EFFECTS OF ARTIFICIAL LIGHT ON HUMAN BEINGS

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By
Danish Azar Zuby MCSD
Interior Design Consultant

What has inspired me to write this paper is a very small incident in a local hospital. It may sound very insignificant but for me it was quite an eye opener. Few months ago, I was under treatment in a small hospital and required an intravenous injection I was brought to a treatment room and directed to lie down on the typical bench. The male nurse, after making his preparations elsewhere came to administer the injection. After piercing the needle several times in my arm and hand he was unable to locate the vein. While I was getting annoyed I noticed that his head and shoulder were creating a deep shadow on my arm because of the location of the florescent light fixture on the ceiling. I made him realize that and moved to a nearby table whereby the light was properly directed on my arm. The same nurse was successful and was able to administer the in the first go.

The nurse was not moved at all with the discovery of faulty location and fixture, and did not take my persuasion seriously. He is probably still doing exactly the same thing the same way, every day. I complained to the concerned administrator but was given a lukewarm response. The whole affair sounds trivial to some of the learned friends but for me it opens up a whole new chapter of “available illumination in our country, the levels and the quality of lighting and the way it can effect us”.

Does the common man who uses lighting extensively, day and night knows enough, better equipped than the educated ones. I have my reservations about that. Are we using the energy that is provided to us intelligently? What are the non visual effects of available illumination, how does it affect our health in general?

The hospital in question was a private one, but what about the civil and general hospitals, what about the school, factories, workshops, our own workplaces in offices? Are they properly lit? Are the level of illumination adequate? Is the light falling in the right direction? A quick glance on the prevalent situation may bring shivers to a professional but a detailed study should, in my opinion, change the direction of our lighting professionals.

An illumination engineer hides his lamps in luminaries/ fixtures or various contraptions. He advises us not to look directly into the light source, but I can say this with great confidence that 90% of the fluorescent tubes installed in our country are exposed directly to the eye. I am sure no one has ever bothered about what this daily dose of ultra violet and other frequencies is doing to us. Go to a marriage hall or a shopping mall and bang! Hundreds of GLS bulbs hanging in bare holders and fluorescent patties, besides creating serious glare problems, are bombarding various frequencies right through your eyes. All that glitters may look nice but the bad effects came later.

In this paper it is not possible for me to quantify the damage done because of poor illumination and absence of lighting awareness or even absence of a lighting counseling or controlling agency but I can say this without exaggeration that the situation is extremely serious.

Although a lot of Buildings and Interiors are handled by practicing architects nowadays but it does not guarantee that the artificial lighting will be done by illumination engineering or even and electrical engineer. Obviously, we all know that we have a problem with availability of able professionals in the country but we must also appreciate that nearly 90% of the built environment is ‘designed and constructed’ by what I call the “informal sector of the built environment”. The bulk of construction does not have an architect or an engineer to direct on the most fundamental decisions.

As far as architectural design is concerned, besides as few able architects, the Engineers, the 'Builders and Developers' are the major contributors, but as far as internal environment is concerned the list of professionals and non-professionals tends to become very long. Interiors are usually done in-house or with the help of some smart lady. The bulk of spaces are completed by managers, furniture designers or suppliers, graphic designers, wallpaper suppliers, skilled craftsmen or Mistri Sahebs etc.

In such a bleak scenario let me also point out that the small percentage of building and construction that do get the attention of a professional builder or architect is mostly deprived of the professional lighting or electrical engineer, with the result that a vast majority of our population is deprived of the benefits of proper illumination. We all know for sure today that lighting can either positively or negatively contribute to the function, sales, efficiency or the aesthetics of any space, yet we have such a tremendous gap in this field.

To take this point a little further please note that the projects that do get a professional electrical engineer not necessarily gets a professional or experienced electrical contractor. The job is mostly awarded to a trustworthy or dependable family electrician. In order to please the client he saves a role of cables or buys sub standard material and the results are quite obvious. (I have in one of my papers claimed that about 80% of the fires in the city are due to electrical faults.)

