ANALYSIS OF SOME SOLAR PASSIVE CONCEPTS

by

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SUMMARY

The present thesis incorporates the design and evaluation of some of the passive solar heating and cooling concepts. In developing different analytical models, the heat flow in the roof/wall is assumed to be unidirectional and in view of periodic nature of solar intensity and ambient air temperature, the temperature distribution in the roof/walls have been assumed to be periodic.

It is seen that a double hollow roof/wall and the one with single cavity divided into two by introduction of metal sheet have same qualitative behaviour, however, the low cost and design simplicity make latter configuration more suitable. The performance may further be improved by placing reflecting sheet in the air-gap, the reduction in infiltrating heat flux achieved by this system is seen to be even more than water-film system. This unwanted heat may be utilized by designing a roof/wall to act as collector-cum-storage system. This is achieved by flowing water in the network of tubes embedded in the roof/wall. The hot water obtained by this system will suffice the domestic needs. Another commonly employed system of cooling the building is roof-pond. The thermal model developed for it is seen to agree with the experiment performed. This system may as well be used for heating in winter, for this the evaporative heat loss is eliminated and overall heat

loss from water to ambient is reduced by employing a movable insulating cover during off-sunshine hours. Its use makes the overall heat transfer coefficient a function of time alongwith meteorological and system performance parameters. A thermal model has been developed for this system and validated by experiment performed at I.I.T. Delhi, India. The relative study of roof with different passive cooling concepts viz. vegetable pergola, roof garden/water-film, removable canvas and inverted earthen pots, has also been made. A shaded roof (vegetable pergola) with a water-film maintained on its top surface is seen to be the best from the load levelling point of view. A seasonal study of different wall structures and their choice with orientation shows that cavity walls on all but south and a massive storage wall on south should be deployed in northern hemisphere.

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