COMPARISON OF YEAR ROUND ENERGY PERFORMANCE WITH DIFFERENT VENTILATION METHODS FOR ACMV SYSTEMS IN THE TROPICS

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Approved:

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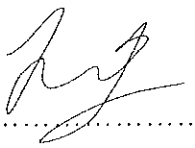
DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

Signature 

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ABSTRACT

Ventilation methods in Malaysia has become obsolete, the usage of mixing ventilation is no longer feasible as it consumes too much energy. The usage of displacement ventilation only applies to large buildings. Stratum ventilation is the solution for minimising energy usage while being applicable to smaller buildings. Stratum ventilation is expected to have a significant impact on the HVAC community in Malaysia as it will phase out the mixing ventilation. China and Hong Kong have come to embrace the usage of stratum ventilation in their seasonal country. This study will compare the year round energy performance for different ventilation methods in a tropical country. The goal in mind is to evaluate the performance of the stratum ventilation in a tropical country. The grounds of INTI International University will be testing platform for this ventilation. A TRNSYS simulation studio was used to project the year round comparison based on data collected from a lecture theatre in the university. The simulation was done in the form of a lecturer's office and lecture room with the usage of the Malaysia weather data to mimic tropical conditions. The studies suggest that stratum ventilation is feasible in a tropical country promising a minimum saving of 10.81% when compared to the displacement and mixing ventilations. The studies also found that the stratum ventilation uses only 3.54% excess energy when compared to the ideal cooling load of a room. The study seems to be a success and may set the path for a new ventilation system for tropical countries.

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DEDICATION

This thesis is dedicated to my parents.

My rock

My foundation

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LIST OF ABBREVIATIONS

ACMV	Air Conditioning and Mechanical Ventilation
CAD	Conventional Air Distribution
CBAD	Ceiling Based Air Distribution
COP	Coefficient Of Performance
HVAC	Heating; Ventilation and Air Conditioning
IAQ	Indoor Air Quality
PMV	Predicted Mean Vote
PLC	Part Load Controller
UFAD	Under floor Air Distribution

NOMENCLATURE

Symbol	Definition
D	mass diffusivity of species in air, m2/s
g	gravitational acceleration vector, m/s2
$Hroom$	zone height (m)
k	thermal conductivity of air, W/(m K)
m	concentration of species, kg of species/kg of air
$Qsen$	sensible load of building zone (kW)
T	temperature; average temperature (with subscript), °C
$Tgrad$	temperature gradient along the zone height (°C−1)
u	velocity vector, m/s
ρ	density of air, kg/m3
β	thermal expansion coefficient, K-1
Cp	specific heat of air, J/(kg K)
μ	viscosity of air, kg/(m s)
θr	dimensionless temperature coefficient

CHAPTER 1

INTRODUCTION

1.1. Background

Malaysia is a country with a tropical climate due to its location in the equatorial region of the world. Temperature in Malaysia rises to a peak of 32 degree Celsius in the year of 2014. Air conditioning and mechanical ventilation (ACMV) system is the main method to overcome this extreme heat. The general idea of ACMV system is to displace or change the air that is contained in an area to provide better indoor air quality as well temperature control to provide a an environment that is comfortable for its occupants. However these air conditioning systems require an enormous amount of energy to function. As Malaysia develops, air conditioning systems are easily available in every household and widely used in commercial buildings. Malaysia uses an estimate of 45% of electricity usage on cooling systems. The estimated power usage of 2014 is 22,100 MW of energy and 9,945 MW is dedicated to cooling systems alone. Ventilation systems in Malaysia commonly divided into mixing systems such as the conventional air distribution (CAD) systems or the displacement systems such as the under floor air distribution system (UFAD). However a new ventilation system has been proposed to be used in Malaysia, it is known as the stratum ventilation.

Mixing ventilations systems are widely used in Malaysia because it easily available and the initial cost of the operating system are affordable. The most common type of mixing ventilation is the overhead or ceiling based air distribution system (CBAD). These systems are the most basic of the ventilation systems which uses basic refrigeration system to cool the indoor temperature. The system contains an evaporator, condenser, expansion valve and a compressor. CBAD capitalizes on the phase conversion by evaporating and condensing the refrigerant inside it to absorb and expel heat. These refrigerants use are able to change physical composition at low temperatures