WAUSAU

WINDOW AND WALL SYSTEMS

WINDOW SELECTION
for Sustainability and Long-Term Performance

(A Wausau AIA-CES Presentation)

Wausau Manufacturing Center - LEED™ Silver

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PROGRAM SPECIFICS

Length: One hour

Credits: 1 learning unit (LU)/HSW

Cost: Free - There is no cost to bring this program to your firm or chapter meeting, or to take the online course

Description: Window selection, design, manufacture, and installation are explored at a basic technical level. Recommendations for specifications and application are included. Learn how windows impact building LEED® certification.

Objective: Provide design professionals with valuable information on different types of fenestration, and review industry standard performance ratings, to support accurate product comparisons.

Point of Contact: For more information or to schedule a presentation, contact Wausau at info@wausauwindow.com or call toll-free at 877.678.2983

FGIA Fenestration & Glazing Industry Alliance

U.S. GREEN BUILDING COUNCIL MEMBER

Wausau Window and Wall Systems is an architectural business unit of Apogee Enterprises

(Stock symbol APOG on the NASDAQ exchange)

From cost-competitive architectural windows to custom-engineered high-performance curtainwall, new construction to historically accurate renovation, sustainable designs to resilient protection – We help you achieve your design visions and construction goals, on time and within budget with support from our experienced technical team and a warranty of up to 10 years.

Wausau Window and Wall Systems is a Registered Provider with the American Institute of Architects' Continuing Education Systems (AIA/CES). Credit earned on completion of this program will be reported to CES records for AIA members. Certificates of Completion for non-AIA members available on request.

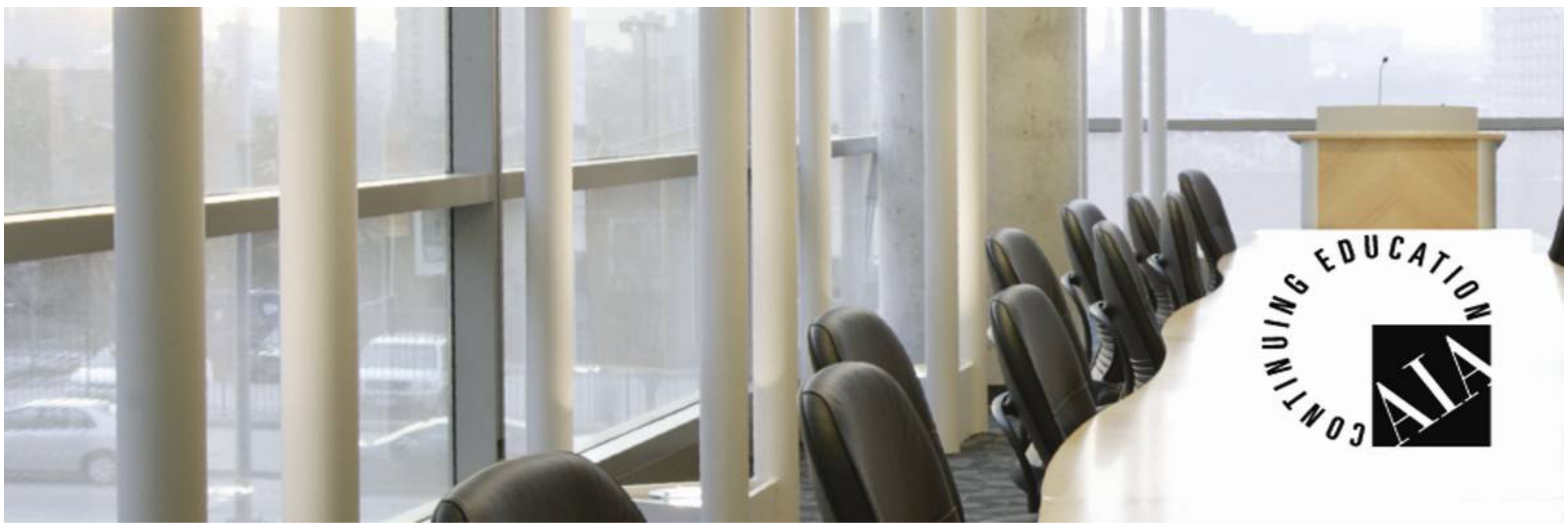
This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

WINDOW SELECTION
for Sustainability and Long-Term Performance

Learning Objectives

1. Distinguish between fenestration **types**.
2. Establish appropriate window **selection criteria**.
3. Use **industry standards** to define performance levels.
4. Understand window energy efficiency and thermal performance criteria.
5. **Compare products.**
6. Understand **LEED® impacts.**



Section One

Fenestration Types

Fenestration Types

Windows
Window Wall
Storefront
Curtainwall

Aluminum Entrances
Terrace Doors
Sliding Glass Doors
Side-Hinged Entry Doors
Skylights and Roof Windows
Tubular Daylighting Devices (TDDs)

“Fenestration” refers to any product used to fill an opening in a wall. It comes from the Latin word “fenestre,” which means “opening”.

The scope of this presentation is limited to windows only.

The definitions on the following slides are abridged from the North American Fenestration Standard (NAFS) AAMA/WDMA/CSA 101/I.S.2/A440.

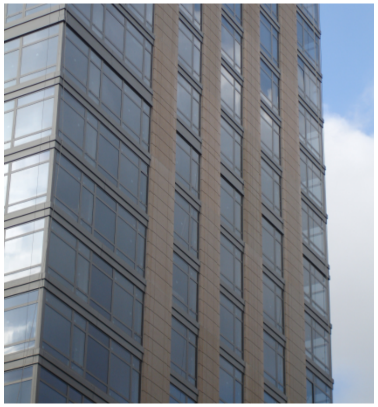
This consensus standard is published jointly by the American Architectural Manufacturers Association (AAMA), Window and Door Manufacturers Association (WDMA), and Canadian Standards Association (CSA).

