بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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MONA MAGHRABY

NUMERICAL STUDY OF SMOKE MOVEMENT AND BEHAVIOUR AT AUDITORIUM HALL

By

Eng. Islam Gaber Mohamed Gaber

A Thesis Submitted to the Faculty of
Engineering at Cairo University in Partial
Fulfillment 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 STUDY OF SMOKE MOVEMENT AND BEHAVIOUR AT AUDITORIUM

Key Words: Smoke- CFD – Fire – temperature distribution – Egress

Summary: This research shows the approach for the smoke layer interface at particular distance above the highest walking surface in an auditorium, The associated smoke exhaust capacity required to provide a large clear height is substantial. Further concerns about the make-up air requirements, especially given that the maximum velocity of 6.0 m/s for the make-up air in case utilizing mechanical ventilation and 4 m/s in case none forced ventilation as in this study utilizing ANSYS Fluent V.18.2 CFD software. Based on that this thesis will discuss how much smoke air should be extracted to enable people escaping from that auditorium in safe way.

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:
Signature:

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Nomenclature

Symbol	Description
a	Constant
C	Solid material specific heat
C	Constant pressure specific heat
D	Density Persons/m2
D	Diffusion coefficient, Dilution parameter
F	External force vector (excluding gravity)
F_c	External force vector (excluding gravity)
F_s	Specific flow Persons per seconds per meter of effective width (Persons/seconds/m of effective width)
F_{sm}	Maximum specific flow Persons per seconds per meter of effective width
G	Acceleration of gravity
H	Acceleration of gravity
I	Radiation intensity
$\dot{I}$	Radiation black body intensity
k	Thermal conductivity; suppression decay factor
K	Constant
Kg	Grad factor
M	Mass production rate of species a by evaporating droplets/particles
m,	Fuel mass flux
P	Population of the assembly area users
Pr	Prandtl number
Q	Total heat release rate Kw
q	Convective flux to a solid surface Kw
Q*	Convective flux to a solid surface Kw
R	Universal gas constant
R	Riser (for stairway) Meters (m) and millimeters (mm)
Re	Riser (for stairway) Meters (m) and millimeters (mm)
S	Riser (for stairway) Meters (m) and millimeters (mm)
S	Visibility, m
S	Speed meters per second (m/s)
T	Thread (for stairway) Meters (m) and millimeters (mm)
t	Temperature ^{O}C
T_0	Ambient temperature
t_d	time to detection from fire initiation (minutes)
t_{pm}	time to detection from fire initiation (minutes)
t_t	time to detection from fire initiation (minutes)
t_u	time to untenable conditions (minutes)
W	Molecular weight of the gas mixture
W	Molecular weight of the gas Species
W	Width Meters (m)
We	Effective width Meters (m)

(x,y,z)	Position vector
ΔH	Heat of combustion kJ/kg

GREEK LETTERS

α	Thermal diffusivity mm^2/s
δ	Delta function
Γ	Diffusivity
ρ	Density, kg/m^3
ε	Turbulence dissipation rate
Φ	Relative humidity
τ	Shear Stress, Pa
ψ	Gaussian random number
μ	Dynamic viscosity, $N.s/m^2$
ν	Kinematic viscosity, m^2/s
ω	Vorticity
κ	Von Kármán constant
ε	Emissivity

ABBREVIATIONS

2D	Two-dimensional configuration
3D	Three-dimensional configuration
AJV	Authority having jurisdiction
ASET	Available safe egress time
ASHRAE	American Society of Heating Ventilation and Air Conditioning Engineers
CFD	Computational Fluid Dynamics under ANSYS V.18.2
HVAC	Heating, Ventilation and Air Conditioning
NFPA	National Fire Protection Association.
p	Pressure
Ppm	Population of the assembly area users
RSET	Required safe egress time
SFPE	SFPE, Society of Fire Protection Engineering, Fire and smoke Handbook. 5 th Edition
T	Temperature
V	Velocity