

SLICE



Student-centred Learning in Construction Education

SUSTAINABILITY IN CONSTRUCTION STUDENT LEARNING PACKAGE 1

**Steven Goodhew
2003**



Student-centred Learning in Construction Education

Student Learning Pack 1

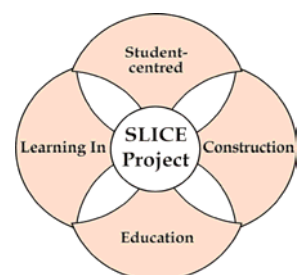
Sustainability and Construction



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2003



Student-centred Learning in Construction Education (SLICE)

*Funded by the Higher Education Funding Council for England
Fund for Development of Teaching and Learning*

Project aims and outputs

The SLICE project aims to enhance student learning by promoting student-centred learning in Building and Civil Engineering undergraduate education.

The SLICE team have produced a total of nine key outputs each designed to be a practical aid to construction lecturers wishing to develop and/or improve small-scale student-centred learning activities. These outputs include:

- ❖ The SLICE *Handbook on Student-centred Learning in Construction Education* – a comprehensive staff manual on the development of flexible learning materials and activities.
- ❖ Eight subject-specialist Lecturers' Toolkits incorporating ready-to-use learning packs, ideas and resource guides for lecturers. The toolkits cover the following subjects:
 1. Environmental Science
 2. Site Surveying
 3. Building Pathology
 4. Structural Behaviour
 5. Construction Health and Safety
 6. Sustainability in Construction
 7. Quantity Surveying
 8. Water Engineering

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Contents

1.0	Introduction to student-centred learning material
	1.1 Why this? Why now?
	1.2 Why student-centred learning?
	1.3 Objectives of this material
	1.4 What is in this learning pack?
	1.5 Is all you need here?
	1.6 How you should use this pack
	1.7 What you should already know
	1.8 Can you cheat?
	1.9 What support can you expect?
2.0	Introducing sustainability
	2.1 What you will cover in this pack
	2.2 Outcomes
	2.3 What is sustainability?
	2.4 The three Es
	2.5 The world summits
	2.6 Agenda 21
	2.7 Summary
	2.8 References
3.0	What is sustainable construction?
	3.1 What you will cover in this section
	3.2 Outcomes
	3.3 How relevant is construction?
	3.4 Can construction be more sustainable?
	3.5 Summary
	3.6 References
4.0	Summary
	4.1 Conclusions
	4.2 Further reading
Appendix	Activity feedback and solutions

Section

1

Introduction to student-centred learning material

1.1 Why this? Why now?

Construction has a massive impact on the environment. Therefore we need to reduce the impacts arising from the design, construction and use of property, and this means change. The changes we need to make affect all aspects of the building life cycle. However, if change is to be successful, we need to have a full understanding of the problem – and the problem is that at present, construction is not sustainable. So, we need to address what sustainability actually means and then to identify and grapple with the often conflicting issues that relate to sustainability. It is important that we draw our own conclusions on what sustainability means to us, and to learn how this impacts on our future as construction professionals.



Plate 1 The Built Environment: can construction become sustainable?

There are some powerful imperatives for you to take these issues seriously, after all:

- ❖ in future your work will undoubtedly involve making or helping to make choices that can affect how buildings are designed, constructed and used. All these processes have environmental impacts
- ❖ you will increasingly be obliged by legislation to consider sustainability related issues and encouraged to do so by government initiatives
- ❖ most professional bodies see sustainability and the active care of the air, land and water environments as a core theme of the construction curriculum.



Plate 2 Our environment – more than simply air, land and water?

It is therefore vitally important for you to develop your understanding of the links between our environment, sustainability and the construction industry.

1.2 Why student-centred learning?

The reason you are being asked to learn in this format is to provide you with flexibility – in terms of perhaps:

- ❖ the pace at which you work
- ❖ the place at which you work
- ❖ supplementing what you already know or do not know.

This approach will also provide you with more variety in terms of *how* you learn on your course. This material has been designed to help you enjoy and maximise your learning about sustainability. The content has been extensively reviewed by lecturers and students to assure its effectiveness.

Once you have completed the pack, you will have the opportunity to give feedback to your tutor on its quality and effectiveness. Thus you will have a part to play in the ongoing improvement of this material.

1.3 Objectives of this material

The aim of this material is to familiarise you with a range of issues associated with sustainability in construction. If you complete this pack, you should be able to:

- ❖ provide a definition for sustainability
- ❖ understand the relationship of equity, environment and economics to sustainability
- ❖ describe techniques for effectively improving the sustainability performance of buildings.

You should also be able to answer, with confidence, any examination question on this topic.

1.4 What is in this learning pack?

The pack contains wide-ranging reading material, in-text self-assessment activities and appended feedback. There are two learning Sections:

- Section 2: Introducing sustainability
Section 3: What is sustainable construction?



Plate 3 The Eden Project is exemplary at promoting sustainability, yet conflicts arise even there. Are the synthetic dome membranes sustainable?

1.5 Is all you need here?

Yes, the reading material here contains the basic information you need to respond to the activities we have provided.

But, if you want to do at all well, you will need to supplement your reading using the following key resources.

Texts
Anink D et al, (2001) <i>Handbook of Sustainable Building</i> James and James, London
Graham P (2003) <i>Building Ecology</i> Blackwell Publishing, Oxford
Hagan S (2001) <i>Taking Shape</i> Architectural Press, Oxford
Lacinski P and Bereron M (2000) <i>Serious Straw Bale</i> Chelsea Green, Totnes England
Pearson D (1989) <i>The Natural House Book</i> Conran Octopus, London
Roaf S (2003) <i>Ecohouse 2, a design guide</i> Architectural Press, Oxford
Smith P(2001) <i>Architecture in a Climate of Change, a guide to sustainable design</i> Architectural Press, Oxford
Thomas R (1996) <i>Environmental Design</i> Spon, London

Web Links

Please note that while these websites were live at the time of writing, internet addresses do change periodically.

