Importance of DAYLIGHT

AMRAN BIN ATAN

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AMRAN BIN ATAN

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AMRAN BIN ATAN

Preface

This book covers and explores learning creatively regarding the sub-topics in Chapter 2. It highlights the importance of daylight for humans and homes. Among the important contents of this ebook are the basic physics of light, the importance of natural light for humans, the impact of daylight on human vision, mental and physical, and the effect of light on health. This book also explains a little bit about daylighting in buildings. The information presented in this book is part of research activities that focus on the importance of daylight for humans and homes. The content of this book is part of knowledge sharing and can be referred to by the general public in raising awareness about the importance of daylight that has an impact on humans. It can also be used as a reference by architecture students and anyone involved in the construction and architecture industry.

AMRAN BIN ATAN (PhD) is an architecture lecturer at Politeknik Merlimau Melaka. Has a Doctor of Philosophy in Architecture, a Master of Science in Architecture from UKM, and a Bachelor of Design (Architecture) from UPM. Has expertise in building lighting and software related to lighting simulation. He is also active as a freelance artist in graphic design and fine (expressionism) national art at and international level.

Author

Senior Lecturer Architecture

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IMPORTANCE OF DAYLIGHT

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Basic Physics of Light



Physics of Light





The spectrum can be detected visually by the sense of sight or the human eye as a colour. Source: Socratic.org

LIGHT is energy in the form of waves and helps us see. The speed of light in a vacuum is 299,792,458 meters per second, meaning that a beam of light can travel a distance of one meter in 1/299,792,458 seconds. Light is electromagnetic radiation that can be detected and seen by the human eye. Light is energy the form of in electromagnetic waves with a wavelength of 380-750 around nanometers (nm). In physics too, light consists of packets of particles called photons. The two properties that light exhibits cause it to be associated with wave-particle dualism. A packet of light called the spectrum can be detected visually by the sense of sight or the human eye as color. The science of physics that is specific to light and human vision is known as optical physics.



Let's listen and talk





- The speed of light is measured in units of
- Q2 Light is energy in the form of waves and is rated in units of



Q3 Physical s<u>cience that specializ</u>es in light also known as

Y9WSNA

optical physics nanometers meters per second **Electromagnetic** Radiation

The Importance of Natural Light for Humans



Natural Light for Humans

2



NATURAL LIGHT is the earliest and most important source of light in influencing human life. This light is obtained from a natural source that is the sun and is very important in fulfilling human needs through biological reactions. According to McCloud (1995) when the sky is clear, sunlight can radiate light to the earth's surface with a complete spectrum as well as light colors in a balanced spectrum that produces a certain amount of white light that cannot be produced by artificial light. Natural light helps a lot in biological processes on Earth.

The process of day and night events due to the rotation of the earth greatly affects the daily activities of humans as well as helping biological processes naturally. This is because natural light supplies several light waves that are complete and essential for the human body to stay healthy and function well. These light waves cannot be obtained from artificial light or electricity. Therefore humans need to get exposure to daylight or natural light for a certain period every day such as doing leisure activities in the park or the like (Figure 1).

Holick (2009) asserts that the content in natural or daylight radiation cannot be found in artificial light and plays a very important role in helping very complex biological processes in the human body. He also explained that through this process natural light from the sun will be filtered by the skin of the human body and produce vitamin 'D' which aims to produce various side vitamins and help improve the human body's immune system against diseases such as cancer and life stress. McMenemy (2010) also stated that the natural light received by the body at an optimal amount can help the mental and physical development of individuals.

Daylight from the sun has certain properties that can benefit human life as well as other living creatures on earth. The properties of daylight are light that travels straight in all directions. The proof is that we can see the scattering of daylight entering through an open space in a dark room.



