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A Study on The Amount of Lux in Kitchen of Medium Cost Terrace House in Kedah

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Abstract

Kitchen is one of the spaces in the house and it plays an important role for the residents of the house. The kitchen used to do some household chores such as cooking, preparing meals, washing dishes and so on. The kitchen area such as cooking space, food preparation space and storage are used to make the work easier for the residents of the house. However, the efficiency of the work is influenced by the amount of lux received on an affected area. Without an adequate level of lighting, it will interfere with the quality of work in the kitchen. Therefore, this topical study was conducted to observe the appropriate amount of lux for a person to do work in the kitchen well. This study is inspired from several articles to look at some factors that influence the amount of lux required in the kitchen. To see the effectiveness of the amount of lux received in the kitchen when doing work, an observation was also conducted in medium cost terrace houses in Kedah and an analysis of the standard amount of lux for the same type of terrace house was held. A sufficient amount of lux based on the information obtained in this study can show that a kitchen in the medium cost terrace house gets enough lighting for the residents of the house to do work in the kitchen.

Keywords: Amount of Lux, Kitchen, Factors that Influence the Amount of Lux, Terrace House, Lighting

Introduction

The kitchen is a space that plays an important role in a house. This is because the kitchen plays important role as a proper place for meal preparation for the users. Several factors need to be considered to ensure that the work can be done without any interruption. Lighting is

one of the factors that cannot be ignored, because without suitable and sufficient light, it will affect the level of work effectiveness in the kitchen.

Lighting can be measured in the form of lux. Lux not only affects the work effectiveness in the kitchen, but also the safety of the users. It's because, there are dangerous and sharp equipment in the kitchens such as knives, cookers, fork and so on. This shows that with adequate lighting, users will feel more comfortable, safe and will increase the work efficiency while using the kitchen space.

When looking at what Adam C said, November 4, 2019, outdoor lighting is about 10 000 lux on a clear day. However, the light in the interior of the house, especially in the middle of the house is 25 to 50 lux and that shows a sharp decrease in lux compared to the situation outside the house. Therefore, the appropriate position of the kitchen on the house also affects the level of light received. Even openings such as windows and doors can also help increase the level of light received in the kitchen area. To see this more clearly, the list for the minimum level of lighting for some spaces in the house is as in the Table 1.

Table 1
List of Minimum Lighting Level for Residential Spaces

SPACES		LUX
KITCHEN	General	300
	Countertop	750
DINING	General	200
HOME OFFICE	General	500
	Task	800
WORKSHOP	General	800
	Task	1100
LAUNDRY	General	200

Problem Statement

Kitchen user's need enough of light to complete their tasks smoothly. This shows that lighting have a major impact to the work performance at the kitchen. There are several problems that we need to considered such as lack of natural and artificial light, unsuitable light fixture and the placement of light source.

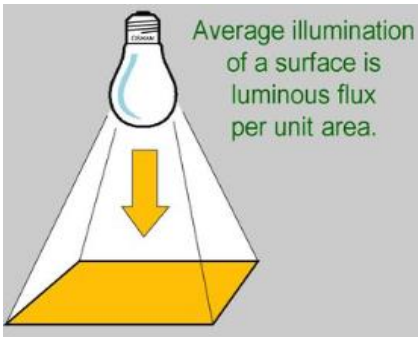
The first problem is lack of natural light at the kitchen, especially light that has been obstructed by others element such as cabinets, walls, partition and so on. The situation become even worse when there are lack number of openings at the kitchen. The situation limits the acceptance of light in the kitchen. Furthermore, when there is only one light source, shadows will occur. This problem will lead to unsafety and unproper environment for the users to complete their task.

Unsuitable light fixture will also create a problem in the kitchen, as it will cause discomfort to the user. Incorrect selection of lighting fixtures occurs when the proportionate of lux and the area of space have too much different, causing the space become too bright or too dark. When the lux of the light fixture is present in large numbers, Glare will occur at the same time will cause inconvenient to the users. This indicates that incorrect lighting fixtures will affect users' comfortability and work efficiency.

Level of Illumination

Illumination level which is the amount of illuminous flux that received on a surface based on that surface area. It is a very important element because it greatly affects a person's level of vision around him. The brightness received on an object will be affected by the amount of light received on the surface of the object itself. For example, when a small object is far from observer so the amount of light needed should be higher and vice versa. This is because, it is influenced by the contrast between the background and the object.

