DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

FAILURE IN CONSTRUCTION AND ITS RECTIFICATION AT RIANA SOUTH CONDOMINIUM

Prepared by:

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

DECEMBER 2018

It is recommended that this practical training report provided

by

SUAIDAH SHIMA BINTI SHAHRIN

2016618252

entitled

FAILURE IN CONSTRUCTION AND ITS RECTIFICATION AT RIANA SOUTH CONDOMINIUM

be accepted in partial fulfilment of the requirement for obtaining the Diploma in Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at TCS Construction Sdn Bhd for a duration of 14 weeks starting from 3 September 2018 and ended on 7 December 2018. It is submitted as one of the prerequisite requirements of DBG307 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Date	:	18 DECEMBER 2018

ACKNOWLEDGEMENTS

Alhamdullillah, praise to Allah, the Most Merciful, the Most Graceful.

I would like to extend my heartfelt gratitude for the guidance, advice and help rendered throughout the period of training by the following group of amazing individuals. First and foremost, I would like to thank Dato' Ir. Tee Chai Seng for the opportunity given, to conduct my training in his esteem company. His team of professionals comprising of En Muhammad Iznan Ibrahim (Senior Site Supervisor), Mr Low GH (Assistance Construction Manager), En Shahrulnizam Said (M&E Coordinator), Mr Lee S.T (M&E Senior Supervisor), En Nik Zakri Razak (Senior Site Supervisor), En Rozlan (Surveyor) and Mr Syed Aminullah (SHO) , have enabled me to learn and develop my understanding, knowledge and feel of real time projects, and the theory involved in analysis of structures, building and civil works. They are also responsible towards streamlining and assessing my training. Also to the site personnel in both TCS Construction and Manda'rina Sdn Bhd (IJM Land) who have extended their cooperation and help to further enhance my ability in understanding the procedures in construction and site administration, tests procedures, site safety and best practices in the industry. It is an honour for me to be given the opportunity to 'work' with all of you.

I would also like to thank ALL the UiTM lecturers that have taught and nurtured me in becoming a better student and person. I would also like to extend my deepest appreciation to the lecturers who are directly involved during my training stint. To Dr. Hayroman Bin Ahmad, Supervising Lecturer, En Muhammad Naim bin Mahyuddin, Practical Training Coordinator and Dr. Ida Nianti Binti Mohd Zin, Programme Coordinator, I value the time, effort, encouragement and ideas that they have contributed towards the successful completion of my training, this report and the valuable knowledge that have been shared over the last few semesters.

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

Thank you so much.

ABSTRACT

Building failure are a building flaw or design mistake that reduces the value of the building and causes a dangerous condition. Failure in construction are the most important thing to elaborate, therefore this report will discuss about the failure that happened in construction and the solution to be taken. This report was conducted for the failure and defect that must be dealt with during the construction of Riana South. The objective of the report is to identify the type of failure in construction and to propose the solution for their rectification. It will focus on the proses of the rectification on failure and defect that must be settle down immediately to ensure a good quality on the building structure which affect the strength of the building. The results would show the poor workmanship is the major contributor to poor quality of construction. In order to minimize the problem, contractor must hire workers with necessary experience and skills.

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CHAPTER 1.0

INTRODUCTION

1.1 BACKGROUND

Construction is a series of actions undertaken by construction companies which produce building and infrastructure. They became competent during the construction work after many years for most of the construction companies. Unfortunately, they have to deal with one major problem in the construction industry which is building failure and defects. Therefor Structural Engineers and contractors are always striving to overcome challenge of defects in buildings, but it is difficult to deal with it completely. (Milan, 2012)

Concrete is the most widely used material in construction, commonly made by mixing Portland cement with sand, crushed rock, and water. The concrete structure is often exposed to damage as a result of several factors including the environment, design, and construction factor. Because of the long time needed for reconstruction of the damaged building, it become necessary to consider several techniques for rehabilitation of the damage structural member in the building. (P.Kumar Mehta, 2014)

Building failure are a building flaw or design mistake that reduces the value of the building and causes a dangerous condition. Construction defects can arise due to many factors, such as poor workmanship and maintenance, deficiencies in the labour of both main contractors and sub-contractor. these may be consequence of lack of skill, lack of care and interest, lack of supervision, or lack of knowledge of the importance of special care in the execution of some important piece of work. Building defects do not appear to have been minimized despite recent advancement in building technology. (http://www.bd.gov.hk)

Some of building failure may create hazards leading to serious or fatal injuries. Most of it can be discovered at their early stage through visible or detectable symptoms such as defect. If not promptly rectified, minor defect can develop into serious ones, causing failure or sudden collapse, endangering lives and becoming costlier to rectify.

Besides, failure also can occur because of the architecture design mistakes which were not detected on the structure drawing & architecture drawing. This will affect the aesthetic of the building and cause an extra work to be done during construction. Design build contract have meant that more consideration of the construction method is given at the time of design. This has often led to more efficient construction. Unfortunately, it has also meant that the design process is dominated by the demands of speed and cost. Sometimes this has led to a designer not to consider all the important effects on the final structure. (Robin Whittle,2013)

Other factors of building defects that have always happened in construction industry which are failures due to wear and tear, the most prevalent symptom of trouble is water where it should not have happened. Other common symptoms are obvious cracking of finishes or structural elements, and corrosion or decay of materials. The understanding of building defects and their causes is essential for better performance of any building. Building defects fall into two categories which are defects that effect the performance of structure and defects that affect the appearance of structure. (Dansk standard, 2004)

During the repair work, it is necessary to survey all exposed concrete surface and carry out appropriate in situ and laboratory test in order to locate and assess the nature, position and extent of individual defects and to determine the appropriate remedial work. Person in charge must take an action in other to repair the failure by carrying out sufficient investigations so that the reasons for the problem were identified and understood. Carefully consider the way in which operational facility will determine the choice of repair method. Lastly, prepare a full specification for the work before repairing work started. (ICRI, 1988)

Failure might delay the completion of the project that will affect the handover of the building for it will take an extra time to inspect and be rectified. On the other hand, lot of money may also be used up during the rectification process. Moreover, it is often difficult in concrete restoration projects to accurately predict the amount of work required to complete the project in a satisfactory manner and within the project budget. (ICRI, 1988)

1.2 OBJECTIVES

1.2.1 Aim

To conduct the failure and defect that happened during construction of Riana South, Cheras.

1.2.2 Objectives

I. To identify the type of failure in construction.
II. To propose the solution of failure rectification.

1.3 SUB-TOPIC

Throughout the three months of industrial training at Riana South project, a lot experienced and technical knowledge had been gained. This report provides information regarding the failure that occur during construction and its solution. This stage involves the planning and development activities associated with building construction and consists of two closely related processes:

I. Preparing and carrying out the data on the building failure occur at case study area.
II. Identifying the method statement for repairing works.

1.4 METHOD OF STUDY

This study is arranged in a systematic sequence to ensure good quality of the study and its objectives can be achieved. The sequence of study is as follows:

1.4.1 Primary Data

I. Interview

Interview sessions with several people who are responsible in charge of the construction site. Several of those people are the senior supervisor, architect, construction manager, project manager, sub – contractor, skilled worker, unskilled worker and much more.

II. Observation

This observation method is done during practical training directly by site visit. The information collected were based on what happened at site construction guided by senior site supervisor. A camera and cell phone was used to record any important information such as progress of construction, equipment and machineries used while construction.

III. Document review

Several of the literature studies are from the drawing project. This drawing project shows details of the beam and the layout of the unit. Besides, standard operating procedure are also used to understand each step of the method.

1.4.2 Secondary Data

I. Book

The main reason for literature review is able to study and find out regarding the building construction about the failure in construction and its solution through relevant books, articles and thesis at Shah Alam library and UiTM Shah Alam library, Selangor.

II. Research

Several of the literature studies are from the project drawings. This project drawings shows details of the beam, carpark plan and the layout of the unit. These drawings include the architectural drawing plans and the structural plans. Besides, standard operating procedure are also used to understand each step of the method.

III. Internet

Internet was also used as a secondary source to obtain information about failure in construction such as defect. There are several websites that have been used to get more information about failure in construction.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 INTRODUCTION OF COMPANY

TCS Construction Sdn Bhd, TCSCSB (formerly known as Projek Bumi Bina Sdn Bhd) was incorporated in 1998 to venture principally into the construction of building and civil engineering works. Its main objective is to establish itself as one of the most reliable and competent contractors in the country. Its goal is to be a contractor of choice. Dato' Ir. Tee Chai Seng is the founder of TCSCSB and he was also the co-founder of Pembinaan Tuju Setia Sdn Bhd, (PTSSB) which specializes in the construction of high-rise buildings, institutional buildings and hypermarkets. He left PTSSB in year 2015 to continue his focus in TCS Construction Sdn Bhd.

TCSCSB is led by a dedicated management team and comprises of qualified engineers from various backgrounds, including civil and structural engineers, mechanical engineers, electrical engineers, quantity surveyors, land surveyors, safety and health officers and independent QA/QC teams with extensive experience in building and civil engineering works.

TCSCSB has established a reputation as a reliable and capable contractor delivering projects with good workmanship and timely completion. Most of the projects are way ahead of schedules. This has enabled TCSCSB to maintain a long-lasting working relationship with its Clients.

TCSCSB has successfully completed several projects ranging from landed residential buildings, shop offices, medium to high-rise buildings and infrastructure works such as water pipelines, service reservoirs, sewerage treatment plants and institutional buildings. They are always committed to achieve the highest standards and quality of works.

TCSCSB is certified with ISO 9001 by SIRIM Malaysia for the building and civil engineering works and currently preparing for ISO 14000 (Environmental) and ISO 45000 for Safety and Health. Their Quality Statement and Quality Policy has always been consistent in quality workmanship, timely completion of projects, effective services and continual improvement in Quality Management System and business relationships.

