Welcome!

Today, there is an ever-growing range of choices for specifying and designing with glass in building facades. The vast array of products brings unlimited ways for architects to express creativity and offer more innovative options to achieve energy goals. At the same time, every decision affects how the building ultimately looks and performs. With all the options available, how do you know which ones are right for your project?

In this presentation, we will review the current glass choices available to architects from both a visual and performance standpoint. Equipped with this knowledge, you will have more control over the end result of your project.

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Let's talk about learning objectives. Upon completion of this course, you should be able to:

- Understand how all the parts of a glass facade work together to meet project vision and goals.
- Discuss how glass composition and low-e coatings affect aesthetics and performance.
- Identify important design considerations for glass substrates and low-e coatings.
- Recognize the ways fabricated glass can affect building aesthetics and performance.

This is the same building at different times of day. As you can see, the glass looks very different depending on the time of day. How is this possible?

A number of factors can change the appearance of glass and how it performs. Elevation, orientation, viewing angles, lighting conditions, and more can all dictate how the final glass facade looks. This is why it is important to think about glass holistically and let the project's unique factors inform your decision. Making choices to achieve your aesthetic and performance goals starts with understanding how glass is made.

Let’s take a look at the foundations of the glass material that makes up your building facade.

Glass is created through a sophisticated process.

To start, the float manufacturer melts and refines raw materials to produce a ribbon of glass, or the glass substrate.

Low-e coaters add performance and aesthetic factors by applying coatings to the float glass. Float-glass manufacturers can also perform this function all in one facility.

The fabricator builds the glass unit based on specification (cutting, seaming, sealing, heat treating, creating IGUs, etc.) and sends the finished product to the subcontractor or glazier.

Finally, the glazier installs the glass into a building and applies the metal system to the glass to make the final unit. Glaziers are experts in metal, not glass, so it is important to direct your glass questions to the source: the glass manufacturer.

What exactly is float glass, and how do manufacturers create it?

Float glass is physically unique material made from a basic formula: silica sand…

…soda ash, salt cake, dolomite, rouge/iron oxide…

…and cullet. The manufacturer melts down these raw ingredients and carefully cools them to make the float glass substrate.

There are several types of float glass: standard clear, tinted, and low iron.

Standard clear glass is simply a product of the recipe we described on the previous slide.

Certain metal oxides give glass color. The rouge/iron oxide that manufacturers add to the standard float recipe gives glass a slightly greenish cast. Adding more will make the glass appear even more green. Other metal oxides give glass bronze, blue, and gray shades. Historically, tinting glass was a way to block out unwanted solar heat to keep interiors cool and comfortable. Tinted glass can also be used to achieve a desired aesthetic.

Low-iron glass is an exciting evolution in glass. It removes rouge/iron oxide from the process to create a more neutral substrate without the green edge you see with standard clear.

Let's take a look inside the float plant to see how glass is made. (Play video!)

Manufacturing float glass is an automated process—people only help with monitoring.

We start with loading raw batch materials into the facility.

The main furnace heats these materials up to a liquid state at 2,900 degrees Fahrenheit.

The glass is floated on a 2,000 degree Fahrenheit bath of molten tin—thus the name float glass—creating a perfect ribbon of glass.

Ribbon pulleys slow down and speed up the glass to control thickness (they slow down to get thicker glass and speed up to get thinner glass). This transition takes only one to two minutes.

Next, the glass moves to the cooling lehr. Controlled cooling produces annealed glass, also known as raw glass. Annealed glass is the flattest glass you can get. Glass can be further strengthened during fabrication by heat treating or tempering.

During quality inspection, scanners read for imperfections like bubbles and scratch

marks.

In an automated process, the glass is seamed on-site, cut down to specified sizes, and carefully packed up for coating or delivery.

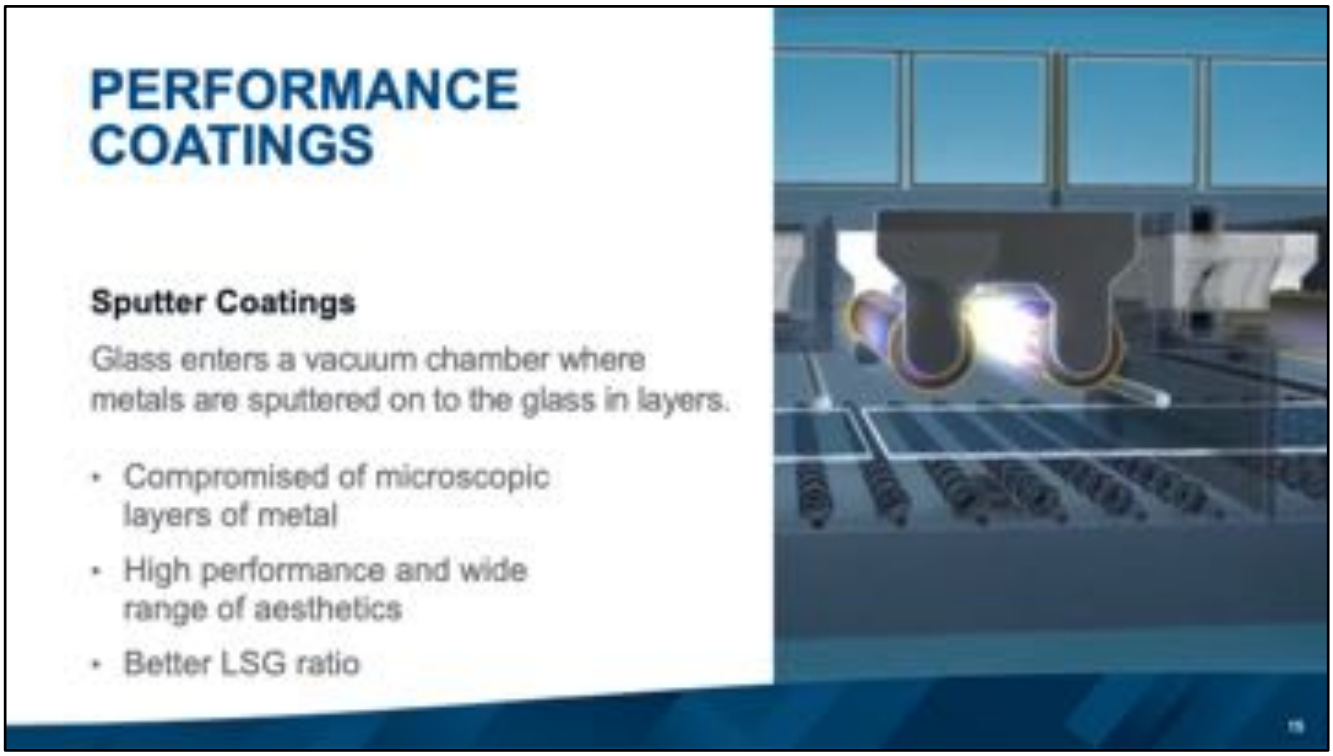
Now that you know how float glass is made, we are going to talk about the ways glass can be enhanced with coatings to meet a variety of performance and aesthetic goals.

The glass you see on a building facade is more than annealed glass substrate—it is often enhanced with coatings.

There are two types of coatings. The older generation is pyrolytic (or “hard coat”).

Pyrolytic coatings are applied while float glass is still pliable in the tin bath using a waterfall effect. The pyrolytic coating then cools and hardens as it moves into the lehr jets, thus the name “hard coat.”

Typically, pyrolytic coatings are added to tinted glass. As we saw earlier, tinted glass tends to absorb more solar energy than clear glass.



