

Unit 2: Sustainable Construction

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| Unit code: | R/600/0212 |
| QCF Level 3: | BTEC Nationals |
| Credit value: | 10 |
| Guided learning hours: | 60 |

● Aim and purpose

The aim of this unit is to enable learners to know which features of the natural environment need to be protected and understand how the activities of the construction and built environment sector impact on the natural environment. Learners will also find out about how the natural environment can be protected against these activities, including the use of sustainable construction techniques.

● Unit introduction

The construction industry poses a major potential pollution threat to our environment and is responsible for many pollution incidents. The implications of this must include possible less evident, longer-term or indirect effects on succeeding generations, other species and biodiversity in general.

Pollution incidents may arise out of ignorance, apathy, neglect, accident, vandalism or theft, and all of these causes must be addressed. This is a challenge, but responding to them should not be looked on as a burden. The cost of non-compliance with increasingly demanding environmental legislation will be very high. The construction industry must carry with it both the public and the institutions that provide its financial backing if it is to prosper.

Learners will understand the important features of the natural environment and the relationship between the natural and the built environment. The unit will provide a fundamental understanding of how the activities of the construction sector impact on the natural environment. The techniques, processes and procedures used to protect the natural environment are investigated and the advantages of adopting a sustainable approach to construction work are explored in the contexts of energy, materials and waste.

● Learning outcomes

On completion of this unit a learner should:

- 1 Know the important features of the natural environment that need to be protected
- 2 Understand how the activities of the construction and built environment sector impact on the natural environment
- 3 Understand how the natural environment can be protected against the activities of the construction and built environment sector
- 4 Understand sustainable construction techniques that are fit for purpose.

Unit content

1 Know the important features of the natural environment that need to be protected

Features: air quality; ozone quality; soil quality; natural drainage landscape; natural amenities; land use; green belts; agriculture; forestry; countryside; heritage; water (resources, quality); marine environment; wildlife; biodiversity; natural habitat

2 Understand how the activities of the construction and built environment sector impact on the natural environment

Global pollution: build-up of greenhouse gases (CO₂) causing global warming; polluting emissions to air causing acid rain; ozone depletion due to use of chlorofluorocarbons (CFCs); over-extraction (of water, fossil fuels and raw materials); increased energy consumption; electricity generation; deforestation; loss of natural habitat; reduction in biodiversity

Local pollution: air pollution from combustion products and volatile organic compounds (VOCs); polluting discharges to water by communities, industry and agriculture, contaminated land; waste disposal; existing site dereliction; comfort disturbance (traffic, smells, noise, dust and dirt); increased pressure on existing services and infrastructure; specification of hazardous materials eg lead and asbestos; extraction of raw materials (by drilling, mining and quarrying); electromagnetic radiation from overhead power lines; 'sick building' syndrome

3 Understand how the natural environment can be protected against the activities of the construction and built environment sector

Protection by legislation: relevant Acts of Parliament; UK regulations; European directives

Protection by control: Health and Safety Executive (HSE); Environment Agency (EA); local authorities (eg environmental services, planning, building control departments)

Protection by design and specification: reduction in energy usage; minimisation of pollution; reduction in embedded energy; specification of environmentally friendly/renewable materials; re-use of existing buildings and sites

Protection by management: simple environmental impact assessments (EIAs); improved management of construction sites; clear policies and objectives (eg reduction in wastage, increase in recycling, noise management, dust and dirt control); sharing of good practice; raising awareness; communication of information

4 Understand sustainable construction techniques that are fit for purpose

Fit for purpose: to meet the needs of the present without compromising the ability of future generations to meet their own needs eg social progress that recognises the needs of everyone, effective protection of the environment, prudent use of natural resources, maintenance of high and stable levels of economic growth and employment

Sustainable construction techniques: energy based; materials based; waste based

Energy-based techniques: eg reduced energy consumption, improved energy efficiency, use of renewable and alternative sources of energy

Materials-based techniques: eg specification of renewable materials, consideration of embodied energy and low-energy manufacture of materials and components

Waste-based techniques: eg producing less waste and recycling more, off-site prefabrication, modern methods of construction

