

### **Protective Barriers**

The prime function of a protective barrier (barrier) is to prevent persons or objects from passing through or toppling over onto an adjacent lower level. Regulation 8 of the Building (Construction) Regulations (B(C)R) and regulation 3A of the Building (Planning) Regulations prescribe the requirements for barriers. This practice note provides the design and construction requirements of the barriers.

#### **Design Requirements**

2. In all circumstances, a barrier should have a height of not less than 1.1m. The lowest 150mm of the barrier should be built solid (except for staircases enclosed with walls and without open stair-well<sup>1</sup>). 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.
3. The height of a barrier should be measured from the finished floor level of the surface adjoining the barrier where people could step on (adjoining floor level). In this connection, the top of a curb or step next to a barrier would not be regarded as an adjoining floor level if the curb or step is higher than 500mm or its protruding width<sup>2</sup> is less than 75mm.
4. For railing type barrier on a curb of less than 500mm high, the top of the lowest horizontal rail should be not more than 250mm above the adjoining floor level. In addition, the barriers should be designed to minimise the risk of persons climbing over the barrier.
5. As barriers required under regulation 8 of the B(C)R are for restricting or controlling the movement of persons and vehicles, this regulation should not apply to any areas of a building which is inaccessible. For the purpose of this practice note, an inaccessible area means an area which is only accessible to restricted personnel for maintenance works or by the use of a cat-ladder or other special appliances. However, authorized persons are strongly advised to take into account the requirements under section 6 of the Occupational Safety and Health Regulation (Cap. 509A) at the design stage of the building.

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<sup>1</sup> Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineer APP-119 is relevant.

<sup>2</sup> The protruding width is measured horizontally from the inner finished surface of the barrier to the inner side of the finished curb or step. The measurement of the protruding width excludes the splayed portion of the curb or step steeper than 45 degrees relative to the horizontal plane.

## **Structural Design Requirements**

6. Structural details of barriers should be submitted to the Building Authority for approval. They should be designed to resist the imposed loads as prescribed in Table 3 of regulation 17 of the B(C)R. The minimum design imposed loads for the barriers to restrict or control the movement of persons and for vehicle barriers are stipulated in regulations 17(3) and 17(4) of the B(C)R respectively. Barrier subjected to wind loads shall be designed to resist the more stringent requirement of either the required imposed load or the design wind loads as prescribed in the Code of Practice on Wind Effects in Hong Kong. The structural design should comply with the laws of mechanics, recognised engineering principles and recognised codes of practice such as BS 6180:2011 – Barriers in and about buildings.

## **Glass Barriers**

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

## **Site Supervision**

8. The construction of 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.

( HUI Siu-wai )  
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 (barriers) are as follows :
  - (a) **Laminated glass** is a safety glass suitable for 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 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.

### **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 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 horizontal imposed loads for areas where people may congregate or susceptible to overcrowding, 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 for area where people may congregate or susceptible to overcrowding, 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 on the barriers applied across the resulting gap without causing structural failure or yielding of the protective barrier system.
- 7. Continuous fixing is recommended 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 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 barriers.

### **Impact Resistance of Glass for Barriers**

9. Glass to be used for 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 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 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 barriers to ensure that the recommended installation procedures are strictly followed.

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(Rev. 4/2015)

**PNAP APP-110**  
**Appendix B**

**GENERAL NOTES**

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

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

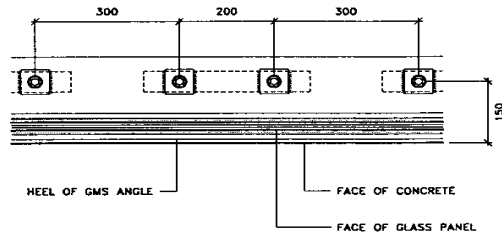
IN ACCORDANCE WITH HONG KONG BUILDING (CONSTRUCTION) REGULATIONS FOR PROTECTIVE BARRIERS IN PLACES OF ASSEMBLY AND ALL PANIC BARRIERS.

