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Tsunami loadings on buildings – use of the new Tsunami Simulators

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An experimentally validated, closed-form set of equations for predicting forces on rectangular buildings impinged by nominally unsteady tsunami inundation flows is presented. The shallow water waves that drive the tsunami inundation flows described in this research are generated using the pioneering Tsunami Simulator developed by UCL and HR Wallingford, uniquely capable of generating very long period waves featuring the characteristic draw-down of real-world tsunami. We describe an experimental study of the forces acting on a rectangular building occupying 10-80 per cent of a channel, fixed in a free-surface-channel flow driven by shallow water waves with periods of 20-240 seconds.

A one-dimensional model based upon open-channel flow principles is proposed for unsteady flows driven by prototype tsunami waves, providing empirical estimates for drag and hydrostatic coefficients. It is observed that the pressure field around the buildings is hydrostatic irrespective of the flow being steady or unsteady. An empirically derived force prediction equation, dependent upon the Froude number of the incoming flow and blocking fraction is presented, which provides good agreement with the experimental results. The equations presented in this paper will provide engineers, tsunami modellers, and risk evaluation experts with a convenient method of tsunami inundation force determination without recourse to computationally expensive multi-scale numerical models. This research forms part of a wider body of work conducted by UCL and HR Wallingford researchers, in which small and large buildings, and multiple rows of small buildings are also investigated.