Pressure Impulses caused by Wave Impact

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Coastal sea defences fail when the impact pressures due to breaking waves cause their constitutive elements to move. This situation is modelled in an idealised domain by solving a boundary value problem for the Pressure Impulse, the integral of pressure over the short time of the impact. The relative insensitivity of this model to the velocity profile chosen when representing the impacting wave, compared to variables such as the wave's height and speed, is demonstrated explicitly for three profiles. In order to analyse further the impulse on a vertical wall, a class of awkward summations of trigonometric terms is approximated with a rapidly convergent series.

The impulsive forces on a body resting on the sea bed are calculated using two different methods, and shown to be dependent on its added mass and volume. A number of different classes of body are examined and larger objects are found to be more prone to movement away from a wall, due to the pressure impulse gradient along the sea bed. The case of a sphere, where the problem is equivalent to finding the potential flow perpendicular to the line joining two touching spheres, is solved with a very accurate numerical method and the distance moved by a near-spherical boulder on a beach subjected to wave impact is calculated. Similarly, a surface-piercing body experiences a vertical impulse when a wave breaks against a nearby vertical wall. The velocity at which a body will initially move is calculated for several different shaped bodies.

The pressure impulse in a fluid filled crack in a wall which is exposed to wave impact is calculated for several different crack geometries allowing the force on an element of a breakwater to be calculated, showing that these impact pressures are the probable cause of failure.