Web address	Comment
www.globalsustainability.org	Alliance for Global Sustainability
www.gcric.ciesin.org/gen_info.shtml	United Nations Environment Programme
www.integerproject.co.uk/index.html	INTEGER projects
www.sussex.ac.uk/Units/gec/pubs/briefing/brief-26.htm	University of Sussex, Measuring and Modelling Sustainability
www.sustainable-development.gov.uk/uk_strategy/quality/life/summary.htm	US Strategy for sustainable development

www.sustainable-development.gov.uk/indicators/index.htm	UK Indicators of Sustainable Development
www.nibs.org/betecsym1.html	Sustainable Buildings III, building environment and thermal envelope council
www.sustainablemeasures.com/	Sustainable Measures
www.telstra.com.au/sustainability/sustain	Telstra
www.aecb.net	Association of Environment Conscious Building
www.business-in-environment.org.uk	Business and the environment
www.ciria.org.uk	CIRIA
www.ciria.org.uk/cief	Construction Industry Environmental Forum
www.environment-agency.gov.uk	Environment Agency
www.forumforthefuture.org.uk	Forum for the Future
www.scream.co.uk/la21	Local agenda 21
www.radar.org.uk	RICS foundation
www.eeexchange.org/sustainability/	Sustainability: an introduction for environmental studies students
www.csf.concord.org/esf/AboutESFThemes.cfm	Education for a sustainable future
www.esig.ucar.edu/espweb4.html	Ecosystem Sustainability Project

There is also a SLICE Sustainability Web Directory that should be available from your tutor. The Directory contains detailed reviews of a range of useful websites. The above are a few of the selected sites that might give you a head start if you have difficulty obtaining the Directory.

1.6 How you should use this pack

This pack is intended to represent 12–15 hours' learning time for you. In order to gain most benefit, we advise you to read each module, respond to the questions and tasks as they arise, and to use the feedback provided in the Appendix to measure your success and to learn even more.

1.7 What you should know already

You should already have a general understanding of basic construction techniques for domestic and non-domestic buildings. You should also have some background knowledge of the issues that form the basis of deciding what is sustainable.

If you feel you lack knowledge on any of these points we suggest you obtain/review the following (or similar) texts.

Texts
Marshall D (1999) <i>The Construction of Houses</i> (2nd Edition) Estates Gazette
Chudley R (2001) <i>Building Construction Handbook</i> (4th edition) Butterworth-Heinemann
Taylor GD (2000) <i>Materials in Construction, an introduction</i> , (3rd edition) Longman
Institute of Structural Engineers (1999) <i>Building for a sustainable future: Construction without Depletion</i> SETO

1.8 Can you cheat?

No. Not because you are not allowed to, but because there is no point. If you are examined in this topic you will be asked to apply your knowledge using different scenarios to the ones contained here. So if you do not genuinely try to undertake the activities set, you will not learn effectively.

The importance of responding to all the activities offered cannot be overstressed.

So obviously, if you do decide to cheat in any way you are cheating yourself.

1.9 What support can you expect?

Your tutor will want to provide you with effective support to enable you to complete this material successfully. The kind of support to expect includes:

- ❖ a proper introduction/induction to the pack and student-centred learning generally
- ❖ perhaps one or two back-up lectures and/or videos to encourage you and enhance your understanding of the topic

- ❖ you should be offered some ongoing tutorial support from your tutor by way of email discussions, individual and/or group meetings, student peer-group meetings
- ❖ the use of the feedback provided within the material itself.

Do not be shy about asking for support you need with your tutor when this material is issued. If you get into difficulty, try to make sure you contact your tutor at the earliest opportunity.

Good luck, we hope you enjoy this student-centred learning pack.

Section 2

Introducing sustainability

2.1 What you will cover in this section

This section explores the concept of sustainability and its components.

2.2 Outcomes

On completing this module successfully, you should be able to:

- ❖ define what sustainability means to you
- ❖ articulate the relationship between sustainability and the environment, economics and social equity.

2.3 What is sustainability?

Sustainability is normally associated with descriptions such as ‘to keep alive’, ‘to continue’ or ‘to endure’ and has a global meaning. To relate sustainability to human endeavour, the UN Brundtland Commission coined the term ‘sustainable development’.

2.3.1 The Brundtland Commission

In 1987 the United Nations Commission on Environment and Development (the Brundtland Commission) drew attention to the fact that economic development often has a detrimental effect on society and the planet. The report defined sustainable development as:

“development which meets the needs of the present without compromising the ability of future generations to meet their own needs.”

(Source: World Commission on Environment and Development (1987) Our Common Future, OUP)

Activity 1

- 1. Briefly explain your interpretation of the term “needs of the present and of the future”**
- 2. The Brundtland Commission’s definition of sustainability refers to the “ability of future generations”. Explain how far into the future you think was envisaged.**

Feedback is provided in the Appendix

As you have now found from completing Activity 1 and reading the feedback, the Brundtland Commission's definition of sustainable development is vague, probably deliberately so. This is because the sustainability concept needs to be communicated to an extremely wide audience. It is therefore appropriate to introduce more selective definitions, narrower in nature, to allow more defined sectors/countries/audiences to understand what sustainability means to them.

2.3.2 Further definitions of sustainability

There is a wide a range of government supported and non-governmental interest groups involved in sustainability. The latter generally have a subscribing membership and engage in awareness-raising activities through magazines and campaigns for particular sustainable development issues. Some have devised their own definitions of sustainability and sustainable development. One example that includes a reference to life on earth comes from the pressure group/think-tank/activist group Forum for the Future (see website list). Forum for the Future stated in 1999 that sustainability is:

“A dynamic process which enables all people to realise their potential and to improve their quality of life in ways that simultaneously protect and enhance the Earth’s life support systems.”

Another definition from the group Education for a Sustainable Future in June 2000 introduces a financial/economic focus, stating that measures should:

“assign dollar values for the use of environmental resources so the market place makes the decisions between development and preservation.”

A statement from the Environmental and Societal Impacts group hints at another key element to sustainability, the social or equitable aspect.

“the degree to which present interactions between human society and nature will be adaptive over the long term, or lead to environmental or ecological degradation in terms that are important to individuals and society.”

Activities 2 and 3 will help you affirm how the Brundtland definition of sustainability has been enhanced by the new definitions described above.

Activity 2	
Using the blank second column of the table below, note how the special-interest groups have broadened, narrowed or challenged the Brundtland definition of sustainability.	
	The changes or evolutions you have identified from the special interest groups
Broadening	
Narrowing	
Potentially challenging focus	

Activity 3

Describe below any common themes or logical steps that either update or make the Brundtland Commission's definition of sustainability more practical for common use.

Feedback is provided in the Appendix

2.4 The Three Es

As you should have discovered from Activity 2, definitions of sustainability are evolving continually. Currently, it is generally accepted that the concept of sustainability includes three core components, known as the Three Es of sustainable development. These are Equity, Environment and Economics. So sustainability can be viewed in the broadest sense as balanced living within the *three pillars* of sustainable development, economic growth, social progress and environmental protection. This is also sometimes known as 'the triple bottom line'.

