LONDON BOROUGH OF HOUNSLOW

PLANNING POLICY ADVICE:

SUSTAINABLE CONSTRUCTION GUIDE FOR THE DEVELOPMENT INDUSTRY

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Sustainable Construction Guide for Planning and Building

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Foreword

This guide sets out to fill a void. A void that became apparent when we asked professionals in both the public and private sector why flagship sustainable development projects such as Bedzed in Sutton and Gallions Ecopark in Thamesmead weren't being replicated throughout London on a regular basis.

With acceptance already apparent in the industry that the environmental consequences of our current practices will seriously impact upon the future quality of our lives, we asked ourselves the question, 'Why aren't large scale changes currently taking place within the construction and demolition industry to reduce the immediate and long term environmental impacts of current practice?

From informal discussions with a variety of different players, it became obvious that a major barrier to adopting more sustainable construction practice has been a lack of awareness of the products and processes on the market and a lack of understanding on where to find out more about specific elements of sustainable construction.

This guide, prepared on behalf of and funded by the London Boroughs of Barking and Dagenham, Greenwich, Lambeth, Lewisham, Haringey, Harrow, Hounslow, Merton, Bexley, Kingston and Waltham Forest, will hopefully answer the simple questions, such as, "What's the more sustainable alternative?", "How does that work?", "Where has that been done before?" and "Who can supply it?"

This guide offers practical information on many of the various components embraced in sustainable construction. It contains information on all the topics that have a key role in meeting future challenges with regards to environmental targets. This guide sets out to assist planners, architects, builders and developers of all abilities and organisational sizes with insights into approaches and technologies that can help and encourage mainstream sustainable development within the construction.

CONTENTS

SECTION 1- INTRODUCTION

About the Guide

Some of the major sustainable development challenges that confront the construction industry include issues that have global as well as local significance, such as resource depletion, protecting bio-diversity and climate change. The process and potential impacts of these are not yet well understood, but the agreement reached at Kyoto 1997 and further discussions at Johannesburg 2002 have brought a new urgency to address such issues.

This guide has been prepared in response to an acknowledged demand from development professions to have practical information about the components that have key role in meeting the challenges of sustainable construction and development. It is based on the simple concept of ensuring a better quality life for everyone, now and for generations to come. It arose from discussions that took place at the first meeting of the steering group in July 2002 and currently available information.

Sustainable development and sustainable or 'green' construction are often discussed in development circles but the definition of specific components and how they can be readily employed in construction today required a greater focus. The recent evolution of the subject has now enabled us to develop a guide that delivers this focus, explaining why these new technologies should be integral to every new development and giving London based examples that demonstrate the practical execution of sustainable construction principles.

The Guide offers clear basic explanations of the merits of the technology involved and useful information on related web sites and organisations that can offer specific guidance and services in a particular field. Practicality is the essence of the guide.

Who Should Use the Guide?

This Guide has been prepared to meet the basic needs of all those concerned with planning and building activities within the building and construction industry. The document will be of particular interest to environmental co-ordinators, developers, builders, manufacturers, housing associations, clients, planners and development officers.

How to Use the Guide

The Guide should be referred to as early as possible in the development process. When the concept of a development is first discussed the guide should be used to see which of the different elements referred to in the guide can be realistically employed in the new project to enable a reduced overall environmental impact.

CHAPTER 2 – LEGISLATION AND GUIDANCE

The Changing Environmental Tide

Sustainable construction is becoming easier and more relevant to everyday lives. There are numerous sustainable construction initiatives underway. The Housing Corporation requires new housing to be constructed in accordance with the Ecohomes 'pass' rating to qualify for grant monies, which will be raised to the EcoHomes 'good' rating in the next year or so. A Sustainable Buildings Task Group has been set up to pinpoint ways in which industry and government can work together to mainstream sustainable construction methods. EcoSe has also been set up by the Environment Agency to raise construction standards for buildings in the South-East. The Building Regulations are being amended and The Energy Performance in Buildings Directive will come into force in 2006. The GLA is soon to release an SPG on Sustainable Construction for Major Projects and the process of securing Planning Obligations is being amended.

It is becoming more and more feasible to make buildings sustainable in a cost-effective manner. Lifecycle analyses show sustainable building can be more cost-effective in the long run. This guide will show you ways in which this can happen.

The publications and legislation below reflect the growing importance attached to environmental consideration in the development process.
1999 – The UK Sustainability Strategy – **'A Better Quality of Life'** provides the Government's vision for sustainable development.
2000 – Local Government Act introduced the power to promote economic, environmental and social well being together with a duty for council's to produce a community strategy to contribute to sustainable development in the UK.
2002 – 'Foundations for our Future' defines DEFRA's Sustainable Development Strategy for the UK.
2003 – Energy White Paper and Renewables Obligation– proposing 20% renewable energy generation by 2020.

In February 2003, the Government released its **Sustainable Communities Plan**. The Plan sets out a programme of action for delivering sustainable communities in urban and rural areas. It aims to tackle housing supply issues in the South East, low demand in other parts of the country, and the quality of our public spaces. The Plan includes not just a significant increase in resources, but a new approach to how we build and what we build.

There are also numerous sources of **funding** for sustainable building and construction initiatives. Some examples of this are grants from the Government's £50 million Community Energy Programme which support projects that reduce energy bills, combat greenhouse gases and fuel poverty, the Major Photovoltaic Programme which helps householders, public buildings, community projects and commercial ventures convert to solar power and the Interreg programmes.

PLANNING POLICY GUIDANCE

The PPG's below set out the Government 's approach to taking account of sustainable development in planning. Most are currently under revision.

1 General Policy and Principles – Explanation of Sustainable Development and references to other relevant strategies.
3 Housing – References the DETR's 'Planning for Sustainable development: Towards Better Practice' (1998)
9 Nature Conservation – Consideration of biodiversity issues in development including designated sites and protected species.
10 Waste management – Planning for necessary waste facilities, Environmental Impact Assessment and site investigation.
11 Regional Planning – Energy efficient patterns of development and buildings.
12 Development Plans – Chapter 4 specifically Sustainable Development refers to resource use, environmental appraisal etc.
13 Transport – Travel Plans, alternative fuels and environmental impact assessments.
22 Renewable Energy – Explanation of sources and benefits.
23 Planning and Pollution Control – treatment and development of contaminated land.
25 Development and Flood Risk – sustainable development and the precautionary principle

The Planning and Compulsory Purchase Bill

The Government has now finalised it proposals for reform of the planning system, including planning obligations. Royal ascent is expected in Summer 2004.

