

**Green Commercial Office Buildings:
Environmental performance and user perceptions**

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Abstract

Buildings labelled as 'green' bring with them high expectations, particularly in the commercial office sector. It is commonly accepted that 'green' buildings are designed, constructed and operated with the specific objectives of efficient use of resources: energy, water and materials, reducing negative impact on the environment, and also provide comfortable and healthy internal environments which result in high levels of occupant satisfaction and related productivity. In theory these 'green' intentions are predicted to bring positive results; however, whether in reality this is always the case is open to question. Unfortunately research into how 'green' commercial office buildings are actually performing is limited due to the relatively recent nature of this building type and the private and restrictive culture of commercial building management.

This research aims to determine whether commercial office buildings whose designs follow 'green' principles or have been assessed by a widely accepted environmental assessment tool are outperforming non green (or conventional) buildings in terms of their environmental performance, specifically in energy and water use and in their ability to provide occupant satisfaction. The research focuses on nine commercial office buildings located in the City of Adelaide, South Australia with approximately 135,000 m² of net lettable floor area. The research was based on post occupancy evaluation involving evaluation of building design, energy (base building and tenancies) and water consumption, monitoring of the internal building environment including temperature, relative humidity and lighting levels, as well as surveying the building occupants to assess perceived thermal, visual and aural comforts, and also perceived health and productivity. Analyses took place in two stages with the first stage involving the analyses of the individual aspects and the second stage correlating these aspects to develop a model of user satisfaction for the assessment of green building performance.

Results show that 'green' buildings are meeting only some of the initial expectations. For example the 'green' buildings demonstrated considerable energy savings; in most cases they consumed less than half of the energy of the conventional buildings. Tenancy energy use was, however, independent of the building and was influenced by the organisations' and occupants' requirements with the results showing that tenancies in the 'green' buildings had similar and in some cases higher energy consumption levels than the tenancies in the conventional buildings. The occupant satisfaction survey showed that 'green' buildings designed for a known occupant fared significantly better in all areas than 'green' buildings designed under speculative conditions which received similar responses in the areas of comfort, health and productivity to the non green buildings. Despite the expected improvements in the buildings claiming to be 'green', temperature in winter and summer, as well as lighting and noise problems remain the key issues for the occupants. Although being in a 'new' space can have a positive effect on occupants, it is evident from this research that in general, little improvement of occupant satisfaction is actually seen in 'green' buildings, with their open plan work spaces and large glazed facades in fact exacerbating problems for the occupants.

This research is this first comprehensive independent study in Australia of green buildings where the holistic approach adopted in the study has refined the post occupancy evaluation methodology bringing together multiple aspects; building design, resource consumption, measurements of internal environments and occupant satisfaction, acknowledging that it is essential for all of these aspects to be optimised for the longevity of 'green' buildings. It is expected that the implementation of the concluding recommendations, particularly those related to thermal, aural and visual issues will lead to happier and healthier occupants, more effective green buildings and contribute to the sustainability of the built environment.

Publications

During the course of this research the following conference and journal papers have been produced:

Menadue, V., Soebarto, V. & Williamson, T. 2013. "The effect of internal environmental quality on occupant satisfaction in commercial office buildings", *ASHRAE HVAC&R Research*, vol. 19 (8). Taylor and Francis
<http://www.tandfonline.com/eprint/srg235OpqtHdMqrDUeiv/full>

Menadue, V., Soebarto, V. & Williamson, T. 2013. "Perceived and actual thermal conditions in green and conventional office buildings", M. A. Schnabel and J-Y Tsou (eds.), *Cutting Edge in Architectural Science: Proceedings of the 47th International Conference of the Architectural Science Association 2013*, Hong Kong 13-16 November 2013, The Architectural Science Association

Menadue, V., Soebarto, V. & Williamson, T. 2012. "Occupant satisfaction in Adelaide's commercial office buildings", *Healthy Buildings 2012, 10th International Conference*, Brisbane 8-12 July 2012, The International Society of Indoor Air Quality and Climate and Queensland University of Technology

Menadue, V., Soebarto, V. 2011. "Post Occupancy Evaluation of Adelaide's Commercial Buildings", *The 8th Asia Pacific Conference on Sustainable Energy and Environmental Technologies (APCSEET 2011)*, Adelaide 10-13 July 2011 (abstract only)

Signed Statement

I certify that this work contains no material which has been accepted for the award or any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Vanessa Menadue

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