



SEGA 07
The 7th International Conference on Sustainable Energy and Green Architecture
Smart City and Urban Resiliency
Bangkok, May 21-22, 2018

ACCEPTANCE LETTER

April 11, 2018

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Affiliation : Faculty of Architecture, Khon Kaen University, Thailand

I am pleased to inform you that your paper entitled

STATUS QUO AND GUIDELINE FOR LIGHTING CONVENIENT STORE

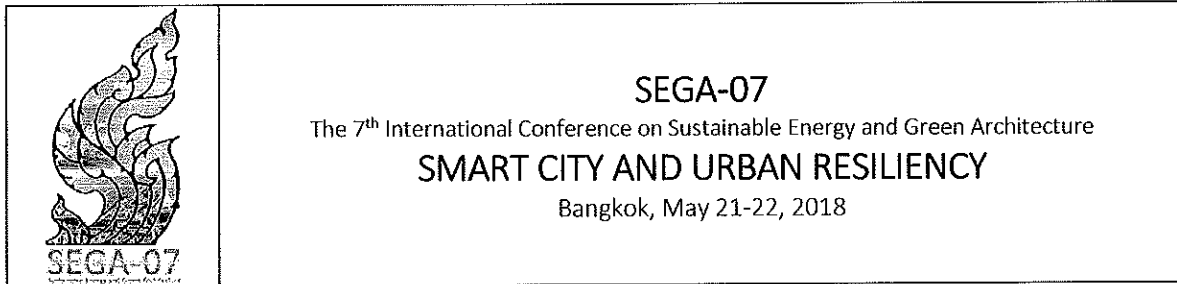
has been formally accepted by the readers for presentation at SEGA07.

Looking forward to receive your camera ready copy and welcoming you at SEGA07 next May 21-22 2018.

Best Regards

Prof. Dr. Joseph KHEDARI

Chairperson, SEGA-07



SEGA-07: Program Overview

The International Conference on **Sustainable Energy and Green Architecture 07 (SEGA-07): Smart City and Urban Resiliency** follow the six successful previous meetings (SEGA-01/ INTA-SEGA-02/ SEGA-03/ SEGA-04/ SEGA-05/ SEGA-06); all held in Bangkok, Thailand.

Today countries are experiencing not only economic boom but also fast transformation in urban infrastructure and development. Unfortunately these remarkable progress of developments are threatened by the potential risks from natural and man-made disasters, degradation of living environment and intensifying social and economic conflict in the area. The fact that most population now live in cities, the urban resiliency and sustainability becoming major concerns. Cities represent agglomerations of population and economic activity, therefore their existence and size is a clear indication of their economic vitality. A city may over exploit its critical resources within its own boundaries or its hinterlands, lose its comparative advantage to other city, or suffer severe economic and social problems. It may also be prone to external impacts such as natural and man-made disasters. Thus, in addition to long-term concerns about limited resource base and community infrastructure, cities must be resilient, or be able to rebound from shortrun or disruptive disasters to be sustainable.

The SEGA-07 will provide an excellent International forum for innovative and knowledge platforms to discuss the present and future challenges in urban resiliency and sustainability, and present some policies and innovative programs. The creative solutions can be found from the urban scale projects to the smart buildings design and eco innovations. The conference will feature a wide range of themes, focusing on smart technologies, sustainable energy and green architecture, case studies on eco-buildings, smart use of materials and resources, renewable energy sources or energy efficient non-renewable sources, natural resources conservation and preservation for eco-buildings and industries, environmental policy, engineering and technological management, innovative and ideas driven for sustainability strategy formulation both in normative and logical perspectives, new techniques improving indoor thermal comfort and air quality and so on.

The SEGA-07 will be held at Bangkok, Thailand, on May 21-22, 2018. Please take the time to check on important dates, and keep yourself up to date on recent changes (<http://www.archd.kmutnb.ac.th>, <http://sega07.ku.ac.th>).



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The conference looks for significant contributions to all major fields of the sustainable built development and sustainability pathways.

