DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

CONSTRUCTION METHOD OF ABOVE GROUND LEVEL SWIMMING POOL

Prepared by:

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

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(PERAK)

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It is recommended that the report of this practical training provided

By

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CONSTRUCTION METHOD OF ABOVE GROUND LEVEL SWIMMING POOL

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

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(PERAK)

(10 JANUARY 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 AMS Maju Bina Sdn Bhd for a 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 fulfilment of the requirements for obtaining the Diploma in Building.

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Date : 10 January 2022

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

Thank you so much.

ABSTRACT

A swimming pool is a water facility that is designed to hold water to a certain capacity in order for swimming or other leisure activities. Above ground level swimming pool types that used the glass wall has a lot of benefits to the owner and for the house itself in the context of the house surrounding. Therefore, this report briefly describes the construction of the above-ground level swimming pool. The objective of this report is to identify the construction method of above ground level swimming pool. In this report, a compressive explanation on the construction method started from the setting out until the testing and commissioning, including equipment, material, and the worker is described to give the overall view about the construction process. On top of that, the problems that occurred during the construction which represent the second objective also been stated along with the solutions to those problems. Three methods of study which is observation, unstructured interview and document review were applied as the data collection and references to achieve a detail explanation on the construction method of this swimming pool. Hope this report can provide knowledge to the reader about each construction method in order to construct the above ground level swimming pool.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

A swimming pool is a water facility that is designed to hold water to a certain capacity in order for swimming or other leisure activities (Miniotaite, R., 2016). The swimming pool has a lot of benefits either for the owner or for the house itself, for example, a pool can provide a great exercise for the owner from the swimming activity, and it also can increase the visual appeal and value of the house's surroundings (Neal, C., 2018). According to Rajan, N. & Raj, L. YC., (2019) stated that four different types of material used in swimming pool such as concrete, fiber glass, vinyl line and above ground level swimming pool. The different of materials used represent different construction method and equipment used.

For each type of swimming pool that as stated above, there are some elements that made it difference with another. According to Rajan, N. & Raj, L. YC., (2019) the pool size and styles are the main thing that made the different to the selection of types of pool. The size and layout of surrounding, how many people will use it and how often the usage of that pool are some factors that need to consider before selection of the suitable types of the swimming pool. In addition, aesthetic features also one the other element that are important to be consider. If the owner wants to create a harmonious outdoor environment, the overall design of the types that will be used need to be consider as each type of swimming pool have their own aesthetic value depend on its purpose.

Thus, this study will focus on the above ground level swimming pool types. Above-ground level swimming pools provide all of the pleasure and enjoyment of an in-ground pool, but at a far lower cost and convenience. From these types, the tempered glass was used as the main material on the pool's wall of above ground level swimming pool. This glass was fixed into the aluminium frame that attached on concrete column that function as a support. Besides, installing glass on a pool wall provide some great features like "see through" the walls feature, which makes them

ideal for small areas. The glass wall allows for more natural light to enter the space, making it appear larger and lighter. Pool walls are also useful for observation as well as making a modern design statement (Glass, O. D., 2019). Therefore, the aim of study for this report was to explain the construction of above ground level swimming pool.

1.2 Objectives

i. To identify the construction method of above ground level swimming pool

ii. To determine the problems occurred during the construction and solutions to the problems

1.3 Scope of Study

The study was conducted at a three-storey bungalow located at Rhu Renggeh, Kuala Terengganu, Terengganu. This practical report focuses on the construction method of above ground level swimming pool. To address the aim of the study and first objective regarding the construction method, a comprehensive explanation including equipment, material, and workers. However, the study does not cover on cost of this project. Apart from that, the problem and solution also take into consideration while the construction of above ground level swimming pool is carried out represent for second objective. Thus, three method of study such as observation, interview, and document review were applied on this report as explained below.

1.4 Methods of Study

i. Observation

The observation method has been done on the site where above ground level swimming pool is being constructed. The focus of this observation is to observe the construction method of above ground level swimming pool. The observation has been done within 12 weeks starting from 26 September 2021 which on week 6 of practical training until 16 December 2021 which on week 17. Apart from that, smartphone cameras are used to take the picture of a progress done day by day and also the picture of equipment and material as a record from the observation.

ii. Interviews

Unstructured interview also being used while observation is done. Several construction respondents such as project manager, site supervisors, designer and workers at the site are being interview in order to get more detail information and understanding regarding the construction method of above ground level swimming pool. The unstructured interview approximately takes about 10 to 15 minutes per session for each respondent. Furthermore, some random question such as the material and equipment used, construction method of each process was asked and from that, the interview data was collected by written it into the notebook.

iii. Document Review

Document review was done by reading the written material. The written material either come from the article, journals, and blog which from the internet sources. Other than that, the sources of document review also come from the company itself, for example company profile and detail drawing that are used as a reference for further understanding before write the complete report.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction of Company

AMS Maju Bina Enterprise is a wholly owned Bumiputera contractor company registered under the Suruhanjaya Syarikat Malaysia (SSM), dated 25 January 2017. It was established to meet the government's recommendations in encouraging Bumiputera to dominate the business economy in Malaysia. Started on 7 February 2019, this company was incorporated under the Companies Act 2016 that changed the company status to private company which also known with the new name, AMS Maju Bina Sdn Bhd.

AMS Maju Bina Sdn Bhd that was located in Padang Midin, Kuala Terengganu, plays an active role in the construction of residential houses, house renovation, sale, and purchase of properties around Terengganu. The main area of the business is to carry out works related to the construction of properties such as residential by offering affordable price packages in the market. Besides, this company also provide the work related to building design and housing, building renovation, legal process and managing the housing loan process.

AMS Maju Bina Sdn Bhd focuses on build the house on client’s own land. This company ready to accept clients who want to build the house on their own land and sketch their home plans based on the packages and designs they want. For the sake of the wishes, preferences and tastes of the customers, there are various designs offered by this company. Armed with a strong residential construction experience and management skills in the property industry, AMS Maju Bina Sdn Bhd is able to provide integrity, advanced and an efficient management approach to its customers.

