DEPARTMENT OF BUILDING
UNIVERSITI TEKNOLOGI MARA
(PERAK)

BUILDING STRUCTURE

Prepared by:

MUHAMMAD NABIHAN ZAHIN BIN MAT NASIR

2019261148

DEPARTMENT OF BUILDING

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

JANUARY 2022

It is recommended that the report of this practical training provided

By

Muhammad Nabihan Zahin bin Mat Nasir
2019261148

entitled

Building Structure

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

Report Supervisor	:	PM TS SR DR. Hayroman bin Ahmad.
Practical Training Coordinator	:	Dr. Nor Asma Hafizah binti Hadzaman.
Programme Coordinator	:	Dr. Dzulkarnaen Bin Ismail.

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

JANUARY 2022

STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at Kitacon Sdn. Bhd. for duration of 16 weeks starting from 2 September 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.

Student's Name: Muhammad Nabihan Zahin bin Mat Nasir.

Matric Number: 2019261148.

Programme: Diploma in Building (AP116).

Faculty: Faculty of Architecture, Planning and Surveying.

Title: Building Structure.

Signature: . . . .

Date: 7^{th} January 2022

ACKNOWLEDGEMENT

Alhamdullillah, praise to Allah, the Most Merciful, the Most Graceful.

I'd want to express my heartfelt gratitude to the following group of incredible people for their guidance, counsel, and assistance throughout the training period. First and foremost, I'd want to express my gratitude to Mr Tan Ah Kee for providing me with the opportunity to do my training in his prestigious company. Mr Yeong Kok Foo, Mr Gabriel Sinnapan, Mr Nik Mohd Khairuddin, Mr Isdan Ismail, and Ms Suhaily Latif, this team of professionals, have enabled me to learn and develop my understanding, knowledge, and feel of real-time projects, as well as the theory involved in structural, building, and civil works analysis. They are also in charge of facilitating and evaluating my training. Also, to the BSP120 (GLOMAC) site personnel, En. Hamidi (Resident Engineer/Senior C.O.W), Ah Ban (Carpenter), Jolil (Kapala), who have extended their cooperation and assistance in further enhancing my ability to understand construction and site administration procedures, tests procedures, site safety, and the industry's quality standards. It is a privilege for me to have the opportunity to 'work' with every one of you.

I'd also like to express my gratitude to all of the UiTM lecturers who have helped me grow as a student and person. I'd want to express my gratitude to the professors who were personally involved during my training period. I appreciate the time, effort, encouragement, and ideas that Dr, Hayroman bin Ahmad, Supervising Lecturer, Puan Nurhasyimah Binti Ahmad Zamri, Evaluation Lecturer, Dr. Nor Asma Hafizah binti Hadzaman, Practical Training Coordinator, and Dr. Dzulkarnaean Bin Ismail, Programme Coordinator have contributed to the successful completion of my training, this report, and the valuable knowledge that they have shared over the last few semesters.

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

Thank you so much.

ABSTRACT

Structural design is the systematic examination of a structure's stability, strength, and rigidity. The primary goal of structural analysis and design is to create a structure that can withstand all applied loads for the duration of its intended life. This report will discuss on the structural design used for a 2-storey terrace house. The objective of this report is to observe the sequence of works for structural works for a 2-storey terrace house and to investigate the materials needed for structural works. Observation on site and studying structural design given by the consultant engineer based on drawing was done for this report to be made. This report will also show the functions of consultant engineers to allow main contractors to continue their work.

CONTENTS			**PAGE NO**

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1.0

INTRODUCTION

1.1 Background of Study

Civil engineering structural design is a highly qualified and skilled field. It can be defined as a set of methods or tools for determining safe and cost-effective construction requirements, as well as ensuring that a proposed structure will be strong enough to support its intended load. Structural engineers undertake a structural analysis to discover what internal and external forces may affect the structure, then design a structure that meets the criteria using the proper materials and reinforcements. The professional disciplines of architecture and structural engineering have a close link. When constructing a building, structural engineers focus on strength, durability, and safety, whereas architects are typically responsible with developing the project's visually appealing aspects.

The land on which a building is built, the temperature of the region, the budget allotted to the construction of the building, the texture of the soil, the existence of water, and other factors all influence the structure and design of a building. The primary focus of structural engineers is the safety and stability of the structures they build. The key technique that structural engineers use to ensure that a structure can withstand the many sorts of forces that it would face during normal operation is structural analysis. When conducting a structural analysis, civil engineers focus on the three (3) attributes of forces. Firstly, is its magnitude; The magnitude of the force acting on the structure. The force's direction; The weight of a heavy snowfall would act downwards, in the direction of gravity, whereas a strong wind would act against the side of the building. To withstand different types of forces, different materials and reinforcement methods are necessary. The force's action is defined by its position. Structural engineers must consider the impact of predicted forces on each individual region of the structure, not just the entire structure as a whole.

The total of forces acting on a structure must constantly equal zero in order for it to remain stationary. Civil engineers, on the other hand, are aware that the structure will be subjected to external forces during its operation. Live loads, such as building inhabitants and furnitures, and environmental loads, such as wind, snow, and earthquakes, are examples of this. In any event, good structural design necessitates civil engineers ensuring that a structure can absorb external force while preserving its internal balance. A building that cannott absorb external forces is subject to damage and instability.

However, the aim of this study is to discuss and learn the typical structure design used and sequence of structural works for a 2-storey terrace houses located at Bandar Saujana Perdana.

1.1 Objectives

Firstly, to observe the sequence of works for structural works in this project including paperworks to be submitted to consultant engineer. Secondly, to investigate the quantity of materials needed for structural elements mainly on concrete usage and their grade of concrete mix used in this project.

1.2 Scope of Study

The study is carried out at Bandar Saujana Perdana, Mukim Ijok, Selangor Darul Ehsan. This study focus on the structural design of a 2-storey terrace house. The methods of installation, materials and machineries used for moving materials needed for each element was observed during this study. The duration for each element to be completed, quantity of labors was also observed.

1.3 Methods of Study

Firstly, observation was done for a duration of 16 weeks comprising of different elements of structure such as piling works, pile cap and etc. The observation was recorded by taking pictures of all the elements of structure before and after concreting works. Secondly, document reviews by referring from construction drawings (structure drawings mainly), standard operating procedures of site management was observed during this study.

CHAPTER 2.0

COMPANY BACKGROUND

2.1 Introduction of Company

KITACON SDN. BHD. was founded in 1990 as a main contractor. Residential and industrial projects are generally the company's major focus. Kitacon Sdn. Bhd. primary projects are located within the Klang Valley. Kitacon Sdn. Bhd. is also certified to MS ISO 9001, MS ISO 14001, OHSAS 18001, and MS 1722.

2.2 Company Profile

Kitacon Sdn Bhd is a Malaysian company with headquarters in Klang. Currently, the company works in the Heavy and Civil Engineering Construction industry. This company was established on March 19, 1990. Kitacon Sdn Bhd's latest financial highlights for 2019 revealed a 5.96 percent reduction in net sales revenue. Over the same time period, its total assets declined by 6.98 percent. Kitacon Sdn Bhd's net profit margin fell by 1.5 percent in 2019.

2.3 Organization Chart

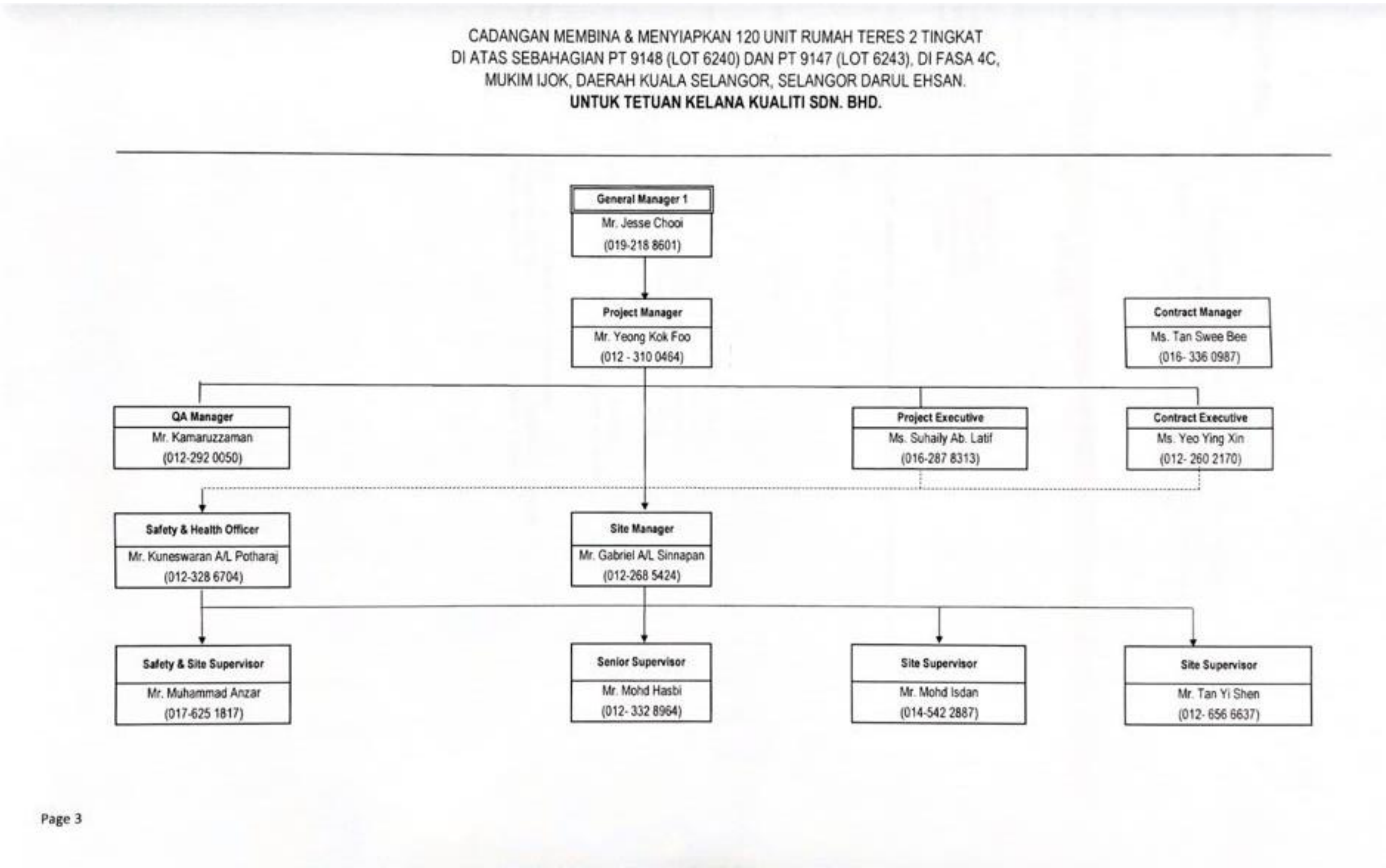


Figure 1: Image shows the organization chart for this project.

2.4 List of Project

2.4.1 Completed Projects

No	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1	EMERALD 299	RM 90 Million	JULY 2019	JULY 2021	2 YEARS	GUOCOLAND
2	SJK (C) Bukit Fraser	RM 6.9 Million	SEPT 2019	27 NOV 2021	1 YEAR 2 MONTH	TROPICANA AMAN SDN. BHD.
4	ECO ARDENCE 224	RM 150 Million	JULY 2018	FEBRUARY 2019	1 YEARS 8 MONTH	ECOWORLD
5	KLK 191	-	JULY 2018	JULY 2021	3 YEARS	KLK LAND
6	WELLOYD 48	RM 56 Million	-	SEPT 2021	-	WELLOYD PROPERTIES
7	Worldwide 147	-	-	SEPT 2021	-	WORLDWIDE

Table 1.0 shows list of completed projects.

2.4.2 Ongoing Projects

No.	Project Title	Project Value	Start Date	Completion Date	Project Duration	Client
1	BANDAR SAUJANA PERDANA 120	RM 28 Million	AUGUST 2021	NOVEMBER 2022	1 YEARS 3 MONTHS	GLOMAC SDN. BHD.
2	Element Residences 231	RM 101 Million	2 MARCH 2020	1 APRIL 2022	2 YEARS 1 MONTH	TROPICANA AMAN SDN. BHD.
3	Freesia Residences 198	RM 133.6 Million	1 JUNE 2021	31 MAY 2023	2 YEARS	TROPICANA AMAN SDN. BHD.
4	Dalia Residences 207	RM 143.3 Million	22 NOVEMBER 2017	10 NOVEMBER 2020	22 MONTHS	TROPICANA AMAN SDN. BHD.

Table 1.1 shows list of ongoing projects.

CHAPTER 3.0

CASE STUDY

3.1 INTRODUCTION

This study was conducted in an ongoing housing project located in Mukim Ijok, Selangor. The project is a ‘Proposed 120 units Double Storey Terrace Houses on Lot 6243 and Lot 6240, Phase 4C, at Mukim Ijok, Kuala Selangor, Selangor Darul Ehsan’. This project began on 2 August 2021 and shall be completed by November 2022. There are 10 blocks of houses with each block containing 12 houses. The main focus during this study was the structure works for the proposed double storey terrace house.

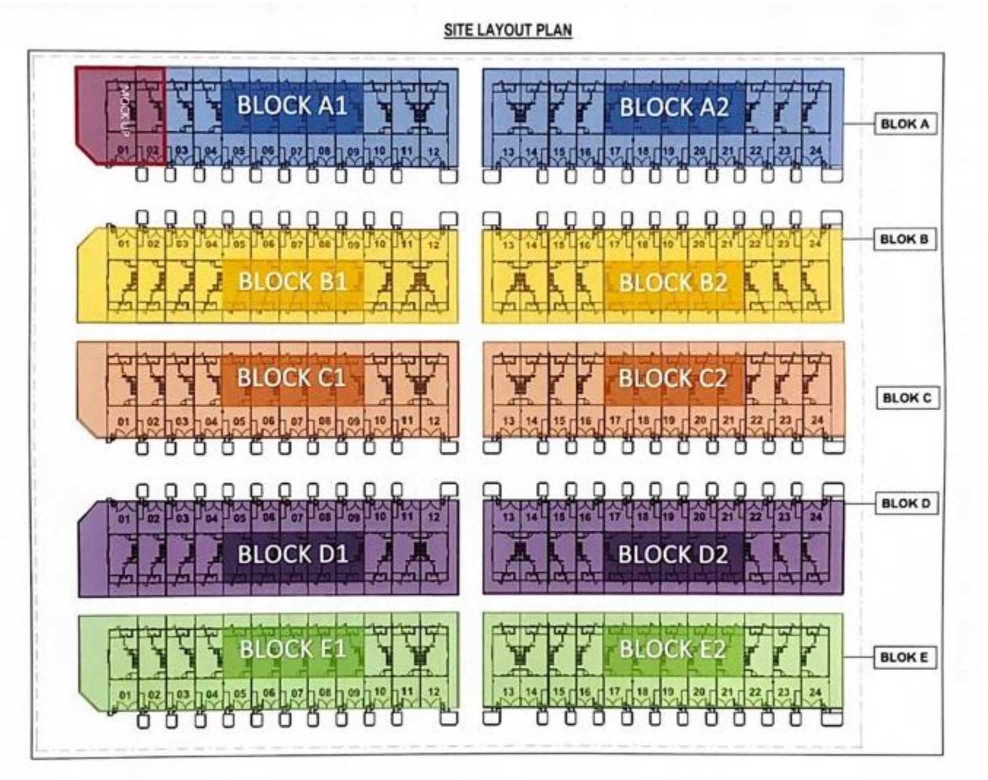


Figure 2: Image shows the site layout plan.

