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# External Shading Design Strategies within the Tropical-Modernist Nigeria: Lessons for Nigerian Designers

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***Abstract:***
*The use of external shading devices proves to be the most efficient passive design strategy for direct solar control in buildings, especially in the tropics. Today, the use of exposed glazed façade as found in curtain walls and large window panes in buildings seems to be the norm. This was largely not the case with buildings designed between the '50s and the '70s in Nigeria of the tropical-modernist period when adequate consideration was given to the effect of the climate on the occupants of a building. This paper looked into the use of external shading devices on buildings in Nigeria during the tropical-modernist era within the afore-mentioned years, by first taking account of the various shading devices and design strategies available and then undertaking a study of selected tropical modernist buildings that employed external shading as a passive design strategy. The study employed case study method and secondary documentation - involving buildings selected in South-west Nigeria. The study presents historical lesson in the aspect of building inside the tropical climate; that is dealing with the solar effects in the tropical Nigeria, and adapting a style to meet our comfort need. Recommendation was then made for the re-introduction of appropriate external shading in buildings by designers. The research hence attempts to revive our adaptive architectural approaches to meeting the thermal comfort need of occupants in a space with respect to external shading.*

***Keywords:*** *External shading, tropics, thermal comfort, tropical-modernist Nigeria*

## 1. Introduction

The Tropical belt around the middle of the earth's lower latitude possesses a characteristic relatively high temperature, rainfall, relative humidity and vegetation cover. A large percent of direct solar radiation is received from the sun within this region. Hence, a substantial amount of heat (due to the high temperature) is experienced in the region from June to November each year (Nkomo, J.C., Nyong A.O. and Kulindwa K., (2006).

The effects of the intense heat on the comfort of building occupants has continually risen and has reached a critical point for designers to be concerned, especially in the advent of today's Green Architecture and much talk about Energy Efficient Buildings that climax at Net Zero Energy Buildings (NZEB). Therefore, a major challenge of designing in the tropics ishow to reduce heat gain and glare in building interiors.

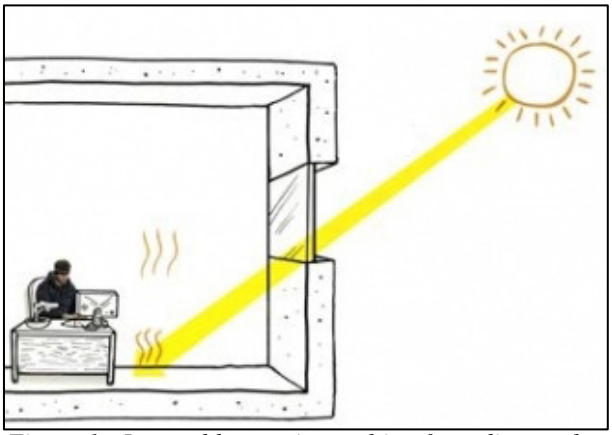

*Figure 1a:Internal heat gain resulting from direct solar radiation (Thermal discomfort)*

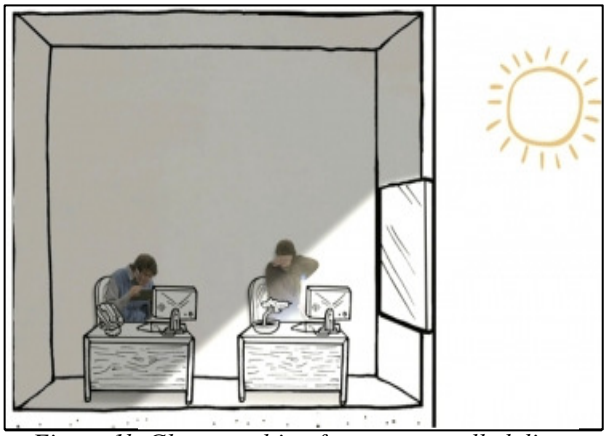

*Figure 1b:Glare resulting from uncontrolled direct sunlight used for day lighting (Visual discomfort)*

*Image sources: (Autodesk Sustainability Workshop, 2014)*

Aside factors like proper building orientation, adequate fenestrations, the use of landscape features and sustainable materials, providing appropriate external shading devices stand pivotal to the promotion of thermal comfort, visual comfort and energy efficiency in buildings (Figures 1a and 1b).The reverse is the case in temperate locale where heating of the interior is necessary at a point to maintain some level of comfort. For example, during winter periods when some degree of warmth is required to provide a balance within the space (minimizing heat loss and increasing heat gain), the use of glazing comes into place – using double glazing to create a form of thermal storage and circulatory system within the enclosure at such cold periods. Meaning, in colder climates the focus shifts from keeping solar heat out of the space to reducing heat loss to the outdoors and in some cases allowing desirable solar radiation into the interior (Okba, 2005). The reason for this is to utilize winter sun for passively heating the perimeter zones while also avoiding solar overheating in the interiors.

