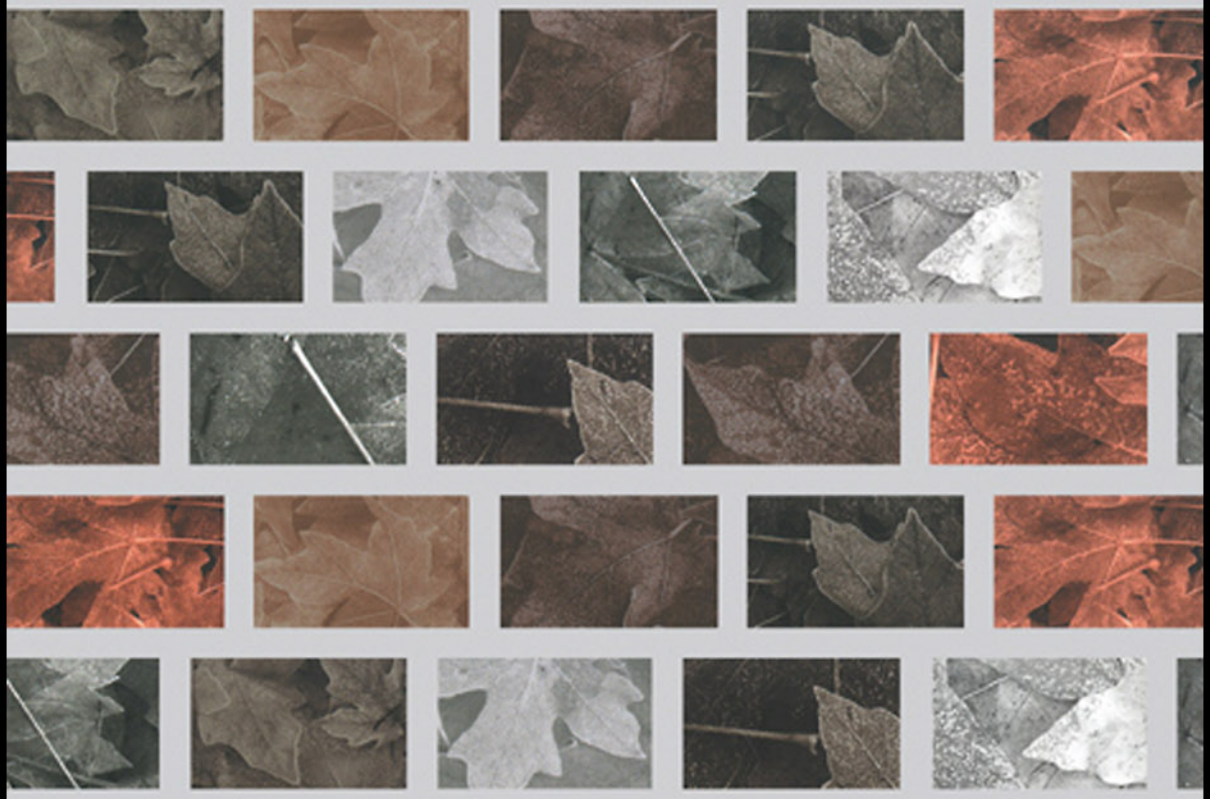
GREEN BUILDING HANDBOOK

VOLUME 2



TOM WOOLLEY AND SAM KIMMINS

Green Building **Handbook**

Green Building **Handbook**

VOLUME 2

A guide to building products and their impact on the environment

Tom Woolley and Sam Kimmins

First published 2000 by E & FN Spon

Reprinted 2002
by Spon Press
11 New Fetter Lane, London EC4P 4EE

Simultaneously published in the USA and Canada
by E & FN Spon
29 West 35th Street, New York, NY 10001

Spon Press is an imprint of the Taylor & Francis Group

This edition published in the Taylor & Francis e-Library, 2005.

"To purchase your own copy of this or any of Taylor & Francis or Routledge's collection of thousands of eBooks please go to www.eBookstore.tandf.co.uk."

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication Data
A record for this book has been requested

ISBN 0-203-30171-4 Master e-book ISBN

ISBN 0-203-34228-3 (Adobe eReader Format)
ISBN 0-419-25380-7 (Print Edition)

Publisher's note

This book has been produced from finished pages supplied on disk by the authors.

Contents

Preface

Much has happened since 1997 when Volume 1 of the Green Building Handbook was published. Interest in *Green Building* has increased substantially. Terms like sustainable construction have become commonplace and there are now numerous awards schemes and competitions for innovative and environmentally conscious designs. However much of this interest remains superficial and fashion based rather than following a genuine commitment to safeguarding the environment. A second volume based on the Issues of the Green Building Digest 13–20 inclusive is therefore needed just as much as when our project began.

Chapters 3 to 6 and chapter 8 are based on Digests researched and written by Sam Kimmins at ECRA, with chapter 2 compiled by Nicola Brooks. Chapter 9 on strawbale building was written by Tom Woolley, but based on research by several of his students. The Chapter on Ventilation was largely the work of Peter Warm, chairman of the Association of Environment Conscious Builders.

For this work to continue it must be put on a sounder footing. Wider links have also been established with initiatives for sustainable building publications in Europe and networks in the USA which will lead to a continuing and radical investigation into the impact of the construction industry on the environment and the health of building occupants. Most building materials are made by companies that are part of multi national conglomerates and thus we need to put pressure on these firms on a global basis. Environmental organisations with large memberships have now recognised the importance of green building and the credibility of the Green Building Digest and Handbook has hopefully contributed to this.

Some readers have raised queries about whether information in the digest/handbook has become out of date. It is true that some materials may change due to product innovation and the availability of new environmental impact research, However, the underlying generic principles and arguments will hold good for some time. The handbooks are intended to give busy clients, designers and specifiers as much information as possible, while presenting the overall conclusions in an ‘at-a-glance’ format. It is also possible to go into some issues in greater detail by following up the references to each chapter.

As the book has become better known, it has attracted some interest from major trade associations which have criticised some of the contents. This is an indication that such organisations are concerned about their environmental profile with specifiers but their initial reaction is generally to reject our concerns out of hand. These organisations tend to play down any negative environmental factors rather than engaging in a real discussion. Apparently they still regard us as sufficiently marginal to not be major threat to their sales, but this is likely to change as more people adopt green strategies. The construction sector is influenced by market pressures and specification fashions, so all of you can do your bit to ensure greener products are more widely used and available. Many big companies and trade association have a vast amount of data and research on the environmental impact of their products but they are not keen to make this widely known.