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

| Assessment and grading criteria | | |
|---|--|--|
| To achieve a pass grade the evidence must show that the learner is able to: | To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to: | To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to: |
| P1 describe six different features of the natural environment that must be considered at the planning stage of a construction project [IE 3, SM2, SM3] | M1 assess the potential environmental impact of a proposed construction project on the local natural environment | D1 assess the importance of addressing environmental issues for the mutual benefit of the community and individual construction firms |
| P2 explain four different forms of global pollution arising from construction projects [SM2, SM3, IE1, IE3, IE4, RL2, TW1] | | |
| P3 explain how four different forms of local pollution arising from construction projects may harm the local environment [SM2, SM3, IE1, IE3, IE4, RL2, TW1] | | |
| P4 explain four key methods used to protect the natural environment from the impact of the construction and built environment sector [SM2, SM3] | M2 compare the four key methods used to protect the natural environment in terms of cost, effectiveness and public perception | |
| P5 explain three different, fit-for-purpose sustainable construction techniques. [SM2, SM3] | M3 compare sustainable construction techniques in terms of relative cost and performance. | |

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

| | | | |
|------------|--|---|--|
| Key | IE – independent enquirers CT – creative thinkers | RL – reflective learners TW – team workers | SM – self-managers EP – effective participators |
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Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting speakers will add to the relevance of the subject.

The intention of this unit is that learners should, at an early point in their studies, become aware that, although the provision of buildings and the built environment is essential to our quality of life and to local and national economies, there is a high price to be paid in terms of environmental damage and the use of large quantities of resources. Delivery should clearly address these issues and the established and emerging sustainable construction techniques used to minimise the environmental impact of the sector.

Delivery should be broad rather than deep, and the unit contextualised as appropriate. For example, learners should be made aware of relevant environmental and building control legislation but an in-depth treatment is not required at this point. The same approach should inform other parts of the unit.

As this unit is designed to be undertaken at an early stage of any programme, it is unlikely that learners will have had the time to develop an in-depth knowledge and understanding of construction technology. This should be taken into account when introducing sustainable construction techniques.

Wherever possible, links should be made to the practical aspects of construction, using photographs, drawings, plans, videos, CD ROMs and DVDs to give learners the opportunity to explore and contextualise environmental and sustainability issues. This can be supported by site visits or by studying schemes in progress or after completion. Links with house-building companies would be useful because they can provide opportunities for learners to explore the planning, design and construction of buildings they are familiar with and to which they have easy access.

Tutors should use these links to encourage learners to:

- perform simple environmental assessments at the planning, design and construction phases of projects
- discuss the importance of controlling and disposing of ground water safely
- consider the various ways that waste can be controlled
- explore recycling issues using catalogues from local architectural salvage and reclamation companies
- suggest locally sourced and low-energy materials
- recognise that building sites generate high levels of noise, dust and fumes
- relate the use of insulation to improvements in energy efficiency
- recognise typical examples of contaminated land such as petrol stations and landfill sites.

Although younger learners may have addressed environmental issues during their time in school, it is unlikely that the focus would have been on the construction and built environment sector and its impact on the natural environment. There are other links with the school curriculum, particularly in subjects such as Personal, Social and Health Education (PSHE), geography, design and technology, religious education and the sciences. Other useful links can be made with *Design Quality Indicators* (DQIs) at www.ogc.gov.uk and with *Education for sustainable development* (ESD). The latter proposes seven interrelated concepts that clarify the interaction between environment, society and economics: interdependence, citizenship and stewardship, needs and rights of future generations, diversity, quality of life, sustainable change and uncertainty and precaution. This can be found at www.nc.uk.net/esd/gq2.htm and will give tutors a useful perspective.

