A Client's Guide to Sustainable Offices

a draft for development

Gaia Research

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" healthy workplaces have done more to boost productivity than all the bandwidth in the world'"
Pape 2003

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1 INTRODUCTION

1. This publication is one of a series of four client guides to sustainable buildings.[1] These guides resulted from a fast track and low budget process - a tiny fraction of the investment they seek to influence. As well as this one focussed on social housing others have been written on offices, schools and private housing. There is some commonality between the publications but each has a sector focus, sector specific case studies and referencing to assist in delivering best practice.

2. It has not been possible within the budget and time constraints to fully develop this guide or to embrace the wealth of experience that exists in the client and design community to-date. This guide is therefore produced as a draft for development with the knowledge that it requires considerable adaptation before it is adequate to meet current needs. It is hoped that they will generate discussion and exchange of information and that the case study information can be expanded significantly and with critical appraisal. Anyone wishing to use this document as the basis of a consultation process with stakeholders, design teams, contractors or fellow professionals is invited to do so. It would be particularly useful to gather and share information on useful networks of expertise and best practice.

3. Buildings are designed to respond to social and/or business needs and they inevitably have social, economic and environmental impact. This series of guides is intended to assist clients to ensure that the influence at all three levels is as far as possible a positive one. The overall aim is to maximise the long term value of a building in meeting the needs, requirements and aspirations of users and the wider community and maximise the positive impact on the environment.

4. The current standard of office building is highly variable and most pays little tribute to sustainable development objectives. There is a need to identify and embrace those elements and available guidance that can enable better offices to be delivered and to ensure the benefits and opportunities are widely disseminated.

[1] Available at www.gaiagroup.org

5. The information here is based on the author's recent experience of writing an extensive training course in Sustainable Design for clients, architects, engineers and cost professionals. [2] The training course covers key themes of sustainable design on a modular basis and includes thorough referencing. Producing these *"sector based"* client guides provides an opportunity to integrate the issues around generic building typologies but does not seek to replicate the training programme which is far more extensive and provides more detailed technical guidance and background information.

Sustainability, as presently defined by government initiatives, challenges industry to produce higher levels of output, while enhancing the quality of life for employees and other stakeholders, using lower levels of input and generating less waste & pollution. This is intended to ensure *"non-declining human welfare over time"* and that a non-declining stock of capital assets, including environmental assets, exists to meet the needs of industry, individual consumers & society in the future. [3]

5. Key Issues faced by the client are

Stewardship	Resource Effectiveness	Biodiversity
Pollution	Communities	Health

7. It is relatively easy to establish the key issues to address for a sustainable project and there is an abundance of existing guidance, but delivering on aspirations often proves to be extremely difficult. This guide supplements existing guidance on best practice procurement but it cannot provide all the answers. Success relies on a complex interaction of design, designed manageability, client commitment and user understanding. Importantly no client, architect or contractor can deliver a sustainable building without attention to the process from inception through to handover and subsequent management. Much of this guide deals with this aspect. It should inspire all involved to pursue the sustainable design of private housing,

[2] Sustainable Construction CPD – Modules 1-15 www.gaiagroup.org
[3] Sustainable Construction CPD – Modules 5 Environmental Legislation & Policy Gaia Research 2002

act as a starting point for clients to develop a robust brief and assist them to establish the knowledge base and the process that will support real delivery. Ignoring or inadequately addressing the issues raised here will lead to a less than satisfactory result.

8. The guides are produced at a time when there is a strong focus on sustainable construction in Scotland and a powerful political trend namely the commitment in 2002 to put sustainable development at the centre of policy.[4] The Scottish Executive's focus on community, citizenship, value, respect and quality are all vital aspects of sustainability. The Building Scotland Act (2003) made 'furthering sustainable development ' a requirement and this too will influence future policy.[5] The Scottish Executive also has a commitment to design quality through a policy on architecture.[6] Policies being developed now are likely to lead to substantial pressure on all involved in built development to improve their sustainability performance.

9. This document does not seek to repeat current arguments and policy objectives, but to support and compliment them with additional guidance to assist in delivery and to draw on these aspects to promote an integrated approach. However, the quality aspirations set out in current policies should be recognised as vital to successfully delivering a sustainable built environment.

10. Comments or suggestions of projects for inclusion in later updates please send to research@gaiagroup.org All named contributions will be acknowledged. We will also host a discussion forum and we invite your participation..[7]

[4] Meeting the Needs www.Scotland.gov.uk/library5/rural/mtnsd.pdf
[5] Building Scotland Act 2003
www.scotland-legislation.hmso.gov.uk/legislation/scotland/acts2003/20030008.htm
[6] Scottish Executive A Policy for Architecture for Scotland
www.scotland.gov.uk/architecture/exec_summary.asp
[7] www.gaiagroup.org/Research/forums/

2 PRINCIPLES OF SUSTAINABLE OFFICE DESIGN

What is Sustainable Building Design?

1. Sustainable building design is applied good sense - an aspiration to build to the highest quality and functional standard, with maximum environmental and social benefit and with cost assessments that reflect the whole building life cycle such that investment can be properly maintained.

2. Achieving sustainability requires us to live within the limits of the earth's capacity to provide the materials for our activities and to absorb the waste and pollution that our activities generate.

3. Sustainable building design means applying of a set of design parameters which have often had insufficient attention in the past:- functional requirements - now and in the future, user needs and aspirations, resource consumption, material sourcing, location and access, impacts on stakeholders including building users and the local community, life cycle operation and costs, maintainability, building life and end-of-life, pollution, waste, biodiversity and health.

4. The process of procurement, design, tendering, construction and handover is a vitally important aspect of delivering buildings that can be sustained. Many projects suffer from a failure to think through design consequences in cost and management terms. There are many examples where this results in crucial aspects being edited, and undermining of project aspirations, late in the process. This is not inevitable but requires strong commitment, planning and considerable expertise if aspirations are to be achieved.[8]

5. The intended outcome is buildings that: -

    a. ….minimise adverse social, environmental and economic impacts by being efficient to operate, effective in their use of resources, minimizing waste & pollution and protecting occupant health and the wider environment during construction, operation, re-use and at the end of their useful life.

    b. ….enhance positive social and economic impacts by providing an environment that is fit for purpose, more responsive to individual, business and community needs and aspirations, more flexible and functional, maintainable and cheaper to run, and more respectful of the environment on which we all ultimately depend.

