

5.6 Glazing Systems

5.6.1 Requirements for All Windows

5.6.1.1 General Requirements

1. The design and detailing of exterior wall systems and assemblies will require significant input from UofC FM&D in the areas of energy/thermal performance, building envelope detailing, and aesthetic. It is expected that the design team regularly and iteratively engage FM&D throughout the entire design process and through the preparation of construction documents. This applies to any project that impacts the exterior envelope of a building in any capacity.
2. All windows and window assemblies to be designed according to pressure equalized rain screen principles incorporating air seals at a protected location in the assembly, and drained and ventilated compartments behind the exterior weather seals. The main mass of the frame is to be located to the interior of the thermal break. Do not use the frame to span the cavity between the inner wythe and the cladding.
3. Clear float glass, regardless of thickness, shall not be used for any installation, interior or exterior, in single pane applications. This includes borrowed lights, transoms, sidelights, doors, display cases and other miscellaneous windows.
4. All seals between frame and glazing to be made with compressed gaskets. Wet seals to the glass are not permitted.
5. Frames to be glazed with internal removable stops or using tamper proof fasteners where security is required.
6. Window installations need to accommodate building movements including inter storey drift during seismic loading.
7. Air leakage shall not exceed 0.1 L/s/m².
8. Water tightness rating for windows to be selected based upon exposure to elements related to location on the façade and site conditions.
9. Sound attenuation ratings for windows to be selected based upon interior requirements.
10. Thermal transmittance and solar heat gain coefficient for windows to be selected in coordination with mechanical consultant and to be coordinated with project sustainability goals. Full window (not center of glass) U-values should be less than 2.3 W/m²·K, Solar Heat Gain Coefficient (SHGC) values should be less than 0.40, and Visible Transmittance (T_v) should be greater than 0.40. Make provision for window washing and other maintenance access to both sides of glazing units.
11. Hardware and seals of operable units should be designed so that hardware can be adjusted and seals maintained or replaced over the life of the window to maintain air and weather tightness.
12. Frames need to be supplied with receiving surfaces for sealing to air and vapour barrier materials, insulation, and cladding in the wall assembly.

13. Sills and flashings to be installed with a definite outward slope (15° degrees or more).
14. Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed. Ensure that masking tape is not used or applied to any glass surfaces.
15. In the event of an emergency failure of any products, materials, or systems during the warranty period, and the issuer of the warranty is unable to or chooses not to respond to a request by the University of Calgary for immediate emergency repair/replacement of the affected items, then the University of Calgary may recover from the issuer of the warranty all costs incurred by the university for the immediate repair/replacement required.
16. Design window and interior surrounds to allow uniform air movement across the glass and frame.

5.6.1.2 Materials

1. Glazing units to be selected with a 10-Year warranty, warranty to also cover interpane dusting or misting.
2. Frame materials to be selected for a minimum 30-Year service life.
3. Suitable frame materials include aluminum with corrosion protection, or selected PVC compounds. A review of the selection and written approval from FM&D is required prior to consideration of frames with PVC materials.
4. Corrosion protection considered to be suitable for aluminum frame material consist of class I anodizing (18 micron) or PPG Duranar, two coat polyurethane paint or better finish.
5. All materials should be shop fabricated and finished with no field cutting of materials allowed.
6. PVC windows to have a minimum exterior wall thickness of 2 mm, and to have internal steel reinforcing in every member.
7. PVC windows to be white or light colours only.
8. Sill accessories and flashing material shall be connected with waterproof joints or shall be underlain with continuous secondary waterproofing. Joints shall remain waterproof while accommodating thermal movement for the life of the installation.
9. Set insulating units to mullions, head and sill members using glazing tapes properly cut and fitted to provide a positive air seal all around each framed section. Install with sufficient pressure to provide a finished clearance between glass and frame of 4.8 mm minimum.
10. All sealed units to incorporate non-metallic (warm edge) spacers.
11. Setting blocks and shims to be neoprene. Do not use wood or organic materials.
12. Choose window frames that will prevent condensation from forming on the frame at the interior design conditions and the 2.5% January design temperature.

5.6.2 Windows – Aluminium Framed**5.6.2.1 General Requirements**

1. Coordinate design with Building Envelope Consultant.
2. Typical for exterior aluminum fixed and operable window framing system.
3. Performance standards include but are not limited to:
 - a. AB Building Code.
 - b. CAN/CSA-A440 "Windows", including A440.1 "User Selection Guide to CSA Standard CAN/CSA-A440 Windows".
 - c. CAN/CSA-A440.2 "Energy Evaluation of Windows and Doors"
 - d. CAN/CSA-A440.4 "Window and Door Installation"
 - e. ASTM E283, "Test Method for Rate of Air Leakage through Exterior Windows Curtain Walls and Doors."
 - f. ASTM E330, "Structural Performance of Exterior Windows, Curtain walls and Doors by Uniform Static Air Pressure Difference."
 - g. ASTM E331, "Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differential."

