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Storm Water Drain Network system in Bengaluru

Ranganathan.B.A,

Associate professor ,Department of civil Engineering
New Horizon college of Engineering, outer ring road, Marathalli, Bengaluru 560103

Abstract - Most of the cities in India are undergoing rapid development in recent decades, and many rural localities are undergoing transformation to urban hotspots. These developments have associated land use/land cover (LULC) change that affects runoff response from catchments, which is often evident in the form of increase in runoff peaks, volume and velocity in drain network. Often most of the existing storm water drains are in dilapidated stage owing to improper maintenance or inadequate design. However, fact the parameters have certainty due to natural and/or inherent randomness. There is special need for re-designing a storm water drain network that can effectively convey the discharge. The present case study evaluates performance of an existing drainage network in Bangalore, India, through reliability analysis by Advance First Order Second Moment (AFOSM) method. In fact parameters that are considered are roughness coefficient, gradient and conduit dimensions. The efficiency of the existing system is evaluated considering 3 failure modes. The 1st failure mode considered when the runoff exceeds capacity of the storm water drain, the 2nd failure mode occurs when the flow velocity in the storm water drain exceeds the maximum velocity for erosion control, and the 3rd failure mode occurs when the minimum flow velocity is less than the allowable velocity for deposition control. For runoff generated from catchments of the area and flow velocity in rain water drains are calculated using Storm Water Management Model (SWMM). If the values are low under the 3 failure modes, then redesign as to be done. Keywords: AFOSM, LULC , SWMM.

1. INTRODUCTION

The study further shows that there is a chance of flooding if the probability of storm event exceeds the estimated limit of 50% (or lower) in any year.

In our country in the early 20th century: lesser houses, scattered roads and very few commercial hotspots here and there. In less than a century, things have changed at an unprecedented rate -- and are still changing. To accommodate this increase in anthropogenic requirements, a lot of rural landscapes are becoming ropland, or a tiles of buildings.

Development that leads to changes in the land cover and land use patterns of a given area. Land use refers to the purpose or the utilization of the land by the people and land cover refers to the habitat type at a given area: forests, wetlands or urban area, for an example.

The urban revolution is leading to many consequences on the landscape itself. One such major change in the manipulation of the storm water drainage system. The rainwater follows a pathway in the form of streams, reaches the rivers and eventually the sea. This path is, however, naturally determined by the elevation of the land, sloping pattern, substrate type, dimensions of the conduit and other factors. Alteration of land usage and land cover results in manipulations of these natural drainage systems that aid in water reaching the sea.

For examining this network, the duo gathered data on daily and sub-daily rainfall of different seasons for more than 20 years, and collected information on the substrate type and land use and land cover for the year 2006. The Storm Water Management Model (SWMM) to estimate quantity and velocity of flow in drains. These estimates together with drain width, depth, slope and roughness related parameters were analyzed to assess the current drainage network.

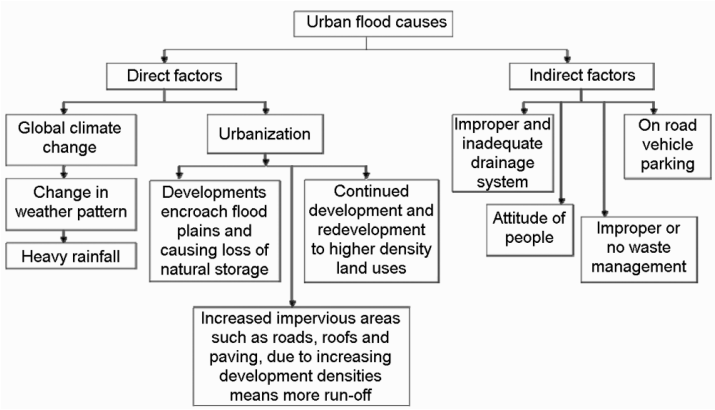
The team has opted a for AFOSM (Advanced First Order Second Moment Method), for considering 3 modes of failure that could occur to a drainage network. If velocity of flow exceeds a particular threshold, it could lead to erosion in drain; on the other hand, if the velocity of flow is lower than the minimum requirement it could cause silt deposition in drain, which would alter capacity of drains. The analysis carried out by the team in all the 34 sub-watersheds has revealed that most of the drains are prone to all the 3 modes of failure. They have found out that flow in most of the drains could exceed their design capacity even when the drains receive flow from rare (extreme) storm events with a return period of 2years.

Redesigning the storm water drainage system by considering the failure modes will help in good management of the storm water, thus reducing the flooding in the area. In order to control erosion and depositions in drains due to runoff and to re- design the capacity of drains, these analyses also recommend considering changes to width, slope and substrate of drains for further analysis in designing the water drainage system.

Local youth can work towards prevention of encroachment of lakes bunds, and proper maintaining of drains by ensuring that they are free from clogging waste materials .

2. Materials and Methods

Root causes of urban floods in India



The first and fore most is the unplanned urbanization has drastically made the altering of the drainage systems. The main characteristics of natural nalls or drainage system, by increasing the volume and rate of surface runoff in huge quantity.

Drainage systems have failed due to the increase

Volume of water , disposal of solid wastes and other waste into drainage. Disasters have events of environmental extremes which are inevitable entities of this living world, and linked to every component of the ecosystem. Urban flooding has been declared as a 'disaster' only after the Mumbai flood in 2005. The interaction of flood causes in urban indicates significance of urban ecology in disaster risk reduction.

