SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

The purpose of this paper is to develop a methodology for assessing the resilience to climate change of UK healthcare buildings based on assessment of the internal thermal comfort and overheating risk.

Thermal Comfort Standards, Measured Internal Temperatures and Thermal Resilience to Climate Change of Free-running Buildings: A Case-Study of Hospital Wards

Lomas, K. J. & Giridharan, R. 2012 | *Building and Environment Volume 55, Pages 57-72*

Key Concepts/Context

There is increasing debate about the impact that climate change may have on the internal summertime temperatures in UK buildings because future summers are likely to be both warmer and drier and there is likely to be an increase in the occurrence of extreme temperatures. In common with other countries within temperate climate zones, the great majority of UK buildings are passively cooled, especially through the use of operable windows and, in non-domestic buildings, mechanical ventilation. The latter is expensive and could simply exacerbate the climate change problem by increasing energy demand. In the UK the National Health Services (NHS) is the publicly funded healthcare system. This system occupies about 14,000 premises or 1% of the UK's non-domestic buildings, yet is responsible for nearly 3% of all UK emissions and 30% of the public sector emissions. The question of nighttime thermal comfort, and more generally comfort whilst sleeping, is important in a hospital context.

Methods

A five-stage methodology was utilized. First, the geometry, construction, servicing strategy, and environmental control of the spaces were determined. This required the study of archive drawings, field measurements and observations, and interviews with facilities management and other staff. Secondly, temperatures were recorded in target spaces to determine the internal temperatures and, when and where possible, air flow rates, CO_2 levels, window opening strategies, etc. Although this work focused on summer conditions, temperatures were recorded throughout the year. These data were archived, cleaned, and key parameters produced. Thirdly, the temperatures were compared with the appropriate thermal comfort standard to assess the extent to which the spaces were, or were not, delivering thermal comfort for the weather conditions that prevailed during the monitoring period. Fourthly, a model of the space(s) to be assessed was built within a dynamic thermal model (computer program). This model was then 'calibrated' using the weather data recorded during the monitoring period with the monitored internal temperatures as the basis for model/data comparison. Finally, the calibrated model was used to predict the internal temperatures in the space, both as is and after refurbishment, for the current climate and the possible future climates at the building's location. Performance under both typical and extreme conditions was of interest. The setting for this study was a hospital tower building which has a simultaneous hybrid ventilation system, that is, the mechanical system runs permanently and in tandem with the manual system of the operable windows. As large models can limit the number of simulations, this paper therefore focuses on the southeast-facing seven-bed wards.

Findings

The monitoring undertaken, albeit limited, indicated that the summertime conditions in three free-running hospital wards were regulated primarily by operable windows, and that the achieved temperatures conformed to the adaptive model of thermal comfort. That is, internal temperatures drifted with the ambient temperature, being generally higher at higher ambient temperatures. In the nursing stations, where there was no provision for occupant control, the internal temperatures were high, leading to occupant dissatisfaction. The uncontrolled escape of heat from the improperly insulated radiant ceiling and from hot water pipes probably contributed to the overheating. Dissatisfaction was heightened because occupants had no mechanism for controlling the local temperatures; there are no operable windows, and the thermostats associated with the radiant ceiling are in a poor state of repair. The uncontrolled introduction of heat into buildings increases their susceptibility to overheating, especially when ambient temperatures are high, be that in warm spells such as heat waves or due to general climatic warming.

Design Implications

Good practice in the maintenance and repair of existing energy services thus has an important role to play in improving the resilience of the existing NHS stock. The cost of doing this is relatively low and doesn't interfere with the functioning of the hospital. Indeed, diligent maintenance can also reduce energy waste operating costs and CO_2 emissions. In UK hospitals there is a move to the provision of single-bed wards. This opens up opportunities to provide occupants with personal control over their thermal environment. Fans could enable the ward to be comfortable right up to the 2080s even in extreme years, and they appear to be a rather simple and low-cost retrofit option for improving the thermal resilience of existing spaces.

Limitations

No limitations are offered by the authors; however, as with any case study, the results are only applicable to this single study. However, the computer modeling program described offers promise for existing facility assessment.

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