The new FGIA organization now publishes AAMA and IGMA standards.

FGIA
Fenestration & Glazing

Windows and Window Wall

Window: An operable or fixed assembly installed in an opening within an exterior wall to admit light or air, usually framed and glazed



Window wall: A non-load bearing fenestration system, which spans from the top of a floor slab to the underside of the next higher floor slab

Windows are typically designed for factory fabrication and glazing.

Fixed windows are sometimes fabricated from storefront or curtainwall systems, in which case they are tested and certified to storefront or curtainwall standards and specifications.

Available with slab edge covers, window wall can be fabricated from windows, curtainwall or storefront systems. Window wall can be made to look as much, or as little, like curtainwall as desirable from an aesthetic standpoint.

Primary provisions for window wall anchorage occur at head and sill conditions, often using receptor systems.

Curtainwall and Storefront

Curtainwall: A non-load bearing wall cladding which is hung to the exterior of the building, usually spanning from floor-to-floor

Storefront: A non-residential, non-load bearing assembly of commercial entrance systems and windows usually spanning between the floor and the structure above it

Curtainwall can be factory-glazed (unitized), or designed to accommodate field fabrication and glazing, including optional structural glazing. Anchorage typically occurs at verticals only.

Storefront is field fabricated and glazed, employing exterior glazing stops at one side only. Provision for anchorage is made at perimeter conditions.

Use curtainwall when spans are longer than 10-feet, or when:

- -the wall runs past the face of the slab
- -periodic maintenance and re-sealing is not expected, or
- -performance requirements are stringent.

Storefront is intended for use at the lowest floors of a building.

NOTE: Many "problem jobs" are a result of trying to use storefront in mid-rise applications. Storefront is "face sealed" at the perimeter, while curtainwall employs two seals, a primary and a secondary.

Operating Window Types

Single- and Double- Hung

SINGLE-HUNG
SIDE-LOAD SASH

DOUBLE-HUNG
TILT SASH

Sliding seals can be prone to air leakage
Operation requires up to 45 lbs lifting force
Not pressure-equalized
Often require 3mm glass for less weight
Balances require periodic replacement
Screens mount on the outside
Operation does not interfere
with window coverings
Tilt-in sash for cleaning (smaller sizes only)
Single-hung frames are more rigid

Hung windows can require a lot of force to operate. They require even more force when seals are made tight to meet the AW air infiltration maximum. Sliding seals can't be expected to last as long as compression seals.

Counter-balances wear out quickly with frequent use, and can bind if never operated, or if exposed to contaminants.

Deep "tank" sills are required to achieve high water test pressure with these non-pressure-equalized products.

Single-hung windows are easier than double-hung windows to install plumb, level, and square, because the rigid five-members frames are less subject to "racking" or sprung jambs.

"Simulated double hung" projected windows are a great alternative when historical accuracy is necessary.

Operating Window Types

Horizontal Rolling (Sliders)

Sliding seals can be prone to air leakage
Operation requires up to 25 lbs of force
Not pressure-equalized
Roller materials critical to durability
Screens mount on the outside
Operation does not interfere
with window coverings
Slide-by feature allows for cleaning
Single-slide frames are more rigid

Sliding windows can also require a lot of force to operate. They require even more force when seals are made tight to meet the AW air infiltration maximum.

Sliding seals can't be expected to last as long as compression seals.

Deep "tank" sills are required to achieve AW-level water test pressure with these non-pressure-equalized products.

Single-slide windows are easier than slide-by windows to install plumb, level and square, because the rigid five-members frames are less subject to bowed heads or tipped sills.

Sliding sash are removable for ease of installation and maintenance, but can be fitted with forced-entry-resistant anti-take-out blocks.

Operating Window Types

Project-Out (PO)

Awnings and Casements

Compression-sealed, easy operation
Awnings provide a natural water shed
Hand- or roto-operated
Four-bar friction hinges
Screens mount on the inside
Do not interfere with window coverings
Ideal for egress
Limit PO opening in high-rise applications
Avoid exterior walking surfaces
Available as zero-sightline insert vents

Maximum vent size for most architectural PO awnings is 5′ wide by 3′ high. Some high-end manufacturers offer larger sizes.

Depending on hardware selection and glazing, architectural PO casements can be 3′ wide by 5′ high or taller. Some high-end manufacturers offer larger sizes.

Hardware selection also affects minimum vent size limitations.

Interior-mounted screens, with or without wickets, require coordination with hardware.

Projected windows are pressure-equalized for excellent air and water performance, yet easy to operate.

PO awnings are also available in “simulated double-hung” for historical renovation.

Operating Window Types
Project-In (PI)

Hoppers and Casements

Compression-sealed, easy operation
Cleaning from the interior (every third lite)
Indirect ventilation
Hand-operated
Four-bar friction hinges
Screens mount on the outside
Can interfere with window coverings
Best placed in window wells
Egress difficult

Maximum vent size for most architectural PI **hoppers** is 5′ wide by 3′ high. Some high-end manufacturers offer larger sizes.

Depending on hardware selection and glazing, architectural PI **casements** can be 3′ wide by 5′ high or taller. Some high-end manufacturers offer larger sizes.

Hardware selection also affects minimum vent size limitations.

Hoppers are best placed in window wells so that sharp sash corners do not open into the room. This is not usually a problem in institutional buildings, as walls tend to be deep.

