

A-4 ARCHITECTURE – GLAZING, WINDOWS AND ASSEMBLIES

1. SCOPE

This section defines the various types of windows for CSC institutions on the exterior and interior except for Control Posts and Weapons Dedicated Routes which are covered in section A-13. Whereas the previous section A-3 dealt with steel grilles and mesh which may be superimposed on exterior of windows, this section deals with a total window assembly designed to achieve a required level of security.

2. RELATED SECTIONS

2.1 *Technical Criteria Document sections:*

- A-2 – Building Construction
- A-3 – Grilles, Mesh and Screens
- A-5 – Doors and Frames
- A-11 – Inmate Cells
- A-13 – Security Control Posts, Galleries and Routes
- ST-1 – Guard Towers

2.2 *CSC/NMS Specifications (NMS-CSC Masterformat 2010 Sections)*

- 08 56 63 Detention windows (Prior to 2004: 08581 – Detention windows)
- 08 88 53 Detention and Security glazing
- 11 19 00 Detention equipment

2.3 *Standards*

- 2.3.1 ASTM Standards
 - A627-03 – Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
 - A673/A673M-07 – Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
 - F1592-05 – Std. Test Methods for Detention Hollow Metal Vision Systems
 - F1915-05 – Standard Test Methods for Glazing for Detention Facilities
- 2.3.2 NAAMM DEMA – Detention Equipment
 - 111900-09 – National Association of Architectural Metal Manufacturers – NAAMM – Guide Specifications for Basic Detention Equipment Requirements
 - 111950-09 – National Association of Architectural Metal Manufacturers – NAAMM – Guide Specifications for Detention Fixed Exterior Windows
- 2.3.3 Canadian Standards Association (CAN/CSA)
 - A440-00/A440.1-00 (R2005) - CAN/CSA-A440-00, Windows
 - A440.1-00, User Selection Guide to CSA Standard CAN/CSA-A440-00, Windows
 - A440S1-09 – Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440
 - A440.4-07 – Window, Door, and Skylight Installation
 - A440.2-09/A440.3-09 – Fenestration energy performance + User guide
 - AAMA/WDMA/CSA 101/I.S.2/A440-08 NAFS - North American Fenestration Standard / Specification for Windows, Doors, and Skylights
- 2.3.4 Canadian General Standards Board (CAN/CGSB)
 - 12.1-M90 – Tempered or Laminated Safety Glass
 - 12.2-M91 – Flat, Clear Sheet Glass
 - 12.3-M91 – Flat, Clear Float Glass
 - 12.4-M91 – Heat Absorbing Glass
 - 12.8-97 – Insulating Glass Units & 12.8-97 AMEND – Insulating Glass Units
 - 12.10-M76 – Glass, Light and Heat Reflecting
 - 12.11-M90 – Wired Safety Glass
 - 12.12-M90 – Plastic Safety Glazing Sheets

3. DEFINITIONS

Tempered glass: Glass that has been processed by controlled heat or chemical treatment to increase its strength compared to float and untreated glass. Heat tempered glass if fractured breaks into rounded grains rather than sharp shards. This glass is approximately three times more resistant to impact than untreated glass for a thickness of 6mm but less for thinner sheets. It is also more resistant to breakage than chemically tempered glass though the latter if fractured breaks up into shards. Heat tempered glass however due to its heat treatment and resulting surface tension is vulnerable to fracture when impacted by a pointed object or struck at the edge or scratched by a harder mineral such as quartz or a ‘precious’ stone. Heat tempered glass cannot be cut.

Safety glass: A laminate of two or more sheets of glass adhered to one another with the use of a plastic interlayer. The type of glass used in laminates can differ but if fractured it remains secured to the plastic interlayer (typically PVB or polyurethane minimally 0.78mm thick (30mil) or multiples of this thickness). Depending on the glass type, the breakage pattern will differ but sharp shards are unlikely to be obtained since by impacting the fractured area, the glass will progressively break up into smaller pieces.

