

## **The impact of daylight on occupant's satisfaction: In the Residential apartments of Amman, Jordan**

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### **Abstract**

The use of daylight has a great impact on the human visual system, circadian system and the overall health. Specific lighting conditions can change the mood of occupants of the buildings, however daylighting in residential apartments is not considered and there are no specific regulations to provide spaces with the optimum amount of natural light. This research focuses on the impact of daylight on occupant satisfaction in residential apartments and trying to reduce the discomfort caused by the lack of natural light entering the spaces by implementing specific equation where the researcher recommended to use this formula as one of the buildings regulations in Greater Amman Municipality.

**Keywords:** Daylight, Satisfaction, occupants, mood

### **Introduction**

#### **The Effect of Natural Light on Human body**

Different wavelengths or spectral distributions of light have different effects on the human body. Most electrical light sources lack the spectral distribution needed for complete biological functions, although full-spectrum fluorescent lighting does come close to that of natural light (Hathaway, et al. 1992). Cool white fluorescent lights are concentrated in the yellow to red end of the visible light spectrum. Incandescent lamps, similarly, are concentrated in the orange to red end of the spectrum. In comparison, energy-efficient fluorescent lighting is typically concentrated in the yellow to green portion of the spectrum. These three light sources lack the blue portion of the color spectrum (Lieberman 1991), which is the most important part for humans and is best provided by natural light. Full-spectrum fluorescent lighting is the

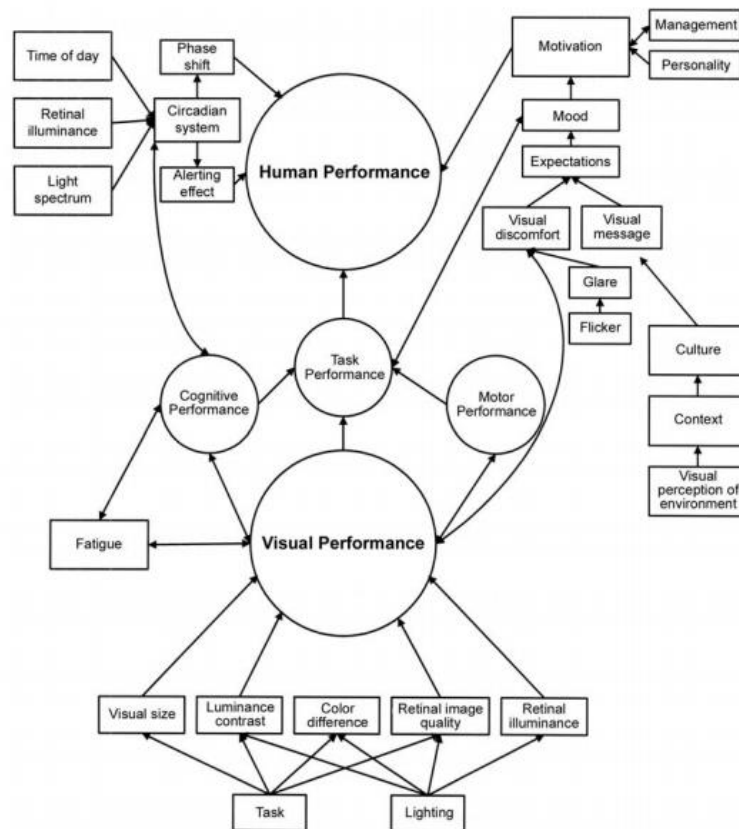
electrical light source that has a spectrum of light most similar to natural light because it provides light in the blue portion of the spectrum. Daylight provides a better lighting environment than cool white or energy-efficient fluorescent electrical light sources because “daylight...most closely matches the visual response that, through evolution, humans have come to compare with all other light” (Franta and Anstead 1994). The majority of humans prefer a daylight environment because sunlight consists of a balanced spectrum of color, with its energy peaking slightly in the blue-green area of the visible spectrum (Lieberman 1991). According to Hathaway, et al. (1992), natural light also has the highest levels of light needed for biological functions.

