
Cecil College Engineering and Mathematics Building – North East, MD

WAUSAU

WINDOW AND WALL SYSTEMS

CURTAINWALL

Products, Performance and Practicality

(A Wausau AIA-CES Program)

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Products, Performance and Practicality

(A Wausau AIA-CES Presentation)

Fenestration & Glazing Industry Alliance

U.S. GREEN BUILDING COUNCIL MEMBER

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: Curtainwall selection, design, manufacture, and installation are explored at a basic technical level. Recommendations for specifications and application are included. Learn how curtainwall impacts building LEED® certification.

Objective: Provide design professionals with valuable information on different types of aluminum curtainwall, ease of installation, movement accommodation, performance, and structural integrity.

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

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.

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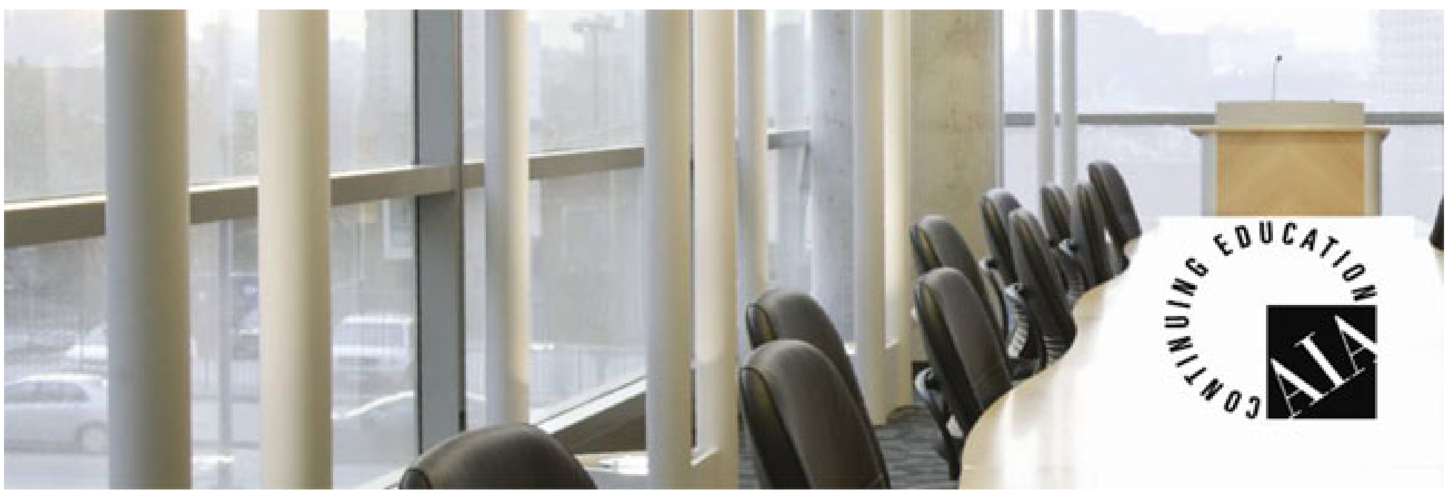
Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

CURTAINWALL
Products, Performance and Practicality

Learning Objectives

1. Recognize and differentiate different **types** of aluminum curtainwall.
2. Understand design parameters for curtainwall **anchorage** to the building, to ensure ease of installation, movement accommodation, and structural integrity.
3. Optimize **energy** efficiency and thermal performance of curtainwall.
4. Mitigate **blast** hazards through curtainwall design.
5. Design for **seismic** movements and induced inertial loads.
6. Understand **LEED®** impacts of curtainwall selection and design.




Shepard Hall – Joint Base Andrews, MD

Section One

Curtainwall Types

Curtainwall Types

Storefront

Stick Wall

I-Beam Wall

Pressure Wall

Unitized Wall

Window Wall

In strictest architectural parlance, a **"curtainwall"** is any non-load-bearing exterior wall that hangs, like a curtain, from the face of floor slabs, regardless of construction or cladding material. However, in common usage, the term curtainwall usually refers to aluminum-framed systems carrying glass, panels, louvers, or occasionally, granite or marble. Curtainwall supports only its own dead load.

The distinctions between the system types discussed in the following slides are not absolute. It's often difficult to clearly differentiate between one system type and another.

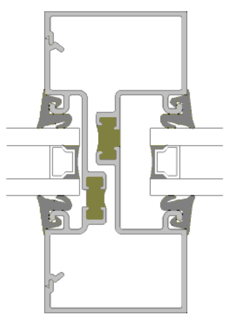
Face width sightline ranges from 2" to 4"; system depth from 4 ½" to 10" or more.

Two-side structural silicone glazing can be done in the field, however, four-side silicone glazing should always be done under factory-controlled conditions.

Storefront

Storefront is appropriate for use in ground-floor applications

Commonality between manufacturers' systems helps ensure basic installer familiarity with fabrication and installation processes



"Storefront" is a non-load-bearing glazed system that occurs on the ground floor, which typically includes **commercial aluminum entrances**. It is installed between floor slabs, or between a floor slab and the building structure above.

Typically, field-fabricated and -glazed storefront employs exterior glazing stops at one side only. Provision for anchorage is made at the perimeter.

