DEPARTMENT OF BUILDING SURVEYING
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CAWANGAN PERAK
KAMPUS SERI ISKANDAR

CRACK ON REINFORCEMENT CONCRETE BEAM (COMPLETE)

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DIPLOMA IN BUILDING SURVEYING

PRACTICAL TRAINING REPORT

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ABSTRACT

Practical training at the Jabatan Kerja Raya Daerah Melaka Tengah, and placed in the Building Department. The introduction of firm organization and repairing work. Describe or exposure the projects and maintenance works being undertaken by the firm. This company as one of the government building to serve all the people for planning, implementing and maintaining infrastructure development for State and Federal Governments at the state and district levels in Melaka State such as street, Baghs, Ports, Bridges and others. This study is conducted to identify types of crack on Reinforcement concrete beam occur in building , to identify causes of building defect occur in building and the repairing work that have be do on the site. The study area is located at Sekolah Jenis Kebangsaan Cina , Sungai Udang Melaka. The methodology adopted is through literature review and interview with the contractor and our supervisor in-charge. The data are collected through questionnaire that had been distributed to the parties involve in repairing work. Types and causes of defect also can be identified according to survey that has been done to people that involve in repairing work at the site.

ACKNOWLEDGEMENT

Firstly, I'm are so grateful and I want to say “Alhamdulillah” with honour to ALLAH S.W.T because give me strength and full commitment to do this task. Besides that, I'm also want to thanks a lot to Jabatan Kerja Raya Daerah Melaka Tengah because received practical in this company. I'm training to advance my knowledge about case study at Sekolah Jenis Kebangsaan Cina Sungai Udang,Melaka.

Again, the most important appreciation I'm dedicate to our honorable lecturer En Mohd Khazli Aswad Bin Khalid and supervisor in-charge at Jabatan Kerja Raya Daerah Melaka Tengah is En Mohd Hafiz bin Abd Khalib because they never tired to give an information and guidance to us.

Besides that, I'm also would like to express our appreciation to, staff and workers at the office company that give co-operation during this research and got a lot of input in my report. Last but not least, I'm also would like to thanks to other friends and all staff that give me more information about this assignment and always support from behind. Also not forgetting my parents who have given a lot of moral support and encouragement.

Sincerely,

Thank you.

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ABBREVIATIONS

JKR	Jabatan Kerja Raya
RC	Reinforcement
RCC	Reinforced Cement Concrete
SJKC	Sekolah Jenis Kebangsaan Cina

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APPENDICES

CHAPTER 1
INTRODUCTION

1.1 Introduction

Jabatan Kerja Raya Daerah Melaka Tengah located at Jalan Taming Sari,Peti Surat 96,(P.O.BOX 96) 75906,Melaka.Goverment development was establish 1974.The department is responsible for planning, implementing and maintaining infrastructure development for State and Federal.In addition, the JKR Melaka Tengah also serves as a technical advisor to the State Government and other agencies.Each explanation and complete information of the company about details of company at Jabatan Kerja Raya Daerah Melaka Tengah.

1.2 Details of Company Background

Figure 1.1 Jabatan Kerja Raya Daerah Melaka Tengah

Jabatan Kerja Raya (JKR) Melaka Tengah is one of the Melaka State Government agencies that headed by Mr. David Tan as Technical Assistant (Right) at 1 October 1974. Next, JKR Melaka Tengah was led by 14 Regional Engineers to this day..JKR Melaka Tengah contains 9 sections and 3 districts such as Administration and Finance Department,Street Department,Building Department,Mechanical Department,Quantity Surveying Deparment, Architecture Deparment,Corporate Deparment and Electric branch.

In Building Department at JKR Melaka Tengah the coordinating body acting as a planner, executor and supervisor of building projects within the State of Melaka for various customer departments. All activities are related to building construction projects and maintenance of State and Federal buildings.State Building Projects are divided into Public Works Department, Chief Minister's Department, State Development Department and Islamic Religious Department while the Federal Project consists of Ministry of Works, Ministry of Education, and other ministries.

Among the various departments of the department, the Department of Education is the department that most performs their projects through the Melaka Public Works Department. To facilitate the business, the 'Education Unit' is set up specifically to focus on the projects of the department.This section is headed by Principal Assistant Director. Others consist of Building Engineer, Assistant Engineer and Junior Assistant.

1.3 Vision,Mission And Objective

1.3.1 Vision

We will be a world class service provider and a center of excellence in asset management, project management and engineering services for the sake of national infrastructure development through creative and innovative human capital and the latest technology.

1.3.2 Mission

Jabatan Kerja Raya Melaka contributes to the Nationalization by:

- Assist customers in delivering policy and service outcomes through strategic partner collaboration.
- Define processes and systems for the sake of delivering consistent results.
- Provide effective and innovative asset and project management
- Empowering existing engineering competitions.
- Bringing new human capital and compentions
- Strive to integrity and deliver services.
- Build harmonious relationships and communities
- Maintain the environment in service delivery.

1.3.3 Objective

To provide infrastructure and public transportation to meet the needs of nationalization and always emphasize on:

- Submit a project that meets the quality, time and cost set.
- Timeframe as soon as possible.
- The best design and quality

1.4 Strategy To Achive The Objective At Jabatan Kerja Raya Melaka

- Mobilize administrative, service and technical affairs to be fully responsible for the relevant areas to achieve the best results.
- Ensure that the expenditure allocated to the department and project maintenance work is controlled and in line with the work intention.
- To supervise, supervise development programs, purchase of machinery, natural disaster emergency work, road signs and ceremonial supervision as well as official functions as planned.
- Promote social development activities and approaches with the general public at the local level and give a positive picture of the real role and function of the Jabatan Kerja Raya.

1.5 Quality Base Of Jabatan Kerja Raya Melaka

- The Malacca Public Works Department is committed to producing quality products that meet their customer satisfaction based on the best practices of professionalism.
- The Malacca Public Works Department will provide continuous improvement on the Quality Management System

1.6 Function Building Department At Jabatan Kerja Raya

In Jabatan Kerja Raya Melaka Tengah that contain building deparment that manage and coordinate the implementation of Federal building projects and coordinate the maintenance work of State government buildings.Its carry out small work requested by other departments .That provide technical advisory services to other government departments and Coordinate ISO 9001 at Melaka State JKR.

1.7 Logo Of Company

Figure 1.2 JKR logo

Logo Discription :

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 colors in this JKR Logo may have its own 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.

