

**A STUDY ON THE TEMPERATURE AND HEAT FLOW
BEHAVIOUR OF A ROOM IN TOP FLOOR OF A
MULTISTOREY RESIDENTIAL BUILDING
LOCATED IN DELHI**

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A THESIS SUBMITTED IN FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY



**Department of Civil Engineering
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To the best of my knowledge the thesis has reached the requisite standard. The material presented in this thesis has not been submitted in part or full to any other university or institution for award of a degree or diploma.



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(M. Srinivasa Reddy)

ABSTRACT

In this study the internal temperature variations and heat flow of an actual, unconditioned room located in a top floor of a brick masonry residential building were measured for the climatic conditions of Delhi. The experimental observations were recorded for a period of one year, namely, 12 months. The air temperatures and relative humidity in the test room and outside were recorded continuously for all the twelve months. Hourly observations of heat flow rates and temperatures of different surfaces were recorded for a period of 24 to 36 hours at a time, usually atleast, once in a month.

The extent of applicability of two methods, namely, admittance and transmission matrix methods, to a room in top floor of a multistorey building located in Delhi, in the prediction of temperature or heat flow was studied. The admittance method was used to predict both internal temperature and heat flow into the room and the transmission matrix method was utilised for the prediction of heat flow, after both the methods were suitably modified to take into account the various factors, namely, longwave radiation loss from the external surfaces, shadows cast by adjacent buildings, effect of shading devices, longwave radiation exchange among the internal surfaces of the room and the effect of external surface heat transfer coefficient.

The relevance of approximate methods in predicting the heat flow, in an unconditioned room, using empirical

fabric performance factors such as time-lag and decrement factor was studied. The approximate method, for conditioned environment, suggested by Koenigsberger et al, has been modified suitably for the unconditioned environment and utilised in this study.

Finally the sensitivity of the thermal response to building fabric variables was investigated.

The temperatures inside the test room, predicted by the admittance method closely followed the measured temperatures during the days which were not drastically different in their external temperatures and in the intensity of solar radiation from one another. In this context, the values of room air temperature seem to be not sensitive to a variation of solar radiation even upto an extent of $\pm 20\%$. The predicted internal temperatures were reasonably close to the measured temperatures even though the mean external temperature of previous days varied by about $\pm 2.0^{\circ}\text{C}$. The room air temperatures were not well predicted by the admittance method during the seasonal changes.

Both the admittance and the transmission matrix methods predicted equally well the heat flow during the steady cyclic periods. The admittance method could not predict the values of heat flow accurately if the unsteady regime was continuously persistent. Whereas, the transmission matrix method could predict slightly better values of heat flow compared to the admittance method.

The agreement between the measured values of heat flow and those obtained by an approximate method suggested by

Koenigsberger et al, was good.

It was observed that, in unconditioned buildings, the considerable expense of the treatments like reflective aluminium foil on the roof, higher value of exterior surface heat transfer coefficient, increased thickness of roof slab and walls and additional insulation in the ceiling was not really worthwhile as the treatments couldnot bring down the mean temperature of the room.

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