STRUCUTRAL PERFORMANCE OF EMBEDDED LIQUID-LAMINATED GLASS CONNECTIONS

CertBond
COST Action CA18120

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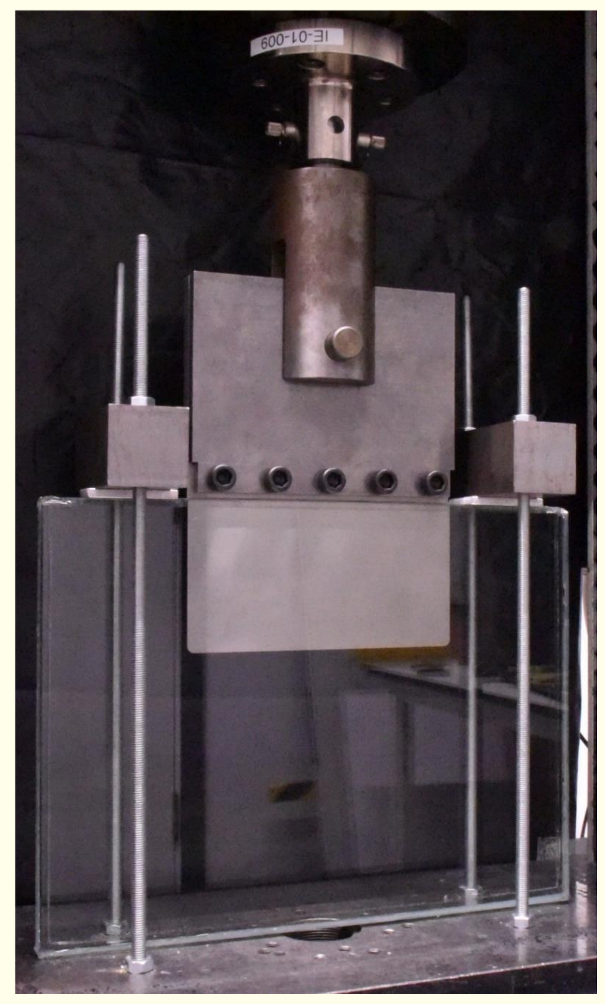
Abstract

Embedded laminated glass connections consist of a metallic insert embedded within a laminated glass unit by means of transparent polymeric foil interlayers. The connection is assembled via the standard autoclave lamination process where the heating/cooling of materials with different coefficients of thermal expansion can lead to residual stresses [1] thus reducing the connection strength.

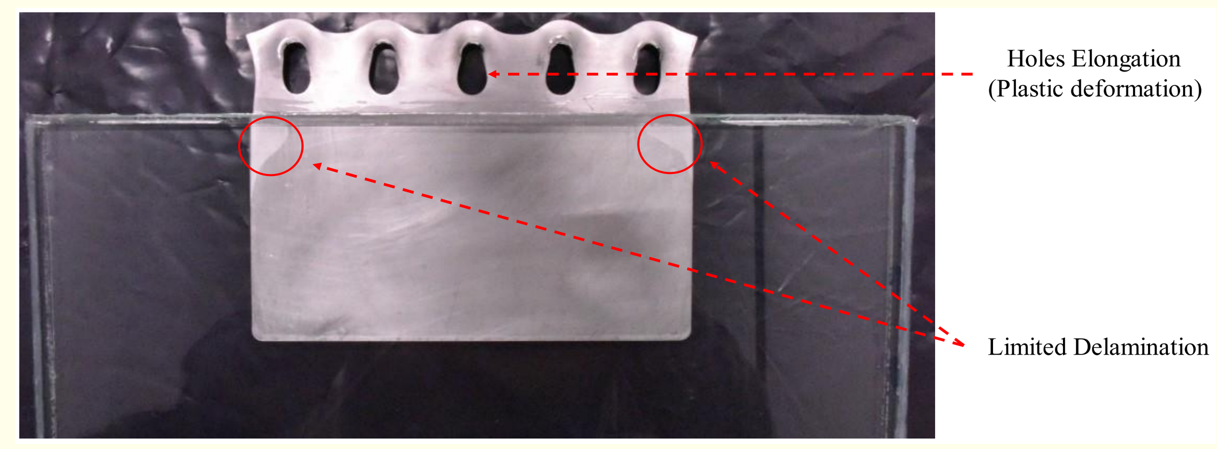
In this work, a variant of this connection is investigated, consisting of a thin steel insert encapsulated by a transparent cold-poured resin to eliminate the unfavourable residual stresses. In particular, the connection mechanical response is assessed via numerical (FE) analyses and pull-out tests performed at different displacement rates (1 & 10 mm/min) to examine the effect of the viscoelastic resin behaviour.