The second type of coating is the most advanced technology for high-performance coatings: sputter coating (or “soft coat”). This product meets stringent ASTM standards.

In this process, the manufacturer adds microscopic layers of metal to achieve high performance and reflect a desired aesthetic.

Sputter coated glass allows for large uncut sheets of coated glass to be transported to fabricators where they can cut, temper, laminate, bend, and insulate glass on a more expedited, regional basis. This results in shorter lead times, localized production and more design flexibility with fabrication.

An important thing to note about sputter coatings is that most of them cannot be exposed and therefore should not be placed on the first surface of the IGU.

Let’s revisit the glass manufacturing plant to see how glass is coated. (Play video!)

Coating glass is an automated process, just like manufacturing float glass.

First the float glass is scrubbed, rinsed, and dried.

Glass is moved through a positive pressure room to remove all contaminants. This is important because any debris that remains on the glass will distort the reflected aesthetic of the coating in the finished, heat-treated product.

The glass enters a vacuum chamber where all the atmospheric pressure is removed to replicate space.

The glass moves through a series of chambers where microscopic layers of metals are deposited.

As the glass moves through each chamber, the process activates a magnet behind a metal cathode suspended above the glass.

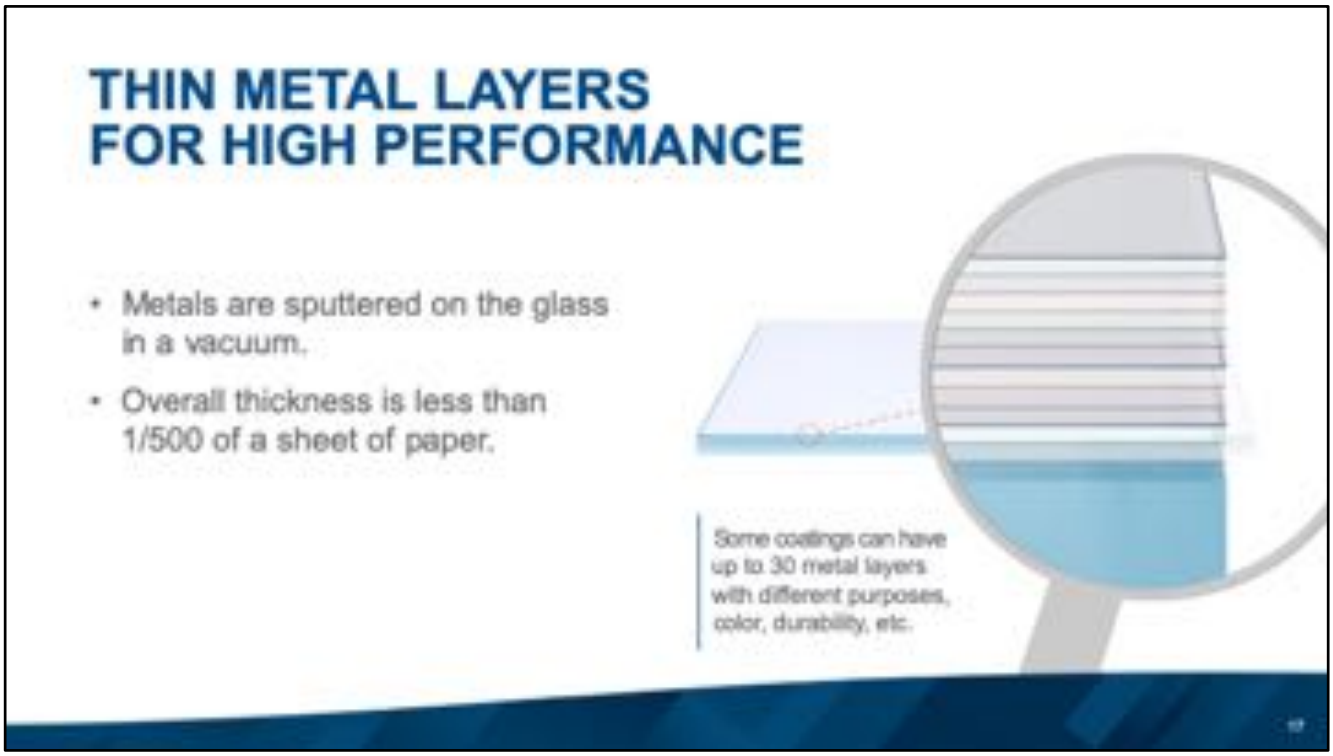
Charged ions rush toward the magnet and collide with the metal cathode.

Metal oxides dislodge from the metal cathode and fuse to the glass.

After the coating is applied, the glass is brought back to regular atmospheric pressure.

Scanners check for uniform, even coverage.

Coated glass is packed and shipped to customers.



As you saw in the video, coatings are made from very thin and sophisticated layers of metal.

Some glass coatings can have as many as 30 layers of metals and oxides—all combined, less than 1/500 the thickness of a sheet of paper!

Manufacturers develop “stacks” of coatings to allow architects to manipulate light in different ways. Some elements and compounds within the stacks give color, while others control light transmission. The complete stack determines the performance and aesthetic qualities of the glass.

Silver is the workhorse of sputter coated glass. Silver is added through three different processes: single silver, double silver, or triple silver. Triple-silver glass can provide powerful insulation where it is needed most. Other metal layers add to performance of the silver.

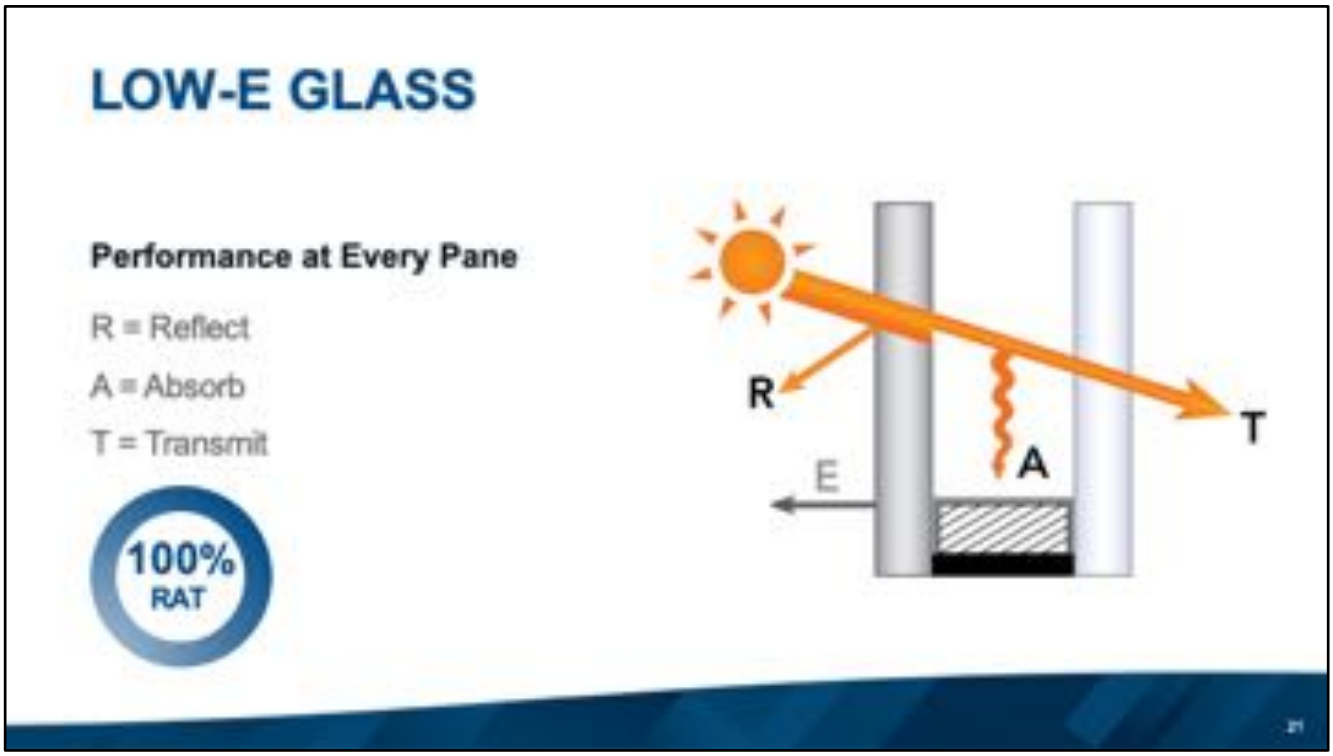
Now that you have a sense of what glass is, let's talk about what glass does for building performance and what measures to look out for as you are selecting the right glass for your project.

