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# Performance Study on Energy Efficiency by Considering Energy Saving Strategies for Restaurant Type Focusing at Indoor Lighting.

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**ABSTRACT**

In line with global initiative toward go green agenda, it is important to realize that the green building concepts need to be implemented to save our planet. The development sector especially building construction has been contributed a lot of pollutions to the earth as it consumes 92 percent total usages come from water, landfill and world energy. Therefore, this paper present the evaluation of lighting on Non Residential New Construction was successfully done based on the DIALux software. The lighting design strategies at the restaurant by using energy saving types have been conducted to compare with conventional type in order to meet the gold GBI score mark. For the daylight factor, The energy saving type for the restaurant can achieve in the range of 1.0-4.0 percent, thus less than 75 percent of the habitable rooms have been achieved.



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## INTRODUCTION

Recent years, the global warming is affecting whole over the world where average temperature of the Earth atmosphere has increased compared to the 19th century. Thus, the global solutions are required in order to face the challenges to planet particularly on climate change and sustainable economic development. The major part of this global problem is construction sector which are consumed about 40% of the world's energy, 12% of it is water and also gives 40% of the waste directed to landfill. Nevertheless, the construction sector also can be the main contributor of the solution. The World Green Building Council (WGBC) is working within the Asia-Pacific region to promote the benefits of sustainable building practices, and Malaysia has embraced the potential of green building (The Green building explanatory Booklet, 2012).

The global effects cause by carbon emissions and the results of climate change are clearly stated in many publications. It is because of the products of civilization such as buildings, cities and the built environment. The increased of carbon emissions are clearly stated which cities development is the main caused contributes to climate change. Though, by applying the Green Building Index (GBI) rating tool, the development of more environment-friendly will be proposed. GBI was acknowledged in Malaysia as green rating tool for buildings and towns in order to create promotion of sustainability in the built-environment and raise awareness of environmental issues amongst developers, architects, engineers and town planners along with the public. Therefore, future generations can look forward the brighter and greener future which will be faced (The green pages Malaysia, 2011).

Many of international and national research study are confirmed that the buildings which are classified as green buildings are consuming less water, less energy; less heat and etc. can which able to give more comfortable environment for the building occupants. Almost of the green building type can fairly reduce the building's operation costs about 9% and at the same time can increase the building values by 7.5% and comprehend a 6.6% increase in return on investment (ROI) (Wan NorsyafizanW.Muhamad, 2010). Hence, green buildings are not just making sound as ecological and environmental sense but able to economic sense too. In this paper, the evaluation of lighting illuminance effect on Non Residential New Construction was successfully done based on the DIALux software and light illumination. The lighting strategy at single storey restaurant by using energy saving type can save the energy compared to the conventional type in order to achieve the certified GBI value. However, the lowest budget with higher achievement will be a good strategy for the developers to obtain the GBI gold certifications (A.M. Kassim, 2013).

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***Project Background:***

This particular project basically is being developed for non-residential new construction (NRNC) of restaurant type.Figure 1 shows the floor layout for the project. Generally, the restaurant consists of dining indoor and outdoor area, kitchen area, corridor area, Chiller and Freezer Room,Costumer Switch room, EP room, female and male toilet, and female, male prayer rooms. Figure 2 shows the floor elevation for the restaurant. By using the normal design in the restaurant, the evaluation of energy which will be used inside the restaurant is conducted. This study will focus only on the internal lighting to evaluate the energy saving performance.


