DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

REINFORCED CONCRETE WALL USING STEEL FORMWORK

Prepared by:

MUHAMAD KHAIRUL NIZAM BIN MAHMOOD

2016991983

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

JULY 2019

It is recommended that the report of this practical training provided

by

Muhamad Khairul Nizam bin Mahmood

2016991983

entitled

Reinforced Concrete Wall Using Steel Formwork

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

Report Supervisor	:	Dr. Azamuddin bin Husin
Practical Training Coordinator	:	En. Muhammad Naim Bin Mahyuddin.
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 are stated herein, prepared during a practical training session that I underwent at Glomac Berhad for a duration of 14 weeks starting from 25th February 2019 and ended on 31st May 2019. It is submitted as one of the prerequisite requirements of DBG307 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Name : Muhamad Khairul Nizam bin Mahmood

UiTM ID No : 2016991983

Date : 31 May 2019

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ABSTRACT

Reinforced concrete wall is a dividing structural element which made of concrete with metal embedded in it. Steel formwork is a mould made of steel that were used to form concrete into structural shapes such as beams, columns, slabs for building. This study is based on 2 ½ storey affordable town-houses unit of Phase 6 Saujana Perdana, Sungai Buloh, Selangor. The objectives of this report are to discuss on the process of building a structural element using steel formwork, which is reinforced concrete wall. This report also discusses materials and equipment's used and imperfection to the wall. The process starts with fitting reinforcement bar, then assembling formwork, next concrete placement ,formwork disassembly and lastly defect inspection. Information is gained to complete this report is by individual interviews, observations, internet research and studying drawing plans. In conclusion, this report will show the benefits of reinforced concrete wall which is one of the main elements of a building.

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CHAPTER 1.0

INTRODUCTION

1.1 Background and Scope of Study

When designing a building, an architect plans for spatial, environment and visual requirements. Once these requirements are achieved, it is necessary to detail the fabric of the building. The choice of materials and the manner in which they are put together to form building elements, such as the foundation, walls, floor and roof, depend largely upon their properties relative to environment requirements and their strength. (Mrema, 2011)

Wall may be divided into two types, load-bearing wall and non-load-bearing wall. Load-bearing walls supports loads from floors and roof in addition to their own weight and resist side-pressure from wind and, in some cases, from stored material or objects within the building. Meanwhile, non-load-bearing walls carry no floor or roof loads.

There are four main groups off walls - masonry walls, monolithic walls, frame walls and membrane walls. Building monolithic walls using steel formwork is gaining popularity nowadays as it can form all concrete features of multi-storey building floor in a single site operation. By using this technology, clients save cost, time and improve the quality of construction.

With the growing focus on affordable houses for all, the need to use new and innovative yet cost efficient construction technology is required. This is where building reinforced concrete wall using steel formwork came to use. Building a house with quality materials and innovative construction method will make houses affordable to owned. Eliminating the use of timber formwork which lifespan is lower than steel formwork will save cost a lot.

In a nutshell, method of construction nowadays has improved a lot. Building a wall using formwork is much faster than bricklaying. In addition, the strength, integrity and other properties are also better than a brick wall. This is important as the wall function is not only supporting the house structure, but also as a barricade that separate different unit of houses.

1.2 Objectives

The following are the objectives of this study

i. To identify the materials and equipment used in the construction.

ii. To understand the method of reinforced concrete wall construction.

iii. To understand the type of defects that could affect the structural integrity of the reinforced concrete wall.

1.3 Methods of Study

There are several methods used in completing this study.

i. Interview

- Interviewed Clerk of Work and Site Supervisor about the construction of reinforced concrete wall. They gave me a lot of useful information which I can put into this study.

ii. Observation

- Visited the construction site where reinforced concrete wall is being construct. Observed the progression of work during construction, how the labours do their job, how many workforce, machineries and plants involved.

iii. Internet

- Finding more information about materials used such as concrete grade, steel bar standards, and strength of materials.

iv. Project drawings.

