A Report on

*REVIEW ON THEORY BEHIND GENERATION OF SYNTHETIC HYDROGRAPH AND INSTANTANEOUS UNIT HYDROGRAPH*

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***CERTIFICATE***

This is to certify that Swapnaneel Ghosh, Roll No.: 13001319052, Registration No.: 016160 and Sayanti Sahu, Roll No.: 13001320085, Registration No.: 201300101320014 have carried out the project work entitled as **“REVIEW ON THEORY BEHIND GENERATION OF SYNTHETIC HYDROGRAPH AND INSTANTANEOUS UNIT HYDROGRAPH”** as a part of the curriculum for the B. Tech Degree in Civil Engineering under Maulana Abul Kalam Azad University of Technology for the year 2019-2023. This project report is approved by the undersigned only for the purpose for which it is submitted. The candidates are entirely responsible for statement, opinions and conclusions contained herein.

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Techno Main Salt Lake

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***ABSTRACT***

This synopsis is made to realize the importance of Synthetic Unit Hydrograph and also the necessities of such a thing even after already having a hydrograph. The main aim is to understand the various techniques needed for establishing a relationship between the basin characteristics and the unit graph characteristics, for a unit rainfall of an ungauged basin; wherein the Synthetic Unit hydrograph theory is of utmost importance. Our goal is to study Snyder’s theory (1938) for Synthetic Unit hydrograph in detail, based on a study of a large number of catchment basins in the Appalachian Highlands of Eastern United States, developed a set of empirical equations, connecting the basin characteristics with the unit graph characteristics; thereby ultimately develop a synthetic unit hydrograph on our own at the end of the project. The synopsis also includes the analysis of three hydrograph characteristics which Snyder found relationships between; those are effective rainfall duration(tr), the peak direct runoff rate(qp) and the basin lag time(ti). Synopsis is mentioned about our way of approach and also the purpose of simulation of basin diffusion by estimating the basin lag based on a certain formula or procedure.

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**CHAPTER-1**

* 1. **INTRODUCTION**

Direct runoff hydrograph (DRH) is the hydrograph generated due to excess rainfall. The surface runoff hydrograph obtained after the base flow separation is also known as direct runoff hydrograph.

Unit hydrograph is a direct runoff hydrograph resulting from one unit (one inch or one cm) of constant intensity uniform rainfall occurring over the entire watershed. The concept of unit hydrograph is based on linear systems theory and follow the principles of superposition and proportionality.

A Synthetic Unit Hydrograph (SUH) retains all the features of the Unit Hydrograph, but does not require rainfall-runoff data. A synthetic unit hydrograph is derived from theory and experience, and it’s purpose is to simulate basin diffusion by estimating the basin lag based on a certain formula or procedure.

The first synthetic unit hydrograph was developed by Snyder in 1938. In order to provide sufficient flexibility for simulating a wide range of diffusion amounts, Snyder formulated his method in terms of two parameters: (1) a time parameter Ct and (2) a peak parameter Cp.

A larger Ct meant a greater basin lag and, consequently, greater diffusion. A larger Cp meant a greater peak flow and, consequently, less diffusion.

**CHAPTER – 2**

**2.1 OBJECTIVE OF THE PRESENT STUDY**

We have aimed at a very methodical approach of doing the synopsis. Firstly, we have gone through the entire process of Computing runoff from a Given rainfall and taken notes from it. Thereafter, we studied the characteristics of both gauged basins and ungauged basins and thereby, ultimately came by Snyder’s Method for Synthetic Unit Hydrograph. We discussed the relations and empirical formulae derived by Snyder regarding ungauged catchment basin characteristics. After the US equations, we further researched deep down into Indian Equations recommended by The Central Water Commission for which we took the reference from two different books. After going through all the relations and taking into account design purposes, we finally added the relation between Discharge vs Time in the form of a graph displaying Synthetic Unit Hydrograph.

***LITERATURE REVIEW***

**SYNTHETIC UNIT HYDROGRAPH: AN OVERVIEW**

* **Snyder (1938)** is based on relationships found between three characteristics of a *standard unit hydrograph* and descriptors of basin morphology. The hydrograph characteristics are the effective rainfall duration, *tr*, the peak direct runoff rate, *qp*, and the basin lag time, *tl*. From these relationships, five characteristics of a *required unit hydrograph*for a given effective rainfall duration may be calculated (*e.g.,* Chow et al., 1988; Bras, 1990): the peak discharge per unit of watershed area, *qpR*, the basin lag, *tlR*, the base time, *tb*, and the widths, *W* (in time units) of the unit hydrograph at 50 and 75 percent of the peak discharge.
* **Bernard (1935)** The distribution graph introduced by Bernard is a variation of the unit hydrograph. It is basically a D-hr unit hydrograph with ordinates showing the percentage of the surface runoff occurring in successive periods of equal percentile intervals of D-h. The duration of the rainfall excess (D-h) is taken as the unit interval and distribution-graph ordinates are indicated at successive such time intervals. Therefore, Bernard’s distribution graph is a plot of time on the x-axis and the percentage of total surface runoff during uniform time travel on the y-axis. The ordinates plotted at D-h intervals and the total area under the distribution graph adds up to 100%. They are useful in comparing the runoff characteristics of different catchments.
* **NRCS (1954)** USDA Natural Resources Conservation Service followed Snyder in developing a synthetic unit hydrograph suited for agency use.2 Since NRCS applications typically involved smaller basins, that is, less than 10 square miles, they chose to set the peak parameter at a fixed ratio of triangular-time-base to time-to-peak Tbt/tp = 8/3. For comparison, in the rational method, this ratio is exactly 2, i.e., no diffusion. Therefore, NRCS introduced some diffusion into their synthetic unit hydrograph, but clearly not a lot. The diffusion is fixed by the 8/3 parameter, and it is certainly less than Snyder's, who unlike NRCS, could vary its diffusion, within certain limits. The NRCS synthetic unit hydrograph is generally justified because the NRCS basins were typically relatively small, and small basins usually do not exhibit a great amount of diffusion. However, caution is advised when attempting to use the NRCS procedure for larger and/or milder basins. In this case, the use of the NRCS unit hydrograph will very likely result in overestimation of the peak flows.