Waikiki Landmark – Honolulu, HI

WAUSAU

WINDOW AND WALL SYSTEMS

BALCONY DOOR SYSTEMS

An AIA CES Program

WAUSAU

WINDOW AND WALL SYSTEMS

BALCONY DOOR SYSTEMS

(A Wausau AIA-CES Presentation)

FGIA
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: This Wausau AIA/CES presentation presents the characteristics of each balcony door option; storefront doors, architectural terrace doors, folding doors, and sliding glass doors, along with their respective functionality and inherent performance limitations.
Objective: Review the application of various door types for access to patios, terraces and lanais, along with commonly-used hardware and functionality, to help ensure weather-ability, accessibility, energy efficiency and structural integrity. Design for ease of installation
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)

WAUSAU
WINDOW AND WALL SYSTEMS

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.

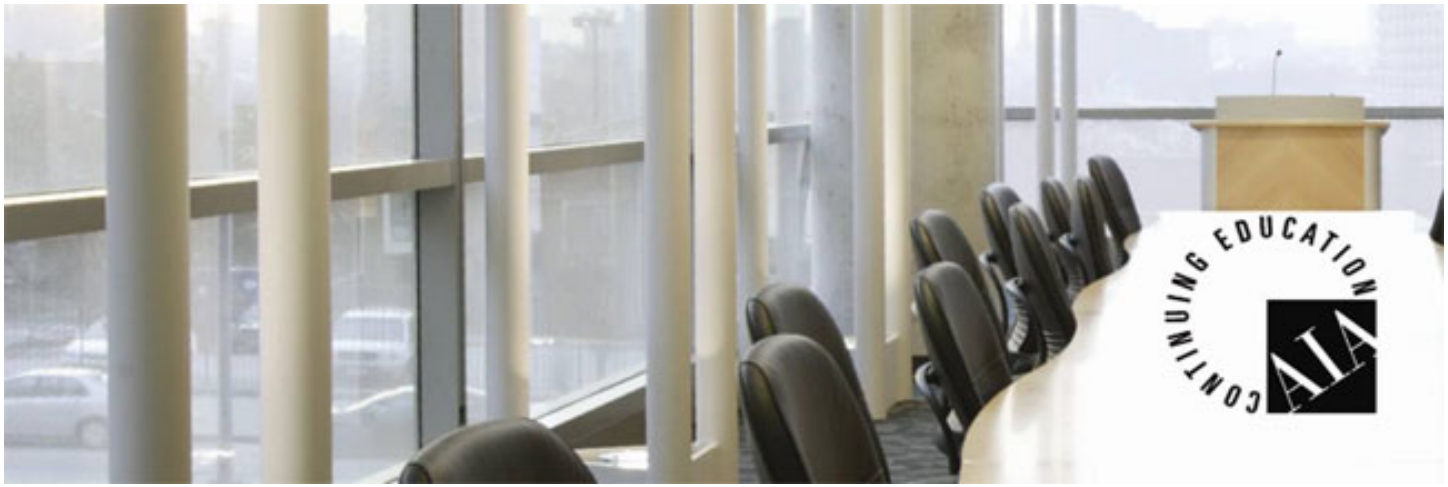
This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any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

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

BALCONY DOOR SYSTEMS

Learning Objectives

1. Review the application of doors for access to balconies, patios, terraces and lanais
1. Understand door types, commonly-used hardware and functionality
2. Help ensure weather-ability, energy efficiency and structural integrity
3. Address accessibility needs
4. Understand LEED™ impacts
5. Design for ease of installation



Residences at CityCenter – Washington DC

Section One

Applications, Substrates and Structure

APPLICATIONS

This presentation covers doors used for access to patios, roof terraces, balconies, and lanais, on upper floors of high-rise residential, commercial and mixed-use buildings.

Balcony doors covered in this presentation are intended for occupant versus staff operation, suitable for use in high-rise applications, and installed with or without protection by overhangs.

This presentation does not cover expansive ground floor “open-able” walls as used in restaurants, retail and mall spaces, and luxury single-family residences, with deep overhangs, flush sills and trench drains.

This presentation also does not cover side-hinged entry doors as used in single-family residences.

SUBSTRATES and STRUCTURE

Identify anchor zones on structural drawings

Allow adequate cure time before loading slabs

Post-tensioned concrete poses unique anchorage challenges

Talk to the building's structural Engineer of Record early

Critical design considerations include deflection, adjustability and settlement:

Deflection of structure can occur at floors above and/or below, so floor "sag" can be additive between floors

Deflection can bind operation or cause door panel disengagement

Adjustability is key – Live load deflection and settlement can "spread" astragals or meeting rails, and spread rails can whistle and leak

Diurnal and seasonal changes are commonplace – Balcony slabs move with temperature changes

Thermal barrier patio slabs are sometimes used in cold climates

Curbs are always advisable; often in conjunction with handicap decking

Park Hyatt - Chicago, IL

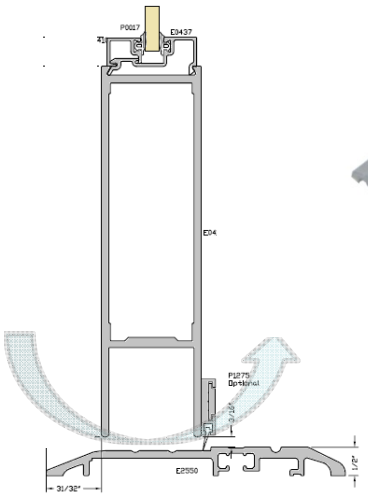
Section Two

Balcony Door Types

BALCONY DOOR TYPES

ALUMINUM ENTRANCES

Use aluminum entrances only for access to low-rise balconies and terraces.



