

ASSESSING ILLUMINANCE LEVELS IN FEMALE UNDERGRADUATE HOSTELS AT THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA

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ABSTRACT

Providing conducive living environments that support academic success and overall well-being is a paramount concern for higher educational institutions in Nigeria. This study investigates the illumination levels within the female hostel facilities at the Federal University of Technology, Akure (FUTA) with a view to improving the database of indoor environmental quality of higher education buildings in South West Nigeria. The objectives that guided the research are to firstly, assess the illuminance levels in the two selected case study units (Jibowu and Awosika halls of residence). Secondly, to compare the measured values against the international standard, whether it was within limit levels. The hourly measurement was carried out using a HS1010A equipment, a handheld light meter on November 1, 2024. The analysis was carried out using descriptive statistics and the student t-test statistical tool. Key findings reveal that the mean value for double-loaded corridor-based hostel design was 180.9 lux compared to 190.8 lux for the courtyard-based hostel. The study concludes that light levels in the rooms of both the courtyard and double-loaded corridor models are within the Nigerian standard of 64.58 lux. However, for the international standard, the results seem to be inconsistent. Longer measurement period to cover both dry and wet season is suggested for further studies.

Keywords: Comfort; Courtyard; Higher educational institutions; Lighting; Occupants.

1. | Introduction

Visual comfort plays a crucial role in both architecture and interior design, significantly affecting the well-being, productivity, and overall satisfaction of building occupants (Hulatt, 2026). This study focuses on assessing the visual comfort levels in female hostels at the Federal University of Technology, Akure, Nigeria (FUTA). The overarching research question guiding this study is "to what extent is the illumination levels in the female hostels at The Federal University of Technology, Akure, Nigeria within acceptable limits? The aim of this

research was to assess the illuminance levels in the female hostels with a view to providing more information towards supporting the indoor environmental quality planning for hostels in the Federal University of Technology, Akure, Nigeria and other hostels in the South West Region of Nigeria. To achieve this aim, measurement and analysis of the illuminance levels in the selected hostel was carried out using the building performance benchmarks for lighting in residential buildings. Female hostels in the Federal University of Technology, Akure, Nigeria comprises of eight

halls in total, with a living capacity of 850 students (FUTA, 2021).

1.1 | Measurement of Illuminance Level

Measuring illuminance levels is a crucial aspect of assessing visual comfort in buildings. Illuminance is defined as the amount of light falling on a surface, it is the total luminous flux incident on a surface per unit area (Szokolay, 2008). It is typically measured in lux (lumen/m²) or foot candles (lumen/ft²). The assessment of illuminance levels provides quantitative data on the quantity of light available in a space, which is essential for evaluating whether lighting conditions meet recommended standards. Measurement of illuminance level was carried out in a higher education facility in Malaysia, the results shows that there was no clear pattern established in the classroom, about 62 % of the measuring period the classroom was within the Malaysian standard (300-500 Lux) and at some other period the light level was below the Malaysian standard (Seman *et al.*, 2020).

Illuminance according to Zitzewitz (2004) can be expressed as:

$$E = \Phi / A \dots \text{(Equation 1)}$$

Where:

E = light intensity, illuminance (lm/m², lux)

Φ = luminous flux-the quantity of light emitted by a light source (lumen, lm)

A = area (m²)

Illuminance is a simple internationally agreed photometric measure and it can be carried at a point in time and also continuously within a period (Konstanzo *et al.*, 2020).

1.2 | Building Performance Benchmarks for lighting in Residential Buildings

This concept expects that a certain light level would present the room as lively, acceptable, satisfactory, productive and would assist the occupants of the hostels to live healthy lives (Preiser & Vischer, 2004; US Green Building Council, USGBC, 2025). This in turn is expected to make a success out of the students' stay on campus. Below this level is internationally unacceptable. For example, the National Building Code (Federal Republic of Nigeria, 2006) expects a light level of 64.58 lux for all habitable rooms, while the Illuminating Engineering Society of North America (IESNA, 2021) suggests a minimum light level of 200 lux for rooms in residential buildings. Both documents suggest a minimum of 50 lux for way finding. Reports of low illuminance levels tend to be prevalent in educational facilities (Budhinyanto, *et al.*, 2024). Both instantaneous measures and seasonal measures are relevant (Davoodi *et al.*, 2021) Subjective evaluations using post occupancy evaluation protocols is also a possibility (Fakhari *et al.*, 2021).

