need to be thinking the solution to use the rest of unused sand. This happened due to nobody know the estimation of raw materials making waste.



Figure 4:4 Excessive sand becomes waste at construction site

4.2.6 RECOMMENDATION 3: STRATEGIC CONSTRUCTION MANAGEMENT

Construction management is a vast field that encompasses all parts of the construction process, including contracts, methods, materials, production and cost estimates, progress and cost control, quality control, and safety. However, with a well-thought-out approach and the correct digital solution, can avoid costly delays and ensure that the project is completed on time and within budget. Therefore, a good strategic construction management is needed from the early stage of the construction project itself.



Material	100kg	400kg	700kg	1000kg	1200kg	1500	2000
Cement (50kg)	338kg	130kg	228	326	391	489	652
Sand (CF)	117	468	819	1170	1404	1755	2310
Aggregate (10mm)	18cf	2	126	180	216	270	360
Aggregate (20mm)	32cf				76	495	660
Brick	2885					324	57480

Figure 4:5 Planning of raw material calculation

4.3 SUMMARY

As summary, the problems in this chapter are common happened and have been studied as well as research. The truth is the problems allies between themselves and the priority matters to them. All problems have solution and action that are need to be taken by following the right steps. The most of all it, safety is the important one since it is related to our self. Without safety precaution, the life of workers is in debt if any incidents happen. Other two problems need to be solved by discussion with the right person and the Person In Charge (PIC).

CHAPTER 5: CONCLUSION

5.1 CONCLUSION TO CASE STUDY

As conclusion, this report basically is a study about defects of flat roof and process of waterproofing remedial application. There are many study and research regarding the application of flat roof especially towards housing developments either in overseas or Malaysia itself. this is due to the common defects and higher maintenance needed but all matters nowadays for a construction project to be in the market is the aesthetic values as well as implementation of design modern architecture.

Next, this study focus to investigate the defects that happen on the flat roof that need an immediate action since the defect near bring the occupants of the building or people staying in the house to fatality incidents. Due to the situation, the action is needed taken by developer of the house due to the new house is still in Defect Liability Period (DLP).

Moreover, advances in waterproofing materials and technologies have revolutionized the modern construction industry, not only with their ease of use, but also with greater durability and smaller and lighter aspects of maintenance. There is also a lot of research in the world to prevent water from entering the structure. With the help of modern solutions from Master Builders Solutions you can provide waterproofing of the entire structure - the foundation, roof, seams, basements, pools, reservoirs, terraces and balconies.

5.2 CONCLUSION TO INTERNSHIP PERIOD

Furthermore, I can learn the whole process of the repairing work as well as follow the monitoring work of waterproofing the flat roof. I have seen the overall procedure starting client making formal defect report, find workers that having basic knowledge to do the works of waterproofing until the end which are finishing job such as installing plaster ceiling and painting work. I am also known the tools, equipment and materials needed to do the repairing slab flat roof and waterproofing process.

In a nutshell, I need to wish thank you to my supervisor and the other workers that had help me a lot by exposed the practical students with the training activities. There is lots of knowledge that can be getting during the period of industrial training. My supervisor and other internship students also are very helpful and always give an advice in order to complete the report. Thank you.

Internship gave an opportunity to student to gain experience before graduating and facing the real working environment. Being an internship student gave me a lot of new knowledge and experience. I learnt that experience is more valuable than theory. Opportunity to get exposed to the bridge construction is an advantage for me to apply it while doing project/assignment as well as when I apply for a job soon. I also learned that the most important thing is communication skill. My communication skill had improved, and I need to identify to whom I am speak too.

The main idea should understand by the recipient. Internship has its own challenge, but I realize that the real working environment will be much more challenge than this. Wise decision and action must be made in a short time and I must be responsible to any action or order that I have made. I can develop my knowledge during completing the tasks and assignments given by my industry supervisor. Next, I can also improve several of technical skills such as work ethics, communication skills, and a good relationship between the staff of the company. From this training programme, I have learned and achieved many things that are important to me before I started working in the future.

REFERENCES

- Abu Awwad, B., Suliman, M. O., & Safran, M. (2018). Study of different pitched roof types. *Civil and Environmental Research*, 10(June), 98–113.
- FLAT ROOF – ADVANTAGE OR DISADVANTAGE OF MODERN MOVEMENT BUILDINGS* Wroclaw University of Technology Wroclaw University of Technology Keywords : Flat Roof , Renovation of Modern Movement Architecture , the Twenties. (2014). 1–16.
- Kvande, T., & Lohne, J. (2018). *GOVERNING FLAT-ROOF CONSTRUCTIONS : A CASE STUDY*. July. <https://doi.org/10.24928/2018/0314>
- Roofing, F. (2019). *Flat Roofing*. <https://jjroofingsupplies.co.uk/flat-roofing>
- Ulubeyli, S., Kazaz, A., Er, B., & Birgonul, M. T. (2014). Comparison of Different Roof Types in Housing Projects in Turkey: Cost Analysis. *Procedia - Social and Behavioral Sciences*, 119, 20–29.
<https://doi.org/10.1016/j.sbspro.2014.03.005>
- Urbanik, J., & Tomaszewicz, A. (2020). *Flat Roof - Advantage or Disadvantage of Modern Movement Buildings* *FLAT ROOF – ADVANTAGE OR DISADVANTAGE OF MODERN*. October 2014.
- Us, A., & Waterproofing, R. T. (2020). *Roof Top Waterproofing Examples of Roof Problem*.

APPENDICES