‘Green-Fingers Developments’ Headway in East African Region

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Introduction

Since the wave of political independence surged across Africa during the 1940’s and 1960’s, the number of capital cities in the continent has increased considerably. Many have since grown rapidly, not only because of the increasing functions of the jurisdictional areas, but also due to the centralization of modern socio-economic functions and transport networks.
Most of African cities are modern, dating from post-colonial times, with a number exhibiting their historic nature. According to Clarke, evolutions of these cities were shaped by a wide range of key activities. To elaborate, capitals like Lagos, Zanzibar etc, originated as trading stations established by the Portuguese; cities like Monrovia and Libreville as settlements for freed slaves. In this paper, we will be elaborating on the growth of one of sub-Saharan African capital on matters buildings in relation to environment created by Europeans amongst other cities like Djibuti (1892), Kinshasa (Leopoldville) (1881), Kampala (1890); that is Nairobi (1899).

In the award winning documentary, ‘Global Warming - An Inconvenient truth’, a former USA Vice president, attributes the growth of the city of Nairobi to the site’s characteristic of being ‘just above the mosquito line’; not too hot yet not too cold. The city region experiences a Tropical Upland type of Climate characterized by strong solar radiation, often with moderate to cool air temperatures. Even during the hot season, air temperatures rarely rise above 30°C. Daily averages of day and night temperature vary only from about 17°C during the cold season (July and August) to 20°C in the hot season (February/March). Diurnal temperature variation is quite large, averaging about 10°C in May and 15°C in February. Air temperature rarely exceeds the upper comfort limit which is about 27°C. However, due to Nairobi’s location near the Equator and the high number of sunshine hours experienced (a high of 9.7 sunshine hours in January), overheating is mainly caused by direct solar radiation. Humidity levels are moderate and there is an almost constant air movement, which is never too strong.

These figures point to the fact that Nairobi’s climate is one of the best in the world, experiencing optimum climatic conditions all year round without any extremes and only direct solar radiation to deal with.

Nairobi was not established by mere chance. The town was carefully planned from the onset as evidenced by the 1901 ‘Plan for a Railway Town’ laid out by railway engineers. At the period when Nairobi was being founded, the architecture and writings of various architects like Vitruvius was seen to recognize the design inspiration offered by site-specific climatic variables and indigenous exemplars. However, no lessons seem to have been learned from them and basic environmental design concepts like street orientation in relation to the solar path.

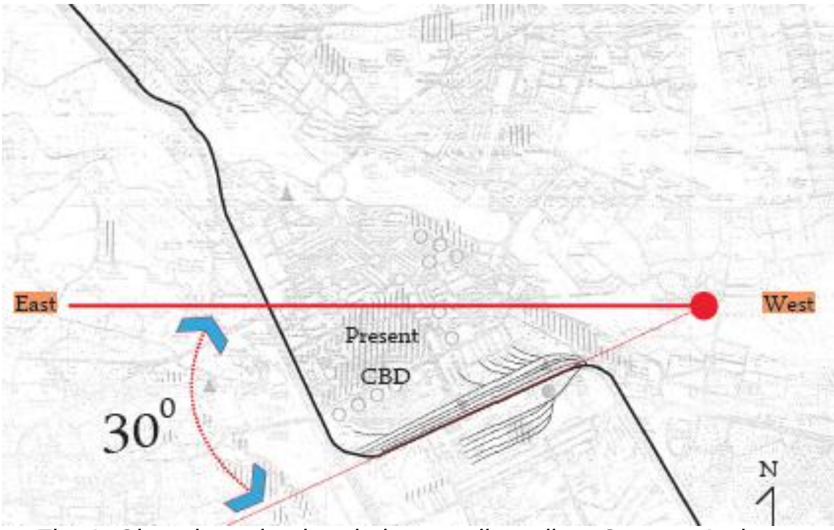

Fig. 1: City orientation in relation to railway line. Source: Author

Environmental Building Design strategies between 1940 and 1950

This period saw massive developments in Nairobi's construction industry. This is an era that saw a new dawn after the Second World War. Immediately after 1946, the development was that of small houses, factories and godowns. By 1954 a considerable amount of residential accommodation consisting of flats, combined on occasions with shops and other types of accommodation was being erected with many storied buildings coming up in the CBD. Materials and technology changed with the greatest being the cement industry.

