In terms of energy demand, although the annual cooling load reduced with the incorporation of night ventilation, the annual heating load increased (refer Figure 8). Due to the limitation of the software, for some days in spring and autumn when the ambient temperature was very low, although night ventilation was not required, the apertures were still open. This might have resulted in an over-estimate of the heating loads. The total annual heating and cooling load for the building was found to be 39 KWh/m² and 42 KWh/m² for Base-case without night ventilation and with night ventilation respectively. These values are higher than the Passivhaus standard of 30 KWh/m²; however the values lie in or slightly above the specified range of 30 KWh/m² to 40 KWh/m² for heating and cooling. This implies that there is scope for improvement in the thermal performance of CSET building.

The lower floors (semi-basement and ground) in the building perform well due to low occupancy and equipment gain, while the upper floors (1st to 4th) suffer due to higher gains and lesser openings. Therefore it is strongly believed that reducing the gains and provision of more openings in the upper floors would improve the performance of the building.

CONCLUSION

From the above analysis, a broader conclusion can be drawn that a heavyweight building i.e. a building with high thermal mass, when coupled with night ventilation, appropriate shading and moderate internal gains from occupancy, lighting and equipments, performs better than a lightweight building in a humid subtropical climate even though this climate has small diurnal range and high humidity. This conclusion is in conjunction with the results of the studies conducted by Szokolay (2000) and (Soebarto, 1999) on the role of thermal mass in warm- humid climate.

Although, this research was contextually bound to one building in Ningbo, China, the inferences made would be helpful in establishing the general performance of thermal mass in humid subtropical climate which would assist building designers designing in this climate anywhere in the world. However, as the design and microclimate of each building plays a very important role in its performance, there are limits to the generalisability of the results. For this reason, it will not be advisable to prepare design guidelines based on the analysis of only one building. Based on a similar methodology as followed in this research, further research may look at thermal performance analysis of more intitutional buildings in this climate zone. Due to high relative humidity associated with humid sub-tropical climate, there is risk of condensation occurring due to contact of moist air with cold internal surfaces in buildings. As an extention to this study, further research may test the risk of condensation associated with lightweight and heavyweight construction in humid sub-tropical climate zone.

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