### SGP, PVB, LOW-E...UNDERSTANDING FENESTRATION GLASS MAKEUPS IN ORDER TO COMPLY WITH FLORIDA BUILDING CODES



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### COURSE DESCRIPTION

THIS COURSE FOCUSES ON: SGP, PVB, LowE: Understanding Fenestration Glass Makeups in Order to Comply with Florida Building Codes

This seminar will teach you about large fenestration openings and how different glass makeups, through impact interlayers and coatings, enable these large openings to comply with Florida Building Code requirements.



# LEARNING OBJECTIVES

At the end of this course, participants will be able to:

- Define / identify different impact
  layers (SGP vs. PVB) and how they
  relate to design press and impact
  requirements for Florida Building
  Code impact compliance.
- 2 Define / identify different glass tints and coatings and how they relate to Florida Building Code energy requirements.
- 3 Define what a large fenestration opening is and the different types available.



### OBJECTIVE 1



Define / identify different impact layers (SGP vs. PVB) and how they relate to design press and impact requirements for Florida Building Code impact compliance.

**Opening Protection** 

#### **Florida Building Code Test Requirements** ----..... \*\*\*\*\*\*\*\*\* **ASTM E1996** SMALL MISSILE TESTING IS REQUIRED 30' ABOVE GRADE **ASTM E1886** \*\*\*\*\*\*\* ..... DESIGN PRESSURES INCREASE AS WINDOWS GET HIGHER IN THE BUILDING SSTD 12 TAS 201, 202 & 203 AAMA 506 LARGE MISSILE TESTING IS REQUIRED UP TO 30" ABOVE GRADE



### HIGH VELOCITY WIND ZONES (East US)





### WIND-BORNE DEBRIS REGION



### WIND-BORNE DEBRIS REGION



### CARIBBEAN REGION



### What is Glass?

A hard, brittle, noncrystalline, more or less transparent substance produced by fusion, usually consisting of mutually dissolved silica and silicates that also contain soda and lime, as in the ordinary variety used for windows and bottles.











### Fabrication Process | Cut

The first step in any glass fabrication process

Glass is scored and then "broken"





Adds strength by heating the glass in a tempering furnace and then rapidly cooling in a quench

















Heat Soak to reduce breakage potential



### Fabrication Process | Coat

#### **Pyrolytic & Vacuum Deposited**



# Fabrication Process | Laminate



# Fabrication Process | Insulate





### PVB









#### **Differences Between PVB vs. SGP**

- Thickness
- Rigidity
- Tear Resistance







#### **Differences Between PVB vs. SGP**





#### **Differences Between PVB vs. SGP**



### OBJECTIVE 2



Define / identify different glass tints and coatings and how they relate to Florida **Building Code** energy requirements.

### Energy Ratings for Doors Climate Zone Map



CLIMATE ZONE	U- FACTOR <sup>1</sup>	SHGC <sup>2</sup>	
Northern	≤0.27	Any	Prescriptive
	=0.28	≥0.32	Equivalent Energy Performance
	=0.29	≥0.37	
	=0.30	≥0.42	
North Central	≤ 0.30	≤ 0.40	
South Central	≤ 0.30	≤ 0.25	
Southern	≤ 0.40	≤ 0.25	

DOORS				
GLAZING LEVEL	U- FACTOR <sup>1</sup>	SHGC <sup>2</sup>		
Opaque	≤ 0.17	No Rating		
≤ ½-Lite	≤ 0.25	≤ 0.25		
> ½-Lite ≤ 0.3	< 0.20	Northern North-Central	≤ 0.40	
	≤ 0.30	Southern South-Central	≤ 0.25	

Air Leakage for Sliding Doors  $\leq 0.3~cfm/ft^2$  Air Leakage for Swinging Doors  $\leq 0.5~cfm/ft^2$ 



### **Glass Selection Process**

Designers typically begin with a concept; concept can dictate solar performance, appearance or both

Solar Performance Attributes

- Solar Heat Gain Coefficient
- U-Value

#### **Appearance Attributes**

- Color
- Reflectivity





### **Laminated Glass**

- Exterior is surface#1
- Each glass ply has two surfaces
- Separated by a polyvinyl butyl
  (pvb) interlayer







