The aftermath of a tsunami

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Credit: EEFIT - Tiziana Rossetto, HR Wallingford

A research background in earthquake engineering seems at first sight like an unusual fit with studying tsunamis. But on her return from Sri Lanka in the wake of the 2004 tsunami, Professor Tiziana Rossetto discovered that very little research had been done into the effects of tsunamis on coastal infrastructure and she wanted to find out more. She will be presenting this research to the public at the TEDx Brussels event on 1 December.

An ambitious exercise

Prof. Rossetto looks back at the origins of her current project as the

result of asking "Why not?" when told that tsunami waves could not be simulated in the lab. She was also attracted to earthquake engineering because it is a new science, and one in which an impact can be made very tangibly. She says that "it allows us to contribute to a revolution in how we design buildings. It combines engineering with seismology, structural dynamics and even the social sciences."

Her ERC-funded research looks at the damage caused by the impact of tsunamis on buildings by modelling the horizontal force that hits buildings during a tsunami, and studying how they react. Looking at the load that buildings can withstand should teach us more about how we can mitigate these forces. The aim is to improve sea defence systems, rather than the buildings themselves, as it is more likely that these coastal defence systems can be constructed and maintained in the areas of the world that are affected by tsunamis, which tend to be developing nations.

The devastating impact that tsunamis can have on infrastructure is illustrated in very distinct ways by the cataclysmic effects of the "Boxing Day" tsunami (2004) and the tsunami which hit Japan in 2011. In the Indian Ocean crisis, whole communities were swept away by the waves. In Japan, the tsunami caused the meltdown of three of Fukushima's nuclear reactors. In a finding of particular relevance for this project, it was determined that the plant could have been better protected against natural disaster. It is precisely this kind of planning which interests Prof. Rossetto and her team.

Modelling a tsunami

The difficulties of this research are compounded by the fact that there is little verified observational data on how tsunamis unfold, due to the rarity of these events. The goal of this research is both to experimentally investigate the transformation of a tsunami nearshore and, alongside this, mathematically model the permutations which cannot be physically

modelled with any degree of ease. Originally Prof. Rossetto was told that it was not possible to model the tsunami waves, which are extremely long. This became a challenge, which was solved with the building of a new type of pneumatic tsunami generator, which is not limited by the piston capacity of traditional wave generators and which can reproduce the extremely long wavelengths associated with tsunamis. It is also the world's only facility able to model trough-led tsunami waves. The tsunami generator is mounted in a 70m long and 4m wide flume at the laboratories of HR Wallingford in the UK. The flume is heavily instrumented and enables the researchers to examine the interaction between tsunami waves and coastal defence structures, individual buildings and groups of buildings: more accurately mirroring what happens in a real-life event.

Experiencing disaster

Prof. Rossetto's research is both experimental and theoretical, encompassing reconstructions and calculations of the tsunami wave and its aftereffects, particularly modelling the fragility of buildings. Calculating the insurance implications of a natural disaster on this scale is a necessary part of the preparations from an infrastructure perspective but there is another side to the insurance question. In a related piece of research, Prof. Rossetto traced a global phenomenon: "how do people living in at-risk areas approach potential disasters? They are not ignorant of the risks, but they do very little to prepare."

The ERC backing has been of enormous help to the project, not least because of the attention it has attracted. She emphasizes: "On a practical level it has ensured that I can concentrate on the work uninterrupted. It has really opened doors because it is seen as such a seal of quality for the work. It has led to conversations with policy-makers and involvement in co-development projects: for example in research collaborations and discussion to include tsunamis in the next European building codes

post-2020."

Prof. Rossetto believes that her research will "spark imagination" at TEDx Brussels. She observes that the combination of real-life threat and hi-tech solutions produces a narrative that should grip the TEDx audience. In the most practical way possible her aim is to "save lives, and in doing so build a safer world for our children".

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