GUARDS & BARRIERS 2B SUPPORT CONDITIONS

Glazing within barriers, or acting as a barrier, must be suitably supported within the surrounding structure. BS 6180:2011 [1] states; "*The glass, framing system and connections of barriers and infill panels should be capable of sustaining and safely transmitting the design loads to the supporting structure.*"

It is also important that the support mechanisms (frame or fixings) don't impart any distortion into the glass. In the case of edge clamping or bolting, alignment and position of fixtures should be considered.

GLASS WITHIN A FRAME

Where glass is held within a frame, it is often described as being simply-supported. Under these conditions, the edge of the glass is not rigidly fixed in the same manner as if it were clamped. As such, no in-plane movement is possible at the edges; however, rotation of the edges is not limited. As a result, the stress distribution across the panel resulting from loading will typically not result in peak stresses around the periphery, and no in-plane deflection.

Based on a single pane under line loading only, the below shows the peak stresses, on the opposite surface to the load application, occurring at the location of the application of the load, with some tensile stress generated at the corners. The edges show no deflection around the periphery where the support is present.

BS 6180:2011 specifies a minimum of 15 mm edge cover for the edge to be considered fully supported, unless test or calculation shows a reduced edge cover will retain the glass under loading.

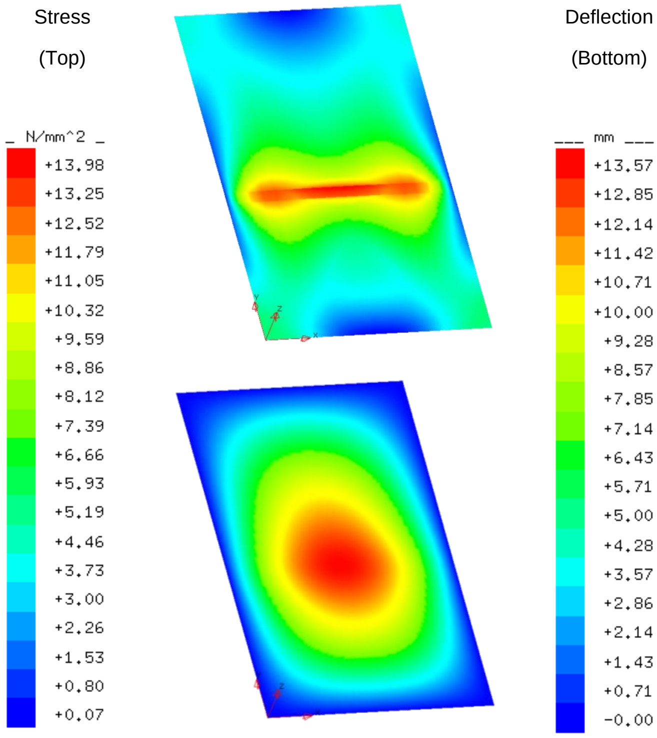

Figure 1 – Load distribution with simply supported glass

CLAMPED GLAZING

Taking the same panel as previous, under the same loading, but with clamped edges, the stress distribution in the pane will change significantly. If all edges are clamped, no rotation of the edges is possible, which results in additional stresses around the periphery, as illustrated below;

