Natural Ventilation in Tropical Climate: A Case Study of a Heritage Building with Site Measurements

Jiuwei Liu, Yeyu Xiang, Lup Wai Chew

HERITAGE BUILDINGS, NATURAL VENTILATION, SITE MEASUREMENT, TROPICAL CLIMATE

BACKGROUND

Natural ventilation is a passive strategy to regulate indoor air quality and temperature. Despites the challenges to adopt natural ventilation in hot and humid climates, some buildings in Singapore have demonstrated the potential of natural ventilation. The study site, Architectural Conservation Laboratory (ArClab) NUS, chosen for its resemblance to typical Singaporean heritage buildings, aims to extend natural ventilation application to heritage buildings.

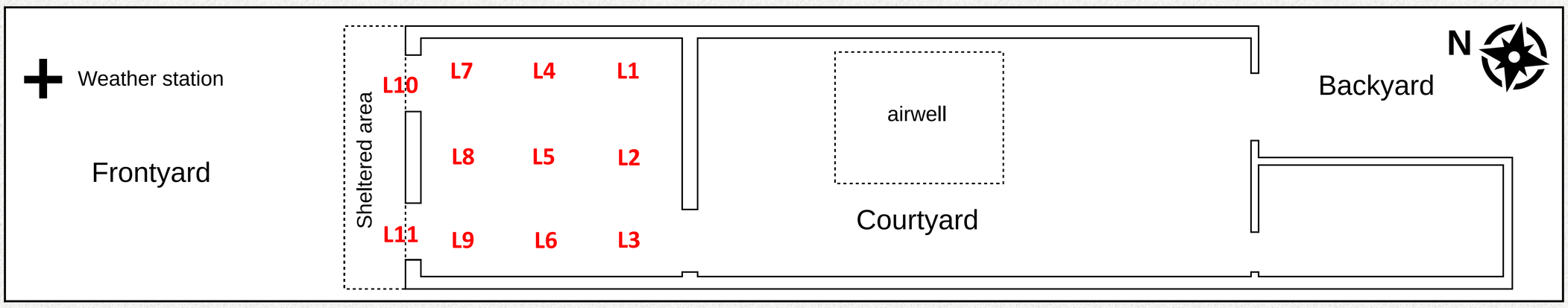
AIM

The specific aims of this study are:

- To collect baseline measurement in ArClab NUS to assess its natural ventilation potential.
- To analyse daytime and nighttime indoor-outdoor temperature dynamics, informing energy-saving potential.
- To provide a dataset for calibration and validation of simulation models of natural ventilation.

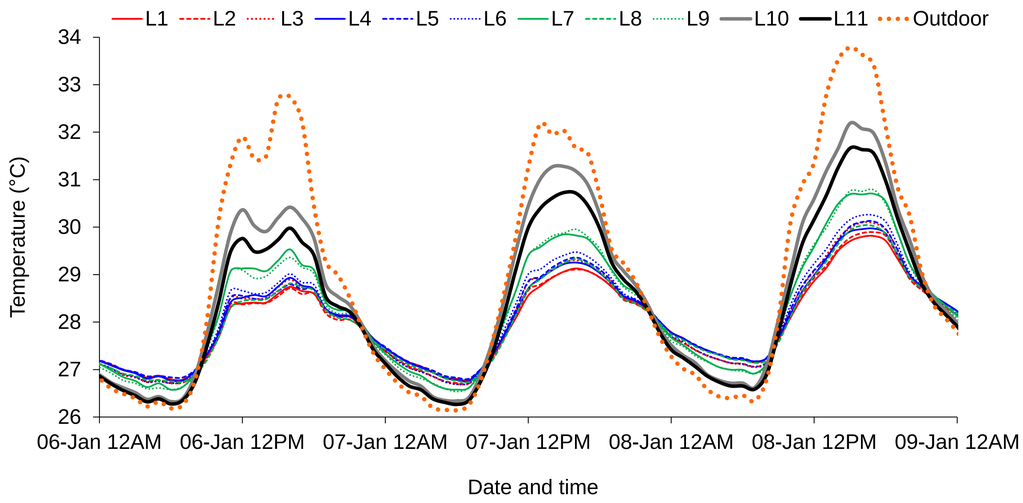
METHODS

A weather station is deployed to collect the outdoor weather data and 11 HOBO loggers are used to record the indoor temperatures. The floor plan below indicates the locations of the weather station and HOBO loggers (L1-L11). All measurements are collected at the pedestrian level (1.5 m above the ground). This study focuses on the living room, with two windows open to the frontyard and a door opens to the courtyard.