1.8 Company Organization Chart

1.8.1 Jabatan Kerja Raya Melaka Organization Chart

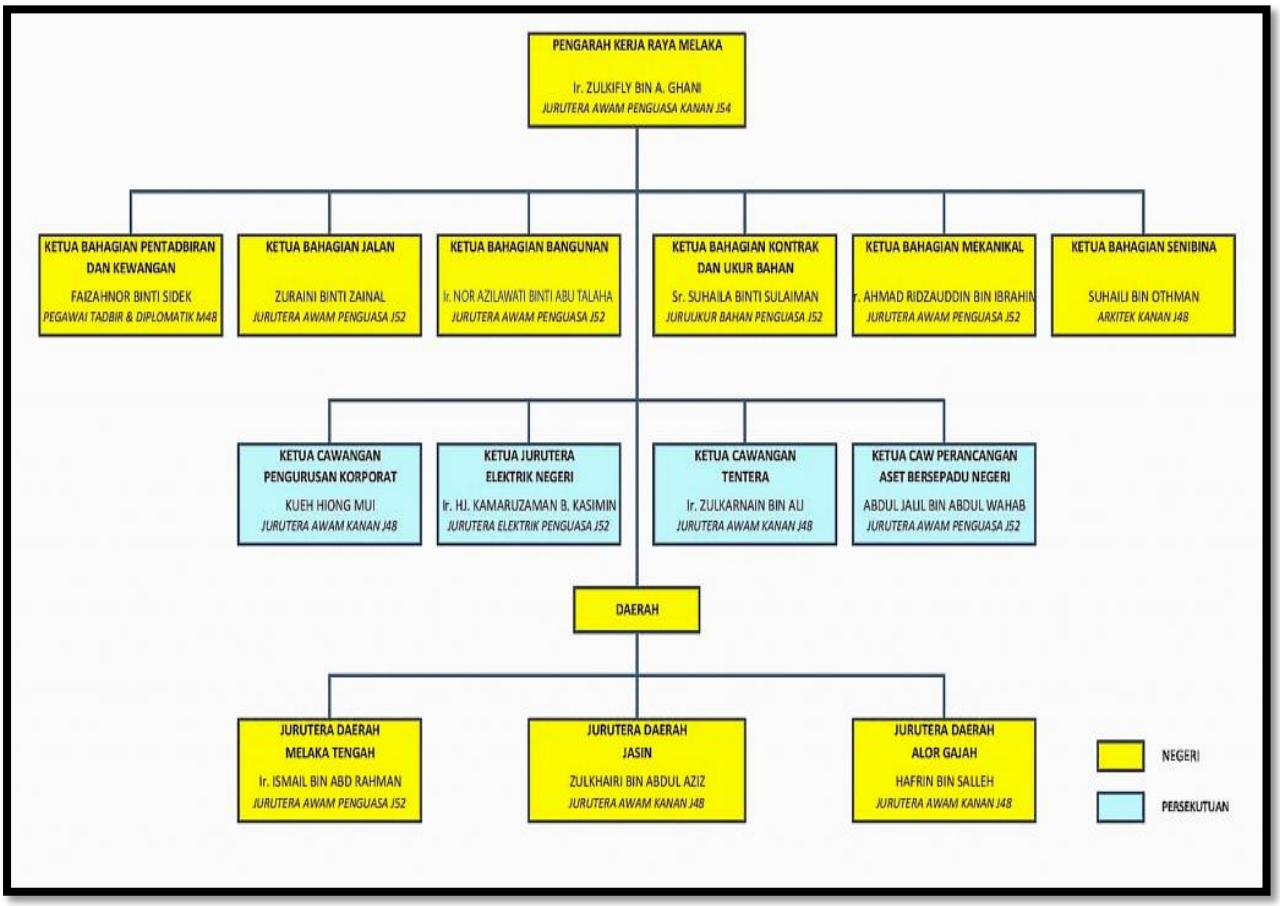


Chart 1.3 JKR Melaka organization chart

1.8.2 Jabatan Kerja Raya Daerah Melaka Tengah Organization Chart

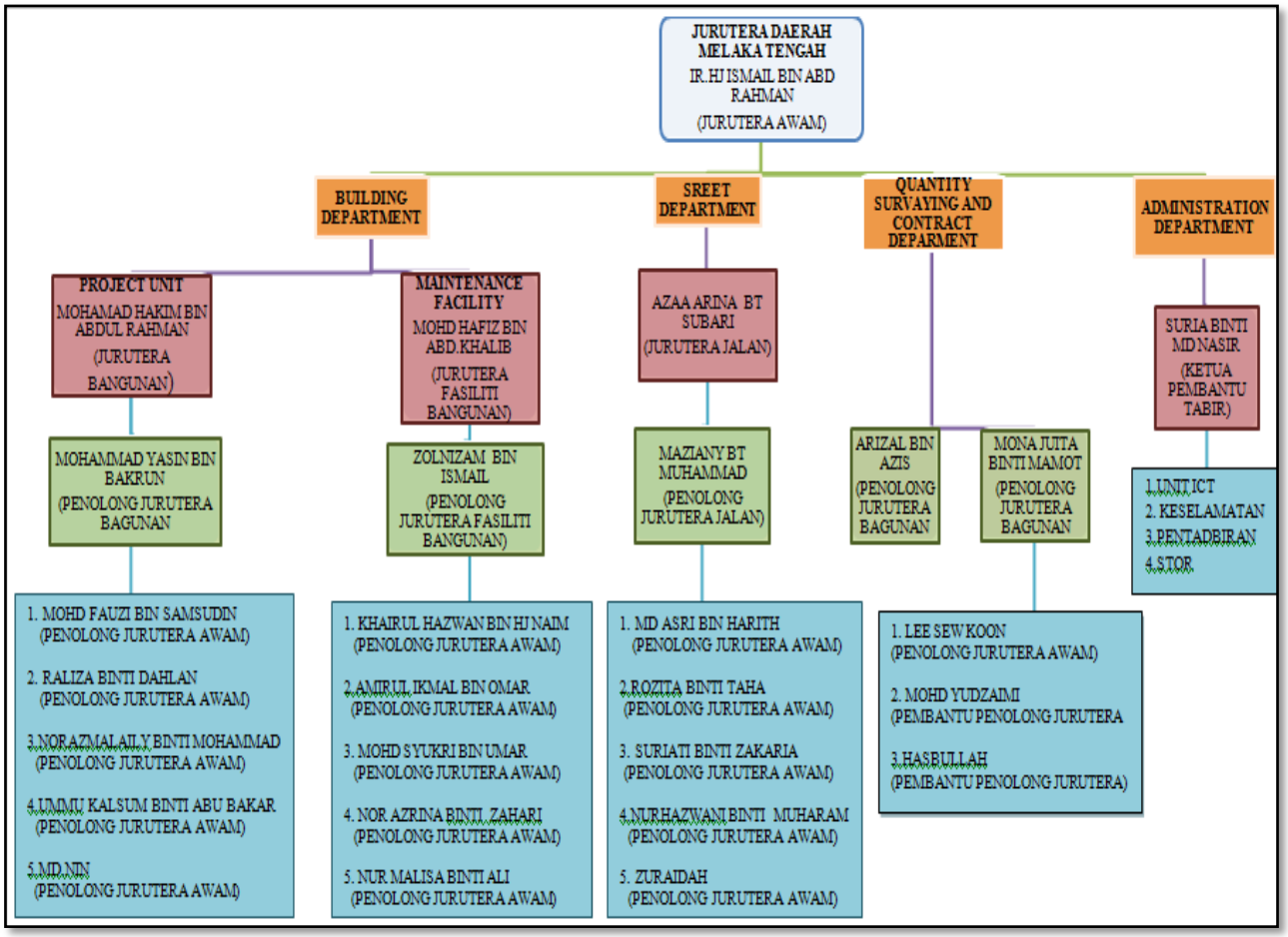


Chart 1.4 JKR Daerah Melaka Tengah Organization chart

1.8.3 Jabatan Kerja Raya Daerah Melaka Tengah (Building Department)

Organization Chart

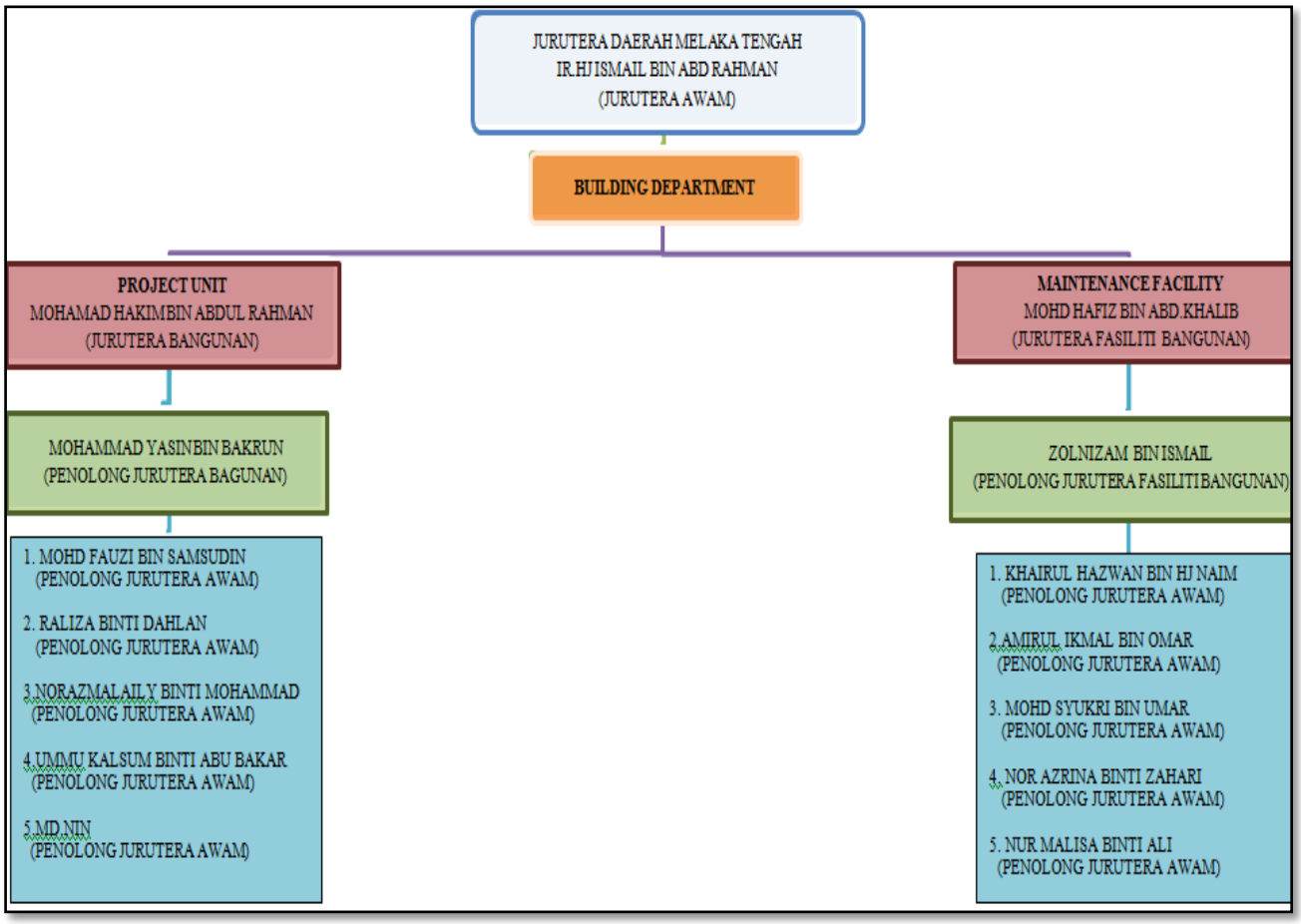


Chart 1.5 Building Department JKR Daerah Melaka Tengah

1.9 Scope Of Work Jabatan Kerja Raya Melaka

Table 1.1 Scope work JKR

DEPARTMENT	SCOPE OF WORK
Building Department	1. Project Implementation of State and Federal Building Projects From Early Planning Level Acceptance of Projects From Client to Account Closure Executed according to specification and standard of building work within completed period and set cost. 2. Implement structural design work for new project 3. Monitor and coordinate maintenance work of state building and several Fedral building. 4. Provide technical advice to the department and government agencies in need
Street Deparment	1. All street and bridge projects can be completed by specifying the specified duration. 2. All street and department structures are always safe for road users. 3. All street side development is implemented according to plan and set standards. Installation of public utilities in the street reclamation is in accordance with the standards set

DEPARTMENT	SCOPE OF WORK
Contract And Quantity Surveying Deparment	1. Implementation of quotation and verification of project payment 2. To provide expertise to other parts of JKR.Negotiation in the implementation of projevt,especially the emphasis on tender management and efficient contract administration of the project to be completed within the agreed time frame and cost.
Administration Department	**Administration** 1. To provide more efficient management and administration services in line with the Department objective in implementing the department functions or program 2. To compete with qualified and disciplined manpower. 3. Provide training to members to be qualified and capable of achieving the objective department. **Finance** 1. Manage administrative expenses or postal money or financial reports or salary or allowances or government loans 2. To provide a quality ,efficient and trustworthy and effective service to all customers in all matter relating to financial matter.

DEPARTMENT	SCOPE OF WORK
	Store 1. Purchase or storage or withdrawal or disposal of goods and assets **Security Service** 1. Controlling safety or traffic and premises **Driver** 1. Ensure the use of departmental vehicles is used as much as necessary and the safety of vehicles

Table 1.1 Scope work JKR

1.10 Building View

a) Front sight

Figure 3.3 Front view
JKR Daerah Melaka Tengah

b) Rear sight

Figure 1.4 Rear view
JKR Daerah Melaka Tengah

c) Left sight

Figure 1.5 Left sight JKR Daerah Melaka Tengah

d) Right sight

Figure 1.6 Right sight JKR Daerah Melaka Tengah

1.11 Location

1.11.1 Key Plan

This key plan shows the map of Malaysia where Melaka is Located at.

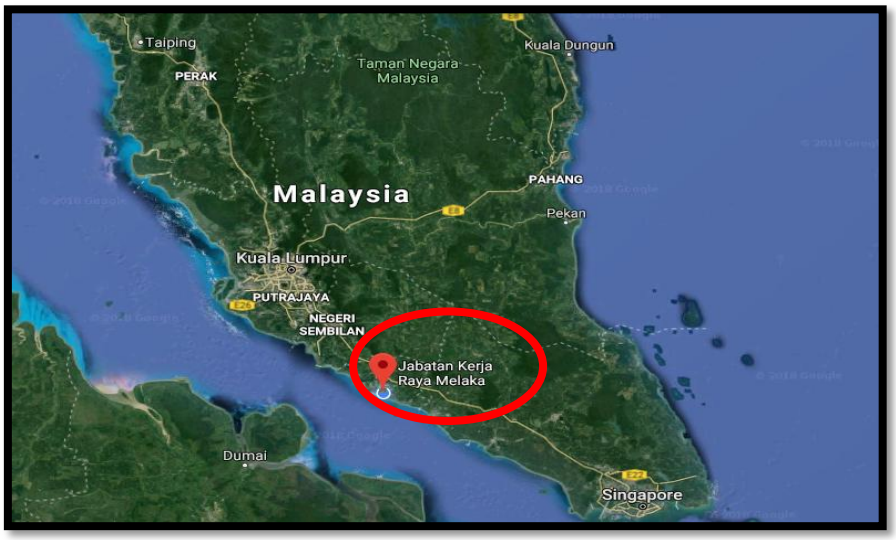


Figure 1.7 Key Plan

1.11.2 Location Plan

The location plan shows the map and exact location of Bandar Melaka

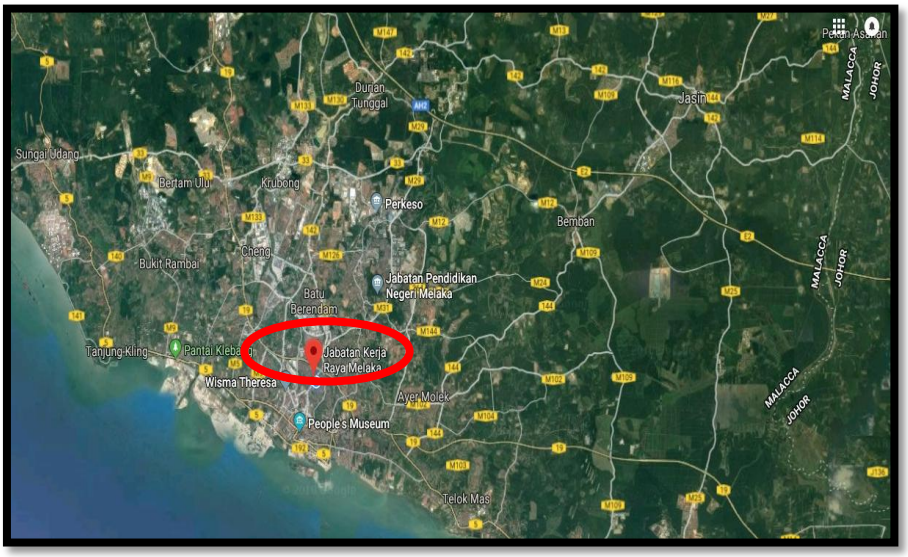


Figure 1.8 Location Plan

1.10.3 Site Plan

The site plan is to show the map of JKR Daerah Melaka Tengah building place

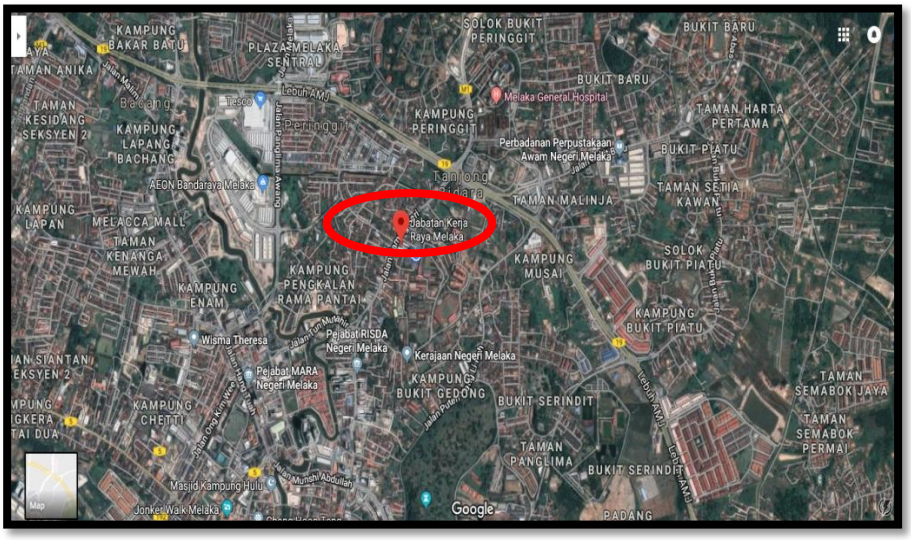


Figure 1.9 Site Plan

1.11.4 Radius 500m

With radius 500m JKR Daerah Melaka Tengah that near with Restoran Melaka FM,HQ Jabatan Kerja Raya Melaka,Jabatan Penyiran Malaysia, RTM Stesen Melaka FM,Shimfa Auto Sdn Bhd,Gabriet Sales & service,Restoran Mata Kucing

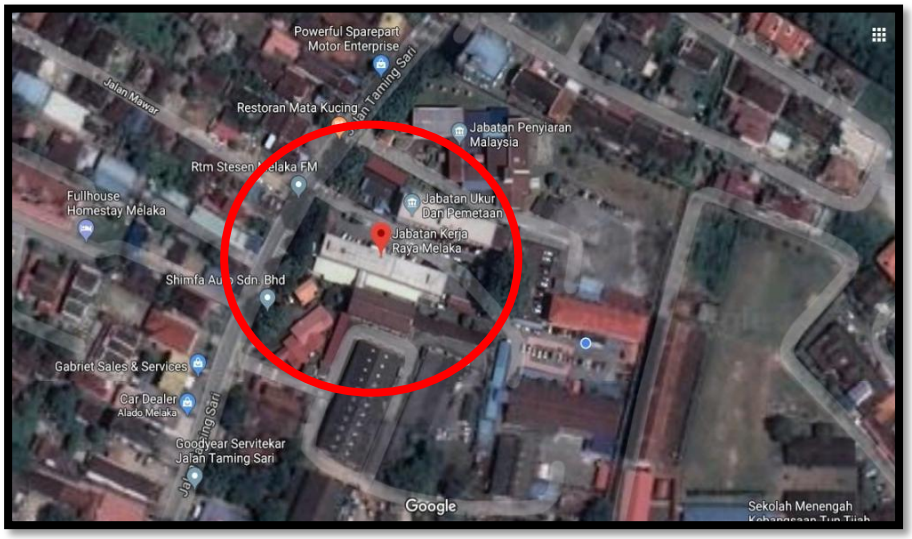


Figure 1.10 Radius 500m

1.12 Summary

Interview session with the in-charge person at the Jabatan Kerja Raya Daerah Melaka Tengah, and placed in the Building Department in maintenance facility unit .The introduction of firm organization background of JKR Daerah Melaka Tengah.Descibe the scope work every department on this companythat the staff take of their responsibility to serve service for customer satisfaction and how JKR that try to achive their vision,mission and their objective by follow their strategy.

CHAPTER 2 :
LITERATURE REVIEW

2.1 Introduction

A beam is a structural element that primarily resists loads applied laterally to the beam's axis. Its mode of deflection is primarily by bending. The loads applied to the beam result in reaction forces at the beam's support points. The total effect of all the forces acting on the beam is to produce shear forces and bending moments within the beam, that in turn induce internal stresses, strains and deflections of the beam. Beams are characterized by their manner of support, shape of cross-section, length, and their material.

Beams are traditionally descriptions of building or civil engineering structural elements, but any structures such as automotive automobile frames, aircraft components, machine frames, and other mechanical or structural systems contain beam structures that are designed to carry lateral loads are analyzed in a similar fashion.

Sources : Whitney, William Dwight, and Benjamin E. Smith."Beam" def. 1. The Century dictionary and cyclopedia. vol, 1. New York: Century Co., 1901

2.2 Type Of Beam

2.2.1 Reinforcement Concrete Beam

Figure 2.1 Reinforcement concrete beam

Reinforced concrete beams are structural members that support the transverse load which usually rest on supports at its end. Girder is a type of beam that supports one or more smaller beam

2.2.2Universial Beam

Figure 2.2 Universial Beam (I-Beam)

An I-beam, also known as H-beam (for universal column, UC), w-beam (for "wide flange"), universal beam (UB), rolled steel joist (RSJ), or double-T, is a beam with an I or H-shaped cross-section. The horizontal elements of the "I" are known as flanges, while the vertical element is termed the "web".

2.2.3Trussed Beam

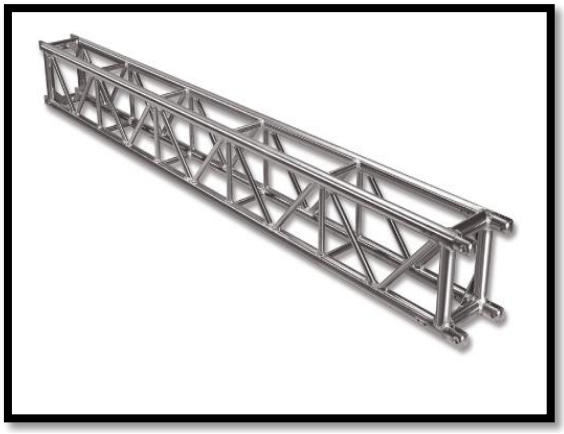


Figure 2.3 Trussed Beam

A trussed beam or girder forms the transition between the truss and the solid-web girder. Less connecting rods are needed, but this generally results in bending stress for the compression chord.

2.2.4 Hip beam

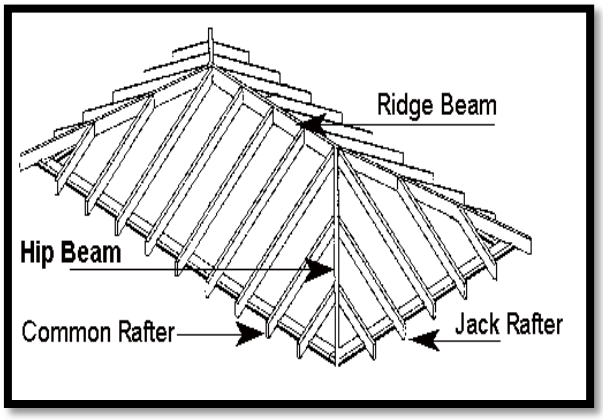


Figure 2.4 Hip Beam

Hip beam designs are popular in roofing designs. A hip beam provides support for other load bearing beams branching off at symmetrical angles. This design is often used in residential construction.hipor valley beam by entering the span length and the pitch of the two roofs that are coming together. StruCalc will then determine the slope adjusted actual length of the beam, behind the scenes Structure calculation also calculates the loading that the beam feels, and the size of the member.

