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SMART CITIES

ENERGY SIMULATION OF HIGH

PERFORMANCE GREEN BUILDINGS

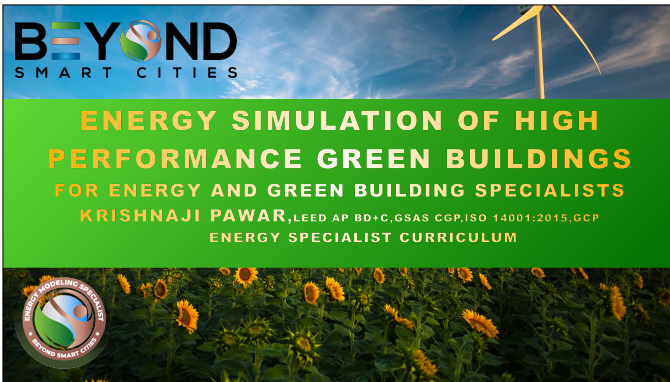
FOR ENERGY AND GREEN BUILDING SPECIALISTS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY SPECIALIST CURRICULUM

ENERGY MODELING SPECIALIST

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SUN SHADING

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LEARNING OBJECTIVES



What is sun shading

Types of shading

Solar Shading Automation

What do you Need to Consider when Looking at Solar Shading Options?

Sun path diagram architecture

Sun Shading Analysis

What The Benefits of Solar Shading to be used.?

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WHAT IS SUN SHADING?

Solar shading (sometimes referred to as 'solar control' or 'solar protection') is the term used to identify a number of systems to control the amount of heat and light admitted from the sun into a building.

Solar radiation provides natural light and heat, which reduces the need for artificial lighting and heating, although excessive solar radiation could result in overheating, which would need to be countered with cooling air conditioning. This is where solar shading methods can reduce the cost and energy usage of this environment control. Another issue solar shading alleviates is glare and other visual discomforts caused to the occupants of the building.

The sun makes a huge difference in the design of a building and can present a serious problem to large areas of glazing. This is where solar shading is important to mitigate the impact of a buildings' energy use whilst providing thermal and visual comfort.

There are two types of solar shading – Fixed or Dynamic

FIXED SOLAR SHADING

This type of device is usually external and part of the architectural design of the building, although fixed shading can also be a separate structure or even trees and vegetation.

Architectural sun control can capably reduce heat gain within a building and improve natural lighting, especially for visual comfort by controlling glare. During warmer seasons excess solar gain would result in using air-cooling systems, so external window shading is an appropriate solution to help ease this problem. The shading design can factor in the low-angled sun for solar penetration during winter months or even act as a reflector, bouncing light into building interiors.

Effective fixed solar shading depends on the orientation of a buildings' façade. It is necessary to understand the position of the sun during the day in all seasons in terms of altitude and azimuth angles. Our Specialists are experts in Solar Control, please contact us if you have any questions or projects regarding external shading solutions, including Tensile Fabric Structures or Window Films.

Types of Fixed Solar Shading: Overhangs, vertical fins or balconies, Canopies and awnings, Trees, hedges and other vegetation, External louvres, Light shelves, Solar control glazing, Recessed windows

DYNAMIC SOLAR SHADING

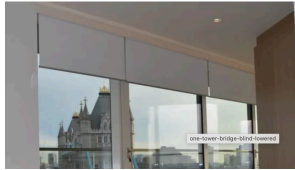
The complication of controlling sunlight and heat gain is due to the variable angles of the sun and the most efficient way of managing this is by fitting retractable shading devices. Internal blinds or curtains are the most popular method, but external systems can be potentially more efficient as they stop the sunlight before it hits the glass. There can be a fixed / dynamic cross-over here as awnings, louvres and canopies can be permanent or retractable.

Daylight levels can be most easily controlled, regardless of the season or time of day with a dynamic solar shading solution. These devices can be operated manually with cords, chains, wands or crank handles and have electronically powered systems, even timer or conditional automation. Effective dynamic shading will provide an improved thermal indoor climate, minimize the risk of glare, manage the entrance of natural daylight and maintain privacy.

