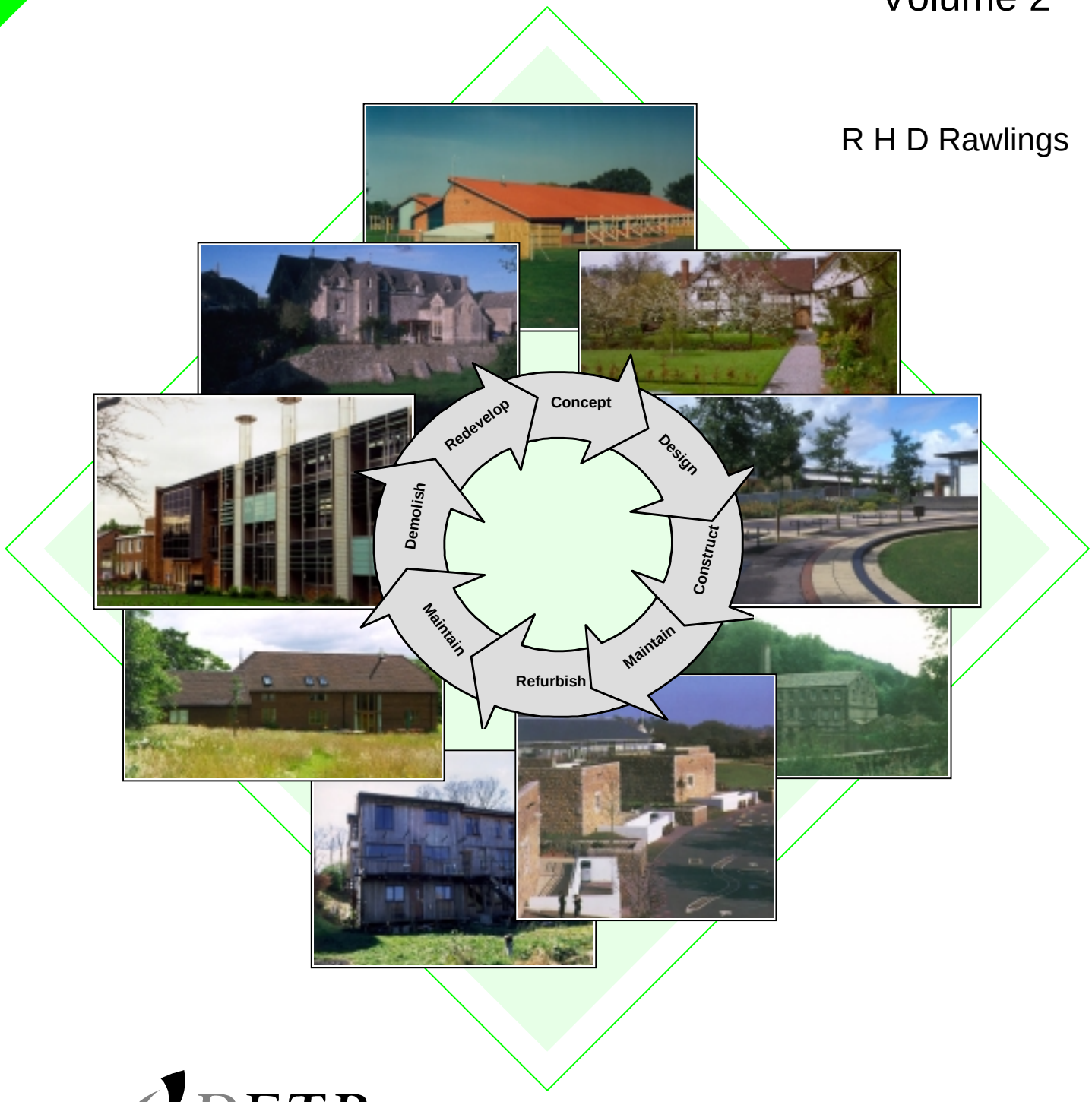
Case Studies CS 16/99

ENVIRONMENTAL CASE STUDIES

Volume 2

R H D Rawlings



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Department of the Environment, Transport and the Regions
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The research project was undertaken under the guidance of a project steering group drawn from industry representatives. The Steering Group contributors were:

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Colin Burden, Plincke Landscape
Peter Charnley, NatWest Environmental Management
Dermot Galvin, Iain Paul, and Carl Saxon, Worcestershire County Council and The Herefordshire Council
Bill Gething, Feilden Clegg Architects
Matthew Hill, Leeds Environmental Design Associates
Rod Hughes, Lowe Rae Architects
Rob Jarman & Judy Richmond, the National Trust
Keith Lodge, Ecologic Ltd
John Parker, Geoscience Ltd
Lynette Warren, University of Luton Research Centre

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Every opportunity has been taken to incorporate the views of the steering group, but final editorial control of this document rests with BSRIA.