We have a long way to go before legislation and other pressures forces these companies to take environmental protection seriously and when they do many products and materials will disappear.

Sadly, ACTAC, the technical aid network, which started publishing the Green Building Digest as a joint venture with ECRA in 1994/95, has been wound up. Publication was then transferred to Queens University Belfast, School of Architecture as a joint project between QUB and ECRA. At the time of writing, the future direction of the Green Building Digest is under discussion. Experience of editing the Digest has shown that far more research is required and in far greater depth than has been possible so far. While the intention of *digesting* already published material is still valid, it often becomes very frustrating when it is apparent that little useful research has been done on topics of great importance. Work on the Digest so far has been a relatively low budget operation and has relied on the good will and voluntary effort of many people committed to the ideal of greener buildings.

Tom Woolley, Crossgar, September 1999

Acknowledgements

Tim Robinson, Siobhan Doolan, Polyp, Queens University Publications Fund, Queens University School of Architecture, Rob Harrison, Jane Turner, Eddie Walker, Peter Warm, Nicola Brooks, Aisling Irvine, Anna Marie Higgs, Valentijn Nouwens, Annika Nurmi, Jean Finn, the Shell Better Britain Campaign, Ronnie Wright, Steve Smith, Debbie McCann and Lynn McCann

Members of the Green Building Digest Advisory Panel who have assisted with the issues in this book:

Pam Parkinson, Christopher Day, Jonathan Hines, Rod Nelson, Sandy Halliday, Keith Hall, Sally Hall, Mark Strutt, Mark Gorgolewski, Heimir Salt, Cindy Harris and Brian Ford.

Part 1

Introduction

The Development of Sustainable Construction
1

1.1
Changing Government Policy

An important consultation document was issued by the UK Government in 1998.[1] Part of a wider consultation exercise on sustainability, it discussed some principles of sustainable construction and current practices in the industry. Following the consultation process, which brought in a relatively small number of responses, a Government strategy based on this consultation process will soon be published, though it is likely to fall well short of the standards advocated in this volume. While the government approach is hardly radical, recognition of the subject is a huge step forward and is to be greatly welcomed.

Other steps have also been taken, in particular the establishment of a scheme to provide one day's free design advice to anyone planing to build a green building over 500 square metres. The Design Advice for Greener Buildings scheme is funded by the DETR and administered by BRECSU.[2] This scheme demonstrates recognition of the importance of an holistic approach to consider all aspects of green building rather than simply focusing on energy efficiency which was previously the only area where financial help was available.

The construction industry has been under a great deal of scrutiny following the publication of the "Latham" report and more recently the "Egan" report.[3] Both these reports recognise the inefficiency of the construction sector and the need to be more competitive and better managed. It is only in this economic sense that sustainability is usually referred to and the debate about the nature of building construction in the future largely ignores questions of environmental impact. Indeed the word sustainability only appears once, in the Egan report (paragraph 58) with a call for greater priority to be given in the design and planning stage to *"flexibility of use, operating and maintenance costs and sustainability."*

While the UK lags behind, in some European countries, much higher standards and working practices have been adopted. These include the careful separation of waste on site into separate skips so that it is then recycled, the greater use of recycled materials in place of newly quarried aggregates and the elimination of many toxic and non environmentally friendly materials to improve building worker safety and improve indoor air quality. Most of these measures are covered by European directives and then enforced in particular countries by building or local regulations.[4]

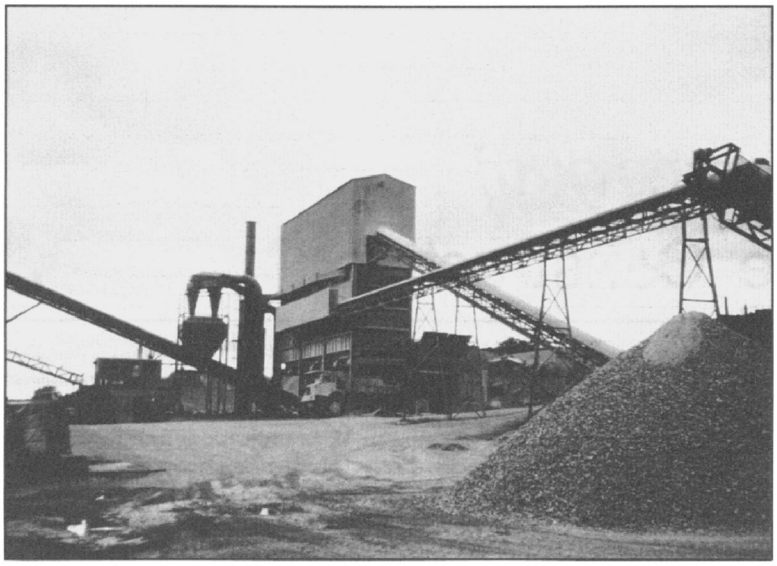


Fig 1: Conventional construction materials consume vast quantities of energy and raw materials, and pollute the environment.

Photo: Clare McCaughey

1.1.1
Demand for green materials?

At present most of these sustainability measures are barely on the agenda of the building regulation formulation process in the UK and there are strong industry lobbies to maintain the status quo for as long as possible. Many environmentally friendly products are now available in Europe, but few of them are sold in bulk in the UK. This is surprising in that many producers and distributors of building materials and products are multi national companies. Akzo Nobel, the Swedish company (of Nobel peace prize fame) for instance own many of the paint companies in the UK and are in the process of marketing these products under the name Akzo Nobel but it isn't clear whether we can look forward to the introduction of Sweden's higher environmental standards into the UK paint industry[5]

One argument that is used by building companies, designers and suppliers in the UK is that clients are not interested in eco products and so market forces continue to dictate that we continue to use materials that are not so environmentally friendly as they could be. There is some evidence of this in that when "Construction Resources" was set up in Southwark in London, the UK's first eco builders merchants,[6] many of their suppliers in Germany and Holland were unwilling to invest in the centre because their market research had told them there was little interest in the UK. In Germany, where there is even a federation of eco builders merchants, green materials have a significant share of the market.[7]

However this is something of a chicken and egg situation. Clients are frequently not told about green materials and even when they are interested, most materials cannot be sourced in normal ways, so if builders cannot obtain them from their normal suppliers they won't use them. If designers promoted green materials and builders merchants stocked them, there would undoubtedly be greater use.

