DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

RETAINING WALL

Prepared by:

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DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

DECEMBER 2019

It is recommended that the report of this practical training provided

By

Nur Fatin Azini binti Mohd Zulkifli

2017206964

entitled

Retaining Wall

accepted in partial fulfillment of the requirement for obtaining the 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 are stated herein, prepared during a practical training session that I underwent at UDA Land (South) Sdn. Bhd. for a duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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UiTM ID No.: 2017206964

Date : 20 December 2019

ACKNOWLEDGEMENT

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

I would like to extend my genuine appreciation for the guidance, advice and help extracted throughout the period of training by the following group of amazing individuals. First and foremost, I would like to thank En. Karim Supok for the opportunity given, to conduct my training in his esteem project department. His team of professionals comprising of En Syahid Hassan, En Misman Hj Omar, En Fauzi Samigon, Pn Marliza, Pn Yanti, En Mohd Dali, and En Norazim, have enabled me to learn and develop my understanding, knowledge and feel of real time projects, and the theory involved in analysis of structures, building and civil works. They are also responsible towards streamlining and assessing my training. Also, to the site personnel in both Bandar UDA Utama, Johor Bahru who have extended their cooperation and help to further enhance my ability in understanding the procedures in construction and site administration, tests procedures, site safety and best practices in the industry. It is an honor for me to be given the opportunity to 'work' with all of you.

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Finally, my special thanks to my beloved parents for their sacrifices over the years.

Thank you so much.

ABSTRACT

Main objective of this report is to develop the knowledge about the reinforcement concrete retaining wall based on findings through the analysis of designing the stabilization of retaining wall. A qualitative case study technique has been used in this paper for the data collection and analysis. First and foremost, data and information gather from references book, past research, articles and internet sources. All the findings and outcome from the fiction reviews are combining to make conclusion. This paper is providing a helpful idea in choosing the suitable of retaining wall throughout in method statement of retaining wall, design structure and the characteristic of suitable retaining wall depends on different location. For an academic view, it provides knowledge about the usage of reinforced concrete retaining wall, the method statement of construction, and the criteria to build a stabilization of reinforced concrete retaining wall. The study is to provide an idea about the reinforcement concrete retaining wall based on the critical success factors extracted by analysis in a multi case study research. The study further opens new lines of research and highlights the usage and advantages of reinforcement concrete retaining wall. It gives valuable information and guidelines which hopefully help to develop the information about this retaining wall.

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CHAPTER 1: INTRODUCTION

1.1 Background and Scope of Study

All development project by UDA Land (South) Sdn Bhd certified with their own ISO MS 9001: 2015, all the documentation and the procedure to complete one development completed by this company in order to set up their quality control to ensure that the project run smoothly. The report focuses on an elevated water tank.

This development located at lots 1993 – 2005, Lots 2297 – 233 and Lot 2624, Mukim Pulai, Johor Bahru, Johor. This development classified as commercial consists of shop office, apartments and residential area. The Messrs. UDA Land (South) Sdn. Bhd will develop this development. Hence, the development needed water tanks that could supply water for the daily needs.

The development will be developed by the Messrs. UDA Land (South) Sdn. Bhd and the water supply system for the whole department was designed by Messrs. SABA Consultant Sdn Bhd and was approved by Ranhill SAJ on 15th February 2017.

There were several processes to complete the elevated water tank. The process includes site clearance, earthwork, piling, and concreting. Each water tanks that will be constructed must follows all the specification given by Ranhill SAJ and JKR.

Total water demand for the whole development is estimated at 6,957,832 lpd (1.53 mg) as per Table 1 and is divided into 7 phases as per Table 2. Layout plan of development plan phases is attached in the appendix.

The development is based on the Development Order (KM) that was approved by MBIP approved plan no: RR/PJ=912 PELAN PINDAAN-3 as attached in the appendix. The total development area is 469.92 acre.

1.2 Objectives

1. To understand the terminology of retaining wall
2. To identify the types of a retaining wall
3. To understand and know the method construction of retaining wall

1.3 Method of study

The research method of conducting this case study

I. Observation – The site observed for the retaining wall location and scope of work for RC retaining wall construction.

II. Document reviews – The drawing refer as the guideline to even understand better the structure of the retaining wall. The contract document and construction drawing courtesy of UDA Land (South) Sdn Bhd (client), MH Consult (Civil & Structure Consultant) and SBH Engineering & Enterprise (contractor) that have included the method statement of the construction process. Documents are read and bought to the site in order to understand better the project.

III. Interviews – the interview being conducted during the site visit were an impromptu interview. The site visits are usually accompanied by clerk of work in charge for this project. Notes are taken for later referencing or logging.

CHAPTER 2: COMPANY BACKGROUND

2.1 Introduction to Company

UDA stands for Urban Development Authority, which is a Malaysia holding company. UDA served to launch and oversee urban development projects related to business, industry and housing. It was also tasked with developing urban infrastructure. After undergoing a couple of status changes, it now exists as UDA Holdings Berhad, a publicly listed company.

Established on 12 November 1971, under the Ministry of Public Enterprise. In 1996, UDA was incorporated and changed its full name to UDA Holdings Sendirian Berhad (UDA Holdings Private Limited). But it has changed its status to a public limited company and changed its name to UDA Holdings Berhad. It was subsequently publicly listed on the Main Board of Kuala Lumpur Stock Exchange (KLSE). This company offered differed aspects in the construction like properties, malls, and hotels. Also, UDA Land offers the facilities management services in order to maintain and enhance the beauty of the building. UDA Land have more than 50 property projects, 7 townships, 3 shopping malls and 5 hotels and resort projects that UDA Land have been achieved yet so far.

UDA have yet developed and recover urban structures as it sees fit. Although, UDA mainly confined to redevelop a tumbledown building, it also responsible for a conservation of historic urban buildings. Several new towns have been developed by UDA, including Bandar Tun Hussein Onn in Cheras, Bandar UDA Utama in Pulai And Bandar Baru UDA in Johor Bahru. In Johor Bahru, there are three projects that have been going the Plumeria Avenue, Rosa Terraces and Neuvo Centro. There will be the upcoming launches of Pisonia Ville and Neuvo Centro Pac 3. The Plumeria Avenue and Rosa Terraces are the residential proposed made building which are located at Bandar UDA Utama. The Neuvo Centro made to be a commercialized building that also located at Bandar UDA Utama.

2.2 Company Profile

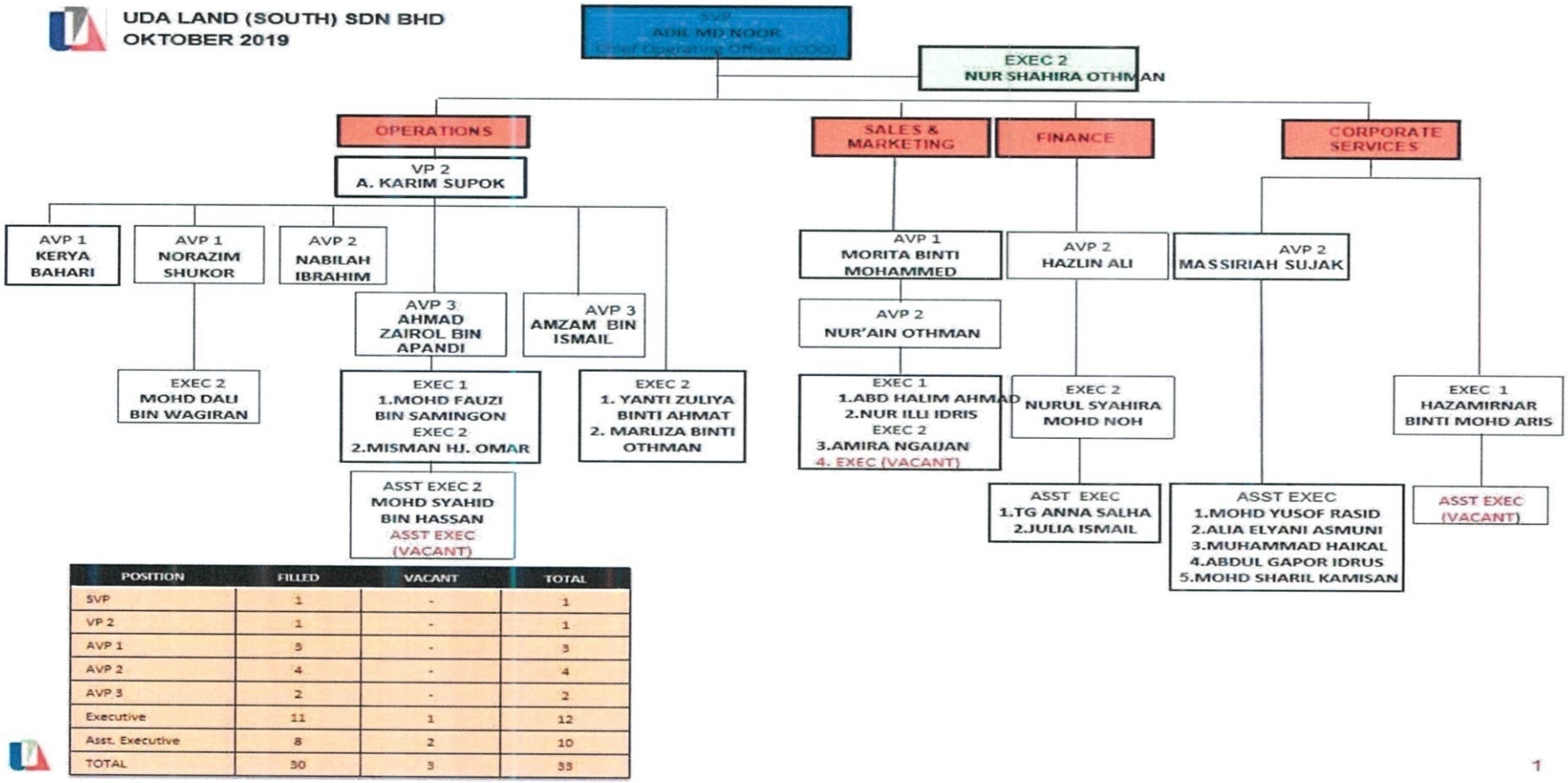
Figure 1: UDA Land (South) Sdn. Bhd Headquarters

Company Name	:	UDA Land (South) Sdn Bhd
Status	:	Active
Established Date	:	17 July 1975
Registered Address	:	Tingkat 16, Menara BB Plaza, Lot 111 Jalan Bukit Bintang, 55100, Kuala Lumpur Fax: Tel:
Business Address	:	Wisma SBBU, No. 1, Jalan Padi Mahsuri 12, Bandar Baru UDA, 81200, Johor Bahru. Fax: Tel:

Main activity	:	Property management Development Project Agent
Management	:	Adil Md. Noor – Chief Operating Officer
Vision	:	UDA Land (South) Sdn. Bhd will be a leading and dynamic real estate developer and management company with the latest technology and excellent service quality.
Mission	:	UDA Land (South) Sdn. Bhd will committed and responsible through the unified involvement of staff to produce real estate products and services that meet our customers' needs and provide our customers with the best possible investment.

