

INVESTIGATING THE PERFORMANCE OF GLASS FACADES UNDER BLAST LOADINGS

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A global rise in explosions has made protective buildings a priority. Glass is still a popular material for modern facades, valued for its aesthetics, cost-effectiveness, and durability. While extensive research exists on Frame Fixed Glass Façade Systems (FFGFS) with continuous edge support, the performance of the more common Point Fixed Glass Façade Systems (PFGFS) under blast loads remains largely unknown. Since experimental procedures are costly and time-consuming, accurate numerical modelling is essential. This study prominently investigates the dynamic behaviour of PFGFS laminated glass facades under blast loads, emphasising the critical role of spider arm connections. Using the LSDYNA software, a detailed numerical model simulates a glass panel and its spider arm assembly across different blast scenarios. The model was initially validated using the literature review for 0.8 TNT and 1.2 TNT blast loads, and these validated models were then used for the parametric study. Using a realistic meshed spider arm instead of an idealised one provided a more accurate representation of the system's structural behaviour. This approach allowed for a better understanding of localised responses, such as stress concentration and energy absorption. The blast load simulation and the accurate assignment of material properties for the glass, PVB, sealant, and spider arms were all based on findings from a literature review. This comprehensive analysis assesses key factors, including the overall energy absorption capacity, stress concentrations in the glass and connecting parts, and maximum deflection. This research also includes a comparative analysis between PFGFS and FFGFS. The findings show that the FFGFS has superior blast resistance. The PFGFS experiences high-stress concentrations near the point supports, which can lead to localised failure. Additionally, the FFGFS experiences high stress concentration around its supports. While the FFGFS quickly transfers loads to its supports, the PFGFS demonstrates greater energy dissipation but is susceptible to failure due to large movements. The numerical simulations, which capture the intricate interactions among the glass, spider arm components, and the supporting structure, allow for a detailed examination of stress propagation, deformation characteristics, and potential failure mechanisms. Incorporating the spider arm model significantly reduced the deflection discrepancy by 16.5% and 20.5% for blast loads of 0.8 TNT and 1.2 TNT, respectively. Since the blast charges had less intensity, the glass largely absorbed the internal energy, and the PVB layer's potential wasn't fully utilised. The results highlight the spider arm's significant impact on the facade system's structural integrity and offer crucial insights into complex load transfer paths and the role of PVB layers in absorbing energy. This research provides important guidance for designing and optimising visually appealing architectural glass facades in blast-prone environments. By advancing the understanding of the blast resistance of PFGFS, this study helps engineers to design more resilient and safer glass façade systems.

Keywords: Laminated glass, Finite element modelling, Point fixed glass facade, Spider arm.

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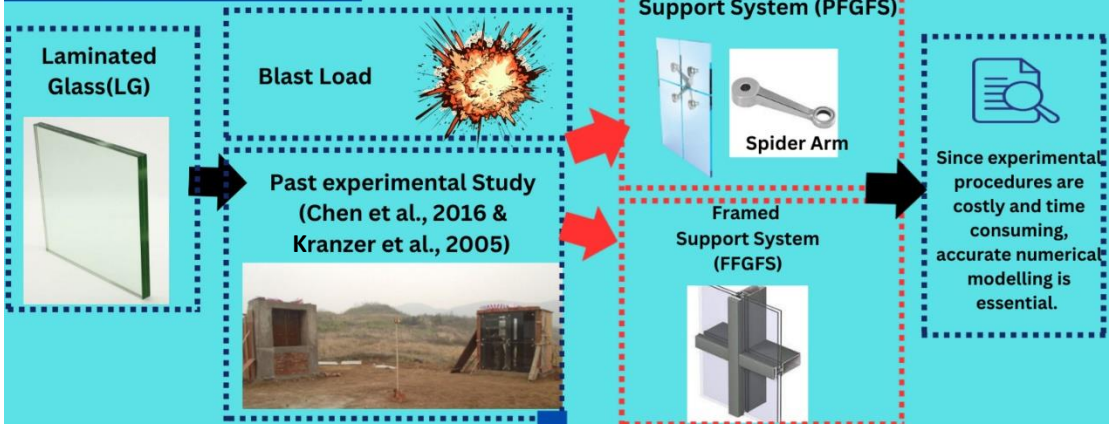


- Application of glass facades has grown increasingly in buildings
- Glass for load-bearing in buildings is a challenge for structural designers

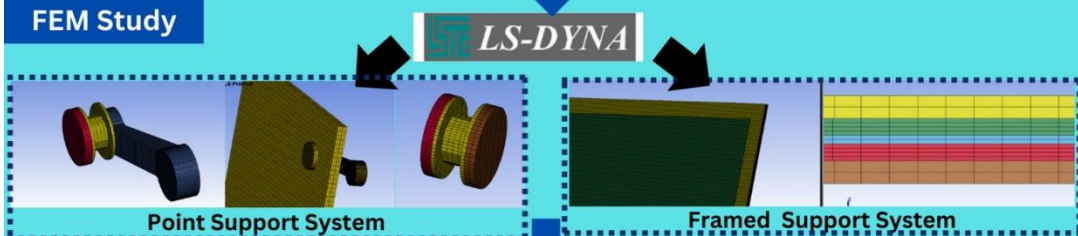


Intentional and unintentional explosion attacks are rising in the world

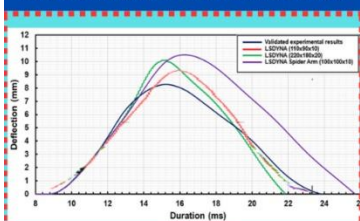
Research methodology



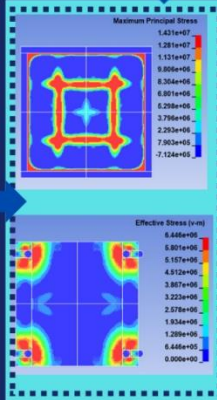
FEM Study



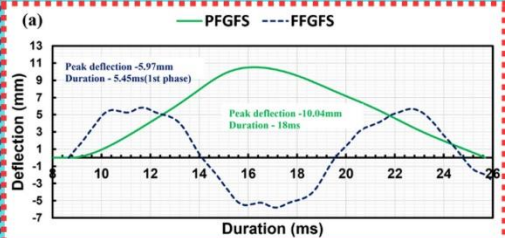
Observation and results



Incorporation of spider arm has improved the accuracy of the model by 16.5 % and 20.5%



Comparative Study



The FFGFS has great performance over the PFGFS in terms of deflection