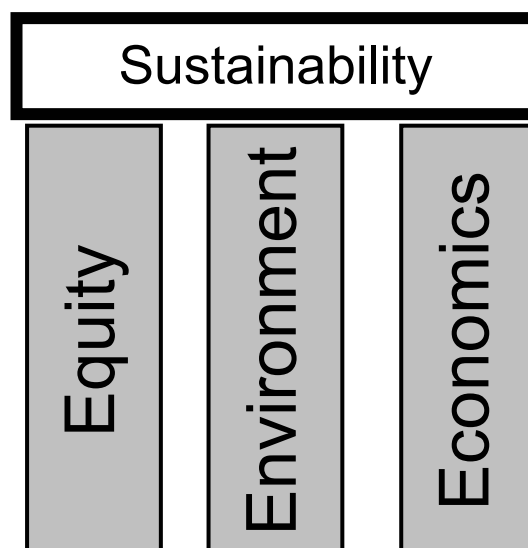


Figure 1 The three Es of sustainability

The three Es model is used by the Government as a tool to measure or identify sustainable practices when funding research projects. One recent funding call from the Department of Trade and Industry emphasised that the equitable and economic elements of sustainability are of equal importance to the environmental features of any proposal.

Although the three Es model is commonly accepted as the basis for any analysis of sustainability, the Forum for the Future has designed a more penetrating analysis of sustainability in partnership with Keele University. This analysis comprises a 12-feature model that is intended to be comprehensive, internally consistent and culturally neutral. According to Forum for the Future, the:

“12 features model helps organisations evaluate the sustainability of their projects.” The link below is an extract from the Forum for the Future website (www.forumforthefuture.org.uk/whatwedo/default.asp?pageid=330)

The 12 features within the model are categorised within five broad forms of capital.

1. Manufactured capital
2. Natural capital
3. Human capital
4. Social capital
5. Financial capital.

Manufactured capital comprises material goods, or fixed assets which contribute to the production process rather than being the output itself.



Plate 4 An ethanol manufacturing facility, one example of manufactured capital

If you could identify the elements of manufactured capital that contribute to sustainable development, what would they be? Listing them all would take some time, but use Table 1 as a brief summary.

Examples of manufactured capital	Applicability to sustainable development
Tools, machines and buildings	Should infrastructure, technologies and processes aim to make minimum use of natural resources and maximum use of human innovation and skills?

Table 1 Examples of manufactured capital

Natural capital is any stock or flow of energy and material that produces goods and services.



Plate 5 By using the available land, lining a large hole in the ground is an example of using natural capital

To help you understand the exact relevance, worth or value of natural capital, you should now undertake Activity 4, and then check your response against the feedback in the Appendix.

Activity 4

By completing the right-hand column you will enhance your understanding of the worth or value of each element of natural capital. The first section has been completed for you as an example.

Examples of natural capital	What they do	Your explanation of their value or worth?
<i>Processes</i>	Climate regulation	Climate regulation involves the natural and man-made influences upon the action of the global climate. Most checks and balances are natural, but some influences that are large enough to affect the climate are thought to be man-made. Much of the value of climate regulation is to ensure that ecological system integrity is maintained, biological diversity and productivity are protected or enhanced. An increase in freak weather events, extremes in temperature, precipitation and winds can be expected if climate regulation is not maintained.
<i>Sinks</i>	Absorb, neutralise or recycle wastes	
<i>Resources</i>	Renewable and non-renewable materials are the raw material for development	

Feedback is provided in the Appendix

Human Capital consists of people's health, knowledge, skills and labour. All the things are needed for productive work.



Plate 6 The use of human skills add value to a project: human capital

Enhancing **human capital** through education and training is central to a flourishing economy. In a similar exercise to Activity 4 (natural resources), you should undertake Activity 5, filling in the blank second column stating how sustainability and human needs are connected. Then check your solutions against those in the Appendix.

Activity 5	
Following the example given, indicate in the right-hand column what you consider best describes the aspirations of the human population if sustainable development is to be achieved.	
Categories of human capital	Your explanation of the relevance to sustainability of human needs
<i>Health</i>	At all ages, individuals have a right to enjoy a high standard of health.
<i>Learning</i>	
<i>Work</i>	

Feedback is provided in the Appendix

Social capital concerns the institutions that help us maintain and develop human capital in partnership with others, eg families, communities, businesses, trade unions, schools and voluntary organisations.



Plate 7 Community self-build in the USA.

Now undertake Activity 6.

Activity 6	
Explain in the right-hand column what best describes the needs of society if sustainable development is to be achieved.	
Issues that threaten society	Explanation
No equity	There needs to be trusted and accessible systems of governance and justice.
Apathy	
Lack of responsibility	
Crime and danger	

Feedback is provided in the Appendix

Financial capital plays an important role in our economy, enabling other types of capital to be owned and traded.



Plate 8 Financial capital – savings, investment and spending

Unlike the other types, it has no real value in itself, but is representative of natural, human, social or manufactured capital.

Examples of financial capital	Applicability to sustainable development?
Shares, bonds or bank notes	Financial capital needs to accurately represent the value of natural, human, social and manufactured capital

Table 2 Examples of financial capital

2.5 The world summits

Now you have some understanding of the definitions of sustainable development and the major elements that stem from those definitions. But how is all this theory put into practice? How do countries, governments, authorities, pressure groups and other organisations progress sustainable development? How does sustainability become real?

The world's governments first addressed environment and sustainability issues at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3–14 June 1992. At this event the gravity of the threat to the global environment was generally accepted. A number of commitments, codes of practice and mechanisms were put in place to reduce human impact upon the environment and to move towards a more sustainable human society. As a result Agenda 21 was established, which is one of the more important, more inclusive outcomes from the summit. Agenda 21 addresses sustainability holistically and encourages action at all levels of society.

Since Rio (as it is often referred to), there have been two further relevant global gatherings, Kyoto in 1998 and Johannesburg in 2002. Both of these events made headlines because of the problem achieving consensus over issues that threatened Western lifestyles and the rate of development in developing countries. It is useful, however, to use the information stemming from these events as it reflects many of the stumbling blocks that prevent global progress. Nevertheless, Agenda 21 has taken off and provides real promise for improvement.

2.6 Agenda 21

Agenda 21 is a series of 27 principles, which recognise the integral and interdependent nature of the earth. These principles offer a framework to deal with problems such as resource depletion, poverty and the destruction of habitats. The 27 principles are grouped under four main sections:

1. **Section I** social and economic dimensions
2. **Section II** conservation and management of resources for development
3. **Section III** strengthening the role of major groups
4. **Section IV** means of implementation.

The UN Commission on Sustainable Development (CSD) has a duty to monitor the implementation of Agenda 21 at all levels, from the international to localised levels. Thus local, regional and national governments were expected to develop Agenda 21 action plans.

