DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

THE CONSTRUCTION FOR ISMAIL PETRA MOSQUE EXTENDED BUILDING

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It is recommended that the report of this practical training provided

By

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THE CONSTRUCTION FOR ISMAIL PETRA MOSQUE EXTENDED BUILDING

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

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Public Work Department (PWD) Tanah Merah for duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. 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

The construction of superstructure is the most essential part for every construction in which to able the load to be transmitted to substructure. There are many types of structural concept in superstructure, however, the aim of this report is to discover the cast in-situ skeletal structure of superstructure at Ismail Petra Mosque, Tanah Merah, Kelantan. All the data was collected through observation during site visit, document reviews and interview. The construction of cast in-situ superstructure need to be done by skilled workers to ensure every element in the construction being immaculately constructed with the guide from structural and architect design provided by the consultant. Furthermore, all the parties involved had diligently planned on how to spend the fund gained from the public donation in order to assure the new addition three-storey being constructed successfully. The construction of additional three-storey for Ismail Petra Mosque benefit the Muslim society as the main purpose of the construction is to provide extra and multiple for many Islamic activities.

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CHAPTER 1: INTRODUCTION

According to Basic Components of a Building's Superstructure (2019), the superstructure is the parts in the building structure built on the ground level after the construction of substructure. It serves the purpose of structure's intended use. It also transfer lateral loading on exterior surfaces of building directly to the substructure which is foundation that further the load distribution to the underlying earth (Chudley, 2014). Other than that, superstructure also provide rigidity and limit deflection on building (Taranath, 2010). It also provide armature for the suspension and support of secondary structure and other building systems such as the exterior envelope, mechanical systems, interior partitions etc. The surfaces which form the envelope, that is the walls, the floors and the roof of the building, are subjected to various types of loading: external surfaces are exposed to the climatic loads of snow, wind and rain; floors are subjected to the gravitational loads of the occupants and their effects; and most of the surfaces also have to carry their own weight (Macdonald and Angus, 2001).

In addition, the superstructure consists of three basic structural concept which are skeletal structure, solid structure and surface structure. In skeleton framing all the gravity loadings of the structure, including the walls are supported by the steel or concrete framework (Chudley, 2014). Such walls are termed non-bearing or curtain walls (Deceased & Ricketts, 1995). Meanwhile, solid structure is a load bearing wall which a wall of a building, interior or exterior is used to support ends of main structural elements carrying roof or floor loads. The walls must be strong enough to carry the reaction from the supported members and thick enough to ensure stability against any horizontal forces that may be imposed (Deceased & Ricketts, 1995).

However, this solid structure is only for low-rise buildings because the load bearing wall cannot handle large loads. Internal walls which form permanent partitions are normally covered with lathing or other material capable of holding plaster and the plaster applied and smoothed to give a finished surface to the wall (Chudley, 2014). Then, the surface structure is a thin plates of material or flexible sheet membranes stretched over supporting members (US2986150A 1958). Simply lending curvature to a surface does not derive any structural capacity automatically; instead, shell shapes need to be carefully designed according to well-established structural principles. Shells either follow certain simple geometric shapes such as sphere segments, hyperbolic paraboloids or hyperboloids, or their shapes need to be based on equilibrium figures (Bechthold, 2011). There are the examples of common superstructure elements which are beam, slab, column, lift shaft, wall, parapet and roof.

Furthermore, the superstructure have three types of framed structure which are in-situ reinforced concrete, precast concrete and steel. In-situ reinforced concrete is the work cast on site which is can be cast into any shape or size according to the structural drawing. The reinforcement is required to take tension and it also requires formwork (Hanna, 1999). Next, the precast concrete is the structural components are cast in factory or off site and it was transported to site. It also requires proper connections when to install into their final position. Form costs may be greatly reduced, because reusable forms can be located on a casting-plant floor or on the ground at a construction site in protected locations and convenient positions, where workmen can move about freely (Deceased & Ricketts, 1995). However, the making of component in factory or off site will be costly because requires delivery to the site. Moreover, the steel framed structure sometimes encased in concrete. The jointing will be use bolt or by welding. It was a simple in construction procedure and fast in construction speed but it will be costly. Lastly, there are many types of structural concept in superstructure, however, the aim of this is to discover the cast in-situ skeletal structure of superstructure at Ismail Petra Mosque, Tanah Merah, Kelantan.

1.1 Objectives

The objective of this study are:

1. to identify the parties involved and their responsibilities in the construction of Ismail Petra Mosque, Tanah Merah, Kelantan.
2. to investigate the construction methods of cast in-situ superstructure.
3. to determine the problems occurred during the super structure construction and solutions to the problems.

1.2 Scope of study

This study focuses on the construction of cast in-situ superstructure of the Ismail Petra Mosque, Tanah Merah, Kelantan. As the project is a public funded project, it is important to identify the parties involve and the scope of work for the mosque. Each part of the building is erected by different party/ company including the superstructure. All problems identified are only related to works of superstructure. Other problems and elements such as planning, workers and plants are not within the scope of this study.

1.3 Research methods

Research methods are important because it was the strategies, procedures or techniques used to gather data or proof for evaluation to collect an information or generate a stronger knowledge of a subject. The research method adopted for this study are:-

1. Observation.

   The construction methods of superstructure was observed on site, two times a week for three months. In addition to that, site visits were carried out when there were specific jobs, for example concreting work. The observation includes every single works carried out by the general worker and operator. All the data from observation were recorded by writing on observation diary. Other than that, the pictures and video were taken using the F1s Oppo smartphone. This is because by having a pictures and video it will make easier to recall especially when it come for construction method. The observation normally took an hour and thirty minutes.

2. Interview.

   The unstructured interviews have been done on-site visits. Usually, unstructured questions will be pointed to the workers at the construction site, especially during installations that require high expertise. For example, the installation of reinforcement bars. Unstructured interviews also will be conducted by the site supervisor regarding the structure found at the construction site and have been compared with structural drawings. By having unstructured interviews, the data will be recorded by writing short notes in a notebook. After that, the semi-structured also been carried out which is the question that will be prepared before asking directly to the site supervisor and the data will be recorded by Oppo F1s smartphone's audio recorder. Some of the questions asked are about the project background and construction method. It also will be conducted at the office, which will take 30minutes. The semi-structured interview will be done from time to time.

3. Documents reviews.

The type of documents that have been referred to is architecture drawing and structural drawing. Another document is the company profile that was used to describe the company background. The progress report has been referred include progress pictures that have been captured by site supervisors using a camera from a Samsung J7 smartphone. This is because to find out the missing progress. A document review will be done in the office. All important information will be written briefly into a notebook meanwhile documents with diagrams such as architecture plan and structural plan will be captured by using Oppo F1s smartphone's camera. It is intended for future use when the document is not available.

CHAPTER 2: COMPANY BACKGROUND

Public Work Department (PWD) Kelantan was established in 1938 that function as provide the state infrastructure. The establishment of PWD Tanah Merah has a two phase. Before it become a full colony of PWD, it was placed under PWD Kelantan Barat which consists of Pasir Mas, Tumpat and Tanah Merah. At that time, the first engineer for PWD Kelantan Barat is H.R Frost. In 1978, PWD Tanah Merah become a full colony of PWD. It was governed by a colonial engineer and being support by colonial engineer assistant. Furthermore, PWD Tanah Merah also take a responsible to monitor and conduct all the project in Jeli district before PWD Jeli being establish in 1st January 1996. The first Colonial Engineer is Yong Yun Fui. Today, the operational area is in Jabatan Kerja Raya, Pejabat Jaurutera Jajahan, 17500 Tanah Merah, Kelantan. Company status is Government Company.

The Public Work Department's vision is Become a World-Class Service Provider and Centre of Excellence in the areas of Asset Management, Project Management and Engineering for National Infrastructure Development Experienced in Creative and Innovative Human Capital as well as Latest Technology. That means, PWD will make their company equivalent to an international company. Besides, Public Work Department's mission are to assist our customers realizing policy objectives and deliver services through partnership cooperation strategy, standardisation of processes and our system to provide consistent outcomes, to provide asset management services and an effective and innovative project, strengthening of existing engineering competence, to develop human capital and new competencies, the promotion of integrity in service, a harmonious relationship with society and preserving the environment in service delivery. Thus, Public Work Department has an objective that make them become customer friendly and it will be attraction to the other contractor for cooperate in implement the project. The objective is submit the project in a good quality, time and costs that have being approved.

Lastly, in PWD Tanah Merah, the project that was handled is more to Quotation project which is total cost not more than RM 500,000.00 which is suitable for contractor grade one (1) and grade two (2) and the duration for completing the project only in a few weeks. However, there are also tender project. Usually, this project will be delivered to headquarters to get approval from the Director of Public Work Department. This is because the Colonial Engineer in PWD Tanah Merah does not qualified to approve the tender.

2.1 Completed Projects

Public Work Department Tanah Merah has monitored many government projects that have been completed under main contractors as shown in Table 1.

Table 1: Completed projects

Project's Name	Contractor's Grade	Price (RM)	Duration	Started	Finished
Recommendations of re-building and upgrade daif school using the industrialised building system (IBS in the Penisular Malaysia (phase1) year 2018 for the state of Kelantan: package 1 (Pasir Mas/Tanah Merah)	Grade 7	64,460,000.00	13 weeks	7/3/2018	6/6/2018
Renovating and upgrading office buildings and related work in the Tanah Merah District's Information Office,Tanah Merah, Kelantan.	Grade 2	385,250.00	20 weeks	1/8/2018	16/12/2018
Work to construct and complete pedestrian crossing and related works at section 20.0 (SMK (u), on the Tanah Merah- Pasir Mas road (route ft1229) of Tanah Merah, Kelantan.	Grade 2	232,000.00	6 weeks	5/8/2018	16/8/2018
Works on maintenance of the Tabika Kemas Bestari and related work at the Gual Ipoh Tanah Merah, Kelantan	Grade 1	52,880.00	8 weeks	20/9/2018	18/11/2018

2.2 Ongoing Projects

Public Work Department Tanah Merah has monitoring ongoing government projects under main contractors as shown in Table 2.

