



MINISTRY OF EDUCATION

Design and Communication Technology

for Senior High Schools

TEACHER MANUAL



YEAR THREE



NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION



REPUBLIC OF GHANA

**Design and
Communication
Technology**
for Senior High Schools

Teacher Manual

Year Three



**NATIONAL COUNCIL FOR
CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION**

DESIGN AND COMMUNICATION TECHNOLOGY TEACHER MANUAL

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INTRODUCTION

The National Council for Curriculum and Assessment (NaCCA) has developed the third and final set of curriculum materials to support the implementation of the new Senior High School curriculum.

This Year Three Teacher Manual for Design and Communication Technology covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively support learners in their final year of Senior High School. All the necessary information for the Student Assessment Portal has been included in the Year Three Teacher Manual to simplify the development of weekly learning plans, meaning that teachers have a single reference document.

The Year Three Teacher Manual has two main objectives:

- To support learners to consolidate and deepen their understanding of the content, pedagogy, and assessment across all three years of the new Senior High School curriculum in preparation for the West Africa Senior Secondary Certificate Examination (WASSCE).
- To equip teachers with the tools and resources needed to deliver revision-focused, assessment-led lessons that build on the knowledge learners have acquired from Year One to Year Three.

In this third year, teachers will be supporting learners to prepare for the WASSCE. Each section of the Teacher Manual is therefore structured around the highest Depth of Knowledge (DoK) levels, allowing learners to build progressively on knowledge acquired from Year One to Year Three. For each week, learning tasks and pedagogy are built around the assessment, ensuring that classroom activities directly prepare learners for the demands of the examination. Two sets of sample examination papers are also provided; one administered by Week 12 as a first semester practice examination, and one by Week 20 as a mock examination, to gauge learners' competencies and identify areas requiring remediation.

To further support teachers in delivering Year Three, NaCCA, working with the Ghana Education Service, has developed a subject specific App for each subject.

The Year Three PLC sessions have been revised in response to findings from the 2025 annual evaluation survey. The survey confirmed that teachers have made strong progress in lesson planning, use of varied instructional methods, ICT integration and modes of assessment. To address the identified gap in explaining concepts clearly using examples familiar to learners, each PLC session now includes a dedicated Content Exploration segment. This ten-minute segment brings the subject group together to work through one challenging problem or concept from the week's Teacher Manual content, not to plan how to teach it, but to ensure that every teacher in the group fully understands it.

The PLC sessions in Year Three also place particular emphasis on connecting the week's content to equivalent topics taught in Years One and Two. Teachers are encouraged to note the recap weeks signposted throughout the Teacher Manual and to use the App to explore how content across all three years links together.

As in previous years, teachers are expected to integrate National Values, Gender Equality and Social Inclusion (GESI), Social and Emotional Learning (SEL), and 21st-century skills into their learning activities, assessment tasks, and rubrics and mark schemes. The subject-specific App will support teachers in doing this throughout the year.

Ghana Education Service acknowledges the dedication of the teachers who have implemented the new curriculum across Years One and Two and recognises that Year Three represents both the culmination of that effort and a critical moment for learners. The Year Three Teacher Manual and its accompanying resources have been developed to ensure that every learner, regardless of background, ability, or school context, is fully prepared to demonstrate what they know and can do in the WASSCE and to progress confidently to further studies, the world of work, and adult life.

ACKNOWLEDGEMENTS

Special thanks to Professor Samuel Ofori Bekoe, Director-General of the National Council for Curriculum and Assessment (NaCCA) and all who contributed to the successful writing of the Teacher Manuals for the new Senior High School (SHS) curriculum.

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Prof. Philip Gborsong	University of Cape Coast	English Language
Sylvia Baaba Yankey		Food and Nutrition
Gregory Nana Kobina Nketsia Mensah	Mfantsipim School, Cape Coast	French
Joyce Okreyewa Odei	Hope College, Gomoa Fetteh	General Science
Prof Kofi Adu Boahen	University of Education, Winneba	Geography
Prof. Regina Caesar	University of Education, Winneba	Ghanaian Languages
Clement Adu Acheampong	Prempeh College SHS, Kumasi	Government
Prof Wilson Yayoh	Univertsity of Cape Coast	History
Felicia Archeresuah	Nkoronza Technical Institute	Information Communication Technology
Dr. Frank Kwabena Nyarko	Kwame Nkrumah Univ. of Science and Technology	Manufacturing Engineering
Ezekiel Osei Bonsu	Bono East Regional Education Office, Nkoranza	Mathematics
Ms. Anna Holdbrooke	Swedru Senior High School	Management in Living

Reviewers		
Name of Reviewer	Institution	Subject
Prof Mark–Millas Fish	University of Education, Winneba	Music
Francis Maxwell Ayamba	Atebubu College of Education	Physical Education and Health Core
Sulemana Ahmed Tijani	Atebubu College of Education	Physical Education and Health Elective
Dr. Godfred Asare Yeboah	University of Education, Winneba	Performing Arts
Peter Bekoe	Our Lady of Mount Carmel Girls SHS, Techiman	Physics
Christain Kwarteng Mensah Oppong	Prempeh College, Kumasi	Religious and Moral Education
Dr. Yaw Okraku–Yirenki	Kofi–Annan Centre of Excellence in ICT	Robotics
Samuel Larbi	St Louis Girls SHS, Kumasi	Social Studies
Prof. Jonson Asunka	University of Ghana Legon	Spanish

SECTION 1: CONCEPTUAL DRAWING

UNIT 1: CONCEPT SKETCHES

Strand: Conceptual drawing

Sub–Strand: Concept sketches

Learning Outcome: Demonstrate basic knowledge in concept sketches by creating designs through the use of basic shapes, rendering techniques, perspective and proportions

Content Standard: Apply the understanding of concept sketches and the techniques of rendering in designing objects in their environment

INTRODUCTION AND UNIT SUMMARY

This section will draw on learners’ understanding of concept sketches in year 1 and 2 to create more complex forms using a three- point perspective. Three-point perspective is a powerful technique used to create dynamic and realistic depth in drawings. Unlike one- or two-point perspective, three-point perspective adds a third vanishing point, often used to depict skyscrapers or deep plunging views.

Concept sketches provided in this session will help improve creative ability and encourage originality and creativity. This overview provides thorough guidance for learners, highlighting the significance of perspective in creating designs with depth, volume, and realism.

The weeks and the indicators covered by the section are:

- **Week 1:** (Experiment with freehand sketches to create designs in 3- point perspective with emphasis on proportions using basic shapes and rendering techniques.)
- **Week 2:** (Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing)
- **Recap weeks**

Year 1	Week 1: Explain concept sketches and their applications in designing. Week 2: Use basic shapes, forms and rendering techniques in designing. Week 3: Use the principles of perspective drawing and proportion in designing.
Year 2	Week 1: Analyse various basic shapes and rendering techniques used to create complex forms in freehand drawing. Week 2: Experiment with freehand sketches to create designs in 2- point perspective with emphasis on proportions using basic shapes and rendering techniques.

SUMMARY OF PEDAGOGICAL EXEMPLARS

A quick revision on one-point and two-point perspective should link to a three- point perspective. There should be a **Step-by-Step Demonstration** to guide learners through the process of setting up vanishing points and constructing forms in a three-point perspective. The principles of three-point perspective should be emphasised through **Discussions**.

Learners should be guided to use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing.

There should be an opportunity for learners to perform **Hands-On Practice** while Encouraging them to sketch freely without rulers to help them develop confidence in estimating angles and proportions individually or in small mixed ability groups.

ASSESSMENT SUMMARY

Assessment strategies for teaching freehand drawing in three-point perspective and creating complex designs focus on evaluating learners’ understanding of manipulating basic shapes to create complex designs and depth, accuracy in perspective drawing. Here are some key approaches:

Individual/group classwork – learners should be allowed to practice their understanding of three- point perspective principles in producing freehand sketches with graphite and coloured pencils individually or in small mixed ability groups.

Note:

(while learners perform the activity in small mixed-ability groups, critical observation must be made to ensure individual performances are acknowledged.)

- 1. Use a structured rubric to assess technical accuracy, creativity, and adherence to prospective principles, encouraging learners to assess each other’s work will foster critical thinking and help them recognise common mistakes.
- 2. **Group project** – Distribute tasks based on individual strengths, ensuring balanced contributions, encourage learners to share ideas on the given task. Sufficient time should be allocated to the task to enable learners’ function effectively.

Providing ongoing feedback during the drawing process helps learners refine their techniques before final assessment.

Indicators	DOK Level	Assessment Strategy and/or Mode
L1:(Experiment with freehand sketches to create designs in 3– point perspective with emphasis on proportions using basic shapes and rendering techniques)	Level 2 (concept building)	Individual/group classwork
L2: (Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing)	Level 3 (strategic reasoning)	Group project

WEEK 1

Learning Indicator: Experiment with freehand sketches to create designs in 3– point perspective with emphasis on proportions using basic shapes and rendering techniques

FOCAL AREA: CREATING DESIGNS IN 3– POINT PERSPECTIVE

Introduction

Letting learners draw messy, loose and quick can be a great way to master the drawing progress, when learning a skill like freehand three-point perspective drawing. This method of sketching is a common way for artists and learners of any level to get a feel of new techniques, practice perspective angles and refine drawing skills without a ruler, protractor, or any drawing aids.

Freehand perspective drawing can be represented in different ways, i.e., above eye level that is the viewer looking up at the object from a low angle and below eye level that is the viewer looking down from a high angle.

Principles of 3-point perspective

The significant principle of three-point perspective includes the **horizon line** and **three vanishing points**, all objects in the scene must converge at these vanishing points.

To create a successful three-point perspective drawing, learners need to recap on one-point perspective, two-point perspective, parallel lines and orthogonal lines.

Description of three-point perspective drawings

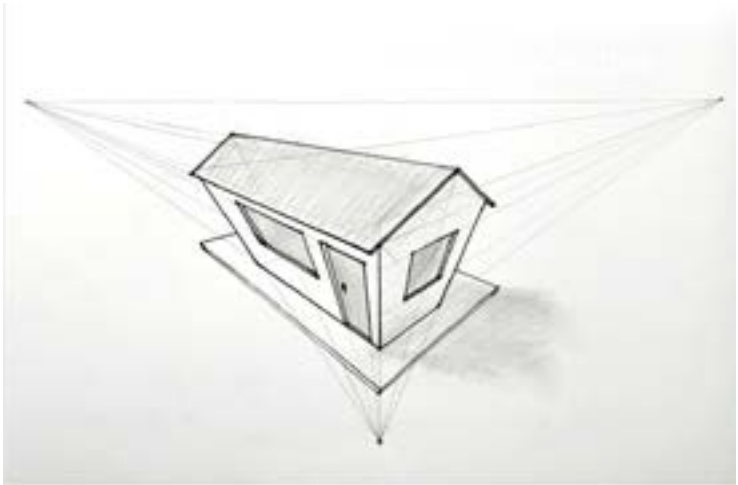


Figure 1.1: A house in three-point perspective

- 1. They are commonly used in architectural renderings, cityscapes, and dramatic compositions.
- 2. Objects appear as if they are towering above (above eye level, at eye level and below eye level).
- 3. This method is particularly useful for extreme angles and compositions where objects are not viewed straight-on but rather from a tilted perspective

Creating designs in 3-point perspective

- 1. Start by sketching the horizon line.

Figure 1.2: Horizontal line

Figure 2 shows a simple horizontal line.

- 2. Place the three vanishing points two along the horizon and one either above or below it, depending on your viewpoint.



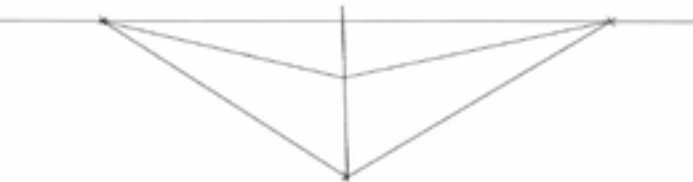
Figure 1.3: Guide for three-point perspective

- 3. Draw a line from the third vanishing point to define the vertical edge of your building or object. From the endpoints of this line, draw lines to the other two vanishing points on the horizon. These create the sides of your object or building.

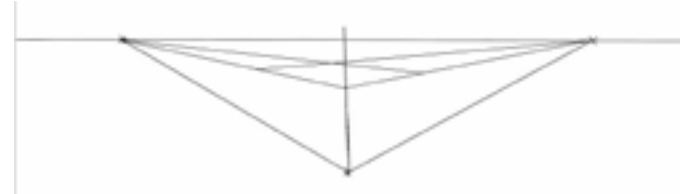


Figure 1.4: Perspective drawing setup

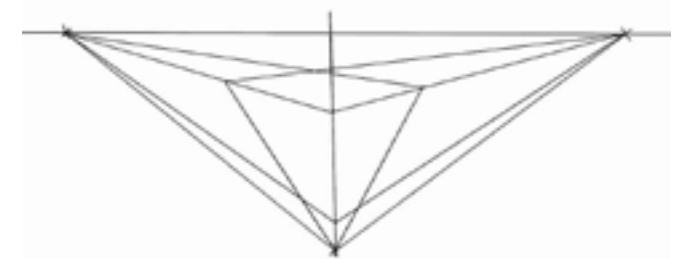
- 4. Indicate the height of the building or object on the vertical line



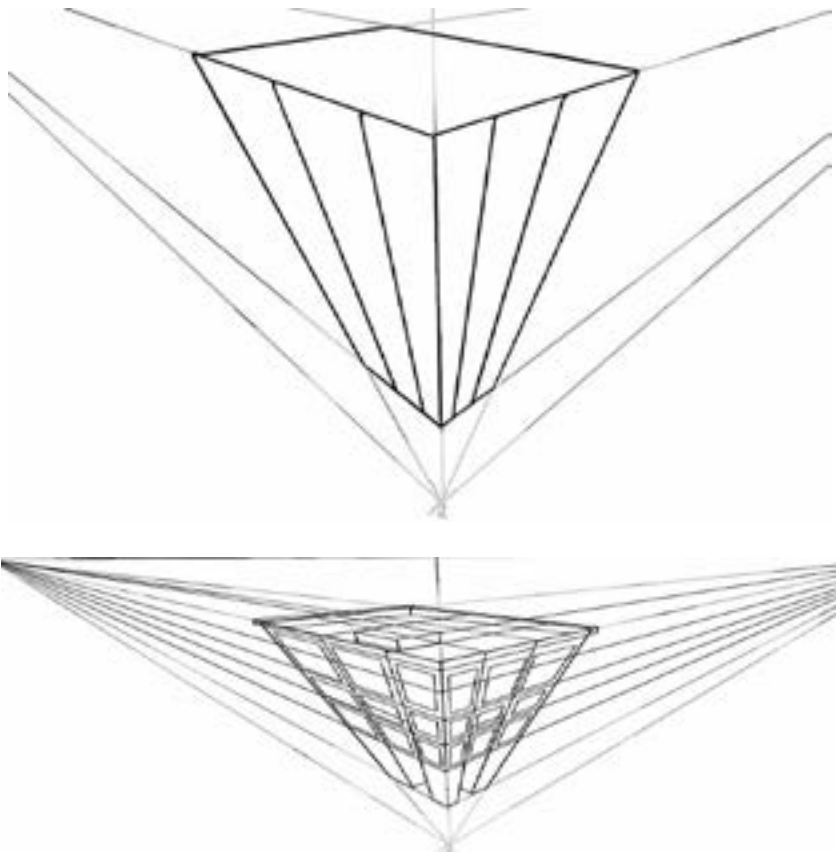
- 5. Indicating the thickness of the building or object



- 6. Obtaining the outline of the object or building



- 7. Adding details and refining



It is crucial to remember that in three-point perspective, all lines will converge to one of the three vanishing points.

Learning Tasks

- 1. Explain the principles of three-point perspective
- 2. Identify the characteristics of three-point perspective drawings.
- 3. Experiment with relevant tools and techniques to create complex forms using 3-point perspectives with emphasis on proportions and freehand sketches.

Pedagogical Exemplars

Discussion: Guide learners to revise on the principles of one-point and two-point perspective and link it to three-point perspective using board illustrations.

Group Work/Collaborative Learning: Provide learners with examples of three-point perspective drawings in the form of photographs, drawings, videos, charts and actual objects in their environment. Assign learners in groups to discuss the characteristics of 3-point perspectives with emphasis on proportions, and how they can be used to create complex forms.

Project-based Learning: Task learners in groups/individuals to experiment with relevant tools and techniques to create complex forms using 3-point perspectives with emphasis on proportions and freehand sketches.

Key Assessment Level 2: Individual Class Exercise

Study the image carefully and complete the following tasks:



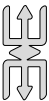
- 1. Create a freehand sketch of this building using 3-point perspective. Your drawing should:
 - a. Show clear understanding of all three vanishing points
 - b. Demonstrate proper proportions between different elements of the building
 - c. Incorporate at least two different basic geometric shapes in your design
- 2. Apply appropriate rendering techniques to show:
 - a. At least two different surface textures
 - b. The direction of light source and resulting shadows
 - c. Depth through line weight variation
- 3. Briefly explain three key principles you applied to maintain accurate proportions in your 3-point perspective drawing.

PLC Session 1

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to

- a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
- a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



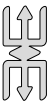
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
- a. The key assessment for the week is *individual class exercise*. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exercise (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 2

Learning Indicator: Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing

FOCAL AREA: CREATING COMPLEX DESIGNS WITH GRAPHITE AND COLOURED PENCILS

Understanding Graphite Pencil Grades

Graphite pencils come in different grades, which determine their hardness or softness. These are indicated by letters and numbers:

1. “H” is Hard and produces lighter marks.
2. “B” is Black and produces darker marks.
3. “F” is fine and produces fine marks.
4. “HB” is medium and is good for general writing and sketching
5. The numbers attached to the Alphabets indicate the level of hardness or softness, e.g. **2B**, **6B**, **5H**, etc.



Figure 2.1: Graded Pencils

Understanding coloured Pencils

Coloured pencils can be in the following form

1. Waxed-based coloured pencils
2. Oil-based coloured pencil
3. Water based pencils

Working with coloured pencils makes artworks lovely and interesting. It is much more difficult to fix darker colours than lighter colours. It is advisable to be aware of the pressure when applying colour.

The stronger the pressure, the more intense the colour will be. Because of this, you may want to start off with light pressure to avoid applying dark colours too quickly.



Figure 2.2: Coloured Pencils

Basic shapes, rendering techniques, complex forms and the relevant tools and materials

Basic shapes	Rendering techniques	Tools and materials
Square	Stippling	Graphite pencil
Circle	Hatching	Coloured pencil
Triangle, etc.	Shading, etc.	Sketch pad, etc.

NB. Refer to year one week two and year two week two for explanations.



Figure 2.3: Examples of complex designs

How to Create Complex Designs Using graphite and coloured pencils

1. Understanding Basic Shapes to start creating complex designs, it is essential to understand the role of basic shapes in designing.
2. Using tools and techniques to turn basic shapes into complex designs.
3. Layering shapes to build complexity.
4. Adding colour and gradients to Shapes.
5. Incorporating patterns and textures.

Learning Tasks

1. Select basic shapes, techniques, tools and materials for creating complex designs.
2. Create complex designs using graphite/coloured pencils.

Pedagogical Exemplars

Discussion: Using questioning engage learners to revise on basic shapes, rendering techniques, tools and materials used to create complex designs

Project-based Learning; Guide learners in groups/individuals to create complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil sketches in freehand drawing.

Project-based Learning; Task learners to generate manual/digital pictorial reports individually on how they created the complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil sketches in freehand drawing.

Key Assessment Level 3: Group Project

Hint



Assign Group Project to learners and give them reasonable time to complete it. Use the SS App to generate the project as well as the rubric. Learners' projects should be marked immediately and scores entered into the SAP.

Scenario

Your community needs a multi-purpose youth centre that will serve as a space for education, recreation, and cultural activities. As a design consulting team, you have been tasked with developing the initial concept for this building.

Task

Create a series of 3 concept sketches for your proposed youth centre (12 marks)

PLC Session 2

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).

3. Use your subject specific app to plan your lesson. Ask the app to
- a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
- a. The key assessment for the week is **group project**. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the project (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or topic/idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through the problem individually for 3–4 minutes
 - c. the group then works through it together the problem, step by step
 - d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
------------	-----------

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).

- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
-----------	------------

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section 1, Unit 1 Review

Under this unit, learners revised relevant previous knowledge on perspective drawing and complex designs from year one and year two. Learners created designs and objects in three-point perspective by experimenting with the techniques and tools available

Learners were taken through the process of creating complex designs and tasked to create genuine designs using graphite and colour pencils.

Varied pedagogical strategies were used to target the different learning proficiencies in the class. The assessment covered the highest levels under the depth of knowledge DoK. To ensure all learners benefits, individual and mixed ability groups was used to perform assigned task. Teaching and learning resources such as videos, internet surfing, charts and pictures were used to enhance the learning process.

Learners expressed understanding through verbal, written, and pictorial means, with responses recorded to evaluate comprehension and facilitate further learning

RUBRICS FOR THE KEY ASSESSMENTS

WEEK 1

Creating freehand sketch of the building using 3-point perspective. (15 marks)

Criteria	3 marks (Very good)	2 marks (Good)	1 mark (Satisfactory)
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Drawing in three-point perspective	Drawing in three-point perspective	Drawing in two-point perspective	Drawing in one-point perspective
Incorporating at least three different basic geometric shapes in your design i.e., square, rectangle and triangle	Incorporating at least three different basic geometric shapes in your design	Incorporating at least two different basic geometric shapes in your design	Incorporating at least one different basic geometric shape in your design
Applying appropriate rendering techniques	Applies three appropriate rendering techniques	Applies two appropriate rendering techniques	Apply one appropriate rendering technique
Briefly explaining three key principles you applied to maintain accurate proportions in your 3-point perspective drawing.	Briefly explaining three key principles you applied to maintain accurate proportions in your 3-point perspective drawing.	Briefly explaining two key principles you applied to maintain accurate proportions in your 3-point perspective drawing.	Briefly explaining one key principle you applied to maintain accurate proportions in your 3-point perspective drawing.
Over all appearance of the drawing - Well defined edges of the drawing - Smooth transition between colours or rendering - Work space is devoid of unwanted pencil marks and dirt. - Timely submission of work.	Learners exhibits three	Learner exhibits two	Learner exhibits one

WEEK 2

Criteria	3 marks (very good)	2 marks (good)	1 mark (satisfactory)
Brainstorming sketches showing analysis of user needs and environmental considerations	Learner provides three brainstorming sketches	Learner provides two brainstorming sketches	Learner provides one brainstorming sketch
Concept Development	Learner produces a sequence of at least three concept sketches showing the evolution of design ideas	Learner Produces a sequence of at least two concept sketches showing the evolution of design idea	Produce a sequence of at least one concept sketch showing the evolution of your design idea

Creating a detailed freehand concept drawing using both graphite and coloured pencils that shows; - Strategic use of graphite for structural elements and form definition - Purposeful application of colour to convey materials, emphasis, and mood - Deliberate rendering techniques to communicate depth, texture and lighting	Learner exhibits all three	Learner exhibits two	Learner exhibits one
A brief written explanation - Justifying the design decisions - How the concept addresses the community's needs - efficiency of the design	Learner exhibits all three	Learner exhibits two	Learner exhibits one

UNIT 2 (OBJECT MANIPULATION)

Strand: Conceptual Drawing
Sub-Strand: Object Manipulation

Learning Outcome: Apply skills in object manipulation to create simple and complex designs as interventions for societal problems using free-hand drawing

Content Standard: Demonstrate understanding and skills in the use of object manipulation techniques to create simple and complex designs as interventions for societal problems.

INTRODUCTION AND UNIT SUMMARY

In this unit, object manipulation techniques in freehand drawing are explored as methods by which innovative solutions to societal challenges can be created. Natural and manufactured forms will be transformed through fragmentation, exaggeration, and recombination, with progression being made from simple natural object manipulations to complex designs that address real-world problems. Throughout the learning, skills in observation, analysis and creative transformation will be developed, whilst technical drawing proficiency is balanced with conceptual understanding. Through collaborative and individual work, both manual and digital design solutions will be created, and the design process will be reflected upon. Beyond technical competence, a design mindset that considers the broader impact of creative work will be cultivated. This is essential for designers who want to use their work to effect change in society. By the end of the unit, object manipulation will have been mastered as a tool that can help generate designs to be used as meaningful interventions for challenges in society.

The weeks and the indicators covered by this section are:

Week 3: Use techniques in object manipulation to generate simple designs from natural objects.

Week 4. Use object manipulation techniques to create simple and complex designs as interventions for societal problems.

Recap weeks

Year 1	Week 4: Analyse and record the concept of object manipulation and manipulation techniques. Week 5: Experiment with various tools and techniques in drawing to manipulate organic and inorganic shapes, forms and objects. Week 6: Use available media and techniques to manipulate objects based on conceptual, symbols, metaphors and narratives associated with objects.
Year 2	Week 4: Investigate how simple and complex objects can be modified through object manipulation techniques. Week 5: Experiment with how objects can be manipulated through drawing to achieve new forms Week 6: Generate simple forms in line with the concepts and narratives associated with objects and designs.

SUMMARY OF PEDAGOGICAL EXEMPLARS

In teaching object manipulation for societal interventions, five complementary pedagogical approaches will be implemented to ensure comprehensive skills development. Managing Talk for Learning will organise learners into mixed-ability groups to create pictorial tables of manipulated designs, promoting inclusive discussion and ensuring all learners contribute meaningfully. Experiential Learning will develop technical proficiency through hands-on practice with materials and techniques, particularly benefiting visual and kinaesthetic learners. Collaborative Learning will engage small groups in examining how manipulated designs address societal challenges, fostering communication skills, critical thinking, and peer knowledge exchange. Problem-Based Learning will contextualise abstract techniques by connecting them to real-world problems, enhancing motivation and demonstrating practical applications. Project-Based Learning will allow learners to create designs at appropriate complexity levels based on individual proficiency. Throughout implementation, these approaches will be scaffolded with visual resources including photographs, videos, and tangible objects.

Assessment will balance technical skill evaluation with conceptual understanding, emphasising how effectively learners apply manipulation techniques to address authentic societal challenges.

ASSESSMENT SUMMARY

Assessment for this unit on object manipulation techniques for societal interventions will evaluate learners’ ability to create designs addressing real-world problems across multiple Depth of Knowledge (DoK) levels: Level 1 (Recall) for identifying basic techniques; Level 2 (Conceptual Understanding) for applying techniques to natural objects; Level 3 (Strategic Reasoning) for analyzing how techniques address societal problems; and Level 4 (Extended Critical Thinking) for comparative analysis tasks like comparing fragmentation versus exaggeration for specific design applications. Assessment modes include design portfolios, practical projects, and collaborative evaluations, with criteria focusing on technique application, design complexity, concept communication, critical thinking, and reflection on design-society relationships. This comprehensive approach will ensure evaluation of both technical proficiency and conceptual understanding across all proficiency levels.

Indicators	DOK Level	Assessment Strategy and/or Mode
L1:(Use techniques in object manipulation to generate simple designs from natural objects.)	Level 4 (Extended critical thinking and reasoning)	Group project
L2: (Use object manipulation techniques to create simple and complex designs as interventions for societal problems.)	Level 4 (Extended critical thinking and reasoning)	Group project

WEEK 3

Learning Indicator: Use techniques in object manipulation to generate simple designs from natural objects

FOCAL AREA 1: GENERATE SIMPLE DESIGNS FROM NATURAL OBJECTS USING TECHNIQUES IN OBJECT MANIPULATION AND FREEHAND DRAWING

Introduction

Generate Simple Designs from Natural Objects Using Freehand Drawing

Nature has always been humanity’s greatest design inspiration. From the spiral patterns in seashells to the intricate veining of leaves, natural objects offer a boundless source of design elements waiting to be discovered and transformed through the skilled hand of a designer.

This unit explores the process of generating simple designs from natural objects using freehand drawing techniques. This involves several key stages such as:

Choose Your Natural Object: The process begins with selecting compelling natural specimens that speak to you as a designer, offering interesting shapes, textures, or patterns that can inspire unique design solutions.

Observe and Analyse: Through careful observation, you’ll develop the ability to break down complex natural forms into their fundamental elements, understanding the underlying structures that make them visually appealing.

Sketching the Design: Using freehand drawing techniques, you’ll translate your observations into preliminary sketches, practicing essential skills in form comprehension, proportion, and perspective.

Add Your Creative Touch: This critical stage involves manipulating and transforming the natural forms through various techniques, where you’ll experiment with rotation, scale, repetition, and stylisation to create something entirely new.

Reflect and Iterate: Design is an evolving process that requires continuous reflection and refinement. You’ll learn to evaluate your work critically and make improvements based on design principles.

Further Exploration: As your skills develop, you’ll discover how these nature-inspired designs can be applied across various design disciplines and potentially address real-world challenges.

Design Complexity Progression

A very good approach is to start with a nature-inspired template, such as the structure of a leaf or the pattern of a butterfly wing, and then advance from simple to complex designs through layering techniques. Begin with basic line drawings that capture the essential form, then gradually add complexity by incorporating line variation, shading, and textural elements. For more sophisticated designs, consider using abstraction to distil the essence of the natural object while introducing metaphorical or symbolic elements that convey deeper meanings. This progression enables you to develop a collection or series that demonstrates both technical skill

and conceptual depth, potentially creating designs that could serve as interventions for societal challenges.

This approach will not only enhance your drawing and observational skills but also promote originality and creativity, which are the essential qualities for any designer. By connecting with natural forms and translating them through your unique perspective, you will develop designs that are both innovative and grounded in the timeless patterns of the natural world

Learning Tasks

1. Embark on mini projects on bioinspired water harvesting solutions.

2. Embark on mini projects on bioinspired sustainable waste disposal solution.

Pedagogical Exemplars

Managing Talk for Learning

Assist learners in mixed groups to generate a manual/digital pictorial table/chart of designs and objects created by manipulating natural objects.

Experiential Learning

In mixed groups, let learners select and use freehand drawing techniques to imitate designs created by manipulating natural objects.

Project-Based Learning

Learners work individually/in groups to create designs from natural objects using freehand drawing and object manipulation techniques.

Key Assessment Level 4: Group Project PROJECT

Integrated Communication Design Technology (Object Manipulation) Project 1

Bioinspired Water Harvesting Solution

(Note: these sample tasks (projects) is based on how the knowledge and skills that learners have acquired can be applied to generate a single artwork (solution)).

Learners are to choose one of the 2 sample projects to work on. (Teachers are to ensure that the selection of the choice of project is not one-sided)



Note:

Aside the 2 sample projects, learners are at liberty to look for other issues in the community and generate solutions for them by using the guidelines provided in the sample projects.

Project Overview

Integrated Communication Design Technology (Object Manipulation) Project 1

Project Scenario: Bioinspired Water Harvesting Solution

In your community, water scarcity has become increasingly problematic during dry seasons. The local school has partnered with environmental engineers to develop innovative water harvesting solutions inspired by nature.

Design Brief

Apply object manipulation techniques to transform natural water-collecting structures into an innovative community water harvesting solution. Through systematic manipulation of natural forms, develop a design that addresses a real societal problem. Use conceptual sketching as your main tool to develop complex designs, using either CAD software or manual drawing tools such as graphite and coloured pencils.

Your solution must be:

- Low-maintenance and durable
- Constructed from locally available materials
- Aesthetically integrated with existing architecture
- Capable of collecting significant water volume

Community stakeholders will evaluate designs for potential implementation as a pilot project.

Group Structure and Dynamics

Learners will work in groups of 3-5 members. Each member must develop one unique water collection concept through detailed sketching, reimagining how natural water-collecting forms can address water scarcity challenges with a cohesive yet distinctive approach.

Project Focus

Create a practical water harvesting system inspired by natural water-collecting objects. Use conceptual sketching techniques to explore how object manipulation can transform these biological mechanisms into efficient water collection systems for community use in areas with limited water infrastructure.

Timeline (2 Weeks)

Week 1: Object Analysis & Concept Development

Natural Object Research Phase

- a. Document selected natural water-collecting structures through detailed sketches using graphite pencils
- b. Create object analysis diagrams showing:
 - Structural properties of water-collecting natural forms through different line weights
 - How these forms capture, channel, and store water
 - Ways to transform these into human-scale systems
- c. Research modern water harvesting approaches using biomimicry
- d. Identify key elements to keep or transform in your conceptual sketches

Design Concept Generation (Graphite & Coloured Pencil)

- a. Each group member must develop one unique water harvesting concept through detailed sketching
- b. Required conceptual drawings per concept:
 - Detailed graphite sketches showing natural water-collecting mechanisms
 - Concept sketches showing manipulation techniques with varying line weights
 - Coloured pencil renderings addressing water collection, filtration, and storage
- c. Hold group critique to select two concepts for further development
- d. **Deliverable:** Water Collection Concept Sketch Portfolio

Week 2: Design Development & Presentation

Design Refinement (Manual Drawing or CAD)

- a. Further develop two selected water harvesting concepts through:
 - Refined conceptual sketches emphasising form development and water flow
 - Detail studies of key features using pencil techniques or CAD
 - Exploration of materials and mechanisms through colour and texture rendering

Design Application

- a. Create comprehensive design visualisations using coloured pencil techniques or CAD showing:
 - The water harvesting system in different settings (rooftops, community spaces, etc.)
 - Key functional elements through exploded or sectional views
 - Water flow diagrams and collection capacity calculations

Design Selection & Prototype Development

- a. Evaluate refined designs based on water collection efficiency and innovation
- b. Select final direction with clear design rationale
- c. Develop final presentation drawings using pencil techniques or CAD
- d. Create detailed documentation of your design process
- e. Build a physical model demonstrating water collection principles

Final Presentation

- a. Present your water harvesting solution to the class (5 minutes per group)
- b. Display progression from initial natural form sketches to final design
- c. Show how your system collects, channels, and stores water
- d. **Deliverable:** Concept Sketch Portfolio, Final Renderings & Physical Model

Project Requirements

Conceptual Sketching Requirements Learners must demonstrate good sketching skills through:

- a. Progressive concept development through multiple sketch iterations
- b. Effective use of line weight, shading, and perspective in graphite pencil
- c. Colour application techniques using coloured pencils to show materials and water flow
- d. Detailed transformation diagrams showing manipulation of natural water-collecting forms
- e. Technical labels and references integrated into sketches

Visualisation Requirements Learners must demonstrate visualisation skills through:

- a. Quality sketch renderings showing water interaction with materials
- b. Detailed visualisations of water collection, channeling, and storage mechanisms
- c. Professional presentation layouts of conceptual sketches
- d. Innovative water harvesting element development through iterative sketching
- e. Consistent representation across all sketch materials

Assessment Criteria

Criteria	Exemplary (85-100%)	Proficient (70-84%)	Developing (50-69%)
Conceptual Sketching	Excellent sketch quality and technique; clear concept development	Good sketch quality; clear concept progression	Basic sketches; minimal development
Natural Form Analysis	Thorough analysis; excellent research; insightful application	Clear documentation; good research; solid analysis	Basic observation; limited research
Water System Development	Innovative concepts; excellent drawing; strong natural connection	Solid concepts; good technique; clear connection	Basic concepts; limited connection
Design Refinement	Sophisticated development; exceptional water flow visualization	Effective refinement; good visualization	Minimal refinement; basic visualization
Technical Documentation	Clear specifications; comprehensive material considerations	Accurate specifications; proper material choices	Basic specifications; limited details
Water Collection Efficiency	Exceptional efficiency; innovative application; thorough testing	Well-considered efficiency; appropriate application	Basic function; minimal efficiency
Community Implementation	Outstanding solution; perfect form/function balance	Good solution; appropriate balance	Limited solution; poor balance

Physical Model	Excellent model; precise details; functional demonstration	Good model; clear details; basic function	Rough model; unclear details; minimal function
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Exhibition Requirements

Concept Sketch Display

- a. Progressive development sketches showing water collection concept evolution
- b. Natural water-collecting object analysis sketches
- c. Transformation sketches showing manipulation techniques
- d. Initial ideation sketches in graphite

Process Display

- a. All initial water harvesting concept drawings (3-5 sets of studies)
- b. Design development sketches showing evolution of concepts
- c. Final design visualisations in coloured pencil or CAD

Application Showcase

- a. Detailed drawings of:
 - Water collection, channeling, and storage mechanisms
 - Material and construction strategy through colour rendering
 - Installation and maintenance considerations
 - Environmental considerations and water quality
 - Community impact in different settings

Design Documentation

- a. Complete specification sketches and diagrams
- b. Material representation through coloured pencil techniques
- c. Water flow diagrams showing collection efficiency
- d. Maintenance and durability information integrated with sketches

Physical Model

- a. Accurate model matching of concept sketches
- b. Professional display base complementing the design
- c. Functional demonstration of water collection principles
- d. Correct material representation
- e. Accurate demonstration of object transformation techniques

INTEGRATED COMMUNICATION DESIGN TECHNOLOGY (OBJECT MANIPULATION) PROJECT 2

Bioinspired Sustainable Waste Disposal Solution

Project Overview

Project Scenario: Bioinspired Sustainable Waste Disposal Solution

In your community, improper waste disposal has become increasingly problematic, leading to environmental degradation and health concerns. The local school has partnered with environmental engineers to develop innovative waste management solutions inspired by nature's decomposition and filtration systems.

Design Brief

Apply object manipulation techniques to transform natural waste-processing structures into an innovative community waste disposal solution. Through systematic manipulation of natural forms, develop a design that addresses this real societal problem. Use conceptual sketching as your main tool to develop complex designs, using either CAD software or manual drawing tools such as graphite and coloured pencils.

Your solution must be:

- a. Low-maintenance and durable
- b. Constructed from locally available materials
- c. Aesthetically integrated with existing architecture
- d. Capable of processing significant waste volume sustainably

Community stakeholders will evaluate designs for potential implementation as a pilot project.

Group Structure and Dynamics

Learners will work in groups of 3-5 members. Each member must develop one unique waste processing concept through detailed sketching, reimagining how natural decomposition and filtration forms can address waste management challenges with a cohesive yet distinctive approach.

Project Focus

Create a practical sustainable waste disposal system inspired by natural waste-processing organisms and systems. Use conceptual sketching techniques to explore how object manipulation can transform these biological mechanisms into efficient waste management systems for community use in areas with limited waste infrastructure.

Timeline (1 Week)

Days 1-2: Object Analysis & Research

Natural Object Research Phase

- a. Document selected natural waste-processing structures (fungi, decomposers, filter feeders) through detailed sketches using graphite pencils
- b. Create object analysis diagrams showing:
 - Structural properties of waste-processing natural forms through different line weights
 - How these forms break down, filter, and transform waste

- Ways to transform these into human-scale systems

- c. Research modern sustainable waste management approaches using biomimicry
- d. Identify key elements to keep or transform in your conceptual sketches

Days 3-4: Concept Generation & Development

Design Concept Generation (Graphite & Coloured Pencil)

- a. Each group member must develop one unique waste disposal concept through detailed sketching
- b. Required conceptual drawings per concept:
 - Detailed graphite sketches showing natural waste-processing mechanisms
 - Concept sketches showing manipulation techniques with varying line weights
 - Coloured pencil renderings addressing waste collection, sorting, and processing
- c. Hold group critique to select one concept for further development
- d. Begin developing the selected concept through:
 - Refined conceptual sketches emphasising form development and waste flow
 - Detail studies of key features using pencil techniques or CAD
 - Exploration of materials and mechanisms through colour and texture rendering

Days 5-6: Design Refinement & Prototype

Design Application & Refinement

- a. Create comprehensive design visualisations using coloured pencil techniques or CAD showing:
 - The waste disposal system in different settings (homes, community spaces, etc.)
 - Key functional elements through exploded or sectional views
 - Waste flow diagrams and processing capacity calculations
- b. Develop final presentation drawings using pencil techniques or CAD
- c. Create detailed documentation of your design process
- d. Build a simple physical model demonstrating waste processing principles

Day 7: Final Presentation

Final Presentation & Exhibition

- a. Present your sustainable waste disposal solution to the class (5 minutes per group)
- b. Display progression from initial natural form sketches to final design
- c. Show how your system collects, processes, and transforms waste
- d. Deliverable: Complete Concept Sketch Portfolio, Final Renderings & Physical Model

Project Requirements

Conceptual Sketching Requirements Learners must demonstrate good sketching skills through:

- a. Progressive concept development through multiple sketch iterations
- b. Effective use of line weight, shading, and perspective in graphite pencil
- c. Colour application techniques using coloured pencils to show materials and waste flow
- d. Detailed transformation diagrams showing manipulation of natural waste-processing forms
- e. Technical labels and references integrated into sketches

Visualisation Requirements Learners must demonstrate visualisation skills through:

- a. Quality sketch renderings showing waste interaction with materials
- b. Detailed visualisations of waste collection, sorting, and processing mechanisms
- c. Professional presentation layouts of conceptual sketches
- d. Innovative waste management element development through iterative sketching
- e. Consistent representation across all sketch materials

Assessment Criteria

Criteria	Exemplary (85-100%)	Proficient (70-84%)	Developing (50-69%)
Conceptual Sketching	Excellent sketch quality and technique; clear concept development	Good sketch quality; clear concept progression	Basic sketches; minimal development
Natural Form Analysis	Thorough analysis; excellent research; insightful application	Clear documentation; good research; solid analysis	Basic observation; limited research
Waste System Development	Innovative concepts; excellent drawing; strong natural connection	Solid concepts; good technique; clear connection	Basic concepts; limited connection
Design Refinement	Sophisticated development; exceptional waste flow visualization	Effective refinement; good visualization	Minimal refinement; basic visualization
Technical Documentation	Clear specifications; comprehensive material considerations	Accurate specifications; proper material choices	Basic specifications; limited details
Waste Processing Efficiency	Exceptional efficiency; innovative application; thorough testing	Well-considered efficiency; appropriate application	Basic function; minimal efficiency

Community Implementation	Outstanding solution; perfect form/function balance	Good solution; appropriate balance	Limited solution; poor balance
Physical Model	Excellent model; precise details; functional demonstration	Good model; clear details; basic function	Rough model; unclear details; minimal function

Exhibition Requirements

Concept Sketch Display

- a. Progressive development sketches showing waste management concept evolution
- b. Natural waste-processing organism analysis sketches
- c. Transformation sketches showing manipulation techniques
- d. Initial ideation sketches in graphite

Process Display

- a. All initial waste disposal concept drawings (3-5 sets of studies)
- b. Design development sketches showing evolution of concepts
- c. Final design visualisations in coloured pencil or CAD

Application Showcase

- a. Detailed drawings of:
 - Waste collection, sorting, and processing mechanisms
 - Material and construction strategy through colour rendering
 - Installation and maintenance considerations
 - Environmental considerations and sustainability features
 - Community impact in different settings

Design Documentation

- a. Complete specification sketches and diagrams
- b. Material representation through coloured pencil techniques
- c. Waste flow diagrams showing processing efficiency
- d. Maintenance and durability information integrated with sketches

Physical Model

- a. Accurate model matching of concept sketches
- b. Professional display base complementing the design
- c. Functional demonstration of waste processing principles
- d. Correct material representation
- e. Accurate demonstration of object transformation techniques

PLC Session 3

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group project**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the project (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 4

Learning Indicator: Use object manipulation techniques to create simple and complex designs as interventions for societal problems

FOCAL AREA 1: MODIFYING EXISTING NATURAL/MANMADE OBJECTS TO CREATE SIMPLE AND COMPLEX DESIGNS AS INTERVENTIONS FOR SOCIETAL PROBLEMS USING FREEHAND DRAWING

Introduction

Good designs can be used to transform ordinary ideas into impactful solutions for real-world challenges. The skill of freehand drawing can be used to reimagine both natural and manmade objects, effectively addressing pressing societal issues. This approach allows for the creation of interventions that are not only practical but also remarkably innovative. This skill enables outside-the-box thinking, leading to fresh ideas that can make a real difference. Designs can be developed to improve everyday items or create new products that meet specific needs. By focusing on practical and innovative solutions, issues like sustainability, accessibility, and social well-being can be addressed. In essence, design is seen as not just about aesthetics; it is regarded as a powerful tool for change that can lead to a better future for everyone.

How to modify existing natural/manmade objects to create designs for societal problems

This creative process follows a structured yet flexible approach:

Identification of the Societal Problem: We begin by carefully examining the challenges in our communities, seeking to understand their root causes and impacts on people's daily lives.

Selecting the Object: With the problem clearly defined, we choose existing natural or manmade objects that have potential for modification. The selected object should have properties or characteristics that could be adapted to address our identified challenge.

Brainstorming Modifications: This stage involves creative thinking about how the chosen object might be altered, combined, or repurposed. We consider changes to form, function, scale, and material to transform it into a solution.

Sketching the Design: Using freehand drawing techniques, we bring our ideas to life on paper. These sketches allow us to explore various possibilities quickly and develop our concepts visually.

Complexity in Design: As our ideas mature, we progress from simple to more complex designs. We might start with basic modifications and gradually introduce more sophisticated elements that enhance functionality or aesthetic appeal.

Prototype and Feedback: Through more detailed drawings, we create visual prototypes of our designs and gather feedback from potential users and stakeholders to refine our concepts.

Communicate the Concept: We learn to effectively present our design interventions, explaining how they address the societal problem and demonstrating their potential impact.

Reflecting and Iterating: Design is never truly finished. We continuously assess our work, identify areas for improvement, and refine our designs accordingly.

By following this process, we harness the expressive power of freehand drawing to reimagine existing objects as solutions to real problems. This approach not only develops technical drawing skills but also cultivates the mindset of a socially responsible designer, someone who sees challenges as opportunities for creative intervention and positive change.

Learning Tasks

1. Embark on a mini-project on Nature-Inspired Mobility Aid for Elderly Community Members
2. Embark on a mini-project on Nature-Inspired Road Safety Solutions for Vulnerable Road Users

Pedagogical Exemplars

Collaborative/Group learning

In small groups, let learners identify and examine how simple/complex designs created by manipulating objects can be used as interventions for challenges in society.

Problem-Based Learning

In small groups, let learners generate a digital/manual pictorial table/chart of designs and objects created by manipulating objects that can be used as interventions for challenges in society.

Project-Based Learning

Let learners work individually/in groups to use the available tools and techniques to create simple and complex designs as interventions for challenges in society, using object manipulation techniques and freehand drawing.

Key Assessment Level 4: Group Project PROJECT 1

Integrated Communication Design Technology (Object Manipulation) Project 1

Project Scenario: Nature-Inspired Mobility Aid for Elderly Community Members

Many elderly residents in your community struggle with mobility challenges, particularly when walking over uneven pavements and steep inclines in the neighbourhood. The local community centre has partnered with physiotherapists to develop innovative mobility aids inspired by natural movement systems.

Design Brief

Apply object manipulation techniques in modifying existing natural/manmade objects to create innovative mobility aids for elderly community members. Study how certain animals and plants move efficiently over difficult terrain for example, examining the flexibility of cat limbs, the stability of mountain goat hooves, or the adaptive structure of climbing plants and use these observations to redesign conventional walking aids. Through freehand drawing, develop concepts that could significantly improve mobility, independence and dignity for elderly community members.

Your solution must be:

1. Low-maintenance and durable
2. Constructed from locally available materials
3. Aesthetically pleasing and non-stigmatising
4. Capable of providing significant stability enhancement

Community stakeholders will evaluate designs for potential implementation as a pilot project.

Group Structure and Dynamics

Learners will work in groups of 3-5 members. Each member must develop one unique mobility aid concept through detailed sketching, demonstrating how object manipulation techniques can transform simple natural forms into complex functional designs.

Project Focus

Create a practical mobility aid system by manipulating natural movement-enabling structures. Your project must demonstrate how object manipulation techniques (such as stretching, compressing, fragmenting, combining, scaling, and repeating) can modify simple biological mechanisms or manmade objects into complex, efficient mobility aids for elderly community use.

Timeline (1 Week)

Days 1-2: Object Analysis & Research

Natural Object Research Phase

1. Document selected natural movement structures through detailed sketches
2. Create object analysis diagrams showing:
 - Original structural properties of movement-enabling natural forms
 - Potential manipulation techniques that could be applied
 - Progressive manipulation steps to transform the natural form
3. Research existing applications of object manipulation in mobility aid design
4. Identify which manipulation techniques are most suitable for your mobility solution

Days 3-4: Concept Generation & Development

Design Concept Generation Through Object Manipulation

- a. Each group member must develop one unique mobility aid concept, showing clear manipulation techniques
- b. Required conceptual drawings per concept:
 - Original natural object sketches before manipulation
 - Progressive sketches showing specific manipulation techniques applied
 - Final concept sketches showing how manipulation transforms the object into a mobility aid solution
- c. Hold group critique to select one concept for further development
- d. Begin developing the selected concept through:

- Advanced manipulation techniques to create more complex forms
- Detail studies showing how manipulation enhances functionality
- Exploration of how multiple manipulated elements work together

Days 5-6: Design Refinement & Prototype

Design Application & Refinement

- a. Create comprehensive design visualisations showing:
 - How manipulation techniques solve specific aspects of mobility challenges
 - How simple forms become complex functional systems through manipulation
 - Technical details showing manipulation-enabled functionality
- b. Develop final presentation drawings highlighting object manipulation
- c. Build a simple physical model demonstrating key manipulation principles
- d. Prepare technical documentation of your solution

Day 7: Final Presentation

Final Presentation & Exhibition

- a. Present your solution to the class (5 minutes per group)
- b. Explicitly demonstrate how object manipulation techniques transformed simple natural forms into complex design solutions
- c. Show how manipulation techniques directly address the societal problem of mobility challenges for the elderly
- d. Display your process work, final visualisations, and physical model
- e. Deliverable: Complete Object Manipulation Journey and Final Solution

Project Requirements

Object Manipulation Requirements Learners must demonstrate mastery of manipulation techniques through:

- a. Clear before/after documentation of manipulated forms
- b. Multiple manipulation techniques applied to natural forms
- c. Progressive complexity development through manipulation
- d. Technical explanation of how manipulation enhances functionality
- e. Strategic application of manipulation to solve specific design challenges

Visualisation Requirements Learners must demonstrate how manipulation creates complex solutions through

- a. Quality sketches showing transformation through manipulation
- b. Detailed visualisations of how manipulated forms enable functionality
- c. Clear connection between manipulation techniques and problem-solving
- d. Innovative applications of manipulation to create complex systems

e. Physical model demonstrating manipulation principles

Prototype Construction Guide

Stage	Steps	Materials	Techniques
1. Planning	• Create scale drawings • Identify key components • Plan movement pathways • Determine connection methods	• Graph paper • Tracing paper • Ruler and compass • Templates	• Scale drawing • Component mapping • Movement diagramming
2. Base Construction	• Cut base elements to size • Mark component positions • Create mounting points • Build supporting structure	• Plywood/MDF/ Foam board • Balsa wood • Adhesive • Cutting tools	• Measuring • Cutting • Joining • Reinforcing
3. Form Development	• Create primary forms from natural inspiration • Apply manipulation techniques • Build primary support surfaces • Form movement mechanisms	• Card stock • Clay/Plasticine • Wire mesh• Plastic sheet	• Folding • Moulding • Bending • Cutting/slicing
4. Mobility System	• Create contact points • Develop stability system • Build grip components • Install flexible elements	• Plastic tubing • Small containers • Flexible materials • Grip materials	• Drilling • Sealing • Connecting • Testing stability
5. Surface Treatment	• Apply texture to surfaces • Add colour treatments • Create surface patterns • Enhance visual elements	• Paint • Coloured paper • Textured materials • Finishes	• Painting • Collaging • Texturing • Finishing

6. Functionality Testing	• Test stability • Verify movement pathways • Check weight capacity • Assess comfort	• Weight tests • Movement simulations • Measuring tools • Stopwatch	• Controlled testing • Measurement • Documentation • Refinement
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Assessment Criteria

Criteria	Level 1 (50-69%)	Level 2 (70-79%)	Level 3 (80-89%)	Level 4 (90-100%)
Manipulation Techniques	Basic single technique; limited transformation	Multiple techniques; clear transformation	Effective techniques; innovative transformation	Masterful techniques; exceptional complexity
Functional Solution	Basic function; minimal stability enhancement	Functional purpose; adequate stability	Enhanced functionality; effective solution	Innovative solution; outstanding efficiency
Model & Documentation	Basic model; limited documentation	Adequate model; clear documentation	Well-constructed; comprehensive documentation	Exceptional model; precise documentation
Design Process	Limited process evidence; basic sketches	Clear process; adequate sketches	Well-documented; quality progression	Comprehensive process; exceptional communication

Exhibition Requirements

Manipulation Process Display

- a. Before/after sketches showing transformation through manipulation
- b. Step-by-step manipulation technique documentation
- c. Analysis of how manipulation enhances functionality
- d. Comparison of simple forms versus complex outcomes

Design Development Through Manipulation

- a. Progressive sketches showing increasing complexity through manipulation
- b. Multiple manipulation techniques applied to the same form
- c. Final complex designs emerging from simple natural forms

Application Showcase

- a. Detailed drawings showing:
 - How manipulation techniques solve specific mobility challenges
 - How simple forms become complex functional systems
 - How manipulation enhances performance and efficiency

- How multiple manipulated elements work together

Technical Documentation

- Manipulation technique specifications
- Material applications for manipulated forms
- Functional diagrams showing manipulation-enabled features
- Implementation and maintenance considerations

Physical Model

- Clear demonstration of manipulation techniques
- Functional representation of mobility aid principles
- Accurate demonstration of simple-to-complex transformation
- Interactive elements showing how manipulation enables functionality

PROJECT 2

Integrated Communication Design Technology (Object Manipulation) Project 2

Project Scenario: Nature-Inspired Road Safety Solutions for Vulnerable Road Users

Many pedestrians, cyclists, and motorcyclists in your community face significant safety challenges, particularly when travelling at night or in poor visibility conditions. The local transport authority has partnered with road safety experts to develop innovative safety solutions inspired by natural visibility and protection systems found in nature.

Design Brief

Apply object manipulation techniques to modify existing natural/manmade objects in creating innovative road safety solutions for vulnerable road users.

Study how certain animals and plants enhance visibility and protection in challenging environments, for example, examining the reflective properties of cat eyes, the high-contrast patterns of certain insects, or the protective structures of seed pods and shells, and use these observations to redesign conventional road safety equipment. Through freehand drawing, develop concepts that could significantly improve visibility, protection, and overall safety for road users.

Your solution must be:

- Low-maintenance and durable
- Constructed from locally available materials
- Aesthetically pleasing and user-friendly
- Capable of providing significant safety enhancement in various weather and light conditions

Community stakeholders will evaluate designs for potential implementation as a pilot project.

Group Structure and Dynamics

Learners will work in groups of 3-5 members. Each member must develop one unique road safety concept through detailed sketching, demonstrating how object manipulation techniques can transform simple natural forms into complex functional safety designs.

Project Focus

Create a practical road safety system by manipulating natural visibility-enhancing and protective structures. Your project must demonstrate how object manipulation techniques (such as stretching, compressing, fragmenting, combining, scaling, and repeating) can modify simple biological mechanisms or manmade objects into complex, efficient safety solutions for vulnerable road users.

Timeline (1 Week)

Days 1-2: Object Analysis & Research

Natural Object Research Phase

- Document selected natural visibility and protection structures through detailed sketches
- Create object analysis diagrams showing:
 - Original structural properties of visibility-enhancing natural forms
 - Potential manipulation techniques that could be applied
 - Progressive manipulation steps to transform the natural form
- Research existing applications of object manipulation in road safety design
- Identify which manipulation techniques are most suitable for your safety solution

Days 3-4: Concept Generation & Development

Design Concept Generation Through Object Manipulation

- Each group member must develop one unique road safety concept, showing clear manipulation techniques
- Required conceptual drawings per concept:
 - Original natural object sketches before manipulation
 - Progressive sketches showing specific manipulation techniques applied
 - Final concept sketches showing how manipulation transforms the object into a road safety solution
- Hold group critique to select one concept for further development
- Begin developing the selected concept through:
 - Advanced manipulation techniques to create more complex forms
 - Detail studies showing how manipulation enhances functionality
 - Exploration of how multiple manipulated elements work together

Days 5-6: Design Refinement & Prototype

Design Application & Refinement

- Create comprehensive design visualisations showing:
 - How manipulation techniques solve specific aspects of road safety challenges
 - How simple forms become complex functional systems through manipulation

- Technical details showing manipulation-enabled functionality
- b. Develop final presentation drawings highlighting object manipulation
- c. Build a simple physical model demonstrating key manipulation principles
- d. Prepare technical documentation of your solution

Day 7: Final Presentation

Final Presentation & Exhibition

- a. Present your solution to the class (5 minutes per group)
- b. Explicitly demonstrate how object manipulation techniques transformed simple natural forms into complex design solutions
- c. Show how manipulation techniques directly address the societal problem of road safety for vulnerable users
- d. Display your process work, final visualisations, and physical model
- e. Deliverable: Complete Object Manipulation Journey and Final Solution

Project Requirements

Object Manipulation Requirements Learners must demonstrate mastery of manipulation techniques through:

- a. Clear before/after documentation of manipulated forms
- b. Multiple manipulation techniques applied to natural forms
- c. Progressive complexity development through manipulation
- d. Technical explanation of how manipulation enhances functionality
- e. Strategic application of manipulation to solve specific design challenges

Visualisation Requirements Learners must demonstrate how manipulation creates complex solutions through:

- a. Quality sketches showing transformation through manipulation
- b. Detailed visualisations of how manipulated forms enable functionality
- c. Clear connection between manipulation techniques and problem-solving
- d. Innovative applications of manipulation to create complex systems
- e. Physical model demonstrating manipulation principles

Prototype Construction Guide

Stage	Steps	Materials	Techniques
1. Planning	• Create scale drawings • Identify key components • Plan visibility systems • Determine connection methods	• Graph paper • Tracing paper • Ruler and compass • Templates	• Scale drawing • Component mapping • Visibility diagramming

2. Base Construction	• Cut base elements to size • Mark component positions • Create mounting points • Build supporting structure	• Plywood/MDF/ Foam board • Balsa wood • Adhesive • Cutting tools	• Measuring • Cutting • Joining • Reinforcing
3. Form Development	• Create primary forms from natural inspiration • Apply manipulation techniques • Build primary visibility surfaces • Form protective mechanisms	• Card stock • Clay/Plasticine • Wire mesh • Plastic sheet	• Folding • Moulding • Bending • Cutting/slicing
4. Safety System	• Create reflective elements • Develop visibility system • Build protective components • Install flexible elements	• Reflective materials • Transparent containers • Flexible materials • High-contrast materials	• Drilling • Sealing • Connecting • Testing visibility
5. Surface Treatment	• Apply texture to surfaces • Add colour treatments • Create high-visibility patterns • Enhance visual elements	• Paint • Coloured paper • Reflective materials • Finishes	• Painting • Collaging • Texturing • Finishing
6. Functionality Testing	• Test visibility • Verify protection capabilities • Check durability • Assess user comfort	• Light tests • Impact simulations • Measuring tools • Stopwatch	• Controlled testing • Measurement • Documentation • Refinement

Assessment Criteria

Criteria	Level 1 (50-69%)	Level 2 (70-79%)	Level 3 (80-89%)	Level 4 (90-100%)
Manipulation Techniques	Basic single technique; limited transformation	Multiple techniques; clear transformation	Effective techniques; innovative transformation	Masterful techniques; exceptional complexity

Functional Solu- tion	Basic function; minimal safety enhancement	Functional pur- pose; adequate safety	Enhanced func- tionality; effec- tive solution	Innovative solu- tion; outstanding efficiency
Model & Docu- mentation	Basic model; limited docu- mentation	Adequate model; clear documen- tation	Well-construct- ed; comprehen- sive documenta- tion	Exceptional model; precise documentation
Design Process	Limited process evidence; basic sketches	Clear pro- cess; adequate sketches	Well-docu- mented; quality progression	Comprehensive process; excep- tional communi- cation

Exhibition Requirements

Manipulation Process Display

- a. Before/after sketches showing transformation through manipulation
- b. Step-by-step manipulation technique documentation
- c. Analysis of how manipulation enhances functionality
- d. Comparison of simple forms versus complex outcomes

Design Development Through Manipulation

- a. Progressive sketches showing increasing complexity through manipulation
- b. Multiple manipulation techniques applied to the same form
- c. Final complex designs emerging from simple natural forms

Application Showcase

- a. Detailed drawings showing:
 - How manipulation techniques solve specific road safety challenges
 - How simple forms become complex functional systems
 - How manipulation enhances visibility and protection
 - How multiple manipulated elements work together

Technical Documentation

- a. Manipulation technique specifications
- b. Material applications for manipulated forms
- c. Functional diagrams showing manipulation-enabled features
- d. Implementation and maintenance considerations

Physical Model

- a. Clear demonstration of manipulation techniques
- b. Functional representation of road safety principles
- c. Accurate demonstration of simple-to-complex transformation

- d. Interactive elements showing how manipulation enables enhanced safety

PLC Session 4

45 minutes	Planning & Reviewing the Learning Plan
------------	--

- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group project**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the project (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Unit Review

In this Unit, object manipulation techniques through freehand drawing for societal challenges have been explored. Skills in observation, drawing, manipulation methods, critical thinking, and design communication have been developed by learners. Their ability to create varied designs, generate concepts from natural objects, modify existing objects, and communicate ideas has been demonstrated. Five pedagogical approaches have been incorporated: Managing Talk for Learning, Experiential Learning, Collaborative Learning, Problem-Based Learning, and Project-Based Learning. These have been supported by visual

resources for learners at all proficiency levels. Assessment across DoK levels 1–4 has been conducted through comparative analysis, portfolios, projects, and collaborative evaluations, measuring both technical and conceptual understanding. Moving forward, learners should refine manipulation techniques while expanding their understanding of design for societal challenges, building towards more sophisticated interventions in future work.

UNIT 3 (PATTERN DESIGN)

Complex 3D Templates and Patterns

Strand: Conceptual Drawing

Sub-Strand: Templates and Patterns

Content Standard: Demonstrate knowledge and skill in using freehand drawing techniques to create 3-dimensional templates and patterns for objects and concepts.

Learning Outcome: Apply the understanding and skills of creating templates and patterns to develop freehand-drawn 3-dimensional templates and patterns for objects and concepts.

