UEL Research & Knowledge Exchange Conference 2013

Call for Abstracts

Name & Title of Presenter:	Dr Ravindra Jayaratne, Senior Lecturer in Civil Engineering
School:	Architecture, Computing & Engineering (ACE)
Co investigators:	-
Title of Abstract:	Field Survey of Coastal Dyke Failure due to 2011 Great Eastern Japan Earthquake Tsunami
Key Theme/ Key words:	Post-tsunami field survey, coastal dyke, practicing coastal engineer, numerical modelling, UEL-Waseda research collaboration

Abstract (No more than 400 words):

Post-tsunami field investigations are an essential component for improving our understanding of tsunamis and in developing tools necessary to mitigate their effects. Scientific data collected after a large tsunami is important for decision and policy makers, government bodies and practicing coastal engineers.

On the 11th of March 2011, an earthquake of magnitude 9.0 on the Richter scale struck the offshore of the northeast coast of Japan. This was one of the strongest earthquakes which generated a major tsunami in the modern history. This tsunami devastated large parts of Fukushima, Miyagi and Iwate prefectures of Japan's north-eastern coastline, inundating over 400 km^2 of land, and causing a loss of large number of lives. On the Sendai Plain, the maximum inundation height was 19.5 m, and the tsunami propagated as a bore for around 4.0-5.0 km inland. The maximum run-up height was 40.4 m, making it the third world's field-scale tsunami in the last ten years (Tohoku Earthquake Tsunami Joint Survey Group, 2011). Coastal protection infrastructure, including many well-engineered reinforced seawalls and dykes, earth embankments and armoured breakwaters were washed away or suffered extensive damage. It was reported that most these structures were built after a typhoon-induced storm surge in 1953 and the Chilean earthquake tsunami in 1960. This disaster, referred to as the *2011 Great Eastern Japan Earthquake Tsunami*, was one of the worst tsunamis that affected Japan since records began, which is only expected to occur one in every several thousand years.

The two joint field surveys of UEL-Waseda University (Japan), carried out in summers of 2011 and 2012, covered particularly coastal dikes in Watari, Soma, Higashimatsushima, Ishinomaki, Iwanuma and Yamamoto cities in Miyagi and Fukushima prefectures. According to the surveys, the leeward toe of coastal dikes was scoured in many surveyed areas, though the seaward slope was often not completely washed away. Thus, the tsunami wave appears to first overtop the front face of the wall generating strong turbulence and currents at the leeward toe, creating a large scour hole. Then, due to the large wave pressure and buoyancy forces in the scour-hole area the protection cover in leeward slope is uplifted causing a complete failure of the structure (Fig. 1).
The author will highlight the detailed results of two field surveys, general failure modes of coastal dykes and numerical modelling at Waseda University (Jayaratne et al, 2013; Esteban et al., 2013) at the conference.

Figure 1. Failure of coastal dykes and the field survey team of UEL-Waseda University research collaboration

References

Jayaratne, R., Mikami, T., Esteban, M., and Shibayama, T. (2013). Investigation of coastal structure failure due to the 2011 Great Eastern Japan Earthquake Tsunami, *Coasts, Marine Structures and Breakwaters 2013,* Institution of Civil Engineers (ICE) UK, Edinburgh (in Press).

Esteban, M., Jayaratne, R., Mikami, T., Shibayama, T., Mizuno, Y., Kinoshita, M., and Matsuba, S. (2013): Analysis of the stability of armour units during the 2011 Tohoku Tsunami in Japan, Coasts, *Marine Structures and Breakwaters 2013,* Institution of Civil Engineers (ICE) UK, Edinburgh (in Press).