Storefront doors meet most designers' size expectations and are durable and adjustable, accepting a broad range of hardware.

However, performance of aluminum entrances is suitable only for vestibule applications, and they are properly used only where protected from the elements

Door closers are always a good idea in case of unexpected wind gusts on doors left unlocked or even unlatched in severe weather events.

The problem is air and water resistance:

There is no requirement for entrance water testing under wind pressure – Flat thresholds are required.

Air infiltration is 8 x sliding doors and 25 x projected windows

Storefront framing water test pressure (WTP) is only10% of inward acting design load.

BALCONY DOOR TYPES

ARCHITECTURAL TERRACE DOORS (ATDs)

Ask for ATDs that are side-stacking with window wall systems, for matching runs of framing and accessories, single source responsibility, one warranty, one finisher, one set of shop drawings and calculations

Terrace doors are side-hinged, and designed for high-rise air, water and structural performance - Single leaf and French astragal options available

AAMA AW Performance Class

ATDs are tightly compression sealed, but may be subject to limited size

A limited breadth of hardware is available - multi-point locks are necessary for weather-tightness

Door closers are always a good idea in case of unexpected wind gusts on doors left unlocked or even unlatched in severe weather events.

A typical French ATD hardware package includes, a designer handle, butt hinges, door latch, Euro-track locks, thumb-turn, and flush bolt

Plumb, square and level are critical - balcony settlement can occur

BALCONY DOOR TYPES

ARCHITECTURAL TERRACE DOORS (ATDs)

Life Cycle Testing Comparison
(AAMA SFM-1, AAMA 920 and AAMA 910)

Storefront doors
500,000 hinge cycles

Residential doors (SHDs)
25,000 hinge cycles

Architectural terrace doors
25,000 hinge cycles, and
maintain air/water after 4,000 cycles

Minimum ATD gateway
test size is 48 " x 96"

Air infiltration less than 0.10 cfm per sqft at 6.2 psf test pressure (50 mph)
Minimum water resistance test pressure (WTP) 8 psf
Minimum design pressure 40 psf
Minimum structural overload 60 psf

Accessible "Fair Housing Act" threshold height affects water performance and ease of installation

Five-pound ADA closers are available to control opening and closing force, but force-to-latch expectations differ by jurisdiction and application

BALCONY DOOR TYPES

FOLDING DOORS

www.nanawall.com

Panels can be hung from the head rail, or ride in the sill track

Inswing, outswing; center or sliding pivot - Flush, saddle or weathering sill tracks

Interior or exterior use

Retail	Automotive
Residential/Hotel	Health care
Mall fronts	Restaurants

Technical information courtesy of Nana Wall Systems, Inc., Corte Madera, California

Maximum panel width:
3′-3″ to 4′-0″

Maximum height:
10′-0″ to 12′-0″

Folding doors have been added to NAFS-2017 as a unique product type

High-performance sills are available to 12 psf WTP, depending on door height

Saddle sills may require supplemental drainage

BALCONY DOOR TYPES

SLIDING GLASS DOORS (SGDs)

Play video

Sliding glass doors
move in the plane of the wall, and
are designed for high-rise air,
water and structural performance

Inside-track for Juliet balconies
Outside-track for low profile sills

Like all “sliding seal” fenestration product types, SGDs exhibit an inherent trade-off between air-tightness and operating force

AAMA maximum operating forces are 40 lbs. to initiate door motion, and 25 lbs. to maintain door motion

SGDs are available as conventional or Euro-style “lift and slide” operation

Lower unlatching force
on conventional SGDs

Lower operating force on
lift and slide SGDs

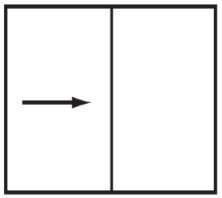
More threshold adjustment on conventional SGDs to accommodate balcony settlement

Performance, size expectations, and hardware capabilities are manufacturer-specific