INTRODUCTION AND SECTION SUMMARY

The section looks at the development of 3-dimensional freehand templates and patterns as an essential skill set for learners interested in design, engineering, and the creative arts. The three-week module seeks to equip learners with the requisite abilities to visualise, plan, and create complex 3D representations through progressive skill development. Learning to create 3D templates holds significant value in today’s world. These skills directly support innovation, allow for the preservation of cultural artefacts, and enable design solutions for community challenges. Learners develop spatial reasoning, problem-solving abilities, and creative thinking that transfer across multiple disciplines and career paths. The pedagogical approach employs collaborative methods where mixed-ability groups work together to solve authentic problems. Through guided discovery, learners select appropriate materials, develop drawing frameworks, and refine their designs based on peer feedback. Activities progress logically from simple material selection to complex pattern development and finally to design finalisation and documentation. Assessment occurs at Level 4 (Extended Critical Thinking) through research projects situated in authentic contexts, where learners might design models for healthcare education, document traditional artefacts and crafts at risk of being lost, or create sustainable packaging solutions. These assessments require learners to evaluate materials, justify design decisions, and reflect critically on their process, challenging them to apply technical skills to meaningful real-world challenges.

The weeks and the indicators covered by the section are:

- *Week 5: Select appropriate drawing materials and tools that can be used to create three-dimensional free-hand-drawn templates and patterns:*
- *Week 6: Develop appropriate drawing frameworks and necessary elements to create three-dimensional templates and patterns*
- *Week 7: Finalise the complex 3-dimensional template and pattern design*

Recap indicators for the section are:

Year 1	Week 7: Select appropriate drawing materials and tools that can be used to create 2-dimensional free hand-drawn templates and patterns Week 8: Develop an appropriate drawing framework and necessary elements to create 2-dimensional templates and patterns Week 9: Finalise the 2-dimensional template and pattern design
Year 2	Week 7: Analyse the sources and use of templates and patterns in the community. Week 8: Investigate the designing and creation processes of templates and patterns. Week 9: Use appropriate materials, tools and freehand drawing techniques to design and create 2-dimensional and 3-dimensional patterns as interventions for challenges in the community

SUMMARY OF PEDAGOGICAL EXEMPLARS

The section’s pedagogical strategies for the teaching of complex 3-dimensional freehand template design employ several effective approaches that support learning through collaboration and authentic problem-solving. Throughout this section, learners work in groups, ensuring peer support and diverse perspectives during the creative process. The journey begins with idea generation sessions, where groups generate potential 3D template ideas based on real needs. This foundation in authentic problems gives purpose to their technical skill development. As learners progress to creating multiple sketches and selecting appropriate materials, they engage in project-based activities that mimic professional design processes. The section also relies heavily on problem-based strategies when learners must evaluate various tools and materials based on their suitability for specific projects. These practical decision-making builds critical thinking skills while developing technical knowledge. The peer review process, where groups present their evolving designs for feedback, introduces students to constructive critiques as an essential skill in design fields. The most critical pedagogical strategy in the section involves documentation and communication, with learners producing reports explaining their process and demonstrating how their templates address community needs. This reflection connects technical skills to broader impacts, supporting assessment at Level 4 (Extended Critical Thinking) where students must justify decisions and evaluate outcomes within realistic contexts like healthcare education or sustainable packaging design.

SUMMARY OF ASSESSMENT STRATEGIES

The assessment strategies employed in this section for complex 3-dimensional template design skills equally employ complex strategies that measure learners’ abilities to think critically and solve complex problems. Thus, all assessments operate at Level 4 (Extended Critical Thinking), challenging students to move beyond technical mastery to evaluate, analyse and create innovative solutions. The research-based assessments, for instance, provide authentic contexts that mirror real-world applications, where learners might design models for healthcare training, document traditional crafts at risk of being lost, or create sustainable packaging solutions. These contexts make assessment meaningful while connecting to broader educational goals

like cultural preservation and sustainability. Each assessment requires multiple cognitive skills, for which learners must evaluate different materials based on specific criteria, justify their design decisions with evidence, analyse how their choices affect usability, and reflect on their entire creative process. This comprehensive approach ensures that learners demonstrate deep understanding rather than surface-level skills. The assessment tasks directly reflect the collaborative and problem-based teaching approaches used throughout the unit. Just as they learn through authentic challenges, they demonstrate their learning by solving complex design problems that require technical proficiency and conceptual understanding. This alignment between teaching and assessment creates a coherent learning experience where students clearly understand how their developing skills can address real community needs.

Summary of Learning Indicators, Assessment Levels and Assessment Types

Learning Indicators	DOK Level	Assessment Strategy and/or Mode
Select appropriate drawing materials and tools that can be used to create three-dimensional free-hand-drawn templates and patterns	4	Group Research Project
Develop appropriate drawing frameworks and necessary elements to create three-dimensional templates and patterns	4	Group Research Project
Finalise the complex 3-dimensional template and pattern design	4	Group Research Project

WEEK 5

Learning Indicator: Select appropriate drawing materials and tools that can be used to create three-dimensional free-hand-drawn templates and patterns

FOCAL AREA: SIMPLE TO COMPLEX 3-D FREEHAND TEMPLATES AND PATTERNS DRAWING TECHNIQUES

Complex 3-D Freehand Templates and Patterns Drawing Techniques

Complex 3-D freehand templates and patterns are advanced drawing techniques that allow artists and designers to create detailed three-dimensional representations by hand. These techniques go beyond simple sketching to develop precise guides that can be used to construct physical objects or visualise complex forms.

These techniques are important for several reasons

1. They develop crucial spatial thinking skills, helping learners understand how objects exist in three dimensions—a fundamental ability for careers in design, architecture, and engineering

Unlike computer-aided design, freehand techniques build a deep, intuitive understanding of form and space that transfers across all design disciplines.

2. The inherent techniques bridge the gap between imagination and reality. Learners discover how to translate abstract ideas into concrete plans that can be followed to create physical objects.

This translation process requires advanced problem-solving skills as learners work out how complex forms can be broken down into manageable components.

3. These techniques preserve important traditional design methods that remain relevant in our digital age. Many professional designers still begin with hand-drawn concepts before resorting to digital tools.
4. Freehand techniques are accessible to a majority of learners regardless of access to technology, making advanced design skills available in diverse educational settings while building confidence through the mastery of challenging techniques that produce tangible results.

Why Do Complex 3-D Freehand Templates and Patterns Matter?

Complex 3-D freehand templates and patterns are vital skills that provide essential foundations for numerous design professions and creative practices.

- a. These techniques enable designers to visualise ideas before expensive production, saving crucial resources and time.
- b. They develop cognitive abilities, including spatial reasoning and problem-solving, that transfer across all design fields.
- c. In an environment where technology is limited, unreliable, or unavailable, these hand skills ensure design work can continue without interruption.

- d. They preserve cultural knowledge and traditional craft techniques that might otherwise be lost.

Key Techniques

The key techniques include

- a. Cross-section drawing (showing internal structures)

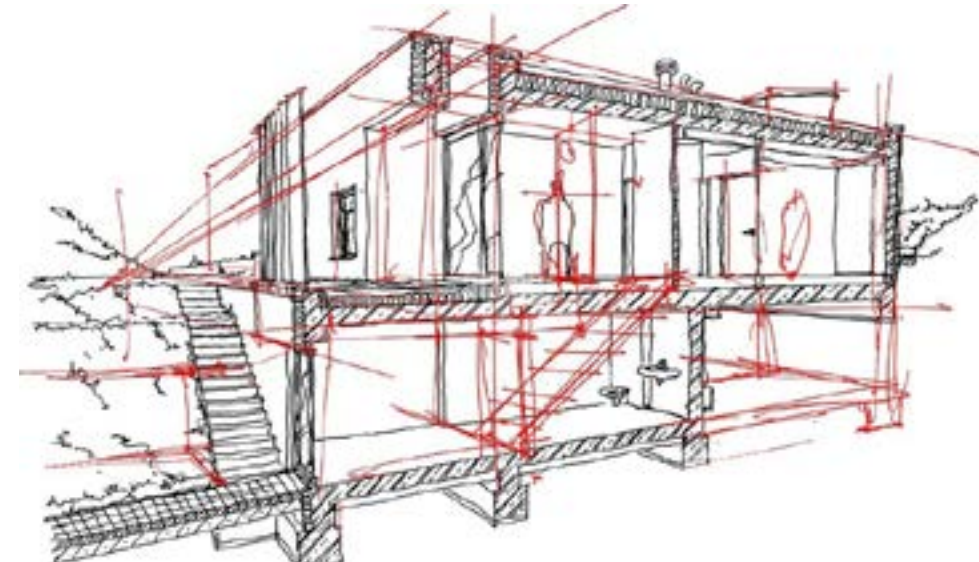


Figure 5.1: Architectural sketch of section of modern two-story detached house with flat roof and garden

- b. Net development (flattening 3D forms into 2D patterns that can be cut and folded),

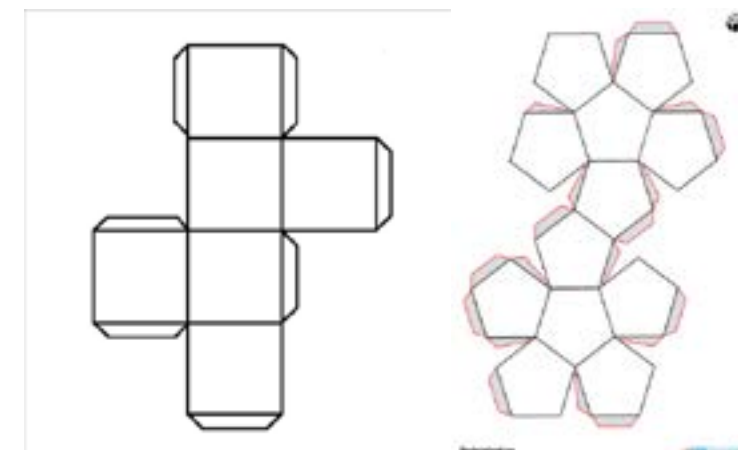


Figure 5.2: Archimedean Cube and Dodecahedron

- c. Orthographic projection (showing multiple views of an object)

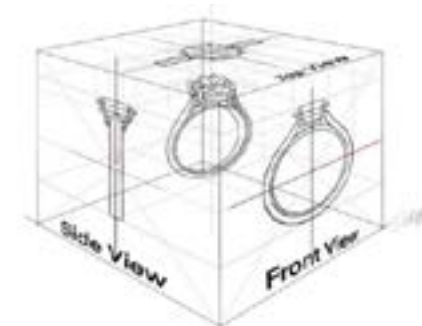


Figure 5.3: Orthographic Drawing to Perspective Drawing

- d. Exploded views (showing assembly relationships)

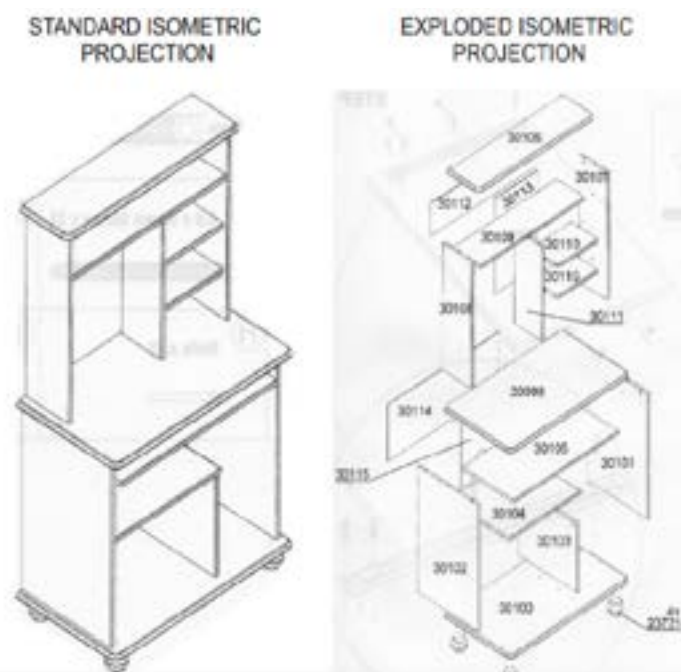


Figure 5.4: Isometric Drawing and Exploded Drawing <https://online.mhjc.school.nz/course/view.php?id=9651>

- e. Vanishing point perspective (creating realistic depth)**

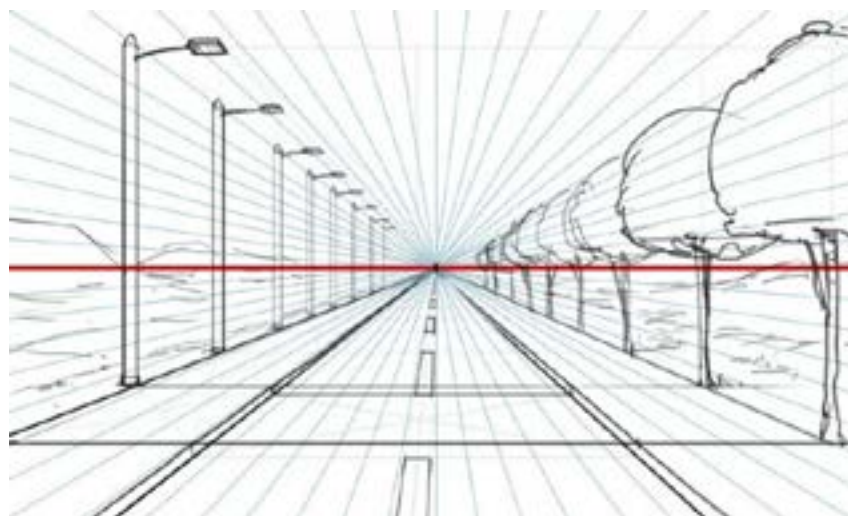


Figure 5.5: *Perspective Drawing with vanishing point*

Key Characteristics of the Technique

1. Layered Complexity

The design evolves from simple frameworks to complex, multi-dimensional structures, often incorporating cultural motifs or symbolic references.

2. Iterative Refinement

Each stage of development refines the previous, ensuring structural and aesthetic coherence.

3. Spatial Interplay

Focus on the relationship between form, void, and viewer interaction, often exploring cultural narratives and local materials.

Examples and Applications

Historical Influences

1. **Gothic cathedrals** exhibit a range of complex design phenomena. The Notre-Dame de Paris, which combines structural elements like pointed arches with intricate façades, is a great example.

These complex architectural feats, along with numerous examples from the classical world, are relevant as they established the foundation for integrating complexity into functional frameworks.



Figure 5.6: *Notre Dame de Paris (Exterior) Westminster Abbey (Interior - cross barrel-vault ceiling), London*

2. African Vernacular Architecture

An example is the **Great Mosque of Djenné** in Mali, which demonstrates a complex-to-complex approach with a mud-based skeletal structure adorned with intricate sculptural protrusions.



Figure 5.7a



Figure 5.7b

- a. The Aksum Obelisk, in Aksum (Tigray Region, Ethiopia), https://en.wikipedia.org/wiki/Obelisk_of_Axum#/media/File:Rome_Stele.jpg
- b. Great Mud Mosque of Djenne, Mali https://en.wikipedia.org/wiki/Great_Mosque_of_Djenn%C3%A9#/media/File:Great_Mosque_of_Djenn%C3%A9_1.jpg

Designers who rely on these skills include

1. Ghanaian fashion designer Abrima Erwiah of Studio One Eighty-Nine uses hand-drafted patterns to create garments that support traditional textile crafts.



Figure 5.8: Ebrima Erwiah of Studio 189

David Adjaye (Ghanaian-British Architect)

Works

- National Museum of African American History and Culture, Washington, D.C.
 - **Complex Framework:** Inspired by Yoruban crown designs, Adjaye's work uses geometric patterns to merge cultural significance with modern structural techniques.
 - **Cultural Innovation:** Combines layered facade systems with bold interior spaces, creating dynamic spatial experiences.



Figure 5.9: National Museum of African American History and Culture, Washington, D.C



Figure 5.10: Metalocus.



Figure 5.11: Werk 5 – New Craft

Abrahamic Family House, Dubai, U.A.E.



Figure 5.12: Abrahamic Family House, with all three spaces in view by Adjaye Associates. Photograph by Adjaye Associates

1. Francis Kéré (Burkina Faso)

- **Example:** Gando Primary School, Burkina Faso
 - **Complex Framework:** Uses locally sourced materials such as clay and timber to create intricate yet functional designs.
 - **Sustainability:** Incorporates natural ventilation systems and layered construction techniques that align with both cultural and environmental contexts.

► **Dano Secondary School, Burkina Faso**



Figure 5.13: Dano Secondary School, Burkina Faso, Kéré Architecture. Photo by Erik-Jan Ouwerkerk.

► **The Coachella Installation 2019**



Figure 5.14: Installation drawings of Sarbalé Ke. Image © Francis Kéré
Sarbalé Ke by Francis Kéré at the Coachella Valley Music and Arts Festival 2019, photo by Iwan Baan.

2. Simphiwe Mbunyuza (South African Sculptor)

- **Example:** Sculptural works combining ceramics and metal to explore African identity.
 - **Complex Technique:** Starts with abstracted traditional forms, refining them into highly detailed, tactile sculptures that engage with contemporary issues.



Figure 5.15: Simphiwe Mbunyuza (2023), explores African cultural symbolism through functional and non-functional ceramic pots, delving into relationships and interactions within African culture, with special focus on Xhosa people. <https://sacreative.co.za/cultural-symbolism-through-clay-with-simphiwe-mbunyuza/>

3. Mariam Kamara (Nigerian Architect – f. Atelier Masōmī)

- **Example:** Niamey Cultural Centre
 - **Complex-to-Complex Application:** Integrates traditional Hausa architectural motifs into a modern design, transitioning from geometric 2D sketches to dynamic 3D forms.



Figure 5.16a



Figure 5.16b

- a. Atelier Masōmī, *Making of an Artisan's Valley*, Venice Architecture Biennale, 2021 <https://www.designboom.com/architecture/mariam-kamara-atelier-masomi-interview-09-30-2021/>
- b. Atelier Masōmī uses colorful metal canopies to build Dandaji Market in Niger, 2018 <https://edition.cnn.com/style/article/mariam-kamara-architecture/index.html>

Global Practitioners

1. Antoni Gaudí

- Example: Sagrada Família combines organic forms with structural innovation.



Figure 5.17a



Figure 5.17b

- a. Antoni Gaudí, Freehand Sketch, 1905 <https://thinkinginsomniac.wordpress.com/wp-content/uploads/2010/12/sagrada-familia-sm.jpg>
- b. Sagrada Família Basilica <https://www.musement.com/us/barcelona/sagrada-familia-entrance-tickets-and-small-group-tour-345085/>



Figure 5.18: *Sagrada Família, Passion Façade*, in 2018 and *Portal of Charity on the Nativity Façade*, created by Etsuro Sotoo https://en.wikipedia.org/wiki/Sagrada_Fam%C3%ADlia

2. Frank Gehry

- Example: Guggenheim Museum Bilbao showcases flowing, dynamic forms derived from a skeletal framework.

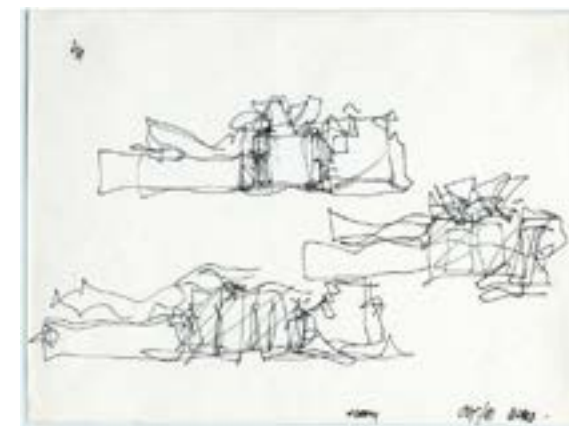


Figure 5.19a

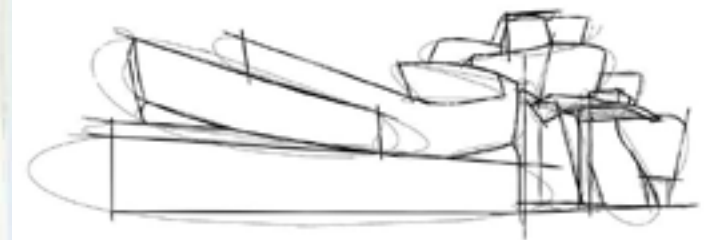


Figure 5.19b

- a. Guggenheim Museum Bilbao Project Sketch _026. Copyright: Frank O Gehry, 1991. Image courtesy of Gehry Partners, LLP. https://www.researchgate.net/publication/359968335_Recapturing_meaning_Toward_a_new_material-based_design_theory_for_architecture/figures?lo=1
- b. Frank O Gehry, Sketch, ca. 1991, <https://www.etsy.com/listing/1802384754/guggenheim-museum-bilbao-unique>



Figure 5.20: *Guggenheim Museum, Bilbao and Aerial view of the museum* [https://en.wikipedia.org/wiki/Guggenheim_Museum_Bilbao#/media/File:Museo_Guggenheim,_Bilbao_\(31273245344\).jpg](https://en.wikipedia.org/wiki/Guggenheim_Museum_Bilbao#/media/File:Museo_Guggenheim,_Bilbao_(31273245344).jpg)

3. Zaha Hadid

- Example: Hadid’s designs explore fluid geometries, evolving simple shapes into complex spatial compositions. For Hadid, painting was a design tool, and abstraction an investigative structure for imagining architecture and its relationship to the world we live in.

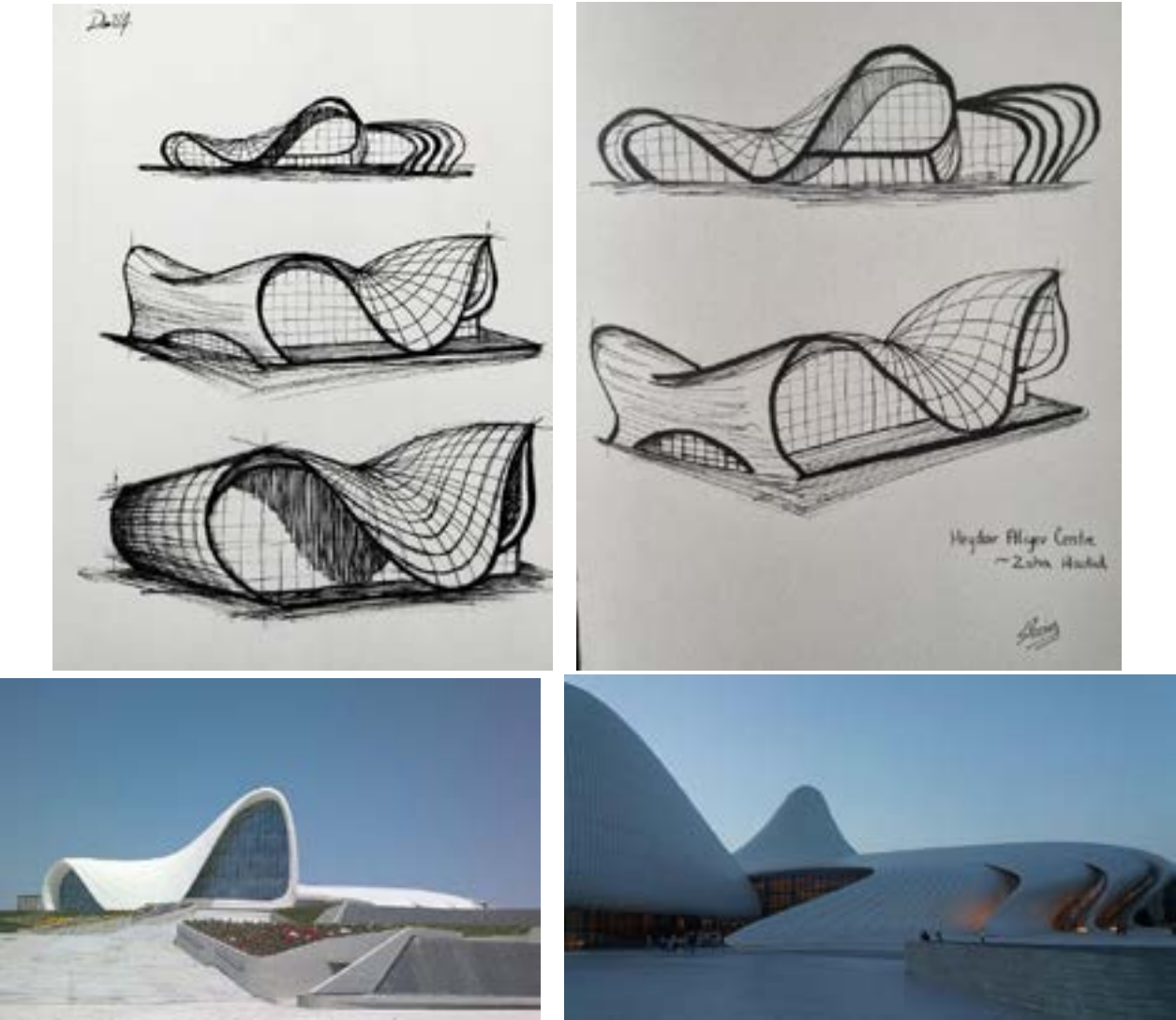


Figure 5.21: *Exteriors and Interiors of Heydar Aliyev Cultural Centre (2012), Baku, Azerbaijan.* https://en.wikipedia.org/wiki/Heydar_Aliyev_Center

2. Alexander McQueen, the late British fashion designer, was renowned for his revolutionary pattern-cutting techniques. His complex 3D templates enabled the structural garments that defined his collections. McQueen would develop complex paper patterns by hand before any fabric was cut, allowing him to create his signature sculptural silhouettes.



Figure 5.22: *Sketchbook spread from the McQueen’s ‘Savage Beauty’ exhibition at the Met*



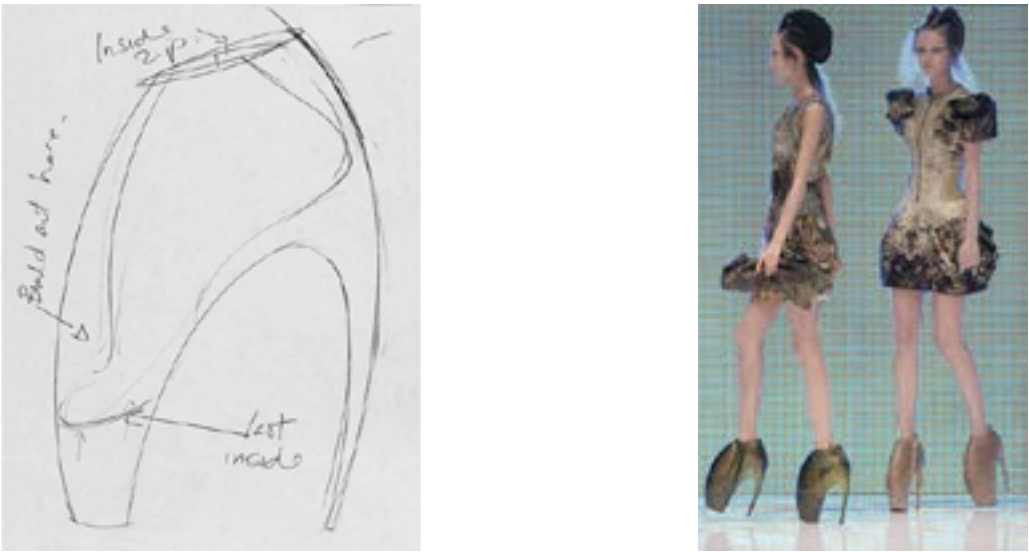


Figure 5.23: *Widows of Culloden* by Alexander McQueen. *The Armadillo Boot* by Alexander McQueen, 2009

3. George Nakashima, the influential furniture designer, relied exclusively on hand-drawn templates to create his signature woodwork. His process involved creating full-scale patterns that responded to each unique piece of wood.



Figure 5.24: *George Nakashima*



Simple to Complex Techniques

Translating, Converting, and Permuting Simple to Complex Techniques

The Progression Pathway

The structured approach allows learners to develop spatial reasoning and technical skills to create complex 3D templates, accurately representing sophisticated designs and remaining

practical construction guides. This systematic progression builds skills from simple to complex template techniques.

Basic Translation Techniques

Simple flat shapes are first translated into three-dimensional forms through fundamental techniques:

- a. **Extrusion** - extending a 2D shape along a third axis (e.g., circle to cylinder)
- b. **Revolution** - rotating a profile around an axis to create a form (e.g., semicircle to sphere)
- c. **Stacking** - building layers to create depth and form
- d. **Contour drawing** - using parallel lines to show surface curvature

Conversion Methods

Convert between different representational systems by

- a. **converting orthographic views** (top, front, side) into isometric drawings
- b. **transforming 2D nets** into visualised 3D objects through folding lines
- c. **shifting between cross-sections** to understand internal structures
- d. **translating measurement drawings** into proportional sketches

Complex Permutations

Advanced techniques involve permutating and combining multiple approaches of

- a. **hybrid projection systems** that mix perspective and orthographic elements
- b. **exploded axonometric drawings** showing assembly relationships
- c. **compound curvature representation** through grid deformation techniques
- d. **nested forms** with transparent outer layers showing internal components

Practical Application Process

The practical process typically follows this sequence:

- a. begins with simple geometric primitives (cubes, cylinders, spheres);
- b. progresses to compound forms created by joining primitives;
- c. introduces curved surfaces and organic forms;
- d. develops complex assemblies with multiple interrelated components;
- e. creates templates that include internal mechanisms and moving parts.

Advancing from Complex to Hyper-Complex 3D

Evolutionary Design Processes

1. **Iterative complexity:** Taking existing complex 3D free-hand designs and systematically increasing their intricacy through multiple iterations

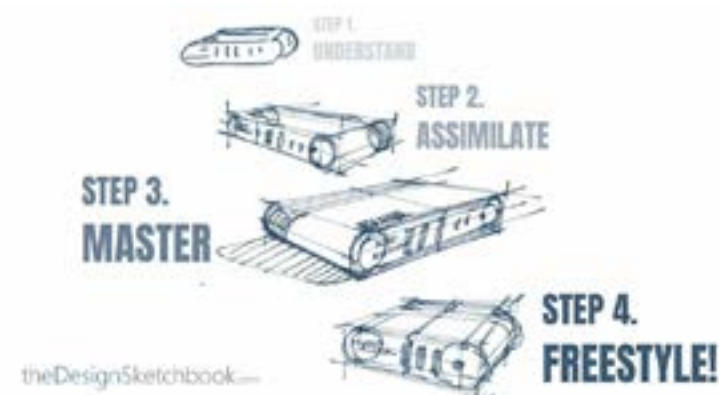


Figure 5.25: Draw It 4 Times Technique

- Draw It Many Times Differently OR Draw Same Thing Differently Incrementally.

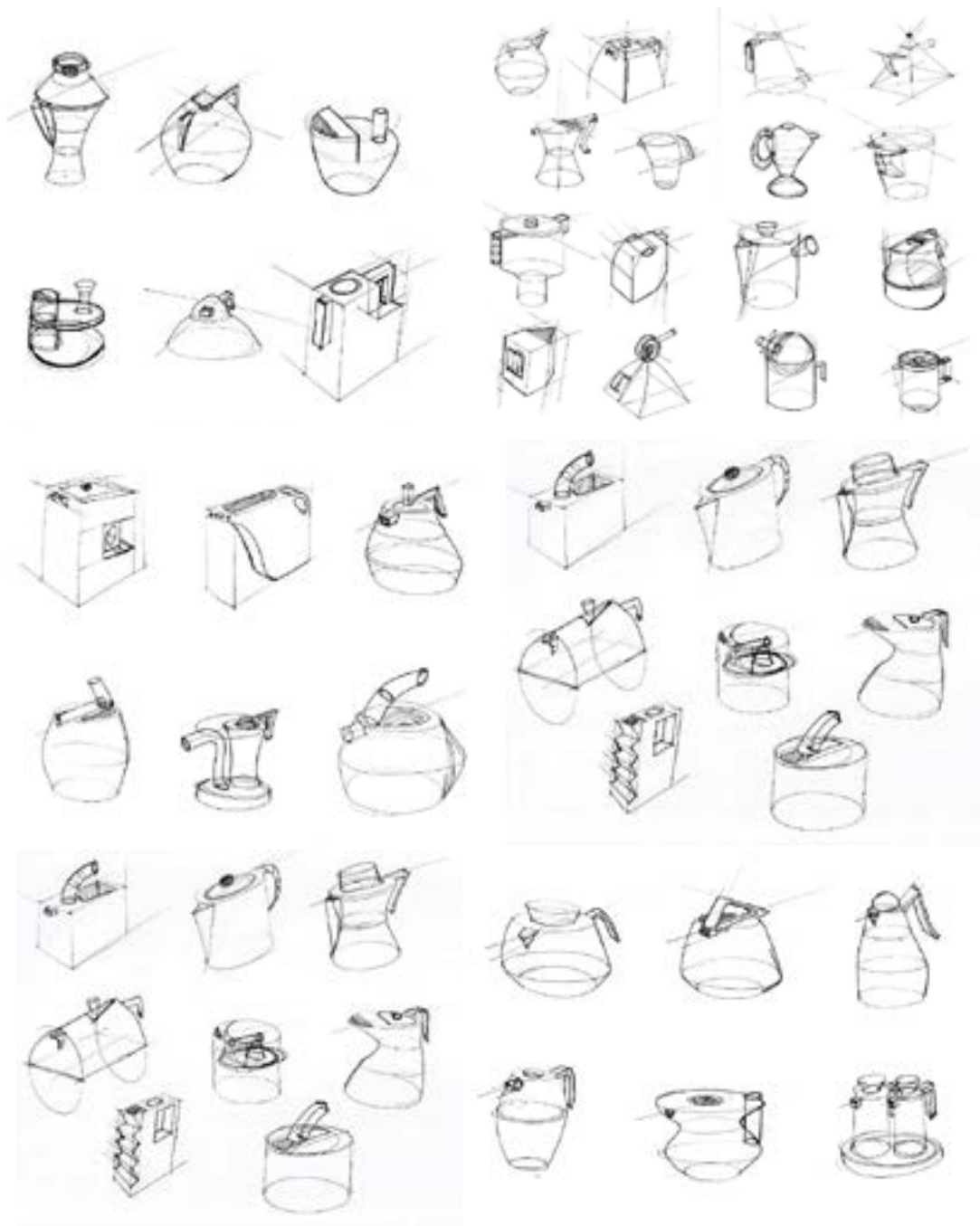


Figure 5.26: Kettle Iterations (Different type iterations)

- 2. **Dimensional layering:** Adding nested dimensions within an already complex 3D structure

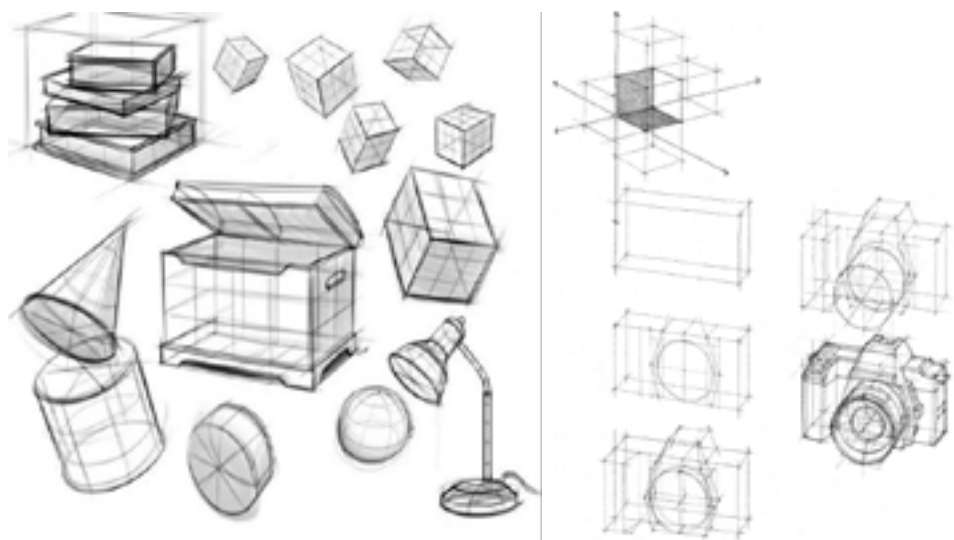


Figure 5.27: Drawing through the form. Thinking 3-dimensionally

- 3. **Fractal-inspired development:** Incorporating self-similar patterns at different scales within the same 3D framework

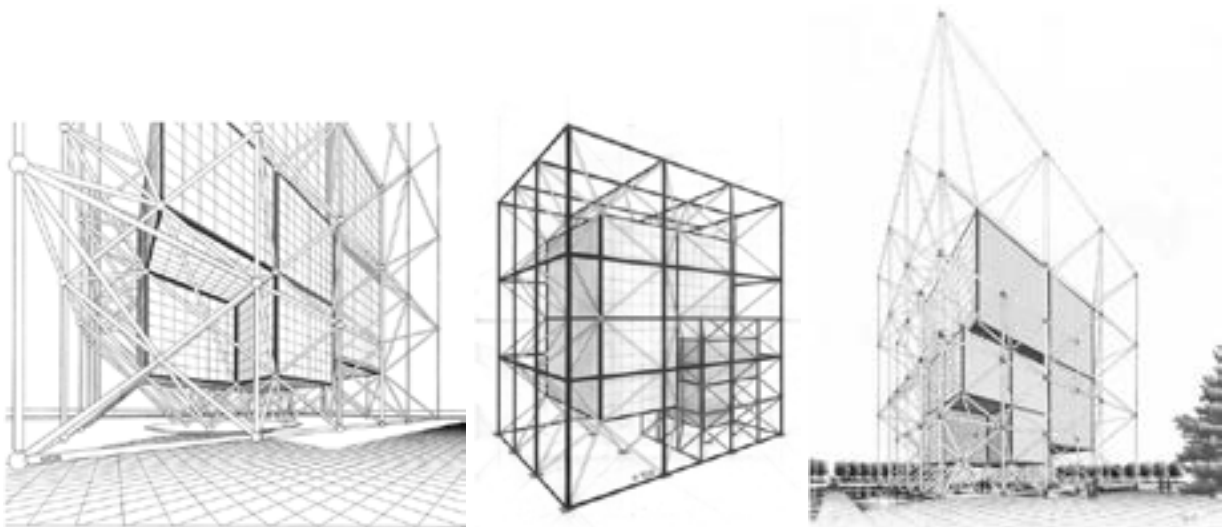


Figure 5.28: Fractal Hypercube-Building

Advanced Free-Hand Techniques

- 1. **Multi-perspective integration:** Creating drawings that simultaneously represent multiple viewpoints of a complex 3D form



Figure 5.29a

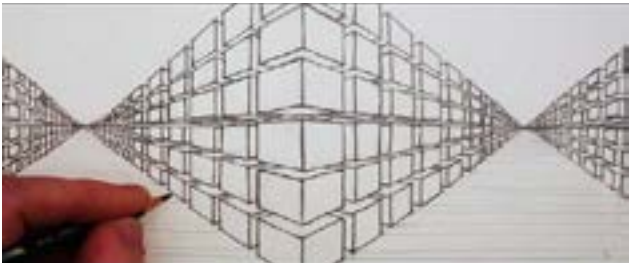


Figure 5.29b

- a. Generative AI. Colourful, imaginative depiction of a floating city composed of various interconnected, stacked buildings in diverse shapes and sizes. <https://www.dreamstime.com/colorful-whimsical-depiction-floating-city-composed-various-interconnected-stacked-buildings-diverse-shapes-sizes-image361421436>
 - b. Perspective// cube judgement system for three-point perspective bravedrawnworldldotnet.wordpress.com/2015/09/15/perspective-cube-judgement-system-for-three-point-perspective/
2. **Cross-sectional mapping:** Developing detailed interior structures that complement exterior complexity



Figure 5.30a

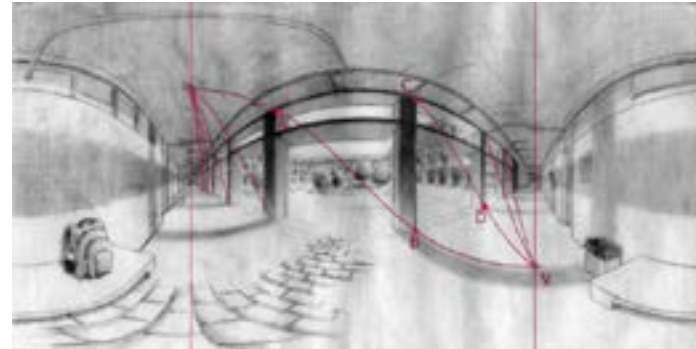


Figure 5.30b

- a. Sectional diagrams reveal internal structures, materials, and spatial relationships while integrating exterior factors, aesthetics and context, to ensure optimal design and functionality. <https://illustrarch.com/articles/architectural-diagrams/27039-what-is-architectural-sectional-diagram.html>
 - b. A case for internal spherical perspective that combines conical anamorphosis with a compact visual sphere flattening, offering mathematical and artistic applications https://link.springer.com/rwe/10.1007/978-3-319-70658-0_100-1
3. **Negative space articulation:** Defining complex forms through the careful rendering of spaces between structural elements



Figure 5.31a



Figure 5.31b

- a. The architectural diagrams depict a futuristic floating grid of circles and squares, interconnected by thin metal structures, which blend minimalist design with a balance of structure and openness. https://www.instagram.com/p/DBafWtktera/?img_index=1
- b. Tertrix-inspired Concepts:

- i. The “Curvilinear Atrium” sketch envisions a vibrant shopping mall with sweeping curves, bold colours, and a dynamic design that reimagines the commercial interior as a living organism. <https://www.instagram.com/architegram/p/DKJP3uUMn9T/>
- ii. The “Fluid Retail Loop” sketch reimagines a shopping mall interior as a space of dynamic movement and playful spatial interaction. <https://www.instagram.com/architegram/p/DJ-8qKqsYhF/>

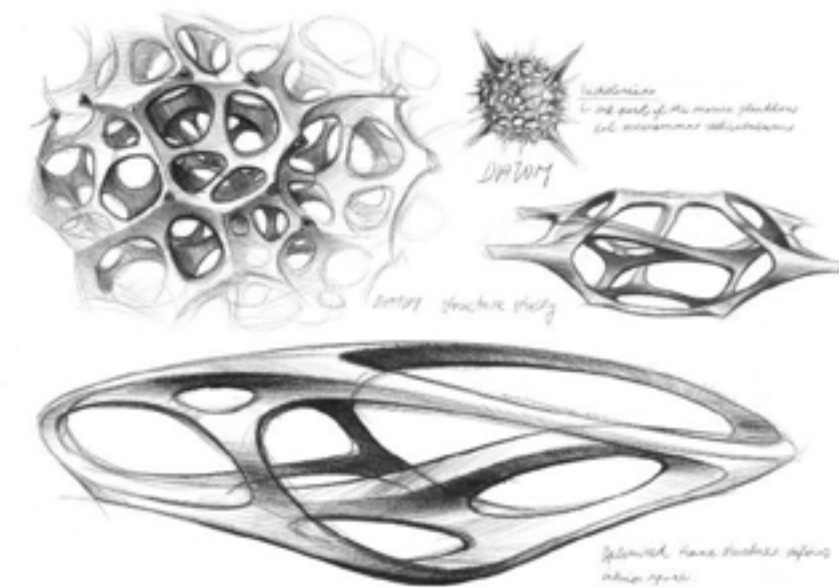


Figure 5.32: Mercedes-Benz Interior Space Conceptual Sculpture

Experimental Approaches

1. **Deconstructive drawing:** Breaking down complex 3D forms and reassembling them in more intricate configurations

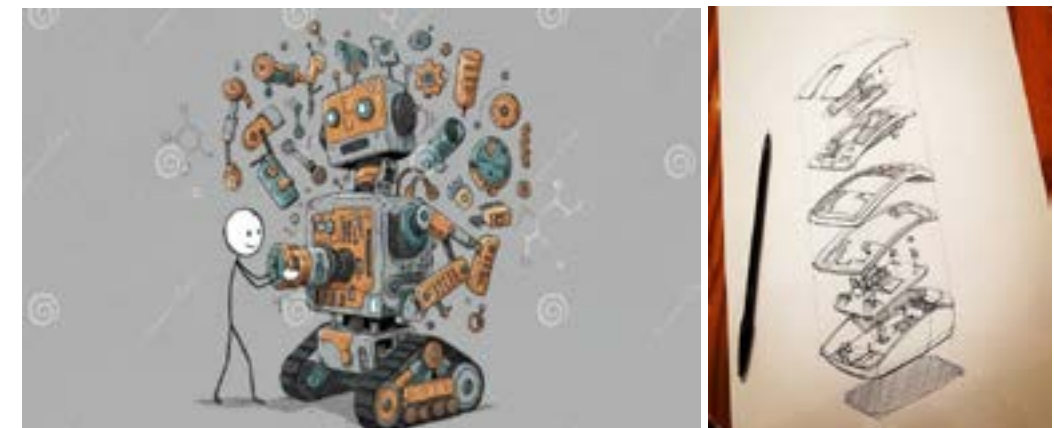


Figure 5.33a.

Figure 5.33b.

- a. Assembling a robot with floating components. <https://www.dreamstime.com/whimsical-depiction-stick-figure-assembling-robot-floating-components-stylized-illustration-features-simple-character-image383643325>
 - b. Deconstructed sketch of a computer mouse by @wanku. https://www.instagram.com/p/BqnW_cTHg-A/?utm_source=ig_share_sheet&igshid=1pqyya2jgs7ia
2. **Metamorphic progression:** Documenting the transformation of one complex 3D form into another more elaborate structure

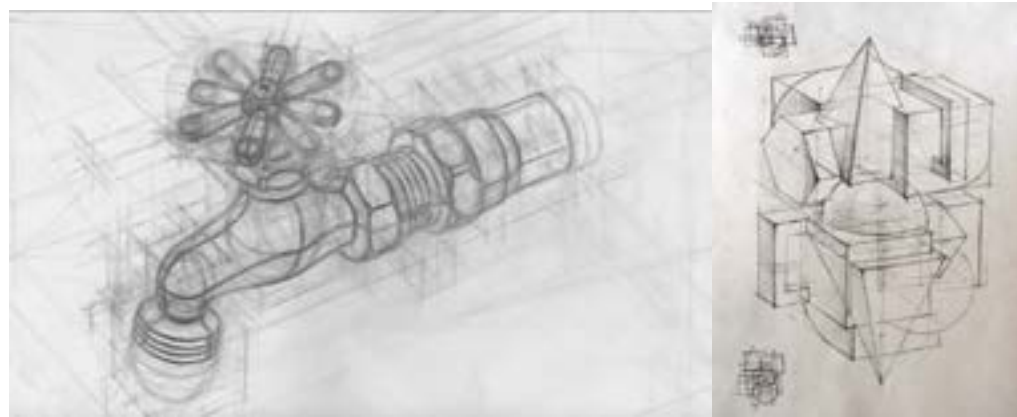


Figure 5.34a.

Figure 5.34b

- a. Cecila Ramay Complex Object Drawing <https://ceceramey.myportfolio.com/complex-object-drawing>
 - b. Object Fusion <https://www.pinterest.com/pin/438397344962716200/>
3. **Spatial narrative development:** Creating sequences of drawings that show how complex forms evolve through space and context

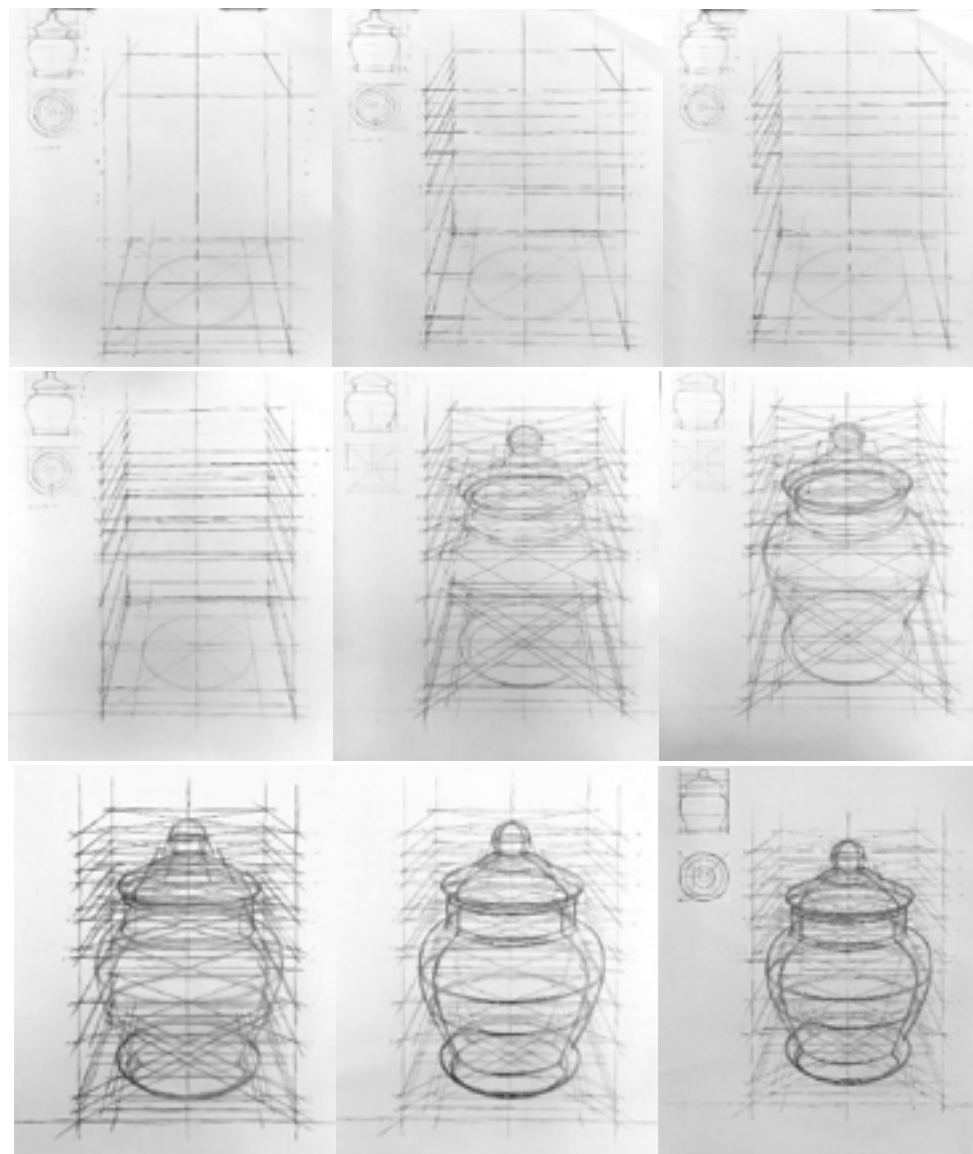


Figure 5.35: Keith Wash Complex to Complex Objects

Learning Tasks

Instruct learners to attempt a 4-step progression that requires scaffolded instruction by creating

1. early exercises by focusing on single translations (2D to simple 3D)
2. intermediate works by introducing multiple views of the same object
3. advanced projects that require learners to imagine internal components not visible externally
4. final works with the ability to create complex but discernible templates for others to follow

Duration - 3 Weeks (12-18 Hours)

Project Brief 1

Phase 1

Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the final outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs.

Project Brief 2

Phase 1

Design a modular furniture piece for your school's common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Project Brief 3

Phase 1

Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Pedagogical Exemplars

Group work/Collaborative Learning: In mixed-ability groups, learners brainstorm to come up with ideas for drawing freehand templates and patterns.

This could be a theme, an object or an idea, and what the 3-dimensional template and pattern drawing is for; e.g., objects, forms, gadgets, vehicles, etc.

Group work/Collaborative Learning; Project-based Learning: Learners in mixed-ability groups develop at least five small sketches and drawings based on their ideas to see which ones could work as 3-dimensional templates and patterns.

Problem-based learning: Learners in mixed-ability groups identify and select appropriate materials and tools, such as pencils, pens, markers, saws, knives, blades, cardboards, wood boards, foam, Styrofoam, etc., for their free-hand-drawn 3-dimensional template and pattern projects.

Key Assessment Levels 4: Research Project

Brief 1 - Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs. The project emphasises how hand-drawn 3D templates evolve into reproducible production templates suitable for dummy manufacturing.

Phase 1: Research and Cultural Pattern Exploration (4 hours)

Task Requirements

- 1. Research indigenous patterns and symbols from your local cultural context, documenting their meanings and traditional applications.
- 2. Investigate colour palettes with cultural significance, noting their traditional sources and symbolic associations.
- 3. Develop exploratory freehand drawings that merge packaging structures with indigenous pattern elements.
- 4. Create five detailed freehand pattern studies adapting traditional motifs for contemporary packaging.
- 5. Produce three complex freehand 3D template drawings showing how indigenous patterns might integrate with structural elements.
- 6. Research dummy manufacturing requirements for packaging, noting industry standards and specifications.

Deliverables

- 1. Cultural research documentation with annotated visual examples of indigenous patterns
- 2. Colour palette studies with cultural significance notes
- 3. Exploratory freehand structural drawings incorporating cultural elements (minimum 8 A4 pages)
- 4. Five detailed indigenous pattern adaptations with annotations explaining cultural references
- 5. Three complex freehand 3D template drawings showing integration of structure and cultural pattern
- 6. Research notes on dummy manufacturing specifications for the packaging industry

Brief 2: Design a modular furniture piece for your school’s common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Phase 1: Cultural Research and Drawing Exploration (4 hours)

Task Requirements

- 1. Research indigenous furniture forms, construction methods, and decorative elements from your cultural context.
- 2. Create observational drawings of the school common area, identifying opportunities for cultural integration.
- 3. Develop conceptual freehand sketches exploring how traditional patterns might inform modular furniture.
- 4. Create five detailed studies of indigenous patterns, analysing their geometric structures and potential for scaling.
- 5. Produce three complex freehand 3D template drawings showing different approaches to furniture that incorporates cultural elements.
- 6. Research furniture dummy production standards, noting industry specifications for scale models and mock-ups.

Deliverables

- 1. Research documentation of indigenous furniture and decorative traditions
- 2. Observational drawings with cultural integration opportunities noted
- 3. Conceptual freehand sketches merging traditional and contemporary forms
- 4. Five indigenous pattern studies with geometric analysis
- 5. Three complex freehand 3D furniture template drawings with cultural elements
- 6. Research notes on furniture dummy and mock-up production standards

Brief 3: Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Phase 1: Cultural Textile Research and Pattern Development (4 hours)

Task Requirements

- 1. Research indigenous textile traditions, documenting pattern motifs, colour palettes, and traditional techniques.
- 2. Investigate the cultural significance of specific patterns and symbols in traditional garments.
- 3. Develop a series of exploratory freehand drawings reinterpreting traditional textile patterns.
- 4. Create five detailed freehand pattern studies that adapt indigenous motifs for contemporary fashion.
- 5. Produce three complex freehand garment template drawings showing different approaches to incorporating cultural patterns.
- 6. Research garment dummy and toile production standards in the fashion industry.

Deliverables

- 1. Research documentation of indigenous textile traditions with visual examples

- 2. Cultural significance notes for selected patterns and symbols
- 3. Exploratory freehand pattern reinterpretations (minimum 10 A4 pages)
- 4. Five detailed indigenous pattern adaptations with contemporary fashion context
- 5. Three complex freehand garment template drawings with integrated cultural patterns
- 6. Research notes on industry standards for garment dummies and toiles

PLC Session 5

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

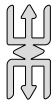
- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **research project**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the research (NTS 3k-3q).

10 minutes	Content Exploration
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- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)

- b. all teachers in the group work through a similar problem individually for 3–4 minutes
- c. the group then works through the problem together step by step
- d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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- 6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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- 7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
- 8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
- 9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 6

Learning Indicator: Develop appropriate drawing frameworks and necessary elements to create three-dimensional templates and patterns

FOCAL AREA: APPROPRIATE 3-D FREEHAND TEMPLATES AND PATTERNS DRAWING TECHNIQUES

1. Elements and Principles of Complex 3D Pattern Drawing for Object Construction

- **Focus:** Designing patterns that translate into three-dimensional forms or embellishments.
- **Elements**
 - **3D Geometry:** Incorporating spheres, cubes, and other solids into patterns.
 - **Surface Patterns:** Applying 2D designs onto 3D surfaces, accounting for curvature and distortion.
 - **Depth and Layering:** Adding dimensionality by stacking or offsetting pattern elements.
 - **Materiality:** Patterns influence how light interacts with 3D objects (e.g., matte vs glossy).
- **Principles**
 - **Continuity:** Ensuring patterns flow seamlessly over 3D surfaces.
 - **Perspective:** Adjusting design elements to account for viewer angles and object orientation.
 - **Scale:** Balancing the pattern's size with the object's volume.
- **Example:** Designing the façade of a building where geometric patterns create shadows and textures based on light direction.

2. Elements and Principles of Complex Pattern Drawing (3D)

- **Focus:** Creating patterns that exist as standalone 3D objects or sculptural forms.
- **Elements**
 - **Volume:** Patterns extend into space, forming intricate structures (e.g., lattice or mesh).
 - **Structural Strength:** Patterns function as part of the object's framework, not just decoration.
 - **Interaction:** The design responds to the environment (light, air, or touch).
- **Principles**
 - **Balance:** Ensuring the pattern maintains structural integrity in 3D.
 - **Tessellation:** Repeating units fit seamlessly in three dimensions.
 - **Dynamic Flow:** Patterns guide the eye or create movement within the space.

- **Example:** A 3D-printed pavilion featuring interlocking cellular patterns.

Elements and Principles of Complex Object Construction (3D)

- **Focus:** Integrating patterns into the structural and aesthetic design of three-dimensional objects.
- **Elements**
 - **Internal Framework:** Patterns inform the object's internal support system.
 - **Surface Modulation:** Textures and patterns enhance visual appeal and functionality (e.g., grip or aerodynamics).
 - **Material Properties:** The Choice of material dictates how patterns are expressed in 3D.
- **Principles**
 - **Form and Function:** Patterns must serve a purpose, such as reducing weight or adding strength.
 - **Spatial Efficiency:** Patterns optimise the use of 3D space within and around the object.
 - **Interaction:** Users engage with the patterns through touch or movement.
- **Example:** A parametric chair design where the backrest features a perforated pattern that adds flexibility and reduces weight.

3. Principles of Template Appropriation (3D)

- **Focus:** Using templates to create 3D designs or objects while introducing unique adaptations.
- **Principles**
 - **3D Mapping:** Adapting 2D templates for 3D forms (e.g., unfolding a 3D shape into a flat template for fabrication).
 - **Transformation:** Using templates to guide shape transformations (e.g., scaling or morphing).
 - **Precision:** Templates must account for material thickness and assembly tolerances. For example, a fashion designer uses a flat fabric template and reinterprets it into a 3D garment using draping techniques.

Examples

1. **Parametric Architecture:** A pavilion with tessellated patterns that adapt to sunlight, creating shaded spaces.



Figure 6.1: The Pentaurea Pavilion is a timber umbrella made to give students and teachers at Escola Turó de Can Mates, a primary school in Sant Cugat del Vallès, Spain, a place to hang out and get shade from the sun.

2. **Sculptural Design:** A 3D-printed vase with flowing patterns that change density along its surface.



Figure 6.2: 3D-Printed Vases https://www.reddit.com/r/3Dprinting/comments/lixaje/ive_been_designing_a_collection_of_modern/

3. **Industrial Design:** Car grills featuring honeycomb patterns that combine aesthetics with aerodynamics.



Figure 6.3 Honeycomb Grille Compatible for Audi A3 S3 2017 2018 2019 2020

When these principles are applied in 3D templates and patterns, they add a deeper level of complexity and functionality, allowing patterns to become integral to both the form and purpose of the object.

Learning Tasks

Project Brief 1

Phase 2

Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the final outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs.

Project Brief 2

Phase 2

Design a modular furniture piece for your school's common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Project Brief 3

Phase 2

Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Pedagogical Exemplars

Group work/Collaborative Learning; Problem-based Learning: Learners in small groups brainstorm to determine appropriate dimensions and proportions for 2-dimensional free-hand-drawn templates and patterns.

Learners can refer to the small sketches approach in LI 1

Group work/Collaborative Learning; Problem-based Learning: Learners in small groups identify and develop steps to create 2-dimensional free-hand-drawn templates and patterns.

The steps can include drawing simple shapes or light outlines by using soft strokes to plan how the finished drawing will look. This will help as a rough guide for the drawing.

Group work/Collaborative Learning; Project-based Learning: Learners in small groups used the steps they developed to create 2-dimensional free-hand-drawn templates and patterns with appropriate details, textures and ornamentations.

As details are added to the 2-dimensional free-hand-drawn templates and patterns, ensure that everything looks balanced and organised. Pay attention to how different parts of the created design come together to form a cohesive template and pattern.

Key Assessment Levels 4: Research

Brief 1- Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs.

Phase 2: Template Development and Materials Sourcing (6 hours)

Task Requirements

1. Refine your most promising freehand 3D template, ensuring reproducibility for dummy manufacturing.
2. Develop detailed pattern drawings with precise measurements suitable for reproduction.
3. Research and source appropriate materials for creating durable, reproducible templates, including:
 - Template board materials (cardboard, mount board, plastic sheet)
 - Pattern transfer materials (carbon paper, transfer paper, digital printing options)
 - Cutting and scoring tools for precise template production
 - Durable marking tools for template annotation
4. Research and source appropriate materials for dummy production, including:
 - Board grades that match commercial packaging specifications
 - Adhesives suitable for dummy construction
 - Finishing materials that simulate commercial production
5. Create a material and tool specification document with sourcing information.
6. Produce initial template prototypes using selected materials, testing for accuracy and reproducibility.

Deliverables

- Refined freehand 3D template drawings with production specifications
- Detailed pattern drawings with precise measurements and registration marks
- Materials research and sourcing documentation with samples
- Tools assessment and selection justification
- Material and tool specification document with supplier information
- Initial template prototypes with testing notes

Brief 2 - Design a modular furniture piece for your school’s common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Phase 2: Template Development and Materials Sourcing (6 hours)

Task Requirements

1. Refine your most promising freehand 3D furniture template, ensuring suitability for dummy production.
2. Develop detailed component templates with precise measurements for both scale models and full-size elements.
3. Research and source appropriate materials for creating durable, reproducible furniture templates, including:
 - Template materials for different scales (card, MDF, acrylic sheet)
 - Pattern transfer materials for different surfaces
 - Cutting tools for various template materials
 - Marking and measuring tools for precise template production
4. Research and source appropriate materials for furniture dummy production, including:
 - Model-making materials for scale dummies
 - Structural materials for full-size component mock-ups
 - Surface materials for simulating finishes
 - Joining methods appropriate for dummy construction
5. Create a comprehensive material and tool specification document with sourcing information.
6. Produce initial template prototypes at different scales, testing for accuracy and reproducibility.