2.3 Organizational Chart

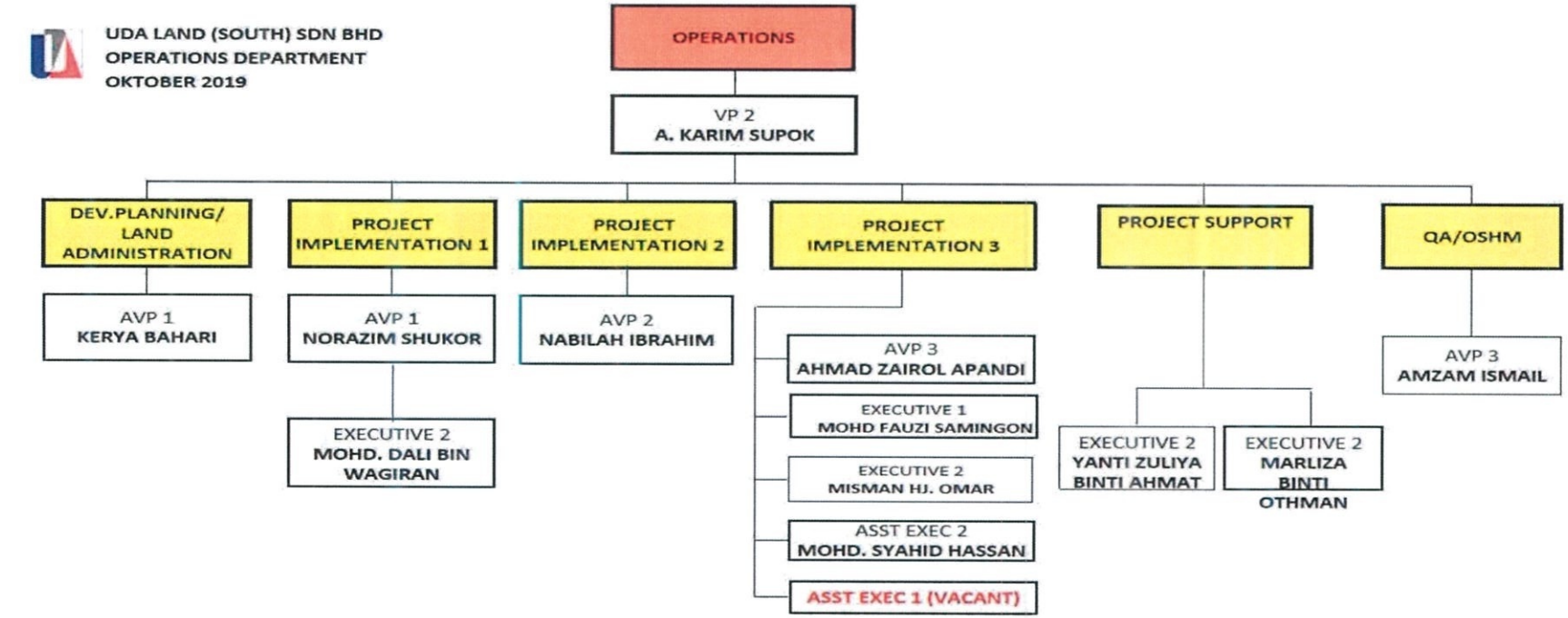
2.3.1 Organizational Chart for all department in UDA Land (South) Sdn. Bhd



POSITION	FILLED	VACANT	TOTAL
SVP	1	-	1
VP 2	1	-	1
AVP 1	3	-	3
AVP 2	4	-	4
AVP 3	2	-	2
Executive	11	1	12
Asst. Executive	8	2	10
TOTAL	30	3	33

Figure 1: Organizational Chart of UDA Land (South) Sdn Bhd

2.3.2 Organizational Chart for Project Department in UDA Land (South) Sdn. Bhd.



POSITION	FILLED	VACANT	TOTAL
VP 2	1	-	1
AVP 1	2	-	2
AVP 2	1	-	1
AVP 3	2	-	2
Executive	5	-	5
Asst. Executive	1	1	2
TOTAL	12	1	13

3

Figure 2: Organizational Chart of Project Department.

2.4 List of Project

2.4.1 Completed Project

Table 1: Completed Project list

No	Title	Contractor	Start Date	End Date	Contract Price
1	Proposed housing development which contain: I. 20-unit 2-storey terrace house type 'B'  **Figure 3: Type 'B' (25' X 60')**	D-JAH Corporation SDN BHD	08 / 11 / 2017 15 Months	07 / 02 / 2019	RM 17,797,041.40

II. 42-unit 2-storey terrace house type 'C' at Plot B

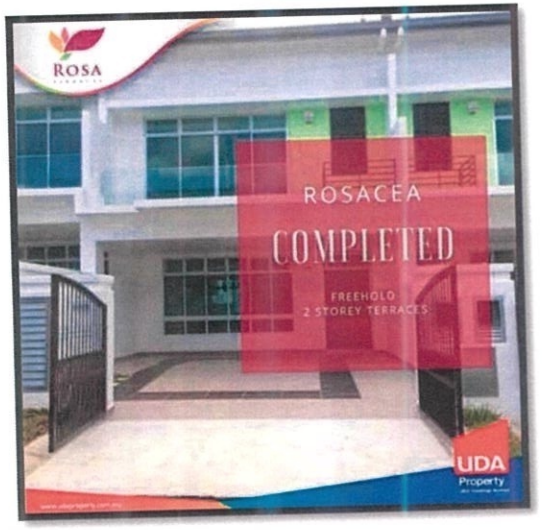


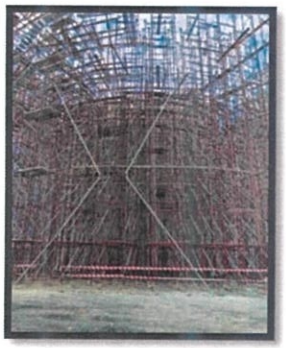
Figure 4: Type 'C'

	III. 1-unit 2-storey terrace house type 'C' at Plot B Phase7B, Bandar UDA Utama, Mukim Pulai, Johor Bahru, Johor (Package 3B)				
2	Proposed landscape works for the construction of main road at Bandar UDA Utama, Mukim Pulai, Daerah Johor Bahru, Johor Darul Takzim (Package 1)  **Figure 5: Final look of proposed landscaping works.**	UDA Dayaurus SDN BHD	06 / 03/ 2018 6 Months	05 / 09 / 2018	RM 1,836,396.00

3	Proposed development of 2- unit terrace show house 2-storey (25' X 75') type 1, PTD 203 779 & 203780, Phase 6C, Bandar UDA Utama, Mukim Pulai, Daerah Johor Bahru, Johor Darul Takzim.  **Figure 6: Proposed rumah contoh.**	Jing Lai Creation Group SDN BHD	15 / 03 / 2018 8 Months	14 / 11 / 2018	RM 1,266,237.00

2.4.2 Project in Progress

No	Title	Contractor	Start Date	End Date	Contract Price
1	Proposed development for 37-Unit of 2 & 3 storey shop office which contain: i. 8 – unit of shop office 3 storey ii. 29 – unit of shop office 2 storey iii. 2- unit of Tenaga Nasional Berhad Substation (single chamber) Bandar UDA Utama, Mukim Pulai, Daerah Johor Bahru, Johor Darul Ta'zim.  **Figure 7: Neuvo Centro 2 shop office**	Lee Choon Seng & Sons Sdn. Bhd	25 / 04 / 2018	24 / 09 / 2019	RM 15, 588, 384.80

2	Proposed development Bandar UDA Utama at Lots 1993 – 2005, Lots 2297 – 2334 and Lot 262, Mukim Pulai, Johor Bahru, Johor Darul Ta'zim. - Design and build 900,000 gallons elevated RC Water Tank No.2   **Figure 8: Staging process at proposed water tank**	Pembinaan Usadaya	15 / 01 / 2019 12 Months	14 / 01 / 2020	RM 3,760,000.00

3	Proposed development at Bandar UDA Utama 73 – unit terrace houses 2 story- house: - 43 – unit 2 – story type 2 - 30 – unit 2 – story type 3 - 1 – unit TNB Substation, double chamber.  **Figure 9: Concreting work of ground slab in Block J**  **Figure 10: Installation of underground pipe at Block K**	Jing Lai Creation Group Sdn Bhd	08 / 10 / 2019 35 Weeks	08 / 06 / 2020	RM 23,454,554.00

4	Proposed development at Bandar UDA Utama 16 – unit shop office: - 4 – unit 3 – story shop office - 8 – unit 2 – story shop office - 1 – unit TNB Compact Substation  **Figure 11: undergoing piling works**	Kelisa Murni Sdn. Bhd	19 / 11 / 2019 18 months	18 / 02 / 2021	RM 6,500,000.00

5	Proposal to construct and complete the Reinforced Concrete Retaining Wall at Bandar UDA Utama, Mukim Pulai, Johor Bahru.  **Figure 12: Installation of weep holes at the retaining walls**  **Figure 13: Concrete work done by stages**	SBH Engineering and Entreprise	19 / 08 / 2019	19 / 04 / 2020	RM 2,881,405.00