2. | Materials and Methods

The research employs a case study approach to assess visual comfort in the selected hostels. Quantitative data was collected using a HS1010A equipment (Figure 1), a handheld light meter to measure illuminance levels between 8 am and 7 pm on the 1st of November, 2024 in two hostels: Jibowu and Awosika Hostels in the Federal University of Technology, Akure, Nigeria. Preliminary analysis of the layouts of the hostels was carried out and it was observed that Jibowu Main Hall, Jibowu Annex 1, Jibowu Annex 2, Jibowu Annex 3, Oba Adebiyi Adesida Afunbiowo and Jadesola Akande Hall have similar layouts with centralized courtyards while Futascoops Hostel and Awosika Hostel have double-loaded corridor systems. Using a fish bowl arrangement, Jibowu Main Hall was selected as case study 1 to represent the courtyard model while

the Awosika Hall was selected for the double-loaded corridor-based hostel.

The measurements were carried out hourly from 8 am to 7 pm on the 1st November, 2024 to capture typical lighting conditions experienced by residents during the day. The light readings were taken hourly with the light meter positioned at a distance of 1500 mm away from the walls and 800 mm away from the floor at a height of 720 mm. The reason for the choice of two cases, was to be able to answer the research question, whether the light level is significantly different from the national and international standard in both cases. This method of research is commonly referred to as quasi-experimental research (Woodside, 2014). It can also be called a cross-sectional study, this kind of study is useful for an initial part of a future research (Wang *et al.*, 2020). The study is limited by the very way natural lighting interacts with building interiors, which changes by season. It is more intense and there are clearer skylines in the dry season than in the wet season in the research area. The research is thus limited to the measurements on the 1st of November, 2025, this falls within the dry season period, the day was clear, with no rain.



Figure
picture

1 | A
of the

HS1010A light meter.
Source | Tester (2024)

Case Study 1: Jibowu Main Hall

The Jibowu Main Hall is located within the university along Elkanemi Road, off Faduyi Street. The hostel was commissioned in the late 1990s, with a population of 570 students (FUTA, 2021) aligning with FUTA's commitment to enhancing student accommodation. It consists of a main block with rooms on the ground floor and the first floor, while Block 2 is a bungalow building which stands alone. This research will be limited to the main block only. The layout takes after the traditional courtyard system. Each room with features two sets of louvre windows. The first set of windows are open to the connecting corridors leading to the courtyard, it consists of two units measuring 900 mm by 1200 mm each, while the opposite window in between the beds measures 2700 mm by 1200 mm and opens to the outside of the building (Figure 2, Figure 3 & Figure 4). One room was selected on the first floor for the study. The dimensions of the room is 4.5 m by 4.86 m, making an area of 21.87 m², the axis along the length of the room is in the North-East, South-West orientation.



Figure 2 | Site Layout of Jibowu Hostel, FUTA.
Source | Google Earth (2024)

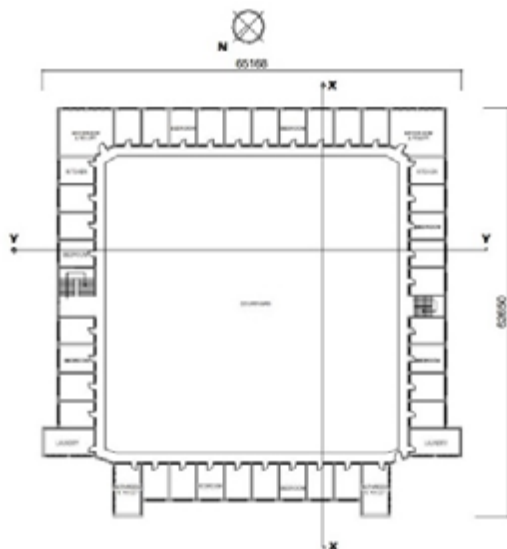


Figure 3 | Ground Floor Plan of Jibowu Hostel, FUTA
Source | The Directorate of Physical Planning, FUTA.



Figure 4 | Aerial photograph of the Jibowu Main Hall
Source | The Directorate of Physical Planning, FUTA.