There was an influx of European architects with the likes of Amyas Connel, Graham McCollough, Jackson & Hill, Blackburne, Norbun and Idris & Davis setting up in the city. Great and climate responsive buildings of this period include the Kenyan Parliament, Norwich Union building by Amyas Connel, Prudential Assurance building, the Sadler house (now consolidated bank house) by Jackson & Hill. This paper will briefly examine the latter.

Sadler House

This building was designed in the late 1940s and first appears as a 'building of the future' in Nairobi: A Jubilee History 1900-1950, a publication by the City Council of Nairobi. It is one of the longest buildings in Nairobi, stretching about 80 metres from Koinange street to Loita street.

E' shaped layout: This allows for mutual shading of the different masses creating shaded enclosures which trap cool air keeping the building cool. This is a very effective solution which created a well shaded mass out of a very long building plan (about 80 metres). The would-be long deep plan (80m x 40m) was broken down into four blocks joined by a long block consisting of servant spaces including the corridor, stores and the toilets.

Fig. 2: Sadler house layout. Source: Author

Fig. 3 shows placement of spaces in relation to the solar path. From the plan the stores are located on the western block which is the most affected by the hot afternoon sun. The other blocks have corridors on the Western side, leaving the eastern spaces for office use.

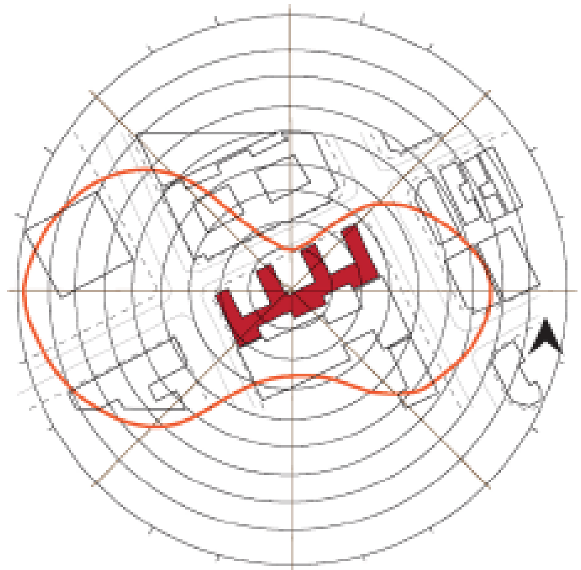

Fig. 3: Position of the building in relation to sun path. Source: Loki and author

The building is broken down into four blocks with each shading the other from the hot afternoon sun. The last block on the Western side, which is also the most exposed, has small sized window openings to cut down on heat gains with the spaces also allocated for storage.

Fig. 4: Image of Sadler building. Sorce: Author

It is worth noting that the architect opted for narrow elongated plan in order to resolve the problem of deep plans by broking down the building mass into four thin blocks, each about 9 metres in deep. This allows for single banking ensuring adequate day-lighting to the various spaces.

Environmental building design between 1960 and 1980

This period falls under the country's post independence era. The 1960s and 70s saw an extensive use of sunshading devices on white painted concrete building masses. Most of Nairobi's most climate responsive architecture was arguably done during this period and it appears that responses to the tropical sun had been well concretized developing a clear language. Many a buildings were developed in this period but we will only consider Ufungamano house along Mamlaka road.

Fig. 5: View of Ufungamano building. Source: Author

Built to be a Christian student's leadership centre, Ufungamano house was designed to provide space for an auditorium/community centre block, a chapel, a library and a residential block. The building was completed in 25th February, 1977. The architect employed structural wall construction with a sandwich course of 100mm exterior clay bricks, a 50mm thick lightly reinforced concrete core and a 100mm thick internal skin of either clay bricks or concrete blocks. There are no structural columns and very few beams.

