



**DEPARTMENT OF BUILDING  
UNIVERSITI TEKNOLOGI MARA  
(PERAK)**

**BUILDING STRUCTURAL WORK FOR  
CONCRETE SLAB & COLUMN**

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(PERAK)**

**FEBRUARY 2022**

It is recommended that the report of this practical training provided

**By**

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**entitled**

**Building Structural Work For  
Concrete Slab & Column**

be accepted in partial fulfillment of requirement has for obtaining Diploma in Building.

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(PERAK)**

**FEBRUARY 2022**

**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 Abu Construction for duration of 20 weeks starting from 23 August 2021 and ended on 7 January 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.

.....  
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## **ABSTRACT**

Building structure is very important thing in constructing the building, therefore this report will discuss about the method to develop concrete slab and column. This report was conducted for single storey bungalow house at Jitra, Kedah. The objective of this report is to analyze the proper technique and materials used for constructing concrete slab and columns in order to avoid structural flaws. Particularly, it analyzes whether there is another issue that occurred influenced the building's structural failure. To test the hypothesis that lesser issues lead to a higher rigidity of the building structure, an observation was conducted throughout a visit at construction site. The observation was carried out along with an interview with sub-contractor on the construction site were undertaken. Sub-contractors were asked about every step in developing concrete slab and columns, as well as some construction precautions for preventing the structure collapsing. The data supported the hypothesis that higher rigidity of the building structure is related with fewer issues. This report concludes that when a problem arises during the pre - construction stage, cracking and collapsing of the structure are more likely to occur. The use of the incorrect material also one of the reasons for building's failure. In fact, the right procedure and material needed should be taken into the account when constructing the building structure.

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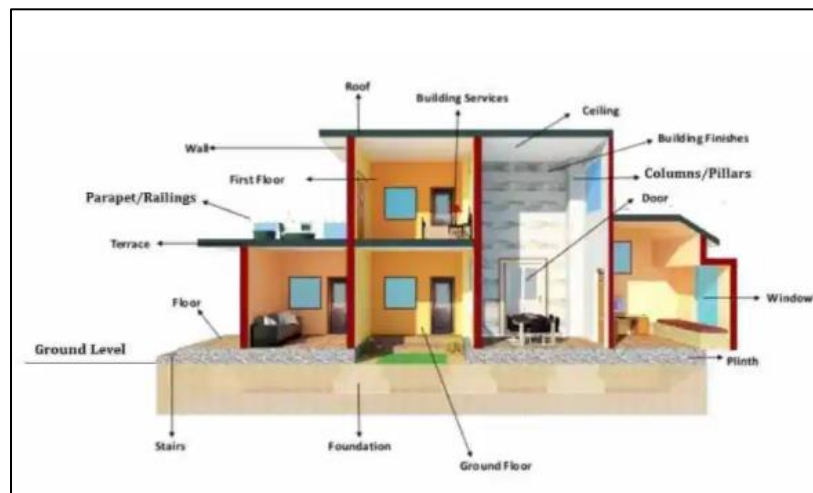


## CHAPTER 1.0

### INTRODUCTION

#### 1.1 Background of Study

In building environment context, a structure is described as a system of interconnected members constructed in a stable configuration and utilized to support a load or a combination of loads while maintaining various external forces and internal reaction in equilibrium. The load might affect the structural components in both vertical and lateral directions (Rohan Naik, 2019). Different types of joints or supports are used to join structural members together. Pin-jointed or hinged supports, roller supports, and fixed supports are the most common types of supports (Rohan Naik, 2019).



**Figure 1.1: Basic Components of a Building**  
Source: The Constructor (2019)

The basic components of a building structure are the foundation, floors, walls, beams, columns, roof, stair, etc. The purpose of these elements is to support, enclose, and protect the building structure (The Constructor, 2019). Generally building structures are classified as load bearing structure or frame structures depending upon how the load is transferred from various elements of the structure (Rohan Naik, 2019). Besides, trusses, girders, beams and columns of various sections, connectors, and other features are also common in industrial structures. The basic component in the building can be seen in figure 1.1 above.

Apart of that, bridges are made up of cables and arches. Nevertheless, dome structures, shell structures, 3D diaphragm sheets, and other structures are utilized in stadiums and meeting halls. Many geometric shapes, patterns, sizes, materials, and configurations are possible for the construction (Rohan Naik, 2019). When a structure is unstable under any loading system, it is referred to as a mechanism. Any construction must be thoroughly investigated and planned to ensure its safety and utility (Rohan Naik, 2019).

However, this study only focused on two basic components which are reinforced concrete slab and concrete column. Briefly, the reinforced concrete slab or as known as floor is an important structural element that provides flat surfaces in buildings (floors and ceilings). Slabs are categorized as one-way slabs or two-way slabs based on the reinforcement given, beam support, and the ratio of spans (The Constructor, 2018). The former is supported on both sides and has a greater than two ratios of long to short span. The latter, on the other hand, is supported on four sides and has a shorter long-to-short span ratio than two (The Constructor, 2018). The purpose of reinforced concrete slab is to provide a level surface that can support a building's occupants, furniture, equipment, and internal partitions (Mohd Waqar, 2014).

It is necessary to satisfy a few requirements for a slab construction in order to build a safe building. The following requirements needed are adequate strength and stability, adequate fire resistance, sound insulation, damp resistance, and thermal insulation. There are several types of slabs that usually used in construction which are one-way slabs, two-way slabs waffle slab, and flat slab.

Furthermore, a vertical structural element designed to convey a compressive load is known as a column. A column transmits the load from the ceiling/roof slab and beam to the base, including its own weight (admin, 2015). A column is a major element of a building structure since the entire structure may collapse if the design of a column fails. Columns are usually made of concrete in today's construction sector; however, other materials such as wood, steel, fibre-reinforced polymer, cellular PVC, and aluminium are also employed. The scale, coast, and application of the structure determine the sort of material used (admin, 2015). There are a few classifications for constructing the column according to its shape, slenderness ratio, type of loading, and pattern of lateral reinforcement.

## **1.2 Objectives**

There are various objectives that need to be achieved in this study. The following objectives are;

- i. To discover the method of building structural work process of ground floor slab and RC column.
- ii. To detect problems that arise during the construction of structural work.
- iii. To investigate the types of reinforcement used for slab and column.

