

ISSN 1339-5270 (print) ♦ 2453-9813 (on-line)

# LINKING OF DAYLIGHT EFFECTS AND HUMAN HEALTH

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#### ABSTRACT

Historically people only ever worked outdoors; two hundred years ago 75% of the population worked outdoors, now less than 10% of the population work in natural outdoor light. Whilst this is fine in the summer months when there are longer daylight hours, in the winter months, people tend to go to work in the dark and go home in the dark and don't get to enough natural daylight. Nowadays, we spend much time in rooms, where only the artificial light and no daylight are present. During the day is lack the daylight and during the night is lack the normal darkness. This article deals with influence of shortage natural /day light at human psychic and describes chances, how we can prevent this one negative influence. There is showed on the crucial positive impact of natural daylight for visual and psychological comfort of man. One from options of appropriate lighting for positive seeing is using so-called SAD lamps, marks as healthy light.

**KEY WORDS:** SAD (Seasonal Affective Disorde), lighting, daylight, circadian stimulus, lamps.

#### Introduction

Day light is natural and inseparable part of human life and its influence reaches so far beyond function center of visual perception. Humans organism adapts during millennium on natural alternation of light and darkness. With appearance of artificial light source, their development and expand began change life style and human began to "extend" a day and "shorten" a night. Centuries have passed without that someone has seriously dealt with the idea if are the hits to natural bio – rhythm and manner of life, on who was humane organism ever before adapted, haven't got negative influence at its psychic and physically comfort.

Daylighting is the art and science of managing natural light to minimize the use of artificial lighting, reduce carbon emissions, and positively affect the performance, mood, well being and health of people of any space[4]. Designing, predicting, and planning for the impact of daylighting in a space is often misunderstood and underestimated. When lights dim using daylight harvesting we are saving over 30% of energy, Fig.1.



*Fig. 1. Energy saving daylighting[11]* 

#### Effects of day light on human body

Results from last years approve that day light effects to right behaviour of human apparatus and their mutual combination, its results general salutary condition of human body. Human recieves light and humans body needs it for important life processes. The light has 3 features [10]:

- Visual functions adaptation of visual impulses and perceptions.
- Sence system percepcion, as sence of visual discomfort and common sence of environment.
- Non-visual functions needed to protect biological processes in organism and general physic condition of human body.



2016, Number 7, Volume 4, date of issue 30th Juni 2016

ISSN 1339-5270 (print) 2453-9813 (on-line)

Scientific study showed the crucial positive impact of natural daylight for visual and psychological comfort of workers [5]. Therefore, its availability in areas where people spends most of the time, extremely desirable. The role of artificial light is to fulfill its complementary function, or replace it where is completely absent. It is therefore important in the design space full advantage of the availability of natural light and the artificial light to adapt the properties as much as possible as daylight [14].



Fig. 2. The effect of daylight on human body [14]

Researchers now tell that a disrupted circadian system is connected to a whole host of long-term health and behavioral problems: fatigue, cancer, obesity, diabetes, depression, mood and sleep disorders, reduced physical and mental performance, reduced productivity and irritability are all related in some shape or form to a circadian system that isn't functioning the way it's supposed to.



Fig. 3. The Circadian clock [15]

### Seasonal Affective Disorder

Pro affection caused by lack of daily light oneself utilizes marking Seasonal Affective Disorder (SAD). Be those so called hibernal depression involved thereby that the during shorter winter days humane organism don't get its usual batch daily (sunny) light. By one of frequent extrinsic characteristic is psychic depression. Others sign are raising slowness, reduced work capacity, raising body weight, static concentration et cetera.

Last years were developing important research activity destined to comparisons effects daily and artificial light on human. Photobiology is the scientific study of the interactions of light and living organisms. Modern science photobiology oneself dealt scientific by studying effects light on humane organism. Relatively much studio is devoted uses light on treatment SAD, that it's a type of depression which occurs when you develop symptoms of depression during the darker winter months each year. Winter blues or sub-syndromal SAD (S-SAD) is a less severe form of the condition. Perhaps as many as 12-13% of people have S-SAD names winter blues. SAD is less common in countries near to the equator where the hours of sunlight are more constant and bright throughout the year. Estimates oneself that the winter depressions as SAD are affected 4- 6% population mostly from Nordic land, and at of other 10- 20% population oneself occurring mild form SAD referred to as how hibernal melancholia. SAD usually first begins between the ages of 20 to 30, but it can develop at any age. It affects four times as many women as men. For hygienically practice is terminative physiological and psychological response human on concrete load [9]. Notable responses on load is tiredness (Fig.4).



2016, Number 7, Volume 4, date of issue 30<sup>th</sup> Juni 2016

### ISSN 1339-5270 (print) 2453-9813 (on-line)



Fig.4 Division tiredness

For general valuation tiredness maybe use different division [8]:

- Most widely known criteria is division tiredness on detached and subjective. Detached tiredness oneself manifests
  measurable reduced qualities and quantity performance and in the metergasia organism (physiological process of).
  Subjective tiredness oneself projects in feeling tiredness wanness (psychological process of). Feeling tiredness gives
  the first one message by over loaded organism. May await that the chronognosis tiredness oneself needn't cover with
  detached tiredness.
- Another criteria for valuation tiredness is classify into local and wholes tiredness. Local tiredness concerns only individual organs (eye, arm) and come into being by the its long term loaded. General tiredness (generalized) oneself concerns entire organism.
- The other criteria is division on working and nonwork tiredness. In the event chronic difficulty workers is possibly and cumulation working and nonwork tiredness (e.g., gave activities at home by the computer et al).