Agenda 21, the Rio Declaration on Environment and Development, and the Statement of Principles for the Sustainable Management of Forests were adopted by more than 178 governments at the United Nations Conference on Environment and Development (UNCED).

The full implementation of Agenda 21, the Programme for Further Implementation of Agenda 21 and the Commitments to the Rio Principles were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa from 26 August to 4 September 2002.

The report outlining Agenda 21 can be found at:
<http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>

Undertake Activity 7 to explore the relationship between Agenda 21 and construction.

Activity 7

Highlight or circle the relevant parts of each of the following Agenda 21 principles that impact, or could impact, upon construction activities.

Principle 4 *In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.*

Principle 8 *To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies*

Principle 17 *Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.*

Feedback is provided in the Appendix

2.7 Summary

You have learnt that sustainability is a tricky topic to define, but if you use the Brundtland report's definition as a basis for any decisions or judgements, you will not be far wrong.

The three pillars of sustainability, the economic, environmental and equity aspects, illuminate well problems of sustainability.

The global response to sustainability has been in the form of several earth summits and the most identifiable outcome from these summits is the Agenda 21 movement.

At this point in your journey through definitions and implications of sustainability, you have at last come to some direct links with sustainable development that would be applicable to the construction industry.

In the next section you will investigate sustainable construction and what it really means. You will be faced with some practical choices about how to make a building or structure sustainable.

2.8 References

World Commission on Environment and Development (1987) *Our Common Future* OUP

For Agenda 21 <http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>

For forum for the Future
www.forumforthefuture.org.uk/whatwedo/default.asp?pageid=330

Section 3

What is sustainable construction?

3.1 What you will cover in this section

Section 3 covers what is meant by sustainable construction and also explores why the construction industry is important to sustainability.

3.2 Outcomes

On completing this section successfully, you should be able to:

- ❖ explain the term ‘sustainable construction’
- ❖ demonstrate an awareness of the UK Government’s view of sustainable construction.

3.3 How relevant is construction?

Construction projects clearly have a major impact on the environment, not just in terms of materials and techniques used, but also due to energy usage during their lifetime, their maintenance and their demolition. As construction outputs last a long time, buildings and structures need to be designed, built, used and reused in a sustainable way.

The importance of the construction industry is demonstrated by its role in providing the infrastructure that countries may need to function. The construction industry is integral to achieving environmental improvements by enhancing energy performance, by developing the social infrastructure and by contributing strongly to economic performance. Thus, environmental, economic and social benefits can be realised by a healthy construction sector that is operating in an efficient and sustainable way.

3.4 Can construction be more sustainable?

The culture based on the notion of sustainable construction should steer the construction industry towards achieving the aims of sustainable development described in the first part of this learning pack.

The UK Department of Environment, Transport and the Regions (DETR), published a strategy for sustainable development in April 2000 entitled *A Better Quality of Life*. This report identified a range of priorities and corresponding aims arising from those priorities to encourage a more sustainable construction industry. Activity 8 will give you the opportunity to link the broader priorities with the practical aims.

Activity 8 – Sustainable Construction

Listed below are the UK Government's priorities for the contribution that sustainable construction can make to sustainable development.

Place the number of the aim in the column on the right, next to the priority on the left that you feel best encapsulates its meaning.

To give you a head start, the priority concerning investment, has been paired with the third aim, which is focused upon being more profitable.

Priority action for sustainable construction		Aim	
More investment in people and equipment for a competitive economy.	3	Enhancing and better protecting the natural environment.	1
Achieving higher growth whilst reducing pollution and use of resources.		Respecting and treating stakeholders more fairly.	2
Sharing the benefits of growth more widely and more fairly.		Being more profitable and more competitive.	3
Improving our towns and cities and protecting the quality of life.		Minimising the impact of the consumption of energy (especially carbon-based energy) and natural resources.	4
Contributing to sustainable development internationally.		Delivering buildings and structures that provide greater satisfaction, well-being and value to customers.	5

Feedback is provided in the Appendix

The above exercise should help you to understand the Government's vision of sustainable construction as part of sustainable development. As you will probably agree, these statements are broad in scope. So, what does the construction industry need to do to achieve them? What are the current challenges that the construction industry faces? What does the construction industry do that affects sustainability? Plates 9 and 10 overleaf and the accompanying facts give you two examples.



Plate 9 Could construction be less wasteful?

13 million tonnes of materials delivered to site are thrown away unused.
Source: Department of Environment, Transport and the Regions (DETR), *A Better Quality of Life*, April 2000

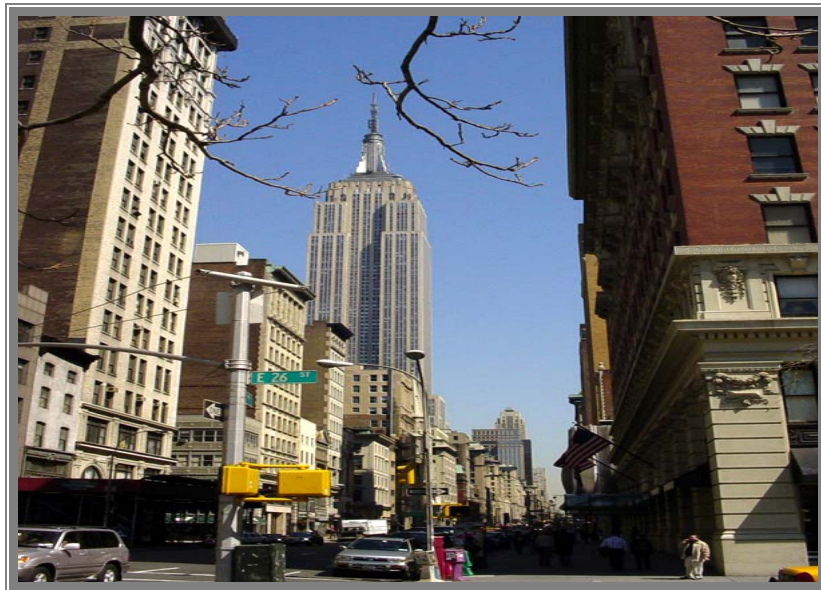


Plate 10 Are cities taking over?

The net change from rural to urban land use in the UK is around 6,500 hectares per annum.
Source: Department of Environment, Transport and the Regions (DETR) *A Better Quality of Life*, April 2000

Completing Activity 9 will reinforce for you some of the construction industry's negative impacts upon our environment and sustainable development generally.

Activity 9

Answer the following multiple-choice questions concerning construction industry influence upon sustainability. (Sources of information: BRE and Forum for the Future.)