Figure 3: Image shows the signboard of the project where this study was conducted.

Figure 4: Image shows the site progress as of 3/1/2022

3.2 PILING

Deep foundations were used in this project. A deep foundation transmits building loads to the soil further below the surface than a shallow foundation, which transfers loads to a subsurface layer or a range of depths. A pile, also known as a piling, is a vertical structural part of a deep foundation that is pushed or drilled into the earth in situ at the construction site. One of the main reason deep foundation is used for this project is that the soil at shallow depth is poor.

Driven piles, *prefabricated reinforced concrete piles with the size of 150mm x 150mm was used in this project*. A pile driver is used to drive prefabricated piles into the earth. Square, octagonal, and circular cross-sections are available in concrete piles. They are frequently prestressed and strengthened with rebar. Mechanical and other methods such as welding pile heads together can be used to join concrete piles. Driving piles rather than drilling shafts is advantageous because the displaced earth compresses the surrounding soil, creating friction against the piles' sides and therefore enhancing their load-bearing capability. Because of its technique of installation, driven piles are also regarded to be "tested" for weight-bearing capabilities; as stated by the Pile Driving Contractors' Association's slogan, *"A Driven Pile...Is a Tested Pile!"*.

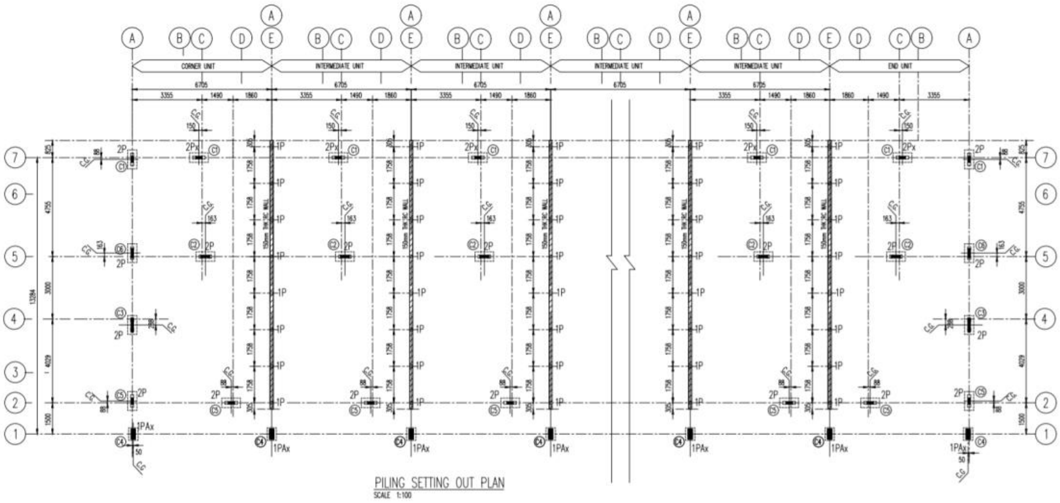
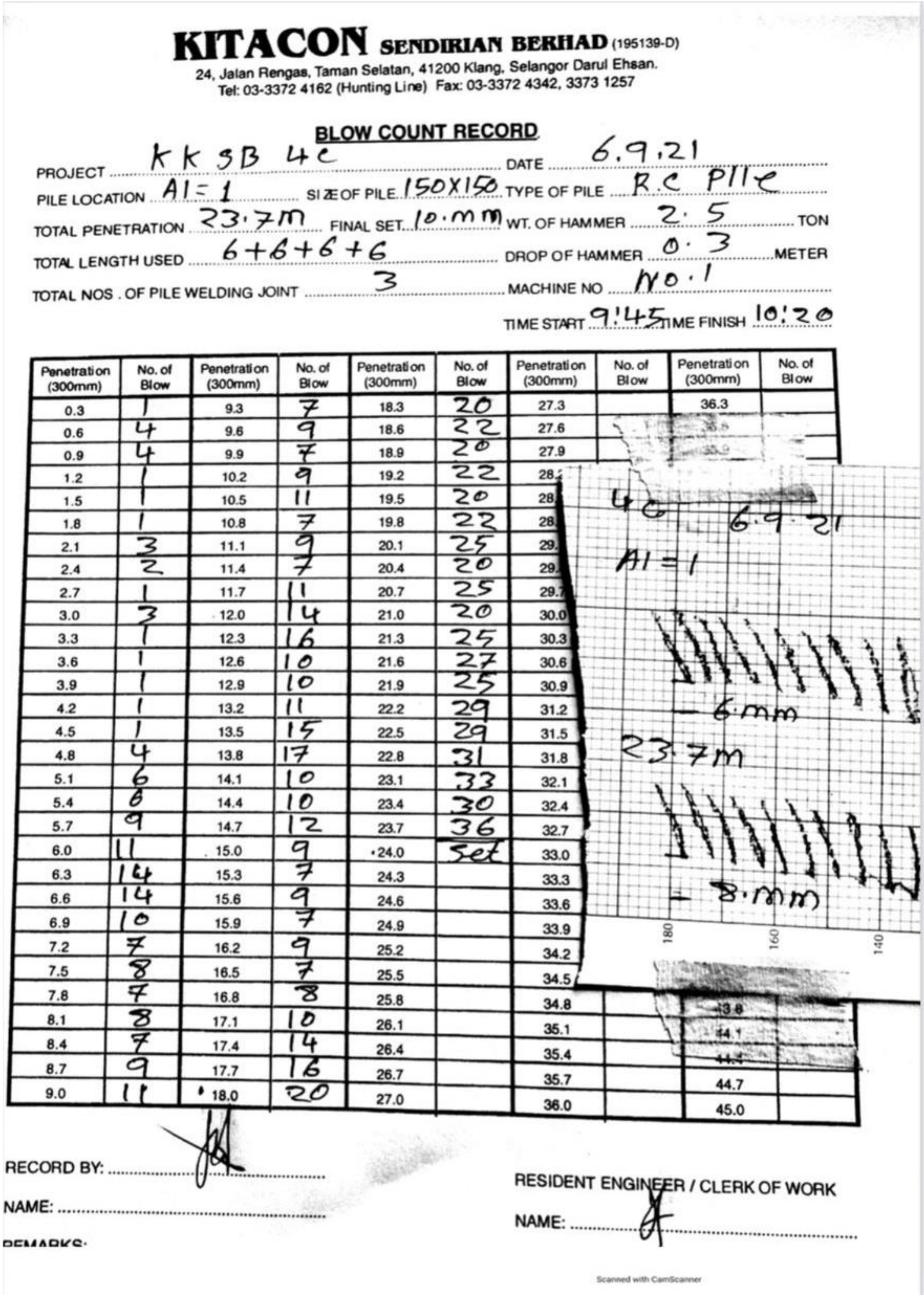


Figure 5: Image shows the piling setting out plan for this project

Figure 5 shows the dimensions for piling points to be driven for this project. A total of 1890 pile points; 189 pile points per block was pegged by the surveyor before piling works begin. The points are then checked by the site supervisor to verify each block contains 189 pegged pile points with its dimension of points true to drawing given by the consultant engineer.

Figure 6: Image shows a piling frame used in this project.

For this project, hydraulic hammer system was used for pile driving with a design working load of 250KN for each pile and its maximum length of pile driven taken at 30 meters. Other than that, a factor of safety of 2 times of the working load was obtained during test loading of piles.



KITACON SENDIRIAN BERHAD (195139-D)
24, Jalan Rengas, Taman Selatan, 41200 Klang, Selangor Darul Ehsan.
Tel: 03-3372 4162 (Hunting Line) Fax: 03-3372 4342, 3373 1257

BLOW COUNT RECORD

PROJECT: KK SB 4C DATE: 6.9.21
PILE LOCATION: A1 = 1 SIZE OF PILE: 150X150 TYPE OF PILE: R.C Pile
TOTAL PENETRATION: 23.7m FINAL SET: 10 mm WT. OF HAMMER: 2.5 TON
TOTAL LENGTH USED: 6+6+6+6 DROP OF HAMMER: 0.3 METER
TOTAL NOS. OF PILE WELDING JOINT: 3 MACHINE NO: No. 1
TIME START: 9:45 TIME FINISH: 10:20

Penetration (300mm)	No. of Blow	Penetration (300mm)	No. of Blow	Penetration (300mm)	No. of Blow	Penetration (300mm)	No. of Blow	Penetration (300mm)	No. of Blow
0.3	1	9.3	7	18.3	20	27.3		36.3	
0.6	4	9.6	9	18.6	22	27.6			
0.9	4	9.9	7	18.9	20	27.9			
1.2	1	10.2	9	19.2	22	28.			
1.5	1	10.5	11	19.5	20	28			
1.8	1	10.8	7	19.8	22	28			
2.1	3	11.1	9	20.1	25	29.			
2.4	2	11.4	7	20.4	20	29.			
2.7	1	11.7	11	20.7	25	29.7			
3.0	3	12.0	14	21.0	20	30.0			
3.3	1	12.3	16	21.3	25	30.3			
3.6	1	12.6	10	21.6	27	30.6			
3.9	1	12.9	10	21.9	25	30.9			
4.2	1	13.2	11	22.2	29	31.2			
4.5	1	13.5	15	22.5	29	31.5			
4.8	4	13.8	17	22.8	31	31.8			
5.1	6	14.1	10	23.1	33	32.1			
5.4	6	14.4	10	23.4	30	32.4			
5.7	9	14.7	12	23.7	36	32.7			
6.0	11	15.0	9	24.0	Set	33.0			
6.3	14	15.3	7	24.3		33.3			
6.6	14	15.6	9	24.6		33.6			
6.9	10	15.9	7	24.9		33.9			
7.2	7	16.2	9	25.2		34.2			
7.5	8	16.5	7	25.5		34.5			
7.8	7	16.8	8	25.8		34.8		43.8	
8.1	8	17.1	10	26.1		35.1		44.1	
8.4	7	17.4	14	26.4		35.4		44.4	
8.7	9	17.7	16	26.7		35.7		44.7	
9.0	11	18.0	20	27.0		36.0		45.0	

RECORD BY: ....
NAME: ....
REMARKS:

RESIDENT ENGINEER / CLERK OF WORK
NAME: ....

Scanned with CamScanner

Figure 7: Image shows an example of blow count record for a driven pile point.

Figure 7 shows that a driven pile point was driven to set and its set graph taken twice. Figure 7 also shows that the weight of hammer used in this project is 2.5 tonnes with a drop height of 0.3 meters. After piling works have finished for each block, a surveyor surveyed the whole block to submit an as-built piling layout to the consultant engineer. Based on the piling structural notes given by the consultant, "The deviation of piles from its intended position shall not exceed 75mm."

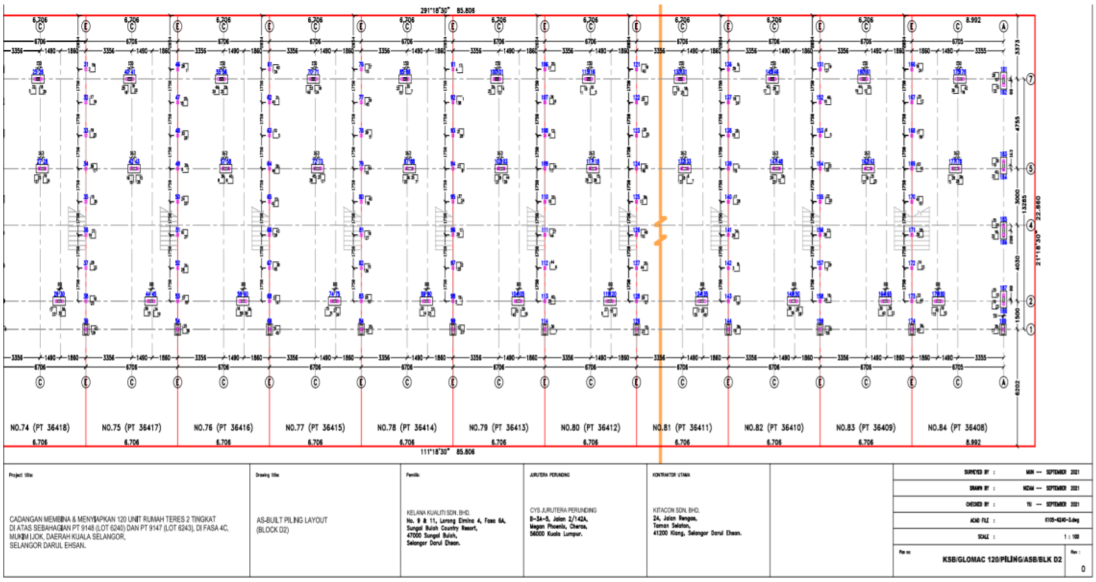


Figure 8: Image shows an example of an as-built piling layout submitted to the consultant engineer.

Figure 8 shows that the deviation of piles does not exceed 75mm as per requirements given by the consultant engineer. Furthermore, there are 24 points of driven piles tested by using PDA (Pile Driving Analyzer). The Pile Driving Analyzer (PDA), also known as dynamic pile testing (DPT), is a form of dynamic test.