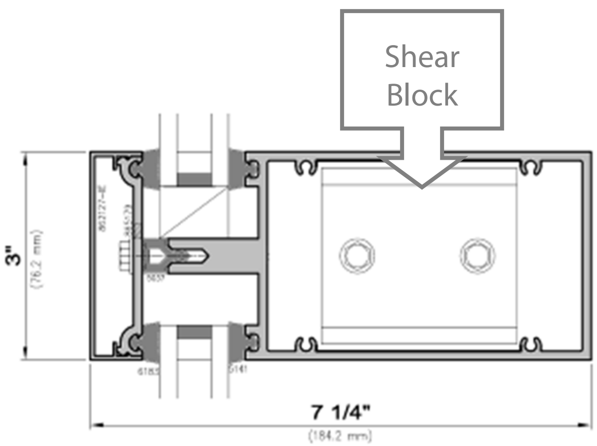
While sometimes used as a low-cost alternative to curtainwall systems for low-rise buildings, performance requirements for storefront are generally less stringent, and materials may require more-frequent maintenance.

Typical Performance:
Air less than 0.06 cfm per sqft at **1.57** psf
6 to **8** psf Water Test Pressure

Stick Wall

Shipped in pieces as:

Stock Lengths
-or-
Knocked Down (KD)



"Stick wall" systems are shipped in pieces for **field-fabrication and/or -assembly**. These systems can be furnished by the manufacturer as "stock lengths" to be cut, machined, assembled, and sealed in the field, or as "knocked down" parts pre-machined in the factory, for field-assembly and -sealing only.

All stick curtainwall is field-glazed.

Frame assembly requires the use of:

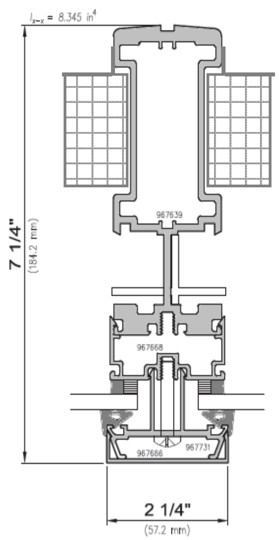
a) "shear blocks" to connect vertical and horizontal framing elements, or
b) "screw-spline" construction, in which assembly fasteners feed through holes in interlocking vertical stacking mullions into extruded races in horizontals.

Typical Performance:
Air less than 0.06 cfm per sqft at **6.24** psf
8 to **10** psf Water Test Pressure

I-Beam Wall

Field assembled
Structurally-efficient
I-Beam vertical members

Interior trim at vision areas
No finish required at spandrel areas.



Once very popular, **"I-Beam wall"** has seen market penetration decrease.

"I" or "H" shaped, structural, vertical back members are set into openings in the field, with horizontals then clipped to verticals.

After glazing, extruded aluminum interior trim is cut and snapped into place at vision areas. Since unexposed spandrel areas receive no interior trim, savings in material and finish (painting or anodizing) can result, partially offset by added field labor.

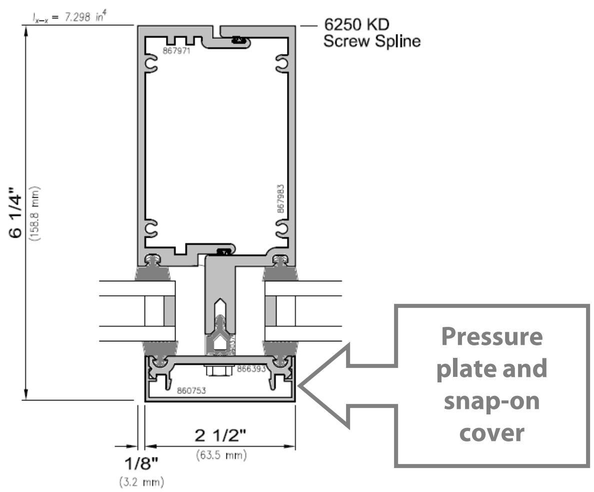
Maintaining vapor retardant continuity at interior trim joints can be challenging, in the presence of positive building pressure.

Typical Performance:
Air less than 0.06 cfm per sqft at **6.24** psf
8 to **10** psf Water Test Pressure

Pressure Wall

Can be stick or factory-assembled
Field glazed using zone dams at frame corners

Pressure plates and snap-on covers at exterior, with joints allowing thermal expansion



Some stick curtainwall is called **"pressure wall,"** because exterior extruded aluminum plates are screw-applied to compress glass between interior and exterior bedding gaskets. A snap-on cover or "beauty cap" is then used to conceal fasteners.

Performance of any field-assembled or field-glazed curtainwall is only as good as field workmanship allows, limited by variables such as weather, access, and job site dirt and dust. Many critical seals are necessary, even in systems that are designed to drain or "weep" rain penetration from the system back to the exterior.

"Compartmentalization" of each lite is strongly recommended to isolate glazing pockets.

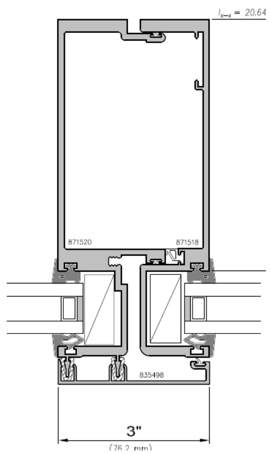
Typical Performance:
Air less than 0.06 cfm per sqft at **6.24** psf
10 to **15** psf Water Test Pressure

Unitized Wall

1

2

3



Factory-assembled and factory–glazed under controlled conditions

Units are hung from the floor above on pre-set anchors

To accomplish as many critical seals as possible under controlled factory conditions, and to minimize dependence on field labor, **"unitized wall" systems** have been developed.