Circle your answer and check your responses against the answers in the Appendix.

The number of people currently living in cities worldwide as a percentage of the total population is

A	18%	B	35%	C	41%	D	55%
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What percentage of the total UK energy consumption is used to manufacture and transport building materials?

A	4%	B	6%	C	8%	D	10%
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In the UK approximately how many refrigeration systems still use ozone-depleting refrigerants?

A	200,000	B	300,000	C	400,000	D	500,000
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What percentage of office water use do WCs account for?

A	20%	B	30%	C	40%	D	50%
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How many tonnes of waste are generated by the UK construction industry annually?

A	5 million	B	15 million	C	25 million	D	35 million
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What range of the total energy costs of offices does lighting typically represent?

A	5%-15%	B	10%-20%	C	20%-40%	D	30%-40%
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How much of the UK's carbon dioxide emissions do buildings account for?

A	1/8	B	1/4	C	1/2	D	3/4
---	-----	---	-----	---	-----	---	-----

Activity 9 deals with one side of the equation; what about the other side? What about the opportunities?

Activity 10

Answer these multiple-choice questions concerning the opportunities that the construction industry has to influence the built environment's sustainability.
(Source of information: BRE and Forum for the Future.)

Circle your answer and check your response against the answers in the Appendix.

Even though a total of 396km² of derelict land existed in England in 1993, it is estimated that the reclaimable area was?

A	258km ²	B	316km ²	C	355km ²	D	388km ²
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What percentage of waste from office buildings can be recycled?

A	20%-30%	B	30%-40%	C	50%-60%	D	50%-70%
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What percentage of CO₂ emissions from older buildings could be saved by retrofitting insulation?

A	12%	B	22%	C	32%	D	42%
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How many million tonnes of demolition materials are recycled or reused each year?

A	10	B	12	C	14	D	16
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How many more million tonnes of demolition materials could be recycled or reused each year?

A	2	B	4	C	6	D	8
---	---	---	---	---	---	---	---

Feedback is provided in the Appendix

Activities should hopefully demonstrate that the construction, use and disposal of buildings/structures significantly impacts upon the progress of sustainable development. The reactions of most people that encounter such facts and figures can be divided into four broad groups of opinion.

1. **The Thomist position or 'doubting Thomas'**, leading from the broad-based doubts concerning any link between environmental problems and our way of life.
2. **The 'business as usual' or the 'Macawber syndrome'**, where people accept that there are problems with the world's systems but believe that something will turn up, so they do not need to concern themselves unduly.
3. **The 'no-regrets' philosophy**. This approach notes the problems with the world's systems and takes the view that concerted action might be helpful as long as it does not 'break the bank'.

4. **The precautionary principle.** This precautionary principle focuses upon the logical argument that many resources will have to be employed to reduce the impact of unsustainable development, and if in doubt we should take whatever reasonable action is necessary to avoid disaster.

Activity 11 allows you to investigate each of these sectors of opinion.

Activity 11			
Listed in the left-hand column below are the four philosophies that sum up common opinion regarding taking action on sustainable development. Each of the sectors of opinion gradually become more informed as you get closer to the bottom of the table.			
Attempt to fill in the blank boxes. The first row is completed for you.			
Sector of opinion	What do the facts and figures in Activities 9 and 10 suggest?	What measures could be taken?	The person or organisation that might fit this stance
The Thomist position	That the facts and figures are a bunch of anomalous results	None, because this position believes that the earth is 'infinitely adaptable'	Many oil companies?
Business as usual'	That any environmental threat is real		
No-regrets	That unsustainable development will have some undesirable consequences		
The precautionary principle	That unsustainable development will have many undesirable consequences		

Feedback is provided in the Appendix

You might conclude from Activity 11 that a successful drive towards a sustainable future requires us to adopt the precautionary principle, but it may also incorporate features of the other positions. For example:

- ❖ new technologies can have a positive impact upon the construction performance. However, it is best not to rely upon unknown and uncertain future technologies (ie technology can help, but it is not a panacea)
- ❖ the ability for the biosphere to bounce back is certainly remarkable, but this might take longer than we need and the end result may be that some forms of life survive, but will we?
- ❖ it may be possible to make economic gains whilst still being 'sustainable' but sometimes a long-term view is needed and a short payback period cannot always be expected and should not always be the deciding factor
- ❖ in some instances it may be more sustainable to refurbish than demolish.



Plate 11 A sensitive refurbishment can exemplify sustainable construction principles if designed and managed appropriately

But what actions can the construction industry be expected to undertake? The UK Government's *A Better Quality of Life* (DETR, 2000) promotes ten themes to guide future action for the construction industry.

Theme 1 – Reuse existing built assets. This notes that clients' requirements may often be met by reusing existing structures; new ones may demand more resources. However, refurbishment may not always be a more sustainable solution.

Theme 2 – Design for minimum waste. This theme requires us to design out waste at all phases of the construction cycle. We need to think in terms of whole-life costs, engaging the supply chain, the careful specification of new and recycled materials that can be dismantled and reused again.

Activity 12 – Themes for sustainable construction

Complete the interpretations of the remaining eight themes in the spaces provided

Theme 3 – Aim for 'lean construction'

Interpretation: Work on continuous improvement, waste elimination

.....

Theme 4 – Minimise energy use in building

Interpretation: Be aware of the energy consumed in the production

.....

Theme 5 – Minimise energy use in building

Interpretation: Consider energy-efficient design solutions like passive systems, using natural

.....

Theme 6 – Do not pollute

Interpretation: Understand environmental impacts and have policies/systems to manage them

.....

Theme 7 – Preserve and enhance bio-diversity

Interpretation: Look for opportunities to enhance bio-diversity throughout the construction process

.....

Theme 8 – Conserve water resources

Interpretation: Design for increased water efficiency and water conservation

.....

Theme 9 – Respect people and their local environment

Interpretation: Be responsive to the community in planning and undertaking construction

.....

Theme 10 – Set targets

Interpretation: Measure and compare your performance with others

.....

*(Source: *Building a Better Quality of Life: A Strategy for More Sustainable Construction*
Department of Transport, Environment and the Regions, April 2000)

Feedback is provided in the Appendix

Do you feel the themes cover the majority of what it means to create a sustainable construction industry? Could two themes be split or others combined without losing coherence or ‘coverage’?

It is important for you to reflect upon the issues and principles that you have learnt about within the learning pack. Many of these issues and principles are very general in nature and need to be applied to an industry that has a reputation for being ‘hard nosed’ and robust in its defence of current working practices. To round off this learning pack, undertake Activity 13 and try to reflect on the implementation of sustainable principles to the construction industry.