**Fig. 1:**Floor layout of the New Non-residential restaurant.

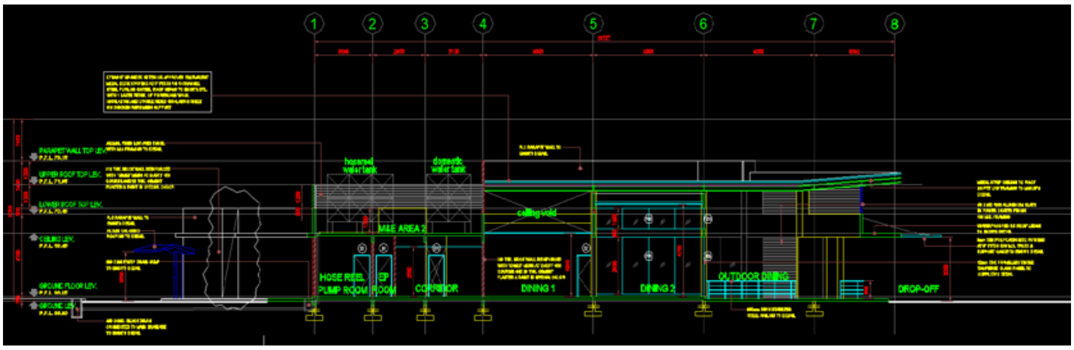


**Fig. 2:**Floor Elevation of the New Non-residential restaurant.

***Energy Efficiency Strategies:***

***Lighting Strategies:***

Lighting generally will consume about 20% to 50% of the electricity consumption which leads to the highest amount of electricity usage in a building. Basically, a lot of energy and cost can be saved if the lighting is used efficiently and effectively. In order to measure the rate of luminaires in a room, rooms' size, dimension and illuminance level are the main factors to be considered when doing the lighting design. Equation (1) to (3) shows the formula to obtain the rate of luminaire which needed in a room. Besides, rooms with square dimensions provide the highest potential to be designed as energy efficient lighting system. The parameter to measure the Light Lost Factor (LLF) also considered. Here, Ballast Factor (BF) set to 95%, Room Surface Dirt Depreciation (RSDD) set to 97%, Lamp Lumen Depreciation (LLD) set to 85% and Luminaire Dirt Depreciation (LDD) set to 90%. These parameters stated above will be used to evaluate the lighting performance in order to achieve energy saving criteria.

$$\text{Room Cavity Ratio (RCR)} = \frac{(5 \times \text{Room Cavity Height}) \times (\text{Length} + \text{Width})}{(\text{Length} \times \text{Width})} \quad (1)$$

$$LLF = BF \times RSDD \times LLD \times LDD \quad (2)$$

$$\text{No. of luminaires} = \frac{(desiredilluminance) \times (roomarea)}{(lumensperluminaire) \times CU \times LLF} \quad (3)$$

The lighting design stage will begin with the proper planning from the building electrical plan. The building space and room concept will determine the lighting application that can be applied. Normally, the luminaires

