



Clear View

Window Film Solutions

Security | Solar | Designer | Decorative

REAL SOLUTIONS FOR REAL WORLD PROBLEMS



DAYLIGHTING FILM SOLUTIONS

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DAYLIGHTING FILM SOLUTIONS

☀ *Natural Light* ☀

☀ *Cost Effective Lighting Savings* ☀

Benefits of Natural Light

Daylighting Strategies

Natural light provides many benefits, which are often missed indoors

- Natural light has been shown to improve:
 - Sleep patterns
 - Circadian health
 - Productivity
 - Patient recovery times
 - Student test scores
 - Retail purchase behavior
 - Alertness, mood, memory, and health
 - SAD/Seasonal Depression
- In some developed countries people spend >90% (professor Dan Krepke at UCSD estimates >95%) of their lives inside



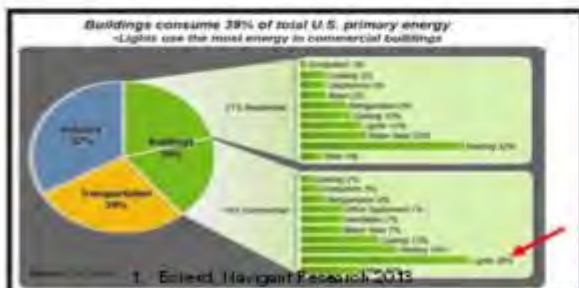
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It's important to find a solution that allows natural light indoors so these benefits are not missed

Daylighting Strategies

Daylighting delivers cost-effective light savings

- Buildings use:
 - 30% of all energy used in the US, 40% used globally¹
 - 67% of all the electricity used in the US
- Daylighting delivers cost-effective light savings
 - 30% to 80% lighting energy savings
 - 5% to 10% whole-building energy savings
 - 10% to 20% reduction in peak electricity use



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Light Sources in Commercial Buildings

Daylighting Strategies

TYPICAL Artificial OFFICE Lighting

- Most Indoor tasks require 20-100 fc
 - 1 foot-candle (fc): 1 lumen/ft²
 - Origination: Light from 1 candle 1 foot away
 - Illuminance: a measure of incident light
- Typical Office Light levels are 30 – 40 fc

Daylighting Strategies

Skylight and sunlight act differently when compared as light sources

- | Skylight | Sunlight |
|---|---|
| <ul style="list-style-type: none">• Light is diffused, creating soft shadows• Variable with cloud cover and solar position• Provides 1,000-5,000 fc from the whole sky hemisphere | <ul style="list-style-type: none">• Light is a direct beam, creating crisp shadows• Always moving along a predictable path• Varies in intensity with position and cloud cover• Provides 1,000-10,000 fc from a single point source |



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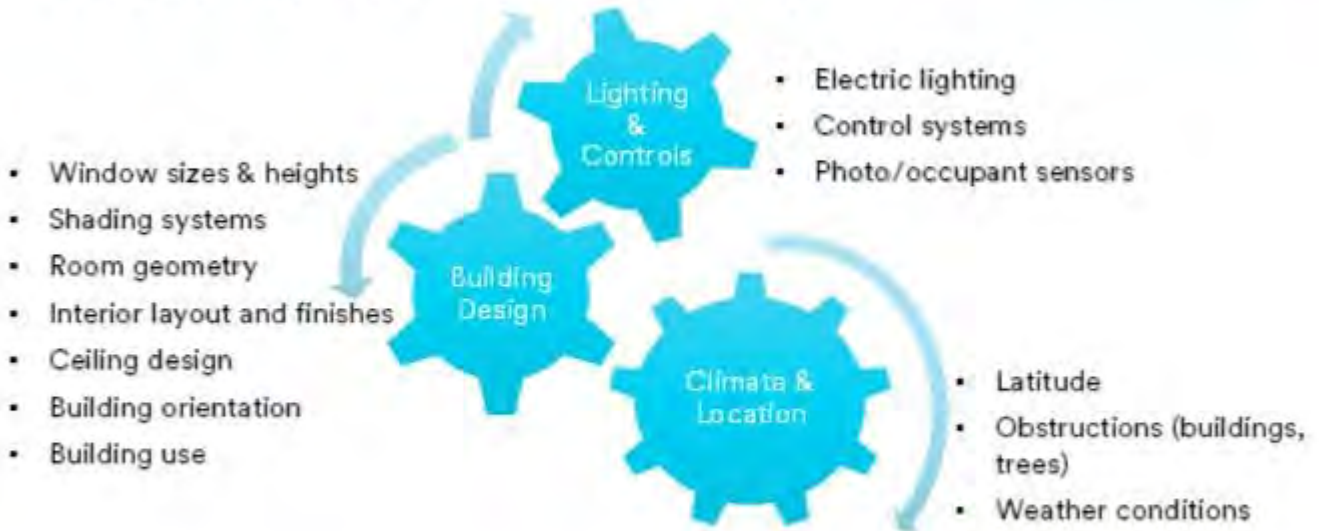
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Designing for Daylight