### **Insulated Glass**

- Exterior is surface
  #1
- Each glass ply has two surfaces
- Triple insulating = six surfaces
- Separated by seals space, air or gas fill





### Glass Performance Key Terms

- Visible Light Transmittance (VLT)
- Exterior Reflectance
- Winter U-Value
- Summer U-Value
- Solar Heat Gain Coefficient (SHGC)





### Sun & Glass

#### Solar Spectrum = Energy from the sun

51% Infrared47% Visible Light2% Ultraviolet





### Sun & Glass






#### Visible Light Transmittance (VLT)





#### Exterior Reflectance











#### Solar Heat Gain Coefficient (SHGC)





#### Glass Appearance





#### Float Glass Substrates

One way to change the appearance is to use a tinted glass substrate





#### Florida Sea Turtle Protection Code

Insulating	Glass									
	1/8" - space -	-1/8" 3/10	5" - sp	ace - 1/8'	' 3/16" - s	pace - 3/16"	M	Monolithic Glass		
	Gray	Gr	ay	Bronze	Gray	Bronze		Gray		
Clear	0.56	0.	46	0.53	0.45	0.52	1	/8" 0.62		
Solarban 60	0.50	0.	40	0.47	0.40	0.47	3,	/16" 0.55		
Solarban 70XL	0.44	0.	36	0.42	0.36	0.41	1	./4" 0.44		
Laminated	d Glass			1000	-		a columba			
	5/16" La	mi	7/16	" Lami	9/1	6" Lami			E POINT	
	Gray		Gray Bron		e Gray	Bronze	a start and a			
Clear	0.60	(	0.49 0.50		0.42	0.50	and the second second	Contraction of the local division of the loc		
Solarban 60	0.49	(	0.41 0.4		0.35	0.42				
Solarban 70XL	0.40		.34	0.44	0.30	0.40	the second second			
						A DATE.	Sales -	STORE AND	1.20-	
Laminated	d Insulati	na Glas	s							
	1/8" - space -	- 5/16" Lami	Lami 1/8" - spa		7/16" Lami	3/16" - spac	e - 5/16" Lami	3/16" - space	- 7/16" Lam	
	Gray	Bronze	G	iray	Bronze	Gray	Bronze	Gray	Bronze	
Clear	0.55	0.61	0.53		0.58	0.44	0.51	0.43	0.50	
Sungate 500	0.52	0.57	0	0.50	0.55	0.42	0.49	0.42	0.48	
Solarban 60	0.46	0.50	0	.43	0.48	0.37	0.43	0.37	0.42	
Solarban 70XL	0.37	0.41	0	.36	0.40	0.31	0.36	0.30	0.34	
Contor of Class	Values	-				-		Contra Ta		



### Coatings

Adding a coating is another way to change the appearance and energy performance of the glass

Attributes

- Composed of multiple thin layers of metal
- Change glass performance and appearance
- Added to provide energy savings
- Can be applied to any substrate: clear, tinted or low-iron





#### Low-E Coatings

Most common type of coating used today, stands for low emissivity

Emissivity is the ability of a material's surface to reradiate heat

Low emissivity means the material does not absorb heat but radiates it back to the source





