Revision Date: 07/29/2021

1. **Design Criteria**:
    a. This section discusses fiberglass windows specifically but is inclusive of other Resin/uPVC materials and their manufacturers, which can be useful when low-cost and highly energy efficient windows are desired. The design standard sections related to windows are not intended to exclude product options not included in fiberglass and aluminum window categories.
    b. Vinyl and Steel Windows are prohibited.
    c. Wood Windows are allowed in only special circumstances. Contact the UVM Project Manager (PM) for approval.
    d. Commercial quality windows are required in all installations.
    e. Coordinate design and detailing of windows with the air and moisture management layers of the building envelope.
        i. Window perimeter details are critical for the air and water penetration resistance of the building envelope. The shape of frame members can affect flashing and sealing details. Project detail drawings and specifications need to be coordinated with the intended window types, wall assembly, and construction sequencing to avoid issues during installation.
    f. Operable windows at UVM for new buildings and renovations, are generally limited to opening 4" maximum, to provide fall protection. Special hardware may be required to be installed by the window manufacturer to achieve this. Retrofitting new windows in the field is not allowed. Review project requirements with the UVM Project Manager to determine any opening limitations.
    g. Replacement windows in historic buildings will most likely be evaluated by the Vermont Division of Historic Preservation in conjunction with the UVM PM and UVM PDC. Review the process and the materials requirements by DHP for the evaluation for each project with the UVM PM and the appropriate UVM PDC staff member.
    h. Sill flashing pans are required at windows. Preformed are preferred but shop-made are acceptable when constructed in a durable and water-tight manner. Field pans made of self-adhered membrane flashing are also acceptable.
    i. Window Testing:
        i. Standard testing requirements may include a quantity of windows that are required to be tested. On smaller projects this quantity may not test enough windows to establish a passing record. For example, a typical requirement that 5% of windows be tested on a 10 window project is only half a window. Verify the number of windows that will be tested according to specified

testing requirements are a meaningful number of windows to establish successful results, but no less than three windows shall be tested on every project.

1. On large projects, consider including requirements for phased manufacture and delivery of windows that allows initial testing of three to five of the initial 10 to 20 windows, to identify any problems and take corrective action prior to the manufacturing and delivery of the remaining windows.
2. More frequent testing may be required if failures of field tests are common. Review this as part of the testing strategy with the UVM PM to determine the requirements for the project.

ii. Manufacturer's published test results come from standard testing of specific assemblies of a specific size. Different sizes or assemblies, including ganged or mulled windows, may not pass the same tests.

1. Expanded field testing of installed or mock-up windows may be required to confirm that desired performance ratings are achievable. Review the importance of performance goals and the scope of field-testing services with the UVM PM to develop a plan for testing during construction or installation.

iii. Review mockup requirements that need to be included in the specifications, with the UVM Project Manager to determine the need for mockups of window installations to set quality requirements and standards of installation.

iv. Corrective actions shall be mandated in the specifications for all windows, not just the windows yet to be installed when problems are found from field observations or field testing.

v. When it has been determined that third party field tests are not going to be required by the UVM Project Manager, consider simple water spray tests from a hose to confirm the installation is watertight.

2. References

a. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

b. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
c. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
d. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
e. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
f. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
g. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights.
h. AAMA 511-08 – Voluntary Guideline for Forensic Water Penetration Testing of Fenestration Products.
i. Refer to the current Vermont Energy Code for required U-values of window assemblies.
j. Refer to the LEED Standard being applied if the project is seeking a LEED certification, and factor the U values into the building energy modeling.

3. **Required Submittals**:
    a. Product Data: Provide component dimensions; information on glass and glazing; internal drainage details; descriptions of hardware and accessories.
    b. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations and installation requirements.
    c. Samples for Verification: For fiberglass windows and components required, prepared on samples of size indicated below:
        i. Exposed Finishes: minimum 2 inches by 4 inches.
        ii. Exposed Hardware: Full-size units.

4. **Products, Materials & Equipment**:
    a. Glass for window or curtain wall elements is to be energy efficient insulating glass.
    b. Exterior applied muntins shall be considered for all window and curtain wall elements.

c. Glazing within stair towers shall be tempered safety glass. Glazing in toilet areas shall be obscure glass. Samples of frit or obscuring film are to be reviewed during design to confirm the visual effect of the glass meets the intended goals.
d. Operable window units will be determined on a project-by-project basis.
e. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    i. Marvin Windows.
    ii. Fibertec Window and Door Manufacturing.
    iii. Inline Fiberglass Ltd.
    iv. Milgard Windows, Inc.
    v. Pella Corporation.
    vi. Thermotech Windows Ltd.
f. Source Limitations: Obtain fiberglass windows from single source from single manufacturer.
g. Screens shall be provided at operable windows. Screens shall be aluminum wire fabric.

5. **Installation, Fabrication, and Construction**:
    a. Preinstallation meetings shall be held prior to installation of windows unless they have been installed as part of a mockup and previously approved.
    b. Items to be discussed include, but are not limited to:
        i. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
        ii. Review, discuss, and coordinate the interrelationship of fiberglass windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
        iii. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
        iv. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.
    c. Inorganic shims are preferred for window installation.
    d. Where specified, the window manufacturer's field representative shall observe for proper installation and submit a report.

e. Review field testing requirements with UVM Project Manager. The following testing shall be discussed and incorporated into the project as directed by UVM:
    i. Provide field testing of installed windows by AAMA accredited agent. Testing agent will be hired by UVM.
    ii. Perform tests on three individual windows, at least one of each type.
        1. Field test for water penetration in accordance with ASTM E1105.
        2. Field test for air leakage in accordance with ASTM E783.
        3. Test for water leakage at sills with simple hose tests filling up exterior sill surfaces with water for a set period of time and observing for leaks at the interior.
        4. Establish minimum allowed leakage rates.
f. Remove and replace noncomplying windows and retest as specified above.
g. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
h. Adjust hardware for smooth operation and secure weathertight closure.

6. **Warranties**:
    a. Provide Manufacturer's minimum 10-year manufacturer warranty covering:
        i. Failure of glass seal on insulating glass units, including interpane dusting or misting.
            1. Include provision for replacement of failed units.
        ii. Excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
        iii. Work found to be defective within a 10-year period after the date of substantial completion will be corrected (including labor) by the Manufacturer.
        iv. Failure to meet performance requirements.
        v. Structural failures including excessive deflection, water leakage, and air infiltration.
        vi. Faulty operation of movable sash and hardware.
    b. Installer's one-year warranty on installation and craftsmanship.