[8] Sustainable Construction CPD – Module 9 Site Issues & Construction Processes Gaia Research 2002

The changes in attitudes towards the environmental and social impact of construction, and consequential changes in policies and legislation, that have been taking place in society over recent years have been prompted by a range of factors, including:

- the disturbing results of research into global warming, climate change, depletion of the ozone layer, and widespread pollution of water, land and air;
- the increased awareness of these and other environmental issues and their increasing presence and importance on the political agenda – locally, nationally and internationally - especially since the UN Conference on Environment and Development in Rio, 1992 and its Agenda 21 declaration;
- increasing recognition that buildings and the natural environment are essential to the maintenance of our human life and to improving quality of life;
- increasing realisation that the built environment has a crucial impact on the physical and economic health and well-being of individuals, communities and organisations;
- increasing realisation that the construction, fit out, operation and ultimate demolition of buildings is a huge factor in human impact on the environment both directly; through material and energy consumption and the consequent pollution and waste, and also through the pressures on inefficient or avoidable infrastructure;
- increasing realisation that it is important to design in ways that best employ financial resources in the long term. This means looking at whole life costs and building functionality .as fundamental aspects of design;
- increasing concern about indoor air quality, personal environmental control and other adverse factors within buildings, highlighted in the specific aspect of increasing child asthma and allergy but also the number of incidences of non-specific ‘Sick Building Syndrome’;
- increasing concern that a sustainable construction industry cannot be seen in isolation from supply, construction processes and manufacturing or from the proper management and maintenance of buildings in use. Sustainable construction has to be seen as a process rather than a product delivered at handover;
- the action of individuals, professionals and communities in challenging imposition of inappropriate development projects on communities rather than development that meets the identified needs of communities;
- the increased understanding that achieving a sustainable built environment brings real quantifiable benefits.

Why is sustainable building design important?

The widespread political and social concern for the environment has been one of the most significant changes of recent years. Until recently environmentally responsible building and manufacturing was largely seen as a peripheral activity. To many in architectural circles it was seen as a style to be resisted. In economic terms it was perceived as being wasteful of capital. In social terms it was perceived as elitist. Changes in society and policy have made it evident that these perceptions were profoundly wrong.

Increasingly environmental concern has been identified as intertwined with social and financial consideration as vital components of sustainable development. It is not a style or wasteful or elitist but an approach that is intended to ensure development that results in increasing 'quality of life' for all. This is now fully acknowledged by national and international policy. Sustainable building design is not just an important aspiration it is a vital one and a legal, financial, social and environmental imperative. The alternatives *'unsustainable development'* or *'no development at all'* are manifestly less attractive.

The pressures on the industry to address the three strands of sustainability (economics, social equity and environmental protection & enhancement) have led and are continuing to lead to government and corporate policy changes, and to more-stringent legislation. The industry is developing practices that can lead to built development projects that are significantly more efficient and affordable, more fit for purpose, much more socially acceptable, and much less damaging to the environment than before.

An important consideration is concerned with change management. There is a need to ensure that investment made today is relevant to future needs and aspirations including social, technological and regulatory changes. International commitments to sustainable development, echoed by the Scottish Executive, mean that substantial changes are planned in respect of regulations, legislation and fiscal policy to assist in meeting policy objectives. These are intended to promote the right sort of development rather than development for its own sake.

Sustainable buildings provide a potentially promising way to help address a range of challenges facing Scotland including:

- the high cost of infrastructure and security of energy supply;
- increasing cost of waste disposal;
- continued European pressure to cut pollution;
- the rising incidence of allergies and asthma, especially in children and the elderly;
- continued European pressure to improve indoor air quality through regulation;
- growing concern over the cost of global warming;
- increasing expenses of maintaining and operating public building;
- pressures on biodiversity;
- pending increases in water charges;
- manufacturing of sustainable building products for import substitution and export
- employment in long term healthy and productive industry

Features of a sustainable office

- Attractive design
- Result from a well-understood and organization-wide proactive commitment to engage in sustainable construction as a positive social and economic driver.
- Meets the functional needs of the organization, the users and the wider community
- Recognizes people as the most important assets of any organisation
- Enhances the work environments through healthy and vibrant internal environments including excellent levels of natural light and ventilation with personal control and with quality external environments that facilitate outdoor activities
- Does not endanger the health of the occupants, or any other parties, through exposure to pollutants, the use of toxic materials or providing host environments to harmful organisms
- Is responsive to local stakeholder needs, requirements and aspirations
- Enhances biodiversity locally by landscaping based on best practice guidance and globally by not using materials from threatened species or environments
- Does not cause unnecessary waste of energy, water or materials due to short life, poor design, inefficiency or poor construction and manufacturing procedures
- Uses materials that are environmentally benign in manufacture, use and disposal
- Are affordable to run and simple to manage and maintain in a benign manner.
- Does not consume a disproportionate amount of resources, including land during construction, use or disposal
- Use renewable and recycled and recyclable resources wherever possible.
- Have a green travel plan at inception to create minimum dependence on polluting forms of transport and encourage access to, and the development of, safe, non-polluting and sustainable forms of transport.
- Are flexible to facilitate changes in response to demographics and technology and which allow expansion or contraction in the future, where appropriate.

Why a sustainable design guide for offices?

> " a number of studies document measurable benefits for enhanced daylighting, natural ventilation, and improved indoor air quality in buildings. Benefits associated with these "green" features include enhanced employee performance and student productivity, as well as reduced absenteeism and illness."[9]

Buildings and the built environment have a crucial impact on the physical and economic health and well-being of individuals, communities and organisations. Where buildings contribute to disaffection, alienation and undermine community and where they create excessive financial liability, they are clearly not only undesirable but unsustainable.

Much recent office development is clearly less efficient, less healthy and less attentive to user and client needs than it might otherwise be. People spend over 90% of their time in buildings much of it will be at work.

There are real financial, social and qualitative advantages to be gained from building in a more sustainable manner. Flexible, healthy, efficient, maintainable and manageable buildings can drastically reduce adverse environmental impact, deliver financial benefits from resource productivity and maintain long-term investment. The health and productivity gains from better indoor environments have been well-documented and employers are increasingly attentive to the productivity benefits of improving the work environment.

Research for the Royal Academy of Engineering in 1999 demonstrates the typical relationship between first cost, running cost of the building and people etc as 1:5:200. This means that the design costs can be estimated at 0.1. The ratio of design input to value added is 1:2500 at least. Conventional commercial development concentrates on the '1', ignoring the rest. PPP development is based on the '5', setting the capital cost to minimise whole life cost. The obvious route is to invest in the design quality that adds value by better meeting the needs of the occupiers.

It is important that we put these social and economic issues at the centre of our aspirations for offices to ensure that they provide ongoing benefit into the future rather than the unwelcome burden that much of our current stock represents.

[9] Module 13: Cost Issues - Gaia Research Sustainable Design CPD 2004

3 ACHIEVING SUSTAINABLE DESIGN

Client's role in sustainable procurement

There is a significant resource of information on setting objectives and aspirations for sustainable housing. The guidance is highlighted in the appendix and detailed references on particular aspects are provided in each of the Gaia CPD modules.

