EVALUATION OF A MECHANICAL ANCHORING SYSTEM TO IMPROVE PERFORMANCE OF CARBON FIBER REINFORCED POLYMER MITIGATED CONCRETE SLABS UNDER CLOSE IN BLASTS

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ABSTRACT

Recent events, including the bombings of the Murrah Building in Oklahoma City in 1995 and the World Trade Center in New York in 2001, have drawn attention to the fact that explosive loads can cause extreme damage and loss of life through catastrophic damage to structural components. Reinforced concrete slabs are an extremely common structural component in transportation, military, commercial, and utility infrastructure. Often, reinforced concrete slabs are not designed for blast loads and a threat reassessment during the structure’s service life suggests the need for improved resilience to blasts.

This research identifies a promising retrofit system utilizing structural steel plating and carbon fiber reinforced polymer (CFRP) sheets. CFRP is used to lower dead loads and to permit the installation of the system in close quarters. A slab section is retrofitted with steel armor plating on the compression face and CFRP on the tension face, and a mechanical anchoring scheme is used to ensure the development of the full CFRP strength during flexure. A static three-point-bending test is performed in order to evaluate the efficacy of the anchoring system and to determine a static resistance function.

Finally, nonlinear bending analysis is used to validate the test results, and the static test results are used in a single degree of freedom (SDOF) dynamic analysis to make predictions of dynamic behavior under blast loads.