Accepted Manuscript

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PII: S1359-8368(16)33196-1

DOI: 10.1016/j.compositesb.2017.05.062

Reference: JCOMB 5085

To appear in: *Composites Part B*

Received Date: 23 December 2016

Revised Date: 12 April 2017

Accepted Date: 21 May 2017

Please cite this article as: Castori G, Speranzini E, Structural analysis of failure behavior of laminated glass, *Composites Part B* (2017), doi: 10.1016/j.compositesb.2017.05.062.

STRUCTURAL ANALYSIS OF FAILURE BEHAVIOR OF LAMINATED GLASS

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Abstract

The use of laminated glass is increasing since it is able to guarantee robustness requirements so by improving the post-breaking characteristics of the glass. Due to the brittle nature of glass the reason for employing such composite materials are related to their ability to avoid cracks propagation, retain the glass fragments and present a post-cracking phase. Since the behavior of laminated glass depends on the constituent materials and especially on the type of interlayer, this research deals with the structural behavior of laminated glass plates made with different types of interlayer materials: PVB, SGP, EVA and XLAB. Twenty-four specimens were constructed with two annealed glass plies and transparent interlayer and were subjected to four point bending tests with the aim to study their structural behavior in both elastic and post-breaking phases. Laboratory outcomes highlight the enhanced initial-breakage strength of the XLAB plates, as well as the influence of the laminate type on the post-failure safety, since the use of thicker (double or triple ply) and/or stiffer (such as SGP and XLAB) interlayers seemed not to improve the residual load-carrying capacity. Finally, a 3-dimensional FE model is also presented for reproducing the structural behavior of the glass plates. The ability of the numerical model to reproduce experimental results for the load–deflection curves is validated promoting a deeper understanding and knowledge of the capabilities of the different types of interlayers in the context of the laminated glass design.

Keywords: A. Glasses; A. Layered structures; C. Strength; D. Mechanical testing.

1. Introduction

Structural robustness is an essential requirement in glass structures design, since glass breaks suddenly (even if stresses are low) due to inclusions within glass, to the presence of micro-defects or to scratches caused by the finishing and cutting process as investigated by Speranzini et al. in [1]. Robustness is a property that makes constructions not suffer disproportionate failure, including progressive collapse [2]. It can be obtained by eliminating or reducing risks to which structures can be subjected, or by designing structural solutions with low sensitivity to risks [3][4]. Thus structural glass design is based on the new “fail-safe” design philosophy, which is aimed at ensuring safe breakage and avoiding collapse [5]. These objectives can be achieved by structural