For further information: **www.planning.odpm.gov.uk**

BUILDING REGULATIONS

PART L1 BUILDING REGULATIONS

In 2002 the Part L Building Regulations (Conservation of Fuel and Power) came into force for England and Wales. The amendments to the regulations were driven by the threat of climate change and a need to decrease carbon dioxide emissions – a report by the Royal Commission on Environmental Pollution says that the UK needs to decrease emissions of carbon dioxide by 60% by 2050. On an international level the UK Government has agreed to a Kyoto Protocol target of a 12.5% reduction of greenhouse gases from 1990 levels by 2012 but has gone beyond that with a voluntary target of a 20% reduction of carbon dioxide emissions by 2010. At first this target looked achievable as emissions fell in the late 90s, however most of this was due to the change from coal to gas fired powered stations. This trend has now reversed and the target is now looking harder to meet.

The Energy Policy Review published in February 2002 had a target of a 20% improvement in domestic energy efficiency by 2010. The Part L changes will improve the energy efficiency of new houses and other dwellings so that less fuel will be consumed to keep the house at a comfortable temperature. The carbon saving required from existing buildings by 2010 is 1.4 MtC (8% of the total national saving), it is estimated that 21% of this will come from new dwellings and 47% from existing dwellings, (plus 3% from air conditioned buildings and 29% from naturally ventilated non-domestic buildings).

Part L, which sets out the legal requirements for the conservation of fuel and power in buildings, has been subdivided into Part L1, covering dwellings, and Part L2, covering other types of buildings.

Further information: **www.practicalhelp.org.uk**

CHAPTER 3 – SITE PREPARATION - CONTAMINATED LAND

Introduction

Our industrial heritage has left us with a legacy of contaminated land. With the Governments' aim of building some 60% of all new developments on 'brownfield' land, it is necessary to highlight the importance of appropriate decontamination techniques.

Traditional techniques for dealing with contaminated land have usually involved the removal and disposal (dig and dump) of the contaminated soil, or capping of the contaminate with an impervious layer.

Civil engineering solutions still dominate contaminated land remediation in the UK, with process-based techniques accounting for only 20-30% of the work carried out. This preference can be attributed to many factors, but perhaps the most important are the cost of traditional "dig and dump" or encapsulation 'capping', when compared to the more advanced forms of remediation. However, the major advantage of using process-based solutions is the removal of risks and the associated liability. The cost difference between these two types of disposal has been significantly reduced as a result of the ever-increasing costs associated with landfilling. The prospect of significant legal liabilities resulting from housing developments on contaminated land are also becoming more and more an everyday reality.

In 1999, the Environment Agency carried out a survey of local authorities and large companies to identify what remedial treatments were being used. 94% were using civil engineering techniques, 16% of sites employed processes and 5% used ex-situ remedial methods.

The disadvantage 'traditional' civil engineering techniques have over other techniques is that they usually transfer the problem to another location or delay dealing with the problem for a varying length of time. Occasionally due to the level or type of contamination there is no choice but to remove the contaminate but often the selection of these 'traditional techniques' is the result of time pressures or simply a lack of consideration or understanding of other treatments available

It is now more important than ever before to purse the use of new technologies to provide high value, environmentally progressive, solutions to contamination problems. The following offers an insight into some of these evolving but proven techniques.

Bioremediation treats the contamination in situ, obviating the need to excavate and remove large quantities of materials. The technique is based around introducing microbes the soil that literately eats the contamination over a period of months. It is particularly successful in the treatment of hydrocarbon contamination often found on redundant garage and car breakers sites.

In most cases, bioremediation is not the single answer to a contamination problem, but should be considered as part of an overall reclamation strategy. Bioremediation is very effective in permeable, sandy soils or gravels. It is less effective in heavy clays where it is difficult to break

down the soil structure to one amenable to oxygen transfer and biodegradation activity. Bioremediation needs to be considered as an option as early as possible in the development of a remediation scheme.

Bioventing – this can be used to biodegrade contaminants above the water table, in the unsaturated zone. Extra oxygen is supplied through one or more monitoring wells fitted with perforated pipes, to improve conditions for degradation. Contaminant vapours are removed through peripheral boreholes, which promote airflow through the contaminated soil. Nutrients can be added to improve degradation.

Biosparging – this is effective in the saturated zone below the watertable. Air is injected into the saturated zone through boreholes finished with screened wells. It then forms small bubbles in the groundwater, encouraging the dissolution of oxygen and the movement of air towards the surface. As the air rises, it picks up the volatile compounds in the groundwater and transfers them to the unsaturated zone.

Injection and recovery (pump and treat) – this effectively creates the conditions of a bioreactor in the treated medium. Contaminated groundwater is pumped to a treatment tank on the surface where nutrients and oxygen, along with other treatment substances like sulphate and nitrate are added. The partially treated groundwater is pumped back into the contamination zone, where it stimulates microbial activity. (Source : Environment Business Magazine (June 2002))

Legislation and Regulation

Part IIA of the Environmental Protection Act (EPA) sets up a regime for the identification of land that is posing unacceptable risks to health or the environment, and for securing remediation where such risks cannot be controlled by other means.

Additional Information and References on Remediation of Contaminated Land:

www.environment-agency.gov.uk

CHAPTER 4 – CONSTRUCTION AND DEMOLITION WASTE RECYCLING

Introduction

Construction and Demolition (C&D) debris consists of the waste generated during construction, renovation, and demolition works. It covers a wide array of materials including concrete, steel, brick, gypsum and timber. C&D debris is a large and complex waste stream. Reducing C&D debris conserves landfill space, reduces the environmental impact of producing new materials, and can reduce overall building project expenses through avoided purchase and disposal costs.

Waste arising from construction and demolition constitutes one of the largest waste streams within the EU. The estimates for the UK are 30m tonnes/yr and just over 500 kg/person/yr respectively, putting the UK in second place behind Germany. A large proportion of this potentially useful material is disposed of as landfill.

