DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

PILE CAP CONSTRUCTION FOR KLINIK KESIHATAN

(TYPE 3)

(KK3 KEPALA BATAS, KEDAH)

Prepared by:

TENGKU AMMAR HAKIM BIN TENGKU MAHUSIN

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FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

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Be accepted in partial fulfilment of requirement has for obtaining Diploma in Building.

Report Supervisor : _____

Ts. Dr. Mohd Rofdzi bin Abdullah

Practical Training Coordinator : _____

Dr. Nor Asma Hafizah binti Hadzaman

Programme Coordinator : _____

Dr. Dzulkarnaen bin Ismail

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Bina Jaya Mantap Sdn Bhd for duration of 20 weeks starting from 23 August 2021 and ended on 7 February 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

……

Name : Tengku Ammar Hakim bin Tengku Mahusin

UiTM ID No : 2019296546

Date : 10 January 2022

ACKNOWLEDGEMENT

Alhamdulillah, praise to Allah, the Most Merciful, the Most Graceful. First and foremost, I would like to express my gratitude toward the guidance, advice, and help throughout the period of my practical training at Bina Jaya Mantap Sdn. Bhd. Thanks to En. Mohd Faizal bin Sahar for the opportunity given, especially for the internship placement in the company. His team, which consists of the project engineer/SSS (Pn. Aniyah Mahfuzah binti Zainuddin), safety and health officer (En Moustaqqim bin Abd. Rahim), QAQC (Pn. Farah Haryani binti Abdul Kirom), site supervisor (En. Izzudin bin Zainudin) and environmental officer (Pn. Kausar binti Ismail), have taught and enabled me to develop my understanding, knowledge, and experience during my time at the site. Besides, they are also responsible for my training by giving me tasks about the building's construction and structure. Their commitment to enhancing my knowledge and ability to understand the project management, test procedures, site safety, and so on. It is an honour for me to be given the opportunity to "work" with them.

I am grateful to all of the UiTM lecturers who have contributed to my report and the guidance I received during my internship. To Cik Nor Azizah binti Talkis, Ts. Dr. Mohd Rofdzi bin Abdullah, who is the supervising lecturer during my internship, En. Muhammad Naim bin Mahyuddin, the practical training coordinator, and last but not least, our programme coordinator, Dr. Dzulkarnaen bin Ismail, I am deeply appreciative of all of the guides' time and effort in order to make my internship a success. Finally, I'd like to express my heartfelt gratitude to my beloved parents for their contributions to my internship period.Their countless love and efforts are truly amazing and I am lucky enough to have them as my parents.

Thank you so much.

ABSTRACT

Because the foundation is the most important aspect of a building structure, this report will go over the pile caps for the RC piles that were used in this project. This report was prepared for the pile cap for the piling of 282 piling points of the two-story clinic building, 88 piling points for quarters and 15 points for the electrical substation in Kepala Batas, Kedah. The purpose of this report is to determine the construction method for pile caps for a two-story clinic building, two units of quarters, and a one-unit electrical substation. This project involves the construction of public facilities in terms of health, which includes preliminary work, substructure, superstructure, architectural work, external work within the lot boundary, and infrastructure work. When illustrating the function of pile caps to the building structure, including the pile cap definition, materials used, construction method, and design that adhere to the Standard Specification for Building Works, there are several important aspects to be considered.

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CHAPTER 1

1.0 INTRODUCTION

1.1BACKGROUND OF STUDY

Pile cap can be defined as a type of thick mat-like structure that sits on the pile. A pile cap is responsible for providing a secure foundation for the entire system of a building. Moreover, the concrete pile cap works by receiving the massive load from the superstructure and allowing it to flow to the piles as it can provide a stable bearing capacity towards the building. Besides, a raft foundation is one similar structure that provides a stable foundation for the building. Furthermore, the pile cap enables an even distribution of the weight carried by the pile group, ensuring that no individual member is overstressed. To build a pile cap, pilings are first cut to ensure that all of the individual columns are the same length and have flush tops. When structure loads are evenly distributed, contractors may support the structure using a concrete pile cap. This enables the pipe pilings to be equally placed beneath the structure and then linked together with the pile cap to form a strong foundation system. Pile cap construction is commonly used in high-rise buildings in order to support the structure load, imposed load, and other loads. Therefore, in order to get a solid building structure, constructing pile caps is a vital thing to be done first.

Besides that, pile caps are usually placed on top of deep foundations such as the spun pile, rc pile, and any type of pile. A pile cap is defined as a concrete block cast on the head of a group of piles that is to transmit the load from the structure to the group of piles. Generally, a pile cap transfers the load from the structure to a pile group, and then the load is further transferred to firm soil**.**

1.2 OBJECTIVES

- To identify the materials used in the pile cap construction
- To learn and study the construction of pile caps
- To identify the precautions in constructing pile caps

1.3 SCOPE OF STUDY

The study was conducted based on the Klinik Kesihatan (Jenis 3) project that is located at Kepala Batas, Kedah Darul Aman. This practical report focuses on pile cap construction for the clinic building. In addition, there are 88 pile caps that need to be constructed at the clinic building, as the clinic building will be installed and provided with heavy machines and facilities for the public's use. Therefore, the study intends to know the procedure of constructing pile caps from the very beginning, the material of constructing pile caps, and the importance of pile caps in order to achieve a suitable bearing capacity. The study also pays attention to what types of machinery and equipment were used for the pile cap construction. These machines and equipment are excavators, backhoes, concrete mixers, and so on. Besides, this report also shows how many general workers are required to do the pile cap construction, such as cutting off piles, laying lean concrete, formwork installation, etc.

1.4 METHOD OF STUDY

To obtain and fulfil the session, there are a few methods of study that were done during the practical training. The studies were started by gathering all of the relevant information, and this information was collected from the company office and site project. Two stages of collecting data and information were used, and they are primary data and secondary data.

1.4.1 Primary Data

The methods that being used in gathering the primary data are :

- Observation

  Observation was done at the site project by taking photographs that related to the report study. By using this method, we are able to the photos that had been taken as our reference or the description of any data in the report.

- Interview

  This method can be done by interviewing the person that in charged with the project such as :

  - Project Manager
  - Project Engineer
  - Workers
  - Site supervisor
  - Safety and Health Officer

  All of the information and details can be collected without any mistakes through this method of study.

1.4.2. Secondary Data

The secondary is being obtained or collected by doing some research before and after setting the primary data. These data were taken from the :

i. Books

Books are one of the earliest sources of knowledge that researchers in every country have utilised to do study. Company magazines, contract book samples, journals, progress reports, and other books linked to our research are examples of books that can be employed. We may learn more about what we're searching for in our study by reading all of the books.

ii. Internets

The internet is now the most widely used technique of information retrieval. This is because we may obtain information by accessing the internet on our laptops, computers, or smart phones and typing the information we want to discover for our report. It also provides us with information quickly rather than wasting time seeking for it.

iii. Drawings

Drawing is one of the most useful kind of information for our studies and research because it allows us to learn more about the symbols used in the picture and how they link the 2D drawing to a real 3D structure. The use of a sketch also allows us to determine the type, size, and length of pile cap that will be utilised in the construction.

CHAPTER 2

2.0 COMPANY BACKGROUND

2.1 INTRODUCTION OF COMPANY

Bina Jaya Mantap Sdn. Bhd. is based in Malaysia. The head office of Bina Jaya Mantap (BJM) is located in Alor setar, Kedah (Figure 2.1). The company operates in the Heavy and Civil Engineering Construction industry and has been completed several government and private projects successfully. The company was established on 28th of October 1993. Bina Jaya Mantap Sdn. Bhd. had organised a PKK Class A Bumiputera and CIDB G7 registration. Among the projects completed Malaysia National Archives Building, Perak Branch, Reconstruction of JKM Quarters in RSK Bedong, Kedah, Construction and completion (2) R&D Building at Universiti Tekologi Petronas, Bandar Seri Iskandar, Tronoh Perak, Construction of Asrama Akhlak Pokok Sena, Kedah and others.