- CAST IN ANCHORS SHOULD BE SELECTED TO RESIST THE FOLLOWING WORKING DESIGN LOADS:

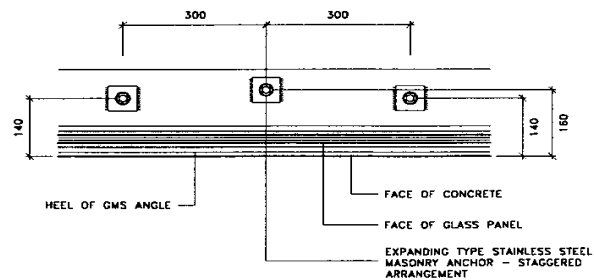
TENSION:  $T = 17.7\text{kN}$  (TOTAL)  
SHEAR:  $V = 1.5\text{kN}$  (TOTAL)

- MASONRY ANCHORS SHOULD BE SELECTED TO RESIST THE FOLLOWING WORKING DESIGN LOADS:

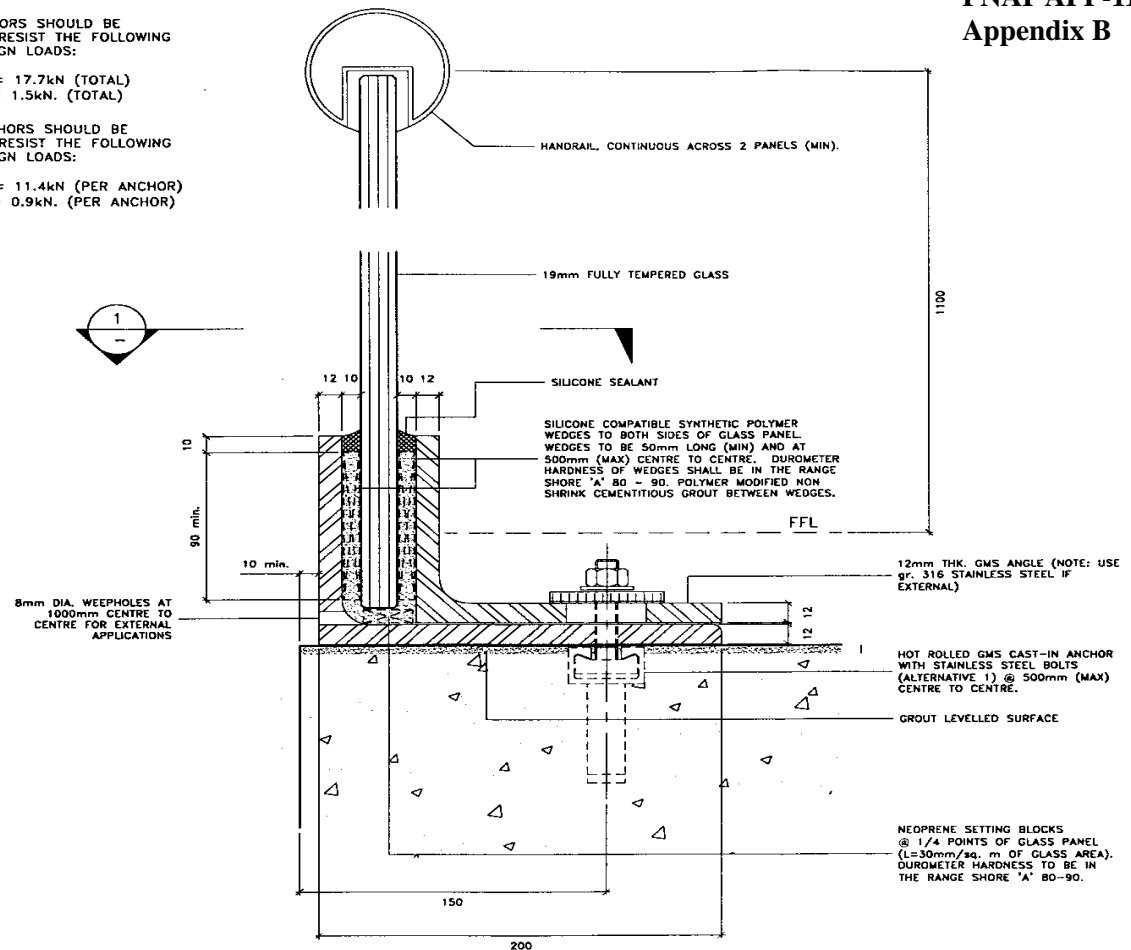
TENSION:  $T = 11.4\text{kN}$  (PER ANCHOR)  
SHEAR:  $V = 0.9\text{kN}$  (PER ANCHOR)



1 PLAN SECTION - (ALTERNATIVE 1)



1 PLAN SECTION - (ALTERNATIVE 2)



TYPICAL CLAMPING DETAIL FOR FREE STANDING GLASS  
PROTECTIVE BARRIER