National Protective Security Authority

GOOD PRACTICE FOR REDUCING INJURIES

Internal Building Glazing Subjected to Blast

Introduction

Architects are more commonly using glass inside buildings to create a sense of space within the structure. The glass is used in a variety of ways, including balustrades, partitions, and wall lining panels. It may be structural (to protect building occupants from hazards) or for decorative use as an architectural feature.

Internal areas may be vulnerable to security risks, and if glazing is used then the performance against the threats need to be understood. Security threats may be considered as explosive devices and MTA. This guidance note only focuses on the reducing the glazing hazard from the blast load from an explosive device, however the measures recommended are likely to be beneficial against for MTA where people may want/have to seek shelter in a room with glass walls or doors.

The performance and hazard created from the glass will be dependent on the glass type and fixing arrangements, and poorly designed systems can contribute to the number/severity of injuries to people nearby.

The information within this guidance note should be used as a guide in best practice to reduce glazing hazard against a blast. If there is a specific blast threat which needs to be considered, NPSA recommend that specialist advice is sort from a suitable member of the Register of Security Engineers and Specialists.

Aim of this guidance note

This guidance note is aimed at security managers, specifies of internal glazing and blast engineers, as it provides recommendations for minimising the hazard from glass used inside buildings against a blast threat.

It is part of a suite of NPSA guidance notes on glazing, and it is recommended these are read in conjunction with this guidance note, in particular the guidance note on the use of laminated glass. The suite of guidance notes can be found on the NPSA website.

Hazard from internal glazing subjected to blast

Due to its use in populated areas, safety glass is normally used for internal glazing. Safety glass can be either toughened or laminated glass (using an appropriate interlayer).

The response of internal glazing subjected to a blast will vary depending on the glass make up and support conditions. The following hazards may occur:

- if toughened glass is used the glass may break into small pieces and be projected into the building, creating a large number of glass fragments,
- if laminated glass is used the number of glass fragments will be significantly reduced, however this may increase the load applied to the frame and connections holding up the glass. If these are overmatched then the whole glass may fall out of the frame and be projected into the building, creating one large and heavy hazardous fragment.

Either of the above effects may result in a significant risk to human injury. To minimise this risk, it is recommended to follow the best practice outlined in this guidance note.

Recommended glass types

The glass must be designed to meet the needs of everyday use and comply with any general safety requirements, as defined for example by building regulations etc, as well as any other specific project requirements e.g. fire requirements. To minimise the glass fragmentation hazard, it is recommended that laminated glass is used, using either a PolyVinyl Butyral (PVB) or Ionomer (SentryGlas®) interlayer which are at least 1.52mm thick. EVA, Cast/poured Resin and all other interlayers types do not perform as well and should be avoided. To improve its performance of the laminated glass, thermally toughened or heat strengthened glass may be used. Further guidance on the specification of laminated glass and interlayers types can be found on the NPSA website.

Glass fixing details

The fixing details of the glass within the frame will depend on where and how the glass is being used within a building. Within this document are some fixing detail recommendations for some typical applications.

Balustrades

A glass balustrade is an element of a building or structure intended to prevent persons from falling and to retain, stop or guide persons and are typically fixed to the floor only. Balustrades that are intended to prevent persons falling, for example in a shopping centre atrium, are typically designed to more stringent requirements than balustrades which are designed only to guide people, for example in a queuing area.

There are many differing types of balustrade which are designed to meet performance and architectural requirements. The most common balustrade types include:

- cantilevered (where the glass is only fixed into a base channel on the floor)
- 4 or 2 edge supported (where the glass is supported within a frame on either 2 or 4 edges)
- bolt fixed (where the glass is retained via bolted connections which are often located at the corner of the panels).

Fixing arrangements

If the glass is clamped only in a base channel then the channel must be robustly fixed to the floor, using fixings designed to withstand the maximum strength of the glass. The minimum engagement of the glass in the channel is recommended to be 100mm. The glass must be securely fixed within the channel. Recommended options include embedding the glass within Epoxy Resin, using a large bond of structural silicone to secure the glass in the channel (figure 1) or a deep dry glazed clamp. The installation and depth of the structural silicone bond should be conducted in accordance with the manufacturers guidance.