A lot of guidance also relates to the activity involved in the construction process to ensure that this is undertaken in an environmentally sound manner. Initiatives such as "considerate constructors" are helpful in promoting the requisite attitude and methods for undertaking the construction process in a manner that is attentive to neighbours rights and needs and provides good guidance on site management.[10]

Significantly less attention has been given to problems of tender strategies, cost cutting and handover which have the potential to undermine the project aspirations, and to which sustainability objectives are often particularly vulnerable.

This dearth of information on the delivery of sustainability objectives of projects is surprising, given the far reaching and long-term impact. Documents such as the Environmental Code of Practice, its Feedback Case Studies and the Green Guide to the Architects' Job Book are perhaps the most thoroughly developed to date in terms of dealing with sustainable construction as a process and not a product. Module 9 in Gaia's Sustainable Design Series also covers the process issues from tender through to handover, in a succinct manner.

[10] www.considerateconstructorsscheme.org.uk

Establish or Review your Sustainable Development Policy

> "I see an important irony in a situation where clients of construction, who mostly do not have Environmental Policy Statements and Environmental Management Systems, let alone Sustainability Policies, engage designers and other consultants who do not have EPs or EMSs. Between them, they make THE KEY decisions that affect lifetime environmental performance. Then, when they come to the construction stage, they specify that the contractor should have an EMS! In PFI and other contractor-led consortia, this is now leading to situations where designers are being asked how they are going to deliver the contractor's Environmental Policy!" - R. Venables - CRANE Environmental

The first step in the process of achieving a successful built development project is to confirm the necessary commitment on the part of the Client or those with the requisite authority within the Client Group. Client commitment, expertise and direction is particularly important in the early stages to inform strategic thinking.

This would be a good time to establish or review and update the client organisation's Sustainability Policy

Writing a sustainable development policy need not impose additional burdens. It can be a good time to integrate existing strategies towards finance, people and the environment. A sustainable development policy for example can unify otherwise disparate commitments to community, investment, health, well-being, training, the environment and purchasing. Look at the office as a whole and any existing policies with which your sustainable development policy might be integrated.

The adoption of a formal management system is appropriate to a moderately sized organisation but for small offices may be onerous and inappropriate. Whatever form the policy takes it should reflect your office's uniqueness and contain a central vision that can be easily understood and communicated to all stakeholders.[11]

Your commitments should include adequate provision and structures in place to communicate the policy and to provide the appropriate training.

It will be useful to be aware of government policy and any commitments made by relevant professional bodies.

Once the sustainable development policy is established or brought up to date then you will be in a position to develop a Policy Statement that can be used to inform the Project development.

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Become an informed client

The transition to a culture of more sustainable construction is more likely to be reinforced by knowledge of the issues, the appropriate questions to ask and, importantly, the proper time to ask them. An informed client is essential to the success of any project.

To become an informed client you need to thoroughly understand what sustainable development is and the direction of economic, social and environmental policy that will impact on your project.

All clients should give consideration to undertaking in depth training on sustainable design issues and should expect design teams to have undergone or commit to training. The Gaia CPD series involves a thorough review of the issues and additional guidance is available in the referenced publications and web sites.

Visit best practice exemplar projects and become involved in discussion networks on best practice.[12]

Talk to a wide variety of people experienced in procurement, design and construction and to specialists in sustainable design.

As a client or client body you should be aware of the legal and other responsibilities that might inform your approach. Recognise that as a result of international and government policy, the regulatory framework is changing and there may be significant financial and legal implications for building operators that need consideration at the outset.

As the client you have the responsibility of communicating to all involved the nature of a sustainable development approach, and the benefits, responsibilities and issues involved. Identifying and firmly agreeing responsibilities at an early stage for example, is likely to be the most significant component of success.

As a client you should recognise the importance of vigilance at all stages if the project is to have a successful outcome. You should identify appropriate tools and techniques for use as the project progresses to ensure that best practice is adhered to, in particular a good process guidance tool.[13]

Commit to maintaining sustainable design on the agenda throughout the design and construction process if necessary in the form of a sustainability advisor to the client.

[12] Public Sector forum on sustainable Design
[13] Sustainable Construction CPD – Module 14 Appraisal Tools & Techniques Gaia Research 2004.

Gaia Research CPD series: Sustainable Construction CPD

Module 1: Materials Selection: … aims to give the reader a sound and broad grasp of the issues and priorities affecting materials selection in the design of places, buildings, services and objects and a realistic perspective on the range of issues which will affect decision making.
Module 2: Lighting and Daylighting: … is designed to enable the professional to be better able to make informed decisions about lighting & daylighting design. It directs the reader to contemporary tools and guidance which will assist in implementing best practice.
Module 3: Water and Sewage Management: … considers the flow of water through buildings. It looks at its efficient use, the appropriate treatment of the wastewater discharged and the potential for reuse. It also considers rain falling on and around buildings, the potential for reuse and appropriate discharge.
Module 4: Heating: …aims to enable the reader to deliver high quality buildings which have a low heating demand . It emphasises the role of minimising demand at the outset through passive measures.
Module 5: Environmental Policy and Legislation: … aims to highlight the key policy drivers for the creation of more-sustainable construction and the legislative requirements that need to be met.
Module 6: Cooling and Ventilation Strategies: …. seeks to highlight the principal issues and sources of guidance to ensure that buildings are as comfortable and healthy as they might be while minimising reliance on unnecessary energy for ventilation & cooling. The issue of healthy indoor environments is of increasing importance.
Module 7: Renewable Energy Technologies: ….give guidance on how to make best use of the available opportunities and how to go about designing and specifying appropriate renewables systems. They are increasingly part of the design pallet and have increasing support from government, but are still new to the majority of designers and clients.
Module 8: Sustainability Drivers: … provides a review of the principle milestones which have brought about the shift in attitudes towards sustainable design of the built environment.
Module 9: Construction Processes, Site Issues and Handover: …best practice guidance on tender evaluation, site practice, management and handover. A much neglected area which is fundamental to delivering client aspirations.
Module 10: Low Impact Construction: ….looks at recent innovative initiatives to design using very low impact materials such as straw, earth, hemp and timber.
Module 11: Electrical Installations
…. intended to help designers to develop strategies for low impact electrical services design and to implement them effectively. A subject that meets
Module 12: Post Occupancy Evaluation: …A thorough and concise review of methods of obtaining feedback from buildings in use and the history of development of the techniques with a series of case studies largely taken from the PROBE studies.
Module 13: Cost Issues: …This module undertakes a comprehensive review of the cost implications of 'green' building.
Module 14: Appraisal Tools & Techniques: … the use of expert guidance, designed processes, tools and formal & informal environmental management processes to deliver efficient, healthy, responsible buildings.
Module 15: Urban Ecology: …considers the sustainable design of the built environment of our cities and countryside.
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Assess in-house skills and consider external advice

Before carrying out an initial analysis of a building project, the client needs to assess its own capacity and skills base.