Group activities are allowed, but tutors will need to ensure that individual learners have equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken before practical activities are taken. Centres are advised to read the *Delivery approach* section in the specification, and *Annexe H: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

| Topic and suggested assignments/activities and/assessment |
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| <p>Introduction</p> <p>What is the environment? What is meant by sustainability?</p> <p>Visiting lecturers/site visit to contextualise</p> |
| <p>Features of the natural environment</p> <ul style="list-style-type: none"> • Group research • Presentation by groups to whole class – tutor to summarise |
| <p>Assignment 1: Environmental Features to be Protected</p> <p>Production of a report</p> |
| <p>Impact of construction on the environment</p> <p>Group research global pollution Group research local pollution Presentation by groups to whole class – tutor to summarise</p> |
| <p>Assignment 2: Pollution</p> <p>Presentation – learners can work in groups but must produce individual evidence</p> |
| <p>Reducing the impact of construction on the environment</p> <p>Legislation – whole-class, tutor-led discussion Control – small-group work Design and specification – whole class, tutor-led discussion Management – small group work Presentation by groups to whole class – tutor to summarise</p> |
| <p>Sustainable construction techniques</p> <p>Energy-based techniques – small group work Material-based techniques – whole-class tutor-led discussion Water-based techniques – whole-class, tutor-led discussion Presentation by groups to whole class – tutor to summarise</p> |

Topic and suggested assignments/activities and/assessment

Assignment 3: Sustainable Construction Techniques

Production of a report supported by diagrams, charts and tables as appropriate

Unit review and assignment feedback

Assessment

Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical assignments.

There are many suitable forms of assessment that could be used, and tutors are encouraged to consider and adopt these where appropriate. Some examples of assessment approaches are suggested below. However, these are not intended to be prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable.

Some criteria can be assessed directly by the tutor during practical activities. If this approach is used, suitable evidence would be observation records or witness statements. Guidance on their use is given on the Edexcel website.

The structure of the unit suggests that the grading criteria could be addressed fully by using three assignments. The first of these would cover P1, M1 and D1, the second would cover P2, P3, P4 and M2 and the third P5, M3 and D2. Different aspects of one real or virtual construction project could be used for all three assignments.

To achieve a pass grade learners must meet the five pass criteria given in the grading grid.

For P1, learners must describe six different features of the natural environment that could suffer as a result of bad practice in the construction and built environment sector. The six features should be differentiated from each other clearly and must not be different aspects of the same thing. There is no requirement for details of how any harm may occur. Evidence for this criterion could be provided, for example, in the form of a presentation, a report on a real project that has been studied or through oral questioning based on a tutor-provided case study.

For P2, learners must explain four different forms of global pollution arising from construction projects. The forms chosen should be differentiated clearly and must not be different aspects of the same thing. A clear explanation of how each form of global pollution may harm the environment is required, but detailed explanation of any underpinning science is not required. Examples of suitable approaches to evidence are as for P1.

For P3, learners must explain how four different forms of local pollution arising from construction projects may harm the local environment. The forms chosen should be differentiated clearly and must not be different aspects of the same thing. A clear explanation of how each form of local pollution may harm the environment is required, but detailed explanation of any underpinning science is not needed. Examples of suitable approaches to evidence are as for P1.

For P4, learners must explain how four key methods (legislation, control, design and specification, management) are used to protect the environment from the impact of the construction and built environment sector. Learners should demonstrate an understanding of how legislation and control is used, and the time and expense involved in each. There is no requirement for learners to demonstrate a detailed knowledge of environmental legislation although they should name the most important pieces of relevant legislation, and understand which statutory bodies would monitor, police and enforce such legislation. Learners should provide examples to support their descriptions of design and specification and management. Examples must be clearly categorised as a design, specification or management technique. Diagrams should be used to support the text, wherever appropriate, but the standard of sketching and drawing is not an issue here. Examples of suitable approaches to evidence are as for P1.

For P5, learners must explain three different, fit-for-purpose sustainable construction techniques. The techniques should cover one from each of the following areas: energy, materials and waste.

To achieve a merit grade learners must meet all of the pass grade criteria and the three merit grade criteria.

For M1, learners must base their evidence on either a proposed local construction project or a virtual project provided by the tutor. In either case, the project should be of a reasonable size and complexity. Useful examples include a school, a housing estate, a shopping complex, a new sports ground, or something similar. Learners must identify and evaluate the features of the natural environment that are under threat during the pre-construction, construction and post-construction phases of the given project. Non-specific responses that refer to construction projects in general are not acceptable. There is no requirement for a detailed scientific treatment of how the natural environment may be harmed. The proposed project could also be used in M2, D1 and D2.

