Use of Network Analysis for Designing Better Water Drainage System of Cities in India

Rabindra Kumar
Resident Engineer
LNMIPPL

Abstract— Scientific system to catch the storm water could be a future ambition of the society, particularly in cities. Increasing development activities have known as badly for the requirement of discharging runoff safely in to surroundings. It is usually being happened that over concretion and modification of undeveloped land is additionally ensuing exaggerated flow with exaggerated pollution. No matter the town, most of our city's face are broken, if an important storm with high get away is hit, because of improper emptying facilities. Most of our existing storm water drains ar in tatterdemalion stages and not operating properly, losing self-cleansing, no correct maintenance, and incorrect style with none scientific base, the bottlenecks go therefore on. a correct storm water style suggests that a correct information of a group of information like understanding the precipitation data clearly, recognize the infiltration indices, concentration time, intensity of precipitation, runoff details etc. It seems most of the time that a lot of the information might not be correct and therefore the planning of the storm water drains with these therefore known as data are a catastrophe. This study is that the work in deep trouble the emptying style in Indian cities wherever the surplus runoff is admittedly a threat to the surroundings because of dense population.

Key words: Drainage, Runoff, Storm water

I. INTRODUCTION

The observation of storm water management has evolved considerably over the last twenty years and it's targeted totally on flood and erosion management. Flash floods being a phenomenon, total elimination or management of floods is neither much doable nor economically viable. Hence, flood management aims at providing an inexpensive degree of protection against flood harm at economic prices and preserves the surroundings. Structural measures embody storage reservoirs, flood embankments, emptying channels; anti-erosion works, channel improvement works, detention basins and non-structural measures embody flood prediction, flood plain division, flood proofing, disaster state etc. an honest and economical storm water management is badly needed at the instant everywhere the universe particularly in developing countries like Republic of India. The concept of economical storm water management relies on the necessity to guard the health of the general public, welfare and safety of the general public, conservation of water, ought to try for property surroundings etc. Basic issues in an exceedingly storm water catch basin style are useful necessities, technical necessities, and social and economic issues. Urban emptying includes two varieties of fluids viz. waste matter and storm water, waste water is that when the utilization for keeps support, method from trade this has to be collected and transported while not inflicting any unsafe problems however on the opposite hand storm water is that the runoff that caused because of precipitation. Each storm water likewise as waste water has to be thought of for the system coming up with and style.

Storm water emptying is that the method of debilitating excess water from streets, sidewalks, roofs, buildings, and alternative areas. The system accustomed drain storm water is usually remarked as storm drains, however they are conjointly known as storm sewers and emptying wells. Storm water collects due to precipitation, like rain, snow, and sleet. a number of this water soaks into the bottom, however while not correct emptying, excess water might collect and gift dangers to each individuals and property. Storm water emptying style is essentially supported runoff amount estimation. Numerous strategies are out there for runoff amount estimation.

1) Rational Method
2) Hydrograph Method
3) Empirical Formula Method
4) Rainfall-Runoff Correlation Studies

In this research, Rational Method is used for drainage design.

A. Surface Runoff and its Characteristics:

Surface runoff is water, from rain, snowmelt, or alternative sources that flows over the land surface, and could be a major element of the water cycle. Once runoff flows on the bottom, it will devour soil contaminants like fossil fuel, pesticides, or fertilizers that become discharge or land flow. Urbanization will increase the surface runoff, by making a lot of acid-fast surfaces like pavement and buildings don't permit percolation of the water down through the soil to the formation. Exaggerated runoff reduces groundwater recharge; therefore lowering the formation and creating droughts worse United Nations agency rely upon water wells. The height rate, volume, and temporal arrangement of runoff ar vital characteristics within the coming up with and style of storm water management observe. Runoff rate and volume typically increase when urbanization and this development alters the characteristics of runoff. If the downstream data rate is exceeded, flood can occur over the plain, another connected drawback is channel erosion that depends on runoff rate and its period. Thus, urbanization not solely will increase runoff rate and volume however conjointly their frequency and frequency of runoff rate includes a direct impact on erosion and sediment transport of stream channel. Runoff from non-urban areas carries worn sediments, nutrients from natural and/or agricultural sources, microorganism from animal stool, and pesticides and herbicides from agricultural practices. when urbanization, runoff carries solids particles from automobile wear and tear, dirt and dirt, and winter sand, nutrients from residential fertilizers, metals such metal, copper, and lead, hydrocarbons natural action from asphalt pavement materials, spilled oils and chemicals, and microorganism from sheep. This transformation of runoff

quality causes a general degradation of water quality within the receiving waters.

