International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 09 | Sep 2021 www.irjet.net p-ISSN: 2395-0072

Structural and Non-Structural Flood Mitigation Techniques for Ulhas River in Badlapur Region, Thane

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Abstract – *Flooding remains the most common and one of the disastrous categories of natural hazards. Flood protection is one among the sensible methods in damage reduction. It is impossible to be completely shielded from flood disaster but major a part of damages are often reduced by mitigation techniques. This project depicts the optimum flood mitigation plan determined by risk analysis by accepting possibilities of flood overtopping. Remote Sensing and Geographical Information Systems has been applied within the mapping of flood risk areas to assist be prepared and to strengthen local infrastructure. The main aim of the study is flood risk mapping in Badlapur area with respect to the physical, demo-graphical and socio- economical vulnerability indicators. With the major river Ulhas flowing along the region and rapid growth of urban areas there have been many indicators of risk which was analysed in this paper. We review flood hazard mitigation policy, describe a number of the environmental damage related to current policies, and review current policy proposals to stipulate ways to mitigate the flood hazard without promoting catastrophic losses and environmental damage.*

Key Words: Flood disaster, Mitigation techniques, Flood risk analysis, Risk mapping, Structural & Non-structural.

1. INTRODUCTION

A case study of Ulhas river catchment in Badlapur region of Thane has been chosen as it covered wider aspects and complexities related to urban flooding in the Indian environment. The study targets to integrate the flood management aspects with innovative methods and their application in the Indian scenario. The National Institute of Disaster Management (NIDM) report reveals negligence and gross lack of awareness on the part of the authorities support to manage the disaster under the preparation plans for the city, absence of a sustainable model of urban planning wherein the long-term objectives are replaced by short-term gains at the cost of the ecology and the demands of the majority population that relies in a deep way on them for their survival. (NDMA Government of India [2010], NDMA Guidelines: Management of Urban Flooding)[10] The weather in Badlapur region is warm and moderately humid tropical climate with maximum temperature of 41°C and minimum temperature of 17°C. The annual rainfall ranges between 1900 mm to 2700 mm. Due to heavy rainfall, runoff is increasedon the ground surface this creates a problem like economic losses, tangible losses, intangible losses.To avoid this loss it is necessary to mitigate such runoff which is causing a flood. By using traditional methods, floods should be mitigated but it can be found that it is not applicable for the urban areas. In most cities in India, the runoff from roads, buildings and other urban areas, is directed to conventional drains/ conveyance systems. During the rainy season, it can be found that these drainage systems are exceeded hence that causes floods. This research aims to study flood problems in complex urban areas. (Apte N Y [2009], Urban Floods in context of India)[1]

BASIC CONCEPTS AND LITERATURE SURVEY

Geographical Aspects: One such suburb that experienced huge spurts of growth is that the region of Badlapur under thane district. It lies on the central line of the railways. The Badlapur region lies along the 19° 10' 0.4224'' north latitude and 73° 14' 12.4584'' east longitude, Thane. the world has the Ulhas basin on the western and northern boundaries which has its origin at Tungarli near Lonavala descending at Bhor ghat meeting the ocean at the Vasai creek. The study area of the project is little 12 towns of Kulgaon-Badlapur Municipal Council (KBMC) in Thane district near mumbai city. KBMC in its jurisdiction has the planet of about 35.68 sq. Kms [(13.78 sq mile), elevation 44 m (144 ft)], which is split into 34 wards & 13 operating zones.

Climate And Rainfall: The weather in Badlapur region is warm and moderately humid tropical climate with maximum temperature of 41°C and minimum temperature of 17°C. The annual rainfall ranges between 1900 mm to 2700 mm. There are four seasons namely the winter (October- January), summer (February- May) and

monsoons (June-September) followed by retreating monsoons especially during the month of October.

