SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

This study examines how window glazing types and sizes impact heating and cooling within patient rooms and subsequently effect energy savings.

Energy savings in hospital patient rooms: The role of windows size and glazing properties

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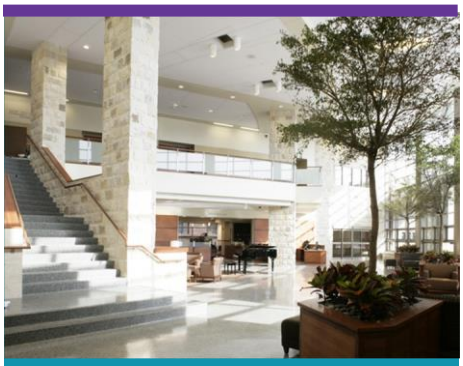
Key Concepts/Context

The heating and cooling of patient rooms creates extremely high energy demands, especially since these rooms typically are located at building perimeters to provide natural daylight, and therefore are most affected by the condition of the building's envelope. The results from this study may inform design decisions regarding choices of window sizes and glazes for the sake of facility-wide energy efficiency.

Methods

The authors used dynamic simulations of building energy to analyze how different window glazing systems can alter patient room energy demands while accounting for façade designs and orientations, the presence of people, the architectural form of the building, and its spatial layout and distribution. Google SketchUp was used to create a geometric model of a hospital, while a dynamic energy simulation program, TRNSYS, was used to estimate energy performance on both the individual room and building level. The simulated hospital is considered a typical instance of an Italian healthcare building, based on structural details the authors gathered from six case studies. This means that the simulated building is seven stories tall and L-shaped with a relatively outdated building envelope. Regional weather data were gathered from the Meteonorm database and local weather stations.

The simulations performed evaluated the energy needs of the entire building as well as a patient room located on the third floor, both being equipped with an air conditioning system operating 24/7. The simulated room maintained a set infiltration rate and level of internal heat gain due to the presence of two patients per room. The patient room simulation was examined from four different orientations (north-, south-, east-, and west-facing). Two window sizes were evaluated in the simulation, with the larger window size featuring a retractable external shading system (similar to a drop-shade or thick curtain), and both window sizes were evaluated through 14 different commercially available glazing systems.



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Findings

The authors found a significant difference between the values of heating and cooling needs and the levels of energy savings that could be achieved, as well as evidence that window glazing with both high and low U-values (the ability to transmit heat from warm spaces to cold spaces) were less energy efficient than their mid-level U-value counterparts. The results highlight that the energy demands for heating and cooling need to be considered separately and will vary widely depending on geographic location. It is always worth consulting local weather data to assess what kinds of energy needs (between heating or cooling) are more relevant, adjusting glazing systems and external shading systems appropriately.

Once designers determine the appropriate glazing specifications based on the site-specific climate, the authors suggest that designing patient rooms with wider windows could reduce energy requirements for heating by minimizing thermal transmission and maximizing solar heat gains. Conversely, narrower windows with external shading systems and proper glazing systems can significantly reduce cooling energy needs. Window shading systems can also mitigate thermal losses by remaining closed overnight, which could lead to further energy savings.

Limitations

All data involved in this study were gathered from computer simulations and models; no real-world observational data, qualitative or quantitative, were gathered. The authors acknowledge that their results are specific to their own geographical region, and that these findings will vary widely depending upon location. Scenarios involving higher patient populations (over two patients per room) were not included in this study.

Design Implications

In order to maximize the energy-saving benefits offered by windows in patient rooms, designers should consider choosing window sizes and glazing based on local weather patterns, building orientation, building envelope, and expected patient population sizes.