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LIGHT SECURITY

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Abstract: *Light has a dual nature. On the one hand, it represents a flow of photons that have a corpuscular character, and on the other hand, it has a wave character, as part of electromagnetic radiation. Natural light is an energy source of the living environment. Natural day and night light has an essential role in the biological development of people and representatives of living nature. It satisfies all physiological needs for human development. The lack of light leads to disturbances in the biological development of living organisms, in their physiological and psychological satisfaction. Its insufficiency also leads to violation of security requirements. The purpose of the present work is to bring light into the general context of Security, by formulating the content of Light Security as the highest level in the hierarchy of Light Organization.*

Keywords: *Light Security, Abraham Maslow's 5-level hierarchical system, Risks, Light Organization, Light Pollution; Light Environment.*

INTRODUCTION

Light has a dual nature. On the one hand, it represents a flow of photons that have a corpuscular character, and on the other hand, it has a wave character, as part of electromagnetic radiation. Natural light is an energy source of the living environment. Natural day and night light has an essential role in the biological development of people and representatives of living nature. It satisfies all physiological needs for human development.

Artificial light complements and/or replaces natural light in all quantitative and qualitative indicators of natural light. In addition, artificial light is a source of information, providing conditions for the emergence of a communication environment through the transmission of data via optical fibers and wireless technology “Li-Fi” (“Ligh-Fidelity”). Last but not least, artificial light is an element related to providing the necessary conditions for people's life and work, and it also has a certain relation to the biological development.

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EXPOSITION

A. The “Light Security” concept in the context of the Safety and Security needs.

Requirements for Lighting Security

The satisfaction of “Physiological needs”, occupying the first hierarchical level in the 5-level hierarchical system of the American psychologist *Abraham Maslow* (Fig.1), (Maslow, A. H.,1943), is related to the biological requirements for human survival. The classic scheme of human needs from the *first level of Maslow's system* includes the following components: air, food, water, shelter, warmth, clothing, sex, rest (Maslow, A. H., 1943). The present report proposes the inclusion of a new need, the overlooked *Light*, among the Physiological needs of the first hierarchical level (Fig.1).

The need for security is inherent in man. It falls into the second level of basic human needs, formulated in *Abraham Maslow's 5-level hierarchical system* (Fig.1), (Maslow, A. H., 1943). Security is a functional condition of a system in which there is no threat (State commission on information security).

Security contains a group of subsystem elements to which "*Light Security*" belongs. Sometimes, significant horizontal interrelationships, interactions, interdependencies occurs between Light Security and other subsystem elements of security (incl. Energy Security, Social Security, Ecological Security, Economic Security, Political Security, etc.).

In the context of the "Security" concept, the following definition of "*Light Security*" is proposed: Light Security is a set of conditions, actions, processes and factors that ensure a stable functional condition of the light environment formed by natural, artificial and mixed light for:

- (1) ensuring a healthy psycho-physiological impact of light on the human organism;
- (2) ensuring nature-friendly impact and development of the representatives of living nature;
- (3) continuous satisfaction of the needs of light in adequate quantity and quality, by place and time;
- (4) continuous satisfaction of the needs of light for visual information of the surrounding environment and its components;
- (5) continuous satisfaction of the needs of light for the realization of visual communication;
- (6) continuous satisfaction of the needs of light under any circumstances, incl. in case of emergency, disasters, accidents, terrorism, other circumstances;
- (7) continuous satisfaction of the needs of light according to the purpose: productivity and quality of work;
- (8) continuous satisfaction of the needs of light for educational activities;
- (9) continuous satisfaction of the needs of light for activities in the field of culture and art (including public activities);
- (10) continuous satisfaction of the needs of light to provide people with safety conditions for rest;
- (11) continuous satisfaction of the needs of light in the conditions for work activities;
- (12) continuous satisfaction of the needs of light for mobile safety (road, air, shipping, space objects).
- (13) protection from harmful effects of light on people, representatives of living nature, incl. environment.
- (14) availability of light, as a factor of the quality of life, without light poverty.



