

SECTION 6
SUPPORT CRITERIA



Support Criteria

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Title	Rev.	Date
6.1 Not Used		
6.2 Criteria for Glazing Systems	A1	July 09
6.3 Floor Finishes Checklist	A2	June 15

Criteria for Glazing Systems

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1	GENERAL
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The criteria do not apply to the choice of glass and glazing systems for use in Civil Defence shelters. The designer shall refer to the Building and Construction Authority for any civil defence materials and workmanship specifications.

“Accepted,” “Reviewed”, “directed”, “rejected”, “endorsed” and similar expressions mean accepted, reviewed, directed, rejected, endorsed in writing by the Engineer

The designer shall assume the responsibility to fully develop, analyse and document the proposed design by appropriately qualified and experienced licensed professional engineers. The design shall be adequate to satisfy structural requirements, aesthetics, air and water leakages, etc. The designer shall verify that the design complies with the applicable regulations. Fabrication shall not proceed until the written approval of the Engineer is obtained.

2	PERFORMANCE
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2.1 Impact

Glazing shall be used such that the public are protected from danger. All glass that the public are likely to come into contact with must comply with the requirements of Singapore Standard SS 341: Safety Glazing Materials for Use in Buildings (human impact considerations).

The impact load from an external object shall be limited to that required in SS341. Where risk assessments show that there is an increased possibility of accidental breakage, the impact load shall be that required by the German anti-vandal standard, DIN 52290 Part 4, category A2.

Feasible mitigation measures (e.g. impact barriers) acceptable to the Engineer shall be provided where glazing systems are susceptible to impact.

2.2 General Loading

The design of the structure shall be in accordance with AS 1288, established good engineering practice and principles. The design and loading requirements shall be as follows:

- a) The loads specified and effects for the most severe combination of forces on every component /member.
- b) The method and sequence of construction shall be specified and taken into account in the design.
- c) Possible imperfections in fabrication and erection shall be considered in the design. The structurally acceptable margins of tolerance shall be clearly specified for critical members and installation/ operations.
- d) Unless otherwise demonstrated by the Designer and accepted by the Engineer that there is no impact on public safety in case of glass failure, all glass above 2.1m shall be designed for one ply failure. The remaining unbroken/ un-shattered glass ply shall be designed to carry self-weight of the whole panel and wind load.
- e) Structural fixings shall be designed to resist all anticipated loads such as dead loads, live loads, wind loads, etc. including all structural movements individually and in combinations. All fixings shall accommodate the worst combination and the overall articulation of the glazing.
- f) All glazing elements shall be designed such that effective maintenance and replacement of these elements can be carried out without damaging adjacent components. This shall be demonstrated as specified in Clause 6.2.1.7.
- g) The breakage or removal of any panel of glass or any component shall not lead to a collapse or failure of adjacent elements or the system as a whole.
- h) Horizontal elements of suspended glass such as skylights, etc. shall be designed to withstand all the anticipated loads including the imposed roof loads as specified in the Civil Design Criteria without material failure or permanent deformation of structural members.
- i) The loads appropriate to the design of glass parapets and balustrades shall be in accordance with the Civil Design Criteria.
- j) The design shall incorporate the clearances, dimensions, configurations and withstand the loads created by the selected window washing system. Loads induced by the system shall be considered to act simultaneously with the design wind pressures.

- k) The glazing system shall be capable of withstanding dynamic effect, including vibrations if appropriate. When the glazing is adjacent to a carriageway, it shall be designed to withstand a vibration of 10mm/sec without breakage of the glass or separation of the glass from the supports.

2.3 Temperature Loads

- a) Glazing shall be designed to provide for expansion and contraction over the following temperature ranges without buckling, sealed joint failure, glass breakage, stone breakage, undue stress on members or anchors, and other detrimental effects:
- b) External environment: Temperature range ambient from 15°C to 37°C.
- c) Internal environment: Temperature range ambient from 20°C to 35°C. In addition, if the premise is air conditioned, additional temperature range of 21°C +/- 6°C shall be considered.
- d) Surface temperature allowance shall be +33°C i.e. 60°C.

2.4 Design Calculations

The Designer shall submit calculations for all the elements. The following calculations shall be submitted:-

- a) Structural calculations for frames, connections and glass panels including calculations for one ply failure condition to show that the total maximum stresses and deflections do not exceed specified performance requirements under full design loading. Building movements including loading deflections, shrinkage, creep, temperature variation and vibration, etc. are to be taken into account.
- b) Thermal stress calculations for each type, size and thickness of exterior glass.
- c) Calculations on expected expansion and contraction shall be compared against the allowable values in the design.
- d) Structural calculations for the anchorage of the glazing washing systems.
- e) Calculations for all the anchors, inserts and fasteners, demonstrating that they will sustain all imposed design loads.

2.5 Maximum Deflection

The maximum deflection limits shall be as follows:

- a) Suspended glass wall system: Maximum deflections shall comply with the requirement of SS CP 96: Code of Practice for Curtain Walls.
- b) Horizontal and sloped elements of suspended glass (e.g. skylights etc): Maximum full load deflections, normal to the projected area of the suspended glass, for any support member shall not exceed 1/240 of its clear span or 19mm, whichever is less. Maximum full load deflections, parallel to projected area of suspended glass, shall not exceed 75% of the design clearance dimension between that member and the panel, glass or other part immediately adjacent.
- c) For glass to be considered as four-edge fully supported, the deflection of edge of the glass shall be limited to glass span/175. This requirement shall also be applied to the one ply failure condition. Only self-weight and wind load (if applicable) need to be considered under such a condition.
- d) Permanent deformation: Weld or fastener failure, component dislodgement or breakage shall not occur under loading equal to 1.5 times the design load pressures. Permanent deformation is defined as deflection without recovery exceeding length/1000.

