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Sustainable Underground Water Drainage System for Mumbai City

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Abstract: **Mumbai being the financial capital of India suffers the extreme flood event every year, which leads to huge loss of life, property, plants & animals. Hence, it is very essential to control floods in Mumbai city. On July 26, 2005 Mumbai experienced unprecedented flooding with record rainfall of 944 mm causing direct economic damages estimated at almost144, 980 Cr and 500 fatalities. It caused the worst havoc in decades. The existing under-ground drainage system which is built in British era is capable of handling only 25 mm rainfall. The .It is necessary to study and propose solution to the problem. Project work on sustainable underground drainage system is undertaken. There is need to control floods in small region of the particular area of the Mumbai region which experienced the highest flood impact.**

A smaller area of 1 km is taken into consideration i.e (from Parel to Hindmata). Further identification of flood prone area is done using Quantam GIS. With the help of flood prone area and using Hazen-Willians formula the calculation are done. Three silos of concrete at 1 km stretch of 10m diameter, 5m height and pipe of 0.5m diameter are suggested. The stored water in silos can be treated and conveyed to the water scarcity area in Mumbai.

Index Terms*: *Flood management, sustainable development, planning, under ground drainage system.

I. INTRODUCTION

Flood is one of the most significant disaster in the world. More than half of global flood damages occur in Asia. Causes of extreme floods are due to natural factors such as heavy rainfall, high tides etc, & human factors such as blocking of channels or aggravation of drainage channels, improper land use, deforestation in head water regions etc. Flood results in losses of life & damages to properties. Managing risks from extreme events is a crucial component of flood management. Good planning &management can help in curbing the risk of flooding.

In Mumbai there are four rivers but, Mithi river is crucial for storm water drainage as it separates the main city from its outskirts. However, over the years, land encroachment along the banks of the rivers have disrupted its course, while untreated sewage, wastewater, industrial effluents, and garbage have clogged the river. Shockingly, the storm water drainage system in Mumbai was built during the British rule. At present, the drainage system is capable of handling 25 mm rain. Roads get flooded Heavy rains stopped everything in Mumbai, leading to the death of many people and leaving thousands of commuters stranded across the city as transportation services failed to serve. Even the. In several parts of the city, waist-high water was seen and it also entered in thousands of home. The maximum city received 316 mm rain, which was the heaviest since July 26, 2005, record of 944 mm rain. The rains in 2005 is caused the worst havoc in decades in the business capital of the country.

The reasons for flooding are-i) extensive reclamation & faulty zoning regulations, ii) faltering drainage systems, iii) natural drain: Mithi river, iv) incapable storm water drains, v) reduction in the catchment area of Mithi river, vi) change in path of the Mithi River due to Airport runway, vii) construction of Bandra-Worli sea linkon the mouth of mithi river, viii) Maintenance of drains, ix)link between storm water drains & Sewerage network etc. Hence, there is need to study and provide an effective sustainable and long lasting under drainage system for Mumbai city.[1]

The objectives of work
1. To assess the flooded area in Mumbai city by using Q-GIS tool.
2. To Design the underground drainage system for Hindamata to Parel.

II. METHODOLOGY

The proposed study consisting of the assessment of flood in Mumbai, identification of flood prone areas in Mumbai including two visits. From the suggested measures worked on provision of Underground Drainage system for flooded area and analysis of floods and design of underground system using Q-GIS tool.

Assessment of flood in Mumbai

Assessment of flood is done through the two site visit to Mumbai city.

Identification of flood prone areas in mumbai (Hindamata to Parel)

From the assessment of Various floods areas in Mumbai such as Mumbai central, Hindamata ,Dadar TT, King Circle, Juhu, Tara Road, SV road, Parel, Santacruz etc. From, these Identify the Maximum flood prone areas parel and Hindmata. The reason for selecting Parel and Hindmata as the maximum flood prone area. On the basis of low lying area. Due to low lying area the water from higher elevation get enter into these region and maximum flood occurs. For these areas suggested a underground drainage system as shown in fig.*1*

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Fig1: Study area showing Hindmata to Parel, Mumbai (source: google)

III. RESULT AND DICUSSION

From previous chapter it is cleared about the existing drainage system of Mumbai from the storm water department report and also explains about the area selection from visit report. To find flood prone area there is need to use QGIS software is cleared from visit report. By using, Hazen-Williams formula, overall dimension of interconnecting silos and pipes is obtained. Analysis of flood prone area is done using Q-GIS.

Below figure.2 shows the measured flood prone area using QGIS tool. The flood prone area shown in the figure is from Hindamata to Parel which measures area $6.539X10^4 m^2$

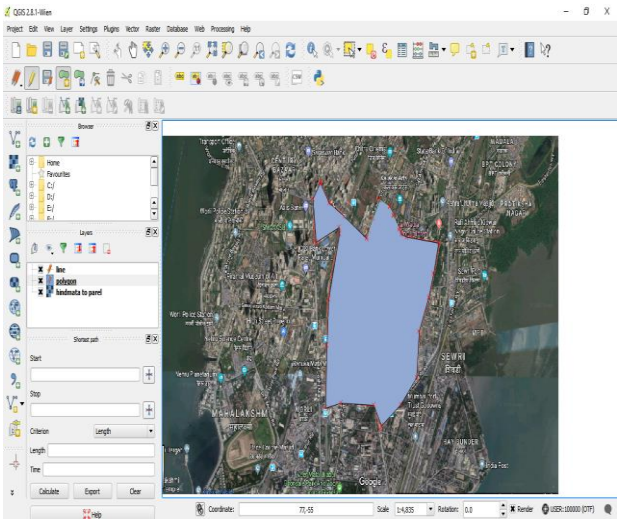

Fig 2 flood prone study area (source: Q-GIS software)

After finding out flood prone area (Hindamata to Parel) by using QGIS further work of designing underground silos and interconnecting pipe is done using Hazen Williiams formula.

DATA

1. Average annual Rainfall- 2400mm
2. Flood prone area- 6.539×10^4 m^2

Design of pipe,

Now, By using Darcy law,

Q=K.I.A

Where,

Q = Total annual rainfall in m^3

K = Coefficient of runoff = 1 ……For urban area

(source - BRIMSTOWARD)

A=Area in m^2

I=Average annual rainfall

$Q = K.I.A$

$= 1 \times 2400 \times 10^{-3} \times 6.593 \times 10^4$

$= 158232 m^3/year$

$= 18.06 m^3/hr$

$Q = AV$

For calculating velocity using Hazen -Williams Formula,

$$V = 0.85 \times C \times R^{0.63} \times S^{0.54}$$

(source google)

Where, C = Coefficient of roughness=140……..for concrete

R= Hydraulic radius

S= Slope

$$18.06 = \pi/4 \times D^2 \times 0.85 \times C \times R^{0.63} \times S^{0.54}$$

D = 0.5 m

Design of silos,

Provision of 3 silos in 1 km length at a distance of 500m

D = 10 m H = 5 m

Results for underground silos and interconnecting pipes are mentioned further.

IV. CONCLUSION

After studying the literature review and methodology and looking over the topographical condition of Mumbai we are planning to suggest a solution of Underground drainage system.

To provide underground drainage system consisting of 3 silos at 500m distance for a stretch of 1km silos of 10m diameter, 5m height and interconnecting pipe of 0.5m.

This stored flood water from silos can be treated and convey to the water scarcity area in Mumbai. Example Juhu (low pressure area).

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