Unit 44: Linear and Level Surveying

Delivery guidance

This unit appears as an optional unit in both the Diploma (720 GLH) and the Extended Diploma (1080 GLH) programmes and will give learners the practical skills and knowledge required to accurately carry out linear and level surveys. Learners will develop their understanding and link their skills to the development of site maintenance and design project planning for areas such as gardens, parks, sports grounds and nurseries.

Learners will be able to demonstrate practical skills when undertaking their own linear and level surveys of a site using equipment that is commonly used within the industry and accurately record the data collected. Learners will then use this information to investigate how it could be presented as a drawn survey plan before eventually producing their own. Using their survey plans, learners will carry out setting out activities safely in both shape and level, including two-dimensional areas and three-dimensional setting out for gradients.

Access to suitable areas with opportunities for hands-on practical experience is critical to this unit. Learners will be given a brief to individually carry out tasks relating to linear and level surveying so they must be able to access suitable areas. Forging connections with a range of local professionals and businesses in areas such as estate, historical and botanical gardens, sports grounds, nurseries and local parks should be used to support the delivery of this unit.

Approaching the unit

Learning aims may be combined so that the theory is taught alongside practical tasks helping learners to put the unit into context. Other units could be linked where appropriate. For example, you could teach health and safety considerations in *Unit 42: Landscape and Garden Design* relating to the use of tools, equipment and machinery or link to *Unit 7: Work Experience in the Land-based Sectors* where learners will work directly with decorative horticulture features. In addition, content from *Unit 43: Constructing Decorative Landscape Features* and *Unit 45: Computer-aided Design in Horticulture* can be used to support the designing of plans.

For learning aims A and B, learners will be shown a range of linear and level surveying techniques and processes and they should be able to demonstrate how to use these effectively. They will be taught when to use different approaches and methods in various appropriate contexts. You could organise guest speakers to visit the centre to talk about these surveying techniques and processes, as well as discussing what is required from the role of a surveyor and future employment.

Learners will also be introduced to the survey equipment that is commonly used in the industry, including both manual and digital methods (such as GPS), and be taught how to use them correctly while considering possible reliability issues and constraints. Visits to landscaping sites could be arranged so learners can examine the range of equipment available to the surveyor.

Tutor-led practical demonstrations can be used to show safe equipment use and PPE, identifying potential hazards and site preparation. You should take into account learners' previous experience in this area, as more advanced learners could be asked to demonstrate some practical tasks where appropriate. Ensure learners work independently on their tasks so that you can monitor their skills development.

Learners will be taught how to interpret survey measurements and be given examples of these, showing how to correctly record the data. They should be given time to practise these skills in pairs or small groups.

For linear surveys, this will include:

- offsets
- triangulation
- single and multiple baseline use
- locating survey points.

For level surveys, this will include:

- setting up equipment
- datum types
- data processes.

Learners should be given examples of detailed scaled plans that are a standard layout including title blocks and an information panel.

You will need to demonstrate to learners how to carry out linear surveys safely and the various ways of gathering data including measurements, perimeters, structures and vegetation. This could be completed on- or off-site as appropriate ensuring learners can collect enough data for their plans. Learners will need to develop an understanding of measurement data and descriptions, adding this information to their own detailed scaled plan.

You will also need to demonstrate how to carry out a level survey safely, identifying a suitable point for datum and a clear view point for gathering data as spot heights or a grid survey, applying remarks for most sights. This could be completed on- or off-site as appropriate ensuring learners can collect enough data for their plans. Learners will investigate booking sheets and how to carry out accuracy checks.

For learning aim C, learners will need access to a practical area where they can produce an individual setting-out plan and perform setting-out activities safely, both in shape and level. They will also need access to specialist resources such as:

- OS local maps
- drafting boards
- drafting drawing equipment
- survey site with existing details to record
- survey site with undulations and significant level changes
- surveying equipment – surveying tapes, fixing arrows, stakes, string lines and marker spray
- level surveying equipment, e.g. optical level, laser level, GPS or total station.

Learners will be asked to identify the risks linked to all practical activities and recognise the potential hazards of the equipment used, discussing the effective control measures that need to be put in place. Learners should be given templates so they can produce a risk assessment for these practical tasks.

