

Natural Light Influence in Architecture

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Natural light affects human comfort, health and mood, but it has varies type depending on where we are. In architecture, this is an integral part of the design of a building, it brings added value.

There are different types of natural light that enter a building, here are a few:

Diffuse and uniform light (coming from larger and regular openings, example: banded windows around a room);

Direct light (from direct sunlight to the desired location on the floor or other surface);

Overhead light (coming from the ceiling like a skylight);

Reflected light (coming from any surface and redirected in space).



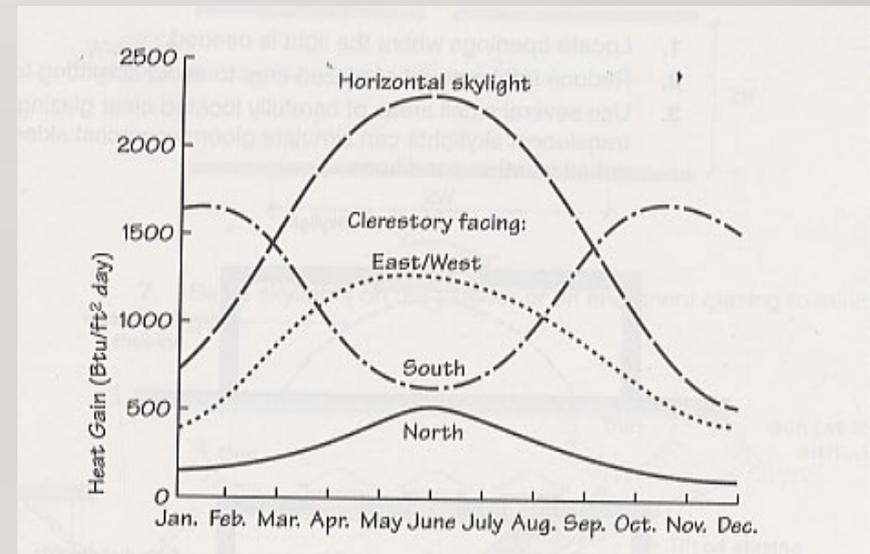
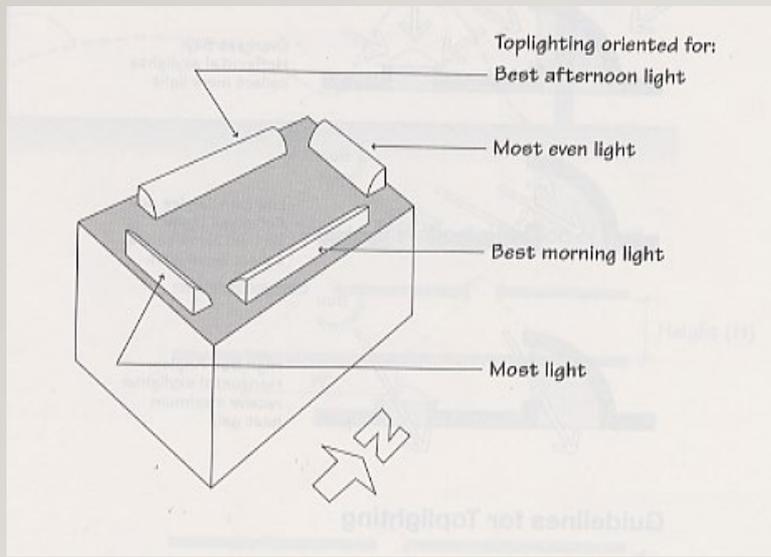
Natural Light influence in Architecture:

Natural light provide a valuable amenity that tells us the time of day, weather conditions and gives a self satisfaction feeling.

Natural light in building can provide natural illumination which reduce the need for artificial lighting and therefore saves on resources.

Natural light if not properly understood can be difficult to control. Hence resulting in excessive heat gain, uncomfortable glare and loss of resources.

