Urban and Advance Flood Control Model for Mumbai City

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ABSTRACT

Our weather is changing rapidly and it is resulting more and more mega natural disasters like Giant Storms, Droughts, Floods etc.In the same way "Mumbai" the capital city of Indian state of Maharashtra, being a low laying and saucer area, gets flooded almost each and every year during rainy seasons and high tides. Being the financial capital of India Mumbai contributes huge losses to the nations economy, due to the closed downs during flooding.

The MCGM has carried out various projects to reduce the floods every year since the havoc caused in 2015, but all in vain. In this project we have tried to introduce new methods that can reduce the floods and impact caused by them.

IndexTerms*-Catchment, Drainage, Underground Wells, Tunnels,Balancing Tanks etc*

I INTRODUCTION

As per the BMC, Mumbai and the suburban areas received more than 70 mm rain in the just one hour on August 29. Flooding has been reported in the Sion, Dadar, Mumbai Central, Kurla, Andheri, Sakinaka areas.

Mumbai recorded **468** mm of rainfall in twelve hours, the highest in a day in August since 1997, according to data from the India Meteorological Department. Transport systems came to a virtual standstill with local trains in Mumbai stationary and various flights cancelled with almost all delayed. On Link Road, a building collapsed. The Maharashtra Government declared 30 August 2017 a holiday for all schools and colleges

What we have scenario about Mumbai is concern there are certain death happened during flood. So in this regard we have some statistics.

1.As of the morning of 30 August 2017, fourteen people have been confirmed killed

2. Flooding caused a building to collapse, killing at least 21 people

Floods resulting from a number of basic causes of which the most frequent are climatological in nature. The report of RashtriyaBarhAyog (RBA, 1980) lists various situations related to floods as follows:-

1. Streams carrying flows in excess of the carrying capacity within their banks, thus overflowing adjoining land,
2. Heavy rainfall synchronizing with their river spill,
3. Heavy local rainfall,
4. Backing up of waters in tributaries at their outfalls into the main river with or without synchronization of peak floods in them,
5. Typhoons and cyclones,
6. Ice jams or landslides blocking stream courses resulting in back water overflowing river banks,
7. Inadequate drainage to carry away surface water with the desired quickness.

Metrological Causes

Occurrence of heavy to excessive rainfall plays a critical role in distribution and occurrence of large floods. Flood climate regionalization of world by Hayden (1988) shows sub- continent of India has many pre-requisite hydro climatic conditions for large floods. Rivers are rain fed or get peak discharges.
Excessive rainfalls in monsoons are associated with following:-

1. Monsoon depressions and cyclone storms originating over Bay of Bengal and Arabian Sea.

2. Orographic lifting along mountain barriers;

3. Breaks in the monsoons. (Ramaswamy, 1987; Nandargi, 1996; Rakesha and Pisharoty, 1996)

Episodic high magnitude rainfall events are also associated with short period intense thunderstorms from the perspective of hydro meteorlogy , Ganga and Brahmaputra basins have highest potential for floods (Rakesha and Pisharoty, 1996). Although Western Ghats provide necessary orographic and hydrometeorlogical conditions for generation of high magnitude floods not as devastating and frequent as Extra-Peninsular India.

Geomorphic Causes

Floods have occurred due to failure of natural dams, landslides, surging glaciers block rivers causing floods. For example Indus, Shyok, Lihut, Sutlej, Bhagiratha, Alaknanda, Birehganga, Teesta and Subansiri (Khan, 1969; Starkel, 1972; Wadra, 1975; Moha, 1982, Sarma, 1992). Channel migration, meander growth and avulsion are also few causes (Dunne, 1988; Schumm, 1985).

Anthropogenic Causes

Construction of dams, barrages, embankments and other engineering works modify natural behavior of rivers. In last few years, anthropogenic process have wrought immense changes. Changes in land use, large scale deforestation in catchment areas and building activities in flood plains adversely affect riverinesystems.

