



**DEPARTMENT OF BUILDING  
UNIVERSITI TEKNOLOGI MARA  
(PERAK)**

**THE CONSTRUCTION OF MAINLINE WORKS AT SUNGAI  
BESI - ULU KELANG HIGHWAY (SUKE) PRIVATIZATION  
PROJECT.**

**Prepared by:  
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DEPARTMENT OF BUILT ENVIRONMENT STUDIES AND  
TECHNOLOGY  
UNIVERSITI TEKNOLOGI MARA  
(PERAK)**

**FEBRUARY 2022**

It is recommended that the report of this practical training provided

**By**

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**entitled**

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

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**FEBRUARY 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 PDP Utek (M) Sdn Bhd for duration of 20 weeks starting from 23 August 2021 and ended on 10 January 2022. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Date : 10<sup>th</sup> January 2022

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Last but not least, I'd like to express my gratitude to every each one of my colleagues and classmates who assisted me in some way.

## **ABSTRACT**

Stephen Gardiner once said, "Good buildings come from good people, and all problems are solved by good design."

This report discusses the pipe jacking and grouting methods used to create an effective drainage system in a particular area. Pipe jacking is a method of constructing underground pipes and drainage systems. It is often called as microtunnelling but in a smaller size. Practical engineering concerns and economics may limit the use of individual pipe jacks.

Continue to the following technique, grouting. Injection grouting is a technique that entails injecting a material under pressure into cracks, open joints, voids, or honeycombs in concrete or masonry structural components to fulfill certain goals.

The report's main objective is to know the exact term and purpose of all contract components in order to accomplish a project effectively. Additionally, to discover the specific methodology for pipe jacking and grouting operation, as well as their method description along with to have a better understanding of the benefits and drawbacks of the pipe jacking and grouting work methods.

In conclusion, in today 's environment, choosing the accurate material and technique for pipe jacking operation is crucial to have an efficient drainage system that can be used for a long period of time especially when flooding season arise in Malaysia

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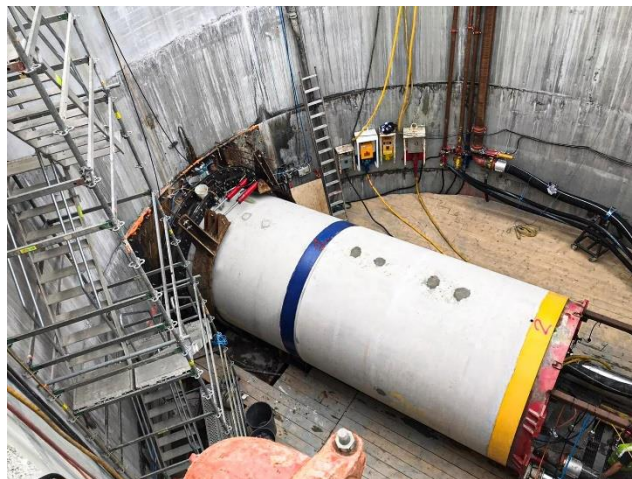


## CHAPTER 1.0

### INTRODUCTION

#### 1.1 Background of Study

Pipe jacking, also known as microtunnelling in smaller diameters, is a method of building underground pipelines, ducts, and culverts as Pipe Jacking Association clearly explained on their website which called The Pipe Jacking Association, [www.pipejacking.org/about\\_pipe\\_jacking](http://www.pipejacking.org/about_pipe_jacking). At the same time as excavation is going place within the shield, powerful hydraulic jacks are employed to force specially engineered pipes through the earth behind the shield. As the tunnel is excavated, the process produces a flexible, structural, waterproof finished pipeline.



*Figure 1.1: Pipe jacking process  
Source: Tracey Concrete, 2003*

Individual pipe jacks have no theoretical length limit, but practical engineering concerns and economics may impose limitations. There are a variety of mechanical and remote control excavating methods to choose from. The pipe jacking method requires less overbreak than alternative systems, and construction tolerances are equivalent to other tunnelling methods. It acts as a ground support and decreases the possibility of ground displacement. Mechanical excavation techniques are comparable to those used in other tunnelling applications. For a wide range of ground conditions, shields, excavation, and face support can be provided.

Thrust and receiving trenches are built, usually at manhole locations, to lay a pipeline using this technique. A thrust pit's dimensions and structure vary depending on the specific requirements. Plus, the purpose of a thrust wall is to produce a response against which to jack. To boost the thrust wall's reaction capabilities in poor ground, piling or other additional measures may be required. When there isn't enough depth to build a typical thrust wall, the jacking reaction must be resisted by a structural framework with appropriate restriction given by piles, ground anchors, or other horizontal load-transfer mechanisms. (Pipe Jacking Association & Pipe Jacking Association Staff, 2017)



*Figure 1.2: Cement grouting for microtunnelling  
Source: Babcock, 2017*

Injection grouting is a method that involves injecting a material into cracks, open joints, voids, or honeycombs in concrete or masonry structural components under pressure to achieve the desired objectives, such as strengthening a structure and preventing water movement.

Grout is a flowable plastic substance that should shrink very little in order to completely fill the gap or spaces and stay stable without cracking, delamination, or crumbling. Cement grout, polymer-cement slurry, epoxy, urethane, and high-molecular-weight methacrylate are all examples of grouts while this project was focused on cement grouting.

These grout types are chosen for certain concrete or masonry restoration jobs based on the grout's compatibility with the original material. The desired goals of the grouting procedure will not be met if the wrong grouting material is used. (Hamakareem, 2020)

## **1.2 Objectives**

In preparing this Practical Training Report, there are a few objectives that must be met. The following are the objectives:

### **1. To identify the project contract's terms and contents**

Understand the actual term and purpose of all of the contract's elements in order to achieve successful project.

### **2. To determine the installation method of pipe jacking and grouting work procedure**

Understand the specific method used for pipe jacking and grouting work as well as their method statement for this project.