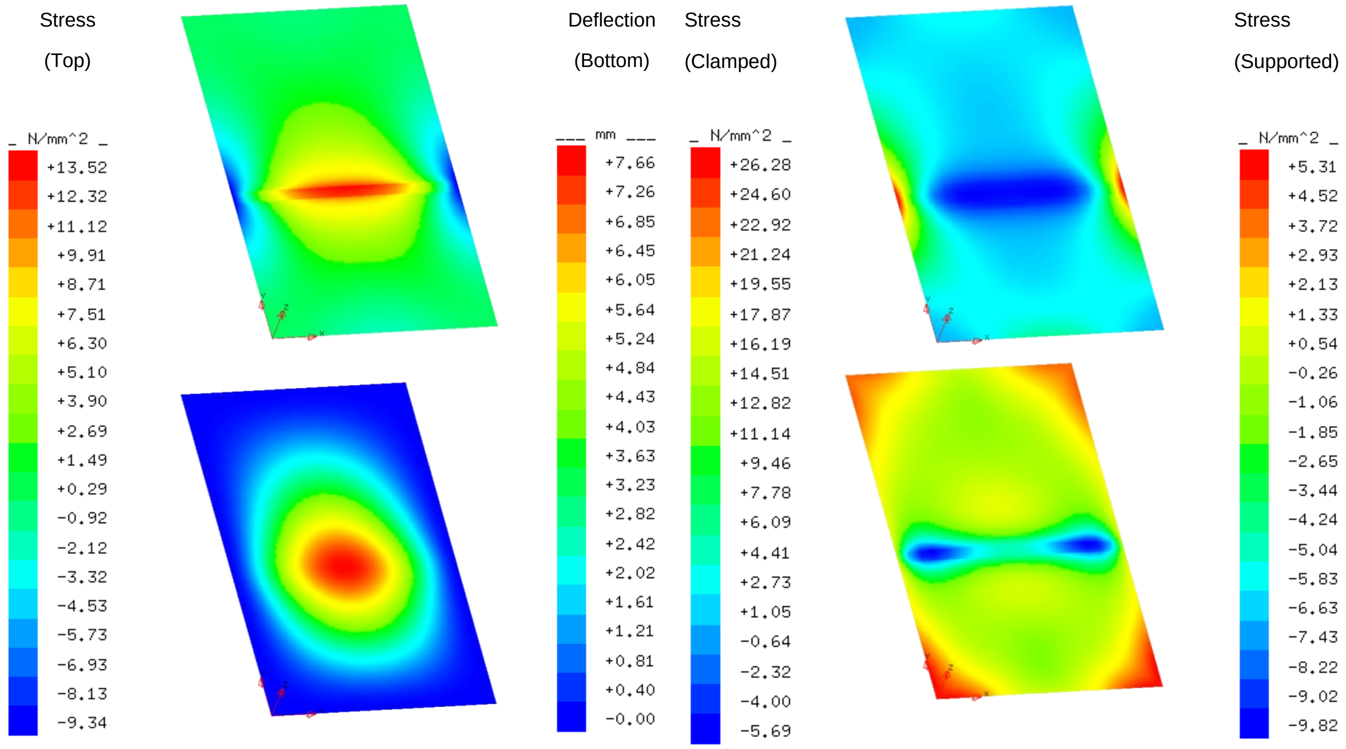

Figure 2 – Load distribution with clamped edge supported glass

Whilst it may appear that a clamped support condition is an improvement over the simple support due to the reduced levels of stress on the opposing surface to the load, the below shows the levels of stress compared to the simply supported pane, on the surface on which the load is applied.

As can be seen from the stress concentrations at the edges at the line where the load is applied, an increased level of stress is present, almost 5 times more, than in the simply edge supported scenario.

FREE-EDGES

Where less than 4 edges are supported the glazing will typically be subjected to increased levels of stress and deflection. As such thicker glass will be required to limit the deflection, and potentially toughened glass to withstand stresses. Calculations can give an indication of the expected stresses under loadings.

The above shows the pane from the first example, with one long edge support removed. The resultant stress is approximately 3.5 times greater, and deflection approximately 8.5 times greater.

Glass fins can also provide edge support, and BS 6262-6:2005 [2] provides guidance on their use. Additionally, structurally glazed systems can also provide sufficient edge support, depending upon the sealant adhesion and mechanical properties and sealant bite. BS 6262-6:2005 also provides guidance for sealant systems. In the case of both fins and structural sealant systems, advice should be sought from glazing system and sealant manufacturers, or a structural engineer.