The public sector could give a lead in this respect so that local authorities, hospitals trusts and central government could adopt green specification standards and because of the bulk of materials which they order, the market would have to change to meet this demand. The Greening Government Section of the DETR has produced an excellent report which gives guidance on how to achieve greener buildings.[8] Apart from covering most topics, under 38 headings, including indoor air quality, it has an excellent and comprehensive set of appendices giving sources of information and useful contacts. Needless to say, the Green Building handbook gets mentioned throughout. This document, which contains a Green Code for Architects (based on BREEAM),[9] would be very useful to anyone trying to persuade a sceptical public sector client that green building is not a strange and hippie activity but quite normal and sanctioned by Government.

1.1.2 Timber Certification

As yet there are few materials and products which exhibit any credible form of environmental certification to the general public or specifier. Eco-labelling has virtually collapsed and the UK eco labelling board wound up.[10] Only the certification of timber products has really become established. The Forest Stewardship Council logo (FSC)[11] can now be commonly seen in many supermarkets and DIY outlets. The Forestry Industry in the UK is slowly moving towards the full adoption of certification which will be compatible with FSC, but there have been problems with the timber trade setting up rival schemes. A number of countries, such as Finland, have set up their own national certification scheme, but busy specifiers do not have time to check out each scheme or obtain the many hundreds of pages detailing the particular certification. Forests Forever, for instance is a Timber Trade Association campaign which advocates acceptance of this wider range of certification because they claim that some commercial interests will not join in with FSC.[12] Some of their activity should be welcomed as they do promote FSC and the importance of using certified timber strongly. They produce a standard specification clause for architects and claim that they are producing guidelines for certification for the rival schemes to FSC. However a proliferation of such labelling can only cause confusion and be used as an excuse for those hostile to green specification to ignore it.

1.1.3 Public Interest in Green Building?

The general public has become much more aware of environmental issues through food scares, BSE, genetically modified foods and the abuse of anti-biotics and this has had a significant impact on consumption with supermarkets switching to organic foods. It is not clear why this public awareness has not yet switched to building materials and products such as these have just as big, if not bigger impact on our health and the environment. Organisations such as Greenpeace have had more impact on GM crop trials than they have through their anti PVC campaign[13] and part of the problem can be laid at the door of the mass media. I have found it extremely difficult to interest radio, TV and national newspapers in green building, though there is a lot of interest from local radio. A proliferation of house improvement programmes on the television, have featured some green initiatives such as the Integer House (see section 1.4), but none of these have gone into the issues of green materials in any depth.

1.1.4 Environmental Profiling

Despite the lack of media interest it is only a matter of time before the issue of green buildings becomes topical or fashionable and then we need to ensure that a robust system of evaluation is in place before every product and material is repackaged as environmentally friendly. An important initiative which will contribute to this is the establishment of a an environmental profiling database for materials at the Building Research Establishment. This provides a methodology for materials producers to analyse the environmental impact of their products which are assessed against a wide range of indices. The development of the methodology was supported by 24 companies and trade associations and identifies and assesses the impacts of all construction materials ad components over their life cycle.[14]

Life cycle analysis is a complex and time consuming activity, but it is essential if you want to make a comprehensive analysis of the environmental impact of materials. Energy used, carbon and other emissions, disposal and re-use, all of these have to be analysed and calculated. The methodology can be made quite transparent but it must take account of many hundreds of factors and may appear to be complicated. Also all life cycle analysis has to include certain assumptions which are known as "Goal and Scope." The analysis has to include certain parameters and boundaries and these are based on the use that will be made of them.[15] While the number crunching in life cycle analysis is quite objective and scientific, the data that is fed in will largely come from the manufacturers. Their information about emissions and chemicals and disposal will often be seen as commercially confidential, so the data used will often have to be taken on trust. Of course, independent analysis of all the energy consuming and manufacturing processes can be done, but this is time consuming and expensive. Only when legislation requires companies to make all this information publicly available, with some kind of random, independent auditing procedure, can we be sure of what we are being told.

Also, as the BRE themselves state,

> *"A cradle to grave assessment appears at first sight to be the most complete and comprehensive and hence most justifiable. However…large numbers of assumptions must be made about the use phase of the materials and products over typically long time scales for buildings."*

Thus the environmental impact of materials and products is not just in the hands of the manufacturers but also the developers and managers of buildings and those who come to demolish them in 60 or 100 years time. Buildings are often refurbished and repaired several times and this must also be taken into account.

Underlying the development of environmental profiling and the interest of trade associations is the assumption that we should be constantly redeveloping buildings and consuming vast quantities of newly manufactured materials.

A deeper green position would question this materialistic approach and look for alternatives to using up so much of the world's scarce resources, especially in the rich, developed countries. Natural and renewable materials could present one alternative and are discussed below.

1.1.5 Green Responsibility in Building Development

This raises another important issue about achieving green building, which is the need to make developers of buildings to accept a social contract of responsibility for the buildings over a reasonably long period of time. Many developers, whether they are financing office, factories or schools lose interest once the

building is handed over and so there is no incentive to make the building energy efficient or last as long as possible. However some public sector private finance initiative[16] projects are now requiring developer management over 25 years and this means that the developer will be hit in the pocket if buildings consume a lot of energy or requires a lot of repair and maintenance. Undertaking a life cycle analysis of the specification in this context can be shown to save money for developers. Thus as we could take a longer term and more responsible and sustainable view of our building stock and this will inevitably lead to the use of greener materials.

However this will largely be done from the point of view of self interest. A developer will want to know if a building will be cheap to heat and ventilate, maintain and repair and that the indoor air quality will ensure there are no problems with sick building syndrome. They are less likely to be concerned at the impact on the environment which doesn't directly affect their building, such as where the materials were quarried and manufactured and any toxic waste by products that have to be disposed of long before materials gets to site. There are therefore two key issues in promoting green building, the selfish motivation and the ethical or moral responsibility.

1.1.6 The Ethics of Building

An important conference on this subject was held in April 1999, organised by the University of Central Lancashire.[17] It brought together academics and practitioners from a wide variety of backgrounds and the discussions that took place began to set a new agenda for the discussion of green building. Much of the important scientific, technical and government policy work which is now going on in the environment and on the sustainability agenda could be taking place in an ethical vacuum. The scientists attempt to measure the environmental impact by establishing indices which can measure emissions, life cycle impact, disposal costs, energy used and so on are vital, but it is a mistake to assume that the issue can be brought down to sets of figures. Instead someone, somewhere has to take decisions or make assumptions as to what is or is not good or bad for people and the environment. Philosophy and Ethical debate has largely been concerned with the morality of people. This anthropocentric view often ignores the impact of people on the planet and so environmental ethics has tended to take the opposite view, has been biased towards the natural environment and casts humanity as the villain. In convening the Ethics of Building conference, philosopher Warwick Fox argued that the built environment ended up as piggy in the middle and he was attempting to kick start what should be an important and essential debate.

