Building Envelope Design Guide

Supplemental Guidance to Meet High-Performance Envelope Requirements and Follow Best Practices

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Marriott INTERNATIONAL

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INTENT

The intent of the Building Envelope Design Guide is to provide guidance in meeting building envelope requirements for New Build Marriott properties and to provide additional best practices that support the design and construction of a high-performance envelope.

The strategies in this guide are intended to take advantage of opportunities to improve performance at the most cost-effective point in a building life-cycle: during construction. This is due to the high cost of modifying or improving a poor building envelope once construction is completed.

The enclosure performance supports Marriott and Owner/Franchisee goals in the following ways:

- Meeting decarbonization goals through energy efficiency
- Increasing comfort for staff and guests
- Decreasing operational costs from utilities and building maintenance

Please direct questions to globaldesignsustainability@marriott.com

THE BUILDING ENVELOPE

The building envelope is comprised of all the building enclosure systems that separate conditioned space from unconditioned space. They include the roof, wall and floor systems; fenestration systems such as glazing, doors, and skylights, as well as conditioned canopies and soffits. Each system or assembly must be designed to limit water penetration, air leakage, vapor diffusion and thermal heat transfer to maintain comfort and control energy use. The degree to which this is controlled is dependent on the climate of the project location. Each system should also be designed to perform appropriately with respect to the interior conditions such as relative humidity and temperature, and within the climate the project is located.

Note that although not specifically addressed in this guide, there are additional functions of the building envelope that may be included or required for a project such as acoustical control, energy production, glare-control, and security.

It is important to construct the building envelope correctly. **A building envelope can be difficult to modify once constructed.** Few, if any building envelope components are modified to improve performance after a building is in operation.

Processes and coordination aimed at improving the building envelope, such as building envelope commissioning (BECx), is recommended and/or required by many third-party sustainability certifications like LEED and BREAM. Certifications recognize that efforts to ensure proper construction can have significant benefits to building envelope performance outcomes. For example, points required to achieve a higher level of LEED Certification can be obtained by including building envelope commissioning processes on a project.

Building Envelope Performance Measures

The building envelope is a primary element of architectural expression, and as stated above, it is also the main barrier between the interior conditioned spaces and the exterior environment. Because the envelope controls the variation between environments, the envelope performance can significantly impact how much energy may be required to maintain the interior environment.

This guide focuses on **two primary performance outcomes** of the building envelope to strategically increase building performance and reduce energy consumption. These performance outcomes are:

- Building enclosure air tightness (Measure 1)
- Building envelope thermal performance (Measure 2)

Good performance outcomes reduce energy demand loads and energy consumption. It is important to note that a high-performance building envelope can help designers reduce the size and therefore cost of mechanical and electrical systems.

MEASURE 1: BUILDING ENCLOSURE AIR TIGHTNESS

MI Design Standards

Chapter GR3: Materials and Products
Division 07 - Thermal & Moisture Protection

Air Barriers: Meet the following criteria.

- Air Leakage: The measured air leakage shall not exceed the lesser of local code or 0.30 cfm/ft² (or equivalent L/s × m²) of the building thermal envelope area at a pressure differential of 0.3-inch water gauge (75 Pa).
- Testing: The building thermal envelope shall be tested in accordance with ASTM E779, ANSI/RESNET/ICC 380, ASTM E3158 or ASTM E1827 or an equivalent approved method.
- The air barrier shall be continuous for, and across assemblies that are the thermal envelope of the building; see IECC 402.4.1.1: Air Barrier Construction.
- Sealing: IECC 402.5.1.1.2; seal penetrations in a manner compatible with the construction materials and location and allow for expansion, contraction, and mechanical vibration; seal joints and seams associated with penetrations in the same manner; sealed materials shall resist positive and negative pressure from wind, stack effect, and mechanical ventilation.

Chapter GR1: Overview & Project Administration
Construction Documents Phase Requirements

Construction Documents: Include a diagram showing the building's pressure boundary in plan(s) and section(s) and a calculation of the area of the pressure boundary to be considered in the allowable air leakage test.

Air leakage can result in significant energy loss, condensation, bio growth (mold), and occupant discomfort. Reducing unwanted air leakage can improve performance, material durability, and the guest experience.

