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URBAN FLOODING – CASE STUDY OF HYDERABAD

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Abstract

Urban flooding is significantly different from rural flooding as urbanisation leads to developed catchments which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times, sometimes in a matter of minutes. Urban areas are centers of economic activities with vital infrastructure which needs to be protected 24x7.The basic philosophy of urban drainage systems, or "storm water management", for re-directing water flow has been to seek maximum convenience at an individual site by the most rapid possible elimination of excess surface water after a rainfall. In other words, "get that water out of here NOW" has been the overlying philosophy of creating drainage systems in urban areas. A Holistic approach for storm water management is necessary for its sustainability.

1.0 Introduction

Increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. Urban floods will happen in a relatively short period of time and can inundate an area with several feet of water. Although volume of water to be handled is not as severe as a flash flood of a river system the property damages and indirect financial losses are significant as surface water runoff is controlled and managed by humans in a concrete world as this flooding occurs in highly populated areas.

As the Environment Agency sustainable development Unit said in June 2001: "Major floods that have only happened before say, every 100 years on average, may now start to happen every 10 or 20 years. The flood season may become longer and there will be flooding in places where there has never been any before"[1].

Urban flooding is significantly different from rural flooding as urbanisation leads to developed catchments which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times, sometimes in a matter of minutes. Urban areas are centers of economic activities with vital infrastructure which needs to be protected 24x7.

In urban areas, water must follow the prescribed pathways set forth by large water systems that direct water where to flow. According to FEMA, the basic philosophy of urban drainage systems, or "storm water management", for re-directing water flow has been to seek maximum convenience at an individual site by the most rapid possible elimination of excess surface water after a rainfall and the containment and disposal of that water as quickly as possible through a closed/ Open conveyance system. In other words, "get that water out of here NOW" has been the overlying philosophy of creating drainage systems in urban areas[2].

2.0 Urbanization in India

In 2001, there were about 286 million people residing in urban areas in the country accounting for about 27.8 % of the total population. Urban population is projected to be around 433 million by 2021. There is a marked impact of globalisation on urban growth, which is increasingly concentrated in and around urban areas, large and small. The trend of urbanisation in India is shown in Table 1.2.

Table 1.1: Trend of Urbanization in India

S.No	Details	Year			
		1991	2001	2011	2021#
1	No. of Urban Agglomerations, Cities & Towns	3768	5161	7935	10000
2	Urban Population (in million)	216.61	285.35	377.1	433
3	Percentage of total population	25.71	27.8	31.16	32.3

 # Projected

3.0 Hyderabad Flooding – A Case Study

The city of Hyderabad was founded by Mohammed Quli Qutub Shah on the southern bank of Musi River in 1591. Hyderabad is situated in the Deccan plateau, at an elevation of 536 meters above sea level. The city lies between 17.366°

N latitude and 78.476° E longitude. The landscape of the city is dominated by hills, tanks, forests and rock formations. Soil type is mainly red sandy interspersed with areas of black cotton soil.

It has been seen from the records of rainfall from the District Planning Office of the Hyderabad District, the months of July, August and September are generally heavy rain months. The total rain in these months works out to 490.2 mm for normal rain fall. Hyderabad city gets annual average rainfall nearly 787mms. Out of this, nearly 75% is from South west Monsoon and rest of the rainfall from North East monsoon. City gets nearly 590 mms of rain fall in June to September period. Due to its unique topography of many undulations, rain water flows to the low-lying areas rapidly resulting in inundation of many low lying areas very quickly.

Due to the above reasons several parts of the city experiences local floods mainly confined to the low lying areas in the built up areas and the fore shore areas of the tanks. This type of situation was not experienced in the past, possibly due to much less population as compared to the present level and also the fact that infrastructure and constructions were limited. Due to this situation the city experienced floods as a result of heavy rains in recent years.

3.1 Floods in Hyderabad

Musi River was the cause of frequent flood devastation of Hyderabad city. History Records that flood occurred eleven times in Hyderabad since 1572AD. The city had experienced 15.32 cms of rainfall on September 28, 1908. According to historians, 15,000 people were killed and over 80,000 were rendered homeless. As many as 600,000 people were affected by the river's fury

Year wise record of heavy rainfall events are given below:

- On August 1, 1954 recorded a rainfall was 190.5 mms
- In 1970 recorded rainfall was 140 mm.
- On 24th Aug 2000, recorded rainfall was 240mm, of rainfall in just 24 hours. Total rainfall in August was 469mm.This has been the worst calamity for the city in almost 50 years, with as many as 90 residential areas in the city under water (in some places under 10 to 15 feet) and many parts of the roads were washed away.
- In August 2001 recorded rainfall was 230.4mm.
- In August 2002 recorded rainfall was 179.4mm.
- In 2006 recorded rainfall was 218.7 mm.
- In August 2008, recorded rainfall was 220.7mms in 36 hours.