Discussions with professional advisers at the earliest stage can assist in determining and defining design priorities and setting project objectives.

Assess in house skills and determine whether additional advice is necessary to train those involved, prepare the brief, appraise the tenders and carry the sustainability aspirations through to completion, or other services.

Considering the ability of yourself or others to integrate sustainability considerations and manage them through a project may have an influence on the various types of appointment, the associated roles and responsibilities and any specialist consultants and/or requirements.

A crucial issue in considering sustainable building design is to recognise that considerable attention is required throughout the procurement and design process if the appropriate outcome is to be achieved. Yet further attention is needed to ensure that the investment is maintained in optimum condition after handover. You will need to take advice.

Sustainable development is a specialist skill and clients should give serious consideration to appointing an independent sustainable design advisor, whose remit is to support the client and design team with appropriate advice.

Every client procuring a new building should consider the opportunity to champion sustainable design and be open to innovative approaches that promote continual improvement.

It will help you and your advisor members to visit projects with similar objectives and to have a thorough and open discussion of achievements and failings.

Sustainable design is intended to deliver a number of specific benefits to clients

- A better managed construction process
- Improved integration between planning, construction and other policy objectives
- Improved build quality
- Smoother handover and operation
- Improved performance and work satisfaction
- Reduced building related ill- health
- Improved occupant comfort
- Future proofing against legislation
- Reduced long term legal and financial liability
- Improved access and reduced travel times
- Improved flexibility in building design to extend building life
- Improved effectiveness in use of financial resources
- Reduced costs in use
- Reduced capital cost
- Improved maintainability

In addition clients need to recognise their wider responsibilities to meeting govt and social objectives :-

- Reduced construction waste
- More effective use of products and materials
- Reduced adverse impact on water, air and land resources
- Reduced infrastructure
- Improved community benefits
- Improved feedback
- Reduced pressures on biodiversity
- Recognition through a number of specific awards

Identify and communicate the benefits of sustainable design

" healthy workplaces have done more to boost productivity than all the bandwidth in the world'"
Pape 2003

It is a good idea to draw up a list of specific opportunities and benefits to the client, the user, the community and the contractors and keep these at the forefront of your thinking as a design develops. These might include cost-in-use, user satisfaction, community enhancement, improved health & productivity and reduced liability.

The benefits include some factors that are relatively easy to quantify, such as power, energy and water savings and avoidance of waste (on average 25-30%, 25-40% and 50-75% respectively). More significant still are the estimates of productivity improvements and reduction in sickness and ill-health resulting from better indoor environments through avoidance of off-gassing materials, better ventilation, personal control and good daylighting. There is little UK data to provide a comprehensive analysis of the actual costs and financial benefits of green buildings. To date best estimates from US studies indicate that an average 0-2% increase in capital cost of a building leads to a 20% payback over the building life.

The financial benefits are still rarely adequately attractive to most investors but are likely to increase as the balance of taxation continues to reflect concerns for adverse social and environmental impacts. The direction of current policy makes it clear that this looking for short term gains is not good sense.

Market awareness, legislation and government & private sector policy have provided incentives to improve construction practice and to set in place procedures for continual improvement. This has resulted in development of a range of tools and methodologies to promote, assist and measure achievements in sustainable construction. They cover different professions and stages in the construction process as well as widely different elements. Most have a useful role to play at some level.

There are also excellent exemplars of tools and techniques in increasingly common use outside of the UK and some of these are likely to guide UK practice in future either through EU regulatory standards or commercial interests.

Ensure that yourselves and the design team are fully aware of the issues.

Remember that standard practice lags significantly behind what is possible and changes will reinforce this over the life of your project. Aim for the best possible standards. Every client procuring a new building should champion sustainable design and be open to innovative approaches that promote continual improvement.

Maintaining the Investment

There is a lot of evidence to suggest that sustainable buildings are more expensive then standard construction. Estimates based on American projects certified under LEED- a US based rating scheme similar in principal to the UK BREEAM - indicate 0-3%, for the lower and up to 10% for the higher ratings. Elements of this include increased design time, and the cost of higher performance products and benign materials. [14]

In truth all building design involves a balance between up-front expense, on going running costs and maintenance, eventual decommissioning and dismantling.

There is growing evidence that sustainable buildings provide significant social, financial and environmental benefits over their life that conventional buildings do not. Design decisions should reflect this lifecycle but we are currently at an early stage in our ability to do this.

Even in PPP projects there is evidence of an overemphasis on capital costs because we are culturally driven to seek short-term gains at the expense of the longer term. As a consequence life cycle benefits of maintenance, productivity and resource effectiveness are overlooked in favour of short-term capital cost savings or stock solutions.

The running of a facility must be considered at the outset and hence the building operation strategy needs to be well-documented throughout the design process.

We know that building presents certain risks to health and well-being and that individuals and organisations are in future likely to be much more pro-active in asserting their rights and making clients and designers accountable.

We know some of the principal causes of waste and hazard that are likely to impact on costs and these can be designed out.

Importantly, a large number of beneficial features have little or no additional capital cost e.g., site and window orientation and strategic approaches to the layout plan and form to reduce cable and pipe runs.

Passive solutions and design solutions aimed at low maintenance strategies and are less likely to incur high costs then highly serviced environments. NB: Beware "no maintenance" strategies that invariably mean that something is unmaintainable!

Other sustainable options such as high levels of insulation or passive design may cost more in the design phase but can be offset by the reduced cost of a smaller mechanical system or by designing it out altogether.

[14] Sustainable Construction CPD - Module 13 Cost Issues Gaia Research 2004

Set out the project aims through consultation with stakeholders

> "Organisations must transform themselves into highly flexible dynamic networks through which people and other resources generate high added value"
> Phillip Scott Associates [15]

Consult the affected stakeholder communities to inform the process. This will probably include the staff, facilities managers, and local community. Ideally occupants should be engaged from the beginning but if that is not possible then the outcome from post-occupancy studies should form part of the briefing and post-occupancy evaluation should form part of the feedback to the design team.

Be sure to undertake any consultation professionally so as to raise aspirations but not expectations that cannot be delivered.

You may wish to think radically about your current and future needs. Be prepared to rethink assumptions about office and the office environment. The impact of social and demographic changes, in combination with new technology, are profound. The evolution of the new work environment calls for radical rethinking and responses in how we deliver offices. Work with the current members of the organisation to identify key business technical, human resource and environmental pre-requisites necessary to achieve the goals and objectives.