### **3. To explain the importance of pipe jacking and grouting work**

Acknowledge the pros and cons of the work method involved in pipe jacking and grouting work.

## **1.3 Scope of Study**

This is the proposed working statement for proposed grouting using double polymer grout along the proposed pipe jacking alignment using mansfield method. The length of the pipe jacking is 40m across the MRR II highway at Ampang.

In this case study report, all of the definitions of contract conditions, and their specific conditions, are summarised in order to complete this project. This report was written to help people understand how to utilise pressure grouting to fix existing or potential subsurface problems. Procedures, materials, and equipment for planning and conducting a grouting project are all included. Pressure grouting methods that have been demonstrated to be effective are detailed, as well as numerous types of grouts and their qualities.

Pipe jacking and microtunnelling are commonly used for new sewage and drainage construction, sewer replacement and lining, gas and water mains, oil pipelines, electricity and telecommunications cable installation, and culverts. Pipe jacking is frequently used to replace open cut excavations or other tunnelling methods. Unfortunately, this study covered the technique for installing a pipejacking mansfield in a drainage system. There is no mention of a sewer system.

## **1.4 Methods of Study**

A report is a compact piece of writing that examines issues, situations, events, or findings using facts and evidence about variety of issues with a specific goal. Reports are a type of non-fiction that aims to be as objective and fact-based as possible. These are the method applied to accomplished this report:

### **1. Observation**

Due to the exposure to the real work, this method is used immediately while conducting a project site visit. Within a five-month period, observations were made to study the procedure of pipe jacking and grouting, as well as their method. By looking at the different sorts of materials that are used, it is clear that the method and outcome will be affected. Throughout the observing procedure, photographs and recordings were taken. Taking written notes during the observation is also important to ensure that no important information is overlooked.

### **2. Interviews**

The interview is a good way to get a lot of information. When questions can be asked immediately and answers can be obtained on the spot, an unstructured interview process occurs. During the educational site visit, interviewing professionals with experience in the construction business, such as supervisors, architects, engineers, quantity surveyors, and labours on site, is used to gather and analyse information. to grasp concepts in order to gain in-depth insights on a problem or come up with new ideas for this report. Because different people have varied skills and experiences, it will be beneficial to gain a better understanding while conducting the observation.

### **3. Document reviews**

This strategy requires systematic data collection from the company's existing records, such as construction drawings, company profiles, monthly progress reports, and photographs taken by employees. The majority of the important and confidential data about the project can be obtained and used to meet the report's objectives.

## CHAPTER 2.0

### COMPANY BACKGROUND

#### 2.1 Introduction of Company



*Figure 2.1: Logo of PDP UTEK (M) SDN BHD  
Source: PDP Utek, 2002*

PdP UTEK (M) Sdn. Bhd. is a recognised and well-established 100 percent Bumiputera Specialist Contractor that oversees and controls pipe jacking and underground utility related projects.

From the beginning inquiry to the final execution, PdP UTEK (M) Sdn. Bhd. aims to deliver professional services in all aspects of our work. They work with their clients at every stage to fulfil their needs and provide competent advice. This firm offers conceptual proposals, budgeting, site inspection, and project implementation.

The mission of this company is Towards Global Competitiveness Through Quality Excellence & Committed Service to The Industries.

The visions are:

- 1- Contribute to Industries by Providing Efficient & Quality Services
- 2- Consistently Improves & Develop Our Technology to Meet the Needs of the Industry Provide Training Within & Outside Our
- 3- Organisation In the Area of Underground Utility Management

## 2.2 Company Profile

Block C, No. 7-5-1, Tingkat 5 Jalan Semarak Api 2, Diamond Square, Off Jalan Gombak 53000 Kuala Lumpur was the address of PdP UTEK (M) Sdn. Bhd. It was founded on August 1, 2002, with a paid-up capital of RM 300,000.00. Their website is <http://www.trenchlessolution.com.my/index.php> which can be reach out to them through this platform. Any inquiry can be referred to 03-4022 2867 and their email, [pdputek@gmail.com](mailto:pdputek@gmail.com).



Figure 2.2: Map location of PDP (M) Utek  
Source: Google map location of PDP (M) Utek

PDP (M) Utek is a company that has G5 CIDB grade. It provides some good services which are pipe jacking, horizontal directional drilling (HDD) and dilapilation survey. A Professional Building Surveyor's dilapidation survey is an examination of the existing structural state of the surrounding buildings and structures prior to the start of demolition, construction, or development.

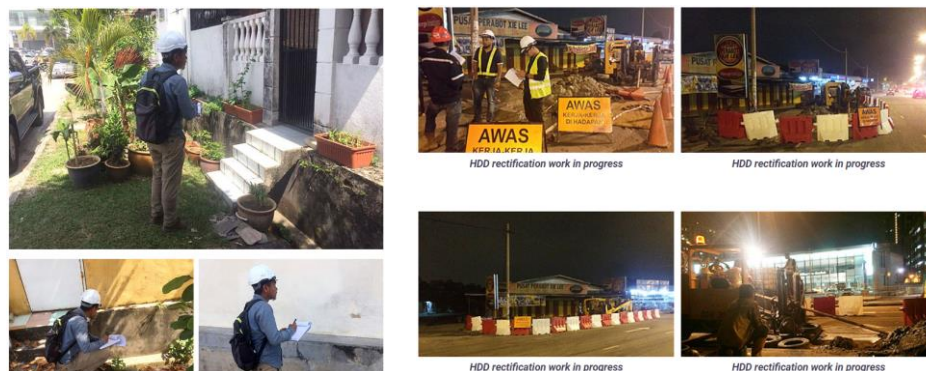


Figure 2.3: Dilapidation survey and HDD work activity by PDP's worker  
Source: PDP Utek, 2002

Furthermore, the authorised capital of PdP UTEK (M) Sdn. Bhd. is RM 500,000.00. The majority of the shareholders are bumiputera and the shareholders are Noor Zamri Yaacob (75%) and Shahrin Sabu (25%) respectively.



