DEPARTMENT OF BUILDING SURVEYING
FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

THE WORK FLOW OF BUILDING INSPECTION AT TRAINING NURSE HOSTEL (BLOCK E)

NUR FARHANAH BINTI MA'ZIN
2015881846
DIPLOMA IN BUILDING SURVEYING

PRACTICAL TRAINING REPORT
MARCH – JULY 2018

ABSTRACT

Practical training at the Jabatan Kerja Raya Muar Johor. The JKR Muar have a few department which is building department, road department, facilities department, quantities survey and administration. This company is function is to conduct the construction project, monitor the federal road and maintain the building. This also learn about the general inspection on the building that used by the building surveyor. On the inspection there are learn a few defect that on the building such as the crack on the wall, and concrete spalling. From this, its can identify the pattern, and possible causes of the defect. The case study area is located at Training Nurse Hostel (Block E), Sultanah Fatimah Specialist Hospital. The objective of the inspection on the building is to identify the causes of defect on building structural, to inspect and evaluate the defect on building structural, and the proposing the repair structure to be submitted by JKR Muar and JKR Johor. This learn about the flow chart for the building inspection on the Training Nurse Hostel (Block E). The inspection is involved the professional team such as Geotechnics Engineering Department, and Civil and Structure Engineering Department.

ACKNOWLEDGEMENT

First, I want to grateful with ALLAH S.W.T because give me chance and strength to do this task. Besides that, I'm also want to thank you Jabatan Kerja Raya Muar because give me chance for me to practical on this company. This is give me opportunity to learn a lot of the on the construction, and maintenance.

The most important appreciate that I want to give to my lecturer En Khazli Aswad Khalid that give me some advice for complete this report I want to thankfully to En. Azizul Azham which is the supervisor in charge that help me to give the information on the case study.

I'm want to thankfully to the staff of the company, worker and supervisor that give co-operation during the research and give a lot of input and information to complete the report. Last but not least, I'm would like to thanks to other friends and the officer of JKR Muar that give me more opportunity to learn many thing on this practical training for four months. They also give me the information about the case study for the report and support from me. I also not forget about parents that give me moral support and encouragement.

Sincerely,

Thank you.

TABLE OF CONTENT

CHAPTER 3 : CASE STUDY

CHAPTER 4 : PROBLEM AND ECOMMENDATION

LIST OF TABLE

LIST OF FIGURE

LIST OF CHART

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In this chapter is explain about the company background that should know. This chapter content about the background, the organization chart, the view of the building and the scope of work. There are method that can be used for collect the information such as interview with the staff, collect information on the info board and the internet

In the company, there have a few departments that responsible for specific work such as maintenance, construction, financial and road construction. This is make easy to manage the project which their have the person that responsible for the work.

In this chapter is explain about the background and history of JKR Muar, the organization chart, the department that have in JKR Muar, the scope of work in JKR Muar. This is also show the view and location of JKR Muar that make easy to identify the location.

1.2 COMPANY BACKGROUND

Figure 1.1 Jabatan Kerja Raya Muar

JKR Muar is office building which is located at Jalan Othman, Taman Sri Tanjung, Muar, Johor. JKR Muar is strategically which is located near Pos office and Police Station. Initially the JKR Muar was headed by Datuk Mat Salleh bin War which is tasked with leading the Department of Survey, Land and Works of Johor. Activities and functions of the JKR Muar began from 10 April 1887 which is the date of Datuk Bentara Luar Johor began his task of developing Modern Muar.

Previously, the JKR Administration, Muar, was located at the Sultan Abu Bakar Building, Jalan Petri Muar, from 1922 to 31.05.1974. JKR Muar has moved to its own Building at Jalan Othman Muar Johor today at 01.06.1974. The building was formerly a Muar Lodge.

On JKR Muar have six department which is administration department, financial department, building department, quantity surveying department, building department, road department and facilities department. The head of JKR Muar is Ir. Rahmat Bin Rasib which is district engineer.

1.3 COMPANY SUMMARY DETAIL

The table show the important data of this company. It is details of company to make easy to understand.

Table 1.1: Summary Detail of JKR Muar

JABATAN KERJA RAYA MUAR	
Building Owner	Jabatan Kerja Raya Muar (JKR)
Building Address	Jalan Othman, Taman Sri Tanjung, 84000 Muar, Johor
Building Type	Office Building
Building start operation	1 June 1974
No of storey	2 storey
Head of JKR Muar	Ir. Rahmat Bin Rasib

1.4 VISION, MISSION AND OBJECTIVE

1.4.1 Vision

We will be provide a world class service and center of excellence in asset management, project management and engineering for the national infrastructure development based on creative and innovative and latest technology

1.4.2 Mission

The JKR's mission is to contribute the development of the country with:

1) Help out customers realize basic information and deliver services through cooperation as a strategic partner.

2) Evaluate our processes and system to deliver consistent services outcomes.

3) Provide effective and innovative assets and project management services.

4) Strengthen existing engineering competencies.

5) Develop new human capital and competence.

6) Prioritize integrity in providing services.

7) Promoting harmony with society.

8) Preserve the environment in services delivery.

1.4.3 Objective

To provide infrastructure for the ministry to meet the nation's development policy by focusing on:

1) Deliver 100% of projects according to agreed schedule with variant of 10%

2) Completing 100% of the project at cost approved with variance of 10%

3) Towards product that satisfies customer satisfaction to a level greater than 70% (based on customer satisfaction form)

4) Spending 100% of the project's annual budget with a 5%

1.5 LOGO OF COMPANY

Figure 1.2: JKR logo

Logo Description:

The JKR logo reflects all areas of work that have been entrusted to this department. The meanings of objects in the JKR Logo are as follows:

- Black dots on the bottom represent the waterworks as well as reflecting JKR as a dynamic organization.
- The black-thick black stripes symbolize bridge work as well as illustrating the JKR which basically carries out all engineering works.
- The black lining above represents the work of the road which is the responsibility of the JKR to build, maintain and maintain it.
- 14 black lines symbolize building work as well as reflecting 14 states in Malaysia including the Federal Territory.

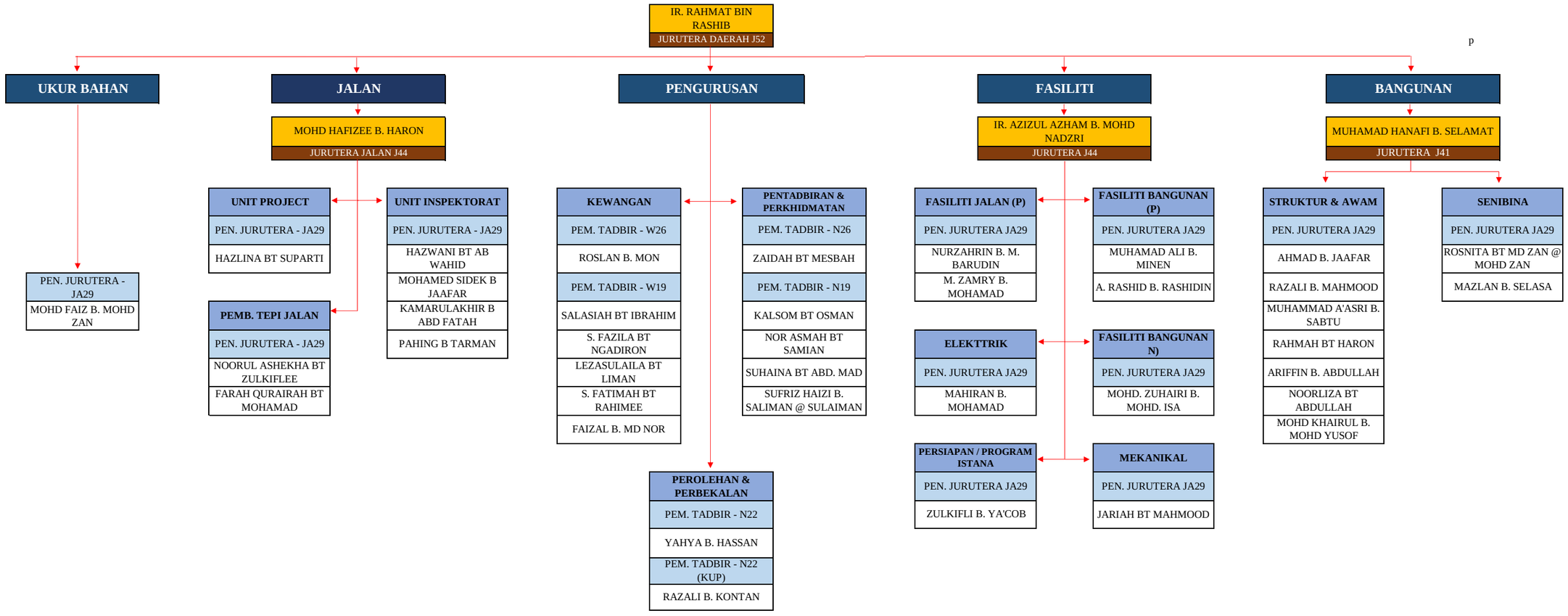
The colours in this JKR Logo may have its own meaning:

Table 1.2: meaning of colour.

COLOUR	MEANING
Yellow	Symbolize maturity or maturity to reflect JKR as the longest established organization in addition to showing the most mature image in achieving its objectives.
Black	Emphasize soundness or unity as a feature among branches in the handling of projects.
Grey	Illustrates the inferiority of the service among the employees in the JKR.

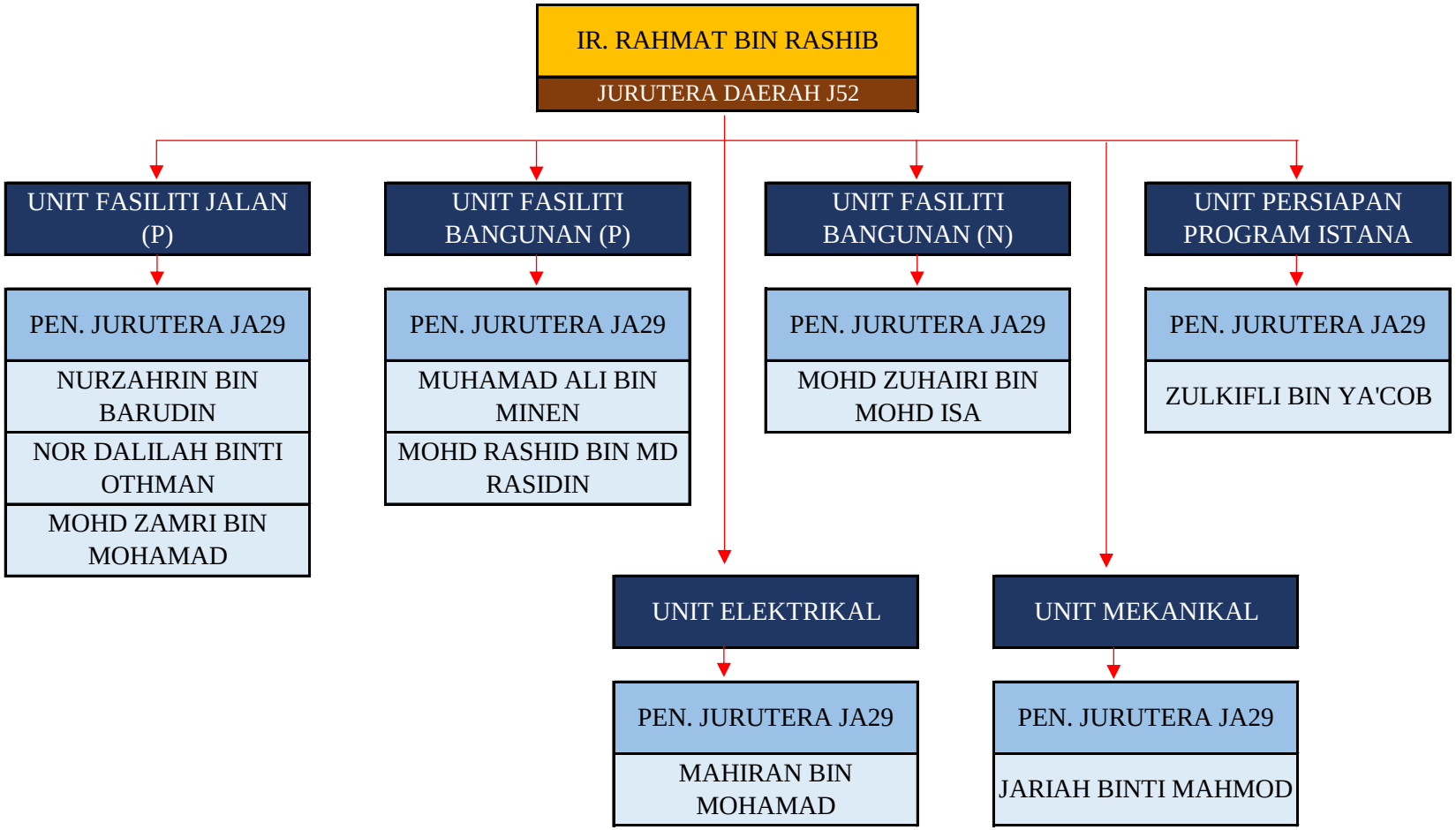
1.6 COMPANY ORGANIZATION CHART

CARTA ORGANISASI JABATAN KERJA RAYA MUAR



1.7 ORGANIZATION CHART OF FACILITIES DEPARMENT

CARTA ORGANISASI BAHAGIAN FASILITI JKR MUAR



1.8 SCOPE OF WORK

Every person has their responsible in their scope of work such as facilities manager and building maintenance. The purpose of scope of work is to detail the tasks and responsibilities and provide an overall understanding of the services to be provided.

1.8.1 Administration and Corporate Department

- Ensure that the outgoing and incoming mail is allocated to the right department within the organisation
- Organise and assist fellow employees with meetings, conferences and direct telephone calls when required
- To communicate with members of the public when an inquiry is made
- Manage and maintain the filing system that has been implemented into the organisation e.g. information systems
- Clerical duties that involve the ordering of equipment, office supplies and other inventories that are required

1.8.2 Building Department

- Plan, monitor and identify the implementation of federal and state project.
- Suggest new design to the building and advice to get some pat of building reconstructed as per the latest technology and design
- Monitor the quality material is used in construction of the building.
- Monitor the progress of construction of the building

1.8.3 Facilities Department

- To monitor the condition of building of ‘istana’
- Maintain the federal and state road
- Maintain and inspect the building from the client report which involved federal and state building
- Prepare the progress report after inspect and related project budget
- To coordinate and monitor the implementation of federal road project

There are a few scope of work for each staff. Every staff has their responsible that they should do.

Table 1.3 Scope work JKR

NO	POSITION	SCOPE OF WORK
1.	District Engineer Ir. Rahmat Bin Rashib	-The head of JKR Muar which is monitor the progress report prject
2.	Facilities Engineer Ir. Azizul Azham Bin Mohd Nadzri	-The head of facilities department and monitor the progress work that involved of maintenance for the building and road.
3.	Building Engineer En. Muhamad Hanafi Bin Selamat	-The head of building department in JKR Muar which is conduct the project involved construction
4.	Assistant Engineer of Mechanical Jariah Binti Mahmod	-Make sure the mechanical system in good condition to ensure the problem. -Check and monitor the mechanical system that related of government building
5.	Assistant Engineer of Electrical Mahiran Bin Mohamad	-Make sure the proper maintenance of electrical, compliance with electrical codes

NO	POSITION	SCOPE OF WORK
6.	Assistant Engineer of Building Muhammad Ali Bin Minen Mohd Rashid Bin Md Rasidin Mohd Zuhairi Bin Mohd Isa	- Inspect the building that report from client -Prepare the report after inspect the client building -Monitor and inspect the building for renovation approval -Maintain the minor defect that happen on the building
7.	Assistant Engineer of Road Nurzahrin Bin Barudin Nor Dalilah Binti Othman Mohd Zamry Bin Mohamad	- Monitor the condition of federal and state road that be use by public -Maintain the road that have defect to ensure no problem for public

1.9 BUILDING VIEW

a) Front view

Figure1.3**:** Front view

JKR Muar

b) Rear view

Figure 1.4 Rear view

JKR Muar

c) Left side

Figure 1.5: Left side

JKR Muar

d) Right side

Figure 1.6: Right side

JKR Muar

1.10 LOCATION

1.10.1 Key Plan

This key plan shows the map of Malaysia where Muar, Johor is located.

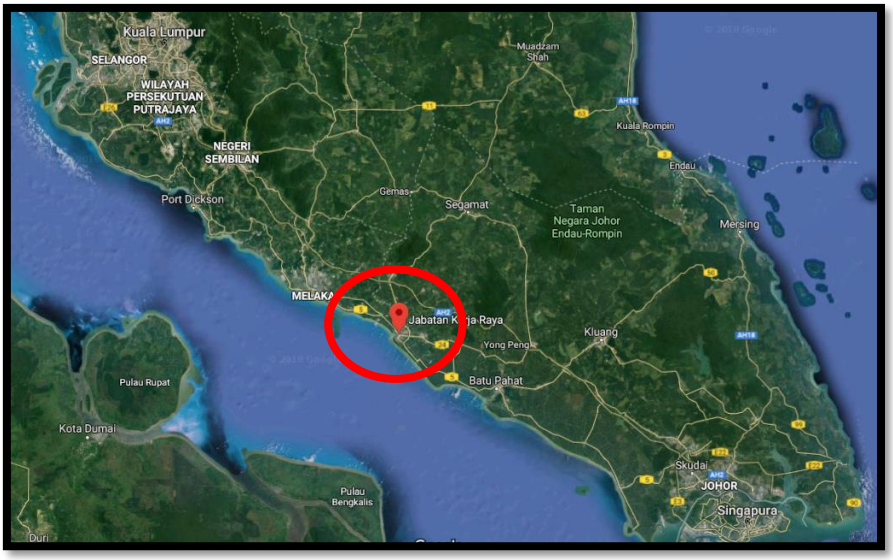


Figure 1.7: Key Plan

1.10.2 Location Plan

The location plan shows the location of Muar District

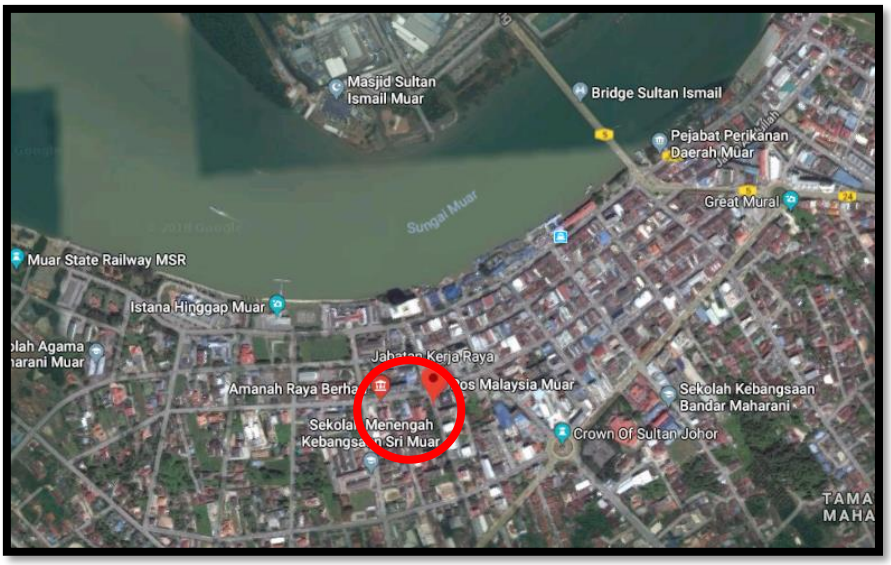


Figure 1.8: Location Plan

1.10.3 Site Plan

The site plan is to show the map of JKR Muar building.