It is important and will be useful to identify if your current premises are being used effectively and whether there is opportunity to identify beneficial changes. You may want to keep this in mind as the project develops.

Remember that you are looking to develop a solution that improves your ability to carry out your core responsibilities. This is more likely to be achieved if it enhances the well-being of individuals or communities, is functional, efficient and healthy, internally and in their impact on the wider world.

With changes in technology and lifestyle attitudes there are new opportunities. This is being exhibited in more mixed use developments and more flexibility to suit part time and freelance working. Looking for multi-functional uses is increasingly the norm.

Clients should establish their views and aspirations, and their aims will become the reference point throughout the design and construction stages, and can be used to test the overall success of the project over the longer term. Set out your objectives clearly taking into account that offices are changing.

[15] Building Services Research and Information Association – Environmental Code of Practice for Buildings and their Services Halliday S.P. 1994

The appropriate approach with an emphasis on sustainability should assist in providing a framework for:

- establishing, developing and communicating client priorities & value systems;
- setting the sustainable design strategy;
- communicating with stakeholders to define the functional needs, requirements and aspirations for all those affected;
- enabling user and management participation at an early stage in the design process;
- improving briefing procedures;
- preparing tender documentation such that sustainable design is tied down;
- establishing supply chain management where specifications involve real or perceived innovation;
- engaging bidders cogniscent of the issues and benefits of sustainable design;
- selecting the design team who understand sustainable design in practice;
- maintaining the sustainable design strategy throughout the project;
- setting appropriate fee structures;
- developing teamwork and robust communication;
- allowing adequate time for design development of engineered solutions involving passive design & good ergonomic control;
- implementing responsible site procedures;
- ensuring that commissioning and handover is undertaken properly;
- reducing waste;
- minimising pollution in all forms;
- avoiding use of toxic substances;
- maximising positive impacts on biodiversity;
- establishing formal feedback mechanisms including post-occupancy evaluation

Develop the brief in accordance with best practice

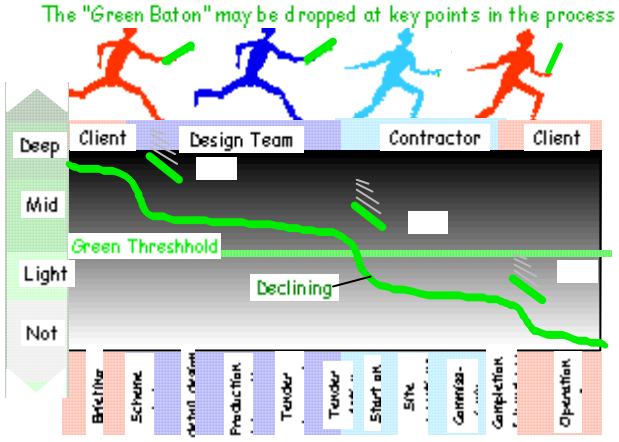
> "The outset of the project is likely to be the time of greatest aspiration in respect of environmental quality and sustainability objectives for client, architect or, occasionally, both. All projects will tend to find these aspirations are at risk and it is likely that important aspects will be undermined as it progresses from first thoughts to completed building. However much can be achieved with appropriate guidance."[16]

The client should set out their sustainable design objectives clearly using an appropriate briefing guide. This will benefit from discussion of options.

Having identified the key issues, investigate the appropriate benchmarks so as to make explicit the sustainable development objectives and make them visible, quantifiable, life cycle and evidence based. Getting the right balance between flexibility and pinning down the deliverables will need experience.

Setting targets against current norms is not adequate and will not deliver the best possible life cycle benefits.[17] Innovation should be encouraged.

The requirements should be reinforced through all subsequent stages of the process. There is a high risk of the "sustainability baton" being dropped throughout the process and particularly as responsibilities are transferred from the Client to the Design Team to the Contractor and back to the Client.



..Once dropped it is difficult to pick up again and regain lost ground. In some circumstances, with the right experience, aspirations can be exceeded.

Gaia Architects

[16] Sustainable Construction CPD – Module 9 Site Issues & Construction Process Gaia Research 2002
[17] Action Energy www.actionenergy.org.uk

The effect of compromises will inevitably depend on the aspirations at the start-out. A project with low expectations will be lucky to have green credentials at all by the time it gets to its delivery point.

Key sustainable design issues

The client and the stakeholder community will have their view on the issues and of their relative importance but these are provided as guidance.

Management of the Process
The design and delivery process is crucial to proper implementation of sustainable building design.
Implement a management system or adopt a process guide.
Have in place process tools that extend from consultation, through outline design, site issues, commissioning, handover and post occupancy evaluation. Take advice on your legal responsibilities e.g., duty of care for waste during construction and building life.
Become familiar with recent prosecutions so that you are aware of the scope of issues to be addressed.
Ensure that your advisors show commitment to legal compliance evidenced by method statements
Ensure a commitment to responsible procurement and purchasing in your sustainable development policy
Ensure that those engaged understand the sustainable design strategy and their role in ensuring its delivery
All professional service providers should show evidence of their approach and of past performance.
Take a rigorous approach to exploring the commitment of the design team and contractors.
Employ specialist advice in undertaking appraisal of their commitment, aspirations and experience.
Commitment to training of themselves and their subcontractors should be evidenced
Make sure that you understand the design and that alternative approaches have been properly considered.
Ask questions and demand straightforward answers – nothing should be too complicated to understand.
The brief should be fully understood by the design team and the results must be measurable.

Creating healthy environments
Consider the impact of the indoor environment on the well-being of users.
Occupants appreciate a view and daylight especially if they are largely working from one place. Consider at the outset the impact on the layout, building depth and schedule of accommodation.
Avoid materials that contain VOC's or other pollutants.
Put in place a cleaning regime that uses non polluting materials
Locate noisy equipment away from sensitive areas
Extract any pollutants or heat locally.
Controls – People like to have control of their environment. A certain amount of centralisation is acceptable if the occupants are consulted and understand the reasons.
Make links to outside to encourage outdoor enjoyment and recreation.

