Photo: Matt Oberer, MattO Photo

Specifying interior roller shade fabrics is not simply an interior design decision.

Whole Building Approach to Interior Roller Shade Fabric Selections

Many factors impact building performance, energy efficiency, and aesthetics

Sponsored by Draper Inc. | *By Barbara Horwitz-Bennett*

When glancing up at the facade of a high-rise, office/medical building, or educational facility, do the interior roller shades blend in seamlessly with the enclosure and surrounding environment, or are they a mishmash of colors and styles, haphazardly raised and lowered?

Beyond aesthetics, fabric shades can make a significant contribution toward whole building performance, health, and wellness.

"It is critical to select the right shade properties to ensure glare protection, reduce energy use, and enhance occupant comfort and well-being," explains Thanos Tzempelikos, Ph.D., professor of civil engineering, Center for High-Performance Buildings, Purdue University.

As architects evaluate fabric shade options, including weave pattern, openness factor, color, and material composition, Brandon Andow, Ph.D., NCARB, senior building performance analyst and senior associate at EYP Architecture & Engineering in Denver, explains that the shades' properties of visible light transmission (VLT), absorption, reflection, scattering, and emissivity will not only affect views and daylighting but also significantly impact HVAC loads from heat and radiation transfer through the fenestration, aesthetics, thermal comfort and circadian health of occupants, productivity, and surface condensation.

In optimally choosing shade fabrics to best compliment whole building

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Learning Objectives
After reading this article, you should be able to:

1. Evaluate the whole building impact of roller shade fabrics on thermal comfort, energy efficiency, productivity, aesthetics, and views.
2. Identify the characteristics of fiberglass and polyester shades, including the different fabric weave patterns and view-through options.
3. Adjust colors, openness factors, and weaves to optimize comfort, performance, and aesthetics for the customized needs of each project application.
4. Discuss the benefits of a complex glazing, whole building approach that considers how a fabric performs with the glass as a total system and integrates with the building's facade, surroundings, geographical location, and orientation.
5. Review modeling tools and mock up best practices to optimize shade fabric designs.

To receive AIA credit, you are required to read the entire article and pass the quiz. Visit **ce.architecturalrecord.com** for the complete text and to take the quiz for free.

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Photo: Barry Rustin

The main considerations in selecting a shade fabric should be related to performance factors, such as glare reduction, thermal comfort, and occupant comfort, as shown here at the Champaign Public Library in Champaign, Illinois.

performance and aesthetics, architects must be knowledgeable about the different materials, weaves, openness factors, and performance standards.

FIBERGLASS VERSUS POLYESTER

Starting with the material selection, the composition of the yarn core forming the fabric roller shades is typically fiberglass or polyester. To select the best material for the application, a review of each selection's characteristics is helpful.

Fiberglass is a fiber produced mainly from sand, and polyester is a synthetic fiber derived from coal, air, water, and petroleum. A typical fiberglass core yarn holds 200–400 filaments, and a polyester core yarn contains 50–100 filaments. Most of the world's fiberglass shade fabrics are woven in the United States and Europe.

Technically speaking, polyester core yarns have a higher strength rating than fiberglass. However, pound for pound, fiberglass is actually stronger than steel. So practically speaking, strength values are negligible as both materials are more than strong enough for roller shade applications.

Because fiberglass is not affected by heat, it has greater dimensional stability. This means that shades have less fullness and limits on motorized units will rarely have to be reset. Generally speaking, fiberglass yarn is thinner and therefore offers somewhat better glare control and improved view-through characteristics. Its high dimensional stability makes it more suitable for tensioned shades. Its thinness and light weight also mean an overall smaller profile, which means smaller rollers, clutches, motors, bracketry, and other hardware, as well as lower cost. At the same time, recent developments in polyester yarns have made them more competitive in the realm of thinness and weight. That said, heavier and thicker fabrics require bigger head boxes that use more raw materials, increasing cost, and can be more visible.

Another characteristic of both materials is the fact that they can be coated by PVC vinyl. This coating provides color, durability, UV resistance, and other properties, including antimicrobial effectiveness, fungal resistance, colorfastness, lightfastness, and washability.

Where coatings for fiberglass and polyester shade fabrics vary is in their proprietary blends of UV stabilizers, pigments, plasticizers, and fire retardants. Some polyester fabrics on the market are made with non-PVC coatings, which is an eco-friendly option. There is also a polyester product that is Cradle-to-Cradle Certified Bronze and therefore meets rigorous criteria in the realm of material health, material reutilization, energy, water, and social responsibility.