Over the period started from 2017, AMS Maju Bina Sdn Bhd managed to complete more than 100 residential units throughout Terengganu including Besut, Setiu, Kuala Terengganu, Marang, Dungun and Kemaman with no abandoned projects

2.2 Company Profile

2.2.1 Company Information

Figure 2.1: Logo of AMS Maju Bina Sdn Bhd

Company Name	:	AMS Maju Bina Sdn Bhd
Company Registration No	:	TR 0168056-K
Registration Date	:	25 January 2017
Company Address	:	NO 64-C, Jalan Kuala Berang, 21400 Kuala Terengganu, Terengganu.
No. Tel	:	09-6193067/ 019-9559406
Business Types	:	General Construction Contractor, Cleaning Work Area for addition and Patronage of Land, Plumbing Work, Household Electrical Wiring, Wiring work & Aluminum and Glass installation
Business Ownership	:	Sole Proprietorship
Owner	:	Mohd Sufian Bin Embong
Registered Bank	:	RHB Bank Kuala Terengganu branch

2.2.2 Company Services

AMS Maju Bina Sdn Bhd has obtained a G2 class contractor license under CIDB Malaysia on 13 July 2017 and has been registered under the Contractor Service Centre consisting of 3 subheads namely Building Construction, Civil Engineering Construction, Mechanical and Electrical. This company also have a ministry of finance license to boost the company's activities to be more competitive and to enhance career advancement with greater excellence. Furthermore, this company is also capable and experienced in carrying out the following construction work, which is renovation work, legal service process, interior design consultant, construction project management and rental services of backhoe machines, lorry, and portable cement mixers.

Besides, as the project especially the construction of bungalow was complicated and required skills to carry out the work, AMS Maju Bina Sdn Bhd as the main contractor worked together with the sub-contractor from different types of business to carry out particular elements of works for example, building structural work, aluminium work, electrical wiring work, plaster ceiling work and tiles installation work. The list of sub-contractors that registered under AMS Maju Bina Sdn Bhd were, Dra Jaya, Nariamas Enterprise, Sh Setia Resources and Sbp Jaya that focus on the building structural work. Besides, for the aluminium work, the sub-contractors that was registered were Ibnu Taqwa Enterprise and Permata Teguh Enterprise. Next, Mma Sinar Enterprise and R & A Global was responsible for electrical wiring work. The sub-contractor for plaster ceiling work was Shaari Maju Jaya Enterprise and for the tile installation work, the sub-contractor was Shah Mosaic Kampung Laut.

2.3 Company Organization Chart

Started from the establishment of AMS Maju Bina Sdn Bhd in 2017, Encik Mohd Sufian Bin Embong was a Managing Director for this company with the help from his wife, Tuan Norsyahida Binti Tuan Ramli as an Assistant Manager. Throughout the year, he was responsible on leading projects and technical, ensuring that development projects run smoothly, controlling the cost of construction projects, and leading the operating group in development projects. Furthermore, this company have seven department which is Accounting Department, Marketing Department, Designer Department, Aluminium & Glass Department, Property Department, Project Department, and Logistic Department. All of this department work as a team and have their own responsibility in order to ensure every project that come through will be done successfully. Figure 2.2 shows the organization chart of this company.

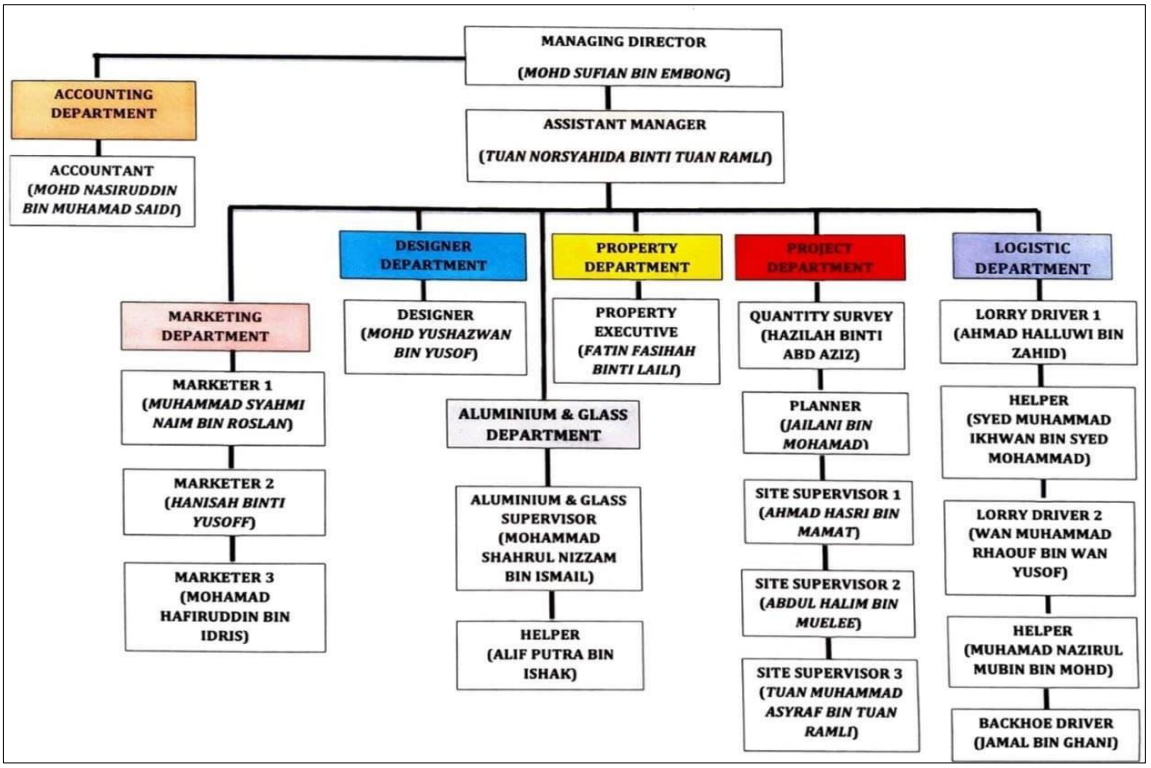

Figure 2.2: Company Organization Chart

Source: AMS Maju Bina Sdn Bhd (2021)