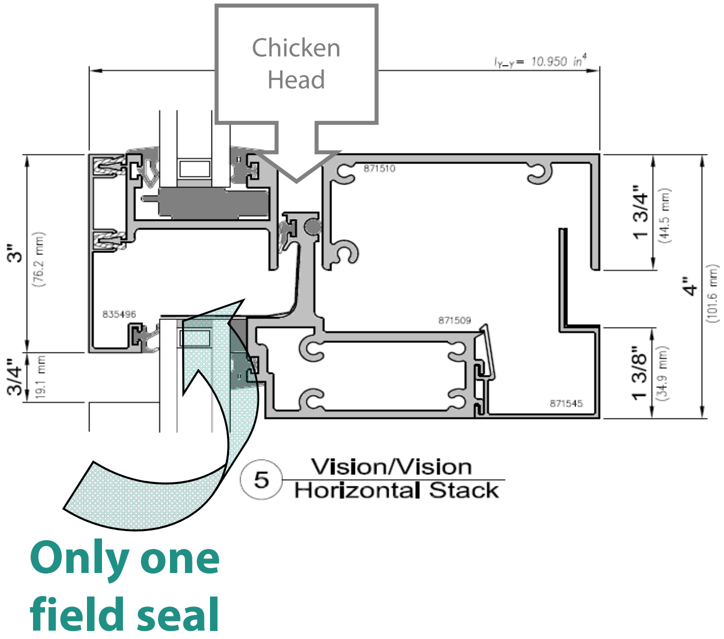
Unitized wall is factory-assembled and -glazed, then shipped to the job site in units that are typically one lite wide by one floor tall.

Most unitized wall systems are installed in a sequential manner around each floor level, moving from the bottom to the top of the building.

Typical Performance:
Air less than 0.06 cfm per sqft at **6.24** psf
12 to **15** psf Water Test Pressure

Play unitized curtainwall installation video

Unitized Wall (continued)



Only one unit-to-unit splice, usually a translucent silicone sheet or patch, needs to be field-sealed. Seal bedding is visible through the sheet.

Only one anchor per mullion needs to be attached to the exterior face or top surface of the floor slab.

The horizontal gutter weather-seal is sometimes called a "chicken head" detail, due to its unique configuration.

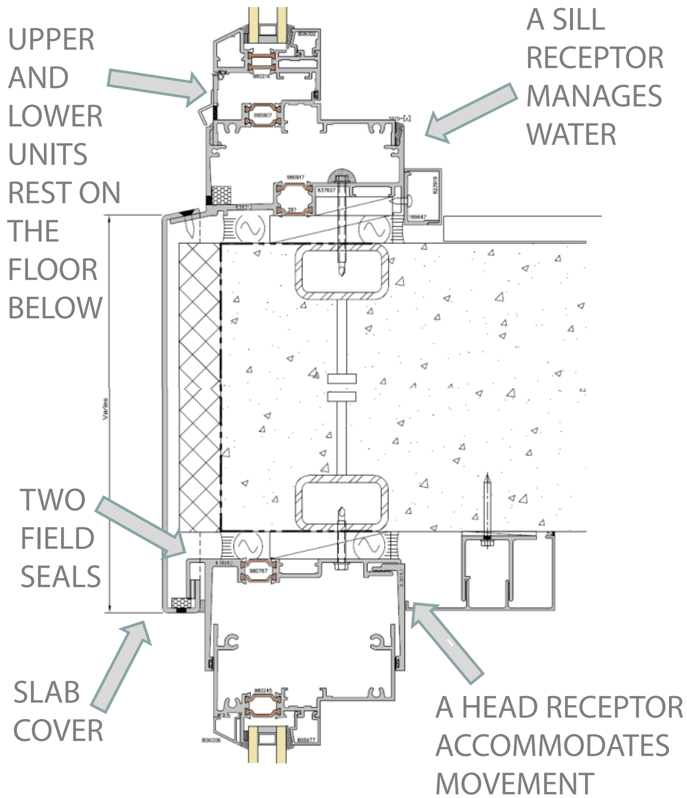
Interlocking unitized wall frame members are weather-stripped to seal to one another, both horizontally and vertically. This accommodates thermal expansion and contraction, inter-story differential movement, concrete creep, column foreshortening, and/or seismic movement.

Unitized Wall (continued)
Product Selection Summary

Choosing between Stick and Unitized Wall Systems		
Selection Criteria	**Stick Wall**	**Unitized Wall**
Project size	Small	Large
Wall configuration	Complex (Many changes in plane, soffits, corners)	Monolithic (Large expanses of flat wall)
Joint pattern	Random	Uniform horizontal sill line
Glazing	Field	Factory
Inter-story movements	Very limited	Inter-locking frames accommodate movements
Quality control	Subject to site variables (Both environment and equipment)	Controlled factory conditions
Modification	Can be cut-to-fit in the field	Pre-engineered
Sealing	Subject to site variables	Minimal field sealing
Field labor cost	High (Many parts to track and assemble)	Low
Field labor duration	Slow	Fast (Often setting 75 sqft or more per unit)
Access and safety	Exterior access required	Set from the interior (Exterior optional)

Window Wall

Based on a window system



"Window wall" spans from the top of one floor slab to the underside of the slab above.

Window wall employs large, side-stacking window or curtainwall units, contained in head and sill receptors, also called "starters," which accommodate movement and drainage, but require field-applied sealants.

Slab covers can be fabricated from aluminum extrusions, sheet, panels, or even glass.

Window walls easily accept operable windows, and unlike curtainwall, can be installed non-sequentially.

"Hybrid" systems combine characteristics of multiple wall types. For example, some four-side silicone wall systems use stick wall grid frames, with factory-glazed "cassettes" or "carrier frames."

Section Two

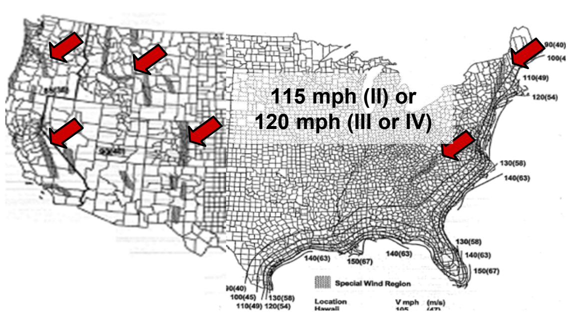
Structural Design

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.

