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UNCERTAINITY ANALYSIS OF INFILTRATION MODELS IN ARID REGIONS

A Thesis Submitted for the Partial Fulfillment of the
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STATEMENT

This thesis is submitted to the Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University in the partial fulfillment of the requirements for the Degree of Master in Civil Engineering.

The work in this thesis was carried out in the Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University from January 2007 to September 2012.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

When no discharge measurements are available, design of water structures usually relies on using frequency analysis of historical rainfall data, and applying a rainfall-runoff transformation to estimate the resulting hydrograph using, for example, the Soil Conservation Services (SCS) Curve Number (CN) unit hydrograph method. Calibration of the CN from nearby, flow gauged watershed is limited and subject to high uncertainties due to scarcity of data. Therefore, the inherent uncertainty/variability in the SCS parameters, which is usually ignored, may have considerable ramifications on the safety of the design.

In this work, a reliability approach is used to evaluate the effect of the CN parameter uncertainty in the SCS method. The stochastic sensitivity of the probabilistic outcome to the basic uncertainty in the input parameters is calculated using First Order Reliability Method (FORM). The results from FORM are compared with the traditional deterministic SCS results which is taking solely the uncertainty in the rainfall event.

Moreover, the relative importance of the uncertainty of the SCS parameters is estimated using different uncertainty scenarios. It is found that the traditional approach used by many practitioners may grossly underestimate the risk of failure for designed water structures, due to neglecting the probabilistic nature of the SCS parameters and especially the Curve Number. This is especially important in regions where low coefficient of variation of rainfall is located (COV < 0.50). The study concluded that the SCS-global methodology should be avoided in these cases. Also the study concluded that for regions, where the combination of P, rainfall COV and CN would lead due to variability expected into probability of failure between 0.02 and 0.04, it's recommended to use CN_{III} instead of mean CN given in NEH lookup table. Such combination is illustrated in the table presented in conclusions and recommendations sub-section.

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