

Research abstract

There is an ever increasing trend for all glass buildings. Traditionally glass is used as a filler element, carrying no load other than self-weight and some wind load. Standard building materials such as steel and concrete are extremely ductile. Failure is slow, and is preceded by easily observable warning signs such as excessive deflections and cracking. Glass however, is a perfectly brittle material. Failure is sudden and catastrophic. Naturally there are concerns about the use of glass as a load-bearing structural element.

Before glass can safely be used as a load-bearing element, the failure process must be slowed down, providing time for users to evacuate and engineers to respond. This has already been achieved through the use of laminated glass. Laminated glass is constructed of two or more layers of glass sandwiched together using a polymer interlayer. If one or more layers of glass were to break, the glass shards would stick to the polymer interlayer. Load can then be carried through interlocking of the glass shards and tensile or membrane action in the polymer interlayer. What is as yet unknown is the load-bearing capacity of this fractured laminate.

In the design of critical structural glass elements (e.g beams, columns, floors, walls) it is a requirement that a degree of load-bearing capacity in this post-glass breakage stage is provided. The exact level required varying with application. Currently, in order to prove this, engineers must test full-scale mock-ups to destruction. This is costly and inefficient. A method is required to predict the post-fracture capacity without the need for full-scale tests. The aim of this PhD research is to determine this method.

This research has been decomposed into several stages. Firstly an investigation into which factors affect post-fracture performance. Secondly a testing phase which defines the relationship between each influencing factor and the post-fracture performance. Finally an amalgamation phase, where the influence of all factors are combined in order to predict the post-fracture performance of a real-world design problem.