Activity 13

Now you have studied the separate parts that potentially make up the basis of a sustainable construction industry, reflect upon how realistic you feel the implementation of sustainable construction might be. Write your thoughts below based upon the learning within this pack.

Feedback is provided in the Appendix

3.5 Summary

At this point it is useful to quickly recap on the learning you have encountered in this section.

- ❖ Sustainable development is supported by the Government and involves the full range of the three Es (see Section 2.4 for the definition of the three Es if you are still unsure).
- ❖ Although the construction industry is responsible for many environmental impacts, there is much scope for developing more sustainable practices.

- ❖ To become more sustainable, the construction industry needs to adopt the precautionary principle and will have to look to longer-term returns rather than the business-as-usual scenario.
- ❖ The ten themes are advocated by the Government are intended to direct the construction industry's future actions.

At last you have a broad recipe for sustainable construction. To experiment with these ingredients and apply them to the reality of construction, it is suggested that you ask your lecturer to give you the second SLICE learning pack on sustainability, *Sustainability and Construction: Case Studies and Practicalities*. In that pack you will be guided through a number of activities that will help to establish sustainable construction in a more practical context.

3.6 References

Building a Better Quality of Life: A Strategy for More Sustainable Construction Department of Transport, Environment and the Regions (April 2000)

Section

4

Summary

4.1 Conclusions

Sustainability is becoming an increasingly important aspect of construction industry activity. This module has helped you define what sustainability means, both in a general sense and specifically to the construction industry.

You have carried out a number of different exercises that have highlighted the importance of construction when considering global sustainability. This has included the impacts that the UK construction industry is responsible for.

You have investigated the different stances of the many 'players' involved in shaping the future of construction. You have analysed their possible viewpoints and have probably come to some conclusions as to their likely actions in different scenarios.

Finally you have started to link the broader sustainability goals of the UK with the more practical details of construction.

The practice of sustainability and sustainable thinking is constantly evolving, and it is only through the continuous development of more sustainable practices that anything will become lasting. So keep up to date!

4.2 Further reading

A few extra texts that you might find useful.

Text	Comment
Abley I and Hertfield J <i>Sustaining Architecture</i> Wiley Academy, Chichester (2001)	Merges case studies, such as The Eden Project, Cornwall with other contributions. The influence of 'rethinking construction' can be seen
Boulevard N and Steemers K <i>Energy and the Environment in Architecture</i> Spon, London (2000)	A technical design guide, based upon the Cambridge 'LT' method, 2.1
Dawes K <i>The Technology and Ecological Buddy</i> Birkhauser Velog, Berlin (1994)	Explains the philosophy of ecological building
Edwards B, <i>Rough Guide to Sustainability</i> RIBA, London (2001)	A no-nonsense guide to sustainability
Edwards B <i>Green Buildings Pay</i> Spon, London, (1998)	A series of studies that explore the production of sustainable patterns of development
Edwards B <i>Towards Sustainable Architecture</i> Butterworth, Oxford (1996)	Sets out the story behind sustainable architecture
Farmer J <i>Green Shift</i> 2nd edn Architectural, Oxford (1999)	Puts 'green thinking' in context
Hawkins D <i>The Environmental Tradition</i> Spon, London (1996)	A series of studies showing the development of environmental design in architecture
Jones DL <i>Architecture and The Environment</i> Lawrence Kay, London(1998)	Forty buildings that exemplify the best in environmental architecture
Maldonado E <i>Environmentally Friendly Cities</i> Lisbon, Portugal, Jones and Jones, London (1998)	A discourse focusing upon quality and the building environment on an urban scale
Prasal RS and D <i>Global Warming and the Built Environment</i> Spon, London (1996)	Offers solution for those concerned with the effect of the building environment upon global warming
Scott A <i>Dimensions and Sustainability</i> Spon, London (1998)	A review of contemporary ideas and innovations
Stenar C, <i>Eco-Tech Sustainable Architecture and Technology</i> Thames and Hudson, London (1997)	An international survey of environmentally intelligent buildings of the 1990s

Truelove J and Greer N <i>Hot Dirt and Cool</i> Harper Collins, New York (2001)	24 case studies showing different forms of 'eco' housing
Woolley T, Kimmins S, Harrison R and Harrison P <i>Green Building Handbook</i> , Parts 1 and 2 E and FN Spon, London (1987)	A guide to building products and their impact on the environment. Part 1: Introduction: An essay highlighting important trends in Green Buildings and explaining the rationale and methodology behind the handbook. Part 2: Key to product table, which includes: fencing products, flat roofing membranes, glazing products, electrical wiring, adhesives, straw bale housing, interior decoration, indoor air quality and ventilation.

APPENDIX

ACTIVITY FEEDBACK AND SOLUTIONS

Introduction to feedback

This feedback is intended to provide you with some of the possible responses to the activities presented to you in the previous three sections.

It must be emphasised that when learning about a subject like sustainability you should be aware of that:

- ❖ the subject is broad and often there are no completely correct answers. Because of this your solutions can be valid even if different from those presented here. Just be sure that you understand the feedback and that if you disagree, do so from a standpoint of academic strength. (Make sure your answers come from legitimate sources)
- ❖ the amount that you have written in response to the activities may be less or considerably more than is written in the feedback here. Treat the solutions here as 'pointers' and if you wish to continue adding suggestions to your solutions using extra paper, please do
- ❖ if you do not feel you have grasped the essential elements of any part of the feedback, ask for the SLICE Sustainability Web Directory that will give you a lead to clarifying your questions. Look down the alphabetical listing to locate a site that will be of interest. Your lecturer will be able to help you.

Feedback for Activity 1

Answer the following questions concerning the possible meaning of the Brundtland Commission's definition of sustainability

1. Briefly explain your interpretation of the term “needs of the present” and “of the future”?

The majority of texts, authors and ‘experts in the field’ normally relate these needs to individual, local, regional and global requirements for the human species to exist and function in a relatively comfortable environment.

At this point you could refer to Maslow's hierarchy of needs or even to the similarly basic thermal comfort requirements also covered by the SLICE Environmental Science learning pack, (Author D Dowdle). However, it is more helpful for to you to relate the ‘need’ back to the requirement for a service, structure, form of energy or any other activity that will have an impact or detrimental effect upon our surroundings at all geographical levels. This might be exemplified as our need for disposal of waste, or our need for shelter, both particularly relevant to the construction industry.

2. The Brundtland Commission's definition of sustainability refers to “the ability of future generations”. Explain how far in the future do you think was envisaged?

This question is more straightforward in some ways, but the impact of your answer could have major repercussions.