- Project drawings such as structural drawing and architectural drawing really helps me to understand more on construction of reinforced concrete wall. These drawings show important information such as dimensions and types of materials.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

Figure 2.1 Glomac Berhad logo

Glomac Berhad was founded by Tan Sri Dato' Mohamed Mansor bin Fateh and Datuk Richard Fong Loong Tuck back in 1988. Currently the company is managed by Datuk Seri Fateh Iskandar bin Tan Sri Dato' Mohamed Mansor. Today, more than 55 subsidiaries are under Glomac Berhad which involvement in every aspect of real estate business including property development, property investment, construction, property management and car park management.

On 13th June 2000, Glomac Berhad was listed on the Main Board of Bursa Malaysia Securities. Since its establishment, the main focus of the Group is property development. With this, the Group's reputation as a responsible and visionary property developer with its excellent record of developing townships, residential, commercial and mixed development properties.

To-date, more than RM8.5 billion of total sales value has been completed by the Group. Entering into a new phase of growth, Glomac Berhad is in the middle of launching properties worth more than RM658 million. Glomac Berhad is continuously planning and designing new projects for their existing landbank and evaluating new landbank opportunities and seeking out for new opportunities in the country.

2.2 Company Profile

Table 2.1 Company profile

1.	Company Name	Glomac Berhad (Bandar Saujana Utama)
2.	Company Address	9, 11, 13 (Fasa 6A) Lorong Elmina 4, Sungai Buloh Country Resort, 47000, Sungai Buloh, Selangor.
3.	Contact	Phone No. Fax No. Hotline E-mail ge@glomac.com.my Website www.glomac.com.my
4.	Year of Establishment	1988
5.	Company Registration No.	110532-M
6.	Listed on Bursa Malaysia Securities Berhad	13th June 2000
7.	Company Vision	Our vision is to help improve the quality of life by providing a better place to live or work in. By carrying out this vision, we want to be recognised by our customers, shareholders and employees as a world-class property developer.
8.	Company Mission	Our mission as a caring and reliable property developer is to deliver outstanding service, quality products and value for money for our customers. Through dedication, innovation and passion, we are confident about our ability to achieve these goals.
9.	Main Business	Property development.