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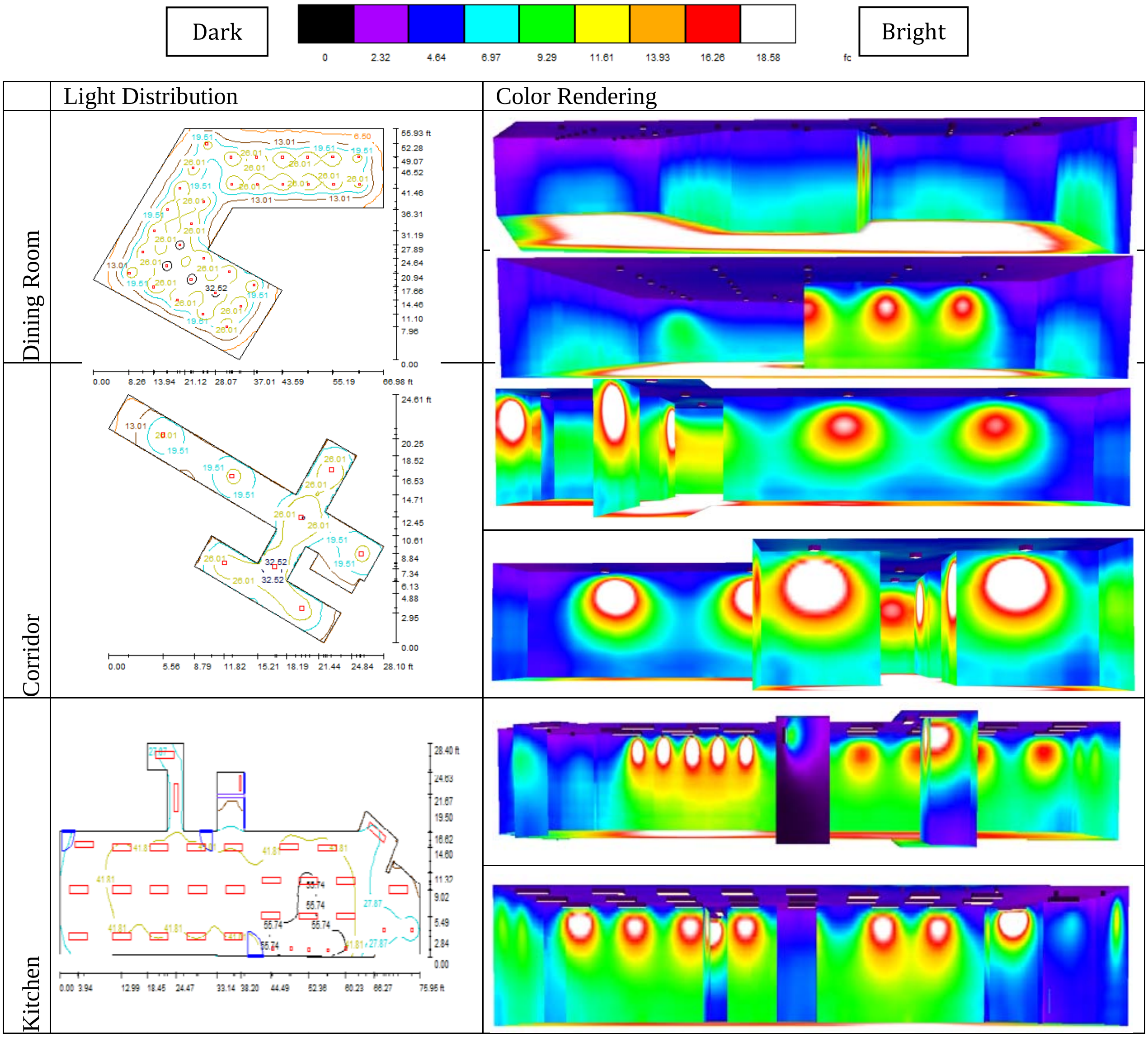
calculation will be conducted to determine the average luminaries for particular room or application that has been tested. The more the luminaries level the more the power consumed. However, there is an IES Standards Illumination level need to be followed for particular location that has been set by Malaysia authorities. Table 1 shows the load details toward energy saving type for indoor lighting in the restaurant. The diversity factor was chosen by following the standard that had been given by Malaysia electrical authorities. (e.g. JKR Malaysia). Based on the lighting simulation, the suitable lighting fitting can be chosen by considering lux and energy consumption elements.

**Table 1:** Load Details – Energy saving type.

| *Item* | *Description* | *Unit Load (kW)* | *Qty* | *Connected Load (kW)* | *Diversity Factor* | Maximum Demand (kW) |
|---|---|---|---|---|---|---|
| Lighting bar | EXTRALEDSATURN2X18W<br>EXTRALEDBATTEN1X18W<br>EXTRALEDBATTEN1X9W<br>EXTRALEDLMH25W<br>EXTRALEDLMH11W | 0.036<br>0.018<br>0.009<br>0.025<br>0.011 | 49<br>2<br>1<br>87<br>8 | 1.764<br>0.036<br>0.009<br>2.175<br>0.088 | 0.66 | 1.1642<br>0.0237<br>0.0059<br>1.4255<br>0.0580 |
| | Total | | | 4.072 | | 2.6773 |

