

Climatic Design of Vernacular Homes in Kenya to Meet Requirements of Modern Living

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Abstract: Neglect of climatic conditions in buildings have resulted to severe energy loss throughout Kenya with its climatic conditions. The results of excess consumption of fuels have an impact on the environment pollution. The aim of the research is to look back to Kenya's vernacular homes and reflect how they were designed to shelter them from climatic conditions and how interpretation can be made to meet the requirements of modern living. Vernacular homes were chosen in comparison with modern building because their main characteristics is that they are designed with a deep understanding and respect towards nature. The research will be based on three major ethnic groups' vernacular homes, which are the Maasai, Rendile and Taita. With the awareness of global environment vernacular homes in Kenya can be designed to meet the requirements of the modern living and as a result bring back the identity, culture and environment of the place itself.

Keywords: Climate, Architecture, Vernacular house, Modern house, Kenya.

1. INTRODUCTION

Creating comfortable living environments has been one of the main goals towards building construction. With challenges of different climatic conditions around Kenya, there have been many different vernacular homes which have multiple solutions to learn from. Following the modern era, technological solutions have emerged to solve mechanical ventilation, heating and cooling system as well, which consumes a lot of fossil fuels making so many of our current buildings dependent on fossil fuels. In Kenya, most buildings are designed not taking consideration of the climatic conditions of the environment unlike our vernacular homes which were designed in harmony with the environment. The use of local available material, space organization, orientation and form of building has a huge impact on the results of the living environment of our buildings.

1.1 SIGNIFICANCE AND NECESSITY OF THE RESEARCH:

High consumption of fossil fuels in Kenya due to climatic conditions has led to an enormous impact on the environment. Kenya fossil fuel consumption has risen from 2,427kt CO₂ emission in 1960 to 13,300kt CO₂ emission in 2013. [1]. Which equivalates to about 548% rise of CO₂ emission in Kenya within the past 53 years. With such a rise of consumption of CO₂ we should reflect on our vernacular houses which used natural cooling system and compare them with the current buildings and how we can try to integrate them in order to save most of the fossil fuels used to regulate the temperature of the living environment.

II. CHANGES, THREATS AND CONSTRAINS OF VERNACULAR HOUSES IN KENYA

After the independence of Kenya in 1963 there was large movement of settlement from rural to urban migration. 'Although rural to urban migration was seen as the major flow of migration especially between 1963-1990, we have also seen aspects of return migration.' [2]. Increasing population in urban settlement led to construction of large scale housing estates. The design and planning were most likely similar and were duplicated all around. Since then, most vernacular

houses were no longer built in the urban region and if existed, were replaced with the modern buildings which often had lack of adequate lighting and proper ventilation system. The local materials used to build houses were neglected and replaced with stones, concrete, steel and glass. The changes are often considered irrelevant and surely disregards the socioeconomic, environmental and cultural conditions.

III. KENYA CLIMATE AND ENVIRONMENT

Kenya has a tropical climate and lies on the equatorial region. She also has a large variation of climatic conditions, experiencing both hot and dry seasons. On the dry seasons the day temperature are usually around 23°C to 28°C. On the wet season, temperatures are between 25°C and 27°C. At lower altitudes, daytime temperatures are more consistent and hover at 30°C. The total annual precipitation is about 900mm. The coastal regions experiences Monsoon winds from the Indian Ocean making it experiences hot and humid climate. The central region in Kenya experiences hot and dry climate. The Average temperature is 17 °C and has a monthly temperature varying by 3.5°C. precipitation average is 900 mm and receives an average of 8 hours of sunshine per day. [3].