### **1.3 Scope of Study**

The scope of study has been carried out at PT 194, Kolej Heights Utara, Bandar Darulaman, Kubang Pasu District, 06000 Jitra, Kedah. Due to a pandemic and the need to finalize another agreement with numerous parties, the project began on September 28, 2021, almost 9 months after the agreement was signed by the client. This project is expected to be completed in March 2022. The project is a construction of a One Storey Bungalow House costing roughly One Hundred and Forty-Nine Thousand Ringgit Malaysia (RM149,000.00) owned by our client, Jamil bin Kassim. Since the project is still in its early stages, the study will be focused on the process of constructing the ground floor slab and RC column for building. Not only the construction process, but also the duration of the work is undertaken, the plant and equipment used, and the quantity of manpower required to complete the works. Moreover, this research includes identifying problems that arise during construction process also, the types of reinforcement used to construct the building structure. However, the study does not buckle down to the ground beam structure, the costs of each work and the duration of the work process had been done. This study could be done in particular by collecting data based on field observations, conducting interviews with parties involved, and reviewing a document from the office.

## **1.4 Methods of Study**

### **1. Observation**

Observation research is a type of qualitative research in which researchers observe participants' activities in a real-life context (Fuel Cycle, 2019). It is one of the best methods to collect data. This observation has been taken at the field work daily on how the ground floor slab being develop from backfill the soil until curing process. This observation also includes RC column construction from installing reinforcement until curing process. The average time taken for this observation approximately around 1-2 hours and it is following to the sub-contractor's working hours per day. Since the house's total area is 1,479 sq. ft., the construction process will take a longer time. Hence, the observation takes several weeks to complete the structure of the building. Smartphones were used to record the observation.

### **2. Interview**

Interviews are a type of data collection in social science that involves two or more persons exchanging information through a sequence of questions and responses (DeCarlo, 2018). It is also one of the best ways to collect data since the information can be taken directly by the participant. The interview took place in the office with the company's management clerk, marketing clerk, and director. The interview was also conducted on the construction site while observing the construction process with the project's site supervisor and subcontractor. The interview was conducted on a daily basis to obtain the latest information on the site's progress. The information gathered during the interview was recorded down in a notebook and on a smartphone.

### **3. Document Review**

Documentary research is defined as research that is conducted using official or personal documents as a source of information (Bretschneider, P., Cirilli, S., Jones, T., Lynch, S., & Wilson, N., 2017). The document that has been evaluated in order to gather the information is company profile, architectural drawing, on-going project's file, site progress report, standard operating procedures (SOP), and progress report from site supervisor. On-going project files are frequently used since the files have a complete information for the construction site. Also, the progress report and pictures from site supervisor provide useful data for document review. All the documents are placed at the office.

## CHAPTER 2.0

### COMPANY BACKGROUND

#### 2.1 Introduction of Company

Abu Construction is a contractor company with wholly bumiputera- owned company established on 11 August 2011 in Jitra, Kedah. It is a sole proprietorship company and has been operated for over 8 years at No 77, Tingkat Atas, Taman Halban 1, 06000 Jitra Kedah Darul Aman.



**Figure 2.1: Location of the Company from Satellite View**  
**Source: Google Maps (2021)**

This company has been registered with Malaysian Construction Industry Development Board (CIDB) under grade G3 category B in specialization B04 which is building construction. Abu Construction is also registered under the CE category in the CE21 specialization, which is civil engineering construction. In addition, this company also registered with Ministry of Finance Malaysia since 2011, Companies Commission of Malaysia (SSM) business registration certificate (002062325-K) and have a certificate of Government Procurement. The location of the company can be seen in figure 2.1 above.

This company provide comprehensive services related to building construction and civil engineering such as laminating, tiling, installing building equipment or other construction of various materials. Abu Construction also a retailer of building materials such as hardware, paint, and glass since they collaborated with a few professional companies and specialist. The

collaborated companies consist of Chua Teong Chai & Sons Quarry Sdn. Bhd., Titian Pintar Sdn. Bhd., KC Aluminium Steel Sdn. Bhd., Chin Kang Hardware Jitra, Sdn. Bhd., Harrison Peninsular Sdn. Bhd., ACFirst Ceramics Sdn. Bhd. and many more. Aside from that, they have won the trust of a large number of customers not only in Kedah but also in Perlis as well as Perak since they have completed 200 projects over the year around Kedah, Perlis, and Perak. Most of their completed projects were a construction of single storey bungalow and double storey bungalow on private land with affordable prices according to the size.

The name of this company was taken by the founder of this company, Mr. Abu Taher, an expert contractor with over 15 years experiences in civil engineering field. He started his career in this field as site supervisor for Abu Construction from 2008 until 2018. He is involved in many private home construction projects and more. Not only being a site supervisor, but he also holds the position as assistant managing director in this company. He is in charge of determining the Abu Construction company's direction and performance.

Apart from that, the director of the company sits by Mrs. Nurul Huda. She is the one who got Abu Construction registered with the CIDB as a contractor company with Grade G3 Bumiputera status in April 2012, allowing it to carry out house construction work across the country. Mr. Abu Taher have many employees include his architect, Mr. Hazim Afandi, who was an experienced architect in young age, the clerk, Ms. Norhanani, and new marketing clerk, Mr. Syafiq. They have worked with Mr. Abu for more than 1 years since most of Abu Construction employees must quit from their job due to this Covid-19 pandemic. Not to forget, all his subcontractors are not a citizen of Malaysia and some of them were Mr. Abu Taher family and friends.

## 2.2 Company Profile

Company Name : Abu Construction

Registered Address : No,77, Tingkat Atas, Jalan Halban 1, Taman Sri Halban, 06000 Jitra, Kedah.

