COLLECTION AND PUMPING OF WASTEWATER FOR THE PROPOSED PERMANENT CAMPUS OF UNIVERSITI MALAYSIA SARAWAK

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Universiti Malaysia Sarawak
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Universiti Malaysia Sarawak
Kota Samarahan

fk

BORANG PENYERAHAN TESIS

Judul: COLLECTION AND PUMPING OF WASTEWATER FOR THE PROPOSED PERMANENT CAMPUS OF UNIVERSITI MALAYSIA SARAWAK (UNIMAS)

SESI PENGAJIAN: 1997 - 2000

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FORM OF ACCEPTANCE

This Final Year Project entitle "Collection and Pumping of Wastewater for the Proposed Permanent Campus of Universiti Malaysia Sarawak" was written by Abdul Razak Bin Abdul Karim (IC No: 780619-12-5019) (Matric No: 001476) as a partial fulfillment for the Degree of Bachelor of Engineering (Hons) Civil Engineering.

This Final Year Project is accepted and certified by:

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Date

COLLECTION AND PUMPING OF WASTEWATER FOR THE PROPOSED PERMANENT CAMPUS OF UNIVERSITI MALAYSIA SARAWAK

by
ABDUL RAZAK BIN ABDUL KARIM

A Final Year Project Submitted To
Faculty of Engineering, Universiti Malaysia Sarawak
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To my loves,

mother, father and Norazzlina,

with special thanks for your invaluable supports and encouragement.

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CONTENTS

CHAPTER 2: LITERATURE REVIEW

CHAPTER 3: METHODOLOGY OF DESIGN

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This final year project is described about the design of gravity flow of separate sanitary sewer as a system that should be applied to the Proposed Permanent Campus of Universiti Malaysia Sarawak (UNIMAS). Moreover, it is also recommends a suitable location for wastewater treatment plant as final discharge of collected wastewater for treatment purposes.

In Proposed Permanent Campus of UNIMAS, the wastewater flows are contributed by residential, institutional and commercial area. The wastewater flow rates are estimated based on water bills data from an existing UNIMAS campus. Besides that, for design purposes, an estimation of future population for Proposed Permanent Campus of UNIMAS is also provided.

In this design project, the basic design criteria such as (1) estimation of wastewater flow rates, (2) determination of infiltration allowances and peaking factor for wastewater flows, (3) selection of hydraulic design equation, sewer pipes materials and minimum sizes, minimum and maximum velocities and slope, (4) evaluation of alternative alignment and design, and (5) selection of appropriate sewer appurtenances are based on the available American Standard of Practice.

The recommended sewer network consist of sixteen individual sewer line with a total length of 1760 m and the sewer sizes are varying from 250 mm to 450 mm in diameter. Vitrified Clay Pipes are recommended in this design project because of its capability to resist corrosion and more economic than other sewer pipe materials.

ABSTRAK

Projek tahun akhir ini memperihalkan tentang rekabentuk sistem pengumpulan sisa air melalui aliran graviti sebagai suatu sistem yang perlu diaplikasikan di Cadangan Kampus Tetap Universiti Malaysia Sarawak (UNIMAS). Seterusnya, lokasi bagi loji rawatan sisa air juga disarankan untuk tujuan rawatan sisa air.

Bagi Cadangan Kampus Tetap UNIMAS ini, aliran sisa air adalah disumbangankan oleh kawasan perumahan, institusi dan komersial. Kadar alirannya pula dianggar berdasarkan kepada bil-bil air yang diperolehi daripada kampus UNIMAS yang sedia ada. Selain itu, bagi tujuan merekabentuk, anggaran bagi populasi di Cadangan Kampus Tetap UNIMAS pada masa akan datang juga disediakan.

Dalam projek merekabentuk ini, kriteria-kriteria asas seperti (1) menganggar kadar aliran sisa air, (2) mendapatakan kadar serapan air yang berlebihan dan nilai-nilai puncak, (3) pemilihan persamaan hidraulik, bahan untuk paip kumbahan dan saiz minimumnya, nilai minimum serta maksimum bagi halaju dan cerun, (4) penilaian bagi rangkaian yang dipilih dan rekabentuk, dan (5) pemilihan peralatan tambahan yang sempurna adalah berdasarkan kepada kaedah Amalan Piawaian Amerika.

Rangkaian kumbahan yang telah disarankan ini, mengandungi enam belas paip kumbahan dengan jumlah panjangnya 1760 m dan saiznya dalam diameter adalah di antara 250 mm hingga 450 mm. Paip Tanah Liat Bermasak adalah disarankan di dalam projek merekabentuk ini kerana kebolehupayaannya mengelak daripada berkarat dan lebih ekonomi kosnya berbanding dengan paip-paip kumbahan yang lain.

