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Buildings have a significant impact on environmental quality, resource use, human health and productivity. One definition of sustainable building is that which meets current building needs and reduces impacts on future generations by integrating building materials and methods that promote environmental quality, economic vitality, and social benefit’ (City of Seattle, 2006). In response to a changing view of sustainability the Building Code of Australia (BCA) adopted energy measures in 2005 to residential buildings and, in 2006, to Class 1 – 9 buildings. In many respects the measures represented a watershed for the Australian Building Regulations which had not included sustainability within the BCA. The goals of the BCA are to enable the achievement and maintenance of acceptable standards of structural sufficiency, safety (including safety from fire), health and amenity for the benefit of the community now and in the future (ABCB, 2004a). As with any change some Building Surveyors and construction practitioners viewed these measures with apprehension. How would the measures be assessed? Furthermore, was the BCA the appropriate place for these measures and was this a broadening of the scope of the building regulations beyond its traditional remit of health and life safety in buildings? This research used a questionnaire survey the canvass the views and perceptions of Building Surveyors and Architects with regards to sustainability and the BCA in 2006.

**Keywords**: sustainability, Building Code of Australia, building surveyors, building surveying.
INTRODUCTION

Buildings are inextricably linked to sustainability issues (UNEP, 2006) and the construction industry has a major role to play in reducing the adverse effects on the environment (Ngowi, 2000). One way of ensuring sustainability measures are adopted is to incorporate them into building codes thereby mandating some degree of uptake. In 2006 the Building Code of Australia (BCA) adopted measures on energy efficiency for all buildings (BCA, 2006). However the scope of the BCA has steadily increased over the past decade and some question whether these measures should be incorporated given the goals of the codes have been life safety, health and amenity. Furthermore other questions arise about the ways in which compliance will be achieved and assessed by Building Surveyors. This research sought to ascertain the views of the practitioners who are implementing the new measures in the 2006 BCA.

BUILDING REGULATIONS IN AUSTRALIA

The BCA is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government and State and Territory Governments with the status of building regulations by all States and Territories. The goals of the BCA are to enable the achievement and maintenance of acceptable standards of structural sufficiency, safety (including safety from fire), health and amenity for the benefit of the community (ABCB, 2004a).

DEFINING SUSTAINABLE DEVELOPMENT AND SUSTAINABILITY

Sustainability has a broad and differing definition depending on the context in which it is used. Sustainable development is often classified using Bruntland’s definition as development that meets ‘the needs of the present without compromising the ability of future generations to meet their own needs’ (Brundtland Commission Report, 1987); or ‘Using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased’ (Commonwealth of Australia, 1992). Brundtland
(1987) described the concept of ‘sustainable development’ as a strategy or means to achieve sustainability by optimising the relationship between the global society and its natural environment with consideration of social, economic and environmental goals of the society. Bruntland’s report contained two key concepts; the concept of needs especially in relation to the world’s poor and secondly, of limits to growth to ensure future generations access to natural capital. International concern for the environment was reflected early in the United Nations conference in Stockholm in 1972 and the idea of eco-development emerged from the conference as ‘an approach to development aimed at harmonizing social and economic objectives with ecologically sound management’ (Gardener, 1989).

Although eco-development was the precursor of the concept of sustainable development, Hill and Bowen (1997) noted the early concept of sustainable development was firmly entrenched within the environmental movement and sustainable development was often interpreted as sustainable use of natural resources. Debate continued on the appropriate definition and uses of the concept of sustainability. Solow (1993) argued that development inevitably lead to some of draw down of stocks of non-renewable resources and that sustainability should mean more than the preservation of natural resources. Sustainability is the means by which we strive to achieve sustainable development and Goodland (1995) believed that sustainability had three dimensions; environmental, social and economic. Hill and Bowen (1997) believed the divergence of opinions proved that sustainability is so broad an idea that a single definition can not capture the concept, however there is agreement that uncontrolled exploitation of natural resources is not beneficial to humankind in long term. Sustainable development and sustainability within the context of the built environment was defined by Kibert (2005:9) as construction that created ‘a healthy built environment using resource-efficient, ecologically-based principles.’ Hill and Bowen (1997) established four principles in their concept of sustainable construction which addressed as social sustainability, economic sustainability, technical sustainability and biophysical sustainability. The concept of sustainable construction posited by Hill and Bowen (1997) provides the building and construction industry with a practical framework to guide the implementation of sustainable buildings.
SUSTAINABILITY AND THE BCA

