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Comparison of the hygrothermal performance of two light-framed timber structure buildings under different operation modes

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Keywords: Light-framed timber structure (LTS) buildings; In-situ experiment; Typical operation mode; Indoor environment; Heat and moisture transfer

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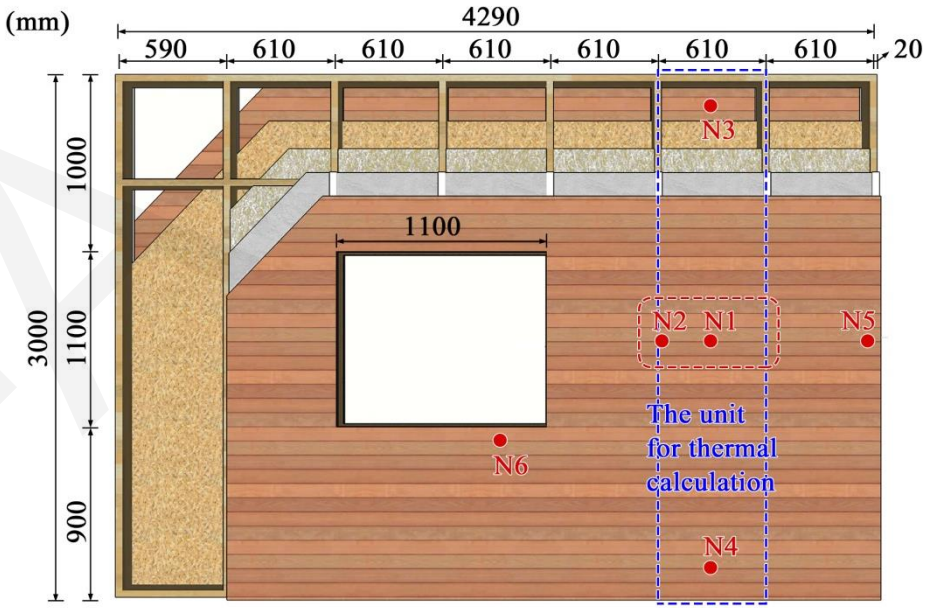
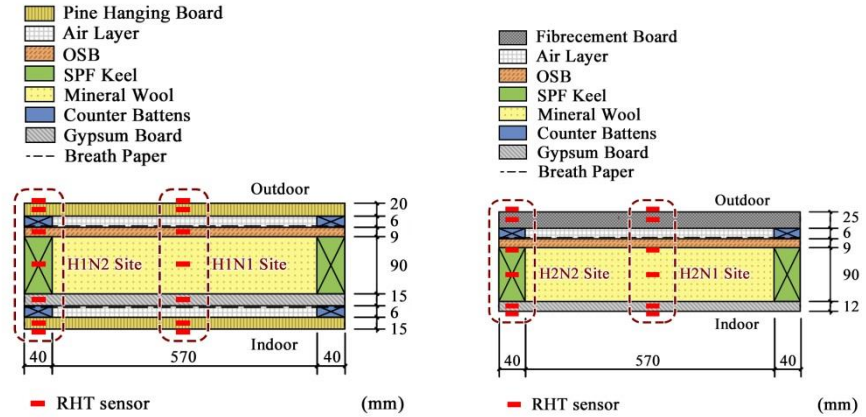
Innovation

1. Full-scale LTS building test models were established, and sensors were placed at different sites on the wall in order to monitor the change of temperature and relative humidity.
2. The intermittent energy consumption modes supplied with natural ventilation were adopted in the test, which made the research more close to the real situation.

Methodology

Full-scale test LTS building models were established





Temperature and relative humidity in both envorionment and inside the wall were monitored