1 Failure Mechanisms

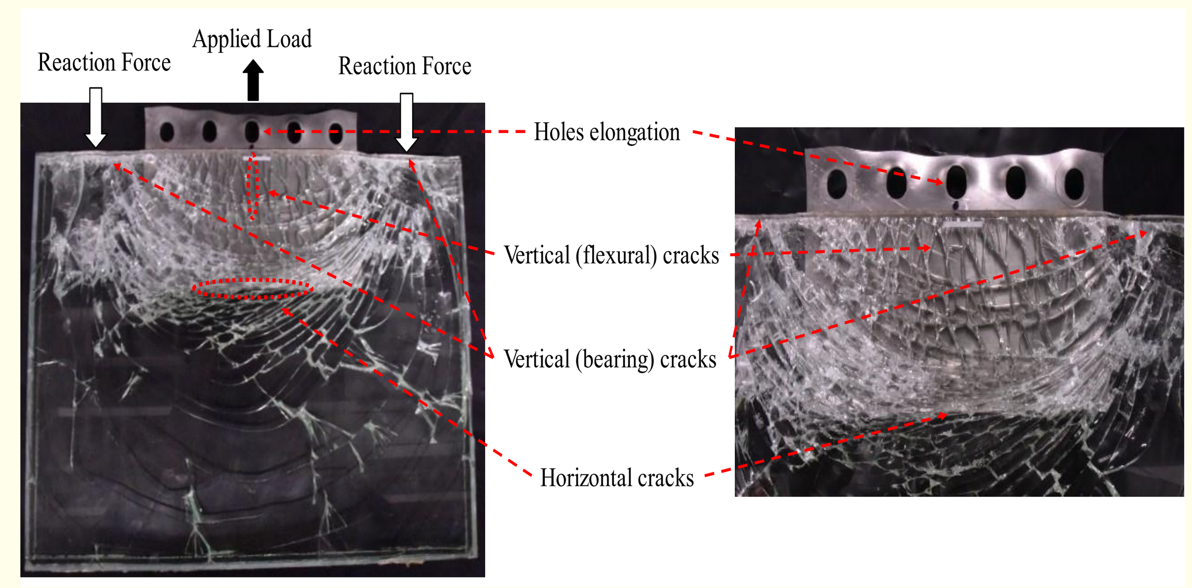
Test Set-up



