DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

RC COLUMN AND BEAM CONSTRUCTION

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

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It is recommended that this practical training report provided

by

Noor Ismanajwa Binti Ismail

2016458372

entitled

RC Column And Beam Construction

be accepted in partial fulfillment of the requirements 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 Pembinaan Marwan Sdn. Bhd. (PMSB) for a duration of 14 weeks starting from 3 September 2018 and ended on 7 December 2018. It is submitted as one of the partial fulfillment of the requirements for obtaining the Diploma In Building.

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Date	:	18 December 2018

ACKNOWLEDGEMENT

Alhamdulilah, praise to Almighty Allah for protecting me and all practical students from any unwanted or harmful incidents during our practical training.

First and foremost, I would like to express my deepest gratitude towards Pembinaan Marwan Sdn. Bhd. for giving me opportunity to complete my practical training session where I has been gaining many informations and knowledges about construction of buildings, the administration management and also a bit of skills in doing Bills of Quantities.

I would also like take this opportunity to extraordinary thank the Project Manager of *Klinik Kesihatan (KK3), Pauh, Perl*is construction site, Mr. Azwan Bin Zakaria for the contribution of valuable informations, guidance and support me in collecting the data for the report. Not to be forgotten, I would also like to thank this construction site team, Mr. Muhammad Taufiq Bin Abdullah (Site Engineer), Mr. Mohamad Nasri Bin Jamil (Environmetal Officer/Site Supervisor C&S), Mr. Syafiq (Site Supervisor Architecture) and Miss Nor Azreen Binti Rodzi (Site Clerk) for helping me in completing my task and always respond everytime I ask for helps despite their busy schedule.

Next, I would like to extend my gratitude towards my lecturers especially to my report supervisor, Mr. Zulkifli Bin Ab. Halim, Dr. Dzulkarnain Ismail as my programme coordinator and Mr. Muhamad Naim Bin Mahyudin as my practical training coordinator who is never tired of their never ending questions regarding the practical training from students.

Last but not least, my special thanks to my beloved parents for their never ending supports and sacrifices all over the years.

Thank you.

ABSTRACT

Structural elements of a building will be include foundation, column, beam, ground beam and others. This report was conducted for the construction of in-situ columns and beams located at *Klinik Kesihatan (Jenis 3) Pauh, Perlis* a project comprising of 1 storey unit clinic building with 5 storeys unit staff quarters building and other ancillary blocks.The purpose of this report is to explain the method of construction of in-situ columns and beams and also to identify the materials and equipment used in this construction. The importance of a good structural element will be clarified through these purposes following the requirements of building criteria. In order to complete this report, the methodology taken are by interviewing the person in charge at the site, do the observations on the construction site, literature review and literature study based on the objectives of this report. It is crucial to make sure the building is following the legal regulations in order to avoid from building collapse or failure because structure components are the main key of a durable building.

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CHAPTER 1.0

INTRODUCTION

1.1 Background and Scope of Study

This Health Clinic (Type 3) project which is located at Pauh, Perlis is a development project by Kementerian Kesihatan Malaysia. Pembinaan Marwan had been appointed as the main contractor of this project under Jabatan Kerja Raya Negeri Perlis.

This report will be explaining the execution of the method of construction of the superstructure of the building including in-situ columns and beams. The activites involve in this project will include :

a) Identifying the type of materials used.

b) Planning and implementing the construction works.

1.2 Objective

i. To explain the method of construction of in-situ concrete columns and beams.

ii. To identify the machineries and equipment used for the construction of in situ concrete columns and beams.

1.3 Methods of Study

1.3.1 Primary Data

i. Interview

Interviews were done with the cooperation of persons in charge at the construction site including the project manager, site supervisor, sub-contractor, staff and workers. Those people give the explanation about the project based on the questions that has been prepared.

ii. Observation

One of the methods of study used is observation through site visits at the construction site on how the works were done during the practical training period. Information was obtained based on the progress of works during the period. Videos and photos has been recorded as the references and to show on how the work progress had been done.

1.3.2 Secondary Data

i. Literature Review

Literature review was done to find more information and knowledge about the method statement and steps in the soil treatment works, the material used and the ways to overcome the problems by referring to some related books, articles, website and the other mass media.

ii. Literature Study

Study had also been done on the project drawings from JKR since it is the government project. It includes the architectural drawing, structural drawing and engineering drawing for each block of the building.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction of Company

On 28th June 1983, Pembinaan Marwan Sdn. Bhd. (PMSB) started their business as a building and civil engineering contractor company. This company is based in Ipoh, Perak. PMSB is a wholly owned Bumiputra company registered with Construction Industry Development Board (CIDB) and Pusat Perkhidmatan Kontraktor (PKK) with Grade Registration G7 (Bumiputra).

Numerous construction and civil engineering projects has been successfully done by PMSB with various Ministries and Private Agencies throughout Malaysia. With a total cost of RM 440, 000.00 million, over 40 small and large projects was successfully completed, ranging from the construction of schools, office building, hospital, court house, wholesale complex to the channelization of river in Kampung Gajah, Perak. PMSB is a visionary company, efficient in the management and technical capacity, in compliance with its practices and innovation, has been recognized as the Kontraktor Bumiputra Berwibawa Malaysia by the Prime Minister's Department.

In 2012, the company was selected to be in Teraju's TERAS Bumiputra Entrepreneurs Programme also by the Prime Minister's Department under Majlis Tindakan Agenda Bumiputra (MTAB). In the year 2015, PMSB received two recognition as a 3 star Construction Company by the Construction Industry Development Board (CIDB) under Evaluation Capacity and Capacity of Construction (SCORE) programme and as Kontraktor Bumiputera Berprestasi Tinggi (KBBT) by Contractor and Entrepreneur Development Division of the Ministry of Works Malaysia.