Projected windows are pressure-equalized for excellent air and water performance, yet easy to operate.

PI hoppers are also available in "simulated double-hung" for historical renovation (shown in photo).

Operating Window Types
Specialty Operators

Dual-Action (Tilt-Turn®)
Vertically Pivoted
Horizontally Pivoted
Circuvent™
Parallel Opening (Pop-Out)
Tilt and Slide
Trickle Vent®

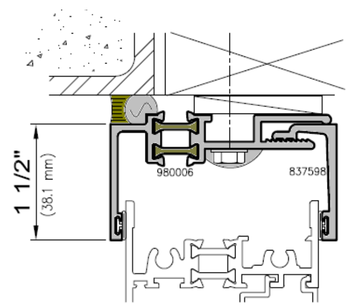
Availability of **specialty operators** can be limited. Most functionality is duplicated in mainstream operating types. For example, in-swing casements can provide the same cleaning and ventilation features as pivoted or dual-action windows.

Parallel opening windows pop straight outward on scissors hinges. They are limited in size, and have generally been considered residential products.

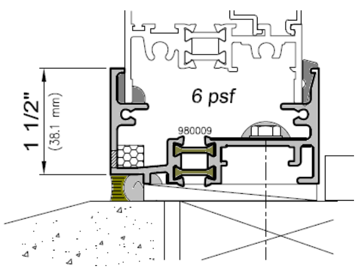
"Tilt and slides" are compression-sealed sliders, offered by some European companies. They have never caught on in non-residential markets in the U.S.

Trickle Vents® are occasionally employed to bring in fresh air, even when windows are closed, or fixed windows installed. They can be added to frame members of many standard window and curtainwall products.

Trim and Accessories



Anchors
Receptors
Retrofit Panning
Muntin Grids



Much of the "applications engineering" for any specific window project is focused on trim and accessories.

Depending on substrates and sequence, through-frame anchors, steel slide-in anchors, or custom-extruded aluminum anchors may be appropriate.

Receptors, also called "starters," are often used to speed installation. Head starters also accommodate movement and tolerances. Sill starters offer secondary water control.

Panning is used to prepare existing openings for replacement windows, and avoids the need to tear out existing frames. Available in historical ogee, cove or reverse cove profiles.

Muntins are available as between-glass, surface-applied, glazed-in grids, or true divided lites (TDLs).

Historical Window Replacement

Historically Accurate: The National Park Service administers the National Register of Historic Places (NRHP); State Historical Preservation Offices (SHPOs) review replacement window designs

Federal tax credits (not just deductions) and state credits may apply for buildings or local/regional historic districts

Historically Influenced: Less rigorous review - Maintain the aesthetic character of a structure, campus or neighborhood, improve curb appeal or tenant experience

"The Secretary of the Interior's Standards for Rehabilitation"

Preserve distinctive **features**, finishes and construction techniques – Refurbish when possible, but when replacement is required, match:

Design/Color	Texture
Visual quality	Material (if possible)

Specific to **windows**, NPS guidelines define "features" as:

Frames and sash	**Muntins** and glazing
Sills and headers	Hoodmolds
Moldings	Shutters and blinds
Paneled/decorated jambs	

Options

Screens
Hardware
Between-Glass Blinds
Interior Accessory Windows

IAWs

Flat screens are used for PI and roto-operated PO vents. Half or full flat screens are available for hung and rolling sash. Insect screens are **not** fall protection devices.

Almost limitless hardware options and combinations are possible for occupant and/or custodial operation. Stainless steel hinges are critical for durability of AW Class projected vents.

Between-glass blinds enhance solar heat gain performance, and reduce wear. Cleaning is made easier.

Interior accessory windows (IAWs) upgrade weather-tight existing windows, and can incorporate between-glass blinds or behavioral care glazing.

Balanced Design

Window selection and design should be based on <u>all</u> applicable criteria, not on any specific single number rating system.

Selection and design criteria almost always include:

Code Compliance
Structural Integrity
Weather-ability
Energy Efficiency
Condensation Resistance
Building Movements
Ventilation and Cleaning Access
Sustainable Design
Durability
Cost
Aesthetics

…and on some projects, also:

Emergency Egress
Hurricane Impact
Psychiatric Detention
Blast Hazard Mitigation
Noise Control
Seismic Movements
Smoke Evacuation


30 Park Place - NYC

Section Two

Industry Standards

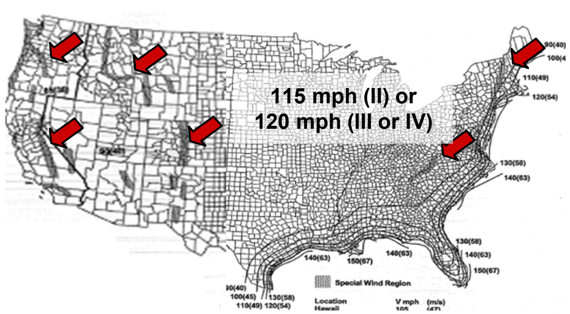
ASCE7-10

Design Loads on Structures

Loads depend on the building Risk Category

When citing design loads, differentiate between
Strength Design
(LRFD - load and resistance factor) or
Allowable Stress Design (ASD) at 60% of LRFD

The non-hurricane-prone eastern 2/3 of the U.S. is in the same mph contour. The leeward slope of mountains are special wind regions.



Factors applied to basic velocity pressure formulae include:
Gust effects, internal pressures, building height, corner zones, exposure, and partial enclosure.

Buildings and their components are designed to withstand code-specified wind loads.