SEGA-07 invites paper on (but not limited to) the following topics:

I: Smart Green Built Environment

- Smart Applications in Built Environment
- Applied Renewable Energy in Eco-Buildings and Industries
- Modern Green Buildings and New Home Appliances
- Advanced Control, Technology and Products of Built Environment
- Indoor Air Quality and Outdoor Pollution
- Evaluation of Sustainable Buildings and Analyses of the Full Periods
- Low Power Consumption Technology
- Evaluation System of Green Building

II: Policy, Design and Practice of the Sustainable Urban Resiliency Development

- Intelligent Control System of Eco-Buildings and Industries
- Ecological Configurations and Scenes in Green Buildings and Industries
- Low Carbon Society and Carbon Credits Analysis
- Trends and Global Strategy on Sustainable Buildings and Industries
- Global and Regional Policies Analysis towards Sustainability
- Globalization and Internationalization of Emerging Technologies
- Sustainable Energy Management

III: Sustainable Technologies

- Eco Innovation in Built Environment
- Technologies of Effective Usage of Resources in Sustainable Buildings
- Development and Application of Environmental and Economical Materials
- Evaluation and Application of Eco Built-Environment Materials
- New Technology and Products of Energy Saving



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Application and Development of Regenerated Energy in Industries
Building Integrated Sustainable Energy
Bio Energy and Green Energy Technologies
Effective Microorganism Technology in Buildings

IV: Other invited paper on (but not limited to) the following topics

Social and Community-based Sustainable Development
Smart Technologies and Culture Preservation
Sustainability, New Perspectives and Models for Sustainable Economics
Environmental Impact Assessment of Sustainable Buildings and Industries
Traditional Wisdom Application to Modern Facilities
Innovation and Sustainable Business Development
New modern Vernacular Architecture

Submission Information:

Papers and Posters are invited on the topics outlined. Abstracts of no more than 300 words should be submitted as soon as possible. Abstracts should clearly state the purpose, results and conclusions of the work to be described in the final paper. Final acceptance will be based on the full-length paper. Submitted papers will be reviewed by technical committees of the conference.

Language: The language of the conference will be English.

Submission of Manuscripts: Authors are requested to follow the guidelines when writing their paper for SEGA-07 International Conference.

Style for Manuscripts: In addition to being concise and consistent in style, spelling and the use of abbreviations, the paper should conform to the following instructions.

- 1) **Language:** Papers must be written in English only. The first page of the manuscript should consist of the title, the authors' name and institutional affiliation, an abstract, key words, and corresponding author's address and telephone number including e-mail address.

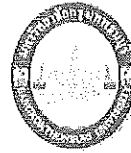


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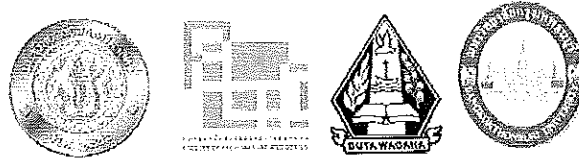


- 2) **Typescript:** Manuscript should be in single-column, single-space, A4 size (21cm X 30cm) format using a font size of Times New Roman 12 points only.
- 3) **Poster Presentation:** The Standard poster size is 36" high by 42" wide. Poster will be clipped onto a foam core board that measure 36" high by 50" wide and display on an easel.
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- 8) **Equations and Mathematical Formulas:** All equations and mathematical formulas should be numbered serially on the right-hand side by Arabic numerals in parentheses.
- 9) **Illustrations and Tables:** Illustrations and tables should be clearly readable. In illustrations, all words (as distinct from mathematical symbols) should be written entirely in capital letters and in type size that is at least 8 points in the printed version.
- 10) **Length:** The manuscript of papers submitted should be restricted in length to 4-6 pages, including abstract, bibliography, and appendices.
- 11) **References:** References to published literature should be quoted in the text in square brackets. Number all references in a single sequence in the order that they are cited in the text, or in alphabetical order according to the author's last name, and list them together at the end of the text.

Submission Methods:

Submit your abstract(s), paper(s) or poster(s) (.pdf, .doc and .docx) with SEGA-07 in the subject line. Please include your name, full address and conference topic through the following e-mail: segathailand2018@gmail.com

	<p>SEGA-07 The 7th International Conference on Sustainable Energy and Green Architecture SMART CITY AND URBAN RESILIENCY Bangkok, May 21-22, 2018</p>
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Conference proceedings:

International Referred Conference Proceedings will be blind peer reviewed by two competent reviewers. The conference abstracts book will be distributed to the conference participants at the conference registration desk. Presentation certificate will be submitted to authors during session's presentation. Full proceeding in pdf/CD/handy drive will be sent to all participants (as appropriate and convenient).