Deliverables

- Refined freehand 3D furniture template drawings with production specifications
- Detailed component templates with precise measurements and assembly references
- Materials research and sourcing documentation with samples
- Tools assessment and selection justification
- Material and tool specification document with supplier information
- Initial template prototypes at different scales with testing notes

Brief 3

Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Phase 2: Template Development and Materials Sourcing (6 hours)

Task Requirements

1. Refine your most promising garment design through iterative freehand drawing.
2. Develop detailed pattern cutting templates with precise measurements and notations.

3. Research and source appropriate materials for creating durable, reproducible fashion templates, including:
 - Pattern paper grades (dot and cross paper, manila card, etc.)
 - Pattern cutting tools (shears, notchers, tracing wheels)
 - Pattern marking tools (tailor’s chalk, water-soluble markers)
 - Pattern transfer materials (carbon paper, dressmaker’s carbon)
4. Research and source appropriate materials for garment dummy production, including:
 - Toile fabrics (calico, muslin, appropriate weight substitutes)
 - Construction materials (threads, tapes, temporary fastenings)
 - Marking materials for pattern placement
 - Appropriate interfaces and support materials
5. Create a comprehensive material and tool specification document with sourcing information.
6. Produce initial pattern templates, testing for accuracy and reproducibility.

Deliverables

- Refined freehand garment drawings with production specifications
- Detailed pattern cutting templates with precise measurements and notations
- Materials research and sourcing documentation with samples
- Tools assessment and selection justification
- Material and tool specification document with supplier information
- Initial pattern templates with testing notes



Hint

Conduct *Mid-semester Examination*. It should cover contents taught from Week 1 to 5. Refer to the *Table of Specification and Structure of the Paper*. Learners’ papers should be marked immediately and scores entered into the SAP.

Structure of Mid-Semeter

Section A: 25 Multiple-choice questions

Section B: 2 Essay Questions

Table of specification for item construction for section A and B

Week	Learning Indicator	Types of ques-tions	DoK Levels				Total
			1	2	3	4	
1	Experiment with freehand sketches to create designs in 3- point perspective with emphasis on proportions using basic shapes and rendering techniques	MCQs	2	2	-		4
		ESSAY	-	-	-		-

2	Use the idea of concept sketches to create com-plex designs with graphite pencil and coloured pencil sketches in freehand drawing	MCQs	2	2	2		6
		ESSAY	-	-	1		1
3	Use techniques in object manipulation to gener-ate simple designs from natural objects	MCQs	-	2	1		3
		ESSAY	-	-	-		
4	Use object manipulation techniques to create simple and complex designs as interventions for societal problems	MCQs	3	2	1		6
		ESSAY					
5	Select appropriate drawing materials and tools that can be used to create three-dimensional free-hand-drawn templates and patterns	MCQs	1	3	2		6
		ESSAY			1		1
		Total	8	11	8		27

PLC Session 6

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - explain the week’s concepts in a practical way that will make it easier for learners to understand.
 - identify three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
 - review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the *Values Learning Community Handbook* and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
 - The key assessment for the week is *mid-semester examination*. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the mid-semester examination (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or topic/idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through the problem individually for 3–4 minutes
 - c. the group then works through it together the problem, step by step
 - d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
 - If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
-
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 7

Learning Indicator: Finalise the complex 3-dimensional template and pattern design

FOCAL AREA 3: APPROPRIATE FREEHAND DRAWN
3-DIMENSIONAL TEMPLATES AND PATTERNS

Learning Tasks: Phase 3

Project Brief 1

Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the final outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs.

Project Brief 2

Design a modular furniture piece for your school’s common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Project Brief 3

Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Pedagogical Exemplars

Managing Talk for Learning: Learners in their groups present their developed 3-dimensional free-hand-drawn templates and patterns in class and record criticisms and suggestions from their peers.

Learners should look at their work objectively with their peers for things they can improve. They should also gather feedback from their peers.

Group work/Collaborative Learning; Problem-based Learning: Learners in small groups use the feedback they receive from their peers in class discussion to make their drawings better.

Group work/Collaborative Learning; Project-based Learning: Learners in small groups write a report explaining how they made their drawings and demonstrate how their 3-dimensional free-hand-drawn templates and patterns can be useful for the community.

Key Assessment Level 4: Research Project

Brief 1 - Design a reusable packaging solution for a local food producer through a process driven by complex freehand drawing, with the outcome being production-ready templates and patterns for dummy manufacturing. Your design must incorporate indigenous patterns, symbols, and colours that reflect local cultural heritage while addressing contemporary sustainability needs.

Phase 3: Production-Ready Templates and Dummy Manufacturing (5 hours)

Task Requirements

1. Produce final production-ready templates using appropriate materials from your research.
2. Create a set of master patterns that can be reproduced accurately for multiple dummy productions.
3. Develop a step-by-step guide for using your templates to create packaging dummies.
4. Produce three identical dummy packages using your templates, demonstrating reproducibility.
5. Evaluate the accuracy and consistency of your templates through the dummy production process.
6. Prepare a presentation focusing on how your templates could be used in a commercial production environment.

Deliverables

- Final production-ready templates with registration marks and assembly instructions
- Master pattern set with reproducible elements
- Step-by-step dummy production guide with photographs
- Three identical dummy packages showing consistency and accuracy
- Evaluation of template performance in dummy production (250 words)
- Presentation on the commercial application of templates and patterns

Brief 2 - Design a modular furniture piece for your school’s common area that incorporates indigenous patterns, symbols, and colours, with the outcome being production-ready templates for furniture dummies. Your design process must demonstrate how hand-drawn 3D templates evolve into reproducible production templates suitable for creating scale models and full-size mock-ups.

Phase 3: Production-Ready Templates and Dummy Manufacturing (5 hours)

Task Requirements

1. Produce final production-ready furniture templates at both scale model and full-size component levels.
2. Create master pattern templates for indigenous design elements that can be accurately reproduced.
3. Develop a comprehensive template application guide for creating furniture dummies.
4. Produce a scale model dummy and at least one full-size component dummy using your templates.

5. Evaluate the accuracy, structural integrity, and reproducibility of your templates.
6. Prepare a presentation demonstrating how your templates bridge conceptual design and production.

Deliverables

- Final production-ready furniture templates at multiple scales
- Master pattern templates for indigenous design elements
- Comprehensive template application guide with step-by-step instructions
- Scale model dummy and full-size component dummy
- Evaluation of template performance across different scales (250 words)
- Presentation on template application in furniture production contexts

Brief 3 - Design a contemporary fashion piece that reinterprets indigenous textile patterns, with the outcome being production-ready templates for garment dummies and toiles. Your design journey must demonstrate how traditional patterns evolve through drawing exploration into reproducible templates suitable for pattern cutting, dummy production, and sample making.

Phase 3: Production-Ready Templates and Dummy Manufacturing (5 hours)

Task Requirements

1. Produce final production-ready pattern cutting templates with all necessary markings and notations.
2. Create master templates for indigenous pattern placement that can be accurately reproduced.
3. Develop a comprehensive pattern-cutting and construction guide for creating garment dummies.
4. Produce a toile/dummy garment using your templates, demonstrating pattern placement and construction.
5. Evaluate the accuracy, fit, and reproducibility of your templates through the dummy production process.
6. Prepare a presentation focusing on how your templates bridge conceptual fashion design and production.

Deliverables

- Final production-ready pattern cutting templates with industry-standard markings
- Master templates for indigenous pattern placement
- Comprehensive pattern cutting and construction guide with step-by-step instructions
- Completed toile/dummy garment showing pattern integration
- Evaluation of template performance in garment dummy production (250 words)
- Presentation on template application in the fashion production context

PLC Session 7

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **research project**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the research (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?

- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section Review

The section has, for the last three weeks, taken learners through three-dimensional freehand template design successfully, and achieved its core educational aims while developing learners’ spatial reasoning and creative problem-solving abilities. The section pushed learners for remarkable progress in technical skills while engaging with authentic design challenges. The rationale for these skills proved sound, with learners recognising their application across multiple fields including product design, cultural preservation and healthcare. Learners recognised the section’s guide towards them visualising complex forms—a skill they had previously found challenging. The pedagogical approaches were particularly effective, with collaborative group work for peer learning for mixed-ability groupings. The problem-based learning strategy engaged even reluctant learners as they worked on realistic design challenges. Groups successfully progressed from initial brainstorming through material

selection to designs, following the sequence of activities. Assessment at Level 4 (Extended Critical Thinking) revealed that most students could evaluate materials critically, justify design decisions, and reflect on their process. The sustainable packaging task proved especially successful, with several groups creating innovative solutions that addressed real environmental concerns. Some learners initially struggled with the analytical aspects of assessment but improved significantly when provided with structured reflection prompts. The section effectively balanced technical skill development with authentic application, achieving its intended learning outcomes while engaging learners in meaningful design work.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 5

Phase 1: Research and Cultural Pattern Exploration (30 marks)

Criterion	Descriptor	Mark Allocation
Indigenous Pattern Research	8 marks	
	Excellent: Comprehensive research of indigenous patterns with clear documentation of meanings, historical context, and traditional applications. Multiple credible sources cited.	7-8
	Good: Thorough research of indigenous patterns with adequate documentation of meanings and applications. Some source citation.	5-6
	Satisfactory: Basic research of indigenous patterns with limited documentation of meanings.	3-4
	Limited: Minimal research with few patterns identified and little contextual information.	1-2
Colour Palette Investigation	4 marks	
	Excellent: Comprehensive colour palette studies with detailed notes on cultural significance and traditional sources.	4
	Good: Adequate colour palette studies with some notes on cultural significance.	3
	Satisfactory: Basic colour palette studies with limited cultural context.	2
	Limited: Minimal colour exploration with little or no cultural context.	1
Exploratory Free-hand Drawings	6 marks	
	Excellent: Extensive exploratory drawings (exceeding 6 pages) showing innovative integration of cultural elements with packaging structures.	5-6

Criterion	Descriptor	Mark Allocation
	Good: Adequate exploratory drawings (4 pages) showing clear attempts to integrate cultural elements.	3-4
	Satisfactory: Basic exploratory drawings with limited integration of cultural elements.	2
	Limited: Minimal exploratory work with little connection between patterns and structures.	1
Detailed Pattern Studies	5 marks	
	Excellent: Five or more detailed pattern studies showing sophisticated adaptation of traditional motifs with comprehensive annotations.	5
	Good: Five detailed pattern studies showing clear adaptation with adequate annotations.	3-4
	Satisfactory: Four to five basic pattern studies with limited annotations.	2
	Limited: Fewer than four pattern studies with minimal annotations.	1
Complex 3D Template Drawings	5 marks	
	Excellent: Three complex, well-executed 3D template drawings showing sophisticated integration of patterns with structural elements.	5
	Good: Three clear 3D template drawings showing adequate integration of patterns.	3-4
	Satisfactory: Two to three basic 3D template drawings with limited pattern integration.	2
	Limited: Fewer than two template drawings with minimal pattern integration.	1
Dummy Manufacturing Research	2 marks	
	Excellent: Comprehensive research on industry standards with specific notes on specifications.	2
	Satisfactory: Basic research on industry standards with limited specifications.	1
	Limited: Minimal or no research on industry standards.	0

WEEK 6

Phase 2 Marking Scheme

Template Development and Materials Sourcing (35 marks)

Criterion	Descriptor	Mark Allocation
Refined 3D Template	8 marks	
	Excellent: Sophisticated refinement of freehand template with comprehensive consideration of reproducibility. Precise measurements and annotations.	7–8
	Good: Clear refinement of template with adequate consideration of reproducibility. Accurate measurements.	5–6
	Satisfactory: Basic refinement with limited consideration of reproducibility. Some measurements included.	3–4
	Limited: Minimal refinement with little consideration of reproducibility. Few measurements.	1–2
Detailed Pattern Drawings	7 marks	
	Excellent: Comprehensive pattern drawings with precise measurements, clear registration marks, and excellent attention to detail.	6–7
	Good: Adequate pattern drawings with accurate measurements and registration marks.	4–5
	Satisfactory: Basic pattern drawings with some measurements but limited registration information.	2–3
	Limited: Minimal pattern development with few measurements.	1
Template Materials Research	6 marks	
	Excellent: Comprehensive research and sourcing of appropriate materials with detailed justification and samples.	5–6
	Good: Adequate research and sourcing with clear justification.	3–4
	Satisfactory: Basic research with limited justification.	2
	Limited: Minimal research with little consideration of appropriateness.	1
Dummy Production Materials Research	6 marks	
	Excellent: Comprehensive research and sourcing of appropriate materials with detailed justification and samples.	5–6
	Good: Adequate research and sourcing with clear justification.	3–4
	Satisfactory: Basic research with limited justification.	2
	Limited: Minimal research with little consideration of appropriateness.	1

Criterion	Descriptor	Mark Allocation
Material and Tool Specification Document	4 marks	
	Excellent: Comprehensive specification document with detailed sourcing information and excellent organisation.	4
	Good: Clear specification document with adequate sourcing information.	3
	Satisfactory: Basic specification document with limited sourcing information.	2
	Limited: Minimal specification with little useful information.	1
Initial Template Prototypes	4 marks	
	Excellent: High-quality initial prototypes with comprehensive testing notes and evidence of refinement.	4
	Good: Clear prototypes with adequate testing notes.	3
	Satisfactory: Basic prototypes with limited testing notes.	2
	Limited: Poor-quality prototypes with minimal testing.	1

WEEK 7

Phase 3: Production-Ready Templates and Dummy Manufacturing (35 marks)

Criterion	Descriptor	Mark Allocation
Final Production Templates	8 marks	
	Excellent: Exceptional production-ready templates with comprehensive registration marks and assembly instructions. Professional quality.	7–8
	Good: Clear production templates with adequate registration marks and instructions.	5–6
	Satisfactory: Basic production templates with limited registration marks and instructions.	3–4
	Limited: Poor-quality templates with minimal guidance.	1–2
Master Pattern Set	6 marks	
	Excellent: Comprehensive master pattern set with excellent reproducibility features and professional presentation.	5–6

Criterion	Descriptor	Mark Allocation
	Good: Clear master pattern set with adequate reproducibility features.	3-4
	Satisfactory: Basic master pattern set with limited reproducibility considerations.	2
	Limited: Minimal pattern set with poor reproducibility.	1
Step-by-Step Guide	5 marks	
	Excellent: Comprehensive, clearly illustrated guide with detailed instructions and troubleshooting advice.	5
	Good: Clear guide with adequate instructions and photographs.	3-4
	Satisfactory: Basic guide with limited instructions.	2
	Limited: Minimal guide with poor instructions.	1
Dummy Package Production	6 marks	
	Excellent: Three identical, high-quality dummy packages showing exceptional consistency and accuracy.	5-6
	Good: Three dummy packages showing good consistency and accuracy.	3-4
	Satisfactory: Three dummy packages showing limited consistency.	2
	Limited: Fewer than three packages or poor consistency.	1
Template Evaluation	5 marks	
	Excellent: Sophisticated evaluation (750 words) with insightful analysis of template performance and evidence-based conclusions.	5
	Good: Clear evaluation with adequate analysis of template performance.	3-4
	Satisfactory: Basic evaluation with limited analysis.	2
	Limited: Minimal evaluation with poor analysis.	1
Commercial Application Presentation	5 marks	
	Excellent: Professional presentation with comprehensive exploration of commercial applications and excellent visual support.	5
	Good: Clear presentation with adequate exploration of commercial applications.	3-4
	Satisfactory: Basic presentation with limited commercial context.	2

Criterion	Descriptor	Mark Allocation
	Limited: Poor presentation with minimal commercial relevance.	1

Total: 30 + 35 + 35 = 100 marks

Key Assessment Criteria Across All Tasks

- 1. Research quality and depth (indigenous traditions, industry standards)
- 2. Drawing skill and development (freehand exploration to refined templates)
- 3. Technical accuracy (measurements, registration marks, notations)
- 4. Material selection and justification (for both templates and dummies)
- 5. Production quality (of templates and dummy products)
- 6. Evaluation and reflection (on process and outcomes)
- 7. Cultural sensitivity and appropriate integration of indigenous elements

SECTION 2: GRAPHIC COMMUNICATION

UNIT 1: PLANE GEOMETRY

Strand: Geometry

Sub-Strand: Plane geometry

Learning Outcome: Use the concepts of plane geometry to construct complex plane geometrical shapes and design different complex artefact based on plane geometrical figures

Content Standard: Apply the concept of plane geometry in designing.

INTRODUCTION AND SECTION SUMMARY

This unit builds upon the foundational knowledge learners acquired in their previous years of study. In this section, learners will deepen their understanding of plane geometry, exploring how these two-dimensional figures serve as essential elements in graphic communication and design.

Learners will explain the concept of auxiliary projections and draw auxiliary elevation and plan (primary) of given objects and how it applies in everyday life. Auxiliary projection is a technique used in engineering and technical drawing to determine the true size and shape of inclined and oblique surface of objects. Learners will also be introduced to arches which will include various types of arches, their construction, applications and bridge gaps with suitable arches. Learners will explain the principles of forces acting on a beam and find the magnitude of reaction forces keeping beams and trusses in equilibrium.

Learners should be able to confidently apply the concepts of auxiliary projections, arches and forces acting on beams in their design work, demonstrating mastery of both the theoretical principles and practical applications required for success in their final examinations and future careers.

The weeks and the indicators covered by the section are:

- **Week 8:** Explain the concept of auxiliary projection.
- **Week 9:** Draw auxiliary elevation and plan (primary) of given objects.
- **Week 10:** Construct the types of arches and their applications in real life situation
- **Week 11:** Explain the principles of forces acting on beams and trusses.

- **Week 12:** Find the magnitude of reaction forces keeping beams and trusses in equilibrium.

Recap weeks

Year 1	Week 16/17: Blending of arcs and circles Week 21: Surface development
Year 2	Week 12: Draw orthographic projections of given objects.

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section requires an application-focused approach to facilitate learning of plane geometry concepts for form three learners. Teachers should build upon learners' previous knowledge from forms one and two, emphasising independent application and creative problem-solving, teachers should consider the pedagogical exemplars below;

Environmental Analysis and Observation Guide learners to conduct detailed analyses of architectural structures, product designs, and visual communications in their environment and facilitate discussions on how plane geometrical principles influence design decisions in professional contexts.

Collaborative Learning Organize mixed-ability groups to tackle complex design challenges that require application of multiple geometric principles. Implement design thinking protocols where learners must justify their geometric choices based on both aesthetic and functional requirements (arches). Ensure all learners (AP, P, and HP) contribute meaningfully by assigning specific roles that leverage individual strengths while rotating the roles to ensure equal participation among learners.

Technology Integration Incorporate CAD software demonstrations to show how plane geometry translates to digital design environments Encourage learners to use appropriate digital tools to enhance precision and explore geometric variations efficiently

Real-World Application Projects Assign projects that require learners to solve authentic design problems using plane geometric principles

ASSESSMENT SUMMARY

Assessment should be comprehensive, covering DoK levels 1-4 with emphasis on levels 3 and 4. Evaluate learners' ability to independently select and apply appropriate geometric principles to construct and design. Assess technical precision in construction alongside creative application, include opportunities for learners to explain and justify their geometric design decisions verbally or in writing.

During instruction and assessment, teachers should ensure inclusive participation with appropriate support for learners at different ability levels

This approach prepares Form Three learners not only for their final assessments but also for the application of geometric principles in future academic and professional contexts.

Indicators	DOK Level	Assessment Strategy and/or Mode
L1: Explain the concept of auxiliary projections	Level 2 (skills of conceptual understanding)	Individual/group classwork

L2: Draw auxiliary elevation and plan (primary) of given objects	Level 3 (strategic reasoning)	Individual class work
L3: Construct the types of arches and their applications in real life situation	Level 4 (Extended critical thinking and reasoning)	Individual/group presentation
L4: Explain the principles of forces acting on beams and trusses.	Level 2 (skills of conceptual understanding)	Presentation
L5: Find the magnitude of reaction forces keeping beams and trusses in equilibrium.	Level 4 (Extended critical thinking and reasoning)	Individual class work

WEEK 8

Learning Indicator: Explain the concept of auxiliary projection

FOCAL AREA: AUXILIARY PROJECTIONS

Auxiliary projections are supplementary views used when the principal orthographic views (front, top, and side) do not adequately show the true shape or size of an inclined or oblique surfaces that cannot be accurately depicted in standard orthographic projections.

Application of auxiliary projections in technical drawing

- 1. They reveal the true shape of inclined surfaces
- 2. They show true lengths of lines that appear foreshortened in principal views
- 3. They are essential for accurate dimensioning and manufacturing of complex objects
- 4. They help in determining true angles between surfaces

Types of Auxiliary Projections

- 1. Primary Auxiliary Views
 - Auxiliary Elevation (projected from the front view)
 - Auxiliary Plan (projected from the top view)
 - Auxiliary Profile (projected from the side view)
- 2. Secondary Auxiliary Views
 - Projected from a primary auxiliary view
 - Used for more complex situations

Primary auxiliary views will be considered in this unit.

Real-World Application of Auxiliary Projections

- 1. Architectural Design and Construction
 - **Specific Example:** When designing a building with sloped roofs, auxiliary views are critical to show the true shape of roof planes, accurate roof pitch angles, and the precise intersection of different roof sections
 - **Impact:** Ensures proper water drainage, structural integrity, and accurate material calculations for construction
- 2. Aerospace Engineering
 - **Specific Example:** When designing an aircraft wing with its air foil shape, auxiliary views reveal the true profile at various sections along the wing span
 - **Impact:** Critical for achieving proper aerodynamic performance, structural strength, and weight distribution in aircraft design
- 3. Mechanical Engineering and Manufacturing

- **Specific Example:** When designing a mounting bracket with angled flanges, auxiliary views show the true shape of each flange and the exact hole locations for proper assembly
- **Impact:** Ensures components fit together correctly, function as intended, and can be manufactured with precision

Each of these applications demonstrates how auxiliary projections bridge the gap between conceptual design and practical implementation by providing the true geometric information needed for accurate construction or manufacturing. Without auxiliary views, engineers and designers would struggle to communicate the precise geometric details necessary for these complex real-world projects.

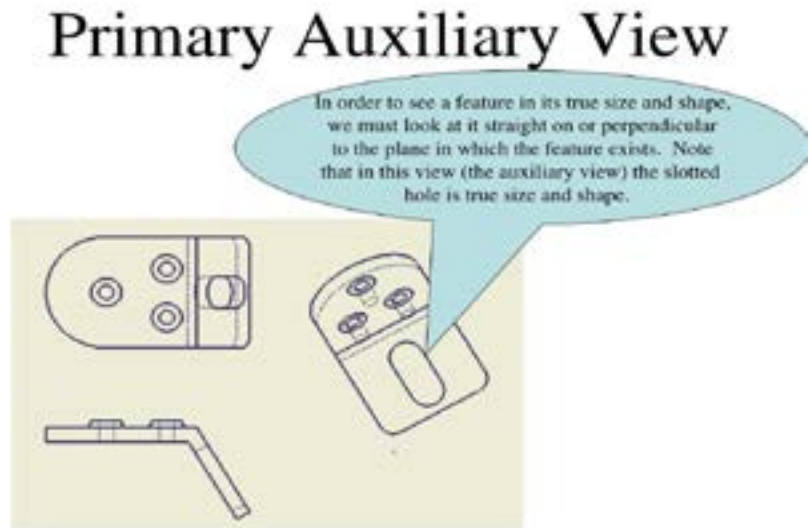


Figure 8.1: Auxiliary projection

Learning Tasks

1. Explain when and why auxiliary projections are necessary in design communication.
2. Identify four real-world applications where auxiliary projections are essential for accurate representation.

Pedagogical Exemplars

Discussion: Using questioning engage learners to revise on orthographic projections from year two.

Initiating talk for learning and Research: Put learners in small groups of four (4) and with the use of charts, internet surf, pictures and YouTube videos engage them in a discussion to explain auxiliary projection.

Activity based learning: task learners to present their report in groups and discuss.

Key Assessment Level 2: Group Class Work

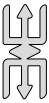
1. Explain why auxiliary projection in technical drawing is important.

2. Identify four real-world applications where auxiliary projections are essential for accurate representation.

PLC Session 8

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group classwork**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the classwork (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 9

Learning Indicator: Draw auxiliary elevation and plan (primary) of given objects

FOCAL AREA: CONSTRUCTING AUXILIARY PROJECTIONS OF GIVEN OBJECTS

First and Second Auxiliary Projections

When an auxiliary projection is made, a second projection can be made from the first projection. The first auxiliary projection, this second projection is called a second auxiliary projection. Depending on the auxiliary elevation, then the second auxiliary projection will be an auxiliary plan or vice versa.

The auxiliary projection is projected from a view, which is already inclined to any of the principal planes,

Note that the second auxiliary projection is normally a pictorial projection, and that it is projected at right angles to the first auxiliary projection.

Objects, which have inclined faces, may have these faces projected to show the true shapes of the inclined surfaces.

To construct the first auxiliary elevation of a cube

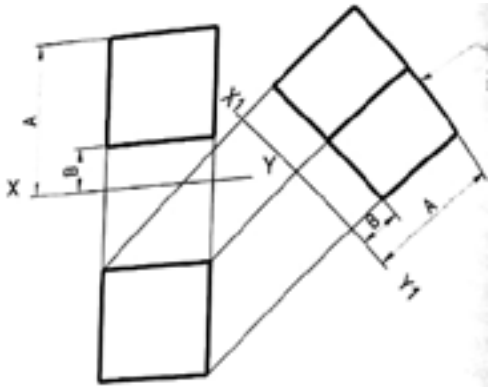
Construct the front elevation and plan of the object	
Construct a new ground line X1 and Y1 at the required angle to the principal plane	
Construct lines perpendicular to line X1 and Y1 from the sides in the plan	
Take vertical measurement from the elevation and transfer these lines to the auxiliary elevation	

Figure 9.1: 1st Auxiliary elevation
Figure 9.1 shows an auxiliary projection diagram used in technical drawing. It features three squares connected by lines, with one square positioned horizontally, another vertically, and the third at an angle. The diagram includes lines extending from the edges of the squares, marked with letters such as A, B, X, and Y, indicating dimensions and angles. This type of projection is used to represent three-dimensional objects on a two-dimensional plane, showing different views and angles.

To construct the first auxiliary plan of a cube

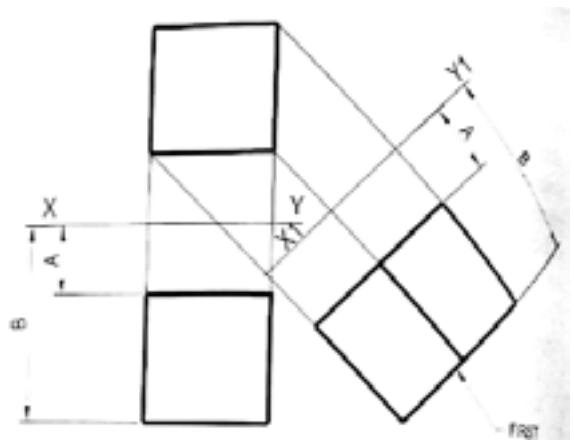
Construct the front elevation and plan of the object	
Construct a new ground line X1 and Y1at the required angle	
Construct vertical lines to the line X1 and Y1 from the edges of the elevation	
Take measurement A, B, etc. from the plan and transfer these into the auxiliary plan to show the shape of the projection	

Figure 9.2: First Auxiliary Plan
Figure 9.2: In first angle projection, the front elevation is positioned to the left of the auxiliary plan, showing the true shape and size of the object's front face. The plan view is placed below the front elevation, providing a top-down perspective of the object's layout. The auxiliary plan in the image offers an angled view to accurately represent features not parallel to the main projection planes.

To construct the second auxiliary projection of a cube

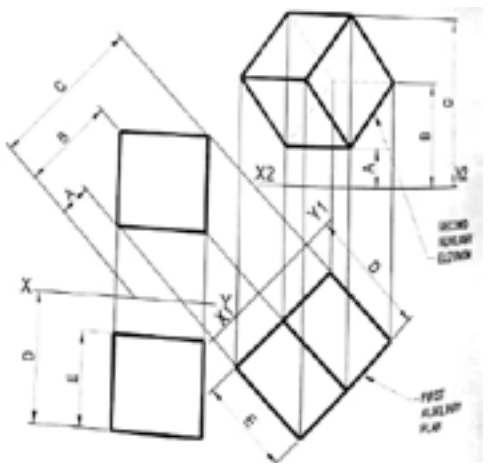
Construct the front elevation and plan of the object	
Construct the first auxiliary plan on X1 and Y1	
Construct the new plan line X2 and Y2	
Construct line perpendicular to the ground line X2 and Y2 from the corner of the first auxiliary projection into the new projection take the transfer measurement from the original elevation to make the second auxiliary	
Firm in the plan, elevation and the auxiliary projections	

Figure 9.3: Second Auxiliary Projection of a cube
Figure 9.3: shows a technical drawing of a cube in different projections. The image shows three views of a cube: a top view, a front view, and an isometric view. The top view and front view are represented as squares, while the isometric view shows the cube in a three-dimensional perspective. The drawing includes various labelled dimensions and lines, such as A, B, C, D, E, F, G, H, I, J, K, L, X, Y, X1, Y1, X2, and Y2. The terms "First Auxiliary Plan" and "Second Auxiliary Elevation" are also labelled on the drawing.

To construct the first auxiliary elevation of a cylinder

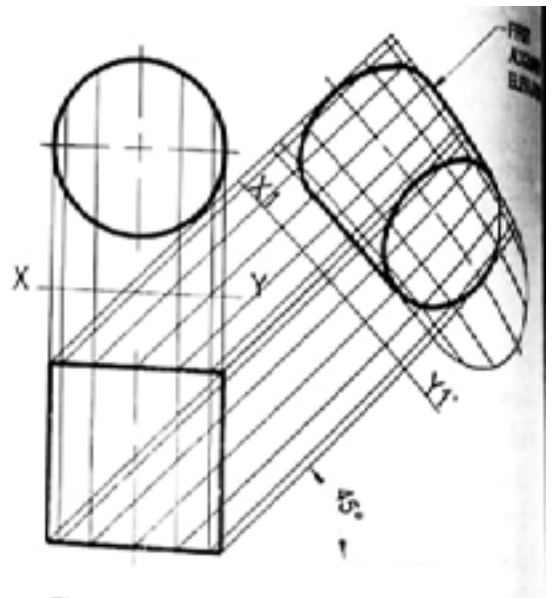
Draw the front view and plan.	
Divide the circle into a number of equal parts and number.	
Draw the new ground line X1Y1.	
From the plan draw lines from the numbered point's perpendicular to the X1Y1 line.	
Transfer distances from the elevation to the perpendicular line.	
Mark the points and draw a smooth curve through the points to give the auxiliary elevation of the cylinder.	

Figure 9.4: First Auxiliary elevation of a cylinder
Figure 9.4 shows a drawing of a cylinder in three different views. The left side shows a front view with a circle, the bottom left shows a plan view with a rectangle, and the right side displays the first auxiliary elevation of the cylinder tilted at a 45-degree angle. The drawing includes projection lines connecting the plan and the auxiliary elevation.

Complete the drawing by adding the relevant lines to give the first auxiliary elevation.
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To construct the first auxiliary plan of a cone

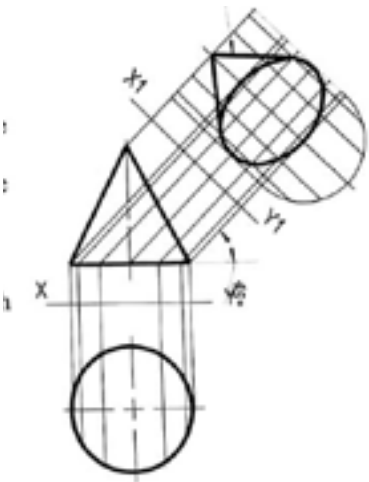
Construct the given elevation and plan.	
Divide the circle into 12 equal parts and number.	
Draw the new ground line X1Y1.	
Draw lines from the numbered points in the elevation into the new projection.	
Draw a line parallel to the X1Y1 a distance equal to the diameter.	
Draw a semi-circle, divide and number this semi-circle	

Figure 9.5: First auxiliary plan of a cone
Figure 9.5 is a drawing of a cone with the front elevation and plan drawn in first angle orthographic projection, including an auxiliary plan drawn with a projection from the front elevation generated from X1-Y1 axes.

Transfer measurements from the plan to the new projection
Trace like numbers and mark the points and draw a smooth X curve through them to give the first auxiliary plan.

Common Challenges and Solutions

Challenge 1

Determining Which Auxiliary View to Use

- Solution: Look for inclined surfaces that appear as lines in the principal views. If the surface appears as a line in the top view, use an auxiliary elevation; if it appears as a line in the front view, use an auxiliary plan.

Challenge 2

Maintaining Accurate Measurements

- Solution: Use dividers or compasses to transfer measurements precisely. Double-check all dimensions before finalising the drawing.

Challenge 3

Complex Objects with Multiple Inclined Surfaces

- Solution: Tackle one surface at a time. Label points clearly to avoid confusion when projecting to the auxiliary view.

Learning Task

Construct primary auxiliary elevation and plan of given objects using the appropriate drawing instruments.

Pedagogical Exemplars

Demonstration: using the marker board and board instrument demonstrate the construction of **primary** auxiliary elevation and plan to learners using appropriate drawing instruments

Activity- based learning: Help learners individually to construct primary auxiliary elevation and plan of given objects using the appropriate drawing instruments

Key Assessment Level 3: Individual Assignment

The figure below shows the front elevation and plan of a truncated cone in first angle orthographic projection with height 75mm and diameter 60mm

Using the drawing sheet provided;

- Draw the given views to scale.
- Draw a primary auxiliary elevation that shows the true shape of the inclined surface

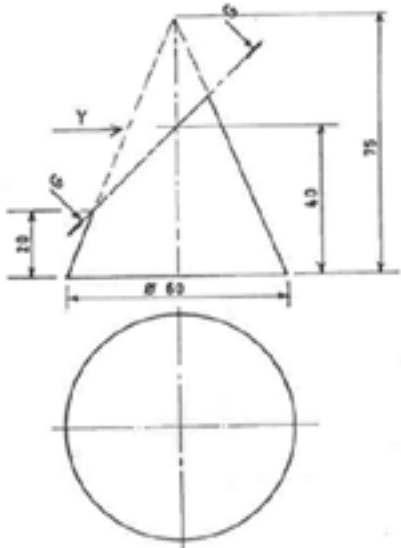


Figure 9.6: Front elevation and plan of a truncated cone

- Draw a primary auxiliary plan that shows the true length of the edge.

PLC Session 9

45 minutes	Planning & Reviewing the Learning Plan
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- Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- Use your subject specific app to explore the content before planning. Ask the app to
 - explain the week’s concepts in a practical way that will make it easier for learners to understand
 - identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- Use your subject specific app to plan your lesson. Ask the app to
 - suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- Plan the week’s key assessment with your app
 - The key assessment for the week is **individual assignment**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the assignment (NTS 3k-3q).

10 minutes	Content Exploration
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- As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - all teachers in the group work through a similar problem individually for 3–4 minutes
 - the group then works through the problem together step by step
 - highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 10

Learning Indicator: Construct the types of arches and their applications in real life situation

FOCAL AREA: ARCHES

In architecture, an arch is an opening in a structure that is curved on top and designed with stones, bricks or timber to distribute weight. Arches are used in structural engineering because they can support a very large mass placed on top of them. You may see arches over entrances, doors and windows. They are frequently used to construct bridges.



Figure 10.1: Types Arches

Types of arches

1. Segmental
2. Semi-circular
3. Semi-elliptical
4. Flat
5. Tudor
6. Ogee
7. The lancet
8. The parabolic

Terminology of arches

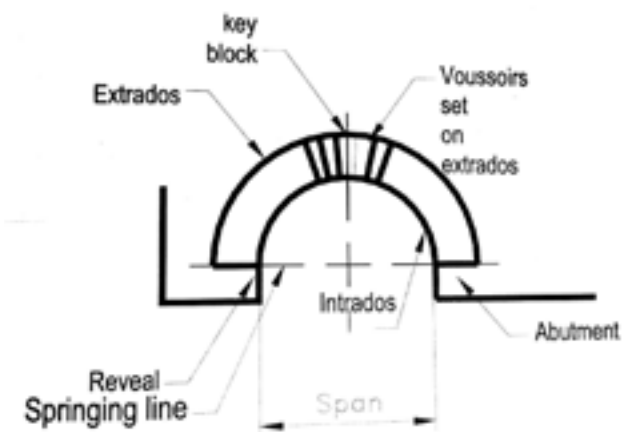


Figure 10.2: An Arch Structure

Construction of arches

Equilateral arch

In constructing equilateral arches, the span equals the radius

- 1. Draw the span AB
- 2. With centre A and B and radius and radius AB draw arcs to intersect at C

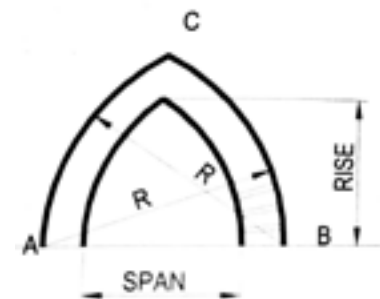


Figure 10.3: Equilateral Arch

Parabolic arch

To set out the pointed parabolic arch,

- 1. Draw the rectangle ABCD.
- 2. Bisect AB at E.
- 3. Divide AD into four equal parts and number.
- 4. Divide AB into eight equal parts and number.
- 5. Draw horizontal lines through the points on AD.
- 6. From D draw radial lines to the number points on AB.
- 7. Plot points with like numbers.
- 8. Draw a smooth through the points to obtain the parabolic arch

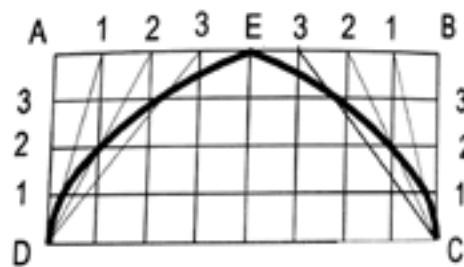


Figure 10.4: Parabolic arch

Semi-circular arch

To set out the semi-circular arch,

- 1. Draw the span AB.
- 2. Bisect it at C.
- 3. With centre C and radius AC, draw the outline of the semi-circle AB.

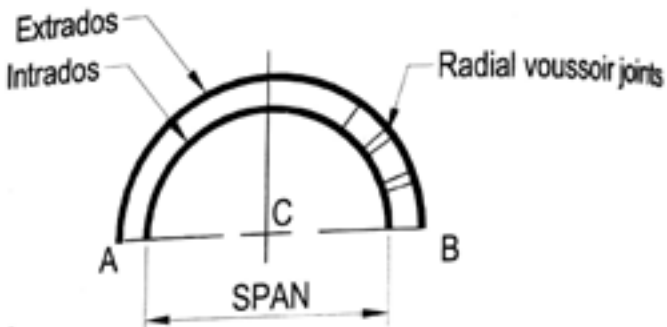


Figure 10.5: Semi-circular arch

Demonstrating simple model of an arched bridge from paper and books

Materials

- 1. Two study books
- 2. Strip of paper approximately 50mm wide and 200 mm long
- 3. A small lightweight object of your choice, like a small cardboard box

Procedure

- 1. Place the books about 150mm apart
- 2. Create a paper bridge by placing the strip of paper on top of the books depending on the design of arch you are using
- 3. Place the object on top of your paper bridge to see whether it supports it or not.



Figure 10.6: Simple model of an arched bridge from paper and books

Real life application of arches

Architecture & Construction: Arches are common in bridges, doorways, windows, and tunnels. They evenly distribute weight, making them ideal for supporting heavy structures.

Engineering: Structural engineers use arches in modern skyscrapers, dams, and stadiums to improve load-bearing capacity.

Automotive Design: The curved frames in car designs enhance aerodynamics and reduce drag.

Medical Science: The human foot has a natural arch that helps with balance and movement.

Learning tasks

1. Explain arches and outline the common types.
2. Draw types of arches using the appropriate drawing instrument.
3. Design an arch that can be used on the door of a chapel and draw it using appropriate tools and instrument.

Pedagogical Exemplars

Initiating talk for learning and Research: With the use of pictures, videos, environmental observation and internet surf engage learners in small groups and in a whole class discussion to come out with the explanation of arches and outline the common types of arches

Project- based learning, Activity based learning: Guide the learners individually to design an arch with two study books and a strip of paper which will be used on the door of a chapel

Activity based learning: Help learners through demonstration to draw types of arches using the appropriate drawing instrument.

Guide the learners individually to design an arch that can be used at the school entrance and draw it using appropriate tools and instrument.

Key Assessment Level 4: Group Presentation

Part A

1. Construct the following two types of arches using proper geometric techniques. Your constructions must be precise, with all construction lines visible but distinguished from outlines:
 - a. Semi-circular arch (span: 70mm)
 - b. Gothic (equilateral) arch (span: 65mm)

Marking scheme for part A

- a. For drawing the span AB =**1 mark**
- Bisecting line AB at C = **1 mark**
- b. Drawing the outline of the semi-circle with centre C and radius AC = **2 marks**
 - c. Drawing the span AB = **2 mark**
- Using centre A and B and radius AB, draw arcs to intersect at C = **2 marks**

Total score: **8 marks**

Part B

School building entrance: A modern SHS building with an entrance (6500mm wide) needs a new entrance arch design that complements its modern design while maximising the entrance height within a 4000mm total wall height.

Tasks

Draw your recommended arch type to scale (1:50)

Explain how your selection balances aesthetic and functional requirements

PLC Session 10

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)

b. all teachers in the group work through a similar problem individually for 3–4 minutes

c. the group then works through the problem together step by step

d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 11

Learning Indicator: Explain the principles of forces acting on beams and trusses

FOCAL AREA: FORCES ACTING ON BEAMS AND TRUSSES

Definition: A force is a push or pull that can cause an object to move, change direction, or change shape, force is measured in newton(N)

Types of Forces acting on beams and trusses

1. Compression (pushing forces)
2. Tension (pulling forces)
3. Shear (sliding forces)
4. Bending (combination of compression and tension)
5. Torsion (twisting forces)

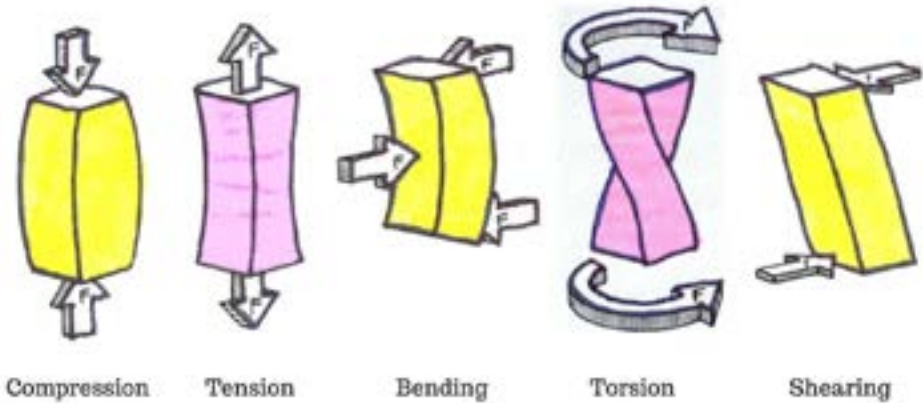


Figure 11.1: Forces acting on a body

Force Characteristics

1. Magnitude (strength of the force)
2. Direction (where the force is acting)
3. Point of application (where the force is applied)



Framed Structures

Definition: Assemblies of linear elements (members) connected at joints to form a stable system

Common Types:

1. Trusses (triangulated frameworks)
2. Beams (horizontal load-bearing members)
3. Frames (combinations of beams and columns)

Applications

1. Bridges

Bridges are designed to withstand the **forces** acting on them. Vertical/ dead loads such as the weight of the deck, girders or trusses and live loads from vehicular traffic or pedestrian, in distributing weight and resisting collapse, here are the key **forces** at play: Compression: A **force** that pushes materials together. Example: The top of an arch **bridge** experiences compression. Tension: A force that pulls materials apart.

2. Roof systems

A roof’s covering and battens convey dead loads (self-weight of materials and permanent fixtures) and live loads (maintenance personnel, wind) to purlins or rafters, which resist bending and shear before transferring reactions to tie beams, collars or directly into supporting walls; tie beams or collar ties carry tensile forces to counter outward thrust at the wall plate,

3. Towers/Building Frames

In multi-storey towers or framed buildings, dead and live loads on slabs are distributed to beams (in beam-and-slab systems) or directly to columns (in flat-slab systems) and then carried as axial compression and bending in columns down to the foundations.

Equilibrium of Forces

Principle: For a structure to be in equilibrium, all forces must balance

Sum of horizontal forces = 0

Sum of vertical forces = 0

Sum of moments about any point = 0

Reaction Forces: Forces exerted by supports to maintain equilibrium

Loading Conditions

- 1. **Concentrated Loads:** Forces applied at specific points
- 2. **Distributed Loads:** Forces spread over an area or length
- 3. **Self-Weight:** The force due to gravity acting on the structure itself

Learning tasks

- 1. Explain the following types of forces acting on a beams and trusses
 - a. compression
 - b. tension
 - c. shear
- 2. Describe the relationship between force acting on beams and building construction.

Pedagogical Exemplars

Demonstration: Station 1: Tension Station, set up an area where students can stretch rubber bands.

Station 2: Compression Station, place foam blocks for students to compress.

Station 3: Bending Station, arrange rulers or sticks that can be supported at both ends with weights to place in the middle.

This engaging 10–15-minute starter activity introduces learners to the concept of forces in structures through hands-on exploration and visual demonstration.

Managing talk for learning: Use charts, board illustrations, the internet and pictures to assist learners understand forces through group discussion. Then engage learners in a whole class discussion to explain the principles of forces acting on beams and trusses.

Key Assessment Level 2: Presentation

- 1. Explain the following types of forces acting on a beams and trusses
 - a. compression
 - b. tension
 - c. shear
- 2. Describe three relationships between force acting on beams and building construction.

PLC Session 11

45 minutes	Planning & Reviewing the Learning Plan
1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied. 2. Use your subject specific app to explore the content before planning. Ask the app to a. explain the week’s concepts in a practical way that will make it easier for learners to understand b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m). 3. Use your subject specific app to plan your lesson. Ask the app to a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds. b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q) c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).	



- Note**
- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
 - Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
- a. The key assessment for the week is **presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).

9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 12

Learning Indicator: Find the magnitude of reaction forces keeping beams and trusses in equilibrium

FOCAL AREA: FINDING MAGNITUDE OF REACTION FORCES KEEPING BEAMS AND TRUSSES IN EQUILIBRIUM

Determining the magnitude of reaction forces is a fundamental skill in structural analysis that ensures beams and trusses remain in equilibrium under applied loads. These reaction forces, provided by supports, counterbalance external forces and prevent structure movement or collapse. This analysis forms the foundation for all subsequent structural design decisions.

To find the reaction forces on the left (RL) and right (RR) of a simple supported beam

1. Draw the space diagram
2. Draw the force diagram
3. Chose any point O let say 40 to 50 mm from the force diagram
4. Join o to the force points to obtain ao, bo, co, do, and eo.
5. Draw a line parallel to ao to intersect lines 1 and 2 at a and b
6. From b draw a line parallel ob to intersect line 3 at c
7. From c draw a line parallel to line oc to intersect to intersect line 4 at d
8. From d draw a line parallel to od to intersect line 5 at e
9. Join the reaction line at a and e, known as the closer
10. Draw a line parallel to ae, the closer from o in the polar diagram to cut the force line at e, this line divides the force line into two parts, ae and ed
11. The distance between ae is the left-hand reaction and ed is the right-hand reaction, measure ae in mm and convert to Kn using the scale to obtain the reaction at RL and measure and convert ed to obtain RR

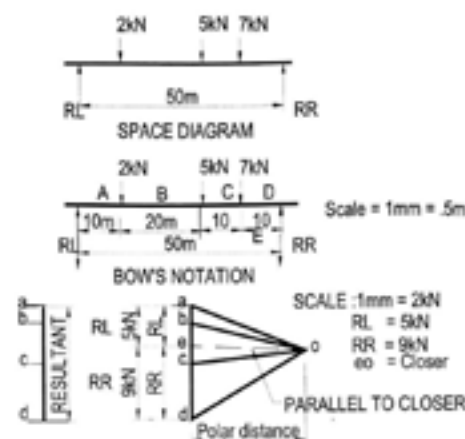


Figure 11.2: Simply supported beam with point loading

To find the resultant wind thrust on the truss, given the load acting on the roof

1. Draw the space diagram
2. Draw the force and the polar diagram
3. Use Bow's notation to letter the diagram
4. Draw the closer
5. Draw of a parallel to the closer
6. At e draw a line parallel to reaction RR to intersect f
7. Draw vertical line from a to cut f
8. The distance af = RL; the reaction on the left
9. The distance ef represent RR, the right end reaction

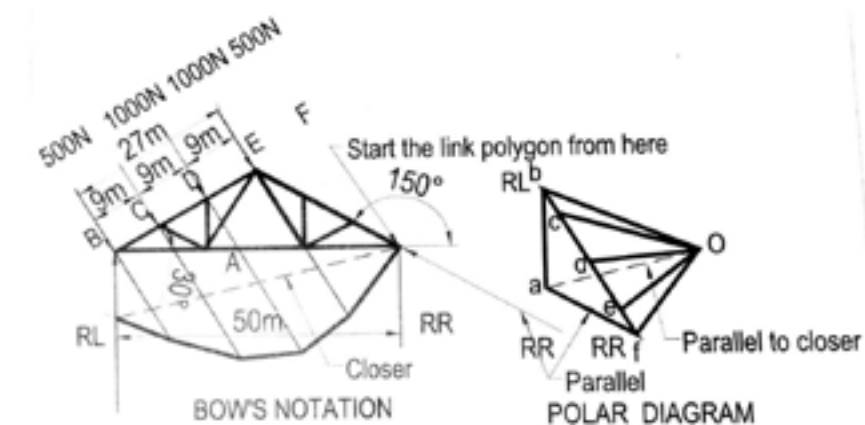


Figure 11.3: Trusses with wind loading

Bending moment and shear force diagram

Bending moment and shear force diagrams are graphical representations that show how internal forces vary along the length of a beam. These diagrams are essential tools in structural analysis and design, providing critical information about where a beam experiences maximum stress and helping engineers determine appropriate beam sizes and materials.

Fundamental Concepts

Shear Force (V)

- The internal force acting perpendicular to the beam's axis
- Tends to cause sliding between adjacent cross-sections
- Measured in units of force (N, kN)

Bending Moment (M)

- The internal moment that causes the beam to bend
- Results from the cumulative effect of loads and their distances
- Measured in units of force $\times$ distance (N•m, kN•m)

Step-by-Step Process for Drawing shear force diagrams

1. Draw the space diagram and extend the force and reaction lines vertically.

2. Draw a horizontal reference line from the force points on the polar diagram to intersect the vertical lines from the space diagram for easy reference
3. Construct the Shear Force Diagram by Starting at the Left End of the Beam
4. Account for Left Support Reaction If there is a support at the left end, plot its vertical reaction value by drawing a vertical line from the reference axis to this value
5. Progress Along the Beam by moving from left to right, addressing each load and its effect
6. **For Point Loads** Create a vertical jump in the diagram equal to the load magnitude Upward jump for downward loads, downward jump for upward loads
7. Continue to the right end and Process all loads in sequence from left to right.
8. Complete and Label the Diagram by Adding Reference Lines, adding a title and scale and Include units for all values
9. Define Sign Convention typically, positive shear forces are plotted upward negative shear forces are plotted downward

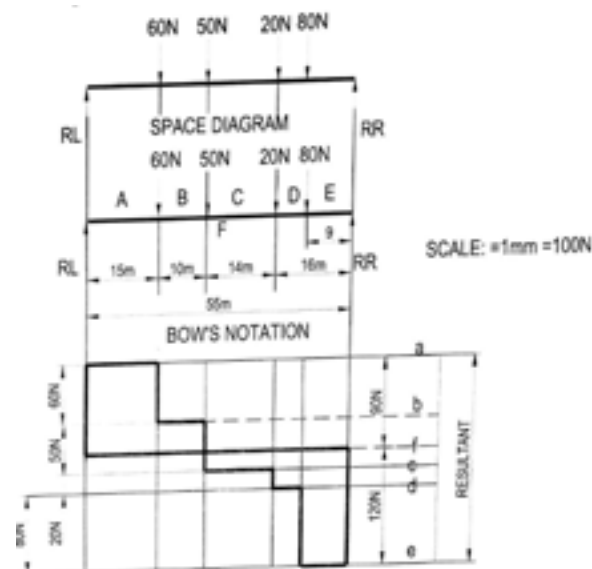


Figure 11.4: Shear force diagram

Step-by-Step Process for Drawing bending moment diagrams

1. Draw the polar diagram
2. Position the pole o to the right of the diagram
3. join the point o to the load point
4. from the reaction RL, draw a line parallel to OA to intersect the loads 5knpont, from the point draw a line parallel to OB to intersect 8Kn line
5. from this point draw a line parallel to OC to intersect the 5kn line
6. from this point draw parallel to OD to intersect reaction RR
7. join the points RL an RR to obtain the closer
8. from O draw a line parallel to the closer to intersect the polar diagram load line
9. to obtain the horizontal base line for the bending moment diagram plot the vertical coordinates at the load point from the horizontal base.

10. Plot these vertical ordinates on the horizontal line

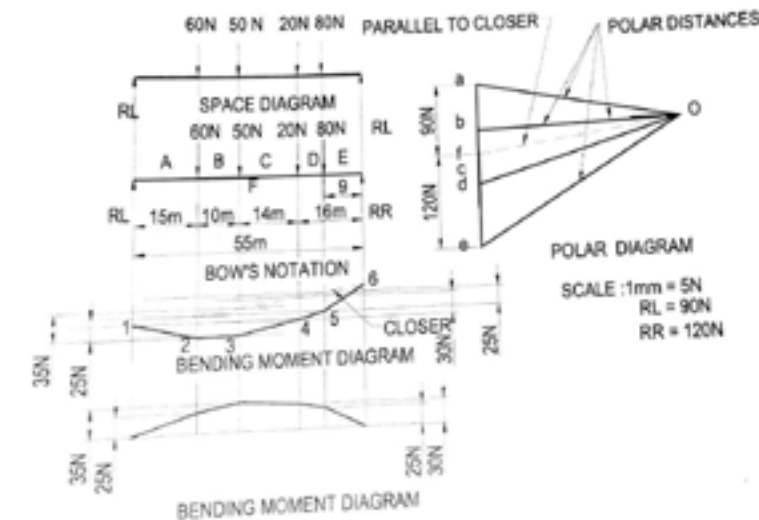


Figure 11.5: Forces with bending moment diagram

Drawing shear force diagrams graphically is a valuable skill that provides immediate visual insight into a beam's structural behaviour. This approach helps engineers and designers understand how forces flow through structures, identify critical design points, and communicate structural concepts effectively.

By following a systematic approach and understanding the fundamental principles that govern how loads affect shear forces, you can accurately represent the internal shear behaviour of beams under various loading conditions. This graphical understanding forms the foundation for more complex structural analysis and design decisions.

Learning tasks

1. Find the magnitude of reaction forces keeping beams and trusses in equilibrium
2. Draw bending moment and shear force diagrams.

Pedagogical Exemplars

Initiating talk for learning: Use charts, board illustrations and pictures to review learners' understanding of forces through group discussion. Then engage learners in a whole class discussion to explain the principles of forces acting on beams and trusses

Activity-based learning, managing talk for learning: With the use of charts, pictures, videos, internet surfing, and using appropriate drawing instruments, guide learners in small group discussion and through demonstration to draw concentrated and varied forces acting on beams.

Activity-based learning: Assist them to find the magnitude of the reaction forces that are keeping the beams in equilibrium from their drawings

Activity-based learning

1. Help the learners to draw bending moment and shear force diagrams using appropriate drawing tools and equipment
1. Use the appropriate drawing instrument to demonstrate the drawing of concentrated loads acting on trusses.

2. Use the drawing to find the magnitudes of the reaction forces keeping the trusses in equilibrium in given structures

Key Assessment: Practice Paper 1

1. Figure 11.6 shows a simply supported beam with two-point loads.

Figure 11.6 A beam of length 8m with supports at both ends, carrying loads of 40N at 2m from the left support and 60N at 4m from the left

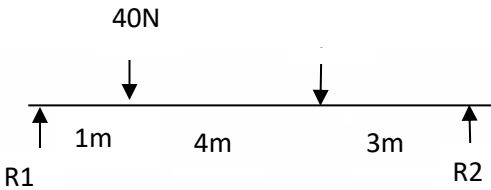


Figure 11.6: Simply supported beam

NB. using a scale of 1m:10mm and 1N:0.5mm

Identify the types of reactions occurring at both supports. (2 marks)

Draw the shear force diagram of the forces (2 marks)

Draw the bending moments of the forces. (2 marks)



Hint

Conduct Practice Paper 1. It should cover the contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section to guide you. Learners' papers should be marked immediately and scores entered into the SAP.

TABLE OF SPECIFICATION FOR PRACTICE PAPER 1
MULTIPLE CHOICE QUESTIONS

STRAND	LEARNING INDICATOR	LEVEL OF AS- SESSMENT				TOTAL
		1	2	3	4	
Con- ceptual Drawing	1.1.1.LI.1 Explain concept sketches and their applications in designing	1				1
	1.1.1.LI.2 Use basic shapes, forms and rendering techniques in designing.		1			1
	1.1.1.LI.3 Use the principles of perspective drawing and proportion in designing.		1			1
	1.1.2.LI.1 Analyse and record the concept of object manipulation and manipulation techniques.			1		1

	1.1.2.LI.2 Experiment with various tools and techniques in drawing to manipulate organic and inorganic shapes, forms and objects.			1		1
	1.1.3.LI.1 Analyse the sources and use of templates and patterns in the community.		1			1
	1.1.4.LI.1 Describe the processes in designing.	1				1
GEOME- TRY	1.2.1.LI.1 Explain types of plane geometrical figures and give examples.	1				1
	1.2.1.LI.2 Use ratio to enlarge, reduce or divide plane geometrical figures.		1			1
	1.2.1.LI.4 Construct an ellipse as a plane geometrical figure.		1			1
	1.2.1.LI.3 Blend circles and lines with arcs.			1		1
	1.2.1.LI.5 Construct an Archimedean spiral as a locus		1			1
	1.2.2.LI.1 Explain types of solid geometrical figures and give examples.	1				1
	1.2.2.LI.2 Construct objects in isometric, oblique and perspective.		1			1
	1.2.2.LI.3 Draw the surface development of prisms.		1			1
	1.2.2.LI.4 Draw the surface development of truncated prisms.		1			1
	1.2.3.LI.1 Explain the basic concept of fractal geometry.		1			1
	1.2.3.LI.2 Use the concept of fractal geometry in fractal designs.			1		1
	1.2.3.LI.2 Use the concept of fractal geometry in fractal designs.	1				1
CON- CEPTUAL DRAW- ING	2.1.2.LI.3 Generate simple forms in line with the concepts and narratives associated with objects and designs			1		1
	2.1.3.LI.1 Select appropriate drawing materials and tools that can be used to create 2-dimensional free hand-drawn templates and patterns.	1				1

GEOMETRY	2.2.1.LI.1 Draw orthographic projections of given objects.	1				1
	2.2.1.LI.2 Explain the principles underlying the working of Loci and construct loci.	1		1		2
	2.2.2.LI.1 Construct the development pyramids.		1			1
	2.2.2.LI.2 Draw the curve of intersections of objects meeting at right angles.	1				1
	2.2.2.LI.1 Demonstrate the use of basic concepts of CAD in developing		1			1
	2.2.3.LI.1 Select various geometric shapes used to create fractal designs.	1				1
	2.2.3.LI.3 Draw orthographic views of given objects	1				1
	2.2.3.LI.4 Design artefact with loci			1		1
Con- ceptual Drawing	3.1.2.LI.1 Use techniques in object manipulation to generate simple designs from natural objects.			1		1
	3.1.2.LI.2 Use object manipulation techniques to create simple and complex designs as interventions for societal problems.			1		1
	3.1.3.LI.1 Select appropriate drawing materials and tools that can be used to create 3-dimensional free hand-drawn templates and patterns.	1				1
Geome- try	3.2.1.LI.1 Explain the concept of auxiliary projection.		1			1
	3.2.1.LI.2 Draw auxiliary elevation and plan (primary) of given objects.		1	1		2
	3.2.2.LI.1 Draw the curve of intersections of solids of the same sides meeting at different angles		1			1
	3.2.2.LI.2 Draw the curve of intersections of solids of different sides and meeting at different angles.		1			1

	3.2.2.LI.3 Design artefact using the concept of curve of intersection.			1		1
	3.2.3.LI.1 Select various geometric shapes used to create complex fractal designs.			1		1
	TOTAL	12	16	12		40

PAPER 2**SECTION A**

THERE ARE 3 QUESTIONS FROM THIS SECTION OF WHICH LEARNERS ARE TO ANSWER 1. IT FOCUSES ON CONCEPTUAL DRAWING AND FRACTAL GEOMETRY. IT IS ENTIRELY FREEHAND SKETCHING.