In Nigeria however, focus seems to be shifting from protecting the building envelope from the intense solar radiation to aesthetic facades. The need for designers to embrace the use of passive design strategies that addresses the prevailing climatic conditions in Nigeria cannot be overemphasized. With regard to the present international style, Ogunsote (2002)referred to them as not respecting local conditions of weather and that the resulting buildings often depend mainly on artificial means (active strategies) to achieve comfort.

**2. External Shading Devices and Strategies**

Sunlight provides the only option for daylight and passive heating in buildings. Much as designers need to use adequate fenestration in their designs for admittance of daylight required for visual tasks, care must be taken to prevent heat and glare. Hence, the need for the use of external shading devices in buildings, which according to Givoni (1976),is considered more effective than internal ones ( Figures 2a and 2b).

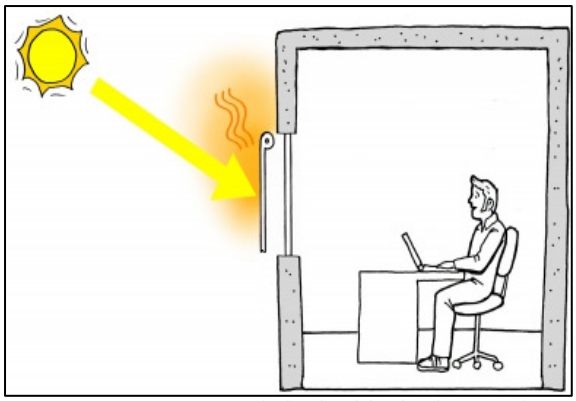

*Figure 2a: External shades blocks direct solar radiation and heat more completely than internal ones.*

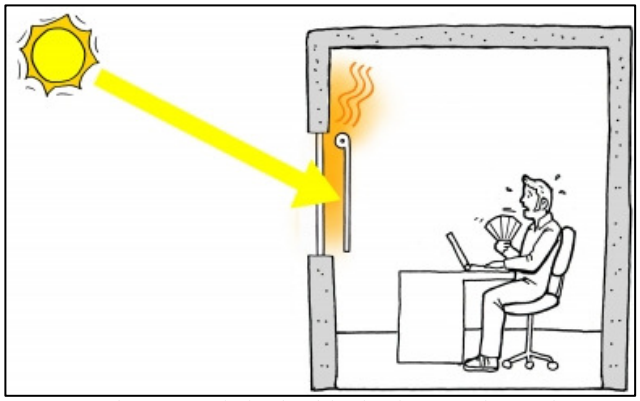

*Figure 2b: Internal shades blocks direct solar radiation, but traps much heat inside.*

*Image sources: (Autodesk Sustainable Workshop, 2014)*

Shading against direct solar heat gain is the most efficient method of passive cooling in buildings(Energy Publication, 2010).

What are external shading devices? These are design shading options incorporated ontoa building envelope with the intent of preventing the admittance of direct solar radiation and its accompanying heating effect on the interiors. Predominantly, they are used in institutional buildings, commercial buildings and high-rise residential apartments.
External shading devices can broadly be grouped into;

i. Fixed
ii. Movable

Examples of fixed shading devices are; horizontal and vertical overhang, fins and egg crate sun screen, while the movable shading device includes; the vertical and horizontal louvers, awnings, retractable canopy, external venetian blind etc.

*2.1. Horizontal and Vertical Overhang*

These are elements positioned over and across an opening as aform of sun shield horizontally or vertically. In Nigeria, they are mostly referred to as "window hoods". The more the depth of the hoods the greater the shade it provides. For effectiveness, the depth of the overhang is determined based on calculations done with the solar altitude of the building locale.

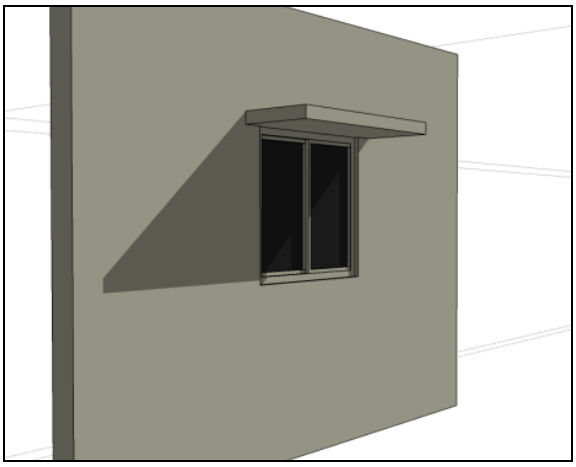

*Figure 3a: Overhang placed above opening*

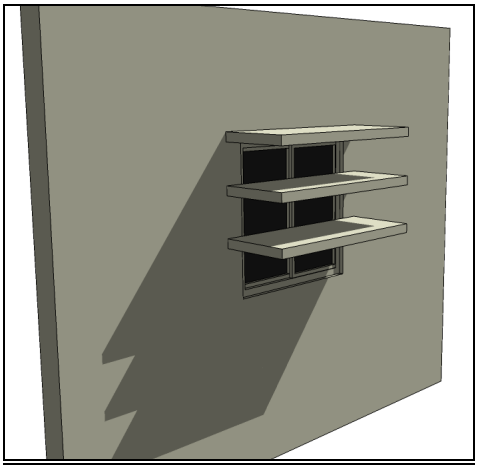

*Figure 3b: Overhang across window openings*

*Image source: Author's 3D illustrations*

*2.2. Sunscreen*

These arealuminium projections that come in the form of louvers installed vertically or horizontally over openings to limit solar penetration. Perhaps, it is highly favourable due to its lightweight and aesthetic qualities.