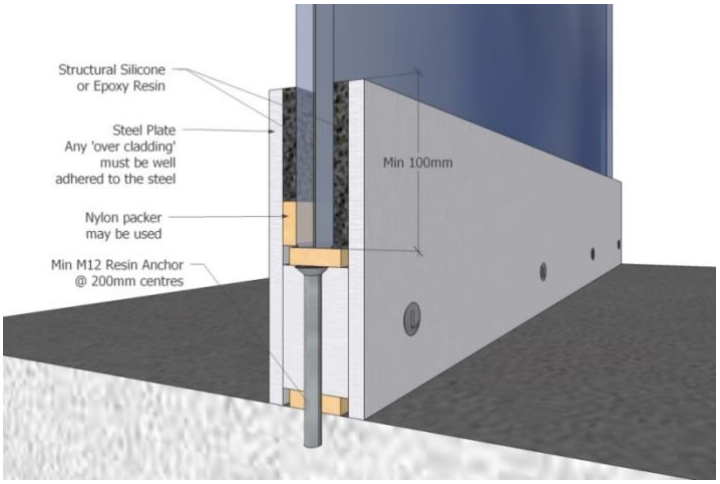

Figure 1: Cantilever Balustrade Fixing Detail

Where the glass is supported within a frame, on either 2 or 4 edges, it is recommended that the glass is bonded within the glazing channels using a structural silicone which is ideally 25mm deep (figure 2).

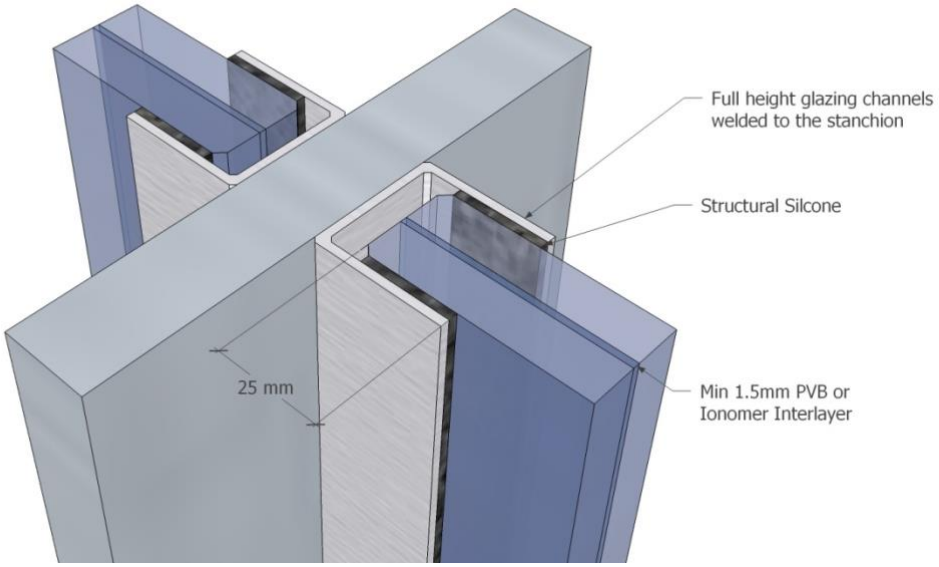

Figure 2: 2 or 4 Edge Balustrade Fixing Detail

Recommended handrail connection(s)

Ideally the handrail should be independent of the glass and mechanically secured to a supporting structure like steel stanchions. Handrails which are fixed to the top edge of the glass using a friction fit/gasket should also be secured to the glass using an adhesive such as silicone. Where handrails are bolted through the glass, large disc fittings should be placed either side of the glass to maximise the contact area and minimise the risk of the handrail pulling through the glass panel.

Glass partitions and full height screens

A glass partition is a wall, screen, or divider that separates one part of a room, or other space from another. Like balustrades, a partition may be structural and used to prevent persons from falling and to retain, stop or guide persons, but more commonly they are used for privacy and segregation. Therefore, the may not be as robustly constructed when compared to a balustrade.

Partitions are typically fixed at the floor and ceiling level. Partitions may be framed on the vertical edges or be butted up to the adjacent panel with a silicone or dry joint connecting the adjacent glass panels.

There are many differing types of glass partitions which vary in design based upon the performance and architectural requirements. The most common types of glass partitions include:

- acoustic partitions that feature either acoustic glass interlayers or two glass panels with a cavity in-between
- one way spanning partitions are held at the head and base
- four edge supported partitions held on all four edges via a frame.

Fixing arrangements

The supporting channel should be selected which offers the greatest level of glass cover. The channels should be robustly secured to either the floor slab or the raised floor using larger diameter fixings at closer centres than standard installation methods. Where possible, the glass should be bonded into the supporting channels using structural silicone to resist the pull-out forces from the glass (see figures 3 and 4). For one way spanning glass, the vertical joints should use a structural silicone to adhere the adjacent glass panels together.

Additional bracing may be required if the glass partition does not extend to the underside of the floor slab (see figure 5).

