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A Study on Tsunami Protection Works

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Abstract : *Coastal communities around the world are at risk to Tsunami. The study was piloted to idealize the efficacy of sea wall in controlling the Tsunami forces on onshore structures. In front of building model different types of sea walls were placed.To reduce the opposite of vulnerability and to increase community resilience, as resilience plays the opposite of vulnerability. This research article examined the planning capacity and social capacity to evaluate community resilience to the Tsunami. The collected data is estimated under a framework which combines eight important resilience elements. These elements are governance, society and economy, resource management, land use and structural design, risk knowledge, warning and evacuation, emergency response and disaster recovery. Tsunami hazard risks are not well addressed and considered in plans and programs for the coastal community. This article will open a new horizon that can help to find the strength and weakness of disaster preparedness in community level. The resilience of coastal community to Tsunami can be achieved through enhancing planning and social capacity.*

Keywords *-Community resilience, Disaster risk, Planning capacity, Social capacity, Vulnerability.*

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I. INTRODUCTION

The word "Tsunami" Japanese for "Harbor wave" comes from a fact that it only seems to appear near the coast. If the trough of a Tsunami reaches shore first, the water will draw farther the normal before the wave heads which can be misleading the dangerous. Tidal waves are commonly known as Tsunamis. They are essentially undulated tidal activity caused by the gravitational forces of the sun and moon. During Tsunamis, larger versions of regular waves were observed. They consists lot of moving water but the movement of energy through water has a trough and a crest. The difference is in where this energy comes from? For normal ocean waves, it comes from wind because this only affects the surface the waves are limited in size and speed. But Tsunamis are caused by energy originating under water from a volcanic eruption, a submarine landslide, one of the most commonly an earthquake on the ocean floor caused when the tectonic plates of the earth surface slip releasing a massive amount of energy into the water. This energy travels up to the surface displacing water and raising it above the normal sea level. But gravity pulls it back down which makes the energy repel upwards horizontally. Thus the Tsunami is born moving over 500 miles per hour.

From shore, Tsunami can be barely evident since it moves through the entire depth of the water. But when it reaches shallow water, wave shoaling occurs. Because there is less water to move through, the still mass amount of energy is compressed. The wave speed slows down while its height rises to as much as 100ft (30.48m).

A Tsunami would not only drown people near the coast but level buildings and trees from mile and even more. Especially in low lying areas, as if that weren't enough, the water flushes the trees dragging with the newly created debris and anything or anyone unfortunate enough to be caught in its path.

The 2004 Indian Ocean Tsunami was one of the deadliest natural disasters in history killing over 2,00,000 people throughout South Asia. Attempts made to stop Tsunamis with sea walls, flood gates and channels to divert the water. But these are always not effective. In 2011, the Tsunamis repast the flood wall protecting Japan's power plant causing a nuclear disaster in addition to claiming over 18,000 lives. Many scientists and power sea makers are focusing on early detection, monitoring under water pressure in seismic activity and establishing global communication that works quickly distributing alerts. When nature is too powerful to stop, the safest course is to get out of its way.

The hazard of major Tsunami occurred during 2004 Sumatra Earthquake and Indian Ocean Tsunami. Tsunami science and engineering were inevitable to save human society, industries and natural environment. Tsunamis are long oceanic waves that are mainly caused by earthquake in the ocean floor. Near origin, waves maintain larger wave length and smaller wave height. As they are transmitted towards the shore, their wave length decreases; however, wave height and speed increase. During transmission from the origin, they dissipate very little energy; as a consequence, they reach the shore with nearly unchanged tremendous energy. Field surveys in the affected areas indicated the weaknesses of existing guidelines in estimating Tsunami forces on structures. Though a number of researches have been done on the formation and propagation of Tsunami as well as interaction between Tsunami and land structures, still there is room for improving Tsunami researches.

II. THE GREAT WALL OF JAPAN

Tsunamis hits most frequently in Japan in the world. The proficiencies are well documented. In 1896, the Tsunami science started when the Meiji Great Sanriku Tsunami claimed 22,000 lives. An idea of comprehensive countermeasures was officially introduced after the 1933 Showa Great Sanriku Tsunami.