Types of Dynamic Solar Shading: Internal blinds, Curtains, Internal shutters, External shutters, Adjustable awnings, louvres and canopies

SOLAR SHADING AUTOMATION

The manner in which these devices are controlled can have a significant impact on energy efficiency and occupant comfort. Incorrect operation can lead to shading when it doesn't need to be, overheating and the lack of glare control. And one of the great benefits that this type of solar shading has to offer is the incredible control over the light that enters a room, thermal conditions and maintaining privacy, so automation or programmable electronic movement can ensure these function efficiently.



Having a solar shading system that is effectively controlled helps to create a better indoor environment and can positively influence comfort, well-being and productivity in the workplace and significantly contributes to energy management.

WHAT DO YOU NEED TO CONSIDER WHEN LOOKING AT SOLAR SHADING OPTIONS?

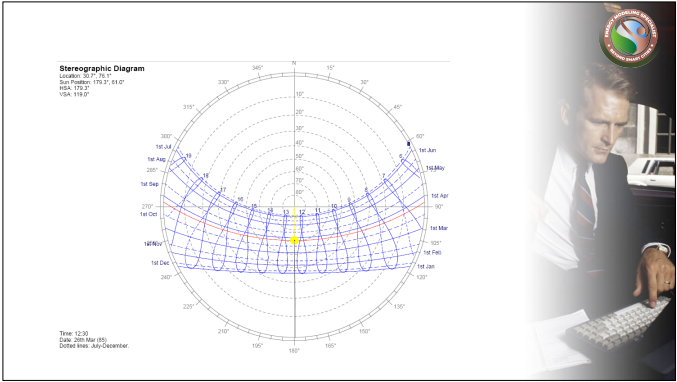
Location : Knowing whether your window faces north, south, east or west is the first step in choosing the right solar shade. The sun is at its coolest in the morning east facing and its hottest in early to mid afternoon south-west facing depending on the time of year. Knowing the direction your window faces will help in determining which solution offers the level of control you are seeking combined with the individual style that is aesthetically appealing.

Performance : Solar Shades can reduce solar heat gain, reduce glare, provide a degree of daytime privacy and filter natural light to illuminate the interior. However, you may need to decide which feature is the most important or find a comfortable balance between them.

WHAT DO YOU NEED TO CONSIDER WHEN LOOKING AT SOLAR SHADING OPTIONS?+

Openness Factor for Blind Fabric : The Openness Factor represents the density of the weave in some types of blind fabric. A fabric with a low Openness Factor (OF) prevents more UV rays from passing through, provides greater daytime privacy and offers the greatest glare reduction. A fabric with a high OF provides a better view out but doesn't reflect as much UV light, reduces daytime privacy and allows more natural light to filter through the fabric to illuminate the interior. Many of the benefits associated with a low or high Openness Factor can be enhanced or negated depending on the fabric colour selected.

Mounting Style for Dynamic Shades : Before taking any measurements, step back from your window and decide if you want to mount the window treatment inside the window recess or outside on the wall or molding. We usually recommend an inside mount whenever possible because it provides a cleaner look. However, an outside mount can make a window appear larger or hide an unattractive window as well as adding better privacy and insulation, unless roller blind side channels are utilised.

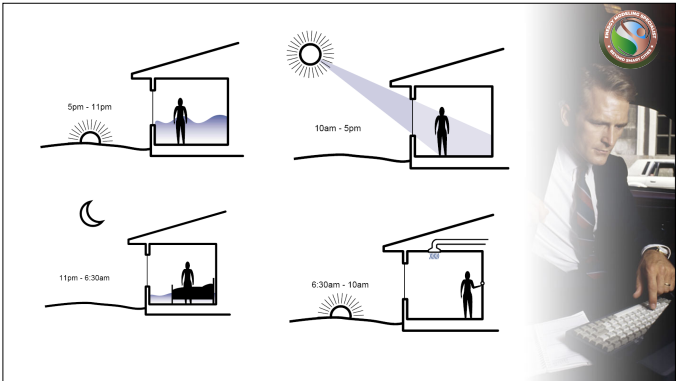


SUN PATH DIAGRAMS

Sun path diagrams can tell you a lot about how the sun will impact your site and building throughout the year. Stereographic sun path diagrams can be used to read the solar azimuth and altitude for a given location.

