DEPARTMENT OF BUILDING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

THE CONSTRUCTION PROCESS OF STRIP FOOTING FOR 465 UNITS SINGLE STOREY HOUSE

Prepared by:

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

FEBRUARY 2022

It is recommended that the report of this practical training provided

By

Mohammad Nazirul Mubin Bin Mohd Rasfan
2019426822

entitled

THE CONSTRUCTION PROCESS OF STRIP FOOTING
FOR 465 UNITS SINGLE STOREY HOUSE

be 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 Arkitek Azman Zainonabidin Partnership for duration of 20 weeks starting from 23 August 2021 and ended on 7 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

…………………………………………………….

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Date : 10 January 2022

ACKNOWLEDGEMENT

Alhamdulillah, praise to Allah, The Most Generous and The Most Merciful.

Firstly, I would like to give my utmost respect and gratitude for the advice, teaching, and guidance throughout the practical training period to all involved individuals. I also very grateful by the opportunity given by En. Azman Zainonabidin from ArAz Arkitek to do internship at his company. Not to forget, En Agos as supervisor for his guidance for the project and the staff at ArAz Arkitek for their cooperation and guidance at the office.

Besides that, many people from the contractor company, Energiser Sdn Bhd have contributed their help, guidance, and support in the development of the project from the time I began practical work until the completion of the reports. I would like to thank En Sofan, En Izal and Mr Lee as CoW, site supervisor and site engineer in this project and his team, for their wisdom and valuable knowledge about construction and experience they share at the site since the training started.

I also like to thanks to Ir. Raja Nurulhaiza Raja Nhari as report supervisor for giving me a lot of advice and give me strength to finish my industrial training programme in Diploma of Building. To all lecturers that give me a lot of necessary information and knowledge about building.

Lastly, million thanks to my family and friends for supporting me to finish this practical training. To my family, thanks for all the support, encouragement and giving me strength all the time. Thank you so much to everyone I mentioned above, I really appreciate your help.

ABSTRACT

Substructure is one of the important things to be considered in construction process. Therefore, this report will discuss about substructure works based on Energiser Enterprise Sdn. Bhd. Specification. This report is conducted at Cadangan Pembangunan Secara Usahasama Program Khas Perumahan Perwira Negeri Perak (PKPPNP) Di Atas Lot 11523, Lot 11530 Dan Sebahagian Lot 10940 (Tanah Kerajaan), Mukim Bota, Daerah Perak Tengah, Perak Darul Ridzuan. The objective of this report is to study the construction method of strip footing. This report focused on all works related to concreting works and all the machineries and equipment used. This report also looks at the problems occurred during construction and their solutions. The strength of substructure is important for long term to make sure the building structure does not collapse, and all the load is properly distributed to the ground.

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INTRODUCTION

1.1 Background of Study

The substructure is the lower portion of a building that is built below ground level. The substructure's function is to transfer loads from the superstructure to the underlying soil. As a result, the substructure has direct contact with the supporting soil. Substructure work includes footings and plinth, piling work, foundation, column stump, underground floor and foundation base floor(Gopal Mishra, 2021).

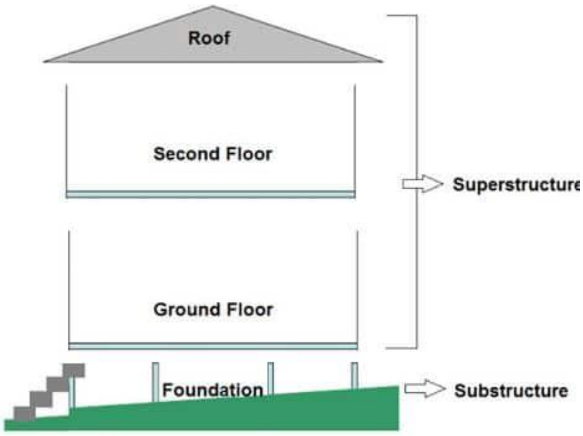

Figure 1.1 Building component

Based on figure 1.1, it shows the building component that have in every building. An experienced structural engineer should create plans and works for a building project's substructure. Furthermore, structural engineers oversee calculating the stresses and loads that must be supported by the building under consideration. Finally, structural engineers must understand how to incorporate support beams, columns, and foundations into substructure designs.

Strip foundations (or strip footings) are a type of shallow foundation used to provide a continuous, level (or occasionally stepped) strip of support to a linear structure such as a wall or closely spaced rows of columns built centrally above them.

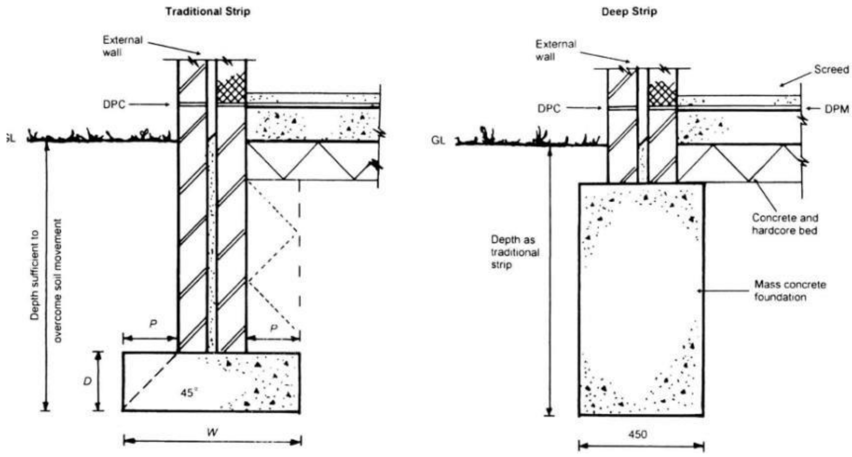

Figure 1.2 Strip footing

Strip foundations can be used on a wide range of subsoils, but they're best for soil with a high bearing capacity. Low rise or medium rise domestic building mainly use strip foundation because they are suitable for light structural loads. Other situation may require reinforced concrete. (Ed, 2021).