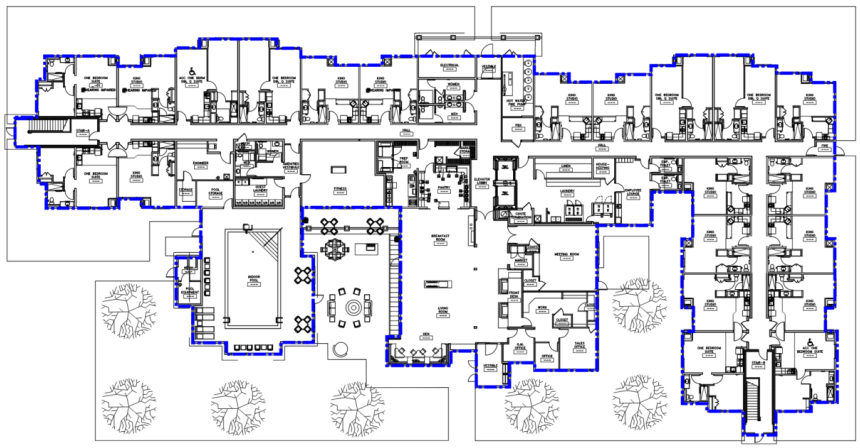
Practical Application Requirements

It is important to design and construct buildings with air tightness as a goal and include a successful process. Design phase steps and construction phase validation can support a successful outcome for air tightness. The following are requirements during the design and construction phase of the project:

Air Barrier Diagram	**Included in drawings.**
Air Barrier Components	**Identified by design team (narrative submittal or table on general sheets).**
Air barrier Specifications	**Included in specifications and/or basis of design products**
Whole building Air Leakage Performance	**Testing method and inspections specified for building**

Air Barrier Diagrams

- The air barrier diagram is submitted with documents for design review. The diagrams shall identify the location of the air barrier on the overall building plans and sections.
- The goal of the diagram is to help designer confirm that the building envelope is continuous at all interfaces and transitions and terminations of systems. An example of a plan diagram is shown below.



Air Barrier Legend

PLANE OF AIR BARRIER CONTINUITY	CRITICAL NOTE - Extents drawings utilize colored hatching and line work. They are intended to be viewed and printed in color. Printing or viewing in black and white may lead to loss of information.

Air Barrier Components

Air barrier materials and components may vary from project to project. The design team shall identify the air barrier system, materials, or product for all assemblies such as walls, floors, and roofs. Performance standards for air leakage shall be specified for fenestration, glazing, and door systems. The components providing the air barrier performance shall be identified on the air barrier diagrams.

To meet the allowable air leakage targets for the entire building, it is best practice that the design team identify air leakage performance criteria for components and assemblies. The following are criteria recommendations for products and assemblies to be used as a primary air barrier:

- Air barrier materials with an air permeance less than 0.004 cfm/sf per ASTM E2178.
- Air barrier wall assemblies shall have an air leakage rate less than 0.04 cfm/sf per ASTM E2178.
- Air Leakage performance for windows: Air infiltration rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.2 psf (300 Pa).

Air Barrier Specifications

- Specifications shall include performance requirements for components that provide air tightness for walls, windows, doors, floors, and roof systems.

Air Barrier Testing

- The Whole building Air Leakage Industry Test Method shall be according to the following: ASTM E 779 (Standard Test Method for Determining Air Leakage Rates by Fan Pressurization) or an equivalent method approved by the owner.
- Alternatively, portions of the building may be tested, and the measured air leakages shall be area weighted by the surfaces of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach the following portions of the building shall be tested:
    - The entire envelope area of all stories that have any spaces directly under a roof.
    - The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade.
    - Representative above-grade sections of the building totaling at least 25 percent of the wall enclosing the remaining conditioned space.

MEASURE 2: BUILDING ENVELOPE THERMAL PERFORMANCE

MI Design Standards
Chapter GR3: Materials and Products
Division 07 - Thermal & Moisture Protection

Provide continuous water barriers, insulation and air barriers in assemblies that separate conditioned and unconditioned space. Provide roofing over conditioned spaces. Assemblies and interfaces along the plane of the building envelope must prevent or limit rain or other types of water penetration, air leakage, vapor diffusion and thermal transfer.