2.3 Organization Chart

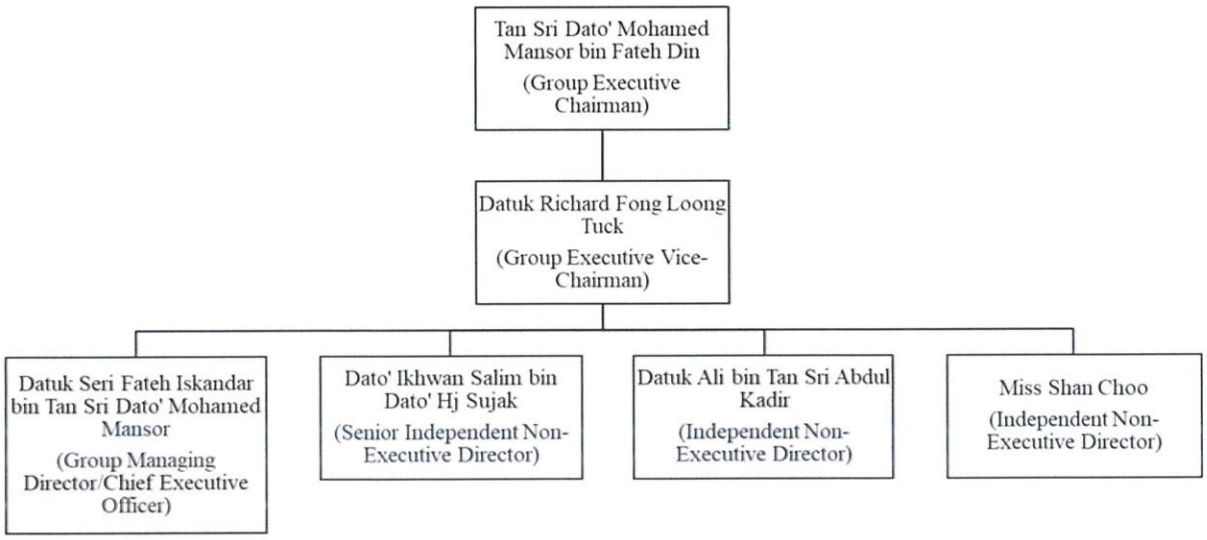

Figure 2.2 Company organizational chart

Source: Glomac Berhad

2.4 List of Project

2.4.1 Completed Projects

a) Residential

i. Prima 16, Section 16, Petaling Jaya, Selangor.

ii. Suria Residen, Cheras, Selangor.

iii. Seri Bangi, Bandar Baru Bangi, Selangor.

iv. Reflection Residences, Mutiara Damansara, Selangor.

v. Suria Stonor, Persiaran Stonor off Jalan Stonor, Kuala Lumpur.

b) Commercial

i. Glomac Cyberjaya 2, Cyberjaya, Selangor.

ii. Glo Damansara Mall, Jalan Damansara, Kuala Lumpur.

iii. Glomac Business Centre, Petaling Jaya, Selangor.

iv. Worldwide Business Park, Shah Alam Selangor.

v. Glomac Tower (now known as Prestige Tower), KLCC, Kuala Lumpur.

c) Mixed Development

i. Lakeside Residences, Puchong, Selangor.

ii. Glomac Damansara, Damansara, Kuala Lumpur.

d) Township.

i. Saujana Aman, Sungai Buloh, Selangor.

ii. Saujana Perdana (Phase 1,2 and 3A), Sungai Buloh, Selangor.

iii. Saujana Rawang (Phase 1-8), Rawang, Selangor.

iv. Saujana KLIA, Sepang, Selangor.

v. Saujana Utama, Sungai Buloh, Selangor.

2.4.2 Projects in Progress

a) Residential

i. Saujana Residen, Kota Tinggi, Johor.

b) Mixed Development

i. Plaza Kelana Jaya, Petaling Jaya, Selangor.

c) Township.

i. Saujana Perdana (Phase 3B, 3C and 6A), Sungai Buloh, Selangor.

ii. Saujana Rawang (Phase 9), Rawang, Selangor.

iii. Perumahan Komuniti Johor, Saujana Jaya, Kulai, Johor.

iv. Sri Saujana, Kota Tinggi, Johor.

CHAPTER 3.0

REINFORCED CONCRETE WALL USING FORMWORK OF PHASE 6A SAUJANA PERDANA, SUNGAI BULOH, SELANGOR

3.1 Introduction to Case Study

Glomac Berhad is a well-known property developer especially in Klang Valley area. Ranging from township, commercial, to residential, Glomac Berhad is determined to become a leader in the Malaysian property development industry. To achieve those goals, Glomac Berhad commit to continually improve the effectiveness their policies, systems, processes, people and compliance to statutory and regulatory requirements.

Phase 6A is an affordable housing project built under the scheme 'Rumah SelangorKu' by Selangor State Government. Glomac Berhad through its subsidiary Kelana Kualiti Sdn Bhd is responsible to build 180 unit of 2 ½ storey affordable town-houses. Illustration of the completed construction is as shown in Figure 3.1.

The case study will focus on construction of reinforced concrete wall using steel formwork as it is the on-going work happening on the site. All the progress of this construction work is observed during the 3 months period of practical training. The reinforced concrete wall act as a supporting structure and also divider between each unit of houses. It also falls into the load-bearing wall category.