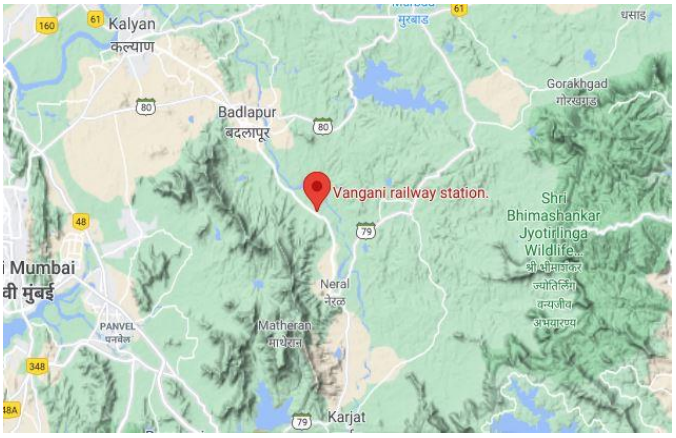

Fig 1. Area of study

1.2. NEED AND SCOPE

The main aim to study is flood risk mapping in badlapur area with respect in Badlapur area with respect to the physical, demographical, and socio-economical vulnerability indicators.

• to spot the low-lying areas with built-up lands.

• to research the flood risk factors and supply the structures which can help to attenuate the flood risk. (JTCDM, TISS [2008])[2]

2. METHODOLOGY

The flood mitigation study will identify the most critical areas of flooding, and determine the best alternative for flood damage reduction. The study focuses on the areas where damages and losses are greatest and proposes accordingly a preliminary plan for the region. The process includes damage cost assessment for different flood levels in various plans separately. It is therefore necessary to hold out a cost/benefit analysis for the most mitigation schemes and choose the simplest alternative by means of flood damage risk based analysis. (Volume-1 Issue-4 [April 2014] Evaluation of Non-structural and Structural Flood Management Measures.)[11]

2.1. DESCRIPTION OF SYSTEM

2.1.1. STRUCTURAL MITIGATION TECHNIQUES

Structural Mitigation is that the physical changes or act of protection from disasters or hazards. Taking geographical location, rainfall intensity, rainfall pattern, area under land use, catchment area into consideration, mitigation techniques are designed accordingly. (Byron Tasseff, Russell Bent, Pascal van Hentenryck [2019])[8] Following are the mitigation techniques adapted:

• **Channelization**

Channelization is the moderate way of increasing river depth and width of specific portion of river to increase the flow volume capacity, it will cause less damage to the banks. Channelization maintains velocity and flow of water body. Frequency of flood is reduced through channelization by discharging flood water effectively and quickly as possible. Concrete lining of the bank prevents bed or bank erosion. For increasing flow of water , roughness of channelized streams is also decreased and therefore increase in scour. Also, channelization leads to changes to the flow and direction of a river.

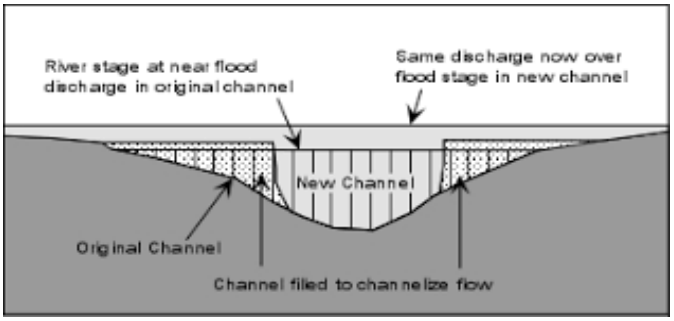

Fig 2. Channelization

• **Weir**

The weir is constructed across the width of the river which acts as a barrier , results in changing the water flow characteristics and also vary the height of flood water level flowing along river. Before cascading down to lower level, flow of water is freely above the top of weir crest. There are many designs of weir, but commonly water flows freely over the highest of the weir crest before cascading right down to a lower level. Generally, weirs are constructed to prevent flooding, measure discharged water. Weirs can vary in size both horizontally and vertically, with the littlest being only a couple of inches tall whilst the most important could also be many metres long and many metres tall. Some common weir purposes are outlined below.