2.2 COMPANY PROFILE

Name of Company	:	**TCS CONSTRUCTION SDN BHD**
		(Formerly known as **PROJEK BUMI BINA SDN BHD) (466772-H)**
Registered Address	:	No.76A, Jalan SPU 1, Saujana Business Park,
		Bandar Saujana Putra,
		42610 Jenjarom, Kuala Langat Selangor Darul Ehsan, MY
Telephone	:	
Facsimile	:	
Business Address	:	No.78A, Jalan SPU 1, Saujana Business Park,
		Bandar Saujana Putra,
		42610 Jenjarom, Kuala Langat Selangor Darul Ehsan, MY.
Telephone	:	
Facsimile	:	
Date of Incorporation	:	August 04, 1998
Nature of Business	:	Building & Civil Engineering Contractor
Paid Up Capital	:	RM 2,000,000.00
Board of Directors	:	1. Dato' Ir Tee Chai Seng 2. Datin Koh Ah Nee
Company's Secretary	:	YKF Management Services
		No. 50-2, Jalan Bendahara 38/7
		Bandar Mahkota Cheras, 43200 Cheras, Selangor
Telephone	:	
Facsimile	:	

2.2.1 Owner

DATO' IR. TEE CHAI SENG (Managing Director)

Dato' Ir Tee holds a Bachelor of Science in Civil Engineering (High Honors) from The University of Texas at Arlington, United States. He is a registered Professional Engineer, Malaysia (P Eng), a Chartered Professional Engineer, Australia (CP Eng, Aust), a corporate member of The Institution of Engineers, Malaysia (MIEM) and a member The Institution of Engineers, Australia (MIE Aust). He is also a member of Association of Consulting Engineers, Malaysia (MACEM). He passes the Engineer-In-Training (EIT) Exam for Professional Engineers conducted by The Texas State Board of Professional Engineers. He is a member of The Institution of Civil Engineers, UK (ICE).

Dato Ir Tee started TCS Construction Sdn Bhd in year 1998 to undertake construction of building and infrastructure works and design and build contract.He has more than 34 years of working experience in the construction of building and infrastructure works. He is also a practicing civil and structural consulting engineer, a project manager and involved in property development. He has successfully completed the design and supervision of many projects ranging from mixed developments and major townships to infrastructure work, high-rise and super high-rise buildings, commercial and retails complexes, institutional and industrial buildings, highway and bridges, water treatment and wastewater treatment plants, jetties, marina and coastal engineering, geotechnical and foundation engineering.

He has previously lectured part time for the working individuals pursuing BEM Part I and Part II Exams conducted by Engineering Council, UK. He continues to give specific lectures and career talks to the graduating engineers at the Universiti Teknologi Malaysia (UTM), Universiti Sains Malaysia, UKM, UPM and UTAR. He is currently preparing a design manual for Civil and Structural Engineering Practices – "A practical approach to infrastructure and structural design; Design Errors, Mistakes and Blunders and a manual for construction on, "Site Planning and Management with case studies". He is leading the site teams on quality assurance and control for all the site works and familiar with the quality assessment, Qlassic by CIDB Malaysia.

2.2.2 Company Vision

"TO BE A PREFERRED BUILDER AND CONTRACTOR OF CHOICE IN THE COUNTRY. TO BUILD PEOPLE, BRANDING, REPUTATION AND TRUST."

2.2.3 Company Mission

"DELIVERY ON TIME / AHEAD WITH BEST WORKMANSHIP"

2.2.34 Company Location

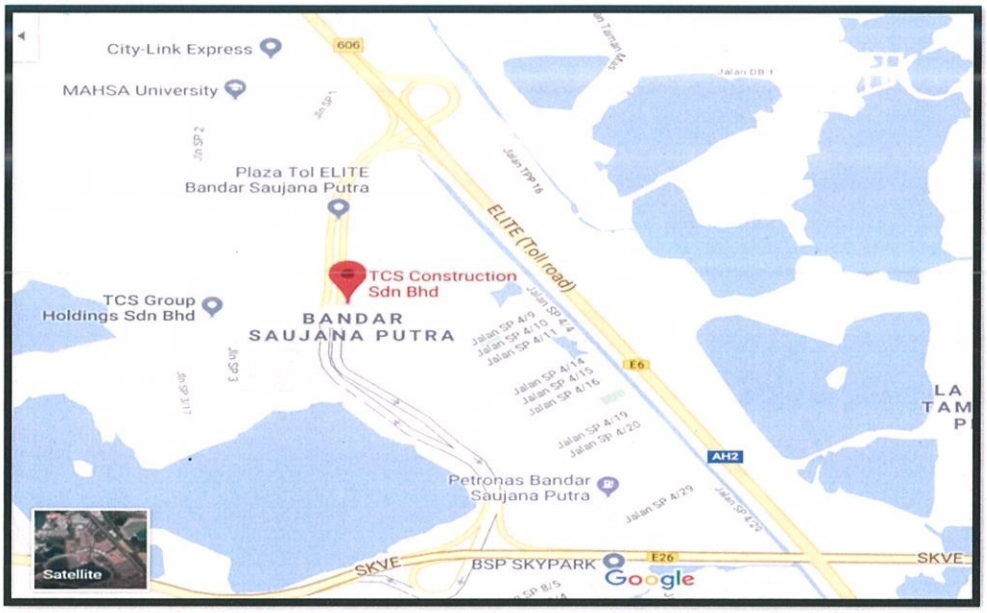


Figure 2.1 : Location of TCS Construction Sdn Bhd

Source: www.google.com/halflandingstaircase

TCS Construction Sdn Bhd. No.78A, Jalan SPU 1, Saujana Business Park, Bandar Saujana Putra, 42610 Jenjarom, Kuala Langat Selangor Darul Ehsan, Malaysia.

