From Data to Install:
A Guide for Your Window Journey

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October 22, 2024

Part 1 – Flanged Windows

- *What it is; best practices*

Part 2 – Non-Flanged Window Systems

- *What they are; best practices*

Part 3 – Window System Design

- *Daylighting*
- *Geometry, detailing, proportions*

Part 4 – Glass and Glazing

- *Key metrics, characteristics*

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- *Geometry, detailing, proportions*

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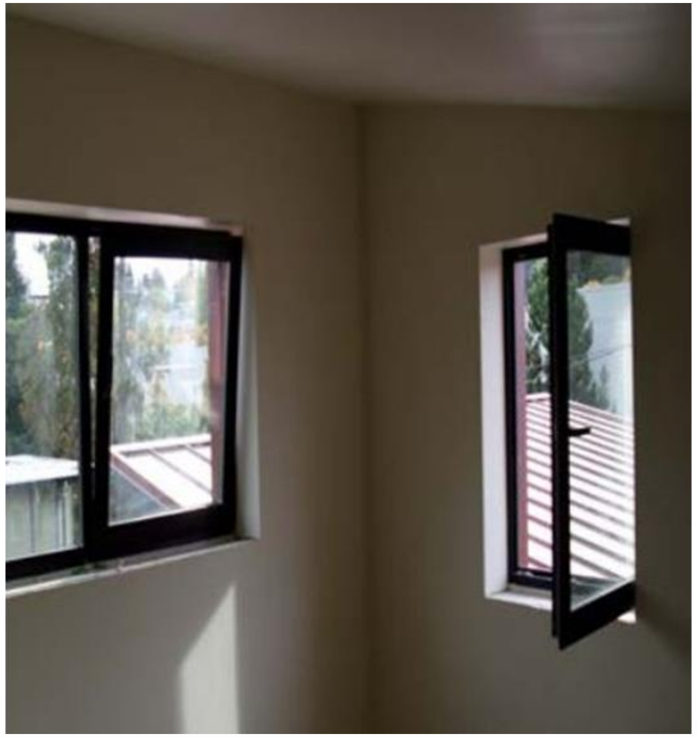
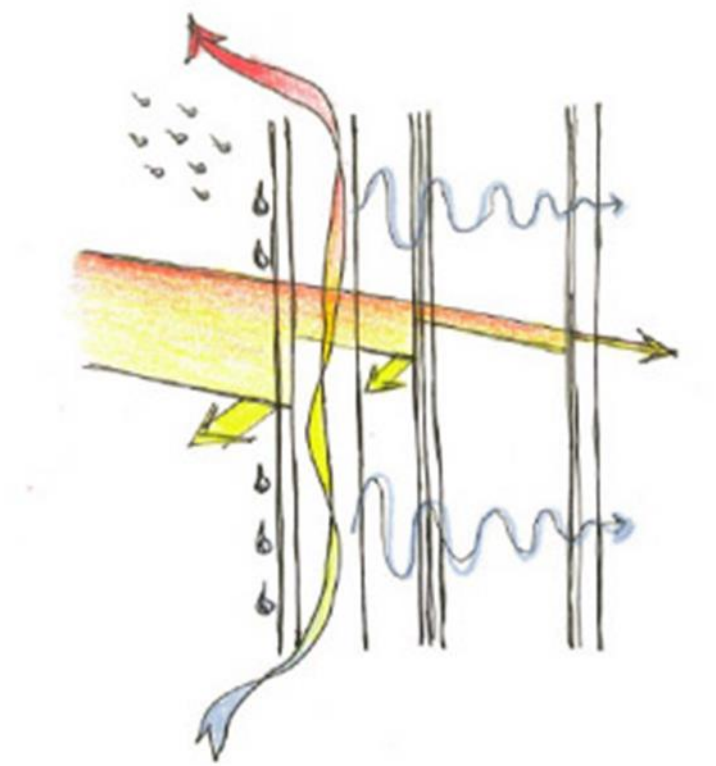


Tilt and Turn (good)

Double-Hung (bad)

T AUSTIN
TECTURE

https://www.youtube.com/watch?v=_047-1_fLL0



Water Penetration and Air Leakage Testing of Flanged Window Details

T. Brown, J. Posenecker, K. Simon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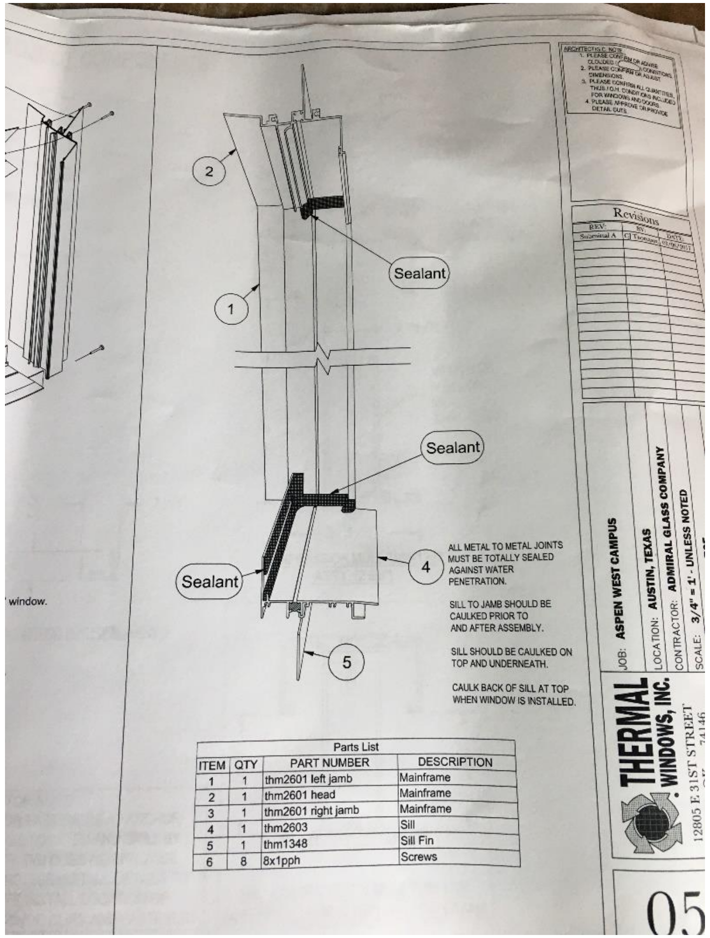
WARRANTY



ALL METAL TO METAL JOINTS MUST BE TOTALLY SEALED AGAINST WATER PENETRATION.

SILL TO JAMB SHOULD BE CAULKED PRIOR TO AND AFTER ASSEMBLY.

SILL SHOULD BE CAULKED ON TOP AND UNDERNEATH.

CAULK BACK OF SILL AT TOP WHEN WINDOW IS INSTALLED.

Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	thm2601 left jamb	Mainframe
2	1	thm2601 head	Mainframe
3	1	thm2601 right jamb	Mainframe
4	1	thm2603	Sill
5	1	thm1348	Sill Fin
6	8	8x1pph	Screws

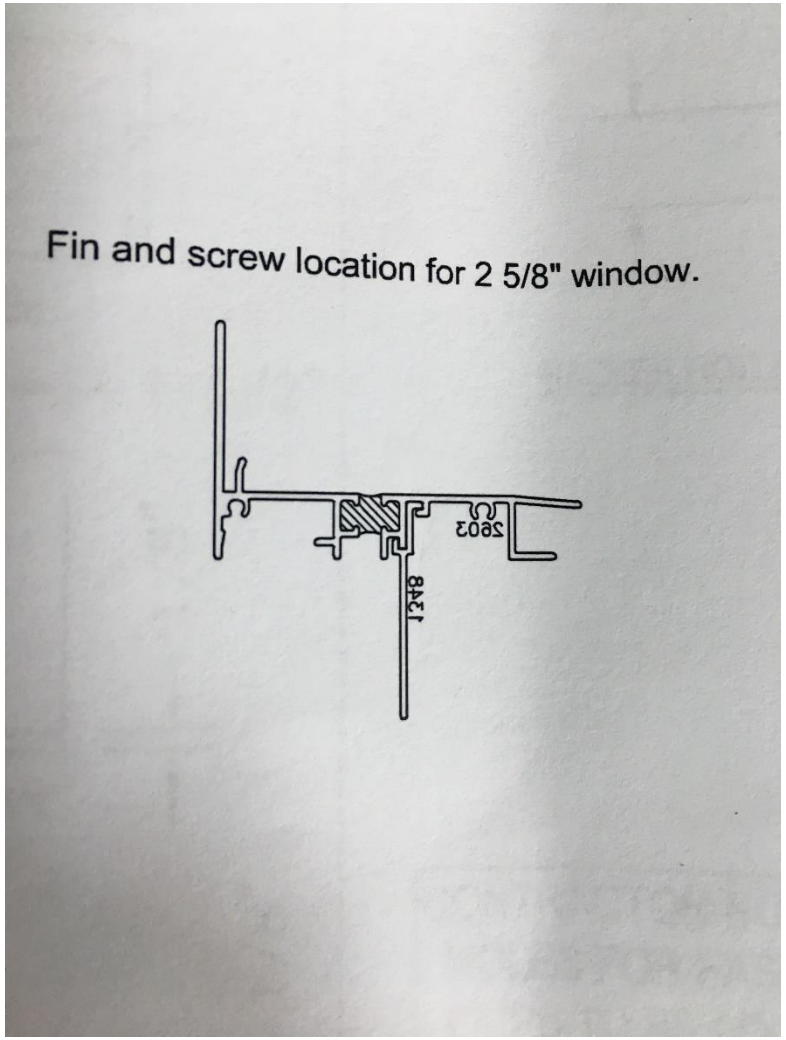
Revisions

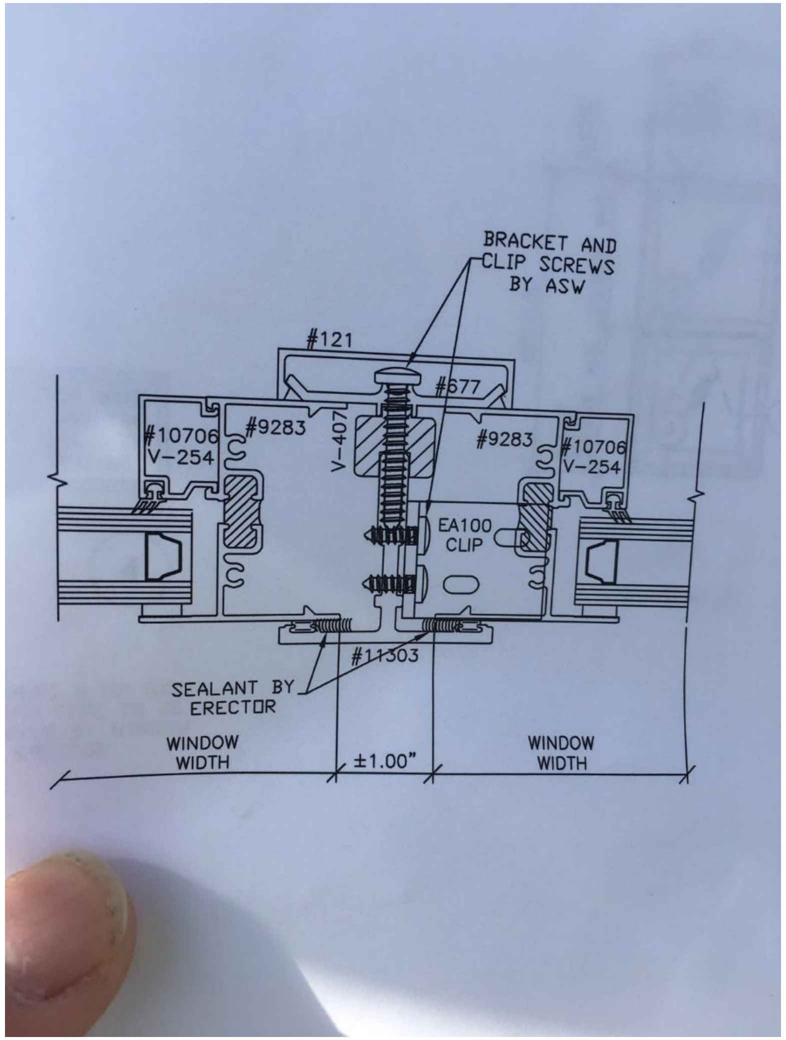
REV:	BY:	DATE:
Submittal A	CJ Thomason	03/06/2017

JOB: ASPEN WEST CAMPUS
LOCATION: AUSTIN, TEXAS
CONTRACTOR: ADMIRAL GLASS COMPANY
SCALE: 3/4" = 1' - UNLESS NOTED

THERMAL WINDOWS, INC.
12805 E 31ST STREET
74146

05


Fin and screw location for 2 5/8" window.



T. Brown J. Posenecker K. Simon Austin AIA Summer Conference August 24, 2018

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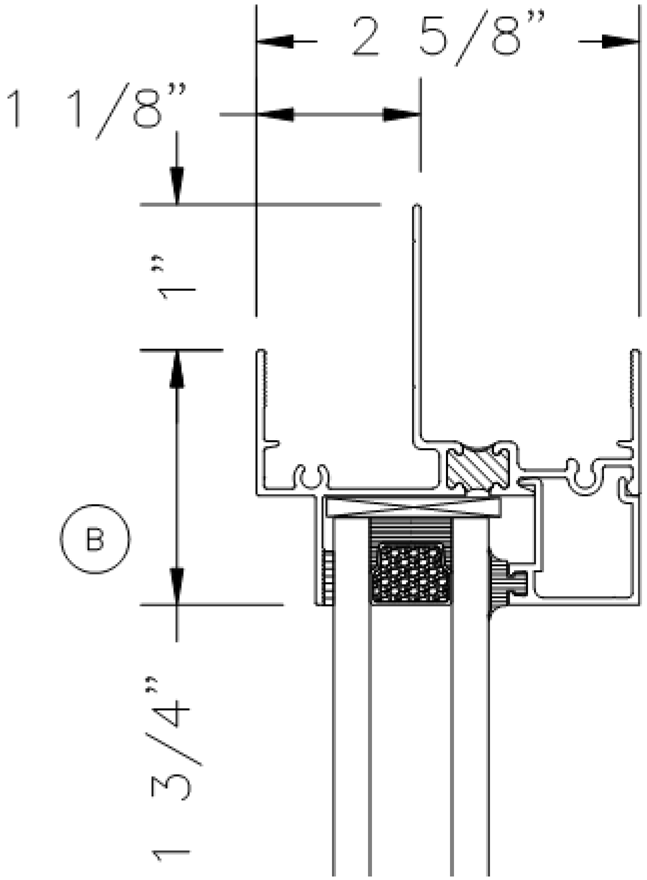
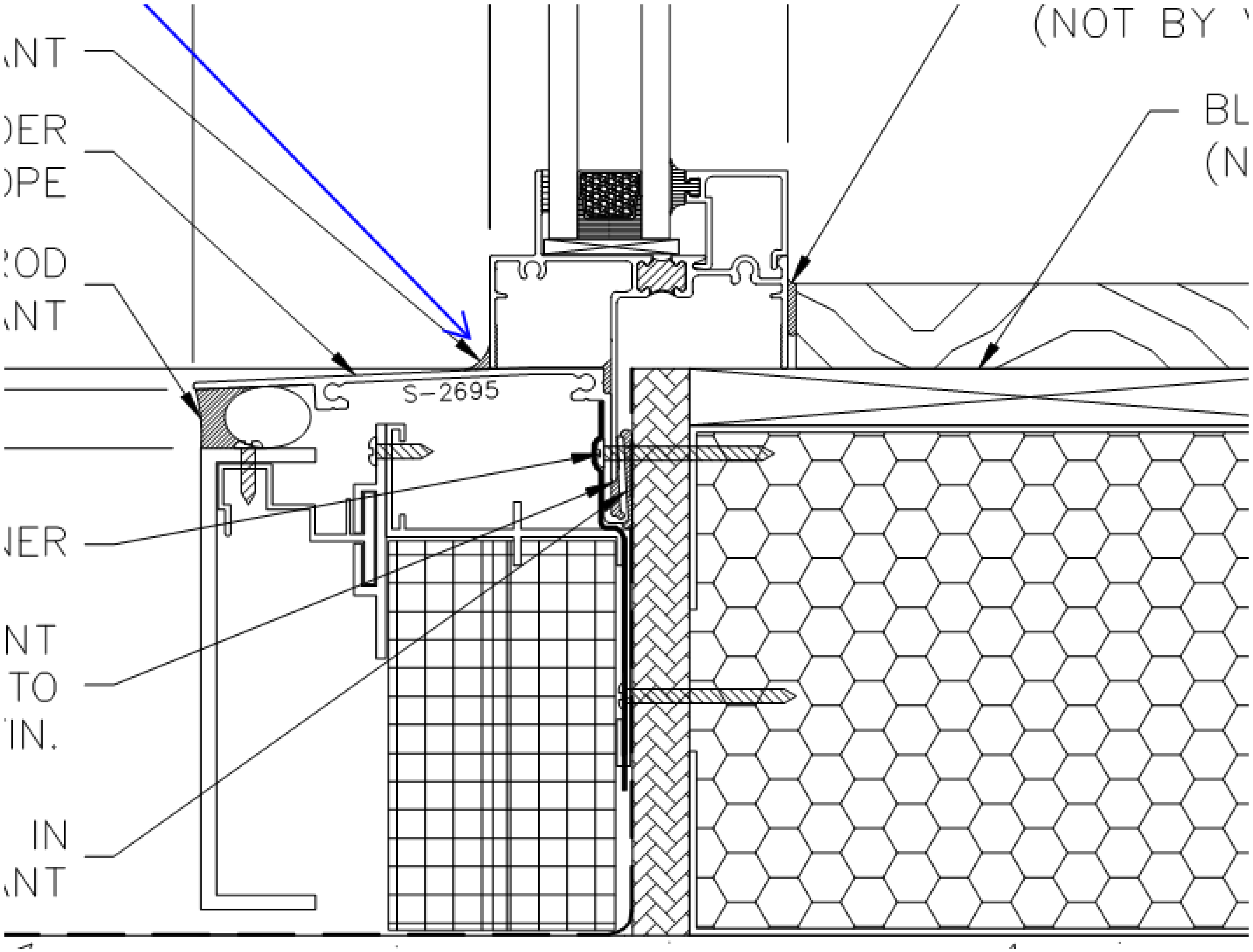
Austin AIA Summer Conference August 24, 2018


2 5/8"
1 1/8"
1"
1 3/4"
B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Relevant Standards and Guidelines: Installation

- **AAMA 100-07** Standard Practice for the Installation of Windows with Flanges or Mounting Fins in Wood Frame Construction
  - Section 1.1 "*This standard practice covers…**no more than 3 stories in height**.*"
- **AAMA 2400-10** Standard Practice for Installation of Windows with a Mounting Flange in Open Stud Frame Construction for Low Wind/Water Exposure
  - Section 1.1 "This practice covers…***residential buildings of no more than four (4) stories in height***."
- **ASTM E2112-07** Standard Practice for Installation of Exterior Windows, Doors, and Skylights
  - Section 1. "*This practice covers…**as used primarily in residential and light commercial buildings**.*"
- **DuPont Flashing Systems Commercial Installation Guidelines**, 04/09

Relevant Standards and Guidelines:
Air Leakage Testing

- **AAMA/WDMA/CSA 101/I.S.2/A440-08** NAFS Specification for windows, doors, and skylights
  - Table 1: **AW** Performance Class, Minimum PG 40
- **ANSI/NFRC 400-2014** Determining Fenestration **Product** Air Leakage
  - Section 4. "***ASTM E283*** *shall be the only method used to measure product air leakage rates…A differential static pressure of* ***300 pascals*** *(6.24 psf) shall be acceptable if the NAFS is used for products obtaining an HC or AW rating.*"
- **ASTM E 283-04(2012)** Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- **ASTM E 783-02(2010)** Standard Test Method for **Field** Measurement of Air Leakage Through Installed Exterior Windows and Doors
- **ASTM E2357-17** Standard Test Method for Determining Air Leakage of Air Barrier **Assemblies**
  - Section 9.1.1 "…in accordance with ASTM E283"

Relevant Standards and Guidelines:
Water Penetration Testing

- **ASTM E 331-00** Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by **Uniform** Static Air Pressure Difference
- **ASTM E 547** Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by **Cyclic** Static Air Pressure Difference
- **ASTM E1105-15** Standard Test Method for **Field** Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by **Uniform or Cyclic** Static Air Pressure Difference

From Cascadia Windows and Doors Presentation page 18

Mockup Construction

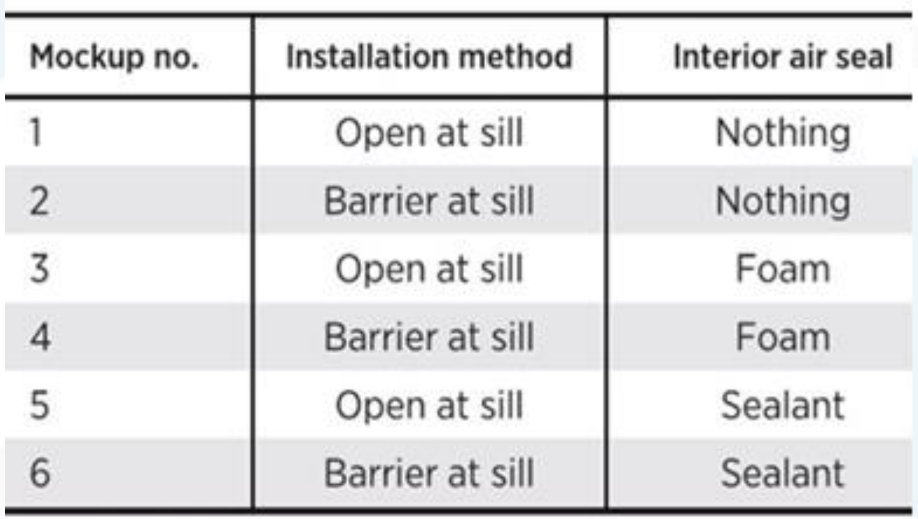
A little of this:

ASTM E2112-07 Standard Practice for Installation of Exterior Windows, Doors, and Skylights

And a little of this:

DuPont Flashing Systems Commercial Installation Guidelines, 04/09

Mockup Construction



Mockup no.	Installation method	Interior air seal
1	Open at sill	Nothing
2	Barrier at sill	Nothing
3	Open at sill	Foam
4	Barrier at sill	Foam
5	Open at sill	Sealant
6	Barrier at sill	Sealant

Mockup Construction

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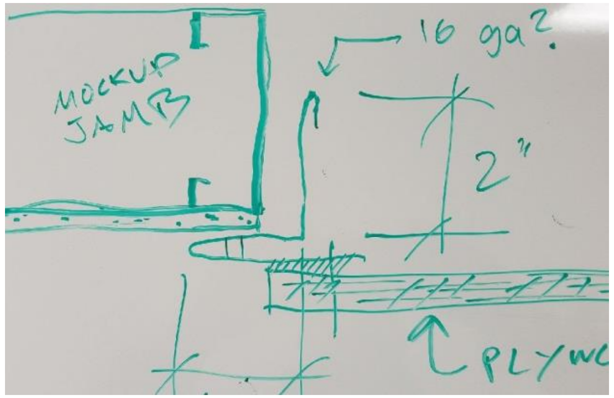
Window “Blanks”



I-Cut

Sill Flashing

Flange Sealant

Window "Blank" Installation

Sealant "Bleed-Out" Visible

Controversy at the head…

Controversy at the sill…

Pressure Chambers

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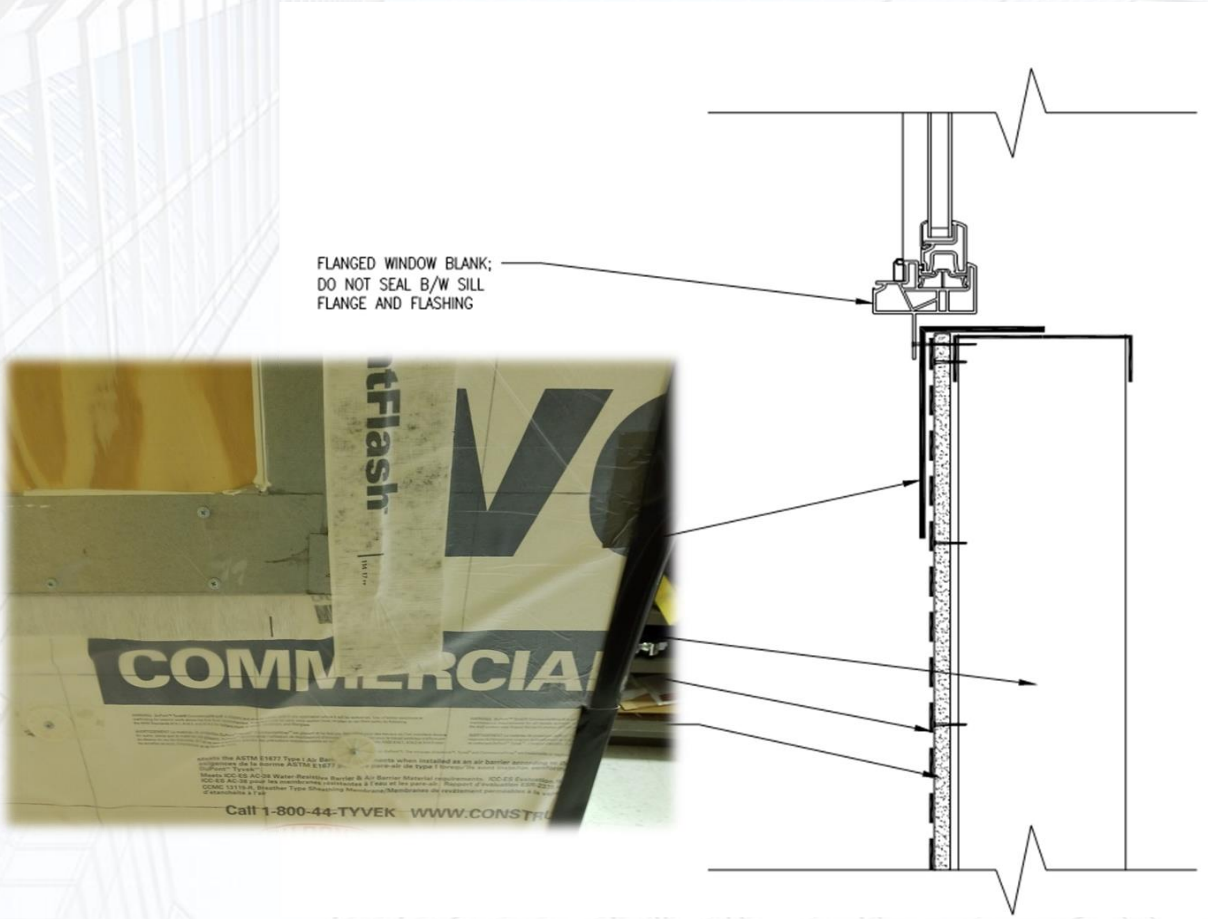
Details

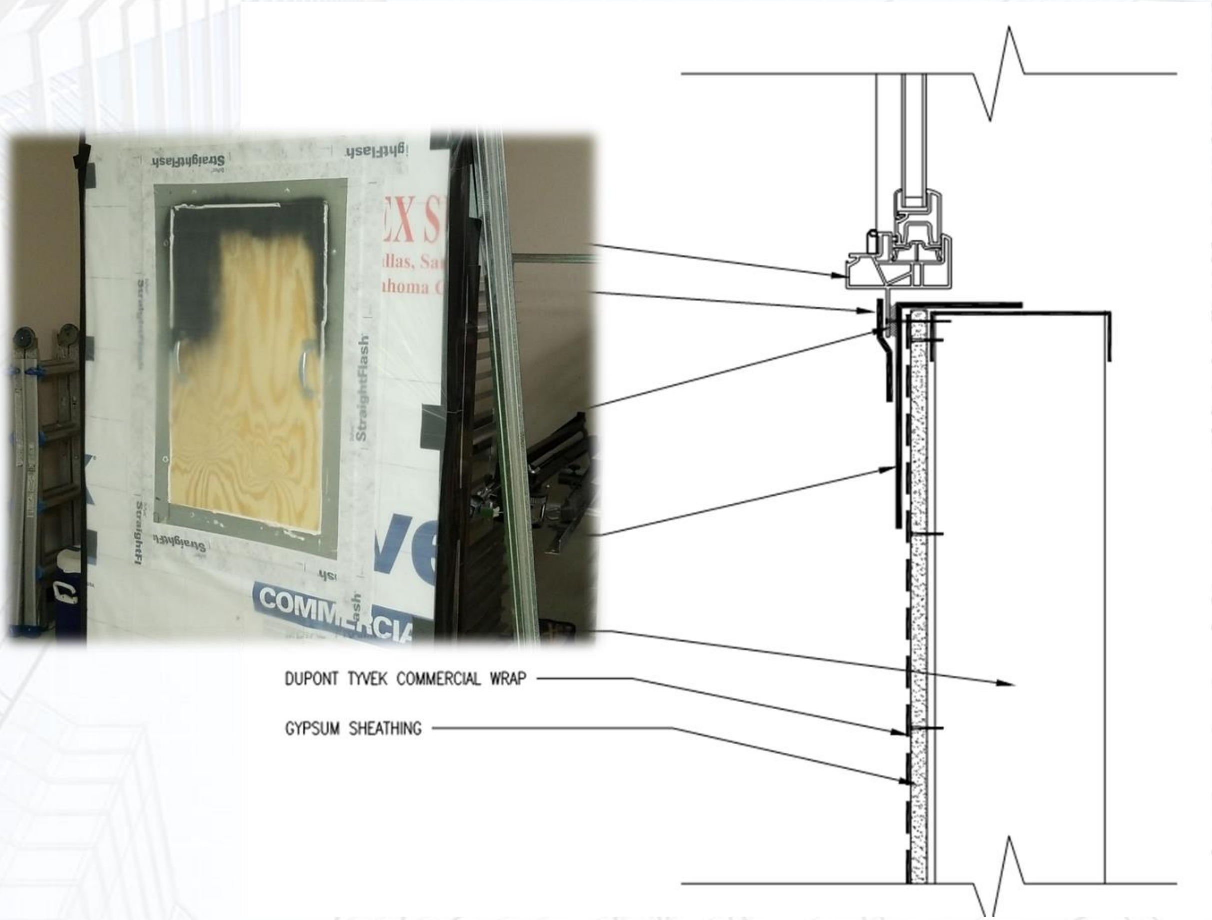
Mockup Information

Mockup No.	Installation Method	Interior Air Seal
1	A1	Nothing
2	B1	Nothing
3	A1	Foam
4	B1	Foam
5	A1	Backer Rod & Sealant
6	B1	Backer Rod & Sealant

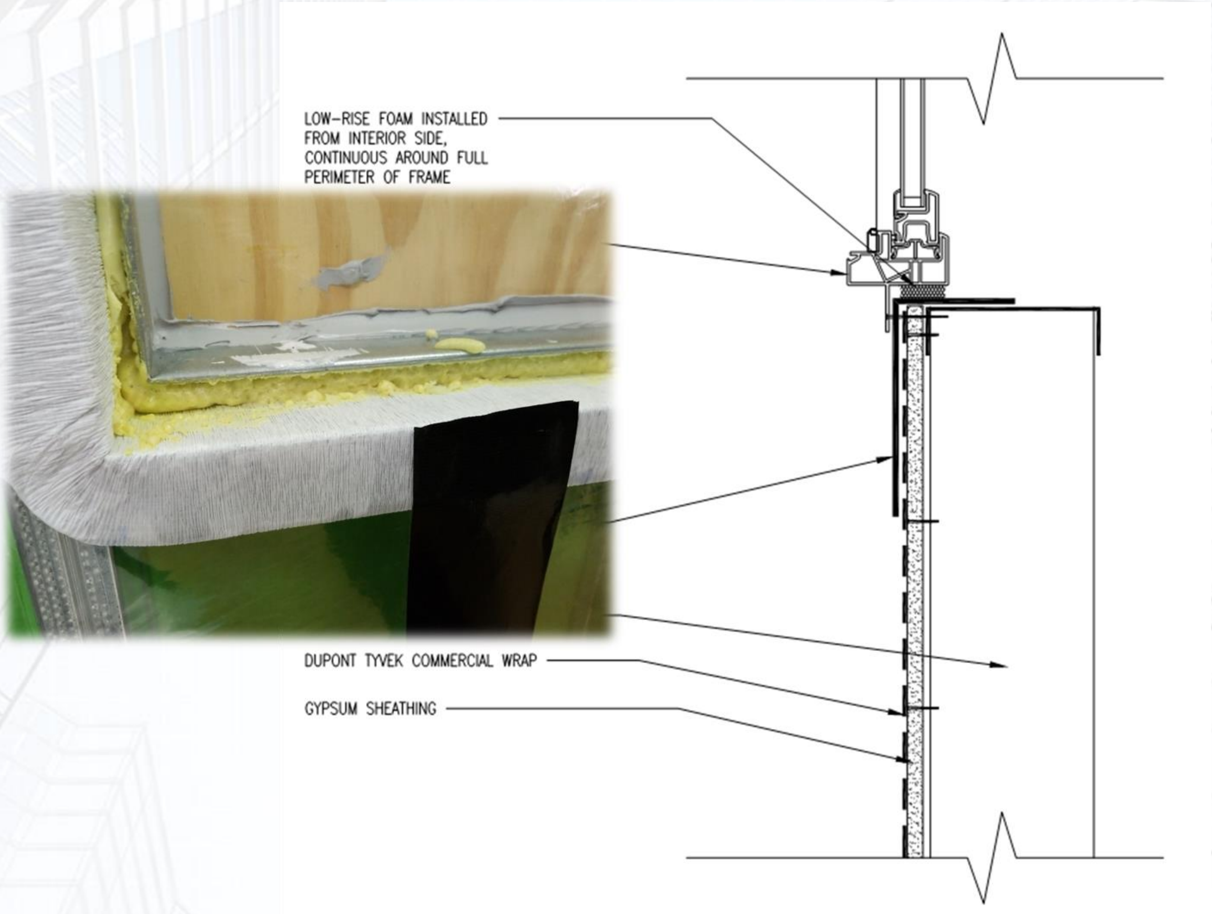
Mockup #1 E2112 Method “A1” No Foam/Sealant



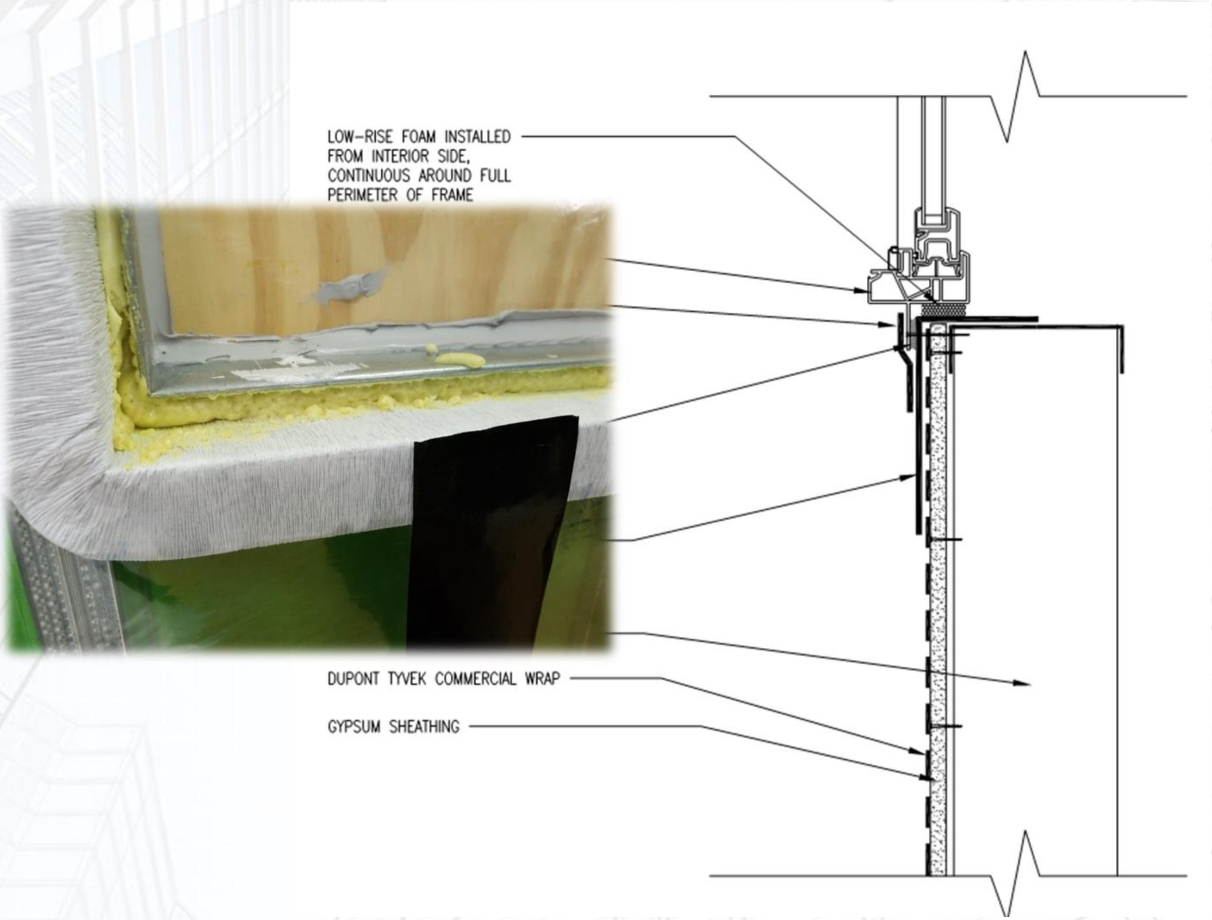
Mockup #2 E2112 Method “B1 No Foam/Sealant