SAD oneself gives in connections with impaired balance between melatoninom and setotoninom. Numerous published studies have linked the lower levels of light in the autumn and winter to tiredness, overeating, low moods and social withdrawal. From results of the questionary surveys linked that 79% of people are less productive or are less energised in winter, Figure 5. [16]



Fig. 5. Impact winter months on people – percentage rate [16]

### **Circadian stimulus**

Many people find that bright light therapy helps to improve their symptoms of SAD. It is generally agreed by doctors that there is a good chance that light therapy can improve symptoms if you have SAD. Most frequently used light source pro treatment SAD is spectral fluorescent lamp, which produces light with 2000 lux, what oneself equal about fifty tenths brightness sunny summer day. Aunts sources can fashion lighting corpuscle as are lamp on reading. Special apparatuses used at phototherapy make it develop brightness equivalent 10 000 lux, whereby reduce time necessary to treatment up - to for half an hour daily [10]. In the last few years LED light boxes for the treatment of seasonal affective disorder have been proven to be just as effective as traditional SAD light devices (lamps).

Besides symptom SAD is also apt for problems of connection with repression temporal shifts, shift work - without having straight daily light, seasonal changes and tiredness [1, 2]. To help optimize the light design process, designers need for the



2016, Number 7, Volume 4, date of issue 30<sup>th</sup> Juni 2016

ISSN 1339-5270 (print) 2453-9813 (on-line)

decision the impact of lighting design on the circadian light resource to analyze moreover. Methodological procedure is shown on Figure 6. [7]



Fig.6. Design process physiological and functional aspects of lighting solutions

#### Calculator of circadian stimulus

Biological rhythms that repeat approximately every 24 hours are called circadian rhythms. Light is the main stimulus that helps the circadian clock, and thus circadian rhythms, keep a synchronized rhythm with the 24-hour day. If lack of synchrony or circadian disruption occurs, we may experience decrements in physiological functions, neuro-behavioral performance, and sleep. Definition of cirkadianne effective radiation be in years 2000 - 2001 was ahead into the bargain, that being today possible to at full length define ground claim to SAD, their marking and measure are in follow table (Tab.1) [3].

Marking	Unit	Name
CS	[-]	circadian stimulus
CL <sub>A</sub>	[lx]	calculated circadian light (cirkadianne effective lighting)
Ev	[lx]	vertical (≈ corneal) illuminance
E <sub>H</sub>	[lx]	illuminance at the eye on the workplane (not just horizontal illuminance)
ССТ	[K]	correlated colour temperature
SPD	[-,-]	Spectral Power Distribution

Table 1. Key parameters for SAD

Lighting characteristics that are effective to the circadian system are different than those effective to the visual system. In order to apply light to mitigate symptoms of depression, jet lag, or sleep deprivation, we need understanding of the quantity, spectrum, timing, duration, and distribution of light that is effective for the circadian system. The website: *http://lightingpatternsforhealthybuildings.org/* assists lighting designers and specifiers in selecting quality lighting that supports healthy living. Designed in the spirit of traditional architectural pattern books, it presents model designs for typical rooms that can be adapted to specific buildings and styles [13].

The patterns are based upon the 24-hour lighting scheme for older adults proposed by Mariana Figueiro in 2008, which recommends cycled electric lighting with cool, high light levels for high circadian stimulation during the daytime, and warm, low light levels for reduced circadian stimulation in the evening, along with good lighting for visibility, and nightlights to provide horizontal/vertical cues to improve postural control and stability. This website allows users to view lighting patterns showing base case and new lighting design analyzed for CS (circadian stimulus). Each pattern presents lighting plans, renderings, and generic luminaire information useful for providing healthy lighting throughout the day [11].

The LRC developed a calculator to determine CS for any combination of source type and light level in photopic lux. This tool was designed to help lighting professionals select light sources and targeted photopic light levels that will increase the potential for circadian light exposure in a building. The calculator is available on webside:

*http://www.lrc.rpi.edu/resources/CircadianStimulusCalculator\_30Apr2016* [12] (this link will directly download a Microsoft Excel file), see Figure 7.



2016, Number 7, Volume 4, date of issue 30<sup>th</sup> Juni 2016

### ISSN 1339-5270 (print) ♦ 2453-9813 (on-line)



Fig. 7. Circadian Stimulus Calculator [12]

#### Conclusion

Bearing, which is to natural light on humane organism far exceeds his exerted and traditional feature as a means of pro visual perception. His shortage leads to cut - down not only visual, but also wholes psychic amenities human, what manner results in a quite a number of negative, namely away from the cut - down working performance and concentration, pending depressively construction sequence cases. One from options such as this one prevent is apply convenient lamp SAD and reach some positively results in relatively short era. On the other hand oneself can we as far back as the youth proposal lighting system dealt thereby, that result was she not only lighting system with satisfactory and specified illumination intensity, but also level lighting with suitable photo - biological effect.

Daylighting is the art and science of managing natural light to minimize the use of artificial lighting, reduce carbon emissions, and positively affect the performance, mood and well being of occupants of any space. Designing, predicting, and planning for the impact of daylighting in a space is often misunderstood. This article provides a basic introduction to designing lighting to help designers create lighting plans that deliver prescribed amounts of CS throughout the workday also addressing to management of companies to create a vital intersection of aesthetics, functionality and health.

### Acknowledgments

The research in this paper was supported by a grant "Research of influence of chosen parameters of working environment on working power and productivity" VEGA – No 1/0537/2015 (50%) and project "Transfer of knowlledge from scientific-researche activities into multimedial education process in the subject "Environment and manufacturing" KEGA – No 048TUKE - 4/2015 (50%).

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2016, Number 7, Volume 4, date of issue 30<sup>th</sup> Juni 2016

ISSN 1339-5270 (print) ♦ 2453-9813 (on-line)

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