Other developed countries, such as the UK, Canada and the US have a history of adopting measures, such as energy efficiency into the Building Regulations. Originally this was driven by health reasons to create warm habitable buildings however it has now become a sustainability measure too with the aim of reducing carbon emissions and mitigating climate change (www.communities.gov.uk, 2007). Overtime these standards adopted in energy efficiency have increased. Governments have looked to the building regulations as a means of adopting some measures to address sustainability issues and these include energy and water economy. Australia, with its hot climate, abundance of coal and commonwealth resistance to the existence of climate change lagged behind. However the evidence supporting climate change was growing and at state and local government level there was acceptance of the need to take action in the early 21st century.

Sustainability issues were debated and consultations held with key stakeholders and while the idea of using the BCA to implement sustainable buildings in Australia was adopted, debate continued about which sustainability issues to include. As the Australian Building Codes Board (ABCB) noted ‘it is difficult to determine … whether there is community consensus over what is a desirable level of sustainability for buildings’ (Productivity Commission, 2004a). With a lack of consensus over the meaning of sustainability, the ABCB preferred the term ‘environment’ in which all the factors related the environment fitted into two broad categories. The first category was to reduce the emissions that harm the environment thereby controlling a range of adverse effects of buildings on the environment: greenhouse gases, waste water, construction and demolition waste, and noise. The second was to conserve scarce natural resources that include water, non-plantation timbers and energy and other non-renewable resources (Productivity Commission, 2004a). The ABCB report Sustainability and the BCA (Ashe, 2003) concluded the building-related sustainability issues for the BCA were durability, energy, waste, climate change, adaptability, noise, indoor air quality, water, urban salinity, assessment tools and benchmarking (see Table 1 below). Though Ashe (2003) concluded that a broad range of sustainability issues were within the remit of the building regulations, to date only energy has been incorporated in the BCA (BCA, 2006). A limitation of sustainability and building
regulation is that compliance relates to a point in time, in Australia when the occupancy permit is signed off by the Building Surveyor, thus the BCA does not include the occupation phase of the building life cycle.

Table 1 - Sustainability issues for Building Regulations

<table>
<thead>
<tr>
<th>Sustainability issue</th>
<th>Rationale for inclusion in building codes and existing legislative provision</th>
</tr>
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<tbody>
<tr>
<td>Durability</td>
<td>Prolonging the life of products reduces the consumption of materials</td>
</tr>
<tr>
<td>Energy</td>
<td>Should include embodied energy and operating energy for energy efficiency measures. The current BCA has provisions for operating energy efficiency</td>
</tr>
<tr>
<td>Waste</td>
<td>Comprises waste reduction, recycling and reuse. Some legislation at State/Territory level regarding waste management</td>
</tr>
<tr>
<td>Climate change</td>
<td>The impact on building construction is likely in flooding, drought and bushfire.</td>
</tr>
<tr>
<td>Adaptability</td>
<td>Adaptability includes: flexibility (ease of change of spatial organisation or of technology and services), convertibility indoor air quality (ease of change for new use), and expandability (ease of additions).</td>
</tr>
<tr>
<td>Noise</td>
<td>Refers to ‘community noise’ from the sources of roads and neighbourhoods etc.</td>
</tr>
<tr>
<td>Indoor air quality (IAQ)</td>
<td>Poor IAQ may lead to sick building syndrome, building-related illness and multiple chemical sensitivities. The Productivity Commission (2004a) suggested eliminating the pollutant source inside the building and improving ventilation. The BCA has provision in the area of ventilation only (ABCB, 2006b).</td>
</tr>
<tr>
<td>Water</td>
<td>Water is critical and scarce, often poorly managed and over exploited (PC, 2004b) with some water management legislation at State/Territory level. The Productivity Commission (2004a) suggested the BCA should include water efficiency measures and water reuse and could be treated as the same way as energy efficiency.</td>
</tr>
<tr>
<td>Urban salinity</td>
<td>Some developments at Local and State/Territory levels (Ashe, 2003).</td>
</tr>
<tr>
<td>Assessment Tools</td>
<td>‘Green Star’ evaluates the environmental performance. It is specifically developed for use on commercial buildings as a guide for sustainable design (GBCA, 2006).</td>
</tr>
<tr>
<td>Benchmarking</td>
<td>Measures and compares performance. It is vital to monitor the effectiveness of any environmental measure (Ashe, 2003). The benefits are; simple, easy to interpret and shows trends over time, responsive to changes in the environment, a basis for comparisons, well founded in technical and scientific terms, based on international standards and consensus concerning validity is adequately documented, of known quality, and updated regularly.</td>
</tr>
</tbody>
</table>