Humans are affected both psychologically and physiologically by the different spectrums provided by the various types of light. These effects are the less quantifiable and easily overlooked benefits of daylighting. Daylighting has been associated with improved mood, enhanced morale, lower fatigue, and reduced eyestrain. One of the important psychological aspects from daylighting is meeting a need for contact with the outside living environment (Robbins 1986). According to Dr. Ott (Ott Biolight Systems, Inc. 1997a), the body uses light as a nutrient for metabolic processes similar to water or food. Natural light stimulates essential biological functions in the brain and is divided into colors that are vital to our health. On a cloudy day or under poor lighting conditions, the inability to perceive the colors from light can affect our mood and energy level. Dr. Lieberman (1994) also mentioned that light plays a role in maintaining health.

A 1986 study by West as cited by Heerwagen (1986) evaluated the effects of light on health by evaluating prison inmates with different window views. He found that inmates with windows facing a meadow or mountains had significantly lower rates of stress-related sick calls than inmates with a view of the prison courtyard and buildings. Furthermore, inmates on the second floor had lower rates of stress-related sick calls compared with inmates on the first floor. Reasons for the differences in sick calls included a more expansive view from the second floor, which provided increased positive psychological benefits. Inmates on the first floor had added stress from lack of privacy because of visibility to passersby. Because natural views tend to produce positive responses, they may be more effective in reducing stress, decreasing anxiety, holding attention, and improving mood. Studies in 1979, 1981, and 1986 by Ulrich (Heerwagen 1986) support the effectiveness of natural views. Ulrich found that viewing vegetation and water through slides or movies is more effective in creating psycho-physiological recovery from stress than built scenes without water or vegetation. Also, individuals recovered faster and more completely from a stressful event when exposed to films of natural settings as opposed to urban scenes. Nature group subjects also had lower muscle tension, lower skin conductance, and higher pulse transit along with possibly lower blood pressure from these health differences. Furthermore, Ulrich reported more positive emotional states and wakeful relaxation states for people exposed to natural scenes.

Studies show that windows are highly valued by office workers in the workplace. A survey of office workers (Collins 1975) found that 35% of employees responded instantly that the lack of windows was their biggest difficulty with their office space. The specific reasons given for the dislike of the windowless offices were: “no

daylight, poor ventilation, inability to know about the weather, inability to see out and have a view, feelings of being cooped-up, feelings of isolation and claustrophobia, and feelings of depression and tension.” Another study on the affects of windowless offices supports the findings of the Collins study by stating that employees in windowless buildings had much less job satisfaction and were substantially less positive (Finnegan and Solomon 1981).



**Fig 1:** A conceptual framework setting out the routs by which lighting and can influence human performance. the arrows indicate the direction of the effect. Ref:(Boyce and Rea,2001)

### Windows and occupants mood

The presence of windows reduces the negative mood of the occupants.( Hedge,1994) measured the performance of the occupants in a room lit by different electric lighting systems with and without windows where he found significance improvement in task performance when windows where present. Windows are preferred by occupants because people have negative impression from electric lighting because of its high cost, this impression have been reported by Cuttle (2002).

### **Literature review summery**

Occupant's behaviors affected by the natural lighting. In addition, different aspects such as visual comfort, thermal comfort and natural ventilation play essential role on how and why occupants behave in specific way .Therefore, a serious steps must be taken to raise the efficiency of the spaces to enhance the user experience in a comfortable environment and link the area of opening with special regulation to ensure that every user gain the amount of natural light which will affect on their behavior positively .

### **Methodology**

Mixed method approach was supposed as the most appropriate procedure according to the nature of the research, which embrace qualitative post occupancy evaluation (POE) surveys and qualitative interviews, these techniques provided a deeper understanding of the research problem.

### **Mixed Method Design**

This research followed a consecutive mixed –methods design. The first phase of the study included open- ended interviews with experts in the field, data -bases and literature.

The second phase of the study executed a large-scale survey, which was distributed online via email to individuals who live in residential apartments. Additional quantitative data were collected during the study measuring illumination using lux meter.