1.2 Objectives

Based on the practical training session, following are the objectives of this study:

i. To study the method of construction for strip footing.-.

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iii. To determine the problem occurred and solution taken to solve the problems during the construction of strip footing.

1.3 Scope of Study

This study focused on the substructure works which is strip footing and was conducted to understand the structure and method of construction according to building specification. This study mainly focuses on the construction of strip footings which include the concrete works and the domestic services installation before pouring concrete at Cadangan Pembangunan Secara Usahasama Program Khas Perumahan Perwira Negeri Perak (PKPPNP) Di Atas Lot 11523, Lot 11530 Dan Sebahagian Lot 10940 (Tanah Kerajaan), Mukim Bota, Daerah Perak Tengah Untuk Tetuan Ratus Nautika Sdn. Bhd. The construction of the project is divided into three phases. This research focused on the first phase of the project, which included 465 single-story terrace houses (PT 30672 – PT 31136).

In addition, this study pursues to describe all related process required to be applied on the strip footing. This stage includes all the progress activities associated with:

i) Determining the type of machineries, equipment and materials used in concreting strip footing.
ii) Identifying the problem and method required for the defects on concrete.

1.4 Methods of Study

The case study on the building's substructure was researched using a variety of methods to gather more information.

i) Observation

The observation method is the most used method because it has been used throughout the entire practical training directly by daily site visits for the entire period. The data gathered is based on all the activities that took place at the construction site under the supervision of site supervisors. All information is gathered using a mobile device to take photos and record videos of site activities such as work progress, equipment and machinery used in any process.

ii) Interview

The interview method also plays a significant role, as it was carried out by holding interview sessions with the Site Supervisor from the Main Contractor. The interview provided a wealth of information and new construction knowledge.

iii) Web Browsing

There are numerous internet websites that have been recommended as a secondary source for learning more about concrete and domestic service installation methods. The websites has been a huge help in gaining more knowledge about substructure construction through articles and visuals.

iv) Document Review

There is much information obtained by conducting studies on structural plans and drawings of related construction processes based on all drawings provided. Architectural drawings also aid in predicting the outcome of all construction processes related to the case study.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction of Company

Arkitek AZMAN ZAINONABIDIN (ArAZ) was established in year 2000 by Ar. Hj. Azman bin Zainonabidin as a sole proprietorship firm. This company will provide true professionalism and dedication to all assignments undertaken, as well as a prolonged striving for the highest standard in design and project delivery. After 17 years in 2017, ArAZ has been changed from a sole proprietorship to a partnership.

ArAZ recognizes the importance of innovative design approaches that are compatible with Malaysia's environment and culture and strives to follow this trend while remaining mindful of sound constructional principles to ensure the long-term durability and reliability of all projects undertaken.

ArAZ draws on the experience and expertise of its principal, who has worked for major Malaysian practises. High-rise condominiums, housing development, mixed development, offices, shopping complexes, resorts, sports complexes, highway facilities, and interior design were among the projects completed.

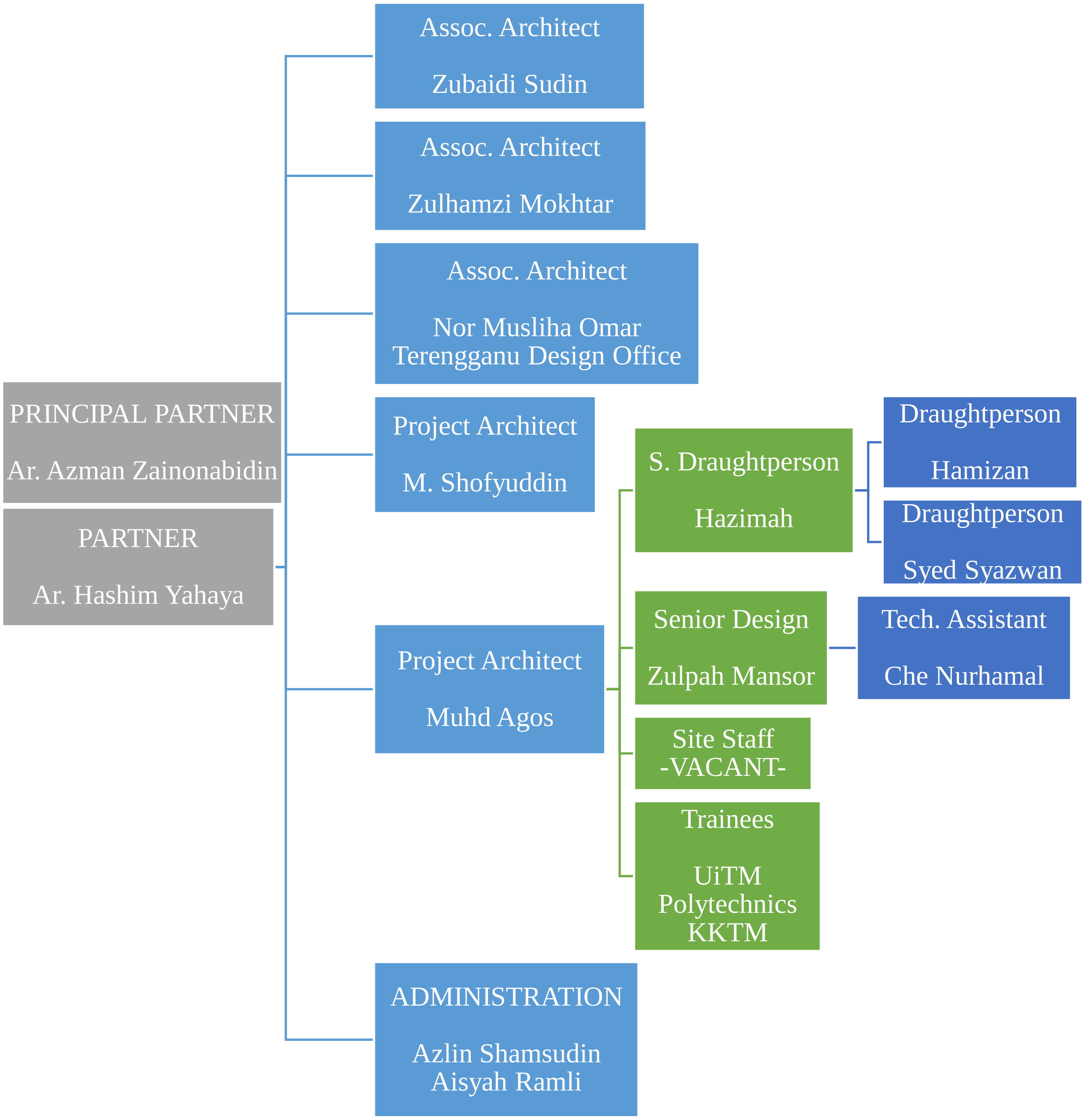
ArAZ offers a wide range of services such as master planning, architectural concept design, contract management, and interior design.