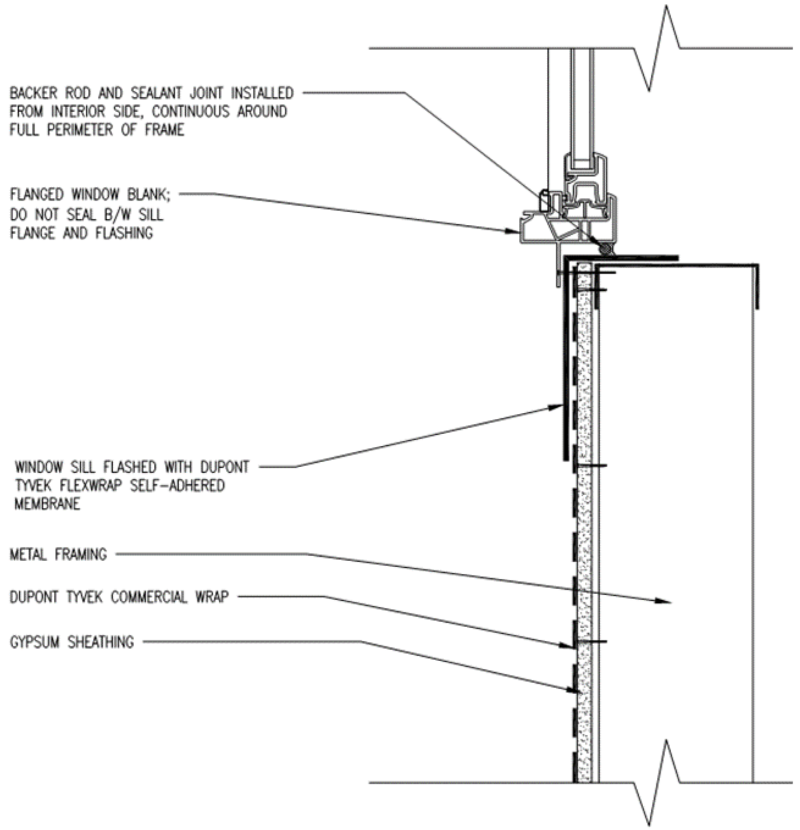
Mockup #3 E2112 Method "A1" With Foam



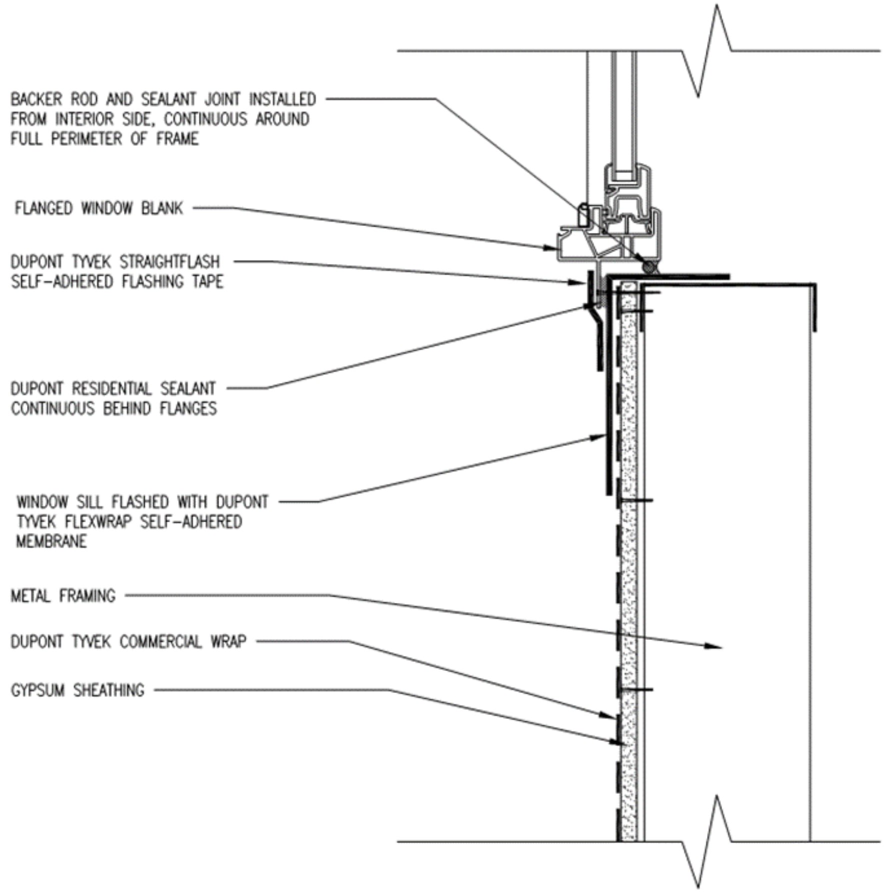
Mockup #4 E2112 Method "B1" With Foam



Mockups #5 E2112 Method "A1" With Backer Rod & Sealant



Mockups #6 E2112 Method “B1” With Backer Rod & Sealant

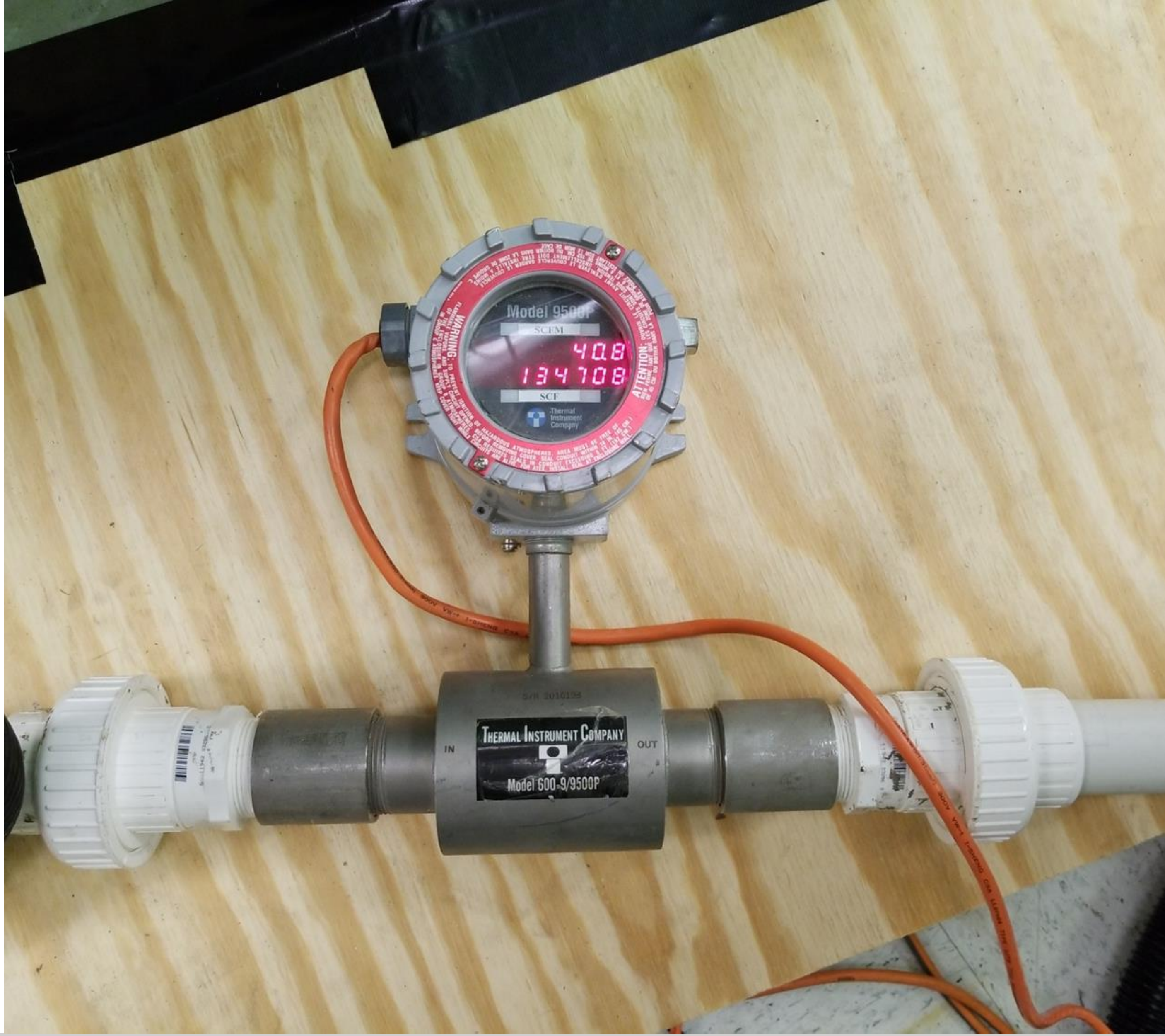


Air Leakage Testing

ASTM E 783-02(2010) Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors

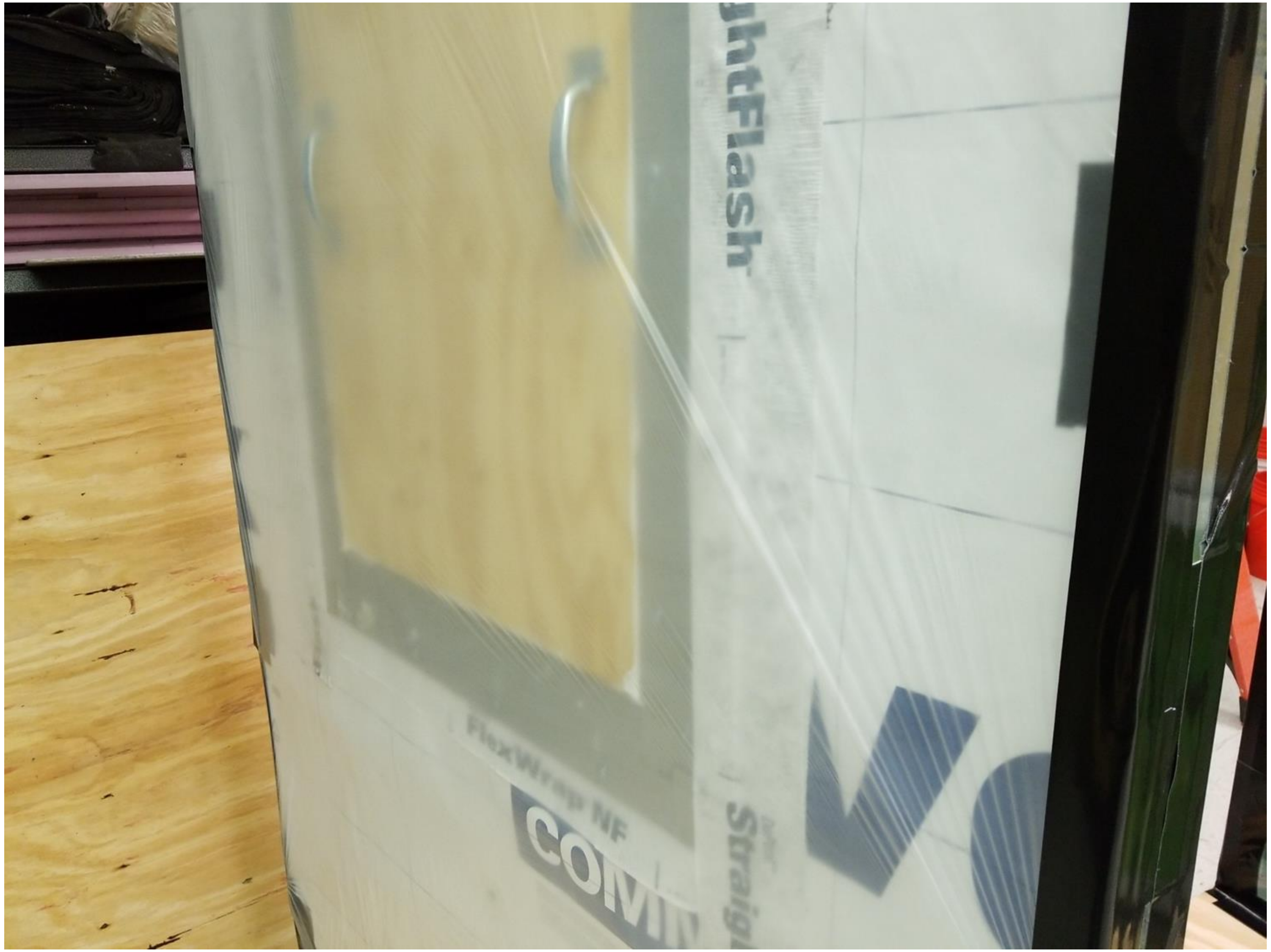
Manometer (inches of water)

Airflow Meter (cfm/sf)



T. Brown J. Posenecker K. Simon **NAPHC** September 22, 2018

Full Isolation



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“Blank”
Isolation

No Isolation

Isolation v.2.0

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Air Leakage Testing: Results Round 1

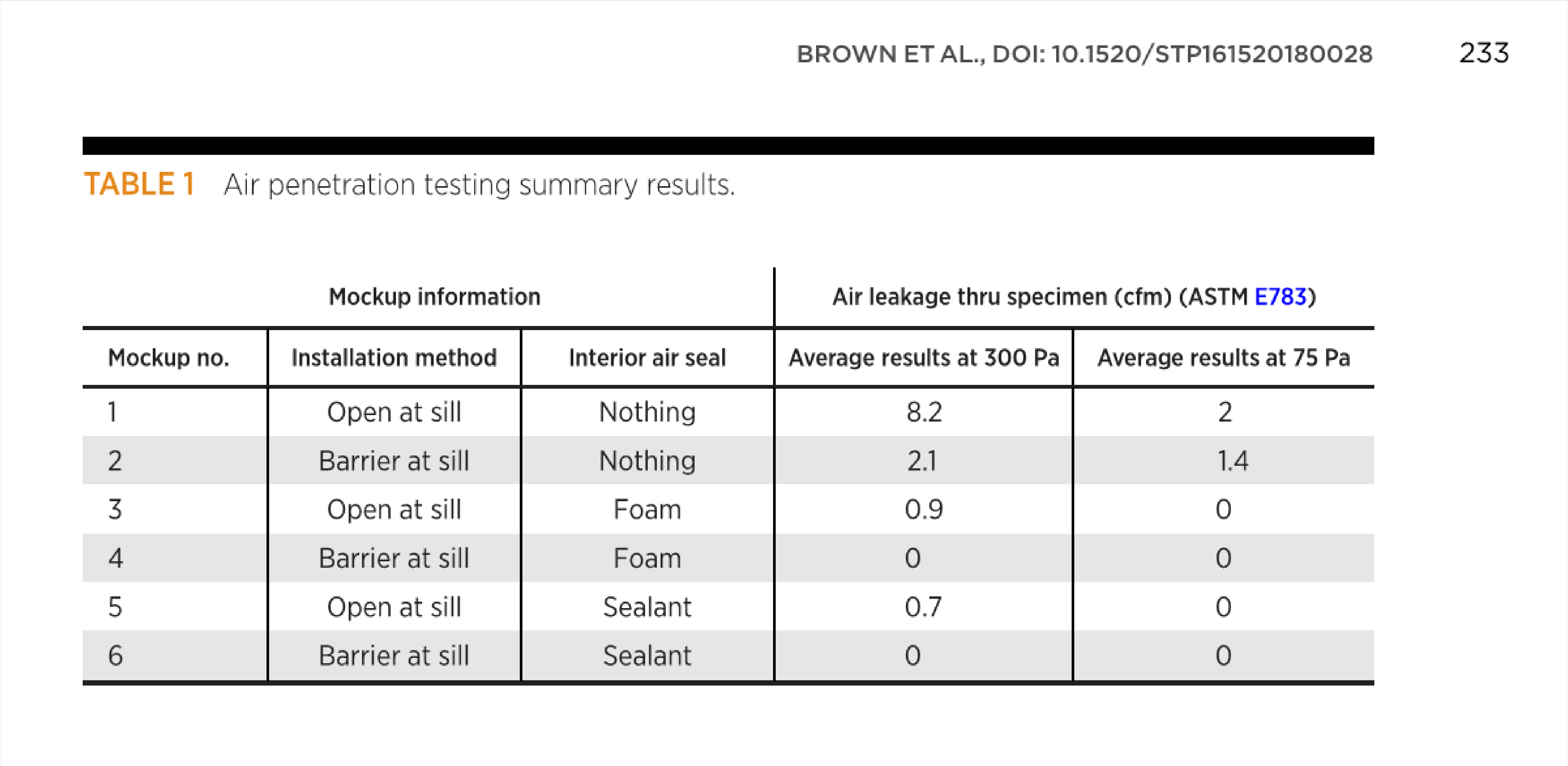

TABLE 1 Air penetration testing summary results.

Mockup information			Air leakage thru specimen (cfm) (ASTM E783)	
Mockup no.	Installation method	Interior air seal	Average results at 300 Pa	Average results at 75 Pa
1	Open at sill	Nothing	8.2	2
2	Barrier at sill	Nothing	2.1	1.4
3	Open at sill	Foam	0.9	0
4	Barrier at sill	Foam	0	0
5	Open at sill	Sealant	0.7	0
6	Barrier at sill	Sealant	0	0

Water Testing

ASTM E1105-15 Standard Test Method for **Field** Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or **Cyclic** Static Air Pressure Difference

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Water Testing: Results Round 1

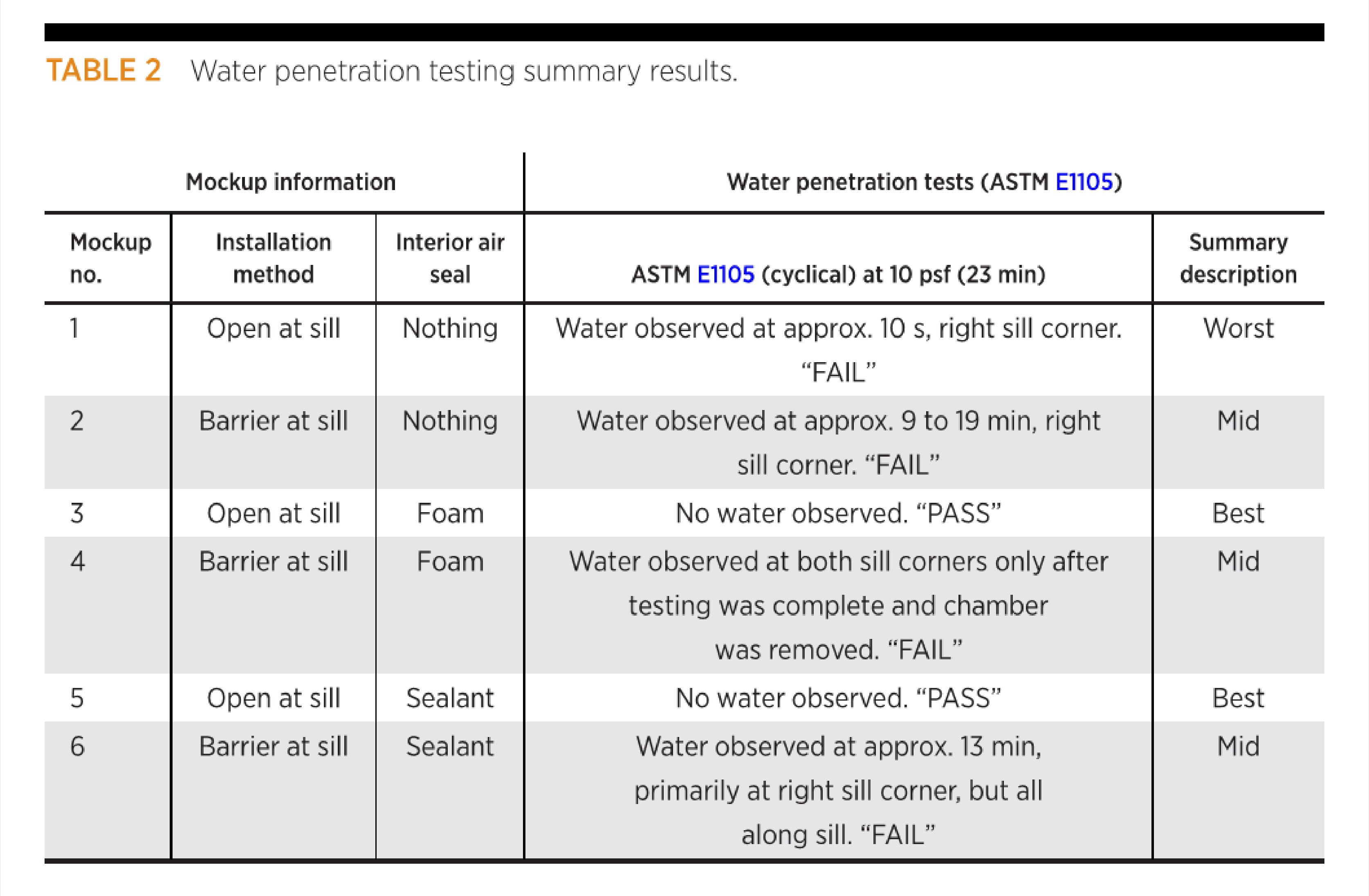


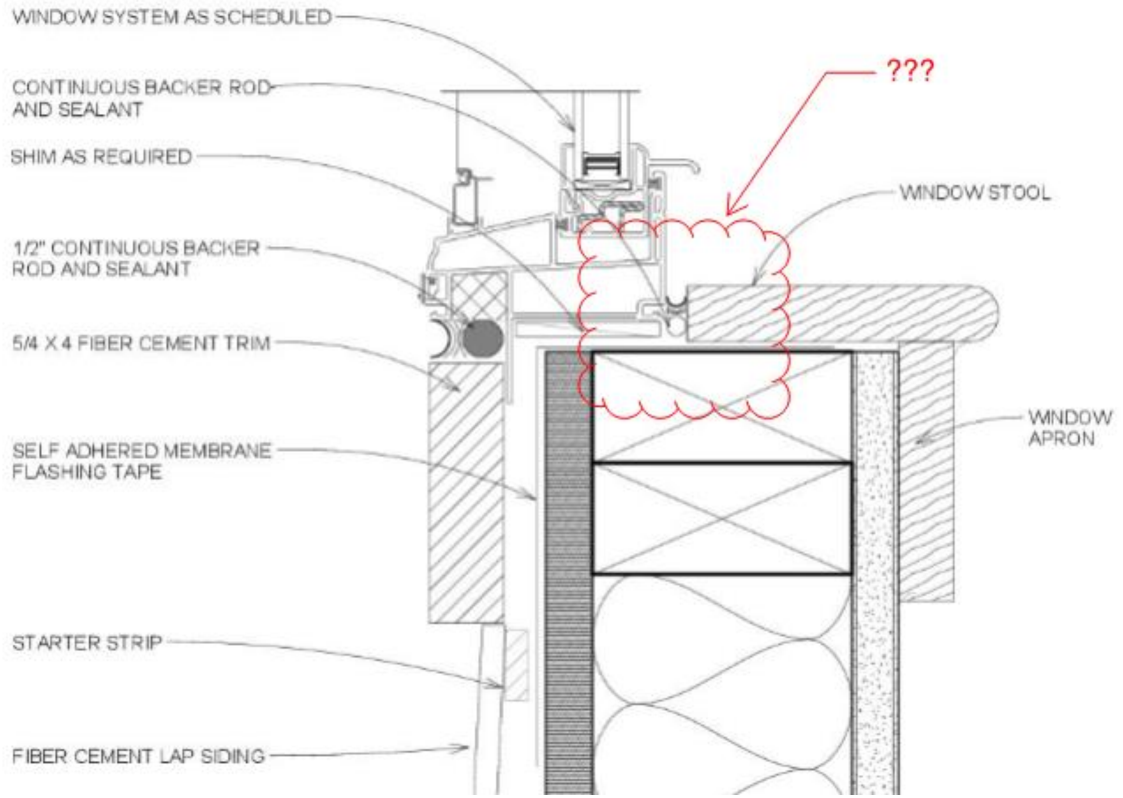
TABLE 2 Water penetration testing summary results.

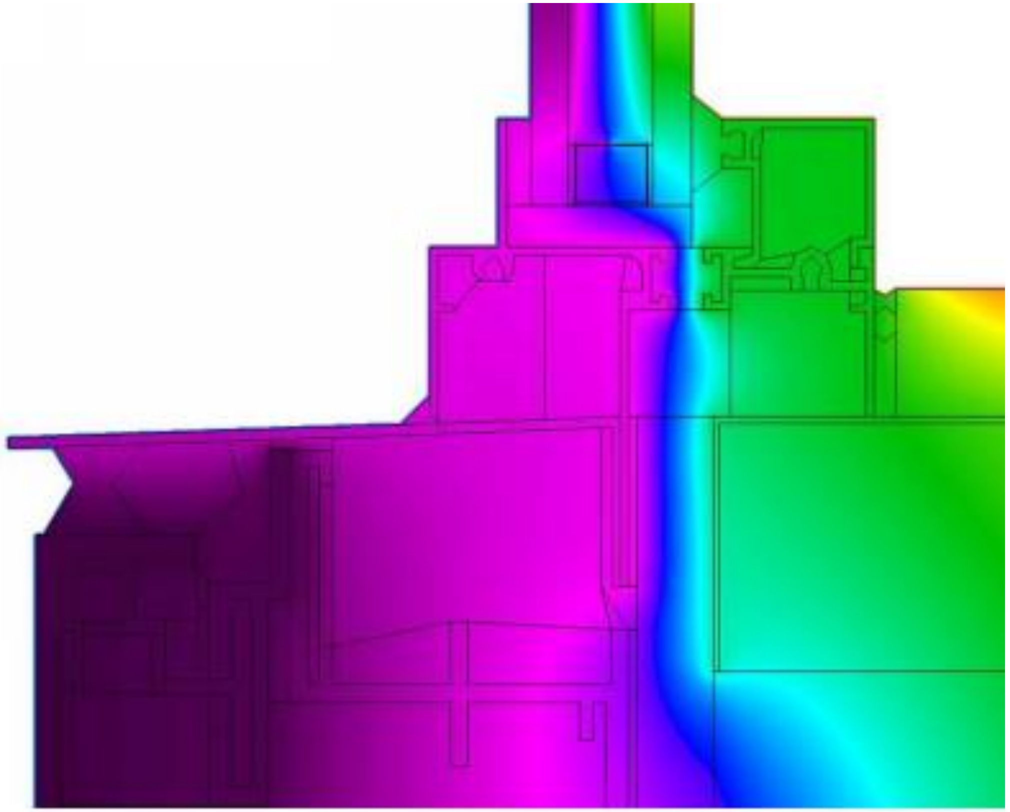
Mockup information			Water penetration tests (ASTM E1105)	
Mockup no.	**Installation method**	**Interior air seal**	**ASTM E1105 (cyclical) at 10 psf (23 min)**	**Summary description**
1	Open at sill	Nothing	Water observed at approx. 10 s, right sill corner. "FAIL"	Worst
2	Barrier at sill	Nothing	Water observed at approx. 9 to 19 min, right sill corner. "FAIL"	Mid
3	Open at sill	Foam	No water observed. "PASS"	Best
4	Barrier at sill	Foam	Water observed at both sill corners only after testing was complete and chamber was removed. "FAIL"	Mid
5	Open at sill	Sealant	No water observed. "PASS"	Best
6	Barrier at sill	Sealant	Water observed at approx. 13 min, primarily at right sill corner, but all along sill. "FAIL"	Mid

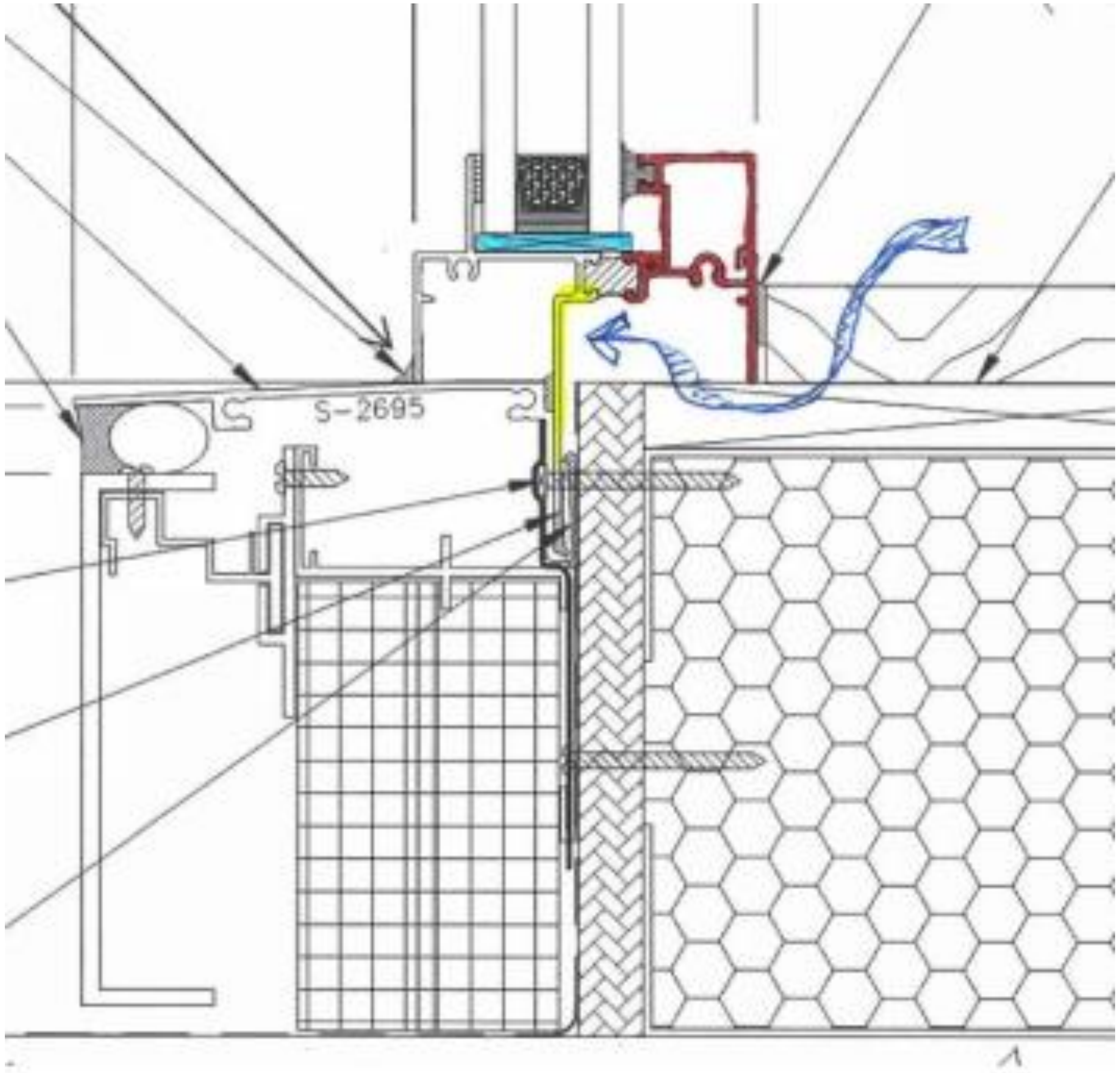
Conclusions

1. The backer rod and sealant or foam installed from interior…is very important!

Lessons Learned





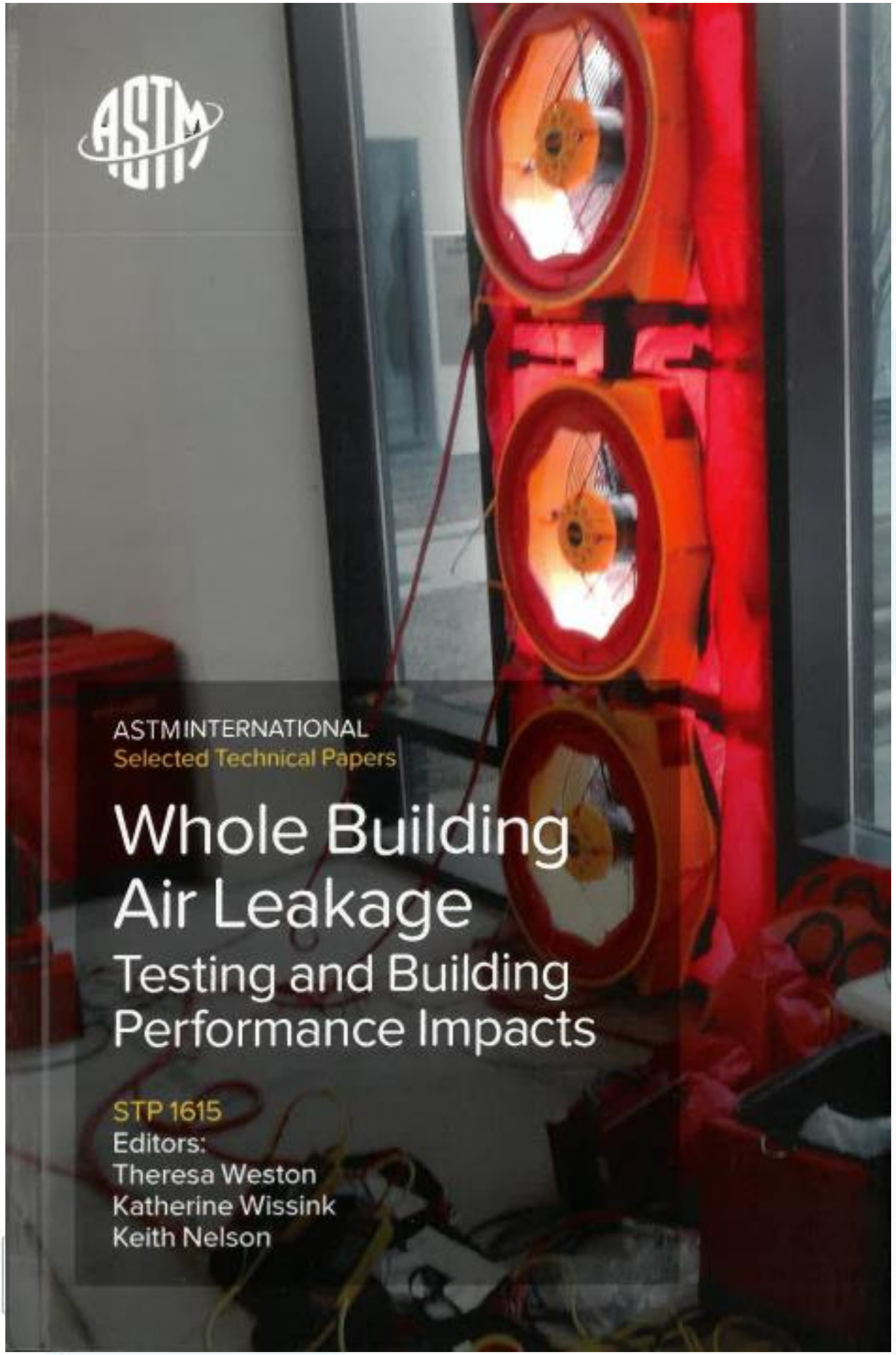

S-2695

Lessons Learned

2. E2112 Method “A1” appears to be better than “B1” at managing water, but more testing needed to verify high rise construction, hurricane zones.

3. E2112 Method “B1” is the best for air tightness. But “A1” can be good too.

4. Doesn’t matter at 75 pa (Code, Passive House). Could make a difference at 300 pa, high rise construction, hurricane zones.



