Fabrication of life guard shell from tsunami

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ABSTRACT

This paper describes the life guard shell from tsunami which is a personal safety system, designed to protect against tsunami events, tornadoes, hurricanes, floods. The life guard shell is designed to save lives during a Tsunami event. It is designed and stressed using Engineering methods of analysis for load cases such as initial Tsunami impact, large debris impact, sharp object penetration and many more. The internal hollow structure combined with external fiber shield, were specially designed for high strength but low weight. The shell is also a variable disaster solution, which means it can vary position according to the water depth, so it will never be inundated by water levels rising too high. The shell is targeted at communities along coastlines, at sea level and within a potential Tsunami event zone. It also provides warmth, safety, and shelter during the initial post-disaster period before rescue crews and relief workers have arrived on the scene

Keywords: *Life guard shell, Tsunami, Debris impact, Personal safety system, Tornadoes, Hurricanes, Floods*

I. INTRODUCTION

A tsunami is a series of wave in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations of underwater nuclear devices), landslides, glacier carvings, meteorite impacts and other disturbances above or below water all have the potential to generate a tsunami. Unlike normal ocean waves, which are generated by wind, or tides, which are generated by the gravitational pull of the Moon and the Sun, a tsunami is generated by the displacement of water. The 2004 Indian Ocean tsunami was among the deadliest natural disasters in human history, with at least 230,000 people killed or missing in 14 countries bordering the Indian Ocean. The 2004 Indian Ocean earthquake occurred at 00:58:53 UTC on 26 December with the epicenter off the west coast of Sumatra, Indonesia. Despite a lag of up to several hours between the earthquake and the impact of the tsunami, nearly all of the victims were taken completely by surprise

There were no tsunami warning systems in the Indian Ocean to detect tsunamis or to warn the general population living around the ocean. Tsunami detection is not easy because while a tsunami is in deep water it has little height and a network of sensors is needed to detect it. Setting up the communications infrastructure to issue timely warnings is an even bigger problem, particularly in a relatively poor part of the world. Built with strength and survivability in mind, life guard will operate safely and efficiently in the harsh circumstances and environments to which a natural disaster would expose it. The sphere will withstand the initial impact of a natural disaster, as well as sharp object penetration, heat exposure, blunt object impact, and rapid deceleration. Life guard shell is to be mounted inside or outside the home or business establishment. The shell is targeted at communities along coastlines, at sea level and within a potential Tsunami event zone. The shell can be built in different sizes to cater to families ranging from four on upwards. The shell would be especially valuable during a night time event. Reaching high ground may not be an option for many residents. The shell will ensure survivability and is not restricted only to Tsunamis; it is also effective in any potential flooding scenario. Recent studies have shown that increasing populations in coastal areas will expose 2.75 billion people worldwide to the effects of sea level rise and other coastal threats posed by global warming

The act of saving human lives is a form of cost effectiveness. It reduces the search and rescue effort during the post Tsunami phase, which reduces costs substantially for government and local authorities. The use of life

guard will reduce the total number of victims and substantially reduce mental trauma for rescuers related to Tsunami victim recovery. Thus resources can be redirected towards the clean-up operation, reconstruction and containment or prevention of environmental hazards.

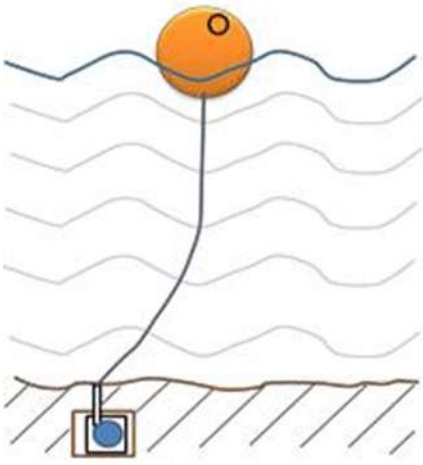
II. OBJECTIVE

The tsunami wave is a constant threat to coastal communities in 135 countries worldwide. The prediction for a future earthquake/tsunami event, made by the JMA (Japan Meteorological Agency), for the region south of Tokyo Bay, is a death toll upwards of 250,000 people. The total exposed coastal population exceeds 2.5 million people. Hence, the Life guard shell is an attempt to mitigate some of this risk and provide people in these regions with an alternative option. The tsunami event is a highly hostile environment and presents many significant and demanding requirements of such a structure which will have to endure such load cases as large object impact, sharp object penetration, dynamic impact, shock and thermal whilst maintaining its floatation integrity. The purpose of the life guard shell is to provide people with an alternative. The people who perish during a tsunami tend to be people who, do not heed the warning signs, are ignorant of the dangers of the tsunami, are physically unable to evacuate to the safe havens or do not get the warning signals in time. In certain circumstances the typical period between earthquake event and landfall of the tsunami may be too short thus putting the whole coastal community in danger.