2.2.5 Composite beam

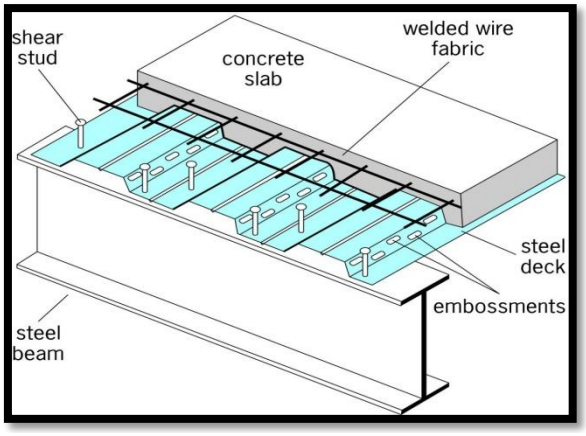


Figure 2.5 Composite beam

A structural member composed of two or more dissimilar materials joined together to act as a unit. An example in civil structures is the steel-concrete composite beam in which a steel wide-flange shape (I or W shape) is attached to a concrete floor slab (see illustration). The many other kinds of composite beam include steel-wood, wood-concrete, and plastic-concrete or advanced composite materials–concrete. Composite beams as defined here are different from beams made from fiber-reinforced polymeric material.

There are two main benefits of composite action in structural members. First, by rigidly joining the two parts together, the resulting system is stronger than the sum of its parts. Second, composite action can better utilize the properties of each constituent material. In steel-concrete composite beams, for example, the concrete is assumed to take most or all of the compression while the steel takes all the tension.

2.2.6 Bridge beam

Figure 2.6 Bridge beam

Beam bridges , also known as stringer bridges, are the simplest structural forms for bridge spans supported by an abutment or pier at each end. No moments are transferred throughout the support, hence their structural type is known as simply supported.

Simplest beam bridge could be a log, a wood plank, or a stone slab laid across a stream. Bridges designed for modern infrastructure will usually be constructed of steel or reinforced concrete, or a combination of both. The concrete elements may be reinforced, prestressed or post-tensioned. Such modern bridges include girder, plate girder, and box girder bridges, all types of beam bridges.

Source : A.J.Clark,Introduction to beam Structural Design,2002

2.3 Type Of Reinforcement Concrete Beam Support

2.3.1 Simple Concrete Beams

Simple concrete beam refers to the beam having a single span supported at its end without a restraint at the support. Simple beam is sometimes called as simply supported beam. Restraint means a rigid connection or anchorage at the support.

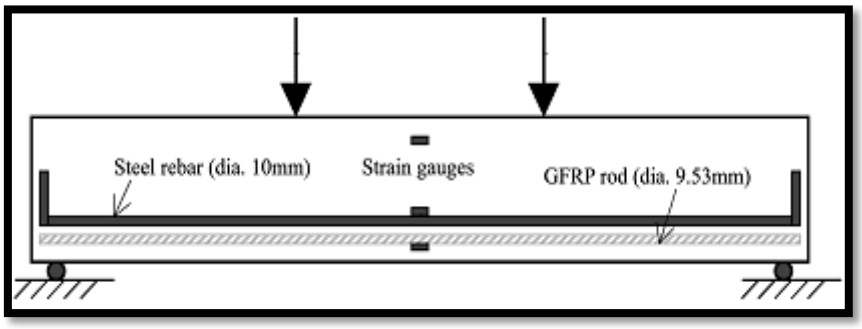


Figure 2.7 Simply supported beam

2.3.2 Continuous Beam

It is a beam that rest on more than two supports. It can be a single beam provided for long span between columns or walls with intermediate supports of smallar beams or a single continuous beam for entire length of the structure with intermediate column or wall supports.

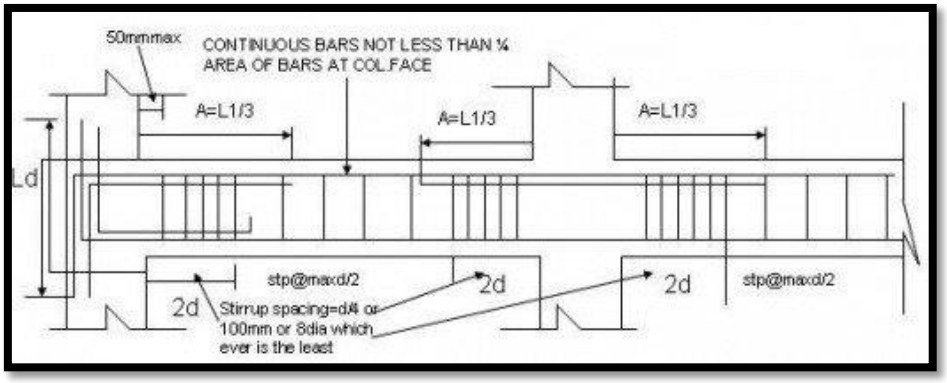


Figure 2.8 Continuous beam with reinforcement details

2.3.3 Semi-Continuous Beam

Refers to a beam with two spans with or without restraint at the two extreme ends.

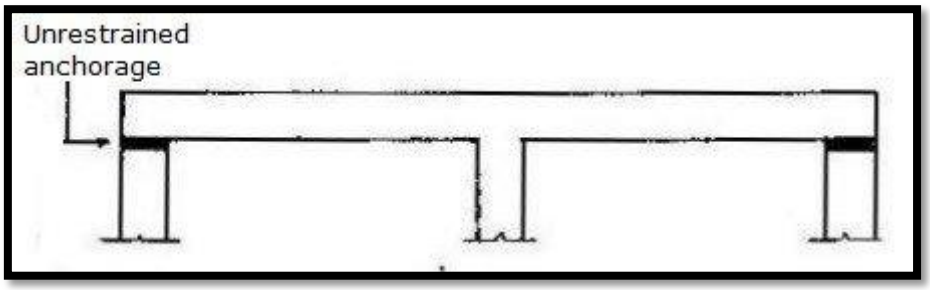


Figure 2.9 Semi-continuous beam

2.3.4 Cantilever Beam

Cantilever beams are supported on one end and the other end projecting beyond the support or wall.

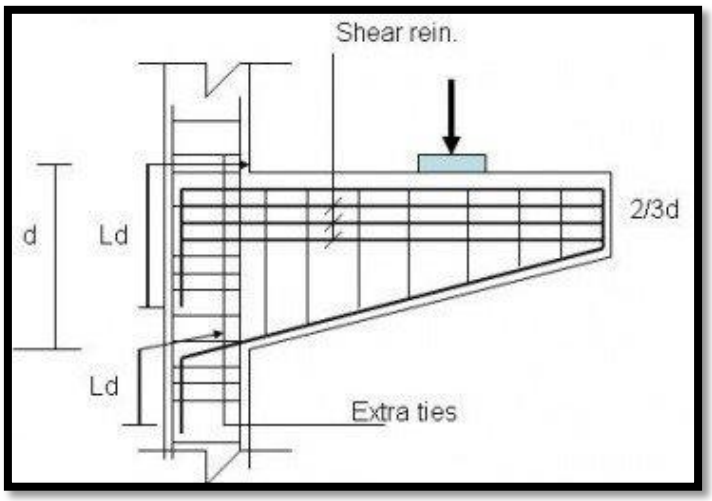


Figure 2.10 RCC Cantilever beam reinforcement details

2.3.5 T – Beam

When floor slabs and beams. are poured simultaneously producing a monolithic structure where the portion of the slab at both sides of the beam serves as flanges of the T-Beam. The beam below the slab serves as the web member and is sometime called stem.

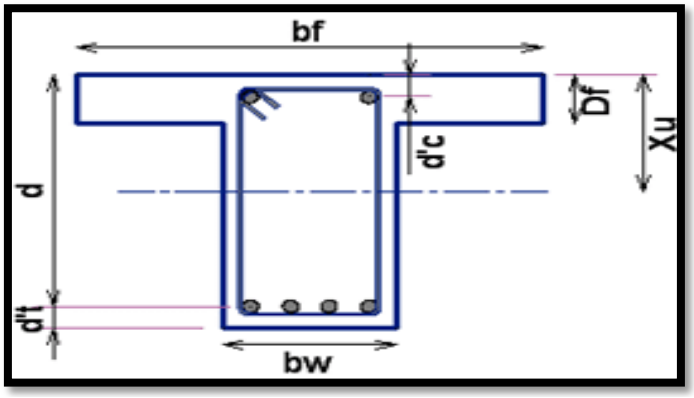


Figure 2.11 RCC T-beam

Source : A.J.Clark,Introduction to beam Structural Design,2002

2.4 Construction work for Reinforcement Concrete Beam

Table 2.1 RC Beam Construction work

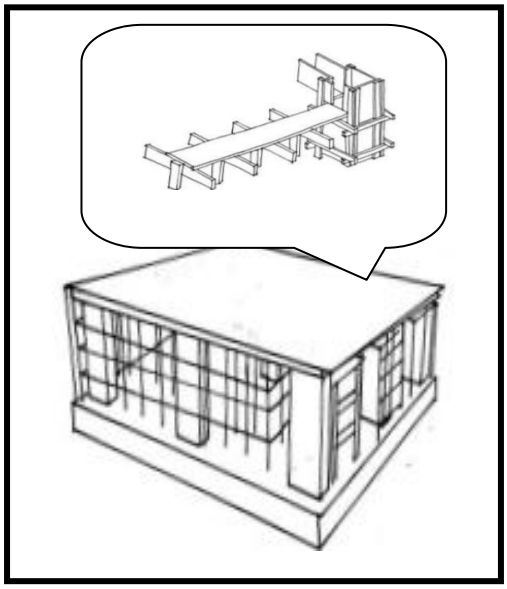
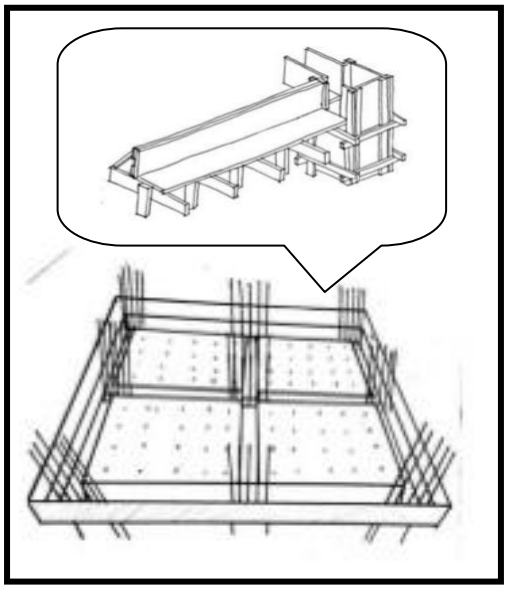
FIGURE	PROCESS CONSTRUCTION WORK
1. Set up beam  Figure 2.12 Soffit of beam set up	• Erect the props and support,set up the soffit of beam
2. Construction Formwork  Figure 2.13 construction formwork	• Construct formwork for the side of beam.Cover block are provided for slabs and beam

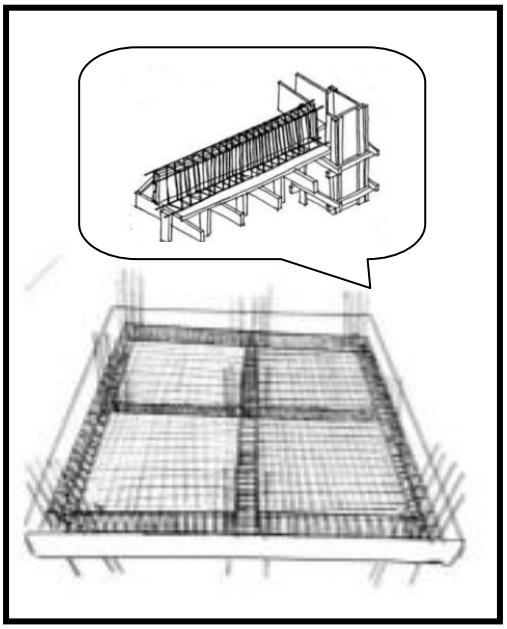
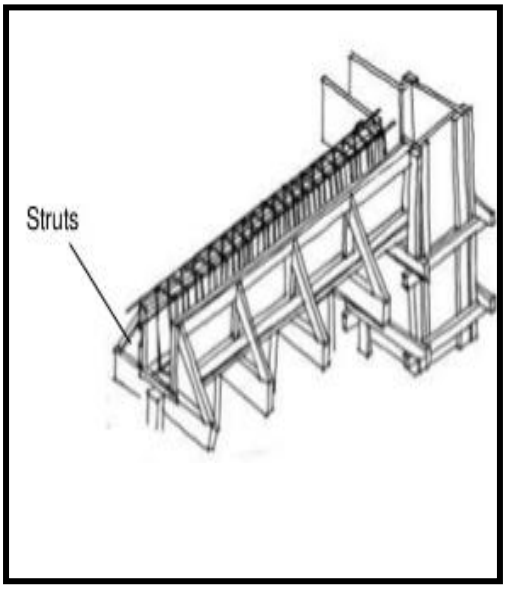
FIGURE	PROCESS CONSTRUCTION WORK
3. Place steel reinforcement  Figure 2.14 place steel reinforcement	• Place the steel reinforcement to be fixed and anchored into the column
4. Eract side beam formwork  Figure 2.15Eract other side beam formwork	• Eract the other side of the beam formwork,and complete with struts for extra support

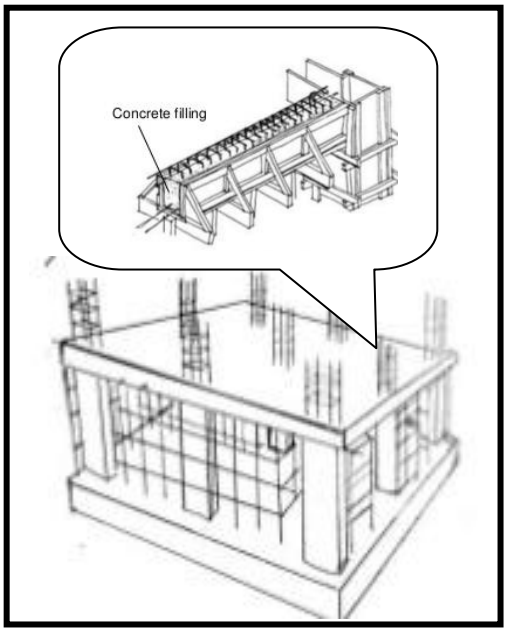
FIGURE	PROCESS CONSTRUCTION WORK
5. Concrete filling  Figure 2.16 concrete filling	• Pour the concrete into formwork processof 28 days,the formwork would be remove.