B. Sewers and Overflows:

Storm sewers (also storm drains) square measure giant pipes or open channels that transport storm water runoff from streets to natural bodies of water, to avoid street flooding. A storm drain, is meant to empty excess rain and well water from paved streets, parking tons, sidewalks, and roofs. Storm drains vary in style from little residential dry wells to giant municipal systems. They are fed by street gutters on most motorways, freeways and alternative busy roads, still as cities in areas that expertise significant downfall, flooding and coastal cities that expertise regular storms. Several storm emptying systems square measure designed to empty the storm water, untreated, into rivers or streams. A combined sewer may be a variety of sewage works that collects sanitary waste matter and storm water runoff in a very single system. Combined sewers will cause serious pollution issues owing to combined sewer overflows, that square measure caused by giant variations in flow between dry and wet weather. This kind of sewer style is not any longer utilized in building new communities; however several older cities still operate combined sewers. In these systems a unexpected giant downfall that exceeds waste matter treatment capability are going to be allowed to overflow directly from the storm drains into receiving waters via structures referred to as combined sewer overflows. Combined sewer overflow is that the discharge of effluent and storm water from a combined sewage works directly into a watercourse, stream, lake, or ocean. Overflow frequency and period varies each from system to system, and from outlet to outlet, inside one combined sewage works. Throughout significant downfall once the storm water exceeds the sanitary flow, the combined sewer overflow is diluted. Every storm is totally different within the amount and kind of pollutants it contributes. As cities become a lot of densely inhabited, the per-household volumes of effluent exceed the infiltration capability of native soils and need larger emptying capability.

C. Introduction of Sewer:

1) Drainage System Principles and Runoff Estimation:

A storm system may be a system receiving, conveying, and dominant storm water runoff in response to precipitation and snowmelt. Such systems include: ditches, culverts, swales, underwater fighter drains, roadways, curb and gutters, catch basins, manholes, pipes, attenuation ponds and repair lateral lines. It is designed to convey runoff from frequent storms (e.g., up to a pair of or five year storms). The most purpose of this method is to reduce storm water ponding at intersections and pedestrian crossings which can cause inconvenience to each pedestrians and motorists thus it's additionally referred to as the convenience system. The key system contains the natural streams and valleys and artificial streets, channels and ponds. It is designed to accommodate runoff from less frequent storms (e.g., a hundred year or the Regional storms). The most purpose is to basically eliminate the danger of loss of life and property injury because of flooding. There are several methodologies developed earlier to estimate the full runoff volume, the height rate runoff and therefore the break out hydrograph from land surfaces beneath a range of conditions like runoff curve variety technique, tiny storm geophysical science technique, infiltration model ways etc. for earlier stages and Rational technique, SCS method, changed Rational technique in gift stages. The technology followed here is predicated on Rational method, that is adopted wide, but toilsome effort area unit needed to make sure that the few input file needed for rational technique is correct.

II. Review of Literature

Various techniques and methodologies are developed to style the storm water within the past. Usage of Rational technique and therefore the definition of parameters and its calculation are clearly mentioned within the drain criteria manual of town of Winnipeg. Style of the storm water mistreatment rational technique and therefore the comparison of identical mistreatment SCS and changed rational technique were pictured clearly within the course Manuel of PDH engineer the benefits of rational ways, it short falls, and ways to seek out the time of concentration, guide lines for locating runoff coefficients etc were clearly mentioned.

Steven J. Burian describes the requirement of correct and economical urban system. It additionally compares the drain systems of past and therefore the gift, that with none doubt points to the actual fact that for a healthy setting particularly in cities the correct style and coming up with of the drain systems area unit inevitable.