There are also several fiberglass and polyester fabrics that are GREENGUARD Gold certified for low chemical emissions.

Specifiers will also want to consider the extent to which products are prone to frayed edges. Some manufacturers utilize ultrasonic technology to create a clean, non-frayed edge when cutting the shade fabrics. However, this only works with polyester since the material is sensitive to heat. There is a small possibility that the polyester fabric will fray after some time in the field, but this can be remedied with the careful application of heat/flame to melt the frayed pieces away.

With fiberglass, advanced cutting methods help to reduce the likelihood of fraying. If it does become an issue, scissors can be used to trim down stray yarns.

Photo courtesy of Phifer Inc.

The type of weave can impact view-through characteristics of the shade fabric, as well as the look and feel of the material.

WEAVE TYPES

With both fiberglass and polyester, designers can choose between different types of fabric weaves.

As the simplest weave pattern, the **plain weave** is created by passing each weft yarn over and under an alternating warp. This produces the same look on the front and back. Fashioned with a larger yarn, the **rib weave** creates a ribbed line effect in both the warp and weft directions.

With a **basket weave**, even numbers of the weft yarns cross over and under alternating yarns of the warp in a 1-to-1 ratio. This produces equally sized square openings and therefore offers the best view-through of any weave pattern, consequently making it the most popular pattern.

A **twill weave** is formed when weft yarns are threaded over one or more warp yarns and then passed under another two or more warp yarns. As each yarn row is offset from the previous, this produces a diagonal rib pattern. Also called a duplex fabric, the fabric is unique in that it offers identifiabley different colors and tones on each side.

Any weave pattern that does not fall into the category of plain or twill and results in a textured surface or pattern is called a **fancy weave**. Custom weaves and colors are available, though they typically require longer lead times and increased cost.

For example, a **satin weave** technique is where four or more weft yarns float over a warp yarn. Consequently, the warp lies under four or more weft yarns before interlacing over one weft yarn. The satin weave creates a dual-sided fabric where one side consists of more warp color and the other side shows more weft color. All satin weave fabrics have a predominantly white warp, which produces a predominantly white street-side view and enhanced solar protection. At the same time, the interior can incorporate different interior room-side color schemes while maintaining exterior building uniformity with a white street-side appearance.

A **mock leno weave** is produced when three or more warp and/or weft yarns are grouped together so that adjacent groups of threads are separated during weaving. The threads in each group interlace with, or float over intersecting yarns independently, creating a textured weave pattern. The separation of grouped threads causes the overall fabric to have openings that allow for good view-through capabilities.

VIEW-THROUGH

A number of key factors combine to determine the view-through of the roller shades. These include the weave, openness, color, and dominant lighting.

The openness factor is the percentage of space within the weave. The smaller the openness factor, the less light gets through, and the higher the openness factor, the better the view-through characteristics, as more light shines through. At the same time, a higher openness factor comes along with more solar radiation (i.e., heat gain, entering the room, and potentially glare).

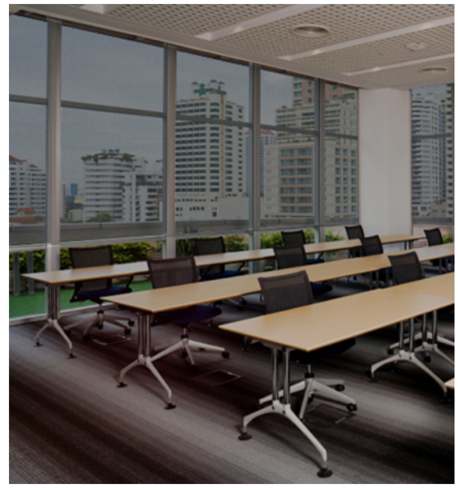
For example, if preventing light pollution is a priority, then a 1 percent openness or an opaque fabric would be most appropriate.

Dual roller systems, where two shades are built into the same headbox, offer the best of both worlds, with a mesh fabric allowing view-through during the day and an opaque fabric providing privacy at night.

In selecting a color, the darker the fabric, the easier it is to see through, and the lighter the color, the lower the view-through and level of glare control. Darker colors offer superior view-through because they absorb more light. The human eye focuses on the first source of light it sees, so a darker color allows the eye to look through the fabric to the dominant light source outside. At the same time, light-colored fabrics offer a high level of daytime privacy and good natural ability to reflect solar energy.