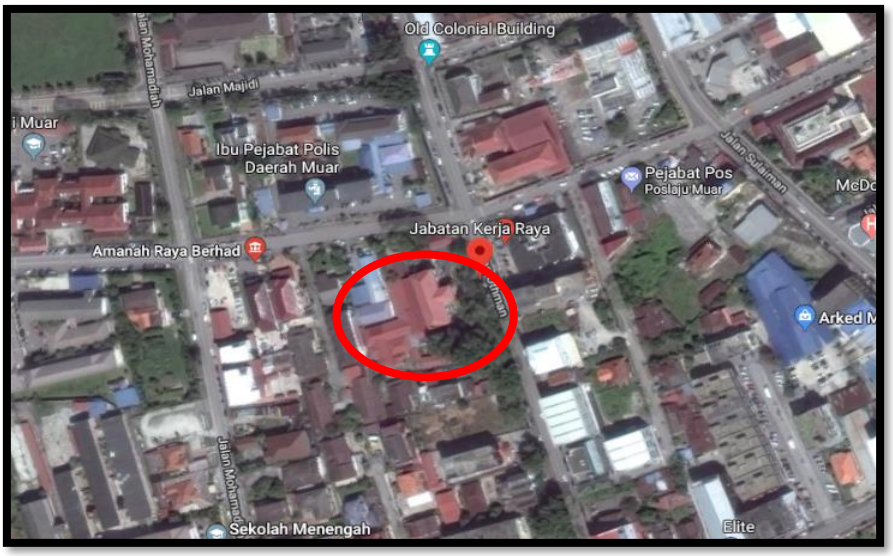


Figure 1.9: Site Plan

1.10.4 Radius 500m

On the radius 500m from JKR Muar which is near with Poslaju office, Police Station, Old Colonial Building, Sekolah Menengah Kebangsaan Sri Muar, Wetex Parade, Istana Hinggap Muar, Local Authority, and Bas Station

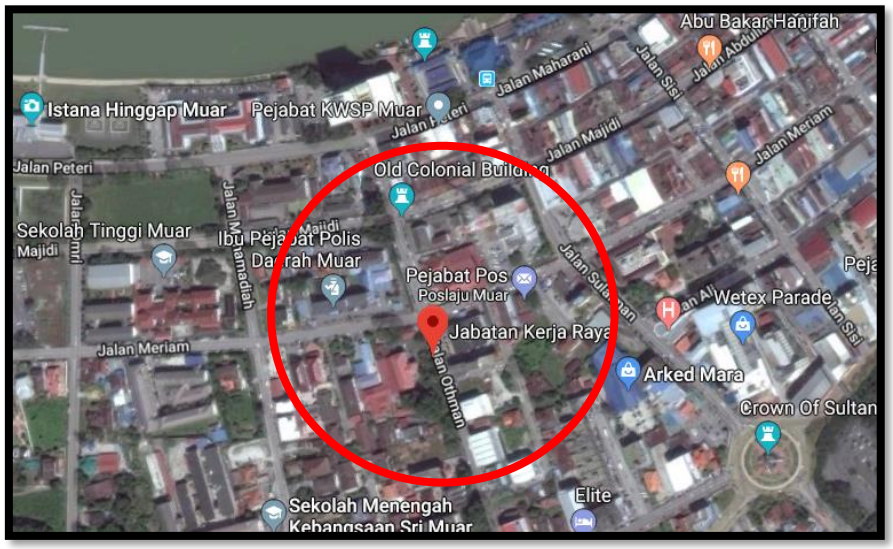


Figure 1.10: Radius 500m

1.11 SUMMARY

From this chapter, know this building background information like name of head JKR Muar, the building address, the history of JKR Muar and the function of JKR Muar. There are a few departments such as building department, facilities department, road department, quantity surveying department, administration department and financial department. Every person has their responsible on scope of work such as facilities engineer and building engineer. This make easy to manage work which they have their scope of work. In this chapter, know the mission, vision and objective for the JKR Muar. This chapter also get learn about the vision and mission that JKR Muar target to achieve for the future.

CHAPTER 2:

LITERATURE REVIEW

2.1 INTRODUCTION

Defect is generally defined as defect in the design, the workmanship, and in material or system used on a project that result in a failure of a component part of a building or structure and cause damage to person or property, usually resulting in financial harm to the owner. An apparent defect has been perceived when it looks wrong, something smells strange, someone heard something, it just felt wrong, and something felt.

Common sources of defect such as lack of maintenance which is failure to allocate sufficient financial resources for maintenance. The changes of use of building also sources of defect appear which is alteration or change without consultation from designer will give negative implication. For example, the implication upon space configuration, fire precautions and increased floor loading.

When an inspection or condition survey is being undertaken, the set of requirements for the particular building type or use will help to set performance benchmarks against which is gauged by reference to the benchmark.

The purpose of condition survey is to give an independent professional opinion on the condition of the properties. Its also provided considerable amount of important data on performance of buildings, component and element. The important of building inspection is to enhance the sustainable maintenance approach for the building or asset, to improve the quality of building, and to retain the function and performance of building.

(Sources: Kevin Barrett, (2009), Defective Construction Work: And the Project Team**)**

2.2 DEFINITION OF BUILDING INSPECTION

A building inspection is an inspection performed by surveyor, a person that is employed by township or county and is usually certified in one or more disciplines qualifying them to make professional judgment about a building by building code requirements. A building inspector may certify as residential or commercial building inspector, as a plumbing, electrical or mechanical inspector who may inspect structure at different stage of completion. Building inspection is inspection that check for defect in property, renovation on building, refurbishment of building or after building has been completed from constructed.

The building inspection is generally cover such as the electrical work on the property which to make sure the electrical requirement that installed is proper. The building inspection also cover the all plumbing and drainage that follow the drawing, the condition of the window, door and any fitting within the home. Its also inspect the condition of the wall, retaining wall, and all the internal and external of the building.

Standard building inspection will report on the condition of property which is not include the estimates for the cost of repairing work that are found on the building. The standard of the building inspection will not report on minor problem or termites were found.

(**Sources**: James Douglas, (2010), Building Surveys and Report)

2.3 THE TOOL AND EQUIPMENT FOR BUILDING INSPECTION

There are a few tools and equipment that can be used by inspector or surveyor to inspect the building. The tools and equipment used to make easy for the surveyor to inspect the building. The purpose of the tools and equipment is to execute a building condition and monitor the building performance in long term duration.

Table 2.1: The type of tools and equipment.

Figure	Tools & Equipment	Function
 Figure 2.1: the measuring tape 7.5 meter	Measuring tape 7.5 meters	To measure the length of defect that appear at the building which is small scale. For example, length of the window and door.
 Figure 2.2: the measuring tape 50 meters	Measuring tape 50 meters	To measure the length that has large scale. For example, to measure the length for the area

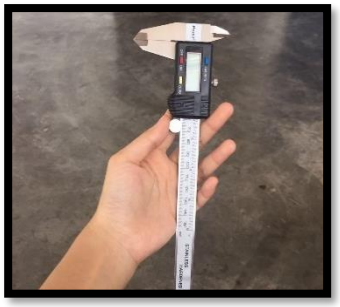
Figure	Tools & Equipment	Function
 Figure 2.3: the digital calliper	Digital Calliper	To measure the thickness and the length of the defect. For example, crack.
 Figure 2.4: the moisture meter	Moisture meter	To detect the moisture content in materials
 Figure 2.5: the 4 in 1 meter	4 in 1 meter	This is used for measuring wind speed, and is a common weather station instrument

Figure	Tools & Equipment	Function
 Figure 2.6: the camera	Camera	To take photo or view at the site to make easy to know the evidence.
 Figure 2.7: the paper and pen	Paper and pen	To take note the data on site such as the sketch of plan, the type of defect on site and the location of the defect.

(**Sources**: Sr. Mohd Nor Faisal Bin Baharuddin, Building Survey Practice Chapter 4 Surveying Tools & Equipment)

2.4 PROCUDER OF THE BUILDING INSPECTION

Thee are a few step that should be follow for building inspection. A surveyor should follow definite procedure when inspecting a property. The procedure that being are:

- A preliminary inspection of the whole property to familiarize the Surveyor with type and layout.
- A detail inspection of the main roof-space and any subsidiary roof voids which are accessible.
- A room-by-room inspection at each floor level starting form the topmost floor.
- Inspection of accessible basements, cellars, and sub-floor areas.
- An examination of the roof structure and coverings from ground level, using binoculars if necessary, and from ladders or through roof voids where accessible.
- An examination of the elevations, including structure and finishes.
- Inspection of the site boundaries, outbuildings and surroundings.
- Examination and testing of drains

(**Sources**: Sr. Mohd Nor Faisal Bin Baharuddin, Building Survey Practice, Chapter5& 6 Preparation & Procedure of Condition Survey)

2.4.1 Preliminary inspection of the whole

The preliminary inspection of the whole is important for surveyor to familiarize with types and layout. In the preliminary inspection the surveyor has to notes general characteristic and description of the property such as detached, semi-D, terrace, and flat.

The preliminary inspection, surveyor also has to notes general lie of the land and the gradient on which the building stand. If gradient abnormal-look on possibility of ground movement/landslip need on structural check on the foundation design.

The surveyor has make a reference to the geological survey map of area to check on subsoil condition such as shrinkable clay, and gravel pit which is surveyor aware and inspection will have armed with this information.

On this section, surveyor has to know ascertain the age of structure to be inspect and also the age of building which is important for deciding some advice to give on a wide range of problem. For the example, pitched roof or flat roof covering, brickwork, timber used, finishes that can be determined by the period during which the building was erected.

2.4.2 A detail inspection on main roof space

In this section of detail inspection on main roof space, the surveyor must fully describe the information detail. For the example the type of roof covering and condition, high proportion of the survey time. The surveyor must ensure there is an access to get into safety. For the example 3 meters ladder will be appropriate as a measure. If not, advice that no inspection was possible and recommends that access is made.

A detail inspection on main roof space, the surveyor must check the material that used and the construction for the roof structure. The surveyor must identify the condition of roof rafter, the condition of the joints such as metal nail plate.

On the inspection at main roof space, the surveyor must identify the condition of water tank if that have at roof top, the material of water tank, the material of tank cover, the ball valve is work or not, the condition of water tank.

The inspection on main roof space, the surveyor must inspect to avoid the wild animal or other wildlife in the roof void. This is to avoid any defect at roof that causes from the wild animal.

2.4.3 Room by room inspection

The room by room inspection, the surveyor must prepare a sketch plan for each floor level to identify the location on site. The surveyor also has marking all openings and the locations of the power and lighting points in sketch plan. The surveyor must take the measure of the area for each floor.

On this section inspection, the surveyor must take a note about the condition of the ceiling, wall and floors. The surveyor also has to test the condition of the doors and window by opening and closing the element. During the inspection too, the surveyor must describe the fixture, fittings, fixed appliance, and electrical points.

In the building, surveyor also has to check the dampness which is test it under the window, all the wall in each floor, exterior and interior partitions, ground floor, skirting, and top floor at the back of gutter. Surveyor also check the surfaces of the plaster work to identify the defect.

2.4.4 Inspection of Accessible Basement and Sub floor area(internal)

On this section, the inspection of accessible basement and sub floor is to conduct a close study on damp-proof courses, ground floor timbers and main wall construction.

For the wall, the surveyor must identify the type of construction and the type of material that used. This also surveyor must identify the type of finishes that used and the condition of the finishes. This for to know the sign of defect will be appear.

For the window and door, the surveyor must take a note about the type of the window and door that used in the building. The surveyor also has to take note about the material of window and door that use which is easy to the surveyor give some suggestion for repair. Surveyor also has to inspect the window and door to know the condition of it in the building.

For the floor, the surveyor must to know the method of the floor construction. For the example timber suspended, solid concrete or suspended concrete beam. If the timber floor, the surveyor must know the damp wall is supported by joists bearing. This also for the solid floor, the surveyor must examine the gaps below skirting all the round the ground floor to see if there any risk of movement in the floor slab. If there cement screed as the finishes, test the floor screed for level of dampness.

2.4.5 An examination of the roof structure and covering from the ground level (External)

On this section, the inspection is mostly paying attention to slipped, cracked or laminated tiles and other signs of deterioration. The surveyor has to inspect the roof structure to know the condition of hip and ridge tile is checked especially to the bedding mortar.

For the example of the roof, the surveyor must know the type of the roof that used on the building and the appearance. The surveyor must include a sketch or photograph to explain the roof layout. The surveyor also has to know the constructed of the roof to easy give some suggestion about the defect that appear on roof.

Other than that, surveyor must take a note about the roof covering material that used and the appearance to get some evidence which is using photograph. On the roof surveyor need to note any defect that appear such as uneven surface.

The surveyor must inspect the condition of the roof which is to know the roof need to maintenance or renew. This is to avoid any problem that appear on the roof such as leaking of roof cover or crack. The surveyor also need to inspect the slope of the roof and drainage system. This inspection is to avoid problem that will appear if not maintain.

2.5 DEFINITION OF CRACK

A crack is a complete or incomplete separation of concrete inti two or more parts produced by breaking or fracturing. Crack are one kind of universal problem of concrete construction as it affects the building artistic and its also destroys the wall's integrity, affect the structure safety and even reduce the durability of structure

Cracks can mean so many things depending on where they are in a structure, what type of structure it is and other things relating to the site's situation and location. Problems that often arise in the building of walls in buildings or spaces are cracks in sections such as walls, columns and beams. The cracks that appear on the building will cause disability.

There are cracks that occur on the walls is structural and non-structural cracks. The cause of structural cracking is the movement of the soil, immediate action should be taken to prevent the strength of the building to be less. Vibrations that occur around the building may also cause structural crack. For non-structural cracks, only occurs on the wall layers only and its shapes are irregular.

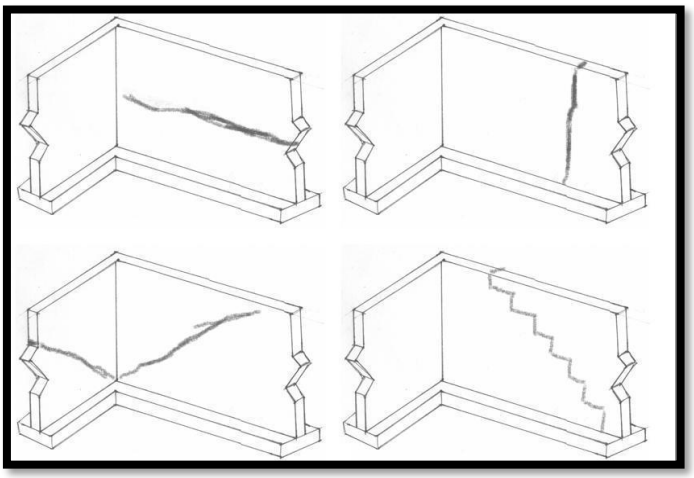


Figure 2.8: the example of the crack

(**Sources**: Crack Information &Statistic, retrieved September from https://www.cirquelodge.com)

2.6 TYPE OF CRACK

Cracks are one of the key things that we are asked to look out for when carrying out a building survey or structural survey. The cracking can take many forms and sizes from hairline cracking to wide open cracks.

2.6.1 Hairline crack

It is normal for plaster to crack from movement and stress, especially in a new home. The wood dries, the vibrations from the construction equipment and other factors play a significant role in this for a brand-new home. Hairline cracks are typically around a 1/16 of an inch wide or smaller, if the crack is bigger than that, than chances are that some other element is the culprit. Some cracks are of equal width at the top and the bottom; other cracks have a V shape and are wider at the top than the bottom and cracks that are the opposite being wider at the bottom than the top.

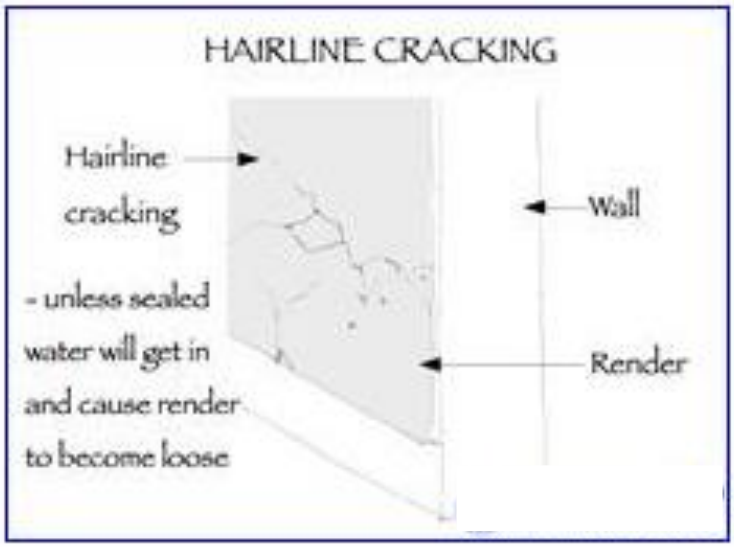


Figure 2.9: The example of hairline crack

(**Sources**: Khlefa Alarbe Esaklu, (1992) Handbook of Case Histories in Failure Analysis, Volume 2)

2.6.2 Vertical crack

An equal width crack found at the corner of a building typically means there is pressure in the building where there is perhaps expansion or contraction from the outer wall causing a pushing movement and a vertical crack.

Vertical crack is appearing in multiple which is one or more area. The vertical foundation crack that tend to appear nearly straight or wandering which is caused by shrinkage and usually low risk. It the cause of shrinkage, it less of concern the if due to settlement.

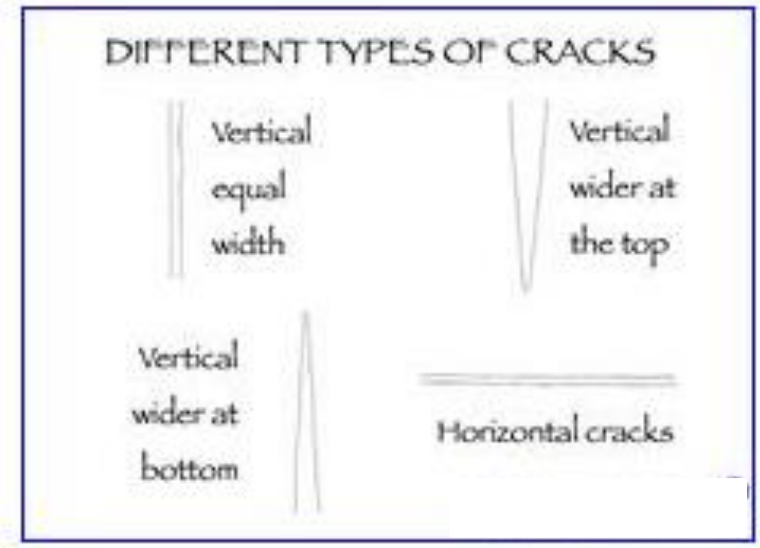


Figure 2.10: The example of vertical crack

(Sources: Type of Crack in Concrete, retrieved December from www.flexomeric.com)

2.6.3 Diagonal crack

Diagonal cracking is an inclined crack beginning at the tension surface of a concrete member. In addition to diagonal cracking caused by external effects, it can also occur from internal problems. Diagonal shrinkage cracks can occur in a concrete wall due to improper mix or improper curing at the time the concrete was set in place.

