



TSUNAMI WAVEBAG

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ABSTRACT

The Tsunami WaveBag is a safety vest designed to ensure survival in case of tsunami. The tsunami of December 26th, in 2004 in the Indian Ocean, resulted in almost 300,000 deaths but was proportionally more fatal to women and children. The tsunami is a discriminating natural disaster because wherever it happens it affects pre-existing social conditions of life in the stricken area. For example, when the 2004 tsunami struck coastal cities in Sumatra, females, children and older people were more vulnerable and died in greater numbers due to the fact that they did not have the same physical strength as men to climb trees or to swim. The death rate for women and children was three times greater than it was for males. Children are particularly vulnerable because of their physical fragility and possible inability to swim. This presentation describes the Tsunami WaveBag, a safety vest designed particularly for women and children. The Tsunami WaveBag vest is designed as a floating device to prevent drowning, but also as an airbag device to protect a person from trauma caused by wave action and floating missiles carried by the tsunami's powerful currents.

The vest has six inflatable chambers that protect the most vital and at risk areas of the body that may be injured during the tsunami. The material used for its fabrication is particularly resistant to impact. The chambers get inflated automatically soon as the water impacts against the person wearing it, thanks to an inflatable system reacting to water itself. To carry a baby, the Tsunami WaveBag has a carrier pocket on the front. In order not to crush a baby against the mother's body, the pocket is filled with memory-shaped foam. The Tsunami WaveBag is intended for distribution to local communities vulnerable to the tsunami and to be shown at local workshops in order to instruct the basics on how to wear it. A prototype of this device is available and can be exhibited along with other graphical materials and completed studies.

Introduction

This paper is about my graduation thesis in Industrial Design entitled “The Project of Emergency”, developed at the Polytechnic of Turin, Italy, 2006, with the supervision of the mentor Claudia De Giorgi.

The phenomena of Tsunami

Since last December 2004, the phenomena of Tsunami became part of the collective culture of the whole world thanks to the quick spreading and sharing of news and digital material by the media, including the internet.

The Tsunami in the Indian Ocean destroyed coastal areas by a distance of 10000 km from the epicenter and caused about 250000 victims. The strike of this catastrophic event had a fatalistic echo and woke up the discussion on tsunami danger and mitigation in other countries at a lower risk of tsunami and in countries that had experienced that natural event long time ago. Even if tsunamis are generally more frequent in the areas surrounded by the Pacific Ocean or belonging to the subduction zone of the Ring of Fire, up to the last event of 2004, the record for devastation and victims was hold by Europe¹ due to the Lisbon tsunami, in Portugal, year 1755, and to the Sicily and Calabria one, in Italy, year 1908. In the Mediterranean Sea, for example, the islands of Cyclades and Stromboli are two areas with a potential risk of tsunami.

In 2002, the Stromboli island experienced a tsunami due to a submarine landslide originated from the side of the volcano. On that occasion there were no victims thanks to the fact that it didn't happen during the tourist season, but since that the Italian Civil Defense has designed a plan for the risk prevision and mitigation on the island. The COA (Advanced Operative Centre) was established in Stromboli and it is always connected with the national civil defense. The mission of COA is to constantly monitor the volcano and analyse the data coming from the scientific stations set on the crater or under the sea. In case of a tsunami alert, it becomes vital the rapidity of spreading the alarm among the population. Getting away from the coastal area and reaching higher zones is the only way people have to defend themselves against the anomalous wave and it is the main point of the COA plan against tsunami.



Figure 1. The anomalous wave reaching the coasts of Stromboli, 2002. Image Source: COA.

¹ Source: National Oceanic and Atmospheric Administration NOAA, Pacific Marine Environment Laboratory.



Figure 2. The coastal area of Stromboli submerged by the anomalous wave, 2002. Image Source: COA.

Focusing on the most vulnerable groups

Regarding to the tsunami in 2004, it had a terrific impact on the demographic concentration of two particular groups of people: women and children. A study from Oxfam International² tells about how different is the number of victims between female and male population, highlighting the main causes and foreseeing social implications for the next future. The Oxfam dossier focuses on Indonesia, Sri Lanka and India. The main insight in the study is that every disaster has somehow a discriminatory impact on the population because, wherever it happens, the existing social structure and lifestyles determines what are the most vulnerable groups in respect to others in that particular context.