Calculating wind loads is important in design of wind force-resisting systems, against sliding, overturning, and uplift actions. Wind loads are often quantified using the American Society of Civil Engineers' "ASCE 7" publication and the International Building Code.

Determining wind loads is the job of the building design team's engineer of record, not the window manufacturer. Criteria should be listed on the first sheet of the structural drawings.

Differing interpretation of corner zones, insurer mandates, and local code peculiarities could result in costly re-design if wind load determination is left ambiguous in bid documents.

Industry Standards

Basic air, water and structural performance for windows is covered in NAFS:
AAMA/WDMA/CSA 101/I.S.2/A440-17
Cited by the IRC and IBC for compliance verification

For storefront, curtainwall and window wall:
AAMA Storefront Manual SFM-1
AAMA Curtainwall Manual CWM-1 (updated in 2019)

For energy efficiency:

NFRC 100/200 certification for U-factor and Solar Heat Gain Coefficient (SHGC)
AAMA 1503 for Condensation Resistance Factor (CRF)
ASHRAE 90.1 and IECC model energy codes set performance requirements

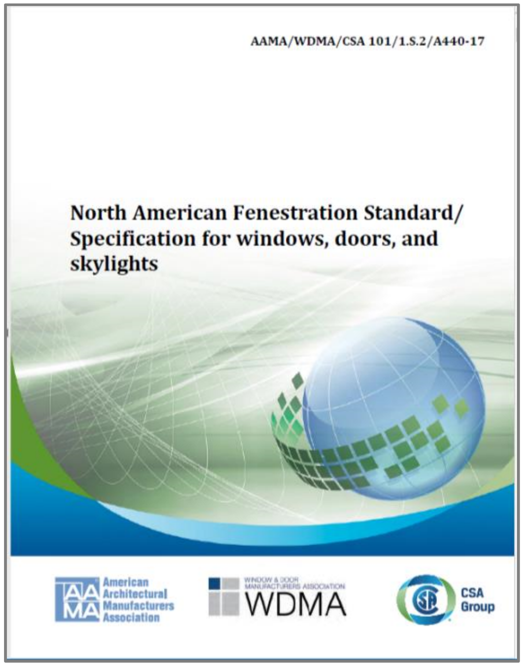
For sustainable design:

USGBC LEED® Rating System™,
ASHRAE 189, IgCC, or CalGreen

Other design criteria:

Local authorities having jurisdiction (AHJs), DoD, GSA, etc.

NAFS


AAMA/WDMA/CSA 101/I.S.2/A440-17

North American Fenestration Standard/
Specification for windows, doors, and
skylights

North American Fenestration Standard
(NAFS)
AAMA/WDMA/CSA 101/I.S.2/A440-17

Joint standard "owned" by all three industry associations through the Joint Document Management Group (JDMG)

Follows the International Code Council® (ICC) three-year code cycle

FGIA
Fenestration & Glazing Industry Alliance

The **NAFS** standard is material-neutral. It includes aluminum, wood, PVC, cellulosic composite and fiberglass framing types.

The scope of NAFS is limited to:

Windows
Residential side-hinged entry doors
Terrace doors, folding doors and
sliding glass doors
Unit skylights, roof windows and TDDs

The scope **does not** include curtainwall, sloped glazing, entrances or storefront, <u>or windows fabricated from these systems</u>.

Only basic air, water, structural, and durability requirements are included. No thermal or acoustical parameters are specified in NAFS.

NAFS

Performance Classes

Reduced in number from five to four in NAFS 2008

Performance Classes	
in NAFS 2005	in NAFS 2017
R	R
LC	LC
C	CW
HC	
AW	AW

R and LC are maintained by WDMA, CSA and the AAMA Residential Products Group

No L/175 deflection limits

No minimum test size – 15 psf min. design load

There are major differences in performance requirements between Classes.

CW and AW are maintained by the AAMA Architectural Products Group

L/175 deflection limits for insulating glass warranty and perception of rigidity

Defined gateway sizes – 30 psf min. design load

NAFS
Performance Classes (continued)

Descriptions from NAFS
AAMA/WDMA/CSA 101/I.S.2/A440-17


UCLA Luskin Center

NOTE: Few architectural manufacturers are certifying products to the CW grade. CW is used mostly as an upgrade for residential windows used in clinics, motels, etc. Institutional work is typically specified as AW Class.

R commonly used in one- and two-family dwellings.

LC commonly used in low-rise and mid-rise multi-family dwellings and other buildings where larger sizes and higher loading requirements are expected.

CW commonly used in low-rise and mid-rise buildings where larger sizes, higher loading requirements, limits on deflection, and heavy use are expected.

AW commonly used in high-rise and mid-rise buildings to meet increased loading requirements and limits on deflection, and in buildings where frequent and extreme use of the fenestration products is expected.

NAFS

Performance Classes (continued)

A long list of stringent performance requirements differentiates **AW Class** "Architectural" Windows.

Limited UP TO 10 YEAR Warranty

Lower air infiltration rate (0.1 cfm/sqft)
Higher air test pressure (6.24 psf)
Higher water test pressures (up to 15 psf)
Larger test sizes (3′ x 5′ casement)
Higher design pressure (Minimum 40 psf)

Deflection limits
(L/175)
Key to insulating glass life

Life cycle testing (to 4000 cycles)
Now 4000 cycles, including thermal cycling

Misuse testing
Unglazed sash torsion testing
Hardware load tests

Class I anodic finishes
Color-fast AAMA 2605 paint

Warranty expectations
Durability and sturdy construction

ADA Accessibility


Operating force test

ADA is a law, not a code or test method
IBC cites ANSI A117.1 - 2009

Applicable to operable windows and doors in Accessible and Type A units
Also in Type B units in NYC only
Skilled nursing, apartments and condominiums, education

To help ensure that fresh air and a connection with the outdoors are made accessible to people with physical disabilities...