Concrete walls tend to display vertical cracks but settlement or frost heaving at a corner of a concrete wall can produce diagonal cracks or breaks in that location. Steep diagonal cracks may also appear in concrete foundations due to unusual point loads that exceed the compressive strength of the concrete.

Figure 2.11: The example of diagonal crack

(Sources: Diagonal Crack in Foundation and Wall, Retrieved March by https://civildigital.com)

2.6.4 Horizontal crack

Horizontal cracks in walls are much influenced by expansion and contraction of a slab, deflection of a slab, and thermal effects. The crack is horizontal, it might mean there's a more serious problem such as severe foundation shifting or water damage. Surface-blemish cracks can often be repaired with drywall putty, sanding tools and a fresh coat of paint. More severe cracks usually require professional help to determine the exact cause and might include some reconstruction to prevent further damage.

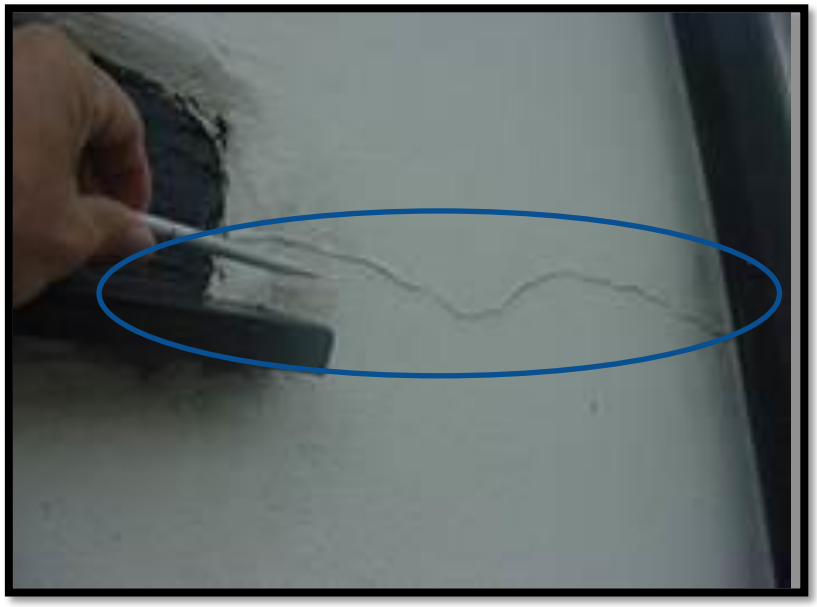


Figure 2.12: The example of horizontal crack

(Sources**:** R. Springenschmid, (2014), Thermal Cracking in Concrete at Early Ages)

2.6.5 Stepped cracking

Stepped cracking is normally being in brickwork and does indicate that the weaker mortar has cracked rather than brick itself. It is when the brick has cracked that have a problem usually.

Stepped crack is usually follow the mortar joints and also the corner of building. Stepped crack usually occurs through wall movement which is related to the foundation movement including subsidence

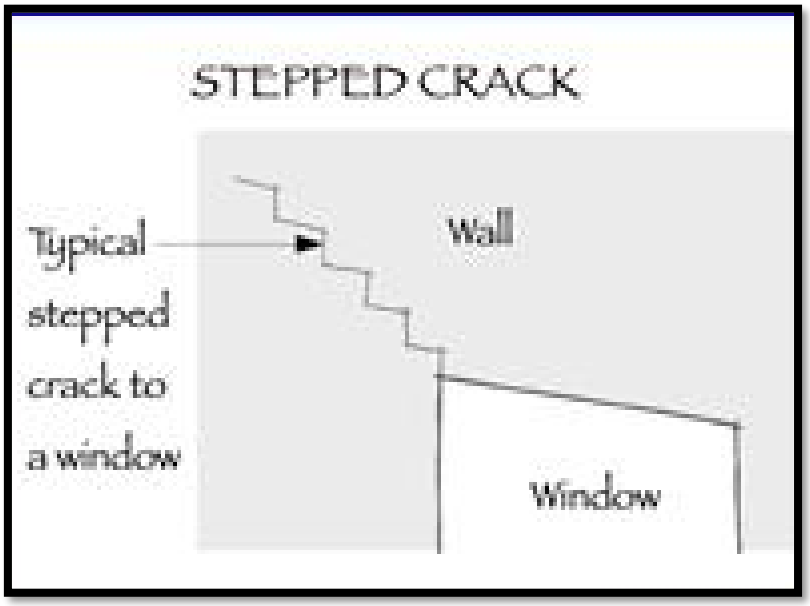


Figure 2.13: the example of stepped cracking

(Sources:, J.W Williams (2002), Old-House Journal)

2.7 CONRETE SPALLING

Concrete spalling is type of defect that usually appear on the building. Concrete spalling normally seen in a concrete slab or a layer of concrete in location that have colder climates. Concrete spalling also knows as the concrete scaling**.** Concrete spalling is the type of defect that administered in harder concrete structure. The concrete will slowly have broken down into small flakes.

2.7.1 Concrete Spalling by Corrosion

Concrete spalling is caused by corrosion of the steel reinforcement bars embedded on concrete matrix. The concrete spalling also can be caused by the ferrous element either fully or partially embedded in structure. There are a few building elements that causes common of damage. For the example of building element is handrail, metal pipes and structural I-beams.

Corrosion of the reinforcement steel is common causes of spalling of concrete structure. Steel reinforcement is used in concrete to provide the strength of the element which is high in compressive strength. One of the principle of reinforced concrete is high alkaline content of concrete passivates and protect embedded steel from corrosion.

Figure 2.14: the example of concrete spalling by corrosion

2.7.2 Prevention Of The Spalling On Concrete

1. Corrosion protection is provided the amount of concrete cover the protecting the steel reinforcement in the concrete.

2. The preventing is usually can be done at outset of the concrete mixing which is used the air-entrained concrete.

3. To prevent the spalling has to making sure to apply water-repellent sealer after slab is cure which is most essential ingredient needed to prevent spallation.

(Sources: Spalling of Concrete-Causes, Prevention and Repair, Retrieved February from https://civildigital.com)

2.8 CONCRETE DELAMINATION

Delamination of concrete is the serious problem that should need attention. Delamination is knowing as the area that the concrete is not properly bonded with the reinforcing steel. Delamination is the failure for composite materials and steel. The resulting of the delamination at the surface that run parallel to the surface are due to corrosion at the reinforcing bar at the top or below the slab. Delamination is similar to blister that delaminated the area of surface mortar

Delamination area that separated from underlying concrete can be leave a hole in the surface. Its also can leave a resemble spalling which can make the reinforcement bar in the concrete is corrosion. A delamination survey can be conducted by sounding which is dragging a chain across the surface and also by tapping the surface with the hammer which is for follow the hollow sound. The delamination is can be repairing by patching or grinding and overlaying with the new surface.

Figure 2.15: the example of delamination

(Sources: Nayef Ghasem, Redhouane Henda , (2009,)Principles of Chemical Engineering Processes)

2.8.1 Causes of Concrete Delamination

The delamination can be happen in any building. The concrete is content the cement and aggregate which is follow the ration that suitable for the building. The natural settlement causes the excess mix water and entrapped air which that to be displaced.

If the finishing of the operation start prematurely and close or seal the surface before the bleeding is complete, the can cause the air or the water is trapped in the densified surface mortar. The concrete that harden, the subsurface are void create weakened below the surface than eventually detach during used the slab.

Figure 2.16: the slab surface contain blister

Figure 2.17: the example delamination on floor

2.8.2 The Prevention of the Concrete Delamination

Delamination is the serious problem that should be avoid before its appear. There are a few step that can follow to avoid the delamination

1. Don't seal or close the slab surface that too early. This is the bleeding on the surface must be complete before the starting the finishing work is operate which is to close the surface. Should be aware the sticky mixers with high cementitious or the sand content tend to bleed more slow

2. Don't finish slab placed on imperious surface too early. This is because the concrete is placed impervious subbase. The blend water that rise to the to because it can't exit out of slab bottom.

3. Do take precaution when finishing if the concrete is all entrained. The delamination will be less potential if the surface was a lighter steel-trowelled finish and broom finish which is slip resistance is a concern.

4. Do warm the concrete or use the small doses of set accelerator which to promote the more uniform setting of the mix. This is because to make the concrete is easier to judge for the timing of final for the finishing of the surface. This is to avoid the delamination that happen on the slab.

(Sources: Mark G. Alexander, Hans-Dieter Beushausen, Frank Dehn, Pilate Moyo, (2008) Concrete Repair, Rehabilitation and Retrofitting II**)**

2.9 SUMMARY

For this chapter, the references that be use is books, journal, newspaper and magazine. For the chapter, there are many information that can be fine from the journal, book and internet. In the literature review too, the information is good to add a knowledge. On the building there are many types of crack that can be appear from any cause. For the example of cause is vibration surrounding of the building and overload in the building. In this chapter is learn about the inspection on the building. Inspection of the building is important to make sure the building can be use in long- term. There are a few steps that surveyor should know before inspect the building. After the inspect on the building, the surveyor will give some advice or suggestion to the owner of building about the repairing the defect on the building. This make easy to owner to do repairing work on the defect.

CHAPTER 3:

CASE STUDY

3.1 INTRODUCTION

On this chapter is about the Sultanah Fatimah Specialist Hospital. This hospital is the third hospital that important in Johor after Sultanah Aminah Hospital and Sultan Ismail Hospital. This hospital also be references for the Batu Pahat, Tangkak and Segamat. On this chapter will introduce about the building background of the Sultanah Fatimah Specialist Hospital.

For the case study, the building is the Training Nurse Hostel (Block E) which is located at behind the hospital. The block E building function is to be the hostel for the nurse that training at this hospital. For a while the hostel for a few problem on the building

In this case study, learn about a few defect that can be identify in the building. It also can learn how the inspection should be done from the person in charge. this chapter also learn about the flow chart of building inspection for the building under JKR Muar.

3.2 BUILDING BACKGROUND OF CASE STUDY

Figure 3.1: Training Nurse Hostel (Block E).

Sultanah Fatimah Specialist Hospital was build around 1990 at Jalan Petri, Muar and know as Government Dispensary. This specialist hospital is the third hospital that important in Johor after Sultanah Aminah Hospital and Sultan Ismail Hospital. This hospital also be references for the Batu Pahat, Tangkak and Segamat.

. Conversion and the declaration of the name of Hospital Muar to Sultanah Fatimah Specialist Hospital was completed by the Duli Yang Maha Mulia Sultanah Johor on October 13, 2003. In the area of Sultanah Fatimah Specialist Hospital, there are a few buildings that build such as the Training Nurse Hostel (Block E) which is the case study for this report. It was officially opened by the health minister, En. Bahaman Bin Shamsuddin on 1965.

The location of the hostel is at the behind the hospital. The Training Nurse Hostel (Block E) is constructed on 1965 and the building started used on 1965. The building is categories as a building hostel for the training nurse to stay. The building is have one staircase for the occupant to used. And then they add one more staircase to make easy for the occupant to use it.

3.3 THE SUMMARY OF THE BUILDING

The table show the summary of the case study which is about the Training Nurse Hostel at hospital. It is details of company to make easy to understand.

Table 3.1: Summary of building

TRAINING NURSE HOSTEL (BLOCK E)	
Address	Asrama Jururawat (Block E), Kolej Kejururawatan Muar Hospital Sultanah Fatimah Muar, 84000 Muar , Johor
Date start constructed	1965
Building start operation	1965
Building Categories	Hostel
Number of Level	3 level

3.4 LOCATION OF SITE

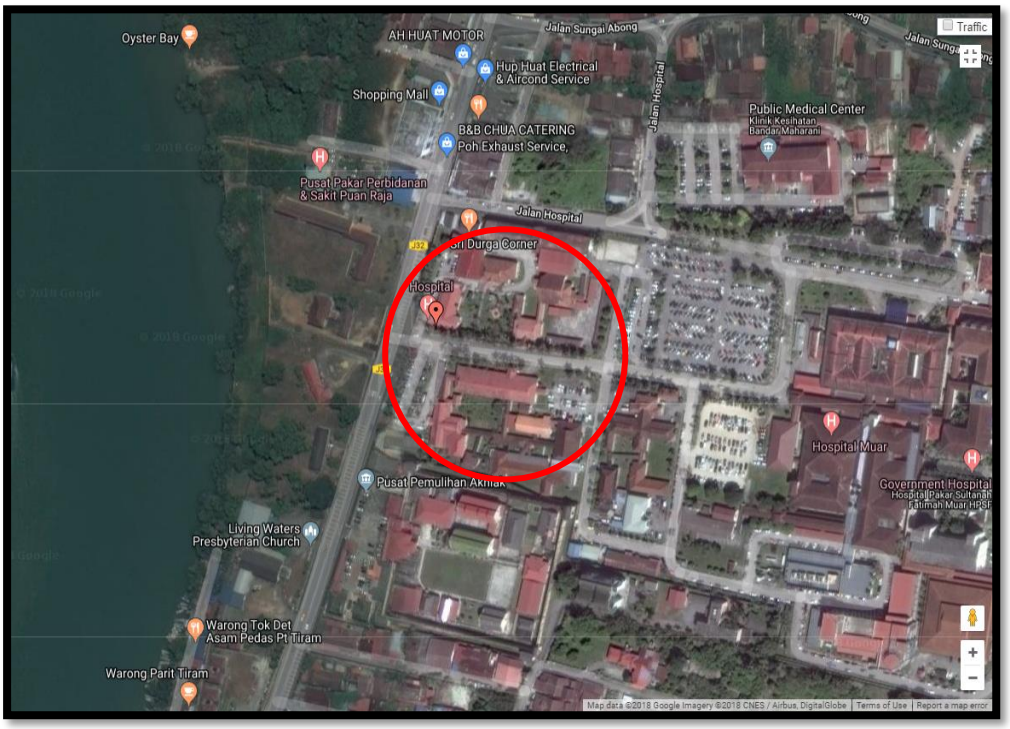


Figure 3.2 Location Sultanah Fatimah Specialist Hospital

3.5 OBJECTIVE

- To identify the causes of the defect on building structural
- To inspect and evaluate the defect on building structural
- Proposing the repair structure to be submitted by JKR Johor and JKR Muar, Johor.

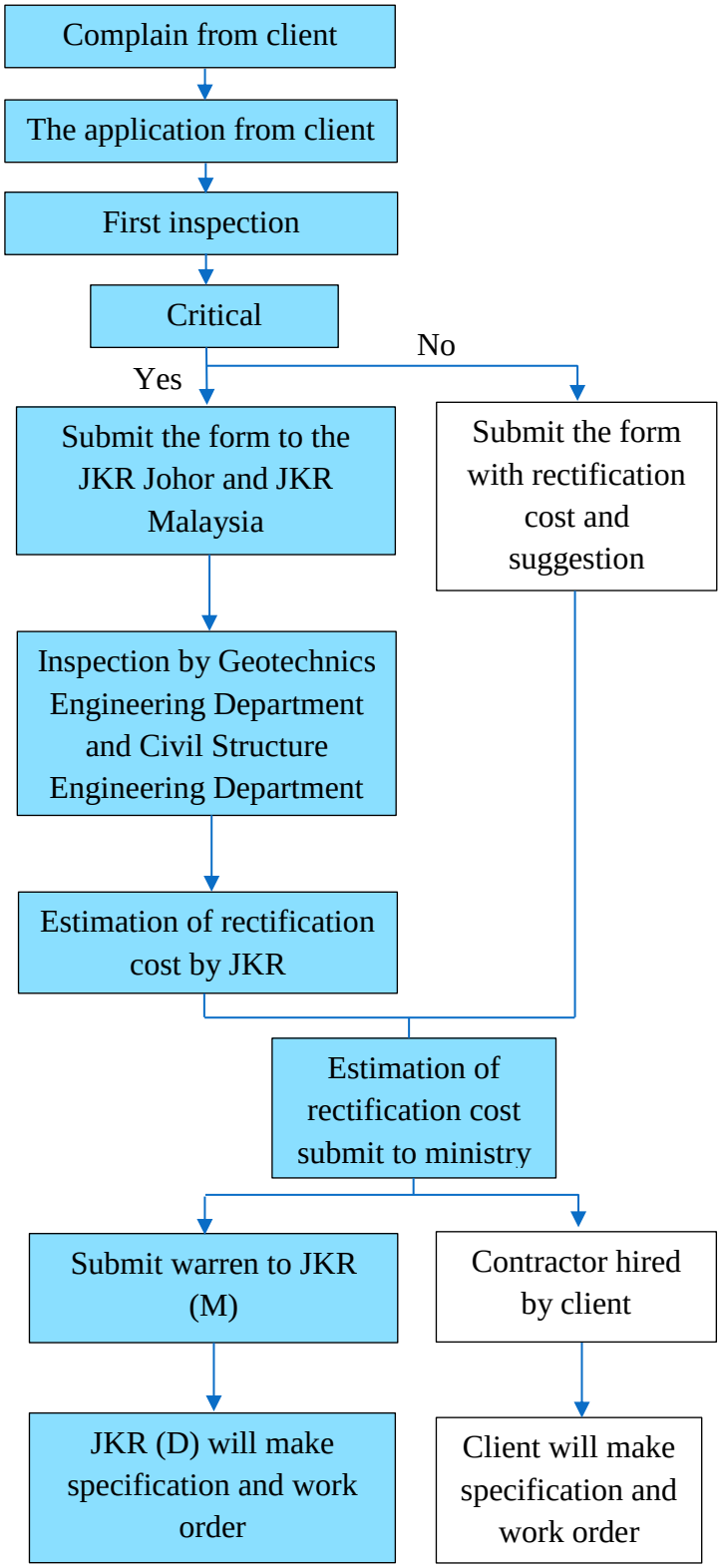
3.6 METHODOLOGY OF INSPECTION

The inspection is protected by to the following methodology:

- Conduct visual and physical checks on building structure.
- Discussion on the site with all party involved

3.7 THE FLOW CHART OF BUILDING INSPECTION

Chart 3.1: the flow chart of building inspection under JKR Muar



3.7.1. Complaint

From this, client will identify the problem that appear on their building. The complaint will be done by person in charge on the building which is to make easy for officer JKR to contact. The person that in charge on the building must know the information such as the age of the building, the type and method constructed that be used and the type of material which is to make easy for officer JKR to get detail information.

