DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

PRACTICAL REPORT TITLE

PROCEDURES OF CORRECTIVE MAINTENANCE FOR COMMERCIAL BUILDING

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DEPARTMENT OF BUILDING

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FEBRUARY 2022

It is recommended that the report of this practical training provided

By

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entitled

Procedures of Corrective Maintenance for Commercial Building

be accepted in partial fulfillment of requirement has for obtaining Diploma in Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Kluang District Public Works Department for duration of 20 weeks starting from 23 August 2021 and ended on 07 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

…….

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Date : 10 January 2022

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Last but not least, my special thanks to my beloved parents for their sacrifices over the years.

Thank you for going above and beyond!

ABSTRACT

Maintaining the building prevents it from deterioration and makes it more resilient over the time. There are many types of maintenance in building maintenance work. Therefore, this report will discuss about one type of maintenance work that have been carried out for commercial building. This report was conducted for the administrative building in Malaysian Veterinary Institute (MVI). This report is aiming to see how the type of maintenance work is carry out and what are the effects and differences achieved after the work is completed. Roughly, the objective of this report is to find out the procedures that have been set to carry out this maintenance work. For overview of this project, this project involves repairing work of the roof, walls, ceiling and interior work for the administrative building. However, these maintenance work is not done all at a time. It is carry out from time to time according to the predetermined schedule. Therefore, this project is very important to give comfort and safety to all users of the building in the future. Moreover, from this report, I am also being able to gain knowledge about building maintenance.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

In general, building maintenance can be described as the job done by someone with knowledge and expert to keep the building maintained and also to ensure that every element of the building is properly improved. (UKEssays.com, 2021) Moreover, according to the committee on maintenance under government of India, they defined building maintenance as, "the work done to keep, restore, or upgrade every facility, i.e., every section of a building, its services, and its surroundings to a current acceptable quality in order to maintain the facility's utility and value". (Zeeshan T, 2016) Therefore, building maintenance is very important to ensure that the building is effectively maintained, thus the process of efficiency in building maintenance procedures must be taken into consideration. (Zeeshan T, 2016)

Damage occurs in a building when a component of the structure is unable to operate properly. This damage may possibly cause by a variety of factors, however they can be divided into three types which is environmental factors, material/structural flaws, and ground movements. (Mea, 2021) There are many types of damages in the building such as the electric system, water supply system, floor, roof, drainage system and wall. (UKEssays.com, 2021) This problem might be solved by doing building maintenance to repair or restore equipment that is not working properly. Therefore, maintenance of buildings may be broadly classified in three categories which is corrective maintenance, preventive maintenance, and predictive maintenance. (Tony, 2015)

The first category of building maintenance is corrective maintenance. Corrective maintenance is the process of identifying, isolating, and repairing a defect in order to get equipment, machine, or a system to an operational condition so it can fulfil its intended purpose. (TWI, 2021) Corrective maintenance is also known as a maintenance task performed to restore a non- or under-performing asset to an optimum or operational condition. (Beackley, 2021) Corrective maintenance is frequently related with breakdowns or reactive maintenance which also includes troubleshooting, disassembly, adjustment, repair, replacement, and realignment. (TWI, 2021) Corrective maintenance can be classified by two categories which is planned corrective maintenance and unplanned corrective maintenance. (GeeksforGeeks, 2020) Planned corrective maintenance (PCM) also known as scheduled corrective maintenance (SCM) is a maintenance that is required but not required to be carried out immediately. For example, when a spray nozzle becomes blocked, lubrication stops pouring through it. At the time of the next inspection, a work order is generated to remove the obstruction or replace the nozzle head. Next is unplanned or unscheduled corrective maintenance which refers as Maintenance that is necessary as a result of a serious breakdown that must be repaired as soon as possible. For example, Hard water minerals pile up in a pipe, increasing the pressure and causing it to explode. It is imperative that the pipe need to be replaced as quickly as possible. (Beackley, 2021)