As Government makes essentially pragmatic decisions about environmental standards and many manufacturers make environmental claims about their products, the general public have no way of being sure of how standards are established. An open and democratic system is required where ethical principles are brought into play.

The scientific and technical work is being done to give us the information we need to make a decision about the environmental impact or profile of materials and products but the key issue is who will make the decisions and whose principles will they be based on.

1.1.7 Green is Fashionable?

Another possible area of confusion for those who want clear guidelines on green building has been caused by claims that greenness is now fashionable in architectural design circles. Brian Edwards talks of "Eco

Cool—the new aesthetic" and confuses a revival or interest in "organic architecture" among architecture students as synonymous with a wider acceptance of ecological design.[18] The popularity of organic forms in avant garde architecture does not necessarily mean that the buildings are environmentally friendly. Many recent icons of modem architecture involve expensive and energy consuming aluminium and steel technologies to achieve curvilinear forms.[36] Eco might be cool but such interest can be superficial and transient.

A more serious attempt to hi-jack environmental architecture comes from the 'bio climatic' architecture movement which claims many examples of highly regarded modern architecture. On the face of it, the principles of bio climatic architecture, as they refer to the use of solar shading and natural ventilation, particularly in tropical countries, make a lot of sense. However many of the buildings claimed as "bio-climatic" are large hi-tech office and industrial buildings. In *Architecture and the Environment; Bioclimatic building design,*[19] David Lloyd Jones analyses 46 examples of buildings against a range of energy and environmental factors. The book includes some stunningly good examples but quite a few which have only a limited positive rating against his environmental criteria. These examples are prefaced with a version of architectural history in which Lloyd Jones attacks the Green Architecture movement as "designing down to a sustainable solution" and "looking to simple community based life styles where everything that is taken from the world's limited supply of resources is returned…". Such an idealistic aim should be supported rather than criticised.

He advocates bio-climatic architecture as "riding the materialist bandwagon" and creating "inspired architecture." In other words, green architects must play to the tune ofbig business construction needs for signature buildings. There are a number of dangers in these arguments. Firstly is the patronising idea that genuinely green buildings are mundane, unattractive and uninspired, but also that for green architecture to be accepted it has to be watered down to meet the needs of giant energy guzzling developments. There is an important debate to be held here if only the proponents of these different views could be brought together.

There are those who suggest that green ideas will only be accepted in the building sector when the big names of the establishment take them on board. While it is encouraging to see "signature" buildings include eco materials such as the Eden project in Cornwall, designed by Nicholas Grimshaw and partners using rammed earth walls,[20] this does not guarantee that other aspects of the building will follow a green agenda. The main benefit is that the technology is explored in such circumstances and this might lead to wider acceptance.

1.1.8
Developing Consensus

For the time being, there is no real consensus on what is a green building and the architectural design community and the scientific and building research community are a long way apart. Certainly in the building research world a great deal of work has been carried out to establish internationally recognised standards or criteria for green buildings. A conference in *Maastricht*[21] in October 2000 will bring together the various strands of this work including the many people who contributed to the *Green Building Challenge conference* in *Vancouver* in October 1998.[22]

Much of the work in the scientific community is concerned with mathematical models and methods for classifying green buildings, benchmarking and assessment. While some scepticism remains as to the likelihood of coming up with simple mathematical answers to what is or is not green, such classification issues may be essential if government funding requires certain environmental standards to be met. At present there are a wide range of standards and tools across the world, but a reading of the proceedings of

Fig. 2: Strawbale, roundwood timber and thatch. Ecological use of local and renewable materials in Ireland. Photo: Tom Woolley

the Green Building Challenge shows that common principles are beginning to emerge and the wide range of contributions shows that sustainable building is on the agenda in many countries.

1.2 Natural Materials

As discussed above, without common ethical principles, environmental classification systems can often be conceived within a closed loop which accepts current levels of consumption of synthetic materials. Economic growth requires more and more buildings and raw materials but this can be challenged by the development of interest in the use of natural materials that are fully renewable with only limited amounts of manufacturing and processing. A good example of such a natural material is *Hemp*.[23] Hemp is a fibrous material which can be grown in the fields with a minimal amount of fertiliser and no need for pesticides. It grows very quickly to enormous heights and the resulting crop can be used in many ways. Oil can be extracted which has a variety of therapeutic uses, even ice cream can be made from hemp. The fibre can be spun into material for high quality clothes and at one time was the principle material for rope making. The left over hurds or straw can be used in building construction and fibres combined with cement or lime. Such a natural material is infinitely renewable and has no known toxic or polluting effect on the environment. There is no waste and the energy consumed in planting and harvesting is minimal. If we could make

buildings using such materials we can significantly reduce the use of synthetic materials such as cement and plastics and metals.

Of course the ubiquitous renewable material is timber, but it takes a long time to grow and thus requires careful management. Hemp and other forms of straw and reeds grow much more quickly. Bamboo is another material which has similar properties and uses to timber but regenerates and grows much more quickly. Innovative buildings from bamboo have been developed in various parts of the world.[24] It is also possible to use earth as a building material, but unlike fired bricks or tiles, which require a lot of energy and processing, earth can be used as it is dug up on site. We can thus imagine the possibility of creating buildings which are largely composed of materials which are both natural in origin, locally sourced and resulting in zero or nearly zero emissions. While the use of such materials may seem impractical at present, the idea has to be seen as a challenge to anyone interested in green building.[25]

How can we argue that a building is green and environmentally friendly when it is still composed of materials which have required a lot of energy, processing, waste disposal and transportation to get it into place? Thus in the future we are likely to see far more discussion of the use of zero emission and natural materials or at least their incorporation into more conventional buildings. The use of such materials, particularly hemp and lime, bamboo and earth construction are likely to be subjects for future issues of the Green Building Digest. Strawbale construction is dealt with in this book and is the best known example of using a zero emission, fully renewable, virtually waste product as a replacement for materials such as concrete blocks, giving very high levels of insulation.