The gender is one of the main factor that splits the population concerning to the impact of the disaster. Due to the tsunami 2004, about 250.000 people died and, of course, much more people lost their houses. It is not well known that the number of male survivor is much bigger than the female. The reasons of the cutting down of female population are often quite similar in the countries that have been analysed:

- despites men, women are usually not trained to climb trees and swimming.
- women daily task is taking care of the houses, children and elderly people in the family. When the tsunami hit, they tried to save their beloved first;

Others reasons are linked to particular context. For example, in Indonesia, women have an active role in the country economy since they organize the fish collected by fishermen for the selling in the markets. The day of the tsunami 2004, lots of women were waiting for fishermen coming back from the sea on the beaches. The result was that all the fishermen on the boats could survive to the big wave, while all women and other people on the beaches had no possibility to escape, both because they couldn't swim and they had their children with them to carry. In Indonesia the victims proportion between male and female is 1:3 , such as for each male, three female died. In the Indian village of Pachacnkuppam the only victims were female. In Sri Lanka the physical differences between the two genders were fatal. Men, used to climb trees since kids in order to pick fruits, managed to save themselves from the wave.

² Oxfam International is a NGO , such as a no government organization, (www.oxfam.org).

The tsunami of 2004 implied a demographic collapse and many organizations have been warning of future abuses for the female population.



Figure 3. A man in Sri Lanka able to climb trees in order to pick coconuts.



Figure 4. A typical fish market with women in Sri Lanka.

As regards to children mortality due to tsunami, its main reasons are physical fragility and inability to swim for female population. Children are the most vulnerable to the polytrauma³ and they are much more subjected to the kinetic energy associated to the abnormal wave than adults. Each crash on a child body affects a smaller body surface than on an adult body, thus the power of the impact has much more pressure on vital organs because it stresses a tiny area. Besides this, the weight of a child provides less resistance to the impact of the wave. In particular, children in the regions of south east Asia have usually no adipose tissue, thus preventing them from having a natural energy absorption in their bodies.

Maps of polytrauma that could lead to death

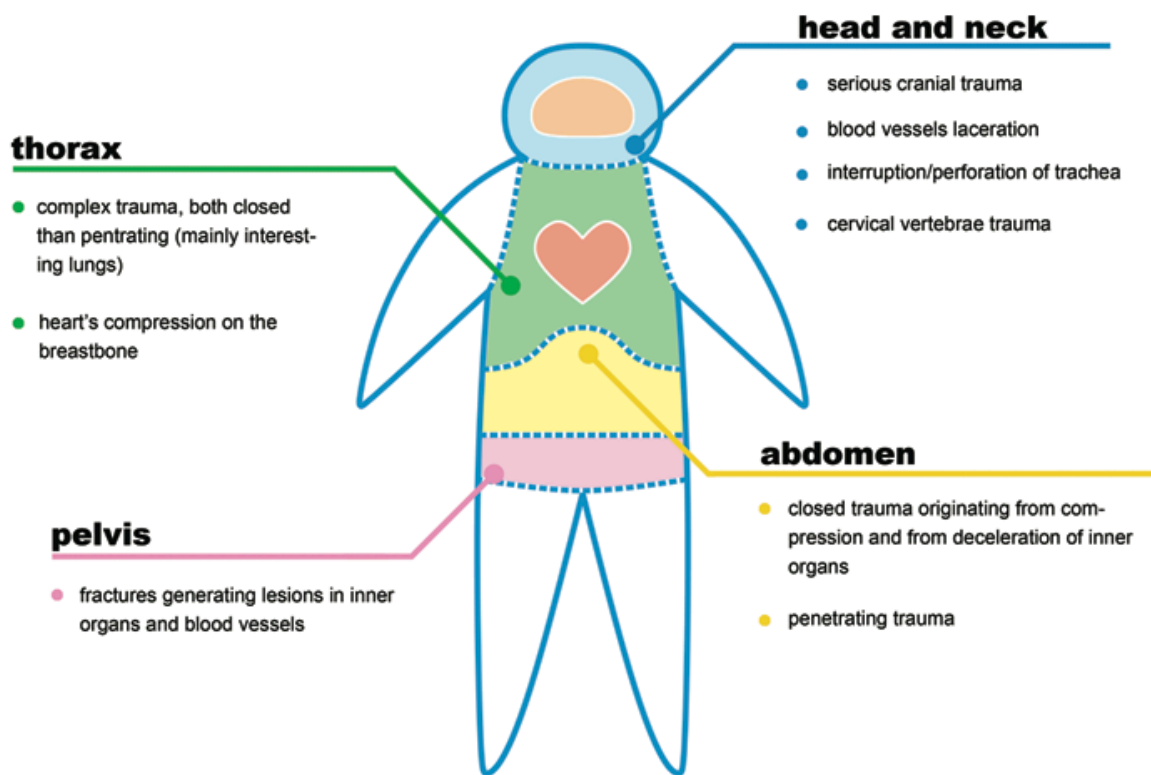


Figure 5. Maps of polytrauma that could lead to death.