3.0 CASE STUDY

3.1 Introduction to the case study

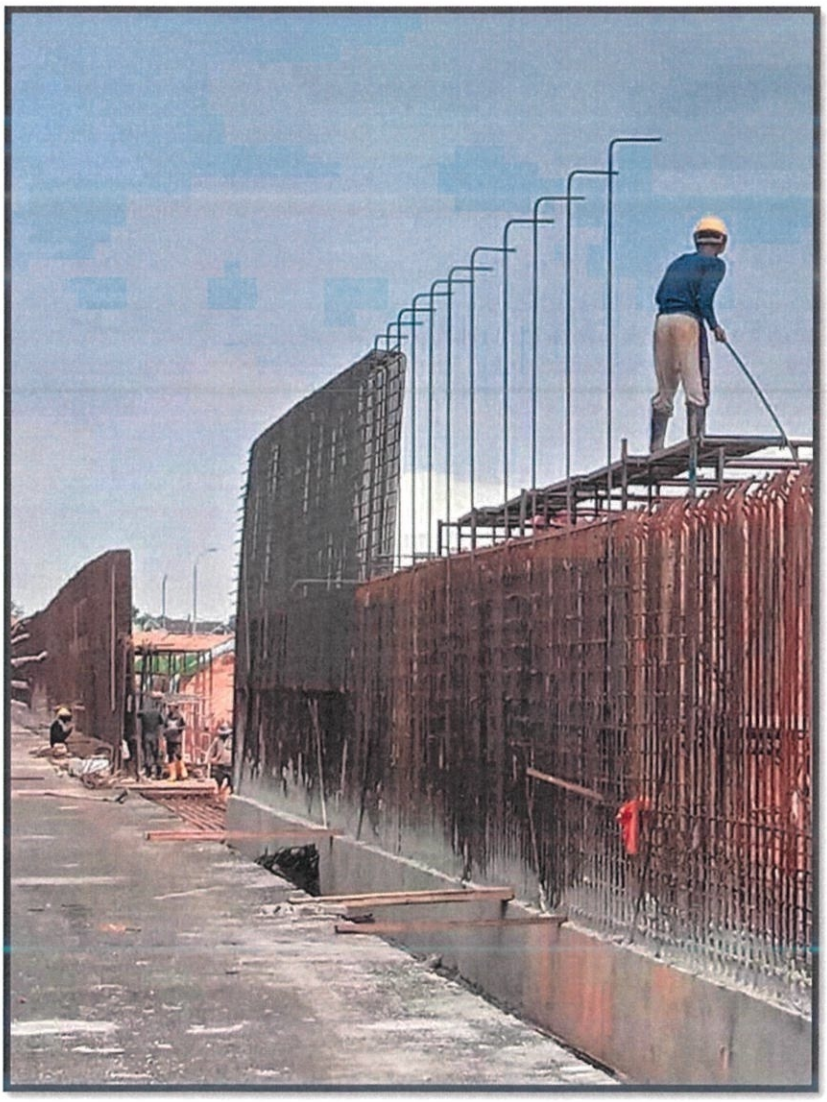


Figure 14:Constructionof retaining wall in Bandar UDA Utama.

The project was "Cadangan Pembinaan Tembok Penahan termasuk Kerja – Kerja Berkaitan di Fasaa 6C, Bandar UDA Utama, Mukim Pulai, Johor Bahru, Johor. The main contractor for this project was **SBH Engineering and Enterprise** and the owner is **UDA Land (South) Sdn. Bhd**. The main objective of this project is to prevent

landslides at that area because there is on-going construction beside the retaining wall location.

This project is expected to be completed by 19 April 2020, the contract period for 35 weeks and will cost RM 2,881,405.00. The project area is the residence development area and home to the businesspeople. SBH Engineering and Enterprise involved in this project as the contractor and the main office located at No. 8B, Jalan Padi Ria 13, 13, 81200, Johor Bahru, Johor.

This project currently is concreting process and installation of steel formwork at the wall structure of the retaining wall. The types of retaining wall is Reinforced Concrete Retaining Wall. The contractor used grade 30 normal mixture for the concrete. There are many types of retaining walls that been used in the construction. For example: cantilevered retaining walls, gabion retaining walls, and others. For this site, the types of retaining wall; cantilevered retaining walls.

3.1 Cantilevered Retaining Wall Terminology

These walls which retain earth by a wall cantilevering up from a footing are the most common type of retaining walls in use today. These walls are classified as "yielding" as they are free to rotate (about the foundation) because of the lack of any lateral restraint. Cantilevered retaining walls are generally made of masonry or concrete, or both, but can also take other forms as will be described. (Brooks,2013)

Cantilevered retaining walls have unique descriptive terminology as illustrated below:

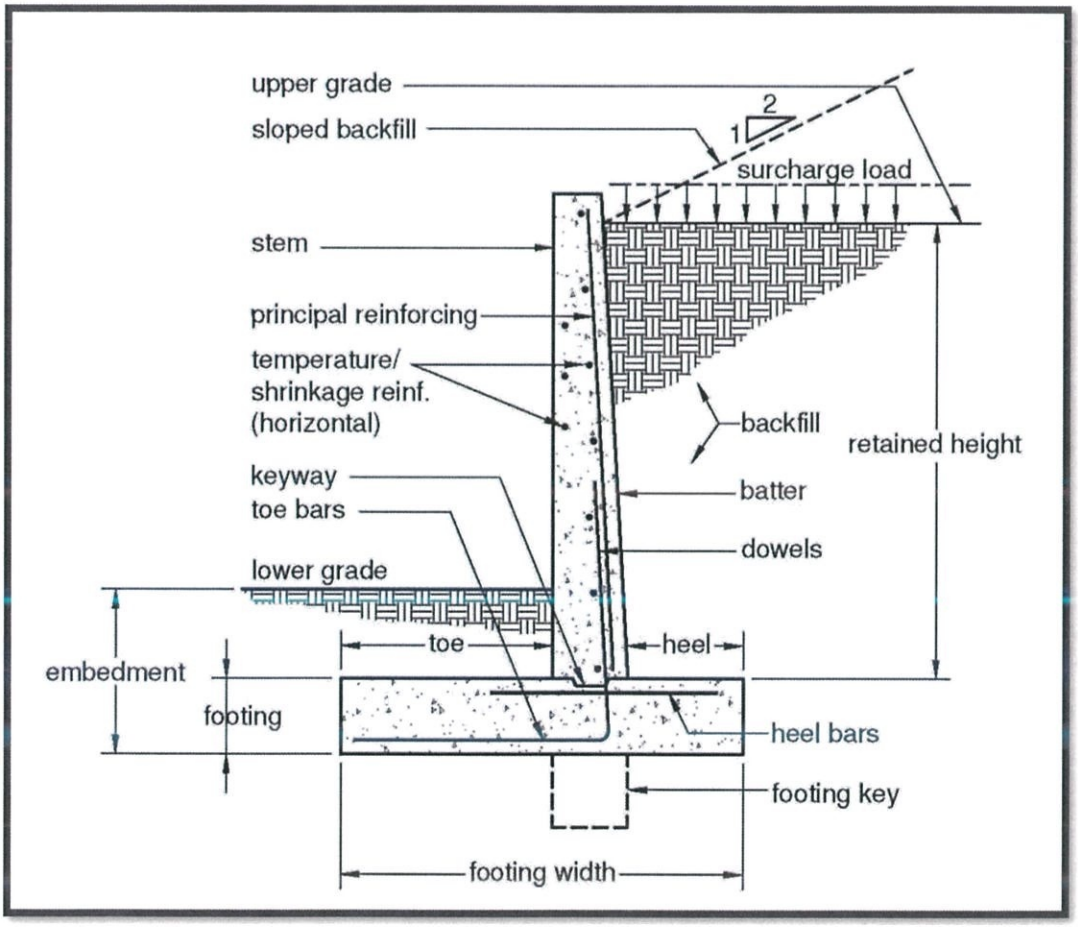


Figure 15: Retaining wall terminology.

Source: Brooks (2013)

What the Terms Mean:

Backfill: The soil placed behind a wall.

Backfill slope: Often the backfill slopes upward from the back face of the wall. The slope is usually expressed as a ratio of horizontal to vertical.

Batter: The slope of the face of the stem from a vertical plane, usually on the inside (earth) face.

Dowels: Reinforcing steel placed in the footing and bent up into the stem a distance at least equal to the required development length.

Footing (or foundation): That part of the structure below the stem that supports and transmits vertical and horizontal forces into the soil below.

Footing key: A deepened portion of the footing to provide greater sliding resistance.

Grade: The surface of the soil or paving; can refer to either side of the wall.

Heel: That portion of the footing extending behind the wall (under the retained soil).

Horizontal temperature/shrinkage reinforcing: Longitudinal horizontal reinforcing usually placed in both faces of the stem and used primarily to control cracking from shrinkage or temperature changes.

Keyway: A horizontal slot located at the base of the stem and cast into the footing for greater shear resistance.

Principal reinforcing: Reinforcing used to resist bending in the stem.

Retained height: The height of the earth to be retained, generally measured upward from the top of the footing.

Stem: The vertical wall above the foundation.

Surcharge: Any load placed in or on top of the soil, either in front or behind the wall.

Toe: That portion of footing which extends in front of the front face of the stem (away from the retained earth).

Weep holes: Holes provided at the base of the stem for drainage. Weep holes usually have gravel or crushed rock behind the openings to act as a filter and prevent

clogging. Poor drainage of weep holes is the result of weep holes becoming clogged with moss, thereby increasing the sideways pressure against the wall. Unless properly designed and maintained, weep holes seldom "weep". Alternatively, perforated pipe surrounded with gravel and closed within a geotextile can be used to provide drainage of the backfill.

Types of Cantilevered Retaining Walls Include:

i) Gravity retaining walls

This type of wall depends upon the dead load mass of the wall for stability rather than cantilevering from a foundation. Also, it depends on self-weight only to resist lateral earth pressure. Usually, gravity retaining wall is massive due to significant gravity load to counter act the soil pressure. Gravity retaining wall,

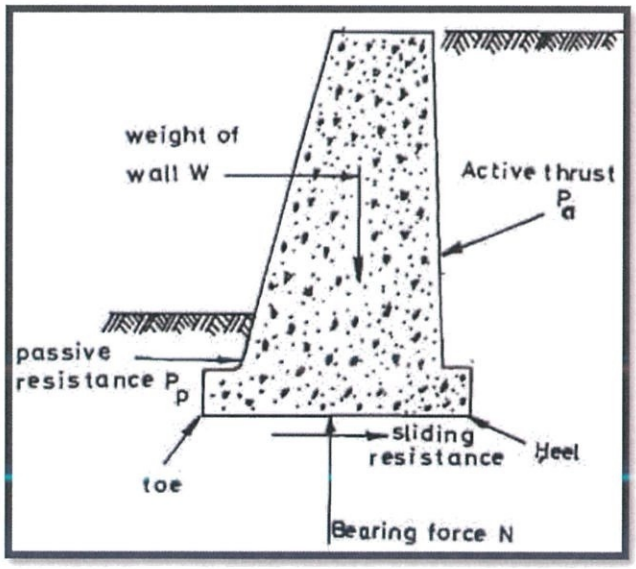


Figure 16: Gravity retaining wall.

