ABSTRACT

In many dry climate areas, summer is long by a mean daily maximum temperature of 30°C. Approximately 30% of the total power generation being consumed by air-conditioning systems in domestic buildings. A hybrid cooling technology to reduce the domestic cooling demand would have both environmental and economic benefits. A renewable cooling technique, which assists the situation, is the earth's cooling potential. Thermal energy accumulated in the ground can be used with earth air heat exchangers (EAHE), in which a single pipe or multiple pipes are buried into the ground. As the ventilation air is passed through the pipe, the air is heated during the winter and cooled during the summer because of the difference in temperature between the air and the ground. By utilizing this free energy, the energy consumption required for space conditioning can be reduced.

In this thesis, few designs are attempted to reduce the energy use for air conditioning. First, an earth air heat exchanger (EAHE) system has been designed and developed in order to formulate a theoretical model to predict the outlet air temperature of the EAHE system used for cooling a building situated in the southern part of India during hot atmospheric conditions. EAHE can be able to reduce the electric power consumption of a typical house by 30%. Further, the EAHE has been combined with Solar Chimney (SC) in order to improve the cooling and ventilation of an indoor room. With the effect of SC, the hot air present in the room is expelled to the atmosphere, due to the functioning of SC and could achieve the required air change it helps to meet the indoor comfort. The EAHE combined with commercial air conditioning machine was studied by numerical using CFD software. This attempt made to identify the performance of the EAHE system in South India, Chennai. The observed computational results were compared with the experimental results of the proposed design and with earlier investigations. The cooling performance

of combined cooling systems experimentally explored and identified the best approach within the four different modes of EAHE-AC.

Through the findings, the successful functioning of EAHE separately or combined with other devices can provide the cooling of buildings and also reduce the energy required for air conditioning in the study locations. The correlations between analytical, simulation and experimental results are verified at each design stage with fair outcome. Due to the ambient conditions of the chosen locations, the EAHE performance was limited and it is unable to provide the cooling at a steady rate. So, the study is extended, where the successful functioning of Ground Source Heat Pump (GSHP) system is identified in the similar location which is used to achieve the cooling effect in the printing plates room in ‘The Hindu Publication house, Chennai’. Better energy savings were achieved based on the optimal design parameters of EAHE. Though the potential of energy saving in the preferred location, the GSHP is found to be more feasible than EAHE.