The highest-performing coatings are low-emissivity (low-e) coatings that can help you get selective about glass performance.

The most popular coatings are low-e coatings that improve solar performance by controlling heat gain or loss.

Manufacturers can apply these low-e coatings to clear or tinted glass substrate.

As we mentioned earlier, manufacturers once used tinted glass to add performance. With low-e coatings, it is easier to zero in on the recipe needed to meet specific project goals and building codes.

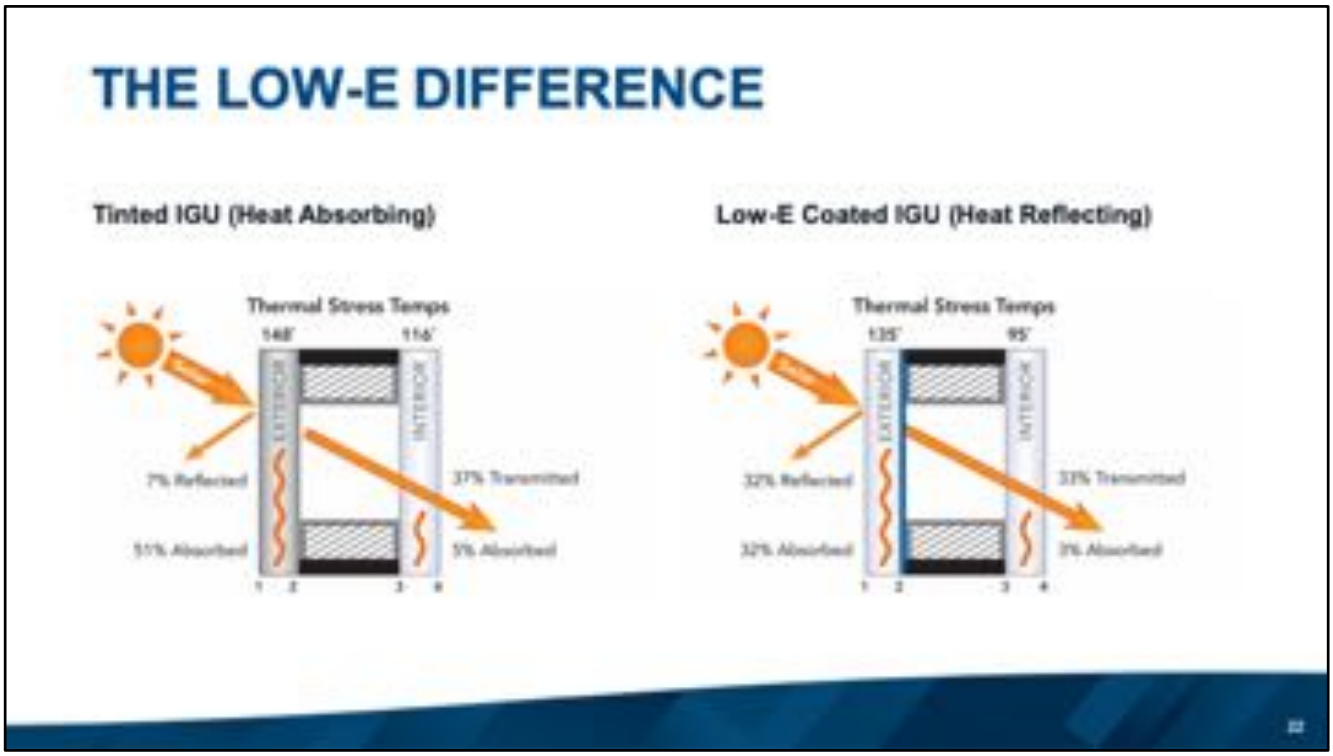


Low-e glass allows selectivity for keeping light in or out.

When solar energy strikes a window, only three things can happen to it. It will be:

- reflected by the glass or the coating,
- absorbed by the glass or the coating, or
- transmitted into the room and beyond.

Solar energy is reflected, absorbed, or transmitted in different proportions, depending on the type of glass involved. There is an equation for this—the RAT equation—that accounts for 100 percent of solar energy. The design of a low-e coating achieves the ideal balance of these proportions.



Low-e coatings make a clear difference in the performance of a glass unit. Also called double glazing or triple glazing, insulated glass units (IGUs) contain multiple glass surfaces, separated by a space and sealed together in a unit that can be incorporated in a window frame. Tinted substrates can help you achieve the performance you need, but low-e coatings can perform better even on a clear or neutral substrate.

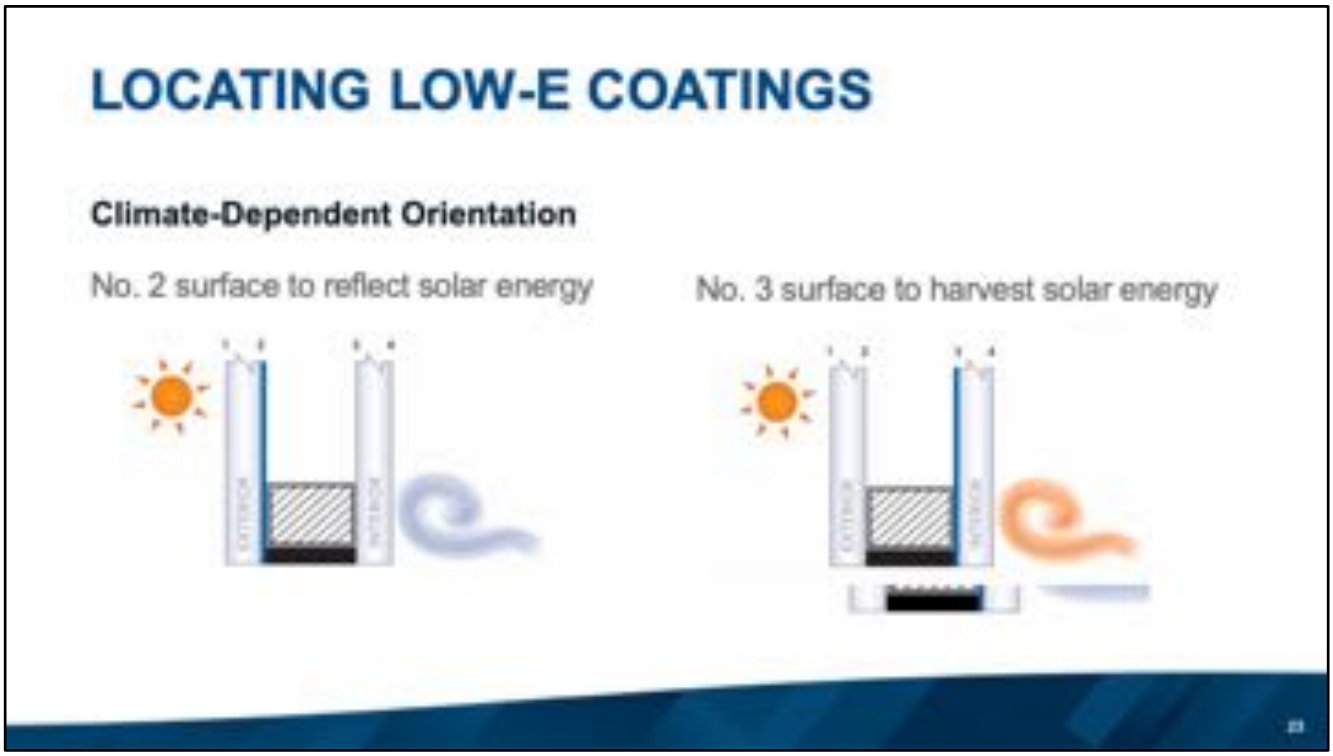
In this graphic, we can see how the types of glass and coatings used on each glass surface can yield varying performance results.

