Buildings Department | **Practice Note for Authorized Persons and Registered Structural Engineers** | **235**

Protective Barriers

The prime function of a protective barrier is to prevent persons or objects from passing through or toppling over onto an adjacent lower level. Building (Construction) Regulation 8 and Building (Planning) Regulation 3A prescribe the layout of protective barriers. In all circumstances, a protective barrier should have a height not less than 1.1m and the lowest 150mm of the barrier should be built solid. Any gap or opening in the barrier should be so constructed as to inhibit the passage of particles more than 100mm in its smallest dimension.

Structural Design Requirements

2. Structural details of protective barriers should be submitted to the Building Authority for approval. Protective barriers should be designed to resist the imposed loads as prescribed in Table 3 of Building (Construction) Regulation 17. The minimum design imposed loads for protective barriers to restrict or control the movement of persons and for vehicle barriers are stipulated in Building (Construction) Regulation 17(3) and 17(4) respectively. Protective barriers subjected to wind loads, shall be designed to resist the more stringent of either the required imposed load or the design wind loads as prescribed in the Code of Practice for Wind Effects, Hong Kong 1983. The structural design should comply with the laws of mechanics, recognised engineering principles and recognised codes of practice such as BS 6180 – Barriers in and about buildings.

Glass Protective Barriers

3. Recommendations on the salient aspects of the design and construction of protective barriers involving the use of glass are given in **Appendix A**. Typical clamping detail for free-standing glass protective barriers are shown in **Appendix B**.

Site Supervision

4. The construction of protective barriers should be supervised by a suitably qualified person to ensure that the works are carried out in accordance with the plans approved and the required standards are complied with.

(C M LEUNG)
Building Authority

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Recommendations on the Salient Aspects of the Design and Construction of Glass Protective Barriers

Types of Glass for Protective Barriers

1. Glass types considered suitable for use in protective barriers are as follows :

   (a) **Laminated glass** is a safety glass suitable for protective barriers where the glass is fully framed. It is subject to measures being taken to ensure the glass edges are protected from direct exposure to moisture and compressive forces that can cause delamination.

   (b) **Tempered glass** is a safety glass suitable for protective barriers where the glass is fully or partially framed or is free-standing. The configuration of any opening in this type of glass should be agreed with the manufacturer and the fabricator. Due to the possibility of spontaneous breakage in tempered glass, AP/RSE should ensure that an acceptable method of quality control (such as infrared photography, laser photography or heat soaking) has been adopted in order to prevent the debris of glass formed due to the spontaneous breakage of tempered glass from falling to the lower levels.

Fixing of Glass

2. Contact between glass and any other hard substance with a hardness equivalent to or greater than the hardness of glass should be prevented. Neoprene gaskets or other glazing materials should be used with frame systems. Where bolted connections are used, it is essential to ensure that the glass does not come into direct contact with bolt or the clamping plates. Proper bushing material shall be used in which its hardness shall be less than that of the glass material. The use of setting blocks and distance piece to support and locate glass panels may be in accordance with BS 6262 – Code of Practice for glazing for buildings. Other standards may also be accepted if the equivalent performance can be demonstrated.

Protective Barrier with Glass Infill Panels

3. The main frame of the barrier (viz. handrail and baluster) is designed to withstand all loads applied to the handrail and the glass is used to form the infill panels. The glass in no way provides any support to the main frame and to the handrail.

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4. Recommended dimensions for glass infill panels are given below :

(a) For fully framed or two-edged framed infill panels, the frame section should give a minimum of 15 mm edge cover to the glass. The frame section and its connections to the main frame should be capable of withstanding the design load transferred through the glass.

(b) For clipped infill panel, the clips should be positioned around the periphery of infill panel, at a maximum spacing of 600 mm. Each clip should be not less than 50 mm in length and give a minimum depth of cover to the glass of 25 mm. The clips and their connections to the main frame should be capable of withstanding the design load transferred through the glass.

(c) For point bolted supports, tempered glass should be used and the position of the connectors should not allow the glass to undergo reverse curvature effects, as these could lead to enormous stress concentration at bolted connections. There should be clamping plates and gaskets on both sides of the glass that provide a minimum of 50 mm diameter cover to the glass. Where the length of a glass panel is greater than the span between the bolted connectors, giving rise to a cantilevered portion of the panel, the length of the cantilevered portion should be less than one-quarter of the span between the bolted connectors. The fixing of the bolted connectors to the main frame should be capable of withstanding the design load transferred through the glass. Under the design loads, the barrier should be designed such that the relative in-plane movement of the bolted connections in the same panel is not greater than 2 mm.