2.4 List of Projects

2.4.1 Completed Projects

Table 2.1: Completed Project of AMS Maju Bina Sdn Bhd

No.	Job Scope	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Proposed to build and completion one unit bungalow at Kampung Alor Limbat, Bukit Payung (6)	RM 152,076.00	8/1/2019	20/6/ 2020	17 Month	Ahmad Hakimi Bin Mohammad
2.	Proposed to build and completion one unit bungalow at Kampung Sura, Dungun (6)	RM 108,182.00	18/12/2019	1/12/2021	23 Month	Muhammad Taufiq Bin Jamaludin
3.	Proposed to build and completion one unit bungalow at Kampung Banggol Durian	RM 105,455.00	24/12/2019	31/5/2021	17 Month	Nur Hidayu Binti Ahmad Razali
4.	Proposed to build and completion one unit bungalow at Kampung Nyior Paka	RM 111,630.00	29/12/2019	16/7/2021	18 Month	Mohd Alias Bin Ibrahim
5.	Proposed to build and completion one unit bungalow at Kg Gong Pak Damat	RM 168,247.00	15/7/2020	5/1/2022	17 Month	Wahab Bin Ngah

Source: AMS Maju Bina Sdn Bhd (2021)

2.4.2 Project in Progress

Table 2.2: Project in Progress of AMS Maju Bina Sdn Bhd

No.	Job Scope	Project Value	Start Date	Estimated Completion Date	Status	Client
1.	Proposed to build and completion a semi-detached bungalow at Pasir Panjang (1)(2)	RM 200,680.00	23/9/2020	March 2022	Ongoing	Nurul Saiyidah Binti Ibrahim
2.	Proposed to build and completion one unit bungalow at Lot 50093 Gong Badak, Kuala Nerus (7)	RM 161,460.00	21/10/2020	2022	Ongoing	Nur Raihan Binti Sa'id @ Zaidun
3.	Proposed to build and completion one unit bungalow at Padang Minyak, Dungun (11)	RM 137,610.00	25/3/2021	2022	Ongoing	Che The Binti Che Abdullah
4.	Proposed to build and completion one unit bungalow at Kg Kubang Palas, Bukit Payung (12)	RM 100,350.00	12/9/2021	2023	Ongoing	Azizah Binti Ngah
5.	Proposed to build and completion one unit bungalow at Lot 7785 Belukar Jambu, Chendering (2)	RM 160,600.00	16/9/2021	2023	Ongoing	Mohd Zulkifli Bin Abdullah
6.	Proposed to build and completion one unit bungalow at Kg Bukit Tok Beng (2)	RM 167,963.71	29/9/2021	2023	Ongoing	Ramlee Bin A. Rahman

Source: AMS Maju Bina Sdn Bhd (2021)

CHAPTER 3

CONSTRUCTION METHOD OF ABOVE GROUND LEVEL SWIMMING POOL

3.1 Introduction to Case Study

The project that was carried out during the practical training was the project construction and completion of one unit of a three-strorey bungalow on Lot 306, Kampung Rhu Renggeh, 21080, Kuala Terengganu, Terengganu. The project value of the construction and completion for one unit of three storey bungalow was RM 785,300.00 (Seven Hundred Eighty-Five Thousand and Three Hundred Only). This project construction was started on September 2019 and completed in December 2021

Furthermore, in this construction project, there are some parties involved that was responsible for the completion of this project. Between the parties involved in the construction and completion of one unit of three-storey bungalow was Encik Mohd Sufian Bin Embong as a client for this project and also as a managing director for AMS Maju Bina Sdn Bhd who act as a main contractor in this project. The architectural design of this project was fully completed by the designer department in this company which was held by Encik Mohd Yushazwan Bin Yusof who was the designer for AMS Maju Bina Sdn Bhd. Besides, there was also some sub-contractor that involved in this project and one of them was Shah Mosaic Kampung Laut that mainly focused on finishes and tile installation works.

This bungalow project comes with another project on the house's yard that includes together in the construction of this bungalow. The example of project carried out on site was the construction and completion of fishpond, outdoor BBQ kitchen, in-ground swimming pool that used the skimmer box system and above ground level swimming pool that situated on the backyard of this bungalow. However, for this case study, above ground level swimming pool with the dimension of 6690 mm x 3670 mm and 680 mm height from the ground level are chosen. This type of swimming pool was used the tempered glass that fixed into the aluminium framed which attached on eight concrete columns with the size of 230mm x 120mm for each column. Furthermore, the design of this swimming pool was function to be used by kid from age 8 to 12 years

old. Figure 3.1 shows the plan of above ground level swimming pool.

