

Indoor exposure to outdoor air pollutants controlled by different urban design strategies

Zhiwen Luo¹, Jian Hang², Man Lin², Baoming Wang²

¹School of the Built Environment, University of Reading, United Kingdom

²School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, P.R. China

Introduction

In compact mega-cities such as London and Beijing, motor vehicle emissions have been a major source of local urban pollution. However, a significant part of exposure to outdoor pollution occurs indoors as people spend over 80% of their time living indoors, and the outdoor pollutants can penetrate indoors via doors, windows, ventilation systems and building cracks.

Urban design can alter the outdoor pollutant dispersion, as well as the indoor-outdoor exchange of the pollution. We are asking the research question: **How we can reduce the indoor exposure to outdoor pollution by changing the urban design strategies?**

Research summary

In this research, a technique called Computational Fluid Dynamic (CFD) modelling was applied to investigate the influence of street canyons and traffic design in a variety of urban settings (including where a viaduct has been installed) on pollutant dispersion and exposure. The street canyon was simulated, taking account of the airflow and pollution dispersion between the street canyon and within the buildings flanking it.

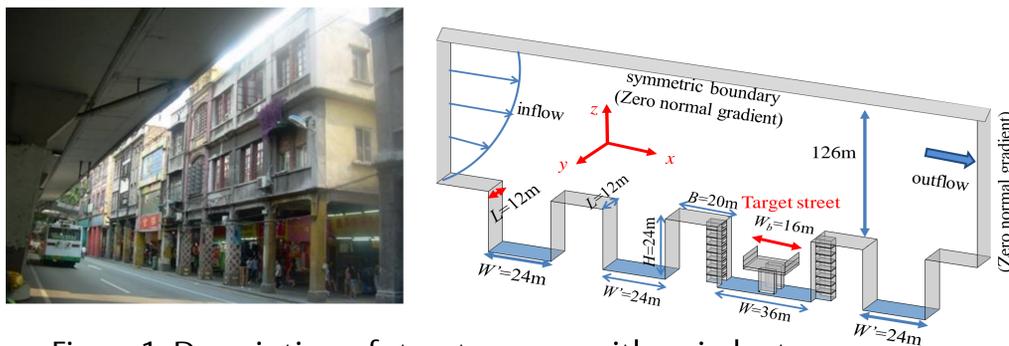


Figure 1. Description of street canyon with a viaduct

Carbon Monoxide (CO) was used as the trace gas from the vehicular emission, released either from the ground or an elevated viaduct. In the Hong Kong example this helped provide an exposure assessment that revealed the daily exposure as well as personal intake fraction for people

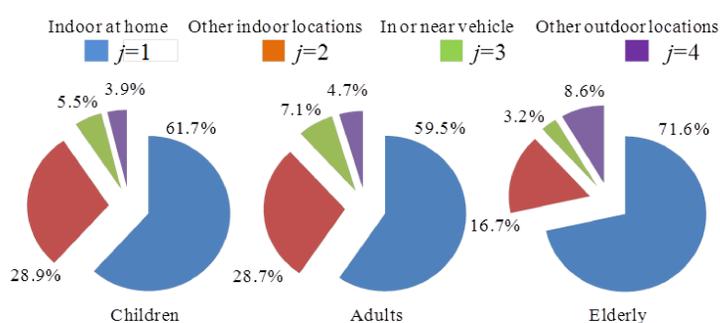


Figure 2 Daily time activity patterns for Hong Kong people

Research findings

- Widening the street could alleviate the pollutant concentration in the street canyon and less indoor exposure.
- The presence of urban viaduct could reduce the indoor exposure to pollution resulting from vehicular emissions in the street
- In design of public realm and buildings fronting streets containing vehicle emissions, attention should be paid to the spatial distribution of pollution concentration and exposure, particularly leeward vs windward and exposure indoors in buildings on different floors