(Source: Authors adapted from Ashe (2003), ABCB (2005) ABCB, (2006b). Building life cycle and the Building regulations)
There are seven phases in a building’s life cycle; all affect its sustainability. The phases are: planning, material, design, construction, operating, maintenance, demolition and disposal (Dailey and Grabar, 2003). Accordingly the BCA covers approximately half of the building life cycle from the planning to the construction phases. Other phases are covered by mandatory or non-mandatory measures in different states/territories. Dailey and Grabar (2003) believed that the standard of those measures which are not covered by a uniform building regulation often vary from state to state dependent their commitment and development of sustainability.

![Diagram of Building System Processes and Control](image)

**Figure 1- Building Life Cycle and the BCA (Ashe, 2003)**

In addition Ashe (2003) suggested further sustainability issues related to social and economic aspects of sustainability which are outside the scope of the BCA. These issues include: encouraging eco-efficiency in undertaking lifecycle environmental and
cost assessments for new buildings, design for disassembly in manufacturing sector for re-cycle and re-use building materials, new procurement policies with introducing environmental innovation, eco-labeling building materials with having information on service life, re-usability, environmental emissions and cost, and finally, encouraging owner and tenants to recognize the value added by the green buildings. Similar opinions emerged to propose the BCA cover the full building life cycle (Dailey and Grabar 2003, PC 2004a). If the BCA extended its scope it could result in a holistic concept of sustainable development and implement integrated sustainability through a single regulatory tool.

**SOCIO-ECONOMIC BARRIERS TO SUSTAINABILITY**

The barriers to best practice of green buildings in the Australian building industry are socio-economic. The Building Commission report (BC, 2004) noted financial concern on affordability and fear of additional cost among clients/owners may influence their attitudes to green buildings. Expensive design and construction and long-payback periods are associated with sustainable buildings and, as owners do not pay operating costs, there is little incentive for the market to provide such buildings (Callender and Key, 1997. Wilkinson & Reed, 2006). Fear of additional costs may incline clients/owners not to use their influence on the development of sustainable buildings (Building Commission, 2004). From an economic perspective, insurance and financial institutions are key drivers in building construction but they are not engaged in a drive towards sustainability (Ashe, 2003).

Referring to social barriers, Dailey and Grabar (2003) noted that resistance to change may occur. While the building regulations have served society for over 150 years, the term ‘sustainability’ only appeared as an objective of the BCA from 2004. Adopting sustainability will force the industry to change and resistance is expected. Dailey and Grabar (2003) posited that for change to be successful, people have to be educated and trained. However the BCA is not a static document and is continuously improved, sustainability is relatively a new issue and changes must be made known to practitioners (Ashe, 2003). A final issue is that the work load of practitioners may
increase enormously with sustainability measures in the BCA, and the quality of design and construction will be affected (Productivity Commission, 2004a).

