IDENTIFICATION OF STORM RAINFALL PATTERN OF SUNGAI ARA CATCHMENT

RUZLINA BINTI OMAR

This dissertation is submitted
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Kolej Universiti Teknologi Tun Hussien Onn

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To my beloved parents

Haji Omar b.Mat Yusoff and Fatimah bt. Bulat

husband

Mohamed Alias b. Hj Abd. Muti

and children

Haima Nabila Shafreen and Haima Nurbasyira Shafreen

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ABSTRACT

Rainfall is a nominal phenomenon in Malaysia which is situated near the equatorial line. The total rainfall that Malaysia receive every year are quite high which is between 2000mm to 2500mm. Every rainfall event produce different pattern and characteristics. The study undertaken was to determine the typical storm rainfall pattern at Sungai Ara Catchment, Wilayah Persekutuan, Malaysia. This study only consider storm rainfall which the total depth of rainfall more than 10mm. The study was carried out based on the rainfall data of five minutes interval in year 2000 and 2001. The rainfall data is obtained from the Department of Irrigation and Drainage Ampang which are recorded from 13 station automatic rainfall gauges. The main objective of this study is to know the typical storm rainfall pattern of the studied area. The methodology is by plotting the graph of percentage cumulative rainfall depth versus percentage cumulative time. Then the 45° line are added to show the idealised storm rainfall pattern. The curve above the 45° line will be categorised as positive condition and the curve below the 45° line will be categorised as negative condition. The result of this study found that the typical storm rainfall pattern is simple which there are only two curve. The curve start with negative condition which are below the 45° line and then it turned to the positive condition which are above the 45° line. The typical hyetograph pattern has only one peak point and situated between 20% to 40% of cumulative time.

ABSTRAK

Hujan merupakan fenomena biasa bagi Malaysia yang terletak di garisan Khatulistiwa. Malaysia menerima hujan tahunan yang agak tinggi iaitu diantara 2000mm hingga 2500mm setahun. Setiap curahan hujan menghasilkan corak dan ciri-cirinya yang berbeza. Kajian yang dilakukan merupakan kajian corak hujan ribut di Kawasan Tadahan Sungai Ara, Wilayah Persekutuan, Malaysia. Hanya hujan yang melebihi 10mm diambilkira di dalam kajian ini. Kajian ini dijalankan berdasarkan data hujan sela masa lima minit dalam tahun 2000 dan 2001. Data hujan ini diperolehi daripada Jabatan Parit dan Saliran (JPS) Ampang yang dicatatkan daripada 13 tolok hujan rakaman automatik. Objektif utama kajian ini adalah untuk mengetahui corak kebanyakan curahan hujan ribut bagi kawasan kajian. Kaedah kajian adalah dengan memelot graf peratus kumulatif kedalaman hujan ribut melawan peratus kumulatif masa dan garisan 45° dimasukkan bagi menunjukkan corak hujan ribut yang ideal. Lengkung graf di atas garisan 45° dinyatakan sebagai berkeadaan positif dan lengkung graf di bawah garisan 45° dinyatakan sebagai berkeadaan negatif. Hasil daripada kajian didapati corak kebanyakan hujan ribut adalah ringkas iaitu hanya mempunyai dua lengkung sahaja yang bermula dengan lengkung berkeadaan negatif iaitu berada di bawah garisan 45° dan kemudian berubah ke lengkung berkeadaan positif iaitu berada di atas garisan 45°. Bentuk kebanyakan hyetografnya pula mempunyai hanya satu titik maksima yang berada di antara 20% hingga 40% daripada kumulatif masa.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Malaysian geographical location which situated at equatorial line are hot and moist through the whole year. During the day are generally hot and humid but the night are pleasantly cooler. Rainfall are a nominal phenomenon to Malaysian people. Total rainfall every year are quite high which are between 2000mm to 2500mm. The driest month is in July with the average rainfall is about 99mm and the wettest month is in April with the average rainfall is about 220mm This happened because of the monsoon changes. Every rainfall event produce different pattern and characteristics. Rainfall with high intensity are the critical one and should be used to design the hydraulic structure. The different of rainfall pattern and characteristics are quite important and interesting to study besides it can contribute more information in effective designing of hydraulic structure.

