

## Introduction

It is well known that underground miners are exposed to one of the most dangerous working environments on earth. As miners delve deeper into the earth, the rock pressure and temperature rise, which in turn have an adverse effect on the environment and thus lead to higher operating costs. Furthermore, in coal mines where methane gas and dust is also produced in coal beds, the combination of methane accumulation, oxygen and spark/heat can trigger explosions – which may cause fatal accidents.

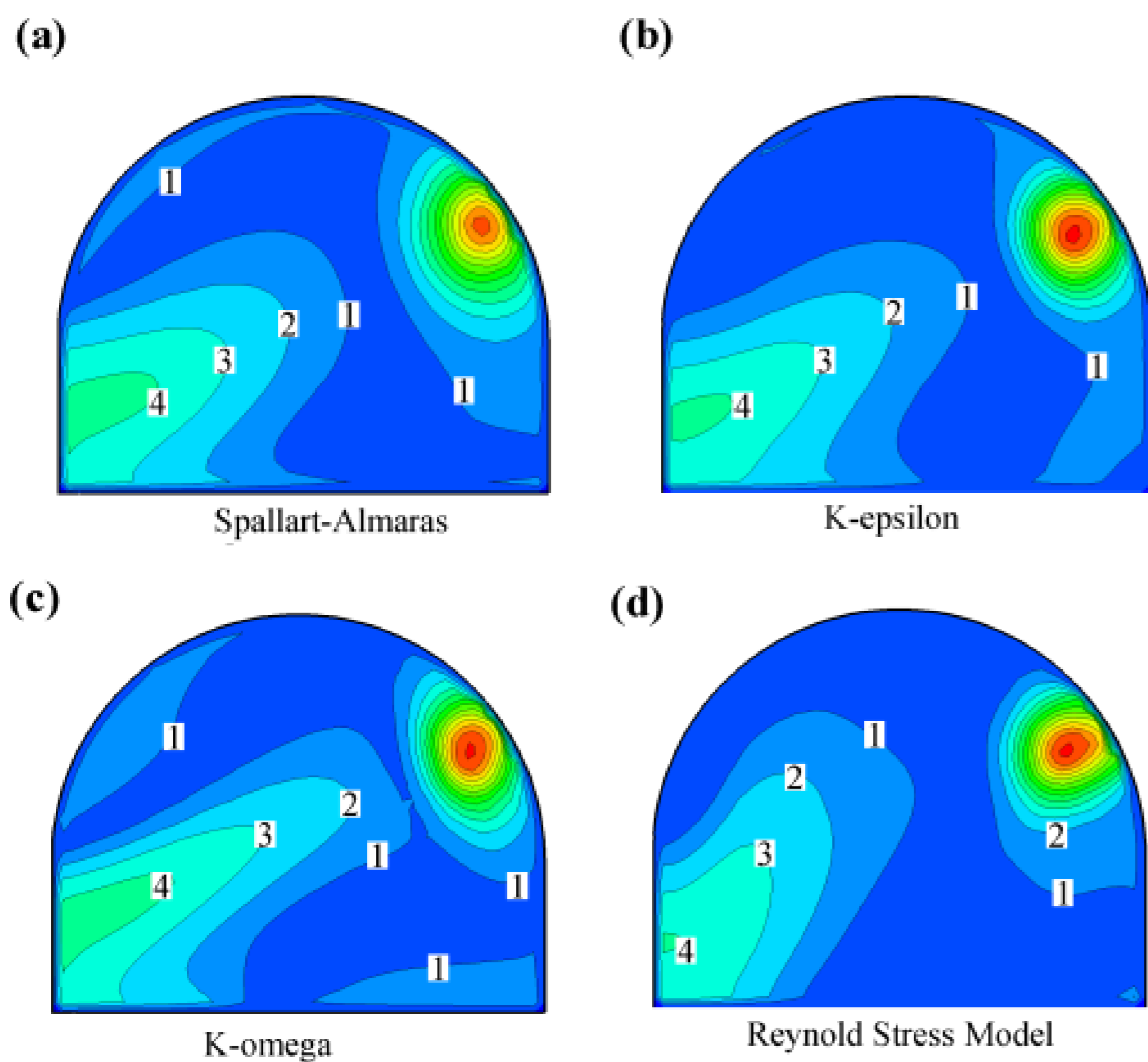
## Aims and Objectives

The objective of this study is two-fold:

- (i) Develop mathematical model for ventilation and total air-conditioning in mines;
- (ii) Improve, optimize and introducing innovative design of underground mines to ensure miners safety and productivity whilst reducing the operating cost.

## Mathematical Model

The mathematical model comprises of conservation equations of mass, momentum, species and energy as well as scalar transport equations for turbulence model. Several turbulence models are tested and compared with experimental counterpart.



