

# The Comparison Study Between UK Daylighting Simulation-Malaysia Daylighting Simulations Due To Overcast Sky Conditions

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**Abstract**—Due to the growing demand for building energy simulation in buildings, lot of work has been done in research since last 50 years but still a huge area needs to be covered. The current state of research which is moving towards building energy simulation is driven by the ongoing development. The ability to analyze energy requirements accurately in new buildings at various design stages can help clients achieve optimization and meet the requirements laid down by local energy legislation. Further increase in the demand for building energy performance simulation is too completed as new policies and regulations are coming up, such as the European Union (EU) directive on building energy performance. With increasing concern in this field, architects and building designers are demanding more simulation and validation to be performed on buildings prior to construction, so as to better understand the building design and energy performance relationships. This compassion study presented the sky conditions which are varying every single second. Therefore to analyze the performance of daylighting, its effectiveness that affected into work places in two different locations in UK and Malaysia.

**Keywords**—Day-lighting; Simulation; Energy Saving; RADIANCE, & IES(VE)

## I. INTRODUCTION

Guan et al. (2010), suggest that the Climate has influence in the building energy performance and its parameters like temperature on heating and cooling, wind speed and direction on space heating and ventilation, the solar radiation on cooling and lighting, hours of day lighting. In building design, daylighting is an essential element of any building. U.S. department of energy (2012) suggests that proper lighting improves the performance of indoor spaces and provides illumination for risk and activities.

An efficient lighting strategy, including natural daylighting, can provide proper levels of illumination and reduce energy costs. Achieving these, benefits require integration of natural and artificial lighting sources early in the building design process (Energy efficiency & Renewable energy buildings, 2014). According to U.S. department of Energy (2014), lighting technologies are presented as follows:

- Daylighting
- Lighting controls devices
- Lamps
- Ballasts
- Luminaries

### A. Main Objectives of this Research

- How the energy performance varying envelope design by generic air conditioned office model
- How to make interlink between envelop building design and energy performance
- How can simulation software predict the relative performance of buildings with typical envelope design characteristics

## II. COMPARISON BETWEEN DAYLIGHTING SIMULATION

### A. Malaysia Daylighting Simulation

This research presented the IES<VE> lighting simulation software has used to predict the impact of envelope building design for energy saving due to daylighting In Malaysia. The aim of this research is how the software can be applied and the results were compared through the use of lighting simulation and also compare similar results as those produced by a lighting simulation, thus validate the simulation software or tool (Ahmed & Ibrahim, 2014). In this study given brief information about the available integrated tools or software's capacity which are able to provide detailed information about the solar energy and building parameters (Crawley et al., 2012). Still it's a big issue for selection of accurate simulation software or tool in the industry so the researcher can identify the widely used lighting simulation software for building design simulation.

IES<VE> lighting simulation software work on perimeter base case model, researcher used the same assumption for the simulation with daylight use which is shown in Fig 1 and Fig 2.