Table 2.1 RC Beam Construction work

Source : By Charles Casandjian, Noël Challamel, Christophe Lanos, Jostein Hellesland ,Reinforced Concrete Beams, Columns and Frames, ,2013

2.5 Reinforcement Beam Detail

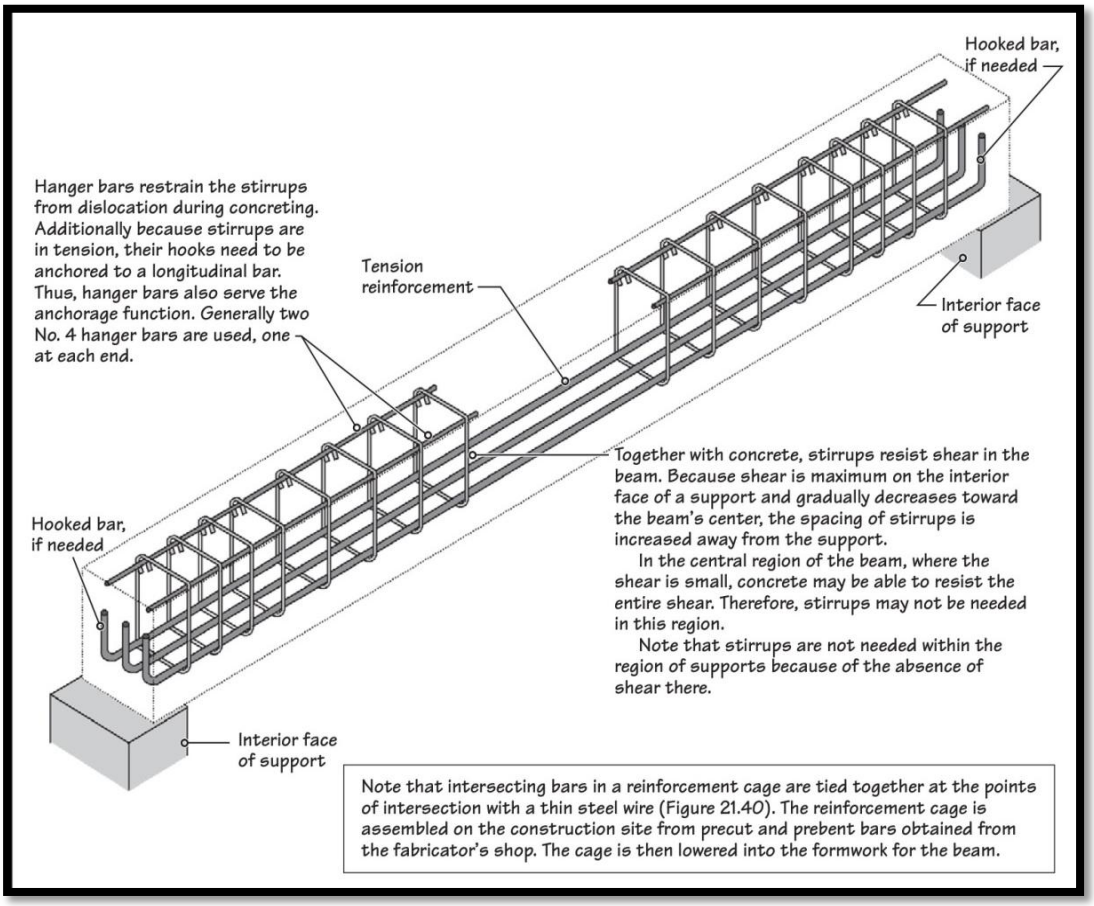


Figure 2.17 Reinforcement Beam Detail

Sources : American Concrete Institute, Manual of standard practice for detailing reinforced concrete structures, ACI 315-65, 1965

2.6 Definition Crack On Reinforcemenet Concrete Beam

The occurrence of various crack patterns in the building mostly takes place during construction and or after completion. A building component develops cracks whenever the stress in the components exceeds its strength. Stress in the building component is caused by externally applied forces/loads.Almost all the types of cracks in Reinforced Concrete Beams are fundamentally defined by the principle cause or mechanism associated with the function of cracks.

Reinforced concrete structures have found wide application in the construction industry. Like other construction materials, reinforced concrete has limited strength characteristics. When these limiting values are exceeded, the structure may fail. Fracture of concrete usually occurs as the process of nucleation and growth of cracks. Initially the crack formation does not lead to complete loss of the carrying capacity of the structure, but it can be considered as a fracture precursor. Knowledge of the crack nucleation process is important to ensure early prediction of emergency situations and prompt use of techniques to restore damaged reinforced concrete structures.

Source : By Zihai Shi,Crack Analysis in Structural Concrete: Theory and Applications,1987

2.7 Type Crack On Reinforcement Concrete Beam

The occurrence of various crack patterns in the building mostly takes place during construction and or after completion. A building component develops cracks whenever the stress in the components exceeds its strength. Stress in the building component is caused by externally applied forces/loads.

Almost all the types of cracks in Reinforced Concrete Beams are fundamentally defined by the principle cause or mechanism associated with the function of cracks.

2.7.1 Flexure Cracks in Reinforced Concrete Beams:

Flexure word also means "Bending". Cracking in reinforced concrete beams subjected to bending usually starts in the tensile zone i.e. soffit of the beam. The width of flexural cracks in reinforced concrete beams for short-term may stay narrow from the surface to the steel. However, in long-term under continuous loading, the width of crack may get increased and become more uniform across the member.

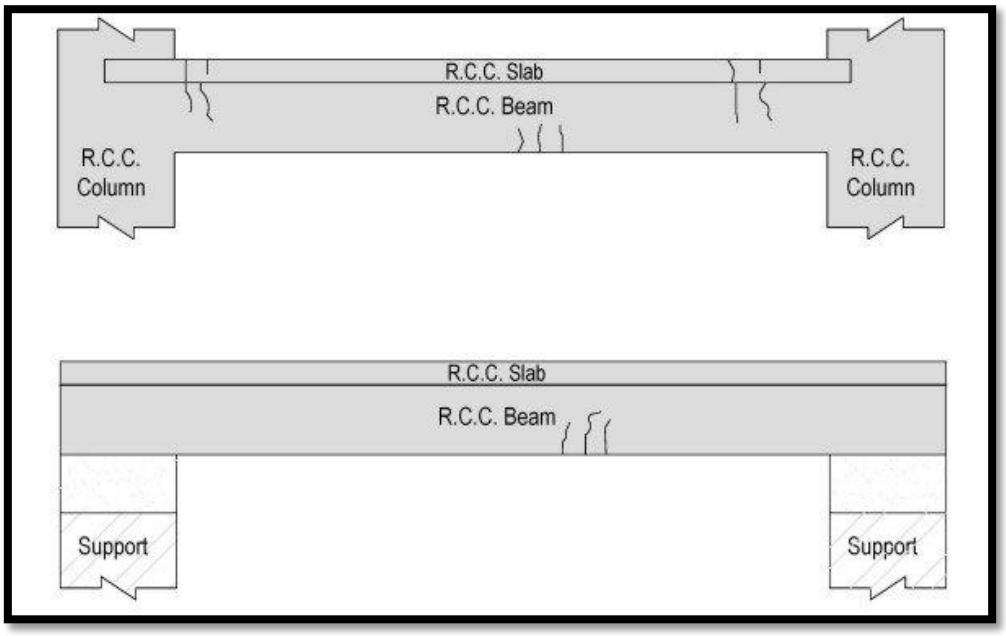


Figure 2.18 Flexure Crack

2.7.2 Shear Cracks in Reinforced Concrete Beams:

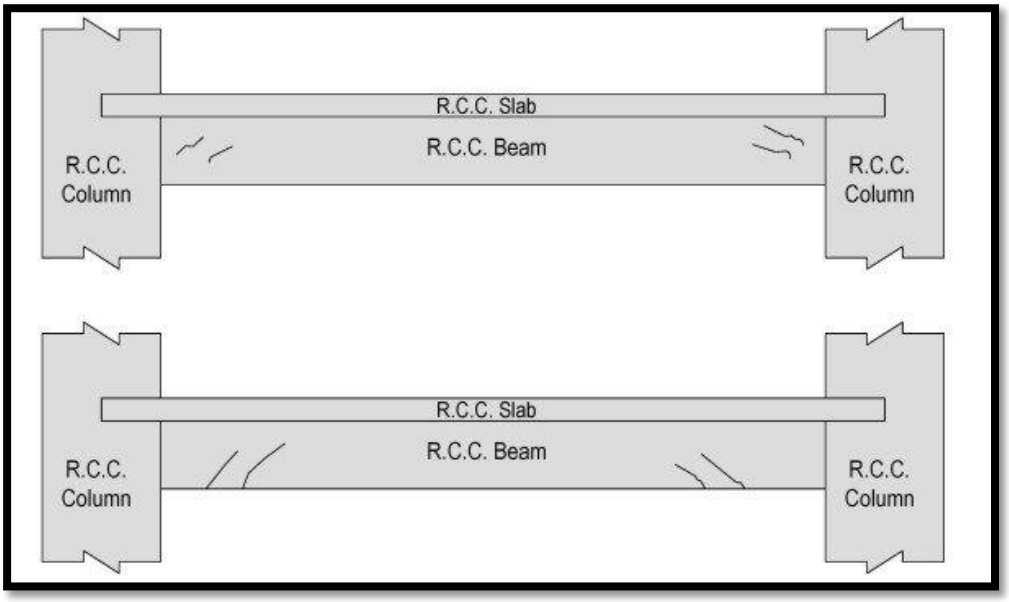


Figure 2.19 Shear Crack

Shear cracks in reinforced concrete beams occurs in hardened stage and it is usually caused by structural (self weight) loading or movement. These types of cracks are better illustrates as diagonal tension cracks due to combined effects of flexural (bending) & shearing action.The most important possible of shear cracks is Shear Capacity of the beam is inadequate,cross section or torsional reinforcement insufficient and both here happen due to loading more than designed load.

2.7.3 Torsional Cracks in Reinforced Concrete Beams:

Usually, beams are subjected to torsion along with bending moment and shear force. Bending moment & shear force occurs as loads acts normal to the plane of bending. However, loads away from the bending plane will cause torsional movement.Most possible reasons isTorsional strength of the beam is inadequate.and cross-section or torsional reinforcement insufficient

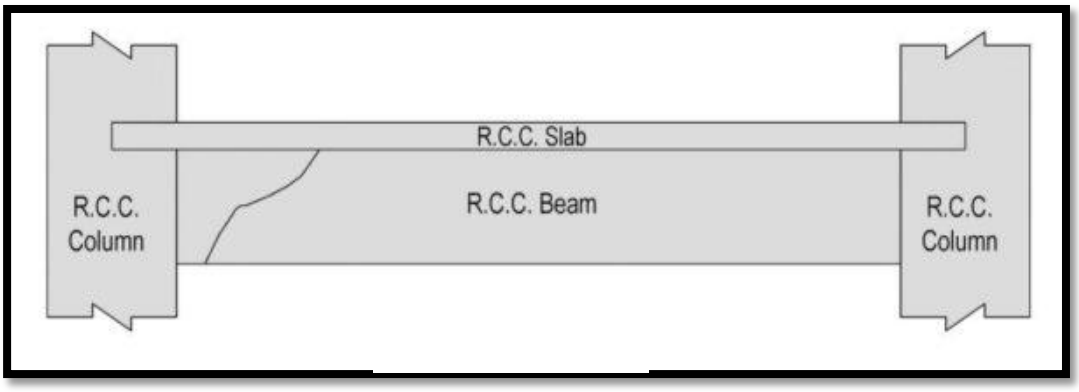


Figure 2.20 Torsion Crack

2.7.4 Corrosion Cracks in Reinforced Concrete Beams:

Corrosion crack or bond crack is can be possible resond that bond between reinforcing bars and concrete not satisfactory and may be due to corrosion of bars or fire damage.Corrosion cracks in reinforced concrete beams run along the line of reinforcement. It usually separates the concrete from reinforcing bars. It is mostly manifested by discolouration of paint or stains of rust.

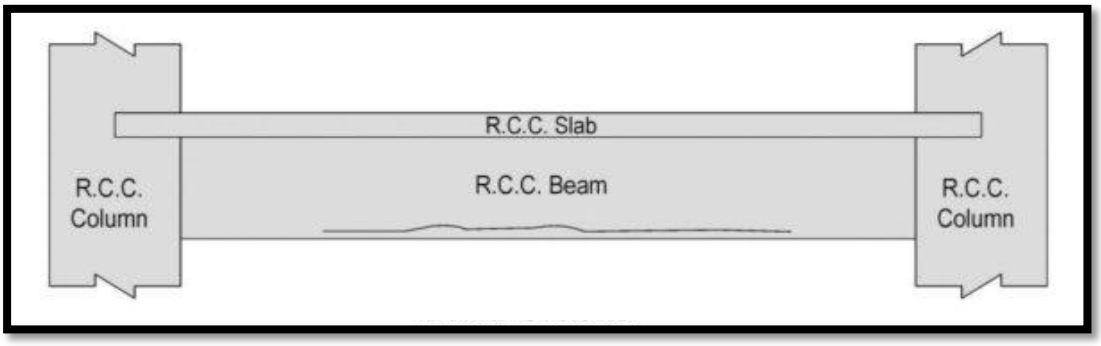


Figure 2.21 Bond Crack

2.7.5 Shrinkage Cracks in Reinforced Concrete Beams:

Shrinkage cracks in reinforced concrete beams occur during two stages, which are a pre-hardening stage and hardened stage. In pre-hardening stage, these types of cracks are called as plastic shrinkage cracks & in the hardened stage they are known as drying shrinkage cracks. Shrinkage cracks occur when fresh concrete is subjected to a very rapid loss of moisture.This shrinkage due to curing is inadequate or no control over water-cement ratio,Usage of excessively rich mix and shrinkage reinforcement, if any, insufficient.

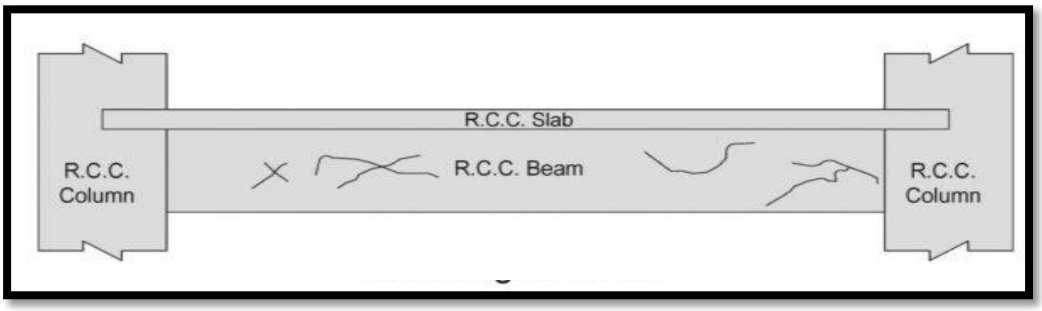


Figure 2.22 Shrinkage Crack

2.7.6 Sliding Cracks in Reinforced Concrete Beams:

The diagonal mode of failure by sliding along the critical cracks is known as a failure by sliding and usually appears at the edge of the supports of the beam. These types of concrete cracks appear if concrete gets disturbed in a fresh state.

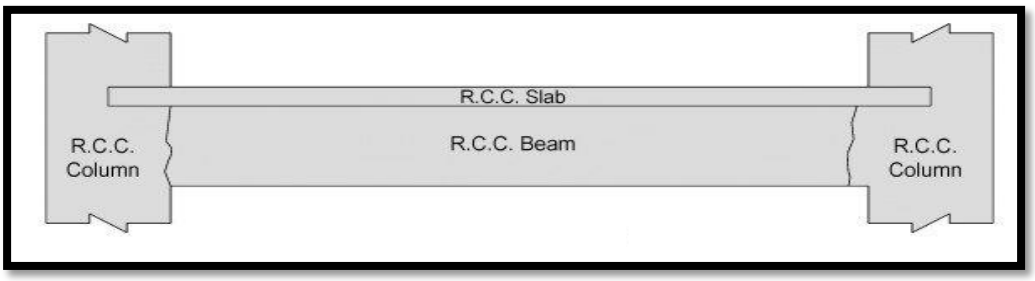


Figure 2.23 Sliding Crack

2.7.7 Tension Cracks in Reinforced Concrete Beams:

Tension cracks in reinforced concrete beams occur usually due to shrinkage or temperature variations. Tension cracks usually appear in those members where restraint is provided in the longitudinal movements. Usually, tension cracks tend to propagate over the full depth of the cross-section of beam.Tension crack is appear over the whole periphery. Generally over the whole length of the member that parallel to each other and uniformly observed.The possible resons tension crack due capacity of the member in tension is inadequate and tensile reinforcement is insufficient.