A. CLIMATIC BUILDING CONSIDERATIONS IN KENYA:

In order to attain optimum thermal comfort in buildings, there are basic recommendations needed to archive this. Cross ventilation allows cooling of the room by reducing the heat accumulation and thus reducing humidity. Use of materials with low thermal impact greatly improves the indoor thermal comfort. The proportions of the area of windows is also a factor to consider since air flow easily and cools the inner spaces. Houses should be designed and properly oriented in order to catch the breeze effectively. Climatic study is required before choosing the orientation of the building. In terms of plan organisation, a long narrow floor plan is mostly required since it catches the breeze best. By reducing the number of partitions within the house, the level of air flow increases thus keeping the house cool. The type of roofing systems used is also important since hot air rises. It is best to keep the roof space vented while having protection against rain.

Most modern homes are built without taking consideration of most of the aspects mentioned above. As a result, a lot of energy is required to cool the surrounding. Vernacular houses in Kenya are mostly built with the nearby available materials and are at the same time environmental friendly.

IV. TYPES OF VERNACULAR HOMES IN KENYA

Kenya consists of multiple ethnic groups which have different vernacular homes. The paper focuses on three major types of vernacular homes that are vastly built in Kenya. These ethnic group are the Maasai, Rendile and Taita.

A. THE MAASAI:

The Maasai home is called an 'enkaji'. These houses are temporary homes because the Maasai are a nomadic community. The homes consist of simple frame structure which are built from twigs, soil, grass and cow dung. Wood is from an Oiti tree that resists termites and insects which is mostly found in both high and lowlands. All the materials used to create the home are found within the nearby surroundings. The roof is overlaid with dry grass. The wall consists of soil, cow dung and ashes mixed together. The general size is (3m x 5m x 1.5m tall). [4].

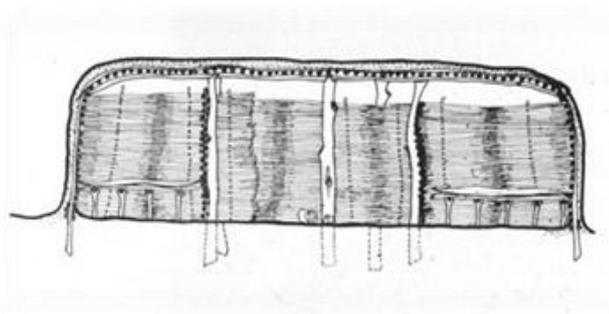


Fig 1: Section of typical Maasai home. [5].

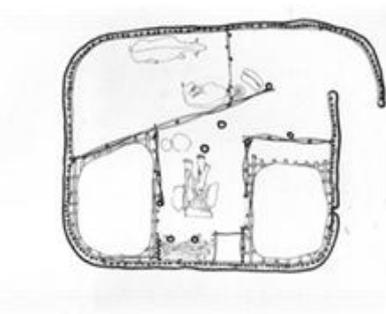


Fig 2: Plan of typical Maasai home. [5].

B. THE RENDILE:

Rendile huts consists of pre-arched frames made of sticks from trees from nearby rivers. The frames are tied with ropes of long leaves of *Sansevieria robusta*. [6]. If the ground is soft, the frames are buried about half a meter. If the ground is hard then stones would be preferred around the base. The structure is resilient and can sway with the wind without being blown away by the desert winds. The huts are generally facing towards West or Southwest directions. The house is about three meters wide and about two meters high. The interior is not partitioned but divided into zones for various functions. There isn't any smoke outlet since the desert wind ventilates the interior.

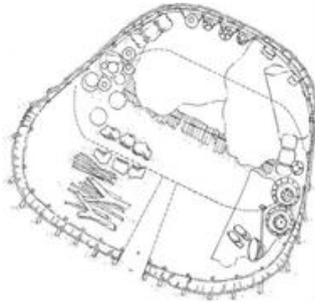


Fig 3: Rendile typical plan. [6]

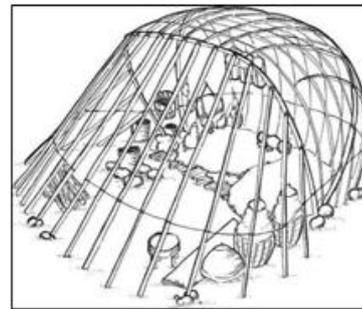


Fig 4: Rendile typical tent. [6]