In the construction of a building, the foundation, whether shallow or deep, is the "core structure" because it plays a crucial role in providing safe, stable, and appropriate strength to sustain the entire structure. To ensure the safe and stable high performance of the building structure, the foundation must be precisely selected based on structural requirements, subsurface condition, site conditions, and economics. For a deep foundation to work as intended, its ultimate strength must fulfil both structural and geotechnical restrictions.

CYS JURUTERA PERUNDING

Consulting Engineers
B-3A-5, Jalan 2/142A, Megan Phoenix, Cheras, 56000 Kuala Lumpur
Tel: 03-91011613
E-mail: cysjp23@yahoo.com; cysjp23@gmail.com

Your ref. : KITA-SP120/CYS/2021/21-026-PRO
Our ref : CYS2205/PH4C/KITA/21/024
Date : 18th October 2021

KITACON Sendirian Berhad
24, Jalan Rengas, Taman Selatan,
41200 Klang,
Selangor Darul Ehsan.
Tel: 03- 3372 4162
Attn: Mr.Yeong Kok Foo

RE: CADANGAN MEMBINA DAN MENYIAPKAN 120 UNIT RUMAH TERES 2 TINGKAT DI ATAS SEBAHAGIAN PT 9148 (LOT 6240) DAN PT 9147 (LOT 6243), DI FASA 4C, MUKIM IJOK, DAERAH KUALA SELANGOR, SELANGOR DARUL EHSAN UNTUK TETUAN KELANA KUALITI SDN BHD

- PDA Tests Report No.4 (Block B2,C1,C2, & D1) -

With reference to the above, we wish to confirm that the PDA tests carried out on the following pile points are satisfactory and the capacity of the piles have achieved more than twice the design load.

Block B2
1. Pile no.15 : capacity 60.1 tons
2. Pile no.148 : capacity 64 tons

Block C1
3. Pile no.2 : capacity 57.0 tons
4. Pile no.90 : capacity 60 tons
5. Pile no.182 : capacity 59.1 tons

Block C2
6. Pile no.90 : capacity 55 tons
7. Pile no.149 : capacity 60.1 tons
8. Pile no.188 : capacity 62.1 tons

Block D1
9. Pile no.137 : capacity 59.9 tons
10. Pile no.147B : capacity 52.1 tons

Thank you.

Yours faithfully,
CYS JURUTERA PERUNDING

....
Ir. CHONG YOON SANG
C.C. - Kelana Kualiti Sdn Bhd
Arkitek JuruPerunding Suria Rahim
WT Partnership
C.O.W.

Figure 9: Image shows the chosen driven pile points for PDA (Pile Driving Analyzer) testing.

Figure 9 shows the points for PDA (Pile Driving Analyzer) was chosen by the consultant engineer. The chosen points are then given to main contractors for PDA (Pile Driving Analyzer) test to begin.

Figure 10: Image (Left) shows 2 sets of accelerometer gauges bolted on pile & image (Right) shows PDA equipment for PDA testing.

Figure 10 shows using wall plugs, two sets of strain and accelerometer gauges were bolted on opposing sides of the pile. These gauges are linked to a PDA (equipment shown in figure 10) for dynamic signal recording and field evaluation of data quality, soil resistance, and pile integrity.

By using the hydraulic hammer with a weight of 250KN and drop height of 0.3 meters, the hammer was dropped to cause a driving force onto the driven pile. Gauges mounted to the pile will collect dynamic force and velocity measurements. At the conclusion of the testing, the transducers and accelerometers will be dismantled. The data from the PDA will be transmitted and saved to a disc for later reporting and analysis. The PDA will process this information to provide an immediate visual and permanent record on location. Max. Resistance (RMX), Pile Integrity (BTA), Max Force (FMX), Max Stress (CXS), and Energy at Pile Top (EMX) are the most important markers for these results.

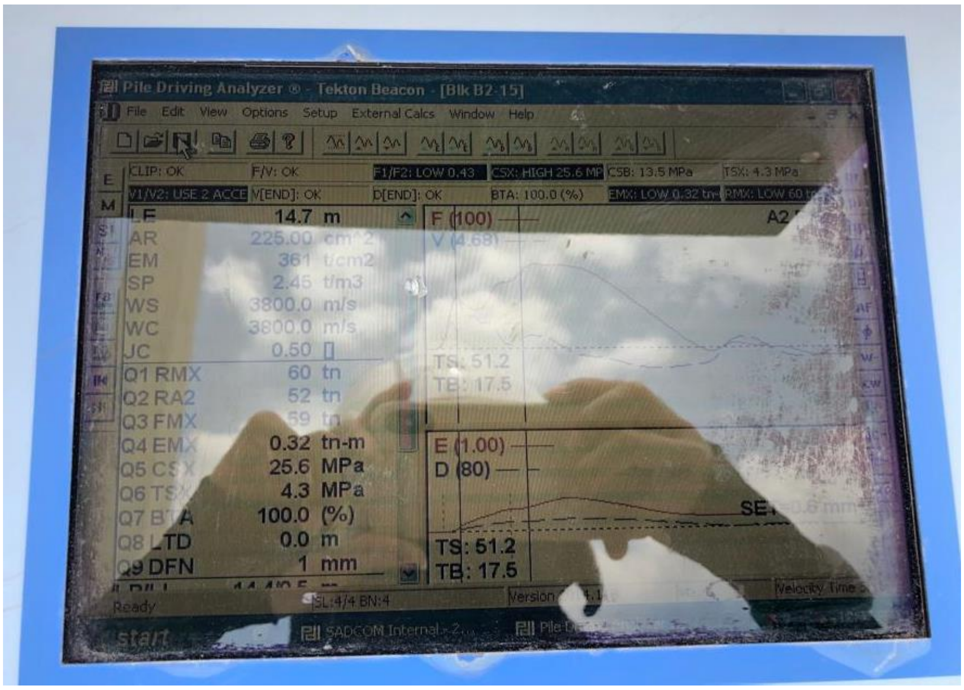
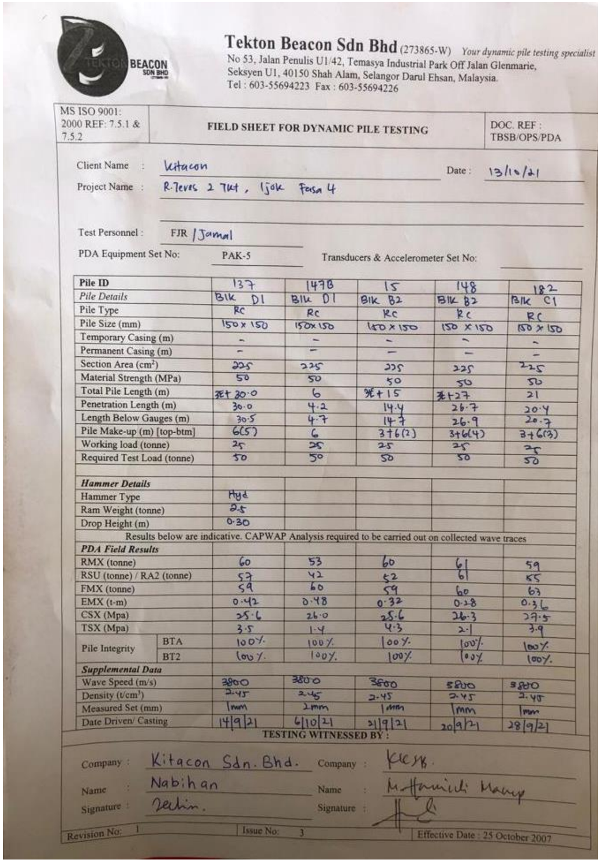


Figure 11: Image shows the results of a PDA test for a driven pile.



Tekton Beacon Sdn Bhd (273865-W) *Your dynamic pile testing specialist*
No 53, Jalan Penulis U1/42, Temasya Industrial Park Off Jalan Glenmarie,
Seksyen U1, 40150 Shah Alam, Selangor Darul Ehsan, Malaysia.
Tel : 603-55694223 Fax : 603-55694226

MS ISO 9001: 2000 REF: 7.5.1 & 7.5.2 | **FIELD SHEET FOR DYNAMIC PILE TESTING** | DOC. REF : TBSB/OPS/PDA

Client Name : Kitacon Date : 13/10/21
Project Name : R.Teres 2 Tkt, Ijok Fasa 4

Test Personnel : FJR / Jamal
PDA Equipment Set No: PAK-5 Transducers & Accelerometer Set No:

Pile ID		137	147B	15	148	182
Pile Details		Blk D1	Blk D1	Blk B2	Blk B2	Blk C1
Pile Type		RC	RC	RC	RC	RC
Pile Size (mm)		150 x 150	150x150	150 x 150	150 x 150	150 x 150
Temporary Casing (m)		-	-	-	-	-
Permanent Casing (m)		-	-	-	-	-
Section Area (cm²)		225	225	225	225	225
Material Strength (MPa)		50	50	50	50	50
Total Pile Length (m)		3Et 30.0	6	3E + 15	3E + 27	21
Penetration Length (m)		30.0	4.2	14.4	26.7	20.4
Length Below Gauges (m)		30.5	4.7	14.7	26.9	20.7
Pile Make-up (m) [top-btm]		6(5)	6	3+6(2)	3+6(4)	3+6(3)
Working load (tonne)		25	25	25	25	25
Required Test Load (tonne)		50	50	50	50	50
Hammer Details						
Hammer Type		Hyd				
Ram Weight (tonne)		2.5				
Drop Height (m)		0.30				
Results below are indicative. CAPWAP Analysis required to be carried out on collected wave traces						
PDA Field Results						
RMX (tonne)		60	53	60	61	59
RSU (tonne) / RA2 (tonne)		57	42	52	61	55
FMX (tonne)		59	60	59	60	63
EMX (t-m)		0.42	0.48	0.32	0.28	0.36
CSX (Mpa)		25.6	26.0	25.6	26.3	27.5
TSX (Mpa)		3.5	1.4	4.3	2.1	3.9
Pile Integrity	BTA	100%	100%	100%	100%	100%
	BT2	100%	100%	100%	100%	100%
Supplemental Data						
Wave Speed (m/s)		3800	3800	3800	3800	3800
Density (t/cm³)		2.45	2.45	2.45	2.45	2.45
Measured Set (mm)		1mm	2mm	1mm	1mm	1mm
Date Driven/ Casting		14/9/21	6/10/21	31/9/21	20/9/21	28/9/21

TESTING WITNESSED BY :

Company : Kitacon Sdn. Bhd. Company : KKSYB.
Name : Nabihan Name : M. Hamidi Manap
Signature : Zechin. Signature :

Revision No: 1 | Issue No: 3 | Effective Date : 25 October 2007

Figure 12: Image shows the field sheet results for PDA testing conducted in this project.

Figure 11 shows the results of a PDA test with its specific graphs while figure 12 shows the field sheet results that was signed by a main contractor PIC (Person-in-charge) and a Resident Engineer appointed for this project. These results are then submitted to the consultant engineer for their review and instructions to be given after PDA testing has completed.

CYS JURUTERA PERUNDING
Consulting Engineers
B-3A-5, Jalan 2/142A, Megan Phoenix, Cheras, 56000 Kuala Lumpur
Tel: 03-91011613
E-mail: cysjp23@yahoo.com; cysjp23@gmail.com

Your ref. : KITA-SP120/CYS/2021/21-026-PRO
Our ref : CYS2205/PH4C/KITA/21/024
Date : 18th October 2021

KITACON Sendirian Berhad
24, Jalan Rengas, Taman Selatan,
41200 Klang,
Selangor Darul Ehsan.
Tel: 03- 3372 4162
Attn: Mr.Yeong Kok Foo

RE: CADANGAN MEMBINA DAN MENYIAPKAN 120 UNIT RUMAH TERES 2 TINGKAT DI ATAS SEBAHAGIAN PT 9148 (LOT 6240) DAN PT 9147 (LOT 6243), DI FASA 4C, MUKIM IJOK, DAERAH KUALA SELANGOR, SELANGOR DARUL EHSAN UNTUK TETUAN KELANA KUALITI SDN BHD

- PDA Tests Report No.4 (Block B2,C1,C2, & D1) -

With reference to the above, we wish to confirm that the PDA tests carried out on the following pile points are satisfactory and the capacity of the piles have achieved more than twice the design load.

Block B2
1. Pile no.15 : capacity 60.1 tons
2. Pile no.148 : capacity 64 tons

Block C1
3. Pile no.2 : capacity 57.0 tons
4. Pile no.90 : capacity 60 tons
5. Pile no.182 : capacity 59.1 tons

Block C2
6. Pile no.90 : capacity 55 tons
7. Pile no.149 : capacity 60.1 tons
8. Pile no.188 : capacity 62.1 tons

Block D1
9. Pile no.137 : capacity 59.9 tons
10. Pile no.147B : capacity 52.1 tons

Thank you.

Yours faithfully,
CYS JURUTERA PERUNDING

....
Ir. CHONG YOON SANG
C.C. - Kelana Kualiti Sdn Bhd
Arkitek JuruPerunding Suria Rahim
WT Partnership
C.O.W.

Figure 13: Image shows the results reviewed by the consultant engineer.

Figure above shows the results from PDA test conducted for this project. Based on this review, the main contractor can begin piling cutting works for preparation of pile cap.

Figure 14: Image shows 'checking' of boundary rails that was marked with the intended pile positions.

Before piling cutting works begin, a boundary rail that was marked based on the dimensions of intended pile positions was installed. This was done to check for deviation of piles that might need an enlargement of pile cap.

