P32 Blast Testing of Annealed and Tempered Glass Windows

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Abstract:

The effect of blast loading is becoming an increasingly common consideration in the design of civilian structures. Of particular concern is the response of architectural glazing, as the failure of this element often results in an increased level of hazard for the building occupants. Several software packages exist for the analysis and design of glass façades under air blast loading; however, accurate and reliable experimental data to validate these models and the various analysis methods they employ is often limited or non-existent.

Several full-scale blast arena experiments were performed recently to investigate the response of architectural glazing to air blast loading, and data from the tests was collected and analysed. The challenges and set-up of the tests, and the comparison of the experimental results to software predictions are presented herein. A number of monolithic annealed and tempered glass panes were tested at various scaled distances in order to obtain statistically significant results. The one-metre square glass panes, 12 mm thick, were instrumented to measure the free-field and reflected pressure-time history, central pane displacement and time of glass failure. Measurements of the spread of the glass fragments were also collected to determine the hazard ratings of the tests. In addition to the field tests, laboratory experiments were conducted on the glass material to determine its static and dynamic properties.

The experimental data obtained from the blast experiments was compared against the output of several blast analysis software packages. For this purpose, both single degree of freedom and explicit dynamic finite element methods were used to model the test panes and predict their behaviour. In addition to using the maximum principal tensile stress criterion for the glass failure, the experimental data collected was also used to investigate the applicability of the probability-based Glass Failure Prediction Model to blast loading.

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