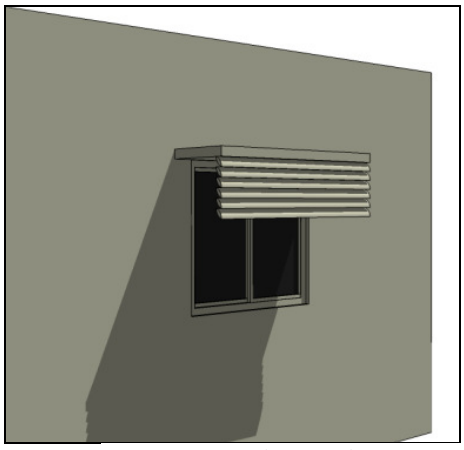

*Figure 4a: Sunscreen used in combination with overhang.*

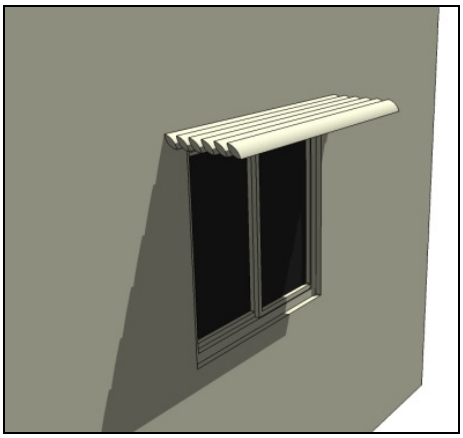

*Figure 4b: Sunscreen used horizontally in place of overhang for more diffused light while still shading.*

*Image source: Author's 3D illustrations*

*2.3. Fins*

Fins come in vertical form, protruding from the building envelope at varying depth by the sides and across openings, and are arrayed at intervals based on calculations done with the solar azimuth of the building locale.

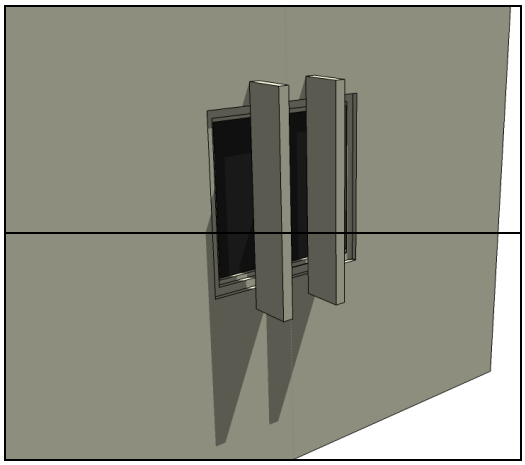

*Figure 5a: Vertical Fins used as sun shade.*

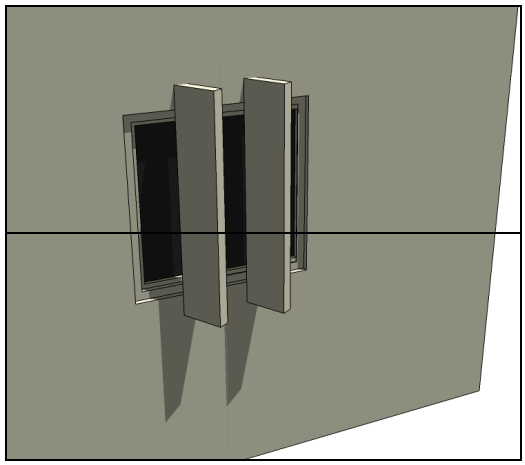

*Figure 5b: Slanted Vertical Fins used as sun*

*Image source: Author's 3D illustrations*

*2.4. Egg crate*

This possesses a combination of fixed horizontally and vertical projections, mostly made out of concrete or aluminium.

