

## Daylight in the Office – A Matter Of Balance

During the early years of office working, and until around the mid seventies, it was believed that artificial light was far superior to daylight. Research indicated that the best way to work was under uniform electric light, and little or no benefit was recognised in providing daylight as a source of illumination, or to the role of windows as a link to the outside world. It is only in the last decade that research has begun to show the benefits of daylight. These advances were led by American software giants looking for solutions to the problem of reduced productivity among teams of software developers. They found that the single most detrimental factor was a poor office environment. For these companies, improving the office design, includes ensuring high levels of daylight, proved to be the most effective solution. Although the evidence is not always conclusive, it is now generally believed that gains in productivity can be correlated to a well-designed, daylight illuminated learning, retail or workplace environment



European legislation on the subject remains vague at this time – the EU Directive states that “workplaces must as far as possible receive sufficient natural light and be equipped with artificial lighting adequate for the protection of workers’ safety and health”. The recommended ratio of artificial light to natural light at any long-term work setting is 1:5. In Germany, Workplace Ordinance actually requires that occupants of a workspace must have visual contact with the outside world. But apart from these vague official guides, what more can be done to achieve the optimal use of daylight in an office?

### Daylight is good, sunlight is bad

Daylight is important for human vision, and for our health. It is available in abundance, free, although is not reliable or consistent. For many reasons, its use as a basis for office lighting has unique advantages. However, there are also disadvantages to the use of daylight – often arising from a particular type of daylight – direct sunlight. An understanding of the positive and negative effects of daylight is essential to making the best use of this natural resource in the office environment

### Vision

Human vision under daylight conditions is normally better than under artificial light. It is usually present in higher quantities and has better colour rendering, enabling us to see things more clearly. However, if too bright, or too direct, daylight, or especially sunlight, can cause glare, preventing us from seeing properly, or even causing eye damage. In addition, it is important that the brightness of daylight does not contrast too much from the background lighting levels, making it hard for our eyes to adjust as we move from one light source to another

### Health

The link between daylight and human health is becoming increasingly clear. Essentially daylight stimulates the production of vitamin D, an essential element for maintaining a healthy immune system, and plays a major role in the control of our circadian rhythm – the cycle that regulates our body’s sleep at night and alertness during the day. Lack of daylight in offices has been linked to ‘sick building’ syndrome, with some research showing a direct link between a worker’s distance from the window and symptoms of illness. In contrast, sunlight is known to cause damage to the eyes and skin if exposed to high levels

## Mood

The link between light and mood, and mood and productivity is complex, and not easy to prove scientifically due to the number of other contributory factors. However, studies have made links between improvement in workplace daylighting and productivity, and even the success of retail outlets has been shown to dramatically increase with the introduction of skylights. In addition to delivering light, windows also provide a view. This has been more directly linked to improved workplace satisfaction, reduced stress and increased productivity. A view gives workers contact with the outside world, the weather, the time of day or year, and provides variety and stimulation.

Naturally not all views are uplifting, and equally daylight does not always have a positive impact on productivity. Where sunlight enters an office directly, it can be distracting and create hot-spots, likely to decrease the productivity of the workers it effects. Overly large windows may also be problematic by causing loss of privacy.

## Cost and Environmental impact

Increased use of daylight in the office can dramatically reduce the costs and energy consumption of electric lighting. The ideal situation is one where photosensors adjust the levels of electric lighting to compensate for changes in levels of daylight. As long as the daylight is indirect, it is also cooler than electric lighting, so will require less powerful air conditioning to compensate.

However, if not filtered or shaded, direct sunlight will cause overheating and require expensive cooling for offices. Windows, as a source of daylight need to be carefully planned as they can be both a source of overheating or heat loss in colder climates.

## Delivering daylight

Although most buildings have limited options to change the amount of daylight that reaches the office space, there are ways to ensure that the daylight is used to best effect, and the negative aspects described above are avoided.

## Windows

Many buildings are built to include 24 – 30% of wall area as window, in line with value engineering limitations. Although little can be done to alter this in existing buildings, luckily this proportion is ideal for the average building. This should enable sufficient daylight levels without over-lighting.

Over-lighting is becoming a more common phenomenon, with the current popularity for buildings swathed in glass, rather than traditional bricks and mortar. The result is that too much heat is lost in low sunlight, and too much heat generated when sunlight is bright. Workers will experience high levels of glare and backlighting, with the most common result being that blinds are drawn almost continuously, losing all the benefits design advantages of large windows.

Similarly to artificial lighting, the best solution is a dual window approach. A top window is placed high up, letting in high levels of daylight that can reach deep into the room, without causing glare. Below this are windows to provide a view, that are shaded from direct sunlight and let in lower levels of daylight. The effect is enhanced still further if combined with dual artificial lighting to augment the ambient light, and provide specific task lighting where appropriate.

A new technique, claimed to be more effective at delivering daylight indoors is the use of Sun pipes. Translucent, faceted domes on the roof of the building collect sunlight, which is then transmitted through a series of reflective pipes and prisms deep into the building. While avoiding issues of heat and glare, and saving the energy costs of artificial lighting, a pipe of only 30cm diameter is said to deliver more daylight than a normal 900x900mm window



## Daylight systems

There are a number of simple methods to control the levels of daylight entering a building, and to filter out direct sunlight wherever possible:

- Blinds are the most common method of filtering daylight as it enters the office. The most effective blinds consist of slim horizontal slats made from a pale, non-reflective material. This will allow a more even and diffuse light to pass through, remove glare, and provide a simple means for workers to have greater personal control of their environment.
- Plants can be used to great effect both inside and outside a building to filter out direct sunlight, as an alternative or addition to blinds.
- Special glazing, coatings or foil can be used on existing windows to cut down the direct sunlight entering and office.
- Overhangs or light-shelves can be applied internally or externally to shade a window from direct sunlight.

With any of the daylight control systems above, it is important to avoid dark colours, as these will result in a visually distracting contrast with the brightness of the window.

However, while all of these techniques can be used to moderate the amount of sunlight entering a building, if applied excessively the result will be insufficient natural light, and we are back where we started.

## Artificial daylight

Many attempts have been made to simulate daylight using artificial light. In fact, technology has reached a point where bulbs do exist that emit the full spectrum of light present in daylight. What the bulbs cannot replicate is the natural fluctuations of the composition of the daylight spectrum according to the weather, time of day, time of year and even geographic location or surrounding landscape. This variation in natural spectrum light plays an essential role in providing the benefits of daylight environments, and has not yet been successfully replicated by any artificial system.

Interestingly, experiments have shown that what we perceive to be 'natural light' coming from an artificial source is in fact quite different to actual daylight, so there may be little benefit in continually trying to develop such a thing

## A matter of balance

Clearly, providing the correct level of natural daylight for an office is not simply a case of maximising window area. Neglecting to consider the negative impact of excessive direct sunlight can be costly. However, an array of design and lighting solutions are available to control the balance of natural and artificial light in the workplace - it is the responsibility office designers and managers to utilise them creatively.

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*The Workplace Intelligence Unit was founded by forward thinking inc. and Herman Miller*

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