2.2 COMPANY PROFILE

2.2.1 Company Detail

Company Logo	 Bina Jaya Mantap Logo
Company Name	Bina Jaya Mantap Sdn. Bhd.
Company Address	No. 18, Tingkat 4, Wisma BJM, Lebuhraya Darul Aman, 05100 Alor Setar, Kedah Darul Aman.
Contact Number	Tel : 04-7318125 Fax : 04-7301331
Email	bjmantap@yahoo.com.my
Main Services / Activity	Construction
Number of Employees	± 25 persons

Table 2.1 : Company detail

2.2.2 Company Location

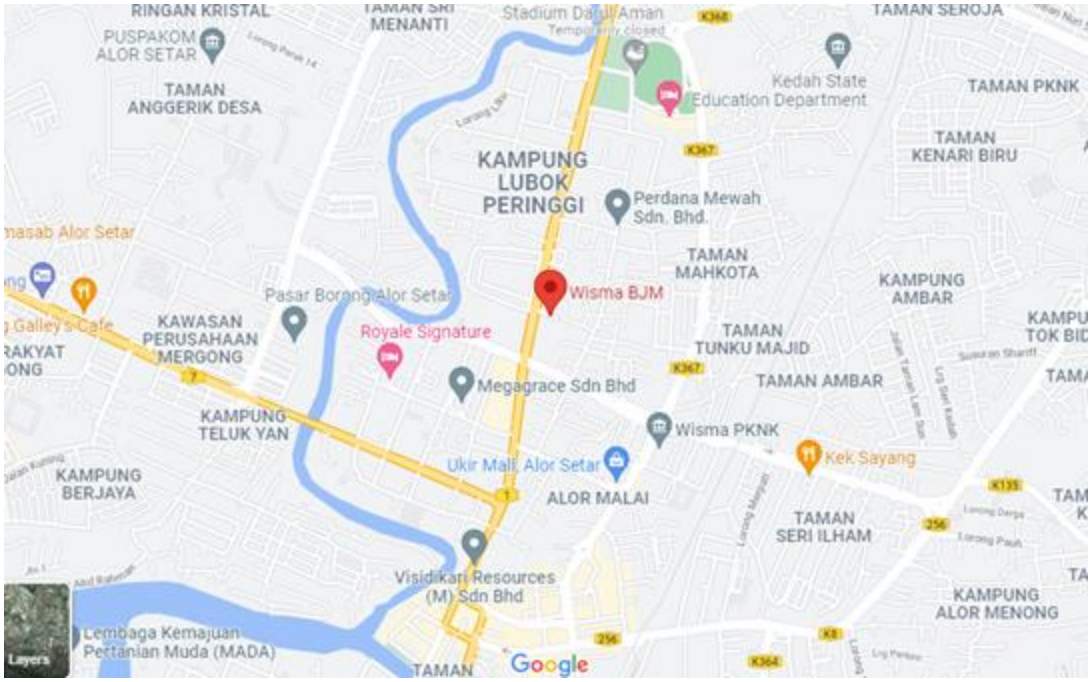


Figure 2.1 : Bina Jaya Mantap Sdn. Bhd. Location

2.2.3 QUALITY POLICY

Bina Jaya Mantap Sdn. Bhd. is dedicated to providing Quality Construction Services that meet or exceed the expectations of its customers by implementing MS ISO 9001:2008 Quality Management Systems. We will continuously improve the value of services by implementing practical operational functions and positioning the company as an industry leader.

Our belief is well supported by the Quality Policy:

- Maintain systems to comply with MS ISO 900:2008 Quality Management Systems and other related statutory and regulatory requirements.
- Provide training programmes to help employees improve their skills, awareness and competency.
- Establish and sustain a quality culture within the organisation.
- Review, improve and implement Quality Control and best practise procedures on a regular basis.

2.2.4 Vision

Bina Jaya Mantap Sdn. Bhd. is a company that fully committed to the implementation of and will work toward quality and provide customers satisfaction by implementing continual throughout the business activities

2.2.5 Mission

The company operates their business for the customers with the following Quality objectives :

- Accident — 0 cases / project
- Project Performance — ≥ 95% on Schedule
- Complaint — 0 cases / project
- Training — Min 3 hours / key person
- Supplier / Sub-con Performance — Min 10m Points
- Customer Satisfaction — Min 18 Points

2.2.6 Code of Ethics

1. To know your job responsibilities and do them so as to maintain our own safety of the community.
2. To know customer requirements and to do things right at the first time & every time.
3. To work according to our schedule to meet customer requirement.
4. To inculcate a strong spirit of teamwork.
5. To strive for continual improvement.

2.2.7 ENVIRONMENTAL POLICY, SAFETY AND HEALTH

KITACON Sdn. Bhd., as a construction contractor registered with CIDB Gred7, services construction buildings and civil engineering works, as well as a member of the global community responsible for protecting the beauty of the environment and safeguarding the welfare of the resources that are priced based on the use of cutting-edge technology and the commitment of its employees to avoid uncontrolled development. We also prioritise the best working environment for employee safety and health by preventing injuries and property damage at the headquarters (HQ) and construction site.

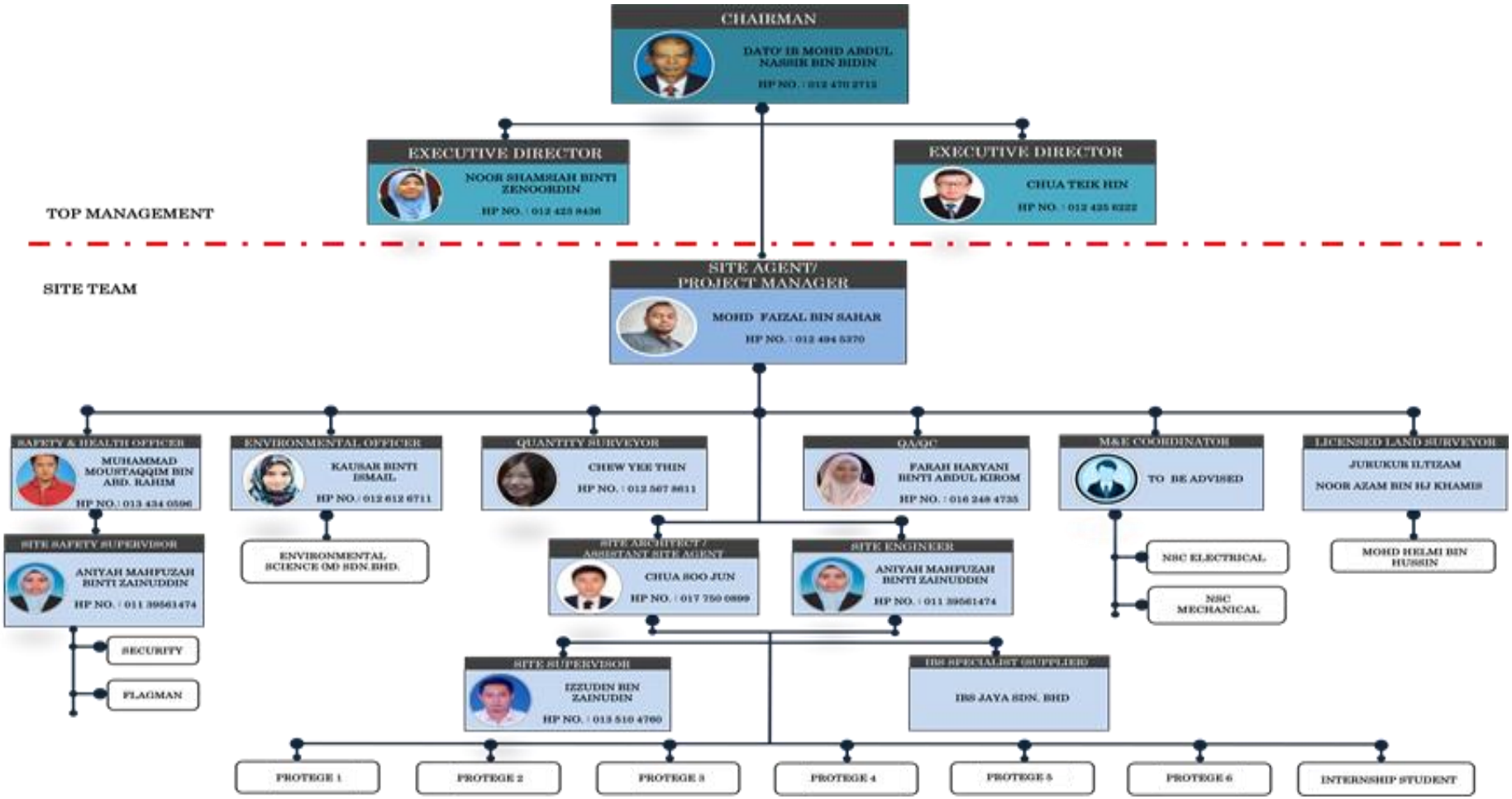
The following steps will be taken by the company to promote environmentally friendly activities in all aspects:

- Control and prevention of pollution, injuries and distubances.
- Minimize waste and accidents
- Provide information and training to all employees, especially those who interact with hazardous materials.

Bina Jaya Mantap Sdn. Bhd. on environmental, safety and health issues.

- Comply with all rules, environmental laws, safety and health requirements and other requirements including needs of the other parties involved,
- Improve the performance quality of the environment, safety and health through monitoring and constant evaluation
- Environmental policy, safety and health to the appropriate authorities.

2.3 ORGANIZATION CHART



2.4 LIST OF PROJECT

2.4.1 COMPLETED PROJECT

NO	PROJECT TITLE	CLIENT/ CONTRACTOR	ESTIMATE CONTRACT VALUE (RM)
1.	*Cadangan Pembinaan Kompleks Pejabat 6 Tingkat, Pencawang TMB, di Atas Lot 1974, Tapak TMB, Jalan Kolam Air, Alor Setar, Kedah*	*Telekom Malaysia Berhad*	11,109,674.67
2.	Muda River Water Scheme Phase 4A : Supply, Delivery and Commissioning of New Lahar Tiang Pumping Station and The Construction of Associated Works. (Package 1)	*Pengurusan Bekalan Air, Pulau Pinang*	16,213,392.46
3.	The Proposed Construction and Completion of Landscape Works At Waterfront & Roads At Precinct 2 and Landscape & Irrigation Works at Roads Precinct 3and precinct 4, Putrajaya Development.	Putrajaya Holdings Sdn. Bhd.	10,980,993.00
4.	*Cadangan Membina dan Menyiapkan Asrama Pelajar Institut Perguruan Darul Aman (IPDA), Jitra Di Atas lot 4004, Mukim Naga, Daerah Kubang Pasu, Kedah*	*Kementerian Pelajaran Malaysia*	21,798,033.90

5.	*Pembinaan Asrama Akhlak Pokok Sena, Kedah Darul Aman. (IBS – Rekan dan Bina) Di Atas Lot 4004, Mukim Naga, Daerah Kubang Pasu, Kedah*	*Kementerian Pembangunan Wanita, Keluarga & Masyarakat*	19,997,838.48
6.	Proposed Construction & Completion Of Package 2 (Fodder & Pasture Works) of The Muadzam Shah Castle Research & Innovation Centre, Pahang Darul Makmur	Majlis Pembangunan Wilayah Ekonomi Pantai Timur	15,966,958.57
7.	*Cadangan Pembangunan Projek Pendidikan Bagi Sekolah Kebangsaan Bukit Kiara – Pakej 6*	*Kementerian Pelajaran Malaysia*	22,780,599.60
8.	The Proposed Construction and Completion of Forty (40) Units of Houses, Twenty (20) Units of Animal Production Unit (APU), Fodder Plot Establishment, Infrastructure Works and other Facilities For the Development Of Pekan Agropolitan Project (PAP) at Kawasan 3,5,6,7 and 9 at Batu 8, Mukim Lepar In The District Of Pekan, Pahang Darul Makmur	*Majlis Pembangunan Wilayah Ekonomi Pantai Timur*	22,676,743.50
9.	*Pembinaan Semula Kuarters Jabatan Kebajikan Masyarakat (JKM) Di Rumah Seri Kenangan Bedong, Kedah Darul Aman*	*Kementerian Pembangunan Wanita, Keluarga & Masyarakat*	18,689,893.30

10.	*Projek Cadangan Membina & Menyiapkan Bangunan Arkib Negara Malaysia Cawangan Negeri Perak*	*Kementerian Pelancongan dan Kebudayaan Malaysia*	27,514,889.47

Table 2.2 : Completed project

2.4.2 PROJECT IN PROGRESS

NO	PROJECT TITLE	CLIENT/ CONTRACTOR	ESTIMATE CONTRACT VALUE (RM)
1.	Klinik Kesihatan (Jenis 3) Kepala Batas, Kedah	Kementerian Kesihatan Malaysia Jabatan Kesihatan Negeri Kedah/Pejabat Kesihatan Daerah Kubang Pasu	22,802,851.00