"While the default might be to select a tighter weave where more sunlight or glare is anticipated, it is important to consider the combination of openness and color," explains Susanne Gruening Angarano, ASID, CID, NCIDQ, principal and senior interior designer at Ashley McGraw Architects in Syracuse, N.Y. "For instance, a 1 percent open charcoal colored shade will allow for some visibility from the inside out while performing well for glare and daylight control. But a 1 percent open white-colored shade will block most visibility in addition to performing well for daylight control."

Photos courtesy of Draper Inc.



Openness factor impacts a shade's view through, as well as performance in glare reduction and solar heat gain. Shown is the difference between 1 percent and 5 percent openness factors on the same color fabric.

With blackout shades, 100 percent of solar radiation is prevented from entering the space. While this is ideal for high levels of privacy, at times the shades can be inconvenient, as the only way to see out or allow daylight in is to raise the shade.

With darker colors, less solar radiation is reflected, so it can sometimes be difficult to find a happy medium between view-through and thermal comfort. Some duplex fabrics offer a light exterior and dark interior. There are also certain performance fabrics that help with this issue, and fabrics are available with a metalized backing to provide high reflective values on darker colors.

Offering some design insights here, Chris Coulter, associate and lighting designer at Buro Happold in New York, points out that lighter-color shades allow for more diffuse light transmission into a space, but tend to "glow" more under direct sun, which may reduce views out even in higher openness factor shades. "Lighter-color fabrics tend to be more neutral and align with a wider range of interior designs, whereas darker fabrics feel much more limited in their potential use. We often find ourselves recommending light- or medium-gray fabrics to offer a compromise between performance and aesthetics."

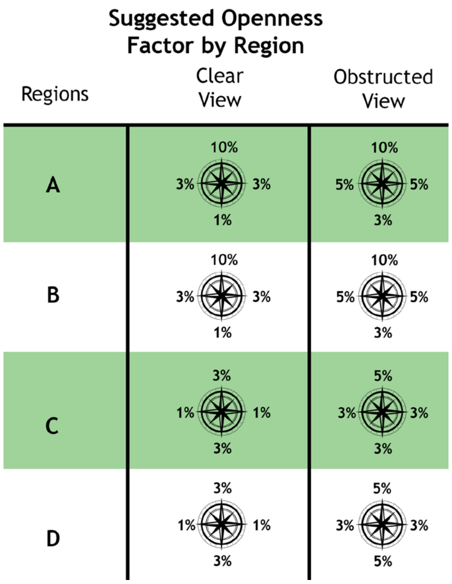
Although openness factor and color are the major factors in view-through, the type of weave can also have an impact. A twill weave with contrasting colors on each side, for instance, provides excellent view-through because it provides a darker color on the inside and a lighter color on the outer side. A basket weave's excellent view-through comes from its uniformly square openings of equal size.

With the assistance of an online simulator, architects can compare how different openness factors impact view-through. For example, the visuals produced by the simulator demonstrate the difference between a dark fabric with 1 percent openness and a 10 percent open fabric.

A final factor for view-through is dominant lighting. When people enter a space, their eyes are naturally drawn to the dominant light source. For instance, on a sunny day, the eye focuses on the light outside, not the dark fabric strands. In the same way, on a cloudy day or darker evening, we focus more on internal lighting, and our view through the fabric is not as clear. Architects should consider the major light source in the space and where is it coming from (e.g., from the sun or artificial lighting).