Importance Dates:

Abstract Submission	March 1, 2018
Notification of Abstract Acceptance	March 20, 2018
Full paper & Poster Submission	April 1, 2018
Notification of Full Paper & Poster Submission	April 20, 2018
Authors' Registration (Early Bird Registration)	May 16, 2018
SEGA-07 Conference Dates	May 21-22, 2018



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Conference Registration

Registration Fees

Registration Fees		Early-Bird			Standard		
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International Participants (USD)	Student author delegates	<input type="checkbox"/> 170	<input type="checkbox"/> 120	<input type="checkbox"/> 60	<input type="checkbox"/> 200	<input type="checkbox"/> 150	<input type="checkbox"/> 100
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2) Payment of fees must accompany all registration forms. No registration will be confirmed until payment is received.

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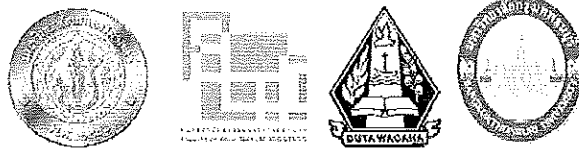
1) Notification of any cancellation must be made in writing to the Secretariat Office.

2) For cancellation before 15 days of the conference, your 50% pre-paid conference registration fees will be refunded (per person cancellation fee).

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Conference Venue and Accommodation

Bangkok Chada Hotel



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The Conference offers the opportunity to become a sponsor or exhibitor in the Conference, please contact the conference secretariat at segathailand2018@gmail.com

Conference program

The conference program will be announced shortly.

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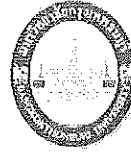


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STATUS QUO AND GUIDELINE FOR LIGHTING CONVENIENT STORE

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ABSTRACT

Since the last three decades, local grocery store had been prevailed over by chain convenient store. There are many crucial factors which change in local shopping patterns from local grocery to the modern one stop convenient store. Shop environment communicate the store's image and purpose to customers. The interior of the store also stimulates customer excitement at the shop premise. Lighting is one of many related factors that has been used to draw attention to customer to enter the store. The level of interior illuminance is used to create high brightness in modern convenient stores, and the brightness becomes norm of store to customers. This study explored lighting in four brand convenient stores which have the highest number of branches running in Thailand. Firstly field surveys were conducted to investigate lighting installation and these sampled stores were simulated in DIALux 4.13 for illuminance conditions. The results suggest that illuminance levels in the store are above 300 lx and light distribution is relatively uniform varied from 0.6 to 0.8. Power consumption in lighting system of shop samples show mean value below legislation requirement. Final part of this study suggests a guideline of designing a lighting system based on light fixture density (unit/m²) for an average configuration store. Simple equations for estimating illuminance in the store were derived from the data and examination, when inputting the number of light fixtures, light levels can be estimated.

Keywords: Lighting, Convenient store lighting, Store lighting guideline

INTRODUCTION

Nowadays, the number of convenience stores in city of Thailand is increasing. Global-chain stores have been spread to almost every street in the city especially the big urban area. Since the first modern convenient store, 7-Eleven has been open in 1989 (Wikipedia, 2018), the number of the stores are increasing over the past three decades. Now there are over 10,000 chain convenient stores. The most numbers are 7-Eleven, Tesco Lotus Express, Family Mart and Mini Big-C consecutively (Saranya

Jansawang, 2017). This work explores existing lighting configuration in these stores. The survey data are used for comparing and contrast luminaire setting and illuminance levels to recommendations and legislation standards.

In the past local grocery store was owned by a local owner and they serviced around community. Customer Grocery store is a typically vender selling consuming goods and neither variety in the store nor fresh food. Moreover, customers were not persuaded to stroll inside the shop in some grocery setting. The sale was usually completed at the front shop when a shopkeeper was asked for goods usually taken from the stock behind to serve customers. Nowadays, modernization has changed living tradition that includes local grocery shopping. There are many factors which change in grocery shopping patterns from traditional shopping markets to the more modern one-stop shopping store. Many dimensions have driven this change, for examples, behavior accessibility services hours of operation travel-related. One of the country's favorite and most profitable convenience store chains offer both great service and competitive prices. Customers are drawn into the store to select products and have service inside the space.