Figure 15: Image shows piling cutting works

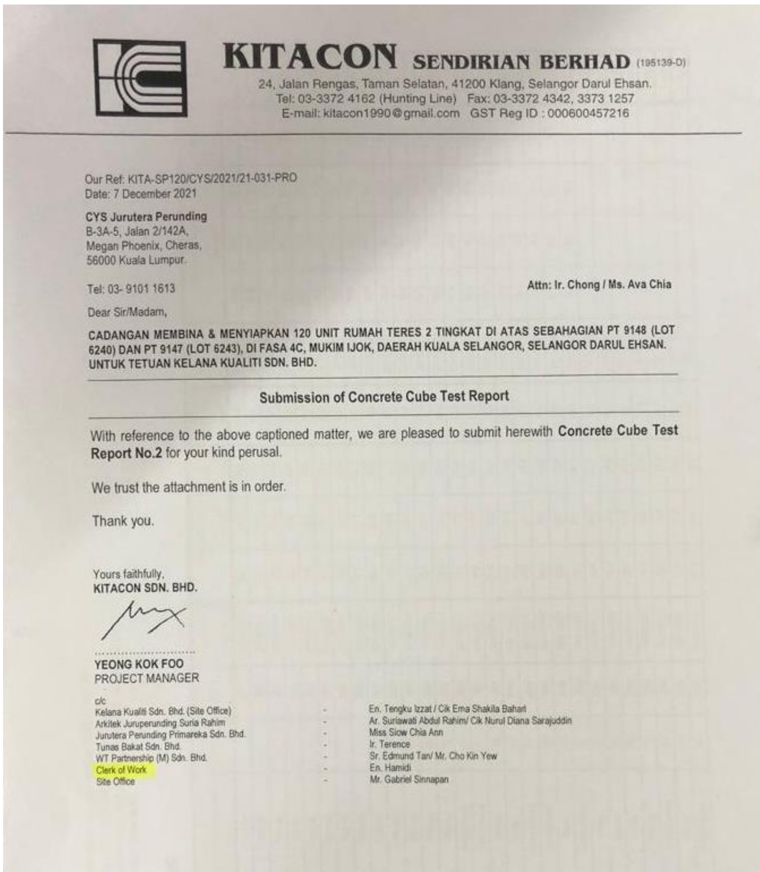
Figure 15 shows piling cutting works using oxidation of steel bar inside the pile for easier removal.

3.3 Concrete

Grade 25N reinforced concrete mix with 315 kg/m³ cement content was chosen and used in this project. Grade 25N indicates a compressive strength of 25N/mm² after 28 days of cube test. Grade 25 is a standard grade concrete that also indicates a mix proportion of 1:1:2 (Cement: Sand: Coarse Aggregate). Before concreting on site begins, a slump test and a cube test was done (Figure 16). The cube of concrete will then be submitted to a laboratory for cube strength test after 28 days. Reinforced concrete mix grade 25 is a standard grade for the construction of slabs, beams, columns and footings.

Figure 16: Image shows concrete cube filling and slump test on site

Figure 17: Image shows concrete cube to be submitted to the laboratory for strength test.



KITACON SENDIRIAN BERHAD (195139-D)
24, Jalan Rengas, Taman Selatan, 41200 Klang, Selangor Darul Ehsan.
Tel: 03-3372 4162 (Hunting Line) Fax: 03-3372 4342, 3373 1257
E-mail: kitacon1990@gmail.com GST Reg ID : 000600457216

Our Ref: KITA-SP120/CYS/2021/21-031-PRO
Date: 7 December 2021

CYS Jurutera Perunding
B-3A-5, Jalan 2/142A,
Megan Phoenix, Cheras,
56000 Kuala Lumpur.

Tel: 03- 9101 1613

Attn: Ir. Chong / Ms. Ava Chia

Dear Sir/Madam,

CADANGAN MEMBINA & MENYIAPKAN 120 UNIT RUMAH TERES 2 TINGKAT DI ATAS SEBAHAGIAN PT 9148 (LOT 6240) DAN PT 9147 (LOT 6243), DI FASA 4C, MUKIM IJOK, DAERAH KUALA SELANGOR, SELANGOR DARUL EHSAN. UNTUK TETUAN KELANA KUALITI SDN. BHD.

Submission of Concrete Cube Test Report

With reference to the above captioned matter, we are pleased to submit herewith **Concrete Cube Test Report No.2** for your kind perusal.

We trust the attachment is in order.

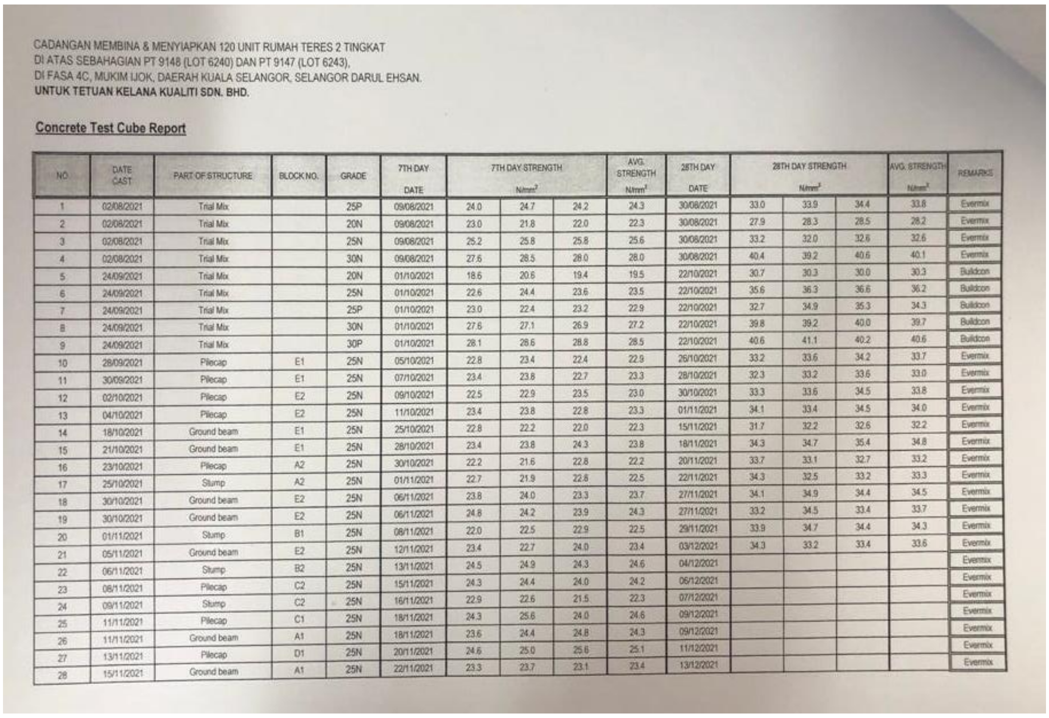
Thank you.

Yours faithfully,
KITACON SDN. BHD.

YEONG KOK FOO
PROJECT MANAGER

c/c
Kelana Kualiti Sdn. Bhd. (Site Office) - En. Tengku Izzat / Cik Ema Shakila Bahari
Arkitek Juruperunding Suria Rahim - Ar. Suriawati Abdul Rahim/ Cik Nurul Diana Sarajuddin
Jurutera Perunding Primareka Sdn. Bhd. - Miss Siow Chia Ann
Tunas Bakat Sdn. Bhd. - Ir. Terence
WT Partnership (M) Sdn. Bhd. - Sr. Edmund Tan/ Mr. Cho Kin Yew
Clerk of Work - En. Hamidi
Site Office - Mr. Gabriel Sinnapan

Figure 18: Image shows the concrete cube test report to be submitted to the consultant engineer.



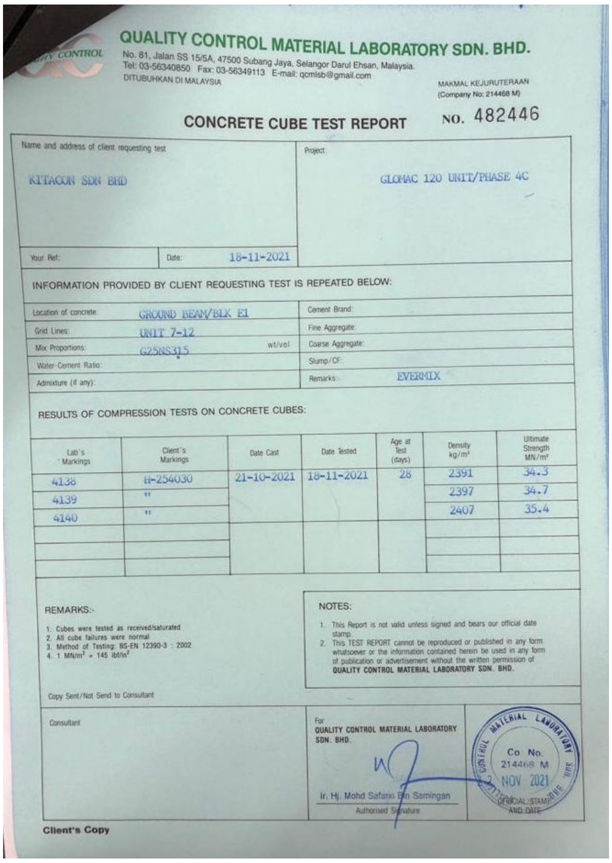
CADANGAN MEMBINA & MENYIAPKAN 120 UNIT RUMAH TERES 2 TINGKAT
DI ATAS SEBAHAGIAN PT 9148 (LOT 6240) DAN PT 9147 (LOT 6243),
DI FASA 4C, MUKIM IJOK, DAERAH KUALA SELANGOR, SELANGOR DARUL EHSAN.
UNTUK TETUAN KELANA KUALITI SDN. BHD.

Concrete Test Cube Report

NO.	DATE CAST	PART OF STRUCTURE	BLOCK NO.	GRADE	7TH DAY DATE	7TH DAY STRENGTH N/mm²			AVG. STRENGTH N/mm²	28TH DAY DATE	28TH DAY STRENGTH N/mm²			AVG. STRENGTH N/mm²	REMARKS
1	02/08/2021	Trial Mix		25P	09/08/2021	24.0	24.7	24.2	24.3	30/08/2021	33.0	33.9	34.4	33.8	Evermix
2	02/08/2021	Trial Mix		20N	09/08/2021	23.0	21.8	22.0	22.3	30/08/2021	27.9	28.3	28.5	28.2	Evermix
3	02/08/2021	Trial Mix		25N	09/08/2021	25.2	25.8	25.8	25.6	30/08/2021	33.2	32.0	32.6	32.6	Evermix
4	02/08/2021	Trial Mix		30N	09/08/2021	27.6	28.5	28.0	28.0	30/08/2021	40.4	39.2	40.6	40.1	Evermix
5	24/09/2021	Trial Mix		20N	01/10/2021	18.6	20.6	19.4	19.5	22/10/2021	30.7	30.3	30.0	30.3	Buildcon
6	24/09/2021	Trial Mix		25N	01/10/2021	22.6	24.4	23.6	23.5	22/10/2021	35.6	36.3	36.6	36.2	Buildcon
7	24/09/2021	Trial Mix		25P	01/10/2021	23.0	22.4	23.2	22.9	22/10/2021	32.7	34.9	35.3	34.3	Buildcon
8	24/09/2021	Trial Mix		30N	01/10/2021	27.6	27.1	26.9	27.2	22/10/2021	39.8	39.2	40.0	39.7	Buildcon
9	24/09/2021	Trial Mix		30P	01/10/2021	28.1	28.6	28.8	28.5	22/10/2021	40.6	41.1	40.2	40.6	Buildcon
10	28/09/2021	Pilecap	E1	25N	05/10/2021	22.8	23.4	22.4	22.9	26/10/2021	33.2	33.6	34.2	33.7	Evermix
11	30/09/2021	Pilecap	E1	25N	07/10/2021	23.4	23.8	22.7	23.3	28/10/2021	32.3	33.2	33.6	33.0	Evermix
12	02/10/2021	Pilecap	E2	25N	09/10/2021	22.5	22.9	23.5	23.0	30/10/2021	33.3	33.6	34.5	33.8	Evermix
13	04/10/2021	Pilecap	E2	25N	11/10/2021	23.4	23.8	22.8	23.3	01/11/2021	34.1	33.4	34.5	34.0	Evermix
14	18/10/2021	Ground beam	E1	25N	25/10/2021	22.8	22.2	22.0	22.3	15/11/2021	31.7	32.2	32.6	32.2	Evermix
15	21/10/2021	Ground beam	E1	25N	28/10/2021	23.4	23.8	24.3	23.8	18/11/2021	34.3	34.7	35.4	34.8	Evermix
16	23/10/2021	Pilecap	A2	25N	30/10/2021	22.2	21.6	22.8	22.2	20/11/2021	33.7	33.1	32.7	33.2	Evermix
17	25/10/2021	Stump	A2	25N	01/11/2021	22.7	21.9	22.8	22.5	22/11/2021	34.3	32.5	33.2	33.3	Evermix
18	30/10/2021	Ground beam	E2	25N	06/11/2021	23.8	24.0	23.3	23.7	27/11/2021	34.1	34.9	34.4	34.5	Evermix
19	30/10/2021	Ground beam	E2	25N	06/11/2021	24.8	24.2	23.9	24.3	27/11/2021	33.2	34.5	33.4	33.7	Evermix
20	01/11/2021	Stump	B1	25N	08/11/2021	22.0	22.5	22.9	22.5	29/11/2021	33.9	34.7	34.4	34.3	Evermix
21	05/11/2021	Ground beam	E2	25N	12/11/2021	23.4	22.7	24.0	23.4	03/12/2021	34.3	33.2	33.4	33.6	Evermix
22	06/11/2021	Stump	B2	25N	13/11/2021	24.5	24.9	24.3	24.6	04/12/2021					Evermix
23	08/11/2021	Pilecap	C2	25N	15/11/2021	24.3	24.4	24.0	24.2	06/12/2021					Evermix
24	09/11/2021	Stump	C2	25N	16/11/2021	22.9	22.6	21.5	22.3	07/12/2021					Evermix
25	11/11/2021	Pilecap	C1	25N	18/11/2021	24.3	25.6	24.0	24.6	09/12/2021					Evermix
26	11/11/2021	Ground beam	A1	25N	18/11/2021	23.6	24.4	24.8	24.3	09/12/2021					Evermix
27	13/11/2021	Pilecap	D1	25N	20/11/2021	24.6	25.0	25.6	25.1	11/12/2021					Evermix
28	15/11/2021	Ground beam	A1	25N	22/11/2021	23.3	23.7	23.1	23.4	13/12/2021					Evermix

Figure 19: Image shows a table of concrete cube test report.

Figure 19 shows the date of casting for each element of structure at its exact location and concrete grade used. The laboratory then shows the 7th day and 28th day strength of cube test for each element.



