Unit 8: Graphical Detailing in Construction and the Built Environment

Unit code: A/600/0222

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit gives learners the opportunity to produce 2D and 3D graphical drawings using manual drafting techniques and to produce graphical information in the form of simple specifications and schedules.

Unit introduction

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

Drawings are used in a number of ways 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 the 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 graphical information 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 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 develop the skills required to produce graphical information using manual techniques. Learners 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 graphical information

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

3 Be able to interpret graphical drawings, details, schedules and specifications

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

Unit content

1 Know the main equipment, media and techniques used in the production of manual 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)

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

Techniques: drawing lines; drawing shapes; drawing to scale; lettering and dimensioning; graphic conventions; use of standard symbols; projection techniques, standards and conventions eg British Standards, Coordinated Project Information, Uniclass system, CISfB system

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

CAD techniques: commands (set-up, drawing, editing, zoom); layers; line weights; drawing scale; model view; paper view; plotting methods

CAD information: 2D drawings; 3D virtual models; linked scheduling; layouts; exploded diagrams; rendering; walkthroughs; photo-realisation

CAD drawing management: workflow tracking and reporting; real time mark-up and reviews; sharing/security and back-up issues

Benefits: electronic transmission; ease of amendment; saving; automatic conversion to 3D; walk through

3 Be able to interpret graphical drawings, details, schedules and specifications

Graphical drawings and details: constructional and dimensional data for 2D and 3D; 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 and specifications: specification information; steel fabrication design data; reinforced concrete bar bending schedules; timber cutting lists

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

Graphical drawings and details: plans; elevations; sections; details; 2D and 3D projections (isometric, axonometric, orthographic, developments); sketches; perspectives; presentational charts; schematic diagrams

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

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 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 identify the use of equipment and media used to produce manual graphical information [IE2, IE4, RL4]	**M1** compare the use of manual and CAD techniques in the production and presentation of graphical information	
P2 describe correct drawing standards and conventions [IE2, IE4, RL4, RL6]		
P3 describe manual presentation techniques [IE2, IE4, RL4, RL6]		
P4 explain techniques and uses of different types of CAD information [IE2, IE4, RL4, RL6]		
P5 describe the benefits of using CAD for the production and management of graphical information [IE2, IE4, RL4, RL6]		

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:**	
P6	interpret graphical drawings, details, schedules and specifications [IE2, IE4, CT4, RL4, RL6]	**M2**	extract and report clear, accurate and valid information from graphical sources, details and schedules	**D1**	evaluate how the quality of graphical information relates to the quality of the final constructed project
P7	produce 2D and 3D graphical drawings using manual drafting techniques [IE2, IE4, CT4, RL4, RL6, SM2, SM3]	**M3**	apply manual techniques and resources to produce complex graphical information.	**D2**	produce manual graphical information to a high level technical skill.
P8	produce graphical information in the form of simple specifications and schedules. [IE2, IE4, CT4, RL4, RL6, SM2, SM3]				

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	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

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 expert speakers could add to the relevance of the subject.

The learning outcomes are split equally 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 manual detailing techniques. Learning outcomes 3 and 4 are also linked and relate to the interpretation of drawings and 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 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 can be delivered without using CAD software or plotting routines. However, some 'hands-on' development activities would be advantageous so learners can make experiential comparisons between CAD and manual techniques.

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

It is recommended that for learning outcome 3 learners have access to a variety of current drawings that relate to their particular vocational pathway. 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 practise 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 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
Equipment, media and techniques used in the production of manual graphical information Introduction to equipment and media – discussion/group research Drawing standards and conventions – discussion/group research Manual presentation techniques – demonstration/practical work
Use of CAD and its benefits CAD techniques and information – discussion Benefits of CAD – discussion
Assignment 1: Graphical Detailing Practice and the Benefits of CAD Produce a booklet: Beginner's Guide to Detailing Preparation/delivery of a presentation on the techniques, uses and benefits of CAD
Interpret graphical drawings, details, schedules and specifications Case study Talk by practitioner
Assignment 2: Interpretation Interpretation of given drawings, details, schedules and specifications
Produce graphical drawings, details, schedules and specifications Produce 2D graphical drawings Produce 3D graphical drawings Produce specifications Produce schedules
Assignment 3: Graphical Drawings, Details, Schedules and Specifications Produce graphical drawings, details, schedules and specifications
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, and tutors are encouraged to consider and adopt these where appropriate. 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 could be assessed directly by the tutor during practical activities. If this approach is used, suitable evidence would be observation records or witness statements.

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, P2, P3, P4, P5 and M1 and could be in the form of a booklet, the second would cover criteria P6, M2 and D1 and the third P7, P8, M3 and D2.

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

For P1, learners must identify the equipment and media used to produce manual graphical information. They should demonstrate knowledge of how the equipment is used to ensure the quality and consistency of the presentation of the final drawing.

For P2, learners are required to describe correct drawing standards and conventions. They should be able to appraise a set of drawings and identify good and bad practice with reference to current standards.

For P3, learners are required to describe manual presentation techniques. This should include a working knowledge of how drawings are set out and presented according to current industry practice.

For P4, learners have to explain techniques and uses of different types of CAD information. They do not need to produce details and drawings. Evidence linking to software company product literature and websites is acceptable provided that learners demonstrates an understanding of the uses of CAD.

For P5, learners must describe the benefits of using CAD.

For P6, learners must interpret graphical drawings, details, schedules and specifications. Learners could be presented with case studies that contain information for interpretation.

