

# Daylighting in Office Buildings

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**Abstract:** Daylighting is a sustainable strategy that helps us in lowering our bills, reduction in construction cost and providing high quality indoor environment. It's presence in office creates altogether a very different atmosphere than the offices without it. This paper describes about the effects of daylighting with the parameters that cause changes in it, different ways through which it can be included and also measures to control it to prevent excess heating, discomfort and glare.

**Keywords:** Daylighting, sustainable strategy.

## 1. Introduction

Daylighting is the ingress of natural light (which can be direct or diffused) into a building. It reduces the need of electric lighting which in turn saves energy and costs. It is a highly cost effective means to reduce lighting and cooling loads. So, best results can be achieved through proper planning and organization of spaces within a building. The presence of natural light in office can enhance the mood and increase the productivity of its occupants.

## 2. Effects of natural light in office

- Presence of natural light in the workplace leads to sound sleep among employees at night, which is an added benefit besides health and productivity.
- Natural light affects our immune system keeping us healthy away from sickness.
- Mind can stimulate and concentrate when needed in brightly lit office with natural light rather than artificial light.
- Office with natural light can increase people's creativity by 15%.
- It can reduce one-third of total building energy's cost by reducing electric lighting and cooling loads.
- It also reduces construction cost.

## 3. Parameters influencing daylighting performance

### A. Climate

The climatic conditions of site determine the daylighting design for visual and thermal comfort, energy performance and sunlight availability.

*Obstructions and reflections on site:* Elements like buildings, vegetation, ground surface surrounding the building site effects the amount of daylighting reaching inside a building.

*Building design:* Geometry - Building geometry effects the level of daylight in the interiors of a building. If building is deep and windows are only on façade, then light can reach up to a certain depth.

*Interior surface* - The colour and reflectance of interior surfaces in a building are a part of lighting system. Light surfaces reflect more light than bright surfaces.

### B. Windows and skylights

- *Orientation* – Window orientation effects the quality and amount of light in the interior. In the northern hemisphere, light from north is diffused, comfortable and stable throughout the day. Light from other directions can be direct and vary significantly throughout the day.
- Windows and skylights on roof receive direct sunlight.
- *Glazing transmittance* – Number of glass layers in a window pane reduces the amount of light that passes through it. Visible transmittance of a window pane is reduced by coloured or coated glass.
- *Shading* – Shading and sun screening is desirable to achieve better results. Blinds can be used to alter the amount of daylight in a space.
- External shading such as roller shutters and awning blinds is the best solution to prevent direct solar radiation.
- Dark grey screen can also be used to avoid glare.
- *Position* – Window position effects daylight distribution in a room. Window position should be according to outside view and eye level of occupants.
- *Linings* – The shape and size of window linings effects the daylight entering the room so it can be used to alter illumination in a room and achieve the desired level.

## 4. Types of openings

### Roof light:

A horizontal roof light is three times more effective than a vertical window. They cast light in a more uniform way without any obstruction. Direct light from sun can be diffused by glazing. Angled reflectors can be used for beautiful effects.

### Atria:

The orientation and geometry of atrium determines the daylight performance of an atrium. The performance of wide, shallow square atrium is better than deep, narrow, rectangular

ones. Atrium walls should be light in colour to increase internal reflection. Windows on atrium walls should be avoided as it reduces reflection. Glass roof over an atrium reduces the amount of light entering inside. Glare can be controlled by shading or baffles.

*Translucent walls:* Glass brick walls are transparent or translucent. They are hollow with fine concrete grout. Walls can be transparent if glue matches with refractive index of glass.

*Light shelf:* Light shelf is the overhang above eye-level that reflects daylight to the ceiling and then into deeper spaces. This is used in building face with maximum sunlight. They shade areas near window to cut-off excess light. Exterior shelves are more effective than interior shelves.

*Light tube:* Also known as light pipes or tubular skylights. It is placed on roofs to admit light in a specific area of the building where light cannot reach by any means. Much of heat is not transferred as they have low surface area.

*Windows:* Windows should be provided on various faces as per lighting requirements. Walls near to windows should be light in color as light color reflects more light. Windows can also be placed on high levels (clerestory windows). But they can admit excess light or glare. So, face on which it is to be provided should be wisely chosen and if required overhang or light shelves can be provided.

### 5. Solar shading and daylight control

Solar shading is the control of amount of solar heat gain and visible light that enters in a building. Shading is provided

- To reduce heat gain
- To cut-off sun glare
- For privacy
- Thermal and visual comfort

*Types of shading:*

*External shading:*

They control the amount of radiation that enters a building. They should be chosen according to climatic conditions of site, the durability and the exterior façade. They can be horizontal, vertical or egg-crate devices. Horizontal devices provide shade in summers but allow sunlight in winters. Vertical devices can be used in east or west. Egg-crates are combination of horizontal and vertical shading. They are used in hot regions since their shading efficiency is very high.

External shading devices include overhangs, canopies, shutters, awnings, louvers, roller blinds, etc.

*Internal shading:* They reduce the glare from sun and light entering through window. They are adjustable and easily operated as per occupant's need. They are less efficient than external shading devices as heat that has already entered, is difficult to counter. They are easy to maintain. Internal shading

devices include curtains, venetian blinds, blackout blinds, louvre blinds, roller blinds, pleated blinds, etc.

### 6. Surfaces that diffuse natural light

Reflective surfaces make us feel space larger than actually it is. They reflect more when light strikes its surface. They also make us feel much better, boosting our mood and creativity.

Some surfaces that diffuse more light are:

- *High-gloss paint:* Walls can be painted with high-gloss paint as they reflect light well and space seems bigger and brighter than it actually is because of the shine.
- *Glass:* Materials made up of glass like glass bowls or furniture's with glass surfaces can be used as they reflect light around the room. But they should be positioned at the right height to avoid any accidents.
- *Mirrors:* Mirrors can be used as they make spaces look larger. And due to their flexibility of being available in all shapes and sizes, they can be a very good option and can be merged anywhere.
- *Light colors over dark:* Light colors reflect light and heat while dark colors absorb light and heat. So, light colors should be preferred.
- *Water:* Water is also a reflective element that can make space feel brighter. So, water showpieces or aquarium or fountains can be added that can also be the focal point of the room.

### 7. Conclusion

A properly planned and thoughtful design of daylighting in office will not only improve the indoor quality but also will reduce monthly energy bills. Modern office buildings make glass façade to let more and more natural light. But this increases solar heat gain causing discomfort to employees. Therefore, enough measures should be provided to counter all this. Overhangs, canopies, light shelves or other elements of suitable shape, size and material should be provided wherever required. Building orientation should be according to region and the purpose.

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