Department of Irrigation and Drainage Ampang are the government department that is responsible in collecting. Before this, there were no specific study being done to describe the rainfall or storm rainfall pattern for Malaysia. This paper will determine the typical pattern of storm rainfall for Sungai Ara catchment area at Wilayah Persekutuan which is part of Malaysia. This study were referred to the data

and information from Department of Irrigation and Drainage Ampang hydrometeorology station which cover 13 stations in that area.

1.2 Study Background

Malaysia which located in the tropical season and receive rainfall through the whole year always have the problem of water control especially during monsoon season while the rainfall are quite high. The rainfall during monsoon season may cause flood. The pattern of every rainfall were not uniform and sometimes it was unexpected. Normally, the rainfall started with low intensity but sometimes it started with unexpected extreme storm rainfall. This phenomenon is quite interesting to study.

1.3 Problem Statement

Development process in Malaysia are rapid with constructions in various infrastructure. This development process contribute an effect to the hydrological cycle and directly to the environment. The balance of nature started to change and always causing problems to human. Phenomenon like flood, erosion and soil collapse are clear sign of uncontrolled development. In the design of some hydrological systems or hydraulic structures, it is important to know not only the frequency distributions of extreme storm rainfall amounts for various storm duration, but also need to consider the storm rainfall pattern.

Besides the geologic formation, geomorphic and topographic features and dominant forms of vegetation, the rainfall also contribute the changes of hydrologic process. Effect of rainfall will relate to the hydrologic aspect. For example, the design of a drainage system should be depend on the related rainfall situation to make sure that the structure are use in the optimum function and can avoid the world disaster especially the flash flood.

Eventhough hydrological aspect have been studied since long time ago, but their application and research lack in depth and detail. In Malaysia the information that is related to the hydrological aspect which contribute to the information for the hydraulic and drainage system design are still not enough.

1.4 Objectives

This study only consider storm rainfall which the total depth of rainfall exceed 10 mm.

There are three objectives in this study which are:-

1. To generate the storm rainfall pattern of the studied area. From the various storm rainfall pattern, the typical storm rainfall pattern for the study area can be determined. From this storm rainfall simulation the strength (rainfall intensities) of the storm rainfall can be determined.

2. To determine the typical number of rainfall hyetograph peak point for the study area. Only the peak point less than 15 percent of the optimum peak point of hyetograph has been considered as the peak point.

3. To determine the situation of the rainfall hyetograph peak point for the studied area.

The storm rainfall pattern can be explained from the graph of % cumulative rainfall depth versus % cumulative rainfall duration and by adding the 45° line as an idealised storm rainfall pattern. The negative and positive conditioned can be determined whether the curve is above or lower than the 45° line The graph shows the storm rainfall pattern for the studied area and it have been categorized in several types and then the typical storm rainfall pattern have been recognized.