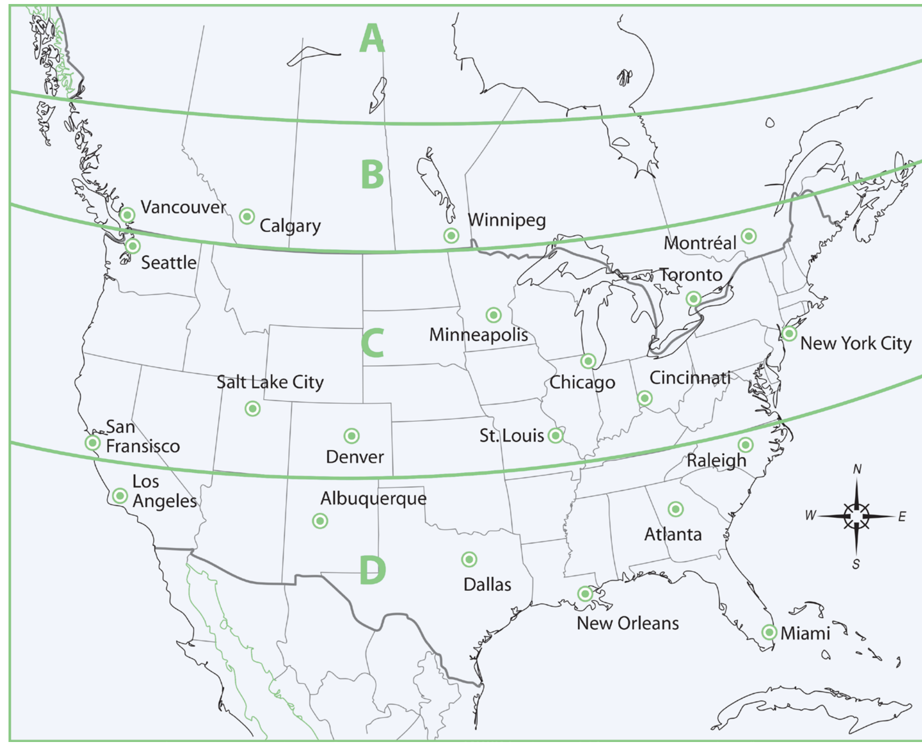
While openness and view-through are significant variables impacting specifications, shade performance is important as well, and this is impacted by a number of factors, including window size, geographical location, and building orientation. To assist with the latter, a Suggested Openness Factor by Region chart (shown above) gives examples of openness options that might work best based upon a bulding's location and orientation. For example, in Chicago in Region C, a 3 percent open fabric is recommended for an obstructed view on the south elevation, whereas a building in Dallas in Region D would do better with a 5 percent open fabric for an obstructed view on the south elevation.

Image courtesy of Draper Inc.



This chart gives examples of openness options that might work best based upon location and orientation.

Image courtesy of Draper Inc.



Several things should be considered when choosing a fabric's openness factor. A building's geographic location, orientation, and surroundings may dictate that different openness factors be used on different facades of the same building.

UNDERSTANDING FENESTRATION DATA

Fenestration data is key information used to explain how a fabric will perform and is typically found on charts included on manufacturers' swatch cards. Some key numbers to consider are encompassed in the RAT equation, which is an acronym for solar reflection, solar absorption, and solar transmission.

Total solar reflectance (Rs) is the percentage of solar energy directly reflected by the fabric. The higher this number, the more heat the fabric reflects back toward the window.

Total solar absorbance (As) is the percentage of solar energy absorbed by the shade fabric. The lower the number, the cooler it is near the window. This number will always be the opposite of the Rs, so if the Rs number is high, the As will be low, and vice versa.

Total solar transmittance (Ts) is the percentage of solar energy directly transmitted through the fabric. The higher the number, the more solar energy is being allowed through into the building. Taken together, the percentages of Rs, As, and Ts should add up to 100.

In addition to these RAT values, there are a number of other values associated with roller shade fabrics.

Visible light transmission (Tv) is the amount of visible light (in the range of 400–700 nanometers) that is directly transmitted through the fabric. This includes both direct and diffused light. The lower the value of the fabric, the greater its impact on controlling glare. Darker colors have a smaller number, which means they absorb more visible light, and this is why darker colors have better view-through characteristics.

Reflectance in the visible spectrum (Rv) is the percentage of visible light reflected by the fabric. Lighter colors will have a higher number, meaning they reflect more light and reduce glare. If too much visible light gets through the shade fabric, this creates glare. Darker colors block more visible light than light colors, reducing the amount of glare and allowing better view-through.

Reflectance in the infrared spectrum (Rs IR) is the percentage of solar energy in the infrared range reflected by the fabric. The IR spectrum is where heat is generated, so the higher the number, the cooler the surface of the shade fabric will be.

UV transmittance measures the percentage of ultraviolet (UV) energy directly transmitted through the fabric. A higher number means more UV light is getting through. In the long term, this can lead to fading of fabric-covered furnishings. This is inversely related to the openness of the fabric.