Current UK Scene and Using Recycled Aggregates

In 1995 the Government White Paper "Making Waste Work" pointed out that some 70 million tonnes of construction waste, including clay and sub-soil, were generated annually. The aim should be to minimise the waste generated and maximise the quantities of material reused and recycled. The White Paper included targets for increasing the use of waste and recycled materials as aggregates from around 30 to 55 million tonnes per year by 2006. Current estimates of recycled construction waste are between 12-15 million tonnes per year, mainly in low-grade applications such as hardcore and landscaping fill. Making more effective use of materials through reclamation and higher grade recycling would have a valuable impact on the total use of construction resources such as aggregates. It would also save energy and reduce pressures on landfill sites.

By 2012, if the UK's demand for aggregates increases by an expected 1% per cent per annum, an extra 20 million tonnes of aggregates will be needed each year. This additional demand can be satisfied by extracting further primary aggregates, or we can follow a more sustainable route and continue to increase our use of recycled and secondary aggregates. Scope for obtaining additional supplies already exists in construction, demolition and excavation wastes that are currently landfilled, and through better use of secondary resources. The suitability of using recycled and secondary aggregates for a wide range of applications has been well documented.

For further details see various websites at the end of this section.

Construction and Demolition Waste Recycling

London Remade

'London Remade' is a strategic partnership between the business sector, London boroughs and regional government, waste management companies and the not for profit sector. Its principle objective is to develop and promote new markets and secondary industries based on the reprocessing and reuse of London's recycled materials. The programme is supported by Single Regeneration Budget funding from the London Development Agency whose Economic Development Strategy for London acknowledges the role organisations like London Remade have to play delivering sustainable economic growth. The programme operates across London although the inward investment programme is particularly focused on the Thames Gateway region and the promotion of river transport.

London Remade is active in establishing a range of support services geared specifically to the recycling, reprocessing and manufacturing sectors. This includes the processing of construction and demolition waste for reuse in value-added outlets, such as concrete production. Plus the use of recycled glass in producing sharp sand and aggregate.

Potential applications

Recycled aggregates can be used in a range of value-added applications. These include: (i) concrete aggregate, (ii) in paved roads as aggregate base, aggregate sub-base, and shoulders, (iii) in gravel roads as surfacing, (iv) as base for building foundations, (v) as fill for utility trenches and so on.

The case studies, supported by the technical notes available on the AggRegain (the sustainable aggregates information from WRAP) website, clearly demonstrate that recycled and secondary aggregates are fit for purpose. They also demonstrate the cost benefits achieved where these aggregates were cheaper to source than primary aggregates, where costs savings were generated as a result of lower disposal costs of site generated wastes and where a reduction in transportation costs was achieved.

Additional Information and References on Recycled Aggregates and Building Construction:
www.aggregain.org.uk
www.wrap.org.uk
www.kingston.ac.uk
www.daygroup.co.uk
www.bre.co.uk
www.londonremade.com

CHAPTER 5 – WATER CONSERVATION AND SUSTAINABLE URBAN DRAINAGE SYSTEMS

Introduction

From 1999 to 2021 it is predicted that 3.8 million new homes will be required to meet housing demand in England. Such growth will dramatically increase the demand for water. To minimise the impact on scarce water resources and alleviate the environmental problems of flooding and pollution associated with traditional urban drainage systems, it is important to take greater control of water use and disposal and to implement sustainable water conservation and drainage systems.

Water Conservation Measures

Every day a person uses on average 150 litres of water, of this 50 litres is for WC flushing, representing 35% of all household consumption. The following measures can drastically reduce the amount of water we consume:

- The installation of low flow appliances such as supply restrictor valves, low flow showerheads, spray taps and dual flush toilets. There now exists complete washroom control systems for the non-domestic market that regulate water supply, lighting and ventilation, supplying services on demand.

  Advantages include: minimal additional build and installation costs, up to 40% reduction in water usage for user, additional selling point for developer.

- Directing all roof run-off via water butts.
  Advantages include: minimal additional build cost, reduced 'peak-flow' surface water run-off and ready supply of water for irrigation purposes.

- Grey water recycling through reusing the water used in washing for toilet flushing.
  Advantages include: significantly reduced water consumption and additional selling point for developer.

SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)

SuDS is a wholistic approach to managing surface water runoff which ensures that its absorption into the ground is as close as possible to the point where it falls. SuDS are being promoted by many organisations (including the Environment Agency and Scottish Environment Protection Agency) and through government guidance (e.g. PPG25 Development and Flood Risk and Building Regs ptH) to encourage their widespread use as an alternative to traditional piped drainage systems and as a means of reducing flooding, reducing pollution, conserving resources and creating habitat.

SuDS are a flexible series of options that allow a designer to select those that best suit the circumstances of a particular development. It is essential that these issues are considered at the earliest point of the design stage. A basic summary of the main components and their advantages over traditional drainage systems are as follows:

- The use of permeable hard and soft surfaces, such as block and sand, gravel and grasscrete to reduce runoff.
  Advantages: reduced peak flows to watercourses, filtration of pollutants, reduced need for deep drainage excavations, tailored so that construction costs suit the proposed usage and design life and costs are comparable to, or lower than, conventional surfacing and drainage solutions

- Installing Green or Brown Roofs comprising growing medium plus grasses, Sedums etc
  Advantages: regulates and reduces water run-off, improved aesthetics, improved insulation values, reduced particulate pollution, improved biodiversity, minimal maintenance, up to 25 year guarantee.

- Infiltration trenches and basins – excavations that have been back-filled with stone to create underground reservoirs that gradually infiltrate into the subsoil
  Advantages: costs are comparable to or lower than traditional piped systems, pollution filtration and replenishment of groundwater supplies

- Retention ponds - where large non-permeable hard surfaces are unavoidable, such as substantial road provision.
  Advantages: – Acts as buffer at peak flow times and can offer wetland habitat creation opportunities and recreational facility.

Further Information and References

Sustainable Urban Drainage Systems, 'Conserving Water in Buildings (Fact Sheets)', 'Enhancing the Environment: 20 Case Studies in London'– The Environment Agency – General Info. Tel. 0845 933 3111 – www.environment-agency.gov.uk

Construction Industry Research and Information Assoc. (CIRIA) – www.ciria.org.uk, Tel.020 7222 8891

CHAPTER 6 – BUILDING TECHNIQUES – PREFABRICATION

Introduction

The arguments in favour of off-site construction have been well known for many years. Quality, health and safety and control handling and storage of materials are obvious advantages but other benefits include greater opportunity for designers to exercise their skills and enormous potential for reducing waste from surplus and damaged materials and a reduced impact on the surrounding environment and residence due to a reduced time on site.

