

PERFORMANCE-BASED CAR PARK VENTILATION MODELING

The Innovation A CSIRO performance-based dilution model on the total carbon monoxide (CO) emission for car parks has been developed to compute the total car park ventilation requirement to fulfil Worksafe Australia criteria for maximum CO exposure during a specified period. The model takes into account parameters such as number of cars, vehicle engine CO emission rate, daily usage profile, de-park time, exit time, etc.

A hybrid ventilation (mechanical + natural ventilation) model was also developed to determine the natural ventilation airflow rate for semi-enclosed car parks. The models enable the prediction of ventilation requirements to assist in the optimum design of traffic routing, amount and location of wall and roof ventilation openings, number and location of exits, etc. The hybrid ventilation model predicts the available natural ventilation flow rates due to wind pressures in the choice of external louvres for the façade of multi-level car parks by modelling the porosity and spacing of the louvres.

Why it is innovative Car park ventilation design has generally been based on the prescriptive method described in Australian Standard (AS)1668.2-1991 and AS1668.2-2002. In the estimation of natural ventilation flow rates for car parks, there is no definitive methodology to account for airflow through various openings in the building envelope. The CSIRO dilution and hybrid ventilation models combine all the factors affecting car park ventilation to enable the designer to examine each contributing factor separately at the design stage.

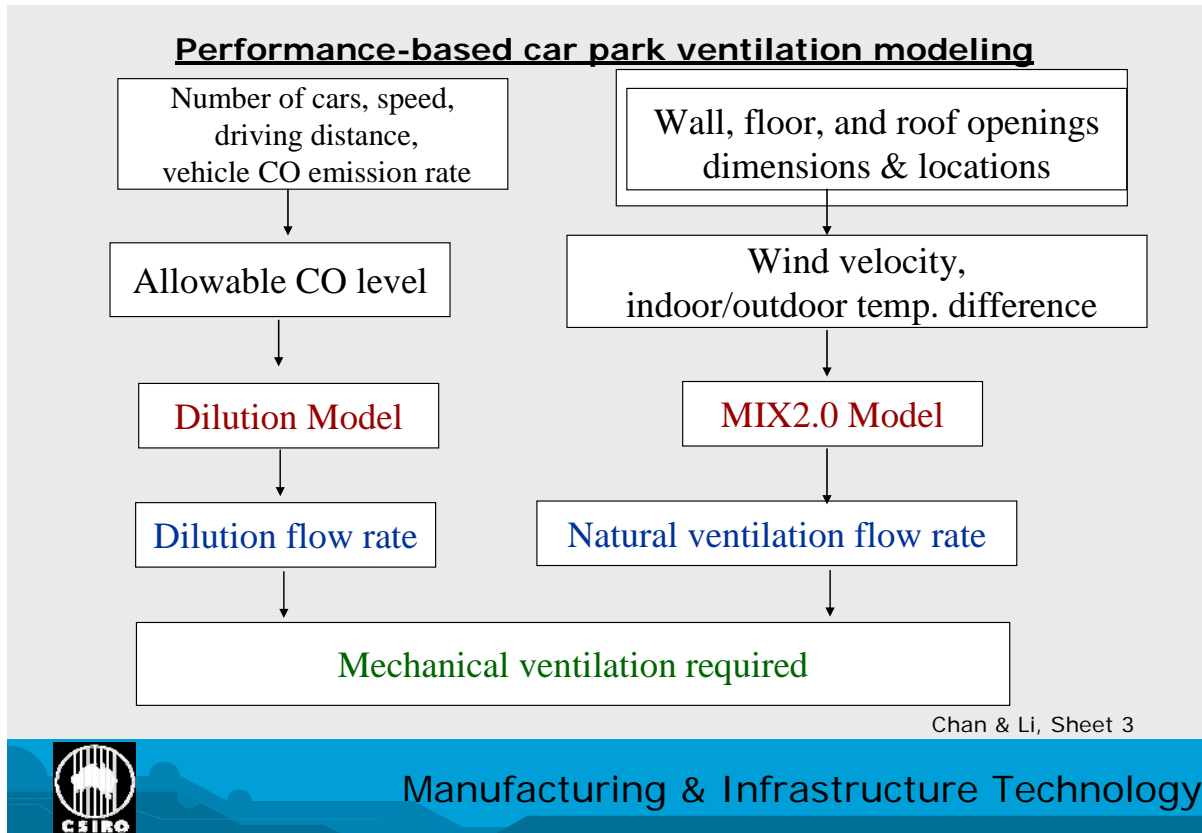
What it changed or replaced Anecdotal evidence has shown that prescriptive methods in ventilation standards often lead to over-design due to its generality. A performance-based approach, however, can be modelled to parameters specific to the particular car park. Our design approach has resulted in up to 40% reduction in ventilation requirement in large car parks. It has been shown by post-construction on-site CO measurements that a performance-based approach rather than the prescriptive method was more realistic in the determination of car park ventilation air quantity. For multi-level car parks such as those in large shopping centres, energy consumption due to the ventilation requirements can be very high; the CSIRO performance-based design approach will contribute substantially to the reduction of building energy usage.

Where and when originated, used and to be used The performance-based design was developed by CSIRO Australia in 1998. The design approach has been applied to a number of Westfield Shoppingtown multi-storey car parks in Australia, as well as apartment car parks in Australia and Hong Kong. Projects include: Westfield Burwood, NSW; Westfield Hornsby, NSW; Westfield East Gardens, NSW; Westfield Bondi Junction, NSW; Westfield Liverpool, NSW; Westfield Innaloo, WA; Westfield Doncaster, VIC; Meriton Apartments, NSW; Waltcorp NSW; and Westfield Queensgate, NZ.

Specific Innovations

- Dilution model can be used as a driving-distance based or a driving-time based model.
- Parameters such as de-park time, vehicle speed, daily usage profile, etc. can be varied.
- Hybrid ventilation model allows airflow through multiple openings to be computed.

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