

ARCHITECTURAL GLASS PERFORMANCE AND TRENDS

A Balanced Approach

Design Parameters

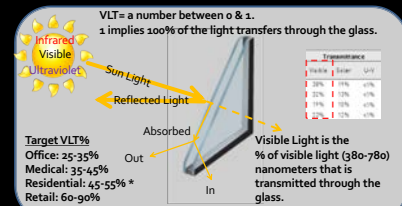


■ Performance ■ Aesthetics ■ Occupancy Comfort ■ Cost

Key Glass Design Parameters

- Solar energy performance
 - Visible Light Transmittance (VLT)
 - Solar Heat Gain Coefficient (SHGC)
 - Light to Solar Gain Ratio (LSG)
 - U-Value (Center of Glass)
- Aesthetics
 - Glass color
 - Minimize visual distortion
- Structural performance
 - Hurricane resistance
 - Wind pressure resistance

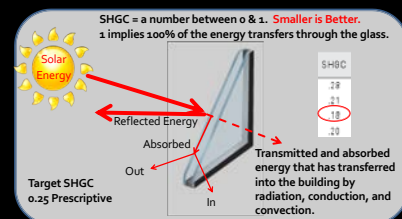
Visible Light Transmittance (VLT)



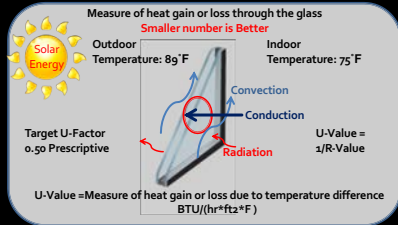
*FDEP Marine Turtle Code Maximum VLT 45%



Solar Heat Gain Coefficient (SHGC)



U-Value – Center of Glass



2017 FBC Commercial Energy Code Compliance Methods



- Prescriptive Compliance Section 402
 - SHGC 0.25 30% window to wall ratio vertical walls
 - SHGC 0.35 for Skylights 3% gross roof square footage
 - SHGC can be adjusted upward for vertical walls using "PF" factor to maximum 0.40
 - U Factor 0.50 Fixed - 0.65 Operable - 1.10 Entrance Doors - 0.75 Skylight
- Performance Based Compliance Section 407
 - "Compliance based on building performance of a proposed design(s) total annual energy cost is less than or equal to the annual energy cost of the standard Code minimum reference design"
 - Systems evaluated include HVAC, Water Heating, Fan Systems, Lighting Power, Receptacle Loads & Process Loads
 - Building Envelope design effects HVAC and Lighting Power
 - Energy Performance Trade-Offs can be modeled by MEP to enable alternative building envelope design(s) (ASHRAE 90.1) simulation software

AESTHETICS



Finding The Right Color



High Performance Solar Coatings

Reflective - Low light transmission, high reflection and an exterior mirror like appearance



Low-emissivity (Low-e) - High light transmission and low reflection



Hybrid Low-e - Combines properties resulting in a vivid exterior appearance and a high level of performance