Table 2: Ongoing project

Project's Name	Contractor's Grade	Price (RM)	Duration	Started	Estimated to finish
Proposed work to build and repair additional three (3) storey mosque, roof repairs and related works in the Ismail Petra Mosque, Tanah Merah, Kelantan.	Grade 7	1,301,000.00	48 weeks	15/3/2019	15/3/2020
Work to build and complete one (1) unit of MSB and compact sub building and related works at Ismail Petra Mosque, Tanah Merah, Kelantan.	Grade 2	100,000.00	17 weeks	16/6/2019	8/10/2019
Malaysia Immigration Department building (JIM) state repair work through private financing initiative II A (PFA II A) year 2018 immigration depot (PATI) Manal, Tanah Merah, Kelantan.	Grade 1	115,007.50	12 weeks	31/7/2019	16/10/2019

2.3 Organisation Charts

In order to carry out the mission, vision and objective, every company shall form a formal structure of hierarchy. At PWD Tanah Merah, there are three departments which are Building Department, Road Department and Administration Department. The Colonial Engineer's name is Sir Azlan Bin Agus. He is responsible in managing staff administration, in terms of the Service Scheme, benefits in and after the service as well as discipline. Besides, he will plan and carry out road maintenance works, bridges, masonry and all road furniture under the jurisdiction of the Department (State and Federal). Then, he also will take a responsible in planning and implementing maintenance works of government buildings (State and Federal). Lastly, he implements and monitors the implementation of road and building development projects. In figure 1 below, it shown a general organisation chart for Public Work Department Tanah Merah.

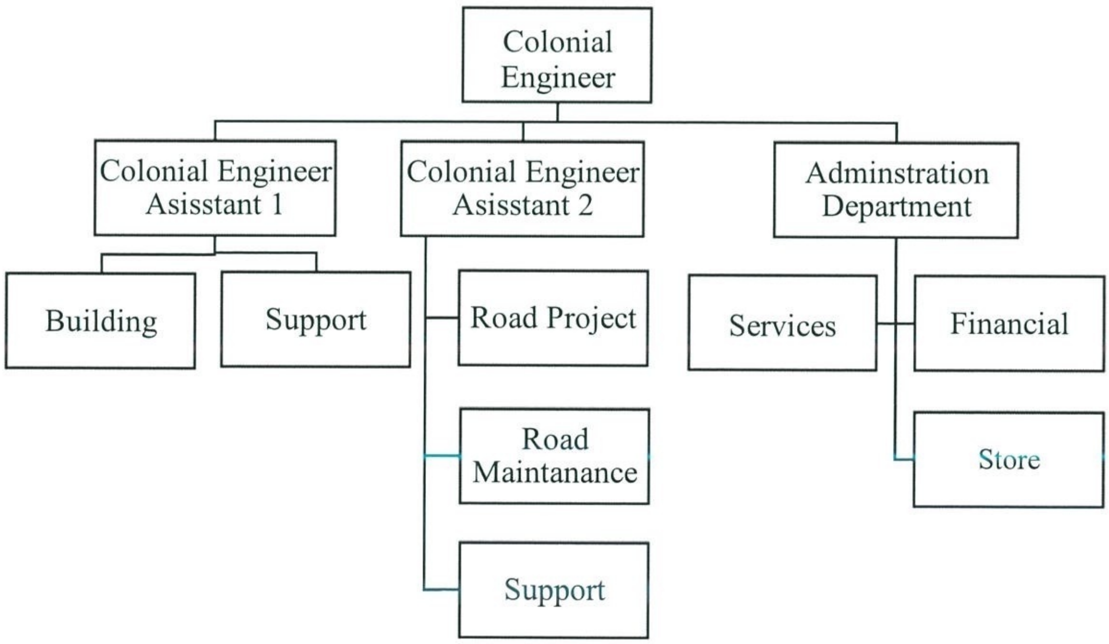


Figure 1: Public Work Department in Tanah Merah organisation chart

Organisation Chart for Building Department

Building Department is responsible to carry out the duties of the Administration Contract to educational projects, general building, and state and federal government security. They also responsible to maintain state and federal buildings, plan and supervise the work of the state and federal building design and appoint a contractor to execute the project through a quotation and tender. While for who are under electricity, they are responsible for maintenance and installation of electricity for customers in the government department. They also need to make sure that all material and equipment in a good condition to ensure the quality of works. In figure 2 below shown the organization chart of building department.

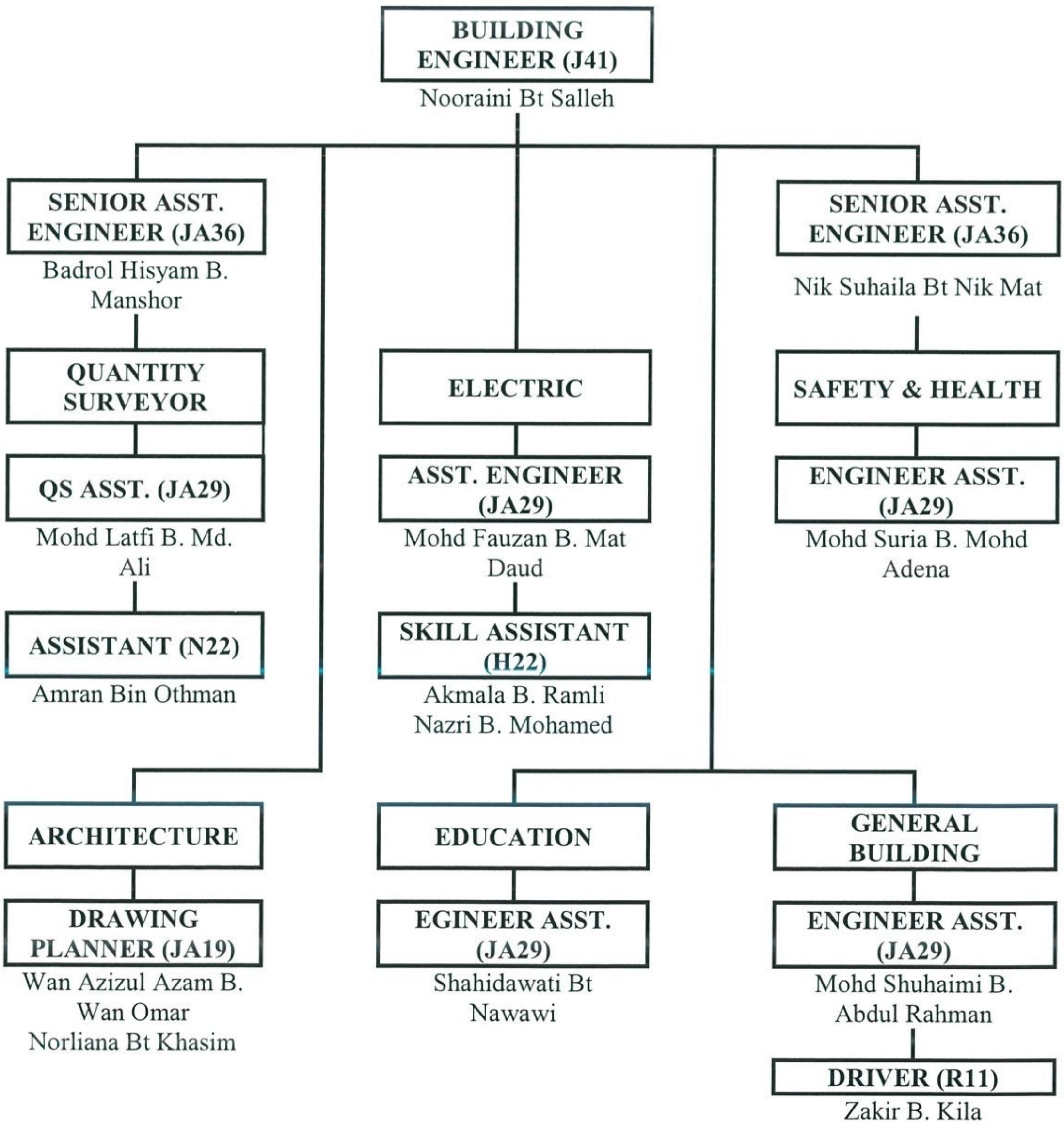


Figure 2: Department of Building organisation chart

Organisation Chart for Road Department

Then, for road department they are responsible for the road they have been assigned to them. They need either to maintain the road, widening or make sure that the road have followed the specification that have being set. They also responsible to construct drainage to make sure the flow of water will not damage the road. The figure 3 below shown the organization chart for road department.

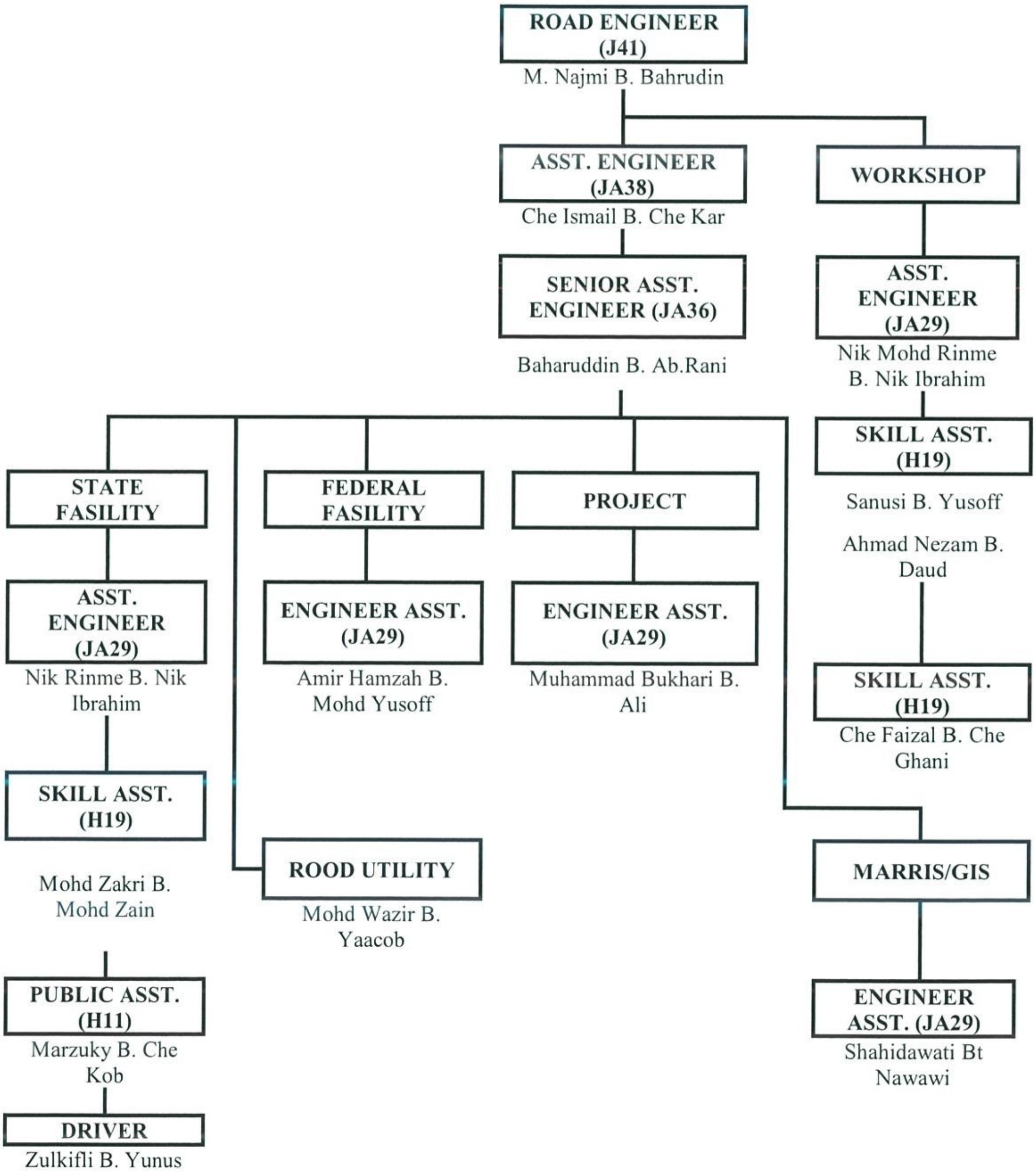


Figure 3: Department of Road organisation chart

Organisation Chart for Administration Department

For the administration department, it has a responsible to manage all the works that relate to administration such as administration staffs and finances. For administration staffs they need to manage the staffs' salary, their holiday, their attitude and also about correspondence. For finances they need to handle all the things that related to finances affair such as manage the receipt and expenditure, distribution of allocations to each division, or sign all payment vouchers of each section. The organisation chart of administration department was shown in Figure 4.