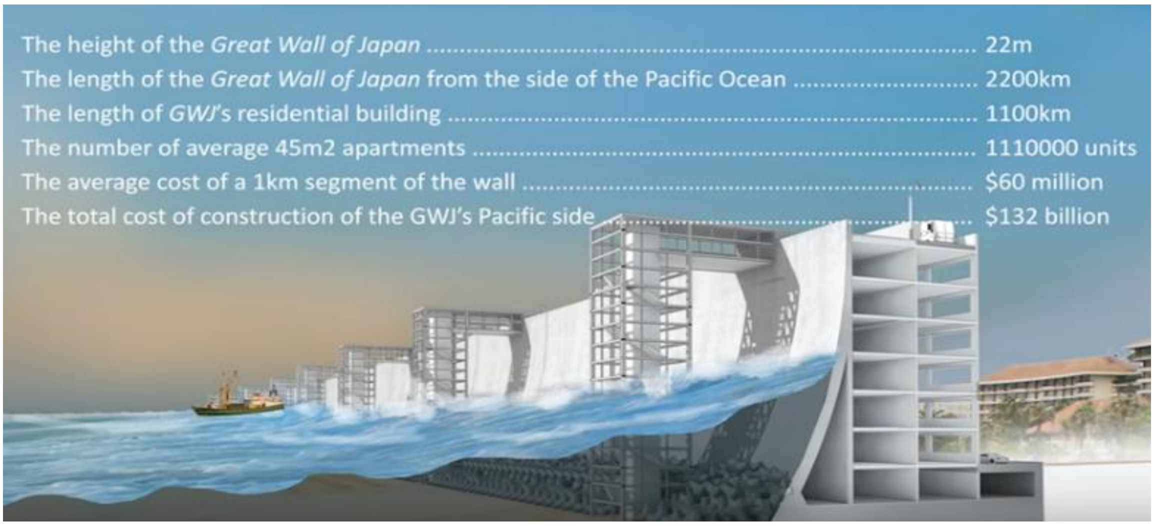

Figure 1: Great wall of Japan
(Source: https://www.youtube.com/watch?v=s1uaB41bLRk)

The loss of infrastructure caused by the earthquake and Tsunami in March, 2011 was over $300 billion. Construction of the GWJ would represent 40% of the losses incurred in the infrastructure only caused by one Tsunami. Seismologists agree that the next Tsunami of similar magnitude will occur within the next 30 years. The probability of its occurrence within this time is estimated to be over 90%.

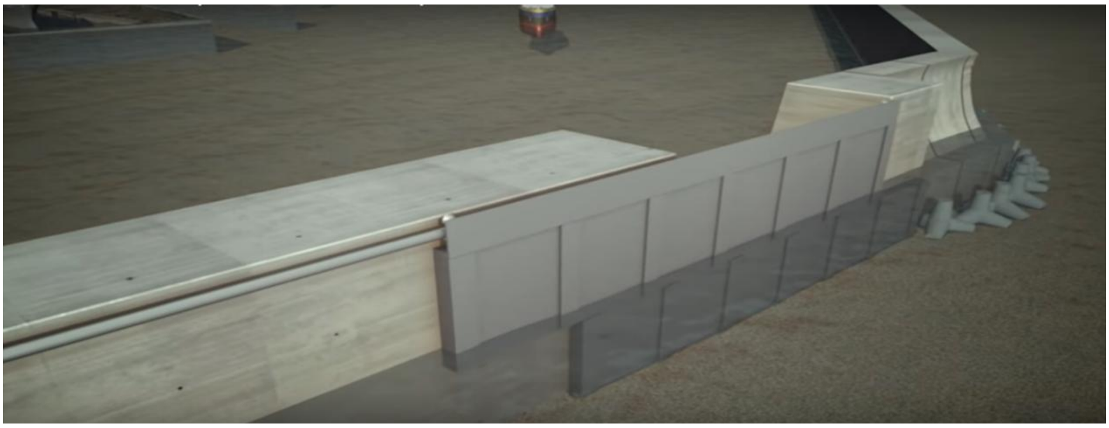

Figure2: Illustrates the Great wall of Japan with sliding door
(Source: https://www.youtube.com/watch?v=s1uaB41bLRk)