2.2.6 Company Logo

Figure 2.2 : TCS Construction Sdn Bhd Logo

Source: www.google.com/halflandingstaircase

2.3 ORGANIZATION CHART

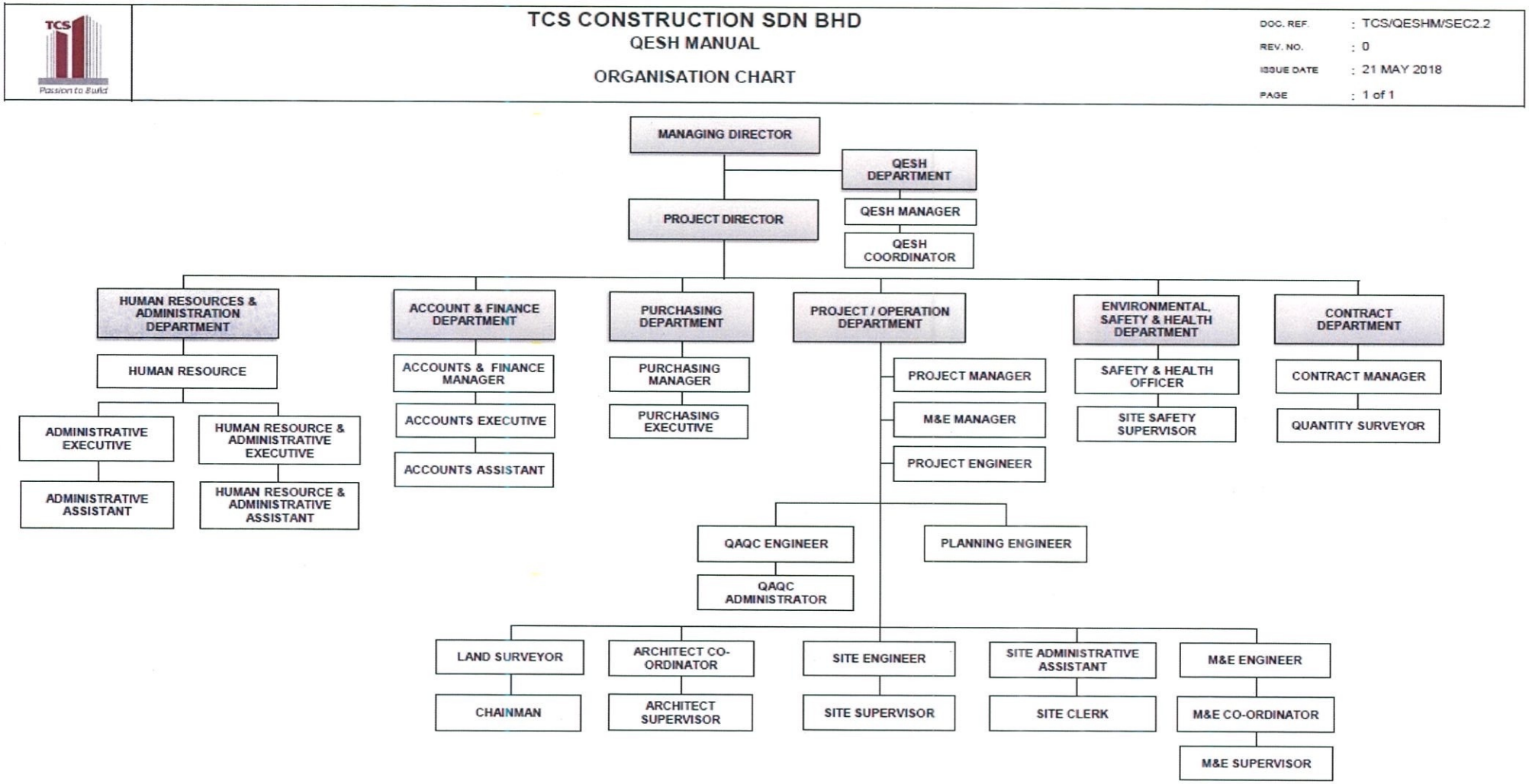


Figure 2.3 TCS Construction Sdn. Bhd. Organization Chart

2.4 LIST OF PROJECTS

2.4.1 Completed projects

PROJECT TITLE	CLIENT	CONTRACT SUM (RM)	PROJECT TYPE
-The Design, Construction And Completion Of Reinforced Concrete Retaining Wall (RC Wall) for 87 units 3-1/2 Level Shop / Office In Bandar Puchong Jaya for M/S Pilihan Megah Sdn. Bhd.	IOI Corporation Bhd	151,000,000.00	250 length of R.C. Retaining Wall Of Various Height From 6m To 8m
-Tanks, Elevated Water Tanks And Pump House at Phase3I For Bukit Sentosa, on Lot 1696, 1707, 199 & 192, Mukim Serendah, Daerah Hulu Selangor, SEL.D.E. For M/S Talam Industries Sdn Bhd.	Talam Corporation Bhd.	3,698,500.00	R.C. Elevated Tank, Suction Tank And Pump House
-Construction and Completion of 154 units of 1-1/2 Level Terrace Houses (20' x 65') Type "Suria", Bandar Puchong Jaya for M/S Paksi Teguh Sdn Bhd.	IOI Corporation Bhd	8,500,000.00	Construction of 154 units of 1-1/2 Storey Terrace Houses.
-Proposed Construction of 0.65 Million Gallons Reservoir At P.T. 19402, Bandar Puchong Jaya, Mukim Petaling Daerah Petaling, Selangor Darul Ehsan For M/S Pilihan Megah Sdn Bhd.	IOI Corporation Bhd	600,000.00	Construction of 0.65MG Water Tank
-Proposed Construction of 85 Units 1 Level Low Cost Shop House & 2 Units TNB Sub-station for the Proposed Development of Phase 3A/2 on Lot 60 & 16635 (Part of Ladang Sungai Kapar) Sungai Kapar Indah, Mukim Kapar, Daerah Klang, SEL.D.E. For M/S Pembangunan Hartanah Guthrie Sdn Bhd	Kumpulan Guthrie Bhd.	6,580,000.00	Construction of Single Level Shop using fairface Precast hollow blocks
-Proposed Development on Lot 3 & 60(Part of Ladang Sungai Kapar) Sungai Kapar Indah, Mukim Kapar Daerah Klang, SEL.D.E. For M/S Pembangunan Hartanah Guthrie Sdn Bhd	Kumpulan Guthrie Bhd.	175,820.00	Construction of 2 Units Show House
-Proposed Construction of 68 Units 2 Level Shop Office & 2 Units TNB Sub-station for the Proposed Development of Phase 4H on Lot 3 & 60 (Part of Ladang Sungai Kapar) Sungai Kapar Indah, Mukim Kapar, Daerah Klang, SEL.D.E. For M/S Pembangunan Hartanah Guthrie Sdn Bhd	Kumpulan Guthrie Bhd.	13,418,043.50	Construction of 68 Units 2 Level Shop Office
-Proposed Construction of 55 Units 2 Level Shop Office and 1 Unit TNB Sub-station for the Proposed Development of Ladang Sungai Kapar Phase 5B on Lot 3 & 60 (Part of Ladang Sungai. Kapar), Mukim Kapar, Daerah Klang, Selangor For M/S Pembangunan Hartanah Guthrie Sdn. Bhd.	Kumpulan Guthrie Bhd.	8,832,694.35	Construction of 55 Units 2 Level Shop Office

Table 2.1 : List of completed projects

2.4.2 Project in progress

NO	PROJECTS TITLE	CLIENT	COMMENCE COMPLETION	CONTRACT SUM (RM)	WORK PROGRESS
1.	Proposed phase 8A1 Development 356 double storey terrace houses (20' x 65') at part of Lot 11605 at Mahkota Hills, Mukim Lenggeng, Seremban, Negeri Sembilan Darul Khusus	Kia Ace Development Sdn Bhd	08/10/2018 04/02/2021	71,994,847.90	4 %
2.	Cadangan pembangunan komersil bercampur di atas Lot PT 4191, Kawasan KTCC, Muara Selatan, Bandar Kuala Terengganu, Daerah Kuala Terengganu, yang terdiri daripada: i) 1 blok podium pusat membeli-belah di tingkat 1, 2 & 3 beserta tempat letak kereta di tingkat basemen dan tingkat 4, 5, 6, & 7	KTCC Mall Sdn Bhd	01/10/2018 30/07/2019	101,015,000.00	6 %
3.	Proposed Construction and Completion of 4 Blocks 18 Storeys Height with 1 Block 7 Storey Detached Elevated Carpark Podium Complete with Common facilities such as of Multi – Propose Hall, Management Office, Swimming Pool, GYM Room, Guard House, Refuse Chamber and Provision of SSU Podium at Lot PT 41254, PT 41255, PT 41256 & PT 41258 and rizab jalan mukim Tanjong Dua Belas, Daerah Kuala Langat, Selangor Darul Ehsan	Tropicana Aman Sdn Bhd	22/01/2018 21/09/2020	151,000,000.00	10.75 %
4.	Cadangan Pembangunan 2 Blok yang terdiri daripada:- (1) Blok A – Kondominium 27 Tingkat (288 unit) , (2) Blok B – Kondominium 28 Tingkat (248 unit) di atas 5 tingkat Podium tempat Letak kereta dan 1 tingkat kemudahan penduduk di atas lot 45751, Jalan Mandarina Damai 1, Mukim Petaling, Wilayah Persekutuan, Kuala Lumpur.	Manda'rina Sdn Bhd	01/11/2017 30/04/2020	119,721,700.00	37.11 %

Table 2.2 : List of project in progress

CHAPTER 3.0

CASE STUDY

3.1 Introduction of Project 536 Units Condominium –Riana South at Cheras, Kuala Lumpur

Figure 3.1 : Riana South at Cheras, Kuala Lumpur

Riana South is a luxurious condominium located at along Persiaran Alam Damai, Cheras, 56000 Alam Damai, Federal Territory of Kuala Lumpur. Riana South development is nestled in the heart of Bukit Manda'rina by IJM Land Berhad. At Bukit Manda'rina, be enfolded in nature's tender embrace and luxuriate in the best of KL lifestyles and will be featured against the backdrop of the Sungai Besi Forest Reserve. This condominium consists of two blocks and 536 units in total which situated on 5.79 acres of leasehold land. There are three types of layouts which are A1, B1 and B2 of 3 bedrooms 2 bathrooms to 3+1 bedrooms 2 bathrooms with sizes ranging from 947 sq.ft. to 1,238 sq.ft. Each unit will be provided 1-2 parking bays.

This project has taken the site on 1 November 2017 with a completion period of 30 months and the expected completion date is 30 April 2020. The main work for this project is to build two condominium block consists of two blocks which is Block A- 27 storey condominiums (288 units) and Block B- 28 storey condominiums (248 units)

that were constructed Above 5 levels of carpark podium and 1 level of residents' convenience above Lot 45751, Jalan Mandarina Damai 1, Mukim Petaling, Wilayah Persekutuan Kuala Lumpur.

The total of construction project cost in Ringgit Malaysia is one hundred and nineteen million seven hundred and twenty-one thousand and seven hundred ringgits (RM 119,721,700.00). A total of 536 units of residential suites are reported to be included in its twin condominium blocks, in addition to various exciting amenities and facilities such as a grand lobby, water features, elevated gymnasium, green landscapes, swimming pools, facilities decks, full futsal court and half-basketball court.

This project was proposed by **Manda'rina Sdn Bhd** (a subsidiary of IJM Land) as the client and being done by **BEP Arkitek Sdn Bhd** as the superintending officer, **TDS Consulting Engineering Sdn Bhd** as the civil and structure engineer, **JUBM Sdn Bhd** as the quantity surveyor, **PTA Design Sdn Bhd** as Landscape architect, **Zaidun-Leeng Engineering Sdn Bhd** as the mechanical & electrical engineer and TCS **Construction Sdn Bhd** as the main contractor. Clerk Of work from Manda'rina Sdn Bhd been selected as to conduct the progress of the project.

