INVESTIGATION OF CAR PARK VENTILATION SYSTEM PERFORMANCE

By

Mohamed Salah Abdel Maboud Sayed

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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2016

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DEDICATION

This work is dedicated to Prof. Dr. Essam E. Khalil who has had an important role in the completion of this thesis. In simple words you have our sincere thanks and appreciation for helping me and encouraging me throughout my research.

ABSTRACT

With the efforts to release the overcrowding and traffic pressure in the Cairo Festival City (CFC), an underground multistory car parking at Cairo Festival City (CFC) is being built.

According to the Egyptian code of garages recommends that, for the underground car parking, the CO concentration shouldn't exceed 50 ppm in the normal operating case and 100 ppm in the most peak case.

The main objective of this thesis is to investigate the air flow and velocity profile of jet fans system in an underground car parking by using computational analysis and compare the results with other different jet fans configurations.

Jet fans is used to enhance air circulation in an enclosed space like underground car parking because of vehicle emissions such as CO and CO_2 from exhaust. It is also applied to dilute the air and then extract out the smoke or CO_2 product of fire to allow evacuation and for fire brigade to take action. An underground car parking is modeled in proprietary Computational Fluid Dynamics (CFD) software to investigate only the air ventilation pattern and effectiveness of dilution with number of jet fans in operation in the same enclosed car parking.

Commercial package of ANSYS FLUENT CFD is employed to simulate numerically three operating cases, Results show that the concentration levels of CO in the car parking, it is also shows that the air distribution scheme produced temperatures and velocities in the car parking.

The first case: the car park ventilation using 12 jet fans. It was found that the velocity of the air inside the car park and air distribution be somewhat weak, which does not provide good ventilation.

The second case: the car park ventilation using 18 jet fans. It was found that the velocity of the air inside the car park and air distribution be good, which is provide good ventilation.

The third case: the car park ventilation using 24 jet fans. It was found that the velocity of the air inside the car park and air distribution be quite large, which does not provide good ventilation.

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LIST OF SYMBOLS AND ABBREVIATIONS

Abbreviation	Description
ACH	Air changes per hour
ACGIH	American Conference of Industrial Governmental Hygienists
BOCA	Building Officials Code Administrators International
CFD	Computational fluid dynamics
CPU	Central processing unit
EPA	Environmental protection agency
HVAC	Heating ventilation and air conditioning
ICBO	International Conference of Building Officials
NFPA	National fire protection agency
OSHA	Occupational Safety and Health Administration, USA
ppm	Particle per million
RANS	Reynolds averaged Navier stokes equations
SBCCI	Southern Building Code Congress International
SIMPLE	Semi-implicit pressure linked equations algorithm