Daylighting Strategies

Good daylighting requires well integrated systems



Lighting and controls, building design, and climate and location must all work together

Daylighting Strategies

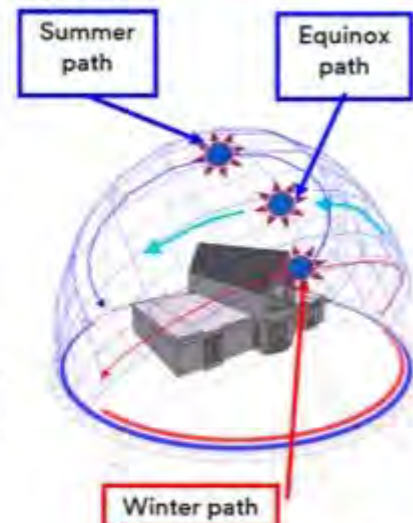
Solar position is affected by location and time of year

Winter Path

- Sun is low in the sky
- Most sunlight is to the south
- Lowest height of the sun occurs at winter solstice (December 21/22 in northern hemisphere; June 20/21 in southern hemisphere)

Summer Path

- Sun is high in the sky
- More sunshine on east and west than south
- Highest solar height is the summer solstice (June 20/21 in northern hemisphere; June 20/21 in southern hemisphere)



Latitude determines the solar angles at different times of the year - the further away from the equator, the greater the variation in summer to winter path

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Daylight is Better but there are Downsides

Daylighting Strategies

Direct sunlight causes discomfort and glare

- Direct sunlight, especially from high transom glass, causes glare and discomfort
- When occupants are uncomfortable, they will take action to make themselves more comfortable (e.g. close blinds)
- The location and intensity of the direct sunlight will vary throughout the year (and day)



Daylighting Strategies

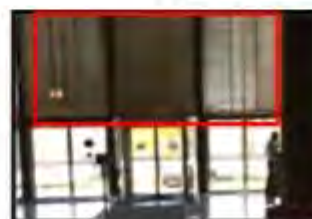
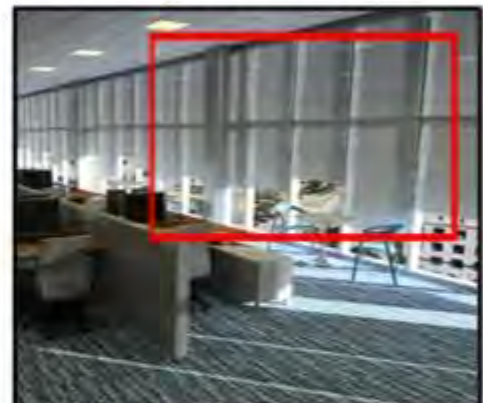
Shades and blinds control glare & heat, but have multiple drawbacks

Blinds and Shades:

- Require action to be closed/opened
- Often remain in closed position once closed
- Can be automated with additional cost for wiring, controls, and maintenance

When blinds are closed:

- o How much natural light brought in through the window?
- o How does it affect the view outside for all occupants?
- o How does the building look from the exterior with some open and some closed?