2.2 Company Profile

Name of company	:	Arkitek Azman Zainonabidin
Registered office	:	19A, Persiaran Dataran 2, 32610 Seri Iskandar, Perak Darul Ridzuan
Handphone no.	:	05-3712796
Registered year	:	2000
Company registration no.	:	201503314527 (IP0441753-M)
Principal Partner	:	Ar. Hj. Azman bin Zainonabidin Adv.Dip.Arch.[ITM], Dip.Arch.[ITM]
Partner	:	Ar. Hashim bin Yahaya B.Arch. (Hons)[UiTM] Dip.Arch.[ITM]

2.3 Company Organisation Chart

The principal for this company is Ar. Azman Zainonabidin and his partner Ar. Hashim Yahaya. There are 3 Associate Architect which is Zubaidin Sudin, Zulhamzi Mokhtar and Nor Musliha Omar. 2 Project Architect that is M. Shofyudin and Muhd Agos. Administration is consist of 2 staff which is Azlin Shamsudin and Aisyah Ramli.



2.4 List of Projects

2.4.1 Completed Project

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Pejabat MDPT	9.5 million	December 2010	October 2013	3 Years	Majlis Daerah Perak Tengah
2.	Ibu Pejabat Bomba Negeri Perak, Ipoh, Perak	18.0 million	12 September 2011	April 2016	5 Years	Kementerian Perumahan (KPKT)
3.	Pejabat RISDA	3.7 million				RISDA
4.	Balai Polis Pulau Pangkor	23.5 million	2013	2016	4 Years	Kementerian Dalam Negeri
5.	Kolej TLDM Lumut	47.0 million	2009	2013	4 Years	Kementerian Pertahanan
6.	Blok Akademik UUM	98.0 million				Universiti Utara Malaysia
7.	Hotel Taiping Perdana	24.0 million				Koperasi Guru Taiping Bhd.

2.4.2 Projects in Progress

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1.	Perumahan Perwira	111.777 million	26 July 2021	June 2024	34 Months	Ratus Nautika Sdn. Bhd.
2.	Bilik Kuliah 2 Tingkat, Kuala Kangsar	2.7 million	22 April 2021	2022	1 Year	RISDA

CHAPTER 3

CASE STUDY
(THE CONSTRUCTION PROCESS OF STRIP FOOTING FOR 465 UNITS SINGLE STOREY HOUSE)

3.1 Introduction to Case Study

During my practical study, the project that I have been assigned to is Cadangan Pembangunan Secara Usahasama Program Khas Perumahan Perwira Negeri Perak (PKPPNP) Di Atas Lot 11523, Lot 11530 Dan Sebahagian Lot 10940 (Tanah Kerajaan), Mukim Bota, Daerah Perak Tengah, Perak Darul Ridzuan. Perwira Seri Iskandar is a special housing project for ATM and PDRM members including their heirs. This project is collaboration between developers, Ratus Nautika Sdn. Bhd. & Lembaga Perumahan Hartanah Perak (LPHP) as shown in figure 3.1. The project consists of the development for 1039 single-storey housing units and 28 shop units as well as other basic facilities with 3 phases of construction. The total cost for this project is one hundred and eleven million, seven hundred and seventy thousand Ringgit (RM111,770,000.00). The duration of this construction contract is 34 months starting from 26th July 2021 and estimated to finish on 8 June 2024. The construction method for this project is mainly by cast in situ concrete. This whole project is monitored by the client, Ratus Nautika Sdn. Bhd. and Energiser Enterprise Sdn. Bhd. As the main contractor that fully in charge for this project.