Level of illumination of the modern store is brighter and higher than that is in the conventional local store as shown in Figures 1 - 2. Because lighting can be designed to create the appropriate atmosphere that fit consumer habit, the higher brightness of the store interior will provide an effect of attention to the pedestrians and customers. Previous study suggested that atmospherics stimulate customer excitement at shopping premises (Wakefield and Baker, 1998). Proper illuminance of the store provides spaciousness and clarity impression for customer as seen in Figure 2. Popular convenient stores in Thailand were thus selected for this study, (1) 7-Eleven, (2) Tesco Lotus Express, (3) Family Mart and (4) Mini Big-C. These brands are the top four biggest in branch numbers in Thailand (Saranya Jansawang, 2017). Especially, 7-Eleven expects to reach its branch number of 10,000 branches in 2018 (CP All, 2018).

In Thailand, lighting standards are suggested by TIEA (Illuminating Engineering Association of



Thailand, 2018) and other international lighting organizations, for instance CIBSE (CIBSE, 2002) and IES (IESNA, 2003). The legislation requirement controls the minimum illuminance to ensure safety of workers and people in various environments. This work implements TIEA recommended illuminance as a guideline to measure sale area and lighting in the sample stores. TIEA suggests a minimum illuminance of 300 lx for sale area and till area at 500 lx. A computer program- DIALux 4.13 was used for analyzing illuminance levels and lighting criteria for each store. Then the final part of this paper proposes another consideration in lighting systems with lighting fixture density for designing lighting in the conventional store.

and contrast between the local and modern convenient stores were done visually and systematically. Then the stores were modeled in DIALux 4.13 program (DIALux, 2018) to simulate existing lighting circumstances. Daylight is not included in the simulation as the modern store is open 24 hours. Thus artificial lighting will represent a worse condition of illuminance. In the program, store interior surfaces are set to 0.2, 0.5 and 0.7 for floor, walls and ceiling reflectance consecutively. Furniture within the store is neglect. Wall zone is 0.50 m. where the refrigerators and top of the shelves are usually located. Although it has an effect on the illuminance level (Yingsawad Chaikyakul, 2015; Apichai Patimakrontakoun and Yingsawad Chaikyakul, 2016), this work attempts to simplify the data from various convenient stores.

The results will be then compared with the illuminance standards. The second part is to replace existing T8 fluorescent lamp with a higher efficacy LED T8 lamp in modern convenient stores to illustrate the change of illuminance and energy consumption of the system. Final part of this paper includes study of exiting light power density (LPD) and lamp fixture density (LFD). These two factors are calculated in Equations 1 and 2. Thus guideline to reduce energy use in lighting systems and simple prediction of store illuminance are proposed.

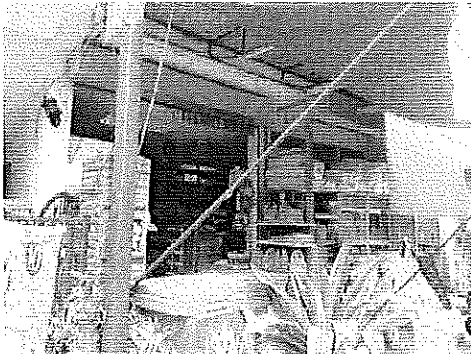


Figure 1 Dim front store and interior of local grocery during the daytime



Figure 2 Bright illuminance interior in modern convenient store

METHOD

Two local stores and twelve modern convenient stores examined in this work selecting through a convenience sampling technique to cover top four chain brands. The aim of the field survey is to identify store configurations (floor area and height of the room) and lighting systems installed. Luminaire type and layout plan were also identified. Compare

$$LPD = \frac{\text{Power in lighting system (watt)}}{\text{Area (m}^2\text{)}} \quad \text{Eq.1}$$

$$LFD = \frac{\text{Number of Lighting fixture (unit)}}{\text{Area (m}^2\text{)}} \quad \text{Eq.2}$$

DISCUSSION AND RESULTS

Local grocery stores nowadays have configured to provide services and convenience to customers as seen in sampled stores shown in Figures 3 and 4. Batten fluorescent T8 fixtures are commonly used in the stores. In the surveyed stores, light fixtures are placed differently as shown in Figures 5 and 6. Lighting installed cannot give illuminance to meet requirement at 300 lx, although LPD is below 18 watts/m². LPD of Stores A and B are 6.0 and 2.25 watts/m² consecutively. The quantity of light are as shown in Tables 1 and 2 and Figures 5 and 6 show light distributions of the two local stores. Lighting layout and goods shelves are not associated.