1.2.1
Strawbale construction

There has been a great deal of public and media interest in Strawbale building, and it has many advantages and attractions to self builders. However, there are problems of official recognition and there appear to be practical problems with dampness unless considerable care is taken during construction. We are therefore only likely to see greater use of Strawbale once it gains greater official acceptance and research has been carried out which establishes Strawbale standards included in the building regulations. In the USA many state building codes now cover Strawbale construction and fire and structural tests have been carried out. Strawbale buildings have spread throughout the USA where it is no longer considered as unusual for housing and even public buildings. A European network of Strawbale enthusiasts has been established and there have been two European conferences.

The use of earth walls and earth and clay plasters is also becoming widespread, adapting an ancient technology in a modern way. Earth can also be combined with straw and there are now European examples of Strawbale buildings which have been plastered with earth rather than lime or cement based renders (fig.3). In Finland research is underway into a wide range of natural materials, often looking back at traditional methods but with a view to the adoption of these techniques, not just for a handful of eccentric selfbuild enthusiasts but by volume builders and the mass market. Natural materials could provide a *benchmark* for establishing environmental standards for other materials and products.

It is important to stress that such innovative natural techniques require a great deal of experience and expertise to use. Because such materials are natural and cheap, some people assume that they can therefore create extremely low cost buildings and there is no need to employ qualified architects and structural engineers. This can be a serious and costly mistake and such enthusiasts can run into trouble with unsympathetic officialdom. The rule of thumb should be that if you want to use innovative techniques and

Fig 3 Strawbale timber frame house in the Eco-Village near Gotenborg, Sweden.

Photos: Stefan Wallner

materials you need to take even more care than usual, employ an architect who really understands the technology and go out of your way to win over and bring along the regulatory authorities.

There is an interesting debate about whether innovative green buildings should be built despite or with the approval of the authorities. We all resent the interference of red tape and bureaucracy, but there is a danger that ignoring planning and building control procedures will generate even more entrenched opposition for those who follow later. An eco village in west Wales attracted a lot of press attention when it was threatened with demolition as it didn't have planning permission.[26] There is little doubt that such a project has a much lower environmental impact and the objectives of the builders should be supported, but the planning laws also exist to stop developers covering the countryside with concrete and PVC bungalows and we flout them at great risk. Ideally authorities should be won over and encouraged to accept the concept of eco villages and other projects which try out innovative green ideas. Surprisingly there is a great deal of positive interest and support, particularly among the building control community for innovative green experiments and this should not be ignored. Given the level of government commitment to Agenda 21, it should be hard for them to reject such proposals if they are responsibly formulated.

1.3
Criteria for Green Development

This raises an important issue for green builders, as to how to establish criteria for such developments to ensure that eco-villages and similar initiatives are genuinely going to follow ecological principles. This is an issue facing various groups today and they cannot wait for several international conferences to debate the issue. One interesting group which has had to set its own standards are setting up an Eco Village in West Cork in the Republic of Ireland. The Hollies Sustainable Hamlet hopes to develop 15 houses and a permaculture farm and visitor centre. They are currently negotiating for planning permission. They are part

of a world wide network of eco-villages and many are planned in several countries.[27] There is a great deal of variety between them, but all are united by the aim of finding a way to live on the earth with as low an impact as possible on the environment.

As the Hollies hamlet will involve selling plots for housing development to incoming eco-village members it was necessary to draft the development conditions to be followed by everyone involved. This will also be a condition of the planning approval. These are reproduced in full on page 12, as they provide a useful set of principles to be followed by anyone planning to build in a green way. However they are not necessarily exhaustive and apply to this particular site and community. It will be interesting to see whether the use of gentle words such as TRY TO and ENCOURAGE rather than MUST and SHOULD will cause problems in the years to come when someone ignores the eco intentions.

1.4
Green Prizes and Awards

Apart from eco villages there have been many other green building projects built and planned in the past two to three years, too many to document here. There has also been a proliferation of green and sustainable award schemes and competitions. Apart from the Green Building of the Year, the Civic Trust are making a special annual award for sustainability[28] (fig. 4) and a new organisation has set up "International Eco Design Awards" which are being awarded in 1999 for the first time.[29] This is an indication of the importance and value of sustainable design but often the procedures and the judging panels for these awards leave a lot to be desired with the criteria often left unclear or unstated. Several architectural competitions to design environmentally friendly buildings are also appearing. One example was to design a House for the Future to be built at the Museum of Welsh Life near Cardiff won by architects Jestico and Whiles of London (fig. 6, overleaf).

There is some value in these one off show houses and competition projects and awards in that ostensibly they bring green building ideas to the attention of the public and future clients. However we should really be moving into the next phase of sustainable building development with more substantial eco schemes being implemented, not as special one off exhibition pieces but as part of normal housing and building development. The danger of one-off demonstration or exhibition schemes is that they are often sponsored or received extra finance so that they are not seen as realistic buildings by the general public. This gives the misleading impression that green buildings cost more and are out of the reach of ordinary people, or need massive subsidies to be feasible.

One example of this is the "Integer" house which was presented on a series of BBC TV programmes.[30] The Integer House presented a lot of information on a range of green design ideas, not only with the Integer Building at the BRE in Garston, but examples of other projects around the country. While this attention to green building ideas is welcome, the Integer House itself was built in a way to put it in the luxury house class even though it is meant to be a model for social housing of the future. Public sector housing organisations are being encouraged to sign up to future Integer house projects an it will be interesting to see whether anyone is able to reproduce the Integer formula for realistic costs and without donations of materials from a range of suppliers.[31]

An organisation called *The Crossover Trust* is planning "cost effective sustainable construction on a massive scale" in partnership with a wide range of public sector organisations. Funding has not yet been established but such initiatives will allow more significant evaluation of eco-construction and a challenge to the private sector who claim that green construction cannot be marketed.[32]

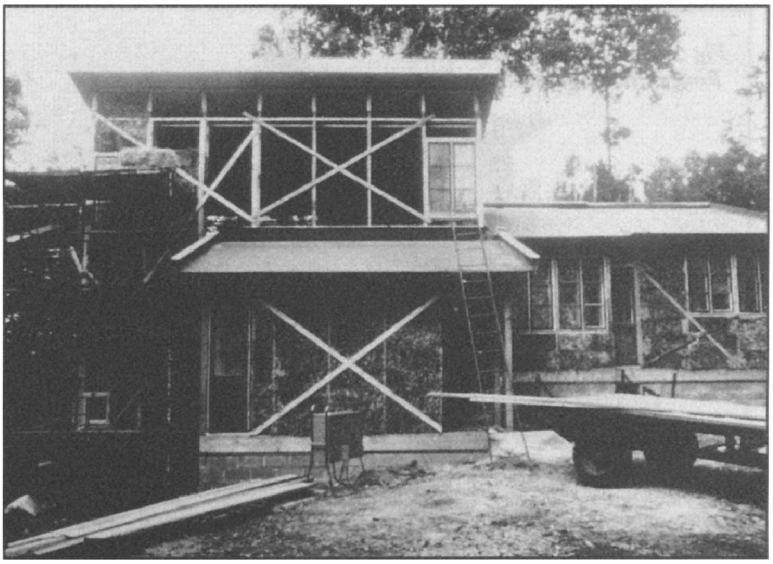


Fig 3 Strawbale timber frame house in the Eco-Village near Gotenborg, Sweden.