On the left side, we see a window surface with a tinted gray outboard over a clear inboard and no low-e coating.

On the right side, we have a clear-over-clear with a double silver low-e coating.

Measuring performance side-by-side, we can see that a low-e coating on a clear substrate is more effective when it comes to keeping a building energy efficient.

You can also combine low-e coatings with tinted substrates to increase performance and create different reflected aesthetics.



Placement of the low-e coating on the IGU can impact this RAT equation. Typically, we want to place low-e coatings on second surface—as close to the sun as possible to reflect or absorb the sun's energy.

Only select coatings can go on the third surface. This is because when you place a coating on the third surface, you will see the backside of the coating. This can make the glass look pink/purple or gold/yellow at certain angles.

Depending on the climate of your project, you may want to change the location of the coating. In northern climates, low-e coatings can go on a third surface to harvest the passive heat into the building. In southern climates, you can use low-e coating on the third surface along with a tinted substrate.

There are multiple measurements to look out for when you are selecting glass to meet performance goals: U-factor, solar heat gain coefficient, light to solar gain, and visible light transmittance.

U-factor measures heat gain or loss through glass due to difference between indoor and outdoor temperatures. A lower number means better performance. The inverse of U-value is R-value, or resistance to heat flow.

One way to manipulate the U-value is changing the airspace in the IGU to argon. It has been said the argon can permeate out of the unit about 1 percent each year. If that is a concern, you can use a fourth surface coating in conjunction with the second surface coating to lower the U-value roughly four points.

Low-e coatings can help control solar heat gain.

The term **solar heat gain coefficient** (SHGH) measures how well a product blocks heat caused by sunlight. It's measured in values from 0 to 1.

The direct gain portion equals solar energy transmittance. The indirect portion is solar incident absorbed, re-radiated, or convected indoors.

Simply put, the lower the SHGC, the less solar heat it transmits and the more comfortable you are inside the building.

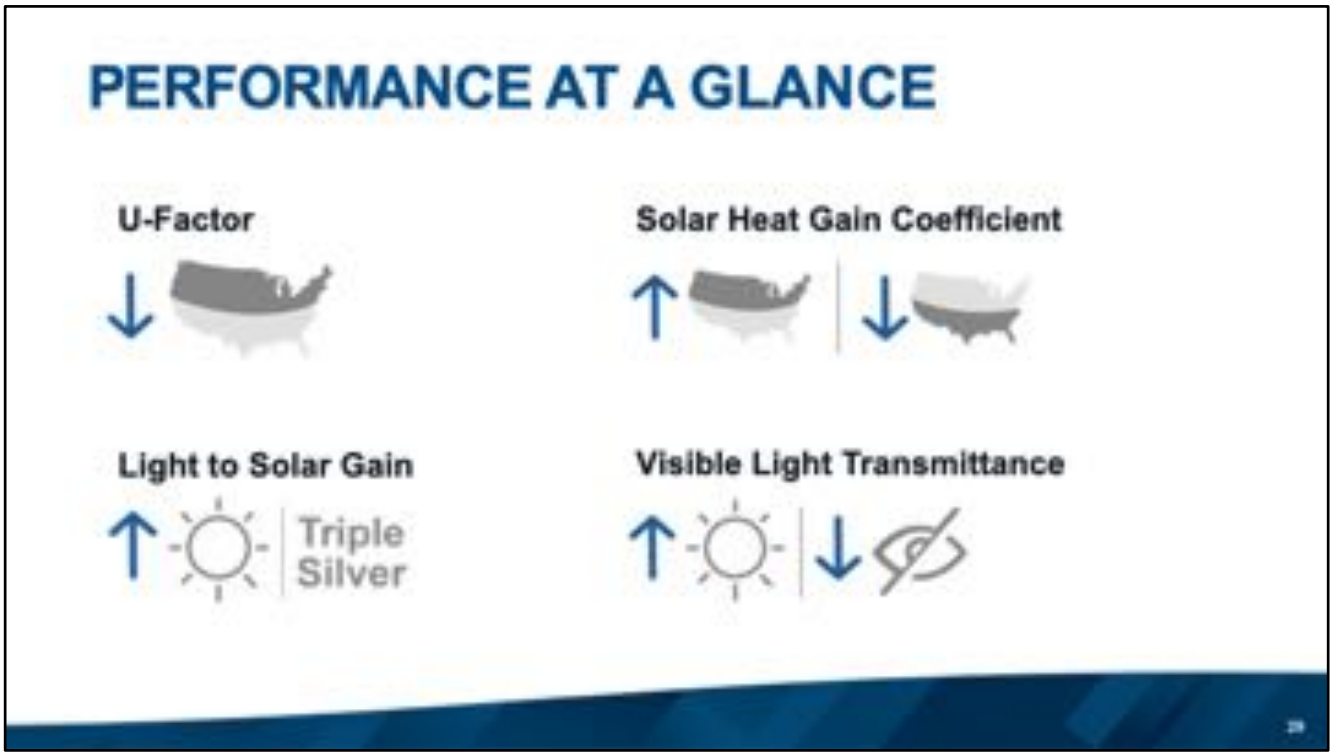
Light to solar heat gain ratio (LSG) compares the amount of visible light transmitted to the SHGC that the glass achieves. To get this measurement, we measure the amount of visible light shining through glass and divide that amount by the solar heat gain coefficient.

You will want to pay attention to LSG when you are designing for energy performance that does not compromise aesthetic experience.

Visible light transmission (VLT) is the percent of visible light that passes through glass.

The most visible light you can get from low-e product is roughly 78 percent. A clear-over-clear IGU without a low-e coating can achieve 80 percent VLT.

VLT can help facilitate daylighting and, if designed thoughtfully, can offset electric lighting and cooling loads.



Based on the location of your project, there are a few rules of thumb you can apply when selecting your glass based on these measurements.

There are recommended U-factors for each climate. Specify a lower U-factor in the North, and know that a double silver or triple silver low-e product automatically meets code for southern climates.

