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Opportunities to improve indoor temperatures and electricity use in remote Australian buildings

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Abstract

Adaptation to climate change and mitigation of the rising costs of electricity are key incentives for improving building energy efficiency. The need is particularly acute in remote communities in Far North Queensland and Central Australia. Electricity is expensive, incomes are relatively low and maintenance services are difficult to access. At the same time buildings have to provide an environment that is safe and productive while coping with extremely challenging climates. We report eight case studies that investigated community buildings and their associated electricity consumption, temperatures and relative humidities over a nine month period. The study focused on two building construction types: i) concrete block and ii) steel frame, in the hot arid and hot humid climate zones of northern Australia. Key findings are described relating to i) improving building thermal efficiency, ii) reducing the electricity consumption by appliances, particularly standby consumption, iii) the potential for adapting the energy efficiency rating tool AccuRate for use in remote communities in arid and tropical northern Australia.

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Keywords: Aboriginal; AccuRate; air-conditioner; building; energy efficicncy; remote communities; standby power;

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1. Introduction

Buildings used by community enterprises such as art centres and Aboriginal corporations in remote northern Australia need to provide apparent temperatures that are sufficiently low to allow safe and productive work in locations where temperatures can be extreme and the cost and availability of electricity and maintenance may sometimes preclude air-conditioning. The work presented here is part of an ongoing study that aims to provide recommendations for reducing electricity consumption, improving building thermal efficiency and maintaining better temperature and humidity control inside such buildings. It reports on the thermal characteristics and electricity consumption in eight enterprise buildings in Far North Queensland (climate zone 1 – tropical, hot and humid) and Central Australia (climate zone 3 - hot and arid).

The research sites comprised simple building structures that were representative of the workplace built environment in remote Australia. Enterprise buildings were selected to be similar in function so that electricity consumptions could be more usefully compared. Four of the research sites were Aboriginal art centres and one was an Aboriginal Corporation. The construction methods were either concrete block or steel frame. The study characterised the building designs, their space heating or cooling appliances, and their relationships with workspace temperatures, humidities and electricity consumptions.

2. Methodology

2.1 Sample selection

Eight buildings/structures were selected to represent two types of construction: concrete block and steel frame, Figure 1. All but one building were associated with art centres. Four of the structures were large single room studios including one attached to an office, and four were multi-room buildings. The buildings were unoccupied for several weeks during the nine month period of study and this allowed them to be studied with and without active cooling or heating, with both low and high thermal and electrical loads. An Aboriginal corporation office in Far North Queensland was also studied to further characterise office equipment thermal and electrical loads.

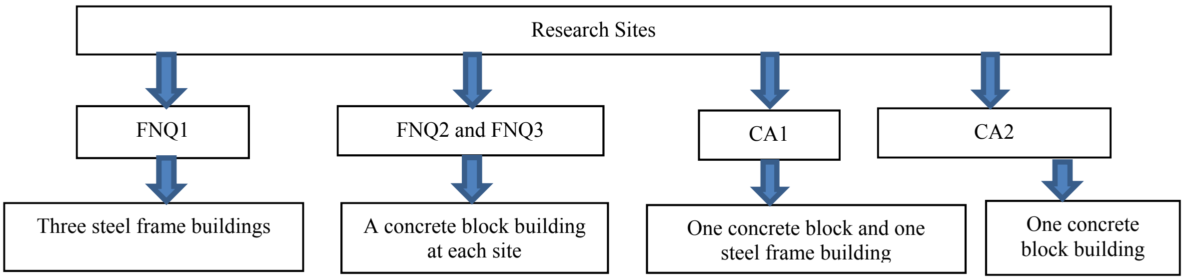

Figure 1 Research sites: geographic distribution of building construction types

2.2 Data acquisition

Surveys were carried out on all the buildings and architectural schematics were drawn up with sufficient detail to allow thermal analysis. Construction materials were noted together with room, window and door dimensions, the presence or absence of skylights and insulation, the location of lighting, heating and cooling appliances and the location of about 100 temperature and humidity sensor-data loggers.

Temperatures and humidities were recorded at a central location inside the building at 10 minute intervals, using temperature/humidity data loggers. Supplementary temperatures at walls and windows were measured hourly using button cell data loggers. The button cells were able to withstand severe environmental conditions and were also used in shaded and unshaded areas outside the building. The temperature readings were compared with