Can we be bold enough to admit today that we do not posses a single professional "illumination engineer" amongst us or maybe, I am not aware of such a professional. Today lighting engineering is a highly diversified discipline, requiring not only the skills of a lighting engineer, but also those of an architect, the medical and health specialist, the economist, the ergonomist and specialists of various branches of engineering. In addition to knowledge, a great deal of flexibility and creativity is required to solve the many problems associated with the creation of good and economic lighting scheme.

Without light life would be impossible, but with inappropriate light life can be painful and hazardous. Isn't it an irony that, in this part of the world lighting is either completely left out in basic planning or done as an after thought. It is quite embarrassing to sound like a school teacher giving the very basic, the very fundamentals of lighting but I am perturbed to note that simple things like "brightness, levels of light, direction of light, light contrasts, glare problems or the colour rendering of light" are either unknown or remain secondary to a lot of the people in the trade of building and construction.

As there has been no research on the subject in this part of the world it is difficult to say what local problems and health strains have developed due to this bizarre situation. A search of the literature indicates that a person could spend a lifetime reading the reports of research that have already been carried out in the developed world concerning the non visual effects of both natural and artificial light. It is, therefore not intended in this paper to present a brief of the work that has already been carried out but to make a list of problems in general.

GLARE: Glare can cause serous strain on the eye. It is a most common and a familiar phenomenon. It can be caused by excessive luminance values in the field of view, (e.g. as I mentioned before the high wattage lamps (bulbs) in bare holders, hanging form the ceiling in a cloth shop, hitting directly in the eye), or too high luminance contrasts or a combination of both.

There are two types of glare:
Discomfort glare: This is a sensation of annoyance or pain, probably the result of frequent changes in pupil size caused by excessive brightness contrasts. As the name says discomfort glare causes discomfort, does not necessarily impair visibility in extreme cases of glare problems but it can lead impairment of vision.
Disability glare: is a result of interference in the visual process. A frequently occurring form is 'veiling glare', whereby light is dispersed or scattered in the optical system of the eye, notably in the cornea and the lens, to such a degree that a uniform veil is drawn over the retina, for example, if we examine something against a very bright light source of visibility is impaired.

Adaptive glare: is also a disability glare but prolonged exposure to this glare can also leave a strain on the eye, for example headlights of oncoming cars, which is quite common in our case. When high luminance occur in the field of vision, the eye adapts to these luminance values, making it difficult if not impossible to perceive contrasts in darker areas of the field of view. It takes time for the eye to adapt to lower luminance values.

AFTER IMAGE and FLICKER:
After image: Because the visual process in the retina is essentially a photochemical one, it is subject to time lag. This means that, after the visual stimulus is taken away, its effect will persist, in shorter or a long time, depending upon the age and health of the eye.
When, after gazing at a bright or well lit coloured object, one looks away at a relatively neutral surface, 'after image' of the same object, in the same shape and size appear to block the vision. These are of reverse or complimentary colours and brightness and called a "successive contrast". I have no data in hand on the subject but I feel that as the eye is responding to a stressful situation it is bound to have a strain which may not be apparent immediately, but I am sure it effects the health and again of the eye.

Flicker: Light stimuli following each other in rapid succession at regular intervals will cause Flicker. If the frequency of flickering exceeds a certain value, the flickering effect will disappear, and the eye will perceive as a steady light source. The frequency at which this happens is called the "critical fusion frequency" and it depends on the luminance of the light source. It generally lies in the order of 50 fifty periods per second or somewhat more. If we remember our old manual movie projectors, we could see the pictures go by, one by one, on a slow hand movement, as the frequency of each picture was less than twenty four frames per second. Modern projectors present each pictures three times and therefore the result is steady movie.

