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Numerical investigation of glass windows under near-field blast

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Abstract. The determination of the blast protection level and the corresponding minimum load-bearing capacity for a laminated glass (LG) window is of crucial importance for safety and security design purposes. In this paper, the focus is given to the window response under near-field blast loading, i.e., where relatively small explosives would be activated close to the target, representative of attack scenarios using small commercial drones. In general, the assessment of the load-bearing capacity of a window is based on complex and expensive experiments, which can be conducted for a small number of configurations. On the other hand, nowadays, validated numerical simulations tools based on the Finite Element Method (FEM) are available to partially substitute the physical tests for the assessment of the performance of various LG systems, especially for the far-field blast loading. However, very little literature is available on the LG window performance under near-field blast loads, which differs from far-field situations in two points: i) the duration of the load is very short, since the blast wavelength tends to increase with the distance and ii) the load distribution is not uniform over the window surface, as opposed to the almost plane wave configuration for far-field configurations. Therefore, the current study focuses on the performance assessment and structural behaviour of LG windows under near-field blasts. Typical behavioural trends are investigated, by taking into account possible relevant damage mechanisms in the LG window components, while size effects for target LG windows are also addressed under a multitude of blast loading configurations.

Keywords: blast; damage; failure; glass windows; near-field; numerical modelling

1. Introduction

The quantification and determination of the blast protection levels attained by glass windows and facades is of crucial importance for both safety and security design purposes (Bedon *et al.* 2018a), and it is normally performed through experimental tests or coupled experimental-numerical investigations (Kranzer *et al.* 2005, Larcher *et al.* 2012, Spiller *et al.* 2016, Chen *et al.* 2021). In the recent years, it is commonly accepted that numerical methods have become much

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