BALCONY DOOR TYPES

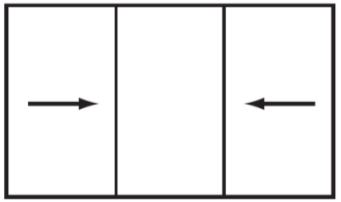
SLIDING GLASS DOORS

Two-track configurations



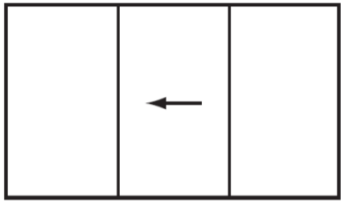
1

Half-slide



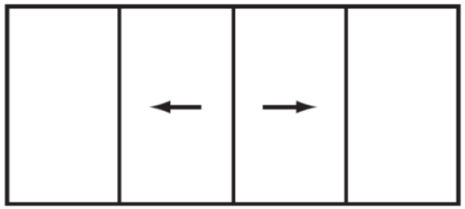
2

End-slide



3

Center-slide



4

Center-open

Configuration nomenclature:
X= operable panel, O = fixed panel

XO, XOX, OXO, OXXO are available; XX is not a good idea due to higher cost, air infiltration, maintenance, and head frame span; Marginal weather-ability and safety

Two-track versus multi-track:

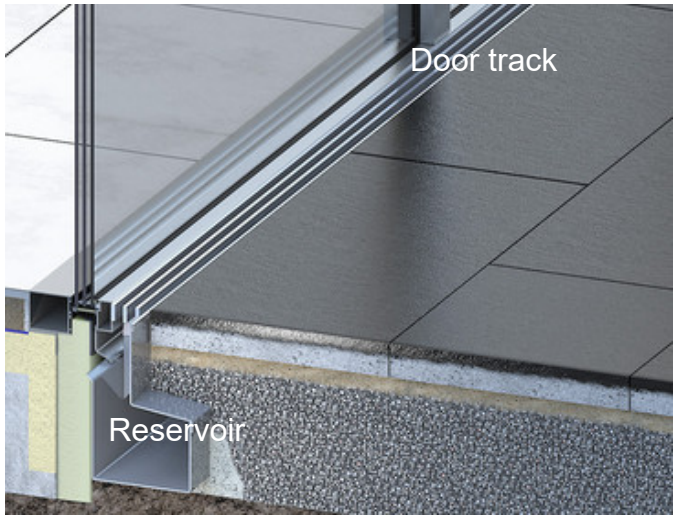
Two-track SGDs provide 50% open area or less (including the XX configuration)

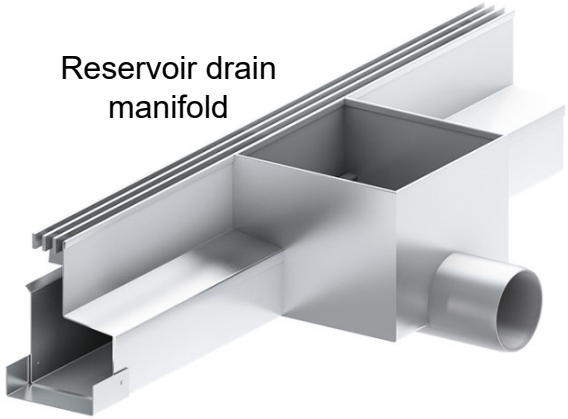
Multi-tracks can provide more than 50% open area, but are limited to smaller panel width

Ask for SGDs that are side-stacking with window wall systems, for matching runs of framing and accessories, single source responsibility, one warranty, one finisher, one set of shop drawings and calculations

BALCONY DOOR TYPES

SLIDING GLASS DOORS

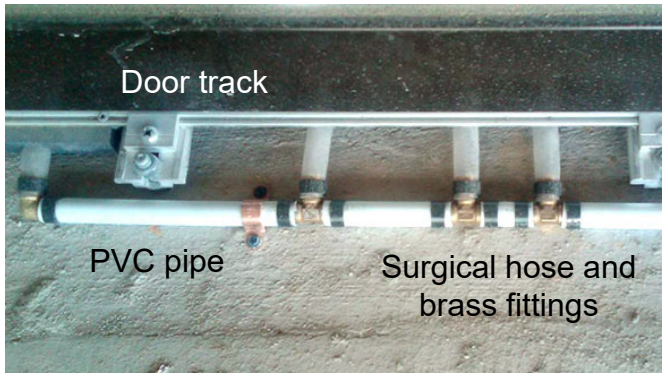




"Read the fine print:"

Not all doors are self-contained; some may require reservoir tanks, "plumbing," overhangs, curbs, trenches, or other added building design features

Drainage provisions may interfere with balcony construction or sequence, and require finish floor removal to clean



BALCONY DOOR TYPES

SLIDING GLASS DOORS

Life cycle testing
(AAMA 906 and AAMA 910)

10,000 roller cycles
Maintain weather-tightness after
4,000 cycles

AAMA AW Performance Class Sliding Glass Doors are designed and tested for high-rise applications

Minimum NAFS gateway
test size is 60" x 95" (see Section 3)

