

Original Article

Increasing Light Intensity with Anthropometry

I Ketut Wijaya¹

¹Department of Electrical Engineering, Udayana University, Bali, Indonesia

¹Corresponding Author : ketutgedewijaya@gmail.com

Received: 16 August 2022

Revised: 24 September 2022

Accepted: 07 October 2022

Published: 23 October 2022

Abstract - The eye needs light intensity from the lamp to see objects around it. The eye can see objects because of the light that hits the object and reflects it to the eye. The distance of the object to the light greatly affects the condition and existence of the object. Determining the distance of light hitting objects will affect the brightness of objects that affect the eyes, and over time the eyes become unhealthy. Eye health is very important to do the job. The light intensity from the lamp must be under predetermined standards. Standard use of lights makes eyes healthier in addition to food and nutrition patterns. It is necessary to standardize the effect of distance and the brightness of the light used in work. The distance of the lights can be done by using the anthropometry of workers in that place.

Keywords - Light, Eyes, Light distance.

1. Introduction

The amount of light reflected by an object to the eye depends on the position of the object. Objects reflect light depending on the smoothness of the object's surface. The smoother the surface of the object, the more perfect the intensity of light reflected by the object's surface to the eye. Light intensity is a form of light reflection from an object due to objects exposed to light or objects with light. The light intensity depends on the lamp's distance and the lamp's wattage that hits the eye. The size of the lamp is used to get the intensity of light that illuminates the desired surrounding area. The amount of light intensity needed depends on the needs, benefits, and goals so that the place becomes comfortable.

Comfort can be achieved in various ways, such as installing lights and designing the workplace to be harmonious and pleasing to the eye. Besides, the light intensity must not cause glare problems in the eyes. Glare in the eye will cause damage to the retina of the eye and possibly permanent blindness. Avoid excessive use of lights and avoid glare to maintain a comfortable atmosphere. A comfortable atmosphere is obtained with a lamp design under the place's conditions, and the distance of the lamp or a reflector is used. In order not to add lights and get the desired comfort, the lights should be placed slightly down by adding a rope with an artistic design so that the comfort of the place can be achieved.

Design is prioritized because it can make things better, and the design must include all elements, namely the owner of the house as well as the designer. It is done so that all elements feel they have the work that will be used and appreciated.

2. Literature Review

At this time, many efforts are being made to reduce the burden of using electricity and with energy saving. This model must be continued because electric power is getting increasingly expensive.

According to Imdad Ali et al., In 2021, with the increasing price of electricity, everyone in the use of electricity will buy tools to reduce the use of electricity. Electric power is currently very important, and its use is almost all tools that use electricity. Electric power in relation to the economy is very close because electric power makes the economy excited and can make the economy lively. Almost all of the tools sold by the market use electricity, both large and small capacities. Electric tools make it easier to do work or business with the appearance of electrically powered tools.

According to Smolder. et al. 2012, nowadays people can work at night for dinner or meet friends safely and comfortably.

Brandi. et al. 2019, night walks or just looking for entertainment are the habits of city people in terms of entertaining themselves. Sometimes the entertainment is in the city square prepared by the city government with sufficient lighting designs, or they want to have dinner with family or friends. Entrepreneurs start calculating in making drinks (the price of food sold); if the price increases, the subscription will be lost. It may be a calculation so that a design method of this model is made, as well as an office or business for which an office or business must use a model design like this. According to Salunke, P. (2015), with this anthropometric design, the electricity used is reduced, and



the monthly electricity bill is lighter. With this design, one month's electricity bill will relieve entrepreneurs because the lights do not increase, and the room will be brighter.

3. Materials And Methodology

All lamps obtained in the market were selected to obtain data with the intent of this study. Lamps are selected according to research criteria to get the desired experimental results. All lamps must meet experimental standards and can be tested perfectly, and are not damaged (problematic). All lights will be tested in the laboratory.

The data is obtained by installing the lamp perfectly according to the installation standards and getting the calculation results. Installation of lights can be done on the ceiling or pasted on the wall as desired. The lamp data is already on the light box, but the light intensity data must be measured differently. Getting data on lights installed on the ceiling can be done by measuring directly on the ceiling or lowering it as needed. Lowering the lamp's location makes it easier to replace it if damaged. The lamp is mounted on a wall facing sideways or upwards to obtain a light intensity that does not cause glare.

4. Data Analysis And Interpretation

4.1. Data

Anthropometric measurement data were obtained using 30 Persons in Measurement Standing Upright Grasping. Alternate measurements were made to obtain a mean data of 196.97 with a standard deviation of 7.52.