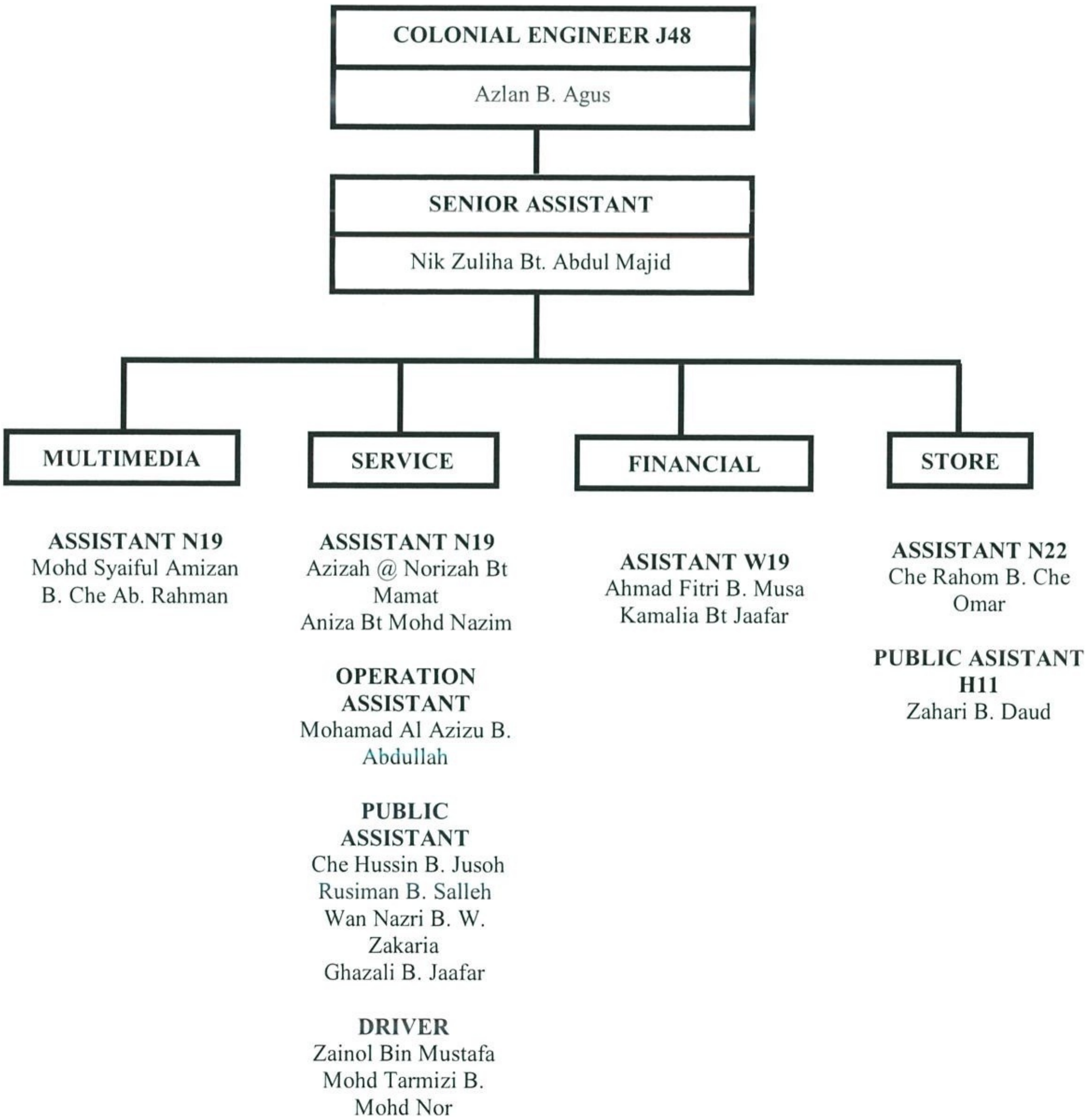


Figure 4: Department of Administration organisation chart

CHAPTER 3: CASE STUDY

The case study was a proposed construction to build an additional three (3) storey building attached to the existing Ismail Petra Mosque, Tanah Merah, Kelantan. The construction is located near the city centre point, in front of the mosque is the Tanah Merah District Police Headquarters, while at the back of the mosque is a residential area and a shop as shown in Figure 5. This construction site is near to the Tanah Merah Railway Station.

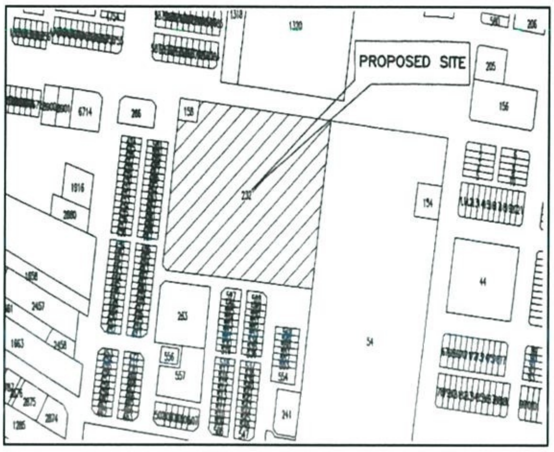


Figure 5: The location plan of Ismail Petra Mosque

The existing mosque is a single-storey building and has two sections: the first section consists of existing prayer hall area and existing office area, while the second consists of main prayer hall area, women existing prayer hall, *Bilal* & audio-visual (A/V*)* room, *Imam*'s room and existing VVIP room. The new additional 3-storey building extended from the existing main prayer room and consists of mortuary management's house, canteen, internet centre, a guest house and a compact sub. The total area of ground floor is 5,872 Square Feet. Meanwhile, the total area for first floor is 6,086 square feet and it served as a mosque office. The mosque seminar room situated on the second floor was a room with the total area of 5,512 Square Feet. The additional building consisted of lift for vertical transport purposely to help elders and disables to commute back forth from ground floor to second floor.

The overall construction of the 3-storey building is funded by the public and thus, it has no client. As the money to construct the new building is mainly depending on the public fund, the construction needed to be divided into phases as Table 3.

Table 3: The phases of construction an additional three storey Ismail Mosque

PHASE	PROJECT
1	Construction of building structure.
2	Installation of exterior and interior walls.
3	Installation of building partitions and finishes.
4	Electrical wirings and fittings.
5	Mechanical works such as water pump, air conditioning system and lift.
6	Repair of the entire roof of the mosque.

The construction of phase 1 started first as the money gathered was enough for the construction of structures. Other phases were arranged to start once phase 1 is completed and fund is sufficient for the construction works to be carried out. The total cost for phase 1 is RM 1,301,000.00. The Parliament Member of Tanah Merah had donated RM 50,000.00 for the construction of the additional 3-storey Ismail Petra Mosque (Phase 1) and the remaining balance was a fund from the public. This construction does not have client due to Ismail Petra Mosque been noted as government property in which it falls under District Officer responsibility to coordinate it.

The Public Work Department (PWD) Tanah Merah was appointed as the bureau of development and infrastructure by the District Council Tanah Merah for the overall project. The main contractor, Anggerik Sutera Construction is responsible to construct phase 1 until phase 6. Parties involved in the construction of 3-storey additional building at Ismail Petra mosque are explained in the next section.

3.1 Parties involved and their responsibilities

The construction of overall project involved many professionals from different organisations who worked to complete the Ismail Petra Mosque. Figure 6 shows the committee members who were appointed to manage the whole construction of the mosque utilising the fund collected from the public.