Telephone No. : 04-9161094

Email : abuconstruction82@gmail.com

Date of Starting Business : 11 August 2011

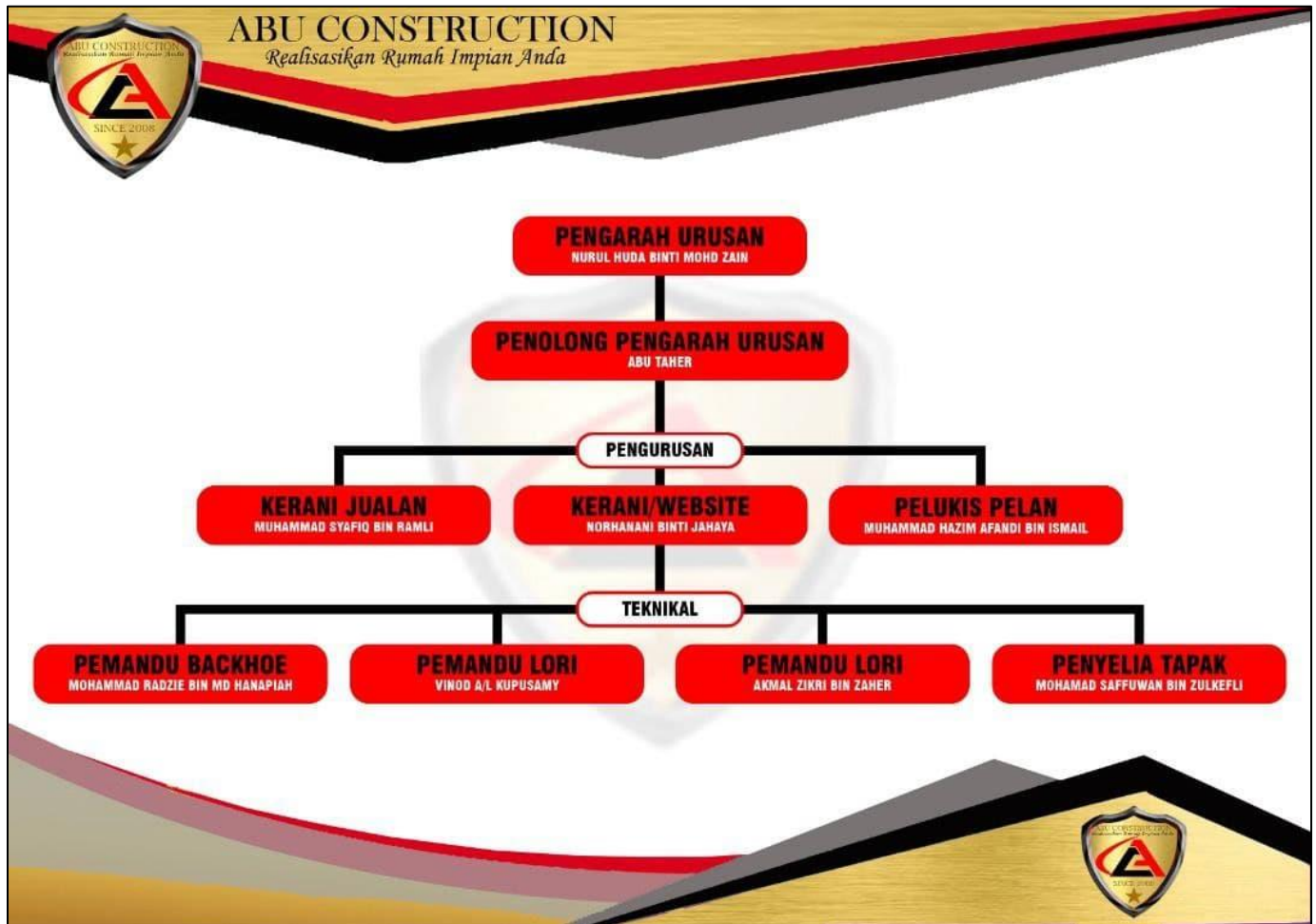
No. Business Registration : 002062325-K

Type of Business : Sole Proprietorship

No. CIDB Registration Certificate : 0120120422 - KD142121



## 2.3 Company Organization Chart



**Figure 2.2: Organization Chart of Abu Construction.**

Figure 2.2 above shows the organization chart of the company starting the name from the top of the chart, which is the manager of Abu Construction, Mrs. Nurul Huda Binti Mohd Zain followed by the name of the assistant manager of the company, Mr. Abu Taher. Below the name of assistant manager of the company, there are the employees name in management department who work in the office. The name included marketing clerk, Mr. Muhammad Syafiq Bin Ramli, management clerk, Ms. Norhanani Binti Jahaya, and drawing planner, Mr. Muhammad Hazim Afandi Bin Ismail. Next, the following name in the chart shows is the employees name in technical department who works outside the office. The name included backhoe driver, Mr. Mohammad Radzi Bin Md Hanapiah, lorry driver, Mr, Vinod A/L Kupusamy and Mr. Akmal Zikri Bin Zaher, and site supervisor, Mr. Mohammad Saffuwan Bin Zulkifli.

## 2.4 List of Project

### 2.4.1 Completed Project

**Table 1.1: List of Completed Projects**

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Kerja Pengubahsuaian Dan Membina Bangunan Di No.248, Batu 5 ½ Titi Gajah, 06000 Alor Setar, Kedah	Forty-Nine Thousand Malaysian Ringgit (RM49,000)	14 November 2019	16 April 2021	17 Month	Azmi Bin Din
2.	Kerja Pembinaan 1 Unit Rumah Di No. 35 Kampung Asam, 06500 Langgar, Alor Setar, Kedah	Ninety-One Thousand Six Hundred Malaysian Ringgit (RM91,600)	04 March 2020	06 May 2021	14 Month	Zainiroh Binti Ismail
3.	Kerja Pembinaan 1 Unit Rumah Di Kampung Gajah Puteh, Padang Sera, 06100 Koding, Kedah	Ninety-One Thousand Eight Hundred Malaysian Ringgit (RM91,800)	25 June 2020	23 August 2021	14 Month	Mohamad Asyraf Bin Abdul Aziz
4.	Kerja Pembinaan 1 Unit Rumah Di Lot, 2444/3 Jln. Surau, Kampung Chelong Chuping, 02500, Mata Ayer, Perlis	One Hundred and Fifty-Five Thousand Eight Hundred and Forty-Four (RM155,844)	29 August 2020	29 August 2021	12 Month	Faizah Binti Mustafa

