ROAD DEFEC[illegible] INFRASTRUCTURE INSTALLATION

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ABSTRACT

In the era of technology advancement and sophisticated, Malaysia is among of the developing country with the increasing of road users. There are many of new project being launched include with the construction of underground infrastructure. The construction of underground infrastructure is made up of assembly the electrical cable, water supply, sewerage, telecommunication cable and so on. The research of underground infrastructure process has been carried out at the State of Kelantan. The underground infrastructure maintenance to some extent affects the road surface with the deterioration of road. The questionnaires have been distributed to the 50 respondents and the data analyzed throughout the relative average index. The method of underground infrastructure installation have been analyzed from the questionnaire is open cut, horizontal direct drilling, micro-tunneling, thrust boring, pipe jacking and pipe ramming. The analysis also determines the type of road defect occurs after the underground infrastructure installation done is crack, depression, and pothole, and raveling, delamination, rutting and bleeding.

ABSTRAK

Dalam era kemajuan teknologi dan kecanggihan, Malaysia adalah salah sebuah Negara yang sedang giat membangun tambahan pula dengan pengguna jalan raya yang semakin meningkat. Terdapat banyak projek baru dijalankan termasuk kerja-kerja pembinaan infrastruktur bawah tanah. Pembinaan infrastruktur bawah tanah adalah terdiri daripada pemasangan kabel elektrik, saluran paip air, saluran sisa buangan, kabel telekomunikasi dan sebagainya. Kajian proses pemasangan bawah tanah ini dijalankan di kawasan negeri Kelantan. Penyelenggaraan infrastruktur bawah tanah sedikit sebanyak memberi kesan terhadap kerosakan jalan di permukaan jalan. Kajian soal selidik telah diagihkan kepada 50 reponden dan analisis data dijalankan dengan menggunakan kaedah indek purata. Kaedah pemasangan infrastruktur bawah tanah dikenalpasti daripada soal selidik ialah '*Open Cut*', '*Horizontal Direct Drilling*', '*Micro-tunneling*', '*Thrust Boring*', '*Pipe Jacking*', dan ' *Pipe Ramming*'. Kajian ini juga mendapati jenis kerosakan jalan selepas pemasangan infrstruktur bawah tanah ialah retakan, lekukan, lubang, pengikisan, pengupasan, aluran dan lelehan.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Nowadays, the road can be classified as the most important medium in transportation and communication (Rancangan Malaysia ke-6). The road also plays a role in enhancing the economic growth for one place or countries. In addition, the perfect road network can be further facilitated to become more seamlessly transaction and quickly after delivery.

In Malaysia, there are five types of road categories, which are Federal highways, Toll highways, State roads, Municipal or County roads and Minor roads. The Federal highways also can be known as the main entrance to the city of countries as well as linking the main towns with other city and other states. Federal highways are constructed and maintained under the department works in alliance. Malaysia Highway Board (*Lembaga Lebuhraya Malaysia, LLM*) is government sector, which is responsible for the construction and maintenance of Toll roads. The Toll highways act as an alternative to the Federal highways while the State road was built to improve relations in the country to foster community relations with local residents and provide a road infrastructure in that area of the state.

However, with the rapid modernization-taking place and today we find the existing roads are mostly unable to handle the increasing of the road user. This problem is not only experienced by other countries but our Malaysia also facing the similar traffic problems. The congestion not only resulted in waste of time, even if it is not able to overcome a bigger impact as the country's economic downturn and the occurrence of casualties worse. Therefore, the upgrading, expanding and building up the new alternative route is being actively implemented throughout the country. In implementing this effort and the planning need to manage properly in order to avoid any difficulties and road accidents. Any problems in the construction of that new alternative road will result in maintenance the utilities work; the inconvenience during the underground infrastructure installation work would affect the defect of the road.