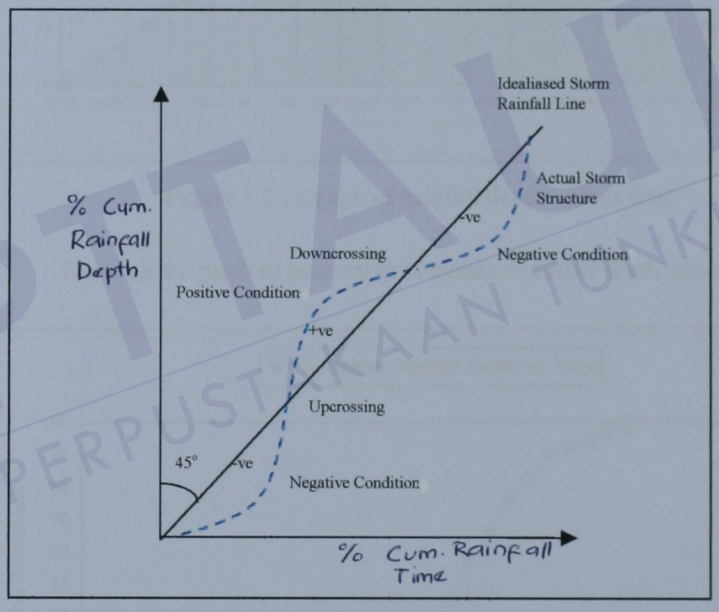

Figure 1.1 : % Cumulative rainfall depth vs % cumulative rainfall duration

In this study, the Huff's dimensionless mass curve theory has been adopted which will be related to the researched. Huff's results of a studied of heavy storms have been published since 1967. He found that storm duration tended to be associated with the quartile in which most of the rain fall.

Procedures:

i. From the graph of rainfall depth versus time

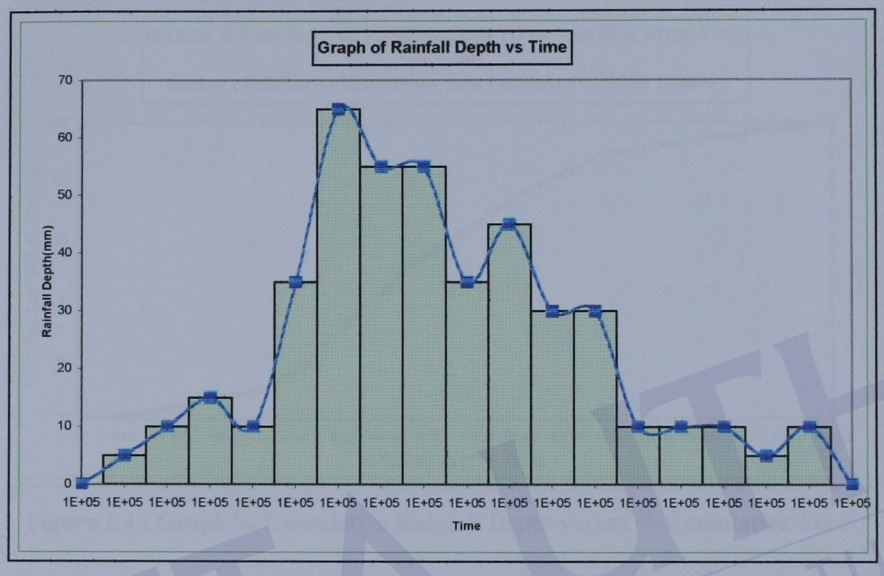

Figure 1.2 : Graph of rainfall depth versus time

ii. Made up the graph of percentage cumulative rainfall depth versus time

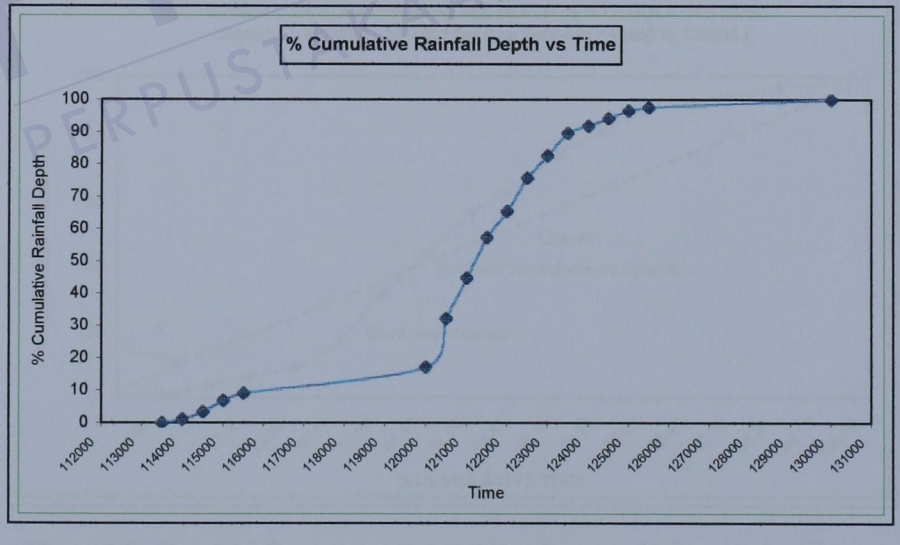

Figure 1.3 : % Cumulative Rainfall Depth versus Time

iii. Made up the percentage cumulative depth versus percentage cumulative time which are similar to the Huff's dimensionless mass curve