## 2.4.2 Project in Progress

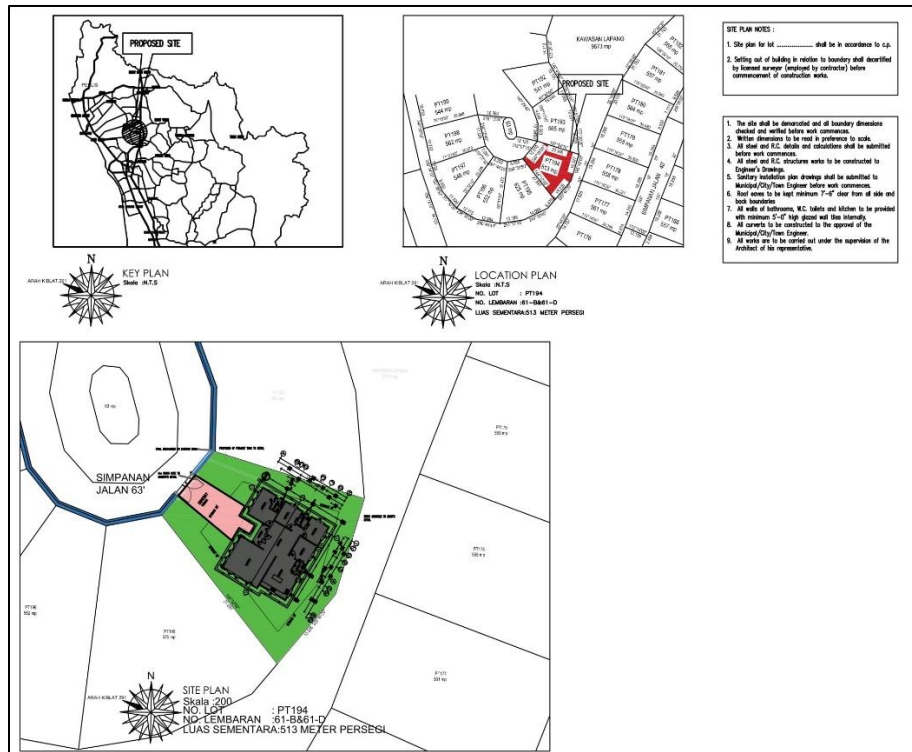
**Table 1.2: List of On-Going Project**

<b>No.</b>	<b>Project Title</b>	<b>Project Value</b>	<b>Start Date</b>	<b>Completion Date</b>	<b>Project Duration</b>	<b>Client</b>
<b>1.</b>	Kerja Membina Bangunan Di Alor Merah, Alor Setar, Kedah	One Hundred and Two Thousand Four Hundred Malaysian Ringgit  (RM102,400)	27 January 2021			Rahayu Binti Abdul Rahman
<b>2.</b>	Kerja Pembinaan 1 Unit Rumah Di Kampung Paya Kechut, 06000 Jitra, Kedah	Fifty-Six Thousand (RM56,000)	10 February 2021			Mohd Saiful Hafiz Bin Mat Noor
<b>3.</b>	Kerja Membina Bangunan Di Kampung Padang Temusu Mukim Derang, 06400 Pokok Sena, Kedah	Four Hundred and Twenty Thousand Malaysian Ringgit  (RM420,000)	7 March 2021			Noor Azman Bin Ahmad
<b>4.</b>	Kerja Membina Bangunan Di Kg Suka Menanti, Alor Setar, Kedah	One Hundred and Five Thousand Malaysian Ringgit  (RM105,000)	23 March 2021			Latipah Binti Abu Bakar