Meanwhile, the second category of building maintenance is preventive maintenance. Preventive maintenance entails tasks that are necessary to keep the building strong and sound, as well as resistant to early deterioration or damage. (Zeeshan T, 2016) According to Meaghan, K. (2021) explain preventive maintenance (also known as "preventative" maintenance) is a systematic approach to building operations with the goal of predicting and preventing catastrophic equipment failures before they happen. (Meaghan, 2021) There are two common types of preventive maintenance which is time-based maintenance and usage-based maintenance. (Wu, W., 2021). Time-based maintenance (TBM) is a maintenance that follows a calendar schedule and performed on equipment. This indicates that for this sort of maintenance, time is the maintenance trigger. (Fiix, 2021) Time-based preventive maintenance is appropriate for bounded assets (such as fire/safety equipment)

and essential assets (such as HVAC systems and pumps). For example, semi-annually inspection for water heaters, inspection of parking lot for cracks once a month and change air handling unit filters every three months. (Meaghan, 2021) Next, usage-based maintenance or UBM is a maintenance that initiated based on actual usage of the fleet's asset, similar to meter-based programs. This form of maintenance considers an asset's typical daily consumption and utilizes it to estimate a due date. (Summerville, 2021) Usage-based preventive maintenance ensures that equipment continues to function as planned by the manufacturer. For example, service motor vehicles every 5,000 miles, belts inspection every 100 hours of production and lubricate pumps every 10,000 run-hours. (Kelly, 2021)

Next building maintenance category is predictive maintenance. Predictive maintenance is a method of detecting abnormalities in your operation and potential faults in equipment and processes using data analysis tools and methodologies, so you can correct them before they fail. (Fiix, 2021) The objective of predictive maintenance is to be able to anticipate when equipment will fail (depending on a variety of criteria) and then avoid the failure through routine and corrective maintenance. (Noria, 2010) For implementing predictive maintenance, a few major components are required for implementing purposes which are data collection and preprocessing, early defect identification, fault detection, time to failure prediction, maintenance scheduling, and resource optimization. (Wikipedia contributors, 2021)

Therefore, from all the explanation above, it can be concluded that there are three categories of building maintenance which is corrective maintenance, preventive maintenance and predictive maintenance. All the maintenance works have their own criteria and process in ordered to keep any building maintained and well improved. However, in this study report, corrective maintenance is the highlighted categories since the ongoing project on site is performing the corrective maintenance work.

1.2 Objectives

1. To identify the procedures of the corrective maintenance for commercial building.
2. To determine the problems that occurred while conducting the maintenance work and how to overcome it.

1.3 Scope of Study

The study was carried out at Malaysian Veterinary Institute (MVI) which is located at KM 13, Jalan Kluang, Pulau Kampung Batu Jalan Kluang, 86100 Kluang, Johor. This study is focusing on the building maintenance work which is corrective maintenance that categorized as one of the building maintenance categories. The study also comprises the procedures undertaken for the maintenance work. Some of the procedures are, identifying project location, document submission, material testing and checking requirements, approval of material and types for section properties, dismantle of existing structure, storage and handling and installation of the new structure. Moreover, in this report also find out the structure involves for the maintenance work which is roof and ceiling structure. Not only that, this report also shows of how much this maintenance work is required in order to ensure the safety and comfort to all the building users. Lastly, this report is also consisting of the problems that occurred throughout the period of maintenance work is carried out. Therefore, to address the above objectives there were three method of study were conducted such as observation, interview and document review. Below is the comprehensive explanation for this report.

1.4 Methods of Study

1. Observation – This report is carried out using observation method. Some of the observation includes the progress of work done by the workers and the specifications of the items involved for the maintenance work. The observation basically took about 5 hours on the site to observe some of the works done by the workers. All the data and pictures were being recorded by using mobile phone in order to help collecting all the necessary information during the observation.

2. Interviews – An unstructured interview was undertaken during the observation. Several respondents such as supervisor, client and workers regarding the procedures of the corrective maintenance were carried out. The questions were being asked spontaneously and took about 20 minutes per session in total. The conversations with the respondents were being recorded using mobile phone and also written in the note book.

3. Document Reviews – Documents such as architectural drawing and standard operating procedures were also have been used as the references in order to gain information. Some of the information obtain from the documents are the dimension of each components, the area of the work involved during maintenance work including method statement. All the documents were received from the site supervisor which is also from Kluang Public Works Department (PWD).

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

The Kluang District Public Works Department (PWD) office was built in 1935. The cost of expenses was borne by the Johor State Government amounting to RM 15,800.00. It is one of the oldest government agencies in Kluang District. Moreover, there were many other government office buildings, including the existing roads, were built by the Kluang Public Works Department which making it an agency that also plays an important role in the rapid development of the country.

Kluang Public Works Department (PWD) is divided into 7 departments which are, Mechanical, Road, Electrical, Building, Facility, Material Survey and Management department. However, this report is focusing on the Building Department since the writer undergoing the practical training under the supervision of Building Department.