Figure 3 Store A- Dim lit interior.



Figure 4 Interior of local store-B shows light fixture and dim environment.

Table 1 Simulation results of the surveyed stores

Local store	Dimension (WxDxH)	Area (m ²)	light fixtures
1. Store A	4 x 6 x 3	24	4
2. Store B	4 x 8 x 3	32	2

Table 2 Simulation results of the surveyed stores

Local	Floor		0.75 m.	
	E _{av} (lx)	U _o	E _{av} (lx)	U _o
1. Store A	248	0.506	182	0.562
2. Store B	202	0.581	146	0.580

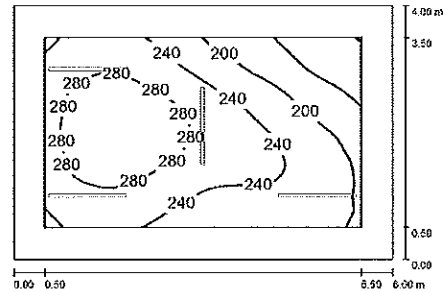


Figure 5 Local store-A light fixture layout and illuminance distribution

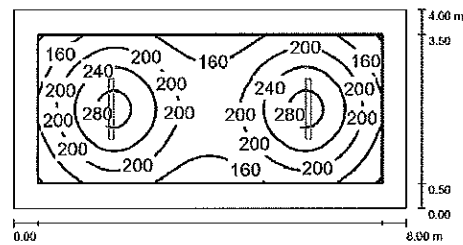


Figure 6 Local store-B light fixture layout and illuminance distribution

Comparatively, environments of sampled modern store chains are shown in Figures 7-10. The store sizes are varied and the ceiling heights are between 2.60 and 3.00 m. The areas are from 80-240 m². The light fixtures installed are batten fluorescent T8. Luminaire layout plans of each store are shown in Figures 11-14. 7-Eleven store lays light fixtures adjacently each row. There are two Tesco Lotus Extra install light fixture with two lamps in a unit. Lighting is designed to provide general lighting from the luminaire installed on the ceiling and supplementary lighting is integrated within the beverage refrigerator. In every store, the luminaires are laid uniformly to distribute general light all over the store area. In the simulated models, only general lighting mounted on ceiling are considered. The results of illuminance on the floor and on the horizontal level at 0.75 m. (around half height of store shelf) are shown in Tables 3 - 4.

Table 3 shows the size of each store and its configurations. Table 4 shows results of averaged illuminance (E_{av}) on the floor and on the 0.75 m. workplane. All the store illuminance passes the recommended values. The uniformity (U_o) or light distribution of the stores exceeds 0.4 recommended by TIEA (Illuminating Engineering Association of Thailand, 2018).



Figure 7- Interior environment and light fixtures in 7-Eleven store. The light fixtures are continuously laid.



Figure 8- Interior environment and light fixtures in Tesco Lotus Express. The light fixtures are uniformly laid.



Figure 9- Interior environment and light fixtures in Family Mart. The light fixtures are uniformly laid.

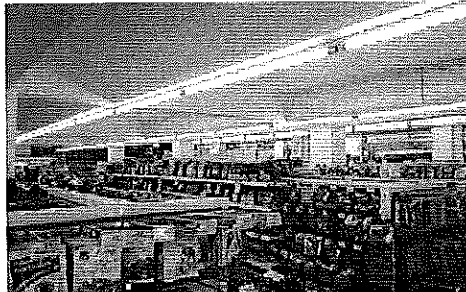


Figure 10- Interior environment and light fixtures in Mini Big-C. The light fixtures are continuously laid.

