Blast wave injury risk assessment in complex scenarios using numerical simulation

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In recent decades, the rise of terrorist actions as a new threat has led to the need to increase safety levels in urban environments. These environments represent a complex scenario for the expansion of the blast wave, which entails an added difficulty when carrying out survivability analyses. Therefore, further research is necessary to better understand the risks of casualties from blast overpressure, particularly from improvised explosive devices (IEDs) and person-borne explosive devices (PBIEDs) detonated inside buildings. To develop a quick blast wave injury risk assessment, numerical simulation appears as a common tool. However, the complexity of the problem means that the level of uncertainty is usually quite high. For this reason, validation of the numerical results by means of experimental tests is of vital importance, but the number of full-scale experiments is very limited. In this research, three tests have been carried out with different IED configurations simulating a PBIED inside a building using vest bombs. The building consisted of a small concrete structure of 6.80 x 5.80 m with a corridor and an inner room. This work focuses on the injury risk assessment inside the building. For this purpose, the Viper Blast CFD solver is employed to accurately model the blast wave propagation and its interaction with the building's facade and structural elements. The assessment is made using Axelsson SP model by means of ASII (Adjusted Severity of Injury Index) together with tertiary blast injury due to whole body translation and impact. The combination of primary and tertiary blast injury results in an overall risk of fatality. The results are validated by comparing the pressure-time histories recorded during the testing with those obtained from numerical simulations at the same locations, demonstrating that such numerical tools can be used with some degree of confidence to perform predictive injury modelling.