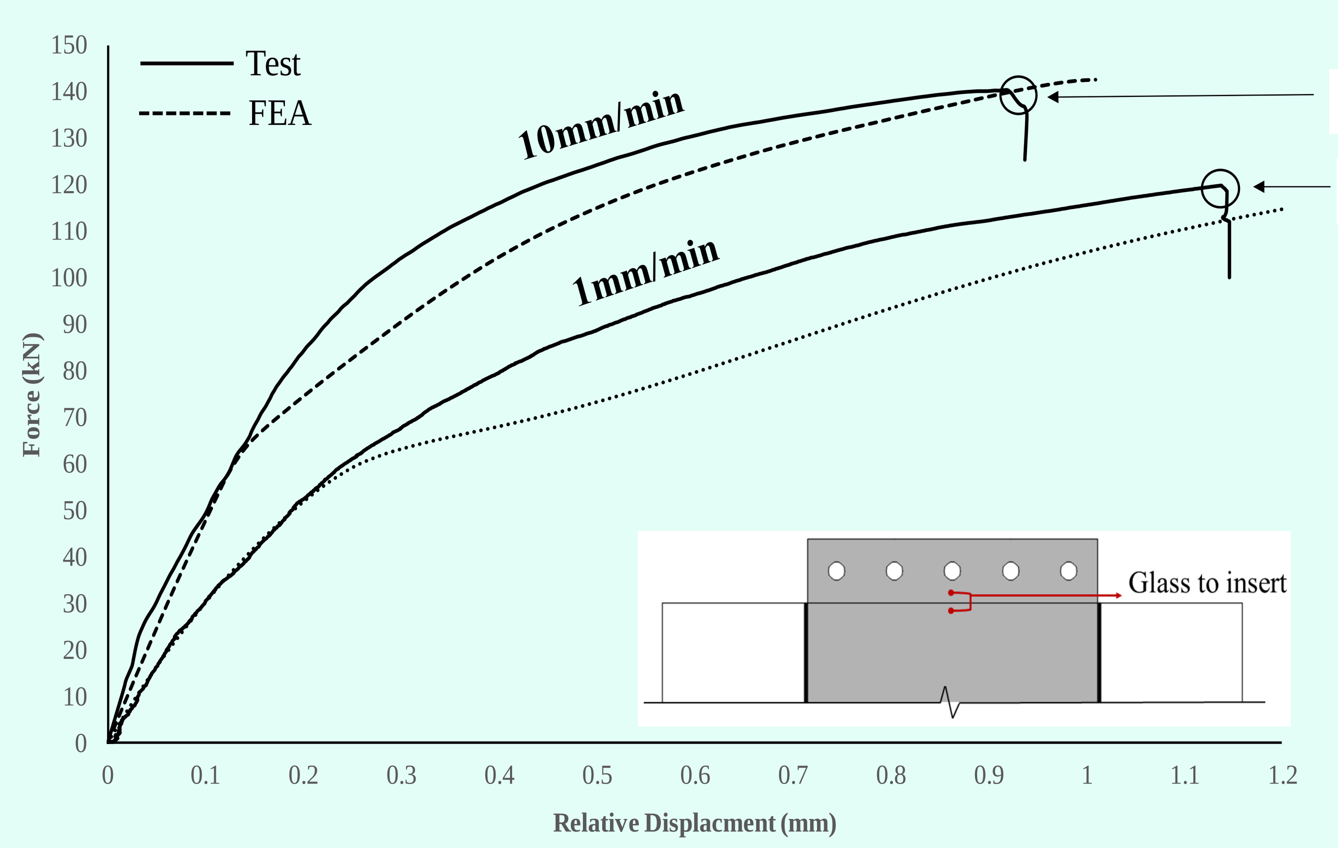
Steel failure (high strain-rate)



Glass failure (low strain-rate)

