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IMPS 2017

International Multidisciplinary Conferences on Productivity and Sustainability

PROCEEDING

of the 2017 International Multidisciplinary Conferences on Productivity and Sustainability

Alila Hotel
Jakarta, 5-7 December 2017

UKRIDA press

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PREFACE

To make people are fascinated to us (either as a researcher or academician), we can make them keep asking about our research and project. The more interests from others, the more recognitions we get. The easiest way to learn about research and projects is by participating in an academic forum which discusses recent studies and facts from various disciplines. It is also a cost-effective way to build network with various researchers and academicians from various backgrounds.

On 5-7 December 2017, the 2017 International Multidisciplinary Conference on Productivity and Sustainability (IMPS 2017) is organized based on the fact that today's world demands better productivity due to the harsh competition, as well as the needs of sustainability as regards the scarce resources and global competition. Three sub-conferences are formed to accommodate the diversity of academic backgrounds: Science, Engineering and Technology (ICSET); Economics, Business and Management (ICEBM); and Social and Behavioural Science (ICSBS).

We have +250 papers submitted by authors from Indonesia, Malaysia, Taiwan, Japan, Vietnam, India, P. R. China, and USA, 154 papers were accepted, and 136 have registered to present their papers in the conference. **Selected authors are committed to publish their papers in the proceeding**, while the rest will continue their studies and publish their works in various reputable journals.

We would like to thank all the authors for participating in the IMPS 2017. Thanks to our invited speakers: Professor Naoki Kobayashi (Saitama Medical University, Japan), Professor Suganda Jutamulia (University of Northern California, USA), Professor Joewono Widjaja (Suranaree University of Technology, Thailand), Associate Professor Ferry Jie (Edith Cowan University, Australia), Dr. Hamin (Krida Wacana Christian University, Indonesia), Professor Sri Suryawati (UN; Gadjah Mada University, Indonesia), Dr. Pillar Ramos-Jimenez (Philippine NGO Council on Population Health and Welfare, Philippine), and Professor Johana Endang Prawitasari (Krida Wacana Christian University, Indonesia). We appreciate Professor Stuart Yin (Pennsylvania State University, USA) for his insightful invited paper. A heartfelt thank is given to the committee, moderators and reviewers who have been involved in the organizing conference with heart and soul.

Finally, thank you for our organizing partners for making this happen: Taiwan Education Centre, Chang Jung Christian University (Taiwan), Tunghai University (Taiwan), Parahyangan Catholic University (Indonesia), and Petra Christian University (Indonesia).

Jakarta, 20 March 2018

Dr. Oki Sunardi
Krida Wacana Christian University, Indonesia
General Chair

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Energy Efficiency for the Train Lighting in an Executive Passenger Carriage Train from Jakarta to Surabaya Using LED Strip Lamp

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Lighting in the train includes many different types of lighting such as general lighting, sleep lighting, and reading lighting. This paper conducted the survey and measurement of those several types of lighting in the executive *Sembrani train*, PT KAI which compared to the standard and lighting simulation to obtain appropriate lighting condition for the passenger carriage wagon. The average illumination measurement for general lighting exceeds the standard with the result of 650.95 lux which need to be decreased to reduce power consumption, while the measurement of reading light need to be increased twice to meet the standard requirement.

Keywords: *LED strip train lighting, general lighting, reading lighting, energy efficiency*

1. Introduction

Train lighting is one of the important passenger facility. Lighting in the train includes general lighting, sleep lighting, reading lighting, toilets lighting, emergencies lighting, together with the lighting for circulation space, generator room, restoration, dining and kitchen wagon. This paper provides an overview of the lighting inside the train carriages which includes general lighting, emergency lighting, and reading lighting. General lighting illuminates the entire space in the train when the passengers are not sleeping. Usually the general lighting is dimmed or switched off for sleeping time. Passengers can use the reading lighting for reading. Emergency light should automatically turn on in emergency. The purpose of emergency lighting is to ensure that people can move safely in the event of power failure and they should be able to see clearly the emergency exit and evacuation route instructions from their seats.[1] Emergency lighting system failures and low levels of illumination during the accidents have been reported as the cause of confusion and as a contributing factor for the injuries and victims.[2]