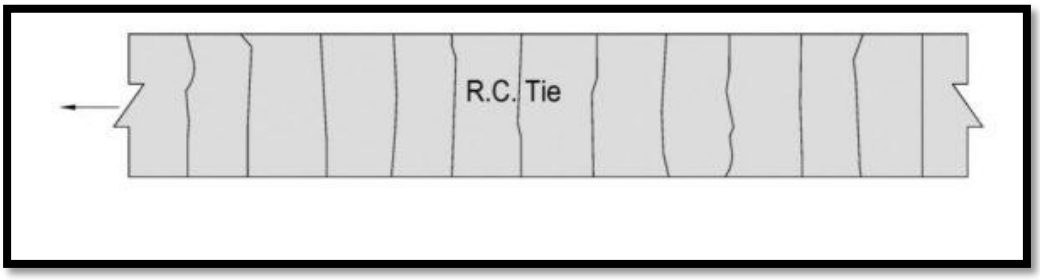


Figure 2.24 Tension Crack

Source : G. D Base,An investigation of the crack control characteristics of various types of bar in reinforced concrete beams,1966 Part 1

2.8 Method Statement

2.8.1 General structural crack repair by epoxy injection

Table 2.2 Method by epoxy injection

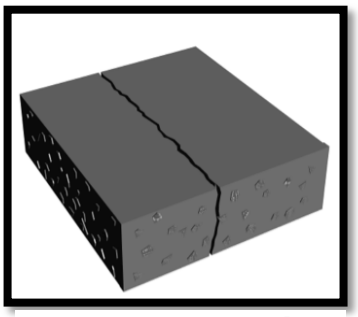
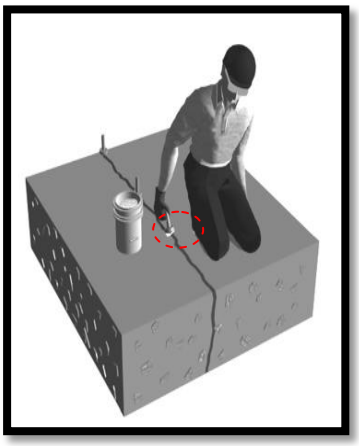
FIGURE	TOOLS AND EQUIPMENT	REPAIR PROCEDURE
1. Surface area  Figure 2.25 Crack surface area	 Figure 2.26 Wire brush	• Clean the surface area with wire brushing about ½ in (13mm) wide on each side of the crack.Contaminants can also be removed by high-pressure water,'oil-free' compressed air or power vacuums
2. Port Installation  Figure 2.27 Port Installation	 Figure 2.28 Entry port	• Port installation by install the entry ports only after proper surface preparation.There are two types of entry ports are available for the injection process,first is surface mounted and socket mounted. • Entry port can be any tubelike device that provides for the successful transfer of the epoxy resin under pressure into the crack. • Proprietary injection guns with special gasketed nozzles are also available for use without port adaptors.Port spacing typically 8 in.(40mm) on centre.

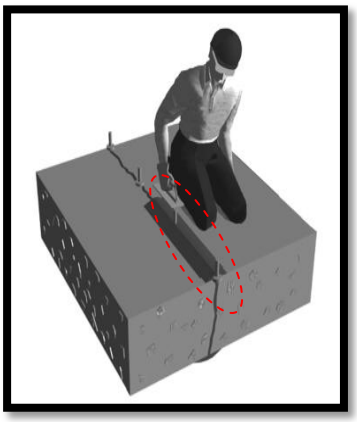
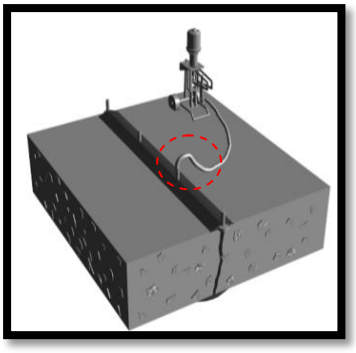
FIGURE	TOOLS AND EQUIPMENT	REPAIR PROCEDURE
3. Install Cap Seal  Figure 2.29Install cap seal	 Figure 2.30 Cap seal	• Install the cap seal that must properly installed,the cap seal contains the epoxy as it is injected under pressure into the crack. • When the cracks penetrate completely through a section,cap seals perform best when installed on both sides of the cracked element , ensuring containment of the epoxy. • Cap seals have been successfully installed using epoxies , polyesters , paraffin wax,and silicone caulk
4. Pump by Epoxy Injection  Figure 2.31 Epoxy injection	 Figure 2.32 Epoxy pump	• Inject the epoxy.For the successful epoxy injection,start with proper batching and mixing of epoxy components in strict accordance with the manufacturer's requirement. • Start the injection at the widest section of a horizontal crack.(Be sure to locate and mark these areas before installing the cap seal)Vertical crack are typically injected from bottom up.

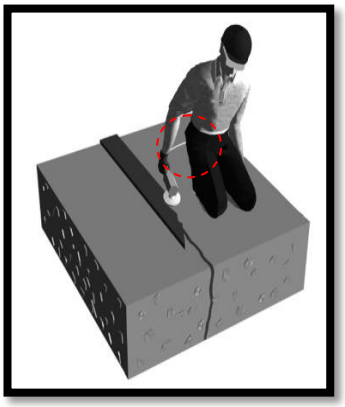
FIGURE	TOOLS AND EQUIPMENT	REPAIR PROCEDURE
		• Continue the injection until refusal.If an adjencent port start bleeding,cap the port being injected and continue injection at the furthest bleeding port.
5. Remove port and cap seal  Figure 2.33 Remove port and cap seal	 Figure 2.34 metabo grinder	• Upon completion of the injection process,remove the ports and cap seal by heat , chipping , or grinding.If the appearance is not objectionable to the client , the cap seal can be left in place.If complete removal is required for a subsequent application of cosmetic coating,prepare the concrete surface by griding.

Table 2.2 Method by epoxy injection

Source : By Brian F.Keane ,ACI Committee ,2009, "Field Guide to Concrete Repair Application Procedures.

2.8.2 General structural strenghtening work

Table 2.3 Method strengthening work

FIGURE	TOOLS AND EQUIPMENT	REPAIR PROCEDURE
1. Prepare surface  Figure 2.35 Prepare MapeWrap	 Figure 2.36 Roller	• Prepare and apply Mapewrap primer 1 onto the clean and dry concrete surface with a roller or brush.
2. Smooth surface  Figure 2.37Smooth surface using MapeWrap	 Figure 2.38 notched trowel	• For the smooth over the surface using Mapewrap primer 11 apply while it is still “fresh”, apply 1 cm thick layer using notched trowel,then smooth over the surface using a flat trowel to completetely remove light imperfection.

FIGURE	TOOLS AND EQUIPMENT	REPAIR PROCEDURE
3. Apply mapewrap  Figure 2.39 apply MapeWrap	 Figure 2.40 short haired roller	• Prepare and apply mapewrap 31 approximately 0.5mm with brush or short haired roller over the still fresh
4. Place Mapewrap  Figure 2.41 Place Mapewrap	 Figure 2.42 aluminium roller	• Place mapewrap C uni-ax as fabric over the still fresh,ensuring no wrinkles are present.Pass over an aluminium roller with worm screw in order to completely eliminate any air bubbles formed during application

Table 2.3 Method strengthening work

Source :MAPEI,MapeWrape C UNI-AX and MapeiWrap C UNI-AX HM,2014

2.8. General method to check the repairing structural crack

To ensure that injection has been successful,quality anssurance measure may include test cores or non-destructive evaluation (NDE)

Table 2.4 Method To Check The Repairing Structural Crack

METHOD	TOOLS &EQUPMENT	PROCEDURE
1. Test Core  Figure 2.43 Sample core test	 Figure 2.44 Coring Machine	• Core location should be chosen to avoide cutting reinforcing steel , drilling cores in area of high stress , or creating core holes below the waterline. The engineer should determine core locations when these types of conditions exist. • Be sure the epoxy has set before extracting a core • Take core (normally 2 in. (50 mm) to check that penetration of the epoxy is adequate. • Inspect the core visually to determine the penetration of the epoxy into the crack.

METHOD	TOOLS &EQUPMENT	PROCEDURE
2. Nondestructive evaluation  Figure 2.45 Non destructive testing	 Figure 2.46 Megnetic particle	• Impact echo (IE) • Ultrasonic pulse velocity (UPV) • Spectral analysis of surface waves (SASW)

Table 2.4 Method To Check The Repairing Structural Crack

Source : By Brian F.Keane ACI Committee ,2009, "Field Guide to Concrete Repair Application Procedures.

2.9 General tools for structural crack repairing work

2.5 Table General Tool

TOOLS	FUNCTION
1.  Figure 4.47 Wire brush	• Wire brush is used for cleaning or finishing different types of metals. • Durable cutting capability make them most appropriate to apply on hard surfaces such as concrete, metal, stone and wood. • Used for cleaning rust and removing paint. • to clean surfaces and to create a better conductive area for attaching electrical connections.
2.  Figure 2.48 epoxy pump	• Pump to the packer during the injection take place. • Contain chemical epoxy resin
3.  Figure 2.49 Metabo Grider	• Hand held power tool used for grinding(abrasive cutting) and polishing • For removing excess material from a piece • Has large bearings to counter side forces generated during cutting, unlike a power drill, where the force is axial.

TOOLS	FUNCTION
4.  Figure 2.50 roller brush	• A paint roller is a paint application tool used for painting large flat surfaces rapidly and efficiently.
5.  Figure 2.51 trowel	• Used by masons for leveling, spreading, and shaping cement plaster , and mortar.
6.  Figure 2.52 Aluminium rolller	• To completely eliminate any air bubbles formed during application
7.  Figure 2.53 coring machine	• To remove a cylinder of material, much like a hole saw • Core drills are used frequently in mineral exploration where the coring may be several hundred to several thousand feet in length.

TOOLS	FUNCTION
8.  Figure 2.54 magnetic particle	• For detecting surface and shallow subsurface discontinuities in ferromagnetic materials such as iron, nickel, cobalt, and some of their alloys.

2.5 Table General Tool

Source : by Samson K.Y. WONG Building Diagnostic Tests as Assessment Tools,2013

2.10 Summary

For the litreture review using secondary data by reference books , Journals , and Magazine.That state of the Beams are traditionally descriptions of building or civil engineering structural elements, and reinforced concrete structures have found wide application in the construction industry.That listed the procedure of construction beam process and the defect that been occur on reinforcement concrete beam.The method of repairing work that state the comman and general repairing procedure for repairing crack on reinforcement concrete beam.

CHAPTER 3
CASE STUDY

3.1 Introduction of case study

Figure 3.1 Sekolah Jenis Kebangsaan Cina Sungai Udang,Melaka

The project aims to do repairing works at Sekolah Jenis Kebangsaan Cina Sungai Udang,Melaka. This school build on 2002.At December 2015,the principle of SJKC Sungai Udang,Melaka,Cik Tan Kim Hoon make complaints letter to Jabatan Kerja Raya Daerah Melaka Tengah (JKR) .JKR do inspection, that found have crack on two reinforcement concrete beam at 4th floor 3M classroom.After JKR Daerah Melaka Tengah do that inspection, that decide do repairing work on April 2018.That hire out source contractor from Quickcorn Specialist Sdn Bhd to do this repairing work. This repairing work it done almost 1 month.The overall cost contract for this repairing works is RM 221,500.00.

3.2 Location Of Site

Figure 3.2 Location SJKC Sungai Udang Melaka

SJKC Sungai Udang Melaka,located at No. 1, Sungai Udang, Melaka, 76300.With radius 500m SJKC Sungai Udang Melaka near with Shell Sungai Udang,Klinik Kesihatan Sungai Udang,Sg Udang Ho Hup Tranding Sdn Bhd,SK Kem Terendak II and SK Sungai Udang.

3.3 Objective

- Identify and evaluate structural damage
- Evaluate the level of safety of the structural structure
- Checks on other damage to the structural component in the same location
- Submit appropriate repair recommendations

3.4 Methodlogy Of Inspection

- Conduct visual inspection of the structure of the building
- Discussions with all relevant parties namely representatives of JKR Daerah Melaka Tengah and SJKC Principal of Sungai Udang Melaka
- Reviewing the structure of the roof beam structure of the building

3.5 Procedure inspection crack on reinforcement concrete beam

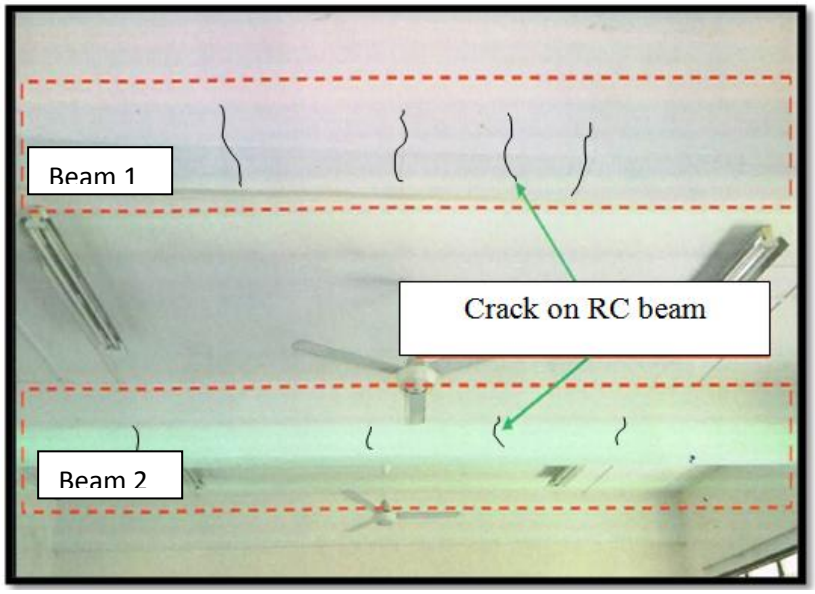


Figure 3.3 Crack on beam location

From the inspection at Sekolah Kebangsaan Jenis Cina Sungai Udang Melaka , at 4th floor 3M class, two of the reinforcement concrete beam size 230mm x 550mm (Refer appendix A for structure floor plan) have flexural crack on beam that the inability of the beam to accommodate the overloaded load.The causes isconstruction of beams that do not follow the specification to the design and grade of non-standard concrete.

JKR was take action to hire specialist from out source contractor for do this repairing work.That suggest to do repairing work structural crack by epoxy injection and strengthening work by use carbon plate and carbon wrap.