Learners will be shown how to set out from a given plan that meets given tolerance and they should gain an understanding of the need to be accurate in all measurements. This will enable them to utilise the methods and techniques when carrying out the setting-out tasks.

You should ensure learners gain the relevant knowledge of the setting out or excavation of levels, including how to use a range of levelling equipment and techniques safely and competently. In these practical activities, you should show learners how to carry out levels using a given tolerance in the application of a fall within an identified set out shape (such as a patio or path).

Learners should be encouraged to reflect on the approaches they used during the setting-out activities and consider their effectiveness, making recommendations for future improvement.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Investigate methods used in linear and level surveying of sites	**A1** Methods, equipment and recording **A2** Potential issues and constraints	Report analysing the different methods and approaches used to carry out linear and level surveying. Portfolio of practical evidence, including evidence of: • carrying out linear and level surveys safely • producing documentation to record the survey outcomes.
B Undertake linear and level surveying of sites to produce accurate data and representations	**B1** Working safely **B2** Managing a survey and associated equipment **B3** Presenting outcomes of measures and surveys	
C Carry out setting out on the ground from plans	**C1** Interpreting and developing plans **C2** Setting out	Portfolio of practical evidence, including evidence of: • producing a setting-out plan • carrying out setting-out activities safely, both in shape and level.

Assessment guidance

This is an optional, internally set unit comprising two summative assignments that will examine learners' knowledge through written tasks and practical competency skills.

For learning aims A and B, learners are required to produce a report that analyses the different methods and approaches used to carry out linear and level surveying. They should produce a portfolio of practical evidence including evidence of them carrying out linear and level surveys safely and producing the relevant documentation to record the survey outcomes.

Reports should show that the learner has a detailed understanding of surveying techniques, approaches and methods that can be used, as well as the areas they are most suited. Learners should also show their understanding of using appropriate equipment safely and their methods of recording data.

For their portfolio of evidence, learners will carry out their own linear surveys by gathering data that includes measurements, perimeters, structures and vegetation. Learners should use their measurement data and descriptions to inform their own detailed scaled plan. They should also carry out a level survey identifying a suitable point for datum and a clear view point gathering data as spot heights or a grid survey, applying remarks for most sights. Learners should produce level booking sheets as appropriate with accuracy checks completed. Learners will be required to produce complete survey recording documentation and a cross-section plan, using a scale that demonstrates the reduced levels of the given site.

For learning aim C, learners are required to produce a second portfolio of practical evidence, including an individual setting-out plan and evidence of them undertaking setting-out activities safely both in shape and level.

Learners need to show they can identify the risks linked to all practical activities and recognise the potential hazards of equipment, identifying effective control measures to be put in place. Learners will then produce a risk assessment for their tasks and demonstrate safe working practices at all times.

Learners will be able to set out from a given plan that meets given tolerance and gain an understanding of the need to meet accuracy in all measurement. This will enable them to

utilise the methods and techniques in order to carry out the setting out and levelling tasks effectively.

Once the setting-out plan and activities are complete, learners should reflect on the approaches that they used and consider their effectiveness, making recommendations for future improvement.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 44: Linear and Level Surveying

Introduction

Learners are to be introduced to a range of different sites that may require development such as gardens, parks, sports grounds and nurseries, as well as the equipment that is commonly used to carry out surveys effectively. There are also excellent opportunities to invite guest speakers such as head gardeners, landscape surveyors, grounds person and horticulturalists who can discuss the subject with learners first-hand.

Inform learners that they will carry out linear and level surveying, collect data and record this accurately in order to present survey data in a scaled plan and then set out using this information. You should link both the theory and practical criteria together to allow learners to practise surveying skills both inside and outside of the classroom.

There are excellent opportunities to develop strong links with local employers during this unit, including guest speakers or guided tours so that learners can gain first-hand knowledge of surveying, planning and setting out.

Observations of learners completing work experience could be used as evidence where appropriate throughout this unit.