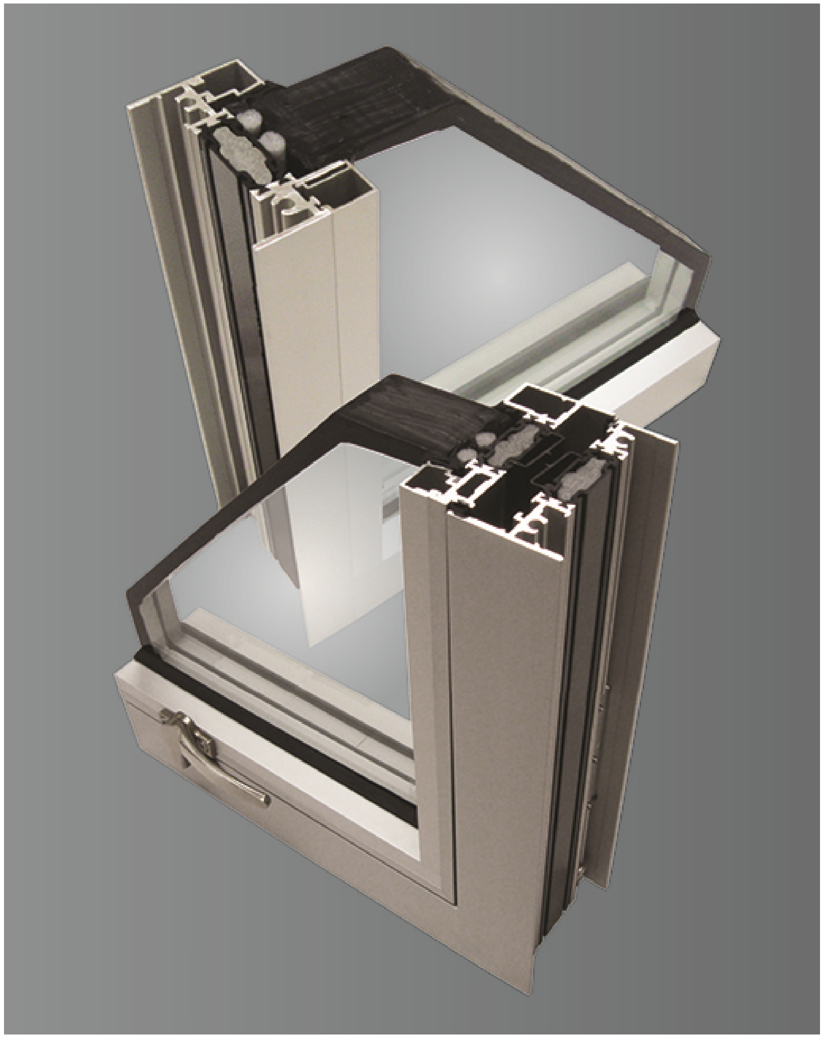
…windows must operate with one hand, using a force of five pounds or less, without tight grasping or twisting of the wrist.

Hung and rolling 8.5 pounds

Don’t forget threshold height, reach, approach area, etc.

Laboratory-tested per AAMA 513-14 as included in the ANSI A117.1-2016 update (NOTE: The updated ANSI A117.1 is not yet cited in IBC 2018)

Local interpretations vary



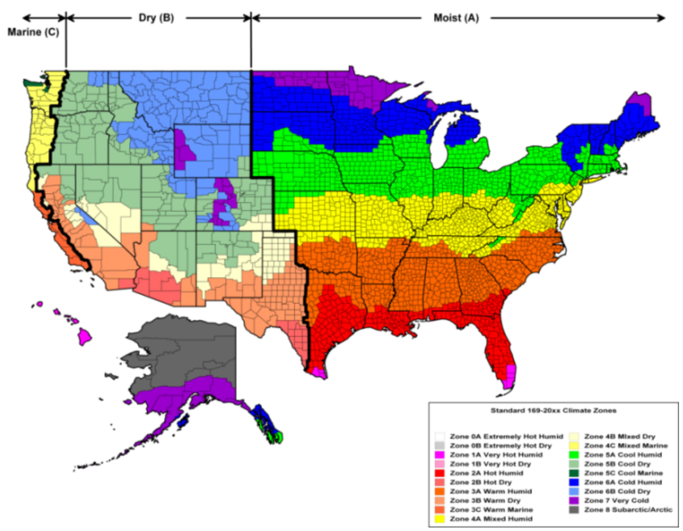
Section Three

Energy Efficiency

Energy Efficiency

Model Energy Codes (MECs) are
based on Climate Zone

ASHRAE 90.1
IECC



The U.S. Department of Energy's Marc LaFrance:
"Reduction in air-conditioning-driven peak electrical load is an environmental issue. Reduction in heating oil consumption is also a national energy security issue."

There many reasons why new MECs are being adopted more quickly nationwide:

Building operating costs
HVAC equipment cost
Useable perimeter space
Occupant comfort and productivity
View
Natural daylighting
Need for secondary glare control
Sanitary conditions
Maintenance and damage
Environmental responsibility/LEED®

MECs from ASHRAE and ICC represent consensus "best practices" and are being updated every three years. AHJs' adoption of the latest version of these documents help ensure energy efficiency.

The ASHRAE climate zone map was recently updated to reflect global warming.

Overall Window U-Factor

An area-weighted average

Don't confuse overall window U-Factor
with center-of-glass (COG) U-Value

Prescriptive maximums are given in MECs
such as ASHRAE 90.1 and IECC.