Table 2.3 : Project in progress

CHAPTER 3

3.0 CASE STUDY

3.1 INTRODUCTION OF PROJECT

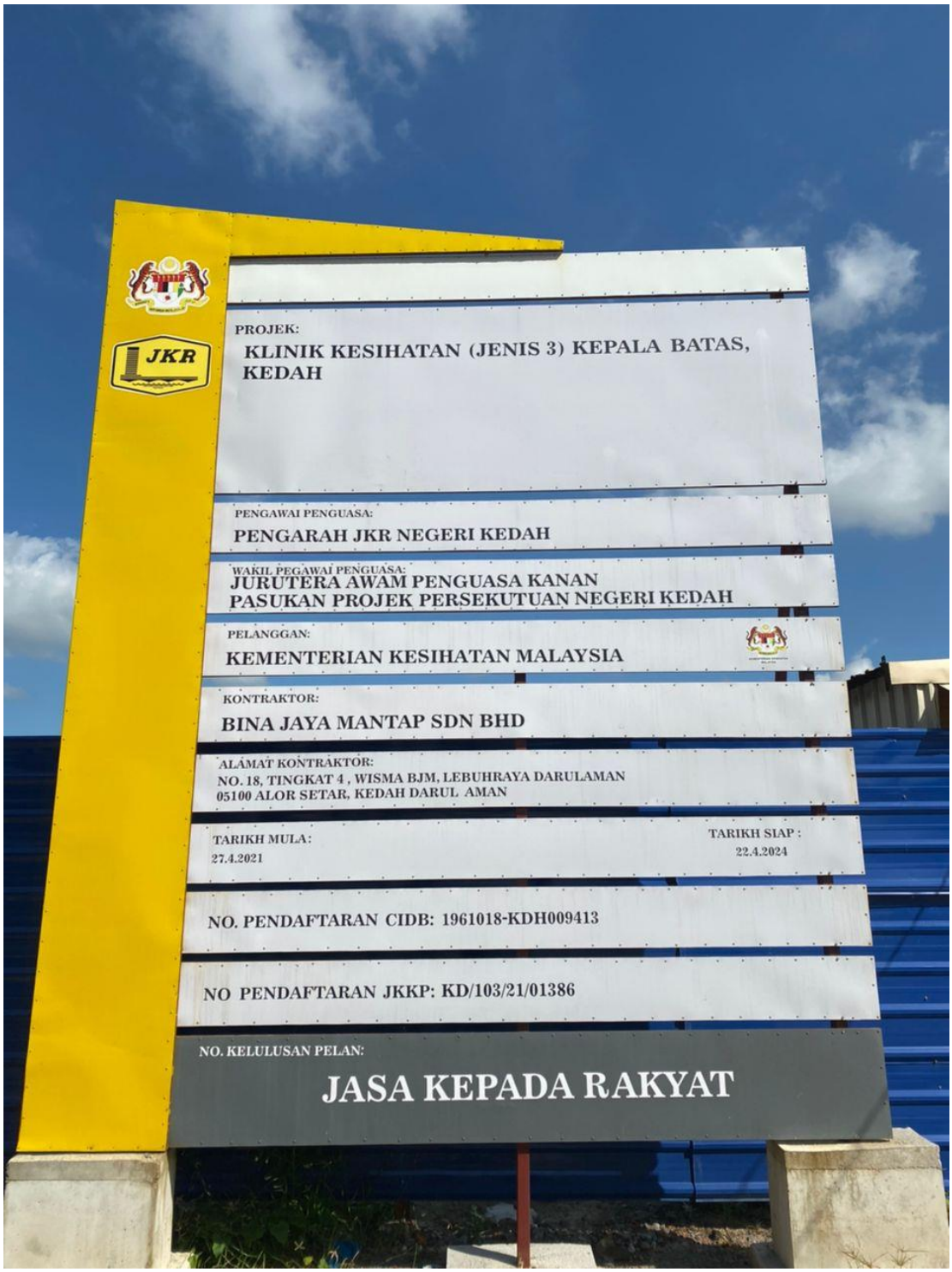


Figure 3.1 : Project signboard

I was trainee under Bina Jaya Mantap Sdn. Bhd. company and the construction that is ongoing developed is Klinik Kesihatan (Type 3) Kepala Batas at Jitra, Kedah. Based on the development and population growth factors in Kepala Batas especially with the opening of new housing area had made the existing health clinic unable to accommodate the need of resident and need the enlarged. The existing clinic building is also in bad condition and limited equipment causing user discomfort and some certain patients cannot be treated at the clinic.

Therefore, Jabatan Kerja Raya Malaysia in collaboration with the Ministry of Health Malaysia and Kedah State Health Office and Jabatan Kerja Raya Negeri Kedah are intends to develop Project Klinik Kesihatan (Type 3) Kepala Batas, Kedah Darul Aman to cover the needs of Kepala Batas resident. Bina Jaya Mantap Sdn. Bhd. has been awarded as the Contractor to implement the project. The number of blocks to be constructed is eight blocks, which are clinic block, quarters, compact sub, genset room, guard house, store, pam house, and ambulance garage. The clinic has been equipped with various basic amenities like parking lot, playground, cottage for rest and others utilities. The plan of project will be attached at appendix part.

3.1.2 PROJECT DESCRIPTION

This project concept is conventional. Below are the details of the project :

- Condition of contract : Conventional
- Project Cost : RM 22,802.851.00
- Duration of Contract : 156 weeks
- Date of Site Possession : 27th April 2021
- Date of completion : 22nd April 2024
- Main Contractor : Bina Jaya Mantap Sdn Bhd

3.1.3 PROJECT LOCATION

The new health clinic will be built on about 3.06852 Hectares (30685.2 m^2) of land at Kepala Batas Town, Kubang Pasu District, Kedah. The access road to this project site is via North-South Expressway and Hutan Kampung Toll exit. The Key plan and location of the proposed project site is given in Figure 3.2 and Figure 3.3 respectively and the layout pan is shown in Figure 3

Figure 3.2 : Key Plan

Figure 3.3 : Location of project

Figure 3.4 : Layout plan

3.1.4 Introduction Of Rc Pile Cap

As seen in Figure 2, pile caps are typically installed on top of deep foundations such as spinning piles, rc piles, and other types of piles. A pile cap is a concrete block that is cast on the head of a set of piles, as illustrated in Figure 3.5, to transfer load from the structure to the piles. In most cases, a pile cap distributes the load from the structure to a pile group, which subsequently transfers the load to solid soil.

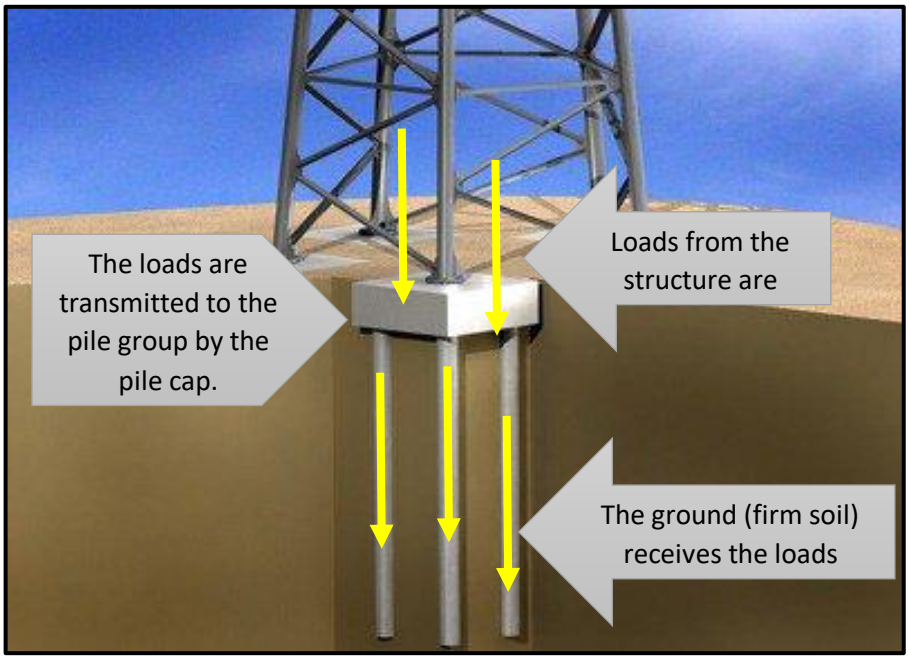


Figure 3.5 : The structure transmits loads to the ground.

Source: Google image (2016).

3.1.5 Functions of Pile Cap

Pile caps are critical components of a building structure because, as seen in Figure 2, pile caps serve as the foundation for supporting and positioning the building structure. The Pile Cap performs a variety of other roles, which are detailed below.

i. To spread a single load evenly throughout the pile group, hence distributing the weight over a larger region of bearing potentials.

ii. The goal of this technique is to laterally stabilise individual pilings while simultaneously enhancing the overall stability of the pile group. It is illustrated in Figure 3.6 how damage would occur to the building structure if the pile cap fails, due to the fact that the pile group is in an unstable state.

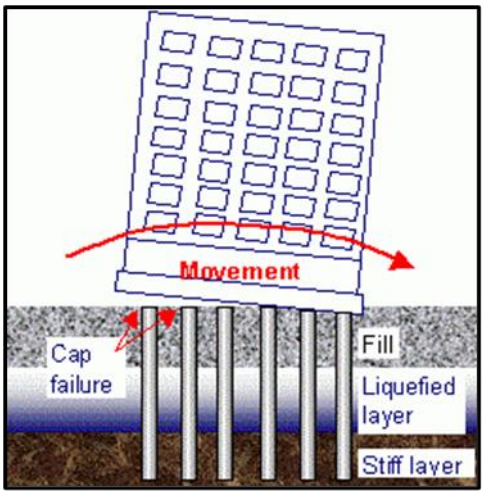


Figure 3.6 : Failure of the pile cap will result in the collapse of the structure.

