

DESIGNING AND BUILDING GREEN IN AUSTRALIA AND THE CASE OF CENTRAPLAZA



Steve Burroughs

Summary

This paper examines aspects of the design, construction, and operation of green buildings in Australia. The key drivers of green strategy and design in Australia are the issues of water conservation (in a drought-prone country) and reduced energy consumption (in a market of rising costs). In addition, social aspects such as occupant well-being and productivity are becoming increasingly important considerations. Centraplaza, a new commercial office building in Canberra, is at the forefront of green design and building in Australia. In the development of Centraplaza, a triple bottom line approach (economic, environmental, and social) was used, focussing on conserving energy and water and creating a healthy, productive workplace for the building's occupants.

Keywords: Green design; green buildings; environmental performance; energy; water; occupant health and productivity; Australia; Centraplaza

1 Introduction: Green Buildings and Building Green

The production of environmentally sustainable buildings requires a reinvention of building design processes. This is needed in order to extend responsibilities and returns to all stakeholders and to incorporate consideration of economic, environmental, and social impacts and costs across the entire life cycle of a building. In Australia, green building initiatives are being motivated by various stakeholders, including regulators, tenants, conservation organisations, socially responsible investors, and the property/building industry. A green building is designed and operated with various aims in mind, including: reducing energy consumption, water use, and waste production; using low maintenance, environmentally friendly building materials; providing safe and healthy indoor environments in terms of ventilation, temperature, air quality, lighting, and noise; and to improve occupant safety, health, comfort, and productivity. Concerns in Australia that are influencing the design of, and demand for, green buildings are water shortages and rising energy costs [1]. In addition, stakeholder demands and expectations concerning environmental performance are continuing to rise. To operate effectively in this context,

organizations are now required to demonstrate proactive management of environmental aspects in their business activities including in the construction and operation of buildings.

1.1 The Costs and Benefits of Building Green

Benefits to organizations of building green may include water and energy savings, lower operating and maintenance costs, reduced risk of obsolescence, ability to command higher lease rates, lower tenant turnover, higher occupancy rates, improved attraction and retention of workforce through improved working environment, improved occupant health and productivity, and better customer relationships [1], [2]. In addition, it would seem that green buildings are becoming more valuable than standard buildings, especially when the figures are calculated taking into account their longer lifespan, reduced replacement schedule, and lower operating costs [1].

Characteristics of buildings and their indoor environments influence occupant health including the occurrence of respiratory illnesses and sick building symptoms[2], [3]. There is increasing evidence that well designed buildings also contribute to occupant productivity [4]. Productivity can be enhanced by increases in worker well-being, by reduced amounts of sick leave, and by a reduction in time during which sickness diminishes workers' performance while at work [3]. Leaman and Bordass [4] suggest that productivity gains of up to around 20 % may be attributed to the effects of building characteristics on occupants. The pertinent variables include: comfort and personal control thereof; ventilation type and the size, depth, and shape of the building; and the intent of design and how this is communicated (or not) to users/occupants so that they may use the technologies properly. The key factors associated with occupant comfort and productivity are the thermal environment (temperature, humidity level, and ventilation), air quality, and the types and level of ambient lighting [2].

The Green Building Council of Australia (GBCA) [5] presents a strong case for designing and building green in Australia. The findings show that green buildings can deliver: a reduction in annual operating costs from \$120-\$60 per m² via a 60 % reduction in water and energy consumption; higher relative investment returns (minimum ROI of 14 %); a 10 % increase in market value of asset; higher rents by 5-10 %; higher occupant working productivity (1-25 % increase); and lower staff turnover. The GBCA estimates that the cost premium to build green should be <3 % over the costs of standard construction. This makes the "green premium" for a central business district office building <\$100 /m². In contrast, it would need only a 2 % increase in productivity for an occupant worker with an annual aggregate salary of \$100,000 and occupying a floor space of 20 m² to yield a saving of \$100 /m²/year. This is also in contrast to energy cost-saving: at 10 cents per kilowatt hour, a 50 % reduction in office building energy consumption from 200 kw/hr/m² saves \$10 /m²/year.

Another recent analysis of the costs and benefits of building green in Australia [1] gives provides not dissimilar results. Modelling using parameters applicable to a large office building indicates that, at present, the impact on green construction costs (compared with standard construction) is 3-5 % for a 5-Star rated building and 9-11 % for a 6-Star rating (see Section 2.1 for rating tools). These equate to "green premiums" of \$98/m² and \$203/m² respectively [1]. The additional gross lease rental needed to cover these costs for a 5-Star building is modelled to be cancelled by a productivity rise of around just 1.5 %.