The Building Department is headed by a building engineer named Mrs. Siti Norhaslin Binti Mohd Yusof which holds the position of Grade 41 Engineer. She is assisted by 6 Assistant Engineers, an Architectural Officer and a Planner. Each of the assistant engineers holds the position of Grade 29 Civil Engineer. Everyone on the department play an important role in developing the Building Department indirectly maintaining the good name of Kluang PWD.

Since the establishment of PWD until now, Kluang District PWD has been led by a total of 31 District Engineers and is now worn by Ir. Mohd Zaharudin Bin Ayep. Therefore, in forming a quality Government Department, the Kluang District Public Works Department has laid down its quality policy and objectives as principles at all times that meet the requirements of ISO 9002.

2.2 Company Profile

Figure 2.1: Public Works Department (PWD) logo

Source: Icon Ape (2020)

Table 2.1: Kluang Public Works Department (PWD) profile information

Name of Company	Kluang District Public Works Department (PWD).
Date of Incorporation	In the year of 1935.
Building Number	PWD-CJ 322
Registered Address	2a, Jalan Ibrahim, Kompleks Pejabat-pejabat Kerajaan, 86000 Kluang, Johor.
Company E-mail	kluang@jkr.gov.my
Telephone	07-7724040/41
Fax	07-7744030

Source: Kluang PWD company profile document

2.3 Company Organization Chart

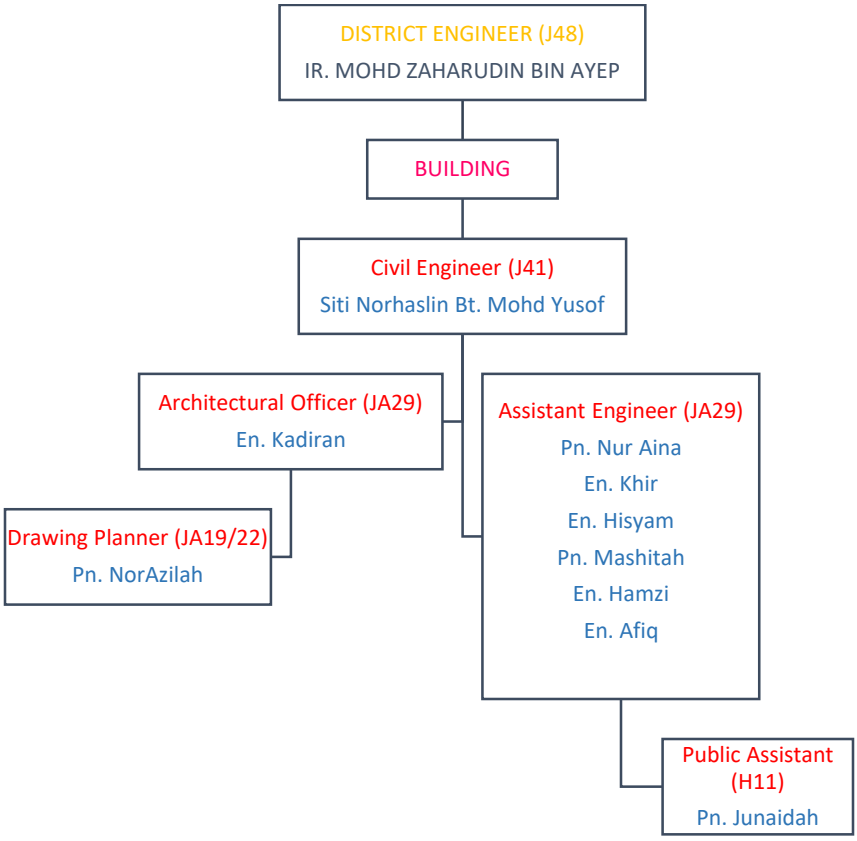

Figure 2.2: Building Department of PWD Kluang organization chart

Kluang Public Works Department (PWD) consists of 7 departments in the organization. In this report, the organization chart is focusing on the Building Department since the writer is undergoing the practical training under the supervision of the department. PWD Kluang is led by the District Engineer, Ir. Mohd Zaharudin Bin Ayep. He has held the position of Grade 48 Engineer for a year. He is also assisted by a Civil Engineer who is a Grade 41 Engineer, Mrs. Siti Norhaslin Bt. Mohd Yusof. Under the supervision of Mrs. Siti Norhaslin, she was assisted by an architectural officer, 6 assistant engineers, a drawing planner and a civil assistant. Each respectively holding the positions of Civil Engineer Grade 29, Civil Engineer Grade 19/22 and Civil Assistant Grade 11.

2.4 List of Projects

2.4.1 Completed Projects

Kluang District Public Works Department (PWD) has done a lot of huge projects over the past few years until now. It shows that this agency has contributed a lot in the development of the country. Therefore, Table 2.2 below shows some of the completed projects by PWD Kluang for the past 10 years.