***Keyword**: Traffic problems; road defect; utilities installation.*

1.2 PROBLEM STATEMENT

Recently, the road surface condition has become an issue to be dispute for all the road users in Malaysia. Due to the upgrade the existing underground infrastructure in the road structure area, the cut and dug of underground installation are needed to install the new service. But, the underground works give impact to the deterioration of road structure due to the many reasons. In Canada, the National Research Council proved that the underground infrastructure installation permanently deteriorated the road structure even though the companies involved have installed it well prepared.

The repairing works of underground infrastructure such as utility cuts has resulted in along the road surface which is the uneven road pavement that lead to the uncomfortable to drive, ride, cycle and also walk. The driver's visually may be interrupted due to the uneven pavement surface. As an example like our body if it being cut deeply in surgery, the body surface structure would appear the scars in permanently and significantly same goes to the pavement surface.

Nevertheless, the patches can solve the problem where they lead to the hazards of road users. Other than that, the problem that will be facing in this research is which method have been used for underground installation work, and analysis of the impact of underground installation due to the road structure.

1.3 RESEARCH OBJECTIVE

According to the problem statement above, there are the objectives identified for the study:

1. To identify which one of the most method used for underground infrastructure installation.

2. To analyze the type of road defect after the underground infrastructure installation.

1.4 SCOPE OF RESEARCH

In achieving the research objective, the specific scope of study is investigating along the Kelantan state road and the scope should be determined first in order to get the correct and exact date information. The scopes are aim of identifying on the management of underground infrastructure construction work which involved with the authorities (Jabatan Kerja Raya (JKR), Consultant, and Contractor) of utility installation and the occurs of road defect. Then, analyzed on the underground infrastructure related to the road defects.

1.5 SIGNIFICANT OF RESEARCH

Hopefully, this research will provide improvements and positive impact on the implementation process of underground infrastructure installation for reduced the road defects. Also, the relevant authorities can make sure that the contractors involved in the maintenance work follow the JKR specification so that the condition of road structure can be improved.

1.6 RESEARCH METHODOLOGY

The research methodology briefly shown in the Figure 1.1 below:

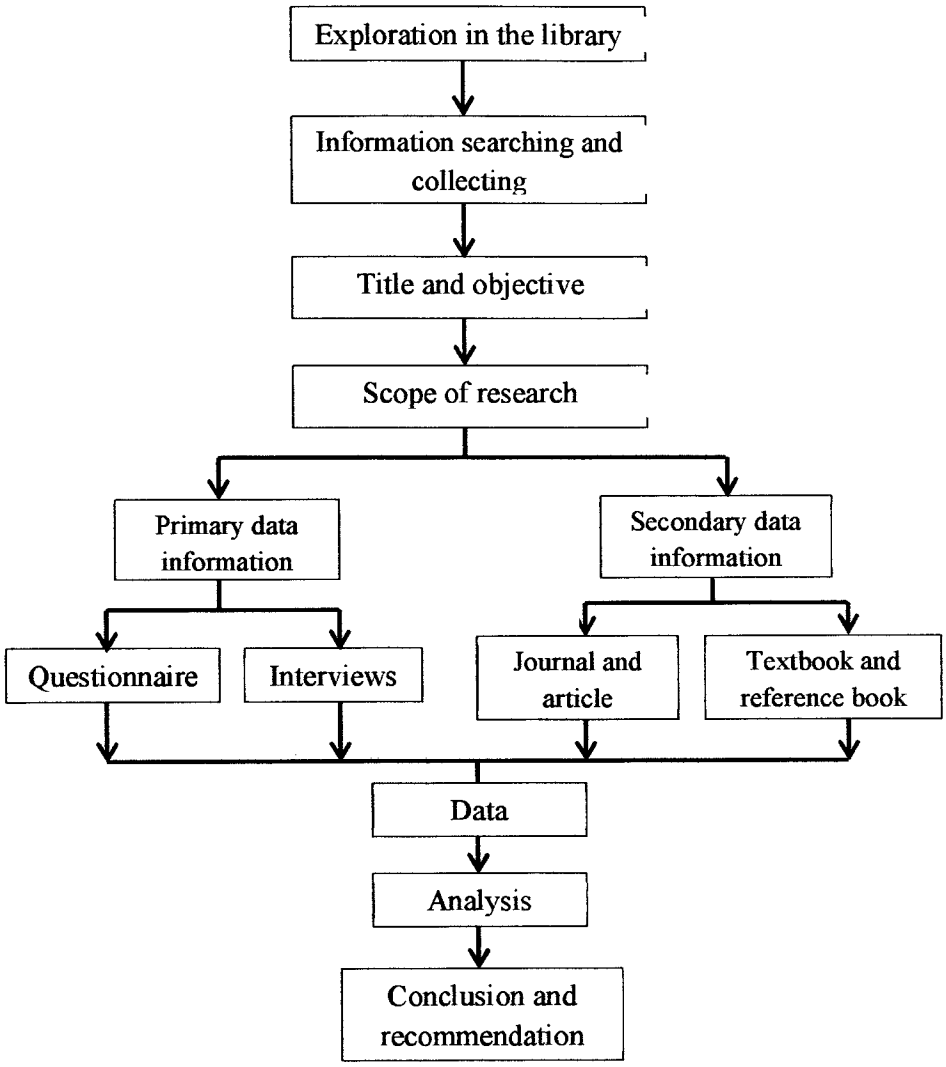

Figure 1.1: Methodology Flowchart

CHAPTER 2

LITERIRATURE REVIEW

2.1 OVERVIEW

Based on the "*Rancangan Malaysia Ke-Enam*" state that from 1991 until 1995 the core of infrastructure and public facilities will be increased in the capacity also improves the efficiency of infrastructure services. However, economic growth is higher than expected has resulted in capacity constraints that required immediate prevention to overcome that problems such as in processing and a faster method of construction.

Moreover, some several major projects were launched while the existing project is still in progress have been accelerated. Implementation of infrastructure projects by now increased the capacity of roads, ports, airports, telecommunications, water supply and sewerage facilities have contributed to the rapid economic growth.

In this century, the development of roads including bridges are more focused on the achievement of the goal to increase the road network, particularly to enhance the relationship between the city, get over the capacity constraints and increase road network to develop new growth centers and rural areas. In addition, during 90's year there are 70 percent of roads in Malaysia have been paved and with the raised development country, the paved roads increased to 75.4 percent by years 1995. In summary, during 1990 periods, there are 53 984 kilometers of road, that have been constructed and it is has been increased by 19.2 percent become 64,328 kilometers in 1995.

However, today, all the vehicle users resulting in increasing traffic congestion and require measures to establish new alternative roads and widening of existing roads. The important things should be considered during do the implementations of road work such as the work on utilities installation in order to make sure the smoothness of the project can be satisfied.

2.2 UNDERGROUND INFRASTRUCUTRE

The underground infrastructure has been known as one of the complex networks which is serving our livelihood with the utilities maintenance and yet one that is invisible from the ground surface and thus one that goes unnoticed unless it fails in some manner. Nevertheless, in determining the condition of underground buried work being high in problems whereas the location of underground infrastructure is in the absence of comprehensive and accurate maps.

The complexity of the underground utility networks derives from the many types of utility services being supplied and the materials of the pipelines and conduits through which they are delivered, their interconnectedness, their different ages and their different sensitivities to disturbance. The different utility service lines include water pipes, gas pipes and electricity cables; sewers and storm water drainage (which are sometimes combined, 04-CTS-6URa, 2010); telecommunication cables (fiber optic cables being particularly vulnerable to damage and expensive to repair); and street lighting and traffic lighting cables (McMahon et al., 2005).

