

UK Technical Bulletin

The Causes of ‘Spontaneous Fracture’

The purpose of this bulletin is to take a closer look at what causes glass to break – in particular, toughened glass which often labelled as ‘spontaneous fracture’.

The causes of fracture of toughened glass are listed here in the order of **likelihood**.

Impact damage (deliberate or accidentally)

Edge damage (during handling)

Poor installation (tight glazing, missing setting blocks, proud fixings/hard surface contact with glass)

Poor design (insufficient clearances, structural movement)

Inclusions in the glass (foreign particles/impurities)

By far the more likely of these is **impact damage**.

Impact Damage

This is the commonest form of ‘spontaneous’ breakage of toughened glass, often from deliberate impact (throwing stones, pellet guns etc.). It can be very difficult to identify because the ‘star’ pattern seen in annealed glass is overwhelmed by the innate fracture pattern of the toughened glass which often falls from the frame. The impacting object, a pebble or air gun pellet may not end up in the vicinity of the broken glass which can then lead to the misconception of ‘spontaneous fracture’ being deemed as the cause of breakage.

Edge Damage

Edge damage can occur when the glass is being handled at any stage of its processing, prior to being glazed. Whilst the majority of such damage will cause an instant breakage or is insignificant, some edge damage can lead to delayed fracture.

Toughened glass is manufactured in a way that produces a built-in compressive stress at the surface of the glass with a counter balancing tensile strength at the core. As ordinary glass breaks from tensile stresses at the surface, toughened glass is much stronger due to the surfaces compressive stress. For the glass to fracture this outer compressive layer has to be compromised and the crack must reach the inner tensile core for the glass to fracture and disintegrate into small particles.

It is possible for damage to penetrate close to the inner tensile zone without causing complete fracture. In many cases, the toughened glass may remain in a stable state permanently but on occasion, the damage is such that it destabilises the built-in stresses around the damaged area to an extent which can allow a static fatigue mechanism to operate and which causes complete fracture to occur at some time after the initial damage was caused. This fracture may be seconds or months away from actually occurring, however, this type of occurrence is relatively rare, most toughened glass will fracture at the time of damage or not at all.

Poor Installation

Most framing systems are designed so the glass is adequately supported giving no stress concentrations on the glass. However, incorrect installation or adding attachments to the frame may introduce unacceptable stress conditions into the glass. For example a raised hard surface in a frame, such as a screw not tightened fully, if in contact with the glass, may cause a breakage once the glass is subjected to a design loading, such as wind or a barrier loading.

Poor Design

Insufficient clearances for glazing or if there is structural movement of the building may result in glass deflecting beyond its limits and breaking. A twist being created by supporting arms which are not co-planar may also create a fracture in the glazing, particularly if bolts are being used to fix the glass in position.

Inclusions

By far the most commonly attributed cause of toughened glass breakage is Nickel Sulphide Inclusions, as it is a convenient solution which exonerates the parties most closely involved with the contract. In reality, this is the least likely cause with quality glass supplied by reputable glass manufacturers such as Pilkington Group Limited.

Nickel Sulphide should only be confirmed as the cause if all of the pieces are gathered and examined by a suitably qualified person to identify the inclusion as being present. As this can be a daunting task, quite often it is not undertaken and the broken glass fragments are usually disposed of.

It should be noted that there are several (rare) types of foreign particles which may cause ‘spontaneous fracture’, but breakages due to Nickel Sulphide are only associated with the toughening process.

Further guidance on this subject can be found in the following publication: 'Glass in Buildings – Breakage – the influence of nickel sulphide' published by CWCT (Centre for Window & Cladding Technology) ISBN 1 874003 27 0. Telephone 01225 386541. Web page www.cwct.co.uk.

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