Unit 45: Computer-aided Design in Horticulture

Delivery guidance

This unit is an optional unit for the Extended Diploma programme (1080 GLH) and will give learners the skills and knowledge required to use computer-aided design (CAD) software and hardware in order to produce two-dimensional (2D) and three-dimensional (3D) drawings. Learners will also be taught the skills required to produce models of horticulture products and landscape gardens, along with the knowledge of how to edit and modify them accurately.

Teaching this unit alongside other units will enable learners to demonstrate their skills when producing portfolio evidence, as it gives them the opportunity to include both 2D and 3D plans and models. Access to CAD workstations, 2D CAD software, 3D modelling software and output devices are essential for this unit.

This unit allows for you to forge connections with a range of local professionals, such as a landscape draftsperson or technician, and businesses that can be used to offer support by hosting external visits and/or providing guest speakers.

Approaching the unit

This unit requires learners to use computer-aided design workstations and software from the very beginning. Learning aims may be combined so that the theory is taught alongside practical CAD tasks, helping learners to put the unit into context. Other units could be linked where appropriate – for example, Unit 4: Work Experience in the Land-based Sectors where learners will work directly within areas of horticulture. In addition, units where CAD drawing could be used within portfolio evidence could include *Unit 42: Landscape and Garden Design*, *Unit 43: Constructing Decorative Landscape Features* and *Unit 44: Linear and Level Surveying*.

Guest speakers could be invited to show learners examples of 2D and 3D plans and models, as well as providing them with industry advice on using computer-aided design software within horticulture.

For learning aim A, learners will be taught how to produce 2D computer-aided design plans. This will begin with learners being shown how to use a range of drawing commands. Learners will be introduced to 2D CAD systems with tutor-led demonstrations. This could be done using an interactive board or by producing step-by-step worksheets as a guide. Learners will need time to practise using the CAD systems after being shown how to use configuration, drawing commands, polar array for features, display commands and how these can be modified.

Demonstrations will continue to show learners how to develop 2D horticultural drawings. They will be introduced to a range of drawing commands, the use of layers, object controls, the use of blocks and symbols, using modification and dimensioning. You will introduce international standards so that learners will be able to effectively develop their own drawings meeting these.

Tutor-led demonstrations will include showing learners how to output their 2D drawings, which will involve the setting up of output parameters, creation of the design plan and final layout. This will include file name, annotations and printing in scale.

For learning aim B, learners will be taught how to produce a 3D element based on a computer-aided garden design plan. They will be shown 3D modelling and modelling commands (see unit specification). This could be demonstrated also by using an interactive

board or by producing step-by-step worksheets as a guide. Learners must be given time to practise new skills ready to start developing their 3D component.

Tutor-led presentations and examples can be used to show learners how to develop a 3D component which will include you showing the placement of components, assembly constraints, modification to 3D components and consideration of assembly. You could also demonstrate storyboarding to support learners with this process.

Your presentations should emphasise the importance of meeting British and industry standards when producing drawings. Guest speakers from the Landscape Institute (LI), the Society of Garden Designers (SGD) or the Royal Institute of British Architects (RIBA) could be invited into the centre to talk about the standards with learners.

You should demonstrate and show examples of drawing templates, facilitating learners' creation of their component drawings, allowing them sufficient time to do this meeting the required standards.

For learning aim C, learners will produce 2D construction detail plans and a planting schedule based on 3D features. Learners will use the knowledge and skills gained so far to include construction detailing on their plans.

A site visit to look at planting plans and plant schedules against works completed would support learning and give learners a 'hands-on' idea of how planting zones are configured on plans; the graphics used for different plant types; data included; and the reports and schedule development. Learners should then be given time to produce their plans and schedules, meeting international standards and output their product drawings as instructed.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Produce a 2D computer-aided garden design plan	**A1** Using 2D drawing commands **A2** Developing 2D horticultural drawings **A3** Output of 2D drawings	A practical drawing activity to produce computer-aided 2D drawings of a garden design, using layers.
B Produce a 3D element based on a computer-aided garden design plan	**B1** 3D modelling and modelling commands **B2** Developing a 3D component **B3** Output of drawings from a model	A 3D model of three 3D elements of a computer-aided garden design plan and three drawings of the 3D model with multiple viewports. Two 2D construction detail plans containing multiple 2D views and technical information, and a planting plan and schedule for a 15 m^2 area.
C Produce 2D construction detail plans and a planting schedule based on 3D features	**C1** Construction detailing **C2** Planting plan and plant schedule **C3** Output of product drawings	

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 aim A, learners will be required to produce an accurate horticultural plan from an image or site-conditions plan imported from an external source, such as Drawing Interchange Format (DXF) or Global Positioning System (GPS) data. The plan will be for a landscaped garden design to cover an area of between 150–250 m^2.

The design will contain a series of layers containing well-orientated features. The plan will contain clear zoning and space allocation of a multiple array of garden features.

