World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:12, No:12, 2018

Investigation of the Material Behaviour of Polymeric Interlayers in Broken Laminated Glass

Authors : Martin Botz, Michael Kraus, Geralt Siebert

Abstract : The use of laminated glass gains increasing importance in structural engineering. For safety reasons, at least two glass panes are laminated together with a polymeric interlayer. In case of breakage of one or all of the glass panes, the glass fragments are still connected to the interlayer due to adhesion forces and a certain residual load-bearing capacity is left in the system. Polymer interlayers used in the laminated glass show a viscoelastic material behavior, e.g. stresses and strains in the interlayer are dependent on load duration and temperature. In the intact stage only small strains appear in the interlayer, thus the material can be described in a linear way. In the broken stage, large strains can appear and a non-linear viscoelasticity material theory is necessary. Relaxation tests on two different types of polymeric interlayers are performed at different temperatures and strain amplitudes to determine the border to the non-linear material regime. Based on the small-scale specimen results further tests on broken laminated glass panes are conducted. So-called 'through-crack-bending' (TCB) tests are performed, in which the laminated glass has a defined crack pattern. The test set-up is realized in a way that one glass layer is still able to transfer compressive stresses but tensile stresses have to be transferred by the interlayer solely. The TCB-tests are also conducted under different temperatures but constant force (creep test). Aims of these experiments are to elaborate if the results of small-scale tests on the interlayer are transferable to a laminated glass system in the broken stage. In this study, limits of the applicability of linear-viscoelasticity are established in the context of two commercially available polymer-interlayers. Furthermore, it is shown that the results of small-scale tests agree to a certain degree to the results of the TCB large-scale experiments. In a future step, the results can be used to develop material models for the post breakage performance of laminated glass.

Keywords : glass breakage, laminated glass, relaxation test, viscoelasticity
Conference Title : ICCCE 2018 : International Conference on Construction Materials and Civil Engineering
Conference Location : New York, United States
Conference Dates : December 17-18, 2018