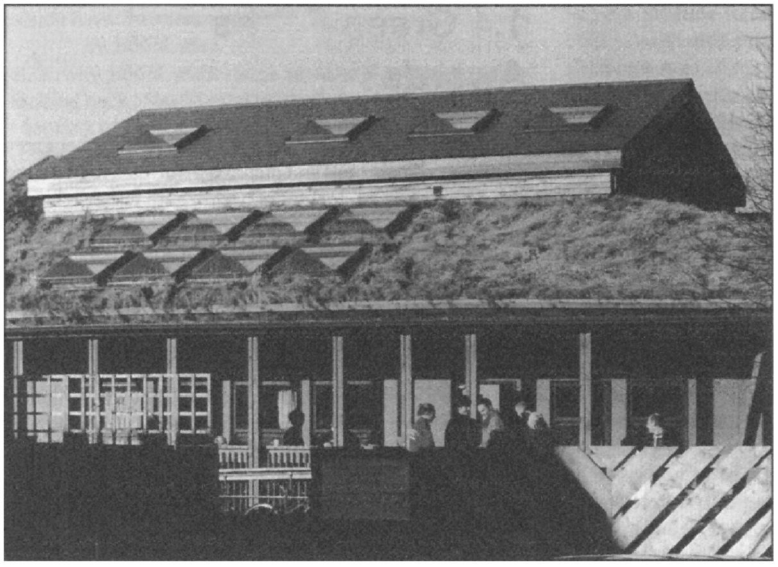
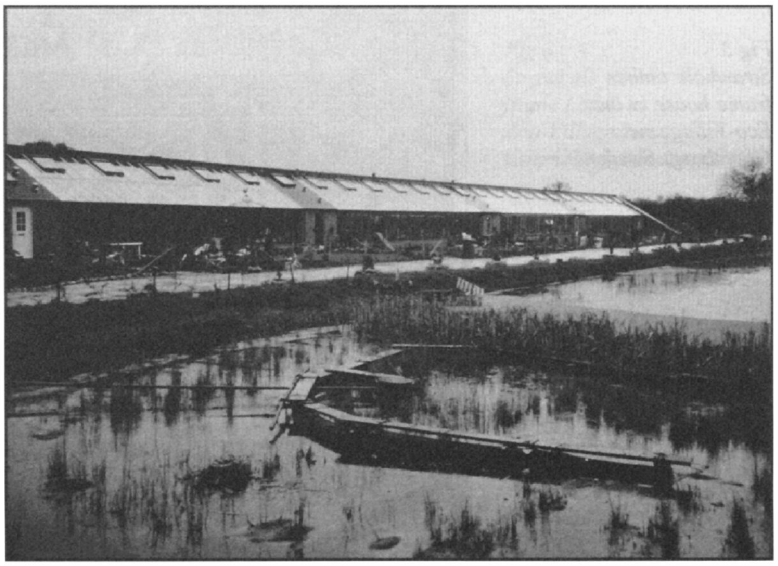


Fig.4: Haven Day Centre, Watford New Hope Trust. Designed by COMTECA. Civic Trust Sustainability Award.

Other realistic models for green housing can be found in some projects which have been built or are planned to meet normal housing needs without spending huge amounts of money. Such projects will demonstrate that it is possible to live in a low energy building, built with environmentally friendly materials without it costing any more than conventional housing.

The *Hockerton* Project (fig. 5) in Nottinghamshire is an excellent example of a "zero energy" (i.e. it requires zero, or minimal energy input in use) housing scheme.[33] Its high levels of insulation are backed up

Fig 5: Hockerton Housing Project, Nottinghamshire.



with earth sheltering to the north and the single aspect south facing houses are warmed by a large passive solar conservatory. The scheme includes heat recovery and a heat pump and will include a windmill to offset any electrical energy that was required when the autonomous systems didn't cope. Unfortunately, it has taken several planning applications to now get planning approval for the windmill. This short-sighted opposition to local, co-operatively owned wind power can be contrasted with the ease by which mobile telephone companies can erect micro wave transmitter masts. Hockerton is a model of sustainable building, with rainwater harvesting, reedbed sewage and many many other sensible measures included in the scheme. Group guided visits can be arranged to the housing project.

Perhaps influenced by the success of Hockerton a much bigger sustainable housing development is planned nearby in a derelict coal mining area of Nottinghamshire. The *Sherwood Energy Village*[34] will not only consist of housing but is part of an economic regeneration strategy which will include eco-tourism with exhibitions about coal mining history, an energy and convention centre, a biomass power station, research, training and industrial facilities and much more, all to high energy efficiency standards and incorporating renewable energy features.

Another large development is planned in the London Borough of Sutton with a partnership between the local authority and the Peabody Housing Association in association with a local organisation, the Bio-Regional Development Group.[35] Known as the Beddington Zero Energy Development and designed by architect Bill Dunster, the project will have government funding through the Housing Corporation. Approval has been given for some extra expenditure on the various innovative features as the Government has recognised that the reduction in carbon emissions can be offset against the development costs of the scheme. Such a green funding formula should encourage other authorities in the future.