2.2.1 UTILITY WORKS

Normally, the process upgrading of existing roads usually involves with the widening and adding lanes baseline. On the other hand, the kinds of utility work will occur in the area of road construction. The work of transferring utility in the new work area should be organized in order to make sure the related construction works are done. However, some case which is the authority doing the utility alteration work with their own

capability that would be interference on road construction work planning for the contractor that have been chosen by the government involved. There are three major of utility maintenance in our country, which is electricity, water circulation, and telecommunication. Nevertheless, the utility types are varying depending on the supplying agencies that provide for utility facilities.

In addition, utilities installation work progress also required a cost to associate the repairing and maintenance work and the impact of these can be significant which is the deduction of 30% of the estimated cost of pavement life service as the utility work done such as an open cut operation (Tighe et al., 2002). So, further repairs of pavement surface would be increased in order to improve the pavement structure. However, in fact state that those utility work such as trenches, open cut or else has make the deterioration of pavement which is pavement deform progressively, crack on the pavement surface, pothole or edge defect (Pucker et al., 2006).

2.3 UNDERGROUND INSTALLATION

2.3.1 OPEN CUT METHOD

Open cut is the most easy and famous method compared to others method of installation. It is also known as a conventional method for underground construction work, repair of underground utilities, and replacement of construction. According to that method, it is also can be called as dig-and-install, dig-and-repair, or dig-and-replace. Based on the type of work, the direct installation of utility systems aslo include in the open-cut trenches process.

Besides that, the open-cut method also needs to deep dig for a trench along the length of the pipeline that have been proposed by the related authority, placing the pipe in

the trench on suitable bedding materials and then backfilling. Usually, the cost is more effective initially to install the service by cutting a trench and reinstating it. Nevertheless, the consideration of the impacts is necessary because of the life of pavement, the effect on business, the probability of crashes, the surrounding of environment and aslo the traffic disruption that might have effected.

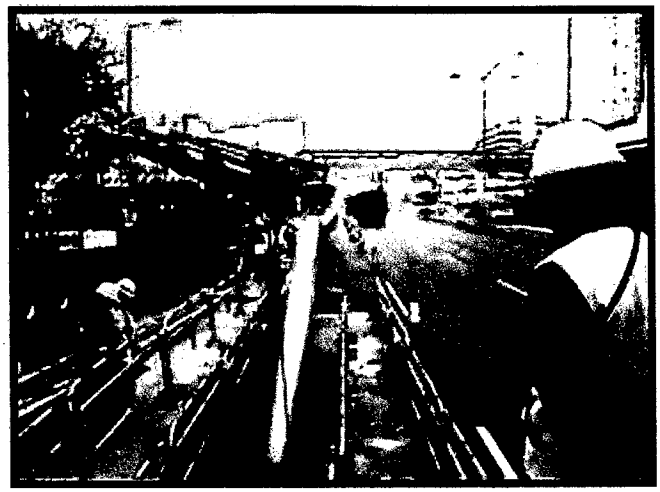

Figure 2.1: Open Cut Installation

2.3.2 TRENCHLESS METHOD

2.3.2.1 HORIZONTAL DIRECT DRILLING

The Horizontal Direct Drilling methods are usually used for the installation of pressure pipelines and cable line. Moreover, that method involves a steerable systems for installation of any size of diameter pipelines. The directional drilling methods have a two-stage process which is the first stage consists of drilling a small diameter pilot hole along

the proposed centerline and the last stage is enlarging the pilot hole to the desired diameter to accommodate the underground installation line and pulling the utility line through the enlarged hole.

Besides that, the enlargement process might be involve in the several steps which is the proposed diameter is obtained gradually. Because of the unique ability to track the location of the drill bit and steer it when the drilling process of work, that the methods used are so named. So, the result may greater capability in the placing of underground infrastructure in the difficult conditions.

