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### RESEARCH PAPER ON TSUNAMI EVACUATION SYSTEM BASED ON TOPOGRAPHY OF SURAT CITY USING SRTM DATA

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**Abstract:** Some natural Hazard, e.g. tsunamis or earthquakes, often lead to catastrophes with spectacular cost. In this time natural disasters caused loss hundreds of thousands of human, smash up to infrastructure, disturbance of monetary activity and loss of millions of money worth of matter. This presents the hazard mapping for Tsunami and strategy for Tsunami evacuation for Surat (21° 10' 12.86" N, 72° 49' 51.82" E) and western coast of Gujarat state on Indian subcontinent. The purpose of this study is to develop tsunami vulnerability maps by analysing the coastal stream characteristics of Gujarat. The need for the revise is to aware people for the hazard of tsunami and saving utmost lives when tsunami occurs there. The overall goal of this study is preparing a tsunami evacuation map for Surat city and western cost of Gujarat state. The past chronological earthquakes of Tsunami source of Makran subduction zone which was liable for causing tsunami on western coast of Gujarat. The outcome of this study can be utilized by public guiding principle and judgment makers in developing disaster board strategies.

**Keywords:** Tsunami, Evacuation system, earthquake, Natural disaster, Surat, Gujarat

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## INTRODUCTION

Tsunami is a Japanese word meaning “harbor” (tsu) as well as “wave” (nami) also identified as a seismic sea sign, is a chain of waves in a water body cause by the displacement of a huge water volume, in general in ocean or a large lagoon. Time between crests of the wave can vary from a few minutes to over an hour, generally are in the range of 15 to 25 minutes. Tsunami can also be generated by volcanic eruptions, underwater explosion and landslide that cause displacement of additional water vertically upward. Many epicentre are located at the base of ocean or sea, are able to generate tsunami waves. These events, so known as tsunamigenic earthquakes, characteristics of high energy, and the magnitude on the richer scale are  $M > 7.0$  are reason for tsunami. The horizontal zone of the strongest bottom oscillations during event may be as great as 100 KM or further. An earthquake can be measured to be produced by rupturing of the earth’s crust with a virtual displacement of its two sides and the release accumulates of elastic strain that been created by tectonic process. A landslide activity process is typically caused by long term acculumulation of the sediments at ocean bottom. Volcanic eruptions signify also impulsive disorder, which can displace an enormous volume of water and produce extremely destructive tsunami waves. For the given location on the Earth, risk of a "direct" hit from an asteroid is light; researchers researched that an ocean impact had the potential to be much more destructive due to the extra vulnerability of tsunami. There are main two types of main evacuation system, Which is Horizontal Evacuation system and vertical evacuation system

A vertical evacuation system for tsunami is contain building or earthen mound that has sufficient height above the ground level or sea level to elevate evacuees above the level of tsunami inundation with design and strength which can resist tsunami waves effect easily Vertical evacuation system refuges can be stand-alone. There can be single purpose refuge-only facilities, or multi-purpose facilities in regular use when not serving as a refuge.

A horizontal evacuation system for tsunami is a type of building or area covered near or on the seashore in order to rescue at the time of vulnerability. A horizontal structure is created to rescue the people to the safe or vertical structure.



Fig. 1: Horizontal Evacuation System<sup>(1)</sup>



Fig. 2: Vertical Evacuation System<sup>(2)</sup>

### **PROBLEM DEFINITION**

The Surat city is situated at very low depth below the mean sea level, so at the time of tsunami people have to face vast problem. Presently it is not having a proper tsunami evacuation system due to which at the time of tsunami huge loss of lives and property is caused.

### **POSSIBILITY OF TSUNAMI IN GUJARAT**

The Introduction should lead the reader to the importance of the study; tie-up published literature with the aims of the study and clearly states the rationale behind the investigation. It should be complete enough to allow experiments to be reproduced. All the procedures should be described in detail, previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail. Great earthquakes out of five earthquake in Makran due to ruptured of the plate boundary in different four segments of lengths, about 200 Kilometre each in 1483 (58–60°E), 1864 (61–63°E), 1945 (63–65°E), 1765 (65–67°E) and in 1851. From all earthquakes only the 1945 earthquake is known more due to caused large tsunami which followed a large aftershock in 1947 immediately to the south. For the western Makran zone has no clean record of historic great earthquake. Absence of frequent earthquakes indicates or shows either that seismic subduction or that the plate boundary is now locked and experiences great earthquake with long repetition periods. One of the majority fatal tsunamis yet recorded in the Arabian Sea occur with its epicentre located at the offshore of Pansi in the northern Arabian Sea, around 100 kilometre south of Churi (Baluchistan), Pakistan, at 21.56 UTC (03.26 IST) on November 28, 1945.