***Lighting Simulation:***
***Light Distribution:***



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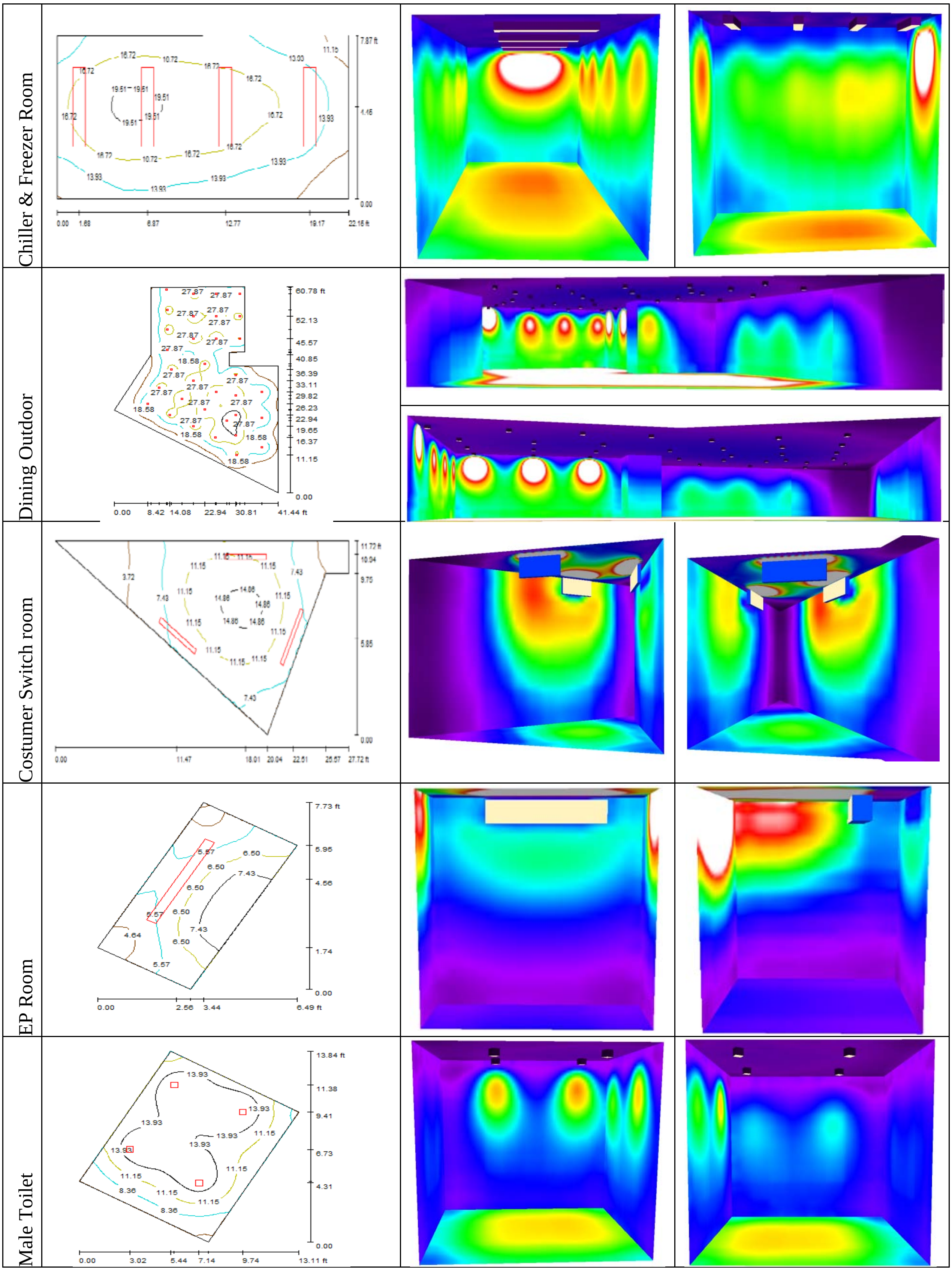

