

Unit 8: Graphical Detailing in Construction and the Built Environment

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Clear and appropriate communication of information is vital to the successful design and construction of building and civil engineering projects.

Drawings have a number of uses depending on which stage of the project is being considered. During the early stages of a design it is important to have an overview of the project. Then, as the elements or components of the design evolve, detailed drawings are required to show their individual methods of construction, shape and dimensions so that they can be fabricated or set out. It is also common practice to include written specifications for the workmanship and/or materials on the drawings.

At any stage it is crucial that the graphical information shown is clear, accurate and correct. Drawings forming part of the contract documents for a project are legally binding. If a drawing is badly produced or presented, then it is unlikely that the resulting project will be fit for its purpose.

Learners will come to appreciate, the layout of drawings, the choice of scale and proportion, the types of views used, the use of correct line widths, conventional graphic symbols and the appropriate use of annotation. They will be able to understand drawings, demonstrate a basic knowledge of graphical conventions, and have the skills required to produce graphical information using manual techniques. They will also be able to describe the uses and benefits of Computer-Aided Design (CAD) in producing graphical information.

Learning outcomes

On completion of this unit a learner should:

- 1 Know the main equipment, media and techniques used in the production of manual and CAD graphical information
- 2 Understand the use of CAD and its benefits in the production and management of graphical information
- 3 Be able to read and understand a variety of graphical drawings, details and schedules
- 4 Be able to produce graphical drawings, details and schedules using traditional manual drafting techniques.

Unit content

1 Know the main equipment, media and techniques used in the production of manual and CAD graphical information

Equipment: hand drafting equipment (pens, pencils, scale rules, erasers, erasing shields, adjustable set squares, compasses, templates and flexible curves, stencils, parallel motion drawing boards, drafting tape); CAD equipment (computer hardware, design and detailing software, plotters, intranets and project extranets)

Media: grades of pencil (HB, H, 2H); ink (pens 0.2, 0.25, 0.4, 0.5 mm thick); CAD plotter pens; paper (detail paper, cartridge paper, tracing paper, A1, A2, A3 and A4 sizes); reprographics, including photo-static methods; CAD plotter procedures; loading plotter rolls

Techniques: British Standards, Co-ordinated Project Information; Uniclass and CISfB systems; manual techniques (drawing lines and shapes, drawing to scale, lettering and dimensioning, graphic conventions, use of standard symbols, projection techniques); CAD techniques (set-up/drawing/editing/zoom commands, layers, line weights, drawing scale, model view and paper view, plotting methods)

2 Understand the use of CAD and its benefits in the production and management of graphical information

Production of CAD drawings: availability of specialist industry-related applications for 2D drawings and 3D virtual models; linked scheduling, layouts; exploded diagrams; rendering; walk-throughs; photo-realisation

Management of CAD drawings: DWG/DXF/DWF formats; workflow tracking and reporting; real time mark-up and reviews; sharing/security and back-up issues

3 Be able to read and understand a variety of graphical drawings, details and schedules

Drawings and details: extraction of constructional and dimensional data for 2D and 3D as appropriate to the vocational pathways; planning and surveying drawings; preliminary sketch drawings; design drawings, production drawings; structural and civil engineering drawings; fabrication drawings; component drawings; services drawings; layout drawings; freehand sketches

Schedules: specification information; schedules; steel fabrication design data; reinforced concrete bar bending schedules; timber cutting lists

4 Be able to produce graphical drawings, details and schedules using traditional manual drafting techniques

Graphical drawings and details: plans; elevations; sections; details; projections (isometric, axonometric, orthographic, developments, as appropriate); sketches; perspectives; presentational charts; schematic diagrams. All as appropriate to the vocational pathways

Schedules: specification information; schedules; steel fabrication design data; window and door schedules bending schedules; timber cutting lists

Grading grid

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

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 identify and describe equipment and media used to produce manual and CAD drawings and information		
P2 identify and describe the types and formats of CAD information	M1 compare the use of manual and CAD techniques in the production and presentation of graphical information	D1 evaluate how the quality of graphical information relates to the quality of the final constructed project
P3 identify and describe the main factors in the organisation and management of CAD information		
P4 identify and describe correct drawing standards, conventions, layouts and presentation techniques	M2 extract and relate clear, accurate and valid information from a range of graphical sources, details and schedules	
P5 produce simple 2D and 3D graphical drawings using traditional manual drafting techniques	M3 select and apply manual techniques and resources to produce complex graphical information.	D2 demonstrate a professional level of technical skill, neatness and accuracy in the production of manual graphical information.
P6 produce graphical information in the form of simple specifications and schedules.		