STRAND	LEARNING INDICATORS	LEVEL OF ASSESSMENT	TOTAL
		1 2 3 4	
CON- CEPTUAL DRAW- ING	2.1.1.LI.3 Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing.	2	2
	2.1.2.LI.3 Generate simple forms in line with the concepts and narratives associated with objects and designs		
	2.1.3.LI.2 Develop appropriate drawing framework and necessary elements to create 2-dimensional templates and patterns.		
	3.1.1.LI.2 Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing		
	3.1.2.LI.1 Use techniques in object manipulation to generate simple designs from natural objects.		
	3.1.2.LI.2 Use object manipulation techniques to create simple and complex designs as interventions for societal problems.		
	3.1.3.LI.2 Develop appropriate drawing framework and necessary elements to create 3-dimensional templates and patterns		

GEOME-TRY	1.2.3.LI.2 Use the concept of fractal geometry in fractal designs.	1	1
	2.2.3.LI.2 Experiment with the creation of various fractal designs using geometric shapes.		
	3.2.3.LI.2 Use the idea of fractal geometry to create complex fractal designs.		
		3	3

SECTION B

PART 1 (PLANE GEOMETRY) - COMPULSORY						
STRAD	LEARNING INDICATOR	LEVEL OF ASSESSMENT				TOTAL
		1	2	3	4	
GE- OME- TRY	1.2.1.LI.2 Use ratio to enlarge, reduce or divide plane geometrical figures.	1				1
	1.2.1.LI.3 Blend circles and lines with arcs.					
	1.2.1.LI.4 Construct an ellipse as a plane geometrical figure.					
	1.2.1.LI.5 Construct an Archimedean spiral as a locus.					
	2.2.1.LI.1 Draw orthographic projections of given objects.					
	2.2.1.LI.3 Design artefact using the principle of loci					
	3.2.1.LI.2 Draw auxiliary elevation and plan (primary) of given objects.					
	3.2.1.LI.3 Construct the types of arch and their applications in real life situation					
	3.2.1.LI.4 Explain the principles of forces acting on beams and trusses					
	3.2.1.LI.5 Find the magnitude of reaction forces keeping beams and trusses in equilibrium					
PART II (SOLID GEORMETRY) 2QUESTIONS, CHOOSE 1						

GE-OME-TRY	1.2.2.LI.1 Explain types of solid geometrical figures and give examples.	2	2
	1.2.2.LI.2 Construct objects in isometric, oblique and perspective.		
	1.2.2.LI.3 Draw the surface development of prisms.		
	1.2.2.LI.4 Draw the surface development of truncated prisms.		
	2.2.2.LI.1 Construct the development pyramids.		
	2.2.2.LI.2 Draw the curve of intersections of objects meeting at right angles.		
	3.2.2.LI.1 Draw the curve of intersections of solids of the same sides meeting at different angles		
	3.2.2.LI.2 Draw the curve of intersections of solids of different sides and meeting at different angles.		
	3.2.2.LI.3 Design artefact using the concept of curve of intersection.		
	TOTAL	3	3

PAPER 3

THERE ARE 3 OPTIONS IN THIS PAPER, LEARNERS ARE TO ANSWER QUESTIONS FROM ONLY ONE OF THE OPTIONS

OPTION 1 BUILDING DRAWING						
STRAND	LEARNING INDICATOR	LEVEL OF ASSESSMENT				TOTAL
		1	2	3	4	
EX-TENDED DRAW-ING	2.3.1.LI.2 Make freehand sketches of elevations of simple domestic buildings in relation to their plans.	1				1
	3.3.1.LI.2 Make freehand sketches of floor plan of simple domestic buildings.					
	3.3.1.LI.3 Draw floor plan of simple buildings using appropriate drawing Instruments or CAD					

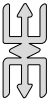
	3.3.1.LI.5 Draw the sectioning of simple buildings using appropriate drawing Instruments or CAD					
TOTAL						1
OPTION 2 MECHANICAL DRAWING						
EX- TENDED DRAW- ING	2.3.2.LI.2 Sketch the sectional views of machine parts and components in freehand.	1				1
	2.3.2.LI.3 Draw the sectional views of machine parts and components with drawing instruments.					
	3.3.2.LI.2 Prepare assembly drawing from component parts.					
	3.3.2.LI.3 Prepare detailed working drawings to scale using appropriate drawing instrument or CAD					
TOTAL						1
OPTION 3 GARMENT DESIGN TECHNOLOGY						
EX- TENDED DRAW- ING	2.3.3.LI.2 Take accurate body measurement to prepare a bodice block	1				1
	2.3.3.LI.3 Draft garment patterns using bodice block, skirt block and sleeve block.					
	2.3.3.LI.4 Cut out the patterns to be used for the garment					
	3.3.3.LI.3 Manipulate patterns to make adaptations of different garment designs					
	3.3.3.LI.4 Make Pattern adjustments and alterations					
TOTAL						1

PLC Session 12

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to

- a. explain the week’s concepts in a practical way that will make it easier for learners to understand.
- b. identify three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
- a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
- b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
- c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



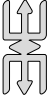
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
- a. The key assessment for the week is **practice paper 1**. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the practice paper (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or topic/idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- b. all teachers in the group work through the problem individually for 3–4 minutes
- c. the group then works through it together the problem, step by step
- d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section 2 review

Under section two, learners explored plane geometry by building on previous knowledge in year one and two to discuss auxiliary projections, arches and forces acting on beams and trusses. Learners developed skills in observation, drawing, and application methods, varied pedagogical approaches have been incorporated: Managing Talk for Learning, Experiential Learning, Collaborative Learning, Problem-Based Learning, and Project-Based Learning are among a few. Assessment across DoK levels 1-4 has been conducted through explanation, project-based assessment, etc. These principles underscore the importance of combining graphical techniques with mechanical insight to design structures that are not only functional but also resilient and enduring, mastery of these topics equips learners to innovate and design with confidence across a wide range of applications—from bridges and buildings to machinery and infrastructure.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 8

Question 1 (Explain why auxiliary projection in technical drawing is important)

[Total: 6 marks]

Criteria	Description	Marks
Definition (Understanding of auxiliary projection)	Gives a clear explanation of what an auxiliary projection is (e.g., a method used to show true shape and size of inclined surfaces).	2 marks
Purpose / Importance	Explains why it is used — e.g., helps represent features that are not parallel to the principal planes, allows accurate measurement and dimensioning.	2 marks
Clarity and Relevance	Explanation is clear, technically correct, and directly addresses the importance (e.g., improves accuracy, visualization, and understanding of object geometry).	2 marks

Example of a full-mark answer

“Auxiliary projection is important in technical drawing because it allows inclined or oblique surfaces to be shown in their true shape and size. It ensures accurate representation and dimensioning of features that cannot be shown correctly in standard orthographic views.”

Question 2 (Identify four real-world applications where auxiliary projections are essential for accurate representation)

[Total: 8 marks (2 marks each)]

Criterion	Description	Marks
Application 1	Correct and relevant real-world example (e.g., aircraft design – showing wing inclination).	2
Application 2	Correct and relevant example (e.g., architectural drawings – sloped roofs or ramps).	2
Application 3	Correct and relevant example (e.g., mechanical engineering – inclined holes or surfaces in machine parts).	2
Application 4	Correct and relevant example (e.g., automotive design – angled body panels).	2

Example of full-mark answers:

1. Aircraft design — to accurately show inclined wings and tail surfaces.
2. Architecture — to represent true shapes of slanted roofs or ramps.
3. Mechanical engineering — to show the true size of inclined holes, slots, or faces on components.
4. Automotive design — to represent angled panels or windshields accurately.

Total Marks: 14 marks

WEEK 9

a. Drawing given views to scale. (12marks)

- i. For drawing the front elevation of the cone (height=75, base=60)

2
- ii. For indicating the cutting plane G-G (left=20, on the axis =40)

2

- iii. For using short dashes to indicate the cut portion2
- iv. For indicating a centre line1
- v. For indicating arrow Y1
- vi. For drawing circle with diameter 60 in plan2
- vii. For drawing the cut surface in plan2

12marks

b. Drawing primary auxiliary elevation (6marks)

- i. For projecting lines from the plan at angle 45°2
- ii. For constructing a line perpendicular to the lines X¹ – X¹1
- iii. For picking and transferring points from the elevation to the lines projected2
- iv. For joining point to complete the auxiliary elevation1

6marks

c. Draw a primary auxiliary plan that shows the true length of the edge. (6marks)

- i. For projecting lines from the front elevation perpendicular to the cutting plane – 2
- ii. For constructing a line perpendicular to the lines projected from the front elevation
Y¹ – Y¹ – 1
- iii. For picking and transferring points from the plan to the lines projected2
- iv. For joining point to complete the auxiliary plan1

6marks

d. Addendum (2mark)

- i. For quality of lines and accuracy1
- ii. For neatness1

2marks

WEEK 10

Assessment Rubric for part B

Criteria	4 marks (Excellent)	3 marks (very good)	2 marks (good)	1 mark (Needs improvement)
Scale Accuracy	Drawing accurately uses 1:50 scale with all measurements precisely converted (6500mm→130mm, 4000mm→80mm)	Drawing uses correct scale with minor measurement errors (±2mm)	Drawing uses correct scale with minor measurement errors (±5mm)	Incorrect scale used or major measurement errors

Aesthetic Considerations	Comprehensive explanation of how the arch design complements modern architecture; thoughtful consideration of visual appeal	Good explanation of aesthetic choices with some connection to modern design principles	Basic explanation of aesthetic considerations with limited connection to modern design	Minimal or no explanation of aesthetic considerations
Functional Analysis	Provides detailed analysis on the four topics Detailed analysis on; • how the design maximises entrance height • structural integrity • passage for vehicles and pedestrians • a place to write the school's name, vision and mission statements.	Provides detailed analysis on only three topics	Provides detailed analysis on only two topics	Provides detailed analysis on only one topic
Design Justification	Exceptional justification for the chosen arch type with clear references to both aesthetic and functional requirements	Good justification for the chosen arch type with references to both requirements	Limited use of technical vocabulary; demonstrates basic understanding	Incorrect or missing technical vocabulary

WEEK 11

Question 1

- a. **Compression:** Compression is a pushing force that acts inward along the axis of a structural member, causing it to shorten or compress. [1 mark]
- b. **Tension:** Tension is a pulling force that acts outward along the axis of a structural member, causing it to elongate or stretch. [1 mark]
- c. **Shear:** Shear is a force that acts parallel to a cross-section of a structural member, causing adjacent parts of the material to slide relative to one another [1 mark]

Question 2

- a. **Floor Systems:** Beam arrangements in floor systems distribute loads from slabs to columns or walls (1 mark).

The magnitude and direction of forces determine beam spacing, depth, and configuration (simple spans, continuous spans, or cantilevers) (1 mark).

- b. **Roof Structures:** Roof structures must resist both gravity loads and lateral forces from wind or rain activity (1 mark).
- c. The force distribution informs the roof pitch, beam orientation, and bracing requirements (1 mark).
- d. **Load Transfer Paths:** Beams create load paths that channel forces through the building to the foundation (1 mark).

The proper alignment of beams ensures efficient force transfer without overloading any single element (1 mark).

or any relevant response from learners

Total score 9 marks

WEEK 12

- a. For drawing the space diagram – 1 mark
- b. For drawing the force diagram – 1 mark
- c. For drawing the funicular diagram – 1 mark
- d. Finding reaction at R1 – 1 mark
- e. Finding reaction at R2 – 1 mark
- f. Drawing shear force diagram – 2 marks
- g. Drawing the bending moment – 2 marks
- h. Hatching the shear force and bending moment diagram – 1 mark

Total score: 10 marks

SECTION 2: GEOMETRY

UNIT 2: SOLID GEOMETRY

Strand: Geometry

Sub-Strand: Solid geometry

Learning Outcome: Use the concept of intersection to draw and design artefact

Content Standard: Apply the concept of solid geometry in designing

INTRODUCTION AND SECTION SUMMARY

In this section, learners will explore the concept of intersection in solids geometry and develop the skills to draw and design artefacts using these principles. By understanding how two or more solids intersect, learners will gain the ability to visualise and construct accurate curves of intersection, which are essential for creating complex three-dimensional forms. The overall learning outcome is for students to confidently apply the concept of intersection to produce clear, precise drawings and to translate those drawings into tangible artefact designs. By the end of the section, learners should be able to demonstrate how intersecting solids of various sizes and orientations generate specific curves, and how those curves can inform the design of practical objects or structural components.

Over the course of three weeks, students will build their understanding step by step. In Week 13, they will focus on drawing the curves formed when solids of the same size meet at different angles, using the principles of orthographic projections and locate corresponding points on each solid. In Week 14, the emphasis shifts to solids of different sizes meeting at various angles, requiring students to adjust their projection techniques to accommodate differing dimensions. Finally, in Week 15, learners will apply these drawing skills to design an artefact that incorporates one or more curves of intersection, synthesising their knowledge of solid geometry to create a finished product. By the end of this section, learners will have acquired both the theoretical understanding and the practical skills necessary to apply intersection concepts in their own design work.

The weeks and the indicators covered by the section are:

- *Week 13:* Draw the curve of intersections of solids of the same sizes meeting at different angles.
- *Week 14:* Draw the curve of intersections of solids of different sizes and meeting at different angles.
- *Week 15:* Design artefact using the concept of curve of intersection.

Recap week

Year 2	Week 12: Draw orthographic projections of given objects.
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SUMMARY OF PEDAGOGICAL EXEMPLARS

In order to facilitate the understanding of the lesion on intersections, learners should revise the lesion on orthographic projections they have learned in year 2. Learners should be guided chronologically through demonstration, critical thinking and the use of ICT tools to form concepts and solve day to day problems in their environment using the principles of curve of intersections. Real objects made with curve of intersections such as pipe joints, model of intersections and videos should be used to enhance understanding. Learners must use cardboards to exhibit their understanding of the concept. Whilst the focus is on curves of intersection of pipes of the same size meeting at angles other than 90°, mention must be made of intersections at right angles Drawing instruments

ASSESSMENT SUMMARY

Assessment strategies proposed to be used for facilitating the evaluation of lessons on intersections are

- 1. **Individual classwork** – learner should be given the opportunity to individually practice the drawing of curves of intersection using instruments, clear instruction should be given to learners with ample time for them to carry out the work. Keen supervision must be made to ensure learners carryout the work individually.
- 2. **Home work** – learners should be given a take-home assignment with clear instructions and a well-defined duration e.g., two days or three days. It should be spelt out that the work must be done by the learner and not passed on to other.
- 3. **Exhibition** – learners must be put into mixed ability groups with maximum membership of 5 depending on the class size, instructions for the work must be typed and printed/ projected or written for learners to copy. Outline the deliverable for the learners based on the question and give them the timeline for the submission of each deliverable till the task is completed. Thoroughly discuss the rubrics for scoring the exhibition with learners before the start of the exhibition.

Indicators	DOK Level	Assessment Strategy and/or Mode
Draw the curve of intersections of solids of the same sizes meeting at different angles	Level 3 (Strategic Thinking);	Class Work
Draw the curve of intersec- tions of solids of different sizes and meeting at different angles	Level 3 (Strategic Thinking)	Home Work
Design artefact using the concept of curve of intersection	Level 4 (Extended Critical Thinking)	Exhibition

WEEK 13

Learning Indicator: Draw the curve of intersections of solids of the same sizes meeting at different angles

FOCAL AREA 1: CURVE OF INTERSECTIONS OF THE SAME SIZE

In engineering, curves of intersection are used to define the precise lines where two or more solid components meet, ensuring accurate fitting and smooth transitions between parts. For example, in mechanical design, intersection curves guide the cutting and welding of pipes or ducts so that cylindrical or conical sections join without gaps, preserving flow and structural integrity. In civil and architectural work, these curves determine how curved roofs, domes, or columns meet adjacent surfaces, allowing builders to fabricate panels or cladding that fit perfectly and reduce on-site adjustments. Likewise, in automotive and aerospace engineering, intersection curves help design body panels and fuselage sections that join at subtle angles, optimising aerodynamics and assembly precision. In each case, engineers employ projection techniques, computer modelling, or numerical methods to derive these curves and apply them in both design and construction.

In this unit, students will learn how to draw the curves formed when two solids of identical dimensions intersect at various angles. By using orthographic projection and basic geometric constructions, learners will discover how to locate and connect points along the edges of each solid to reveal the precise shape of their intersection. Working with solids of the same size simplifies measurement and helps students focus on how the angle between the two shapes influences the resulting curve. Through guided exercises, students will develop confidence in visualising three-dimensional intersections and in producing accurate technical drawings that show how these curves change as the angle varies.

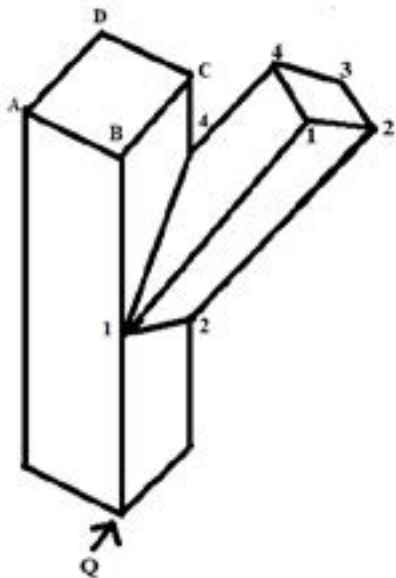


Figure 13.1: Intersection of Two Identical Solids at an Angle

Procedure for drawing the curve of intersection of equal square pipes

- 1. Draw the front elevation and plan of the main pipe in orthographic projection (first angle or third angle) and label the vertices A,B,C and D

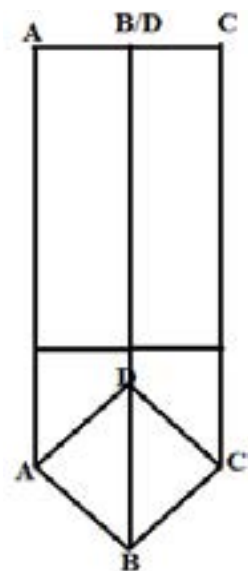


Figure 13.2

- 2. Draw the duct at a given angle to the main pipe in the front elevation and label the vertices 1,2,3 and 4.
- 3. Project the duct to the plan and label 1,2,3 and 4

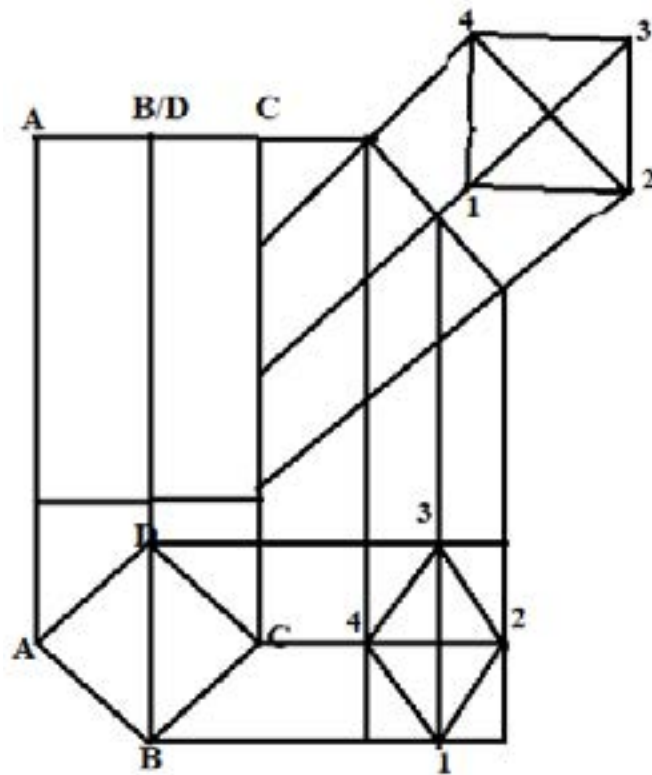


Figure 13.3

- 4. Project from the plan the points of intersection of the lines from the duct with the main pipe to the front elevation.
- 5. Extend the lines on the duct in the front elevation to intersect with their corresponding lines from the plan.
- 6. Join the points according to the numbers to form the curve of intersection

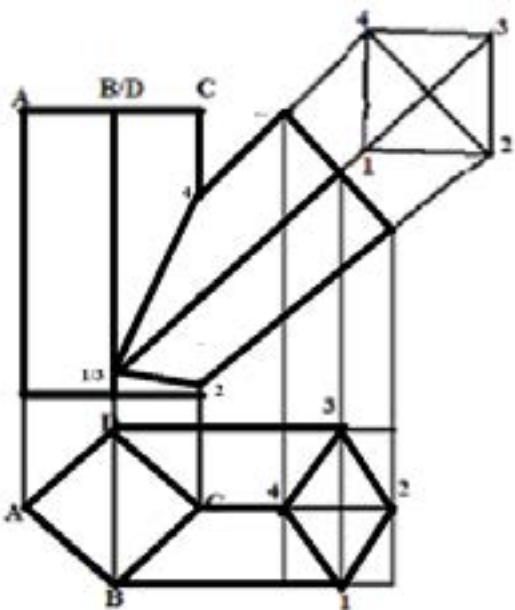


Figure 13.4

Learning Task

Draw the curve of intersections of solids of the same sizes meeting at different angles

Pedagogical Exemplars

Managing talk for learning

With the use of videos and pictures review learners’ knowledge on intersections from year two through group activities and help them to explain the curve of intersections of square and cylindrical pipes of the same sides meeting at different angles

Managing talk for learning

Demonstrate the construction of curves of intersection of square and cylindrical pipes of the same sides meeting at an angle other than ninety degrees (90°) using appropriate drawing instrument

Activity based learning

Help learners to draw the curve of intersection of given pipes using drawing instrument

Key Assessment Level 3: Classwork

- 1. As an engineer, you have won a contract with Ghana Water Company to design joints to be used in their new distribution lines within your locality. The figures are shown below:
 - a. Draw the front elevation and plan of the figure in first angle orthographic projection.
 - b. Draw the complete right end elevation.
 - c. Draw the curve of intersections of the pipes.

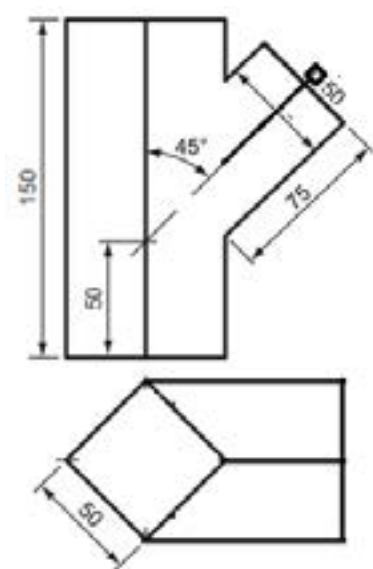


Figure 13.5

PLC Session 13

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **classwork**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the classwork (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 14

Learning Indicator: Draw the curve of intersections of solids of different sizes and meeting at different angles

FOCAL AREA 2: CURVE OF INTERSECTIONS OF DIFFERENT SIZES

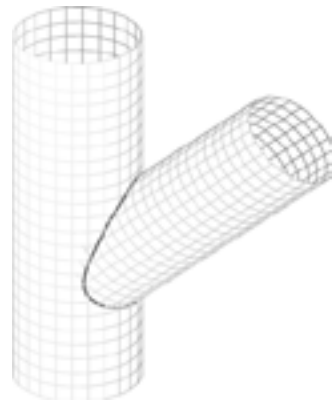


Figure 14.1: Intersection of Cylindrical Pipes of Different Diameters

Procedure for drawing the curve of intersection of equal square pipes

1. Draw the front elevation and plan of the main pipe in orthographic projection (first angle or third angle).
2. Construct a semi-circle at the end of the duct in the front elevation, with the radius of the duct
3. Divide the semi-circle into a number of equal parts (8 or 12) and label
4. Construct a semi-circle at the end of the duct in the plan, with the radius of the duct,
5. Divide the semi-circle into a number of equal parts as done in the front elevation and label
6. Project lines that are parallel lines to sides of the duct from the divisions on the semi-circle into the main pipe in front elevation.
7. Project lines that are parallel lines to sides of the duct from the divisions on the semi-circle to intersect with the circumference of the main pipe in plan.

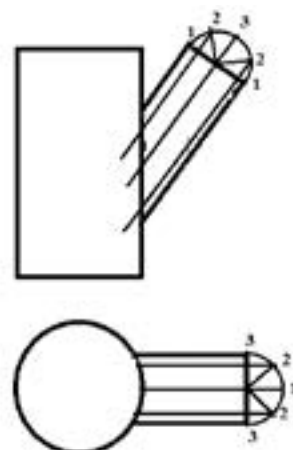


Figure 14.2

8. Project vertical lines from the end of the duct in the front elevation to the plan
9. Join the points of intersections of the lines from the front elevation and their corresponding lines in the plan with curves to complete the plan.
10. Project vertical lines from the point of intersections of the main pipe and the duct in plan to intersect their corresponding points in the front elevation.

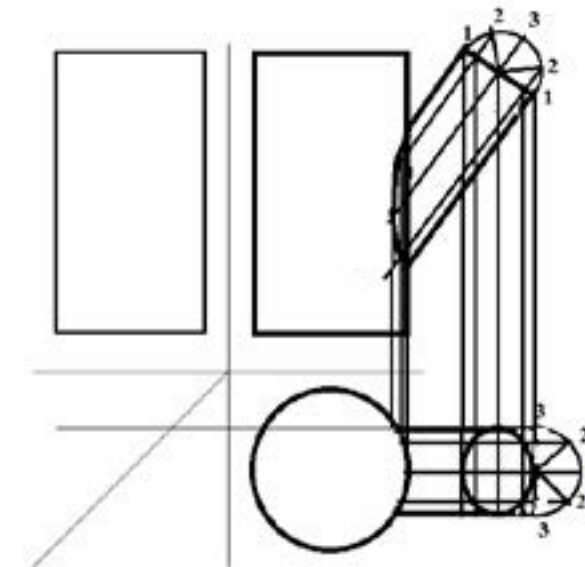


Figure 14.3

11. Join the points of intersections on the front elevation to produce the curve of intersection in the front elevation.
12. Project from the front elevation and plan to produce the end elevation as done in orthographic projection.
13. Clearly outline the work to make it complete and indicate the curve of intersection.

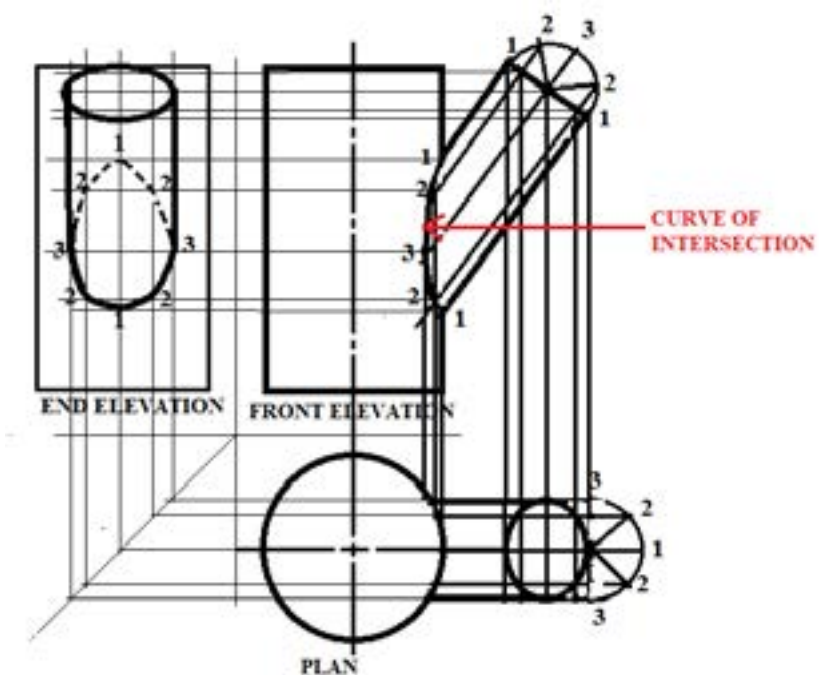


Figure 14.4

Learning Task

Draw the curve of intersections of solids of different sizes and meeting at different angles.

Pedagogical Exemplars

Managing talk for learning

- 1. With the use of videos and pictures review learners’ knowledge on intersections from year two through group activities and help them to explain the curve of intersections of square and cylindrical pipes of different sides meeting at different angles
- 2. Demonstrate the construction of curves of intersection of square and cylindrical pipes of different sides meeting at an angle other than ninety degrees (90°) using appropriate drawing instrument

Activity based learning: Help learners to draw the curve of intersection of given pipes using drawing instrument

Key Assessment Level 3: Homework

- 1. As an engineer, you have won a contract with Ghana Water Company to design joints to be used in their new distribution lines within your locality. The figure is shown below:

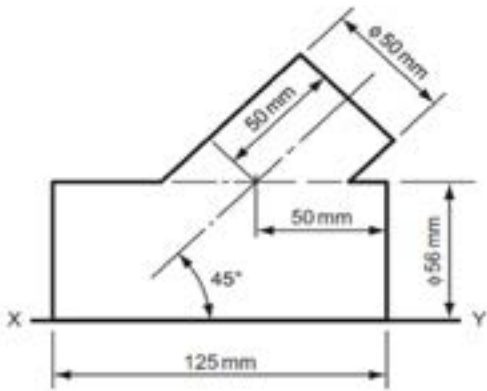


Figure 14.1

Draw in third-angle orthographic projection;

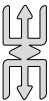
- a. The front elevation of the figure.
- b. Draw the complete plan.
- c. Right end elevation
- d. Draw the curve of intersections of the pipes.

PLC Session 14

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.

- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



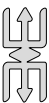
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **homework**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the homework (NTS 3k-3q).

10 minutes	Content Exploration
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- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.

- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 15

Learning Indicator: Design artefact using the concept of curve of intersection

FOCAL AREA 3: DESIGNING ARTEFACTS

Introduction to real-life applications

Curves of intersection occur where two or more geometric solids meet, forming both elegant and practical shapes. Examples include pipe junctions in plumbing to ensure smooth fluid flow, bicycle frame tube intersections for strength and aerodynamics, and modern furniture joints using intersecting curves for stability and visual appeal. Recognising these intersection curves helps designers balance functionality with aesthetics.

Examples of artefacts made with curve of intersections

A. Pipe connections and joints



Figure 15.1: Pipe connections and joints

B. Design of watering cans



Figure 15.2: Watering cans

C. Furniture design



Figure 15.3: Furniture

D. Playground items



Figure 15.4: Playground items

E. Bicycle Frames



Figure 15.5: Bicycle Frames

F. Industrial pipe connections and valves



Figure 15.6: Industrial pipe connections and valves

Role of curve of intersection in artefacts design

Functionality: Distribute forces or guide movement (e.g., pipe intersections reduce turbulence; bicycle frames channel loads smoothly).

Structural Integrity: Elimination of stress concentrations and improvement of stability.

Aesthetics: Creation of visual harmony, softness, and dynamic form.

User Interaction: For smooth transitions and enhancement of ergonomics and comfort (e.g., handrails, seating).

Material and Manufacturing: Influences material choice and fabrication methods.

Learning Task:

Design artefacts using the concept of curve of intersection.

Pedagogical Exemplars

Project-based learning, Activity-based learning

In mixed ability groups of not more than four members, *display images or models of existing artefacts that prominently feature curves of intersection. Learners analyse and discuss the role of intersection curves in their functionality and aesthetics.*

Assist learners to design artefacts using the concept of curve intersection. *Learners brainstorm and sketch original artefacts applying their existing knowledge of intersection curves.*

Activity based learning: Leaners peer review their drawings based on a given criteria.

Key Assessment Level 4: Exhibition

Task: Create and showcase an artefact that uses curves of intersection to combine strength and style.

a. Sketches (10 marks)

Draw two clear sketches of solids intersecting.

Label each sketch with:

- i. The two solids you chose.
- ii. The angle and curve formed.

Add a short note on how the curve adds both function (e.g., load support, smooth flow) and beauty.

b. Model or Detailed Drawing (10 marks)

Build a simple scale model or create a detailed drawing/rendering.

Clearly show:

- i. The exact curves where the solids meet.
- ii. Overall size and shape.
- iii. Chosen material or finish.

c. Short Explanation (5 marks)

In 100–150 words, explain:

- i. How your curve solves a specific function (e.g., strengthens structure, guides movement).
- ii. How it enhances the artefact’s appearance.

Review (20 minutes)

Learners present their exhibition items to peers and teacher for feedback. (20 minutes)

Learners briefly present their exhibited artefact to peers and teacher.

Peer and teacher feedback session.

PLC Session 15

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
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Note

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4. Plan the week’s key assessment with your app

- a. The key assessment for the week is **exhibition**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exhibition (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
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 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
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 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
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Section 2, Unit 2 Review

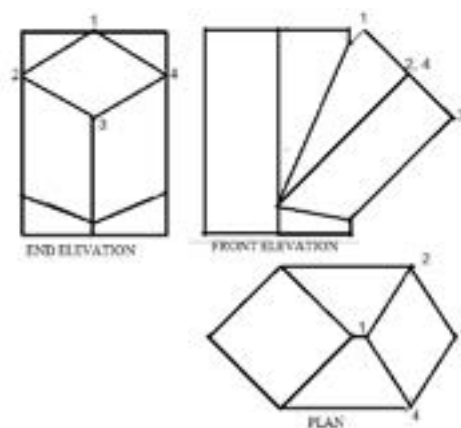
Under this unit, learners revised relevant previous knowledge on intersections of solids at right angles from year two.

Learners were taken through the process of drawing curves of intersection of solids of the same size and different sizes intersecting at angle other than 90°. Learners created designs and objects using the principles of intersections, analysing the role of intersections in designing and manufacturing.

Varied pedagogical strategies were used to target the different learning proficiencies in the class. The assessment covered the highest levels under the depth of knowledge DoK. Learners expressed understanding through the exhibition made.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 13



- A. Draw the front elevation and plan of the figure in first angle orthographic projection. (Total: 12 Marks)
 - I. For drawing 3 vertical lines – 2 marks
 - II. For drawing 2 horizontal lines – 1 mark
 - III. For drawing 3 lines inclined at 45° – 2 marks

- IV. For drawing 1 line perpendicular to the 45° inclined lines -1 mark
- V. For drawing 3 horizontal lines in plan – 2 marks
- VI. For drawing a square on its vertex to represent the vertical pipe in plan – 1mark
- VII. For drawing a square on its vertex to represent the inclined pipe in plan – 1mark
- VIII. For indicating front elevation and plan – 2marks

B. Draw the complete right end elevation. (Total: 9 Marks)

- I. For drawing 3 vertical lines – 2marks
- II. For drawing 2 horizontal lines – 1 mark
- III. For drawing a square representing the end of the duct – 3marks
- IV. For drawing 2 inclined lines at the base of the duct – 2marks
- V. For indicating front elevation – 1 mark

C. Draw the curve of intersections of the pipes. (Total: 4 Marks)

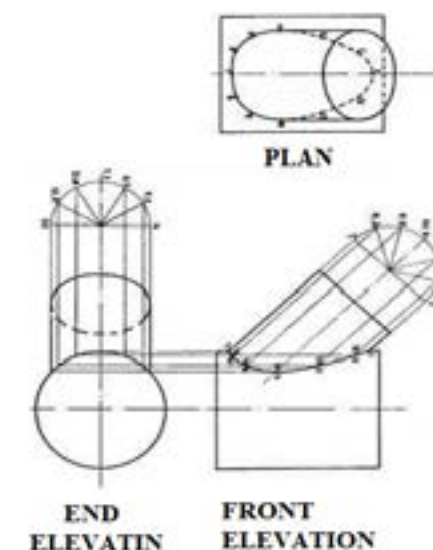
- I. For extending points 2 and 4 on the duct to intersect the centre line in the front elevation – 1 mark
- II. For projecting point 1 to intersect with 2 on the front elevation – 1 mark
- III. For connecting the point of intersection of 3 on the and the vertical pipe to the centre – 2mark.

D. Addendum (Total: 2 Marks)

- I. Using scale 1:1 — 1 mark
- II. Neatness and line work — 1 mark

Total score – 26marks

WEEK 14



- A. The front elevation of the figure (Total: 5 Marks)

- I. Drawing the horizontal pipe — 1 mark
- II. Drawing the duct — 1 mark
- III. Drawing the duct 45⁰ to the main pipe — 1 mark
- IV. For using the right measurement – 1mark
- V. For indicating 2 centre lines, 1 in the main pipe and 1 in the duct - 1
- B. Draw the complete plan. (Total: 6½ Marks)
- I. Drawing the main pipe – 1mark
- II. Projecting divisions on the duct from the front and end elevations – 2marks
- III. Locating the points of intersection of the lines projected from the front and end elevations – 1mark
- IV. For joining the points with smooth curves and 2 straight lines to complete the duct – 2marks
- V. For indicating 1 horizontal centre line – ½
- C. Right end elevation. (Total: 4 Marks)
- I. Drawing the main pipe in a circular form – 1mark
- II. Drawing the duct – 1mark
- III. For show hidden details of a portion of the duct – 1mark
- IV. For indicating 2 centre lines, 1 horizontal and 1 vertical - 1
- D. Draw the curve of intersections of the pipes. (Total: 7½ Marks)
- I. For dividing the duct in the front elevation into a number of equal parts and projecting them to the main pipe – 1marks.
- II. For dividing the duct in the end elevation into the same number of equal parts and projecting them to the main pipe – 2marks.
- III. For projecting the point of intersection of the lines with the main pipe in the end elevation horizontally to the front elevation – 2marks
- IV. For identifying the points of intersection of the corresponding lines in the front elevation and drawing the curve of intersection through – 2½ marks
- E. Addendum (Total: 2 Marks)
- I. Using scale 1:1 — 1 mark
- II. Neatness and line work — 1 mark

Total Marks: 25 Marks

WEEK 15

Criteria	Excellent (Marks-10)	Good (Marks-8)	Needs Improvement (Marks-6)
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Sketches (10 marks)	Two clear, precise sketches All labels are accurate; Note insightfully links curve to both function and beauty.	Sketches clear with minor issues; Most labels correct; Note adequately explains function and aesthetics.	Sketches lack clarity or detail; Labels missing/inaccurate; Note missing or superficial.
Sketches (10 marks)	Two clear, precise sketches; All labels accurate; Note insightfully links curve to both function and beauty.	Sketches clear with minor issues; Most labels correct; Note adequately explains function and aesthetics.	Sketches lack clarity or detail; Labels missing/inaccurate; Note missing or superficial.
Short Explanation (10 marks)	Concise 100–150 words; Clearly explains function solution and aesthetic enhancement.	Explanation covers both function and aesthetics with minor gaps.	Explanation missing or addresses only one aspect superficially.
Total marks	30	36	18

UNIT 3: FRACTAL GEOMETRY

Strand: Geometry

Sub-Strand: Fractal geometry

Learning Outcome: Demonstrate knowledge and understanding of fractal geometry in creating fractal designs.

Content Standard: Demonstrate knowledge and understanding of fractal geometry in creating fractal designs.

INTRODUCTION AND UNIT SUMMARY

This section will draw on learners understanding of fractal geometry in year 1 and 2 to create more complex fractal designs. A fractal is a never-ending pattern that is self-similar across different scales – a shape that, when split into parts, each part is approximately a reduced-size copy of the whole. Learners will select various geometric shapes used to create complex fractal designs and use the idea of fractal geometry to create complex fractal designs.

The weeks and the indicators covered by the section are:

- Week 16: Select various geometric shapes used to create complex fractal designs.

- *Week 17: Use the idea of fractal geometry to create complex fractal designs.*

Recap weeks

Year 1	Week 23: Explain the basic concept of fractal geometry. Week 24: Examine the application of fractal geometry in designs.
Year 2	Week 20: Use various geometric shapes to create complex fractal designs. Week 21: Experiment with the creation of various fractal designs using geometric shapes.

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical exemplars provide a comprehensive approach to teaching fractal geometry in Form 3, emphasising observation, exploration, and creative application.

Observation-Based Learning for Discovering Patterns in Nature and Design

Talk for Learning for Explaining Fractal Geometry in Our Own Words

Research-Based Learning for Exploring Types of Fractal Geometry

Collaborative Design for Selecting Geometric Shapes for Fractal Design

Problem-Based Learning for analysing How Geometric Shapes Create Fractals

Experiential Learning for creating Self-Similar Fractal Designs

Project-Based Learning for complex Fractal Design Project

Differentiation Strategies

For high proficiency (HP), Introduce more complex fractal types (e.g., 3D fractals, IFS fractals) and Provide opportunities to explore fractal-generating software. Assign more challenging design briefs with multiple constraints

For Proficient Learners (P), Provide structured guidance with some room for exploration while Offering templates for more complex fractal patterns end encourage peer collaboration with advanced performers

For Approaching proficiency (AP), Provide step-by-step guides with visual supports and use simpler geometric shapes and fewer iterations. Offer more direct teacher guidance during activities and Pair them with more confident peers for collaborative work

By implementing these strategies, teachers can help students develop both conceptual understanding and practical skills in creating fractal designs while accommodating diverse learning needs.

The exemplars align with 21st-century skills development by incorporating collaboration, communication, critical thinking, and creativity throughout the learning process, while also ensuring inclusive participation through mixed-ability grouping and differentiated support.

ASSESSMENT SUMMARY

The assessment framework should provide a comprehensive approach to evaluating student understanding and application of fractal geometry in Form 3. By incorporating a variety of assessment methods across different cognitive levels, teachers can gain insight into learner’s

conceptual understanding, technical skills, and creative application abilities. The assessment can be written and practical assessment.

The assessment strategies designed should to be inclusive, allowing students of different ability levels to demonstrate their learning while providing appropriate challenge for advanced performers. Regular feedback opportunities support ongoing improvement and help learners develop metacognitive awareness of their learning process.

By implementing a balanced assessment approach, teachers can effectively evaluate student achievement of the curriculum standards related to fractal geometry while supporting the development of both technical skills and creative design thinking.

Indicators	DOK Level	Assessment Strategy and/ or Mode
L1: Select various geometric shapes used to create complex fractal designs.	Level 3 (strategic reasoning)	Presentation
L2: Use the idea of fractal geometry to create complex fractal designs.	Level 4 (extended critical thinking)	Exhibition

WEEK 16

Learning Indicator: Select various geometric shapes used to create complex fractal designs

FOCAL AREA: FRACTAL GEOMETRY

Selecting appropriate geometric shapes is the foundation for creating effective and visually compelling fractal designs. This guide explores the various geometric shapes that can be used as building blocks for complex fractal patterns, their properties, and how they can be effectively combined and transformed to create sophisticated designs.

Basic Geometric Shapes for Fractal Design

1. Triangles

Selection Considerations:

1. Equilateral triangles create balanced, harmonious designs
2. Scalene triangles can create more dynamic, asymmetrical patterns
3. Right-angled triangles work well for grid-based fractal systems

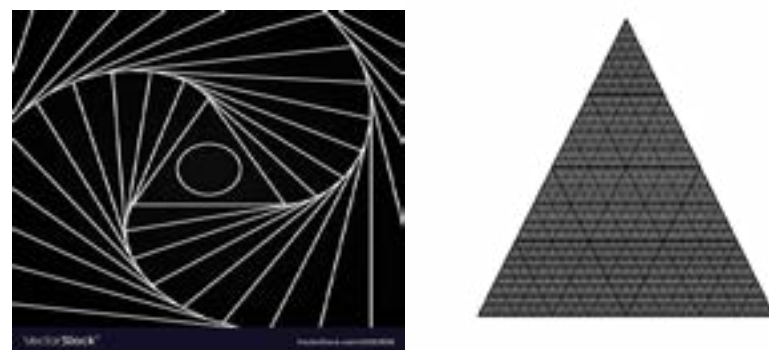


Figure 16.1: Basic Geometric Shapes for Fractal Design

2. Squares and Rectangles

Selection Considerations

1. Squares create ordered, structured fractals with clear alignment
2. Rectangles with different proportions can add rhythm and direction
3. Easily combined with other shapes in composite designs

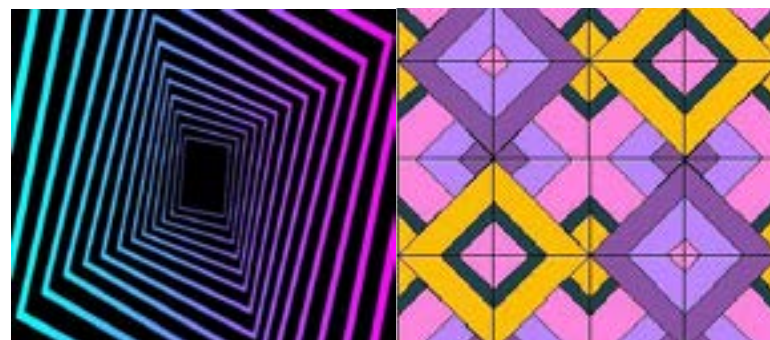


Figure 16.2: Squares and Rectangles

3. Circles and Ellipses

Selection Considerations

1. Circles create organic-feeling fractals with flowing aesthetics
2. Challenging to construct precisely by hand but effective in digital designs
3. Can be combined with straight-edged shapes for contrast

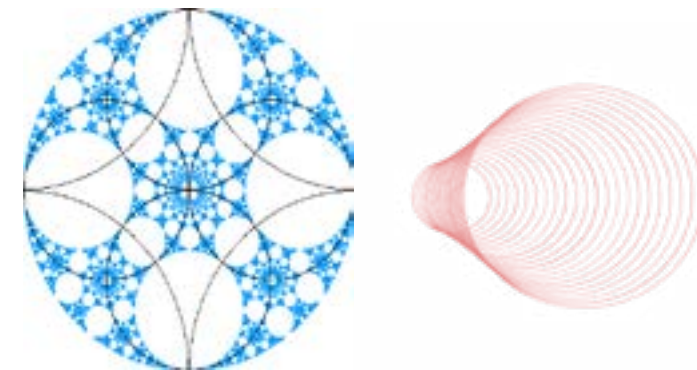


Figure 16.3: Circles and Ellipses

4. Stars and Polygons

Selection Considerations

1. Creates visually striking patterns with cultural resonances
2. More complex to construct but visually rewarding
3. Effective for decorative applications

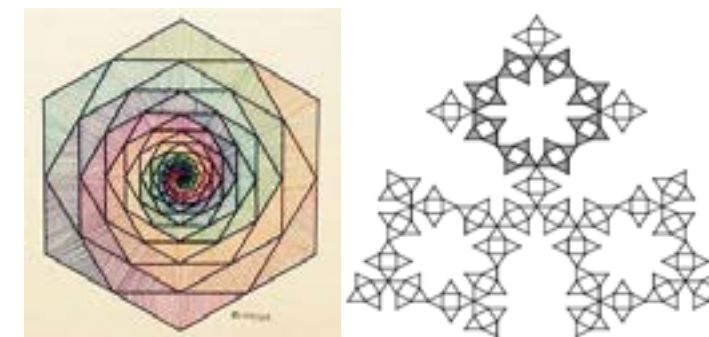


Figure 16.4: Stars and Polygons

Combining and Transforming Shapes

1. Composite Shapes (Combining multiple basic shapes into a single generator unit)

Design Potential

1. Allows for more distinctive and original fractal patterns
2. Creates more complex self-similarity relationships
3. Enables greater creative expression



Figure 16.5: Combining and Transforming Shapes

The selection of geometric shapes for fractal design is both a technical and creative decision that fundamentally impacts the final design outcome. By understanding the properties and potential of different geometric forms, learners can make informed choices that lead to more effective and visually compelling fractal designs.

The most successful fractal designs often come from thoughtful shape selection combined with systematic application of transformation rules. Whether working with simple triangles or complex composite shapes, the key is to understand how the initial shape will evolve through iteration and how this evolution will serve the overall design purpose.

By applying the selection criteria and process outlined in this guide, learners can develop the skills to choose appropriate geometric shapes for creating complex, visually engaging fractal designs that effectively fulfil their intended purpose.

Learning tasks

- 1. Discuss the characteristics of geometric shapes used to create complex fractal designs
- 2. Generate manual/digital pictorial charts of geometric shapes that can be used to create complex fractal designs.

Pedagogical Exemplars

Discussion: Engage learners using questioning to revise their previous knowledge on fractal geometry from year 1 and 2

Group Work/Collaborative Learning: Learners in groups discuss the characteristics of geometric shapes to be used to create fractal designs with the aid of relevant resources such as photographs, drawings, videos, charts and real objects in the environment.

Problem-based Learning/Experiential Learning: Learners in groups observe how geometric shapes have been used to create fractal designs with the aid of relevant resources such as photographs, drawings, videos, charts and real objects in the environment.

Project-based Learning/Experiential Learning: Let learners in groups generate manual/digital pictorial charts of geometric shapes that can be used to create fractal designs.

Key Assessment Level 3: Presentation

A public building requires **THREE** different fractal design applications:

A floor pattern representing flowing water

A wall panel suggesting local plant life

A ceiling feature inspired by traditional cultural patterns

Tasks: in groups of no more than four members,

- 1. Strategically select the most appropriate geometric shape from your analysis
- 2. Justify your selection with reference to specific properties of the shape
- 3. Create a preliminary sketch showing how your selected shape would develop through 3 iterations

PLC Session 16

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes	Content Exploration
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- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
- b. all teachers in the group work through a similar problem individually for 3–4 minutes
- c. the group then works through the problem together step by step
- d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 17

Learning Indicator: Use the idea of fractal geometry to create complex fractal designs

FOCAL AREA: CREATING COMPLEX FRACTAL DESIGNS

Fractal geometry offers a powerful framework for creating complex, visually engaging designs that exhibit self-similarity across different scales. In this Form 3 we will explore how to leverage fractal principles to create original sophisticated designs that can be applied to various contexts including textiles, architecture, product design, and visual arts.

Foundational Fractal Techniques

1. Iterative Subdivision

Technique Overview: Creating complexity through repeated division of geometric shapes

Process

1. Begin with a primary geometric shape (triangle, square, etc.)
2. Establish a subdivision rule (e.g., divide into smaller similar shapes)
3. Apply the rule consistently across multiple iterations
4. Maintain geometric precision at each stage

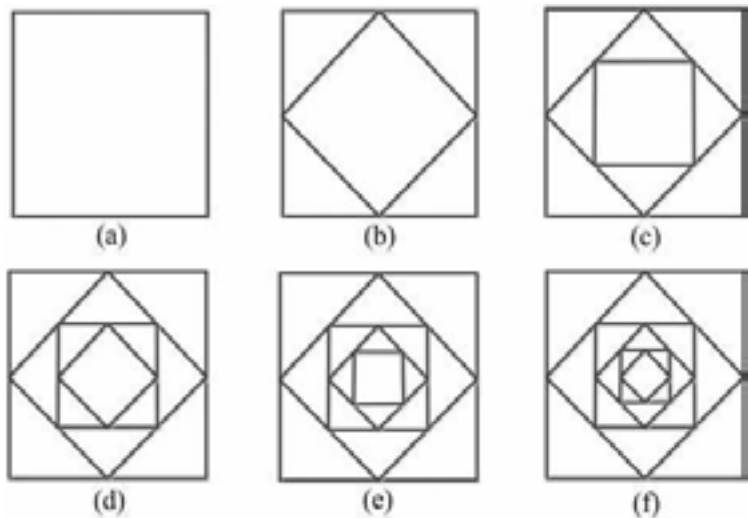


Figure 17.1: Iterative Subdivision

2. Boundary Transformation

Technique Overview: Modifying the boundaries of shapes through consistent replacement rules

Process

1. Begin with a simple boundary (straight line or simple shape)
2. Create a generator pattern to replace each segment
3. Apply the generator to each straight segment
4. Repeat for multiple iterations

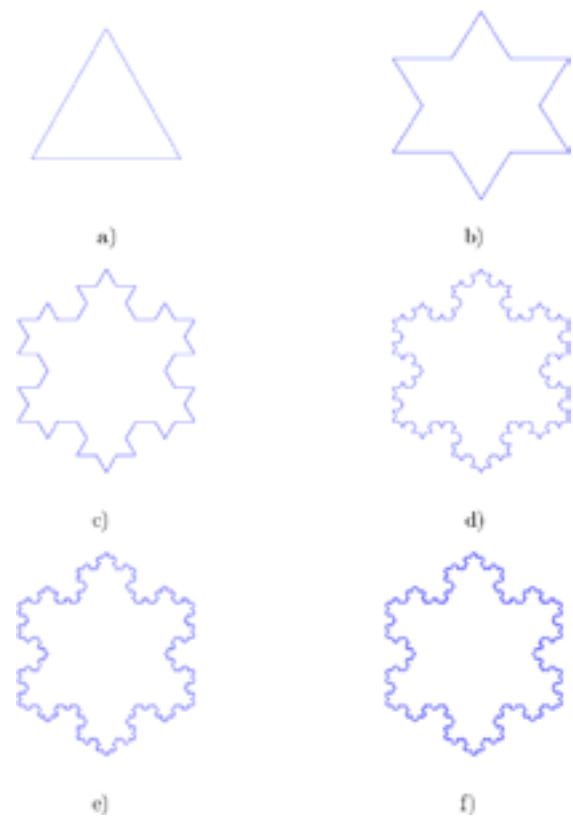


Figure 17.2: Boundary Transformation

3. Iterated Function Systems (IFS)

Technique Overview: Using mathematical transformations to create self-similar patterns

Process

- 1. Select a base shape or pattern
- 2. Define a set of transformations (scaling, rotation, translation)
- 3. Apply these transformations to create smaller copies
- 4. Combine the copies into a unified design

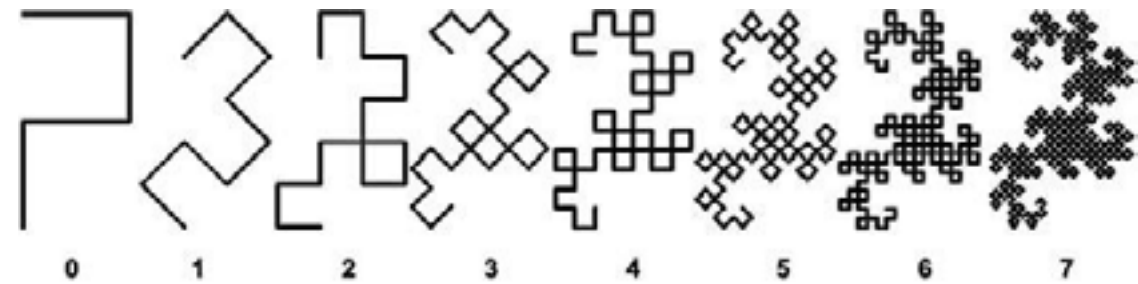


Figure 17.3: Iterated Function Systems (IFS)

4. Fractal Hybridisation

Technique Overview: Combining multiple fractal types into a single cohesive design

Process

- 1. Select two or more complementary fractal patterns
- 2. Identify integration points where patterns can merge
- 3. Establish transition rules between different fractal systems

- 4. Maintain visual cohesion across the hybrid design

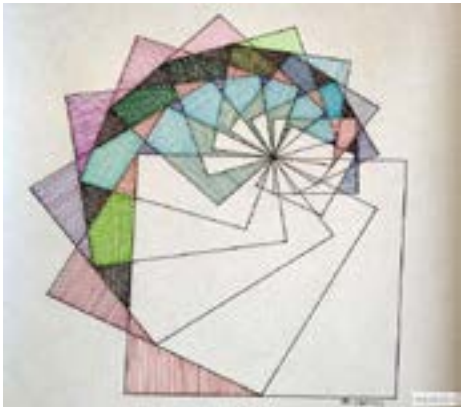


Figure 17.4: Fractal Hybridisation

5. Organic Adaptation

Technique Overview: Modifying geometric fractals to create more natural, organic forms

Process

- 1. Begin with a structured geometric fractal
- 2. Introduce controlled irregularity to straight lines and angles
- 3. Vary the scaling factor slightly between iterations
- 4. Add natural elements like curves and asymmetry



Figure 17.5: Organic Adaptation

Project Development Process

Research and Inspiration; analyse existing fractal designs in nature and human-made contexts, collect visual references from diverse sources and identify potential applications for your design

Fractal Selection and Planning; choose appropriate fractal types for your design goal and determine the number of iterations needed

Sketching Initial Ideas; create thumbnail sketches exploring different approaches while experimenting with various geometric foundations and test different iteration rules and their visual effects

Technical Development

- 1. Draw the foundation shape with precise measurements
- 2. Establish clear guidelines for iteration
- 3. Set up a coordinate system or grid if needed
- 4. Apply the selected fractal rule with careful attention to detail
- 5. Maintain geometric accuracy
- 6. Evaluate the visual effect and make adjustments if necessary
- 7. Progressively develop the design through planned iterations
- 8. Maintain consistency in application of rules
- 9. Use appropriate tools to ensure precision
- 10. Add line weight variation for visual hierarchy
- 11. Refine intersections and connections between elements

Design Enhancement

- 1. Emphasise certain iterations through line weight or colour
- 2. Ensure the design reads well at different viewing distances
- 3. Develop a colour strategy that enhances the fractal structure
- 4. Consider using colour to differentiate iteration levels
- 5. Explore gradients or colour progressions that follow the fractal logic

Application Development

- 1. Modify the design to suit its intended application
- 2. Consider how the fractal will translate to the intended medium
- 3. Create final renderings showing the design in context

Learning task

Create a beautiful complex fractal design

Pedagogical Exemplars

Experiential learning: provide learners with visuals of various complex fractal designs for learners to appreciate the dynamics and beauty of complex fractal designs

Collaborative Learning/Managing talk for learning: Learners in groups brainstorm to select the types of geometric shapes they will want to use to create complex fractal designs and the relevant tools and materials that will be used.

Project-based Learning, Activity-based learning: Guide learners in groups/individuals to create complex fractal designs using the selected geometric shapes and relevant tools and materials

Project-based Learning, Activity-based learning: Let learners generate manual/digital pictorial reports individually on how they created the complex designs with the geometric shapes and the relevant materials and tools

Key Assessment Level 4: Exhibition

Based on the assessment in week 15, create a beautiful fractal design for;

- 1. The floor pattern representing flowing water (16 marks)
- 2. The wall panel suggesting local plant life (16 marks)
- 3. The ceiling feature inspired by traditional cultural patterns (16 marks)

And exhibits the designs on the classroom walls.

PLC Session 17

45 minutes	Planning & Reviewing the Learning Plan
1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied. 2. Use your subject specific app to explore the content before planning. Ask the app to a. explain the week’s concepts in a practical way that will make it easier for learners to understand b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m). 3. Use your subject specific app to plan your lesson. Ask the app to a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds. b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q) c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).	
Note • Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson. • Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.	

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is *exhibition*. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exhibition (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



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30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

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8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

- c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 16

1. Selecting an appropriate geometric shape for the;
- a. Floor i.e., square, triangle, circle, etc. (1 mark)
 - b. Wall i.e., square, triangle, circle, etc. (1 mark)
 - c. Ceiling i.e., square, triangle, circle, etc. (1 mark)

2.

Criteria	3 marks (very good)	2 (marks) good	1 mark (need improvement)
Comprehensively explains relevant mathematical/geometric properties of the selected shape i.e. triangle: has three straight lines, three internal angles, etc. square: has four straight lines, four internal angles, etc. circles: has no corners, bounded by series of arcs	Provide these explanations for all three selected, i.e., floor, wall and ceiling	Provide these explanations for only two selected, i.e., floor, wall and ceiling	Provide these explanations for only one selected, i.e., floor, wall and ceiling

3.

Criteria	4 marks (very good)	3 (marks) good	2 mark (need improvement)
Sketch shows precise application of iteration rules with perfect geometric accuracy Each iteration correctly builds upon the previous one	Provides three sketches that correctly builds upon the previous one	Provides two sketches that correctly builds upon the previous one	Provides one sketch that correctly builds upon the previous one

WEEK 17

Criterial	4 marks (very good)	3 marks (good)	2 marks (satisfactory)	1 mark (needs improvement)
Originality of Concept • Floor • Wall • ceiling Total:12 marks	Highly original approach that extends beyond common fractal types; innovative combination of elements or techniques	Original approach with some creative adaptations of known fractal types; some innovative elements	Standard approach using common fractal types with minor variations; limited originality	Directly copies known fractal examples with no personal innovation

Iteration Quality • Floor • Wall • ceiling Total:12 marks	Executes at least 3 complete, precise iterations with perfect consistency in rule application	Completes 2-3 iterations with good consistency in rule application; minor errors	Completes 1-2 iterations with inconsistent rule application; several errors	Incomplete or incorrect iterations; fails to maintain consistent rules
Pictorial drawings • Floor • Wall • ceiling Total:12 marks	3D	2D	1D	No defined dimensional drawing
Geometric Accuracy • Floor • Wall • ceiling Total:12 marks	Perfect geometric precision across all iterations; maintains exact proportional relationships; flawless execution	Good geometric accuracy with minor inconsistencies; maintains most proportional relationships	Acceptable geometric construction with several inconsistencies; some proportional errors	Poor geometric accuracy with major construction errors; significant proportional problems
Enhancement Techniques • line weight variation, • colouring • shading) • Rendering techniques Total:12 marks	Applies four enhancement techniques	Applies three enhancement techniques	Applies two enhancement techniques	Applies one enhancement techniques

SECTION 3: EXTENDED DRAWING

OPTION 1: BUILDING DRAWING

Strand: Extended drawing
Sub-Strand: Building drawing

Learning Outcome: *Employ the understanding of floor plan and sectioning with the use of building codes, standards and symbols.*

Content Standard: Understanding the concept of building drawing.

INTRODUCTION AND UNIT SUMMARY

Building drawing represents a specialised and highly valuable skill set within the field of Design and Communication Technology. Progressing through Year three, this unit will dwell on learners’ understanding of building drawing and ability to produce freehand sketches of building elevation in year two to explain building codes and standards, produce ground floor plans and sectioning in buildings.

Learners will explore building codes and standards which will include, standard room dimensions and spatial requirements, door and window specifications, circulation and accessibility standards, basic structural requirements, and conventional representation of building elements, etc.

Learners will also produce sketches of floor plans of domestic buildings and proceed to develop it with drawing instrument or CAD as well as the sectioning.