Table: 2.2: List of completed projects

NO	PROJECT TITLE	PROJECT VALUE	START DATE	COMPLETION DATE	PROJECT DURATION	CLIENT
1	Proposed repair and upgrading of sports facilities at Tunku Mahkota Ismail Sports School (SSTMI), Bandar Penawar Johor (Phase 1)	RM11,076,978.40	26th June 2013	21st September 2014	52 Weeks	Tunku Mahkota Ismail Sports School (SSTMI)
2	Upgrading works of the sports track at the Kluang Johor Sports Complex	RM2,200,000.00	04th November 2018	06th April 2019	22 Weeks	Kluang Johor Sports Complex
3	Proposal to design, construct and complete a Kluang Syariah Court building on land ptb 11336, mukim bandar Kluang	RM25,970,000.00	14th February 2016	13th February 2018	24 Months	Mahkamah Syariah Kluang
4	Repair and upgrading of facilities at Intan Kampus Wilayah Selatan (IKHWAS), Kluang Johor	RM1,663,483.00	09th July 2019	25th November 2019	20 Weeks	Intan Kampus Wilayah Selatan (IKHWAS)
5	Proposed slope repair and related works at Tun Hussein Onn National Secondary School, Kluang Johor	RM1,104,910.00	10th February 2015	09th February 2016	52 Weeks	Tun Hussein Onn National Secondary School

Source: Kluang PWD Previous Project Contract Document

2.4.2 Project in Progress

There were also some projects which still in progress. Table 2.3 below shows some list of the projects done by PWD Kluang that were still in progress.

Table 2.3: List of projects in progress

NO	PROJECT TITLE	PROJECT VALUE	START DATE	COMPLETION DATE
1	Roof upgrading work at the administrative block as well as other related work at the Kluang Johor Veterinary Institute	RM467,365.50	17th August 2021	22nd November 2021
2	Proposal to build and complete new building of mechanical and manufacturing engineering workshop, electrical and electronic engineering workshop, civil engineering workshop and other facilities at Kluang Vocational College, Kluang Johor (smv conversion program vocational college 7 pilot colleges)	RM9,040,211.00	5th September 2019	30th December 2021
3	Upgrading the dental clinic building in Kluang, Johor	RM5,569,012.80	30th June 2020	29th December 2021

Source: Kluang PWD Project Contract Document

CHAPTER 3.0

CASE STUDY OF PROCEDURES FOR CORRECTIVE MAINTENANCE

3.1 Introduction to Case Study

In this report, the corrective maintenance works for the project of Roof Upgrading Work at The Administrative Block as Well as Other Related Work at The Kluang Johor Veterinary Institute have been selected. The administrative block was a two-story building with 74 numbers of room spaces in total. It was the main building which was surrounded with hostels, main hall, experimental laboratory and also near to the cow barn, deer cages and goat shelter. The estimated cost for this project was RM467, 365.50. The project was started on 17th August 2021 and also expected to be completed on November, 22 in the same year. However, the project was delayed due to the pandemic Covid-19 and also the movement control order from the government. Because of that, the project is still in progress until now. The client for this project was Malaysian Veterinary Institute (MVI). They have made their report submission to Kluang District Public Works Department (PWD) as consultant to undergo further action for the maintenance work.

3.1.1 Site Location

Figure 3.1: Location of the project from the map view

Source: Maps (2021)