U = **1.20** BTU/hr.sqft.°F Non-thermal single glazed

U = **0.60** BTU/hr.sqft.°F Standard uncoated, insulating glass

U = **0.20** BTU/hr.sqft.°F Highest performing **fixed windows**

U-Factor (formerly U-Value) is a measure of thermal transmittance, and is the reciprocal of R-Value.

U-Factor represents heat flow per unit area, time, and °F temperature difference in inch-pound units of BTU/sqft.hr.°F.

It is measured in a guarded hot box test, or modeled using finite element heat transfer algorithms.

U-Factor allows the HVAC engineer to check for code compliance, as well as calculate peak loads and energy consumption, for any size window in any climate.

Energy Star® for Windows applies to residential products only. Energy Star® for Buildings is the commercial program

With U-Factor, lower is better, but for the overall unit, is highly size-dependent.

Solar-Optical Performance
SHGC

SHGC = Solar Heat Gain Coefficient

Prescriptive maximums are given in MECs such as ASHRAE 90.1 and IECC.

SHGC =	**0.87**	1/8” clear glass
SHGC =	**0.52**	Grey, tinted, insulating glass
SHGC =	**0.29**	Grey, reflective glass

Solar Heat Gain Coefficient (SHGC): A dimensionless ratio of the total visible, infrared and ultraviolet energy flowing through glazing, divided by incident energy.

Overall system SHGC is always less than COG SHGC.

SHGC is affected by the shading “Projection Factor” (PF), which is vision glass setback or overhang depth; divided by height. PF = d/h

For most cooling-mode-dominated commercial buildings, SHGC is the most impactful thermal performance parameter.

State-of-the-art, spectrally-selective, low-e coatings can yield low SHGC with relatively high Visible Light Transmission (VT) for effective, natural daylighting.

Thermal Performance

CRF

CRF = Condensation Resistance Factor

Determined through surface temperature measurement in guarded hot box testing.

CRF **29**	Non-thermal single glazed
CRF **52**	Standard, uncoated, insulating glass
CRF **80**	Highest performing curtainwalls

$$\mathbf{CRF} = \{[\min(\mathbf{FT},\mathbf{GT})-\mathbf{T}_{ext}]/(\mathbf{T}_{int}-\mathbf{T}_{ext})\} \times 100$$

Where:

FT = Average Frame Temperature (adjusted for cold points)

GT = Average Glass Temperature

$\mathbf{T}_{int}$ = Interior Ambient Temperature, and

$\mathbf{T}_{ext}$ = Exterior Ambient Temperature

Condensation Resistance Factor (CRF): A dimensionless ratio of surface temperature to ambient temperature difference.

CRF is useful in comparing design options, but less useful in predicting field condensation. Condensation is a local phenomenon, and average surface temperatures are less important than local "cold points."

CRF is especially important in cold-climate, high-humidity applications such as high-rise residential buildings, hotels, hospitals, computer rooms, museums, laboratories, and kitchens.

Thermal Performance

CRF (continued)

FGIA (AAMA) provides an online calculation tool for CRF recommendations.

https://aamanet.org/pages/crf-tool

Examples of Major U.S. Cities (assuming an Indoor Air Temperature of 70°F)

Recommended CRF

Location	ASHRAE 99.6% Heating DB	Relative Humidity				
		10	20	30	40	50
Atlanta	18.8		16	36	50	62
Washington DC	15.9		21	39	53	64
Boston	7.7		31	47	59	69
Chicago	-5.0		43	56	66	74
Minneapolis	-14.9	30	49	61	70	77

AAMA recommendations assume a small amount of condensation is acceptable under extreme conditions.

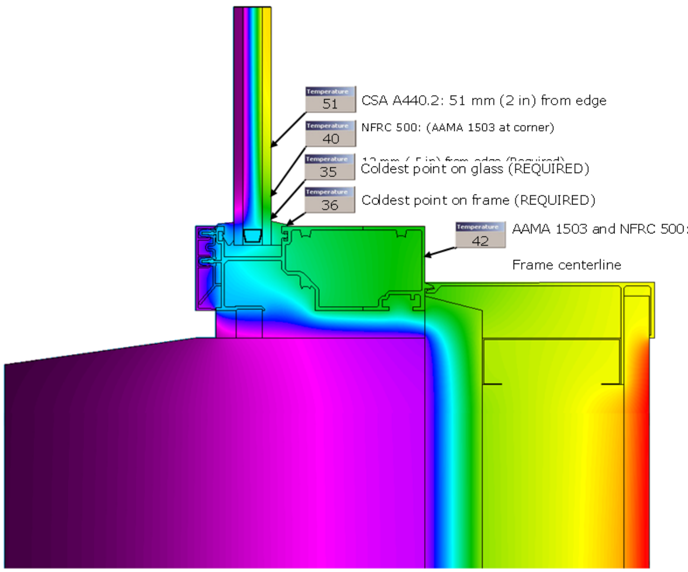
High-humidity occupancies like hospitals, condominiums and hotels warrant special attention.

Below 32 °F surface temperature, condensation forms as frost, which can persist even when temperatures moderate.

Always look first to interior Relative Humidity (RH) for condensation control.

Thermal Performance

Finite Element Modeling



Modeling with DoE-sponsored WINDOWS and THERM software is the basis of NFRC energy labeling.

Guarded hot box testing per AAMA 1503 has been used to validate modeled U-Factors.

Finite element thermal modeling software is widely used to predict U-Factor and SHGC of fenestration systems of all types.