The weeks and the indicators covered by the section are:

- **Week 18:** *1. Explain floor plan in relation to building codes, standards and symbols.*
- 2. *Make freehand sketches of floor plan of simple domestic buildings.*
 - **Week 19:** *(Draw floor plan of simple buildings using appropriate drawing Instruments or CAD)*
 - **Week 20:** *(Explain sectioning in relation to building codes, standards and symbols)*
 - **Week 21:** *(Draw the sectioning of simple buildings using appropriate drawing Instruments or CAD)*

Recap weeks

Year 2	Week 19: Manipulate drawings with CAD tools through editing and plotting techniques Week 22: Explain building elevations in relation to building plans. Week 23: Draw elevations of simple buildings in relation to their plans using appropriate drawing instruments.
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SUMMARY OF PEDAGOGICAL EXEMPLARS

The design studio lies at the heart of architectural education where learning through a pedagogical process of ‘learning by doing’ should form the primary learner’s experience. This requires a blend of technical instruction, practical application, and creative problem-solving skills while developing the specialised skills needed for building drawing. The following pedagogical approaches can be considered;

- **Research-Based Learning:** (Guide learners to investigate building codes, standards, and symbols using reliable sources)
- **Collaborative Learning:** (Organise learners in mixed-ability groups to leverage diverse strengths)
- **Experiential Learning:** (Incorporate field visits to construction sites or buildings under development)
- **Problem-Based Learning:** (Present authentic architectural challenges that require drawing solutions)
- **Project-Based Learning:** (Develop comprehensive building documentation projects that extend over time)
- **Technology-Enhanced Learning:** (Integrate appropriate digital tools alongside traditional drawing methods)
- **Differentiated Instruction:** (Provide multiple entry points for tasks based on learners’ strengths, i.e., **AP**, **P**, and **HP**)

By implementing these varied pedagogical strategies, teachers can create engaging learning experiences that prepare learners for both further education and professional practice in architecture, engineering, and construction fields.

ASSESSMENT SUMMARY

This assessment summary provides a comprehensive framework for evaluating learner’s competency in Building Drawing. The assessment strategies must align with curriculum standards focusing on floor plans, sectional drawings, and the application of building codes and standards. This balanced assessment approach incorporates both formative and summative methods to evaluate technical skills, conceptual understanding, and practical application. Learners will be assessed on their ability to:

1. Explain floor plans in relation to building codes, standards, and symbols
2. Make freehand sketches of floor plans of simple domestic buildings
3. Draw floor plans of simple buildings using appropriate drawing instruments or CAD

4. Explain the principles of sectional drawing
5. Draw sectional views of buildings using appropriate drawing instruments or CAD

Indicators	DOK Level	Assessment Strategy and/or Mode
L1:(Explain floor plan in relation to building codes, standards and symbols.	Level 2 (concept building)	Group presentation
L2: (Make freehand sketches of floor plan of simple domestic buildings)	Level 3 (strategic reasoning)	Individual classwork
L3: (Draw floor plan of simple buildings using appropriate drawing Instruments or CAD)	Level 3 (strategic reasoning)	Individual classwork
L4: (Explain sectioning in relation to building codes, standards and symbols)	Level 2 (concept building)	Group presentation
L4: (Draw the sectioning of simple buildings using appropriate drawing Instruments or CAD)	Level 4 (extended critical thinking)	Individual classwork

WEEK 18

Learning Indicators

1.

Explain floor plan in relation to building codes, standards and symbols
2.

Make freehand sketches of floor plan of simple domestic buildings

FOCAL AREA 1: BUILDING CODES, STANDARDS AND SYMBOLS

Building codes, standards, and symbols form the essential language of architectural communication and construction regulation. They create a standardised framework that ensures buildings are safe, functional, and constructed according to recognised best practices.

Building Codes

Building codes are legally enforceable regulations established by governmental authorities that set minimum requirements for the design, construction, alteration, and maintenance of buildings. These regulations primarily focus on:

- **Public Safety:** Protecting occupants from structural failure, fire hazards, and health risks
- **Accessibility:** Ensuring buildings can be used by people of all abilities
- **Energy Efficiency:** Regulating thermal performance and energy consumption
- **Sanitation:** Establishing requirements for plumbing and waste management
- **Structural Integrity:** Setting minimum standards for structural systems

Building codes typically have the force of law and are adopted at national, regional, or local levels. In Ghana, the Ghana Building Code (GBC) provides the regulatory framework for construction practices throughout the country.

Building Standards

Building standards are documented agreements containing technical specifications or precise criteria to be used consistently as rules, guidelines, or definitions of characteristics. Standards may be:

- **Voluntary:** Recommended practices developed by industry organisations
- **Mandatory:** When referenced or incorporated into building codes
- **Consensus-based:** Developed through collaboration among experts, manufacturers, and users

Standards address specific aspects of building design and construction, such as:

- Material properties and performance
- Testing methodologies
- Installation procedures
- Product specifications
- Design methodologies

Standards are typically developed by organisations such as the Ghana Standards Authority (GSA), International Organisation for Standardisation (ISO), or industry-specific bodies.

Building Symbols

Building symbols are graphical representations used in architectural and construction drawings to communicate design intent, spatial arrangements, and technical information. These symbols provide a universal visual language that allows drawings to be understood across language barriers and professional disciplines.

Building symbols include:

- **Architectural Symbols:** Representing walls, doors, windows, stairs, and other building elements

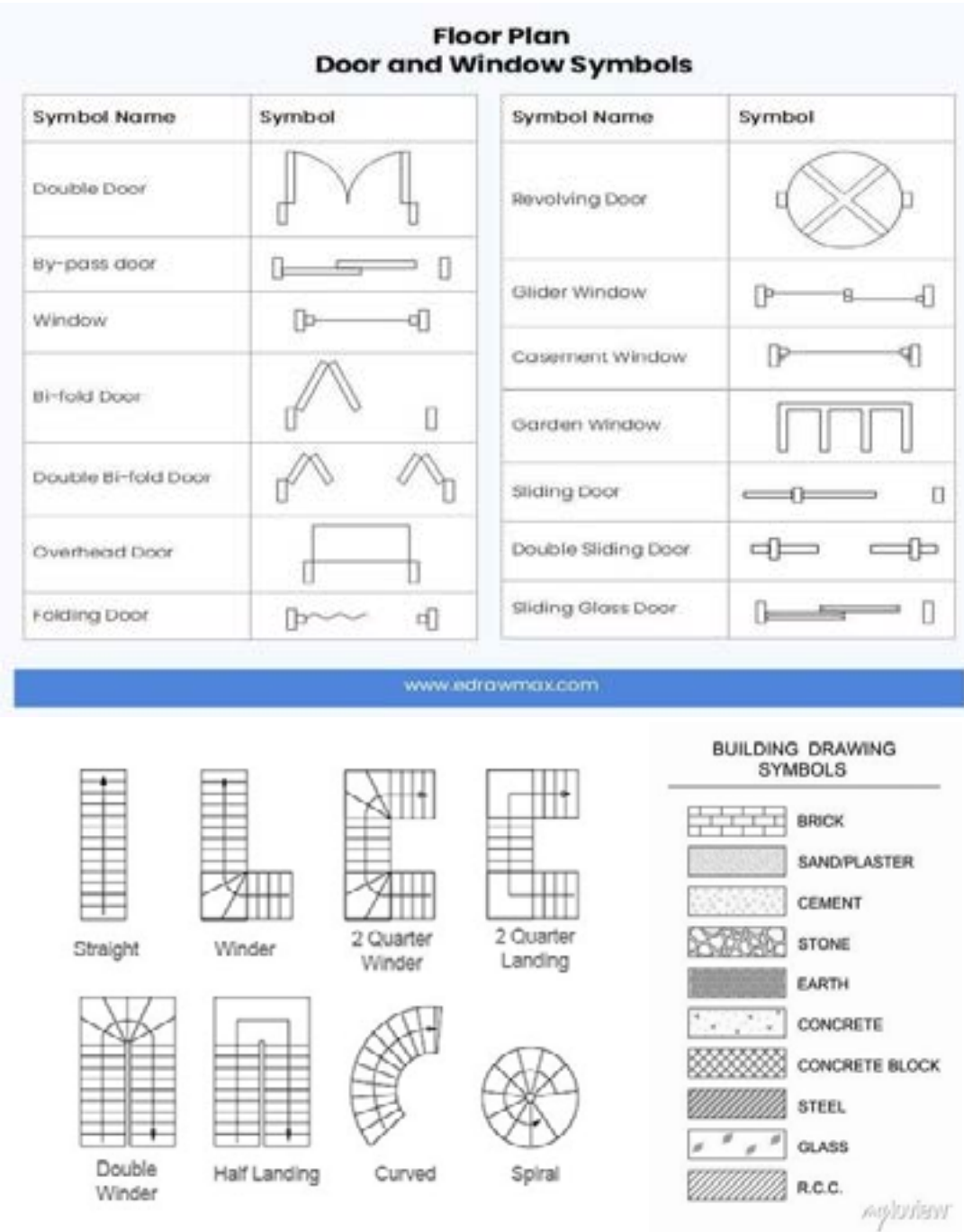


Figure 18.1

- **Material Symbols:** Indicating different construction materials

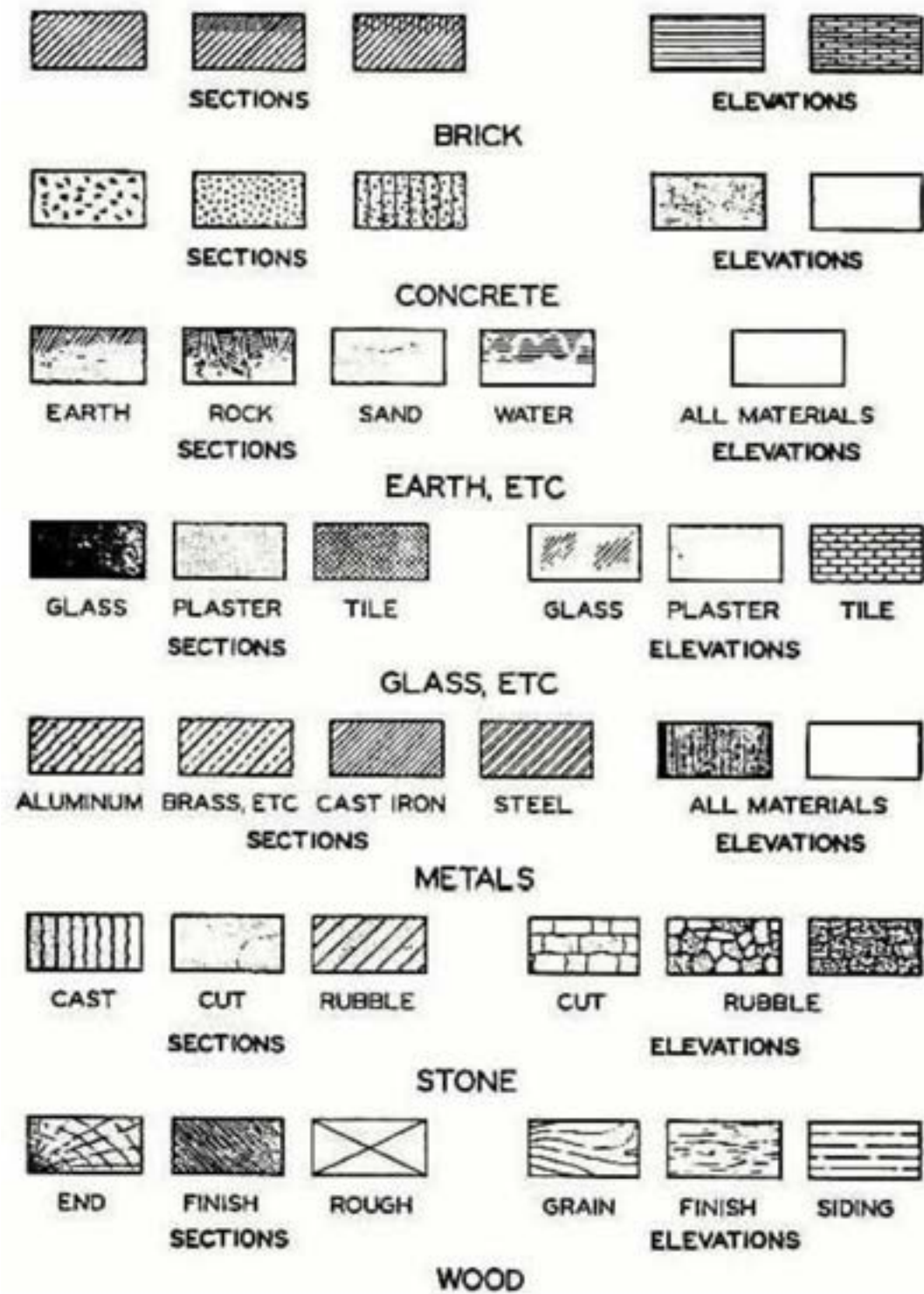


Figure 18.2

- **Electrical Symbols:** Showing lighting fixtures, outlets, switches, and electrical systems

	Electrical switchbox		Single Pole Switch
	Three-Way Switch		SinglePlex Receptacle
	Duplex Receptacle		Duplex Receptacle WP= Waterproof
	GFCI Duplex Receptacle		Isolated Ground Receptacle
	Switched Receptacle		FourPlex Four Gang Receptacle
	240-Volt Receptacle		Ceiling Mounted Light Fixture PC= Pullchain
	Wall-Mounted Light Fixture		Recessed Light Fixture
	Weatherproof Light Fixture		Fluorescent Light Fixture
	Ceiling Fan		Combination Light & Fan
	Power Vent Fan		Electric Motor Number=HP
	Smoke Detector		Circuit Breaker
	Telephone Jack		Doorbell Transformer
	Doorbell Pushbutton		Ground

Figure 18.3

● **Plumbing Symbols:** Representing fixtures, pipes, and sanitary systems



● **Mechanical Symbols:** Indicating HVAC components and equipment

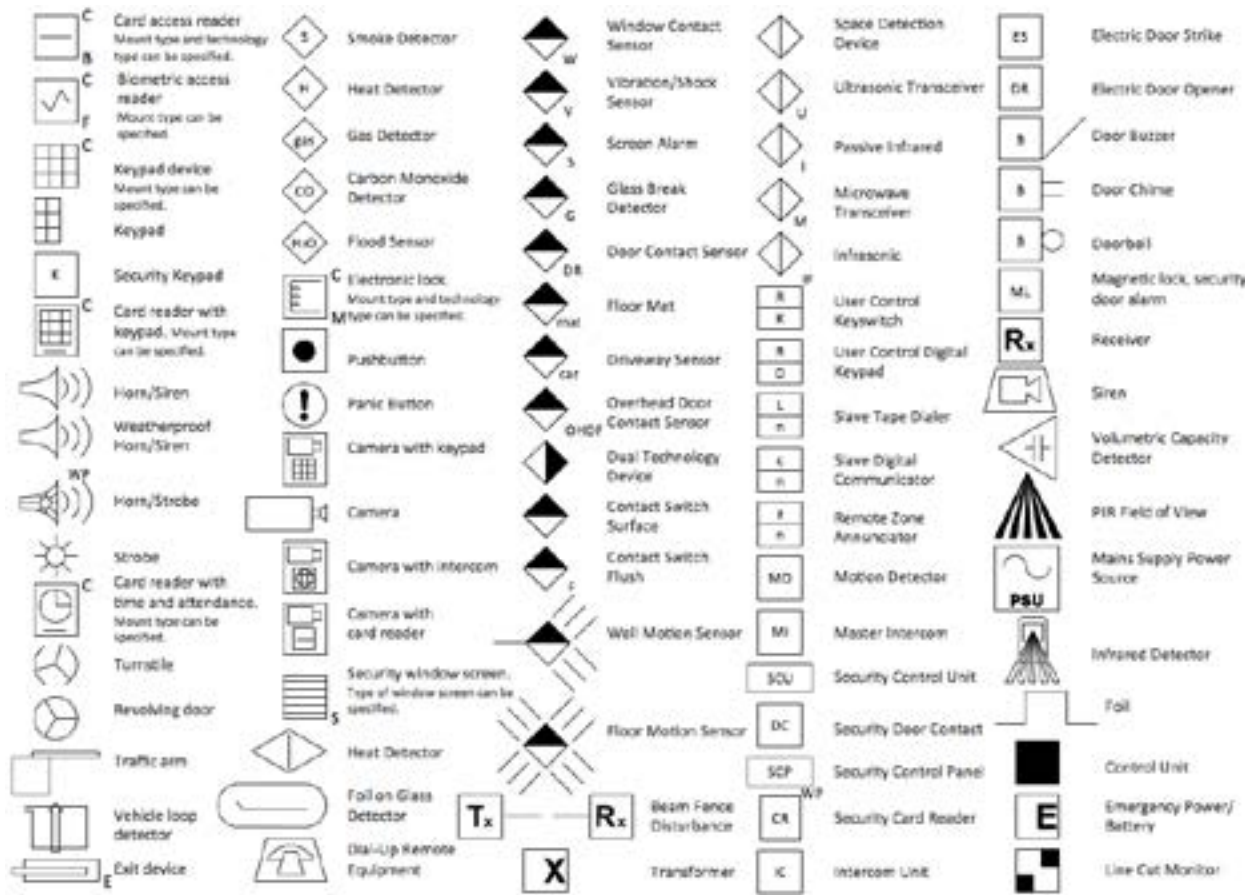


Figure 18.4

Importance of Building Codes, Standards, and Symbols

1. **Ensuring Public Safety and Welfare:** The primary purpose of building codes and standards is to protect public health, safety, and general welfare as they relate to the construction and occupancy of buildings. They establish minimum requirements to:
 - a. Prevent structural collapse
 - b. Ensure adequate ventilation and air quality
 - c. Prevent electrical and mechanical hazards
 - d. Provide accessibility for people with disabilities
 - e. Ensure sanitary conditions
2. **Facilitating Clear Communication:** Building symbols and standardised drawing conventions enable effective communication among all stakeholders in the construction process:
 - a. Architects and designers can clearly express design intent
 - b. Engineers can specify technical requirements
 - c. Contractors can accurately interpret construction documents
 - d. Building officials can verify code compliance
 - e. Clients can understand proposed designs
3. **Promoting Consistency and Quality:** Standardisation through codes, standards, and symbols promotes:
 - a. Consistent application of best practices
 - b. Predictable building performance
 - c. Quality assurance in construction
 - d. Efficient construction processes
 - e. Reduced construction costs through standardisation
 - f. Simplified maintenance and renovation
4. **Supporting Legal and Regulatory Frameworks:** Building codes and standards provide:
 - a. Legal basis for enforcement of safety requirements
 - b. Clear criteria for design approval and permitting
 - c. Benchmarks for inspection and quality control
 - d. Framework for dispute resolution
 - e. Basis for building permit review

Building codes, standards, and symbols form the essential framework for architectural communication and construction regulation. They ensure that buildings are safe, functional, and constructed according to recognised best practices. Understanding these elements is fundamental for anyone involved in the design, construction, or regulation of buildings.

Learning tasks

- 1. Explain ground floor plans in relation to building codes and standards.
- 2. Identify various symbols (electrical, plumbing, materials and architectural) used in floor plans.

Pedagogical Exemplars

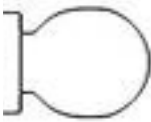
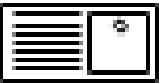
Initiating talk for learning: Engage learners to recall some of the rules and regulations in the school and its relevance, and link it to the need for standards and regulations in the building industry.

Research, collaborative learning: With relevant resources engage learners in mixability groups to discuss floor plans, building codes, standards and symbols.

Presentation: Task learners to present their findings in groups with the use of charts, pictures, etc.

Key Assessment Level 3: Group Presentation

- 1. Explain a floor plan in relation to:
 - i. Use of a floor plan (4 marks)
 - ii. Building codes (4 marks)
 - iii. Standards and symbols (4 marks)
 - iv. Relevance to the building industry (4 marks).
- 2. Identify the following building drawing symbols (5 marks)

Building drawing symbols	Description
	
	
	
	
	

FOCAL AREA 2: FREEHAND SKETCHES OF GROUND FLOOR PLANS

Freehand sketching of floor plans is a fundamental skill in architectural design and communication. These preliminary drawings serve as visual thinking tools that allow designers to quickly explore spatial ideas, communicate concepts, and document existing conditions without the constraints of formal drafting tools. Mastering freehand floor plan sketching provides a valuable foundation for both design development and technical documentation.

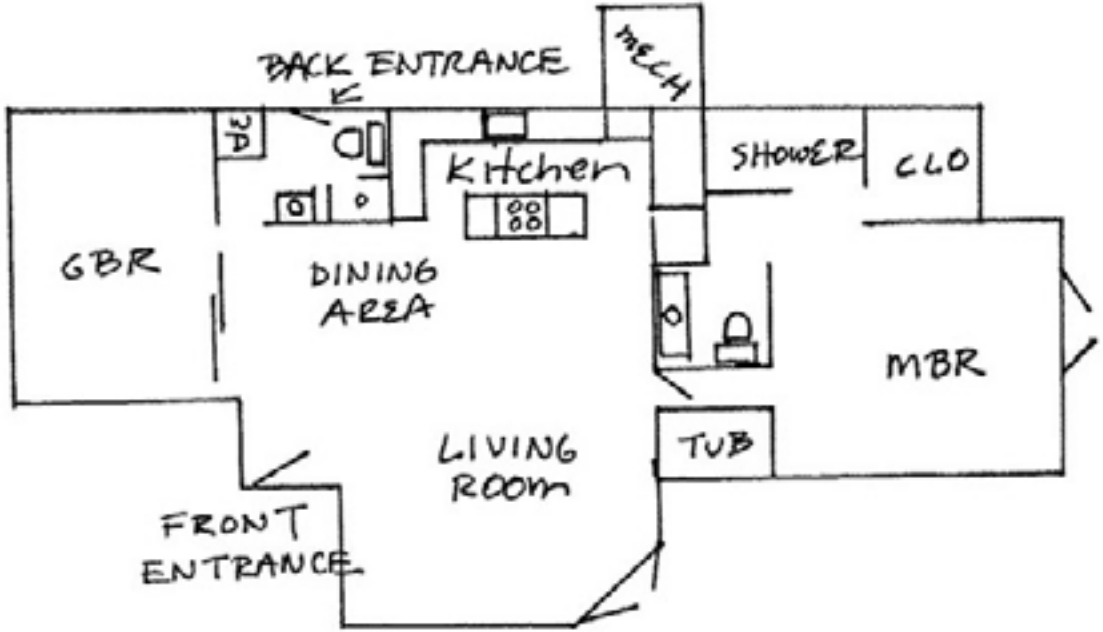
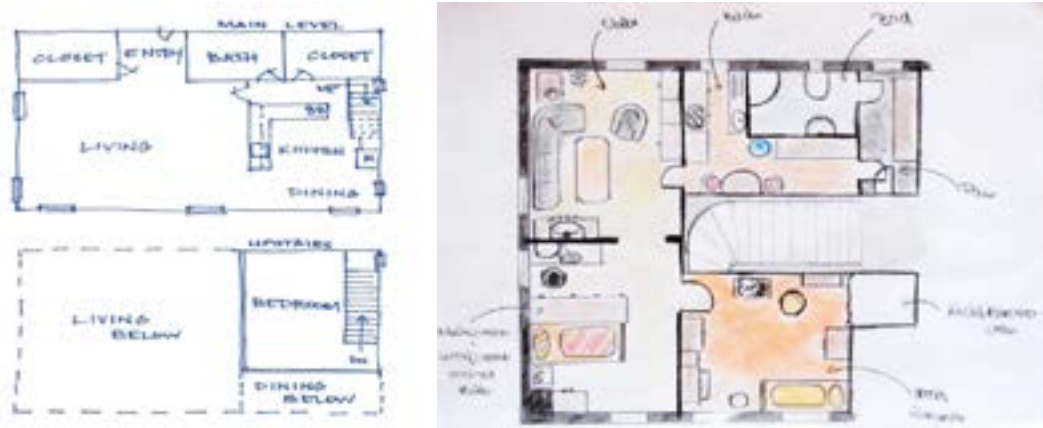


Figure 18.5

Purpose and applications of floor plan sketches

- 1. Quickly visualise multiple spatial arrangements
- 2. Testing different layouts and circulation patterns
- 3. Rapidly modify and refine spatial concepts
- 4. Conveys design ideas in an accessible format
- 5. Share concepts with colleagues and consultants easily and quickly.
- 6. Records existing conditions during field visits
- 7. Provides clarification during site meetings

- 8. Participate in collaborative design sessions
- 9. Creates immediate visual responses to client input
- 10. Establishes basic layouts before formal drafting

Fundamental techniques in sketching floor plans

1. Establishing Scale and Proportions

Work at a consistent scale (typically 1:50 or 1:100), maintain relative sizes of spaces even without precise measurements. Consider using grid paper to maintain proportions (each square can represent a standard measurement)

2. Line Hierarchy

Bold, confident lines for main structural walls, medium-weight lines for interior partitions, lighter lines for built-in elements and dotted or very light lines for context or below elements

3. Architectural Symbols and Conventions

Architectural element	Description	Sketch
Wall Representation	Parallel lines with appropriate thick-ness.	
Door Notation	Simple arcs showing swing direction.	
Window Indication	Breaks in wall lines with sill marks.	
Stair Representation	Parallel lines with direction arrows.	
Fixture Symbols. i.e. water closet, bath, etc.	Simplified rep-resentations of standard elements.	

4. Annotation and Dimensioning

- a. Room Labels: Clear text identifying space functions
- b. Key Dimensions: Critical measurements noted directly on the sketch
- c. Notes: Brief explanations of special features or requirements
- d. North Arrow: Simple indication of orientation

Learning task

Create freehand sketches of floor plan.

Pedagogical exemplars

Discussion: Engage learners in a whole class discussion to describe how the layout of their homes is and task them to sketch the layouts. Based on the sketches provided, task learners to make modifications if they want and justify why they modified the existing plan/layout.

Experiential learning: Provide visuals of existing sketches of floor plans and discuss the features and symbols used with learners.

Managing talk for learning, Activity-based learning: Task learners to produce a free hand sketch of the floor plan of their dream house using the appropriate symbols.

Key Assessment: Practice Paper 2

Task: Concept Building

Create a freehand sketch of a floor plan for a simple two-bedroom residential house for a client that meets the requirements below.

Requirements

- 1. Your floor plan must include and clearly label the following spaces:
 - a. Living room
 - b. Kitchen
 - c. Dining area
 - d. Two bedrooms
 - e. three bathrooms
 - f. Entrance porch or verandah
- 2. Your sketch must show:
 - a. Appropriate placement of doors and windows
 - b. Wall thicknesses (using double lines)

Hint



Conduct Practice Paper 2. It should cover the contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section to guide you. Learners’ papers should be marked immediately and scores entered into the SAP.

TABLE OF SPECIFICATION FOR PRACTICE PAPER 2
PAPER 1

STRAND	LEARNING INDICATOR	LEVEL OF AS- SESSMENT				TOTAL
		1	2	3	4	
CON- CEPTUAL DRAWING	1.1.1.LI.2 Use basic shapes, forms and rendering techniques in designing.		1			1

	1.1.1.LI.3 Use the principles of perspective drawing and proportion in designing.			1		1
	1.1.2.LI.1 Analyse and record the concept of object manipulation and manipulation techniques.		1			1
	1.1.2.LI.2 Experiment with various tools and techniques in drawing to manipulate organic and inorganic shapes, forms and objects.					
	1.1.2.LI.3 Use available media and techniques to manipulate objects based on conceptual, symbols, metaphors and narratives associated with objects.		1			1
	1.1.3.LI.1 Analyse the sources and use of templates and patterns in the community.		1			1
	1.1.3.LI.2 Investigate the designing and creation processes of templates and patterns.			1		1
	1.1.3.LI.3 Use appropriate materials, tools and free-hand drawing techniques to design and create 2-dimensional templates and patterns as interventions for challenges in the community.			1		1
	Describe the processes in designing.		1			1
	1.1.4.LI.2 Write a brief to an identified problem			1		1
	1.1.4.LI.3 Generate solutions to solve identified problems.			1		1
GEOMETRY	1.2.1.LI.1 Explain types of plane geometrical figures and give examples.					
	1.2.1.LI.2 Use ratio to enlarge, reduce or divide plane geometrical figures.					
	1.2.1.LI.3 Blend circles and lines with arcs.		1			1
	1.2.1.LI.4 Construct an ellipse as a plane geometrical figure.	1				1
	1.2.1.LI.5 Construct an Archimedean spiral as a locus.	1				1
	1.2.2.LI.1 Explain types of solid geometrical figures and give examples.			1		1
	1.2.2.LI.2 Construct objects in isometric, oblique and perspective.			1		1
	1.2.2.LI.3 Draw the surface development of prisms.			1		1
	1.2.2.LI.4 Draw the surface development of truncated prisms.		1			1
	1.2.3.LI.1 Explain the basic concept of fractal geometry.	1				1
	1.2.3.LI.2 Examine the application of fractal geometry in designs.				1	1

CON-CEPTUAL DRAWING	2.1.1.LI.1 Analyse various basic shapes and rendering techniques used to create complex forms in freehand drawing.			1		1
	2.1.1.LI.2 Experiment with freehand sketches to create designs in 2-point perspective with emphasis on proportions using basic shapes and rendering techniques.		1			1
	2.1.1.LI.3 Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing.		1			1
	2.1.2.LI.1 Investigate how simple and complex objects can be modified through object manipulation techniques.	1				1
	2.1.2.LI.2 Experiment with how objects can be manipulated through drawing to achieve new forms.	1				1
	2.1.2.LI.3 Generate simple forms in line with the concepts and narratives associated with objects and designs.	1				1
	2.1.3.LI.1 Select appropriate drawing materials and tools that can be used to create 2 dimensional free hand-drawn templates and patterns.	1				1
	2.1.3.LI.2 Develop appropriate drawing framework and necessary elements to create 2 dimensional templates and patterns.		1			1
	2.2.1.LI.1 Draw orthographic projections of given objects.	1				1
	2.2.1.LI.3 Design an artefact using the principle of loci.		1			1
GEOMETRY	2.2.2.LI.1 Construct the surface development of pyramids.		1			1
	2.2.2.LI.2 Draw the curve of intersections of objects meeting at right angles.	1				1
	2.2.2.LI.3 Design an artefact using the concept of solid geometry.		1			1
	2.2.2.LI.1 Demonstrate the use of basic concepts of CAD in developing drawings.	1				1
	2.2.2.LI.2 Manipulate drawings CAD tools through editing and plotting techniques.			1		1
GEOMETRY	3.2.1.LI.3 Construct the types of arch and their applications in real life situation.	1				1
	3.2.2.LI.1 Draw the curve of intersections of solids of the same sides meeting at different angles.		1			1

	3.2.2.LI.2 Draw the curve of intersections of solids of different sides and meeting at different angles.	1				1
	3.2.2.LI.3 Design artefact using the concept of curve of intersection.			1		1
	3.2.3.LI.1 Select various geometric shapes used to create complex fractal designs.		1			1
Total		12	16	11	1	40

PAPER 2

Section A

STRAND	LEARNING INDICATOR	LEVEL OF ASSESSMENT				TOTAL
		1	2	3	4	
CON-CEPTUAL DRAWING	1.1.1.LI.1 Explain concept sketches and their applications in designing.	2				2
	1.1.1.LI.2 Use basic shapes, forms and rendering techniques in designing.					
	1.1.1.LI.3 Use the principles of perspective drawing and proportion in designing.					
	1.1.2.LI.1 Analyse and record the concept of object manipulation and manipulation techniques.					
	1.1.2.LI.2 Experiment with various tools and techniques in drawing to manipulate organic and inorganic shapes, forms and objects.					
	1.1.2.LI.3 Use available media and techniques to manipulate objects based on conceptual, symbols, metaphors and narratives associated with objects.					
	1.1.3.LI.1 Analyse the sources and use of templates and patterns in the community.					
	1.1.3.LI.2 Investigate the designing and creation processes of templates and patterns.					

	1.1.3.LI.3 Use appropriate materials, tools and freehand drawing techniques to design and create 2-dimensional templates and patterns as interventions for challenges in the community.					
	1.1.4.LI.1 Describe the processes in designing.					
	1.1.4.LI.2 Write a brief to an identified problem					
	1.1.4.LI.3 Generate solutions to solve identified problems.					
CON-CEPTUAL DRAWING	2.1.1.LI.1 Analyse various basic shapes and rendering techniques used to create complex forms in freehand drawing.					
	2.1.1.LI.2 Experiment with freehand sketches to create designs in 2-point perspective with emphasis on proportions using basic shapes and rendering techniques.					
	2.1.1.LI.3 Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing.					
	2.1.2.LI.1 Investigate how simple and complex objects can be modified through object manipulation techniques.					
	2.1.2.LI.2 Experiment with how objects can be manipulated through drawing to achieve new forms.					
	2.1.2.LI.3 Generate simple forms in line with the concepts and narratives associated with objects and designs.					
	2.1.3.LI.1 Select appropriate drawing materials and tools that can be used to create 2 dimensional free hand-drawn templates and patterns.					
	2.1.3.LI.2 Develop appropriate drawing framework and necessary elements to create 2 dimensional templates and patterns.					
	2.1.3.LI.3 Finalise the 2-dimensional template and pattern design.					

	2.1.4.LI.1 Draw exploded views of final solutions.					
	2.1.4.LI.2 Make a neat working drawing.					
CON-CEPTUAL DRAWING	3.1.1.LI.1 Experiment with freehand sketches to create designs in 3-point perspective with emphasis on proportions using basic shapes and rendering techniques.					
	3.1.1.LI.2 Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing					
	3.1.2.LI.1 Use techniques in object manipulation to generate simple designs from natural objects.					
	3.1.2.LI.2 Use object manipulation techniques to create simple and complex designs as interventions for societal problems.					
	3.1.3.LI.1 Select appropriate drawing materials and tools that can be used to create 3 dimensional free hand-drawn templates and patterns.					
	3.1.3.LI.2 Develop appropriate drawing framework and necessary elements to create 3-dimensional templates and patterns.					
	3.1.3.LI.3 Finalise the 3-dimensional template and pattern design.					
Geometry (Fractal Geometry)	1.2.3.LI.1 Explain the basic concept of fractal geometry.	1				1
	1.2.3.LI.2 Examine the application of fractal geometry in designs.					
	2.2.3.LI.1 Use various geometric shapes to create complex fractal designs.					
	2.2.3.LI.2 Experiment with the creation of various fractal designs using geometric shapes.					

	3.2.3.LI.1 Select various geometric shapes used to create complex fractal designs.					
	3.2.3.LI.2 Use the idea of fractal geometry to create complex fractal designs.					

Section B

Part 1(plane geometry)

STRAND	LEARNING INDICATOR	LEVEL OF ASSESSMENT				TOTAL
		1	2	3	4	
GEOM-ETRY (plane geometry)	1.2.1.LI.1 Explain types of plane geometrical figures and give examples.	1				1
	1.2.1.LI.2 Use ratio to enlarge, reduce or divide plane geometrical figures.					
	1.2.1.LI.3 Blend circles and lines with arcs.					
	1.2.1.LI.4 Construct an ellipse as a plane geometrical figure.					
	1.2.1.LI.5 Construct an Archimedean spiral as a locus.					
	2.2.1.LI.1 Draw orthographic projections of given objects.					
	2.2.1.LI.2 Explain the principles underlying the working of Loci and construct loci.					
	2.2.1.LI.3 Design an artefact using the principle of loci.					
	3.2.1.LI.1 Explain the concept of auxiliary projection.					
	3.2.1.LI.2 Draw auxiliary elevation and plan (primary) of given objects.					
	3.2.1.LI.3 Construct the types of arch and their applications in real life situation.					
	3.2.1.LI.4 Explain the principles of forces acting on beams and trusses.					
	3.2.1.LI.5 Find the magnitude of reaction forces keeping beams and trusses in equilibrium.					

Part 2

GEOM- ETRY (solid ge- ometry)	1.2.2.LI.1 Explain types of solid geometrical figures and give examples.	2				2
	1.2.2.LI.2 Construct objects in isometric, oblique and perspective.					
	1.2.2.LI.3 Draw the surface development of prisms.					
	1.2.2.LI.4 Draw the surface development of truncated prisms.					
	2.2.2.LI.1 Construct the surface development of pyramids.					
	2.2.2.LI.2 Draw the curve of intersections of objects meeting at right angles.					
	2.2.2.LI.3 Design an artefact using the concept of solid geometry.					
	2.2.2.LI.1 Demonstrate the use of basic concepts of CAD in developing drawings.					
	2.2.2.LI.2 Manipulate drawings CAD tools through editing and plotting techniques.					
	3.2.2.LI.1 Draw the curve of intersections of solids of the same sides meeting at different angles.					
	3.2.2.LI.2 Draw the curve of intersections of solids of different sides and meeting at different angles.					
	3.2.2.LI.3 Design artefact using the concept of curve of intersection.					

PAPER THREE

STRAND	LEARNING INDICATOR	LEVEL OF ASSESSMENT				TOTAL
		1	2	3	4	
BUILDING DRAWING						

EX- TENDE DRAWING 1	2.3.1.LI.1 Explain building elevations in relation to building plans.	1				1
	2.3.1.LI.2 Make freehand sketches of elevations of simple domestic buildings in relation to their plans.					
	2.3.1.LI.3 Draw elevations of simple buildings in relation to their plans using appropriate drawing instruments.					
	2.3.1.LI.1 Distinguish between electrical circuit and electronic circuit.					
	2.3.1.LI.2 Use electronic and electrical symbols to draw simple electronic and electrical circuit diagrams.					
	3.3.1.LI.1 Explain floor plan in relation to building codes, standards and symbols.					
	3.3.1.LI.2 Make freehand sketches of floor plan of simple domestic buildings.					
	3.3.1.LI.3 Draw floor plan of simple buildings using appropriate drawing Instruments or CAD					
	3.3.1.LI.4 Explain sectioning in relation to building codes, standards and symbols					
	3.3.1.LI.5 Draw the sectioning of simple buildings using appropriate drawing Instruments or CAD					
MECHANICAL DRAWING						

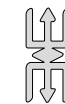
EX- TENDED DRAWING 2	2.3.2.LI.1 Explain the principles of sectional drawing.	1				1
	2.3.2.LI.2 Draw the sectional views of machine parts and components using drawing instruments					
	2.3.2.LI.3 Draw the sectional views of machine parts and components with drawing instruments.					
	2.3.2.LI.1 Distinguish between electrical circuit and electronic circuit.					
	2.3.2.LI.2 Use electronic and electrical symbols to draw simple electronic and electrical circuit diagrams.					
	3.3.2.LI.1 Explain the principles of assembling component Parts.					
	3.3.2.LI.2 Prepare assembly drawing from component parts.					
	3.3.2.LI.3 Prepare detailed working drawings to scale using appropriate drawing instrument or CAD					
GARMENT CONSTRUCTION TECHNOLOGY						
EX- TENDED DRAWING 3	2.3.3.LI.1 Assess the tools used in garment design, and their applications.	1				1
	2.3.3.LI.2 Take accurate body measurements to prepare a bodice block.					
	2.3.3.LI.3 Draft garment patterns using bodice block, skirt block and sleeve block.					
	2.3.3.LI.4 Cut out the patterns to be used for the garment.					
	3.3.3.LI.1 Grade patterns to different sizes					
	3.3.3.LI.2 Examine garment designs to break patterns down into different components					
	3.3.3.LI.3 Manipulate patterns to make adaptations of different garment designs					
	3.3.3.LI.4 Make Pattern adjustments and alterations					

PLC Session 18

45 minutes

Planning & Reviewing the Learning Plan

1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
 - a. The key assessment for the week is **practice paper 2**. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the practice paper (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through the problem individually for 3–4 minutes
 - c. the group then works through it together the problem, step by step
 - d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 19

Learning Indicator: Draw floor plan of simple buildings using appropriate drawing Instruments or CAD

FOCAL AREA: DRAWING FLOOR PLANS WITH APROPPRIATE DRAWING INSTRUMENT

Unlike the freehand sketches produced in week 17, here, learners will Create precise floor plans using appropriate drawing instruments.

Precisely drawing floor plans is a fundamental skill in architectural documentation, which produces technically accurate plans with consistent line quality, precise measurements, and professional presentation. This technical approach ensures that floor plans communicate design intent clearly while meeting industry standards for construction documentation.

Essential Drawing Instruments

1. Drawing Board
 - a. Size: A1 or A0 recommended for architectural drawings
 - b. Features: Parallel straightedge or T-square track
 - c. Purpose: Provides stable, flat surface with straight-edge reference
2. T-Square
 - a. Types: Fixed head or adjustable head
 - b. Features: Straight edge with perpendicular head
 - c. Purpose: Creates horizontal lines and guides set squares
3. Set Squares
 - a. Types: 45° (45°-45°-90° triangle) and 30°/60° (30°-60°-90° triangle)
 - b. Materials: Clear plastic preferred for visibility
 - c. Purpose: Creates vertical and angled lines.
4. Scale Rule
 - a. Types: Architectural scale with multiple ratio options
 - b. Common scales: 1:50, 1:100, 1:200 for residential plans
 - c. Purpose: Measures and draws to exact scale ratios
5. Compass
 - a. Types: Beam compass for larger arcs, standard compass for smaller curves
 - b. Features: Adjustable radius, replaceable lead
 - c. Purpose: Creates precise circles and arcs

6. Dividers

- a. Features: Two metal points for transferring measurements
- b. Purpose: Transfers dimensions without relying on scale measurement

7. Drawing Paper

- a. Types: Tracing paper, detail paper, presentation paper
- b. Standard sizes: A1, A2, A3 for floor plans
- c. Features: Smooth surface

8. Drawing Pencils

- a. Grades: H (hard) for construction lines, and HB for final lines, B for emphasis
- b. Purpose: Creates different line weights and types

9. Erasers

- a. Types: Plastic eraser for pencil, erasing shield for precision
- b. Purpose: Corrects errors without damaging paper

**Figure 19.1****Step-by-Step Floor Plan Drawing Process based on given specifications.****Stage 1: Construction Lines and Basic Layout****1. Establishing the Walls**

- a. Draw constructional lines for exterior wall faces
- b. Add wall thickness to constructional lines
- c. Draw square corners using set squares
- d. Verify wall intersections are properly resolved
- e. Confirm overall dimensions match with given specifications

2. Room Layout

- a. Divide interior space according to room requirements
- b. Verify room dimensions meet given specifications

3. Openings Placement

- a. Mark door locations and swing directions
- b. Position windows according to design
- c. Locate major openings in walls

Stage 2: Detailed Development**1. Door and Window Details**

- a. Draw door swings using compass or templates
- b. Add window details with proper sill and jamb representation
- c. Include door and window symbols

Stage 3: Refinement and Technical Details**1. Line Hierarchy Implementation**

- a. Heavy lines: Cut elements (walls, built-ins)
- b. Light lines: Hidden features, centre lines
- c. Very light lines: Construction lines (may be erased)

2. Include hatching

- a. Add wall hatching.
- b. Indicate different flooring materials if required
- c. Show special construction elements with appropriate patterns

3. Dimension Addition

- a. Add primary dimensions (overall building)
- b. Include secondary dimensions (room sizes, openings)
- c. Use proper dimensioning conventions with dimension lines, and text

Stage 4: Annotation and Finalisation**1. Room Labelling**

- a. Add room names and numbers
- b. Use consistent text size and style

2. Title Block Completion

- a. Add author information
- b. Add project information
- c. Include drawing title and number
- d. Add scale and date

3. Final Review

- a. Check dimensions for accuracy and consistency
- b. Verify all required elements are included
- c. Ensure drawing meets professional standards



Scan the QR code above for a video tutorial on how to draw floor plan with drawing instruments

Learning task

Draw ground floor plan of a simple two-bedroom house using drawing instrument

Pedagogical exemplars

Managing talk for learning, Activity-based learning: Using the free hand sketches of floor plans produced, assist learners to use the appropriate drawing instruments to draw the floor plans correctly. Taking into consideration the dimensions.

Key Assessment Level 2: Concept Building

Task

With a scale of 1:100, Produce a detailed floor plan of the sketch produced in week 17 with drawing instruments. **(20 marks)**

Specifications

WALLS

All walls are 225 and Crete hollow bricks with 12 mortar rendering on both sides.

DOORS

D1 – 1200 x 2100 glazed metal door.

D2 – 900 x 2100 flush door with 100 x 75 hardwood timber frame.

WINDOWS

All windows are glazed aluminium sliding type

W – 1500 x 1200

W1 – 600 x 600

PLC Session 19

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **concept building**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the assessment (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
- b. After the enactment, ask for structured feedback from the group
- i. was the concept explained in a way that a learner with no prior knowledge could follow?
- ii. were the examples grounded in contexts familiar to Ghanaian learners?
- iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
- b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
- c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 20

Learning Indicator: Draw floor plan of simple buildings using appropriate drawing Instruments or CAD

FOCAL AREA: DRAWING FLOOR PLANS WITH AUTOCAD

AutoCAD for Floor Plan Development

Learners mastering AutoCAD for floor plan creation will acquire essential skills for further education and professional practice in architecture, engineering, and construction fields.

Essential requirement

- AutoCAD architecture, 2008 and above
- Computer specification:1.5Gz and above and RAM 4gb and above

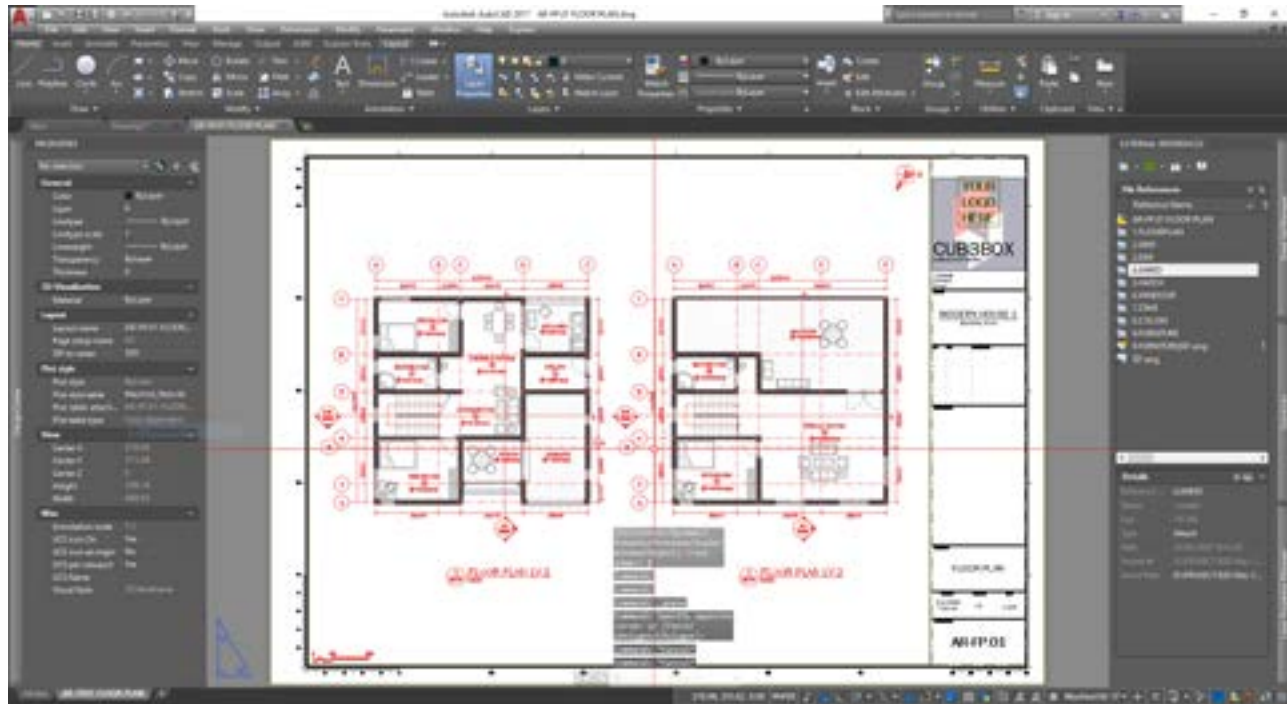


Figure 20.1

Advantages of AutoCAD for Floor Plan Creation

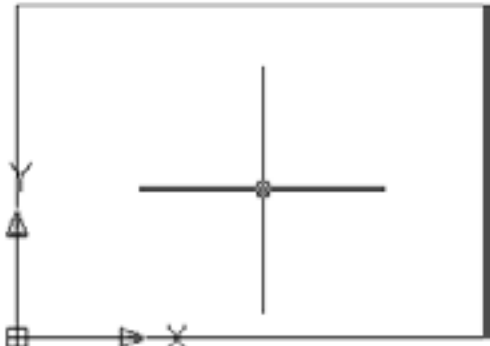
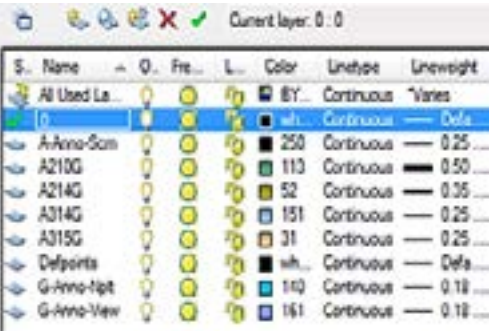
1. Exact measurements and dimensions to any required precision
2. Consistent line weights and types throughout the drawing
3. Accurate scaling for all elements
4. Easy editing without redrawing entire plans
5. Quick duplication of common features
6. Automated dimensioning and annotation
7. Easy scale changes without redrawing
8. Multiple layout options from the same base drawing

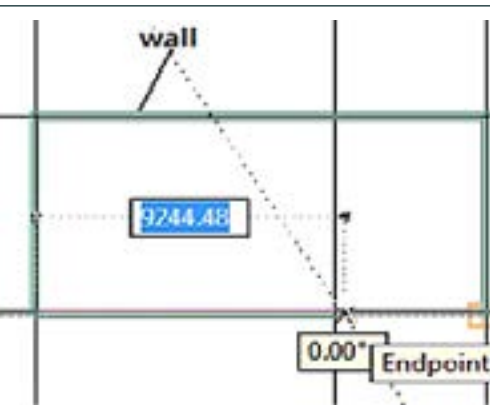
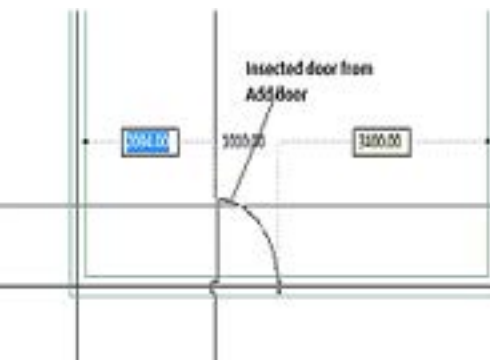
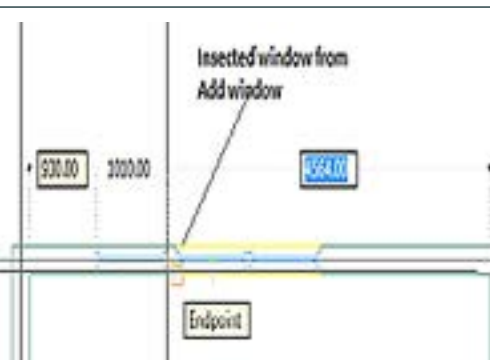
- 9. Standardised output for construction documentation
- 10. Digital delivery and storage capabilities

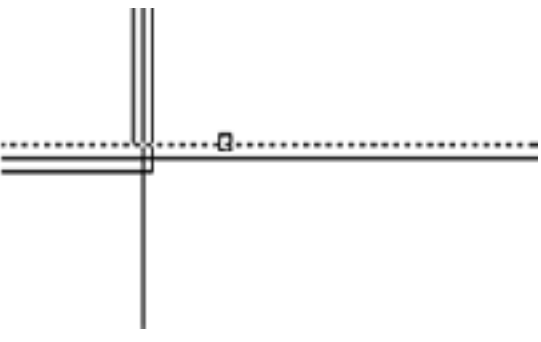
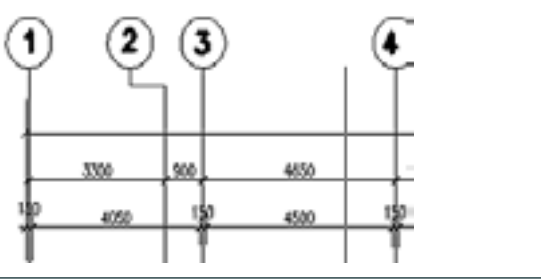


Figure 20.2

Table 2.2.2 Guide

Use the figure above to draw in AutoCAD by using the following command:	
	Set the sheet by using MVSETUP: MVSETUP ☒ Enter Enable paper space [NO/YES] <Y>: NO Enter unit type [Scientific/Decimal/Engineering/Architectural/Metric]: M Enter the scale factor: 1 Enter the paper width: 420 (A3) Enter the paper height: 297 (A3) OR Use a customise sheet set.
	Set new layers and choose deferent colours, line type and line weight before starting to draw the actual objects. (See chapter 2 for information on Layers)

	Use line command and offset command to draw title block lines in 2D space. (see Draw commands for the steps of line and modify commands for the steps of offset)
	1. Use line command and offset command to draw grid lines in 2D space. (see Draw commands for the steps of line and modify commands for the steps of line offset). OR 2. Use the column grid command.
	Use the Add Wall command to offset the grid lines to obtain wall thickness (see chapter 10 for the steps of Add wall).
	Insert door from design centre or tool palettes. Or use the command Add door.
	Insert windows from design centre or tool palettes. Or use the command Add window.

	Use the erase command to erase unwanted parts or object (see modify command for the steps of erase). Use the trim command to trim unwanted parts or object (see modify command for the steps of trim).
	Use the dimension commands (e.g., Linear) to dimension the object.
	Use multiline text to Wright text in AutoCAD. (See Draw command for the steps of multiline text).

Learning task

Draw ground floor plan of a simple two-bedroom house using AutoCAD

Pedagogical exemplars

Managing talk for learning, Activity-based learning: Using the free hand sketches of floor plans produced, assist learners to use AutoCAD to draw the floor plans correctly. Taking into consideration the dimensions.

Key Assessment Level 2: Group Presentation Task

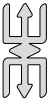
With a scale of 1:100, Produce a detailed floor plan of the sketch produced in week 17 with AutoCAD. (20 marks)

PLC Session 20

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to

- a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



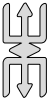
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
------------	-----------

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
-----------	------------

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 21

Learning Indicators

1. Explain sectioning in relation to building codes, standards and symbols

2. Draw the sectioning of simple buildings using appropriate drawing instruments or CAD

FOCAL AREA: SECTIONING

Sectional drawings are critical components of architectural documentation that reveal the internal construction of buildings by conceptually cutting through the structure along a defined plane. Unlike floor plans that provide horizontal views, sections offer vertical perspectives that expose relationships between levels, structural systems, spatial volumes, and construction assemblies. When properly executed, sectional drawings serve as essential communication tools that demonstrate compliance with building codes, adherence to industry standards, and proper application of architectural symbols.

Definition and Purpose

A building section is a vertical cut through a structure that reveals interior spaces, construction details, and the relationships between different building elements that would otherwise remain hidden. Sections serve multiple critical purposes:

1. **Revealing Vertical Relationships:** Showing connections between different floor levels, foundations, and roof structures
2. **Documenting Technical Requirements:** Demonstrating compliance with building codes and standards
3. **Communicating Design Intent:** Expressing spatial qualities and architectural features
4. **Demonstrating Construction Methods:** Illustrating how various building components connect and interact

Types of Building Sections

1. **Building Sections (Full Sections)**

a. Cut through the entire building, typically from foundation to roof

b. Show overall vertical relationships and major spatial organisations

c. Demonstrate the complete building assembly system
2. **Wall Sections**

a. Detailed vertical cuts through specific wall assemblies

b. Focus on construction details and material transitions

c. Typically drawn at larger scales (1:50)
3. **Partial Sections**

a. Focus on specific areas requiring detailed explanation

- b. May include stairs, special ceiling conditions, or unique features
- c. Provide targeted information about complex areas

Full sectioning will be considered in this section.

Drawing sectioning with drawing instruments

1. Before beginning to draw, Identify the Cutting Plane by;

- a. Locating the section line on the floor plan
- b. Noting the direction of view indicated by arrows
- c. Identifying all elements intersected by the cutting plane

2. Scale Configuration

- a. Select appropriate scale (typically 1:50 for building sections)
- b. Note scale on drawing for reference

3. Establishing the Basic Structure

Drawing foundation elements;

- a. Draw foundation walls at correct depth
- b. Show footings with proper dimensions
- c. Indicate foundation drainage and waterproofing

Drawing structural Framework;

- a. Establish floor levels with horizontal lines
- b. Draw structural walls, columns, and beams
- c. Show floor and roof structural elements
- d. Indicate structural connections

Drawing the building Envelope

- a. Draw exterior walls with correct thickness
- b. Show roof lines with proper slopes
- c. Indicate major openings (doors and windows)
- d. Outline stair locations and vertical circulation

4. Adding Building Elements and Details

Drawing interior Partitions and Features;

- a. Draw interior walls cut by the section
- b. Show doors and openings in section
- c. Add built-in elements and fixtures

Drawing window and Door Details;

- a. Show window and door openings in section

- b. Include lintels
- c. Draw sills and thresholds

Drawing Roof Details;

- a. Draw roof structure and covering
- b. Indicate eaves, fascia, and gutter details

5. Material Indication and Hatching

Apply appropriate hatching patterns to cut materials;

- a. Concrete
- b. Masonry
- c. Wood
- d. Earth
- e. Metal

6. Technical Annotation

Add vertical dimensions for:

- a. Floor-to-floor heights
- b. Ceiling heights
- c. Opening heights
- d. Foundation depths
- e. Label major materials and assemblies

7. Title and Information

- a. Add section identification matching floor plan references
- b. Include scale information
- c. Note drawing number and project information
- d. Add north arrow if needed for orientation

8. Final Review

- a. Check dimensional accuracy
- b. Verify correct representation of assemblies
- c. Ensure all required elements are included
- d. Confirm proper line weights and hatching

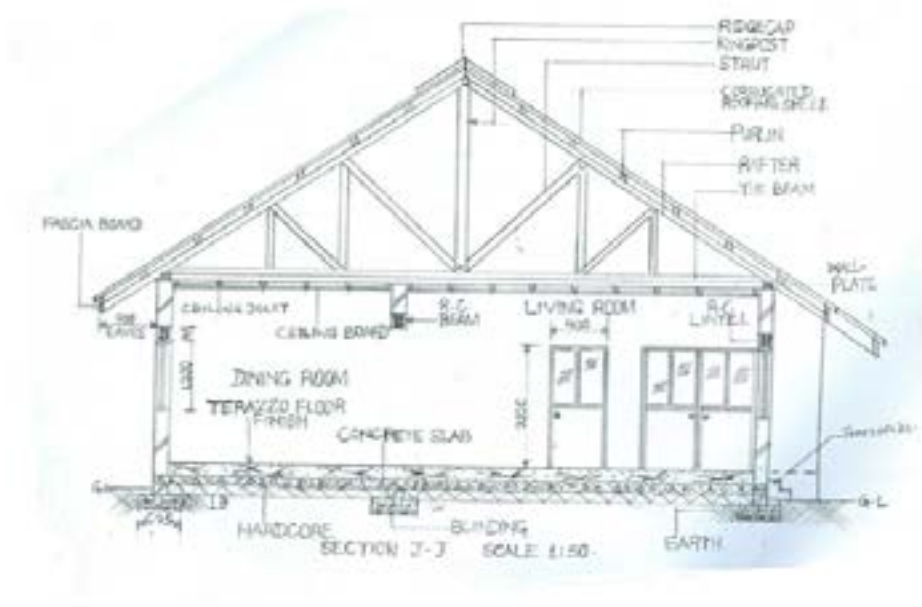


Figure 21.1



Scan the QR code above for a video tutorial on how to draw sectioning from a given plan with drawing instruments

Draw the sectioning of simple buildings using AutoCAD

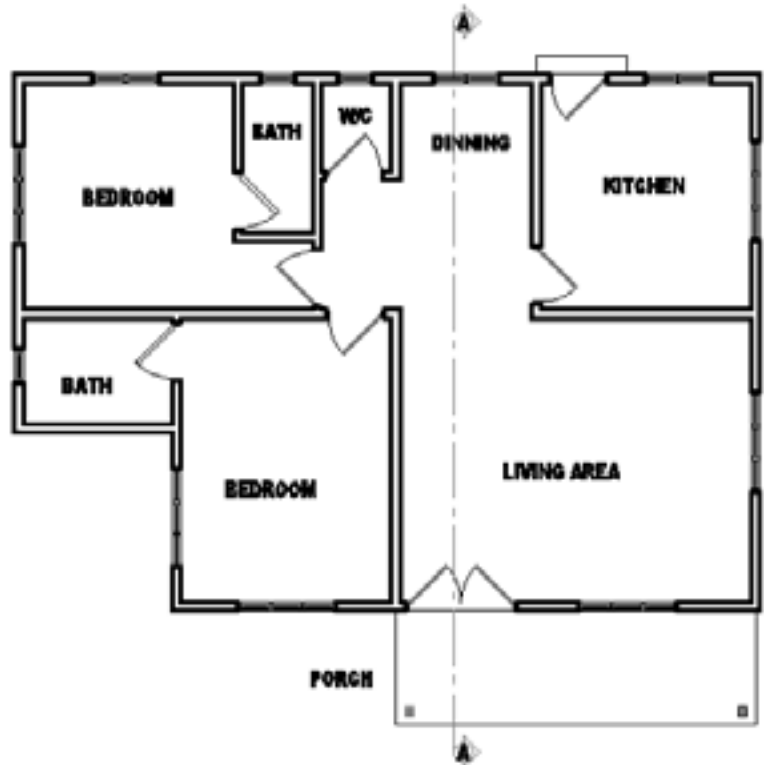
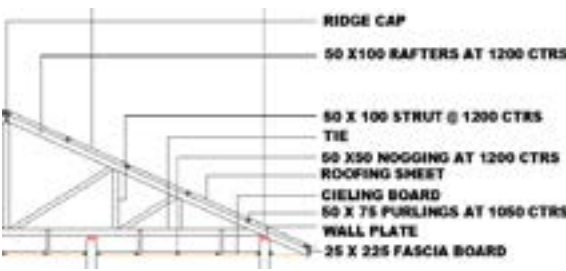
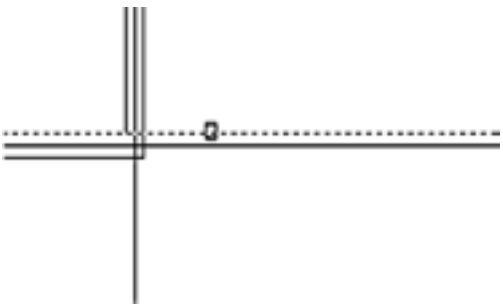
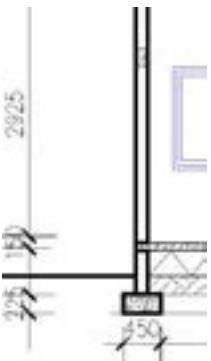
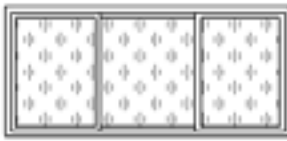


Figure 21.2

Table 2.2.2 Guide to draw the section plan with AutoCAD

Use the figure above to draw in AutoCAD Architecture by using the following command:	
	Set the sheet by using MVSETUP: MVSETUP ☒ Enter Enable paper space [NO/YES] <Y>: NO Enter unit type [Scientific/Decimal/Engineering/ Architectural/Metric]: M Enter the scale factor: 1 Enter the paper width: 420 (A3) Enter the paper height: 297 (A3) OR Use a customised sheet set.
	Set new layers and choose deferent colours, line type and line weight before starting to draw the actual objects. (See chapter 2 for information on Layers)
	Use line command and offset command to draw title block lines in 2D space. (see Draw com- mands for the steps of line and modify com- mands for the steps of offset)
	1. Use line to draw grid line as the ground level 2. Use line command to draw vertical line and offset command to offset the lines in 2D space. (see Draw commands for the steps of line and modify commands for the steps of line offset). OR 3. Use the column grid command.
	1. Use the offset to obtain the foundation 2. Use the Add Wall command to offset the grid lines to obtain wall thickness (see chapter 10 for the steps of Add wall). 3. Use the hatch command to obtain earth, concrete and hardcore hatch.

