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Design of Tsunami Evacuation Buildings for Ship Impact Loads

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Abstract

Past tsunamis carried a huge amount of waterborne debris inland. Even massive ships were also carried by tsunamis, and some of them were reported to have caused critical damage to buildings. Although tsunami evacuation buildings (TEBs) need to be appropriately designed against tsunami-driven ship impact loads as well as tsunami loads, the impact loads are not specified quantitatively in the current design guidelines for TEBs. The following three studies were therefore made to propose a design method of TEBs against these impact loads. Firstly, we investigated 143 ship behaviors during the tsunami event caused by the 2011 Great East Japan Earthquake, and concluded that the uncontrollable ships, of which drafts are less than tsunami inundation depth, should be considered as the potential impact load source. Secondly, four case studies were made on ship collisions with coastal structures observed during the tsunami event, and a rectangular pulse was employed as the ship impact load considering previous theoretical and experimental studies. Finally, a simplified method to estimate the maximum building response due to the above impact loads was proposed based both on the predominance of the first mode of building response and the equality between external and internal energy. The maximum building responses by the above proposed method were then found to successfully estimate those computed by dynamic response analyses.



Ship impact with crane and warehouse, Sendai, Japan

Date: Friday, September 15th, 2017. 2:00 to 3:00PM

Location: University of Hawaii at Manoa, Holmes Hall Room 244
Parking Available at the UH Lower Campus Structure (\$5.00 for the day).

Speaker Bio

Tatsuya Asai is a Ph.D. candidate in the Department of Architecture at the University of Tokyo (Ph.D. expected Sept. 2017). He has contributed to development of structural design methods of Tsunami Evacuation Buildings (TEBs). In his Master's study, he evaluated the tsunami loads based on damage observations after the 2011 Great East Japan Earthquake, and the findings from the study were directly reflected in the structural design guidelines of TEBs issued by Japanese Ministry in 2011. He is currently a member of committees on tsunami loads of both Architectural Institute of Japan and Japan Association for Earthquake Engineering, and is engaged in research to develop the design methods of TEBs against tsunami-driven ship impact loads. Besides his research work, he also has practical experience in structural design of buildings in a general constructor, Maeda Corporation, and has become licensed as a first-class architect in Japan.