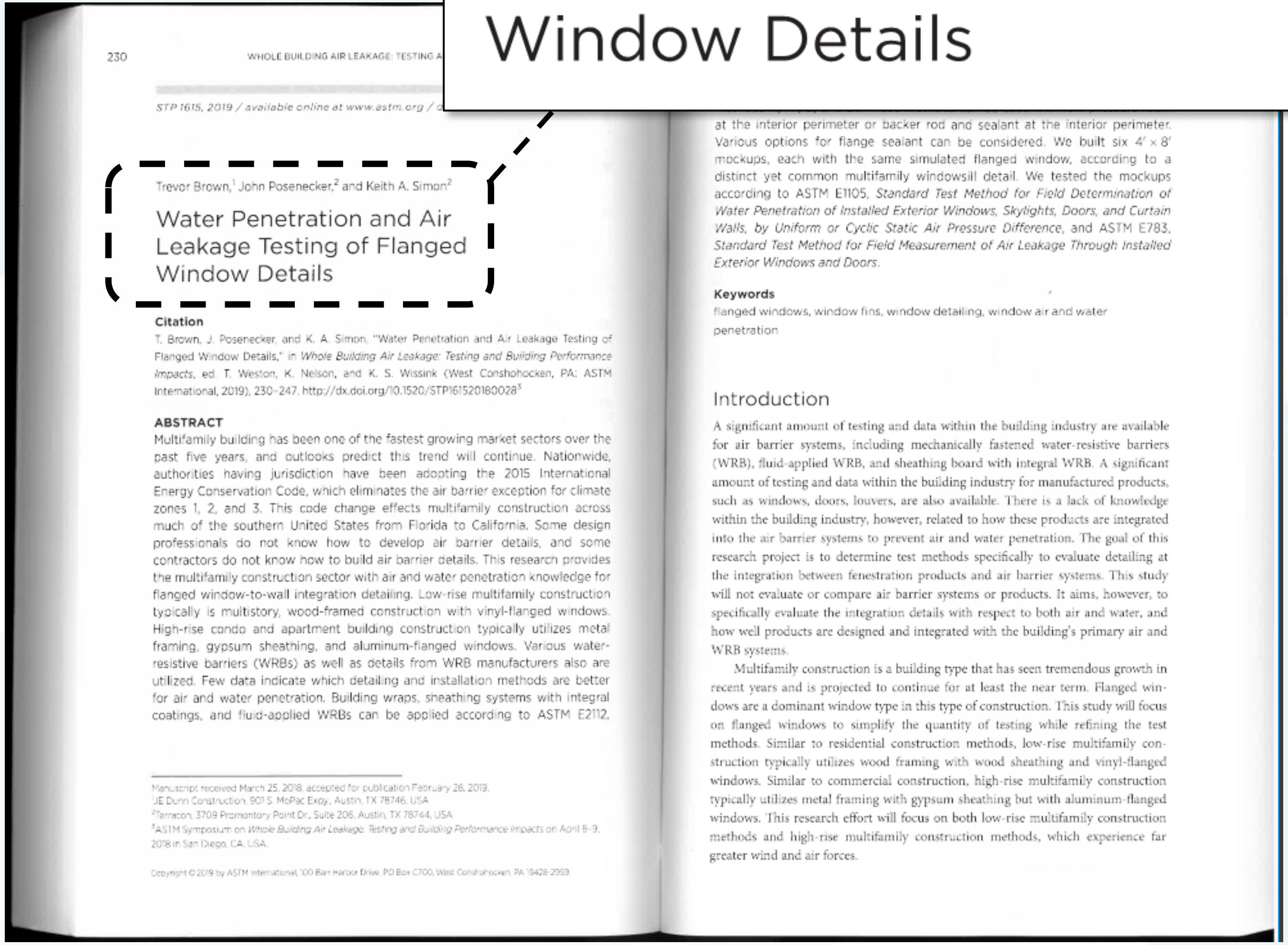
ASTM INTERNATIONAL
Selected Technical Papers

Whole Building
Air Leakage
Testing and Building
Performance Impacts

STP 1615
Editors:
Theresa Weston
Katherine Wissink
Keith Nelson

Trevor Brown,[1] John Posenecker,[2] and Keith A. Simon[2]

Water Penetration and Air Leakage Testing of Flanged Window Details



STP 1615, 2019 / available online at www.astm.org / d

Trevor Brown,[1] John Posenecker,[2] and Keith A. Simon[2]

Water Penetration and Air Leakage Testing of Flanged Window Details

Citation
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ABSTRACT
Multifamily building has been one of the fastest growing market sectors over the past five years, and outlooks predict this trend will continue. Nationwide, authorities having jurisdiction have been adopting the 2015 International Energy Conservation Code, which eliminates the air barrier exception for climate zones 1, 2, and 3. This code change effects multifamily construction across much of the southern United States from Florida to California. Some design professionals do not know how to develop air barrier details, and some contractors do not know how to build air barrier details. This research provides the multifamily construction sector with air and water penetration knowledge for flanged window-to-wall integration detailing. Low-rise multifamily construction typically is multistory, wood-framed construction with vinyl-flanged windows. High-rise condo and apartment building construction typically utilizes metal framing, gypsum sheathing, and aluminum-flanged windows. Various water-resistive barriers (WRBs) as well as details from WRB manufacturers also are utilized. Few data indicate which detailing and installation methods are better for air and water penetration. Building wraps, sheathing systems with integral coatings, and fluid-applied WRBs can be applied according to ASTM E2112,

at the interior perimeter or backer rod and sealant at the interior perimeter. Various options for flange sealant can be considered. We built six 4′ × 8′ mockups, each with the same simulated flanged window, according to a distinct yet common multifamily windowsill detail. We tested the mockups according to ASTM E1105, *Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference*, and ASTM E783, *Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors*.

Keywords
flanged windows, window fins, window detailing, window air and water penetration

Introduction

A significant amount of testing and data within the building industry are available for air barrier systems, including mechanically fastened water-resistive barriers (WRB), fluid-applied WRB, and sheathing board with integral WRB. A significant amount of testing and data within the building industry for manufactured products, such as windows, doors, louvers, are also available. There is a lack of knowledge within the building industry, however, related to how these products are integrated into the air barrier systems to prevent air and water penetration. The goal of this research project is to determine test methods specifically to evaluate detailing at the integration between fenestration products and air barrier systems. This study will not evaluate or compare air barrier systems or products. It aims, however, to specifically evaluate the integration details with respect to both air and water, and how well products are designed and integrated with the building's primary air and WRB systems.

Multifamily construction is a building type that has seen tremendous growth in recent years and is projected to continue for at least the near term. Flanged windows are a dominant window type in this type of construction. This study will focus on flanged windows to simplify the quantity of testing while refining the test methods. Similar to residential construction methods, low-rise multifamily construction typically utilizes wood framing with wood sheathing and vinyl-flanged windows. Similar to commercial construction, high-rise multifamily construction typically utilizes metal framing with gypsum sheathing but with aluminum-flanged windows. This research effort will focus on both low-rise multifamily construction methods and high-rise multifamily construction methods, which experience far greater wind and air forces.

Manuscript received March 25, 2018; accepted for publication February 26, 2019.

[1] JE Dunn Construction, 901 S. MoPac Expy., Austin, TX 78746, USA
[2] Terracon, 3709 Promontory Point Dr., Suite 206, Austin, TX 78744, USA

[3] ASTM Symposium on *Whole Building Air Leakage: Testing and Building Performance Impacts* on April 8–9, 2018 in San Diego, CA, USA.

Round 2 Testing

Tremco Cleveland Testing Facility


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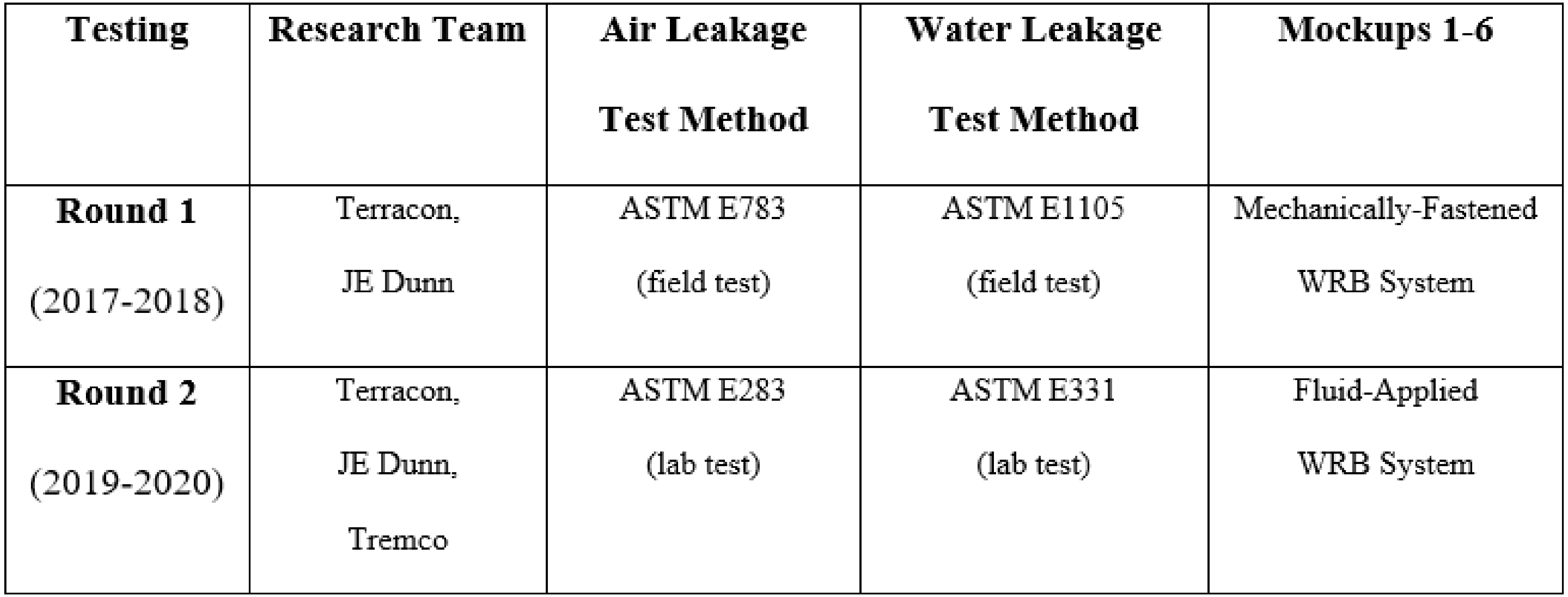
schwerdtel GmbH
Spezialmaschinen
WARNING

Tremco Cleveland Testing Facility



Testing	Research Team	Air Leakage Test Method	Water Leakage Test Method	Mockups 1-6
Round 1 (2017-2018)	Terracon, JE Dunn	ASTM E783 (field test)	ASTM E1105 (field test)	Mechanically-Fastened WRB System
Round 2 (2019-2020)	Terracon, JE Dunn, Tremco	ASTM E283 (lab test)	ASTM E331 (lab test)	Fluid-Applied WRB System

Round 2 Mockups

TREMCO
Construction Products Group

Test Report
For
JE Dunn and Terracon

Tremco
Tested in Accordance with
ASTM E283, E331

Products Tested:
ExoAir 230, ExoAir 110AT, Dymonic 100

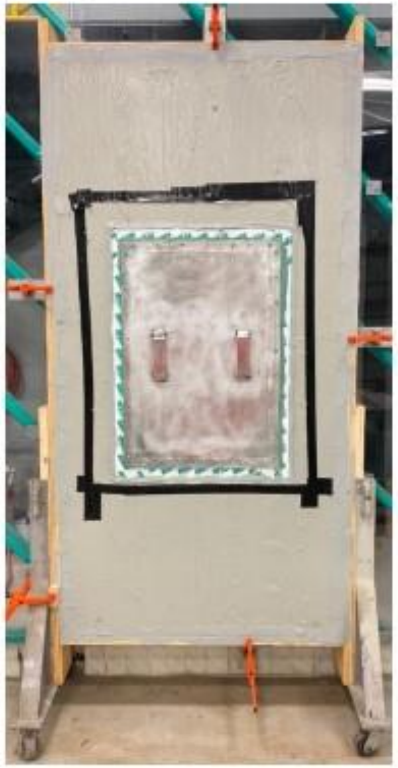
Test Start: 9/9/202
Test Completion: 9/10/2020

Test Technician: Cory Bendokas
Test Engineer: Dante Marimpietri

Tremco Commercial Sealants & Waterproofing
4475 E 175th St. Cleveland, OH 44128

Test Specimen Description

Specimen size is 4'x8' framed with 18gauge steel studs and track. Studs placed at 0", 12", 36", and 48". Two horizontal pieces of studs were used to frame out a rough opening that measured 2'x3' in the middle of the specimen. The specimen was sheathed with one piece of 4'x8' 5/8" thick exterior gypsum sheathing. The rough opening was cut out from the sheathing, all fastener heads detailed with Dymonic 100, then ExoAir 230 was applied at 50 wet mils. Once the membrane was cured, the rough opening was flashed with ExoAir 110AT with the top edge and 6" down each side detailed with a bead of Dymonic 100. A nail flanged window blank was installed into the rough opening into wet Dymonic 100 around the header and jambs. After the initial air test was run, a 4" strip of ExoAir 110at was applied to the header and jambs over top of the window blank with the top edge and 6" down each side detailed with a bead of Dymonic 100. (Wall #1)



Wall 1 prior to the 4" ExoAir 110AT being applied

Test Results

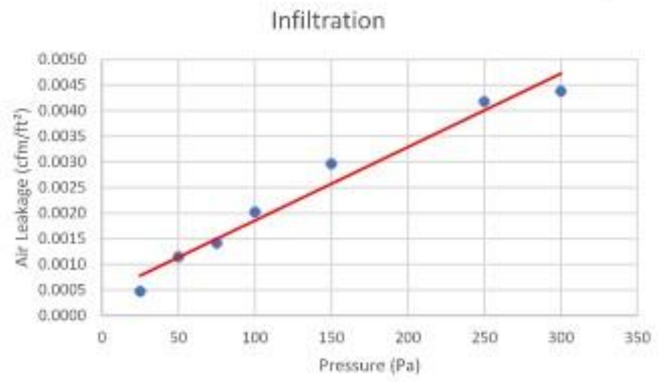
Test Standard	Duration (minutes)	Window Perimeter Result
ASTM E283	n/a	Pass
ASTM E331 @ 1.57psf	15	Pass
ASTM E331 @ 6.2psf	120	Pass
ASTM E331 @ 9psf	15	Pass
ASTM E331 @ 12psf	15	Pass
ASTM E331 @ 15psf	15	Pass
ASTM E331 @ 18psf	15	Fail
ASTM E331 @ 21psf	15	Fail
ASTM E331 @ 25psf	15	Fail

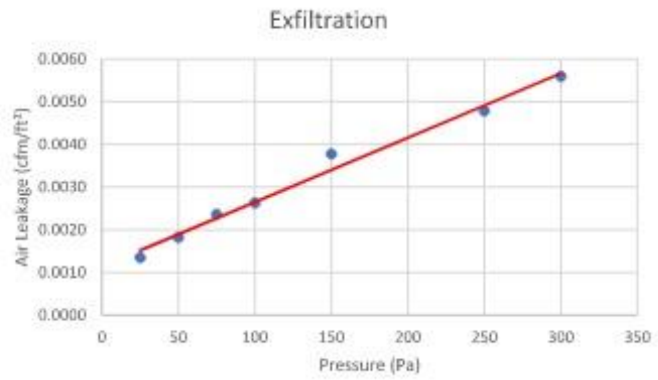
Comments

1. During 6.2psf water test, water infiltration observed coming in from a window fastener in the sill. Since we are looking at the window perimeter for this test, this is not considered a failure.
2. During 18psf water test, water infiltration observed coming in the sill connection at the window perimeter

Photos

1.  Refer to comment #1

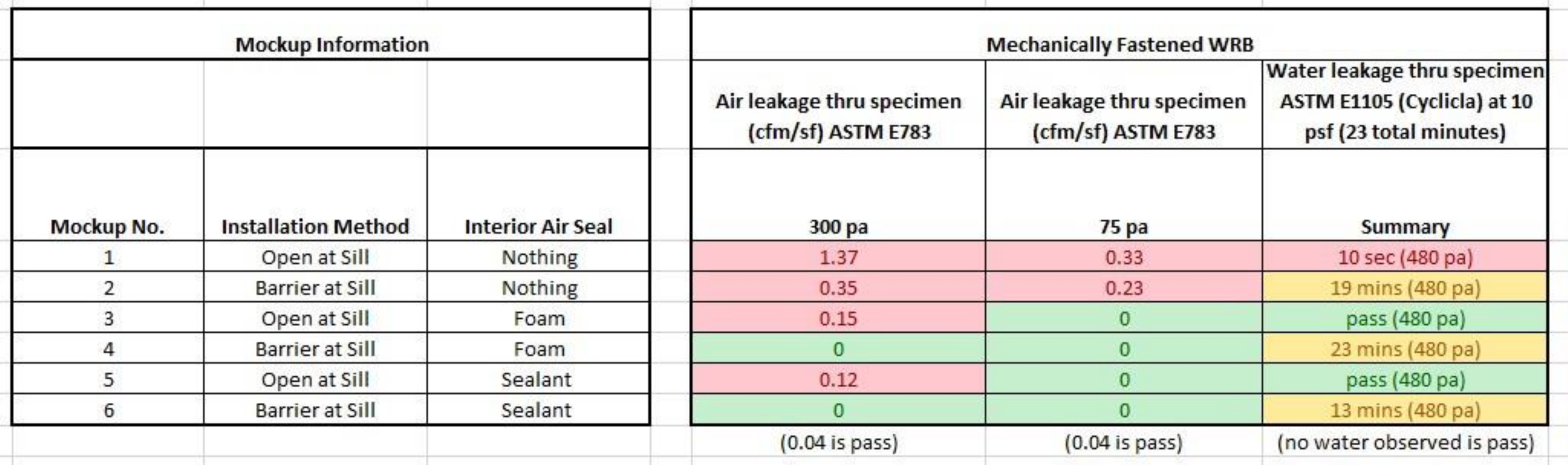




Iteration 2:

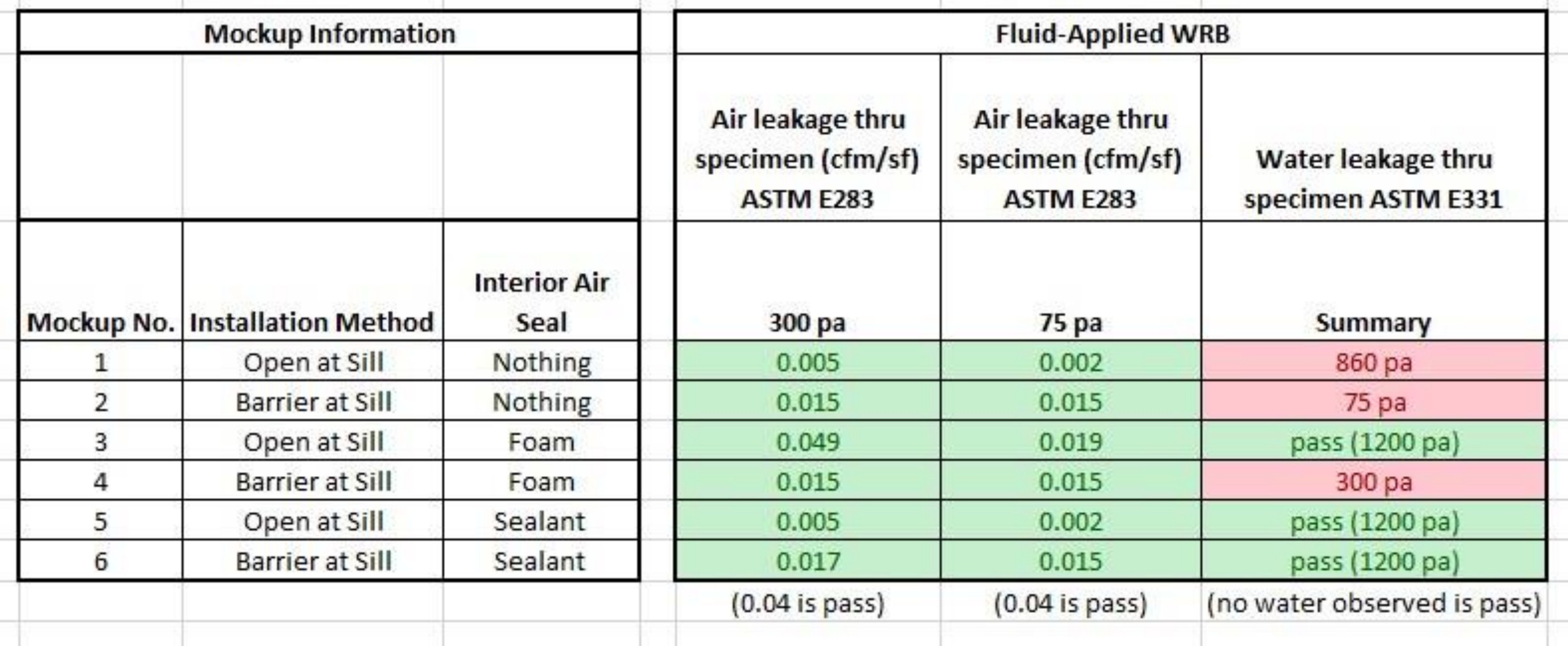
Pa	L/s	L/s*m²	cfm	cfm/ft²
-25	0.0092	0.0031	0.0194	0.0006
-50	0.0153	0.0051	0.0323	0.0010
-75	0.0285	0.0096	0.0604	0.0019
-100	0.0376	0.0127	0.0798	0.0025
-150	0.0458	0.0154	0.0970	0.0030
-250	0.0621	0.0209	0.1315	0.0041
-300	0.0804	0.0271	0.1703	0.0053
25	0.0173	0.0058	0.0366	0.0011
50	0.0254	0.0086	0.0539	0.0017
75	0.0326	0.0110	0.0690	0.0022

Results: Round 1 Testing



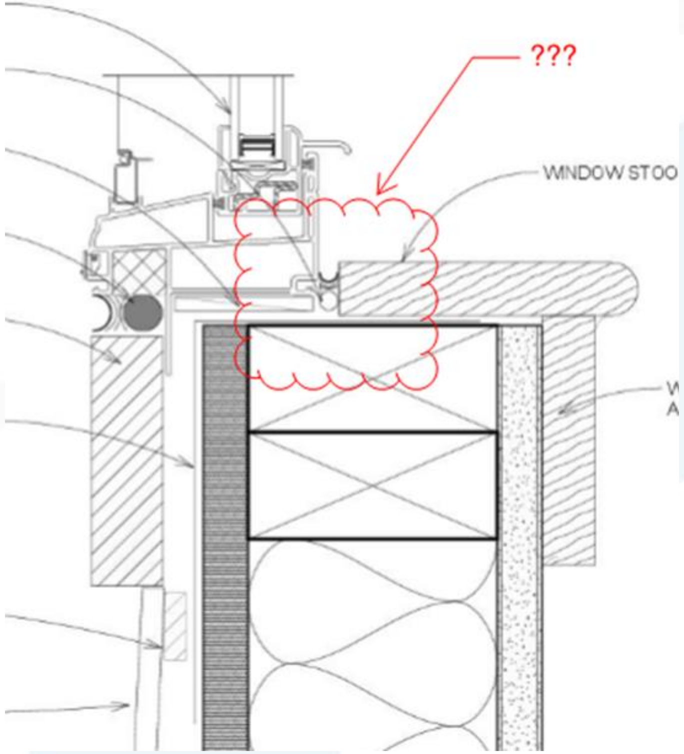
Mockup Information			Mechanically Fastened WRB		
			Air leakage thru specimen (cfm/sf) ASTM E783	Air leakage thru specimen (cfm/sf) ASTM E783	Water leakage thru specimen ASTM E1105 (Cyclicla) at 10 psf (23 total minutes)
Mockup No.	**Installation Method**	**Interior Air Seal**	**300 pa**	**75 pa**	**Summary**
1	Open at Sill	Nothing	1.37	0.33	10 sec (480 pa)
2	Barrier at Sill	Nothing	0.35	0.23	19 mins (480 pa)
3	Open at Sill	Foam	0.15	0	pass (480 pa)
4	Barrier at Sill	Foam	0	0	23 mins (480 pa)
5	Open at Sill	Sealant	0.12	0	pass (480 pa)
6	Barrier at Sill	Sealant	0	0	13 mins (480 pa)
			(0.04 is pass)	(0.04 is pass)	(no water observed is pass)

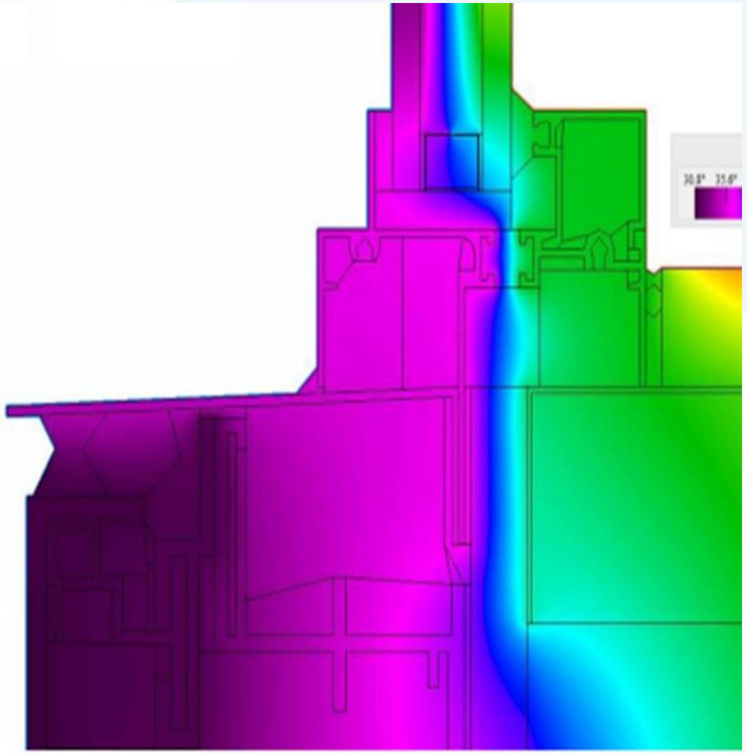
Results: Round 2 Testing

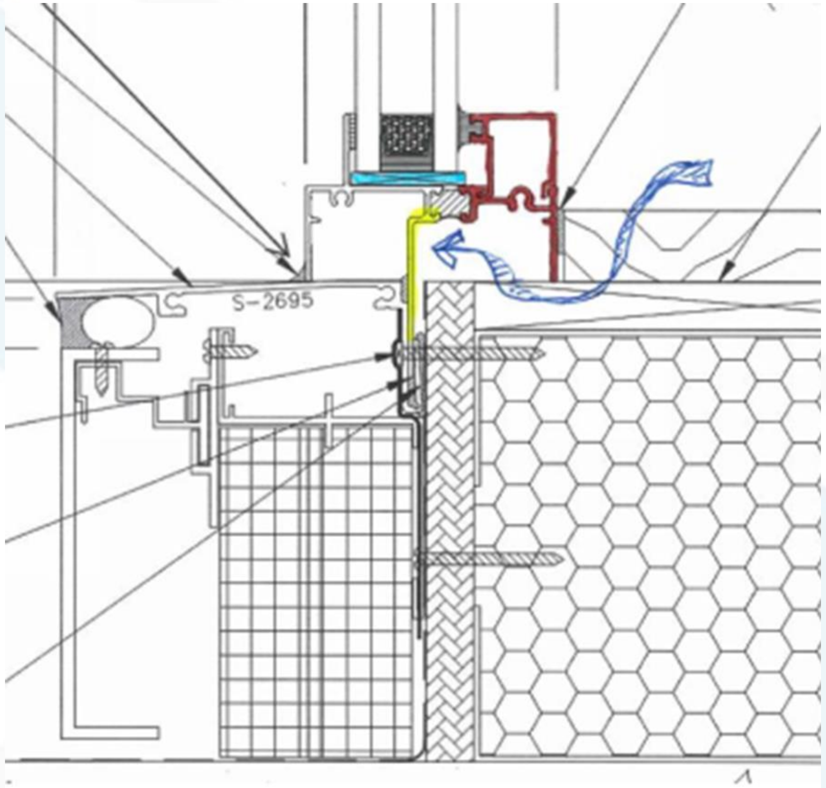


Mockup Information			Fluid-Applied WRB		
			Air leakage thru specimen (cfm/sf) ASTM E283	Air leakage thru specimen (cfm/sf) ASTM E283	Water leakage thru specimen ASTM E331
Mockup No.	Installation Method	Interior Air Seal	300 pa	75 pa	Summary
1	Open at Sill	Nothing	0.005	0.002	860 pa
2	Barrier at Sill	Nothing	0.015	0.015	75 pa
3	Open at Sill	Foam	0.049	0.019	pass (1200 pa)
4	Barrier at Sill	Foam	0.015	0.015	300 pa
5	Open at Sill	Sealant	0.005	0.002	pass (1200 pa)
6	Barrier at Sill	Sealant	0.017	0.015	pass (1200 pa)
			(0.04 is pass)	(0.04 is pass)	(no water observed is pass)

Conclusions







Conclusions

- **Foam/sealant is critical** for both air and water management and performance. Pros and cons between the two options.

- **Open at sill better** at water management than barrier at sill for low-rise construction.

- Barrier at sill is the best for air tightness, **but** open at sill can be very airtight too (sometimes also zero air leakage). Doesn’t matter at 75 pa (Code, Passive House). Could make a difference at 300 pa, high rise construction, hurricane zones.

- Significant upgrade in performance going from mechanically-fastened WRB to a **fluid-applied WRB**.

IIBEC

International Institute of
Building Enclosure Consultants

Water Penetration and Air Leakage Testing of Flanged Commercial Windows

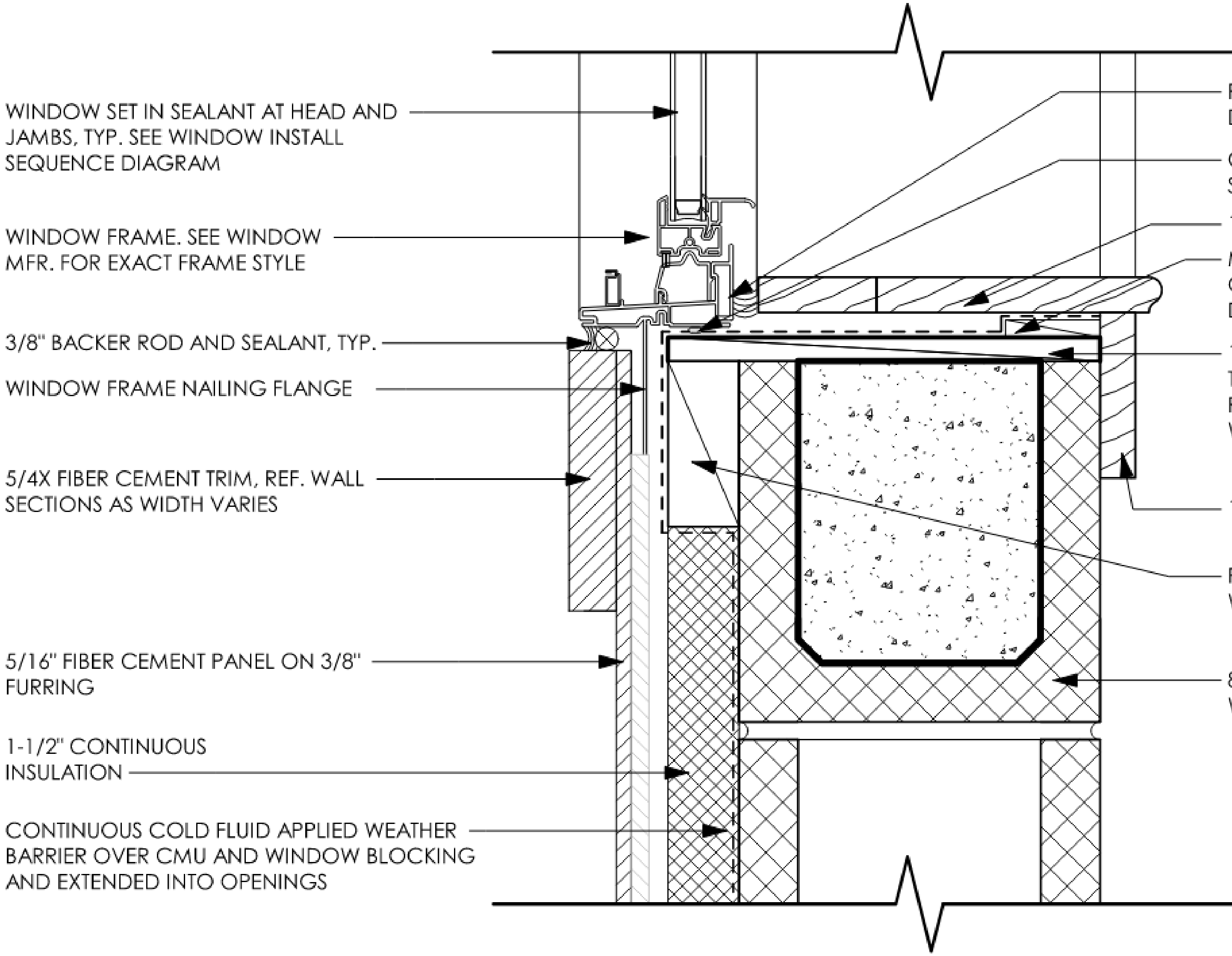
Keith Simon, John Posenecker (Terracon)

Trevor Brown (JE Dunn)

Dante Marimpietri, Marcy Tyler (Tremco)

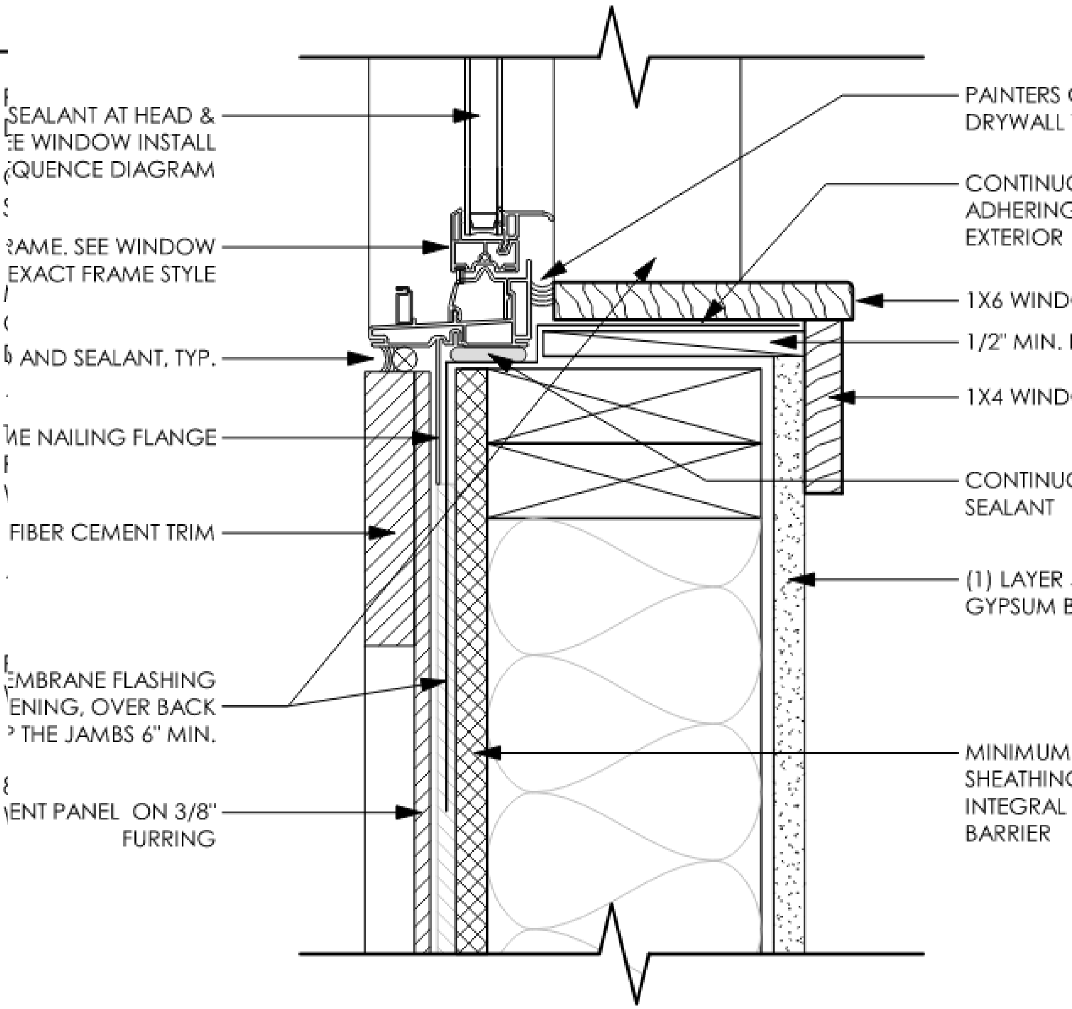
IIBEC 2021 International Convention and Trade Show

Phoenix, Arizona

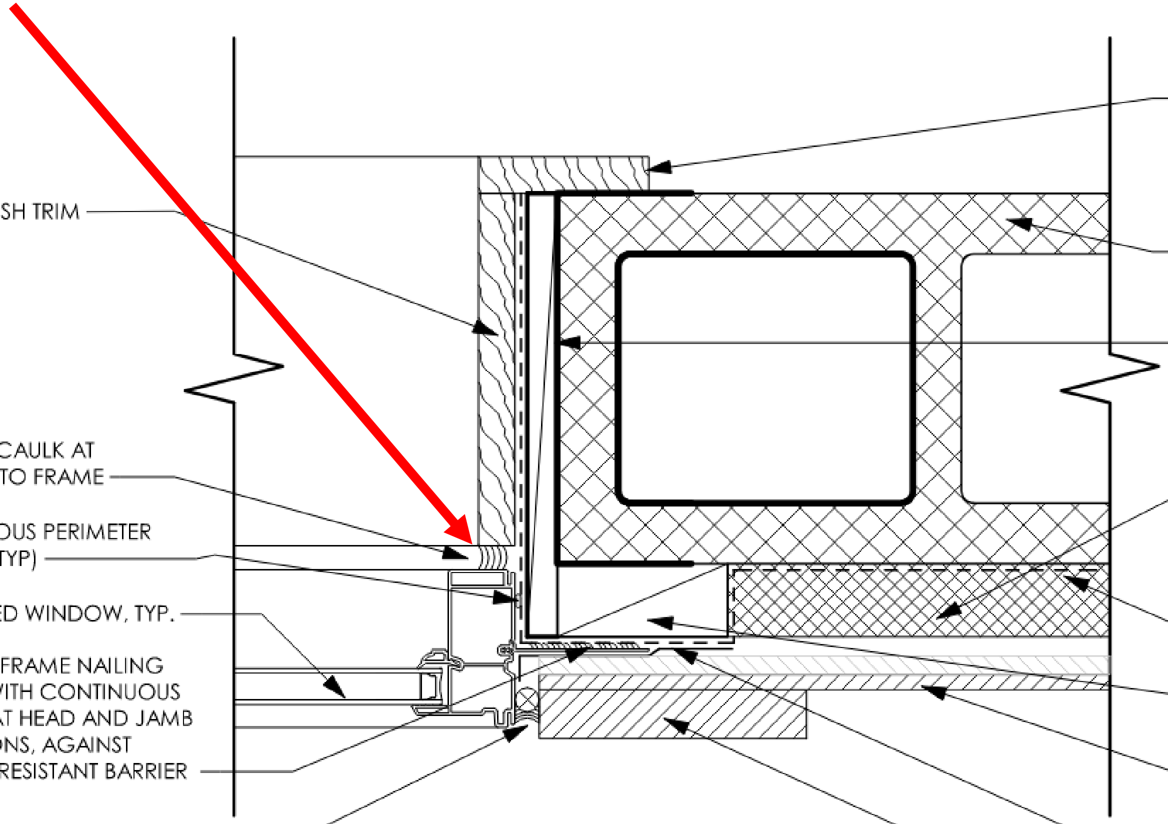


1 WINDOW SILL DETAIL (CMU) AT FIBER CEMENT PANEL & TRIM

3" = 1'-0"



ETAIL AT F.C. BOARD & TRIM



1 X 4 FINISH TRIM

1 X 8 FINISH TRIM

8" CMU, FINISHED
WITH INTERIOR PAINT

1/2" MIN. PLYWOOD, GC
TO COORDINATE CMU
ROUGH OPENING WITH
WOOD BLOCKING

PAINTERS CAULK AT
DRYWALL TO FRAME

1-1/2" CONTINUOUS
INSULATION

CONTINUOUS PERIMETER
SEALANT (TYP)

SCHEDULED WINDOW, TYP.

