THE DEVELOPMENT OF RAINFALL TEMPORAL PATTERN IN GOMBAK

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B. ENG(HONS.) CIVIL ENGINEERING

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We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Analisis hujan bagi corak taburan hujan adalah sangat penting dalam proses reka bentuk hujan. Maklumat mengenai corak taburan hujan dalam kejadian hujan merupakan faktor penting yang mempengaruhi keputusan pemodelan hidrologi. Taburan hujan temporal yang berbeza boleh membawa kepada perubahan dalam tindak balas kawasan tadahan, dan dalam beberapa kes banjir boleh berlaku kerana taburan hujan temporal yang lebih tidak mencukupi. Di Malaysia, corak hujan temporal disediakan di Manual Saliran Mesra Alam Edisi Kedua (MSMA 2). Data yang tersedia tidak dikemas kini selepas tahun 2010 dan dinyatakan khusus mengikut wilayah. Tujuan kajian ini adalah untuk membangunkan corak temporal hujan di Gombak menggunakan Kaedah Kepelbagaian Purata (AVM), Kaedah Pengagihan Masa Huff (HTDM) dan Kaedah Institut Penyelidikan Sumber Air (WRRI) dan bandingkan keputusan untuk AVM dengan MSMA 2 dan HTDM dengan WRRI. Kajian ini dijalankan untuk tujuh stesen hujan di Gombak. Data 5 minit sela hujan telah diekstrak dan dianalisis sebelum membangunkan corak temporal hujan berdasarkan kaedah AVM, HTDM dan WRRI. Berdasarkan perbandingan antara AVM dan MSMA 2 yang dibuat untuk 7 stesen di Gombak menunjukkan stesen 2 iaitu stesen Ibu Bekalan KM. 16 untuk tempoh 60 minit mempunyai perbezaan peratusan tertinggi (1% -79%) dan stesen 5 iaitu stesen Kg. Kuala Sleh mempunyai perbezaan peratusan terendah (6% -19%). Bagi perbandingan antara HTDM dengan WRRI, keputusan yang diperoleh menunjukkan bahawa julat terendah adalah dalam kuartil keempat iaitu antara 0.95% hingga 13.58 dan untuk julat tertinggi pada tempoh 60 minit berada dalam kuartil kedua iaitu antara 24.07% hingga 32.42%.

ABSTRACT

Rainfall temporal pattern analysis of rainfall duration is very important in the process of design rainfall. Information about temporal rainfall distribution within a rainfall event is an important factor that influences hydrological modelling results. Different temporal rainfall distributions can lead to changes in catchment response, and in some cases flooding can occur due to more inconvenient temporal rainfall distribution. In Malaysia, temporal rainfall pattern is provided in Malaysian Urban Storm Water Management Manual Second Edition (MSMA 2). The data available was not updated after 2010 and is stated specific by region. The aim of this study are to develop rainfall temporal pattern in Gombak using Average Variability Method (AVM), Huff Time Distributions Method (HTDM) and Water Resources Research Institute Method (WRRI) and to compare the result for AVM with MSMA 2 and HTDM with WRRI. This study is conducted for seven rainfall stations in Gombak. The data of 5 minutes rainfall interval were extracted and analysed before develop the rainfall temporal pattern based on AVM, HTDM and WRRI method. Based on the comparison between AVM and MSMA 2 made for 7 number of stations at Gombak shows that station 2 which is Ibu Bekalan KM. 16 station for 60 minutes duration has the highest range of percentage difference (1%-79%) and station 5 which is Kg. Kuala Sleh station has the lowest range of percentage difference (6%-19%). For HTDM with WRRI, the result shows that the lowest range is in fourth quartile that is between 0.95% to 13.58. For highest range in differences for 60 minutes duration is in second quartile that is between 24.07% to 32.42%.

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LIST OF SYMBOLS

MV	Mean Value
%	Percentage
TPF	Temporal Pattern in Fraction
RTP	Rainfall Temporal Pattern
AVM	Average Variability Method
HTDM	Huff Time Distribution Method
WRRI	Water Resources Research Institute
DID	Department of Irrigation and Drainage
ARI	Average Recurrence Interval
SCS	Soil Conservation System
IDF	Intensity Duration Frequency
MSMA	Urban Storm Management Manual
NR	New Rank
hr	Hour
min	Minutes

CHAPTER 1

INTRODUCTION

1.1 Background

Floods in Malaysia are regular natural disasters which happen nearly every year during the monsoon season. Flood occurs when a river's discharge exceeds its channel's volume causing the river to overflow onto the area surrounding the channel known as the floodplain. The increase in discharge can be triggered by several events. The most common cause of flood is prolonged rainfall. If it rains for a long time, the ground will become saturated and the soil will no longer be able to store water leading to increased surface runoff. Rainwater will enter the river much faster than it would if the ground wasn't saturated leading to higher discharge levels and floods.