## 2.3 Company Organisation Chart

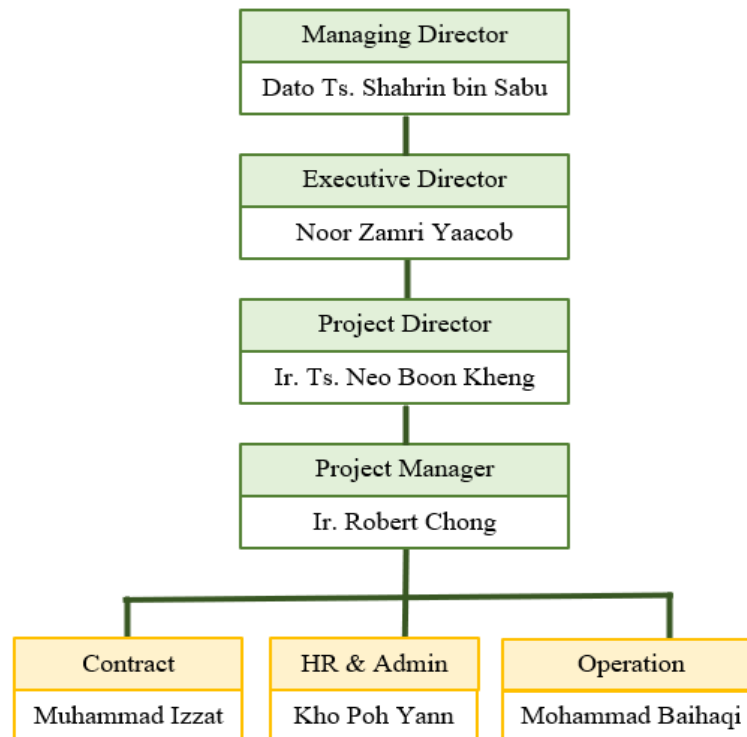


Figure 2.4: Organisation chart for PDP (M) Utek  
Source: PDP (M) Utek's company profile document, 2018

The director for PDP (M) Utek is Dato Ts. Shahrin bin Sabu. He majors in design and supervision of trenchless work, highway, pavement, flood mitigation, soil improvement & soil stability, infrastructure, substructure, rock drilling, TMP, hot tapping & line -stopping, underground utilities mapping, dilapidation survey. Some of his major project involvements are Cadangan Saliran Utama Dari Pembangunan Kuala Lumpur City Centre (KLCC) Hinga Ke Sg Klang and also Jacking Of 700mm MS Pipe At Subang Airport (Microtunnelling Method). Moreover, Noor Zamri Yaacob as executive director. He completed his study successfully in agribusiness. He also involved in some big project which one of them is Manage and supervision for Putrajaya Sewerage Project.

Furthermore, project director for this company is Ir. Ts. Neo Boon Kheng. Over 15 years of trenchless technology project experience, including pipe jacking, microtunnelling, horizontal directional drilling, RD utility detection, and ground penetration radar detection, as well as over 10 years of experience as a resident engineer designing sewerage networks, pumping mains, and sewerage treatment plants, and supervising sewerage work. Plus, he is taking a big part in a project called Kerja-Kerja Pengantian Paip Utama Di Muadzam Shah & Bandar Chini, Pahang

## 2.4 List of Project

### 2.4.1 Completed Projects

Table 2.1: List of completed project  
Source: PDP (M) Utek's company profile document, 2018

Item	Project Title	Client	Contract Value	Status of Completion	Completed
1	Kerja-Kerja Menaiktaraf Sistem Saluran & Kerja-Kerja Yang Berkenaan, Di Bandar Rawang Fasa 2. -Sub-Contractor for Survey and Pipe Jacking Work	Tasek Menara Sdn. Bhd.	800,000.00	100%	2016
2	Cadangan Meningkatkan Perparitan Secara Pipe Jacking Menyeberangi Jln. Cheras Dari Kalbat Sediada Ke Longkang Sungai Krayong, Berhampiran Dengan Persimpangan Jalan Mutiara Barat Dan Jalan Cheras, Mukim Kuala Lumpur. (2014/Ai84) - Sub-Contractor for Pipe Jacking Work	Alfa Ehsan Sdn. Bhd.	1,658,500.00	100%	2016
3	Pakej D44 - Pembinaan Rangkaian Paip Pembetulan Di Bunus, Kuala Lumpur. (Reka & Bina). - Sub-Contractor Works (Tmp) Traffic Management Plan	Geostrength Sdn. Bhd.	100,000.00	100%	2017
4	Cadangan Pembangunan Rumah Kedai Di Pekan Sg. Besi Lama Untuk Tetuan Dbkl Sub-Contractor Works Pipe Jacking Work for Sewerage	New Bridge Sdn. Bhd.	1,390,804.80	100%	2017



5	Akej D44 - Pembinaan Rangkaian Paip Pemetungan Di Bunus, Kuala Lumpur (Reka & Bina) -Sub-Contractor Works: Dilapidation Survey Zone 12 & 4	Ban Hin Electrical & Construction Sdn. Bhd.	250,000.00	100%	2017
6	Pakej D44 Pembinaan Rangkaian Paip Pemetungan Di Bunus, Kuala Lumpur. (Reka & Bina) Sub-Contractor Works - Pipe Laying & Pipe Jacking Construction Work (Zone I)	Puncak Niaga Construction Sdn. Bhd.	4,926,428.00	100%	2018
7	Pembinaan Loji Rawatan Kumbahan Serantau Dan Rangkaian Paip Pemetungan Di Tampin Negeri Sembilan Utk. Tetuan Jabatan Perkhidmatan Pemetungan. -Sub-Contractor Works: Temporary Treatment Using Enzymme	Visi Sdn. Bhd.	80,000.00	100%	2018
8	Projek Membina Struktur Kawalan Banjir Serta Kerja-Keria Berkaitan Di Taman Mesra, Shah Alam Dearah Petaling, Selangor Darul Ehsan. - Sub-Contractor Works;	Rh Mutiara Sdn. Bhd.	688,000.00	100%	2019