## CHAPTER 3.0

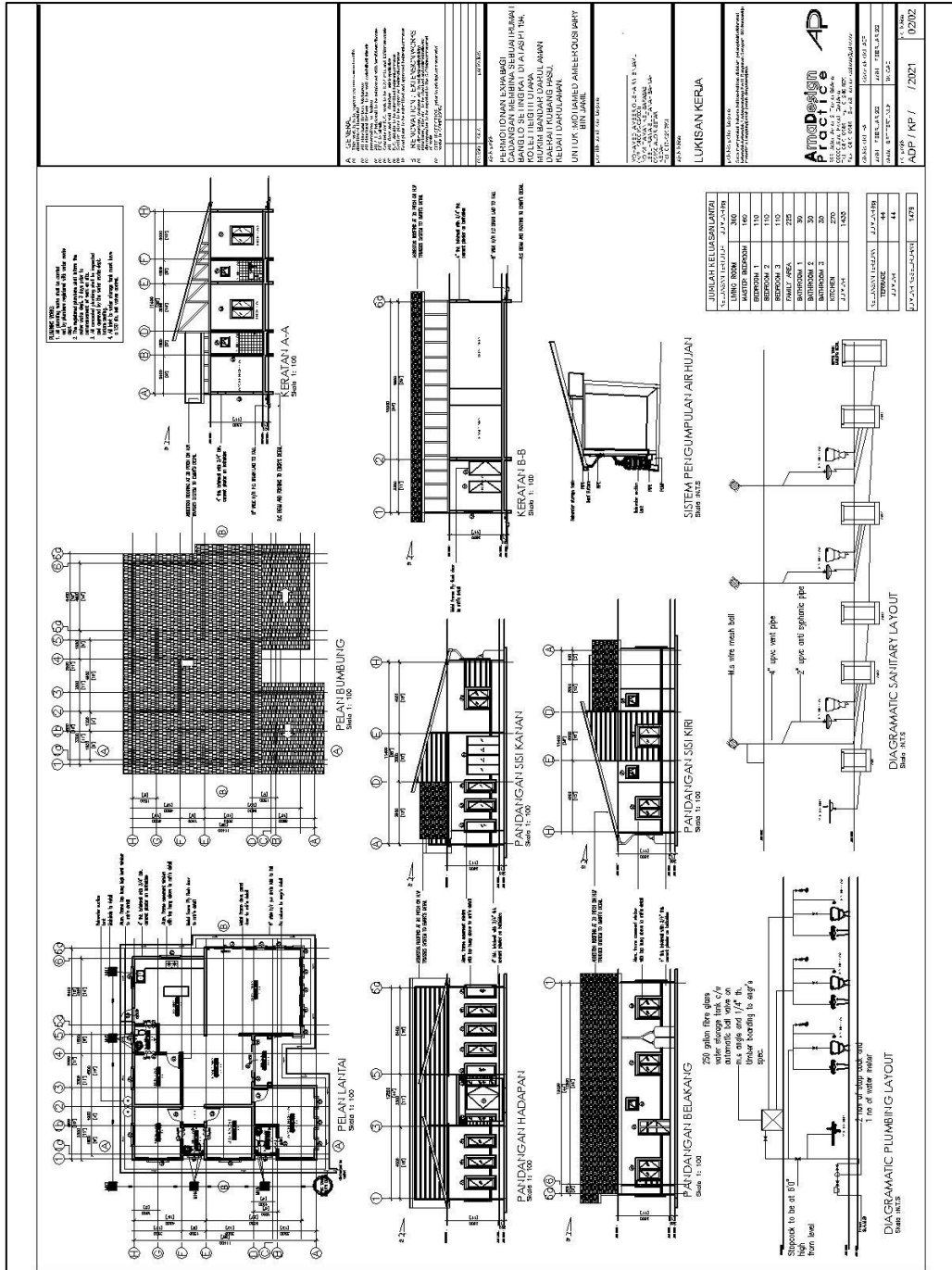
### CASE STUDY

#### 3.1 Introduction to Case Study



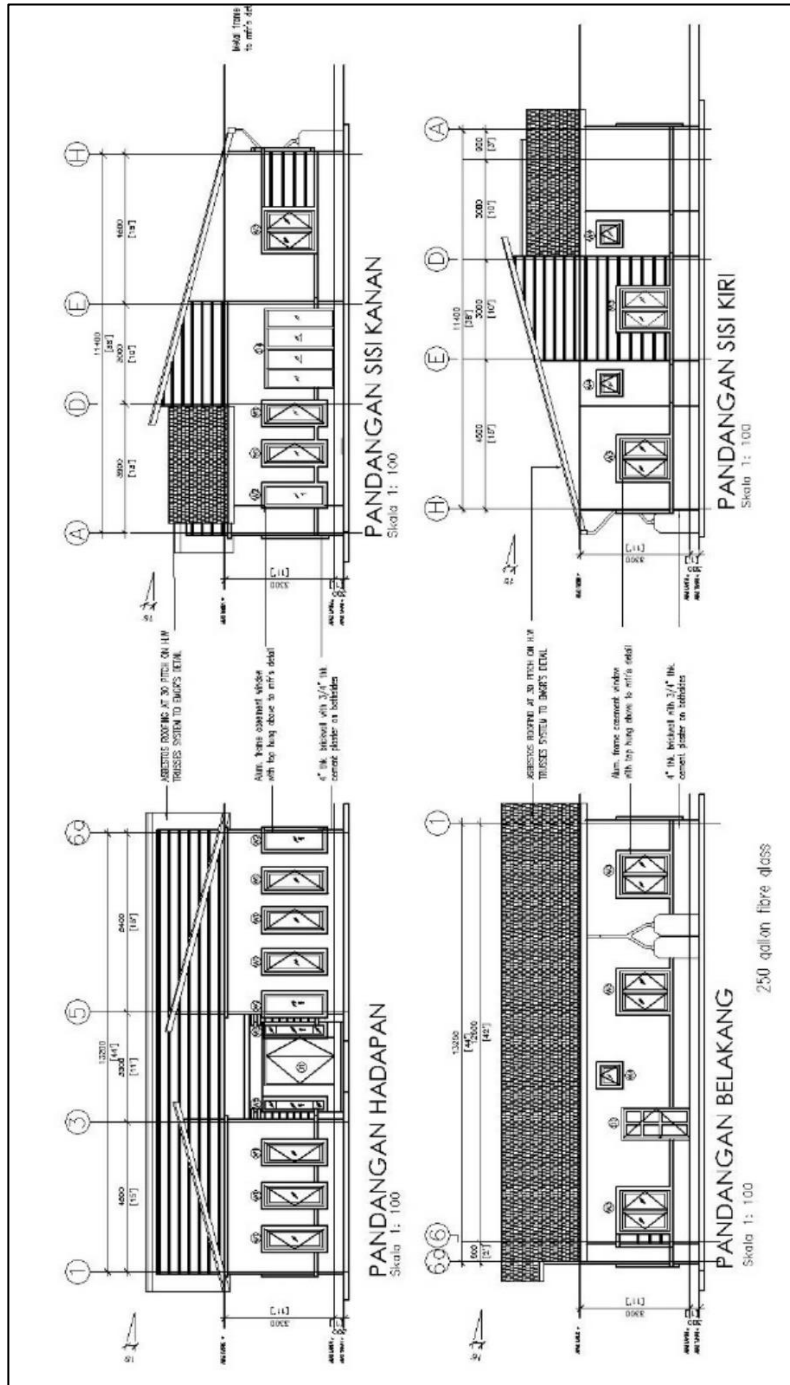
**Figure 3.1: The Location Plan, Site Plan & Key Plan of the Project.**  
**Source: Hazim Afandi (2021)**

The study is about to construct a ground floor slab and RC column of a single-storey bungalow house. The project began on September 28 and will be expected to complete in March 2022. This project is costing roughly one hundred and forty-nine thousand Ringgit Malaysia (RM149,000.00) owned by our client, Jamil bin Kassim. The project is currently on the early stages; however, the clearing and leveling work including installation process of sub-structure has been applied with 3 feet depth of footing and stump, also a construction of ground beam. Thus, the study will explain further about slab and column. The construction project proposed at Kolej Heights Utara, Bandar Darulaman, Kubang Pasu District as shown in figure 3.1 above.



**Figure 3.2: Drawing Plan of the Project.**  
**Source: Hazim Afandi (2021)**

Figure 3.2 above shows the drawing plan drawn by Hazim Afandi which consists of every elevation for a single-storey bungalow house, section view of the house as well as diagrammatic of plumbing layout.



**Figure 3.3: The Elevation of the House.**  
**Source: Hazim Afandi (2021)**

Figure 3.3 above shows drawing plan consists of front elevation, back elevation, left elevation, and right elevation of the house.

The construction project is located at Lot PT 194 Kolej Height Utara, Mukim Bandar Darulaman, Daerah Kubang Pasu, Kedah. The construction area is in a private freehold landed housing estate with some bungalow land plots located in Bandar Darulaman, Jitra called College Height Utara. It was developed by Country Heights Holding Bhd. Despite, the project is being held on bungalow land plots with the land price starting from RM300,000.00 for one lot. The total area of the land is 513 sq. m.. while the total area of the building is 1,479 sq. ft..

The location of the construction project is surrounded by several unoccupied and yet-to-be-sold land plots, as well as a three-story bungalow house adjacent to the project site and two of three-story bungalow house behind the project site. The project includes one living area, one family area, one terrace, four-bedroom, three bathroom, and one kitchen. The project completed with five manholes, two suction tank of rainwater collection system, and 20 feet of driveway tarmac.