LIMITATIONS OF THE BUILDING REGULATIONS

Paradoxically a major barrier to implementing sustainability may arise from the remit of building codes. Like other codes, the BCA is concerned with minimum acceptable level of construction, whereas sustainable building requires best practice. A means must be found to reconcile the two issues (Ashe, 2003) though a major philosophical shift in approach is needed. Also quantifying the effectiveness of sustainability is an issue for the BCA and the construction industry needs to design an acceptable tool to assess sustainable buildings including the environmental costs and the cost of benefits (Dailey and Grabar 2003, PC 2004a, Robinson et al 2005). The ABCB acknowledged that limitations in the scope of the BCA may be a barrier to implementation as the BCA covers the design to maintenance phase and not the whole building life cycle, sustainability issues highlight a ‘planning vs. building’ conflict that is better addressed at the planning stage (Ashe, 2003).

RESEARCH METHODOLOGY

This research is qualitative. It is concerned with individual’s attitudes, motivations, views, behaviours and perceptions of an issue, in this case sustainability and the building regulations (Hakim, 1987:26). The researchers sought to identify the views of practitioners who professing an expertise in sustainability towards the adoption of a range of sustainability issues in the BCA. It was appropriate to collect this type of data via a questionnaire survey of a sample of the research population (Nachimias & Nachimias, 1976:100). Whilst this approach does not elicit the rich deep data that results from interviewing, it was our intention to canvass as wide a range of views as possible with this research. It is acknowledged that a limitation of the method is that the research reveals the ‘what’ but not the ‘why’.
A sample of building surveyors and architects from metropolitan Melbourne, Australia was selected to participate in this research as they were considered the most likely practitioners to have a direct experience of the BCA and sustainability issues. The Royal Australian Institute of Architects (RAIA) website was used to target Architects who were advertising ‘sustainability’ their professional services and a 120 were identified in the Metropolitan Melbourne area. A similar approach was adopted for the Building Surveyors through the Australian Institute of Building Surveyors (AIBS) website where 100 Victorian practices were identified. This research focused on commercial construction only.

Questions were derived from the issues identified in the literature review as being potentially part of the scope of building regulation. Best practice was adopted for the questionnaire design (Oppenheim, 1992, De Vaus, 2002) to ensure that respondent’s views would be gathered. The questionnaire was designed in three parts, the first dealt with the respondents background and experience to assess the quality and reliability of the responses. A mix of open and closed questions was used. The second section dealt with the scope of the BCA and sustainability and what respondents felt about a range of issues. The final section asked respondents to rank barriers to sustainability in order to assess the importance of the barriers. A pilot of the survey was undertaken prior to the mail out and some questions were amended for clarity. Out of a total population of 220 practices, 150 questionnaires were sent to Architects registered with the RAIA and members of the AIBS. Twenty one responses were received from Architects and twenty two from Building Surveyors, totaling 43 returned questionnaires, a response rate of 35% for the survey and a sample of 19% of the total population. Given this degree of response these results can be said to be representative of the views about sustainability and the BCA of Architects advertising professional services in sustainability in Melbourne and Building Surveyors in Victoria.

All the responses were coded and input into an excel spreadsheet prior to analysis using the Statistical Package for Social Scientists (SPSS) version 13. The data was analysed using a combination of univariate and bi-variate descriptive statistical analysis to explore the differences between the two groups.
DATA ANALYSIS

The respondents were evenly distributed between the architects and the building surveyors and therefore the overall results can be said to reflect the views of both professions. All 43 respondents have worked for over 3 years with 33% working on more than 10 commercial projects, therefore they are experienced practitioners. 95% felt the BCA was important to their business and were familiar with the content of the BCA. Significantly all had worked on at least one project with sustainability features, though the architects were more likely to have worked more on sustainability.

