

## Interaction between Indoor and Outdoor Air Pollution in Natural Ventilating Building: Application to Sense-City urban area

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As majority of people spend 90% of their time in indoor environment, air quality has become an important scientific field in the last few decades. Indoor air quality is affected by many factors. One of the significant factors is outdoor air pollutions [1]. They enter the indoors through ventilation systems or natural ventilation and may stay indoors for a long time due to the airtightness of buildings. The present study especially focuses on nitrogen dioxide (NO<sub>2</sub>) concentration in a natural ventilating room that comes from outdoor pollutant source such as vehicle emissions.

In the present study, we have performed numerical simulations of a controlled environment in Sense-City urban area [2]. Sense-City is a unique full-scale equipment that can reproduce controlled conditions of temperature, humidity, airflow and pollution using an atypical climatic chamber. Reynolds Averaged Navier-Stokes (RANS) simulations have been carried out to calculate outdoor and indoor NO<sub>2</sub> concentrations. RANS simulations are performed in two steps: district scale and building scale. Pressure values and pollutant concentrations are extracted from the district scale simulation and applied to the building scale simulation as boundary conditions. As expected, a sensitivity analysis study shows that the NO<sub>2</sub> concentration in the building depends mainly on the pollutant concentration at the windows. Once opening windows, indoor pollutant concentration reached the almost same level of that of outdoor within a few minutes. Therefore, the interaction between outdoor and indoor air quality cannot be negligible for indoor air quality.

This study can be useful for engineers and for local authorities to understand the importance of considering the interaction of the indoors and outdoors, the potential and limitation of RANS simulation in a natural ventilating. Considering the limitation of the number of sensors for air pollution in real applications, CFD simulation is promising to obtain air pollutant distribution cartography. It can also be used as a decision-support tool for relevant urban planning such as the optimal placement of sensors and depolluting systems in urban areas.

### REFERENCES

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