The term off-site construction (or manufacturing) covers a wide range of products and solutions. That range from individual building components to entire-factory built structures and building modules.

One of the most popular off-site construction solutions is timber framing, which is used for houses and apartments up to five storeys high and accounts for about of 13% of homes built in the UK. Light gauge steel frames compete in the same market complemented by numerous pre-cast concrete systems.

Also in regular use are modular elements- such as fully fitted bathroom or kitchen pods – used in conjunction with traditional construction or timber and steel frames as well as concrete systems. Hotels were the first market to embrace these elements wholeheartedly, but they are now also frequently incorporated into apartment buildings.

Off-site manufacture has also seen the emergence of numerous factory-made cladding solutions using everything from traditional bricks to modern composites.

The ultimate example of off-site manufacture is fully volumetric construction, in which buildings are created by fixing together a series of room or apartment modules that have been built, fitted out and finished in a factory environment. Again, the hotel and leisure sector was the first to adopt this technique, but it is equally popular for schools and hospitals and has recently been adopted for the construction of affordable housing, such as the Peabody Trust's critically acclaimed Murray Grove development in east London.

CHAPTER 7 – SUSTAINABLE BUILDING MATERIALS

Background

Building materials, design and construction techniques, and building operations and maintenance all have considerable environmental impacts that can be minimised. Sustainable building merges sound, environmentally responsible, practices to look at the environmental, economic and social effect of a built project as a whole.

The entire life cycle of the built environment, including planning, design, construction and maintenance, and demolition, requires detailed examination. **Life Cycle Assessment** examines the total environmental impact of a product through every step of its life -- from obtaining raw materials (e.g. through mining or logging) all the way through manufacture, retail, use, and disposal. Disposal options include incineration, landfill, or recycling.

Careful building design and materials selection can substantially reduce these impacts. Some strategies, such as using renewable and embodied energy in buildings, can improved degraded environments and increase the comfort and productivity of building occupants. Some materials should be avoided altogether such as the use of peat and limestone, which can have significant impacts on important landscapes and habitats.

The Government is targeting a 20% reduction in UK emissions of greenhouse gases below 1990 levels by 2010. This is expected to be achieved through a number of measures, including the promotion of energy efficiency in buildings. In this context, the Government has identified the importance of using materials more efficiently to reduce overall energy demand, stating that `about 10% of national energy consumption is used in the production and transport of construction products and materials-embodied energy`.

EMBODIED ENERGY

Embodied energy is the energy needed for extracting raw materials, manufacture, transport, construction, maintenance and repair. The total amount of energy needed can be high, typically accounting for 20% of the building's energy use during a 50-year life cycled, the equivalent of 10 to 20 times the annual energy use. Reducing embodied energy can reduce the overall environmental burden of a building, and provide pointers to reducing capital cost. The range of published figures on embodied energy of commonly used building materials is listed in the table below (Source: Building Research Establishment- UK, 1994).

BUILDING MATERIAL	DENSITY	LOW VALUE		HIGH VALUE	
	Kg/m^3	GJ/tonne	GJ/m^3	GJ/tonne	GJ/m^3
Natural Aggregates	1500	0.030	0.05	0.12	0.93
Cement	1500	4.3	6.5	7.8	11.7
Bricks	~1700	1.0	1.7	9.4	16.0
Timber(prepared softwood)	~500	0.52	0.26	7.1	3.6
Glass	2600	13.0	34.0	31.0	81.0
Steel (sections)	7800	24.0	190.0	59.0	460.0
Plaster	~1200	1.1	1.3	6.7	8.0

In summary, for best practice:

- Keep embodied energy down but without compromising efficiency in use or overall environmental impact.
- Minimise energy in use through high standards of insulation and any other practical means.
- Specify the use of recycled materials, wherever it is technically and economically possible.
- Purchase locally produced materials to minimise transport energy incurred.
- Restrict using systems with high maintenance requirements of which need frequent replacement.
- Minimise embodied energy costs by including features from the outset rather than retrofitting at a later date.

SUSTAINABLE TIMBER

Much timber produced internationally involves the use of unsustainable practices resulting in deforestation, the loss of wildlife habitat, pollution and in some countries changes to socio-economic structures.

Forest Stewardship Council

The Forest Stewardship Council (FSC) is an independent, non-profit, non-governmental umbrella organisation which provides the public with reliable information on forest products. It has gained the support of major companies, NGO's and governments around the world. Qualified and independent certifiers operate using clear guidelines and agreed standards with regard to forest operations and grant labels certifying that timber has been produced from well managed forests. The FSC established 10 global principles and criteria regarding the procurement of forest products from certified well-managed forests.

The FSC use accredited auditors to ensure monitoring and compliance, while retaining overall management of the scheme. The forestry market has undergone considerable transformation and now it is becoming increasingly difficult to sell non-FSC timber in the UK. Current figures suggest that approximately 40% of forest and 60% of timber harvested in the UK is FSC certified.

Forthcoming Forestry Centre

The Government has recently announced it is to establish a Central Point of Expertise on forestry and sustainability in the UK in 2004. The Centre will operate at arms length from Government and be answerable to a management board. It will research existing forest certification schemes, provide guidance on where to find sustainable and legal timber and set standards for purchases of timber and products made from wood.

CHAPTER 8 - ENERGY EFFICIENT BUILDING DESIGN

Introduction

The vast majority of energy we use is derived from the burning of fossil fuels that are not only a fast diminishing finite resource but whose emissions contribute to air pollution on a local scale and climate change on a global scale. In order to address this and meet the commitments of the Kyoto agreement, the Government's Energy White Paper published on 24th February 2003 sets targets for reducing carbon dioxide by 60% by 2050. For the first time, increasing the energy efficiency of buildings has been identified as the cheapest, cleanest and safest way of achieving the government's policy objectives.

An energy efficient dwelling is passive solar by design, and minimises household energy needs for services such as lighting, hot water, space heating in winter and cooling in summer. Passive solar design principles combine and balance the effects of building and window design, orientation and shading, insulation, thermal mass and finally ventilation, to create naturally comfortable thermal interiors to create homes that are warm in winter and cool in summer.