Summary of Storm Water Drainage System

Sr.	Drain hierarchy / Type	Island City	Western Suburbs	Eastern Suburbs	Total
1.	Major Nallah (width>1.5m)	9	90	102	201
2.	Major Nallah (width<1.5m)	--	21	66	87
3.	Arch/Box Drains	59	40	52	151
4.	Roadside Open Drain	20	669	1298	1987
5.	Closed pipe or Dhapa Drain	443	36	86	565
6.	Total SWD length	531	857	1603	2991
7.	No. of Water Entrances	27893	609	1706	0208

Fatal Causes

The unprecedented rainfall in Mumbai resulted in a near complete inundation of the city as flood waters rose to engulf the first floor of most buildings. The population exposed to this natural disaster was about 13 million, with a density of about 28,000 persons per squarekilometer. Both flash flooding and river flooding contributed to the damage. Drainage infrastructure was incapable of accommodating the volume of runoff water resulting in failure of the sanitary sewer system. The Mithi and other rivers overflowed as discharge exceeded capacity. The resulting floods cut off rail and road systems. Residents reported having to spend the night stranded in cars or wading home through
the high water. More than 100,000 residential and commercial buildings reported damage, along with 30,000 vehicles (Gupta, 2007).

The flood produced an estimated $1 billion (US) in damage. The business economy was especially hard hit; the airport was closed for two days, trading on the stock exchange was suspended for a day, and many areas of the city remained flooded and were without power for more than a week. Slum dwellers were especially hard hit as poor drainage and infrastructure hindered receding water. Residents were left with no choice but to live in their flooded dwellings. Areas reported no clean drinking water for up to a week after the flood (Anonymous, 2005; Kewalramani, 2006).

The floods impacted the health of the Mumbai population in several ways. Total deaths in the city were over 400 with over 3000 serious illnesses also reported. Drowning was the number one cause of death followed by landslides and stampedes due to false rumors of an approaching tsunami. Three years after the disaster a complete accounting of the victims remains problematic (IANS, 2008). The lack of clean drinking water led to outbreaks of diseases such as hepatitis, fever, conjunctivitis, gastrointestinal illness, and nose and throat infections. Increased cases of malaria and leptospirosis (contacted by wading through water infected by animal waste) were also reported (Government of Maharashtra, 2005).

Bhagat*et al*. (2006) examined the flood from an urban planning perspective and concluded that land-use decisions and a lack of coordinated planning were responsible for the flooding. Of the six major natural drainage systems of the area, four of them are over 40 percent built up. The rivers themselves are often clogged with garbage due to inadequate waste management. Open gutters in the suburban area of Mumbai carry both storm water and sewage. After the flood these became slow-draining cesspools which contributed to the disease outbreak. Government agencies with
legislatively mandated responsibilities share planning authority but lack effective coordination. Thus India's most populous city has no integrated urban planning system and agencies are free to blame other agencies after a disaster.

Victims

Mumbai faced heavyrains on 26thand 27th July 2005. On 26thJuly, 2005, in theafternoon after 14.00 p.m. the Mumbai Suburban Area and the entire M.M.R.D.A. Regionwasstruckwith a heavy storm. Indian Meteorological Department (IMD), Santacruzhad recorded a 944 mm. of rain for the 24 hoursended at 8.30 hours on 27thJuly.This resulted in the flooding of many parts of the

Mumbai City and Suburbs. RoadsAnd railway lines at many places were under water for more than 24 hours. The railand road traffic came to a halt. The airport was also closed on account of waterlogging andclimaticreasons.People at large were caught off guard. They werestranded for many hours.

In Mumbai 26th and 27th July 2005

- Total Rainfall in 24 Hours 944mm
- Human Deaths 914
- Cattle Deaths about 20000
- Houses damaged 250000
- Small vehicles damaged 20000
- BEST Bus damaged 2500
- Trains damaged 25%
- Road, railways and airports submerged-transportationcame to a comegrinding halt.
- Millions stranded and many had to wade through neck deep water.
- Landslides claimed several lives and electricity supply was cut off.
- Total estimated loss Rs. 450,00,00,000/-

II METHODOLOGY

Why Mumbai?

Mumbai as mentioned before is the financial capital of India, these floods cause huge heavy damages to Indian economy along with these they also cause a huge loss of life property and cattle, giving rise to diseases and emotional disturbances for those who survived. A huge amount of money is to be invested for the recovery of the havoc caused by the floods.Further we will be studying about the reasons for flooding, the effects and the solutions there on.

Factors Affecting The Quantity Of Stormwater

The surface run-off resulting after precipitation contributes to the stormwater. The quantity of stormwater reaching to the sewers or drains is very large as compared with sanitary sewage. The factors affecting the quantity of stormwater flow are as below:-

I. Area of the catchment

II. Slope and shape of the catchment area

III. Porosity of the soil

IV. Obstruction in the flow of water as trees, fields, gardens, etc.

V. Initial state of catchment area with respect to wetness.

VI. Intensity and duration of rainfall

VII. Atmospheric temperature and humidity

VIII. Number and size of ditches present in the area

To Decide Reduced Level

To find out saucer area at which maximum damage due to flood estimated.by this data we are designing the number of wells as per requirement.by using ELEVATION software.