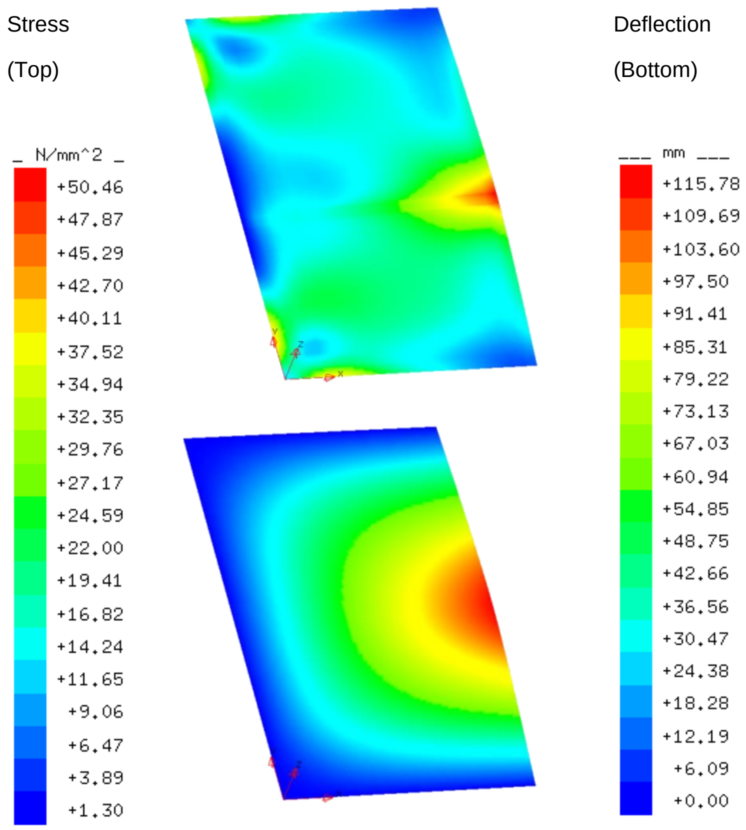

Figure 3 – Load distribution with an unsupported glass edge

FREE-STANDING BARRIERS

Free-standing barriers should be clamped to the structure along the bottom edge, using either point fixings, continuous fixing clamps or glazed into a channel. Guidance is provided in Annex B of BS 6180:2011 and BS 6262-6:2005, including;

Table 1 – Free-standing barrier support methods

Fixing Method	Recommendations
Point Fixing Clamps	Fixing clamps on either side of glass along base; Suitable metal, Dimensions greater than 100 mm x 150 mm, 12 mm minimum thickness.
Continuous Fixing Clamps	Fixing clamps on either side of glass; Suitable metal, Not less than 100 mm wide, Maximum bolt spacing of 500 mm, Continuous for entire length of glass pane.
Glazing Channel Clamps	Glass glazed into channel; 75 mm minimum depth (unless integrity proven otherwise)

For the purposes of calculation, full edge clamping is typically assumed, and will result in peak stresses at the clamp interface and maximum deflection at the top of the pane, as illustrated below for a free-standing balustrade under line loading.