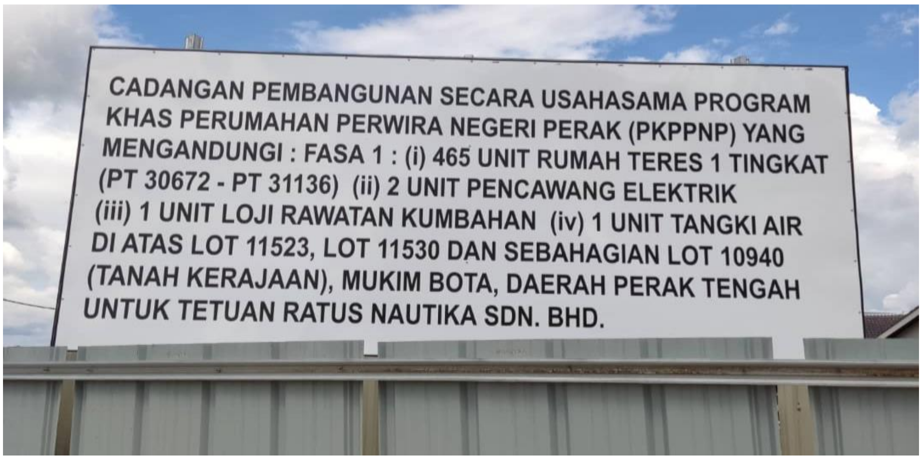


Figure 3.1 Project Signboard

Figure 3.2 Project Signboard

Based on figure 3.2, it shows the company that involved for this project. Main contractor is Energiser Enterprise Sdn. Bhd. And the architect is Arkitek Azman Zainonabidin. T.S Yee & Associates is the consultant for civil and structure engineering. For electrical and mechanical engineering, Consultant KYS Sdn. Bhd. Is chosen.

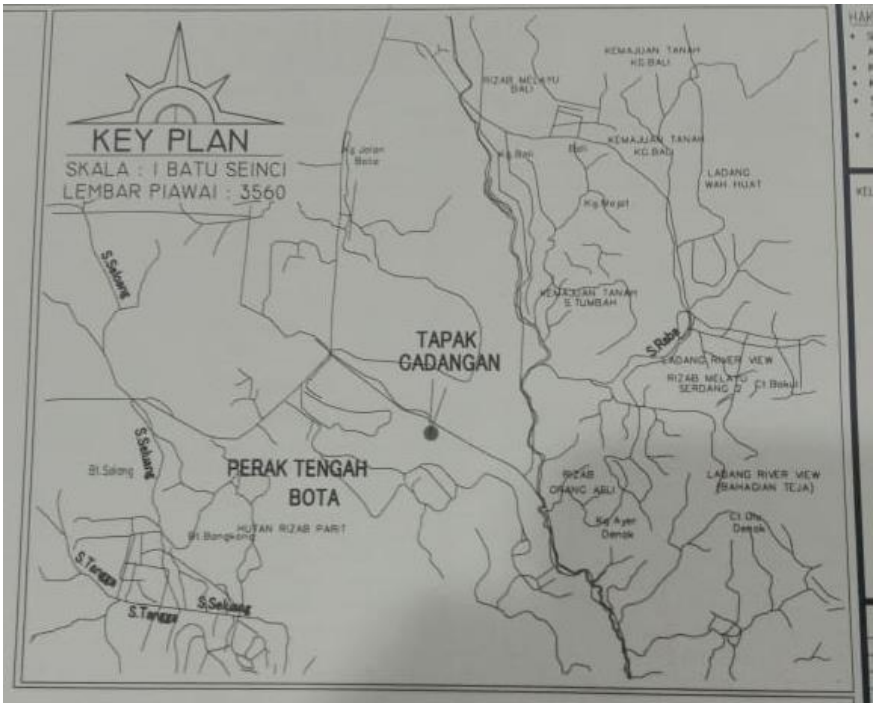


Figure 3.3 Key plan of site (Source: Arkitek Azman Zainonabidin)

Figure 3.4 Location plan of site (Source: Arkitek Azman Zainonabidin)


Figure 3.5 Show house

Figure 3.6 Site view

Figure 3.5 shows the show house that buyers can enter to check the house condition. Next, through the practical training, I been assigned to monitor and supervise the work in progress for this project. For phase 1, there are 465 single-storey terrace housing unit to be built.

This house is built using IBS System formwork that use formwork designed by manufacturer to replace conventional formwork system. The house floor area is approximately 130 m^2 and come with a living room, kitchen, 1 master bedroom, 2 bedrooms, 2 bathroom and car porch. There are also 2 built in tabletop at the kitchen and dining as shown in figure 3.7.

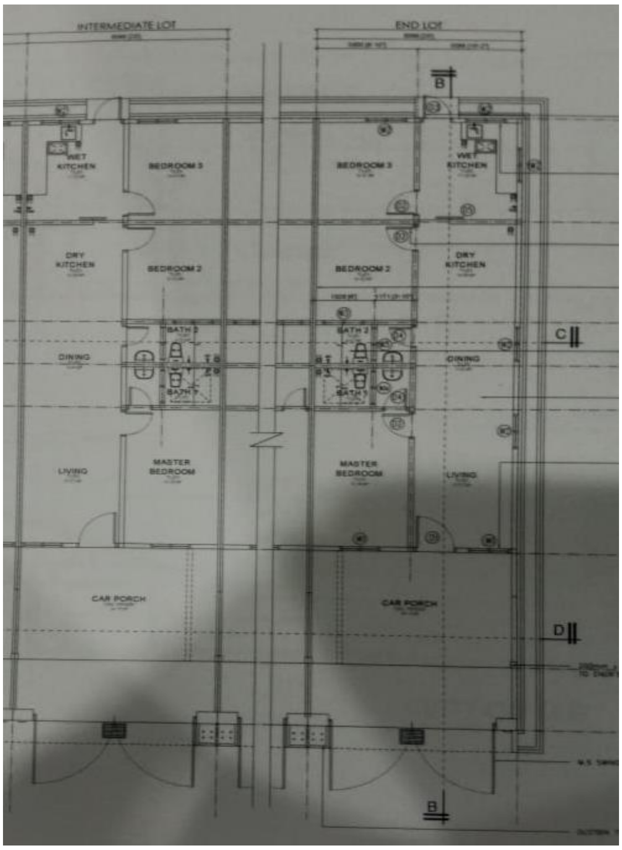


Figure 3.7 House plan

There are key-persons in-charge for all activities occurred at site to ensure all works run smoothly, which are the Project Manager, En. Shahrom, En Sofan as the C.O.W, En Mustaqim as Safety and Health Officer, Mr Lee as the Site Engineer, En. Izal as Site Supervisors.