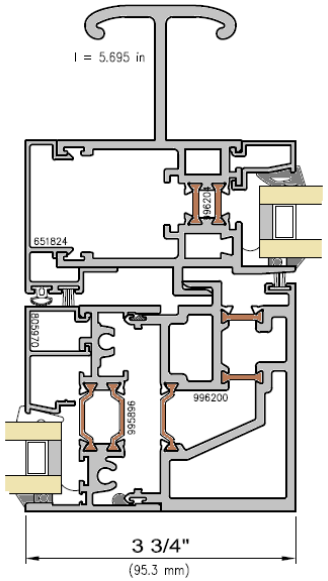
Air infiltration less than 0.30 cfm per sqft at 6.2 psf test pressure (50 mph)
Minimum water penetration resistance test pressure (WTP) 8 psf
Minimum design pressure 40 psf
Minimum structural overload 60 psf

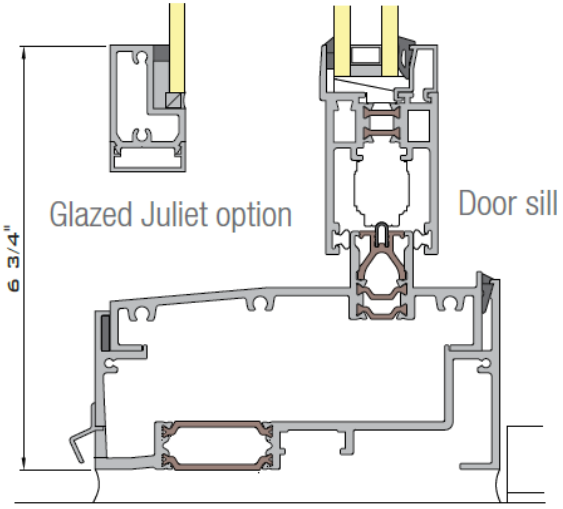
Accessible "Fair Housing Act" threshold height affects water performance and ease of installation

BALCONY DOOR TYPES

SLIDING GLASS DOORS

Juliet railing attaches here





Juliet balcony railings require a Factor of Safety of 4: 1 during testing to IBC requirements – This is especially important when doors are oversize in width

BALCONY DOOR TYPES

SLIDING GLASS DOORS

Oversize SGDs

"Bigger is better"
Expansive views, even when closed
Lower U-Factor and air infiltration

New BIG Glass™ capabilities
have come on line in the US

Exercise caution in application of oversize sliding glass doors, now available in panel sizes as large as 8' x 10'

Check glass vibration, glass deflection, and oil-canning on tempered safety glass – Increase glass thickness as necessary to achieve 1" maximum center-of-glass deflection at ASD design wind pressure

Check weight, hardware limits and operating force when the necessary glass package is determined

When comparing maximum sizes, keep in mind that ground-floor performance expectations and design wind pressures are much lower than high-rise expectations

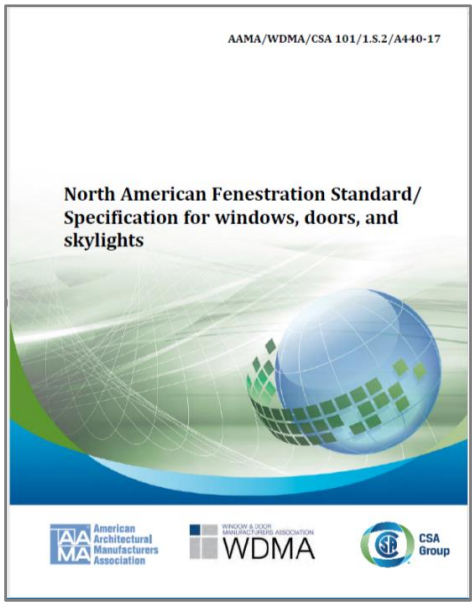

Sheraton Waikiki – Honolulu, HI

Section Three

Balcony Door Performance

AIR, WATER AND STRUCTURAL

PERFORMANCE



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

There are four NAFS Performance Classes: R, LC, CW, and AW

AW Class is generally deemed appropriate for high-rise construction; minimum AW 40 - Performance Grade (PG) 40 = Allowable Stress Design (ASD) wind pressure

Certain applications may warrant AW 60, AW 90 or even AW 100

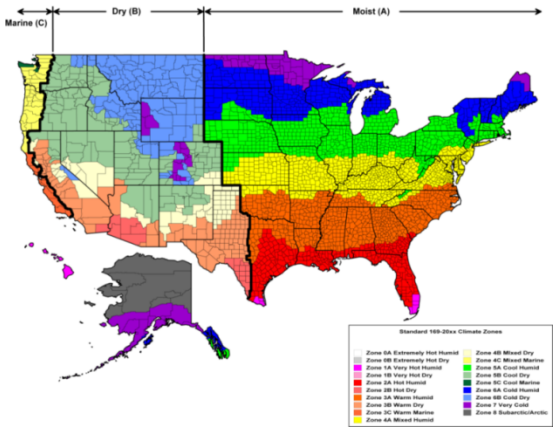
NAFS ratings and deflection calculations are based on ASD wind loads (ASD = 0.6 x Strength Design)

Water Test Pressure (WTP) for AW Class is 20% of the inward-acting ASD design pressure. This can affect AW rating of improved access sills - 8 psf WTP means AW 40 maximum

