

**EVALUATION OF DESIGN CRITERIA FOR INFLOW AND
INFILTRATION IN SEWERAGE SYSTEM**

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This study is especially dedicated to my beloved late Mother that already at the other side waiting for me, and also to my Father and Brother, for their everlasting love, care and support, May Allah bless us all.

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ABSTRACT

The main problem in the sewer pipe is when there are occurrences of inflow and infiltration in the sewerage system. It will increase the wastewater flow quantity in the sewerage system itself. Therefore, the rate of inflow and infiltration must be determined, especially for the sewer pipes that is more than 10 years of age. The objectives of this study are to evaluate the rate of inflow and infiltration in sewer pipes, and to evaluate the peak flow factor and characteristics of domestic wastewater in the sewerage systems. The scope of this study involves wastewater flow measurement in residential areas at Putrajaya, Wilayah Persekutuan and Skudai, Johor Bahru, Johor that up to a total of 80000 population equivalent. The wastewater flow is measured by using flowmeter model ISCO 4250, while the automatic rain gauge is used to measure the rainfall intensity. The results of the study indicate a higher rate of inflow and infiltration than the allowable infiltration rate value by Malaysian Standard. Meanwhile, the actual peak flow factor value is lower than the design peak flow factor value. Rainfall events will increase the wastewater quantity and also inflow and infiltration rates in the sewerage system.

ABSTRAK

Masalah utama dalam paip pembedung ialah apabila berlaku aliran masuk dan penyusupan di dalam sistem pembentungan. Ia akan meningkatkan kuantiti kadar aliran kumbahan dalam sistem pembedung itu sendiri. Oleh itu kadar aliran masuk dan penyusupan mesti ditentukan terutamanya bagi paip pembedung yang telah melebihi 10 tahun usianya. Objektif kajian ini adalah untuk menilai kadar aliran masuk dan penyusupan dalam paip pembedung, dan untuk menilai faktor aliran puncak dan ciri-ciri aliran kumbahan domestik dalam sistem pembedung. Skop kajian ini meliputi pengukuran aliran air kumbahan di Putrajaya, Wilayah Persekutuan dan Skudai, Johor Bahru, Johor yang hingga mencapai 80000 jumlah penduduk setara. Aliran air kumbahan diukur dengan menggunakan alat meter aliran model ISCO 4250 manakala tolok hujan automatik digunakan untuk mengukur keamatan hujan. Keputusan kajian menunjukkan kadar aliran masuk dan penyusupan yang lebih tinggi daripada nilai kadar penyusupan yang dibenarkan oleh Piawaian Malaysia. Manakala nilai faktor aliran puncak sebenar adalah lebih rendah daripada nilai faktor aliran puncak rekabentuk. Kejadian hujan akan meningkatkan kuantiti air kumbahan dan juga kadar aliran masuk dan penyusupan di dalam sistem pembentungan.

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CHAPTER I

INTRODUCTION

1.1 Introduction

In an area of construction and land development, sewerage system is one of the essential infrastructures apart from the water supply system, electricity and road facilities. Sewerage system includes physical facilities which consist of the source, collection of wastewater and treatment plant facilities. Those physical facilities are crucial to ensure the quality of wastewater outflow from the treatment plant is according to the Malaysian Standard moreover, the sludge termination will be more regulated. Nowadays, sewerage system is an important element in the housing development project and also the water pollution control. The establishment of a company such as Indah Water Konsortium (IWK) is intended to maintain and ensure the sewerage system runs well and perform its best.

The sewerage system maintained by IWK consisted of domestic sewerage system. Domestic system comprises of wastewater flow produced by places such as public toilets, toilets and bathrooms, laundries, kitchens and canteens in housing areas, commercials, offices, schools and hospitals.

The sewerage system has to be designed and installed very well so it can be well functioning to enhance the health and comfort of the communities, residences and users. Apart from that, the quality of the sewerage system itself needs to be improved from time to time in order to meet the increasing demands of housing developments.

