Effective natural ventilation in modern apartment buildings

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ABSTRACT

This paper addresses the challenge of evaluating for natural ventilation in modern apartment buildings. A number of natural ventilation design rules of thumb from published literature are listed. Their incorporation into one code for Australia (the Residential Flat Design Code, or RFDC) and India (the National Building Code, or NBC), in relation to apartment buildings is examined. Practical limitations to converting these rules of thumb into effective natural ventilation systems for apartment building designs are discussed. Apartment designs in the moderate locations of Sydney, Australia and Bengaluru, India are also reviewed to assess their effectiveness for natural ventilation. Simulation analysis presented indicate large energy savings are possible if apartments are retrofitted/designed to the proposed code requirements and designs compliant with thumb rules are capable of delivering effective natural ventilation if users choose to operate the apartment in "free running mode" during times when the outside dry bulb temperatures lie in an appropriate band. The paper also discusses how sub-optimal design solutions, affluence and adaptation to more stringent thermal conditions can negate the potential for natural ventilation and calls for proactive efforts to maintain climate responsive design standards and education/policy to encourage the benefits of natural ventilation over airconditioning.

INTRODUCTION

Apartment buildings have become one of the most affordable residential building configurations in cities around the world. In many locations, they purport to incorporate natural ventilation design elements, usually based on the minimum mandatory requirements of applicable codes and standards. Anecdotally, an increasing number of such apartments are also being fitted with air-conditioning systems. These are either fitted by the builder (usually in developed countries like Australia, or upmarket offerings in developing countries like India), or retro-fitted by the occupant.

Easy access to air-conditioning brings with it the possibility of its increased use, even when conditions outside are conducive for natural ventilation to provide adequate thermal comfort. Therefore, the challenge faced in the design of modern apartment buildings is to ensure that the natural ventilation "system" is effective at providing thermal comfort at appropriate times, and to make the natural ventilation "mode" easily accessible to occupants.

Evaluating the effectiveness of natural ventilation in real building designs has always been difficult. The analyst is limited to using simplified equations developed for idealised room configurations, or complex energy simulation programs that can solve heat transfer and airflow network equations

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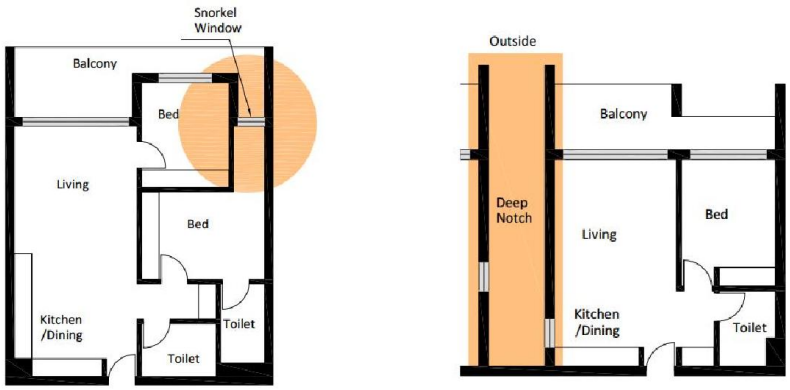

Figure-7b: Examples of design solutions that reduce effectiveness of natural ventilation

In places like Bengaluru, apartments are permanent homes, with many new developments offering high levels of luxury within the security of a gated community. Such luxury developments do have adequate spacing between apartment blocks to have an increased potential to operate in a naturally ventilated mode. However, such luxury apartments are also generally pre-fitted with A/C systems, and this easy access to air-conditioning diminishes the incentive for occupants to adapt to ambient conditions. This is exacerbated for the modern knowledge-worker, who aspires to live in such luxury apartments; regularly works in air-conditioned offices, and whose tolerance for temperatures beyond the closely controlled temperature band in the office drops with increasing adaptation to air-conditioning.

CONCLUSIONS

In a world where there is increasing evidence of rapid anthropogenic climate change, it is critically important that apartment designs provide easy access to the real potential for reduced CO2 emissions, so occupants can minimise their use of non-renewable energy use with little extra effort.

It is clear that the apartment designs selected for the two cities indicate that they pass the critical requirements to be able to provide Effective Natural Ventilation. The simulation analysis undertaken here predicts that

- large energy savings are possible if apartments are retrofitted/designed to the proposed NBC requirements of Part 11, and
- effective natural ventilation is possible if users choose to operate the apartment in "free running mode" during times when the outside dry bulb temperatures lie in an appropriate band

However, it is argued that this potential for effective natural ventilation, and energy efficient living can be easily subverted. As discussed in this paper, sub-optimal design solutions, affluence and adaptation to more stringent thermal conditions can negate the potential for natural ventilation even in the relatively mild climates such as Sydney and Bengalaru. This calls for proactive efforts to maintain climate responsive design standards and education/policy to encourage the benefits of natural ventilation over airconditioning.

REFERENCES

ABCB 2013, Australian Building Codes Board, National Construction Code 2013

BIS 2005, Bureau of Indian Standards, National Building Code of India 2005, (SP 7:2005)

BIS 2012, Bureau of Indian Standards, Draft Amendment No. 1 to National Building Code of India 2005 (SP 7:2005), to incorporate a new Part 11 Approach to Sustainability

Dept of Planning and Environment, NSW, Australia, 2013, BASIX Thermal Comfort Protocol

Lechner, N., 2008, Heating, Cooling, Lighting – Design methods for Architects,

Indraganti, M. 2010. Thermal comfort in naturally ventilated apartments in summer: Findings from a field study in Hyderabad, India. *Applied Energy, 87*(3), 866–883

Manu, S., Shukla, Y., Rawal, R., Thomas, L., de Dear, R., Dave, M., & Vakharia, M. 2014. Assessment of Air Velocity Preferences and Satisfaction for Naturally Ventilated Office Buildings in India. In *PLEA 2014: 30th Conference on Passive and Low Energy Architecture.* Ahmedabad, India: CEPT University, Ahmedabad

Thomas, P.C., and Venkatesan, A., 2012, Review of Natural Ventilation and Daylighting Guidelines for RFDC, Dept of Planning and Infrastructure, NSW