Fig.1. Pyramidal hierarchical model of the needs according to Abraham Maslow, adding the need of Light and Light Security.

Light Security is represented by several levels, depending on the scope: Global Light Security; European Lighting Security; National Lighting Security; Regional Lighting Security; Local Light Security; Group Light Security (of specific groups of people); Individual Light Security (of the individual). In the most general sense, Light Security implies the fulfillment of the requirements given in Table. 1.

Table 1. Requirements for Light Security

Requirements	Description
LIGHTING SYSTEMS. LIGHTING TECHNIQUES AND TECHNOLOGIES	Realization of lighting systems built with an adequate lighting technical element base, according to the regulatory requirements (international, European, national, etc.). Implementation of lighting systems by providing adequate values of the quantitative and qualitative indicators of lighting.
HEALTH AND SAFETY CONDITIONS OF THE ENVIRONMENT, WORK ENVIRONMENT, HOME, TRAFFIC	Ensuring people's visual comfort and safety. Ensuring optimal working conditions. Ensuring conditions for safe mobility (road traffic, air traffic, shipping, space, others). Avoiding contamination with hazardous waste, light pollution, radiation, acoustic noise, harmful fumes, other harmful effects.
CONTINUITY OF SUPPLY WITH QUALITY ELECTRICITY	Provision of light through artificial lighting systems based on electrical energy supply. Providing artificial light through the application of energy-efficient lighting systems. Maximum use of daylight. Satisfying of the needs of light through the application of photovoltaic systems (e.g., autonomous light photovoltaic modules for outdoor lighting and outdoor light signaling); The use of back-up power units.
AVAILABILITY OF LIGHTING SYSTEMS	Avoiding energy and light poverty. Application of innovative light sources and lighting solutions. Ensuring affordability for payment of electricity costs and the costs of repair and maintenance of the lighting systems.
OPERATIONAL STABILITY OF LIGHTING SYSTEMS	Maintaining the values of the quantitative and qualitative lighting technical indicators and the energy-economic indicators at stable conditions - until the end of the life cycle of the lighting systems as whole and their technical components. Ensuring the operational stability of lighting systems to atmospheric effects, to mechanical effects (e.g. vibrations), to aggressive environments and others.
RATIONAL BALANCE "BENEFIT/DAMAGE"	Satisfying of the human needs of light through the functionality, aesthetic and emotional impact of lighting systems. Ensuring the necessary quality of life, including ensuring health conditions; ensuring safety of people, optimal working conditions (exclusion of light poverty in human activities). Limiting the harmful effects of light and lighting systems.

B. The "Light Security" concept in the hierarchical model of the Light Organization

The systemology of lighting technology and lighting design operates with a hierarchical structure following the development of the Light Organization (Kyuchukov T., (2023 b). The present report proposes *an evolutionary step* of the pyramidal model of the Light Organization, including a base level (Light) and five hierarchical levels represented in Fig. 2, (Kyuchukov T., (2016, 2019).

In the model, the *"Light Security"* takes the highest hierarchical level. The place of Lighting Security in the Light Organization's model forms a complete hierarchical structure corresponding to the overall systemic lighting organization, achieving logical consistency and coherence.

Light conditions are a component of the quality of life, and light is the civilizational choice of people. Light scattering is a relatively new phenomenon that has a direct impact on humans and living nature. Also known as "Light Pollution", the scattering of artificial light is generated to the sky and the surrounding space - it is uncontrolled, unlimited, and in many cases even aimlessly overdosed (Kyuchukov T.,2023 a).

As a result, Light Pollution leads to harmful effects of light on people and living nature. "Light Security" implies the prevention of the harmful effects of light on people and representatives of living nature with the implementation of measures to limit the scattering of light to the sky and the surrounding space.