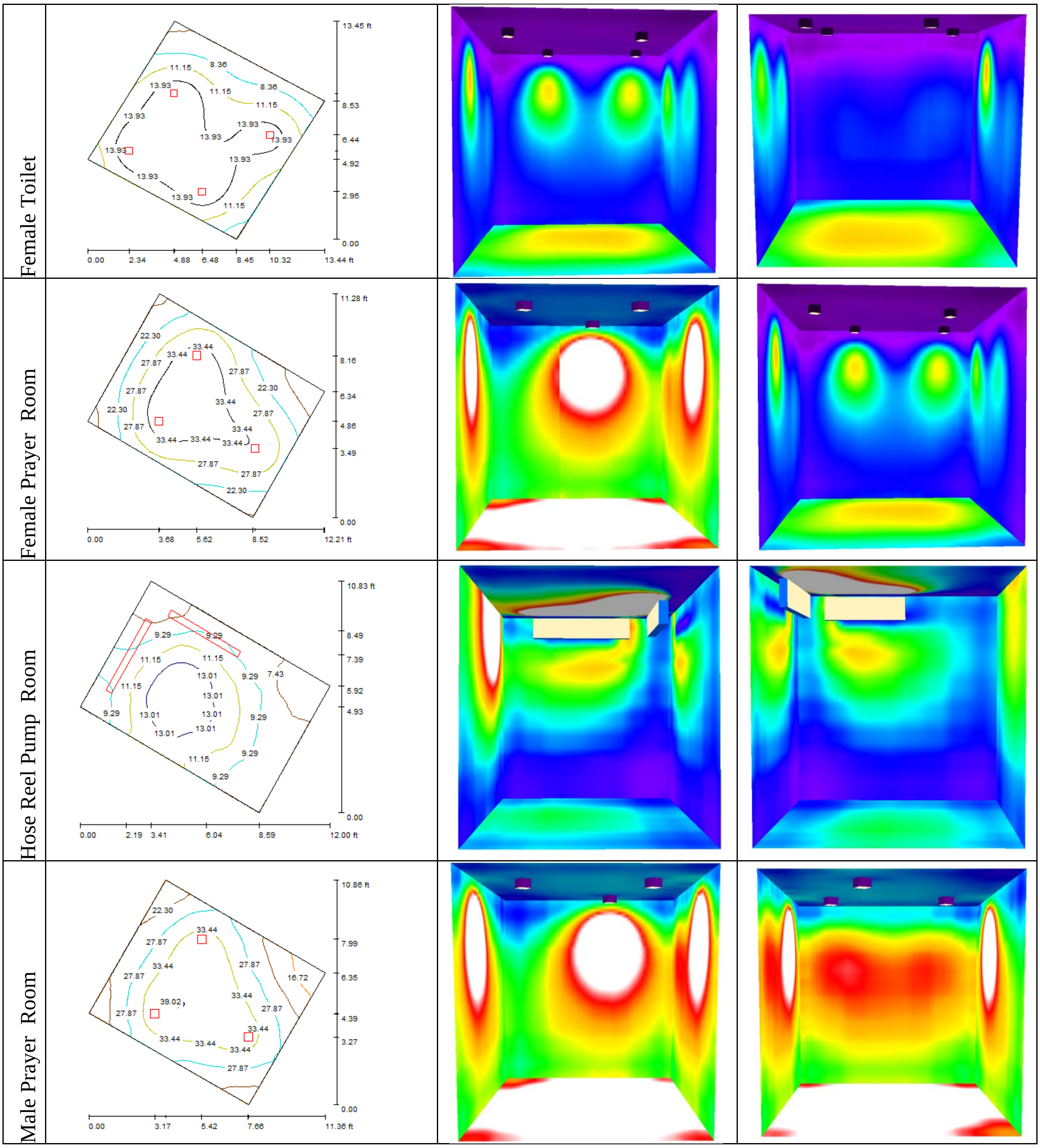


***Lighting Zone by DIALUX simulation:***

The lighting strategies will be divided by seven zones of lighting. Each of the zones will have the control circuit to enhance the energy saving consumption. The kitchen area is the major part of assessment; this area had been consumed0.1354 watt by considering 10.97 W/m2 at 123.43 m2 for ground area. In dining area, the total energy usage is 0.0831 watt at 4.82 W/m2 in 172.64 m2 for ground area. In addition, dining outdoor area consumed 0.0831 watt at 5.82 W/m2 in 142.78 m2 for ground area.Corridor area consumed 0.0201 watt at 10.07 W/m2 in 20.01m2 for ground level. Chiller and freezer room consumed 0.0088 watt at 5.43 W/m2 in 16.20 m2 for ground area. The remaining zones area will reflect the low energy consumption within the range of 0 to 0.002 watt where by 20% of saving area. All the lighting been used is compiled for MS 1525:2007 standard to enhance the energy saving achievement. LED lighting is used to minimize the energy to improve energy efficiency in the restaurant. The LED implementation will not reduce the capital cost due to installation, but it will give a better result in term of return of investment ROI. In order to meet the GBI requirement, all the lighting is individual switch where the size of individual switched lighting zones is not exceed 100m2 for 90% of the NLA.

***Daylight Factor:***

Daylight factor is expressed as a percentage of the ratio of internal illumination falling on the work plane divided by the external illumination on a horizontal plane under an overcast sky. The daylight factors need to be considered to enhance the electrical energy efficiency performance in enclosed space area. In the kitchen area, the sky light tunnel at the top of roof is introduced to achieve the percentage of daylight factor that is required by the GBI standard tool which is greater than 75% of space population required.Provide proper roof insulation (U-value) at lightweight roof U less than 0.4 W/m2k.A sky tunnel can provide between 1000 and 2000 lux on a sunny day. While for indoor dining area, glass with good thermal properties which is double glass low E unit type has been used at the side wall to provide well light on a sunny day. This strategy will improve the optimal energy usage in lighting where by the daylight factor in a space more than 4% measured at floor level.