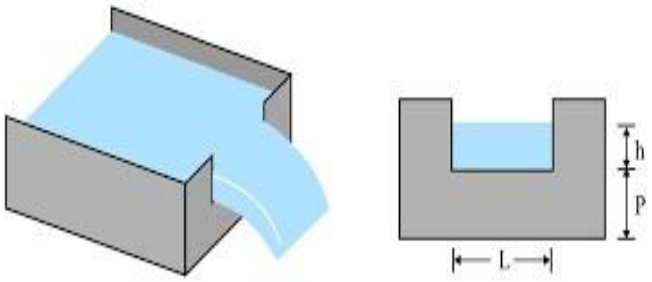

Fig 3. Weir

- **Anti-Flood Water Reservoir**

Anti-flood water reservoir is a structure build along the sides of river which collects water from the river in case of full river capacity. Once the reservoir is full the water is released back to the river from the outlet through pumps. Anti-flood reservoir , generally called a flood mitigation reservoir, stores a portions of the flood flows in such a way as to minimise the flood peaks at the area to be protected downstream. The entire inflow entering the reservoir, which is then gradually released, so as to recover the storage capacity for the next flood. Anti-flood reservoir stores the portion of flood flows in such a way so as to minimize the flood peaks at the area to be protected downstream.

- **Grid Channel**

Grid channels also known as grid screen is installed before the detention basin in order to remove the floating material and plastic from the river flow. Grid screen are set up before detention basin for the removal of floating materials , paper ,plastics and metals so the clogging of suspended particles and damage of equipments can be prevented.

Fig 4. Grid Channel

2.1.2. NON-STRUCTURAL MITIGATION

Non-structural mitigation measures helps to reduce the risk of damage of property and loss of livelihood. (Dodo J. Thampapillai, Warren F. Musgrave [2016])[9] Following are the mitigation techniques adapted:

- **Alarm System**

Flood alarm detectors are electronic devices that set off an alarm when sensors are triggered due to the presence of water at marked levels.It detects water leaks and overflows and takes action to prevent additional damage using a sensor, wifi capability, phone or email alerts. At places where a flooding crisis goes undiscovered, an alarm system plays a vital role in preventing flood damage. There are two types of flood alarm devices available.

Spot Detectors - Sensors get activated when in comes in contact with moisture and water.

Area Detectors - In case of flood condition sensor wires get activated.

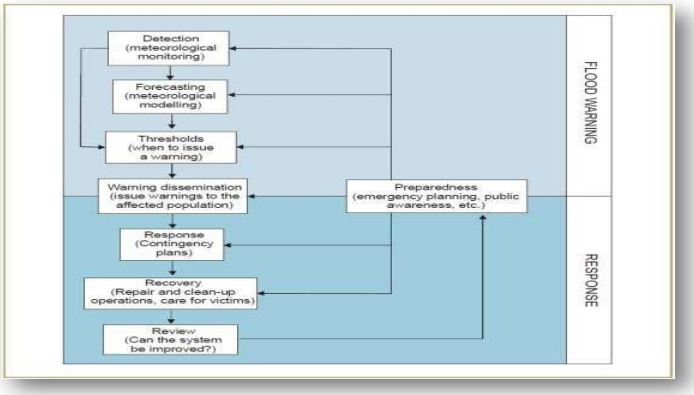

Fig 5. Alarm System

- **Relocation**

Relocation is the process of moving of one or more individuals leaving one dwelling and settling in another due to adverse conditions . In the event of a flood, citizens are ready to relocate their homes to higher ground or areas outside of the floodway. Typically, this act of clearing the floodway may be a recovery activity that helps to attenuate future damage. Clearing the floodway of homes and businesses ensures that damage and high costs are often avoided in floodways while making room for rivers to flow along their natural course. These mitigation options can be more effective than other mitigation methods because they provide the opportunity to relocate in an area outside of the floodplain.

