REHABILITATING SEWERAGE LINE SYSTEM IN CONGESTED URBAN AREA

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DEDICATION

Glory and praises be to God the Almighty
for the completion of this project report

To my beloved mother and father
who have been my inspiration. Without their love and support
this project would not have been made possible

Thank you for all love and inspiration
throughout the entire creation of this project report.

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ABSTRACT

Since 1957, after Malaysia independent, there were only few proper sewerage systems because of low population density in urban area and not rapid urban developments. After 57 years of independent and in Malaysia heading to be a developed country by 2020, the restoration of good condition sewerage line system, it operation and maintenance is very important at urban area. There are challenges when the rehabilitation works for sewerage line system is carried out in developed area. In rapid development area for sewerage line, the space areas are very limited and congested. Besides many other utilities are sharing road services areas. The paper highlights the investigation of common problems occur installation of sewerage line system and propose suitable area for sewerage line system that will help designer in making decision to selecting sewerage line system alignment. Questionnaires were distributed to respondents in order to gain information of data collection. The feedbacks were analysed using descriptive analysis with the help of SPSS and excel in order to priorities the main problem in rehabilitation sewerage line system in congested urban area. This study found improvement in systematic sewerage rehabilitation planning in congested urban area, determination of effective rehabilitation methods and substitution pipe materials, improvement of construction methods and providing clean and fresh environment of surrounding area are the key factors in the justification of rehabilitation works of sewerage line system in urban area.

ABSTRAK

Sejak tahun 1957, selepas Malaysia merdeka, terdapat hanya beberapa sistem pembetungan yang sesuai kerana kepadatan penduduk yang rendah dan bandar tidak membangunan denga pesat. Selepas tahun 57 merdeka Malaysia menuju ke arah negara maju menjelang tahun 2020, pemulihan keadaan sistem talian pembetungan, operasi dan penyelenggaraan adalah sangat penting di kawasan bandar. Pelbagai cabaran-cabaran apabila pemulihan kerja-kerja untuk sistem talian pembetungan dijalankan di kawasan maju. Kawasan pembangunan yang pesat menyebabkan sistem pembentungan mempunyai ruang yang sangat terhad dan padat. Selain itu banyak utiliti lain dalam kawasan jalan raya. Tujuan kajian ini adalah untuk mengenal pasti masalah utama dihadapi dalam memulihkan sistem talian pembetungan dan cadangan kawasan yang sesuai untuk sistem pembetungan bagi membantu pereka bentuk dalam menentukan pemilihan jajaran sistem pembetungan. Borang soal selidik akan diedarkan kepada orang untuk mendapatkan maklumat pengumpulan data. Maklum balas yang akan dianalisis mengenai masalah utama dalam pemulihan sistem talian pembetungan di kawasan yang sesak dengan menggunakan analisis deskriptif dengan bantuan SPSS dan excel. Kajian ini dijangka dapat meningkatkan sistematik perancangan pemulihan pembetungan di kawasan bandar yang sesak, menentuan kaedah pemulihan yang berkesan dan bahan paip penggantian, meningkatkan kaedah pembinaan dan menyediakan persekitaran yang bersih dan segar dari kawasan sekitar adalah kunci utama untuk membuktikan dengan wajar kerja-kerja pemulihan sistem pembetungan.

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PPTM	-	Pertubuhan Penduduk Tahunan Malaysia
IWK	-	Indah Water Consortium
SSD	-	Sewerage Servic Department
MS	-	Malasian Stardard
TNB	-	Tenaga Nasional Berhad
HDPE	-	High Density Polethylene Pipe
VCP	-	Vitrified Clay Pipe
PE	-	Polyethylene Pipe
TIE	-	Technical instruction Engineer

LIST OF SYMBOLS

$\sum$	-	Summation
N	-	Total number of response
ai	-	Constant expressing the weight to each response (1 to 5)
xi	-	Frequency of the response
$\geq$	-	Greater-than or equal to
$\leq$	-	Less-than or equal to
R	-	Respondent

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CHAPTER 1

BACKGROUND OF STUDY

1.1 Introduction

Towards the urbanisation of a country, the urbanities processes pressured the infrastructure needs and the requirements are increased or take place in any nation. This scenario is also impacted due to the demand of sewer line system that needs to be upgraded or rehabilitate. The Prime Minister of Malaysia set the goal to implement Green Technologies. One of the objectives of Green Technologies is to focus about the management of sewerage system including the sewerage line, Malaysia Environment Industry (2010). According to the Sustainability Report 2011 of Indah Water Konsortium, the organization has been practicing the reuse of sewage by-products at 13 of their regional plants as an initial effort to conserving water, energy and the environment. The reuse of the treated effluent from their plants is currently confined to internal housekeeping or non-potable use, such as STP compound cleaning, vehicles cleaning and watering of plants for landscaping purposes. A good planning and strategic management system on the sewerage line and the sewerage treatment plant in Malaysia should provide a clean and fresh environment, in which the sewerage line system should not contributes from any leakage and blocking of sewerage pipe lines. Poor operation and maintenance of sewerage line would contribute to bad smell and dirty surrounding.

