ARCHITECTURAL QUALITY AND SUSTAINABILITY

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Summary

Rab Bennetts’ keynote lecture will identify the key elements of his firm’s sustainable design strategy, illustrated by projects from more than 30 years’ experience. In particular, he will focus on the reduction of carbon-dioxide emissions in order to combat climate change, supported by performance data. He will also describe the strong connection between low environmental impacts and architectural quality, which he believes is the key to greater acceptance of sustainable buildings in general.

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1 30 years of experience in designing for sustainability

Bennetts Associates is a general architectural practice with a wide-ranging portfolio of projects, from offices and universities to theatres, hotels, housing, urban regeneration and transport infrastructure. Since its foundation in 1987, the firm has won more than 100 awards for its work.

The co-founder of the firm, Rab Bennetts, has been interested in the environmental impacts of architecture since he was a student. After qualification in 1977 he joined the multi-disciplinary firm Arup and gained first-hand experience of working with engineers and other specialists on what would now be described as ‘green’ buildings. From 1979-82 he played a leading role in a project known as Gateway 2 in Basingstoke, near London, which pioneered many of the key features of sustainable design in large buildings. Subsequently, he continued to monitor the post-occupancy performance of the building and this process continued for several years after leaving Arup to establish Bennetts Associates.
2 Principles of passive design

The opportunity to develop the first ideas about sustainability came when Bennetts Associates was commissioned by Powergen in 1991 to design its new headquarters building in Coventry.

The client was one of the two large electricity companies that had been created out of the Thatcher government’s privatisation programme, so it was interested in energy-efficiency...
rather than sustainability in its broadest sense. The architectural strategy was based on ‘passive’ design principles that influenced many later projects, as follows:

- Orientation of the main facades towards the south, to facilitate solar control
- External solar shading, to eliminate excessive heat gains in summer
- Heavy thermal mass with a high surface area (i.e.; vaulted concrete structure) exposed to the internal airstream, to stabilise internal temperatures
- Night-time ventilation of the building, to cool the structure in hot summer conditions
- Opening windows for natural ventilation wherever possible
- Unobstructed air paths across the office floors
- High levels of thermal insulation
- Concentration of ‘hot spots’ in enclosed areas that could be separately cooled
- Relatively narrow office floors, to ensure that daylight levels were high.
- A raised floor cavity to allow for future mechanical ventilation, to provide for possible changes in the building’s pattern of use.

Extensive computer analysis of airflow and internal comfort conditions was far more advanced than had been possible in the late 1970s and the Powergen project pioneered the use of dynamic thermal modelling to persuade the client that air conditioning could be avoided for all but a small part of the building. The analysis also demonstrated that the natural airstream did not necessarily follow the architect’s preferences!

In architectural terms, the elements that were crucial to the building’s energy-efficiency were also the most powerful visual characteristics - in particular the richness of the façade, the spatial composition of the concrete interior and the strong sense of light and air.

The building was completed in 1994 and is still occupied by the same company, now absorbed within the E-On group.

3 The importance of local conditions

Following on directly from the Powergen project were two office buildings on the outskirts of Edinburgh in Scotland, approximately 300 miles to the north of Coventry. These buildings were for John Menzies (1993-1995) and BT (1997-1999).
The design intent was the same, as both clients supported the idea of low energy buildings. However, local climatic conditions were significantly different and they had a major effect on the designs, as follows:

- The higher winds speed meant that opening windows could not be relied upon for ventilation at all times of year. Therefore, fresh air was supplied from the floor cavity at 18°C all year round, with opening windows available for use when conditions were favourable.
- The higher wind speeds would have meant that external solar shading assemblies were more robust and visually obtrusive.
- However, the cooler external temperatures allowed solar shading to be placed in the cavity of the double glazing units. Although cavity blinds are not as effective as external shading, the overall performance was not so critical in the cooler temperatures.
- The local air temperatures meant that fresh air from below the floor would not require any cooling. Like Powergen, the thermal mass of the structure could also be used to enhance the cooling of the building during hot periods. Local heat wave conditions rarely extend beyond 2 or 3 days.
- Using a mechanical system in a cool climate allowed heat reclamation from the airstream during winter months, whereas opening windows would have resulted in lost energy.
Overall, when local conditions were considered, mechanical ventilation was found to be more energy-efficient over a whole year than the natural ventilation strategy as employed at Powergen. This is consistent with the recent findings of the European ‘Passivhaus’ programme for domestic properties.

Once again, the architectural ‘language’ of these buildings was more interesting than a typical air-conditioned office, but the key lesson was that local conditions can be a significant influence, even within a small country like the UK.

Projects in different parts of the world could be expected to experience a much wider range of conditions and, therefore, their architectural form should be markedly different in response.

4 A strategy for sustainability

Being able to pursue a continuous sequence of projects based on the same building-type - offices - allowed Bennetts Associates to compare projects directly as they evolved.