15 psf WTP cap - No dynamic water testing is required by NAFS, but is often specified

ENERGY EFFICIENCY

AND NFRC RATINGS



IECC and ASHRAE 90.1 Model Energy Codes are based on U-Factor and Solar Heat Gain Coefficient (SHGC)

Code requirements are Climate Zone-specific

U-Factors are headed down nationwide, while Climate Zones are headed north due to global warming

Model energy codes call for aggressive improvements within each three-year code cycle

The compliance path used for permitting is key to proper product selection and specification provisions:

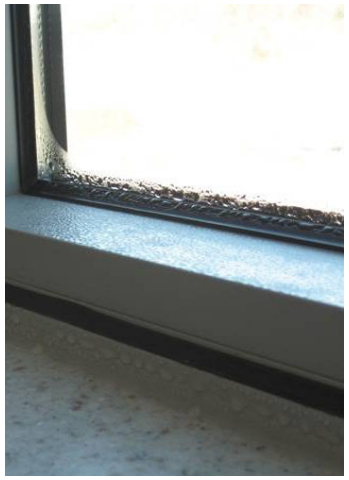
Default Path:
Glazed area limited to 10%

Prescriptive Path:
NFRC label certificates or equivalent

Performance Path:
Component trade-offs, ComCheck® software, or whole-building energy modeling

Air barriers are required in many jurisdictions, and interfaces at fenestration are critical to their effectiveness

CONDENSATION RESISTANCE



There are three rating systems used for product comparison:

AAMA
Condensation Resistance Factor (CRF)
NFRC
Condensation Resistance (CR)
CSA
Temperature Index (I)

Ratings are not comparable, and of limited use in condensation prediction

In critical occupancies, dew point should be determined using the psychometric chart, then expected local surface temperatures estimated through modeling or guarded hot box testing

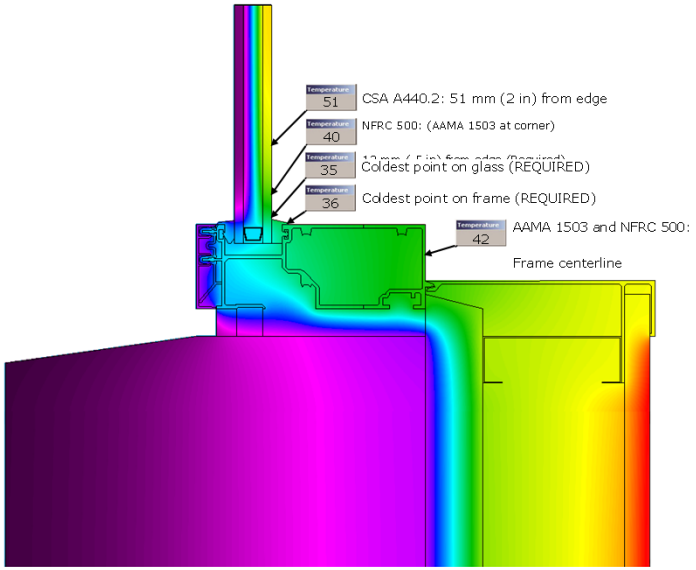
Consider 3D heat transfer and substrate/balcony slab detailing

Coordinate with the building Mechanical Engineer early to understand design conditions, as control of relative humidity may be minimal

Critical occupancies include health care and laboratory spaces, as well as high-rise residential, where only core make-up air is often provided, and occupants may or may not operate exhaust fans regularly

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.

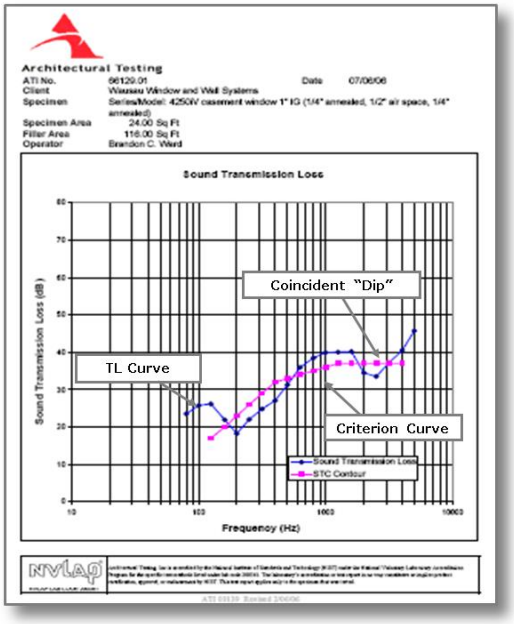
Finite element thermal modeling software is used to predict U-Factor and SHGC of fenestration systems of all types.

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.