Source : Google Image (2016)

3.2 THE MATERIALS USED IN PILE CAPS CONSTRUCTION

-Reinforcement Bar (Grade R-250 N/mm2 & Grade H-500 N/mm2)

Based on Reinforcement Handbook (2010), the length for one reinforcements steel bars that usually used in construction are around 6 to 18 meters only. This type of reinforcements steel bars are the straight rolled bars. In this cases, our project required to use reinforecement bar grade R-250 N/mm2 & grade H-500 N/mm2 for constructing 8 types of pile cap which consist of different size of reinforcement bar. Then, in accordance with the drawing details, this rebar will be moulded into a pile cap shape as shown in the photo below.

Figure 3.7 : Reinforcements steel bars

Figure 3.8 : Pile cap rebar

-Concrete G37 N/mm2

Concrete is one of the most significant building materials. In this case, concrete is being used to lay lean concrete and to concrete the pile cap itself. For constructing the pile cap work, special concrete was used, which is concrete grade 37, was used to concrete the pile cap. According to Sidney Mindess (2003), concrete is made up of 11 percent cement, 26 percent fine aggregates (sand), 41 percent coarse aggregates (rock), and 16 percent water and air (6 percent). As indicated in the diagram below, the combination

a. Cement

The most often utilised type of cement in this construction projects is "PORTLAND CEMENT." According to Sidney Mindess (2003), Portland cements are hydraulic cements, which means they chemically react and harden when water is added. Cement is a mixture of limestone, clay, cement rock, and iron ore that has been heated to between 1200 and 1500 degrees Celsius. The resultant "clinker" is then processed to a powder consistency. Gypsum is added to the mixture to regulate the setting time. Below is a photograph of a bag of Portland cement.

Figure 3.9 : Portland cement

b. Fine aggregate (Sand)

While fine aggregate is referred to as sand, this sand is distinguished by having a smaller diameter than course aggregate. “This component can be made of natural sand or crushed stone, and it represents particles smaller than 3/8”, according to Sidney Mindess (2003). In most cases, it contributes for 30 percent to 35 percent of the total combination. As illustrated in the photograph below, this sand is often obtained from a quarry or a beach.

Figure 3.10 : Quarry sand

c. Coarse Aggregate (rock)

Coarse aggregate, as seen in Photo 12, can be either gravel or crushed stone, and it should account for 40 percent to 45 percent of the total combination weight, with particles larger than 1/4 inch in size (Sidney Mindess, 2003).

Figure 3.11 : crusher run

d. Water

Water is a clear fluid that makes up the world's streams, lakes, oceans, and rain, and is the primary constituent of creatures' fluids. Water is the agent in construction that combines cement, coarse aggregate, and fine aggregate to form a concrete mixture, as seen in figure 3.12.

Figure 3.12 : The concrete mixture was mixed with water.

Source : (*Water Quality Tests for Concrete Construction and Recommended Limits*, 2014)

-Formwork – Mixed wood and plywood

2” x 3” x 10’, 2” x 4” x 8’, 1” x 2” x 8’, 2” x 3” x 8’, and 2” x 3” x 8’ are the sizes of the wood in this mixed wood. Additionally, plywood was utilised in the construction of this pile cap. All of the mixed wood was utilised to create formwork for each pile cap, which took up the entire pile. Also known as “formwork,” this is the temporary or permanent support structure/mold into which concrete is poured during the construction process. It is referred to as centring or shuttering in some contexts. In order for concrete to harden in the appropriate shape and gain strength and durability, formwork must be used before it can harden. In addition, This mixed wood will be cut to the length specified in the detailed drawing for each individual piece.

Figure 3.13 ：Mixed wood and plywood delivery

Figure 3.14 : Mixed wood

Figure 3.15 : Pile cap formwork

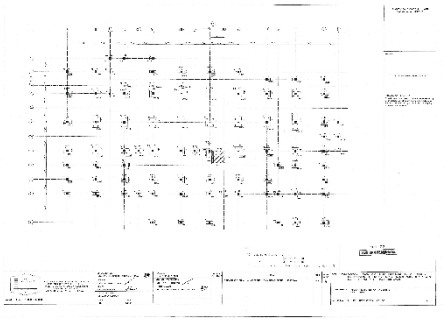
-Spacer Block

Concrete spacers are small concrete components used to align rebar with the appropriate cover. These spacers, bars, and blocks are critical for ensuring the poured concrete's optimal adherence. The following are the primary advantages of concrete spacer:

• High compressive strength, no deformation in extreme heat or cold, precise maintenance of concrete cover.
• Spacers remain in place during formwork installation and concreting.
• Ideal for impermeable concrete; no hairline cracks between the spacer and the concrete.

Figure 3.16 : spacer block

3.3 METHOD STATEMENTS

OPERATION	SEQUENTIAL DIAGRAM
• Determining the design of the pile caps that will be constructed on-site in accordance with the RC Pile Caps Plan Layout**.** Mr. Izzudin, the site supervisor, was in charge of the job. • The pile cap will be built once the S.O. approves the piling as built**.** • Before setting the coordinates of the pile caps, **the building control peg** must be known. The setting out must be carefully checked for location and alignment. Dumpy level can be used to determine the levels of the pile caps. The bubble must be placed in the centre of the dumpy level when it is created. The staff must be placed vertically for an accurate reading.	 Figure 3.17 : RC pile cap plan layout

- Take a look at the detail sketch of the pile cap steel in figure 3.18.
- This work requires the assistance of a bar bender and a carpenter.
- Mr. Izuddin, the site supervisor (contractor), is in charge.
- The bar bender and carpenter must read the detail for the steel reinforcement bar cutting and formwork on the pile caps.

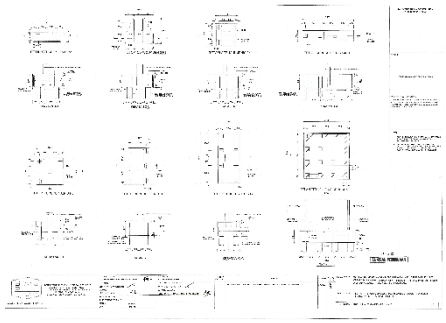


Figure 3.18 : Pile cap detail

- Before **the excavation**, accurate evelling must be performed and reported to S.0 / S.O representatives. The contractor will take all required procedures and actions to guarantee that the excavation activity does not harm the piles.

Figure 3.19 : Pile cap excavation

- **Cut off pile** or trimming to the required level
- After that, laying 50mm of **lean concrete** as specified by the S.O representatives.

Figure 3.20 : Cutting pile works

Figure 3.21 : Laying lean concrete

- **The Formwork** – Sizes, Tightness, Orientation, Cleanliness

  a) Method of formwork installation

- Formwork must be prepared in accordance with the shape, orientation, level, height, and dimension specified in the structural designs.
- After finishing the reinforcing bars and formworks, the structure element must be clean and clear of all debris and/or mud using an air compressor and/or water.