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Daylight is Better but there are Downsides

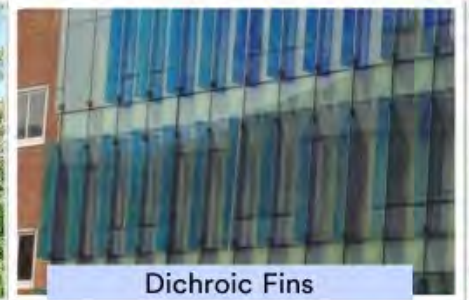
Daylighting Strategies

Additional solutions exist to control glare, but vary in price

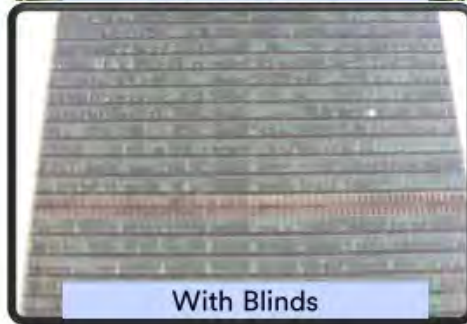
- Exterior shades and fins
 - Construction and maintenance challenges
 - May not reduce glare at all times
 - Reduces solar heat as well
- Dynamic glazing
 - Darkens as needed (automated or controlled)
 - Reduces solar heat as well
 - Expensive
- Tinted glass or solar film
 - No occupant action needed
 - Consistent look to the building
 - Reduces solar heat



Exterior Shades



Dichroic Fins



With Blinds

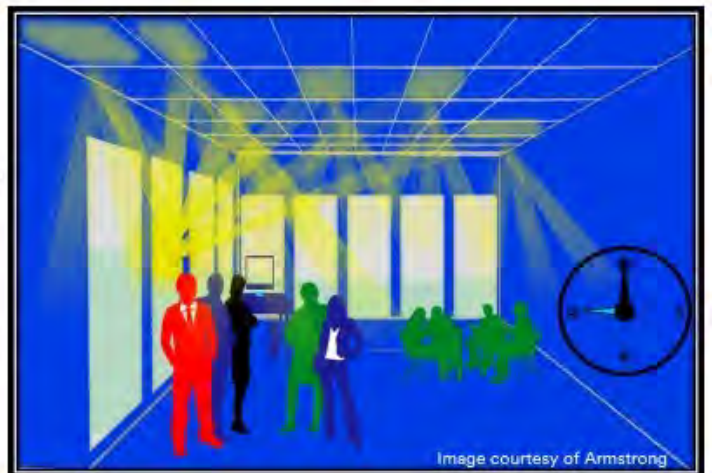


With Window Film

Daylighting Strategies

Ceiling & office design/layout affect daylighting penetration

- Higher ceilings will increase daylighting penetration with light redirecting products
- Open offices that minimize walls and have low cube walls allow for greater use of natural light
- White ceiling surfaces with higher reflectance (i.e. 90%+) will redirect more light into the interior



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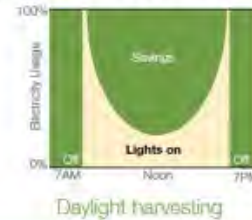
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Daylighting Strategies

Daylighting Strategies

Lighting and controls can be used to improve daylighting efficiency

- To save energy, artificial lights need to be turned off or dimmed
- Lights with adjustable dimming ballasts dim artificial lights to save energy
- Photosensors measure natural light to provide feedback to turn off or dim lights
 - Photosensors are placed at multiple depths in the interior to match with lighting zones
- Occupancy sensors detect if people are present and turn lights off (or dim) if no one is around



Daylighting Strategies

Toplighting and sunlighting are two daylighting strategies

Toplighting Methods

- Roof windows (monitors)
- Skylights



- Toplighting only works on the top story or on a single-floor building as the roof is needed

Sunlighting Methods

- Clear or diffuse clerestory windows
- Light shelves
- Redirected blinds
- Redirecting films
- Ducted light systems
- Usable on all floors

- Sunlighting is usable on all floors

Different solutions for different design and aesthetic considerations

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Daylighting Strategies

Daylighting Strategies

Clear transom glass functions best with no direct sun

- Clear glass allows for great light when there is no direct sun, which causes discomfort and glare
 - To avoid discomfort, blinds are often closed, and stay closed
 - The higher the glass, the deeper direct sunlight will penetrate and cause discomfort
- Vision glass generally provides adequate light for the first 8' from the window
 - A clear 'transom' glass will have limited penetration
 - Unless the blinds are closed