CONTINUOUS COLD FLUID APPLIED WEATHER
BARRIER OVER CMU AND WINDOW BLOCKING
AND EXTENDED INTO OPENINGS

WINDOW FRAME NAILING
FLANGE WITH CONTINUOUS
SEALANT AT HEAD AND JAMB
CONDITIONS, AGAINST
WEATHER RESISTANT BARRIER

P.T. 2X BLOCKING FOR
WINDOW ATTACHMENT

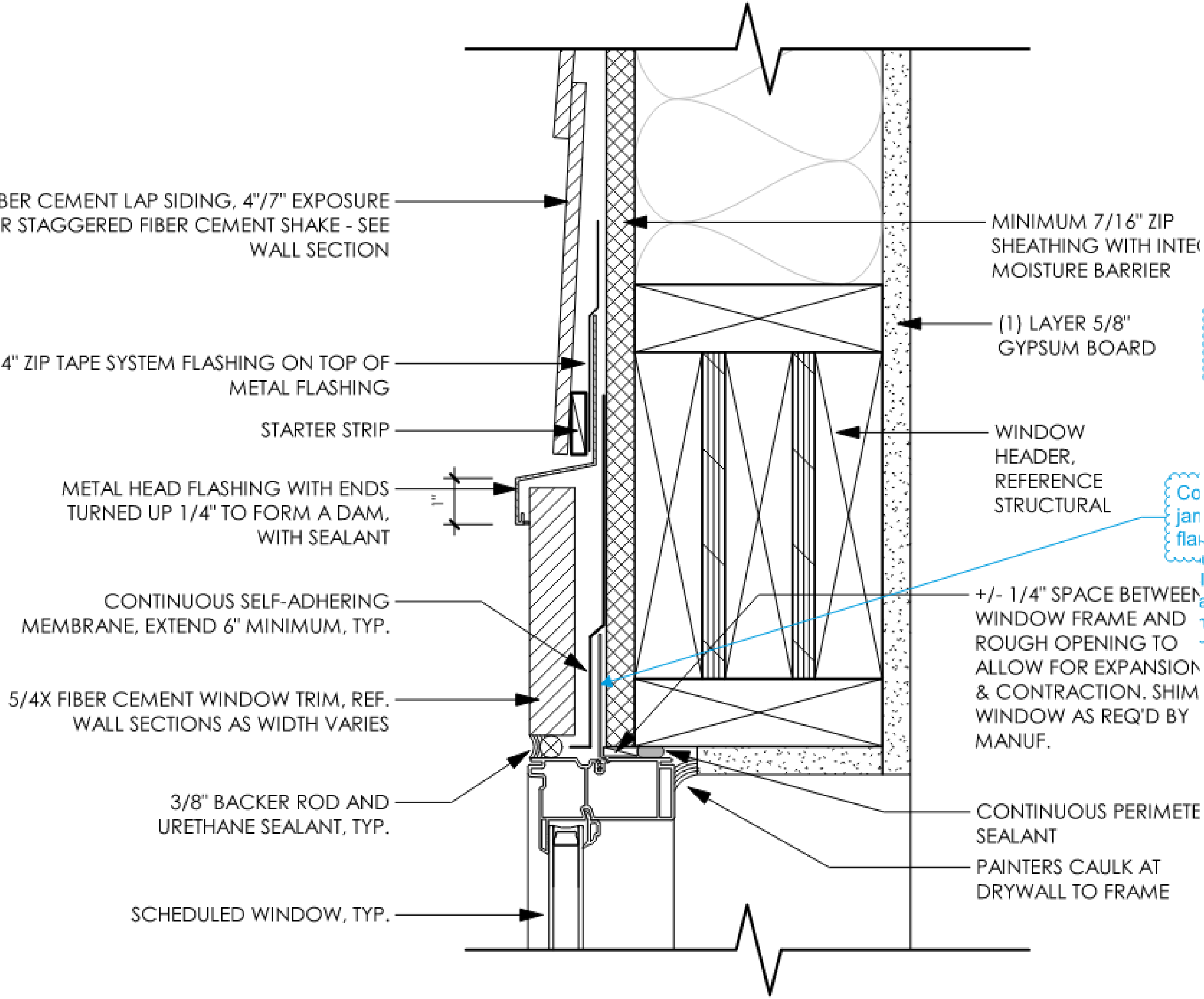
5/16" FIBER CEMENT PANEL
ON 3/8" FURRING STRIPS

3/8" SILICONE BACKER
ROD AND SEALANT, TYP.

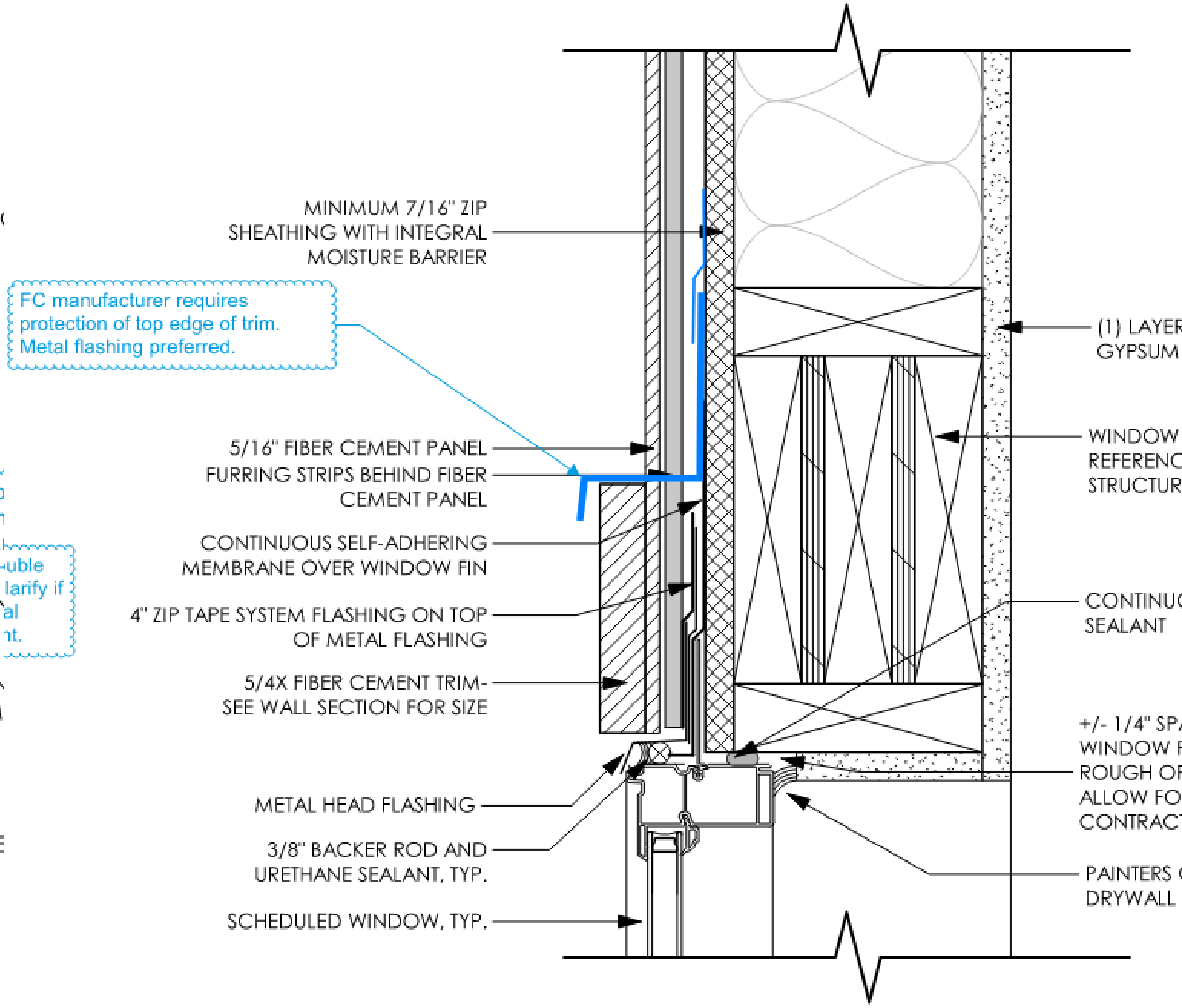
LIQUID FLASHING OVER NAILING
FIN/AIR BARRIER

5/4X FIBER CEMENT TRIM, REF. WALL
SECTIONS AS WIDTH VARIES

③ WINDOW JAMB DETAIL (CMU) AT FIBER CEMENT PANEL & TRIM
3" = 1'-0"



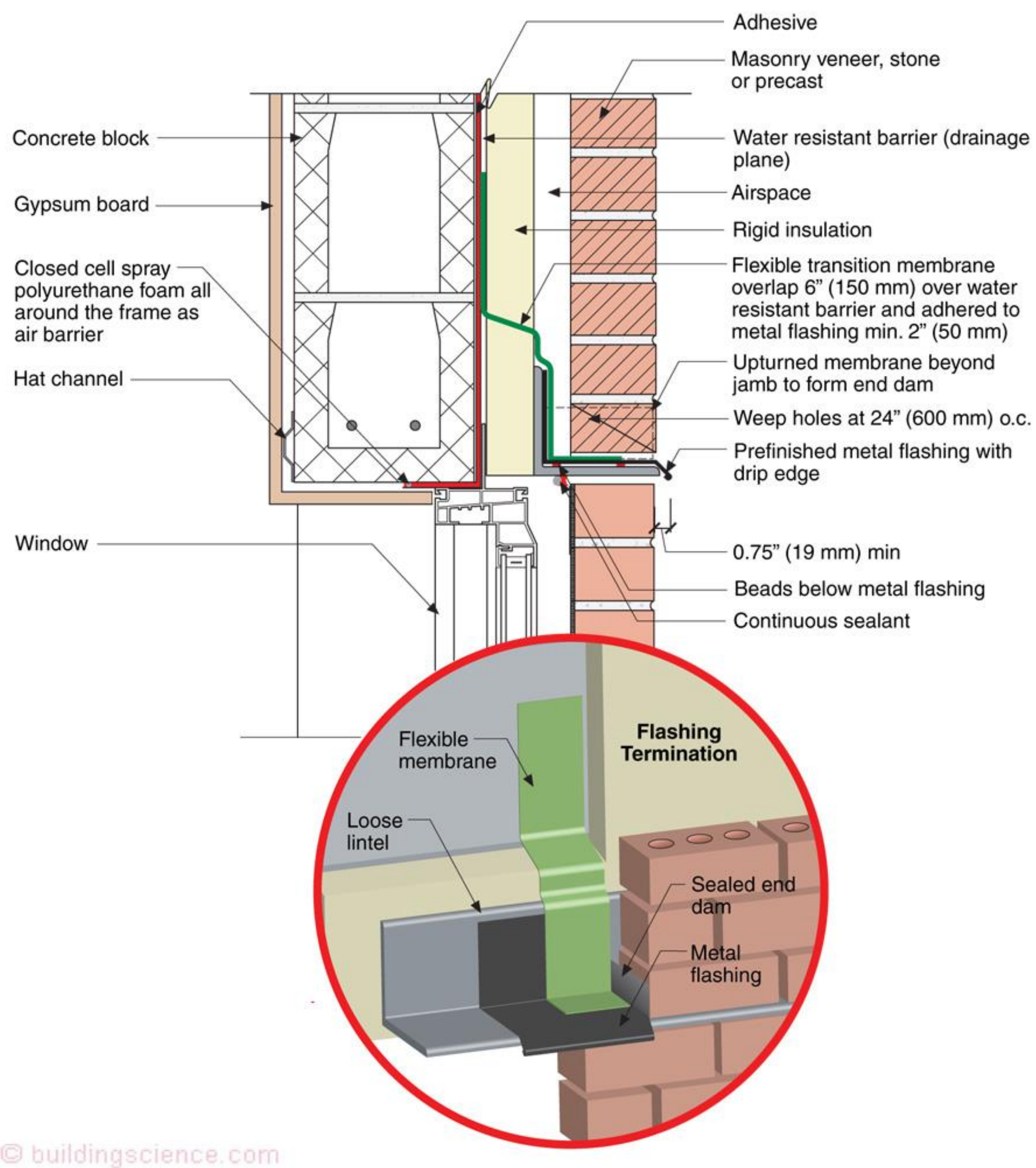
② WINDOW HEAD DETAIL AT F.C. LAP SIDING & TRIM
3" = 1'-0"



⑤ WINDOW HEAD DETAIL AT F.C. BOARD & TRIM
3" = 1'-0"

ThermalBuck

BSI-062: ***Thermal Bridges Redux***



From Data to Install:
A Guide for Your Window Journey

Keith A. Simon, FAIA, CPHC, BECxP, CxA+BE, LEED AP, CEI
VP Design Phase Services, Salas O'Brien
Adjunct Faculty UT School of Architecture

keith.simon@salasobrien.com
512.800.4485
@buildingthoughts on instagram

October 22, 2024

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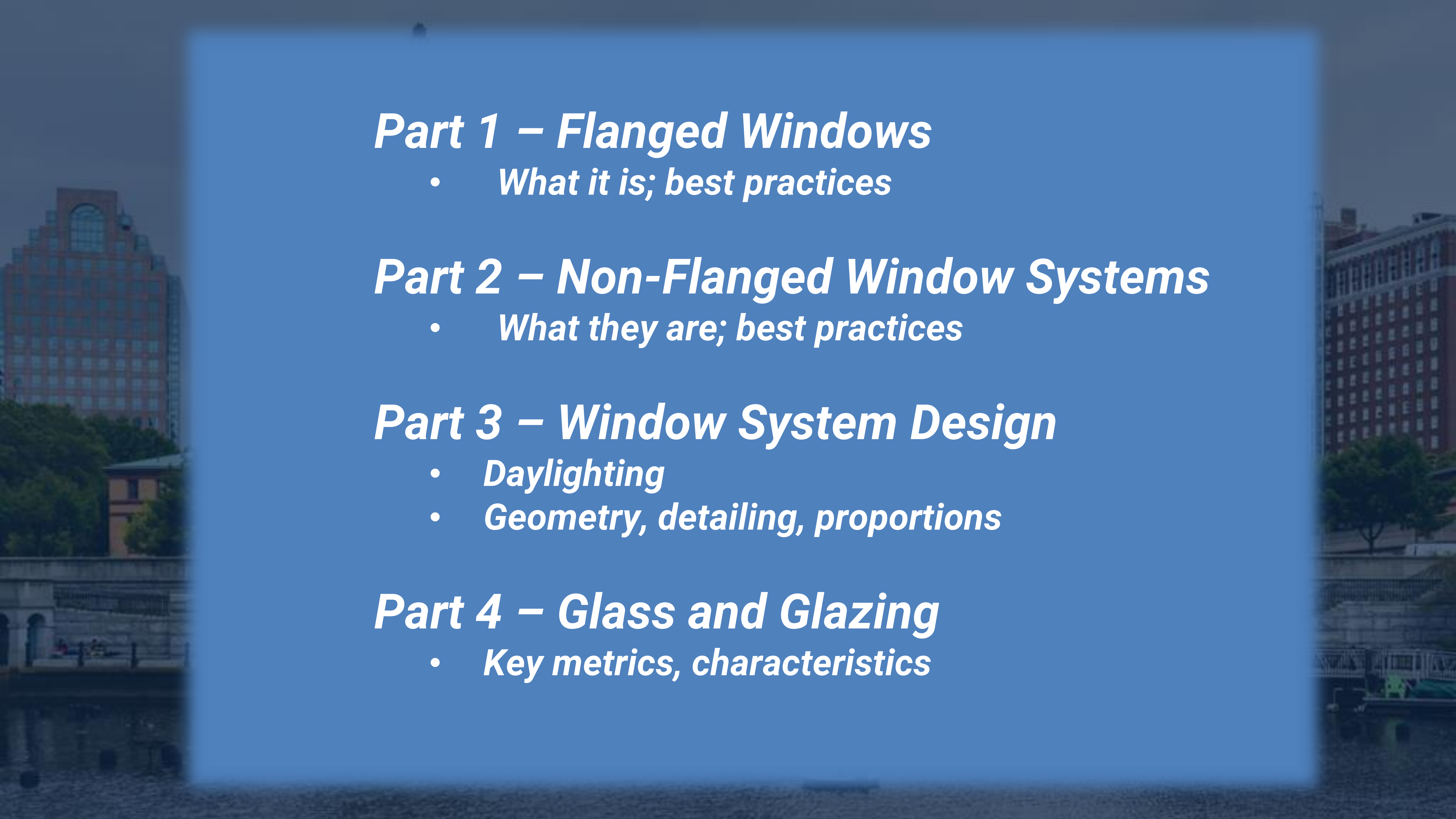
October 22, 2024



Part 1 – Flanged Windows

- *What it is; best practices*

Part 2 – Non-Flanged Window Systems

- *What they are; best practices*

Part 3 – Window System Design

- *Daylighting*
- *Geometry, detailing, proportions*

Part 4 – Glass and Glazing

- *Key metrics, characteristics*

Part 1 – Flanged Windows

- *What it is; best practices*

Part 2 – Non-Flanged Window Systems

- *What they are; best practices*

Part 3 – Window System Design

- *Daylighting*
- *Geometry, detailing, proportions*

Part 4 – Glass and Glazing

- *Key metrics, characteristics*

What is *daylighting?*

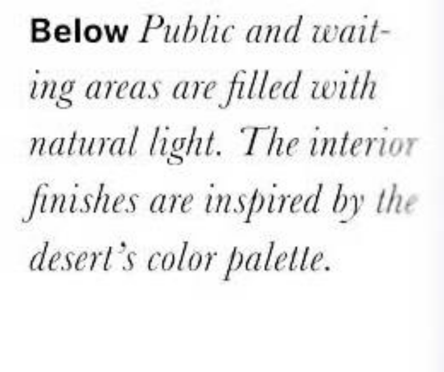
The ***controlled*** distribution of natural light in a space

What is *daylighting?*

NOT:
sunlight

Texas Architect Magazine

September/October 2013

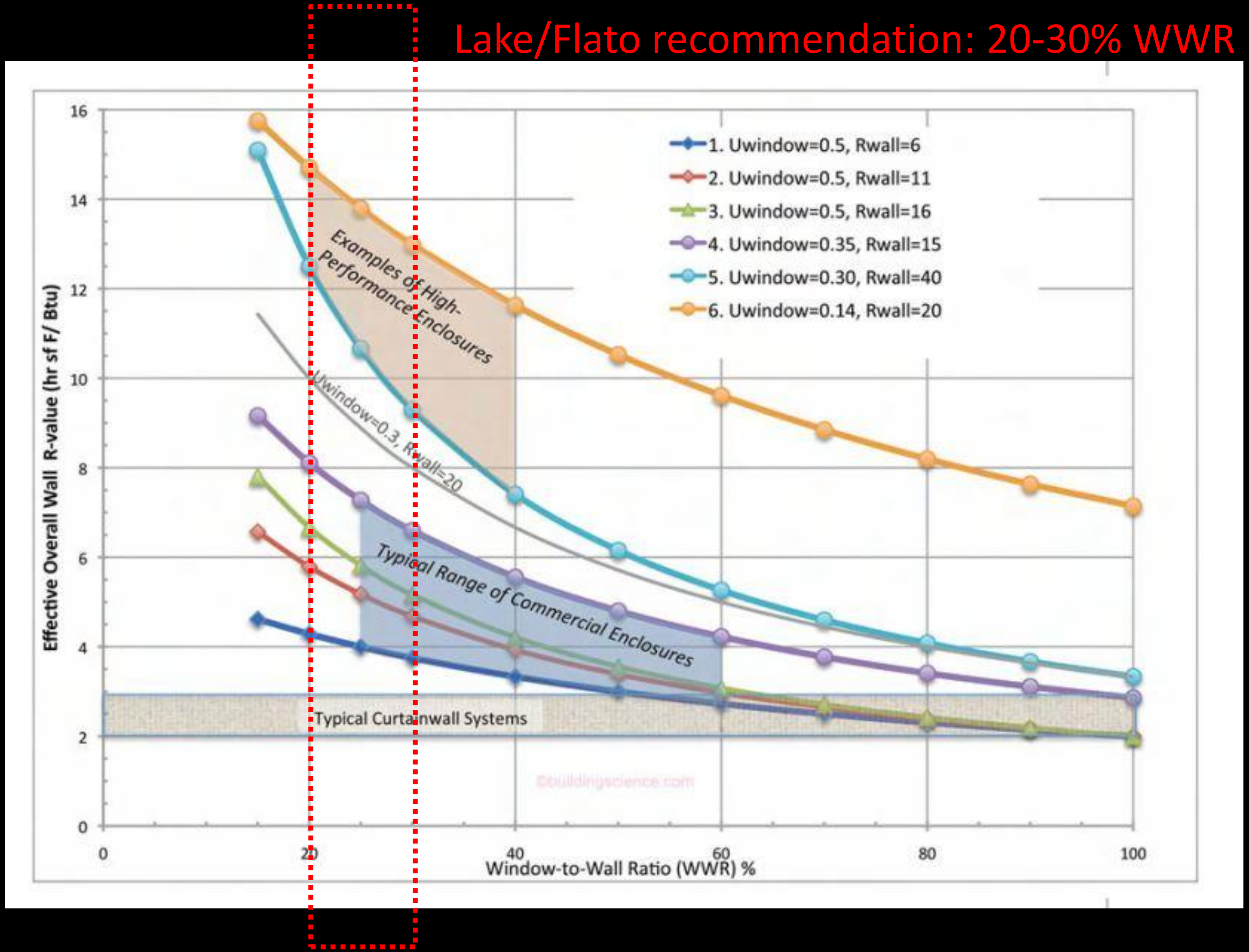


Below *Public and waiting areas are filled with natural light. The interior finishes are inspired by the desert's color palette.*

What is *daylighting?*

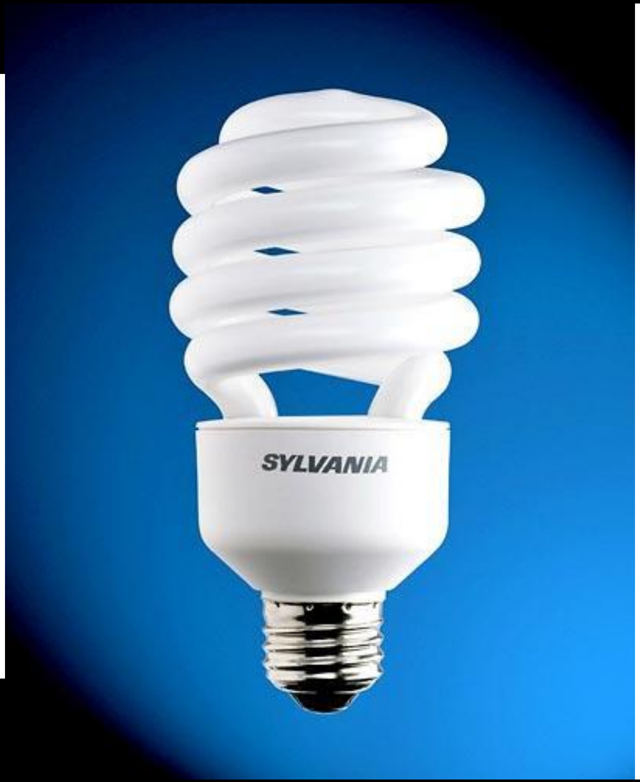
Can Highly Glazed Building Facades Be Green

by John Straube, BSI-006, 2008



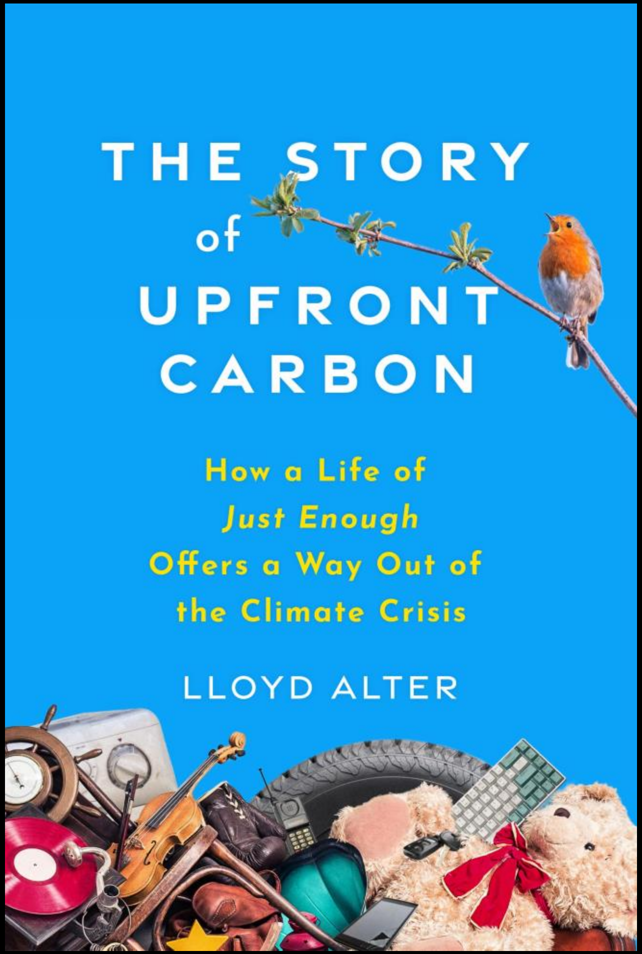
Lake/Flato recommendation: 20-30% WWR

www.GeigerCars.de
HUMMER
www.GeigerCars.de
NewCarWallpaper.com


SYLVANIA


PHILIPS

Lloyd Alter ***The Story of Upfront Carbon*** – Use Less!!!



Why is daylighting so important?

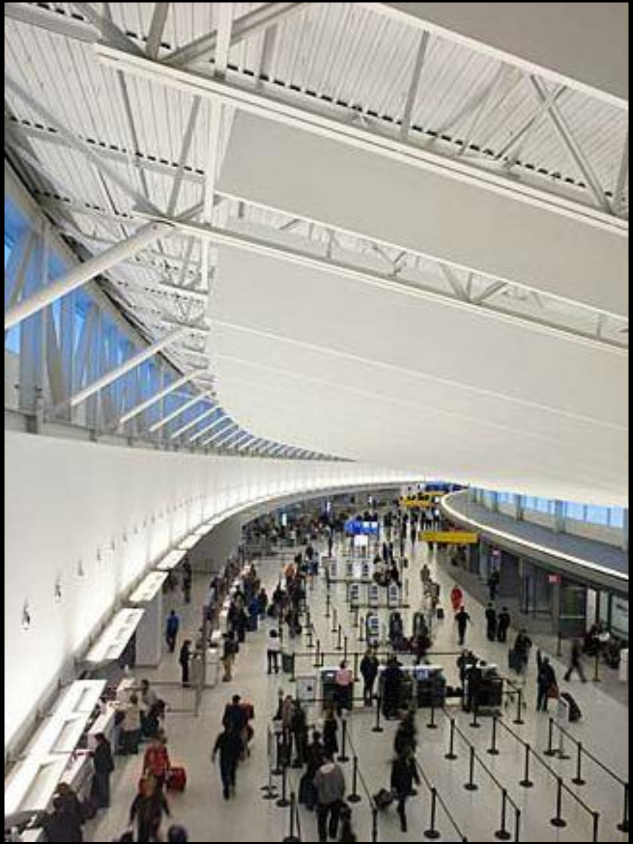
- Energy Efficiency
- Health
- Productivity
- (Almost) Perfect Color Rendering

How does daylighting save electricity?

Rainha Santa Isabel Secondary School/Oficina - Ideias em Linha


DIRECTV
1049.99
699.99
729.99
399.99
899.99
399.99
5.99
Canon
Nikon
COOLPIX
TEXAS
ANGING THE WORLD OF
EOSCIENCES

Jet Blue terminal at JFK

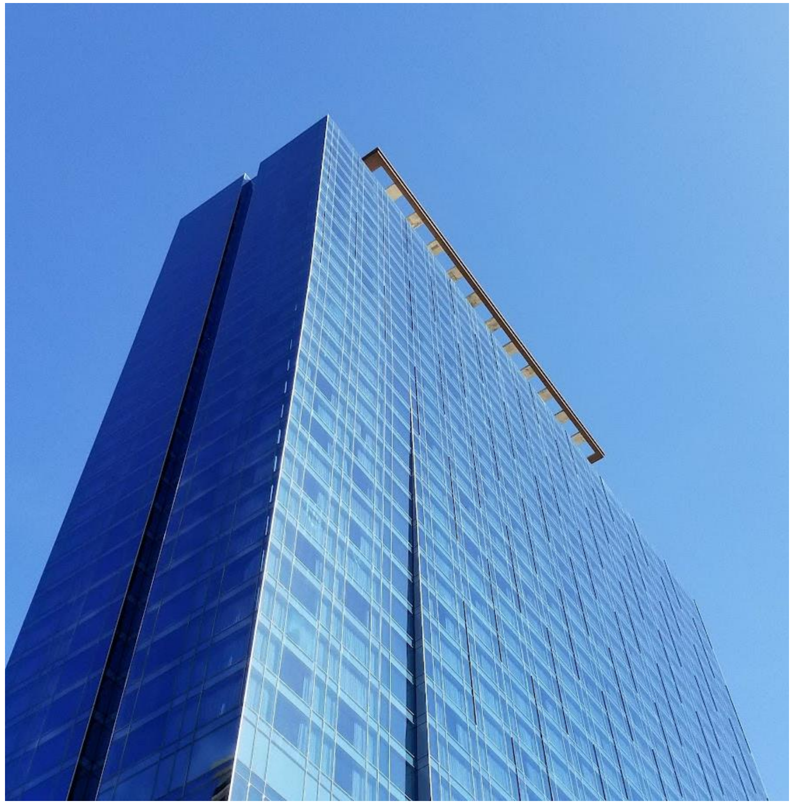



Bag Drop
CRMP
UNITED
Economy
Newark

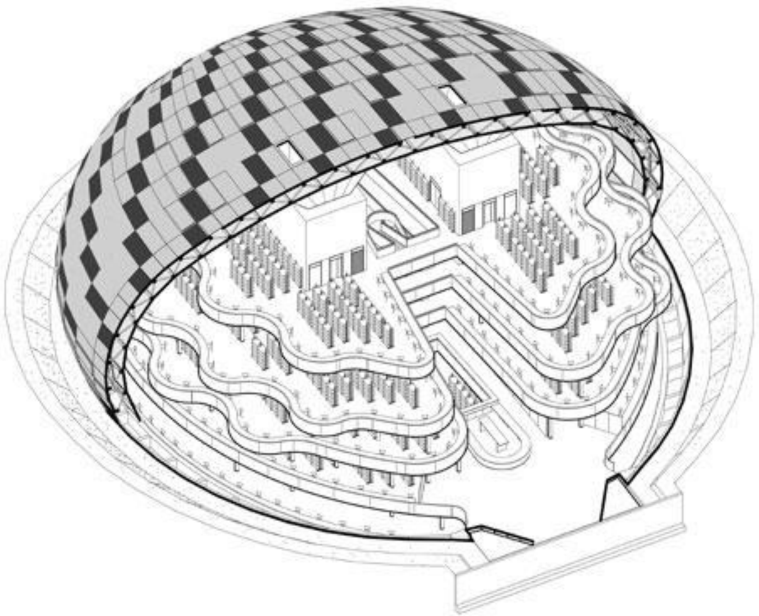
Basic Daylighting Strategies

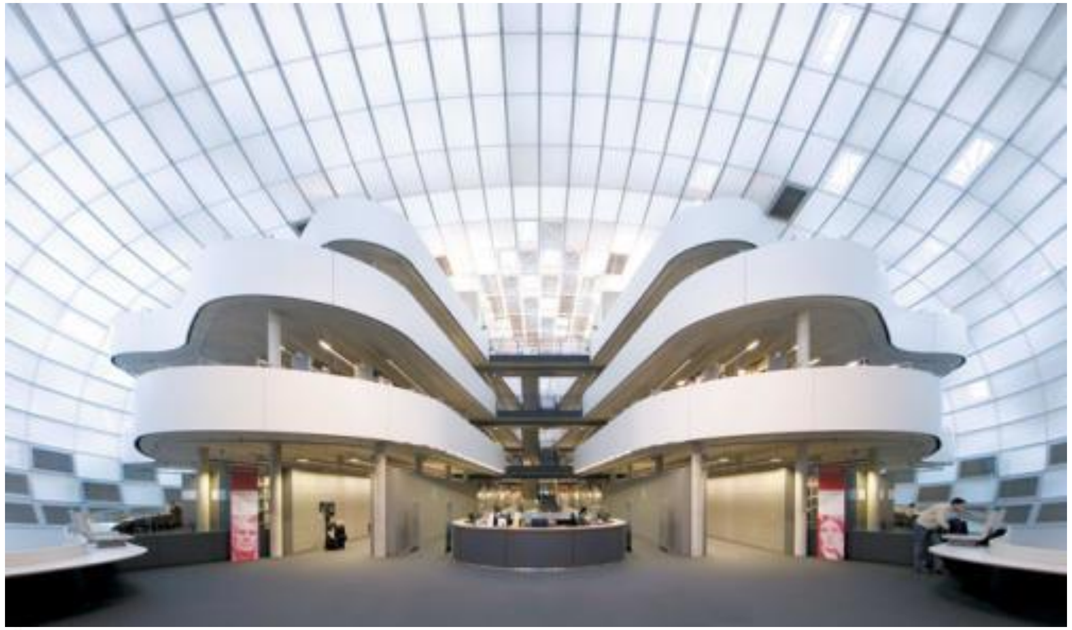
- **Solar Geometry**
- Sidelighting
- Toplighting
- Form
- Programming
- Space Planning
- Surface Reflectances