ACOUSTIC PERFORMANCE



Sound pressure level is expressed logarithmically in decibels (dB)

Frequency-specific transmission loss (TL) results are used to calculate STC or OITC

OITC is preferred for exterior noise sources, as 85% of acoustic energy through glass is transmitted below a frequency of 200 Hz

Noise attenuation is dependent on mass, air space, and damping

Framing effects are minimal if glass is rigidly-supported and glazing/frame are air-tight

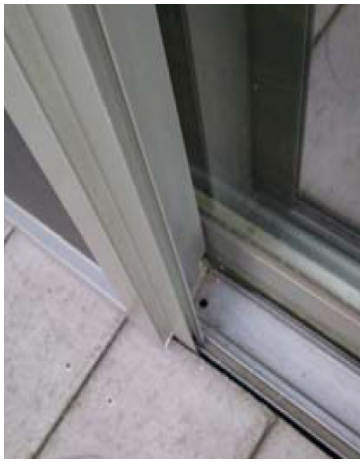
Small lites perform better than large lites

Test-to-test variation is considerable; ±2 dBA or more

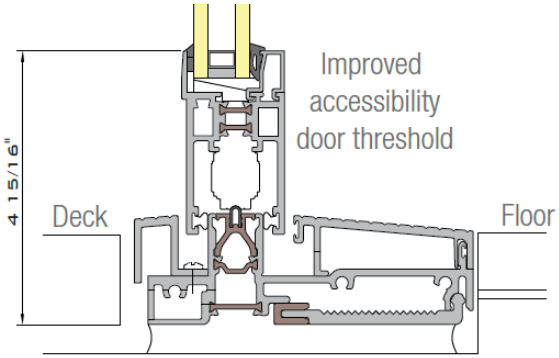
Human hearing can detect a difference of about +/-3 dBA

NYC "E-designated" site requirements are OITC-based, while California Quality of Indoor Life initiatives are STC–based

ACCESSIBILITY



Permeable decking can allow the use of weather-able sills and a curb under an accessible threshold

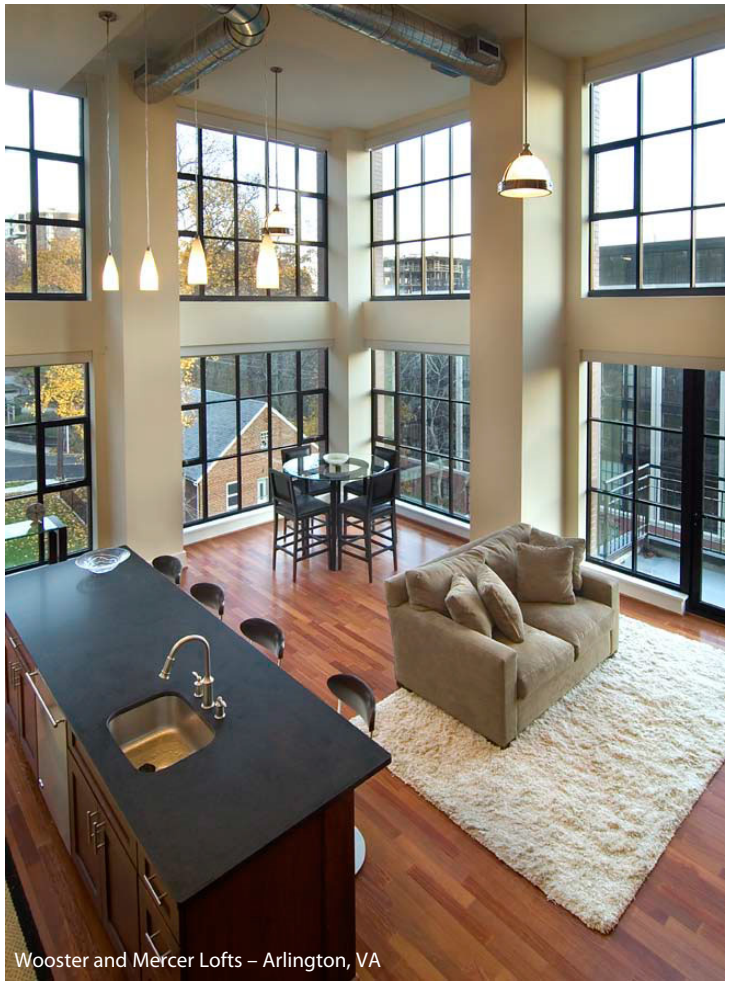


To help ensure that fresh air and a connection with the outdoors are made accessible to people with physical disabilities...

ANSI A117.1 is applicable to balcony doors in Accessible and Type A units, as well as Type B units in NYC only. Requirements for Type B units elsewhere are consistent with HUD's Fair Housing Act (FHA), for threshold height, width and wheelchair turning radius only.

Beveled threshold height is limited to 0.50" except sliding glass door tracks, which can be 0.75" in height

Don't neglect approach area, kick plates, handle height limits and other ADA requirements. Due to security concerns, five-pound force-to-latch is generally not a requirement for exterior doors.



Wooster and Mercer Lofts – Arlington, VA

Section Four

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."

The LEED® Scorecard


Toledo Hawkins School

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

Many of the total credits available are affected directly by window, door 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, curtainwall and/or balcony doors 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

Balcony doors 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.

