Numerical simulation on the characteristics of blast pressure acting on a box-type structure

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To design structures subjected to blast waves, evaluating the blast loads acting on the structure is necessary. According to previous studies based on geometrical similarities and test results, the scaled distance Z, which is defined as the distance R between a structure and an explosive (stand-off distance) divided by the cubic root of the explosive mass W, has been proposed and used as an index for calculating blast pressure parameters. Using the scaled distance, the incident peak overpressure (peak incident pressure), peak reflected pressure, loading duration, and impulse can be calculated using the charts in the U.S. Protective Facilities Criteria (TM5-855-1 (1986), UFC 3-340-02 (2014)) and the Canadian Design Guidelines (Canadian Standards Association (2012)). Although the behavior of blast waves surrounding a structure is highly complex, the U.S. standards proposed a design method by calculating uniformly distributed pressure on the front wall, top roof, side wall, and rear wall. However, there are no technical documents or design guidelines describing the concept of this method.

This study aims to investigate blast pressure characteristics acting on structures by conducting explosion tests and numerical analysis. First, the evaluation method proposed by the U.S. standards was briefly described. Then, explosion tests were conducted to investigate the pressure characteristics acting on a box-type structure. The correlation between these characteristics and uniformly distributed pressure according to the U. S. standards was discussed.

Numerical simulation was conducted to reproduce the test results and discussed the reflection and diffraction at the front wall, and propagation of the blast wave around the box-type structure.