THE DEVELOPMENT OF RAINFALL TEMPORAL PATTERN IN GAMBANG

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STUDENT'S DECLARATION

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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Date : 31 MAY 2019

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Thesis submitted in partial fulfillment of the requirements
for the award of the
B.Eng (Hons.) Civil Engineering

Faculty of Civil Engineering & Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

First and foremost, thanks to God and his willingness, I have done accomplished this final year project as a requirement to finish study and acquire a bachelor degree in civil engineering from University Malaysia Pahang (UMP).

A big appreciated to express my grateful to my supervisor, Puan Shairul Rohaziawati Binti Samat for her guidance, adviser, and encouragement throughout the thesis process until done the project. She has sincerely helped me with giving more knowledge and support me until the end.

Also thanks to Mr. Norasman Bin Othman as my co-supervisor, and a big thanks for a great knowledge and experience for believing in me and giving guidance throughout finish my thesis for assisting on my work until done.

To my parents, Ahmad Zaimi and Rohaya Abdullah who always giving advices, encouragement and support in order also give inspiration to me throughout doing my work and the course's requirement. Not forgetting to my friends, who has been a good supporter throughout his friendship and also made it valuable time of my life during these four year student.

Finally to my presentation's panel of this project and thank you for the comments and advises while improving the project better.

ABSTRAK

Tujuan utama dalam reka bentuk hujan yang mengenai pembangunan corak hujan berkala adalah mewakili pelbagai jenis taburan hujan semasa hujan ribut. Kajian ini memberi tumpuan kepada pembangunan corak hujan berkala bagi kawasan Gambang dan JKR Gambang. Maklumat data corak hujan yang terdapat dalam Manual Saliran Mesra Alam Edisi kedua (MSMA 2) tidak seragam bagi setiap tahun disebabkan oleh perubahan cuaca di Malaysia berubah-ubah dan data untuk beberapa kawasan daerah tidak dinyatakan didalam MSMA 2. Selain itu, pembangunan corak hujan menghasilkan jenis-jenis bentuk hujan pada setiap kawasan yang berbeza dan bandingkan dengan corak hujan dalam MSMA 2. Corak temporal hujan telah dibangunkan menggunakan kaedah Kepelbagaian Purata (AVM) yang disusun mengikut 10 jumlah data hujan tertinggi manakala bagi Kaedah Taburan Masa Huff (HTDM) di mana terbahagi kepada empat kuartil. Kajian ini dilaksanakan di kawasan Gambang dimana merangkumi data hujan setiap 5 minit untuk 15 tahun bermula 2003-2018 diperolehi dari Jabatan Pengairan dan Saliran (JPS) untuk stesen JKR Gambang dan 2016 hingga 2018 taburan hujan dari stesen UMP Gambang. Tempoh masa corak hujan berkala adalah selama 15 minit, 20 minit, 30 minit, 45 minit, 60 minit, 90 minit, 120 minit, 135 minit, 150 minit dan 180 minit. Walaubagaimanapun, bagi HTDM hanya 60 minit, 120 minit dan 180 minit hujan yang terpilih disebabkan oleh data acara perlu dibahagikan kepada empat kuartil. Tambahan pula, corak temporal hujan berkala dibangunakan untuk menentukan bentuk hujan berdasarkan corak hujan yang sediakada mengikut kumpulan iaitu jenis awal, jenis pertengahan dan jenis lambat. Keputusan menunjukan kawasan Gambang mempunyai corak hujan yang tersendiri. Setelah mendapat keputusan, terdapat berbezaaan peratusan dalam kaedah AVM dan HTDM iaitu 28 peratus (%) hingga 100 peratus (%) untuk tempoh corak hujan 60 minit. Manakala untuk corak hujan 120 minit terdapat perbezaan peratusan 46 peratus (%) hingga 400 peratus (%). Corak taburan hujan untuk 180 minit perbezaan peratusan ialah 99 peratus (%) hingga 100 peratus (%).

ABSTRACT

The purpose of designing rainfall temporal patterns is to represent the typical variation of rainfall intensities during a typical rainfall. This study focuses on developing a temporal rainfall pattern for the Gambang area in Pahang region. The existing data of rainfall temporal pattern design is not consistence for every year because of Malaysia climate always change and the data of rainfall station nearest district area are used to design the area that is not stated in Malaysia Urban Storm Management Manual Second Edition (MSMA 2). The rainfall temporal pattern will provide rainfall distribution for the specific station area compared to the regional pattern provided in the MSMA 2. The rainfall temporal pattern were developed using Average Variability Method (AVM) and Huff Time Distribution Method (HTDM). This study was conducted in UMP Gambang station and JKR Gambang station which is developing rainfall temporal pattern for several duration of rainfall event. Data of every 5 minutes rainfall event for 15 years starting from 2003 to 2018 were collected from Department of Irrigation and Drainage (DID) for JKR Gambang station and 2016-2018 rainfall data from rainfall station in UMP Gambang. The temporal rainfall pattern developed are for 15 minutes, 20 minutes, 25 minutes, 30 minutes, 45 minutes, 60 minutes, 90 minutes, 120 minutes, 135 minutes, 150 minutes, and 180 minutes. The rainfall temporal pattern were divided the type of temporal pattern according to representative rainstorm pattern classified which is advance-type, intermediate-type and delayed-type. The analysis is run for both method and compare in term of percentage. There was a difference analysis of the rainfall temporal pattern developed by AVM and HTDM method, the difference percentage in each of method from about 28% to 100% for 60 minutes rainfall event. For 120 minutes rainfall event is 46% to 400% while for 180 minutes is about 99% to 100%.