Wind Load (continued)

For adequate glass support:

Limit deflections perpendicular
to the wall to L/175
-or-
L/240+0.25" for spans greater than 13'-6"

IBC cites 0.75" maximum for any single glass lite

Designed to withstand wind loads and provide adequate glass edge flexural support, curtainwall can be:

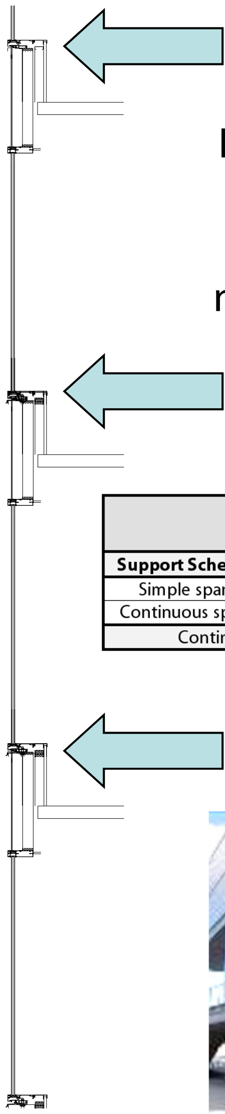
a) **"simply supported,"** with curtainwall mullions anchored only at their ends;

b) **"twin span,"** with mullions spanning two floors and anchoring at the intermediate floor or other structure; or

c) **"continuous span,"** with the system's vertical mullions spliced at points of zero moment (inflection points).

These are listed in order of increasing structural efficiency, but before deciding on an appropriate strategy, movements and the ability of the structure to support dead loads must be considered.

Wind Load (continued)



Ideal splice location is
20-22% of span
Only shear loads
need to be transferred

Span Example 5' x 13' units at 50 psf wind load		
Support Scheme	**Required "I" Value**	**System Depth**
Simple span	18 in^4	7"
Continuous span	8 in^4	5"
Continuous spans are the most structurally-efficient.		

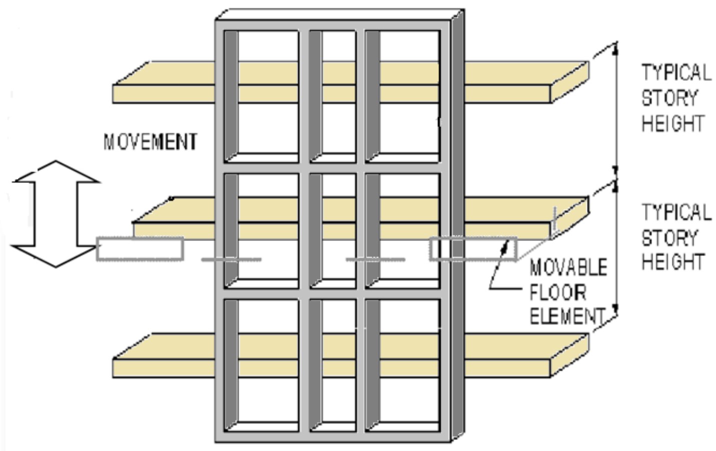
The **ideal splice location** is typically 20% to 22% of span, occurring at the "zero moment" point, where flexural stresses reverse from compression to tension at mullion flanges.

This can be important in locating interior stools, interior finishes, shadow boxes, or spandrel areas. The zero moment point will be the most economical location for the splice.

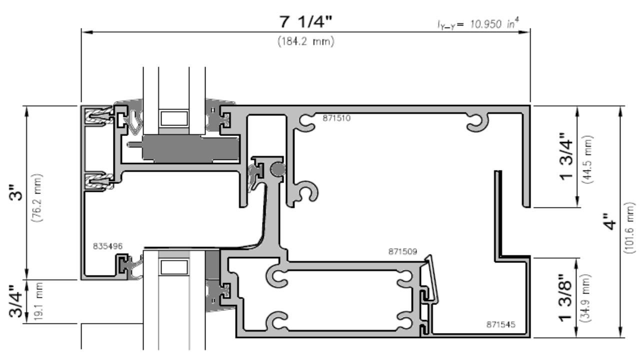
Designers need to be aware of the maximum deflections for both vertical and horizontal frame members. The typical **unit is hung from the top**, therefore drywall and other interior finishes only can be attached in a manner allowing freedom of vertical movement with the floor above, and freedom of horizontal movement with the upper unit mullion.

For tall "free span" atrium walls, be sure to check additive deflections of glass, horizontal members and vertical mullions.

Vertical Movements



Aluminum curtainwall is a dynamic assembly



5 Vision/Vision Horizontal Stack

Live load movements result from all occupants, materials, equipment, construction, or other elements of weight supported in, on, or by structural elements likely to move.

Live load movements can cause upward or downward motion. For example, a downward live load on a floor below can result in disengagement of improperly designed curtainwall anchors on a floor above that remains static, while resulting in a "crushing" action at the floor below.

