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Design and Analysis of Existing Storm Water Drainage Lines for Area Using Bentley's Storm Cad

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Abstract – Storm CAD is a comprehensive modeling software program for design and analysis of storm sewer system. Storm CAD provides calculations for catchment runoff, inlet capacity and gutters & pipe network flow. Storm CAD can import and export drainage data directly from INROADS, Storm CAD allows the input of external contributing areas, additional flow and carry over flow to model non-local runoff contributing to the discharge at any inlet. Stom CAD provides several methods for computing travel time, including full pipe velocity, normal velocity, average end velocity and weighted average velocity. For the efficient functioning of the any housing or industrial sector proper drainage facilities is a must. To overcome these problems simulation of the existing network of the areas or zones is essential is carried out by using Storm CAD. Effective management of storm water runoff is the basic necessity which will help in satisfying the above objectives. Absence of storm water management will result in pollution, sedimentation, local flooding, stream channel instability, declination in the level of ground water table etc. These effects can be reduced to some extent by having a well-designed drainage network. A properly designed storm drainage network will contribute in appropriate disposal of storm runoff, which will help in reducing the stagnant water bodies' formation in the locality due to inappropriate execution of drainage network

Keywords- Smart cities, Storm Water Drainage System, Warje, Simulation, Storm CAD

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I. INTRODUCTION

In modern cities the storm water drainage system is the essential part of urban infrastructures .Basically the most important use of the storm water drainage system is to carry the excess rain water in the monsoon season from the roads, streets, roofs and make the city free from the problems of backflow and also from the flood. There are limitations for certain existing drainage system so there comes a need where need to provide an efficient and economical drainage system.

Storm CAD helps you be as effective as possible on storm sewer development project. Storm CAD is such software where drainage lines can be prepared over any existing or new area by studying the rainfall pattern of that area or by obtaining the AutoCAD plan and by calculating the discharge of that area Storm CAD allows the input of external contributing areas, additional flow and carry over flow to model non-local runoff contributing to the discharge at any inlet. Stom CAD provides several methods for computing travel time, including full pipe velocity, normal velocity, average end velocity and weighted average velocity.

Bentley Storm CAD is an extremely powerful program for the design and analysis of gravity flow pipe network. The program can be run within Micro Station or AutoCAD, giving you all the power of those software packages' capabilities, or in Stand-Alone mode utilizing its own graphical Interface. Storm CAD V8i allows you to construct a graphical representation of pipe Network containing all your information, such as pipe data, inlet characteristics, watershed areas, and rainfall information Storm CAD which runs as a Stand-Alone application, which is flexible enough to work with any other application is used as a designing tool. It can analyze gradually varied flow, unlimited number of storm events, automated design for pipes and inlets, curved pipe inlets etc. and provides the most efficient drainage system design.

II. STUDY AREA &DATA COLLECTION

Warje village is situated about 10 km from the center of Pune. Prior to 1970, it was a small village with farming being the main economic activity. Warje is on the bank of the Mutha River, making the village a catchment area for the western hills due to the good soil and sufficient water for farming. With a dense forest in proximity to river and creek areas, Warje was one of the stops during sheep migration from Konkan to regions inland. Signs of this can be seen in rocky areas next to Ganpati temple at the west of the town. Ganpati temple has existed since 1982 and for probably quite some time before that. A society named Shriram society, Warje was selected as our site. This society was going under immense problem of water-logging. People staying in this locality were facing this problem in a tremendous level during monsoon season. There were many of the warnings and complaint letters to the corporation office. So looking at this scenario we decided to work on this area as our project site. The area was developed at the foot of hilly region, this created problem as the water running through the hilly region was getting collected in this area, as there was no proper drainage system and lack of flow path too. The data collected was from ward office, kothrud which had a huge complaints regarding the area facing problems. Visit to ward office was beneficial as the meeting with junior engineers handed us information and data of whole area. Ward office engineers was also on the survey of getting the efficient and cost effective results .This site is one of the major problems giving rise to water logging.

A CAD file of the existing Storm water Drainage Network of two trunk lines with catchment areas and IDF curve (Intensity-Duration- Frequency curve) of selected zone was obtained from the Ward Office (Pune Municipal Corporation-PMC). The file includes the diameter of each pipe with manholes and also consist the reduce level (RL) of each point in the whole network. In existing network, total 1 number of outfalls with their RL and IL (Invert level) are available. One outfall meets canal.

III. DESIGNING A MODEL USING STORMCAD

By inputting all the existing data in the Storm CAD the simulation is carried out. In manhole, the data of elevation, invert level, width and length and structure type is inserted. In conduits, the diameter, types of conduit structure, material, manning's values are inserted. In catchment, runoff coefficient and time of concentration is added. After computing successfully, the flux table of out fall, conduits and manhole is studied out. The software itself calculates the velocity and flow in each conduit from the inserted data. Here the rational method is used in the software for the calculation. The network of two lines of existing drainage system in Storm CAD is also given below in the figure no.1.