The respondents were asked how much they agreed that a range of issues such as energy efficiency, climate change and so forth be included within the BCA. A Likert scale was used to calibrate answers and a neutral option was provided. With regards to energy efficiency over 95% regarded this as an important part of the BCA and it was of equal importance to both groups and showed consistency with the ABCB view (Ashe, 2003). Though fewer (77%) felt that water was an issue for the BCA there was an overall majority in favour of its inclusion in the BCA. 70% of respondents felt recycling should be part of the BCA confirming Ashe’s report (2003) and the Productivity Commission view of the significance of this issue (2004a). Architects were less disposed towards the evaluation of material use in the BCA presumably because it might restrict their design freedom.

EXTENT TO WHICH SUSTAINABILITY ISSUES SHOULD BE INCLUDED IN THE BCA

When it came to climate change issues, less than 60% felt this should be part of the BCA. This result is interesting because greenhouse gas emissions resulting from energy consumption is a cause of climate change and therefore is covered by including energy efficiency in the BCA. Perhaps this response reveals some misunderstanding of this issue in the group and the need for further education. Less agreed (55%) that adaptability should form part of the BCA with a high percentage (25%) being neutral, possibly reflecting the potential difficulties in assessing building design on this basis. Furthermore architects were different in their view on this issue with more agreeing to adaptability in design. 90% agreed that IAQ and 87% agreed
noise abatement measures should form part of the BCA agreeing with the ABCB perspective (Productivity Commission, 2004a); significantly both these issues are mainstream associated with internal comfort and occupant satisfaction. When urban salinity measures were considered only 50% were neutral and 33% agreed it should be within the BCA. Again more architects were in agreement with this issue. Whilst the majority of architects agreed that rating tools should be used in the BCA, most Buildings Surveyors were neutral or not in favour of this option with the use of tools potentially perceived as deskilling the profession. Overall around half the respondents felt ratings tool should be included. When benchmarking was considered 66% agreed this should be a part of the BCA and therefore the use of some means of evaluating and measuring sustainability is viewed positively though the use of the ‘off the shelf’ rating tools above was less favourably viewed for some reason. Whilst there was a range of agreement with regards to which issues should be included in the BCA overall the levels of agreement reflected a general acceptance of sustainability issues in this group.

**RANKING SUSTAINABILITY ISSUES IN THE BCA.**

When the rank order of issues is considered an interesting variation in views was noted (see figure 2 below). When asked to identify the number one sustainability issue, 63% ranked energy, 12% IAQ and 10% recycling; therefore over 85% of the group selected from just three issues. Both BS and architects felt energy was the number one issue but interestingly in a country on stage 3 water restrictions in Victoria and under going a severe drought, no one considered water conservation as a number one issue.
However when asked to identify the second most important issue, there is a change and less agreement in the group. Here water was ranked highly (31%) along with materials (28%). Overall the selection of the second most important sustainability issue revealed a much greater divergence of views among the sample (See figure 3 below).

When the group selected the third most important issue recycling was ranked by 24%, IAQ 21%, and material use and water scored equally at 14%. Overall there was considerable divergence with the remaining issues. This lack of consensus is an issue previously identified (Productivity Commission, 2004a) for sustainability and reveals research, education and training issues which need to be addressed to inform practitioners.
SOCIO-ECONOMIC ISSUES AND THE BCA

The next section of the questionnaire examined the socio-economic issues which historically have not featured as a part of the remit of building regulation. 40% of architects and 21% of building surveyors agreed that the building life cycle should be part of the BCA, however a high percentage, 72% of building surveyors objected to its inclusion in the code. Not surprisingly, given the professional backgrounds of the respondents there was less support for the concept of eco-efficiency (i.e. a concern for the balance between cost and environment) where 46% agreed it should be part of the BCA. Building Surveyors were more in favour of the concept of design for disassembly being part of the BCA than the architects who were mainly neutral. When asked about the adoption of a new procurement policy to encourage environmental innovation architects were more in favour than building surveyors who do not get involved in procurement issues typically in Australia. Most agreed that eco-labeling of materials should be adopted and concurred with Ashes proposal (2003). 85% agreed that owners should be encouraged to adopt sustainability issues in building and there is overwhelming support for the concept. Clearly some of these issues are currently removed from the work of the building surveyor; a profession already under extreme pressures through lack of recruitment, an aging workforce and expanding areas of professional services (Zillante and Wilkinson, 2006).