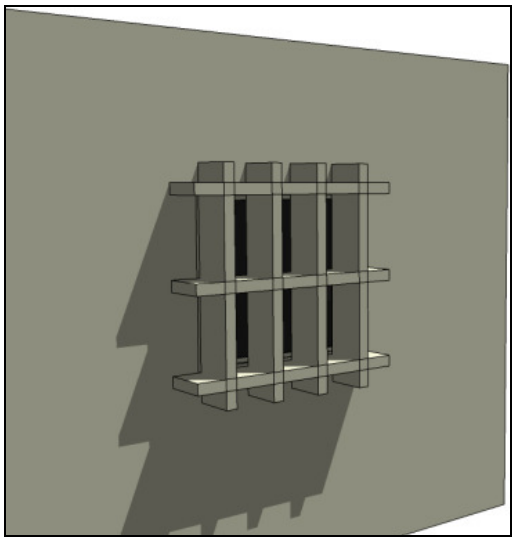

*Figure 6a: Egg crate with horizontal and vertical combined.*

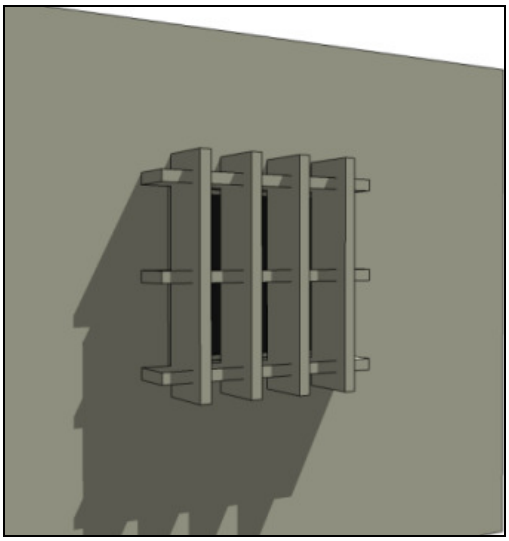

*Figure 6b: Egg crate with vertical and movable horizontal combined.*

*Image source: Author's 3D illustrations*

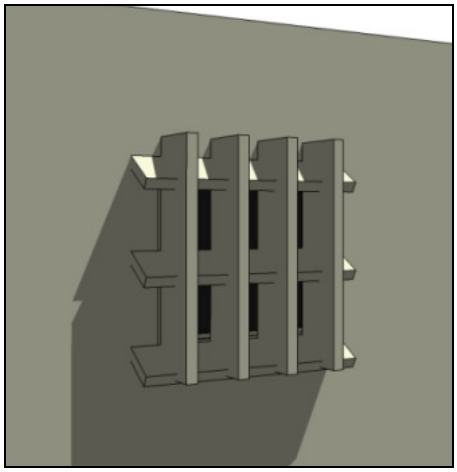

*Figure 6c: Egg crate with horizontal and slanted vertical combined.*

*Image source: Author's 3D illustrations*

*2.5. Vertical louver*

They come in the form of slats which are installed in an adjustable manner. Sometimes they could also be automated as popularly used in the developed world. They are however, capital intensive and require regular maintenance.

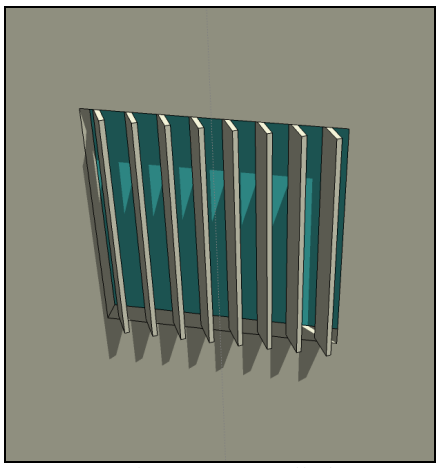

*Figure 7: Vertical Louvers installed over a window opening.*

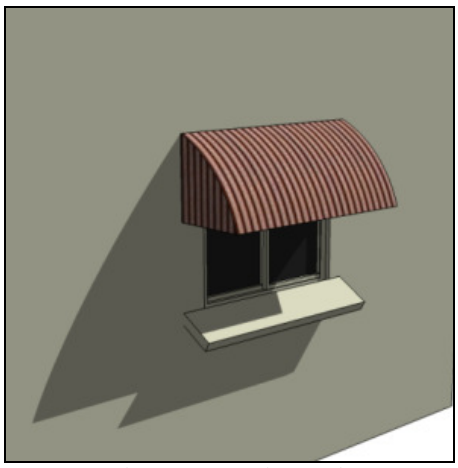

*Figure 8: Hood Awning made of fabric protruding over a window opening.*

*Image source: Author's 3D illustrations*

*2.6. Awnings*

Made of fabric or metal, awnings are used as protruding, sloping cover over and beyond openings. It is quite effective in reducing heat gain into an indoor space. They could equally be retractable. Hood awning as also known provides a good shade from solar radiation and when mounted at 45 degrees looks good to the sight.

*2.7. External venetian blind*

Made of metal (aluminium) and in the form of slat as covering on windows, they offer protection against the excessive penetration of direct sunlight and the concomitant heat and glare. Its operation and control is simply by pulling a cord which drives the single control rod.

