

CONFIRMED
DECEMBER 2007

Code of practice for

Energy efficiency in buildings

UDC [69 + 72.011]:620.9

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Committee (BDB/-) to Technical Committee BDB/2 upon which the following bodies were represented:

Aggregate Concrete Block Association	Department of the Environment for Northern Ireland
Association for the Conservation of Energy	Electricity Supply Industry in England and Wales
Association of Building Component Manufacturers Ltd.	Engineering Equipment and Materials Users' Association
Association of County Councils	Eurisol (UK) Association of Manufacturers of Mineral Fibre Insulation
Association of District Councils	Flat Glass Manufacturers' Association
Association of Metropolitan Authorities	Greater London Council
Autoclaved Aerated Concrete Products Association	Gypsum Products Development Association
Brick Development Association	HEVAC Association
British Board of Agrément	Incorporated Association of Architects and Surveyors
British Gas Corporation	Institution of Civil Engineers
British Precast Concrete Federation Ltd.	Institution of Gas Engineers
Building Employers' Confederation	Institution of Structural Engineers
Building Services Research and Information Association	Lighting Industry Federation Ltd.
Cement and Concrete Association	Ministry of Defence
Chartered Institute of Building	National Council of Building Materials Producers
Chartered Institution of Building Services Engineers	National House-building Council
Concrete Society	National Illumination Committee of Great Britain
Consumer Standards Advisory Committee of BSI	Royal Institute of British Architects
Cranfield Institute of Technology	Royal Institution of Chartered Surveyors
Department of Education and Science	Scottish Development Department
Department of Energy (Energy Efficiency Office)	Structural Insulation Association
Department of Health and Social Security	Timber Research and Development Association
Department of the Environment (Building Research Establishment)	Trades Union Congress
Department of the Environment (Housing and Construction Industries)	Watt Committee on Energy Ltd.
Department of the Environment (Property Services Agency)	

This British Standard, having been prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 August 1985

© BSI 10-1999

The following BSI references relate to the work on this standard:
Committee reference BDB/2
Draft for comment 82/14255 DC

ISBN 0 580 14607 3

Amendments issued since publication

Amd. No.	Date of issue	Comments
8151	February 1994	Indicated by a sideline in the margin

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
Section 1. General	
1 Scope	1
2 Definitions	1
3 Procedures	1
4 Energy requirement	1
5 Energy targets and environmental objectives	1
6 Economic considerations	2
7 Energy management	2
Section 2. Design approach	
8 General	3
9 Design methodology	3
10 Check-list and timing of decisions	3
Section 3. Economic analysis	
11 Cost in the evaluation of energy efficiency	5
12 Types of analysis	5
Section 4. Energy management	
13 Essential energy management features	7
14 Energy management programme	7
15 Owner's manual	7
16 Operating and maintenance procedures	7
17 Commissioning and testing	8
18 Monitoring	8
Appendix A Bibliography	9
Appendix B Check-list	10
Appendix C Summary of main stages in energy and environmental design	16
Figure 1 — Comparative break-even point	6
Table 1 — Bar chart showing timing of design decisions	4
Table 2 — Design check-list	10
Publications referred to	Inside back cover

Foreword

This British Standard has been prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structure Standards Committee. The standard was amended in 1994 to include recommendations for environmental objectives related to energy conservation and a summary of the main stages in energy and environmental design.

Buildings account for about half the fuel and electric power expended in the UK. Most of this is used for heating, hot water, lighting and air conditioning. The chief incentive for energy efficiency in buildings is economy, i.e. eliminating waste and thus reducing expenditure, taking into account both the capital outlay and running costs. There is also a national interest in conserving fossil fuels.

Energy efficiency can also reduce the risks of acid rain and global warming. At present carbon dioxide emissions are estimated to be responsible for about three-quarters of the effect of global warming. Half of the carbon dioxide emitted in the UK results from the use of energy in buildings. Energy efficiency can therefore make an important contribution to the quality of the environment.

The aim of this standard is to promote energy efficiency in buildings, that is, conserving energy in cost-effective ways. It seeks to provide a basis on which the designers of buildings and their clients can work to achieve this aim.

