

# Optimization of dilution ventilation layout design of isolation building using CFD

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**Abstract:** Dilution ventilation is employed to enhance air quality and decontaminate workspaces. A properly designed dilution ventilation system can improve workplace safety and maintain favorable working conditions, such as regulating temperature and humidity control. Dilution ventilation systems may vary based on workplace conditions; hence, it is essential to investigate the optimized layout when designing such a system.

In this study, Computational Fluid Dynamics (CFD) simulations were conducted using three turbulence models (RNG k- $\epsilon$ , SST k- $\omega$ , and RSM), with literature data providing the required information for the turbulence models (Kosutova et al., 2019). The 3D model's layout incorporated the directions of the inlet and outlet, as well as the angle of the louvers. The inlet and outlet directions consisted of "center-center, bottom-bottom, top-top, top-bottom, and bottom-top". Furthermore, configurations included a basic setup without a louver and four louver angles (0°, 15°, 30°, 45°). Contaminants in the workplace were represented as air and harmful air (O<sub>2</sub>, O<sub>3</sub>, CO, CO<sub>2</sub>, H<sub>2</sub>S). Ventilation efficiency according to these layout conditions was evaluated using dimensionless airflow rate calculation and Eulerian advection-diffusion equation for passive scalar in ANSYS Fluent.

Upon evaluation, the top-bottom inlet and outlet directions yielded an Age of Air (AOA) of 0.83s and an Air Exchange Efficiency (AEE) of 46.55%. Additionally, it was observed that AEE improved in the top-bottom configuration when the louver angle was 0°. The highest AEE (53.4%) was achieved with a center-to-center configuration and a 15° louver angle, while the lowest AEE (20%) was found in a top-to-top configuration with a 0° louver angle.

Through this study, it was confirmed that the directions of the inlet and outlet, as well as the angle of the louvers, play a crucial role in determining the efficiency of a dilution ventilation system's layout. This study can give important insights for optimizing the layout of a ventilation system, and it is expected that these results will help build a more efficient and safer working environment.

## ACKNOWLEDGEMENTS

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## REFERENCES

Katarina Kosutova, Twan van Hooff, Christina Vanderwel, Bert Blocken, Jan Hensen., 2019. Cross-ventilation in a generic isolated building equipped with louvers: Wind-tunnel experiments and CFD simulations. Building and Environment 154, 263–280.

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