Figure 3.1 Illustration of completed construction

Table 3.1 List of parties and consultants involved

Owner	Tan Sri Dato' Mohamed Mansor bin Fateh Din, P.S.M., D.P.M.S., A.M.P., J.P., P.J.K. Group Executive Chairman 401012-08-5361
Developer	Kelana Kualiti Sdn. Bhd., No. 9 & 11, Lorong Elmina 4, Fasa 6A, Sungai Buloh Country Resort, 47000 Sungai Buloh, Selangor. No. tel. :
Contactor	Maran Econ Build Sdn. Bhd., No. 12-16, Jalan 17/54, 46400 Petaling Jaya, Selangor. No. tel. :
Architect	Gabungan Arkitek Sdn. Bhd., No. 86-1, Jalan Wangsa Delima 6, KLSC, Seksyen 5, Wangsa Maju, 53300, Kuala Lumpur. No. tel. :
Engineer	CYS Jurutera Perunding, B-3A-5, Jalan 2/142A, Megan Phoenix, Cheras, 56000 Kuala Lumpur. No. tel. :

Source : Glomac Berhad

3.2 Reinforced Concrete Wall Using Steel Formwork of Phase 6A Saujana Perdana, Sungai Buloh, Selangor.

3.2.1 Reinforcement steel

Reinforcement steel or 'rebars' is cut and bended at the metalworking shed as shown in Figure 3.2. Rebars is cut and bended according to dimension in the structural drawing plan. Then it is transported to the site where it's going to be installed.

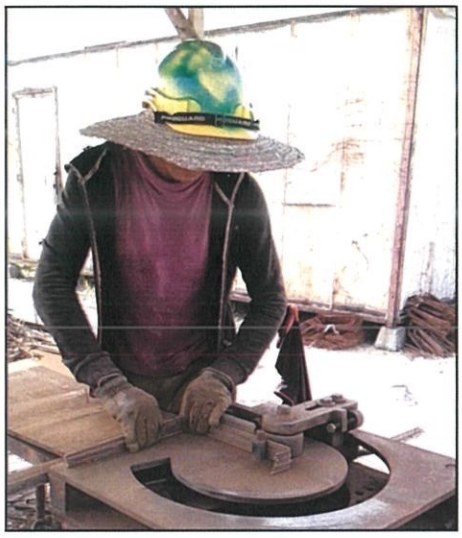

Figure 3.2 Bar bending works

Figure 3.3 shows the rebar is erected and anchored on the rebar of a beam. This so that when concrete is poured, the wall and the beam became one concrete structure, thus increasing the strength of the wall. A mild steel wire is used to tie the rebar to one another.

Figure 3.3 Erected wall rebar

3.2.2 Assembly of steel formwork

Figure 3.4 Steel formwork panel

To build a wall, there will be six panels of steel formwork to be used. 3 panels on the right-hand-side and 3 panels on the left-hand-side. By using crawler crane, steel formwork panels are moved to the place where the wall is going to be build as shown in Figure 3.4.

Figure 3.5 Crawler crane moving steel formwork panel

Once in place, two workers will adjust the position of the steel formwork so that it will be in-line with the others. There is one panel that needs support as there is no ground next to it due to stairwell opening. So, a few hollow steel bars are placed across the stairwell opening for formwork panel foot to sit on as shown in Figure 3.6.

Figure 3.6 Steel formwork panel next to a stairwell opening

When all the panels are in-line, the workers will install the tie rods and wing nuts as shown in Figure 3.7 to secure the panels on the right and left-hand-side. This is also to make the panels tight so that no concrete can get out when concrete is placed.

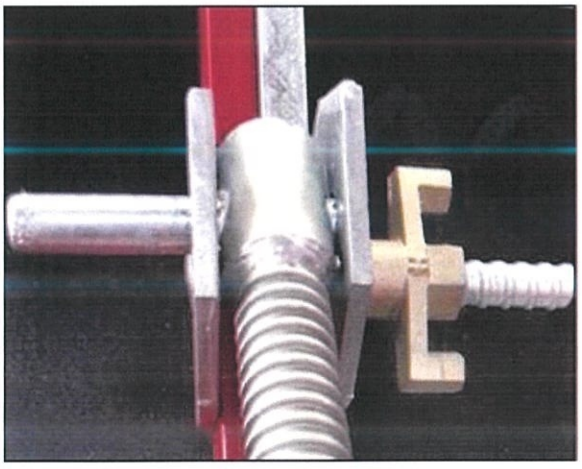

Figure 3.7 Tie rod and wing nuts installed

Then the workers will install silicon cone that penetrate the formwork panel. The use of the silicone cone is to make space for a tie that will hold both side of the formwork panels.