Figure 2.2: Horizontal Direct Drilling Method

2.3.2.2 PIPE RAMMING

Pipe ramming is the process of the dynamic force and energy which is transmitted by a percussion hammer that have been attached to the end of a pipe. Generally, it comprises a ramming of steel pipe through the soil by using an air compressor.The pipe ramming allows the installation of large steel casings in any of condition of soil

Furthermore, it is providing the continuous casing support during the work hours with no over the excavation take places, and it is do not require the jetting action of water or drilling fluids.

Moreover, the pipe ramming is used for the installing of larger pipes in the shortest of distances and also for the shallower depths. It is suitable for all ground conditions except solid rock, and is often safe where some other trenchless methods can lead to unacceptable surface settling. As a tunnel construction work for an existing infrastructure such as a railroad track, the application of pipe ramming is usefull with the installation of steel pipe to build up a roof support for that construction.

As we can see, the ramming is typically used for horizontal installation, but it is also can be applied for vertical construction, like a piling of driving or micropiling. When a bridge cannot support the weight of a crane necessary in a traditional method of installation of such piles, the installation of vertical supporting piles from a bridge through a body of water is an example of the vertical installation application. (Atalah et al.,1998)

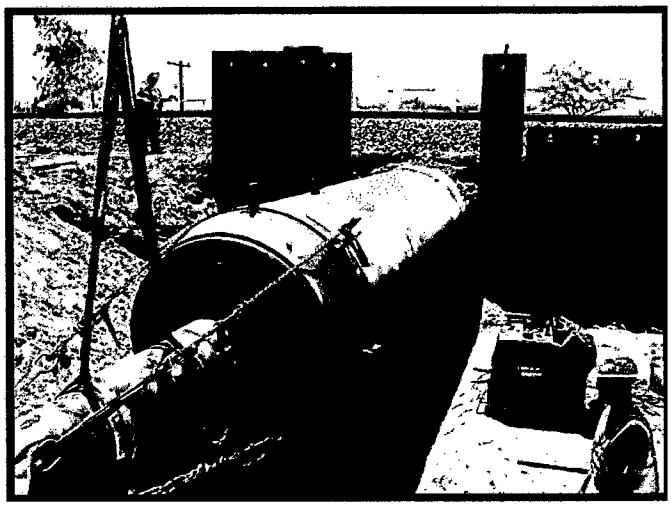

Figure 2.3: Pipe Ramming Method

2.3.2.3 PIPE JACKING

Pipe jacking is the other types of method in a trenchless technology for installing process of a prefabricated pipe through the ground from a drive shaft to a reception shaft. At the end of 19^{th} century, among 1950 – 1960 the pipe jacking technology is being introduced to the construction. The European and the Japanese companies have produced the new capabilities of pipe jacking by the including extended drive length, upgraded line and grade accuracy, enhanced joint mechanism, new pipe materials, and improved excavation and face stabilizing shields.

In these thecnology globlalisation, the development of pipe jacking has raised up the improvement of operator skills and experience during handling the pipe jacking and as well as increased the popularity of trenchless technology. In this operation, the pipe jacks are located on the drive shaft propel the pipe machine.

On the other hand, the jacking force is transmitted through the pipe to pipe interaction, to the excavating face. As the excavation work completed, the spoil is transported through the jacking pipe to the drive shaft by manual or mechanical means. The micro tunneling is required the rates of pipe jacking for excavation and spoil removal process.