	Use the Insert doors from the design centre or tool palettes, or use the command Add window to insert the door symbol.
	Use the Insert windows from the design centre or tool palettes, or use the command Add window to insert the window symbol.
	1. Use the line command and Polar tracking to obtain the angle for the rafters. 2. Use the line command and offset to obtain the rest of the roofing members.
	1. Use the erase command to erase unwanted parts or objects (see the modify command for the steps of erase). 2. Use the trim command to trim unwanted parts or objects (see the modify command for the steps of trim).
	Use the dimension commands (e.g., Linear) to dimension the object.
	1. Use the line command and offset to draw the door and door frame. 2. Use hatch command to hatch the flash door

	1. Use the line command and offset to draw the window frame and window. 2. Use hatch command to hatch the symbol for glass
	Use multiline text to Wright text in AutoCAD. (See Draw command for the steps of multiline text).
Add Other Elements	

Final work

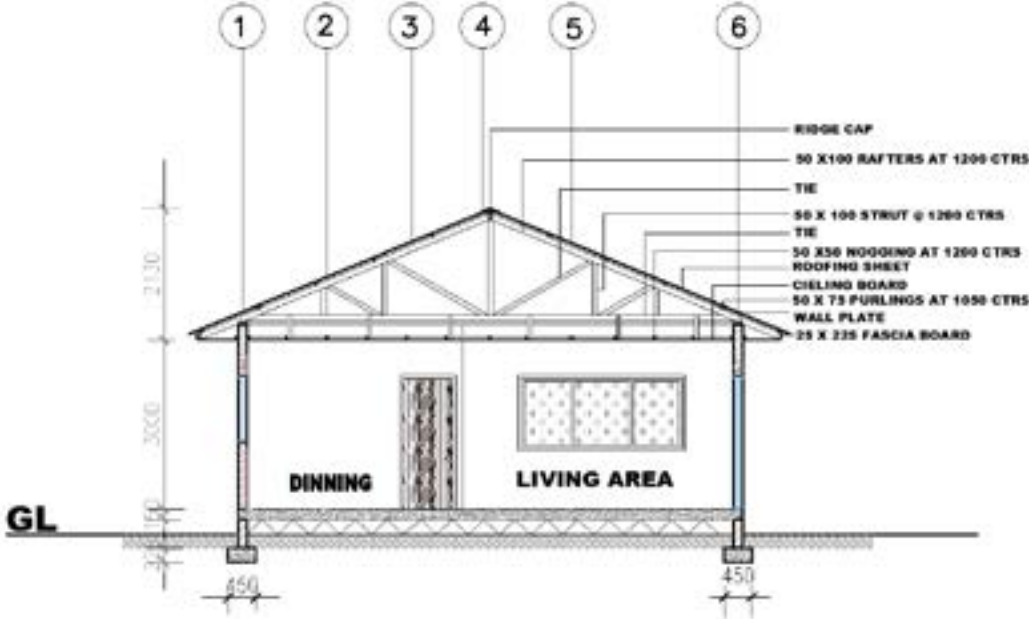


Figure 21.3

Learning tasks

1. Explain sectioning in relation to building codes, standards and symbols
2. Draw the sectioning of simple buildings using appropriate drawing Instruments or CAD

Pedagogical Exemplars

Experiential learning: show learners visuals of a vertically collapsed building that shows the various building components. i.e., roof structures, lintel, floor, foundation, etc.

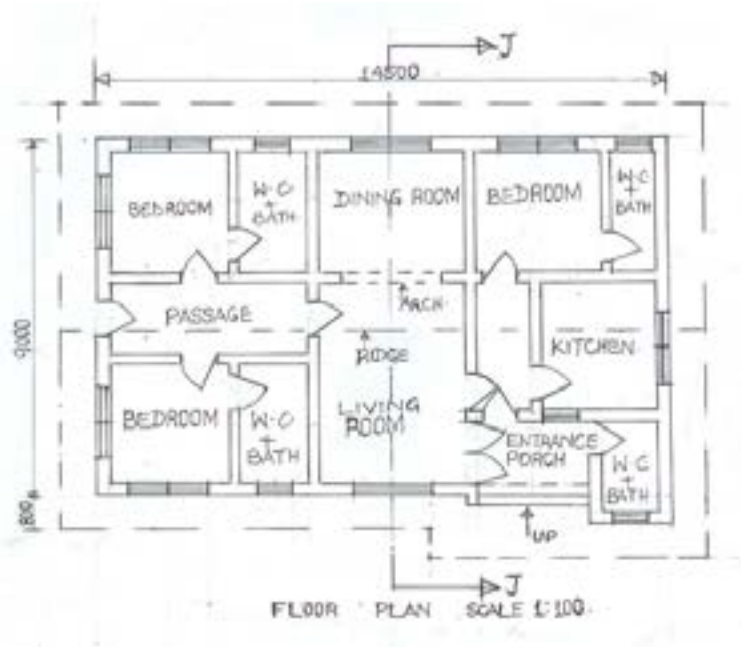
Managing talk for learning: task learners to discuss the features of the collapse building and identify the building components.

Research, Collaborative learning/ Group work: With relevant resources engage learners in mixability groups to discuss sectioning and its relevance to the building industry.

Managing talk for learning, Activity-based learning: Using the drawings produced earlier assists learners to introduce a cutting plane and draw the sectioning with appropriate drawing instruments or AutoCAD considering the dimensions.

Key Assessments Level 2: Individual Classwork

- 1. Explain the meaning of building sectioning (4 marks).
- 2. Draw the section of the floor plan provided below (20 marks).



PLC Session 21

45 minutes	Planning & Reviewing the Learning Plan
------------	--

- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is *discussion and homework*. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the homework (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
------------	-----------

- 6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
-----------	------------

- 7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
- 8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).

9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Unit 21 Review

Under this unit, learners were introduced to the concept of sectioning and floor plans in relation to building codes, standards and symbols. Learners explored the importance of sectioning in communicating internal details of buildings and studied the conventions used in technical and architectural drawing.

Learners were guided through the process of drawing sections and floor plans of simple domestic buildings using appropriate drawing instruments and CAD applications. Through demonstrations and guided practice, learners developed skills in interpreting and producing accurate floor plans that conform to accepted standards. Learners also made freehand sketches of simple floor plans to strengthen their visualisation and drawing abilities before producing instrument and CAD-based drawings.

Varied pedagogical strategies were employed to cater for the diverse learning proficiencies within the class. Activities such as demonstrations, guided practice, collaborative learning, practical exercises and project work enabled learners to actively participate in the learning process. Assessment tasks targeted higher levels of the Depth of Knowledge (DoK), requiring learners to apply concepts, analyse layouts and produce accurate technical drawings. Learners demonstrated their understanding through the floor plans, sectional drawings and practical works produced during the unit.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 18

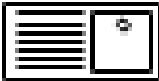
FOCAL AREA

Question 1(16 marks)

Criteria	4 marks (excellent)	3 marks (good)	2 marks (satisfac- tory)	1 mark (need im- provement)
Explaining floor plan: Keywords to include; a. scaled, b. horizontal section c. room spaces d. a view from above e. layout	Learner includes four of the keywords in their expla- nation	Learner includes three of the keywords in their expla- nation	Learner includes two of the keywords in their expla- nation	Learner includes one of the keywords in their expla- nation

Explaining Building codes, standards and symbols, key words to include; a. regulation b. documented c. specifications d. regulatory bodies e. Standardised f. Universal language	Learner includes at least four of the keywords in their expla- nation	Learner includes at least three of the keywords in their expla- nation	Learner includes at least two of the key- words in their expla- nation	Learner includes one of the keywords in their expla- nation
Linking floor plan to building codes, standards and symbols a. Room size b. Ceiling height c. Exit access d. Bathroom layout e. Door clearance f. Window symbol g. Door symbol	Creates a link with any four of the bulleted	Creates a link with any three of the bul- leted	Creates a link with any two of the bulleted	Creates a link with any one of the bulleted
Relevance to the building industry i.e. a. Ensuring public Safety and welfare b. Facilitating clear Communication c. Promoting Consistency and quality d. Supporting Legal and Regulatory Frameworks Or any other relevant response from learner	States four relevance	State three relevance	State two relevance	State one relevance

Question 2

Building drawing symbols	Description
	Water closet
	Single door
	window
	Block wall
	Sink

1 mark each=5 marks

FOCAL AREA 2

Criteria	3 marks (excellent)	2 marks (good)	1 mark (satisfactory)
Client requirements	Learner includes all client requirement in the sketch	Learner ignores two of client's requirement	Learner ignores three of client's requirement
Drawing Quality & Symbol Usage Learner includes symbols for a. doors b. windows c. walls	Learner includes three symbols	Learner includes two symbols	Learner includes one symbol
Annotation & Communication Learner includes a. dimensions b. label spaces c. indicates north arrow	Learner includes all three	Learner includes two	Learner includes one

WEEK 19

Rubrics

Criteria	4 marks (excellent)	3 marks (good)	2 marks (satisfactory)	1 mark (need improvement)
Wall thickness Approximately (3 mm)	3 mm	Plus, or minus 1 mm	Plus, or minus 2 mm	Plus, or minus 3 mm
Drawing Quality & Symbol Usage Learner includes symbols for a. doors b. windows c. walls d. hatching for walls	Learner includes all four	Learner includes three	Learner includes two	Learner includes one
Annotation & Communication Learner includes a. dimensions b. label spaces c. indicates north arrow d. describes the drawing	Learner includes all four	Learner includes three	Learner includes two	Learner includes one

Drawing presentation i.e. a. well erased unwanted pencil marks b. neat drawing sheet devoid of crumples c. sheet devoid of soils/dirt d. timely submission	Learner includes all four	Learner includes three	Learner includes two	Learner includes one
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WEEK 20

Rubrics

Activity	Marks
Setting up the sheet by using MVSETUP or Using a customised sheet set.	2
Setting new layers and choosing different colours, line type and line weight before starting to draw the actual objects.	2
Using line command and offset command to draw title block lines in 2D space.	2
1. Using line command and offset command to draw grid lines in 2D space. OR 2. Using the column grid command.	2
Using the Add Wall command to offset the grid lines to obtain wall thickness	2
Inserting doors from design centre or tool palettes. Or using the command Add door.	2
Insect windows from design centre or tool palettes. Or use the command Add window.	2
Using the erase command to erase unwanted parts or object Use the trim command to trim unwanted parts or object	2
Using the dimension commands (e.g., Linear) to dimension the object.	2
Use multiline text to Wright text in AutoCAD. (Draw command for the steps of multiline text).	2

WEEK 21

Question 1

Criteria	4 marks (Excellent)	4 marks (Very good)	4 marks (satisfactory)	1 mark (Need improvement)

Definition Keywords: Vertical cross section Cutting plane. two-dimensional Hidden structural elements	Learner provides four	Learner provides three	Learner provides two	Learner provides one
Types of sectioning i.e. Full sections Partial sections Wall sections Transverse sections	Learner provides four	Learner provides three	Learner provides two	Learner provides one
Relevance: i.e. Revealing materials and structures used Documenting Technical Requirements Communicating Design Intent Demonstrating Construction Methods	Learner provides four	Learner provides three	Learner provides two	Learner provides one
Relation to building codes, standards and symbols Visual Demonstration of Compliance Regulatory Review Reference Technical Verification Medium	Learner provides four	Learner provides three	Learner provides two	Learner provides one

Note: consider any relevant response from learners as well

Question 2

1. Draw to correct scale = [1 mark]
2. Draw the ground line = [1 mark]
3. Draw three foundation footings 100 below ground level = [1 mark]
4. Draw the earth fillings = [1 mark]
5. Draw the hard core = [1 mark]
6. Draw the concrete slab = [1 mark]
7. Draw the terrazzo floor finish = [1 mark]
8. Draw three walls in section = [1 mark]
9. Section the three walls = [1 mark]
10. Draw wall in elevation = [1 mark]
11. Draw two lintels and beam = [1 mark]
12. Draw two windows in section = [1 mark]
13. Draw two doors in elevation = [1 mark]

14. Draw the facial board= [1 mark]
15. Draw eaves projections = [1 mark]
16. Draw five roof members i.e. struts, king post, rafter, and ridge cap= [1 mark]
17. Draw the two wall plates = [1 mark]
18. Draw ceiling and noggings = [1 mark]
19. Write section J-J = [1 mark]
20. Clearly label rooms and structural members = [1 mark]

Total score = **20 marks**

SECTION 3: EXTENDED DRAWING

OPTION 2: MECHANICAL DRAWING

Strand: Extended drawing

Sub-Strand: Mechanical drawing

Learning Outcome: Apply the concept of assembly and working drawings in applied technology

Content Standard: Understand the concept of Mechanical drawing.

INTRODUCTION AND SECTION SUMMARY

This session is designed to equip learners with a thorough understanding of assembly drawing principles, from recognising individual component parts through to producing detailed working drawings using both manual drafting techniques and CAD software. Over the course of four thematic areas, each spanning two meetings, students will gain the knowledge and practical skills necessary to interpret part geometry, apply basic and advanced assembly conventions, prepare complete assembly layouts (including bills of materials), and finally generate accurate, to-scale working drawings. By the end of the section, learners should be proficient in translating component details into fully dimensioned assembly and part drawings, ensuring they can both visualise and communicate mechanical relationships effectively

Within four weeks, students first learn to identify and classify component parts; understanding datum features, fits (clearance, transition, interference), joining methods (bolts, pins, press-fits) and the role of tolerancing, before progressing to advanced assembly principles, including sequencing sub-assemblies, locating elements (keys, dowel pins) and alignment considerations, alongside industry drawing conventions (line types, exploded views, bills of materials and annotation standards). They then translate individual part drawings into complete assembly layouts, establishing datum references, sketching orientations, inserting component outlines with correct hidden/visible lines, dimensioning critical clearances, and compiling a simple parts list. Finally, learners contrast manual drafting with CAD techniques to produce to-scale working drawings: using drawing instruments (T-squares, set squares, compasses) for orthographic projections, sections and detail enlargements, and applying hatching conventions, before moving to a CAD environment to set up units and layers, create precise 2D profiles, generate sections from 3D models where applicable, and prepare drawings for plotting.

The weeks and the indicators covered by the section are:

- **Week 18:**(Prepare an assembly drawing from components)
- **Week 19:**(Prepare an assembly drawing from components)
- **Week 20:**(Prepare detailed working drawings to scale using appropriate drawing instrument or CAD)
- **Week 21:**(Prepare detailed working drawings to scale using appropriate drawing instrument or CAD)

Recap weeks

Year 2	Week 22
	1. Explain the principles of sectional drawing.
	2. Sketch the sectional views of machine parts and components in freehand.

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section requires a practical approach to facilitate learning of Assembly and Working Drawings for form three learners. Teachers should build upon learners’ previous knowledge from form two, emphasising independent application and creative problem-solving. Progressive complexity should be the priority of the facilitator such that lessons must start from basic part identification to complete scaled drawings. Visual literacy and standards awareness must be emphasised, focusing on drawing clarity, conformity, and industry standards (ISO/BS). Teachers should consider the pedagogical exemplars below;

- **Hands-On Learning:** facilitators should engage learners through the use of tangible components, sketching, and CAD modelling to enhance understanding of lessons
- **Problem-Based Learning:** learner should be granted the opportunity analyse real-world assembly failures (e.g., misaligned dowel holes).
- **Collaborative Activities:** learners should be engaged in group planning, peer reviewing, and critiquing to enhance participation in lessons and learning retention.
- **Technology Integration:** Incorporate CAD software demonstrations to overlay part drawings onto physical objects. Encourage learners to use appropriate digital tools to enhance precision and explore assembly and working drawings efficiently
- **Industry Connect:** the services of Guest speaker (e.g., manufacturing engineer) can be sourced to engage learners based on industrial experience and demands on assembly and working drawings.
- **Real-World Application Projects** Assign projects that require learners to solve authentic design problems in assembly and working drawings.
- **Differentiated Instruction:** (Provide multiple entry points for tasks based on learners’ strengths, i.e. **AP**, **P**, and **HP**)

ASSESSMENT SUMMARY

Assessment should be comprehensive, covering DoK levels 1-4 with emphasis on levels 3 and 4. Evaluate learners’ ability to independently prepare assembly drawings from component parts, detailed working drawings to Scale manually and using CAD. Assess technical precision

in construction alongside creative application, include opportunities for learners to explain and justify their decisions verbally or in writing.

During instruction and assessment, teachers should ensure inclusive participation with appropriate support for learners at different ability levels

Peer assessment should be used in some of the lessons, rubrics for grading of drawings and other assessments should be discussed with the learners for them to be actively involved in the assessment process.

This approach prepares Form Three learners not only for their final assessments but also for the application of geometric principles in future academic and professional contexts

Indicators	DOK Level	Assessment Strategy and/or Mode
L1: Explain the principles of assembling component parts.	Level 2 (skills of conceptual understanding)	Individual/group classwork
L2: Prepare an assembly drawing from components.	Level 4 (Extended critical thinking and reasoning)	Individual class work
L3: Prepare detailed working drawings to scale using appropriate drawing instrument or CAD	Level 4 (Extended critical thinking and reasoning)	Individual/group presentation

WEEK 18

Learning Indicator: Explain the principles of assembling component parts

FOCAL AREA: INTERPRETING COMPONENT DRAWINGS FOR ASSEMBLY

Introduction

In the world of engineering and design, drawings are a universal language. Before any machine, tool, or structure can be built, it must first be carefully planned on paper or on a computer. This is where component drawings come in. These drawings show us the shapes, sizes, and features of individual parts that will be assembled into a final product.

In this lesson, we will explore how to read and understand these technical drawings. We’ll focus on two main types: orthographic views (which show an object from different angles) and sectional views (which cut through the object to reveal what’s inside). You’ll learn to identify key features such as holes, shafts, slots, and keyways — all essential for fitting parts together properly.

Being able to interpret these drawings is a critical skill in many fields such as mechanical engineering, architecture, manufacturing, and construction. It helps ensure that all parts fit correctly and work smoothly when assembled.

By the end of this lesson, you’ll be able to look at a component drawing and confidently understand how it’s shaped, how it functions, and how it connects with other parts.

Understanding Orthographic and Sectional Views

These are 2D views of 3D objects, typically including:

- a. Front View
- b. Top View (Plan)
- c. Side View (End Elevation)

Each view shows a specific face of the component. These views are drawn to scale and aligned properly

Orthographic projection can be presented in either first angle or third angle projection.

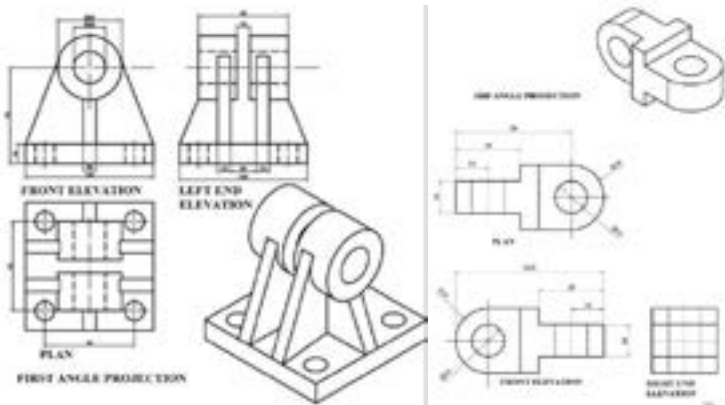


Figure 18.1

Sectional Views

These are used to show hidden features by slicing through the object, making internal details like holes, shafts, and keyways visible.

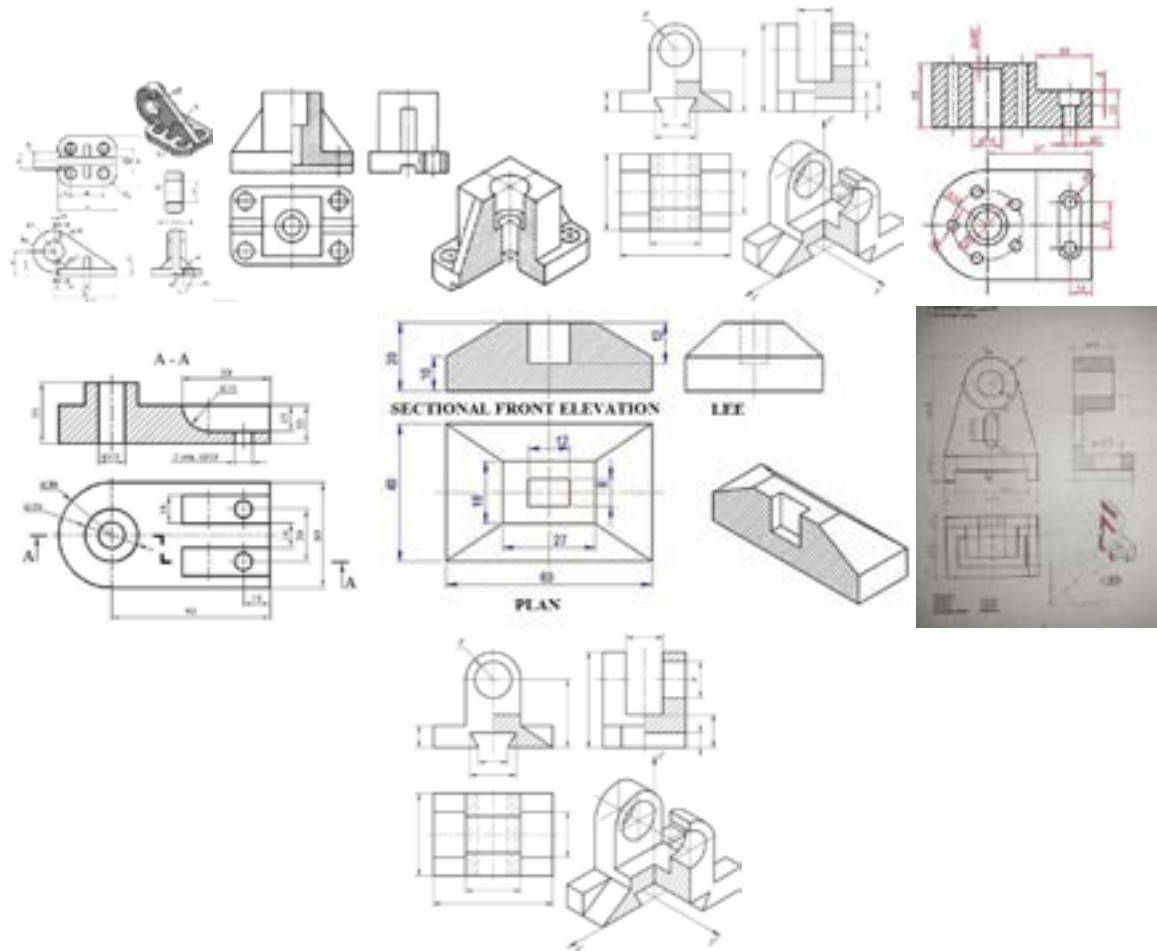


Figure 18.2

Identifying Common Mating Features in Drawings

Holes

Holes are circular cut-outs, often to house fasteners or allow shafts to pass. In section, holes appear as blank circular or cylindrical voids, showing clearly through the thickness.

No hatch lines cross these areas—this indicates absence of material.

Centre lines mark their axes—two alternating long and short dashes that run through the centres of circles

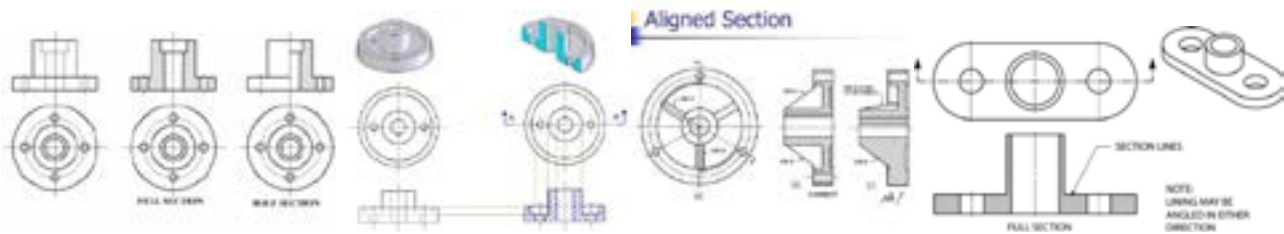


Figure 18.3

Shafts

Shafts fit into holes with tight or loose tolerances. Shafts get sectioned like solid material—so they are filled with the same hatch pattern. If deeper detail is needed, sometimes a half-section is used where only one side of the shaft is hatched. In assembly drawings, shafts (and bolts, keys, pins) are usually not hatched, even if the section plane intersects them. This helps keep them distinct.

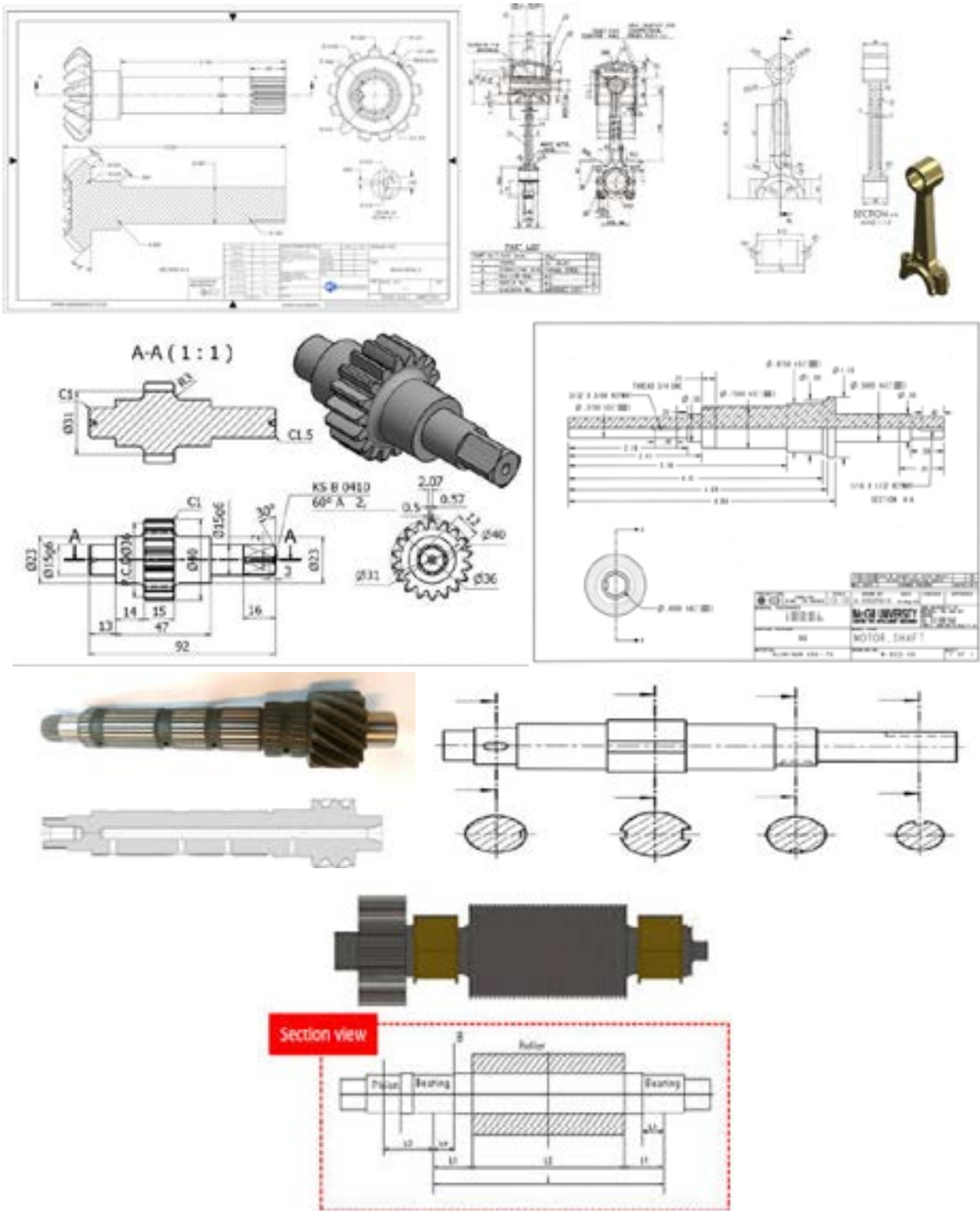


Figure 18.4

Slots

Long narrow cuts typically used for guides, clearances, or adjustable parts.

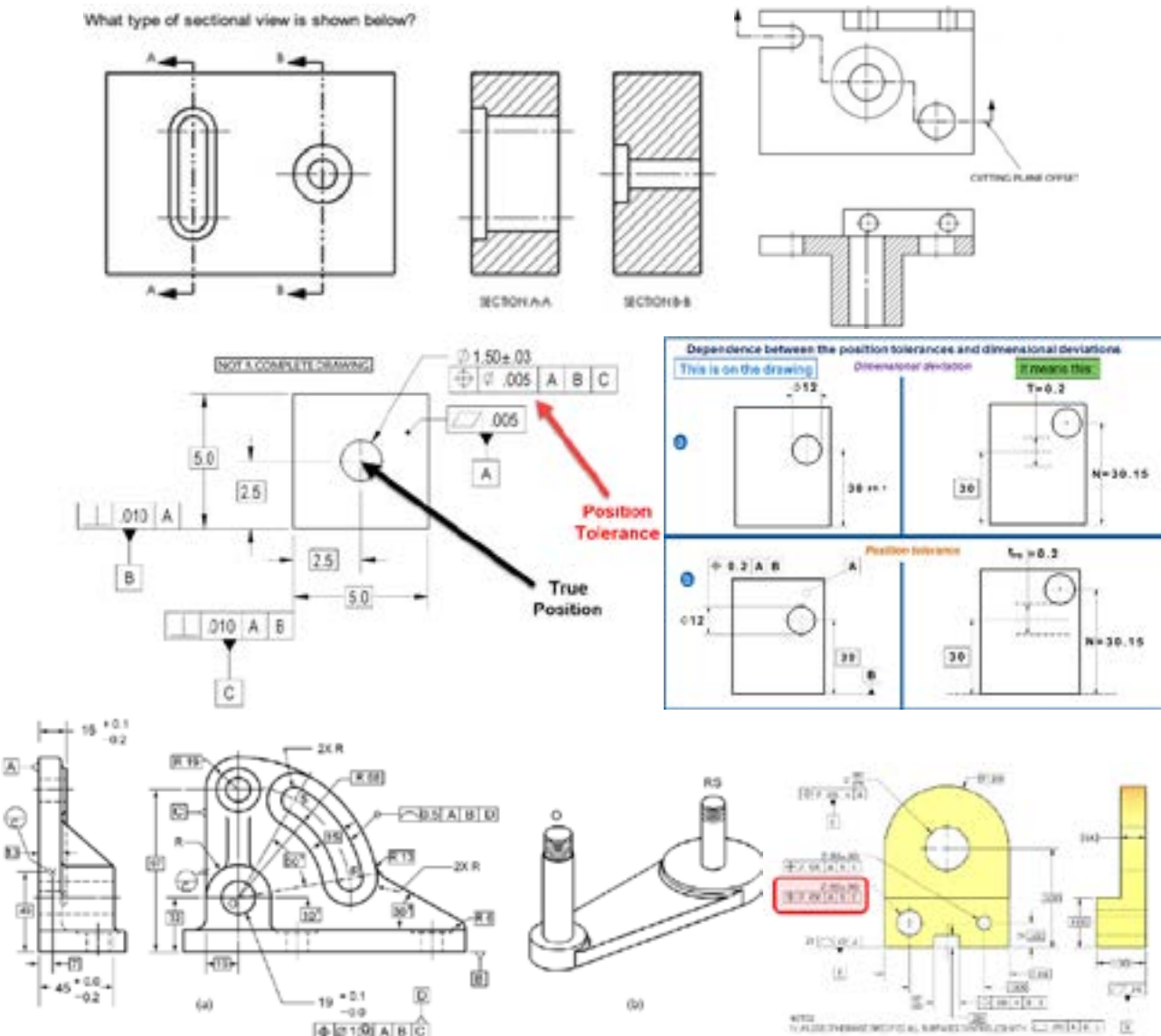


Figure 18.5

Keys and Keyways

Used to connect rotating components like gears to shafts to prevent relative rotation.

They are not sectioned

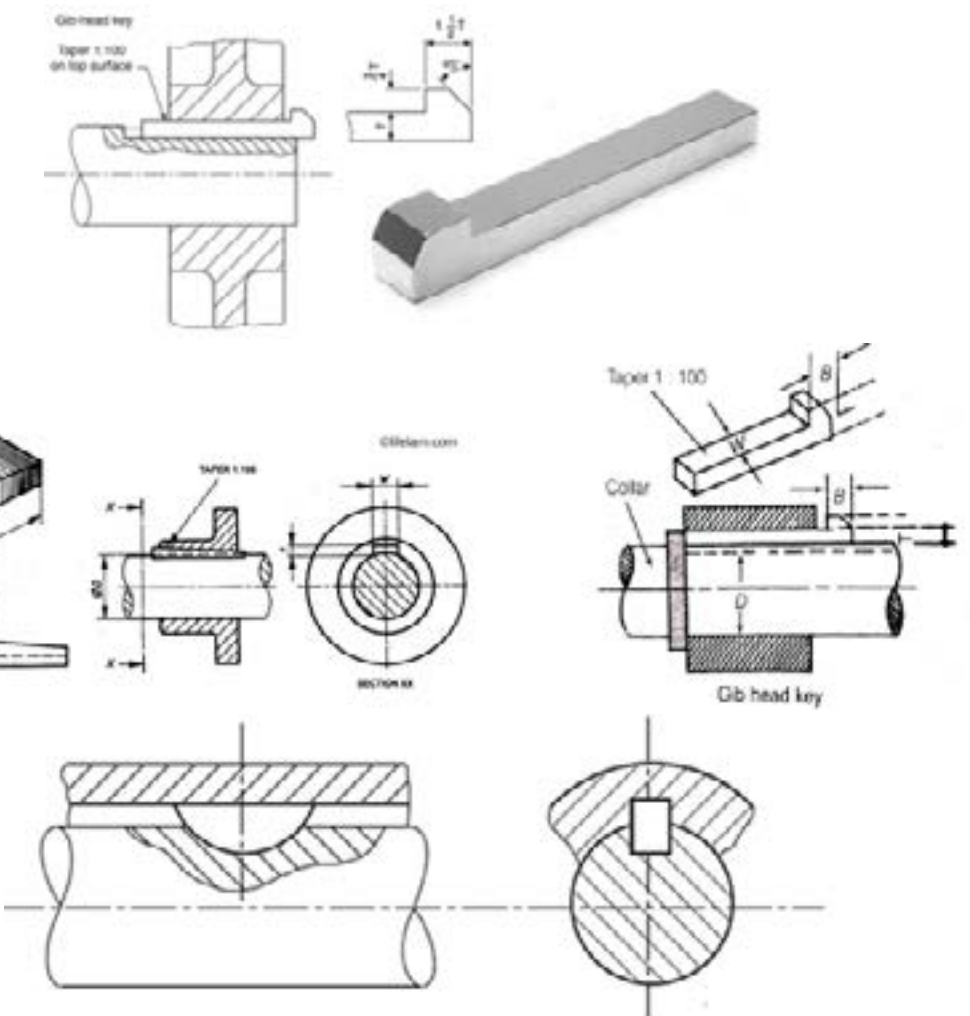
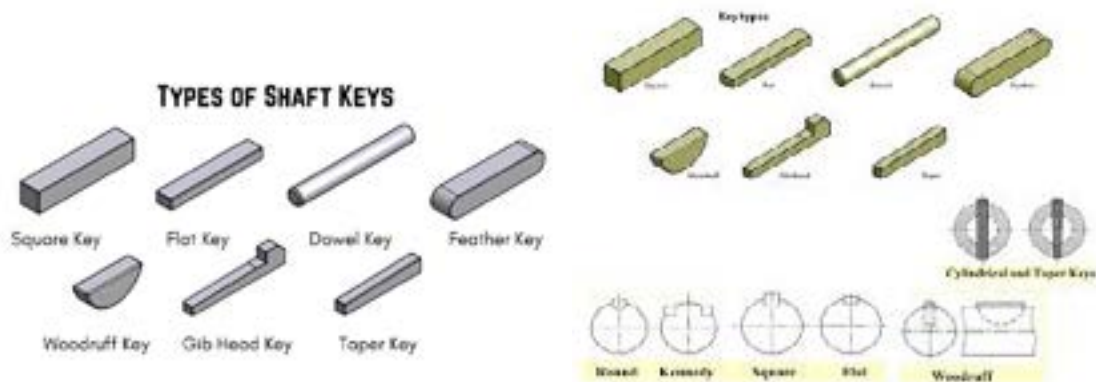


Figure 18.6

BOLTS AND NUTS

A. Bolts

Bolt Representation

Bolts (externally threaded fasteners) are shown with the thread profile; in sectional views, the bolt threads are clearly depicted on the cut side and overlay the mating part's seat. Their head (e.g., hexagon, socket cap) appears in correct geometric form, often simplified to fit the drawing scale.

Hatching Rules

In assembly drawings, even if the cutting plane passes through the bolt, it is not hatched. Instead, the surrounding material is hatched to indicate solid, while the bolt remains clear to show it is a separate component.

B. Nuts

Nut Representation

Nuts (internally threaded fasteners) are displayed in their true hexagon or square head shape. Their internal thread detail is simplified or omitted in many cases for clarity, especially when part of an assembly.

Hatching

Nuts behave like bolts in drawings: when included in an assembly section, they are shown without hatching, even though they are technically inside the section. Sectional Joint Detail

Thread Interaction

In a sectional view of a bolt–nut assembly, the bolt’s external threads are drawn over the mating hole, but the hole’s internal threads are usually not shown.

Half-Section Illustration

A half-section is often used (as shown in the image): one half is cut (hatched background), and the bolt and nut threads are visible in detail. On the uncut half, the exterior profiles are shown.

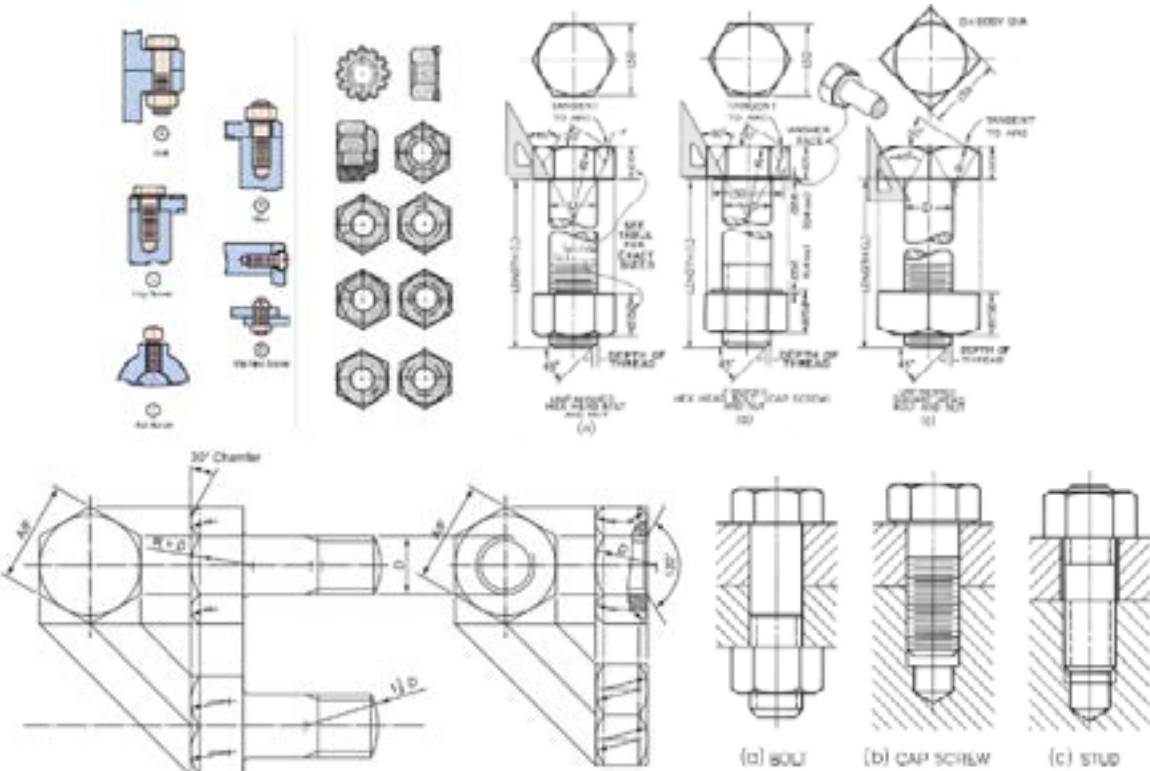


Figure 18.7

FASTENER LOCKING

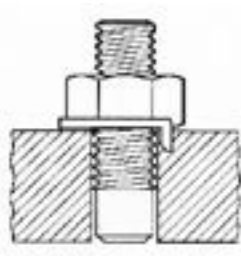
Fasteners are locked to prevent loosening under vibration or stress, both sectional views and assembly drawings use clear, standard conventions. The following shows the methods of locking fasteners and their standard conventions.

a. Locking Washers (e.g., Tab or Lock Washer)

Tab washers are drawn as thin washers beneath the bolt head or nut.

After tightening, one or more tabs are lifted (“bent up”) against the flats of the bolt or nut, locking it in place.

In section views, the washer is hatched like solid material, and the bent tab is shown pressing up against the bolt or nut.



b. Lock Nuts and Self-Locking Nuts

A lock nut (e.g., nylon-insert or serrated nut) is drawn in the assembly without special hatch lines; it’s shown unhatched to indicate it’s a separate part.

Internal locking features (such as a nylon ring) aren’t usually detailed, only indicated by notes or callouts (e.g., “nylon insert”).

c. Castle Nuts and Split Pins (Cotter Pins)

Castle nuts feature radial slots and are paired with a split pin inserted through a cross-drilled bolt.

In sections, the nut slots and pin are clearly drawn, with the pin hatched if it lies on the cut plane. This provides a visual lock that resists rotation.

d. Thread-Locking Clips or Nuts with Tines

Some nuts use small spring tabs or tines that engage notches in the bolt threads. In assembly views, you’d see the nut plus tabs or clips, with tines embedded in bolt notches to show direction-limited rotation.

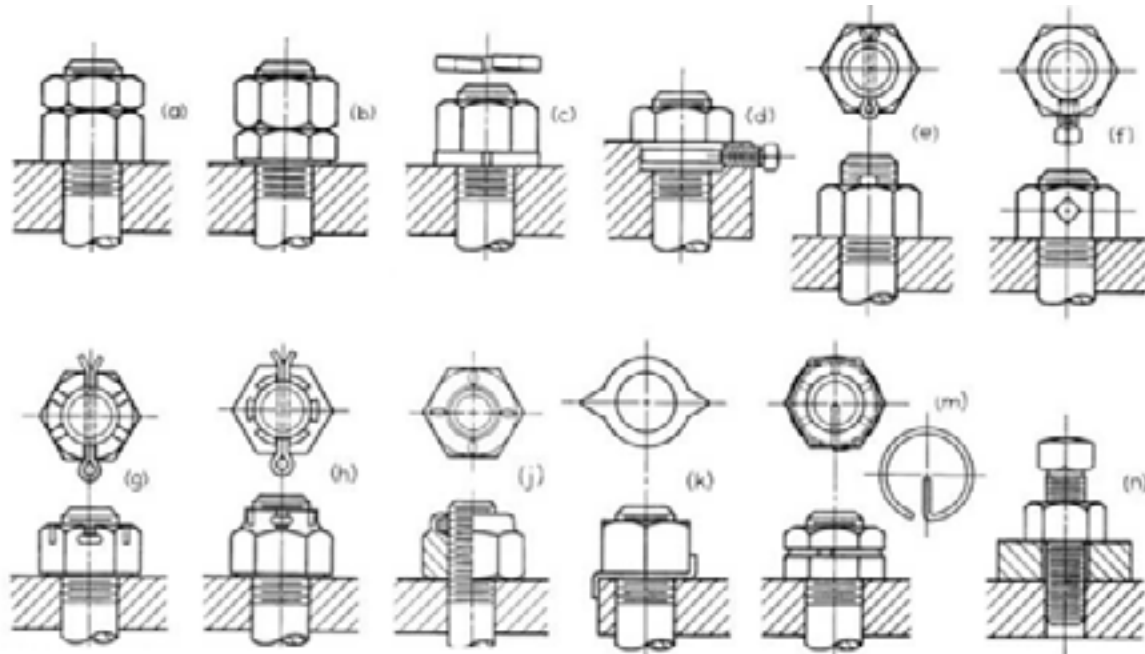


Figure 18.8

Lock Nut Types

1. **Regular Unfinished Jam Nut (Amer Std):** A thin nut used as a lock when jammed against a standard nut.
2. **Regular Semi-Finished Jam Nut (Amer Std):** Similar to (a) but partially machined for finer fit.
3. **Wing Nut:** Features wings for hand tightening; self-locking when hand-tightened.
4. **Set-Screw Lock Nut:** A standard nut with an integrated set screw to lock it in place.
5. **Slotted Nut with Cotter Pin:** A hex nut with slots cut into it, secured by a cotter pin for positive locking.

- 6. **Lock Nut with Locking Plate:** A nut paired with a locking plate (or tab washer) bent over to prevent rotation.
- 7. **Finished Slotted Nut (Amer Std):** Precisely machined slotted nut secured via cotter pin.
- 8. **Finished Castle Nut (Amer Std):** Similar to slotted nut but with castellations; uses cotter pin for locking.
- 9. **ESNA Stop Nut:** A nut with a nylon or resin insert providing prevailing torque for self-locking.
- 10. **Tab Nut (Press-On Lock Nut):** Incorporates tabs that engage the flats of the bolt to prevent loosening.
- 11. **Serrated Lock Nut:** Features serrations on the bearing surface that bite into the mating surface.
- 12. **Prevailing-Torque Nut (e.g., Nyloc):** Contains a deformed top section or insert that provides frictional locking.

Putting It All Together in Drawings

Locking Method	Section Drawing	Assembly Drawing
Tab Washer	Washer hatched, tab bent up	Side view with bent tab
Lock Nut	Nut unhatched, noted locking	Shows nut, distinct from material
Castle Nut + Pin	Nut slots & pin visible, pin hatched if cut	Clear depiction with pin through bolt
Clip/Tines	Clip shown, tines in bolt notches	Shows engagement of threads

Rivets in Assembly and Sectional Views

A rivet is a permanent fastener. It's like a metal pin that holds two or more plates together by deforming one or both ends so it can't come out. Rivet has a cylindrical rod with a head and a shank (the straight body that goes through holes)

Types of

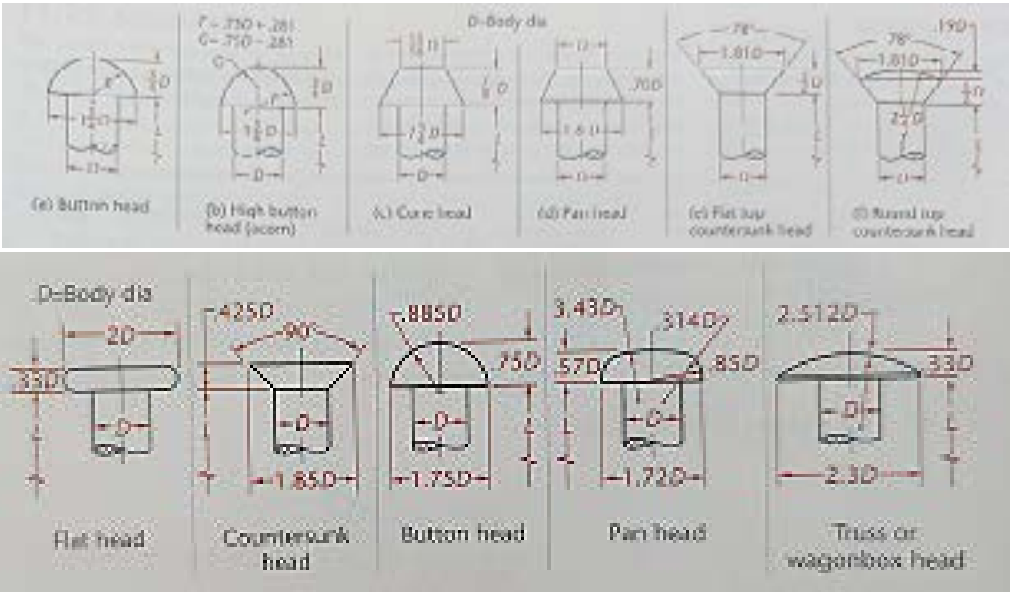


Figure 18.9

Rivet in Assembly Drawing

When doing an assembly drawing, show the rivet in position, joining the parts. Visible lines are used to indicate the rivet head and shank. Hidden lines are used to show the shank inside the plates if the view doesn't cut through.

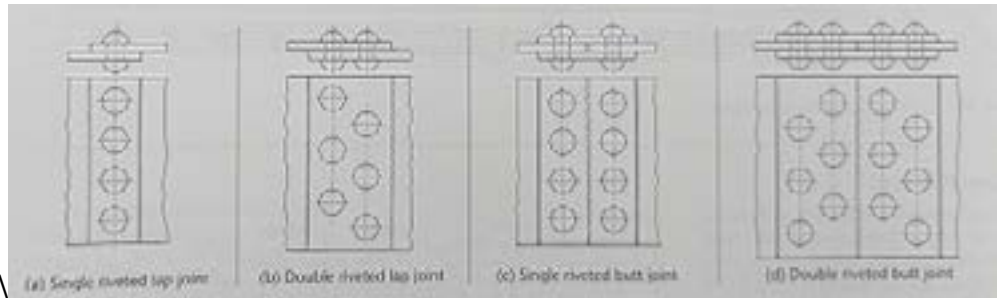


Figure 18.10

Rivet in Sectional View

Sectional views are very useful for showing how a rivet passes through parts.

In a section, show the rivet cut in half, so you can see the shank inside the plates, the formed tail end (flattened) and the head on the opposite side. Hatching is applied to the plates but not to the rivet.

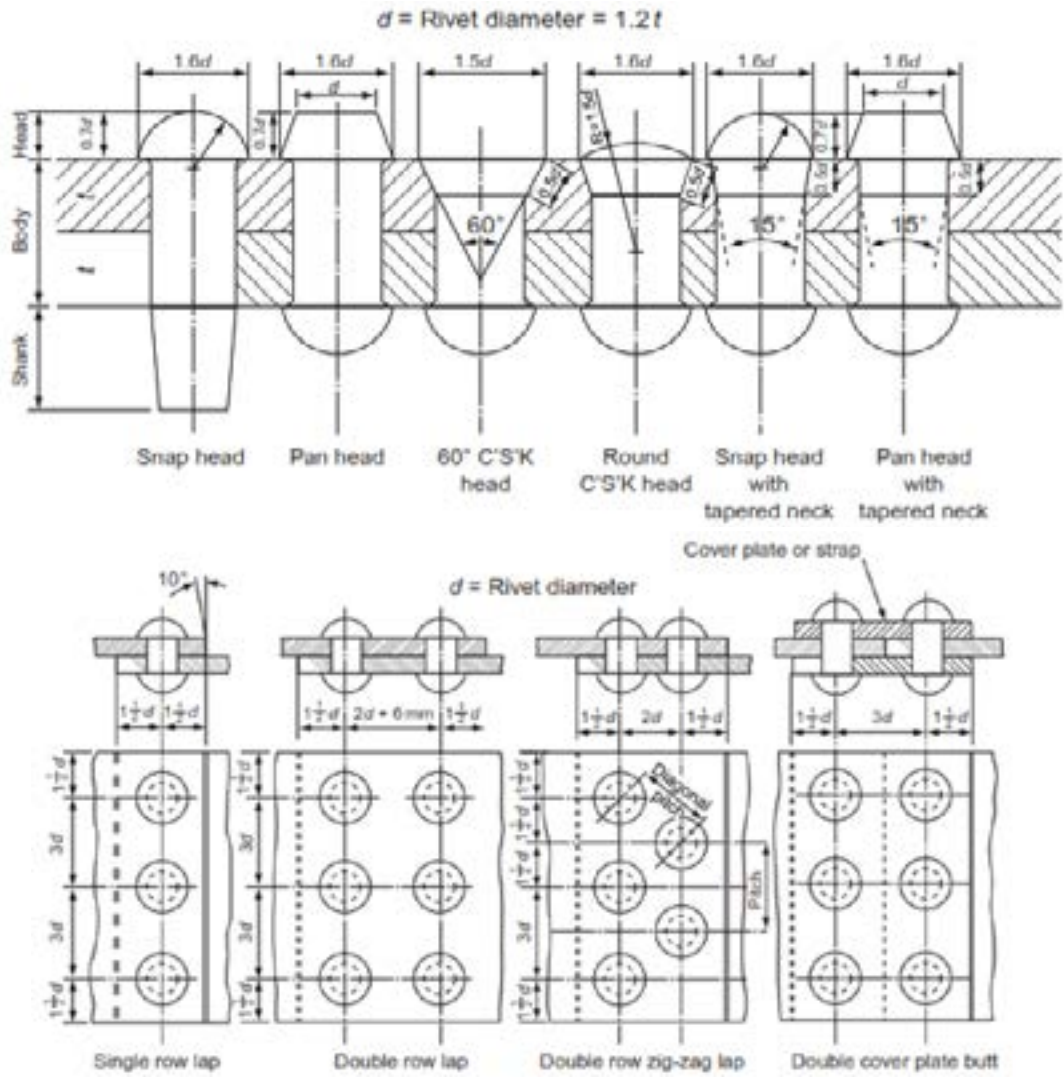


Figure 18.11

Learning Task

Interpreting component drawings for assembly.

Pedagogical Exemplars

Experiential learning: provide learners with bolts and nuts, rivets, screws, washers and components that have been fastened together for learners to interact with during the lesson.

Collaborative Learning/Managing talk for learning: Learners in groups identify holes, shafts, slots, keys, keyways and bolts & nuts

Research-based Learning, Activity-based learning: learners in their groups surf the internet for the components identified and how they are presented in sections and assembly drawing (YouTube videos would be preferred). Learners sketch their findings with notations.

Key Assessment: Practice Paper 2

Question

Look at the sectional drawing provided carefully.

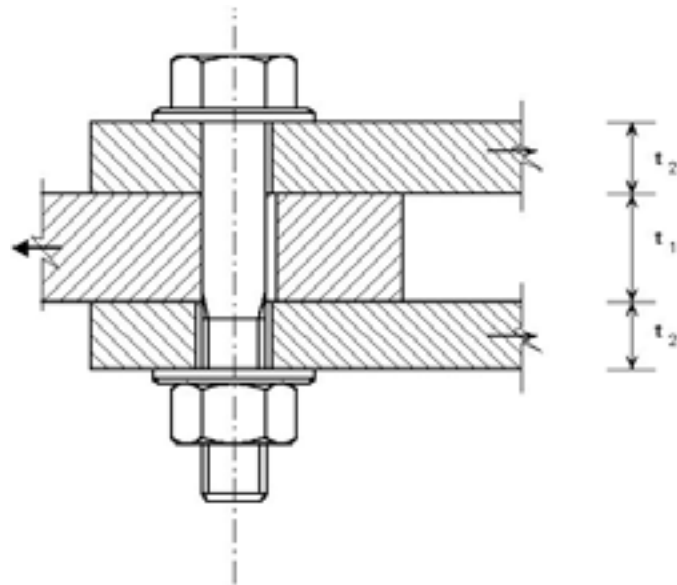


Figure 18.12

Task

Analyse the drawing and answer:

- I. Describe step by step how you know which parts are solid material and which are fasteners.
- II. Explain why the bolt, nut, and washer are drawn without hatching,
- III. What is the role of fasteners in the assembly

Hint



Conduct Practice Paper 2. It should cover the contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section to guide you. Learners' papers should be marked immediately and scores entered into the SAP.

PLC Session 18

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
 - a. The key assessment for the week is **practice paper 2**. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the practice (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through the problem individually for 3–4 minutes
 - c. the group then works through it together the problem, step by step
 - d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 19

Learning Indicator: Prepare an assembly drawing from components

FOCAL AREA: CREATING ASSEMBLY LAYOUTS

In the previous lesson, learners focused on drawing component parts how they are properly represented in assembly drawing and sections. Learners will build upon their understanding of individual component drawings to organise and communicate how parts fit and function together. Learners will be guided to select appropriate datum features and reference planes to establish a clear spatial framework, then choose the most effective views, orthographic, exploded or sectional to reveal assembly relationships and hidden details. Through precise sketching, they learn to orient each component correctly, label key features, and present a coherent assembly drawing that guides fabrication and inspection.

Assembly drawing

A drawing that shows the various parts of a machine in their correct working locations in an assembly drawing.

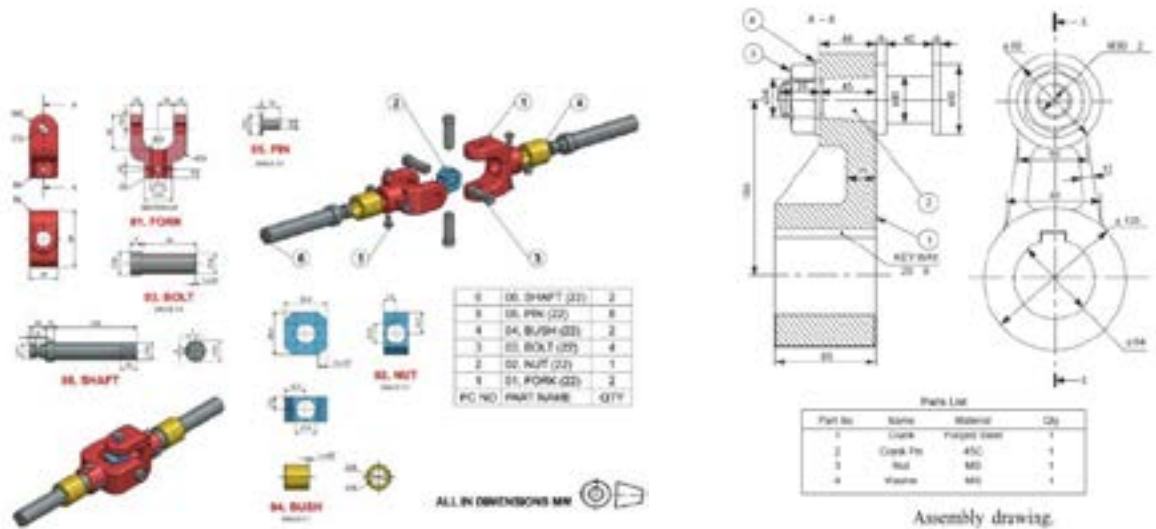


Figure 19.1

Types of assembly drawings

Design Assembly Drawing

When a machine is designed, an assembly drawing or a design layout is first drawn to clearly visualise the performance, shape and clearances of various parts comprising the machine.

Detailed Assembly Drawing

It is usually made for simple machines, comprising of a relatively smaller number of simple parts. All the dimensions and information necessary for the construction of such parts and for the assembly of the parts are given directly on the assembly drawing. Separate views of specific parts in enlargements, showing the fitting of parts together, may also be drawn in addition to the regular assembly drawing.

Sub- Assembly Drawing

Many assemblies such as an automobile, lathe, etc., are assembled with many pre-assembled components as well as individual parts. These pre-assembled units are known as sub-assemblies. A sub-assembly drawing is an assembly drawing of a group of related parts, that form a part in a more complicated machine. Examples of such drawings are: lathe tail-stock, diesel engine fuel pump, carburettor, etc.

Installation Assembly Drawing

On this drawing, the location and dimensions of few important parts and overall dimensions of the assembled unit are indicated. This drawing provides useful information for assembling the machine, as this drawing reveals all parts of a machine in their correct working position.

Assembly Drawings for catalogues

Special assembly drawings are prepared for company catalogues. These drawings show only the pertinent details and dimensions that would interest the potential buyer.

Exploded Assembly Drawing

In some cases, exploded pictorial views are supplied to meet instruction manual requirements. These drawings generally find a place in the parts list section of a company instruction manual. In exploded views, the parts are positioned in the sequence of assembly, but separated from each other.

