Indoor/outdoor air quality relationship in an urban street canyon

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Large Eddy Simulations (LES) is used to investigate the indoor/outdoor air quality relationships and the air penetration indoors in an urban street canyon, typical in developed area. The geometric configurations being studied include two identical height building canopies, each containing different openings to represent the ventilated floors located at different floor heights. The simulations are conducted with a cross-wind attack with magnitude defined by Reynolds number (Re). Different combinations of floor height is found to constitute different flow and pollutant dispersion patterns and most importantly, affecting the penetration of pollutants and thus the indoor/outdoor pollutant ratio (IO). Relationship between wind, canopies' configuration and floor height is the primary goal of the present study. The pollutant source is unleashed inside the canyon, and which is the only available source in the computational domain.

Raising the Reynolds number is found to have a significant effect on canyon pollutant source, in which case, the latter gives a faster and greater diffusion, and ultimately shorten the time for a full penetration of pollutants inside the indoor environment. Airflow pattern is another notable effect caused by Re increase. The size of the canyon vortex is gradually expanding as well as lifting the vortex centre towards the top of the leeward canopy. The flow patterns are seen to conform with previously observed flow regimes for building blocks in spite of the presence of openings. Dilution of pollutant concentration inside the canyon is achieved by carrying pollutants either over the top of the canopy or through the indoor environment. However, the major portion of pollutants is found to leave over the top of the leeward canopy with only a small amount of emitted pollutants able to enter the indoor environment of the leeward canopy. It is also anticipated and observed that the greater the wind speed, the larger the pollutant penetration into the indoor environment. Since the static pollutant source is released inside the canyon, no penetration into the indoor environment from the outward-facing canopy faces could be observed. No pollutants could be pushed back into the indoor environment of the outward-facing canopy faces as air is blowing out from it into the canyon resulting in unfavourable pressure development.

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