Learners will show they can select and use appropriate CAD commands evidenced via screen dumps with a supporting third-party observation. Learners will produce a portfolio of drawings that will demonstrate a scaled, existing site-conditions plan, a landscape garden design plan, screen dumps and supporting documentation

For learning aims B and C, learners will individually produce three 3D decorative landscape features from aspects of the 2D landscape garden design plan produced in learning aim A. Learners will also individually produce two 2D construction detail plans for two of the 3D features, along with a planting plan and schedule.

Learners will create a portfolio of drawings to demonstrate the three 3D models, and will show orientated multiple viewports, screen dumps and supporting documentation. The drawings will be produced to a relevant international standard, as indicated in the unit content.

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 45: Computer-aided Design in Horticulture

Introduction

Learners will be taught how to develop two-dimensional (2D) detailed drawings and three-dimensional (3D) models using a computer-aided design (CAD) system. There are excellent opportunities to bring in guest speakers (e.g. landscape surveyors, technicians, architects or draftspersons) who can discuss the subject with learners.

Learners will be introduced to CAD equipment and learn to use both CAD software and hardware. You should link the teaching of knowledge and practical criteria together to enable learners to practise using their CAD skills.

There are excellent opportunities to develop strong links with local employers during this unit with site visits being arranged to put learning into context.

Learning aim A: Produce a 2D computer-aided garden design plan

- For learning aim A1, you could start by arranging a visit to a local stately home, National Trust property or landscaped green area to look at a range of landscape design ideas. While on the visit, learners could create their own ideas board to bring back to the classroom.
- Lead a demonstration using the interactive board. Learners will be shown 2D drawing commands while following directions using their own CAD machines. Demonstrations should include:
  - configuration of a 2D CAD system including format units, snap and automatic snaps, grid, precision, angular, drawing limits, layers, user coordinate system, world coordinate system and file systems
  - use of drawing commands, including *line*, *arc*, *circle*, *polyline* and *open circle*
  - use of polar array for relevant features, e.g. step stones, fence posts, panels, pergolas
  - use of display commands, including *pan* and *zoom*
  - use of modify commands, including *erase*, *trim*, *mirror*, *move*, *array*, *copy*, *undo* and *stretch*.
- Guest speakers could be invited to host a workshop showing learners a range of example 2D and 3D plans and models, as well as giving industry advice on using computer-aided design software within the horticulture industry.
- You could deliver a presentation on the importance of international standards with examples. Learners could get into small groups and be given plans that meet standards and those that don't in order to discuss and compare them.
- For learning aim A2, facilitate a practical task using CAD. Learners will be able to practise using 2D drawing commands using screen dumps to evidence their work completed so far.
- As a formative assessment task, learners will be asked to research symbols and blocks to create a glossary for their own understanding and to refer to when developing their plans.
- Learners could follow an assignment brief containing instructions on how to create a horticultural plan for a landscaped garden design which they will follow individually. Learners should produce clear, accurate drawings with accurate scaling to cover an area of 150 to 250 m^2. Instructions will include the use of drawing commands, layers, blocks and symbols, dimensioning and ways to modify commands.
- Learners should begin to build their portfolio of drawings, which should demonstrate a scaled, existing site-conditions plan, a landscape garden design plan, screen dumps and supporting

documentation. The evidence should contain well-orientated 2D components with elements on appropriate layers and control demonstrated in the use of editing and manipulation tools.

- For learning aim A3, facilitate a tutor-led discussion on the requirements of output parameters. In small groups, learners will be allocated one of the following headings: paper size, units, plot area, scale, orientation, paper space, model space, model and layout drawing, template to discuss and feedback.
- You could deliver a presentation using examples about the creation of the design plan. This should include orthogonal views, appropriate scale and requirements of a final layout plan.
- In pairs, allocate learners with an example of a final layout plan that has items missing, such as: CAD file name, drawing title, date, drawn by details, outer frame, callouts, title block with scale, annotations to identify material types and heights of elements. Learners should then identify the missing elements and add these to the plans.
- You should carry out practical observation of learners as they print in scale and use colour, textures and line style appropriately when creating their final layout plan.
- Allocate time for learners to complete their summative assessment where they must produce a computer-aided 2D drawing of a garden design, using layers.

Learning aim B: Produce a 3D element based on a computer-aided garden design plan

- For learning aim B1, you could carry out a tutor-led demonstration using the interactive board. Learners will be shown 3D modelling and modelling commands while being able to follow directions using their own CAD machines. Demonstrations should include:
    - configuring the parametric modeller, including origin, units, snap and grid, correct format, project files, selection of file types and planes, e.g. XY, XZ and YZ
    - sketching commands, including *line* and *polyline*, *arc*, *centre line*, *construction line*, *circle*, *fillet* and *dimension*
    - display commands, including *pan*, *zoom* and *orbit*
    - editing commands, including *erase*, *extend*, *trim* and *rotate*
    - construction commands (see unit specification)
    - 3D features, including fillet and chamfer
    - combination of solid objects, including Boolean operations
    - 2D sketching on 3D faces
    - modification of the 3D model, including addition of features to existing geometry, e.g. move, projected geometry, extrusions.
- As a formative assessment activity, you could facilitate a practical task by giving learners instructions to follow in order to create 2D sketches (including basic shape, dimensioning, modifications and geometric constraints), then use those 2D sketches to make a 3D model (including rotate about an axis, revolve, extrude and Boolean manipulation) using screen dumps as evidence.
- For learning aim B2 you could deliver a presentation to show decorative 3D components landscape features such as a gazebo or pergola and how these will be assembled into a 3D model with the components orientated correctly. You should cover the placement of components, assembly constraints, modifications and considerations of assembly.
- You could deliver a presentation on the importance of meeting British and Industry Standards when producing drawings. Guest speakers from the Landscape Institute (LI), the Society of Garden Designers (SGD) or the Royal Institute of British Architects (RIBA) could be invited in to talk about these with learners. This presentation should also look at assembly constraints and the relationships between components – angle constraints, insert constraints and tangent constraints, placing of texture, moving and rotating objects.