Daylighting Strategies

Different transom glass types reduce glare, but also light penetration

- If clear glass is not addressed with shades or blinds, this can cause great discomfort
 - Occupants may take action such as placing cardboard in the window
- Diffuse glass
 - With diffuse glass, most sunlight is still directed down to floor
 - May lessen glare, but glare may still be an issue
 - Diffusing, not redirecting
- Fritted Glass
 - Helps reduce glare by blocking light, but also reduces amount of light



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Daylighting Strategies

Daylighting Strategies

Light shelves redirect direct sunlight to the ceiling

- Reflective shelves redirect light up to the ceiling
 - Interior or exterior light shelves available
 - Shelves are installed between vision and transom glass
- Maintain clear view out from deep in the interior
- Light is redirected at an angle equal to incident light angle
- Reflection is focused in one area
 - Concentrated light can make areas of the room appear much darker than reality
 - Curved shelves are designed to spread light more evenly



Daylighting Strategies

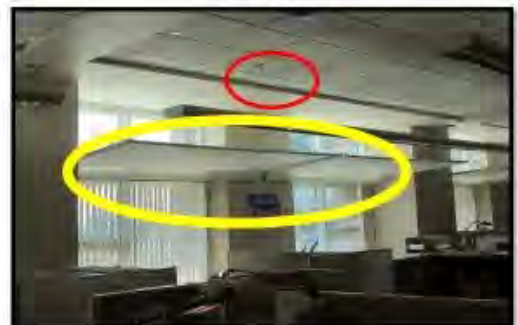
Light shelves have multiple shortcomings

- Low angle sun can bypass shelves entirely, causing glare
- Shelves requires periodic cleaning (dust, dirt)
 - Dirt will lessens the amount of light redirected
 - Storage of things on the shelf can be an issue
 - Difficult to reach existing clerestory glass for cleaning
- Challenging to retrofit an existing building
 - Structural loads
 - Potential interference with fire suppression
- Can block sprinklers or artificial lights



Light can bypass lightshelves at low angles causing glare

Light can bypass light shelves at low angles causing glare



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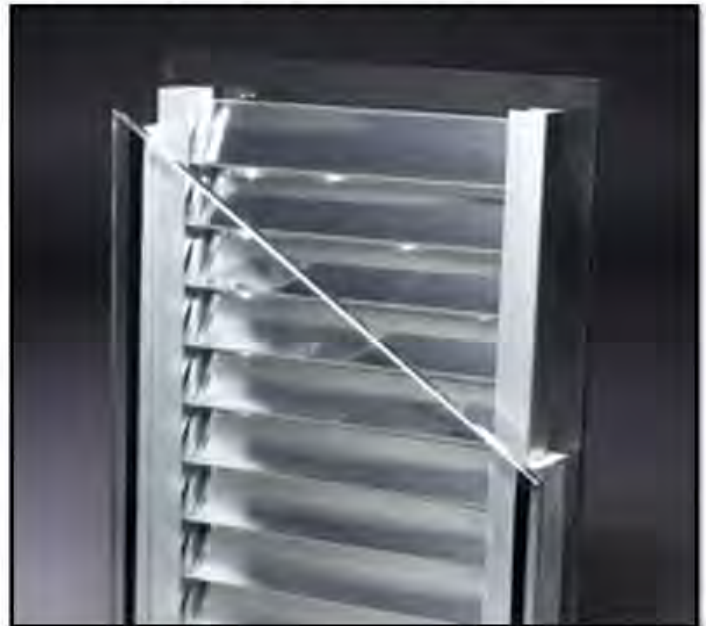
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Daylighting Strategies

Daylighting Strategies

Light redirecting blinds redirect direct sunlight to the ceiling

- Reflective (metallic) blinds redirect light up to the ceiling
 - Blinds generally have a curved shape
 - Blinds are generally fixed, although adjustable and automated blinds are also available (for a higher price)
- Can be installed inside insulated glass unit or on interior
- Do not block lights or sprinkler systems
- Easily installed like other blinds or window treatments
- Can be used in new construction or renovations