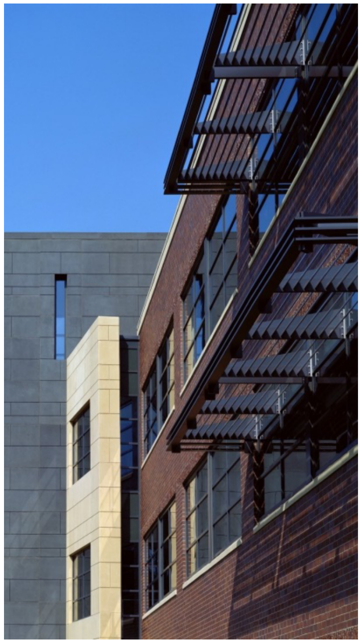
THERM modeling is also widely used to predict interior surface temperatures, for condensation prediction in critical occupancies. Interior ambient air relative humidity and temperature yield an expected dew point temperature for comparison purposes.

AAMA 515-19 sets forth a standardized voluntary procedure for consistency in THERM modeling's application to surface temperatures.

AAMA 501.9-19 addresses surface temperature assessment in full-size laboratory wall mockups.

Solar-Optical Performance

Sun Control



Exterior sun shades are used to block solar heat gain and increase PF.

Interior light shelves are used to redirect visible light deeper into interior spaces with southern exposure.

The use of aluminum sun shades is a growing trend in architectural design on buildings of all types. Architects are exercising their creativity with sun shades using louvers, blades, catwalk grids, and solid panels to accomplish their aesthetic and daylight control goals.

In the most innovative designs, sun shades are combined with interior light shelves to control glare, while maximizing daylight penetration depth.

Sun shades present some engineering challenges in wind loading, snow loading, ice build-up, and loads imparted by maintenance operations.

Close coordination of solar control accessories with fenestration system manufacture is critical to maintain color match, continuity of line, and structural integrity.

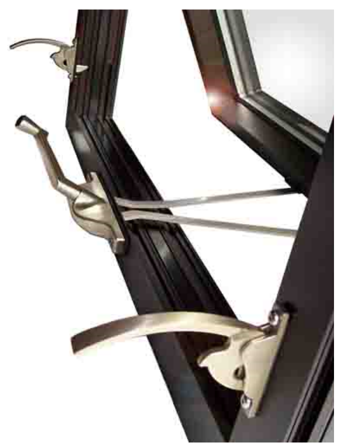

Slate – Portland, OR

Section Four

Comparing Products

Comparing Products

Nothing provides a better comparison than full-size operating samples, along with project-specific proposal drawings.



Expectations of architectural windows:

AW gateway size and multi-lite configuration, not single-lite or “down-sized” prototypes

Test reports from an AAMA-accredited laboratory

Life-cycle testing for durability

0.125” extrusion wall thickness at hardware attachments, stainless steel hinges

Eco-friendly finishing processes

In-line water testing prior to shipment

10-year standard limited warranty, bonding capacity

Wooster and Mercer Lofts – Arlington, VA

Section Five

Sustainable Design

Sustainable Design

Bren School of Environmental Sciences
University of California at Santa Barbara
LEED® Platinum

Environmentally-responsible, sustainable, building design and operation is a top-of-mind issue for anyone in architecture, construction, or real estate.

Buildings represent about 1/3 of the energy consumption in the U.S., along with the corresponding amount of greenhouse gas emissions.

Since its inception in 2000, USGBC's voluntary, consensus-based LEED® (Leadership in Energy and Environmental Design) Rating System™ has emerged as the leading sustainable building "scorecard."

U.S. GREEN BUILDING COUNCIL MEMBER℠

The LEED® Scorecard

Toledo Hawkins School

The USGBC LEED® system rates and certifies buildings, not building products such as curtainwall.

Many of the total credits available are affected directly by window and curtainwall selection and design.

There are both environmental and financial benefits to earning LEED certification. These include:

Lowering operating cost and increasing asset value

Reducing waste sent to landfills

Conserving energy and water

Increasing health and safety for occupants

Reducing harmful greenhouse gas emissions

Qualifying for tax rebates, zoning allowances and other incentives in hundreds of cities through energy benchmarking

Demonstrating an owner's commitment to environmental stewardship and social responsibility

The LEED® Scorecard

(continued)

Energy and Atmosphere (EA)

Prescriptive building envelope requirements are based on ASHRAE 90.1 compliance for U-Factor and SHGC.

Employ natural daylighting with artificial lighting controls to maximize benefits, as verified through whole-building energy modeling.

Combined with spectrally-selective high-performance low-e glass, the “right” windows for the building type and climate zone is a significant opportunity to impact any building’s LEED® rating.

Design for natural daylight harvest is the ultimate “integrated design” activity, as many fenestration parameters affect lighting, HVAC, occupant comfort and programmatic outcomes.

Involve the entire design team early, and keep coordinating as the design evolves. The use of Building Information Modeling (BIM) can facilitate this cooperation.

The LEED® Scorecard

(continued)

Materials and Resources (MR)

For products, recycled content is calculated based on weight of constituent materials. Glass represents about 70% of the weight of a typical curtainwall assembly.

For contribution to a building's LEED® points, recycled content is proportioned by value, as defined by the general contractor's Schedule of Values.