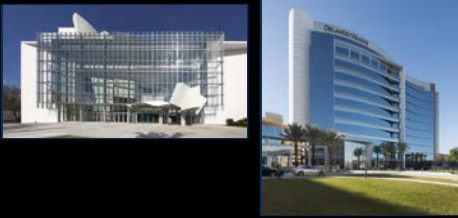
High Performance Coatings

Solar coatings can change both appearance and performance



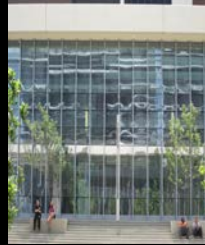
High Performance Coatings

Solar coatings can change transparency and reflectance



Coatings and Distortion Risk

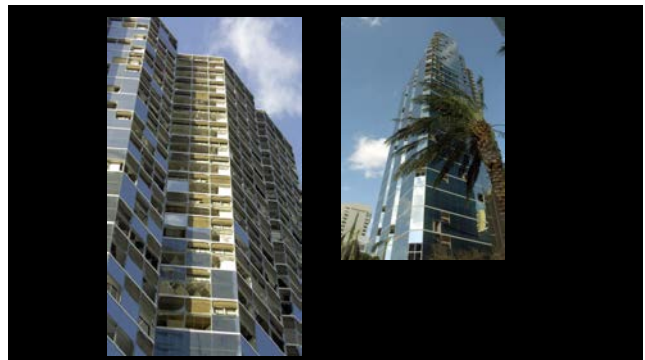
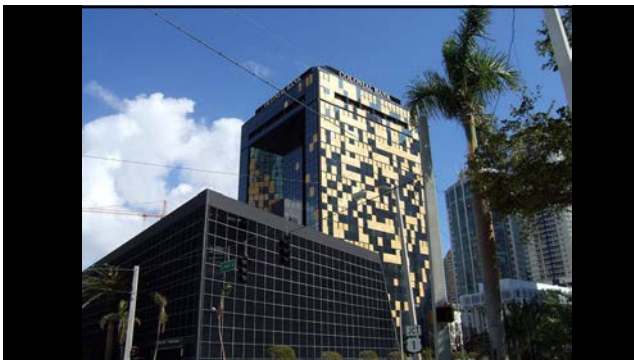
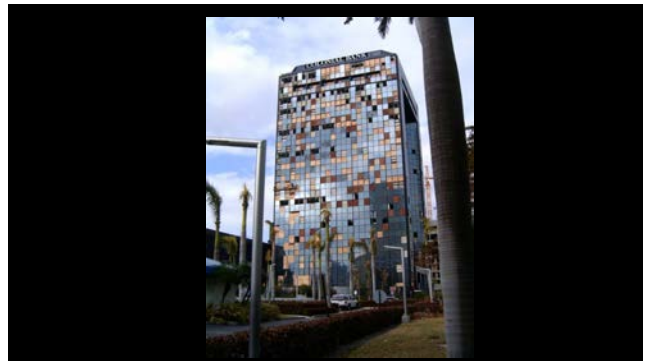
Coating applied prior to tempering

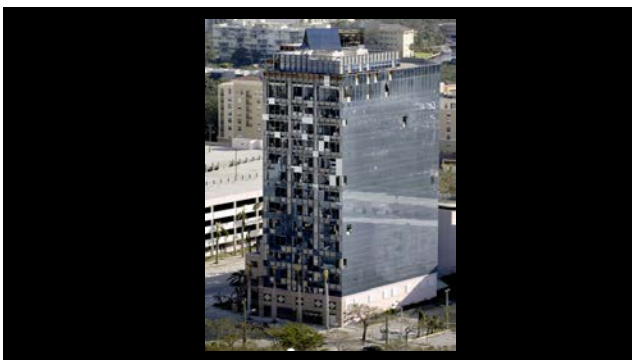
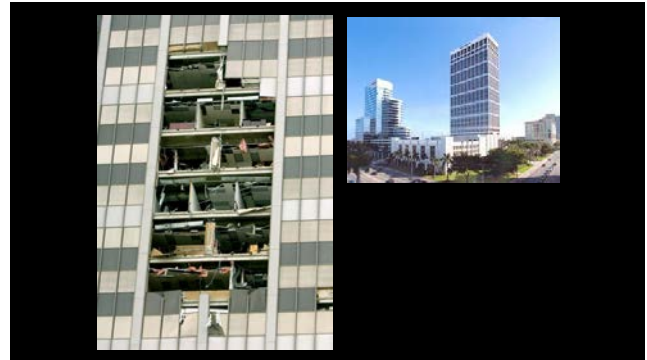


Coating applied after tempering



Hurricane Protection





2017 FBC Wind Zones

6.2.2.1 *Wind Zone 1*—130 mph \leq ultimate design wind speed, $V_{ult} < 140$ mph.

6.2.2.2 *Wind Zone 2*—140 mph \leq ultimate design wind speed, $V_{ult} < 150$ mph at greater than one mile (1.6 km) from the coastline. The coastline shall be measured from the mean high water mark.

6.2.2.3 *Wind Zone 3*—150 mph (67 m/s) \leq ultimate design wind speed, $V_{ult} \leq 170$ mph (76 m/s), or 140 mph (63 m/s) \leq ultimate design wind speed, $V_{ult} \leq 170$ mph (76 m/s) and within one mile (1.6 km) of the coastline. The coastline shall be measured from the mean high water mark.

6.2.2.4 *Wind Zone 4*—ultimate design wind speed, $V_{ult} > 170$ mph (76 m/s).

