Natural ventilation

Deemed to satisfy (DTS) requirements for the natural ventilation of occupied spaces within buildings are located in the National Construction Code BCA Volume One Section F, F4 Light and ventilation.

In addition Australian Standard AS 1668.4 (2012) includes requirements for natural ventilation system design when alternatives to BCA DTS requirements are being proposed.

In this age of high importance for low energy design, design for natural ventilation can aid economic achievement of comfort.

When buildings are naturally ventilated the objective is to provide comfort to occupants through the cooling effects of air flow, and the exchange of air for health reasons.

Naturally ventilated buildings should have insulation in the building envelope, in particular radiant barriers below the roof, in walls and suspended floors, to minimise radiation heat transfer. Shading is also desirable in warm to hot climates; and orientation to allow sun penetration in cold climates.

When roof spaces are ventilated, the most effective method is to have vents at the soffits which take in air and ridge vents to expel it.

Ventilation openings in walls should be well positioned in accordance with the following Natural Ventilation Guidelines from ASHRAE (reproduced below).

Natural Ventilation Guidelines (for hot climates)

Several general guidelines should be observed in designing for natural ventilation. Some of these may conflict with other climate-responsive strategies (such as using orientation and shading devices to minimize solar gain), with fire compartmentation requirements, or with other design considerations.

a. In hot, humid climates, use mechanical cooling.

b. If mechanical cooling is not available, air velocities should be maximized in the occupied zones.

c. In hot, arid climates, consider evaporative cooling.

d. Airflow throughout the building should be maximised for structural cooling, particularly at night when the temperature is low.

e. Topography, landscaping, and surrounding buildings should be used to redirect airflow and give maximum exposure to breezes. Vegetation can funnel breezes and avoid wind dams, which reduce the driving pressure differential around the building. Site objects should not obstruct inlet openings.

f. The building should be shaped to expose maximum shell openings to breezes.

g. Architectural elements such as wing walls, parapets, and overhangs should be used to promote airflow into the building interior.

h. The long façade of the building and the majority of the door and window openings should be oriented with respect to the prevailing summer breezes. If there is no prevailing direction, openings should be sufficient to provide ventilation regardless of wind direction.

i. Windows should be located in opposing pressure zones. Two openings on opposite sides of a space increase the ventilation flow. Openings on adjacent sides force air to change direction, providing ventilation to a greater area. The benefits of the window arrangement depend on the outlet location relative to the direction of the inlet airstream.

j. If a room has only one external wall, better airflow is achieved with two widely spaced windows.

k. If the openings are at the same level and near the ceiling, much of the flow may bypass the occupied level and be ineffective in diluting contaminants there.

l. Vertical distance between openings is required to take advantage of the stack effect; the greater the vertical distance the greater the ventilation.

m. Openings in the vicinity of the neutral pressure level (NPL) are least effective for thermally induced ventilation. If the building has only one large opening the NPL tends to move to that level which reduces the pressure across the opening.

n. Greatest flow per unit area of total opening is obtained by inlet and outlet openings of nearly equal areas. An inlet window smaller than the outlet creates higher inlet velocities. An outlet smaller than the inlet creates lower than but more uniform airspeed through the room.

o. Openings with areas much larger than calculated are sometimes desirable when anticipating increased occupancy or very hot weather.

p. Horizontal windows are generally better than square or vertical windows. They produce more airflow over a wider range of wind directions and are most beneficial in locations where prevailing wind patterns shift.

q. Window opening should be accessible to and operable by occupants.

r. Inlet openings should not be obstructed by indoor partitions. Partitions can be placed to split and redirect airflow but should not restrict flow between the building's inlets and outlets.

s. Vertical airshafts or open staircases can be used to increase and take advantage of stack effects. However, enclosed staircases intended for evacuation during a fire should not be used for ventilation.

The potential application of pure natural ventilation systems may be limited in hot or humid climates by thermal comfort issues and the need for reliability. However, hybrid (or mixed-mode) ventilation systems or operational strategies offer the possibility of saving energy in a greater number of buildings and climates by combining natural ventilation systems with mechanical equipment.

For those periods when there is no wind, or inadequate airflow from wind, the installation of ceiling fans should be included in bedrooms and living rooms in residences, and in work areas in commercial and industrial buildings, wherever possible, to provide airflow for cooling of occupants during those periods.

For large spaces, such as warehouses and factories, high volume, low speed ceiling fans can provide cooling for workers in summer; eliminate condensation on concrete floors when buildings are frequently opened for loading; and to provide destratification of air in winter, to increase the energy savings of the mechanical systems.

Source: ASHRAE Handbook – Fundamentals 2009, Ch.16. Ventilation and Infiltration.

References

AS 1668.2 (2012) Ventilation design for indoor air contaminant control, Standards Australia

National Construction Code Volume One, BCA Class 2 to 9 Buildings (2013), ABCB

ASHRAE Handbook – Fundamentals 2009, Ch.16. Ventilation and Infiltration.