The data's have been collected and interpreted in the context of flood risks and urban management. It shows wider issues and many lessons for flood challenges in our country cities and towns.

Bengalure mean annual rainfall is about 880 mm with about 60 wet rainy days a year. Bengalure is known as the 'IT hub' of India due to the presence of several software companies. Bengalure is the 5th largest city of India with population of about 8.52 million and 6.2million vehicle, located around 130 km from the Caveri River. There has been a growth of nearly 150% in urban areas of Greater Bangalore across 37 years (1973–2015). Encroachment of green lands, flood plains, etc. is causing obstruction to floodwater and loss of natural flood storage in Bengalure.

The Bengalure water supply & Sewage Board has installed capacity of the wastewater treatment system (450 MLD) as against the estimated generation of domestic water (700 MLD) is evident.

Bengalure has been identified 134 flood-prone areas (Table 1). The City Corporation has identified these areas after a survey of critical locations which are prone to recurrent flooding. However, some areas in the city face the brunt of the rains more than the others and are more prone to flooding.

Table-1

Top five flood-prone areas identified in Bengalure city

Ejipura/Koramangala :	National Games Village area
BTM Layout :	I and II stage area
Shankarappa Garden :	Magadi Road area
Brindavan Nagar:	Mathikere area
Ambedkar College :	Airport road area

In the year 2005, flooding was worst by unauthorized developments took place around & along lakes. The drainage path was choked and led to residential areas, and traffic was severely affected.

Thousands of Bangalureouns were stranded on the waterlogged roads. School and colleges were declared holidays and several residential apartment complexes were flooded with Water, water also entered office buildings, including India's third largest software exporter, WIPRO.

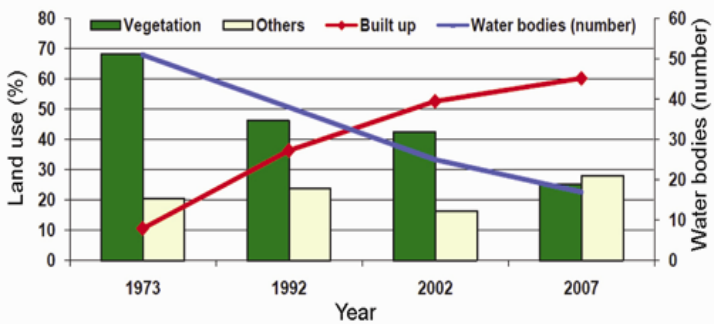
The flood created hundreds of families homeless and various health problems and environmental challenges. Built-up area (16% in 2000) has now increased to 23–24% in the metropolitan area There are 542 slums located in the jurisdiction of Karnataka Slum Clearance Board (218) and Greater Bangalore City Corporation (324), out of which 310 are undeclared settlements.

As per record (Table 2) decline of wetlands from 51 in 1973 (321 ha) to merely 17 (87 ha)

in 2007. The number of water bodies reduced from 159 to 93.Most of the lakes in the city have been covered with urban infrastructure. As a result, in the heart of the city only 17 good lakes exist as against 51 healthy lakes in 1985.

Bengalure city has nearly 180 km long primary and secondary storm-water drainage system, which often fails to take the load of the rains due to silt and block by garbage. An amount Rs 45 million was been made for the flood-management fund with 12 squads on call, of which six are rain and flood relief squads; 20 personnel have been assigned in each squad. The Jawaharlal Nehru Urban Renewal Mission (JNURM) project was launched in December 2005 and Bengalure has been allocated a budget for the next six years

3. Result



Slums and high-density poor settlements

Loss of water bodies

Bangalore city			Greater Bangalore	
Year	No. of water bodies	Area (ha)	No. of water bodies	Area (ha)
SOI	58	406	207	2342
1973	51	321	159	2003
1992	38	207	147	1582
2002	25	135	107	1083
2007	17	87	93	918

SOI, Survey of India, topographic maps (published in 1973);

DISCUSSIONS AND CONCLUSIONS

Urban flooding is significantly different from flooding in rural areas as urbanization results in impermeable catchments causing flood peaks by up to 3 times
flooding occurs quickly due to faster flow rate
(in a matter of minutes). As a result to discuss the
growing flood menace
The flood of 2005 was a disaster as it receded only after 7weeks and affected 20 million people.
It destroyed more than 14,000 homes, and damaged more than 350,000; about 200,000 people had to stay in relief camps. The agricultural sector was heavily hit as 20,000 ha of farmland lost the topsoil and 550,000 ha of crop was damaged. Unprecedented
rainfall in one day was certainly one major
cause of the floods;
The dam-water release or failure, inadequate drainage systems,blockade, housing in floodplains and natural drainage or riverbed and loss of natural flood-storages sites.
It demonstrated on how unplanned, rapid urban development has stretched the natural ecosystems in and around a city to its limits, and made disaster from natural flood

Flood impacts and risk assessment
Given the high spatial concentration of people and values
In the cities, even small-scale floods may lead to considerable damage.
In extreme cases urban floods can result in disasters that set back urban development by years or
even decades. Velocity is also a major factor in determining

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BIOGRAPHIES

Prof. Ranganathan.B.A.
Associate Professor –Dept of civil Engg
(Former Site –Manager-BEC-Oman, Chief-Manager –Federal Moghal Ltd, Head-ECC-Cipla Ltd)