***Light sensor, motion sensor and controller:***

Light sensor can be classified into two major classes that are photosensor and passive infrared sensor (pyroelectric sensor). Well, in this case study passive infrared sensor was highly recommended. The basis function of passive infrared sensor is to detect the temperature. For an example, a human body with skin temperature that will normally emitted infrared in wavelength of micrometer which can be easily detected by the passive infrared sensor since it was very high in sensitivity with change of infrared intensity. So, after the sensor detected the change of infrared, it will automatically turn on the light and turn off upon the time set in the timer. So, it does not waste energy if someone forgot to turn off the light after leaving the room. Passive infrared sensor normally set up in indoor dinning, outdoor dining, and kitchen and so on. By this way, it could save up to 50% of electrical. Also, the light can be manually turn on as well and turn off automatically upon the time set after some modification being made. The motion sensor can be obtained in so many types available in the market. Infrared motion sensor is the new 180 degree ceiling mount PIR detector that can be operated automatically to on the light when needed and turn light off when leave. It consumed only 0.45 watt at static 0.1 watt required. Working humidity is less than 93% of relative humidity. It can be easily adjusted by tuning the lux and timer for certain application depends on the location. Otherwise, another option is embedded motion sensor complete with LED tube can be applied to achieve GBI required in order to meet gold score mark. Therefore, motion sensor had been used in prayer rooms, toilet, store room, chiller and freezer rooms for this building.

***Insulative Paint:***

Insulative paint is the paint containing ceramic micro-spheres which possess heat reflect properties. This function work same as the applied on the tiles on space shuttle but space shuttle used ceramic based material instead of ceramic micro-spheres. When the paint dried after painted, the ceramic micro-spheres inside the paint were able to reflect, refract and dissipates heat rapidly thus it will make the house maintain it room temperature because the extra heat from sunlight does not penetrate into the house. For an example, a product from Nippon weatherbondsolarreflect was designed by Nippon Paint Company was applicable GBI credit. This type of paint can help in reflect heat and reduce surface temperature of the wall and maintain the house in lower temperature.

***Electrical Sub-metering for lighting:***

As to prove the energy saving improvement, the sub-metering needs to be installed in order to monitor the energy usage in the building. Conventionally, there has main metering used to measure the total energy usage that had been installed by the authority (e.g TNB).However, the problem come from the result is based on the all energy used in the building, whereas details energy consumption in lighting cannot be properly measured or monitored.Thus, this issue can be solved by implementing the sub-metering for lighting to monitor energy consumption that only focus on lighting. The implementation of sub-metering can improve power management system in the building toward energy saving performance. Result obtained from sub-metering can easily identify the energy usage by days, months and years. Basically, as to comply GBI rating for gold score mark, six sub-meters have been installed especially in lighting to energy saving performance.

***Conclusions:***

As conclusion, this paper describes the basic study on indoor lighting performance at the restaurant for non-residential new construction development. The basic study on illumination is conducted through calculation by using illuminance formula which has been used nowadays. The number of luminaires can be obtained by installing energy saving tube/bulb at particular room in the building. The DIALux software also been used in this paper to evaluate the lighting effect for each room in the building by using false color rendering method.

In addition, focusing in indoor lighting energy saving performance might lead to consider other strategies to enhance energy usage. The lighting zones, daylight factor, light sensor, motion sensor and controller, insulative paint and sub-metering are the strategies that have been applied to improve energy consumption. It is shown that

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the LED lamps with less wattage can also brighten the room with the illuminances that is fixed in the IES Standards Illumination Level.

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## REFERENCES

Kassim, A.M., M.S. Jamri, M.N. Othman, M.Z.A. Rashid,S.J.S. Ismail, 2013. Advanced Materials Research,748:.1125-1129.

System Design for Building,International Conference Intelligent Systems, Modeling and Simulation (ISMS), pp: 282-286.

The Green building explanatory Booklet, 2012.Malaysia Green Building Council.

The green pages Malaysia, 2011. The green building products& service directory, Issue 1.

Wan NorsyafizanW.Muhamad, Mohamad Yusof Mat Zain, 2010.Energy Efficient Lighting.