Int. J. of Sustainable Water and Environmental Systems
Volume 2, No. 1 (2011) 7-16

Rainfall Intensity-Duration-Frequency Relationship for some Regions in Saudi Arabia

Ibrahim H. Elsebaie[a*]

[a] *College of Engineering, King Saud University, Riyadh, Kingdom of Saudi Arabia, 11421*

Abstract

Intensity-Duration-Frequency (IDF) relationship of rainfall amount is one of the most commonly used tools in water resources engineering for planning designing, and operation of water resources projects, or for various engineering projects against floods. The objective of this research is therefore, to derive IDF relationship of rainfall for two regions in the kingdom. These relationships are useful in the design of urban drainage works, culverts and other hydraulic structures. Two commonly frequency analysis techniques were used to develop the relationship between the rainfall intensity, storm duration, and return periods from rainfall data for two regions in Saudi Arabia. These techniques are: Gumbel and the Log Pearson Type III distribution. In order to do that, rainfall data was obtained for different durations. A set of curves was plotted using the intensity-duration-frequency data to be the basis of the analysis .

An equation for calculating rainfall intensity for the every region was derived based on the results obtained from the IDF data. The results obtained using Gumbel distribution are slightly higher than the results obtained using the Log Pearson III distribution. In general, the results obtained using the two approaches are very close and have the same trend. Rainfall intensities are drawn from these two methods and the results obtained from that work showed good consistency with what has been done before in some parts of the study area. Further studies are recommended whenever there will be more data to verify the results obtained or updating those IDF curves.

Keywords: *IDF curve, rainfall intensity, rainfall duration, rainfall frequency relationships.*

1. Introduction

Rainfall Intensity-Duration-Frequency curves (IDF curves) are graphical representations of the amount of water that falls within a given period of time [1]. Rainfall Intensity-Duration-Frequency is used to aid the engineer when creating the design. The establishment of such relationships was done as early as in 1932 (see [2] and [3]). Since then, many sets of relationships have been constructed for several parts of the globe. However, such map with rainfall intensity contours has not been constructed in many developing countries [4].

Koutsoyiannis [4-5] cited that the IDF relationship is a mathematical relationship between the rainfall intensity *i*, the duration *d*, and the return period *T* (or, equivalently, the annual frequency of exceedance, typically referred to as 'frequency' only). Indeed the IDF-curves allow for the estimation of the return period of an observed rainfall event or conversely of the rainfall amount corresponding to a given return period for different aggregation times.

A set of Intensity-Duration-Frequency (IDF) curves constitutes a relation between the intensity (more precisely, the mean intensity) of precipitation (measured in mm/h), the duration or the aggregation time of the rainfall (in min) and the return period of the event. The return period of an event indicates how rare/how frequent is this event and is defined by the inverse of the annual exceedance probability (see references [6] and [7])
In Kentucky, rainfall IDF curves are used in conjunction with the Rational Method to calculate runoff from a particular watershed. The information from the curves is then used in hydraulic design to size culverts and pipes [1]. Further studies by [8] performed Rainfall analysis and regionalization computing intensity-duration-frequency curves for different regions.

There is a high need for IDF-curves in the tropical region of KSA but unfortunately the adequate long-term data sets are frequently not available. The purpose of this study is mainly to produce IDF-curves for precipitation for different regions in Saudi Arabia.

In recent studies, various authors are tempting to relate the IDF-relationship to the synoptic meteorological conditions in

[*] Corresponding author. Tel.: +966501214635
Fax: +96614677008; E-mail: elsebaie@ksu.edu.sa

DOI: 10.5383/swes.02.01.002