The **solar heat gain coefficient (SHGC)** number is the complex glazing value taking the glass and shade fabric into account. Dual-pane glass with an SHGC of 0.20 or greater is usually specified for new installations. This means that 80 percent of the sun's heat energy is prevented from entering the space.

Different weavers use different standards to evaluate their fabrics and verify their specifications. Starting with ASTM E903: Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres, the Rs, As, Ts, Rv, Tv, and Rs IR are all measured with a spectrophotometer.

Another standard is ASTM E891: Tables for Terrestrial Direct Normal Solar Spectral Irradiance Tables for Air Mass. This covers the calculations for the values Rs, As, Ts, Rv, Tv, and Rs IR. ASTM E891 replaced an older standard, ASTM G173, but the reference tables remain the same.

ASHRAE Standard 74: Method of Measuring Solar-Optical Properties of Materials is a well-known method of using a pyranometer to measure and calculate the fenestration properties of sunlight.

COMPLEX GLAZING

To optimize roller shade fabric specifications, a complex glazing approach considers how the fabric performs along with the glass as a total system. Similarly, an integrated, whole building approach evaluates the building's facade, surroundings, geographical location, orientation, lighting requirements, and how the space will be used.

"From a whole building perspective, architects should select the shade's openness value, visible transmittance, and fabric reflectance that provides protection from glare, visual comfort, daylighting performance, allows some view to the outside, and aesthetically matches with the rest of the building facade," Tzempelikos says.

For example, while roller shade specifications typically come after the glazing and facade design, Tzempelikos advises that the properties and control of glazing and shading systems be designed together so that their combined impact on occupant comfort and energy use can be assessed in a holistic, integrated way. "Shading properties like angular transmittance and reflectance add and interact with the effects of glazing properties, such as SHGC and the overall angular thermal and light transmittance of the window system."

Along these lines, Angie Lee, AIA, IIDA, interiors, FX Collaborative, New York, recommends having a sample of the exterior glazing in hand when selecting the shade fabric. She explains that the color rendition and intensity of light coming through the glass can significantly alter the color of the shade. While there is a slightly smaller range of noticeable color variations from the exterior, once the level of tonal saturation has selected, the impact of the glass specifications is more noticeable on the interior. At the same time, as previously noted, darker shade colors are much more forgiving in the rendering of natural light transmitted through the glass.

Angarano agrees that different glazing colors (i.e., clear, green, blue, gray, etc.) will impact the appearance of the shades from the exterior. Further, the exterior side of the shade should complement or match the exterior facade and how the glazing appears at different times during the day.

Describing windows as representing a spatial recess or expansion that connects the interior to views, natural light, and the greater world outside, Lee cautions against selecting shades that detract from this.

Photo courtesy of Mermet USA

Different weavers use different standards to evaluate fabrics and verify their specifications. Performance specifications of shade fabrics are measured using tools such as spectrophotometers and pyranometers. Total solar reflectance, total solar absorbance, and total solar transmittance are among the measurements taken.

Photo: Matt Oberer, MattO Photo

To optimize roller shade fabric specifications, a complex glazing approach considers how the fabric performs along with the glass as a total system, as shown here at the University of New Mexico Physics and Astronomy Building.

"In the past, shade fabric was always white and resulted in a plasticky aesthetic that diminished the positive effects of having a window," she explains. "Interior design principles have thankfully steered the coloration of the shades to mimic the darker or more saturated tones of an exterior landscape, sky, or cityscape."

Expounding upon this point, Lee adds, "The shade fabric will enhance and complement the exterior, or it will become the unintentional feature that can render a carefully constructed building wall as chaotic instead of curated. The width, color, texture, and alignments of the shade system are integral to the design intent being evident from the exterior view."

In a similar vein, Robert H. Adams, associate principal at Amenta Emma Architects in Hartford, Conn., points out that the shading material plays a major role in the building facade. "Stand in any city and look around. Those beautiful facades that architects and designers labored over are now a mishmash of shades—some up, some down, some halfway, etc."

Andow adds the following observation: "Let's face it: There is a common story where the exterior aesthetic of a thoughtfully designed curtain wall facade is ultimately marred by a disorganized patchwork of manual roller shades positioned at various heights that are left drawn for days or weeks. It is never captured in renderings, but it is a defining characteristic of the aesthetic of all glass buildings."

To help mitigate this, Adams advises against shades that are denser and brighter in color and instead selecting darker, more porous shade materials that tend to disappear from the outside, thereby enabling the exterior to present as intended.

