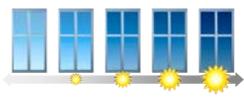




## Self-tinting Dynamic Glass for Daylighting and Energy Efficiency



Suntuitive® Self-tinting Glass  
 by Pleotint  
[www.suntuitive.com](http://www.suntuitive.com)

### Course Description

This course is about Self-tinting Dynamic Glass and will provide an overview of Dynamic Glass and how the use of Self-tinting Dynamic Glass can promote proper daylighting and energy efficiency. Specific case studies can be modeled to compare standard glazing packages to a glass package incorporating Self-tinting Dynamic Glass.

### Learning Objective #1

Understand solutions to common glass problems and the importance of energy efficiency

- Overview of current solutions to traditional glass problems
- Importance of energy efficiency year-round

### Why Using Glass Is So Important

**Using Glass for People:**

- Connection to the outdoors
- Views of the environment
- Allows natural light in
- Sense of well-being/health



### Traditional Glass Requires Compromises



**Problems = Heat, Glare and Energy**

- In a continuously changing environment, traditional glass is fixed
- Compromises must be made when using traditional glass to determine the tradeoff between light transmission and heat
- Solutions to traditional glass problems are inefficient and unappealing

**Compromises made to balance: Heat, Glare and Energy**

### Compromises for Traditional Glass



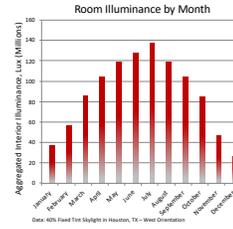
Interior manual and automated shades, exterior sun-blocking devices, post-application window film and tinted glass

### Complications with Traditional Compromises



**Shades stay shut.**  
 In a study by the USGBC, shades remained shut 59% of the time in 75% of buildings studied.  
 This makes preplanned daylighting irrelevant since natural light is not being utilized as expected.  
 Building performance also suffers or is lower than planned if blinds stay shut.  
**Blinds are unsanitary and costly to maintain.**

### Why Glass Must Be Used Properly



**Importance of Lighting Efficiency Year-Round**  
 Glazing that is efficient in one season might not be efficient in a different season.  
 The demands and intensity of the sun changes which can completely flood an area with too much daylight, heat and glare.

Having the right glass technology in place will allow the glass to adapt to the environment.

### Learning Objective #2

Understand current glass technologies and drivers of change in the glazing industry

- Overview of Dynamic Glass technologies
- Drivers of change in the glazing industry

### Overview of Dynamic Glazing Types

Thermochromic (heat) Continuously variable	
Thermotropic (heat) Defined Set-point	
Electrochromic (voltage)	
Photochromic lenses (light)	

### Overview of Dynamic Glazing Types

Description	Transmission Stages	Size Limitations	Shapes	Wiring (Installation)	*IGU Cost/ Sq. Ft.
<b>Thermochromic (Santobive)</b> Gradually changes from high light/heat transmission to low light/heat transmission when <b>temperature</b> is increased.	Infinite (Progressive)	64" Wide, No Height Limits	Yes	No	\$5
<b>Thermotropic</b> Changes from clear to tinted with change in <b>temperature</b> from a defined set-point (e.g. 49°C or 50°C).	2 (Clear, Dark)	48" x 48" Only	No	No	\$55
<b>Electrochromic (SAGE)</b> Changes from high light/heat transmission to low light/heat transmission when <b>electrical</b> voltage is applied. Must "clear" and cycle through all 4 "States" every 8 hrs.	4 (Defined "States")	60" Wide x 120" High (Bus bars every 32")	Limited	Yes	\$555
<b>Electrochromic (View)</b> Changes from high light/heat transmission to low light/heat transmission when <b>electrical</b> voltage is applied. Must "clear" and cycle through all 4 "States" every 8 hrs.	4 (Defined "States")	72" Wide x 120" High	Limited	Yes	\$555

### Drivers of Change in the Glazing Industry

- Sustainability Push From the Department Of Energy (DOE) and Others
- LEED® / Green / Net Zero Energy Movement
- Codes and Regulations (California's Title 24)
- Importance of Proper Daylighting
- Importance of Building Performance
- Importance of Occupant Experience

### Sustainability



**Ways to be sustainable:**

- Block the heat before it gets inside a building
- Use natural daylighting strategies
- Energy generation

**Facts:**

- ~50% of all energy consumed by buildings in the United States is attributed to space heating, space cooling, and lighting.<sup>1</sup>
- DOE estimates 54% of a homeowner energy bill is heating & cooling their home. Lighting adds another 6%.<sup>2</sup>
- DOE estimates \$35 Billion/ year in energy dollars lost through windows

Buildings Energy Data Book - U.S. Department of Energy  
1. <http://buildingsenergydatabook.eere.gatech.edu/energy-use/factbook/1.4>  
2. <http://buildingsenergydatabook.eere.gatech.edu/energy-use/factbook/2.2>

### Sustainability

**Push from DOE:**

- Develop marketable Zero-Net Energy Commercial Buildings

**California Building Standards Code**

- All residential buildings must be Zero Net Energy by 2020.
- All commercial buildings must follow suit by 2030.



