# DESIGN GUIDELINE 4.2
# BUILDING ENVELOPE

## Scope

Building envelopes shall effectively control moisture migration, heat transfer and air leakage. This Design Guideline highlights areas requiring special attention and consideration with respect to building envelope design. This guideline also includes the U-M Building Envelope design review process and requirements.

## Related Sections

**U-M Design Guideline Sections:**
2.1 Owner's Project Requirements and Basis of Design Documents
6.1 – DG 075000 Roofing Systems and Accessories
6.1 – DG 079200 Joint Sealants
6.1 – DG 084113 – Aluminum-Framed Entrances and Storefronts
6.1 – DG 085113 – Aluminum Windows
6.1 – DG 088000 – Glazing
6.1 – DG 084413 – Glazed Aluminum Curtain Walls

**Reference Documents:**
U-M Envelope Inspection Form
ASTM E 783 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
ASTM E 2357 Test Method for Determining Air Leakage of Air Barrier Assemblies
ASTM E 2178 Standard Test Method for Air Permeance of Building Materials

## Moisture Control

Moisture control shall be a primary consideration in the building envelope design of new buildings, additions and renovations. Moisture migration from bulk water, capillary water, vapor diffusion and air leakage shall be minimalized. Perform the following tasks to ensure moisture control in the design of the building envelope:

- Confirm the location of the water table and soil conditions prior to the start of design. Moisture prevention and control for below-grade walls shall be designed for the water table location and soil conditions specific to the project site.
- Perform dew-point analysis of exterior wall assemblies for all new buildings, renovations adding a significant amount of insulation to the envelope and when moisture load generated within the space is expected to increase significantly. Confirm that materials will be above the dew-point and will not accumulate moisture on the conditioned side or the inside of the envelope assembly.
- Provide comprehensive detail drawings for windows, doors, skylights, stacks, ducts, and all other envelope penetrations that will protect the building from water infiltration.

- Ensure efficient shedding of rainwater and prevent moisture infiltration into wall constructions. Provide adequate drainage and ventilation systems (e.g. weep holes) to prevent the collection of water in wall cavities.
- Provide designs that accommodate special programming conditions which impact the building envelope (e.g. an interior with high relative humidity levels).

## Thermal Performance

Thermal performance shall be considered in the design of the building envelope to control heat transfer through conduction, radiation, and convection.

- Prevent conductive heat loss caused by thermal bridging in foundation and framing members.
- Minimize convective thermal loss with the prevention of air leakage through windows, doors and other penetrations in the building envelope.
- Select glazing and roofing materials to minimize radiative heat loss.
- Minimize thermal heat gain and maximize occupant comfort by shading exterior windows and the building envelope.
- Consider the orientation, size and performance of fenestration to minimize solar radiation while balancing the amount of daylighting with the amount of heat loss.
- Ensure reduction of heat loss by including details and specifications that identify the type and thickness of insulation for exterior walls, floors, ceilings, and roof areas.
- Carefully select materials and design placement of air barriers to ensure air tightness of the building envelope.

## Continuous Air Barrier

For all new building construction and additions design a fully continuous air barrier for the entire building envelope that is capable of controlling air leakage into and out of the conditioned spaces.

- Design the air barrier assembly to withstand positive and negative air pressures due to design wind pressures, stack effect and fan pressures.
- Pay particular attention to the design of the air barrier at joints and points of intersection of two different building materials to maintain continuity. The design shall have enough strength and flexibility to accommodate differential movement of material substrates.
- Design the air barrier to remain in continuous contact with its substrate material in the building envelope.
- Select durable materials for the air barrier assembly, that will last the lifetime of the building.

For additions, design a complete air barrier for the addition enclosure as described above. Where existing walls and/or roof construction abut the new addition, continue the air barrier through the wall or roof construction in order to prevent air leakage at the juncture between the new and old construction.

- U-M does not have a preference for a particular type of air barrier or air barrier assembly. Select materials which are listed by the Air Barrier Association of America. It is acceptable to have a combined air barrier and vapor retarder; however, when they are combined the barrier must be located on the inside of the thermal insulation of the building envelope (for projects in Michigan).

## U-M Building Envelope Design Review

Projects with a scope of work related to above and/or below-grade building enclosure elements will undergo a building envelope design review process. This review process will evaluate the materials, components, systems, and assemblies that comprise the above and/or below-grade building enclosure. Building Envelope Design Review shall begin at Schematic Design and continue until the end of Bid Documents phase.

### Schematic Design Phase

- Establish the building envelope performance goals with building occupants and U-M Design Manager.
- Include envelope description and performance goals in the Owner's Project Requirements and Basis of Design (OPR/BOD) documents.
- Promote the use of construction mock-ups and other quality assurance techniques and participate in the evaluation of building envelope mock-ups.

### Design Development Phase

- Further develop BOD document to include a building enclosure design description of materials, components, systems, and assemblies that make up the building envelope.
- Conduct a minimum of one meeting during DD dedicated to the presentation of the building envelope design to U-M and, when hired by U-M, a Building Envelope Specialist (BES). At the meeting, present drawings and specifications that demonstrate the envelope design concept as it relates to thermal protection, moisture control, and air leakage.
- During the Owner's Review of the DD documents, the BES shall provide written comments on the envelope design. Respond to the comments per U-M's document review procedures.

### Construction Documents Phase

- Update BOD document to clarify and expand on the design description of materials, components, systems, and assemblies that make up the building envelope.
- Complete detail drawings of all transitions, perimeter sealing around fenestrations, doors, and penetrations through the exterior walls by structural members, parapet walls, etc.
- Provide specifications that include instructions about prepping surfaces and any primers needed to insure proper adhesion of air barrier materials.
- Include language for coordination of all trades whose work impacts the continuity of the air barrier. Reference the Air Barrier specification section in all of the affected trades.

- Include in the specifications the requirement for a pre-installation meeting with mandatory attendance by all trades whose work is related to the envelope, insulation, and the air and moisture barriers.
- Conduct a minimum of one meeting during CD dedicated to the presentation of building envelope design to U-M and the BES. Present drawings and specifications that demonstrate the effectiveness of envelope systems in controlling moisture migration, heat transfer and air leakage.
- During the Owner's Review of the CD documents, the BES shall provide written comments on the envelope design. Respond to the comments per U-M's document review procedures.
- At the end of CD phase, the BES shall provide a project specific version of the U-M Envelope Inspection Form. Review project specific U-M Envelope Inspection Form and submit recommendations for additional inspections and tests to the U-M Design Manager.

**Inspection and Testing of Building Envelope**

U-M will employ independent specialists, inspectors and testing agencies for projects involving building envelope work. To understand what will be inspected refer to the U-M Envelope Inspection Form. Consult with Design Manager regarding the scope of testing for this project.