FINITE ELEMENT ANALYSIS OF POINT FIXED LAMINATED GLASS PANELS UNDER DISTRIBUTED LOAD: A COMPARISON BETWEEN MECHANICAL AND BONDED FIXING SOLUTION

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Eliana Inca (PhD Student); Sandra Jordão (Coordinator of GF SEISMIC Project) ;
Chiara Bedon (Co-Supervisor); Afonso Mesquita (Researcher)

Motivation, Objectives & Methodologies

Pointed Fixed Laminated Glass System are typically used on contemporary building's façade as an architectural statement of transparency, allowing to reach lighter and spacious facilities [Fig. 1]. The fixing elements are characterized by **stainless steel bolts**, that are mechanically attached or bonded to the glass surface [Fig. 1]. However, despite the exponential growth of glass façade construction industry, **design codes** for glass elements are still **under development**.

The numerical analysis here presented, was developed with the aim of **characterize the structural behavior** of Bolted Pointed Fixed Laminated Glass Panels (**PFLGP**), subjected to orthogonal distributed load, e.g., Wind Load. The study focused on the **methodologies to numerically modelled** the articulated bolts and its interaction with the Laminated Glass Panels (LGP), benchmarked with an ongoing **experimental campaign** [Fig. 3]. The first stage was the characterization of the lamination material, considering three different interlayers: PVB, EVA and SentryGlas® [Fig. 2] [Fig. 4]. Next, the characterization of PFLGPs and the correspondent finite element numerical models [Fig. 5], were developed, aiming to compare the performance of three different fixing methods: i) Mechanical (Countersunk bolts), ii) Laminated (Embedded) and iii) Bonded bolts.

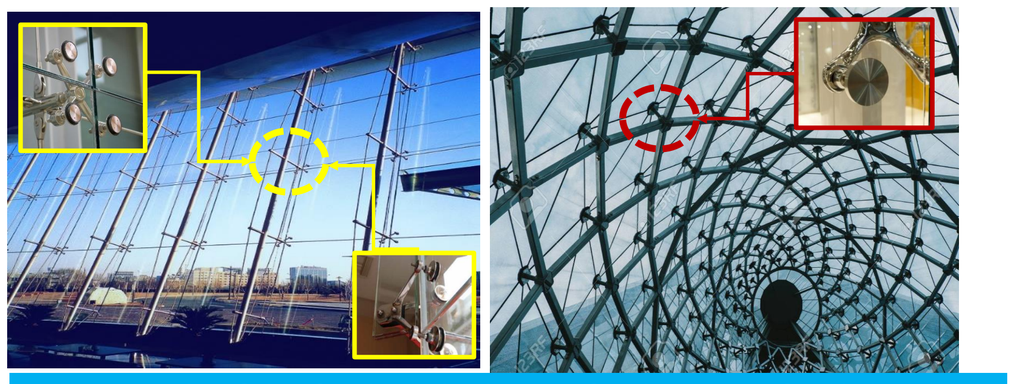


Fig. 1 – Examples of glass façades and utilization of spiders in point fixed bolted panels