### California's Title 24

**What it is:**  
Title 24, also known as the "California Building Standards Code", is part of the Energy Efficiency Standards for Residential and Commercial Buildings.

The standards were created to reduce California's energy consumption and to incorporate new energy efficiency technologies and methods.

California's Title 24 raises the bar for existing energy codes in place throughout the US while also raising awareness of what's possible.

California paves the way for higher standards which are then replicated by other states.

**Quick Facts:**

- The latest 2017 standards will save Californians \$1.6 billion in energy costs
- They are 25% more energy efficient for residential and 30% more efficient for commercial construction than previous standards

[http://www.energy.ca.gov/title24/2013\\_title24/2013\\_Accomplishments.pdf](http://www.energy.ca.gov/title24/2013_title24/2013_Accomplishments.pdf)

185

### California's Title 24

**Impacts on Glass**

The standards ensure that better windows and other features that reduce energy consumption are installed in homes and business.

The new standards place rigorous performance requirements on glass that require the use of advanced technologies.

The California Energy Commission has specifically listed "Dynamic Glazing" as a solution to meet the new rigorous fenestration requirements.

Specifically, "Thermochromic Glazing" is listed as a solution.

### Why Glass Must Be Used Properly

**Proper daylighting in the workplace:**

- Workers to be more productive
  - Smart daylighting can increase productivity up to 15%<sup>1</sup>
  - Lighting is #1 contributor to productivity<sup>2</sup>
- 10% of absences can be attributed to not having a connection to nature, a person's view being the primary predictor of absenteeism.<sup>3</sup>
- Integrating quality daylighting into an office space can save over \$2,000 per employee per year in office costs<sup>4</sup>

Which of these offices is going to make you feel good about coming to work?



1. USGBC  
2. Hesch  
3. Empathy Study at the University of Oregon  
4. The Economics of Biophilia by Terrance Bright Green Inc, 2012

### Why Glass Must Be Used Properly

**Proper daylighting in healthcare sector:**

- Patients to recover faster
  - Patients in day lit rooms spend up to 20% less time in hospital rooms<sup>1</sup>
  - Over 50 studies have been published showing the following results from utilizing natural daylight and views to nature<sup>2</sup>:
    - Faster recovery rates for patients
    - Decreased dependency on medication
    - Reduced staff and family stress
    - Improved emotional wellness
- Patients exposed to greater dosages of sunlight:
  - Perceived less pain
  - Took 22% less analgesic medications per hour
  - Had 21% lower pain medication costs for the length of their stay<sup>3</sup>
- Patients who stayed in rooms with windows that overlooked a scene of nature were released 8.5% faster.<sup>4</sup>
- Over \$93 million could be saved annually in healthcare costs by providing patients with views to nature.<sup>2</sup>



1. Journal of Affective Disorders  
2. The Economics of Biophilia by Terrance Bright Green Inc, 2012  
3. Walsh et al., 2005  
4. Walsh, 2009

### Why Glass Must Be Used Properly

#### Proper daylighting in the education sector:



- Students to study and test better
- Schools with natural daylighting show children learn 20-26% faster.<sup>2</sup>
- Test scores drop 17% in classrooms without windows.<sup>1</sup>

- Proper daylighting is key
  - A study of 8,000 students in Fresno, CA revealed that excessive glare negatively impacted students learning, especially in math.
  - Too much heat and light into classrooms is associated with negative student performance<sup>3</sup>

1. Nickles & Bafco, 1996  
2. Heath & Evans, 2002 Westing, 2009  
3. Heschung Maluma Group

### Why Glass Must Be Used Properly

#### Daylighting in the retail sector leads to a significant increase in sales



HighRise developed by Kohn Pedersen Fox LLP Management Co.

- Studies show skylights increase sales in:
  - grocery stores
  - clothing outlets
  - retail chains across the country<sup>1</sup>
- Stores with quality daylighting offer a 40% competitive advantage over those without<sup>2</sup>

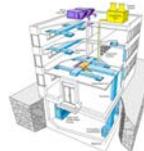
1. Heschung, 2003  
2. The Economics of Biophilia by Terrapin Bright Green Co, 2012

### Learning Objective #3

Understand Self-tinting Dynamic Glass technology and its effects on the building performance and energy efficiency

- Daylighting
- Key benefits of Self-tinting Glass
  - Productivity
  - UV Fading Protection
  - Safety and Noise Reduction

### High Rise Office: Peak Demand



Self-tinting Glass can provide:  
**15% Peak Demand Savings**

- Potential to reduce HVAC equipment
- Reduction would result in up-front capital (CAPEX) savings

### LEED® v4 Credits

Credit Categories	Possible Points
Integrative Process	1
Energy and Atmosphere	
• Optimize Energy Performance	1
• Demand Response	1
Indoor Environmental Quality	
• Thermal Comfort	1
• Daylight	3
• Quality Views	2
• Acoustic Performance	1
Innovation	
• Innovation	1-2
Pilot Credits	
• Ergonomics Strategy	1
• Bird collision deterrence	0-1
<b>Possible Points</b>	<b>12-14</b>