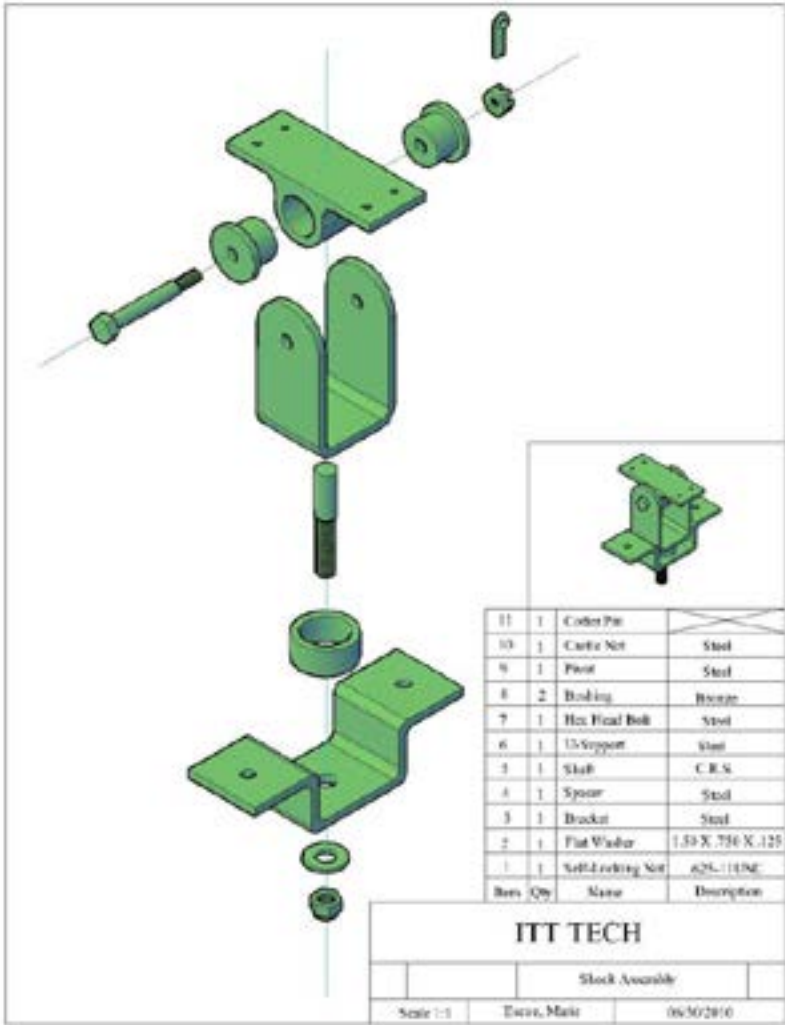


Figure 19.2

Assembly Drawings for instruction manuals

These drawings in the form of assembly drawings, are to be used when a machine, shipped away in assembled condition, is knocked down in order to check all the parts before reassembly and installation elsewhere. These drawings have each component numbered on the job.

Schematic Assembly Drawing

It is very difficult to understand the operating principles of complicated machinery, merely from the assembly drawings. Schematic representation of the unit facilitates easy understanding of its operating principle. It is a simplified illustration of the machine or of a system, replacing all the elements, by their respective conventional representations.

Machine Shop Drawing

Rough castings and forgings are sent to the machine shop for finishing operation. Since the machinist is not interested in the dimensions and information of the previous stages, a machine shop drawing frequently gives only the information necessary for machining. Based on the same principle, one may have forge shop drawing, pattern shop drawing, sheet metal drawing, etc.

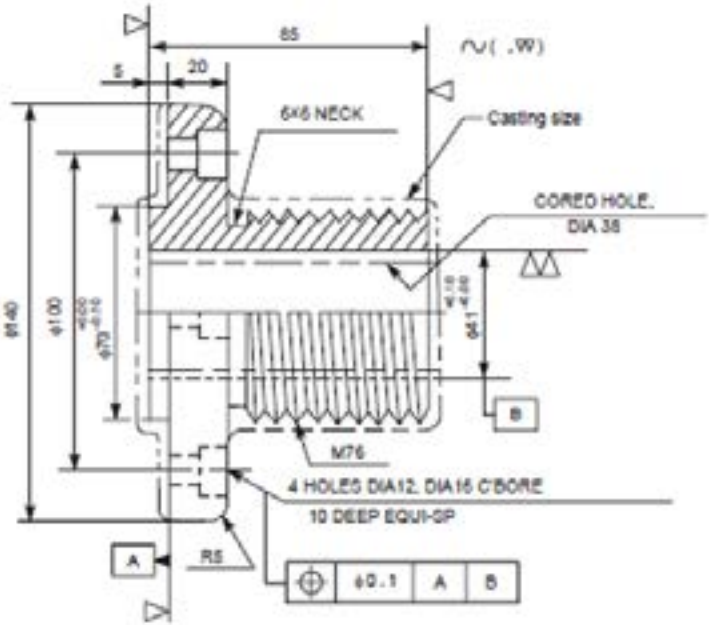


Figure 19.3

Patent Drawing

When new machines or devices are invented, patent drawings come into existence, to illustrate and explain the invention. These are pictorial drawings and must be self-explanatory. It is essential that the patent drawings are mechanically correct and include complete illustrations of every detail of the invention. However, they are not useful for production purposes. The salient features on the drawing are numbered for identification and complete description.

Reference Planes & Datums

Reference Plane

A reference plane is an imaginary, perfectly flat surface from which measurements, orientations and views are established in an assembly drawing. It serves as a primary organising datum: all parts are aligned relative to this plane to ensure consistent positioning. In practice, you might choose a principal face or a plane through key features (e.g., the mounting face of a bracket) as your reference plane.

Datum

A datum is a defined point, line or plane on a component that acts as the origin for all dimensions and tolerances. Datums establish the part’s orientation and location within an assembly. Follow the link to learn more about datums <https://www.youtube.com/watch?v=PLnMkcYywVA>



Primary Datum: Constrains movement along three axes (X, Y, Z) and is used to fully locate the part.

Secondary Datum: Constrains movement along two axes, orienting the part around the primary datum.

Tertiary Datum: Constrains movement along the final axis, fully fixing the component in space.

Areas to consider when selecting a datum

- a. Functional surfaces.
- b. Mating surfaces.
- c. Readily accessible surfaces.
- d. Surface of sufficient size to allow repeatable measurements.

By selecting clear reference planes and datums, you create a common framework that ensures every component is drawn and manufactured to fit precisely in the assembly.

View Selection

Assembly drawing can be made in orthographic projection, exploded view, and sectional view, depending on what one is looking for.

- a. Orthographic: Best for dimensioning standard features.
- b. Exploded: Shows component relationships and assembly sequence.
- c. Sectional: Reveals hidden interfaces and fit-up details.

Sketching Techniques

Use light construction lines for datum axes.

Break lines and cutting plane symbols must be clearly indicated.

Label each component and datum feature with reference letters/numbers.

Examples of assemble drawings

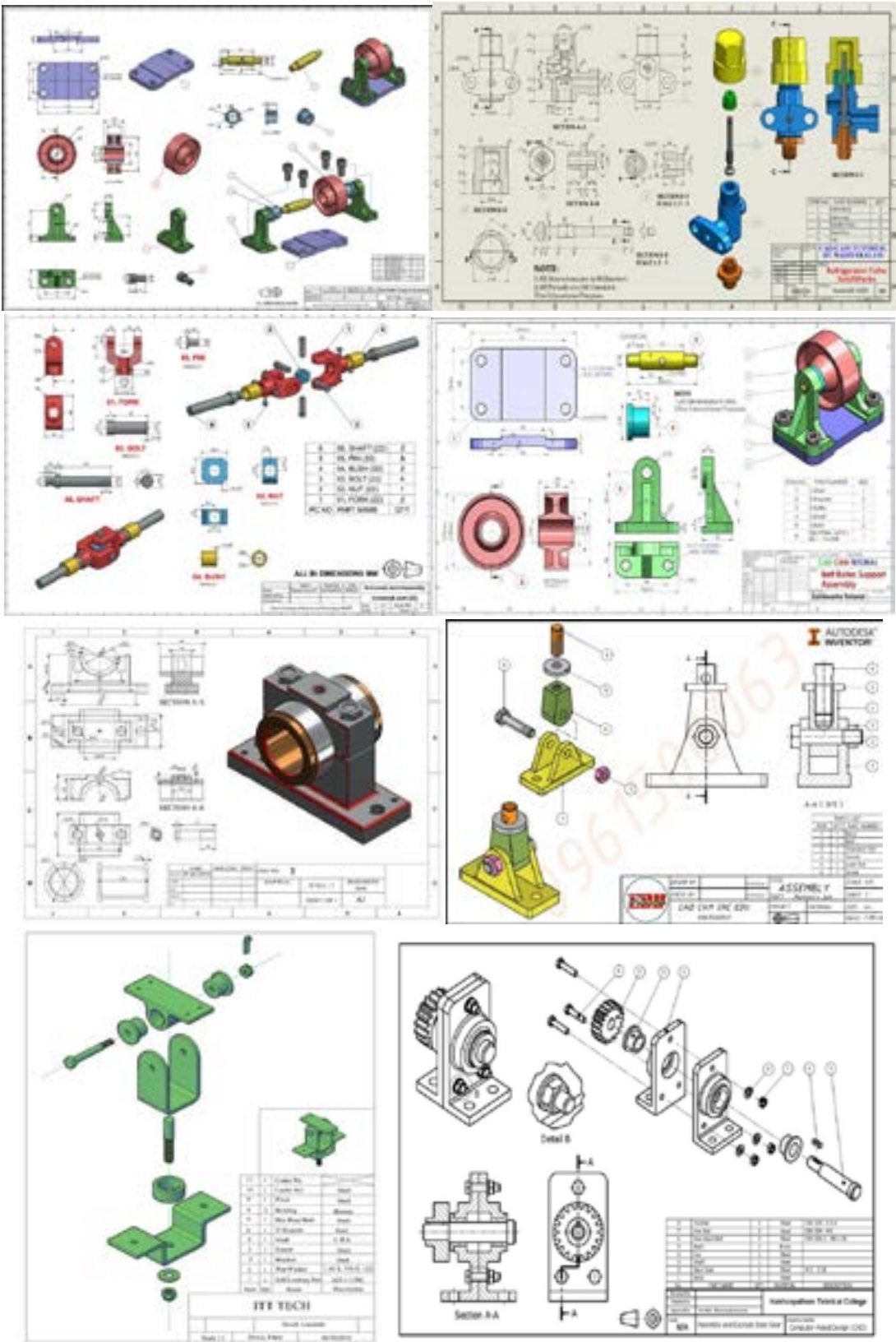


Figure 19.4

Learning Task

Prepare assembly drawing from component parts

Pedagogical Exemplars

Activity-based learning (think-pair-share) – pose a question to the learners: for example, which view best reveals the details of a specific object and why? Give learners some two minutes to jot down their responses, turn to their neighbour to compare answers, agree and share with the rest of the class.

Problem-based learning - Learners tackle an open-ended, real-world problem in small teams

Scenario: Present a “broken” exploded drawing of a simple pump assembly where two parts are mis-aligned and fasteners omitted.

Task: In groups of three, diagnose what’s wrong—identify missing datums, incorrect view choice, or mis-orientation—and propose corrections.

Reporting Back: Each team sketches their corrected layout and explains how establishing the proper datum plane and view choice solved the assembly issue.

Jigsaw Method: Each learner becomes an “expert” on one area, then teaches it to peers.

Divide the content of the lesson into smaller areas, such as selecting primary and secondary datums, exploded vs sectional view conventions, etc., and assign these areas to learners in groups as experts to master those areas. Let “expert” groups work on their specified areas for 5 minutes. Re-form mixed groups with one expert from each area. Each expert teaches their peers (3 minutes each), so every student learns all facets before doing the guided practice.

Key Assessment Level 4: Individual Classwork

The object below is a belt roller support drawn in an exploded view. Observe it and answer the questions that follow.

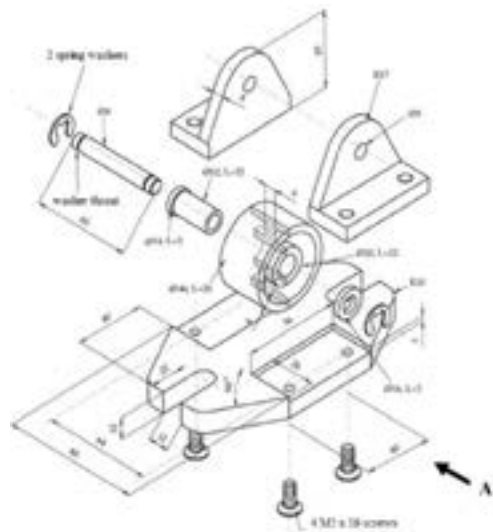


Figure 19.5

Task

Draw in full size the assembly drawing of the Belt Roller Support in first-angle orthographic projection showing the;

- a. Front view in the direction of arrow A
- b. Plan
- c. Left and view.

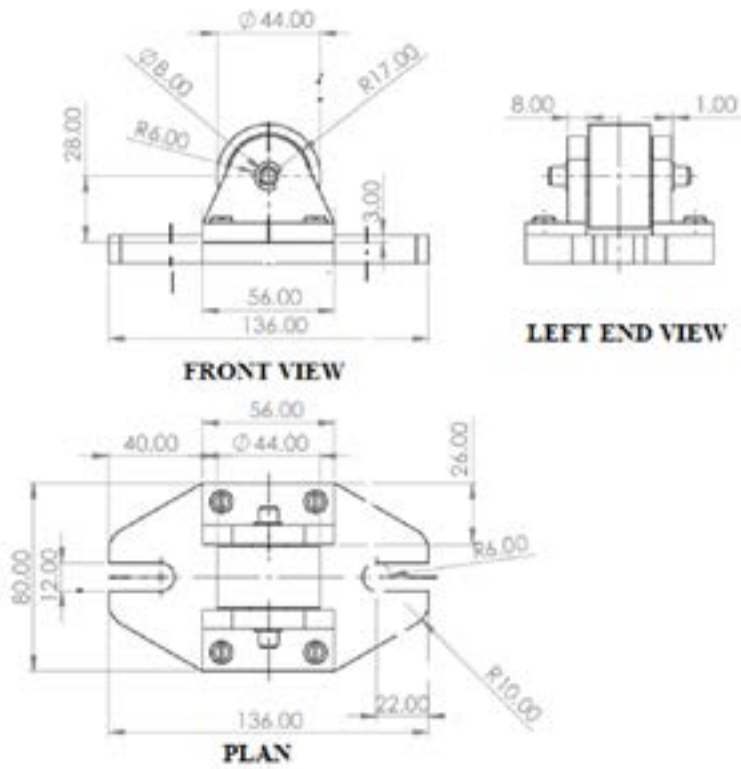


Figure 19.6

MARKS ALLOCATION

A. FRONT ELEVATION (11 MARKS)

- i. For drawing 3 centre lines (all vertical) using correct line type 1 mark
- ii. For drawing 4 horizontal lines (2 long, 2 short) 1 mark
- iii. For drawing 6 vertical lines (4 on the base, 2 on the bracket) 1½ marks
- iv. For drawing the body of the screws (4 vertical, 2 horizontal) 1½ marks
- v. For drawing the spring washer (an arc of radius 6) mark each 1 mark
- vi. For drawing the shaft (circle of diameter 8) 1mark
- vii. For drawing of 2 inclined lines and an arc of radius 17..... 2 marks
- viii. For drawing the circle of the roller of diameter 44 1 mark
- ix. For writing “FRONT ELEVATION” beneath the drawing 1 mark

TOTAL 11 marks

B. PLAN (16 MARKS)

- i. For drawing 4 centre lines (3 vertical and 1horizontal) using the correct line type 1mark
- ii. For drawing 6 horizontal lines and 6 vertical lines on both the brackets and roller 3 marks
- iii. For drawing 4 horizontal lines and 2 semi-circles of radius 6 2 marks
- iv. For drawing 2 horizontal lines indicating the spring washers 1mark

- v. For drawing 4 vertical lines, 2 horizontal lines and 4 chamfers indicating the shaft extension 3marks
- vi. For drawing 4 inclined lines, 4 arcs of radius 10 and 4 short vertical lines 4marks
- vii. For drawing 2 concentric circles x 4 representing the screws 1 mark
- viii. For writing “PLAN” beneath the drawing 1 mark

TOTAL 16 marks

C. LEFT END ELEVATION (13 MARKS)

- i. For drawing 4 centre lines (1 horizontal and 3 vertical lines) using correct line type 1 mark
- ii. For drawing 2 horizontal and 2 vertical lines on the roller 1 mark
- iii. For drawing the brackets (4 horizontal, 4 vertical lines) 2 marks
- iv. For drawing the shaft (2 horizontal, 2 vertical lines, 4 chamfers and 2 vertical lines representing the spring washers) 4marks
- v. For drawing the screws (4 verticals, 2 horizontals, 4 chamfers) 2 marks
- vi. For drawing the base (1horizontal and 8 vertical) 2 marks
- vii. For writing “LEFT END ELEVATION” beneath the drawing 1 mark

TOTAL 13 marks

D. ADDENDUM (3 MARKS)

- i. For drawing to scale 1:1 1 mark
- ii. For correct placement of drawing in first angle projection 2 marks
- iii. For neatness and quality of line works (or correct complete drawing) 2 marks

TOTAL 5 marks

GRAND TOTAL (11 + 16 + 13 + 5) 45 MARKS

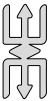
PLC Session 19

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand

- b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).

- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



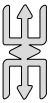
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **individual class exercise**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the exercise (NTS 3k-3q).

10 minutes	Content Exploration
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- 5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 20

Learning Indicator: *Prepare detailed working drawings to scale using appropriate drawing instrument or CAD*

FOCAL AREA: **MANUAL DRAFTING OF WORKING DRAWINGS**

- Learners will use drawing instruments to produce scaled orthographic and sectional views, applying standard hatching, dimensions, and title blocks.
- Emphasis on precision and conventions (BS/ISO).

Working Drawings

A working drawing, also known as an engineering drawing, serves as a detailed blueprint for the production of a component, product, or structure. It provides the precise specifications necessary to manufacture or construct the item accurately. This includes all the dimensions, shapes, materials, tolerances, and assembly instructions needed to guide machinists, fabricators, or construction workers. The purpose of a working drawing is to convey the design intent from engineers or designers to the individuals who will bring the design to life.

Working drawings are typically detailed and precise to ensure that the final product conforms to the desired design. They often contain multiple views of the object, such as front, top, side, and section views, to give a comprehensive representation of its geometry. In addition to these views, they include detailed annotations, such as dimensions, surface finishes, and notes on specific manufacturing processes. They also outline material specifications and any necessary treatments, like heat treatment or coatings.

These drawings follow standardised conventions and symbols to ensure clarity and avoid ambiguity. For example, they use specific line types to differentiate between visible edges, hidden features, and centre lines. Symbols indicate things like types of welds, surface finishes, and geometric tolerances. Adherence to industry standards, such as those set by the American Society of Mechanical Engineers (ASME) or the International Organisation for Standardisation (ISO), is crucial for the effectiveness of working drawings, as this ensures they can be understood universally by professionals in the field.

Manual Drafting of Working Drawings

A Step-by-Step Guide to Producing Scaled Orthographic and Sectional Views

Introduction

Manual drafting is a fundamental skill for engineers, architects, and designers, ensuring precision and adherence to technical drawing standards (BS/ISO). This guide covers the step-by-step process of creating orthographic and sectional views with proper hatching, dimensioning, and title blocks.

Materials and Tools Required

Before starting, ensure you have:

1. Drawing board (with T-square or parallel rule)
2. Drawing paper (A2/A3/A4, depending on project size)

- 3. Pencils (H, 2H for construction lines; HB for final lines)
- 4. Eraser & sharpener
- 5. Set squares (30°/60° and 45°)
- 6. Compass & dividers
- 7. Scale ruler (for scaling drawings)
- 8. French curves (for irregular shapes)
- 9. Protractor (for angular measurements)
- 10. Templates (for standard symbols and shapes)

Step 1: Setting Up the Drawing Sheet

- 1. Select the appropriate sheet size (A2, A3, or A4) based on the complexity of the drawing.
- 2. Fix the drawing sheet onto the board using drafting tape.
- 3. Draw the border lines (typically 10-20mm from the edge).
- 4. Add the title block (bottom-right corner) with:

Drawing title

Scale used

Drafter’s name & date

Company/project name

Revision number (if applicable)

Step 2: Selecting and Applying the Scale

Choose a suitable scale (e.g., 1:1, 1:2, 1:5, 1:10, 1:20, 1:50, 1:100) based on the object size.
BS/ISO standards require clear indication of the scale in the title block.

Step 3: Drawing Orthographic Views

Orthographic projections (front, top, side views) must follow Third Angle Projection (BS 8888:2020) or First Angle Projection (ISO 5456-2) as per requirements.

Steps

- 1. Lightly sketch construction lines (using 2H pencil) to define the main outlines.
- 2. Project lines from one view to another to maintain alignment.
- 3. Draw visible outlines (using HB pencil) with consistent line weights:
 - Thick continuous lines (0.5mm–0.7mm) for visible edges.
 - Thin continuous lines (0.2mm–0.3mm) for construction/extension lines.
- 4. Add hidden details (dashed lines, 2mm dash, 1mm gap) for obscured features.
- 5. Check accuracy using the 45° miter line method for depth consistency.

Step 4: Creating Sectional Views

Sectional views reveal internal features by “cutting” the object.

Steps

- 1. Choose the cutting plane (indicate with a thick dashed line and arrows showing the viewing direction).
- 2. Sketch the sectioned area, removing the front part.
- 3. Apply standard hatching (BS EN ISO 128-50:2001):
 - Hatching lines at 45° (thin, evenly spaced).
 - Different materials may have unique patterns (e.g., concrete, metal).
- 4. Draw visible edges behind the cutting plane.
- 5. Label the section (e.g., “SECTION A-A”).

Step 5: Dimensioning the Drawing

Follow BS 8888:2020 or ISO 129-1:2018 for dimensioning rules.

Key Guidelines:

- Place dimensions outside the view where possible.
- Use aligned or unidirectional dimensioning (consistent throughout).
- Avoid over-dimensioning (only critical measurements).
- Arrowheads should be slim and filled (1:3 ratio).
- Leader lines point clearly to features.

Step 6: Finalising the Drawing

- 1. Review for errors (missing lines, incorrect dimensions).
- 2. Darken final lines (HB pencil or technical pen).
- 3. Erase construction lines carefully.
- 4. Add notes & annotations (e.g., surface finishes, tolerances).
- 5. Sign and date the title block.

Conclusion

Manual drafting requires patience and precision. By following BS/ISO standards, learners can produce professional-quality working drawings with correct orthographic projections, sectional views, and dimensioning.

Additional Tips

- Keep tools clean to avoid smudging.
- Practice line consistency for clarity.
- Refer to BS 8888 or ISO 128 for detailed conventions.

Learning Task

Prepare detailed working drawings to scale using appropriate drawing instrument.

Pedagogical Exemplars

1. Demonstration-Based Learning - Introduce drafting techniques with clear, step-by-step modeling. Use activity like live drafting demonstration. In this activity, the facilitator models how to:
 - Set up a drawing sheet (border, title block).
 - Sketch orthographic views using construction lines.
 - Convert construction lines into final outlines.
 - Apply hatching in sectional views.
 - Dimension according to BS/ISO standards.
2. Guided Practice (Scaffolding) - Scaffold learning with structured exercises, delivering them one after the other. Example
 - a) Provide a simple object (e.g., a mechanical bracket or building block).
 - b) Break drafting into stages:
 - i. Sketch construction lines in groups.
 - ii. Refine into final orthographic views.
 - iii. Add a sectional view with hatching.
 - iv. Apply dimensions.
 - c) Facilitator circulates to provide real-time feedback.
3. Collaborative Learning - Group Drafting Challenge
 - Assign a moderately complex object (e.g., a pulley wheel or simple assembly).
 - Groups of 3-4 students collaborate to:
 - Divide tasks (one student per view: front, side, top, section).
 - Ensure consistency across views.
 - Present final drawing to the class.
 - Encourage discussion: How did they maintain alignment? Were dimensions clear?
4. Real-World Application (Case Study)
Reverse-Engineering a Technical Drawing
 - Provide an existing engineering drawing (BS/ISO compliant).
 - Students analyse:
 - Scale, line types, hatching patterns.
 - Dimensioning standards.
 - Title block information.
 - Task: Identify errors or missing elements and correct them.

Key Assessment Level 4: Group Presentation

Evaluate mastery of manual drafting

Learners prepare a full Technical Drawing Portfolio that consists of:

- Orthographic views of an assigned object.
- A sectional view with hatching.
- Fully dimensioned drawing with title block.
- Graded against BS/ISO standards (precision, conventions).

Extension: Compare manual drawings to CAD versions for discussion on pros/cons.



Note

For beginners: Provide pre-drawn construction lines to trace.
For advanced students: Introduce auxiliary views or exploded diagrams.
Multimodal support: Video tutorials on hatching techniques.

PLC Session 20

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app

- a. The key assessment for the week is **group presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes

Content Exploration

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
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- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
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5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

- a. transfer your chats into your learning planner template.
- b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
- c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 21

Learning Indicator: Prepare detailed working drawings to scale using appropriate drawing instrument or CAD

FOCAL AREA: CAD MODELLING AND PLOTTING OF WORKING DRAWINGS

Using CAD Software to Generate Accurate 2D Drawings from 3D Models

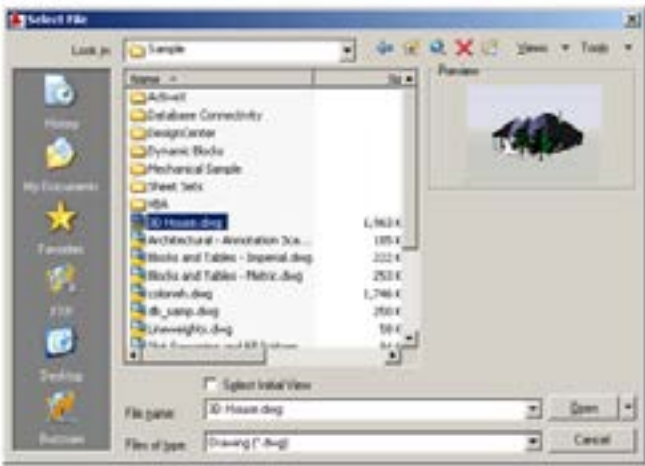
Step 1- Import a 3D Model

Procedure

- a. Open your CAD software (AutoCAD).
- b. Import an existing 3D model file (e.g., `.STEP`, `.IGES`).

Example

- 1. File
- 2. Open
- 3. Select a 3D model.



Step 2 – Orient and Create 2D Views

Procedure

- a. Generate the required orthographic views (front, top, right side) and any sectional views.
- b. Align views properly.
- c. Add an isometric view for clarity if needed.

Example

Use `VIEWBASE` command to generate views automatically from 3D.

<https://youtu.be/Sz2iMcdEhOY?si=7xfZb9M3YUQmP9kO>



<https://youtu.be/05k4p4IIXqo?si=LGIQcxcN0dN9KhtK>



Step 3 – Add Dimensions and Annotations

Procedure

- a. Apply linear, angular, and diameter dimensions.
- b. Use notes, symbols, and tolerances where necessary.
- c. Ensure dimension styles are consistent.

Example

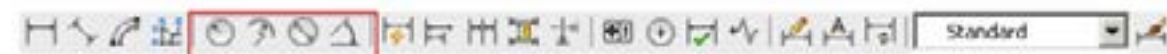
Use `DIMLINEAR`, `DIMDIAMETER`, `TEXT` commands.



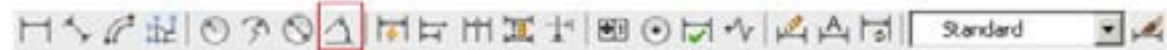
Aligned



Radius or diameter



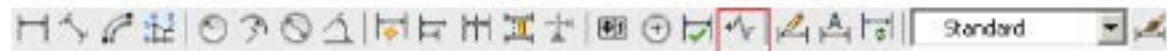
Angular dimension



Continue or Baseline dimension



Leader dimension



Apply Correct Units, Layers, Line Types, and Export for Printing/Plotting

Step 1 – Set Drawing Units

Procedure

- a. Confirm that the drawing uses millimetres.
- b. Adjust units accordingly.

Example

`UNITS` command set to `millimetres`.

Step 2 – Organise Layers

Procedure:

- a. Create and assign layers for:

- 1. Visible edges
- 2. Hidden lines



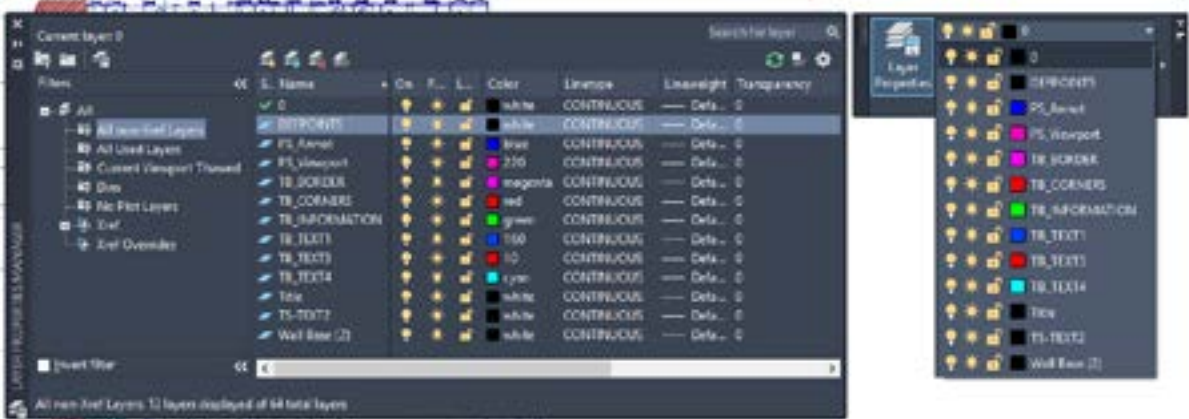
- 3. Centre lines
- 4. Dimensions
- 5. Annotations
 - b. Set appropriate colours and line types.



Example
`Layer Properties Manager`
Create layers

- 0 - Visible` (continuous line)
- 1 - Hidden` (dashed line)
- 2 - Centre` (centre line)
- 3 - Dimensions` (continuous line)

Assign colours (e.g., blue for hidden, green for centre lines).



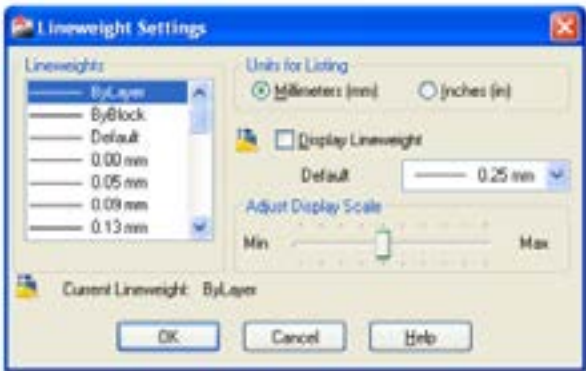
Step 3 – Apply Line Types and Weights

Procedure

Assign line types to each layer:
Visible – Continuous
Hidden – Dashed
Centre – Centre line



Set line weights (thickness):
E.g., Visible lines = 0.5 mm, Hidden lines = 0.3 mm.
Example
Properties` palette to set line weights.



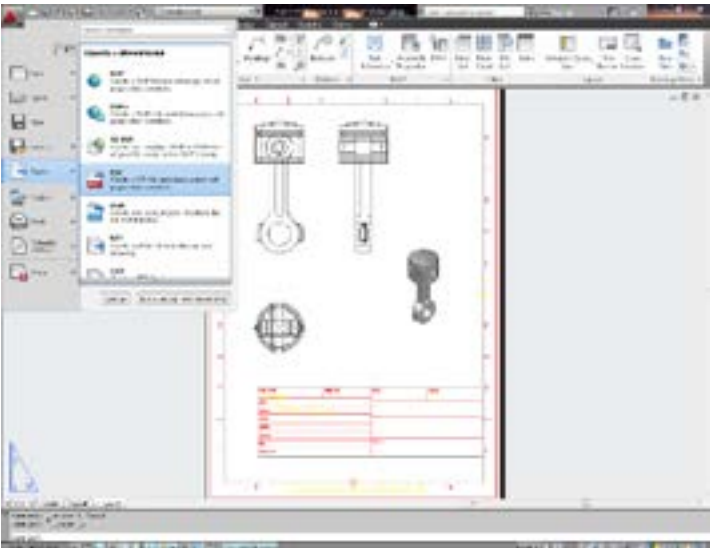
Step 4 - Export Drawing for Plotting

Procedure

- a. Save the drawing in a suitable format (`DWG`, `DXF`, `PDF`).
- b. Prepare the file for printing or digital sharing.

Example

- 1. `PLOT` command > choose printer/plotter > select paper size.
- 2. Export as PDF: `EXPORTPDF`.



Set up Sheet Sizes, Viewports, and Line Weights

Step 1 – Define Sheet Size

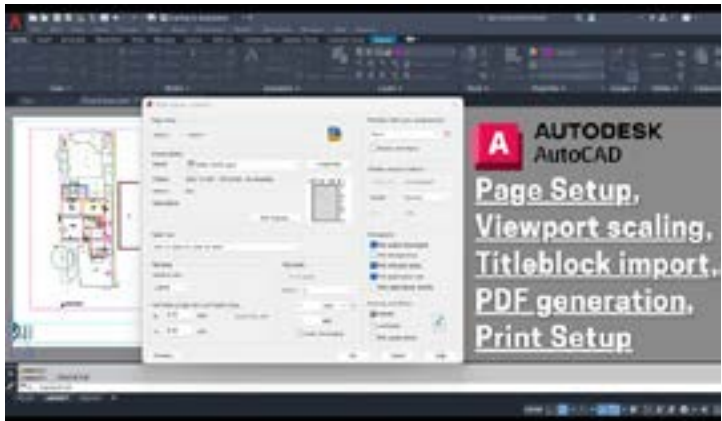
Procedure

- a. Choose appropriate paper size (A3, A2, A1).
- b. Set margins and title block.

Example:

`Layout` tab > `Page Setup Manager` > Modify > choose A3.

https://youtu.be/tOHGb8Ay_Ls?si=W8VyyQ4_6BRBwlSs



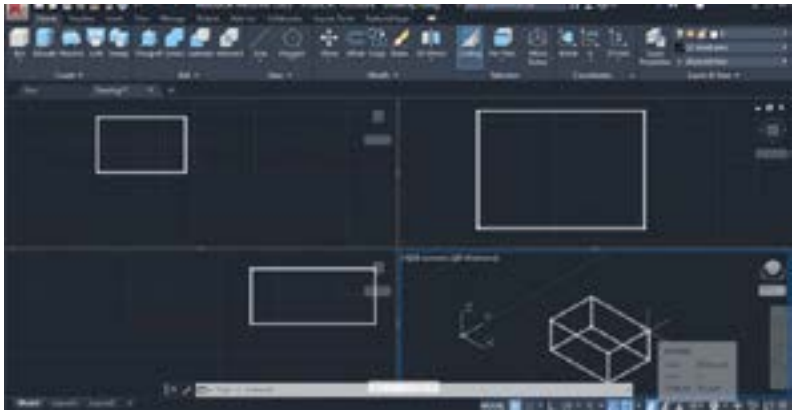
Step 2 – Create Viewports

Procedure

Insert viewports in the paper space to display different views.

Example

`Layout` tab > `Layout Viewports` > `Rectangular` > draw viewport.



Step 3 – Assign View Scales

Procedure

Set scales for each viewport:

e.g., 1:1, 1:2, 1:5 depending on the component size.

Example

Select viewport > Properties > Standard Scale > select 1:2.

Step 4 – Check and Adjust Line Weights

Procedure

- a. Preview how line weights will look when plotted.
- b. Adjust if necessary.

Example

1. `Plot` > `Preview` to see line weight representation.
2. Practical Example: Create and Plot a Bracket Drawing

Learning Tasks

1. Learners will use CAD software to generate accurate 2D drawings from 3D models, apply correct units, layers, line types, and export for printing/plotting.
2. Includes setting up sheet sizes, viewports, and line weights.

Pedagogical Exemplars

Demonstration and Guided Practice

- Begin with a teacher demonstration of the complete CAD workflow from model to working drawing
- Use screen sharing/projection to show each step in real-time
- Provide a digital handout with screenshots of key commands and processes
- Have students follow along on their own computers, completing each step after demonstration
- Build in checkpoints where students verify their progress before moving to the next step

Differentiation

Provide pre-recorded video segments for students to review at their own pace.

Create tiered instruction sheets (basic, intermediate, advanced) for different ability levels

Worked Example and Completion Tasks

- Provide students with a partially completed CAD model and working drawing
- Clearly identify which elements students need to complete
- Progress from simple completion tasks (adding dimensions) to more complex ones (creating missing views)
- Include deliberate errors for students to identify and correct
- Gradually reduce scaffolding as students demonstrate competence

Differentiation

Vary the percentage of completion based on student ability

Provide hint cards for students who need additional support

Collaborative Peer Teaching

- Organise students into pairs with complementary strengths
- Assign specific CAD functions for each pair to master (e.g., sectioning, dimensioning, viewport creation)
- Have pairs create a brief tutorial on their assigned function
- Conduct a “knowledge exchange” where pairs teach their function to others
- Conclude with a collaborative drawing task requiring all functions

Differentiation

Strategically pair students to balance technical skills and communication abilities

Provide expert role cards to give less confident students structured ways to contribute

Key Assessment Level 4: Group Presentation

Title: Mechanical Component Technical Documentation Package

Total Marks: 100 Time Allocation: 3 hours Assessment

Component Description

Students will work with a provided 3D model of a **mounting bracket assembly** consisting of:

- Main bracket body with mounting holes
- Reinforcement ribs
- Countersunk holes for fasteners
- Curved support surface

Specific Requirements and Mark Allocation

1. Model Analysis and Setup (10 marks)

- **Open and analyse the model (2 marks)**
 - Identify all key features that need to be documented
 - Note critical dimensions and relationships
- **Set drawing units and precision (3 marks)**
 - Set units to millimetres
 - Set linear precision to 0.1mm
 - Set angular precision to 0.1°
- **Create layer structure (5 marks)**
 - Create and name the following layers:
 - VISIBLE (color: continuous black, linewidth: 0.7mm)
 - HIDDEN (color: blue, linewidth: 0.35mm, linetype: dashed)
 - CENTRE (color: red, linewidth: 0.25mm, linetype: centre)

- DIMENSION (color: green, linewidth: 0.25mm)
- TITLE (color: magenta, linewidth: 0.5mm)
- VIEWPORTS (color: gray, linewidth: 0.25mm)

2. View Generation (20 marks)

- **Front elevation (4 marks)**
 - Correctly oriented showing primary mounting face
 - All visible edges shown
 - All hidden details shown with appropriate line type
- **Top plan (4 marks)**
 - Correctly aligned with front elevation
 - All visible edges shown
 - All hidden details shown with appropriate line type
- **Side elevation (right) (4 marks)**
 - Correctly aligned with front elevation
 - All visible edges shown
 - All hidden details shown with appropriate line type
- **Isometric view (4 marks)**
 - Set at 30°/30° angles
 - All visible edges only (no hidden lines)
 - Positioned to show key features clearly
- **View alignment and projection (4 marks)**
 - First angle projection symbol included
 - Views correctly positioned according to first angle projection
 - Consistent scale across orthographic views

3. Line Work and Visibility (15 marks)

- **Visible lines (4 marks)**
 - Continuous line type (0.7mm)
 - Applied consistently to all visible edges
 - Corners properly joined with no overshoots or undershoots
- **Hidden lines (4 marks)**
 - Dashed line type (0.35mm)
 - Applied consistently to all hidden features
 - Proper spacing and dash length

▷ **Centre lines (4 marks)**

- Centre line type (0.25mm)
- Applied to all holes, cylindrical features and axes of symmetry
- Extended appropriate distances beyond features

▷ **Line weights and hierarchy (2 marks)**

- Clear visual hierarchy between line types
- Consistent application throughout drawing

▷ **Line work consistency (1 mark)**

- Uniform quality across all views
- No duplicate or missing lines

4. Dimensioning (20 marks)

▷ **Overall dimensions (5 marks)**

- Length, width, and height of the complete bracket
- Dimensions placed outside the views where possible
- Appropriate extension and dimension lines

▷ **Feature locations (5 marks)**

- Position of mounting holes from datums
- Location of reinforcement ribs
- Positioning of critical features from reference edges

▷ **Hole specifications (5 marks)**

- Diameters of all holes clearly indicated
- Countersink specifications where applicable
- Depth information for blind holes

▷ **Detail dimensions (3 marks)**

- Radii of fillets and rounds
- Thickness of material sections
- Angle measurements where needed

▷ **Dimensioning conventions (1 mark)**

- BS 8888 dimensioning style consistently applied
- Appropriate dimension arrows and text placement
-

▷ **Dimension organisation (1 mark)**

- No redundant or overlapping dimensions

- Logical grouping of related dimensions

5. Sheet Layout and Presentation (20 marks)

▷ **A3 sheet setup (4 marks)**

- Correct A3 size (420mm × 297mm)
- Appropriate borders (10mm margin)
- Correct orientation (landscape)

▷ **Title block information (8 marks)**

- Name and candidate number (2 marks)
- Drawing title: “Mounting Bracket Assembly” (2 marks)
- Scale information for each view (2 marks)
- Date of completion (1 mark)
- Material specification: “Aluminium Alloy 6061-T6” (1 mark)

▷ **Viewport arrangement (4 marks)**

- Logical placement of views on sheet
- Efficient use of available space
- Clear separation between views

▷ **Viewport scaling (4 marks)**

- Orthographic views at 1:1 scale
- Isometric view at appropriate scale (1:1 or 1:2)
- Consistent appearance and line weights across viewports

6. Quality Control and Output (15 marks)

▷ **Error checking (5 marks)**

- No missing lines or features
- No duplicate entities
- Accurate representation of the 3D model

▷ **Line weight verification (3 marks)**

- Line weights display correctly in all viewports
- Line weights print correctly in PDF output
- Appropriate line weight for drawing scale

▷ **Text and annotation (3 marks)**

- All text legible (minimum 2.5mm height)
- Consistent text style and formatting
- Proper placement of notes and annotations

➤ File output (4 marks)

- Correct PDF export settings (vector output, not raster)
- PDF named “SURNAME_Firstname_MountingBracket.pdf”
- All elements visible and properly displayed in PDF
- PDF configured for A3 paper size

Submission Requirements

➤ Students must submit the following by [specific date and time]:

- AutoCAD drawing file (.dwg) named “SURNAME_Firstname_MountingBracket.dwg”
- PDF export named “SURNAME_Firstname_MountingBracket.pdf”
- Reflection document (200-250 words) addressing:
 - Technical challenges encountered and solutions applied
 - Specific drawing standards implemented
 - Areas for improvement in future technical drawings
- Resources Provided
- 3D model file: “MountingBracket_Assessment.dwg”
- BS 8888 reference sheet (digital copy)
- Sample title block template file: “A3_TitleBlock_Template.dwg”
- AutoCAD layer and linetype reference guide

Assessment Criteria

[As detailed in the previous response with mark allocations]

Accommodations

- Students with specific learning needs may request:
- Additional time (up to 30 minutes)
- Pre-configured layer templates
- Step-by-step guidance sheets
- Enlarged reference materials

PLC Session 21

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
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Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **group presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.

b. After the enactment, ask for structured feedback from the group

i. was the concept explained in a way that a learner with no prior knowledge could follow?

ii. were the examples grounded in contexts familiar to Ghanaian learners?

iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to

a. transfer your chats into your learning planner template.

b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).

c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section Review

Under this section, learners were introduced to the principles of assembling component parts and the preparation of detailed working drawings using appropriate drawing instruments and CAD applications. Learners explored the importance of working drawings in communicating accurate construction and manufacturing details, as well as the role of assembly drawings in showing how individual components fit and function together as a complete unit.

Learners were guided through the process of preparing detailed working drawings to scale, applying appropriate dimensioning techniques, line conventions and drawing standards. Through practical activities, learners developed skills in producing accurate assembly drawings from given components, interpreting component relationships and arranging parts correctly to achieve functional assemblies. Learners also applied CAD tools and manual drawing techniques to improve precision, neatness and presentation quality.

Varied pedagogical approaches such as demonstrations, guided practical sessions, collaborative activities and project-based tasks were used to address the diverse learning needs within the class. Assessment activities targeted higher levels of the Depth of Knowledge (DoK), requiring learners to apply technical drawing principles, analyse component relationships and produce complete assembly drawings. Learners demonstrated understanding through

the preparation and presentation of scaled working drawings and assembled component drawings produced during the section.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 18

Criteria	Excellent (5 Marks)	Good (3 Marks)	Needs Improvement (2 Marks)
1. Identification of Solid Parts vs Fasteners	Clear, step-by-step description showing how hatching, out-lines, and conventions distinguish solid parts from fasteners.	Generally clear description with minor gaps or some unclear steps.	Incomplete or vague explanation, little understanding shown
2. Explanation of Why Fasteners Are Unhatched	Correct and clear explanation that fasteners are unhatched to show they are separate, removable parts.	Mostly correct explanation but missing some detail.	Incorrect or no explanation provided.
3. Interpretation of Fasteners' Role	Clear statement that fasteners join components and are not part of the main body, with good understanding of their function in assembly.	Partial explanation, generally correct but less detail.	No clear understanding of the role of fasteners.
Total	15	9	6

WEEK 19

1. Orthographic Views (25 marks)

Criteria	Excellent (25)	Very Good (20)	Satisfactory (15)	Needs Improvement (10)
Accuracy of Views	All views perfectly represent the object with precise alignment and projection. Third angle projection symbol correctly placed.	Views correctly represent the object with minor alignment issues. Projection method clearly indicated.	Views adequately represent the object with some noticeable projection errors. Some alignment issues present.	Views poorly represent the object with significant errors. Projection method unclear or incorrect.

Line Work	Consistent line weights throughout; clear distinction between visible, hidden, and centre lines. Perfect line quality.	Good line weight variation with occasional inconsistencies. Line types generally follow standards.	Acceptable line work with noticeable inconsistencies. Some line types incorrect or poorly executed.	Poor line quality; difficult to distinguish between line types. Many lines incorrect or missing.
View Placement	Perfect spacing and alignment between views following BS/ISO conventions. Excellent use of drawing space.	Good spacing and alignment with minor deviations from standards. Effective use of drawing space.	Acceptable spacing with some alignment issues. Inefficient use of drawing space.	Poor spacing with significant alignment problems. Ineffective use of drawing space.

2. Sectional View (25 marks)

Criteria	Excellent (25)	Very Good (20)	Satisfactory (15)	Needs Improvement (10)
Section Line Placement	Section line perfectly positioned to reveal internal features effectively. Cutting plane clearly indicated.	Section line well positioned with minor improvements possible. Cutting plane indicated.	Section line adequately positioned but misses some key features. Cutting plane indication has errors.	Section line poorly positioned; limited internal detail shown. Cutting plane missing or incorrect.
Hatching	Perfect hatching at correct angle and spacing; appropriate for material. Consistent throughout.	Good hatching with minor inconsistencies in spacing or angle. Material representation clear.	Acceptable hatching with noticeable inconsistencies. Some errors in material representation.	Poor hatching with significant errors. Incorrect material representation or missing hatching.
Cut Surface Representation	All cut surfaces clearly identified and consistently represented. No errors in sectioning conventions.	Most cut surfaces clearly identified with minor inconsistencies. Few errors in sectioning conventions.	Cut surfaces adequately represented with some errors. Several errors in sectioning conventions.	Cut surfaces poorly represented with significant errors. Sectioning conventions not followed.

3. Dimensioning and Title Block (25 marks)

Criteria	Excellent (25)	Very Good (20)	Satisfactory (15)	Needs Improvement (10)
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Dimension Placement	All dimensions perfectly placed according to BS/ISO standards. No crossing dimension lines.	Dimensions well placed with minor deviations from standards. Few crossing dimension lines.	Dimensions adequately placed with some errors. Several crossing dimension lines.	Dimensions poorly placed with significant errors. Many crossing dimension lines or cluttered appearance.
Dimension Accuracy	All measurements precise and complete; no redundant dimensions. Units clearly indicated.	Measurements accurate with minor omissions or redundancies. Units indicated.	Most measurements accurate with some significant omissions. Some units missing.	Several inaccurate measurements; important dimensions missing. Units often missing or incorrect.

4. BS/ISO Standards Compliance (15 marks)

Criteria	Excellent (15)	Very Good (10)	Satisfactory (8)	Needs Improvement (0)
Conventions	Perfect adherence to all technical drawing conventions. No errors in application of standards.	Good adherence with minor deviations from conventions. Few errors in application of standards.	Adequate adherence with some noticeable errors. Several errors in application of standards.	Poor adherence with significant errors. Many standards incorrectly applied or ignored.
Precision	Exceptional precision throughout; professional standard achieved. Drawing could be used for manufacturing.	Good precision with occasional minor inaccuracies. Drawing suitable for production with minor corrections.	Acceptable precision with some noticeable errors. Drawing would require several corrections before production.	Poor precision with significant inaccuracies. Drawing unsuitable for production purposes.

5. Extension: Manual vs. CAD Comparison (10 marks) – Optional

Criteria	Excellent (10)	Very Good (8)	Satisfactory (6)	Needs Improvement (4)
Analysis	Comprehensive, insightful comparison with specific examples. Clear understanding of strengths and limitations of both methods.	Good comparison with some specific examples. Sound understanding of differences between methods.	Basic comparison with limited examples. Some understanding of key differences.	Superficial comparison with few valid points. Limited understanding of differences.

Total Marks: 100 (90 without extension)

Overall Grade Descriptors

Excellent (80-100): Work of exceptional quality showing comprehensive understanding of technical drawing principles and perfect execution of BS/ISO standards. Portfolio demonstrates professional-level drafting skills.

Very Good (65-79): Work of high quality showing strong understanding of technical drawing principles and good execution of BS/ISO standards. Minor improvements possible but overall portfolio demonstrates solid drafting skills.

Satisfactory (50-64): Work of acceptable quality showing basic understanding of technical drawing principles and adequate execution of BS/ISO standards. Portfolio demonstrates functional drafting skills requiring development.

Needs Improvement (0-49): Work below acceptable standard showing limited understanding of technical drawing principles and poor execution of BS/ISO standards. Portfolio demonstrates insufficient drafting skills requiring significant development.

Differentiation Notes

For beginners: When using pre-drawn construction lines, focus assessment more on accuracy of completed views and understanding of conventions rather than line quality.

For advanced students: When including auxiliary views or exploded diagrams, assess these additional elements using the same criteria as the main components, with particular attention to spatial understanding and advanced convention application.

WEEK 20

1. Model Analysis and Setup (10 marks)

Criteria	Excellent (8-10)	Very Good (7)	Satisfactory (5-6)	Needs Improvement (0-4)	Criteria
Units and Precision	Units set to millimetres. Linear precision set to 0.1mm. Angular precision set to 0.1°.	Units set to millimetres. Either linear or angular precision set incorrectly.	Units set to millimetres. Both linear and angular precision set incorrectly.	Units set incorrectly or not set at all.	Units and Precision

Layer Structure	All 6 required layers created (VISIBLE, HIDDEN, CENTRE, DIMENSION, TITLE, VIEW-PORTS). All layers assigned correct colours, linetypes and lineweights.	5 of 6 required layers created. Most layers assigned correct properties.	4 of 6 required layers created. Some layers missing correct properties.	Fewer than 4 required layers created. Layer properties significantly incorrect.	Layer Structure
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2. View Generation (20 marks)

Criteria	Excellent (16-20)	Very Good (14-15)	Satisfactory (10-13)	Needs Improvement (0-9)
Front Elevation	Shows all visible edges correctly. All hidden details shown with correct line type. Properly oriented showing primary mounting face.	Shows all visible edges correctly. Most hidden details shown. Orientation correct.	Shows most visible edges. Some hidden details missing or incorrect. Minor orientation issues.	Missing significant visible edges. Few or no hidden details shown. Incorrectly oriented.
Top Plan	Perfectly aligned with front elevation. All visible edges shown correctly. All hidden details shown with correct line type.	Well, aligned with front elevation. All visible edges shown. Most hidden details shown correctly.	Alignment with front elevation has minor errors. Most visible edges shown. Some hidden details missing or incorrect.	Poor alignment with front elevation. Missing significant visible edges. Few or no hidden details shown.
Side Elevation	Perfectly aligned with front elevation. All visible edges shown correctly. All hidden details shown with correct line type.	Well aligned with front elevation. All visible edges shown. Most hidden details shown correctly.	Alignment with front elevation has minor errors. Most visible edges shown. Some hidden details missing or incorrect.	Poor alignment with front elevation. Missing significant visible edges. Few or no hidden details shown.

Isometric View	Set precisely at 30°/30° angles. All visible edges shown clearly. No hidden lines included. Shows all key features clearly.	Set at approximately 30°/30° angles. All visible edges shown. No hidden lines included. Shows most key features.	Angles noticeably off from 30°/30°. Most visible edges shown. May include some hidden lines. Some key features unclear.	Significantly incorrect angles. Missing many visible edges. Hidden lines inappropriately included. Key features not visible.
Projection Method	First angle projection symbol included and correctly drawn. Views positioned exactly according to first angle projection. Consistent scale across all orthographic views.	First angle projection symbol included. Views positioned correctly according to first angle projection. Consistent scale across orthographic views.	First angle projection symbol included but drawn incorrectly. Minor errors in view positioning. Scale mostly consistent.	First angle projection symbol missing or completely incorrect. Views incorrectly positioned. Inconsistent scale across views.

3. Line Work and Visibility (15 marks)

Criteria	Excellent (12–15)	Very Good (10–11)	Satisfactory (7–9)	Needs Improvement (0–6)
Visible Lines	All visible lines use continuous line type at 0.7mm width. All corners properly joined with no overshoots or undershoots.	All visible lines use continuous line type at 0.7mm width. Most corners properly joined with minimal overshoots or undershoots.	Most visible lines use continuous line type. Some inconsistency in line width. Several corners have joining issues.	Many visible lines use incorrect line type or width. Numerous corners poorly joined with significant overshoots or undershoots.
Hidden Lines	All hidden lines use dashed line type at 0.35mm width. Consistent dash spacing throughout. All hidden features correctly represented.	All hidden lines use dashed line type at 0.35mm width. Mostly consistent dash spacing. Most hidden features correctly represented.	Most hidden lines use dashed line type. Some inconsistency in width or dash spacing. Some hidden features incorrectly represented.	Many hidden lines use incorrect line type or width. Inconsistent dash spacing. Many hidden features incorrectly represented or missing.

Centre Lines	All centre lines use centre line type at 0.25mm width. Applied to all holes, cylindrical features and axes of symmetry. Extended appropriate distances beyond features.	Centre lines use centre line type at 0.25mm width. Applied to most holes and cylindrical features. Mostly extended appropriate distances.	Most centre lines use centre line type. Some inconsistency in width. Applied to some holes and features. Extension distances sometimes incorrect.	Many centre lines use incorrect line type or width. Missing from many holes and features. Incorrect extension distances.
Line Hierarchy	Perfect visual hierarchy between line types. Consistent lineweights throughout the drawing.	Clear visual hierarchy between line types. Minor inconsistencies in lineweights.	Basic visual hierarchy established. Several inconsistencies in lineweights.	Poor or no visual hierarchy. Major inconsistencies in line-weights.

4. Dimensioning (20 marks)

Criteria	Excellent (16–20)	Very Good (14–15)	Satisfactory (10–13)	Needs Improvement (0–9)
Overall Dimensions	All overall dimensions (length, width, height) clearly shown. Dimensions placed outside views. Extension and dimension lines correctly drawn.	All overall dimensions shown. Most dimensions placed outside views. Extension and dimension lines mostly correct.	Most overall dimensions shown. Some dimensions poorly placed. Minor issues with extension or dimension lines.	Missing several overall dimensions. Many dimensions poorly placed. Major issues with extension or dimension lines.
Feature Locations	All mounting hole positions dimensioned from datums. All reinforcement rib locations dimensioned. All critical features positioned from reference edges.	Most mounting hole positions dimensioned from datums. Most reinforcement rib locations dimensioned. Most critical features positioned from reference edges.	Some mounting hole positions dimensioned from datums. Some reinforcement rib locations dimensioned. Some critical features positioned from reference edges.	Few or no mounting hole positions dimensioned from datums. Few or no reinforcement rib locations dimensioned. Few or no critical features positioned from reference edges.

Hole Specifica- tions	All hole diam- eters clearly indicated. All countersink specifications included where applicable. All depth informa- tion for blind holes provided.	All hole diam- eters clearly indicated. Most countersink specifications included. Most depth informa- tion for blind holes provided.	Most hole di- ameters indi- cated. Some countersink specifications missing. Some depth informa- tion for blind holes missing.	Many hole diameters missing. Many countersink specifications missing. Many depth informa- tion for blind holes missing.
Detail Dimen- sions	All radii of fil- lets and rounds dimensioned. All material thick- ness dimen- sions shown. All required angle measurements included.	Most radii of fillets and rounds dimen- sioned. Most material thick- ness dimensions shown. Most required angle measurements included.	Some radii of fillets and rounds dimen- sioned. Some material thick- ness dimensions shown. Some required angle measurements included.	Few or no radii of fillets and rounds dimen- sioned. Few or no mate- rial thickness dimensions shown. Few or no required angle measure- ments included.
Dimensioning Style	BS 8888 di- mensioning style per- fectly applied throughout. All dimension arrows and text correctly placed.	BS 8888 di- mensioning style consist- ently applied with minor errors. Most di- mension arrows and text cor- rectly placed.	BS 8888 di- mensioning style applied with several errors. Some di- mension arrows and text incor- rectly placed.	BS 8888 di- mensioning style not fol- lowed. Many di- mension arrows and text incor- rectly placed.
Dimension Or- ganisation	No redundant dimensions. No overlapping dimensions. Logical group- ing of related dimensions.	No redundant dimensions. Few overlapping dimensions. Mostly logical grouping of dimensions.	Some redundant dimensions. Several over- lapping dimen- sions. Some il- logical grouping of dimensions.	Many redundant dimensions. Many overlap- ping dimen- sions. Illogical grouping of dimensions.

5. Sheet Layout and Presentation (20 marks)

Criteria	Excellent (16- 20)	Very Good (14- 15)	Satisfactory (10-13)	Needs Improve- ment (0-9)
A3 Sheet Setup	Exact A3 size (420mm × 297mm). 10mm margins on all sides. Landscape orientation.	Correct A3 size. Margins be- tween 8-12mm. Landscape ori- entation.	A3 size with minor errors. Margins in- consistent but present. Correct orientation.	Incorrect sheet size. Missing or severely incon- sistent margins. Incorrect orien- tation.

Title Block In- formation	Complete name and candi- date number. “Mounting Bracket Assem- bly” title in- cluded. All scale information for each view pro- vided. Current date included. “Aluminium Alloy 6061-T6” material speci- fication includ- ed.	Complete name and candidate number. Correct title included. Scale informa- tion for most views provided. Date included. Material speci- fication includ- ed.	Name and can- didate number included. Title present but incomplete. Scale informa- tion for some views missing. Date included. Material speci- fication missing or incorrect.	Name or can- didate num- ber missing. Title missing or completely incorrect. Scale information missing. Date missing. Mate- rial specification missing.
Viewport Ar- rangement	Optimal place- ment of views on sheet. Ex- cellent use of available space. Clear separation between views.	Logical place- ment of views on sheet. Good use of available space. Adequate separation be- tween views.	Acceptable placement of views on sheet. Some inefficient use of space. Minimal sepa- ration between views.	Poor placement of views on sheet. Ineffi- cient use of space. Views overlapping or too crowded.

6. Quality Control and Output (15 marks)

Criteria	Excellent (12- 15)	Very Good (10- 11)	Satisfactory (7-9)	Needs Improve- ment (0-6)
Error Checking	No missing lines or features. No duplicate en- tities. 100% accurate rep- resentation of the 3D model.	No missing lines or features. Few duplicate entities. Highly accurate rep- resentation of the 3D model.	Few missing lines or fea- tures. Several duplicate enti- ties. Generally accurate rep- resentation of the 3D model.	Many missing lines or fea- tures. Many duplicate enti- ties. Significant inaccuracies in representa- tion of the 3D model.
Line Weight Verification	All line weights display correctly in all viewports. All line weights print correctly in PDF output. Line weights perfectly ap- propriate for drawing scale.	Line weights display cor- rectly in most viewports. Line weights print correctly in PDF output. Line weights ap- propriate for drawing scale.	Line weights display correctly in some view- ports. Minor issues with line weights in PDF output. Line weights mostly appropriate for drawing scale.	Line weights display incor- rectly in many viewports. Major issues with line weights in PDF output. Line weights inap- propriate for drawing scale.

Text and Annotation	All text minimum 2.5mm height. Single consistent text style used throughout. All notes and annotations perfectly placed.	All text minimum 2.5mm height. Consistent text style used with minor variations. Most notes and annotations well placed.	Most text minimum 2.5mm height. Some inconsistency in text style. Some notes and annotations poorly placed.	Text smaller than 2.5mm height. Multiple inconsistent text styles. Many notes and annotations poorly placed or missing.
File Output	Vector PDF correctly exported. File named exactly "SUR-NAME_First-name_MountingBracket.pdf". All elements perfectly visible in PDF. PDF configured correctly for A3 paper size.	Vector PDF correctly exported. File named correctly with minor errors. All elements visible in PDF. PDF configured correctly for A3 paper size.	PDF exported but with some quality issues. File named incorrectly. Most elements visible in PDF. PDF mostly configured correctly for A3 paper size.	PDF exported with major quality issues. File named incorrectly or missing. Many elements not visible in PDF. PDF not configured correctly for A3 paper size.

SECTION 3: EXTENDED DRAWING

OPTION 3

Strand: Extended Drawing

Sub-Strand: Garment Design Technology

Learning Outcome: Use the principles and skills of concept sketches, object manipulation and geometrical drawings to design garments for different vocations

Content Standard: Demonstrate understanding and techniques in conceptual and geometrical drawings in designing garments

INTRODUCTION AND SECTION SUMMARY

To design, develop, and manufacture garments, the discipline of garment design technology blends the fundamentals of fashion design with new technical developments. Concept development, pattern creation, fabric procurement, production methods, and many other areas are all included.

One essential element of garment design is pattern drafting. The final garment will fit and be made appropriately if the patterns are accurate. Without well-drafted patterns, it would be challenging to get the perfect fit and silhouette.

Learners will examine key ideas and abilities in pattern creation for garment construction in this section. By the end of the unit, learners ought to be able to analyse garment designs to determine and break them into their components, work with pre-existing patterns to modify, grade patterns according to size, produce new designs, and make precise adjustments and alterations to guarantee proper fit and style. This section gives learners the fundamental knowledge they need to comprehend how garment patterns work in the design and production process. It also gives them the tools they need to adapt and change garment patterns to fit variety of body sizes and design requirements.

