



## Daylight Illumination and Building Architecture - Effect at Workplace

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### Abstract

Occupational health and architecture on the modern office-based work environment is a major public health concern of this era. Information and communication technology have created a world where a high-quality working environment is vital for the office workers. Majority of the nation provide quantity rather than quality of work conditions. According to the researcher's poor indoor environmental quality, such as illumination, has a detrimental influence on human health and performance. The purpose of this study is to discuss about the effect of day light illumination on worker productivity. This paper has analyzed previous researches and have directed for future research. This study also shows that an adverse day light condition has a negative impact on workers' health and resulting adverse effect on productivity and efficiency. They are also at risk of contracting occupational ailments. Proper day light illumination is advisable which is a necessity for both employee and employer.

**Keywords:** Daylight; Architecture; Technology; Indoor Work; Human Resource; Workplace Behaviour

### Introduction

The diurnal light cycle has a crucial influence on circadian rhythm all living things of the planet. Occupational health and architecture integrated following World Health Organization (1994) Declaration on Occupational Health for All concerning the "Sick building syndrome" (SBS) of the 1970s. SBS is often described as a combination of factors causing health problem related to building environment (United States Environmental Protection Agency, 1991). With the increased interest today in green architecture, daylighting is becoming an important design consideration. Lack of exposure to natural light in a rest/activity rhythm on cortisol and melatonin levels, which leads to in turn, are related to depressive symptoms and poor quality of sleep. This eventually creates different stress on psychological variables in humans (Harb,

Hidalgo & Martau, 2015). This may result in stress, anxiety and poor work performance at workplace. The surrounding environment can have a significant impact on a worker's performance. There are a number of important micro and macro environmental factors that have been shown to affect employee moods. Workplace environment has been scientifically demonstrated to influence employee productivity. Employees' productivity, creativity, and mood are also influenced by the psychological consequences. It's no secret that a worried mind is the enemy of productivity. Cortisol (the stress hormone) is released by humans when they are stressed, which normalizes their responses (Silvester & Konstantinou, 2010). People's working habits have changed dramatically in recent years. Most workers have been compelled to

increase their labour while also coping with continuously changing requirements and a faster rate of work in order to produce a memorable customer experience. It is therefore incumbent upon employers to develop workplaces which best meet the demands of 21st century workers while guaranteeing maximum levels of well-being and performance (Silvester & Konstantinou, 2010).

For a wide range of tasks, humans are reliant on natural light. Daylight changes can have a significant impact on the eyesight and behaviour of the human resources. The link between light and circadian cycles is well established, according to lighting experts (Escuyer & Fontoynt, 2001). It is therefore possible for employees to feel drowsy and lethargic if the workplace lighting is not able to accurately replicate natural light. Science firmly supports the notion that unsuitable lights can reduce employee productivity while also making people feel unhappy and agitated. This is one of the most typical issues encountered in office environments, as worried authorities refrain from investing in appropriate lighting solutions. Employees may get disengaged in their work as a result of this issue, which may impair their performance (Ul Haq *et al.*, 2014). Workplace lighting's primary purpose is to allow workers to see, so they can accomplish their tasks comfortably and safely.

### **Objective**

The present study aimed to analyse the previous findings in order to discover the qualities of an optimal lighting control system. This study attempts to synthesis and evaluate data relating to the link between lighting and employee well-being and productivity in an office setting. This research also intends to examine how work is evolving and how new advances in the lighting industry may aid in the creation of workspaces which will be capable of boosting organizational well-being and performance.

### **Review of Literatures:**

Many researchers believe that both the qualitative and quantitative components of workplace illumination play a significant role in influencing the productivity of their personnel.

