| | **Project datasheet COST Action TU0905** |
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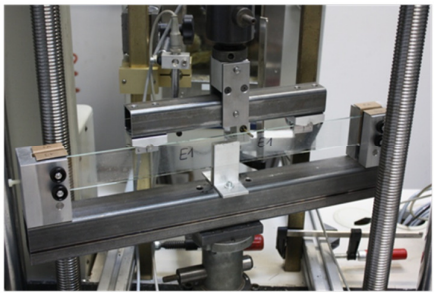
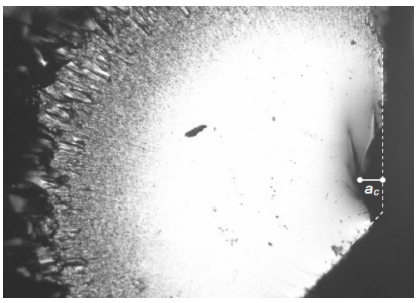
| Research project : | **GLASS EDGE STRENGTH MODEL** |
| Images : |  Fig. 1: In-plane four-point bending test setup  Fig. 2: Measurement of the critical flaw depth by means of an optical microscope |
| Keywords : | Glass, experiment, flaw, edge strength model, subcritical crack growth. |
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| Time span : | 2009 – ongoing |
| Description : | **INTRODUCTION**<br><br>A precise estimation of the edge strength becomes an important issue when designing structural glass beams or façade mullions. However, in literature, the edge strength is poorly documented compared to the surface strength. In particular, the experimental validation of an edge strength model is lacking. Therefore, in this project, firstly the parameters of the edge strength model are determined by means of testing at a high stress rate. Secondly, the edge strength model is validated by the test results at a low stress rate.<br><br>Multiple parameters affect the edge tensile strength of glass, such as 1) the type of edge finishing, 2) the load duration and 3) the environmental conditions. The first parameter affects the number and the shape of the edge flaws and the corresponding flaw population caused by processing the edge. This flaw population determines the inherent variability of the inert or short-term strength, i.e. the strength when no subcritical crack growth occurs. However, the atomic bond strength has a rather constant, much higher value. This confirms that it is not the material itself, but the flaw population on the surface which causes the strength variability, as is generally accepted in linear elastic fracture mechanics. The latter two parameters have an impact on the subcritical crack growth induced by stress corrosion (static fatigue).<br><br>**OBJECTIVES**<br><br>The main objective is to establish an edge strength model for different edge finishings. |

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| | **METHOD**<br><br>In this project, glass specimens were subjected to in-plane four-point bending tests (Fig. 1). These tests were performed on polished, ground, arrised and cut edges at a high stress rate (50 MPa/s), at a medium stress rate (2 MPa/s) and at a low stress rate (0.08 MPa/s). Testing the edge at different stress rates, is, although rarely exercised in past studies, essential for the validation of an edge strength model.<br><br>Firstly, after the high stress rate testing, the critical flaw causing failure was examined by means of an optical microscope to determine its depth (Fig. 2). By means of linear elastic fracture mechanics principles, the geometry factors of the critical flaws were determined for the edge flaws, and were found to be close to the theoretical values for quarter circle edge flaws described in literature.<br><br>Secondly, the experimental results at the low stress rate were found to comply with the edge strength model, using the aforementioned geometry factor and the stress corrosion parameters commonly used for surface strength assessment. |
| Most important publications : | - VANDEBROEK, M.,BELIS, J., LOUTER, C., VAN TENDELOO, G.<br>*Experimental validation of edge strength model for glass with polished and cut edge finishing*<br>Engineering Fracture Mechanics, 2012 (in press)<br>- VANDEBROEK, M., BELIS, J., LOUTER, C.<br>*Influence of load history on the edge strength of glass with cut edge finishing*<br>Challenging Glass 3, Conference on Architectural and Structural Applications of Glass, Delft: 2012, 587-596.<br>- VANDEBROEK, M., LINDQVIST, M., BELIS, J., LOUTER, C.<br>*Edge strength of cut and polished glass beams*,<br>Proceedings of Glass Performance Days, Tampere: 2011, 476-479.<br>- LINDQVIST, M., VANDEBROEK, M., LOUTER, C., BELIS, J.<br>*Influence of edge flaws on failure strength of glass*,<br>Proceedings of Glass Performance Days, Tampere: 2011, 126-129. |
| Working group : | WG 2. Material characterization and material improvement |
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