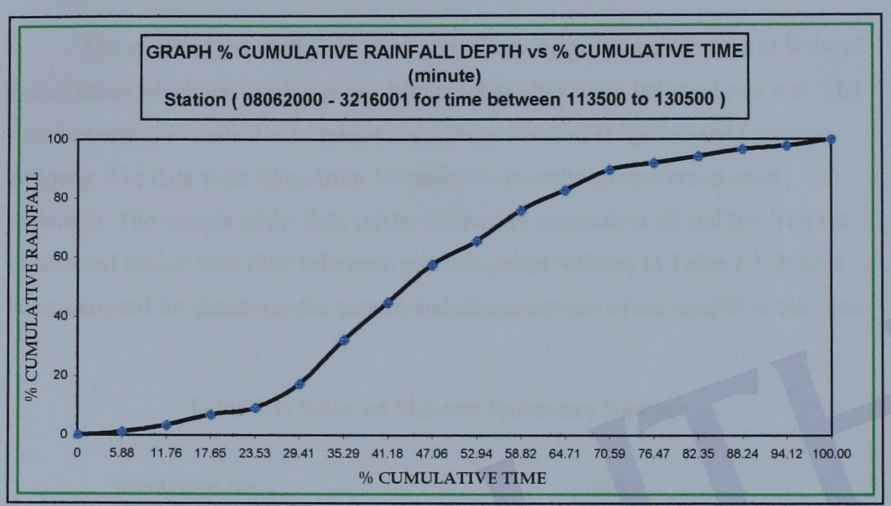

Figure 1.4 : Graph % Cumulative Rainfall Depth versus % Cumulative Time

iv. Inserted the 45° line as a guide for the idealised storm rainfall pattern which related to my study

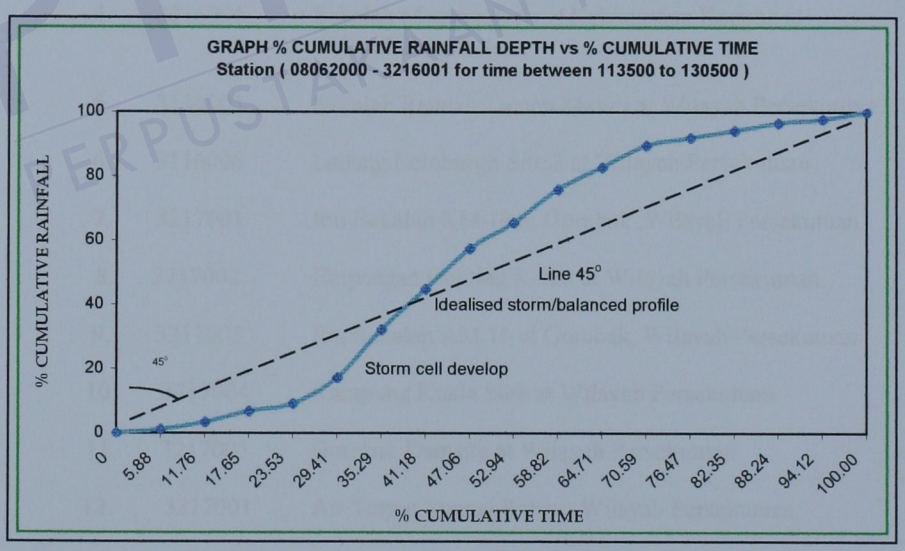

Figure 1.5 : Graph % Cumulative Rainfall Depth versus % Cumulative Time

1.5 Scope

The scope of the study area were specific to Sungai Ara catchment at Wilayah Persekutuan which the rainfall gauge data are available and it believed was real. The raw data and information as obtained from Department of Irrigation and Drainage Ampang. The data were taken from 13 stations where the gauges are in good condition. The sample of the data can be referred to appendixes (i) and (ii). The list of selected station with their reference number can be referred to Table 1.1. It have been analyzed for determine the pattern and characteristics of the rainfall in that area.