As time passed by, after decades of steady growth powered by a relentless dedication to excellence, PMSB will strive to enhance its reputation by participating with government agencies and private projects throughout Malaysia in order to be known as a successful Bumiputra Contractor's Company.

2.2 Company Profile

2.2.1 Name of Company

Pembinaan Marwan Sdn. Bhd.

2.2.2 Date of Incorporation

28th June 1983

2.2.3 Executive Chairman/Managing Director

Datuk Hj. Wan Azizi B. Dato' Seri Hj. Wan Mohamed

2.2.4 Director

Wan Azhar B. Dato' Seri Hj. Wan Mohamed

2.2.5 Company Mission and Vision

i. To be a leading construction company in Malaysia in term of client services.

ii.To provide services efficiently and effectively through its personnel and capital resources.

2.2.6 Type of Organization

Private Limited

2.2.7 Business and Registered Address

No 6, Jalan Canning Estate, Canning Garden, 31400 Ipoh, Perak Darul Ridzuan.

2.2.8 Official Bank

i. Maybank Berhad (MBB) Ipoh Main Branch, Bangunan Maybank Trust, 28 Jalan Tun Sambathan, 30000 Ipoh, Perak Darul Ridzuan.

ii. RHB Islamic Bank Berhad, No. 2,4,6 & 8, Jalan Tun Sambathan, 30000 Ipoh, Perak Darul Ridzuan.

2.2.9 Website Address

http://marwan.com.my

2.2.10 Email

webmaster@marwan.com.my

pmsb_mw@yahoo.com.my

2.2.11 Official Logo

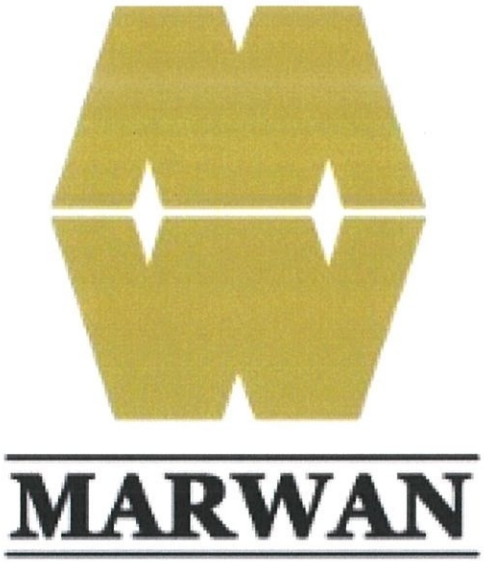

Figure 2.1 : Official Logo of Pembinaan Marwan

Source : Official Document of Pembinaan Marwan

2.3 Organization Chart

The figure below shows the official organizational chart of company Pembinaan Marwan Sdn. Bhd. :