Aluminum is the ultimate recycled material. The Aluminum Association reports that:

- Annual U.S. aluminum can consumption is 100 billion units, the equivalent of one per day for each citizen
- It requires only 5% of the energy to recycle aluminum as it does to smelt new aluminum
- Because of recycling, more than 2/3 of the aluminum ever smelted is still in use
- Upon demolition, 90% of the aluminum in buildings is recycled
- One case of un-recycled aluminum cans wastes the energy in a gallon of gas
- On average, aluminum cans are back in use 60 days after recycling
- The aluminum industry has cut carbon emissions by 53% in the last 15 years

Most aluminum window manufacturers can provide frame extrusions fabricated from secondary billet, containing more than 40% LEED "combined" recycled content.

The LEED® Scorecard

(continued)

ARTIC – Anaheim, CA

Materials and Resources (MR)

Building Product Disclosure and Optimization:

Environmental Product Declarations (EPDs)

Sourcing of Raw Material

Material Ingredients

The joint industry "Window Product Category Rule (PCR)" ensures a level playing field for manufacturer-specific and industry-wide curtainwall EPDs.

Generic environmental profiles are available from www.quartzproject.org for anodized and PVDF-coated aluminum window and curtainwall extrusions, EPDM curtainwall seal gaskets, and laminated glass.

EPDs for insulating glass units may be available from the glass fabricator.

Product transparency reports disclosing potential material hazards may be self-declared using the Pharos online database (a project of the Healthy Building Network), or third-party certified through Health Products Collaborative™ HPDs, International Living Futures Institute Declare™ labels , or Cradle-to-Cradle™ certification, among others.

The LEED® Scorecard

(continued)

Indoor Environmental Quality (IEQ)

Ventilation, Comfort and Control

Daylight and Views

Low-Emitting Materials

Operable windows can be part of an effective, natural ventilation strategy, when incorporated per the Carbon Trust "Good Practice Guide 237"[1998] and ASHRAE 62.1-2004.

To achieve both Daylight and Views points, the design must provide daylight and a view to the outdoors for 90% of the regularly occupied spaces. Ultra-clear glass is not required.

Credits for low-emitting materials, including paints and coatings, specifically exempts factory baked-on finishes used on curtainwall framing. Eco-friendly anodizing, powder painting and VOC-capture incineration spray painting are all environmentally-responsible processes.

All primers, structural glazing adhesives, and metal-to-metal sealants recommended for use on-site must meet VOC limits.

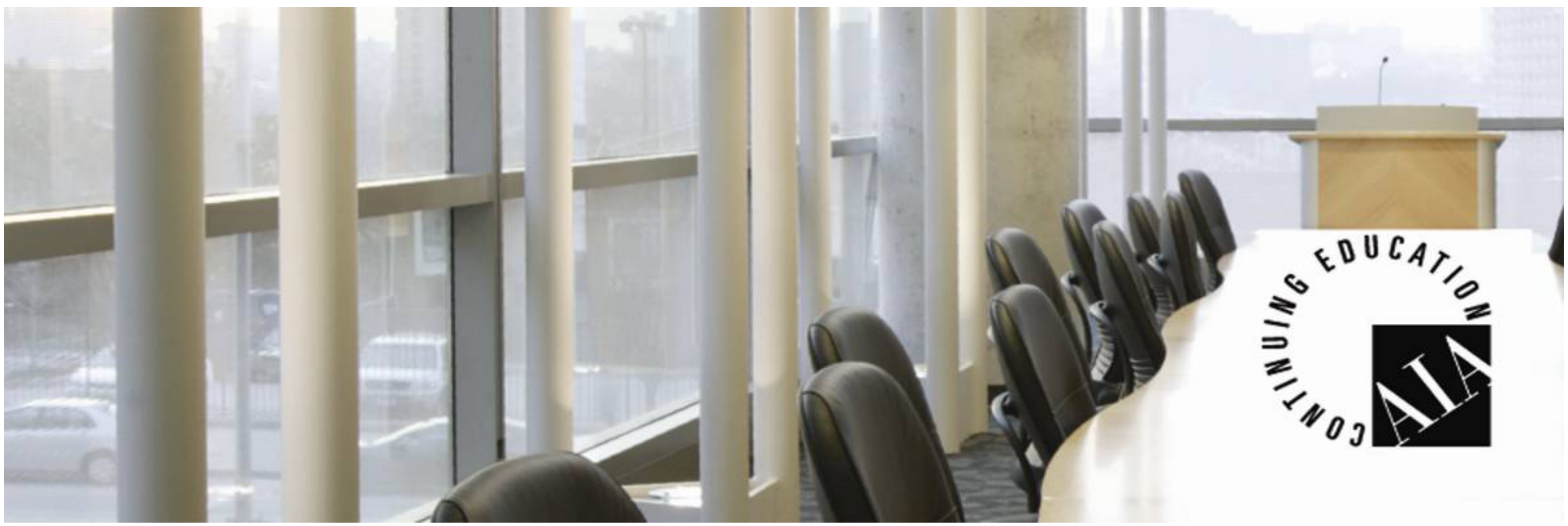
10 Rittenhouse – Philadelphia, PA

Section Seven

Summary

Learning Objectives Recap

1. Distinguish between fenestration types.
2. Establish appropriate window selection criteria.
3. Use industry standards to define performance levels.
4. Understand window energy efficiency and thermal performance criteria.
5. Compare products.
6. Understand LEED® impacts.



For buildings using curtainwall systems as design elements, it is important to consult with an experienced manufacturer early in the process. Teamed with a reputable, local glazing subcontractor, manufacturers can provide design input, budget pricing, sequencing, and schedule information that may prove valuable to the design team.

Course Evaluations

In order to maintain high-quality learning experiences, please access the evaluation for this course by logging into CES Discovery and clicking on the Course Evaluation link on the left side of the page.

Valor Christian Academy – Highlands Ranch, CO

WAUSAU WINDOW AND WALL SYSTEMS

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