3.1.2 Site Plan

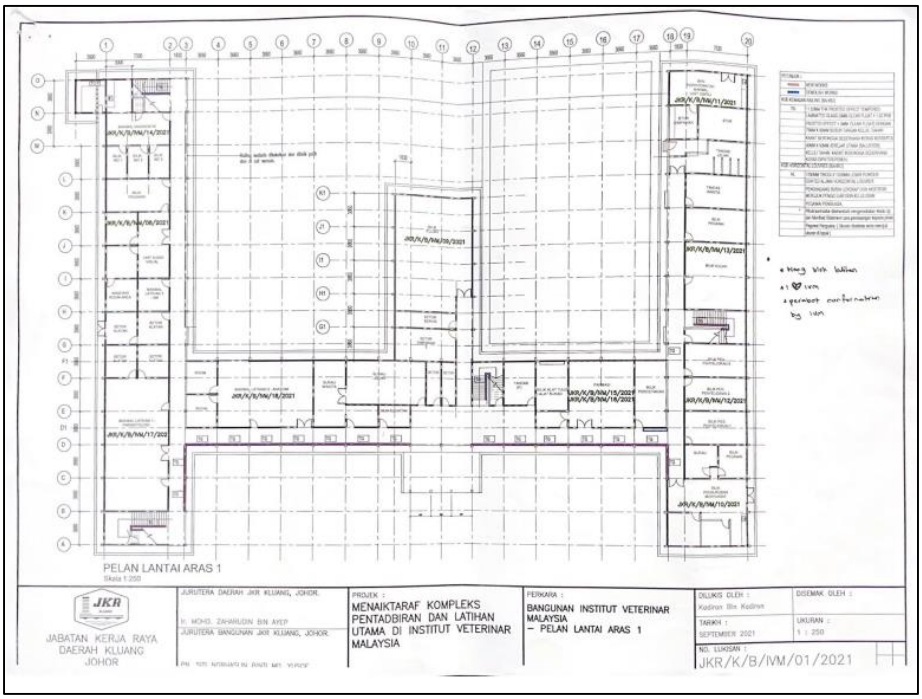

Figure 3.2: First floor plan

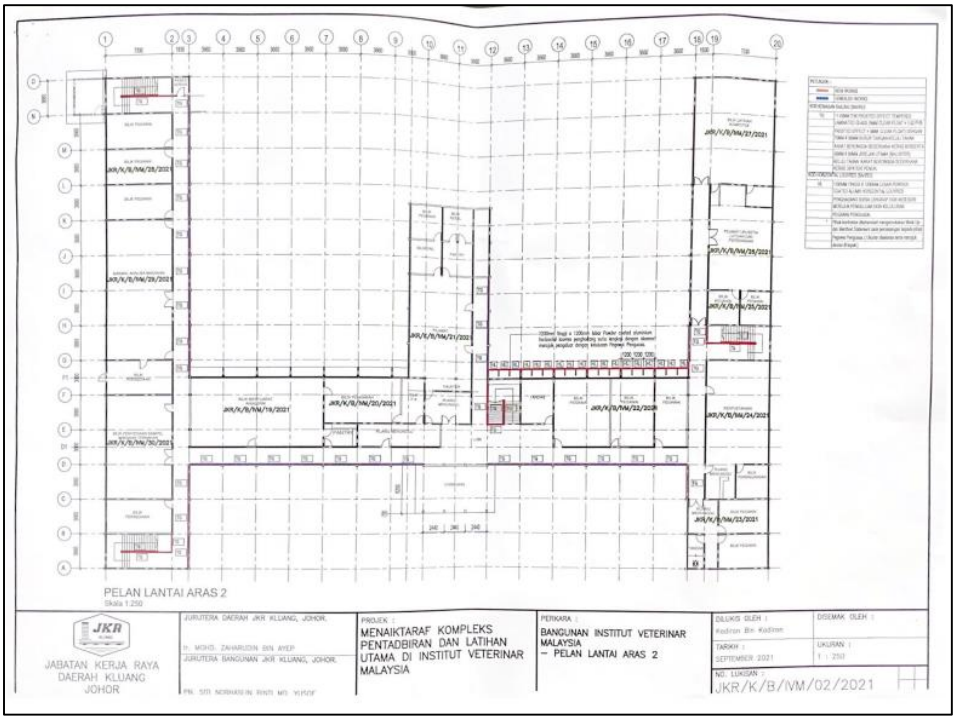

Figure 3.3: Second floor plan

Figure 3.4: View of the Malaysian Veterinary Institute (MVI) administrative block from the front

3.2 Identify the Procedures of the Corrective Maintenance for Commercial Building.

The corrective maintenance work is carried out systematically according to the specific procedures to make sure all the work is done correctly. These procedures are also use as a guideline and helps to avoid dissatisfaction from all parties. Figure below shows the flow for the corrective maintenance procedures for the commercial building.