C. THE TAITA:

The Taita floor plans are circular with no wall partition within them having clear function separations around with a fire place in the middle in order to maximise the area within. It contains a thatched roof which have poles that are tied toward the centre pole and is sometimes supported by outside side poles. [7]. Sticks are used to hold the poles and grass is used for the thatched roof which are laid in layers. The overhang thatched roof enhances protection from direct sunlight. The wall is build using mud with brackets used to tie together the mud. The materials used have high thermal mass and keeps the interior cool. The Taita house has very small punched windows on the top ends of the wall to release hot air from within. Minimum light penetrates in, which creates an illusion of coolness.

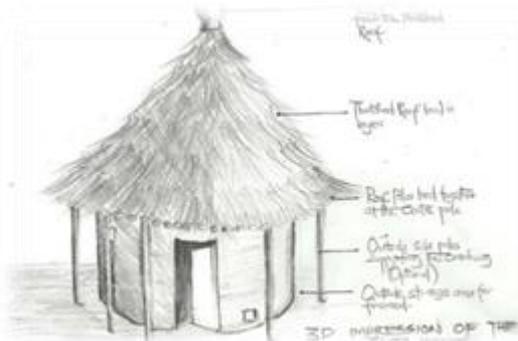


Fig 5: Taita perspective. [7]

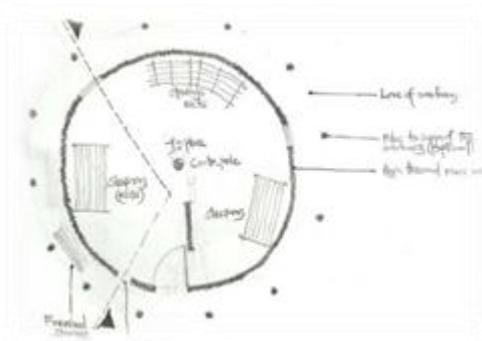


Fig 6: Taita plan. [7]

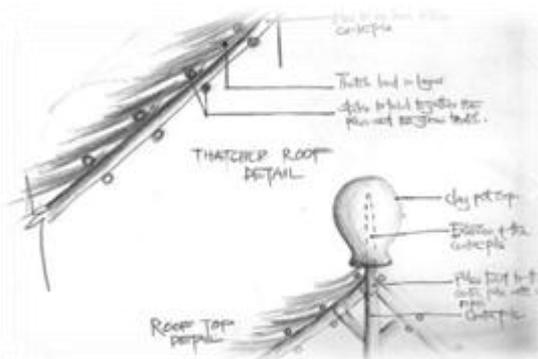


Fig 7: Taita roof details. [7]

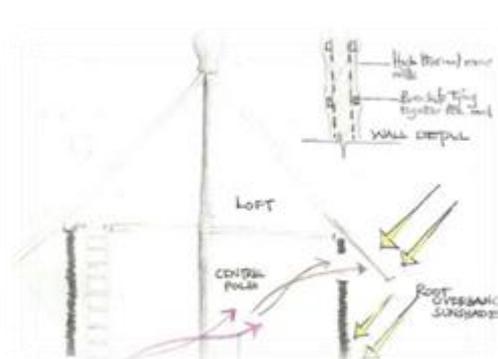


Fig 8: Taita section. [7]

V. COMPARISON OF CLIMATIC DESIGN VERNACULAR HOMES WITH MODERN HOUSES

Most vernacular houses were replaced with the modern houses (brick wall) which is vastly used in Kenya. The comparison will be based on climatic conditions that affect the home. Some of the factors that we will be looking at are the layout, the use of material, ventilation, solar radiation, lighting and glare, and design of both the house types.