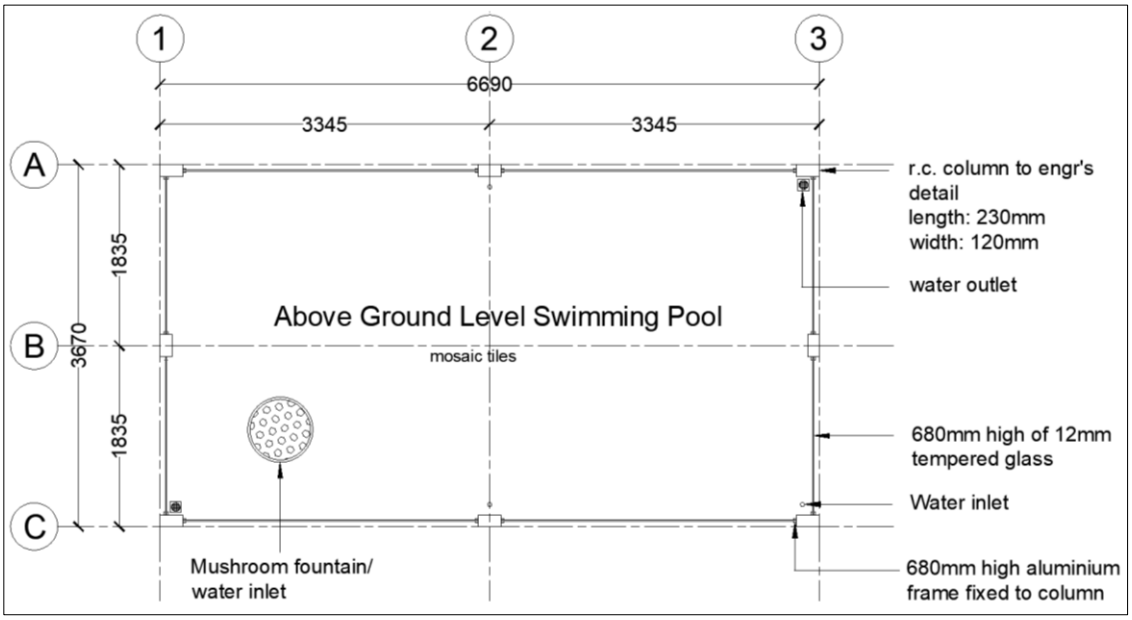

Figure 3.1: Plan of above ground level swimming pool

Source: AMS Maju Bina Sdn Bhd (2019)

From that, this study will be focused on every construction method of above ground level swimming pool started from the setting out, until the testing and commissioning of this swimming pool. Besides, this case study also concludes some problem that occurred during the construction process and solution to that problem along with the conclusion of the construction of above ground level swimming pool. Figure 3.2 show the 3D model of above ground level swimming pool.

Figure 3.2: 3D model of above ground level swimming pool

Source: AMS Maju Bina Sdn Bhd (2019)

3.2 Construction Method of Above Ground Level Swimming Pool

3.2.1 Setting Out

The first method of construction of an above-ground level swimming pool was setting out. Setting out can be defined as the process of transferring the position and level of the structure that was already marked on a plan to the site of construction or actual ground (Gutti, B. M., 2019). The information from the construction design drawings was taken which then profiles, pegs, or other marks are set in order to make sure that each element was constructed in the right position and to the correct level.

In the construction of the swimming pool, the first thing that need to be determined was the length, width, and depth of the pool. For this project, the size of the above ground level swimming pool that needs to be setting out was 6690 mm x 3670 mm with the 2 feet depth. Even though this swimming pool was on the above ground level swimming pool category, but the setting out of 2 feet depth was required in order to install the plumbing connection underneath the pool's slab which will connect the water to the pool pump and filter system and also for the installation of reinforcement on the pool slab. Figure 3.3 shows the plan of setting out for above ground level swimming pool.

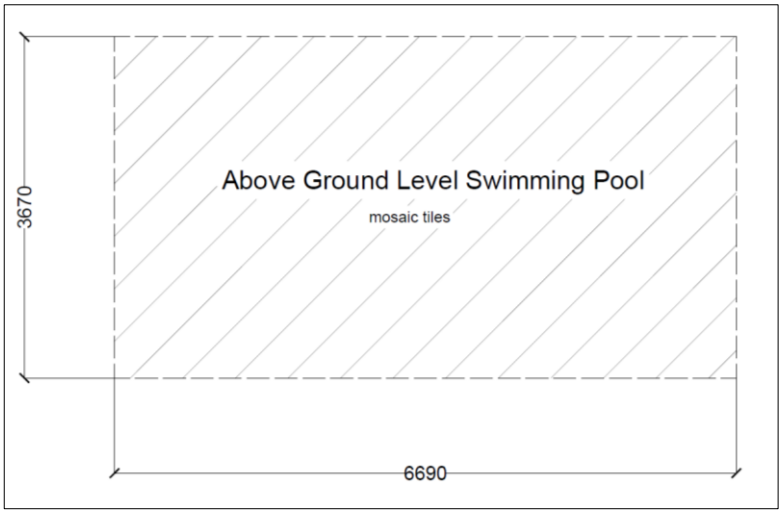

Figure 3.3: Plan of setting out for above ground level swimming pool

Source: AMS Maju Bina Sdn Bhd (2019)

The first step for the setting out was site clearance work which is the work of clearing the unwanted bushes, weeds, and plants on site as well as preparing and

levelling the land. Then, all the necessary materials like pegs, nails, ropes, or string lines, hammers, measuring tape, and marking tools were prepared. After that, profile boards were built around the proposed site for this swimming pool using wood with the size of 1" x 2" as shown in figure 3.4. The profile boards represented the setback and also used to take some marking on it using a nail as a guide based on the setting out plan. After that, the rope or line are used in order to determine the position of the first pegs which will be located at the corner of the swimming pool. Figure 3.5 show the Site Supervisor (SV) inspected the setting out work.

Besides, there was a variety method that can be used in setting out process, thus for this swimming pool, 3:4:5 method of setting out was used as it was simple and practical for a small site. This method was an application of the Pythagoras Theorem to form the right angle. A triangle shape was formed on the corner of the swimming pool based on the setting out plan, as any triangle with sides of 3, 4 and 5 units will have a 90-degree angle opposite to the 5-unit side. For this setting out work, 3 workers were involved with the supervision from the Site Supervisor.

The first step for this method was determined the building line and one corner of the swimming pool was established by using a plumb bob and then driving a peg at that point with the nail on the top. Next, the 3-feet distance was measured using measuring tape from the first peg along the building line and a second peg was established at the point where 3-feet marks end. Thirdly, the ring of the tape on the second peg with the 12-feet mark was held over by one worker and the 3-feet mark was held by another worker over the corner peg (first peg), then the tape was stretched out and wide to get the position of the third peg at the 7-feet mark.

The method above was repeated on all four corners of the swimming pool in order to get the 90-degree angle for each corner. Then, wooden peg and string lines was used to mark out the line from corner to corner of the pool on the ground that functions as the perimeter and actual dimension of above ground level swimming pool for setting out process before the excavation works begin.