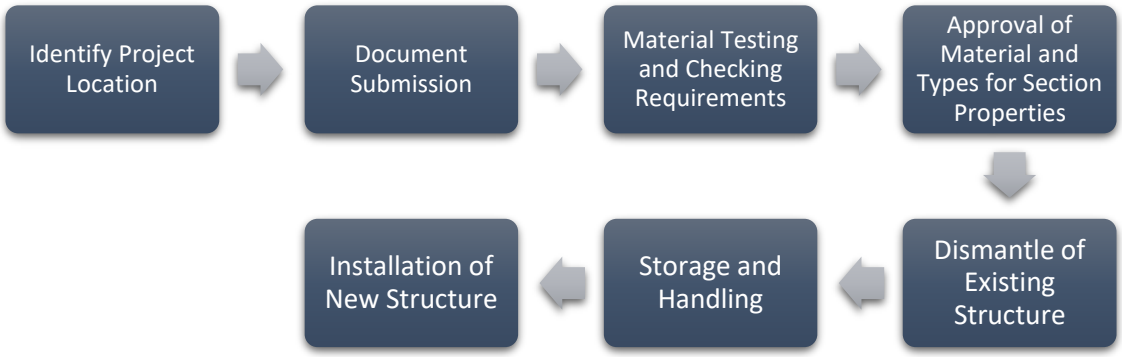

Figure 3.5: Procedures for corrective maintenance work

3.2.1 Identify Project Location

Corrective maintenance work procedures begin with the process of identifying project location. In this process, the Public Works Department (PWD) and the appointed contractor by PWD with the client will make a site visit to determine the location of the project. They will make a detailed inspection at an early stage in determining the location involved in the maintenance work according to the client's requirements. For this project, the location involves for the corrective maintenance work is the roof and ceiling for the administrative block of the Malaysian Veterinary Institute (MVI). This initial process is very important to be carry out to prevent the occurrence of addition works due to the error of the workers performing work at locations that is not specified in the scope of the required maintenance work. Figure below shows some location involved for the project.

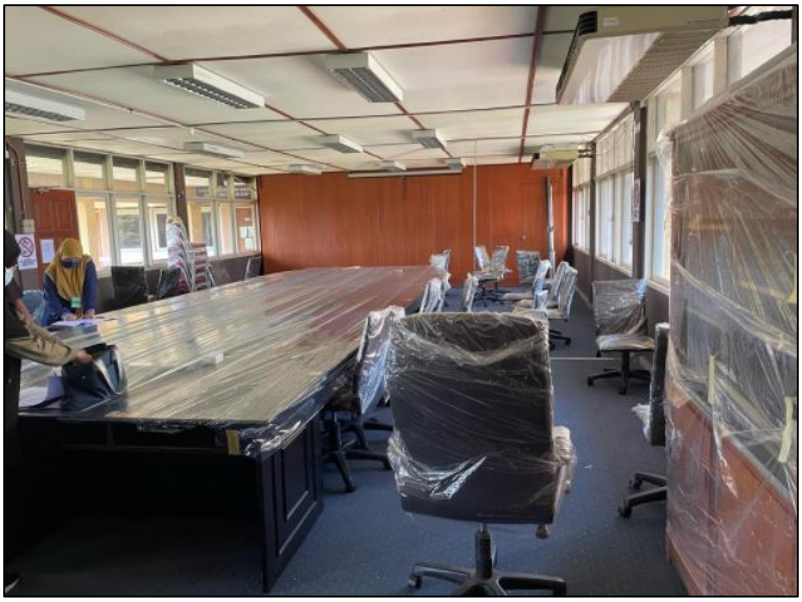

Figure 3.6: Meeting Room Ceiling

Figure 3.7: Staff office ceiling

Figure 3.8: Inspection work on the MVI administrative block roof

Figure 3.9: MVI administrative block roof

3.2.2 Document Submission

The next procedure for the corrective maintenance work is document submission. After the location of the project has been identified, the contractor need to submit all the necessaries document for the project to the Public Works Department (PWD) for approval. The document must contain the work related to the project as well as details indicating the qualifications of the selected material prior to installation. For this project, the contractor need to submit the documents about the qualification of material of roof, trusses and ceiling structure that have been choose from their appointed provider as well as the installation stages for the project. Some of the documents includes, fabricator and installation works, technical specification, method statement and quality assurance.

After the submission of the document is made, the PWD will examine the document before making an approval. Each material selection made by the contractor will be referred according to Public Works Department Standard Specifications for Building Works. For example, all trusses must be assembled by a licensed fabricator under the supervision of a CIDB-registered Superior Officer, and installation work must be completed and overseen by qualified personnel holding valid CIDB certificates.

3.2.3 Material Testing and Checking Requirements

After that, this corrective maintenance work need to go through the next procedure which is material testing and checking requirements. In this process, the materials that have been choose by the contractor like roof trusses and roofing sheet will be tested in the lab and will be checked before it can be install. Some of the tests are tensile test, bend test, chemical composition of base metal test and point bending test for the roof trusses members. For the metal roofing sheet, the thickness of the roof will be checked. All the test results will be submitted to the PWD for approval or rejection referring to the PWD Standard Specifications for Building Works. Therefore, the figure below shows the picture while checking the thickness of the roofing sheet.