Solar Orientation – making the most of the sun

Buildings should be designed specifically for their site. Designs should clearly demonstrate that consideration has been given to solar orientation. In a house the living zones (lounge, dining room and, conservatory) are generally the most heavily used, and are therefore located on southern side for maximum thermal benefit. Bedrooms have different thermal comfort requirements and can be located on the northern or western side of a house as can service areas such as the bathroom, kitchen, laundry and garage.

Thermal mass

The term 'thermal mass' describes the building materials ability to store thermal energy. Using materials with high thermal mass in the floor or walls of a building enables those elements in the structure to:

- absorb heat from the sun during the winter day, and release that heat back into the living spaces at night or during cooler periods, producing more comfortable even temperatures.
- absorb heat from the building during hot summer days having been cooled down via natural ventilation during the previous cooler evening, i.e., provide 'natural air conditioning' producing more comfortable, even temperatures.

Shading

Shading elements such as eaves or awnings should be designed relative to the aspect of the windows requiring shade, considering the seasonal variations in the angle of the sun for each location and access to views.

Windows and ventilation
Generally, windows need to be designed to provide access to sun in winter, but be shaded from direct sun during summer. Windows let in light, heat and air, and provide access to views. In terms of an energy balance, the critical variables are windows' orientation, shading and size, and the area of glass relative to both the floor area and solid wall area.

Heating
Heating our homes, including the heating of hot water, accounts for the vast majority of energy that is used domestically and represents one of the greatest wastes of energy. Outdated, oversized and inefficient systems do not make the greatest use of energy delivered to them. In considering replacing a heating system there are a number of steps and issues that should be first considered.

Insulation - Lofts and cavity walls. This should be done before putting in a new heating system. A well insulated home will need a smaller heating system. This will mean smaller fuel bills. Consideration should be given to the new range of sustainable insulation materials now on the market including recycled newspaper and sheep's wool.

Heating appliances are not the only sources of heat within our homes. Other sources are lights, cookers, refrigerators, hot water and appliances. If a home is well insulated all this heat can be conserved and these additional sources then begin to provide a larger contribution to heating.

Boilers
Making the right choice of boiler will make a big difference in terms of environmental impact and money saved. If a boiler is 15 years old or more, replacing it with a new condensing boiler or micro CHP with appropriate heat output for your property size will save around a third on heating bills immediately.

Today's boilers not only look better than their predecessors, but they use less fuel to produce the same amount of heat. Replacing a 15 year-old boiler could save over 20% on fuel bills, around 32% if installing a condensing boiler, and up to 40% if installing the right heating controls.

Ventilators
Passive cooling technology can be used in new buildings to minimise the need for air conditioning.

Further Information
www.ecoconstruct.com
www.thegreenshop.co.uk
www.greenbuildingstore.co.uk

CHAPTER 9 – RENEWABLE ENERGY AND COMBINED HEAT AND POWER SYSTEMS

Introduction

Renewable energy refers to energy resources that occur naturally and repeatedly in the environmental and can be harnessed for human benefit. Renewable energy sources include solar, wind, hydro, geothermal, tidal and wave energy, and biofuels. These can provide electricity, mechanical power, heat and/ or fuel. Almost any new or existing building can be equipped to draw power from renewable sources using one or more of several emerging technologies that may include:

- **Solar thermal collectors;**
- **Photovoltaic generators;**
- **Wind turbines;**
- **Biofuel consuming equipment;**
- **Geothermal plant**
- **Landfill Gas**
- **Sludge Digestion Gas**

The main advantage of using renewable energy is its contribution to limiting the emissions of greenhouse gases (the gases that cause global warming). The main greenhouse gas is carbon dioxide (CO2), produced principally from the burning of fossil fuels. At present power generation accounts for around one third of CO2 emissions. Some renewable energy sources (e.g. solar, wind and tidal) produce no CO2 or gaseous emissions at all. Others, such as the combustion of naturally arising waste materials or energy crops (e.g. fuel from coppiced woodland), emit CO2 but, since the CO2 has recently been extracted from the atmosphere, there is no net addition to atmospheric concentrations of greenhouse gases – the carbon dioxide is simply recycled.
The Energy White Paper 2003 proposes that the UK will generate 20% of energy needs via renewables.

Application in an urban environment

Although all of the above types of renewable energy generation can theoretically be used in an urban environment the most viable application in a dense urban environment is solar, as a result of the low visual impact and minimal disturbance to neighbours. In certain industrial locations there may be opportunity to employ other renewable technologies.

Solar

1. Solar Thermal – using the sun's energy to directly heat water or oil.
Solar collectors fall into two categories, the traditional flat plate collector and the more efficient evacuated tube system (delivering hot water even in freezing conditions). You can expect a relatively small inexpensive system (£1200 per dwelling) to meet 50% of annual hot water demand.

These systems are widely used in many countries but are not particularly widespread in the UK (50,000 examples) due to a perception that the weather in the UK is not sunny enough, this not correct, the systems do not require direct sunlight and do work successfully in the UK. They are one of the most cost effective proven systems that can be installed either during construction or after completion.

2. Solar Photovoltaics – using the suns energy to generate electricity via photovoltaic panels.
Semi-conductor panels that convert light into electricity. Can be used in the home and exported to the local electricity network. They are best placed facing south at an angle of 45 degrees. Recent developments include panels specifically designed for integration into buildings, such as roof tiles, roof mounted systems, semi-transparent PV panels for atrium/conservatory roof systems and façade systems using large area panels. Integration at a construction stage improves economics as the panels replace wall claddings or roofing materials.

Grant Funding
The Department of Trade and Industry (DTI) are offering substantial grants for the installation of solar technology in order to meet the target of 5% UK energy generation from renewable by 2005 and 10% by 2010.

Over the last three years the DTI has progressed its support for the Solar industry through a three stage Photovoltaics Major Development Programme (PV MDP). The first stage involved the installation of solar to 160 new build houses, which are now being occupied; the second stage was to support to another 380 houses and large public buildings such as libraries, schools, sports centres etc and the third and most important is the announcement in May 2002 that a further £20m will be available to support future projects.

Geothermal

An undergraduate 'Global Perspective Program' has been researching the suitability of the introduction of the technology into London. At present some 400,000 of the geothermal systems exist in USA but only 150 in the UK. Initial assessment of the costing show short payback periods for the technology and running cost for householders that are lower than gas. The possibly exists for London to utilise one of the cheapest energy system in the UK.