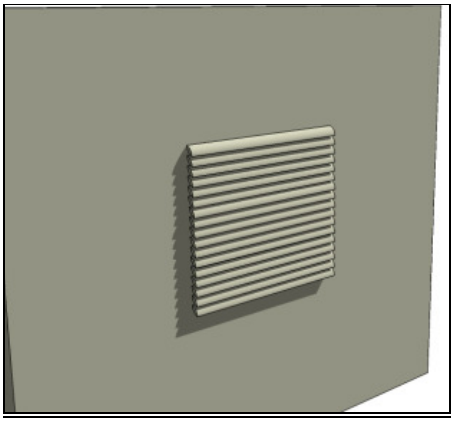

*Figure 9: External venetian blind installed over a window opening.*
*Image source: Author's 3D illustrations*

*2.8. Others*

Apart from the afore-mentioned, some balconies and verandahs are so designed to serve the function of a shading device to prevent direct solar radiation from getting to the openings below them. Likewise, "Recessed Window"also known as "Deep Reveal"isused as design strategies on building envelope. Exaggerated eaves is another solar shading technique worth mentioning.

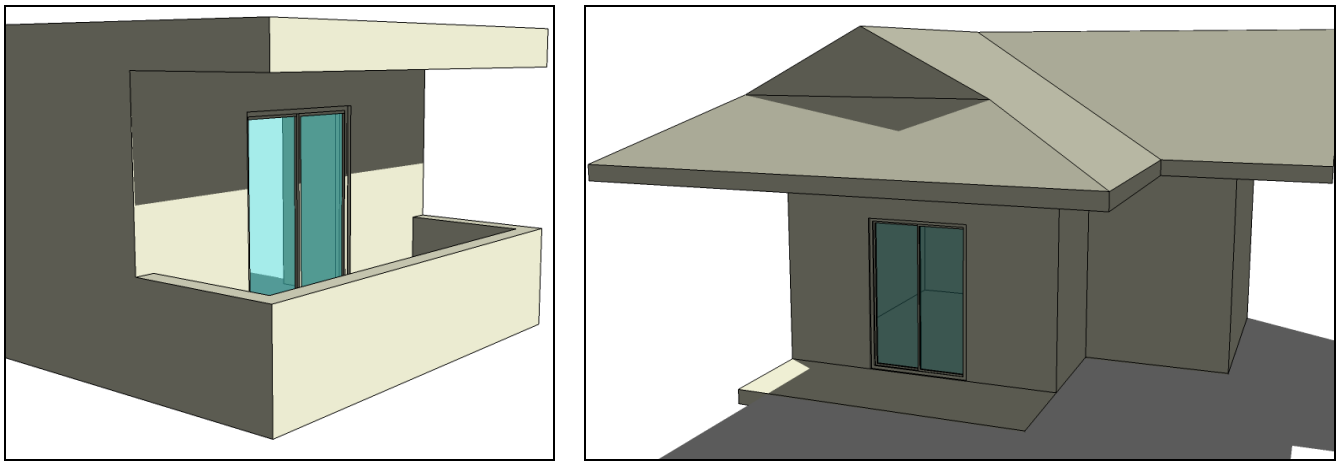

*Figure 10: Balcony and verandahs and exaggerated eaves designed for shading device.*
*Image source: Author's 3D illustrations*

In the same vein, trees are also used as "Sun Breakers" (Figure12).They are strategically planted around the building as an integral part of the landscape, but also doubles as sun breakers to passively shade the required parts of the building taking into account the building orientation vis-à-vis the sun path of the locale.

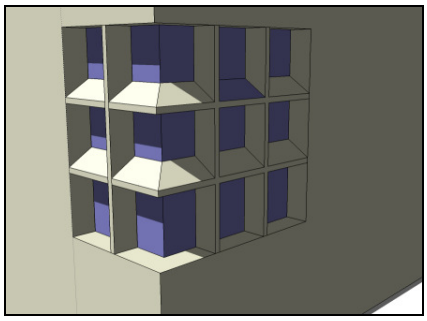

*Figure 11: "Deep Reveal".*

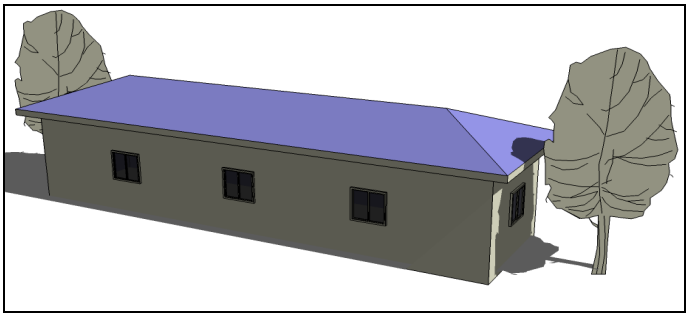

*Figure 12: Trees used as Sun Breakers.*
*Image source: Author's 3D illustrations*

**3. Tropical Modernist Nigeria: X-Ray of Architecture**

According to Daniel Immerwahr (2007), 'tropical modernism' is an "architectural idiom" developed shortly after the second world war by architects building in the British West Africa particularly in Nigeria. Their efforts were bent on providing principles by which designs in Africa would be made more adaptable to the climate of the region. The group as was constituted then, was made up of the British members and some African students who were part of the then Architectural Association (AA), and having learned their 'lessons' came down to West Africa.