For this case study, the focus will only be on the substructure according to the Energiser Enterprise Sdn. Bhd and T.S Yee & Associate specification.

3.2 Method -of Construction for Strip Footing

3.2.1 Strip Footing

There are numerous foundation types. Different ground conditions, proximity of trees, backfilled land, soil types, proximity of drains, and wind speeds all influence the shape of our foundation work. This project will only cover the strip foundation, which is the most common and widely used. Where strip foundations are not appropriate, an indication will be provided. A strip foundation is simply a concrete strip placed in a trench. This strip's absolute minimum thickness is 150mm.

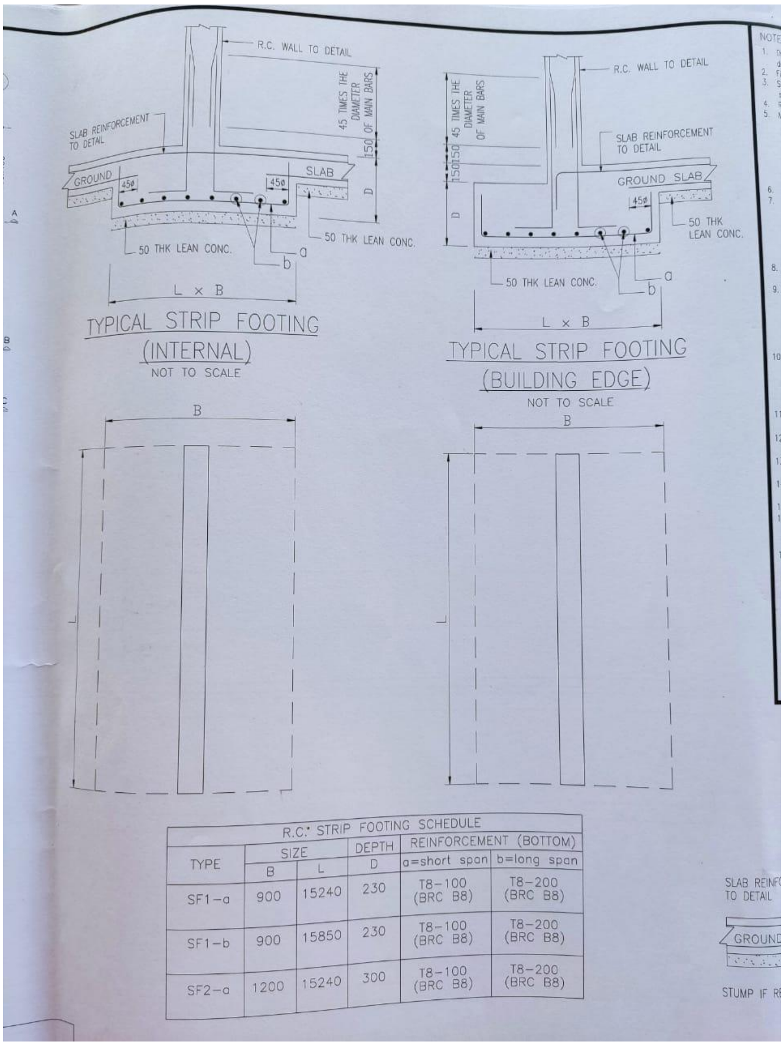


Figure 3.8 Strip footing detail drawing

The building regulations for foundations provide a clear set of guidelines for when strip foundations are appropriate. This is dependent on the walls that the foundations support being placed centrally on their respective strip of concrete:

a) There is no "made" ground (imported soil, etc.) or significant soil strength variation in the loaded area (construction floor area or "load"), nor are there any weak soil patches that are likely to cause foundation failure.

b) The foundation strip width is determined by RC Strip Footing Schedule in figure 3.19.

c) The thickness of the concrete strip is equal to or greater than the projection from the wall face, and it is never less than 150mm.

d) The upper level of a stepped foundation overlaps the lower level by twice the step height, the foundation thickness, or 300mm. Whichever is greater.

3.2.2 Thing to be considered when using Strip Footing

I. Trees

Existing trees absorb a significant amount of moisture from the soil, which is especially important in clay soils. Even without trees, the ground will rise and fall in different conditions, and in a dry summer, the trees will continue to draw water from the ground, shrinking the clay even more. Between Winter and Summer, the ground around a tree can rise and/or fall by up to 40mm. (Edward, 2021)

When a tree is cut down, the ground can swell up to 150mm in clay conditions because the roots are no longer drawing water from the ground. This can, of course, have an impact on the foundations and any drains within the tree's root zone. It is a general rule that, whenever possible and using strip foundations, the structure be kept at least as far away from the tree/s as the tree's height. When trees are planted in rows, this can be increased to 1.5 times the tree's height. These precautions may include piling the foundations or other measures determined by the building inspector to be necessary. It should also be noted that dead trees will eventually rot underground, resulting in depressions and weakened bearing. (Edward, 2021)

II. Mining

If there has ever been mining in the area, a special check with local authorities will be required to determine the extent of the works.

The load placed on a foundation determines its size. This load is distributed throughout the property and bears down on the walls, which are actually supported by the foundation. For example, the weight of the roof, a particularly heavy part of the structure, is distributed to the structure's walls via roof trusses. This is also true of the suspended floors within the property. This "loading" is calculated for the property, and the foundations are built to accommodate it. However, the nature of the ground will have a significant impact on this design criteria.

