PROPOSED DRAINAGE SYSTEM AND STROM WATER MANAGEMENT STRATEGY

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ABSTRACT

This paper focuses on the provision of drainage systems and stormwater management strategies at CT University. Although engineered infrastructure is a component for drainage of urban runoff, non-structural approaches are important complementary measures, focusing on actions to prevent and mitigate problems related to flooding as well as those related to pollution and deterioration in environmental health conditions. The following will be the analysis taken at CT University to provide solutions to the improper functioning of the drainage system. A participatory approach is recommended within a strategic framework of stormwater planning.

Keywords: Storm Drainage system, storm water management, run off.

Introduction

From research we can tell that a well-maintained landscape can increase the value of a place on the other hand a poorly maintained landscape cause damage to the structure and to bring other health problems, therefore storm water being one of the most affecting factors that need to be looked out for in our environments, we are going to examine and analysis how storm water is managed at CT University.

A quick overview of storm water; Stormwater management is the effort to reduce runoff of rainwater or melted snow into streets, lawns and other sites and the improvement of water quality.

It can be applied in rural areas (e.g., to harvest precipitation water), but is essential in urban areas where run-off cannot infiltrate because the surfaces are impermeable.

Modern approaches aim to rebuild the natural water cycle, i.e., to store runoff water (e.g., retention basins) for a certain time, to recharge ground water (e.g., infiltration basins) and to use the collected water for irrigation or household supply.

Example of storage approaches used in storm water management

Retention ponds are primarily designed to improve the quality of water from stormwater flows, but are often employed as flood control devices. They are designed not to dry out during dry periods, thus retaining water permanently as a part of their volume.

Infiltration trenches are shallow excavations that are filled with uniformly crushed stone (similar to soak pits) to create underground reservoirs for stormwater runoff. The runoff gradually exfiltrates through the bottom of the trench into the subsoil and eventually into the water table. The walls and the top are lined with geotextile to avoid sediment penetration. Trench designs may be modified to include vegetative cover and other features, establishing a bio-filtration area. They are often constructed beside outdoor parking lots or beside streets. Treatment occurs during infiltration into the soil. However, there is a risk of clogging where sedimentation concentration in runoff is high.

Literature Review

Yannopoulos et al. There is a long history of the use of drainage systems as far back as the early third millennium B.C. The study of functional technological solutions to water transport problems therefore has a long history, having its roots in ancient time.[1]

Dake et al. The rapid urbanization and industrialization of recent years, along with significant changes in land use and land cover patterns, have caused contamination of hydrological systems.[2]

Luna B. Leopold et al. Notes that hydrologic response to urbanization is typically characterized by increasing flood peak magnitudes, decreasing lag time, and increasing runoff volumes. The hydrologic processes affected by urbanization are primarily infiltration and surface runoff Impervious surfaces associated with urbanization reduce infiltration and increase surface runoff, altering the pathways by which water (and any associated contaminants) reach urban streams. It alters natural hydrology, generally leading to more frequent, larger magnitude and shorter duration peak flows.[3]

Hollis et al. Suggested that small floods may increase 10 times by urbanization, and that floods with a return period of 100 years may be doubled in size by 30% impervious land cover.[4]

Roedel S. Tejero et al. Some waste comes from other sources, including illicit and or inappropriate entries to the storm drainage system. There is no treatment for waters from septic tanks entering the storm drainage system. In cities and large municipalities, septic tank system discharge to storm drainage system without treatment. Septic water is a source of micro pollution and toxic substances that are harmful to humans, especially when the septic system fails. It is important to construct storm water drainage systems which will be effective to prevent toxic substances come in contact with humans or animals.[5]

Rodríguez et al. Sustainable urban drainage management is becoming increasingly important at an international level, in terms of the environmental improvement of urban spaces, the reduction of flooding (increasingly more serious and dangerous), the reduction of operating costs and the expansion of urban sanitation networks.

Recently, stormwater has been considered a resource instead of a waste. Through the use of different system like infiltration trenches, storm water can be used to recharge underground waters. Hence it is now referred to as storm water management.[6]

Storm water management

Von M. P.Wanielista et al. Stormwater management is knowledge used to understand, control, and utilize waters in their different forms within the hydrologic cycle.[7]

It can be applied in rural areas, but is essential in urban areas where run-off cannot infiltrate because the surfaces are impermeable. Traditional stormwater management was mainly to drain high peak flows away. Unfortunately, this only dislocates high water loads.