QUALITY CONTROL MATERIAL LABORATORY SDN. BHD.
No. 81, Jalan SS 15/5A, 47500 Subang Jaya, Selangor Darul Ehsan, Malaysia.
Tel: 03-56340850 Fax: 03-56349113 E-mail: qcmlsb@gmail.com
DITUBUHKAN DI MALAYSIA
MAKMAL KEJURUTERAAN
(Company No: 214468 M)

CONCRETE CUBE TEST REPORT NO. 482446

Name and address of client requesting test: KITACON SDN BHD
Project: GLOMAC 120 UNIT/PHASE 4C
Your Ref:
Date: 18-11-2021

INFORMATION PROVIDED BY CLIENT REQUESTING TEST IS REPEATED BELOW:

Location of concrete:	GROUND BEAM/BLK E1	Cement Brand:	
Grid Lines:	UNIT 7-12	Fine Aggregate:	
Mix Proportions:	G25NS315 wt/vol	Coarse Aggregate:	
Water-Cement Ratio:		Slump/CF:	
Admixture (if any):		Remarks:	EVERMIX

RESULTS OF COMPRESSION TESTS ON CONCRETE CUBES:

Lab's Markings	Client's Markings	Date Cast	Date Tested	Age at Test (days)	Density kg/m³	Ultimate Strength MN/m²
4138	H-254030	21-10-2021	18-11-2021	28	2391	34.3
4139	"				2397	34.7
4140	"				2407	35.4

REMARKS:-
1. Cubes were tested as received/saturated
2. All cube failures were normal
3. Method of Testing: BS-EN 12390-3 : 2002
4. 1 MN/m² = 145 lbf/in²

NOTES:
1. This Report is not valid unless signed and bears our official date stamp.
2. This TEST REPORT cannot be reproduced or published in any form whatsoever or the information contained herein be used in any form of publication or advertisement without the written permission of QUALITY CONTROL MATERIAL LABORATORY SDN. BHD.

Copy Sent/Not Send to Consultant

Consultant

For QUALITY CONTROL MATERIAL LABORATORY SDN. BHD.
Ir. Hj. Mohd Safarin Bin Samingan
Authorised Signature

OFFICIAL STAMP AND DATE
MATERIAL LABORATORY
Co. No. 214468 M
NOV 2021

Client's Copy

Figure 20: Image shows the concrete cube test report from the laboratory.

Figure 20 shows the density kg/m³ and ultimate strength MN/m² of cube test for Ground Beam casting at Block E1 after 28 days.

For lean concreting, Grade 15 concrete mix was used in this project. Grade 15 mix consists of a ratio of 1:2:4 (1 Cement, 2 Sand and 4 Aggregate). Grade 15 is commonly used as Plain Cement Concrete that can be useful as bedding for footings, beams, and slabs. Furthermore, Concrete mix Grade 15 does not need a slump test and cube test because every usage of grade 15 concrete mix in this project does not hold any reinforcements.

In every casting of structural elements, concrete cover was applied according to the specified requirement given by the consultant engineer. Protecting the reinforcing steel from corrosion induced by environmental factors necessitates the use of concrete cover. The steel reinforcement will deteriorate due to oxidation if it is not correctly installed or shielded from the environment. Moisture infiltration and/or carbon dioxide entry through the concrete cause oxidation of the reinforcing steel. Steel reinforcement will rust and expand to a higher volume than the steel itself when it corrodes. The concrete covering the steel cracks, spalls, and delaminates as a result of this reaction. The more solid cover there is, the longer it will take for moisture or carbon dioxide to infiltrate. Although the concrete cover protects the structural reinforcement from the environment, it also protects it during a fire. Concrete may reach temperatures of up to 815°C on its surface. When exposed to temperatures above 649°C, reinforcing steel, on the other hand, loses 50% of its steel strength. Concrete cover is required to keep reinforcing steel cooler than the outside environment, and the thicker the concrete cover, the higher the fire rating.

Figure 21: Image shows concrete cover used for pile cap.

Vibration of concrete is essential during casting of structural elements. Vibrating concrete is important because it increases the density and strength of the concrete by removing air bubbles and packing the aggregate particles together. A concrete structure with tightly packed particles will be stronger and more durable.

Concrete that has not been vibrated is full of microscopic air pockets (honeycomb), resulting in a poor finish and a fragile structure.

Immersion vibrator has been used for this project. Immersion vibrators, often known as "poker" or "needle" vibrators because of their tubular design, with an eccentric weight that causes vibrations to ripple from the casing and across the concrete in which they are immersed. The radius of the vibration is determined by the diameter of the casing, the instrument being used, and the frequency and amplitude settings. Immersion vibrations are currently available in a variety of action radiuses and are powered by fuel, electricity, or compressed air motors. When it comes to the actual process of concrete vibration, it is recommended that the immersion vibrator be inserted for 15 to 20 seconds until air bubbles stop surfacing.

Figure 22: Image shows the vibration of concrete during casting using an immersion vibrator.

Concrete curing was done by laying wet gunny sack on concrete slab in this project as shown in figure 23. Concrete curing is necessary as it helps prevents problems that could occur afterwards. Firstly, concrete curing help enhances hydration of concrete to reap better strength. Secondly, it improves the sturdiness of concrete by way of decreasing cracks. Thirdly, it could also provide better serviceability overall performance by way of increasing abrasion resistance.

Figure 23: Image shows the curing of Bathroom.

There is no way to build a structure without using construction joints. Because we cannot finish the job all at once, construction joints in concrete are unavoidable. Vertical and horizontal construction joints are provided at various phases of construction depending on the type of structural elements. In this project, construction joint for beam and slab was provided at one third of its whole length. Construction joint was not provided near or on the toilet area of the structure to prevent from leaking. For all construction joints provided in this project, it was shaped as 'step by step' for better jointing of concrete. Figure 24 shows an example of construction joint on 1st floor slab provided in this project.

Figure 24: Image shows a construction joint for 1st floor slab.

3.4 R.C Pile Cap

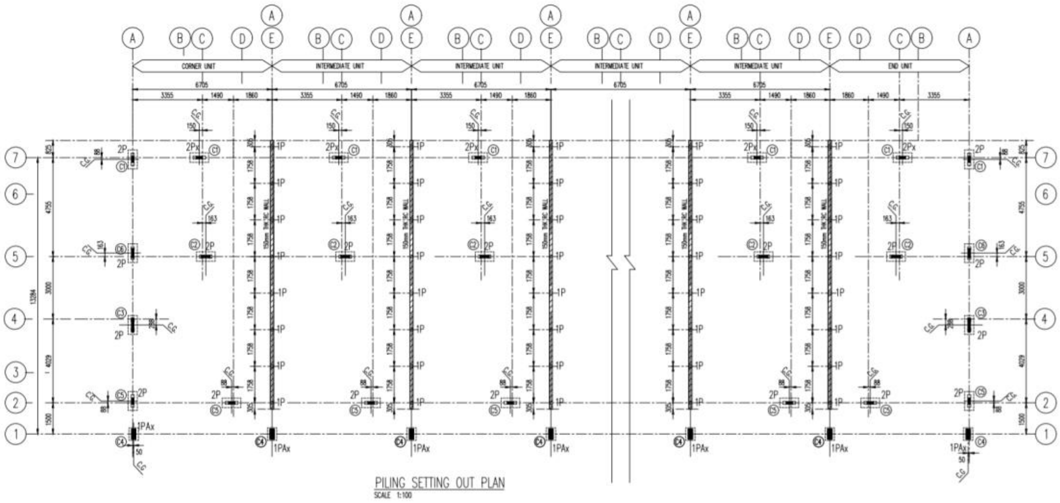


Figure 25: Image shows pile cap locations for each house

Figure 25 shows the pile cap locations based on the piling layout of each house. Based on the figure above, there are a total of 5 pile caps for intermediate houses with 2 of its pile cap is shared on the partition wall with another unit. As for the corner and end unit, its outer wall has their own pile cap arrangement but it still has 3 pile caps in the middle zone of the house and a shared pile cap for a partition wall. This concludes that corner and end units has a total of 9 pile caps.

The shape and plan dimensions of the pile cap are determined by the number of piles in the group and their spacing. Rectangular pile caps are commonly used for 2 pile groups of pile caps.

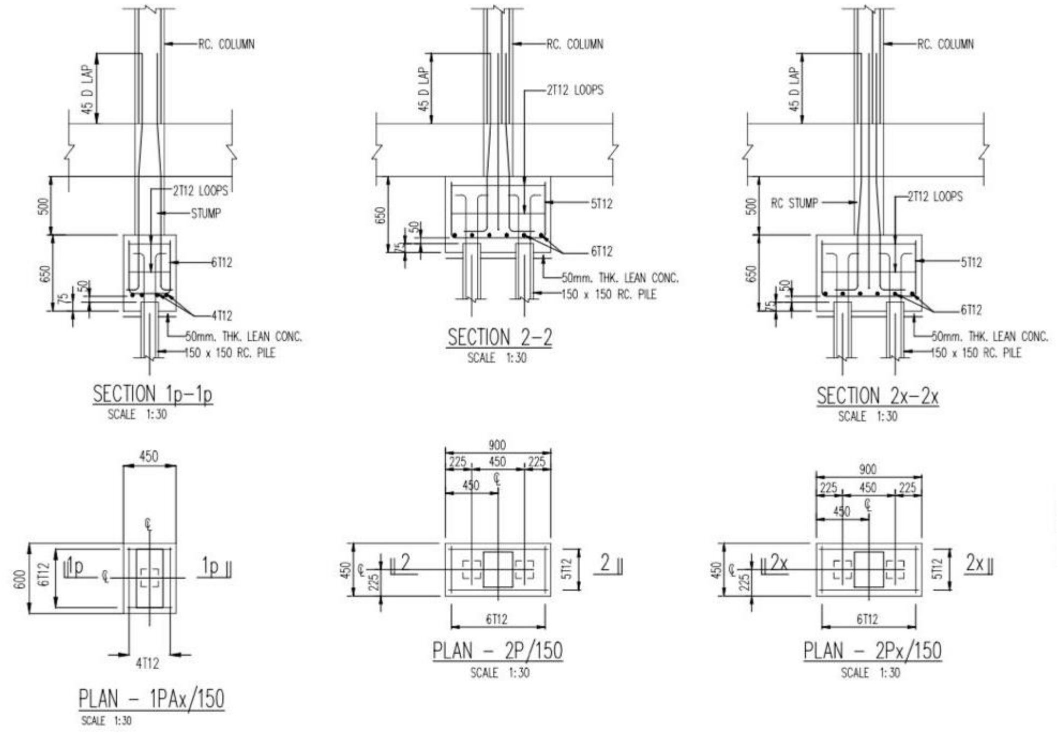


Figure 26: Image shows the specifications of pile cap.

Figure 26 shows the shape of pile caps used in this project was a standard regular shaped pile cap. The specifications for the 1 pile group of pile cap was used for partition walls and the end of outer walls that was located at the same row as pile cap mentioned for partition walls specifically designed for corner and end units.

Individual pilings can be used, or they can be grouped together and connected by a reinforced concrete cap. Pile caps provide a stable foundation and a greater surface for the building load to be distributed onto the piles. They function similarly to piled raft foundations, in which a concrete slab rests on potentially movable soil above a collection of piles.

Firstly, excavation works was done after piling cutting works has completed above topsoil. The earth was excavated for 1200mm deep for pile cap with stumps while pile caps without stumps was excavated for 700mm deep as shown in figure 28.

Figure 27: Image shows excavation works for pile cap.

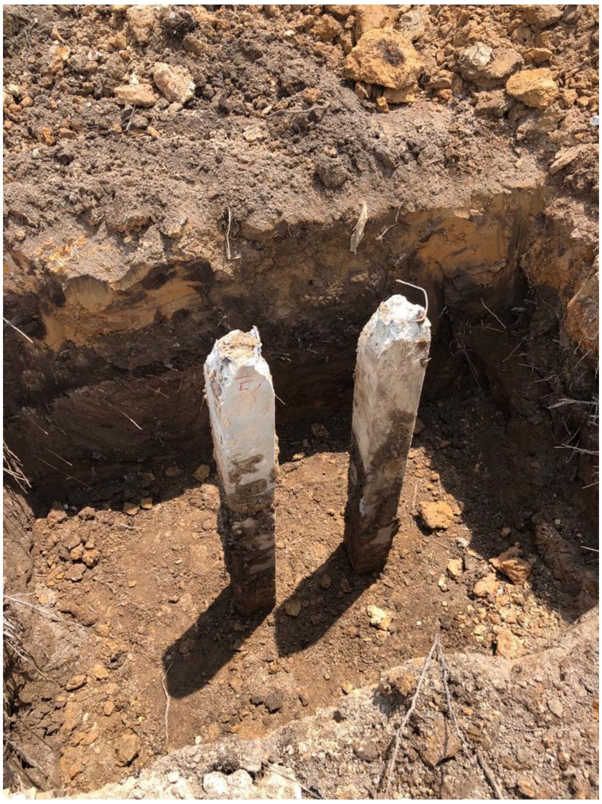


Figure 28: Image shows excavated pile cap point.

Secondly, lean concreting using concrete mix grade 15 of pile cap with thickness of 50mm was done. Lean concreting of pile cap acts as a bedding to avoid water from underground from direct contact with the finished structure.

Figure 29: Image shows lean concreting of pile cap.

Figure 29 shows lean concreting of pile cap before piling cutting works begins. Piling cutting works in the pile cap was done by leaving around 4 inches of the pile head to follow the requirements given by the consultant engineer based on structural drawing of pile cap. It also acts as a 'platform' for rebar to be installed. After piling cutting works for pile cap has completed, formwork installation of pile cap was done. During this stage, the level using theodolite and a staff of top concrete surface of pile cap was taken by the carpenter and marked using nails hammered on the inside of the pile cap formwork to act as a 'marker' for mason workers during concreting. The level of pile cap height for each pile cap design was done by following the structural design of pile cap shown in figure 26 which shows 650mm height for all pile caps. By pulling strings from nails marked as shown in Figure 14, the carpenters can also determine the centre gridline of the pile cap.

Figure 30: Image shows installation of pile cap formwork.

After the installation of formwork has completed, rebar installation began. Reinforcement bar for pile cap was installed complete with its concrete cover and following the structural design based on the specifications of each pile cap as shown in figure 21. After inspection was done by the clerk of work assigned in this project, concreting works can begin. A total of 20m³ of concrete mix grade 25 was needed for 12 houses including corner and end units.

