THE DEVELOPMENT OF INTENSITY DURATION FREQUENCY CURVES FITTING CONSTANT AT KUANTAN RIVER BASIN

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FITTING CONSTANT AT KUANTAN RIVER BASIN

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LIST OF SYMBOL

P	maximum precipitation
N_x	Annual rainfall at missing data station
N_i	Annual rainfall at neighbor station
n	The number neighbor station whose data are used
P_x	The missing precipitation
P_n	The precipitation value at n station
N	The total number of record
$\bar{x}_i$	Mean of the sample
P_T	The frequency precipitation
K	Gumbel frequency
S	Standard deviation of P value
P_{ave}	The average of the maximum precipitation in a specific duration
T_d	Duration in hours
$P*_T$	The frequency precipitation
$\bar{P}^*$	Mean Precipitation
I	Intensity
$S*$	Standard deviation of $P*$ value
K_T	The Pearson frequency factor
T	Return period (years)

LIST OF ABBREVIATION

DID	Department of Irrigation and Drainage
MSMA 2	Urban Stormwater Management Manual Second Edition
LP3	Log-Pearson Type III
LN	Log-Normal
IDF	Intensity-Duration-Frequency
GEV	Generalized Extreme Value Distribution
IPCC	Intergovernmental Panel on Climate Change

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ABSTRACT

Changing in climate is one of the main parameter that affecting the water resources as it affects the whole hydrologic cycle thus cause variation in rainfall intensity, duration and frequency of precipitation. The rainfall Intensity Duration Frequency (IDF) relationship is one of the tools that is commonly used in water resources engineering, either for planning, designing and operating the water resources project. The aims of this research is to develop the fittings constants based on the intensity duration frequency (IDF) curves for Kuantan River Basin. Two frequency analysis were used to develop the IDF curve from rainfall data along Kuantan River Basin. These techniques are: Log Normal Distribution and the Normal Distribution Function. These method is used to obtain the IDF curve for twelve durations (5, 10, 15, 30, 60, 180, 360, 720, 1440, 2880, 4320and 7200) minutes. This study used Annual Maximum Series data obtained from Department of Irrigation and Drainage (DID). It consists of 10 stations along Kuantan River Basin. Derived equations for calculating rainfall intensity for Kuantan River Basin was obtain by using two technique based on result obtained from IDF data. The estimation for fittings constants of IDF curve for different return periods was performed using empirical formula. The equations are Sherman Equation and Bernard Equation. These equations are used to computed the locality constants (a, b, c). The rainfall intensity value obtain from Sherman Equation is larger compare to the rainfall intensity from Bernard Equation which is the percentage different of Sherman Equation is 10% until 700% while the percentage different of Bernard Equation is 10% until 300%. This is because the reference station that is Station 3930012 (Sg. Lembing PCCL Mill) is located at the upstream and other station were located at the downstream of the river. Thus the intensity of downstream is lower compare to the intensity at the upper stream of the river.

ABSTRAK

Perubahan iklim merupakan salah satu faktor yang memberi kesan kepada sumber air kerana ia boleh menjejaskan kitaran hidrologi keseluruhan dan seterusnya menyebabkan perbezaan kepada kuantiti hujan, tempoh dan kekerapan hujan. Keamatan Tempoh Frekuansi (IDF) adalah salah satu alat yang biasa digunakan di untuk merancang, mereka bentuk dan mengendalikan projek sumber air. Tujuan kajian ini adalah untuk membangunkan parameter berdasarkan Keamatan Tempoh Frekuansi (IDF) di Sungai Kuantan. Dua analisis frekuansi digunakan untuk membangunkan Keamatan Tempoh Frekuansi (IDF) di sepanjang Sungai Kuantan. Tenik – teknik ini adalah: Log Taburan Normal dan Taburan Normal. Kaedah ini digunakan untuk mendapatkan Keamatan Tempoh Frekuansi (IDF) sebanyak dua belas jangka masa (5, 10, 15, 30, 60, 180, 360, 720, 1440, 2880, 4320 dan 7200) minit. Kajian ini mengunakan data Siri Maksimum Tahunan yang diperoleh daripada Jabatan Pengairan dan Saliran (JPS). Ia terdiri daripada 10 stesen di sepanjang Sungai Kuantan. Persamaan yang diperolehi untuk mengira keamatan hujan untuk Sungai Kuantan adalah diperoleh mengunakan dua teknik berdasarkan keputusan yang diperoleh daripada data IDF. Anggaran untuk parameter IDF bagi tempoh kala kembali yang berbeza telah dilakukan dengan mengunakan formula empirik. Persamaan tersebut adalah Persamaan Sherman dan Persamaan Bernard. Persamaan ini digunakan untuk mengira pemalar a, b, c dan e yang terdapat dalam formula empirik. Perbandingan yang diperoleh menunjukkan nilai keamatan bagi Persamaan Sherman lebih tinggi dari Persamaan Bernard dengan kadar peratus bagi Persamaan Sherman adalah 10 peratus sehingga 700 peratus dan Persamaan Bernard adalah 10 peratus sehingga 300 peratus. Hal ini kerana stesten rujukan iaitu Stesen 3930012 (Sg. Lembing PCCL Mill) terletak di hulu sungai manakala stesen lain terletak di hilir sungai. Oleh itu, kadar hujan yang diterima di hulu sungai tinggi berbanding dengan kadar hujan yang diterima di hilir sungai.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND STUDY