Case Study 2: The Awosika Hostel

The Awosika Hostel is located within the Federal University of Technology, Akure (FUTA), it is in close proximity to the School of Earth and Mineral Science and Adeboye Hostel. It was commissioned in 2011. It was designed to accommodate 780 students

(FUTA, 2021). The two-storey building consists of various facilities, including bedrooms, bathrooms, toilets, kitchens, reading rooms, butteries and a reception area. The layout combines a central courtyard with the double-loaded corridor system, with each wing having a long hallway connecting rooms together (Figure 5, Figure 6 & Figure 7). A

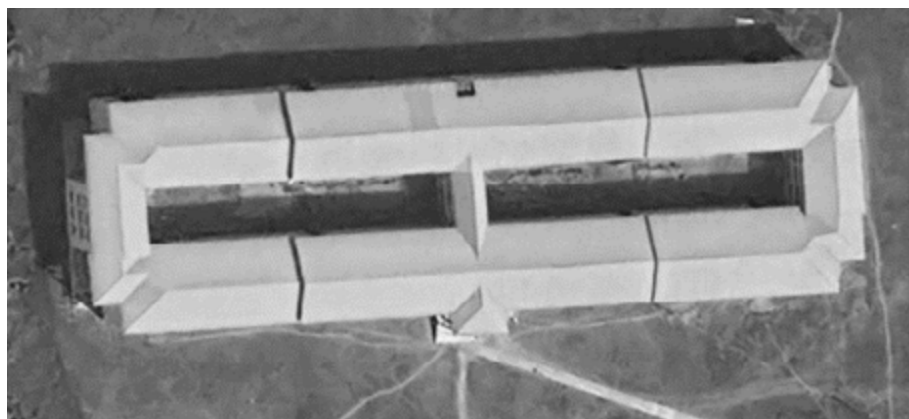


Figure 5 | Layout of the Awosika Hostel
Source | Google Earth (2024).

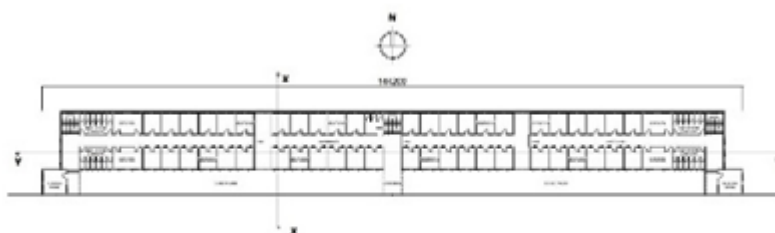


Figure 6 | Part Ground Floor Plan of the Awosika Hostel, FUTA.
Source | The Directorate of Physical Planning, FUTA.



Figure 7 | An aerial view of the Awosika Hostel
Source | The Directorate of Physical Planning, FUTA.

representative room was also selected in the first floor, where the measurements were carried out. The room has a length of 4.8 m by a breadth of 4.5 m, making an area of 21.6 m². The longer side of the room is located along the North-South axis.

3. | Results and Discussion

A quick visual check of the shape of the histogram for the datasets was carried out, it was discovered that the dataset for the double-loaded corridor-based design was skewed, thus a decision was taken to further check for the normality of both datasets using the Kolmogorov-Smirnov test. It was discovered that the test was significant for both datasets (rooms in double-loaded corridor hostels, p-value

= 0.096 and courtyard-based hostel design, p-value = 0.200). In both cases, the significant value was higher than 0.05. Thus, the one-sample t-test was used to compare the statistical difference between the mean for the dataset and a known value, in this case the national and the international standard for residential lighting.

A descriptive analysis of the light levels in the hostel within the research area shows that the mean value for double-loaded corridor-based hostel design was 190.8 lux compared to 180.9 lux for the courtyard-based hostel (Table 1). The maximum value for the double-loaded corridor model is 330 lux at 15:00, while the minimum value was 3 lux at 19:00. In the case of the courtyard-based model, the maximum value was 360 lux also at 15:00 and the minimum

Table 1 | Descriptive statistics comparing light levels in the double-loaded corridor model with the courtyard-based model in the research area.

