

# Sustainable Buildings that Encourage Sustainable Behaviour

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## Introduction

This paper represents the ongoing study of theory and practice in relation to the development of sustainable buildings and the embedding of sustainable features to optimise their potential for teaching and learning about sustainability. It is hoped this will lead not only to a raising of awareness of the impact of buildings on the natural environment but to enable people to positively change their behaviours in terms of economic, environmental and social sustainability in and around their own built environments.

The primary focus of the research is on the design, construction and use of the Twickenham River Centre as a leading example of sustainable design with environmental education at its heart.



Figure 1 The Twickenham River Centre showing accessible green roof, passive solar design and use of sustainable materials.

National and local government, corporations and many other organisations are increasingly recognising that resources are finite, pollution levels must be controlled and the burning of fossil fuels impacts on our climate through global warming with local, national and international implications for flooding, extreme weather conditions, loss of biodiversity and ultimately threatening life on Earth with additional negative social and economic consequences [1]. Buildings play a significant part in this, currently accounting for 50% of total carbon emissions in the UK [2] through the

winning, manufacture, transportation and use of materials and energy expended in the construction and operation of buildings.

The UK Government has set a number of challenging targets for improving sustainability, starting with the overarching goal of an 80% reduction in carbon emissions in the UK by 2050 compared to 1990 levels [3] and recognising the need to change our building practices with targets for zero carbon and low water usage new-build housing by as early as 2016 and new build non-domestic buildings by 2019 for England and Wales [4].

Buildings and human behaviour are inextricably linked to environmental issues such as global warming and climate change, national environmental issues such as extreme weather events, energy supply and local environmental issues such as water, ground and air pollution, localised flooding, high levels of water consumption and habitat destruction.

The main hypothesis 'To what extent do sustainable buildings encourage sustainable behaviour' further poses the questions of 'how do you define a sustainable building?', 'how do you measure and influence sustainable behaviour?' and 'how do you prove the link between the two?'

An initial literature review has revealed current best practice in the fields of sustainable building design, technology and construction, education for sustainable development (ESD), and environmental and architectural psychology. The provision of sustainable educational and community buildings is high on the political agenda which is being tackled through public and private initiatives and most notably through the ambitious UK governments' Building Schools for the Future Programme [5] with varying degrees of success.

Professor D.W. Orr [6] a leading academic in this field, speaks of “the hidden curriculum that is the building itself”. The misconceptions that unsustainable buildings impart through their design, construction and use are that our consumption of scarce resources is disconnected from our everyday lives and are considered almost infinite, if considered at all, wastage is often factored-in to building contracts as normal practice and it is not unusual for us to be physically removed from natural processes in the buildings we inhabit such as day lighting, well ventilated spaces, natural, healthy and breathable materials. A sustainable building should be diametrically opposed to this and should in its design construction and use both explicitly and implicitly encourage and enable us to lead more sustainable lifestyles.

### Defining a sustainable building

There are a number of standards developed over recent years that have reached a high level of complexity in assessing the environmental impact of buildings. For the purpose of this study the Building Research Establishment Environmental Assessment Method (BREEAM) has been adopted as a benchmark of sustainability in order to compare and contrast selected buildings under the following categories:

- Management
- Health & Well-being
- Energy
- Transport
- Water
- Material & Waste
- Land Use and Ecology
- Pollution

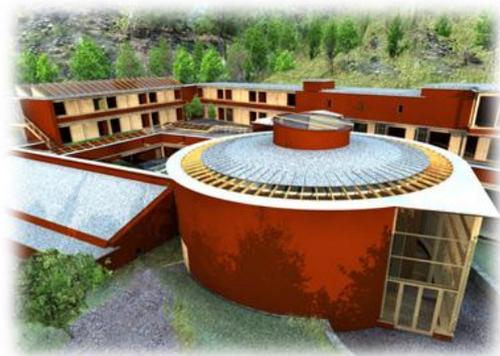
Like the Twickenham River Centre itself each building chosen for the case studies will have attained or will aspire to the BREEAM ‘excellent’ standard. However, even with this industry recognised standard there are many different approaches to achieving a sustainable building with broad variability because of, for example, design limitations, wasteful construction practices, poor operation and use. Evidence will be collected in order to study the relationship between certain variables in the design, development and use of sustainable buildings used for educational and community purposes.

### Case Studies

The value of the case study approach over pure theoretical study is discussed in Cherulnik [7]. Case studies can establish actual impacts on environment and behaviour and offer the benefit of local contexts in terms of climate, local resources, infrastructure etc, they apply theory and research in a reciprocal relationship and can have a proselytising function by enhancing impact on target audiences. A detailed case study permits adequate descriptions related to setting, defining problems, programming, design process, use and generation of useful behaviour theory or research.

