

# A Detailed Study of Sunshades and their Effects on Performance

#### Joe Fong, AIA, NCARB, BPAC, LEED AP BD+C

#### Senior Associate

Diagnostics Group Walter P. Moore and Associates, Inc.

WALTER P MOORE





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# Learning Objectives

Participants will :

1. Identify the performance factors of building enclosure practice

2. Understand how integrated building enclosure system should be evaluated

3. Distinguish benefits and considerations in using sunshade

4. Recognize the appropriate simulation tools in different design stages





EDUCA

NUINC

## Enclosure Design Performance Factors





EDUCA

NUNG

## Enclosure Design Performance Defects





### **Integrated System Analysis**

#### Performance Mandates

• Critical implications for the delivery of this performance mandate

O Some implication for the delivery of this performance mandate

EXAMPLES OF ENVELOPE SYSTEM DESIGN DECISIONS AFFECTING PERFORMANCE											
ENVELOPE	SPATIAL QUALITY	THERMAL AIR QUALITY QUALITY		ACOUSTIC QUALITY	VISUAL QUALITY	BUILDING INTEGRITY					
Wall / roof / exterior floor											
Exterior surface, material properties		0				•					
Composite materials, thickness	•	0	0	0		•					
Interior surface	0	0	0	•	•	0					
Form: planar, curved	•	0		•	0	0					
Slope, orientation	•	0		•	•	0					
Module size, shape	•	0				•					
Connection to other env. components	0	•	0	0		•					
Windows / openings											
Material Properties	•	•		•	•	•					
Size, shape, spacing	•	•	•	0	•						
Orientation		•	•	0	•	0					
Control systems, sunshading	0	•		0	•	•					
Control systems, heat loss		•				0					
Control systems, ventilation	0	•	•		0	•					
Frame connections, plan/section	0	•	0	0	•	•					
Access, visual and physical	•	0	0		•	•					
Expansion potential (vert/horiz)	0				0						
Change potential for access/image	0				0	0					
Color, texture, ornament	0		0		•	•					





# Sunshade and its Effects on Building Performance







#### **Design Considerations**

- Benefits:
  - Energy Consumption
  - Daylighting & Glare
- Cautious:
  - Thermal Bridging
  - Condensation
  - Structural Integrity





#### **Benefits of Using Sunshade**

#### **Control Direct Sunlight**



#### **Offer Energy Savings**







## Control Direct Sunlight (South View)







### Energy Comparison (South View)







# Energy Comparison (Overall Building)



BEST 4 Study \_Energy Performance - Baseline Design (02/24/15 @ 11:34) BEST 4 Study \_Energy Performance - Window Ext Shading EEM 4' all sides (02/24/15 @ 11:34)



### Be Cautious with Sunshade

- Thermal Bridging
- Condensation
- Structural Integrity





### **Thermal Bridging**







# **Thermal Bridging**

U-factor delta T Length Btu/h/82 F F inches Rotation Forsanc 202.0 24.2950 N/A Projected Y

% Error Energy Norm 6.36%

- Exterior 105 deg F, Interior is 75 deg F
- Isotherms
  - To understand temperature difference as a contour pattern
  - U-Factor is 0.5485
- Flux Vector
  - to indicate the direction





# **Thermal Bridging**

- Color infrared
  - temperature migration
    differentiated visually
    between the exterior and
    interior temperature





#### Condensation

- Air Temperature
- Relative Humidity
- Dew Point Temperature
  - If Air Temp is 75 F
  - Relative Humidity is 65%
  - Dew Point is 62 F
  - Condensation can be easily occurred when the air temperature is dropped lower than 62 F

Air Temperature in Degrees Fahrenheit

Air Temp ℉	% Relative Humidity												
	100	95	90	85	80	75	70	65	60	55	50	45	40
110	110	108	106	104	102	100	98	95	93	90	87	84	80
105	105	103	101	99	97	95	93	91	88	85	83	80	76
100	100	99	97	95	93	91	89	86	84	81	78	75	71
95	95	93	92	90	88	86	84	81	79	76	73	70	67
90	90	88	87	85	83	81	79	76	74	71	68	65	62
85	85	83	81	80	78	76	74	72	69	67	64	61	58
80	80	78	77	75	73	71	69	67	65	62	59	56	53
75	75	73	72	70	68	66	64	62	60	58	55	52	49





#### When Moisture Meet Structure









#### One Tool Fits All?

#### Interoperability







# Simulation Tools for Performance Analysis

	ANALYSIS								
SOFTWARE	Daylighting	Heat Gain / Loss	Thermal Bridging	Condensation	Thermal Comfort	Energy Usage	CFD		
Revit / Vasari	X	X				Х			
Climate Consultant	X	X							
Ecotect	X	Х			Х	X			
Rhino / DIVA	X								
ComFen	Х					Х			
IES VE	Х	Х		X	Х	X	X		
DesignBuilder	Х	Х			Х	Х	Х		
Therm		Х	Х						
WUFI		Х		X					

Conceptual / Schematic Design Stage

Schematic / Design Development Stage

Design Development / Construction Document Stage





### Conclusions

- Daylighting heat can be absorbed by the metal sunshade device at the same time when blocking the direct sunlight or the heat can be left from the interior space to outdoor during cold climate season
- Energy Usage U factor can affect the overall R-value of the exterior enclosure system and the energy usage could be increased
- Condensation Due to the heat transfer and the cold surface, condensation can be happened within the structural components
- Thermal Bridging Heat transfer through structural components and can be impacted by the condensation
- Structural Integrity Whenever structural got condensed, corrosion and deterioration can be occurred



No one tool can analyze all the performance factors during different design stages



#### Questions

- Jfong@walterpmoore.com
- 713-630-7300

#### THANK YOU!