Lamp Installation Formula,

$$K = \frac{pl}{h(p+l)} \quad (1)$$

$$d = 0,57 + \frac{\eta_1 - K}{\eta_2 - K} (\eta_1 - \eta_2) \quad (2)$$

$$n = \frac{E \times A}{Q \times \eta \times d} \quad (3)$$

Where:

n is the number of lamps calculated

k is the index of the shape of the lamp (found in the table of provisions)

l is the width of the place where the lamp is installed

p is the length of the place where the lamp is installed

h is the height where the lamp is installed

E is the light intensity

A is the area of the building

Q is the number of lamps used in one armature (lumen)

d is the provision for the length of time the lamp has been used (the provisions in the lighting efficiency table).

Table 1. Anthropometric Measures of Person Height

No.	Height Of Person In Measurement Standing Upright Grasping (Anthropometry)
1	195.00
2	208.00
3	196.00
4	205.00
5	200.00
6	203.00
7	190.00
8	195.00
9	195.00
10	200.00
11	208.00
12	210.00
13	210.00
14	195.00
15	190.00
16	180.00
17	187.00
18	192.00
19	190.00
20	198.00
21	189.00
22	185.00
23	196.00
24	197.00
25	198.00
26	194.00
27	195.00
26	200.00
29	208.00
30	200.00
Average	196,97

Table 2. Light spectrum

Light spectrum	Wavelength	Frequency (X 1014 Hz)
Red	6,200-7,800	4.82-4.60
Orange	5,900-6,200	5.03-4.82
Yellow	5,700-5.970	5.20-5.03
Green	4,820-5,770	6.10-5.20
Blue	4,550-4,950	6.59-6.10
Purple	3,900-4,550	7.69-6.59

- Anthropometric size. The anthropometric table of measurement results is expected to help designers and homeowners have a height limit for installing lights. If it is higher in installation than the lamp, it will be difficult to replace if the lamp is damaged. Besides, the location of the lights can be mounted on the wall to make it more practical and reduce the risk in case of glare problems. The lamp's color depends on its use, benefits, and where the lamp is placed. The most important thing is the design of the lamp placement so that the lamp can be used correctly. The Anthropometric mean data from the lamp's location can be written as 196.97 ± 7.52 , which means that in the application, it can be made to be 204.49 high or 190.45. This size is intended so that if there is damage to the lamp, it is not difficult to replace it.
- Work error. The design of the lamp installation must be really good so that the intensity of light that comes out of the lamp does not cause glare. Glare should be as small as possible or not present at all so as not to cause damage to the eyes. Glare should not be present as it can cause errors in doing work. The function of the design is to reduce glare, causing discomfort in activities. Convenience is a principal thing in the design of laying lights. Comfort must be created in the workplace to make the atmosphere nice, cool, and comfortable. Lights that are not bright are at risk of causing work accidents and causing material losses. Very bright lights can increase work productivity.
- Lamp color. Color is needed to beautify the workspace, making the room's atmosphere cool and comfortable to use. Beauty is obtained from the right design for the workspace through color combinations or mixed colors that are under utilization to make the atmosphere calm and comfortable. The color of the walls also affects the color of the lights used as a combination of two or more existing colors. The color of the lamp must be adjusted to the purpose for which the lamp will be used to give life to the conditions and clarify the meaning of what is shown.
- Use of the lamp. The installed lighting helps increase productivity and create comfort and security in an economic system. The greater the intensity of light given to a workplace can increase the production results. The use of a lot of lights causes waste in the use of electricity, but

the right way should be done so that electric power can be useful and efficient. Saving in the use of electricity is to utilize the design of technology without adding lights but can save on the use of electricity.

5. Comparison With Conventional Calculation Results

In the old design, calculations with ordinary results were carried out but have not carried out calculations based on humans who use facilities or buildings. Calculations are good, but electricity can still be reduced by lowering the height of the electric lamp based on humans who use it (anthropometry), and the purpose of this design is to show how to use energy to be more efficient because electricity is getting more expensive and besides that, it will be difficult to replace balloon lights in case of damage.

5.1. Novelty

Eliminating glare from lamps is a must, but saving is also a goal. Lowering the location of the lamp is the simplest way without having to reduce the light intensity that has been determined through calculations,

- The first method is the installation by lowering the lights, which can be done when there are no lights (beginning of construction), so there are no additional costs.
- The second way is that the installation is done after the lamp is installed, which is then replaced and added with additional tools so that the lamp changes its position downwards to increase the intensity of the light.

6. Conclusion

To get additional light intensity without adding lights, lower the lamp's location in a downward position according to the anthropometric size of the upright person holding it. It is recommended to install the lamp by lowering it before it is installed not to increase the design cost. Increasing the light intensity by lowering the lamps is a simple way to reduce the number of lamps and aims to save on electric energy bills.