Solar Geometry

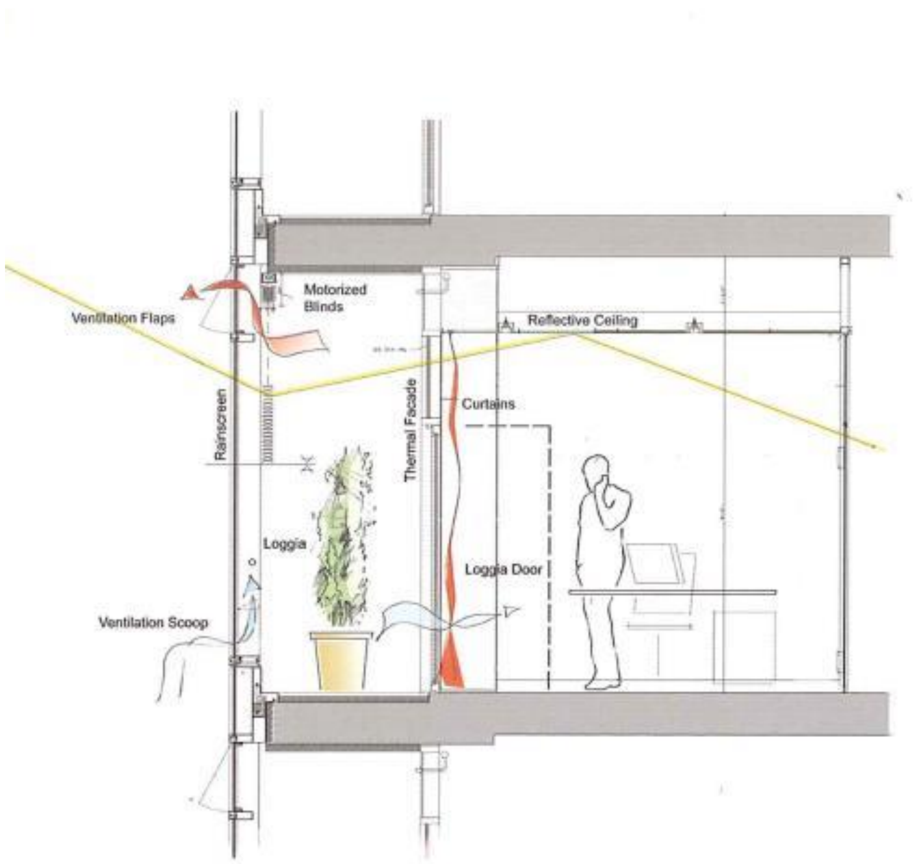


Free University Library, Norman Foster

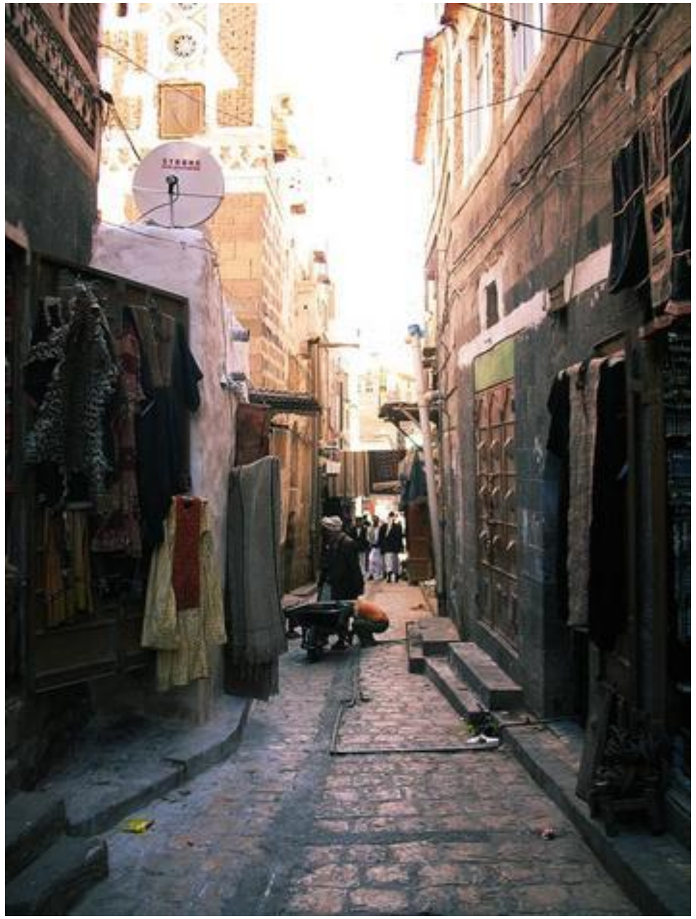




Genzyme Center, Stefan Behnisch

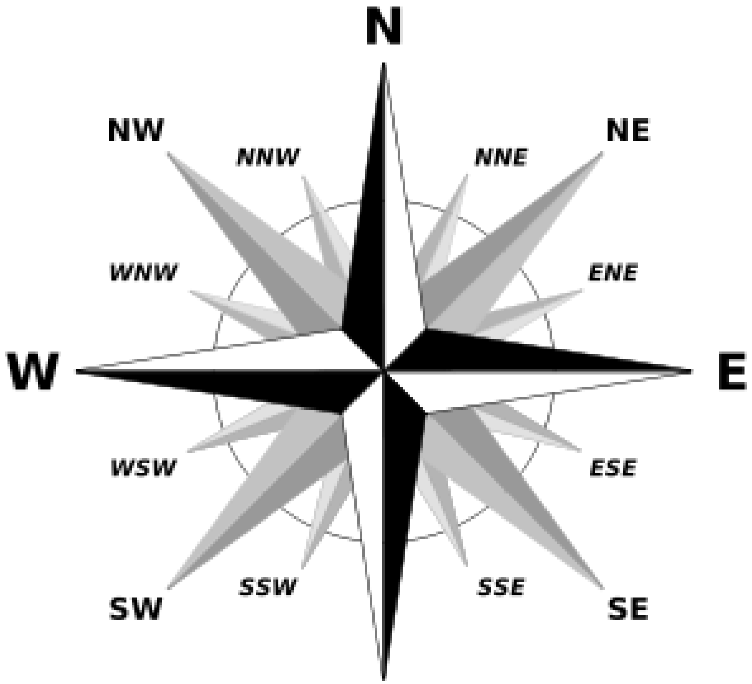


Sana’a, Yemen



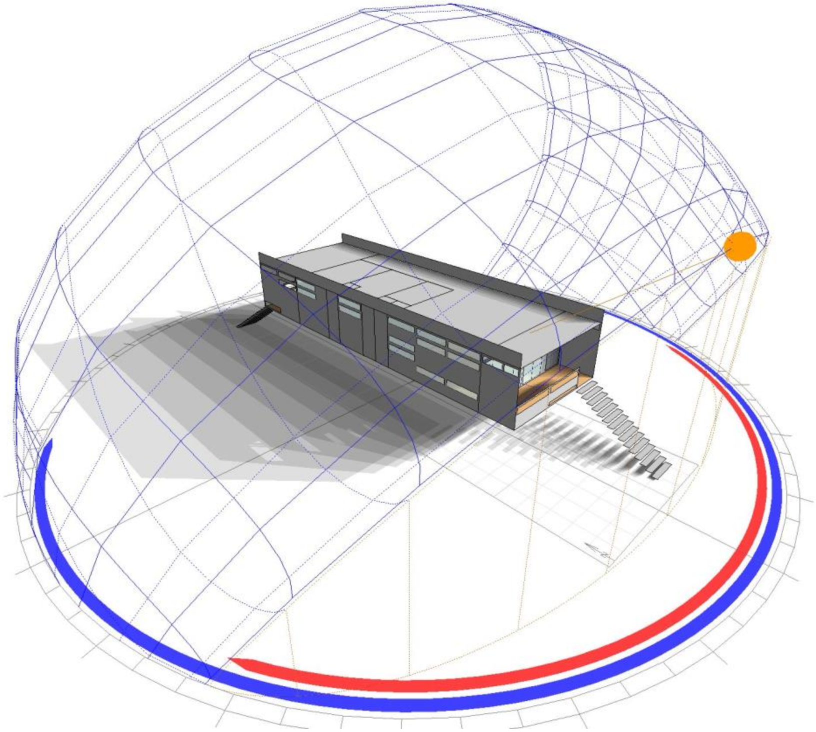
Solar Development, Georg Reinberg, Vienna

Southern Orientation



S

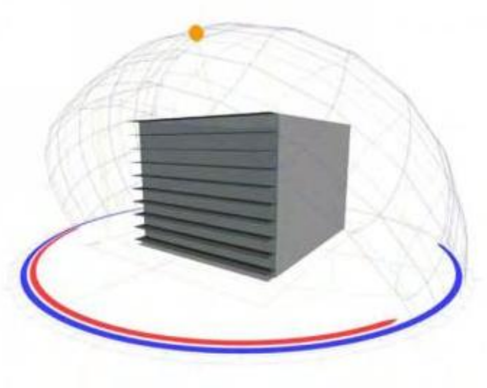
Southern Orientation



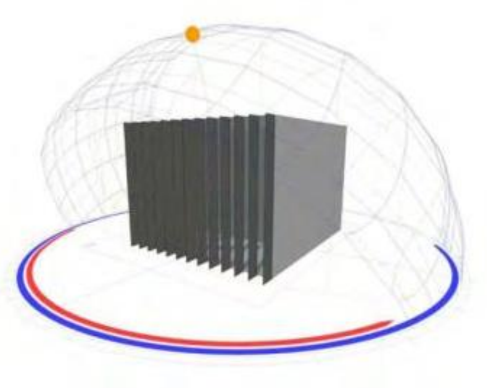
A Pattern Language, Alexander, pattern #128: *Indoor Sunlight*

From UTSoA Facade Thermal Lab:

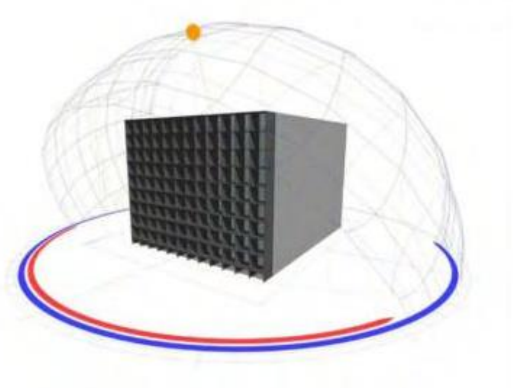
Stefan Bader
Dr. Werner Lang
Professor Matt Fajkus, Thermal Lab Director



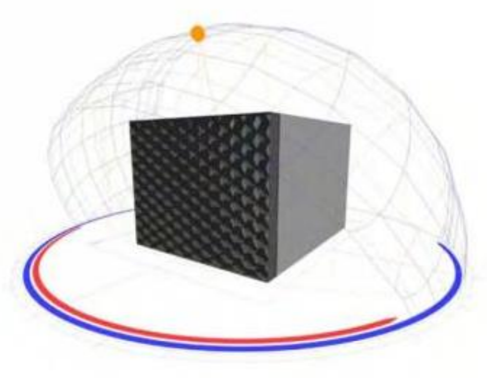
a) Horizontal shading devices



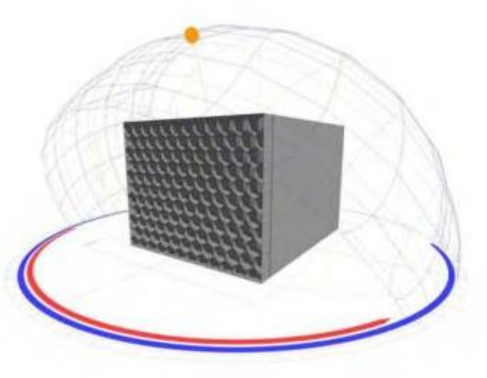
b) Vertical shading devices



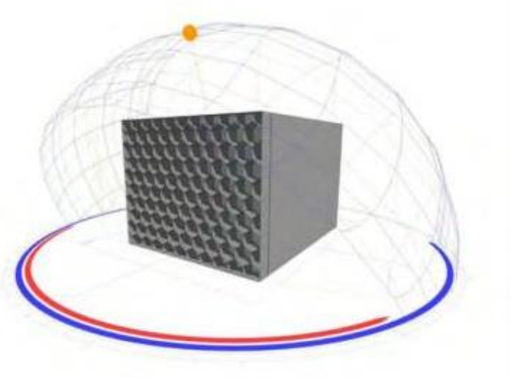
c) Eggcrate shading structure - square



d) Honeycomb shading structure - horizontally oriented

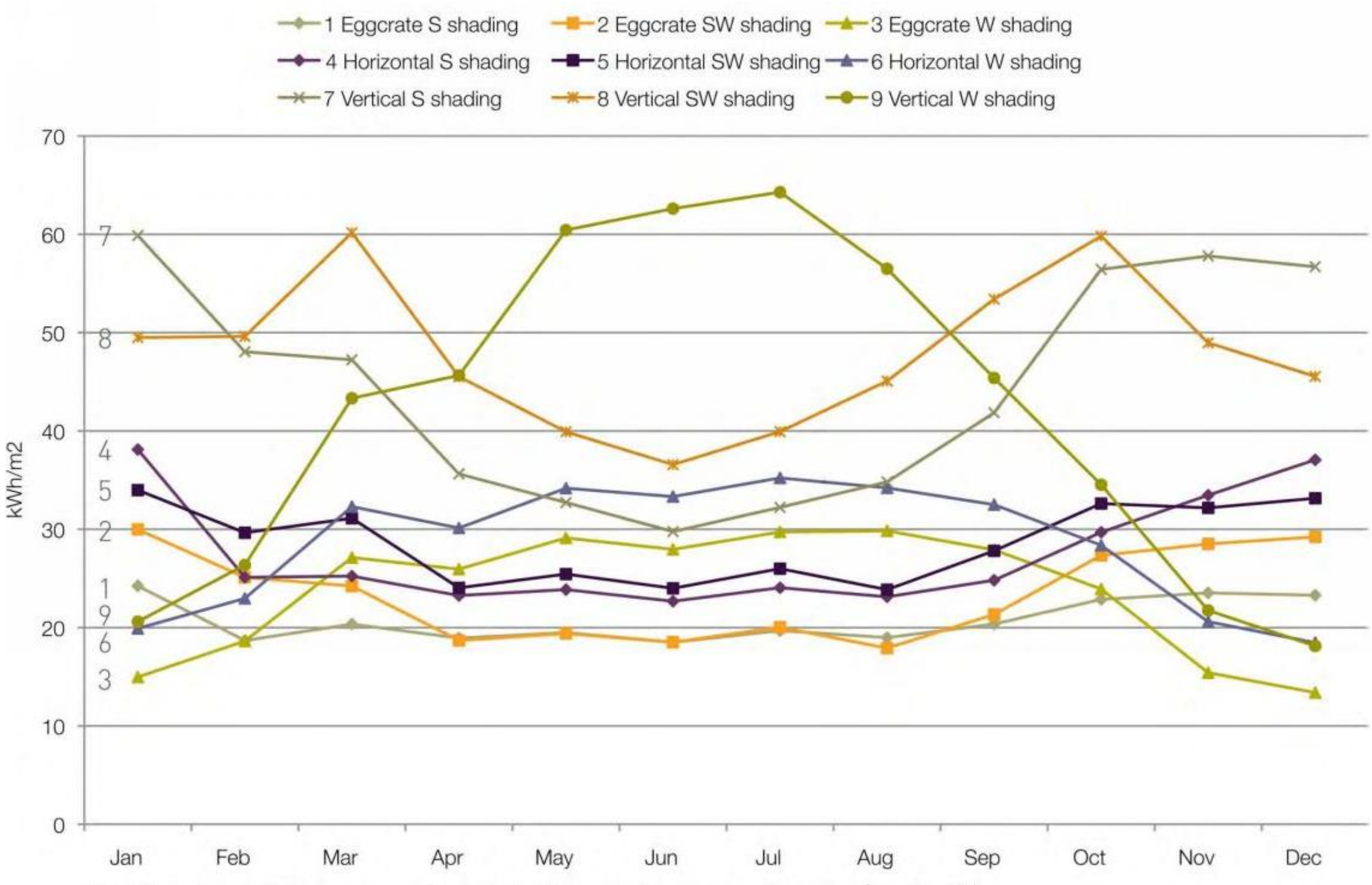


e) Honeycomb shading structure - vertically oriented



f) Honeycomb shading structure - vertically oriented - 4' circumference

From UTSoA Facade Thermal Lab:
Stefan Bader
Dr. Werner Lang
Professor Matt Fajkus, Thermal Lab Director



Monthly solar radiation - comparison of shading structures per orientation (Austin, TX)

Don’t be this guy!

South Elevation; 12pm October 10th; Austin, TX

Noon South Summer

5pm
South
June 5

Don’t be this guy either!

East
Summer

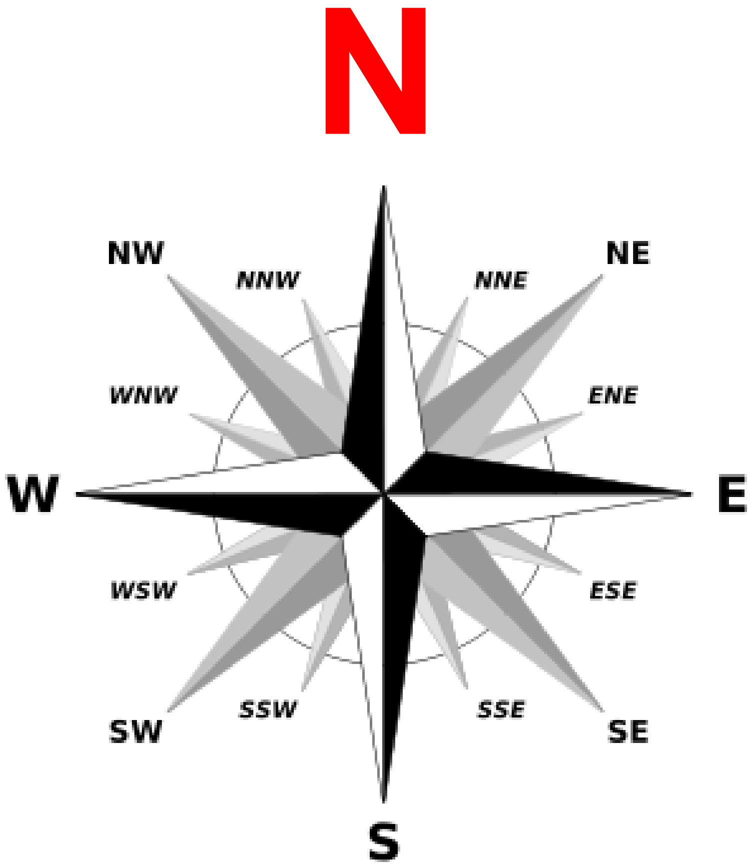
Yikes!

2:30pm
South
June 17

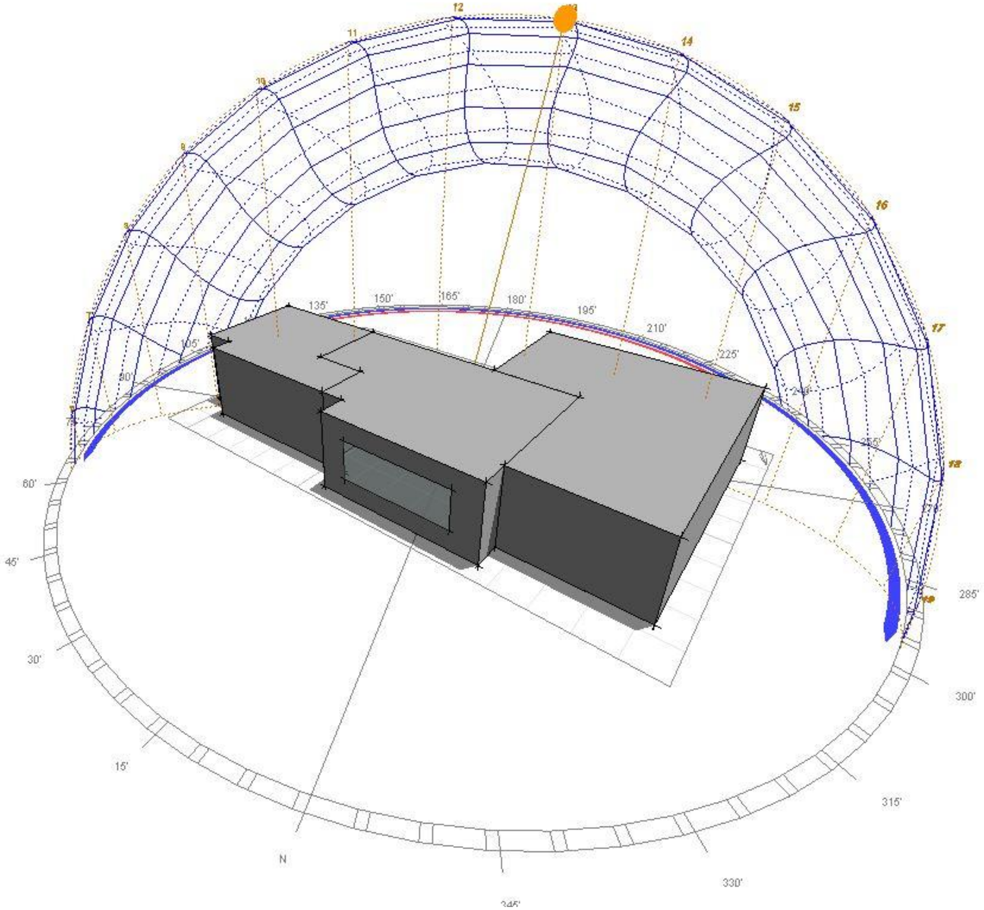
South, SW Elevations; 3pm September 29th; Austin, TX