Figure 1: Dimensions of aging by National Senior Citizens Policy 2011



Source: Sarah Glemence Gordon et al (2019)

Shadows

Shadows are dark area that appeared when the surface is blocked from any object. The shadows that appeared on the surface is an unwanted situation, as it will interfere the user's vision and the ongoing work.

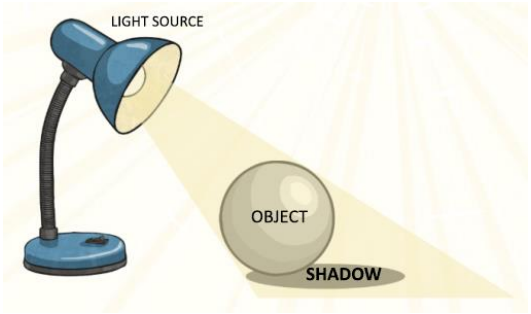


Figure 2: Shadow Cast
Source: Sarah Glemence Gordon et al (2019)

Glare

Glare can be defined as the harsh lighting brightness that can cause a person feel inconvenient and reduce their visual performance. It will occur in two types of ways, whether it will occur reflectively or directly. Glare that occurs through reflection is caused by light reflected from an object into a person's eye. A glossy and shiny object surfaces can cause light to be reflected at the same time producing glare. This shows that light travels from the light source to the object and reflected to the eye. The second glare occurs directly from the light source directly into a person's eyes. For example, direct glare occurs when a person sees a direct light source such as the sun or a lamp. This shows that light will travel from the light source directly to the eye.

Figure 3: Direct and Reflected Glare
Source: RMD Task-Lights (2019)

Guidelines on Occupational Safety and Health for Lighting

The overall purpose of these guidelines is to identify any hazards that may occur in current lighting conditions, assess the risks and provide the necessary measures to ensure consumer safety will be enhanced. Therefore, the guidelines given focus on matters concerning interior lighting especially on the workspace under the purview of Occupational Safety and Health Act 1994 [Act 514]. That suggests employers, occupational safety, health practitioner and employees involved in lighting installers are advised to follow these guidelines especially when using artificial lighting. However natural lighting is also included. The table below shows the recommended amount of lux for some rooms and activities.

Table 1
Lighting requirement for some rooms and activities

TYPE OF INTERIOR, TASK OR ACTIVITY	LUX
KITCHEN	500
DINING ROOM	200
BUFFET (RESTAURANT)	300
RECEPTION / CASHIER DESK (RESTAURANT)	300
CORRIDORS	100

Source: Adams el at (2019)

Table 2
IES recommended lighting levels

KITCHEN ENVIRONMENT	*FOOTCANDLES*	*LUX*
GENERAL	*9*	*100*
STOVE/COOKTOP	*28*	*300*
PREP COUNTERS	*47*	*500*

Source: Oca et al (2019)

Table 3
Combination recommended lighting levels

KITCHEN ENVIRONMENT	*FOOTCANDLES*	*LUX*
GENERAL	*20-50*	*215-538*
PREPARING/COOKING	*50-100*	*538-1076*

Source: Oca et al (2019)

Methodology

In terms of a qualitative approach, information collected through literature review and readings from websites, articles and journals related to the lighting in the kitchen. Besides, quantitative approach is performed by collecting the information of the lux required from the experts. Not only that, this approach also looks at the amount of lux that is typically required in some workplaces in the kitchen.

Once all the required information has been gathered, it will be analyzed to see the important aspects about the required amount of lux. Next, the data that involves observation on 5 medium cost terrace houses in Kedah will be collected. The calculation and analysis will be made based on the data from electrical engineers and also lighting specialist.

The calculation from The Guidelines for Interior Lighting that using theLumen Method will be used to calculate the amount of lux and it is recommended by Jabatan Kerja Raya (JKR) Malaysia. The calculation method is shown in Figure 4. From the information, conclusions and recommendations will be made by considering whether the terrace houses are supplied with sufficient lux or not.

Figure 4: Interior Lighting Design Work Calculation
Source: Oca et al (2019)

Result & Discussion

The data of lighting analysis in the kitchen is shown based on information gathered from electrical engineers and lighting specialist. The electrical engineers involved is from “North M&E Consulting Engineers” and “Samudera M&E Engineering” and the lighting specialist involved is from “CK Lighting”. The results of the analysis will show the effectiveness of lighting in medium cost terrace house kitchens in Kedah. The analysis had considered several factors such as the method of calculations performed by electrical engineers and the

recommendations from lighting experts. In addition, the terrace houses were selected randomly from newly constructed project to represent current terrace houses in Kedah. It is to ensure that the results from this analysis can be adopted.