According to Keith Hanks (2004), the city of Los Angeles has conducted an evaluation to the methods that is used to rehabilitate its major noncircular cross-section sewers. The rapid growth of Los Angeles has brought to the attention of the public in many ways during the past few years and especially by the recent census taken by the Federal government. In January, 1920 had a population of 576,673 which is an increase of 81 % over its population of 319,198 in 1910. The cause of that needs a major rehabilitation or replacement considerations. (Keith Hanks, 2004).

While in Taiwan construction case, the completion of the new infrastructures of sewerage started from 2000 until 2007, sewerage rehabilitation planning is considered as a major work (Jyh-Bin Yang and Pi-Yun Liao, 2008). The systematic sewerage rehabilitating planning consists of sewer inspection, diagnosis of pipe defects, grading of sewerage structural conditions and determination of cost-effectiveness rehabilitation methods and substitution pipe materials. Sewer line systems are important infrastructures for developing and developed countries. The percentage of the connected houses is regarded as the critical index of national competitiveness. Taking the example of Taiwan, up to October 2009; the percentage of the connected houses in Taiwan is about 22.1% and annually increases about 1.65 %. Due to the invisibility of sewer line systems, the sewer systems are usually difficult to maintain, monitor and rehabilitate (Ming-Der Yang, Tung-Chiang Su, 2001). Furthermore, the negligence in the sewerage pipe failures increases the maintenance and rehabilitation costs significantly. Additionally, even though when the financial condition turns into a limit, the economical and effectiveness of the sewerage line system rehabilitation methods become necessary. (M.D.Yang *et al.*, 2010).

On other example, the deterioration, inadequacy and insufficiency of the nation’s infrastructure is a serious problem affecting the United States. Several important organizations have documented this problem extensively and provided specific recommendations for the research. The task group agreed that the civil urban infrastructure has not been properly maintained to meet the present society needs. The task group also identified the important barriers that are currently precluded by the United States civil systems. Furthermore, the task group recommended a research strategy to address the rehabilitation of civil urban infrastructure through the

application of a holistic systems approach that includes the issues of system behaviour, deterioration and renewal. (M. Reyna, *et al*.1994). Although sometimes ignored in early pipeline rehabilitation projects, manholes are inherently susceptible to the same forms of deterioration as the pipe lines carrying the waste. In the U.S today, over 20 million manholes provide the primary means of access for inspection and repair of collection systems. (Joanne B. Hughes, 2004). According to Trenchless Technology Magazine (2010), 20% of the manholes area at least 50 years old and another 25% are 30 to 50 years. Additionally, more than three million are believed to be suffering from serious structural decay and are in need of immediate rehabilitating or replacement. (V.Firat Sever, Mohamad Najafi, Abhay Jain, et al, 2013)

1.2 Research Background

The increase of the urban population caused to waste water treatment plants expanded, and sewerage lines have to be replaced, and their replacement is not only expensive but also disruptive since many sewer lines are buried under the public streets. According to the 2005 census, the population of the Petaling district is at a density of 1418.700 for 2929.3/km^2 (PPTM ICT, 2014). According O.S Abu-Rizaiza, (2000), in the early 1960s, Jeddah expended the it sewerage line system because the population quadrupled to around 1300, 000(Farsi 1997), due mainly to migration area is 14.6 km^2. Water demand rose to 45,000m^3/day. New sewerage systems were thought too costly to build and run, and disposal through cesspools was believed economic and adequate. There were three major entities that is involved in the development of a private sewerage system. Firstly, Sewerage Service Department is responsible to enforce the legal requirements and the processes in protecting the consumers. The second is the Indah Water Consortium (IWK) which basically looks after the consultant and the contractor to execute the works and the third is the developer which is presented by his consultant and his contractor to execute the sewerage lines and treatment plant. The sewerage system should be complying with MS 1228, Sewerage Service Department's guideline and specification. (SSD, 2003).

The sewerage lines were a collection of waste water-services from houses, shops, factories, offices, canteen and public toilets to the sewage treatment plant. The maximum length that is allowed by the IWK was 100 m length from manhole to manhole or complying with Malaysian Standard (MS 1228: 1991). The sewerage lines were connected from one manhole to another manhole to temporary restore the sewage before transferring to the sewage treatment plant with sewer lines.

