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Accurately measuring giant waves – for effective tsunami protection

How British researchers use sensors from Kistler to ensure efficient coastal defenses

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Japanese fishermen on the high seas noticed nothing unusual. Everything was calm, conditions at sea were normal. But a shock awaited them when they ran into port: almost nothing was left standing – a gigantic wave had slammed into buildings and boats, sweeping animals and people away with devastating force. This phenomenon is known as a tsunami, which means "harbor wave" in Japanese. Force sensors from Kistler have played a key part in tsunami research.

Effective design of defensive structures depends on knowing what forces tsunami waves produce when they impact on structures – but until now, almost no research has been undertaken on this subject. Coastal protection agencies clearly need to base the construction of future installations on guaranteed data. To meet this requirement, HR Wallingford – an independent British hydraulic research association – joined forces with Dr David McGovern, a Lecturer at London South Bank University and former Research Associate at University College London. The English town of Wallingford is home to one of Europe's largest wave-current flumes, the Fast Flow Facility, and is the only location in the world where tsunamis can be simulated. The present tests were undertaken at a scale of 1:50. The Fast Flow Facility measures 70 x 4 meters. The extremely complex forces that give rise to tsunamis can only be understood by examining how they develop in three-dimensional space.

Faced with this challenge, Dr McGovern approached Kistler, the Swiss expert on sensor technology, for help with realistic visualization of the forces that act as the wave builds up. Kistler, the market leader for piezoelectric measurement, works with sensors that include specially grown quartz crystals. The crystal converts forces generated by waves and moving masses of water into electrical charges – and this makes it possible to measure the forces. The special feature in this case: the sensors used for tsunami research can measure forces in all three dimensions.

Thanks to this technology, the research team was able to obtain precise measurements of the entire build-up of the wave in space and over time. The team was also able to confirm that data for the simulated waves matched the data for real tsunamis, so they could be sure that their research

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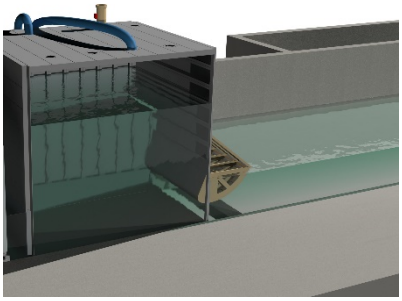
results were meaningful and reliable. The data now provides a sound basis for future coastal defense construction projects, because researchers finally have a reliable method to simulate and calculate the effects of tsunami on different structural shapes. With support from the Swiss measurement technology experts, the British team has played an important part in ensuring that future defensive measures will help save lives when a tsunami strikes.

Image material (reproduction is free of charge if the sources are cited)

The English town of Wallingford is home to one of Europe's largest wave flumes, the Fast Flow Facility, where tsunamis can be simulated on a scale of 1:50. (Source: © HR Wallingford www.hrwallingford.com)



The tsunami researchers used sensors from Kistler that can measure forces in all three dimensions. Thanks to this technology, they were finally able to obtain precise measurements of the entire build-up of the wave in space and over time. (Source: © HR Wallingford www.hrwallingford.com)

To measure the masses of water, the research team used special 3D force sensors from Kistler that can measure forces in all three dimensions. (Source: Kistler Group)

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