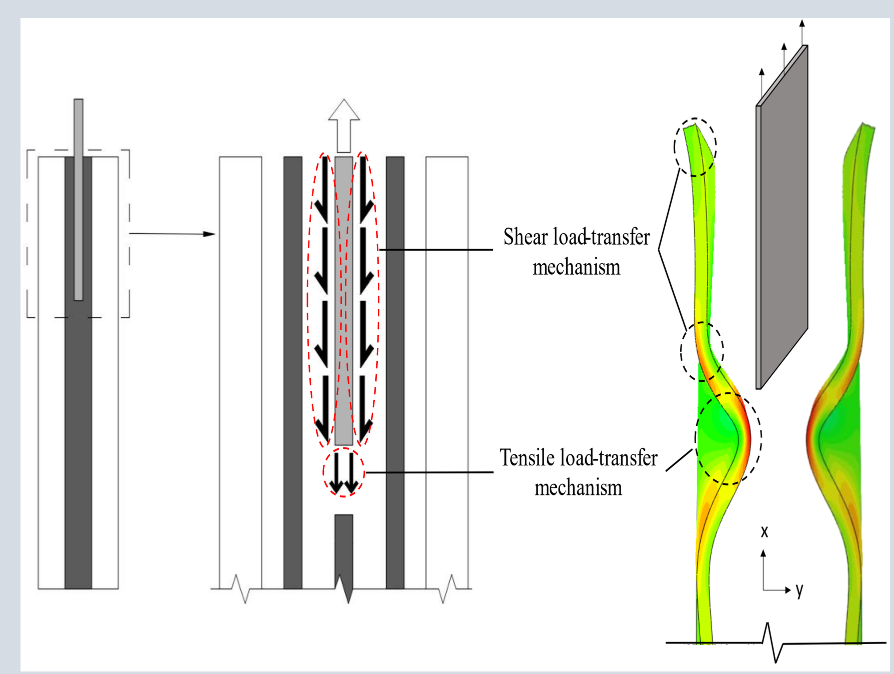


2 Load-Displacement behaviour



High strain-rate tested specimens exhibit higher strength and stiffness

3 Load-Transfer Mechanisms