For the Training Nurse Hostel (Block E), the client of the Training Nurse Hostel (Block E) building which is En. Mohammad Yazid B. Sulaiman has complain about the additional staircase on the building which is has problem that can affect the occupant in the building. The client found the defect on the additional staircase such as crack on parapet wall that can damage the occupant if the continue use it. The client will make the letter to JKR Muar for inform them about the problem that appear on the building.

3.7.2. The application from client

Furthermore, JKR will analyse the letter from client to know the purpose of complaint. The officer in charge will refer in detail about the purpose of the letter. From the letter, JKR will make an approval from head department to inspect the building.

In that case study at Training Nurse Hostel (Block E), the client will inform about that had been faced at the building. In-depth of researches, the client was realised that the defect on additional staircase are happened which had cracked at the parapet wall that causes damage to the occupants if keeping used the staircase.

In order than that, the client wants JKR Muar officer to inspect the condition of the additional staircase in the building. It is important to identify the safety for occupants if they keep using the additional staircase.

3.7.3 The First Inspection

For this section, the first inspection is about the inspect is done by the officer JKR that in charge the work. This inspection is to exanimate the condition of the building which is to know the statues of the defect. The inspection is inspecting the causes and the condition of defect. This to know it critical or not for occupant to use it.

During the inspection, the officer of JKR who is En. Rashid Bin Rasidin will use the form which is help to inspect the building. The form is content the element that should be inspect to know the causes of the defect. There is a difference form that used for the inspection. If the critical condition the initial report form damage for building structure will be used to inspect more detail for the building and if the condition of the building not critical, the JKR officer will come out with the initial report form damage for building structure.

In this section the officer identifies the additional staircase in the critical condition which is they found a large crack on the parapet wall of the additional staircase. The additional staircase will be worse if the occupants on the building continue used it. For the safety aspect, the additional staircase is requested to close temporarily for detail inspection from the professional team.

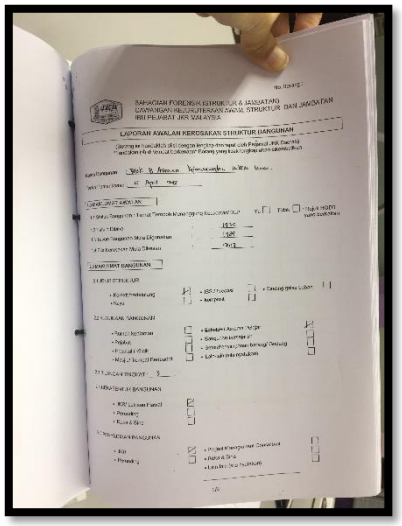


Figure 3.3: the example of the form.

Figure 3.4: the concrete crack on parapet wall

Figure 3.5: the crack on the slab of additional staircase

Figure 3.6: the concrete spalling and concrete delamination

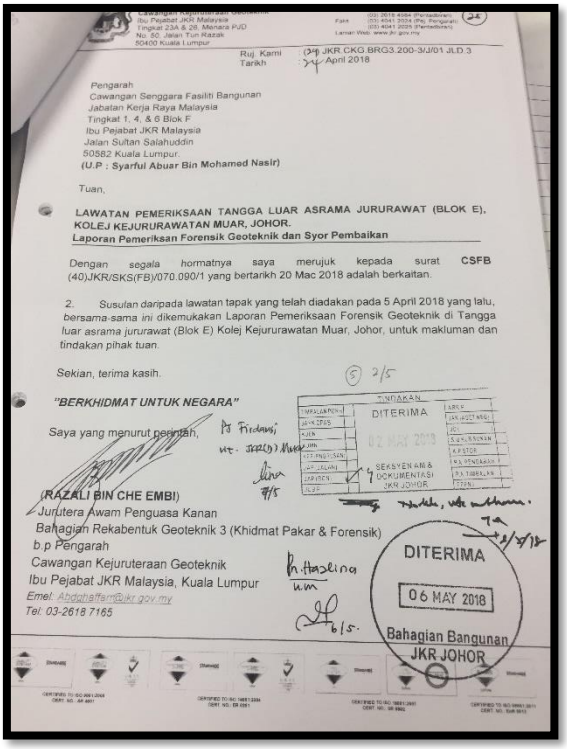
3.7.4 Submit Form to JKR Johor and JKR Malaysia

On this section, the form that use by the officer is initial report form damage for building structure for the critical condition on the building. The form is submitting to the JKR states for the next inspection to collect more information of the condition on the building. The form will be analysis to know the condition of the building for the further inspection application on the building.

For the Training Nurse Hostel (Block E), the form that use is initial report form damage for building structure, which is the condition of the additional staircase on the building is in critical. The form for the building show the parapet wall was in worse condition which is has a large crack, and also the strain on beams and slabs of the outside additional staircase.

The form that use is help the officer to inspect more proper of each element on the building. The form will be submitted to the JKR Johor to apply the further inspection for the building. The form that submitted by JKR Muar will be analysis by the officer JKR Malaysia to help them know the situation of the building and condition on the building.

After analysis the form, the officer of JKR Johor will make the application to the JKR Malaysia at Kuala Lumpur to get permission to do further inspection. This application is to make further inspection to know the more detail about the possible causes of the defect that appear at additional staircase. JKR Johor will hired the professional team such as Geotechnics Engineering Department, and Civil and Structure Engineering Department.



Ibu Pejabat JKR Malaysia
Tingkat 23A & 28, Menara KJD
No. 50, Jalan Tun Razak
50400 Kuala Lumpur

Ruj. Kami : JKR.CKG.BRG3.200-3/J/01 JLD.3
Tarikh : 24 April 2018

Pengarah
Cawangan Senggara Fasiliti Bangunan
Jabatan Kerja Raya Malaysia
Tingkat 1, 4, & 6 Blok F
Ibu Pejabat JKR Malaysia
Jalan Sultan Salahuddin
50582 Kuala Lumpur.
(U.P : Syarful Abuar Bin Mohamed Nasir)

Tuan,

LAWATAN PEMERIKSAAN TANGGA LUAR ASRAMA JURURAWAT (BLOK E), KOLEJ KEJURURAWATAN MUAR, JOHOR.
Laporan Pemeriksan Forensik Geoteknik dan Syor Pembaikan

Dengan segala hormatnya saya merujuk kepada surat CSFB (40)JKR/SKS(FB)/070.090/1 yang bertarikh 20 Mac 2018 adalah berkaitan.

2. Susulan daripada lawatan tapak yang telah diadakan pada 5 April 2018 yang lalu, bersama-sama ini dikemukakan Laporan Pemeriksaan Forensik Geoteknik di Tangga luar asrama jururawat (Blok E) Kolej Kejururawatan Muar, Johor, untuk makluman dan tindakan pihak tuan.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(RAZALI BIN CHE EMB!)
Jurutera Awam Penguasa Kanan
Bahagian Rekabentuk Geoteknik 3 (Khidmat Pakar & Forensik)
b.p Pengarah
Cawangan Kejuruteraan Geoteknik
Ibu Pejabat JKR Malaysia, Kuala Lumpur
Emel: Abdrazlee@jkr.gov.my
Tel: 03-2618 7165

TINDAKAN
DITERIMA
02 MAY 2018
SEKSYEN 6/8 & DOKUMENTASI JKR JOHOR

DITERIMA
06 MAY 2018
Bahagian Bangunan
JKR JOHOR

Figure 3.7: the example of the letter from JKR Malaysia.

3.7.5 Inspection by Geotechnics Engineering Department and Civil Structure Engineering Department

For this section, Geotechnics Engineering Department and Civil and Structure Engineering Department will involve if the possible causes of the defect on the building related with the geography and structure element.

Geotechnics Engineering is the branch of civil engineering concerned with engineering behaviour of earth materials and is important in civil engineering. Geotechnics Engineering is to evaluate stability of natural slope, risks posed by site condition, design earthworks and structure foundation, and monitor site condition and foundation construction.

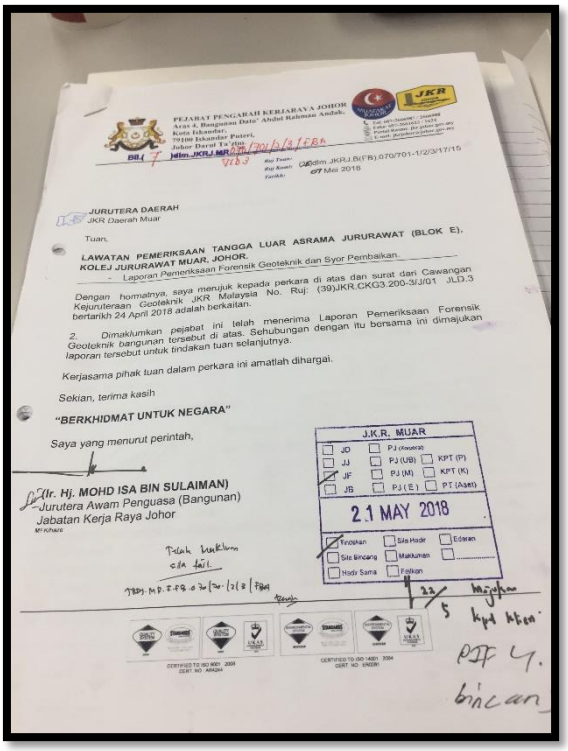
Civil and Structure Engineering is to understand and calculate the stability, strength and rigidity of built structure for building. It also to monitor the condition of building which is to identify the structure element such as beam, column and walls.

After the JKR Johor submit the form and application, JKR Malaysia will analysis the form to know the condition of the building before they approve the application. The form will be analysis by the officer in charge on the work. After that, JKR Malaysia hired the professional team such as Geotechnics Engineering Department, and Civil and Structure Engineering Department. They will inspect the building to find the possible cause that appear on the Training Nurse Hostel (Block E) building.

On the inspection, the Structure Engineering Department will inspect the element such as beams, columns, walls, and floors to know the possible cause on the building if the element on building can give a problem. The inspection is done by a few professional person to identify the causes of the crack on the additional staircase. The inspection involved En Mohd Mohaiman Bin Mohd Usak, En Othman Mohd Joned and En. Mohd Firdaus Bin Khamis.

The inspection is continue to the Geotechnics Engineering Department to monitor possible causes on the building. Before the inspection they need the detail information of the building that to know the possible cause that can causes because of the age of the building. Every level on the building is inspect by them to avoid any mistake to know the possible causes. They also monitor design earthworks and structure foundation, and monitor site condition on the building to find out the possible cause.

After the inspection, the team will make a report to submit to JKR Muar for do the repairing work. The report is to analysis the possible causes the appear on the building and also the suggestion that they give for repair the defect. The report than will be submit to JKR Johor for monitor the building.



PEJABAT PENGARAH KERJARAYA JOHOR
Aras 4, Bangunan Dato' Abdul Rahman Andak,
Kota Iskandar Puteri,
79100 Iskandar Puteri,
Johor Darul Ta'zim

Tuan,

LAWATAN PEMERIKSAAN TANGGA LUAR ASRAMA JURURAWAT (BLOK E), KOLEJ JURURAWAT MUAR, JOHOR.
- Laporan Pemeriksaan Forensik Geoteknik dan Syor Pembaikan

Dengan hormatnya, saya merujuk kepada perkara di atas dan surat dari Cawangan Kejuruteraan Geoteknik JKR Malaysia No. Ruj: (39)JKR.CKG3.200-3/J/01 JLD.3 bertarikh 24 April 2018 adalah berkaitan.

2. Dimaklumkan pejabat ini telah menerima Laporan Pemeriksaan Forensik Geoteknik bangunan tersebut di atas. Sehubungan dengan itu bersama ini dimajukan laporan tersebut untuk tindakan tuan selanjutnya.

Kerjasama pihak tuan dalam perkara ini amatlah dihargai.

Sekian, terima kasih

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

Ir. Hj. MOHD ISA BIN SULAIMAN)
Jurutera Awam Penguasa (Bangunan)
Jabatan Kerja Raya Johor

J.K.R. MUAR
21 MAY 2018

Figure 3.8: the letter from JKR Johor.

A) Civil Structure Engineering Department Inspection

The visual observation found that the outside staircase structure was constructed separately from the original building structure. However, the parapet walls of the staircase and floor layers were constructed on the outside structure of staircase and the beam of the original building. From the observation, the parapet wall is attached to the wall in the original building through the mortar bond.

The cracking on the parapet wall and the floor layer may be due to the deposition of additional staircase structure where the suspended soil under the base of additional staircase has undergone secondary consolidation following the receipt of additional loads.

The structure and the parapet wall are not monolithic and not built at all. Therefore, it should not be tied to any of the original building structure and should be allowed to move freely. In comparison, the correct connecting method is to use expansion joint or sealant that allow any movement to occur.

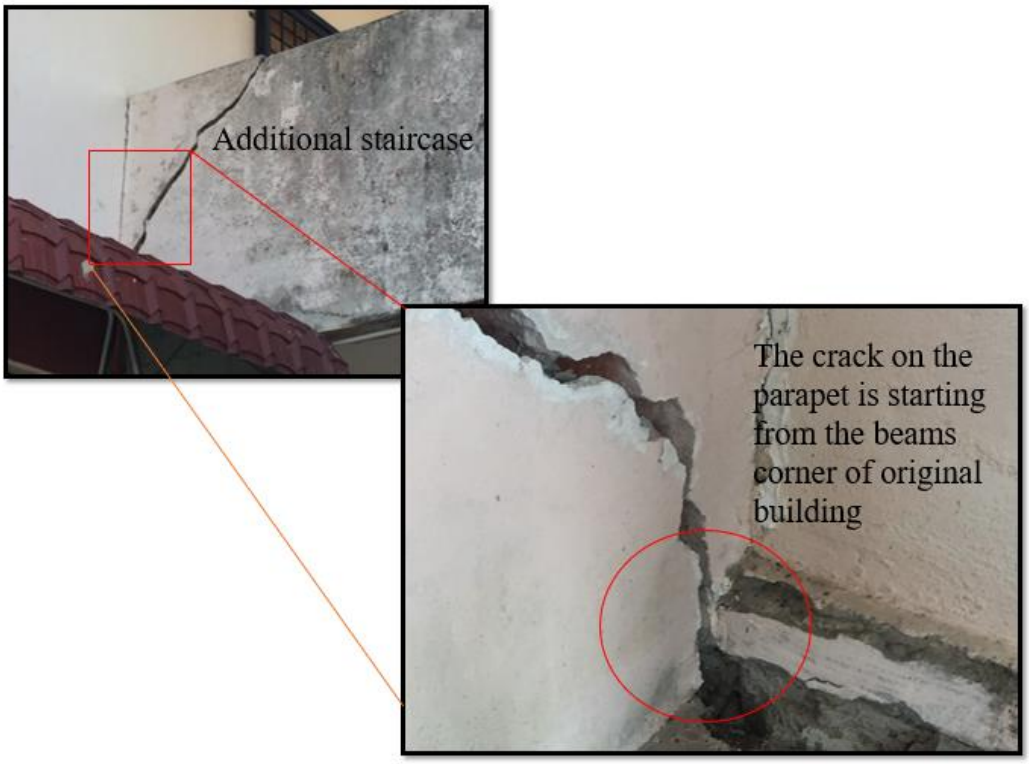


Figure 3.9: the view concrete crack on the parapet wall

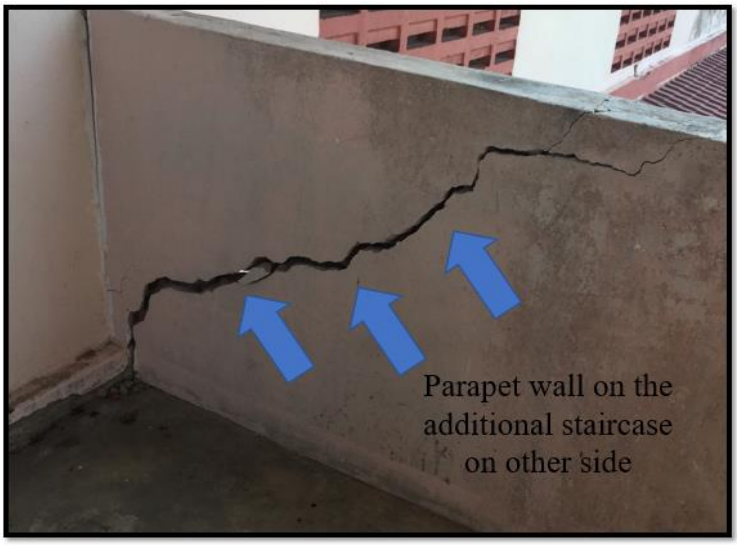


Figure 3.10: the view of parapet on other side

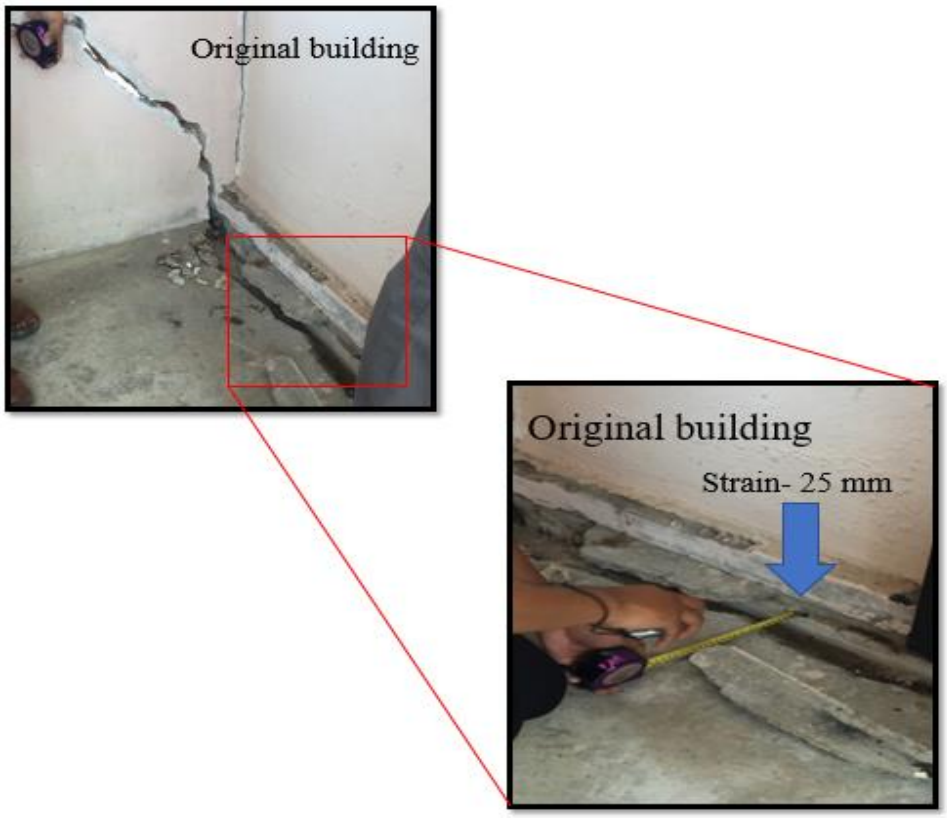


Figure 3.11: there is a stretch about 25 mm between the original building and slab of the additional staircase.