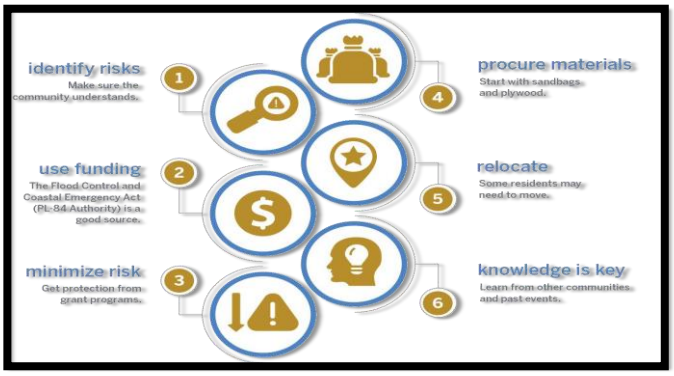

Fig 6 . Relocation

- **Flood Warning System**

Flood warning System helps to detect threatening incidents in advance. To alert Disaster Relief forces and residents, Indian Meteorological Department (IMD) is working on Flash Flood Guidance System (FFGS) , to prevent possibility of flash flood upto 6 hours in advance, it's primary objective is to reduce exposure to coastal flooding. Flood warnings are more severe and are issued if widespread flooding is expected across a large region. Basically sensors are placed beside reservoirs, river channels and once the High water level is triggered above which flood conditions takes place , the signal is send to base station.

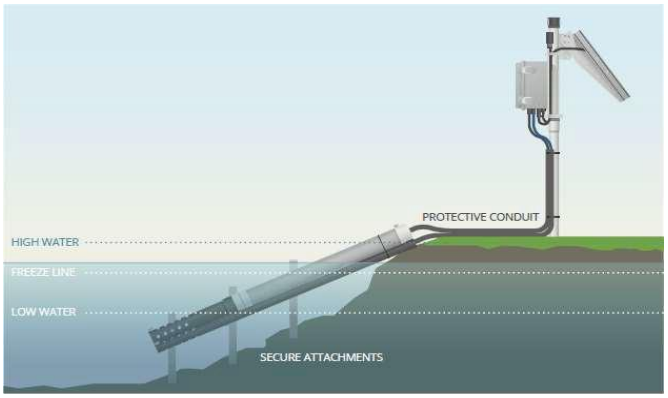

Fig 7. Flood warning system

3. CONCLUSION

Considering the previous flood exposure area , the flooded region i.e low lying area can be less affected due to structural mitigation techniques . Hence, the affected area will be very less as compared to previous results . The designing of the structures can be in such a way that there must be minimum area affected due to rainfall in this region. The designing of the structures can be carried out with proper study of the physical , geographical, climatic and many other aspects so as to reduce the catchment area.

In case of structural failure, the non-structural mitigations can be carried out to prevent the losses and damage of property and people's life. Following issues got to be addressed while developing and implementing such plans.

The current study demonstrates integration of data from flood map and land use map .

- The current study represents methodology of evaluation of non-structural and structural flood management measures.
- The study suggests structural flood management measures and underlines its importance by way of controlling the flood exposure for the study area.
- The proposed structural flood management measure are easy to construct, maintain and also cost effective.
- The recognition of exposure component facilitates the understanding of flooding event because it underlines that only the combination of natural and human factors create flood exposure.
- Monitoring and evaluation of implemented measures helps to constantly improve flood exposure management plans.

The use of these mitigations and geo-informatics in the area of risk mapping in the Badlapur area thus helps in preparing and strengthening the local infrastructure and making them disaster resilient.

This research thus basically analyzes the flood risk and how the mitigation techniques can be carried out for which we can have minimal effects of flood in our study area.

4. ACKNOWLEDGEMENT

It is a privilege for us to have been associated with Prof. Harshal Pathak (Professor, Dept. of Civil Engineering and Technology), our guide, during this research work. We have been greatly benefited by his valuable suggestions and ideas. It is with great pleasure that we express our deep sense of gratitude to him for their valuable guidance, constant encouragement and patience throughout this work.

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BIOGRAPHIES

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