Plastic Polycarbonate and Acrylic sheet: Plastic materials which are clear, tough, and shatterproof but are more affected by UV rays than glass. Polycarbonate, a thermoplastic polymer (commonly known by the trademark ‘Lexan’), is the softer of the two materials, more resistant to impact but less to abrasion though it could be hard coated to improve abrasion resistance. Acrylic (commonly known by the trademark ‘Plexiglass’) is harder and therefore more apt to crack under impact but is more resistant to abrasion. This material, commonly used for light diffusers, is not normally found in detention application due to its inferior performance against physical attack. Sheets of polycarbonate can be laminated together using polyurethane as an interlayer to enhance their performance against physical or ballistic attack. Polycarbonate will burn when exposed to continuous flame but if the flame is withdrawn, it chars and rapidly extinguishes itself.

Composite translucent material: Glass combined with polycarbonate in multiple layers to improve performance against physical or ballistic attack while achieving enhanced resistance to chemicals, fire or abrasion. Glass is typically applied on the exposed sides but may be only on 1 side if a threat from ballistics requires that the protected side be spall free. The interlayer used in composite glazing is typically polyurethane due to the two materials having a different coefficient of expansion.

Fire resistant applications: Glass in fire separations is usually comprised of wired glass, tempered glass or glass blocks subject to area and location limitations. Ceramic glass technology is also becoming increasingly popular. Other usages of glass in fire separations consist of combinations with window sprinkler treatments and include specific framing restrictions.

4. PERFORMANCE CRITERIA

The following applies to the use of windows in correctional environments:

- 4.1** Glazed windows for exterior and interior locations are used in combination with other measures or components to achieve the required security. The measures may include restricted openings, attack resistant glazing or security bars / grilles / or mesh.
- 4.2** The extent of the exterior window clear glass opening to be provided in all bedrooms and cells shall be 5% of the net room area.

- 4.3** Windows in bedrooms and cells shall have an operable sash to allow for fresh air controlled by the inmate. The unobstructed ventilation area¹ of the window shall be sized minimally at 125mm in the narrow dimension.
- 4.4** Windows on a given project shall be of equal size to the extent possible in order to reduce manufacturing costs and to simplify the stocking of glazing materials.
- 4.5** Glass in windows in minimum security institutions including that which is used in interior areas does not need to be treated to prevent shards when broken except where required by the NBC. Glass in windows in medium and maximum institutions including that which is used in interior spaces shall be heat tempered or safety (laminated) type to prevent shards when broken.
- 4.6** Tinting films for one way viewing shall not be used on glazing except as indicated in Chapters A-13 and ST-1 for Observation galleries and Guard towers respectively.
- 4.7** Curtains (and blinds at minimum security institutions) may be used on exterior windows for reasons of comfort and upon request. Curtains in windows at medium and maximum may be attached using ‘Velcro’.
- 4.8** Skylights, where provided, shall meet the same level of performance as that required in wall openings except where they are inaccessible and located in supervised areas.
- 4.9** For medium and maximum security institutions bars or grilles shall be used on windows to achieve confinement or intrusion protection. The bars shall be spaced to form a clear opening between bars of 125 mm and shall be designed to minimize the effect of “tunnel vision”. Bars shall be located on the interior side of the window to be protected from exposure to weather and to assure adequate anchoring to the interior side wall material which typically is reinforced masonry or monolithic concrete. A grille fabricated from mild steel or screens of galvanized steel mesh or stainless steel generally applied on the exterior of the window, do not achieve the security performance of that of a bar.
- 4.10** Windows used along with bars may have varied configurations to respond to suspension point concerns. For medium security cells, the fixed window sash may span the full opening and be set away from the bars. Bars in this case must be set on the vertical and have no intermediate horizontal members in order to lower the height of potential suspension points to the window sill. For maximum security cells and for segregation and observation cells, the bars shall be in contact with the window glass or window mullions. The window mullion or glass shall be sealed or caulked to each bar to prevent feeding a line behind the bar to achieve a suspension point. As such, windows for maximums and segregation units can have bars set in either vertical or horizontal direction. It should be recognized that suspension prevention is only achieved when the glass is intact. An inmate intent on committing suicide can break the glass on each side of a bar to allow wrapping a ligature around the exposed bar. Closed and secure control posts contribute to sound attenuation preventing hearing glass breaking within a cell.
- 4.11** Openings for natural ventilation by means of operable sashes or pass through restrictors shall be equipped with insect screens.
- 4.12** Glazed partitions or wall assemblies for interiors where Security Construction 2 or 3 is required, shall use glass which does not break into shards in combination with grilles or mesh or alternately polycarbonate or composite glazing without the use of grilles or mesh. For secure construction 1, laminated glass may be used to offer a degree of

¹ National Building Code of Canada 2010, 13th Edition 2010, National Research Council, Vol. 2, Section 9.32.2.2

protection. Where fire rated construction is required, NBC compliance shall dictate the choice of materials.