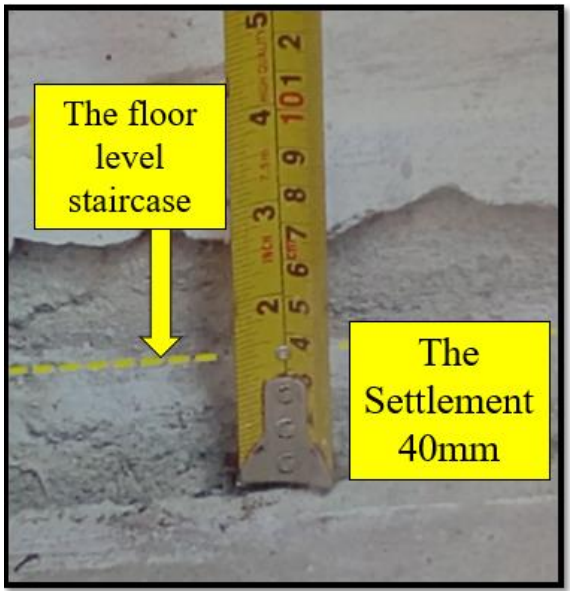


Figure 3.12: the settlement on the slab of the additional staircase is 40 mm.

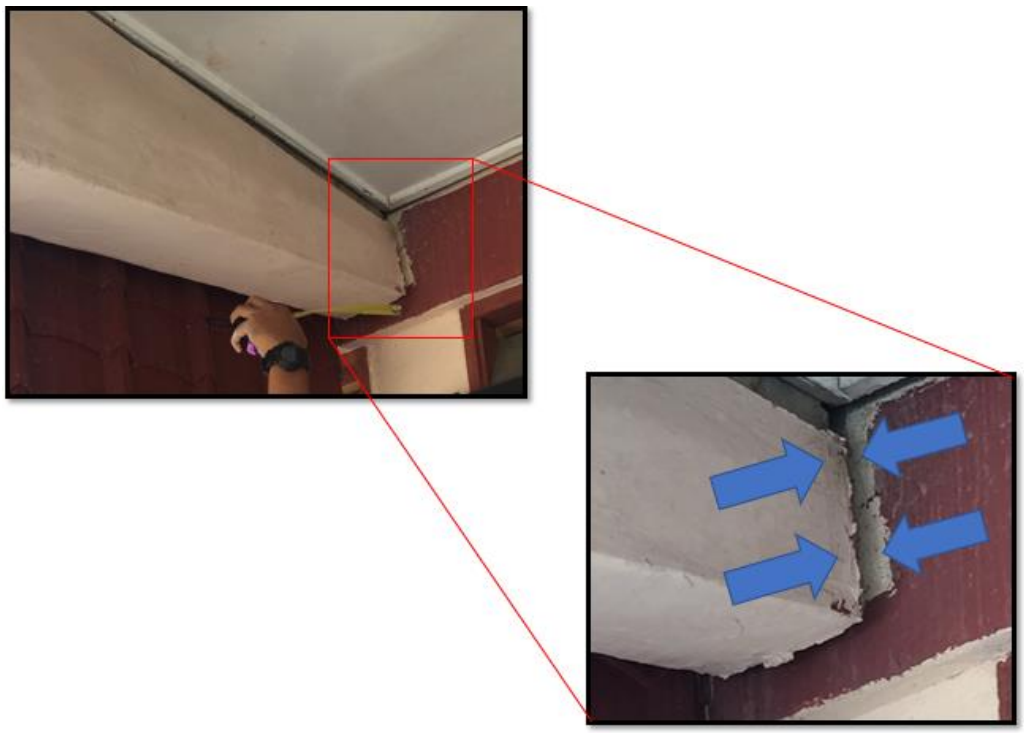


Figure 3.13: there is a strain between the beam and the slab of the staircase with the original building.

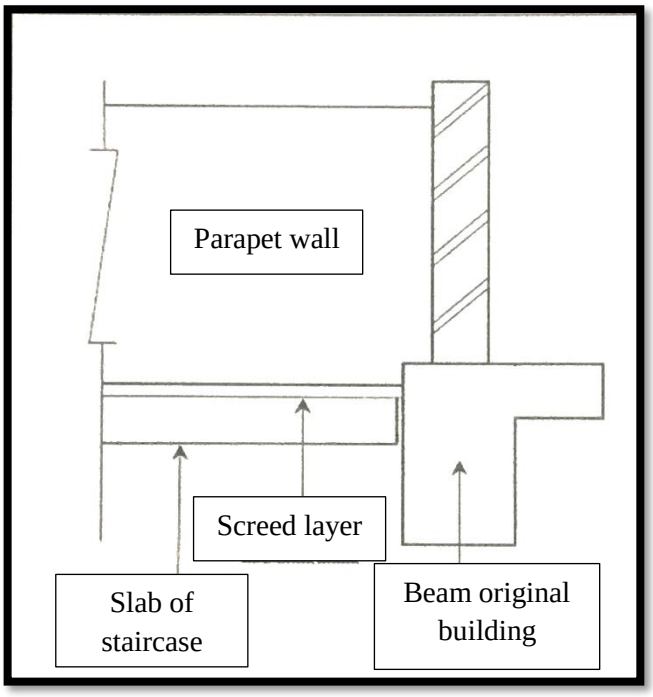


Figure 3.14: sketches existing connection on site

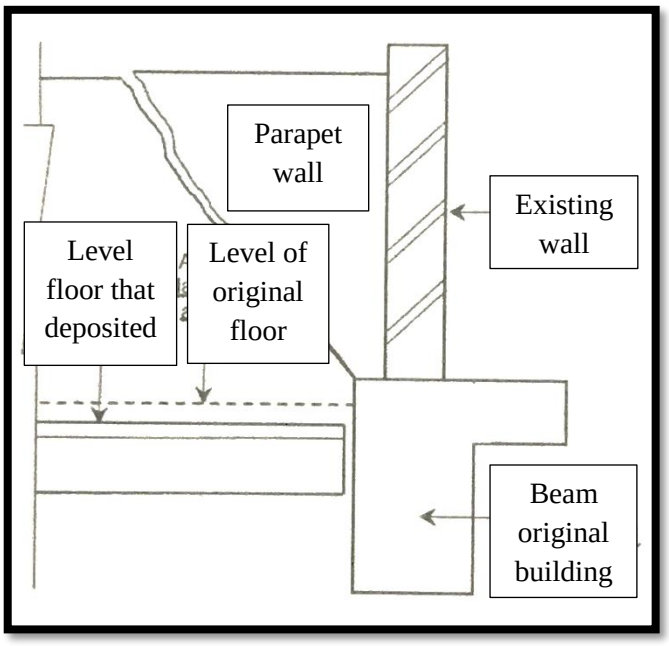


Figure 3.15: sketches condition of connection after deposited or structural movement occur

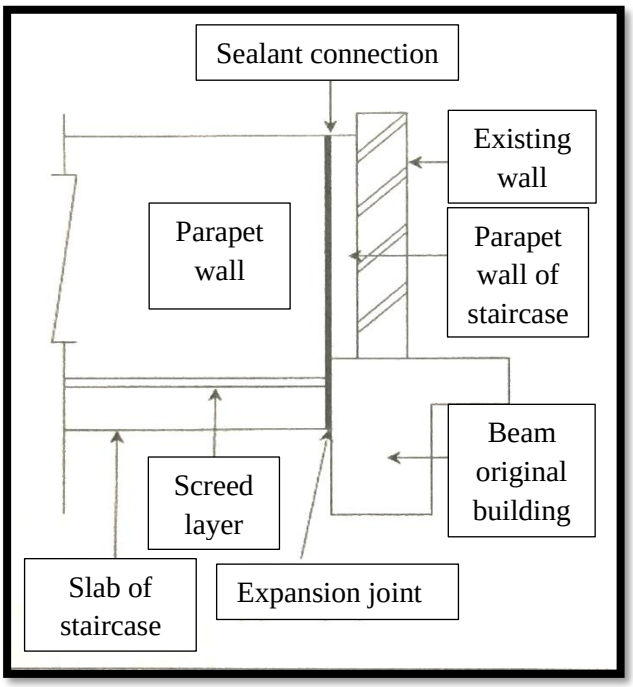


Figure 3.16: the example of recommended extensions

Concrete spalling and concrete delamination on stairs soffit and slab stems from corrosion of steel reinforcement. the corrosion reinforcement of steel is due to the oxidation reaction of steel reinforcement with the presence of oxygen and water.

Typically, oxidation responses occur when a passive protective layer of steel reinforcement is destroyed by long carbon coating activity. In addition, inadequate concrete cover also contributes to increased carbonization rates

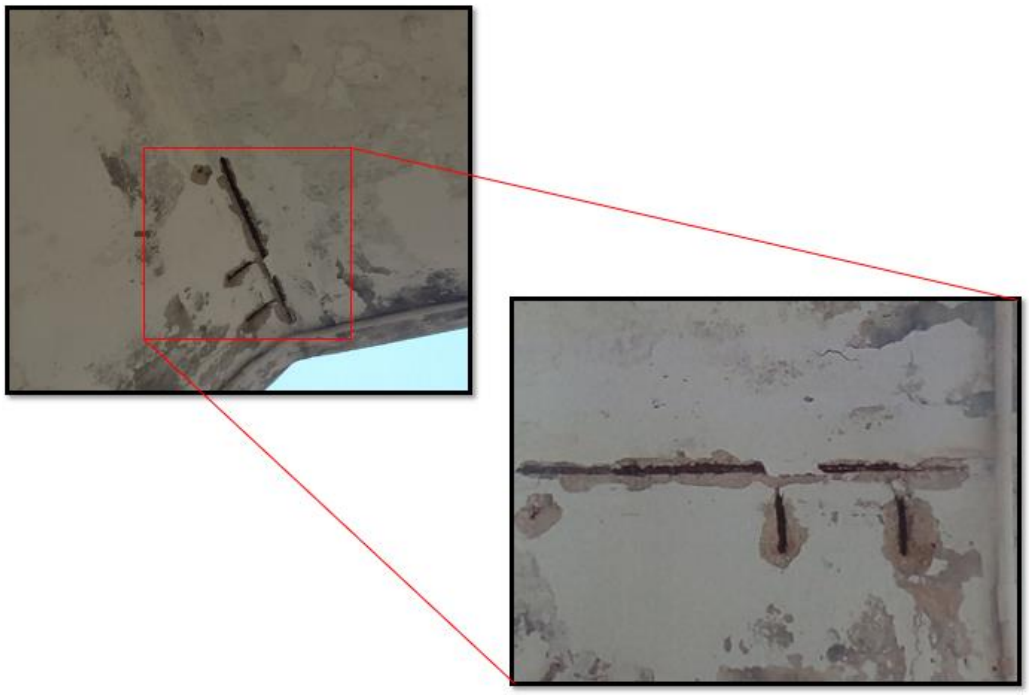


Figure 3.17: the concrete spalling at staircase soffit

The concrete spalling at staircase soffit at level 2. The visual inspection found that steel reinforcement has been rusted and the thickness of the concrete cover is believed to be insufficient

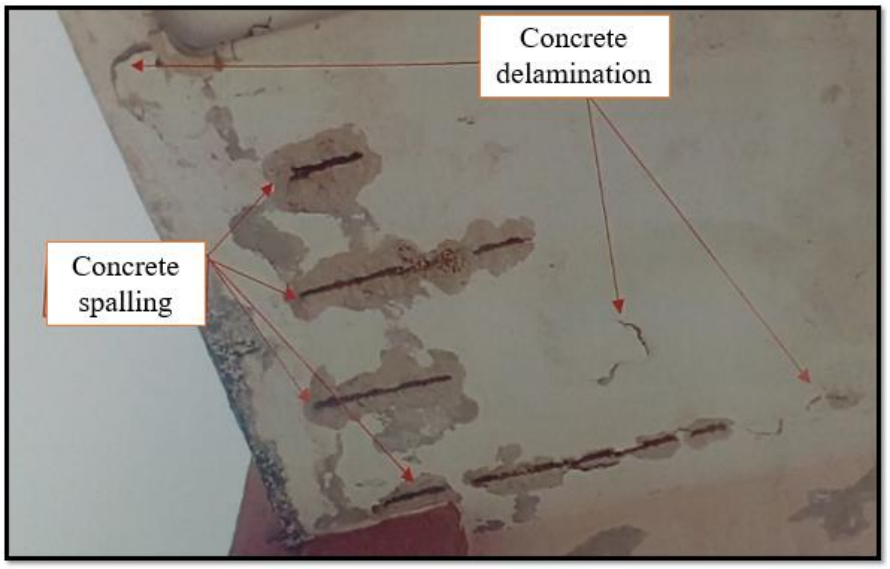


Figure 3.18: the concrete spalling at staircase soffit.

The concrete spalling at staircase soffit. The visual inspection found the concrete delamination is appear at the same location. The steel reinforcement is found to have rusted and the thickness of the concrete cover is believed to be insufficient

The table is about the defect that appear on the case study. It also contents the possible causes that can be made for the defect that appear

Table 3.2: the defect and possible causes

NO	DEFECT	POSSIBLE CAUSES
1.	Crack at parapet wall and the slab staircase	The possible causes on the building is due to the deposition of additional staircase structure where there suspected soil under the base of the additional staircase foundation has undergone secondary consolidation following the receipt of additional loads. The location of both staircase is found to has no corresponding extension expansion to accommodate any concrete structure expansion.
2.	Concrete spalling and concrete delamination on soffit structure the additional staircase.	The possible causes on the building is corrosion reinforcing steel. The reinforcement steal is due to oxidation reaction with the presence of oxygen and water.

B) Geotechnics Engineering Department Inspection

The inspection by Geotechnics Engineering Department is to investigate the causes of failure or problems encountered on the site. This inspection is also to provide the scope of required extension investigation as well as the provisioning requirement, and suggest appropriate repair recommendation, short- term fix and cost estimates.

The objective of the inspection is to determine the appropriate repair method based on the geological background of the site, the problem of the site encountered and the history of the construction of the intended asset.

From the inspection, the Block E is finish construct on the 1985. The building has two staircases at outside which is built separately from the original block. On the staircase, there is a sloping pillar at the upside and also a stretch of strain between the rest platform and the Block E building.

On this inspection, the officer of Geotechnics Department is also found that there is a wall fracture due to brick shrinkage at the rest platform level 1 which is the magnitude of the cracking is 30mm.

The suggestion of the repairing work is conduct regular monitoring of column pitch and stretch through the method Tiltmeter and Building Settlement Marker (BSM) in six months. This suggestion should be do as soon as possible before the appropriate repair method are recommended.

Figure 3.19: the area that appear the defect on staircase.

Figure 3.20: show the pole structure that start from the step of staircase at level 1.

There are the few defects that appear on the staircase based on the Geotechnics Inspection. There has a strain that happen on the staircase which is the magnitude of strain is between 40mm to 50mm

Figure 3.21: strain on staircase beam structure

Figure 3.22: strain on staircase slab.

This is the crack that happen on the diagonal parapet wall. The slab beam of the staircase at level 1 was also found there is a deposit which is around 50mm.

Figure 3.23: crack on diagonal parapet wall.

3.7.6 Estimation of Rectification Cost By JKR

On this section, the estimation of rectification cost is the approximation of the cost of the project. The cost estimate is the product of the cost estimating process. The estimate cost will use the specific material cost to estimate. Its used to predict the quantity, cost and price of resources required by the scope of a project.

For the case study, the JKR Muar will make bill quantities to submit to the client which is Sultanah Fatimah Specialist Hospital. This bill quantities is to help the client for repairing work which is to application for the budget. On this bill quantities, the JKR Muar use the JKR specification cost for the material cost and the quantity that need for repair.

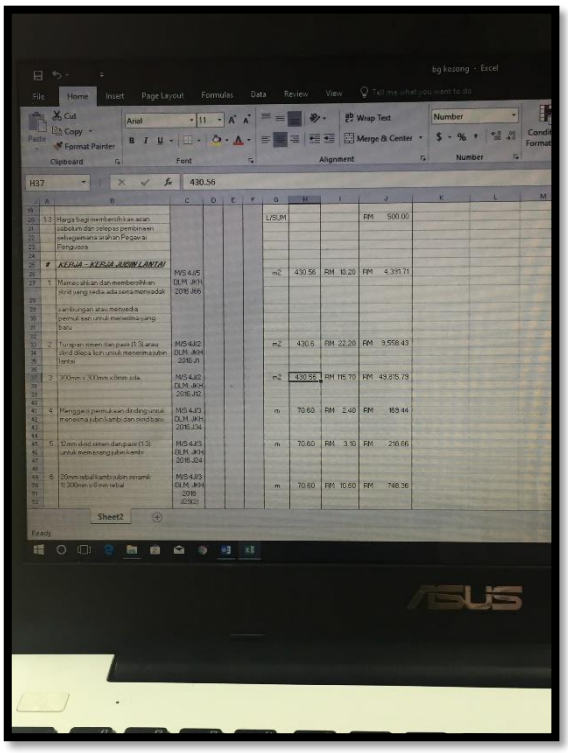


Figure 3.24: the example of cost estimating

3.7.7 Estimation of Rectification Cost Submit To Ministry

On this section, the estimation of rectification cost is more about list of the material cost for repairing work. In this estimation of rectification cost is help for the client to buy the materials that should to repair the defect.

For this case study, JKR Muar will submit the report that from the Geotechnics Engineering Department, and Civil and Structure Engineering Department to the client for the analysis. The report will submit with the rectification cost that the officer JKR Muar has prepare.

After the analysis the report and agreed with the estimation of rectification cost, the client can submit to the ministry to claim some cost for repairing work. Sultanah Fatimah Specialist Hospital will submit to the Health Ministry to get some cost for repairing work.

The Health Ministry will analysis the report and the estimation of rectification cost before approve the budget. The amount of budget that will approve is depend on the report and estimation of rectification cost that submit by client.

3.7.8 Submit warren to JKR (M)

On this section, the estimation of rectification that are agreed and approve by Ministry will be submit the warren to JKR. The warren is to inform the JKR that about the estimation of the rectification cost that agreed and want to get the approval from JKR to start the repairing work stage.

In the case study, the estimation of rectification cost that done by the officer JKR Muar that agreed from client will be submit to JKR Malaysia at Kuala Lumpur. This submission will content the estimation of the rectification cost and the letter from client that agreed with the cost that suggest from JKR.

From submission, JKR Muar will submit the warren allocation to the JKR Malaysia. This warren was contented by the cost which is needs to be repairing the work and subsequently the inspection report from Geotechnical Engineering Department and Civil Structure Engineering Department to ease the officer to analysis the repairing of work progress and also applying an approval letter from JKR Muar.

3.7.9 JKR (D) will make specification and work order

On this section, the approve the budget from the ministry will be inform to the JKR. The budget that agreed and approve will be the cost for repairing work.

After the approve the budget, JKR Muar will make a specification and work order for repairing work depends on report from the Geotechnics Engineering Department, and Civil and Structure Engineering Department. The work order is follow the suggestion and recommendation on the report.