Promoting biodiversity
Materials should be used with minimum adverse impact on biodiversity
A full investigation should appraise the opportunities for enhancing biodiversity
Maximise habitat creation and minimise disruption - Bird and bat boxes
Creation of zones: wildlife / human / traffic and wildlife corridors and create self-sustaining habitats
Use SUDS to create variety of habitats (seasonal, wet / dry / semi-dry)
Maintain a low maintenance regime
Treat pollutants locally
Choice of plant / seed varieties for range of microhabitats & feeding opportunities
Use native species for main structure planting shelterbelts, to form new local woodland
Alternatives to hard landscape (porous paving / car block / gabions)

Supporting communities
Consult internally and externally
The project should enhance the local environment by quality design and provision of improved facilities.
The local community/ communities should be consulted and their concerns respected.
Consider the throughputs from the building and how it might impact on local communities
Avoid nuisance during construction or post completion.
Look to sourcing materials and skills locally

Minimise Pollution

All materials and products should have minimal adverse environmental impact at all levels from sourcing to end of use. The answers to this are rarely simple but some principles are possible.
Products should be fit for their purpose and present no health risk over their lifecycle.
They should be controllable, maintainable for long efficient use and facilitate safe recycling in all or part and ultimately safe disposal.
They should have minimum dependence on non-renewable resources over their lifecycle.
Systems should be validated in there own right in respect of their value and cost-effectiveness.
Materials should have minimum embodied toxicity and have long maintainable life with ultimately safe and efficient recycling or disposal.
Materials such as paints and finishes should be free of chemicals.
Avoid treatment of timber through design to prevent water retention.
Use local materials if possible and as close to their natural state as possible.
Locate building near to low-impact transport networks.
Consider the availability of the public transport infrastructure and encourage use of public transport and cycle, pedestrian safe access and storage and facilities that will encourage like shower provision
Mixed use and high density development can reduce the need to travel and bring lifestyle advantages
Avoid out of town retail or business facilities
Traffic calming
Consider joint uses between the project and the local community – such as café space or library facilities
Discourage through traffic or commuter parking
Use landscape design as an integral part of minimising the adverse impacts of transport and enhancing the positive elements such as cycle ways and pedestrianisation.

Resource Effectiveness
Energy & Water
It makes environmental and economic sense to minimise energy and water consumption and sewage outfall to reduce infrastructure and minimise costs in use associated with energy, water and sewage charges.
There are many opportunities to improve energy and water utilisation and to offset demand.
Considerations should be based on usability and whole life costs.
Conservation is always the best first option. Negawatts and negalitres are invariably the low hanging fruit.
E.g., site treatment and re-use of water, low consumption fittings, low flush and waterless fittings.
Toilet effluent is manageable
Avoid forms of recycling that raise the overall costs and introduce need for chemical treatment.
Rainwater harvesting can be used to offset demand and contribute as part of an enhanced suds strategy
SUDS offer excellent potential to improve landscape design quality and enhance biodiversity
All proper precautions re- legionella are now well documented.
Consider form, orientation and landscape and opt for passive solutions wherever possible. Mechanical systems should support passive systems not substitute for them.
Look for local sources of heating and cooling such as incineration or aquifer cooling
Controls, management are also vital
Materials Waste
Recycled materials should be considered but embodied toxicity may be an issue
Design for dismantling
Recover materials on site
Use pre fabrication if appropriate
Understand your legal responsibilities with respect to waste.
Understand the cost of waste and the benefits of waste avoidance.
Build on existing sites rather than on green fields
Recycle as much as possible
Include waste minimisation in design criteria
Design in waste management to the completed building

Write the tender documentation

Make sustainable design a fundamental criteria for selection of successful bidders.

Clearly and thoroughly define and demand sustainable design or you will not get it.

Use available benchmarking, measurable criteria and evidence based awards based on very best practice targets to address site practice, design quality, process planning for commissioning and handover, feedback and post occupancy evaluation.[18]

Reinforce the targets using appropriate tools and techniques

Market awareness, legislation and government & private sector policy have provided incentives to improve construction practice and to set in place procedures for continual improvement. This has resulted in development of a range of tools and methodologies to promote, assist and measure achievements in sustainable construction. They cover different professions and stages in the construction process as well as widely different elements. Most have a useful role to play at some level.

There are also excellent exemplars of tools and techniques in increasingly common use outside of the UK and some of these are likely to guide UK practice in future either through EU regulatory standards or commercial interests.

Ensure that time is allowed to develop an appropriate design based on a single system.

This is the time to ensure that the tender documentation makes explicit the need for process management including that Log Books are to be established and maintained throughout the design and construction period and that bidders will sign up to the Considerate Constructors Scheme Make feedback a fundamental requirement against established and firm targets.

Ensure that time is allowed for commissioning and handover and that appropriate information is gathered. Careful handover is central to efficient building operation. The commissioning, servicing, cleaning, maintaining and operations strategies should be described in a user manual along with a clear plan to indicate how this information will be communicated at handover.

Specify all the testing regimes and ensure they are costed out.

[18] Sustainable Construction CPD - Module 14 Appraisal Tools & Techniques Gaia Research 2004

Seek evidence that the tendering bodies are aware of the benefits of sustainable design

It is critically important to ensure that the design team members understand the significance of pursuing a sustainable development strategy, and are committed to it.

Sustainable design is now perceived as a business edge and inexperienced, ill-informed and unscrupulous designers and contractors will read this document and offer a variation on the content by return. Beware those just talking the talk they will not be able to deliver.

Seek supportable evidence of achievements through professional practice, built development, benchmark standards achieved, professional recognition or other means. Ensure that they have adequate commitment, skills and experience to deliver including expertise in sustainable design.
All members of the team (designer, contractor) should:-

- show a genuine commitment to sustainability
- provide evidence of appropriate training
- show real experience of delivering sustainable design
- show a working knowledge of best practice nationally and internationally, and a commitment to raising standards through networking.

Determine any additional training needs that tendering bodies might need. Few of them will have adequate knowledge or training to really deliver best practice.

Each office environment is unique and the design responses should reflect this.

Look for an integrated design team approach with an emphasis on a single design response rather then disparate elements, especially expensive 'sustainability add-ons' that simply increase cost and servicing needs.

Look for straightforward simple solutions that work well rather than add ons especially where they add capital cost and have high or unknown maintenance implications.[19]

[19] Eco-minimalism – Getting the Priorities Right by Liddell H.L. & Grant N.
www.gaiagroup.org/Architects/eco-min.pdf

Maintain a watching brief to ensure that objectives can be delivered as the design develops

If the project is well established with suitable targets and agreements then this should form the basis of a constructive agenda.

Design changes are inevitable and should be assesses in terms of their impact on sustainable design to ensure that they are neutral or beneficial.

Establishing controls within the routine of the site operations will be beneficial
• Unique or unusual elements, materials, products or services systems should by this stage have been fully explained - however a site has a large and ever increasing workforce and key issues should be part of the induction process for new site staff (this is required for Health & Safety and could be included with it).
• Environmental issues regarding the building being delivered and the construction-related activities on site, should be a permanent agenda item
• Within reason all relevant sub-contractors should have explanations of key environmental elements, and have the important installation aspects highlighted.
• Monitoring, checking & testing routines should be established at the outset.
• The design team should ensure that they are informed and present at all key checkpoints.