3.2 Flash floods in Hyderabad

City of Hyderabad experienced unprecedented flooding in August 2000 leading to massive property damages and some human loss. City of Hyderabad with a population of around 3.82 million (2001 Census) and spread over an area of 55sq.km had severe floods in September 1908; August 2000 and August 2008. Property losses and human lives lost along with extent of people affected in these floods is presented in table 2 below. The current water drainage capacity of Hyderabad is to handle 12 mm/hour rainfall. Clogged up drains, unauthorized encroachments of moosi river beds and development along river banks that block natural drains further reduce storm water drainage capacity of the urban areas.

Table 2 : Property and other losses[3]

Details	28/29 February 1908	23/24 August 2000	8/9/10 August 2008
Rainfall	430mm	240.5mm	237mm
Property Loss/Worth	80,000 homes	35,693 homes, 135 lakhs	Rs.49.2 Lakhs
Human Lives lost	1500	26	NIL
Population affected	6,00,000	2,00,000	1,50,000

3.3 Urbanisation of Hyderabad:

Hyderabad became the capital of the state of Andhra Pradesh in 1956 and experienced a large scale of migration from coastal areas, Rayalseema and other parts of Telangana region. Poverty was the main factor for this rural-urban migration because of the employment opportunities created by the rapid development that took place especially in the Ninety's. As per 2001 census, Hyderabad city is one of the fastest growing metropolitan cities with a decadal growth rate of 32%.After creation of Greater Hyderabad Municipal Corporation (GHMC), Hyderabad became the second largest in India, in terms of its' geographical area, with a spread of 7,000 sq. km.

This population shift resulted in enormous pressure for shelter and services fraying the infrastructure. Urban development plans could not cope with the population settlements which came up quickly wherever land was available. This haphazard growth had its consequential effect on the communities, whenever there is a heavy rain fall which caused inundation of the low lying areas due to the peculiar topography of the city and surrounding areas. The drainage system did not have the capacity to drain the runoff of the rains quick enough to prevent inundation. The common experience has been that the surplus rain water created major traffic jams inundated several areas of the built up area, and floods in some parts of the city resulting in damages to public and private property.

4.0 Factors causing Floods in Hyderabad:

4.1 Urbanisation and Pressure on Land

Not only in Hyderabad but in all Indian cities and towns, large habitations are coming up in low-lying areas, often encroaching over drainage channels. In some cases, houses are constructed even on top of nallahs and drains. Encroachment in the immediate upper catchments of hilly urban area has also caused serious flooding in the flood plains of cities surrounded by hills. Urbanisation in Hyderabad leads to increase in impervious areas which, in turn, significantly increased the rate of runoff, resulting in overwhelming of designed capacity of the stormwater drainage system. As a result of all these happenings, even small amounts of rainfall are generating urban flooding.

Flooding is largely caused by Meteorological factors (like cyclonic storms, monsoon rains), Hydrological factors (like Groundwater and soil moisture level prior to storm Natural surface infiltration rate, Presence of impervious cover, Channel cross-sectional shape and roughness) and Human factors like Land use changes (e.g. surface sealing due to urbanization, deforestation) increase runoff and sedimentation, Occupation of the flood plain and thereby obstructing flows, Inefficiency or non maintenance of infrastructure, Urban micro-climate may enforce precipitation events, Indiscriminate disposal of solid waste. In the case of Hyderabad frequent flooding is largely caused by human factors rather than meteorological and Hydrological factors.

5.0 Managing Urban Runoff

5.1 What Homeowners Can Do

To decrease quantity of runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks and roads instead of using a hose. They should also practice water conservation measures to extend the life of their septic systems.

5.2 Controlling Impacts from New Development

Developers and city planners should attempt to control the volume of runoff from new development by using low impact development, structural controls and pollution prevention strategies. Low impact development includes measures that conserve natural areas (particularly sensitive hydrologic areas like riparian buffers and infiltrable soils); reduce development impacts; and reduce site runoff rates by maximizing surface roughness, infiltration opportunities and flow paths.

5.3 Controlling Impacts from Existing Development

Controlling runoff from existing urban areas is often more costly than controlling runoff from new developments. Urban planners and others responsible for managing urban and suburban areas can first identify and implement source control opportunities. They should seek out priority reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities. Local governments are encouraged to take lead roles in public education efforts through public signage, storm drain marking and partnerships with citizen groups and businesses. Citizens can help volunteer to become involved in restoration efforts and mark storm drains with approved "don't dump" messages.