EarthDome has started work on a live demonstration development in Merton of four Eco Flats using the geothermal and thermal mass technology.

Combined Heat Power (CHP)

A CHP plant generates heat and power simultaneously in a single process. The basic elements of a CHP plant are a combustion process driving an electrical generator, and heat recovery equipment that uses the heat generated by the combustion process. CHP typically achieves a 35% reduction in primary energy usage compared to a power stations and heat-only boilers solution. CHP can therefore offer economic and environmental savings where there is a suitably balanced demand for both heat and power.

CHP works best in mixed-use developments where there are a number of energy and heat demands throughout the day that require a consistent supply. It is often necessary to have a significant 24 hour demand (e.g. a swimming pool, or hospital) to enhance the efficiency of the process. For larger buildings with significant heat requirements (e.g. a residential development with gym and swimming pool) CHP systems can provide an economic and efficient energy source.

Micro CHP units for domestic use are relatively new and they are still undergoing commercial development. However they have the potential to offer a 28% reduction in energy use over an average new boiler and a 12% reduction over an efficient condensing boiler by utilising electricity generated within the home and potentially selling it into the supply grid.

There are financial incentives to encourage greater CHP use in the UK including exemption from the Climate Change Levy and the Carbon Trust/EST Community Energy Programme which provides grants for CHP installation.

(Source: Westminster City Council, Draft Supplementary Planning Guidance on Sustainable Buildings in Westminster (May 2002)

Further information on Renewable Energies:
www.energyprojects.co.uk

Further information on Solar Power:
www.solarcentury.co.uk
www.solartwin.com
www.solarsense.co.uk
www.sunnythings.com

For Further information on CHP's:
www.chpa.org
www.chpclub.com

www.chpqa.com

For Further information on geothermal energy:

www.geothermal-uk.com

For further info on buying renewable energy:

www.npower.com

www.foe.co.uk

CHAPTER 10 - LANDSCAPING

Introduction

The design of landscaping around a building can have a considerable effect on how that building functions and its environmental impact. For example the retention of mature deciduous trees in a landscaping scheme will result in a cooler microclimate surrounding the built structure during the summer months as a result of increased shading and transpiration. In addition to this trees also act as effective particulate filters and noise dampers as well as providing habitat for wildlife.

Materials

Materials are also an important consideration in landscaping schemes. Is the hard landscaping element of a development using sustainable, reclaimed or recycled materials. Is the surface porous to allow drainage into the sub soil (see Water Conservation Chapter)) and are the plants suited to the soil/area or will they need continual irrigation?

Biodiversity

As pressure increases on our open spaces it is vital that landscaping offers some element of habitat creation. Planting indigenous species that provide a home and food source to birds, insects and mammals is vitally important if we are to maintain and enhance wildlife in our urban areas.

Green Roofs and Brown Roofs

A 'Green' roof is a roof where the architect has substituted a contemporary roofing material such as tiles, slates or bitumen with a growing medium and vegetation on top of an impermeable membrane. A brown roof is the same concept but with broken substrate replacing the organic growing medium.

These benefits have already been recognised on the continent with Germany leading the green roof revolution by offering tax incentives to stimulate the market. In 1995, 10,000,000m² of roof space had been 'greened', by 1999 this figure had risen to 84,000,000m².

Two types of Green Roofs– Intensive and Extensive

Intensive roofs have deep soil profiles that can grow and support lawns, shrubs and trees. These are more elaborate in design, and are intended for human use and interaction. They will need to be engineered to conform to load requirements

The more realistically applicable system is the alternative, '**EXTENSIVE**' type that is based on shallower soil profile roofs that are planted with mosses and sedums. These are more often non-access roofs as compared to the 'intensive' type. Extensive greenroofs are lightweight veneer systems of thin layers of drought tolerant self-seeding vegetated roof covers using colourful sedums, grasses, mosses and meadow flowers requiring little or no irrigation, fertilisation or maintenance.

Generally, extensive greenroofs can be constructed on roofs with slopes up to 33%, and can be retrofitted onto existing structures with little, or most often, no additional structural support. The average weight of a fully saturated extensive greenroof is 17 pounds per square foot, which is comparable to the weight of gravel ballast placed on many conventional roofs. These roofs are not intended for recreation, or to accommodate the weight of people, larger shrubs nor trees. Extensive greenroofs are much less costly than intensive green roofs.

The only universal process that removes carbon dioxide from the atmosphere is photosynthesis. For this reason roof planting on a large scale could play a crucial role in the sustainable development practices of the future.

The benefits of roof planting

- **Improved rainwater management**
- **Improved building thermal performance**
- **Reduction in sound transmission**
- **Improvement in air quality**
- **Reduction in the urban heat island effect**
- **Provision of habitat for native flora and fauna**

Rainwater Management benefits

Green roofs reduce rainwater run off by a number of processes:

- storm water management
- Retention of the rainwater in substrate and drainage layers.
- Uptake and release of water from the substrate by the plant
- Layer through transpiration.
- Solar and wind driven evaporation of water from the substrate.

Air quality and Pollution Control benefits

- As well as removing atmospheric carbon dioxide and releasing oxygen, plants and substrate can absorb a range of pollutants including nitrogen, phosphorus and heavy metals such as cadmium, copper, lead and zinc.
- Plants and substrate release water vapour so humidifying the air.

- Airborne particulate pollutants are deposited in the substrate, on the leaf surfaces of the plant layer, and onto the moist internal surfaces of the leaf.
- Air borne heavy metals are absorbed onto plant and substrate surfaces.
- A range of organic volatiles including formaldehyde, xylene, toluene and benzene are removed from the atmosphere.
- Large-scale roof planting will reduce the 'urban heat island effect' and improve the flow of cool fresh air into the city.

Improved building thermal performance

Planted roof systems are widely acknowledged to offer both winter insulation and summer cooling. Planting the roof surface dramatically reduces the amount of solar radiation absorbed by the roof's bare surface. It can be concluded that roof planting will result in reduced thermal gradients between the interior and the exterior of the building through out the year. Reducing this thermal gradient means that roof planting lessens the driving force for heat loss from the building's interior to the exterior when external temperatures are low and for heat gain from the exterior to the interior when external temperatures are high. Roof planting means that energy requirements by heating or air conditioning systems to maintain acceptable ambient temperatures within the building will be reduced.