Source: Brooks (2013)

ii) Gabion or crib walls

A gabion wall is a type of gravity wall whereby stones or rubble are placed within wire fabric baskets. Crib walls are a variation of the gabion method whereby mostly steel bins are filled with stone or rubble. Another variation is to stack a grillage of timbers and fill the interior with earth or rubble. Precast concrete crib walls are also widely used.

Figure 17: Gabion retaining wall.

Source: Brooks (2013)

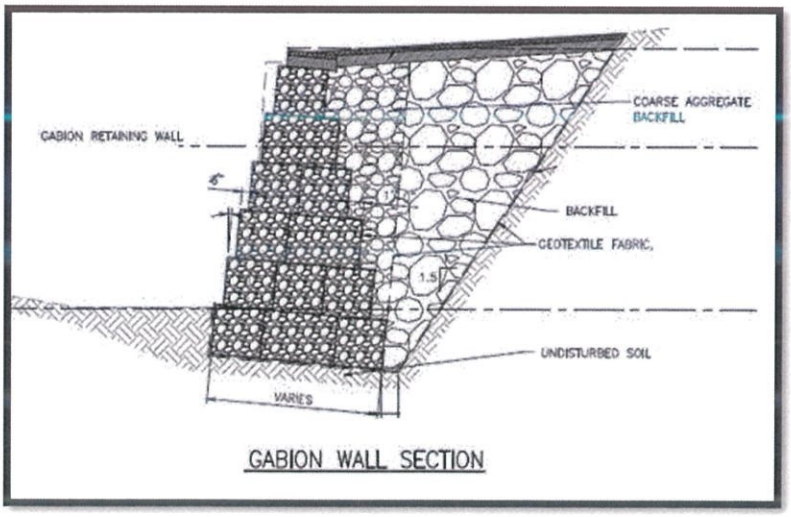


Figure 18: Gabion wall section.

Source: Brooks (2013)

iii) Counterfort retaining walls

Counterfort cantilevered retaining walls incorporate wing walls projecting upward from the heel of the footing into the stem. The thickness of the stem between counterforts is thinner (than for cantilevered walls) and spans horizontally, as a beam, between the counterfort (wing) walls. The counterforts act as cantilevered elements and are structurally efficient because the counterforts are tapered down to a wider (deeper) base at the heel where moments are higher. The high cost of forming the counterforts and the infill stem walls make such walls usually not practical for walls less than about 16 feet high.

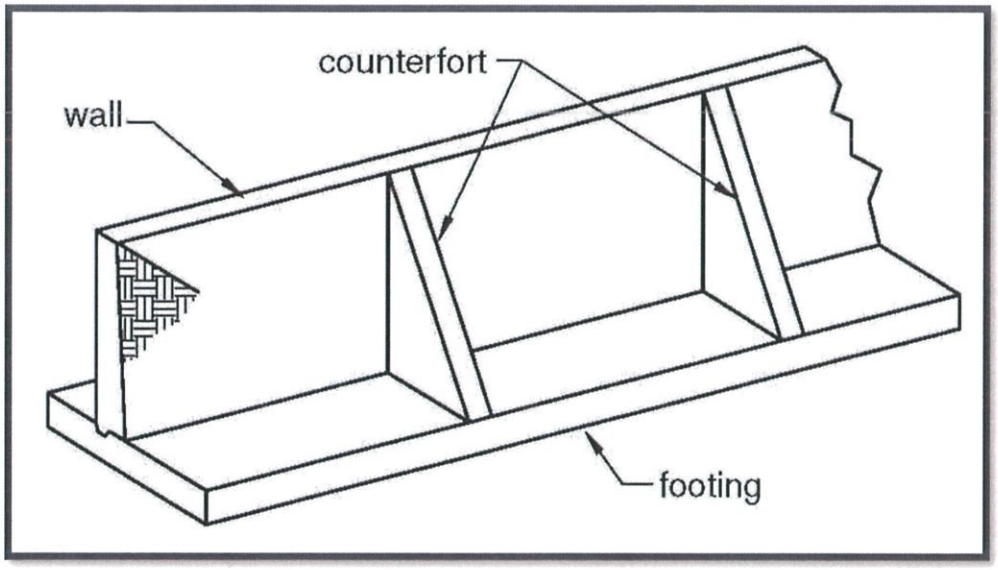


Figure 19: Counterfort retaining wall.

Source: Brooks (2013)

iv) Anchored (tieback) walls

Anchors or tiebacks are often used for higher walls where a cantilevered wall may not be economical. Restraint is achieved by drilling holes and grouting inclined steel rods as anchors into the zone of earth behind the wall beyond the theoretical failure plane in the backfill. The anchors can be placed at several tiers for higher walls and can be post-tensioned rods grouted into drilled holes, or non-tensioned rods grouted into the drilled holes. The latter are also known as soil nails.

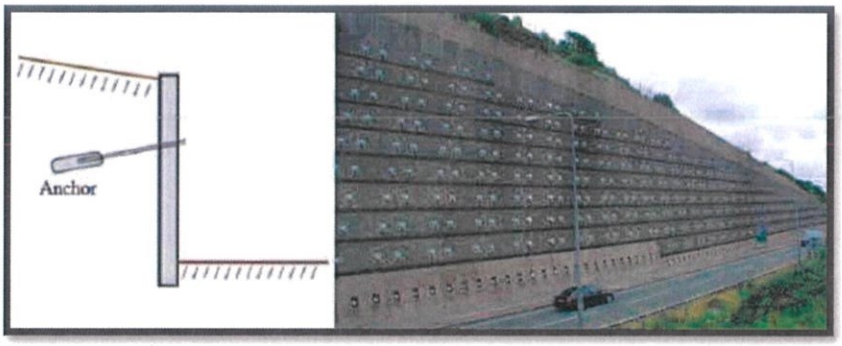


Figure 20: Anchored retaining wall.

Source: Brooks (2013)

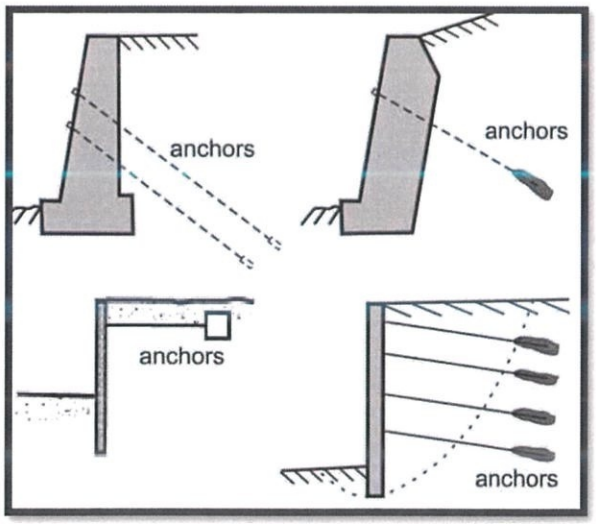


Figure 21: Types of anchored retaining wall.

Source: Brooks (2013)

v) Piles retaining wall

Pile retaining wall are constructed by driving reinforced concrete piles adjacent to each other as shown in the Fig 8.0 and 9.0. Piled walls offer high stiffness retaining elements which can hold lateral pressure in large excavation depths with almost no disturbance to surrounding structures or properties.

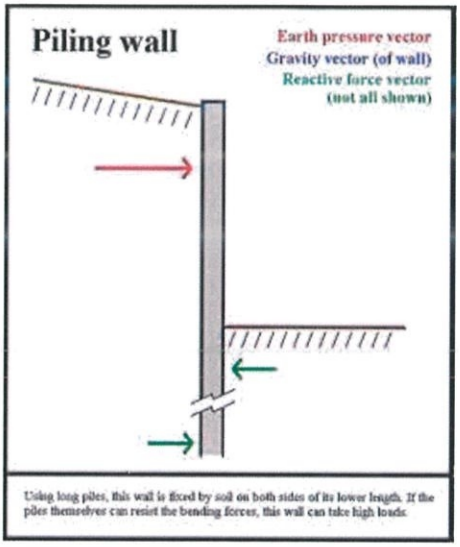


Figure 22: Piling wall cross section.

Source: Brooks (2013)

Figure 23: Piling wall

Source: Brooks (2013)

3.1 Method construction for retaining wall in Bandar UDA Utama, Mukim Pulai, Johor Baru, Johor.

Figure 24:Retaining wall in Bandar UDA Utama.

The construction for this retaining wall includes site clearance, fill earth including trimming, compacting in layer to form a platform, temporary works like wash through, sediment basin and earth drain. Not to mention reinforced concrete retaining wall concrete works itself, resurfacing road works after being hacked for the purpose of construction and installation of street lighting and cable system.

Site clearance started with the clearance the obstruction visible on site approximately 8.5 m by cutting all trees regardless of size, gathering up all the debris, demolishing all structures including the existing hoarding on site cart away debris move to dump site. The earthworks begin fill with the soil gains obtained on site, compacted and spread in layers in making up levels in fill

areas as required up to the platform level in order to protect the slope from falling.

Then, the temporary works begins with the construction of the reinforced concrete wash through, 11.20 m x 3.50 m. The wash through complete with water supply piping, pressure water jet, fittings including the disposal discharge to details as shown in Appendix F draw alongside the construction of a sediment basin size 82.00 m x 15.00 m deep internally consist earth bunds, banks and slopes, perforated risers, anti-vortex device, stone heap, pipe culverts, silt gauge, emergency spillway complete connecting to the existing drains as in Appendix . The two of elements of temporary have a regular desilting and maintenance for the 35 weeks according to the contract document.