A. BUILDING MATERIAL:

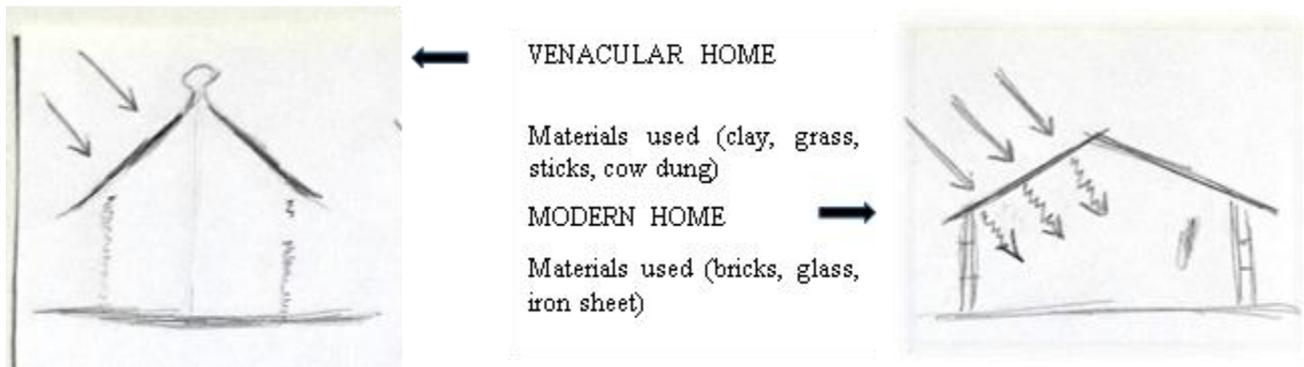


Fig 9 and 10: Comparison between Vernacular material and Modern material. [Author].

The type of material used in buildings have a great impact on the thermal comfort on the indoor spaces. Vernacular homes in Kenya are constructed by clay, grass, sticks and cow dung which are environmental friendly materials and are vastly available on the region having low thermal capacity and stores little heat which usually cools at night. 'Thin body sheet roof or wall building structures gets warm very fast, often within 1 hour of sunrise, making it nearly impossible to stay indoors. The thin body structure, however, cools down within 1 hour of sunset time, allowing quicker reoccupation of the interior space.' [8].

Modern homes use bricks or concrete which have high thermal capacity that radiates the heat causing discomfort. Typically, in a hot climate area a building with substantially heavy masonry and concrete begins to warm up after sunrise and continues to absorb heat till 1100 to 1500 hours'. [8].

B. LAYOUT:

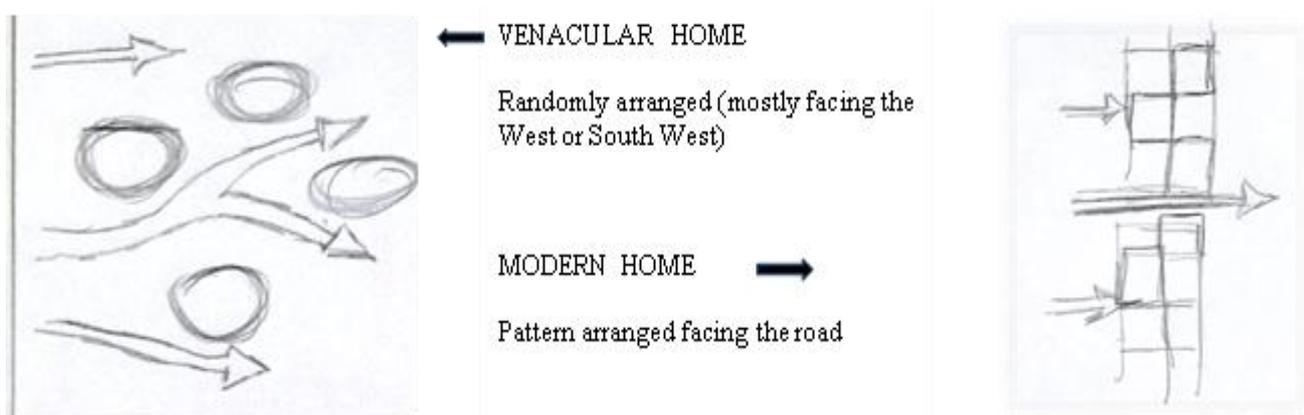


Fig 11 and 12: Comparison between Vernacular layout and Modern layout. [Author].