Currently, the train lighting for passenger carriages mostly uses tube lamps (TL), such as T8 or T12 type, which are arranged in a long row using acrylic lid.3 The current technology has proposed the use of light-emitting diode (LED) lights. The LED light is famous for the energy efficiency, long-lasting life, and easy to apply. In train lighting system, the use of LED lights can be integrated with a smart system for a comfortable transportation systems and also provide a significant reduction of the maintenance cost. Also, it can be implemented for both outdoor and indoor lighting. The use of LED lighting reduce the energy consumption over 50% with a lifecycle 5 to 6 times longer, and the cost savings can be up to 70% of their lifetime. Furthermore, LED lights for train lighting offer the benefits of reduced environmental impact.[4] This is in accordance with the research on energy consumption, investment cost, and CO2 gas generated from LED lamps which compared to the non-LED or conventional lamps to reduce Greenhouse Gases / GHG.[5]

2. Experimental Details

The measurement was taking place on a reserved train in a parking mode at the railway station warehouse of PT Kereta Api Indonesia (PT KAI). The train name is Sembrani, an executive train with a capacity of 300-400 seats and each carriage consists of 50/52 seats. The passenger carriage wagon was the work of PT INKA, while the LED lighting for the general lighting was the work of PT Kreasi Mustika, and the LED modules and drivers were the product of PT Philips.

The type of the lighting system and its location are: 1. General lights, using semi direct luminaires system mounted with recessed system in two long rows; 2. Emergency lights, using 3 LED strips, one light strip is mounted in the center of the general lights and one light strip at each corner of the passenger carriage; 3. Reading light, located above the center of each passenger seat with a direct luminaire light which consist of 2 LED lights, one light for each seat. Reading light is installed with recessed system. The lighting and lights location is illustrated in Figure 1.

The measurements were conducted at night, using a Luxmeter instrument to measure the average illuminance in the passenger carriage wagon. The measurement was done in 3 lighting conditions, first, using only general lights. The results are shown in Figure 2. Second, the general light was off and the sleep light was on. One reading light was on, and then two reading lights were turned on together.

3. Results and Discussion

3.1. Analysis for general lighting

The result of general light shows that the average illuminance value ($E_{av)}$ = 650.95 lux, minimum illuminance (E_{min}) = 330 lux, and the maximum illuminance (E_{max}) = 1086 lux (see Figure 2). The magnitude of uniformity (u_0) = 0.3. The simulation result for general lighting is shown in Figure 3. It shows that E_{av} = 722 lux, E_{min} = 260 lux, E_{max} = 1094 and u_0 = 0.361. The light used for general lighting in the passenger area is 50 LED Strip lamp, 1400 lumens, 13 W. The dimension of the passenger train area is 15.5 × 3 m. The measurement and the simulation results have a slightly different illuminance, indicating that the LED light is very good, since more than 90% of the light is illuminated. However, the results of this measurement exceed the standard for the circulation area. The illuminance of the circulation area in the train is equivalent to the working space where simple visual tasks are performed with 100 lux to 200 lux.6 Therefore, the flus luminous light (in lumen unit) should be reduced to more than 50% for energy efficiency, while the number of the lights should be kept the same, as it is already in accordance with the size of the train wagon.

3.2. Analysis for reading lighting

The reading light measurement with one reading light on gives a result of E_{av} = 178.4 lux, E_{min} = 145 lux and E_{max} = 231 lux. While the measurement of 2 reading lights provides E_{av} = 281,22 lux; E_{min} = 176 lux and E_{max} = 409 lux. These results informs that the average illuminance for reading lights (178.4 lux) is smaller than the standard reading light, which is 300 lux.[6,7] In this case, the luminous flux of the LED light for the reading light should be increased twice which equal to the measurement of 2 reading light with an average illuminance of 281.22 lux.

3.3. Analysis for Emergency Lighting

The result of emergency lighting is shown in Figure 4, which provides E_{min} = 3.5 lux, E_{max} = 17.6 lux, and uniformity 0.20. The results are the combination of emergency light and sleep lighting. Preferably, the sleep lighting should be turned off. However, the sleep lighting could not be turned off because the default setting for the sleep lighting is always on for security reason to protect the passengers and their properties from criminal action. It means that the sleep lighting also serves as a security lighting. Prior to the installation of the lights on the train carriage, a lighting design for the carriage was performed. The design was realized using Dialux software based on the size of the wagon, the luminaire, and the type and specification of the lights to be used and their installation procedure. The simulation results with 50% dimming is provided in Figure 5. The illumination measurement on floor obtained E_{min} 11 lux, E_{max} = 42 lux and uniformity 0,26. While the measurements of the illumination on wall gave E_{min} = 5.53 lux, E_{max} = 110 lux, uniformity 0,025.