- Service Life: Select products and systems having a proven record of success (minimum of 10 years) for the application. Provide systems for low maintenance and minimum service life of 20 years.
- Design the building envelope to meet the performance criteria provided in the table below (Table A). Where local codes are more stringent, local codes shall apply.
- Slope & Drainage: Design structures to receive waterproofing with positive slope to drains to avoid standing water. Ponding is not allowed. Moisture must drain or dry within 48 hours of rain event.

Waterproofing: Provide waterproofing for below grade walls and basement concrete slabs on grade consistent with recommendations of a soils engineer. Follow ACI 301.2 Guide to Concrete Floor and Slab Construction where applicable.

- Balconies: Balconies shall be waterproofed using a product or system that is designed for the application. Waterproof roof decks or balconies over conditioned space with a system that complies with IBC requirements for a roof assembly. Deck products that are not tested as a roofing membrane by ICC are not allowed over conditioned spaces or spaces where the tolerance for moisture is unacceptable.

Dampproofing: Dampproofing and sealers may be appropriate to help repel or shed moisture on concrete and CMU but shall not be used as the primary waterproofing layer of the assembly.

Building Insulation: Design continuous insulating material to meet performance requirements. Where insulation cannot be continuous, use the effective insulation u-values to determine if the components meet the required thermal values for the climate zone.

- Coordinate thermal insulation with vapor and air control layers to minimize the risk of condensation.
- Comply with ASHRAE 90.1 2022 or equal, for continuous insulation.

Sealant Joints: Design exterior seals at expansion joints to maintain the performance of the building enclosure. The joint closure assembly shall provide the same waterproofing, air leakage and thermal insulation performance as the adjacent assemblies.

Roofing: Provide Primary and Secondary (overflow) roof drains. Secondary drains shall outlet in a visible area to alert building maintenance of potential issue with primary roof drain.

Chapter GR3: Materials and Products
Division 08 – Openings (Doors and Windows)

Design: Include performance criteria for the building enclosure that is specific to climate and anticipated site-specific loads. Performance requirements to include, but are not limited to:

- Maximum load resistance
- Acoustic and noise transmittance requirements
- Condensation resistance (where applicable for climate or intercorrelate humidity)
- Maximum allowable air leakage
- Water penetration resistance
- Deflection
- Assembly effective U-factor, SHGC, and VLT see <1> for acoustic performance criteria.

Glass & Glazing – Insulated Glass: Provide glazing system that meets thermal performance required by this standard or local code, whichever is more stringent.

Chapter 1: Site and Building Exterior
Building Exterior & Features

Windows: Provide commercial class and double glazing unless acoustic comfort and energy efficiency dictates additional glazing.

Insulation & Vapor Barrier: Required to provide long term energy efficiency and guest comfort and based on project location.

Table A. Thermal Envelope Performance Criteria – Global

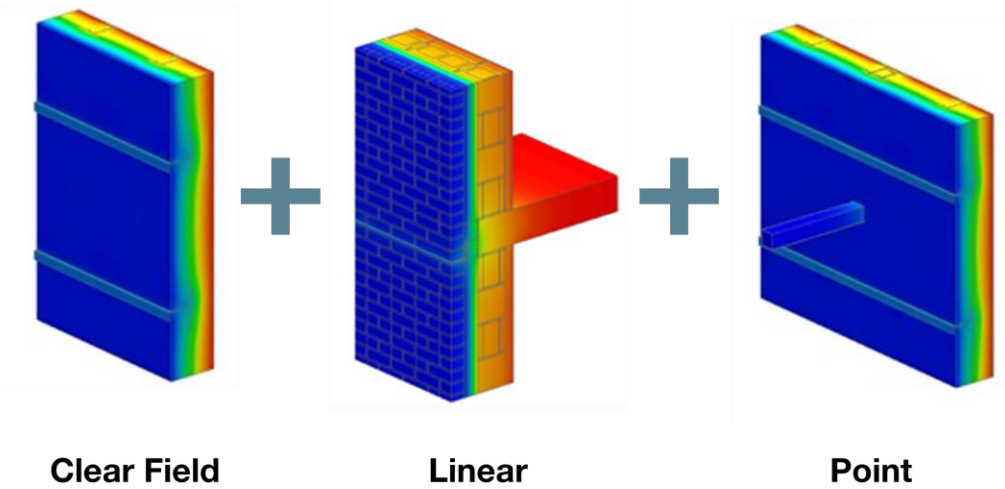
The table below lists prescriptive path requirements, based on project specific ASHRAE climate zone U-value requirements (or local code-whichever is more stringent).