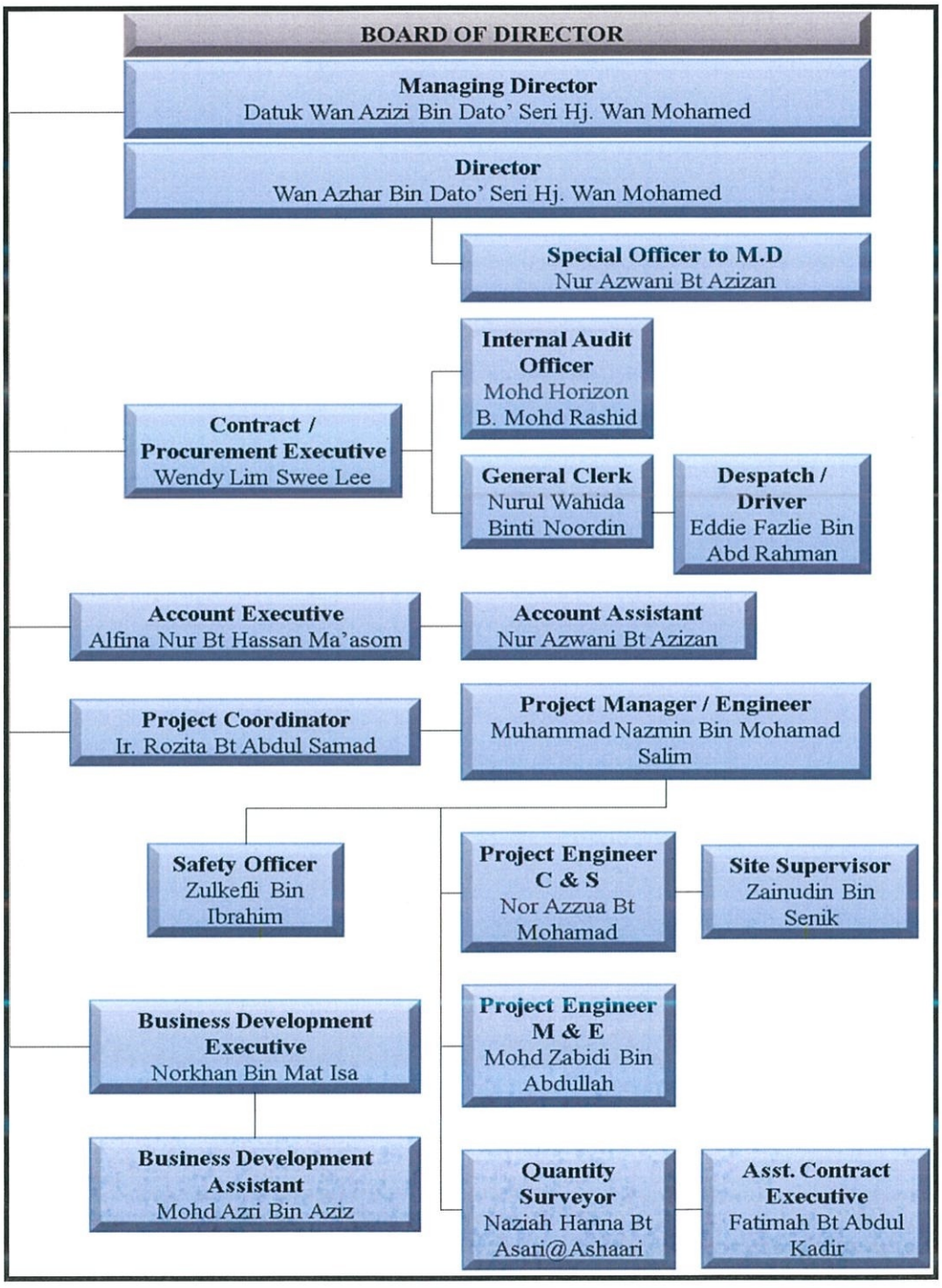

Figure 2.2 : Organizational Chart of Pembinaan Marwan

Source : Official document of Pembinaan Marwan

2.4 List of Projects

2.4.1 Completed Projects

Pembinaan Marwan has successfully done various types of construction for years as stated in the table below:

Table 2.1 : Completed Projects of Pembinaan Marwan

Bil.	Project	Client	Value	Complete Date
1	Channelisation of Sg. Kinta and Sg. Tumboh for Tumboh Swamp Drainage Scheme, Daerah Perak Tengah, Perak Darul Ridzuan	Department of Irrigation and Drainage	RM 6,489,125.00	20 October 2002
2	Hostels for (T) Sultan Idris Shah II, Gerik, Perak Darul Ridzuan	Public Work Department	RM 5,345,204.11	10 December 2003
3	Construction and Completion of Inner Ring Road, Bandar Baru Seri Iskandar, Perak Darul Ridzuan	Public Work Department	RM 17,805,149.88	10 April 2004
4	The Design, Construction, Equipment and Commisioning of Ambulatory Care Centre, Hospital Ipoh, Perak Darul Ridzuan	Malaysian Public Work Department	RM 51,000,000.00	22 August 2005

5	Proposed Construction of Malay Chamber Commerce Malaysia Neger Perak Office at Lot PT 138197, Jalan Panglima Bukit Gantang Wahab, Ipoh, Perak Darul Ridzuan	Malay Chamber of Commerce Malaysia Negeri Perak	RM 1,451,890.00	14 April 2006
6	Proposed Development for National Food Terminal (TEMAN) and Related Facilities in Lot H/S (D), KA70076, PT3676, Sg. Raia and Teja, Kinta District, Perak Darul Ridzuan	Federal Agricultural Marketing Authority (FAMA)	RM 140,000,000.00	31 July 2009
7	The Design and Built of Water Treatment System of Perkampungan Orang Asli, Perak for Package 1A	Ministry of Rural and Regional Development	RM 11,789,709.00	11 February 2010
8	Proposed Educational Project Development for Secondary School Education Mata Ayer, Mukim Ngulang, (18CR) Perlis Indera Kayangan	Ministry of Education Malaysia	RM 21,417,585.50	29 February 2012

9	Complete of Abandoned Works at Pulau Pangkor Police Station at Lot 5325 Pangkor, Lumut District, Manjung, Perak Darul Ridzuan	Ministry of Home Affairs	RM 22,622,300.67	6 December 2013
10	Intergrated Development Program for Orang Asli in Sungai Siput, Perak - Mini Project for Rural Transformation Centre (RTC) Kg. Orang Asli, Sungai Siput, Kuala Kangsar, Perak, Phase 2 - Construction of Secondary School and Hostels	Malaysian Public Work Department	RM 26,270,252.00	30 Jun 2016

Source : Official Document of Pembinaan Marwan

2.4.2 Project in Progress

Table 2.2 shows the ongoing projects that in construction under Pembinaan Marwan Sdn. Bhd. :

Table 2.2 : Ongoing Projects of Pembinaan Marwan

Bil.	Project	Client	Value	Complete Date
1	Health Clinic Kuala Kangsar, Perak Darul Ridzuan	Malaysian Work Public Department	RM 21,997,480.29	12 May 2019
2	Health Clinic Pauh, Perlis Indera Kayangan	Malaysian Work Public Department	RM 22,114,223.00	20 November 2019

Source : Official Document of Pembinaan Marwan

CHAPTER 3.0

CASE STUDY

3.1 Introduction to RC Columns and Beams Construction

The project was carried out at this site is to construct a Health Clinic which is located at Pauh, Perlis Indera Kayangan. The site area for this project in Pauh is 1.759 hectare which used to be a corn farm. The duration of construction as stated in the contract is 130 weeks starting from 25th May 2017 and expected to be completed on 20th November 2019. The total contract cost for this Health Clinic construction project is RM 22,114,223.00. The figure below shows the organizational chart of this construction site:

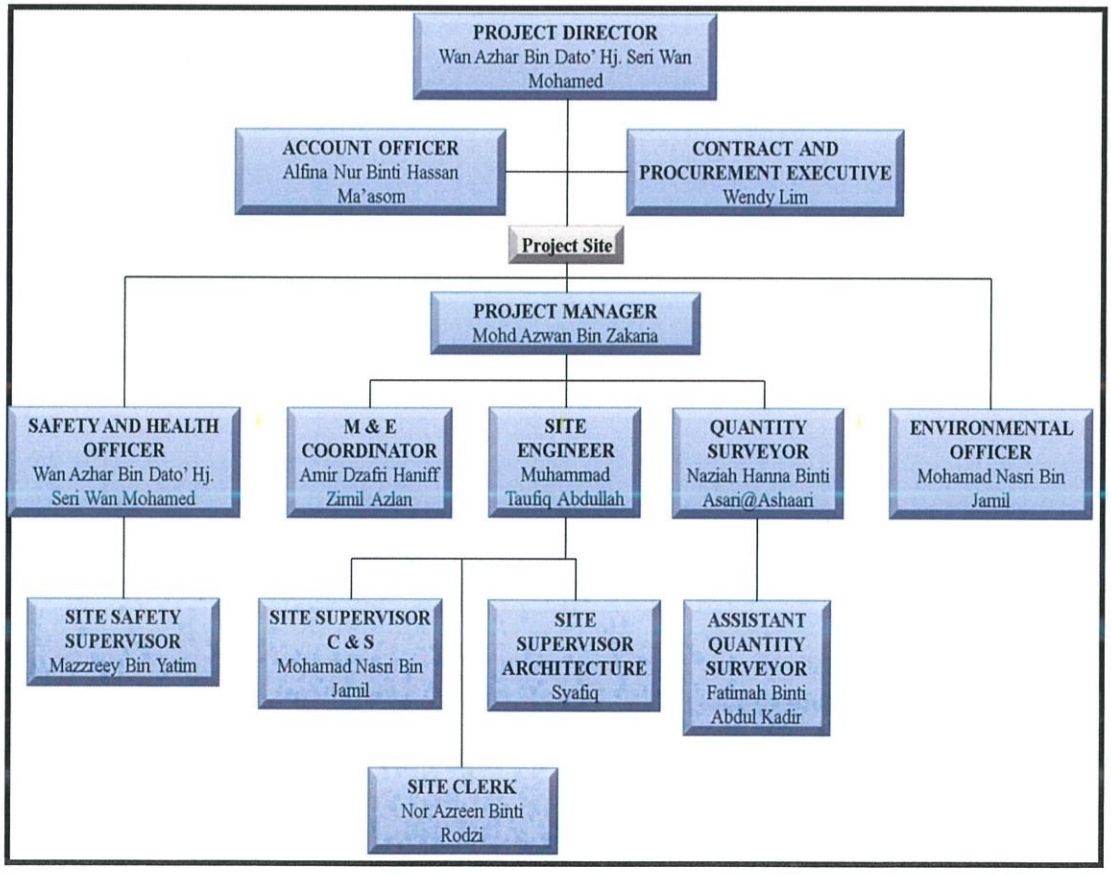

Figure 3.1 : Organizational chart for Klinik Kesihatan Pauh Perlis construction site

This Health Clinic project location is at Pauh, Perlis as shown in Figure 3.1 below:

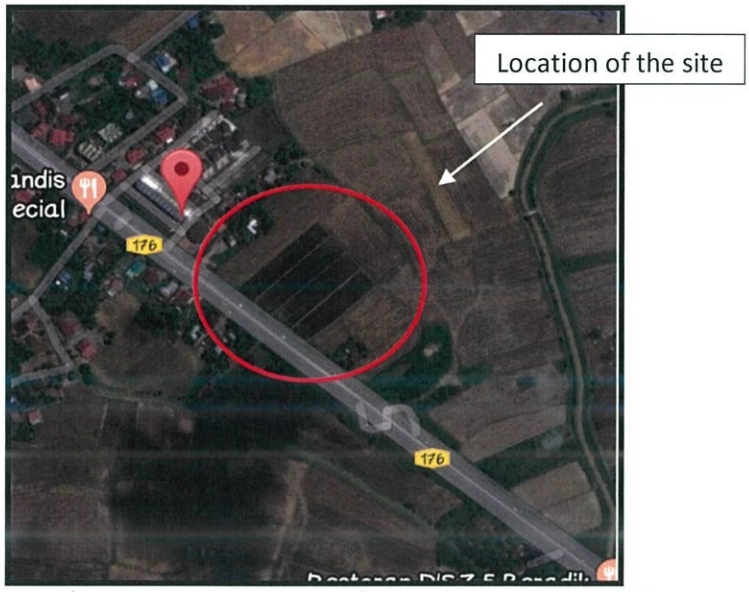

Figure 3.2 : Location of Klinik Kesihatan Pauh Perlis construction site

Source : https://www.google.com/maps

The parties involved in this construction project include the Health Department Malaysia as the client of this project, Public Works Department as the executor of this project and Pembinaan Marwan Sdn. Bhd. as the main contractor. Photo 3.1 below shows the signboard containing project information which placed at the outside of the construction site:

Photo 3.1 : Signboard of the contract informations of the Klinik Kesihatan (Jenis 3), Pauh Perlis project

The buildings to be constructed in this Health Clinic (Type 3) project are :

a)	Health Clinic (Type 3)	- 1 Unit
b)	Quarters G2	- 5 Units
c)	Pump House	- 1 Unit
d)	Guard House	- 1 Unit
e)	Ambulance Garage	- 1 Unit
f)	Garbage House	- 1 Unit
g)	Supporting Block	- 2 Units
h)	TNB Substation	- 1 Unit

The building structure in this project mostly used in-situ concrete but certain parts of the buildings in this project will be using pre-cast concrete structure component including the main clinic block.

This report will focus on the **construction of in-situ column and beam** for the main building and the quarters. At the start of the practical training session, the substructure of the buildings had been done and the workers begin the construction of the superstructure. The concrete grade used for this in-situ column and beam is concrete Grade 35 for both buildings. The steel bars used for reinforcement needed for in-situ columns and beams are diameter size Y32 for clinic building and Y25 for quarters building according to the structural drawings.

The reinforcement bars for both column and beam were made of steel bars which being cut according to the size as shown in Photo 3.2 below:

Photo 3.2 : Shows the steel bar prepared to be cut

Photo 3.3 shows the concrete blocks being prepared :

Photo 3.3 : Shows the concrete blocks prepared for reinforcement bar

The strength of the concrete used is determined by undergoing a cube test. For this pupose, every batch of concrete delivered test cube shall be made. The cubes should be tested at 7 days and at 28 days.