It is worthy of note that these attempts were just coming behind the works of the renown international acclaimed father of modern architecture– Le Corbusier (with ideas from Mies Van DaRoheand Walter Gropius) who developed a solar responsive design strategy in the use of "Brise Soleil"from 1930 to 1950 (Figure13).According to Hannah (Le Roux, 2003), this innovation was applied in the regions of Tunisia, Algeria, Brazil, and India.

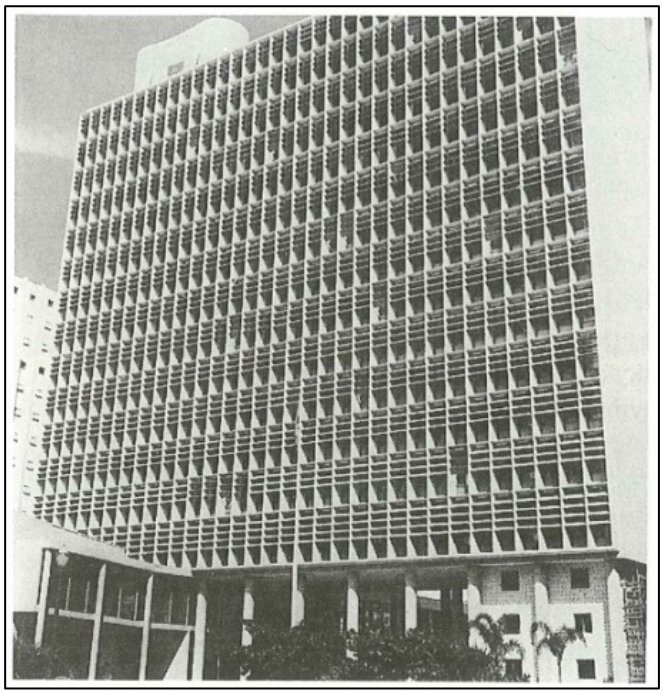

*Figure 13: Ministère de l'EducationNationale et de la Santé, Rio de Janeiro, Brazil, 1936*
*Source: (http://www.architectural – review.com/archive/1993)*

The advent of the theories of tropical architecture in Nigeria to a large extent brought about a contextually established approach to building designs in the region. Proponents abound in the 50s in Nigeria of designers who attempted at reaching a design conclusion for the tropics. Of such is the Fry and the Drew, the principal tropical modernist theorists (Immerwahr, 2007), with a few of their architectural works showing the practical design means of limiting the extent of solar penetration within the building. In the Nigerian Context, architects often tried to make the buildings suitable to the weather and local conditions. Of such architectural firms during the period are Design Group Nigeria, Oluwole Olumuyiwa & Associates, James Cubitt & Partners, Maxwell Fry& Jane Drew Partners, John Godwin &Hopwood, Alan Vaughan Richards among others. The buildings designs that fall within this category are, the Independence house, Lagos built in 1960 by the Federal Ministry of Works, the Cooperative bank, Ibadan (1956) by Maxwell Fry & Jane Drew Partners, Christ Church Cathedral School, Lagos (1957) by John Godwin & Hopwood, CSS bookshop, broad street Lagos (1977), by John Godwin & Hopwood, Kenneth Dike Library, University of Ibadan (1954), by Maxwell Fry, Drew and Associates among others.

**4. Method**

The study was undertaken and presented as an appraisal of the use of external shading design strategies in the late 50s, 60s and 70s. The study employed primary data through the use of case study method. Three buildings were selected from the south-western Nigeria – precisely Lagos and Ibadan. The buildings are identifiable as notable buildings which the era in question. The research used observation as a means of analysis. The paper did not however, delve into detailed mechanism of application.

**5. Case Study**

*5.1. Case Study I – Kenneth Dike Library, University of Ibadan*

The building which exists as one of the oldest tropical modernist style was designed by Maxwell Fry, Drew and Associates in the early 50s (1953-1954). This "archifact" pictures in an enormous sense the use of external shading devices in the then Nigerian setting when there was growing interest in designing to suite the context of the tropical climate. It was at this point that there was the emergence of a patterned guide of sunscreens – taking a cue from Le Corbusier's "Brise-Soleil"(French word for sun breaker) from one of his earlier buildings - Ministère de l'Education Nationale et de la Santé, Rio de Janeiro, Brazil, 1936. As a matter of fact, Fry and Drew built on the practical study done by Le Corbusier on the African climate.

This building consists of concrete grille (Figure 14) meant to protect the interior space from the harsh effect of solar radiation. The effectiveness of the device lies in the fact that the direct solar intensity impact is altered and made to have little effect. By the principle of convection, the remnant heat that develops passes and rolls through the gap between the grille and the inner wall thereby rising by buoyancy to be replaced which then creates a cool air bracket. Aside this, the solar radiation consequently hits the inner wall at a very minimal and insignificant level. It is really worth mentioning that there was no provision for the use of air-conditioner system in the building as it was all passively cooled through the design strategy employed by mean of the shading screen. It is on record that this strategy became a shading guide for other architects in West Africa.