- 4.13** Window accessories shall not be easily removable or dismantled. The use of vertical sliders in other than minimum security must not incorporate sash balances; instead, sash bolts shall be used.
- 4.14** Glass used in required fire separations:
- 4.14.1** Glass used in fire separations must be carefully selected for its use, size, location, type as well as security requirements to ensure that there are no conflicting requirements.
- 4.14.2** Wired glass and glass blocks shall conform to the requirements of the NBCC with respect to testing, size and area.
- 4.14.3** Ceramic glass products shall conform to the requirements of CAN4-S106-M “Fire Test of Window and Glass Block Assemblies” for the required rating of the assembly.
- 4.14.4** Where ceramic glass products are used, these shall be subject to the same area limitations of the NBCC for wired glass unless the material is also tested to limit temperature rise (exposure to radiant heat) at which point the product’s listing shall govern.
- 4.14.5** Window sprinkler applications (protection of glazing using listed sprinklers) shall only be permitted if a specific listed assembly is selected and installed based on ULC/ORD-C263.1-99.
- 4.14.5.1** A window sprinkler protected glazed wall assembly shall not be installed in:
- 4.14.5.1.1** Fire separations requiring a fire resistance rating of more than 2 hours,
- 4.14.5.1.2** A firewall,
- 4.14.5.1.3** A high hazard industrial occupancy, or
- 4.14.5.1.4** Any part of an exit serving a high building, a care and detention occupancy (Group B), or a residential occupancy.

5. WINDOW TYPES

General

Window design may be subject to an examination of a mock-up and / or certification of compliance to standards for critical components by an independent laboratory.

5.1 Commercial Level 1 (CW1) – Applicable at Minimum Institutions only

Conventional window conforming to medium duty standards outlined in *CSA A440-8*². This window is not intended to resist forced passage. The thermal unit glazing is medium duty float glass. All windows in housing units shall provide for detection of unauthorized egress or deliberate tampering. This is achieved by using stops on the operable sash to limit the opening to 125 mm or by affixing the screens with security screws to the window frames.

² AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights

5.2 Commercial Level 2 (CW2) – Applicable at Medium and Maximum Institutions

Conventional window conforming to medium duty standards outlined in *CSA A440-8*³ but with a glazing type which does not form shards when broken. The thermal unit glazing is medium duty heat tempered glass. For secure applications, this window is used in combination with grilles, mesh or bars which provide for containment or intrusion protection.

5.3 Commercial Level 3 (CW3) – For Secure Construction 1 application

Conventional window conforming to medium duty standards outlined in *CSA A440-8* (see footnote 2) but having safety glass as one layer of the thermal unit, the other being heat tempered. This window is intended to delay and frustrate a breach attempt and to provide evidence of breach attempts (e.g. broken glass). Window comes with the outside glass of the thermal unit made of two layers of 6 mm float glass held by minimally a 0.78mm (30mil) interlayer of polyvinyl butyral (PVB).

5.3.1 For window retrofits, security films are acceptable provided they are installed on the interior glass covering the entire glass area below the bite or covering the glass and returned and anchored onto the frame.

5.3.2 This type of window may not be appropriate for non-supervised areas where heightened security is required. In this case a combined CW2 window with exterior grilles or mesh should be considered.

5.4 Detention Level 1 (DW1) – For Secure Construction 2 application

This refers to a combination CW2 window combined with bars which limit the opening between bars to a maximum, in one dimension, of 125 mm (5”) to achieve containment. Plate A-4-1 illustrates an example of a security window meeting the requirements of a Detention Level 1 (DW1) window. This window has the following characteristics:

5.4.1 Resistance to bending, jacking, impact and cutting achieved by the steel bars (as defined in *ASTM A627-03*⁴) using Hollow Structural Steel Section with an interior tool resistant steel rod. The rod may be mounted freely to enable rotation using dimples at both ends and a spacer ring to keep from leaning. See Partial Plan View of Plate A-4-1 and Plate A-4-2.