The cube being prepared before going through the test as shown in photo below :

Photo 3.4 : Shows the making of concrete cube for concrete Grade 35

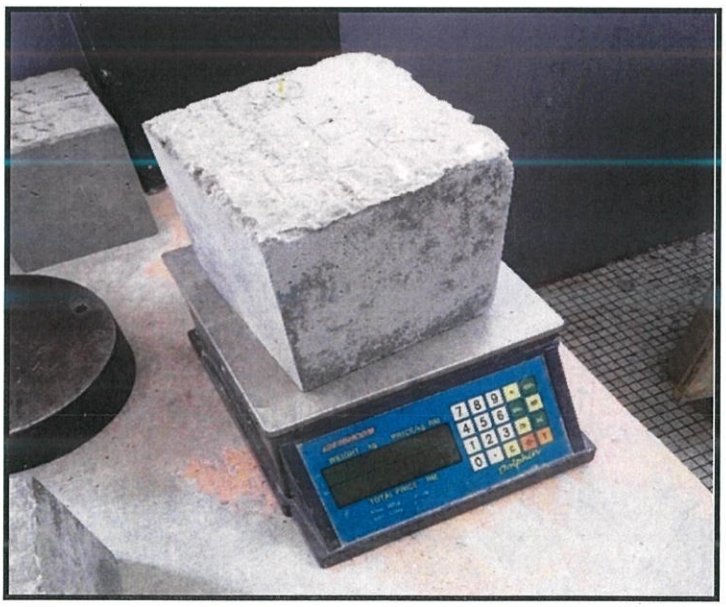

Photo 3.5 : Shows concrete cube Grade 35 being weighed before undergoing the cube test

Photo 3.6 : Shows the concrete cube Grade 35 being tested

3.1.1 Concrete In-situ Column

Column which also known as pillars are structures which are used to transmit load from the upper structure to the substructure. Concrete in-situ column was the type of column which were casted at the construction site. Column which was constructed at ground level of the building will be installed on either pile cap, edge beam or any type of foundation.

The type of loads that column structure need to withstand included :

- Dead Load - The permanent weight of all loading and the weight from the structure itself (Mario Salvadori, 1986)
- Live Load - All loads that other than dead load which can be moves include humans and animal, machines and fixtures, partitions and other non structural elements (Mario Salvadori, 1986)
- Dynamic Load - The loads come from the traffic such as brakes and accelerating loads
- Wind Load - All buildings need to be designed to resist the wind speed especially tall buildings or large surface buildings

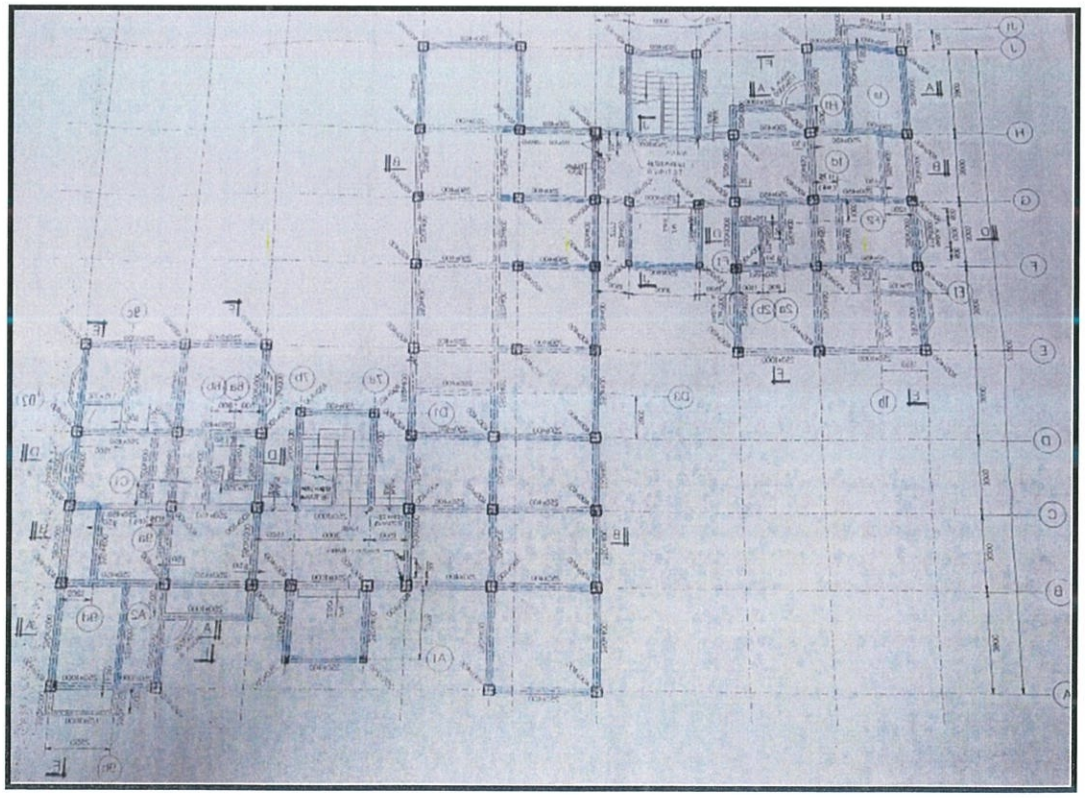

Photo 3.7 : Shows the floor plan of in-situ column at quarters building

The steel reinforcement bars provide the tensile strength the column in order to counteract the force from the upper structure. The footing must be suitable and strong enough to support the weight of the column and loads transfer through to the column. The loads that the column must sustain and withstand need to be exactly estimated by the Engineer, so that the type of concrete and the strength of the reinforcement can be well considered.

