Characterisation of residual stress in glass

B.A. Balan[1], M. Achintha[1*]

Faculty of Engineering & Environment, University of Southampton, SO17 1BJ, UK.

* Corresponding author: e-mail – Mithila.Achintha@soton.ac.uk

Although the effect of residual stresses is significant when predicting strength of glass, lack of availability of a reliable experimental or numerical method means that in current designs the effects of residual stress is often neglected. This paper presents a validated hybrid experimental/numerical modelling tool to characterise the residual stresses present in commercially available float glass. The contour method, where the knowledge of the surface contour developed due to the stress relaxation occurs along a newly cut plane is used to construct the associated residual stress distribution in the original glass specimen. The results of contour method analyses match well with that determined from experiments. The results show that a notable residual distribution presents in float glass. The stress depth profile shows a parabolic distribution, with surface compression and mid-depth tension.

The results of the contour method analyses have also been used to study the effect of specimen thickness on the residual stress generated. The paper also shows that once the underling eigenstrain distribution has been determined the complete residual stress distribution can simply be determined by incorporating the eigenstrain distribution as a misfit strain in a finite element (FE) model. It is shown that the method allows modelling residual stress in new geometries (e.g. pieces cut from the original glass panel) and/or during subsequent loading application, by simply installing the eigenstrain as an initial "load step" in FE models.

Keywords: *Eigenstrain, Finite element, Glass, Residual stress*