CHAPTER 1

AN INTRODUCTION

1.1 General

Wastewater or the water supply that has been use for many purposes must be collected and disposed properly which then can help us to maintain healthful and prevent the community away from disease. Therefore, a modern wastewater management system is needed to reduce the nuisance that produce by improper wastewater collection and disposal activities.

The elements of a modern wastewater management system include; (1) the individual sources of wastewater; (2) processing facilities at the sources; (3) collection facilities; (4) transmission facilities; (5) treatment facilities; and (6) disposal facilities (Ray K. Linsley, 1992). The interrelationship between these element is shown in Figure 1.1 (Appendix B). Two important factors that must be concern in the implementation of a wastewater management system are quantity and quality as shown in Table 1.1, Appendix A.

1.2 Definitions of Wastewater

Wastewater is generally defined as "the combination of the liquid and water-carried wastes from residence, commercial buildings, industrial plant and institutions together with any groundwater, surface water and storm water that may be present."

(Robert A. Corbit, P.E. 1990)

1.3 General Quantity of Wastewater

Generally, the quantity of wastewater can be classified as; *domestic (also called sanitary) wastewater* discharge from residences, commercial buildings and institutional; *industrial wastewater* in which industrial wastes predominate; *infiltration / inflow* extraneous water that enters the sewer system through various means; and *storm water* resulting from precipitation runoff.

Classification of the quantity of wastewater is one of the most important steps in the design of wastewater collection system. Therefore, in the design of wastewater collection system for the Proposed Permanent Campus of UNIMAS, classification of the quantity of wastewater from its sources also be made and discussed more details in Chapter 2.

1.4 Characteristics of Wastewater

The characteristics of wastewater can be divided into three parts:

(1) *Physical characteristics* by measuring its solids content, color, odor and temperature. Total solids of wastewater consist of the insoluble (suspended solids) and the soluble compounds dissolved in the water. The content of suspended solids can be found by drying and weighing the residue removed by filtering the sample.

(2) *Chemical characteristics* which also divided into inorganic chemical and organic chemical. For inorganic chemical, tests include free ammonia, organic nitrogen, nitrites, nitrates, organic phosphorus, chloride sulfide, pH and alkalinity. Furthermore, organic chemical tests consist of the measurement of biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total organic carbon (TOC).

(3) *Biological characteristics* where the total count of organisms is made. The principal groups of organisms that can be found in surface water and wastewater include bacteria, fungi, algae, protozoa, plants, animals and viruses. These organisms also can be classified as *eucaryotes*, *eubacteria* and *archaebacteria* (refer Table 1.2 in Appendix A).

1.5 Definition and Types of Wastewater Collection System

Wastewater collection system can be defined as network of sewers where sewers are known as the individual pipes that use to collect and convey wastewater to its final destination.

Generally, type of wastewater collection system can be divided into three parts:

(1) *Sanitary sewers* (also known as gravity flow sewer) which often identified as separate sewers, the flow was by gravity and usually use to remove domestic wastewater.

(2) *Stormwater sewers* which usually larger than sanitary sewers, develop to collect the stormwater and also constructed to eliminate pollution problems associated with the discharge of untreated wastewater from combine sewers into water courses and receiving water.

(3) *Combined sewers* which collect both domestic wastewater and stormwater but nowadays, they are seldom constructed and used.

The separate sanitary sewers are use in the design of wastewater collection for the Proposed Permanent Campus of UNIMAS.

1.6 Principal Sources of Domestic Wastewater

The principal sources of domestic wastewater are generated from residential areas, commercial districts, and other important sources such as institutional and recreational facilities.

In the Proposed Permanent Campus of UNIMAS, the main sources of wastewater are consists of; residential that produced by student apartments; institutional by faculties' buildings; and commercial buildings that generated from food courts. Therefore, the sources of wastewater from the Proposed Permanent Campus of UNIMAS can be classified as domestic wastewater.

Besides that, infiltration / inflow will be taken into consideration for this proposed design of sanitary sewers. Otherwise, the stormwater resulting from precipitation runoff is neglected.

1.7 Wastewater Treatment and Disposal System

After the wastewater collection system, the final discharge of wastewater should be conveying to water treatment plant for treatment before disposal. The water treatment system may be classified as preliminary, primary, secondary or tertiary or advanced which depends on the degree of processing.

Besides that, it also can be disposed on land without treatment by using several methods such as oxidation pond or lagoons, irrigation, incineration, burial, composting, and dewatering and conversion into fertilizer.

For this design project, only a suitable location of wastewater treatment plant is recommended as the final destination of the wastewater. Therefore, the design of the wastewater treatment plant is not involved.