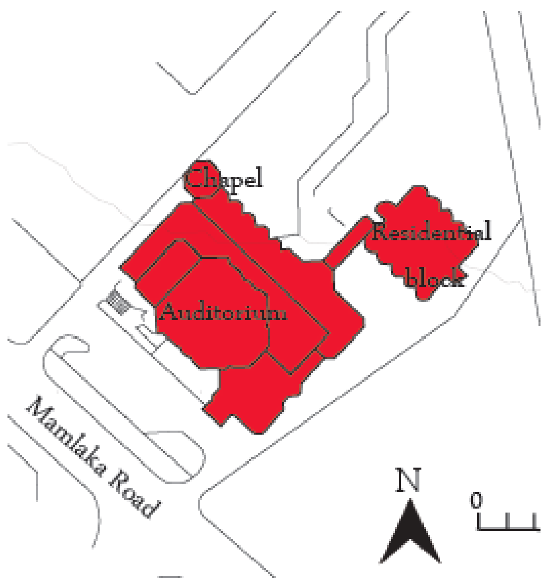

Fig. 6: Orientation of the building in relation to north. Source: Loki and author.

The building mass is laid at 45^{o} on the site with zigzagged facades which in addition to providing structural stability help in sunshading. Windows are placed on the north and south facing sections of the zigzagged walls. To note is the extensive use of bricks as brick reduces heat built-up by reflecting much is the sun's rays (brick has a reflection factor of solar radiation 0.14 compared to white paint which has a reflection factor of 0.7).

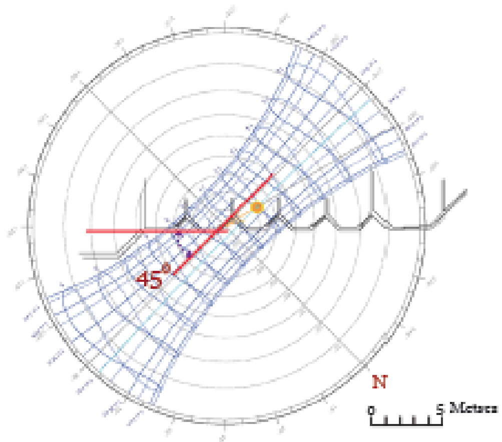

Figure 7: Zigzagged facade in relation to solar path. Source: Author.

The following are the findings from the analysis of Ufungamano house:

On aspect for provision for thermal comfort

- Building's orientation with openings to facing away from direct solar radiation helps reduce overall heat gains.
- Zigzagged walls allow for north or south facing window openings cutting heat gains through direct solar radiation.
- The extensive use of brick (this material has both a high reflectivity and a high thermal resistivity) keeps most of the solar radiation and heat out reducing overall thermal load.

On aspect of provision for day-lighting

- Responsive arrangement of activities to allow for the most light intensive at the perimeter of the building while the service core is centrally located taking the worst lit space.
- Atrium lighting allows for the day-lighting of deep plans.
- Clear glazed windows and doors allow for maximum day-lighting.
- Perspex roof lighting allows for day-lighting in deeply located spaces.
- Reflective white paint on ceilings reflects day-light getting in through the windows to working surfaces.

Aspect on provision for natural ventilation

- Thoroughfares allow for cross ventilation through building.
- Louvered and top-hung windows allow for air movement into and out of the building.
- High placed louvered windows allow for stack ventilation.
- Low level ventilation grilles allows for adequate air movement.

Environmental building design Strategies from 1980 to present

This period saw a change in passive design with the use of glass taking root in the city. At first glass was used cautiously as a sunshading element and in other scenarios well sunshaded when used extensively. Since the 1990's Nairobi has seen an extensive use of solar reflective and heat absorbing glass as the only building skin. This section highlights three buildings giving a glimpse of the rapid changes in building design and response to prevailing climate.