BARRIERS TO IMPLEMENTING SUSTAINABILITY IN THE BCA.

When asked about the perceived barriers to implementation, 90% agreed that the conflict between the regulations being a minimum standard permissible and the requirement that sustainable buildings achieve high standards was a barrier. Ninety five percent of the respondents (100% of architects but not all building surveyors) viewed a lack of education in sustainability as a barrier. Interesting only 66% felt affordability was a barrier to sustainability though other groups such as quantity surveyors might hold a different view. When the increased workload was considered 55% agreed this might be a barrier and in the BS group 64% felt this would be a problem. Given the lack of education noted above, presumably building surveyor’s time would be taken up in learning about the new measures and how to evaluate...
whether building proposals are compliant with the code. Furthermore the respondents did agree that increased workloads would affect the quality of work as noted by the Building Commission (2004). Dailey and Grabar’s view about resistance to change was supported by the group with sixty six percent agreeing that resistance to change would be a barrier to sustainability measures in the BCA. Equally there was agreement that client perceptions of higher costs associated with sustainability issue remained a barrier to greater uptake. The respondents considered also that the financial and insurance institutions were not promoting sustainability issues in building and that this was a barrier still. A significant proportion (90%) viewed the issue of quantifying sustainability as a barrier for adoption in the BCA. When asked which was the most significant barrier, 29% felt the conflict between the regulations being a minimum permissible standard and the requirement that sustainable buildings achieve a high standard was the most significant barrier. However affordability (26%) and client’s fear of additional costs (22%) were close behind this issue. Overall these results showed that fear of additional costs and affordability remained barriers along with the philosophical conflict between the remit of building codes and sustainability. Additionally a lack of architects educated in sustainability issues and the issue of over-regulation was also raised by some respondents.

CONCLUSIONS

Sustainability is an issue for all parts of the construction industry and practitioners. One potential method of increasing sustainability and sustainable development is to increase the range of measures in the building codes thereby mandating for green buildings. Typically and over the recent past, energy efficiency has been the key sustainability issue considered in building codes, however this is changing. Ashe’s 2003 report suggested a much broader range of issues that could be incorporated into the codes such as the water conservation, urban salinity, durability, waste and recycling for example. This research asked a representative sample of practicing Architects and Building Surveyors in Melbourne Victoria to rank their views and perceptions about introducing these sustainability issues into the BCA. The results showed that the majority of respondents accepted the eleven issues identified by Ashe
(2003) and noted in Table 1 above, even though this broadens out the scope of building regulations. Furthermore most respondents agreed that socio-economic sustainability related issues should be included in the BCA and again this requires broadening of the scope of building regulations. Nine potential barriers were revealed in the literature review which would impede the adoption of sustainability measures (Ashe, 2003. Building Commission, 2004. Dailey & Grabar, 2003. Productivity Commission, 2004a) and the results showed that these barriers remain, especially perceptions about affordability and cost. It is considered that further evidence and publicity regarding the economic argument for sustainable buildings will help to overcome the perceptions of affordability and high costs.

However this research concludes that the most important step with regards to the BCA and sustainability issues is that minimum acceptable levels of sustainability need to be determined and agreed and then the broader range of issues needs to be adopted in the legislation. Given the small increment to the total building stock each year, typically between 2 - 3%, building regulations have a limited role in addressing climate change on its own. However sustainability does have a vital role in the BCA and mandated standards are important signaling that the issue is deemed of great consequence by legislators. In addition extension of the building code standards to a wider range of renovation and refurbishment projects is another way of increasing the uptake of measures within the total stock. However the issues of recruiting and retaining people into the profession within Australia (Zillante and Wilkinson, 2006) may be a more significant barrier yet to implementing sustainability within the BCA.
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