Malaysia is a Southeast Asian nation that is 4.1936˚N on the latitude and 103.7249˚E on the longitude. Malaysia is the 67th largest country by total land area, with a land area of 329,847 km^2. Malaysia was a developing country which is the construction ways has become new and modern as the infrastructure had increase. Many rural areas have become an urban area throughout the year. As Malaysia is located near the equator, its climate is being categorized as hot and humid throughout the year.

According to Meteorological Department Malaysian, there is two monsoon winds seasons. The Southwest Monsoon is happening at late May to September where the November to March is called Northeast Monsoon. The Northeast Monsoon brings more rainfall as it is originating in China and the North Pacific where the Southwest Monsoon originating from the deserts of Australia. Thus, Malaysia has extreme variations in rainfall that are linked with the monsoons.

From the Meteorology Department Malaysian, the highest rainfall in a year was recorded at Sandakan, Sabah in 2006 with 5687 mm of precipitation. The lowest rainfall in a year with precipitation 1151 mm was recorded at Tawau, Sabah on 1997. The highest average annual rainfall is 4159 mm recorded at Kuching, Sarawak while the lowest average annual rainfall was recorded at Sitiawan, Perak with 1781 mm precipitation. Besides that, the Meteorology Department Malaysian also state that the weather in Peninsular in July 2015 is wetter than in June 2015 but some areas around Terengganu, interior Pahang, Selangor and South Perak is recorded to be drier. On December 2014, the reading of Kuantan, Pahang is 1806.0 mm since last time in year 2001 and the monthly highest rainfall amount recorded was 1471.1 mm.

Meanwhile in Malaysia, Department of Irrigation and Drainage (DID) have been using the Urban Stormwater Management Manual Second Edition (MSMA 2) which is the latest urban stormwater management manual for Malaysia. MSMA 2 has been used to provide guidance for all regulators, planners, engineers, designers, developers and contractors who were involve in stormwater management.

An Intensity –Duration- Frequency curve (IDF) is a graphical representation of the probability that a given average rainfall intensity will occur. It is a form design rainfall data required for estimation peak discharges. (IDF) curve is used as tools in water resources engineering for planning, design and operation of water resources project by engineers. Rainfall intensity (mm/hr), rainfall duration and rainfall frequency are the parameters that make up the axes of the graph of IDF curve. An IDF curve is created with long term rainfall records collected at a rainfall monitoring station. It helps the engineer designing the drainage works safe and economically. In the study, the attempt has been made to find the difference between the observed data and derived data by taking the rainfall data available for 15 minutes of time interval (Zameer Ahmed, 2012).

1.2 PROBLEM STATEMENT

An engineer used Urban Stormwater Management Manual Second Edition (MSMA 2) as a guideline to make design. The data of IDF curves in MSMA 2 was updated until 2009 only The data in IDF curve is not consistence for every year because of Malaysia climate always change (MSMA, 2012).

As the change of climate effect the data, a new data is needed. It is very important to keep the efficiency of the drainage for a long time as the ARI is for about 100 years. Besides, the provided data in MSMA 2 is already out to date due to the climate change. During existing data of year 2009 to the new data of year 2015, a lot of thing can happen to change the consistency of the data such as the instrument and human errors, changes in surroundings while taking the data and change in the method of exposure.

Besides that, the current data was only collect based on the state and major town only. For the district that is not covered in the data collection area, the data to be used while designing is nearest district data. It will affect the value that supposed to be used while designing that current place. Thus, it is not efficient to be used at nearest district as the place is different. So, the design will be not very effective to be used. It can lead to uneconomically drain design and overloading water in the drain that can caused flooding.