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 the use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject.

The learning outcomes form an equal split between knowledge of graphical detailing and the application of manual techniques and methods. Learning outcomes 1 and 2 are linked and form a sound basis for understanding both manual and CAD detailing techniques. Learning outcomes 3 and 4 are also linked and relate to the development and use of mainly manual detailing skills.

Teaching and learning strategies designed to support delivery of learning outcomes 1 and 2 should take an integrated learner-centred approach. This would involve learners in undertaking practical activities and researching equipment, media, methods and detailing techniques; for example learners could undertake research to produce a *Beginners' Guide to Detailing* booklet. Learning outcome 2 relating to CAD can be delivered without using CAD software or plotting routines, however some 'hands-on' development activities would be advantageous to enable learners to make experiential comparisons between CAD and manual techniques.

Learning outcomes 3 and 4 are linked closely to the development and practice of detailing skills, both in reading and understanding drawings, and in producing these using manual techniques.

It is recommended that learning outcome 3 be delivered and assessed with learners having access to a variety of current drawings that relate to their particular vocational path. Learners should be allowed to make comparisons between real drawings and current best practice as outlined in British and European Standards. Learning outcome 4 requires sufficient time for learners to practice detailing skills during which formative feedback should be provided on the progress of the learner's graphical skill development.

Group activities are permissible, but tutors will need to ensure that individual learners are provided with equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be strictly reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken prior to practical activities. Centres are advised to read the *Delivery approach* section on page 24, and *Annexe G: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

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 employed, and tutors are encouraged to consider and adopt these where appropriate. Some examples of possible assessment approaches are suggested below. However, these are not intended to be either prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable. General guidance on the design of suitable assignments is available on page 19 of this specification.

Some criteria could be assessed directly by the tutor during practical activities. If this approach is used, suitable evidence from guided activities 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 may be fully addressed by using two assignments. The first of these would cover criteria P1, P2, P3, M1 and D1 and could be in the form of a structured report. The second assessment would cover criteria P4, P5, P6, M2, M3 and D2. Alternatively, this second assessment could be split into two parts using an oral presentation for P4 and M2 and a drawing project for P5, P6, M3 and D2.

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

For P1, learners must identify and describe equipment and media used to produce manual and CAD drawings and information. They should demonstrate knowledge of equipment and techniques and how they are used to ensure the quality and consistency of the presentation of the final drawing. With regard to CAD, the learner needs to demonstrate an appreciation of the hardware, software and interface technologies, such as the existence of a main server and internet links.

For P2, learners have to identify and describe the types and formats of CAD information. They should show an understanding of the various formats in which CAD is used to present visual information but is not required to produce details and drawings. Evidence from software companies' product literature and websites is acceptable provided that the learner demonstrates an understanding of the benefits of the different formats and their uses.

For P3, learners must identify and describe the factors in the organisation and management of CAD information. They need to have an overview of the 'back-office' functions of CAD which are available to manage, monitor and store drawings in digital format. Learners must understand the purpose of these functions but detailed technical explanations of how they operate are not required.

For P4, learners are required to identify and describe correct drawing standards, conventions, layouts and presentation techniques. This should include a working knowledge of how drawings are set out and presented according to current industry practice. They should be able to appraise a set of drawings and identify good and bad practice with reference to current standards.

For P5, learners have to produce simple 2D and 3D graphical drawings using traditional manual drafting techniques. This requires demonstration of an ability to produce a range of projections and views for given arrangements and elements of a typical construction project. The skill level demonstrated should be acceptably proficient. The work should have minimal linework errors, be well laid-out, neat, accurate and 'fit for purpose'.

For P6, learners must produce graphical information in the form of simple specifications and schedules. This should include textual information on the drawings which is acceptably positioned, annotated and neatly presented. They should also be able to extract and present information in the form of tables or schedules according to the vocational discipline studied. The content of the specification can be reproduced from standard construction details and the learner should not be assessed on technical specification knowledge, but on how it is presented.

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

For M1, learners must compare the use of manual and CAD techniques in the production and presentation of graphical information. They need to provide a balanced comparative evaluation of the use of CAD and manual techniques in terms of convenience, speed, safeguards required, financial outlay, quality of output and storage issues. The advantages of each should be explained qualitatively with respect to their 'fitness for purpose'.

For M2, learners should extract and relate clear, accurate and valid information from a range of graphical sources, details and schedules. They must be able to appraise a range of given graphical information sources for their fitness and conformity with current drawing standards. The information provided in the drawings and details must be used to extract or create further details, sections or elevations, etc – all to current best practice and standards.