*Figure 14: Kenneth Dike Library, University of Ibadan*
*Source: (http://en.wikipedia.org/wiki/file:Ibadan)*

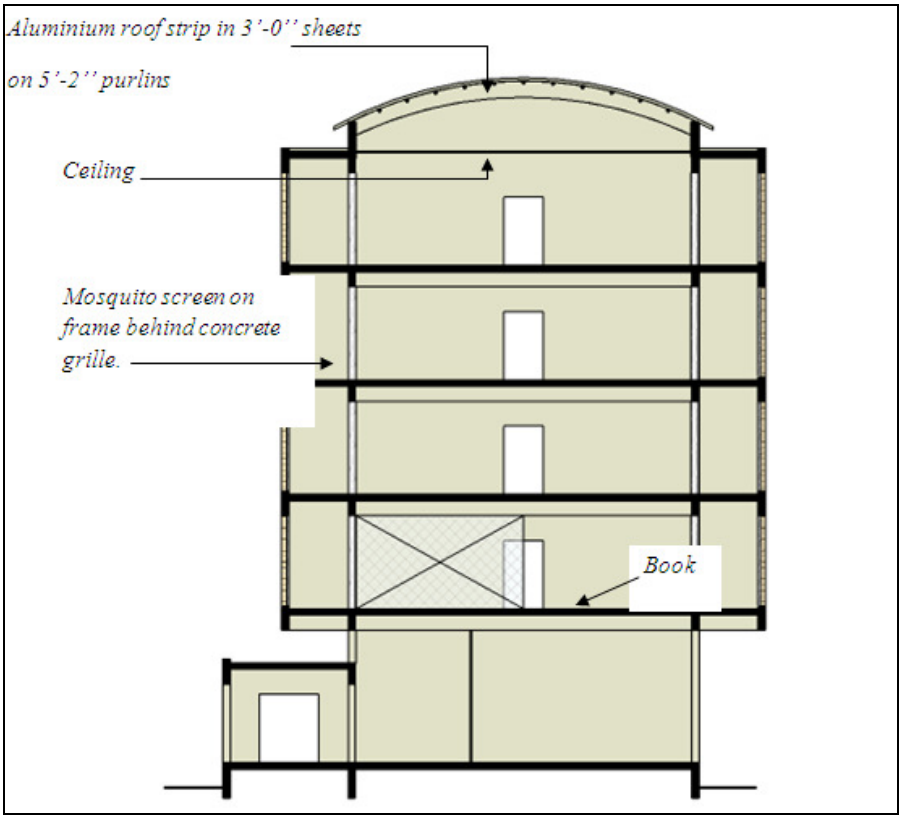


*Figure 15: Section through the library.*
*Image source: Author's 3D illustrations*

*5.2. Case Study II – Elder Dempster, Lagos*

This building was designed and constructed in 1961 by James Cubitt &Partners. James Cubitt Architects in West Africa was setup by the London practice in about 1950 in Ghana and eventually opened up the Nigerian branch in 1956. The client was Elder Dempster which was prime UK shipping company for West Africa. The building is located on a corner piece site with a narrow frontage on the

Lagos Marina, with a view onto the lagoon now the site of a flyover. In the 1960's and1970's it was the most distinguished building on the Marina. At the maximum possible height as laid down by the Lagos State Physical Planning and Urban Development Regulations and the top part of the building, bears the company's logo. The structure which is glazed on all sides has a covering of sun breakers that have been designed to protect the external wall and glazing from the strident impact of the prevailing solar radiation. Although the building as at the time was fully air conditioned, the extent of thought into the requirement for shading is commendable at the least in a warm humid climate as Nigeria. Meaning that even when the air-conditioning system is not in use the inside could still be made thermally-conducive for the occupants.


*Figure 16: Elder Dempster, Lagos*
*Source: (Uduku, 2006)*


*Figure 17: Pictorial of Book house.*
*Source: (http://www.detomosabroad.com)*

*5.3. Case Study III – Bookshop House, Lagos*

Godwin & Hopwood Chartered Architects now known as Godwin Hopwood Kuye (GHK) Architects opened up their practice in 1955 as Godwin & Hopwood Architects at 8, Oil Mill Street, Lagos after John Godwin had served with Architect's Co Partnership for about a year.

The office building was built for CSS bookshops Limited constructed on a site in central Lagos and completed in 1977. The block is fourteen-storey high comprising of a tower block of eleven storeys (Figure 17) much research was put into the climatic context of the building design. The locale was well studied in terms of exposure to solar radiation (sun's path) culminating to the temperature ranges. The firm saw it necessary to adopt design means to reduce air conditioning loads by proper insulation and protection from sun rays. All the aforementioned in the perspective of the present day issues are key factors and indices for fostering energy conservation. Having successfully used the 'shading masks' from the solar chart, the specific angles and positions of the anodized aluminium shading elements were prepared (Figures 18 &19).Besides, the shading devices was constructed and standardized to a certain length for precision. For example, it affords the occupants visual comfort whether they are sitting or standing. The overall design was indeed made so as to accommodate the variation in the amount of incident solar radiation throughout the year. And few years after construction of the building, it is on record that the design strategy has worked well. Most especially in keeping an appreciable degree of thermal comfort at the times when the Air-Conditioning system was not in use.