The use of life guard will reduce the total number of victims and substantially reduce mental trauma for rescuers related to Tsunami victim recovery. The act of saving human lives is a form of cost effectiveness. It reduces the search and rescue effortduring the post Tsunami phase, which reduces costs substantially for government and local authorities. Thus resources can be redirected towards the clean-up operation hence tsunami life guard shell can be defined as a "Personal Safety System", it allows for immediate isolation from the impending danger

III. LITERATURE REVIEW

Within the last decade the world has witnessed 2 major oceanic earthquakes and subsequent tsunamis resulting in the deaths of roughly a quarter of a million people, displacing over 1.7 million across 14 counties. These catastrophic tsunamis have been a wake call to coastal communities throughout the world. There are roughly 135 countries exposed to the threat of the tsunami wave many of which, up to recently, did not even recognize the word "tsunami". Many nations in the Indian Ocean did not have tsunami preparedness programs in place.



The discrepancy between countries that are prepared and those who are not is vast. Japan can be considered one of the most tsunami prepared nations in the world today and yet statistically Japan can still expect to lose between 8 and 10% of the population exposed to the tsunami wave. In Sendai, Japan there were roughly a quarter of a million people exposed to the tsunami wave and about 23,000 people lost their lives of which 6000 people still remain missing. In less well prepared nations this percentage loss factor creeps up which helps explain why so many deaths occurred during the Indian Ocean 2004 earthquake and tsunami event. The purpose of the tsunami life guard shell is to provide people with an alternative. The people who perish during a tsunami tend to be people who either, do not heed the warning signs (major earthquake ground displacement), are ignorant of the dangers of the tsunami, are physically unable to evacuate to the safe havens or do not get the

warning signals in time. In certain circumstances the typical period between earthquake event and landfall of the tsunami may be too short thus putting the whole coastal community in danger.

Figure 1: Examples of Variable and Fixed Evacuation Solutions

Tsunami evacuation structures such as the capsule and vertical evacuation towers can be divided into "fixed systems" and "variable systems. The fixed system is the most practiced nowadays, the fixed system consists of vertical fixed towers which can withstand the effect of tsunami. The fixed system is not a systematic approach since the tsunami waves can rise to large heights, causing devastation to the buildings.

Engineers in America Julian Sharpe and Scott Hill have invented a floating survival shelter that, in the event of a disaster can house between two and ten people for up to five days. It is made from aircraft – grade aluminum, the spherical water tight capsule will protect the occupants from the initial impact of a natural disaster. The problem found was that the aluminum structure requires lots of money and it can be manufactured only in big manufacturing unit with the help of advanced machines.

The life guard shell apart from all this structures is very cheap and light in weight due to the fiber material used in case of aluminum; the life guard shell can be manufactured easily by common people due to its simple design specifications. The life guard shell is very useful for those people who are living near the coasts of sea.

Figure 2- survival capsule build in America

IV. METHODOLOGY

For the project summarized in this thesis an approach of both experimental and theoretical nature was chosen. During the first stage of the project, extensive experimental research was conducted with the aim to investigate

the feasibility of the floating life guard shell. The second half of the project was mainly devoted to development of models based on results from experimental data. The order of the work conducted in the project, first experiments then modeling, was determined based on the fact that studies done by other researchers until the start of the project were of theoretical nature. Therefore, as a proof of concept it was determined to be more appropriate to start with studies based on experiments and then use the knowledge gained from these experiments in order to develop more realistic models that can withstand the impact of tsunami.

V. COMPONENTS

5.1 Fiber-reinforced plastic

Fiber-reinforced plastic (FRP) is a composite material made of a polymer matrix reinforced with fibers. The fibers are usually glass , carbon , aramid, or basalt. Rarely, other fibers such as paper, wood, or asbestos have been used. The polymer is usually an epoxy, vinyl ester, or polyester thermosetting plastic, though phenol formaldehyde resins are still in use. FRPs are commonly used in the aerospace, automotive, marine, and construction industries.

Characteristics of FRP

FRP is known for its mechanical strength and a popular choice when it comes to corrosion resistance. Furthermore is FRP light weight, has excellent temperature-resistant properties, offers thermal insulation and can be formed in complex shapes. FRP products are easy to repair and hardly require any maintenance. FRP products are known for their smooth internal surface and seamless shapes, providing perfect flow of products.