It is good practice for a handbook & operational manuals, to be maintained through the site operations in a manner that allows it to be presented in a manner that the client can navigate. The new CIBSE Log Books provide an opportunity for a coordinated approach.

Particular attention should be paid to the commissioning operations - not just of innovative technology - but also of the routine ones, as they can also undermine a system. It will become clear at this point how important it was to specify all the testing regimes at the tender period and for these to have been costed out and accounted for.

The social agenda should be apparent to all users and they should have clear mechanisms for expressing any concerns.

Ensure that handover is undertaken properly and that feedback is thorough and formalized

The interface between completion of a project on site, handover and ongoing operation & maintenance is a key point in the procurement process. If Client, Design Team and Contractor have been attentive to the issues and requirements then the building will be delivered as intended. However, the first period of occupation involves a learning curve as well. A lack of understanding of controls, regimes or design parameters can reduce their efficiency or undermine them altogether. This is where sustainability as a process and not a product is really demonstrated.

As the client you need to understand the various cycles of building management and the difference between routine O&M and contractual issues relating to snagging and defects.

The point of formal handover should be very soft. With training and involvement of users and O&M staff before handover and a "hand holding" exercise by the design team and specialist technology / materials installers afterwards.

It is not unusual in the last minute rush to handover for training to be more rudimentary than it should be. It is not adequate for one representative of a specific aspect of a building to talk to one representative of the user. Training should involve as many potential operational staff as possible, and refresher inputs should also be considered.

Check that products are of the specified quality, and that they work as specified and operate according to the manufacturer's recommendations is essential.

Essential training is needed for all who can contribute to the smooth and effective annual usage cycles. It should have been written into the original contract.

Once the building is under operation there is value in the design team maintaining a direct interest - and this should be properly resourced. This acts as a two way dialogue as the design team gain the benefit of feedback as to how the building is performing.

The critical point in the cycle of procurement is when the building becomes the full responsibility of the operators.

Monitor key aspects of a buildings' resource usage (energy, water, waste materials, etc.) as part of the sustainable development policy. This will help to identify problems at an early stage.

Effective feedback on how a building is operating technically, in terms of human mechanics, spatial organisation, ease of management and communication, has a large potential for resource saving.

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are needed to see this picture.

4 EXAMPLES

Prisma Mixed Development, Nürnburg

Joachim Eble Architects

The inner courtyard of this 9 storey, mixed use development in the centre of Nurnburg offers a secure environment for a kindergarten, which serves the on-site housing. The ground floor is a shopping precinct, the next three floors are offices and the top floors are residential. All the commercial properties get their pre-conditioned ventilation from a large solar atrium.

Attention was given to specification of environmentally sound materials - notably the finishes. Where possible floors are of mass timber (Brettstapel - dowelled or nailed wood block to form an equivalent to concrete beam and block flooring). Concrete is only used where absolutely necessary. Timber finishes are used throughout and the paint and other surface treatments are all low or zero emission.

Passive solar and natural ventilation strategies utilise waterflows and planting in atrium spaces. The water strategy is based on catching, conserving and recycling on site.

BRE Environmental Building

Architects: Feilden Clegg Bradley

This office was designed as a model for future offices and a flagship for integrated passive design. The brief called for minimum use of artificial lighting and air conditioning. It requires about 30% less energy than typical offices.

The building is L-shaped in plan; a three storey open plan office block for 100 staff and a smaller seminar block. The narrow plan (13.5m wide) and high ceilings (3.45m) allows use of natural light with large areas of opening windows. At occupancy level these are manually operated, while the high-level hopper windows are integral to the natural ventilation strategy and under the control of the building energy management system. The top floor incorporates clerestory windows, giving this floor much higher daylight levels than those below.

Daylight and solar gains are controlled by external, motorised, fritted-glass louvers mounted on the south facade. The louvers are normally automatically controlled, to follow the path of the sun.

The artificial lighting uses a system of suspended fluorescent luminares, with high frequency ballasts. It is automatic, but can be overridden by the occupants.
Some light is allowed to shine onto the floor soffit to increase the ceiling illuminance and so reduce glare problems and gloominess. There is also task lighting. Artificial lighting control

Oekohaus, Frankfurt

Architect: Eble & Sambeth

The Oekohaus cultural and business centre, situated near the centre of Frankfurt adjacent to a rail line, opened in May 1992. It is a 10,900m^2 mixed use building built for a largely pre-existing mixed client group of 40 organisations. As well as offices they included a printer, doctors, dentists, restaurant & a Kindergarten. Described by the architects as *"an alternative example to Frankfurt's usual business premises. Respecting ecological principals in its entirety and in its details, at costs not excessively above the usual"*. It is a modern design using traditional construction materials & methods. The mechanical systems:- heating, cooling, ventilation, water treatment, rainwater harvesting, air quality etc were designed to be small scale and integrated. Care was also taken in the material specification.

It is of heavyweight construction, with thick walls & clay block floors, to reduce peak temperatures. A glasshouse encloses the south face and captures passive solar energy whilst also providing a bright circulation space. The site is next to a busy railway station and so the sunspace also provides a useful buffer for noise. The windows are designed to reject peak solar energy. The existence of an integral printing works provided the opportunity to collect waste heat and this is used to heat the offices. Rainwater is collected from the roof of the building for use in a variety of non-potable uses including toilets and watering in the extensively planted sunspaces. The primary energy consumption is 70-80kWh/m^2/yr and mains water consumption is 25% of the benchmarked norm. Both elements save the tenants significant financial outlay.

Renewable Energy Office

for Forrest Estate and Natural Power Consultants.

The building was commissioned in the summer of 1999 by Forrest Estate and purpose built in response to the needs of the tenant Natural Power Consultants. Open plan office space capable of accommodating 20 people forms the majority of the 360 square metre internal floor area. Employees work alone or in groups on a *hot desking* basis with maximum adaptability in use. Natural Power Consultants offer development services to the international renewable energy sector with specialisms in on and off shore wind farms, as well as conference space for one off meetings for local organisations. The building is an identifiable company image for the business, which promotes renewables, for both political and business interests, and is a comfortable base for many personnel, who are often out in the field. The client's design brief required that the building's construction was consistent with the principles of the work going on in it; that their innovation with renewables was matched with the equivalent in sustainable building practice. More importantly, however they wanted a comfortable, healthy, bright and beautiful space.

