Proper Orientation of Building to Conserve Solar Energy

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Abstract

Nowadays, many countries suffer from severe shortage of energy resources and unable to save energy. It is necessary to develop a strategy, to make buildings consume less energy and to integrate active and passive design techniques. Since the building orientation is one of the most important factors affecting the energy consumption, this paper addresses its effect on the amount of energy consumption within buildings. We employ the simulator "Energy-plus" to estimate the energy consumption, annually and during critical months in summer and winter. To obtain the best orientation for maximum energy saving, different orientations are tested. It is found that an air-conditioned building that has a southern facade (Face)consumes less energy. However, a western facade causes higher annual energy consumption by 26% over the southern facade. In the case of a two-facade building, the lowest energy consumption is obtained between the northern and southern orientations in Cairo, Egypt.

Keywords: Buildings orientation, Passive techniques, Active techniques, Energy consumption, Solar Cells

Introduction:

Energy represents a major component in any country's economy and hence it affects the world's economy. Saving energy consumption, especially in buildings, directly affects national economy. The shortage in the traditional energy sources and the early stages in using the renewable energy sources motivated the design of energy saving buildings. Many design treatments are developed to achieve energy

saving. These treatments are targeted to enhance the thermal performance of the building shell e.g. walls, ceilings, floors, and openings . Many studies have tried to reveal the effect of the building shell components and its orientation on energy usage efficiency. Many passive and active strategies for energy saving are employed to enhance the efficiency of cooling, warming, ventilation and lighting. The effect of building shell improvement on the of energy consumption efficiency is extensively studied. This includes the techniques for thermal insulation for walls and ceilings and the techniques for openings shading, the type of glazing, and the window-wall ratio (WWR). In addition, the building orientation was subject to many experiments, especially in cold regions. This paper focuses the effect of building orientation on the amount of consumed energy. This is important as the orientation is a basic factor that affects the exposure to sun radiations and hence the thermal insulation, ventilation and lighting. The amount of consumed energy in hot dry climate is calculated for the different orientations annually and during critical months in winter and summer.

Methodology

The **methodology** is based on the study of energy problem, its causes and their impacts on the buildings sector. In addition, we discuss different strategies and architectural solutions to reduce energy consumption in buildings. The study of the effect of buildings' orientations on reduction of energy consumption is achieved by using the simulation program ―Energy plus. The impact of different orientations on the study model is calculated every 15 degrees. The selected study area is the city of Cairo, Egypt. The consumed energy in summer and winter is monitored to get the optimum orientation for achieving lower energy consumptions inside the building. The energy consumed in summer and winter is measured during the critical months and is annually measured.

There are two types of solar energy techniques:

1. Active solar techniques

2. Passive solar techniques

Advantages:

- Energy Efficiency
- Environmental Impact
- 3.Comfort and Well-being
- Architectural Design .
- Urban Planning
- Technological Innovations
- Cultural and Historical Perspectives.
- Flexibility to Climate Change

Conclusions:

In the hot arid zone climate like the city of Cairo that is the capital of Egypt, it is found that the building orientation has a major effect on the amount of the energy

consumed to achieve comfort for its users. As the building is adapted to the local climate, it can benefit from the surrounding environment and achieve users comfort. This will directly reflect on reducing the energy consumption. It is found that a southern facade results in the least energy consumption because of lower heating loads in winter. However, the western facade causes the highest annual energy consumption by 26% over the southern façade. In case of two facades for the building, the optimum orientation for least energy consumption is the NorthSouth. The orientation that is leaning with an angle ranges from 15 to 30 degrees with East causes slight higher consumption than the North-South. The orientation that leans from 15 to 30 degrees with the West leads to slight higher consumption than the former. These two leaning directions introduce low rates in annual energy consumption, which is no more than 5% as compared to the North-South direction.

In the simulated compound model (the chain of adjacent modeled rooms), it is found that the energy consumption for the facades North-South is lower than the energy consumption for the facades East-West by nearly10%, which is reflected on reducing the annual energy consumption rates by about 13%.

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