

Unit 12: Setting Out Processes in Construction and Civil Engineering

Unit code:	Y/600/0227
QCF Level 3:	BTEC Nationals
Credit value:	10
Guided learning hours:	60

● Aim and purpose

The aim of the unit is to enable learners to gain a knowledge of setting out processes, carry out standard tasks involved in setting out and understand the emerging technologies used in setting out.

● Unit introduction

Setting out is the process by which information is taken from construction design drawings and then pegs, profiles or other marks are set to control the construction work and ensure that each element is constructed in the right position and to the correct level.

Learners will work with traditional methods in order to understand the essential mathematical and practical skills required for the setting out process, including application of the basic principles of techniques to ensure appropriate levels of accuracy. The use of modern electronic instruments and awareness of emerging technology will also be addressed.

Construction projects are normally designed on a coordinate grid and calculations are carried out to convert these into a form useful for setting out. Learners must attain a reasonable standard of arithmetic and trigonometry in order to complete this unit successfully. Spreadsheets and dedicated software play an important role in reducing the calculation load for the engineer.

This is essentially a practical unit through which learners will come to understand setting out as a key part of the construction process, and be able to carry out the standard tasks and calculations involved.

● Learning outcomes

On completion of this unit a learner should:

- 1 Be able to establish grids of levels over a site and use them to establish contours and carry out volume calculations
- 2 Be able to set out construction work in a plan to appropriate accuracies
- 3 Be able to control the level and gradient of construction works
- 4 Understand the uses and advantages of emerging technology in setting out.

Unit content

1 Be able to establish grids of levels over a site and use them to establish contours and carry out volume calculations

Contours: interpolated and calculated from spot heights

Volumes: simple calculations from grids of levels

2 Be able to set out construction work in a plan from coordinates to appropriate accuracies

Works: buildings; manholes; roads

3 Be able to control the level and gradient of construction works

Works: drainage runs; first and second stage earthworks

4 Understand the uses and advantages of emerging technology in setting out

Emerging technology: lasers; Global Positioning System (GPS); digital levels; machine guidance; automated total stations

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 carry out fieldwork to establish grids of levels and contours over a site [TW1, SM1, SM2]	M1 explain the need for meeting specified accuracies in setting out	D1 analyse procedures in terms of accuracy
P2 carry out volume calculations [TW1, SM1, SM2]		
P3 carry out fieldwork to set out construction work in a plan, from coordinates, to appropriate accuracies [TW1, SM2, SM3]	M2 specify appropriate instruments and techniques for setting out tasks	
P4 carry out fieldwork to control level and gradient [TW1, SM2, SM3]		
P5 discuss the emerging technologies in setting out processes. [[IE1, IE2, IE4, IE6, CT1, CT2, SM3]	M3 compare two examples of emerging technology in terms of cost and utility.	

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated 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 and supervised practical work will predominate, but the use of personal and/or industrial experience should also be considered. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject for learners. However, as mentioned above, this is essentially a practical unit and learners would benefit from hands-on activities. The learning outcomes are not linked to each other but there is a natural progression through grid levelling, setting out works in plan and controlling level and gradient. Learning outcomes 1, 2 and 3 are essentially practical. Learning outcome 4 is less practical in nature but it gives learners the opportunity to investigate new technologies and relate their use to the practical work they have already carried out. The unit gives learners opportunities to carry out realistic setting-out tasks and produce high quality results. It is likely to be delivered later in the programme, since familiarity with the use of surveying equipment and an understanding of basic levelling and angle calculations are assumed. Group activities are permissible, 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
Introduction to the unit
Lectures on setting out processes and learner study time
Visiting speakers on setting out processes and emerging technologies
Demonstrations establishing grids of levels and, carrying out volume calculations using data obtained
Demonstrations on setting out construction work to appropriate accuracies
Demonstrations on controlling the level and gradient
Formal practise and practical assignment on setting out including learner own study time to complete assignment
Assignment 1: Setting Out Fieldwork
Visits to observe the use of emerging technologies and learner research
Assignment 2: Setting Out and Emerging Technologies
Review of unit 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. Some example 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 then suitable evidence would be observation records or witness statements. Guidance on the use of these is provided on the Edexcel website.

The structure of the unit suggests that the grading criteria could be addressed fully by using two assignments. The first of these would cover P1, P2, P3, P4, M1, M2 and D1, and the second would cover P5, M3 and D2.

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

For P1, learners must carry out fieldwork to establish grids of levels and contours over a site. They need to calculate the results and produce a contoured drawing to a reasonable standard of neatness and accuracy. It is acceptable for the drawing to be produced manually or by computer-aided design (CAD). However, all learners should have an understanding of the calculations involved in interpolating contours.