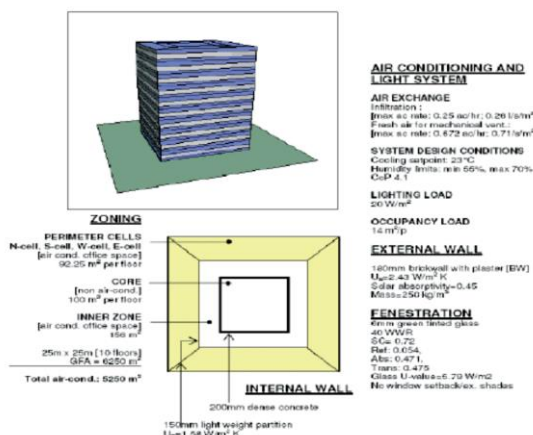


Figure 1 Descriptions of base-case model

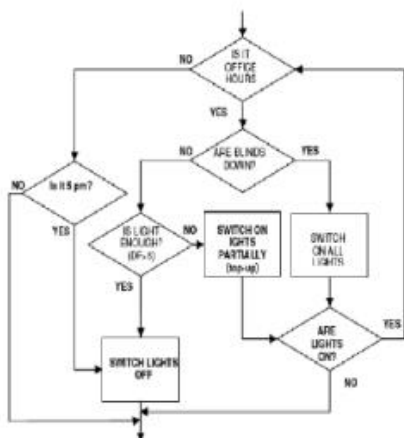
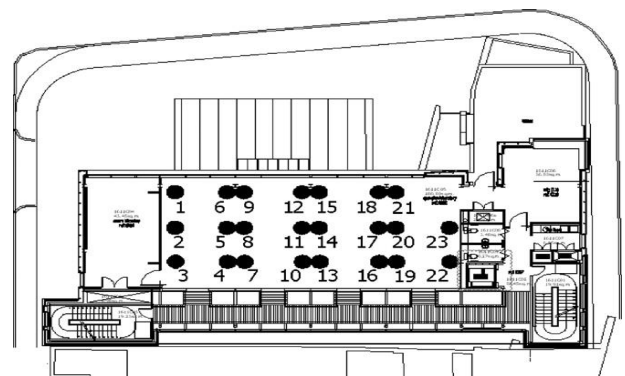


Figure 2 Block diagram of light switching pattern in response to blinds operation

After the experiment researcher claimed the reliability of the prediction was proven by IES<VE> lighting simulation software.

### B. United Kingdom Daylighting Simulation

This research used RADIANCE lighting simulation software. To show the importance of daylighting which are transferred across the glazing, in sunny periods shading is needed to prevent excess brightness into work places which may cause luminance distribution. This study is located in Sheffield, in the University of Sheffield, United Kingdom. The aim of this study is the south façade capable of providing appropriate daylighting into the working environment, to check and verify is luminance acceptable or not are the luminance distribution selected for the lighting measurement used daylighting simulation, so from 1 to 23 points mark into the actual building and for representation shown in floor plan in Fig 3.



The researcher wanted to see the luminance due to direct sun light and no artificial light used. Then measured where is brighter or dark into room.

RADIANCE is used for daylighting simulation to evaluate the daylighting performance which helps in calculating the brightness levels over the working area, as shown in Fig 4 and Fig 5.

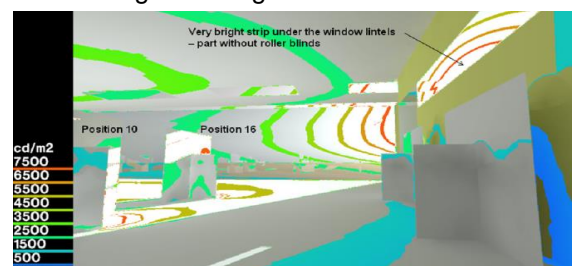
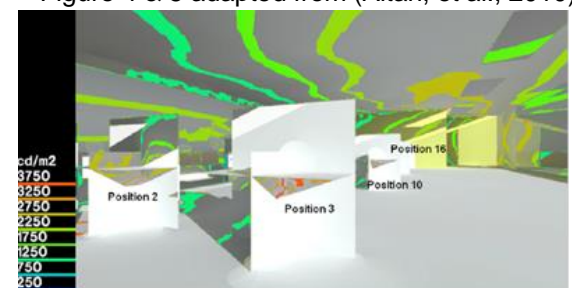


Figure 4 & 5 adapted from (Altan, et al., 2010)



The research findings of the experiment concluded that daylighting can provide a high quality of work performance in the environment.

### III. HIGH PERFORMANCE BUILDING IN DIFFERENT COMPONENTS

Energy efficiency means using your building's individual components to do the same job, less efficient components for less money over the long term (U.S. Department of Energy, 2010).

The components of efficient building apply to everything from the building envelope which includes efficient lighting, windows, foundation, insulation and roof) to achieving less energy, less cost to work, and have less of an environmental impact than predictable building design.

So that case must need to have high performance buildings. The process of designing, constructing, or renovating a high performance building must be different from traditional design methods (U.S. Department of Energy, 2010).

This section provides component names, which are used in the process of designing, constructing, or renovating a high performance building. This study also describes the key steps and component names. Moreover, two components will be discussed to provide a successful green building or renovation design.

- Lighting and day lighting
- Building envelope
- Whole building design
- Site design and planning
- HVAC systems (Heating, Ventilation, and Air Conditioning )
- Service water heating

#### A. Lighting and Daylighting

In building design, daylighting is an essential element of any building. U.S. department of energy (2008) suggests that proper lighting improves the performance of indoor spaces and provides illumination for risk and activities. An efficient lighting strategy, including natural daylighting, can provide proper levels of illumination and reduce energy costs. Achieving these, benefits require integration of natural and artificial lighting sources early in the building design process (Energy efficiency & Renewable energy buildings, 2008).