Learning aim A – Investigate methods used in linear and level surveying of sites

- For learning aim A1, you could invite a guest speaker from a local landscaping business to introduce learners to both linear and level surveying processes. This introduction could outline what each process involves and how digital technology has affected their work. You should arrange guest speakers with the unit specification to work from in advance to ensure unit coverage.
- Facilitate a discussion on the methods used for a nominated site to be surveyed using grid referencing/bearing with OS maps and GPS coordinates. Examples of these could be brought in and shown to learners. You could facilitate the identification of additional survey information to develop a site inventory including boundaries, existing features and trees present in the survey area.
- You could deliver a presentation on the methods used to record linear site data including worked examples of booking sheets, recording of site aspect and site outline sketch, along with blank templates for learners to fill in after being set worksheets of data to be recorded.
- You could arrange for learners to complete a practical task outside where they can practise collecting data of curvilinear lines and trees, including their canopy, girth, utility services and external buildings details. This should include windows, doors, drainpipes and manholes. You can show examples of previous techniques used to record this data once collected.
- You could deliver a practical demonstration on how to use linear surveying equipment such as survey tapes, ranging poles, measuring wheel and fixing pins, as well as current digital methods used to conduct linear surveying (e.g. total stations and GPS). Learners could then practise using this equipment in pairs.
- Facilitate a discussion on the methods used for a nominated site to be surveyed for OS (Ordinance Survey) benchmarks, contour plans, falls and slopes, and how to identify topographical rise and fall. Discuss the provision of a suitable fixed-site datum and the considerations for its selection. For example, a fixed and permanent point on site, door threshold, known OS benchmark etc. You could give learners examples of these to discuss in small groups.

- Facilitate a classroom-based activity where learners are to identify different level survey types (or this could take place on site with an employer). Learners should be shown spot heights, grid surveys and cross-section surveys, as well as how to identify backsights, intermediate sights and foresights with examples so each can be put into context. Learners could then get into pairs and be allocated one of the survey types each to research and present to the class.
- You could deliver a presentation on the methods of recording level survey site data using a rise and fall notebook with examples. You could also show methods of checking accuracy by providing learners with worked examples to check on a rise and fall notebook, including manual calculation checks and digital rise and fall spreadsheet formula templates.
- Learners could get into small groups and be given task sheets with survey measurements to interpret, including the identification and calculation of a rise or fall, reduced levels relating to an actual OS benchmark, or a suitable imposed site datum.
- You could organise a visit where learners are taken to a site with significant level changes and be shown the techniques for surveying these. (If this is not possible, learners could be shown pictures and techniques on the interactive board instead.)
- You could arrange a practical task outside for learners to practise collecting data, showing them different examples of the techniques used to record this data once collected. Learners could then be given the opportunity to record their data using a template of a rise and fall notebook.
- You could demonstrate to learners how to use level surveying equipment, including the set up methods of moving equipment and recording on the notebook including backsights, intermediate sights and foresights. You should also show learners the different techniques used when carrying out and reading measurements. In pairs, learners could then practise using these.
- You could organise a site visit where learners can experience first-hand the implications of site conditions and how to record measurements that affect survey accuracy. Guest speakers could be given the specification for learning aim A2 to deliver on site using examples where possible (see specification).
- As an active learning task, learners could be asked to individually list the site conditions and common issues they could face when completing surveys. Possible answers should include:
    - trips and falls
    - hidden hazards
    - debris
    - above height hazards
    - unprotected services/utilities
    - broken and faulty equipment (e.g. stretched tapes, optical levels out of service)
    - site safety issues during inclement weather
    - linear surveying on slopes
    - multiple visual and physical obstacles.

  Once identified, you should facilitate a class discussion on what can be done about these potential issues and constraints.
- As a formative assessment activity, learners could complete a short test where they have a list of survey measurements including: offsets, triangulation and levels that require recording correctly; rise and fall calculations that require accuracy checks; survey tapes examples and level survey measurements that require reading accurately; and scenarios that could be written to confirm their learning for learning aim A.
- Ensure you give learners the necessary time to complete the summative assessment activity. Learners should be given an assignment brief to produce a report analysing the different methods and approaches used to carry out linear and level surveying.