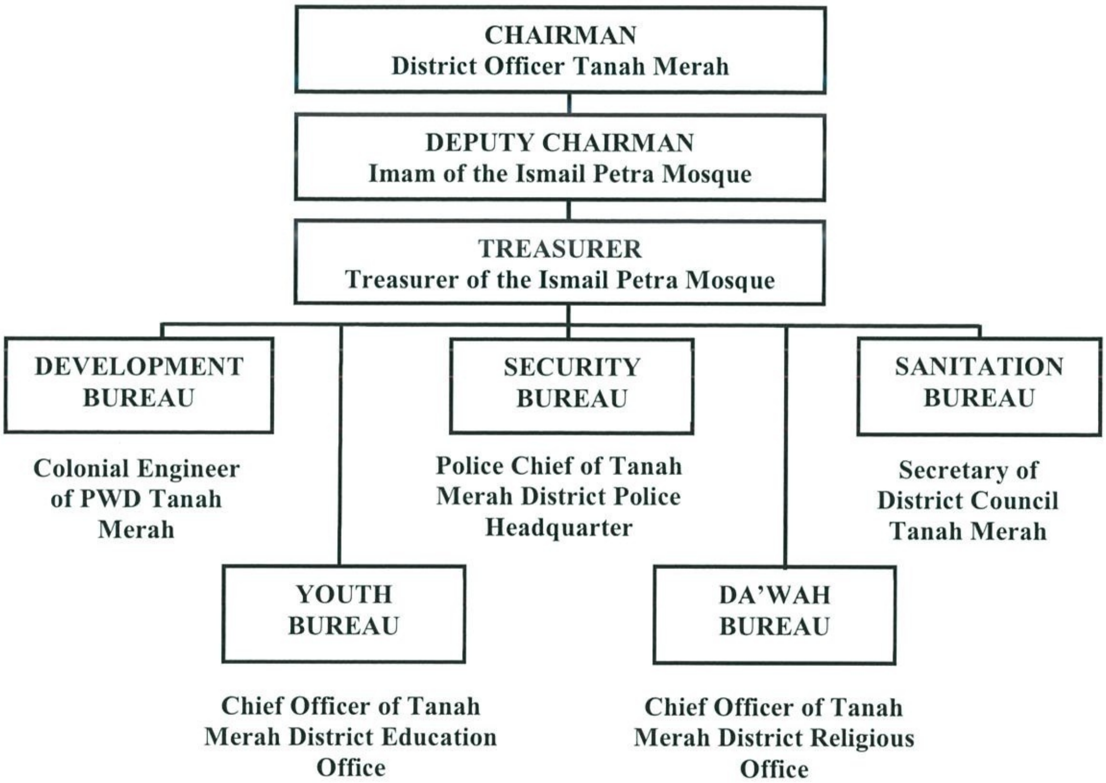


Figure 6: The organisation chart of committee members for Ismail Petra Mosque for the whole construction

At the district level there were several departments that carry out their respective development tasks such as Public Work Department (PWD) and etc. To ensure the project progress as planned, the District Officer had to coordinate all the development made in Tanah Merah district. Ismail Petra Mosque is a government property and due to this, the new additional three-storey building needed to gain the District Officer approval before being proceed. The *Imam* sent an application requesting for the additional three-storey building at Ismail Petra Mosque to the District Officer. The District Officer then approved the applications for the construction to be proceed and the mosque committee member held a meeting in order to discuss the preliminary planning of the additional three-storey building construction. The District Officer was appointed as the chairman in organisation chart of authority members for Ismail Petra Mosque in which the District Officer need to coordinate all the progress made in the construction. The responsibility of the District Officer was to approve any document related to the construction of the additional three-storey Ismail Petra Mosque. For example, the selection of contractor was selected through tenders advertised by Public Work Department (PWD) Tanah Merah. When the Colonial Engineer from PWD Tanah Merah selected the most suitable contractor among the contractors that bid the tender, the District Officer of Tanah Merah was the person who approved the appointment of the selected contractor. Apart from that, the District Officer appointed five bureaus to ensure that all relevant activities in the construction of the mosque followed the project planning. Each bureau had played their roles. The District Officer appointed PWD Tanah Merah as a development bureau, Tanah Merah district police headquarter as the security bureau, district council Tanah Merah as the sanitation bureau, Tanah Merah district education office as the youth bureau and Tanah Merah district religious office as the *da'wah* bureau as shown in Figure 6.

The *Imam* of the Ismail Petra Mosque was appointed as the Deputy Chairman for the mosque committee members in construction of the additional three-storey. He was responsible to control all activities or problems related to the mosque. For an example, the extension of road construction for flyover in front of the mosque requires the mosque's fence to be demolished. The *Imam* had to deal with the representative contractor that responsible for the flyover construction. The *Imam* has made an agreement that the contractor bear all the expenses for the construction of the new mosque fence. The treasurer was the person in charge to manage all the Ismail Petra Mosque financial matters. All the fund raised from public donation was kept in Bank Islam Malaysia Berhad account under the Ismail Petra Mosque name. All the expenses related to the additional three-storey construction had to go through the treasurer. All expenses were recorded and kept at the mosque office.

Development bureau

The development bureau was the most crucial committee member that was responsible for the construction of Ismail Petra Mosque. The colonial engineer of Tanah Merah PWD tasks were to monitor all activities during construction and he had appointed three other personnel from the PWD Tanah Merah to share the responsibilities as shown in Figure 7. The PWD Tanah Merah advertised tender in websites such as http://jkr.kelantan.gov.my/ and newspaper which is *Berita Harian*. A briefing regarding the construction of additional three-storeys for Ismail Petra Mosque to the contractors was held at PWD Tanah Merah. The Colonial Engineer was responsible to choose the most suitable contractor from the shortlisting made by the Quantity Surveyor.

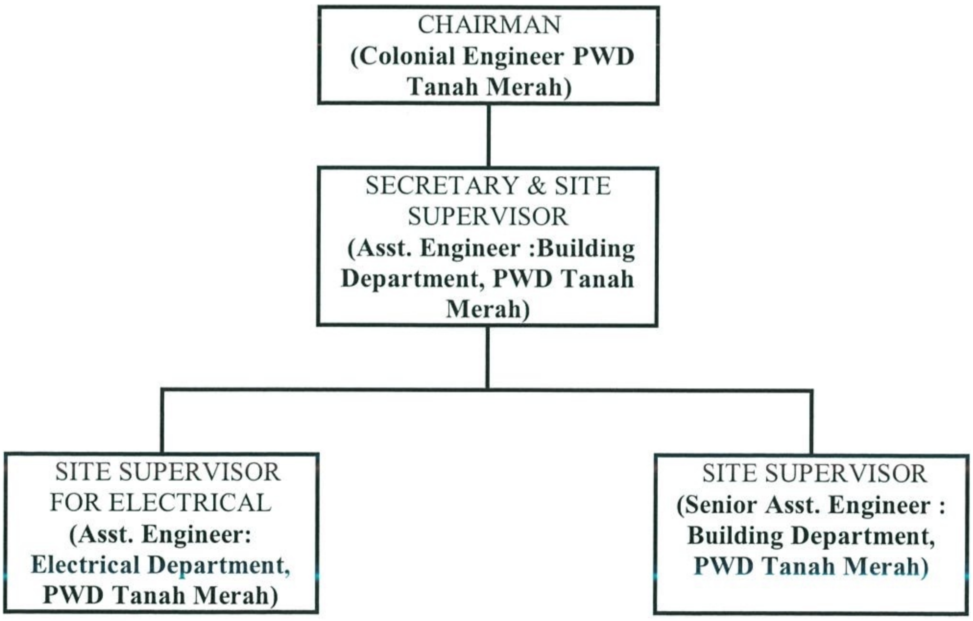


Figure 7: The organisation chart for committee members in PWD Tanah Merah

The assistant engineer from building department of PWD Tanah Merah was appointed as the secretary and site supervisor. His role was to ensure that all construction work were carried out as accordingly to the Planning Critical Path Method (CPM). The Assistant Engineer and Senior Assistant Engineer from building department supervised all the structure installation such as the installation of reinforcement bars. While, the electrical wiring will be install by the sub-contractor which sub-contractor will be selected before phase 4 begins. The Assistant Engineer from electrical department supervised all the activity involved the installation of wiring for electricity.

Consultants involved for the additional construction were Azanik Consultant (Civil Engineer), Arkitek Ilham Karya (Architecture) and Perunding Nukleus Sdn. Bhd. (M&E Consultant). Arkitek Ilham Karya, Azanik Consultant and Perunding Nukleus Sdn. Bhd were appointed by The District Officer Tanah Merah. While, main contractor for this project is Anggerik Sutera Construction and it was appointed by the Colonial Engineer PWD Tanah Merah and was approved by The District Officer Tanah Merah. IKRAM QA Services Sdn. Bhd was a Material Testing Laboratory trusted by PWD Tanah Merah.

Arkitek Ilham Karya provides architectural drawings where the idea for the architect's plan was a combination of the idea from Assistant Engineer from building department PWD Tanah Merah. The additional three storeys will be as big as the first section in existing building and all the positions of the rooms were designed by the architect according to the suitability of the space. On the ground floor, there are open prayer room, pump room, electric room, set, lift room and two indoor staircases. For the first floor there are *Imam*'s room, mosque office space, waiting room, electric room, service room, pantry, meeting room, toilet, lift room and two indoor staircases. Meanwhile, on the second floor there are seminar hall, toilet, electric room, service room, lift room and two indoor staircases.

Azanik Consultant has provided structural drawing based on architectural drawing. Azanik Consultant was assigned to design the building structure by calculating the load on the building. This structural drawing was very important when installation reinforcement bars on certain elements were used. Azanik Consultant was also responsible to inspect the structure installation before concreting.

Nevertheless, the professional services to be rendered by Perunding Nukleus Sdn. Bhd includes the provision of all expert technical advice and skill which normally required for both mechanical and electrical services. The services offered by this consultant are cold water installation which was an internal work. Other than that, this consultant needs to design the sanitary plumbing installation, firefighting installation and passenger lift. While for the electrical works, Perunding Nukleus Sdn. Bhd. has designed the system for extra-low voltage installation and the other electrical work such as proposed the Tenaga Nasional Berhad (TNB) sub-station location and has obtained approval from TNB. In addition, the air conditioning and mechanical ventilation were also the responsibility of Perunding Nukleus Sdn. Bhd. Once the project is fully completed, Isma Teknik Econd & Servis will take full responsibility for the maintenance of the air conditioning and mechanical ventilation. This company has took a contract with the Ismail Petra Mosque, in which they, has been called to repair or a new installation related to air conditioning and mechanical ventilation.

Every reinforcement bar ordered from the supplier was sent to Kumpulan IKRAM Sdn. Bhd. located at Block 5, Unipark Suria, Jalan IKRAM-UNITEN, 43000 Kajang, Selangor. IKRAM was the organisation that providing Total Integrated Engineering Solutions for engineering forensic and consultancy services. The three bars of reinforcement bars of each size were sent there for tensile strength testing to Kumpulan IKRAM Sdn. Bhd. The size of the reinforcement bar involved in this construction were T20, T16, T12, T10 and for the link it used M10. Every sample has been cut to two feet. The tensile strength results have been sent to Public Work Department (PWD) Tanah Merah.

<u>Security bureau</u>

The District Officer of Tanah Merah has appointed the Police Chief of Tanah Merah District Police Headquarters as the leader for security bureau. The role of the security bureau was to ensure safety within the mosque area. Tanah Merah District Police Headquarters was located opposite the mosque, hence, the duty to monitor the safety at the mosque was easier. Following this, a few policemen were appointed by the Police Chief of Tanah Merah District Police Headquarters to monitor the mosque area according to the schedule approved by the Police Chief of Tanah Merah District Police Headquarters. They are patrolling twice per day which were in the morning and night. The construction of the three storeys required more monitoring to avoid theft machineries and tools. The policemen who do patrols were not being paid because it was one of their job scope are within the area of their duty to keep the construction mosque site safe.