ASHRAE 169-2021 Climate Zone	Roof U-Value (Maximum)	Exterior Wall U-Value (Maximum)	Window U-Value (Maximum)	Window SHGC (Maximum)
0A	0.029	0.086	0.45	0.2
0B	0.029	0.086	0.45	0.2
1A	0.034	0.086	0.45	0.21
1B	0.034	0.086	0.45	0.21
2A	0.034	0.052	0.41	0.23
2B	0.034	0.052	0.41	0.23
3A	0.034	0.052	0.378	0.23
3B	0.034	0.052	0.378	0.23
3C	0.034	0.052	0.378	0.23
4A	0.029	0.052	0.324	0.32
4B	0.029	0.052	0.324	0.32
4C	0.029	0.052	0.324	0.32
5A	0.029	0.046	0.324	0.42
5B	0.029	0.046	0.324	0.42

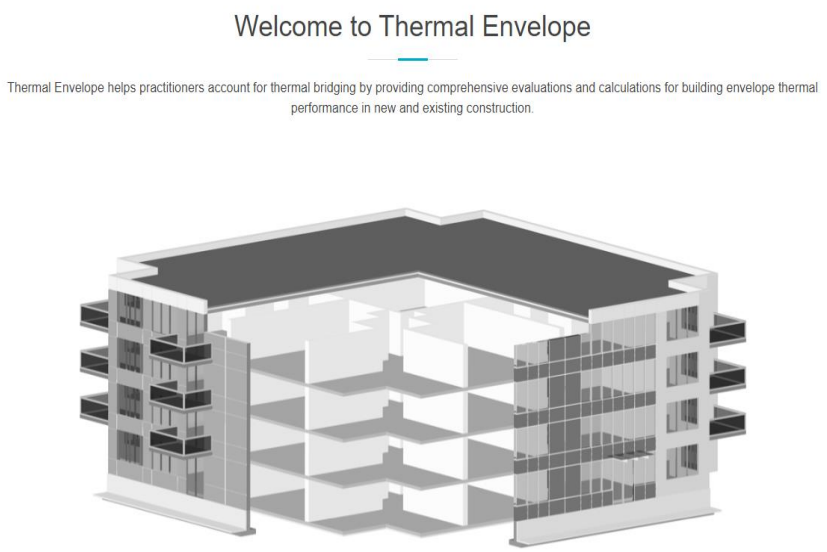
5C	0.029	0.046	0.324	0.42
6A	0.029	0.042	0.306	0.42
6B	0.029	0.042	0.306	0.42
7	0.026	0.037	0.261	0.44