In an ideal situation the flicker of the common fluorescent tube, energized with 50 HZ ac supply is around one hundred periods per second, therefore it appears as a steady light source. But, this is common knowledge that ours is not an ideal situation as far as available energy is concerned. Dangerous fluctuations of the voltage and a flood of fluorescents is a fact of life.

Flicker at frequencies below the critical fusion frequency may produce very disturbing effects. The brain is trying to follow what is going on, will suffer from a form of overload related to epilepsy, resulting in dizziness and eventually, unconsciousness. Indeed sufferers from epilepsy appear to be more sensitive to this effect.

Stroboscopic Effects: Stroboscopic effects also result from flicker. If a periodically moving object, like a machine part, is illuminated by light flashes of the same frequency as the movement, it will appear to stands still, or move very slowly if the frequencies are different. The flicker of a fluorescent tube can produce this effect under certain circumstances, and thus produce a potentially dangerous situation.

Toxic effects: Modern lamp manufacturing involves the use of wide range of elements and compounds, some of which in sufficient concentration could be detrimental to the health of the human beings or the environment. Potentially toxic materials are found in the fillings of discharge lamps and fluorescent powders. One must take care when disposing off used lamps. Sodium, although extremely aggressive as an element, leaves no toxic residue behind. However when brought into contact with water, it reacts violently and combustion may be spontaneous. Utmost care should therefore be exercised when disposing low pressure sodium lamps.

ULTRA VIOLET and INFRA RED RADIATIONS: As the name suggests these radiations which are known as 'radiant heat' and 'Actinic radiations' lie on both sides of the visible spectrum which is approximately:

100nm to 360nm	Ultra violet	
360nm to 780nm	visible spectrum	(LIGHT)
780nm to 10,000nm	Infra red	

The adverse effects from the available quantities of UV in gas discharge lamps e.g. fluorescent tube, has been debated several times in the west and many articles have been published on the same. Some have gone as far to call the radiation from the lamp sources as “sick’ rays while the major manufacturers conducting their own research claim that the amount of harmful radiation that one gets from artificial lighting in many months is equal to a few moments of the sunlight exposure staying outdoors. However it is generally agreed that the prolonged exposure to radiations on the limits of the visible spectrum can be detrimental to the health.
Exposure to ultra violet radiation involves potential health risks. The actual effect depends on the radiation levels, the duration, and part of the body that is exposed. Moderate exposure causes tenderness and Redding, whereas grossly excessive doses may cause blistering or even bleeding. The effect is called “Erythema” and can be very painful. The defense mechanism of the skin against Erythema is Tanning. Long term exposure to UV results in premature aging of the skin and increases risk of skin cancer. The latter condition is prevalent among people, especially with a fair skin, who spend most of their life outdoors, or who live in hot climate.
The eye is the part of body most at risk from UV. Short term effects are inflammation of the cornea, or the inflammation of the cornea, or the inflammation of the conjunctiva and in severe cases detachment of the retina. Retinal damage is more easily sustained if the UV radiation is not accompanied by visible radiation, because the pupil does not contract in response to high intensity UV.

The effects of IR radiation on humans and animals are normally of a purely thermal nature. In contrast with UV radiation, where the harmful effects, in the form of Erythema, will only be noticed after a considerable time, any over heating or burning of the skin due to IR will provoke an immediate and violet response which is normally quite sufficient to prevent further damage. However the eye is more susceptible than the skin to high intensity short wave IR. Permanent damage will only result, however, from prolonged exposure and serious risk is therefore restricted to a small number of specialist workers, such as glass blowers an arch welders.

In light of above my resolution for this occasion is
To increase general awareness of lighting among the masses, to raise the LIGHT Literacy among people via the print and the electronic media. To design lighting keeping in the health factors, for example utilize proper luminaries (fixtures) for lamps, and make use of indirect lighting or Uplighting wherever possible, change the fluorescent on expiry of its life hours etc. To initiate local research on energy and illumination matters with regard to general health of the public as soon as possible.

Danish Azar Zuby
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