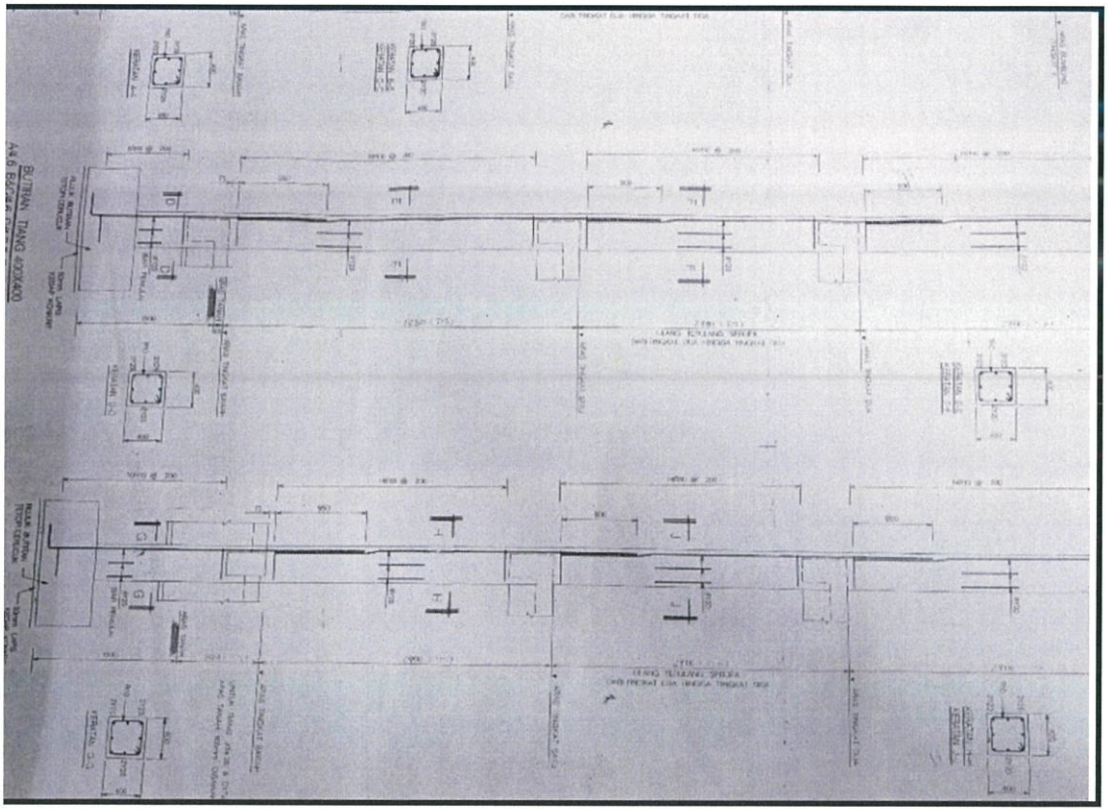

Photo 3.8 : Shows the detail structural drawing of reinforcement bar in in-situ column

3.1.2 Concrete In-situ Beam

Beams act as a horizontally spaning structural member which distribute the load from upper structure to the columns, so that the columns can transmit the load to the substructure. If the load was well distributed, the forces will be separated evenly to the columns which will prevent the structure from cracking. A beam is basically faced with four types of forces:

Forces :

- The loads applied to the beam
- Reactions to the loads from the supports
- Bending moments
- Shear forces

There were several types of beam that generally used in construction :

- Simply supported Beam
- Fixed Beam
- Cantilever Beam
- Continuous Beam
- Overhanging Beam

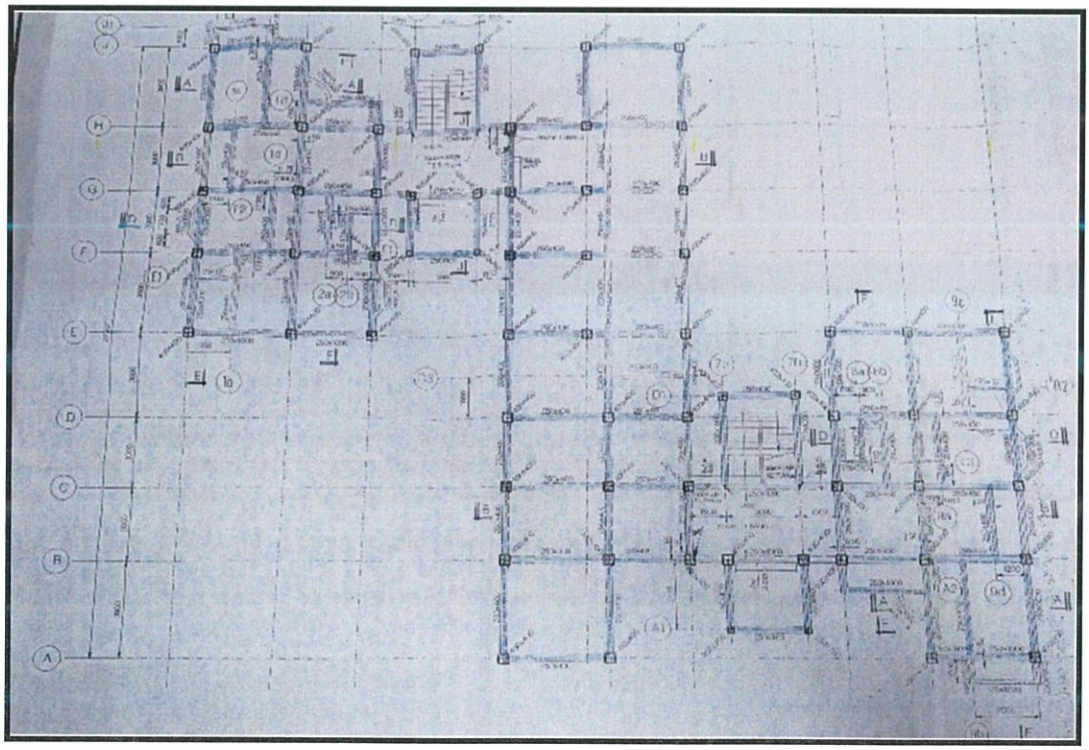

Photo 3.9 : Shows the floor plan of in-situ beam at quarters building

Steel reinforced concrete beams are usually required at most buildings in Malaysia where this type of beams can be designed to be strong enough to stand the forces imposed by either dead, live or wind loads. Beams are one of the important elements in building a good structure of a building because if the beam bends or deflects, it may collapse.