The easy answer would be ‘for ever’. This response, however, has to be measured, in that the definition could be used as the basis for legal proceedings, and establishing the effects of an unsustainable process that were then defined as lasting ‘for ever’ could deter some vital areas of activity completely. ‘Future generations’ need to be set into a framework that is reasonable and that can be reasonably anticipated by those carrying out those processes.

Feedback for Activity 2

Using the blank second column of the table below, note how the special-interest groups have broadened, narrowed or challenged the Brundtland definition of sustainability.

	The changes or evolutions you have identified from the special-interest groups.
Broadening	The Forum for the Future definition uses the term ‘dynamic process’ (the Brundtland definition implies that their focus could be static in that the development <i>could either meet or not meet the needs</i>). The Forum for the Future definition also uses the word enhance which is not necessarily implicit in the Brundtland definition which just suggests not compromising future needs rather than enhancing future possibilities. However, it could be argued that unless certain aspects of the current situation were not enhanced, future generations would not be able to survive.
Narrowing	The <i>Education for a Sustainable Future</i> definition suggests the use of ‘dollar values’ and establishes a possible method of measuring sustainable development. The Environmental and Societal Impacts group definition mentions only the environmental and social sides of sustainability, and could be said to have discounted the economic face of sustainability. The Forum for the Future definition uses the terms ‘quality of life’ and ‘Earth’s life support systems’ implying social and environmental dimensions.
Potentially challenging focus	The <i>Education for a Sustainable Future</i> definition suggests that the use of ‘dollar values’ could be seen as a way of trying to quantify the unquantifiable.

Feedback for Activity 4

By completing the right-hand column you will enhance your understanding of the worth or 'value' of each element of natural capital.

Examples of natural capital	What they do	Your explanation of their value or worth
<i>Processes</i>	Climate regulation	Climate regulation involves the natural and man-made influences upon the action of the global climate. Most checks and balances are natural, but some influences that are large enough to affect the climate are thought to be man-made. Much of the value of climate regulation is to ensure that ecological system integrity is maintained, biological diversity and productivity are protected or enhanced. An increase in freak weather events, extremes in temperature, precipitation and winds can be expected if climate regulation is not maintained.
<i>Sinks</i>	Absorb, neutralise or recycle wastes	To act as a buffer or storage capacity that prevents excessive amounts any substance to unbalance the many ecological or chemical cycles*. Examples of those cycles are then carbon cycle and the nitrogen cycle. Ecological systems include food webs and predation. In their manufacture and use, most substances should not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment) and overwhelm any sinks.
<i>Resources</i>	renewable and non-renewable materials are the raw material for development	To provide us with the basis of food, manufactured goods, energy and shelter. In their extraction use and disposal, substances taken from the earth should not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment). Hence the value of sinks.

*** A good series of explanations of these cycles can be found in *Earth Systems, Processes and Issues*, edited by WG Ernst, Cambridge University Press, 2000. Turn to the section concerning Global Biogeochemical Cycles: Carbon, Sulphur and Nitrogen, page 278, for further assistance.**

Feedback for Activity 5

Following the example given, indicate in the right-hand column what you consider best describes the aspirations of the human population if sustainable development is to be achieved.

Categories of human capital	Your explanation of the relevance to sustainability of human needs
<i>Health</i>	At all ages, individuals enjoy a high standard of health.
<i>Learning</i>	Individuals are adept at relationships and social participation, and throughout life set and achieve high personal standards for their development and learning. This tends to enhance sustainable lives, maximising the likelihood of more inclusive decisions being taken.
<i>Work</i>	There is access to varied and satisfying opportunities for work, personal creativity, and recreation. Fulfilling work and the ability for people to enjoy their employment is likely to enhance their work performance and provide more efficient services etc.

Feedback for Activity 6

Explain in the right-hand column what best describes the needs of society if sustainable development is to be achieved.

Issues that threaten society	Explanation
<i>No Equity</i>	There need to be trusted and accessible systems of governance and justice.
<i>Apathy</i>	Communities and society at large share key positive values and a sense of purpose. Less time and resources are squandered in dealing with a lack of motivation.
<i>Lack of Responsibility</i>	The structures and institutions of society need to promote stewardship of natural resources and development of people.
<i>Crime and danger</i>	Homes, communities and society at large should provide safe, supportive living and working environments.

Feedback for Activity 7

Highlight or circle the relevant parts of each of the following Agenda 21 principles that impact, or could impact, upon construction activities.

Principle 4

In order to achieve sustainable development, **environmental protection shall constitute an integral part of the development process** and cannot be considered in isolation from it.

As construction is a pivotal part of the development process, it has also to take account of the environmental protection of the environment. You can debate how far that responsibility can be taken: local, regional or global.

Principle 8

To achieve sustainable development and a higher quality of life for all people, **States should reduce and eliminate unsustainable patterns of production and consumption** and promote appropriate demographic policies.

The construction of buildings and structures and decisions concerning their location, design, fabrication and materials employed will undoubtedly affect patterns of production and consumption. The trick will be to satisfy all of the interests, some conflicting, that have a bearing upon those relevant decisions.

Principle 17

Environmental impact assessment, as a national instrument, **shall be undertaken for proposed activities** that are likely to have a **significant adverse impact on the environment** and are subject to a decision of a competent national authority.

Without question, buildings and structures can be singled out for their potential impacts upon the environment. Impact assessments often need to undertaken as a legal requirement for construction projects of a certain size or type. However, at the pre-design stage or during the design stage, often the time period when impact assessments are being contemplated, some judgements are almost like crystal-ball gazing and can be subjective. Other decisions are very clear: the draining of wetlands is very likely to reduce the number of animal species; any extra discharges of waste that can be categorised as ‘harmful’ will have an impact.

Feedback for Activity 8 – Sustainable Construction

Listed below are the UK Government's priorities for the contribution that sustainable construction can make to sustainable development.

Place the number of the aim in the column on the right, next to the priority on the left that you feel best encapsulates its meaning.

Priority Action for Sustainable Construction		Aim	
More investment in people and equipment for a competitive economy.	3	Enhancing and better protecting the natural environment.	1
Achieving higher growth whilst reducing pollution and use of resources.	5	Respecting and treating stakeholders more fairly.	2
Sharing the benefits of growth more widely and more fairly.	2	Being more profitable and more competitive.	3
Improving our towns and cities and protecting the quality of life.	1	Minimising the impact of the consumption of energy (especially carbon-based energy) and natural resources.	4
Contributing to sustainable development internationally.	4	Delivering buildings and structures that provide greater satisfaction, well-being and value to customers.	5

As you will have found by undertaking this exercise, some of the above aims could be attributed to more than one of the priorities and vice versa. The matching of each has been undertaken as a 'best fit', and does not imply that the above answers are the only ones you should accept.