In order to maximise the effectiveness of natural ventilation for passive cooling, the orientation and positions of buildings should be carefully placed. Vernacular homes in Kenya are randomly arranged which results to low velocity reduction in wind. Modern houses use rigid pattern which tends to block the wind flow. The alignment of one building after another creates a huge wall for passive cooling as compared to vernacular houses which are staggered and mostly with a circular plan allows a dynamic effect of wind. As a result, the cooling effect is greatly reduced. According to Givoni, wind that incidence at 45° improves the wind velocity and provides a greater flow of dynamic effect of wind. [9].

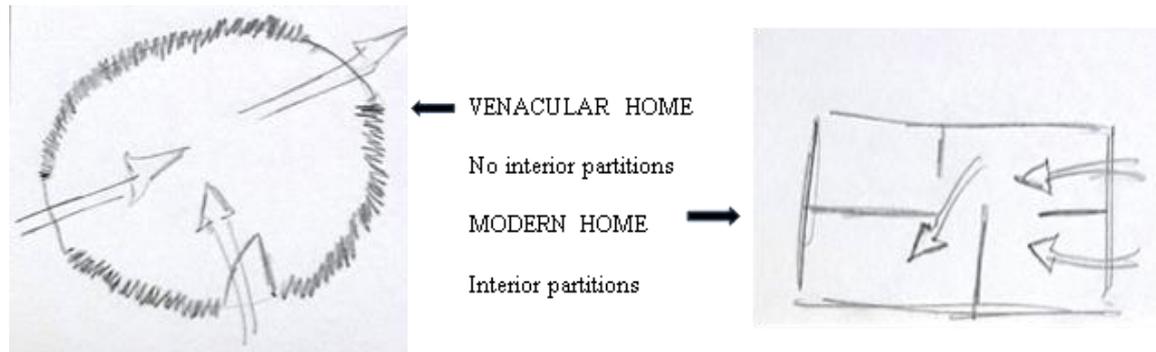
C. CROSS VENTILATION:

Fig 13 and 14: Comparison between Vernacular ventilation and Modern ventilation. [Author].

Kenya experiences two major seasonal winds which are the monsoon winds from the Indian ocean and north east monsoon winds from the Persian Gulf which can take advantage to cool our homes during the current seasons. Vernacular homes fully depend on natural ventilation and does not rely on any form of energy supply to cool the interior space. The openness of the plan allows easy passage of air into the house. Modern houses consist of many partitions which restricts motion of air to channel all through the house. Passive cooling is greatly hindered within the partitions and mostly requires mechanical insulations to cool the interiors.

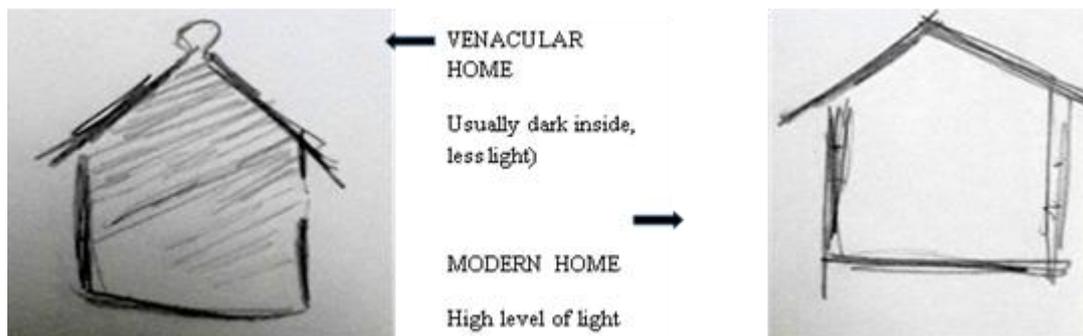
D. LIGHTING LEVEL:

Fig 15 and 16: Comparison between Vernacular lighting and Modern lighting. [Author].