5.6.2.2 Quality Control and Assurance

1. Require submittal to FM&D of:
 - a. Shop drawings sealed and signed by Design Engineer.
 - b. Manufacturer performance test data to confirm performance criteria.
 - c. Samples, including finishes for selection.
 - d. Maintenance Data
 - e. Source for replacement parts required for as-installed hardware.
 - f. Maintenance instructions.
2. All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the province of Alberta, to also carry out periodic site reviews during construction and at completion, and submit reports and letters of assurances for professional design, field review and building code and project criteria compliance. Costs to be included in the contract price.
3. UofC at its discretion may appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization.

5.6.2.3 Materials

1. In addition to any other applicable codes, standards and project requirements, exterior systems to meet or exceed the following minimum requirements.
 - a. Systems to utilize exterior rain screen deterrents, interior air seal barriers, and cavities pressure equalized to the exterior to minimize water infiltration into the internal areas of the system, assembled and installed to provide control and drainage to the exterior of any water which enters the pressure equalized cavities.
 - b. Window wall systems may be considered for student residences only. The desire to use a window wall system must be conveyed to FM&D very early in the design process and written authorization to proceed past schematic design with such a system must be obtained.
 - i. Window wall systems must:
 - employ pressurized rain screen principles
 - be designed to meet the requirements of CSA S478-95 - Guideline on Durability in Buildings
 - be designed so that the expected service life of the window wall components equal or exceed the design service life of the building.
 - ii. Detail drawings to be submitted to FM&D for review and approval early in design development and regularly throughout the preparation of contract documents.
 - iii. Face sealed systems are to be avoided. Written authorization from FM&D must be obtained prior to selection of a face sealed system, also, all detailing of such a system is to be approved in writing prior to manufacture/installation.
2. Environmental Separation
 - a. Water Penetration: no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 15 lb per sq. ft. (720 Pa).
 - b. Air Infiltration: not more than 0.3 L/s/m² (0.06 cfm/ft²) of fixed area (excluding operable door edges) when tested in accordance with ASTM E283 at an inward test pressure differential of 8.32 psf (400 Pa).
 - c. Conform to CAN/CSA-A440 Windows, including the following ratings:
 - i. Water tightness shall be B4.
 - ii. Air infiltration, see above.
 - iii. Wind load resistance shall be C3.
 - iv. Resistance to forced entry shall be F20 (windows reachable from grade).
 - v. Window systems to incorporate a thermal break.

5.6.2.4 Engineering Design

1. Wind loads shall be assemblies, reinforced where required, capable of withstanding local positive and negative wind pressures.
2. Minimum 25 psf (1.2 kPa) inward and psf (1.2 kPa) outward acting normal to the plane of the wall.
3. As required to meet Project Structural Design Criteria.
4. As required to meet the requirement of AB Building Code.
5. C5 rating to CAN/CSA-A440.
6. Based on CAN3-S157 and allowable deflection of 1/175.
7. Seismic design to meet all of the requirements for AB Building Code.
8. System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental affect to system components.
9. The system capable of withstanding a metal surface temperature range of 180° F (100° C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.
10. Assemblies to support design loads and accommodate structural deflection and long term creep movements and drift as shown on the Structural Drawings without stress on glass, buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects caused by structural movement.
11. The connection of windows and window framing to the structure of the building to be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments to be applied by the curtain wall to the structure or structural support.

5.6.2.5 Fasteners

1. In accordance with AAMA Guide Specification Manual to suit base metals in which they occur. Where exposed, finish and color to match surface in which they occur.
2. All fasteners, brackets and reinforcing: aluminum, hot-dip galvanized, or stainless steel.
3. Bitumen coating: where required to prevent electrolytic corrosion.

5.6.2.6 Prescriptive Requirements

1. Windows in Laboratory spaces to be operable only with a controlled tool, for use only in the event of Mechanical System shut-down/failure.

