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Dynamic structural response of laminated glass panels to blast loading

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Abstract

This paper presents an analytical model of 'fully-clamped' laminated glass panel subjected to pulse-pressure loading in an air-blast. The dynamic structural response of the laminated glass panel is decoupled into two distinct phases of motion: phase I is controlled by the elastic deformation of the brittle glass plies whilst phase II is dominated by the large inelastic deformation of the Polyvinyl Butyral (PVB) interlayer. Transition between the two phases follows the large scale fragmentation of the glass plies - this will be captured through a stress-based damage criterion. Following the work of others, the PVB interlayer is idealised as a rigid-perfectly plastic material which allows its large inelastic response to be modelled within the constitutive framework of limit analysis. An interactive yield criterion is adopted to capture the simultaneous influence of bending and membrane stretch that governs plastic flow in the interlayer. Predictions by the analytical model are validated against existing experimental data and they will be shown to be in good agreement. Parametric studies were performed to elucidate the effects of total mass (per unit area) and thickness ratio on the maximum transverse deflection. The efficacy of Youngdahl's technique on desensitising pulse shape effects is also studied.

Keywords: Laminated glass, large deformation, crack formulation, limit analysis, pulse shape

1. Introduction

The structural response of laminated glass panels to high-intensity, short-duration pulse pressure encountered in an air-blast is the subject of several recent assessments, see [1–

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