Table 3 Survey results of the surveyed stores

Store	Dimension (WxDxH)	Area (m ²)	No. of light fixtures (lamps)
1. 7-Eleven ^a	8x16x3	128	60
2. 7-Eleven ^b	10x12x3	120	58
3. 7-Eleven ^c	6x12x2.6	72	32
4. 7-Eleven ^d	8x15x3	120	70
5. Lotus Express ^a	10x12x3	120	36 (72)
6. Lotus Express ^b	12x20x3	240	64 (128)
7. Lotus Express ^c	12x16x2.6	168	36
8. Lotus Express ^d	10x10x2.6	100	25
9. Family Mart ^a	8x10x3	80	36
10. Family Mart ^b	8x10x3	80	36
11. Family Mart ^c	8x12x2.6	96	32
12. Family Mart ^d	8x12x2.6	96	48
13. Mini Big C ^a	8x20x3	160	72
14. Mini Big C ^b	8x20x2.6	160	60

Table 4 Simulation results of the surveyed stores

Store	0.75 m. level		Floor level		LPD (watts/m ²)
	E _{av} (lx)	U _o	E _{av} (lx)	U _o	
1. 7-Eleven ^a	834	0.836	733	0.749	16.88
2. 7-Eleven ^b	850	0.665	739	0.608	17.40
3. 7-Eleven ^c	749	0.744	623	0.633	16.00
4. 7-Eleven ^d	910	0.708	791	0.614	21.36
5. Lotus Express ^a	1041	0.698	909	0.609	21.60
6. Lotus Express ^b	983	0.675	997	0.576	19.20
7. Lotus Express ^c	427	0.700	378	0.583	7.71
8. Lotus Express ^d	449	0.726	388	0.632	9.00
9. Family Mart ^a	809	0.740	680	0.652	16.20
10. Family Mart ^b	813	0.730	686	0.650	16.20
11. Family Mart ^c	613	0.719	524	0.652	12.00
12. Family Mart ^d	910	0.714	778	0.656	18.00
13. Mini Big C ^a	877	0.707	770	0.638	16.20
14. Mini Big C ^b	702	0.696	614	0.624	13.50

Figures 11-14 shows examples of store light fixture layout and illuminance distributions. Lighting



strategy in all stores (including ones not shown) are similar by using batten T8 fixture laid uniformly. Uniform layout luminaire creates good visibility for reading labels, and provides a bright clean environment. Exposed sources are effective to project a “discount” or “speedy service” image (Hayden McKay Lighting Design and Lindsley Consultants Incorporated).

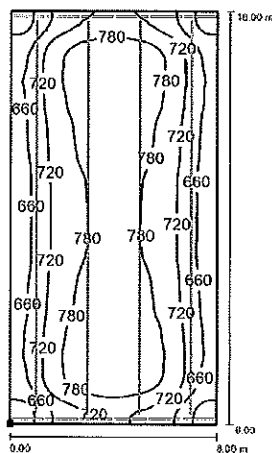


Figure 11- Simulation results show fixture layout and illuminance distribution in a 7-Eleven sample

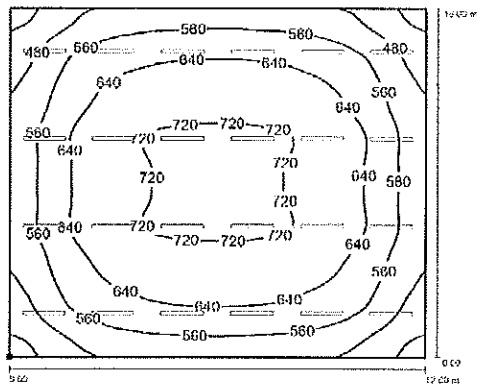


Figure 12- Simulation results show fixture layout and illuminance distribution in a Tesco Lotus Express sample

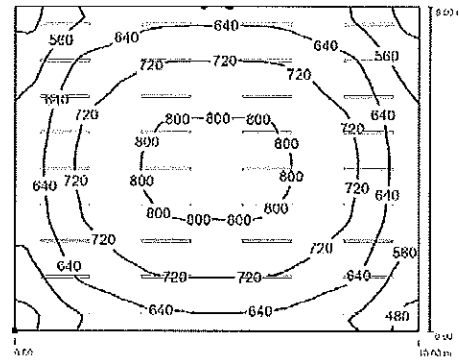


Figure 13- Simulation results show fixture layout and illuminance distribution in a Family Mart sample

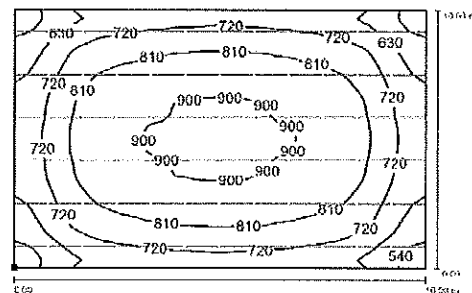


Figure 14- Simulation results show fixture layout and illuminance distribution in a Mini Big-C sample

The current store lighting has been changing perception of customers. Nowadays people have been familiar to high level of illuminance and store brightness. Although illuminance recommended in the standards is to ensure people visual performance and safety. Other factors such as visual satisfactory and cognition influence pleasant emotions when Previous work suggested that lighting attributes were related to atmosphere dimensions. Among of the attributes, brightness is one of the most important (Custer, de Kort et al., 2010).

