EVALUATION AND DESIGN OF RETROFIT OF STEEL COLUMN SUBJECTED TO NEAR-CONTACT PBIED

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Key words : Steel column, retrofit, PBIED, CFD, Near-contact

As evidenced by available test data, steel columns are susceptible to failure due to large localized deformations and fracturing of the k-area when subjected to near-contact explosive loading. This paper describes a case study performed on two different steel columns subjected to near-contact loading from a person-borne improvised explosive device (PBIED) along with a retrofit developed to reduce the expected damage to the columns. The analysis was performed using a loosely coupled computational fluid dynamics (CFD) and computational structural dynamics (CSD) code. The CFD code models the detonation of the high explosive, propagation of the shock wave in ambient air, shock reflection from the floor and column, and overpressure loading on the column flange and web surfaces. The CSD finite element (FE) code captures the local displacement and deformation of the column. In this coupled approach, the movement of the column influences the airblast which in turn affects the loading on the structure.

The retrofit developed consists of adding concrete between the flanges of the column to provide added mass that acts to dissipate the energy imparted to the column through damage of the non-structural concrete. The retrofit concept provides a simple yet effective way to minimize the damage to the steel column that does not require expensive strengthening or increase in size of the structural column.