Narrow street Wide street With viaduct With Noise barriers

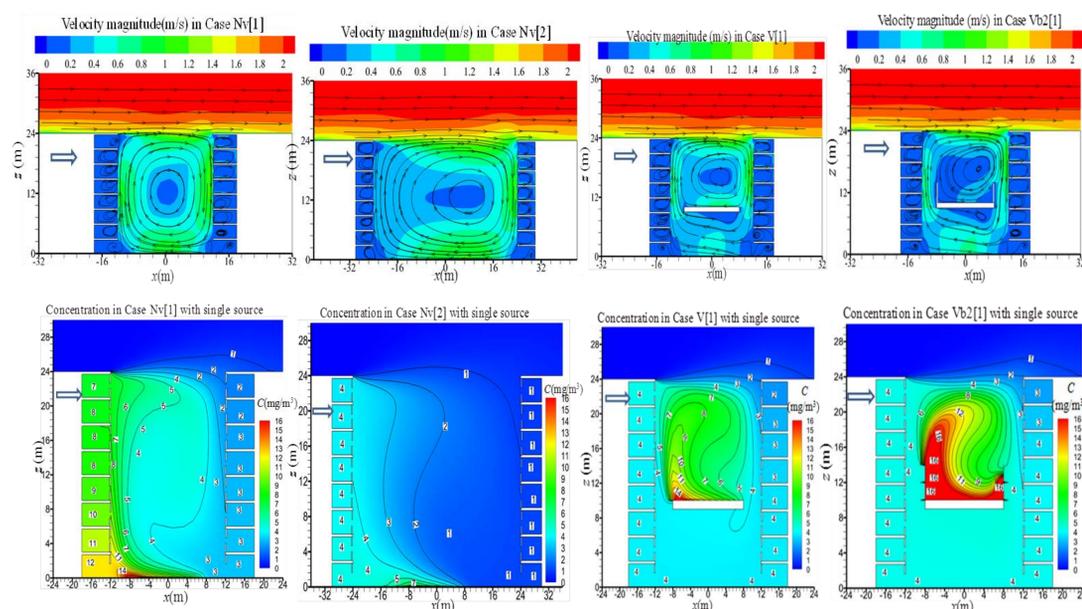
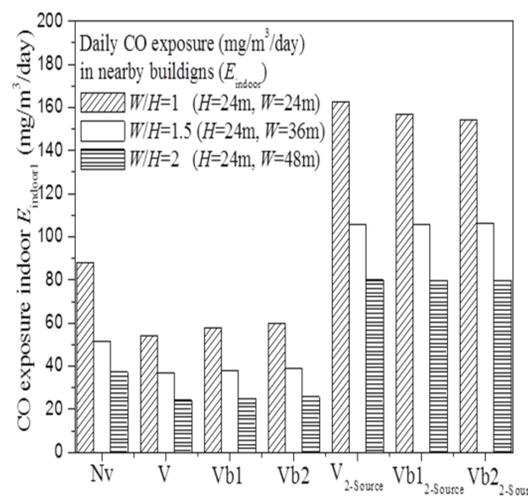


Figure 3. Airflow pattern and CO concentration for different urban design scenarios

Indoor Exposure



Pedestrian exposure

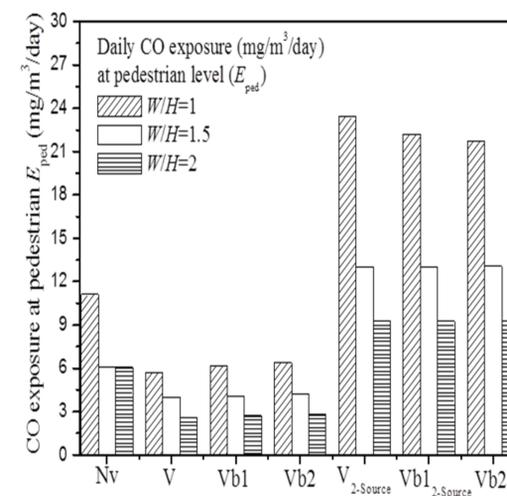


Figure 4. Indoor and pedestrian exposure for different urban design scenarios

Contact information

- School of Construction Management and Engineering, University of Reading, Whiteknights, RG6 6AH
- Email: z.luo@reading.ac.uk | www.reading.ac.uk/CME/about/staff/z-luo.aspx