III. THE TWIN WING TSUNAMI BARRIER

It is the eventual and reflexive Tsunami protection solution and remedy. The human and pecuniary devastation that Tsunamis brought to densely populated and industrial coastal regions was witnessed around the world. During recent Tsunami events in Asia and Japan, hundreds and thousands of people were dead, homes and businesses got destroyed, and lives wrecked. The challenge to create a barrier capable of destructing and neutralizing the overwhelming power of Tsunami waves has now been met with the introduction of twin wing Tsunami barrier. As the coastal waters are drown outby the approach of negative Tsunami wave. The coastal wing of the barrier deploys frapping the coastal water behind it, creating a carrier of calm water. The water which is being sucked out till its volume merging positive Tsunami wave as it rushes towards the coast.The second larger wing of the barrier now deploys stopping the water in its track and reflecting the energy back out to sea. The twin wing Tsunami barrier has steel wings and the concrete foundation constructed from pre-fabricated 24m blocks. These are floated out when sunk to a depth of 1.5mand fixed to itby four concrete filled cushion pulled piles. The 2m high casein is loaded with macro ballast and the wings are restrained by steel houses. The twin wing Tsunami barrier is capable of protecting most coastal areas which are vulnerable to Tsunamis. Two independently activated barrier wings could protect from the devastating effects of both negative and positive Tsunamiwaves. In known critical conditions, the barrier will be on horizontal resting on rubber baffles across its foundation, presenting no threat to coast shipping or marine life. Located at a depth of 10m, it will only be deployed by the approaching water surgeof the Tsunami wave. Operating independently from the coastal systems and position the cross of bayor along the coast line, people, communities, economies and governance of low lying coastal areascan now be protected.

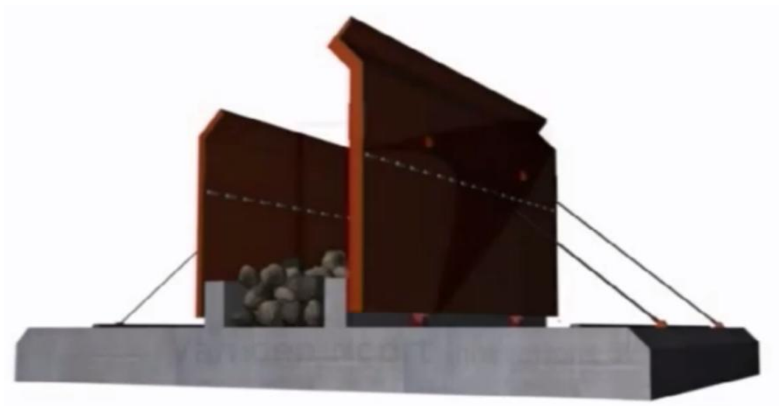

Fig 3: Schematic view of the twin wing Tsunami barrier
(Source: https://www.youtube.com/watch?v=r9bCCxihAiw)

The data folder of twin wing Tsunami barrier is that the depth of the water is of 10m; the width and length of the foundation plate are 30m and 24m respectively; the total weight of the foundation plate is of 1896kN; the weight of the natural foundation is of 360kN; the foundation depth in the ground is of 1.5m; the thickness and height of the positive barrier are of 0.6m and 13m respectively;the thickness and height of the negative barrier are of 0.3m and 9m respectively; the weights of positive and negative barriers are 228kN and 115kN respectively; the total weight of the twin wing Tsunami barrier is of 2599kN; the maximum speed of Tsunami wave is of 10.5m/s; the maximum pressure at 10m water depth is of 51.4kN/m^2; minimum free water depth above the barrier(LW) is of 5m; maximum orbital speed of wind waves at a depth of 10m is of 0.65m/s;the lift up speed of water for negative and positive barriers is of 1m/s & 1m/s respectively.

Advantages

- Saves the people life.
- Reduces the property damage.
- Protection of natural resources.
- The destruction by the Tsunami can be reduced.

IV. CONCLUSIONS

This study was performed to identify the possible protection achieved by low-lying sea wall from Tsunami devastation. Building structure fronted by small sea wall showed better performance than that of building without any sea wall. Types of sea wall, wall height and wall position were varied systematically to estimate the amount of reductions in forces. The results were compared with no wall condition to verify the level of reduction. Sea walls could significantly reduce the forces on onshore structures located behind the sea wall over the tested wave conditions. Sea wall 2 (8 cm high) was perceived to be more effective in force reduction than that of wall 1 (4 cm high). For 30 cm impoundment depth, 41% and 27% force reductions were achieved by wall 2 and wall 1, respectively, in position 1, whereas these reductions were somewhat smaller in position 2 for both walls. Thus, sea walls located at adequate distance from the building structures will provide good protection against Tsunami loading. Other researches were performed to evaluate the performance of perforated sea wall in lieu of solid one. As the amount of force reduction attained by perforated sea wall was almost similar to solid sea wall, this study proposed the use of perforated wall instead of solid wall. Moreover, perforated wall allowed easy declining of water to go back to sea, while solid wall trap the coming water behind and thus, creating additional forces on the building. Additionally, less construction cost of perforated wall will make it more attractive than solid sea wall. Finally, it should be noted that the results of this study were appropriate for this particular type of setup as the distance between sea wall and building structures plays a very important role in the declination of forces.

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