Fig. 2 –Experimental campaign Simple Supported Laminated Glass Panels

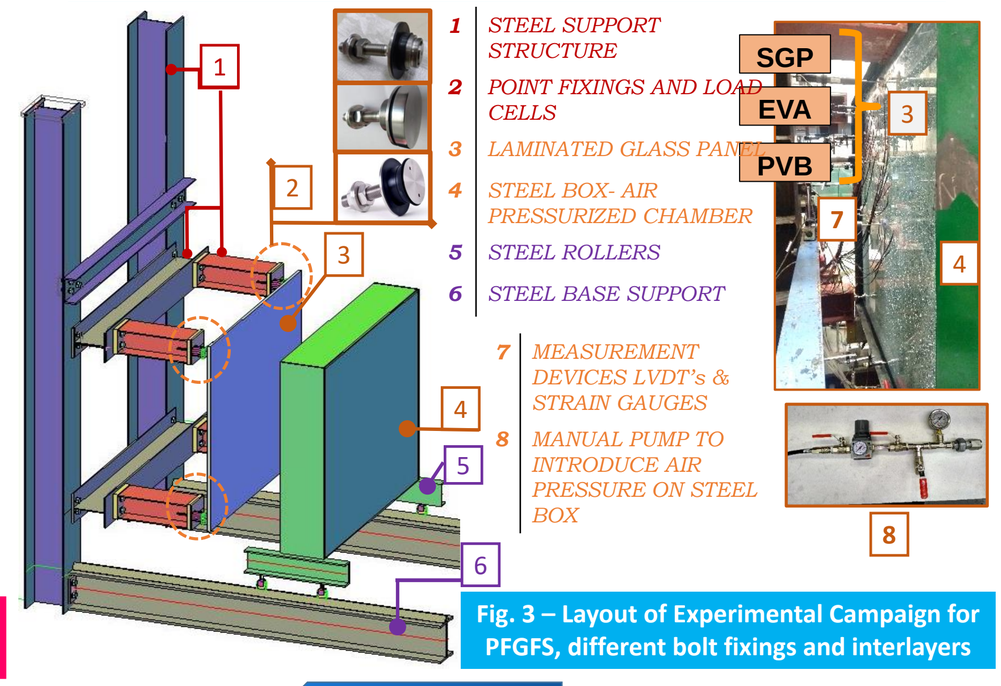


Fig. 3 – Layout of Experimental Campaign for PFGFS, different bolt fixings and interlayers

Experimental campaign on Simple Supported (SSLGP) and Bolted Fixed Panels (PFLGP) under Wind Load

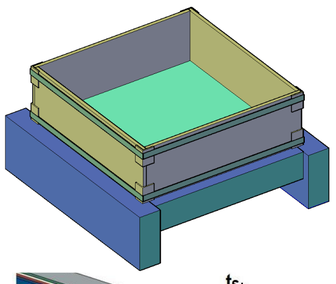
Interlayer: EVASAFE | PVB | SentryGlas

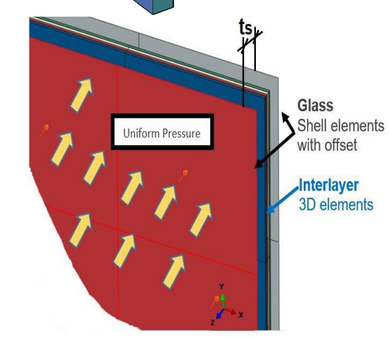
Bolted Fixing: Countersunk | Embedded | Bonded