SITE ORGANISATION CHART

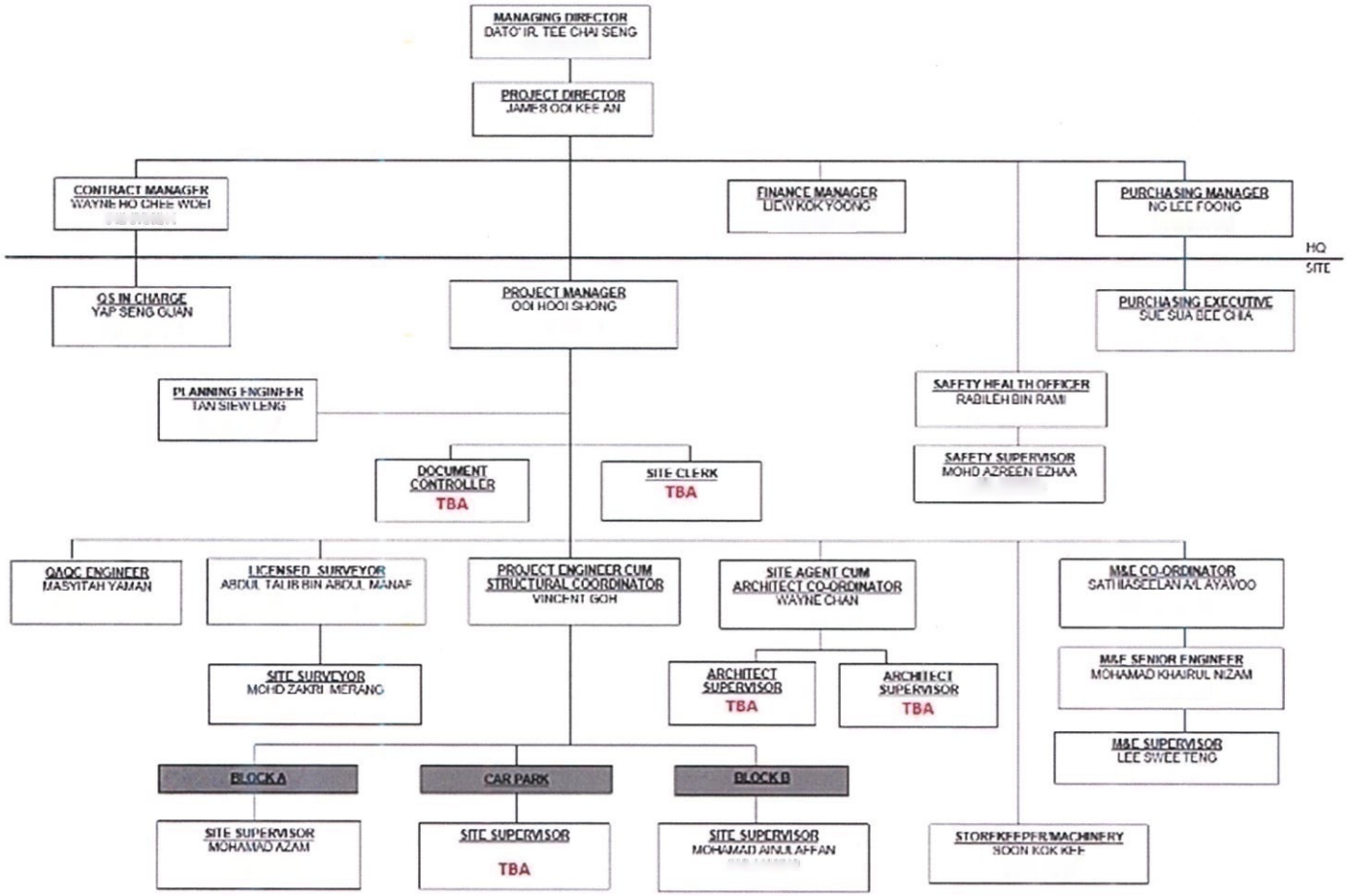


Figure 3.2 : Site organization chart

3.1.1 Location of Project.

The location for this project is at Lot 45751, Jalan Mandarina Damai 1, Mukim Petaling, Wilayah Persekutuan Kuala Lumpur . Riana South is surrounded by a wide variety of amenities and modern conveniences. Popular shopping hotspots in the area include Ikon Connaught, Cheras Leisure Mall, Cheras Sentral and IKEA Cheras. Schools in the vicinity include reputable local such SJK(C) Connaught (2), SJK(C) Taman Connaught, SMK Taman Connaught, SK Seri Anggerik and SMK Seri Mutiara. UCSI University is just short drive away. The area is also the center of business activities such as banks, retail shops, clinics and restaurants. Riana South is accessible via Persiaran Alam Damai which has easy connectivity to East West Link (Connaught Highway), Cheras-Kajang Highway and Middle Ring Road (MRR2). Public transportation in the area includes buses and taxis.

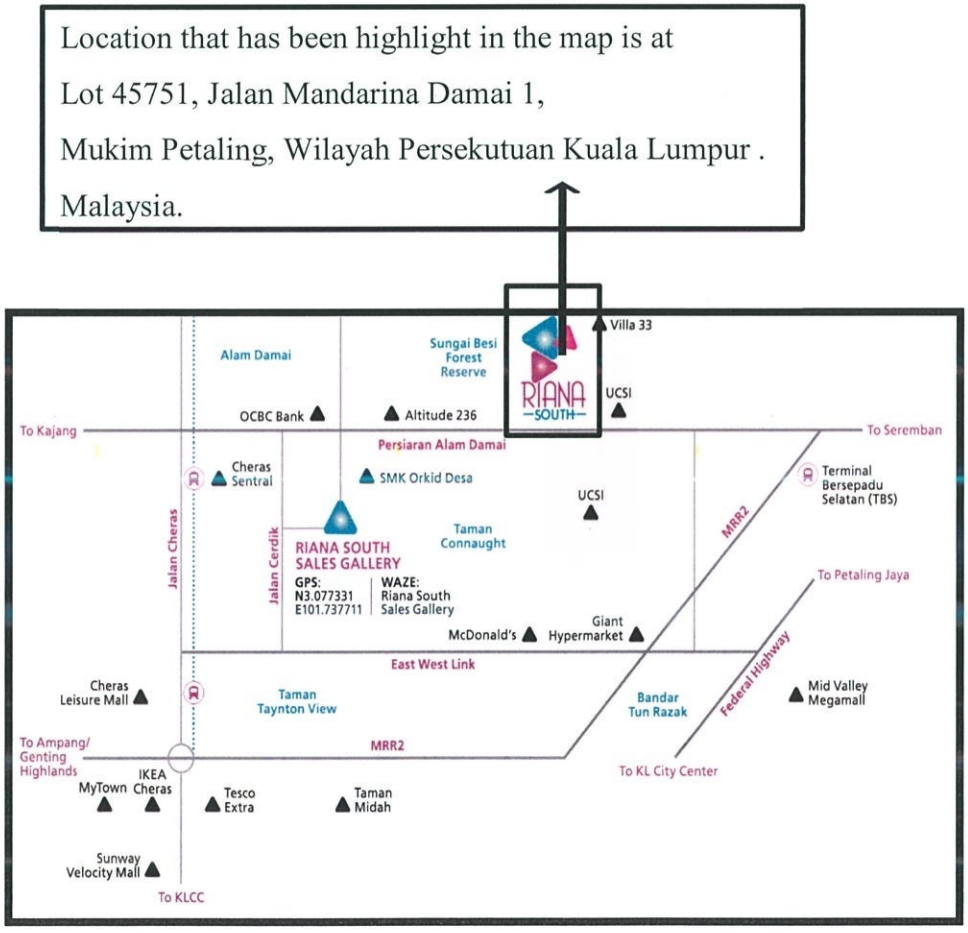


Figure 3.3 : Location of project Riana South, Cheras.

Source: www.google.com/halflandingstaircase

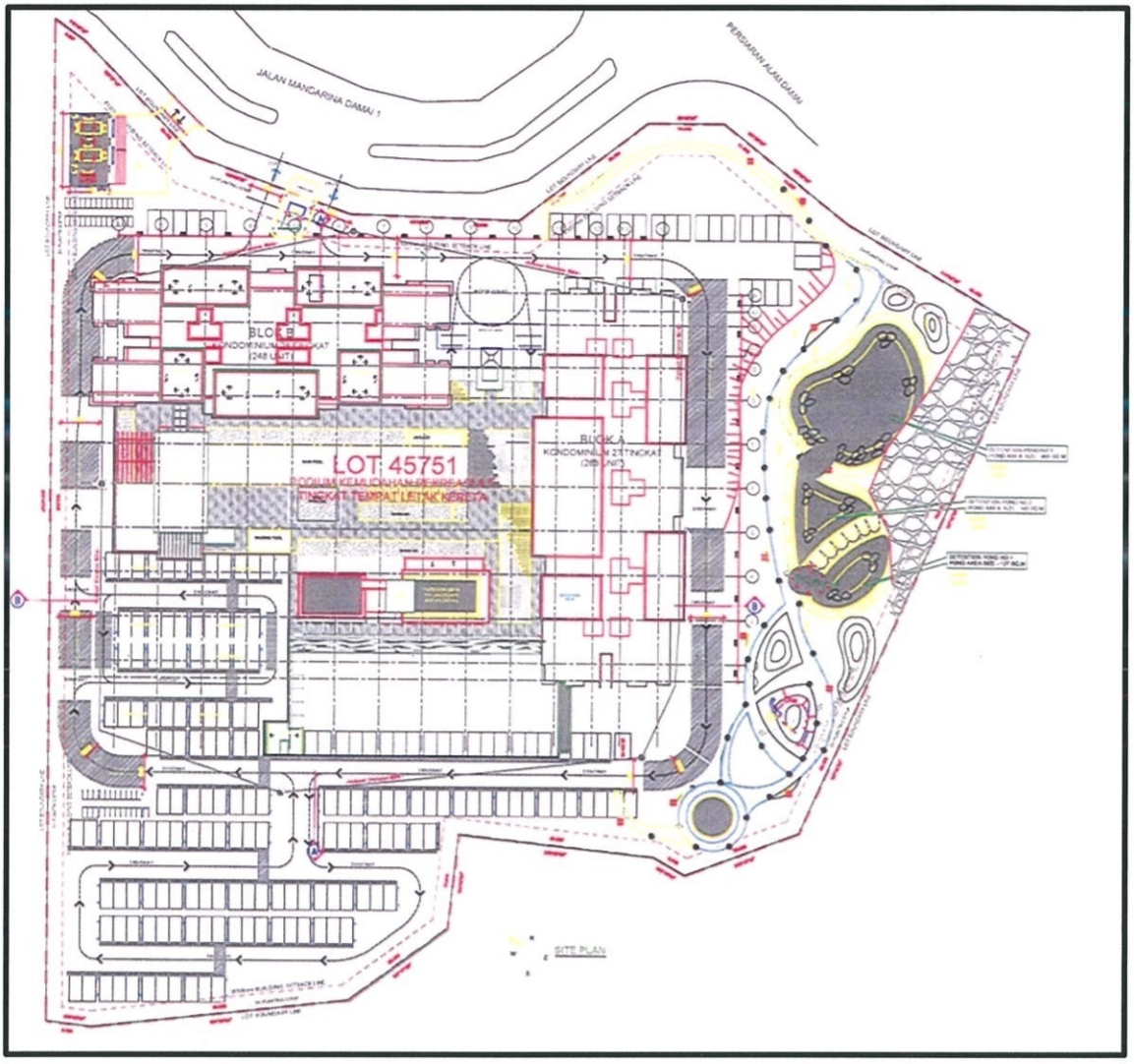


Figure 3.4 : Site Plan.

3.1.2 List of consultants.

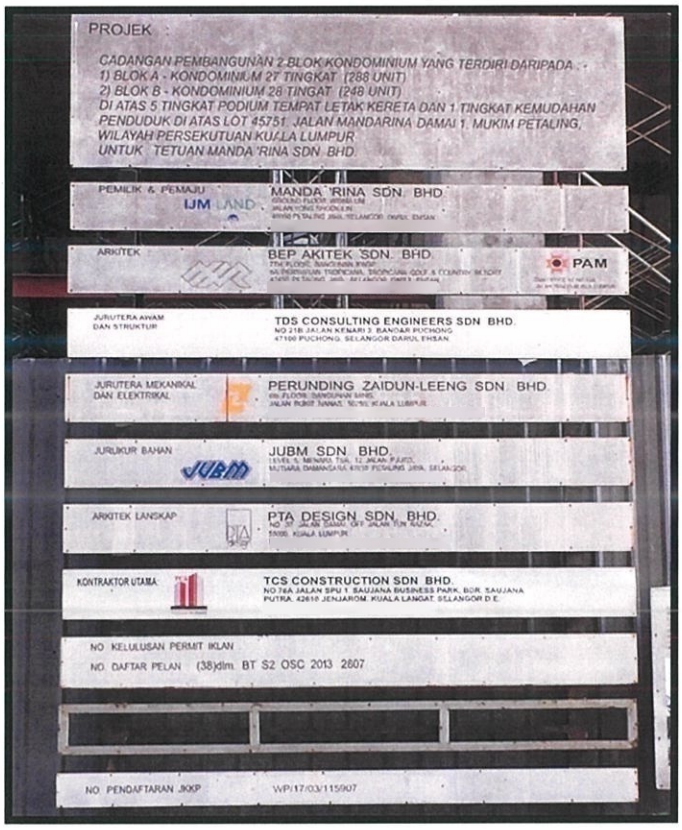


Figure 3.5 : Project signboard.