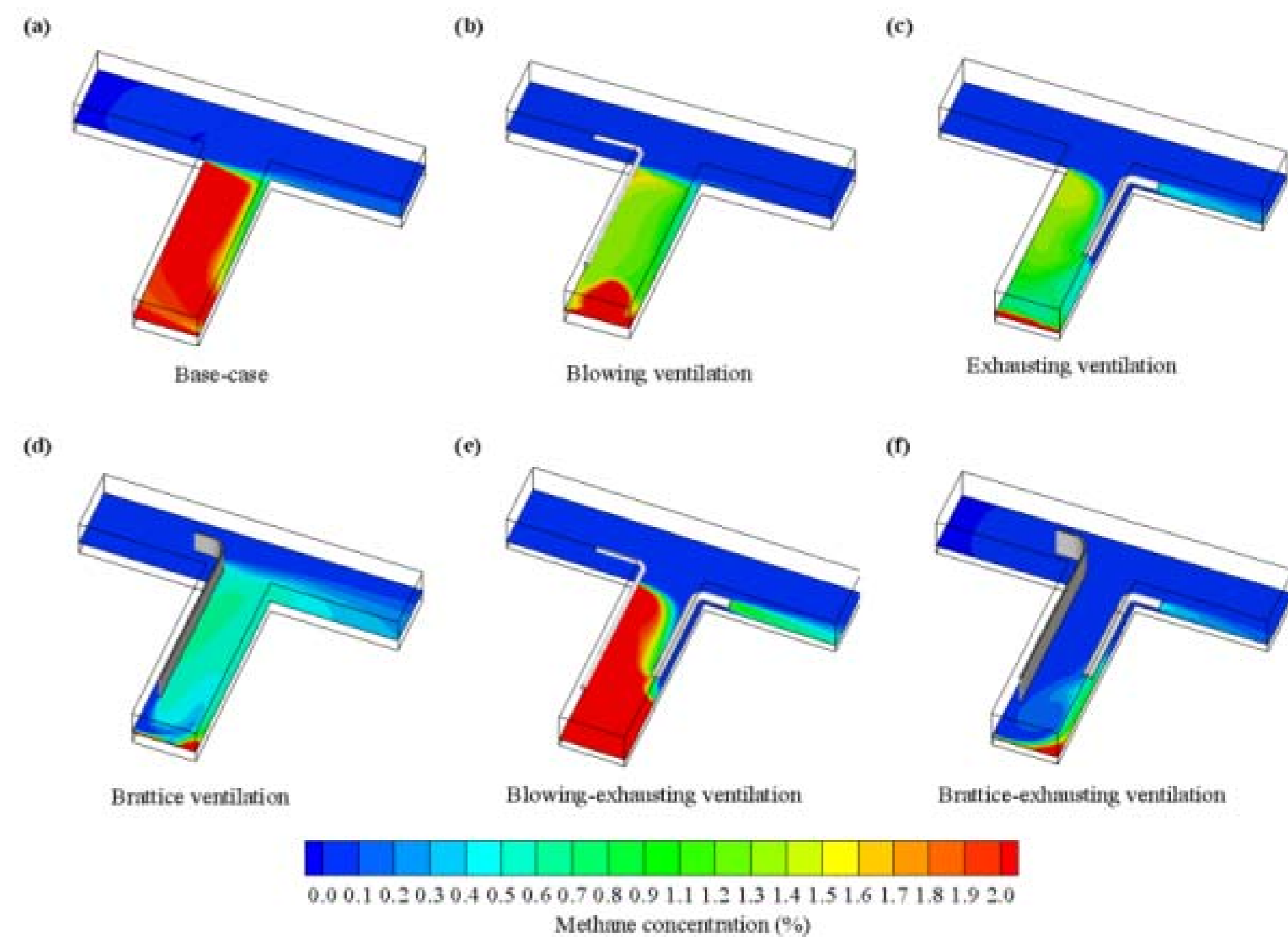
**Fig. 1** Velocity contour at typical underground tunnel for various turbulence model at location 4 m from the dead zone area.

## Design of Flow Stopping

One of the key factors that determine the performance of ventilation system is the velocity profiles inside the mines. In general, a higher velocities results in higher methane removal; more fresh air is also supplied in the mines for miners to breath. In room and pillar mines, a good stopping design can enhance air flow distribution throughout mines; however, careful consideration has to be taken as to balance sufficient ventilation and operating cost.

## Face Ventilation in Cross Cut Region

Several ventilation scenarios in the cross-cut region are investigated with regard to the methane accumulation; they are (a) without additional equipment, (b) with blowing ventilation, (c) with exhausting ventilation, (d) with brattice, (e) with blowing-exhausting ventilation; and (f) with brattice-exhausting ventilation. Fig. 2 shows that the combination of brattice and exhausting ventilation yields the best performance among other scenarios.



**Fig. 2** Methane concentration (%) in the cross-cut region for several ventilation designs.

## Rapid Mine Development Region

It is well-known that mining environments are dynamic and changing very rapidly as mining excavation continues using road header/continuous miner. In essence, changes in mine environment will also change the performance of ventilation system. We investigate various ventilation and total air-conditioning scenarios to ensure safety, comfortability and productivity during excavation whilst maintaining low operating cost.

Further study is underway to investigate various designs, innovations and parameters, e.g., ventilation in rapid mine development, including gas and dust control as well as thermal management in underground mines.

## References

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2. A.P. Sasmito, E. Birgersson, H. Ly, A.S. Mujumdar, Design of Underground Coal Mines Ventilation in Rapid Mining Development Region – A CFD Study, *4<sup>th</sup> Sriwijaya International Seminar on Energy Science and Technology 2011 (SISEST 2011)*, Palembang, Indonesia, 2011.

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