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EXECUTIVE SUMMARY

The aim of this volume of case studies is to provide feedback from environmentally benign building projects to highlight proven cost effective and environmentally effective measures, to evaluate how good ideas in theory work in practice and to highlight the benefits and disbenefits of particular solutions. They discuss the approach taken as well as the technologies involved. In addition the case studies are used to illustrate how the strategy described in *BSRIA's Environmental Code of Practice for Buildings and their Services* can be applied and how use of this Code can assist in minimising the environmental impact of buildings.

The nine case studies cover the main stages in a building's life cycle. They include a range of building types in both the commercial and domestic sectors. Building professionals from many disciplines were involved.

There are three 'mainstream' case studies:

- The Environmental Building, BRE (Building Research Establishment)
- Weobley Primary School, Worcester County Council
- Gibson Mill, National Trust.

The Environmental Office at BRE is used to demonstrate how the procurement process for the design team can influence the design process and the potential for reuse and recycling of materials. This building was one of the first to use the "Energy Office of the Future Specification" as part of its design brief. The study of Weobley Primary School illustrates how an environmentally sensitive solution can be produced within stringent cost constraints and also features a renewable energy source. The third 'mainstream' project, Gibson Mill, is used by the National Trust to demonstrate to themselves and the public how a listed building could be totally self-supporting not only in use but throughout the renovation process.

A wide range of approaches and technologies are illustrated in the other six case studies but two highlight in particular the benefits from careful integration between a building and its landscape and several feature efficient use of water resources. For each case study the main features, benefits and the lessons learned are clearly identified.

Important factors for achieving environmentally responsible solutions which were identified include an integrated design approach, careful choice of team members, good communications, a holistic view and flexibility. The studies clearly show that environmental awareness can result in benefits at all stages of a building's life cycle.

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INTRODUCTION

This collection of case studies is one of three outputs from the fourth phase of a BSRIA research project undertaken with the support of Government and industry to produce, evaluate and update BSRIA's *Environmental Code of Practice for Buildings and their Services*. Phase I and II of this project involved drafting, piloting and publishing the first edition of the Code. Phase III involved evaluation of the Code as used in practice. It led to the production of the first volume of *Case Studies* and identified the importance of feedback to the design process. As a result a fourth phase was initiated, entitled *Feedback*, which produced three publications; a revised edition of the *Environmental Code of Practice*, *Environmental Rules of Thumb* for addressing the environmental consequences of building projects in the UK and this second volume of *Environmental Case Studies*.

This volume provides feedback from nine detailed, practical case studies. They feature cost effective and environmentally effective measures, evaluate how good ideas in theory work in practice and highlight benefits and possible problems of particular environmental solutions. They highlight the approach taken as well as technologies involved.

The case studies were selected to cover different points in the construction cycle. They include a wide range of building types in the commercial and domestic sectors. Many different building professionals were involved.

The following case studies were investigated:

Case study 1: The Environmental Building, BRE
Case study 2: Weobley Primary School
Case study 3: Jersey College for Girls
Case study 4: Tanbridge House School
Case study 5: Ebworth
Case study 6: Gibson Mill
Case study 7: Marsh Country Hotel
Case study 8: Allerton Park
Case study 9: Self-build House

Case studies 1 to 7 cover the commercial or institutional sectors whereas 8 and 9 deal with group and individual housing respectively.

Case study 1 features the well documented Environmental Office building at BRE. It concentrates on two lesser known aspects of the project: the procurement process for the design team and how this influenced the design process, and the extensive reuse and recycling of materials, especially during demolition.

Case studies 2, 3 and 4 all feature school projects. Environmental issues and sustainability are becoming increasingly prominent in education and these case studies demonstrate how school developments can be used to provide a practical demonstration of these issues. Case study 2 features energy efficiency and a sustainable energy source whereas case studies 3 and 4 consider the benefits resulting from integrating the building and landscape.

The case studies described above are all new buildings but case studies 5 and 6, which were contributed by the National Trust, cover renovation of listed buildings. They illustrate how the environmental strategy within an organisation can evolve. The knowledge learned from Ebworth about adopting an environmental approach and incorporating specific technologies encouraged the National Trust to embark on a much more ambitious project at Gibson Mill. This was to demonstrate to themselves and the public how the building could be totally self-supporting not only in use but throughout the renovation process.

The three remaining case studies are examples of how individual building owners can adopt an environmental approach. Case study 7 describes how the proprietor of a small hotel found an environmentally responsible solution to a pollution problem caused by discharge from a septic tank. The last two case studies feature self-build projects; case study 8 looks at the co-operative design of a group of 'Eco houses', whereas case study 9 is an individual dwelling where a sustainable energy source (a ground source heat pump) is being demonstrated.

