Free Standing Barrier Guidelines

A glazed free standing barrier (structural balustrade) is necessary to protect a change in level. Each glass plate should be clamped to the structure along its bottom edge, the handrail attached to the top edge of the glass, and there should be no balusters.

The glass is subject to line, concentrated and uniform loads. The glass, framing system and connections of barriers should be capable of sustaining and safely transmitting the design loads to the supporting structure.

Standards

A barrier must comply with the requirements of:

- BS 6180 : 2011 Barriers in and about buildings
- The glass must withstand the loads appropriate to the building usage that are detailed in BS 6180 : 2011
- The Building Regulations 2010 Part K Stairs, Ramps and Guards (2013 edition)
- The glass in a barrier must also conform to BS 6262 : Part 4 : 2005 Safety related to human impact

All work subject to Building Regulations must be approved by local authority Building Control. It is recommended that such approval is obtained prior to the commencement of work. Compliance with a British Standard does not confer immunity from legal obligations.

Design Considerations

Handrail
BS 6180 : 8.5.2 states “Where a [free standing] barrier protects a difference in level greater than 600mm, a handrail should always be used unless a laminated toughened glass construction is used that would remain in-situ if a panel fails”. As such if a laminated construction is used each ply of the laminate must be capable of sustaining the applied loadings.

Any handrail should be attached to the glass in such a manner that, should a glass panel fail, the handrail:
a) will remain in position

b) will not fail if the design load is applied across the resulting gap.

Condition b) may be relaxed where the glass pane is an end panel and protects a difference in level of 600mm or less, for example, at the foot of a flight of stairs. In cases where an end pane protects a difference in level greater than 600mm, there would normally be some adjacent structure to which the handrail could be attached, thus enabling it to meet condition b)”.

Handrail Attachment
BS 6180 : 8.5.2 also states: “Continuous fixing should be used for fixing the handrail to the glass, or individual fixings where calculations or tests demonstrate that component failure will not occur”

Base fIxIng of free-standing barrIers
If proprietary “dry glazed” base fixings are used it is essential that proof of compliance with BS 6180 is obtained from the supplier for the loadings appropriate to the project and that the glass is properly installed using the correct number of wedges.

Other Considerations

Support from adjacent construction

The designer should ensure that any construction or structure acting as support for barriers is of adequate strength and stability to sustain all applied loads safely without excessive stress, deflection or distortion. (BS 6180 : 6.7)

Hazard Reduction
Any individual point that is damaged and unable to meet the criteria should be replaced with interim guarding awaiting immediate replacement. (BS 6180 : 8.1.2) In dwellings and other buildings which can be accessed by children under the age of 5, gaps in a barrier or infill should not be large enough to permit a sphere of 100mm diameter to pass through making due allowance for deflection under load.

Toughened glass
Toughened glass is four to five times stronger than annealed glass of the same thickness and is ideally suited to most safety critical applications. The increased strength enables it to be supported by two or even one edge and allows the safe use of glass in ways not possible with other glass types, all-glass doors and bolted balustrades being examples. Its use must, however, be subject to careful consideration.

If ever broken, the glass will shatter into small relatively harmless pieces that will no longer support a load or act as a barrier. Toughened glass that is not fully framed is likely to fall from its fixings.

On rare occasions toughened glass has broken in service for no apparent reason. This can be caused by a variety of reasons including damage, impact or inclusions within the glass. One particular type of inclusion, nickel sulphide, has attracted publicity and it is important that specifiers understand its characteristics and the risk of breakage in service.

Nickel sulphide (NiS) is formed naturally within the glass making process but is of concern only in glass that is subsequently toughened. The inclusions are too small to be visually detected by the glass manufacturers and when heated in the toughening process undergo a phase change that reduces their size. Cooling of the glass is far too rapid to allow reversal and this takes place over a period of time. If an inclusion is sufficiently large and is located within the centre of the glass it can cause spontaneous breakage.

It is vital to stress that the risk is very small. Glass manufacturers estimate the incidence at less than 1 in 13,000kg of annealed glass.

Heat-soak testing
This is a destructive test for the presence of nickel sulphide inclusions. It involves placing the toughened glass in an oven and heating it to a temperature of 290^{o}C. The glass is kept at this temperature for a period of time long enough to fracture a large proportion of any panes that might otherwise fail in service. Heat-soak testing achieves a conversion rate of 90 to 95%. Heat soaking will not detect other inclusions such as silica that can also cause breakage.

Heat-soak testing is recommended for safety-critical work such as atrium glazing and balustrades as well as for load-bearing glazing, overhead glazing and highly trafficked areas such as airports. and other high-profile areas where breakage would be very emotive.

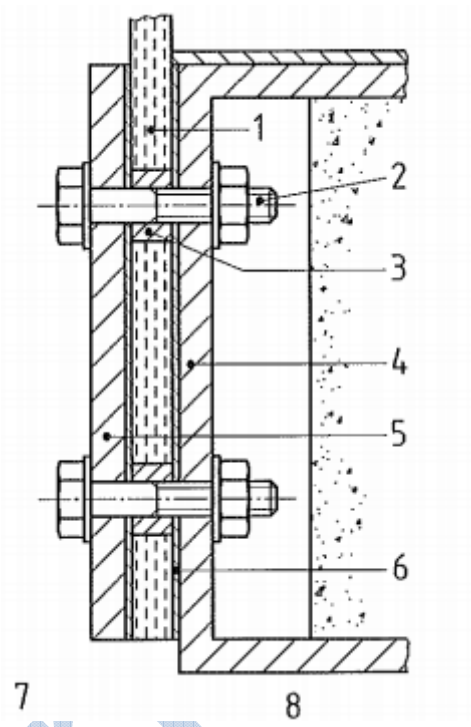
Summary

Toughened glass should be specified only when its inherent characteristics are understood and accepted. It is vital that full and proper consideration is given to the building use, the purpose of the glass and the risk it presents.
Customers can only make an informed choice if they properly understand and accept the nature and inherent characteristics of toughened glass.