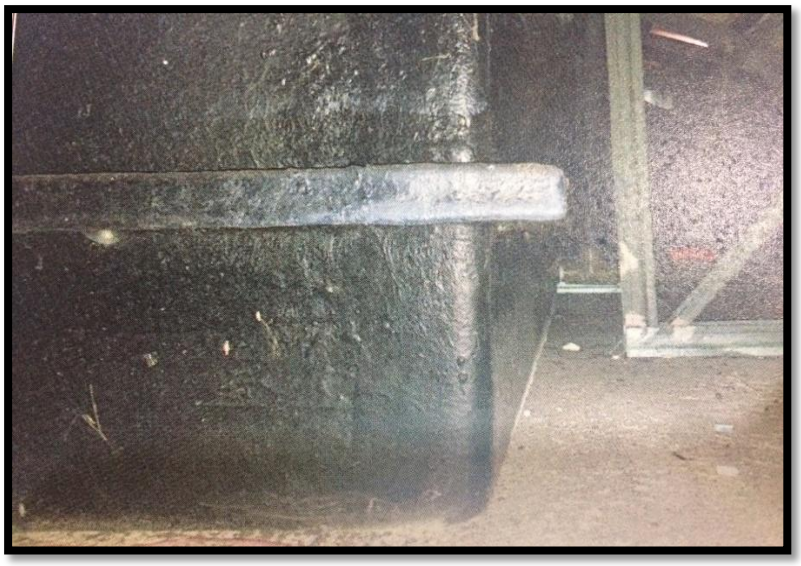


Figure 3.4 Water tank on beam

There are four tanks placed on a four-panel slab taken by the beamthat make the beam cant support the load from that four water tank.(Refer appendix B for roof structure plan)

Figure 3.5 After hacking the surface

For the further inspection on the beam is made by breaking the beam surfaces by hacking the beam crack location to identify the depth of the cracking. The cracking occurs only on the layers and has not yet impacted the structure.

3.6 Drawing Plan Location Of Reinforcement Concrete Beam Crack

The drawing plan show that the location of four-panel slab taken by the beam.That only two crack on the beam.

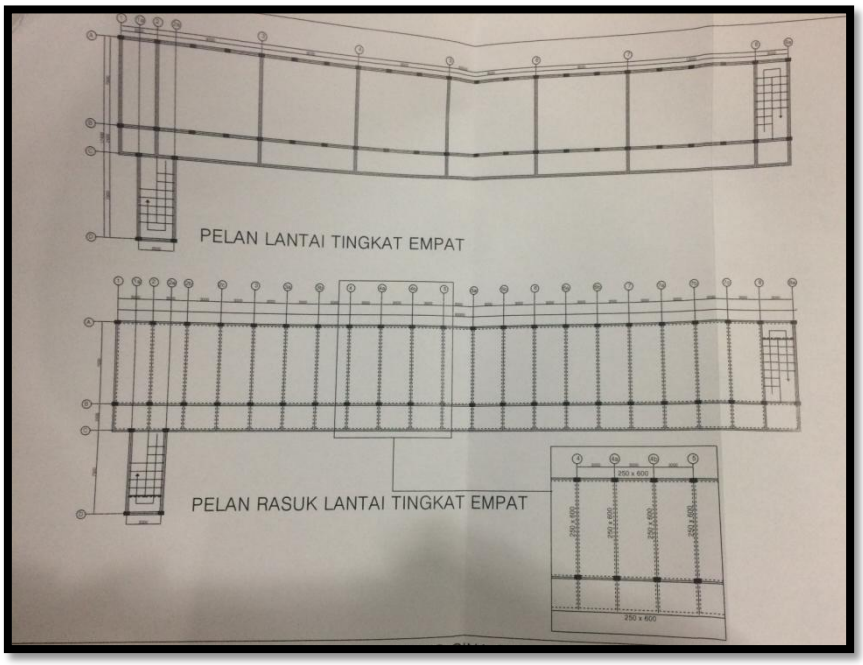


Figure 3.6 Drawing plan RC Beam

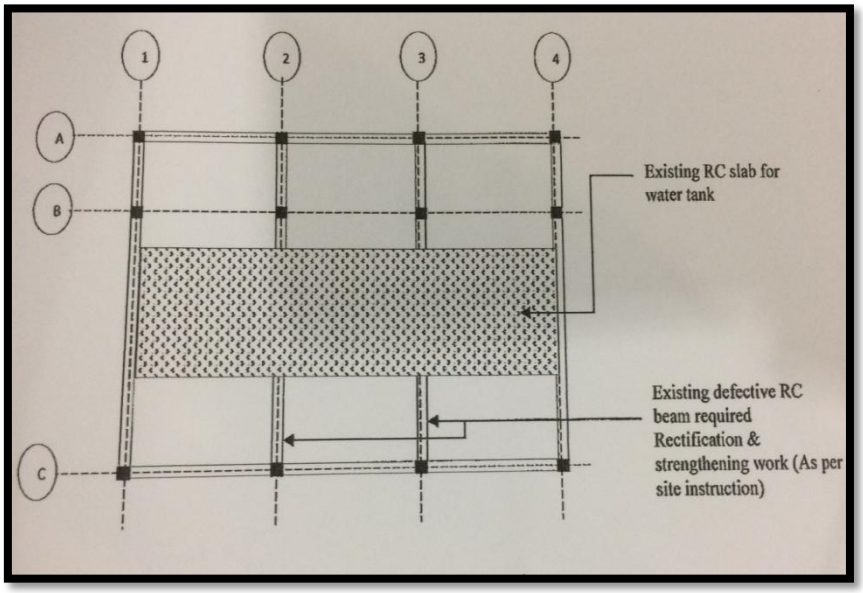


Figure 3.7 Drawing Plan RC Beam

3.7 Analysis of the structure

Conducting material test against cracking on the beam

3.7.1 Method to analysis crack on Reinfrocement Concrete Beam

Table 3.1 Method Analysis structural works

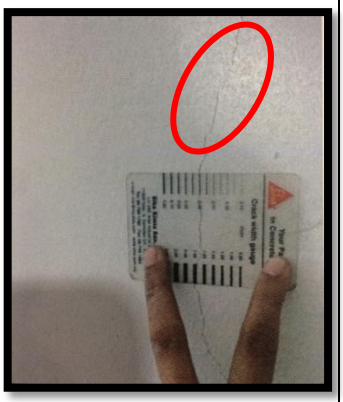
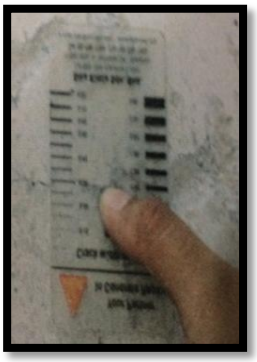
FIGURE	TOOLS& EQUPMENT	PROCEDURE
1. Crack Mapping  Figure 3.8 crack mapping  Figure 3.9 location crack	 Figure 3.10crack width gauge	• Visually observed cracks that appeared at or nearby the affected location of building • Identified the type of cracks whether it is structural or non-structural cracks • Take the dimension of crack with reading 0.7 for the width • Mapping the cracks into the drawing details.

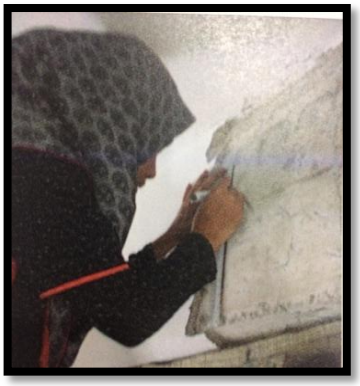
FIGURE	TOOLS& EQUPMENT	PROCEDURE
2. Rebound Hammer Test  Figure 3.11 Rebound Hammer Test  Figure 3.12 Rebound Hammer Test	 Figure 3.13 Rebound Hammer	• The concrete surface should be smooth , clean and dry. • Rebound hammer test should no be conducted on rough surfaces as a result of incomplete compaction , loss of grout , spalled or tooled concrete surface. • The point of impact of rebound hammer on concrete surface should be at least 20mm away from edge or shape discontinuity. • Hold the instrument firmly so that the plunger is perpendicular to test surface. • Gradually push the instrument toward the test surface until the hammer impact. • After impact , maintain pressure on the instrument and if necessary , depress the button on the side od the instrument to lock the plunger in its retracted position. • Read the rebound number on the scale to nearest whole number and record the rebound number.

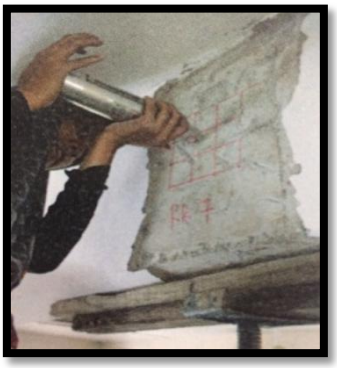
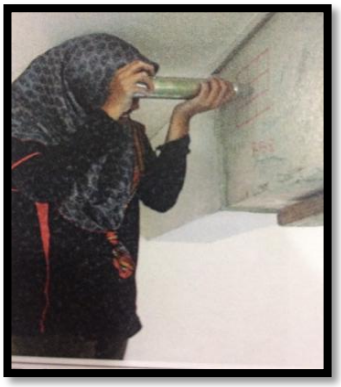
FIGURE	TOOLS& EQUPMENT	PROCEDURE
 Figure 3.14 Rebound Hammer Test  Figure 3.15 Rebound Hammer Test		• Examine impression made on the surface after impact , and if the impact crushes or breaks through a near-surface air void , disregard the reading and take another reading. • Nine reading of rebound number are taken at each point of testing and average of value of the reading is taken as rebound index for the corresponding point of observation on concrete surface.(Refer Appendix C for reading rebound hammer test)

FIGURE	TOOLS& EQUPMENT	PROCEDURE
3. Ferroscan test  Figure 3.16 Ferroscan Test	 Figure 3.17 Hilti Ferroscan Machine	• Determine location RC beam element to perfom scanning image. • Plot grid to RC element. • Scan the embedded reinforcement bar by using Hilti Ferroscan , image to transferred and analysed.(Refer appendix D for imagescan result)
4. Reinforcement bar inspection  Figure 3.18 Reinforcement Bar After Hacking  Figure 3.20 Width For RC Bar	 Figure 3.19 Hacker Machine  Figure 3.21 Vernier Caliper	• Hacking the concrete cover of beam and hack to etract embedded reinforcement bar • using a vernier scale, the user first reads the finely marked "fixed" scale on reinforcement bar by using vernier caliper

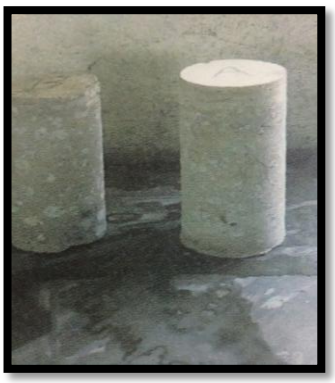
FIGURE	TOOLS& EQUPMENT	PROCEDURE
5. Core compressive test  Figure 3.22 After Core  Figure 3.23 Core Sample	 Figure 3.24 Coring Machine	• Determine location to perfom core sampling. • Place coring machine in position , perform coring on to structural element to abstract sample for analyzing. • Grout the cored hole with non shrink grout • The core sample be carried to laboratories for analysis.The analysis take time almost 7 day. • The result of core is comply with their requirement of coring test.

Table 3.1 Method analysis structural works

3.8 Remedial works for crack on reinforcement concrete beam

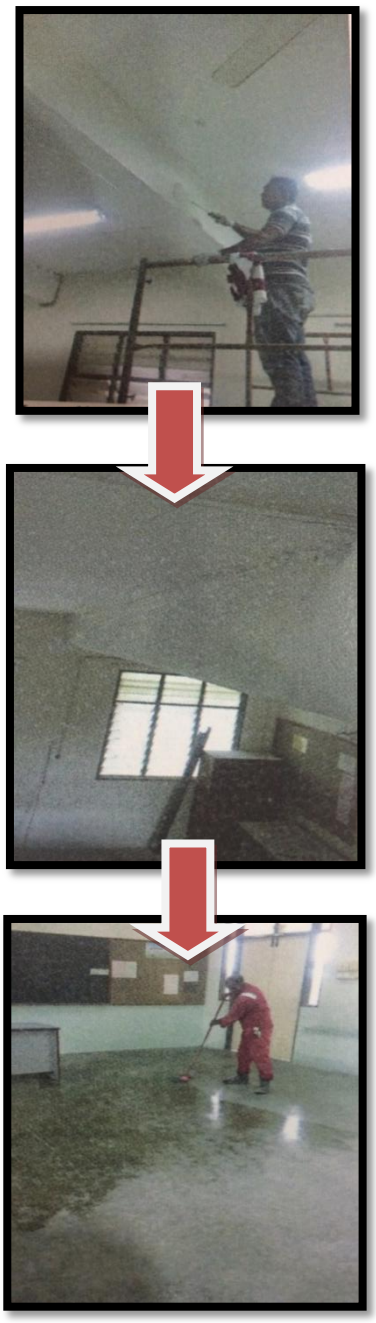
Table 3.3 Remedial work crack on RC Beam

FIGURE	TOOLS& EQUIPMENT	REMEDIES WORK
1. Surface preparation  Figure 3.25 Surface After Scrap	 Figure 3.26 Putty Knife	• Surface preparation , clean and scrap the surface area with putty knife
2. Crack injection 	 Figure 3.28 Steel Brush  Figure 3.29 Epoxy Pump	• Clean the entire concrete surface (along crack line) by steel brush .Remove dust from concrete surface by using electric air blower. • Apply epoxy bonding agent onto the crack surface and around mechanical packer. • Adhere the 1st packer atthe very bottom level of the crack line.The 2nd packer to be apart from 1st packer that depend on width of the beam and follow by the 3rd and 4th packer.

FIGURE	TOOLS& EQUIPMENT	REMEDIES WORK
Crack injection  Figure 3.27 After Injection By Epoxy	 Figure 3.30 Packer  Figure 3.31 Metabo Grinder	• Apply 2mm thick x 50mm wide epoxy bonding agent surrounding the packer and also along the crack surface.This is to prevent the epoxy resin from flowing out during the injection take place.Allow the bonding agent to set for at least 1 day. • Place the injection kit in position at 1st packer and start pumping.During the injection take place , trapped air will be forced out through the 2nd packer and allow the epoxy resin to fill up gaps in crack. • Plug out the air-relief stopper from the 2nd packer and move to 3rd packer.Continue the pumping procedure until the entire gap is fully filled with the epoxy resin. • Allow at least 7 days full cure before removing the adhesive packer by grinder(Refer appendix E for sample diagram of epoxy injection plan)

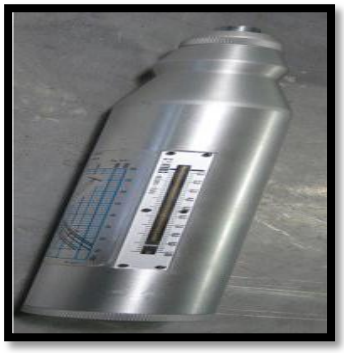
FIGURE	TOOLS& EQUIPMENT	REMEDIES WORK
3. Strenghtening works 	 Figure 3.33 Electric Air Blower  Figure3.34 Carbon Plate	• Remove dust from concerte surface by using electric air blower. • Pour adhesive part B into part A and mix with a drill fitted with a stirrer until the resin is completely even. • After mixing , the product remains workable for approximately 40 miniutes 23’c. • The fabric must be placed over the concrete element that needs to be repaired or reinforced , without leaving any wrinkles. • After the carbon plate dry , set up the surface for wrap up the side and soffit beam.

