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Affordable Housing

UN HABITAT
FOR A BETTER URBAN FUTURE

The Journal of Sustainable Building Design

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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.

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.

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.

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Site Planning

Sustainable site planning begins with the assessment of the building site in terms of its capability to provide natural lighting and ventilation, sun shading but also access to services and facilities.

Microclimate

The microclimate of a certain site is affected by the following factors: landform, urban forms and external space, vegetation, water bodies, street width and orientation.

Urban forms and external space

The urban form cannot change the regional climate but can moderate the microclimate and improve the conditions for the buildings and their inhabitants.

The influence of the climate on the external space of traditional settlements can be well illustrated by the following examples:

1. Settlements for hot, dry climates are characterized by optimal protection against solar radiation by mutual shading, which leads to compact settlements, narrow streets and small squares which are shaded by tall vegetation;

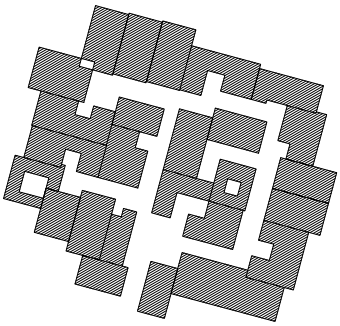
2. Settlements for warm humid areas are laid out to make maximum use of the prevailing breeze. Buildings are scattered, vegetation is arranged to provide maximum shade without hindering natural ventilation.

Urban Patterns

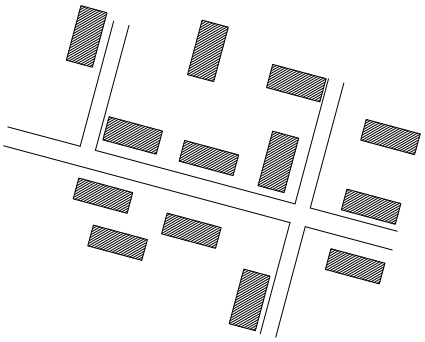
Balanced urban patterns of streets and blocks can be oriented and sized to integrate concerns for light, sun and shade according to local climate characteristics.

Solar radiation control:
Streets orientation and layout has a significant effect on the microclimate around buildings and on the access to sun and wind.
A cardinal orientation will generally cast more shadow on buildings facing north-south streets than a rotated organization, and thus do a better job at shading buildings.
In contrast, rotated orientations provide more shade on the streets for more time

Figure 1: Urban density according to climate



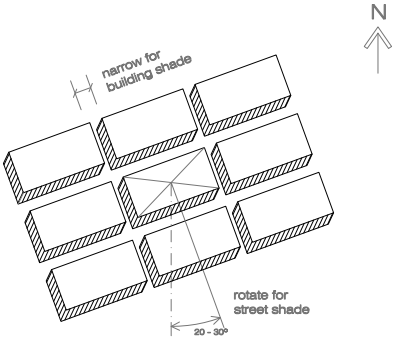
Hot and arid:
Dense urban settlements with narrow streets provide solar protection



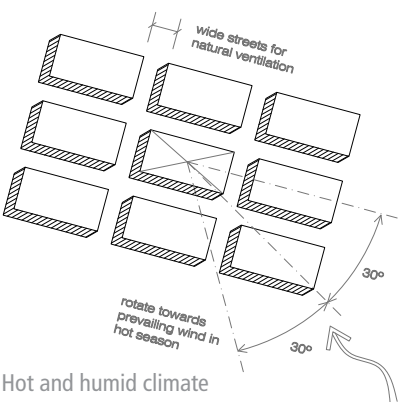
Hot and humid:
Wide streets and space between buildings maximizes natural ventilation

Hot-arid climate
1st priority: Summer shade
2nd priority: Summer wind; winter sun
•Narrow N/S streets for shade.
•Rotate from cardinal to increase street shading.
•Space e/W streets for solar access, if needed. Elongate blocks E/W.

Figure 2: Recommended urban patterns in different climates



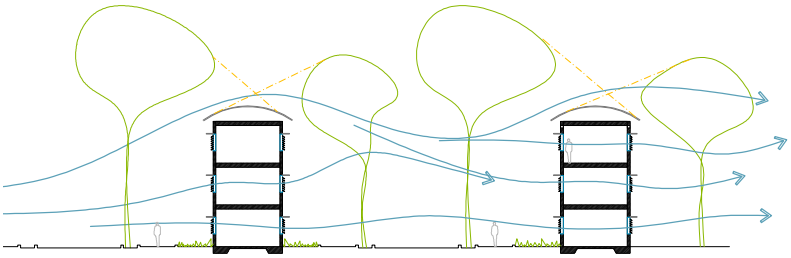
Hot and arid climate



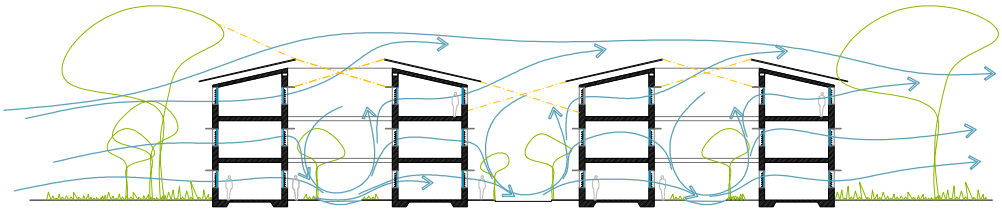
Hot and humid climate

Hot-humid climate
1st priority: Summer wind
2nd priority: Summer shade; winter sun
•Orient streets 20°-30° oblique to summer wind.
•Modify orientation by rotating from cardinal to increase street shading.
•Space e/W streets for solar access, if needed. Elongate blocks E/W.
•Wide streets for wind flow.

Figure 3: Site planning for sunshading and natural ventilation



Hot and humid climate.



Hot and arid climate.

Wind effects
In hot humid climates, loose urban patterns should be preferred in order to maximise cooling breezes.
Breezy streets oriented to the prevailing wind maximize wind movement in urban environments and increase the access of buildings to cross ventilation.
To maximize cross ventilation access and air movement in streets, orient primary avenues at an angle of approximately of buildings to 20°-30° either direction from the line of the prevailing summer breeze.
Dispersed buildings with continuous and wide open spaces preserve each building's access to breezes. Howeve, for a compact development, this is not possible, so buildings should not be in a raw but in a discontinuous pattern. When cooling is the priority, windbreaks should be avoided. The unique exception is in relation to dry hot climates where windbreaks provide important dust and sand protection.

Water effects
Organizations of interwoven buildings and water can be used to reduce the ambient air temperature.
In hot-arid climates, water evaporation can cool air temperature.

Green edges
In hot arid and semi-arid climates, green edges of irrigated vegetation can be formed to cool incoming breezes. Planted areas can be as much as 5-8°C cooler than built-up areas due to a combination of evaporation and transpiration, reflection, shading and storage of cold.

Overhead shades
A layer of overhead shades can protect outdoor space buildings from the high sun.
In many hot climates, both humid and arid, groups of buildings may be linked by shading pedestrian streets or pedestrians may be protected by arcades at the edge of streets and open spaces.

» With the aim of reducing the energy demand of individual buildings, low energy urban design combines analysis of shading, wind and natural illumination for optimising shape, orientation and distances between buildings, in order to control solar radiation and ventilation.