Figure 3.4: workers installed profile boards

Figure 3.5: Inspection by Site Supervisor for setting out work

3.2.2 Excavate The Soil

Before the excavation work began, it was important to make sure that the setting out process early was done properly according to the plan. This process will be determined the shape of the swimming pool to be built on the ground. For this project, the shape of the proposed swimming pool was a rectangular shape with the dimension of 6690 mm x 3670 mm. Thus, from the setting out work early, the perimeter and layout of the above-ground level swimming pool have been marked by using the wooden peg and string lines as a physical layout. Physical layouts serve as a guide for the excavation crew to follow and will develop a better sense of the pool's position at the backyard.

Besides, before any excavation work started, the layout and perimeter of this pool has been double-checked according to the proposed setting out plan to make sure that there was no error because once the excavation process begins, it will be difficult and costly to make any changes. Then, the work of excavating the soil was done using a backhoe to remove the soil within the perimeter of the swimming pool layout. During the excavation, the soil was excavated within 2 feet of depth from the ground level and the excavated soil from the swimming pool site was moved out using a lorry to the other site as the soil can be reused for other purposes. The dimensions of excavating the soil were accurately based on the perimeter and the design plan to make sure that the swimming pool will be correct in dimension and position. Figure 3.6 shows the excavation work is done by using a backhoe.

Figure 3.6: Excavation work was done using backhoe

3.2.3 Construction of Swimming Pool Base

After the excavation work was completed, the construction of the swimming pool base was done. The swimming pool base is one of the most important phases that affect the swimming pool's lifespan. The excavation is carried out in such a way that the bottom face of the excavation becomes flat and homogeneous. However, the soil at the construction site, on the other hand, maybe quite loose, indicating a considerable elastic settlement. Thus, the soil compaction work was the first step to make sure that the soil can sustain the desired structural load. On top of that, this work can improve the soil strength, and decrease any future settlement to the swimming pool floor or structure.

Soil compaction is the process of applying external energy to a loose soil in order to compact it and remove air voids in the soil mass, and therefore enhancing the mass density of soil (Desai, J., 2020). The compaction of soil can be done by applying the dynamic force on top of existing soil or on the filling material like aggregates. Dynamic forces can raise the density of soil as it used movement in the form of vibrations or falling weight with the machine’s static load. In this project, the swimming pool base or soil was compacted using vibrating rammer with respect to the terrain. Once the pool base was compacted correctly, the small layer of Plain Cement Concrete (PCC) was poured on top of the compacted soil. The concrete layer with a thickness of 5 cm was formed to create a perfectly flat and level base for the swimming pool base thus can avoid any direct contact of the soil and moisture with the reinforced concrete that will be construct during the next stage of construction.

3.2.4 Installation of Reinforcement, Formwork, and Plumbing

After the completion of excavation work of the soil and preparation of the base for the above-ground level swimming pool, the next step was the installation of reinforcement, formwork, and plumbing. For this project, the installation of reinforcement consists of two-part which were on the slab of the swimming pool and on the eight rectangular shape columns with the size of 230mm x 120mm for each column located around the pool which act as a support to the tempered glass and functions as the wall structure for this swimming pool.

Firstly, for the slab reinforcement of this swimming pool, the type of steel used was Welded Wire mesh, or "BRC Fabric" as shown in figure 3.7. BRC Fabric was suitable for the reinforcement of concrete slab weather for the suspended or non-suspended slab. In addition, this steel was a prefabricated steel reinforcement material that has been electronically welded into flat sheets with square or rectangular grid patterns. Apart from that, the type of BRC used for the slab of this swimming pool was BRC A10. Furthermore, for the eight rectangular shape columns for this swimming pool, the type of steel was Y10 steel bar as the main reinforcement and R6 steel bar as a link for the column reinforcement.

For the installation of reinforcement on this swimming pool, the BRC A10 was laying on the swimming pool base with only one layer of reinforcement as the slab of this swimming pool was from a non-suspended slab type. Then, for the column, steel cage reinforcement was cast by the worker at the bar bending table. Based on the structural plan, four pieces of Y10 steel bar held vertically with the spacing between Y10 steel bar was 170 mm center to center for the length of the column and for the width, the spacing was 60 mm center to center. After that, the Y10 steel bar was held by the R6 steel bar as a link with spacing 120 mm center to center as shown in figure 3.8. Then, the column reinforcement was held in place and tied together with the slab reinforcement using galvanized iron wire to prevent movement of the reinforcement.

After that, the formwork was cast using the plywood and wood size of 1" x 2" based on the size of the column which was then placed into each column of the swimming pool. The support was installed to the formwork to retain the wet concrete and resist the initial hydrostatic pressure caused by the wet concrete. For

the pool slab, the formwork was placed on the side of the pool that acts as a mould for the slab before pouring the concrete. Before the installation of formwork, shuttering oil was applied to the inner surface of formwork. The function of this oil was to prevent the formwork from sticking to the concrete. Furthermore, it was important that before the concrete was placed into reinforcement, the mud, oil, or other non-metallic coating was free from the reinforcement to make sure that the bond between reinforcement and concrete was not decreased as whenever this happens, it can give an impact on the strength of the structure after the completion.

Next, after providing steel reinforcement, the plumbing work was done. The pipe was installed underneath the reinforcement. Grey PVC pipe was used as it was very durable and for the connection pipe, PVC ball valve was installed together with PVC pipe that function to control the flow of the water either water from the pool or from the fresh water into the pool. Besides, this swimming pool was complete with the filter system and pump that was arranged together in one station which was located in the pump room near the swimming pool. Plumb lines and the hole for the water inlet and outlet were made and installed before the concrete is poured. This pipe was used to move the water from the pool to the filter system and back to the pool through the water outlet. Furthermore, in order to provide fresh water to the pool, the filter system and pump were also connected to the municipal water line. The arrangement is required to restore pool water lost due to splash out or evaporation. The pipes were capped to prevent any materials from entering them during the next stage of construction. Figure 3.11 show the hole inlet while figure 3.12 shows the hole outlet for this swimming pool.