Free-standing Glass Protective Barrier

5. The glass is designed to withstand all design loads. When the barrier is subjected to a loading derived from the most unfavourable combination of wind load and imposed loads for places of assembly and panic barriers, the maximum horizontal displacement at the handrail level of the barrier should not exceed 50 mm.

6. In case the free-standing glass barrier has a continuous run of 2 panels of glass or more and is designed as a panic barrier, the top rail should be attached to the glass in such a manner, that, should a glass panel fracture, the top rail would bridge over the failed glass, remained stable under yield stress conditions and capable of resisting the designed imposed loads for panic barriers applied across the resulting gap without causing structural failure or yielding of the protective barrier system.

7. Continuous fixing is recommendation for fixing the handrail to the glass, since individual fixing points may introduce unacceptable stress concentrations at the glass panel.

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8. It is preferable to use continuous bottom fixing clamps for free-standing glass protective barrier. Such clamps on each side of the glass should have a minimum of 100 mm wide and be made of metal of minimum thickness of 12 mm. The clamps should be continuous for the entire length of the glass panel and have a maximum bolt spacing of 500 mm. Other clamping methods may also be used provided that such clamping methods may provide effective clamping over the length of the glass panel. Where a clamping system that does not rely on bolts is used, the depth over which the clamping force operates should not be less than 75 mm, unless specific tests have been carried out to prove the integrity of the system in resisting its design loads. Appendix B illustrates the typical clamping detail for free-standing glass protective barriers.

Impact Resistance of Glass for Protective Barriers

9. Glass to be used for protective barriers should comply with the impact test requirements for safety glazing materials given in recognised testing standards such as ANSI Z 97.1 "Safety performance specifications and methods of testing for safety glazing material used in buildings" or BS 6206 "Impact performance requirements for flat safety glass and safety plastics for use in buildings". The type of glass for protective barriers should achieve impact resistance not inferior to the impact grade class A to BS 6206 when the free path (or the unhindered distance a body can travel in a direction perpendicular to the surface of the protective barrier) is greater than 1500 mm. In this connection, test certificates on the glass material to prove its impact resistance should be submitted to the Building Authority for consideration. The designer should select materials that will not break when the protective barrier is subjected to the normal design loads that may be applied and will not be penetrated when subjected to the appropriate impact test loads.

Workmanship Control

10. Every glass panel should be visually inspected to ensure that it is free from visual defects before installation. Supervision of the installation of all fixings used to connect the glass to handrails, balustrades or frames should be provided to ensure that they have been constructed in accordance with the approved plans. Apart from glass and fixings, the sealant and handrail should also be inspected. Special attention should be paid to the installation of free-standing glass protective barriers to ensure that the recommended installation procedures are strictly followed.

GENERAL NOTES

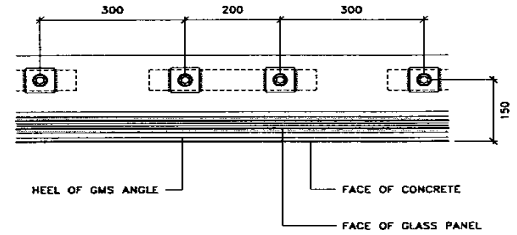
1. DO NOT SCALE FROM DRAWINGS
2. FIGURED DIMENSIONS ARE IN MILLIMETRES AND ARE TO BE FOLLOWED.
3. DESIGN IMPOSED LOAD FOR PROTECTIVE BARRIER:

   UDL = 3.0kN/m RUN AT 1100mm ABOVE FFL

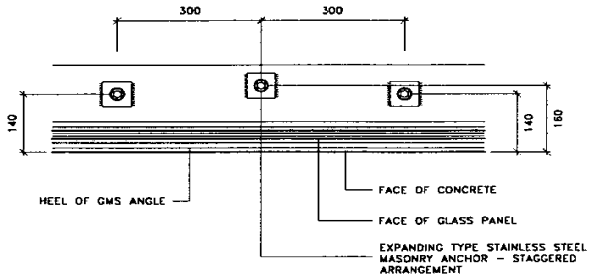
   IN ACCORDANCE WITH HONG KONG BUILDING (CONSTRUCTION) REGULATIONS FOR PROTECTIVE BARRIERS IN PLACES OF ASSEMBLY AND ALL PANIC BARRIERS.
4. CAST IN ANCHORS SHOULD BE SELECTED TO RESIST THE FOLLOWING WORKING DESIGN LOADS:

   TENSION: T = 17.7kN (TOTAL)
   SHEAR: V = 1.5kN. (TOTAL)
5. MASONRY ANCHORS SHOULD BE SELECTED TO RESIST THE FOLLOWING WORKING DESIGN LOADS:

   TENSION: T = 11.4kN (PER ANCHOR)
   SHEAR: V = 0.9kN. (PER ANCHOR)



1/– PLAN SECTION – (ALTERNATIVE 1)



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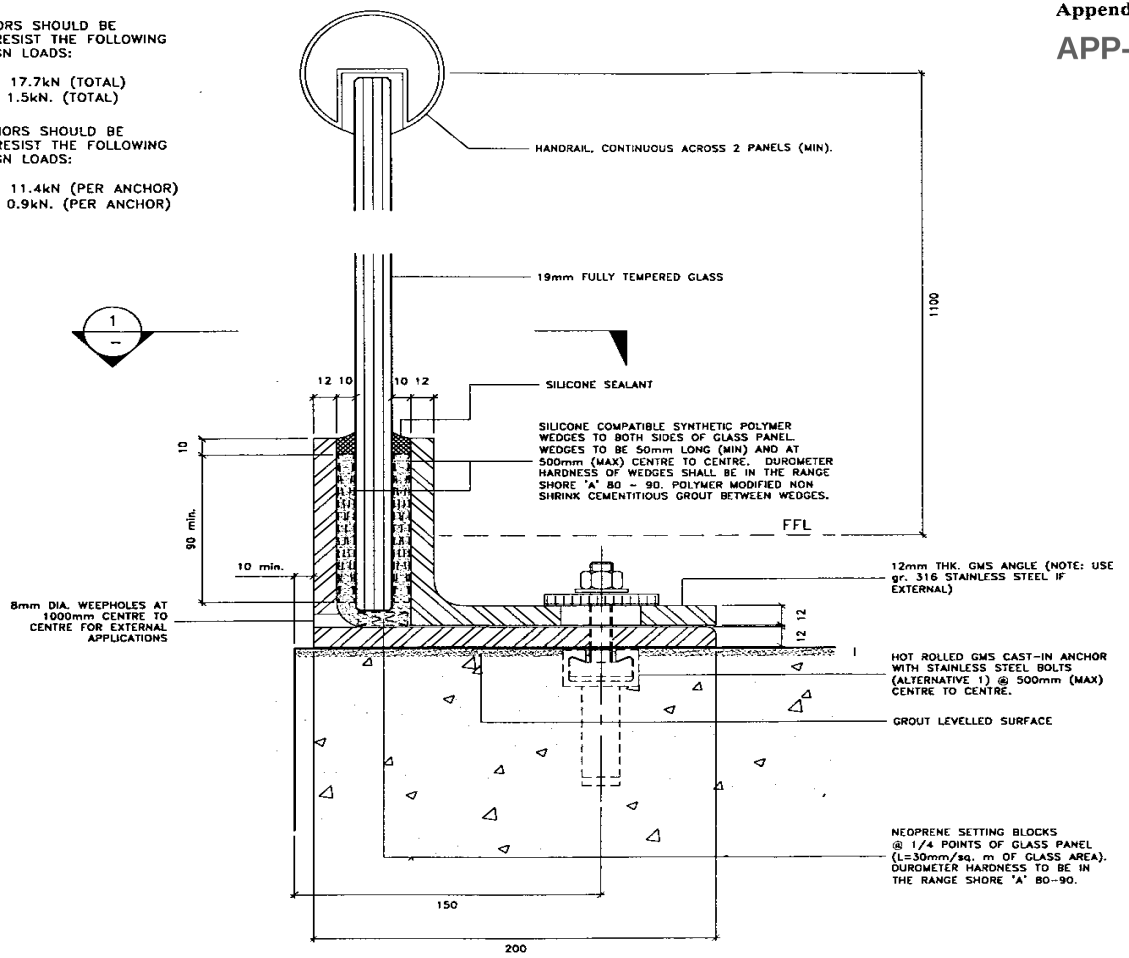

TYPICAL CLAMPING DETAIL FOR FREE STANDING GLASS PROTECTIVE BARRIER