Design flood estimation is often required in engineering practice such as design of hydrologic structures, floodplain management, river ecological studies and flood insurance studies (Bustami et al., 2012). Thus a design rainfall is required which will be later converted into the corresponding design stream flow event which will be later converted into the corresponding design streamflow event. A design rainfall event consists of elements of rainfall duration, average rainfall intensity of an Average Recurrence Interval (ARI) event and rainfall temporal pattern. A temporal rainfall pattern is used to represent the typical variation of rainfall intensities during a typical storm and gives the proportion of total rainfall over certain time interval within a given rainfall duration (Ali, Erfen, & Amat, 1982).

In Malaysia, an urban stormwater management guidelines, namely Malaysian Urban Stormwater Management Manual (MSMA) which also includes guidelines for temporal rainfall pattern has published temporal rainfall pattern for Peninsular Malaysia. There are two

temporal rainfall pattern are available which is for the West and East Coast of Peninsular Malaysia. Based on Hydrological Procedure No. 1 (1982) has been proposed on the temporal patterns for design to be adopted Storms in Peninsular Malaysia, the patterns were prepared for six standard durations which is 0.5, 3, 6, 12, 24 and 72 hours (Bustami et al., 2012).

The purpose of designing rainfall temporal patterns is to represent the typical variation of rainfall intensities during a typical storm burst (Bustami et al., 2012). It shows the temporal distribution of rainfall within the design storm which is an important factor that affects the runoff volume, magnitude and timing of the peak discharge. It is also important element in gaining knowledge of water balance dynamics on various scales for water resources management and planning. Realistic estimates of temporal distributions are obtained by analysis of local rainfall data from recording gauge network. In Malaysia, daily and annual rainfall volumes are recorded in rainfall gauges which are recorded on a daily basis (Bustami et al., 2012).

Daily rainfall data is normally readily available at or close to any location of interest for urban storm water studies. The volume rainfall influences the runoff volume and can be computed into the calculation of storm water quality. A study on temporal pattern is important for flood estimation as well as runoff computation, and further influence the water resource management and planning. Rainfall analyses are important for the primary aspect for hydrological designs, and temporal rainfall pattern provides the general rainfall event that may happen in the proposed project site to the designers. The patterns allow standard design procedures to be adopted in flow calculation. Among the methods available to develop temporal rainfall pattern are Average Variability Method, Huff Time Distributions, Triangular Hyetograph and SCS method.

1.2 Problem Statement

In Malaysia almost every year floods happen during the monsoon season. Malaysia is located near the equator and Malaysia's climate is categorized as equatorial, being hot and humid throughout the year. The average rainfall is 250 centimeters (98 in) a year and the average temperature is 27 °C (80.6 °F). The climates of the Peninsular and the East differ, as the climate on the peninsula is directly affected by wind from the mainland, as opposed to the more maritime weather of the East. Climate change is likely to have a significant effect on Malaysia, increasing sea levels and rainfall, increasing flooding risks and leading to large

droughts. During rainy season our rivers are swollen and cause disastrous floods which cause heavy destruction to life and property.

Flood sweeps away everything that comes in its way. Crops are destroyed, many houses are ruined, many people are rendered homeless, their belongings are washed away and many people and cattle are drowned. The sufferings of the people know no bounds. Railway lines remain under water, and sometimes, these are also washed away. The whole area under a flood presents a very horrible sight.

In Malaysia, temporal rainfall pattern for Peninsular Malaysia is provided in Malaysian Urban Storm Water Management Manual Second Edition (MSMA 2) which is updated data from Malaysian Urban Storm Water Management Manual First Edition (MSMA 1). The patterns were prepared for 9 standard durations which are 15 minutes, 30 minutes, 60 minutes, 180 minutes, 6 hour, 12 hour, 24 hour, 48 hour, and 72 hour. Data collected to establish the patterns were sampled from 24 rainfall stations in different parts of Peninsular Malaysia. However, the data available was not updated after 2010.

Besides, the data from MSMA 2 is stated specific by region which is not represent actual condition at each site. Rainfall temporal pattern more reliable if the actual fraction of rainfall at specific site or station can be developed to use in hydraulic and hydrology design. Therefore, the new rainfall temporal pattern need to develop at every development location.

1.3 Objectives

The main objectives of this study are:

i. To develop rainfall temporal pattern in Gombak using Average Variability Method. (AVM), Huff Time Distributions Method (HTDM) and Water Resources Research Institute Method (WRRI).
ii. To compare the result of AVM with MSMA 2 and HTDM with WRRI.

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