Inflow and infiltration are important and critical parameters in designing the sewerage system and treatment plant. These parameters have to be reviewed and analyzed thoroughly and accurately to avoid any problems in the sewerage system that will be installed for users' health and comfort purpose.

In sewerage system design processes, the value of infiltration allowed by Malaysian Standard, MS 1228:1991 in sewerage pipes is 50 l/km/day/mm-diameter, which is equivalent to 0.05 m³/km/day/mm-diameter. Nonetheless, the infiltration rates are influenced by age factor, material and construction work quality and other identified factors.

1.2 Importance of Study

The importance of this research is to evaluate the role of inflow and infiltration at sites and actual condition whether it is in accordance to the standard and to evaluate the constant value, K that used in sewerage system design used by Malaysian Standard, MS 1228:1991. The value used in the standard should be studied from the accuracy and effectiveness aspects to our country. This is due to the differences in climate, socio-economic, water usage, geological structure and others.

This study also aids the design and construction of sewerage system in regulating the role of inflow and infiltration in the system using vitrified clay pipe.

In addition, through this study, the value rates of inflow and infiltration at sites can be determined and the values can indicate the actual condition and then can be compared with the values that are used in design to be correct and precise, and are also effective in optimizing the usage of the sewer pipes and sewerage treatment plant. Other than that, it also helps to analyze the inflow quantity and the quality of sewer pipes whether it is functioning as expected, that is to provide a better sewerage system facilities for users' health and convenience. Unsurprisingly, this study will assist in curbing the environmental pollution and should be viewed as a long term approach by sectors involved in providing an efficient and affordable sewerage system.

This research can also identify characteristics of wastewater flow in Malaysia specifically for reference and revision in sewerage system design and to ensure the wastewater processing in treatment plant can be better monitored and supervised in order to guarantee the quality of treatment water.

The results of this research will aid in understanding and analyzing the sewer pipe design and also enabling the implementation of conservation activities to avoid or reduce the risk of inflow and infiltration occurrences.

1.3 Objectives of the Study

The objectives of this research are as below:

1. To evaluate the rate of inflow and infiltration in sewer pipes.
2. To evaluate the peak flow factor and hydraulic characteristics of domestic wastewater in the sewerage systems.

1.4 Scopes of the Study

The scope of the study includes the data collection for the inflow and infiltration study and also for the flow characteristics study at residential area. Data collection is also done for daily rainfall measurement with the help of automatic rain gauge. Wastewater inflow and infiltration measurements are carried out for sewerage system involving a residential area at Putrajaya, Wilayah Persekutuan (10743PE-80591PE), Taman Sri Pulai (1705PE) and Taman Universiti (3456PE-9905PE), Skudai, Johor Bahru, Johor. Flow pattern measurement based on one manhole at Taman Sri Pulai (MH11) with PE of 1705 and at Taman Universiti (MH154) with PE of 9905. Flow pattern and inflow and infiltration measurement will also carry out at Taman Universiti (MH299-MH306 & MH154-MH154a). Daily flow pattern measurement at Putrajaya pumping stations (Pumping Station 1, Pumping Station 2, Pumping Station 3, Pumping Station 10, and Pumping Station 5) for 3 months.

The measurement of infiltration quantity for the field model was conducted at the abandoned sewer pipe, MH74-MH74a, Taman Sri Pulai, for one year duration monitoring. The sewerage pipe diameter is 225 mm, 0.048 km of pipe length and 2 m depth from ground level.

1.5 Problem Statement

The main problem in the sewerage system is when there are excessive occurrences of inflow and infiltration in the sewer pipes that can cause reverse flow known as back flow. As a consequence, there will be overflow in toilet bowl, on the road surface, wastewater flows into the groundwater source and surface water and also overloading of treatment plant. Overloading the treatment plant will only increase the operation costs.