FIGURE	TOOLS& EQUIPMENT	REMEDIES WORK
Strenghtening works    Figure 3.32 After complete strenghtening work	 Figure3.35 Carbon Wrap  Figure 3.36 Roller Brush	• Apply Mapewrap primer (carbon plate) . • apply 1 cm thick layer using notched trowel,then smooth over the surface using roller brush • Place carbon wrap as fabric over the still fresh and justify with roller brush.(Refer appendix E for strengthening work RC Beam Plan)

FIGURE	TOOLS& EQUIPMENT	REMEDIES WORK
4. Cleaning Work  Figure 3.37Repaint and cleaning area	 Figure 3.38 Roller Brush  Figure 3.39 White Paint  Figure 3.40 Mop	• Repair the coring area before. • Replaster the beam , undercoat with 1 layer and repaint with 2 layer white colour. • Clean the class from any debris using broom and mop

3.9 Tools on Site

Table 3.4 Tools on site

TOOLS	FUNCTION
 Figure 3.41 Crack Width Gauge	• For deterimined the gap of cracks by using crack width gauge • Use external crack • Suitable for vertical and horizontal movement measurements. • Can get accurancy reading measure
 Figure 3.42 Rebound hammer test	• Used to provide a convenient and rapid indication of the compressive strength of concrete. • Can get automatic reading
 Figure 3.43 Hilti Ferroscan Machine	• Accurately find rebar in concrete • Estimate rebar size and depth of concrete cover required for non-destructive structural inspection

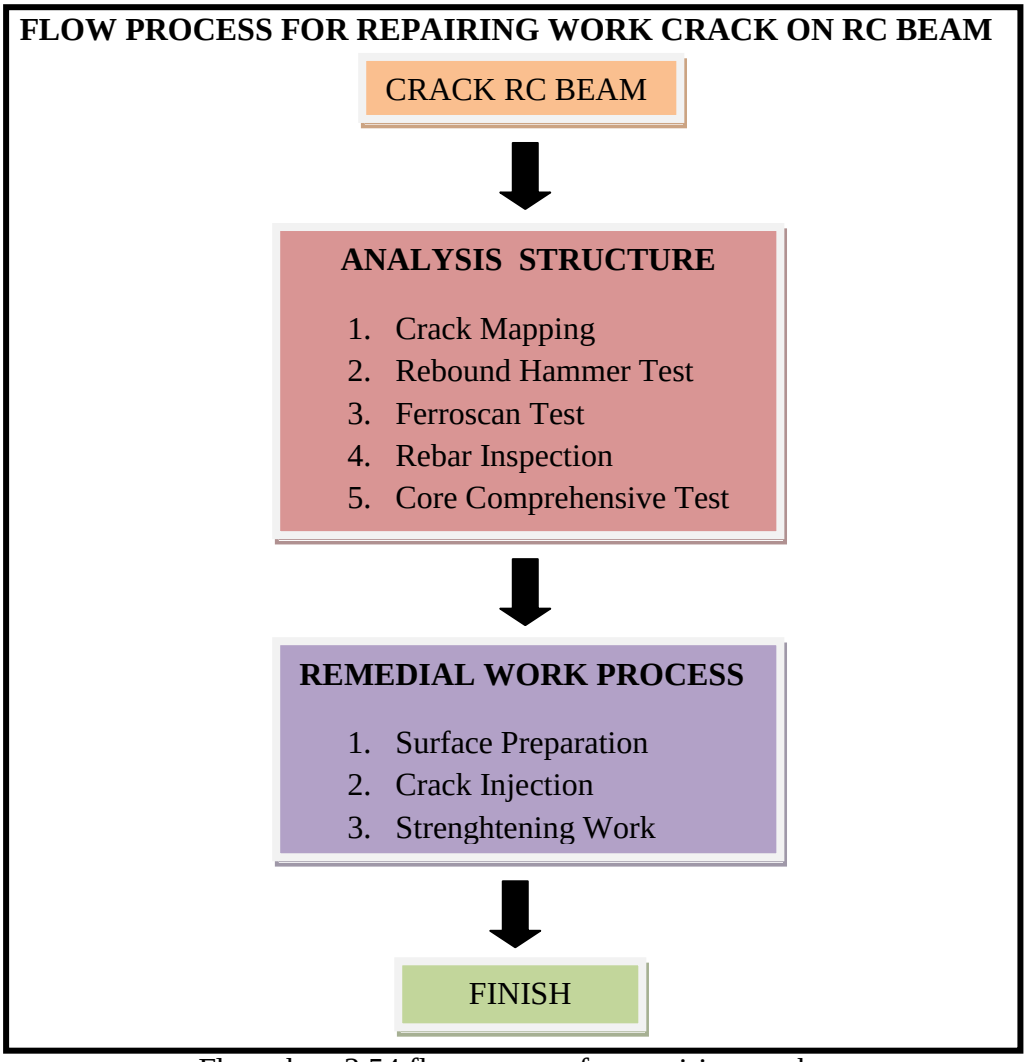
TOOLS	FUNCTION
 Figure 3.44 Hacker Machine	• Hacking the concrete cover of beam and hack to etract embedded reinforcement bar
 Figure 3.45 Vernier Caliper	• Identified the type and diamneter of reinforcement bar
 Figure 3.46 Coring Machine	• Perform coring on to structural element.

TOOLS	FUNCTION
 Figure 3.47 Putty Knife	• To make scraping of paint and plaster on the surface
 Figure 3.48 Steel Brush	• Clean the entire concrete surface to ensure the surface is free from grease
 Figure 3.49 Epoxy Pump	• Pump to the packer during the injection take place. • Contain chemical epoxy resin
 Figure 3.50 Metabo Grinder	• Removing the adhesive packer

TOOLS	FUNCTION
 Figure 3.51 Electric Air Blower	• Remove dust from concerte surface
 Figure 3.52 Roller Brush	• Justify with roller brush to get a flat surface for carbon wrap installation • For undercoat and repaint surface

Table 3.4 Tools on site

3.10 Summary



Flow chart 3.54 flow process for repairing work

Describe or exposure the repairing work and inspection of the defect. For example, a maintenance work that include to repair structural work by their procedure.For the first step , Jabatan Kerja Raya Daerah Melaka Tengah do inspection crack on Reinforcement Concrete Beam for know the condition of major or minor crack defect on RC Beam.Then , JKR hire out source contractor as specialist to do analysis on structure by do crack mapping , rebound hammer test , ferroscan test , rebar inspection and core comprehensive test , its purpose is to determine the concrete strength of the concrete and confirm the width of the steel reinforcement beam.Remedial work that have be done by do crack injection and strengthening work for crack on RC beam.

CHAPTER 4
PROBLEM AND RECOMMENDATION

4.1 Introduction

In every situation, it is common to have problem that need to be face. In this situation, the case study at Sekolah Jenis Kebangsaan Cina Sungai Udang , Melaka has their own problem. Every problem should have their own solver. It is important to make sure all the recommendations for the problem solver will be do. All the recommendation needs to take serious to make sure the condition and environment of this crack defect is good and safe for the occupants. All the problems need to be fixed and the consideration need to be take.

4.2 Problem And Recommendation

PROBLEM	RECOMMENDATION
1. From the observation , I had identified that the JKR team take a long time to do process repairing work at the crack on RC beam.Minor defect can become major defect if they take long time to repair.	1. To overcome the problem , JKR team must be more effective to take action arrange systematic procedure to do process repairing work as soon as possible before it become worse.
2. From the observation, there are no condition survey from the beginning of the inspection period until the repairing work that do at SJKC Sungai Udang,Melaka	2. To overcome the problem, I suggest JKR should conduct a periodic check by time to time to review the building in a good condition,safe for occupant and can avoid from any malfunction of building.
3. From the observation , JKR does not have strategy as their prefix step to prevent the crack from becoming worse.	3. To overcome the problem , I recommend JKR should take early step to suggest client for stopping the function 2 of 4 water tank to reduce the load on the beam involved before further action.

Table 4.1 Problem and Recommendation

CHAPTER 5
CONCLUSION

For the overall, I can concludes industry training is one way to expose students to real work and to strengthen the study of theory that has been studied in the University.From the chapter 1,I can find out more about the background of a company and how to form a systematic organization. The division of work in the JKR Daerah Melaka Tengah is in accordance with the defined areas such as buildings, street, quantity survaying and administrative. JKR Daerah Melaka Tengah is responsible provide technical advisor services to other goverment department at Melaka State.Chapter 2, by using the secondary data,the methodology adopted is through literature review from reference books,journals,and magazine.I can find the required information more legitimately and accurately to become reference material.The literature review is related with my case study that about crack on reinforcement concrete beam beam.Beam are traditionally descriptions of building or civil engineering structural element and reinforcement concrete structures have found wide application in the construction industry.That listed the general procedure of construction beam process and the crack that been occur in reinforcement concrete beam.Next, describe about the inspection and repairing work from the case study at SJKC Sungai Udang,Melaka on Chapter 3. When a building suffers defects, the causes of that defect have to be properly identified before any remedial work can be undertaken. The study has been done to assist professionals and students who are involved in building construction to identify types of building defects and its causes.From the case study,that found crack on reinforcement concrete beam,for first step that do analysis structure to determine the concrete strength of the concrete beam.The remedial work that have done by do crack injection and strengthening work on reinforcement concrete beam. All of the problem on our case study have their own recommendation to avoid and reduce the risk.Effective management systems need to be practiced widely.

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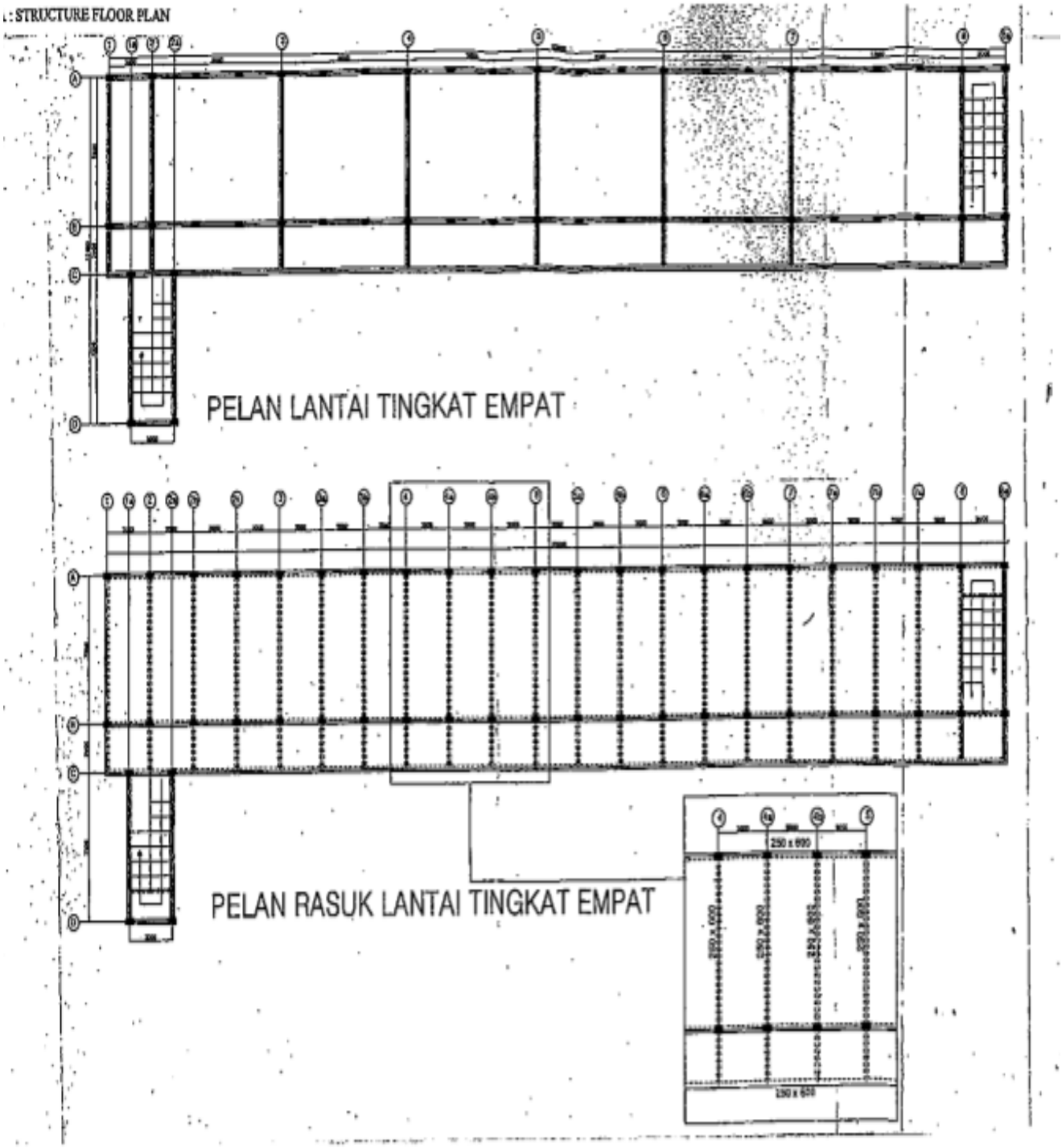
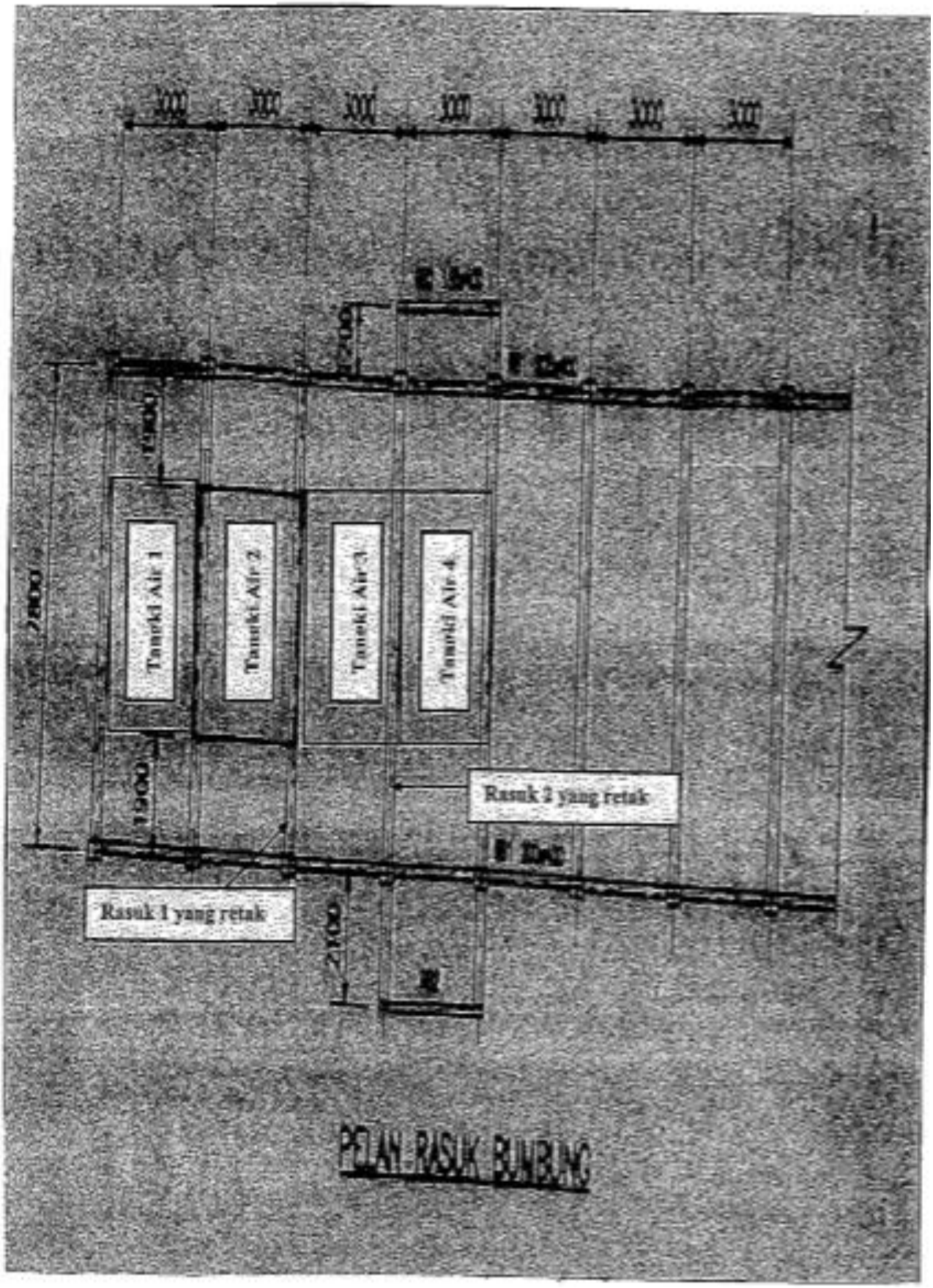
APPENDICES