5.4.2 The bar assembly is cast into the adjacent masonry, welded to a rod or a bracket (wall anchor⁵) cast in masonry or fabricated off site with a precast concrete surround which is anchored to the masonry wall. Bars shall always be set on the interior side of the window.

5.4.3 Sashes are to be removable from the exterior side on account of the interior bars obstructing access.

5.4.4 Window assembly is not intended to prevent suspension points hence is only acceptable for medium security cells other than segregation.

5.5 Bar-less Detention Window (DWb) – For Secure Construction 2 application

A bar-less detention window (DWb) is a security window which maintains forced entry or penetration resistance achieved by a security glazing held in a secure frame assembly.

³ AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights

⁴ ASTM A627-03 – Standard Test Methods for Tool-Resisting Steel Bars, Flats, and Shaped for Detention and Correctional Facilities

⁵ See the wall anchors as shown on figure 1b of ASTM F1592-05 – Standard Test Methods for Detention Hollow Metal Vision Systems and on figure 4 of ASTM F1450-05 – Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention and Correctional Facilities

This window type is used primarily for control posts or within glazed panels such as for sidelights and doors separating areas requiring containment or intrusion protection and unobstructed vision.

- 5.5.1 The frame is hollow metal conforming to *ASTM F1592-05*⁶ Grade 3 anchored to the wall system or a detention door.
- 5.5.2 The glazing type used for windows and large glazed panels in doors in supervised areas or for control posts is described in the Control post Chapter A-13. Conforming glazing is a monolithic polycarbonate of 12.7 mm thickness protected by tempered glass or Georgian wired glass.
- 5.5.3 For applications where inmates are only periodically supervised as for cell windows or glazing in door panels as for Observation cells, a higher performing glazing is required in order to withstand a surreptitious or sustained brute force attack as per criteria set out in Chapter A-11. Conforming glazing shall meet physical attack standards ASTM 1915 Grade 2 or HP White level II. Glazing type meeting these performance standards is a multi-layered polycarbonate glazing with a trademark name 'Lexgard MPC-500'. This glazing is protected by abrasion resistant film on the cell side and tempered glass on the corridor side. See Chapter A-12 for Observation cells.
- 5.5.4 For exterior windows, the security glazing set in its own steel frame shall be used in combination with a separate thermal unit type CW2 to be located on the weather side.
- 5.5.5 For optimal security, exterior DWb windows shall not have any openings (e.g. for ventilation) and as such they are suitable for air-conditioned environments.

5.6 Detention Level 2 (DW2) – For Secure Construction 3 application

This refers to a combination CW2 window along with bars which limit the opening between bars to a maximum, in one dimension, of 125 mm (5") to achieve containment. Plate A-4-3 illustrates an example of security window meeting the requirements of a Detention Level 2 (DW2) window.

As illustrated, the mullion locations mimic the bars and are sealed to the bars to prevent the bars from being used as a suspension point. As such these windows are prescribed only for cells at maximum and all segregation units where the threat of suicide is at the highest. Given that the glass of the thermal unit can be broken; this window cannot achieve absolute prevention of suicide.

- 5.6.1 Forced Entry resistance by bending, jacking, impact and cutting with homogenous tool resistant steel or composite steel (as defined in *ASTM A627-03*, see footnote 3). See 5.4.2 for a typical bar design. In addition, the ventilation opening is covered with a perforated steel plate front with a movable vent sash. A non-removable vent sash controller protrudes without offering a suspension point. See Plates A-4-3 and A-4-4.
- 5.6.2 The window frame is cast into the adjacent masonry or welded to a rod or a bracket (wall anchor, see footnote 4) cast in masonry.
- 5.6.3 Fixed sashes are to be replaceable in situ with glazing stops affixed with security screws.

⁶ ASTM F1592–05 – Standard Test Methods for Detention Hollow Metal Vision Systems

6. WINDOWS SELECTION

6.1 See Section A-2, Table A-2-2 for windows selection.

6.2 ***Multi-Level institutions***

For housing units where medium and maximum classified inmates share the same housing unit but are in separate ranges, follow Table A-2-2 for the areas intended for the specific security level. For other than housing units, follow the Medium security level for the respective functions as maximum classified inmates will be more restricted in their movement and access to programs.