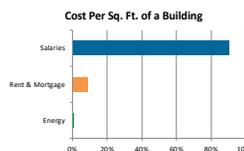
### Impact of Glazing on Productivity

Personnel is the largest expense of a building

- Productivity costs are 112 times greater than energy costs in the workplace.<sup>1</sup>
- The smartest investment is an investment in employees, their productivity, and their overall satisfaction.<sup>1</sup>

Self-tinting Dynamic Glass will:

- Increase comfort
- Optimize daylight
- Reduce solar heat gain
- Reduce noise
- Preserve the view
- Increase health & well-being

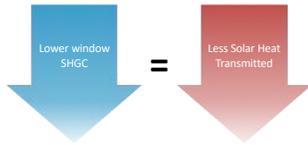


Increasing Occupant Well-being  
= Increased Productivity  
= Greater ROI

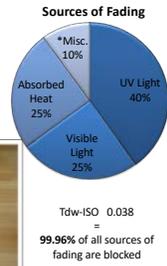
© 2010, 2012, US Department of Labor, 2010

### What is solar heat gain?

- The solar heat gain coefficient ("SHGC") is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed and subsequently released inward
- SHGC is expressed as a number between 0 and 1



### Unparalleled Fading Protection

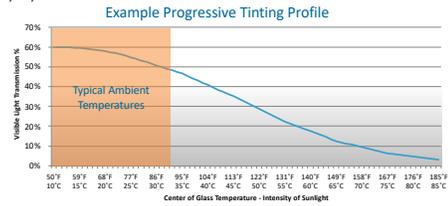


### Key Advantages of Self-tinting Glass

- 1. Automatic Tinting / No Controls or Wires**
  - Automatically tints in direct correlation to energy from sun
  - No special skills to install
  - No electrical contractors needed
  - No drilling holes into siding and framing
  - No controls or accessories needed
- 2. Color Neutrality**
  - Self-tinting Dynamic Glass is very neutral in the clear state
  - Self-tinting Dynamic Glass tints to a neutral gray, which is aesthetically pleasing

### Self-tinting Glass Responds Dynamically

Dynamically responding provides the right amount of daylight and solar heat at the right time of day all year.



Your buildings exist in an ever changing dynamic environment – now your glazing can adjust appropriately.

### Learning Objective #4

Understand how Self-tinting Dynamic Glass can be implemented in the building design

- Appearance of Self-tinting Dynamic Glass
- Construction considerations
- How to specify

### Appearance of Self-tinting Glass



We considered using permanently tinted windows, fritted glass, and mechanical shades, but the self-tinting glass offered the advantages of each without any compromises. The glass naturally adjusts to provide the perfect tint to counteract outside conditions, while allowing the glass to be clear at night." – Senior Project Architect

### Appearance of Self-tinting Glass



"The sunlight coming through the windows with Suntuitive (Self-tinting Glass) is much softer compared to the stark, white sunlight with normal glass." – Building owner

"With Suntuitive (Self-tinting) glass, we were not only able to remove those devices (blinds and shades), but also install bigger windows to increase visibility and daylighting." – Construction Administration Manager

### Does Suntuitive Look Different Than Traditional Windows?



### Construction Considerations



Dynamic Glass makes existing technology better

- Self-tinting Glass can be used with:
- Any thickness of glass
  - Any tint or color of glass
  - High performance low-e
  - Warm edge spacers
  - Gas fill

### Ease of Install



Self-tinting Dynamic Glass units being installed

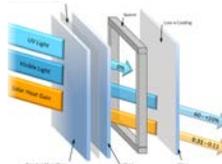
### Added Benefits = Complete Package



### Construction Considerations

#### Vertical Construction

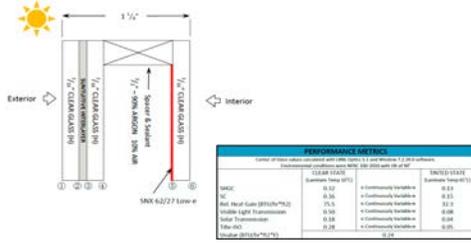
Dynamic Interlayer



The active component of Self-tinting Dynamic Glass is in the PVB interlayer.

It is not a coating or after-market product.

### Overall Typical Construction



### Conclusion/Additional Questions

Self-tinting Dynamic Glass can promote proper daylighting and energy efficiency. Dynamic Glazing offers a new solution for year round building performance requirements.

Specifically, Self-tinting Dynamic Glazing can provide:

- People factors (productivity, learning, healing, shopping, attendance)
  - Improved visual and thermal comfort
  - Healthier high performance buildings
  - Increased occupant health and well-being
- Building performance and sustainability factors
  - LEED®/Green/Net Zero
  - More efficient daylighting strategies
  - Energy savings potential
  - Increased fading protection
  - Safety glazing – new levels of awareness
  - Greenhouse gas emission reduction (CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub>)

### Thank You

Self-tinting Dynamic Glass for Daylighting and Energy Efficiency

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