

Vulnerability of Lock Walls to Waterside Explosive Attacks¹

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ABSTRACT

Infrastructure vulnerability has become a high concern, and the vulnerability of waterway systems in the US to explosive events on and under the water surface is being examined by the US Army Engineer Research and Development Center. This study concentrates on the effects of underwater explosions (UNDEX) against reinforced concrete lock walls. It is impossible to keep vessels away from the locks, as their purpose is to move those vessels up and down the waterways. As such, this study was performed to estimate the damage that could be seen when an UNDEX event occurs in the water within a lock.

A combination of numerical simulations and small scale experiments were performed by varying several parameters. The experimental results provided the basis against which the simulations were gauged to determine their accuracy. Three experiments were performed in a 1/10th scale representation of 400 feet (121.92 m) by 110 foot (33.53 m) wide lock wall system. These had two surface detonations and one underwater detonation. Coupled and uncoupled numerical simulations were performed and then results compared to the experimental data. Preliminary coupled simulations captured the behavior of the water and gross response of the lock wall. Separated, more detailed calculations of the lock walls and the explosion in the water generated good comparisons against the experimental results. Good comparisons between the separated analysis and the experimental results were possible because of the relatively slow response of the concrete walls as compared to the timing of the shock loading in the water. Other UNDEX cases over the parameter space were then examined both for the behavior of the water and the response of the lock walls.