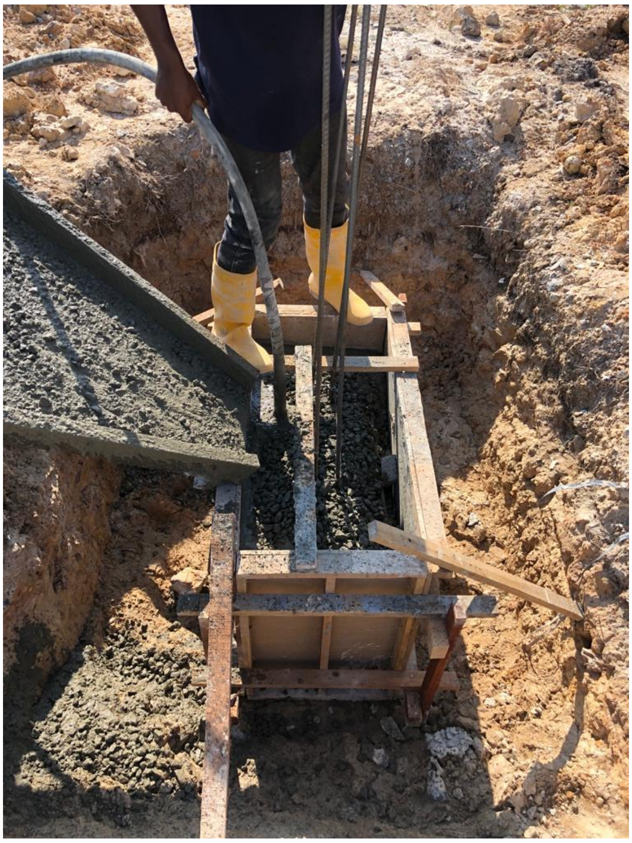


Figure 31: Image shows concreting of pile cap.

Figure 31 shows during the concreting of pile cap; vibration of concrete was done to avoid honeycomb.

Figure 32: Image shows a completed pile cap.

3.5 R.C Ground Beam

Beams are structural elements that transport loads placed along their length to their end points, which are then transferred to walls, columns, foundations, and other structures. As an alternative to standard foundations, ground beams are beams that bridge between pad foundations, piles, and other structures.

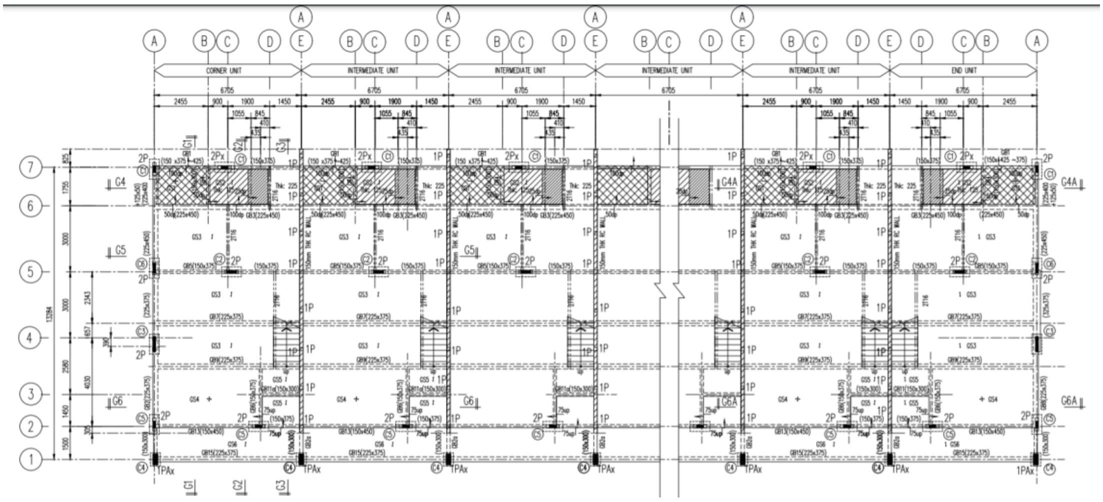


Figure 33: Ground Floor beam sizes plan

Figure 33 shows the ground beam plan with its sizes shown as *(length x height).* After pile cap works has completed, the pile caps were backfilled with soil and ground beam excavations for partition walls' base was excavated. The platform of earth where the ground beam would lay onto was compacted using a 1 tonne roller compactor. This was done for easier access of workers. During this time, a level for the bottom of the ground slab was taken using theodolite and a staff pointing at the ground column starter bar of pile caps. The level was then marked with a tape. As the beam's height show in figure 33 was included with the thickness of the ground slab, carpenters has fabricated their formwork by decreasing 100mm height.

Figure 34: Image shows the excavation site for ground beam works.

Figure 34 shows the pile cap backfilled until the top pile cap surface with ground column starter bars pointing out from the pile cap.

Figure 35: Image shows installation formwork ground beam.

Figure 35 shows the method of installation of ground beam formwork. Firstly, a string was pulled from the site rail marked using nails indicating the sizes of ground beam. The fabricated ground beam formwork was then layed onto the earth while adjusting the length of the formwork manually by hand to match the string indicator line. The same method was used for either horizontal or vertical beam. Figure 35 also shows the pile cap acting as a platform for ground beams which means that the load acting on the ground beam would be transmitted to the pile cap. Based on this study, the installation of ground beam formwork for 6 units would take 3 days to be completed.

Before installation of reinforcement bar may begin, lean concreting of ground beam with thickness of 50mm was done by using Grade 15 concrete mix to act as a bedding for the reinforced concrete afterwards. Reinforcement bars installed were done by following the requirements of steel bars given by the consultant engineer from the structural drawing. Figure 36 shows the structural design for ground beam reinforcement bars for this project given by the consultant engineer. Based on this study, installation of reinforcement bars for 6 units of houses would take 3 days to be completed.

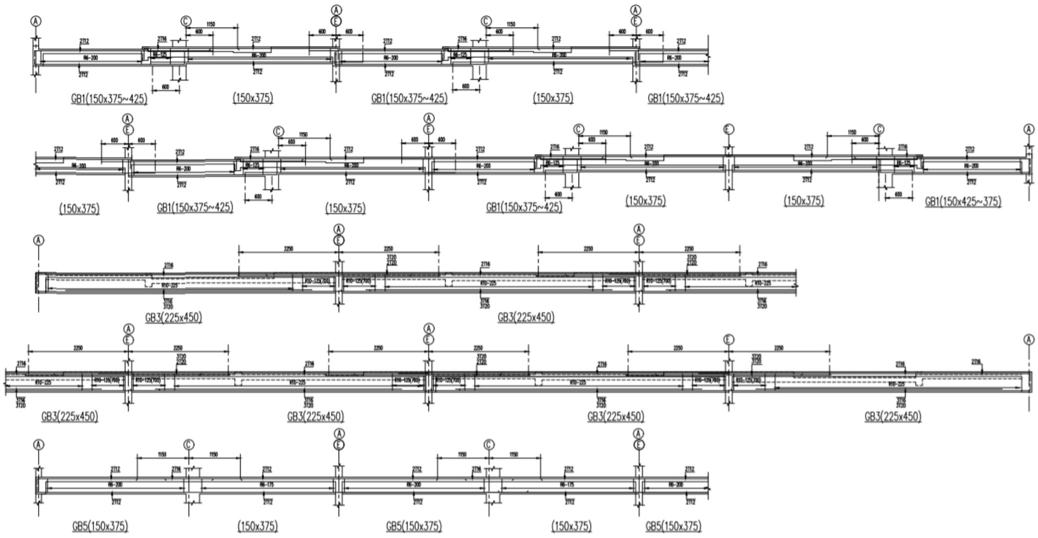


Figure 36: Image shows the reinforcement bars needed for GB1, GB3 & GB5.

Figure 37: Image shows the completed installation of reinforcement bars for ground beam.

Concreting of ground beam would use the average amount of 80m³ of concrete mix grade 25. The concretion of ground beam was vibrated thoroughly during the process (shown on figure 22 and 38).

Figure 38: Image shows the concreting process of ground beam.

Figure 39: Image shows the completed ground beam of 6 units.

3.6 R.C Ground Slab

Concrete slabs span horizontally between supports in the same way as beams do, and they can be simply supported, continuously supported, or cantilevered. Unlike beams, slabs are relatively thin structural components that are typically utilised as flooring and, on rare occasions, roof systems in multi-storey buildings. Reinforced concrete is poured into formwork on-site or into trenches dug into the ground to form slabs. Typically, concrete slabs are 150 to 300 mm thick. The applied floor or roof loads are transmitted to the slabs' supports. Depending on whether they are supported on the ground or suspended in a building, slabs can be divided into two kinds.

Firstly, the level of reinforced concrete slab (top & bottom) was taken using theodolite and a staff (shown in figure 40) to determine the level for backfilling earth into ground beams and lean concreting of ground floor slab for installation of BRC. The level of bottom surface of reinforced concrete ground slab was marked by using a red marker on the side of ground beams.

Figure 40: Image shows the process of levelling for ground floor slab.

Secondly, the backfilled earth into ground beam was compacted using a plate compactor and plywood to level the earth smoothly and to avoid sagging of structures.

Figure 41 shows the completion of compacting backfilled earth done for preparation of lean concreting of ground floor slab.

Figure 41: Image shows compacted 'backfilled' earth for ground slab.

After 'Polyethene sheet' (Damp Proof Membrane) has been layed throughout all the compacted earth of ground slab, lean concreting of ground slab was done with thickness of 50mm using concrete mix grade 15. Lean concreting of ground slab provides smooth surface for installation of BRC as shown in figure 42.

Figure 42: Image shows completed lean concreting of ground slab.

Formwork for ground floor slab was installed to provide ‘markers’ for mason workers the level of concreting needed for areas that includes drop of floor level such as bathrooms and wet kitchens. BRC A7 (200mm x 200mm) ‘cut to size’ was used in this project which helped reduce the duration of installation of reinforcements for ground slab. Figure 43 shows the layout for BRC A7 ‘cut to size’ used in this project given by the supplier.

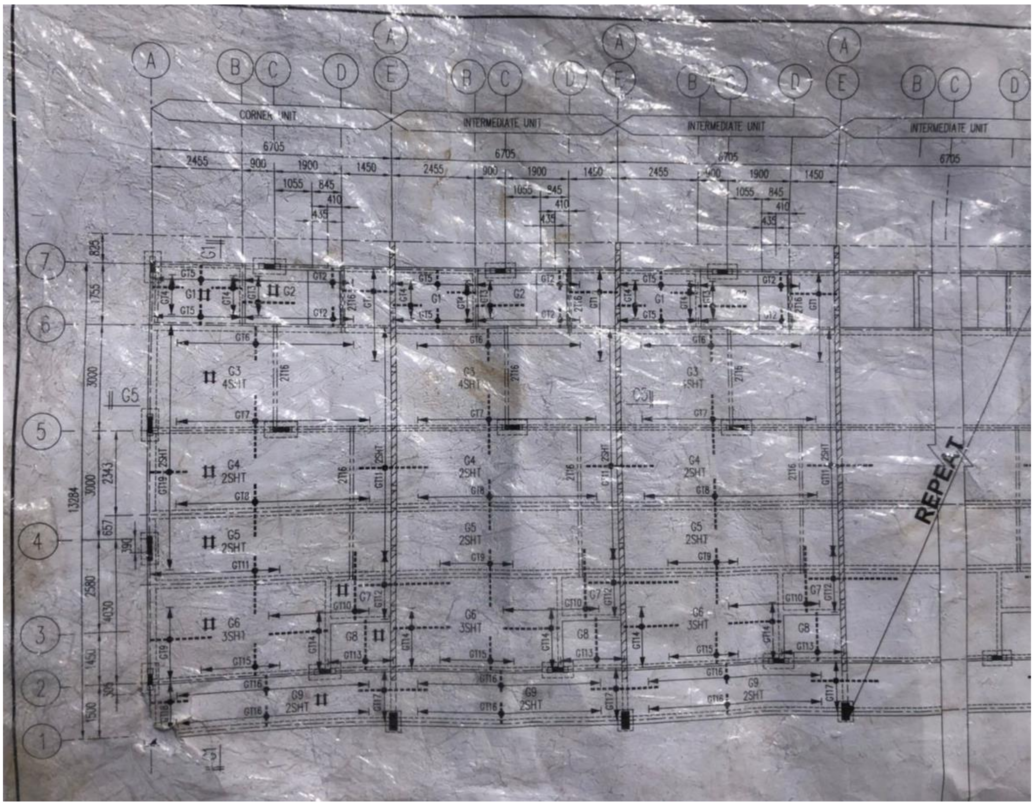
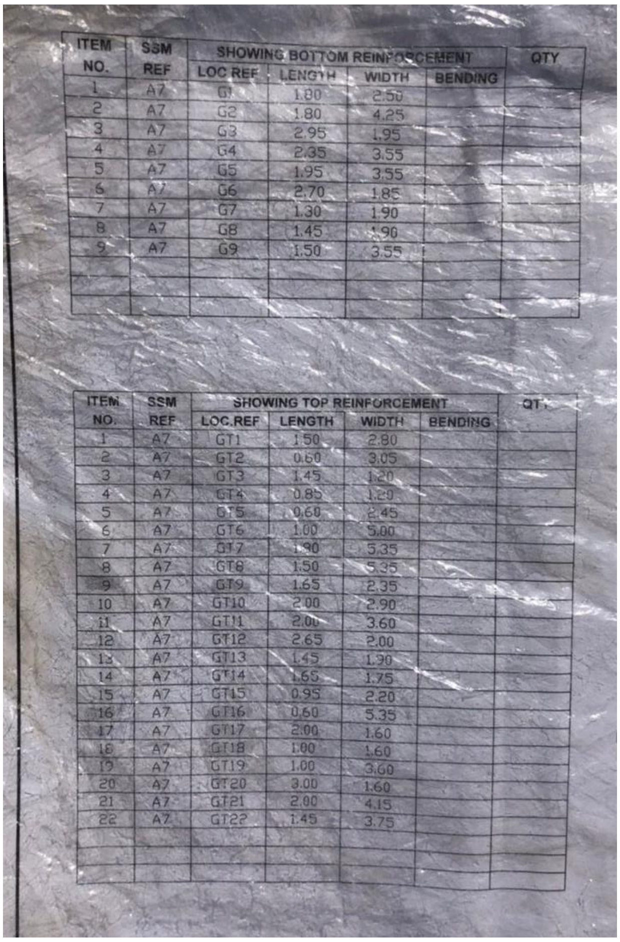


Figure 43: Image shows the BRC layout plan for ground floor slab.