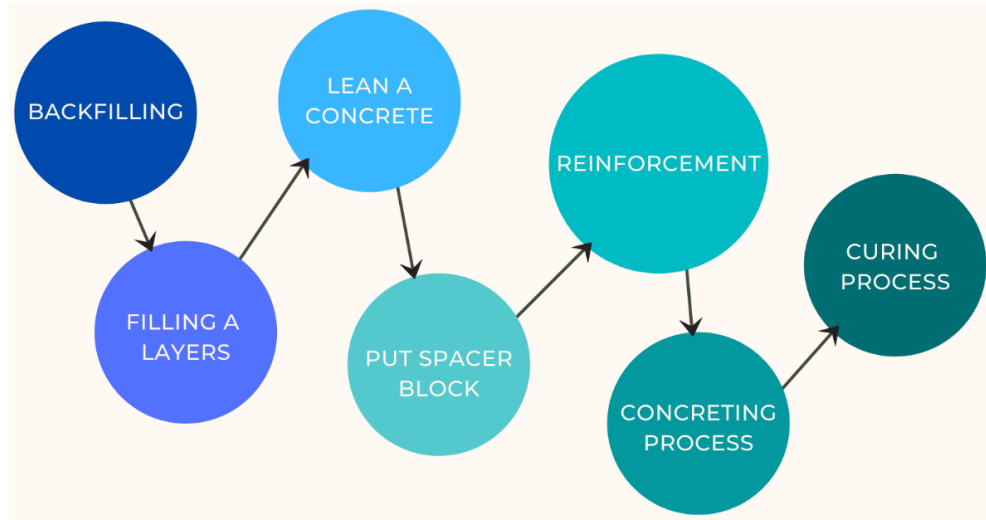
The activities that need to be proposed on this site construction is constructing the ground floor slab. This work will consist a few unskilled workers since this work doesn't require any skill. It also doesn't require much work because the workers just need to mix and lay the mortar on the layer that has been apply earlier. The machineries use in this process are backhoe, concrete mixer truck. Additionally, constructing the column also one of activities that need to propose on this stage. This work must have a teamwork from skill workers and unskilled workers because this work consumes skill and huge energy in order to set up the reinforcement column. The tools such as bucket, wheelbarrow, and shovel also involve in this construction process.

Apart of that, the problems occur during the construction process of slab and column will be establish in every part of the work. The cause and effect of the problem arise throughout the construction process will be emphasized alongside with a few related photos.

Last but not least, the types of reinforcement used in this project will be determined in this chapter which consists of the properties of every reinforcement employed.

### 3.2 To Discover the Method of Building Structural Work Process of Ground Floor Slab and RC Column.

#### Ground Floor Slab.



**Figure 3.4: Procedure to Construct Ground Floor Slab.**

A flowchart of the technique for constructing a ground floor slab is shown in Figure 3.4. The step-by-step procedure can be seen in the bubble above.

#### Backfilling



**Figure 3.5: Backhoe Was Backfilling the Soil.**

First and foremost, the soil is lifted and backfilled by the backhoe throughout the slab area using a backhoe as shown in figure 3.5 above. Once all the soil has been placed into the soil area, the workers compacted the soil using a vibrating plate. The work takes two days to backfill and compacted the soil all over the area. Also, it consumes one skilled worker and two unskilled workers.



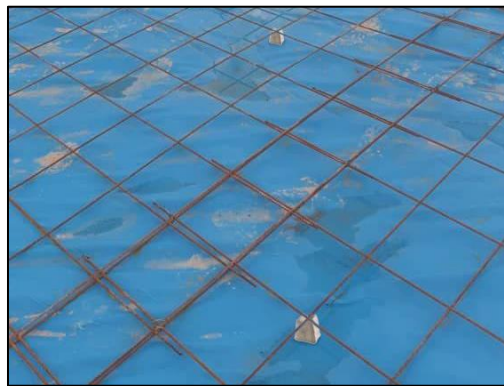
### **Filling a Layers**



**Figure 3.6: DPM Layered on The Compacted Soil.**

Then, the workers were filled one layer with 150mm thick coarse aggregate, one layer with 50mm sand blinding, and 1 layer of damp proof membrane or as known as DPM, a polythene sheet throughout the house area. It can be seen in figure 3.6 above. The DPM was cut into ground floor area shape size which is 1,479 sq. ft. before it being layered on the compacted soil. The equipment involved wheelbarrow and shovel. The works consumes 2 workers and take one day to cut and filled the compacted soil with layers.

### **Put Spacer Block**



**Figure 3.7: Spacer Block Under the BRC.**

The spacer block then being installed before the workers lay the reinforcement as shown in figure 3.7 above. The spacer block is made of concrete and is necessary in the slab construction process to allow for a spacing between the BRC and the base. The works consumes one worker and take one day to put the spacer block.

## Reinforcement



**Figure 3.8: Installed BRC on DPM Layer.**

The workers were installed the BRC reinforcement size A6 on DPM layer and tied the overlapped BRC with a wire. It can be seen in figure 3.8. BRC also had been cut and bend to specific length to ensure the reinforcement can be fit in slab area. The works consumes 3 workers and take one day to cut, bend, and install.

## Concreting Process



**Figure 3.9: Freshly Poured Concrete.**

There were 16 metre of ready-mix concrete grade 25 had been poured into the slab area using a backhoe. The ready-mix concrete was supplied by concrete mixer truck which was ordered from Macro Dimension Concrete Sdn. Bhd.. The workers then leveled the concrete by screeding it across the top of the concrete forms continuously with a help of other workers who were added or removed concrete in front of the screed while it was being pulled. The screeded concrete can be seen in figure 3.9. The work takes one day to pour and screed the concrete. It consumes four workers.