Area Calculation

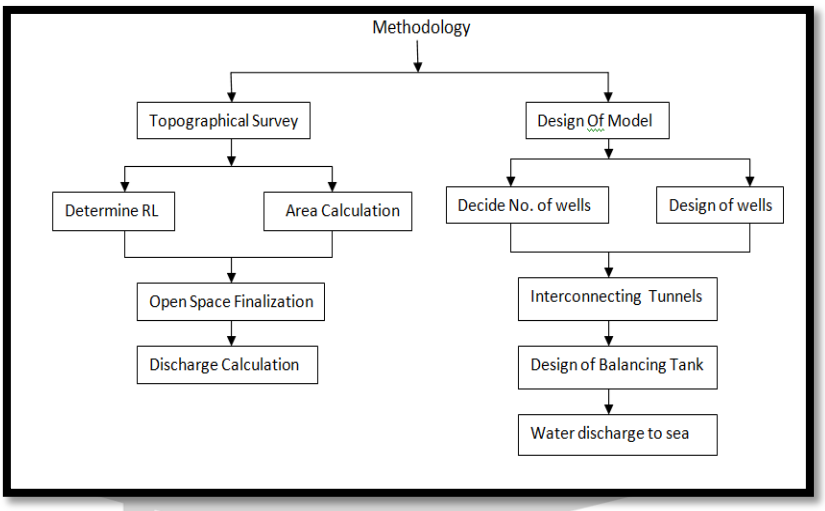
By using Departmental Topographical Map and GIS,GPS Software we are calculate required area.

Measurement of Rainfall

The rainfall intensity could be measured by using rain gauges and recording the amount of rain falling in unit time. The rainfall intensity is usually expressed as mm/hour or cm/hour. The rain gauges used can be manual recording type or automatic recording rain gauges.

Methods for Estimation of Quantity of Storm Water

- Rational Method
- Empirical formulae method



Advantages

- Disaster Management due to heavy rainfall
- Flood free Mumbai
- Protection of Assets
- To create the flood free city.
- To avoid damage to human life and private properties.
- To ensure smooth working of city.
- Requirements of infrastructure of smart city.

Precautions

1. Always keep the surrounding of tank clean .
2. To clean and maintenance of the wells before the monsoon rains.
3. To check and Maintain the screeners.
4. Regular cleaning of drainage system.
5. To check the proper functioning of control room.
6. Timely Maintenance

III COST ESTIMATION

Tokiyo	**Colaba (Mumbai)**
• Installation cost -10000 cr • Collected water- $72x10^8$ lit • Cost per lit – 100000000000/ $72x10^8$ = 13.88 rs per lit Say 27.76 rs per lit	• Water to be collected – 68740000 lit 68740000*3 =206220000 lit • =206220000 *27.76 • 572.47 Cr

III. Result & Discussion

Q = 68740000 Lit/day
Volume = 68740 m3 per day
No. of circular tanks =4
Capacity of each tank =17185

Depth = 20m
Area =17185/20= 859.25 m2
Area = 859.25 m2
859.25= π*D2 /4
D=33m

Cost-

The cost of tank varies according to capacity of tank for both circular and rectangular structure varies from place to place. It ranges from 150 -160 Cr with connection for each tank .and addional cost is requird for balancing tank according to requirement.

IV CONCLUSION

There has been an increase in the population and urbanization of the region in the past few decades. There has been a tremendous pressure on the available land for housing , industries and commercial purposes. There is a huge population that lives in the slums which is a natural outcome of high land prices ,unaffordability of legal houses built in conformity with existing building codes and building byelaws .

REFERENCES

[1] Asian Development Bank: Investing in resilience: Ensuring a disaster-resistant future, Mandaluyong City, Philippines, available at: www.adb.org, last access: 16 October 2013.
[2] Efron, B.: Bootstrap Methods: Another Look at the Jackknife, Ann. Stat., 7, 1–26, 1979.
[3] Escuder-Bueno, I., Castillo-Rodríguez, J. T., Zechner, S., Jöbstl, C., Perales-Momparler, S., and Petaccia, G.: A quantitative flood risk analysis methodology for urban areas with integration of social research data, Nat. Hazards Earth Syst. Sci., 12, 2843–2863, doi:10.5194/nhess-12-2843-2012, 2012.
[4] FEMA: HAZUS: Multi-hazard loss estimation model methodology, Washington DC, 2003.