ITEM NO.	SSM REF	SHOWING BOTTOM REINFORCEMENT				QTY
		LOC REF	LENGTH	WIDTH	BENDING	
1	A7	G1	1.80	2.50		
2	A7	G2	1.80	4.25		
3	A7	G3	2.95	1.95		
4	A7	G4	2.35	3.55		
5	A7	G5	1.95	3.55		
6	A7	G6	2.70	1.85		
7	A7	G7	1.30	1.90		
8	A7	G8	1.45	1.90		
9	A7	G9	1.50	3.55		

ITEM NO.	SSM REF	SHOWING TOP REINFORCEMENT				QTY
		LOC.REF	LENGTH	WIDTH	BENDING	
1	A7	GT1	1.50	2.80		
2	A7	GT2	0.60	3.05		
3	A7	GT3	1.45	1.20		
4	A7	GT4	0.85	1.20		
5	A7	GT5	0.60	2.45		
6	A7	GT6	1.00	5.00		
7	A7	GT7	1.90	5.35		
8	A7	GT8	1.50	5.35		
9	A7	GT9	1.65	2.35		
10	A7	GT10	2.00	2.90		
11	A7	GT11	2.00	3.60		
12	A7	GT12	2.65	2.00		
13	A7	GT13	1.45	1.90		
14	A7	GT14	1.65	1.75		
15	A7	GT15	0.95	2.20		
16	A7	GT16	0.60	5.35		
17	A7	GT17	2.00	1.60		
18	A7	GT18	1.00	1.60		
19	A7	GT19	1.00	3.60		
20	A7	GT20	3.00	1.60		
21	A7	GT21	2.00	4.15		
22	A7	GT22	1.45	3.75		

Figure 44: Image shows the table of sizes for BRC used for ground floor slab.

Figure 44 shows the sizes (meters) in a form of table for each item of BRC A7 ‘cut to size’ to be used for installation of reinforcements for ground floor slab in this project. The delivery of BRC A7 ‘cut to size’ was delivered by schedule planned by the Project Manager of this project. The sizes of BRC ‘cut to size’ was also shown by a tag during the delivery of this item to help barbender identify each item as shown in figure 45.

Figure 45: Image shows 'tag' attached to BRC delivered on site.

Figure 46: Image shows completed BRC installation for ground floor slab.

Figure 46 shows that the installation of BRC A7 for ground floor slab was installed completely with its concrete cover and steel bar chair (70mm) to distinguish the top layer and bottom layer of BRC A7 installed. Based on figure 33, it was shown that there are 2T16 (2 bars of 16mm diameter steel bar) layed on some areas of the house. Those 2T16's was installed in between the top layer and bottom layer of BRC A7 installed for ground floor slab. The purpose of the 2T16's was to act as a reinforcement bar holding the load of brickwalls that will be installed afterwards.

Before concretion of ground slab begins, a level of top of ground slab was taken by using theodolite and staff to help mason workers determine the top level of concrete as shown in figure 47. The level was marked by hammering a steel bar into the lean concrete and adjusting the steel bar to the level required shown in figure 48. Concreting of ground floor slab uses 120m^3 of concrete mix grade 25 including the apron drains. Concretion of ground slab was vibrated thoroughly using an immersion vibrator shown in figure 22. Figure 49 shows the completed ground slab after formwork opening.

Figure 47: Image shows levelling taken for ground floor slab top surface.

Figure 48: Image shows the steel bar indicator for mason workers.

Figure 49: Image shows completed ground floor slab.

3.7 R.C Ground Column & R.C Wall

A column is a vertical structural element that mostly carries compression loads. The column is seen to be the most important structural part of a building because the building's safety is dependent on its strength. This is because the breakdown of a column would cause a building to gradually collapse, although this would not happen if other members failed. Vertical loads are transferred from a ceiling, floor, or roof slab, or from a beam, to a floor or foundation via columns. They also have bending moments in one or both cross-section axes. The load was shifted from all components to the columns since the columns are supported by the foundation. The axial force will then be transferred from the column to the footing via the column starter bars connected to the footing. Furthermore, when lateral loads are exerted, columns transfer such loads to the foundations as well. Finally, moment and shear will be transferred to the footing.

Based on figure 33, it can be seen there were marks such as ‘C1’, ‘C2’ and so on. These codes indicate the points for ground floor columns. Figure 50 shows the design of reinforcement bars following the level of the building.

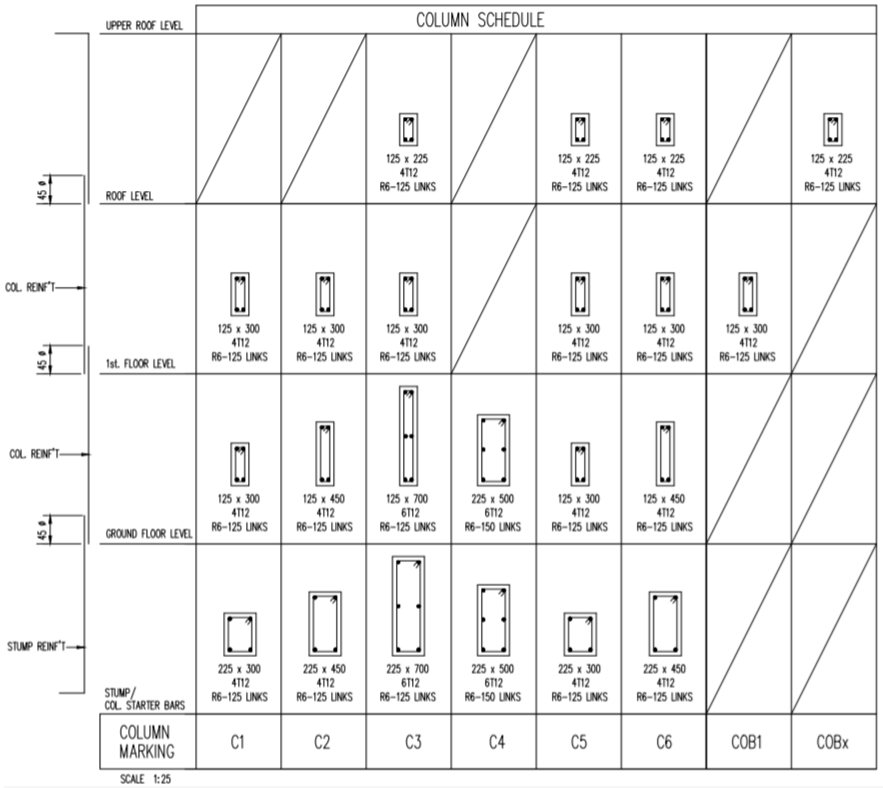


Figure 50: Image shows the table of column schedule.

Figure 51: Image shows completed installation of reinforcement bars for ground column.

Figure 51 shows that the project observed in this study was using aluminium formwork for ground columns, shear walls, first floor beams and slabs. For that reason, the concreting of these elements was not done separately. Aluminium formworks used in this project was designed for one-time concreting after first floor slab reinforcement has been completely installed which was cost effective and not time-consuming.

R.C wall also known as shear wall was used in this project. A shear wall is a structural element that resists lateral forces such as wind forces in a reinforced concrete framed building. Shear walls are commonly employed in high-rise buildings that are subjected to lateral seismic forces. Wind forces become more significant as a structure's height grows in reinforced concrete framed structures. Figure below shows the structural design of an R.C wall used in this project. The structural design of the R.C wall also shows that the thickness of the wall that also acts as a partition wall between unit of houses is 150mm. BRC B6 (100mm x 200mm) was used as reinforcement for this R.C wall. The BRC B6 was connected to a 6T12 (6 bars of 12mm diameter steel bar) starter bar that was installed during ground beam reinforcement bars installation. A portion of reinforcement showing part of gridline from line 7 to 9 as shown in figure 52 can be shown in figure 53. Concreting of ground column and shear wall uses 8m^3 of concrete mix grade 25 pump mix for reasons to slow down the rate of concrete hardening as it takes some time for concretion to be completed using a mobile crane.

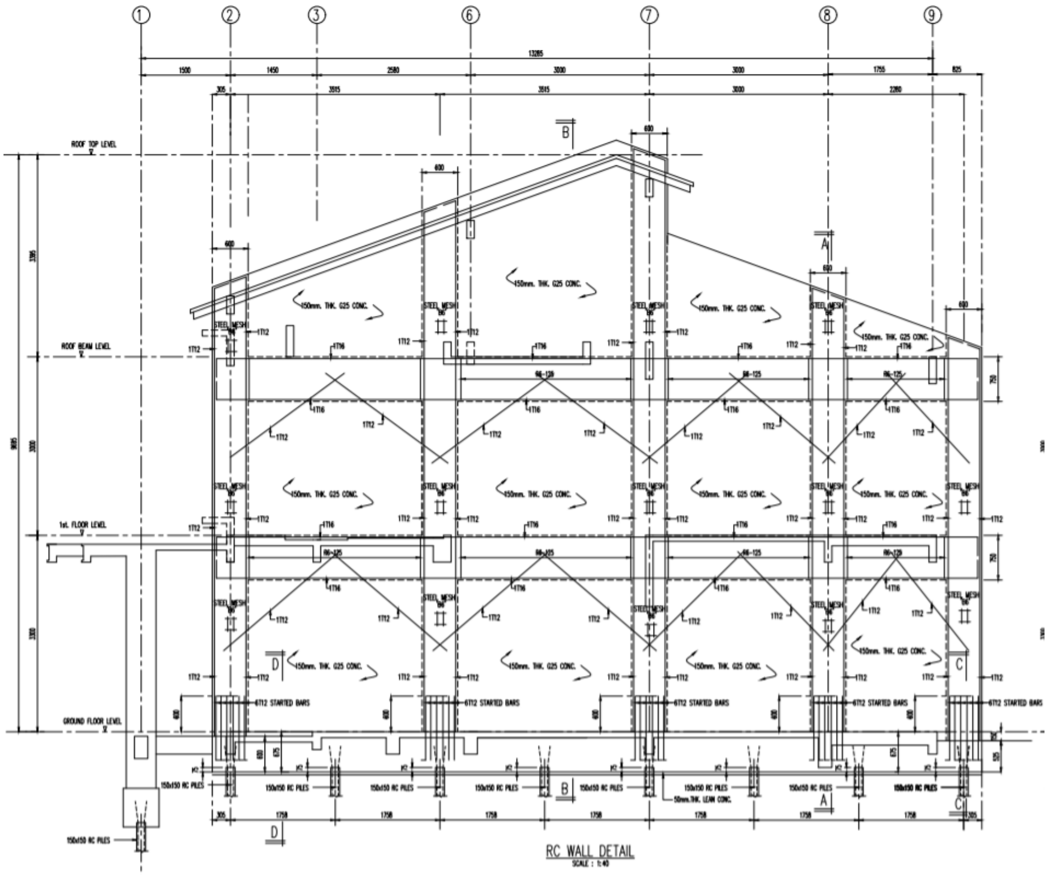


Figure 52: Image shows the structural design of an R.C wall.

Figure 53: Image shows the complete installation of BRC and reinforcement bars for R.C wall.

3.8 First Floor Beam & Slab

The difference between 1st floor beam and ground beam was only that the 1st floor beam was suspended in a building while ground beam was suspended on earth. The difference of using aluminium formwork for 1st floor beam and 1st floor slab is the method of levelling. The method of levelling for aluminium formwork used in this project was by using a laser level which consists of a Rotary Laser and a staff.

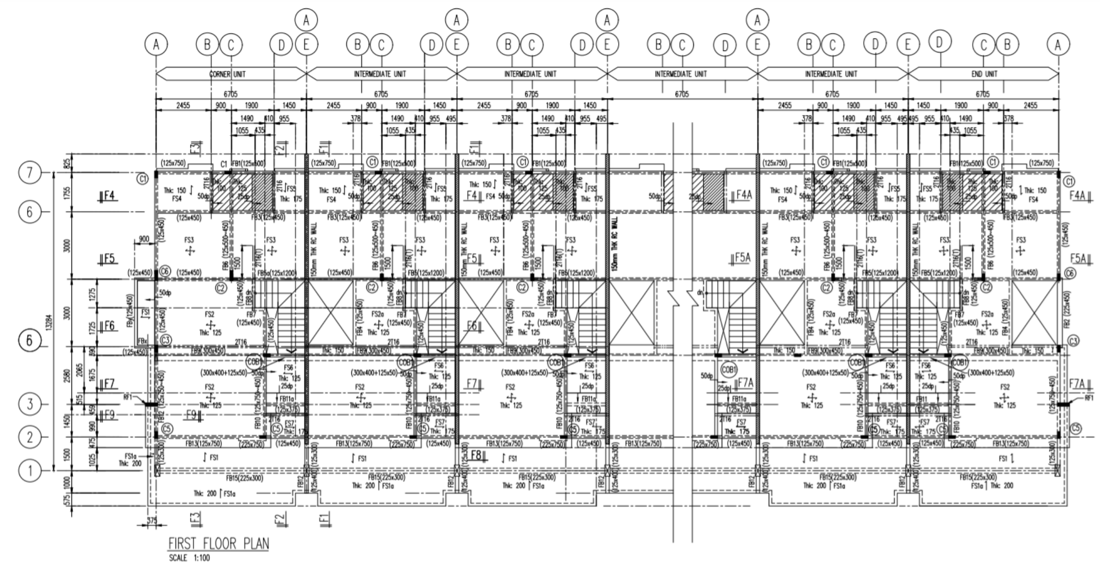


Figure 54: Image shows the 1st floor plan layout.

Figure 54 shows the 1st floor beam's sizes (length x height) and span length shown on the layout. The use of aluminium formwork that was designed specifically following the structural design of the consultant engineer has been time effective. This was shown when the deck of slab of aluminium formwork has been completely installed, barbenders would hoist up their fabricated beam steel bars for installation of 1st floor beams. The installation of fabricated 1st floor beam was done by following the structural requirements of steel bars given by the consultant engineer as shown on figure 55.

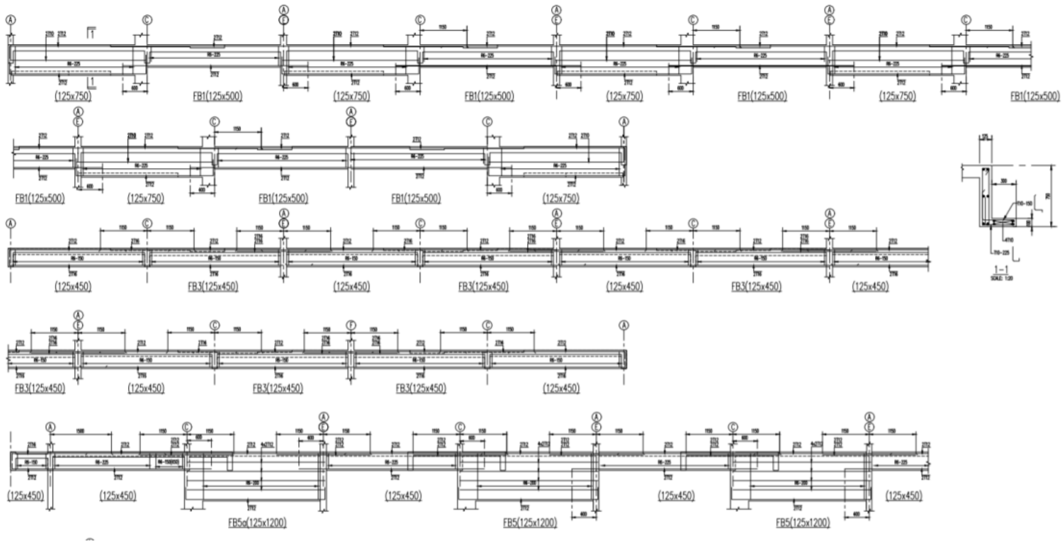


Figure 55: Image shows the structural design of a few 1st floor beams.

