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Welhenage Keerthirathne

138659T

Degree of Master of Engineering in

Water Resources Engineering and Management

Department of Civil Engineering

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Thesis Submitted in Partial Fulfilment of the Requirements for the
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Supervised by

Professor N.T.S.Wijesekera

UNESCO Madanjeet Centre for
South Asia Water Management (UMCSAWM)
Department of Civil Engineering

University of Moratuwa
Sri Lanka

August 2014

DECLARATION

I declare that this is my own work. This thesis does not incorporate without acknowledgement of any material previously submitted for a Degree or Diploma in any other University or institute of higher learning to the best of my knowledge and belief it does not contain any material previously published or written by another person expect where the acknowledgment is made in text.

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The above candidate has carried out research for the Masters thesis under my supervisions

…….. ……..

Professor N.T.S.Wijesekera Date

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ABSTRACT

Since the magnitude and temporal distribution of rain events directly influence the streamflow in watersheds, due focus should be given when selecting the most appropriate storm patterns for the design of hydraulic structures. Design storm can be based on either observed patterns or predetermined distribution such as Alternating Block Method. Lack of recent IDF curves and the concerns that had been raised with ongoing climate variability, engineers worldwide are inclined to use pattern based design events rather than IDF based pattern because they are said to reflect the recent and site specific situations.

The present study evaluated fifteen-minute rainfall records of Colombo Meteorological Station for a period of thirty years in order to identify the impact of guideline based and pattern based design storms on runoff responses. Event separation for the study was carried out by using a Minimum Inter event Time (MIT) of 6hrs. Two hundred twenty one events were extracted from continuous data and grouped into five based on event duration. Event analysis was carried out by developing dimensionless mass curves of each event and then analysing the percentile curves representing the dimensionless mass curves.

Six design events for event durations 6, 12, 18, 24 and 36hrs were developed from percentile curves. Corresponding Alternating Block Method (ABM) and Uniform Intensity distributions for each duration were developed using IDF curve. Eight design hyetographs corresponding to a ten year Average Recurrence Interval (ARI) for each event duration were developed. A mathematical model for a sub catchment in Colombo watershed was developed using SCS HEC HMS model and the runoff response for each design event was evaluated.

A Criticality Indicator was introduced to capture the influence of the design rainfall patterns on both critical parameters of a hydrograph, Namely the flood peak and its time of occurrence. This indicator helped to identify the effects of a flood peak from a particular design rainfall pattern reaching the basin outlet.

Envelope design rainfall pattern developed after analysing the historical data produced the most critical rainfall pattern when the event duration is closer to the time of concentration of the watershed. It was observed that there is a high variation in runoff response with the variation of temporal distribution corresponding an event. Runoff response for Alternating Block Method based pattern and the pattern developed with Envelope curves were found as the most consistent when compared with other design events. Therefore, hydraulic structure designs based on limited observed data were found as associated with high uncertainty. This study also concluded that in the absence of sufficiently analysed past rainfall data, Alternating Block Method would stand out as the most suitable design hyetograph. The present work also caution the use of design patterns based on selected events since they would certainly lead to underestimation of flood peaks.

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