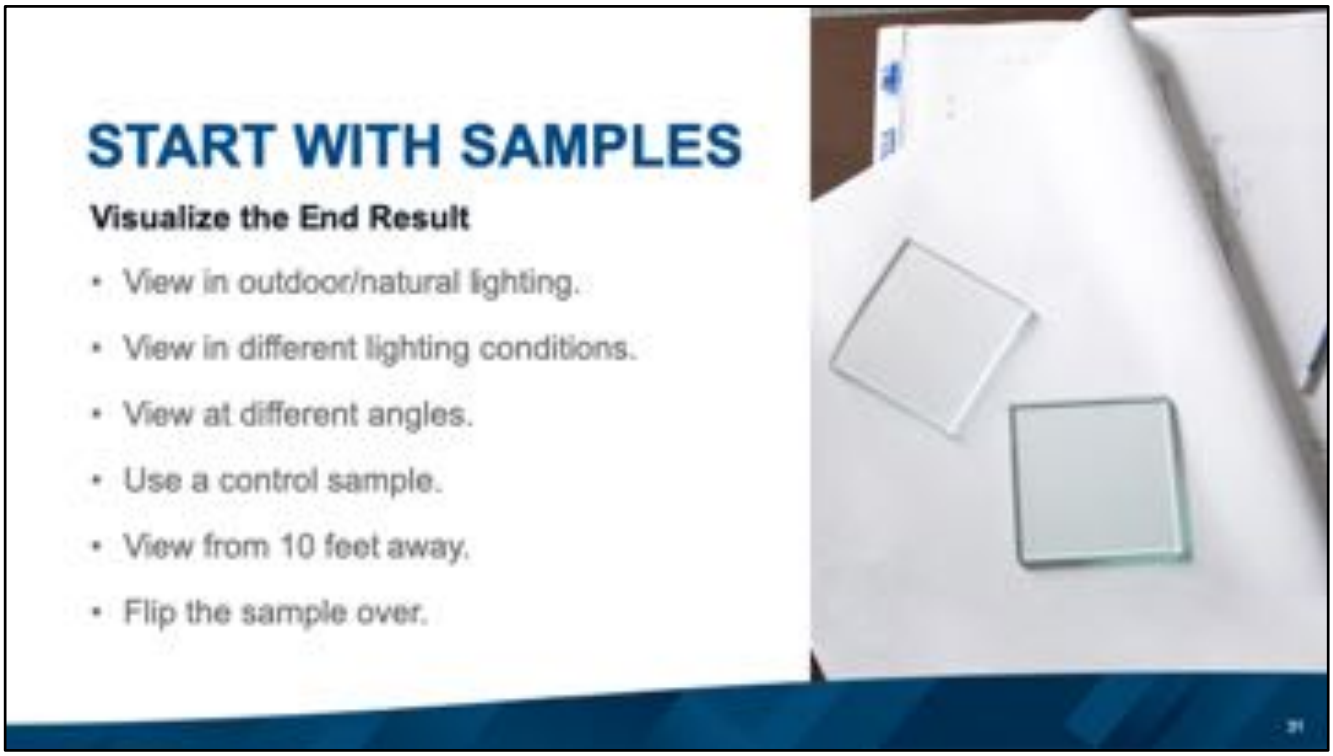
A climate-correct SHGC can serve as a free heat source in cold climates and lower air-conditioning costs in hot climates. Specify 0.4 or below in the North and 0.25 or below in the South.

A higher LSG ratio can make rooms brighter and create more open views.

A higher VLT can enhance daylighting, and a lower one can add more privacy. However, VLT is very important to manage in order to avoid glare and unsightly facades.

When we consider these performance factors, we can ensure a great end result for our building and its occupants.

Now we are beginning to take all the glass knowledge we just covered and apply it toward glass selection.



Oftentimes, glass selection begins with ordering glass samples. Glass samples can help you visualize final glass appearance. There are certain tips to follow to ensure you make the best decision when choosing glass:

- The best way to view samples is outdoors on an overcast day.
- Viewing glass sample on a clear day will make glass look blue by picking up the blue sky.
- View triple-silver low-e coating at a 40- or 50-degree angle to ensure desired color.
- View with control sample to further compare color.
- Never hold a sample right in front of your face—it will not show color accurately.
- Flip a sample over to see the reflectivity of the glass as well as the interior reflected aesthetic. This is a good consideration for hotels and multifamily buildings where nighttime views are important. Flipping glass over will determine if you will see pink/purple or yellow/gold interior reflected aesthetic in such applications.

Glass samples come with two backgrounds, representing the two ways we see glass. These backgrounds help you understand the ways we see glass, and zero in on the right look for your building.

The black background represents reflected color, or what you see when light bounces off the glass.

When you place a black background behind your glass sample, it will replicate a punched open window application without lighting turned on.

The white background represents transmitted color, or what you see looking through the glass.

When you place a white background behind your glass sample, it will demonstrate a nighttime application, an application where there is a white shade behind the glass or a situation where a user is looking through an all glass building corner elevation (shown on slide 40).

Understanding how backgrounds affect the appearance of glass can help us think about how they might affect the aesthetic of your glass facade. For instance, a certain spandrel color or a shade behind the glass can make a difference in the reflected and transmitted color of the glass. However, using a glass sample to see transmitted color will not provide a true indication of the exterior appearance on your final building.

In finished projects, glass can appear different for a variety of reasons. Glass looks different depending the time of day or night, as well as your viewing angle and interior lighting, particularly at a building corner. The decision to build cubicle walls or create open interiors can affect the way glass looks from the outside. As mentioned a moment ago, the colors of shades also play a role.

Consider all of these factors (and more) before specifying, and be sure to view glass samples at least 10 feet away from yourself and at different angles to mimic these effects.

Here's an example of how reflected vs. transmitted color can affect the final appearance of a building.

This building is using a neutral/light silver reflective low-e coating (27 percent). In the image, you can see white shades pulled down behind the glass. This causes light to transmit through the glass, casting a light green color from the low-e coating stack. When the shade is not present, the low-e coating reflects the clear sky and makes the glass appear blue. On an overcast day, this low-e coating will reflect a subtle light silver color.

To harmonize a similar facade, consider using a gray-toned shade. This will cause the low-e coating to show reflected color even when a shade is present.

In the projects above, we see two different applications of reflected vs. transmitted.

Both of these projects are using the same neutral, triple-silver low-e coating, but different designs can make the same low-e coating appear differently.

The project in the left image has an open space design. Light is flooding the building, causing glass to appear more transparent and bright. Even with the low reflectivity of the glass, it still shows a slight blue hue from a sunny day. Remember that when white is behind the glass, the low-e coating stops reflecting and transmits color. You can see that in action here where the white floor slab behind the glass causes the glass to transmit a light green aesthetic.

The project in the right image has an overhang with a deep, dark space behind the facade. Light is only entering the space from the north and south facades. This causes the low-e coating to reflect a neutral aesthetic. The greenish transmitted color can be seen where there are white pillars behind the glass.

Different designs can dictate the reflected aesthetic of the low-e coating. The majority of double and triple silver coatings will always transmit a yellowish/greenish cast with white or lighter colors behind the glass.