For P2, learners must carry out volume calculations from grids of level.

For P3, learners must carry out fieldwork to set out construction work in a plan, from coordinates, to appropriate accuracies. They are required to calculate rectangular to polar coordinates for setting out and participate in fieldwork for at least two tasks which need different standards of accuracy. Examples would be the setting out of building corners and of manholes.

For P4, learners must carry out fieldwork to control level and gradient. They need to calculate typical gradients for controlling level of works and participate in fieldwork for at least two tasks which require different standards of accuracy. Examples could include, but are not limited to, the setting out of profiles for drainage, batter rails or roads. Learners must show their understanding either through questioning by the tutor or by production of a brief report.

For P5, learners must demonstrate an awareness of emerging technology in setting out processes. They must demonstrate knowledge of all the instruments mentioned in the unit content for learning outcome 4. Evidence could be in the form of a written report.

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

For M1, learners must explain the need for meeting specified accuracies in setting out. Learners must be aware of the appropriate British Standards for construction tolerances.

For M2, learners must specify appropriate instruments and techniques for setting out tasks. They should be able to discuss the application of these instruments to typical setting out tasks, including an explanation of how they are used on modern construction projects.

For M3, learners must compare any two of the emerging technologies mentioned in the unit content for learning outcome 4 in terms of relative cost and utility. There is no requirement for absolute costs.

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 analyse procedures in terms of accuracy. They should be able to discuss, using the correct terminology, the methods appropriate to at least two setting out tasks where different accuracies are specified.

For D2, learners must evaluate the advantages of using digital data and new technologies in setting out processes. They should be able to make reasoned judgements about the effectiveness of the new technologies and their appropriateness in terms of cost and site conditions. Learners should also show their understanding of the digital data flow from CAD to setting out.

Programme of suggested assignments

The table below 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 either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4 M1, M2, D1	Setting Out Fieldwork	A surveyor, you are asked to complete the setting out processes for a construction project.	Witness statements Written report Practical assignments Drawings.
P5, M3, D2	Setting Out and Emerging Technologies	As an equipment manufacturer's marketing department consultant, you have been asked to produce a leaflet on the uses and advantages of emerging technologies.	Information leaflet on emerging new technologies for the setting out process.

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
		Surveying in Construction and Civil Engineering

Essential resources

This unit is a practical one and centres will require a suitable range and quantity of equipment and also areas suitable for carrying out realistic tasks safely. As a minimum, the instruments required include tape measures, automatic optical levels and total stations (preferably with on-board data storage). Suitable ancillary equipment such as staffs, tripods and ranging poles will also be required. There should be sufficient instruments available so that during fieldwork teams will be small in number.

Centres will require access to areas of land with a range of topographic and built features where the surveying practical work can be carried out safely.

Health, safety and welfare issues must be considered at all times and risk assessments undertaken where necessary.

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

Bannister A, Raymond S and Baker R – *Surveying, 7th Edition* (Longman, 1998) ISBN 0582302498

Doran D – *Site Engineers Manual* (Whittles Publishing, 2004) ISBN 1870325249

Irvine W and Maclennan F – *Surveying for Construction, 5th Edition* (McGraw-Hill, 2005) ISBN 0077111141

Muskett J – *Site Surveying, 2nd Edition* (Blackwell Science, 1995) ISBN 0632038489

Sadgrove B – *Setting-Out Procedures, 2nd Edition* (Construction Industry Research and Information, 2006) ISBN 0860177076

Uren and Price W – *Surveying for Engineers, 4th Edition* (Palgrave Macmillan, 2005) ISBN 1403920540

Delivery of personal, learning and thinking skills (PLTS)

The following table below identifies the personal, learning and thinking skills (PLTS) opportunities that have been included within the assessment criteria of this unit.

Skill	When learners are ...
Creative thinkers	discussing emerging technologies
Independent enquirers	discussing emerging technologies
Team workers	carrying out fieldwork to: <ul style="list-style-type: none">• establish grids of levels and contours on a site• set out works• control level and gradient
Self-managers	organising their time and resources when doing fieldwork.

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	producing an information leaflet on emerging new technologies
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 	producing an information leaflet on emerging new technologies
Bring together information to suit content and purpose	producing an information leaflet on emerging new technologies
Present information in ways that are fit for purpose and audience	producing an information leaflet on emerging new technologies
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	carrying out volume calculations from survey measurements
Select and apply a range of skills to find solutions	carrying out volume calculations from survey measurements
Use appropriate checking procedures and evaluate their effectiveness at each stage	carrying out volume calculations from survey measurements
Draw conclusions and provide mathematical justifications	carrying out volume calculations from survey measurements