2. Windows manufactured of PVC, CPVC, or FRP not acceptable. Wood, windows are not permitted in non-residential buildings or residential buildings taller than three storeys in building height. Written approval required from FM&D if wood windows are to be considered.
3. Preference shall be clear anodized, or PGG Duranar XL or equivalent.
4. Before installation ensure that a peel-n-stick air barrier membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.
5. Provide edge clearance of 3 mm minimum. Insert spacer shims to centre glass in space. Place shims at 600 mm o.c. and keep 6 mm below sight line.
6. After installation and before installation of sealants, apply spray-in-place polyurethane insulation conforming to current relevant CAN/CGSB standard, to fill and seal all joints.

5.6.3 Glazing

5.6.3.1 General Requirements

1. Coordinate design with Building Envelope Consultant.
2. Applicable to all glass and glazing.
3. Performance Standards include but are not limited to:
 - a. Alberta Building Code and referenced Standards.
 - b. MNECB Model National Energy Code for Buildings, typically using values for "Natural Gas".
 - c. CBIP Commercial Building Incentive Program.
 - d. LEED Leadership in Energy and Environmental Design: Green Building Rating System.
 - e. ASHRAE/IESNA 90.1.
 - f. CAN/CGSB-12 Series Standards: glass types; performance.
 - g. CAN/CGSB-12.20: Structural Design for Buildings.
 - h. IGMAC Insulating Glass Manufacturers of Canada guidelines.
 - i. EN14179-1:2005, Glass in Building. Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass, Definition and Description.
 - j. Exterior glazing to include design to withstand localized positive and negative wind pressure.
4. Quality Control and Assurance
 - a. Submittals:

- i. Shop drawings sealed and signed by Design Engineer.
 - ii. Samples if other than clear glass.
 - iii. Performance data.
- b. Quality Control
- i. Drawings indicate minimum thicknesses and requirements.
 - ii. Final thickness, safety glazing, heat strengthening, and other performance requirements to meet Code and Standards, Project Criteria, and required structural performance are the responsibility of the Contractor based on location and intended use.
 - iii. Structural performance requirements of exterior glazing, as well as that for exterior and interior Structural Glazing including anchorage and fasteners, to be designed and certified by a Professional Engineer registered in the Province of Alberta, who is to also carry out periodic site reviews during construction and at completion, and submit reports and Letters of Assurances for Professional Design, Field Review and Building Code and Project Criteria Compliance. Costs to be included in the contract price.
 - iv. Warranty - 10-Year for sealed units.

5.6.3.2 Materials

1. Energy Performance Requirements - Low E glass should be considered for all conditions. Sealed double glazing generally to include high performance Low-E coating on appropriate surface as recommended by manufacturer for level of performance indicated, as different manufacturers place their coatings on surface #2 or #3 depending on desired end result and resulting performance characteristics. For south and west exposures, consideration can be given for additional treatments such as tinted glass. Tinted glass should not be used for windows at grade.
2. Exterior glazing minimum shall be insulating sealed double glazing units, except for structural glazing requiring single glazing. Component design to maximize energy performance as established by the Project Criteria, including orientation and expected functional use of space in which glazing occurs.
3. Use wired glass only where required for fire rating. Wired glass to CAN2-12.11-M76, type 1 or current relevant standard, polished both sides, square wire mesh style 3, clear, 6 mm thick minimum.
4. Safety glass: to CAN2-12.1-M79, Type 2, Class B or current relevant standard, clear, 6 mm thick minimum.
5. Any staining of glass or other surfaces by alkaline materials is cause for rejection.
6. High profile, large, custom and/or expensive pieces of glazing must be heat-soaked in order to reduce the likelihood of spontaneous breakage as a result of nickel sulphide inclusions.

Refer to EN14179-1:2005, Glass in Building. Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass, Definition and Description.

5.6.4 Glazed Aluminium Curtain Walls

5.6.4.1 General Requirements

1. Coordinate design with Building Envelope Consultant.
2. Coordinate design with Div 26 Electrical Consultant.
3. Coordinate design with Div 27 IT Services, including for Secure Access requirements.
4. Applies to exterior aluminum curtain wall type framing system; doors and windows within system.
5. Performance Standards include but are not limited to:
 - a. BC Building Code, including Accessibility requirements.
 - b. CAN/CSA-A440 "Windows", including A440.1 "User Selection Guide to CSA Standard.
 - c. CAN/CSA-A440 Windows."
 - d. CAN/CSA-A440.2 "Energy Evaluation of Windows and Doors."
 - e. CAN/CSA-A440.4 "Window and Door Installation".
 - f. ASTM E283, "Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors."
 - g. ASTM E330, "Structural Performance of Exterior Windows, Curtain walls and Doors by Uniform
 - h. Static Air Pressure Difference."
 - i. ASTM E331, "Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differential."
6. Quality Control and Assurance
 - a. Submittals include:
 - i. Shop drawings sealed and signed by Design Engineer.
 - ii. Manufacturer performance test data to confirm performance criteria.
 - iii. Hardware schedule refer Section 5.8 – Doors & Hardware.
 - iv. Samples, including finishes for selection.
 - v. Maintenance Data shall include as-installed hardware schedule, installation instructions, and source for replacement parts.