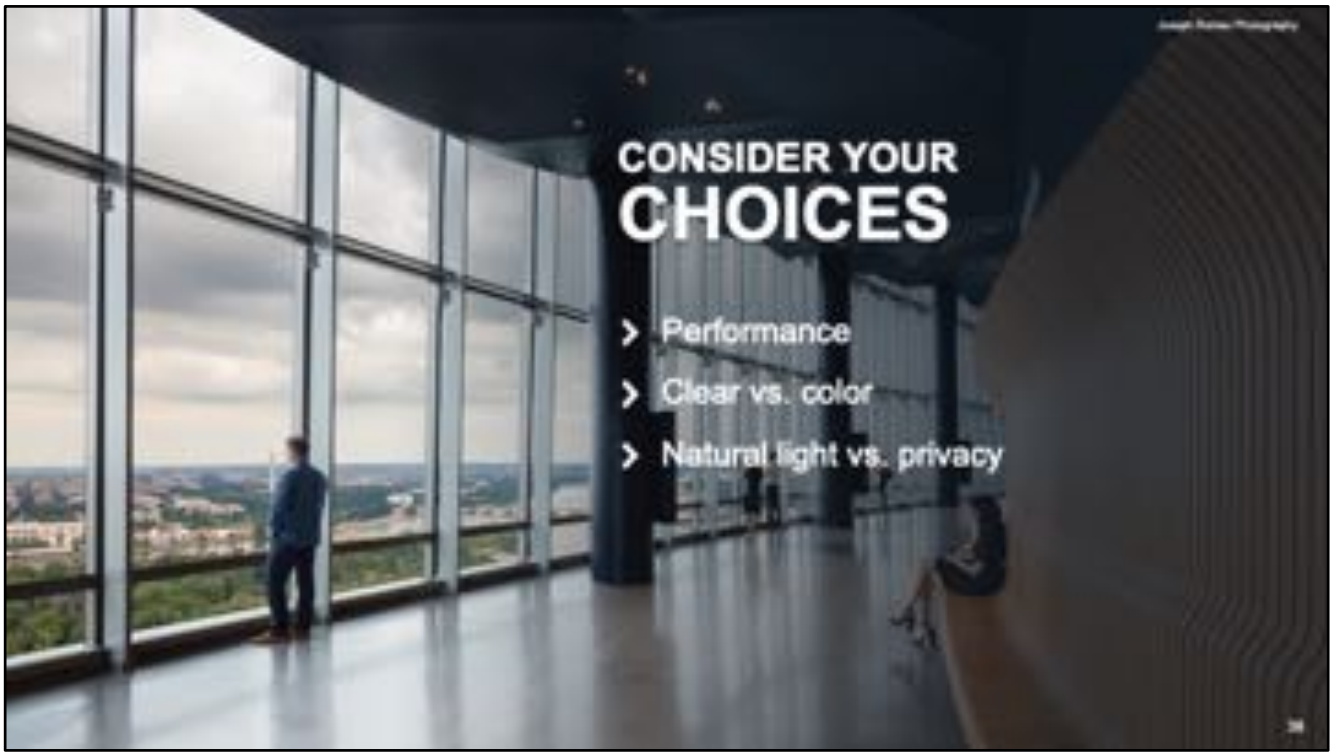
Now that you understand the important concept of reflected vs. transmitted, we are

going to discuss how various design considerations come together to create a stunning glass facade.

The best glass selection happens when all features are considered together rather than letting a single characteristic drive a decision. In this section, we are going to discuss glass materials holistically in order to help you make the right choice.

The float glass and coating you select impact appearance and performance of the complete glass facade. It is important to consider both when you are selecting glass for your project.

For example, see the project above. The same coating can look “clear” as it does on the bottom right side of the image, where light from another elevation softens the glass. It can also look neutral/gray like it does in the center with the dark, deep walls. And it can look slightly reflective, as you can see on the left side where the shade reflects the tree. The glass at the top of the building uses a low-e coating and is frosted to give a slightly opaque appearance.



There are many choices to make when considering float and coated glass selection, including:

- the ideal energy performance for the region;
- clear or color appearance, or the ideal aesthetic for the building; and
- the ideal amount of natural light to enhance occupant well-being and maintain privacy.

Reconciling these choices is the first step toward selecting the right combination of float and coated glass.

In the project shown in the image here, we can see how the combination of float and coat matters. They used a transparent low-e coating on a clear glass substrate (left side of image) with a reflective low-e coating on a clear glass substrate (middle of image) for a desired reflected aesthetic along with performance in mind. The transparent glass is used in the meeting rooms to harvest light, while the reflective glass is used to lower visible light transmission to diminish glare for people working in cubicles.

Here is a side-by-side look at how glass can look quite different depending on the combination of float and coat. In the projects above, we can see how the same, color-neutral low-e coating performs and looks on different substrates.

Left image: This project uses a neutral triple-silver low-e coating on a low-iron substrate. This is done to pull the green out of the glass for a more neutral appearance. You can still see a slight greenish cast from the silver in the low-e coating stack.

Right image: This project uses a neutral triple-silver low-e coating on a tinted gray substrate. Tinted substrates are sometimes used to improve IGU performance and provide multiple reflected aesthetics (blue, green, gray, and more). Applying a low-e coating to a tinted substrate will change the reflected aesthetic of that same low-e coating design on clear glass. It is easier to match vision to spandrel with certain tinted substrates.

Here is another side-by-side comparison, but with two building using the same reflective low-e coating on different substrates instead of a neutral coating. Again, we can see how the coating looks different depending on the substrate.

Left image: This project uses a reflective low-e coating on the second surface with a light gray-tinted substrate. It demonstrates how this combination can achieve a gray/blue reflected aesthetic. Also, the outward reflectivity drops from 28 percent (coating on clear) to 16 percent (coating on light gray).

Right image: This project uses a reflective low-e coating on a clear substrate. High outward reflectivity makes harmonizing vision to spandrel easier, achieving a more uniform reflected aesthetic.

Reflectivity is a complex property of glass to review during selection, but it is also an important one. The amount of reflectivity can help you meet several design goals:

- Reflectivity in glass can help achieve optimal solar control and aesthetic.
- Reflectivity can visually accent your building.
- Highly reflective glass can be especially desirable in hotel or office applications for privacy from outside looking in while preserving views from inside looking out.
- High reflectance can help you pick up more of the surrounding landscape.
- Lastly, high reflectance can help you harmonize vision to spandrel.

Older generations of coatings, such as single silver, needed to be reflective to obtain a lower SHGC and a good spandrel match. Today, reflectivity is purely an aesthetic choice based on the building's design intent. Neutral low-e coatings are available that can provide a low SHGC while harvesting light. We can design a low-e coating to reflect a certain aesthetic, such as neutral, neutral green, blue, and more.

The BNL-BNP Paribas Headquarters in Rome, for example, is achieving a gray/silver reflected aesthetic on a clear glass substrate while providing energy efficiency with a low SHGC. Before current technology was available, this was only attainable through a tinted substrate and a low-e coating combination or a reflective coating.

In the examples above, we can see how the same reflective building can look different based on lighting conditions.

This building uses a silver reflective low-e coating on clear glass. The image on the left was taken on a sunny day, causing the glass to pick up the colors of the sky and appear light blue. You can see how a highly reflective (30 percent) solution can appear more transparent in direct sunlight.

The image on the right was taken on an overcast day. This shows the true reflected aesthetic of the coating, which is light silver. In this lighting, there is a more fluid vision to spandrel match.

This reiterates the importance of viewing glass samples in multiple lighting conditions.

Remember VLT from earlier? Highly reflective glass will have a lower VLT. Be sure to balance this with the right float and coat combination to ensure occupants receive the benefits of natural light.

Reflectivity also looks different depending on the weather and the time of day. In full light or on a sunny day, the glass will look highly reflective. In low light or on an overcast day, you will see more characteristics of the glass.

In the image above, we can see how direct sunlight causes the glass to appear slightly more transparent. With the transmitted light, we can see the shades behind the glass more clearly.