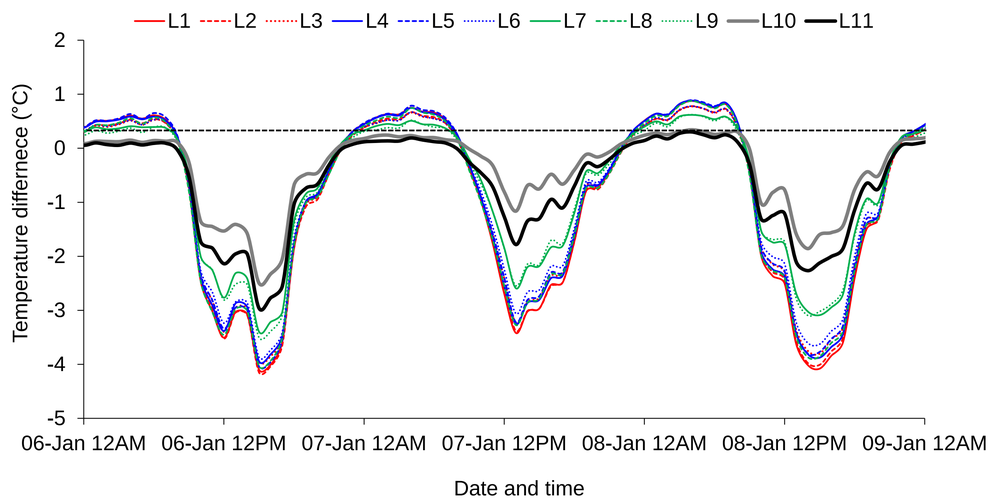
FINDINGS AND KEY DISCUSSION POINTS

Indoor and outdoor temperature trends



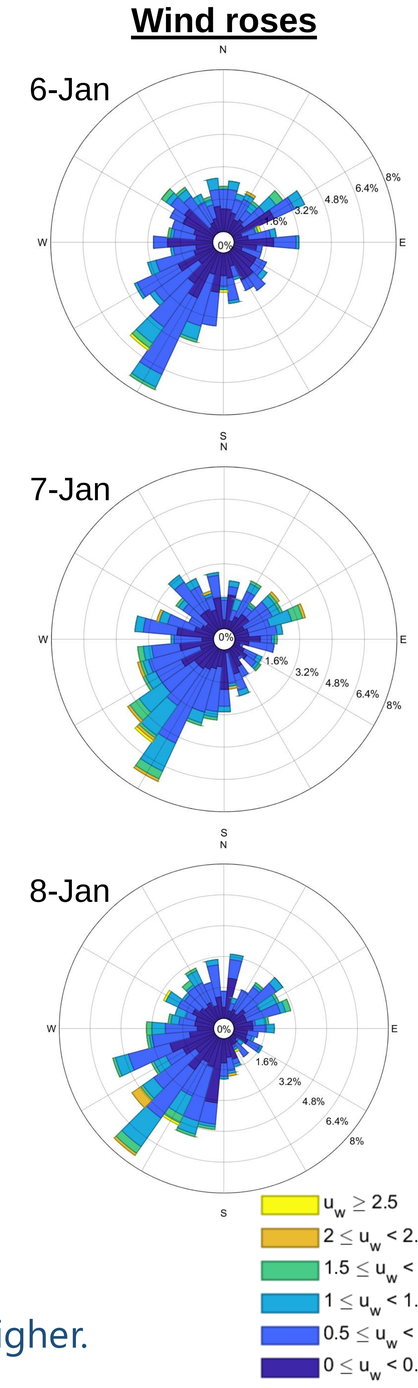
The indoor temperature trend follows that of the outdoor temperature, with peak temperatures in the afternoon and lowest temperatures in early mornings

Indoor-outdoor temperature difference

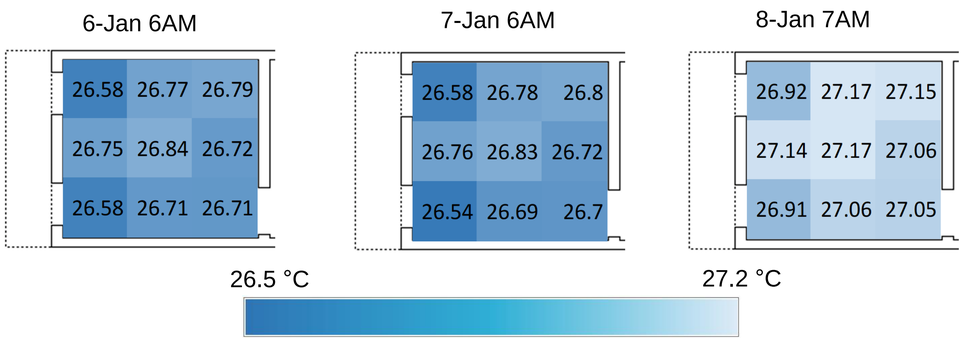


During daytime, the indoor temperature can be up to 4 °C lower than the outdoor temperature, while nighttime indoor temperatures align closely with outdoor.

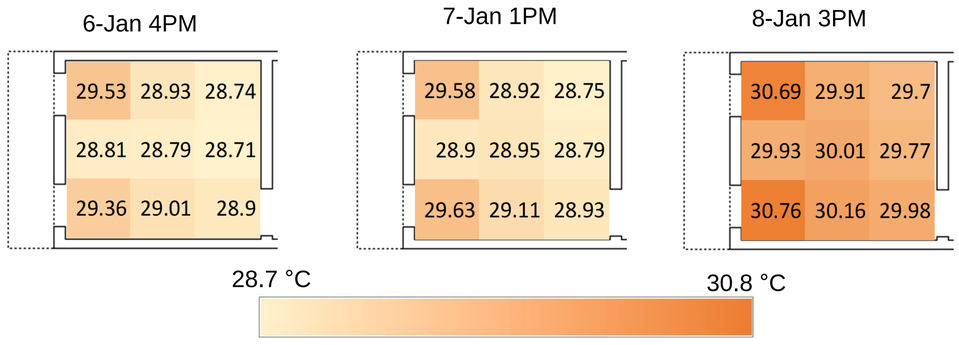
Wind roses



Indoor temperature during the coldest time of a day



Indoor temperature during the hottest time of a day



During the coldest time of the day, the temperature near the two windows is lower, while during the hottest time, it is higher.

CONCLUSION

The baseline measurement in ArClab NUS under naturally ventilated conditions is collected. During daytime, indoor temperatures can be up to 4 °C lower than outdoor temperatures, while nighttime indoor temperatures align closely with outdoor temperatures. The baseline measurement can be used to validate simulation models and derive feasible plans for energy saving by adopting natural ventilation.

Contact

Lup Wai Chew (lupwai@nus.edu.sg)
Website: https://blog.nus.edu.sg/lupwai

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