Variable	Hostel design attribute	Mean	Maximum (lux)	Minimum (lux)	N
1	Double-loaded corridor-based hostels (model 1)	190.8	330.0	3.0	12
2	Corridors access to the rooms in model (1)	14.3	28.0	3.0	12
3	Corridor access to the rooms in model (2)	337.5	504.0	100	12
4	Courtyard based hostels (model 2)	180.9	360.0	3.0	12

value was 3 lux at 19:00, as in the other model. In both scenarios, the mean light level for the day in the research area was above the national standard of 64.58 lux, but below the international standard of 200 lux.

When the sample mean of the light levels in the research area was tested using the Nigerian standard, similar results was arrived at in both cases (Table 2). That is the mean light levels in both the courtyard based and the double-loaded corridor-based designs was significantly above the Nigerian standard of 64.58 lux (p-value 0.001 in the two models). In likewise

manner, where the sample mean of the light levels in the research area was tested using the international standard, similar results was also arrived at in both cases (Table 3). That is, the mean light level in both cases was either significantly less or equal to the international standard of 200 lux (p-value 0.768 for double-loaded corridor and 0.547 for the courtyard-based design). Mathematically, the values for both cases tend to be considered close to the international standard of 200 lux by 9.2 lux in terms of double loaded corridor-based hostels and 19.1 lux in terms of courtyard-based hostel. Practically, the effects of the slight difference may affect the building

Table 2 | One sample t-test statistics comparing light levels in the hostel models with the Nigerian standard.

Test value (64.58)			
Null hypothesis	Test	Sig	Decision
The population mean (double-loaded corridor hostel model = 190.8 is less or equal to 64.58)	One sample t-test	0.001***	Reject the null hypothesis
The population mean (court yard based hostel models = 180.9 is less or equal to 64.58)	One sample t-test	0.001***	Reject the null hypothesis

*** indicates P-value < 0.05 (5% level of significance).

Table 3 | One sample t-test statistics comparing light levels in the hostel models with the international standard.

Test value (200)			
Null hypothesis	Test	Sig	Decision
The population mean (light level in double-loaded hostel models = 190.8 is less or equal to 200)	One sample t-test	0.768	Accept the null hypothesis
The population mean (light level in court yard based hostel models = 180.9 is less or equal to 200)	One sample t-test	0.547	Accept the null hypothesis

occupants in terms of satisfaction and comfort. The result tends to be consistent with Seman *et al.*, (2020) study where the authors informed that there was no clear lighting pattern as well. This is not too surprising as the major source of daylighting from windows open to outside. Therefore, there may be a need to support natural lighting during the day with artificial lighting system.

Additionally, when comparing the mean light levels of the link corridors in the two models with the national and international standard of 50 lux, using the student t-test statistics, it was discovered that the t-test value was significantly above the 50 lux international standard for both models (Table 4). That is, the results seem to be inconsistent as discussed in earlier studies (Fakhari *et al.*, 2023; WBDG, 2024).

Table 4 | One sample t-test statistics comparing light levels in the link corridors of the hostel models with the international standard.

Test value (50)			
Null hypothesis	Test	Sig	Decision
The population mean (light level of the link corridors in the double-loaded hostel models = 14.3 is less or equal to 50)	One sample t-test	0.000	Reject the null hypothesis
The population mean (light level of the link corridors in the court yard based hostel models = 337.5 is less or equal to 50)	One sample t-test	0.000	Reject the null hypothesis

In descriptively terms, the model with courtyard has more illuminance in the corridors (337.5 lux), since the source of lighting is closer, through the courtyard compared to the model with double loaded corridors (14.3 lux), since the lighting source is at the end of the corridors. Historically, both models are popular, depending on spatial and client requirements.

4. | Conclusion

The study concludes that the light levels in the rooms of both the courtyard and double-loaded corridor models are within the Nigerian standard of 64.58 lux. However, for the international standard, the results seem to be inconsistent, since both models have less than 200 lux in the study period. In terms of the corridors leading to the rooms, the results also seem to be inconsistent because descriptively, the light level in the double loaded corridor model was 14.3 lux (less than both the national and international

standard, although in terms of the courtyard model the results was consistent. Illuminance levels lower than agreed standard might lead to dissatisfaction with the lighting system by the occupants. Historically, both the double-loaded corridor system and the courtyard system are common strategies used in residential building construction. Future studies may look at repeating the tests above when measurements are carried out for a longer period across the dry and wet season to explore the same theme.

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