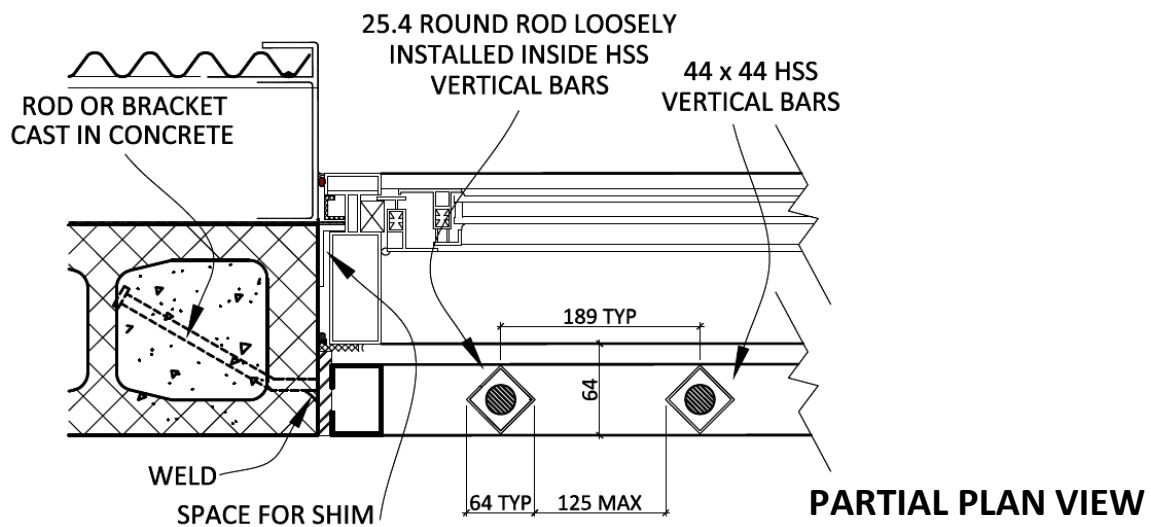
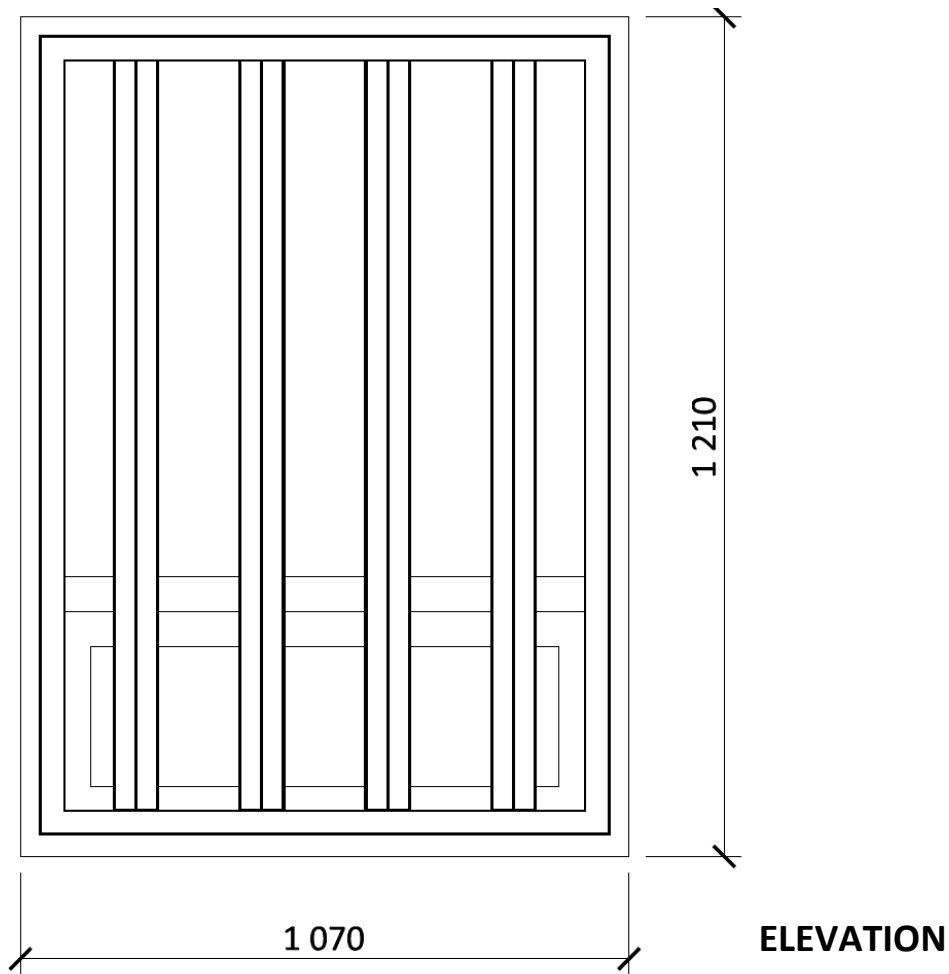