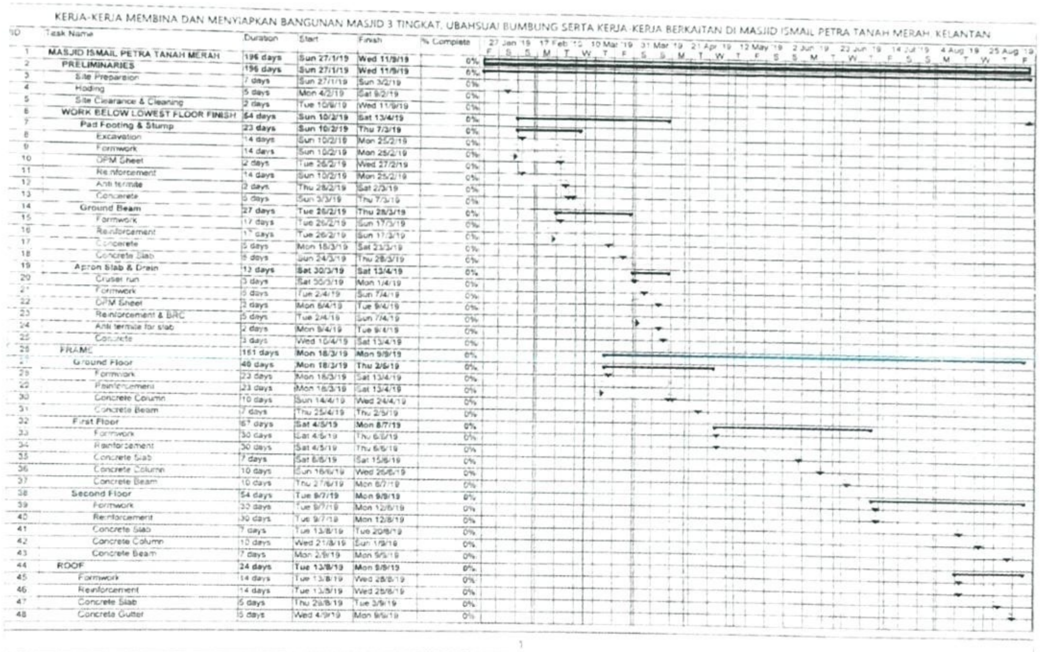
Sanitation and Youth & Da'wah bureaus

The sanitation bureau had to ensure that the mosque was kept clean for health measures especially within the construction area. During the construction, other than for prayer purpose the existing mosque was also been used for Quran reciting class. That was why it was important for the mosque and construction area to be always in clean condition in order to prevent any unwanted accident or disease spread. The workers of District Council Tanah Merah were responsible to maintain the landscape and the cleanliness around Tanah Merah within Ismail Petra Mosque compound. The sanitation bureau was also responsible to maintain the existing landscaping in Ismail Petra Mosque and was responsible to build a landscape once the whole construction of additional three storeys at Ismail Petra mosque is complete.

The Youth Bureau and Da'wah Bureau were not directly involved with the construction of this mosque as they only arranged activities involving the youth or any talk program held at the mosque. However, they have had contributed ideas on the design of the mosque. For example, lift construction was proposed by the Da'wah bureau which to facilitate senior citizens who want to go to the lecture hall located on the second floor.

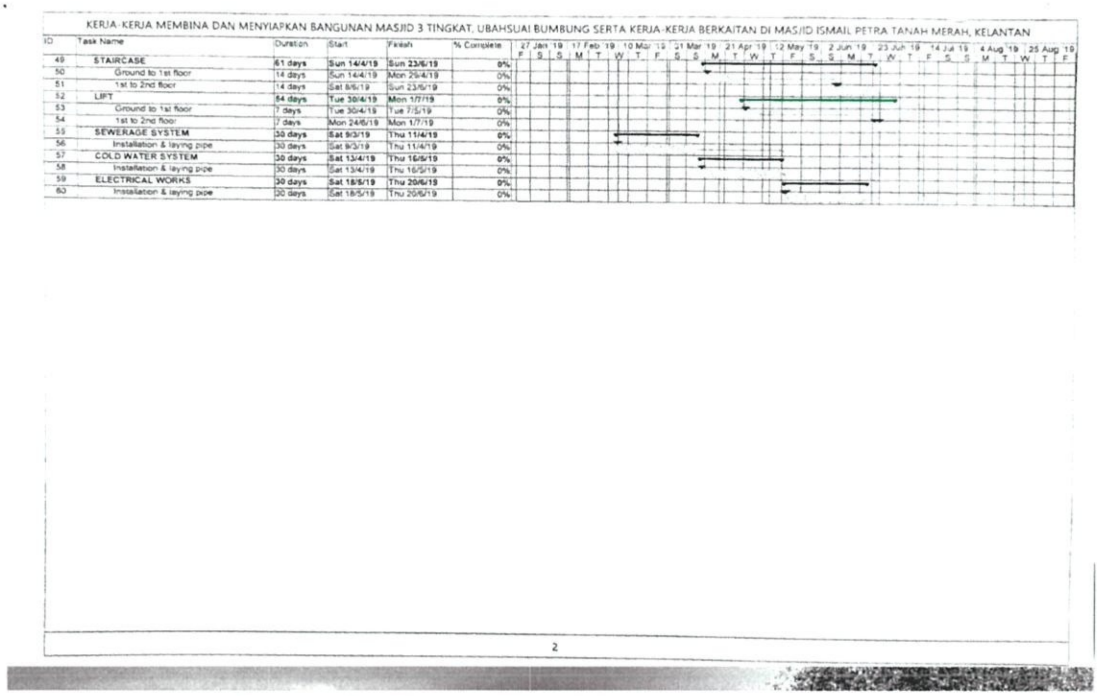
3.2 The construction methods of cast in-situ superstructure

Five elements are investigated in this study: slab, beam, column, lift shaft and staircase. The explanation of slab, beam and column is divided into its type such as non-suspended and suspended slab; ground and upper beam and there are tied and circular column. Apart from these elements, the lift shaft and staircase also used reinforcement concrete but in different shapes, designs and techniques. Figure 8 and Figure 9 shows the Planning Critical Path Method (CPM) of phase 1 of three-storey additional building construction. In Planning CPM, the '%complete' section is not updated because it was early planning. The Actual CPM not updated from the beginning of construction. The contractor has told that once all construction is complete, the Actual CPM will be updated. The Actual CPM and Planning CPM will be compared and this will be raised in one meeting after the construction of phase 1 done. For example, the contractor will explain why there is a delay in construction work on the Actual CPM when compared to the Planning CPM. Several building elements were built concurrently, for example the construction of column and lift shaft.



ID	Task Name	Duration	Start	Finish	% Complete
1	MASJID ISMAIL PETRA TANAH MERAH	196 days	Sun 27/1/19	Wed 11/9/19	0%
2	PRELIMINARIES	196 days	Sun 27/1/19	Wed 11/9/19	0%
3	Site Preparation	7 days	Sun 27/1/19	Sun 3/2/19	0%
4	Hoding	5 days	Mon 4/2/19	Sat 9/2/19	0%
5	Site Clearance & Cleaning	2 days	Tue 10/9/19	Wed 11/9/19	0%
6	WORK BELOW LOWEST FLOOR FINISH	54 days	Sun 10/2/19	Sat 13/4/19	0%
7	Pad Footing & Stump	23 days	Sun 10/2/19	Thu 7/3/19	0%
8	Excavation	14 days	Sun 10/2/19	Mon 25/2/19	0%
9	Formwork	14 days	Sun 10/2/19	Mon 25/2/19	0%
10	OPM Sheet	2 days	Tue 26/2/19	Wed 27/2/19	0%
11	Reinforcement	14 days	Sun 10/2/19	Mon 25/2/19	0%
12	Anti termite	2 days	Thu 28/2/19	Sat 2/3/19	0%
13	Concerete	5 days	Sun 3/3/19	Thu 7/3/19	0%
14	Ground Beam	27 days	Tue 26/2/19	Thu 28/3/19	0%
15	Formwork	17 days	Tue 26/2/19	Sun 17/3/19	0%
16	Reinforcement	17 days	Tue 26/2/19	Sun 17/3/19	0%
17	Concerete	5 days	Mon 18/3/19	Sat 23/3/19	0%
18	Concrete Slab	5 days	Sun 24/3/19	Thu 28/3/19	0%
19	Apron Slab & Drain	12 days	Sat 30/3/19	Sat 13/4/19	0%
20	Cruser run	3 days	Sat 30/3/19	Mon 1/4/19	0%
21	Formwork	5 days	Tue 2/4/19	Sun 7/4/19	0%
22	OPM Sheet	2 days	Mon 8/4/19	Tue 9/4/19	0%
23	Reinforcement & BRC	5 days	Tue 2/4/19	Sun 7/4/19	0%
24	Anti termite for slab	2 days	Mon 8/4/19	Tue 9/4/19	0%
25	Concrete	3 days	Wed 10/4/19	Sat 13/4/19	0%
26	FRAME	151 days	Mon 18/3/19	Mon 9/9/19	0%
27	Ground Floor	40 days	Mon 18/3/19	Thu 2/5/19	0%
28	Formwork	23 days	Mon 18/3/19	Sat 13/4/19	0%
29	Reinforcement	23 days	Mon 18/3/19	Sat 13/4/19	0%
30	Concrete Column	10 days	Sun 14/4/19	Wed 24/4/19	0%
31	Concrete Beam	7 days	Thu 25/4/19	Thu 2/5/19	0%
32	First Floor	57 days	Sat 4/5/19	Mon 8/7/19	0%
33	Formwork	30 days	Sat 4/5/19	Thu 6/6/19	0%
34	Reinforcement	30 days	Sat 4/5/19	Thu 6/6/19	0%
35	Concrete Slab	7 days	Sat 8/6/19	Sat 15/6/19	0%
36	Concrete Column	10 days	Sun 16/6/19	Wed 26/6/19	0%
37	Concrete Beam	10 days	Thu 27/6/19	Mon 8/7/19	0%
38	Second Floor	54 days	Tue 9/7/19	Mon 9/9/19	0%
39	Formwork	30 days	Tue 9/7/19	Mon 12/8/19	0%
40	Reinforcement	30 days	Tue 9/7/19	Mon 12/8/19	0%
41	Concrete Slab	7 days	Tue 13/8/19	Tue 20/8/19	0%
42	Concrete Column	10 days	Wed 21/8/19	Sun 1/9/19	0%
43	Concrete Beam	7 days	Mon 2/9/19	Mon 9/9/19	0%
44	ROOF	24 days	Tue 13/8/19	Mon 9/9/19	0%
45	Formwork	14 days	Tue 13/8/19	Wed 28/8/19	0%
46	Reinforcement	14 days	Tue 13/8/19	Wed 28/8/19	0%
47	Concrete Slab	5 days	Thu 29/8/19	Tue 3/9/19	0%
48	Concrete Gutter	5 days	Wed 4/9/19	Mon 9/9/19	0%