### **AIM AND OBJECTIVE**

Tsunami evacuation system on coast of Surat is helpful to create evacuation map for city as well as its used as a reference map for other surrounding region. Its use for finding tsunamigenic sources for Gujarat west coast and prepare hazardous map and tsunami risk of different west coast of Surat. By analyse the tsunami evacuation plan we can make full proof plan for same region which suggest the site condition and suggestion for evacuation system which is moreover useful during tsunami for saving many people as possible by guiding them to safer zones quickly. Tsunami evacuation system suggests vertical evacuation system or horizontal evacuation system which is used for construct structure horizontal or vertical for tsunami evacuation system.

### **NEED OF STUDY**

Tsunami evacuation system is used to reduce life and property loss and increase the structure stability which is also useful to make evacuation system map during hazardous condition. It is used to provide basic knowledge of different method to resist tsunami.

### PROBLEM DUE TO TSUNAMI

Tsunami caused various problems like tainted water supply of water which is main reason for death, injury and disease It also caused environmental effect and psychological effect. Due to tsunami people may face lake of fresh water and billions of dollars financial loss. Due to tsunami the ocean water get mixed with the water of the Tapi river due to which the people living in the law laying areas have to suffers as the water of Tapi river riches there.

### STUDY AREA

the tsunami evacuation system study are is Surat which is located in Gujarat state of India, the latitude of Surat is  $21.1702^{\circ}$  N as well as longitude is  $72.8311^{\circ}$  E. The total are of Surat city is  $326.515 \text{ km}^2$ . The total population residing in Surat is 44, 67,797 as per Indian census (2011) <sup>(4)</sup>. The major river passing through the city is tapi. The Surat city is also surrounded by ocean so there is a risk of major loss of property due to tsunami in future.

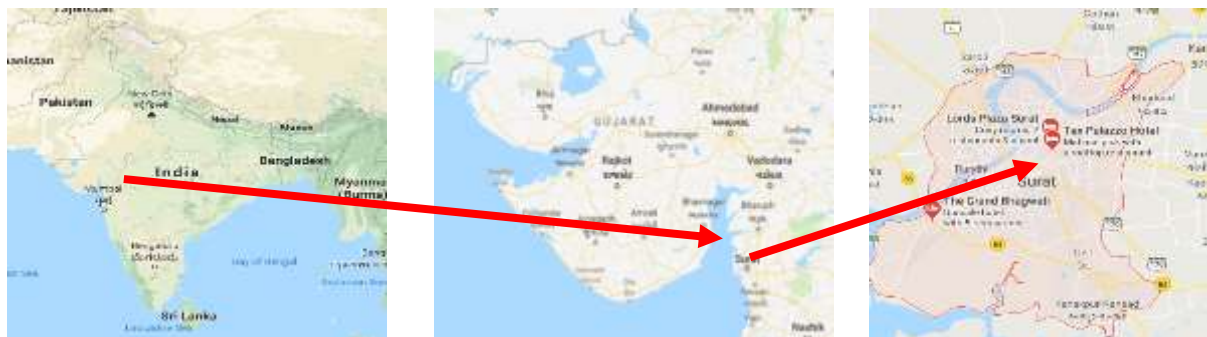


Fig.6: Study area, Surat <sup>(5)</sup>

### IMPORTANT LOCATION

The impotent location at which there is a possibility of tsunami in nearby future in Surat, Gujarat is those location which are surrounded by oceans or are situated near to the sea. The various important locations like Dumas beach, Dandi beach and Hazira beach are described below.