The results of the simulations and the measurements are in accordance with the recommendation of BS EN 1838: 2016 4.2: *call for a minimum of 1 lux on the center of the escape route for normal risk. A uniformity ratio of 40: 1 maximum to minimum must not be exceeded. This illuminance must be provided* *for the full duration and life of the system. 50% of the illuminance must be available within 60 second of supply failure*.

4. Conclusion

In conclusion, the average illumination for general lighting is 650.95 lux which exceeds the standard. Therefore, the flux luminous lights should be reduced, because the passenger circulation area in the train carriage wagon needs only 100 lux until 200 lux. The flux luminous for the reading lights should be increased at least twice from the current condition, because the average illuminance does not match with the recommendation that is at least 300 lux. In emergency condition, the simulation result shows that the minimum illuminance on floor is 11 lux with uniformity 0,25. Similarly the measuring results come with E_{min} 3.5 lux and uniformity of 0.2 which is in accordance with the recommendations. This lighting condition allows the passenger to clearly see the emergency execution instructions and the direction of the evacuation path.

Acknowledgments

This study was conducted with the funding from RISTEK DIKTI, through a grant program to be completed in December 2017 in INSINAS scheme.

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Figure captions

Figure 1. Lighting in the ‘Sembrani’ train passenger carriage wagon.
Figure 2. Measurement Results of General Lighting in Passenger Carriage Train Wagon.
Figure 3. The Lighting Simulation of General Lighting in Passenger Carriage Train Wagon.
Figure 4. Measurement result of emergency lighting together with indirect lighting as the sleep lighting.
Figure 5. Simulation result of emergency lighting.

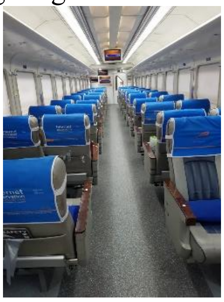

Figure 1. Setyaningsih et al.

335	334	673	806	871	858	801	738	780	755	673	514	445
	304	480	588	617	624	564	547	639	605	533	399	382
526	596	945	1052	1086	1054	977	976	1002	982	853	563	
475	384	645	824	788	884	818	674	803	821	654	475	
365	330	508	654	684	642	542	526	620	630	442	361	332

Figure 2. Setyaningsih et al.

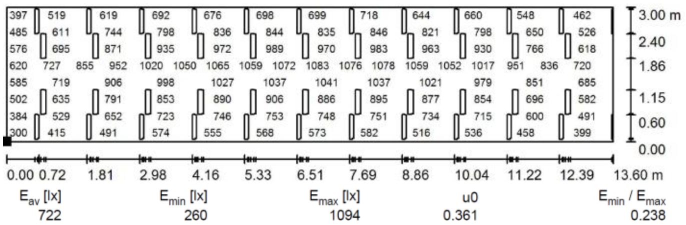

Figure 3. Setyaningsih et al.

3.8	11.5	18.3	17.3	17.6	16.4	15.8	17.3	16.3	14.7	13.2	4.3	3.5

Figure 4. Setyaningsih et al.

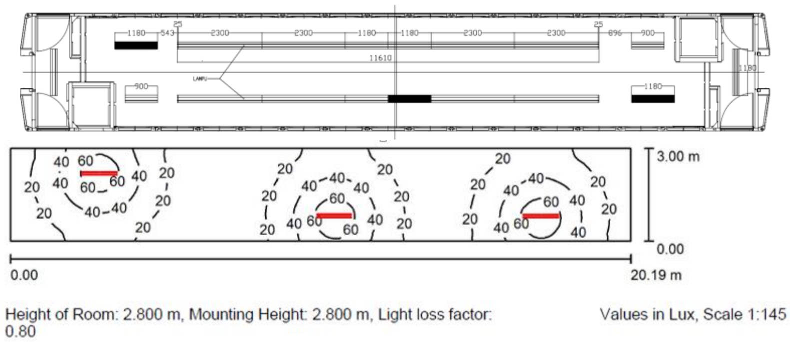

Figure 5. Setyaningsih et al.