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Light redirecting blinds have multiple shortcomings

- Have aesthetic look of highly reflective metallic blinds
 - Blocks view to outside
- Direct sun does not bypass blinds
 - Can bypass manually adjusted blinds
- Requires periodic cleaning/dusting for interior applied units
 - Dirt will lessens the amount of light redirected
- Glare can be a concern at certain angles



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Daylighting Strategies

Daylighting Strategies

Daylight redirecting film redirects direct sunlight to the ceiling

- Redirects natural light to the ceiling to increase comfort and provide natural light deeper in the building
- Can be used in new construction or existing buildings
- Easily installed



No Film

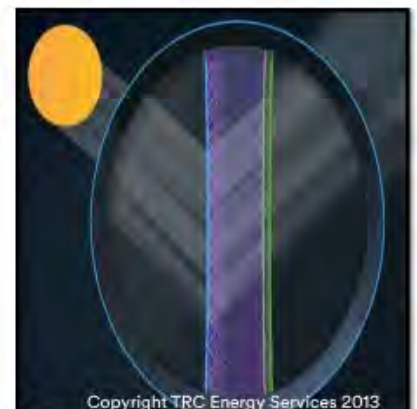


With Film

Daylighting Strategies

Daylight redirecting film provides additional benefits

- Microstructured film redirects natural light up to the ceiling
 - Light is also diffused to more evenly spread the light on the ceiling and increase comfort
- Has aesthetic look of frosted glass
- Direct sun does not bypass
- No special cleaning or maintenance needed
- Will also redirect natural light even without direct sunlight



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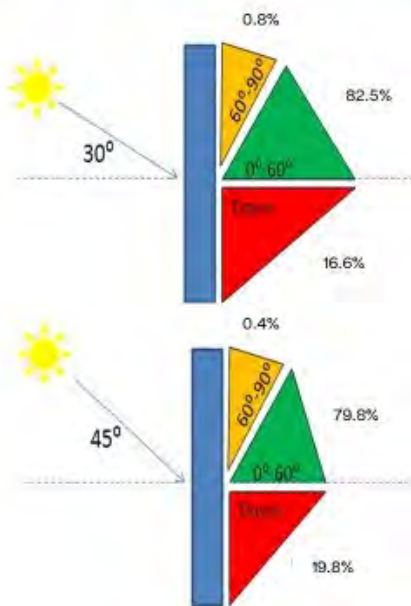
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Daylighting Strategies

Daylighting Strategies

Daylight redirecting film is designed to control where the light goes

- Designed to control where the light goes
 - Lessens glare
 - Redirects natural light up to the ceiling
- Extends 'daylight zone' about 8' into room for each 1' of treated upper window
- Can be combined with solar control films
- Redirects over 80% of the light towards the ceiling (on average)



Daylighting Strategies

Daylight redirecting film-installation and warranty

Placement: 3M Does not recommend installing below 7ft (2.13m). This height was set to minimize the risk of light redirecting up into occupant's eyes.

Warranty: The warranty period for Daylight redirecting film is 10 years.

Roll sizes: Daylight redirecting film is 48" and 24" widths.



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Daylighting — BEST SOLVED with Solar Window Film

Daylighting Strategies

Daylighting & Solar Film

Window films offer a variety of Visible Light Transmission's to improve the quality of light based on any given situation. Softening daylight to appropriate levels to maximize comfort, usage, and productivity are an important part of daylighting techniques.



Daylighting Strategies

Daylighting – Solar Film - Health

Improper daylighting results in unbalanced light, excessive glare, and high temperatures.

This can result in headaches, SAD and eyestrain, which are the number one health problems in offices.



Properly chosen window film can drastically softens glare and improves views to the out-doors.

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Daylighting — BEST SOLVED with Solar Window Film

Daylighting Strategies

How solar window film works

Solar Window Film is designed to block the harmful and damaging elements of the sun while allowing for visible light to still penetrate a space.