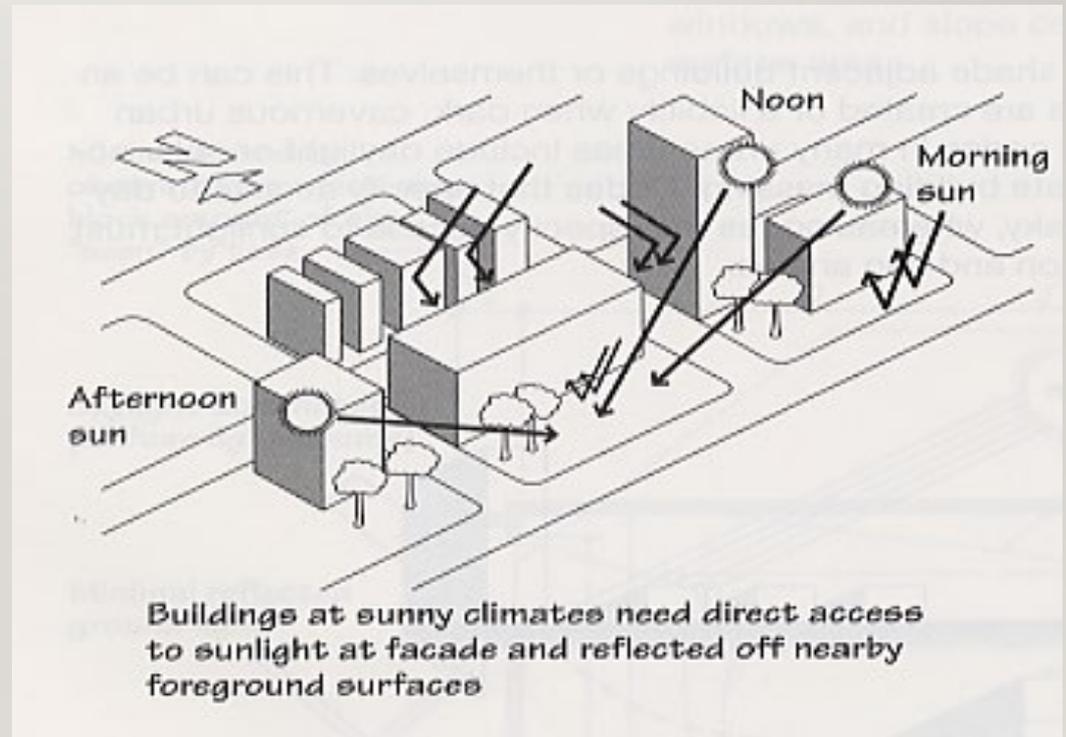
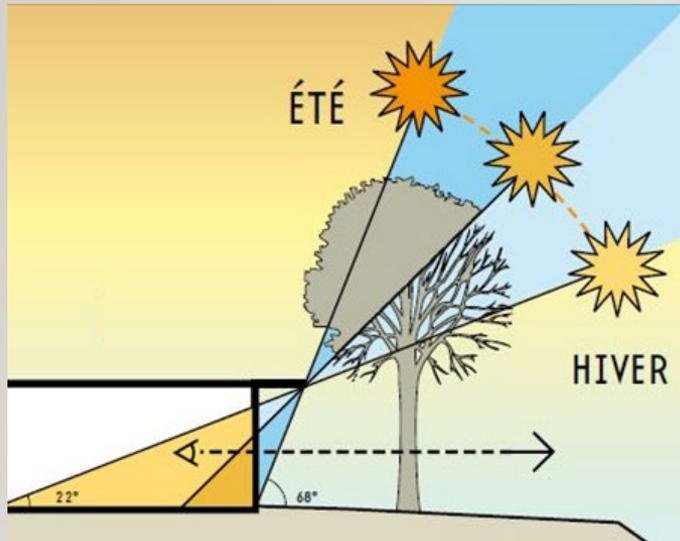
To successfully design with natural light, place the light where it is desired, through good orientation. Also avoid excessive contrasts, glare and unwanted heat gain



Building Orientation:

At the planning level, orienting buildings along the **north-south** promote direct sunlight access, use of shadings and reflected light from the surroundings.

East-west orientation will expose the facades for more light **summer** than in winter. Shading normal windows also blocks vision, therefore high levels windows are preferred here and if they are well shaded can provide an even distribution of light throughout the day.



The location and orientation of the building in relation to the sun

Overall, one of the most influential factors is the orientation of the building in relation to the sun. Not only does its light improve the visual comfort of the rooms, but it improves the energy efficiency of the building. When planning a new project, you must first question the purpose of the building and how it could benefit from the advantages of natural light, taking into account its situation and that of the land. In order to make the most of the sunlight, it is important to prioritize the living rooms, the large halls and the main staircases to the south, among others. The rooms facing north are often reserved for bedrooms, technical rooms and service stairs, for example.

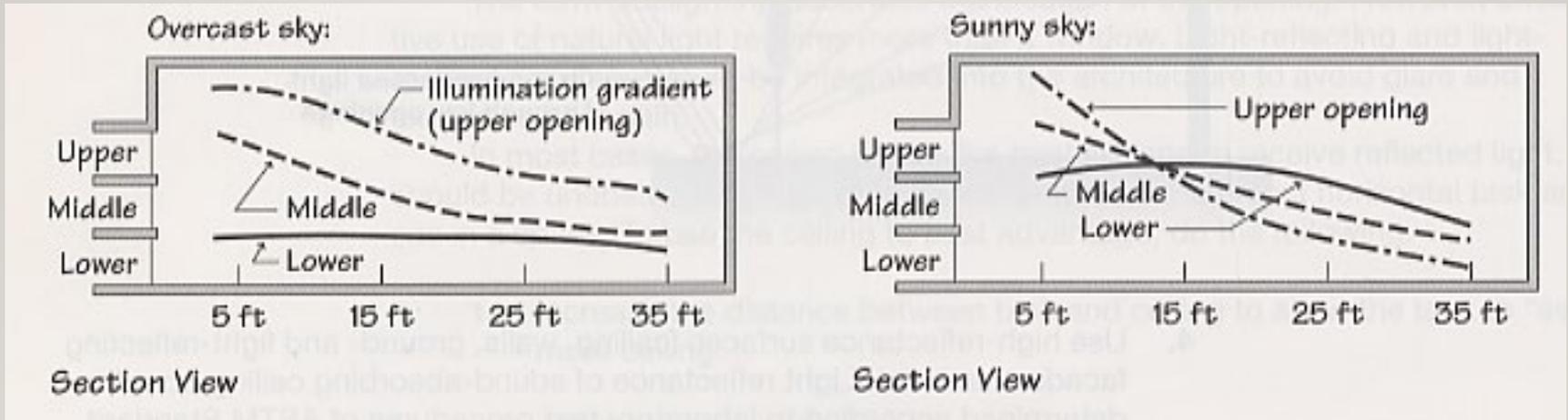


Sources of Natural Light:

Daylight : diffuse light through clouds. (**Sky is dominant light source**).

Sunlight : direct-beam sunlight through clouds or clear skies.

Reflected light : light reflected from natural or man made surfaces. (**ground is dominant light source**).