Modern approaches aim to rebuild the natural water cycle, i.e., to store runoff water for a certain time, to recharge ground water and to use the collected water for irrigation or household supply. Costs depend on technology and the size of the systems.

Urban drainage systems are designed to collect and convey storm water to areas where it can be collected without causing any damage or nuisance. Other objectives related to stormwater management are also considered. These include protecting the environment and reducing the impacts of urbanization on water quality.

Total management of stormwater includes collection and disposal of storm water, as well as its reduction and elimination of its various components. These objectives are often achieved by reduction of greenhouse gas emissions, water conservation, and the utilization of storm water

Tchobanoglous et al. The available choices for handling the quantity and quality aspects of stormwater will be different depending on if the actual sewer system is of combined or separate type. The storm drainage system operates to some degree as a combined sewer system, because it is used to transport both domestic sewage and storm water. It may be that the sanitary sewerage system is not capable of handling the load that would impose on it if a complete sewer separation program were undertaken.[8]

Larry W. et al Stormwater management plans are most successful when they are implemented at the start of development in an area and should be administered as part of a land-use planning process. The implementation of a stormwater management plan, in a remedial mode, to correct stream deterioration resulting from previous uncontrolled development is a much more difficult task.[9]

The decision to build an efficiently working storm drainage system is dependent on the school's decision on how much money it wants to allocate to the drainage system.

(*STORMWATER COLLECTION SYSTEMS DESIGN HANDBOOK*, n.d.) Having the necessary information in place will help you design a system that's designed to handle the volume of water that flows in and out of your area.[9]

Storm drainage

Selvarajah P. et al. Runoff from a catchment is that fraction of precipitation which generates surface flow. It thus represents the output from the catchment corresponding to precipitation in a given unit of time. For a given precipitation, initial losses due to the interception, evapo-transpiration, infiltration and detention storage requirements have to be first satisfied before commencement of runoff. After these losses are met, the excess rainfall moves over the surface termed as storm runoff

The storm runoff has to be properly directed to the outlet of the property. Use of different types of impervious channels increases the efficiency of storm drainage. Drainage should take the use of gravity flow that's why proper study of the topography of the area is a must.[10]

Study Area

Geographically, the study area (CT UNIVERSITY) is located on the central region of Punjab State, India, between latitudes 30.8191° N, 75.5561° E and longitudes 30.8191° N, 75.5561° E. It is a flat surface with low slopes and sandy, clay soil The total area is approximately. 184,353.31 m² of which 72% is pervious and 28% impervious. The impervious area can be classified as roofs, roads and sidewalks, the pervious classified as sports area and unpaved roads. The climate is warm and temperate in Ludhiana. When compared with winter, the summers have much more rainfall. The climate here is classified as Cwa by the Köppen-Geiger system. The average annual temperature is 23.5 °C | 74.4 °F in Ludhiana. In a year, the rainfall is 876 mm | 34.5 inches. CT university is serviced by a storm drainage network but still suffers from flooding during the rainy season.

Figure 1: Topography of CT University

Research Methodology and Procedures.

Survey Work

The first operation to be carried out in any engineering work is site visit which is termed as reconnaissance, this is done to know the situation on the ground and knows the avenue of approach for the design. After reconnaissance, a topographical survey of the site was carried out inside CT University campus so that we could identify the problems facing the drainage systems or the wells of the University.

Research Method.

This study used descriptive method. It is a fact-finding strategy, with adequate and accurate interpretation of the findings, using questionnaires and documentary analysis in data gathering. It describes what actually exist such as current conditions practices situations, or any phenomena.

Since this study is concerned with the storm water management in CT University, the appropriate method of research used was survey work.