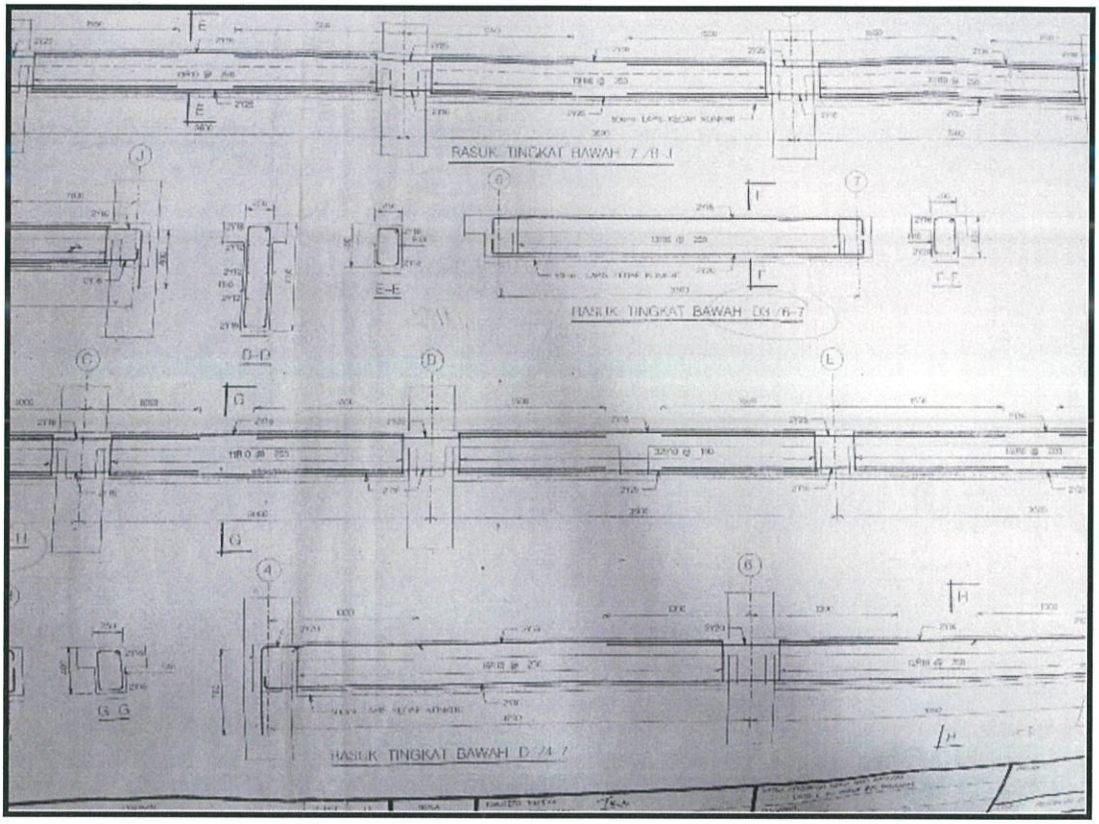

Photo 3.10 : Shows the detail structural drawing of reinforcement bar for the in-situ beams

3.2 Method Statement of Construction

3.2.1 Construction of In-situ Column

NO.	*OPERATION*	*SEQUENTIAL DIAGRAM*	*LABOUR*	*MACHINERY AND PLANT*	*EQUIPMENT*	*DURATION*
1.	Workers prepare steel bars for the columns.		-1skilled worker -2 unskilled workers	- Steel cutter machine - Steel bar bending machine	- Measuring tape - Marker pen - Steel bar	- 2 days (10 Columns)
2.	Main bars for column were connected to the column stump by tying the link to the reinforcement bars using wire ties.		- 3 unskilled workers		- Wire mesh - Wire mesh tying bar - Reinforcement bar - Linkers	-2 days (10 Columns)

3.	Concrete blocks were installed to produce gap between reinforcement bar and formwork.		- 2 unskilled workers		- Wire mesh tying bar - Concrete blocks - Wire mesh	- 2 days (10 Columns)
4.	Timbers were prepared for the columns' formwork while the ground beam and slab were being concreted.		- 1 skilled worker - 2 unskilled workers	- Timber wood cutter machine	- Hand saw - Nails - Hammer - Timber wood - Measuring tape - Marker pen	-3 days (10 Columns)

5.	Workers install the formwork for column.		- 4 unskilled workers		- Hammer - Nails - Column's formwork	- 4 days (10 Columns)
6.	Temporary support for columns were installed to avoid the formwork from falling down during concreting process.		- 2 unskilled workers		- Timber wood - Hammer - Nails	- 1 day (10 Columns)

7.	Holes were made at some part of the columns' formwork for grouting purpose.		- 2 unskilled workers		- Handsaw - Measuring tape	- 1 day (10 Columns)
8.	Cement go through slump test before approved to be used in construction.		- 1 skilled worker - 1 unskilled worker		- Slump cone - Measuring tape - Tamping rod - Non porous base plate	- 2 days (10 Columns)

9.	Concrete was poured into the column's formwork.		- 4 unskilled worker	- Crane - Concrete mixer truck		- 2 days (10 Columns)
10.	Vibrating process been done after the concrete was poured.		- 2 unskilled workers	- Concrete vibrating machine		- 2 days (10 Columns)

11.	After the concrete had hardened, the formwork was dismantled from the column after 3 days.		- 2 unskilled workers		- Hammer	- 3 days (10 Columns)

3.2.2 Construction of In-situ Beam

NO.	*OPERATION*	*SEQUENTIAL DIAGRAM*	*LABOUR*	*MACHINERY AND PLANT*	*EQUIPMENT*	*DURATION*
1.	Workers were cutting and bending the steel bars for beams.		- 1 skilled worker - 2 unskilled workers	- Steel cutter machine - Steel bar bending machine	- Measuring tape - Marker pen - Steel bar	- 2 days (10 Beams)
2.	Supporting timber props was installed before starting with the formwork of beam.		- 2 unskilled workers		- Timber wood - Hammer - Nails - Measuring tape - Marker pen	- 2 days (10 Beams)