For the aspect of energy, Ministerial Regulation (Minister of Energy, 2009) set a light load density for electrical consumption for lighting commercial type of building with a maximum rate 18 watts/m². Table 4 shows three stores have LPD over this value.

Additionally, new affordable LEDs are available in the market. They share higher volume in the shelves and become affordable. The next study of this work is to replace existing light fixture with high efficacy LED T8 fixtures that provide similar luminous flux at 3,500 lm and lower power consumption at 22 watt (Ravee Lighting Group, 2018). The results of



replaced-lamp lighting load density (RLPD) are shown in Table 5. LPDs are reduced by 39% as shown in Figure 15 when comparing with the existing lighting. Illuminance levels of the stores after replacement are shown in Table 5. With the averaged LPD of 9.66 watts/m² derived from the example stores in this study, it is 54% of the legislation. For more than 10,000 of the convenient stores in the country nowadays, the replacement of LED lamps should be noted.

Table 5 Averaged illuminance comparison after replace existing light fixture with LED tubes

Store	0.75 m. level		Floor level	
	E _{av} (lx)	E _{LED} (lx)	E _{av} (lx)	E _{LED} (lx)
1. 7-Eleven ^a	834	906	733	789
2. 7-Eleven ^b	850	916	739	796
3. 7-Eleven ^c	749	806	623	671
4. 7-Eleven ^d	910	980	791	852
5. Lotus Express ^a	1041	1121	909	978
6. Lotus Express ^b	983	1059	997	955
7. Lotus Express ^c	427	460	378	407
8. Lotus Express ^d	449	484	388	418
9. Family Mart ^a	809	871	680	733
10. Family Mart ^b	813	876	686	739
11. Family Mart ^c	613	661	524	565
12. Family Mart ^d	910	980	778	838
13. Mini Big C ^a	877	944	770	830
14. Mini Big C ^b	702	756	614	661

Guideline for predicting illuminance and amount of light fixture can be as follows. Lighting fixture load (LFD) is the amount of lamp per area of the store. Table 6 shows illuminance of the store after LED replacement and light fixture load. From the table, relationship plots between illuminance and LFD can be demonstrated in Figure 16. Relationship lines and empirical equations can be proposed as in Equations 3 and 4 with R-squared values of 0.9458 and 0.9242.

$$E_{av-wp} = 1698.4 LFD + 99.928 \quad Eq.3$$

$$E_{av-flr} = 1489.2 LFD + 78.201 \quad Eq.4$$

Table 6 Illuminance on the floor and workplane and lighting fixture load

Store	E _{av-wp} (lx)	E _{av-flr} (lx)	LFD (unit/m ²)
1. 7-Eleven ^a	834	733	0.47
2. 7-Eleven ^b	850	739	0.48
3. 7-Eleven ^c	749	623	0.44
4. 7-Eleven ^d	910	791	0.58
5. Lotus Express ^a	1041	909	0.60
6. Lotus Express ^b	983	997	0.53
7. Lotus Express ^c	427	378	0.21
8. Lotus Express ^d	449	388	0.25
9. Family Mart ^a	809	680	0.45
10. Family Mart ^b	813	686	0.45
11. Family Mart ^c	613	524	0.33
12. Family Mart ^d	910	778	0.50
13. Mini Big C ^a	877	770	0.45
14. Mini Big C ^b	702	614	0.38

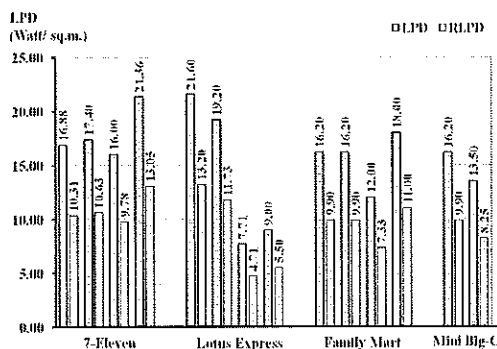


Figure 15- Light power density (watts/m²) before and after LED replacements.