1.2 The Advancement of Green Design and Building in Australia

The building/property industry in Australia is well placed to deliver significant long-term environmental improvements using a broad range of measures. Importantly, it is unique in that it can influence and create behavioural changes at all stages of the supply chain. With regard to delivering such improvements, the GBCA (www.gbcaus.org) was set up in 2002 to promote sustainable development and the transition of the property industry by supporting green building programs, technologies, design practices, and operations.

The GBCA [5] however identifies a number of barriers to the mainstream uptake of green building principles and practices, including: a lack of green building knowledge; too much value placed on short term construction costs compared with long term benefits; uncoordinated regulations; a lack of green/reusable materials; and confusion concerning building environmental rating tools. In response, the GBCA identify the following actions to advance green design and building in commercial developments: establish consistent standards and targets for the building industry; undertake green building educational programmes; encourage government leadership and government-industry partnerships; and provide financial incentives/concessions to increase the use of green building technologies.

2 Sustainability Evaluation Tools Used in the Australian Building Industry

Several tools are available to guide, assess, monitor, and control the design and operation of buildings in Australia, including the Green Star Rating, the Building Greenhouse Rating, Green Leases, and Environmental Management System ISO-14001.

2.1 Green Star Rating

In 2003 the GBCA instituted the Green Star environmental rating system, the aim of which is to assist the building industry in its transition to sustainable development by establishing individual environmental measurement criteria with particular relevance to the Australian marketplace and environmental context. The system sets a standard of measurement for green buildings, encourages whole-building design and promotes awareness of the benefits of green building, recognises environmental leadership, and identifies and considers building life-cycle impacts. The rating features reduced energy consumption, and stricter criteria for a wide range of environmental impacts, including greenhouse effects, water conservation, material selection, waste management, ventilation, air quality, lighting, and noise levels. Green Star has built on existing systems and tools in international markets including the British BREEAM and the North American LEED.

For commercial office design and construction, projects are evaluated against eight environmental impact categories and an innovation category. Within each category, points are awarded for initiatives that demonstrate a project has met the overall objectives of Green Star and the specific criteria of the relevant rating tool. Points are weighted and an overall rating is calculated for the project. Although the rating scale ranges 1-6, the GBCA certifies only buildings that achieve a rating of 4, 5, or 6 Stars. A 4 Star Green Star Certified Rating signifies “Best Practice.” A 5 Star Rating signifies “Australian Excellence.” A 6 Star Rating signifies “World Leadership.” Although Green Star certification requires a formal process, any project can freely download and use the Green

Star tools from the GBCA website (www.gbcaus.org) to track and improve its own environmental performance.

2.2 Australian Building Greenhouse Rating (ABGR)

The ABGR is a voluntary energy rating tool, administered nationally by the Department of Energy, Utilities and Sustainability, which can be used by a building owner, manager, or tenant. The tool rates a building according to its measured performance using 12 months of energy supply-use data. ABGR encourages best practice in the design and operation of commercial buildings to minimise greenhouse emissions and to gain competitive and marketing advantages for energy efficient, low-emission buildings.

The ABGR scheme rates buildings 1-5 stars with 5 stars representing exceptional greenhouse performance. A rough assessment of the rating can be made on the ABGR website [6]. Data concerning building size, occupancy (hours/week), number of workers, number of computers, and the type(s) of energy used are input. The outputs from the online assessment include greenhouse emissions and energy consumption per unit area and per person, and the greenhouse rating from 1 to 5 stars. An accredited assessor is needed in order for a building to obtain an accredited rating.

A 5 star building (emissions of $<135 \text{ kg CO}_2/\text{m}^2$) is exceptional due to integrated design, operation, management, and fuel choice. A new building or lease should meet this 5 star standard to ensure its long term competitiveness and to benefit the environment. The Energy Efficiency in Government Operations policy in Australia requires a 4.5 ABGR rating for new government buildings and leases.

2.3 Green Lease

A green lease is a lease between the landlord and tenant of a green building which ensures that the operation of the building is ecologically sustainable and minimises environmental impacts. Green leases are being promoted by the federal government because it involves commitments from both building owners and tenants. One issue for green lease situations concerns higher up-front costs in developing a green building compared with a conventional commercial building. The owner needs either to bear the extra up-front costs, or pass them on to tenants through higher rents. In the latter case, the prospective tenant may be deterred from occupying a green building and favour leasing a conventional building. A green lease needs to set targets and benchmarks for environmental performance, in order for owners and tenants to monitor their own and each other's performances, and to identify mechanisms to assess compliance with the prescribed targets.

