Cairo University

# CFD INVESTIGATION OF SMOKE MANAGEMENT IN UNDERGROUND TUNNEL

**By**


## Eng. Waleed Mahmoud Mostafa El-Sayed Sweida


**A Thesis Submitted to the**
**Faculty of Engineering at Cairo University**
**in Partial Fulfilment of the**
**Requirements for the Degree of**
**DOCTOR OF PHILOSOPHY**

**In**

**MECHANICAL POWER ENGINEERING**


## FACULTY OF ENGINEERING, CAIRO UNIVERSITY
## GIZA, EGYPT
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**Title of Thesis:** **CFD INVESTIGATION OF SMOKE MANAGEMENT IN UNDERGROUND TUNNELS**

**Key Words: (**Ventilation - Smoke Management - Tunnel Fire - Scaling methods – Jet Fan**)**

**Summary :**
Mechanical ventilation systems play a major role in tunnels safety. All over the world, different systems are used for tunnel ventilation in normal operation and fire conditions based on the tunnel geometry, design and other parameters. The main goal of those systems is a proper smoke evacuation in case of fire.
The aim of this works to study and understand the fires in tunnel systems both experimentally and numerically to attain better understanding of the fire dynamics to help preserve lives in case of fire.
This was achieved by conducting experimental work on small-scale tunnel studying the temperature and velocity distribution inside the tunnel. Also, using scaling methods to calculate the fire size for the experiment and predicting the fire size and data for large scale tunnel simulation using Fire Dynamic Simulator (FDS).
The experimental results and FDS numerical simulations where compered and showed a reasonable agreement between the model and the experiment. This validated the model and gave a detailed look on the temperature and velocity distribution in the full-scale tunnel.
The theoretical verification of FDS computer model is achieved by the comparison of results with literature, this was performed to enhance the confidence in using FDS to estimate both the initial growth and peak heat release rate (HRR) of different tunnel fires. In addition, a HRR semi empirical relation is obtained and implemented in the current theoretical model solution.

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# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES