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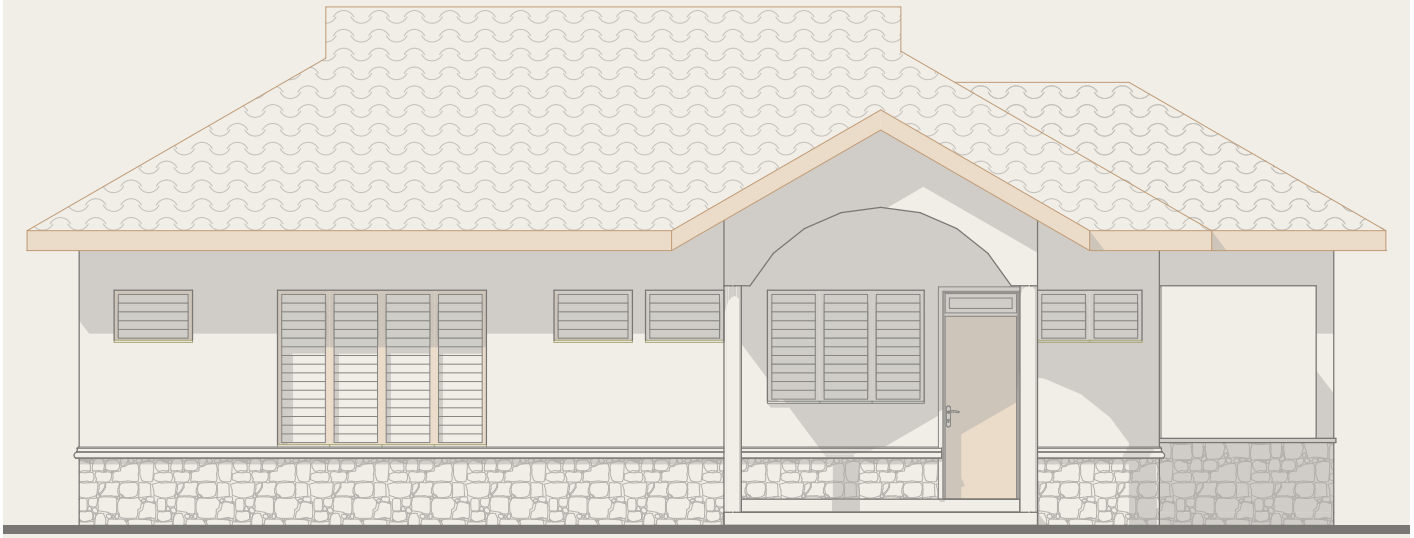
The Journal of SUSTAINABLE BUILDING DESIGNS

Single dwelling housing



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The Journal of Sustainable Building Designs

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1 Introduction

Buildings have a strong potential to impact positively or negatively two important elements of everyday life: our environment and energy bills. Their contribution to climate change mitigation on greenhouse gas emission and higher or lower energy bills are directly related to the way buildings are designed in relation to the local climate and site-specific characteristics.

This journal calls for change in the way we build. It promotes creative ways to produce buildings which achieve optimum conditions for their inhabitants whilst making minimum demands on fossil-based energy. The first step in creating comfort and thermal delight in buildings is to understand the relationship between the local climate and our need for shelter. Buildings should vary with climate and thus with location.

Designing an energy efficient built environment involves minimising the wastage of energy resources while maximising the use of passive design options and renewable energy sources.

The design of energy efficient buildings and homes depends on, solar path and solar radiation, rainfall, humidity, prevailing wind, and ambient temperature of a particular place among others. Design parameters of buildings and homes, therefore, vary with different climatic zones. Therefore, to achieve sustainable housing, it is important to build conssidering the prevailing climatic conditions.

Poor climatic design of buildings, all too often seen in 'modern' architecture, causes many buildings to overheat, even in temperate or cold climates where such problems were never faced before the advent of modern architecture. The influence of the sun should be understood and respected by designers of passive solar buildings in which the sun's free energy is used for natural lighting, heating and drying out but will not interfere with the occupants' comfort. Well-designed buildings with environmentally friendly solutions use less energy. They require lower maintenance compared to ordinary buildings and are more comfortable spaces to live in.

Designing an energy efficient built environment involves minimising the wastage of energy resources while maximising the use of passive design options and renewable energy sources. The green building (or sustainable building) is a result of a holistic approach. It is designed, constructed, and operated in an environmentally responsible way; it is resource efficient (land, water, energy, material, waste) throughout the building's life-cycle.

This journal acts as a guideline in providing applicable passive design principles for different climatic conditions that should be taken into consideration when designing in the different climates. These include:

- Site analysis
- Building orientation
- Natural ventilation
- Day lighting
- Solar shading
- Building materials
- Window sizes
- Window location
- Location of building services

Whereas sustainable buildings are directly related to local climate and site conditions, this journal is not intended to provide generic templates replicable in any part of the East African region. It aims to discuss examples and guide the user on how best to explore local climatic conditions.

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Site Analysis

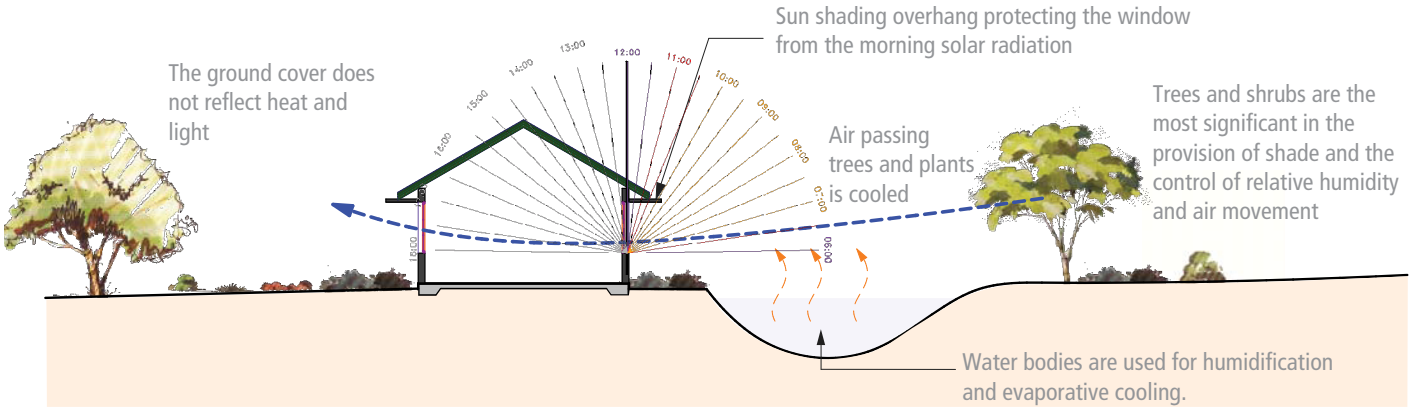
Site analysis helps to identify opportunities or constraints which will influence the outcome of the urban and building design. Careful site analysis and planning ensures that the proposed building placed on the site will have minimal negative effects on the environment while maximizing their efficiency. A proper site analysis should, therefore, be completed before design development can start.

Elements of site analysis include the following:

- **Sun Path:** Understanding the movement of the sun during the day and throughout the year allows for a qualitative analysis of the incident sunlight and heat. It is important to establish the sun shading needs and estimating the effects of the vegetation, relief and neighbouring buildings' shading. In the tropics, the optimal orientation of the main road path is along the East-West axis.
- **Prevailing Winds:** Knowledge of the speed, frequency and directions of the prevailing winds will facilitate natural ventilation. Ideally, the main road or open space orientation should follow the prevailing wind direction to assure natural ventilation and dust removal to all buildings along the road. A compromise, depending on the need for cooling or heating should be taken in case the prevailing winds direction are in conflict with the sun path.
- **Site Topography:** The existence of rivers, streams, valleys, hills, mountains and their position relative to prevailing winds may assist or obstruct natural cooling, wind and sun shading. Proper site analysis is required to maximize the use of the existing microclimate.
- **Vegetation:** The types, density and location of plants affect the site's microclimate (solar radiation, wind, humidity, amount of dust, air quality and temperature), the definition or visual screening of external spaces and the absorption or dispersion of sound. Trees act as windbreakers and produce oxygen through photosynthesis.
- **Neighbourhood:** An analysis of the neighbouring buildings is necessary to understand their effect on the site. For instance, neighbouring buildings with reflective surfaces can increase the proposed building's needs for sun shading if they reflect the sun onto the new buildings' facade. Even if the latter's orientation is optimal.

Urban layout orientation and density also influence ventilation of the urban space and may condition building design.

Figure 1: Passive design strategies



3

Case Studies

The way buildings are planned and designed today has a direct implication on their energy bills.

CASE STUDY 1

CLIMATIC ZONE 1:
Hot and Humid climate

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Climatic Zone 1: Hot and Humid climate

Location	Mombasa, Kenya
Latitude	4°03'S
Longitude	39°40'E
Altitude	55 m above sea level
Temperature	Min average temp 26.3°C; Max average temp 33°C
Annual Rainfall	Average 1083.2 mm
Humidity	Average relative humidity is 77.6%
Prevalent Wind Direction	South and East prevailing winds

Figure 2: MOMBASA (Hours of Sunshine / Temperature)

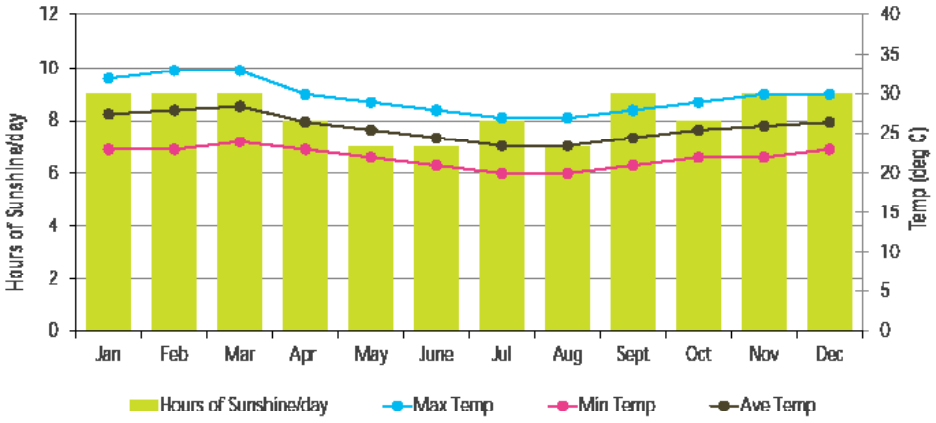

Figure 3: MOMBASA (Relative Humidity / Rainfall)