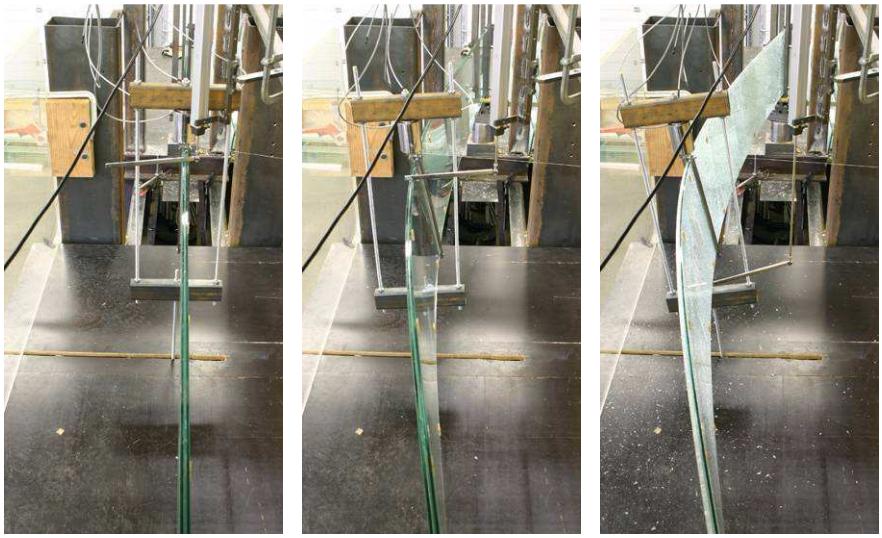
UGent LMO Project sheet

Research project : Lateral Torsional Buckling of Monolithic and Laminated Glass Beams

Image :



Researchers involved :

- BELIS, Jan; (former PhD researcher)
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Time span : 2000 – 2005

Description :

Because structural glass members such as beams and fins typically have a relatively high slenderness, their design will often be dominated by lateral torsional buckling (LTB) and not only by strength. However, there was (and still is) a lack of standards to deal with stability issues in structural glass. In addition, strength issues addressed in existing glass design recommendations are usually limited to data obtained from experiments in which the glass was loaded perpendicularly to its plain, without providing information on the strength of edge loaded glass, as would be required for beams.

Consequently, the main objective of this research was to obtain a better understanding of the load-bearing capacity of monolithic and laminated glass beams, taking into account both stability and strength issues.

Several methods have been applied to obtain these objectives.

Firstly, a large experimental campaign was executed, mostly on beams with a length of three metres and a different height, thickness, glass type and – wherever applicable- interlayer type. More specifically, the major parameters influencing glass beam stability have been investigated, including initial shape imperfections (Fig. 1), load eccentricity, mounting errors, residual stresses, interlayer type and subsequent loading cycles. In addition, the edge bending strength of glass was investigated by means of four-point in-plane bending tests, derived from EN 1288, and a custom test setup was built to determine the torsional stiffness.

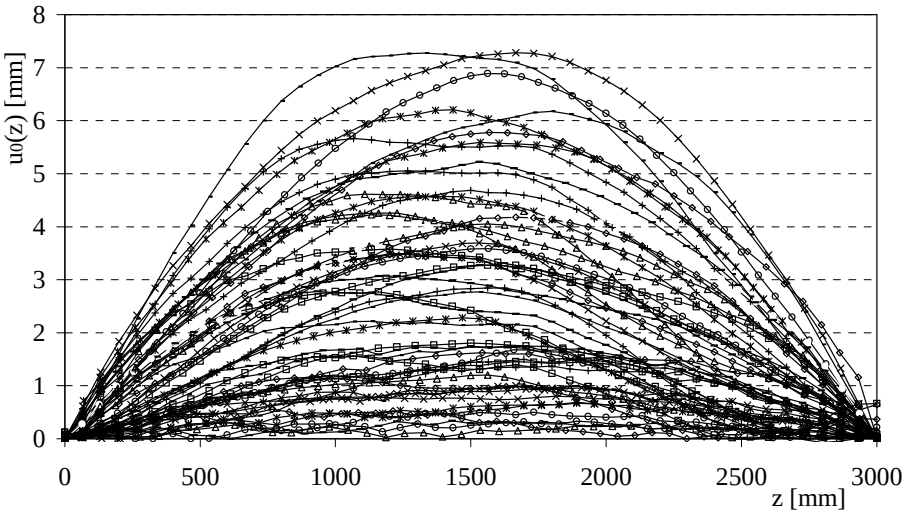

Figure 1. Results of experimental initial geometrical imperfection measurements on laminated glass beams with a length of 3m.

Secondly, a finite elements model was built to numerically analyse the buckling resistance of monolithic and laminated glass beams by means of automated parametric analyses, taking into account all parameters which had been investigated in the experimental campaigns.

As a final result, a design concept was proposed and design tables were created to quickly determine the design load of glass beams with a span of one to six metres, for a length to width aspect ratio of 10 to 25, for a thickness of four to 2*19 millimetres, for PVB and SG, and for different serviceability temperatures.

Most important publications :

- BELIS, J; MOCIBOB, D; LUIBLE, A; VANDEBROEK, M.
  On the size and shape of initial out-of-plane curvatures in structural glass components,
  Construction and Building Materials 2011. 25; 2700-2712.
- BELIS, J; VAN IMPE, R, LAGAE, G; VANLAERE, W.
  Enhancement of buckling-load bearing capacity of glass beams by means of lateral restraints
  Structural Engineering and Mechanics 2003. 15(5); 495-17.
- BELIS, J.
  Kipsterkte van monolithische en gelamineerde glazen liggers
  PhD thesis, Ghent; Ghent University, 2005.
- BELIS, J; VAN IMPE, R; LAGAE, G.
  Parametric approach of buckling of load-bearing glass beams
  Proceedings of Advances in Structural Engineering and Mechanics 2004, Seoul, 1599-9.
- BELIS, J; VAN IMPE, R; PIRAS A.
  Effect of Residual Stresses on the Buckling Behaviour of Glass Beams
  Proceedings of Glass Processing Days 2005, Tampere, 537-3.

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