Dumas Beach is an urban beach along the Arabian Sea, located 21 kilometres southwest of the City of Surat in the Indian state of Gujarat. It is a popular tourist destination in South Gujarat. <sup>(8)</sup>



Fig. 7: Dumas beach, Surat<sup>(6)</sup>

Dandi is a village in the Jalalpore district, Gujarat, India. It is located on the coast of the Arabian Sea near the city of Navsari. It shot into worldwide prominence in 1930 when Mahatma Gandhi selected it to be the destination for the Salt March. <sup>(9)</sup>



Fig. 8: Dandi, Surat<sup>(7)</sup>

Hazira is a town and a Trans shipment port in the Surat district in the Gujarat state in south western India. Hazira is one of the major ports of India and the most important element of Surat Metropolitan Region. <sup>(10)</sup>



Fig. 9: (a) Location of Hazira as per Google Map (b) Hazira Beach, Surat<sup>(8)</sup>

### SRTM IMAGE AND BOUNDARY REGION GUJARAT

SRTM (Shuttle Radar Topography Mission) data of Gujarat region is shown by following image, this type of image used for global mapper software for geo reference in order to make or draw tsunami evacuation system map of particular area or region. It is the data which indicated the depth of various location of a place, city or country based on which we can predict the occurrence of tsunami and prepare the tsunami evacuating map.

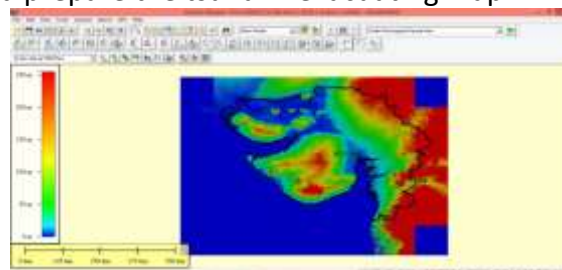


Fig. 10: Boundary data and SRTM data of Gujarat region <sup>(3)</sup>

### BATHYMETRIC DATA

Depth of water is shown by this data by which we can predict the influence of tsunami in any area of city.

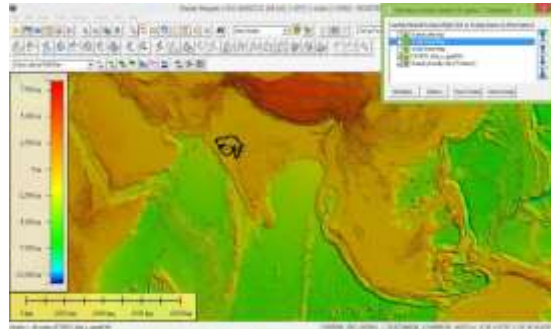


Fig. 11: Boundary data and SRTM data of Gujarat region <sup>(3)</sup>

### SOFTWARE USE

The main software is used for preparing the tsunami evacuation map is Global Mapper and Autocad-2016.

### RESULT AND DISCUSSION

Tsunami and different plate below the ground mostly affect the bed coast which is measured through mean sea level, generally we known mean sea level as a depth or height of sea with respect to local benchmark. Surat has a tropical climate, moderated strongly by the sea to the Gulf of Cambay, so here taken data from global mapper, Autocad which indicated the mean sea level compare to below or above the ground surface level. SRTM data show below indicated the elevation of the sea level above or below the ground level surface. If the level is the below the ground surface it will work as pipe and the undulation of the whole city would occur. The yellow line in the SRTM data indicated the selected region of which the elevation data is shown in the table.

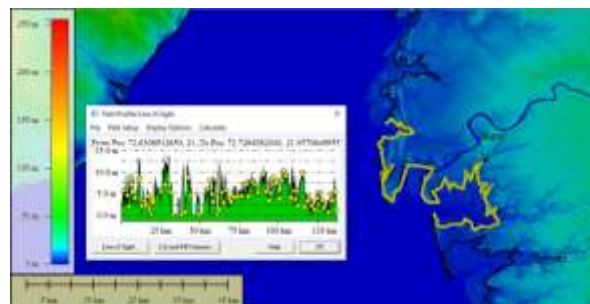


Fig.11 Elevation SRTM data of Surat city

### METHODOLOGY

Tsunami evacuation system done through project selection, definition of problem, literature reviw, reports and objective, collection of tsunami data, data analysis, Suggestion of horizontal & vertical system, Conclusion.

## CONCLUSION

To save human life during tsunami evacuation is the most effective as well as important method, accurate representation of the timing of people's responses to the emergency is used to measured evacuation during tsunami. Using satellite tsunami evacuation map we can generate tsunami evacuation map of western coast of Gujarat state. Using global map system we can develop vertical evacuation as well as horizontal evacuation system which can be use in developing disaster management strategies and decision making policy can utilized done by these Research study.

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