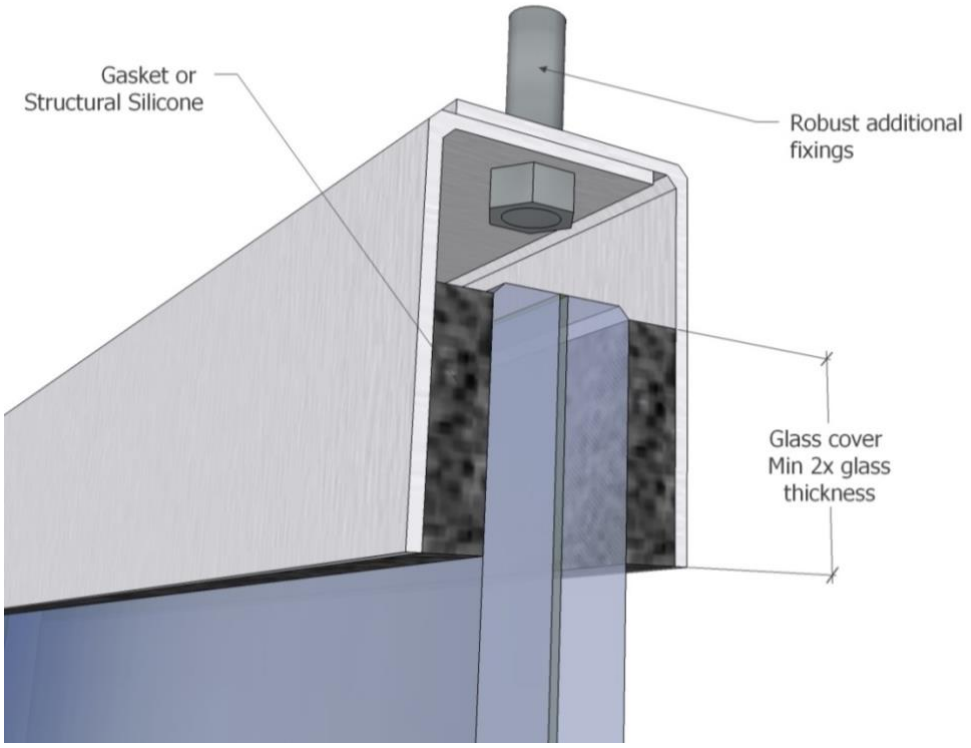

Figure 3: Typical head channel detail

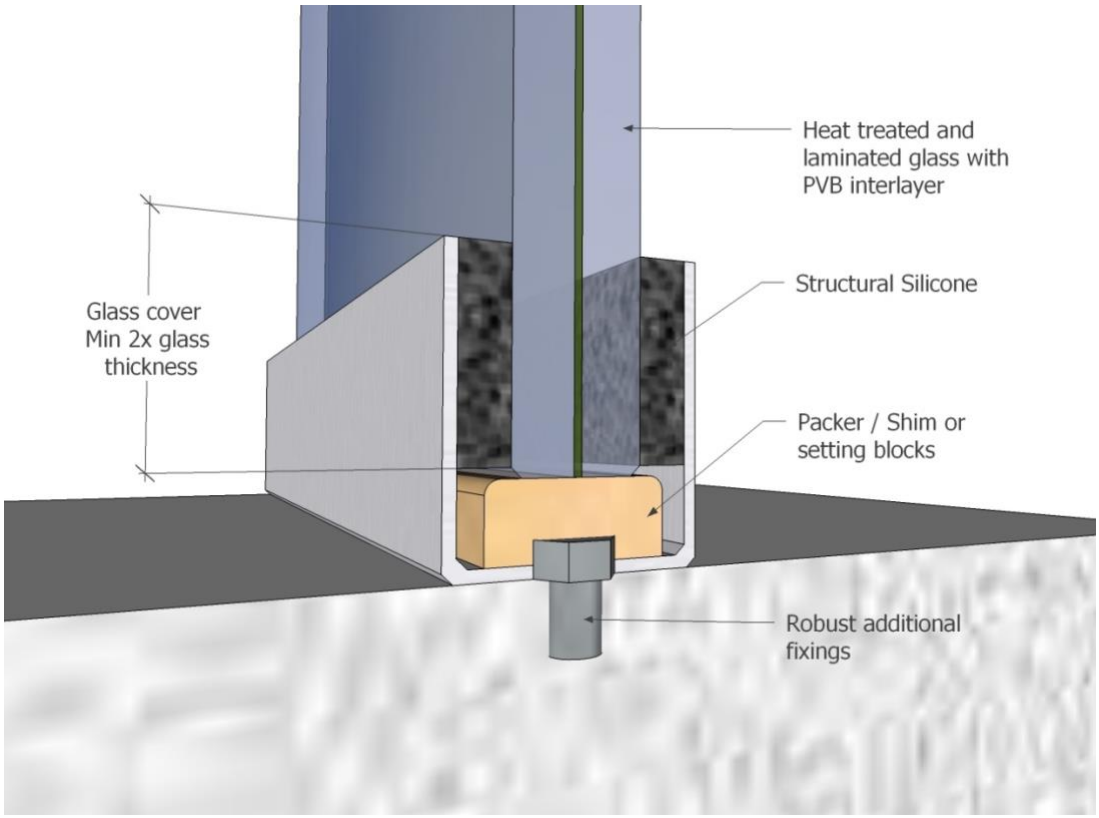

Figure 4: Typical base channel detail

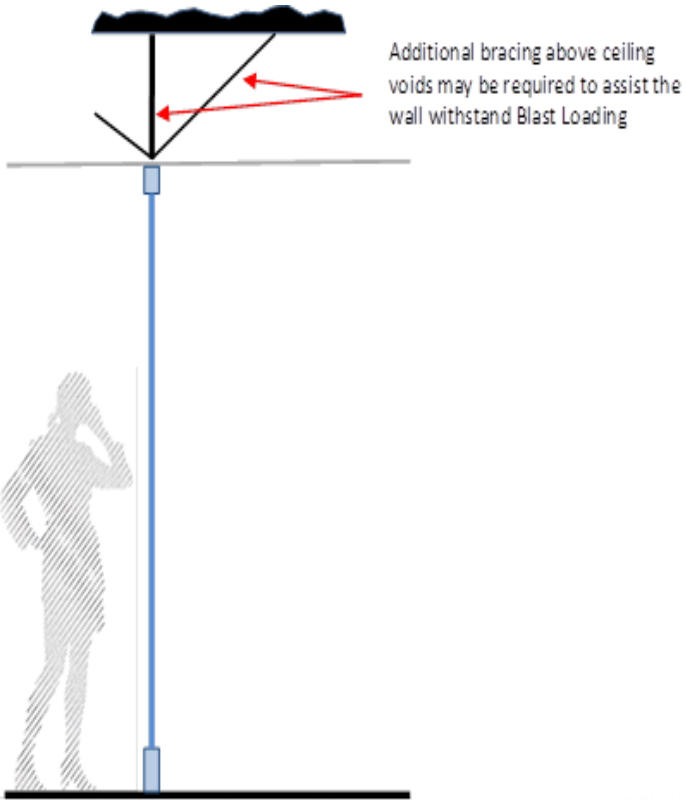

Figure 5: Glass partition fixing details

Glass wall lining systems

A glass wall lining system is not typically structural; it is a decorative or architectural feature only. It is commonly used as a feature wall lining at an airport, railway station or in the reception or lobby area of a commercial building. The wall lining is normally fixed onto a steel or block/brick sub structure.

Fixing arrangements

The glass is typically bonded using structural silicone onto at least two horizontal supporting rails which in turn interlock with corresponding rails which are fixed to the supporting structure. Alternatively, the glass maybe secured at the head and base via channels fixed back to the wall.

When supporting the glass with rails, they must be robustly bonded to the rear surface of the panel. The silicone should adhere directly to the glass surface or enamelled paint. The silicone must not adhere to non-enamelled paints or vinyl surfaces. It is important that the person applying the silicone is competent in using the correct preparation and application methods. The interlocking rails disengage by lifting the glass upwards and the dead weight of the panels holds the glass in situ. A restraint should be installed above each panel to stop it lifting and becoming detached when subject to blast pressures.