2.6 Testing

Tests carried out to demonstrate that should one ply of any laminated glass break, the remaining unbroken plies held within the actual fixings, shall have sufficient strength to carry the weight of the broken ply, together with all anticipated loads with the broken glass being required to remain in position for a minimum of 72 hours.

3 GLASS TYPES

Only laminated glass shall be used for all glass above 2.1m.

All tempered glass shall be heat soaked in accordance with DIN 18516: Part 4 German Standard for Heat Soaking.

4 SUPPORT SYSTEMS

4.1 General

The support systems shall be detailed such that they are:

- Easy to install and replace; and
- Require minimum maintenance.

If point-supports are used for these glass structures, the design of the fixing details shall incorporate sufficient redundancy to avoid glass falling off the supports under the one ply failure condition.

Stress concentration around holes in the glass (e.g. at support locations) shall be considered in the design. Finite element method or other appropriate analytical method shall be used to predict the stress concentration.

The choice of glass type must be considered in the light of the support systems chosen by the designer. However, countersunk support (support with recess in glass) shall not be used.

4.2 Detailing of Supports

Holes at the supports shall be isolated by nylon bushes. Countersunk supports with recess in the glass shall not be used. The dimension of the holes shall be at least equal to the thickness of glass. The typical point support detail is shown in Fig 6.1.

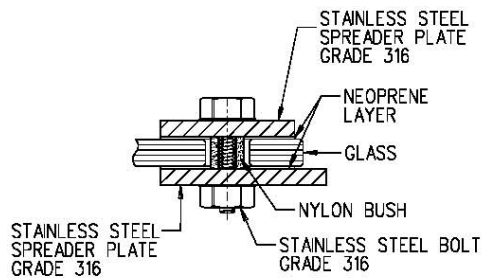


Fig 6.1 TYPICAL POINT SUPPORT DETAILS

5 GLASS SIZES

Designers are encouraged to consider alternative types of glass suited to the size of panel and the support system adopted.

The designer shall ensure the panel sizes and weights for all glass panels compliment the required glazing replacement provisions and delivery access routes and require no additional equipment than allowed for in the maintenance strategy.

For all non-vertical glass panels, the length of each glass panel shall be not more than 1.5m and weigh not more than 150kg unless otherwise justified and subject to acceptance by the Engineer.

6 GLAZING SCHEDULE

Designers shall prepare a full glazing schedule identifying all types of glass used in a station, including its associated support system, material properties and location. Glazing schedules must be included in each formal design submission and accepted by the Authority.

7 MAINTENANCE STRATEGY

A comprehensive maintenance strategy for the glazing system shall be submitted for approval. The strategy shall include periodical inspection requirement of the glazing system and methodology for replacement of broken glass and routine cleaning. The methodology shall be demonstrated during design stage and verified on site with a full mock up at construction stage.

Site specific access and lifting equipment details shall be submitted for approval to demonstrate that panel replacement can be achieved, including all time required for mobilisation and demobilisation of such equipment, within 4 hours for all glass panels

8 SUMMARY

The Authority's performance requirements are mandatory.

Designers are encouraged to consider a variety of ways to meet the Authority's performance requirements.

Designers shall be required to obtain the Authority's acceptance of their choice of glass or glazing system as part of the design review process and demonstrate, using the risk assessment approach criteria in Engineering Standard PED/DD/K9/910/004 that the design will not result in an unacceptable risk to station users, the public, or the building.

Floor Finishes Checklist (for floor tiles only)

Pursuant to The Street Works Act and its Regulations

State Material Used : _____ (eg granite, homogeneous tiles etc)

(✓) Tick the appropriate box for all items

Standard Requirements		Complied	Not Complied	Remarks
1.	The proposed finished floor shall provide a safe and hazard free environment. Any potential risks with appropriate mitigating measures shall be identified.	<input type="checkbox"/>	<input type="checkbox"/>	
2.	Submit full information on the proposed material for open walkways to be maintained by LTA. (brand/ country of origin/ name of manufacturer & supplier/ brochures/ product reference etc.)	<input type="checkbox"/>	<input type="checkbox"/>	
3.	Comply to Slip Resistance (Coefficient of friction for dry & wet.) SS485:2011 for "Slip resistance classification of public pedestrian surface materials".	<input type="checkbox"/>	<input type="checkbox"/>	
4.	Comply to surface hardness according to Moh's scale 7.	<input type="checkbox"/>	<input type="checkbox"/>	
5.	The material selected shall comply to the respective water absorption and compressive strength test requirements of a recognised regulatory body, eg SPRING Singapore.	<input type="checkbox"/>	<input type="checkbox"/>	
6.	The material selected shall have joints that are adequately spaced to cater for movement to prevent debonding.	<input type="checkbox"/>	<input type="checkbox"/>	
7.	The material selected shall comply with any applicable URA Development Control requirements for the particular location.	<input type="checkbox"/>	<input type="checkbox"/>	

Notes :

- The QP shall state the reasons for all non-compliances in the 'Remarks' column.
- A separate checklist shall be completed and submitted for each separate material.
- Nothing shall be construed to exempt any person from otherwise complying with the provision of the Street Works Act and its Regulations, the rules made thereunder and all other written laws for the time being in force.
- Any standard used for compliance must be recognised by SPRING Singapore.
- Test reports of floor materials are not required to be submitted.

Name Of Qualified Person

Signature Of Qualified Person

Date