Total length of network is 0.300 km having a total number of element as given below

1. Manholes:-43
2. Conduits:-43
3. Catchment Areas:-11
4. Outfalls:-01

IV. ANALYSIS OF MODEL USING STORMCAD

Storm CAD Vi8 can be used for the whole phases of the project like analysis of the existing network to the final design of the network or new design of the whole network General uses of the Storm CAD are;

- To design multiple storm water lines;
- To analyze different scenarios for storm water network;
- Import and export AutoCAD and .DXF files.

Predict runoff of rainfall.

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

1) Opening of new project option in Storm CAD;
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 Storm CAD 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 Storm CAD 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.

Fig.1:-Shri Ram Society, Warje (Source : Google Earth Pro)

V. RESULTS & DISCUSSION

The main purpose of the paper was to analyze the existing situation of the one main Storm water drainage system in Shriram society, Warje, Pune city by using Storm CAD tool. Data which are collected from the Pune Municipal Corporation, 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.

Based on the system simulated using the software, it was identified that there are possibilities of getting water collected in that area for a period of time. It was a need to find out the efficient method which will be effective as well as economical too.

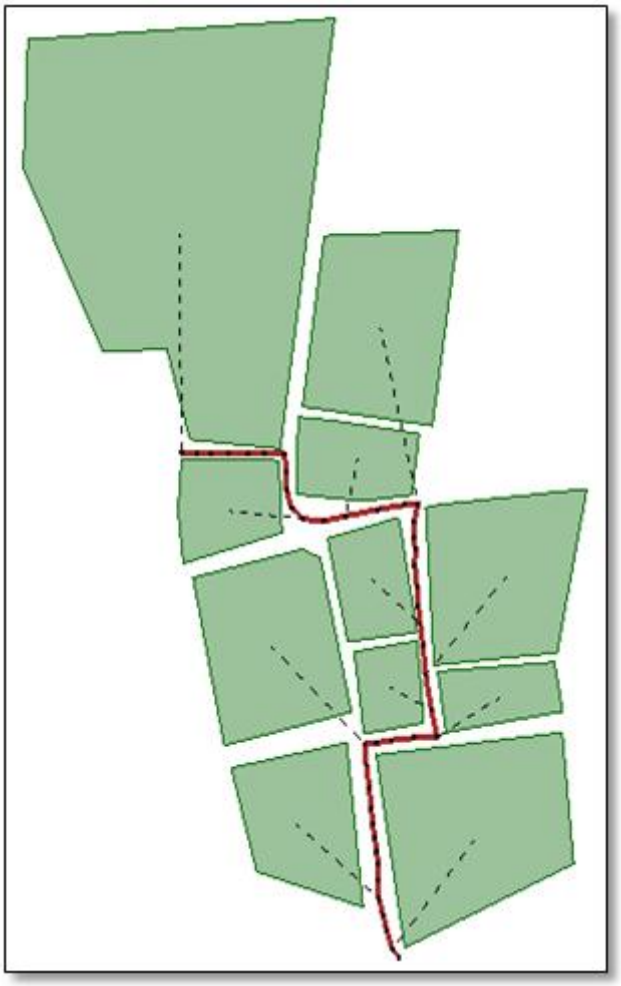

Fig.2:-Designed Section. (Source : Storm CAD)

According to the data inserted and also considering the need of the project conclusion lead to the very efficient and economical design of drainage system covering each and every aspects required. Maintaining the accuracy and less manual and paper work saving the time and practicing the technical innovations.

VI. DISCUSSION AND FUTURE SCOPE

In the frequent study**,** design of new drainage system over an old one will be more beneficial and profitable for people living in that area as well as for the municipal committee people resulting in cheap construction method .Todays era demand for innovative and time with money consuming methods resulting in a output, fulfilling the satisfactory demands. So design of new drainage line with the help of Storm CAD software will help the people residing in that area to get rid of the problem causing due to heavy precipitation and the area located at the

toe of the slope facing the water logging problem. Due to improper and old drainage system area was affected by water-logging. Use of software to fix up issues regarding such water-logged areas will give accuracy in outputs along with balanced financial aspect.

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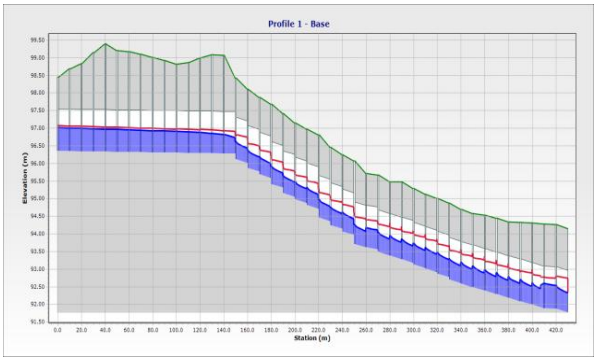

Fig.3:- Conduit Profile (Source: STORM CAD)

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