PLATE A-4-1 – TYPICAL DW-1 WINDOW

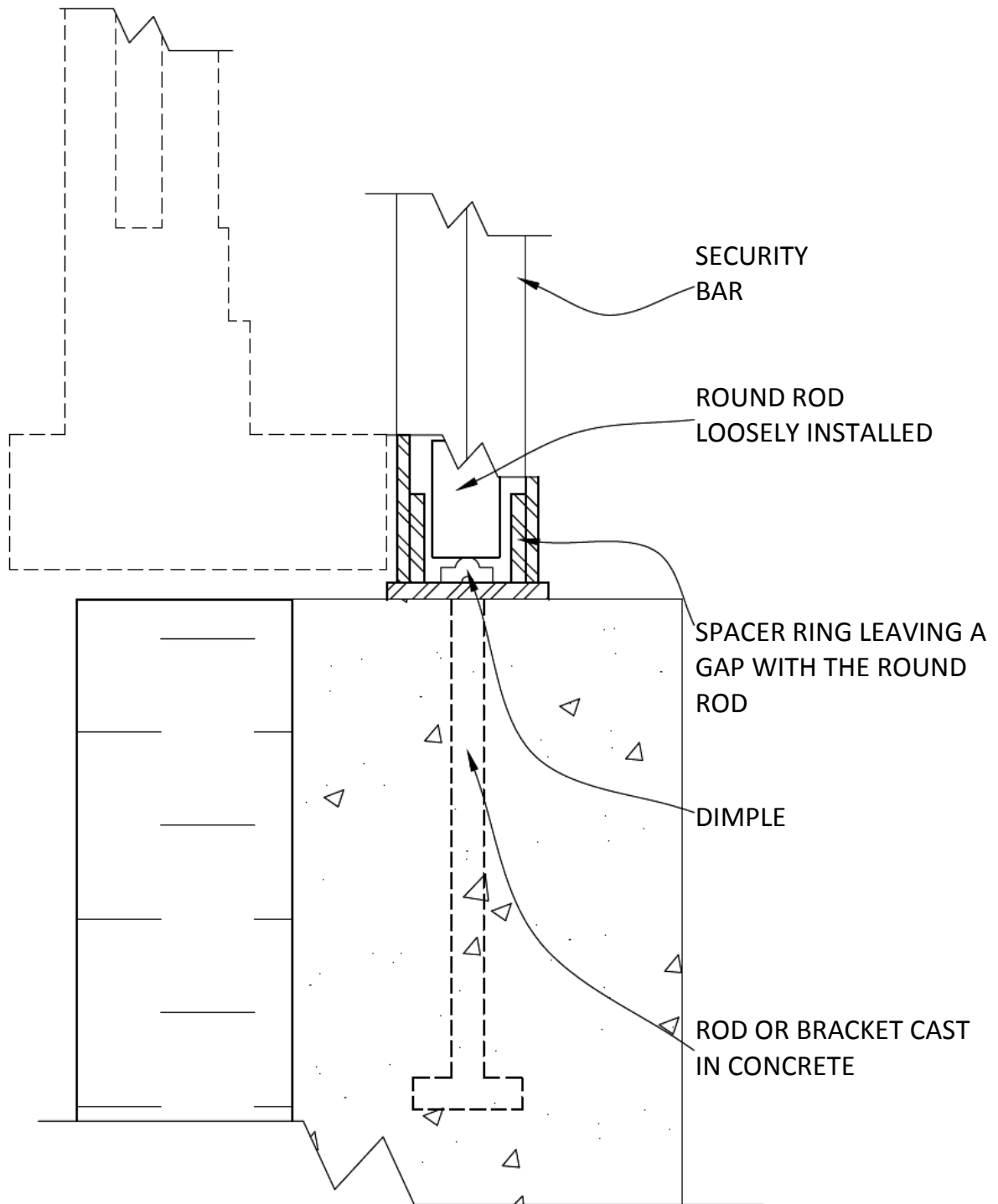