Reinforced concrete strip footing of retaining wall construction starts off with laid a crusher run layer with the thickness 200 mm, move on to the laid a lean concrete, grade 20, thickness 50 mm. After that, the installation of reinforcement bar for both horizontal and vertical this project use T20 with the 125 mm center to center distance between those bars, not to forget the spacer bar. The spacer bar size 50 mm x 50 mm must be installed before the installation of reinforcement bar. Proceed to the installation for the wall structures reinforcement bar, for vertical use T16 with 150 mm center to center while the horizontal bar use T20 with 125 mm center to center.

Figure 25: Installation of reinforcement bar at wall structures.

Figure 26: Reinforcement bar installed at strip footing.

After the installation of reinforcement bar, the installation of water stops. Water stop use size 12.0 m x 0.30 m; PVC water stop (polyvinyl chloride). Water stops is an

element of a concrete structure intended to prevent the passages of water or fluids when embedded in and running continuously through concrete joint. Usually, water stops used for water proofing of below-grade concrete structures like tunnels, water treatment plant, parking structures, and reservoir. Also, the water stops prevent the transmission of water through the construction joint

Figure 27: Water stops has been installed.

Figure 28:PVC water stops (orange); 12.0 m x 0.30 m.

Alongside with the installation of reinforcement bar, the installation of weep holes run concurrently. Weep holes are used for to relieve the hydrostatic pressure or water pressure on the retaining walls itself. This reduces the structural design demand of the water and earth pressure by reducing thickness as well as reinforcement requirement. Also, by installing the weep holes could provide an opening that allows the drainage of any moisture that may come from back of the wall through penetration capillary action or leakage.

Figure 29: Weep holes has been installed in RC wall structures.

After the installation of equipment that need to have in wall structures, the formwork installed for the strip footing and the retaining wall itself. For the strip footing, usually installed before the reinforcement bar installed to gain the right width of the strip footing, which was 4.0 m, the wall height equalizes 4.40 m with the length of 417.45 m as shown layout plan in Appendix A.

Tapered side of wall structures.

Figure 30: Tapered side of wall formwork installed.

The formwork that used for the tapered side of retaining wall was timber formwork. The reason used timber formwork were easily to demold it and it can be used repeatedly. After that, the concrete works starts at the tapered side and strip footing of retaining wall first before moving on to the other elements. The concrete used for this structure was grade 30. The concrete evenly spread and compact using vibrator poker 3.0 m length to prevent any aftereffect like honeycomb.

Figure 31: Strip footing concrete works.

Figure 32: Final look of the strip footing concrete works.

As for the wall structures, formwork that been used was steel formwork. Steel formwork had to be arranged and connected using bolt and nut according to the thickness of the wall which was 0.50 m thick. The double C-channel need to install firmly connected to the steel mold build in a long nut with studs and butterfly washer in the manufacturing company and delivered into the site for the installation.

Figure 33: Double C-channel support.

Figure 34: Steel formwork arrived, front and back.

The next step for installation of steel formwork, the formwork needs to apply mold release oil on its surface to prevent the concrete from stuck to the mold. Steel formwork details, 2.4 m (height) x 10.8 m (length). The steel formwork lifted by crane and laid vertically to the required position. The adjustable probs is installed to restraint the movement of the steel mold during the concrete casting.

Figure 35: Steel formwork lifted by using the crane.

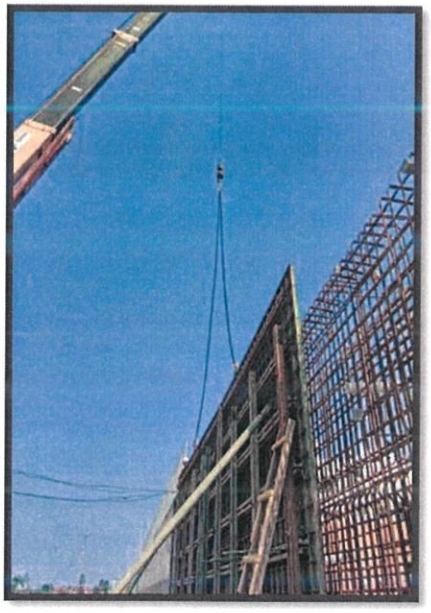


Figure 36: Steel formwork laid on the required position.

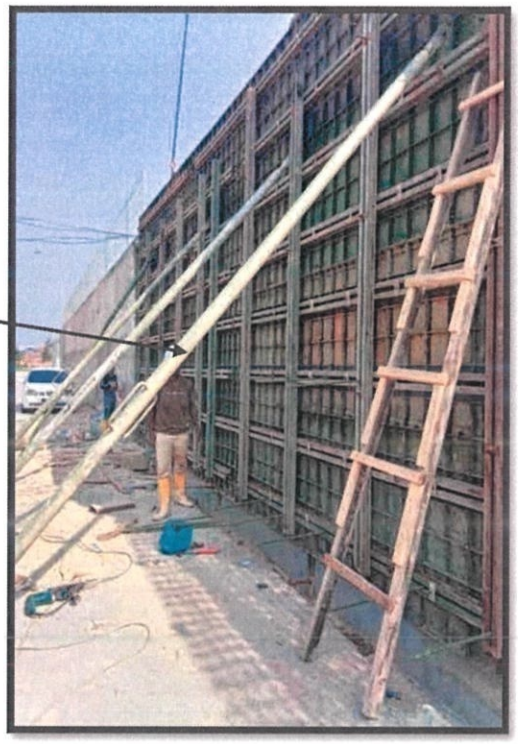


Figure 37: Adjustable props installed to restrain any movement.

Tie rod set in place through the steel mold to tighten the connection of both sides of steel formwork. The concrete, Grade 30 deposited continuously into the steel formwork. The concrete consolidated by using vibrator poker which will be operated by competent workmen. Entire retaining wall shall be cast in stretches of 10m to 20m to suit site condition. Horizontal construction joint provided at predetermined location as per approved pour plan. The vertical construction joint provided by means of wooden stopper at 10m to 20m interval depending on length to be taken at a time.

Pouring will be done in layers and proper compaction will be ensured by using needle vibrators. Electrically operated vibrators with different dia needles viz. 60mm or 40 mm will be used for compaction of poured concrete depending upon the thickness of the layer.

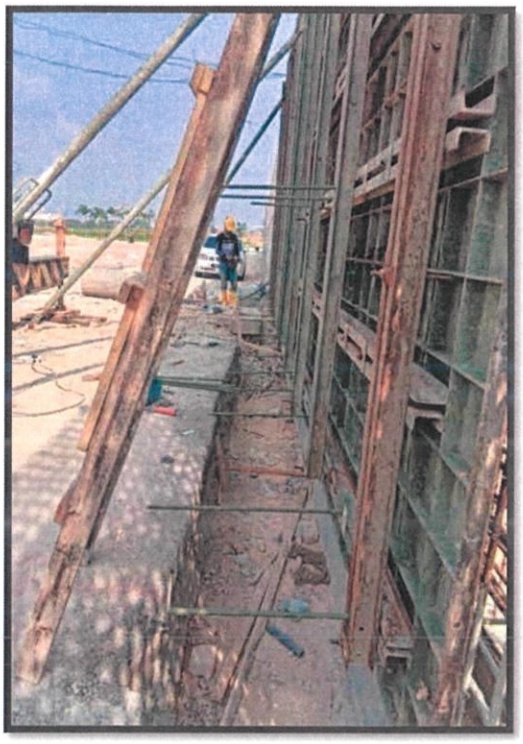


Figure 38: Tie rod being installed to tighten, both sides.

Figure 39: Concrete, grade 30 cast into the steel formwork.

As the concrete is hardened, the adjustable props uninstalled, and steel formwork moved and shifted to the adjacent part of concrete structure.

Figure 40: Steel formwork at 10.8 m distance post – concrete.

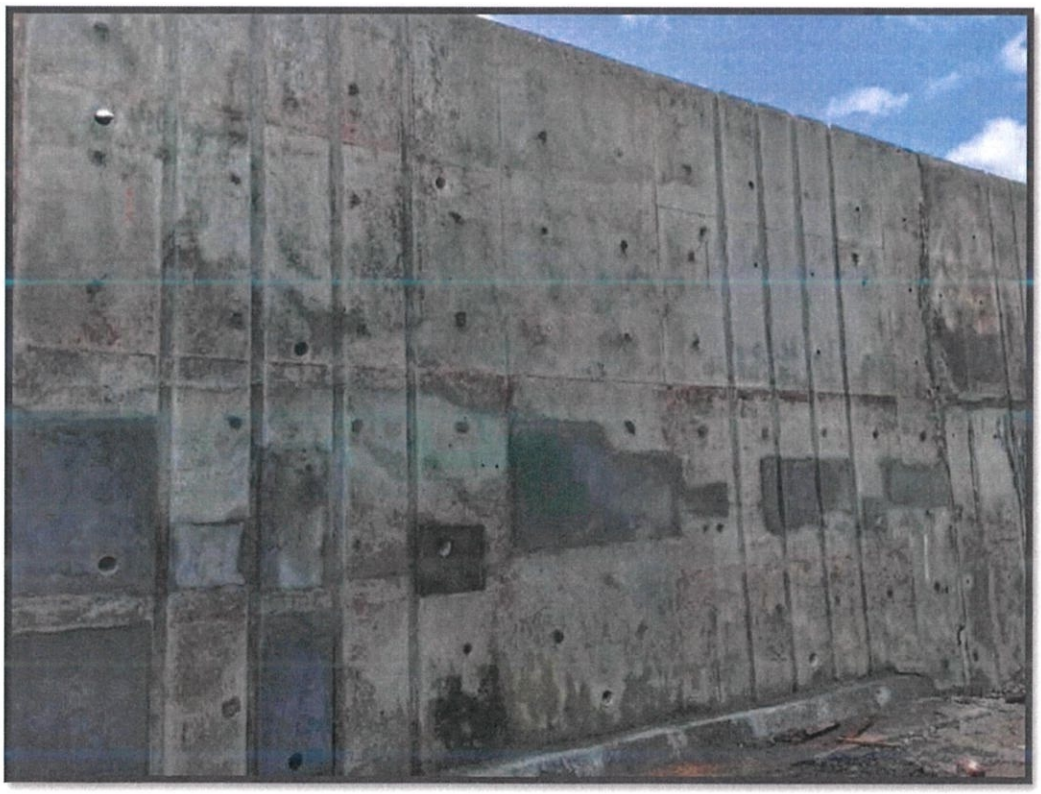


Figure 41: After concrete process.