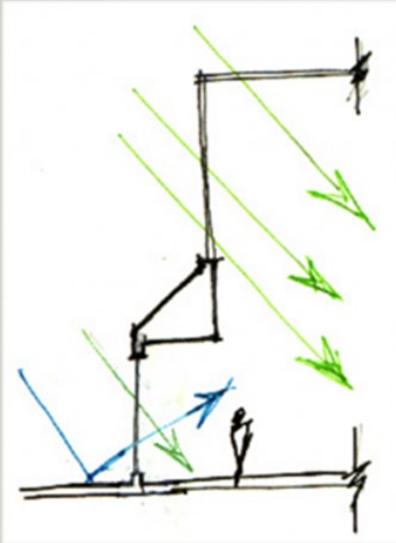


Natural Light Source

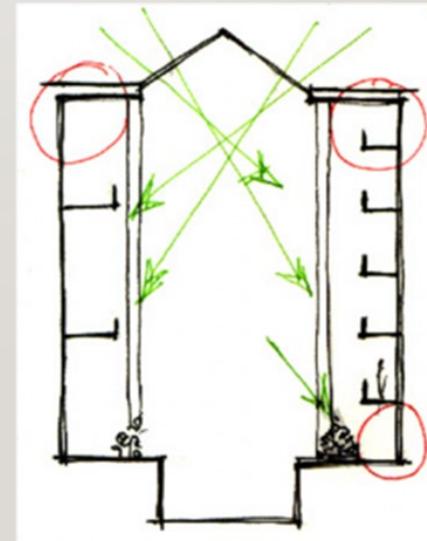
Whether the building is small or large, it is important to analyze all the elements of its geographical location. The light entering the building varies depending on several factors, The location and orientation of the building in relation to the sun; The location and size of windows and openings; Seasons; The type of sky; Clearance around the building. All these factors are interrelated and allow, among other things, better energy efficiency.

Blue arrow: sunlight reflected from outside to inside.

Green arrows: direct light entering the interior, the amount of openings allows uniform light in the space.



Reflected light



Overhead light

Overhead light: opening in the roof allowing uniform light with both sunny and cloudy skies.

The location and size of windows and openings

The location and size of windows and openings also have an impact on the needs of rooms and interior spaces. In addition to visual comfort, they allow control of the type of lighting desired according to use. Whether the window is positioned on the ceiling (skylight), at the top or in the center of the wall, the light entering the room differs, which creates specific lighting for the use.

Seasons

The seasons have a lot to do with the design of a building. In winter, the position of the sun is around 22° and in summer around 68° . Which means that in winter the sun is lower than in summer. Because of the variation in the sun's heights throughout the year, the natural light that infiltrates an opening is not the same depending on the season. For example, for a window in the center of the wall, the summer sun penetrates less directly into the rooms, thus leaving more shaded areas helping to control the heat of a given space. In winter, on the contrary, its presence is more imposing and important and therefore provides comfort to users with its more direct heat.

Again, the use of space defines where the openings are available.



Horizontal surfaces:

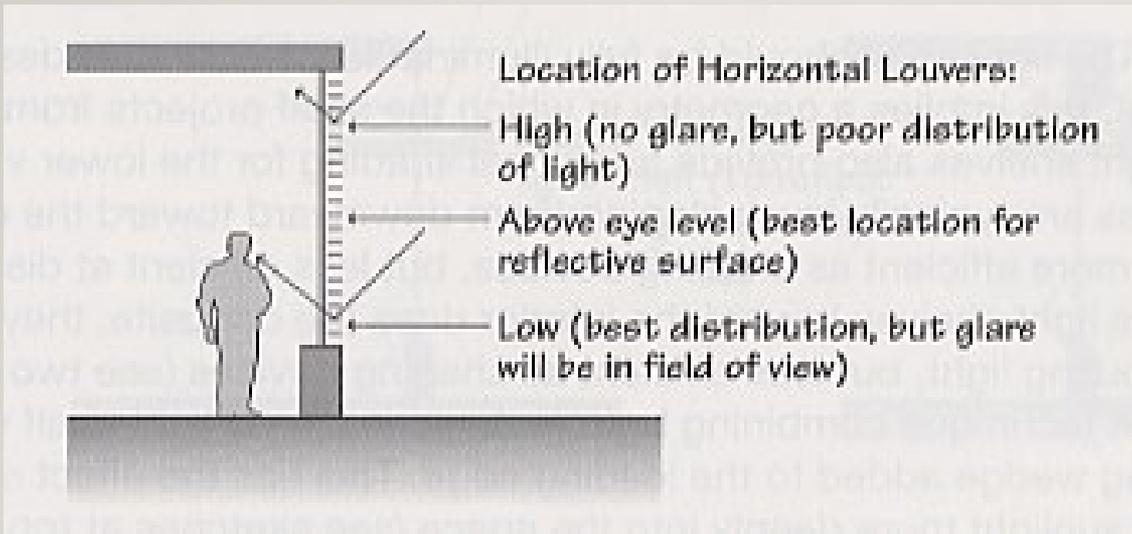
Most abundant on the sunny side of buildings.

Can be a significant source of light in both short or tall buildings.

Short buildings can benefit from direct reflections from the ground.

Tall buildings can benefit from horizontal surfaces attached to their facades.

They can receive the highest radiation in high sun angles as such they could be a big source of glare.