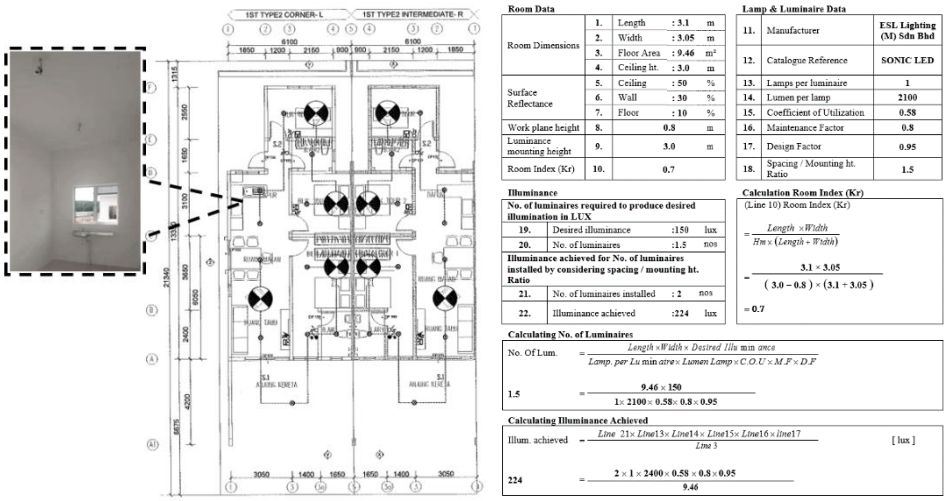


Figure 5: Lighting Calculation of Terrace House at Gurun

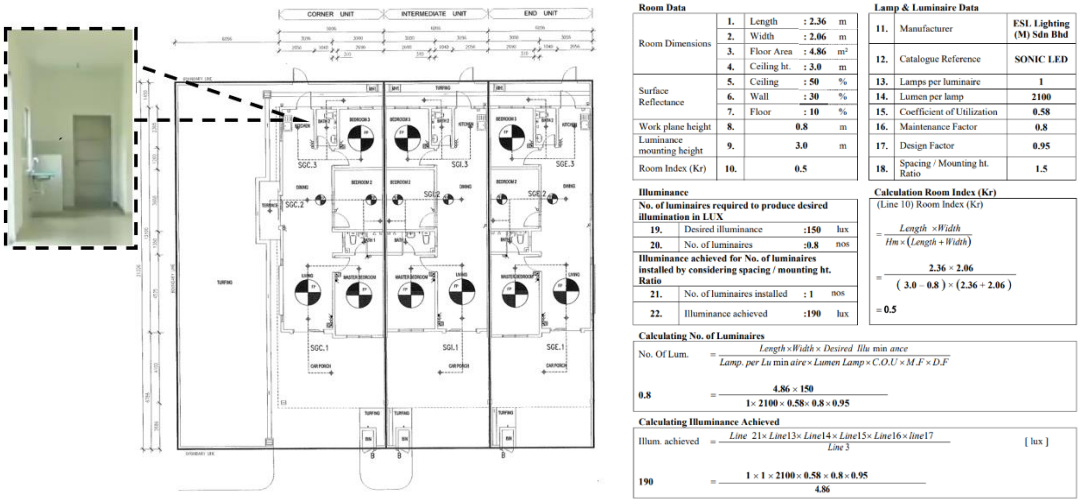


Figure 6: Lighting Calculation of Terrace House at Junjong

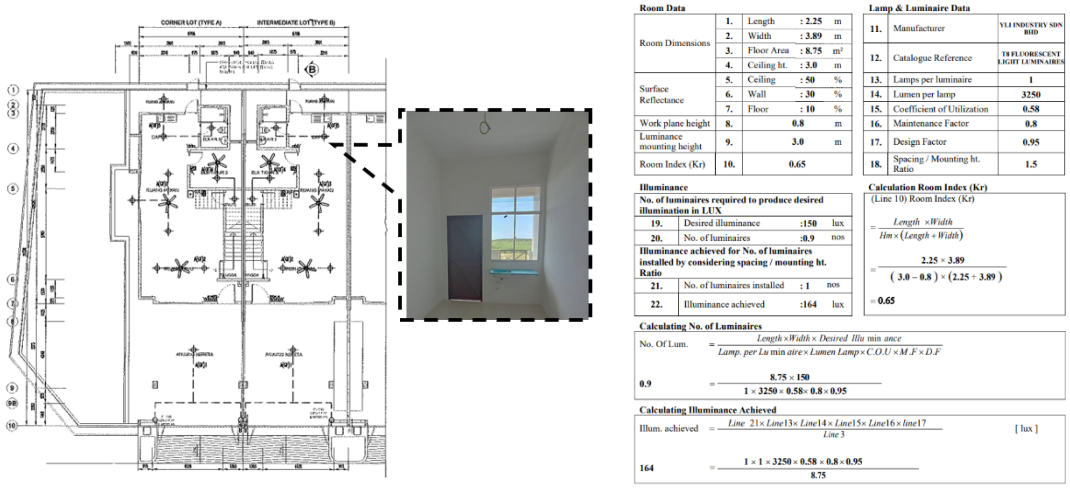
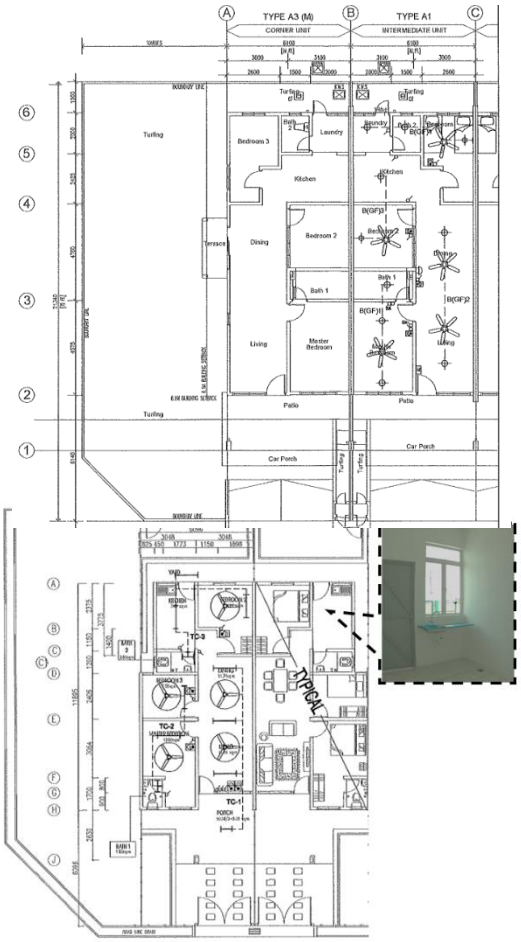


Figure 8: Lighting Calculation of Terrace House at Ayer Hitam

Figure 9: Lighting Calculation of Terrace House at Bandar Simpang Empat



Room Data

Room Dimensions	1.	Length	: 2.43	m
	2.	Width	: 3.50	m
	3.	Floor Area	: 8.51	m²
	4.	Ceiling ht.	: 3.0	m
Surface Reflectance	5.	Ceiling	: 50	%
	6.	Wall	: 30	%
	7.	Floor	: 10	%
Work plane height	8.		0.8	m
Luminance mounting height	9.		3.0	m
Room Index (Kr)	10.		0.65	

Lamp & Luminaire Data

11.	Manufacturer	SNJ LITE TRADING SDN BHD
12.	Catalogue Reference	SONIC LED
13.	Lamps per luminaire	1
14.	Lumen per lamp	3250
15.	Coefficient of Utilization	0.58
16.	Maintenance Factor	0.8
17.	Design Factor	0.95
18.	Spacing / Mounting ht. Ratio	1.5

Illuminance

No. of luminaires required to produce desired illumination in LUX			
19.	Desired illuminance	:150	lux
20.	No. of luminaires	:0.9	nos
Illuminance achieved for No. of luminaires installed by considering spacing / mounting ht. Ratio			
21.	No. of luminaires installed	: 1	nos
22.	Illuminance achieved	:168	lux

Calculation Room Index (Kr)