Polytrauma, both in adults and children population has to be considered the first cause of death in case of tsunami. Crashes against trees, buildings and other objects transported by the water can be fatal even for people that otherwise could manage not to drown. Being able to swim can mean having control on psychological crisis due to panic and help to float on the wave, but it can't make people avoid to be hit by random stuff in water currents. Some humanitarian

³ The condition of a person who has been subjected to multiple traumatic injuries.

organizations use to stress on the importance to learn how to swim in the areas at risk of tsunami for little kids. They organize courses to teach how to stay longer under water and swim while immersed. In the Hawaii Islands always at risk of tsunami, for examples, even if swimming education is still not done in public school everywhere, the Boy Scout use to plan compulsory swimming lessons at each summer camp awarding swim and rescue certificates.

As a conclusion, it seems that it is very urgent to provide an emergency device to minimize the main factors of vulnerability of the populations at risks of tsunami, from children physical fragility to women subordinated condition, without neglecting the needs of floating and absorbing heterogeneous crashes.

The Tsunami WaveBag

The Tsunami WaveBag is a project of a safety vest in case of tsunami that is meant for the most vulnerable part of the population in the areas at major risk of tsunami, such as women and little children. Anyway, it can be used by all the rest of the population without implying any problems for them.

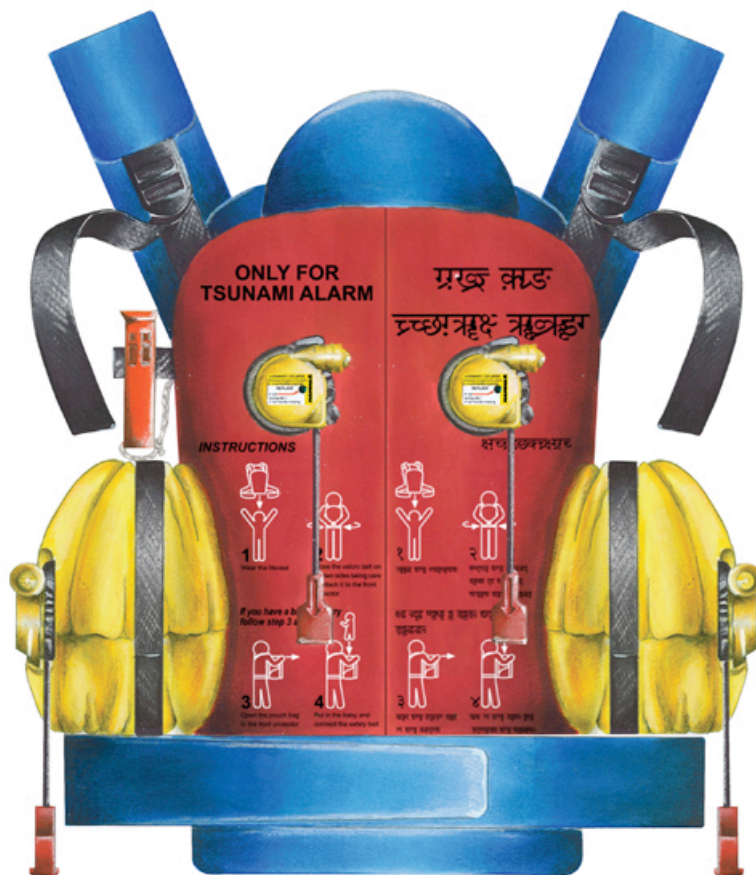


Figure 6. Frontal view of the Tsunami WaveBag.



Figure 7. Lateral view of the Tsunami WaveBag with opened and closed frontal pocket for carrying the baby.

The Tsunami WaveBag is both meant as a floating vest and as a crash absorbing device, like air bags. It also has a big pocket on the front where a little child up to 3 years old could be put up and fastened by belts, thus allowing the adult carrying it to run away from the dangerous zone and to try to save both of them.



Figure 8. Prototype worn by a female user. Details of the different steps before opening the frontal pocket and putting the baby in it.



Figure 6. Prototype worn by a female user and a child of 18 months old.

The Tsunami WaveBag is composed by 6 air chambers distributed around the body areas that could be subjected to polytrauma. They are functional to protect both the adult and the child.



Figure 7. The six inflatable chambers of the prototype.

Conclusions

The Tsunami WaveBag is now available as a not fully working prototype and the air chambers are not operating with the automatic inflator. I managed to test the way the user wears it and put the baby on with quite successful user tests.

At the current stage of the project, one of the main challenges will be to define the right material for the inflatable chamber in order to make them resistant to crash and perforation. The automatic inflation system used in the Tsunami Wavebag will be based on a hydrostatic valve, thus allowing the air chambers to inflate automatically as soon as the water hits the person wearing the safety vest. The safety vest will need to be filled with energy absorption foam in between the baby body and the adult in order to prevent the baby from being pressed against the

person who is carrying him.

The cost of the final product would need to be affordable enough to be distributed by local authorities or humanitarian organization through workshops organized to explain the use of the device itself.

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