PROJECT: PROPOSE CONSTRUCTION AND COMPLETION OF TWO CONDOMINIUM BLOCK CONSISTS OF 1)BLOCK A- 27 STOREY CONDOMINIUMS (288 UNITS) 2)BLOCK B- 28 STOREY CONDOMINIUMS (248 UNITS) ABOVE 5 LEVELS OF CARPARK PODIUM AND 1 LEVEL OF RESIDENTS' CONVENIENCE ABOVE LOT 45751, JALAN MANDARINA DAMAI 1, MUKIM PETALING, WILAYAH PERSEKUTUAN KUALA LUMPUR.	
DEVELOPER	Manda'rina Sdn. Bhd.(IJM Land)
ARCHITECT	BEP Akitek Sdn. Bhd.
STRUCTURAL ENGINEER	TDS Consulting Engineers Sdn. Bhd.
MECHANICAL & ELECTRICAL ENGINEER	Perunding Zaidun-Leeng Sdn. Bhd.
QUANTITY SURVEYOR	JUBM Sdn Bhd
LANDSCAPE ARCHITECTURE	PTA Design Sdb Bhd
MAIN CONTRACTOR	TCS Construction Sdn Bhd.

Table 3.1: List of consultants.

3.2 TYPE OF FAILURE IN CONSTRUCTION

Based on my research topic, namely the Failure in Construction and Its Solution at the site of Project 536 Units Kondominium –Riana South at Cheras, Kuala Lumpur. There are two types of failure that were observed during construction of this project which is "Dinosaur Teeth" and Defect in Reinforce concrete slab and wall.

3.2.1 Dinosaur Teeth

"Dinosaur teeth" is known as post-installed reinforcement which a process of reinforcement bar inserted into borehole filled with Hilti HIT in reinforced concrete structure. In this project, it is happened when sub beam (horizontal beam) and king beam (main beam) are not a line that affect the aesthetic of the building. Dinosaur teeth is named as the characteristic or the figure of the exposed reinforcement bar that were plant into concrete. This failure happened because of the architecture design errors as it is not careful design during design building.

Post-installed reinforcing bars are typically used to facilitate connections between new and existing concrete elements or structures. it is used in both retrofit work and in new construction. There is two type of post-installed reinforcing bar that can use in this project which is rebar and lapped splices.

Rebar as an anchor is characterized by the fact it is not possible to splice the reinforcement due to lack of useable reinforcement. The loads are typically smaller as in the case of structural rebar and the serviceability is slightly lower the anchor failure modes like concrete cone failure or combined concrete cone and pull-out failure are considered in this application according to standard anchor design. For this type of connections an engineer is usually involved in the design.

Lapped splices are used to achieve continuity in the tensile tie of the truss model at construction joints. The load transfer between bars is performed by means of compressive struts in the concrete. the resulting perpendicular forces act in a similar way as the splitting forces. The splitting forces normally are taken up by the transverse reinforcement. Small splitting forces are attributed to the tensile capacity of the

concrete. The amount of the transverse or tie reinforcement necessary is specified. (Post Installed Rebar Connection, HILTI catalogue)

Design of post-installed reinforcing bar connections requires that the type, size, spacing and quantity be established for the connection. This is typically based on either direct calculation of section forces or a requirement to match existing reinforcement. Density and sizing of dowels for shear transfer between new overlays on existing structural elements such as slabs and walls may be based on other considerations.

Figure 3.6: Dinosaur teeth.

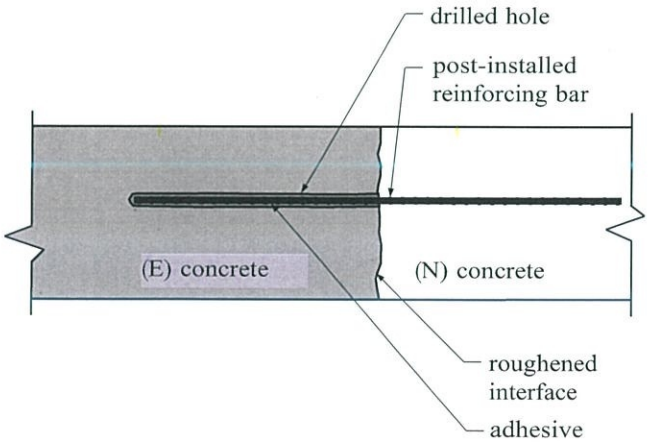


Figure 3.7: Post-installed reinforcement bar section

Source: HILTI ,2018

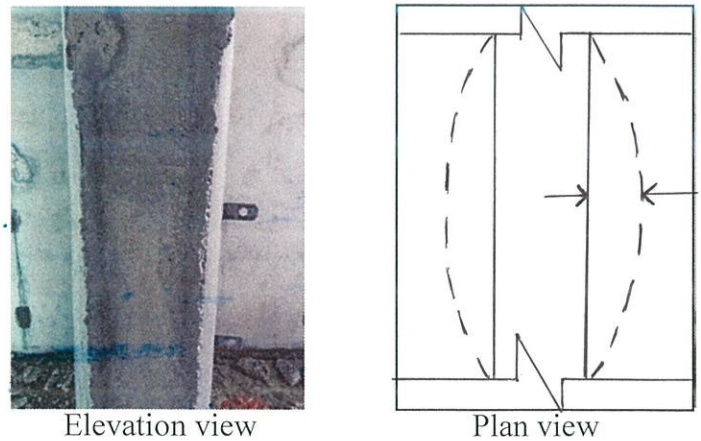
3.2.2 Defect in Reinforce concrete slab and wall

Defect is the nonconformity of a component with a standard or specified characteristic. Defect is used sometimes as a synonym for "failure", but the preferred meaning is to indicate a deviation from some (perceived) standard that may, but will not necessarily, result in failure. If not promptly rectified, minor defect can develop into serious ones, causing failure or sudden collapse, endangering lives and becoming costlier rectify. (David,1997)

Defect in concrete structure can often be related to lack of durability of the concrete, resulting from the composition of the concrete, poor placement practices, poor quality control or the aggressive environment. But, after construction at site, the common type of defect in concrete structure are honeycombing, form failure or misalignment of formwork, dimensional errors, rock pockets and finishing errors. The following all describe the type of defect that occur during construction.

BULGING

Bulging occur because of the form failure or misalignment of formwork that cause uneven surface on the reinforce concrete wall. Mostly happened because of the loose or missing bolts or fixing pins. Bulging also known as blister which are hollow, low profile bumps on concrete surface. Blister occur whenever the surface does not allow water/air to escape into the atmosphere. It can be repaired with surface grinding or hacking to maintain the verticality of the structure. Bulging can be prevented by a proper verticality inspection on the formwork by using plum bob technique, and a proper supervision on the installation of the formwork must be taken.



Elevation view Plan view

Figure 3.8 : Example of Bulging.

HONEYCOMB (SEGREGATION)

Segregation are also known as honeycombs. Honeycomb are hollow spaces and cavities left in concrete mass on surface or inside the concrete mass where the concrete could not reach. It is called honeycomb because of its characteristic that look like honey bees' nest which appears on concrete surface where voids are left due to failure of cement mortar to fill spaces around and among coarse aggregate. Honeycomb is always an aesthetic problem and depending on the depth and extent may reduce both the durability performance and the structural strength of the member. This happened because of poor concrete compaction due to ineffective vibration or rebars congestion, low cement content or improper mix design. This problem will damage the concrete and more serious attack the reinforcement bar in concrete.

Figure 3.9 : Example of Major segregation

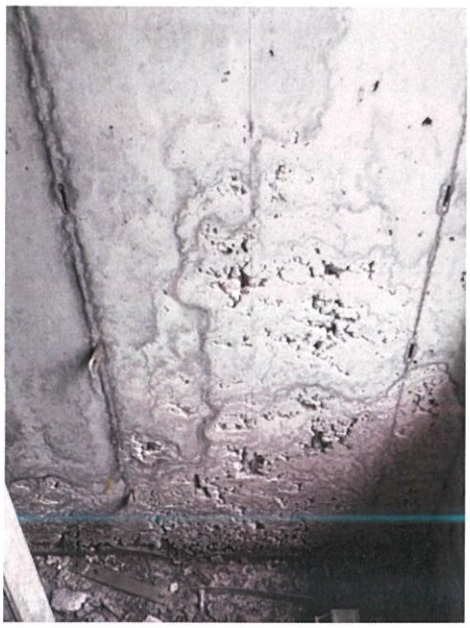


Figure 3.10: Example of Minor segregation

FINISHING ERRORS

Finishing errors in concrete structure can involve over finishing of the concrete surface or addition of more water or cement to the surface during finishing of the concrete. This result in the porous surface which make the concrete permeable resulting in less durable concrete. Poor finishing of concrete results in the spalling of concrete from surface early in their service life. Repair of spalling involves removal of defective concrete and replacement with epoxy bonded concrete.

Figure 3.11 : Example of finishing Error.

CRACK

Crack is a linear fracture in concrete which extend partly or complety through the member. Crack in concrete occur as a result of tensile stress introduced in the concrete. (http://www.aboutcivil.org)

Crack are formed in concrete due to many reasons such as improper mix design, insufficient curing, omission of expansion and contraction joints, use of high slump concrete mix. Excessive movement of the building structure and serious overloading are also one of the reasons. To prevent cracking, low water cement ratio are used and maximize the coarse aggregate in concrete mix, avoid admixture that containing calcium chloride. Surface should be prevented against rapid evaporation of moisture content. Load must be applied on the concrete surface only after gaining its maximum strength

Figure 3.12: Example of crack.