For each case study the main features are listed and the benefits are identified. Features of the project are then described. Tinted boxes alongside the description contain recommendations taken from the BSRIA *Environmental Code of Practice for Buildings and their Services* (2nd Edition). The *Code of Practice* provides a strategy to assist all those involved to minimise the environmental impact of buildings over the entire building life cycle. It makes recommendations for designing best practice environmentally friendly buildings, minimising the adverse environmental impact of buildings in use, and refurbishing buildings and ultimately disposing of them in an environmentally sound way. The case studies can thus be used to illustrate how the strategy described in the *Code of Practice* can be applied and how use of the Code can assist in minimising the environmental impact of buildings. At the end of each case study the main lessons learned are summarised as "Feedback".

1 THE ENVIRONMENTAL BUILDING, BRE: INTEGRATED DESIGN AND REUSE AND RECYCLING

This case study demonstrates that an enlightened client, with an integrated and committed design team, can explore opportunities and achieve many environmental benefits which are replicable. It focuses on the initial stages of design, especially the selection of the design team and on reuse and recycling of materials, especially recovering materials during demolition.

This high profile office building at BRE was the first building to use the Energy Office of the Future(EOF) (General Information Report 30) as part of its design brief and aimed to demonstrate replicable, low energy, environmental design. The energy efficiency aspects of the project formed a major focus and have been widely reported. This case study focuses on the procurement of the design team and how this contributed to the design of this innovative building. All consultants were involved from the earliest stages and were joined by the contractor during the production information stage, adding their expertise as part of a two-stage appointment using the NEC Form of Contract. Although not explicitly written into the brief, reuse and recycling of waste materials also became on objective of the project so that, when the original building on the site was demolished, 96% of the materials were recycled or reused.

CLIENT PRIORITIES

- landmark building
- BREEAM 'excellent' rating
- replicability
- use of the EOF specification
- reuse and recycling of materials.

FEATURES

⇒ Committed client
⇒ Integrated design team
⇒ Innovative project with environmental objectives

BENEFITS

⇒ Update of the Energy Efficient Office of the Future Performance Specification
⇒ 96% of demolition materials recycled or reused

A1.1 INCEPTION
Ensure the selection of a design/project team committed to tackling energy and environmental issues and able to contribute to integrated environmental design.

The brief was set up as a loose framework for the team to develop. It simply called for office space for 100 people that should be flexible, functional and capable of providing both open plan and cellular spaces and high quality seminar facilities. The building was to be of high architectural standard and integrate an environmentally friendly approach with energy performance substantially better than current low energy office buildings. The performance specification drawn up by the Energy Efficient Office of the Future Group was included as part of the design brief. In addition, the building needed to achieve a BREEAM rating of 'excellent' and avoid the use of air conditioning.

Considerable effort was expended in selecting a project team composed of members with a track record in tackling energy and environmental issues and integrated design. The selection of the team was based on lists of criteria which included environmental issues at all stages rather than on a cost-only basis. The client appointed an outside Project Manager and invited expressions of interest from about 15 potential architect-led design teams. Six were shortlisted and invited to make full submissions, including fees, for the provision of architectural and associated services. The selection process included visits to projects with which members of the various teams had been involved, and selection criteria included leadership and the potential of the team to work together and with BRE. Those shortlisted were asked to make presentations on how they would approach the design.

The final decision was based on the track record of the teams as perceived by the client. Balance in the team was important. Another consideration was whether they were likely to produce a 'landmark' building.

A1.7 INCEPTION
Agree fees and conditions of appointment appropriate to the levels of expertise required at this stage to ensure an inter-disciplinary approach.

Bids were made on a "consortium" basis but each consultant was appointed directly and separately by BRE. The project was one of the first to use the New Engineering Contract for the appointment of the main contractor. The NEC Professional Services Contract was not available in time for the appointment of the consultants.

The two-stage tender process enabled a main contractor to be involved early. The first stage covered prelims and pre-contract work and was on a fee basis. The contractor contributed to the design team and advised on buildability issues and assisted with value engineering exercises which were considered vital to the successful integration of architecture, structure, services and specialist contractors and suppliers.

A1.6 INCEPTION
Establish robust and open lines of communication between the client or client's advocate and all members of the design/project team.

An in-house client representative was appointed. He reported to a steering group and approvals panel and attended all Design and Project meetings. The involvement of the client representative, especially at the feasibility stage of the design process, helped to identify preferred options.

A2.6 BRIEFING
Identify specialist skill requirements, suitable consultants and when to introduce them to the project. Ensure availability.

The nature of the project (a demonstration project), the Client (well informed) and the Design Team ensured that researchers and specialists were consulted in developing the design.