The construction type is Timber frame – making use of large section Douglas fir for exposed posts and trusses. This was jointed using mortise and tenon joints but also uses steel connectors and steel wire for the tension members. This predominantly timber building is exemplary of low energy inputs during construction and use – all possible due to the utilisation of native timber. All timber used in this project - with the exception of a few pieces of Oak handrail sourced in mainland Europe, was sourced in Scotland. Three softwood and two hardwood species are used, selected for their practical characteristics. Roughly two thirds of all timber materials used came from the nearby, managed woodland, also owned by our client. Three species of softwood, Norway spruce, European larch and Douglas fir were selected from stands of trees – with the help of the very man, retired forester Robert Watson, who had implemented their establishment some 45 years previously. These trees were cut and the logs, amounting to some 120 tonnes, were converted using a wood-mizer portable mill in the estate yard. The timber seasoned over the summer of 2000 was stacked where it had been converted. A small quantity, some five cubic metres of Douglas fir, was kiln dried locally for internal fit-out purposes.

There was a desire to avoid the use of chemical treatments throughout the construction materials. Naturally durable species were therefore selected for specific elements of the building. European larch was for example used for sole plates and counter battens to the cladding. Heartwood only, Douglas fir was selected for the external cladding, soffits, barge-boards and fascia. Less durable Norway spuce was utilised for all secondary purlins, floor joists and framing. The external balcony was constructed from green Oak as this element is particularly exposed to the Dumfries and Galloway climate. Internally, the upper floor and associated finishes make use of Scottish Sycamore. The staircase was locally fabricated from Oak and Sycamore.

NMB Bank, The Netherlands

Architect: Alberts en van Huut

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are needed to see this picture.

Located south east of Amsterdam, the NMB (now ING) HQ was the largest bank in The Netherlands. This unique building (48,600m^2) consists of a series of ten towers strung together by an internal street forming an "S" shape. Along the street are conference rooms, a lecture theatre, a winter garden, restaurants & eating places.

Different coloured towers create distinct identities in each department. An integrated approach was adopted at the conception of the building project, allowing architects, engineers & landscapers to contribute their ideas. Energy efficiency was given a high priority. The building has been designed to operate without air-conditioning, and a sophisticated passive system controls all the heating, cooling and ventilation needs. Located at the top of each tower is a solar collector & a heat recovery unit. Windows are designed to provide an average 500lux, whilst excluding external traffic noise and preventing excessive heat loss & unwanted gains.

Integration of good insulation levels and careful use of passive heating and ventilation backed up by well-controlled mechanical services mean that it has an energy consumption of 96kWh/m^2 per annum, approximately 90% less energy than a typical 1970's office block. Compared to the consumption of their previous building erected ten years earlier it gives savings in fuel bills of over a £1M/year.

Rocky Mountain Institute, Colorado

Architect: AB Lovins

Situated at 2200m above sea level, outdoor temperatures during the winter can fall to -44^{o}C. Blizzards are common. 1% of the heating needs of the building are provided by two small wood burning stoves and 99% from passive solar. Conventional heating is not needed. The heavy thermal mass curved building stores heat and a large glazed south facing façade allows three-quarters of the light and half of the solar energy to enter the building and retains it.

The walls, made from two leaves of 150mm thick masonry, faced with local stone inside and out, have a U-value of 0.14W/m^{2}K. The highly insulated, earth covered roof has a U-value of 0.09W/m^{2}K. Incoming air is preheated by outgoing air through air-to-air heat exchangers. Hot water for the building is provided by a bank of solar collectors connected to a 7,000 litre superinsulated water storage tank. Low energy appliances are used throughout the building, including a purpose built superinsulated fridge and freezer and further energy savings made by the use of natural light and compact fluorescent luminaires. Thus resulting in a 90% saving in electricity. The extra cost of installing the passive and active systems in the house was repaid after 10 months, at 1984 prices, and the energy savings will pay for the house in about 40 years.

Straw-Bale Office, Dunning

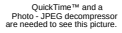
Gaia Architects

A client with an experimental nature helped this innovative project to become reality. The frame is of roundpole, the walls of straw rendered on both sides with lime plaster. The sheep wool insulated roof was covered with turf.

The building began life as a demonstration of a breathing wall for a healthy indoor environment - but discussions led to development of a more ambitious agenda. Radical innovation on a small building, with a willing client/user, was probably easier and more acceptable than it might be on a larger scale, where the users might be unknown and difficult to wrap into understanding the ongoing implications.

Arup Campus Solihull

Architect: Arup Associates



The brief called for a well-equipped, socially cohesive and productive environment for 350 staff of diverse design and engineering disciplines. The distinctive feature of the development is a brief stating that it should fully satisfy developer requirements for market acceptability i.e. be cost effective, flexible, and commercially viable. In the early stages of the design development (1998), cost benchmarking was established. A typical Midlands-based commercial office of similar scale (with air-conditioning) was identified against which the cost effectiveness of the design was to be monitored. A tender target of £89 /sq.ft was used for the alternative naturally ventilated building.

Phase 1 of the development was completed in 2001. It consists of two large, pavilions - long, single volumes with interconnections between floors to encourage social cohesiveness through visual and actual linkages. The central facilities (café, fitness room, library, and a 150-seat auditorium) link the two pavilions. The 24m deep building is naturally ventilated via roof openings with passive climate control assisted by the use of thermal mass. The option to retrofit air conditioning has been maintained by defined service areas and plant room spaces. Reliance on artificial lighting is minimized with roof day-lighting and extensive glazing in the facades. Solar gain and glare are controlled by shutters and louvers, electrically or manually operated depending on their orientation. Automatic lighting controls include daylight. Where possible, the design allows for occupant control e.g. manual operation of the windows.

The final tender was 5% over the base model but some of this was identified as due to pre-planning infrastructure for Phase 2. Differential costs of the Roof, External Cladding, and Mechanical Installation are notable with significant disparity between this design and a benchmark office, with only marginal differentiation between other elements

5 FURTHER INFORMATION

Policy Background

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Organisations

- **AECB** (Association for Environment Conscious Building) covers a wide range of expertise from architecture to specialist subcontractors. They produce a publication listing the range of services available from members. www.aecb.net
- **SEDA (Scottish Ecological Design Association)** covers primarily design concerns but does also have builders in its membership and is heavily buildings oriented. www.seda2.org
- **Centre for Alternative Technology** Fact Sheets and demonstration projects www.cat.org.uk
- **The Gaia Group** - sustainable design and on other modules in this series. www.gaiagroup.org
- ***Considerate Constructors Scheme Information Pack*** considerate.constructors@dial.pipex.co.uk
- ***Conservation Architects Scheme Information Pack*** www.rias.org.uk
- **Construction Resources** www.ecoconstruct.com
- **National Recycling Forum** www.nrf.org.uk/buy-recycled
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- Greenpeace have a website 'PVC Alternatives Database' the website explains issues about PVC. It lists PVC products and alternatives, by country or by product http://archive.greenpeace.org/~toxics/pvcdatabase/
- The Energy Saving Trust- government funded and provides a wealth of information to householders, in particular. The Trust's website is well written and useful for both the commercial sector and individual households. 0207 222 0101, www.est.org.uk
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