Figure 3.7: BRC A10 for the reinforcement of swimming pool slab

Figure 3.8: Casting of the column reinforcement

Figure 3.9: Connection of PVC pipe with PVC ball valve in pump room

Figure 3.10: freshwater pipelines to the pool

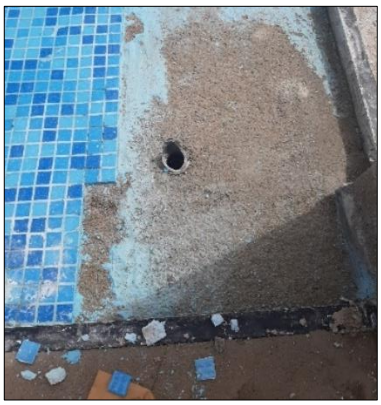

Figure 3.11: Hole inlet

Figure 3.12: Hole outlet installed with floor trap

3.2.5 Concrete Work

Concrete work was done after the installation of reinforcement, formwork, and plumbing into the swimming pool and ready to place the wet concrete on it. Concrete is a composite material made up of sand, aggregate and a cement paste that hardens over time. For this project, concrete grade G30 was used. The ready-mix concrete was used to make the construction process easy and to ensure the quality of concrete used for this swimming pool. Before the placement work was done, slump test was applied to measures the consistency of fresh concrete before it set.

For the placement of the fresh concrete, the fresh concrete was poured into the formwork of the slab and column using concrete bucket. The mobile crane was used to lift the concrete bucket from the concrete mixer truck to the work area. Square shovel was used to spread the wet concrete on the slab. Furthermore, in order to remove the air void from the fresh concrete and prevent the formation of honeycomb, concrete vibrator machine was push into the wet concrete slowly and evenly to all concrete area. After the placement process done, the screed board was used to screed and level the top of the concrete for the slab. This process was required as it help to compact and smoothing the concrete. Figure 3.13 shows the complete process of screeding work on the wet concrete of the swimming pool slab. Then, the curing process was done after that where the concrete was rest and begin to harden. The formwork for column was opened 3 days after the concreting work for column done. Then, light spray of water was applied to the swimming pool slab and column for 5 days. Curing process was very important to the fresh concrete to avoid any cracking and help to retain the moisture in the concrete. Figure 3.14 shows the complete process of concrete work.

Figure 3.13: screeding work on concrete of swimming pool slab done

Figure 3.14: Completed process of concrete work

Source: AMS Maju Bina Sdn Bhd (2021)

3.2.6 Waterproofing

The waterproofing of the above ground level swimming pool was applied after the curing process of concrete are done. For this project, the waterproofing types that was used was Maxiseal 99 with the 2 component of polymer modified waterproofing slurry which was component A (Liquid) and Component B (powder) as shown in figure 3.15. The method of waterproofing used was the non-exposed systems which was concealed from exposure after finished of application. Waterproofing was done to the slab and column of this swimming pool to make it watertight and prevent water infiltration.

Before the waterproofing work started, the concrete surface was clean and free from grease, oil and loosely adhering particles to make sure that the waterproofing slurry stick and bond to the swimming pool concrete surface. Then, the component A (liquid) was slowly mixed with the component B (powder) in clean container as shown in figure 3.16 until the waterproofing slurry was formed. For this swimming pool, 3 coats of Maxiseal 99 applied on concrete surface of slab and column using the brush technique. For the application, the first coat of Maxiseal 99 was applied using hard plastic bristle brush. The slurry was rub well throughout the surface and then leave to harden for 6 to 8 hours before applying the second and third coat. For the floor of this swimming pool, there was a drop of 5 inch from the ground level after the concrete work. On top of that, the drop also needs to waterproof with the 45 degrees in the corners to ensure that the water will not penetrate throughout the corner of the pool. After the waterproofing work done, test was done into the slab to identify weather there was any leaks founds on the slab of this swimming pool. The water was fill into the slab that have 5 inch deep and the heigh of water loss was recorded to conclude the test.

Figure 3.15: Component A and B of Maxiseal 99

Figure 3.16: Mixing the Component A and B

Figure 3.17: Applying waterproof to swimming pool slab

3.2.7 Rendering Work

Rendering work which was done to the swimming pool slab after waterproofing work. Before the finishes work which was the installation of mosaic tile on the floor surface of this swimming pool, rendering work for swimming pool floor was firstly done. The purpose of the rendering work was to give the additional support and create the flat and even surface on the swimming pool slab in order to ensure that the tiles will be installed properly. Besides, the rendering work will provide some grip to the mosaic tiles.

Apart from that, the material used for rendering the floor of the pool was cement that mixed with the sand and water. First, the surface was clean from dust and sand to ensure the cement render bond perfectly with the floor surface. Then, cement and sand mixed together using flat shovel which water was added slowly to form the semi-dry cementitious types of screeds. This mixture was spread and level to the entire floor surface of this swimming pool using screed board with the thickness of 5 cm as shown in figure 3.18.

Figure 3.18: Rendering work on the swimming pool floor

3.2.8 Aluminium Frame Installation

The installation of aluminium frame was done after the rendering process of the swimming pool slab completed. The aluminium frame function as a place for fixing the tempered glass and act as a support for them. Besides, this aluminium frame used “Three-side support” types which also known as U-shaped aluminium channel. The U-shaped aluminium channel was attached to the three side of the swimming pool between the two side of the column and the pool floor leaving the top edge of the tempered glass exposed. Aluminium frame was suitable to be used for this swimming pool as the aluminium has the corrosion and rust resistance features.

For the installation of aluminium frame, firstly, hand drill was used to pilot the hole into the side of the concrete column based on the length of the wall plug. Then, the wall plug was inserted to the hole before attached the aluminium frame to the column using screw. Figure 3.19 shows the complete installation of aluminium frame. After that, the black tape was installed to each aluminium frame as a protective layer before starting the plastering work to the concrete column for this swimming pool. The plastering of concrete column was done using the mixture of cement, fine sand, and water. The plastering trowel was used for spreading the plaster as well as create the smooth finish to the column. The purpose of the plastering work was to close the small gap situated between aluminium frame and concrete column. Furthermore, this work can prevent the water from seeps through the gap. Figure 3.20 shows the complete process of plastering work to the swimming pool column.