Table 1.1: Selected Site and Reference Number

	Reference No	Site
1.	3015001	Puchong Drop at Wilayah Persekutuan
2.	3216001	Kampung Sungai Tua at Wilayah Persekutuan
3.	3116003	Pejabat JPS Malaysia at Wilayah Persekutuan
4.	3216004	Sekolah Menengah Jenis Kebangsaan Kepong at Wilayah Persekutuan
5.	3116005	Sekolah Rendah Taman Maluri at Wilayah Persekutuan
6.	3116006	Ladang Edinburgh Site 2 at Wilayah Persekutuan
7.	3217001	Ibu Bekalan KM 16 at Gornbak ,Wilayah Persekutuan
8.	3217002	Empangan Genting Kelan at Wilayah Persekutuan.
9.	3217003	Ibu Bekalan KM.16 at Gombak, Wilayah Persekutuan
10.	3217004	Kampung Kuala Sleh at Wilayah Persekutuan
11.	3217005	Gombak Damsite at Wilayah Persekutuan
12.	3317001	Air Terjun Sungai Batu at Wilayah Persekutuan
13.	3317004	Genting Sempah at Wilayah Persekutuan

Station Numbering System

A hydrological station consists of seven digits which can be grouped as follows:-

i. The first four digits denote the grid numbering systems latitude and longitude.

ii. The fifth digits denote the type of station

Table 1.2 : Description for Type of Station

Type Number	Description
0 and 1	Rainfall Station
2	Climatic Station
3	Evaporation Station
4	Streamflow Station
5	River Suspended Sediment Station
6	River Water Quality Station

iii. The sixth and seventh digits from the station number of a particular type of station with a grid square

1.6 The Important of Study

Knowledge of typical storm rainfall pattern and its characteristics in such area can contribute to the information in planning and management of a project that is correlated to the rainfall strength. The analysis can assist the expert in planning and to implement the project more effective. Without the analysis, it will be difficult to

predict the profile pattern of the storm rainfall because the raw data came in a number which not yet been summarized in the term of graph or profile.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter included the discussion about literature review and previous researchers that related to the storm rainfall pattern.

2.2 Rainfall Definitions

Rainfall is a major factor controlling the hydrology of a region. It is the main input of water to the Earth's surface and a knowledge of rainfall distribution in space and time is essential to an understanding of soil moisture, groundwater recharge and river flows. Data are more readily available, for more sites and for longer periods, than for other components of the hydrological cycle. In some parts of the world rainfall data may constitute the only directly measured hydrological record. The study of rainfall is thus of fundamental to the hydrologist. Those aspects of its occurrence and distribution that are of direct relevance to the hydrologist. More

detailed investigation of the mechanisms of its formation is the domain of the meteorologist and climatologist.

2.3 Humid Tropic Asian Weather

In Malaysia, there are four major rain generating mechanisms which are convection, convergence, orographic and cyclonic. Most thunderstorms are caused by intense local heating in a warm, moist and unstable atmosphere. The average life span of a convective cell is about half an hour.

The seasonal variation of rainfall in Peninsular Malaysia is of three main types:

(i) Over the east coast districts, November, December and January are the months with the maximum rainfall, while Jun and July are the driest months in most districts.

(ii) Over the rest of the Peninsular with the exception of the southwest coastal area, the monthly rainfall pattern shows two periods of maximum rainfall separated by two periods of minimum rainfall. The primary maximum generally occurs in October till November while the secondary maximum generally occurs in April till May. Over the northwestern region, the primary minimum occurs in January till February with the second minimum in Jun to July while elsewhere the primary minimum occurs in June till July with the secondary minimum in February.

(iii) The rainfall pattern over the southwest coastal area is much affected by early morning "Sumatras" from May to August with the result that the double maxima and minima pattern is no longer discernible. October and November

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