

Study on Variable Refrigerant Volume Air-conditioning System

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Declaration

I hereby declare that this submission is my own work and that, to the best of my knowledge and behalf, it contains no material previously published or written by another person nor material which to substantial extent, has been accepted for the award of any other academic qualification of a university or other institute of higher learning except where acknowledgment is made in the text

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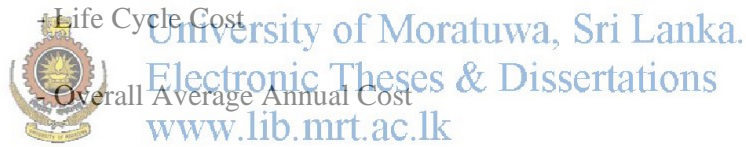
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Abbreviations

CBSL	- Central Bank of Sri Lanka
CLF	- Cooling Load Factor
COP	- Coefficient of Performance
DEC	- Direct Evaporative Cooling
DX	- Direct Expansion
EER	- Energy Efficiency Ratio
EEV	- Electronic Expansion Value
FPFA	- Fan-Coil Plus Fresh Air
IGH	- Internal Heat Gain
LCC	- Life Cycle Cost
OAC	- Overall Average Annual Cost
VRF	- Variable Refrigerant flow
VRV	- Variable Refrigerant Volume



Abstract

During the last two decades, air-conditioning has become a basic requirement in industrial, commercial and residential sectors. With the widened use of air-conditioning in all the sectors, the human community has faced serious environmental and socio economic problems. Prevailing energy crisis and ever increasing energy pieces has made the situation worst. Under the scenario, various novel technologies have been emerged to the air-conditioner market. Variable Refrigerant Volume (VRV) air-conditioning technology is also considered as an advanced technology developed to cater the need of efficient use of energy for air-conditioning.

The major objective of the research study was to analyze the suitability of VRV air-conditioning system, analyze the actual saving potential and cost effectiveness of VRV air-conditioning system compared to the other available types of air-conditioning systems and access the maintainability of VRV air-conditioning system. The study was conducted at a selected representative installation namely at the Sovereign Residences of Central Bank of Sri Lanka. Summary of findings are as follows.

- VRV air-conditioners are suitable for medium scale hotel applications. However, this conclusion cannot be generalized for all the installations and the appropriate air-conditioning system for particular building should be selected only after performing a comprehensive analysis of energy performance of considered options on that particular installation (preferably after a computer simulation and life cycle cost analysis of different options). Therefore, though the demand for VRV air-conditioning system is prevailing due to the higher efficiency rating and the part load performance of the air-conditioning appliances, the desires of the purchases on energy saving potential of VRV air-conditioners could be satisfied only when it is selected for an appropriate application.
- Saving potential of VRV air conditioners could be high as 18 % compared to the energy consumed by split air-conditioning systems when used for appropriate applications. Therefore, the VRV system can be considered as a potential candidate for the installations where the building occupancy and cooling load are regularly varying. Further, Chiller (Central) air-conditioning system can also be considered as a potential candidate as it performs almost efficiently as the VRV system. It consumes around 4 % more energy than VRV system.

- Computer simulation (Equest) shown that VRV air-conditioning system is the most efficient option among the potentially applicable options considered for the building. However, the Life Cycle Cost (LCC) analysis shows that Chiller system is the most economical air-conditioning system for the same building. Therefore, it is vital to perform LCC analysis in addition to performance analysis when selecting the appropriate air-conditioning system for a building.
- Maintainability of the VRV air-conditioning systems is acceptable. It is necessary to select the correct density and thickness of the refrigerant pipe insulation to minimize the possibilities of formation of condensation along the refrigerant pipes. Also, the power quality should be maintained at an acceptable level to ensure the durability and proper functionality of electronics of the VRV air conditioning equipment.



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