UNIVERSITI TEKNOLOGI MARA

ANALYSIS OF PERMISSIBLE CAR PARK AREA FOR NATURAL SMOKE VENTILATION USING COMPUTATIONAL FLUID DYNAMICS (CFD)

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ABSTRACT

A simulation using Fire Dynamic Simulation (FDS) has been conducted at a simplified model of a car park. The dimension and opening size of all models are corresponding to the Uniform Building by Law (UBBL) 1984 which allows that the models to be without any mechanical ventilation system or alarm if certain criteria are fulfil. In the UBBL, the criteria for the natural ventilation are that the opening must be more than 40% than the total wall enclosing the room. Therefore, the opening must be able to effectively remove smoke as the occupant escape from the building. Based on the situation at the car park, the fire source selected is the car. The fire source is produced by a car at 4MW, located at the centre of the building to represent possible cases occur within a car park. As for the design of the car park is fixed at 18.0 meter x 18.0 meter x 4.0 meter for all cases. The combustion of a car will produce heat and hazardous gases component, the analysis will be made to focus on that area. Another study conducted is on the position of fire source effects on the natural ventilation system This is as the criteria are not stated in the UBBL. It is concluded that different position of fire source will provide different behaviour and result of the output. The result shows that all the models with different parameter exhibit different nature of natural ventilation result as temperature, CO concentration, CO_2 concentration and visibility at 2.5m is analysed. Other critical observation made is on the ability of the observed incoming and outcoming airflow which concentrates on the close and open wall corner of the car park. The outputs are likely to be concentrated at the closed corner of the car park due to poor airflow by the natural ventilation of the car park. The poor natural ventilation is cause by the placement of the opening, the size of the opening and the position of the fire source. This is in line with the inability for the airflow to be removed out from the building. Therefore, with this simulation results and data, recommendations have been made as to improve the car park design.

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LIST OF ABBREVIATIONS

Abbreviation

2D	Two Dimension
3D	Three Dimension
ASET	Available Safe Egress Time
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineer
CFD	Computational Fluid Dynamics
CO	Carbon Monoxide
CO_2	Carbon Dioxide
FDS	Fire Dynamics Simulator
FOC	Fire Officers Committee
HC	Hydrocarbon
HC HO	Formaldehyde
HRR	Heat Release Rate
IVS	Impulse Ventilation System
LES	Large Eddy Simulation
M&E	Mechanical and Electrical
MAC	Maximum Allowable Concentration
NIST	National Institute of Standards and Technology
NO	Nitric Monoxide
NO2	Nitric Dioxide
RANS	Reynold-Averaged Navier-Stokes
RSET	Required Safe Egress Time
SO2	Sulphur Dioxide
STEL	Short Term Exposure Limit
TVL-TWA	Threshold Limit Value-Time Weighed Average
UBBL	Uniform Building By-Law

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