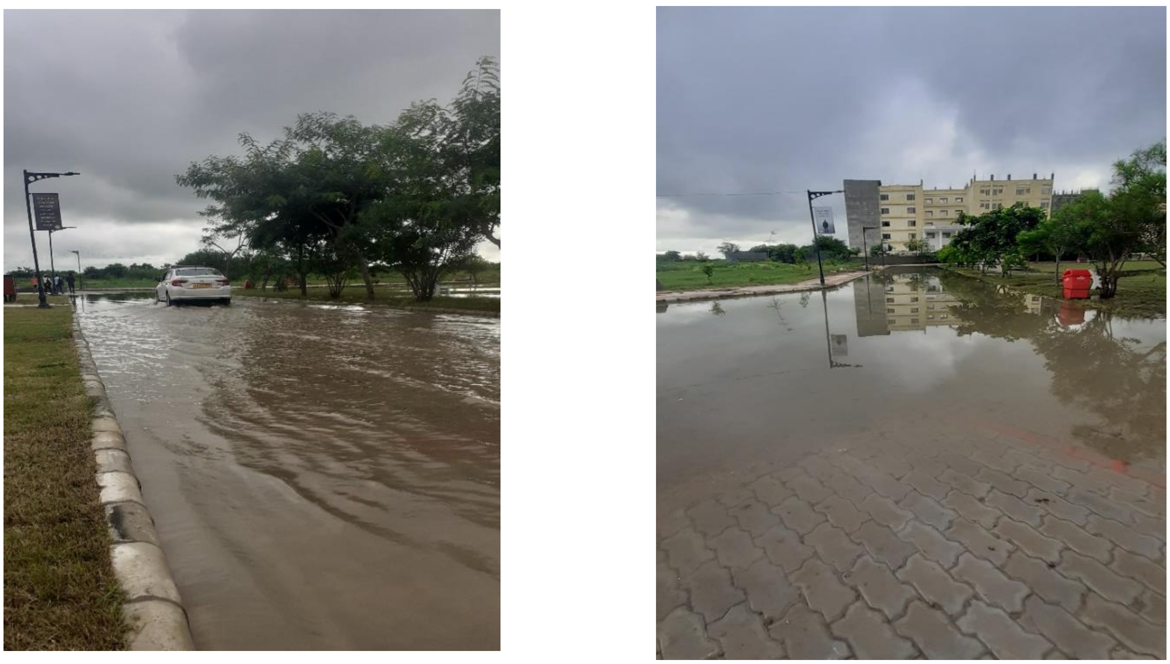

Figure 1: Flood Condition at CT university During Rainy Session.

Figure 2: Under ground water seepage borewell pits.

Results and Discussion

At CT University, there is a provision of five infiltration trenches situated at different locations with different landscapes around the school.

Infiltration trenches transmit surface water to underground and is deeper than its width at the surface. It is lined with concrete perforated casting pipe and can be filled with coarse aggregate or empty.

A proper drainage system has 3 major phases the collection, the conduction and the discharge. Beside an infiltration trench is a sedimentation chamber where the silt is collected from the water.

Based on the survey that taken on the basis of the functioning of the five trenches, the following where results obtained.

1st Pit

- Located behind D-Block of CT University.
- It contains two perforated pipes inside it, covered with a mesh like material acting as filter. One pipe is completely not working and other is blocked
- The silt collector is blocked with a lot of silt
- Entire pit is not working due to blockage

2nd Pit

- Located at Girls hostel of CT University.
- It contains one perforated pipe inside it covered with a mesh like material and both are working well.
- Beside it is a silt collector, properly functioning.
- Inside the pit are aggregates.
- Entire pit functioning properly.

3rd Pit

- Located in front of faculty residence of CT University.
- It contains two perforated pipes inside it covered with a mesh like material. Both pipes are blocked.
- The silt collector beside is blocked.
- No aggregates inside it.
- The pit is not functioning to its fullest capacity due to the blockage.

4th Pit

- Located behind Boys hostel.
- Has two perforated pipes inside it covered with a mesh like material and both working well.
- Contains aggregates Inside it.
- Entire pit functioning properly.
- It only collects the water from the upper side of the road.

5th Pit

- Located beside block E of CT University
- Has two perforated pipes inside it covered with a mesh like material working very well.
- Beside it is a silt collector working very well
- Entire pit working very well.

There is a big depression at the faculty's residence and the boy's hostel, because of the wells not fully functioning the depression collects a lot of water and hence leads to flooding.

Conclusions

- Regular checkup and maintenance should be put in place.
- Use of aggregates should be employed in all pits.
- Most of the mesh which helps in infiltration of the water is blocked, changing the mesh would help in the efficiency of the of the drainage system.
- 4^{th} pit is not used to its maximum, construction of drainage lines to the well is needed to help in drainage of water
- Levelling up of the road to decrease the depression levels around the boy's hostel and the faculty's residence.
- Construction of a system that will transport some of the storm water to the waste water management plant for its reuse.

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