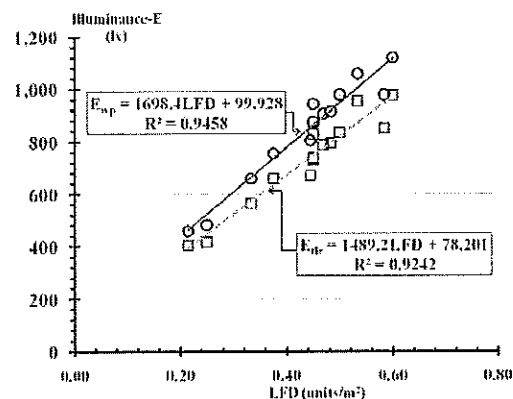


Figure 16- Light fixture density (unit/m²) and illuminance on the floor and workplane (0.75 m).



Example use of empirical equations is as follows. A store size 12.00x10.00x3.00 m, is a size usually found. Light fixture layout is placed to illuminate area uniformly. The store uses 22Watt- LED T8 for illuminate for general lighting. Lighting layout spaced between the luminaire are 1.50 and 1.25 m, as shown in Figure 17. Two lines of fixtures are place on the sides to ensure uniformly distribution. Thus there are 54 light fixtures installed in 120 m² of the store. The simulated results for this presume store show in Table 7. LFD of the store is 0.45 unit/m². Table 8 illustrates the illuminance values on the workplace and floor of the example store from simulated and calculated values.

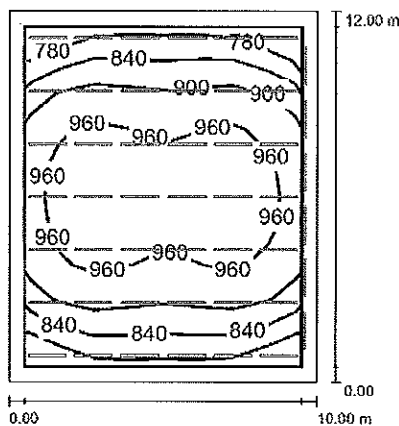


Figure 17 Example room layout

Table 7 Simulated illuminance and uniformity of exemplified store.

E_{av} (lx)	U_o	E_{av-wp} (lx)	U_o	LPD (watts/m ²)
909	0.701	793	0.628	9.9

Table 8 Comparison between simulated illuminance and calculated illuminance

LFD (unit/m ²)	E_{wp} (lx)		E_{fl} (lx)	
	E_{Sim}	E_{Cal}	E_{Sim}	E_{Cal}
0.45	909	864.21	793	748.34

Another implication of Equations 3 and 4 is when the amount of light fixture is query. When the minimum recommended illuminance is known, for example, at

300 lx on the floor, Equation 6 can be applied as follows:

$$300 = 1489.2 \cdot LFD + 78.201$$

$$LFD = 0.15 \text{ units/sq.m.}$$

Thus, the fixture layout should be about 1 units in 6 m².

CONCLUSION

Lighting in the store and perception of customers are intimately related. Quantitative assessment in this paper suggested that current accustomed lighting environment and store appearance have been changed from the past. Although there are conventional local-stores which try to organize imitatively to the modern stores, lighting systems in those stores is not lifted up. The brightness and perception for customer may appear gloomy when comparing with the modern stores. Secondly, the level of illumination of the chain stores is roughly double the suggested level- 300 lx. The illuminance of the store is correlated with the light power density. 18 watts/m², there are LPDs of three stores that exceed the energy obligation. After lamp improvement to LED T8, all the LPDs of the sample stores are decreased 39%. The store environment impact the customers satisfaction and the amount of money and time spent in the shop. The setting of the right environment is important and lighting may take a contribution as one of various elements that play a role. A visually bright attracts customers. The level of light depends on the brightness of the surroundings. Thus higher value beyond standards and recommendation may be acceptable in terms of store purpose to attract customers. Moreover, intensity distribution that is broad enough for good vertical illumination (Tregenza and Loe, 2014). With the LFD found in this study, two simple equations have been proposed to predict quantity of light within the store. A luminaire layout should be uniformly laid as shown in Figures 17 to ensure proper lighting in the store.

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