Stereographic Sun Path Diagrams : Note that these stereographic diagrams are not exactly like a fish-eye photo; such an image would be flipped left to right. These diagrams are from the point of view of the sky looking down at the ground, you can superimpose it on a map or a plan of the building without being confused. (You can see this by following the hour lines from east to west on the diagram.)

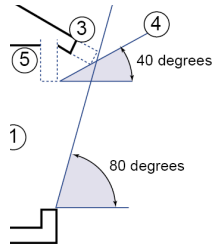
- ✓Azimuth Lines - Azimuth angles run around the edge of the diagram.
- ✓Altitude Lines - Altitude angles are represented as concentric circular dotted lines that run from the center of the diagram out.
- ✓Date Lines - Date lines start on the eastern side of the graph and run to the western side and represent the path of the sun on one particular day of the year.
- ✓Hour Lines/ Analemma - Hour lines are shown as figure-eight-type lines that intersect the date lines and represent the position of the sun at a specific hour of the day. The intersection points between date and hour lines give the position of the sun.



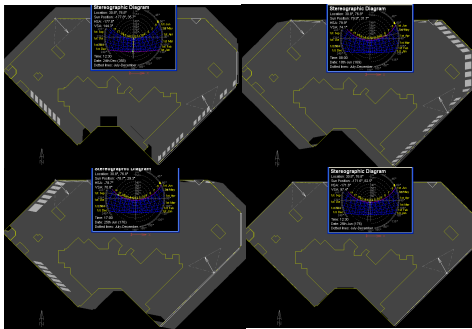
SOLAR INSULATION IN DEHLI

OVERHANG SIZING RULES:

1. Draw the wall to be shaded to scale.
2. Draw the summer sun angle upward from the bottom of the glazing.
3. Draw the overhang until it intersects the summer sun angle line.
4. Draw the line at the winter sun angle from the bottom edge of the overhang to the wall.
5. Use a solid wall above the line where the winter sun hits. The portion of the wall below that line should be glazed.



SUN SHADING ANALYSIS



SUN SHADING ANALYSIS

Shading analysis is one of the most essential steps in phase of solar energy system design or analysis. In photovoltaics it is important to analyse shading caused by surrounding objects and/or vegetation. In special cases like analysis or design of BIPV systems, exact analysis of shadow voltaic systems (overhangs, vertical shading fins, awnings etc.) is also very important. Similar analysis is also part of passive house or solar house design - overhangs must also be planned very carefully in such case.

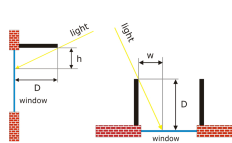


FIGURE 3: Horizontal shading device, overhang, side view (left) vertical shading device, vertical fin, top view (right)

Basic calculations can be done by some simple equations - formulas for some typical simple cases you may find below. Some graphical tools like solar path calculator (pilkington) are also available. For analysis of complex objects several computer tools are available. Some of them offer even 3D simulation.

Shading is especially important in photovoltaics. It should be eliminated as much as possible. Even small obstacles like chimneys, telephone poles etc. shouldn't be neglected. To minimise influence of photovoltaic array shading (if shading can not be avoided) different system optimisation techniques can be used.

THE BENEFITS OF SOLAR SHADING

In conclusion, solar shading is a purposeful insulation of the transparent parts of a building, effectively managing the entry of solar heat and light to provide a thermally and visually comfortable indoor space, that remains cool in the summer and warm in the winter. Accomplishing a glare free space all year round with the outdoor view maintained and a minimum energy demand on installed cooling, heating and lighting units.

It enhances the aesthetics of the building both inside and out and coordinates with the interior design and architecture. With such a wide variety of options there is an ideal solution for any project and multiple ways of achieving this, which offer freedom and usability in controlling the indoor environment.



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