There are many benefits to specifying more transparent glass. You can maximize daylight and views, put interior activity on display, and create a crisp, clean look for your building.

In the examples above, we can see transparency in application within the same building. Atriums are a common application for highly transparent glass.

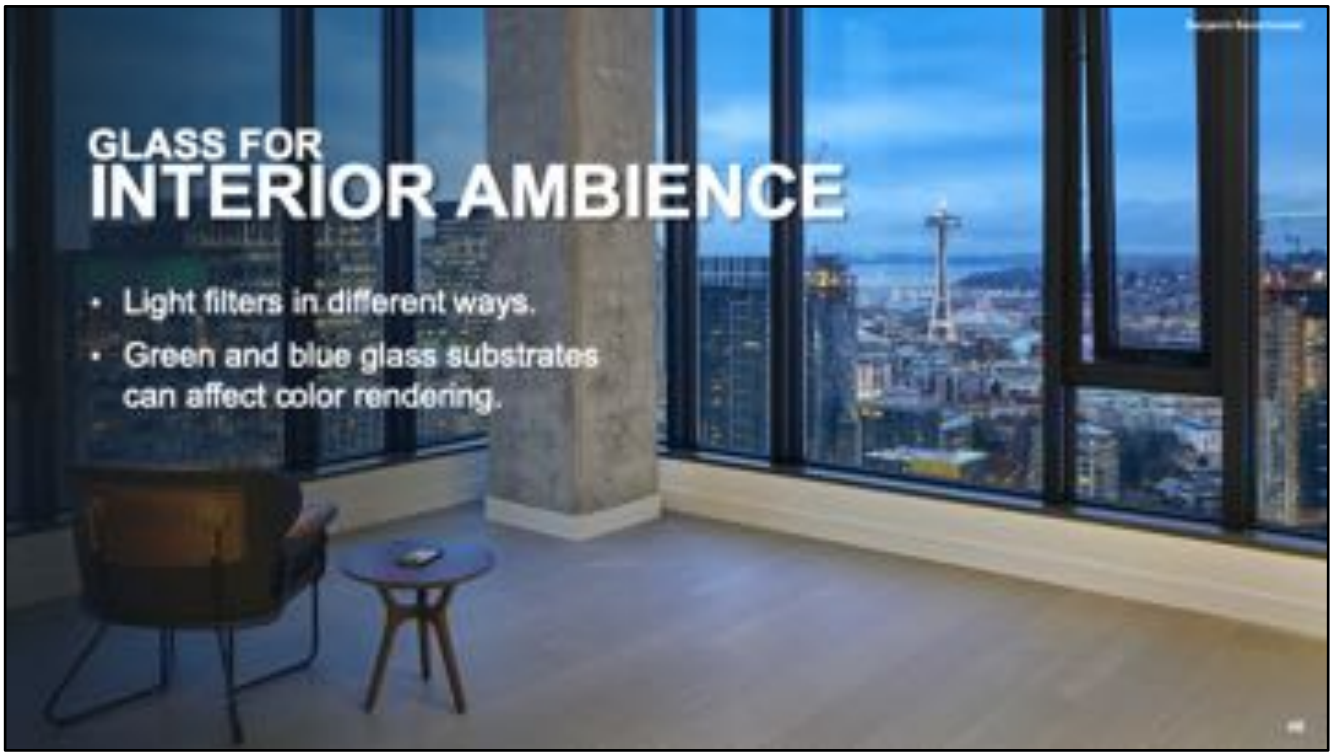
This project combined clear glass with a neutral, highly transparent low-e coating to yield a higher SHGC and achieve a crisp, blue look. The exterior shot on the left shows the coating reflecting a neutral aesthetic. In some conditions, the glass picks up the blue sky while other areas appear more neutral. Where we see white columns, the coating stops reflecting and transmits a light green aesthetic from the low-e coating.

In the interior shot, we see the coating harvesting 70 percent visible light to make the entranceway bright and vibrant.

Considering the inside of the building is just as important as considering the exterior. As we have seen, certain glass selections can yield high VLT.

If you do not right-size VLT, it can cause glare for occupants. A customer might try to fix it on their own by installing shades to block the light streaming through the windows from the outside. Doing so will ultimately impact the exterior appearance of your building. Light-colored shades will cause the glass to show transmitted color, and can be highly visible from the exterior and interfere with street-side aesthetics and cause what we call "visual noise."

If you expect that the VLT level you specify will cause glare, we recommend suggesting a shade color that matches your glass. This will ensure a more uniform look for your building.



A view through color neutral glass is different than a view through tinted or more colored coated glass. Colored glass can filter light in different ways, especially when paired in combination with interior surroundings.

For example, green and blue tints can affect color rendering. This is why it is important to consider interior ambiance goals when you select your glass, as it may cast a color on interior walls or floors or change occupant views.

GLASS FOR INTERIOR AMBIENCE

PRESERVE THE LIGHT

Color Rendering Index

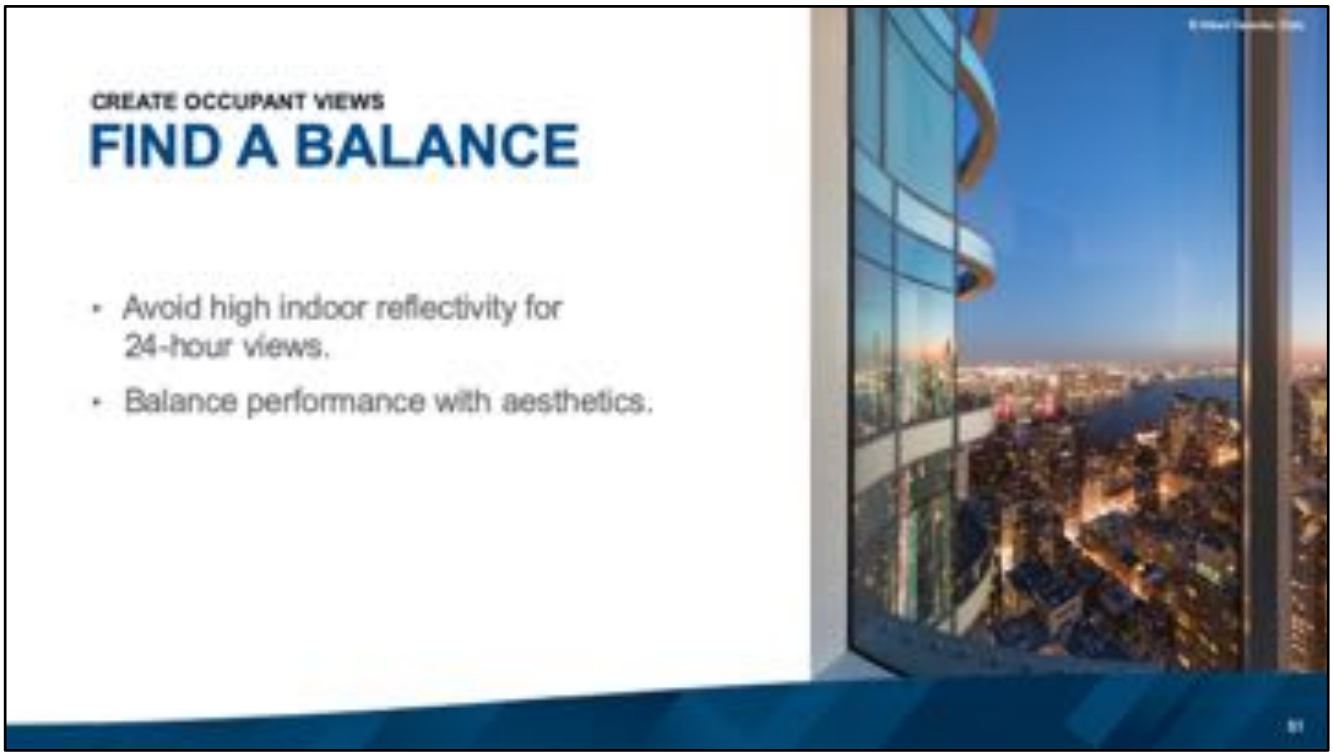
This indicates neutrality of transmitted light—preserving views from the interior.