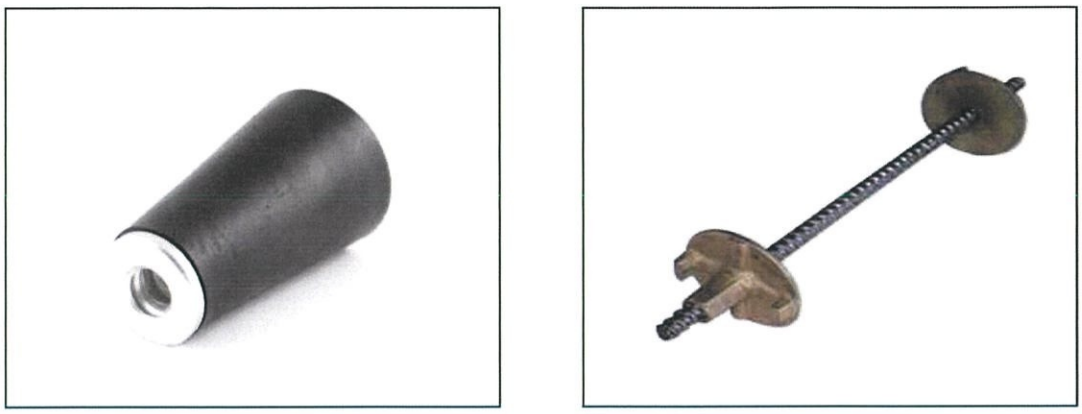

Figure 3.8 Silicone cone and tie

3.2.3 Concreting

Before concreting starts, the surface inside of the formwork panels must be sprayed with releasing agents as shown in Figure 3.9. This to make opening formwork panel when the concrete has set easier.

Figure 3.9 Spraying of releasing agent

After releasing agent is sprayed, then concrete can be poured into the formwork. Concrete from the mixer truck is moved to where the formwork panels erected by using concrete bucket attached to the mobile crane. The concrete used is Grade 25 concrete. This grade of concrete is common for building a reinforced concrete structure.

Figure 3.10 Mixer truck pouring concrete into bucket

In Figure 3.10, three workers are required in concreting work. One operates the bucket, one operates the poker vibrator and one will trowel the concrete.

3.2.4 Disassembly of steel formwork

Once the concrete has set, the formwork panels must be removed so that it can be used to build another wall. The process starts with loosening the tie rods, wing nuts and silicone cone that holds the whole steel formwork panels together. Then crawler crane will lift the formwork panels up and place it where the next wall will be built.

Removing formwork from concrete wall becomes easy because releasing agent has been sprayed onto the formwork panels surface. When all steel formwork panels have been removed, few holes in the wall can be seen. These holes as shown in Figure 3.11 exist due to the use of silicone cone that protect the tie rod that holds the left and right-hand-side of steel formwork panels. Later these holes will be filled with mortar.