3.	Formwork of the base of the beams were installed.		- 2 unskilled workers		- Hammer - Nails - Timber wood - Measuring tape	- 2 days (10 Beams)
4.	The reinforcement bar were installed onto the base of the beam formwork.		- 4 unskilled workers		- Hammer - Measuring tape - Marker pen - Wire mesh - Wire Mesh tying bar	- 2 days (10 Beams)

5.	Reinforcement bar of beam were connected to the reinforcement bar of column.		- 1 skilled worker - 2 unskilled workers		- Wire mesh - Wire mesh tying bar	- 2 days (10 Beams)
6.	The formwork of beam were being installed.		- 6 unskilled workers		- Hammer - Nails - Measuring tape - Marker pen	- 5 days (10 Beams)

7.	The concrete was poured into the formwork mould and worker continue the vibrating process.		- 4 unskilled worker	- Crane - Concrete mixer truck	- Cement vibrating machine	- 2 days (10 Beams)
8.	After the concrete had been fully set, the formwork was dismantled from the beam after 3 days.		- 2 unskilled workers		- Hammer	- 3 days (10 Beams)

3.3 Machineries and Equipment used

3.3.1 Crane

There are many types of cranes used in construction project and the cranes has different function for each works. Cranes are normally used in process of lifting, lowering and moving the heavy materials with the use of its components. Cranes are very valuable because it simplify the works at construction site especially works at high level.

Photo 3.11 : Shows the crane used at the construction site

At this construction site, cranes are used to move the soil from the soil heap to the construction area for backfilling purpose . The crane fasten the works of backfilling to avoid from delay of other works. Other than that, the crane is also used during concreting process which it move and lift the concrete from cement lorry to the construction area by using a bucket with the help of the workers.

Since some parts of this project used Industrialised Building System (IBS) columns and beams, the crane was used to lift the structural elements and help the workers with the installation process.

3.3.2 Concrete Mixer Truck

Usually, the company will buy and order the concrete from the cement factory itself. The supplier will send the concrete straight from factory by using a concrete mixer truck. This truck will mix the cement and aggregates in the part of its body called the mixer equipment. This truck will keep on running during the concreting process. It will transport the concrete to the construction area by using the crane.

Photo 3.12 : Shows the concrete mixer truck pouring concrete into the bucket

3.3.3 Concrete Vibrating Machine

The concrete mixture will produce honeycomb and trapped air which may cause the building become weak and not durable. This concrete vibrating machine will help the workers to released the trapped air inside the concrete mixture to consolidate the freshly poured concrete. Inappropriate consolidation will produce defects in future.

Photo 3.13 : Shows the concrete vibrating machine

Source : https://malaysia.images.search.yahoo.com

3.3.3 Steel Bar Cutter Machine

Steel bars are the most important things that will be on site to produce the reinforcement bars of each structure of the element. Steel bars need to be cut according to the size stated in the structural drawing but it cannot be done manually. So, with the help of this steel bar cutter machine, workers can quicken their works. This machine will also cut the steel bars flawlessly without damaging the steel bars and cause loss of money.

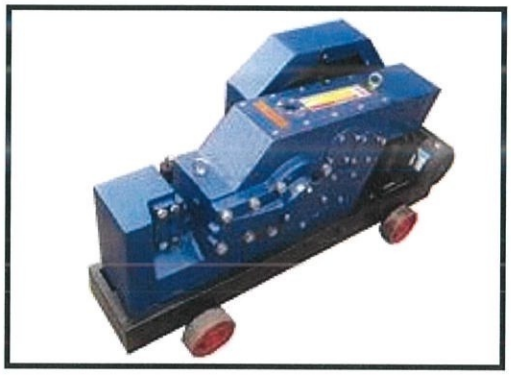

Photo 3.14 : Shows the steel bar cutter machine

Source : https://malaysia.images.search.yahoo.com

3.3.4 Steel Bar Bending Machine

Reinforcement bars need to be bend at some points in order to combine with the other reinforcement bars. This steel bar bending machine will bend the steel bars accurately after being marked by the workers. Bending works canot be done manually since its diameter is big and difficult to be bend.

Photo 3.15 : Shows the steel bar bending machine

Source : https://malaysia.images.search.yahoo.com

3.3.4 Timber Wood Cutter Machine

This machinery is used to cut the timber wood for the formwork structure which can shorten the time compared to use manual equipment such as handsaw.

Photo 3.16 : Shows the timber wood cutter machine

CHAPTER 4

CONCLUSION

4.1 Conclusion

As stated, the objectives of this report are to explain the method statement for construction of cast in-situ columns and beams and to identify the equipments and materials used for the construction of in-situ concrete column and beam. The method has been studied during the construction of the cast in-situ columns and beams at *Klinik Kesihatan (Jenis 3), Pauh Perlis* construction site.

The machineries and equipments used are following the regulations from National Institute of Occupational Safety and Health (NIOSH) and Department of Occupational Safety and Health (DOSH). All the machineries and equipments used at this construction site have legal license following the legislation set by the government.

Every construction has its own problems in dealing with the unforeseen obstacles. Perlis state has a quite different weather compared to the other states because the weather is unpredictable. Therefore, problems occur such as broken formwork during concreting, the steel reinforcement become rusty, the delay of works activities due to sudden weather change.

Last but not least, it can be conclude that this construction site area is safe to enter related to safety and health purpose. The safety precaution has been vigorously taken by obliging the workers to wear Personal Protective Equipment (PPE) to avoid from fatal injuries or minor injuries during the construction works process. Hence, in order to avoid from the contributions of building defects and human injuries, all parties involved in any construction site need to be cautious about the safety and health aspects

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