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Energy Conservation and Efficiency Improvement by Automation in Intelligent/Green Buildings from Concept to Commissioning

ABSTRACT

Building sector is one of the most significant consumers of natural resources and equally contributing towards greenhouse gas emissions, making it a polluting machine without smoke stack. Large amount of energy is consumed for building services like Heating ventilation and air conditioning (HVAC), lighting and others. As energy costs continue to escalate and awareness spreads with regard to the importance of sustainability, interest in reducing energy consumption of buildings is growing. For managers of large stocks of office buildings, the task of selecting building improvement projects is most challenging. A multitude of energy conservation measures (ECMs) is available from which to select.

Various aspects of minimizing energy consumption in building and HVAC system optimization have been less analyzed in several studies. This thesis has investigated the energy conservation and energy efficiency improvement in buildings by combining passive and active methods. The aim of this study is to provide a screening methodology for the evaluation and prioritization of ECMs for implementation in a stock of buildings that exhibit varying characteristics and locations. Prioritization of ECMs is based on

predicted energy consumption savings by different approaches. Several case studies have yielded very good base for reducing the cooling load in buildings. These findings can be conveniently be used to build environmental friendly green buildings.

Another approach in this thesis is focused to improve the energy efficiency of Direct Expansion Air Conditioning (DXAC) system by active automation technique; by mathematical modeling and simulation using Matlab/Simulink software. In this work a combined theoretical-empirical modeling approach is developed for DXAC components: compressor, condenser, evaporator and expansion valve. The functional speed of these components were controlled by a PID controller in DXAC model resulting in better performance and reduction in energy requirements for the given part load condition.

The results show that there is over 9% energy saving by monitoring and controlling the speed of compressor, condenser and evaporator fans. This is mainly due to timely reaction of constant speeding motors to variable speed making compressor to work less owing to low cooling demand and hence reduction in energy consumption. Meanwhile the condenser and evaporator fans make it easier by reducing energy demand, further. This approach to reducing the energy consumption in DXAC by using simulink to create the model in Matlab for simulation resulted in energy saving of above 9% compared to constant speed DXAC system.