Benefits

- **Energy savings**
- **Fade protection**
- **UV protection**
- **Infrared protection**
- **Uniform exterior look**
- **Better views through glass**



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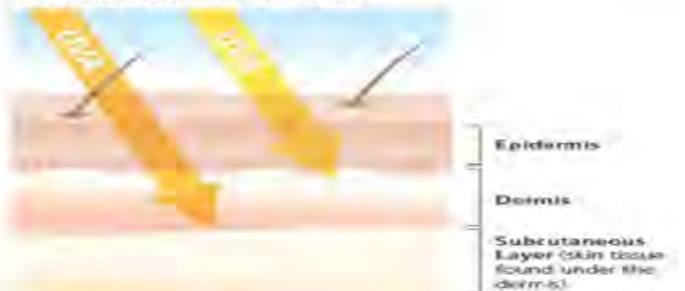
Daylighting — BEST SOLVED with Solar Window Film

Daylighting Strategies

The Effects of UV Rays on Employees

There are two types of UV rays in sunlight, UVA & UVB.

UV Radiation and the Skin



- **UVA rays penetrate clouds and glass**, and are present with relatively equal intensity during all daylight hours and throughout the year. UVB do not significantly penetrate glass or pass through clouds.
- **UVB rays are the chief cause of sunburn**, and tend to damage the skin's Epidermis layer while UVA penetrates the skin more deeply passing through the Epidermis layer into the underlying Dermis layer.
- **UVB rays also trigger the productions of Vitamin D**. UVB in sunlight, through the mediation of Vitamin D activates an arm of innate immunity within the skin and serves to counteract damage and inflammation.
- **Glass blocks UVB rays**, so the production of Vitamin D does not occur indoors, and the skin doesn't typically redden or burn which is the first indicator to people they're receiving too much sun.
- This makes **UVA rays that pass-through glass more damaging in your office** than the direct sunlight outside. Without the protective benefit of Vitamin D production and activation of your skins immune system caused by exposure to UVB that don't pass through glass.

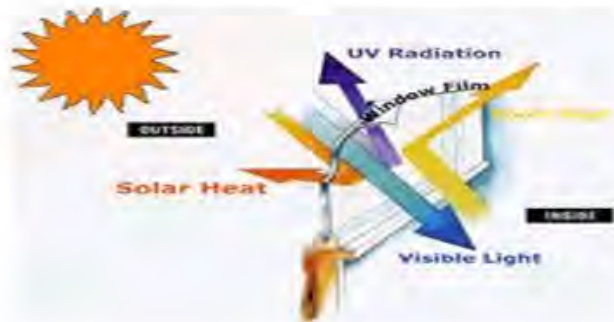
Daylighting Strategies

The Effects of UV Rays on people

Excessive UVA exposure is a skin cancer factor, penetrating more deeply into the skin where most skin cancer develops and is also associated with wrinkling, immune suppression, oxidative stress, and related aging.



The Skin Cancer Foundation has several articles on their website regarding the importance of window film. One such article is titled "Window Film: The Best Sunshield for Car, Home, & Office".



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DAYLIGHTING — Summary

Daylighting Strategies

Natural Light is Important for Health, Productivity, Sleep, Alertness, etc...

- Natural light saves energy
- Daylighting must be thought of as a system
- Location, building design, ceiling, and lighting controls must all be considered
- Direct sunlight causes discomfort from heat and glare
- External shading, blinds, and window films can address glare and discomfort
- There are many sidelighting methods to bring in natural light
 - (e.g. light shelves, redirecting blinds, daylight redirecting film)
- Dynamic modeling is the best way to understand yearly daylight performance
- BIM modeling tools are making this easier to do

Daylighting Strategies

Daylight Redirecting Film Benefits

- Redirects up to 80% of light up towards the ceiling
- Redirects natural light up to 40' deep into the building
- No additional maintenance or special cleaning needed to maintain performance
- Extends daylight zone up to 8' for every 1' of treated window
- Cost-effective compared to other daylighting solutions
- Up to 52% lighting energy savings compared to baseline usage
- Savings of up to 1.5 kWh/ft² of floor area

*Claims based on studies completed by, or in conjunction with, US Department of Defense, Lawrence Berkeley National Laboratories (LBNL), Louisa + Ubbelohde architecture (L+U), Sacramento Municipal Utilities Department (SMUD)

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