ANALYSIS FOR OPTIMIZATION OF ENERGY EFFICIENCY IN OFFICE BUILDINGS IN SRI LANKA

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Degree of Master of Science in Building Services Engineering

Department of Mechanical Engineering

University of Moratuwa
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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Building Services Engineering

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DECLARATION

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Signature of the Supervisor Date

(Prof. K.K.C.K. Perera)

ABSTRACT

Energy consumed in the building sector consists of residential and commercial end users and it accounts for 20.1% of the total delivered energy consumed worldwide [22].Global primary energy demand is projected to increase by annual rate of 1.6% between 2004 and 2030[23].

There are building codes, Standards, Guidelines etc. to regulate and promote energy efficiency in building sector [page 33]. Sri Lanka also had focused on minimising these increasing trends during the past decade. "Code of Practice for Energy Efficient Buildings in Sri Lanka 2008" was introduced as an initiative. Sri Lankan government is carrying out various programmes, seminars and activities to encourage building owners, developers, designers to implement energy saving measures.

In this research three commercial buildings in Colombo region having 8, 8 & 10 floors and total floor areas of around 35 000 ft^2, 60 000 ft^2 & 90 000 ft^2 and monthly average energy consumption around 50 000 kWh, 70 000 kWh & 100 000 kWh were selected. The study and analysis were done to find out whether there are none-compliances of the selected buildings with ASHERAE 92.1-2007 standard and Code of Practice for Energy Efficient Buildings in Sri Lanka-2008 which are used by professionals in the subject and to find out whether there are opportunities to improve energy efficiency of already constructed buildings further by modelling those buildings in Trace 700 software by simulating various possible options.

None of the three selected buildings fully complied with the standards considered. Major weak points were poor building envelope sealing, insufficiency of usage of automatic controls, improper balancing of systems, poor lighting system efficiency , higher lighting power density and higher Solar Heat Gain Coefficient of vertical glazing.

Though Building Automation Systems (BAS) are installed, it was revealed that by adding/upgrading some new features/options to BAS and by eliminating the weaknesses found, there are still more opportunities to increase energy efficiency further significantly.

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LIST OF ABBREVIATIONS

Abbreviation	Description
A	Ampere
AC	Air Conditioning
A.M.	Ante Meridiem
AHU	Air Handling Unit
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
BAS	Building Automation System
BMS	Building Management System
CEB	Ceylon Electricity Board
CFM	Cubic Feet per Minute
CT	Cooling Tower
COP	Coefficient Of Performance
CFL	Compact Fluorescent Lamp
^{o}C	Celsius
DCV	Demand Control Ventilation
DDC	Direct Digital Control
EPF	Envelop Performance Factor
EER	Energy Efficiency Ratio
ft	Feet
^{o}F	Fahrenheit
GMT	Greenwich Mean Time
gpm/hp	Gallons per minute per horsepower
hp	Horsepower
HVAC	Heating, Ventilation and Air Conditioning
hp/CFM	Horsepower per Cubic Feet per Minute
IPLV	Integrated Part Load Value
kW	Kilowatt

kWh	Kilowatt-hours
KIP	Key Performance Indicators
LPD	Lighting Power Density
lm/W	Lumens per Watt
LCC	Life Cycle Cost
LED	Light Emitting Diode
m	Meter
mm	Millimetre
OTTV	Overall Thermal Transfer Value
PCM	Phase Change Material
PV	Photo Voltaic
P.M.	Post Meridiem
ppm	Parts Per Million
PIR	Passive Infra-Red
Rs	Sri Lankan rupees
SHGC	Solar Heat Gain Coefficient
T5	Tubular with 5/8” in diameter
Ton	Cooling capacity in Ton
UV	Ultra Violet
V	Volt
VFD	Variable Frequency Drive
VLT	Visual Light Transmittance
W	Watt
W/m^2	Watts per Square Meter
W/ft^2	Watts per Square Foot