Table 2.1 shown the list of projects that have been completed throughout the year of 2016 to 2019

## 2.4.2 Project in Progress

Table 2.2: List of ongoing projects  
Source: PDP (M) Utek's company profile document, 2018

Item	Project Title	Client	Contract Value	Status of Completion	Target Completed
1	Pakej D43 - Pembinaan Rangkaian Paip. Pembedungan Dan Rasionalisasi Loji Rawatan Kumbahan Di Batu, Jinjang-Kepong. - Sub-Contractor for Supply & Welding of Hdpe Pipe	Ban Hin Electrical & Construction Sdn. Bhd.	358,038.85	95%	Dec 2018
2	Pembinaan Rangkaian Paip Pembedungan Di Kajang Untuk Tetuan Jabatan Perkhidmatan Pembedungan -Sub-Contractor Works - Plant Decommissioning Using Enzymme.	Suhati Sdn, Bhd.	405,000.00	95%	June 2019
3	Pakej D44 Pembinaan Rangkaian Paip Pembedungan Di Bunus, Kuala Lumpur. -Sub-Contractor Works; Pipe Jacking Of 2100mm Rcjp (Reka & Bina).	Puncak Niaga Construction Sdn. Bhd.	1,260,890.00	95%	May 2019
4	Cadangan Pembinaan Langat Centralised Sewage Treatment Plant Dan Penyambungan Rangkaian Paip Pembedungan -Kawasa Tadahan Sg. Langat - Sub-Contractor Works; Gravity Sewer Work for Health Clinic Batu9 and Sekolah Menengah Sultan Abdul Aziz Shah.	Mmc Pembedungan Langat Sdn. Bhd.	1,375,581.93	98%	March 2019

5	Cadangan Pembangunan Rumah Kedai Di Pekan Sg. Besi Lama Untuk Tetuan Dbkl -Sub-Contractor Works	Dewan Bandaraya Kuala Lumpur	4,717,000.00	95%	July 2019
6	Pakej D44 - Pembinaan Rangkaian Paip Pembetulan Di Bunus, Kuala Lumpur (Reka & Bina). -Sub-Contractor; Retionalisation and Decomissioning Works.	Puncak Niaga Construction Sdn. Bhd.	3,870,000.00	10%	March 2020
7	Pakej D44 - Pembinaan Rangkaian Paip Pembetulan Di Bunus, Kuala Lumpur. (Reka & Bina) -Sub-Contractor; Supply and Lay Forcemain at Ama 065 Network Pumping Station.	Puncak Niaga Construction. Sdn. Bhd	1,160,000.00	5%	Sept 2019

Table 2.2 shown the list of projects that still in progress along with the year expected to be done.

## CHAPTER 3.0

### CASE STUDY

#### 3.1 Introduction to Case Study

This is the working statement for double polymer grout grouting along the proposed pipe jacking alignment using the manshield method. The pipe jacking spans 40 metres across the MRR II at the middle of the expressway in Ampang. Figure 3.1 shows the location where it is near to the Liberty Arc, Ampang and Ulu Kelang Free Trade Zone. MRR II is the expressway that majority of klang valley and wilayah people use every day. So, it leads to safety issues due to busy road during day and night, weekdays and weekends as figure 3.2 shown.

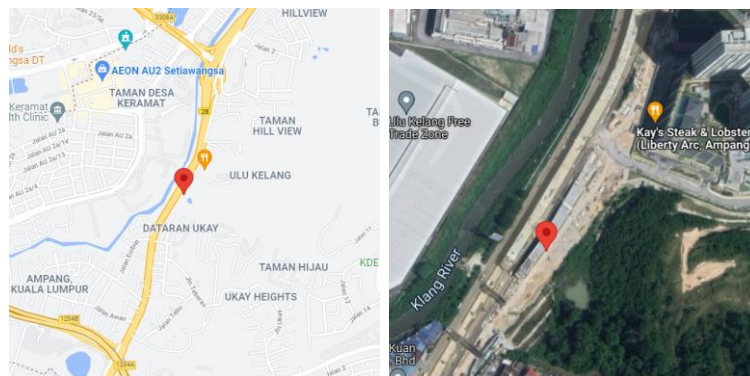


Figure 3.1: Site location at MRR II highway in Ampang  
Source: Google map



Figure 3.2: Site condition  
Source: google map

The project of pipe jacking work worth RM 159,000.00 itself. The other hand, grouting work worth RM 143,000.00. This project focusing on Pipe jacking and grouting work and it leads to all the excavation work, setting out, jacking work and grouting.

### 3.2 Project contract's terms and contents

The drafting of a contract marks the beginning of the parties' contractual relationship, which will influence their rights and obligations during the contract's performance. A contract is a legal instrument that governs the parties' rights. It is a contract between two or more parties that specifies what should be done and what should not be done throughout the construction process.

- **Articles of Agreement**

A contract agreement which agreed and bind both parties who enter the contract, i.e., PDP Utek (contractor) with Gema Swasta and Seri Gopeng (sub-contractor). The details and particulars of the contract are expelled in the article of agreement.

- **Condition of Contract**

Condition of contract constitutes the clause and terms that govern the contract of both parties. In this contract it consists: Part A (Agreement and Definition), Part B (Term of Contract) and Part C (Appendix to Agreement and Terms of Contract).

- **Letter of Award**

The letter is part of the contract award process, which is the formal notification to a subcontractor that they have been chosen to provide services for the work.