3.3 RECTIFICATION METHOD STATEMENT

3.3.1 RECTIFICATION OF "DINOSAUR TEETH" FOR RC BEAM

Safety

1. Scaffold were installed along the sub beam which act as an access for the worker to do their works and safe for use.

Figure 3.13: The installation of scaffold

Rebar

2. The position of "U" bar to be plant is identified by Scanning the reinforcing bars and other embedded elements with a Hilti GPR scanner or Scanners that locate ferrous materials using magnetic fields. Beam surface were Drilled with driller to require depth of 20mm d. There is two type of driller which is hammer drilling and diamond coring drilling. In this case, Hammer drilling were used in this process.

Figure 3.14: The Injection mortar system equipment

Hole cleaning

3. Next, drill hole is cleaned by blower before planting of rebar. Bond between adhesive and concrete is directly influenced by the condition of the hole wall at the time of adhesive injection. The concrete in which the post-installed reinforcing bar is to be installed may be dry, saturated or even partially or completely submerged at the time of installation. Hole cleaning generally involves a water-cleaning process, followed by sequential blowing out the hole with compressed air to remove debris and water, and the use of a wire brush to mechanically scour the hole wall. Approved epoxy Hilti RE-500 is applied into the drill hole and "U" bar details to be T 10-200 were plant into the beam.

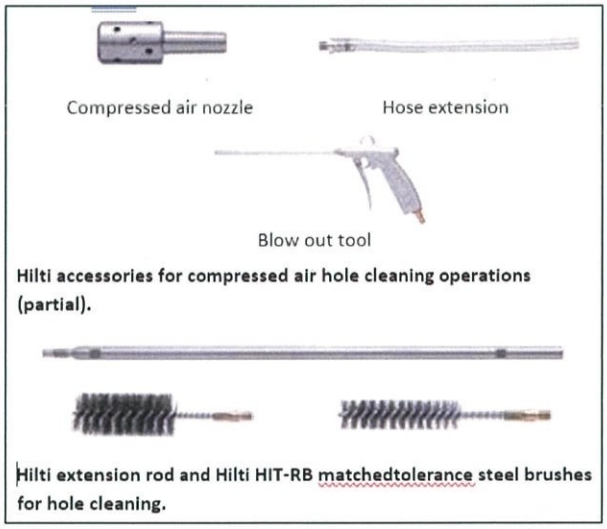


Figure 3.15: Material for hole cleaning

Source: Post-installed reinforcement bar guide, HILTI catalogue

Figure 3.16: Planting rebar

Process of Dry and water-saturated concrete hammer drilling

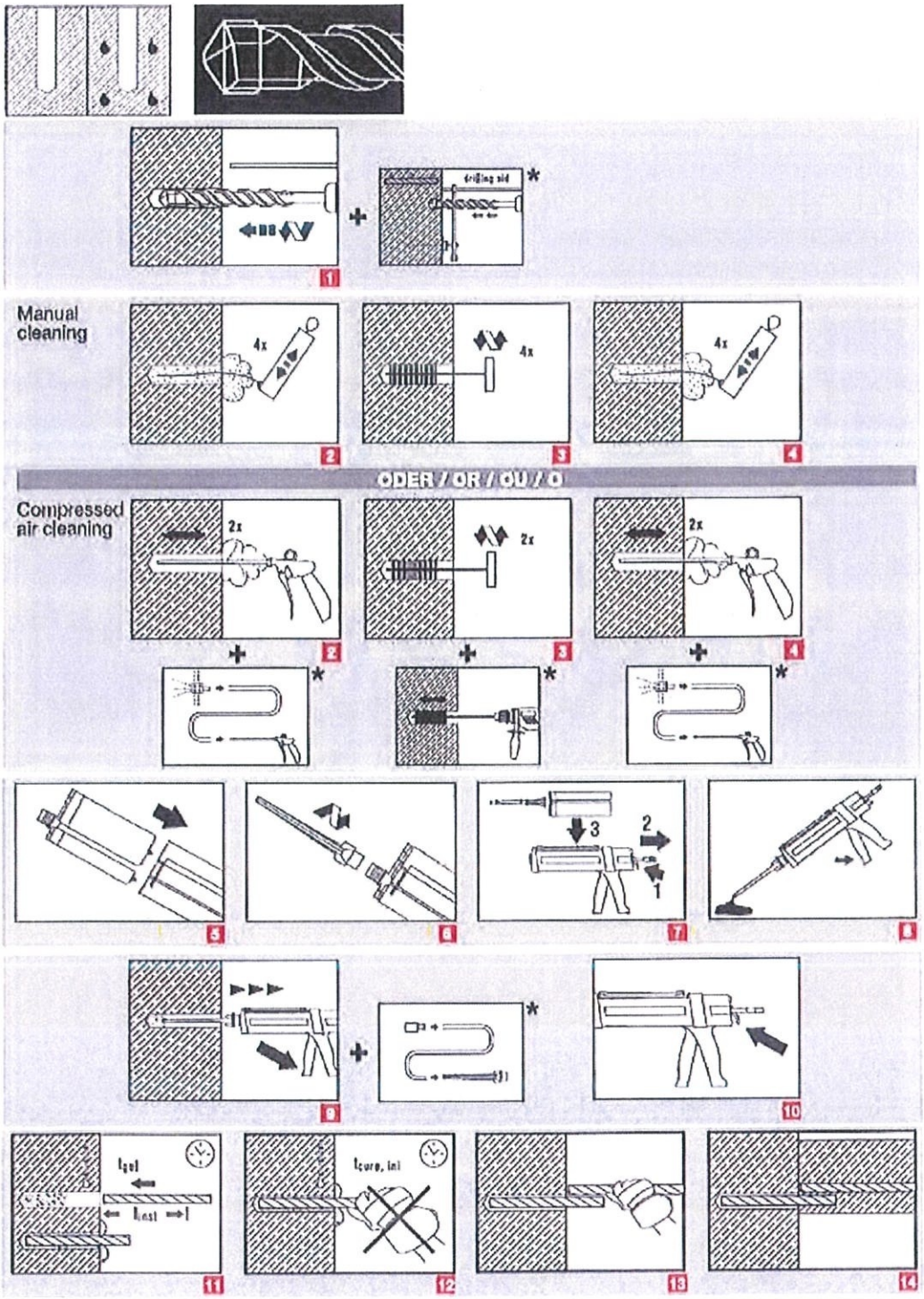


Figure 3.17: Dry and water-saturated concrete hammer drilling

Source: Post-installed reinforcement bar guide, HILTI catalogue

Process Dry and water-saturated concrete by diamond coring drilling

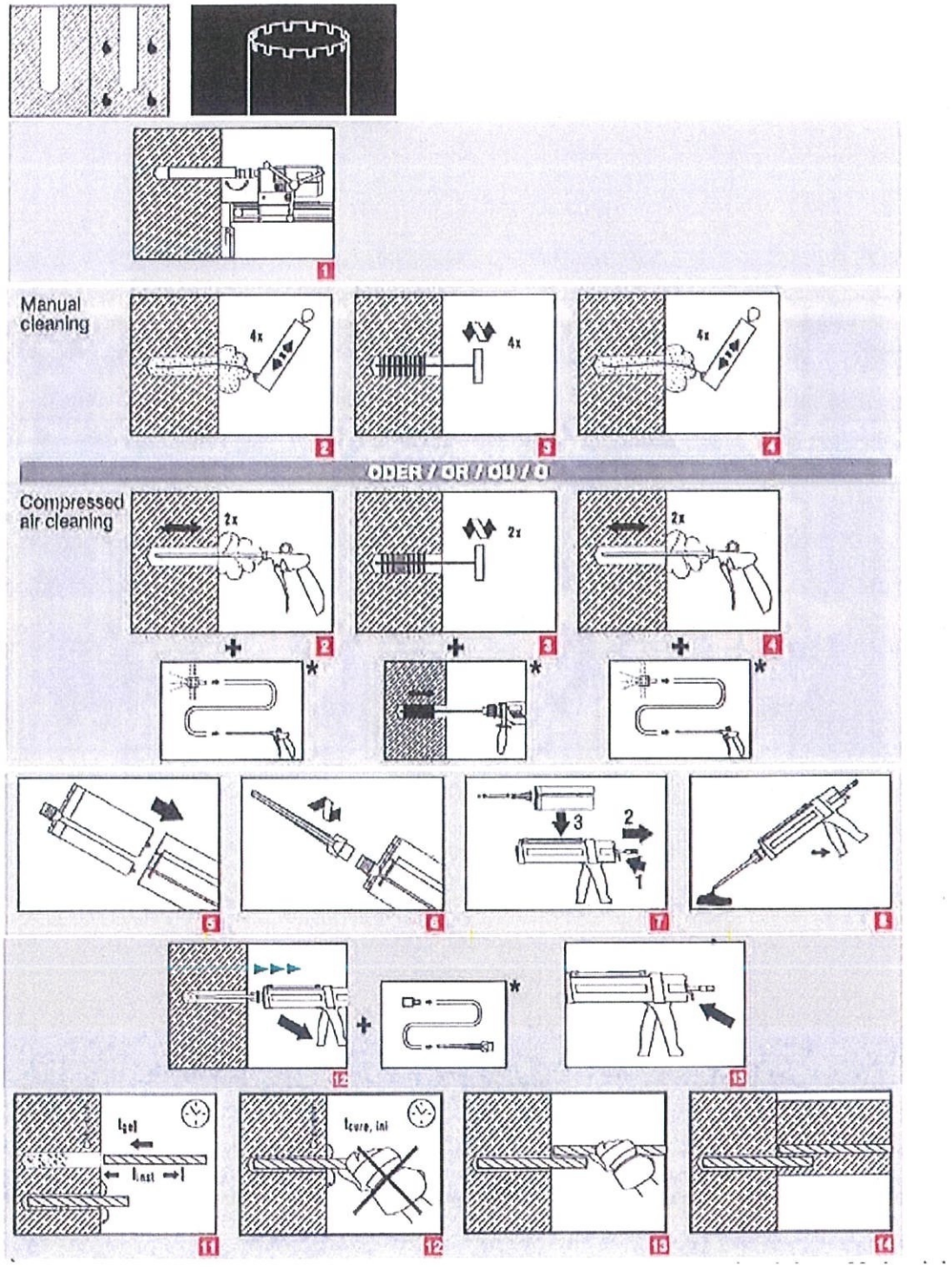


Figure 3.18: Dry and water-saturated concrete diamond coring drilling

Source: Post-installed reinforcement bar guide, HILTI catalogue

Surface preparation

4. Beam form were installed along the beam with the other side of the timber formwork were installed aslope for concrete access to be poured. In addition, GI Pipe props and timber strut were fixed vertically to support the form and the load of the concrete during cast process. Besides, it also help to ensure the formwork were true to alignment. all props are placed on firm base fixed and adequately braced against vibration and displacement during concreting operation.