- b. All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of Alberta, to also carry out periodic site reviews during construction and at completion, and submit reports and letters of assurances for professional design, field review and building code and project criteria compliance. Costs to be included in the contract price.
 - i. UofC at its discretion may appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization.
 - ii. Warranty - 5-Year.

5.6.4.2 Materials

In addition to any other applicable Codes, Standards and Project Requirements, exterior systems to meet or exceed the following minimum requirements:

1. Environmental Separation
 - a. Water Penetration: no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 15 lb per sq. ft. (720 Pa).
 - b. Air Infiltration: not more than 0.06 cfm./sf (0.3 L/s x sq. m) of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 8.32 psf (400 Pa).
 - i. Operable Windows as part of curtain-wall system to conform to CAN/CSAA440 Windows, including the following ratings:
 - ii. Water Tightness shall be B4.
 - iii. Air Infiltration: see above.
 - iv. Wind Load Resistance shall be C3.
 - v. Resistance to Forced Entry shall be F20 (windows reachable from grade).
2. Systems to utilize exterior rain screen deterrents, interior air seal barriers, and cavities pressure equalized to the exterior to minimize water infiltration into the internal areas of the system, assembled and installed to provide control and drainage to the exterior of any water which enters the pressure equalized cavities.
3. Except for doors, exterior systems to incorporate a thermal break.
4. Engineering Design
 - a. Wind Loads:
 - i. Assemblies shall be reinforced where required, capable of withstanding local positive and negative wind pressures.

- ii. Minimum 25 psf (1.2 kPa) inward and psf (1.2 kPa) outward acting normal to the plane of the wall.
 - iii. As required to meet Project Structural Design Criteria.
 - iv. As required to meet the requirement of AB Building Code.
 - v. C5 rating to CAN/CSA-A440.
 - vi. Based on CAN3-S157 and allowable deflection of 1/175.
- b. Seismic Design to meet all of the requirements for AB Building Code,
 - c. System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental affect to system components.
 - d. The system capable of withstanding a metal surface temperature range of 180° F (100° C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.
 - e. Assemblies to support design loads and accommodate structural deflection and long term creep movements and drift as shown on the Structural Drawings without stress on glass, buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects caused by structural movement.
 - f. The connection of the curtain wall to the structure of the building to be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments to be applied by the curtain wall to the structure or structural support.
5. Fasteners
- a. In accordance with AAMA Guide Specification Manual to suit base metals in which they occur. Where exposed, finish and color to match surface in which they occur.
 - b. All fasteners, brackets and reinforcing shall be aluminum, hot dip galvanized, or stainless steel.
 - c. Bitumen coating shall be required to prevent electrolytic corrosion.

5.6.4.3 Prescriptive Requirements

1. Doors shall be Kawneer #500 wide stile (or equivalent), maximum height 2,440 (8'-0"), maximum width 1,220 (4'-0"); minimum width 915 (3'-0").
2. Doors and adjacent frames shall be clear anodized. Preference shall be for clear anodized, or PGG Duranar XL or equivalent.
3. Before installation, ensure that a peel-n-stick air barrier membrane (or equivalent) is installed at exterior locations over the entire perimeter of the opening over which the framing system is to be installed, to drain to exterior.

4. After installation, and before installation of sealants, apply spray-in-place polyurethane insulation conforming to current relevant CAN/CGSB standard, to fill and seal all joints.

5.6.5 Miscellaneous Glass

1. Glass for exterior lights is required to be tempered, vandal resistant, and must not shatter. Glass lenses and protective coverings are preferred over polycarbonate or plastics.
2. Mirrors:
 - a. to CAN2-12.5-M86 or current relevant standard, silvered, type 1B, 5 mm thick, with ground and polished edges where unframed and supported with concealed tamper-proof fasteners.
 - b. Mount mirrors with sufficient fastenings to suit size and weight of mirrors.
 - c. Mirrors in excess of 1800 mm are to be sectionalized into equal parts not less than 900 mm.
 - d. Include adequate quantity of mirrors to meet barrier free design requirements, see Appendix A.

Revision History

Revision Date	Version	Description
Feb 2014	1.0	Baseline version
August 9, 2023	1.0	Added Revision History table to end of document and reset to Version 1.0.