DESIGN OF STROM WATER DRAINAGE SYSTEM NETWORK FOR CMRGI USING BENTLEY STORMCAD

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Abstract:

A proper drainage system to catch the storm water is a long-term need of the society, particularly in cities. This study aims to provide an efficient and useful separate stormwater drainage network for the CMRGI campus to safely discharge stormwater. In this study, the rational method was adopted in estimating the volume of runoff. Manning's Formula was adopted in designing and sizing the stormwater drains and culverts for a catchment area. The rainfall intensity and characteristics of catchment area are the major factors for designing storm water drainage network. Past record of 34 years rainfall data has been taken for study. Rational method is to be adopted for storm runoff estimation which is widely reported in literature. The land use land cover map is to be prepared from the Master plan of the campus. The procedure is followed by catchment preparation and computation of the time of concentration, runoff, and peak discharge. The pipe and drain network have to be designed using STORMCAD v10.01 after inputting the required design criteria and collected data of the institute. The methodology presented in the study can be useful to other educational institutes in India. The benefits of this project work are, it would prevent soil erosion in and around the foundation of structures within the campus, prevents landscape from soil erosion and it will contribute to the development and growth of CMRGI. Campus. Management of the quantity and quality of storm water runoff from urban areas is a complex task which has become an increasingly important environmental issue for urban communities.Together with economic and social issues, this increased awareness of the impacts of urban drainage systems has resulted in a need for system managers to obtain information regarding the drainage system response to varying climatic conditions. In an ideal situation, storm watersystems would be designed and analyzed with catchment modeling systems which fully replicated the important processes involved with the generation and transmission of storm water. This ideal situation, however, requires catchment modeling systems, generally mathematical in form, to be developed that include all potential and feasibility. Effective

urban storm water management is highly dependent on appropriate consideration of the spatial variability of urban watershed characteristics. Urban drainage systems are used to manage urban stormwater. Hyderabad, like many cities in India, has serious floods during monsoons, despite being a water-starved city. There are various reasons for the flooding of this city, including lack of infrastructure specifically for stormwater discharge, clogging of constructed drains and natural drains from improper waste management, lack of systems to recharge groundwater with runoff or to harvest rainwater, and unplanned urban development with relation to the drainage patterns. Stormwater drainage problem is one of the major challenges facing many parts of Hyderabad city and CMRGI campus is taken for the present study.

INTRODUCTION:

General Water which originates during precipitation events and snow/ice melts is known as stormwater. Duringrain, the water which does not soak into the ground becomes a surface runoff which flows from the storm drainage lines to the river or streams. Stormwater Drainage System mainly used to detect the issues related to flood control and water supply (Volume and timing of runoff water) and also related to water pollution. In developing countries the factors which are affecting the stormwater drainage system classified into two categories: 1) Natural 2) Human activity. Rainfall patterns, Properties of catchment areas, soil type, presence ofwater course, climate change etc are the natural factors. Extension of urban areas, impermeability, degradationof plant cover, lack of planning and poor management and such are the Human activities that impacts on natural storm drainage. Conduits with different diameters, manholes, catchment areas, outlets and alike are theimportant elements of any storm water drainage systems. The main purpose of the system is to carry out the excess rain water from the lands occupied by human settlements to the nearby water bodies like ponds, rivers or streams. Urban growth tends to create an impervious ground surface, which increases the possibility of flooding in urban areas due to the construction of roads and buildings. Impermeable areas lead to theaccumulation of storm water on the ground surface which in turn affects the infrastructure and transportation. To reduce such effects, an appropriate storm network is required. The runoff coefficient is one of the main factors affecting the design of storm water drainage systems. Changing the runoff coefficient could affect the design parameters of the drainage network, including outfall discharge, velocity, lag time and cost of construction. Storm water network management is one of the most important aspects of developed cities due tochanges in land surface permeability and the percolation of water. Zeleňáková et al. (2019) studied the percolation of water from surface runoff with an emphasis on the retention capacity of the selected territory andthe intensity of precipitation. The results proved that a geological study must always be conducted 2 with any decision on rainwater percolation in a certain locality. Its range is dependent on the difficulty and type of construction. Recent technological tools such as StormCAD, CivilCAD, SewerGEMS and the Storm Water Management Model (SWMM) can be used in the management of storm water. These tools are accurate and lesstime consuming for the design of the drainage network. StormCAD software is commonly used for designing storm water drainage systems in numerous areas of the world. Bentley gave a brief introduction to StormCAD and its features. StormCAD can be used to determine the actual catchment runoff, gutters, inlets, junctions andpipe networks. It is also used to determine the pipe diameters, slopes, invert elevations, depths of flow, velocityand hydraulic grade lines. Storm water drainage systems in the past were designed for rainfall intensity of 12 – 20 mm. These capacities have been getting very easily overwhelmed whenever rainfall of higher intensity has been experienced. Further, the systems very often do not work to the designed capacities because of very poor maintenance. Encroachments are also a major problem in many cities and towns. Natural streams and watercourses have formed over thousands of years due to the forces of flowing water in the respective watersheds. Habitations started growing into towns and cities alongside rivers and watercourses. As a result of this, the flow of water has increased in proportion to the urbanization of thewatersheds. Ideally, the natural drains should have been widened (similar to road widening for increased traffic) to accommodate the higher flows of stormwater. But on the contrary, there have been large scale encroachments on the natural drains and the river flood plains. Consequently the capacity of the natural drains has decreased, resulting in flooding.

OBJECTIVES:

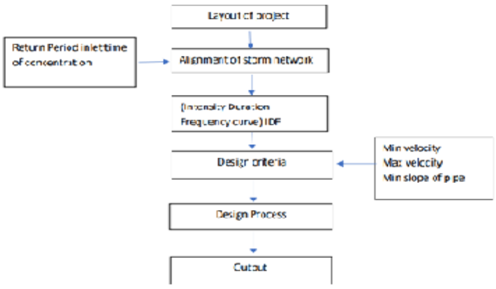
• To develop the outfall hydrograph, water profiles along the storm channels

• To evaluate the runoff volume for the designing storm of various return peri

• To integrate the existing drainage network with interflow to mitigate urban storm water flooding in the study area

METHODOLOGY:

FLOW CHART



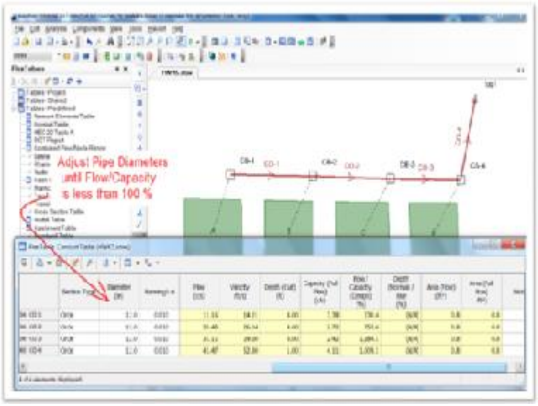


FIG:-1Finally, we conclude that Storm CAD uses the Rational method for calculation of depth, flow,and velocities and using Bing map properties background files of Google maps can be obtained and it is found to be the best tool for the designing of stormwater drainage designs. Urban areas concentrate population and production and provide some obvious advantages over rural settlements. Urban community is served with the facilities of all kinds mostly at door step at a cheaper price compared to rural community. In particular, the service providers have larger and concentrated customer population in urban areas to enable them to maintain lower specific cost for the provision of potable water supplies, sewers and drains, garbage collection, telecommunication, transportation, health, educational and emergency services. Urbanization accompanies the introduction of vast impervious areas, efficient hydraulic conveyance systems and supply of large volumes of pipe water resulting changes to an urban setting to dramatically alter the surface and subsurface hydrology. Urbanization is alsoresponsible for increase of discharging pollutants to natural water bodies. The concentration of domestic, commercial and industrial wastes causes major environmental and health problems for the inhabitants. 40 Modeling of hydrologic processes for estimating runoff generated from the catchment for the purpose of stormwater drainage design is discussed here. Storm water runoff generated by a rainfall event depends on the catchment characteristics and rainfall characteristics. Design requirements for urban stormwater drainage are usually specified in terms of a rainfall of certain return period. 4.3 Catchment and sub catchment delineation The catchment area to be drained is required to be defined based on the topography of the area. In some cases, there may be discharges into the catchment other than through gravity flow from areas outside the normal catchment. For example, there may be pumping of urban drainage flow from an adjacent catchment. The effective catchment area contributing to the catchment drainage flow includes all such contributory catchments. Drainage network in a catchment whether pre-urban or urban catchment, consists of distribution of drainage paths (drains, streams) that converge to form the main drain/stream atthe outlet of the catchment concerned. Urban catchments are usually modeled not as a single catchment but as collection of sub catchments. This practice has several advantages. Distributed properties in a heterogeneous urban catchment can be taken into consideration. Inrelation to the design of components of urban storm water drainage system, the design flows are required not only at the outlet of the catchment but also at the outlets of all drainage paths converging to the main stream. Also, the effect of attenuation of peak flow within thedrainage network of the catchment by routing the flows discharged into the main stream (and submains) at different points with time lags provides realistic distributed discharges in the network. Overland flow routing may be not necessary if a sub catchment is very small.

Different steps for the analysis of two main lines of the existing network by using Storm CAD:

1) Opening of new project option in StormCAD; 45

2) Adding IDF curve in Storm Data;

3) Put the background of the existing network by converting AutoCAD file into .DXF file;

4) Tracing main lines and catchment areas in StormCAD with the help of background files;

5) Color coding of the pipe as per their diameters;

6) Inserting invert level, ground elevation in each manhole;

7) Inserting conduit properties and manning's values in each conduit;

8) Inserting time of concentration and runoff coefficient in each catchment;

9) Validate and simulate the program. After running the program successfully, the software itself calculates the flow and hydraulic grade lines in each manhole and slopes, flow and velocity in each conduit. Study shows that there are some manholes which overflows and causes the problem of backflow in those areas during high intensity of rainfall. The profiles of these manholes are creating by StormCAD which clearly indicate the over flow. In which, HGL means Hydraulic Grade line and EGL means Energy Grade Line. If the green line is below the both lines then manhole is over flooded. To develop a model in stormCAD, a graphical representation of the pipe network, containing all the design details is constructed and variation ranging of conduit diameters can be represented in

different color's using color coding. Intensity- duration-frequency curves are added or directly developed by entering the values of intensity and duration for the given return periods in storm data. Using Bing maps by adjusting the latitude and longitudes we can easily identify the exact location of the network. The complete developed model in stormCAD as shown below in Figure

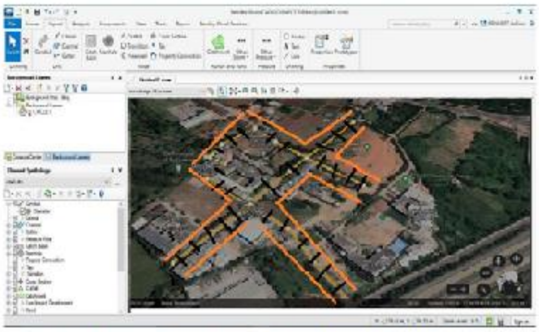


Figure 9 storm water network model Development in storm cad

FIG:-2

RESULT:

The main purpose of the paper was to analyze the existing situation of the one main Stormwater drainage system in CMRGI by using Storm CAD tool. Data which are collected inserted in the software and the simulation of the existing network is carried out. The result indicates that due to heavy precipitation and improper drainage system waterlogging problems in that area was getting severe day by day. So it shows that efficient and smart work is necessary to make the results economical and also to resolve problem with whole feasibility.

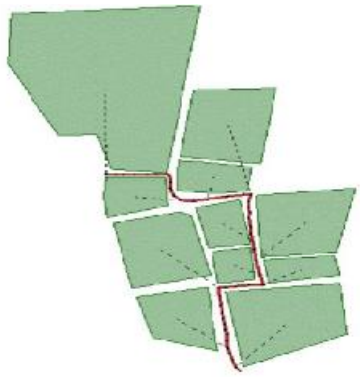


FIG:-3

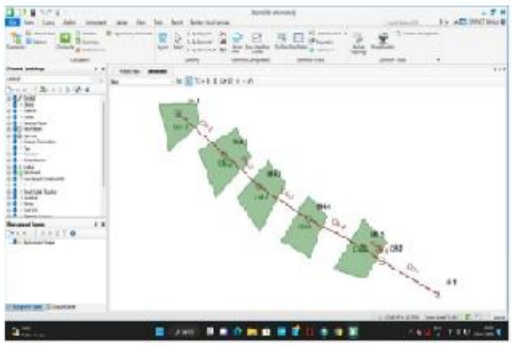
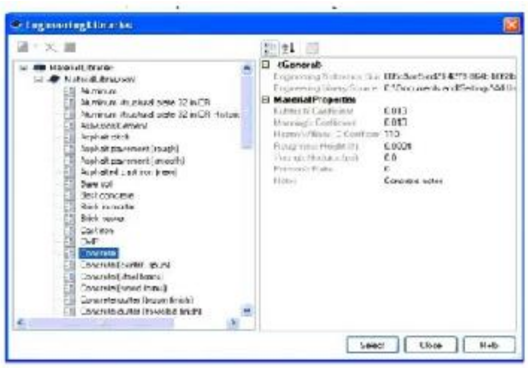


FIG:-4



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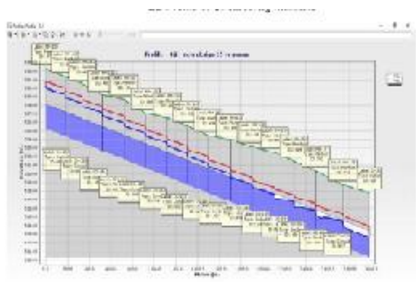

GRAPH:-1

From the analysis it reveals that modified design as proposed is adequate to convey the storm runoff to the outfalls without any spilling and flooding. The shape, volume and peak rate of system inflow and outflow are well matching at outfall as shown in figure. Further, water elevation profile along the drains shows the zero flooding and without spilling at nodes of the drainage system of design storm of 5 year returns period as shown in figure

CONCLUSION:

• It is concluded that Storm CAD uses the Rational method and GVF solver for calculation of depth, flow and velocities and using Bing map properties background files of Google maps can be obtained and it is found to be the best tool for the designing of stormwater drainage designs.

• Different profiles like Two dimensional, Three dimensional and Engineering profiles can be obtained in Storm CAD. Hence, it may also help in filling the gaps by identifying problems to sustainability, taking proper designing stormwater drainage system and proper functioning of drainage schemes in the city.

• The storm drainage system of CMRGI has been analyzed in the present study.

• Five years of hourly rainfall data have been used to estimate design storms and analyzed the simulated runoff results.

• The STROMCAD model was run to dispose of the present runoff generated considering the originally designed by drainage networks without any blockage and we found it is inadequate to dispose of the runoff.

• The condition of the existing drainage networks dispose off the rainfall depth of 2 year return period.

• As a result Zone XII is facing flooding and water logging every year.

• The maintenance of the conveyance system is very poor and people are less concern about the health of the system.

• The drains are chocked due to throwing of garbage, polythene bags, wastages of vegetable and fish markets etc. directly into it.

• Thus people need to beawakened and attention should be given for renovation of the existing drains.

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