Figure 3.10: Checking the thickness of roofing sheet by using Vernier caliper

3.2.4 Approval of Material and Types for Section Properties

Next, the corrective maintenance procedure continued with the approval of material and types for section properties. In this stage, the PWD will decide whether to approve or reject the type of material selected by the contractor. The client also has the right to determine the material and the types for the section properties after consulting the opinion from the PWD. After all items have been approved, it then can be sent to the site.

In this project, the material selection for the corrective maintenance work involving the roof and ceiling structure is metal deck sheet roofing, steel roof trusses and aluminum strip ceiling. Besides, for the section properties types for this project, the PWD and the client have approved and agreed to select the red color of metal deck sheet roofing and dark brown aluminum strip ceiling.

Figure 3.11: Red metal deck sheet roofing

Figure 3.12: Steel roof trusses

Figure 3.13: Dark brown aluminum strip ceiling

3.2.5 Dismantle of Existing Structure

The next procedure of the corrective maintenance is dismantling of the existing structure. The dismantle work is carry out from the bottom to the top of the building. In this project, it is start with dismantling of the existing ceiling structure. It is then proceeded with dismantling the roof insulation foam and finally dismantling the existing roof trusses and roofing sheets. Figure below shows the picture after the existing structure have been dismantle.

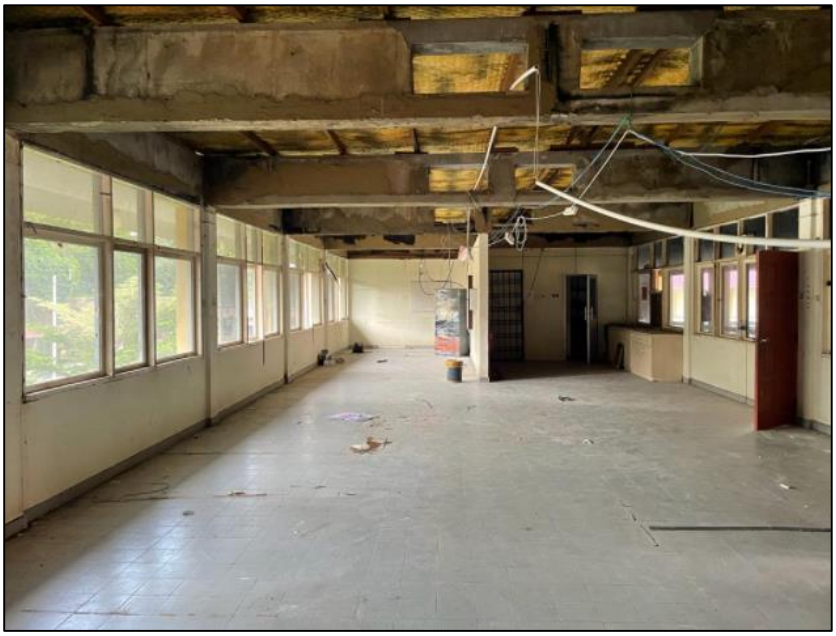

Figure 3.14: Staff office view after dismantling the ceiling structure

Figure 3.15: Meeting room view after dismantling the roof insulation foam

Figure 3.16: View from the top after dismantling the roof trusses and roofing sheets

3.2.6 Storage and Handling

Storage and handling is the next procedure for the corrective maintenance work. In this stage, it shows an overview of how the materials used for this project are being stored and handled. For the storage process, the correct storage method is required. For example, materials for this project such as roof trusses are stacked in one place before being covered with canvas. This is intended to prevent the roof trusses from rusting due to exposure to excessive water and air. Furthermore, for handling work, correct lifting equipment is also very important in ensuring the safety of the material and preventing it from damage. It can be seen from this project that the metal deck roofing sheets is being lifted by the crane with close supervision.

Figure 3.17: The roof trusses are stacked before being covered with canvas

Figure 3.18: Metal deck roofing sheets are lifted using a crane

3.2.7 Installation of New Structure

Lastly, the corrective maintenance work will undergo the final procedure which is installation of the new structure. For the installation work of the new structure for this project, it started by installing the roof trusses first. It was then proceeded with the installation of metal deck roofing sheets. Finally, the aluminum strip ceiling will be installed on the part that has already been installed the roof structure. This installation process is done in reverse with the dismantling work. The reason is to prevent the newly installed ceiling from being damaged due to exposure to rain and heat on its surface. Figure below shows the picture of the project after being installed with the new structure.