2:30pm
South
June 17

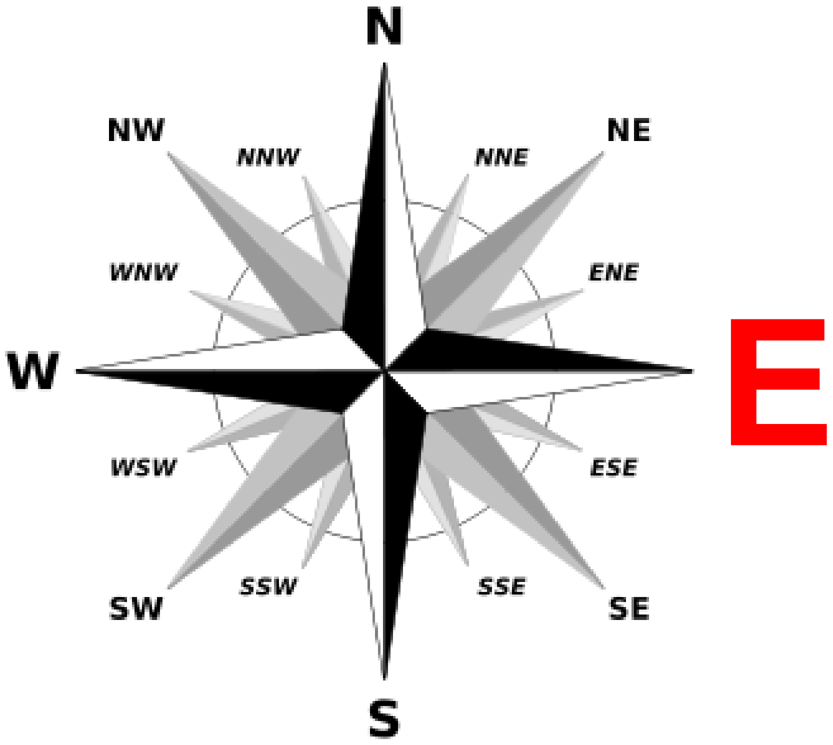
Northern Orientation

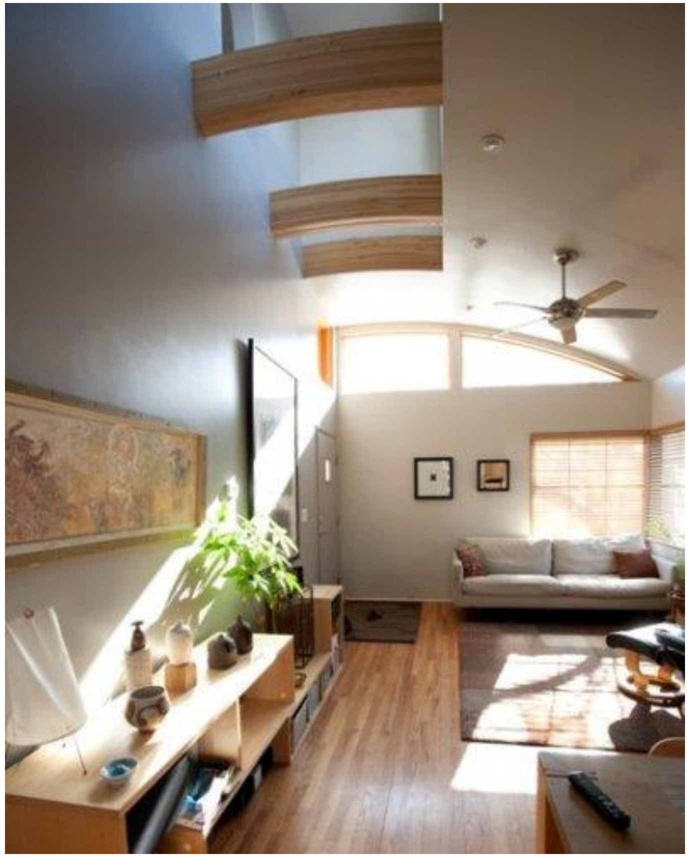


Northern Orientation

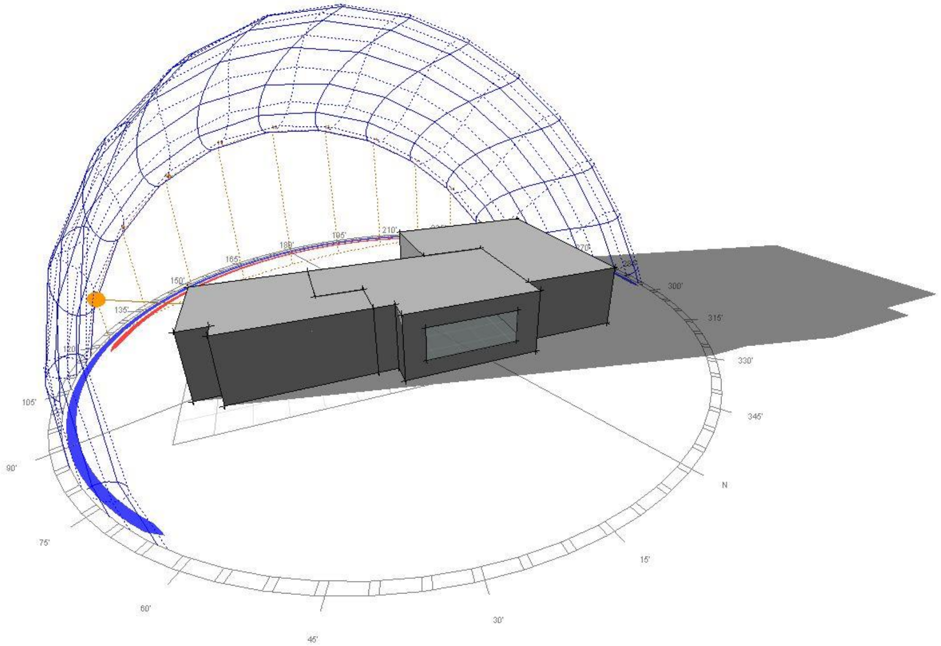


Eastern Orientation





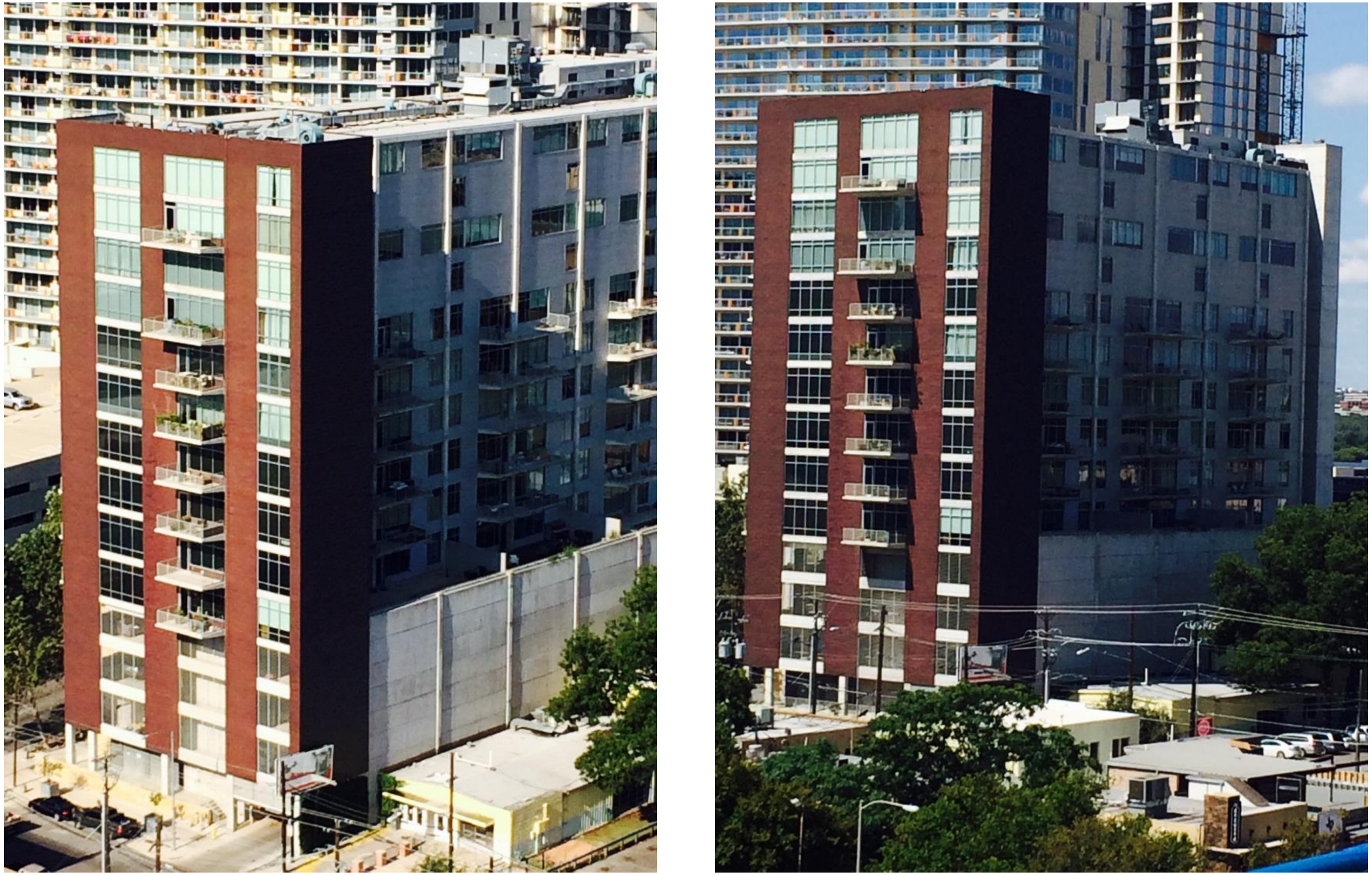
Eastern Orientation



A Pattern Language, Alexander, pattern #138: *Sleeping to the East*

10:00am
East
July 2

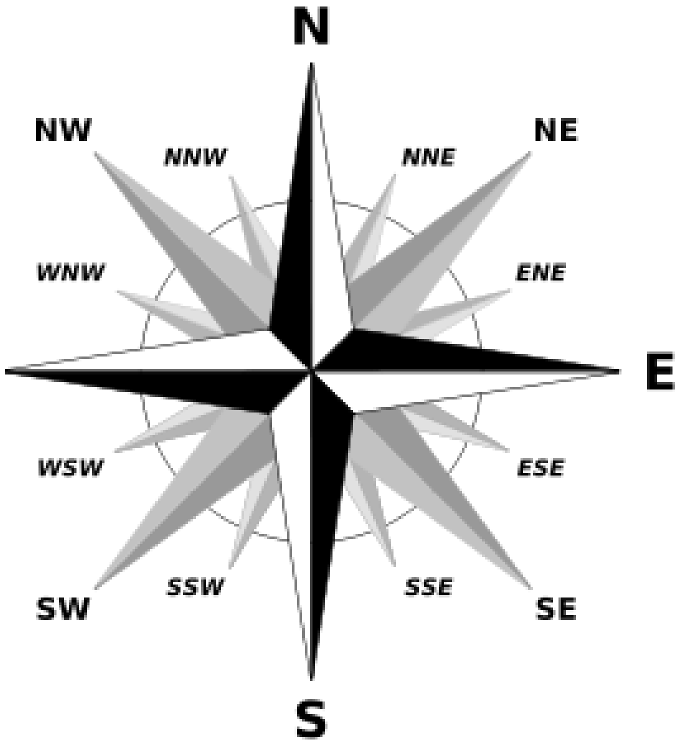
10am, 12pm
East
September 8



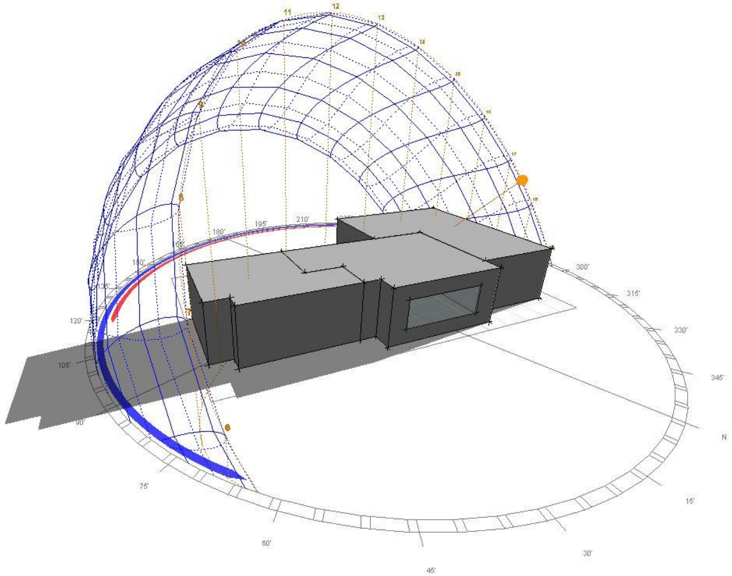
8:45 am
SE
October 17, Austin

Western Orientation

W



Western Orientation

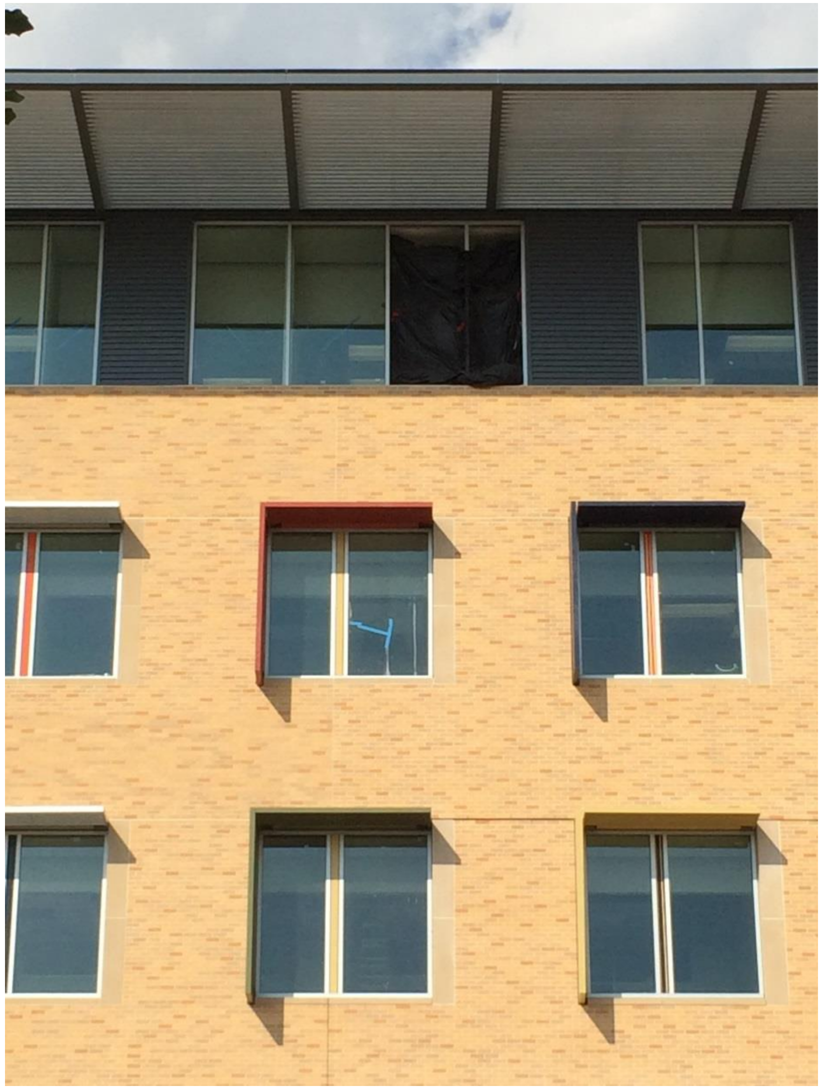


4:15pm
West
August 12

7pm
West
July 12

5:00 pm, Overcast
SE, SW
July 24

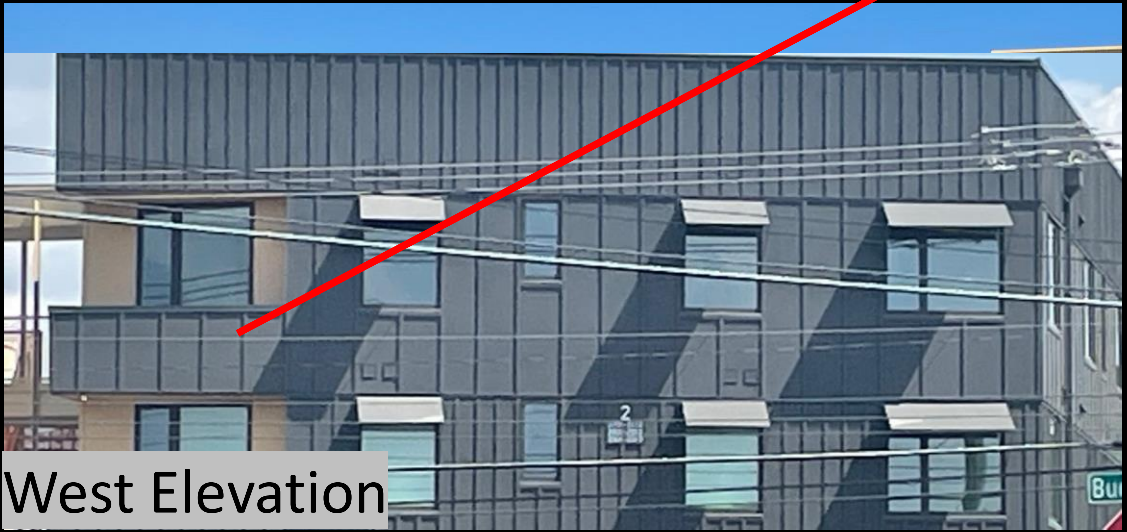
5:30 pm
SW
July 24




Southeast
Southwest Elevation

5:30pm West Sept. 4th

North Elevation

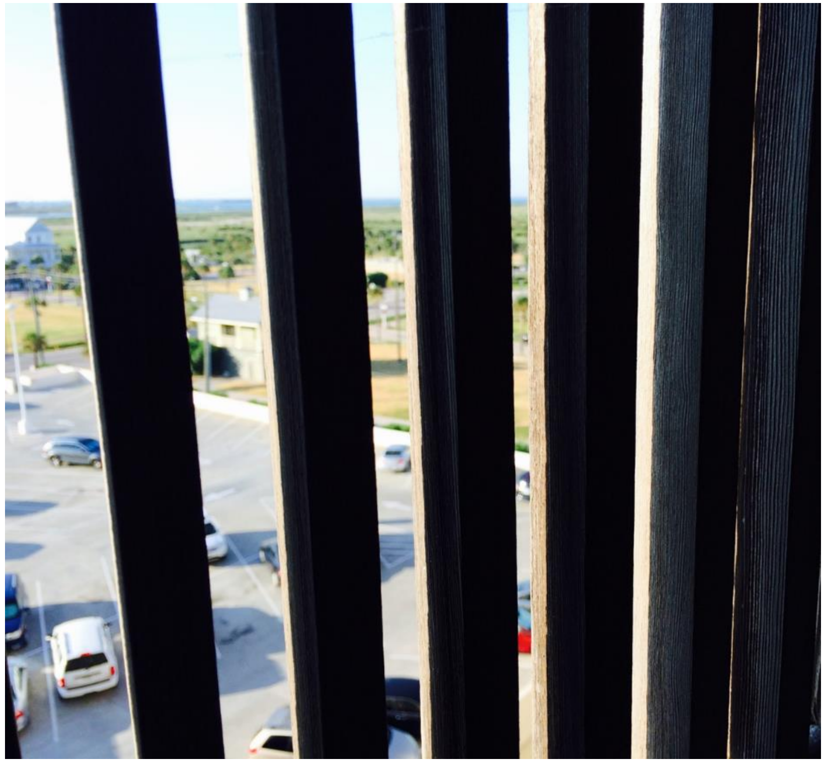


West Elevation

South Elevation

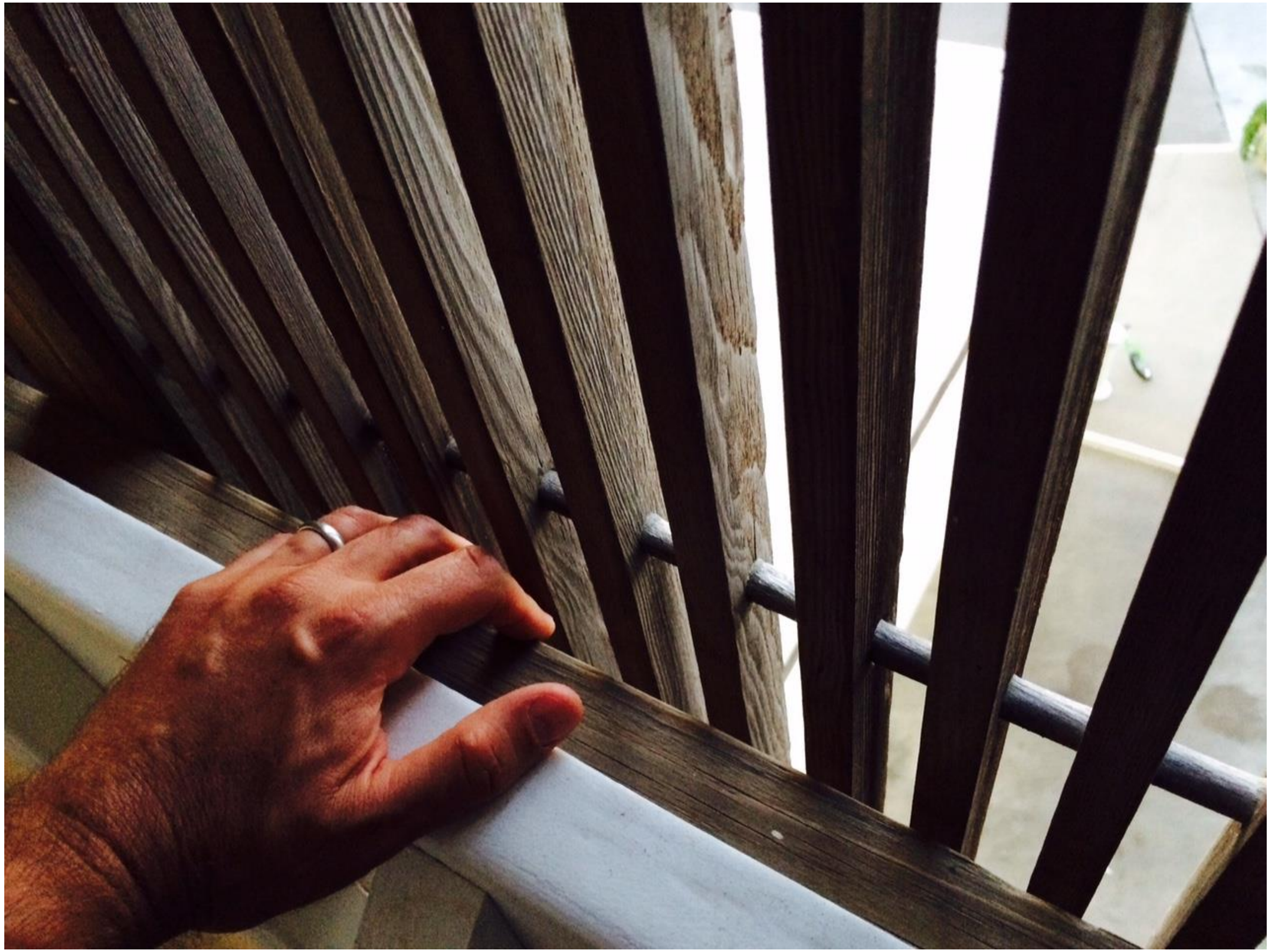
8:00 am
August 4
The Galvestonian – East

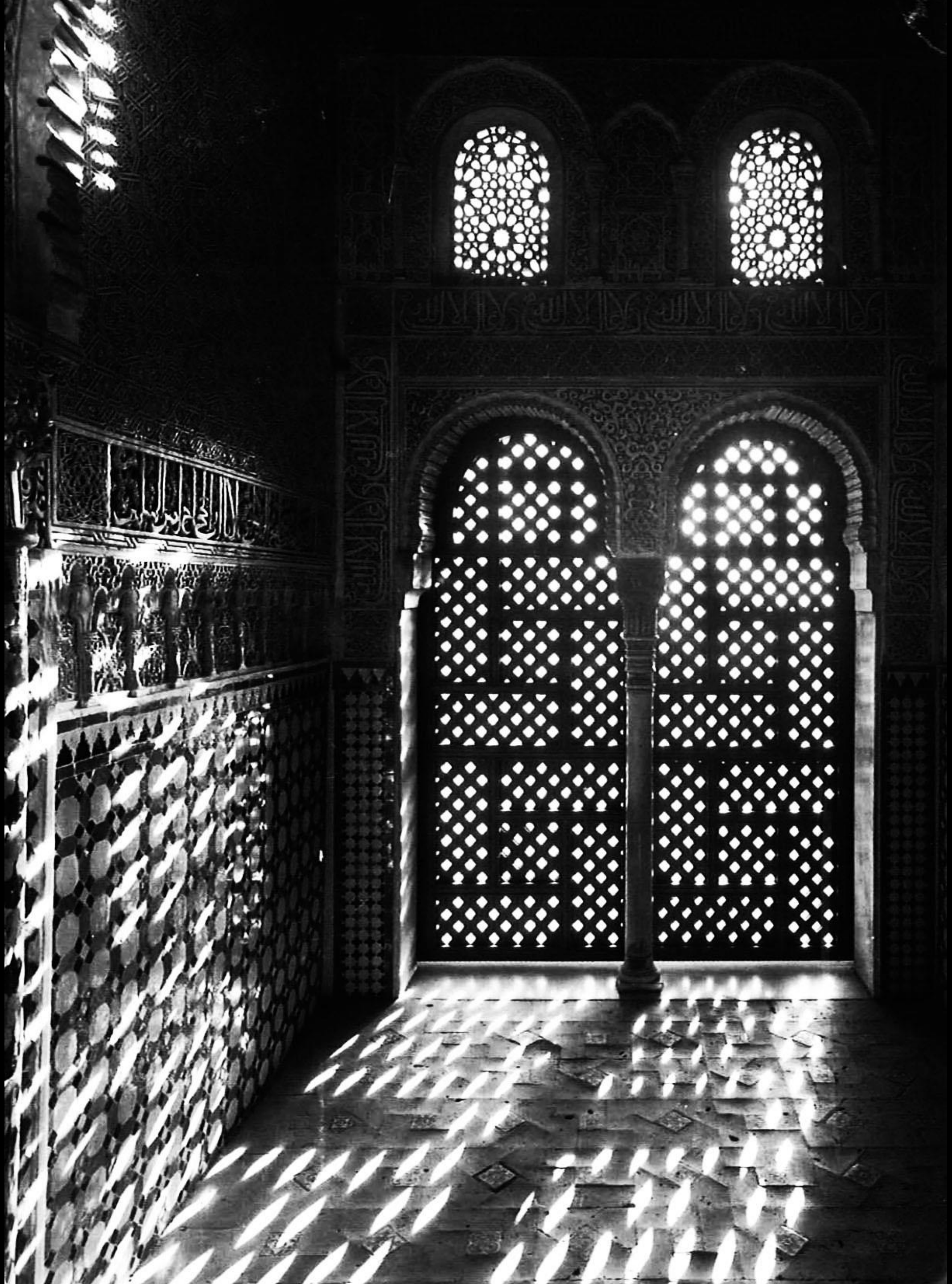
The Galvestonian – West Facade



The Galvestonian – West Facade

The Galvestonian – West Facade





Objectives: Toplighting & Sidelighting

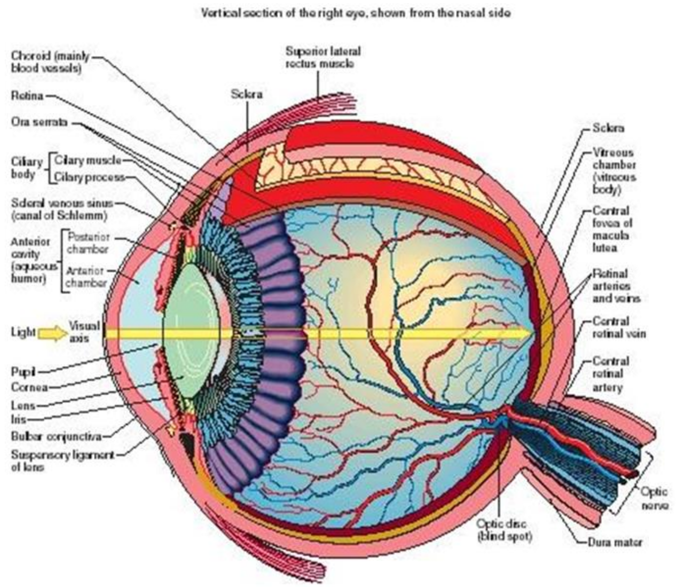
- Solar Geometry
- **Sidelighting**
- **Toplighting**
- Form
- Programming
- Space Planning
- Surface Reflectances

Perception of brightness:

1. **Luminance** of object

2. **Contrast**:
   - Brightness of adjacent objects
   - Luminance Ratios

3. **Biology of Individual**:
   - Health/Age
   - Accommodation
   - Adaptation (time dependent)



Vertical section of the right eye, shown from the nasal side

Eye Adapts to bright background leaving subject in sillouette, Fuller Moore

Mechanical and Electrical Equipment for Buildings, Kwok/Grondzik

Excessive luminance ratios

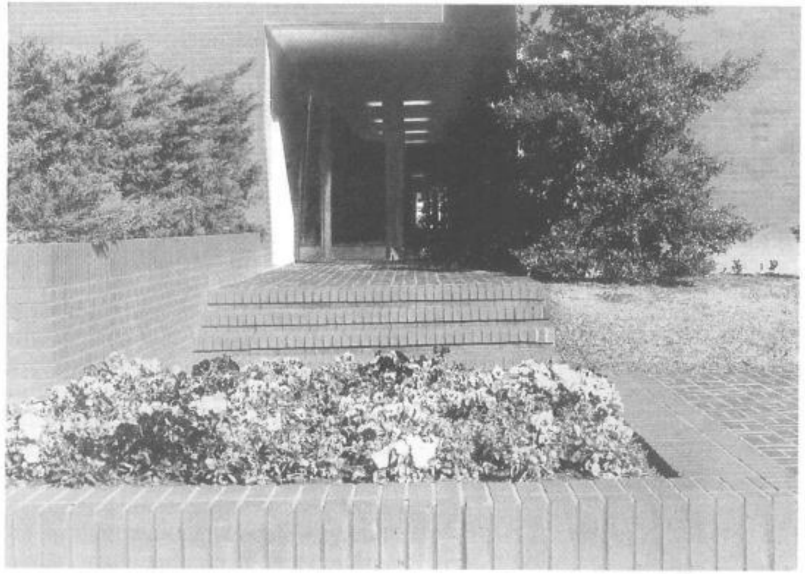
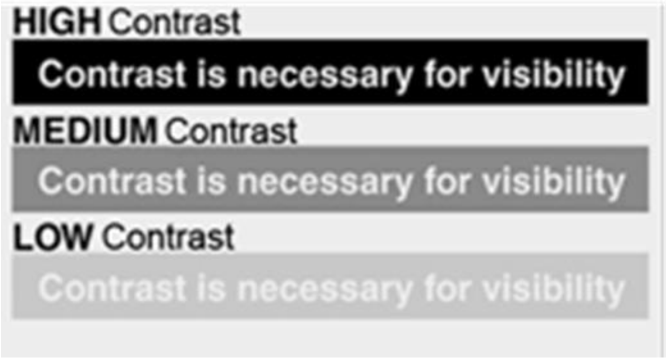


Figure 12.10a In this photograph, the camera was adjusted to correctly expose the high brightness of the exterior. We cannot see indoors because the brightness there is too low compared to the outdoors. This is a problem of excessive brightness ratios.

Figure 12.10b In this photograph, the camera was adjusted to correctly expose the interior. Consequently, we cannot clearly see the outdoor view because it is too bright compared to the interior. This is a problem of excessive brightness ratios.



HIGH Contrast

Contrast is necessary for visibility

MEDIUM Contrast

Contrast is necessary for visibility

LOW Contrast

Contrast is necessary for visibility

Heating, Cooling, Lighting, Lechner, page 417

Light Shelf

- Most effective on south façade
- East and west – must be longer
- Not effective on north

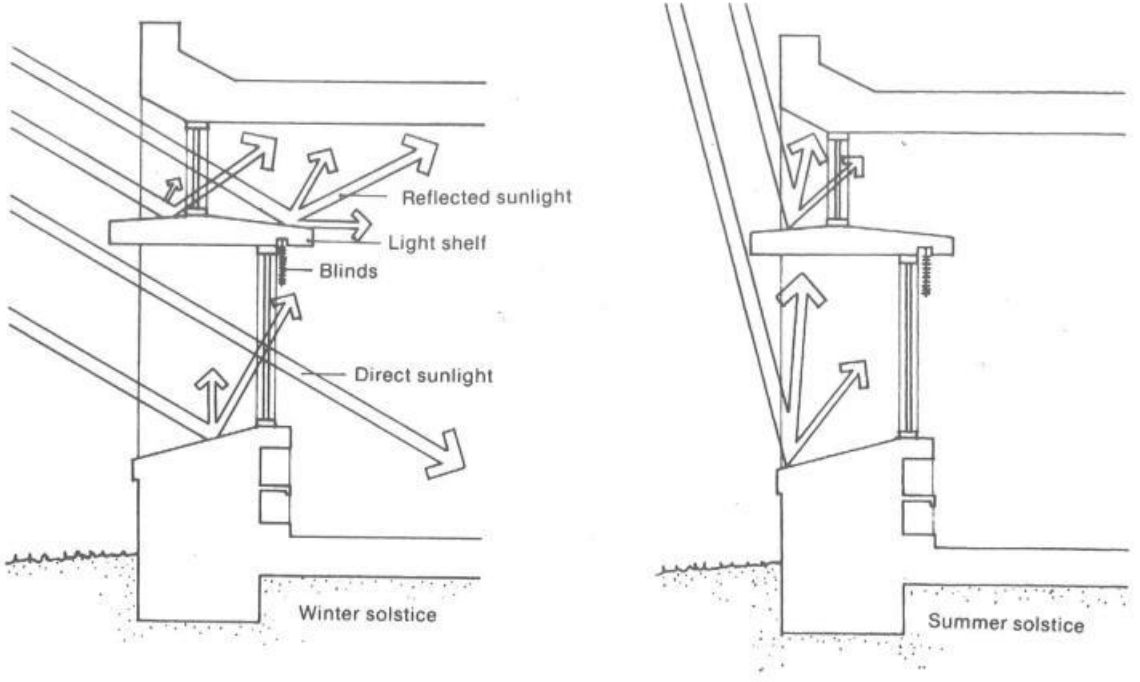


Figure 13.15n Sections through south windows of the Mt. Airy Public Library in North Carolina. More reflected sunlight can enter in the winter than the summer. [From *Passive Solar Journal*, Vol. 3(4). © American Solar Energy Society.]

Light Shelf

Light Shelf

Assessing Light Shelf and Optical Louver Systems in Multi-Story Office Buildings by Using Experimental Methods

Presented at ASES 2011 by Dr. Jianxin Hu, NC State University

Experiments test:

- Light Shelf Top Surfaces
- Partition Materials
- Placement of Partitions
- Ceiling Height
- Comparisons of the Light Shelf & FISCH system

Figure 1: Exterior Image of the Test Cell

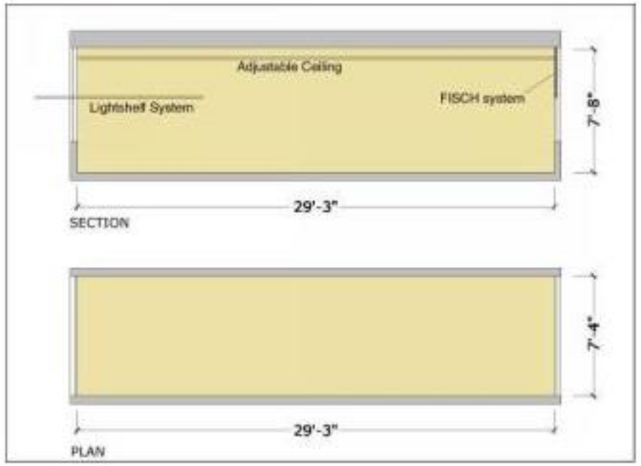


Figure 2: Interior Dimensions of the Test Cell

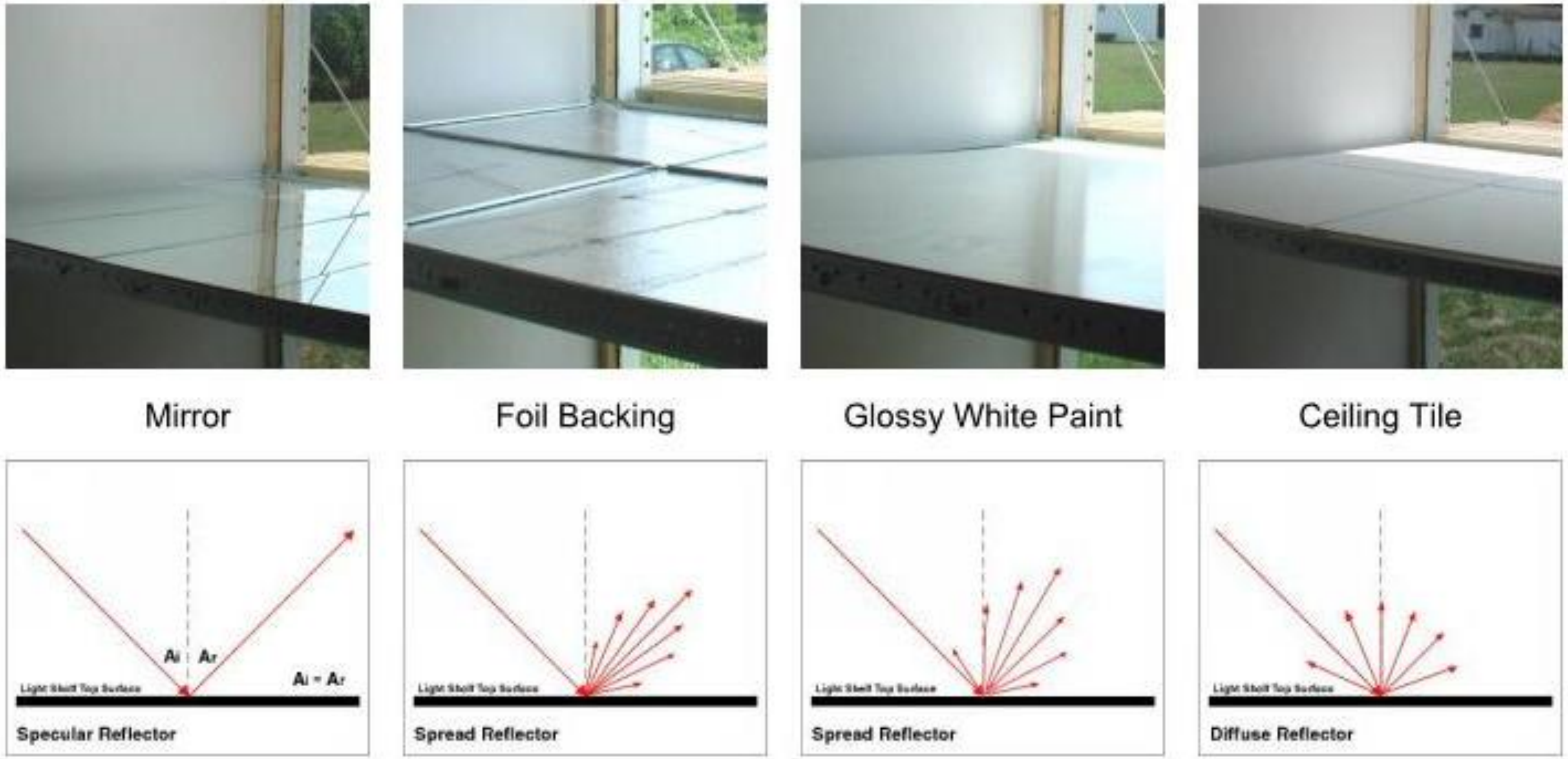


Figure 3: Four Reflectors and Their Optical Properties.

Assessing Light Shelf and Optical Louver Systems in Multi-Story Office Buildings by Using Experimental Methods

Presented at ASES 2011 by Dr. Jianxin Hu, NC State University

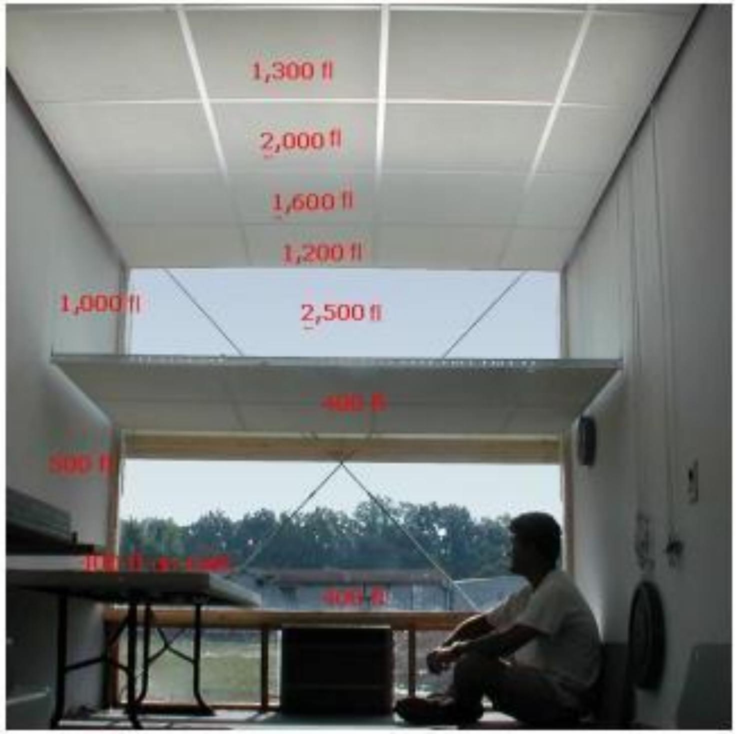


Figure 5: Foil Reflector

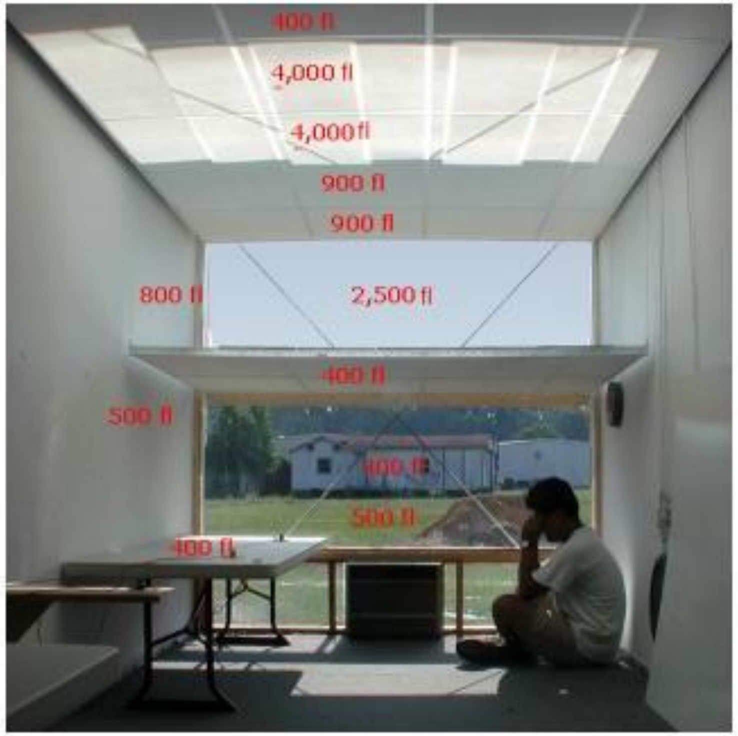
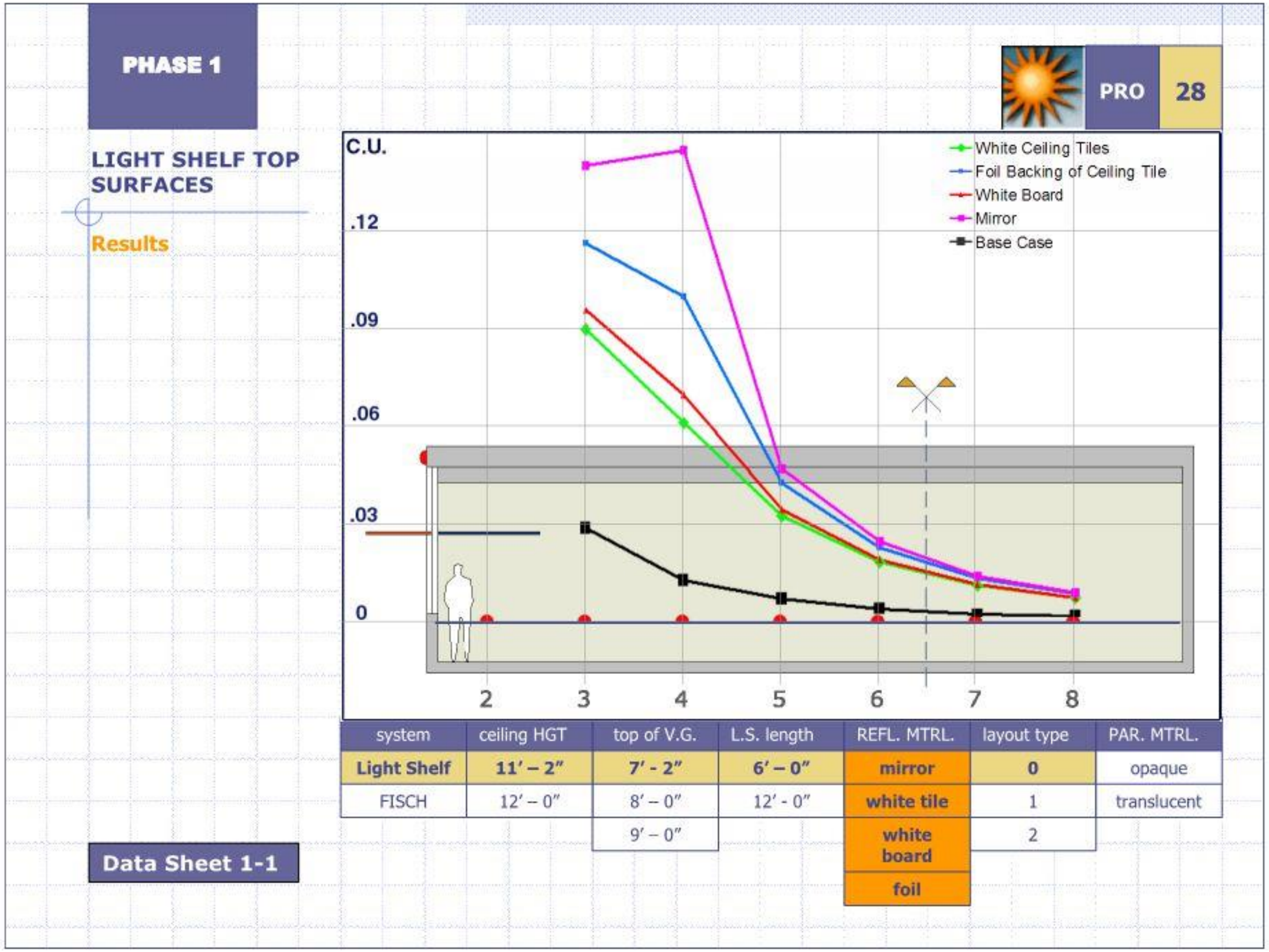


Figure 6: Mirror Reflector

Assessing Light Shelf and Optical Louver Systems in Multi-Story Office Buildings by Using Experimental Methods

Presented at ASES 2011 by Dr. Jianxin Hu, NC State University



PHASE 1

PRO 28

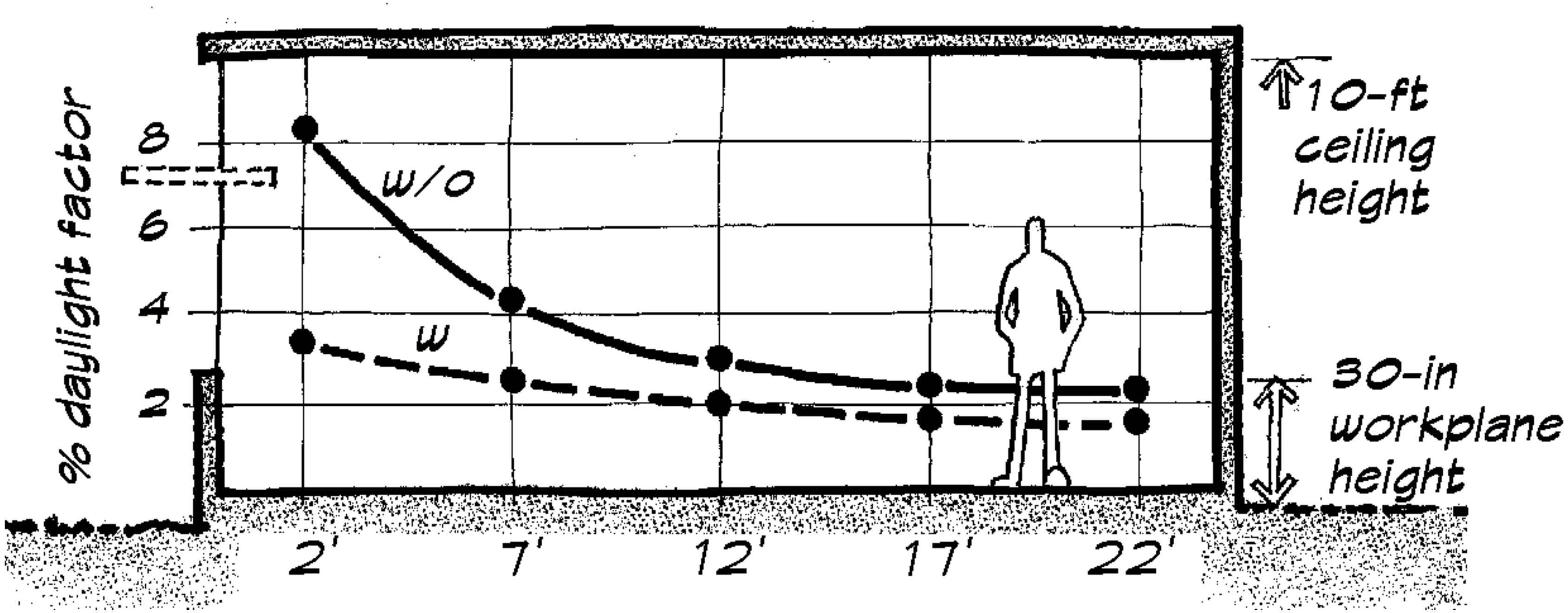
LIGHT SHELF TOP SURFACES

Results

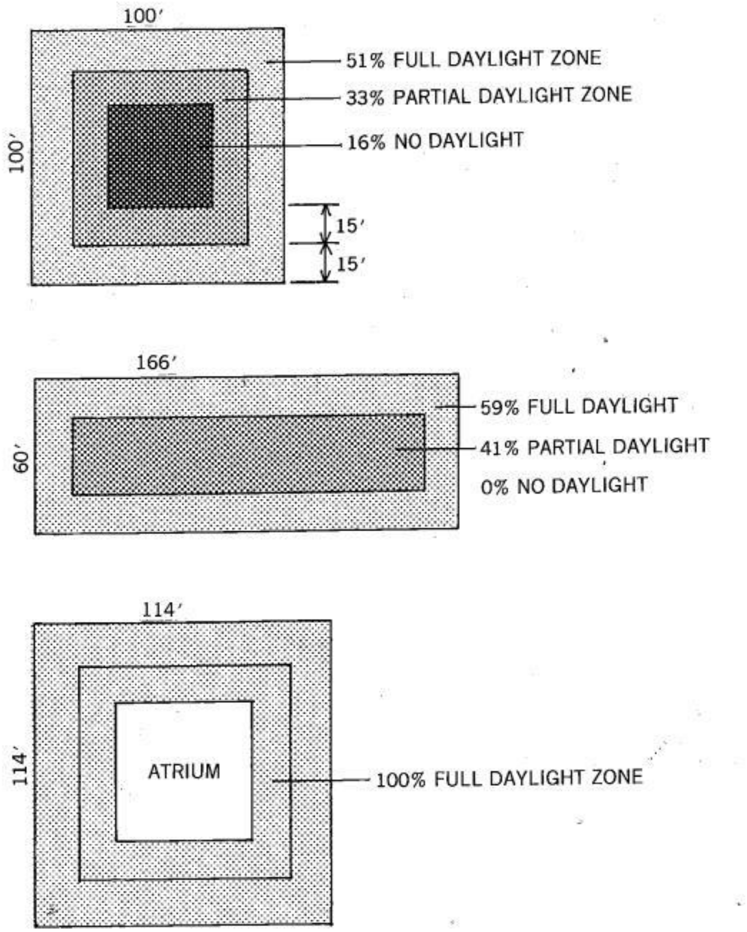
system	ceiling HGT	top of V.G.	L.S. length	REFL. MTRL.	layout type	PAR. MTRL.
Light Shelf	**11′ – 2″**	**7′ - 2″**	**6′ – 0″**	**mirror**	**0**	opaque
FISCH	12′ – 0″	8′ – 0″	12′ - 0″	**white tile**	1	translucent
		9′ – 0″		**white board**	2	
				foil		

Data Sheet 1-1

Environmental Control Systems, Fuller Moore



Building Form



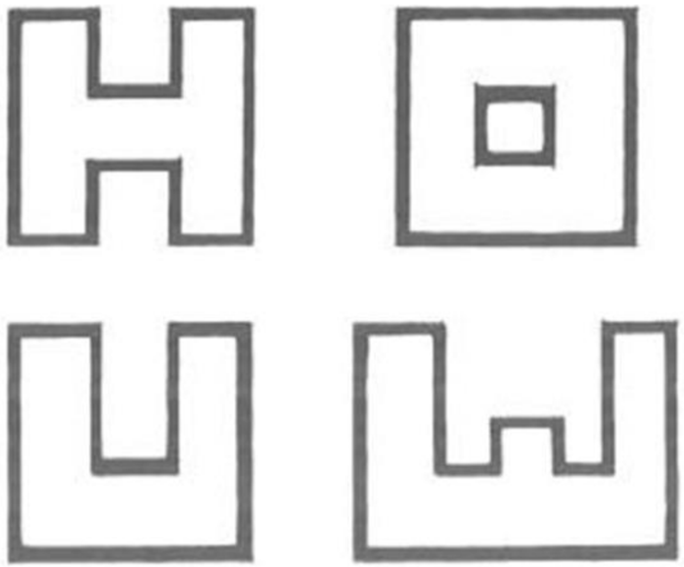


Figure 13.1d These were the common floor plans for large buildings prior to the twentieth century because of the need for light and ventilation.