The lighting conditions in the workplace have an impact on productivity, quality, interruptions, absenteeism rates (Van Bommel, 2006). Light has also long been recognized to help individuals feel more pleasant, comfortable, colourful, stimulated, and less oppressed, in addition to boosting visual performance. (Kruisselbrink, Dangol & Rosemann, 2018). A lack of lighting in the workplace is the primary cause of visual discomfort and physiological and psychological strain among workers. These conditions can lead to anxiety and fatigue as well as migraines and nausea, backache, neck pain, shoulder pain, poor concentration, and daytime sleepiness (Pauley, 2004). Illumination at the workplace is determined by the type of light source, its location and mounting height, as well as the type of luminaire and its dispersion of light (Katabaro & Yan, 2019). Illuminance levels and homogeneity that are at the optimum level increase visual perception, reducing tiredness symptoms including eye pain and headaches. Illuminance levels that are well-maintained improve mood and alertness (decrease tiredness), which are key variables in improving occupants' performance (Van Bommel & Van den Beld, 2004). In order to conserve energy resources, modern lighting systems should be energy-efficient while maintaining quality, the day light penetration in workplace is highly advisable to support "Green Technology". In order to reduce energy consumption and costs while maintaining visual comfort and work performance, lighting installations should be designed with energy efficiency in mind (Bhusal, Tetri & Halonen, 2006).

Several studies have been conducted to investigate the effect of illumination on workplace productivity. In addition to its theoretical importance, light exposure may also have practical applications. Impaired alertness has a negative impact on quality of life due to daytime drowsiness, circadian misalignment, and sleep disorders. It also has an impact on cognitive function, perceptual skills, understanding, and decision-making ability, all of which are likely to affect productivity (Lok *et al.*, 2018; Soto Magan & Andersen, 2019). Changing the lighting in a

workplace can affect workers in three ways: by altering visual capacity (Rea & Ouellette, 1991), by altering visual comfort (Wilbom & Carlsson, 1987), and by changing the perception of the conditions (Flynn *et al.*, 1979). Visual ability has a major influence on task performance. The impact of visual comfort on mood can have an impact on health and well-being. These three factors (visual capability, comfort, and perception of condition) also influence the sense of competence to complete the work and, as a result, desire to complete the task (Bhusal, Tetri & Halonen, 2006; Festenstein & Keeler, 2018). To preserve visual comfort and increase visual performance, it is critical not only to provide the appropriate quantity of light, but also to ensure that the light is evenly distributed across the work area. When the eye is continually forced to adapt to changing brightness, it suffers from eyestrain and fatigue. (Moore, Carter & Slater, 2003).

To effectively identify the appropriate lighting technology, the occupant behaviour of each type of space or structure depending on the type of occupant activities should be examined. This occupancy pattern will then offer a picture of how the room's occupants really utilize energy in those areas (Ul Haq *et al.*, 2014). Apart from occupant usage patterns, there are various other elements that affect the operation of control systems, and these factors may vary depending on the type of control system. For example, for occupancy sensors, time delay setting is a critical issue that can affect their performance; whereas for daylight-linked systems, choosing between switch in and dimming or between open and closed loop algorithms can be critical to the implementation's success (Ul Haq *et al.*, 2014). Technological developments in fluorescent lighting have allowed considerable increases in lighting energy efficiency in commercial office buildings. There is a 39 percent energy savings when to switch from old T12s and magnetic ballasts to new 700 series T8 bulbs with immediate start electronic ballasts. Up to extra 23 percent of efficiency can be gained by using high-performance T8 lights (Sardinsky & Benya, 2003). In the current office lighting paradigm, however, making improvements to bulb and ballast

technology accomplishes little to improve the lighting conditions for occupants (Jones & Gordon, 2004; Boubekri *et al.*, 2014). Lighting has measurable benefits on workers' comfort and performance, according to a review of past research. A study by Boyce *et al.*, (2003) found that workers who had individual control over lighting levels felt more satisfied with their work environment and had a stronger sense of control in general as a result of it. Researchers have shown that using energy efficient electronic ballasts instead of magnetic ballasts reduces headaches and boosts task performance (Veitch & Newsham, 1998; Bhusal, Tetri & Halonen, 2006).

Green Architecture and Green Building practices contribute first to the proper exploitation of nature and renewable sources, as well as to improved energy savings, and second to the development of standards for energy efficiency in structures (Lacroix, Stamatiou & Planner, 2007). The practicality and efficiency of these "Green Architecture" technologies are demonstrated by applications from the United States, Europe, and Asia. A number of well-known "Green Designers and Builders" from throughout the world have made significant contributions to this subject, paving the way for future perspectives of these successful designs (Lacroix, Stamatiou & Planner, 2007). Lehar and Glicksman (2007), have developed a daylight simulation technique which can provide a tool that can be used in the early stage of designing a building to improve daylight coverage and reduce energy consumption. An office room's amount of daylight during working hours can be accurately predicted by using a daylight prediction tool. On the basis of this information, it is possible to estimate the amount of energy required for artificial lighting in any workplace (Lehar & Glicksman, 2007). The "Light Right" study funded market research, investigated the roles and influence of key decision makers in lighting design and installation (Jones & Gordon, 2004). The study uncovered well-known issues in the building industry's delivery system. Their studies revealed, as expected, that lighting designers naturally place a high value on quality lighting and have a high level of authority because they develop the specification. This market