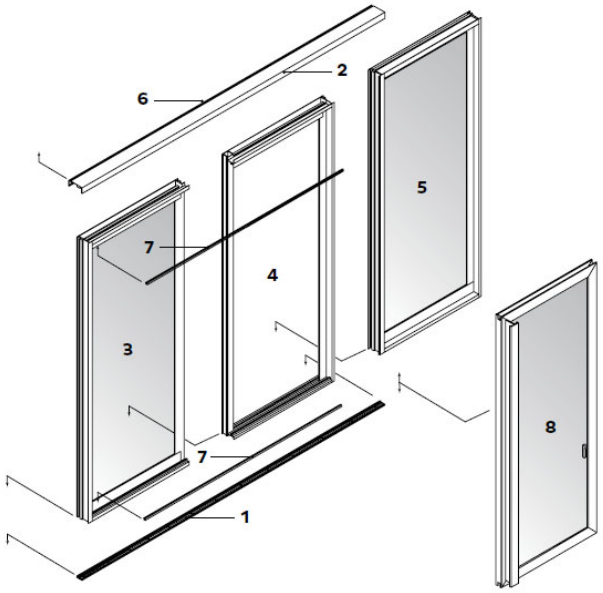
Credits for low-emitting materials, including paints and coatings, specifically exempts factory baked-on finishes used on curtainwall framing. Eco-friendly anodizing, powder painting and VOC-capture incineration spray painting are all environmentally-responsible processes.

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

Section Five

EASE of INSTALLATION

EASE of INSTALLATION



Factory-glazed panels
and Juliets can speed installation, and ensure that units remain square

Window wall units are side-stacking for ease of installation, storefront and stick walls are not

This AIA CES program begins and ends with balcony movement…

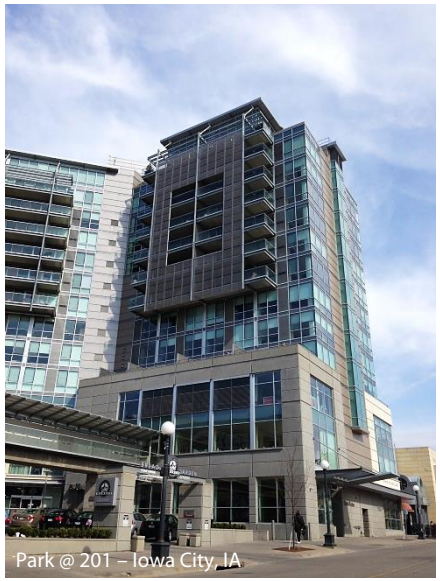
Plan for proper anchorage, and quantify sag, movement and tolerances

Ensure units are plumb, square and level - initially, and after seasonal cycles and live load movement. Verify the adjustment capability of the hardware selected.

Curtainwall integration is more challenging due to differential movement issues at balconies - Wall units are hung from the floor above rather than resting on the floor below like balcony units.

Address these issues in proposal details from the manufacturer or installer

EASE of INSTALLATION


Park @ 201 – Iowa City, IA

Ask for balcony doors that are side-stacking with window wall systems, for matching runs of framing and accessories, single source responsibility, one warranty, one finisher, one set of shop drawings and calculations

Review:

Critical design considerations include deflection, adjustability and settlement:

Deflection of structure can occur at floors above and/or below. Deflection can bind operation or cause door panel disengagement

Adjustability is key – Building movements can “spread” astragals or meeting rails, that may whistle and leak

Thermal barrier patio slabs are sometimes used in cold climates

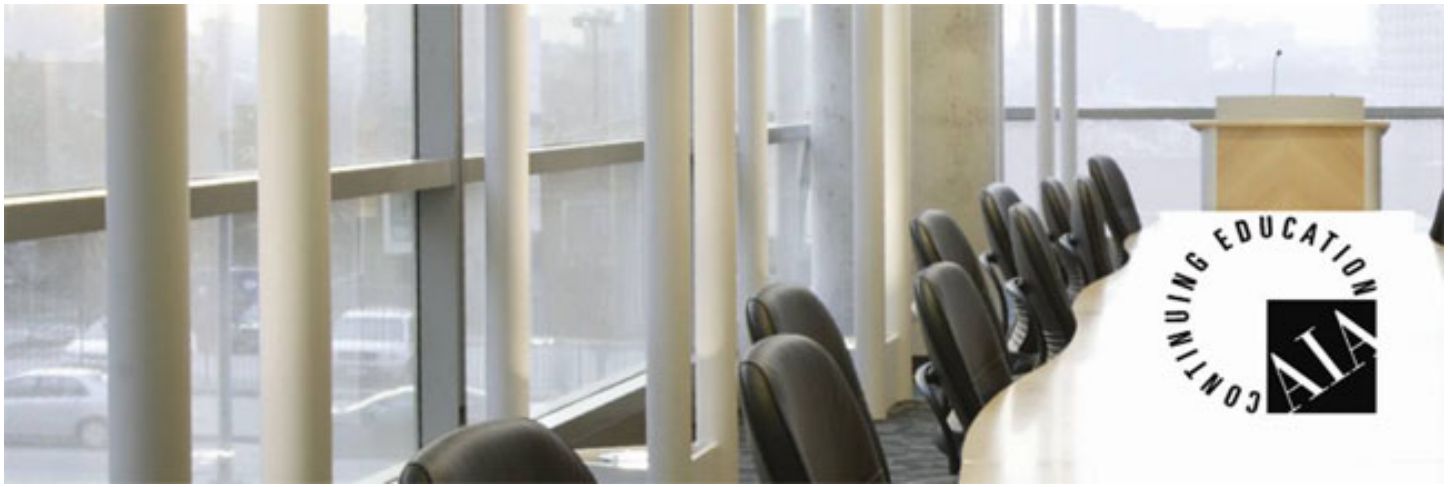
Curbs are always advisable; often in conjunction with handicap decking

