NUMERICAL INVESTIGATION OF THERMAL COMFORT AND INDOOR AIR QUALITY INSIDE BAGHDAD INTERNATIONAL AIRPORT

By

Eng. Manar Kadhem Jaafar Ahmed

A Thesis Submitted to the Faculty of Engineering at Cairo University in Partial Fulfilment of the Requirements for the Degree of MASTER OF SCIENCE

In

MECHANICAL POWER ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis: NUMERICAL INVESTIGATION OF THERMAL COMFORT AND INDOOR AIR QUALITY INSIDE BAGHDAD INTERNATIONAL AIRPORT IN IRAQ

Key Words: (CFD, Thermal comfort, indoor air quality, Airport, air distribution)

Summary:
This thesis focuses on analyzing indoor air quality and thermal comfort inside departure hall in an airport through numerical investigation. Six suggested cases were studied and in each case the location, dimensions and even number of air supply and air extract grilles to discuss the effect of changing these parameters on thermal comfort levels for occupants using ANSYS 19. .Mesh sizes used in present work exceeded 5 million approximately.
The result had shown the best case among the other cases when four supply grilles at the middle and two extract grilles at the ends of the building.

DISCLAIMER

I hereby declare that this thesis is my own original work and that no part of it has been Submitted for a degree of qualification at any other university or institute.
I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Date:

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With the name of ALLAH, I started this research hoping that it accelerates the wheel of progress in this field.

I would like to express my sincere appreciation and infinite thanks to **Professor Dr. Essam E. Khalil**, professor of mechanical power- faculty of engineering–Cairo University, who gave me a great scientific support and guidance to make a progress in my research. Besides, having severe admiration of his gigantic experience and unlimited co-operation and efforts of helping me to introduce this research in the best.

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Last, but not least, I dedicate this research to my home country, Iraq.

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SYMBOLS AND ABBREVIATIONS

NOMENECLATURE

SYMBOLE	QUANTITY
a	Acceleration vector, m/s2 – Speed of sound, m/s
cp	Specific heat at constant pressure, J/kg.K
C	Constant – Convective heat loss from skin surface, W/m2
e	Internal energy, J/kg
E	Total energy of a fluid element, J
g	Gravitational acceleration, m/s2
Gb	Generation of turbulent kinetic energy, *k*, due to buoyancy
Gk	Turbulence kinetic energy n
h	Enthalpy, J/kg – Hour
H	Height, m
I	Overall turbulence intensity
k	Turbulent kinetic energy, m2/s2 – Thermal conductivity coefficient, W/m oC
L	Length, m
M	Mach number – Metabolic rate, W/m2
P	Pressure, Pa
Pr	Prandtl Number, Pr = cpμ / k
Q	Heat flux, W/m2
Q	Volumetric air flow rate, m3/s – Total heat added to a fluid element, J
R	Gas constant, kJ/kg.K – Radiative heat loss from skin surface, W/m2
Re	Reynolds Number, Re = ρ U L / μ
RH	Relative humidity, %
S	Source term – Modulus of the mean rate-of-strain tensor

SF6	Sulfur hexafluoride
t	Time, s
T	Temperature, K
T'	Temperature fluctuation, K
u	Instantaneous velocity component in x-direction, m/s
Iu	mean velocity components, m/s
iu'	Fluctuating velocity components. m/s
U	Axial velocity, m/s – Average velocity near the wall region, m/s
Ui	Inlet jet velocity, m/s
υ	Instantaneous velocity component in y-direction, m/s
V	Room volume, m3 – Velocity vector, m/s
w	Instantaneous velocity component in z-direction, m/s
W	Total work done on a fluid element, J–Width, m–Mechanical work, W/m2
x, y, z	Cartesian coordinate components

GREEK LETTERS

β	Thermal expansion coefficient, K-1
Δ	Element interval –Change interval of any property
Δ	Boundary layer thickness
∇	Gradient
ϵ	Turbulence dissipation rate m2/s3
κ	Von Kármán constant
μ	Molecular viscosity, kg/m.s
Τ	Shear Stress, kg/m.s2
Γ	Diffusion coefficient
ρ	Density, kg/m3
φ	Dissipation function
Φ	Donates scalar property (i.e. density, temperature, etc.)
ω	Vorticity