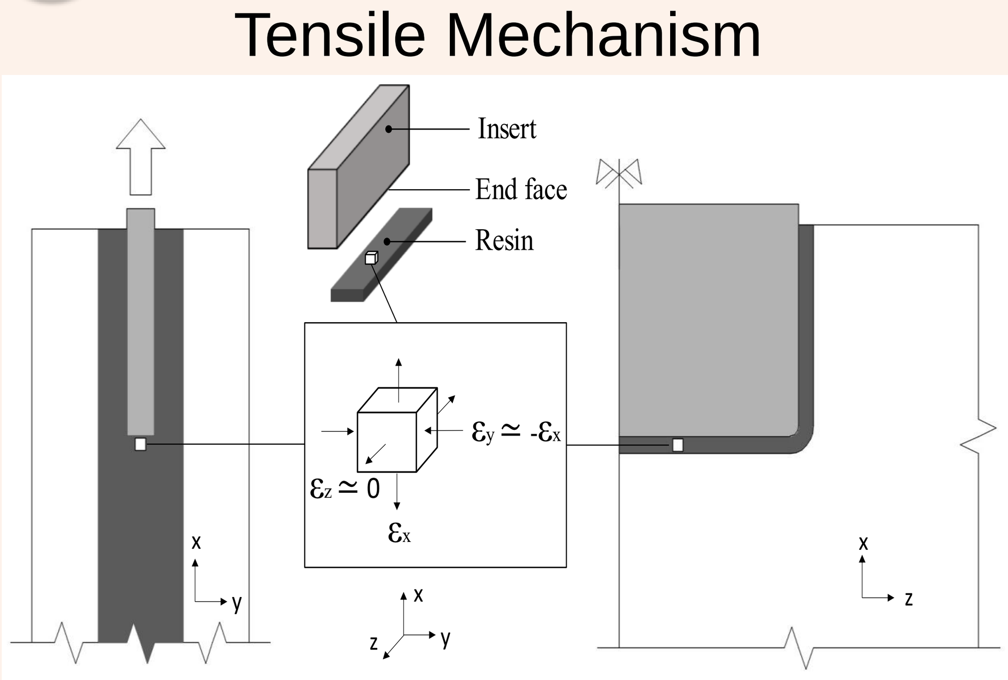


1) Shear mechanism: Shear stresses in the interlayer

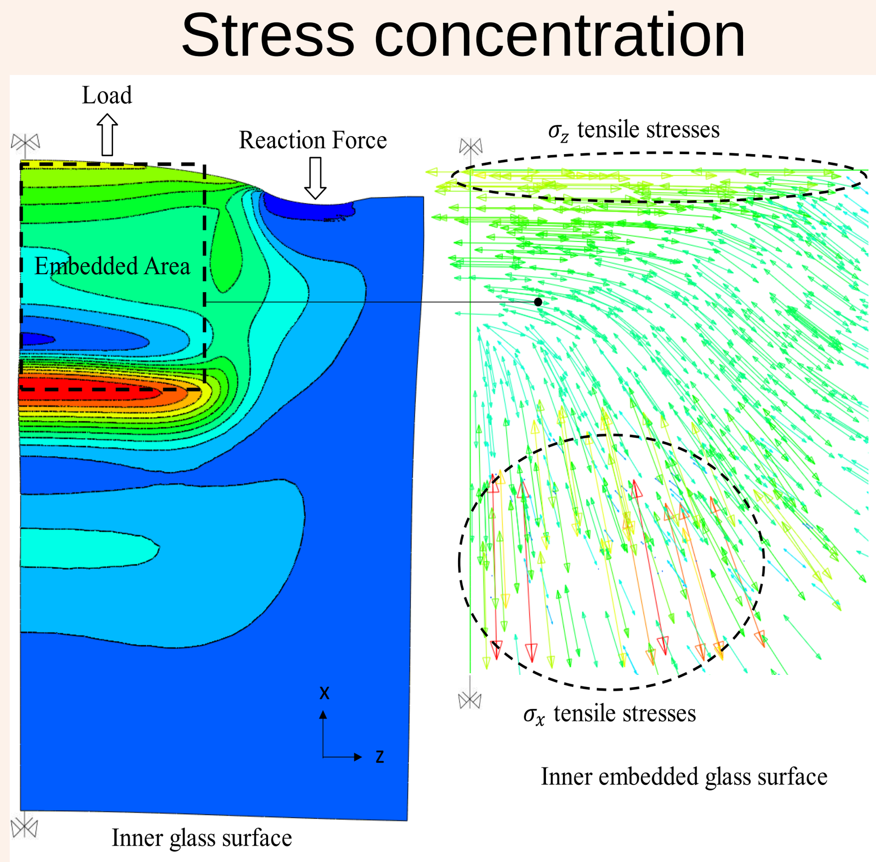
2) Tensile mechanism: Tensile stresses in the interlayer