B1.9 FEASIBILITY
Investigate the potential for strategic fuel saving; using the energy potential of the site or the building structure and purchasing energy from a renewable source.

The issue of strategic fuel (energy) saving was addressed through the EOF Brief. Key features of the building design were the use of high thermal mass, passive environmental control to reduce the effects of temperature swings and the incorporation of natural light and natural ventilation, ground water cooling and a photovoltaic installation. The building has high performance glazing with moveable external solar shading on the south facade and an innovative ventilation strategy using cross-ventilation supplemented with ventilation stacks.

R1.1 DISMANTLING AND DISPOSAL
Define the scope of work for dismantling.

Existing workshop buildings were demolished to make way for the new office. Reuse and recycling of waste materials, while not explicitly written into the brief, became an objective and the demolition phase was used to demonstrate the practicalities of reuse and recycling. Following the appointment of the main contractor, invitations to tender for demolition were sent out specifying the need to maximise reuse and recycling. The demolition contractor was required to submit proposals for complying with environmental aspects of the project. The contract was awarded to the tenderer who offset the salvage value against demolition costs to the greatest extent. They were also the lowest.

R1.4 DISMANTLING AND DISPOSAL
Where information is not available, prepare, or arrange for, asset registers of all buildings, plant, services and materials. Where necessary carry out surveys and/or exploratory work.

An independent reclamation audit was carried out to establish the materials which could be economically recovered. Not everything highlighted in the audit could be achieved in the time available but BRE estimates that the actual percentage of materials reused/recycled was 96% by volume, (likely to be higher for weight-based). The remaining 4% was disposed of to landfill. A summary of the demolition waste management is given in Table 1.

Table 1

A summary of the demolition waste management

Material	Disposal option
Concrete	Crushed on site and used as hardcore
Bricks	Crushed on site and used as hardcore *
Roofing sheets	Reused
Roofing timber	Sold to a furniture manufacturer in Cornwall
Slate cladding	Reused
Iron and steel	Smelted and recycled
Lead and copper	Smelted and recycled
Cast iron drainpipes	Reused
Fixtures and fittings	Reused by BRE or given to charity and distributed to schools and hospitals

**Bricks could not be reclaimed because cement mortar had been used.*

R1.11 DISMANTLING AND DISPOSAL
In consultation with potential contractors, establish a programme which allows enough time to meet all environmental objectives.

The main contract allowed 2 weeks' additional time for the demolition contractor to salvage materials for reuse and recycling and for asbestos stripping. The demolition contractors were unable to store a large amount on their site, it was therefore important to have an immediate market for salvaged material.

D2.3 SCHEME DESIGN
Adopt a design which maximises the energy, water and resource potential of the site and buildings. Maximise effective use of renewable, reusable, recycled and recyclable materials and resources.

During construction of the new building, extensive use was made of reclaimed and recycled building materials. Recycled aggregates from the site were used in hardcore. Crushed concrete from a demolished office block in central London replaced all of the coarse aggregate in the in-situ concrete for the new building. Approximately 80,000 reclaimed bricks were used to clad the building. It was intended to source the bricks from a local demolition site but they were not available in time and the bricks had to be bought from a reclamation company in Cambridge. It was originally hoped that lime mortar could be used so that the bricks could be reclaimed in the future but the larger mass of brick and blockwork that would have been needed to ensure flexural strength could not be justified. Wood block flooring, salvaged from London's former County Hall, was used in part of the building.

CONCLUSIONS

The team procurement process was very detailed and took more time than is normally allocated. The client, however, felt that the integrated design process which resulted led to time being saved later in the project.

The ambitious recycling approach did not extend the construction time, a feat again attributed to the fully integrated team approach used. The project identified the need for identifying an immediate market for salvaged materials. As a result a web-based Materials Information Exchange (http://helios.bre.co.uk/waste) has been set up with support from the DETR.

FEEDBACK

⇒ As host for the Energy Efficient Office of the Future (EOF) project, the design will contribute to an update of the EOF Specification.
⇒ It was important to allow the design to evolve.
⇒ Additional time taken to procure the team led to savings later in the project.

Legislation

⇒ *Construction (Design and Management) Regulations 1994*

Guidance

⇒ *A Performance specification for the energy efficient office of the future.* General Information Report 30, DETR, London 1995
⇒ BR240 BREEAM 4/93 *An environmental assessment method for existing office buildings,* BRE, Garston 1993 (This has now been superseded by: BR350 *BREEAM 98 for offices: An environmental assessment method for office buildings,* Baldwin R, Yates A, Howard N, Rao S, 1998 ISBN 1 86081 238 4
⇒ IP 3/97 *Demonstration of reuse and recycling of materials*: *BRE environmental office*, Hobbs G, Collins R. CRC 1997 ISBN 1 86081 131 0

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