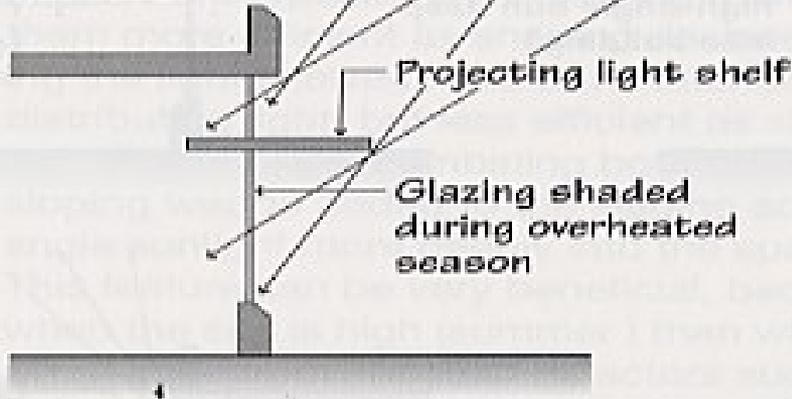


Basic Elements

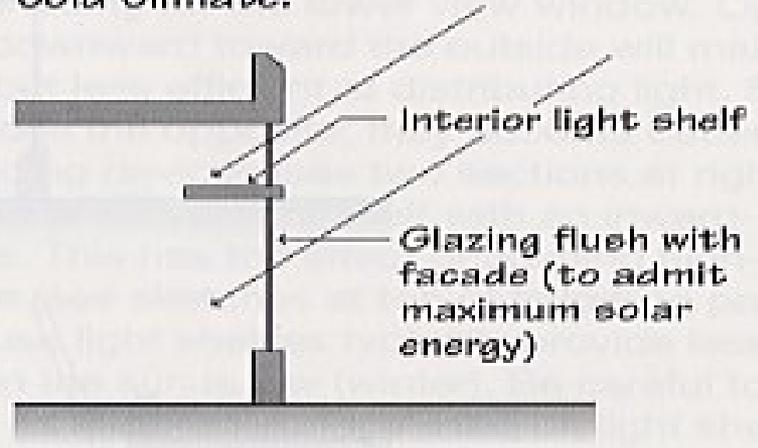
Summer sun

Winter sun

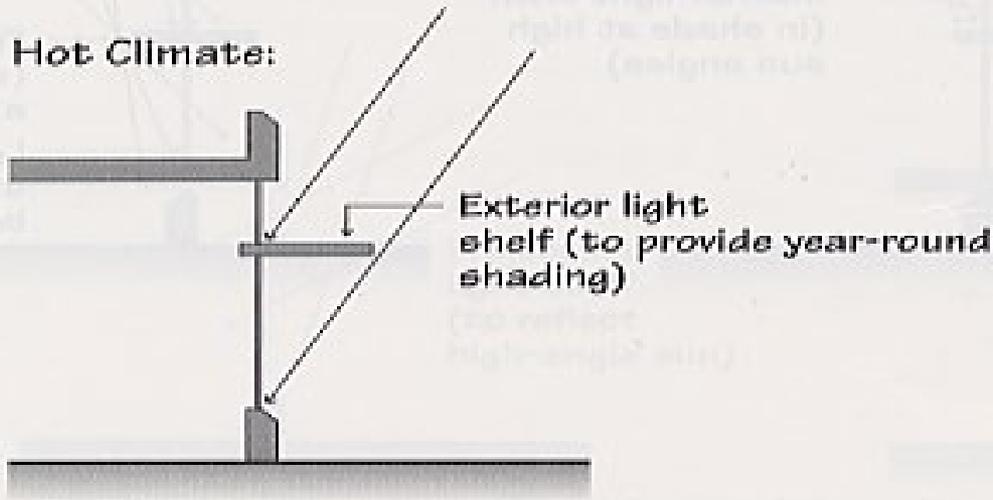
Temperate Climate:

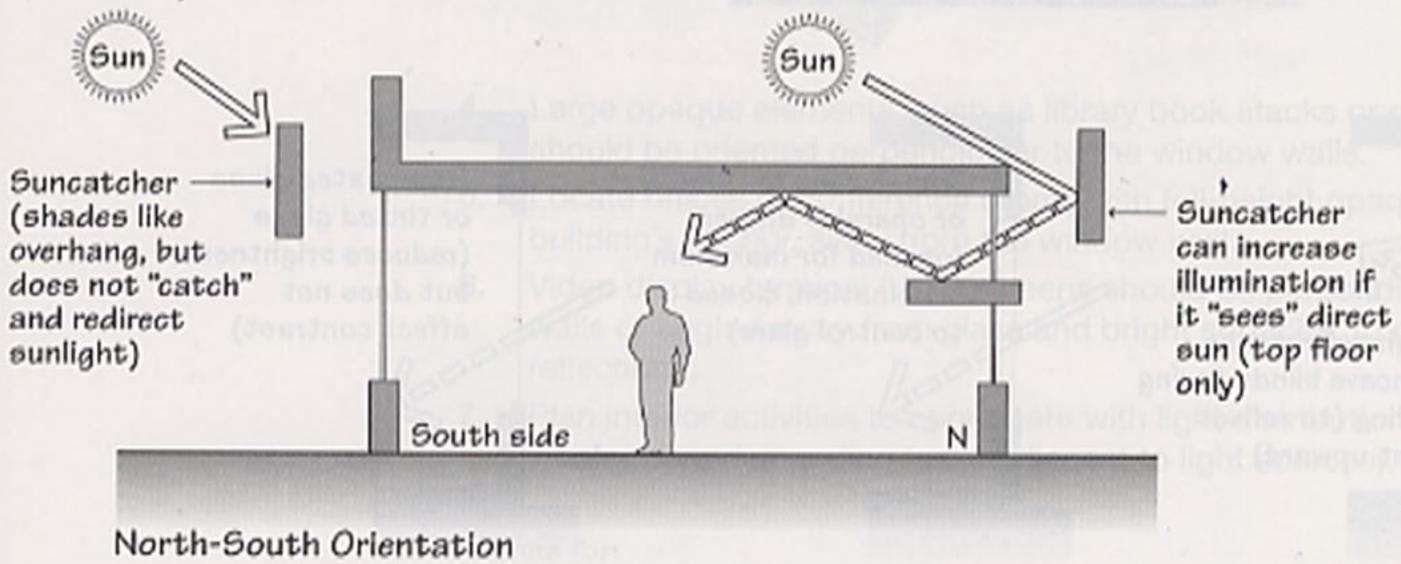
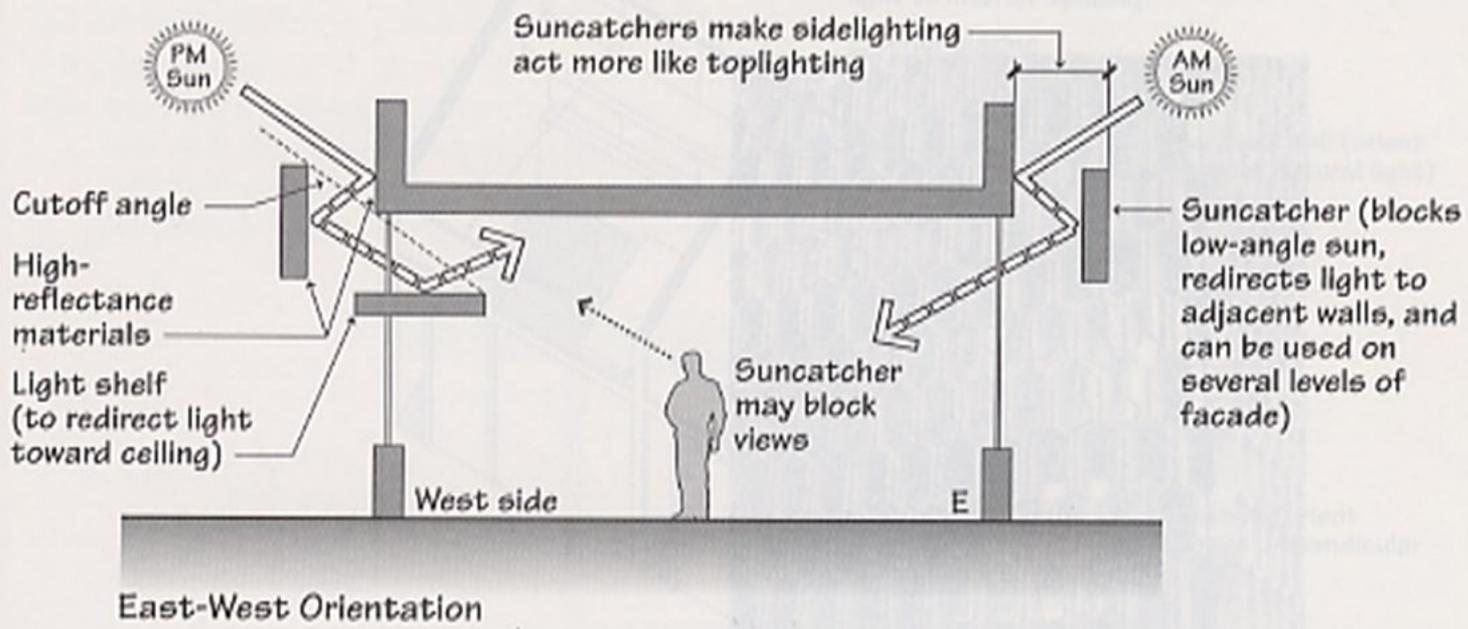


Cold Climate:



Hot Climate:

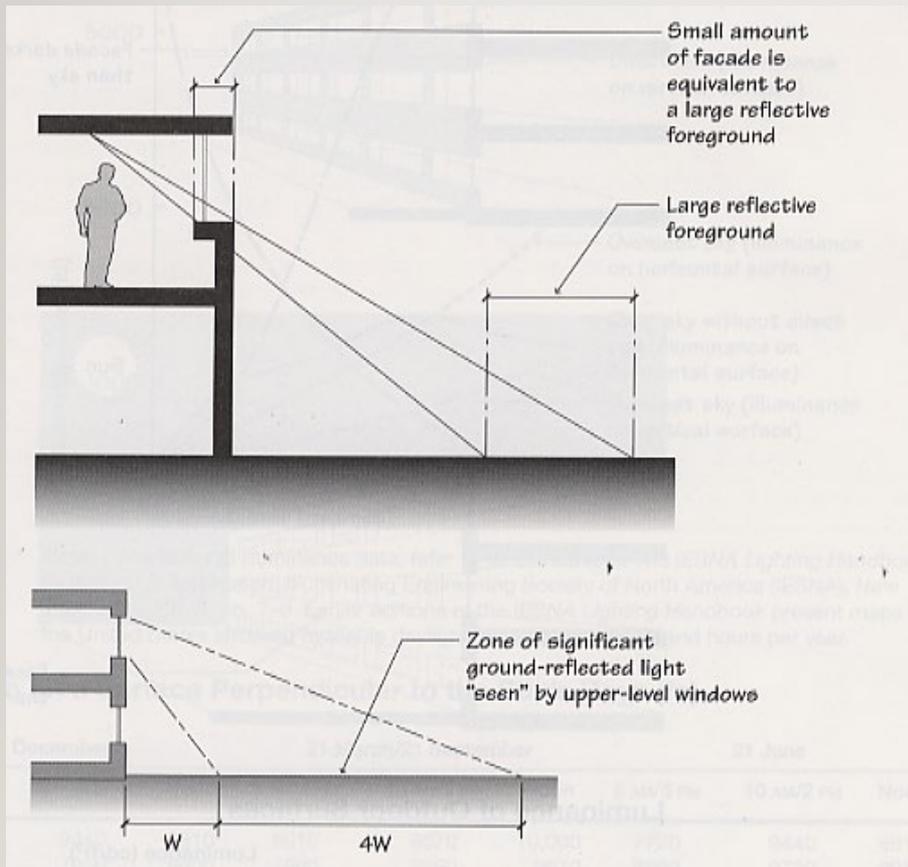


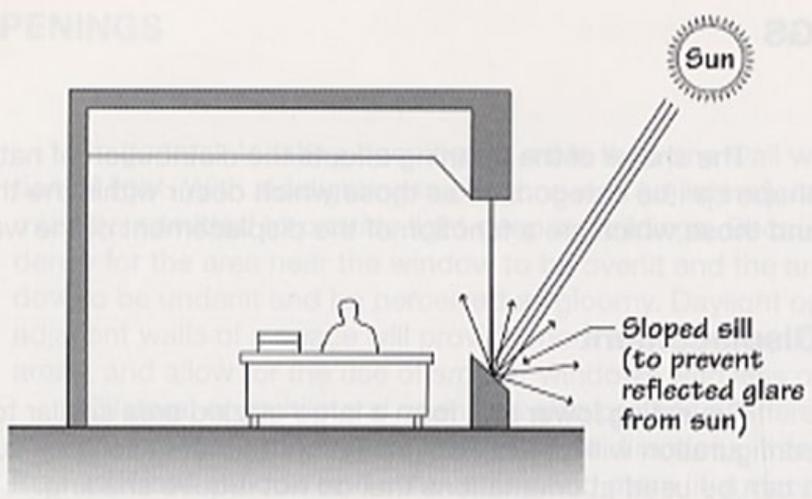


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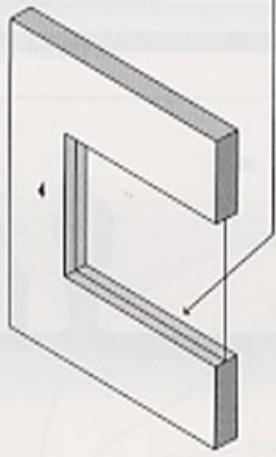




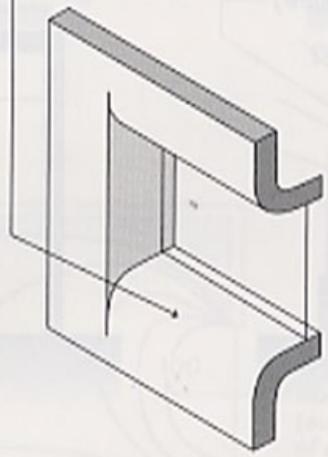
Narrow sill (produces sharp contrast conditions)

Rounded surface (to soften brightness differences)

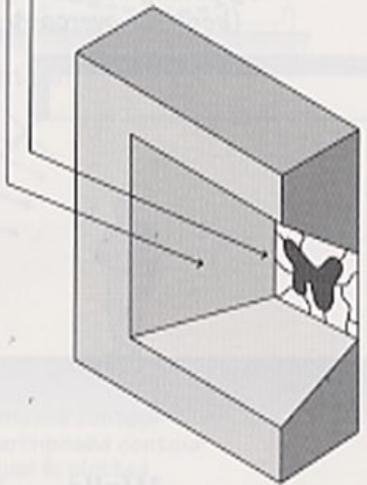
Sloped concrete surface
Stained glass



Sharp Edge



Rounded Edge

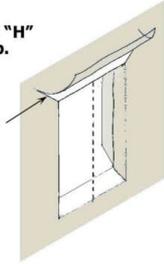


Splayed Edge

Flashing Flange-Type Windows

1. Cut modified "H" in housewrap.

Make angle cuts at corners and fold up flap

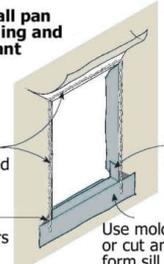


2. Install pan flashing and sealant

Sealant along head and sides only

Patch corners

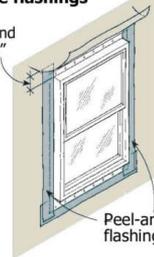
Use moldable flashing, or cut and fold to form sill pan



Turn up 6"

3. Install window and side flashings

Extend up 6"



4. Apply Head Flashing

Seal tape to sheathing



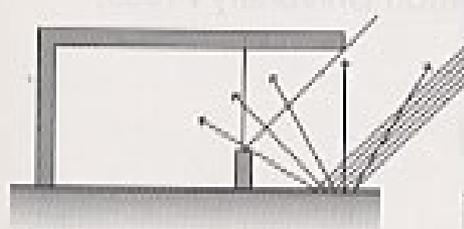
Peel-and-stick flashing tape

5. Tape cuts over head flashing

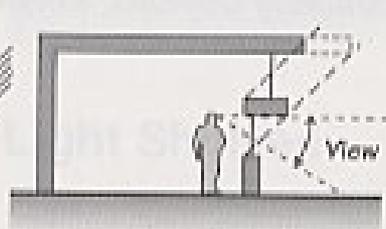


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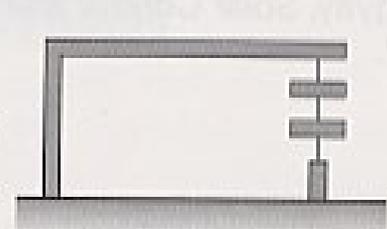
Section views:



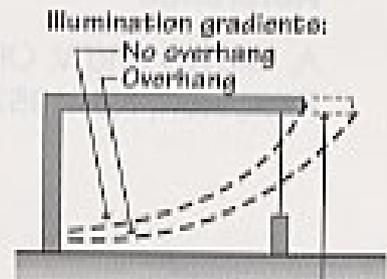
Overhang



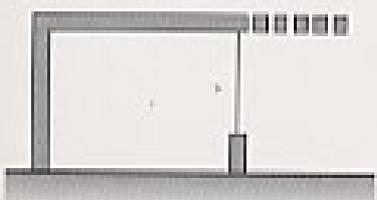
Double Overhang



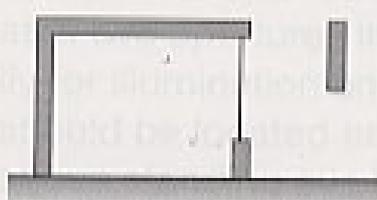
Multiple Louvers



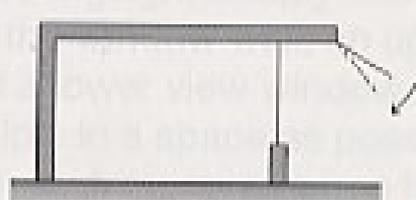
Adding an overhang may significantly reduce amount of light at window wall



Louvered Overhang



Outriggers



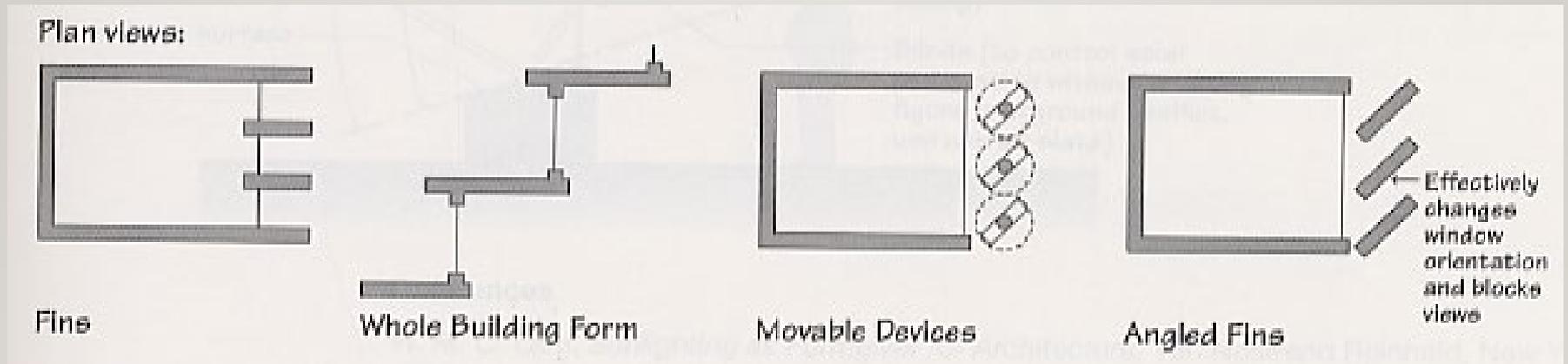
Movable Awnings

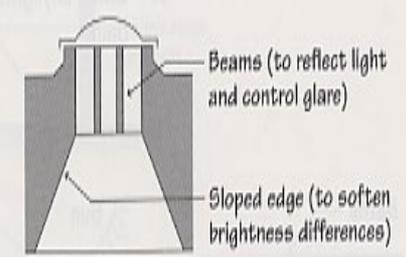
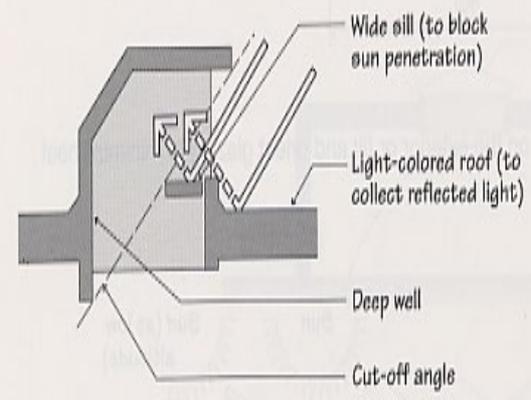
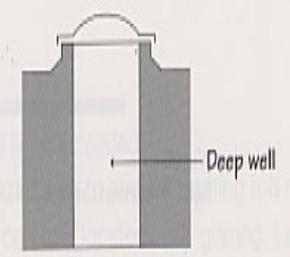
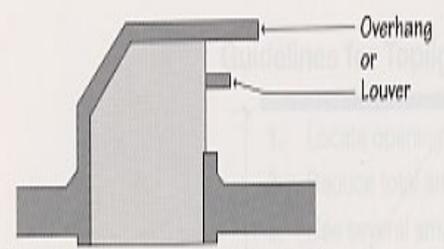
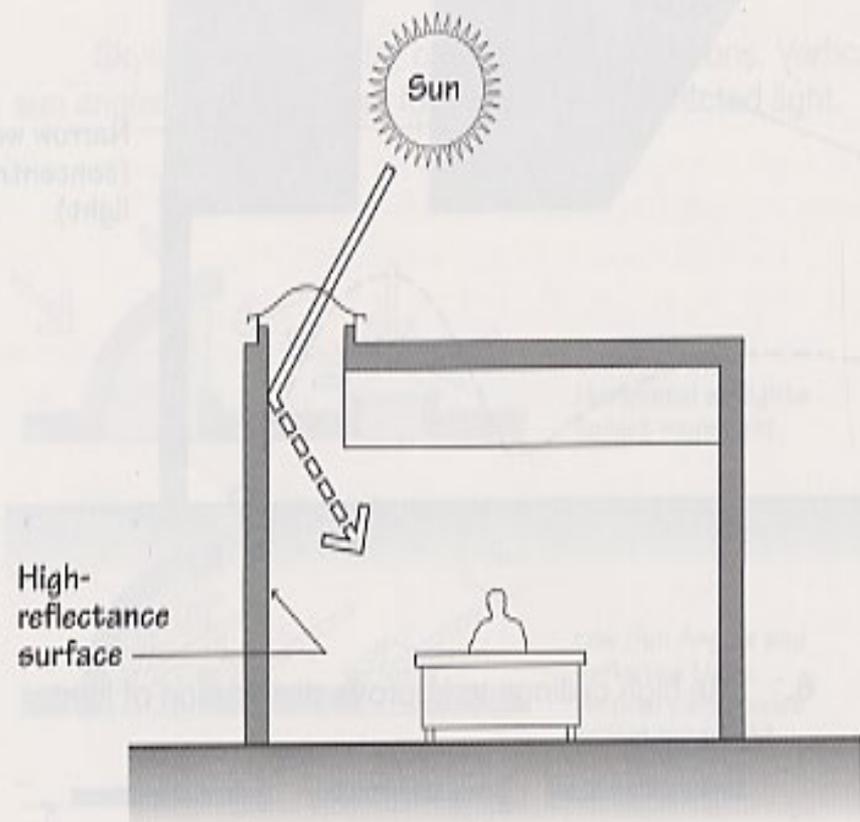
Vertical surfaces:

Most abundant on shady sides of buildings where reflections from adjacent building facades and other vertical surfaces.

They receive their highest radiation at low sun angles such as in winter times and high latitudes.

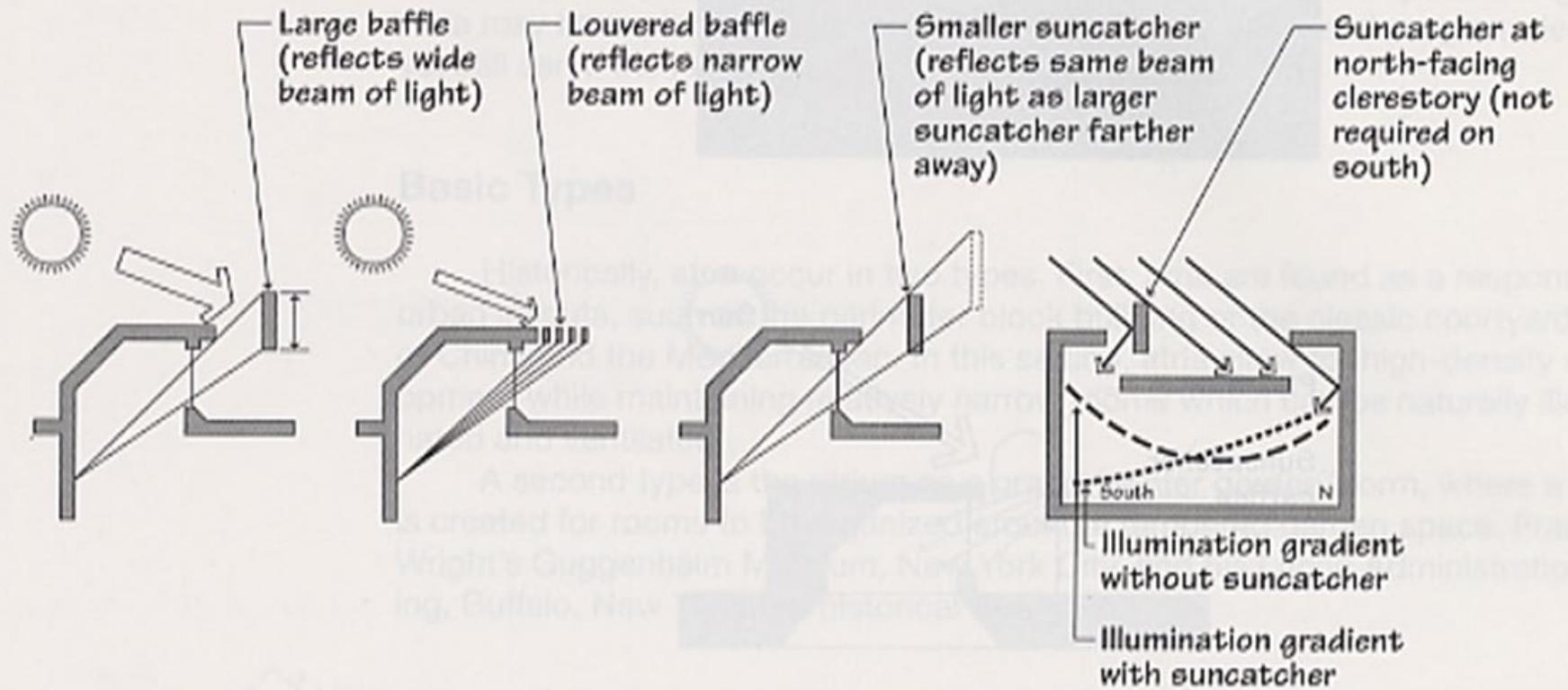
Their light has large horizontal coverage but can be a source of glare therefore they can be located above eye level





Exterior Controls

Interior Controls



Conclusions:

The sun is a powerful source of light, therefore it should be used indirectly to provide the necessary lighting.

The apparent movement daily/seasonally of the sun poses difficulty in controlling the light received.

The architectural design therefore should be made to accommodate this movement to achieve the required lighting levels.

-Shade: Openings to prevent glare and heat gain. North-south openings illuminate horizontal surfaces well. East-west surfaces illuminate vertical surfaces well.

-Redirect: Sunlight where it is needed. Light deeper plans and reduce high contrasts.

-Control: the amount of light entering the space. Light areas when and where needed.

-Efficiency: use light efficiently. Use bright interiors that better reflect light and reduce the amount of lighting needed.

-Integrate: integrate forms of sunlight with the architecture.



References

<https://idinterdesign.ca/a-propos/>

<https://www.allianz.com/en/press/extra/knowledge.html>

<https://slideplayer.com/slide/7355296/>