The Efficacy of Integrated Green Design Strategies in Meeting Green Building Criteria: a South African Case Study

SB10 Sustainable Building 2010,
26-28 May 2009
Te Papa, Wellington

Llewellyn van Wyk

lvwyk@csir.co.za
Presentation Structure

• Introduction
• Materials and Methods
• Results and Discussion
Introduction

• Improve environmental performance of the building
• Reduced construction waste
• Healthier indoor environmental quality
• Lower energy demand
• Lower water consumption
• Enhanced ecological value
Green Star Office Criteria

- Management
- Indoor Environment Quality
- Energy
- Transport
- Water
- Materials
- Land Use & Ecology
- Emissions
- Innovation
Management

- Green Star accreditation
- Commissioning Clauses: contractual obligation, O&M Manual, Commissioning Report
- Building Tuning: monthly monitoring, annual review
- Independent Commissioning Agent
- Building User’s Guide
- Environmental Management Plan during construction
- Waste Management during construction
- Airtightness Testing
Indoor Environment Quality

- Ventilation Rates: better than minimum
- Air Change Effectiveness: ASHRAE standards
- Carbon Dioxide Monitoring & Control
- Daylight: factor improvement
- Daylight Glare Control: glare reduction
- High Frequency Ballasts
- Lighting Levels: max 400 lux
- External views
- Thermal comfort: ASHRAE
IEQ continued

- Individual Comfort Control
- Hazardous Materials: remove from site
- Internal Noise Levels: not exceed max SANS 10103
- Volatile Organic Compounds: paints, adhesives, sealants, carpets, flooring
- Formaldehyde
- Mould prevention: humidity control
- Tenant Exhaust Riser
- Environmental Tobacco Smoke
Energy

- Conditional requirement: be better than SANS 204
- Greenhouse Gas Emissions reduction: modelling, max 20 points for carbon-zero house
- Energy Sub-metering: substantive uses, separate lighting & power
- Lighting Power Density: lighting with minimum energy consumption
- Lighting Zoning: individual switching, 100sq.m. open office
- Peak Energy Demand Reduction
Transport

• Provision of Car Parking: lower than maximum applicable
• Fuel-efficient Transport: car-pool parking spaces, motorbikes
• Cyclist Facilities: bicycle storage, lockers, showers
• Commuting Mass Transport
• Local Connectivity: access to local amenities (ATMs, high-density housing)
Water

- **Occupant Amenity Water:** potable water consumption reduced
- **Water meters:** measure major water uses, automated data collection
- **Landscape Irrigation:** Reduce potable water by 90%, low-water planting
- **Heat Rejection Water:** reduce potable water consumption of heat rejection systems
- **Fire System Water Consumption:** reduce, store
Materials

- Recycling Waste Storage: recycle resources used in the building
- Building Reuse: Maintain as much of an existing building as possible
- Reused Materials: bring in recycled materials
- Shell and Core Fit-out: fit-out to tenant requirement
- Concrete: reduce cement content
- Steel: use recycled steel
- PVC Minimisation
Materials continued

- Sustainable Timber: FSC Certified, recycled
- Design for Disassembly: structure and/or façade
- Dematerialisation: More with less (structure, ducts, building efficiency, finishes, cladding, reduce piping, i.e. waterless urinals)
- Local Sourcing: buy South African, buy local
Land Use & Ecology

- Conditional requirement: low ecological value
- Topsoil: separated and reused on site
- Reuse of Land: Refurbishment, Brownfield
- Reclaimed Contaminated Land: implemented remedial steps
- Change of Ecological Value: No negative ecological impact (specie depletion)
Emissions

- Refrigerant/Gaseous ODP: zero
- Refrigerant GWP: <10
- Refrigerant Leaks: detection systems
- Insulant ODP: Zero
- Watercourse Pollution: zero increase to stormwater flows, treated
- Discharge to Sewer: % reduction
- Light Pollution: spillage
- Legionella: arises out of evaporative systems
- Boiler & Generator Emissions
## Points and Weighting

<table>
<thead>
<tr>
<th>Category</th>
<th>Points</th>
<th>Weighting %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>IEQ</td>
<td>28</td>
<td>15</td>
</tr>
<tr>
<td>Energy</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Transport</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Water</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Materials</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Land Use &amp; Ecology</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Emissions</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Innovation</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>
Ecological Design Principles