Figure 3.19: Installation of U-shaped aluminium channel

Figure 3.20: plastering work for column completed

3.2.9 Finishes

For this swimming pool, the finishes used on the slab of the swimming pool was mosaic tile. This mosaic tile was form by the combination of the smaller ceramic tiles with the size of 2” x 2” each that was glued on the paper sheet with the size 1 feet x 1 feet which known as paper-faced mosaic tiles. In this project, two skilled workers required for the installation of the mosaic tile. Figure 3.21 shows the paper-faced mosaic tile.

Apart from that, before the installation of the mosaic tile to the swimming pool slab was started, the rendering work on the slab was done to ensure the surface was perfectly flat and smooth. The tile layout as shown in figure 3.22 was planned by using the string lines to find the intersecting, perpendicular lines on the pool surface based on the mosaic tile size to enable a perfect square grout. Next, a layer of thin-set adhesive was applied at the center of the layout line cross using a notched trowel. The first mosaic tile sheet was applied into the corner of first quadrant which then was arranged and adjusted based on the tile layout to ensure that the grout spaces remain uniform. Figure 3.23 shows the installation of a mosaic tile sheet on the adhesive layer.

The next step was set the mosaic tiles. A small piece of plywood was pressed gently on the mosaic tile sheet until the surface became smooth and flat with another. On this stage, after adhesive of the mosaic tile was fully cure, the wet sponge was rub to the paper sheet on top of mosaic tiles to ensure the paper absorbed the water before the paper-face can peel away from the mosaic tile. For the small area like water outlet, the individual mosaic tile was trim to match the size that required. This step of installing the mosaic tile was repeated to the entire surface of this swimming pool slab. Then, after the mosaic tiles was harden, the grout was applied into the joint spaces between mosaic tiles using rubber grout float with the 45-degree angle position. After the grout slightly harden as shown in figure 3.24, the mosaic tiles surface was cleaned using the sponge to remove any excess grout. Figure 3.25 shows the complete process of installing mosaic tile to the swimming pool slab.

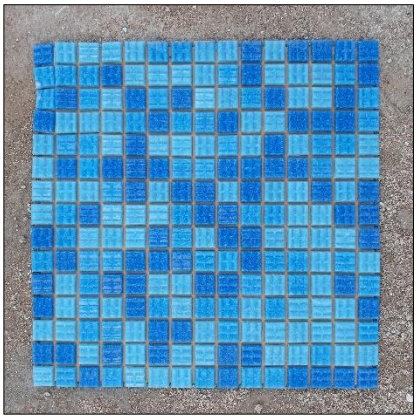

Figure 3.21: paper-faced mosaic tile used for swimming pool

Figure 3.22: set the tile layout for the first quadrant

Figure 3.23: installation of a mosaic tile sheet on the adhesive layer

Figure 3.24: Grouting on the mosaic tile completed

Figure 3.25: mosaic tiles installation complete

3.2.10 Tempered Glass Installation

For this swimming pool, clear tempered glass with the thickness of 12 mm was used and installed as a pool wall. The shape and dimension of this tempered glass was based on the size of the aluminium frame that attached from the side of column to another column. Apart from that, before the process of order the tempered glass from glass supplier, all of the detail dimension and types of top edges of tempered glass which used the radius edges will be stated in the order form. On this process, the supplier will cut and shape the tempered glass and the process take about 2 weeks.

For the installation of the tempered glass, two workers from AMS Aluminium and Glass Department were responsible. Before the installation of tempered glass was done, each column of this swimming pool was paint with white colour as shown in figure 3.26. The types of paint used was from Jotun Jotashield Colur Extreme as this type of paint have anti-algae & anti-fungal and water-resistant feature thus made it suitable to be used for this swimming pool. After that, the black tape on the aluminium frame which act as a protective layer during the plastering and painting work was removed using utility knife. Then, the surface of the u-shaped aluminium channel was cleaned from the dust and sand before placing the rubber block in each end at the bottom of aluminium frame. The rubber block will function as a cushion and also to centre the glass. Next, the 12 mm clear tempered glass was lifted and placed into the aluminium frame using glass suction plate. The tempered glass was slide carefully through the aluminium frame from top to the bottom, resting on top of the rubber blocks. After fixing the tempered glass properly into the frame, clear silicone sealant was installed on the gap between the tempered glass and aluminium frame using silicone sealant caulking gun as shown in figure 3.27. The types of silicone used in this project was x'traseal SA-117 (RTV Acetic Silicone Sealant). Figure 3.28 shows the detail of the tempered glass installation.

Figure 3.26: column painted with white colour

Figure 3.27: silicone sealant caulking gun

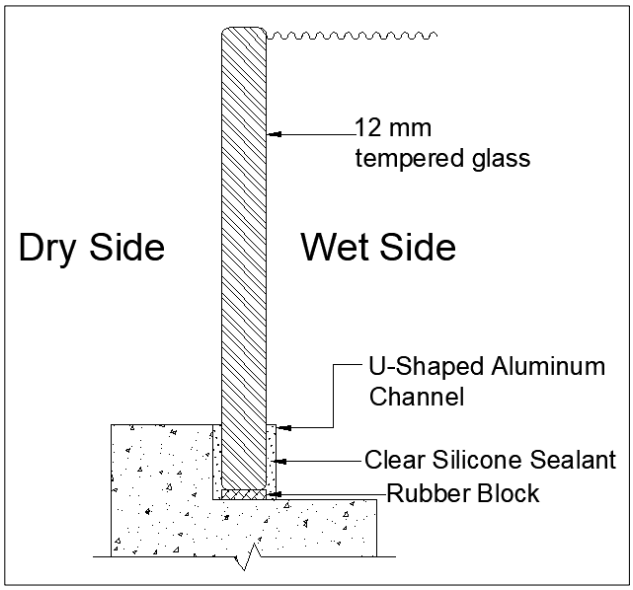

Figure 3.28: the detail of the tempered glass installation

Source: AMS Maju Bina Sdn Bhd (2019)

3.2.11 Pump and Filter Installation

Pump and filter system was very important and essential part for the swimming pool. Swimming pool pump can be referred as the heart of the pool system. For this swimming pool, the operation of pump and filter system was started from the swimming pool where the pool's water was pump to the pump room and back to the swimming pool. Pump was used to suck the water and create the flow of water from the pool hole outlet in the bottom of swimming pool to the filter. The pump was connected to the filter's intake valve to flow the pool's water through the filter. After that, the filter will transfer the filtered water back to the swimming pool's hole inlet through the output valve. This circulation process was necessary for the pool water so that the water was effectively sanitize and clean all the time.