Figure 8: The Planning CPM of phase 1 in case study



KERJA-KERJA MEMBINA DAN MENYIAPKAN BANGUNAN MASJID 3 TINGKAT, UBAHSUAI BUMBUNG SERTA KERJA-KERJA BERKAITAN DI MASJID ISMAIL PETRA TANAH MERAH, KELANTAN

ID	Task Name	Duration	Start	Finish	% Complete
49	**STAIRCASE**	**61 days**	**Sun 14/4/19**	**Sun 23/6/19**	**0%**
50	Ground to 1st floor	14 days	Sun 14/4/19	Mon 29/4/19	0%
51	1st to 2nd floor	14 days	Sat 8/6/19	Sun 23/6/19	0%
52	**LIFT**	**54 days**	**Tue 30/4/19**	**Mon 1/7/19**	**0%**
53	Ground to 1st floor	7 days	Tue 30/4/19	Tue 7/5/19	0%
54	1st to 2nd floor	7 days	Mon 24/6/19	Mon 1/7/19	0%
55	**SEWERAGE SYSTEM**	**30 days**	**Sat 9/3/19**	**Thu 11/4/19**	**0%**
56	Installation & laying pipe	30 days	Sat 9/3/19	Thu 11/4/19	0%
57	**COLD WATER SYSTEM**	**30 days**	**Sat 13/4/19**	**Thu 16/5/19**	**0%**
58	Installation & laying pipe	30 days	Sat 13/4/19	Thu 16/5/19	0%
59	**ELECTRICAL WORKS**	**30 days**	**Sat 18/5/19**	**Thu 20/6/19**	**0%**
60	Installation & laying pipe	30 days	Sat 18/5/19	Thu 20/6/19	0%

Figure 9: The Planning CPM of phase 1 in case study

Ground Beam

The ground beam was built after the construction of pad foundation. The position of ground beam was determined using water pipe levelling and marked using thread. The thread acts as a pointer to erect 12mm thick plywood of formworks. Detail drawings were needed to measure the size of the ground beam, for example, for Ground Beam No. 16 (GB16) as shown in Figure 10, the total length of formwork was measured from the centre of footing D to the centre of footing G (5,452mm + 2159mm + 1067mm).

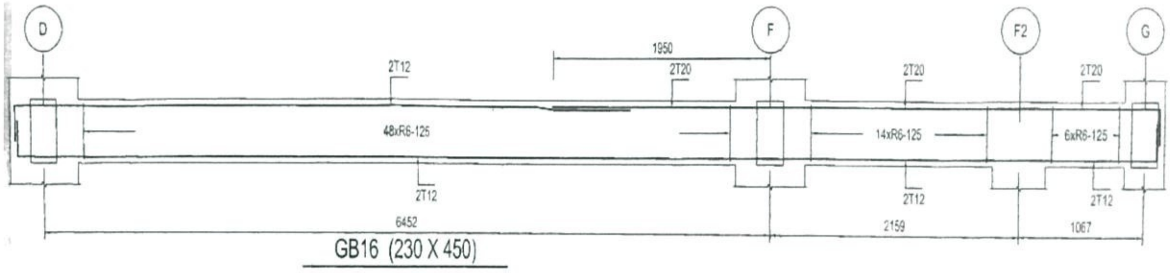


Figure 10: Plan ground beam detail GB16 in structural drawing

This made the total length count 9,678mm in length, with 230mm thick and 450mm wide as according to the section detail drawing. The formwork was built (like a rectangular box as Figure 10, without soffit) using a hammer and nail. The engineer checked to ensure that the connections of the formwork have no openings to avoid leakages and loss of water from concrete that may cause honey comb. The aspects of the formwork that were examined were the size, the verticality, the alignment, the rigidity and that it was free from dirt. As the plywood had smooth surface, it did not require oil/grease to be applied at the inner surface of the plywood. Smooth surfaced plywood made it easy to be removed once the concrete is set, although no oil applied onto it. The strut was then erected at every 500mm as bracing to hold the box formwork so that it would not bulge when tonnes of concrete are poured inside.

After that, main reinforcement bars was formed and tied (also in a box shape based on ground beam detail) using a bar bending machine as shown in Figure 11. Four main bars were required to form the box shape. Stirrups were tied perpendicular to all four bars at every 125mm to resist shearing action and to prevent the bars from bending outwards. The sizes of the main bars varies according the load as calculated by the consultant. For example, for GB16, as shown in Figure 10, two main reinforcement bars of 12mm diameter, high tensile (2T12) started from footing D were overlapped with two bigger bars (2T20) at 1950mm before it reached the footing F to provide structural continuity. The 2T20 continued until the gridline footing G. The other two main bars at lower part of ground beam continued to use similar smaller reinforcement bars, 2T12.

Figure 11: Forming the ground beam reinforcement bars using a bar bending machine

The stirrups from footing D until F used 48 mild steel round bars size 6mm with spacing 125mm centre to centre (48×R6-125) while for footing F until F2 used 14×R6-125 and footing F2 until G used 6×R6-125 size. The stirrups reinforcement bars were cut by using rebar cutting machine according to the length specified in the structural drawing and bent at a radius of 90 by using bar bender machine as shown in Figure 11. The stirrups were tied perpendicular to the main reinforcement bars using a rebar tie wire and it was tied using saddle tie method by using bar-tie wire twister. 50mm thick spacer was tied at lower part of main bars ground beam to allow space for the concrete to fully cover all reinforcement bars. The engineer checked whether the binding was correct and approved before reinforcement bars were inserted in formwork.

Concrete casting was carried out to complete the construction of ground beam. Ready-mix concrete was ordered from concrete batching plant. The grade for crushing strength of concrete was used $30N/mm^2$ (Grade 30). The concrete was poured from the truck to a bucket and in the formwork using a crane. The concrete was properly vibrated by using vibrator to ensure satisfactory compaction. The hand-trowels was used to help smooth the concrete surfaces for their finish coats.

Ground Slab

The ground (base) was compacted for every 1 feet by using compactor machine so that it is able to receive load. After that, 300mm thick of crusher run was used to increase the load bearing capacity. The crusher run was levelled and compacted as shown in the plan detail of ground floor slab in structural drawing as in Figure 12. Concrete

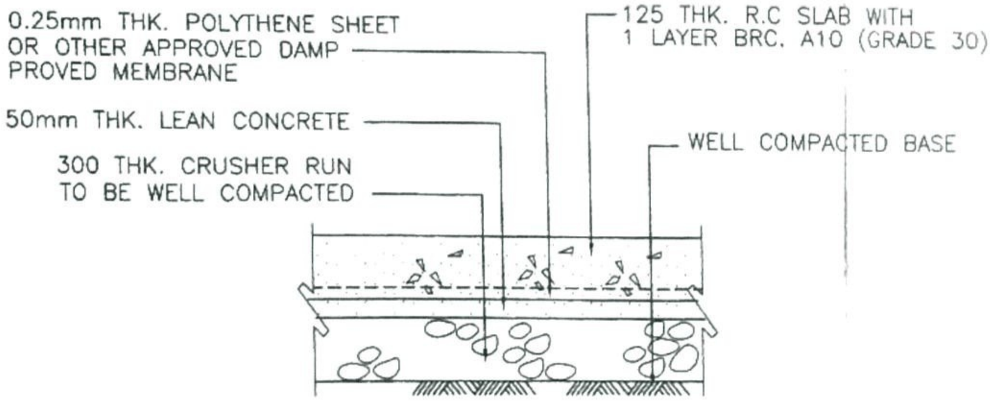


Figure 12: The plan detail of ground floor slab in structural drawing

grade 15 ordered from the batching plant was then poured for form 50mm thick lean concrete to provide uniform surface and prevent direct contact with the crusher run. Next, the damp proof membrane (DPM) was overlaid on the lean concrete once it was dry. The material of DPM used was 0.25mm thick polythene sheet. BRC A10 was laid on top of the lean concrete and 50 mm spacer bars were tied at the bottom of the BRC A10. 125mm thick of concrete grade 30 was poured directed from the mixer truck. The workers used hoe to spread the concrete to slab area. Vibrator was used to ensure that no airspace is left in the concrete mix. The trowel was used to smooth the surface.

Column

The column was built after the construction of ground slab. The position of column was determined by using water pipe levelling and the straight line was marked to the ground slab by using a nail. Figure 15 shows the straight line was marked with nail to the ground slab to make sure the position of column was same as in structural drawing. The column schedule was referred to measure the size of the column, for example, for tied column in ground floor (C5) as shown in Figure 13. The size of tied column (C5) was 450mm×450mm. The 10 main reinforcement bars 20mm, high tensile (10T20) was overlapped with the column stump. The stirrups reinforcement bars were cut by

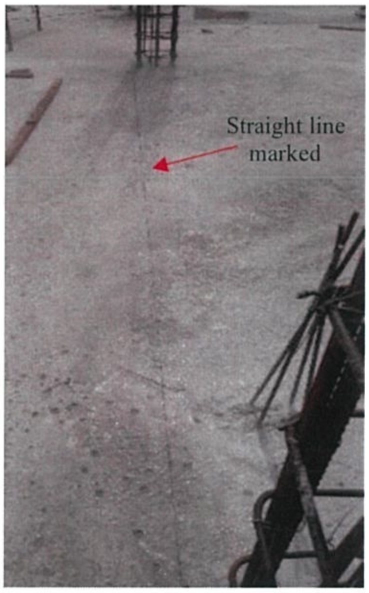


Figure 15: The straight line was marked on the ground slab

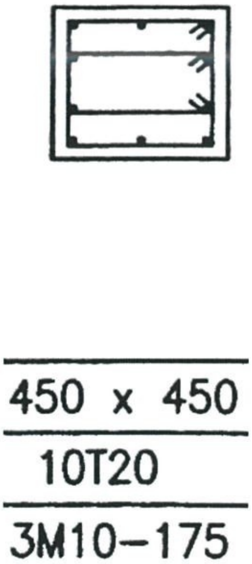


Figure 14: The column schedule for C5

Figure 13: The worker marked the location of stirrup to the main bars

using rebar cutting machine according to the length specified in the structural drawing and bent at a radius of 90 by using bar bender machine. The stirrups for C5 used three mild steel round bars size 10mm with spacing 175mm centre to centre (3×M10-175). The location of stirrups on main bars was measured 175mm using measuring tape and marked with red marker pen as shown in Figure 14. The stirrups were tied perpendicular to the main reinforcement bars to all ten bars at every 175mm using a rebar tie wire by using bar-tie wire twister.