For M2, learners must compare the four key methods used to protect the natural environment (ie legislation, control, design and specification, management) in terms of: how well each achieves the stated objective of protecting the natural environment (effectiveness); the relative expense associated with each in lifecycle terms (cost); and the advantages and disadvantages of each in terms of good public relations and links with the community (public perception). Learners do not need to provide precise figures and relative expressions of cost will suffice (cheap, moderately expensive, and so forth).

Learners do not need to go into great detail but they must demonstrate a broad understanding of the issues. For example, they may conclude that legislation is a long and expensive process, that control measures imply the existence of a large workforce to monitor, police and enforce compliance, that the effects of good design and specification can be felt throughout the entire life of a building and that good management is nothing more than the regularisation of good habits and is relatively inexpensive. These examples are for guidance only.

For M3, learners must compare each of the techniques described for P5 in terms of how well each achieves what it is intended to do (performance) and the relative outlay associated with each in lifecycle terms (cost). Learners do not need to provide precise figures and relative expressions of cost will suffice (cheap, moderately expensive, and so forth). Diagrams should be used to support the text, wherever appropriate, but the standard of sketching and drawing is not an issue here.

To achieve a distinction grade learners must meet all of the pass and merit grade criteria and the two distinction grade criteria.

For D1, learners must assess the importance of addressing environmental issues for the mutual benefit of the community and individual construction firms. They must provide evidence of understanding that the firms are part of the community they serve, that environmental issues are very high on everyone's agenda and that a poor environmental record will lead to a bad reputation with the public and the local authority.

For D2, learners must justify the use of appropriate sustainable construction techniques for a specified (real or virtual) construction project, for example that used for M3, in terms of the associated environmental and sustainability issues. Non-specific responses that refer to construction projects in general are not acceptable.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

| Criteria covered | Assignment Title | Scenario | Assessment Method |
|------------------|--|--|-------------------|
| P1, M1, D1 | Environmental Features to be Protected | A local environmental group has asked you to report on the environmental features that must be considered when planning construction projects. | Report. |
| P2, P3, P4, M2 | Pollution | An environmentally conscious client has asked you to give a presentation on the pollution that may be produced as a result of a construction project that they have commissioned. | Presentation. |
| P5, M3, D2 | Sustainable Construction Techniques | A client has asked you for a report on the impact of a construction project that they have commissioned, and the sustainable construction techniques that will be used in the project. | Report. |

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Construction and the Built Environment sector suite. This unit has particular links with the following unit titles in the Construction and the Built Environment suite:

| Level 1 | Level 2 | Level 3 |
|---------|---------|--|
| | | Science and Materials in Construction and the Built Environment |
| | | Construction Technology and Design in Construction and Civil Engineering |
| | | The Underpinning Science for the Provision of Human Comfort in Buildings |
| | | Construction in Civil Engineering |

The unit links to the Edexcel Level 3 NVQ in Technical Design (Construction Environment) and the Edexcel Level 4 NVQ in Site Inspection.

The learning outcomes and unit content articulate closely with the Environment unit in the BTEC Higher Nationals in Construction and the Built Environment.

This unit links to the following National Occupational Standards at Level 3:

- BE Design
- BE Development and Control
- Transportation.

Essential resources

Some of the issues dealt with in this unit are global in nature and the relevant measuring equipment is not readily available. Relatively inexpensive and accurate equipment is, however, available to measure the parameters associated with local environmental issues such as air and water pollution.

Local authority environmental services departments may be prepared to assist with guest lectures or the loan of equipment. Copies of the *Building Research Establishment Environmental Assessment Method* (BREEAM), and other environmental assessment methods, should be made available for reference purposes. A great deal of useful source material is available, in bulk and at a reasonable cost, from the National Society for Clean Air and Environmental Protection. Greenpeace and Friends of the Earth offer similar resources.