Design considerations

FRP is used in designs that require a measure of strength or modulus of elasticity that non-reinforced plastics and other material choices are either ill-suited for mechanically or economically. This means that the primary design consideration for using FRP is to ensure that the material is used economically and in a manner that takes advantage of its structural enhancements specifically. This is however not always the case, the orientation of fibers also creates a material weakness perpendicular to the fibers

Applications of FRP

Fiber-reinforced plastics are best suited for any design program that demands weight savings, precision engineering, finite tolerances, and the simplification of parts in both production and operation. A molded polymer artifact is cheaper, faster, and easier to manufacture than cast aluminum or steel artifact, and maintains similar and sometimes better tolerances and material strengths.

5.2 GPS tracking unit

A GPS tracking unit is a device, normally carried by a moving vehicle or person, that uses the Global Positioning System to determine and track its precise location, and hence that of its carrier, at intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location database, or Internet-connected computer, using a cellular (GPRS or SMS), radio, or satellite modem embedded

in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analyzing the track later, using GPS tracking software. Data tracking software is available for smart phones with GPS capability

5.3 Diving Cylinder

A diving cylinder is a gas cylinder used to store and transport the high pressure breathing gas required by a scuba set. It may also be used for surface-supplied diving or as decompression gas or an emergency gas supply for surface supplied diving or scuba. Cylinders provide gas to the diver through the demand valve of a diving regulator or the breathing loop of a diving re breather.

Diving cylinders are usually manufactured from aluminium or steel alloys, and are normally fitted with one of two common types of cylinder valve for filling and connection to the regulator Cylinders used for scuba typically have an internal volume of between 3 and 18 litres (0.11 and 0.64 cu ft) and a maximum working pressure rating from 184 to 300 bars (2,670 to 4,350 psi). Cylinders are also available in smaller sizes, such as 0.5, 1.5 and 2 litres.

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5.4 EXIT HATCHES

The emergency hatches or exit hatches are used for exiting from the life guard shell. It consists of water tight doors for preventing the entry of water into the shell. They are lined with rubber coating for reducing the leakage.

5.5 LIFTING AND ANCHORING LUNGS

The lungs provide lifting of the life guard shell with helicopter when the relief is needed. This is required in situations when the people need to be rescued from the tsunami struck place.

VI. EXPERIMENTAL SETUP

The experiment setup consists of manual arc welding for making the frame strong, to make it withstand the effect of tsunami. The fiber sheet is screwed to the frame by drilling it deep inside. Fiber sheet is water proof and it can withstand the wear and tear caused by the heavy water. The compact design of the life guard shell keeps floating and the conical structure prevent the shell from rotating upside down even if large waves come with high velocity. The anchoring lungs are provided at sides to prevent the dislocation of the life guard shell, the shell can be anchored with steal ropes positioned deep inside the ground. The life guard shell is equipped with GPS system, which enables a survivor to give rescue time message regarding his location. The oxygen cylinder allows the person to breathe fresh air before the rescue team has arrived on the scene. The life guard shell is made water proof with applying silica gels at minor gaps.

Figure –frame of life guard shell

VII. FACTORS DETERMINING THE CHOICE OF MATERIALS:

The various factors which determine the choice of material are discussed below.

7.1 PROPERTIES

The material selected must posses the necessary properties for the proposed application. The various requirements to be satisfied Can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection

a. Physical
b. Mechanical
c. From manufacturing point of view
d. Chemical

The various physical properties concerned are melting point, thermal Conductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties Concerned are strength in tensile, Compressive shear, bending, tensional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are,

- Cast ability
- Weld ability
- Surface properties
- Shrinkage
- Deep drawing etc.
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7.2 MANUFACTURING CASE

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

7.3 QUALITY REQUIRED

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

7.4 AVAILABILITY OF MATERIAL

Some materials may be scarce or in short supply, it then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. The delivery of materials and the delivery date of product should also be kept in mind.

7.5 SPACE CONSIDERATION

Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

7.6 COST

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored.

Sometimes factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

VIII. CONCLUSION

The life guard shell is a personal safety system that could save life of people during a tsunami event before rescue workers have arrived on the tsunami event. **.** The life guard shell is designed to save lives during a Tsunami event. It is designed and stressed using Engineering methods of analysis for load cases such as initial Tsunami impact, large debris impact, sharp object penetration and many more. The internal hollow structure

combined with external fiber shield, were specially designed for high strength but low weight. The shell is also a variable disaster solution, which means it can vary position according to the water depth, so it will never be inundated by water levels rising too high. The shell is targeted at communities along coastlines, at sea level and within a potential Tsunami event zone**.** The use of life guard will reduce the total number of victims and substantially reduce mental trauma for rescuers related to Tsunami victim recovery.

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3) Mr. Iwao Iwama and Dr. Yasunori Otsuka of Toho Mercantile, Tokyo, Japan who have shown extreme belief in our product and continue to support Survival Capsule LLC in developing this product and others for the Japanese market and markets across the globe.
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