The fourth in this sequence was the Wessex Water Operations Centre (1998-2000) on a beautiful site in Bath, which is in the relatively warm south-west of England. Wessex Water was an exceptional client and their Business Plan was based on principles of social, economic and environmental sustainability, not just energy-efficiency.

Fig. 5 Wessex Water Headquarters, Bath
The strength of this client commitment enabled Bennetts Associates to develop a range of performance indicators for environmental sustainability in six key areas:

- Reduction of operational carbon-dioxide emissions, by energy-efficiency
- Reduction of embodied carbon-dioxide emissions, through construction
- Reduction of waste, through prefabrication and site management
- Reduction of water usage, through recycling and efficient fittings
- Reduction of transport emissions in the construction process, by sourcing locally
- Improvement of biodiversity, by careful landscaping

By the time this project was commenced in 1998, it was clear that climate change due to greenhouse gases was an urgent issue, so the focus was on reducing carbon-dioxide. This had the effect of simplifying the measurement process and it clarified the core priority for sustainability. Elsewhere in the UK design and construction industry, there was considerable confusion about the complexity of sustainability, so the focus on CO₂ reduction was welcomed by many who were new to the issues.

The Wessex Water project became a national benchmark for sustainability and was used extensively by the Government in setting standards for Building Regulations and Best Practice. Much later, in 2008, the Government set long-term targets for very 80% reduction in CO₂ emissions by 2050. It was possible to demonstrate through the Wessex Water Operations Centre that this was nearly achievable already on a high quality office building.

The project also won many architectural awards and the ‘project of the year’ award from the British Construction Industry.

There have been numerous publications, seminars and conferences that have featured the Wessex Water building and, as a result, Bennetts Associates has been able to promote a strategy for sustainability based on practical experience, with six key steps:
Select the right design and construction team
Ensure that the client’s Brief is optimised for sustainability (for example, when
describing internal comfort conditions and power requirements)
Maximise the ‘passive’ features of the design
Minimise the ‘active’ features of the design (such as air-conditioning)
Use renewable energy sources where possible, once basic energy-efficiency has been
achieved
Carry out post-occupancy assessment, to improve the building’s performance

5 Verification

The last of these principles reflects Bennetts Associates’ belief that actual measurement of
performance is critical to achieving minimum environmental impacts. There are many
examples of buildings that the architects claim are ‘green’, but there is rarely any
substantiation. Moreover, many of the most widely published buildings with ‘green’
aspirations may not be performing as well as the architects and engineers would like.

In the UK, the BREEAM scheme is one widely accepted method of assessing
buildings objectively, but it has been criticised for not focusing sufficiently on reduction of
CO₂.

At Bennetts Associates, each building is compared for its CO₂ performance against
a national scheme for Energy Performance Certificates. For example, whereas the typical
benchmark for an office building is approximately 80-90kg/CO₂/m²/year, the Wessex
Water building has achieved 25-30kg/CO₂/m²/year.

Other projects completed by Bennetts Associates include the new department of
Informatics for Edinburgh University (2005-2008), which has achieved 16kg/CO₂/m²/year.
This very low figure has been achieved with the help of a central combined-heat-and-
power plant for the University’s main buildings.

Another award-winning project was the public library in Brighton (1998-2006) which
targeted 8kg/CO₂/m²/year but only achieved 27kg/CO₂/m²/year. Although this is still
a good figure it is clearly not as good as intended. The reasons for this were (a) an error in
predicting the heating load for the building and (b) far more people using the building than expected, which led to extended opening hours and the use of many more computers and lights than forecast.

![Fig. 8 Brighton and Hove Library, Brighton](image)

Further examples will be illustrated in the keynote speech.

The lessons from publishing these figures must be made available to other designers if higher levels of sustainability are to be achieved.

6 Architectural excellence

All of the buildings illustrated in Rab Bennetts’ keynote speech have won awards for their architectural quality. In other words, the ambition to create a more sustainable future is directly linked to the architectural ambitions of Bennetts Associates. Like most other architects, the firm is most highly motivated when the outcome is likely to be exciting and interesting buildings that the users will enjoy.

For the users, in contrast to an air-conditioned building, sustainable design also offers a connection with the natural world outside through a sense of the changing seasons, the pattern of sunlight or daylight and the effect of the breeze. There is mounting evidence that ‘green’ office buildings result in higher productivity.

For architects, the ‘raw material’ of sustainable design includes many of the architectural virtues, such as good daylight, visually rich facades, the definition of interior space by structure and so on. Moreover, it also offers the prospect of design that is responsive to the locality and which is radically different according to the climate in which it is located. Sustainable architecture is undoubtedly modern and functional, but it represents the opposite of globalisation and the ubiquity of conventional buildings that are the same the world over.