The amount of light penetrating into a house has an impact on the interior spaces and should be controlled due to unnecessary heat gain. Vernacular houses tend to be under lit which gives psychological effect of coolness. Modern houses generally have higher lighting mostly resulting to over lighting and uncontrolled glare. The use of artificial lighting is common in modern houses because of lack of appropriate design to allow natural lighting which results to high consumption of energy.

VI. RECOMMENDATION OF THE NEW DESIGN

Vernacular houses in Kenya helps us understand the ways and means to harness the local climatic condition and how to improve our living conditions. It helps us keep unwanted climate elements such as heat and rain while cooling the inner spaces. Some of the recommendations needed in order to achieve thermal comfort is to keep out direct sunshine, heat and rain by using right materials to cool the inner spaces. Maximising natural ventilation in a building by incorporating openings in walls to allow airflow through the building and reducing the amount of interior partitions to keep cool and improve circulation of wind is essential. Orientation of the buildings should be facing towards the wind direction and avoiding use of rigid patterns in order to allow smooth airflow into the area.

Below are some of examples for modern residential houses adapting the vernacular houses in Kenya. They try to mimic the vernacular houses while having liveable condition of our modern life.



Fig 17: Africana sea lodge Mombasa. [10]



Fig 18: African-cottage-1-Palm B – Bungalow [11]

VII. CONCLUSION

Kenya's buildings should take consideration of climatic factors and reflect on the vernacular houses so as to improve on microclimate. From the comparison between vernacular and modern houses in Kenya, we can conclude that most modern houses usually go against the basic requirements of thermal comfort. The use of unsuitable building materials is currently damaging the environment. Vernacular houses are simple and are mostly perceived as outdated but are usually very effective and can be clearly evolved into modern houses. The status of vernacular houses in Kenya should be embraced and can be evolved to meet to the requirement of the modern living which will greatly improve thermal comfort within the homes. Which is suitable for the environment because of the natural material choice and will embrace Kenya's heritage and culture.

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REFERENCES

- [1] The World Bank Group, Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States.
- [2] Francis, Elizabeth, 2000. "Gender, Migration and Multiple livelihoods: Cases from Eastern and Southern Africa." The Journal of Development Studies Vol. 38, No.5 June 2002
- [3] Nairobi Climate & Temperature, climatemp.com
- [4] Practical Action, Intermediate Technology Development Group – ITDG, SUSTAINABLE TECHNOLOGY EDUCATION PROJECT, Self-build housing, Maasai.
- [5] John Tyman's, Cultures in Context Series, AFRICAN HABITATS: forest, grassland and slum, Studies of the Maasai, the Luhya, and Nairobi's Urban Fringe.
- [6] Ella Pelnovich/Labelle Prussia, African Nomadic Architecture: Space, Place, and Gender (Washington: Smithsonian Institution Press, 1995)
- [7] KILILO MTAMU, AFRICANA, The Taita Sustainable Vernacular House Designing with a Difference, 18 DECEMBER 2014.
- [8] Gautam Shah, HEAT CAPACITY of BUILDINGS, February 14, 2015
- [9] Givoni B, Climate Considerations in Building and Urban Design, 1st Ed. New York, Van Nostrand Reinhold Publishers Ltd. (1998).
- [10] Africana sea lodge, Diani, South Coast of Mombasa, [Online]. Available: <http://www.fkingssafaris.com/AfricanaSeaLodgeDianiSouthCoastofMombasa.htm>
- [11] Hotel Neptune Palm Beach Resort, [Online]. Available: <http://www.zoover.com/kenya/kenya/galu/neptune-palm-beach-resort/hotel/photos#hJRV4FWXQIHq3uot.99>.