In this project, the type of filter used for the above ground level swimming pool was sand filter. Sand filter was a traditional type of filter as it used sand usually sand silica to filter the particle as small as 20-microns that contain in pool water. Beside the intake and output valve on the sand filter, this filter also has the third valve for backwashing which was connected to the wastewater line. For the installation, the pump and filter were installed together in a small room namely as pump room that was built 5-meter away from the swimming pool. In the pump room, all of the swimming pool's water line was connected to pump and filter. Besides, the pump room also complete with the electrical socket in order to run the pump.

Figure 3.29: pump used for above ground level swimming pool

Figure 3.30 sand filter

3.2.12 Testing and Commissioning

After the installation of every element of the above ground level swimming pool completed, the process of testing and commissioning were done. This process was to ensure that all the system and components was operated properly based on the requirement. Apart from that, this swimming pool was fill with fresh water and the pump and filter system was test before it was ready to be used by the client of this project. Furthermore, the chlorine as shown in figure 3.31 was added into this swimming pool water to kill germs which can cause disease. Then, pH level was checked using pH chlorine water quality test as shown in figure 3.32.

Figure 3.31: Chlorine used for swimming pool

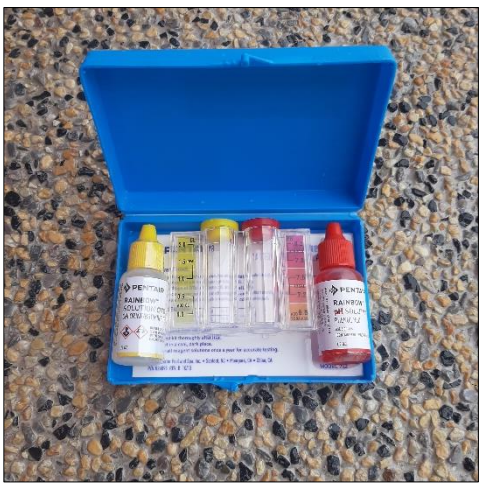

Figure 3.32: pH chlorine water quality test

3.3 Problems Occurred During the Construction and Solutions to the Problems

For the construction of above ground level swimming pool, there were some problems occurred. The problems occurred was due to some factor that came from the unproper of handling and installation technique. Furthermore, for this swimming pool, the most obvious problem came from the finishes work during the installation of mosaic tile was done. However, every problem that came along during the construction work has their solutions. Apart from that, the list of problem was stated below:

3.3.1 Construction Material Get Damage

In the construction of this swimming pool, the construction material that commonly get damaged was the mosaic tile and the tile adhesive. In this project, some of the paper-faced mosaic tile that came in box package was get damaged before it can be used to be installed on the swimming pool slab. Same goes to the tile adhesive where it became harden due to the moisture and rain as shown in figure 3.33. This happens due to the mishandling of the package. Besides, this material was not properly stored in dry place and not protected from the rain and moisture. As a result, the paper sheet on mosaic tile that function to hold the small pieces of mosaic tiles started to peel off thus made them not practical to be used for the installation work. Figure 3.34 shows the damaged of paper-faced mosaic tile. Moreover, this problem has increased the cost of the construction due to the wastage of the mosaic tile. The solution for this problem was by properly stored the mosaic tile and tile adhesive in a dry and enclosed structure. The waterproof sheets like Polythene Sheet can be used to cover this material from rain and moisture. Furthermore, it was recommended to order at least 15% extra of mosaic tiles as this tile has a lot of wastage during the installation and to ensure the project run smoothly.

Figure 3.33: Tile adhesive harden

Figure 3.34: damaged of paper-face mosaic tile

3.3.2 Mosaic Tiles Start Falling Off

The next problem occurred during the construction work of above ground level swimming pool was the mosaic tiles start falling off. This problem occurred to a certain part on the installed mosaic tile. This happens due to the unproper installation technique by the worker. The unproper installation technique was one of the caused to this problem. The mosaic tile was not set properly at certain part as the plywood was not pressed evenly to all surfaces of the mosaic tile. After the adhesive started to harden, the bond between the mosaic tile and the adhesive became weak which made them easy to fall off on certain part. Thus, the solution for this problem was to install again the new mosaic tile to the damaged part with proper technique. Site Supervisor play the important role to supervise the work during the installation of mosaic tile to ensure that the worker follow the right technique and avoid any further damage on the mosaic tile. Figure 3.35 shows the certain part of installed mosaic tile start falling off.

Figure 3.35: Certain part of installed mosaic tile start falling off

CHAPTER 4

CONCLUSION

4.1 Conclusion

In conclusion, this report was explained the construction of above ground level swimming pool. From this report, the two objectives have been appointed to be discuss and from the objective one, the detail of each construction method has been explained started from setting out, excavate the soil, construction of swimming pool base, installation of reinforcement, formwork, and plumbing, concrete work, waterproofing, rendering work, aluminium frame installation, finishes, tempered glass installation, pump, and filter installation and finally on the testing and commissioning. Besides, the problems that occurred during the construction and solutions to the problems also been explained represented the second objective. For the construction of this swimming pool, the method used was a bit similar with the construction of in ground pool. However, the difference between them was on the construction of the pool wall for the above ground level swimming pool as it need to be done properly to avoid any leaks between the tempered glass and the side of column. Every problem that came through during the construction of this swimming pool was successfully solved by the discussion and proper planning by the project manager, site supervisor and workers. Thus, throughout this report, it can be seen clearly on how to construct the above ground level swimming pool.

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