Reduction in sound transmission

Adding mass to the roof structure by planting reduces sound transmission through that structure.

Provision of habitat for native flora and fauna

A green roof cannot fully replace a ground-based habitat for the complexity and diversity of species supported. However, some provision of natural areas for wildlife can be sustained through the use of green roofs as they provide an undisturbed, predator free environment. They should be viewed as complimentary to the maintenance of 'green' corridors for flora and fauna within an urban setting. For certain species, green roofs could provide habitat stepping-stones in the city environment where any protected habitat is becoming increasingly island-like in nature.

Additional Information and references on Green Roofs;

www.erisco-bauder.co.uk/erisco.htm
www.greenroofs.co.uk
www.blackredstarts.org.uk/pages/greenroof.html

CHAPTER 11 – MEASURING SUSTAINABILITY IN CONSTRUCTION

There are several systems which measure offer to measure sustainability. One of the more recognised methodologies has been developed by the Buildings Research Establishment (BRE). Its system of appraisal is referred to as BREEAM (BRE Environmental Assessment Method).

BREEAM assesses the performance of buildings in a number of areas, as briefly outline below.

Management: overall management policy, Commissioning site management and procedural issues.

Pollution: air and water pollution issues.

Materials: environmental implication of building materials, including life-cycle impacts

Energy use: operational energy and carbon dioxide (CO_2) issues.

Transport: transport-related CO2 and location-related factors

Ecology: ecological value conservation and enhancement of the site

Health and well-being: indoor and external issues affecting health and well-being.

Land use: greenfield and brownfield sites.

Since its launch in 1990 BREEAM seems to be increasingly accepted in the construction and property sectors within the UK, offering best practice in environment design and management. For further information. www.bre.co.uk

In order to achieve maximum successes, sustainability indictor and measurements should be considered during design and construction stages of any building engineering project.

It is widely accepted and recognised that assessment tools/ techniques should be used by all parties involved in building construction, including client/ users, planners and developers, so that sustainability can be assessed quickly and easily.

The UK government is currently considering a number of key performance indicators which may include:

- Energy and greenhouse gases - CO_2 per unit area of the building stock
- Resources - primary aggregate per unit of construction value
- Waste and recycling - construction waste going to landfill per unit of construction value
- Land-use - Proportion of development on brown-field sites

SUSTAINABILITY CHECKLIST

After referring to this guide, how many of the design recommendations and considerations can be included and implemented within the proposed development you are involved with?

Use the table below to assess how environmentally sustainable your development

CHAPTER REFERENCE	EXCELLENT	GOOD	AVERAGE	POOR
3. Decontamination Method	On site Bio technology		Capping	Removal from site
4. Aggregate use	Re-use on site demolition waste	Re-use of imported recycled aggregate		Use imported virgin material
5. Water Conservation	Conservation, recycling and SuDS	Two examples of three to the left	One example of three to the left	No examples
6. Prefabrication	Substantial componentry	At least one component		No examples
7. Sustainable Building Materials	Low embodied energy and high thermal performance	Low embodied energy and average thermal performance	Average or high embodied energy and average thermal performance	High embodied energy and average or low thermal performance
8. Energy Efficient Design	Attention to solar orientation, above average insulation and low energy appliances	Attention to two out of three factors to left	Attention to one factor	None
9. Renewable Energy	Renewable energy technology employed	Combined Heat and Power employed		neither
10. Landscaping	Brown installed or Green Roof installed and planted with indigenous species	Green roof installed and planted with non indigenous species	Indigenous landscaping suited to climate and location	Non indigenous planting for aesthetic reasons only

CONCLUSIONS

The case studies in the guide have shown that the sustainable construction and retrofitting of buildings is achievable and worthwhile. It is achievable. The evidence of this is in this guide. It requires is for you to take the initiative and be ambitious.

An important part of sustainable construction is the careful planning of the development. More front-loading is required for sustainability to work well. The end result is more marketable and more cost-efficient.

As someone once said, 'If the earth was an apartment, we wouldn't be getting our bond back'.

Further information on Environmental Sustainability
www.sustainable-development.gov.uk

APPENDIX 1 - CASE STUDIES

ORMISTON WIRE LTD. ISLEWORTH, MIDDLESEX

The wire manufacturers, Ormiston Wire Ltd, are situated within the London Borough of Hounslow. Although it is a relatively small company, size has not prevented the company adopting sustainable business practices. On the 17th February 2003, Ormiston Wire was awarded the Queen's Award for Enterprise sustainable development category, for their commitment to recycling and the environment.

Renewable energy generation:

- The solar and wind scheme generate 'Green' electricity. This energy will be used to power the factory and any surplus will be sold back to Ecotricity, the electricity supplier.
- 120 solar photo-voltaic panels have been installed to produce an annual Energy Prediction of 7589 kWh / Year.
- The WT2500 2.5kW wind turbine produces electricity and knocks units off the electricity bill.

Energy saving methods:

- Light bulbs with motion sensors that turn lights off when no one is around and plastic skylights were installed to reduce the need for artificial light. The company therefore avoids the Climate Change levy because it sources its power from a company that provides renewable energy.
- Water is heated by a high-efficiency condensing gas boiler that provides hot water for radiators and hand washing, while push-taps in the bathrooms prevent water and energy from being wasted.
- During the winter, shutting the heating system down at 4pm rather than 5pm reduces gas use while still keeping the staff warm. Having few doors at the site ensures minimal heat loss.

GREENWICH PENINSULA

The Greenwich Peninsula site covered approximately 296 Acres and contained heavy Gasworks waste contamination, including a 30m diameter, 8m circular tar tank which had been capped off temporarily whilst still full. BTEX, cyanide and PAH contamination was also present.

The landowner – Port Greenwich Ltd (British Gas) – undertook the primary statutory remediation of the site to clear target contaminants that could pollute third party land and aquifers. Subsequent remediation was undertaken under the English Partnerships contracts.

Off site disposal was minimised by employing the following methods:

- Soil Vapour Extraction processes;
- Gravel washing;
- Soil Washing; and
- Dry processing.

The remediation, servicing and landscaping works formed the foundation of the site's regeneration and concentrated on protecting the existing environment, including preventing contaminants entering the Thames, and ensuring the safety of future developments.