Figure 3.22 : Formwork for pile cap

Figure 3.23 : Pile cap formwork

• The formwork must be adequately propped and braced to the support. When processing the formwork, the tightness must be thoroughly checked, as well as the absence of formwork movement during concreting • All formwork shall be inspected by the S.O representatives.	
• **The reinforcement steel bar grade 250 & grade 500 (MS 146)** – Alignment, Concrete cover, Spacing, Cleanliness, Sizes, Sufficient starter bar. • Examine the construction drawing for member sizes. • The foreman must ensure that all laps and rebar are installed in accordance with the construction drawings. • The foreman issues out his order to the following group : a) Cutting b) Bending – main bar and links c) Assembling / Fixing • Check the formwork sizes to ensure they are right. • Using a spacer block, place the relevant member bars.	 Figure 3.24 : Pile cap rebar  Figure 3.25 : Rebar installation

• A spacer block or concrete cover must be utilised to keep the steel bar from hitting the ground or the formworks. • Reinforcement steel bar should be cleaned so that its shear strength to concrete is not reduced. • Prior to calling for inspection, the site engineer shall check and ensure that the works have been completed in compliance with the plans and specifications.	 Figure 3.26 : Pile cap and rebar installation
• **Joint inspection** is being carried out with the S.O representatives.	 Figure 3.27 : Joint inspection

- **Concrete**
- Examine the drawing and determine the total volume of concrete to be ordered in m3.
- The concrete should be placed a day or two before the casting date.
- Before casting, the slump test and concrete cube must be ready when the concrete is carried to the job site.
- A mobile crane will be used throughout the structure's casting. During the casting process, a concrete pump may be necessary. Vibration during concreting must be avoided since it affects the bonding of the concrete as well as the tightness of the formwork.
- Leveling the concrete surface
- A curing compound shall be used for concrete curing works (Sika Antisol A). Using a knapsack sprayer, apply 5–6.5 litres/m2.

Figure 3.28 : Concreting work

• **Dismantle formwork** Check the state of the concrete before removing the formwork. For vertical surfaces, the formwork shall be struck after three (3) days. Any faults in the cast concrete, such as honeycomb or concrete bleeding, must be reported to S.O representatives by the contractor. No concrete patching is permitted without the approval of the S.O. / S.O. representative.	 Figure 3.29 : Dismantle work
• **Spraying anti termite** on side and surface of the pile cap before to backfilling in line with the approved WMS for termite treatment	 Figure 3.30 : Applying anti termite on pile cap  Figure 3.31 : Backfilling

3.4 PRECAUTIONS IN CONSTRUCTING PILE CAP

I. The concrete shall be carried in purpose made agitators operating continuously on concrete trucks. The concrete shall be compacted in its final position within 2 hours of the introduction of cement to aggregate. The time of such introduction shall be recorded on the Delivery Note issued by the supplier. Ready mixed concrete delivered to the job site shall be accompanied by manufacturer's certificates stating the details of mix proportions by weight grade of the concrete, type and size of aggregate, date and time or production details in suitable format.

II. Vibration, the size of the poker and also the method of vibrating must be correct. Vibration method is used to escape the air void from the concrete; hence the strength of the concrete bonding will be stronger. Vibration will also allow the concrete surrounds all reinforcement steel bars. Over vibrating will change the chemical bonding of the concrete and also will affect the tightness of the formwork.

III. Water control, not allow adding in water on site when the concrete is too dry. Supervisor is not supposed to add in water to increase the workability if the concrete is too dry. Adding water into concrete will finally affect the strength of the concrete bonding. The concrete will be rejected if it is too dry.

IV. The pile cap area had to be ensured dry before concreting works were on going.

CHAPTER 4

4.0 CONCLUSION

4.1 CONCLUSION

The pile caps are the most critical component of the building construction. This is because the pile caps will sustain all loads situated at the building structure, whether living or dead, and will pass the loads to the pile groups and, eventually, to the earth. Without the pile caps, the building structure might collapse owing to a lack of a secure basis to support (position) the building structure's column. This study assisted in the explanation of pile cap construction and the measures to be taken on-site during pile cap construction, as every construction project has some amount of risk. These may assist in reducing some risks by providing a method for individuals to deal with human error and unanticipated changes that occur throughout the course of the project.

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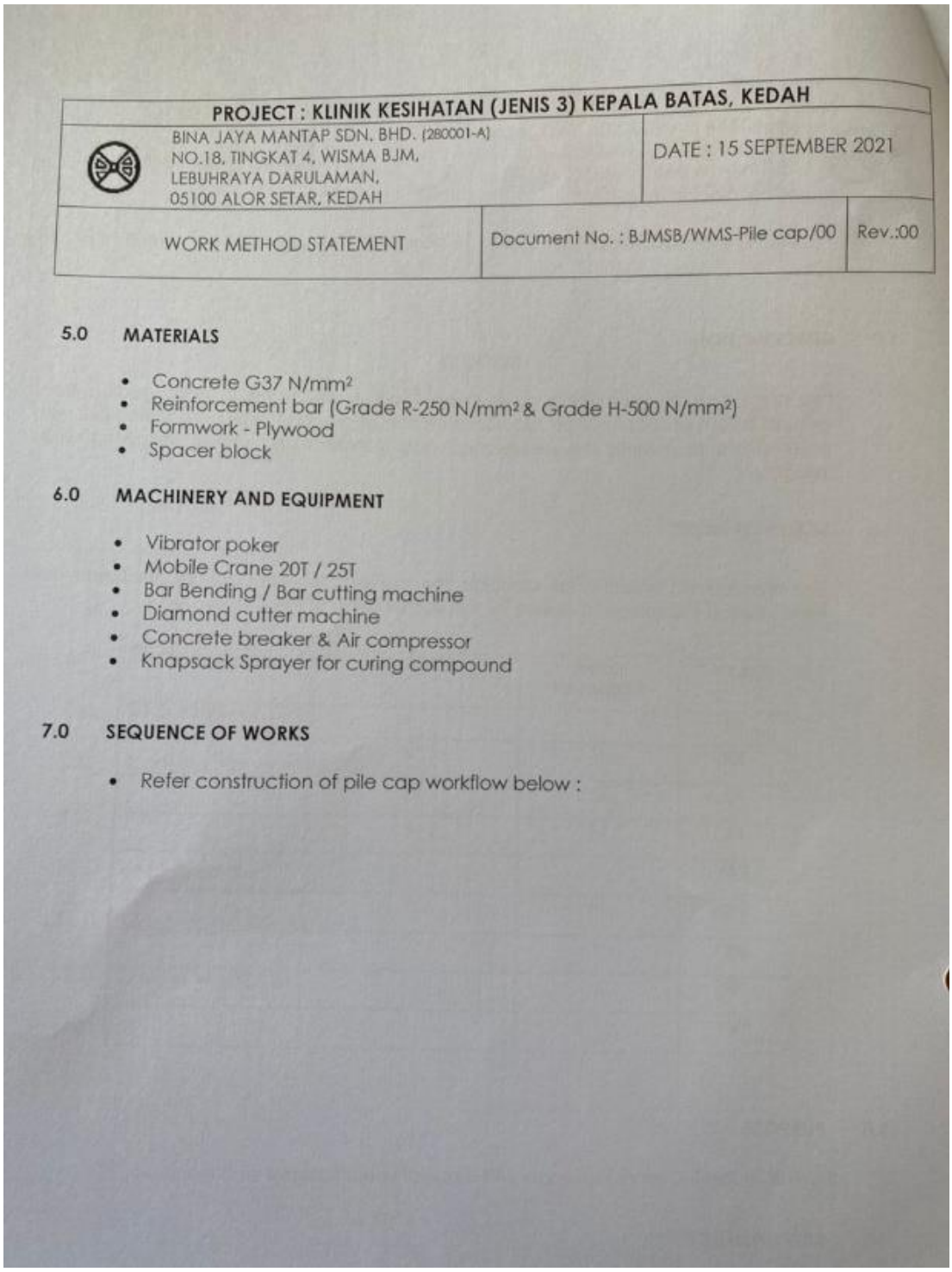
APPENDIX A