For M3, learners have to select and apply manual techniques and resources to produce complex graphical information. They should produce linked graphical information centred on a construction project with minimum tutor support. A sound level of knowledge and understanding of current drawing standards and conventions should be demonstrated. The level of skill should be that approaching a professional detail in its layout, choice of scales, accuracy and neatness. Similarly, schedules should be well produced and accurate.

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 have to evaluate how the quality of graphical information relates to the quality of the final constructed project. They should explain how the clarity, neatness, accuracy and consistency of drawings, as part of the contract documentation, influences the quality of the completed project. Examples of good practice should be cited and discussed with reference to case studies where Co-ordinated Project Information, Uniclass and CISfB systems are utilised.

For D2, learners should demonstrate a professional level of technical skill, neatness and accuracy in the production of manual graphical information. The learner should independently produce linked graphical information centred on a construction project and must demonstrate a thorough knowledge and understanding of current drawing standards and conventions. The level of skill and the choices made should lead to professionally comparable drawings and details that accurately communicate the required purposes.

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

The learning outcomes in this unit are closely linked with, for example, *Unit 5: Construction Technology and Design in Construction and Civil Engineering*; *Unit 6: Building Technology in Construction* and *Unit 7: Planning, Organisation and Control of Resources in Construction and the Built Environment* together with similar units at Higher National and degree level.

This unit may have links to the Edexcel Level 3 Technical and Professional NVQs for Construction and the Built Environment. Updated information on this, and a summary mapping of the unit to the CIC Occupational Standards, is available from Edexcel. See *Annexe D: National Occupational Standards/mapping with NVQs*.

The unit provides opportunities to gain Level 3 key skills in communication and information and communication technology. Opportunities for satisfying requirements for Wider Curriculum Mapping are summarised in *Annexe F: Wider curriculum mapping*.

Essential resources

Learners should be encouraged to provide their own basic drawing equipment for use at home and in the centre. Learners will need guidance in making purchases and should be encouraged to obtain good-quality equipment. Drawing facilities should also be provided by the centre, together with access to CAD facilities to enable learners to produce drawings using CAD should they choose.

There is no requirement for learners to use CAD but it would be beneficial to undertake development activities in the use of CAD if these facilities are available at the centre. Learners will be expected to have access to information about CAD applications and their use.

Learners will also need access to a wide range of existing industry-standard graphical information sources such as drawings, details and schedules. Local professional practices are a useful source of such information, provided the necessary copyright permissions are sought.

Indicative reading for learners

Textbooks

BSI – *Construction Drawing Practice, BS1192 Part 5* (British Standards Institute, 1999) ISBN 0580295141

Ching F D K – *Architectural Graphics* (John Wiley & Sons Inc, 2002) ISBN 0471209066

Fukai D – *Graphic Communications in Construction* (Prentice-Hall, 2002)
ISBN 0130605522

Hill M – *Small Practices – A Guide to Drawn Information* (RIBA Publications, 1999)
ISBN 1859460518

Jenkins D, et al – *Architects' Working Details Volumes 1 to 7*
(EMAP Business Communications, 1989) ISBN 1870308409

Muller, Fausett and Grau – *Architectural Drawing and Light Construction*
(Prentice-Hall, 2002) ISBN 0130271586

McFarlane B – *Beginning AutoCAD 2002* (Butterworth-Heinemann, 2004)
ISBN 0750656107

Porter and Goodman – *Manual of Graphic Techniques, Volume 4*
(Architectural Press, 1985) ISBN 075061627

Reekie F and McCarthy A – *Reekie's Architectural Drawing* (Architectural Press,
1995) ISBN 0340573244

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Tutors should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Communication Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> identifying and describing equipment and media used to produce manual and CAD drawings presenting an appraisal of the quality of a given set of existing drawings for compliance with current standards comparing and evaluating the use of manual and CAD techniques in the production and presentation of graphical information. 	<p>C3.1a Contribute to a group discussion about a complex subject.</p> <p>C3.1b Make a presentation about a complex subject, using at least one image to illustrate complex points.</p> <p>C3.2 Read and synthesise information from two extended documents about a complex subject. One of these documents should include at least one image.</p> <p>C3.3 Write two different types of documents about complex subjects. One piece of writing should be an extended document and include at least one image.</p>
Information and communication technology Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> using the internet and other electronic media to research and gather information on graphical detailing using ICT processes to produce the assessment evidence. 	<p>ICT3.1 Search for information, using different sources, and multiple search criteria in at least one case.</p> <p>ICT3.2 Enter and develop the information and derive new information.</p> <p>ICT3.3 Present combined information such as text with image, text with number, image with number.</p>