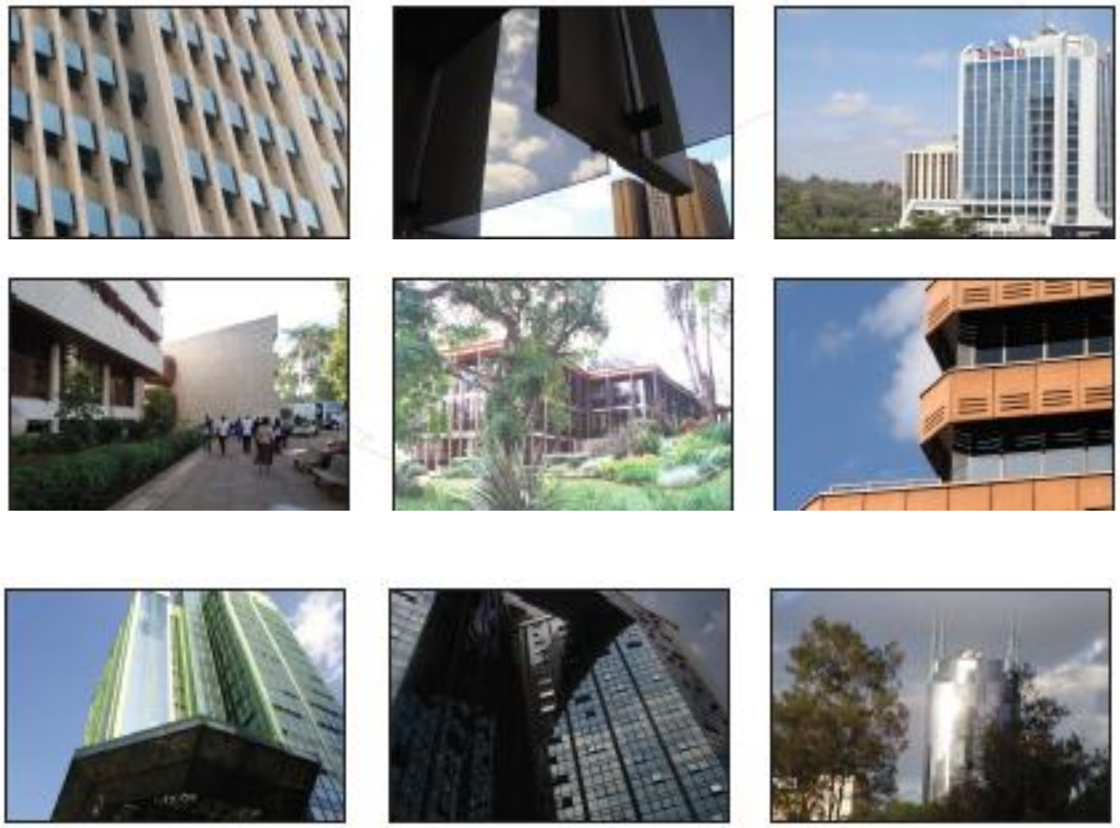

Figure 8: Various building designs in 80's, 90's and 2000's. Source: Author

(1980's) French Cultural Centre Building

Designed by the French architect M.J Lenferna in the 1980's, the French cultural centre building is one of the most climate responsive building in Nairobi. The 5-storied building (plus basement) consists of a large entry/reception lobby, an auditorium, a cafeteria, an outdoor performance area, a library, class rooms, offices and a studio space for Radio France. The building exhibits a simplistic cubic form subtracted to form the recessed inner glazed walls surrounded by deep concrete sunshading fins.

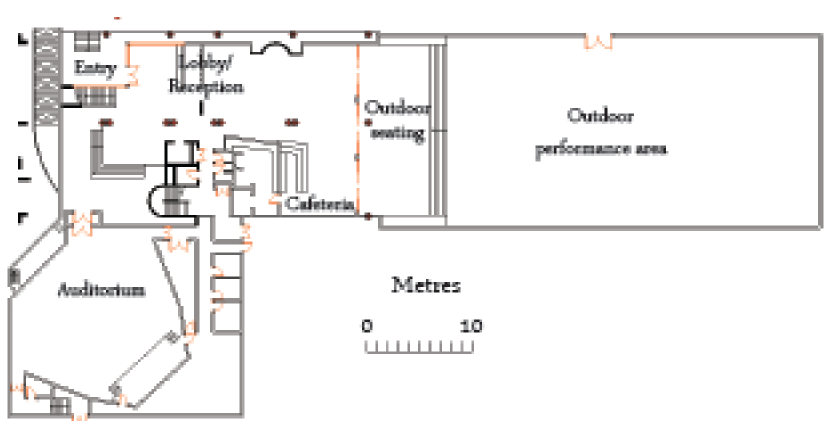

Figure 9: Floor plan of French cultural centre: Source: Loki and Author

The building mainly provides space for performances (both indoor and outdoor), a restaurant, classrooms and office spaces.