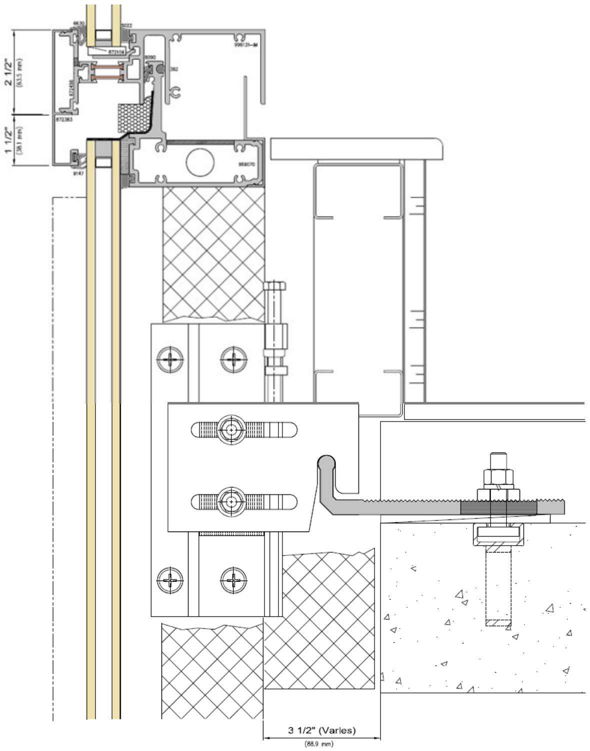
It is most helpful to quantify movements separately in specifications. List live load, column foreshortening, thermal, drift, etc.


Recreation and Wellness Center – University of MN

Section Three

Anchorage

Dead Load Anchors



In some applications, the curtainwall dead load weight is transferred to the base of the wall, through vertical mullions.

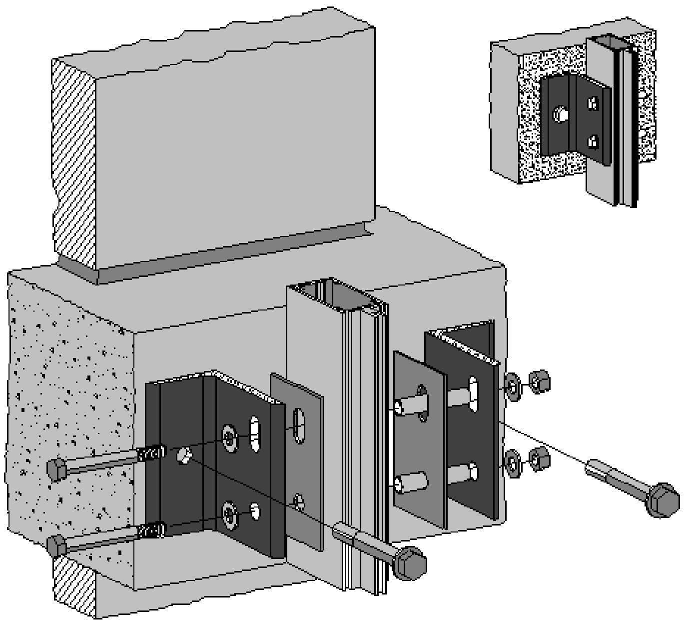
Dead load can also be picked up at intermediate floor slabs.

Curtainwall anchorage must be designed for each individual project's conditions, due to almost unlimited combinations of loads, tolerances, movements, and substrates. However, there are basic anchor types and design principles that are applicable to a wide range of conditions.

Curtainwall anchor systems must carry the **dead load weight** of the curtainwall. This load is transferred from horizontal framing members to vertical mullions, then up or down to anchor points, where it is transferred to the building structure. Dead load acts vertically.

Wind loads primarily act perpendicular to the plane of the wall, both inward (positive) and outward (negative).

Standard Slab Anchors



Three-way adjustment is critical.
Can be bolted or welded in place

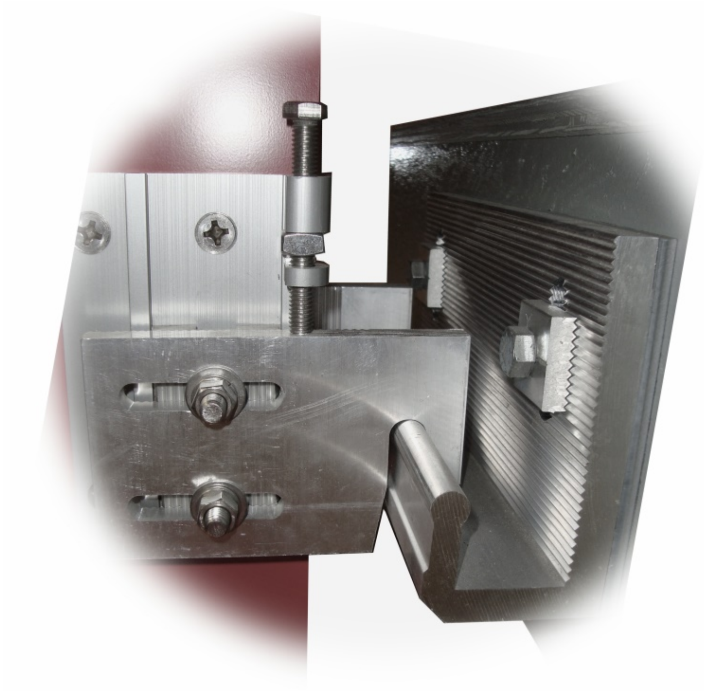
In one standard anchorage method, **“double angle” mullion anchors** straddle both sides of the vertical mullion, and are secured with a through-bolt and pipe spacer.

The pipe spacer allows for vertical and side-to-side building movement of mullions, even when anchor bolts are securely tightened.

The double angles are attached to the face of the slab using insert weld plates, channel-shaped embeds, or expansion bolts drilled into the floor slab.

If embeds are used, it is recommended that the curtainwall manufacturer supply the embed layout drawings, to help avoid excess coordination time and costly errors.

