ESTIMATING BLAST EXPOSURES FROM THE 2020 BEIRUT EXPLOSION AND EXAMINING CORRELATION WITH BLAST INJURIES

J.W.Denny[1], S. Al-Hajj[2], J.Batchelor[1]

[1]*University of Southampton, University Road, Southampton, SO17 1BJ, UK;*
[2]*American University Beirut, Riad El-Solh 1107-2020 - P.O.Box 110236, Beirut, Lebanon.*

Key words: Beirut Blast, blast injury, urban blast loading, population study

ABSTRACT

On 4th August 2020, approximately 2750 tonnes of Ammonium Nitrate stored in the port of Beirut ignited, causing a huge explosion that damaged large parts of the city, causing more than 200 deaths and over 7,000 injuries. Injured victims' locations at the time of the explosion were previously unreported and unknown due to improper documentation. Without such knowledge, a victim's degree of blast exposure cannot be estimated, preventing further understanding of how blast loading contributed to injury outcomes.

As a large, city-scale explosion, a victim's blast exposure will have been significantly influenced by their location, including distance from the port detonation, their elevation, and proximity to buildings. In the absence of pressure measurements, engineering models can estimate and provide useful insight into the blast conditions likely to have occurred at different distances from the blast epicentre.

This paper reports on findings from a first-of-kind forensic study of the 2020 Beirut port explosion that aimed to investigate the relationship between victims' blast injury patterns and predicted blast exposure based on their location. Patients were selected from existing Beirut blast injury databases and invited to participate in this study. Over 300 participants completed a structured interview administered by telephone which acquired information on the participants' exact location at the time of the blast, their circumstances, and self-reported injuries alongside clinical records from prior injury databases. Participant locations were determined as precisely as possible and recorded using Google My Maps to obtain corresponding latitude and longitude coordinates. For each location, estimated blast loading parameters were calculated assuming an idealised, hemispherical surface detonation at the port using equivalent charge mass estimates in the literature. Estimated blast loading conditions were analysed against participants' injury severity scores and reported injury patterns to examine correlation between loading intensity and injury outcomes.

Results from this study highlight the capacity and limitations of blast modelling approaches for injury prediction through examination of a real-world urban blast case study. New knowledge can be used to inform disaster management and guide the protection of civilians exposed to urban blasts.