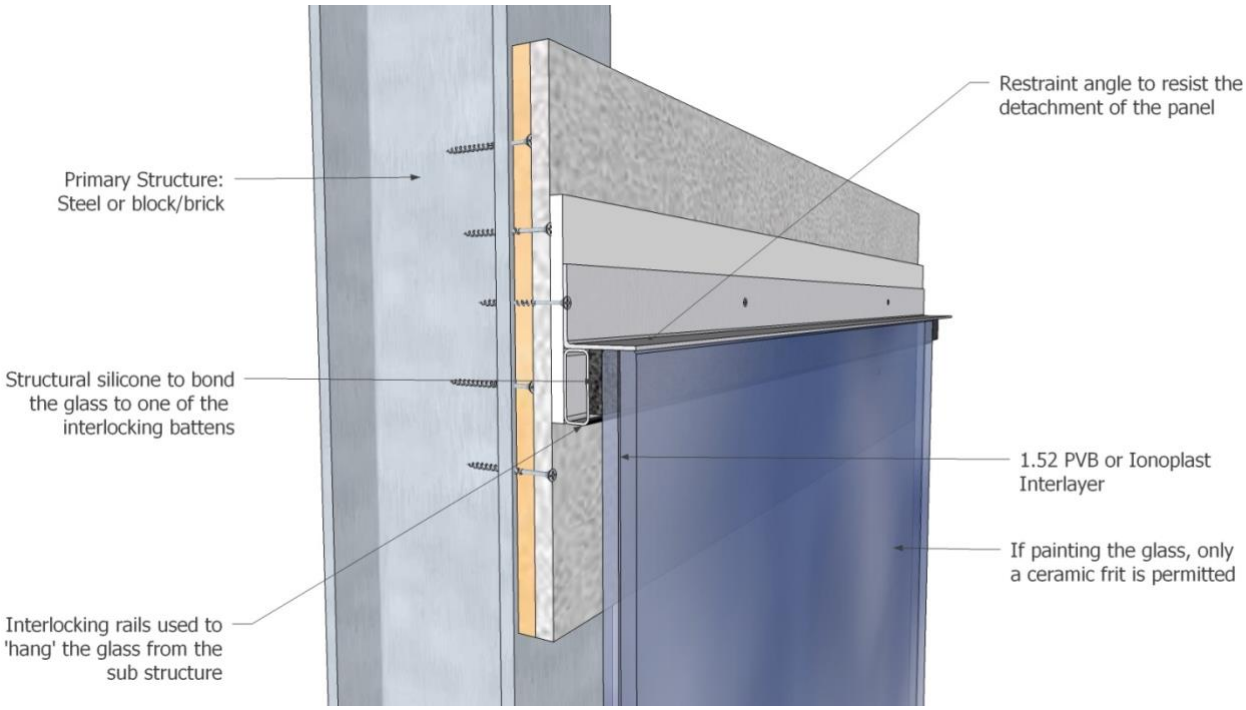

Figure 6: Glass wall lining, typical detail

Escalator infill screens

Escalator infill screens commonly comprise of a monolithic (not laminated) piece of toughened glass, about 10mm thick which is typically supplied by the escalator manufacturer. When subjected to blast loads, the glass may fracture, forming glass fragments. Where possible, the monolithic glass should be replaced with a piece of laminated glass. Most escalator manufacturers can replace the monolithic toughened glass with laminated glass, however, the requirement should be included in the specification.

Fixing arrangements

The channels into which the glass is fixed typically uses a silicone gasket to secure the glass. Where possible the gasket should be bonded using a structural silicone into the supporting channels. However, changing the design of the channel may not always be feasible or practical for all manufacturers.

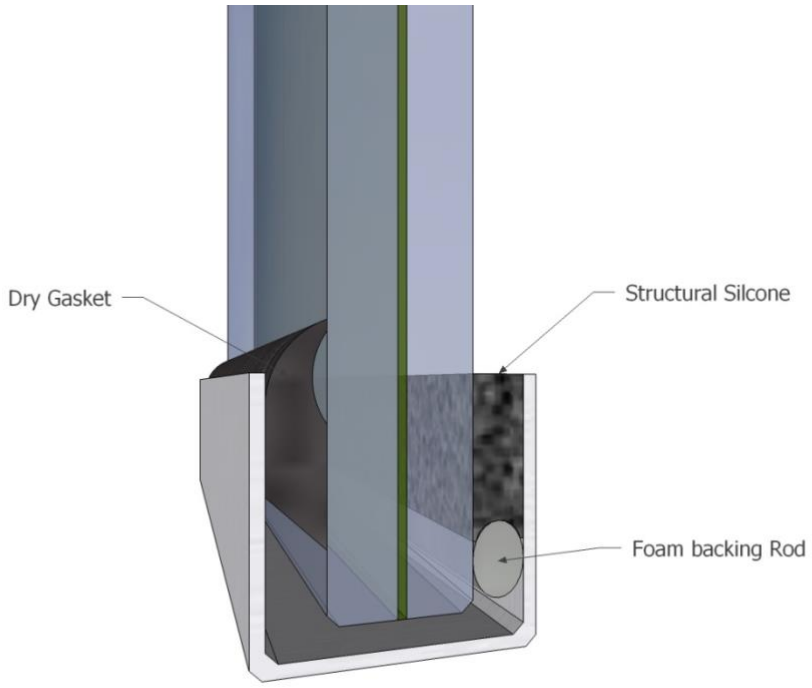

Figure 7: Two glass fixing options i.e. gasket and structural silicone

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