Practical Application Requirements

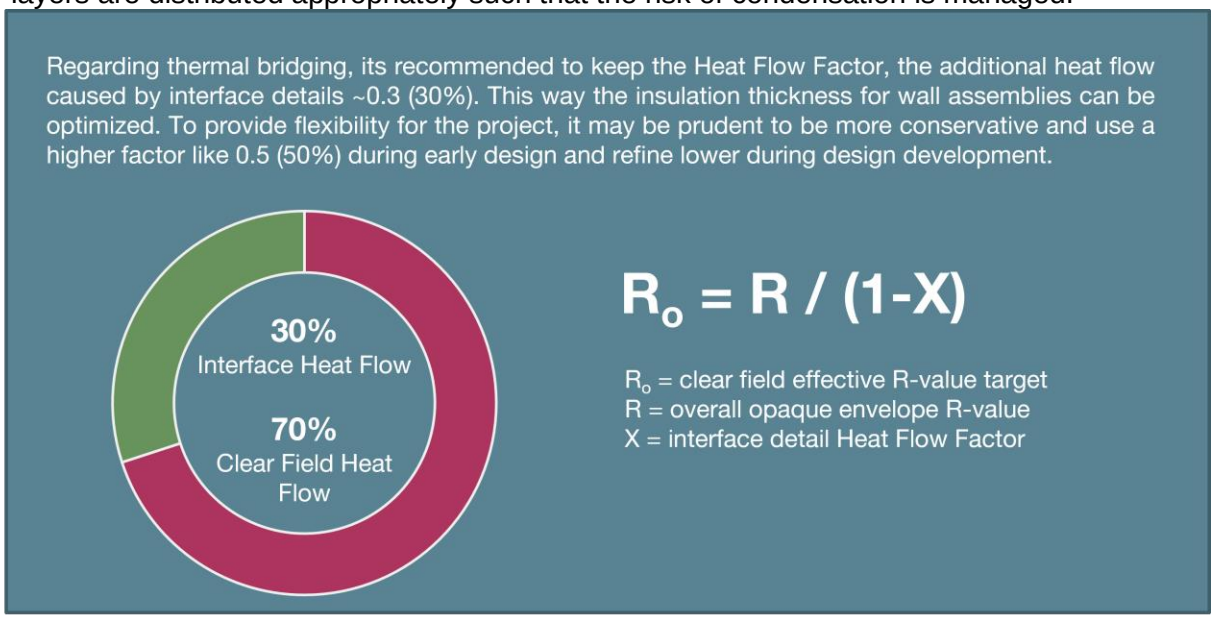
- Where using continuous insulating material to meet performance requirements, it shall be continuous across all structural members without metal thermal bridges other than fasteners that have a total cross-sectional area not greater than 0.04 percent (0.12 percent where all metal thermal bridges are stainless steel) of the envelope surface through which they penetrate, and service openings. Where insulation cannot be continuous the effective insulation u-values shall be used to determine if the components meet the required thermal values for the climate zone.
- Where multiple layers of insulation are required to meet performance requirements, layers shall be lapped no less than 12" (30 cm) each direction.
- Thermal insulation shall be coordinated with vapor and air control layers to minimize the risk of condensation inside undrained cavities of the assemblies and on or withing structural components that cannot resist corrosion.
- Building envelope energy performance requirements shall be met using the following methods or other method approved by the owner.
- Additional design assumptions, specifically those of the mechanical engineer in sizing the mechanical systems required for the building.
- The designer shall review thermal performance requirements and modify the assemblies for unique interior climate conditions (i.e., pool or area that creates elevated humidification and may affect the minimum thermal performance requirements to resist condensation)
- Thermal assembly performance shall be calculated accounting for thermal bridging related to project specific clear field of the assembly, linear, and point transmittances.



- The design can meet the required thermal performance based on defined and specified assemblies, insulation thicknesses and cladding attachment methods, etc. Resources for calculating the effective thermal performance can be found from manufacturers and other assembly thermal model libraries such as **https://thermalenvelope.ca**



- For assemblies not defined in industry product data or libraries, a project may utilize thermal modeling to determine overall U-factors and hygrothermal modeling to determine the hygrothermal conditions of the exterior wall and soffit assemblies under site specific climate conditions.
- For all assemblies the design should confirm that the ratio of insulation and vapor control layers are distributed appropriately such that the risk of condensation is managed.



- The insulation shall be located such that the air barrier shall be maintained above the dew point temperature of the anticipated interior environment at the mean low temperature for the coldest month to reduce the risk of condensation.
- The project conditions for which condensation on interior surfaces is unacceptable shall be defined by the design team and shall be based on the anticipated interior temperature, exterior temperatures, and interior relative humidity.

See Appendix A in this document for basis-of-design assemblies that may be appropriate to meet the target U-value for each climate zone.

ENVELOPE COMMISSIONING

MI Design Standard
Chapter GR1: Overview and Project Administration
Commissioning

Complete the commissioning process (Cx) activities for the building's thermal envelope in accordance with ASTM E2947-21a Standard Guide for Building Enclosure Commissioning, and the ASTM E2813-18 fundamental requirements as they relate to energy, air and water tightness, indoor environmental quality, and durability.

Commissioning of the envelope is included within Marriott International Global Design

The owner/and project team are required to complete the commissioning process activities for the building's thermal envelope. In general, the building industry defines Commissioning as a quality assurance process for verifying the owner's requirements for the building enclosure are defined and met.

Owner may utilize industry standards to develop an understanding of the commissioning process, such as ASHRAE/IES Standard 202, which describes the commissioning process; the roles of the principal agents and stakeholders; and a framework for developing design documents, specifications, procedures, documentation, and reports.

