ENERGY SAVING OF VARIABLE AIR VOLUME SYSTEMS

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DECLARATION OF THE CANDIDATE & SUPERVISOR

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Abstract

Air conditioning is very common in modern buildings. It was originally purposed to maintain thermally comfortable environments for people inside the building. So far, human thermal comfort is not only the criteria adapted to given the control and operation of a system. Most of the commercial buildings in Sri Lanka are sick buildings and having extremely high energy consumption of 50% to 65% of the total power consumption for air conditioning.

The main reasons to have less energy efficiency of central air conditioning systems are over selection of the equipments, poor maintenance and improper controlling. Although having over selected equipment such as chillers, pumps and air handling units of particular installation, the energy usage can be optimized by accommodating a proper control system.

The objective of this research is a conceptual development for air distribution cycle in order to improve the energy saving of existing variable air volume (VAV) system while maintaining the human comfort at a highest level.

This will be only a functional modification of the system (programming concept), any additional sensing elements and or controlling elements will not be required to achieve the results. Any Specialized Building Management System Contractor can use this programming concept in their system with own programming languages or functional blocks. Only the requirement is that the VAV controller shall be connected to air handling unit controller via a communication bus and the few parameters from VAV controllers shall be transmitted to the particular air handling unit (AHU) controller. Generally in VAV air distribution system, thought-out the running period of the AHU, the duct static pressure set point is constant and Variable Speed Drive will be modulated by Direct Digital Controller (DDC) in order to maintain the duct static pressure at the set point. The research describes about the concept of the duct static pressure set point to varying (resetting) according to the actual demand of the total VAV Units which are connected to the particular VAV AHU. This will be an adaptive control loop for pressure set point. At the end of the research (under the result), the actual site experimental data is given for the power consumption of "Fixed Duct Static Pressure Set Point VAV Control System" Vs "Proposed adaptive control of pressure set point VAV Control System". The conclusion and analysis of the dissertation shows 6% of the energy saving from the adaptive control system compare to the fixed duct static pressure set point.

Key Words: Duct Static Pressure, VAV Energy Efficiency, Static Pressure Set Point and VAV AHU.

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LIST OF ABBREVIATIONS

Abbreviation	Description
A	Ampere
AC	Alternative Current
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers
BMS	Building Management System
CAV	Constant Air Volume
CFD	Computational Fluid Dynamics
Co2	Carbon Dioxide
DC	Direct Current
DDC	Direct Digital Control
DW/142	Specification for Sheet Metal Ductwork Addendum-A
DX	Direct Expansion
EMI	Electromagnetic Interference
g	Gravity Acceleration
HVAC	Heating Ventilation and Air Conditioning
Hz	Hertz
IAQ	Indoor Air Quality
kW	Kilo Watt
l/s	Liters per Second
m	Meter
m/s	Meters per Second
m/s2	Meters per Square Second
mA	Milliamp
N/m2	Newton per Square Second
NEMA	National Electrical Manufacturer Association
°C	Celsius

P	Pressure
Pa	Pascal
PI	Proportional-Integral (PI) control
RH	Relative Humidity
RPM	Revaluation per Minutes
SMACNA	Sheet Metal and Air Conditioning Contractors Association
V	Velocity, Voltage
VAV	Variable Air Volume
VFD	Variable Frequency Driver
VSD	Variable Speed Diver
z	Height