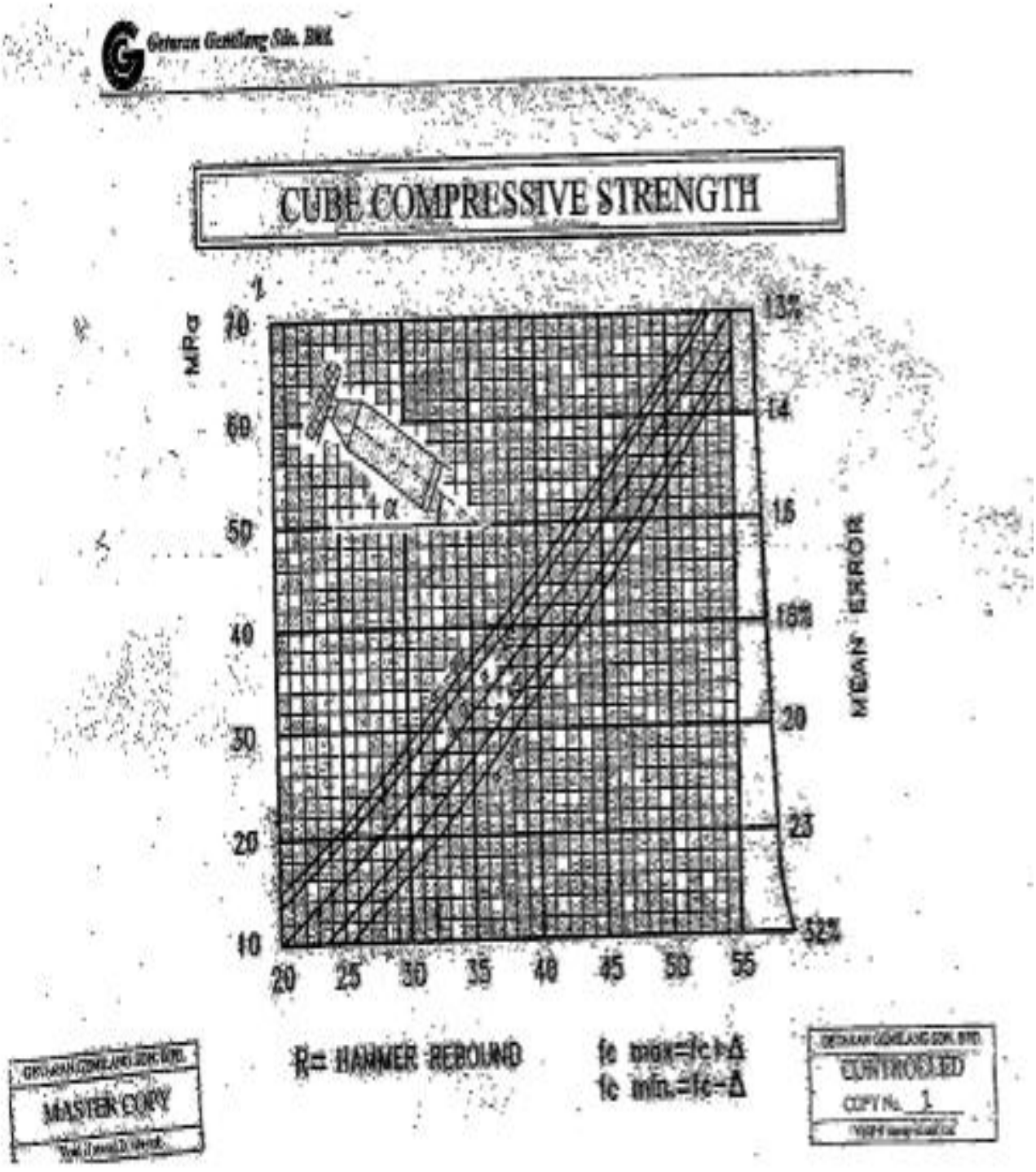
APPENDIX A : STRUCTURE FLOOR PLAN



APPENDIX B : ROOF STRUCTURE PLAN



APPENDIX C : REBOUND HAMMER TEST



APPENDIX C: READING REBOUND HAMMER TEST

QUICKCON SPECIALISTS (M) SDN BHD

37, JALAN JASA MERDEKA 1A, TAMAN DATUK TAMBY CHIK KARIM,
BATU BERENDAM, 75350 MELAKA, MALAYSIA.
TEL : 06 – 317 4901 / 06 – 317 4902 FAX : 06 – 317 4903
WEBSITE : www.quickcon.com.my

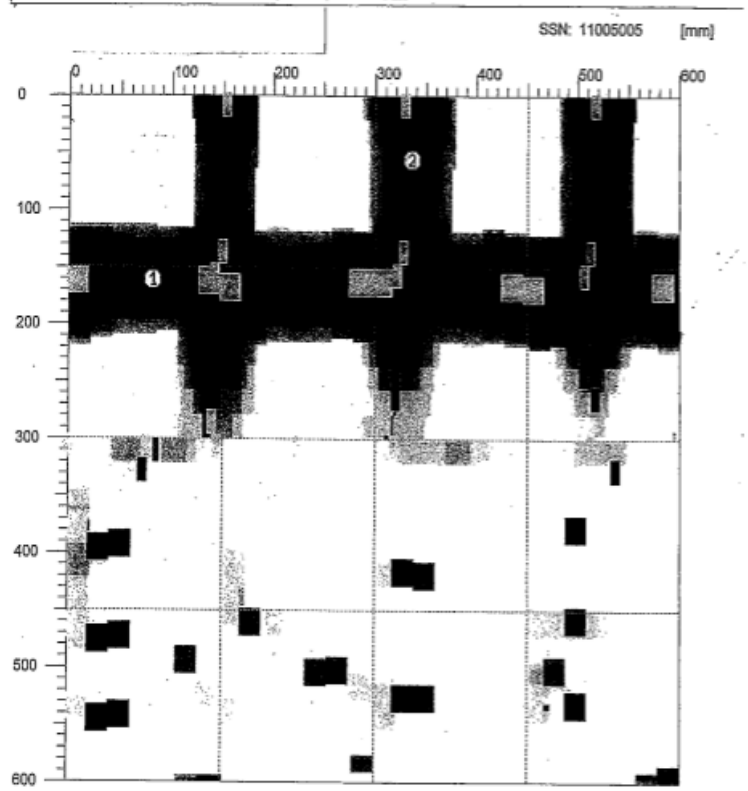
REBOUND HAMMER B.S 1881 : 1971 : PART 4

Project : CADANGAN MEMBAIKPULIH KEMUDAHAN BASUK DI SIRC SUNGAI UDANG
Client : JABATAN KERJA RAYA MELAKA

HAMMER ORIENTATION

POINT	LOCATION OF STRUCTURE	HAMMER ORIENTATION	REBOUND HAMMER READING									AVERAGE READING	COMPRESSIVE STRENGTH (N/mm²)
			1	2	3	4	5	6	7	8	9		
RH 1	Beam	a)	36	34	30	30	30	30	28	30	34	31	25
RH 2	Beam	a)	30	32	34	32	30	36	32	21	28	32	27
RH 3	Beam	a)	32	28	30	30	30	30	28	32	28	30	24
RH 4	Beam	a)	34	30	30	30	36	28	30	30	26	30	24
RH 5	Beam	a)	30	36	36	26	28	32	26	28	32	30	24
RH 6	Beam	a)	30	32	34	34	30	36	32	32	30	32	27
RH 7	Beam	a)	36	32	32	32	30	30	34	32	36	32	27
RH 8	Beam	a)	34	36	30	32	32	36	36	30	32	33	28

Imagescan: APPENDIX D : IMAGESCAN RESULT



Customer: JKR

Location: RC BEAM - SIDE Operator: ALVIN_TAN

Comment:

Beam (1)

1) From the scanning image, the bottom bar was observed laid at approximate 130mm from edge of c oncrete
2) Concrete cover = 115 to 130mm from soffit of RC beam

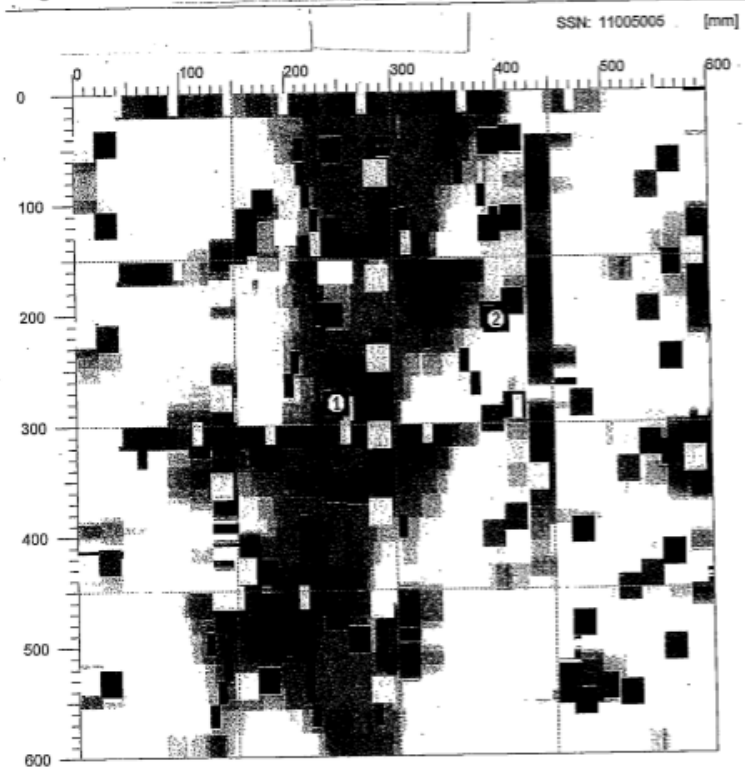
Project: SKJC_SG_IJDAN 1 / 2

Imagescan: APPENDIX D : IMAGESCAN RESULT

Marker:	x: [mm]	y: [mm]	Comment:
1	70	151	Side concrete cover = 62mm
2	326	45	Side concrete cover = 61mm

Project: SKJC_SG_IJDAN 2 / 2

Imagescan: APPENDIX D : IMAGESCAN RESULT



Customer: JKR

Location: BEAM

Operator: ALVIN_TAN

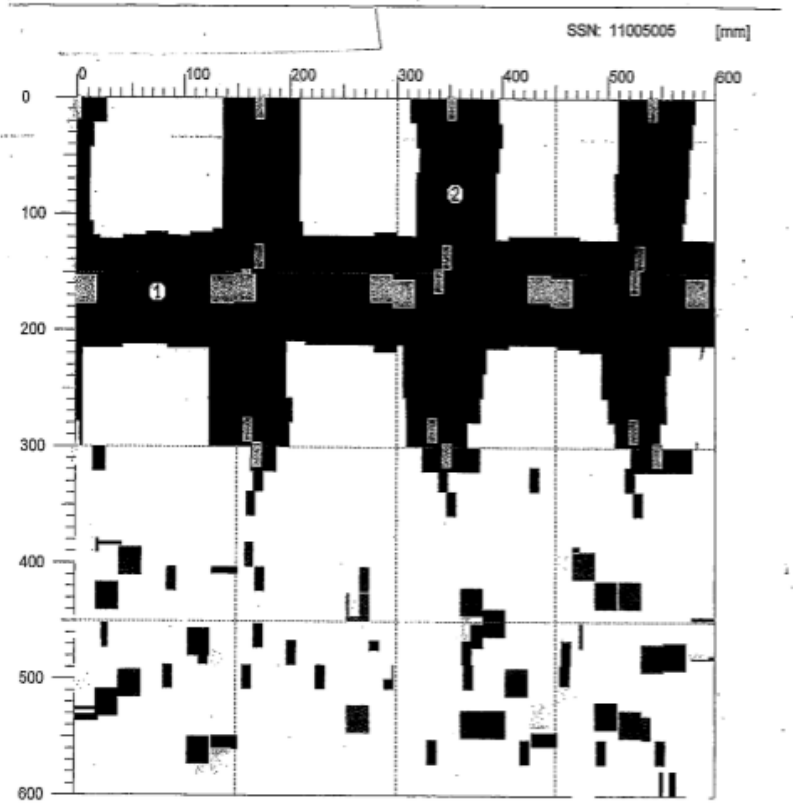
Comment:

Beam (1)
1) Unable to obtain image from overhead scan. Embedded bar is out of scan distant

Imagescan: APPENDIX D : IMAGESCAN RESULT

Marker:	x: [mm]	y: [mm]	Comment:
1	207	208	Concrete cover = 130mm
2	88	188	Concrete cover = 123mm

Imagescan: APPENDIX D : IMAGESCAN RESULT



Customer: JKR

Location: RC BEAM - SIDE Operator: ALVIN_TAN

Comment:

Beam (2)

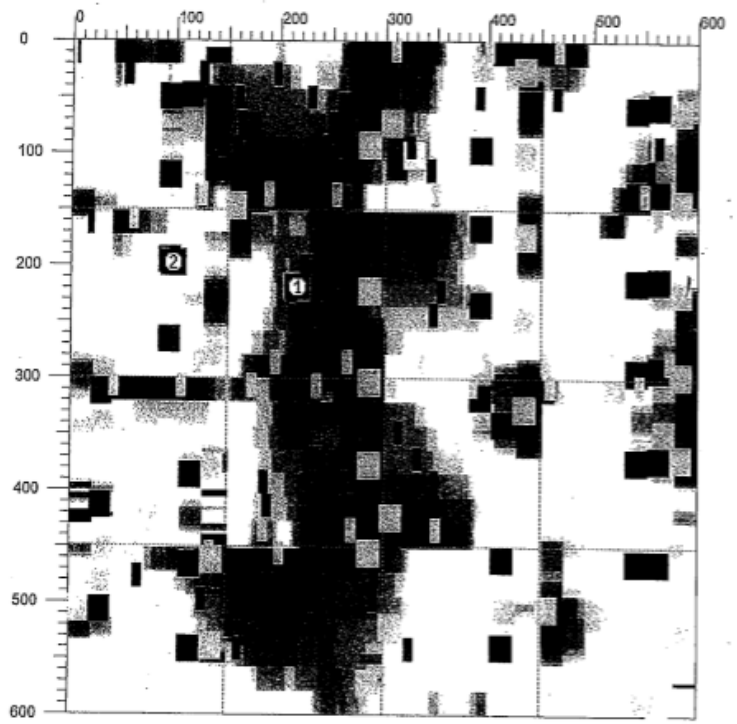
1) From the scanning image

Imagescan: APPENDIX D : IMAGESCAN RESULT

Marker:	x: [mm]	y: [mm]	Comment:
1	64	156	Side concrete cover = 64mm
2	347	70	Side concrete cover = 58mm

Imagescan: APPENDIX D : IMAGESCAN RESULT

SSN: 11005005 [mm]



Customer: JKR

Location: RC BEAM Operator: ALVIN_TAN

Comment:

Beam (2)

1) Unable to obtain image from overhead scan. Embedded bar is out of scan distant

Imagescan: APPENDIX D : IMAGESCAN RESULT

Marker:	x: [mm]	y: [mm]	Comment:
1	207	208	Concrete cover = 130mm
2	88	188	Concrete cover = 1

APPENDIX D : STRENGHTENING WORK