The depth of concrete must be determined after the ground conditions have been determined, loadings have been calculated, and foundation widths have been determined. For ordinary mortals, this is an extremely complex procedure involving punching shear (the tendency of the weight to want to punch a hole through the concrete base) and tension calculations, crushing strength of aggregates, and various mathematical procedures.

3.2.3 Strip Footing Advantages

A strip foundation has a number of advantages that make it the most popular one among all other types of foundations:

1. Its construction is technically simple, inexpensive, and does not typically require the use of heavy machinery.

2. The walls of a strip foundation can also serve as the walls of the house's basement.

3. It can be used to build both small private houses and large apartment buildings.

4. It is possible to construct a house on a slant.

5. The construction can be completed regardless of the weather.

6. The structure's settlement is minimal.

7. It is dependable and long-lasting.

8. It is capable of withstanding heavy loads.

9. It is possible to improve the heat insulation of the house's floors by using a strip foundation.

3.2.4 Strip Footing Disadvantages

Strip foundations have a number of disadvantages as well:

1. A strip foundation necessitates the use of numerous materials.

2. Waterproofing is necessary.

3. With a monolithic concrete foundation, the most dependable type, you must fill the entire lot at once; this is very difficult work that requires a large number of people and the use of machinery.

4. If the above-ground structure to be built is large or you intend to build a basement, you will need to do a lot more earthwork.

This type of foundation should not be used on horizontally unstable or heaving soils (clays). It is also ineligible for use on peat bogs.

3.2.5 Sanitary works

Figure 3.9 Installing sanitary pipe

Sanitary works is about carrying wastewater to the disposal system through plumbing fixtures. As shown in figure 3.8, the plumbers install the sanitary pipes. The PVC pipes are expected to last for a long time and suffer fewer leaks only.

Plumbing is a rough-in element of construction that is typically hidden by finished elements such as walls, floors, and roofs. It can also be used to run beneath sidewalks, stoops, patios, and decks. Any plumbing that runs under the home must be installed before the concrete is poured during the initial construction of a home with a concrete slab foundation and basement level, because the plumbing runs in the dirt, not within the actual concrete.

Figure 3.10 Installing sanitary pipes

The main sewer line is gravity-fed and runs beneath the future slab. The pipe descends gradually until it connects to the public sewer main, which run beneath the street in front of the house. House in rural area, the main sewer line will lead to a septic tank. The main sewer line is the deepest of the drain lines, all of which connect to it beneath the slab.

Before the slab is poured, the contractor makes provisions for draining each fixture. Individual drainpipes for future sinks, utility drains, tubs, and showers are run by the plumber. Each of these drainpipes must have its own gradual descent, or "fall," to allow grey water and waste materials to flow through the pipe and into the sewer line as it connects to the main sewer line.

Water supply lines run above ground, through stud walls, to the fixtures. These are narrower lines made of copper or polyvinyl chloride (PVC). The plumber installs the water supply lines after the builder has completed the rough frame of the house. After the wiring, ducting, and drywall are installed, the plumber returns to connect the water supply lines and drain stubs to the sinks, tubs, and showers.

3.2.6 Design of formwork

Figure 3.11 Strip footing and slab formwork

The contractor is solely responsible for the design and construction of formwork. It must include all moulds for forming the concrete as well as all temporary construction for the proper completion of the work. Before construction work begins, the design must be submitted to the Engineer for approval.

Based on figure 3.11, the strip footing formwork is installed around the house area. Formwork must be installed with perfect lines, grades, and dimensions, with no crevices at joints. It must be securely braced, supported, and wedged in order to maintain its position without displacement or deflection during concrete placement and compaction. Unless otherwise specified, all joints must be horizontal or vertical.

When reusing formwork, ensure that the surface is smooth and clean, and that it is free of warping, twisting, or other deformation. Any formwork that has deteriorated sufficiently in the Engineer's opinion to render it unsuitable for the work shall be rejected and must be removed from the site within 48 hours or broken up once, with new formwork provided at the Contractor's expense.

3.2.3 Cutting and Bending of reinforcement

Bending reinforcement steel bars generally requires careful supervision, skilled craftsmanship, and efficient equipment (IS: 2502). Cutting and bending operations must be performed by qualified personnel.

Figure 3.12 Bending reinforcement steel

Bend dimensions must be such that only a minimal amount of calculation is required for bar marking. As shown in figure 3.11, the reinforcement bar is bend by using bending machine. The dimensioning procedure shall be used in accordance with the drawings, and in the absence of dimensions on the drawings, IS: 2502 shall be used for bending. Before cutting the bars, the dimensions shown in the bar bending schedule must be checked.

Figure 3.13 Cutting BRC

Rebar cages can be prefabricated or built on-site with hydraulic benders and shears. Steel fixers, or on-site labourers, place the rebar and ensure adequate concrete cover and embedment. Spot welding, steel wire tying, or mechanical connections are used to connect rebar cages. Mechanical connections, also known as 'couplers' or 'splices', are a good way to reduce rebar congestion in heavily reinforced areas for cast-in-place concrete construction.

Figure 3.14 Cutting reinforcement bar

Bars must be cut and bent cold using slow, steady pressure or in an approved bar-bending machine. Bending at temperatures above 100 degrees Celsius is only permitted with the approval and supervision of the Site Engineer.

Special care must be taken to ensure that the overall length of bars with multiple bends is accurate and that the bars remain in place without wrap or twist after bending and fixing in place.

3.2.7 Installing Damp Proof Membrane (DPM)

Figure 3.15 Laying DPM sheet

A damp-proof membrane (DPM) is a type of membrane used to prevent moisture transmission. A DPM is typically a polyethylene sheet laid beneath a concrete slab to prevent moisture from entering the concrete via capillary action.