Although developers and building owners have traditionally been unwilling to invest added up-front costs of innovation, technology, and construction to meet voluntary environmental standards, government authorities in Australia report that building owners are increasingly adopting a longer life cycle view when evaluating the commercial benefits of building green. However, there is no financial incentive for the developer and initial owner to develop a green building unless they can maximise cash flow and profit early in the life of the building. Therefore, a balance must be made between rent gained from tenants, higher up-front development costs, and environmental altruism, while marketing the building as providing greater worker comfort and productivity.

2.4 Environmental Management System (EMS)

An Environmental Management System (EMS) is a framework that can be integrated with existing business processes that identify, measures, manages, and controls the environmental impacts and environmental risks of an organisation's activities, products, and services. It enables an organisation to develop policies and objectives to manage environmental performance across a range of aspects of the organisation's operation. An EMS also establishes the means for improving performance and moving towards environmental sustainability through best practice, such as defined by the standard ISO14001. EMS ISO-14001: 2004 is the latest version of this environmental standard, and has been revised to align with ISO 9000.

3 The Case of Centraplaza

Centraplaza Development, in Canberra's Woden Town Centre, is a six-storey commercial office project covering 12,000 m² (**Fig. 1**). The building comprises six storeys with basement car parking, and is one minute's walk from one of Canberra's major public transport hubs. Construction started in October 2005 and finished in March 2007, and currently (May 2007) the building is leasing floor space to new tenants. The design and construction of Centraplaza used the approach of the economic, environmental, and social triple bottom line. The building is the product of today's best design and construction businesses demonstrating an understanding of the environmental implications of good design and construction functions, by considering environmental issues as essential components of the design and construction processes rather than as consequences of those processes.

Various tools (discussed in Section 2 above) were used to help make judgements concerning sustainability during the design and construction phases and to monitor the building's performance during operation. The efficiencies of the building design and operations within the building are measured according to the AGBR and this standard is required to be upheld within the Green Lease. The lease also requires data to be collected on the performance of the building. This complements the EMS, which ensures continuous monitoring of the building's environmental performance and provides procedures for improvement.



Fig. 1 Centraplaza in Canberra, Australia

The planning and design agenda included business decisions and incorporated considerations of sustainable development, employees, and society. Centraplaza is claimed to set "new standards for health, welfare and safety in the workplace" and represents "the future of workplace and office design" [7]. A flexible design and development plan used by the engineering company (BLL) enabled an initial 4.5 Green Star rating to be upgraded to 5 Star during the project at the client's request [8]. Environmental initiatives incorporated into the project include the use of low volatile paints and adhesives, and high performance glass achieving a shading coefficient of 0.35. Structurally, 20 % fly ash was

used in post-tensioned concrete to reduce cement content. Glass, aluminium, plastic, paper, and organic recycling were provided during site establishment. The development also incorporates waterless urinals, which are revolutionary in design and operation with each unit having the ability to save around 65,000 litres of water a year in a commercial setting. Other changes implemented to achieve the 5-star target included: exhaust and supply air fans reselected to achieve lower velocities; alterations to stairwell lighting to reduce energy consumption; and the integration of a fully addressable lighting control system to reduce future consumption. Air-conditioning equipment was selected based on performance, efficiency, indoor air quality, low sound levels, and ease of maintenance.

4 Conclusion

The Australian construction industry is changing rapidly as a result of the priority now being attached by government and business to issues of sustainability, climate change, and resource conservation. As a result, green design and building are gaining momentum, and the perception that green buildings are more expensive is diminishing as stakeholders consider whole life cycle costs. When costs and benefits are analyzed, higher leases for green buildings are offset by lower operating costs and by small increases (1-2 %) in occupant productivity. Green office buildings such as Centraplaza in Canberra offer occupants superior workplace conditions, a major point of difference being used in marketing Centraplaza to prospective tenants.

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Dr Steve Burroughs, Ph.D.

✉ Dr S. Burroughs,
38 Blackman Crescent, Macquarie
ACT, Australia 2614
☎ +61 2 62 51 64 95
☺ sburroug@bigpond.net.au
URL www.earthbuilder.com