BUILDING ENVELOPE FUNDAMENTALS & BEST PRACTICES

This section provides supplemental information to help teams further improve the building enclosure performance. Once constructed the building envelope is modified infrequently, if ever. The enclosure should, over its expected lifetime, do the following:

- Provide durability against exposure to the elements (rain, temperature, humidity, and UV) including the local marine environment, and against biological growth.
- Require minimal maintenance.
- Allow for ease of cleaning.
- Maintain the assembly or enclosure system energy performance.
- Minimize the exchange of unwanted heat, air, moisture to ensure occupant comfort.
- Accommodate differential movements from seismic and wind loading, structural loading, and moisture cycling.
- Provide security against unwanted intrusions.
- Resist abuse and normal wear and tear over its expected lifetime.
- Resist vandalism and graffiti.
- Provide corrosion resistance with respect to the expected lifetimes of the final design.
- Provide acoustical separation from exterior noise.

Benefits of a High-Quality Building Envelope

A high-quality envelope has many benefits including the following:

- High levels of comfort.
- Reduce unwanted air infiltration or air pollution from the exterior.
- Resilient: mold free buildings will have a significantly reduced risk of moisture damage to the structure and finishes.
- Lower heating and cooling costs, despite rising energy prices.
- Easier to convert to a net zero/net negative building.
- Comfortable, reduced temperature swings and improved indoor air quality.
- Lower energy required to run the building makes it easier to offset energy use with renewable energy.

Envelope Performance Verification

It is best practice to include verification measures for the envelope systems. These include mock-up testing, field testing, lab testing for custom systems, commissioning processes, whole-building tests, etc. The following are recommended strategies that are commonly used to achieve quality assurance for high-performance envelopes.

Select mock-up type appropriate for project.

- On-site Stand-alone Mock-up
  - Stand-alone (off-building) mock-up to be utilized.
  - Mock-up to be constructed, tested, and accepted prior to building envelope construction.
  - Mock-up to include all critical, typical building envelope conditions.
  - Mock-up to be fully enclosed (6-sided) to facilitate air leakage testing.
- In-place Mock-ups
  - In-place mock-ups to be used for the initial installation for all major envelope components and interfaces on the building

Life Cycle and Maintenance

The building design should align with an anticipated life cycle goals for the materials and systems. Building envelope systems are intended to be able to be maintained throughout the life

span of the building. Some specific recommendations related to the building envelope life-cycle and maintenance are as follows:

- Primary air, water, vapor, and thermal control layers are to be durable when part of a concealed component of the envelope assembly. Durability and anticipated service life of primary control layer(s) to meet or exceed the exposed component that conceals the control layer(s).
- Custom systems are required to be lab tested to meet performance requirements as a part of the project.
- Custom systems shall be provided with customized maintenance plans and training for the long-term care of the unique system.

Water Penetration Resistance

Water penetration in the building is typically unacceptable for all conditioned spaces. It is best practice to design and construct buildings with rainwater management principles consisting of an exterior weather seal and a secondary waterproof weather barrier separated by a free draining cavity wept to the exterior at regular intervals. Materials outboard of the waterproof weather barrier shall generally be moisture insusceptible and accommodate repeated wetting and drying cycles. In general, the following are recommended principles that should be applied to reduce the risk of water intrusion:

- The building enclosure must be designed to control and prevent water penetration into the interior. A continuous water control layer must be utilized with an exterior bulk water shedding element when applicable. A drainage method or component is required for all concealed water control layer assemblies.
- Materials exterior of the primary water control layer shall be appropriately weather/water resistant and able to accommodate repetitive wetting and drying cycles.
- In general, water penetration resistance tests of the building enclosure are recommended to be performed during the pre-construction and construction phases using mock-ups where many systems must be joined together to complete the building envelope.
- It is best practice to include water penetration resistance testing at interfaces such as those where the window and wall assembly meet. Test pressures when testing in accordance with ASTM E1105/AAMA 501.1 should be no less than 20% of the maximum structural design pressures. AAMA 501.2 testing is a recommended method where ASTM E1105/AAMA 501.1 test is found to be impractical.
- Non-fenestration test specimens such as horizontal or below-grade conditions can be evaluated on a project-specific basis to identify the appropriate level and type of testing.