The approved document suggests that if the ground is covered with dense concrete laid on a hardcore bed and a DPM is provided, a ground-supported floor will meet these requirements. It implies that the damp proof membrane could be above or below the concrete, and that it should be continuous with the damp proof courses (DPC) in walls, piers, and so on.

3.2.8 Fixing of reinforcement

All reinforcing bars, links, spacer bars, and other steel reinforcement parts must be in accordance with the Drawings in terms of number, size, length, shape, type, and position.

Figure 3.16 Fixing reinforcement bar

As shown in figure 3.14, Individual reinforcing bars are joined together to form the reinforcement cage, generally using tying wire. The reinforcement shall be accurately and securely fixed in place so that it is in the correct position in relation to the formwork to provide the specified concrete cover and will not be displaced due to traffic on the site or during the placing and compaction of the concrete or any related operations.

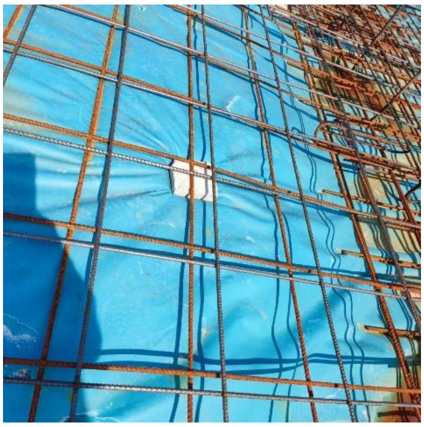


Figure 3.17 Concrete spacer

Plastic spacers or other approved means must be used to keep the correct cover in place. The use of concrete spacing blocks is permitted. As shown in figure 3.14, concrete spacers should be comparable to the surrounding concrete in terms of strength, durability, and form. Fixed spacers are used to parallel reinforcement bars that cannot be found in a straight line across a section. Spacers made of wood, stone, or metal are not permitted.

To maintain the specified cover, starter bars to columns and walls must be securely fixed to the reinforcement in the parent concrete and precisely located. No reinforcement embedded in hardened concrete may be bent.

3.2.9 Production of concrete

All concrete must be subjected to production control under the contractor's supervision. The contractor orders the concrete from 2 batching plant which is MDC Concrete and i-Mix Concrete. Concrete grade 25 is used for concreting substructure. All measures required to keep the properties of concrete in accordance with specified requirements are included in production control. It includes the following:

I. Selection of materials.
II. Concrete design.
III. Concrete production.
IV. Inspection and tests.
V. The use of the results of test on constituent materials, fresh and hardened concrete and equipment.
VI. For ready-mixed concrete, inspection of equipment used in transporting fresh concrete.

The production control system must include well-documented procedures and instructions. These procedures and instructions must be established in relation to the control requirement as specified.

3.2.10 Ready mixed concrete

Ready-mixed concrete is batched, either dry or wet, at a control plant and transported to the job site in specially designed agitators that run continuously or truck mixers.

Figure 3.18 Concrete truck

Ready-mixed concrete must meet the requirements for designed concrete outlined in subsection 3.2 and MS 523-1. All concrete materials, including water and admixtures, must be mixed in the plant before being delivered to the site in specially designed truck mixers. After the concrete has left the plant, no additional water or admixtures may be added.

Ready-mixed concrete delivered to the site must be accompanied by a delivery ticket and a manufacturer's batching record detailing the mix proportions by weight, the grade of concrete, the type and size of aggregate, the date and time of loading at the plant, the type and dosage of chemical admixtures, and other relevant production details in suitable format, failing which the Site Engineer, or his representative, must reject the total load of concrete. The Site Engineer. or his representative, as well as the contractor, must ensure that the information on the deliver tickets and the manufacturer's batching record corresponds to the details of the approved 'designed concrete' and its corresponding consistence.

Rejected concrete shall be removed from the site. The delivery ticket shall be marked 'REJECTED'.

3.2.11 Pouring concrete

Concrete must be transported, placed, and spread using approved methods and in a manner that prevents segregation. Unless an approved retarding admixture is used, concrete that is not placed within 90 minutes of adding water to the mix or before starting its initial set will be rejected.

Figure 3.19 Pouring concrete

As shown in figure 3.16, bucket is use for pouring concrete. Prior to the placement of concrete, all formwork and reinforcement must be clean and free of standing water. Concreting must be done in a continuous sequence of operations between and up to predetermined construction joints. It must be thoroughly compacted and worked into the corners using either hand tamping or mechanical vibration, or both. After tamping, the concrete shall not be subjected to any disturbance other than that caused by vibration compaction. In the event of an unavoidable stoppage in not predetermined location, the concreting shall be terminated on a horizontal plane and against vertical surfaces using stop boards. The location for termination must be approved by the Site Engineer.

Figure 3.20 Concrete compacting

As shown in figure 3.17, during placement, concrete must be carefully and thoroughly compacted to ensure that it completely surrounds the reinforcement, fills the formwork, and excludes voids. During the casting process, all concrete should be compacted using vibrators.

Unless otherwise approved by the Site Engineer, concrete shall be deposited in horizontal layers to a compacted depth of no more than 450 mm when internal vibrators are used, or 300 mm in all other cases. During placement, the surface of the concrete must be kept reasonably level.

Concrete shall not be dropped from a height greater than 1.5 m. However, higher drops may be permitted if the mix is well designed and proportioned. When trunking or chutes are used, they must be kept clean and used in such a way that segregation is avoided.

3.2.12 Dismantling of formwork

Formwork should not be removed until the concrete has developed enough strength to withstand all loads placed on it. The amount of time required before removing the formwork is determined by the structural function of the member and the rate of strength gain of the concrete. The rate of strength gain of concrete is influenced by factors such as concrete grade, cement type, water/cement ratio, curing temperature, and so on.