In the third phase, documents such as photographs, architectural drawings were collected.

The following sections will discuss the sampling participants and types of data collected in more details.

### **Sampling**

#### ***Target population and research context***

The population of interest of the survey included individuals who live in residential apartments in Jordan, specifically in these three districts (Marka, Abu-Nseir, and Alhashemi).

### **Data Collection**

Both quantitative and qualitative data were collected from 10 residential apartments scattered in Amman(4 building in Abu-Nseir, 3 buildings in Marka and 3 buildings in Alhashemi)

**Measurement**

- In total there were 5 questions in the survey, both open- ended and closed-ended questions were included on the survey. Satisfaction response were assessed through a seven point likert scale, which ranged from " strongly disagree" to " strongly agree".
- Interviews and document collections

The qualitative phase included semi-structured and open-ended interviews, along with collection specific documentation of the research buildings such as architectural documents, plans, maps and photographs. Also the amount of illumination in the living room of each apartment was measured using lux meter.

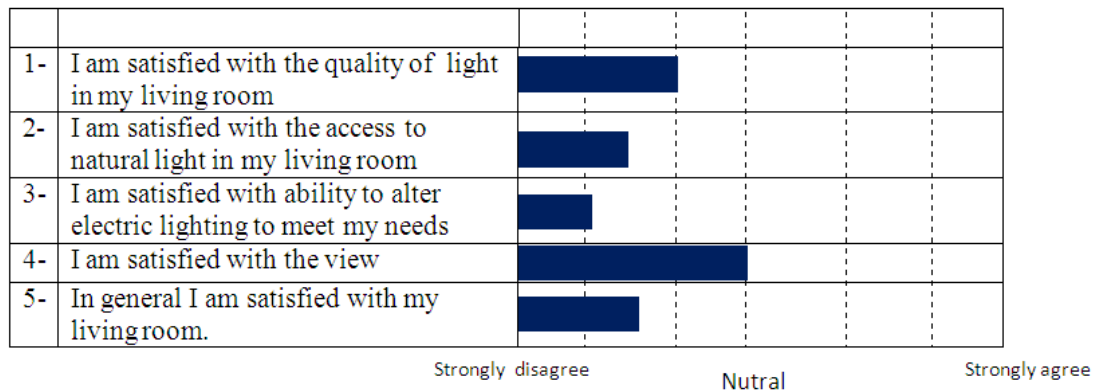
- Measuring the illumination value for the living room spaces in residential apartments.

**Table 1:** Measuring the illumination value for living room spaces in residential apartments. Ref: by author

Region	Building	Measured lumen
Abu-Nseir	Building A	1100
	Building B	1222
	Building C	1180
	Building D	1195
Marka	Building E	1230
	Building F	1280
	Building G	1301
Alhashmi	Building H	1201
	Building I	1200
	Building G	1220
Averag		1212.9
The minimum lumen value recommended for living room spaces =		1430

According to this analysis the amount of the light in living room spaces doesn't reach to the minimum illumination value recommended for living spaces.

- Measuring the occupants satisfaction



### Conclusion and Discussion

This paper examined the relationship between the amounts of natural light in living room space with occupant's satisfaction. According to the analysis for the occupant satisfaction and the measurement of illumination for the living room spaces, the results show that the illumination value does not meet the minimum demands for occupant's satisfaction. In order to upgrade the human comfort and satisfaction, the research found that we could apply the following equations which indicates the relationship between the room area and the opening area  $= (1:10)$  of the room area, this ratio according to hygiene regulation of town hell, Milano(1999), will give the appropriate amount of light for the interior spaces, and if this ratio applied by Greater Amman Municipality in their buildings regulations, most of the occupants will get the appropriate amount of natural light which will increase the spaces efficiency.

### Recommendations for Future Research

There are many opportunities for future researches, it would be ideal if similar study could be repeated with a larger and more random samples and they should also include more information about occupants comfort and satisfaction and examine different factors that affected on the human behavior.

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