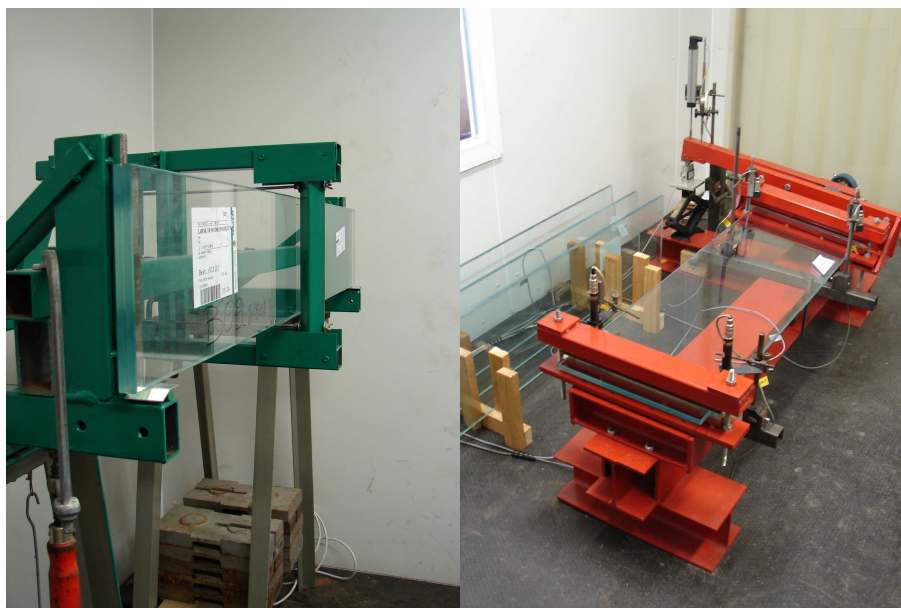


UGent LMO Project sheet

Research project : Stiffness of glass/ionomer laminates in structural applications

Image :



Researchers involved :

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Time span : September 2006 – ongoing. PhD defence expected by the end of 2011

Description : To raise the transparency in constructions, laminated glass is increasingly used as a load bearing element. Although the main reason to combine brittle glass sheets with soft polymer layers is to enhance the post-breakage behaviour (see LMO Project sheet *Post-breakage behaviour of laminated safety glass in structural applications*), these interlayer materials have an important influence on the overall stiffness and strength of the unbroken element as well. Therefore, the mechanical behaviour of the interlayer must be known accurately to allow a safe and economic design. Consequently, the objectives of this project are to experimentally determine the visco-elastic material properties of the ionomer interlayer SentryGlas® and to ameliorate the knowledge on the mechanical behaviour of laminated glass in general. Considering the various loads structural glass elements are often subjected to, the test programme was composed with two pure and complementary loading conditions: three-point bending about the weak axis and torsion about the longitudinal axis. With a combination of these two cases, most realistic loading situations can be evaluated, such as the lateral torsional buckling of laminated beams, which is dominated by the bending stiffness about the weak axis and the torsional stiffness of the laminate. Because this ionomer interlayer behaves visco-elastic, the mechanical properties vary in function of realistic load duration temperatures. Therefore, each experiment was performed at different temperature levels between 5 °C

and 65 °C and lasted no less than 24 hours. Although the shear modulus of the interlayer is always at least a factor 100 smaller than the shear modulus of glass, the experiments proved that the visco-elastic material properties of the ionomer interlayer material extremely influence the overall mechanical behaviour of the laminate. By increasing the temperature or the load duration, the stiffness of the interlayer decreases and the stiffness of the laminate reduces significantly.

From these experiments, it became clear that generalizations between the material properties of the interlayer - determined by the temperature and the load duration - and the overall stiffness of the laminate are dependent on the span and the loading conditions. For example, a change of span has a significantly different effect on the bending stiffness than on the torsional stiffness of the laminate. Consequently, a direct calculation of the stiffness of a laminate for each particular case based on a mechanical material model of the interlayer seems much more reliable than the use of a simplified factor which “translates” a certain interlayer stiffness to a generally valid overall stiffness of the laminate.

Acknowledgements : This project is supported by the Research Foundation Flanders (FWO-Vlaanderen, grant nr. 3G018407)

Most important publications :

- CALLEWAERT, Dieter; BELIS, Jan; DELINCE, Didier; VAN IMPE, Rudy
Experimental Stiffness Characterisation of Glass/Ionomer Laminates for Structural Applications
Submitted to Construction and Building Materials, March 2011.
- CALLEWAERT, Dieter; BELIS, Jan; DELINCÉ, Didier; SONCK, Delphine; VAN IMPE, Rudy
Torsional stiffness of laminated glass elements in structural applications – influence of a elasto-viscoplastic ionomer interlayer on the pre-breakage behaviour
Proceedings of Engineering Plasticity and Its Applications 2010, Wuhan, China, pp. 76-80.
- CALLEWAERT, Dieter; BELIS, Jan; DELINCÉ, Didier; SONCK, Delphine; VAN IMPE, Rudy
Bending stiffness of laminated glass elements in structural applications – influence of a elasto-viscoplastic ionomer interlayer on the pre-breakage behaviour
Proceedings of Engineering Plasticity and Its Applications AEP2010, Wuhan, China, pp. 81-85.
- CALLEWAERT, Dieter; DEPAEPE, Jonathan; DE VOGEL, Kenneth; BELIS, Jan; DELINCÉ, Didier; VAN IMPE, Rudy
Influence of Temperature and Load Duration of Glass/Ionomer Laminates – Torsion and Bending Stiffness
Proceedings of International Symposium on the Application of Architectural Glass ISAAG2008, Munich, Germany, pp. 51-63.
- CALLEWAERT, Dieter; DELINCÉ, Didier; BELIS, Jan; VAN IMPE, Rudy
Temperature-dependent behaviour of glass/ionomer laminates: preliminary test results
Proceedings of Challenging Glass 2008, Delft, the Netherlands.

Sheet compiled on: 2011.08.02