The case studies involve interviewing key stakeholders throughout each phase of the development of the buildings i.e. pre-construction, construction and post-occupancy evaluation of the impact of the buildings on sustainable behaviour and how interaction with a building affects attitudes and behaviours and whether long term change to more pro-environmental behaviour can be proven.

The first pilot case study was undertaken at the Wales Institute for Sustainable Education (WISE) at The Centre for Alternative Technology [8]. As well as having impeccable environmental credentials in terms of sustainable technologies, energy efficiency, passive design techniques and use of natural materials the building will feedback to its occupants’ data about their resource use and the thermal performance of the building fabric in the hope that this experience will influence their behaviour.



The WISE building

The building will be used as a resource to teach and learn about a wide range of environmental topics providing sustainable space for research, workshops, lectures

and seminars as well as accommodation and restaurant facilities all offering an experience of sustainable solutions in practice to influence and effect behavioural change.

Other exemplar sustainable buildings used as case studies are The Genesis Project in Taunton [9], The Core educational building at The Eden Project in Cornwall [10] and The Derbyshire Adult Community Education Eco Centre (DACE) [11].



The Genesis Project clay block pavilion

The Genesis project has 4 pavilions built around a central core that each illustrate different sustainable building methods including straw bale construction, thin mortar joint clay block construction, rammed earth construction and timber frame construction. Key features are the cutaway sections that reveal the construction methods and use of sustainable materials. Many of the finishes are from 100% natural materials ranging from wheat fibre board to earth renders. A teacher who regularly used the building stated that “the use of natural and healthy materials had a positive effect on the behaviour and learning of students compared to more conventional teaching and learning spaces”.



The Core building at The Eden Project

Key sustainable features of The Core building include biomimetic design (literally

meaning imitating nature) based on the Fibonacci series representing the sunflower. The roofing material is from sustainably sourced copper and the roof structure and frame are pre-fabricated glued laminated (glulam) beams from a sustainable source. The structure is visible and intersects with floors and other building elements allowing the building to ‘explain itself’. Housed within The Core are a great many innovative interactive displays encouraging experiential learning through self-directed and user-centred inquiry and play. There are also many displays of student works physically integrated in and around the building which serves to ‘stitch’ the building into the wider community.



The DACE building

Key sustainable features of the DACE building are the use of local stone linking the building to its location and heritage as an existing stone quarry. It uses passive and active renewable energies and has adaptable indoor/outdoor space for teaching traditional crafts and sustainable construction methods as well as wider topics for more sustainable living.

These case studies have elicited a great deal of very useful data that can now be analysed, interpreted and applied to the design, construction and use of the Twickenham River Centre.

### **Attitudes, behaviour change and buildings**

The gap between our attitude toward urgent environmental and social issues and our actions or behaviours in tackling them has been well researched and can be applied to the design, construction and use of buildings. Even the best efforts to develop an effective sustainable building will be undermined if in its design, construction and use sustainable features are not understood or made explicit. This

is known as the 'value-action' or 'intention-behaviour' gap by behavioural psychologists. The reasons for this gap are a highly complex set of human responses in relation to the perception of environmental, social and economic problems.

By investigating behavioural change theory, environmental, architectural and behavioural and ecological psychology and environment-behaviour (E-B) theory and applying these to the provision of buildings that encourage sustainable behaviour through their design, construction and use, it is hoped that a greater understanding will emerge of how this gap can be narrowed.

It has clearly been established by Bell & Fisher [12], among others, that behaviour and environment mutually affect each other and Zeisel [13] states that "E-B researchers need to participate in design decisions as part of the design team in an attempt to put greater emphasis on building users and their effect on the performance of the building as well as the effect of the building on the (pro-environmental) attitudes and behaviours of the users".

The key to encouraging pro-environmental behaviour is to remove barriers. People consciously and sub consciously tend towards congruency in environments, therefore in a sustainable building where operation, services, technologies and materials are inherently sustainable, it can be argued that sustainable and ecological behaviour is more likely. Individuals who believe it will be difficult to carry out environmentally responsible behaviour are unlikely to engage in that action [14].

Jenks & Dempsey [15] state ".....it is behaviour, lifestyles and peoples aspirations that are at the heart of achieving a sustainable environment. The form of urban areas and buildings within them, do not determine sustainable behaviour, but they might provide the right setting for it."