(Line 10) Room Index (Kr)

$$= \frac{Length \times Width}{Hm \times (Length + Width)}$$

$$= \frac{2.43 \times 3.50}{(3.0 - 0.8) \times (2.43 + 3.50)}$$

$$= 0.65$$

Calculating No. of Luminaires

$$\text{No. Of Lum.} = \frac{Length \times Width \times Desired\ Illu\ min\ ance}{Lamp.\ per\ Lu\ min\ aire \times Lumen\ Lamp \times C.O.U \times M.F \times D.F}$$

$$0.9 = \frac{8.51 \times 150}{1 \times 3250 \times 0.58 \times 0.8 \times 0.95}$$

Calculating Illuminance Achieved

$$\text{Illum. achieved} = \frac{Line\ 21 \times Line13 \times Line14 \times Line15 \times Line16 \times line17}{Line\ 3} \quad [\text{lux}]$$

$$168 = \frac{1 \times 1 \times 3250 \times 0.58 \times 0.8 \times 0.95}{8.51}$$

Surface Reflectance	5.	Ceiling	: 50	%
	6.	Wall	: 30	%
	7.	Floor	: 10	%
Work plane height	8.		0.8	m
Luminance mounting height	9.		3.0	m
Room Index (Kr)	10.		0.62	

13.	Lamps per luminaire	1
14.	Lumen per lamp	3250
15.	Coefficient of Utilization	0.58
16.	Maintenance Factor	0.8
17.	Design Factor	0.95
18.	Spacing / Mounting ht. Ratio	1.5

Illuminance

No. of luminaires required to produce desired illumination in LUX			
19.	Desired illuminance	:150	lux
20.	No. of luminaires	:0.8	nos
Illuminance achieved for No. of luminaires installed by considering spacing / mounting ht. Ratio			
21.	No. of luminaires installed	: 1	nos
22.	Illuminance achieved	:183	lux

Calculation Room Index (Kr)

(Line 10) Room Index (Kr)

$$= \frac{Length \times Width}{Hm \times (Length + Width)}$$

$$= \frac{3.52 \times 2.22}{(3.0 - 0.8) \times (3.52 + 2.22)}$$

$$= 0.62$$

Calculating No. of Luminaires

$$\text{No. Of Lum.} = \frac{Length \times Width \times Desired\ Illu\ min\ ance}{Lamp.\ per\ Lu\ min\ aire \times Lumen\ Lamp \times C.O.U \times M.F \times D.F}$$

$$0.8 = \frac{7.81 \times 150}{1 \times 3250 \times 0.58 \times 0.8 \times 0.95}$$

Calculating Illuminance Achieved

$$\text{Illum. achieved} = \frac{Line\ 21 \times Line13 \times Line14 \times Line15 \times Line16 \times line17}{Line\ 3} \quad [\text{lux}]$$

$$183 = \frac{1 \times 1 \times 3250 \times 0.58 \times 0.8 \times 0.95}{7.81}$$

Table 4
Summary of Lighting Calculation of Five Terrace Houses in Kedah

	Terrace Houses				
	At Gurun	At Junjong	At Seksyen 8	At Ayer Hitam	At Bandar Simpang Empat
Floor Area (m^2)	9.46	4.86	8.75	7.81	8.51
Lamps per Luminaire	1	1	1	1	1
Lumen per lamp (lm)	2100	2100	3250	3250	3250
Desired Illuminance (Lux)	150	150	150	150	150
No. of Desired Luminaries (Nos)	1.5	0.8	0.9	0.8	0.9
No. of Luminaires Installed (Nos)	2	1	1	1	1
Illuminance Achieved (Lux)	224	190	164	183	168

Conclusion

For the conclusion, lighting at the kitchen will be depends on the overall kitchen area and lumen of the lamp used. It's because, those factors will affect the amount lux supplied in the kitchen. Based on the calculation for medium cost terrace houses in Kedah, it shows that the amount of lux supplied is exceed the lux desired in the kitchen. The amount of lux supplied based on the floor area of the kitchen.

LED light is the most recommended from the electrical engineers because of its performance. Besides, the lighting specialist recommend three types of lamps which is Pottery Barn Glass Globe Cord Pendant, 6 Inch Ultra-Thin LED Recessed Lights and Hampton Bay Large-Step Linear Track Lighting. Those types of lamps are recommended because of their advantages in designing the kitchen lighting.

Figure 10: (1) Hampton Bay large-step linear track lighting, (2) BBOUNDER 6-inch ultra-thin LED recessed lights, (3) Pottery barn glass globe cord pendant
Source: Lindsey Lanquist et al (2022)

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