Nevertheless, energy efficiency is only one of the requirements that a building should satisfy: the functions for which it is used, its provisions for health and safety, its appearance and its overall economy have also to be taken into account. However, there are minimum standards contained in the Building Regulations regarding the conservation of fuel and power which have to be satisfied. The design team has to produce a balanced solution of which energy efficiency measures are an integral part. To achieve this it is important that the architect and building services engineer work together from an early stage in the project, and are well informed at the outset of the available energy efficiency options.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This British Standard gives recommendations for the main procedures to be followed to obtain the efficient use of energy in the design and management of buildings and to attain desirable environmental objectives. It applies to the design of new buildings and the rehabilitation of existing buildings, to the operation and maintenance of buildings, and to all types of buildings including housing.

NOTE 1 A bibliography, containing some of the more important sources of information relevant to this topic is given in Appendix A.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard, the definitions given in BS 3533 and BS 6100 apply.

3 Procedures

In order to obtain the efficient use of energy in the design and management of buildings, certain procedures should be followed. These procedures, which should be agreed between the client, his professional advisers and, where feasible, the user, are as follows:

- a) adoption of a method for estimating the energy requirement (see clause 4);
- b) establishing the energy targets for the comparison of design options (see clause 5);
- c) assessment of the cost-effectiveness of the proposed expenditures (see clause 6);
- d) taking measures for efficient energy management (see clause 7).

4 Energy requirement

The energy requirement should be established using one of the following procedures.

- a) In the case of new building or major rehabilitation work, a calculation procedure should be used which takes into account at least the following factors:
 - 1) required environmental conditions and periods of use;
 - 2) climatic conditions;
 - 3) thermal transmittance of each part of the enclosure of the building;
 - 4) thermal response of the building's main constructional elements;
 - 5) ventilation strategy and rate of air change (e.g. natural ventilation, mechanical extract, air conditioning);

- 6) lighting requirements and relationship between daylight and electric light;
- 7) effects of incidental gains (e.g. occupants, lighting, solar gain);
- 8) effects of shading;
- 9) effects of controls on the main energy-using services;
- 10) efficiency of the equipment.

The procedure should permit the calculation of the effect and interaction of these and any other factors dealt with.

b) In the case of existing buildings, demand can be established by direct measurements, e.g. by metering of energy use. The effect of any changes in use or modifications to the building should then be assessed using the calculation procedure in item a) of this clause.

5 Energy targets and environmental objectives

5.1 Energy targets

The purpose of an energy target is to provide a yardstick against which to compare the performance of design options (whether estimated performance as in the case of design studies or measured performance when managing an installation) so that judgement can be formed of the quality of performance expected or achieved. Where the energy target includes the possibility of a trade-off between different fuels, then their relative cost may need to be taken into account.

Energy targets should be established using one of the following methods.

- a) In the case of new building design or major rehabilitation work, targets for design purposes may be based upon either:
 - 1) the performance characteristic of buildings of the type being designed where this is available [for example, as in the Chartered Institution of Building Services Engineers *CIBS Building Energy Code*, Part 2 a) or EEO Best Practice Energy Consumption Guides]; or
 - 2) analysis of the estimated energy demand of buildings of the type being designed, using the calculation procedure described in clause 4.
- b) In the case of existing buildings, energy consumption targets should be based on either:
 - 1) theoretical calculations as for new buildings, as described in item a) of this clause, to determine optimum performance; or
 - 2) energy consumption records for the building being considered; or

3) statistically determined performance indicators (e.g. those found in the *CIBS Building Energy Code*, Part 4 or EEO Best Practice Energy Consumption Guides) to compare actual performance with theoretical performance.

c) Energy targets for unusual building designs should be derived by careful modelling work, underpinned where possible with results from analogous buildings.

5.2 Environmental objectives

At an early stage in design, environmental objectives should be selected with a view to limiting primary energy consumption and carbon dioxide emissions and to reducing environmental pollution. Targets for carbon dioxide emissions in kg/m² per year can be chosen by reference to the BRE Environmental Assessment Method (see A.1, item 14).