- In pairs, learners could be given examples of 3D plans with a range of displays to be presented. You could invite a potential customer such as a local employer or a colleague to act as the audience and give learners feedback. Following on from this, learners could evaluate their plans and present their strengths and weaknesses to the rest of the class.
- Learners could follow an assignment brief containing instructions on how to create a set of three 3D decorative landscape features from aspects of their 2D landscape garden design plan. Drawing templates will be created to contain the three 3D models. These will show orientated multiple viewports that would enable the output of a professional portfolio of 3D drawings. The evidence will include a 3D shaded or solid model with multiple viewports that evidences each of the 3D models. They should demonstrate an understanding (and show application of) placement, assembly modification and assembly considerations.
- Learners should build their portfolio of drawings which should demonstrate the three 3D models and show orientated multiple viewports, screen dumps and supporting documentation, while also meeting their purpose displaying a visualisation to a potential customer.
- For learning aim B3, you could facilitate an information-gathering exercise (using the interactive board) on output of drawings from a model. Information gathered should include:
  - evidence that learners have met British and industry standards – the Landscape Institute (LI), the Society of Garden Designers (SGD) or the Royal Institute of British Architects (RIBA) when producing drawings
  - 2D paper space, drawing template, scale, size, title block and editing
  - creation of component drawings, including an orthogonal base view and projected views, 3D solid model/surface model, appropriate scale, detail views, dimensioning and centre lines.
- You should carry out practical observation of learners using correct output as information gathered above that can be included as evidence.
- Allocate time for learners to complete their summative assessment where they must create a professional portfolio of drawings as indicated in their brief. The portfolio of drawings will meet a relevant international standard.

Learning aim C: Produce 2D construction detail plans and a planting schedule based on 3D features

- For learning aim C1, you could carry out a demonstration using the interactive board. Learners will be shown construction detailing that should include:
  - configuration of the parametric modeller, e.g. origin, units, snap and grid, correct format, project files, selection of file types, planes such as XY, XZ and YZ
  - extraction of 2D plan and 3D elements to a given layer, including basic shape, dimensioning, modifications and geometric constraints (see unit specification)
  - use of callout annotations for the provision of specification and technical information, e.g. mortar mixes, types of material to use and dimensions.
- Arrange a landscape site visit where learners can observe a completed job so they can compare this with their own planting plans and plant schedules.
- For learning aim C2, you could show learners a range of example plans that detail planting zones and facilitate a classroom discussion on plant types and seasonal interest areas while discussing software graphics and data.
- As a formative assessment activity, learners should configure planting zones using layer(s) for an area from 15 m^2 to include a tree, shrubs, herbaceous and bulb plants (e.g. seasonal interest border). Learners will use software graphics for plants and include data such as plant data, images, planting distance, prices and pot sizes.
- Learners could individually research the use of reports and write some questions on what's required in preparation for the guest speaker.

- A guest speaker (e.g. a landscape surveyor, technician, architect, project manager or draftsperson) could be invited in to explain reports and schedule development while answering learners' predetermined questions in a Q & A session.
- Allocate learners the time to continue with their summative assessment activities. They should produce a plant selection plan identifying a minimum of one tree species, five shrub species and 15 herbaceous and/or bulb species with an accurate schedule to identify pot or plant size and relevant plant information. Learners will also be required to give information regarding maintenance requirements.
- Learners should create a drawing template to output a professional portfolio of drawings for C3, including appropriate orthographic drawings, and will display information to a potential customer to see. You could arrange for the potential customer to be a local employer or a teaching colleague who could give feedback to learners on whether the information displayed is clear for a third party to understand.

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

This unit links to:

- Unit 27: Identification, Planting and Care of Plants
- Unit 28: Routine Plant Management
- Unit 34: Identification, Planting and Care of Trees
- Unit 42: Landscape and Garden Design
- Unit 43: Constructing Decorative Landscape Features
- Unit 44: Linear and level Surveying.

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.

Textbooks

Wilk S *Drawing for Landscape Architects: Construction and Design Manual* 2e, Dom Publishers, 2016. ISBN 9783869225357 – this book includes useful information on planning design and construction.

Videos

To support the teaching of this unit, search for videos featuring the use CAD in horticulture.

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.