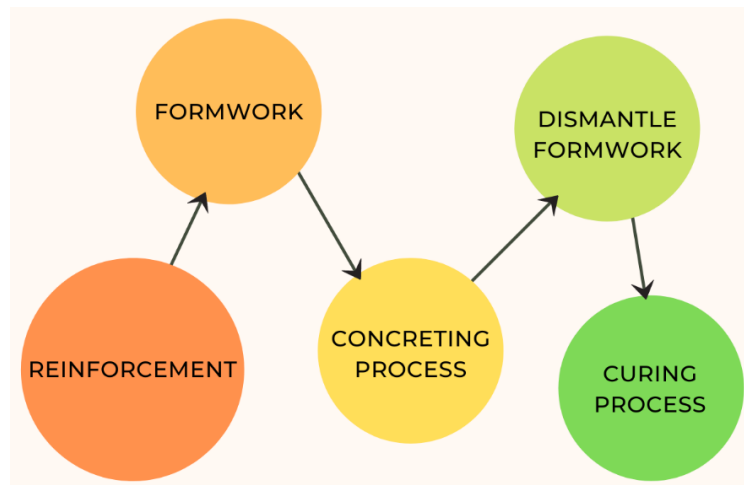
## Curing Process



**Figure 3.10: Concrete Slab That Has Been Cure.**

After dismantling formwork process has been done, the workers were curing the concrete slab by draining water on the concrete surface using rubber pipe which carry a water. Figure 3.10 shows the concrete slab that has completed the curing process. Curing the concrete surface helps to prevent it from drying out too rapidly and cracking. The work takes a day to cure the concrete slab and consumes only one worker.

## RC Column



**Figure 3.11: Procedure to Construct RC Column.**

A flowchart of the technique for constructing an RC column is shown in figure 3.11. The step-by-step procedure can be seen in the bubble above.

## Reinforcement



**Figure 3.12: Y12 Steel Bar That Has Been Fastened Together with R6 Steel Reinforcing Link.**

The workers were tied the Y12 steel bar together with the R6 steel reinforcing link using wire as shown in figure 3.12 above. For one column, 4 rods of Y12 steel bar are used, while 16 rods of R6 steel reinforcing link are used. The reinforcement then being installed to the starter bar from column stump. The works duration takes one day and a half to tie and install the reinforcement. It consumes two workers to install the RC column.

## Formwork



**Figure 3.13: The Column's Formwork That Has Been Form.**



**Figure 3.14: The Column's Formwork Were Installed by the Workers.**

The workers then cut the plywood 11 feet long with stakes using a and installed the formwork. The plywood that had been form can be seen in figure 3.13 above. The plywood nailed it together using a hammer and nails into rectangle's shape in size 4'x 9' as shown in figure 3.14 above. The length of the plywood influenced the height of the column which is 11 feet. The work takes two days and two workers to cut and install the formwork all over the house.



### Concreting Process



**Figure 3.15: The Concrete Was Mixed by the Worker.**

The workers were mixing the sand, cement, aggregate, and water using shovel to produce concrete grade 25 with the ratio is 1: 1½: 3 mixtures of cement, fine aggregates, and coarse aggregate in which one part is cement, one and a half part is sand, and three part is aggregate as shown in figure 3.15. The concrete is then being poured into the formwork using bucket along with vibrator poker to remove air pocket. The works take two days to mix and pour the concrete. It consumes three workers.

### Dismantle Formwork



**Figure 3.16: The Column That Has Been Dismantle.**

Since concrete takes 24 hours to 48 hours to be cured, the workers were removed the formwork after 2 days as shown in figure 3.16. They began by removing the nails from the stakes that were holding the forms in position with the use of a hammer. The stakes are then pulled with a hammer's claw as a stake puller to pull the stakes with minimal force to ensure that the stakes or forms are not damaged. The work takes 1 day to remove the form and consumes only one worker.

## Curing Process



**Figure 3.17: Concrete Column That Has Been Cure.**

After dismantling formwork process has been done, the workers were curing the concrete column by draining water on the concrete surface using rubber pipe which carry a water. Figure 3.17 shown the concrete slab that has completed the curing process. The purpose of the curing process is to allow the concrete to dry fast while keeping moist during the hydration process. The work takes a day to cure the concrete column and consumes only one worker.

### 3.3 To Detect Problems That Arise During the Construction of Structural Work.

When it comes to construction, the structure of a building is crucial. It is considered as a building's main bone as well as its heart. Therefore, when a building collapses or is damaged, the first thing to take into account at is the structure itself. The building structure consists of footing, ground beam, ground slab, column, upper beam, upper slab, and roof structure. Hence, an observation was made at the construction site at Kolej Height Utara while the building structure was being built to determine the cause of the building's collapse.



**Figure 3.18: The Reinforcement Link Was Not Tied Properly.**

The first observation that has been obtained is on the ground beam's reinforcement. As shown in figure 3.18 above, it can be seen that the R6 steel reinforcement link did not tie properly together with Y12 steel bar. This is cause of the workers which lack of skill to tie the wire tightly. Ground beam is the core of a building. It carries the load of the building before the load could be transferred on the ground. However, the building will lead to damage since the reinforcement installation work is poor. It's possible that the slab will crack, causing the slab to lose its ability to keep the tiles in place soon. In addition, the building's strength may deteriorate over time.





**Figure 3.19: Expanded Ground Beam's Concrete.**

Next, the observation that has been obtained is the ground beam's concrete had found to be expanded after dismantling the formwork. It can be seen in figure 3.19 above. This occurred because the ground beam formwork was not removed in a timely manner and had remained in place for a long time. The weather, which alternated between hot and rainy days, also caused the concrete to expand due to an interaction between the plywood and concrete surfaces with air and water.

As the temperature changes, the concrete expands and presses against adjacent plywood. Concrete is an inflexible substance, so when it expands, it pushes everything around it, causing it to crack. Luckily, the concrete just pushes the plywood and does not crack the concrete, however the concrete had been expanded, making the whole concrete ground beam seem unbalanced.



**Figure 3.20: Eroded Concrete of Ground Beam.**

Furthermore, the observation that has been obtained is there is eroded concrete on the edge of concrete ground beam which can be seen in figure 3.20 above. Eroded concrete had exposed the reinforcement of ground beam. This led to building's collapse because the concrete seems to be fragile and easy to erode. This happens as a result of uneven concrete mixing or workers might not remove the air pocket inside the concrete using vibrator poker. The reinforcement also can affect the entire building since it had been exposed. The exposed reinforcement could rust in the future and will make the reinforcement loses its strength and ability to support the load of the building as soon as it will cause the reinforcement to break.