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LIST OF SYMBOLS

%	Percentage
%cum	Cumulative of Percentage
P(t)	Depth of precipitation
P	Total depth of precipitation
h	Height of triangle
i	Rainfall Intensity
Ave	Average

LIST OF ABBREVIATIONS

mm	Milimeter
hr	hour
min	Minutes
JPS	Jabatan Pengairan dan Saliran
MV	Mean Value
NR	New Ranking
TPF	Temporal pattern in Fraction
DID	Department of Irrigation and Drainage
AVM	Average Variability Method
HTDM	Huff Time Distribution Method
SCS	Soil Conservation System
MSMA	Urban Storm Management Manual
RTP	Rainfall Temporal Pattern
Met Malaysia	Jabatan Meteorologi Malaysia
WMO	World Meteorology Organization
USDA	United State Department Agriculture
NRCS	Natural Resources Conservation Servise
ARR	Australia Rainfall and Runoff
TMG	Tokyo Metropolitan Government

CHAPTER 1

INTRODUCTION

1.1 Background of Study

A flood happen when high water flow or over downpour that dominates the natural or artificial banks of river system where without warning and mostly happen when a large volume of rain falls within a short period. Therefore, when water over flow of river bank, the water extend over the flood plain and it will become hazard to the residents. This is commonly occurs when excessive rain, rapid ice melting, or beaver dam can over limit water and sent it spreading over the bound area. To develop flood it take hours or even days, giving resident time to prepare or evacuate .In Malaysia, the flood commonly happen in extreme rain or non-stopping rain (Proxmire and Hayden, 1966).

Malaysia was experienced of natural disaster is flood because of located at southeast of Asia and it divided into two parts which is Peninsular of Malaysia and Island of Borneo. Due to that, Malaysia having a climate hot and humid through all year. In Malaysia the rainfall pattern was influenced by two monsoon which is the South west Monsoon (SM) was occur from May to September and the North east Monsoon (NM) occur from October to March. The location of Malaysia consist of west Malaysia (Peninsular Malaysia) and East Malaysia (Sabah and Sarawak) and they are divided by South China Sea. According to Jabatan Meteorologi Malaysia (MetMalaysia) updated 2016, the region of NM are Pahang, Kelantan, Terengganu and South of Sarawak. These area are usually having heavy downpour rainfall during that short time (Song and Wang, 2019).

Discusses flood risk in Malaysia, which has increased alarmingly in recent decades largely due to changing physical characteristics of the hydrological system caused by human activities: continued development of already densely populated flood plain, encroachment on flood-prone areas, destruction of forests and hill slopes development (Chan, 1997). When rapid development and environmental grow in quickly, the flood events occurs because of people want to positive benefit of economy while they are ignore negative effect. Propose that, Malaysia people less care about flood than they about financial increases from profit economy which is giving sustainable economic. States that, engineering was responsible of ineffective to control monsoon floods. Due to this, in order to control flood flow the drainage system must be apply were in designing hydraulic and hydrology structures based on data rainfall analysis and intensity.

In Malaysia, Malaysia Urban Storm Water Management Manual Second Edition (MSMA 2) are focus to manage storm water instead of drainage away. This manual also responsible in the current problem such as flash flood, river pollution, soil erosion and etc. MSMA 2 introduce the multiple objective which is to ensure safety of the public, control flooding and larger flood events and also minimize the environmental impact of urban runoff on water quality.

Monsoon season influence the rainfall of peninsular Malaysia which is rainfall distribution and pattern can be assessed in order to qualify the nature of change in space and time. Thus, peninsular Malaysia has undergone development at a rapid pace over last decades to become important designing water resources management and planning. However, the climate over Peninsular Malaysia is subjected to pronounced inter annual variability which modulates hydrological variability, including floods and droughts (Wong *et al.*, 2016). Figure 1 shows the flood plain along the peninsular Malaysia.

The purpose of designing rainfall temporal patterns is to represent the typical variation of rainfall intensities during a typical rainfall. It shows that temporal distribution of rainfall within the design rainfall which is an influence factor that affects the runoff volume, magnitude and timing of the peak discharge. Realistic estimates of temporal distributions are content by analysis of local rainfall data from recording gauge network. The function of rainfall temporal pattern is used in the estimation of design rainfall are generally based on frequency-duration relationship derived from intense burst of rainfall of various duration rather than from complete rainfall. The method produce pattern that incorporate average variability of intense rainfall. Temporal pattern also can design hyetographs estimating by the average variability method for any region based on the records. Figure 1.1 show the flood plain along the peninsular Malaysia during monsoon.

Figure 1.1 Flood Prane along Peninsular Malaysia during monsoon.

Source: Department of Irrigation and Drainage (2009).

1.2 Problem Statement

Nowadays, Peninsular Malaysia were analysed for trends in hourly extreme rainfall events at certain region. The intensity of extreme rainfall events have raised concern that human activity might have resulted in an alteration of the climate system. Intense rainfall happen in short temporal scales over long period of time often lead to worst floods resulting in hazardous situation. The increase in rainfall intensities may affect due to flash flood and landslide cases. Sometimes, flash flood may occur due to prolonged rainfall and leads to disrupt communication and transportation between residential areas. The main problem for this is the lack of appropriate knowledge about the hydrology rainfall data in Gambang Catchment.

In Malaysia, Malaysia Urban Storm Water Management Manual Second Edition (MSMA 2) temporal pattern is defined based on region not at the specific area. The rainfall pattern depends on rainfall depth and duration, seasons and geographical location

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