Usually installations of sewerage lines are by open excavation method and there were two types of methods to construct the sewer line by open cut excavation. It could be done vertical or slanting shapes. The advantages of vertical open cut is to retain the earth from collapse by using sheet pile. Meanwhile, the open excavation using slanting shape using a big construction area compared to vertical excavation. In some cases of open excavation were not suitable, the sewerage line installation used pipe jacking method.

1.3 Study Problems

Construction of sewerage line system in congested area or developed area is very challenging and required special consideration to accomplish the job. The most common problem about this situation was a heavy traffic nearby or the sewerage line cross the road. Diversion of traffic makes many parties affected during the construction until the project is complete. Besides that, the common problem is the congested services in road reserved. The utilities cable such as telecom, TNB, gas Malaysia, water pipe and other in the area. When this situation involved the sewer line need to be relocated to another area and incurred new alignments of sewerage line. This study is therefore aims to identify what are the common problems of rehabilitating sewerage line system and the best area that is suitable for the new sewerage line system. The construction work of upgrading the sewage line is considered complicated, especially at the congested areas with rapid transportation

infrastructures. These resulted to small and narrow areas in order to execute construction work and the work is also challenging because of many underground services. These problems can effects the time, cost and design. The installation pipe line must be accurate. The prediction and controlling of the installation works of sewerage pipes have to be very careful to ensure that the structure integrity of installation pipes is achieved.

1.4 Aim of the Study

The aim of this study is to investigate the problems occured due to the installation of sewerage line system and propose suitable area for sewerage line system that will help the designer in making decision to selecting sewerage line system alignment.

1.5 Objective of the Research

The objectives of this study are as followings:

i. To identify the common problems that is occur in rehabilitating sewerage line.
ii. To determine pro and cons in selecting suitable areas and types of construction for sewerage line.
iii. To propose criteria in selecting area for sewerage line alignment.

1.6 Scope of Study

This study was only focused on areas that are found dense populated and congested areas. A consideration is also taken to areas which sewerage lines as well as treatment plants that were sized and constructed before the rapid growth i.e. last 10 to 20 years. Therefore the current-growth now provides challenges to the ability of the systems to handle the amount of waste being generated-in current. The case study was conducted at zones D 47, Petaling Jaya Utara. The total length for rehabilitating sewerage line approximate is 35,494 m with 530 numbers of manholes and a few existing pump houses. The division of the pipeline system consist of 5,986 m length by force main method and 29,498 m length by gravity fall sewer line system.

1.7 Brief Methodology

The main methodology of this study is by distributing the questionnaires to respondents who are involved in sewerage line construction. There were a few stages that were followed. The first stage involves, the literature that is reviewed from journals, guideline, books, magazine, thesis, website and progress report also used to enhance the findings of the primary data collection thus develop the relationship between the theory and the findings form on ground data collection. The data provide wide range of information and knowledge pertaining construction the rehabilitation sewerage line in development areas. After that, the data collection were from two sources, first data collected from questionnaire survey by the relevant identities in site D 47, Petaling Jaya Utara, and also the personal interviews on site.

After the data has been collected, descriptive analysis were applied with the used of SPSS and excel. The evaluation is to get or provide and develop the finding

of this study. The finding would be helped to identify the appropriate way of construction in rehabilitation sewerage line within the congested area.

The later the findings were compared between questionnaire survey which is perspective results and real construction condition at site D 47, Petaling Jaya Utara. The last step was the compilation of conclusion and recommendation which concluded major problems faced in constructing sewerage line and the proposal was made for the suitable options in selecting sewerage line alignment in congested urban areas.

1.8 Expected Findings

The expected findings from this project are:

i. Problems such as building abilities, design, technologies, economic, social, environment, land, safety and health in rehabilitation of sewerage line system in congested urban areas.
ii. Factor such as easy to construct, land or space area, authority requirements, geographical areas, low cost, enhance visual impact of surrounding areas, used reserved constructs, growth rapid transport problems, used/application of high technology and expensive cost are impacted to the efficiency of construction sewerage line system and significant parameter that contribute to the development sewerage line system.
iii. Suitable area for rehabilitating sewerage line such as growth population is the criteria ascertain.
iv. The most proper criteria in selecting the alignment for rehabilitating sewerage line system in congested urban areas. The example guidelines are economic, social and environment.

1.9 Significant of Study

This study will give ideas to the contractor, consultant, developer and client carefully to plan the successful mission of rehabilitating sewerage line system in congested urban areas. This study outcome will also provide information and knowledge to the contractor, consultant, and developer to select appropriate method for constructing sewerage line system.

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