"Jack Bolt" Slab Anchors



Three-way adjustment is critical

Minimize time "on the rig" by allowing manual fine-tuning to level and plumb

One of the most economical ways to anchor curtainwall is through the use of **three-way adjustable anchors.**

These anchors allow for in-and-out, up-and-down, as well as side-to-side adjustment during installation, and feature a "jack bolt" for fine vertical adjustment.

The jack bolt stops the movement of a "saddle plate" attached to the side of the mullion, thus allowing the hoist to unhook and pick another unit, while the curtainwall unit is being dropped into its final position.

This saves field labor by utilizing hoist "travel time" for concurrent fine adjustments.

Jack bolt anchors can pre-set to the top-of-slab or edge-of-slab.

Anchor Design Considerations

Consider substrate strength and normal construction tolerances

Allow for movements

If planning to field-drill into floor slabs or other concrete structural elements, it is necessary to consider where rebar or post-tensioning cables are to be located. This requires close coordination between architectural and structural disciplines.

A building will move during the daily temperature and use cycle. Care must be taken in the design of the wall and its anchorage to accommodate the full range of movements.

The construction process is not one of perfection. If the anchorage cannot accommodate specified building tolerances, time and money is lost.

In design, do not expect perfect visual alignment. For example a ½″ reveal that varies by ½″ can be rather objectionable, but a 1 ½″ reveal that varies by the same ½″ is more visually forgiving.

Advocate Christ Hospital – Oak Lawn, IL

Section Four

Energy Efficiency

Thermal Performance

U-Factor

U-Factor is used by the building mechanical engineer for code compliance, equipment sizing and/or energy performance modeling.

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 curtainwalls

There are three basic thermal performance parameters for wall systems. Expectations for curtainwall performance are listed on each of the following slides.

Thermal Transmittance: A measure of heat flow per unit time, area and temperature difference. U-Factor is expressed in inch-pound units as BTU/hr.sqft.°F.

Don't confuse center-of-glass (COG) U-Values with overall system U-Factors, which include edge-of-glass (EOG) and framing effects.

For most cooling-mode-dominated commercial buildings, U-Factor is a marginally impactful thermal performance parameter.

Prescriptive maximums are given in Model Energy Codes such as ASHRAE 90.1 and IECC.

Solar-Optical Performance
SHGC

SHGC = Solar Heat Gain Coefficient

Prescriptive maximums are given in Model Energy Codes 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, or 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

AAMA 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

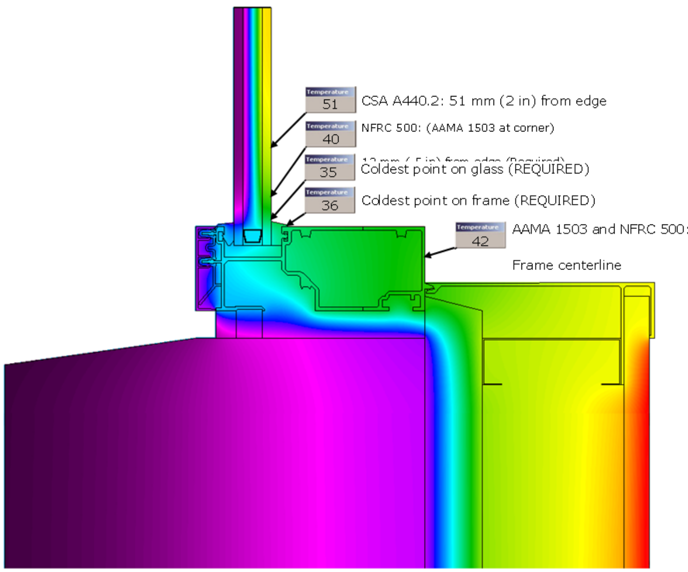
Condensation Resistance Factor (CRF): A dimensionless ratio of surface temperature to ambient temperature difference.

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."

Condensation resistance 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

Finite Element Modeling



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

Guarded hot box testing 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 Projection Factor (PF).

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

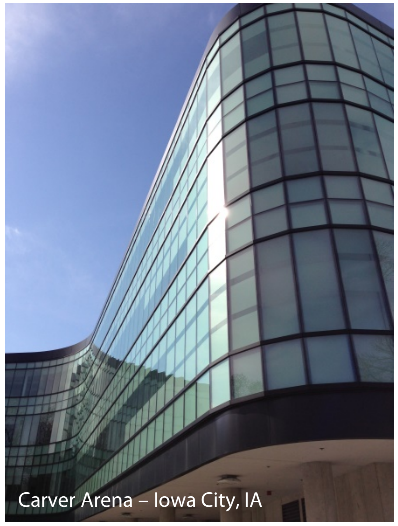
The use of aluminum **sun shades** is a growing trend in architectural design on buildings of all types. Architects are exercising their creativity with sun shades using louvers, blades, catwalk grids, and solid panels to accomplish aesthetic and daylight control goals.

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

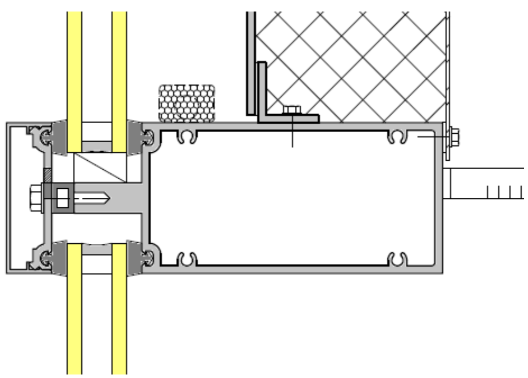
Sun shades present some engineering challenges in wind loading, snow loading, ice accretion and discharge, as well as loads imparted by maintenance operations.