The scope of work that done by the officer JKR Muar is content the step to repair the crack on the parapet wall, and the concrete spalling and concrete delamination. After the scope of work done, the repairing work will be started.

For the example scope of work repair the crack on parapet wall such as hack the parapet wall on the staircase. The new parapet wall need to constructed again. Connection between staircase beams or slab as well parapet wall with original building shall be constructed with expansion joint.

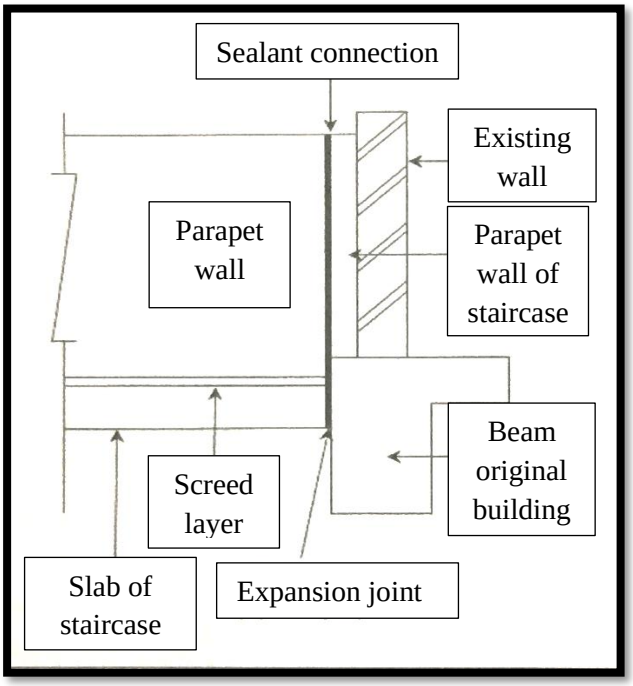


Figure 3.25: the example of recommended extensions

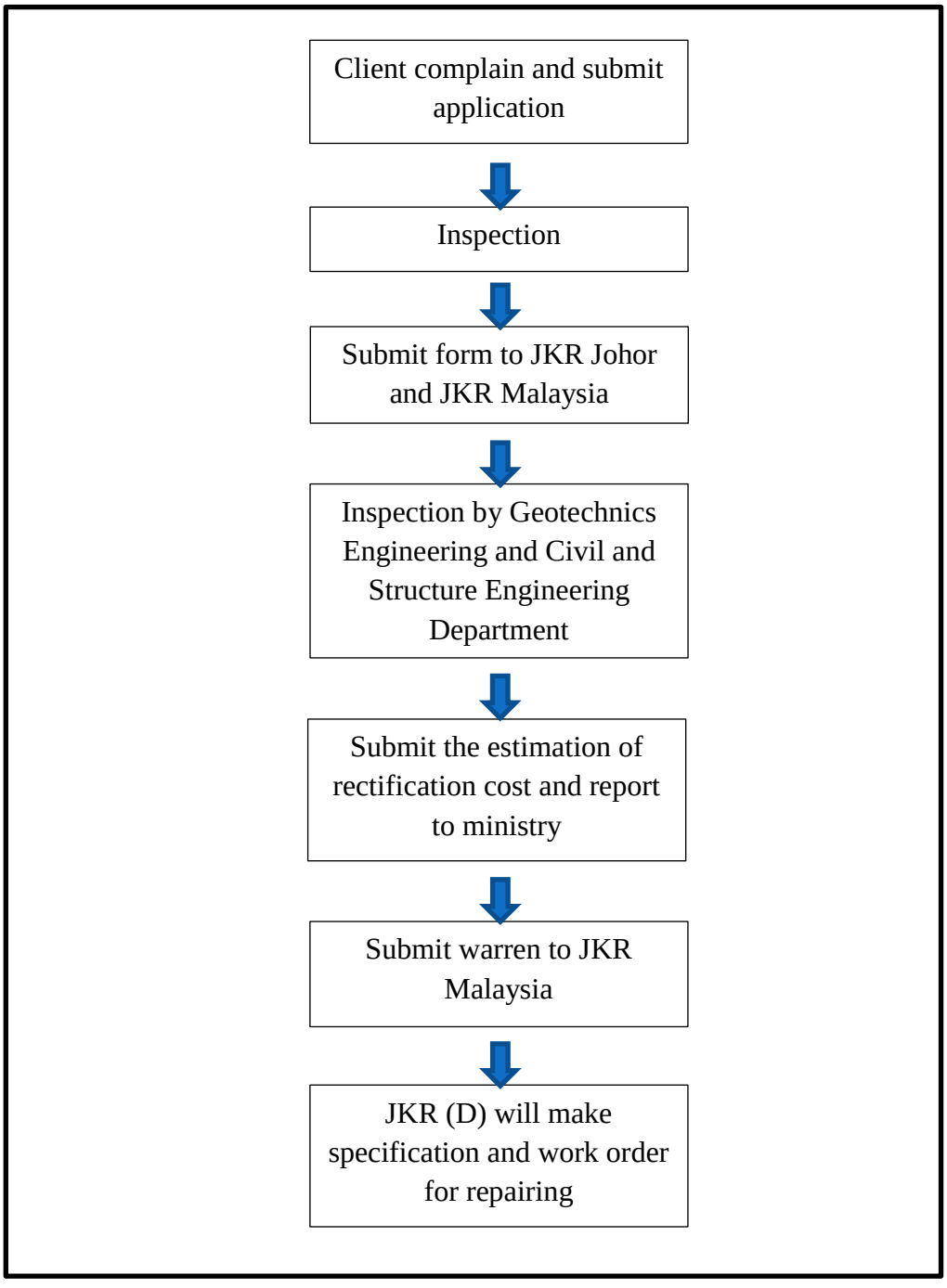
3.8 SUMMARY

From this chapter, many things that can be learn such as the background of the building and the step for inspection in the building. This specialist hospital is the third hospital that important in Johor after Sultanah Aminah Hospital and Sultan Ismail Hospital. This hospital also be references for the Batu Pahat, Tangkak and Segamat. The Training Nurse Hostel (Block E) which is the case study for this report. It was officially opened by the health minister, En. Bahaman Bin Shamsuddin on 1965. The location of the hostel is at the behind the hospital. The Training Nurse Hostel (Block E) is constructed on 1965 and the building started used on 1965.

From this chapter also learn about the flow chart of the building inspection. The flow chart is show the process of the building inspection from the started until the repairing work be done. From the inspection on the Training Nurse Hostel (Block E), there are a few defects that identify by the person in charge for the work. for the example of the defect is crack on parapet wall, concrete spalling and concrete delamination.

The possible causes that can be for the crack is due to the deposition of additional staircase structure where there suspected soil under the base of the additional staircase foundation has undergone secondary consolidation following the receipt of additional loads. For the concrete spalling and concrete delamination which is causes corrosion reinforcing steel. The reinforcement steal is due to oxidation reaction with the presence of oxygen and water.

Chart 3.2: the summary of the flow chart of building inspection



CHAPTER 4

PROBLEM AND RECOMMENDATION

4.1 INTRODUCTION

In this chapter which is problem and recommendation, it is about focusing on identifying problem that occurs on building and also focusing on how to overcome the problem with looking for suitable recommendation to this building. However, the decision of recommendation should be analyzed to assure the suitability before apply to building.

All the recommendation needs to be taken seriously to make sure the condition and the environment of this building is good and safe for the occupants. All the decision need to be discuss before the suggestion was decide. The objective of identify the problem and recommendation to overcome the problem is to ensure the life span of the building is longer and make the building look better. That is why it is important to identify the problems and overcome it. Besides that, the budget to overcome the problem can be prepared earlier if the problems and recommendations have been identified faster.

4.2 **PROBLEM AND RECOMMENDATION**

There is the problem that appear on the site and also the recommendation that should be applied on the site.

Table 4.1: Problem and recommendation

PROBLEM	RECOMMENDATION
1. There has no detail information of the building background on the Training Nurse Hostel (Block E) that required	- The officer of Sultanah Fatimah Specialist Hospital need to save a document in the file for each building information in the area of the hospital to avoid any problem such as to identify the age of the building and the type of method construction that used for the building.
2. The process of building inspection and management of the project takes a long time before the repairing work can be carried out.	- The JKR officer must arrange a time schedule to avoid delay in building for repairing work so that building does not get any worse damage
3. The lack of the maintenance on the building which is there no person in charge that can monitor the condition on the building.	- The JKR Muar officer need to suggest of an idea about hire the building surveyor on the building to monitor the condition on the building to avoid any worse problem will happen again.

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

The conclusion that can be made from this report is know about the building background of the JKR Muar. From the chapter 1, JKR Muar is located at Jalan Othman, Taman Sri Tanjung, Muar, Johor which is the office building. The JKR Muar building is strategic which is near the Poslaju office, Police Station, bank and hotel. There are a few departments such as building department, facilities department, road department, quantity surveying department, administration department and financial department

For the chapter 2, that learn about the general building inspection and the defect on the building such as crack on the wall, concrete spalling and concrete delamination. On this chapter, its can learn about the process inspection for inspect the building. The inspection of the building is important to make sure the condition of the building is good to use. This also learn about defect which is about the type, the pattern, and possible causes. The references that be use is books, journal, newspaper and magazine. There is many information that can be fine from the journal, book and internet

For the chapter 3, the case study is the Training Nurse Hostel (Block E) which is the hostel for the training nurse at Sultanah Fatimah Specialist Hospital. This chapter is learning about the flow chart of the building inspection on that building. The inspection is done by Geotechnics Engineering Department and Civil and Structure Engineering Department. From the inspection, the staircase of building in critical condition. The defect that found on the staircase is crack on parapet wall, concrete spalling and concrete delamination.

Last but not least is learn about the problem and recommendation of the case study. There are a few problems that appear on the case study such as no has detail information of the building. This chapter also recommend some of suggestion for the case study.

REFERENCES

References

1. According to En. Rashid B. Rasidin, Assistant Engineer, Jabatan Kerja Raya Muar, Johor (April 4,2018)

2. According to En. Zuhairi B. Mohd Isa, Assistant Engineer, Jabatan Kerja Raya Muar, Johor (April 15, 2018)

3. According to En. Mohd Firdaus B. Khamis, Assistant Engineer, Jabatan Kerja Raya Johor (April 4,2018)

4. James Douglas, (2010), Building Surveys and Report

5. Sr. Mohd Nor Faisal Bin Baharuddin, Building Survey Practice Chapter 4 Surveying Tools & Equipment

6. Sr. Mohd Nor Faisal Bin Baharuddin, Building Survey Practice, Chapter5&6 Preparation & Procedure of Condition Survey

7. Khlefa Alarbe Esaklu, (1992) Handbook of Case Histories in Failure Analysis, Volume 2

8. R. Springenschmid, (2014), Thermal Cracking in Concrete at Early Ages

9. J.W Williams (2002), Old-House Journal

10. Nayef Ghasem, Redhouane Henda , (2009,)Principles of Chemical Engineering Processes

11. Mark G. Alexander, Hans-Dieter Beushausen, Frank Dehn, Pilate Moyo, (2008) Concrete Repair, Rehabilitation and Retrofitting II

11. Crack Information &Statistic, retrieved September from https://www.cirquelodge.com

12. Type of Crack in Concrete, retrieved December from www.flexomeric.com

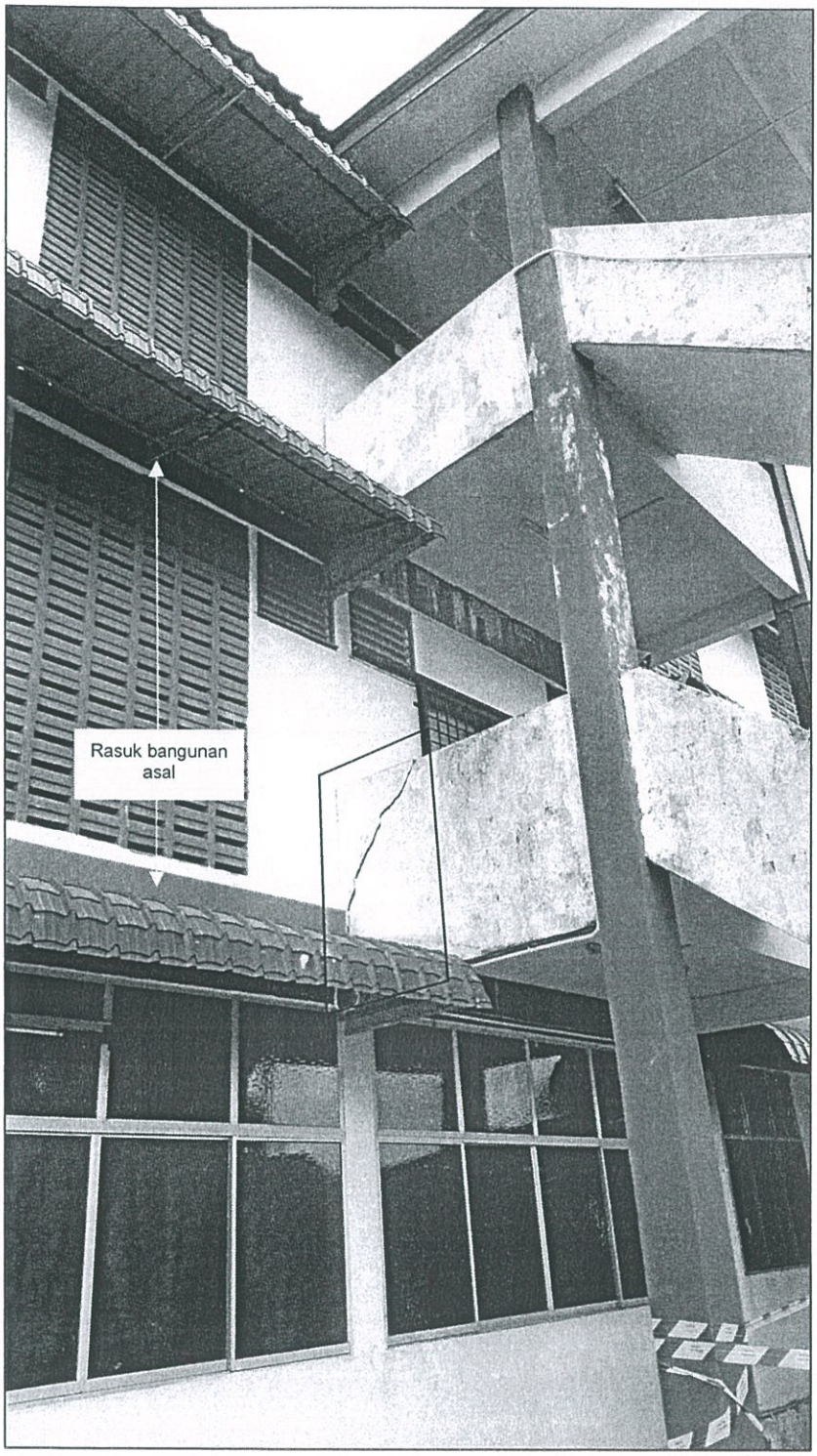
13.Diagonal Crack in Foundation and Wall, Retrieved March by https://civildigital.com

14.Spalling of Concrete-Causes, Prevention and Repair, Retrieved February from https://civildigital.com

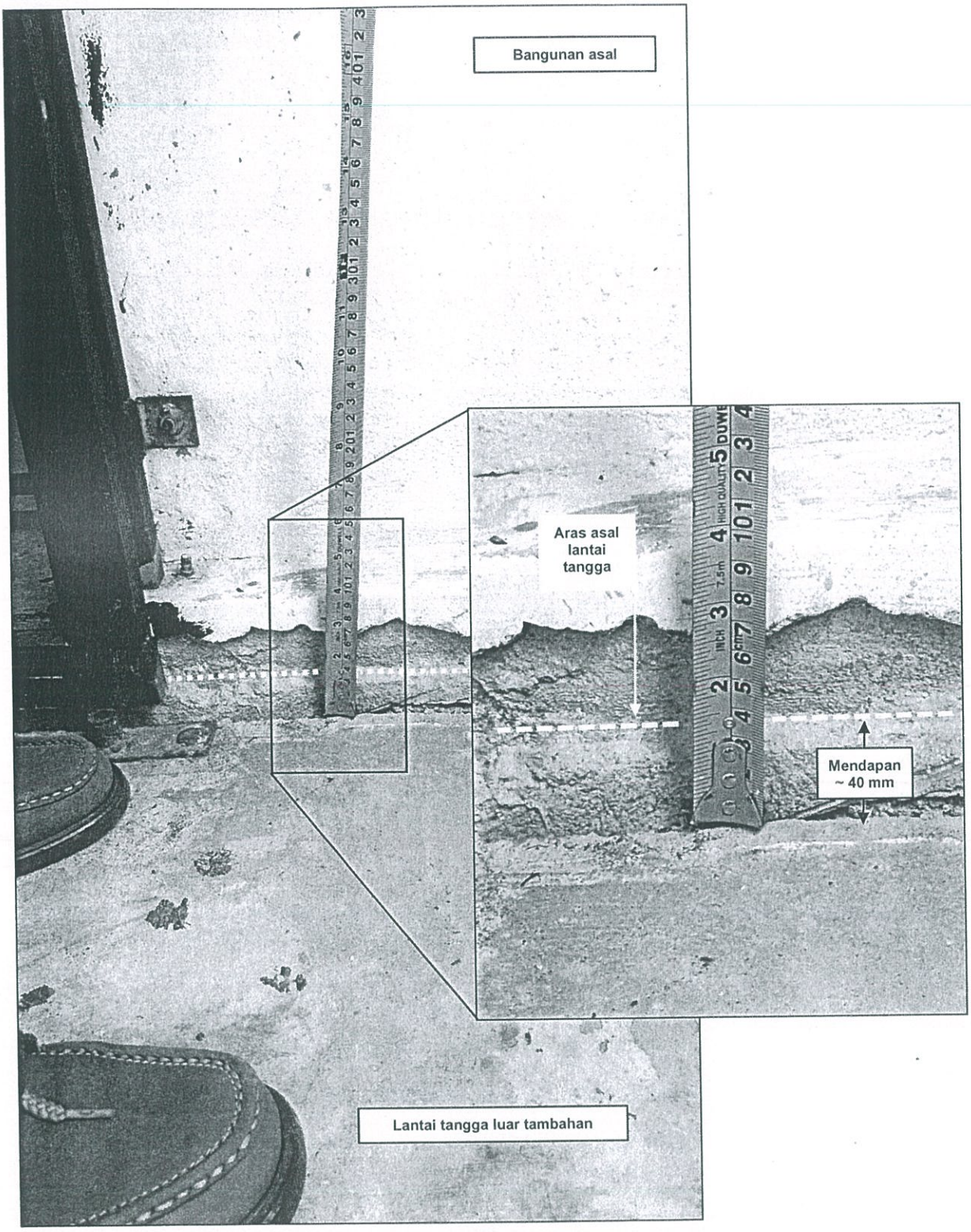
APPENDIX

Lokasi : Tangga 2 (Di bahagian belakang Blok E)