research indicates a significant opportunity to inform and educate building owners and architects about the advantages of more efficient lighting (Jones & Gordon, 2004).

**Research Gap**

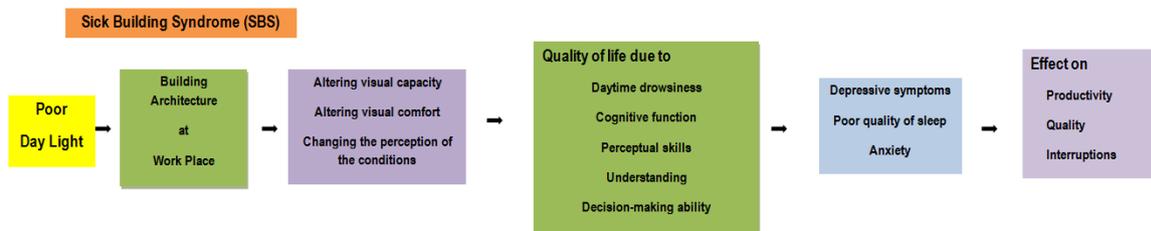
It's no secret that a variety of vital and interconnected factors may have an influence on a person's well-being and work performance. There are many aspects, both at the individual and organisational levels, that can contribute to a healthy, productive work environment. Unexpectedly few studies have examined the impacts of lighting on workers, even though workplace illumination has a major impact on worker safety as well as visual acuity and productivity. Most of the

studies conducted by vision researchers, as a result, there have been little attempts made to combine management, vision research knowledge and practice. It is the goal of this paper to fill this essential knowledge gap. On the basis of research concepts and theories, we believe it will serve as an impetus for future cross-disciplinary study.

**Significance of the Study**

The study is notable for increasing awareness and adding to the body of information regarding the impact of an insufficient lighting environment on occupant health, productivity, and working efficiency.

The flow chart depicts the effect of Day Light on Workplace Productivity (Fig.).



**Fig. Flow chart Showing Effect of Day Light on Workplace Productivity**

**Discussion:**

It's no secret that modern information and communication technologies (ICTs), a growing emphasis on knowledge-intensive jobs, a rapid increase in globalization and workplace diversity, have provided opportunities for organizations to attain quicker growth and competitive market positions. Workers nowadays are obliged to adjust to an even faster pace of change as a result of the same conditions, with responsibilities that are becoming increasingly ambiguous and complicated. In order to meet the demands of 21st century workers, organizations must create work environments that ensure maximum levels of well-being and performance. Numerous studies have shown that poor indoor environmental quality, such as inadequate lighting, has a detrimental influence on human health and, in the case of office workers, can hinder their work performance. The impacts of lighting quality on worker productivity were investigated in this study. The authors found certain variables

based on prior studies. Poor lighting design approaches, the use of obsolete lighting technology, inability to comply to various job lighting standards, and a poor choice of lighting luminaries were found as contributing sources to insufficient illumination. During luminance measurements, the boundary between natural and artificial light was not well established. As a result, predicting the luminance contribution of the two is impossible. Harb, Hidalgo & Martau, 2015 compare melatonin and cortisol level on “with window” and “without window” and found positive correlation on minor psychiatric disorders, depressive symptoms and poor quality of sleep (PSQI). Some offices received a significant amount of sunlight; yet, occupants continued to use artificial lighting to compensate for the inadequacy.

**Conclusion:**

The day light illumination plays an important role on employee health and thereby adversely affects the work productivity. Although the light

pollution has adverse effect but low day light penetration cases a source of Sick Building Syndrome. Present study opens future research study option on building office planning as per requirement of each room occupant's work. We may ease off the diseases caused by low day light illumination.

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#### Conflict of Interest:

Authors declares no conflict of interest.

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