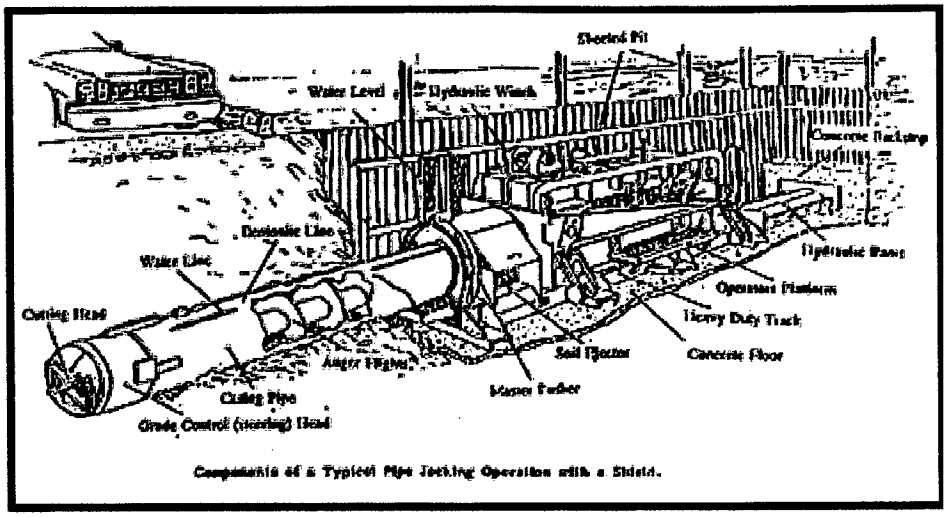

Figure 2.4: Pipe Jacking Technology

2.3.2.4 MICRO TUNNELLING

Another method of installing the pipes of underground level, the microtunnelling is one of the technology installation where the jacking of pipe in behind of a remotely-controlled, steerable, guided, articulated microtunnel boring machine (MTBM). The MTBM are connected to the pipe that have been installed. To make sure the excavated soils are fully controlled by the rate of advancement, the boring machine was used at all times of proposed. The minimum depth of cover to the pipe being installed using the microtunnelling process is normally 6feet or 1.5 times the outer diameter of the pipe being installed, whichever is greater.

One of the advantages by using the microtunnelling method, ground surface settlement can be reduced in size of the area used. In order to satisfiy the ground condition to allow steering and to introduce lubricant, the overcut of the MTBM will be determined first.

Overcut, unless excessive, is not connected to the settlement or heave. Overcut usually should not exceed 24mm on the outside radius of the pipe. The annular space created by the overcut normally is filled with lubrication material that is suitable for a particular soil condition.

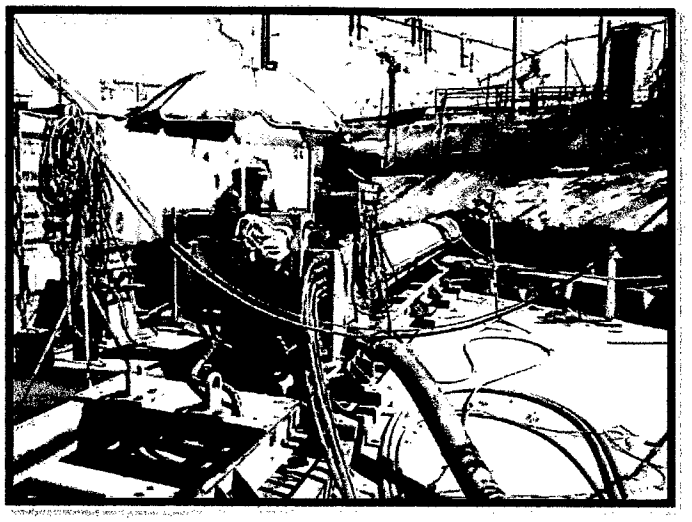

Figure 2.5: Microtunnelling Technology

2.4 DISTRESSES ON THE PAVEMENT

Based on the JKR road specification, there are many of categorized for distresses occur in the flexible pavement, such as pavement cracks, surface deformations, surface defects, patches, and potholes.

2.4.1 PAVEMENT CRACKS

The cracks on the pavement surface are fissures in result from partial or complete cracks of the pavement surface. The crack on the road surface would be happen in widely variety of types, patterns or ranging from the isolated single fractures to an interconnected pattern extending over the entire pavement surface. The impact caused of the pavement