Lechner p.396

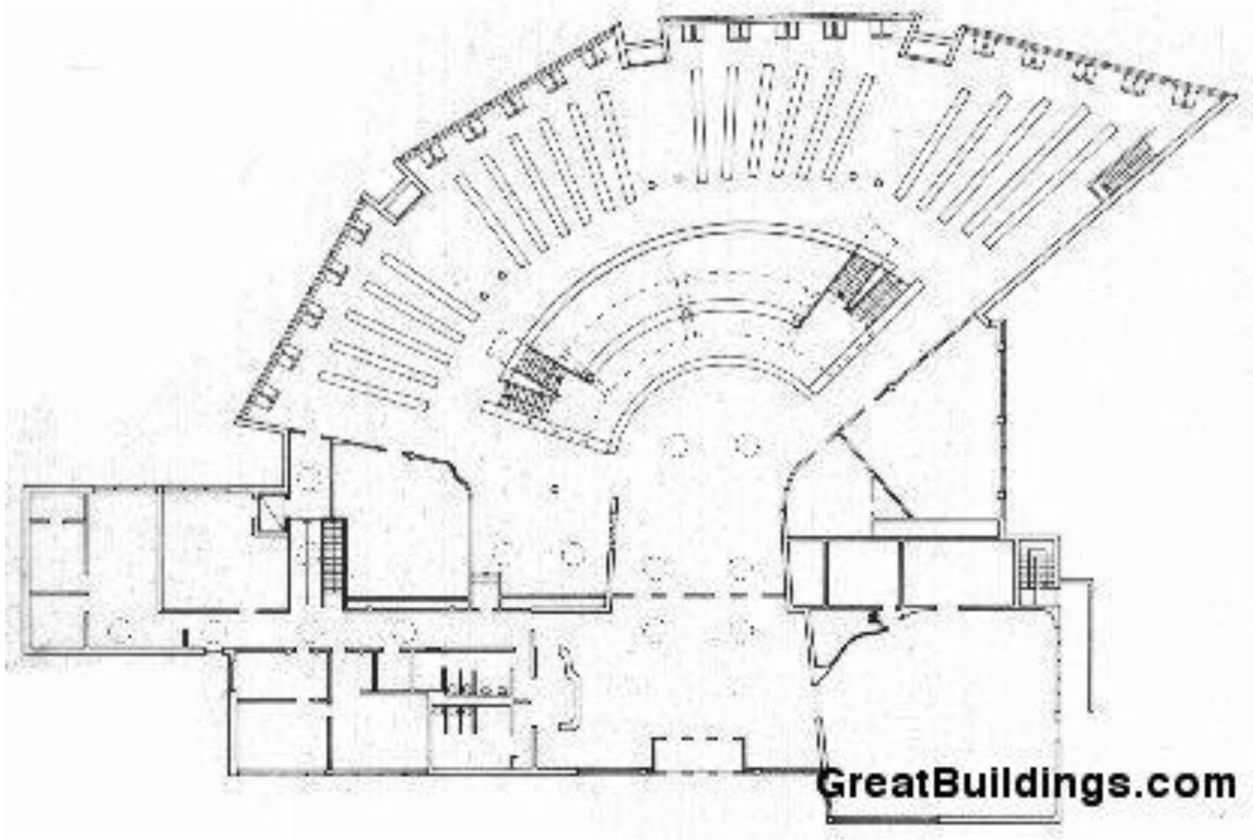





Space Planning

Alvar Aalto Mount Angel

Space Planning: stacks (or desks) perpendicular to windows



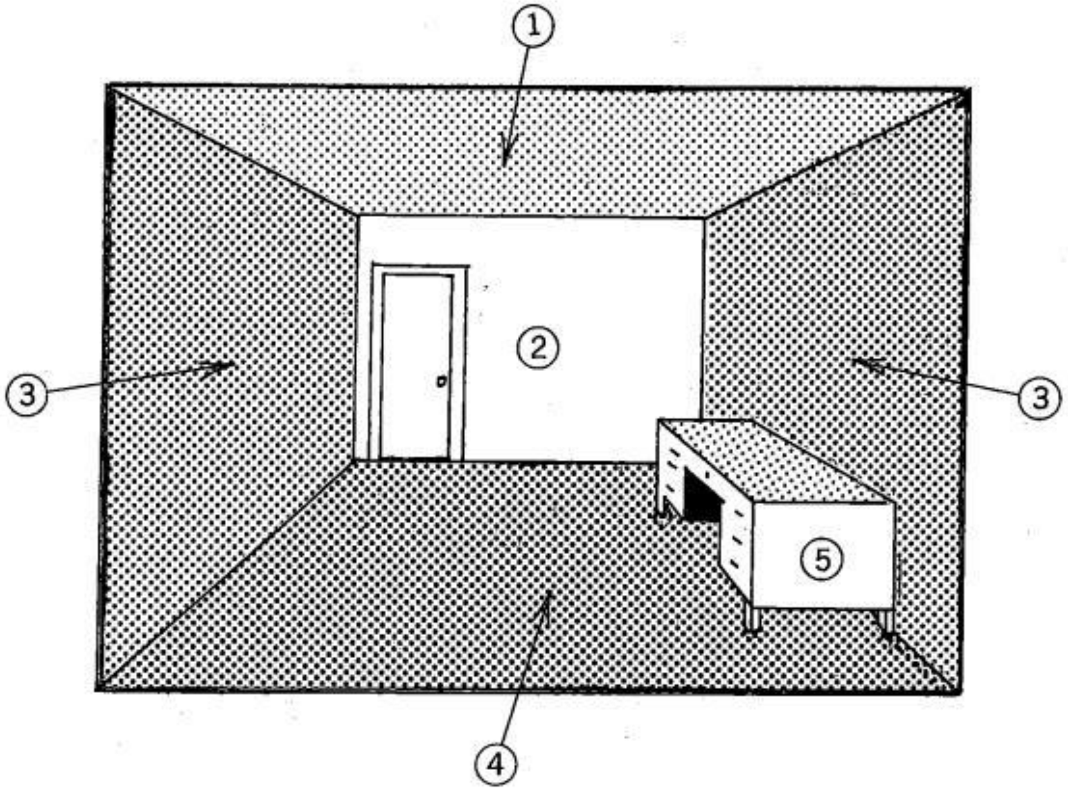
Alvar Aalto Mount Angel

Space Planning: translucent interior partitions

SMP Architects
Space Planning

Color, Surface Reflectances

Heating, Cooling, Lighting, Lechner, page 397



Glazing Selection

World's Best Window Co.

Millennium 2000+
Vinyl-Clad Wood Frame
Double Glazing • Argon Fill • Low E
Product Type: **Vertical Slider**

ENERGY PERFORMANCE RATINGS

U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
0.35	0.32

ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	Air Leakage (U.S./I-P)
0.51	0.2
Condensation Resistance 51	—

U-Factor
U-factor measures how well a window prevents heat from escaping. Ratings generally fall between 0.20 and 1.20. The lower the U-value, the greater a window's resistance to heat flow and the better its insulating value.

Visible Transmittance
Visible Transmittance (VT) measures how much visible light come through a window, expressed as a number between 0 and 1. The higher the VT, the more light is transmitted.

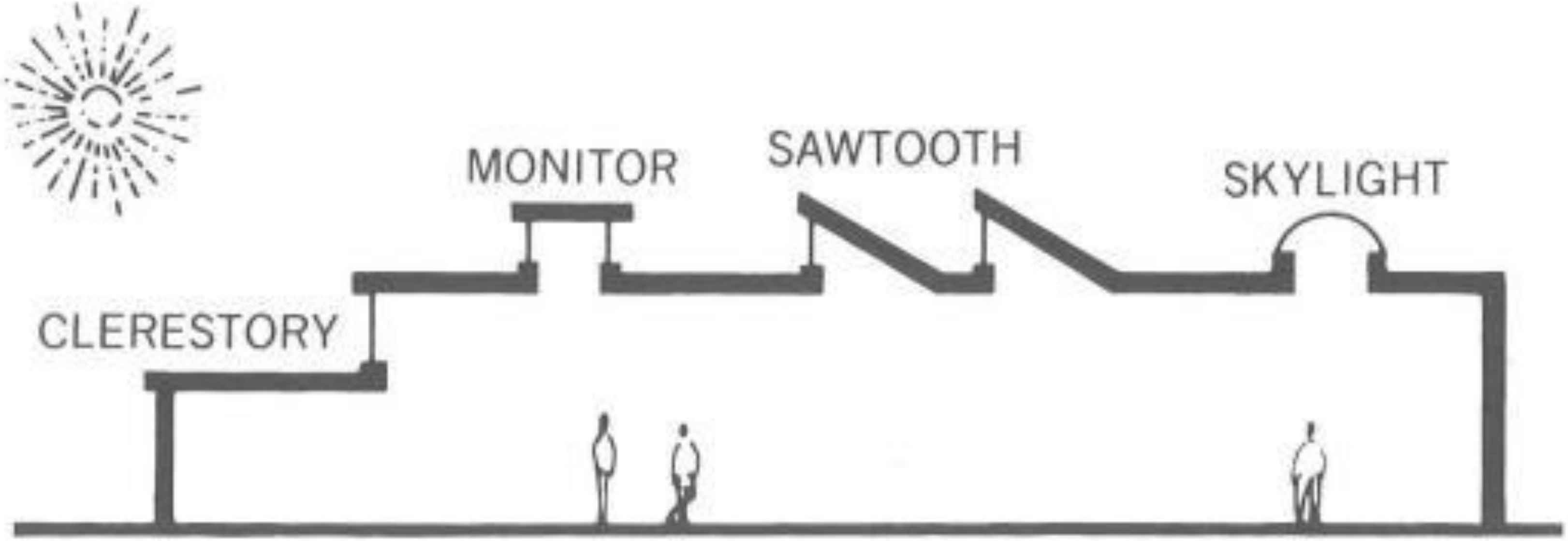
Condensation Resistance
Condensation Resistance (CR) measures on a scale of 0 to 100 the ability of a window to resist the formation of condensation on the interior surface. The higher the rating, the better the product is at resisting condensation. While this rating cannot predict condensation, it allows consistent product comparisons.

Solar Heat Gain Coefficient
Solar Heat Gain Coefficient (SHGC) is the fraction of incident solar radiation admitted through a window as heat gain, either directly transmitted or absorbed by the glass and then released inward. SHGC is expressed as a number between 0 and 1. The lower the SHGC, the less solar heat is transmitted.

Air Leakage
Air Leakage (AL) through a window is expressed as the equivalent cubic feet of air passing through a square foot window area (cfm/sq ft). The lower the AL, the less air will pass through cracks in the window assembly.

Top Lighting

Heating, Cooling, Lighting, Lechner, page 395



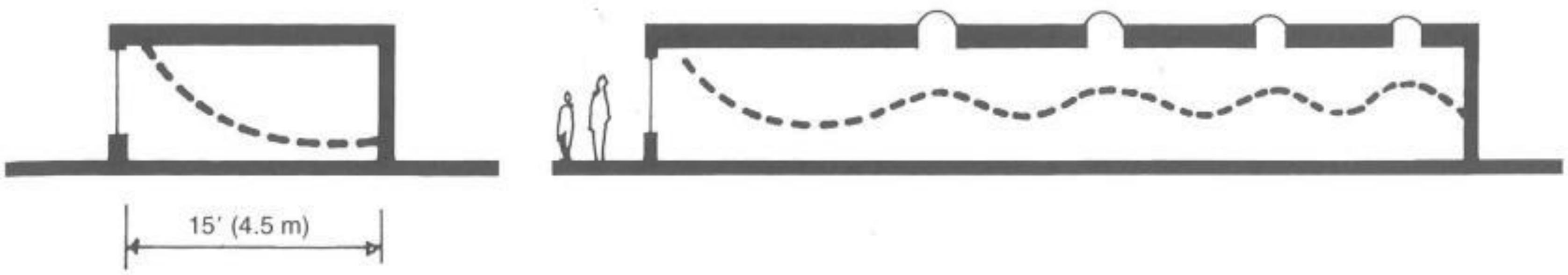
Heating, Cooling, Lighting, Lechner, page 395

Advantages:

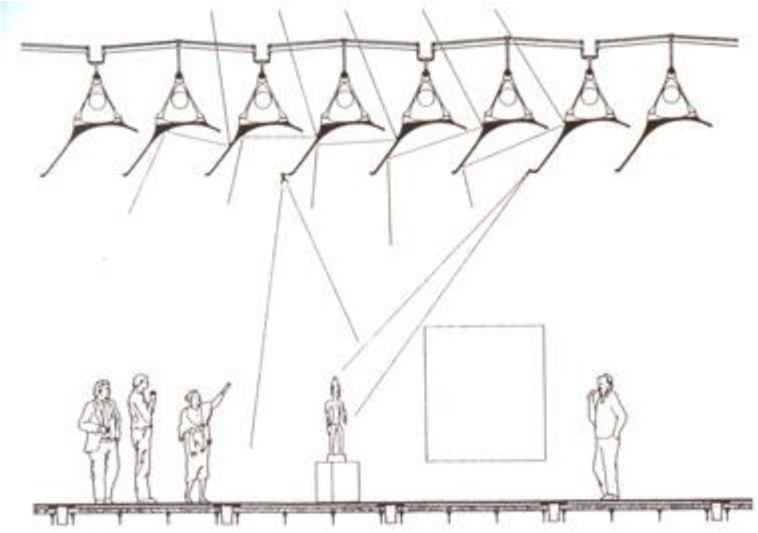
- Potential for uniform illumination over great floor areas
- Receive greater amounts of illumination

Disadvantages:

- Intensity of light is greater in summer than in winter
- Difficult to utilize other than 1-story buildings or the top floor
- Difficult to shade – therefore try to use vertical glazing on the roof (clerestories, monitors, sawtooths)

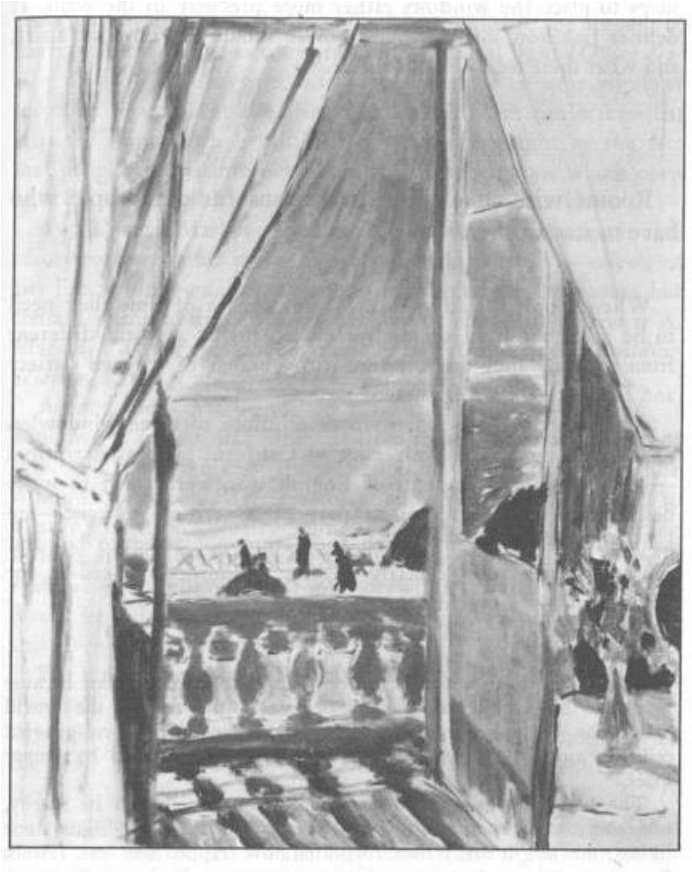


The Menil Museum, Renzo Piano

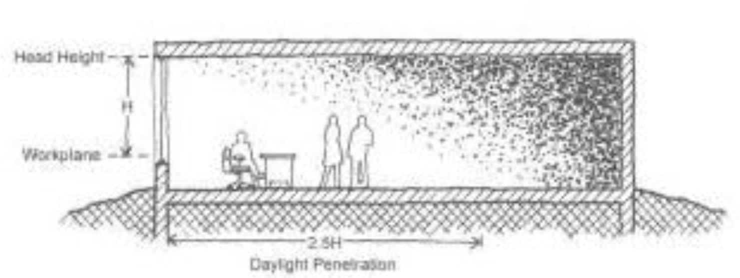


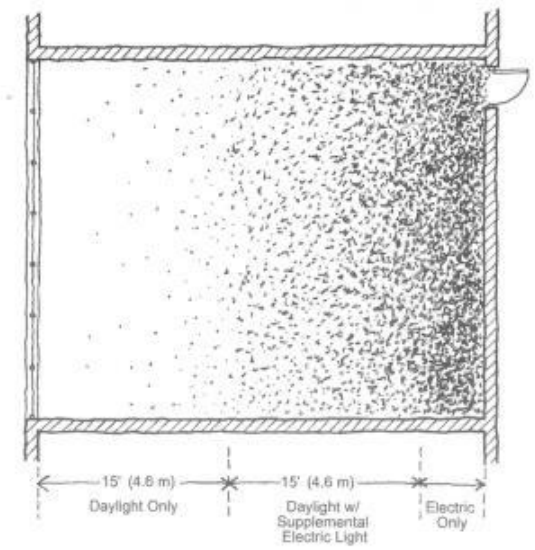
Kahn Kimball

Side Lighting



Grondzik, Walter T.; Kwok, Alison G.; ***The Green Studio Handbook: Environmental Strategies for Schematic Design, 2nd Edition.***
Elsevier, 2011. ISBN-13: 978-0080890524, page 64.





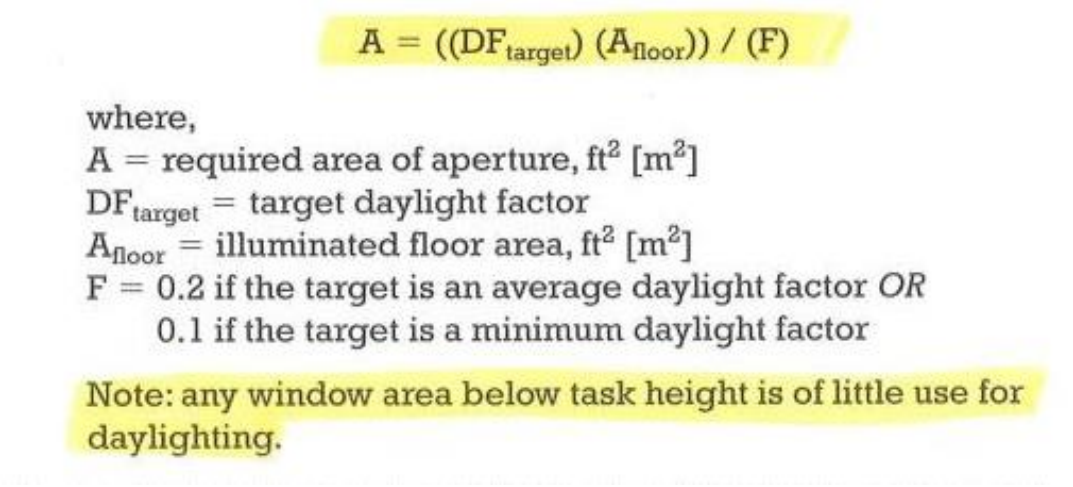
2.5H Rule of Thumb Assumes:
-Clear Glazing
-Overcast Skies
-No major obstructions
-Total window width approximately ½ of perimeter wall

15/30 Rule of Thumb Assumes:
-No assumptions stated
-Very basic guess

Grondzik, Walter T.; Kwok, Alison G.; ***The Green Studio Handbook: Environmental Strategies for Schematic Design, 2nd Edition.***
Elsevier, 2011. ISBN-13: 978-0080890524, page 77.

Calculating Sidelighting Apertures

$$\mathbf{A} = (\mathbf{DF}_{\text{target}})(\mathbf{A}_{\text{floor}}))/(\mathbf{F})$$



$$A = ((DF_{target})\ (A_{floor}))\ /\ (F)$$

where,
A = required area of aperture, ft^2 [m^2]
DF_{target} = target daylight factor
A_{floor} = illuminated floor area, ft^2 [m^2]
F = 0.2 if the target is an average daylight factor *OR*
0.1 if the target is a minimum daylight factor

Note: any window area below task height is of little use for daylighting.


HOMEWOOD SUITES
Hilton


OVIDENCE RIVER PARK


VIDA
Chopin
CYNAR 70
BRANCA MENTA
BLUE CURAÇAO
TUCK
Hennessy
Frangelico
Glenfiddich
2XO

Basics Window Strategies:

From *Heating, Cooling, Lighting* - Lechner

1. Place high on the wall, widely distributed, optimize overall area
2. If possible, place windows on more than one wall
3. Place windows adjacent to interior walls
4. Splay jambs to reduce the contrast between windows and walls
5. Filter daylight
6. Shade windows from excess sunlight in summer
7. Use movable shades
8. Additional Strategies

Heating, Cooling, Lighting, Lechner, page 398

1. Place high on the wall, widely distributed, optimize overall area

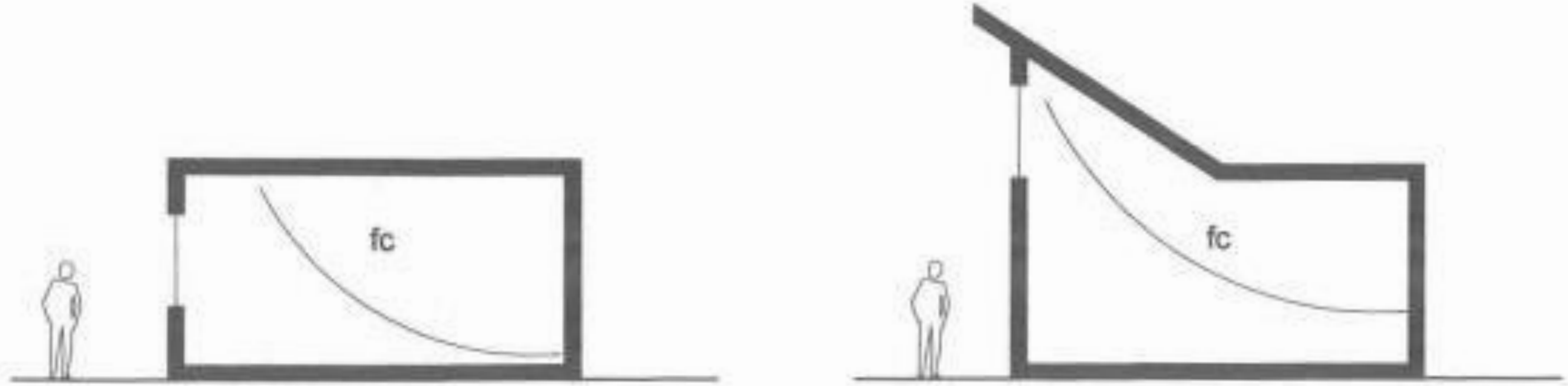
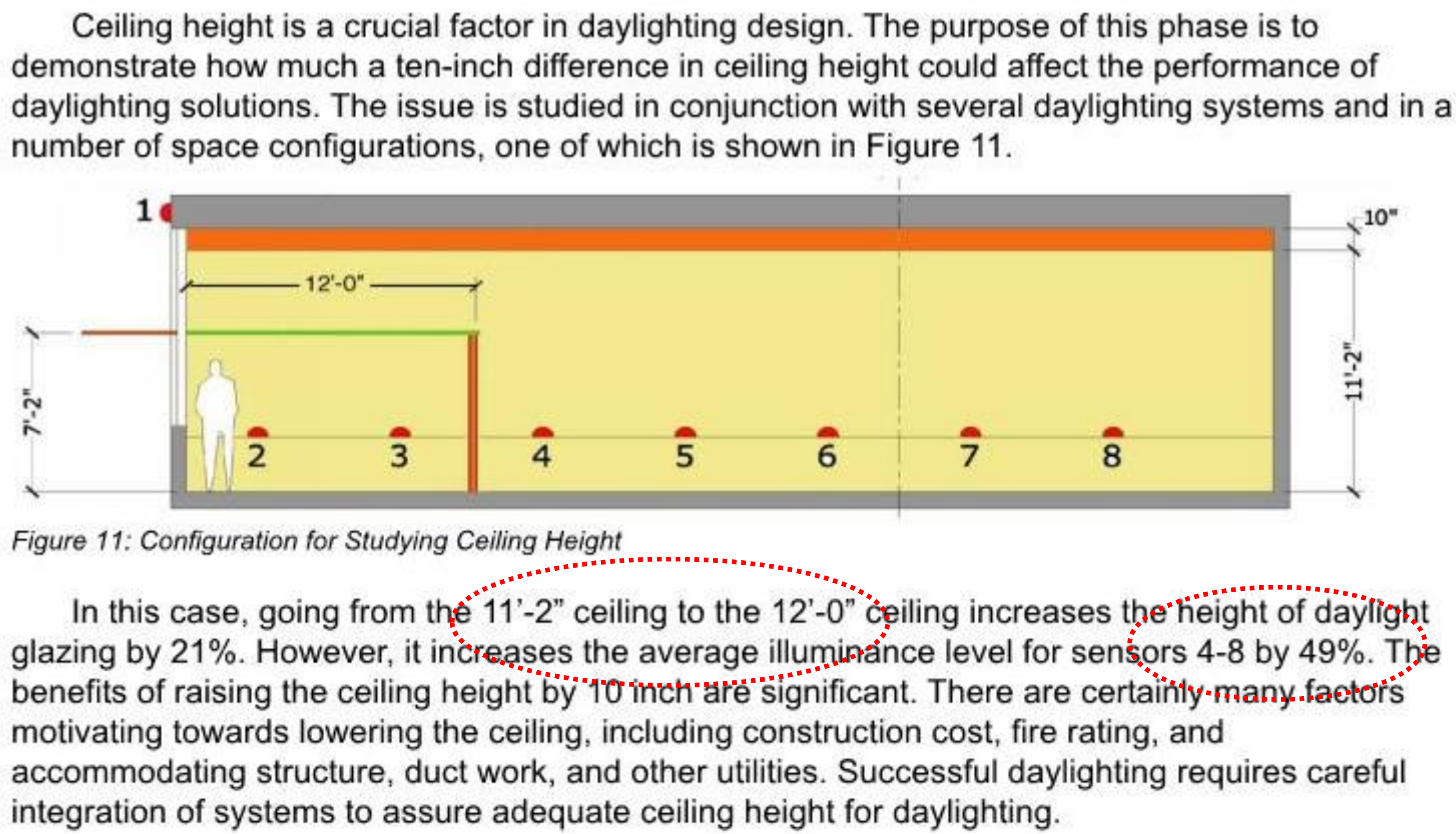


Figure 13.10a Daylight penetration increases with window height.

Assessing Light Shelf and Optical Louver Systems in Multi-Story Office Buildings by Using Experimental Methods

Presented at ASES 2011 by Dr. Jianxin Hu, NC State University

4. Ceiling Height



Ceiling height is a crucial factor in daylighting design. The purpose of this phase is to demonstrate how much a ten-inch difference in ceiling height could affect the performance of daylighting solutions. The issue is studied in conjunction with several daylighting systems and in a number of space configurations, one of which is shown in Figure 11.

Figure 11: Configuration for Studying Ceiling Height

In this case, going from the 11'-2" ceiling to the 12'-0" ceiling increases the height of daylight glazing by 21%. However, it increases the average illuminance level for sensors 4-8 by 49%. The benefits of raising the ceiling height by 10 inch are significant. There are certainly many factors motivating towards lowering the ceiling, including construction cost, fire rating, and accommodating structure, duct work, and other utilities. Successful daylighting requires careful integration of systems to assure adequate ceiling height for daylighting.

Heating, Cooling, Lighting, Lechner, page 398

1. Place high on the wall, widely distributed, optimize overall area

Figure 13.10c Strip or ribbon windows, as seen here in the Maison LaRoche by Le Corbusier, admit uniform light, which is further improved by placing the windows high on the wall. Note that photographic film exaggerates brightness ratios. (Photograph by William Gwin.)

Heating, Cooling, Lighting, Lechner, page 398

1. Place high on the wall, widely distributed, optimize overall area

Heating, Cooling, Lighting, Lechner, page 398

2. If possible, place windows on more than one wall.

Figure 13.10b These plans, with contours of equal illumination, illustrate how light distribution is improved by admitting daylight from more than one point.

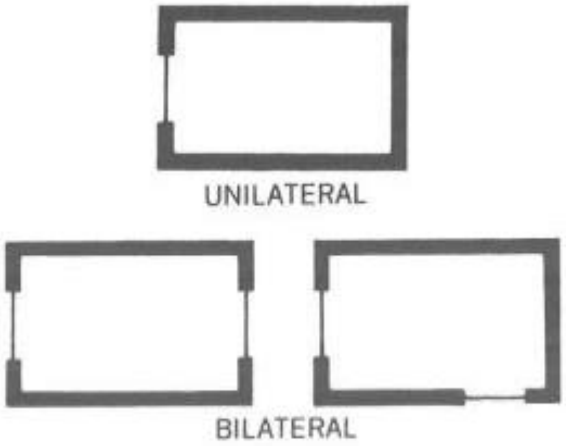
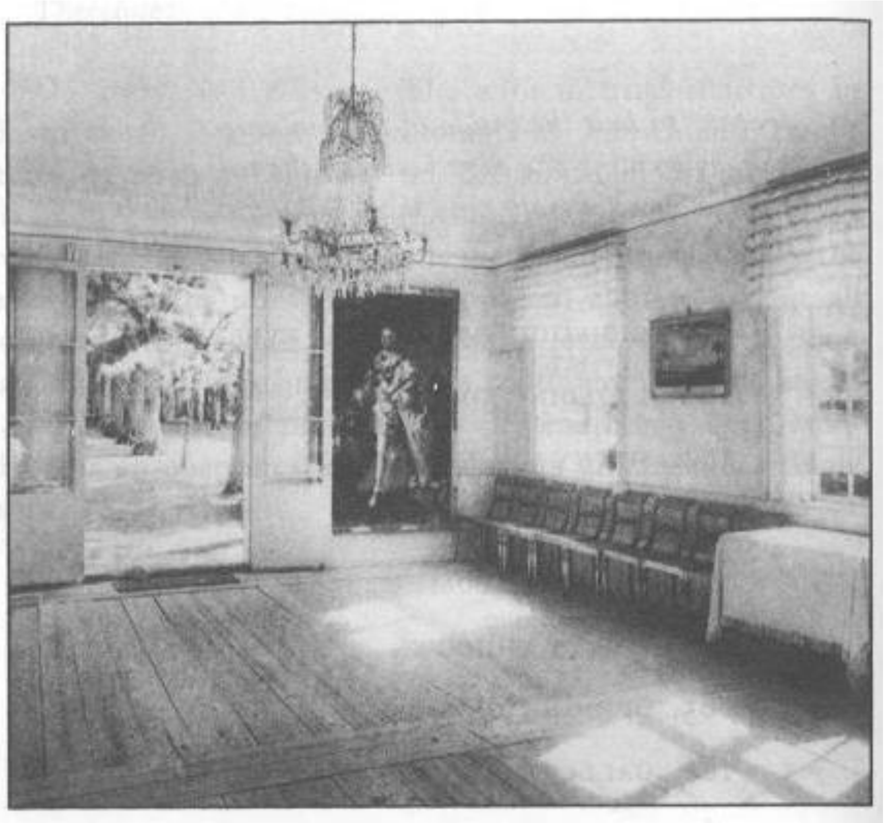


Figure 13.10d Bilateral lighting is usually preferable to unilateral lighting (plan view).

Lady Bird Johnson Wildflower Center

A Pattern Language, Alexander, pattern #159: *Light on Two Sides of Every Room*



Heating, Cooling, Lighting, Lechner, page 399

3. Place windows adjacent to interior walls.

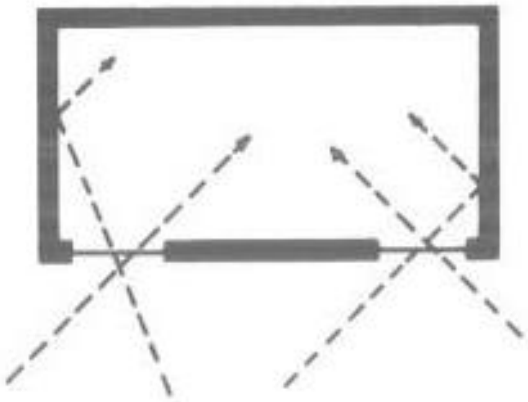


Figure 13.10e Light distribution and quality are improved by the reflection off sidewalls.

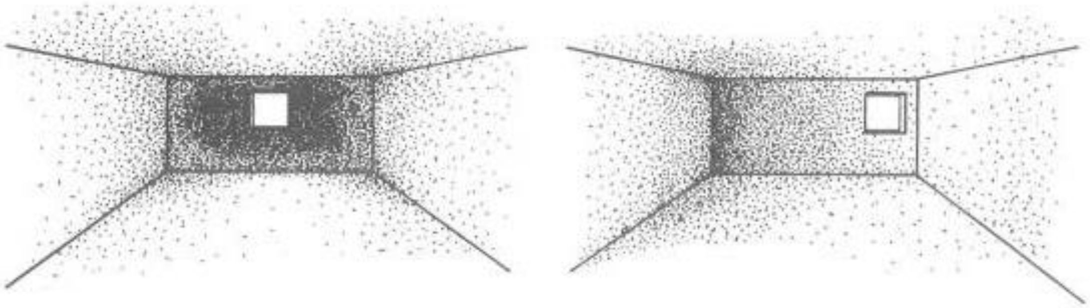


Figure 13.10f The glare from a window next to a sidewall is less severe than that from a window in the middle of a room.