On a recent historical preservation project in Hartford, Adams's team had initially decided upon a light-colored shade material, but then realized that the color would appear to infill the punched openings in the 1931 limestone building and therefore detract from the neoclassical facade. "Instead, we used a darker shade material that is hardly visible from the exterior and preserves the facade of this historical building."

Motorization and automation can also be used to ensure shade fabric panels are properly deployed throughout the day.

EYP's Lead Interior Designer and Interior Design National Group Leader Roseann Pisklak, NCIDQ, AAHID, LEED AP, EDAC, brings up another interesting point, noting that at lower levels, pedestrian movement and vehicular traffic may be distracting, negatively impacting worker performance on those floors. Consequently, in addition to the aesthetics, the practical consideration of productivity can also impact product selections for the lower part of the building.

BUILDING ORIENTATION

Playing a significant factor in shading specifications is the facade orientation. To address variances in the sun's exposure, solar heat gain levels, and the potential of glare, architects will often vary the openness factor based upon the building exposure.

As a general rule of thumb, a higher openness factor shade fabric will typically be selected for the north facade, which receives minimal direct sun. The south and west facades, however, are the most exposed to direct sunlight during working hours, so a lower openness factor is needed.

"A north-facing orientation is almost glare free, so the focus should be on selecting shade properties to maximize outside view, while a west orientation could suffer from low sun angles in the evenings," Tzempelikos explains. "Therefore, the shade openness factor and visible transmittance should be lowered to protect from direct sun glare."

As a general example, Adams says that his team might choose a shade fabric with 1 percent openness on the east and west sides of a building, 1–3 percent openness on the south side, and 3 percent openness or potentially no shades at all on the north side. At the same time, spaces like conference and training rooms might require complete light-blocking shades, and other spaces such as medical exam rooms might need privacy, which would necessitate a shade material with 1 percent openness.

For facade orientations that never or rarely experience direct sun, Andow says that a higher openness factor of 8–12 percent can be used unless there is significant glare expected from what he describes as diffuse sky brightness in high solar climates with a turbid atmosphere. "These are all generic rules of thumb, but unique instances require climate-based daylighting models to more accurately predict the probability of discomfort glare," he explains.

Andow offers an example of a recent office retrofit where a higher openness factor was selected. Manual roller shades in a northwest corner office had created a situation where staff within two desks of the windows were uncomfortably overheated all summer and struggled with glare issues throughout the year. EYP specified an automated 2 percent shade fabric on the west and 8 percent on the north with an aluminized coating on the exterior face of the fabric to reduce solar heat gain. "The staff was noticeably cooler during the summer months, and work disruptions from glare were eliminated throughout the year," he says.

LIGHTING

Because raised shades and higher openness factors impact natural light levels, and when the shades are down, they act as a wall material and contribute to the overall light reflectance of the space, lighting plays into the mix of roller fabric selections.

"We typically have selected the shade material before finalizing the lighting to factor in the amount of natural light entering the space," explains Adams. "The color value of the chosen shade material, along with other materials in the space, are given to

Photo: Brett Drury, Architectural Photography

Fabric color and automation are important tools in presenting a uniform exterior aesthetic in keeping with an architect's original vision without creating visual distraction.

our lighting consultants who take them into consideration when determining the number and placement of light fixtures."

Architects and lighting consultants also consider daylight-harvesting sensors to optimize interior lighting and daylight balance, capture energy savings, and maintain views. One common pitfall from capitalizing on the benefits of daylighting harvesting is when the shades are always pulled down. To address this, Angarano recommends user training. In addition, motorization and automation may be considered as a way to maximize daylighting benefits.

As noted, glare is a significant issue to address in daylighting designs. The WELL Building Standard defines glare as excessive brightness from a light source, excessive brightness/contrast, and excessive quantity of light. Versant Health, a health-care provider specializing in vision and health, describes glare as the loss of visual performance or discomfort produced by an intensity of light in the visual field greater than the intensity of light to which the eyes are adapted.

Though dated, a well-known 2003 California Energy Commission study is still cited to demonstrate the negative impact of glare on worker performance. Heschong Mahone Group documented the performance levels of office workers at the Sacramento Municipal Utility District. They found an inverse relationship between the glare potential from primary view windows and office worker performance in these settings. In fact, productivity dropped 15–21 percent in the presence of glare.