Figure 3.19: The installation of beam form

Figure 3.20: The installation of props and strut

Placing

5. Concrete were poured into the beam form by using bucket and each layer is tamped by using rounded end of the tamping rod in a uniform manner over the cross section of the formwork. The concrete was compacted till it thoroughly worked into the corners of formwork. The concrete was placed in the formwork until it is fully covered the beam depth. While concreting is in progress, samples of the concrete as placed were taken in the form of test cube mould.

Figure 3.21: Pouring concrete into beam form

Figure 3.22: Compacted concrete

6. After 3 days, formwork was carefully dismantled by carpenter without vibration as would damage the concrete.

Figure 3.23: carpenter dismantled the formwork

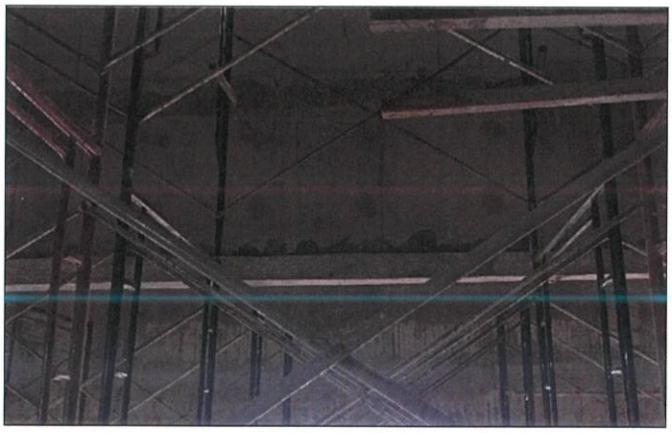


Figure 3.24: beam after formwork dismantled

3.3.2 FORMWORK PRESSURE GROUTING TO DEEP HONEYCOMB RC STRUCTURES

Surface Preparation

1. RC wall is hacked to remove loose concrete in RC structure until sound concrete by using pneumatic or electric breaker. All laitance, loose dirt or dust on the hacked concrete substrate were removed by using electric air blower. The substrate surface was structurally sound, free from oil grease or any loosely adherent material. In addition, the substrate surface was presoaked with water to assist in the formation of bond between substrate and grout.

Figure 3.25: Hacking wall in process

Figure 3.26: Substrate was cleaned

2. Grout-tight timber formwork are installed with necessary bracing and anchored tightly to the concrete structure by using drop in anchor. After that, all gaps are sealed with mixture of ordinary Portland Cement and fast setting admixture (ESTOP) and to introduce grout ports into the formwork at upper most top level and bottom level. The joint between board were tongued and grooved or caulked with bolts, nuts and tight-fitting fillets recessed into adjacent board and covering the joint.

Figure 3.27: formwork is installed

Figure 3.28: All the gap are sealed

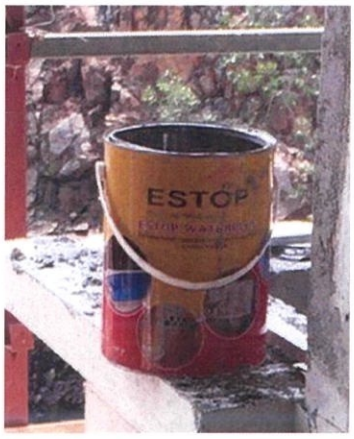


Figure 3.29: Fast setting admixture (ESTOP)

Mixing

3. Estogrout MP 70 non-shrink grout were mixed in a mixing drum using a low speed mixer which is less than 500 rpm for several minutes while adding clean water which not more than 4.4 litres equals to 25 Kg grout. The grout is transfer to a holding drum after it is thoroughly mixed. The grout were mixed continuously for a good quality of mixer.

Figure 3.30: mixing the non-shrink grout

ESTOGROUT MP70

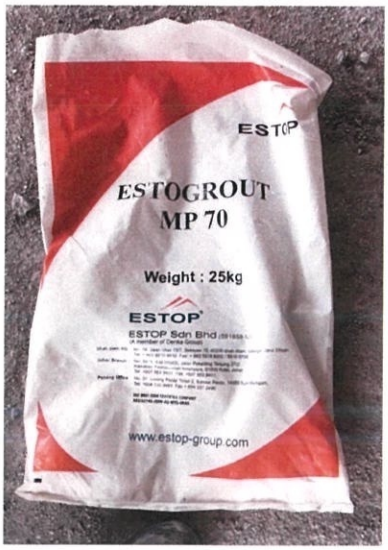


Figure 3.31: ESTOGROUT MP70 is used in grouting

Estogrout MP 70 non-shrink grout provides high flexural and compressive strength performance. It is a ready to use product in powder form and requires addition of water to produce as no shrink grout performance. Estogrout MP 70 Is a blend of Portland cement graded fillers and chemical additives that impart controlled expansion in the plastic state whilst minimizing water demand. The low water demand ensures high early strength. The graded filler is to assist uniform bonding and produce a consistent grout.

Test cube

4. Next, non-shrink grout cube samples were taken for quantity specified in the contract document. Six test cubes were taken, two from each of three samples taken in each day. All cube was clearly marked with undeletable paint with the date of casting. A record was kept to identify each cube by date.

Figure 3.32: cube test sample

Grouting

5. Airless manual pressure grouting equipment with pressure in between 0 to 25 psi is used to force the mixed non-shrink grout to fill up all cavities in the formwork. The grout were poured continuously until the cavity is completely filled

Figure 3.33: airless manual pressure grouting

6. non-shrink grout is to be pumped from bottom pvc inlet pipe until it flows out from the upper most top-level outlet pipe and this show that the void in formwork has been fully filled up. Outlet and inlet pipes were sealed with galvanised iron wires immediately upon completion of grouting process.

Figure 3.34: non-shrink grout is pumped into formwork

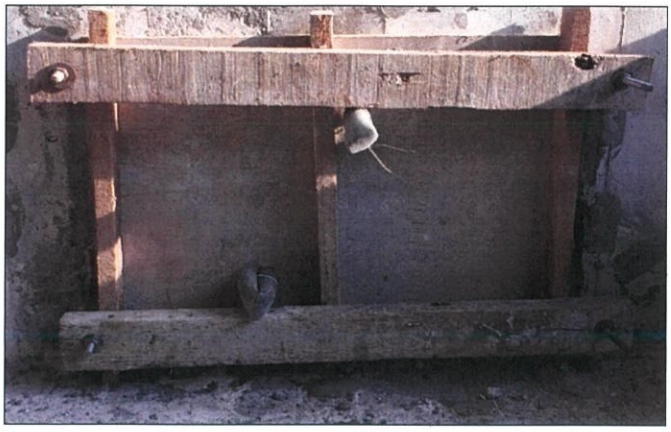


Figure 3.35: outlet and inlet pipe are sealed

7. Formwork is removed after 3 days or after grout achieved sufficient strength. Lastly, the protruding inlet and outlet PVC pipes is grinded off by using concrete diamond grinder for a smooth surface.

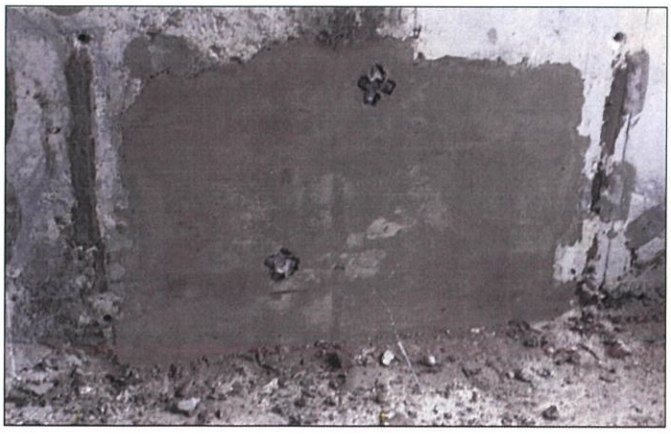


Figure 3.36 : Formwork is dismantled

3.3.3 CARPARK RC SLAB CRACKLINES REPAIRING WORK

Figure 3.37: crack line at carpark RC slab

Surface preparation

1. 20mm deep x 20mm wide were saw cut include 10mm on both sides of the RC slab crack lines by using diamond concrete cutter. Next, Slab is hacked by using electrical breakers along the pre-cut cracks to form 20mm x 20mm U' grooves to receive epoxy resin grout. All Losses materials, dust and laitance in prehacked grooves are cleaned and removed by using electrical blower or vacuum cleaner. Make sure the substrate is sound, dry, clean and free from oil and grease.

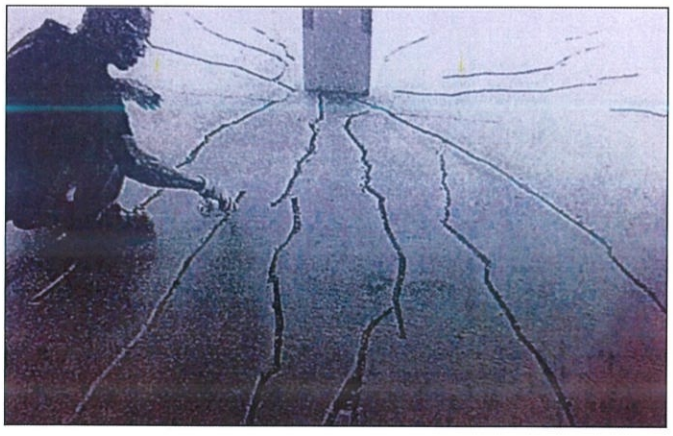


Figure 3.38: slab was hacked and been cleaned

Mixing

2. component of the StoPox EPG Epoxy resin grout which comprises of epoxy resin grout, epoxy hardener and silica sand are mixed by using a low speed electrical drill with mixing paddle (speed less than 500 rpm) until a homogeneous mixture of uniform grey is achieved for approximately 5 minutes.