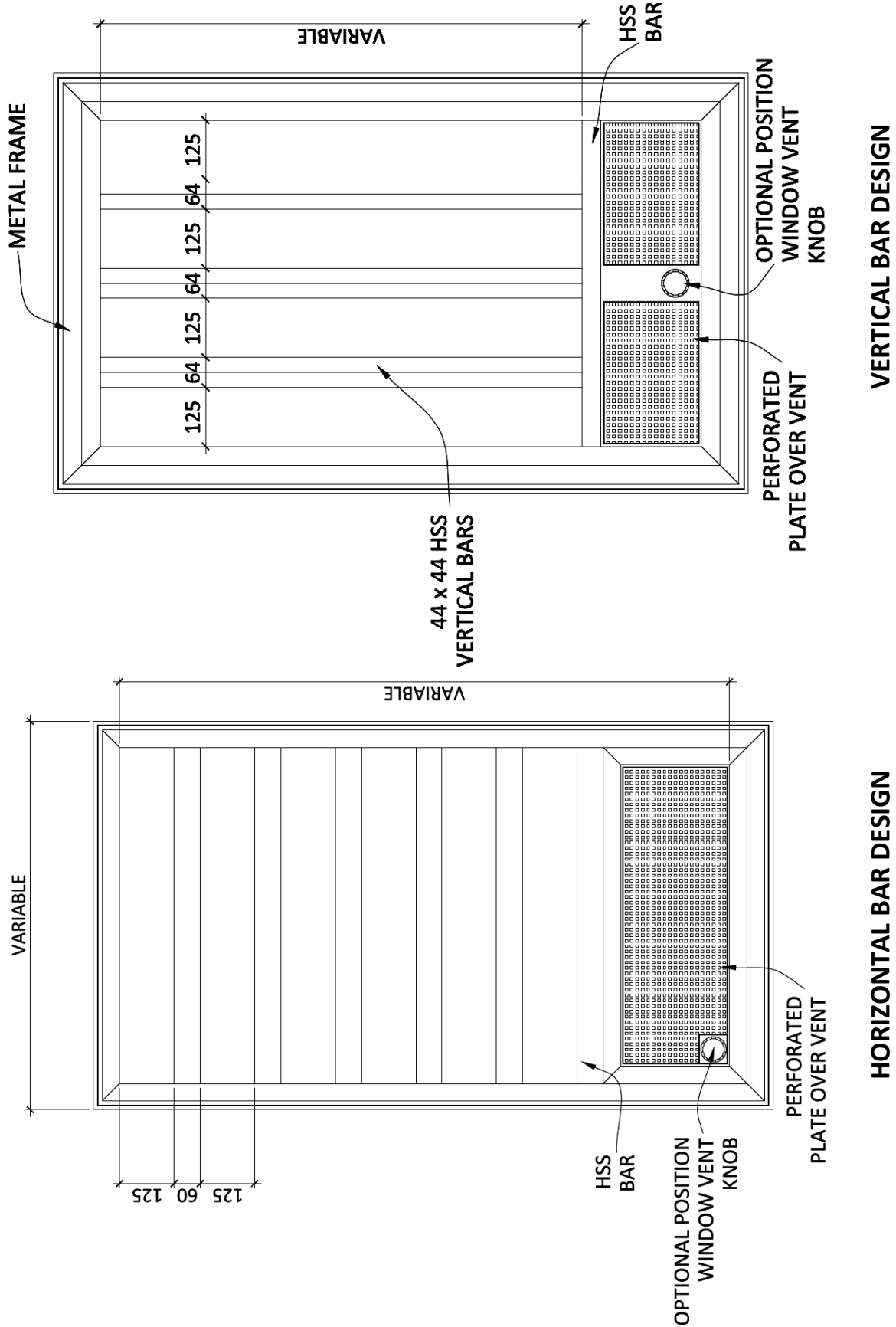