Learning aim B – Undertake linear and level surveying of sites to produce accurate data and representations

- For learning aim B1, show learners a series of short health and safety videos that identify the differences between a 'hazard' and a 'risk', safe lifting procedures and the correct use of personal protective equipment (PPE).
- As a formative assessment activity, learners could individually identify the hazards and risks of carrying out linear and level surveys and produce risk assessments that identify these hazards when carrying them out. This should cover:
    - correct and safe selection, use, transport and carrying of equipment
    - potential hazards when using equipment for the user and others
    - adverse weather conditions
    - working alone or public access areas
    - hidden site hazards
    - safe working procedures to ensure protection of self and others
    - correct use of personal protective equipment.
- For learning aim B2, you will need to describe and demonstrate how to carry out both linear and level surveying. For linear surveying, learners could investigate how to find and use available pre-survey information and documentation, that might include:
    - services plan
    - geographical information systems (GIS) for climate and soil
    - planning restrictions or developments
    - land-ownership documentation.
- You could deliver a presentation on dealing with complex survey areas. Learners could be given tasks sheets with examples of different areas to discuss in small groups; these should include: shapes using single and multiple baselines (i.e. curvilinear borders or pond), and working around obstacles and irregular-shaped sites.
- As a practical assessment activity, learners could individually carry out a linear survey of an area provided by you, using offsets to achieve accuracy and apply recording methods of data. They should use triangulations to achieve accuracy and apply recording methods of data including perimeters, garden features and key vegetation.
- For level surveying, learners could investigate how to identify a datum point, cross-section survey, spot heights and grid survey.
- For learning aim B3, show learners how to use drafting equipment that includes a drawing board with parallel motion, scale ruler, protractors and compass. Learners are then to individually produce an overall linear plan of their site, selecting the correct scale for the paper used and correct setting out techniques with a board, title, information panel with aspect, drawing name, scale and key.
- Learners could carry out a level survey using methods for the relocation and moving of level surveying equipment within the given survey, using calculation techniques to interpret the backsight, foresight and intermediate sights in developing rise or fall. Ensure they show the application of the techniques required for recording the data.
- Learners could individually present a level survey booking sheet producing reduced levels that relate to OS benchmark or a selected datum level point with all accuracy checks completed. This will show the plotting of reduced levels on a linear survey plan and a cross-section survey plan that is of a suitable scale and has sufficient detail.

Learning aim C – Carry out setting out on the ground from plans

- For learning aim C1, learners could be given plans to interpret themselves, identifying the individual design elements and the information relating to the height and linear measurements required to aid with setting out on a given site (e.g. dimensions, falls and shape). You could give these examples or learners could interpret each other's plans.
- As a formative assessment activity, learners could individually produce a presentation on their own plans, demonstrating how they have identified their own design elements. Ensure they use their plan to explain the methods they will be using to set out, including how they will identify accurate measurement points of reference and the importance of the direction and fall.
- For learning aim C2, you could organise a series of practical activities (see specification) where learners carry out setting out on the ground using their plans. Give learners case studies where they can complete the application of a 3,4,5 triangle and a fall for a patio/land drain at 1:100 and 1:80. Learners should select and use the relevant equipment and resources safely and correctly, using various techniques that accurately aid the setting out of various elements on site and use these techniques to apply proposed levels. You will gather evidence for the learners' summative assessment by using video recordings, photographic evidence and/or observation records to add to their portfolios.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 7: Work Experience in the Land-based Sectors
- Unit 42: Landscape and Garden Design
- Unit 43: Constructing Decorative Landscape Features.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Internationals in Agriculture/Horticulture/Land-based subjects. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Videos

To support the teaching of this unit search for videos featuring linear and level surveying, as well as assessing hazards and risks.

Websites

Association of Professional Landscapers (APL) – finds local high-quality landscape businesses and gives helpful advice, guidance and up-to-date news for the sector

British Association of Landscape Industries (BALI) – is useful for finding local landscape businesses and giving helpful advice and guidance

Health and Safety Executive – gives essential information on staying safe in the workplace

Joint Council for Landscape Industries (JCLI) – gives guidance and support for those working in the industry

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.