#### Low-E Coatings Comparisons

SB60 Clr 3/16 - 3/8 ARG - Clr/Clr 7/16 SGP Lami	011	#1: 5283 #2: 2067	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.035	CL	N,G	0.59	N: 0.27 G: 0.24	N: 0.45 G: 0.39	13
SB60 Gry 3/16 - 3/8 ARG - Clr/Clr 7/16 SGP Lami		#1: 5288 #2: 2067	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.035	GY	N,G	0.59	N: 0.19 G: 0.17	N: 0.25 G: 0.22	13
SB70XL Clr 3/16 - 3/8 ARG - Clr/Clr 7/16 SGP Lami	012	#1: 5434 #2: 2067	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.018	CL	N,G	0.59	N: 0.20 G: 0.18	N: 0.40 G: 0.34	13
SB70XL Gry 3/16 - 3/8 ARG - Clr/Clr 7/16 SGP Lami		#1: 5372 #2: 2067	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.018	GY	N,G	0.59	N: 0.15 G: 0.13	N: 0.22 G: 0.19	13
LoeE366 3/16 - 3/8 ARG - Clr/i89 7/16 SGP Lami	013	#1: 2156 #2: 64000	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.022 #4: 0.149	CL	N,G	0.55	N: 0.19 G: 0.17	N: 0.39 G: 0.34	14
LoeE340 3/16 - 3/8 ARG - Clr/i89 7/16 SGP Lami	014	#1: 2166 #2: 64000	#1: 0.197 #2: 0.46	0.375 ARG 90	#2: 0.028 #4: 0.149	GY	N,G	0.55	N: 0.13 G: 0.12	N: 0.23 G: 0.20	13
LoeE270 3/16 - 3/8 Air - Clr/Clr 7/16 SGP Lami	015	#1: 2028 #2: 2067	#1: 0.197 #2: 0.46	0.375 AIR	#2: 0.037	CL	N,G	0.64	N: 0.26 G: 0.23	N: 0.43 G: 0.37	12
LoeE270 3/16 - 3/8 Air - Clr/i89 7/16 SGP Lami	016	#1: 2028 #2: 64000	#1: 0.197 #2: 0.46	0.375 AIR	#2: 0.037 #4: 0.149	CL	N,G	0.60	N: 0.25 G: 0.22	N: 0.42 G: 0.36	12



### Emissivity

#### Comparison

- 0.96 Limestone
- 0.90 Red brick
- 0.84 Glass: uncoated surface
- 0.21 Sandblasted aluminum
- 0.05 Polished aluminum
- 0.04 Glass: Low-E coated surface





# Types of Coatings

#### Reflective

- Introduced in the 1980's
- First type of coatings applied to glass
- Mirrored in appearance
- Low SHGC and VLT
- Stainless steel, pewter, chrome, gold





# Types of Coatings

#### Low-E

- Introduced in the 1990's
- Transparent in appearance
- Multiple options to balance performance, color and reflectivity
- Silver, titanium, tin





#### Laminated Glass Performance

Add a Low-E coating to the #2 surface or a tinted substrate for improved performance





# OBJECTIVE 3



Define what a large fenestration opening is and the different types available.

#### Large Openings Benefits Improve Mental Health

- Better sleep
- Better maintenance of circadian rhythms





#### Large Openings Benefits Hospitals

- 16-41% shorter hospital stays
- Patients need less pain medication
- Patients heal faster

#### Large Openings Benefits Work

- Increased productivity
- Employees with natural light are 12% happier
- Workers exposed to more natural light took
  6.5% less sick leave on average



# Large Openings Benefits

#### Education

- 14-25% increased test scores
- Sunlight exposure increases concentration capability and duration
- Tend to learn faster and more efficiently

#### Large Openings Benefits Investment

- Overall better return on investment on properties with natural light
- Properties with large openings sell at a higher per/sq ft price

#### Benefits of Large Openings Utilizing Glass

#### **Daylight and Views**

- Allows occupants to see out and provides a connection to the outdoors
- Improved mood and enhanced morale in the workplace

#### **Energy Savings**

- Less artificial light needed
- Less cooling required from the artificial light reduction

#### **Aesthetically Pleasing Modern Buildings**

- It was not until close to the mid-20th century that developments in technology allowed the a of large panels of glass that were structurally sound
- Allows for design creativity



Glass is typically specified to provide a daylight for building occupants and/or for a specific facade appearance







#### Energy Savings

#### Allowing more natural light into space reduces the need for electric light sources





# Design Opportunities







### Folding • Large Openings



Max Panel Height: 168" Max Panel Width: 52" Max Panel

> Weight: 350 lbs



















## RADIUS FOLD



# RADIUS FOLD



# Sliding • Large Openings



# Max Height: 168" Max Width: 84"

Max Panel Weight: 800 lbs








#### Pivot • Large Openings



Max Height: 168" Max Width: 100"

> Max Panel Weight: 700 lbs









# FOLDING



# FOLDING



# FOLDING



# This Concludes The American Institute of Architects Continuing Education Systems Course

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