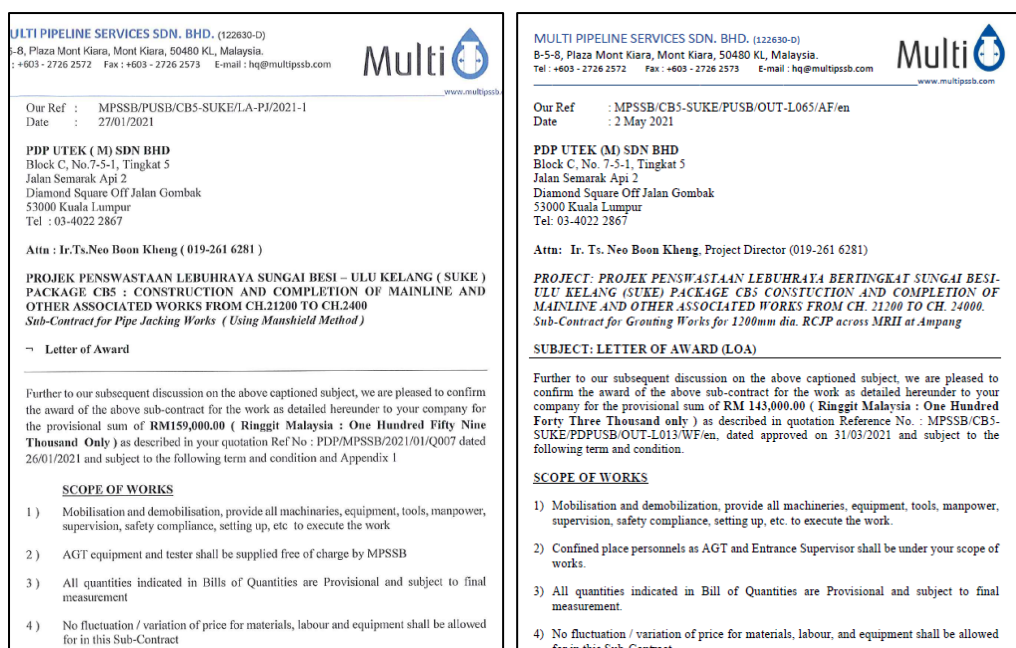


Figure 3.3: Letter of award for pipe jacking and grouting work  
Source: PDP's document, 2021

- **Contract Sum Analysis**

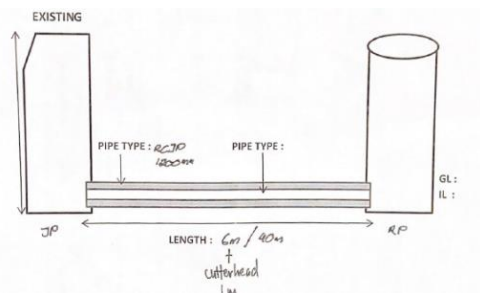
The sum specified in Section F as the break down cost for the overall scope of work that subcontractor, PDP Utek required.

- **Need Statement**

Need statement is an assertion by client of what work and requirement they desire to do for this project i.e., they need to do pump station work to complete this whole project.

- **Specification**

Specification is the design requirements for every material used and each work to be done such as the size of the pipe should be designed to be suitable for the length and the use of the drainage system as this project use 1200mm diameter Reinforced Concrete Jacking Pipe (RCJP) pipe sleeve Class 2Z.



Jacking of 1200mm diameter Reinforced Concrete Jacking Pipe (RCJP) pipe sleeve Class 2Z. Rate to include handling, hauling and positioning of jacking (using Mansfield Method)

Figure 3.4: Detail of drainage system and the type of pipe used  
Source: PDP's document, 2021

- **Defect Liability Period**

A contractor has 12 months from the date of certificate of practical completion (CPC) to repair any defects in completed works caused by faulty materials.

- **Retention Sum**

From payments due to the Sub-Contractor, the Main Contractor will retain a sum equal to 10% of the Contract Sum, up to a maximum of 5% of the Contract Sum in this contract, which is RM 7,950.00 for pipe jacking & RM 7,150.00 for grouting work. The Retention Sum is due to the Sub-Contractor six months after the Main Contractor issues the Certificate of Making Good Defects ('CMGD').

- **Certificate Practical Completion**

Subcontractor, Gema Swasta and Seri Gopeng must complete the Works based on the provisions in this Contract. Gema Swasta and Seri Gopeng must inform PDP Utek's contract administrator in writing when the Subcontractor's Works is practically completed.

- **Interim Payment Certificate**

By the 25th of each calendar month, the Sub-Contractor must submit a monthly claim to the Main Contractor. The claim must include a detailed description of the Sub-claim, the Contractor's invoices, documentation, and other supporting documents. Any claim that lacks specifics may be rejected by the Main Contractor

- **Final Completion Certificate**

When all breaches of this Contract's provisions that the Contract Administrator has ordered to be repaired under this Contract have been corrected, the Contract Administrator may issue a certificate clearly labelled as a final completion certificate.

- **Liquidated and Ascertained Damages (LAD)**

If any liquidated damages, financial compensation rate for a subcontractor's delay, paid on a pre-agreed day which the damages liquidated and ascertained is RM 28.62 per day for pipe jacking work and RM 25.74 per day for grouting work.

- **Delay & Extension of Time**

If the subcon foresee the project cannot be completed within the stipulated time frame of the contract, he shall then first notify the main contractor that the work is going to be delay. Then he shall provide information, evidence and supporting document to justify the cause of delay to the work. Upon assessing the document submitted by the sub-contractor and valuation by the main contractor if they are satisfied then extension of time shall be granted.

### **3.3 Procedure of pipe jacking and grouting work**

#### **3.3.1 Pipe Jacking Manshield**

Pipe jacking manshield method is a technique for installing pipe culvert using manual equipment or tools. Jacking distance for jacking using Manshield Method is **limited to 70m** depending on the pipe size and soil condition

##### **1. Operational Thrust Pit**

A working shaft is constructed at the beginning of the section of pipeline to be jacked and special equipment will install. Jacking operations are carried out from this point.

The initial alignment of the pipe to be jacked is ensured by accurately positioning guide rails on which the pipes are to be laid.