All these initiatives make it clear that the need for good information on green building will become more and more important. This will require risk taking and a willingness to take on board genuinely innovative

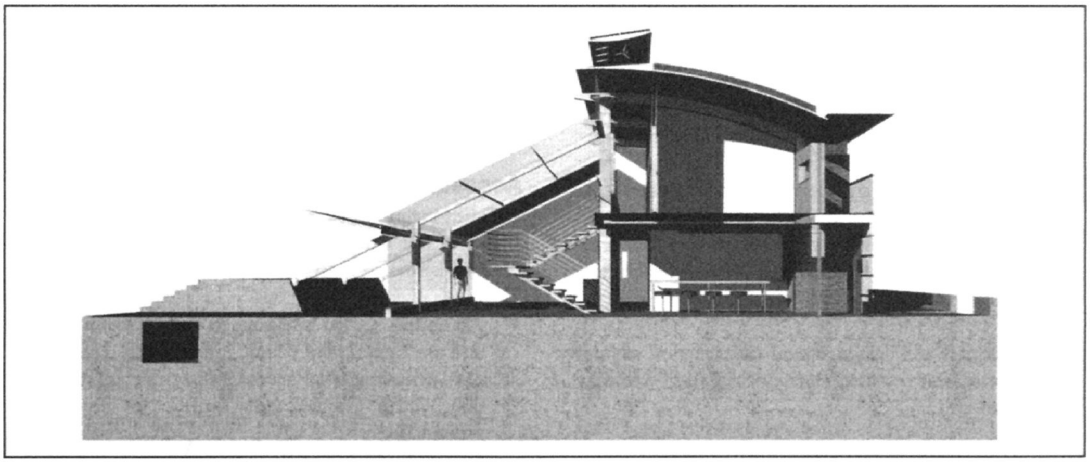


Fig. 6: Cardiff House for the Future, designed by Jestico & Whiles

ideas and materials rather than endless discussion about standards and procedures which will give existing practices some sort of dubious green validity.

Building Design Criteria for The Hollies—the West Cork Sustainable Hamlet

Prepared by Tom Woolley and Rob Hopkins

We would encourage any house design submitted for approval by Baile Dulra Teo's Building Group to show that it has been designed in accordance with the following criteria. Once approved by Baile Dulra, the design can then be submitted to Cork County Council for final planning approval.

Construction Materials

Giving consideration to the materials used in every aspect of the building's construction will ensure that their adverse environmental impacts are minimised. Plot owners will be encouraged to collaborate with the company in ordering materials in bulk where this might provide savings and particularly where 'alternative materials' such as organic paints, certified timber and PVC free cabling have to be imported from abroad. A central store of second—hand materials will also be set up on the site.

The use of whole, unprocessed, locally sourced materials is encouraged where possible i.e. timber, stone found on the site or from demolition within the Cork region, recycled slates, earth, clay, straw and other natural fibres. Timber should be FSC certified if not from local forests and the use of tropical hardwoods is best avoided.

Second hand materials should be used if possible in preference to new. i.e. structural timber, floorboards, doors, roofing etc.

Try to avoid wastage of materials. When designing try to incorporate the use of standard sizes to avoid unnecessary cutting. Surplus materials can be reused or shared with other buildings on the site. There should be no skips or bonfires and all packaging materials should be separated and sent for recycling where possible.

Low embodied energy materials are preferred except where other materials can be justified in terms of life cycle performance and recyclability.

Materials which are derived from petrochemical materials should be kept to a minimum. If using any plastics materials try to ensure that they are derived from recycled plastics. PVC free solutions should be used wherever possible.

Materials and design should take account of future re-use. Soft mortars, mechanical fixings avoiding glues etc.

Design for Low Energy

Careful thought given to energy efficiency at the design stage of the building will lead to a greatly reduced environmental impact as well as making the house much cheaper to run.

Houses should be built with the objective of achieving at least a Zero CO2 rating (as defined in the DETR/BRECSU Best Practice Guide No.53, copies available from the Baile Dulra offic). If at all possible a better level should be the objective, such as Zero Heating.

In order to achieve this, appropriately high levels of insulation and managed ventilation systems should be employed. Designs should make best use of passive solar energy, good levels of daylighting and wind sheltering.

Low energy lighting and appliances should be used.

Efficient heating equipment using LPG boilers, highly efficient wood burning or multi fuel stoves or electricity should be used. Oil fired heating should be avoided.

Designs should incorporate well insulated thermal mass and heat recovery systems if appropriate.

Buildings which strive to generate a significant amount of their own power needs, either through the use of photovoltaic cells, windpower of any other means are pariticularly encouraged.

Accessibility

Buildings should be created with consideration for all stages of one's life and also so as not to exclude any future visitors.

All houses should be designed to facilitate access and use by disabled people, prams, push chairs etc. including level access and agress, appropriate door widths, disabled toilet facilities on the ground floor.

Buildings should be designed to facilitate adaptability, extension and alteration in the future.

Internal Environment

As far as possible, all houses should be constructed with materials which avoid the use of toxic and carcinogenic substances.

Timber treated with highly toxic materials such as copper chrome arsenic and Lindane will not be permitted and suppliers of timber must be asked to provide details of any treatment chemicals where used. Low toxicity chemicals such as boron/borax should be used internally.

Natural fibres should be preferred to artificial and petrochemcial products.
Solvent free paints, timber oil and varnishes, glues and other finishes should be preferred. Paints and stains from natural and organic or low solvent, water based should be used.
Composite boards and other timber products such as MDF, OSB, plywood, chipboard PSL. PVL should have a certified low formaldehyde or preferably zero formaldehyde content.
The use of vinyl and high formaldehyde carpeting should be avoided.

Design in Context

Buildings should be designed which are adapted and designed to fit the landscape, rather than adapting and designing the landscape to suit the house. The landscape of The Hollies offers many exciting opportunities to design buildings to blend into a very varied and diverse landscape.

Buildings should be located on the designated area of the plot agreed in the master plan.
Care should be taken during construction to minimise disturbance to the exciting ecology of the site, plants and wildlife. Any site works, foundations, draining work should be organised to minimise impact and soil compaction.
The site should not be levelled nor should quarry stone be spread for levelling purposes except within the immediate curtilage of the building and for any agreed access road (routes and dimensions of proposed internal roads should also be shown in the submitted plans)
Foundation design should attempt to follow the principle of touching the earth lightly. Large earth moving will only be permitted when earth sheltering is employed. Dynamiting or excessive rock breaking is discouraged.
The external appearance, location, massing and arrangement of the building will be in accordance with the agreed principles of the overall development. This is based on respect for the site, the relationships between neighbours, visual impact of the buildings and local distinctiveness. Where buildings are grouped together, there will be an expectation of visual harmony between them.

Water/Sewage treatment

Appliances and strategies for the conservation of water and the reduction of use should be outlined.
If a composting toilet is employed, residents must outline it's design, it's proper ventilation as well as how the faecal matter will be safely and hygienically composted in such a way as to create no odour or fly problem.
Strategies for rainwater harvesting will be encouraged and welcomed.