When light is blocked, shadows will be produced due to the light moving in a straight line and not deflected. However, daylight can also be reflected by reflective surfaces such as mirrors. This phenomenon is called light reflection. McMenemy (2010) has proven that daylight received by the body in sufficient or optimal amounts can help the mental and physical development of individuals. Lack of daylight and natural ventilation through an opening in the building can cause a deterioration in the quality of the interior space and further lead to various issues related to human health or the occupants such as sick building syndrome (Ibyyeye et al). 2014).





FIGURE 1 Exposure to natural light for a certain period during the day is important for human health.

Let's listen and talk





Light is obtained from renewable sources so that is the sun.



McMenemy (2010), states natural light received by the body in total that is optimal can help the development of **mental** and **physical of the individuals**.



Deficiency in the amount of daylight affects the health of the people who live there, such as **sick building syndrome**.







"...to produce various side vitamins and help improve the human body's immune system against diseases such as cancer and life stress."

- 1. The statement on the side refers to the author _____.
- 2. Light waves _____ obtained from artificial light or electricity.
- 3. The properties of daylight are







Atan. A. dan Nik Ibrahim, N. L. 2018. Daylighting Simulation of Different Light Well Types in Single Storey Terrace Houses. ALAM CIPTA -International Journal of Sustainable Tropical Design Research and Practice. Serdang: Penerbit Universiti Putra Malaysia.

Boylan 1987. The Lighting Primer. Ames: Iowa State University Cambridge International Dictionary of English, Cambridge (1995): Cambridge University Press.

The Impact of Daylight on Human Vision



Human Vision

3



Openings in buildings play an important role in influencing the effectiveness of natural ventilation and daylighting in buildings. It has a very important impact on the interior space of the building and can determine whether the comfort of the interior space is guaranteed or not. Veitch and Newsham (1996) found that the quality of daylight in the building can affect work performance, social interaction, communication, health, safety, visual comfort, behavior, and aesthetic judgment of the occupants.

The importance of daylight or natural lighting is closely related to the level of effectiveness of human vision. This is because the correct daylighting technique or method will supply sufficient light and is important for the comfort and effectiveness of human vision to perform certain tasks. Veitch and Newsham (1996) explained that human visual responses tend to be more accurate and faster in daylight compared to artificial light of the same intensity or rate. However, this situation depends on the quantity and quality of daylight and both aspects are closely related to the climate and geographical position of the area.



Let's listen and talk



Human visual responses tend to be more accurate and faster in daylight than in artificial light. Proper daylighting techniques will provide sufficient light and are essential for the comfort and effectiveness of human vision. The quality of daylight influences work performance, social interaction, communication, health, safety, visual comfort, behavior, and aesthetic considerations.



SUN GLARE Can Damage Your Eyes

UV Exposure Can Cause Short & Long Term Risks



Effects of sunlight on the eyes <u>Source: Dr. Manoj Abraham</u>

The Impact of Daylight on Human Mental and Physical



Human Mental and Physical



Let's read.

McMenemy (2010) states that the optimal amount and quality of natural light can help the mental, physical, and communicative development of humans. This can be explained through the composition of the spectrum that can be seen from a simple experimental method, which is by emitting different light sources through a glass prism. The light spectrum composition of light bulbs is the closest to daylight compared to fluorescent lights which have an unstable composition for the biological processes of the human body according to McCloud (1995).

Effective daylight filtering can have a positive effect on biological activity in the human body. Under- or over-exposure to daylight is likely to affect human health and safety. Fischer (2009) has highlighted the issue of the amount and quality of light required by the human body system. The actual amount or rate of daylight required by the body system in a day is difficult to determine precisely as Fischer (2009) said.

However, the quality of the light received taking into account the spectral composition found in the light is the most important aspect. He also explained that the spectrum emitted in the early morning by daylight can influence the body's biological system to start the next activity and help the formation of cells at night. This matter is also supported by Kramer (2009) who explains that violet (ultraviolet) and infrared (infrared) radiation with a balanced and continuous amount is very necessary for the body regardless of whether the source is daylight or artificial light. In other words, he also suggested that during the day, daylight should not be filtered by semi-transparent glass windows to allow the process of receiving radiation or a balanced beam of light to occur on the human body.

