RESPONSE OF CONCRETE MASONRY WALLS TO SIMULATED BLAST LOADS

AUTHORS

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ABSTRACT

Concrete masonry unit (CMU) walls are a common building component that is vulnerable to the loads generated in an explosive environment. This paper describes a series of tests that were conducted at the University of California, San Diego (UCSD) blast simulator facility to study the response of fully grouted, lightly reinforced CMU walls retrofitted with a carbon fiber reinforced polymer (CFRP) laminate to explosive loads. The UCSD blast simulator employs an array of ultra-fast, hydraulic/high pressure nitrogen driven blast generators (BGs) to create simultaneous impacts that simulate full scale explosive events without actual explosive devices. The facility is used to generate high fidelity data on the response and failure processes associated with critical infrastructure subject to explosive loads. The blast simulator can also be used as a proof-of-concept tool that can help assess the viability of innovative hardening and/or protective measures for new and existing structures. The study used the BGs to impact retrofitted CMU walls at velocities that ranged from 14-27 ft/sec, which correspond to impulses between 130-300 psi-msec. The tests showed that the CFRP laminate provided the walls with significant increases in flexural strength and stiffness. Furthermore, the addition of the CFRP changed the failure process of the wall from a flexural mode with a hinge near the midspan to shear mode with diagonal cracking near the supports. Despite the shift from a ductile failure mode to a brittle one, the tests showed that at the highest loads the wall remained intact and the blast hazard was mitigated. The data generated in these blast simulator tests has been used to validate constitutive models used in finite element simulations of fully grouted, reinforced concrete masonry. The validated models have demonstrated, through comparisons with available shock tube test data, to provide reliable predictions of CMU wall response when subject to a large range of explosive loads.