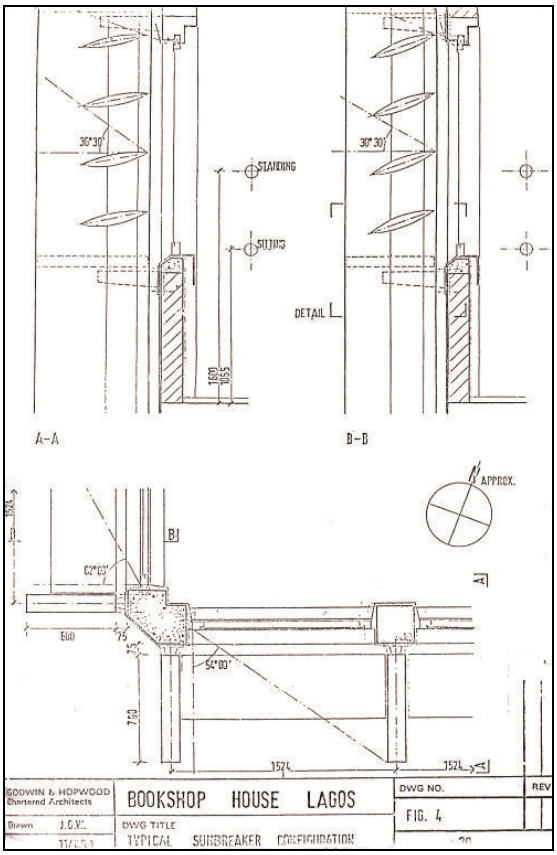


*Figure 18: Configuration of sun breaker.*

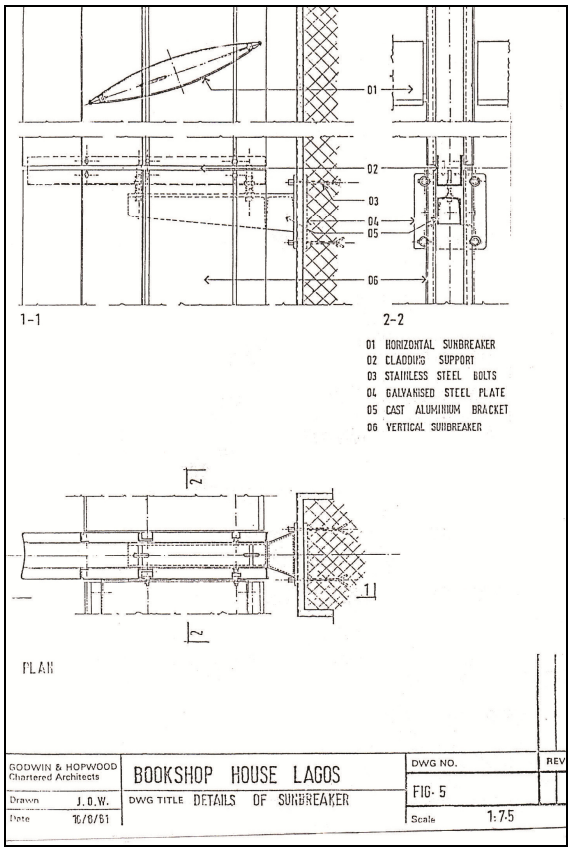


*Figure 19: Details of sun breaker.*

*Source: Godwin and Hopwood's archive as note to student*

**6. Conclusion**

The highlighted, aforementioned tropical modernist buildings in Lagos and Ibadan, most of which fall within the public, commercial and office building type represented the advent of a climate conscious Nigerian architecture. The point is clear here that while the architects at the time in question were not out of touch with the reigning international style, they however seemed to have been brought together by one mind – to find a reason and logic by which to adapt the style into the local tropical climatic sphere – the tropics, prevailing solar effect and the necessity of providing some form of shield. This eventually led credence to one point which is a consciousness and sensitivity to external shading. The concept here therefore, borders on customizing the current vogue of advanced technology and material in construction into the Nigerian context in the area of protecting the exterior surface of building envelope from 'solar attack'. Thus, bearing implications on an appeal to the use of external sun shading devices as means of passive design strategies like it was obtainable or refined in tune with the modern day technology at our disposal.

**7. Recommendation**

It is expedient that architects and designers take a practical cue from the innovation of history. The history, here, refers to the period in which solving a local problem rather than just customizing a foreign architectural idea was the drive. These days, designers need to realize that the issue bordering on solar effect and aftermath heating within the building is critical. This should stimulate designers to come up with strategies (same as used in the period considered or modified) of providing external shading of buildings with the use of appropriate modern materials and technology.

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