Employer engagement and vocational contexts

Support to enable centres to initiate and establish links to industry, and to networks arranging visits to industry and from property practitioners is given below:

- Learning and Skills Network www.vocationallearning.org.uk
- National Education and Business Partnership Network www.nebpn.org
- The Royal Institution of Chartered Surveyors www.rics.org
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) www.warwick.ac.uk/wie/cei/

Indicative reading for learners

Textbooks

Topliss S, Hurst M and Skarratt G – *BTEC Level 3 National Construction and the Built Environment Student Book* (Pearson, 2010) ISBN 9781846906565

Topliss S, Hurst M and Skarratt G – *BTEC Level 3 National Construction and the Built Environment Teaching Resource Pack* (Pearson, 2010) ISBN 9781846906558

Anderson and Howard – *Green Guide to Housing Specification* (BRE Publications, 2000) ISBN 1860813763

Beggs C – *Energy Management and Conservation* (Architectural Press, 2002) ISBN 0750650966

Brownhill and Rao – *Sustainability Checklist for Developments: A Common Framework for Developers and Local Authorities* (BRE Publications, 2002) ISBN 1860815332

Chen Z and Li H – *Environmental Management in Construction* (Taylor & Francis, 2006) ISBN 0415370558

Graham P – *Building Ecology: First Principles for a Sustainable Built Environment* (Blackwell Science (UK), 2002) ISBN 0632064137

HSE – *How to Deal With Sick Building Syndrome Guidance for Employers, Building Owners and Building Managers* (Health and Safety Executive (HSE), 1995) ISBN 0717608611

Hall K – *Green Building Bible* (The Green Building Press, 2003) ISBN 1898130019

Harrison P – *Green Building Handbook Volumes 1 and 2* (Spons, 2000) ISBN 0419261508

NSCAEP – *Pollution Handbook* (National Society for Clean Air and Environmental Protection, 2006) ISBN 0903474492

Park C – *The Environment* (Routledge, 2001) ISBN 0415217717

Shorter B – *Waste Minimisation in Construction – Training Pack, C555TP* (Construction Industry Research and Information Association, 2001) ISBN 0860175553

Smith P – *Eco-refurbishment* (Architectural Press, 2004) ISBN 0750659734

Waters J R A – *Energy Conservation in Buildings Guide to Part L of the Building Regulations* (Blackwell Science (UK), 2003) ISBN 1405112530

Journals and magazines

The Architects' Journal – Emap

Building Engineer – Association of Building Engineers

Conservation Bulletin – English Heritage

RIBA Journal – RIBA

RICS Building Control – RICS

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

| Skill | When learners are ... |
|------------------------------|--|
| Independent enquirers | exploring the features of the natural environment |
| Reflective learners | considering issues of concern regarding the environment and their resolution |
| Team workers | researching issues of concern regarding the environment and their resolution |
| Self-managers | organising time and resources when researching information on the impact of construction on the environment and the built environment sector |

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

| Skill | When learners are ... |
|--------------------------------|--|
| Creative thinkers | considering issues of concern regarding the environment and their resolution |
| Effective participators | researching information on pollution and delivering a presentation on their findings |

● Functional Skills – Level 2

| Skill | When learners are ... |
|--|--|
| ICT – Use ICT systems | |
| Select, interact with and use ICT systems independently for a complex task to meet a variety of needs | using ICT to present findings on sustainable construction |
| Manage information storage to enable efficient retrieval | saving and retrieving information on sustainable construction |
| Troubleshoot | |
| ICT – Find and select information | |
| Select and use a variety of sources of information independently for a complex task | accessing various websites and retrieving information on sustainable construction |
| ICT – Develop, present and communicate information | |
| Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records | using ICT and image retrieval to present assessed work on sustainable construction |
| Present information in ways that are fit for purpose and audience | presenting reports on sustainable construction |
| Evaluate the selection and use of ICT tools and facilities used to present information | judging the suitability of various formats to present work on sustainable construction |
| English | |
| Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts | contributing to class discussions on sustainable construction |
| Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions | reading source material on sustainable construction |
| Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively | writing reports on research and findings for sustainable construction |