Condensation Resistance

Building enclosure systems should be designed such that condensation does not occur interior of the primary water control layer. All enclosure materials including finishes, claddings, membranes, and thermal barriers must be evaluated during design with respect to condensation control for project design conditions (exterior design temperature, interior design temperature, and maximum interior relative humidity. Water condensation shall be defined as any water or wetting of materials interior to the primary water control layer (whether visible or not from the interior).

To achieve a high level of condensation resistance, the air, vapor, and thermal insulation shall be designed as an assembly to withstand the project climate conditions and reduce the risk of condensation in areas and on surfaces of the assemblies that are not designed to be wet.

Structural Loads

The envelope shall be designed to withstand anticipated structural loads:

- Wind loading: It is best practice to design the enclosure to resist wind loads with no failure of cladding, attachment, and framing with no damage to the air barrier, water barrier, vapor barrier, and flashings.
- Seismic loading: The design team shall identify the risk factor for the building and define what constitutes a failure for a defined magnitude seismic event.

Supplemental Assembly Specific Best Practices

The design team shall set qualitative and quantitative performance values for the following assemblies:

Foundation

- Foundation slab is required to maintain distinct line of defense against water penetration.
- Water penetration is unacceptable.
- Foundation waterproofing is required when recommended by the geotechnical engineer or where hydrostatic pressure is anticipated.
- Dampproofing is not an acceptable for use on below-grade walls where hydrostatic pressure is anticipated.
- Foundation must control vapor as required to meet performance and durability requirements and an under-slap vapor barrier is required. (Coordinate with requirements for under-slab waterproofing)
- Thermal Heat Transfer: The foundation is to maintain insulation as required by code and energy requirements. Foundation thermal bridging (primarily linear transmittance at interface with above-grade opaque walls and fenestration) is to be accounted for.

Roof

- The roofing assembly includes all waterproofing membranes, insulation, vapor barriers, parapets and copings.
- The assembly is part of an overall system that includes the roof structure and its attachment to the roofing assembly, roof-to-wall interfaces, and must be designed holistically to achieve its performance criteria over its expected lifetime.
- The assembly should be designed with durability, safety, ease of maintenance, renewals and future changes in mind (such as additions of roof-mounted equipment, solar panels, etc.).
- Building system penetrations need to be minimized to reduce the risk failure.
    - Use of pitch pockets is discouraged.
- Roofing materials and assemblies shall be selected according to the following:
    - Water penetration is unacceptable.
- Roof drainage systems allowed are as follows:
    - Internally drained
    - Sloped-to gutter
    - Through-wall scupper drainage systems are not recommended.
- Water Retention and Drainage
    - Roof to be sloped and drained such that ponding water is not acceptable. System should be designed with drains and overflow scupper in accordance with NRCA placement guidelines
- Vapor Permeability
    - Roof must control vapor as required to meet performance and durability requirements.

    - A continuous Class I or Class II vapor retarder must be provided within the roof assembly. This may also provide the primary air control layer. For projects located in ASHRAE Climate Zone 3 or lower, a project-specific evaluation shall be performed to identify vapor retarder requirements for roofing.
- Thermal Heat Transfer
    - Roof thermal bridging (primarily linear transmittance at roof-to-wall intersections) must be accounted for
- The Solar Reflectance Index shall be selected for the project specific conditions and based on a three-year aged value.
- Darker roofs may be considered in Climate Zone 6 or higher, on a project specific basis where heat absorption may be beneficial to the overall energy use of the building.
- Wind uplift resistance shall be defined according to ASCE 7 for the project location.
    - Edge metal/coping to be tested and approved according to ANSI-SPRI ES-1 requirements.
- All sheet metal to be according to SMANCA current addition.
- Roof life cycle and warranty: The roof is required to have a 20-year roof warranty. This should include a warranty for materials and performance, including watertightness.