BRC A7 (200mm x 200mm) 'cut to size' was also used for 1st floor slab. The installation of BRC A7 for 1st floor slab was also done by following the BRC layout for 1st floor slab as shown in figure below. Its sizes of BRC was also given by the supplier in a form of table shown in figure 57.

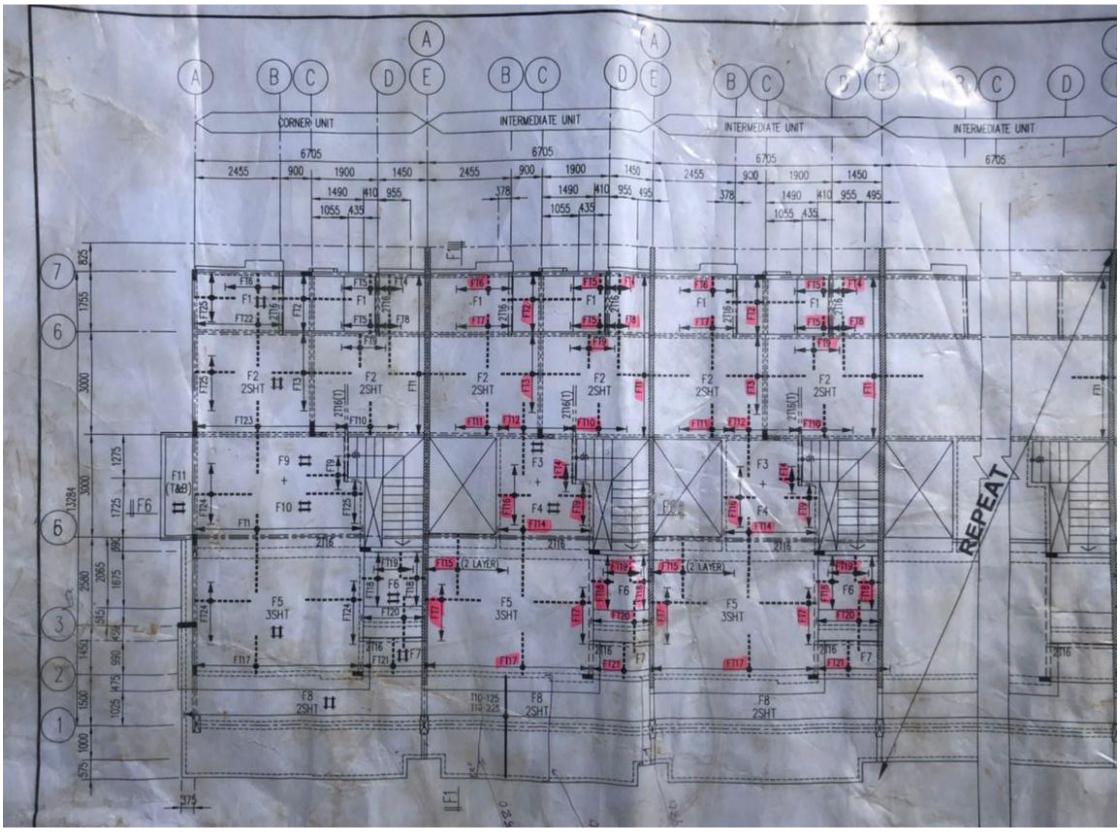


Figure 56: Image shows BRC A7 layout for 1st floor slab.

ITEM NO.	SSM REF	SHOWING BOTTOM REINFORCEMENT				QTY
		LOC.REF	LENGTH	WIDTH	BENDING	
1	A7	F1	1.80	3.40		
2	A7	F2	3.00	1.85		
3	A7	F3	2.25	1.65		
4	A7	F4	2.75	2.10		
5	A7	F5	3.50	1.85		
6	A7	F6	1.90	2.05		
7	A7	F7	1.45	1.90		
8	A7	F8	1.50	3.55		
9	A7	F9	4.35	1.65		
10	A7	F10	4.85	2.10		
11	A7	F11	0.90	3.00		

ITEM NO.	SSM REF	SHOWING TOP REINFORCEMENT				QTY
		LOC.REF	LENGTH	WIDTH	BENDING	
1	A7	FT1	2.30	4.85		
2	A7	FT2	2.30	1.80		
3	A7	FT3	2.30	2.35		
4	A7	FT4	0.60	0.80		
5	A7	FT5	0.60	1.35		
6	A7	FT6	0.60	1.75		
7	A7	FT7	1.65	1.75		
8	A7	FT8	1.60	0.75		
9	A7	FT9	1.00	1.35		
10	A7	FT10	1.00	1.95		
11	A7	FT11	1.00	1.80		
12	A7	FT12	2.15	2.25		
13	A7	FT13	1.50	3.75		
14	A7	FT14	2.40	2.75		
15	A7	FT15	1.80	2.45		
16	A7	FT16	0.95	1.80		
17	A7	FT17	1.25	4.85		
18	A7	FT18	0.65	1.60		
19	A7	FT19	0.75	1.20		
20	A7	FT20	1.50	1.90		
21	A7	FT21	1.10	2.20		
22	A7	FT22	1.60	2.55		
23	A7	FT23	2.15	4.35		
24	A7	FT24	1.65	1.95		
25	A7	FT25	1.65	1.35		

Figure 57: Image shows the 1st floor slab BRC A7 sizes.

Figure 57 shows the specific sizes for each layer (top & bottom) of BRC A7 required for installation of BRC A7 1st floor slab.

Figure 58: Image shows the completion of 1st floor beam and slab.

Figure above shows the use of steel bar chair (70 mm) as an equipment to distinguish top and bottom layer of BRC A7. Wiring conduit and piping was installed before the installation of BRC A7 for 1st floor slab. Similar to ground floor slab, 2T16's was shown in the drawing for first floor plan to indicate reinforcements for brickwall installation. The method of installation for 2T16's for 1st floor slab was similar to installation of 2T16's for ground floor slab.

Concreting of 1st floor beam and slab uses 17m³ of concrete mix grade 25. However, the concreting of ground column and shear wall takes place first before concretion of 1st floor beam and slab can begin.

Figure 59, 60 and 61 shows the completed casting of ground columns, shear walls and 1st floor beam and slab.

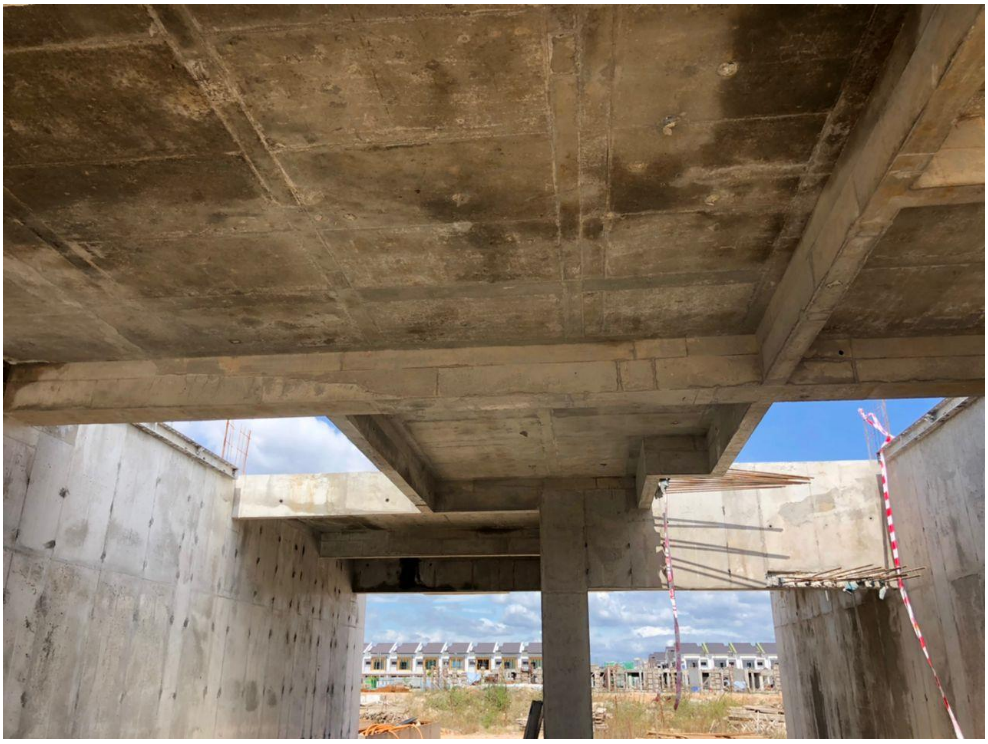


Figure 59: Image shows exposed soffit beams of 1st floor beam after opening of aluminium formwork.

Figure 59 shows the exposed ceiling showing the 1st floor beams and slab before skim coat works.

Figure 60: Image shows shear wall after opening of aluminium formwork.

Figure 61: Image shows completed 1st floor slab.

CHAPTER 4.0

CONCLUSION

From this study, it was observed that structural works of a project such as a housing project is the most important part in the process of building a building. Structural design is important as it is the only component of a building that transmits loads from the whole building into the earth. For example, if a 2 storey building was built with insufficient ground columns, the whole 1st floor could collapse because of excessive load imposed on the columns. As observed in this study, every element of structural works in any projects is very important as it needs to be inspected by an experienced Clerk of Work before concreting works can begin.

Concreting works can only begin by confirmation from Clerk of Work. Completion of casting for structural elements indicates an increase in site progress. For example, if a main contractor does not request for inspection by Clerk of Work before concreting of a structural element such as pile cap but decides to initiate concreting works without confirmation by Clerk of Work. The Clerk of Work appointed for the project can and should send a 'memo' to the consultant engineer appointed for the project to hack the 'casted' pile cap. This is because the Clerk of Work has not inspected the reinforcement bars, formworks, and any other structural requirement necessary for a pile cap following the structural design given by the consultant engineer.

Architecture design might be the factor that attracts customers to buy a house but structural design is the backbone that holds every component of a building together.

REFERENCES

Associates, A. (2017, August 1). *Importance of structural design*. Aarushi Associates. Retrieved December 23, 2021, from http://www.aarushiassociates.in/uncategorized/importance-of-structural-design/.

Prasad. (2020, July 26). *Construction joints in concrete structures*. Structural Guide. Retrieved December 28, 2021, from https://www.structuralguide.com/construction-joints/

Monahan, J. (2019, August 28). *The importance of concrete cover*. Sullivan Engineering LLC. Retrieved December 28, 2021, from https://sullivanengineeringllc.com/2019/05/17/the-importance-of-concrete-cover/

Tyler. (2018, September 28). *What is structural design in civil engineering? - esub*. eSUB Construction Software. Retrieved December 23, 2021, from https://esub.com/blog/what-is-structural-design-in-civil-engineering/

Presentmoment. (2017, December 11). What factors determine the structure and design of a house? Brainly. In. Retrieved December 22, 2021, from https://brainly.in/question/1964475

Wikimedia Foundation. (2021, October 30). *Deep Foundation*. Wikipedia. Retrieved December 27, 2021, from https://en.wikipedia.org/wiki/Deep_foundation

About Pdca. Pile Driving Contractors Association. (n.d.). Retrieved December 27, 2021, from https://www.piledrivers.org/about-pdca/

Chong, W. J., Chan, C. M., & Mukhtar, R. A. (2020, December 2). Pile Dynamic Analyzer (PDA) Test: An Overview of the Pile Integrity Evaluation Technique, 1–4. Retrieved December 27, 2021 from https://publisher.uthm.edu.my/periodicals/index.php/peat

Mudavath, K. (2018, September 6). *Different grades of concrete and their uses/applications*. we civil engineers. Retrieved December 28, 2021, from https://wecivilengineers.wordpress.com/2018/09/10/different-grades-of-concrete-and-their-uses-applications/

Rodriguez, J. (2021, July 14). *Do's and don'ts of concrete vibration*. The Spruce. Retrieved December 28, 2021, from https://www.thespruce.com/how-to-vibrate-concrete-844451

Group, S. (2020, September 24). *Concrete vibration - what is it and how is it done?* Safari Group. Retrieved December 28, 2021, from https://www.safarigroup.com.au/blogs/2019/7/26/concrete-vibration

Namita. (2016, October 2). *Curing of concrete: Purpose of curing: Curing methods - civildigital* -. CivilDigital. Retrieved December 28, 2021, from https://civildigital.com/curing-concrete-purpose-curing-curing-methods/

Buildings, D. (2021, January 3). *Pile cap*. Pile cap - Designing Buildings. Retrieved December 29, 2021, from https://www.designingbuildings.co.uk/wiki/Pile_cap

Buildings, D. (2021, November 26). *Ground beams in construction*. Ground beams in construction - Designing Buildings. Retrieved December 30, 2021, from https://www.designingbuildings.co.uk/wiki/Ground_beams_in_construction

Right, B. (2010, December 10). *Concrete slabs*. Ground slabs - Introduction. Retrieved December 31, 2021, from https://www.dlsweb.rmit.edu.au/Toolbox/buildright/content/bcgbc4010a/04_struct_members/06_concrete_slabs/page_001.htm

Guide, B. T. (2018, September 21). *What is slab, Beam, column, and footing construction?* The Constructor. Retrieved December 31, 2021, from https://theconstructor.org/structural-engg/slab-beam-column-footing-construction/24934/

Engineering, S. (2017, November 13). *What is shear wall? - its types and location in buildings*. The Constructor. Retrieved December 1, 2021, from https://theconstructor.org/structural-engg/shear-walls-structural-forms-positioning/6235/

Unknown. (2019, September 20). *Kitacon Sdn Bhd (Malaysia)*. EMIS. Retrieved January 10, 2022, from https://www.emis.com/php/company-profile/MY/Kitacon_Sdn_Bhd_en_2470207.html