Campbell (2006) explained that the important thing needed by the body is not the amount of time the skin or eyes are exposed to daylight, but the amount of light radiation that is emitted to the human body, that is to the skin and the sense of sight. According to him, purple light (ultraviolet) that exists in daylight from the sun with a range of 405-420 nanometers (nm) is capable of killing bacteria. The application of this violet light, if continued for three days, can reduce the amount of bacteria in the pores of the human body by 99.9 percent.

Let's read.



Holick (2009) showed that the source of vitamin D that comes from daylight that reacts with body systems such as the skin is very important to human health. The lack of exposure to daylight results in health complications and the body's immunization due to lack of vitamin D. According to him, if explained scientifically, when the process of vitamin D is accepted by the skin and accepted as a human diet, the process will involve the liver and kidneys. Through this process, the two elements of vitamin D used by medical experts as parameters for measuring vitamin D in the body are hydroxyvitamin D and dihydroxyvitamin D. The imbalance of the two elements results in instability in the blood.

Holick (2009) also explained that babies in the first year need vitamin D every day. The same goes for babies over one year old. For adults, the minimum amount of vitamin D needed per day depends on the amount of daylight available in each geographical location. He also explained that a lack of vitamin D in babies will result in stunted growth. This problem can occur when there is a lack of exposure to daylight.

For adults, vitamin D deficiency is detected when there is a lack of exposure to daylight due to a lack of activity outside the building. A similar biological effect can be seen in children when there is less exposure to daylight. Daylighting through building openings such as windows and light wells can go a long way in addressing this problem. In designing the opening in the building, it is necessary to consider exposure to sufficient daylight and at an appropriate rate for the occupants. Figure 2 shows a space with insufficient lighting.





FIGURE 2 shows a space with insufficient lighting. Vision becomes blurred and activity is limited.

Let's listen and talk.





The important thing needed by the body is not the amount of time the skin or eyes are exposed to daylight, but the amount of light radiation that is emitted to the human body, that is to the skin and the sense of sight.



Effective daylight filtering can have a positive effect on biological activity in the human body.



The spectrum emitted in the early morning by daylight can influence the body's biological system and help the formation of cells at night.





Physical and Mental Health During Changing Seasons Published in Leeds International Study Centre



Find FIVE (5) Hidden Words

А	В	Α	W	D	A	Е	F	Α	Н	Α
Ι	J	Α	К	Α	С	Ν	Μ	Α	0	Ρ
Α	D	Α	Y	L	Ι	G	Н	Т	Q	Α
Α	R	S	Μ	Α	Т	U	V	Н	W	Α
Х	А	S	Ρ	Ε	С	Т	R	U	Μ	Y
Α	Ζ	Α	В	С	Ν	D	W	Μ	Ε	F
G	Η	Ι	J	К	Α	Т	L	А	Μ	Ν
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W	Ρ	Н	Y	S	Ι	С	А	L	Α	V



5



Answer

Find FIVE (5) Hidden Words

٨	A	J	A	Э		S	Y	Н	Р	M
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A	Н	A	Н	Π	A	D	M	A	В	A

The Impact of Daylight on Health



Daylight on Health

Let's read.



Hollick (2009) and Godar et al. (2008) have linked lack of exposure to daylight with cancer. Cutaneous Malignant Melanoma (CMM) is an element in the human body system that is the cause of dangerous cancer. A comparison was made between workers inside a building who only received light from windows and workers outside a building who were exposed to daylight radiation.

Workers in enclosed buildings usually only receive daylight from limited window openings after that light is filtered by material specifications from glazed windows and filtering elements such as curtains (Figure 2.2). Studies by Hollick (2009) and Godar et al. (2008) found that the skin of workers in buildings that do not receive radiation from daylight necessary for the formation of vitamin D can result in an increase in Cutaneous Malignant Melanoma (CMM) which has the potential to result in cancer.