Roof Access

- Access to window washing operations, equipment, anchorage/accomplishment of fall protection.
- All roofs areas that will have either rooftop equipment, window washing system supported from the roof as well as solar ready roof areas to have primary waterproofing membrane protected by a durable, walkable surface to protect membrane from incidental damage from building maintenance practices.
- Amenity Decks/roof deck
- Vegetated Roof Assembly
- Applicability: This section is only required if Vegetated Roof Landscaping is provided.
- Description: Advanced Vegetative Roof System (AVRS) with a variety of sedum species as tiles, plugs, or plants, and a maximum of 6” growing medium; or an intensive green roof system with more than 6” depth of growing medium and perennials, shrubs, and trees. To be coordinated with landscaping and with potential rainwater / grey water design strategy.
- Performance: AVRS system shall be capable of:
    - Designed in a way such that roots cannot damage the roof waterproofing membrane.
    - Detaining and retaining rainwater and irrigation water.
    - Retaining sufficient water for plant uptake and year-round health.
    - Preventing root rot.
    - Allowing airflow under multilayer system.
    - De-energizing wind flow under multilayer system to reduce chance of wind uplift.
    - Install root barrier under vegetated system and above roof waterproofing system.
- Roofing must have leak detection mat installed as part of the entire system.
- Ease of access for safe maintenance and repairs.

Opaque Walls

The wall assembly includes all air, vapor and waterproofing membranes, insulation, cladding attachment, drainage cavities or mediums, cladding, sheathings, and wall structure.

- Wall assemblies may include various levels of rainwater control:

  - TIER 1: All exterior walls shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall and glazing assembly by providing a continuous air and water-resistive barrier behind the exterior veneer and a means for draining water that enters the assembly to the exterior.
  - TIER 2: All exterior walls shall be designed to rainscreen principles consisting of an exterior weather seal and a secondary waterproof weather barrier separated by a free draining cavity of no less than 3/8” wept to the exterior at regular intervals.
  - TIER 3: All exterior walls to include pressure equalized rainscreen principles which includes compartmentalization of drainage cavities behind the cladding to equalize air pressures within the drainage cavities with those on the exterior face of the cladding.
- Water penetration is unacceptable.
- Water management is required to be designed using rainscreen principles.
- Wall must control vapor as required to meet performance and durability requirements.
- Continuous vapor retarder to be provided where required by code and for the applicable climate.
- Provide or reference a hygrothermal model to help identify where vapor barrier should be located when wall assembly design deviates from perfect wall concepts.

Fenestration

- All exterior window assemblies shall be designed to manage moisture. The glazing cavity, including the frame and detail at the rough openings are to be drained, vented, and compartmentalized, while the IGU remains sealed.
- Exterior windows to be designed to accommodate estimated structural long- and short-term movement of the building (vertical and horizontal displacement).
- Anchorage and Support Framing: Shall be designed to accommodate thermal and building movements without harmful effect to exterior window system, including glass and glazing materials, and sealant applications.
- Design anchoring system to ensure proper embedment can be attained for each proposed slab thickness.
- Anchors (bracing, inserts, clips, bolts, etc.) shall be designed for same loads as exterior windows and checked at 1.5 x "Design Wind Pressure" in addition to all other forces to ensure that the stresses do not exceed the yield point or elastic buckling, whichever is lower.
- Design of fenestration shall minimize the use of exterior sealants wherever possible. If exterior sealants are used, only silicone sealant with at least +/- 50% movement capability are acceptable.
- All sealed glazing units to be IGCC and IGMA certified.
- In addition to requirements listed elsewhere in this standard. It is recommended that the design team include fenestration system performance requirements for all fixed and operable units for the following characteristics:
  - Maximum load resistance
  - Condensation resistance
  - Maximum allowable air leakage
  - Thermal movement
  - Water penetration resistance
  - Deflection
  - Assembly effective U-factor, SHGC, and VLT
  - Noise transmission

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https://morrisonhershfield.com/webinar/framed-walls-insulation-humidity-and-risk/

APPENDIX A: BASIS-OF-DESIGN ASSEMBLIES BY CLIMATE ZONE

The assemblies included in this appendix are intended to help design teams identify potential basis-of-design assemblies that may be appropriate for the project specific climate zone under typical operational conditions.

Thermal bridging impact on effective thermal performance can be calculated using methods commonly accepted in the industry. See **https://thermalenvelope.ca** and **https://www.bchousing.org/publications/Low-Thermal-Energy-Demand-Large-Buildings.pdf** for additional guidance.

Assemblies are examples and are not exhaustive. There are many assemblies that may achieve the same performance outcomes that are not included in this document that can be used.

Note that interior conditions that may increase relative humidity will require specific design consideration.