Notes:

1. Values are ultimate design wind speed and ultimate design wind speed at 100 mph (44.7 m/s) for 100-year return period for 100-year return period for 100-year return period.
2. Values are ultimate design wind speed and ultimate design wind speed at 100 mph (44.7 m/s) for 100-year return period for 100-year return period.
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Hurricane Testing

Missile Impacts – Simulate windborne debris

- **Large Missile** – Two impacts per glass panel with a 9 lb. 2 x 4 at 34 MPH for Level D and 55 MPH for Level E (Essential Facilities)
- **Small Missile** – Three impacts per glass panel with 10, two gram steel ball bearings at 88 MPH



Cyclic Wind Pressure Loading – Simulate winds

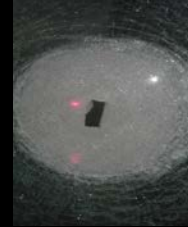
- 4,500 inward cycles
- 4,500 outward cycles



Remember the test is the glass + frame

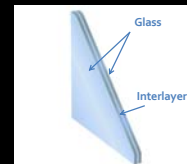
Pass/Fail Criteria

- 3 of 4 specimens required to pass
- Opening maximum- 1/16" x 5" crack

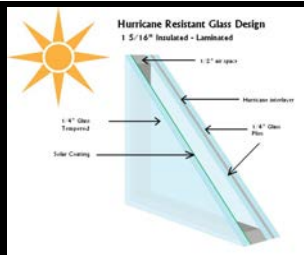


What is Hurricane Laminated Glass?

The most common laminated glass units are constructed with two plies of glass permanently bonded together with one or more interlayers.



Can Build as an Insulating Unit



Laminated Glass Benefits

- Qualifies as safety glazing
- Remains in opening after breaking
- Aesthetic enhancement opportunities
- Provides protection; hurricane, forced entry, and blast
- Can add to insulating units
- Blocks ultraviolet light (up to 99%)
- Exceptional acoustical attenuation (STC 39)



Laminated Glass Interlayers

Colored interlayers are another way to change the appearance of the glass.

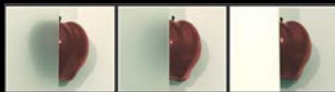
Can achieve vibrant colors not available with substrates.



Aesthetic Opportunities



Translucent Interlayers



79% Visible Light Transmittance

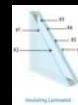
62% Visible Light Transmittance

7% Visible Light Transmittance

The PVB interlayer used to laminate two plies of glass together can be translucent such as Cool White, Arctic Snow or Polar White



Putting It All Together Performance-Aesthetics-Cost



Specifying Your Glass Makeup



Exterior Outboard Lite

Heat Treatment

- Annealed
- Heat Strengthened (2X)
- Fully Tempered (4X)
- Heat Soak

Frit Options

Exterior Outboard Lite

Spacers
Fill Type: Air/Argon

Interlayer
Interior Ply A

Interior Ply B

Balanced Facade Design



Emerging Design Trends

- Building codes continue to drive down SHGC and U-Values as society goes more green.
- Architects and building designers aspire to higher transparency and more solar protection. Looking for neutral color glass solutions to create timeless building designs.
- Bigger sizes are in growing demand.

Which View Would You Rather Have?



B
I
G

G
L
A
S
S



Emerging Trends – Frit Patterns

- Silkscreen or Digital Frit is a growing design trend in Florida. It is being used to improve SHGC and create a unique visual effect



Custom Frit Patterns Require Visual Mockup to Verify Design Intent



Facade Geometry



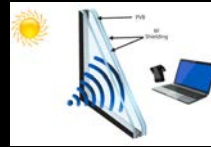
Digital Print To Glass

- Combines Art and Glass
- Vast color selection using inorganic ceramic ink 360 dpi permanently fused to glass
- Custom Images, textures, patterns and text
- Can be combined with Low E coatings, insulated and laminated glass for optimum energy performance
- Varying opacity levels transmittant/translucent



Emerging Trends – RF Shielding

- RF-Shielding is being incorporated on projects to protect data from being breached. This is especially true with government projects, but greater awareness of this technology is reaching the private sector.



RF Shielding coatings block electromagnetic radiation average 45 dB over 35 MHz to 18 GHz while optimizing visible light transmission and neutral appearance



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Thank You