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

Shadow Box Spandrels



Be aware of heat build-up and internal condensation risks, and of "Moire effect" with certain silk-screened patterns



Incorporating shadow boxes can lend spandrel areas a degree of depth and transparency. However, under certain transient weather conditions, internal condensation may form.

Recommendations for venting the shadow box cavity to the exterior vary with different applications and locations. Check all materials and finishes for maximum service temperature.

The shadow box's air cavity must be sealed nearly **air tight relative to interior air in cold climates**, since condensation forms when moist warm air comes into contact with cold surfaces.

In all cases, the use of mineral wool insulation is recommended because it contains no organic materials, and is resistant to the formation of mold and mildew.


Third and Harrison – Seattle, WA

Section Five

Other Performance Parameters

Other Performance Parameters

Acoustics

Use laminated glass to increase acoustical damping, and avoid resonance at high frequency.

Acoustic Transmission Loss (TL) is expressed in decibels (dBs), a logarithmic measure of sound pressure level difference.

In addition to basic air, water, structural, and thermal performance, certain sites and occupancies require other performance characteristics.

When adjacent to highways, rail tracks, airports, or other noise sources, **acoustic** design of curtainwall systems can be vital.

A typical curtainwall glazed with 1" insulating glass exhibits a Sound Transmission Class (STC) of 30 to 34.

Outdoor-Indoor Transmission Class (OITC) is more appropriate for exterior wall products. 1" insulating glass exhibits an OITC of 25 to 26.

If fairly air-tight and providing rigid glass support, frame type and design have little impact on STC or OITC, which are governed by glass type and air space.

Other Performance Parameters

Blast Hazard Mitigation

The most-commonly cited blast protection standard is DoD's Unified Facilities Criteria UFC 4-010-01.

System performance can be analytically determined, or tested in a shock tube or open arena facility.

When curtainwall is exposed to the extreme pressures created by an explosion, all components of the assembly work together. Modern blast-hazard-mitigating designs are intended to be flexible and absorb blast energy.

Threat assessment provides a starting point; charge weight, standoff distance, and level of protection.

Photos show inward-acting peak pressure and outward rebound, in an open arena curtainwall test at 10 psi peak pressure; 91 psi-msec impulse.

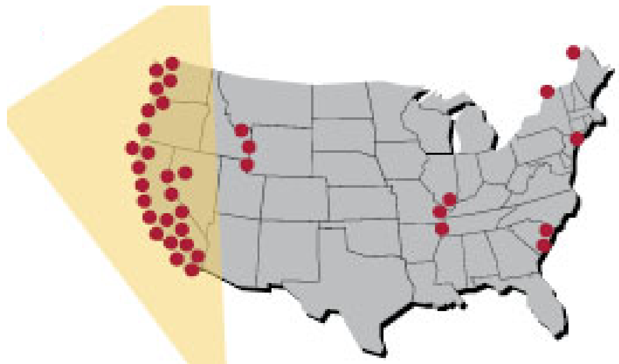
Always contact an experienced manufacturer or blast consultant to discuss design requirements.

Play open arena blast test video.

Play shock tube blast test video.

Other Performance Parameters

Seismic Design



"Story drift" is horizontal displacement that can be induced by wind or seismic events.

Test Methods:
AAMA 501.4
AAMA 501.6

In California, seismic design of hospitals must be approved by the State OSHPD office, well in advance of manufacture and construction.

Seismic drift is expressed as a ratio of floor height (L/200), percentage of floor height (0.5%) or absolute magnitude (0.75 in.)

Adequate glass edge clearance must be maintained. Racking, tipping, and sliding all occur to varying degrees.

Elastic movement is usually 1% or less in a relatively frequent seismic event, after which curtainwall must remain weather-tight – This is an owner's serviceability concern; and is not code-mandated.

Inelastic movement is usually 2% or more in a major seismic event. Glass must remain in place, and no components may fall off, as code-mandated for safety.

Other Performance Parameters

Seismic Design (continued)

Early coordination between all exterior wall components and subcontractors is key to effective seismic movement accommodation.

The most important seismic design criterion:

Make sure curtainwall and surrounding materials move at the same locations, or if not, that differential movements are considered in the design of the wall.

Also, remember that significant inertial forces can be imparted by seismic movements.


Menlo Gateway Phase I – Menlo Park, CA

Section Six

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, the voluntary, consensus-based U.S. Green Building Council LEED® (Leadership in Energy and Environmental Design) Rating System™ has emerged as the leading sustainable building "scorecard."

The LEED® Scorecard

1001 17th Street – Denver, CO

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" curtainwall 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 curtainwall 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 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.

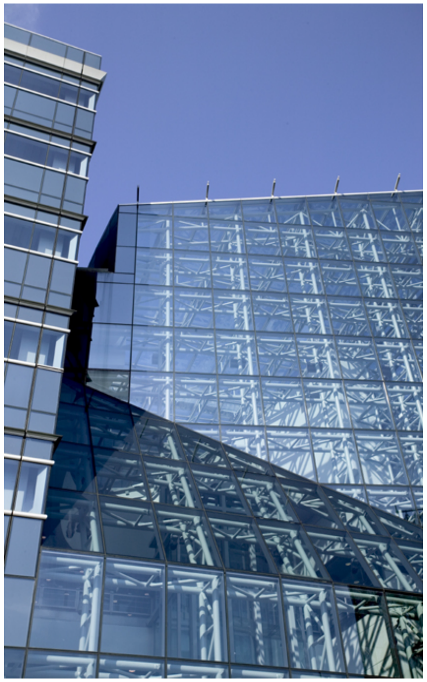
All primers, structural glazing adhesives, and metal-to-metal sealants recommended for use on-site must meet VOC limits.