Figure 3.21 Formwork removal

As shown in figure 3.18, the formwork removal procedure should be supervised by the Site Engineer to ensure the quality of hardened concrete in structural members, for example it should be free of or have a low level of casting defects such as honeycombing, size and shape defects, and so on. These concrete flaws have an impact on the structure's strength and stability. As a result, either immediate repairs can be performed, or the members can be rejected.

Form separation should not be accomplished by pounding crowbars into the concrete. It could cause damage to the hardened concrete. This should be accomplished with the help of wooden wedges.

3.3 The Problems and Solutions during Construction of Strip Footing

3.3.1 Honeycomb

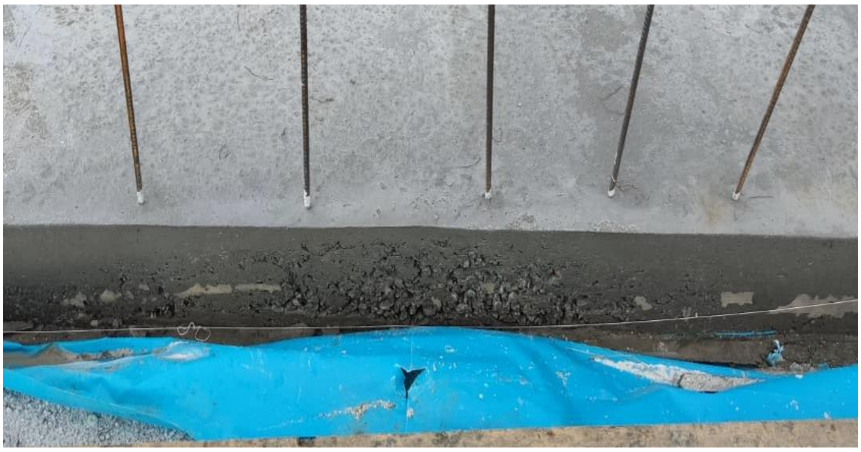


Figure 3.22 Honeycomb

<u>Problem</u>

Honeycombs are hollow spaces and cavities left in concrete mass on the surface or inside the mass where concrete cannot reach. These resemble a honeybee's nest. The main causes of honeycombs in concrete are improper vibration and workability of concrete.

Honeycombs on the sides are visible to the naked eye and can be easily detected once the shuttering is removed. Only advanced techniques, such as ultrasonic testing, can detect honeycombs hidden within a mass of concrete.

Honeycomb is due to non-reaching of concrete to all places due to which cavities and hollow pockets are created, main reasons are:

I. Inadequate vibration during the concrete process.

II. Less protection for reinforcement bars

III. Use of extremely stiff concrete (this can be avoided by controlling water as per slump test).

IV. The presence of a higher percentage of larger aggregate size in concrete also prevents concrete from filling narrow spaces between reinforcement rods.

Solutions

1. Using a hammer or wire brush, remove loose concrete or loosened aggregate. To avoid sound concrete damage around the honeycomb area, avoid the use of large forces such as electrical chippers.

2. Remove any dirt or loose debris from the area.

3. Before applying the repair material, wet the cleaned area.

4. Fill small voids and cracks with a suitable material, such as non-shrinkage epoxy grout, using a mechanical injection pressure pump.

5. If the depth of the honeycombing is greater than 5 cm, the filling process should be done in a 15 mm thick layer. It is recommended to wait 30 minutes before applying the next layer.

6. The strength of the repair material should be equal to that of the structural element's virgin concrete.

3.3.2 Segregation

Figure 3.23 Concrete segregation

Concrete segregation is the separation of cement paste and aggregates of concrete during handling and placement. Segregation can also occur as a result of over-vibration or compaction of concrete, in which cement paste rises to the top and aggregates sink to the bottom.

Concrete segregation has an impact on the strength and durability of structures. All concrete aggregates in a good concrete are evenly coated with sand and cement paste and form a homogeneous mass.

This happen because during the concreting works, suddenly it was raining heavily and cause the cement paste to flow outside the formwork. This causes the reduce of concrete strength and deviate from original grade of the concrete which is 25.

This problem can be solved by concreting half of the footing and slab during the raining and continue concreting the next day. By doing this, the concrete strength will be the same as the cement and aggregates is concrete follow the grade composition.

CHAPTER 4

CONCLUSION

Overall, after being involved in building construction with a focus on substructure elements, construction strip footing is the main bone of the building structure because all loads are transmitted through it. In most cases, the substructure is the building's foundation or ground level. As a result, understanding the various components that comprise the strip footing is critical when deciding on the best materials for the substructure. Aside from that, the characteristics of the method chosen are also required to ensure that it is both time and cost efficient for both parties. Concrete work must also be done by experienced workers throughout the process because it is dangerous and requires specific skills. This ensures that the concrete work is done correctly to provide a stable and strong foundation for the building. Furthermore, according to Energiser Enterprise Sdn. Bhd. building's lifespan regulation, all superstructure designs are made to last more than 50 years, which necessitates a high level of concrete work.

Besides that, to ensure that the reinforced strip footings are completely strong and safe for the superstructure, a Quality Assurance and Quality Control inspection is required to avoid any damage or defects. Some common defects are caused by agents such as atmospheric pollution, poor workmanship, or the use of inferior materials, as well as climatic conditions. Defective building construction increases not only the final cost of the product but also the cost of maintenance, which can be significant. Defective construction includes activities such as compaction that is not done according to specifications, resulting in weak concrete strength and early deterioration of structures. A substructure may fail completely as a result of this. Additionally, inherent failures may occur in a building that must cope with and carry any unresolved defect problem. Defective problems can lead to an unstable building structure that is dangerous to users and occupants.

Building or housing is the most fundamental need for humankind. Therefore, stable and secure buildings are important for the long term. With a strong substructure, the building can last a lifetime.

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