References

- [1] Abdul Latif Abro, Sajid Hussain Qazi, "Performance and Economical Analysis of Solar Photovoltaic Pumping System in Village Malo Bheel, Tharparker," *SSRG International Journal of Electrical and Electronics Engineering*, vol. 8, no. 4, 2021. DOI-10.14445/23488379/IJEEE-V8I4P101.
- [2] Abdullah, R. N., and Ahmad, A. N, "Evaluation of Ergonomic Design of Desk and Chair for Primary Schools in Erbil City," *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, vol. 11, no. 6, pp. 1-14. <https://www.Ncbi.Nlm.Nih.Gov>.
- [3] Aleš Šubic, "Initiative for Regulation of Outdoor Lighting, Slovenia, Reasons for Insufficient Success of Light Pollution Prevention Legislation In Slovenia," *International Journal of Sustainable Lighting IJSL*, 2001
- [4] Ananda, N.S., Dinata, I.M.K, "The Relationship Between Lighting Intensity and Subjective Complaints of Eye Fatigue in Semester II Students of the Medical Education Study Program," Faculty of Medicine, Udayana University, *In 2015, Udayana Medical Journal*, vol. 4, 2015. [Http://Ojs.Unud.Ac.Id/Index.Php/Eum/Article/View/15096](http://Ojs.Unud.Ac.Id/Index.Php/Eum/Article/View/15096).

- [5] Anjah GM, Focho AD, Dondjang JP, "The Effects of Sowing Depth and Light Intensity on the Germination and Early Growth of Ricinodendron Heudelotii," *African Journal of Agricultural Research*, vol. 8, no. 46, pp. 5854-5858, 2013.
- [6] Benedetto, S., Carbone, A., Draï-Zerbib, V., Pedrotti, M., Baccino, T, " Effects of Luminance and Illuminance on Visual Fatigue and Arousal During Digital Reading," *Computers In Human Behavior*. vol. 41, pp.112-119, 2014.
- [7] Boyce, P.R., "Lighting Research for Interiors: the Beginning of the End Or the End of the Beginning," *In: Lighting Research and Technology*, vol. 36, no. 4, pp. 283-293, 2004. <https://www.Researchgate.Net>.
- [8] Brandi L. Smith¹, Jeffrey C, "Informing Good Lighting in Parks Throughvisitors' Perceptions and Experiences," *International Journal of Sustainable Lighting IJSL* , pp. 47-65, 2019.
- [9] Christopher C. M. Kyba, Theres Kuester, Helga U. Kuechly, "Changes in Outdoor Lighting in Germany from 2012-2016. Christopher," *International Journal of Sustainable Lighting IJSL*, pp. 112- 123, 2017.
- [10] Cho, C. H., Lee, H. J., Yoon, H. K., Kang, S. G., Bok, K. N., Jung, K. Y., ... & Lee, E. I, " Exposure to Dim Artificial Light at Night Increases REM Sleep and Awakenings In Humans," *Chronobiology International*, vol. 33, no. 1, pp. 117-123, 2016.
- [11] CRC. Crop Farming Homepage for Light Intensity, Cropsreview.Com and Ben G Bareja. 2016, Accessed on 23/06/2016. www.Light Intensity In Plant Growth and Development.Htm.
- [12] D. Száz, Z. Kolláth, F. Szabó& P. Csuti, "Dark Sky Park and Environmental Friendly Luminaires with Adjustable Light Distribution, Colour and Luminous Flux: Light Pollution Reduction in Hungarian Settlements," *International Journal of Sustainable Lighting IJSL* , pp. 66-75, 2019.
- [13] Gyimah R, Nakao T, Oo MZ, " Effects of Light Intensity and Nutrient on Growth and Electron Transport Rate of Tropical Trees (Bombax Buonopozense, Khaya Ivorensis and Cedrela Odorata) Found in Ghana," *Bulletin of the Faculty of Agriculture*, Miyazaki University. vol. 49, no. (1&2), pp. 69-7, 2003.
- [14] Hariyanto, K., Rijanto, O.A.W, "Analysis of the Relationship Between Physical Factors of the Work Environment on Increasing Productivity of Sewing Machine Operators," *Proceedings of the IENACO Industrial Engineering Nation Conference National Seminar*, pp. 596-602, 2018. Surakarta, Indonesia: Muhammadiyah University of Surakarta.
- [15] Hughes, P.C., Mcnelis, J.F, "Lighting, Productivity, and the Work Environment," *Lighting Design and Application*, vol. 8 , no. 12, pp. 32–38, 1978.
- [16] Imdad Ali., Sajid Hussain Qazi., Irfan Ahmed., Asad Ali., Abdul Latif, " Power Quality Analysis of Micro-Grid (MG) Based on DVR," *SSRG International Journal of Electrical and Electronics Engineering*, vol. 8, no. 4, 2021. DOI 10.14445/23488379/IJEEE-V8I4P105.
- [17] Irwanto, E.D., & Riandadari, D, "The Effect of Workplace Lighting and Noise on Employee Performance at Pt. Perkebunan Nusantara X (Persero) Gempolkrep Sugar Factory, Mojokerto," *Journal of Mechanical Engineering*, vol. 1, no. 2, pp.162-170, 2013.
- [18] Jayashri Bangali, "Discomfort Glare Evaluation Using Dialux Lighting Simulation Software and Using Developed Python Program Model," *International Journal of Sustainable Lighting IJSL* , pp. 44-50, 2018.
- [19] Jitka Mohelnikova, Stanislav Darula, " Light Guide Collector Prototype: Laboratory Testing," *International Journal of Sustainable Lighting IJSL* , pp.124-131, 2017.
- [20] Juslen, H, Lighting, Productivity and Preferred Illuminances - Field Studies in the Industrial Environment. Doctoral Thesis, Helsinki University of Primadi, S.D., Rachmawati, D., Muhsin, A, "Improvements to Lighting Levels in Production Spaces to Increase Worker Product Output Using a Work Procedures Engineering Approach," *Journal of OPSI (Industrial System Optimization)*, vol. 9, no. 1, Pp 59-68, 2016. <https://jurnal.upnyk.ac.id/index.php/opsi/article/view/2192/1924>.
- [21] Aashikha.M, Abisheka Puvan. N, Gowsalya. B, Vijayakumar.D, "Intelligent Street Light for Smart City," *SSRG International Journal of Computer Science and Engineering*, vol. 7, no. 4, pp. 4-6, 2020. Crossref, <https://doi.org/10.14445/23488387/IJCSE-V7I4P102>
- [22] I Ketut Wijaya, " Methods Decrease Electric Field Computer the Using Zise Anthropometric Distance Body User," *International Journal of Engineering and Technology (IJET)*, vol. 7 no. 5, pp. 705-710, 2015.
- [23] I Ketut Wijaya, " Word Effect of Temperature, the Lighting, Workload, Noisce Against Aye Fatigue, General Fatigue and Stress Afect Leaning Outcome the Student Computer User," *International Journal of Engineering and Technology (IJET)*, vol. 58, no. 5, pp. 26-30, 2012.
- [24] Josep Manel Carrasco¹ and Salvador J. Ribas, "An Enhanced Version of the Gaia Map of the Brightness of the Natural Sky," *International Journal of Sustainable Lighting IJSL* , pp. 1-12, 2022.
- [25] Josiane Meie, " Contentious Light: An Analytical Framework for Lighting Conflicts," *International Journal of Sustainable Lighting IJSL* pp. 62-77, 2018.
- [26] JGJ Van Der Westhuyzen¹, F W Leuschne, "The Effect of Age on White Light Perception," *International Journal of Sustainable Lighting IJSL* , pp. 29-43, 2018.
- [27] Kuenda Laze, " Aessing Public Perceptions About Road Lighting In Five Neighborhoods of Tirana, Albania," *International Journal of Sustainable Lighting IJSL* , pp. 38-46, 2019.