1.5
References

1. Department of Environment, Transport and the Regions. 1998. Opportunities for Change: Consultation paper on a UK strategy for sustainable construction. HMSO Doc. Ref. 98EP072

2. Design Advice for Greener Buildings, administered by BRECSU, can be contacted at 01923 664258 or www.bre.co.uk/design advice
3. Rethinking Construction: Report of the Construction Task Force on the scope for improving the quality and efficiency of UK construction. July 1998. Department of Environment, Transport and the Regions. London.
4. Edwards B. Sustainable Architecture 1998 Butterworth Architecture Oxford
5. Akzo Nobel <www.amce.com>
6. Construction Resources is at 16 Great Guildford Street London SE1 0HS Telephone 0171 450 2211
7. Holger Konig, chairman of the German Eco Builders Federation speaking at the launch of Construction Resources April 1998
8. Towards More Sustainable Construction—Green Guide for managers on the Government Estate. Greening Government Team, DETR. Available on the DETR web site.
9. BREEAM—The Environmental Standard Award Building Research Establishment Garston Watford
10. Eco Design Vol. Vi No. 3 1998 p.3
11. Forest Stewardship Council Unit D. Station Building, Llanidloes, SY18 6EB Tel: 01686 413916 <www.fscuk.demon.co.uk>
12. Forests Forever: Timber Trade Federation 26 Oxenden Street, London SW1Y 4EL 0044 171 839 1891
13. Greenpeace: "Look Out"—Implementing Solutions—Briefing Note No. 1, Installing New Windows 1998
14. Howard N., Edwards S., Anderson J., BRE Methodology for Environmental Profiles of Construction Materials. Components and Buildings 1999 BR370 DETR
15. Jonsson A. Life Cycle Assessment of Building Products—Case Studies and Methodology 1998 PhD Thesis Chalmers University of Technology, Goteborg, Sweden
16. Private Finance Initiative, <www.local-regions.detr.gov.uk/pfi/index.htm>
17. Fox W. (Ed) Ethics and the Built Environment. Papers from the Ethics of Building Conference, Penrith April 1999—to be published in 2000 by Routledge.
18. "Eco-cool: the new aesthetic:" Report of lecture by Brian Edwards, Huddersfield University Building Design May 14 1999 pp12–13
19. Lloyd Jones D. Architecture and the Environment: Bioclimatic Building Design. 1998 Lawrence King London
20. Architecture Today—Specifiers Handbook SH31 July 1999 Detail pp 32–33.
21. Sustainable Building 2000—Joint Conference of CIB W-100 Buildings and the Environment and GBC 2000, Green Building Challenge. 22–25 October 2000, Maastricht, The Netherlands Novem: <www.novem.nl/sb2000>
22. Green Building Challenge 98: Conference Proceedings Vols.1 and 2 International Conference on the Performance Assessment of Buildings October 26–28 Vancouver Canada. Minister of Supply and Services.
23. Carpenter R. Hemp—The renaissance of a time honoured material; undated, unpublished paper. Modece Architects 88 St. Johns Street, Bury St. Edmunds Suffolk.
24. Brown P. Shoots of Recovery—Strong and flexible bamboo can be used to build cities of stout houses. The Guardian Wednesday July 14 1999.
25. Zero Emissions Research Initiative: ZERI Foundation <www.zeri.org>
26. Jones S.W. Planning for Sustainability—the Brithdir Mawr Community. Living Lightly Issue 8 Summer 1999 pp 12–13
27. Global Eco Village Network (GEN) Lucilla Borio, via Torri Superiore 5 18039 Ventimiglia, Italy <info@gen-europe.org>
28. The Civic Trust Awards <www.civictrust.org.uk>
29. International Eco Design Awards (Idea) <www.blacknet.co.uk/idea>
30. The Integer House Building Homes January 1999
31. Dougan T. Intelligent Housing—The Integer House Building for a Future Vol. 9 No. 1 Summer 1999. pp 17–22
32. The Crossover Trust 71 The Drive, Wallington Surrey SM6 9ND
33. Hockerton Housing Project The Watershed, Gables Drive, Hockerton, Southwell, Notts. NG25 0QU
34. Building a Sustainable Future—Homes for an autonomous community—(Sherwood Energy Village) Best Practice Programme General Information Report 53 DETR/BRECSU

35. Design to lead housing innovation. Building Design September 3 1999 p. 23.
36. Slessor, C. Eco-Tech, Sustainable Architecture and High Technology. Thomas & Hudson 1997.

How to Use the Handbook

Life Cycle Analysis

The GreenBuilding Handbook's Product Tables present a summary of the environmental impact of each product covered in an 'easy-to-read' format. A circle in a column will indicate that we have discovered published comment on a particular aspect of a product's impact. The larger the circle the worse an environmental impact is thought to be (in the opinion of the author). Marks on each Table will only indicate poor records relative to other products on the same Table.

Every mark on the Product Table has a corresponding entry in the Product Analysis section, which explains why each mark was made against each particular product. Life Cycle or 'cradle-to-grave' analysis of a product's environmental impact is a relatively new, and still contentious field. It is accepted that it should involve all parts of a product's life; extraction, production, distribution, use and disposal. The Green Building Handbook's Product Tables amalgamate these for ease of presentation, so that issues involving the first three, extraction, production and distribution are presented in the nine columns grouped under the heading 'Production'; the last two, use and disposal, are presented together under the heading 'Use'.

Less well accepted are the more detailed headings under which life cycle analysis is performed. Those we have used are based on those used by other LCA professionals, but developed specifically for this particular use—presenting information about building products in a simple table format.

The most fundamental problem with LCA is in trying to come up with a single aggregate 'score' for each product. This would entail trying to judge the relative importance of, for example, 50g emission of ozone depleting CFC with a hard-to-quantify destruction of wildlife habitat. In the end the balancing of these different factors is a political rather than scientific matter.

Key to Product Table Ratings

The environmental impacts of products are rated on a scale from zero to 4 under each impact category. A blank represents a zero score, meaning we have found no evidence of significant impact in this category. Where a score is assigned, bear in mind that the scores are judged relative to the other products on the same Table. The following symbols represent the impact scale: ● ... **worst or biggest impact** ● ... **next biggest impact** • ..... **lesser impact** • ..... **smaller but significant impact** [blank] **no significant impact**