For P7, learners must produce 2D and 3D graphical drawings using manual drafting techniques. This requires demonstration of the ability to produce a range of projections and views for given arrangements and elements of a typical construction project. The level of skill demonstrated should be at least acceptable. The work should have minimal line work errors, be well laid out, neat, accurate and fit for purpose.

For P8, 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 presented neatly. Learners should also be able to extract and present information in the form of tables or schedules according to their vocational pathway. The specification content can be reproduced from standard construction details and learners 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 report clear, accurate and valid information from graphical sources, details and schedules. They must be able to appraise given graphical information sources for their fitness for purpose and conformity with current drawing standards. The information provided in the drawings and details could be used to extract or create further details, plans, sections and elevations for use in M3.

For M3, learners have to 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 of a good quality with accurate 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, influence the quality of the completed project. Examples of good practice should be cited and discussed with reference to case studies of Co-ordinated Project Information, Uniclass and CISfB systems.

For D2, learners should produce manual graphical information to a high level technical skill. This requires neatness, clarity and accuracy in the production of manual graphical information. Learners should, independently, produce linked graphical information centred on a construction project and 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 communicate the required purposes accurately.

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 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, P5, M1	Graphical Detailing Practice and the Benefits of CAD	You are asked, as a consultant, to produce a booklet entitled the *Beginner's Guide to Detailing* for a local training company. As a consultant, you have been asked to deliver a presentation on CAD to the company who are deciding whether or not to implement a CAD system.	Booklet and a presentation for the CAD, in any appropriate format.
P6, M2, D1	Interpretation	A client asks you, as a consultant, to explain graphical drawings, details, schedules and specifications that were produced for their construction project.	A report, possibly supported by tutor questioning and witness testimony.
P7, P8, M3, D2	Graphical Drawings, Details, Schedules and Specifications	A client asks you, as a consultant, to produce graphical drawings, details, schedules and specifications for a construction project.	A portfolio of sketches, drawings, schedules and specifications, all relating to the same construction project.

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
		Construction Technology and Design in Construction and Civil Engineering
		Building Technology in Construction
		Project Management in Construction and the Built Environment
		Surveying in Construction and Civil Engineering
		Building Surveying in Construction
		Computer Aided Drafting and Design for Construction
		Design Procedures in Construction
		Construction in Civil Engineering

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

The unit also links to the following Level 3 NOS:

- BE Design
- Transportation
- Spatial Data Management
- Construction Contracting Operations
- Surveying Property and Maintenance
- BE Development and Control.

This unit has links with the following Higher National units in Construction:

- *Unit 1: Design Principles and Application*
- *Unit 5: Group Project*
- *Unit 12: Refurbishment and Adaptation*
- *Unit 26: Design Procedures*
- *Unit 27: Design Technology*
- *Unit 32: IT Applications – Computer-aided Design.*

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.

There is no requirement for learners to use CAD but it would be beneficial to undertake development activities in using 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 information, provided the necessary copyright permissions are sought. The use of design team information, procedures and documentation, for live or completed construction projects as a basis for assessment tasks would enhance the learning experience by contextualising the study of design procedures.

Employer engagement and vocational contexts

The use of site visits, case studies, project documentation and visiting speakers will add relevance to the unit. 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

Adler D – *Metric Handbook, 2nd edition* (Butterworth Architecture, 1999)

Aubin P – *Mastering AutoCAD Architecture 2008* (Delmar, 2007) ISBN 1428311629

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

Hoboken N J – *Construction Graphics; a practical guide to interpreting working drawings* (Wiley 2004) ISBN 0470137509

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

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

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

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

Rekit A and Langford D – *Computer Integrated Planning and Design in Construction* (Thomas Telford Ltd, 2001) ISBN 9780727730077

Journals

The Architect's Journal – Emap

AT Architectural Design – Chartered Institute of Architectural Technologists

BRE Digests – CMP

Building Magazine – CMP

Contract Journal – *Reed Business Publishing*

Websites

www.bre.com	Building Research Establishment Limited
www.ciat.org.uk	Chartered Institute of Architectural Technologists
www.ciob.org.uk	Chartered Institute of Building

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	identifying the use of equipment and media used to produce manual graphical information
Creative thinkers	explaining techniques and uses of different types of CAD information producing construction drawings amending drawings
Reflective learners	producing construction drawings amending drawings
Self-managers	producing construction drawings amending drawings producing graphical information in the form of simple specifications and schedules.

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	producing the booklet Beginner's Guide to Detailing
Reflective learners	interpreting graphical drawings, details, schedules and specifications
Team workers	participating in group research on drawing standards and conventions
Effective participators	participating in discussions, eg on drawing standards and conventions.

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	producing a booklet *Beginner's Guide to Detailing*
Manage information storage to enable efficient retrieval	producing a booklet *Beginner's Guide to Detailing*
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	producing a booklet *Beginner's Guide to Detailing*
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	producing a booklet *Beginner's Guide to Detailing*
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	producing a booklet *Beginner's Guide to Detailing*
Bring together information to suit content and purpose	producing a booklet *Beginner's Guide to Detailing*
ICT – Develop, present and communicate information	
Present information in ways that are fit for purpose and audience	producing a booklet *Beginner's Guide to Detailing*
Evaluate the selection and use of ICT tools and facilities used to present information	preparing/delivering a presentation on the techniques, uses and benefits of CAD
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating scales for diagrams
Identify the situation or problem and the mathematical methods needed to tackle it	calculating scales for diagrams
Select and apply a range of skills to find solutions	calculating scales for diagrams
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	preparing/delivering a presentation on the techniques, uses and benefits of CAD
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the use of equipment, standards and conventions
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing a booklet *Beginner's Guide to Detailing*