Theodore G. Cleveland delineate the employment of rational technique and changed rational technique normally for the Lone-Star State town. It additionally describes the applicable space of changed rational technique over rational technique.

Francesco D' Asaro describes intimately the Curve variety procedure, that is basically and world-wide used due to this application easiness, permits to estimate the degree of direct runoff for a given precipitation event by means that of one parameter, CN, representing of the basin infiltration storage and looking on soil sorts, land cowl and land use.

III. Study Area and Methodology

A. Existing Facilities in the City for Drainage:

Open surface drains, that area unit inadequate accomplish the storm water disposal to Indian cities, and in most areas, there aren't any correct drain arrangements. These line the edges of the road and ultimately drain to natural drain channels and at last in to ocean or watercourse or Canal. There are a unit numerous forms of roads and not even five hundredth of them have drains. Most of the houses have plastered.

B. Design Criteria:

The Rational technique was accustomed style the drains within the study space. Having analyzed the offered information of precipitation records the intensity of precipitation was observed. The height rate of runoff made from explicit structure depends upon numerous factors like:

- Pattern of precipitation
- Intensity and duration of rainfall
- Rainfall distribution
- Deficiency of soil moisture at a particular time

- Direction of prevailing storm
- Humidity , temperature
- Growing vegetation , crops , trees in the catchment

C. Rational method for estimation of Storm water Runoff:

The characteristics of catchment basin like impermeableness, topography as well as depressions and water pockets, form of drain basins and period of precipitation determines the full runoff to be thought-about within the system. The runoff reaching the drain is given by following formulae of rational technique:

$$Q = 10\ C\ i\ A$$

Where,
Q = Runoff in m3 / hour
C = coefficient of runoff
i = intensity of rainfall in mm/ hour
A = area of drainage basin in hectares
Thus, for estimation of runoff, the basic data required are as follow:

- The runoff coefficient
- Rainfall intensity
- Time of concentration tc
- Probable future condition of the area to be drain

D. Coefficient of Runoff:

The part of the runoff that flows within the network depends on the impenetrability of geographic region, form of geographic region, length of storm water flow. This issue that governs the quantity of flow reaching the drain is thought as "coefficient of runoff".

E. Storm Frequency:

Storm water drains aren't designed for the height storm water frequency. However, there is also some flooding once the downfall exceeds the look price that has got to be permissible. The frequency of such permissible flooding could vary from place to position, reckoning on the importance of the area.

F. Rainfall intensity and Frequency:

The design of storm water drain is chiefly supported the assumptions of downfall during a specific space. The cheap predictions for the runoff within the future are often made up of the applied math analysis of the downfall figures taken from the past records for range of years.

G. Time of Concentration:

The time of concentration is the summation of inlet time along the contributing catchment area and flow time within the network.

H. Design of Storm Water Drain pipes:

The estimated design flows depend, to a large extent, on the belief, the accuracy of that is variable. In spite of this, care is needed to pick associate correct friction-flow formula on avoid combining errors. However, the look apply is to use the Manning‟s formula for storm water drains (pipes).

$$V = 1 / N R^{2/3} S1^{/2}$$

Where,
N = Manning‟s Coefficient of roughness
S = Slope of hydraulic gradient
R = Hydraulic radius in meter =area/velocity
V = Velocity in meter/second

IV. CONCLUSION

Rational technique has been effectively used here to style the storm water drains of the study space. In Rational technique the runoff constant contains heap of things of the geographical area, land use pattern, soil cover, infiltration details etc. Diligent efforts area unit needed to estimate these parameters so as to achieve the worth of runoff constant. In the present study utmost care has been taken to terminate the worth of runoff constant 'C'. It absolutely was noted that the present sections aren't enough in most of the places to accommodate the runoff. The inundation of the study space is especially thanks to the blockage of the drains in numerous points; thus periodical maintenance of existing drains is important. In those places wherever area constraints area unit acute, tetragon sections is also replaced with existing rectangular sections.

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