### 3.4 To Investigate the Types of Reinforcement Used for Slab and Column.

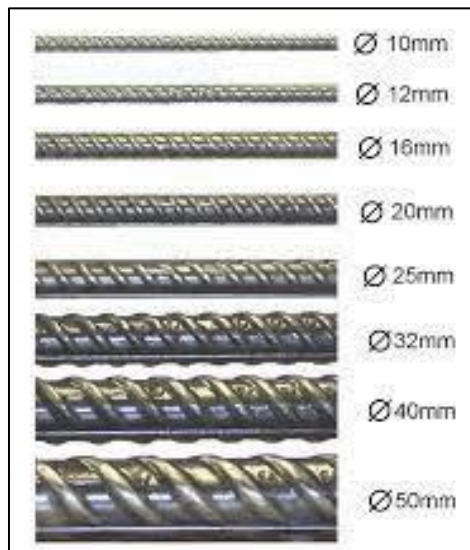
In the process of developing a house, the durability and strength of a house are determined by the type of reinforcement employed in the construction process, which is depending on various important factors. Basically, steel reinforcement is a term that describes steel bar used in combination with plain cement concrete to construct reinforced concrete. Hence, these structures form a steel reinforced cement concrete (R.C.C). Steel reinforcement is commonly called as ‘rebars’ (The Constructor, 2018). Apart of that, cement concrete is also one of materials that contributes to the strength of a building which consists of cement, aggregate, and water. Aggregate is made up from sand, gravel or crushed stone which gives a strength to the mixer when it’s hardened since concrete is strong in compression.



**Figure 3.21: Types of Steel Reinforcement in Metal Categorizes.**

Due to the fact that concrete is strong in compression, it also weak in tension. That is why steel reinforcement should be utilized together with concrete because it is strong in both tension and compression. Also, it can prevent and minimize concrete cracks under tension stresses. The structural element will be designed so that the steel resists the induced tensile and shear forces while the concrete absorbs the compressive forces (The Constructor, 2018). There are several categories of reinforcement that are commonly used in this construction industry. The steels involved are shown in the figure 3.21 above.

For this study, the construction process only included two types of reinforcement which are mild steel and high tensile steel from ferrous metal's category. Both mild steel and high tensile steel are sort of carbon steels. Yet, mild steel contains not more than 2% of carbon and relatively little additional alloying elements. It's also known as soft steel or Low Carbon Steel. Not like mild steel, high tensile steel is a steel with a high ultimate tensile. In contrast to its compressive strength, its tensile strength is extremely high, and it has distinctive alloying components that increase the steel's tensile strength. It is known as Medium Carbon Steel or High Strength Steel.



**Figure 3.22: List of High Tensile Steel Sizing's.**

**Source: Dr. A.P.J. Abdul Kalam Technical University (2018)**

In order to construct a column of a building, high tensile steel is the best choice because of its strength. High tensile steel bar commonly known as Y and has various size such as Y10, Y12, and Y16. The list size of high tensile steel is illustrated in the figure 3.22 above. Y is stand for types of reinforcement and the following digit number is a thickness of the steel bar in unit millimeters (mm). 16mm is a maximum size of high tensile steel bar used in constructing a house. In this project, Y10 is suitable to use in constructing a column since the area of the house is not too big and sufficient to support the load of the building. However, the client request to use Y12 for his house. The overall house costed 25 column that consists of 4 bars of Y12 each RC column.



**Figure 3.23: R6 Steel Reinforcing Link Bonded Together with Y12 Steel Bar.**

The bars are then being knot by mild steel bars, R or known as steel reinforcing link. For this study, R6 was used to tie up the Y12 steel bar which can be seen in figure 3.23 above. R6 refers to the thickness of the mild steel bar itself in unit millimeters (mm) which is 6mm. Each RC column required 16 rods of R6 steel reinforcing link with 200mm x 500mm dimension and 6 inches interval length tied together with 4 bars of Y12 using wire. The dimensions of R6 steel reinforcing link were bent by the bar bender. The rods are first cut into many parts in 1600mm length. Then, the bar bender will be bending every part of rods that had been cut into the following dimension which is in 200mm x 500mm. When it has formed a rectangular shape, the free ends of the rods or called as stirrups will be bent at 90 degrees in two-legged stirrup types to prevent them from opening during strong earthquake shaking. Stirrup are anchored to the anchor bars (hanging bar) or the compressive reinforcement in the compression zone of the column (TeamCivil, 2020).

Apart from this, in order to construct a strong slab, the specific reinforcement should be installed. The types of reinforcement used for developing the slab is BRC wire mesh. BRC wire mesh is a steel reinforcement material used in concrete to replace traditional cut and bend methods and to place steel thermo mechanical treated bars (Aashish Sharma, 2020). This mesh is made up of a series of parallel longitudinal wires welded to cross wires at the specified spacing (Aashish Sharma, 2020). The mesh is made on a machine with precise dimension control, and it saves a significant amount of time, money, and labour (Aashish Sharma, 2020).



**Figure 3.24: Installed BRC on DPM Layer.**

There is various size for BRC, however size A6 were used in constructing the case study house which can be seen in figure 3.24 above. “A” in A6 size refers to types of main wire used and “6” refers to its thickness of the main wire in unit millimetres (mm) which is 6mm. The spacing for main wire in size A6 is in 200mm. BRC in A6 size were used because the slab area was in small to medium size and sufficient to carry a load of the building. The overlapped BRC were tied together with a wire.

## **CHAPTER 4.0**

### **CONCLUSION**

To sum up this report, building structure is the most important core of the building since it is better vibration resistant, saves time during construction, and is more economically efficient. It also can provide safety to the occupants since the main function of the building structure is to bear loads. The building structure method which is concrete slab was started from backfilling, filling a layer, lean concrete, put a spacer block, installing reinforcement, concreting process until curing process. Meanwhile, the RC column method was started from installing reinforcement, installing formwork, concreting process, dismantling formwork until curing process.

The building structure construction procedure took about a month, starting on 3 October 2021 and ending on 26 October 2021, for a concrete slab, and about a week for an RC column, starting on 1 November 2021 and ending on 7 November 2021. The concrete slab construction was postponed several weeks due to a minor issue with a subcontractor and condition of the weather, whereas the RC column installation went off without a hitch. As a result, it takes longer than expected.

The process for constructing a concrete slab and an RC column in this study is a standard method that is similar to the theoretical concept. Nevertheless, the construction method of concrete slab is different from method in theoretical concept such as after laying the coarse aggregate, sand blinding, and DPM layers, it should be lean a concrete on the layer. However, the observations revealed that at lean concrete step had not been done. Moreover, the problems that arise during the construction of structural work can be solved easily with an adequate training and knowledge from sub-contractor. Also, the types of reinforcement used for slab and column can be known in more depth in this development such as the number of bar/rods used, the thickness of the bar/rods, the size of the reinforcement used, etc.



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