The substantial forces required for jacking the pipes that provided by high-pressure hydraulic power packs. To ensure that the jacking forces are distributed around the circumference of a pipe being jacked, a thrust ring is provided of a design dependent on the number of jacks being used. The jacks are interconnected hydraulically to ensure that the thrust from each is the same. The numbers of jacks used may vary according to the pipe size, the length to be jacked and the anticipated frictional resistance.



## 2. Setting Out Inside Jacking Pit

- a) The alignment and level are transfer into the pit.



Figure 3.5: Setting out for jacking pit  
Source: PDP's document, 2021

- b) Place steel H-beam as a jacking track and steel plate as a thrust wall.
- c) Concrete the thrust wall and install the hydraulic at the necessary positions against the steel plate / concrete thrust wall.

## 3. Jacking Operation

- a) Jacking operation to be commenced once both the jacking pit and receiving pit is completed.
- b) First, jacking shield in position true to line and level and jack into the ground. The alignment and level are check



Figure 3.6: Cutter head of the pipe jacking and the process of position it into place  
Source: PDP's document, 2021

- c) The soil/rock inside the pilot pipe are excavated using manual equipment/hand tools, retrieve excavated materials to jacking pit pipe end. The gap between the pilot pipe and front face of the soil/rock shall always be maintained at minimal distance.

- d) This is followed by lowering of the first length of reinforced concrete pipe. The alignment and level are check using laser guidance system. The jacking and excavation operation are repeated.



*Figure 3.7: Process of lowering the first length of reinforced concrete pipe  
Source: PDP's document, 2021*

- e) Second reinforced concrete pipe is placed on the guide rail. The jacking and excavation operation are repeated.
- f) Repeat step `c' to `e' until up to the required distance of the crossing to be pipe jacked.
- g) Horizontal alignment of the pipeline will be checked by plumb and offset or by using a laser guidance system. The vertical alignment will be checked by using a levelling instrument.
- h) If the alignment or level of the pipes is deviated, the pipe rails can be adjusted using hand jack.
- i) The pipeline will be checked and reported for final alignment at completion of the crossing.



*Figure 3.8: Hand jack used for jacking work  
Source: PDP's document, 2021*

- j) The jacking operation will be continued right underneath the road crossing.

- k) Should the jacking works encountering hard material/rock, a pneumatic breaker will be used to break the material into a manageable size to enable removal from the pilot pipe. A smooth outer periphery of the excavation will be maintained when rock is encountered.
- l) Once reach the existing manhole, the existing manhole will be hack manually and retrieve the cutter head. Pipe will jack to the required length inside the existing manhole.
- m) The hacked area then will cover by mass concrete.

#### **4. Prevention Steps to Avoid Incoming Soil during Jacking Works**

The biggest problem in Jacking Works using Man-shield Method is when facing the running sand which will can caused danger to the workers as well as road settlement will be occurred. There are several steps to prevent this incident from occur.

Desk study – Based on SI Report, study on the soil condition at the particular area shall be conducted thoroughly.

1. During piloting period – to identified type of soil and ground water level. If the soil conditions are very soggy, sandy and high water table, Man-shield method is not recommended. If the client insists to do the jacking using man-shield method, soil stabilization works shall be conducted before jacking can be commence such as grouting, point well etc.
2. During Jacking works – In order to control movement of soil, digging works shall be allowed for distance 1 foot before pipe can be jack. This to avoid upper soil become loose and collapsed
3. Gunny sack filled with sand shall be provided and stack properly at the front of cutter head after works stopped every day.

## Equipment

- Gantry crane with 5 tonnes of monorail hoist for pipe jacking

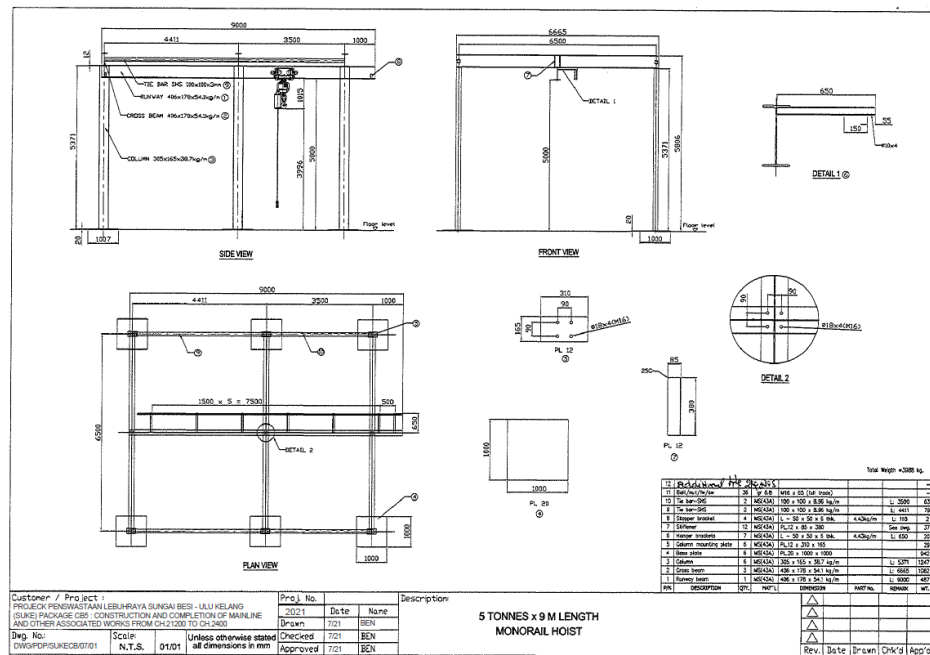


Figure 3.9: 5 tonnes monorail hoist gantry crane detail  
Source: PDP's document, 2021