Anschutz Hospital – Denver, CO

Section Seven

Summary

A Final Word…



Balanced Design

Curtainwall selection and design should be based on all applicable criteria, not on any specific single-number rating system.

Product 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
Ease of installation
Cost
Aesthetics

…and on some projects, also:

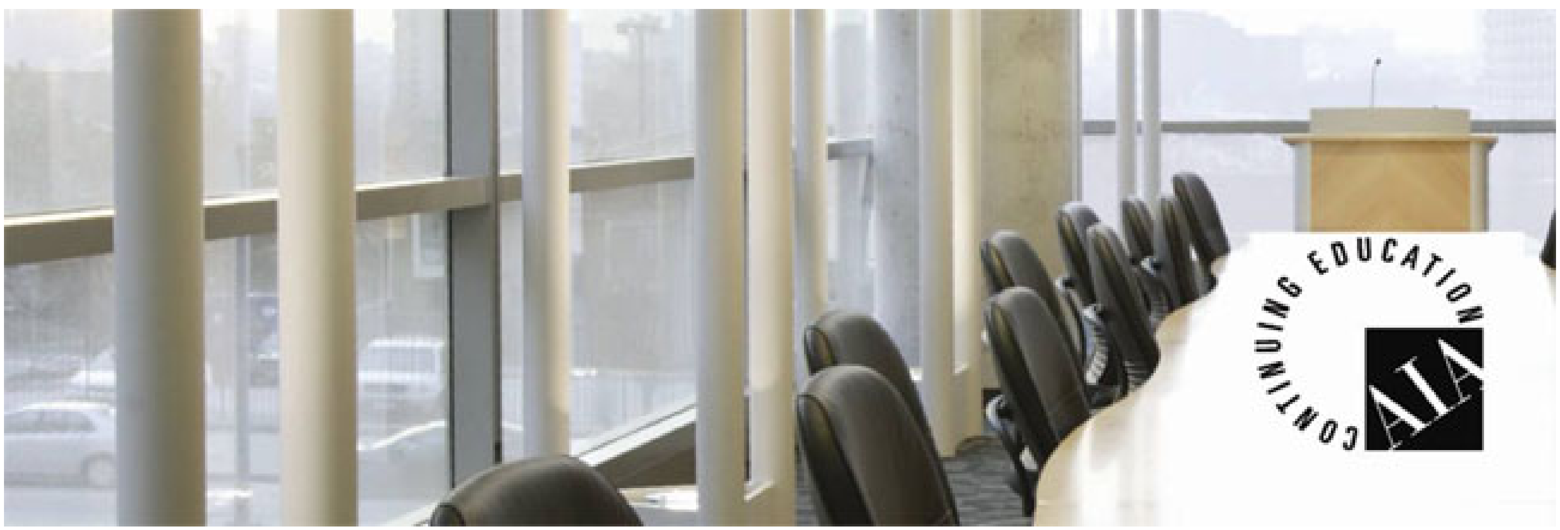
Emergency Egress
Hurricane Impact
Blast Hazard Mitigation
Noise Control
Seismic Movements
Smoke Evacuation

Consider <u>all</u> that apply to your project.

CURTAINWALL
Products, Performance and Practicality

Learning Objectives

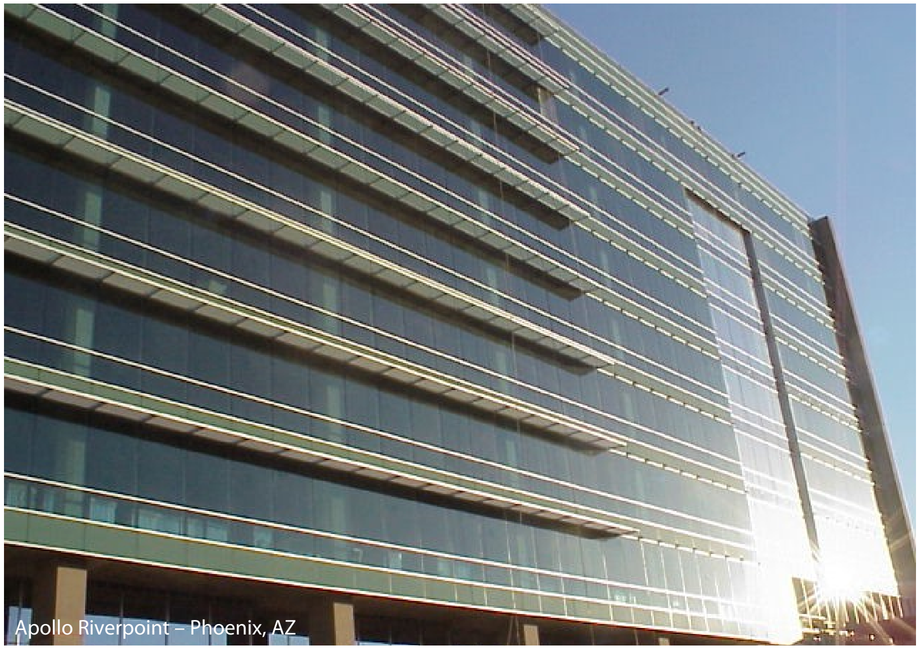
1. Recognize and differentiate different **types** of aluminum curtainwall.
2. Understand design parameters for curtainwall **anchorage** to the building, to ensure ease of installation, movement accommodation, and structural integrity.
3. Optimize **energy** efficiency and thermal performance of curtainwall.
4. Mitigate **blast** hazards through curtainwall design.
5. Design for **seismic** movements and induced inertial loads.
6. Understand **LEED®** impacts of curtainwall selection and design.



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.


Apollo Riverpoint – Phoenix, AZ

WAUSAU

WINDOW AND WALL SYSTEMS

Click here to take Test