#### B. Lighting Controls Devices

These devices can help in terms of saving energy and making lighting more flexible. Around the world most commonly lighting system used on/off switch plugs, but using new technology lighting would be performed more efficiently (U.S. department of energy, 2008). These new technologies are as follows:

- Sound sensors
- Manual dimming
- Occupancy sensors
- Clock wise switches (timers)
- Centralized control

#### C. Lamp

It is widely used to produce light. Lamp's performance are used to Color rendering index (CRI) is the way of measuring a light source accuracy in rendering different colors when it is going to be compared with reference light source with the same correlated color temperature. The highest realistic CRI is 100 Lamps. So the Lamps with CRI above 70 are typically used in office and living environments.

Correlated color temperature (CCT) is also the way to measure on degrees Kelvin (k) by using warmth or coolness of lamps color appearance. In correlated color temperature (CCT) 3200 K is considered warm and 4000 K is considered cool. Efficacy is the light output power ratio, which is measured in lumens per watt, and it is represented by lm/w. to get the more efficient lamp then efficacy must be increased.

Lumps are divided into six types, which are as follows:

- Incandescent Lamps
- Fluorescent Lamps
- Compact fluorescent Lamps
- Low pressure sodium Lamps
- Solid state lighting (LEDs and OLED's)

#### D. Ballast

It is used for consumption with electric discharge lamps such as fluorescent lamps, so it can transform and control to electric power to the light (U.S dept of Energy, 2008). To identify its performance we must consider Ballast factor (BF), Ballast efficacy factor (BEF), and system efficacy.

There are three types of Ballast, which are as follows:

- Magnetic ballasts
- Hybrid ballasts
- Electronic ballasts

#### E. Building Envelope

The building envelope plays vital role in regulating the indoor environment because its very important and critical component of any facility since law protects the building occupants (U.S. department of energy, 2008). They have included all components of the building like:

- Walls
- Roof
- Doors
- Windows

### IV. FOCUS ON LIGHTING SIMULATION

The use of lighting simulation software has increased in recent years due to the growing demands in energy crises, renewable energy resources, sustainability, and health by using daylight in space rather than artificial lights in commercial or institutional space with windows or skylights (Gary, 2012).

Lighting simulation plays a vital role to improve energy performance quality in built environment. According to Tuner (2004), without assessing lighting simulation in buildings will be subject to the negative effects of daylights, whether or not they use its positive qualities because lighting effects may also be used to highlight changes in moods, atmosphere and it can be used for different purposes, by specifically focusing on it's current operation and implementation into the design process.

In doing so, the illumination design could not be operated or complete unless day lighting effects are addressed. Assessing daylights in building design is called 'useful day light illuminance' or 'UDI' (Gary, 2012).

The lighting simulation in building design is a complicated process involving modeling and analytical skills, so the building practitioners and designer are often found to carry out the building energy analysis and comprehend the day lighting simulation results.

#### V. CONCLUSION

This research investigates the important underlying issues affecting the effective use of building lighting simulation tools for validation. The rationale and important issues of lighting have an effect upon performance and have economical consequences. This is of particular concern for commercial or institutional buildings.

This comparative study has discussed the importance of building energy simulations and issues affecting the use of building energy simulation to improve the building efficiency. Around the world majority of new projects are trying to achieve cost, time, and effort reduction. Preventing wider use of simulation in design practice could be overcome and the gap between design and simulation can be bridged. Additionally, energy building codes would also be useful for the design control.

Comparisons between two different continental countries (i.e Malaysia, Asia and UK, Europe) were performed in this research. The experiments, which were based on daylighting simulation relating overcast sky conditions, resulted in successful conclusions. As the research finding states, Malaysia daylight luminance was higher as compared to UK, since Malaysia has a hot climate and most of time the sky conditions are good and clear.

Finally the research derived the reliability of the prediction of the lighting simulation software. Most difficult tasks of the research consisted of designing actual architecture into 3D models and validating the accuracy of the existing building design. Further increase in the demand for lighting performance too completed as new policies and regulations. With increasing concern in this field, architectural industry are demanding more simulation and validation to be performed on buildings prior to construction, so as to

understand better the building design and lighting performance relationships.

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