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Fender: An Innovative Approach to Store Surplus Runoff

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***Abstract*: In this project we have introduced a floating fenders like structure which will act as an artificial lagoon. Quantitative analysis of accumulating runoff pattern is analyzed by using suitable GIS software. This is feasible to store surplus runoff in fenders which will be installed along the costal periphery of Mumbai suburbs. It will also help to reduce the flood and water logging. This stored surplus water can be exported to middle east countries in future and will be very useful in the financial growth of our country.**

***Keywords*: Arc GIS, flow accumulation, Pneumatic fenders, Rainfall intensity, Topography.**

1. Introduction

India is a peninsular country. Many states in India lies along the coastal boundary. Out of which Mumbai is a major city of Maharashtra state and financial capital of India located on the coast of Arabian Sea. Because of having low lying area it gets flooded almost each and every year. Due to which it suffers from huge damages to the property of government as well as private. The heaviest of them was seen on 26th of July, 2005. A huge amount of money is to be invested for the recovery of the devastation caused by the floods. The storm water drainage system of Mumbai was built largely in the days of the British Rule in 1860, when the population of Mumbai was merely one-tenth of what it is at present. The city's existing drainage system is not capable to drain out this much amount of rainfall. So to avoid these damages we are giving a solution to pump out the water spread over the large areas by storing it in pneumatic fenders over the water surface of the sea. Our project introduces the technique to store surplus water in the months of rainy season. The water can be collected and stored in pneumatic rubber fenders by using available water surface or coastal line of city. This will comparatively reduces the amount of excess runoff and water logging.


Fig. 1. Problems faced by Rail transport

2. Materials and methods

Pneumatic fender: A fender is a bumper filled with air used to absorb the kinetic energy of the boat or vessel berthing against jetty or other vessel. Fender prevents damage to vessels and berthing structure. Fender is a device made up of rubber which has life of 30 years and more. It is sustainable to air and water pressure both. So in our case, we are using these fenders to store surplus runoff.


Fig. 2. Pneumatic Fender

Table 1
Standards of fender

Nominal Size Diameter x Length (mm x mm)	Initial Internal Pressure (KPa)
2000 x 6000	50
2500 x 9100	50
3300 x 6500	50
3300 x 8600	50
3300 x 10600	50
4500 x 9000	50
4500 x 12000	50

ARC GIS: Arc GIS is a geographic information system working with maps and geographic information. Using this software geographic information of various points on earth can be collected. By entering latitude and departure or by selecting tiles, DEM is generated and downloaded from BHUVAN satellite's official website. This DEM will help to calculate flow accumulated and its direction as shown in picture below.


Fig. 3. Digital Elevation

Fig. 4. Flow accumulation using Arc GIS

3. Selection of study area

Mumbai is one of the major city in India having population more than 23.5 million. Development of Mumbai city and its suburbs is growing fast therefore many people are migrated to this city for work. Many people in Mumbai travel a lot of distance daily for work. But during rainy season due over flooded roadways and railways they face lots of problem. Drainage system of Mumbai gets clogged not because it is not capable to drain out excess amount of rainfall. As Mumbai is a low laying area and flooded water from city get flown directly in sea. So the sea level rises and this is another major reason for floods in Mumbai. Due to lack of availability of surface area in Mumbai there is no scope to store water on surface. Hence we are taking advantage of coastal boundary to build artificial lagoons. In this case study we have selected Colaba region due to presence of IMD raingauge station and JNPT near coastal boundary.

4. Calculations

Study Area: Colaba, Mumbai
Catchment Area = 2000 Acre.
Precipitation annual rate= 910mm

Calculations:
Q =C.i.A
Where, Q = Discharge
C = Coefficient of runoff = 0.6
i = intensity of rainfall (inches)
A = Catchment Area (Ha)

Q = 0.6 X 35.82 X 2000 = 42984 cubic feet/sec
Q =1217.171 m^3/sec
Q =V/t
V = 1217.17 X 24 = 29212.104 m^3
Number of fenders = 29212.104/9500000 = 0.0307
Therefore, 0.0307 X 32 = 0.98 numbers

Fig. 5. Model image

So that 1 fender is required of size 4500(D) X 12000(L).

This means 4 fenders are needed for whole rainy season to accumulate water from Colaba region. In case of highest intensity rainfall taken in our study.

5. Future scope

The fenders filled with water can be transported to Middle East countries for their purpose. Primary treatment can be applied to the stored water.

6. Conclusion

Colaba region lies at lower elevation as well as drainage system gets chocked due to debris present in storm water so that drainage system does not remain capable to drain out surplus runoff. And replacement of this existing drainage is next to impossible because of lack of space. So by taking advantage of huge coastal boundary we conclude that instead of draining out this water we can store it in Fenders can use it whenever required.

Abbreviations

1. GIS: Geographical Information System
2. DEM: Digital Elevation Model
3. kPa: Kilo Pascal
4. IMD: Indian Meteorological Department
5. JNPT: Jawaharlal Nehru Port Trust

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