- Gantry crane with 3 tonnes of monorail hoist for pipe jacking

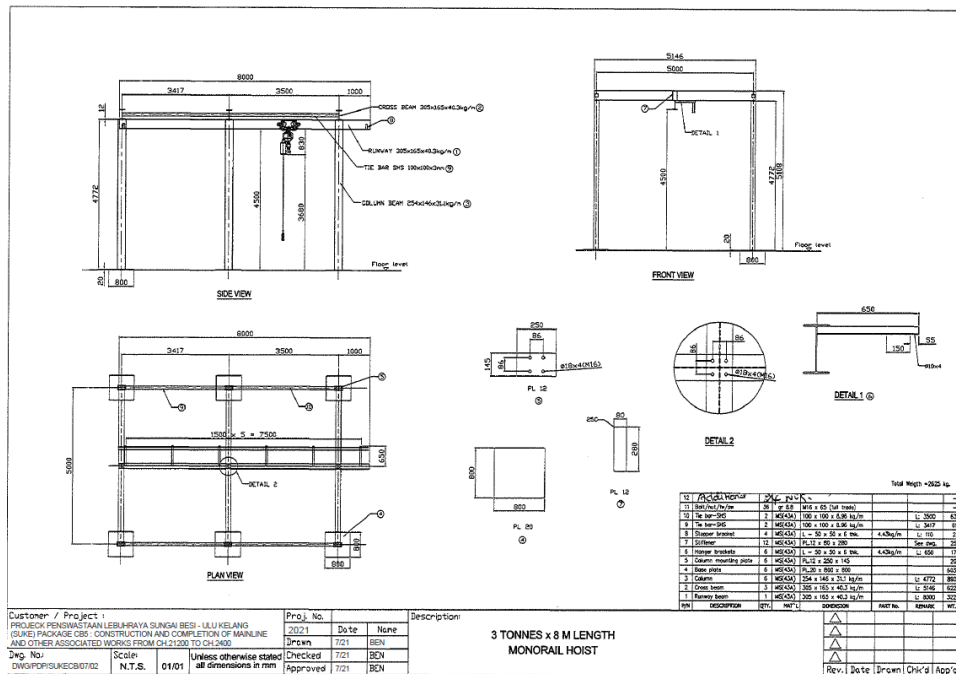


Figure 3.10: 3 tonnes monorail hoist gantry crane detail  
Source: PDP's document, 2021

- Excavator
- 10 wheels dump truck

- Generator set 150 KVA (pipe jacking)



*Figure 3.11:150 KVA Generator set  
Source: alibaba.com,1999*

- Hydraulic/electric water pump
- Plastic barrier
- Ventilation fan



*Figure 3.12: Ventilation fan use for jacking work  
Source: Izzah, 2021*

### **3.3.2. Grouting Work**

Grouting is often done by drilling pipes or boring holes into the ground and then pumping a high-pressure grout solution through inserted tubes.

An analysis of the ground conditions and the computation of a drilling pattern determine the amount of grouting necessary for a certain region. This takes into account the hole's size, spacing, and depth (4000mm diameter, 4000mm depth, 1000mm spacing, 40 000mm long) The spacing of the holes will be influenced by the type of grout used and the specific ground conditions.

The instruments used in the boring process will vary according on the site conditions, although pneumatic tools, diamond drills, and wash-boring are the most popular. Because alluvial soils are prone to collapsing, holes are typically covered.

The grout injection pressure is determined by soil conditions, and in-situ testing may be required before the proper pressure is established. For this experiment, a pressure of 5kPa was applied.

### Equipment

- Hydraulic drilling
- Grout agitator 100L



*Figure 3.13: 100L Grout mixer for grouting work  
Source: LEC,2014*

- Scott Vicker SV65 high speed colloidal grout mixer of 100 litres will be used to mix the double polymer grout and later transfer to paddle agitator as holding tank before injection of grout.



*Figure 3.14: High speed colloidal grout mixer  
Source: scottvickersgroup,2012*



- Koken MG 10 piston and Helical rotary pump PCM20-1-16 of will be used to produce a uniform pressure and constant flow double polymer grout.



Figure 3.15: Koken MG 10 piston  
Source: rajamesinborair,2017

- YBM3 hydraulic feed rotary spindle drilling will be used for the grouting works



Figure 3.16: Hydraulic feed rotary spindle drilling  
Source: indiamart,1996

### The Grouting Procedure

Grouting can begin at either the top or bottom of a horizontal or vertical aperture. The grouting procedure is then switched to the next port when grout emerges at the next port or when the surface seals of cracks bulge out.

Before going on to the next injection spot, the port valves where the grout is pouring out are plugged. Grouting is often started with a thin grout that is quickly thickened to the thickest consistency that can be pumped without clogging.

When injecting cracks that aren't evident on all surfaces, extreme vigilance is required. Hydraulic pumps, paint pressure pots, or air-actuated caulking guns are commonly utilised for epoxy injection.

The injection pressure must be carefully chosen and should not be excessive. When injecting epoxy into vertical or inclined cracks, start at the lowest level and work your way up until the epoxy level reaches the entry port above. After that, the bottom injection port is capped, and the process is repeated until the crack is fully filled.

### Layout of Pipe Jacking and Grouting

THE CONSTRUCTION AND COMPLETION OF PROPOSED SUNGAI BESI-ULU KELANG ELEVATED EXPRESSWAY (SUKE) FOR PROJECT LINTASAN SUNGAI BESI-ULU KELANG SDN BHD  
AMPANG-PIER 6 RAMP 1

