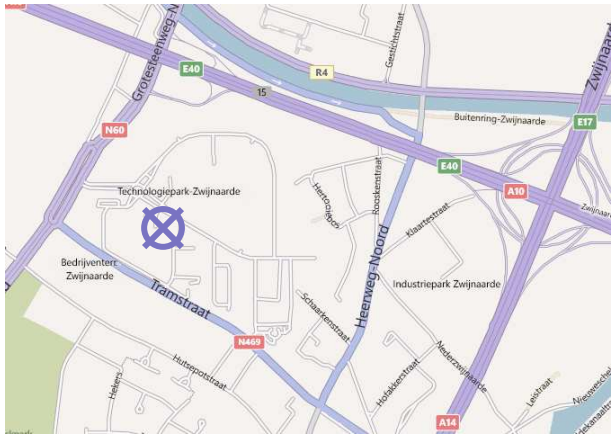
The public PhD defence
will take place on:

MONDAY DECEMBER 12th, 2011
at 15:30

In the **faculteitsraadzaal** of the
Faculty of Engineering and Architecture
Technologiepark 904
9052 Zwijnaarde



After the defence, you are kindly invited for a reception and walking dinner

Please confirm your attendance before Monday December 5th:

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STIFFNESS OF GLASS/IONOMER LAMINATES
IN STRUCTURAL APPLICATIONS

Dieter Callewaert

dissertation submitted
for obtaining the degree of:

Doctor of Philosophy in Structural Engineering

Academic year 2011-2012

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UNIVERSITEIT GENT

INVITATION

to the public PhD defence of

Dieter Callewaert, MSc Eng Arch

Stiffness of Glass/Ionomer Laminates in Structural Applications

Laboratory for Research on Structural Models
Department of Structural Engineering
Faculty of Engineering and Architecture
Ghent University

Summary

The increasing demand for transparent constructions leads to an expanded use of glass as a supporting element. To solve safety issues related to the brittle nature of the material, commonly laminated glass is used. The latter consists of several glass sheets which are attached to plastic interlayers over their entire surface. In case of fracture of a glass pane, this polymer interlayer is able to absorb energy, so the fraction of multiple glass sheets is in most cases avoided. Moreover, the glass fragments stick to the interlayer, so the risk of possible injury is diminished.

This research specifically focuses on the mechanical behaviour of laminated glass with an ionomer interlayer, namely SentryGlas®, in structural applications. SentryGlas® is a relatively stiff interlayer, of which the mechanical behaviour is less known than e.g. the more traditional interlayer material PVB. Therefore, an extensive test program was executed with both torsional and bending tests, by which the time and temperature dependent stiffness of the laminates was determined experimentally.

As a first step in the analysis, the relationship between the test temperature and the load duration was determined. The corresponding time-shift function allows the prediction of the long term behaviour at a certain temperature level based on the experimental results of short tests performed at a higher temperature. Additionally, it becomes possible to analyse together the results of multiple test series, performed between 5 °C and 65 °C.

All results were then processed using the equivalent thickness method, as proposed in the European pre-standard prEN 13474. The outcome indicated that the resulting equivalent thickness is highly dependent on the test configuration and therefore not directly useful to predict the laminate stiffness under divergent loading conditions.

Therefore, all results of experiments on laminated glass were transformed into the actual material properties of the intermediate layer itself, using both analytical and finite element modelling.

Finally, a user-friendly material model was composed, based on the numerically obtained shear modulus of the interlayer which yielded the lowest dispersion and seemed to fit best with the real test configuration. The model allows the calculation of a laminated structural element in an application with realistic loading conditions. This is possible with both simplified elastic models, as with finite element packages for more complex visco-elastic simulations.

Dieter acknowledges the Research Foundation - Flanders (FWO-Vlaanderen, grant nr. 3G018407) for the financial support.

Curriculum

Dieter Callewaert (° Waregem, January 9th, 1982) graduated in 2006 with a Master of Science in Engineering: Architecture from Ghent University. Already during his Master studies, he made his first steps in glass research at the Laboratory for Research on structural Models at the Department of Structural Engineering, with his thesis ‘Bolted and welded joints in float glass: an experimental study.’

After his studies, he immediately started his doctoral research. In addition, he was supervising student project work during the course ‘Engineering Project I’ and he coached 13 master students with their thesis about structural glass. Since March 2011, he works as a project engineer on the technology transfer research project 'Building with glass and adhesives’.

In 2009, Dieter Callewaert won the advanced researcher best presentation prize of the 10th Faculty of Engineering PhD Symposium, Ghent. He was substitute member of the Technical Committee ‘Glass Works’, the working group 'TV special glass applications’ and the IABSE International Working Group ‘Structural Glass'. Currently, he is an active member of the COST Action TU0905 ‘Structural Glass - Novel Design Methods and Next Generation Products’.

Finally, Dieter is (co-)author of about 40 scientific publications and he presented his research findings at numerous national and international conferences.