PROJECT : KLINIK KESIHATAN (JENIS 3) KEPALA BATAS, KEDAH		
BINA JAYA MANTAP SDN. BHD. (280001-A) NO.18, TINGKAT 4, WISMA BJM, LEBUHRAYA DARULAMAN, 05100 ALOR SETAR, KEDAH	DATE : 15 SEPTEMBER 2021	
WORK METHOD STATEMENT	Document No. : BJMSB/WMS-Pile cap/00	Rev.:00

5.0 MATERIALS

- Concrete G37 N/mm²
- Reinforcement bar (Grade R-250 N/mm² & Grade H-500 N/mm²)
- Formwork - Plywood
- Spacer block

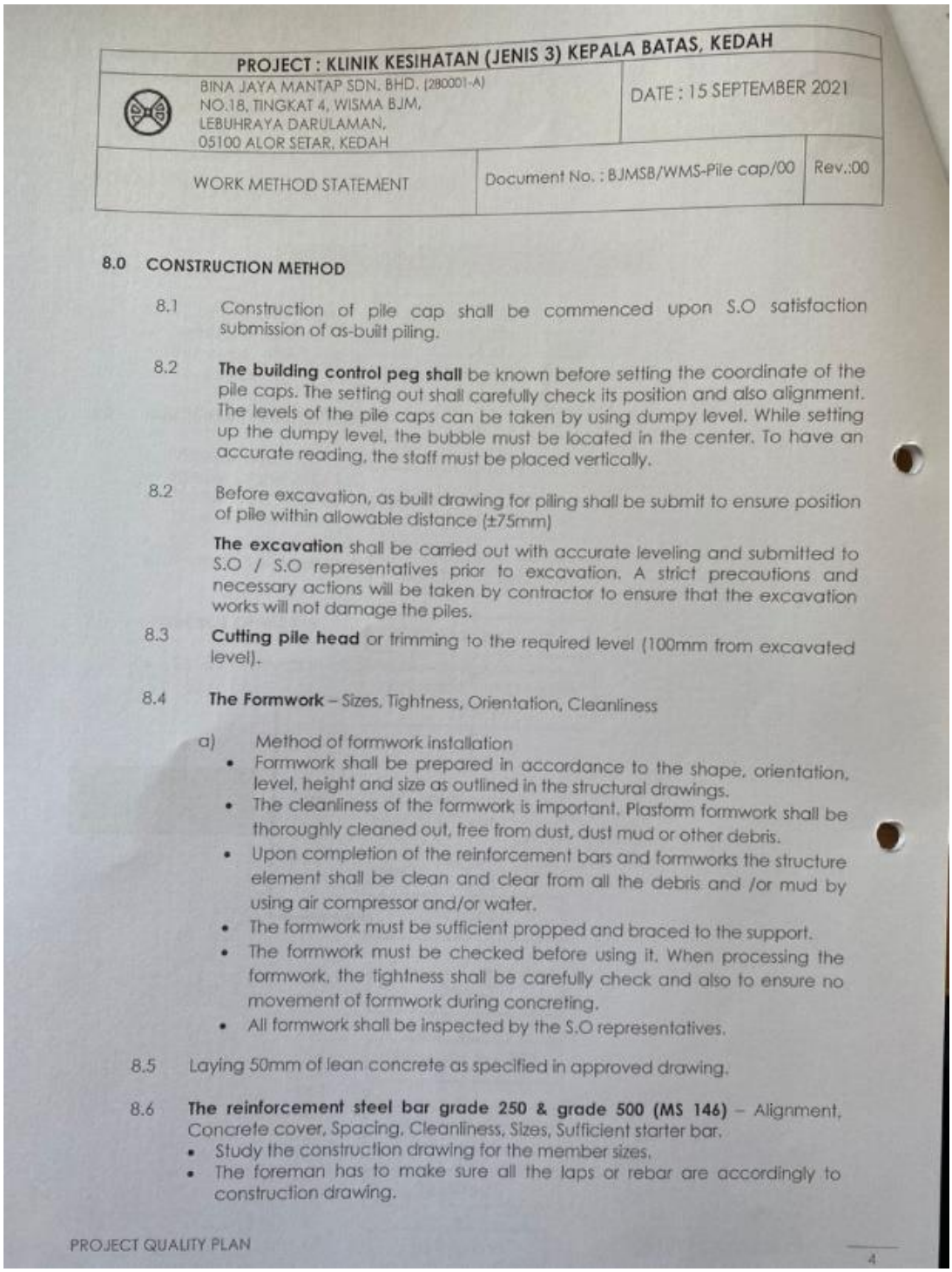
6.0 MACHINERY AND EQUIPMENT

- Vibrator poker
- Mobile Crane 20T / 25T
- Bar Bending / Bar cutting machine
- Diamond cutter machine
- Concrete breaker & Air compressor
- Knapsack Sprayer for curing compound

7.0 SEQUENCE OF WORKS

- Refer construction of pile cap workflow below :

APPENDIX B



PROJECT : KLINIK KESIHATAN (JENIS 3) KEPALA BATAS, KEDAH		
BINA JAYA MANTAP SDN. BHD. (280001-A) NO.18, TINGKAT 4, WISMA BJM, LEBUHRAYA DARULAMAN, 05100 ALOR SETAR, KEDAH	DATE : 15 SEPTEMBER 2021	
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8.0 CONSTRUCTION METHOD

8.1 Construction of pile cap shall be commenced upon S.O satisfaction submission of as-built piling.

8.2 **The building control peg shall** be known before setting the coordinate of the pile caps. The setting out shall carefully check its position and also alignment. The levels of the pile caps can be taken by using dumpy level. While setting up the dumpy level, the bubble must be located in the center. To have an accurate reading, the staff must be placed vertically.

8.2 Before excavation, as built drawing for piling shall be submit to ensure position of pile within allowable distance (±75mm)

The excavation shall be carried out with accurate leveling and submitted to S.O / S.O representatives prior to excavation. A strict precautions and necessary actions will be taken by contractor to ensure that the excavation works will not damage the piles.

8.3 **Cutting pile head** or trimming to the required level (100mm from excavated level).

8.4 **The Formwork** – Sizes, Tightness, Orientation, Cleanliness

a) Method of formwork installation

- Formwork shall be prepared in accordance to the shape, orientation, level, height and size as outlined in the structural drawings.
- The cleanliness of the formwork is important. Plasform formwork shall be thoroughly cleaned out, free from dust, dust mud or other debris.
- Upon completion of the reinforcement bars and formworks the structure element shall be clean and clear from all the debris and /or mud by using air compressor and/or water.
- The formwork must be sufficient propped and braced to the support.
- The formwork must be checked before using it. When processing the formwork, the tightness shall be carefully check and also to ensure no movement of formwork during concreting.
- All formwork shall be inspected by the S.O representatives.

8.5 Laying 50mm of lean concrete as specified in approved drawing.

8.6 **The reinforcement steel bar grade 250 & grade 500 (MS 146)** – Alignment, Concrete cover, Spacing, Cleanliness, Sizes, Sufficient starter bar.

- Study the construction drawing for the member sizes.
- The foreman has to make sure all the laps or rebar are accordingly to construction drawing.