Of course, glare negatively impacts occupant comfort as well. For example, it can be very difficult for mechanical systems to effectively manage the effects of sunlight directly falling on an individual person sitting in front of the window. With proper shading in place, this enhances personal comfort by mitigating the effect of direct sunlight on occupants.

MODELING TOOLS

In addition to issues and variables like glare, geographic location, building orientation, glazing, and view, daylighting metrics including useful daylight illuminance and annual solar exposure can guide roller shade specifications. Consequently, daylight and energy modeling programs can be useful tools for designers.

"Today, we have reliable daylight modeling tools that are able to reasonably predict the impact of fenestration on interior lighting conditions and visual comfort," states Tzempeliko. "In addition, we now have widely acceptable daylight and glare performance metrics, calculated on an annual basis."

For example, Amenta Emma Architects uses Revit and Cove Tool to help visualize how the building interacts with the sun. "We use this information to strike that balance between preserving views and providing shading devices that assist with controlling glare," relates Adams.

Other popular tools include DIVA, Climate Studio, Ladybug/Honeybee, and IESVE, which are all based on the validated lighting simulation engine RADIANCE with additional functionality from DAYSIM and EVALGLARE.

While Coulter agrees that daylight modeling tools can help to analyze glare potential, he notes that they do not provide feedback related to visual perception and glare. But the application of more complex glare studies, such as daylight glare probability, are used to predict visual comfort for a specific view point in a space.

He explains that shades can be modeled for these different analyses, but accurately modeling the specific properties such as weave, openness factor, and materiality can be quite challenging. "A simplified material property can be assigned with color, total transmittance value, and openness factor. However, these basic descriptions do not account for thickness of the woven fabric, which affects angular transmission of a shade, or any "glow" from the woven strands," says Coulter.

Andow explains that calculating the total VLT through a window with a shade fabric minimally requires an integrating sphere measurement, but for more accurate modeling, a gonio-photometer is utilized to determine the bidirectional scattering distribution function (BSDF), which identifies how the light is redirected when light reflects and transmits through it.

"For accurate calculation of the total visible transmittance and total solar heat gain coefficient through a glazing system and shade fabric, designers need to use measured scattering data of the fabric with emissivity and conductivity properties of the material," he says. "Shade fabric manufacturers commonly have this data, and the researchers at Lawrence Berkeley Laboratory have standardized the processing of these complex optical properties in the free software LBL WINDOW, which designers can use to build and calculate the performance properties of glazing systems with fabric shades."

While this level of accuracy in modeling is possible, it is not always necessary, as not all projects require such intense analysis. In these cases, Coulter says a combination of simplified simulations, mockups of possible shade fabrics, and personal experience is usually sufficient in determining what best suits the project.

Ashley McGraw Architects typically uses Sefaira for daylight modeling, which helps adjust variables such as light transmittance and glare. At the same time, the firm will typically mock up the shades so that the entire room set up, including technology and interior artificial lighting, can be reviewed together with the true daylight conditions, explains Angarano.

"There is nothing more effective than mocking up a range of colors with the correct openness percentages that provide the level of outside visibility and physically experiencing the ability of the shades to mitigate glare for a number of different people," agrees Lee. "It is difficult to impossible to transpose a modeling program over the feedback from humans."

Pisklak recommends that the mockup assembly analyzes the shade through the exterior glazing with both internal and external building materials and finishes. "Furthermore, reviewing the mockup outside under daylighting as well as inside helps to inform the best aesthetic solution for both conditions," she adds.

FABRIC CERTIFICATIONS

Another important factor in roller shade fabric selection is ensuring that the product meets key health and safety standards, which are designed to show no negative impact on the health of the building or its occupants. In particular, specifiers should check that the fabrics have been certified by the following:

- NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, which measures the flammability of a fabric when it is exposed to specific sources of ignition.
- ASTM G 21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi, which determines the fabric's resistance to fungal attack.
- ASTM E2180: Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) in Polymeric or Hydrophobic Materials.

Many projects require that fabrics be flame retardant, particularly in schools, health-care facilities, and government projects. Most fabrics use chemical additives—typically brominated chemicals polychlorinated biphenyls (PCBs), a class of organohalogens—to make the fabric flame retardant. Because these chemicals have been known to cause adverse health effects, more fabrics are using flame retardants without these chemicals, while others have dispensed with the need for any additional chemicals because the fabrics are inherently flame retardant.