The engineer checked whether the binding was correct and approved it before the formwork were installed. The 50mm thick spacer bar was tied to the main bars column to allow space for the concrete to fully cover all reinforcement bars as shown in Figure 16. The height of formwork was measured from the ground floor level to the first floor level, 6,096mm. This made the height tied column 6,069mm, with 450mm length and 450mm width according to the column schedule for C5 as shown in Figure 13. The formwork was built using a hammer and nail. The engineer checked to ensure that the connections of the formwork have no openings to avoid leakages and loss of water from concrete that may cause honey comb. The strut with height 6m was then erected at every edges of formwork as bracing to hold the box formwork so that it would not bulge when tonnes of concrete are poured inside.

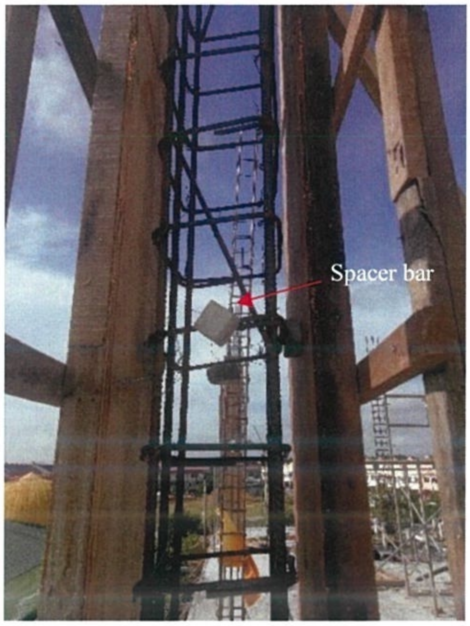


Figure 16: The spacer bar was tied to the reinforcement bar

Concrete casting was carried out to complete the construction of column. Ready-mix concrete was ordered from concrete batching plant. The grade for crushing strength of concrete was used $30\text{N}/\text{mm}^2$ (Grade 30). The concrete was poured from the truck to a bucket and in the formwork layer by layer using a crane. The first layer was poured as high as three meters (half column). The concrete was properly vibrated by using vibrator to ensure satisfactory compaction. The next layer, the concrete was poured for another three meters and properly vibrated by using vibrator. After 20 days, the formwork of column was removed.

Lift Shaft

The construction of lift shaft was built concurrently with columns. Detail drawings were needed to measure the size of the lift shaft, for example the typical lift shaft plan

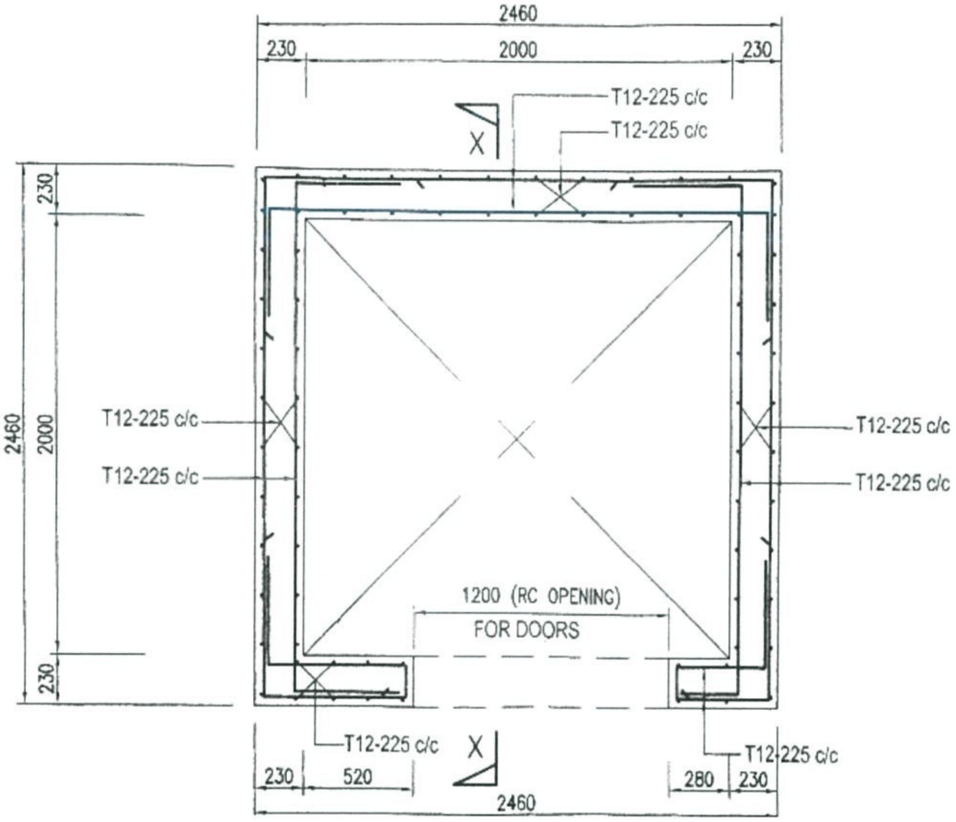


Figure 17: The typical lift shaft plan

shown in Figure 17. The height of lift shaft was measured from ground floor level to the first floor level, 6096mm. This made the height lift shaft was 6,096mm, with 2400mm length and 2400mm width as according to the typical lift shaft plan as shown in Figure 17.

The formwork for inside of lift shaft was built in a shape of box with an opening 1200mm while the length of lift shaft was 2000mm and width 2000mm. Inside the lift shaft the staging was installed to support the formwork of lift shaft. The main bar for lift shaft used size 12mm, high tensile with spacing 225mm centre to centre (T12-225

Figure 19: The starter bar for lift shaft

Figure 18: The reinforcement bar in 'L' shape

c/c). It was cut by using rebar cutting machine according to the length specified in the structural drawing. The main bars (T12-225 c/c) was overlapped vertically with starter bar for lift shaft as shown in Figure 19. For main bars in horizontal also used T12-225 c/c were tied perpendicular to the main reinforcement bars with a rebar tie wire by using bar-tie wire twister. The 1000mm (T12) was bent at a radius of 90 into "L" shape by using bar bender machine. It was used to connect between main bars and column as shown in Figure 18. The engineer checked whether the binding was correct and approved it.

After that, the spacer bar with 50mm thick was tied to the main bars to provide spacing between main bars and formwork. The outer formwork of lift shaft was built according to the typical lift shaft plan as shown in Figure 17. The engineer has to ensure that the connections of the formwork have no openings to avoid leakages and loss of water from concrete that may cause honey comb. Concrete casting was carried out to complete the construction of lift shaft. Ready-mix concrete was ordered from concrete batching plant. The grade for crushing strength of concrete was used $30N/mm^2$ (Grade 30). The concrete was poured from the truck to a bucket and in the formwork using a crane. The concrete was properly vibrated by using vibrator to ensure satisfactory compaction.

First Floor Beam and Slab

The first floor beam was built after the construction of column and lift shaft at ground floor level. The staging was erected on the firm ground to hold the box formwork. Detail drawings were needed to measure the size of the first floor beam, for example, for First Floor Beam No. 7 (FB7) as shown in Figure 20, the length of formwork was measured from the centre of footing B to the centre of footing C1. This made the length 4572mm in length, with 230mm thick and 450mm wide as according to the section detail drawing. The first floor beam formwork was built (like a rectangular box as Figure 19) using a hammer and nail. The formwork for first beam and slab was used

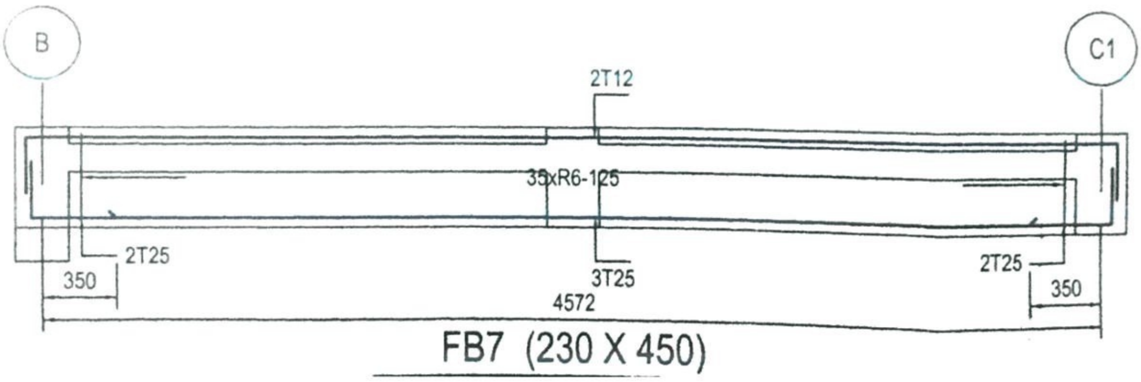


Figure 20: The plan for first floor beam in structural drawing

heavy duty panel. The engineer checked to ensure that the connections of the formwork have no openings to avoid leakages and loss of water from concrete that may cause honey comb. The aspects that were examined were the size of the formwork, the verticality, the alignment, the rigidity and that the formwork was free from dirt. As the heavy duty panel had smooth surface, it did not require oil/grease to be applied at the inner surface of the formwork. Smooth surfaced heavy duty panel made it easy to be removed once the concrete is set, although no oil applied onto it.

Main reinforcement bars for first floor beam was formed and tied (also in a box shape based on first floor beam detail) using a bar bending machine. Five main bars were required to form the box shape. Stirrups were tied perpendicular to all five bars at every 125mm to resist shearing action and to prevent the bars from bending outwards. The sizes of the main bars varies according the load as calculated by the consultant. For example, for FB7, as shown in Figure 20, two main reinforcement bars of 12mm diameter, high tensile (2T12) started from footing B to footing C1. 2T12 were overlapped with two bigger bars (2T25). The other three main bars at lower part of first floor beam continued to use similar reinforcement bars, 3T25.

The stirrups from footing B until C1 used 35 mild steel round bars size 6mm with spacing 125mm centre to centre (35×R6-125). The stirrups reinforcement bars were cut by using rebar cutting machine according to the length specified in the structural drawing and bent at a radius of 90 by using bar bender machine. The stirrups were tied perpendicular to the main reinforcement bars with a rebar tie wire by using bar-tie wire twister as shown in Figure 21. 50mm thick spacer was tied at lower part of main bars first floor beam to allow space for the concrete to fully cover all reinforcement bars. The engineer checked whether the binding was correct and approved before reinforcement bars were inserted in formwork.