PROJECT QUALITY PLAN 4

APPENDIX C

PROJECT : KLINIK KESIHATAN (JENIS 3) KEPALA BATAS, KEDAH		
BINA JAYA MANTAP SDN. BHD. (280001-A) NO.18, TINGKAT 4, WISMA BJM, LEBUHRAYA DARULAMAN, 05100 ALOR SETAR, KEDAH	DATE : 15 SEPTEMBER 2021	
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- The foreman issues out his order to the following group:
  a) Cutting
  b) Bending – main bar and links
  c) Assembling / Fixing
- Inspection to the formwork sizes to reconfirm the correctness.
- Placing the respective member bars into its position with spacer block.
- Spacer block or concrete cover shall be used to avoid the steel bar touching to ground or to the formworks.
- Reinforcement steel bar should be cleaned so the shear strength of the steel bar to concrete will not be reduced.
- Site engineer shall check and satisfy the works have been place in accordance to drawings and specifications prior to calling for inspection.

8.6 Check and carry out **Joint Inspection** with S.O representatives. Request for inspection form shall be submitted to PTB at least 24 hours prior to inspection.

8.7 Concreting
- Study the drawing and calculate the total volume of concrete in m^3 to be ordered.
- The concrete shall place in order a day or two before the casting date.
- When the concrete is transported to work place, slump test and concrete cube shall be ready before casting.
- Mobile crane shall be use during casting for the structure. Concrete pump may be required to be used during the operation of casting. Vibration during the concreting shall be carried out carefully, which will affect the bonding of the concrete and also the tightness for the formwork.
- Leveling to the surface of concrete.
- For PW1 (Lift), to concrete pile cap with lift pit wall up to 300mm high with installation of water stop.

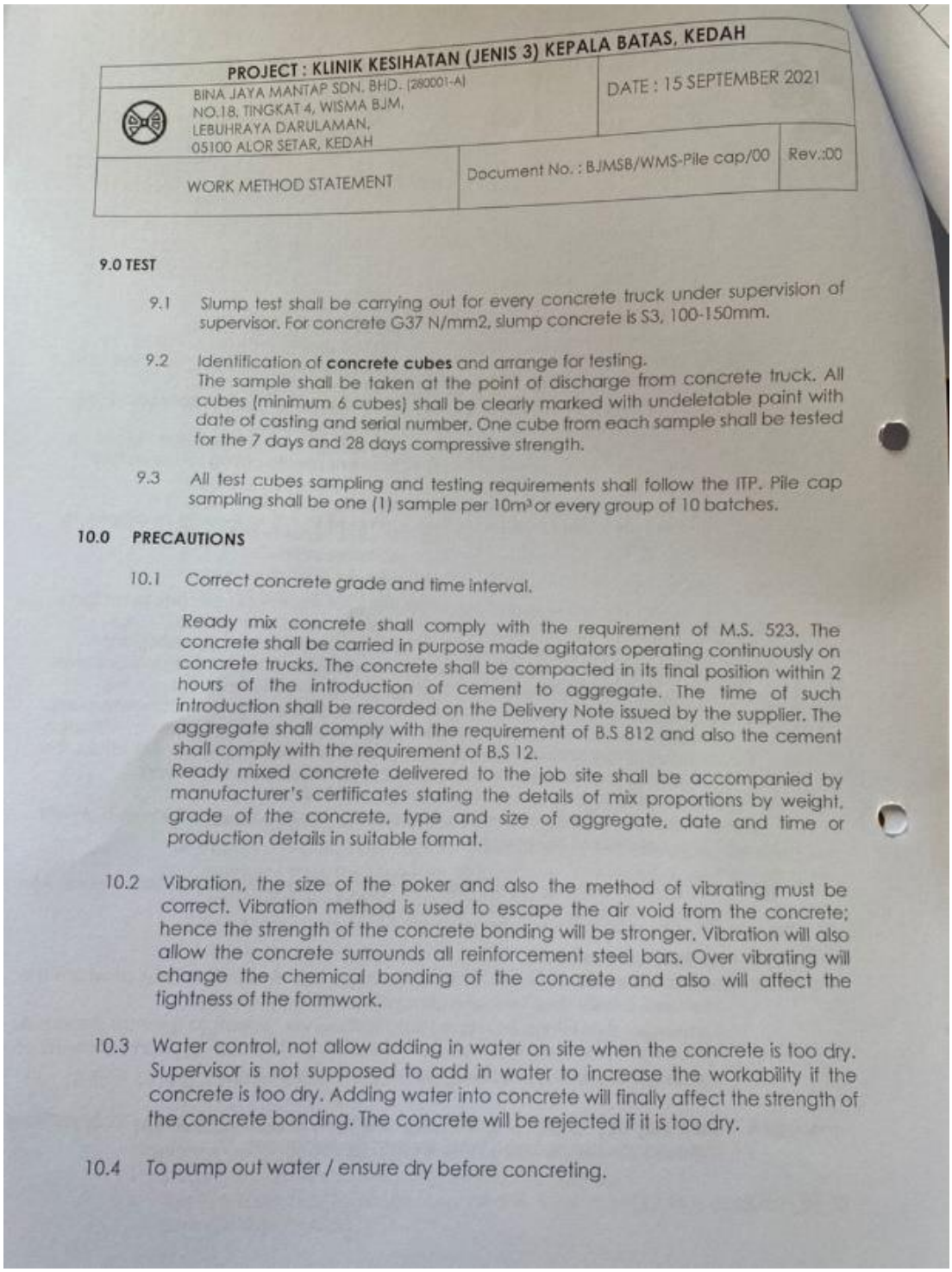
8.8 For concrete curing works shall be using curing compound (Sika Antisol A). Spray 5 – 6.5 litre/m^2 using knapsack Sprayer.

8.9 **Dismantle formwork**
Check concrete condition before dismantles formwork. The time at which the formwork is strike shall be three (3) days for vertical surface.
Contractor shall inform S.O representatives of any defects to the cast concrete, for example honeycomb or concrete bleeding. No patch up works allowed on the concrete without S.O / S.O representative approval.

8.10 Spraying anti termite on side and surface of pile cap prior to backfilling accordance to approved WMS for termite treatment.

PROJECT QUALITY PLAN

APPENDIX D



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9.0 TEST

9.1 Slump test shall be carrying out for every concrete truck under supervision of supervisor. For concrete G37 N/mm2, slump concrete is S3, 100-150mm.

9.2 Identification of **concrete cubes** and arrange for testing.
The sample shall be taken at the point of discharge from concrete truck. All cubes (minimum 6 cubes) shall be clearly marked with undeletable paint with date of casting and serial number. One cube from each sample shall be tested for the 7 days and 28 days compressive strength.

9.3 All test cubes sampling and testing requirements shall follow the ITP. Pile cap sampling shall be one (1) sample per $10m^3$ or every group of 10 batches.

10.0 PRECAUTIONS

10.1 Correct concrete grade and time interval.

Ready mix concrete shall comply with the requirement of M.S. 523. The concrete shall be carried in purpose made agitators operating continuously on concrete trucks. The concrete shall be compacted in its final position within 2 hours of the introduction of cement to aggregate. The time of such introduction shall be recorded on the Delivery Note issued by the supplier. The aggregate shall comply with the requirement of B.S 812 and also the cement shall comply with the requirement of B.S 12.
Ready mixed concrete delivered to the job site shall be accompanied by manufacturer's certificates stating the details of mix proportions by weight, grade of the concrete, type and size of aggregate, date and time or production details in suitable format.

10.2 Vibration, the size of the poker and also the method of vibrating must be correct. Vibration method is used to escape the air void from the concrete; hence the strength of the concrete bonding will be stronger. Vibration will also allow the concrete surrounds all reinforcement steel bars. Over vibrating will change the chemical bonding of the concrete and also will affect the tightness of the formwork.

10.3 Water control, not allow adding in water on site when the concrete is too dry. Supervisor is not supposed to add in water to increase the workability if the concrete is too dry. Adding water into concrete will finally affect the strength of the concrete bonding. The concrete will be rejected if it is too dry.

10.4 To pump out water / ensure dry before concreting.