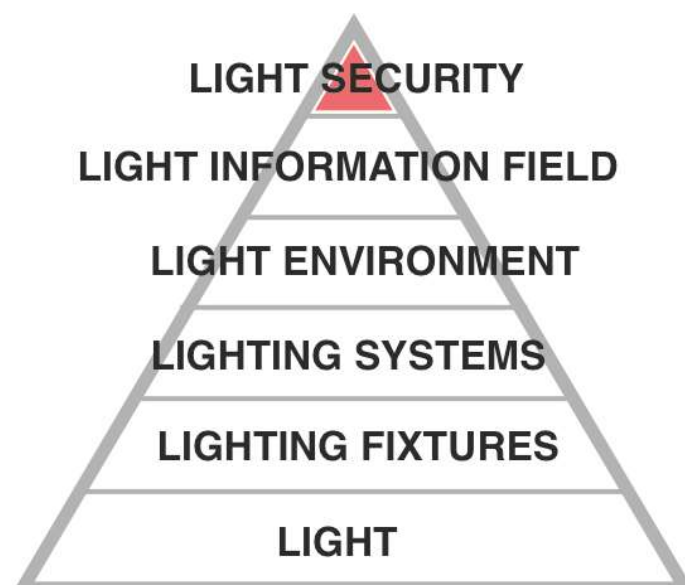


Fig. 2. Hierarchical model of Light Organization

C. Light Security. Risks in lighting systems

Table 2 systematizes the risk conditions in lighting systems.

Table 2. Risk conditions in lighting systems

Risks	Description
RISK OF NOT LIMITING THE AVAILABILITY OF LIGHT	Conditions in which the quantitative and qualitative values of the used artificial light unreasonably exceeding the norms. There is a presence of light pollution (scattering of light towards the sky and the surrounding space); light poisoning - underestimating the harmful effects of light. Occurrence of obtrusive light from street, advertising and architectural lighting that gets through the windows of residential buildings.
RISKS IN DESIGNING LIGHTING SYSTEMS	In a number of cases there are incorrectly selected quantitative and qualitative values of the artificial light indicators; the indicators are set with values that are smaller or significantly greater than the norms (including incorrectly lighting calculations). In a number of cases there is inadequate management of lighting systems with incorrectly programmed functions.
RISKS IN THE CONSTRUCTION AND OPERATION OF LIGHTING SYSTEMS	In practice, there are several cases in which people with little or no practical experience in the field of lighting technology, lighting design and energetics incorrectly evaluate and confidently put into operation several unprofessional lighting projects. In addition, the installation of lighting products often does not correspond to the original design's characteristics resulting in the use of low-quality lighting products. Light sources are used after their normal service life.
RISKS OF LIGHTING OFF	In lighting engineering practice, there are cases in which the artificial lighting is suddenly (without warning) turned off. The reasons come down to a power outage; damage to light sources (out-of-service light sources); vandalism; others. As a result of the light poverty, there is an increase of the number of accidents.
RISKS IN THE PERCEPTION OF VISUAL INFORMATION	As a result of the visual illusions, a person tends to perceive visual information incorrectly, which in some cases leads to danger. Age is also important - with increasing age, there are certain disorders in the human eyes functioning (accommodation, color anomaly, etc.).
RISKS IN THE CONDITION OF MIXED LIGHTING	Daytime natural light can be limited due to dense cloud cover, dust cover, fires, and other reasons. The risks of mixed lighting are associated with poor design, management and operation of lighting openings and poor sun

	protection devices. Violations occur in the joint action of natural and artificial light in case of insufficient natural light, poor quality management of the artificial lighting that supplements the natural light. In some cases that leads to violation of the circadian rhythms (natural biodynamics).
HAZARDOUS WASTE RISKS FROM OUT-OF-USE LIGHT SOURCES	Hazardous waste (such as mercury, luminophores, etc.) from out-of-use light sources (including metals, plastics, glass, etc.) is well known in lighting engineering practice.

CONCLUSION

The present work represents the Light as a significant component of the Physiological human needs following the Abraham Maslow's model. In the same model Light Security is presented as a subsystem element of the Safety and Security human needs. There also has been proposed a concept dedicated to the Light Security included in the Light Organization hierarchical model. The lighting requirements and risk assessment of Lighting Security have been formulated.

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