Light greatly affects human behavior at night. Wirz-Justice (2009) explains the importance of daylight on the human body system. He explained about the amount of light waves received during the day and its influence on the production of melatonin which helps the sleep process at night. This raises the issue of day and night and its influence on human biological processes. The simple concept highlighted is the reception of sufficient light during the day, and the minimal use of light at night or preferably by individuals in a dim space. This concept is seen as very important in the natural process of the body system that if practiced correctly or naturally, the body can function well and in balance. This is because optimal light reception helps the human body tell the brain about the time it is necessary to be active during the day and rest at night. The strength of light (radiation) received during the day has been identified as helping to produce melatonin which plays a role in the normal rest and sleep process at night.



effect on the individual's mood and concentration. This condition can be linked to Seasonal Affective Disorder (SAD) which is closely related to the imbalance of the body to identify the behavior of day and night activities (Zakaria & Ismail 2003). SAD can be overcome through exposure of the human body to sunlight or the use of artificial light with light waves that are almost equal to daylight.

Although artificial light has a very important role as a complement to daylight to illuminate a space, however, artificial light supplied by lamps harms human health. The need for the types of lamps that supply artificial light is different according to the latitude and taste of the user. Typically, white or yellow light is a common theme used in lighting techniques. However, McCloud (1995) explains that the white light produced by fluorescent lamps produces an unstable amount of waves. In addition, fluorescent lights also contain harmful chemicals and toxins that are difficult to dispose of. Whereas, technically the yellow light produced by incandescent lamps or bulbs has a high red wave.

According to Wunsch (2006), although fluorescent lamps have a high red wave distance, but if studied from the point of view of wave stability and color temperature in the light, the light from these lamps does not have a significant gap compared to fluorescent lamps. Thus, he emphasized that the wavelength of this type of lamp is considered to be the best and closest to the wavelength of daylight because it has all the elements of the wavelength of light without significant differences. However, the production of this type of light will use a very high amount of electricity and heat and have a short lifespan. This is because only five percent of the electricity is converted into light. Meanwhile, LED type lights are recommended from the type that produces blue light because this type of light does not interfere with the human biological clock process (McCloud, 1995).

Let's read.



According to Wunsch (2006), humans should rest at night and need to avoid receiving excessive light at this time to allow biological processes and body systems to process the light received during the day. This condition allows what we call the biological clock in the human body to function normally. The imbalance in receiving light radiation during the 12 hours of the day results in short-term and long-term side effects such as insomnia, stress, migraines, and cancer.

Wunsch (2006) also highlighted the issue of chemical content, namely mercury found in fluorescent lamps, which can cause cancer. He revealed that radiation from fluorescent lights (the result of the reaction of mercury and electricity), will enter the skin system of the body and will be stored in the lower layer of the human skin which can cause cancer. The irresponsible attitude of most users also contributes to the risk of these substances to society today. Many consumers take the easy way out by putting broken lamps in landfills without knowing the dangers of mercury. This is exposed to the air and the environment. Toxins exposed to the air will result in long-term effects on human health. Terrace house residents must pay attention to the fact that proper disposal methods need to be implemented to avoid threats to safety and health in the house.

Light and lighting is an important issue of this decade. Among the issues that arise related to these two aspects are usually linked to aspects of health, architecture, and design as well as pollution and energy efficiency. This is because the variety of characteristics and functions of light and lighting provided by natural and artificial light provide different impacts in the context of different lives and activities.





Sunlight's Affect on Human Physiology Source: LEDdynamic





Circadian rhythm and daily activities stock illustration Source: LEDdynamic







Circadian rhythm and daily activities stock illustration Source: Discover Alamy's culture and vision



Daylighting in Buildings



Let's read.