PLATE A-4-2 –INTERNAL ROD DETAIL



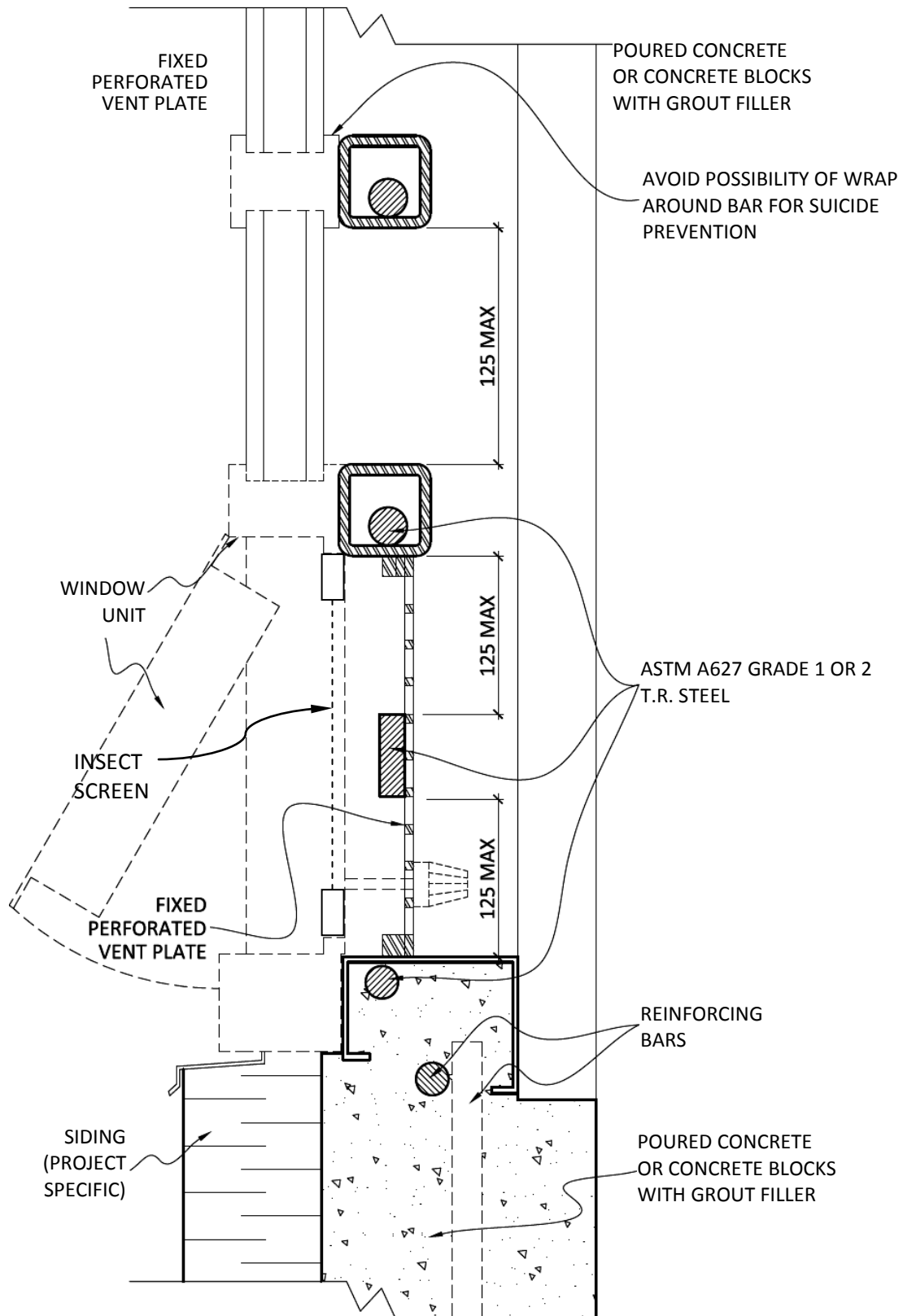


PLATE A-4-4 – DW-2 WINDOW – HORIZONTAL BAR DESIGN – DETAIL