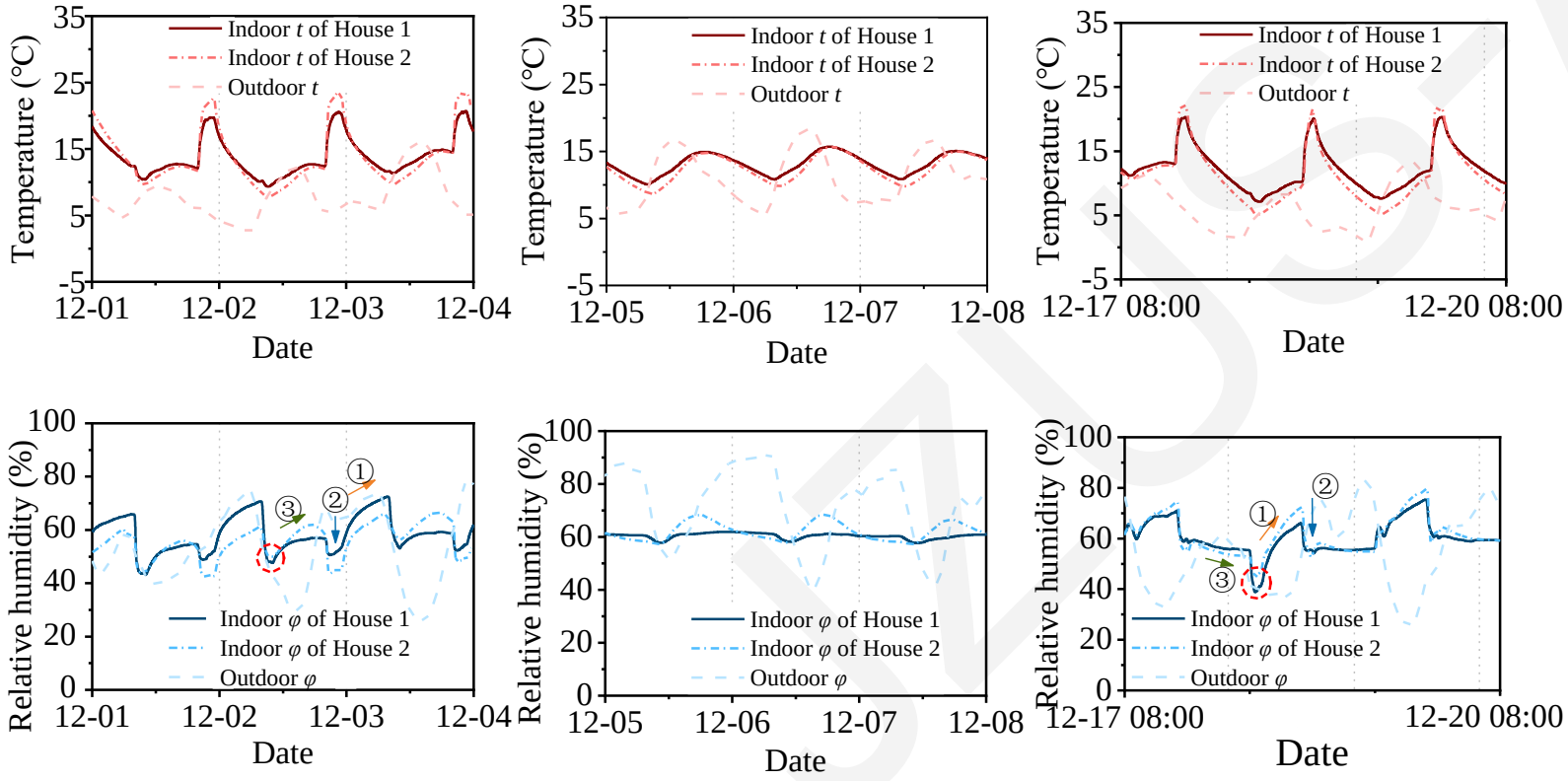
Methodology

Time	Operation mode	Window opening	Energy use	Vapour generation
30th Aug. 0:00-2nd Sept. 0:00	The continuous energy-use pattern in summer (S-AC)	None	0:00-24:00	None
1st Dec. 0:00-4th Dec. 0:00	Typical bedroom mode in winter (W-period 1)	8:00-10:00	20:00-23:00	20:00-8:00 35 g/h/person × 2
5th Dec. 0:00-8th Dec.0:00	The unoccupied mode in winter (W-period 2)	None	None	None
17th Dec. 8:00-20th Dec. 8:00	Typical living room mode in winter (W-period 3)	8:00-10:00	18:00-20:00	8:00-18:00 70 g/h/person × 1 18:00-20:00 70 g/h/person × 2
25th Dec. 0:00-30th Dec. 0:00	The continuous energy-use pattern in winter (W-AC)	None	0:00-24:00	None

The typical operation modes of the bedroom and living room in winter were selected, considering the influence of occupants. The unoccupied and continuous energy-use modes were also selected for comparison since these modes were adopted in most studies

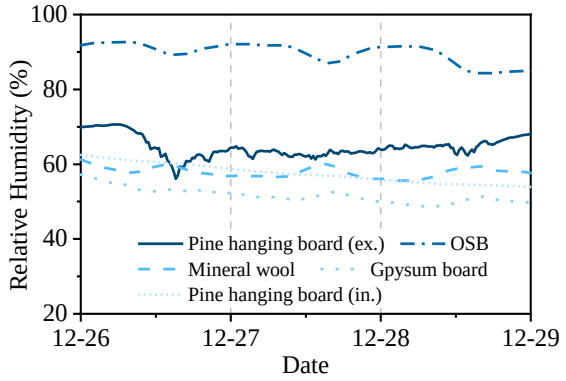
Results

Tempreature and relative humdity values of the indoor space and walls were significantly affected by the behaviour of occupants.

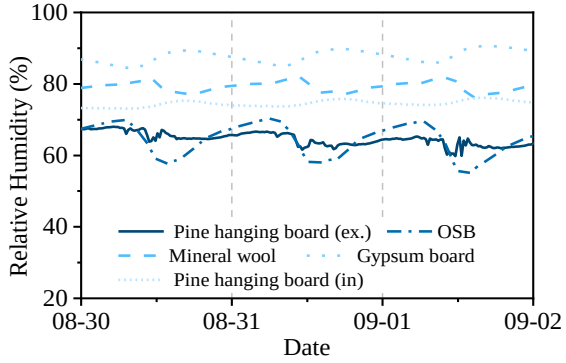


W-period 1 **W-period 2** **W-period 3**

The materials close to the mineral wool exhibited a high relative humidity in summer or winter, due to their larger μ value compared with mineral wool.



Winter case



Summer case

Results

The differences of hygrothermal performance between the two envelopes.

The exterior wall of House 1 attained a higher resistance to changes in temperature and relative humidity

The indoor temperature and relative humidity fluctuations in House 1 were smaller than those in House 2

House 1 performed better in a worse outdoor environment or continouse energy consumption mode. House 2 has a short response time when the heating system was intermittently operated and could quickly reach the set temperature.

The relative humidity values in wood materials can be high, and the drying effect of ventilation on the inner material can be limited by the outdoor environment.