After concrete hardened in 24 hours, the steel formwork removed to the other side of retaining wall. The steel formwork had a maintenance to take care of it, the steel formwork should be cleaned from dust and oil is applied in the mould in order to ease the demoulding process.

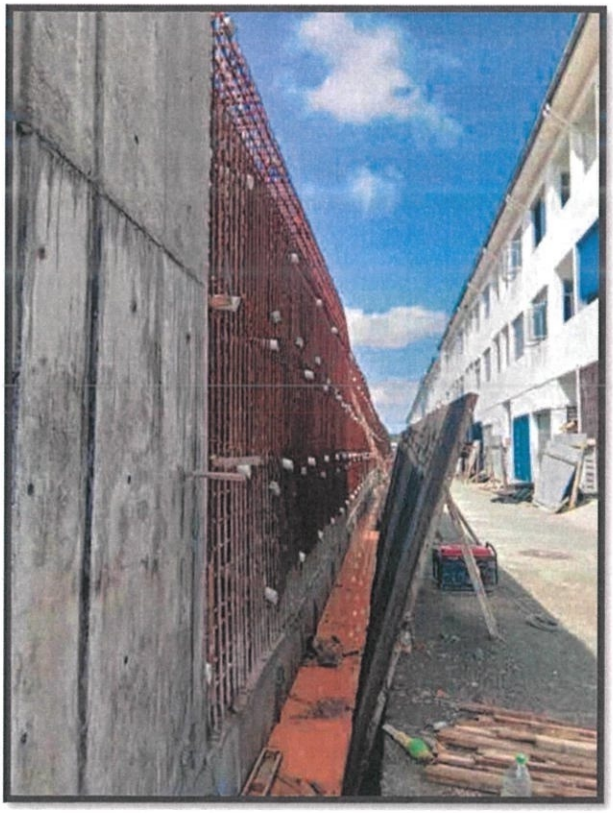


Figure 42: The steel formwork shifted adjacent part of retaining wall.

4.0 CONCLUSION

4.1 Conclusion

The case study found that the type of retaining wall used in this project was a gravity retaining wall where the wall depends upon the dead load mass of the wall for stability rather than cantilevering from a foundation. Also, it depends on self-weight only to resist lateral earth pressure. Usually, gravity retaining wall is massive due to significant gravity load to counter act the soil pressure.

The method construction of this retaining wall used a steel formwork which were a new thing to be discovered. The steel formwork installation much easier than the timber formwork or the conventional method. It really helped deduct time of construction as well as the cost of the construction.

In this project, problem that occurred was the housekeeping of the site and the safety measures that taken lightly by labour. But eventually, this problem solved with some disciplinary action taken by site supervisor as well as safety supervisor.

REFERENCES

1. Chudley, R., & Greeno, R. (2005). Construction Technology. Pearson Education.
2. Brooks, H., & Nielsen, J. (2010). Basics of retaining wall design. HBA Publication, 11.
3. Merritt, F. S., & Ricketts, J. T. (2001). Building design and construction handbook (Vol. 13). New York, NY, USA: McGraw-Hill.

APPENDIX A

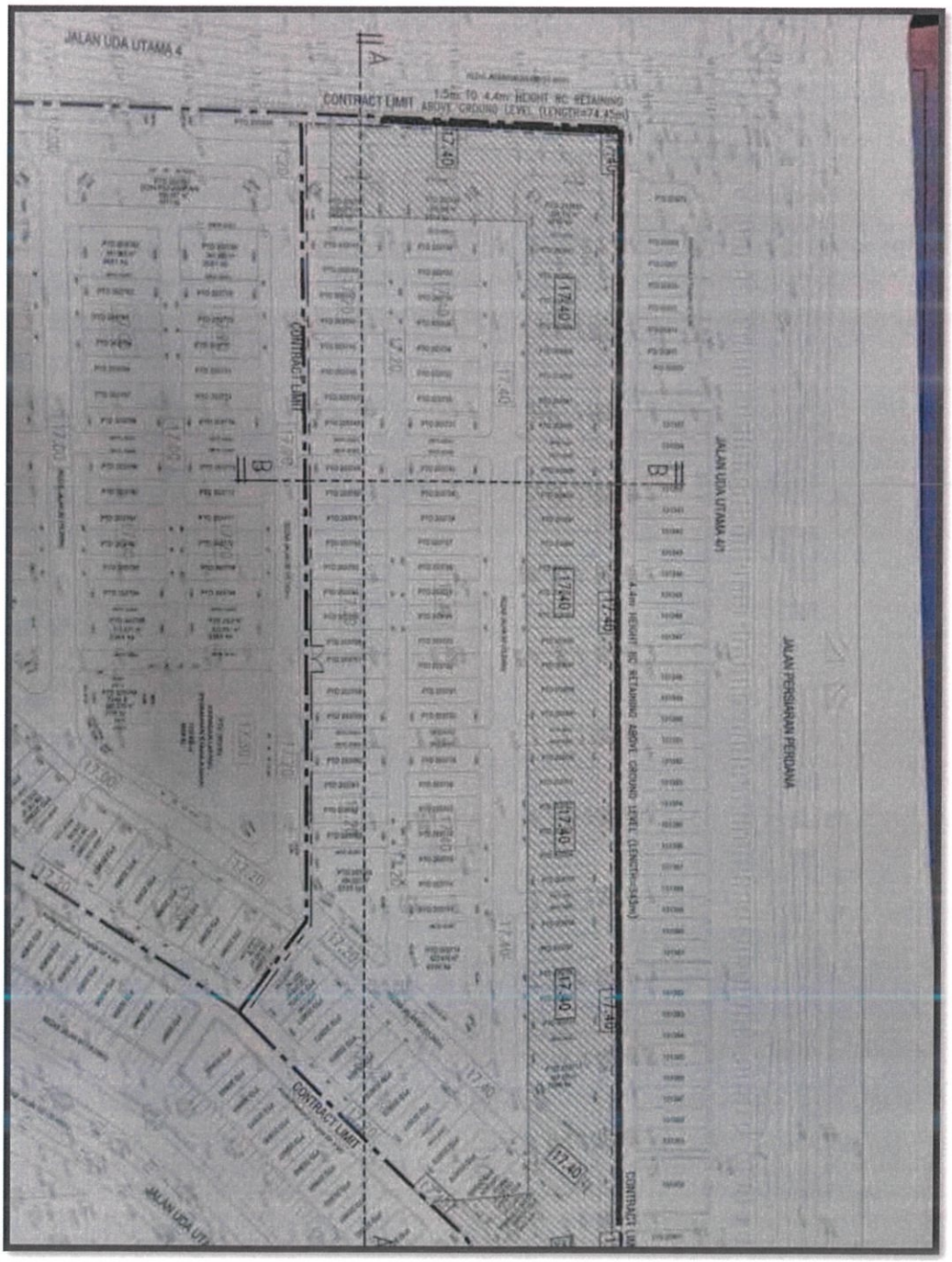


Figure 43: Site layout plan.

Source: UDA Land (South) Sdn. Bhd

APPENDIX B

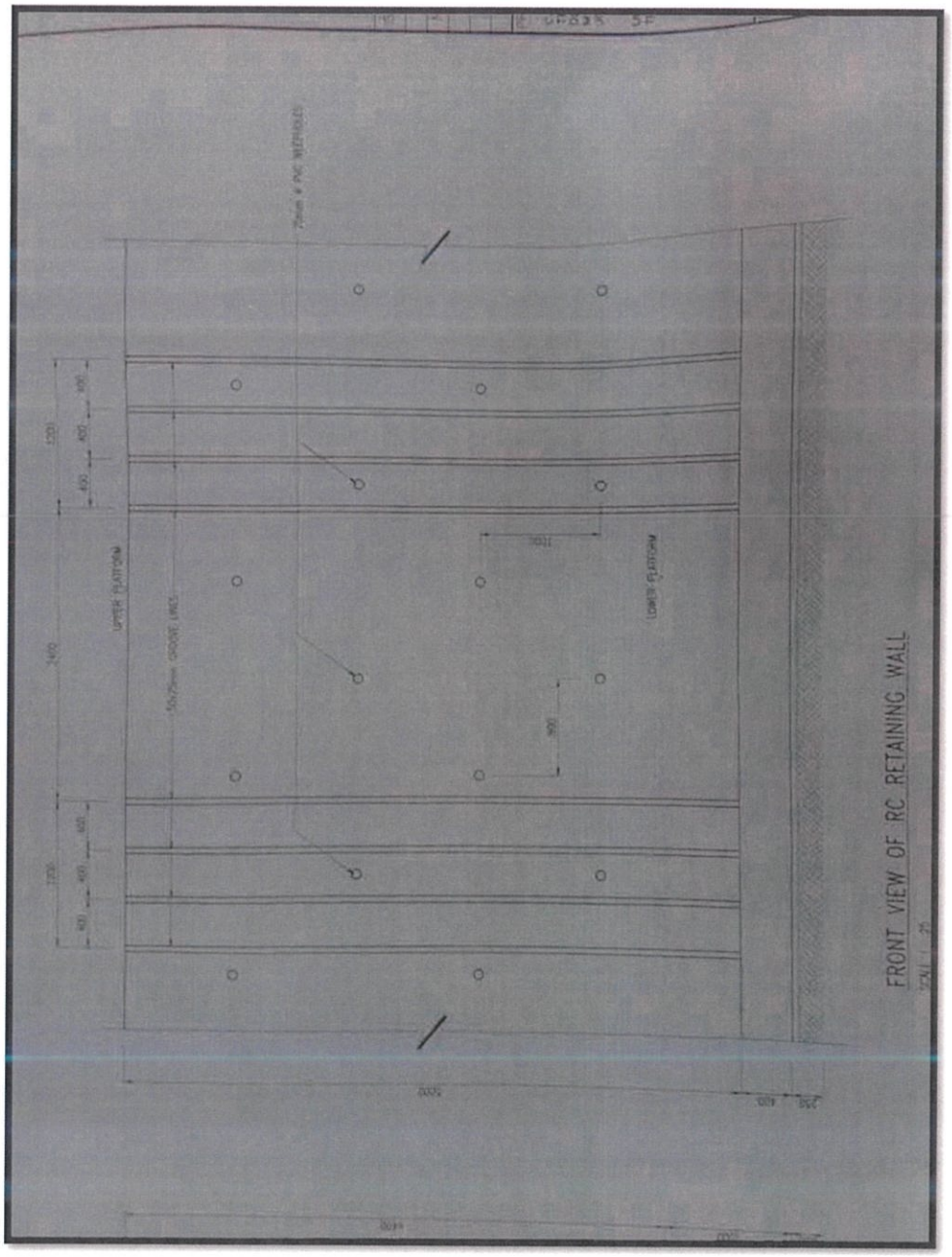


Figure 44: Front view of retaining wall.