MacNaghten [16] states "the practical challenges for such (sustainable) initiatives are far-reaching and would involve sizeable shifts in the culture of planning and building practice: if we are serious in understanding the conditions for

a more sustainable society, we need to recognise that the more directly involved are people in the construction and preservation of their dwellings, the more likely they are to care for and cherish the planet we all inhabit".

Interventions and strategies can modify environmental behaviour. Signs and prompts can be incorporated into a building to remind us we have attitudes which are favourable to pro-environmental behaviour.

Consequent strategies involve intervention after a given behaviour and can include positive reinforcements through rewards for pro-environmental behaviour e.g. feedback on CO<sub>2</sub> saved or negative reinforcements through punishments e.g. high cost of energy. Kohlenberg & Phillips [17] showed that consequent strategies have proved better than antecedent ones (intervention before a certain behaviour) in relation to some pro-environmental behaviour e.g. picking up litter through reinforcement techniques compared with prompts.

It is argued that sustainable buildings allied to sustainable education can have a significant impact on environmentally responsible behaviour through combined technical and pedagogical interventions embedded into the design, construction and operational processes.

Pallack [18] shows that attitudes formed from direct behavioural experience tend to be stronger and are more predictive of later behavioural change than are passive or abstract attitudes. Therefore the more we use buildings as an experiential teaching and learning resource the more likely pro-environmental behaviour is to occur leading to resource efficiency, waste minimisation, increased health and well-being, enhanced biodiversity, low-impact transportation etc.

As social beings we are inherently subject to and highly influenced by social norms. As shown by Newholme [19] those who are well informed are more likely to adopt environmentally responsible views and views translate into corresponding behaviour. However Dwyer [20] illustrated that simply educating people is not wholly effective and environment is critical in facilitating behaviour. Newholme [19] also

concluded that general positive attitudes to the environment are not very predictive of eventual behaviour. Factual knowledge can lead to a change in attitude toward behaviours linked to social and moral values that lead to subjective norms (socially appropriate action) and will eventually lead to behavioural intention and outcomes this is illustrated by the work of Fishbein & Ajzers [21].

The development of buildings presents a complex set of processes and sustainability can often be seen as an extra layer of complexity. From case study analysis and evidence from other sources such as Frankiewicz [22] it is clear that the built environment professions will have to make significant changes in their collective pro-environmental and organisational behaviours.

In order to deliver a building that is sustainable throughout its lifecycle a more integrated approach must be adopted, including i) early and comprehensive stakeholder involvement e.g. BREEAM assessor, educationalists, facilities manager and contractor ii) a new role of sustainability manager with real power to take responsibility for the carbon performance during the buildings' design, construction and occupancy iii) a single organisation with whole life responsibility for a building, ensuring a low carbon approach to design, construction, fit-out, maintenance, refurbishment and even demolition or remodelling iv) comprehensive training is required to move sustainable systems, methods, techniques and skills into mainstream construction and v) there should be a well-managed project handover with training for occupants and building managers on new systems and technologies.

### **Conclusion**

If we are to live more sustainable lifestyles our built environment should be responsive to our needs in a sustainable way whilst our behaviours should not undermine the potential for our buildings to achieve their sustainable design aspirations.

Among all stakeholders in the provision and use of buildings there needs to be a common language of sustainability. In their design, construction and operation buildings need to avoid giving incongruent

messages to users and allow them to easily engage with the buildings functions and operations whilst understanding inherent sustainable features and how they can be realistically interpreted and made relevant to their lifestyles.

All buildings should therefore be a valuable teaching and learning resource for developing an understanding of sustainable methods, materials, technologies and behaviours over the whole of their life cycle. It has been proposed that raising peoples' awareness in terms of the sustainability of their own built environment and landscapes can have considerable impacts on long term pro-environmental behaviour and the tackling of pressing environmental concerns.

The study of exemplar sustainable buildings and the interaction of factors and events can highlight common practices and innovative approaches and methods as well as revealing problems and barriers encountered in achieving sustainable environments.

It is hoped by highlighting best practice, not only in the design, construction and use of sustainable educational and community buildings but also how sustainable and educational features can be embedded throughout the building will inform sustainable building design and enhance sustainable teaching and learning practices, change attitudes and ultimately encourage sustainable behaviour.

The research will continue to try and establish the correlation between sustainable buildings, environmental education and pro-environmental behaviour to ultimately inform the built environment professions through dissemination of research findings and to develop strategies that will have optimum environmental and educational benefits.

The next stage of the research is to engage with the newly appointed development team to apply the theory into practice directly informing the design, construction and use of the Twickenham River Centre as a leading example of a sustainable building to encourage sustainable behaviour.

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