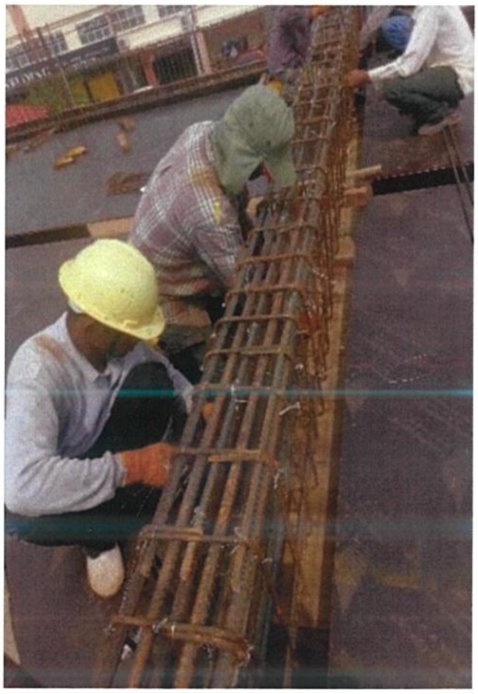


Figure 21: The workers tied the stirrups to the main bar

Next, the PVC conduit pipe for electrical wirings (ground floor) were installed on the formwork of first floor slab. The electrical wirings were put into PVC conduit pipe with diameter 25mm as can be seen in Figure 22. The BRC A10 was then laid on top of the PVC conduit pipe and 50 mm spacer bars were tied at the bottom of the BRC A10 as shown in Figure 22. The reinforcement bar was bent into 'S' shape acts as spacer was put on the BRC A10. The second layer BRC A10 was laid on top 'S' shape spacer.

Figure 22: The BRC laid on first floor slab

Concrete casting was carried out to complete the construction of first floor beam and slab. Ready-mix concrete was ordered from concrete batching plant. The grade for crushing strength of concrete was used $30N/mm^2$ (Grade 30). The concrete was poured from the truck to a bucket and in the formwork using a crane as shown in Figure 23. The workers used hoe to spread the concrete to slab area. Vibrator was used to ensure that no airspace is left in the concrete mix. The trowel was used to smooth the surface.

Figure 23: The workers handling the concrete bucket lifted up by the crane for the first floor beam

Staircase

The RC staircase was built after the construction of the first floor slab. The staging was erected on the firm ground to hold the formwork of staircase. 12mm thick plywood of formworks was built by using hammer and nails. Detail drawings were needed to refer the size of staircase, for example, the typical RC staircase 1 details as shown in Figure 24. The total height of RC staircase was measured from the ground floor level to the first floor level was 6,096mm (3,048mm + 3,048mm). The landing of staircase was built at height 3,048mm measured from ground floor level used high tensile reinforcement bars size 16mm with spacing 150mm centre to centre (T16-150). The T10-225 was tied perpendicularly to the main reinforcement bars (T16-150) with a rebar tie wire by using bar-tie wire twister. The first flight has 20 runs with length 254mm for each run while the height of rises was 152.4mm each.

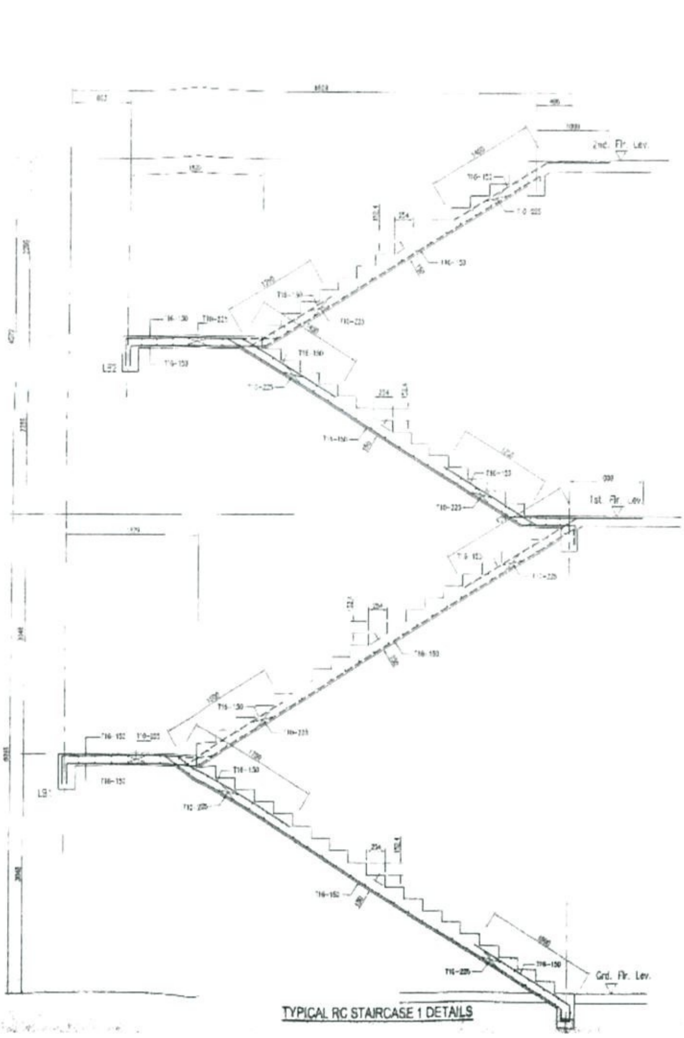


Figure 24: The typical RC staircase 1 detail in structural drawing

The high tensile reinforcement bars size 16mm with spacing 150mm was overlapped with the same size (T16-150) starter bar for staircase. Figure 25 shows the starter bar for staircase. The T10-225 were tied perpendicularly to the main reinforcement bars (T16-150) with a rebar tie wire by using bar-tie wire twister. The trim board was nailed to the side of stairs by using hammer and nail. Then, the timber with height 152.4mm was placed to be made as formwork for rises. Concrete casting was carried out to complete the construction of landing and first flight. Ready-mix concrete was ordered from concrete batching plant. The grade for crushing strength of concrete was used $30\mathrm{N/mm^2}$ (Grade 30). The concrete was poured from the truck to a bucket and in the formwork using a crane. The workers used hoe to spread the concrete to landing area and rises. Vibrator was used to ensure that no airspace is left in the concrete mix. The trowel was used to smooth the surface of runs.

Figure 25: The starter bas for staircase

3.3 The problems occurred during the super structure construction and solutions to the problems

Four main problems have been identified during the construction of the new 3-storey building at Ismail Petra Mosque. The major problem was that since the amount of money used for the construction works was gathered from the public and donation from the Member of Parliament Tanah Merah, the overall construction had to be divided into phases. Phase 2 can only be constructed once the money is sufficient and this will continued until phase 6. It will take the contractor a long duration to finish the entire building. This problem cannot be solved because the financing for this construction depends on funds from the public.

Another issue was about improper usage of personal protective equipment. At the site, only a small number of workers wore Personal Protective Equipment. This was dangerous especially for workers who worked at a high level as well as those at the ground floor. It exposed the workers to high risks of accidents. The simplest personal protective equipment that was not used on the site was the safety helmet. Due to this problem, the site supervisor has reported to the main contractor to provide more personal protective equipment. The site supervisor also imposed penalties on employees who did not use personal protective equipment properly.

Figure 26: The worker does not wear a proper Personal Protective Equipment (PPE)

Unpredictable weather gave problem during construction especially during concreting work for the first-floor beam and slab. Heavy rain poured for 20 minutes had interfered the concreting work. The concrete that has been poured into the first-floor beam was covered with a tarpaulin canvas sheet so that the strength of the concrete was not disrupted. The concreting work continued after the rain.

The last problem identified were design flaws, in which no starter bars were designed for the first-floor beam. According to the criteria outlined by PWD, the starter bars are compulsory. The flawed drawing was drawn by the civil engineering consultant. This problem was solved by the site supervisor by giving instructions to the workers to add starter bars at the first-floor beam as preliminary action was taken to avoid any harm to the structure in future.

CONCLUSIONS

Based on the research in this report, The Cast In-Situ of Superstructure Construction Method was discovered the construction of additional three-storey at Ismail Petra mosque. Firstly, to identify the parties involved and their responsibilities in the construction of Ismail Petra Mosque, Tanah Merah, Kelantan. The parties involved during the construction was divided into Chairman, Deputy Chairman, Treasurer and five different bureau which are Development Bureau, Security Bureau, Sanitation Bureau, Youth Bureau and Da'wah Bureau. However, the important role for the construction progress was the Development Bureau, which was under the responsibility of the Tanah Merah Public Work Department. The District Officer was the one who responsible to appoint competent consultants who will be in charge to design the structural and architect drawing. All the parties involved had diligently planned on how to spend the fund gained from the public donation in order to assure the new addition three-storey being constructed successfully.

Next, to investigate the construction methods of cast in-situ superstructure. For this report, the construction of the additional three-storey building at Ismail Petra mosque mainly focuses on the construction of structural building. There were few elements that had been constructed such as ground beam, ground slab, column, lift shaft, upper beam, first floor slab and staircase. This construction was guided by the structural and architect drawing provided by the chosen consultants.

Last but not least, to determine the problems occurred during the super structure construction and solutions to the problems. There were four problems being identified during the construction process. The first problem identified was the financial state as majority of the money used for the construction was gained by public donation. The next stage can only proceed when sufficient amount of fund gained from the public donation. The second issued problem was that the workers did not follow the standard personal precaution equipment that supposed to be obey by every construction worker in which if the rules are not properly being followed can cause the worker being expose to risk and hazard. The next problem identified was regarding weather occurrence as it is unpredictable thus it cause the concreting work being delayed. The last problem identified was the design flaw made by the consultant. All of these problems has been solved however for the financial problem it solely depends on the public donation.

REFERENCES

Basic Components of a Building's Superstructure. (2019, July 1). Retrieved from https://theconstructor.org/building/basic-components-building-superstructure/34597/.

Bechthold, M. (2011). Surface Structures : digital design and fabrication. *Acadia*, 88–99.

Chudley, R. (2014). Building Construction Handbook. In *Building Construction Handbook*. https://doi.org/10.4324/9781315780320

Deceased, F. S. M., & Ricketts, J. T. (1995). Building design and construction handbook. In *Choice Reviews Online* (Vol. 32). https://doi.org/10.5860/choice.32-2755

Macdonald and Angus J (2001) Structure and Architecture. Published by: Architectural Press, London.

Hanna, A. S. (1999). Concrete formwork systems. New York, NY: Dekker.

Taranath, B. S. (2010). Reinforced concrete design of tall buildings. Boca Raton, FL: CRC Press.

US2986150A - Means for mounting thin, flexible membranes. (1958.). Retrieved from https://patents.google.com/patent/US2986150A/en.