During the development of the design quantitative assessments of the likely environmental effects should be made periodically to assist decision making and to ensure it is on course to meet these targets.

5.3 Energy labels

Energy ratings for new and existing homes are available which can give an estimate of running costs and CO₂ emissions based on the Building Research Establishment's BREDEM and can provide a design tool for energy efficiency. In addition, they may provide assessments of interstitial condensation and of surface condensation risk in the dwelling under various heating regimes. To enable home energy ratings from labelling systems to be compared, the Government has developed a Standard Assessment Procedure (SAP). Details of this are given in a BRE publication (see A.1, item 23).

6 Economic considerations

Methods for assessing the cost-effectiveness of energy proposals should take account of the following:

- a) capital costs;
- b) periodic charges and their timing;
- c) value of benefits and their timing;
- d) discount rate(s);
- e) the period of time over which costs and benefits are to be considered.

The economic objective is normally either:

- 1) to achieve a required return on investment; or
- 2) to get the best return for a fixed budget; or

3) to achieve a stated standard of performance at least cost; or

4) to meet some other economically measurable criterion.

Types of economic analysis are described in section 3.

7 Energy management

The following measures should be taken for efficient energy management.

- a) Energy-using services should be arranged in zones and otherwise so that the controls can respond effectively to changes in occupancy and load.
- b) Appropriate controls should be provided to permit economic regulation of all energy-using services.
- c) Metering and sub-metering of energy supplies should be provided to assist in the management of energy use.
- d) A planned approach to energy management, as outlined in section 4, should be adopted.

Section 2. Design approach

8 General

Many decisions which affect the energy efficiency of buildings are taken at an early stage of design. Table 1 identifies some of the factors involved and shows, in relation to the stages of the Royal Institute of British Architects *RIBA Plan of Work*, how early in the design process they may become fixed. In Table 1, item 5 “site suitability” should include consideration of access by pedestrians and from public transport. Location of buildings is a major determinant of transport energy use, which is the fastest growing energy use sector in the UK.

9 Design methodology

A specific design methodology should be adopted which will identify significant factors and ensure that they are given attention at the proper stages of design. The methodology should be incorporated into the timing and into the overall pattern of design decision making, where many factors have to be balanced against each other and integrated into a single design solution.

It is possible for several different design possibilities to be explored but the economics of the design process will limit the number and the extent of the studies. Therefore, it is important to have a clear objective at the start of design. Initial design concepts inevitably precede analysis. If basic design concepts are not well-informed, then detailed design, although it may make some improvements, cannot produce the best results.

To ensure that the energy objectives have been established in the initial and detailed designs, the following procedure should be adopted.

- a) The client’s requirements should be established. It is especially important to gain a thorough understanding of the client’s needs and their energy implications at an early design stage.
- b) The calculation method to be used in estimating energy demand (see clause 4) should be established.
- c) Energy targets should be established (see clause 5).
- d) A check-list should be used to ensure that significant points are not overlooked. It may be convenient to prepare subsidiary check-lists for particular aspects of design especially as reminders during detailing.
- e) Quantitative assessments of the energy requirement should be made periodically during the development of the design to assist decision making and to ensure that the design is on course for its energy objectives.

f) Sufficient information should be included in contract documents to ensure that those using them can understand what is required [e.g. “vapour barrier (essential that it is free from holes and tears)”].

g) The estimated energy requirement and its economic implications should be reported at the presentation to the client of the scheme design and at the completion of the detailed design.

10 Check-list and timing of decisions

Check-lists help to ensure that significant points are not overlooked during the development of a project. An example of an energy design check-list is given in Appendix B. It may be desirable to prepare particular check-lists, especially for use during detailed development. Checks should be made at each stage to ensure that energy use considerations are influencing decisions suitably.

The timing of decisions is important; for example, many decisions which affect energy economy are taken at early project stages. When decisions are taken without consciously considering energy use implications, it is improbable that they will be the best possible. The bar chart in Table 1 (see also clause 8) shows typical decision timing for a new works project.