5.3.1 Engineering Level

- Separate drainage system must be constructed.
- In order to reduce the surface runoff, pervious pavements must be laid especially in areas where heavy traffic was not there especially in colony bye lanes etc
- Rainwater harvesting structures must be constructed wherever possible by GHMC rather than putting the responsibility on individuals

5.3.2 Policy Level

5.3.2.1 Mitigation Measures

Although not having a formal definition, flood mitigation[4] can be accepted as a variety of measures that alter the exposure of life and property to flooding. It reflects the holistic nature of those flood management measures that do not have structural nature.

Mitigating means planning, programming, setting policies, co-ordinating, facilitating, raising awareness, assisting and strengthening. It also understands educating, training, regulating, reporting, forecasting, warning and informing. However, it does not exclude insuring, assessing, financing, relieving and rehabilitating. If structural measures are the bones of a flood management program, then mitigation is its flesh.

Mitigation is a long-term and ongoing process, prior to the occurrence of a disaster that is directed at reducing future flood damages of the community and the nation. Technically speaking, there is no flood risk that cannot be mitigated through engineering measures, but cost is the determining factor. This process teaches people how to live rationally with floods. Mitigation measures, active and passive, rely on the experience and capacity of people where disaster occurs. Active measures encompass those activities, which require direct contact with people.

Mitigation measures are traditionally referred to as non-structural measures. Unified concept of urban flood management introduces flood recovery measures as a separate entity in order to emphasize the specifics of spreading the cost of compensation over time and among a large number of people exposed to similar risks.

The following measures may contribute to the reduce the effect of rains in the Hyderabad:

i. Installation of advanced Radar system like Doppler to give more accurate information. Setting up of automatic Rain Gauge Systems at every vulnerable area for issuing of timely warnings, whenever there is a heavy rainfall.
ii. Storm Water drains should not be clogged by solid waste matter. Solid waste removal from the roads and the residences to be organised by the GHMC in partnership with the Colony Welfare Committee. People in the colony should be educated about this aspect.
iii. Restoration and Desilting of Nalas to allow rain water from the higher areas and surrounding areas to flow into near by Lakes.
iv. Banning of all future construction activity near the waterlines
v. Officials of Revenue, Police and Fire and Emergency Services army be included in the flood control unit on as required basis.
vi. Tank areas should be identified and boundaries should be protected by wall or strong fence and GHMC should monitor regularly to prevent further encroachments and fix the responsibility of protection of the lakes to the concerned officers the area.
vii. Training programs should be organised for staff involved in operational and administrative measures to enable them to take actions as per the operating procedures.
viii. Sensitization programs should be organised for public representatives on the Flood related aspects.
ix. Damage assessment in the vulnerable areas to be consolidated and sufficient fund allocation be planned to ensure that proper repairs are executed after the floods. This will help in reducing the recurring expenditure for the same damages every year.
x. Activities undertaken by the government agencies for the floods should be documented and publicized in all forms of media.
xi. Public should be informed about town planning laws, water bodies and the regulatory measures in the various acts related to the environment and urban floods.

6.0 Conclusion

Urban storm water management may not be efficient unless it was handled in conjunctive manner. A multidimensional approach is necessary to solve this problem. For the present case some of the management options which has to be carried simultaneously to address the problem are:

- Risk mapping of the areas of the city should be done to assess the vulnerability, related to urban floods, using GIS Technology.
- Limit, reduce and/or mitigate for impervious surfaces throughout the watershed by Use of new engineering techniques like pervious pathways, pervious parking lots should be considered and implemented wherever possible to minimize the surface runoff.
- Conserve and protect areas for groundwater recharge. Utilize conjunctive management to enhance groundwater storage: in some instances, diversions of surface water for groundwater infiltration could enhance flood management by reducing peak flows.
- Promote groundwater recharge and pollutant attenuation by removing concrete flood-control channels and exposing the underlying native sediment.
- GHMC/HMWSSB should rethink its policy of charging amount for rainwater harvesting structures while according permission to plan. They should keep this as a check point for giving occupancy certificate.
- Town Planning department of GHMC should regularly monitor the prohibited areas to prevent encroachments.
- Public should be educated on the risks involved in illegal constructions on or along nalas and tank areas and they should be advised to vacate the vulnerable area. Government should consider relocation for the poor people in some other areas. If this does not work out then, the harsher decision of demolition of the structures must be given a serious thought.

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