GALLIONS HOUSING ECO-PARK, THAMESMEAD

Gallions Ecopark is a development of 39 environmentally sustainable affordable homes for rent, and eight flats for sale. They are situated in the Gallions Reach Urban Village, on the southern banks of the Thames in the London Borough of Greenwich.

The goals of Gallions Ecopark are to:

- Develop in Britain the latest European thinking on environmental sustainability.
- Concentrate on practical details of sustainable construction and design, which can be replicated in future housing developments.
- Provide the opportunity to see the selected environmentally sustainable products in a unique Naked House and Visitors' Centre.

These homes are not an expensive one off showpiece for cutting edge technology that has little relevance to social housing. The aim is to build practical, sustainable homes on a realistic budget.

There are five different house types in the scheme. Information will be gathered about what the homes are like to live in, how much they cost to run and how expensive they have been to build in comparison with each other. Ecopark is an experiment to guide us to the best combination of sustainable features for future developments.

The five house types incorporate different combinations of technologies to reduce the consumption of energy. These features include:

- Sunrooms
- Solar collectors for pre-heating domestic water
- Wind pressure controlled natural ventilation air supply
- Under floor heating
- Low temperature heating and individual condensing boilers

- Grey water recycling
- Low flush toilets
- Water saving taps

All of the homes have high insulation levels for walls, roofs and ground floors, and super insulating windows.

BEDDINGTON ZERO ENERGY DEVELOPMENT (BEDZED)

BedZED, the Beddington Zero Energy Development, is an environmentally-friendly, energy-efficient mix of housing and workspace in Beddington, Sutton. BedZED was the first to incorporate up-to-the minute thinking on sustainable development into every aspect of the scheme, from the energy-efficient design to the way the houses are heated.

BedZED will only use energy from renewable sources generated on site. It is the first large-scale 'carbon neutral' community - i.e. the first not to add to the amount of carbon dioxide in the atmosphere. BedZED shows how housing can be built without degrading the environment.

Key BedZED features include:

- Building materials selected from natural, renewable or recycled sources and wherever possible brought from within a 35-mile radius of the site.
- A combined heat and power unit able to produce all the development's heat and electricity from tree waste (which would otherwise go to landfill).
- Energy-efficient design - with the houses facing south to make the most of the heat from the sun, excellent insulation and triple-glazed windows.
- A water strategy that will cut mains consumption by a third - including installing water saving appliances and utilising rain and recycled water.
- A green transport plan which aims to reduce reliance on the car by cutting the need for travel (e.g. through internet shopping links and on-site facilities) and providing alternatives to driving such as a car pool.

Recycling bins in every home.

PHOTOVOLTAIC PANELS, LADBROKE GROVE

The development near Ladbroke Grove in the London Borough of Westminster, is a £70 million high-tech urban village. The development is to be mixed use and mixed tenure and will feature a number of sustainable attributes including an ecology park and a large landscaped garden, a crèche, children's play areas, and a neighbourhood management service.

The development will also incorporate photovoltaic panels that convert solar power into energy. Peabody Trust was awarded European funding to install the panels - the development will use photovoltaic panels in a mixed use residential and commercial site which will be the largest use of photovoltaic panels in the UK and one of the largest in Europe.

The panels will replace 15000 square metres of conventional cladding materials on roofs and facades. On the sunniest days, the system will generate 200kWp, meeting all the electrical requirements of the site. It is estimated that over the course of a year the panels will generate 10% of the site's electricity.
(Source: Westminster City Council, Draft Supplementary Planning Guidance on Sustainable Buildings in Westminster (May 2002)

HORNIMAN MUSEUM, FOREST HILL

The Horniman Museum's Centre for Understanding the Environment is a modern, open-plan, glass and timber building - with a living, meadow covered roof. "Passive ventilation" is provided by the columns which run from floor to roof. As air inside the columns is heated it rises out through the roof vents and pulls cool air up from the shaded space under the floor, so no energy-consuming air conditioning is needed to cool the building in summer. In winter, the 10cm-thick layer of soil overhead keeps the building well insulated. A regular autumn mowing regime keeps the grass growing and absorbing carbon dioxide. Less electricity consumed, less greenhouse gas emissions, less contribution to climate change. And in extreme weather the roof acts like a sponge, soaking up excess rain and relieving flood pressure on local drains.

APPENDIX 2 - GREEN REGISTER OF CONSTRUCTION PROFESSIONALS

The Green Register (TGR), launched in October 2000, has rapidly expanded from a Southwark based list of architects and engineers to a nationwide network of construction professionals, tradespeople and supporting local Authorities. The ongoing success of the Green Register confirms the importance of ecologically sound construction today.

As well expanding geographically, the Green Register is also supplementing its current programme with more in depth training The Green Register is also working towards providing a hub of information on a range of subjects that will contribute towards raising the profile of sustainable building throughout all sectors and stages of development.

The aims of the Green Register are:

To raise awareness of green building issues
To provide a pre-selected list of construction professionals for those looking for ecological expertise
To provide a wide range of training events for construction professionals
To provide a resource for Construction Professionals, Local Authorities and customers to increase the use of green building practices and materials
To provide national, regional and local fora for networking between construction professionals

The Green Register is the first port of call for householders and businesses who:

Have a refurbishment or new build project and who want to consider ecologically sound building materials and systems
Want to avoid having toxic building materials in their home or office
Are trying to find an architect or engineer that has expertise in the field of ecological design
Are looking for advice on how to make the best use of renewable energy sources, such as solar panels.

There are several ways to search the Green Register

SEARCH. You can search the Green Register online at www.greenregister.org

DOWNLOAD. You can download the complete Green Register from the website, www.greenregister.org

HARD COPY. You can request a hard copy of the Green Register from info@greenregister.org or 020 7820 3159

APPENDIX 3 – GLOSSARY

BTEX Benzene, Toluene, Ethylbenzene, and Xylenes. These chemicals are volatile monoaromatic hydrocarbons commonly found together in crude petroleum and petroleum products such as gasoline.

EX-SITU off site

IN-SITU on site

Life Cycle Assessment A systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product or service system throughout its life cycle.

PAH Polycyclic Aromatic Hydrocarbons

MtC Million tonnes of Carbon

WRAP Waste and Resources Action Programme