Source: UDA Land (South) Sdn. Bhd

APPENDIX C

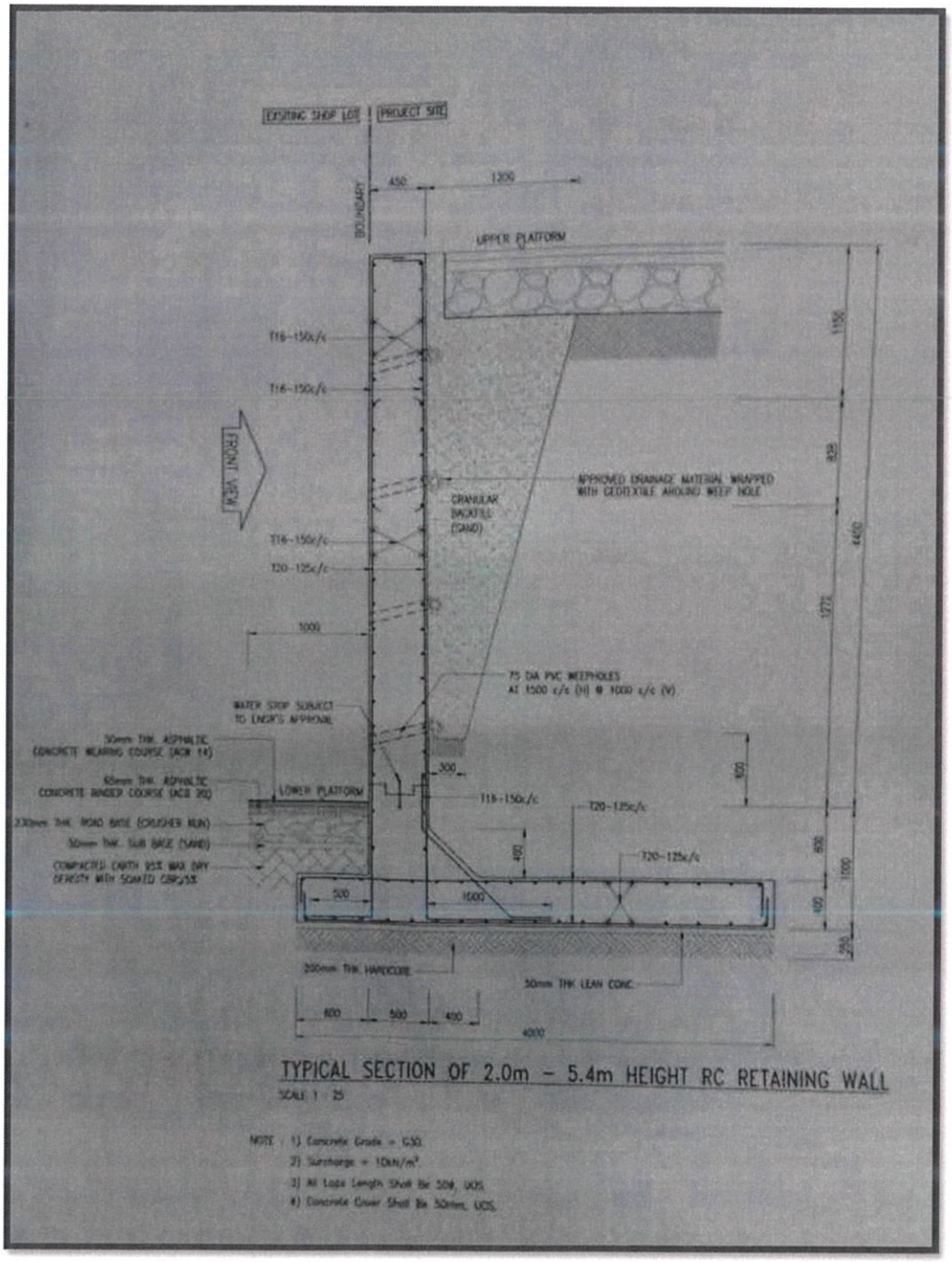


Figure 45: Retaining wall section details.