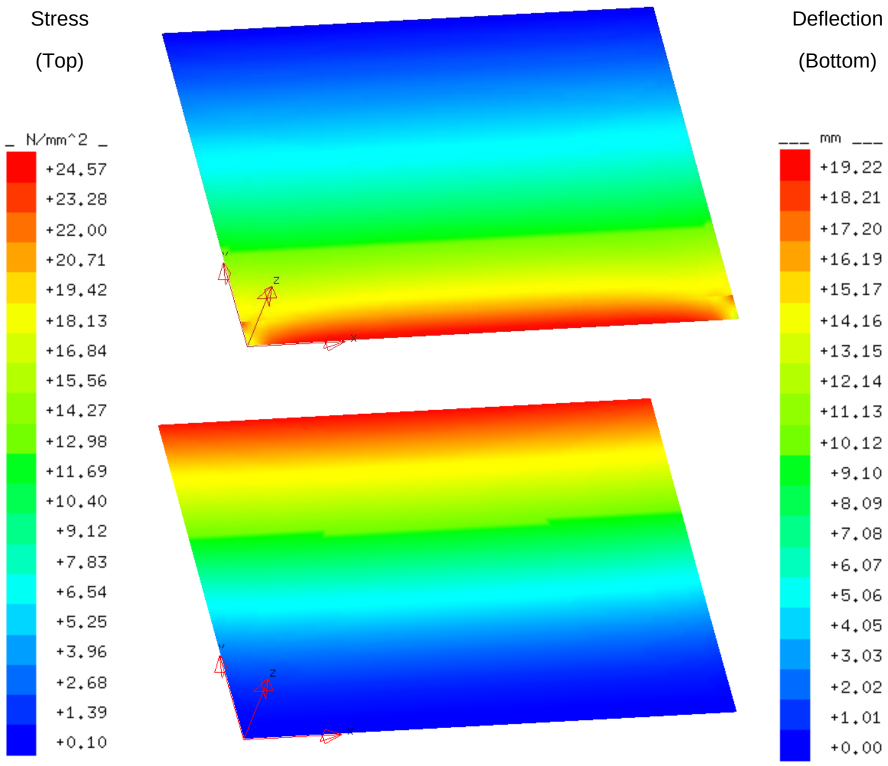

Figure 4 - Load distribution with bottome edge clamped glass

BALUSTRADE INFILL PANELS

Infill panels can be secured within a balustrade by either edge support, clamps or bolt fixings. Framed edge infill panes would be expected to behave as edge supported full height barriers, with sufficient edge cover provided to support the glass. BS 6180:2011 and BS 6262-6 provide guidance for clamped and bolt fixed infill panels, as per the below:

Table 2 – Infill panel support methods

Fixing Method	Recommendations
Edge Clamps	Clamps around the periphery; Not spaced more than 600 mm apart, Each clamp at least 50 mm in length with 25 mm edge cover.
Bolt Fixed	Clamping plates and gaskets; Minimum of 50 mm diameter cover to the glass, Minimum 6 mm thick steel plates, or 10 mm thick for other suitable metals.

When determining suitable glass thicknesses and types for infill panels, consideration must be given to the clamping or bolt fixing points, where stress concentrations will be likely to occur; as illustrated below for a clamped infill panel under a centre concentrated load.

Stress concentrations will be dependent on pane sizes, the magnitude of the load and the design of the fixings, and glass should be specified with consideration to these factors.

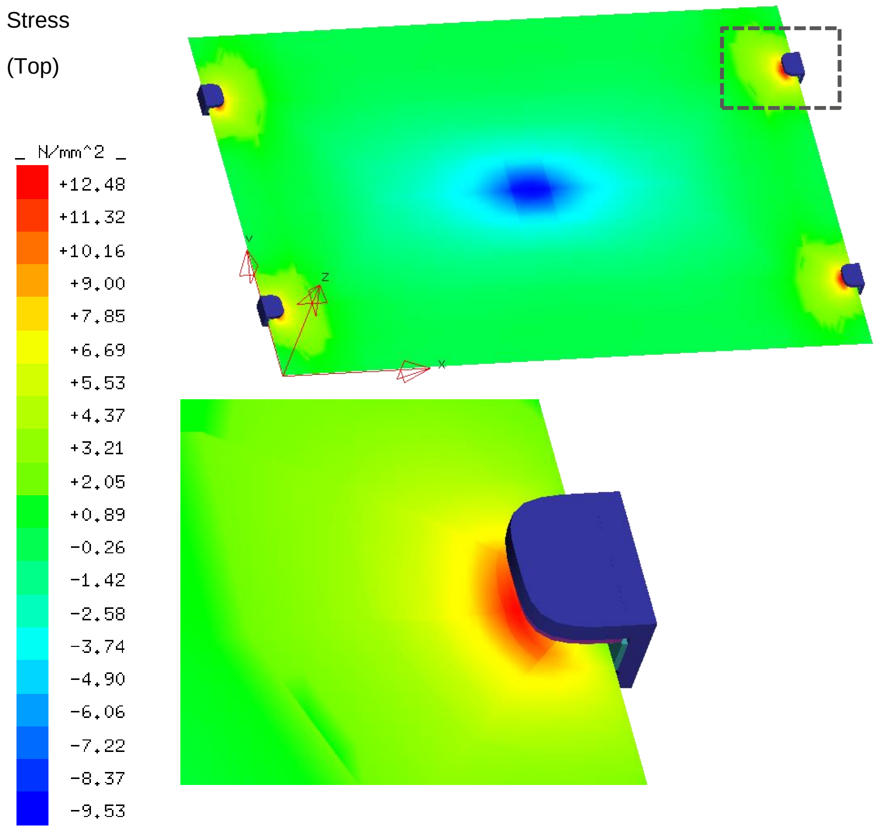

Figure 5 - Stress concentrations in glass around clamp finxings

REFERENCES

[1] British Standards Institute, BS 6180:2011 - Barriers in and about buildings. Code of practice, BSI, 2011.

[2] British Standards Institute, BS 6262-6:2005 - Glazing for buildings. Code of practice for special applications, BSI, 2005.