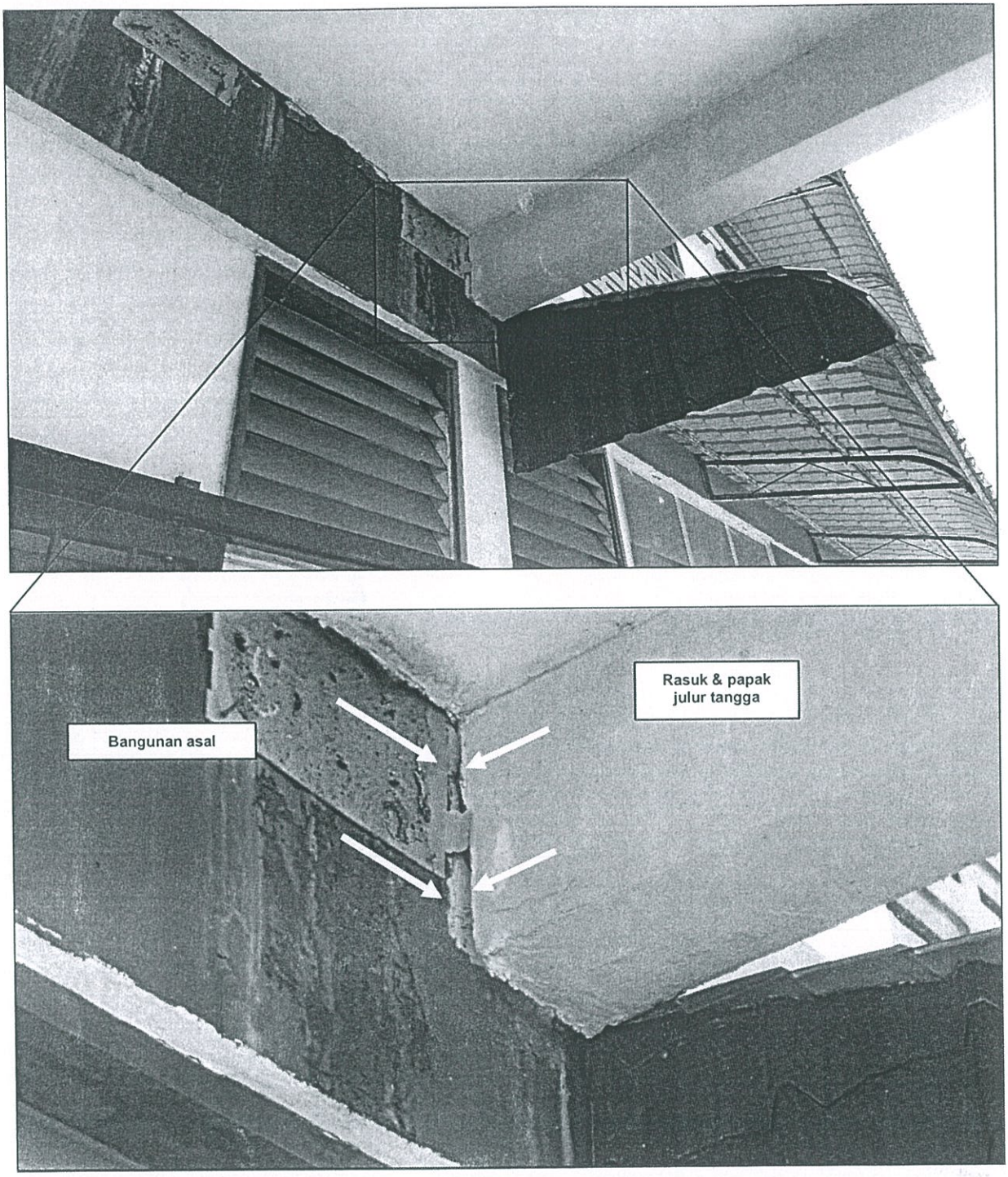
Gambar 3 : Salah satu tangga luar tambahan yang dibina berasingan dari bangunan asal asrama. Tangga ini terletak di bahagian belakang Blok E dan telah ditutup dari sebarang penggunaan. Tiada keretakan struktur dikesan pada mana-mana komponen struktur tangga ini.



Gambar 5 : Pandangan dari luar menunjukkan keretakan pepenjuru pada dinding parapet tangga tingkat satu. Keretakan dikesan bermula dari pepenjuru rasuk bangunan asal.



Gambar 9 : Terdapat pemendapan papak tangga luar sebanyak 40 mm dari aras lantai tangga.



Gambar 11 : Terdapat regangan di antara rasuk dan papak julur tangga luar dengan bangunan asal. Rasuk juga didapati telah mendap.

Lazimnya tindakbalas pengoksidaan berlaku apabila lapisan pelindung pasif tetulang keluli musnah akibat aktiviti pengkarbonatan konkrit dalam jangka masa panjang. Tambahan pula, penutup konkrit yang tidak mencukupi juga menjadi faktor kepada peningkatan kadar pengkarbonatan.

Kerosakan ini tidak menjejaskan struktur bangunan dan boleh dibaikpulih.

7.0 RUMUSAN

Berdasarkan pemeriksaan visual dan fizikal yang dijalankan, kerosakan-kerosakan di Asrama Jururawat (Blok E), Kolej Kejururawatan Muar dapat disimpulkan seperti di bawah:

(i) Keretakan pada dinding parapet dan lapisan lepaan lantai

Keretakan pada dinding parapet dan lapisan lepaan lantai berkemungkinan disebabkan oleh pemendapan struktur tangga tambahan yang mana disyaki tanah di bawah asas struktur tangga tambahan telah mengalami pemampatan sekunder (*secondary consolidation*) berikutan penerimaan beban tambahan. Kedua-dua lokasi tangga ini juga didapati tidak mempunyai sambungan pengembangan yang bersesuaian untuk menampung sebarang pengembangan struktur konkrit.

Walaupun terdapat keretakan pada dinding dan lantai tangga, kerosakan ini adalah kerosakan bukan struktur (*non-structural or superficial*). Ia tidak menjejaskan integriti struktur tangga dan boleh dibaikpulih.

(ii) Pengelupasan konkrit (*concrete spalling*) dan pelekangan konkrit (*concrete delamination*) pada struktur *soffit* dan papak tangga

Pengelupasan konkrit (*concrete spalling*) dan pelekangan konkrit (*concrete delamination*) pada *soffit* tangga dan papak berpunca daripada pengaratan tetulang keluli. Pengaratan tetulang keluli pula berpunca daripada tindakbalas pengoksidaan tetulang keluli dengan kehadiran oksigen dan air.

Lazimnya tindakbalas pengoksidaan berlaku apabila lapisan pelindung pasif tetulang keluli musnah akibat aktiviti pengkarbonatan konkrit dalam jangka masa panjang. Tambahan pula, penutup konkrit yang tidak mencukupi juga menjadi faktor kepada peningkatan kadar pengkarbonatan.

Kerosakan ini tidak menjejaskan struktur bangunan dan boleh dibaikpulih.

1.0 PENGENALAN	Bahagian Rekabentuk Geoteknik 3 (Khidmat Pakar dan Forensik), Cawangan Kejuruteraan Geoteknik (CKG), Ibu Pejabat JKR Malaysia telah menerima permohonan untuk khidmat nasihat teknikal daripada Cawangan Senggara Fasiliti Bangunan (CSFB), Ibu Pejabat JKR Malaysia mengenai masalah kerosakan Tangga Luar Asrama Jururawat (Blok E), Kolej Jururawat Muar, Johor dengan nombor rujukan surat: Bil.(40) JKR/SKS(FB)/070.090/1 bertarikh 20 Mac 2018.
2.0 LAWATAN TAPAK	Lawatan pemeriksaan ke tapak telah diadakan pada 5 April 2018 (Khamis) bersama-sama wakil JKR Daerah Muar dan juga wakil Institut Latihan Kementerian Kesihatan Malaysia (ILKKM) Muar. Senarai pegawai-pegawai yang menjalankan sesi lawatan tapak adalah seperti berikut: a) En. Razali Bin Che Embi (Jurutera Awam Penguasa Kanan/CKG) b) Pn. Norziaty BInti Mohd Noor (Jurutera Awam Kanan/CKG) c) En. Abdul Ghaffar Bin Abd Manap (Penolong Jurutera Awam/CKG) d) En. Ir.Azizul Azham Bin MOHD Nadzri (Jurutera Senggara/JKR Muar) e) En. Mohd Rashid Md Rasidin (Penolong Jurutera Awam/JKR Muar) f) Pn. Rahmah Mohd. Aris (Timb.Pengarah ILKKM Muar) g) En. Yazid Sulaiman (PTK ILKKM Muar) h) En, Muhammad Idris Bin Mohd Nor (CSE / Medivest)

3.0 TUJUAN	Laporan siasatan ini disediakan adalah bertujuan seperti berikut: a) Menyiasat punca-punca kegagalan atau masalah yang dihadapi di tapak. b) Menyediakan skop kerja-kerja siasatan lanjutan yang diperlukan serta keperluan peruntukan dan c) Mencadangkan syor pembaikan yang bersesuaian, langkah-langkah pembaikan jangka pendek dan anggaran kos.
4.0 OBJEKTIF	Objektif laporan ini adalah bagi menentukan kaedah pembaikan yang bersesuaian berdasarkan kepada latar belakang geologi tapak, masalah tapak yang dihadapi serta sejarah pembinaan aset yang dimaksudkan.
5.0 KAEDAH PENYIASATAN	Kaedah siasatan telah dijalankan berdasarkan kepada perkara-perkara berikut: a) Lawatan dan pemeriksaan ke tapak serta kawasan sekitarnya. b) Temubual dengan pihak end-user bersama-sama JKR Negeri/Daerah. c) Mengadakan perbincangan sebaik sahaja pemeriksaan dan lawatan bagi merumuskan hasil pemeriksaan visual yang telah dijalankan.
6.0 LATAR BELAKANG TAPAK	Alamat Penuh: *Kolej Kejururawatan Muar* *Hospital Pakar Sultanah Fatimah Muar* *84000 Muar* *Johor* Koordinat: *2.0558° N, 102.5784° E* Topograpi Kawasan: *Kawasan Landai*

	Maklumat Tambahan: a) *Tahun Dibina: 1975* b) *Tahun Digunakan: 1985* c) *Agensi Pelaksana: Tiada Makumat* d) *Jenis Asas Bangunan: Tiada Maklumat* e) *Pernah berlaku bencana: Tidak Pernah* **LAMPIRAN A** - Pelan Tatatur/Lakaran Pelan Tatatur/*Google Map** adalah Disertakan.
7.0 LAPORAN PEMERIKSAAN DAN PENEMUAN	Pemeriksaan adalah tertumpu di kawasan Tangga A dan Tangga B Blok Kenanga serta Dewan Makan Blok Bakawali. Berikut adalah penemuan sewaktu pemeriksaan dijalankan: **BLOK KENANGA** a) Mengikut makluman wakil pihak pelanggan, Blok Kenangan ini telah siap dibina pada tahun 1985 akan tetapi dua struktur tangga diluar Blok Kenanga dibina secara berasingan dari blok asal. Walaubagaimanapun, tahun dibina dan lukisan terbina tangga tersebut tidak dapat diperolehi **(Rujuk Foto 1)** b) Berlaku mendapan dan keretakan pada struktur apron di kawasan **Tangga A** dan renggangan di antara rasuk (*beam*) dan papak julur tangga luar dengan bangunan asal di aras 2 **(Rujuk Foto 2 – 4)** c) Terdapat tiang yang condong di **Tangga B (Rujuk Foto 6)** serta berlaku rengangan antara *"Rest Platform"* aras 2 dengan Bangunan Blok Kenanga. **(Rujuk Foto 7)** d) Terdapat keretakan dinding disebabkan oleh pengecutan bata di *"Rest Platform"* aras 1 **Tangga B,** Magnitud Keretakan 30mm. **(Rujuk Foto 8)**

	e) Keretakan struktur apron disebabkan mendapan kecil berlaku di aras bawah **(Rujuk Foto 9)** **BLOK BAKAWALI** a) Terdapat struktur dinding yang dibina di atas struktur apron yang sediada untuk menjadikan bilik stor penyimpanan barang dan bilik pegawai penyelia Dewan Makan. Pembinaan dinding tambahan ini telah menambah beban kepada apron yang tidak direkabentuk untuk menanggung beban dan juga beban dari simpanan barang-barang. Magnitud keretakan sebanyak 20mm – 40mm. **(Rujuk Foto 10-12)** **LAMPIRAN B** – Gambar-Gambar Lokasi Masalah di Tapak.
8.0 CADANGAN PEMBAIKAN	Berdasarkan kepada siasatan dan pemeriksaan yang dijalankan pengesyoran pembaikan adalah seperti berikut: **BLOK KENANGA** a) Didapati pelan susun atur asas struktur **Tangga A** dan **Tangga B** tidak dapat dirujuk sepanjang laporan ini disediakan. Oleh itu, disyorkan supaya dilaksanakan pemantauan secara berkala kecondongan tiang dan rengangan melalui kaedah *"Tiltmeter"* dan *"Building Settlement Marker" (BSM)* selama 6 bulan. Sebarang keputusan hasil dari pemantaun ini hendaklah dirujuk semula ke Pejabat ini bagi pengesyoran kaedah pembaikan jika terdapat kegagalan pada struktur asas di kawasan terlibat. Anggaran kos yang diperlukan adalah sebanyak: **RM 70,000.00 (Ringgit Malaysian: Tujuh puluh ribu)** b) Bagi mendapan dan keretakan struktur apron, ianya boleh diperbaiki dengan

	kaedah "*Concrete Patch Repair*" seperti di **Lampiran C.** **BLOK BAKAWALI** a) Untuk struktur dinding yang telah dibina diatas struktur apron, ianya perlu dirobohkan dan digantikan dengan *"Lightweight Brick"* bagi sekatan luaran dan *"Lightweight partition wall"* bagi sekatan dalaman.
9.0 RUMUSAN	Berikutan dari masalah yang berlaku, berikut adalah rumusan yang dapat dibuat seperti: **BLOK KENANGA** *a)* Pemantauan kecondongan dan rengangan struktur tangga dengan mengunakan "*Building Settlement Marker (BSM)*" dan *"Tiltmeter"* selama 6 bulan perlu dilaksanakan dengan kadar segera sebelum kaedah pembaikan yang bersesuaian disyorkan. **BLOK BAKAWALI** *b)* Penggantian dinding-dinding bata di atas apron perlu dibuat mengikut pengesyoran seperti di para 8 yang berkaitan. Sebarang kaedah pembaikan perlulah dilaksanakan mengikut piawaian dan amalan kejuruteraan yang baik.
10.0 PENUTUP	Dipohon agar pihak JKR Daerah Muar mengambil maklum akan cadangan yang dikemukakan oleh Bahagian ini dan membuat pengukuran semula di tapak bagi menentukan anggaran kos kerja-kerja pembaikan yang sebenar.

TYPICAL EXPANSION JOINTS REPAIR

METHOD 1
(Joint width less than 10 mm)

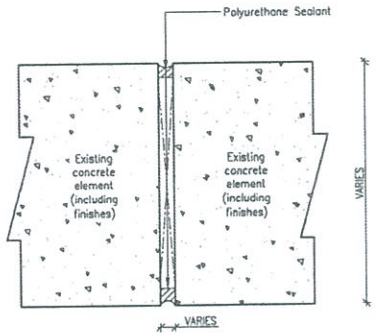


Figure 1 : Typical Non-Movement Joint Detail at Existing Concrete Element (Plan & Elevation View)
(N.T.S)

METHOD 2
(Joint width from 10 mm to 35 mm)

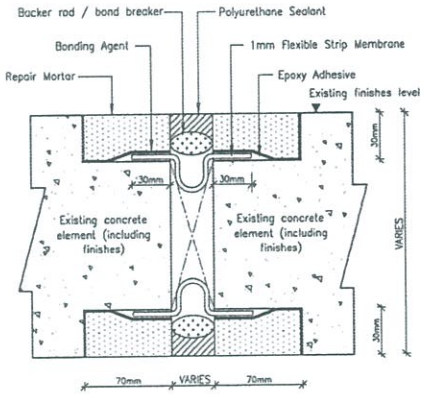


Figure 2 : Typical Expansion Joint Detail at Existing Concrete Element (Plan & Elevation View)
(N.T.S)

METHOD 3
(Joint width up to 35 mm)

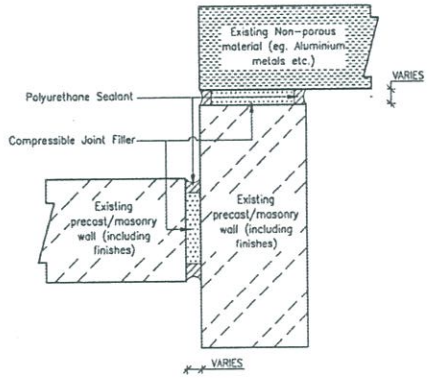


Figure 3 : Typical Expansion Joint Detail at Existing Masonry Wall & Non-porous Materials (Plan View)
(N.T.S)

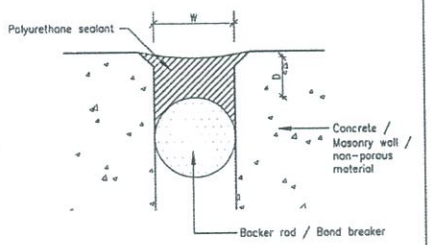


Figure 4 : Sealant Application – Flush Joint (For External & Internal Non-trafficable Area)

Note : A Width (W) to Depth (D) ratio must be maintained at 2 : 1 or to manufacturer's specifications.

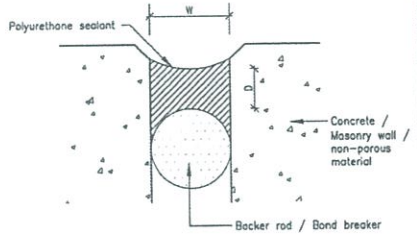


Figure 5 : Sealant Application – Recessed Joint (For External Trafficable Area)

Note : A Width (W) to Depth (D) ratio must be maintained at 2 : 1 or to manufacturer's specifications.

GENERAL TECHNICAL REQUIREMENTS :

1. The external and internal non trafficable sealant shall be a low modulus one-pack polyurethane based elastomeric joint with the following properties :
   a. Minimum working joint expansion & contraction of at least 25%
   b. Tensile strength not less than 0.1 N/mm² at 50% elongation (20°C)
   c. Minimum elongation at break >400% (20°C and 65RH)
   d. Ultraviolet light and weatherproof resistance
2. A minimum Width (W) to Depth (D) ratio of 2 : 1 must be maintained along all sealant joints.
3. The repair mortar shall be an approved polymer modified cementitious repair mortar capable of vertical, horizontal and overhead application or other equivalent material approved by the S.O. The minimum compressive strength shall be in excess of 40 N/mm² at 28 days.
4. The backer rod / bond breaker and compressible joint filler shall be of a closed-cell polyethylene foam or according to manufacturer's specification respectively.