Building opaque elements does not allow light to pass through the object. When exposed to light, the element will form a shadow. Building elements like that are categorized as opaque or opaque elements. Among the examples are wooden walls, stone walls, and so on. Building elements that allow light to pass through them are known as light transparent elements. For example, glass, Perspex, and so on. Light rays can enter the building directly, through reflection and refraction due to the different elements that make up a building. This phenomenon can be detected by observing the entry of light into the building through windows, light wells, or other openings.

Daylight reflection on buildings consists of random reflection and straight reflection. Random reflection occurs when light hits an uneven surface or many different surfaces causing the direction of the reflected rays to become irregular. Straight reflection occurs when daylight hits a flat surface such as a flat mirror surface on a building window, then the reflected rays have a straight and regular direction. Daylight reflection occurs when it hits the exterior and interior surfaces of the building, objects outside and inside the building, and the surface of the ground that is paved or not. An inner space will be affected by the reflection of objects outside and also inside the building.

The term daylighting usually refers to the filtered entry of natural light into a building. Natural light is considered 'clean' light compared to electrical or mechanical lighting. Natural light also contains the full solar color spectrum that can be detected or seen by the eye. Daylight also helps people see and carry out their daily activities comfortably inside the building (Zakaria and Ismail, 2003). A good daylighting system should provide natural light without glare and help the function or program of the building. The human need for daylight or natural light in the building has been proven by the presence of various types of openings or window designs in the historic buildings of the world (Figure 2.3). If the historical buildings were built without openings or windows for daylight, the interior space would always be dark even during the day because at that time electric lights did not yet exist. For this reason, architects and building designers in the past were very sensitive to the need for daylight for the occupants in the building designs they produced.

Let's read



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Source: ResearchGate

Reference



Mc Cloud, K. 1995. Lighting Style: The Complete Guide to Lighting Every Room in Your Home.London: Simon & Schuster

- Holick, M. F. 2009. Vitamin D and Health: Evolution, Biologic Functions, and Recommended Dietary Intakes for Vitamin D. Clinic Rev Bone Miner Metab (2009). 7:2-19Published online: 21 April 2009, Copyright Human Press Inc. 2009.
- Mc Menemy, B. 2010. Light and Austistic Children. Professional Lighting Design Magazine. JanFeb 2010. p.30-33.
- Ibiyeye, A. I., Mohd, F. Z. J.* dan Zalina, S. 2014. Natural Ventilation Provisions in Terraced-House Designs in Hot-Humid Climates: case of Putrajaya, Malaysia. 23 (4): 885-904 (2015).
- Fischer, Karl Albert. 2009. Humanity"s need for light and chrono-biological light rhythms. PLDC 2nd Global Lighting Design Convention, 28-31. October, 2009 in Berlin, Germany. Via-Verlag. Germany. p. 20.21
- Campbell, G. 2009. The Application, Influence, and Potential Benefits of Using Various Lighting Techniques to Aid Healthcare, Wellness, and Recuperation in Holistic Medical Applications. PLDC 2nd Global Lighting Design Convention, 28-31. October, 2009 in Berlin, Germany. Via-Verlag. Germany. p. 20.21.
- Godar, D.E., Landry, R.J. & Lucas, A.D. 2008. Increased UVA exposures and decreased cutaneous Vitamin D³ levels maybe responsible for the increasing incidence of melanoma. Diakses pada 12 November 2009 daripada www.elsevier.com/locate/mehy. 2008.
 - Wirz-Justice, Anna. 2009. Licht und Gesundheit: neues aus der Chronobiologie. Diakses pada 12November 2009 daripada <u>www.chronobiology.ch</u>.
 - Zakaria, R. 2007. Sustainable housing for residential-industrial neighbourhoods in Malaysia - a study on the elements of indoor enivironmental quality improvement. Doctor of Philosophy, Faculty of Built Environmental and Engineering, Queensland University of Technology.
 - Wunsch, A. 2006. Artificial Lighting and Health. Journal of Optometric Phototherapy. April2006. p.1-4 di akses pada 3 Januari 2011 daripada <u>www.international-light-association.org</u>

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Notes



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