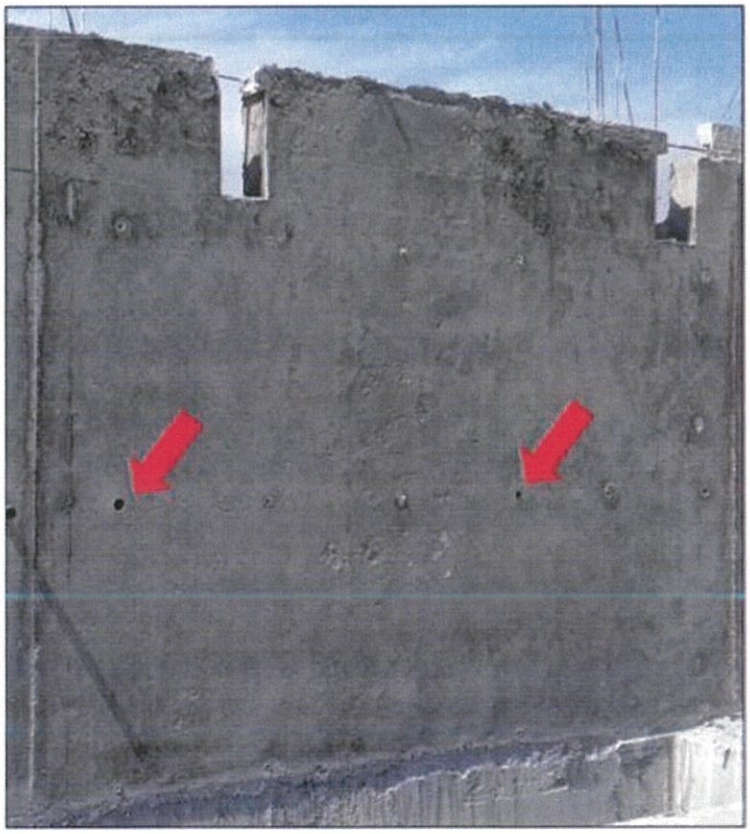

Figure 3.11 Holes in the wall

3.2.5 Concrete defects

Based on my observation, I found several defects on the walls that have been built. The defects are segregation and cold joint.

Segregation can be defined as the separation of some size groups of aggregates from cement mortar. A good concrete is one in which all the ingredients are properly distributed to make a homogenous mixture. (Titti Chandigarh, 2001)

Figure 3.12 Concrete segregation on a wall

There are two possible causes to this segregation. First, the time taken to transport the concrete to the site. If it took too much time to get to the site from the batching plant, water content in the concrete is loss on the way. To prevent, make sure the journey of the mixer truck is well planned.

Another cause is concrete is vibrated too long. This will cause the materials in the mixture to be separated from the others. Concrete should be vibrated adequately.

Cold joint of concrete is a weak plane caused by an interruption in the casting process. It is widely recognized that difficulties in the constructive method of concrete structures can entail cold joints that evidently impair the structural performance, since it reduces the system's stress-strain characteristics. (Harsem, 2005)

Figure 3.13 Cold joint on a wall

Cold joints can be prevented by placing concrete in layers of 18 inches deep and vibrate it so that the layer intermix with the previous layer placed. Concrete placing should start in the corners and works toward the centre. In a hot weather like Malaysia, retarding admixture can be used to slow down concrete setting time. This will make concreter have more time to place concrete and vibrate or compact them.

Another way to prevent cold joints from happening is to make sure plants such as crane and mixer truck is in good condition. If the plants broke down during concreting, it will cause delay in placing concrete thus chance for cold joints to occur is high.

CHAPTER 4.0

CONCLUSION

4.1 Conclusion

Reinforced concrete wall is a cost and time saving method in construction especially nowadays where demands of houses and buildings are high in Malaysia. Reinforced concrete structure allow us to build a higher skyscrapers and stronger buildings to withstand natural disaster. The used of steel formwork saves construction time and cost a lot. A much longer cycle life compared to timber formwork not only saves money, also reduce waste on site.

To ensure the quality of a construction, drawing plans must be referred every time where in doubt. This is because drawing plans is the specification of a structure. Not building according to drawing plans could affect the quality and integrity of a structure, thus invites serious defects or even worse, structure failure.

Safety precautions must be taken seriously by all person involved as heavy machineries and plants are being used. Workers must be alert of surroundings and use proper personal protective equipment (PPE) while working. Failing to do so will exposed the workers to hazards which could lead to incidents such as injury or death. These incidents could affect the work progress of the project.

To conclude, construction is a field that requires high discipline to follow the requirements, and rules and regulations so that a high-quality building can be build. Not only high discipline, implementation of modern construction method also contributes to high-quality building. A high-quality building will last longer due to less problems or defects that they suffer.

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