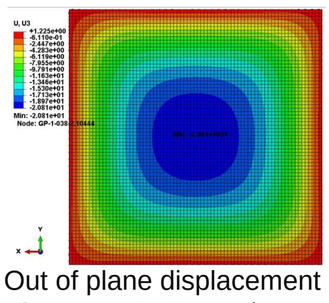
Parametric Variation

Numerical Analysis Validation

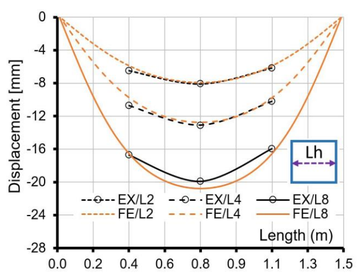
Fig. 4– Workflow



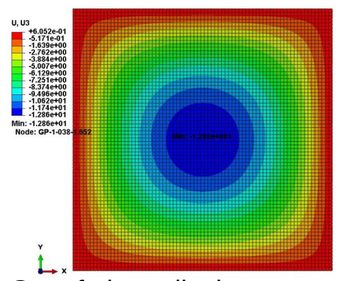




Out of plane displacement Contour– PVB Interlayer



Comparison of Exp and FEM results for Displacement Along Line I - I



Out of plane displacement Contour– SentryGlas® Interlayer

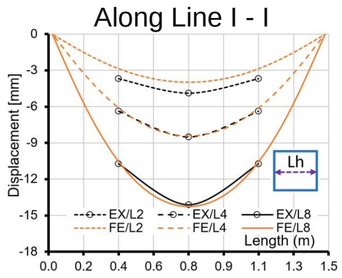
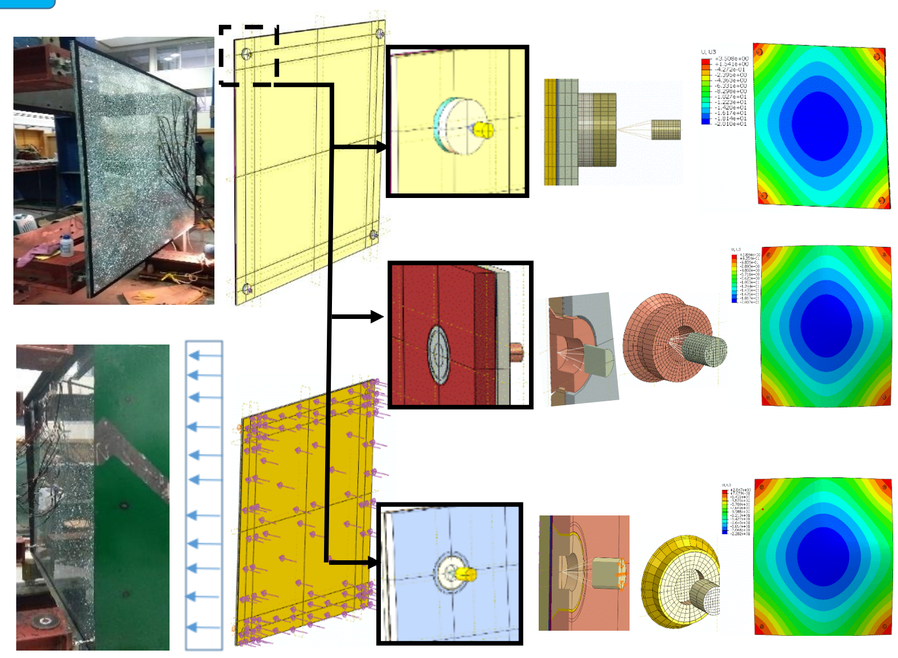
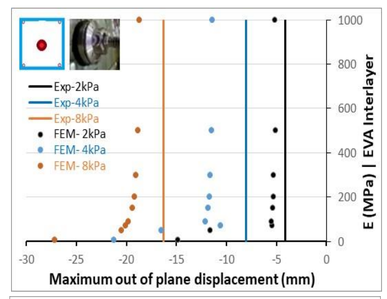
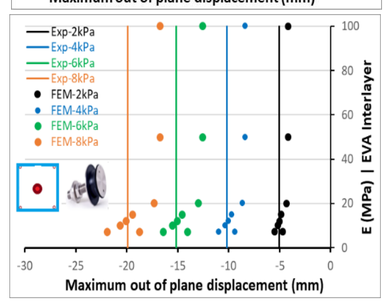


Fig. 5– Numerical Analysis and Results for SSLGP







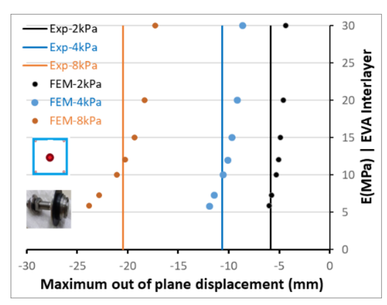


Fig. 6– Numerical Analysis and Results for PFLGP

Outcomes

The methodologies to develop Numerical models for Countersunk, Embedded and Bonded stainless-steel articulated point fixings for Laminated Glass Panels (PFLGP) [Fig. 3], used for facade systems, were presented. The numerical models allow to compare the performance for bonded and classical mechanical fixing solutions, while characterizing the most important parameters for the PFGFS [Fig. 6], in terms of Interaction properties and interlayer material. The results from the numerical models were benchmark with experimental test results from GF-Seismic research project.

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