BS6180 – Fabricated Clamping systems

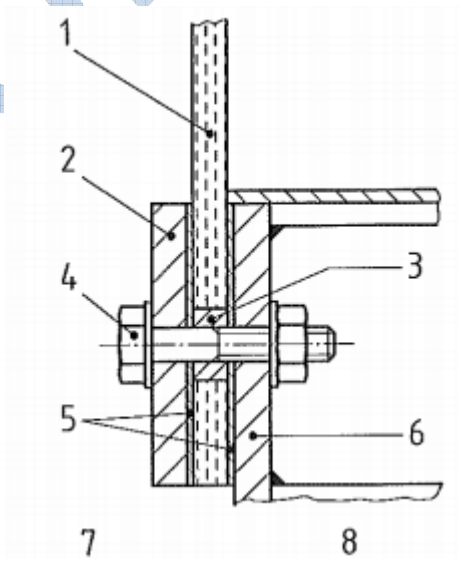
A. Point–fixing clamp

1. Glass
2. M16 bolts
3. 3mm thick bush hard fibre or nylon
4. 12mm or greater metal plate attached to structure at 500mm centres
5. 12mm or greater metal plate, at least 100 x 150mm
6. 1.0mm thick fibre gasket
7. Side of drop
8. Public access side



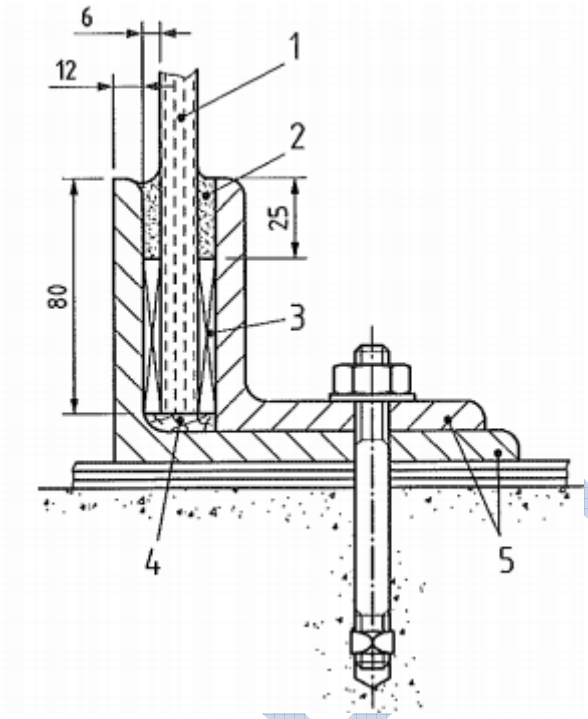
B. Continuous fixing clamp

1. Glass
2. 12mm or greater metal plate continuous at least 100mm wide
3. 3mm hard fibre or nylon bush
4. M16 bolts at 500mm centres
5. 1.0mm thick fibre gasket
6. 12mm or greater metal plate attached to structure
7. Side of drop
8. Public access side



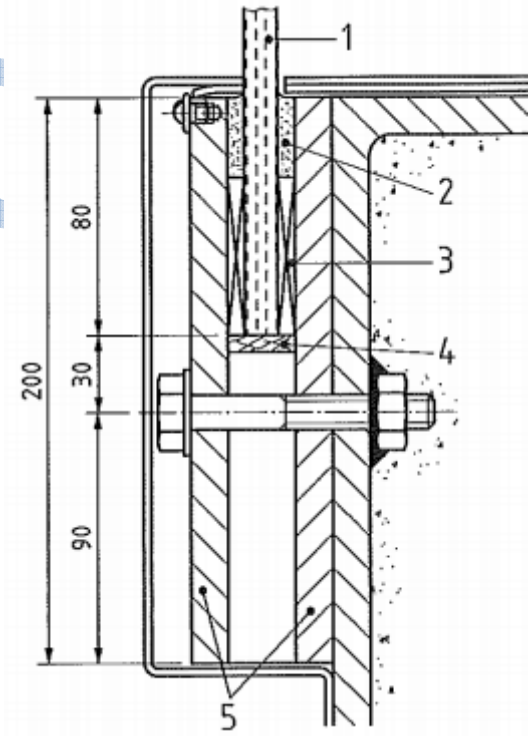
C. Alternative clamping system

1. Glass
2. High modulus sealant
3. Hardwood, extruded silicon S/H 85^{0} or epoxy polysulphide compound
4. Setting block
5. Continuous 12mm thick angles



D. Alternative clamping system

1. Glass
2. High modulus sealant
3. Hardwood, extruded silicon S/H 85^{0} or epoxy polysulphide compound
4. Setting block
5. Continuous 12mm thick plates



In addition to the typical sections indicated, proprietary dry glazed base channel systems do exist that utilise an extruded Aluminium base channel – usually around the 110 x 65 mm size. However this is not suitable for glass thicknesses over 19mm. This can be base or face fixed, however dependent on the particular installation may well require additional bracketry and support.