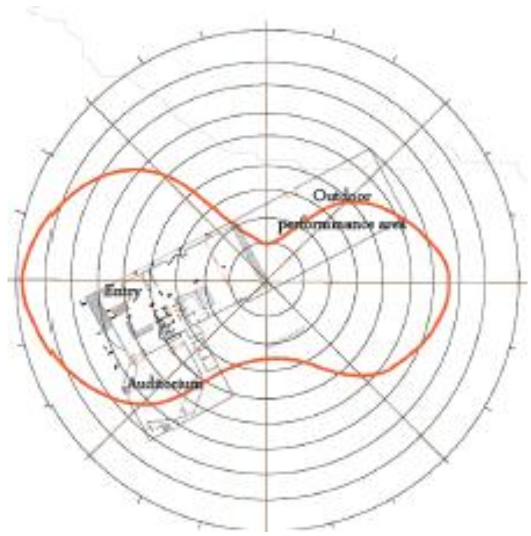

Fig. 10: French cultural building on sun path diagram: Source: Loki

The architect designed outdoor performance area to be on the eastern side. This space is normally used in late afternoons and evenings. Its location helps cut the hot afternoon sun as it is shielded by the main block. In addition, adequate sunshading elements were provided. The building’s form is marked by 1200mm ring walls which act as sunshading elements cutting down on the building’s overall thermal load

(1990’s) The Teleposta Tower (G.P.O)

This building is artificially ventilated and relies mainly on artificial lighting.

Fig. 11: View of Teleposta building. Source: Author.

The sunshading glass prevents ultra-violet rays from the sun from going through. These rays are converted into infra-red rays, which is basically heat. The heat warms the air around it forcing it to rise. The grating on the slab allows for free air movement upwards creating a region of low pressure. Cool air is sucked in to replace risen warm air. This leads to a cooling effect preventing heat build-up.

(2000's) Kenya Methodist University building

This building lies along Koinange street and is one of the most recent developments in the CBD having been completed in 2008. The building utilizes solar reflective glass extensively clad on its wall surfaces. Like most recent buildings in Nairobi, orientation in relation to the sun path is not taken into consideration. Solar control glass is used to mitigate the problems of the hot afternoon western sun. This is not very effective and has resulted in dark interiors, unclear views to the outside and extremely high internal temperatures.

Fig. 12: View of KEMU building. Source: Author

All is not lost! There are few outstanding buildings that have reconsidered the principles governed the design by earlier architects as well as increased consciousness on building response to climate. Examples of these are the cocacola building, standard chartered bank headquarters building and Strathmore business school building amongst others. Actually, some of them have obtained LEED certification. The economic and environmental values realized by these developments have greatly affected the opinions of clients.

For sure, Nairobi will and is rapidly developing into a city full of environmentally conscious buildings which are glazed, to reflect modernity, but still more responsive by displaying excellent passive design strategies. Some of the strategies are summarized as follows:

Provisions for Thermal Comfort

a.) Placement of activities governed by the solar path allowing for the sheltering of thermally sensitive spaces.

b.) Use sunshading elements (including concrete fins in earlier buildings, sunshading solar control glazing and solar control glazing building skins) to help cut direct solar radiation reducing a building's solar load.

d.) Reflective exterior finishes in earlier buildings reduced heat build-up.

e.) Use of plant material in buildings provides cooling by evapotranspiration and absorption.

f.) Use of atrium spaces to allow for cross-ventilation.

Provisions for Day-lighting

a.) Placement of activities in relation to the amount of day-lighting within the building.

b.) Full height glazing allowing for maximum day-lighting.

c.) Roof lighting for day-lighting.

Provisions for Natural Ventilation

a.) Activities placement in relation to prevailing winds.
b.) Cross ventilation allowed for by the placement of openings along the direction of prevailing wind.

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