- [28] Nayab, Mohsin Ali Tunio, Muhammad Rafique Naich, Irfan Ahmed, “Experimental Study on Power Quality Analysis of Hybrid Energy System,” *SSRG International Journal of Electrical and Electronics Engineering IJEEE*, vol. 9, no. 4, 2022.
DOI - 10.14445/23488379/IJEEE-V9I4P102.
- [29] Salvador Bará., Fabio Falchi., Raul C. Lima., Martin Pawley, “Can We Illuminate Our Cities and (Still) See the Stars,” *International Journal of Sustainable Lighting IJSL*, pp. 58-69, 2021.
- [30] Setyawan, H, “Ergonomic-Based Rubber Industrial Work Environment Design to Reduce Workload and Increase Productivity.” *Scientific Journal of Techno*, vol. 12, no. 1, pp.11-24, 2015. [Http://Jurnal.Binadarma.Ac.Id/Index.Php/Jurnaltekno/Article/View/137/16](http://Jurnal.Binadarma.Ac.Id/Index.Php/Jurnaltekno/Article/View/137/16).
- [31] Smolder, K.C.H.J., De Kort, Y.A.W., Cluitmans, P.J.M, “A Higher Illuminance Induces Alertness Even During Office Hours: Findings on Subjective Measures, Task Performance, and Heart Rate Measures,” *International Journal Physiology & Behaviour*, vol. 107, no.1, pp.7-16, 2012.
- [32] Salunke, P, “Identifying Anthropometric Parameters Considered for the Improvement in Ergonomic Design of Classroom Furniture,” *International Journal of Industrial Engineering Research and Development*, vol. 6, no. 1, pp. 1–13, 2015.