PRODUCT	CRI
Low Iron Insulating	98
Clear Insulating	97
Bronze Insulating	95
Clear Low-E Insulating	95
Gray Insulating	95
Light Gray Insulating	93
Green Insulating	88
Dark Green Insulating	85
Blue Insulating	85

One way to plan for this is using the color rendering index (CRI). The CRI indicates the neutrality of transmitted light through the glass. We usually consider a CRI of 90–100 to be good/neutral, although museums typically specify 95 or higher so they can display their exhibitions in the truest possible color.

If you specify a lower value, interior walls and floors may have a colored cast.

Inside-looking-out views are of utmost importance. You put a lot of thought into creating stunning views for the people living and working inside buildings, so make sure you choose the right glass to enable the best views at all times of day.



There are a few things you can do to ensure stellar occupant views. It is important to remember that reflectivity is different outside looking in vs. inside looking out, and to specify accordingly. In this image, we can see a successful application where exterior glass reflects the skyline while views from the inside look clear and open.

Avoid 20 percent or higher indoor reflectivity, as this means occupants will not be able to see outside at night. Instead, it will be like looking in a mirror.

As we mentioned earlier, some low-e coatings can show pink/purple or yellow/gold. This is especially true when indoor reflectivity is present. Consider the surrounding indoor materials and your coating options including multiple coatings, and carefully pair with the right substrate to preserve views.

With the right tools and action steps, you can ensure your building looks and performs the way you want it to.

Use your samples and backgrounds to see how the light affects the glass appearance.

Visit the job site in different lighting conditions and times of day to get the best idea of how lighting will impact the glass.

Finally, contact the manufacturer early to discuss your options—they are here to help you make the best choice for your project needs.

The decisions you make when fabricating float/coated glass can also affect the final appearance of the glass facade.

There are several fabrication techniques that can glass appearance and performance:

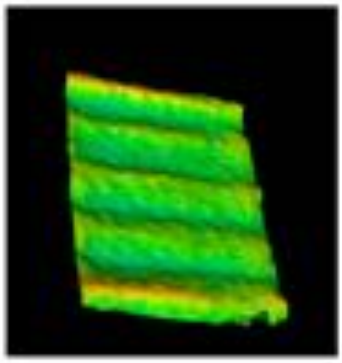
- Heat-strengthening
- Tempering
- Insulating
- Laminating
- Silkscreening
- Digital printing
- Spandrel
- Textured/frosted glass

HEAT-STRENGTHENED AND TEMPERED GLASS

KEEP THE STRENGTH, AVOID UNINTENDED CONSEQUENCES

Avoid Distortion

- Specify rollerwave peak to valley.
- Specify horizontal rollerwave.
- Be cautious with one-to-one ratio.
- Specify early with your manufacturer.



There are two ways to heat treat glass. Heat-strengthened glass is twice as strong as annealed glass. Since this type of glass is unlikely to spontaneously break, it is preferred for vision and spandrel applications. Tempered glass is four times as strong as annealed glass. It is often called “safety glass” because it breaks into small pieces if fractured, so it is most often used for doors and windows near floors.

When a fabricator heat treats glass, distortion can occur. Rollerwave distortion occurs when when the glass is heated to a semi-pliable state and slumps into rollers before it is cooled with forced air.

To avoid rollerwave distortion, specify rollerwave peak to valley. This will limit the number of fabricators that can work on your project, but it will ensure that you get a higher profile fabricator. You can also specify horizontal rollerwave.

We recommend using caution with a one-to-one ratio since it is more difficult to get the glass flat.

Laminated glass is two or more lites of glass permanently bonded together with one or more plastic interlayers using heat and pressure. You may choose to laminate your glass for several reasons: security, strength, sound control, UV resistance, and added visual affects with a color interlayer.

When you fabricate glass for impact resistance, you laminate it. This can cause color shifts when viewing at certain angles due to the low-e coating proximity to the laminated interlayer.

One thing to keep in mind for application where high structural support is needed is that a more flexible interlayer is ideal. This will enhance safety for common uses such as hand railings, glass floors, stairways, etc. A glass expert can help steer you toward the right choice for your project.

A laminated interlayer can also improve sound control capabilities of the glass.

A laminated configuration can help prevent 99.9 percent of UV rays from entering the interior space.

A laminated IGU with a color interlayer can achieve vibrant colors, but can cost a premium based on whether a fabricator has such colors in stock.

Another fabrication method is silkscreening. This method applies ceramic frit dots to the glass. There are many benefits to silkscreening. It can increase IGU performance and reduce glare potential, especially with lighter frit colors that reflect more light. If you desire a frosted pattern, a white dot pattern can achieve such a look.

So on top of performance, you get aesthetic differences with the dot patterns.

For best performance, we recommend putting a low-e coating on the second IGU surface and a warm gray/medium gray frit pattern on the third surface. This will minimize glare and lower SHGC.

If you want a more detailed image on your building, fabricators can use digital printing. Digital printing uses an ink jet printer with a ceramic frit. Typically, you want a high visible light (neutral) product to show the patterns being designed.

Spandrel is also an important consideration for any building design. Spandrel can contrast or complement glass and match glass to create a more uniform appearance.

There are a few options for spandrel materials. Ceramic frit is very durable and completely opaque. Choose this options if you want to minimize unsightly insulation and wiring.

However, ceramic frit does not offer vibrant colors and looks unattractive from the back due to striations and pinholes. More vibrant colors can be achieved with silicone paint. It is very important to place silicone paint on backside of spandrel where it cannot be touched on the number four surface.

Choosing spandrel can either be an aesthetic decision to blend the glass with the spandrel or a bolder choice by making it stand out from the glass.

In the image on the left, we can see how the spandrel intent was designed into the building. With low reflective or neutral low-e coatings (around 11 percent reflectivity out), it is more difficult to hide the spandrel. Warm gray and medium gray spandrel options typically harmonize the best with such low-e coatings.

In the middle image, the combination of the low-e coating and a tinted substrate helps to harmonize the vision to spandrel match. The darker the tint, the easier it will be to match the vision to spandrel areas. We typically match this type of glass with medium gray spandrel.

In the image on the right, we can see how highly reflective glass products make the vision to spandrel easier to harmonize, creating a more uniform facade.

When choosing spandrel colors, keep in mind that white spandrel will bring the green out from the low-e coating. Black spandrel will make the low-e coating roughly four points more reflective, so this color is recommended when the vision area has deep, inset spaces. Warm gray (a lighter aesthetic) or medium gray are most commonly used. Be aware that “warm gray” can vary from depending on the fabricator. Some contain more “white” paint than others, which can cause it to pull greenish hues out

of the coating.

Start a conversation today! Talk to your manufacturer early so that they can forecast your needs—they can be your glass resource as you plan your project. Now equipped with the knowledge of float and coated glass selection, you can surpass your project goals.

Thank want to thank you for your interest in glass. Please let us know if we can help you with your glass selection.