Source: UDA Land (South) Sdn. Bhd

APPENDIX D

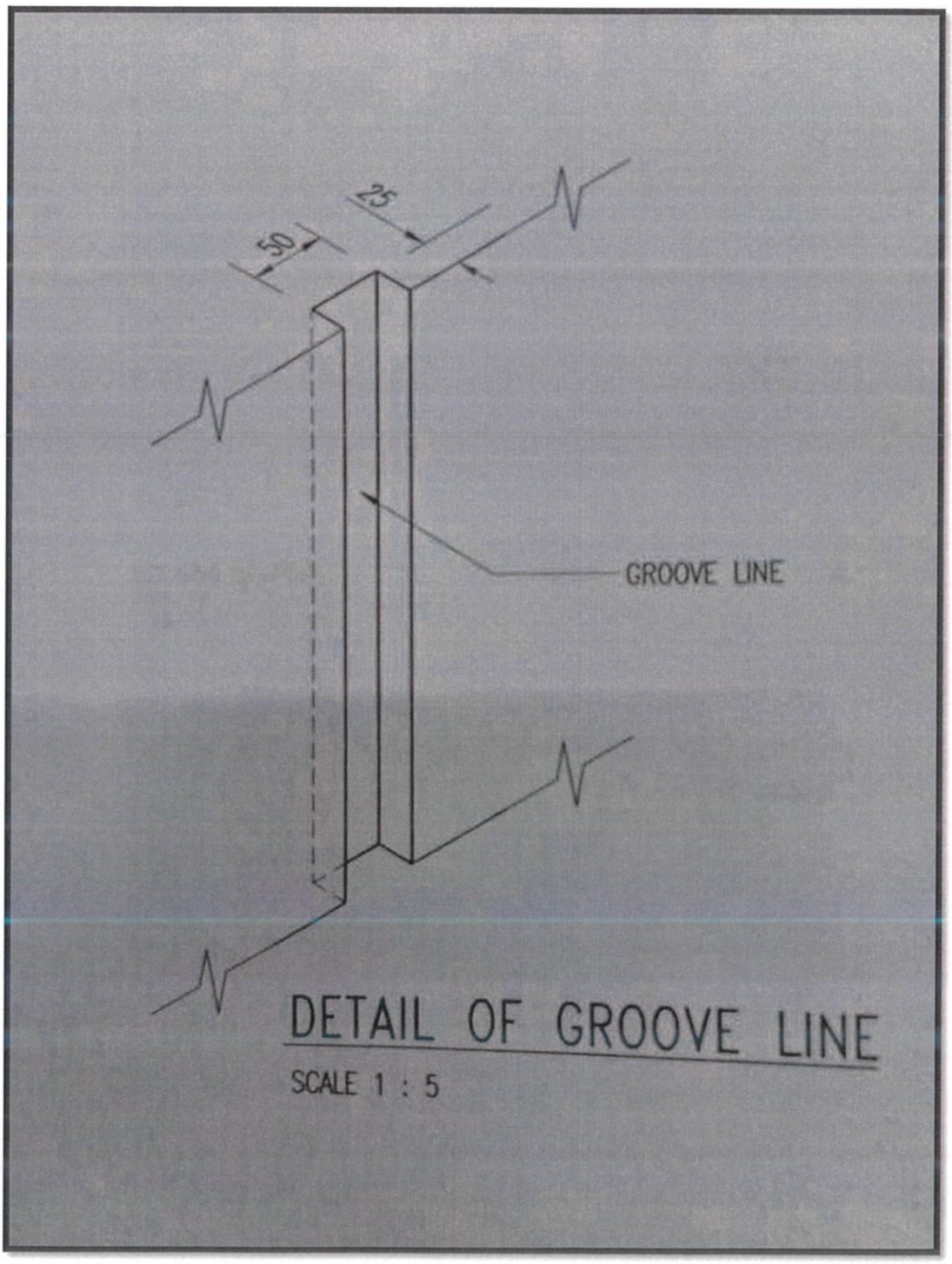


Figure 46: Groove line details

Source: UDA Land (South) Sdn. Bhd

APPENDIX E

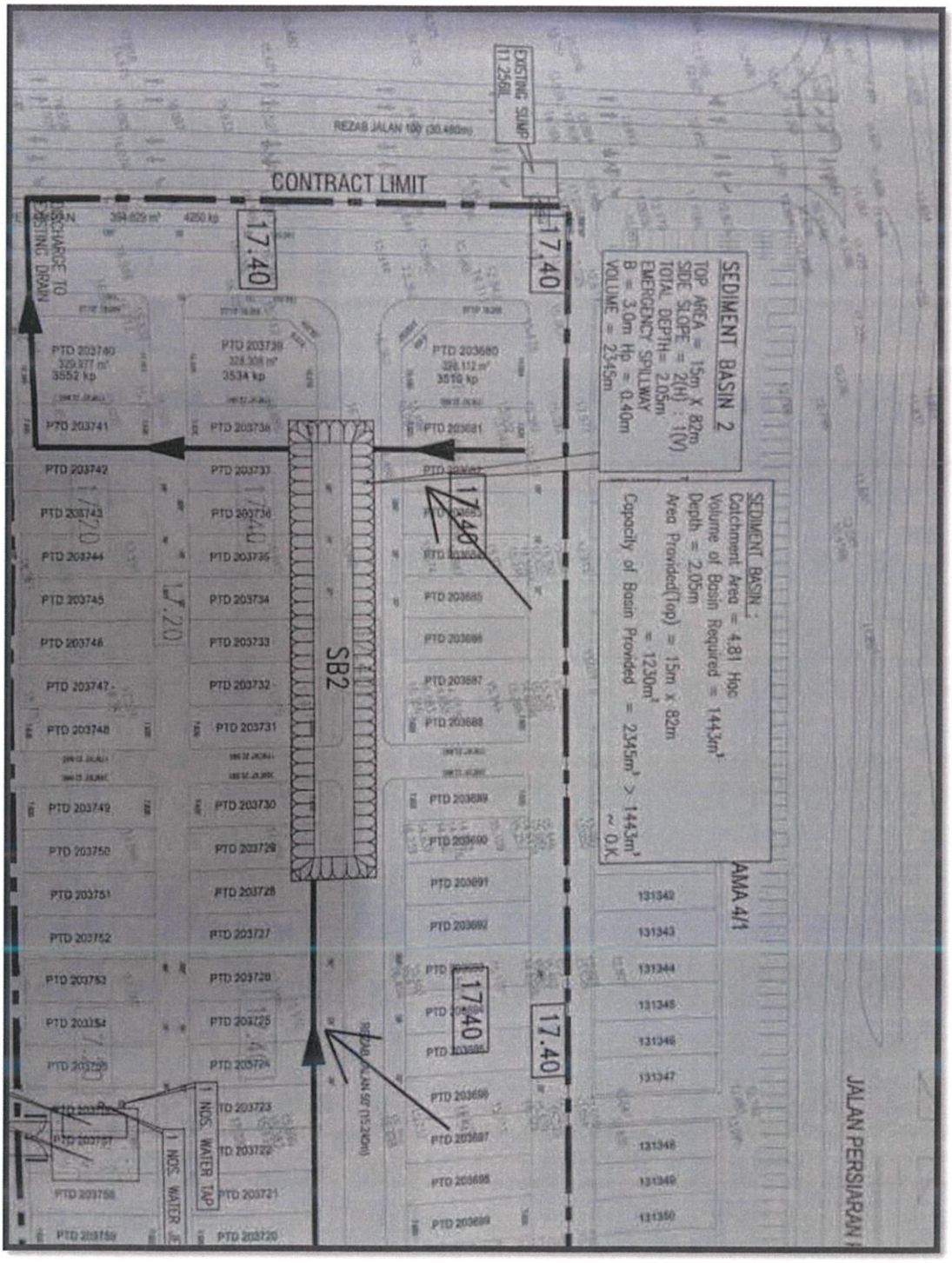


Figure 47: Sediment basin details.

Source: UDA Land (South) Sdn. Bhd

APPENDIX F

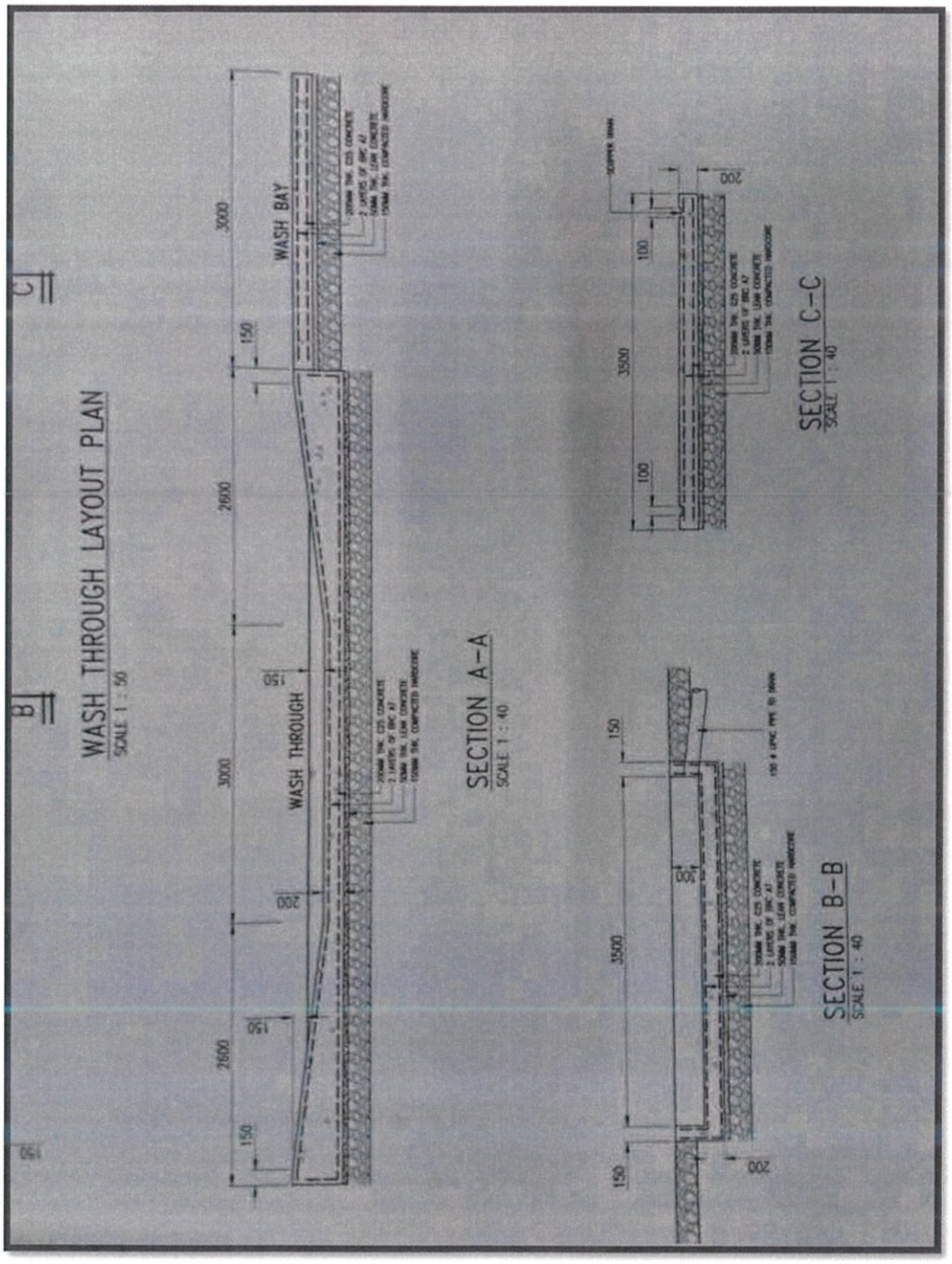


Figure 48: Wash through details.

Source: UDA Land (South) Sdn. Bhd

APPENDIX G

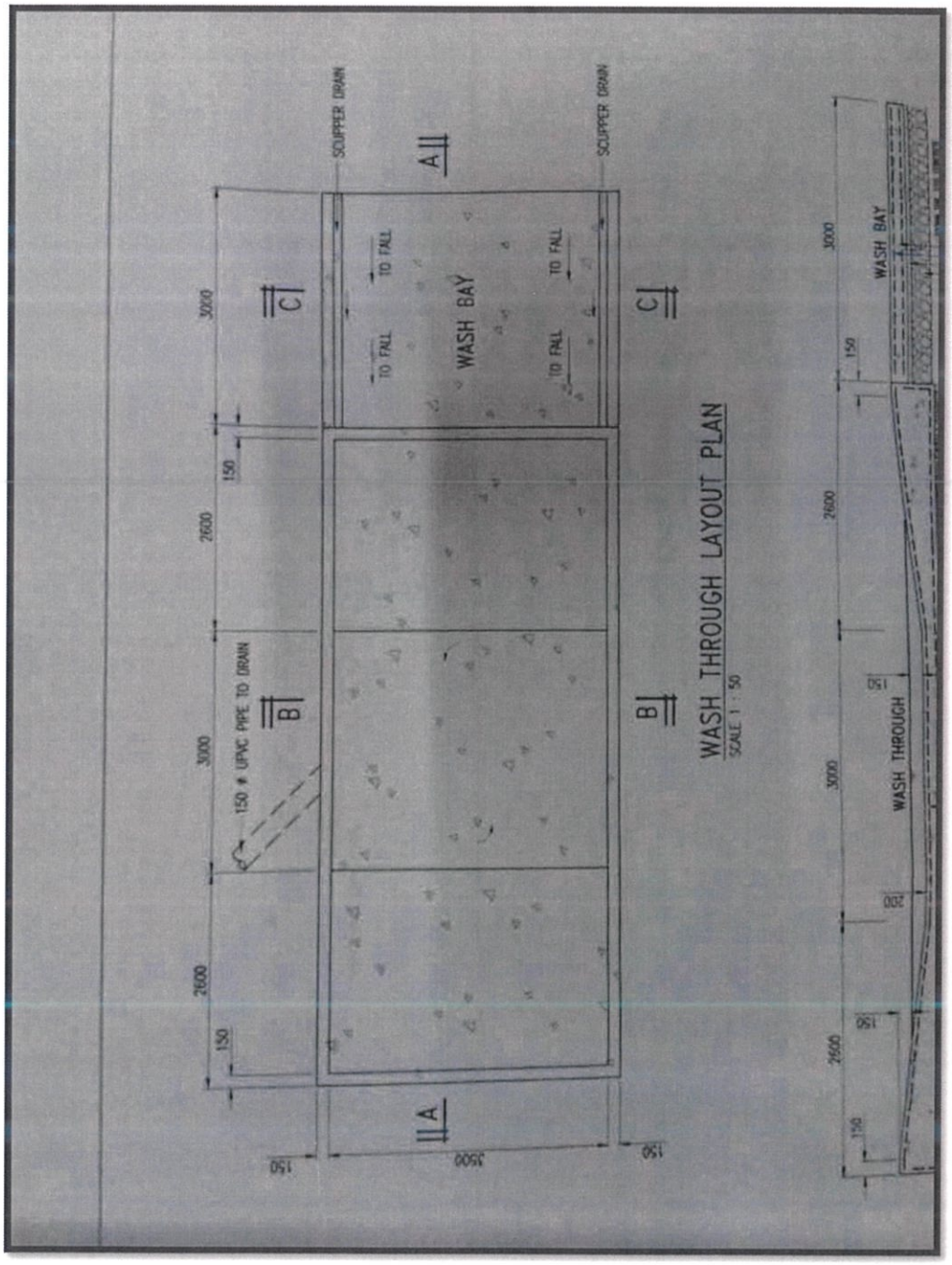


Figure 49: Wash through layout plan.

Source: UDA Land (South) Sdn. Bhd