MARTINI&ROSSI
CYNAR
70
BRANCA MENTA
BLUE CURAÇAO
TUCK
Chopin
VIDA
Hennessy
Frangelico
Glenfiddich
2XO
WHALERS

Heating, Cooling, Lighting, Lechner, page 408

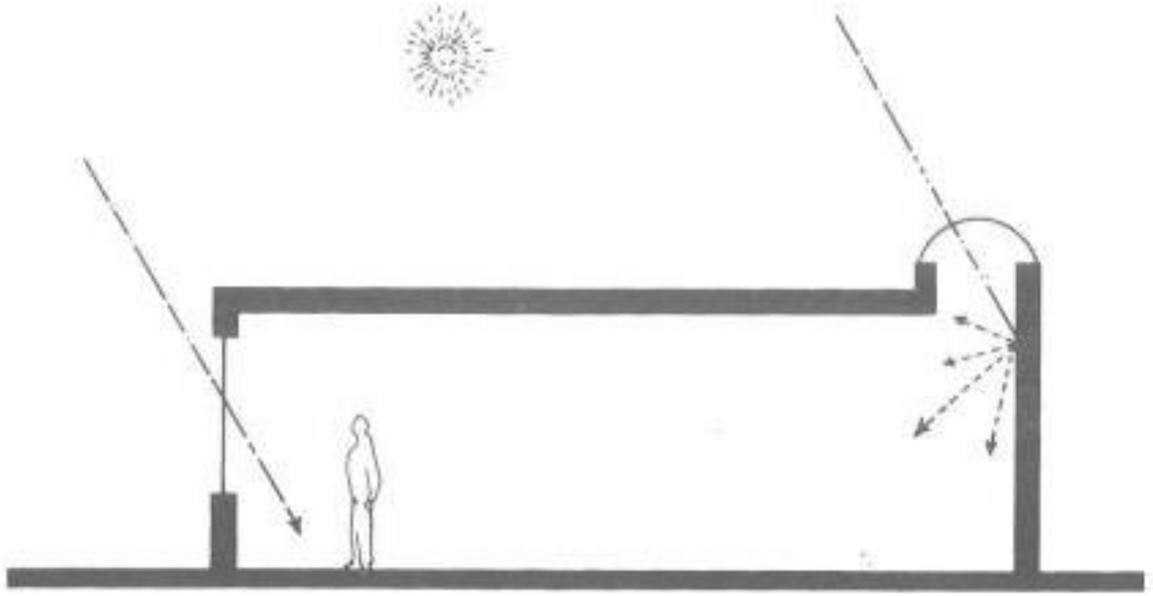
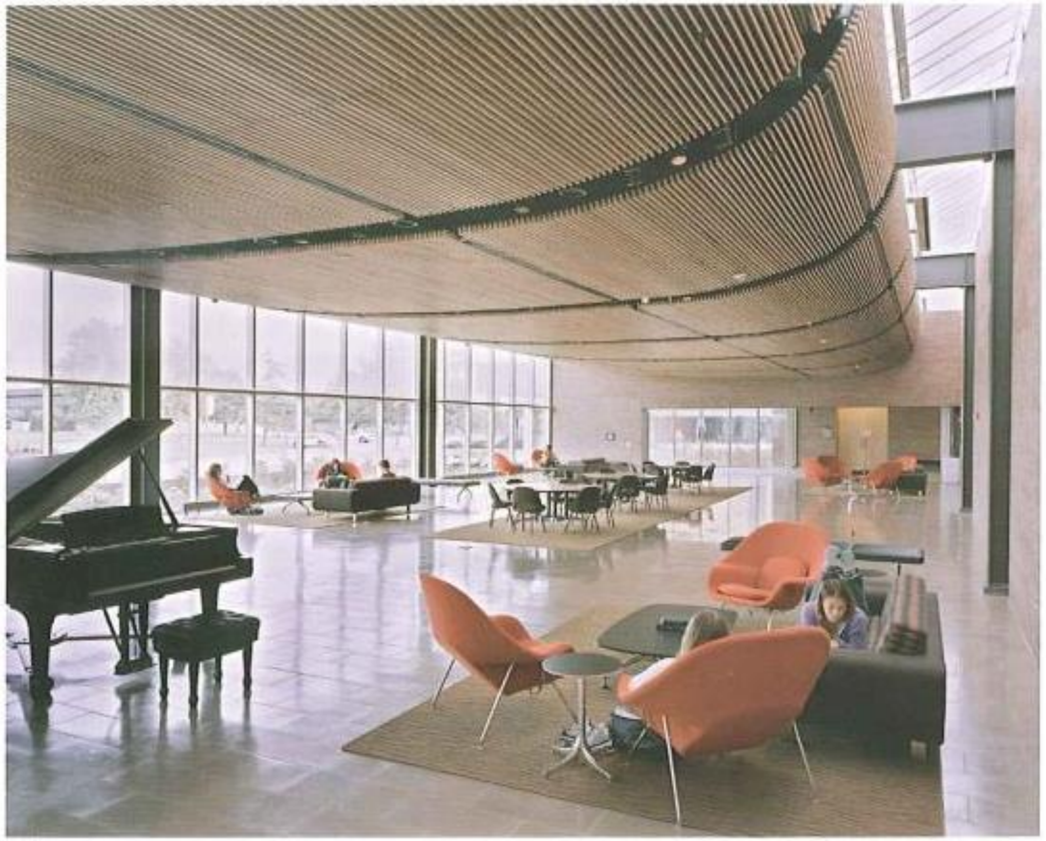


Figure 13.14e Place a skylight in front of a north wall for more uniform lighting and less glare.

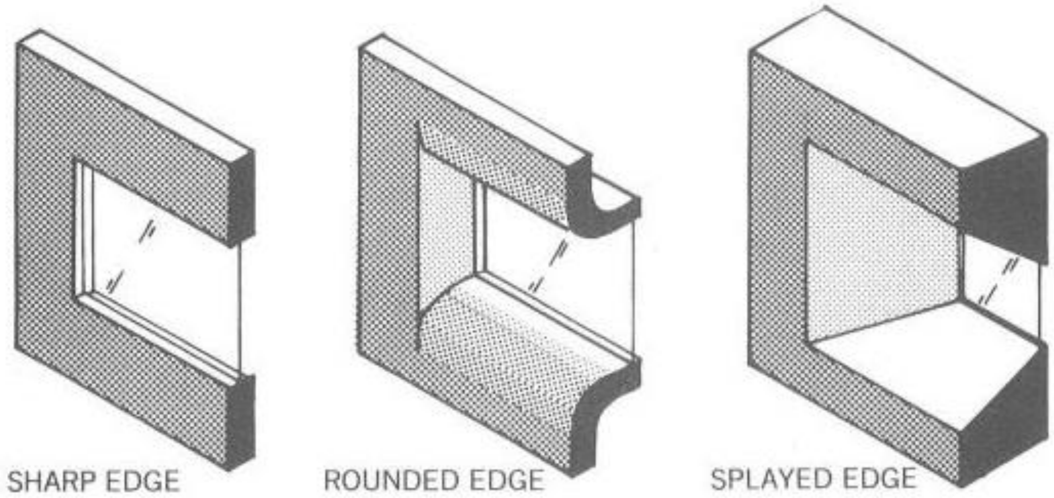
Grondzik, Walter T.; Kwok, Alison G.; ***The Green Studio Handbook: Environmental Strategies for Schematic Design, 2nd Edition.***
Elsevier, 2011. ISBN-13: 978-0080890524.



4.72 Multiuse room with toplighting and sidelighting to provide even daylight distribution at the Christopher Center at Valparaiso University, Indiana. © PETER AARON/ESTO

Heating, Cooling, Lighting, Lechner, page 399

4. Splay window surrounds to reduce the contrast between windows and walls as well as increase daylight penetration.



SHARP EDGE ROUNDED EDGE SPLAYED EDGE

Figure 13.10g The excessive contrast between a window and a wall can be reduced by splaying or rounding the inside edges. (After M. D. Egan, *Concepts in Architectural Lighting*.)

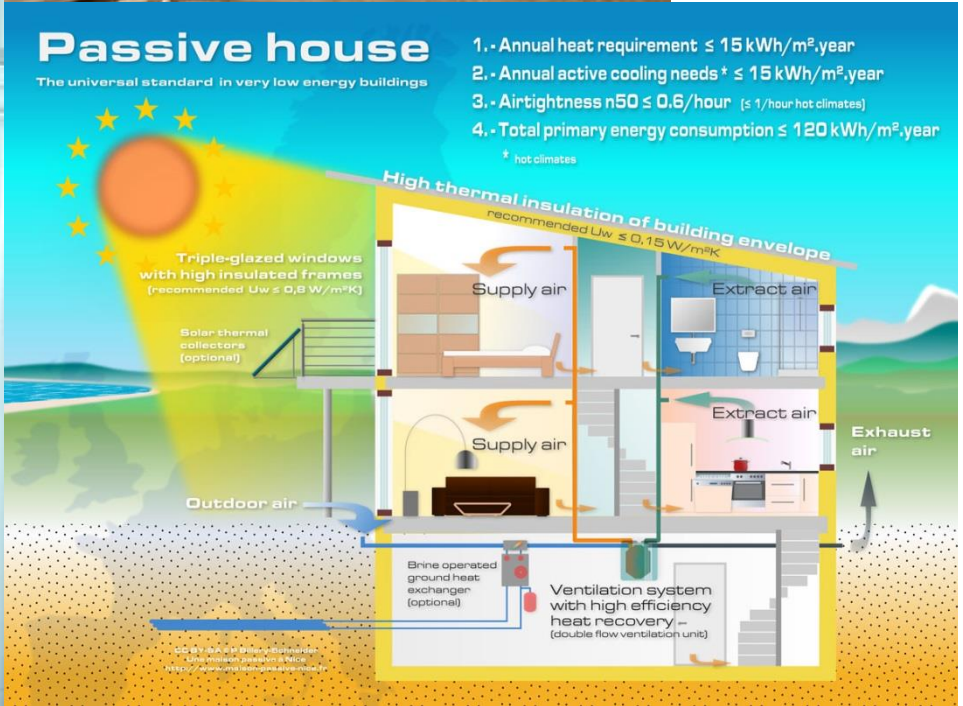
Splay Window Surrounds

I am currently working comfortably under daylight at 6.30 PM in a 240 sq ft north-west facing room in a Cornish cottage which has two windows of less than 6 sq ft glass area each with 18" deep splayed reveals in an 8' x 15'6" wall. So the glass area is just under 10% of wall area and 5% of floor area.

With good wishes,
Bill Bordass

Ft. Macon, North Carolina

Splay Window Surrounds



Splay Window Surrounds

Splay Window Surrounds (same for toplighting)

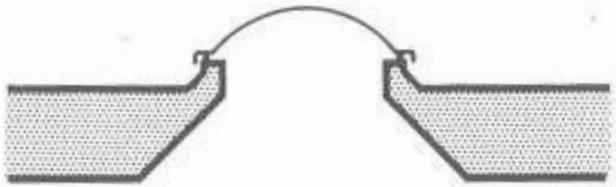


Figure 13.14c Splayed openings distribute light better and cause less glare than square openings.

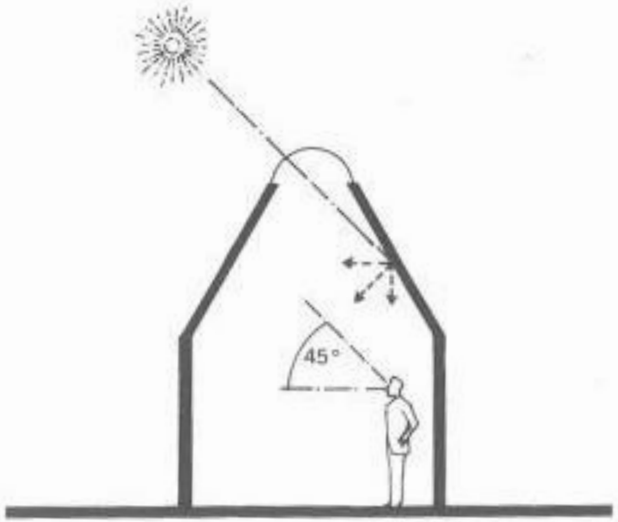
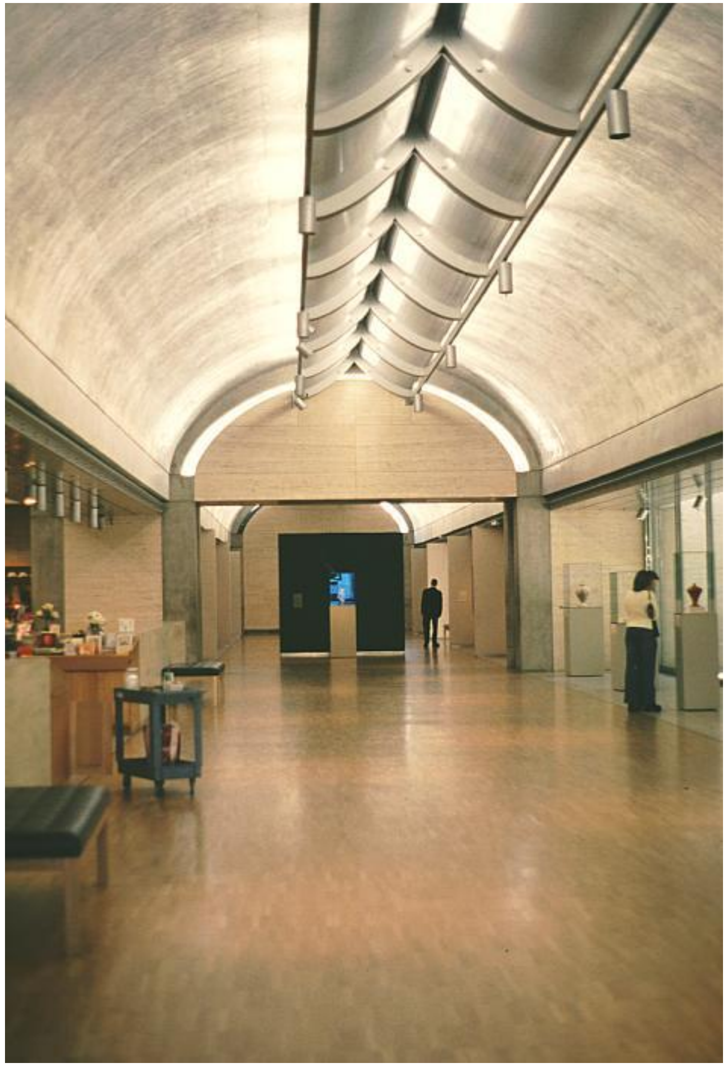


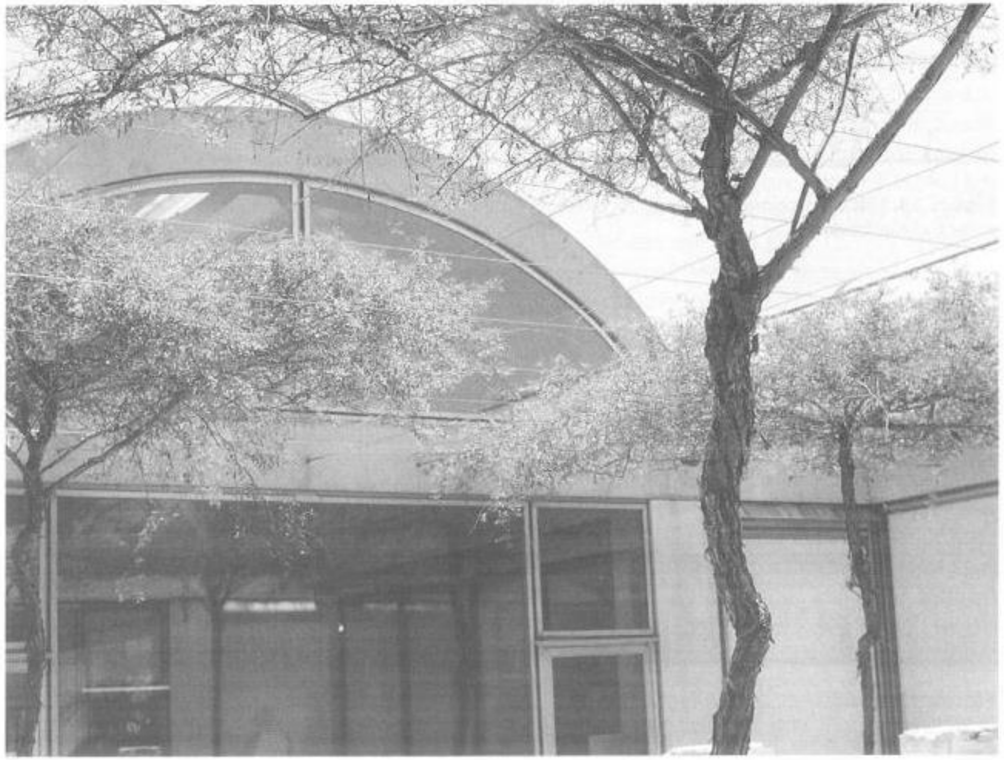
Figure 13.14d In high, narrow rooms, glare is minimal because the high light source is outside the field of view.

The Kimbell Art Museum - Louis Kahn

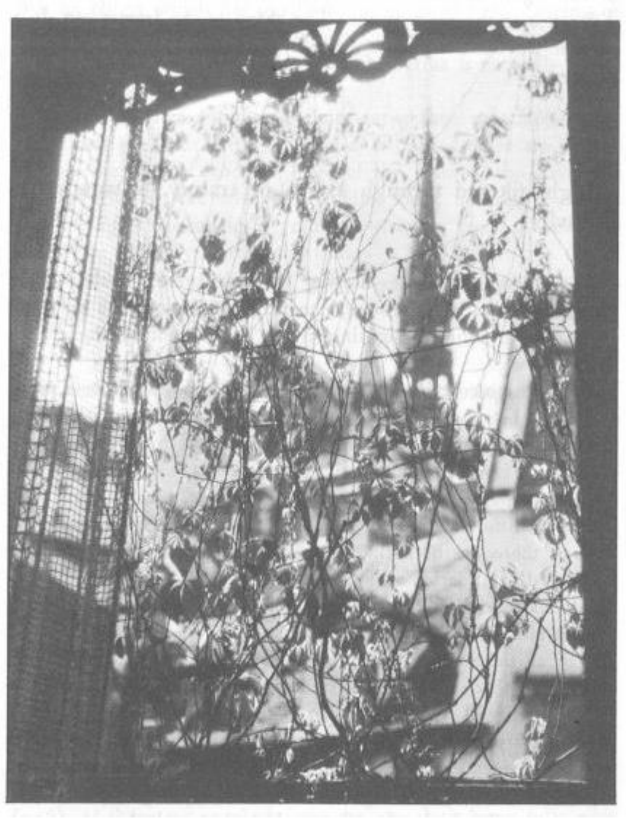


Tucson High School - James Benya

5. Filter Daylight

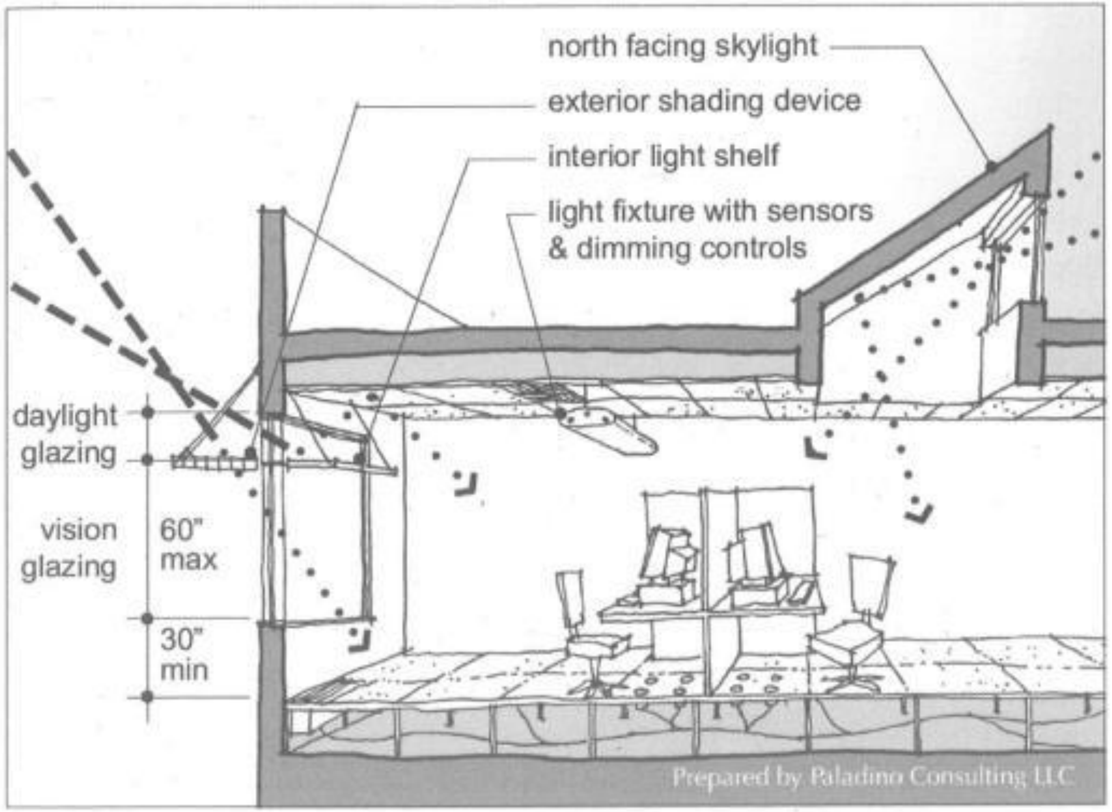


A Pattern Language, Alexander, pattern #238: *Filtered Light*

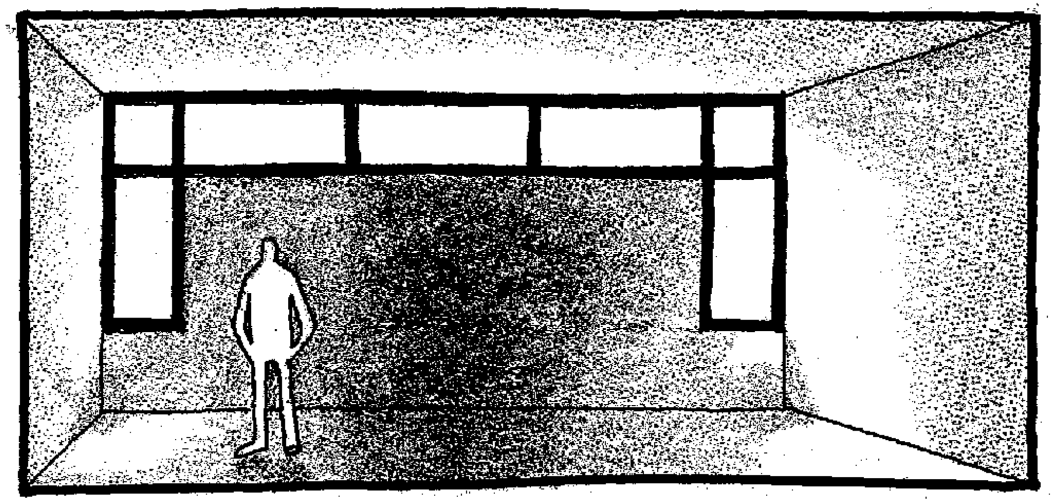


Spicewood Springs Library

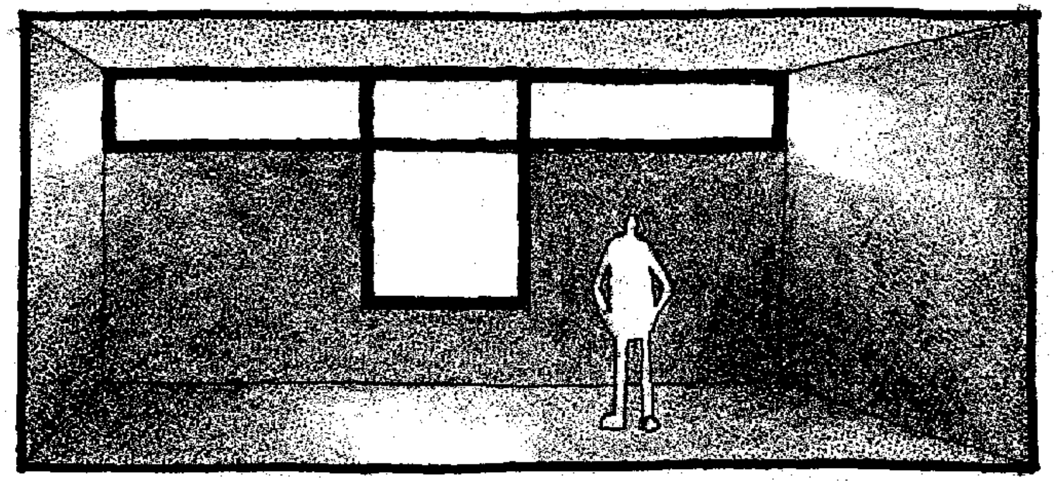
View glazing versus Daylighting



Environmental Control Systems, Fuller Moore



better daylight distribution



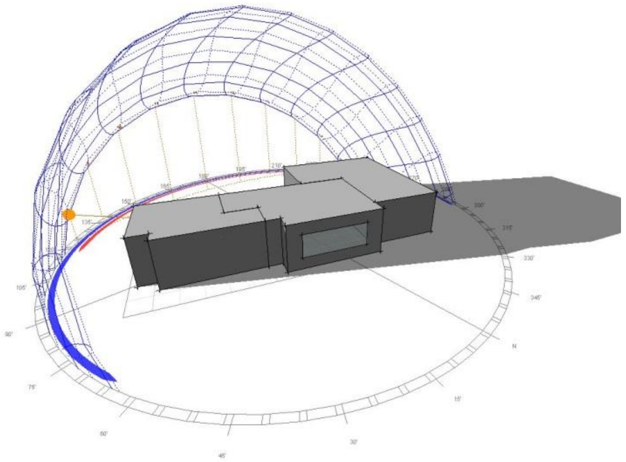
better view

Esherick House, Louis Kahn

Hyland Park Elementary School

6. Shade Excess Sunlight

E,W



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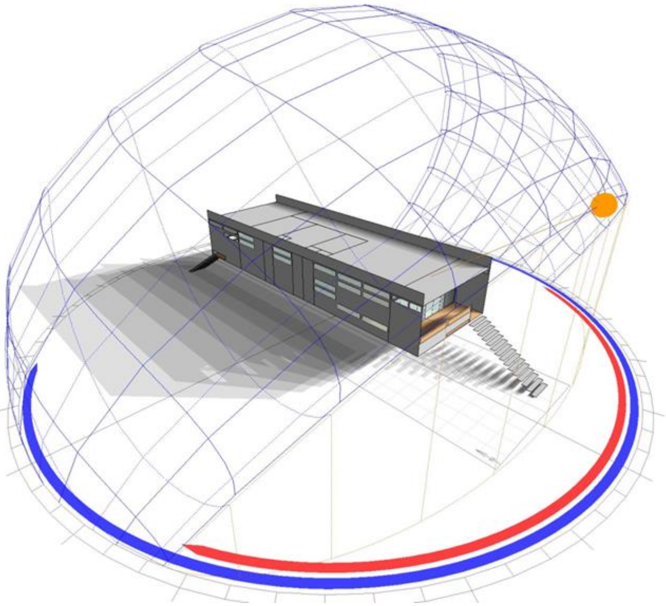

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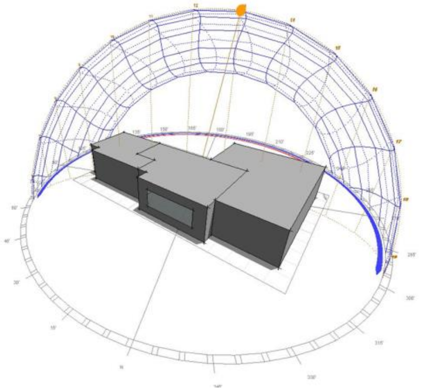
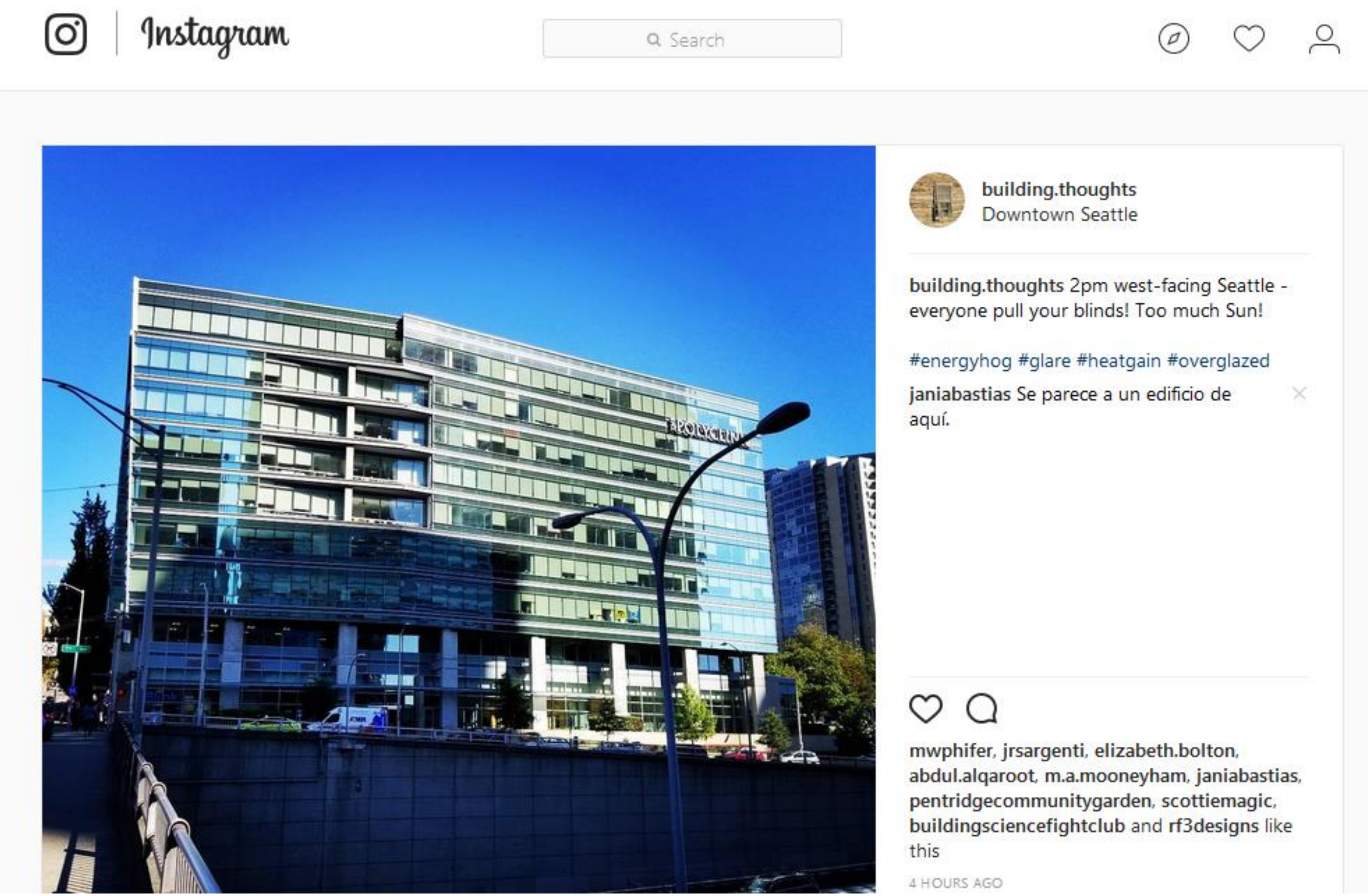


7. Use movable shades

7. Use movable shades:

Venetian Blinds (horizontal slats)

@building.thoughts
Seattle 9/27/17 2pm west-facing



building.thoughts
Downtown Seattle

building.thoughts 2pm west-facing Seattle - everyone pull your blinds! Too much Sun!

#energyhog #glare #heatgain #overglazed

janiabastias Se parece a un edificio de aquí.

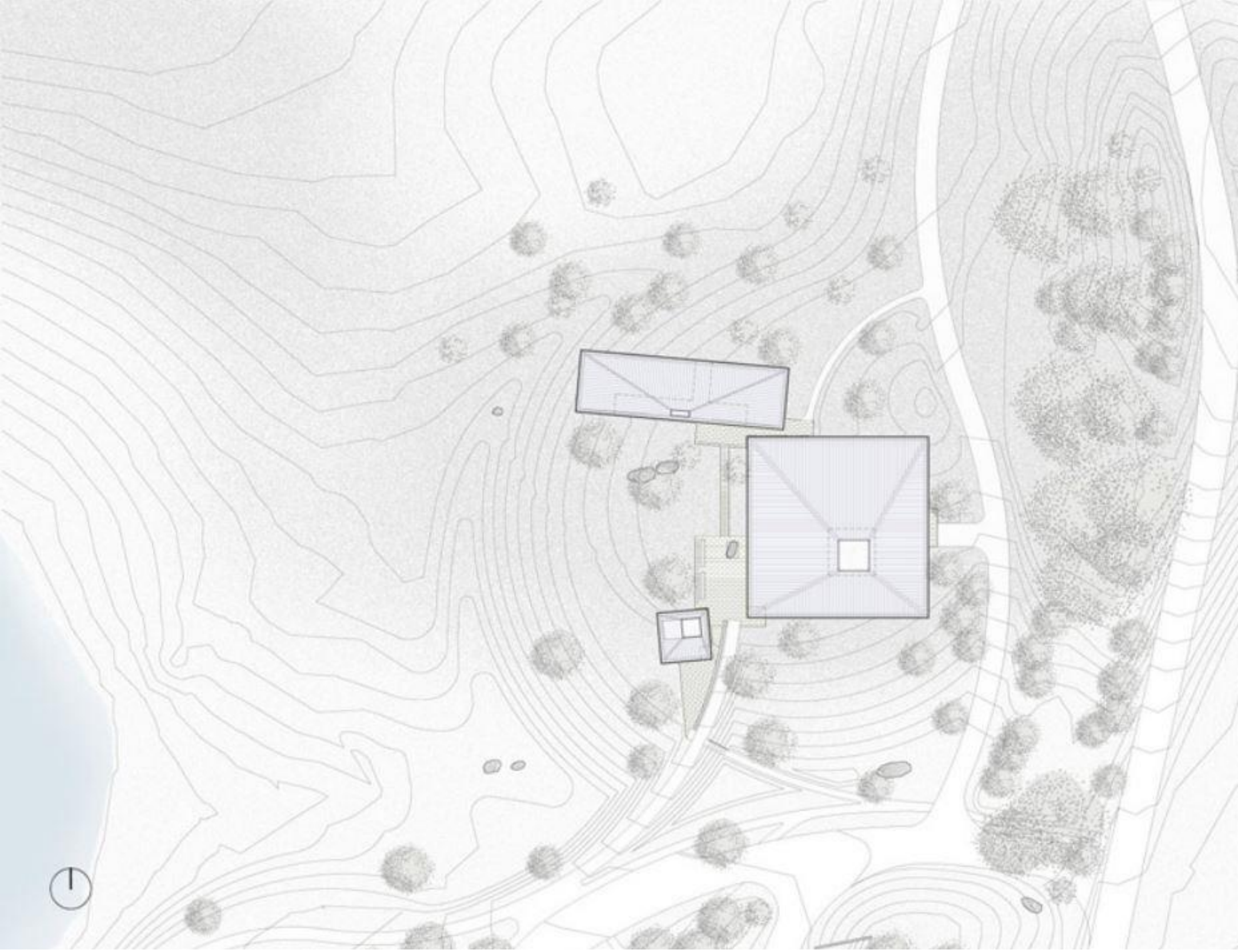
mwphifer, **jrsargenti**, **elizabeth.bolton**, **abdul.alqaroot**, **m.a.mooneyham**, **janiabastias**, **pentridgecommunitygarden**, **scottiemagic**, **buildingsciencefightclub** and **rf3designs** like this

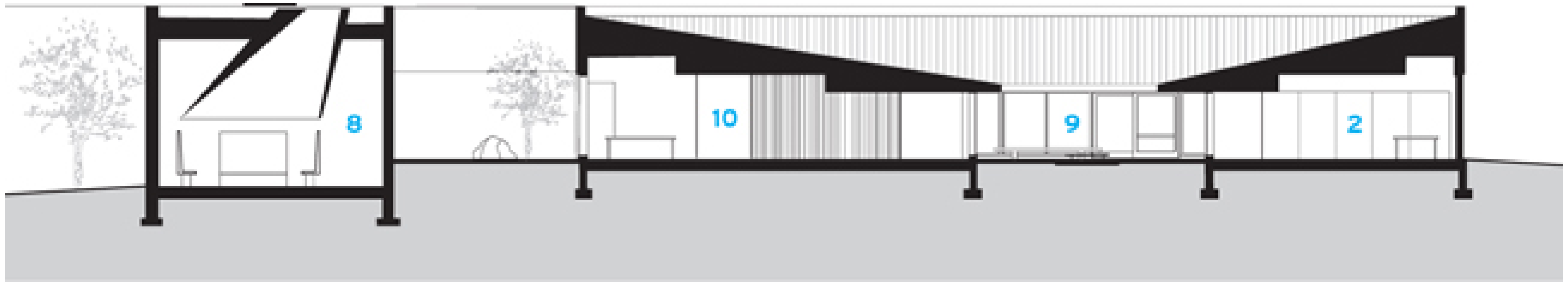
4 HOURS AGO

Is it possible to design a building for daylight only?

Center for Advancement of Public Action, Vermont

Tod Williams Billie Tsien





SECTION A-A

1 ENTRANCE
2 DESIGN LAB
3 FIELDWORK TERM OFFICE
4 FACULTY LOUNGE
5 DIRECTOR'S OFFICE
6 SYMPOSIUM
7 RESIDENCES
8 LENS
9 COURTYARD
10 LOBBY

From Data to Install:
A Guide for Your Window Journey

Keith A. Simon, FAIA, CPHC, BECxP, CxA+BE, LEED AP, CEI
VP Design Phase Services, Salas O’Brien
Adjunct Faculty UT School of Architecture

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512.800.4485
@buildingthoughts on instagram

October 22, 2024