Regarding acoustics, window shade fabrics do not impact sound reduction to the extent that other products and systems do, but they are considered as part of the building design's overall acoustic strategy. As such, shade fabrics are assigned a noise reduction coefficient (NRC)—the higher the number, the more sound is absorbed.

In addition to performance factors, there are also environmental considerations when selecting shade fabrics.

In evaluating whether to invest more in "green" fabrics, there are a number of factors to consider. In addition to the added expense, there are fewer products available, thus choice is more limited. Further, some fabrics can be difficult to work with and may be more prone to damage.

That said, "green" fabrics offer a number of benefits, including no hazardous chemicals, no off-gassing, no hazardous by-products from manufacturing, some recyclability, and the opportunity to preserve building and occupant health. There are also fabrics coated with plant-based plasticizers, which have the added benefits of petroleum savings and greenhouse gas avoidance.

If sustainability is a priority, architects and designers will also want to look into GREENGUARD certification, Cradle-to-Cradle Products Innovation Institute's verified ratings, and health product declarations (HPDs) data.

GREENGUARD standards are less about what is in the material, and more about how much of those ingredients escape into the air via off-gassing of volatile organic compounds (VOCs). Consequently, GREENGUARD certified fabrics meet some of the toughest chemical emissions standards in the world. GREENGUARD Gold certification means the fabric has passed an even more rigorous standard, designed to protect more vulnerable populations, such as children in education environments.

The Cradle-to-Cradle rating system is based on renewable energy, clean water, material health, social responsibility, and material reutilization. Qualifying products receive a basic, bronze, silver, gold, or platinum rating, which require recertification every two years.

HPDs can be consulted to determine what, if any, potentially hazardous chemicals are contained in a shade fabric.

In addition to reducing carbon, sustainably certified buildings have been shown to reduce vacancies and increase productivity.

For example, the U.S. Green Building Council cites a San Diego real estate market study that found the vacancy rate for green buildings to be 4 percent lower than non-green properties, and that LEED-certified buildings often brought in the highest rents.

Further, the engineering firm Cundall reported that its London office demonstrated a positive return on investment outcome from its WELL-certified facility within three months by calculating the reductions in sick leave and attrition alone.

QUALITY STANDARDS AND AVAILABILITY FROM DOMESTIC MANUFACTURERS

While shade fabrics are manufactured around the world, sustainably minded architects advise working with more local, domestic manufacturers.

For example, Andow relates that LEED v4's Regional Materials credit recently changed to be a multiplier if the product meets the other product disclosure requirements and is manufactured within 100 miles. Formerly, the requirement was within a 500-mile radius.

Another noted benefit is shorter lead times. "Shades are typically custom fabricated to fit the window sizes, which takes time," Angarano notes. "Having a product with a shorter, more reliable lead time is important for project schedule."

Additionally, Adams points out that having a good relationship with a local distributor can help expedite the process with quick responses to questions and by working through any concerns that may arise.

When vetting manufacturers, specifiers should ask the following questions:

- What kinds of manufacturing processes do they have in place? Are they using the latest equipment and methods?
- Where are they located, and how responsive are they? (Working with fabric manufacturers that can deliver quickly and maintain inventory on hand and at shade manufacturing locations will ensure a minimum of project delays.)
- How tight are manufacturing tolerances? What standards are followed, and what happens when fabric is produced outside of these standards?
- Do they have an active quality program in place? Do they test their fabrics to make sure they perform as advertised?
- Are the fabrics visually inspected using a backlight to search for flaws?

It is also helpful for architects to have information about technical fabrics and performance fabrics. The former are manufactured to very tight tolerances. The manufacturer knows exactly how many yarns are in the weave and how this affects fenestration.

Performance fabrics offer enhancing attributes outside of openness and color. For example, they may have a metalized backing or additives that allow a dark fabric to reflect heat as well as a light fabric. These special capabilities mean that these fabrics have the highest impact on building performance and occupant comfort.

PART OF THE WHOLE

Overall, it is important that interior shades are not simply viewed as an interior design decision, but rather addressed as an important component in an overall whole building context. With the help of modeling tools and an integrated design team working together to assess the shades' impact on building performance and integration with the facade and exterior environment, optimized solutions can emerge.

This approach will enable roller shades to best control glare, support daylighting, enhance occupant comfort and productivity, and contribute to the overall building aesthetic.

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