- “Design with human habitat with sensitivity to ecological principles” (Wines 2008a:14)
- “More socially responsible and environmentally integrated approach” (Wines 2008b:14)
- “Mirrors nature’s deep interconnections in our own epistemology of design” (Van der Ryn & Cowan, 1996a:x)
- “…any form of design that minimises environmentally destructive impacts by integrating itself with living processes” (Van der Ryn and Cowan 1996b:x)
- “making thoughtful design choices and using ecological materials in ways that create quality, long-lasting environments with minimum damage to the planet” (Hall 1996:14)
Ecological design

• An architecture that basically comes “down to three purposes:
  • first, to advance the purely selfish motive of survival by a cooperation with nature;
  • second, to build shelter in concert with ecological principles as part of this objective; and
  • third, to address deeper philosophical conflicts surrounding the issue of whether we really deserve the luxury of this existence, given our appalling track record of environmental abuse” (Wines 2008c:20)
Materials and Methods

Case Study 1 design completed
Case Study 2 design not started
CSIR specialist adviser
Design Interventions

• **Building 1**
  - No design interventions proposed as construction had commenced on site. Recommendations were however made with regard to the landscaping particularly to make use of xeriscape gardening in order to eliminate the need for irrigation with potable water.

• **Building 2**
  - Over-excavating of the basement to facilitate natural lighting and ventilation; the formation of landscaped berms to act as noise attenuators; natural ventilation to the central connector; solar-heated water to heat the central connector and to supply hot water requirements; maximising the southern façade to bring in cool air at ground level and exhausted through the roof lights; orientating and shaping the rooflights to reduce direct sun and optimising the solar-water heater installation; and using the roof lights in conjunction with below-floor displacement ventilation and a building management system to exhaust hot and stale air.
## Results and Discussion

<table>
<thead>
<tr>
<th>Category</th>
<th>Building 1 (%)</th>
<th>Building 2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>64.2</td>
<td>71.4</td>
</tr>
<tr>
<td>IEQ</td>
<td>70.3</td>
<td>59.2</td>
</tr>
<tr>
<td>Energy</td>
<td>36.6</td>
<td>36.6</td>
</tr>
<tr>
<td>Transport</td>
<td>71.4</td>
<td>35.7</td>
</tr>
<tr>
<td>Water</td>
<td>42.8</td>
<td>78.5</td>
</tr>
<tr>
<td>Materials</td>
<td>64.7</td>
<td>58.8</td>
</tr>
<tr>
<td>Land Use &amp; Ecology</td>
<td>14.2</td>
<td>80.0</td>
</tr>
<tr>
<td>Emissions</td>
<td>29.4</td>
<td>43.7</td>
</tr>
<tr>
<td>Innovation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category</td>
<td>Sub-category</td>
<td>Eco-principles</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Management</td>
<td>Airtightness</td>
<td>✔️</td>
</tr>
<tr>
<td>IEQ</td>
<td>Daylight glare</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>External Views</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Daylight factor</td>
<td>✔️</td>
</tr>
<tr>
<td>Energy</td>
<td>SANS 204</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Energy Use</td>
<td>✔️</td>
</tr>
<tr>
<td>Transport</td>
<td>x</td>
<td>X</td>
</tr>
<tr>
<td>Water</td>
<td>Potable water</td>
<td>✔️ (flow rates)</td>
</tr>
<tr>
<td>Materials</td>
<td>Reuse ex building</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Recycled materials</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Cement reduction</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Local materials</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Disassembly</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Mass reduction</td>
<td>✔️</td>
</tr>
<tr>
<td>Land Use &amp; Ecology</td>
<td>Ecological value</td>
<td>✔️</td>
</tr>
<tr>
<td>Emissions</td>
<td>Watercourse pollution</td>
<td>✔️</td>
</tr>
<tr>
<td></td>
<td>Façade lighting</td>
<td>✔️</td>
</tr>
<tr>
<td>Innovation</td>
<td>Open</td>
<td>✔️</td>
</tr>
</tbody>
</table>
Conclusions

• It may be that integrated green design strategies rather than attention to weighting factors become more prominent in buildings aiming to achieve higher rating scores: however for buildings aiming for four stars the evidence from this comparative study suggests that integrated green design plays a lesser role than maximising mechanical services in the determination of the ‘greenness’ of the building largely due to the relative importance of the weighting factors

• More studies required to test this hypothesis
Thank you