Door closers are always a good idea on side-hinged entrances or architectural terrace doors.

BALCONY DOOR SYSTEMS

Learning Objectives Recap

1. Review the application of doors for access to balconies, patios, terraces and lanais
1. Understand door types, commonly-used hardware and functionality
2. Help ensure weather-ability, energy efficiency and structural integrity
3. Address accessibility needs
4. Understand LEED™ impacts
5. Design for ease of installation



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.

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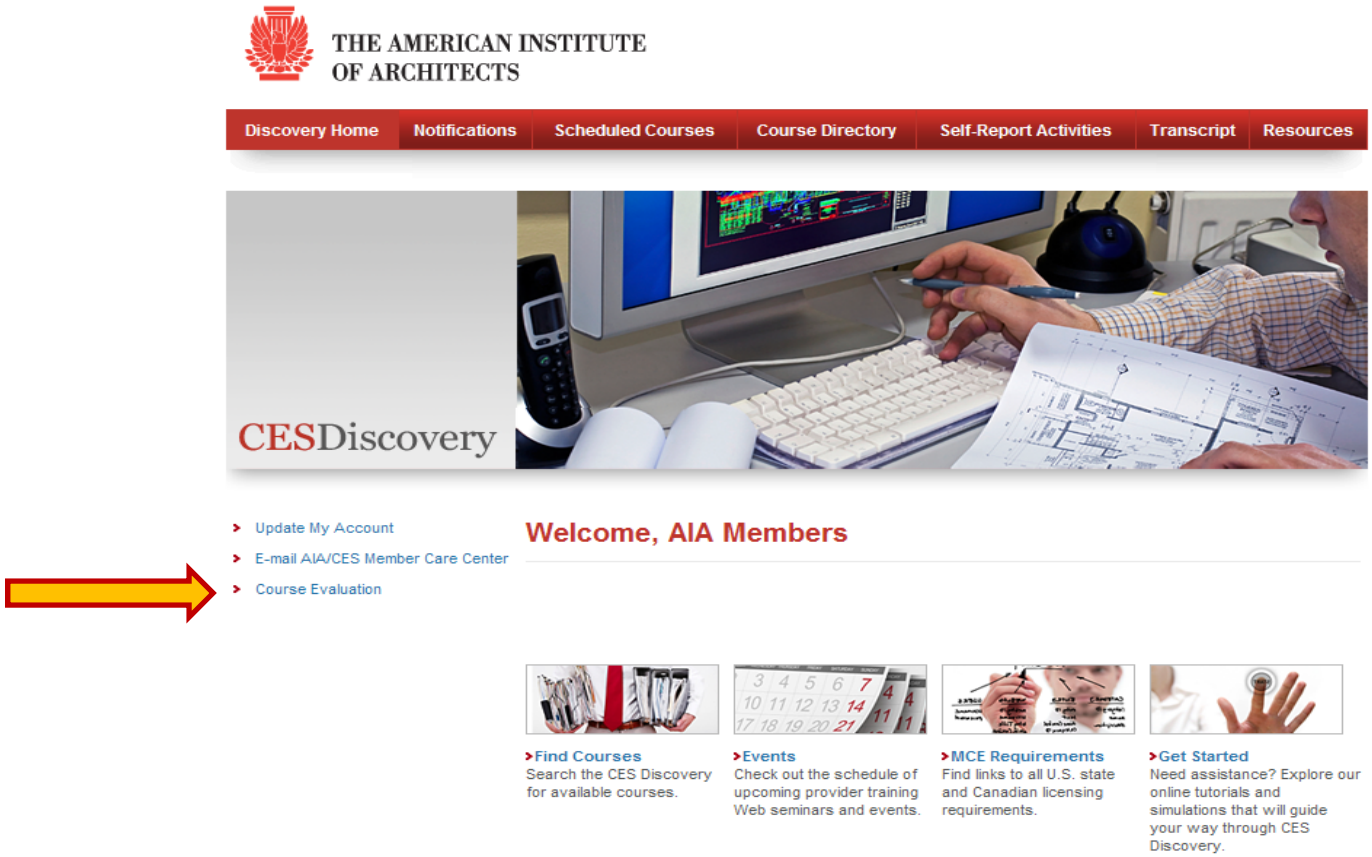
COURSE EVALUATION

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.



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