Placing

3. By gravity pouring method, the premixed StoPox EPG epoxy resin grout is poured in thickness of 0.5cm-4 cm into the prehacked crack lines. Grout were poured from one side or from the corner when underfilling base plate. It was poured continuously until the cavity is completely filled. Next, the epoxy grout surface is smoothed by using steel trowel before gel time. The finish level of the epoxy resin grout shall be the same level with the existing RC floor slab. Lastly, the epoxy resin grout are settled for at least 6 hours.

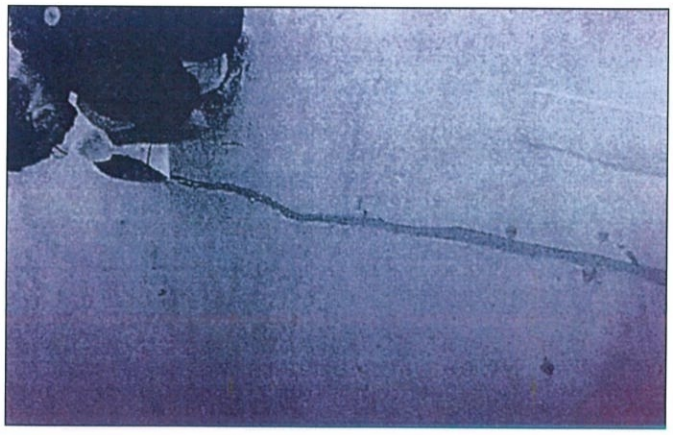


Figure 3.39: StoPox EPG resin grout is pouring in the crack line

Figure 3.40: grout was settled

3.3.4 PRESSURE GROUTING TO RC STRUCTURES / CRACKLINES TO STOP WATER LEAKAGE BY USING POLYURETHANE GROUT

Figure 3.41: water leakage

Surface preparation

1. Holes of 16mm diameter at 50mm deep was drilled into crake lines at 150 mmm intervals along the side of leaking cracks or construction joints or 75mm interval void in reinforced concrete by using electrical breaker either in diaphragm or retaining wall, rc wall, slab or beam.
2. Holes were drilled 20mm away from the existing crack lines or construction joint or around the localised concrete void areas, and to be at 45 degrees into the crack profile or construction joint of thy reinforced concrete or section. The distance between holes depended upon the width of crack or void is to be filled. After that, the mechanical packer was installed and secured tightly into the predrilled holes where pressure grouting is to be carried out.

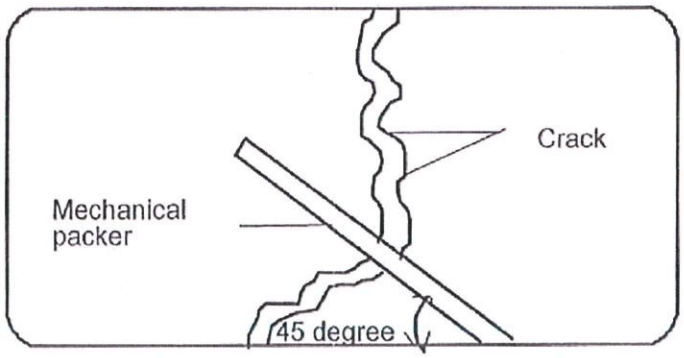


Figure 3.42: installing mechanical packer

Source: method statement for pressure grouting to rc structures / crack lines to stop water leakage by using polyurethane grout

Placing

3. Next, Maxxeal PU Xeal one-part polyurethane grout were poured into holding drum attached on top of the grouting equip Commence application by using motorised / airless hydraulic pressure grouting equipment, ensuring crack or void is filled from one port hole to another. The Maxxeal PU Xeal polyurethane grout reacts almost immediately with the water Due to the expansion of Pentens PU 300 polyurethane grout, it forms a "fluid wedge" and block the leakage. The polyurethane grout is yellowish in colour in the form of expanding foam at initial set stage. Upon completion of the operation, all mechanical packers and plug holes were removed with non-shrink grout. All exposed solidified polyurethane grout or foam on the surface of the concrete were also removed.

Figure 3.43: crack leakage at rc wall

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

In conclusion, there are many new things to learn not only about the type of failure but also basic knowledge to avoid failure in construction. Efficiency in managing site work is also important to ensure that all the work can run smoothly.

A proper supervision should be practiced as the structure is a significant item in the building. On this project, the RC wall is firmly because it has a combine the steel structure and reinforce concrete that supports the structure and there have low possibility the structure tends to failure. In addition, the process of concreting should be properly controlled to avoid any damage occurs on it where before and after work progress also should be inspected to ensure the building structure can running as usual.

A proper care for the material is a must so that the same mistake would not happen again in the future. A few precautions have been established to avoid failure and defect from happening.

One of the main precautions that had been applied is a good workmanship. Poor workmanship is the main reason for the occur of failure, this is because of the lack of supervision from the person in charge which tend to cause an improper procedure of work. Proper compaction should be carried out for ensuring the requirement of strength, impermeability, and durability of the hardened concrete in the actual structure. While concrete mix design and workability should be reviewed and adjusted when needed. Proper construction and monitoring of formwork during pouring of concrete. Besides, defective mould forms and accessories should be repaired or replaced to prevent grout leakage during concreting.in addition, avoided cast in hot weather to prevent crack on the concrete surface.

The other precaution that also has risen is suitability of concrete grade. The correct concrete grade will help in maintaining the quality of concrete slab and wall. There are some tests done it at site to check the quality of concrete, such as cube test and slump test.

Lastly, safety and health are also one of the important things in construction. It can be concluded that construction site area is safe to enter. Proper use of personal protective equipment (PPE) such as safety helmet, safety harness, safety vase and safety boot base on the work to be involve are necessary to avoid any incident occur. Therefore, it is recommended to all parties to take safety precaution regarding the construction part to minimize other contribution factor in building defect and human injury.

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4.2APPENDIX

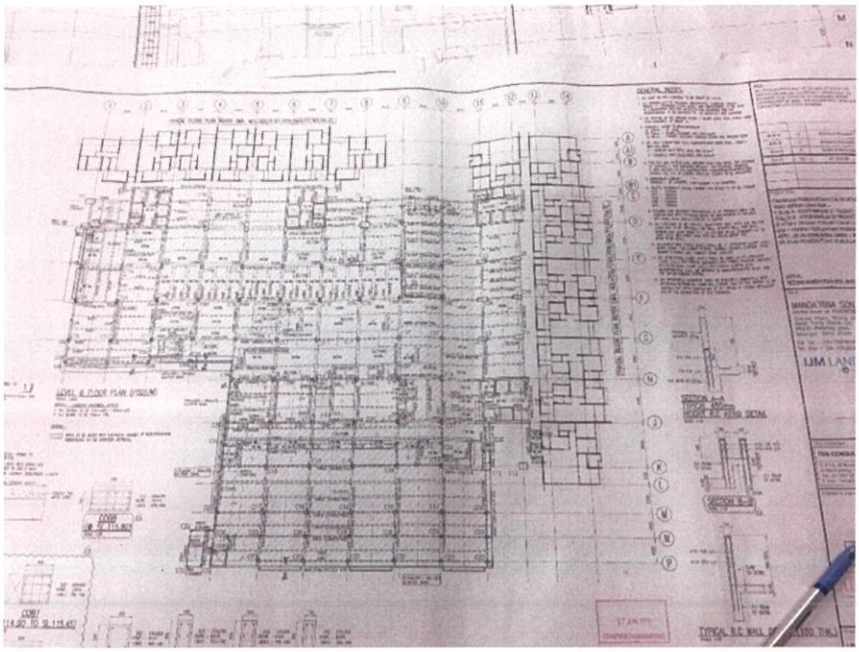

Figure 4.1: carpark plan drawing.

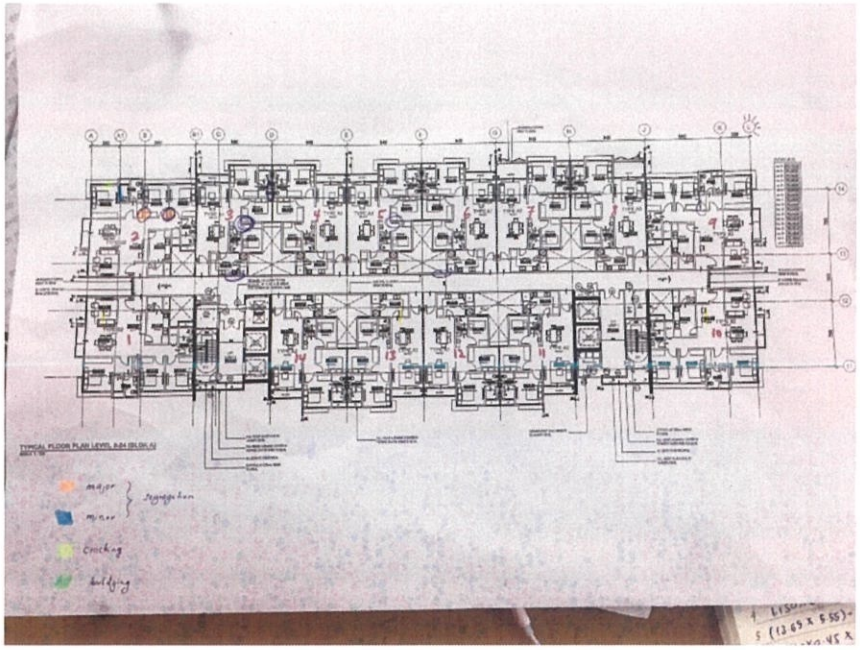

Figure 4.2: drawing for post concreting inspection on defect in concrete.

Figure 4.3: verticality inspection on formwork installation