Feedback for Activity 9

Answer the following multiple-choice questions concerning the construction industry influence upon sustainability. The answers are in bold text.

The number of people currently living in cities worldwide is as a percentage of the total population is



A	18%	B	35%	C	41%	D	55%
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What percentage of the total UK energy consumption is used to manufacture and transport building materials?



A	4%	B	6%	C	8%	D	10%
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In the UK approximately how many refrigeration systems still use ozone-depleting refrigerants?



A	200,000	B	300,000	C	400,000	D	500,000
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What percentage of office water use do WCs account for?



A	20%	B	30%	C	40%	D	50%
---	-----	---	-----	---	------------	---	-----

How many million tonnes of waste are generated by the UK construction industry each year?



A	5 million	B	15 million	C	25 million	D	35 million
---	-----------	---	------------	---	-------------------	---	------------

What range of the total energy costs of offices does lighting typically represent?



A	5%-15%	B	10%-20%	C	20%-40%	D	30%-40%
---	--------	---	---------	---	----------------	---	---------

How much of the UK's total carbon dioxide emissions do buildings account for?



A	1/8	B	1/4	C	1/2	D	3/4
---	-----	---	-----	---	------------	---	-----

Now that you have undertaken this quiz, you may be surprised that the construction industry has such an extended impact. To try and stay ahead of the current figures, why not refer to the governmental or more statistically oriented websites suggested by the SLICE Sustainability Web Directory? Facts and figures are powerful tools if you are trying to make a point within your course work or within presentations.

Feedback for Activity 10

Answer the following multiple-choice questions concerning the opportunities that the construction industry has to influence the built environment's sustainability.
(Source of information: BRE and Forum for the Future.)

Even though a total of 396km² of derelict land existed in England in 1993, it is estimated that the reclaimable area was?



A	258km ²	B	316km²	C	355km ²	D	388km ²
---	--------------------	---	--------------------------	---	--------------------	---	--------------------

What percentage of waste from office buildings can be recycled?



A	20%-30%	B	30%-40%	C	50%-60%	D	50%-70%
---	---------	---	---------	---	---------	---	----------------

What percentage of CO₂ emissions from older buildings could be saved by retrofitting insulation?



A	12%	B	22%	C	32%	D	42%
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How many million tonnes of demolition materials are recycled or reused each year?



A	10	B	12	C	14	D	16
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How many more million tonnes of demolition materials could be recycled or reused each year?



A	2	B	4	C	6	D	8
---	---	---	---	---	----------	---	---

From this activity you will have found that the construction industry's impact/influence upon the environment is quite marked. After completing this exercise it is hoped that you realise that there is a lot the industry can and does do.

To try to stay ahead of the current figures, why not refer to the governmental or more statistically oriented websites suggested by the SLICE Sustainability Web Directory. Facts and figures are powerful tools if you are trying to make point within your course work or within presentations.

Feedback for Activity 11

Listed in the left-hand column below are the four philosophies that sum up common opinion regarding taking action on sustainable development. Each of the sectors of opinion gradually become more informed as you get closer to the bottom of the table.

The solutions below are brief and yours may be more detailed. At the edges of each sector of opinion, some sections of the community could be categorised in either sector.

Sector of opinion	What about the facts and figures in Activities 9 and 10?	What measures could be taken?	The person/organisation that might fit this stance
The Thomist position	That the facts and figures are a bunch of anomalous results.	That the earth is 'infinitely adaptable'	Many oil companies
Business as usual	That any environmental threat is real	New technologies will solve our problems	A minority of current (2003) politicians
No regrets	That unsustainable development will have some undesirable consequences	Preventative measures could be taken but are limited to those with 'no net costs'	The majority of current (2003) politicians
The Precautionary principle	That unsustainable development will have many undesirable consequences	The payment of an environmental insurance premium could reduce the risk of future damage	Most of the 'light green' movement

One of the truisms about the construction industry is that it is as wide as the people that work, contribute and influence it are. Although the above categories are generalisations, many organisations can be roughly categorised as mostly fitting one of the sectors of opinion discussed above. Knowing the background to a person's or organisation's viewpoint can often help you communicate more easily as well as understand 'where they are coming from'.

Feedback for Activity 12 – Themes for sustainable construction

Write your comments on your interpretation of the remaining eight themes in the spaces provided.

Solutions are in ***bold italics***.

The solutions are only suggestions and are not hard and fast.

Theme 3 – Aim for 'lean construction'

INTERPRETATION: Work on continuous improvement, waste elimination, ***strong customer focus, value for money, high-quality management of projects and supply chains. Improve communications between all parties to enhance effectiveness and efficiency.***

Theme 4 – Minimise energy in construction

INTERPRETATION: Be aware of the energy consumed in the production ***and transport of construction products. Adopt 'green' travel policies.***

Theme 5 – Minimise energy in use

INTERPRETATION: Consider more energy-efficient solutions in design including passive systems, using natural light, ***air movement and thermal mass, as well as solutions involving energy produced from renewable sources.***

Theme 6 – Do not pollute

INTERPRETATION: Understand your environmental impacts and have policies and systems to manage them positively. ***Use environmental management systems under ISO 14001 or EMAS. Join the Considerate Constructors Scheme.***

Theme 7 – Preserve and enhance bio-diversity

INTERPRETATION: Look for opportunities to enhance bio-diversity throughout the construction process ***from the extraction of raw materials, through the construction phase, to the landscaping of buildings and estates – to provide and protect habitats.***

Theme 8 – Conserve water resources

INTERPRETATION: Design for increased water efficiency in building services and water conservation ***within the built environment. Ensure that the use of water during the construction process is minimised.***

Theme 9 – Respect people and their local environment

INTERPRETATION: Be responsive to the community in planning and undertaking construction. ***Consider your workforce and the occupants of the buildings and structures.***

Theme 10 – Set targets

INTERPRETATION: Measure and compare your performance with others. ***Set targets for continuous improvement. Benchmark against the best. Consider M4i projects as your focus.***

*(Source: *Building a Better Quality of Life: A Strategy for More Sustainable Construction*, Department of Transport, Environment and the Regions. April 2000)

Feedback for Activity 13

The successful implementation of sustainable construction is in the hands of the people that work in the construction industry. Your personal reflections will differ in at least some aspects from the reflections of others involved in the construction industry. The challenge for that industry is to take the guiding principles that you have encountered within this pack and to incorporate them successfully into everyday construction practice. How do we do that? Ask your lecturer to pass to you the SLICE *Sustainability and Construction: case studies and practicalities* pack.

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