

2011/12 Undergraduate Research Grant Scheme

Project title: Post-breakage strength of glass in structural use

University: University of Birmingham

Supervisor: Dr J Yang

Student: t.b.c.

Aims of research:

In the use of glass as a structural material, the post-breakage strength, i.e., the residual strength following the glass breakage, has caused concerns to structural engineers. At present, it can only be assessed by carrying out prototype tests since there are no engineering assessing models. This problem has led to the aim of the project, i.e., to develop a dataset of test results of post-breakage strength of glass that can be used in the future development of a sound engineering model. The data will be collated from existing reliable literatures supplemented by a series of new tests that will be conducted during this project.

Description of method:

The project will include the following three main tasks:

1. A thorough literature survey will be carried out, from which suitable test data that are presented with detailed background information will be collated to form the dataset. Data will be categorized by the following variables such as the type of constituent glass panels in the laminated glass, the type of the interlayer, the support and loading conditions.
2. The analysis of the existing test data obtained from task (1) will inform the deficiency in the data of particular groups. This deficiency will be addressed by carrying out new lab tests. There is an ongoing research project on the impact resistance of the glass. The test specimens damaged after the impact test for that project can be further used in this one for studying the post-breakage strength. The initial literature survey conducted by the project supervisor has indicated that there will be at least twenty further tests that need to be carried out in this project. New tests will be conducted in a carefully controlled manner and the variables that will be studied include the support condition (two-edge line support, four-edge line support and four-point support), the loading condition (UDL by placing multiple sand bags and point or line load by using Instron loading machine) and various types of constituent material. The glass fragmentation pattern observed prior to the test and the failure evolution and final failure mode will be recorded by using the high-resolution videos. By doing so, the project will produce detailed first hand data, which will be useful to validate or calibrate any future numerical modelling.
3. Parametric analysis on the compiled test data will be carried out, which will provide design guides in addressing the post-breakage strength of structural glass.

Benefits to structural engineering:

The project will create a well detailed pool of experimental data on the post-breakage strength of glass. This will facilitate future works on developing rigorous numerical modelling and engineering-oriented assessment approach. The new tests will be conducted in a well-controlled manner. Data recorded will provide useful first-hand information that can be served as the benchmark of any numerical simulations. Even before a sound engineering model is established, structural engineers can still gain direct benefits by learning the findings from the parametric analysis of test results, which provide insightful guides to glass design, especially in addressing the post-breakage strength problem. The dataset will be made available in the public domain, so it can be extended by other researchers or engineers in the future.

Proposed finish date: May 2012