Figure 3.19: View of the project after being installed with the new roof trusses

Figure 3.20: View of the project after installation of the new metal deck roofing sheets

Figure 3.21: View of the project after the installation of the aluminum strip ceiling

3.3 Determining the problems that occurred while conducting the maintenance work and how to overcome it.

In the world of development, there will inevitably be problems and difficulties while carrying out construction work. Just like this project, there are also problems identified that can lead to harm not only to the individuals involved but also to the equipment around the construction site. However, every problem must have a solution. Therefore, this section will tell about the problems that occurred while conducting the maintenance work and how to overcome it.

3.3.1 The furniture in the building is exposed to rain and sunlight.

The first problem that identified while conducting the maintenance work is the furniture in the building is exposed to the rain and sunlight from outside. This problem occurred when the work of dismantling the roof structure was carried out. This is because when the roof structure has been dismantled, it will leave the space open on the top while allowing rain and sunlight to directly hit the furniture in the building. This will also cause the furniture to be damaged and require a cost to replace with the new furniture. However, this problem was solved by using thick wrapping to cover the furniture in the building. Indirectly, the wrapping helps to prevent rainwater and sunlight from hitting the surface of the furniture and ensure its safety and quality.

Figure 3.22: All furniture is being wrapped to avoid the rainwater and sunlight from hitting the surface of the furniture

3.3.2 Some workers doing their job on the incorrect places.

The next problem that identified while conducting the maintenance work is that there are some workers who are doing their job on the incorrect places. In this project, the worker is doing his job on the top of the meeting room table surface. This matter has caused dissatisfaction from the client after finding out about the matter. Therefore, to overcome this problem, the PWD has met with the contractor to give warning about the misconduct of their employees. Not only that, the PWD has also made regular site visits to ensure that the same thing does not happen again and give satisfaction to the client.

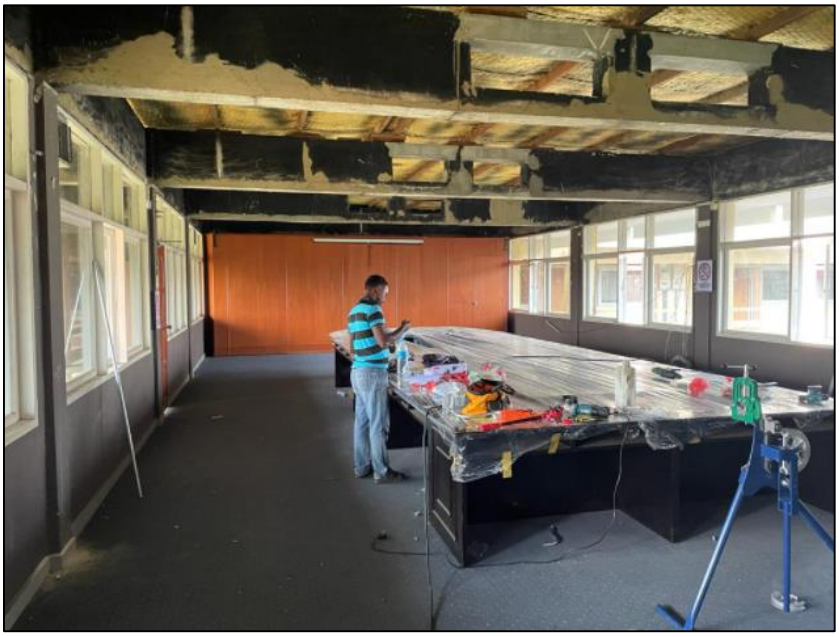

Figure 3.23: The fault of the worker doing the work in the incorrect place

CHAPTER 4.0

CONCLUSION

In conclusion, this report study helped to determine and explain the procedures of the corrective maintenance work for commercial building. Generally, each job done in any construction project will go through its own procedures. Just like the corrective maintenance work which is also undergoes the work process according to the procedures that have been set to enable the maintenance work to be carried out smoothly. In this case study, the structure involved for the corrective maintenance work is the roof and ceiling structure for the administrative block at the Malaysian Veterinary Institute (MVI). During the course of this corrective maintenance work for this project, the prescribed procedures were seen to have a great impact in this project. The procedures include, identifying project location, document submission, material testing and checking requirements, approval of material and types for section properties, dismantle of existing structure, storage and handling and installation of the new structure. With this orderly arrangement of procedures, this project can be carried out according to the time given and ultimately meet the needs and satisfaction of the client. However, there are also some problems that occur during this corrective maintenance work is being carried out. But, every problem must have a solution. Therefore, it is important to follow the procedure of any construction work especially the corrective maintenance work to ensure the productive results and satisfy all parties involved.

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