MINIMUM JOINT WIDTH & DEPTH AND RECOMMENDED DIAMETER OF BACKER ROD FOR JOINTS BETWEEN 10 MM TO 35 MM:

MIN. JOINT WIDTH (MM)	10	15	20	25	30	35
MIN. JOINT DEPTH (MM)	10	10	10	13	15	18
RECOMMENDED DIA. OF BACKER ROD (MM)	10	15	20	25	30	35

GENERAL NOTES:

Expansion joint materials, proposed removal and replacement methods, treatment methods for concrete surface and mock-up shall be submitted to the S.O for approval before commencing the work.

PROCEDURES:

Surface Preparation:

1. Remove all defective expansion joint materials and screed down to sound concrete / bricks / blocks / non-porous surface.
2. Clean the receiving surface using high pressure water jet or other mechanical tools approved by the S.O.
3. Ensure the substrate surface is clean, dry and free of dust and other contaminants.

Application of expansion joint for a non-movement joint with joint width less than 10 mm (For concrete element):

1. Insert the sealant material into sealant gun and extrude the sealant into the joint. Make sure the sealant is in full contact with the side of joint and avoid air entrapment.
2. Push the sealant into the gap to create a flush / recessed joint. Allow it to set properly.
3. Reinstate the existing finishes to the satisfaction of S.O.

Application of expansion joint for joint width up to 35 mm (For masonry wall & non-porous materials)

1. Insert the approved compressible joint filler to the required depth using appropriate tools approved by the S.O.
2. Where primer is necessary, apply primer on the surface of the non-porous materials according to the manufacturer's recommendation and allow it to set properly.
3. Insert the sealant material into sealant gun and extrude the sealant into the joint. Make sure the sealant is in full contact with the side of joint and avoid air entrapment.
4. Push the sealant into the gap to create a flush / recessed joint. Allow it to set properly.
5. Reinstate the existing finishes to the satisfaction of S.O.

Application of expansion joint for joint width between 10 mm to 35 mm (For concrete elements):

1. Prepare a groove section of 70 mm width and 30 mm depth at both edges of the joint and clean the substrate using high pressure water jet or other mechanical tools approved by the S.O.
2. Install and fix a 1 mm thk of flexible strip membrane along the joints using proprietary epoxy adhesive and allow it to cure properly.
3. Lay the bonding agent on the concrete substrate / epoxy adhesive.
4. Fill the groove section with repair mortar and allow it to set.
5. Insert the backer rod / bond breaker to the required depth using appropriate tools approved by the S.O. For joints larger than the backer rod, twist two strands of backer rod together to fill the gap.
6. Insert the sealant material into the sealant gun and extrude the sealant into the joint. Make sure the sealant is in full contact with the side of joint and avoid air entrapment.
7. Push the sealant into the gap and allow it to set properly.
8. Reinstate the existing finishes to the satisfaction of S.O.

JABATAN KERJA RAYA MALAYSIA

BAHAGIAN PERKHIDMATAN FORENSIK STRUKTUR
CAWANGAN KEJURUTERAAN AWAM & STRUKTUR
IBU PEJABAT JKR MALAYSIA
Tingkat 4-10, 19, Blok G, Menara Kerja Raya
Jalan Sultan Salahuddin
50480 Kuala Lumpur
Tel: 03-26181202 Faks: 03-26189155

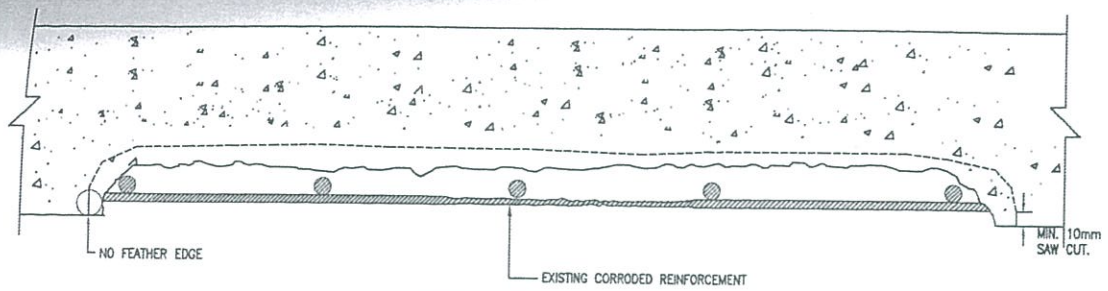
DIREKABENTUK : OTHMAN BIN MOHD JONED	PENGARAH KANAN : KAMALUDDIN ABDUL RASHID	HURUF PETUNJUK	PINDAAN	TARIKH	TANDA TANGAN
DISEMAK : BERNARD TODES	PENGARAH (KHIDMAT PAKAR) : IR. NORMA BINTI NORMAN				
DILUKIS : OTHMAN BIN MOHD JONED	JURUTERA AWAM PENGUASA KANAN :				
SKALA : N.T.S	JURUTERA AWAM PENGUASA : IR. MOHD SHAIFUDDIN BIN ABDUL RAZAK				
NO FAIL PROJEK : JKR/CKAS/(09.700/070/02	TARIKH : JANUARI 2017				

NAMA PROJEK : STANDARD REPAIR DRAWING

TAJUK LUKISAN : TYPICAL EXPANSION JOINTS REPAIR

NO. LUKISAN : JKR/CKAS/P/08/17/01

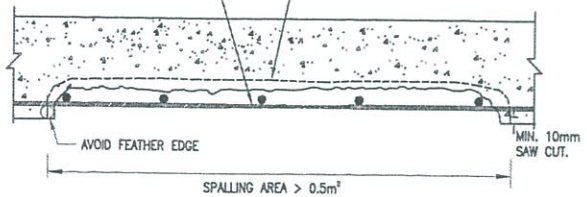
CONCRETE REPAIR BY SPRAYED CONCRETE FOR CORRODED RENFORCEMENT



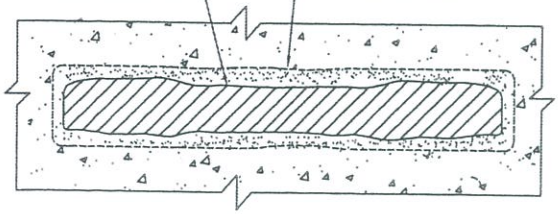
BEFORE REPAIR (ELEVATION)

BEFORE REPAIR WORKS

① CORRODED REINFORCEMENT; ADDITIONAL CONCRETE BREAKOUT WITH CLEARANCE 20mm BEHIND THE EXISTING REINFORCEMENT



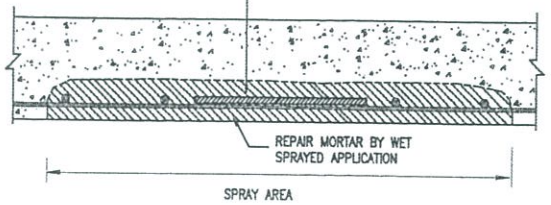
② EXISTING SPALLING AREA; PLANNED REPAIR AREA



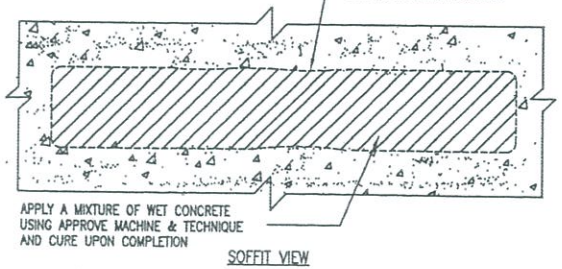
SOFFIT VIEW

AFTER REPAIR WORKS

③ REMOVE ALL RUST AROUND THE REINFORCEMENT BY GRIT BLASTING OR OTHER APPROVED METHODS & APPLY A LAYER OF ZINC-RICH ANTI-CORROSION COATING AND REPLACE EXISTING CORRODED REINFORCEMENT WHICH HAVE LOST ≥ 10% OF CROSS-SECTIONAL AREA (REFER TO DETAIL A)

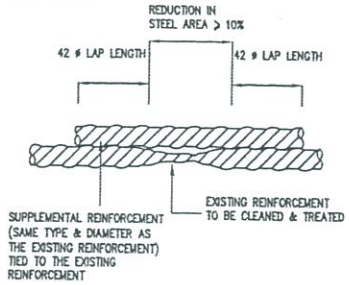


④ THE FINAL REPAIRED SURFACES SHALL MATCH THE FINISH ON THE EXISTING INTERIOR SURFACE

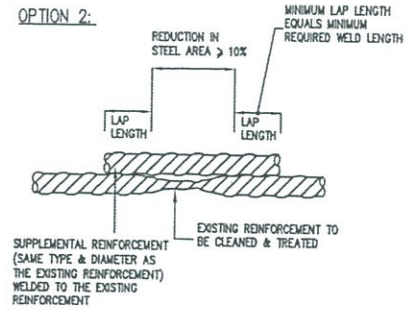


SOFFIT VIEW

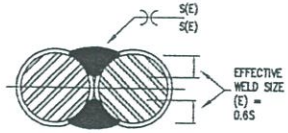
OPTION 1:



OPTION 2:



MINIMUM REQUIRED WELD LENGTHS FOR STEEL REINFORCEMENT	
BAR SIZE (mm)	DOUBLE FLARE V-GROOVE WELD (mm)
10	80
12	100
16	130
20	160
25	200
32	260



DOUBLE FLARE V-GROOVE WELD

LAPPED, WELDED SPLICE DETAIL

NOTES:

1) RADIUS OF STEEL REINFORCEMENT = S.
2) THESE ARE SECTIONAL VIEWS. BAR DEFORMATIONS ARE SHOWN ONLY FOR ILLUSTRATIVE PURPOSES.

DETAIL 'A' – LAPPING FOR NEW REINFORCEMENT

NOTES

1. Marking and removal of defective concrete :
   (a) Locate the damaged areas.
   (b) Mark the perimeter of repair area.
   (c) Cut back the concrete surface to prevent feather edges. Remove all damaged concrete to expose sound concrete substrate using appropriate tools.
   (d) Remove all fragments or other contaminants to fully expose surface.
   (e) Remove the damaged concrete behind the reinforcements with minimum of 20 mm clearance.
2. Surface treatment to reinforcement :
   (a) Remove all rusts around corroded reinforcements using approved appropriate tools.
   (b) For heavily corroded reinforcements with ≥ 10% reduction in cross sectional area, add supplemental reinforcements.
   (c) Apply a layer of zinc-rich anti-corrosion coating to all exposed rebars.
3. The mortar application shall be by the wet-mix spray applied process using a suitable spray machine and cure upon completion.
4. The final repaired surfaces shall match the finish on the existing interior surface.
5. All mock-ups and method statements shall be submitted to the S.O. for approval before commencing any work.
6. All welding works on the supplemental and existing reinforcements shall be conducted by qualified welder.

JKR

BAHAGIAN FORENSIK (STRUKTUR & JAMBATAN)
CAWANGAN KEJURUTERAAN AWAM, STRUKTUR & JAMBATAN
IBU PEJABAT JKR MALAYSIA
Tingkat 20, Menara PJD,
No. 50, Jalan Tun Razak,
50400 Kuala Lumpur
Tel: 03-26181202 Faks: 03-26181228

HURUF PETUNJUK	PINDAAN	TARIKH	T.T.	SKALA
				NTS

DIREKABENTUK : MOHD SAFWAN BIN HARUN	PENGARAH KANAN : DATO' IR. DR. ABDUL AZIZ BIN H.J. ARSHAD
DILUKIS : AMI AFNIZA BINTI ABD WAHAB	PENGARAH (KHIDMAT PAKAR) : EN. KAMALUDDIN BIN H.J. ABDUL RASHID
DISEMAK : NOR HAZLINA BINTI ABDULLAH	KETUA PENOLONG PENGARAH KANAN : IR. DR. LIM CHAR CHING
NO FAIL : JKR.CKASJ/09.700/07/02	KETUA PENOLONG PENGARAH : IR. NOR AZILAWATI BINTI ABU TALAHA

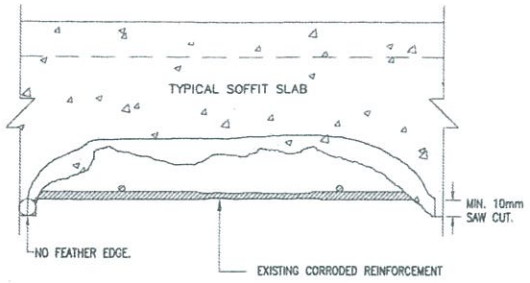
PROJEK : STANDARD CONCRETE REPAIR DRAWING

TAJUK : TYPICAL CONCRETE REPAIR BY SPRAYED CONCRETE

NO. LUKISAN : CKASJ.BFSJ.SRD/2012/03

TARIKH : NOVEMBER 2012

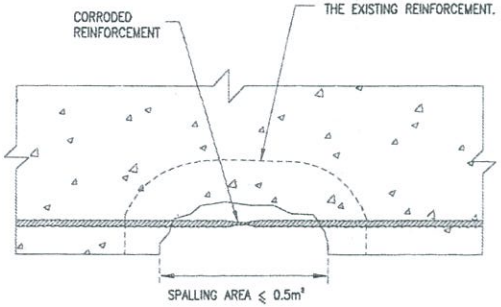
CONCRETE PATCH REPAIR FOR CORRODED RENFORCEMENT



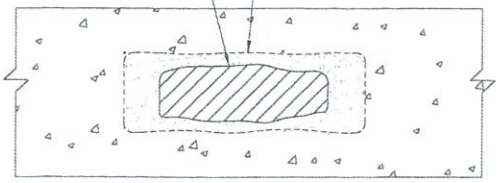
BEFORE REPAIR (ELEVATION)

BEFORE REPAIR WORKS

① ADDITIONAL CONCRETE BREAKOUT WITH CLEARANCE 20mm BEHIND THE EXISTING REINFORCEMENT.



② EXISTING SPALLING AREA — PLANNED REPAIR AREA



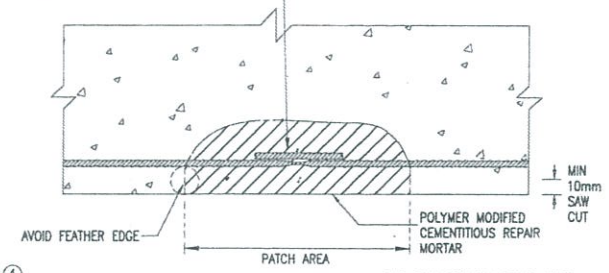
SOFFIT VIEW

AFTER REPAIR WORKS

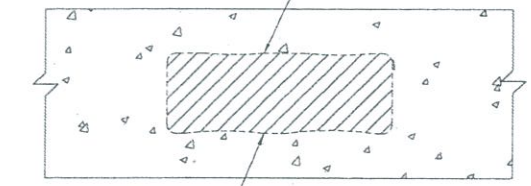
③ REMOVE ALL RUST AROUND THE REINFORCEMENT BY GRIT BLASTING OR OTHER APPROVED METHODS & APPLY A LAYER OF ZINC-RICH ANTI-CORROSION COATING ON EXISTING AND NEW REINFORCEMENTS.

AND

REPLACE EXISTING CORRODED REINFORCEMENT WHICH HAVE LOST ≥ 10% OF CROSS-SECTIONAL AREA (REFER TO DETAIL A)

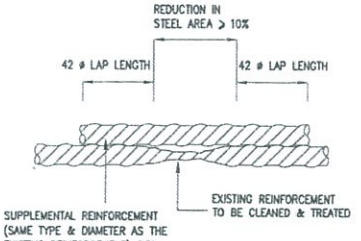


④ THE FINAL REPAIR MORTAR LAYER SHALL MATCH THE FINISH ON THE EXISTING INTERIOR SURFACE.

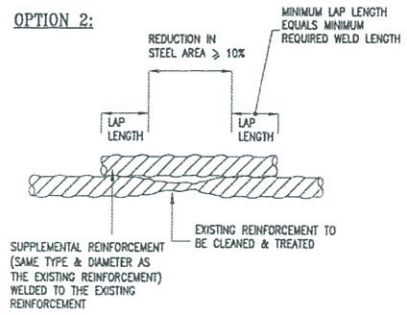


SOFFIT VIEW

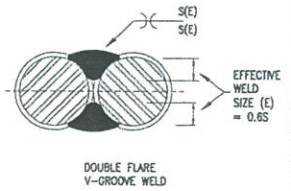
OPTION 1:



OPTION 2:



MINIMUM REQUIRED WELD LENGTHS FOR STEEL REINFORCEMENT	
BAR SIZE (mm)	DOUBLE FLARE V-GROOVE WELD (mm)
10	80
12	100
16	130
20	160
25	200
32	260



LAPPED, WELDED SPLICE DETAIL

NOTES:

1) RADIUS OF STEEL REINFORCEMENT = S.
2) THESE ARE SECTIONAL VIEWS. BAR DEFORMATIONS ARE SHOWN ONLY FOR ILLUSTRATIVE PURPOSES.

DETAIL 'A' – LAPPING FOR NEW REINFORCEMENT

NOTES

1. Marking and removal of defective concrete :
   (a) Locate the damaged areas.
   (b) Mark the perimeter of repair area.
   (c) Cut back the concrete surface to prevent feather edges. Remove all damaged concrete to expose sound concrete substrate using appropriate tools.
   (d) Remove all fragments or other contaminants to fully expose surface.
   (e) Remove the damaged concrete behind the reinforcements with minimum of 20 mm clearance.
2. Surface treatment to reinforcement :
   (a) Remove all rusts around corroded reinforcements using approved appropriate tools.
   (b) For heavily corroded reinforcements with ≥ 10% reduction in cross-sectional area, add supplemental reinforcements.
   (c) Apply a layer of zinc-rich anti-corrosion coating to all existing and new reinforcements.
3. Apply polymer-modified cementitious repair mortar and cure upon completion.
4. All mock-ups and method statements shall be submitted to the S.O. for approval before commencing any work.
5. All welding works on the supplemental and existing reinforcements shall be conducted by qualified welder.

BAHAGIAN FORENSIK (STRUKTUR & JAMBATAN)
CAWANGAN KEJURUTERAAN AWAM, STRUKTUR & JAMBATAN
IBU PEJABAT JKR MALAYSIA
Tingkat 20, Menara PJD,
No. 50, Jalan Tun Razak,
50400 Kuala Lumpur
Tel: 03-26181202 Faks: 03-26181228

HURUF PETUNJUK	PINDAAN	TARIKH	T.T.	SKALA
				NTS

DIREKABENTUK : LEONARD CHUA YAW CHOON
DILUKIS : RAJA KHAIRUL ZAKI BIN RAJA DAUD
DISEMAK : AZIZAN BIN ZAINAL
NO FAIL : JKR.CKASJ/09.700/070/02

PENGARAH KANAN : DATO' IR. DR. ABDUL AZIZ BIN HJ. ARSHAD
PENGARAH (KHIDMAT PAKAR) : KAMALUDDIN BIN HJ. ABDUL RASHID
KETUA PENOLONG PENGARAH KANAN : IR. DR. LIM CHAR CHING
PENOLONG PENGARAH KANAN : HANAFI BIN ABDULLAH

PROJEK : STANDARD CONCRETE REPAIR DRAWING
TAJUK : TYPICAL CONCRETE PATCH REPAIR
NO. LUKISAN : CKASJ.BFJ/SRD/2010/01
TARIKH : NOVEMBER 2012