Tsunami Risk Mitigation Strategy after December 2004 Earthquake in Indian Ocean

Suzanne Lacasse
International Centre for Geohazards,
Norwegian Geotechnical Institute,
Oslo, Norway

ABSTRACT

The 26 December 2004 Indian Ocean tsunami was the most destructive tsunami in modern times, causing approximately 300,000 casualties. The tsunami was generated by a magnitude 9.1-9.3 earthquake caused by propagating stress release on a subduction zone. The earthquake caused vertical seabed movements of up to 5 m over an area of 1200×300 km^2. The largest destruction caused by the 2004 Indian Ocean tsunami was in the region closest to the earthquake epicenter, with maximum tsunami run-up of more than 30 m, and with run-up of 10-20 m along large sections of the coastline. Devastating effects were found over an enormous geographical area, with dominating run-up and maximum water level of 5-10 m along the shorelines of Andaman, Nicobar, Sri Lanka, and western Thailand, and several meters along most of the eastern Indian coastline, Myanmar, Malaysia, the Maldives, and parts of eastern Africa. The 2004 Indian Ocean tsunami showed the possibly devastating effects of tsunamis generated by mega-thrust earthquakes, and raised the question on how the profession could deal with tsunami hazard and risk, including early warning.

A study was done to assist the authorities in Thailand with evaluating the future tsunami risk and to develop plans for how to deal with the risk, with main purpose to establish practical guidelines for land use and rehabilitation of the exposed areas. The study included earthquake prediction for the future, tsunami simulations and comparisons with observed wave and inundation levels, an assessment of the risk associated with potential future tsunamis towards Thailand, and the elaboration of a tsunami mitigation strategy. The study of earthquake statistics and plate tectonics concluded that it will take at least 300 to 400 years before an event of similar magnitude and destruction occurs again north of the tectonic barrier, as much of the energy that was accumulated along the northern part of the subduction zone is now released. However, the study concluded that the area has an active fault zone with frequent earthquakes that may generate tsunamis again. For earthquake scenarios of magnitude 8.5, and with the potential for generating tsunamis impacting western Thailand, the lower bound return period is estimated to be 200 years. The risk to human life and property in Thailand from tsunamis can be regarded as tolerable within the next 50 to 100 years. However, the tsunami risk will increase with time after that if mitigation measures are not taken.

About Dr (Mrs.) **Suzanne Lacasse** - next page

BIOGRAPHY

Dr. Lacasse was born in the small mining town of Noranda in northern Québec, Canada. She completed first her Bachelor of Arts, and in 1971, her studies in Civil Engineering at Ecole Polytechnique of Montréal. Graduate studies followed at the Massachusetts Institute of Technology in the USA and Ecole Polytechnique. She obtained her Ph.D. in 1976. She was Lecturer at Ecole Polytechnique (1973-1975), and at MIT (1975-1982). She was also Head of the Geotechnical Laboratory at MIT.

Dr. Lacasse became a permanent employee of the Norwegian Geotechnical Institute (NGI) in 1980, where she combined her position at NGI with visiting lectureship at MIT. She took several foreign research and consulting assignments, and has given invited lectures in over 25 countries. She became NGI's Managing Director in 1991 after 10 years as a Senior Engineer for NGI. She holds a number of positions on the Board of private companies and research organisations in Norway and abroad.

During the early part of her professional career, Dr. Lacasse concentrated her work in the field of geotechnical laboratory techniques, soil behaviour studies and in-situ investigation methods. She published several often referred to articles and reports within these fields. Subsequently, she worked in the area of foundation engineering and design, both for structures on land and offshore, projects involving slope stability evaluation and improvement, and development of calculation procedures. In her work, Dr. Lacasse concentrated on combining mathematical and numerical analyses with practical geotechnical engineering design considerations. She was a key member of the NGI-team developing practical design analysis procedures for offshore platforms subjected to storm loading. The procedures have become widely recognised and accepted. In recent years, she developed and applied probabilistic analyses to assist in the foundation design and decision process and is well known for these contributions. As Managing Director of the Norwegian Geotechnical Institute, she maintains a keen interest for the technical aspects of NGI’s work, and still carries out research and advisory tasks.

Dr. Lacasse received many awards, including doctorates Honoris Causa from the Universtiy of Dundee and the Norwegian University of Trondheim, the K.Y. Lo Medal of the Engineering Institute of Canada for excellence in engineering, the 125-Year "Personalités"-Award of the Ecole Polytechnique of Montréal and the Effective Teaching Award in Civil Engineering at MIT in 1978. She is member of the U.S. National Academy of Engineers, the Canadian Academy of Engineers, the Norwegian Academy of Engineering and Sciences and the Royal Norwegian Society of Sciences and Technology. Dr. Lacasse is a fellow of the Royal Society of Canada, a fellow of the Engineering Institute of Canada, a fellow of the American Society of Civil Engineers and a Knight of the First Class in the Order of the Falcon of Iceland She gave the 37th Terzaghi Lecture in 2001. She also gave, among others, the Cross-Canada Lecture Tour of the Canadian Geotechnical Society, the MIT Sam Mathis Lecture, and the Theme Lecture for the International Society of Soil Mechanics and Geotechnical Engineering in 2001. She was President of the Canadian Geotechnical Society in 2003 and 2004.