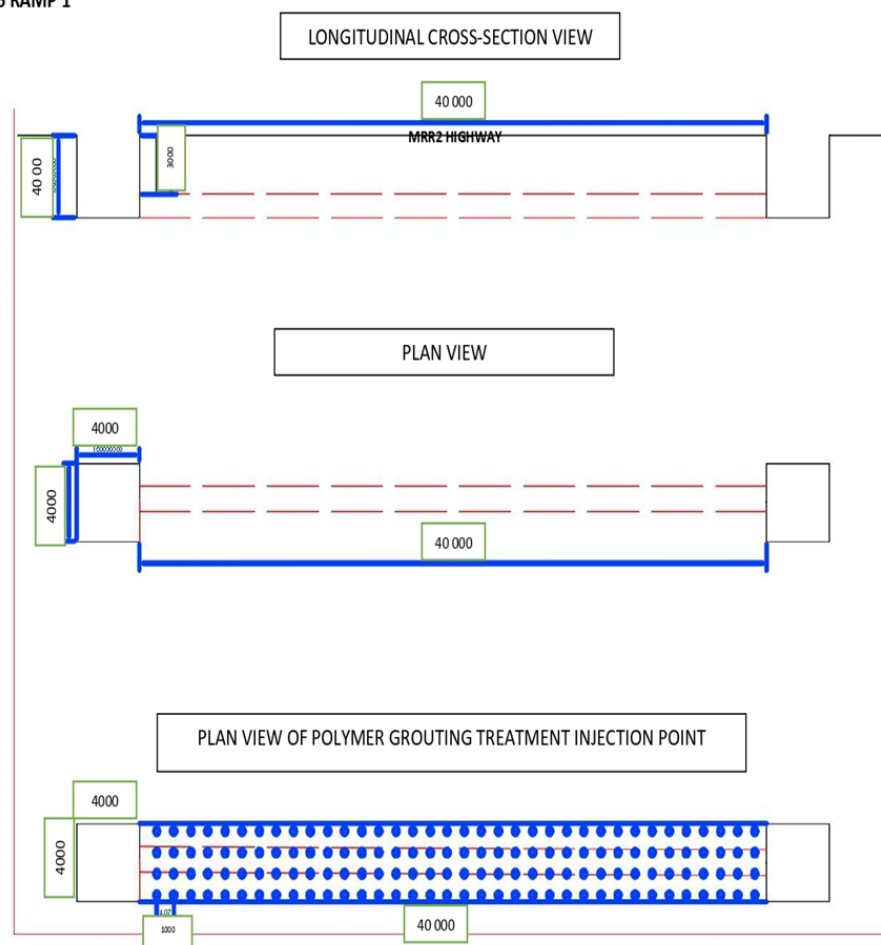


Figure 3.17: Layout plan for jacking and grouting works  
Source: PDP's document, 2021



### 3.4 Importance of pipe jacking and grouting work

#### Pipe Jacking

Pipe jacking is a trenchless procedure for sending a prefabricated pipe through the earth from a drive shaft to a reception shaft. Tunnel boring equipment and hydraulic jacks in a jacking pit are used to place pipelines beneath the ground.

The technique was created as an alternative to open-cut excavation for going beneath highways, trains, rivers, canals, buildings, airfields, and other infrastructure to reduce or eliminate traffic disruption.

#### Benefits:

*Table 3.1: Benefits of pipe jacking*  
*Source: Pipe Jacking Association & Pipe Jacking Association Staff, 2017*

Technical	<ul style="list-style-type: none"> <li>• Internal finish is smooth, allowing for optimal flow.</li> <li>• There is no need for an additional lining.</li> <li>• Installation speed</li> <li>• There are far fewer joints than in a segmental tunnel.</li> <li>• Installing invert channels in larger pipes to confine a sewer's dry weather flow in a combined system</li> <li>• There's a lower chance of a settlement.</li> <li>• Minimal disruption to the surface</li> <li>• In metropolitan regions, there is less of a need for utility diversions.</li> </ul>
Environmental	<ul style="list-style-type: none"> <li>• Reduce the quantities of incoming and outgoing materials</li> <li>• Reduction in tipping of spoil and quarrying of imported stone fill.</li> <li>• Reduced vehicle movements</li> <li>• Less associated disruption</li> <li>• carbon impact is significantly reduced</li> </ul>
Safety	<ul style="list-style-type: none"> <li>• Health and Safety Executive guidance suggests these risks should be reduced “if appropriate using ‘trenchless’ technology to</li> <li>• The incidence of accidents is less with pipe jacking</li> <li>• Reduction in the risk of</li> </ul>

Table 3.1 shows that there are substantial benefits to be gained by the use of pipe jacking techniques. It proven to be less associated disruption. Any resultant void after the pipe has been installed is replaced by imported stone backfill overlain by a coated stone surface reinstatement. In addition, carbon impact is significantly reduced, particularly on urban main drainage and flood relief schemes and this can be readily assessed using the carbon calculator.

In many cases the use of pipe jacking techniques instead of open trenching will contribute positively towards workplace safety, the interface with the general public, and the local and wider environment. Pipe jacking is an inherently safer method of working than open trench construction or traditional segmental tunnelling. There is also significant reduction in the risk of injury as a result of utility strikes and interface with the public.

### **Grouting**

Pressure grouting is defined as the process of injecting a liquid or suspension under pressure into the voids of a soil or rock mass, or between these materials and an existing structure.

Within the treated voids, the injected grout must eventually form a gel or solid, or the grouting procedure must result in suspended solids deposition. The main objectives of pressure grouting a soil or rock mass are to increase its strength and durability while reducing its permeability. (Grouting Methods and Equipment, 2004)

### **Benefit:**

This can be done on almost any surface. Furthermore, it generates no vibration and can be controlled to avoid structural damage. It may also have an effect on the improvement of underground structures, which can be tracked. Grouting is also useful in situations with limited space and headroom. In addition, slab jacking is used to lift or level a distorted foundation. Finally, it can be installed adjacent to existing walls. (Rajput, 2021)

## **CHAPTER 4.0**

### **CONCLUSION**

In a nutshell, knowing what the most important part is and the level of detail required for each job is essential to complete a worthwhile project. Furthermore, all parties involved have a personal obligation to cooperate in order to complete a high-quality task. Aside from that, the mansfield method is a traditional jacking technique that is carried out mechanically by labours, with the product pipe functioning as a support for the tunnel face at the needed pressure to prevent subsidence. Furthermore, there are numerous advantages to selecting the proper pipe jacking and grouting procedure, which can affect the smoothness of technical, environmental, and safety issues. “If a building looks better under construction than it does when finished, then it’s a failure.” –Doug Coupland.

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