SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The aim of this research was to present a comparison of energy consumption and daylighting performance of simulated patient rooms in Cairo, Egypt.

Energy efficient hospital patient room design: Effect of room shape on window-to-wall ratio in a desert climate

Sherif, A., Sabry, H., Arafa, R., & Wagdy, A. 2014 | *Sustainable Habitat for Developing Societies Choosing the Way Forward*. Volume 2, Pages 352-360

Key Concepts/Context

Windows are significant to the healing process in hospitals because of their ability to provide access to daylight and external views. However, in desert climates windows also contribute to increased hospital energy consumption because of the increased cooling load. The authors initiated a simulation exercise to compare daylight and energy consumption in three types of patient rooms with varying window-to-wall ratios (WWRs). The study concluded that even though patient rooms with outboard bathrooms had higher WWRs, patient rooms with nested and inboard bathrooms were more energy efficient.

Methods

This research took place in two stages. In the first, annual energy consumption for the three room types was examined and in the second daylight performance was examined in those rooms that displayed the lowest energy consumption.

The following assumptions were associated with the simulated patient rooms

1. Located on the second floor
2. Windows had no external obstruction
3. Windows faced south
4. External ground surface had a 20% reflectance
5. Building was fully air conditioned, and
6. External wall was 0.35 meters thick with a double brick-insulated cavity wall with the window in the center.

DESIGN IMPLICATIONS

The authors recommend the use of simulation techniques to identify the appropriate window size to ensure energy efficiency and maximum access to daylight.

The three simulated rooms examined were patient rooms with outboard, nested, and inboard bathrooms, and all had the same room area and similar parameters. WWRs or window size values were calculated for each of the three room types to determine energy consumption. Grasshopper, a parametric modeling tool, and Diva-for-Rhino, both plugins for Rhinoceros modeling software were used for simulation along with EnergyPlus, Radiance, and Daysim software.

Findings

The following were the findings of the first stage of the study:

- Energy consumption was the highest for cooling, followed by lighting and was almost negligible for heating.

Patient rooms with nested bathrooms:

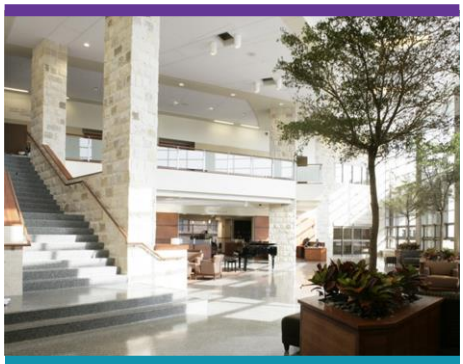
- Had the lowest energy consumption - as low as 147 Kwh/m2 at WWRs of 30%-40%
- At 90% WWR, this room type had an energy consumption of 183 Kwh/m2.
- Had fewer acceptable WWR options (20 – 45%) and smaller window sizes
- Energy consumption
    - For lighting, decreased with increase of WWR
    - For cooling, increased with increase of WWR

Patient rooms with inboard bathrooms

- Had energy consumption of 151 Kwh/m2 at a WWR of 35%
- Had the fewest choices of acceptable WWRs (30-40%)
- With a 90% WWR, this room type had an energy consumption of 183 Kwh/m2.
- The energy consumption
    - For lighting, decreased with increase of WWR
    - For cooling, increased with increase of WWR

Patient rooms with outboard bathrooms

- Had the highest levels of energy consumption – 177 Kwh/m2. At a 15% WWR, the energy consumption was 192 Kwh/m2.
- Had larger windows and more acceptable WWR options (between 40-90%) compared to the other two layouts



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- The consumption of electricity for
    - Lighting decreased with increase in WWR
    - Cooling increased with increase in WWR

There were two criteria for acceptable daylight availability – 1. 100% of patient beds should receive daylight, and 2. At least 50% of patient rooms should receive daylight. The following were the findings of the second stage of the study:

- In patient rooms with outboard bathrooms, acceptable daylight availability was possible in rooms with large WWRs. Of the 11 energy-efficient rooms, only five met the daylighting criteria.
- In patient rooms with nested bathrooms, four of the five energy-efficient rooms met the acceptable daylight availability criteria.
- In patient rooms with inboard bathrooms, all three of the three energy-efficient rooms met the acceptable daylight availability criteria.

Limitations

The authors do not identify any limitations to their study. It may be noted that this was a simulated study; a study conducted in a real life scenario may yield more robust results. Secondly this study is specific to Cairo, Egypt which experiences a clear-sky desert sun; it may not be generalizable to all geographic regions

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