4 Glass stress state

Tensile Mechanism

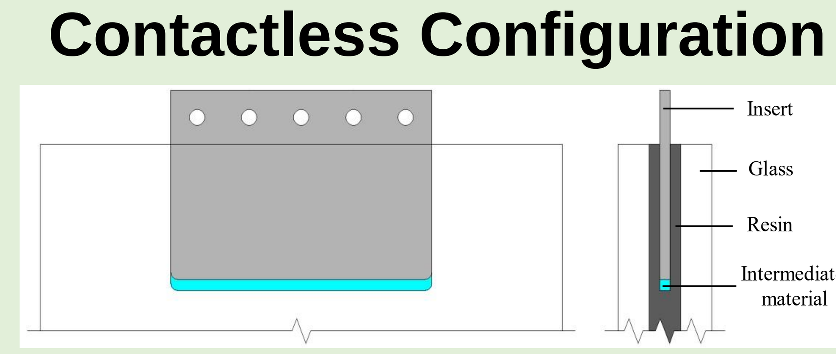


Stress concentration

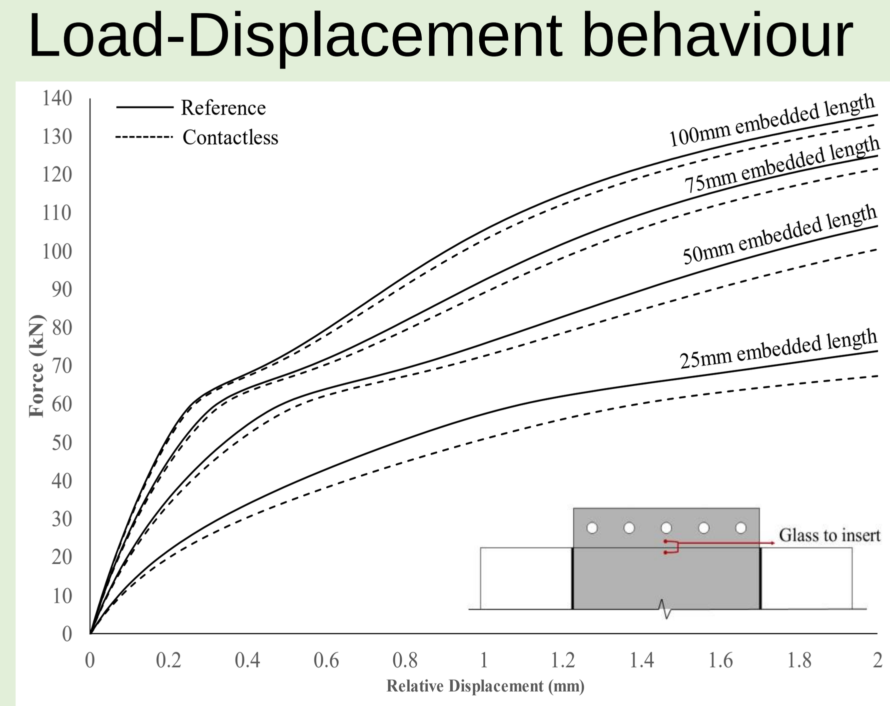


- Resin highly confined

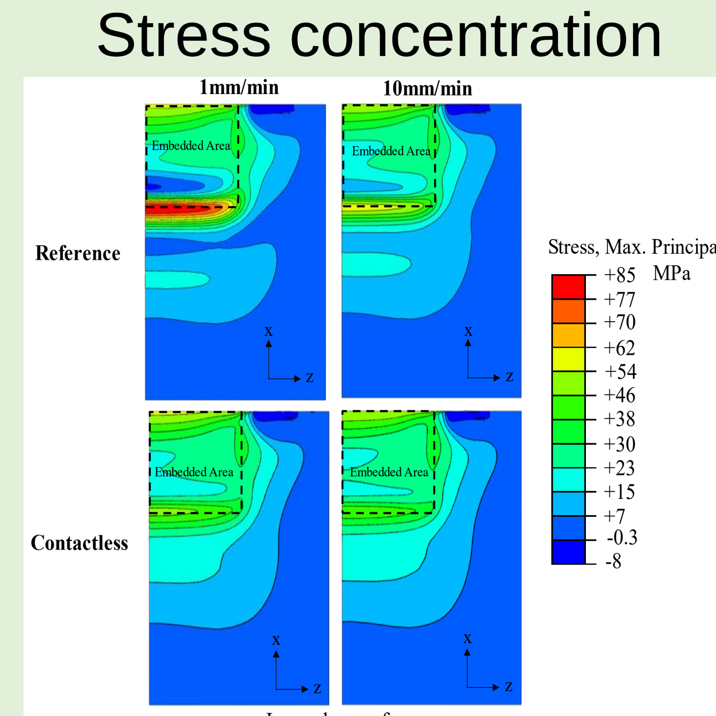
5 Contactless Configuration



Load-Displacement behaviour



Stress concentration



Conclusions: The tests showed that the stiffness, the load-bearing capacity and the failure mode of the connection are significantly affected by the imposed strain rate. The FE results indicate that the resulting stress state within the connection is a consequence of two load-transfer mechanisms and that the relative contribution of each mechanism depends on the relative stiffnesses of the constituent materials. In this regard, a modified embedded connection (contactless) configuration was proposed that significantly reduces the glass stress concentration without compromising the pull-out stiffness of the connection or its aesthetic qualities.

References : [1] Santarsiero, M., Bedon, C., Louter, C.: Experimental and numerical analysis of thick embedded laminated glass connections. Composite Structures, 242-256 (2018)

Funded by the Horizon 2020 Framework Programme of the European Union

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