The weeks covered by sub-strand 3 (Garment Design Technology) are:

Week 18: Grade patterns to different sizes

Week 19: Grade patterns to different sizes

Week 20: Examine garments designs to break patterns down into different components

Week 21: Manipulate patterns to make adaptations of different garment designs

Year 2	Week 18: Use basic principles to take accurate body measurements Week 19: Draft basic pattern blocks for bodice and sleeve
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SUMMARY OF PEDAGOGICAL EXEMPLARS

Teachers/ facilitators should take a practical, learner-centred approach that incorporates a critical examination of garment patterns, guided practice, and demonstration. To help students grasp sizing systems, instruction should start with concrete and visual examples of graded patterns in various sizes. Teachers should assist students in analysing different garment designs, helping them recognise essential elements such as bodices, sleeves other features. Through organised pattern manipulation exercises, students will practice changing pre-existing patterns to produce new styles and adaptations. When teaching pattern changes and alterations, teachers should place a strong emphasis on precision and problem-solving skills, motivating students to assess fit and design results. It is anticipated that students will gain the technical know-how to confidently alter patterns, comprehend the design principles underlying pattern building, and use these abilities to produce clothing that satisfies predetermined design standards.

ASSESSMENT SUMMARY

Indicators	DOK Level	Assessment Strategy and/or Mode
Grade patterns to different sizes	Level: 2 (Skills of conceptual understanding)	Practical Demonstration, Product Evaluation, Written Response, Process Documentation by individual or in groups
Examine garments designs to break patterns down into different components	Level:3 (Strategic Reasoning)	Process Portfolio, Technical Illustration, Written Analysis and Oral Presentation by individual or in groups
Manipulate patterns to make adaptations of different garment designs	Level: 4 (Extended critical thinking and reasoning)	Process Portfolio, Technical Illustration, Written Analysis and Oral Presentation by individual or in groups
Make Pattern adjustments and alterations	Level: 3 (Strategic Reasoning)	Process Portfolio, Technical Illustration, Written Analysis and Oral Presentation by individual or in groups

WEEK 18

Learning Indicator: Grade patterns to different sizes

FOCAL AREA: PATTERN GRADING IN GARMENT DESIGN

The process of adjusting a completed garment pattern to provide a range of sizes while preserving the original design, form, and proportions is known as pattern grading. Using a conventional size chart, it entails methodically increasing or reducing particular parameters, such as length, hip, waist, and breast.

The goal is to create garments from a single original (base) pattern in several sizes, such as S, M, L, or 8, 10, and 12. You can do this using computer-aided design (CAD) software or manual tools like rulers and measuring guides. The original design’s form and aesthetic must hold true at all sizes. Applications include both custom tailoring and mass production, such as ready-to-wear apparel.

Grading enables you to make variations of the same garment patterns in sizes 8 (by reducing measurements) or 12 (by increasing measurements) without having to design each size from scratch if the basic pattern is in size 10.

Purpose and Importance of Pattern Grading

Both small-scale tailoring and the fashion industry depend heavily on pattern grading. It guarantees that a single garment design can be made in various sizes to accommodate various body shapes while maintaining the original design’s proportions and integrity.

1. Creation of Size Ranges

Grading enables a fashion designer to generate a comprehensive size range (e.g., sizes 6 to 18) by methodically increasing or decreasing the dimensions of a base pattern, which is typically developed in one standard size. This process guarantees that various clients can choose from the same style.

2. Production Efficiency

Grading offers a consistent and time-saving way to create numerous sizes from a single design instead of drafting each size from scratch. This capability is crucial for both personalised tailoring and large production, particularly for clothing manufacturers or fashion houses.

3. Comfort and Fit

Each size is guaranteed to retain the original design’s intended fit, comfort, and proportions thanks to accurate grading. Customers may be unhappy with clothing that is too tight in some places and too loose in others due to poor grading.

4. Economical Manufacturing

Pattern grading is a component of a streamlined process for factory-produced and ready-to-wear apparel that lowers labour and material costs while guaranteeing that the clothing is marketable for a wide range of consumers.

5. Accessibility and Inclusivity of Size

Grading makes fashion more accessible to people of different body shapes and sizes by enabling designers and brands to provide apparel in inclusive size ranges. To promote body positivity and client happiness, this is becoming more and more crucial.

6. Personalisation and adjustments

Grading facilitates the manufacture of customised clothing through small-scale fashion production or custom tailoring. Without sacrificing the design, tailors can modify a basic pattern to fit each client’s precise dimensions.

7. Encourages the Use of Digital Fashion technology.

Digital grading is used by CAD (Computer-Aided Design) systems in fashion design nowadays to efficiently create, save, and replicate designs in various sizes, minimising paper waste and promoting sustainable practices.

Standard Size Chart

In the clothing industry, a standard size chart is a table or manual that offers predetermined body measurements that are used to design clothing patterns that suit a wide variety of individuals. To guarantee uniformity and effectiveness in the manufacturing of apparel, it serves as a reference tool for designers, pattern makers, and manufacturers.

► Purpose of a Standard Size Chart

- 1. **Aids in Pattern Grading:** Assists pattern makers in accurately scaling a single pattern into multiple sizes
- 2. **Promotes Consistent Sizing:** Enables clothing to be manufactured in sizes (e.g., 6, 8, 10, M, L, XL) that correspond with average body measurements
- 3. **Supports Mass Production:** Crucial for creating ready-to-wear (RTW) clothing for retail
- 4. **Enhances Fit and Comfort:** This ensures that the clothing fits a wide range of body proportions.

► Ladies’ Standard Size Chart (cm and inches)

The standard size chart for women follows international sizing, a common practice in garment manufacture and pattern making. The chart includes important body measurements that are necessary for pattern grading.

Note: Size charts may differ significantly depending on the brand, fashion house, and area (e.g., US, EU, UK). You can use this chart as a general reference for pattern changes and instructional purposes.

Here is a Standard Size Chart for Ladies presented in both centimetres and inches, which is helpful for pattern grading, tailoring, and garment design. It includes key body measurements: bust, waist, hip, and back waist length.

Table 1: Ladies’ Standard Size Chart (cm and inches)

Size	Bust (cm/in)	Waist (cm/in)	Hip (cm/in)	Back Waist Length (cm/in)
6	78 / 30.7"	60 / 23.6"	84 / 33.1"	38 / 15.0"
8	82 / 32.3"	64 / 25.2"	88 / 34.6"	39 / 15.4"
10	86 / 33.9"	68 / 26.8"	92 / 36.2"	40 / 15.7"
12	90 / 35.4"	72 / 28.3"	96 / 37.8"	41 / 16.1"
14	94 / 37.0"	76 / 29.9"	100 / 39.4"	42 / 16.5"
16	98 / 38.6"	80 / 31.5"	104 / 40.9"	43 / 16.9"
18	102 / 40.2"	84 / 33.1"	108 / 42.5"	44 / 17.3"
20	106 / 41.7"	88 / 34.6"	112 / 44.1"	45 / 17.7"

Measurement Descriptions

Bust: Around the fullest part of the chest and shoulder blades.

Waist: Around the natural waistline, usually the narrowest part of the torso.

Hip: Around the fullest part of the buttocks/hips.

Back Waist Length: From the base of the neck (nape) down the spine to the waist.

Methods of Pattern Grading

Different techniques are used to grade patterns for different sizes. Each method varies in complexity and is suited for different scales of production, from manual drafting to digital mass production. These include;

1. Slash and Spread Method

The slash and spread method is a manual pattern grading technique used to increase or decrease the size of a pattern while maintaining the original style and proportions. This method is ideal for small-scale production and custom fitting.

Step-by-Step Process involved in the slash and spread grading method

1. Prepare the Base Pattern

Start with a basic pattern in the original size (e.g., Size 10).

Ensure it is neatly traced on a separate sheet for grading.

2. Identify Key Points

Mark key reference points: bust, waist, hip, shoulder, armhole, neckline, etc.

These are areas where adjustments typically occur during grading.

3. Draw Cutting Lines

Draw vertical and horizontal lines on the pattern through areas of adjustment (e.g., centre front/back, bust point, hip line).

These lines divide the pattern into manageable sections.

4. Slash the Pattern

Carefully cut along the drawn lines, leaving a hinge point at the top or bottom (for control).

The pieces should be able to pivot or move apart slightly.

5. Spread or Overlap

Spread the pieces apart to grade up to a larger size.

Overlap the pieces to grade down to a smaller size.

Use a ruler to measure the amount of increase or decrease based on your grading chart (e.g., ½ inch at the bust).

6. Tape the Adjusted Pattern

After spreading or overlapping, tape the adjusted sections onto a new sheet of paper.

Keep the pattern flat and aligned.

7. Redraw the Outline

Smooth out and redraw the outer edges using a curved ruler or French curve.

Ensure all curves (armholes, neckline, hem) flow naturally and are symmetrical if needed.

8. Add Seam Allowances

Redraw and add seam allowances if they were removed during the process.

Check consistency across all pattern sections.

9. Label the New Size

Clearly label the new size (e.g., Size 12) and pattern piece name (e.g., Front Bodice).

Include grainlines, notches, and any markings needed for construction.

10. Repeat for Other Pattern Pieces

Apply the same grading adjustments to all related pattern pieces (e.g., back bodice, sleeve, skirt).

Tips

- Use a grading increment chart to determine exact measurements for each size.
- Always maintain proportions and balance across pattern pieces.
- Ideal for use in educational settings or small-run fashion production.

HOW TO RESIZE PATTERNS USING THE SLASH AND SPREAD METHOD WITH IMAGES

Determining how much width has to be added or subtracted is the first step in grading a design. The first step is to compare your actual measurements with the pattern's size chart. When grading a pattern, keep in mind that woven clothing patterns include an inherent degree of ease (the space between your body and the garment). Ensure the pattern retains the same ease as it did during its initial production. That can be aided by the measurements of the completed garment.

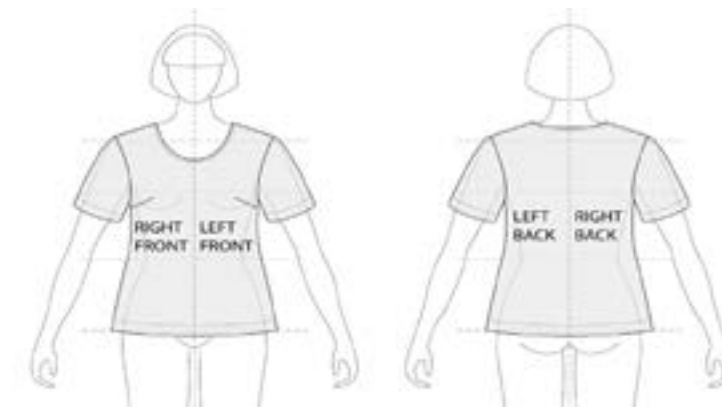


Figure 18.1: *Ease = finished garment measurements - body measurements*

As an example, let's assume you need to add 10 cm (4 in) to your hip, waist, and bust patterns.

Typically, a bodice design involves cutting the front and back pieces on the fold to form the entire garment. Thus, you have a left front, a left back, a right back, and a left back. This implies that you must divide the change among the pattern's four sections when grading it.

We divide this by 4 (the four components of the design) to increase it by 10 cm, meaning that each component will grow by 2.5 cm.

It is therefore necessary for you to determine what ¼ of this sum is. To keep these figures in front of me, I find it useful to write them down at the start of the procedure.

¼ = 6.25mm (I'll round to 6.2mm). ½ = 1.25cm (I'll round to 1.3cm) in this instance.

DISTRIBUTE THE GRADE THROUGH THE PATTERN

It's helpful to have a diagram of where the alteration will be made in front of you as specific parts of a pattern need to be altered, and this will be the same across most patterns.

MARK THE LINES ON THE PATTERN



Figure 18.2: *Marked lines on pattern*

Step 1

Mark in the horizontal slash lines on the pattern. We're working on a top pattern, so the horizontal lines go through the armhole and the waist. These lines need to be perpendicular to CENTRE FRONT.



Figure 18.3: horizontal slash lines marked on the pattern

Step 2

Mark in the vertical slash lines. They go through the neckline (close to the centre front), through the shoulder, and through the armhole near the side seam. These lines should be parallel to the CENTRE FRONT.

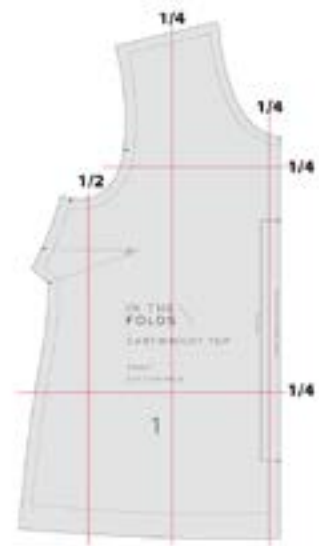


Figure 18.4: Vertical slashes lines marked on pattern

Step 3

Take note of how the grade will be distributed through the piece.

For the vertical lines, $\frac{1}{4}$ goes through the line closest to CENTRE FRONT, another $\frac{1}{4}$ through the shoulder area, and $\frac{1}{2}$ through the armhole area. If you add these fractions together you get 1, which means the whole grade will be distributed through the piece.

For the horizontal lines, we will distribute $\frac{1}{4}$ through each line.



Figure 18.5: Grade distribution

Step 4

Cut through the slash lines. Being careful to not mix up the pieces.



Figure 18.6: Slash line cut through

Step 5

Take a piece of pattern paper that is larger than your pattern piece (if grading the pattern up) and mark in the CENTRE FRONT down one side.



Figure 18.7: One side of the Centre front marked down

Step 6

Start with the CENTRE FRONT next section of the pattern. Line up the CENTRE FRONT edge with the CENTRE FRONT marked on the page and glue or tape in place.



Figure 17.8: CENTRE FRONT marked on the page and glued or taped in place

Step 7

Draw a line down the side of the piece that is taped in place, parallel to the CENTRE FRONT. Draw a line across the bottom of the piece, perpendicular to CENTRE FRONT.

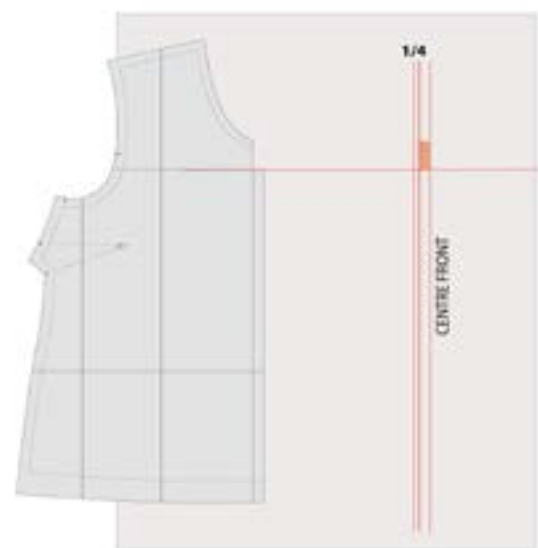


Figure 18.9: A line drawn down the side of the piece that is taped in place, parallel to the CENTRE FRONT. A line drawn across the bottom of the piece, perpendicular to CENTRE FRONT.

Step 8

Referring to your diagram in Step 3, you will see that $\frac{1}{4}$ of the grade (i.e., 6.2mm) needs to be added to this section.

Draw a line 6.2mm from the vertical line, making sure it's parallel to the first line.

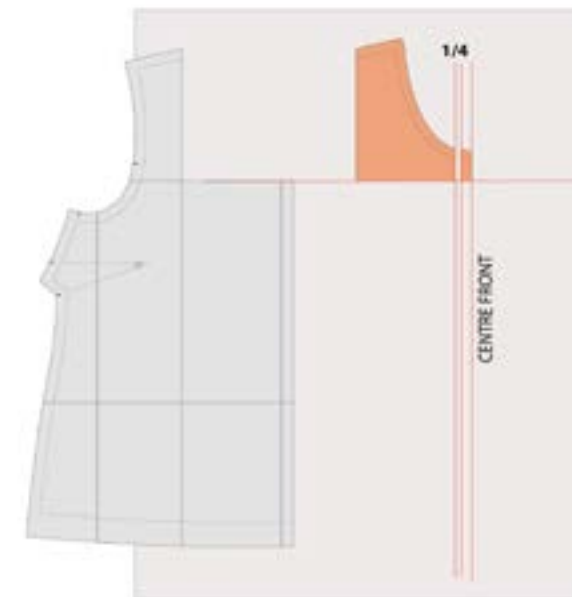


Figure 18.10: A line of 6.2mm from the vertical line drawn, making sure it's parallel to the first line

Step 9

Slide the next piece of the pattern over and line up the corner of the piece with the corner created by the lines. Tape or glue in place.

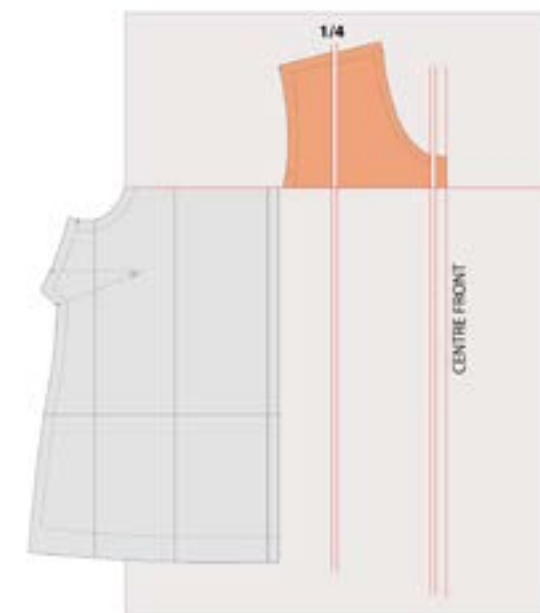


Figure 18.11: The next piece of the pattern slide over and lined up to the corner of the piece with the corner created by the lines. Taped or glued in place

Step 10

Repeat the process on the other side of the piece, again adding $\frac{1}{4}$ of the grade. Slide the pattern piece over and tape or glue in place.

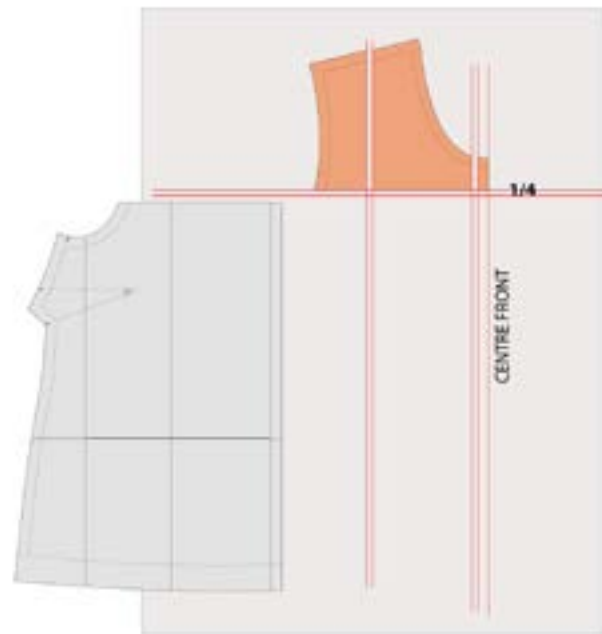


Figure 18.12: The process on the other side of the piece repeated, $\frac{1}{4}$ of the grade in addition added. The pattern piece slid over and taped or glued in place.

Step 11

At this stage you have the top section of the pattern in position, so you now need to move to the next row of pieces.

Before we get started, we need to add $\frac{1}{4}$ of the grade to the piece vertically. Use your ruler to mark this in below the pieces that are stuck in place.

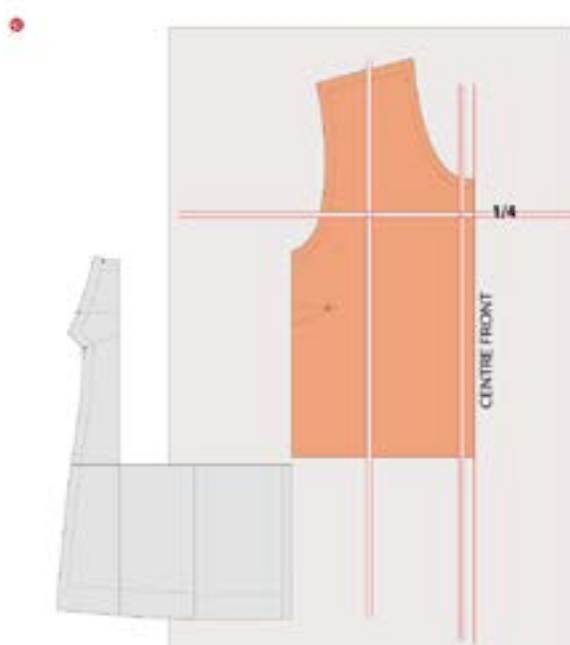


Figure 18.13: $\frac{1}{4}$ of the grade added to the piece vertically

Step 12

Place the next three pieces in position using the guidelines. Stop when you get to the armhole, as we need to add another guideline there.

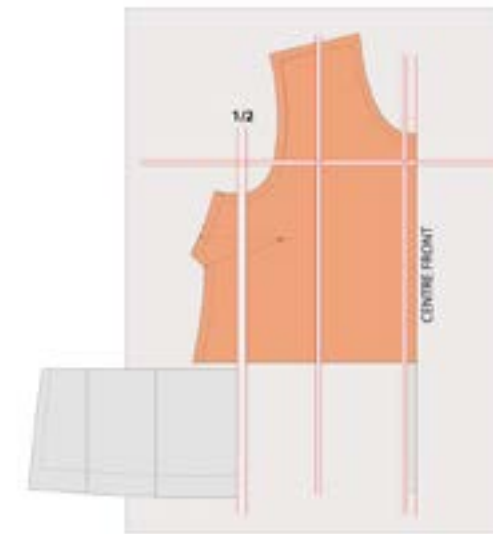


Figure 18.14: Another guideline added at the armhole there

Step 13

Draw a line down the side of the last piece that is taped in place, parallel to the CENTRE FRONT.

Mark in another guideline, parallel to the CENTRE FRONT, this time $\frac{1}{2}$ of the grade (i.e., 1.3cm). Slide the next part of the pattern over and tape or glue in place.

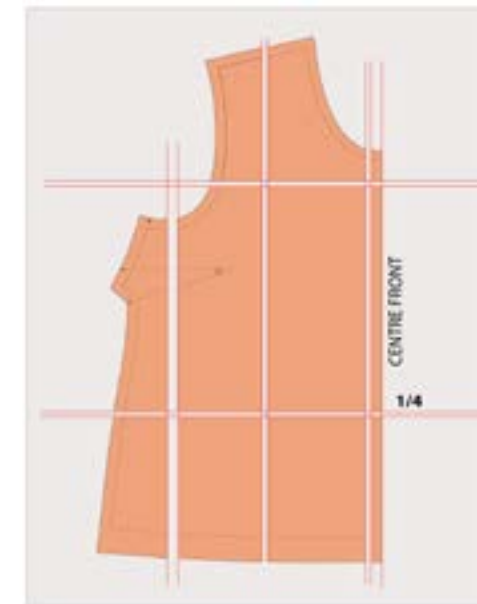


Figure 18.15: The next part of the pattern slid over and tape or glue in place.

Step 14

Rule a line across the bottom of the pieces and another $\frac{1}{4}$ of the grade down from that. Position the remaining pattern pieces and tape or glue in place.

FINALISE THE PATTERN

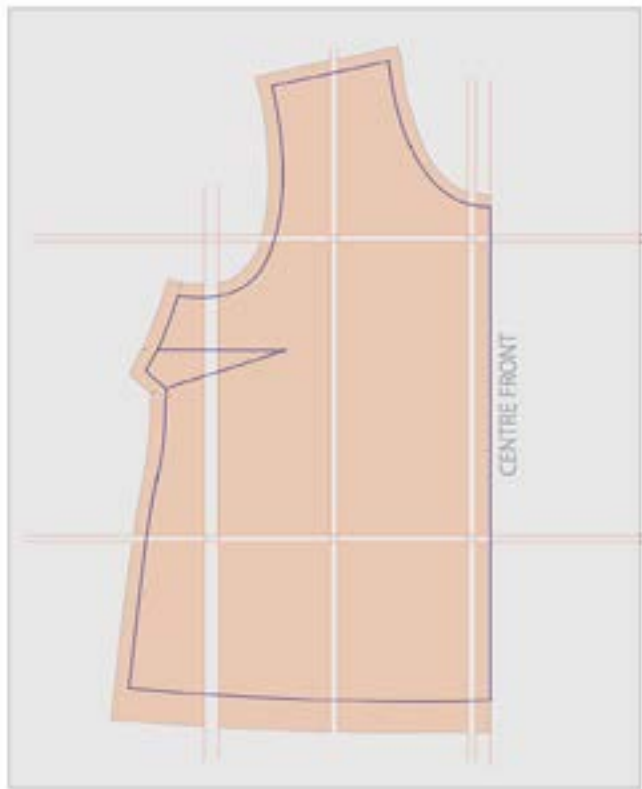


Figure 18.1:6 Final Pattern

Redraw smooth stitch lines over the alteration. Add seam allowance back onto the pattern.

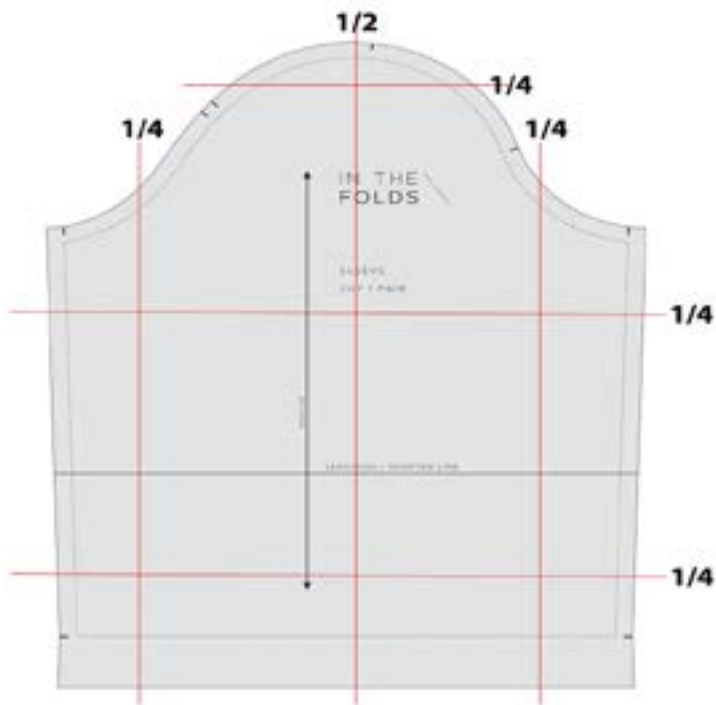


Figure 18.1:7: Repeated process done for the back pattern (with the guidelines in the same positions as on front) and sleeve (if it has one)

MAKING THE PATTERN SMALLER

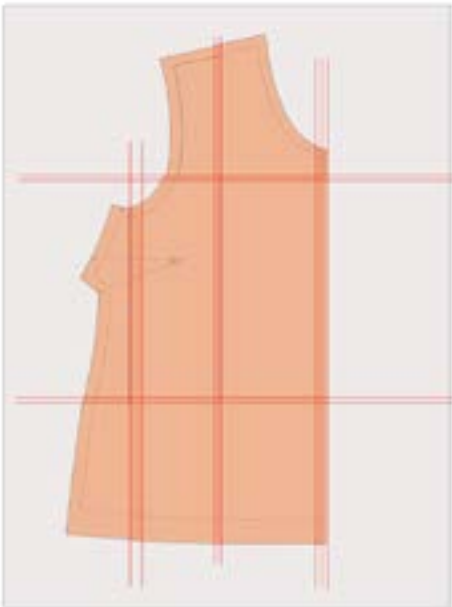


Figure 18.1:8: The same process can be used for making a pattern smaller. Rather than slashing and spreading to add width, you need to overlap the sections of the pattern to make it smaller

Finally, check and true the pattern.

2. Pattern Grading using the shift (or cut and move) method

Description:

This is a manual technique similar to Slash and Spread but involves shifting the entire pattern section horizontally or vertically without slashing it into multiple parts.

Steps

1. Redraw the pattern on a new paper.
2. Shift the pattern outward or inward by a fixed amount depending on the size increase or decrease.
3. Redraw the outline after shifting to complete the new size.

Best for

Simple patterns and small grading increments (like children’s wear or single-size adjustments).

2. Computer-Aided Grading (CAD Grading)

Description

Uses specialised software to grade digital patterns efficiently.

Software like Page maker, Gerber AccuMark, Lectra, Optitex, and CLO 3D automate the grading process using predefined rules.

Steps

1. Import or create a base pattern.
2. Enter a grading rule table with measurement increments.
3. The software generates all desired sizes instantly.

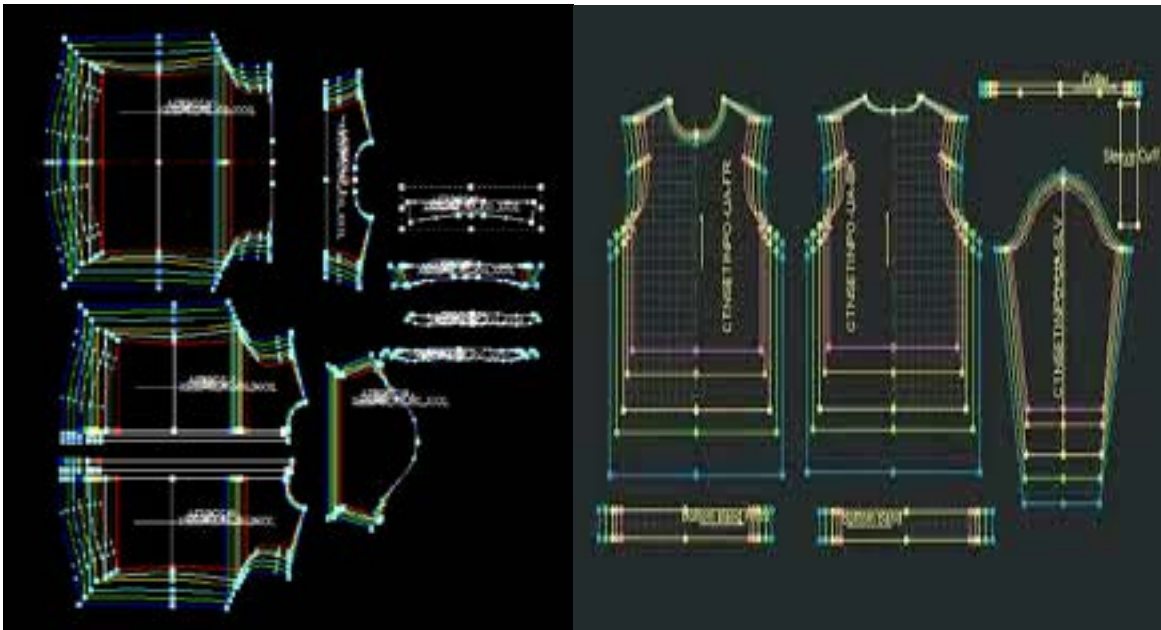


Figure 18.19: Auto CAD/ CLO standalone pattern grading

Best for

Mass production, commercial fashion design, and high accuracy needs.

3. Nested Grading

Description

Involves stacking or overlaying multiple sizes on a single pattern sheet, often using different coloured lines for each size.

Process

- 1. Create each size pattern using another grading method.
- 2. Overlay all sizes together in a “nest” for visual comparison and efficiency.
- 3. Often used in pattern books or industrial settings.

Best for

Size range comparison, home sewing patterns, and visual teaching.

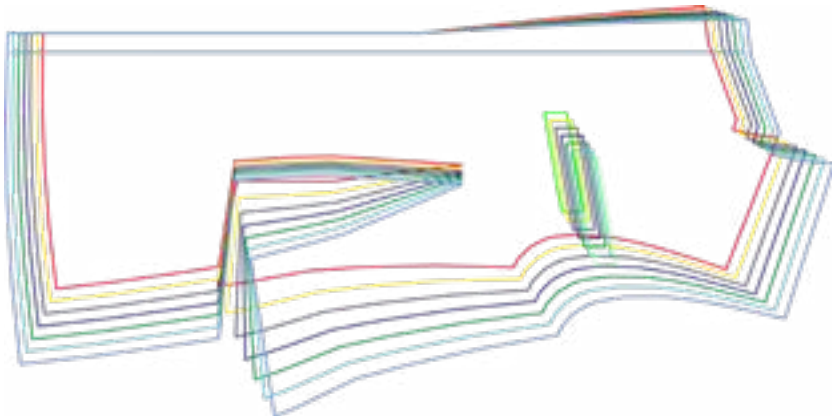


Figure 18.20: Nested Grading

1. Pattern grading using multiple sizes method (Manual Redrafting)

Description

Involves manually drafting each size from scratch using measurement charts rather than modifying a base pattern.

Process

- 1. Start with a standard measurement chart
- 2. Draft each size individually without using a base pattern.

Best for

Custom tailoring or when grading is not feasible (e.g., when fit must be highly individualised).

Application in Pattern Grading

Use this chart to determine grading increments (e.g., between sizes 10 and 12, bust increases by 4 cm / ~1.6”).

Distribute increments evenly across key parts of the pattern (e.g., half at the front, half at the back).

Apply consistently to bust, waist, hip, and length areas for professional results.

Learning Tasks

- 1. Define pattern grading in garment design
- 2. State the purpose and importance of pattern grading
- 3. Describe the ladies’ standard size chart (cm and inches)

Pedagogical Exemplars

Group work/Collaborative Learning,

Learners in groups explain pattern grading in different sizes using the standard size charts through the use of videos, photographs, drawings, and charts and present their findings in a whole class discussion.

Research, Group work, Experiential learning

Help learners in their groups to find out the importance of grading patterns in sizes with the use of internet surfing, videos, photographs and drawings. Let the learners examine the various garment sizes that can be graded during garment design and pattern making. Generate a manual or digital chart of grading, sizing and their importance/uses. Present their reports in a whole class discussion

Project based learning, Group work

Pair learners and ask them to identify their various partners sizes on the standard size chart and make patterns for them using a base pattern as a guide

Key Assessment: Practice Paper 2

You have been given a basic bodice pattern in size 12. Using the provided size chart, the necessary materials and your knowledge of pattern grading principles:

- 1. Analyse the size chart to determine the measurement differences between sizes 12 and 14 (40 Marks).

- 2. Grade the basic bodice pattern up to size 14 using the slash and spread method (30 Marks).
- 3. Mark all the necessary pattern markings on your new pattern, including: (15 marks)
 - Grainline (3 Marks)
 - Notches (3 Marks)
 - Darts (3 Marks)
 - Seam allowances (3 Marks)
 - Size label (3 Marks)
- 4. On a separate sheet, explain TWO reasons why maintaining the original style proportions is important when grading patterns (15 Marks).



Hint

Conduct Practice Paper 2. It should cover the contents taught from Year 1 to 3. Refer to the Table of Specification and Structure of the Paper at the end of this section to guide you. Learners' papers should be marked immediately and scores entered into the SAP.

PLC Session 18

45 minutes	Planning & Reviewing the Learning Plan
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- 1. Begin the session by recapping lessons from the previous session, focusing on how learning was applied.
- 2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week's concepts in a practical way that will make it easier for learners to understand.
 - b. identify three common misconceptions learners may have on the week's content and how to address them using contexts familiar to Ghanaian learners (NTS 3a, 3g and 3m).
- 3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week's concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q).
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

- 4. Use your app to plan and administer the mode of assessment for the Student Assessment Portal (SAP).
 - a. The key assessment for the week is *practice paper 2*. Chat with your app to plan this assessment by reviewing or developing the assessment items/tasks and marking schemes/rubrics for the practice paper (NTS 3k-3q).

10 minutes	Content Exploration
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- 5. As a subject group, select one problem or topic/idea/term in the week's content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through the problem individually for 3–4 minutes
 - c. the group then works through it together the problem, step by step
 - d. highlight the most common errors made at each step (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not 'How do I teach this?' but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
------------	-----------

- 6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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- 7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
- 8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).

9. Remember to

- a. transfer your chats into your learning planner template.
- b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
- c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 19

Learning Indicator: *Grade patterns to different sizes*

FOCAL AREA: CALCULATING GRADING RULES TO GRADE BASE BLOCKS TO SIZES

Pattern grading is the process of creating various sizes by methodically increasing or decreasing a base pattern’s (block’s) proportions. Grading guidelines must be developed using a consistent size chart to accomplish this effectively. These guidelines specify how much the pattern’s important measurement points such as length, hip, waist, and bust should change across sizes.

Step-by-Step Guide to Calculating Grading Rules

1. Identify Size Increments from a Standard Size Chart

Begin by selecting the base size (e.g., Size 10) and comparing it to the next size (e.g., Size 12) on a standard size chart.

Example (Metric): in centimetre (convertible to inches version)

Measurement	Size 10	Size 12	Difference
Bust	86 cm	90 cm	4 cm
Waist	68 cm	72 cm	4 cm
Hip	92 cm	96 cm	4 cm
Length	40 cm	41 cm	1 cm

These differences become the total grading increments.

2. Distribute the Increments Across Pattern Pieces

Each total increment must be evenly divided across the seams and sections of the pattern. This includes:

- Front and Back (shared evenly)
- Left and Right sides (split further)

Example for Bust Grading (+4 cm total):

2 cm to the front and 2 cm to the back

Each half of front and back = 1 cm

Each side seam = 0.5 cm increase (front + back)

Apply the same logic for waist and hip areas.

3. Apply Increments to Specific Pattern Points

Pattern Area	Total Increase	Per Piece (Front or Back)	Per Side (½ pattern)
Bust	+4 cm +2 cm	+1 cm	
Waist	+4 cm +2 cm	+1 cm	
Hip	+4 cm +2 cm	+1 cm	

Length (vertical) +1 cm Add at hem or shoulder Full addition

Notes

Shoulder, armhole, neckline, and darts may also need proportional adjustments.

Changes must be made symmetrically to ensure balance.

4. Record Your Grading Rule Table

A grading rule table lists each pattern point and how much to shift it horizontally or vertically for each size step.

- Example (Per Size Step)

Pattern Point	X (Width)	Y (Height)
Bust Point	+1.0 cm	0.0 cm
Waist Side Seam	+1.0 cm	0.0 cm
Hem	+1.0 cm	+0.5 cm
Shoulder Tip	+0.5 cm	+0.5 cm

5. Use Tools for Precision

Manual Grading: Use rulers, French curves, and square tools.

Digital Grading: CAD software (e.g., Gerber, Lectra) allows input of these rules for automated scaling.

Key Tips

- Maintaining uniformity is essential; use the same guidelines for every pattern element.
- It might be necessary to modify the ease allowed to provide comfort in all sizes.
- Always test graded sizes using toiles or muslins to ensure fit integrity.

Sample Pattern Grading Rule Worksheet

Use this worksheet to record and apply grading rules when scaling a base pattern to different sizes. Refer to a standard size chart to calculate the required increments.

Table 1.2: Sample Grading Rule Table (Per Size Step)

Pattern Point	X (Width Ad-justment)	Y (Height Ad-justment)
Bust Point	+1.0 cm	0.0 cm
Waist Side Seam	+1.0 cm	0.0 cm
Hem	+1.0 cm	+0.5 cm
Shoulder Tip	+0.5 cm	+0.5 cm
Armhole Curve	+0.5 cm	0.0 cm

Use the table below to input your own grading rules:

Pattern Point	X (Width Ad-justment)	Y (Height Ad-justment)

Learning Tasks

Explain measurement descriptions and its application in Pattern Grading

Pedagogical Exemplars

Mixed ability, research

Learners in mixability groups search for the various grading rules and use the ones familiar to prepare bodice block

Key Assessment Level 3: Process Portfolio

Using a basic bodice block pattern in size 14 and all the necessary pattern drafting tools and materials, grade for a client this pattern in size 10 for a custom garment order.

- Using the pattern shift method, grade the bodice pattern down from size 14 to size 10.
- On your new pattern, clearly mark:
 - All seam allowances
 - Dart placements
 - Waistline and hemline
 - Zipper placement
 - Size label
- Complete the provided worksheet showing your calculations for:
 - Waist reduction
 - Hip reduction
 - Length adjustment
- Briefly explain how grading the pattern down differs from grading up in terms of techniques and considerations.

PLC Session 19

45 minutes	Planning & Reviewing the Learning Plan
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1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
2. Use your subject specific app to explore the content before planning. Ask the app to
 - a. explain the week’s concepts in a practical way that will make it easier for learners to understand
 - b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
3. Use your subject specific app to plan your lesson. Ask the app to
 - a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).



Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
 - a. The key assessment for the week is **process portfolio**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the portfolio presentation (NTS 3k-3q).

10 minutes	Content Exploration
------------	---------------------

5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
 - a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - b. all teachers in the group work through a similar problem individually for 3–4 minutes
 - c. the group then works through the problem together step by step
 - d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
------------	-----------

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
 - a. Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - b. After the enactment, ask for structured feedback from the group
 - i. was the concept explained in a way that a learner with no prior knowledge could follow?
 - ii. were the examples grounded in contexts familiar to Ghanaian learners?
 - iii. did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
-----------	------------

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
 - a. transfer your chats into your learning planner template.
 - b. read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - c. integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 20

Learning Indicator: Examine garment designs to break patterns down into different components

FOCAL AREA: FEMALE GARMENT DESIGNS AND PATTERN BREAKDOWN

As a garment designer, there is the need to know how different garment designs appear in order to achieve easy pattern construction. Understanding the garment's components is necessary before you can design one. The pieces that need to be sewn together to create the garment as a whole are called components. Exposure to different forms of garment designs and how the components relate with each other helps in pattern breakdown. At this level we will concentrate on female garments placing emphasis on dresses.

Components of Female garments

The components of female garment refer to the individual parts that are assembled during the construction of a complete piece of clothing. Understanding these components is essential in garment design, pattern drafting, and sewing.

There are fundamental components you'll encounter in many female garments. The specific design and style of a garment will determine which of these components are included and how they are executed. The basic garment components that are essential in pattern making are as follows:

1. **Bodice:** This is the upper part of a garment, above the waist. It often includes the shoulders, bust, and back. The top front and back is the garment's primary component, which gives the garment structure. It covers the torso of the wearer. It consists of shoulder, chest/ bust, waist, neck and torso length measurements. It is the base for all other components which are attached to it. Back and front of the top are assembled to complete the upper structure of the garment. According to the dress's style, the front and rear of the top can have a princess line, yokes, panels, etc. Although the style line provides the garment with a distinctive appearance, it does not impact how well it fits. It can be achieved by replacing darts, and adding colour blocks, yoke and princess lines in the garment.

Front Bodice: The front piece of the bodice. It often features shaping elements like darts or princess seams to fit the bust.

Back Bodice: The back piece of the bodice. It can be a single piece or multiple pieces and may include darts or other shaping for the back and shoulders.

2. Sleeves

These cover the arms and are attached to the armholes of the bodice. Sleeves are an essential fixture of any garment. It is the part of garment that covers the arm, from the

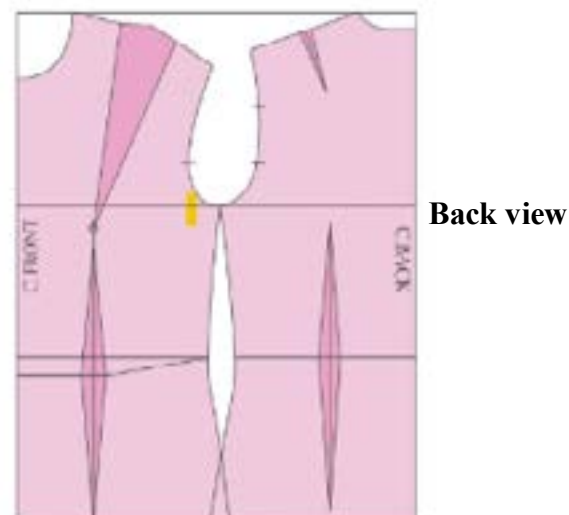


Figure 20.1: Front and back bodice

shoulder to the wrist or elbow. It is part of the upper garment and attached to the armhole of the bodice. It has both aesthetic and practical functions on the garment. There are various types of sleeves. Some are fitted and some are creating fullness. The length of the sleeve can be changed according to the wearer's choice.

Parts of sleeves

A sleeve has five parts which are discussed below:

- **Cap Line:** The curved top part of the sleeve above the biceps line.
- **Cap Height:** The distance from the sleeve cap at centre to the bicep level. It is an upper portion of the sleeve that is attached at the shoulder.
- **Side Seam:** The side seam is the area of the stitch where the sleeve is joined to form a tubular structure.
- **Hemline:** It is a finished bottom edge of the sleeve. It may also consist of the cuff and other treatments.
- **Upper Sleeve Round:** This is around the fullest part of the sleeve.
- **Elbow Round:** The fullest part of the elbow is known as elbow round.
- **Wrist Round:** This is part of the arm where the palm starts.

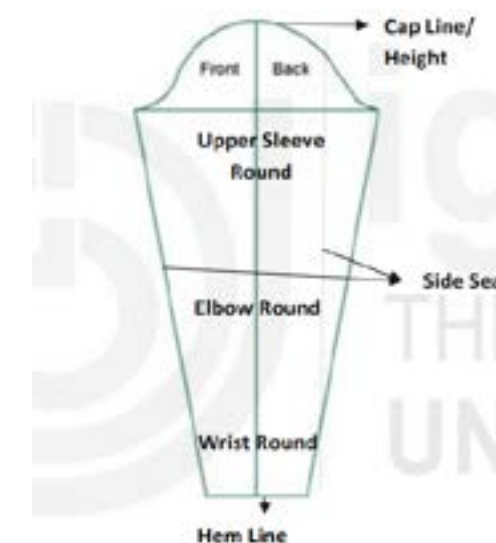


Figure 20.2: Parts of a sleeve

Types of sleeves: Sleeves can be classified into two ways according to length and according to stitching.

(a) **According to the length:** sleeves can be divided as

- **Long sleeve:** This is a full-length sleeve from shoulder to wrist.
- **Bracelet:** This type of sleeve ends just above the wrist.
- **Third quarter sleeve:** This sleeve ends just below the elbow.
- **Elbow sleeve:** The length of the sleeve till the elbow.
- **Short sleeve:** This is also known as a half sleeve. It ends between the elbow and the shoulder.
- **Cap sleeve:** This sleeve has a short length and hugs at the shoulder cap.



Figure 20.3: Type of sleeve length

(b) According to stitching: Sleeves can be divided according to the method of stitching as

Set in sleeves: These sleeves are the sleeves in which the side seams are attached to form a circular structure. It is attached to the front and back of the bodice and set into the armhole and creating smooth and tailored appearance (Figure. 2.4). The primary example of this sleeve is the sari blouse sleeve.

Open construction sleeves: These sleeves are the sleeves in which the sleeve is first attached to the armhole of the bodice front and back. Then the sleeves and bodices side seams are stitched as a straight line. Shirt sleeves are the best example of open sleeves (Figure 2.5).

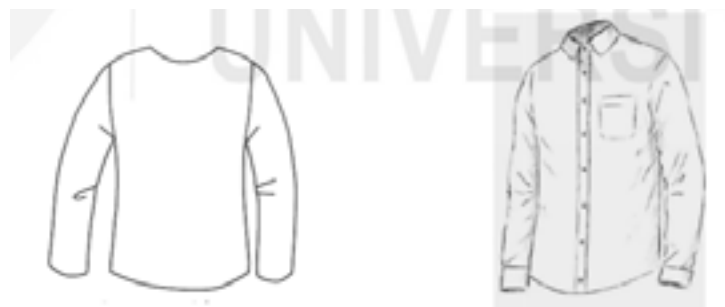


Figure 20.4a: Set-in Sleeve



Figure 20.4b: Open construction sleeve

C. Other sleeves

Various sleeve styles can be loose and flowy, structured or puffy, long or short, and can be made from any fabric. These are discussed below:

Bell Sleeves: A sleeve that flares out from the elbow or wrist, creating a bell like shape is bell sleeve. It is also known as peasant sleeves.

Raglan Sleeve: The sleeve extends to the neckline with a diagonal seam from the underarm to the collarbone.

Kimono Sleeve: Cut as part of the bodice, wide and often tapered at the wrist.

Bishop Sleeves: These sleeves give volume at the shoulder with flares and gathered at the wrist, often with a cuff.

Leg-of-Mutton Sleeves: These sleeves are structured like the leg of mutton. It is gathered and puffed at the shoulder or upper arm and then fitted on the forearm.

Puffed Sleeves: These sleeves are puffed at the shoulder and gathered at the hemline, which gives a puffed effect

Cape Sleeves: Cape sleeves are fully flowing, like capes. The fabric is gathered at the shoulder and flares out like a cape from there.

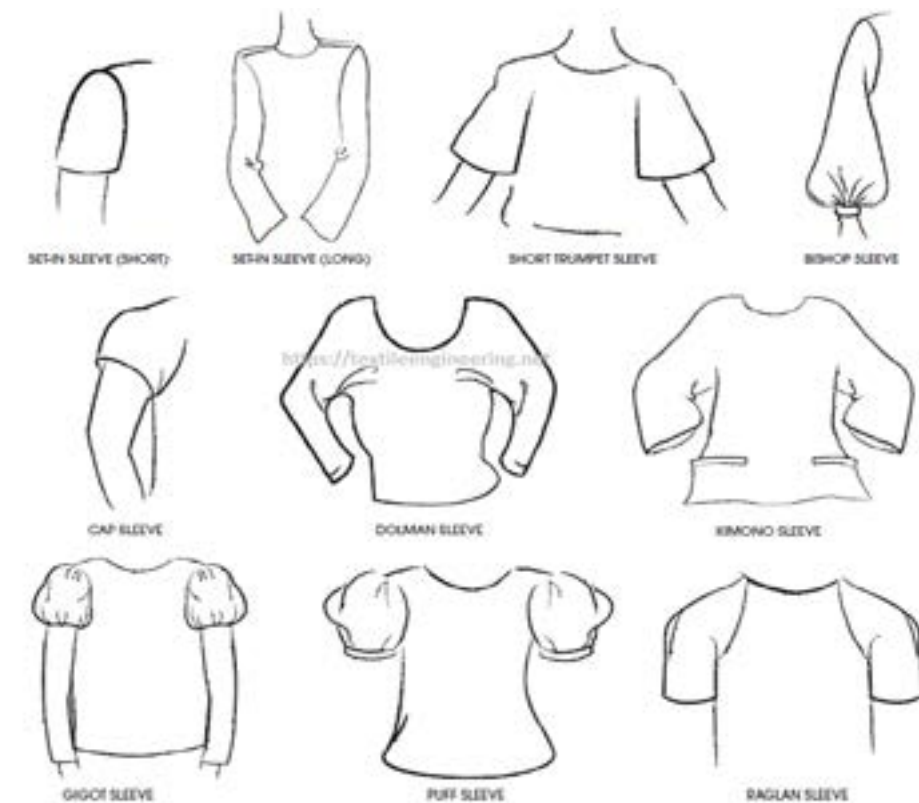


Figure 20.5: Other types of sleeves

3. Cuffs

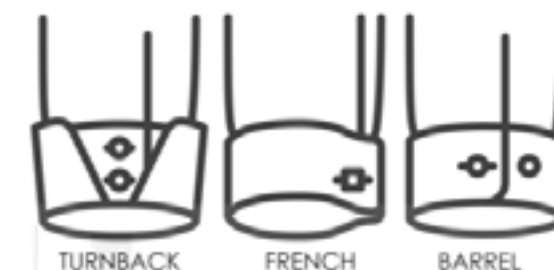
Bands of fabric at the ends of sleeves. Cuffs are a band of fabric at the end of sleeve of a garment that can be rolled up or down and can be fastened with buttons. It is the additional fabric sewn at the end of the sleeve. It provides the enclosure to the wrist. They can be an important design element in clothing and can add functionality or style to the garment. It is usually made on shirt sleeves, and cuffs with cuff links are mostly used in the formal shirt.

Cuffs are of various types. Here some common cuffs are discussed below:

Cocktail Cuffs: It is also known as turn-back cuff. It is folded until the hems form diagonal lines.

French or Double Cuffs: This is a trendy type of cuff. It is twice as long as the single cuff. These required cufflinks to close them.

Barrel or Button Cuffs: It is one of the most popular cuff styles, frequently worn with business and casual attire. They usually involve two horizontally positioned buttons with an approximate 3/4-inch gap between them. That is either fastened with a single button or pair of buttons.



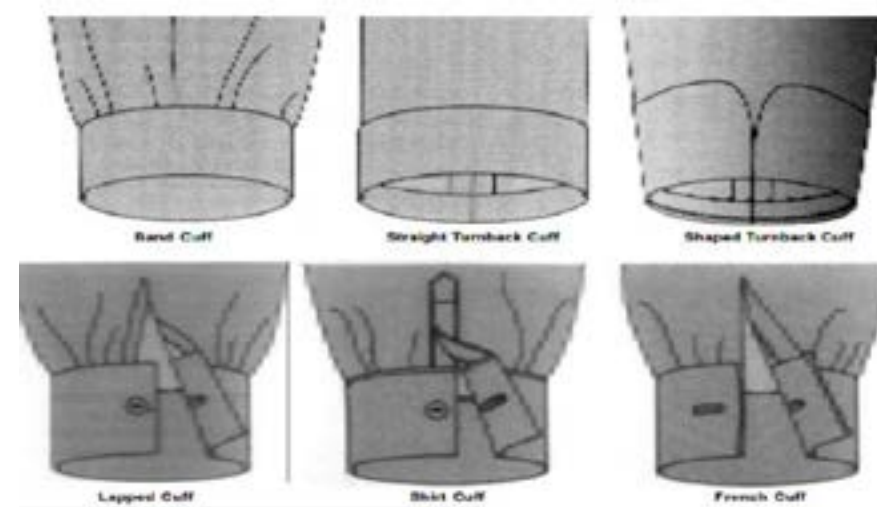


Figure 20.6: Types of cuffs

4. Neckline

Neckline refers to the shape or style of the opening at the upper edge of a garment that encircles the neck. Neckline is the opening of the garment for the head. Neckline can be divided into front neckline and back neckline. Necklines are an important design element in overall look and feel of the garment. The wearer should determine the neckline's depth and width. The wearer can choose their preferred neckline design. All of the necklines needed facing/binding and trimming to be finished. Here are some common types of necklines

Type of necklines: The neckline can be classified according to its shape. Let us discuss its variation below:

1. **Round Neckline:** This neckline is circular and curved toward the centre front. It is always deeper at the front than the back. It can be finished by facing and by piping.
2. **Square Neckline:** This neckline is square. It has four sharp corners, two in front and two in back. It can be finished by facing, which makes it contrast.
3. **V-Shape Neckline:** This neck forms the V-Shape in centre front and is round at the back. It can be finished with piping and facing finishes.
4. **U-Shape Neckline:** This neck forms the U-Shape in centre front and is round at the back with some height. It can be finished with piping and facing finishes.
5. **Heart Shape Neck:** The front line from the heart shape and is deeper at the front.

Other Necklines

1. **Boat Shape Neckline:** It is a wide, shallow neckline that runs horizontally across the collarbone. There may be a little difference in the front and back neckline.
2. **Keyhole Neckline:** This front neckline is shaped like a keyhole at the front and is high at the back.
3. **Cowl Neck:** This neckline is folded around the front. It can be made with one or two folds. Bias fabric is used for making a cowl.
4. **Halter Neck:** This style has straps instead of the shoulder that wrap around the back of the neck, leaving the shoulder and back bare.

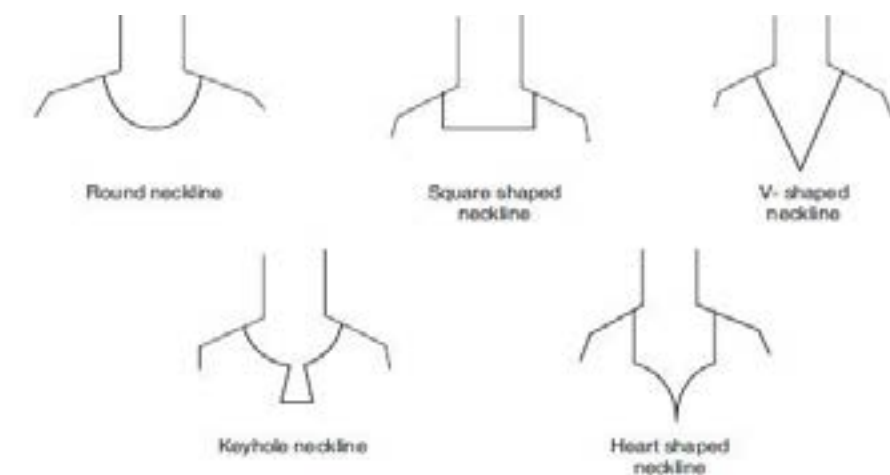


Figure 20.7: Types of necklines

5. Collar

Collars are a band of fabric that circles the neck of a shirt, jacket or coat. Collars can be used at the neckline to enhance the look of the garment. Collars are the central part of the garment because they provide a frame to the face of the wearer. They are an important design element in clothing and can affect the style and look of the garment. Collars can be classified as high or low stand and bands. The fashion trend chooses the collar design, style and shapes. Collars can have a square or pointed corners or adjusted edges.

Let's define the parts of collars.

The collar has three main parts i.e., stand, fall, and roll. Stand is the part from neckline to roll line, and roll line from where the collar starts roll. Fall starts from the roll line. A band of fabric that stands up or folds over the neckline.

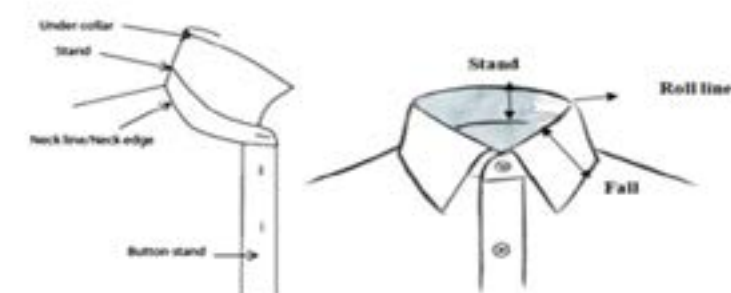


Figure 20.8: Parts of collar

Collar also has other parts like point, spread, neck edge, button stand and under collar (Fig. 2.6). Point is pointed corner of the collar and spread is the space between two points. The stand's lower edge attached to neckline is known as neck edge. The back side of the fall is known as the under collar and centre front edge of the shirt attached to the collar is button stand.

Types of Collars

Collars come in a variety of styles. The component lists three fundamental collar types such as:

Stand Collar: The collar has only a stand without any fall, known as a stand. Mandarin collars are the primary example of the stand collar. It usually rises two to five centimetres vertically from the neckline.

Flat Collar: Flat collars lie flat to the neckline against the bodices of the garment. It has no height off of the neckline. One such example of a flat collar is the Peter Pan collar, which has the rounded corners

Roll Collar: A collar that has a rolled edge, often found on knitwear. There are two types of collars i.e., full roll and partial roll collars. Full Roll collar has an identical height of stand and fall. Partial roll collars have low stand and more falls.

Other Types of Collars

- 1. **Convertible Collar:** These collars are the same as full roll collars similar to a whole roll, but hold the neckline closer to the side of the neck or shoulder.
- 2. **Shawl Collar:** It is known by its centre back seam. It is wide and rounded and attached to the part of the bodice. Usually found on jackets or coats.
- 3. **Shirt Collar:** It has a separate neckband that serves as the stand.
- 4. **Notched collar:** a collar that has a v-shaped notch where it meets the lappel of the jacket and coat.
- 5. **Different Styles of Collar:** There are numerous collar styles for the dress, like Chelsea, Sailor, Bertha, Puritan, Stovepipe, Tie etc.



Figure 20.9: Types of collars

6. Pockets

A pocket is a small pouch or compartment in a piece of clothing sewn into or onto the garment. It is designed to hold small personal items such as keys, coins or a phone. It can be found on a wide range of clothing items from pants and jackets to shirts and skirts. It is used for functional as well as decorative purpose in the garment. It is used as a functional element to store smaller essentials like a watch, keys, handkerchief, etc., instead of carrying a purse or bag for everyday

carry essentials. It also compliments the wearer with its decorative aspects. Pockets can be made from a variety of material, including the same fabric as the garment, contrasting fabrics or specialised materials such as mesh or leather. The placement, size and design pockets can also vary depending on the garments style and intended use.

Patch Pocket: Patch pockets are widespread and mainly seen on shirts (Figure12.15). These pockets are sewn onto the outside of the garment, typically at the chest or hip. Different styles can also be created in the basic structure, which makes it more appealing and decorative. It is the additional piece of fabric that is patched on the garment from the three sides; the top side is the pocket opening. The raw bottom edges of the pocket can be turned according to shape and the desired width on the wrong side. This is attached to the fabric by the top seam. Variations of patch pocket is discussed below:

Patch with Pleat: A patch pocket with a box pleat creates more space in the pocket. This is used in shirts.

Kangaroo: These are located at the front of the garment, typically on a hoodie or sweatshirt. They are large and have a single opening allowing the wearer to put their hands inside. A wide patch pocket is divided into two parts by a stitch line. Patch pockets with top pockets are other patch pocket variations.

Flap Pockets: Flap pockets are produced when the patch pocket is closed with the flap with or without a button. The flap provides the pocket opening, mainly used on jackets, shirts and pants. They may be available in different styles as double-flap pockets.

In Seam Pockets: These pockets are also known as secret or invisible pockets. It has a functional purpose in the garment and fulfills aesthetic purposes by using decorative seams to make it more decorative. These pockets have variations also like:

- a. **Side Seam Pocket:** Most inseam pockets are sided seam pockets. These pockets have openings along the side seam line of the garments. These types of pockets are usually made on pants, skirts, kurties etc.
- b. **Welt Pocket:** A “Welt” refers to the narrow fabric edges (one or two), which are attached separately to the pocket opening. Two edge welt pocket is the Double welt pocket usually made on jackets. Various welt pockets also have a flap. Welt pockets are mainly used in jackets and formal coats.
- c. **Slashed or Slanted Pockets:** These pockets are at a slant position and made for functional purposes. The shape of this pocket allows the wearer to slide their hands in and out quickly.

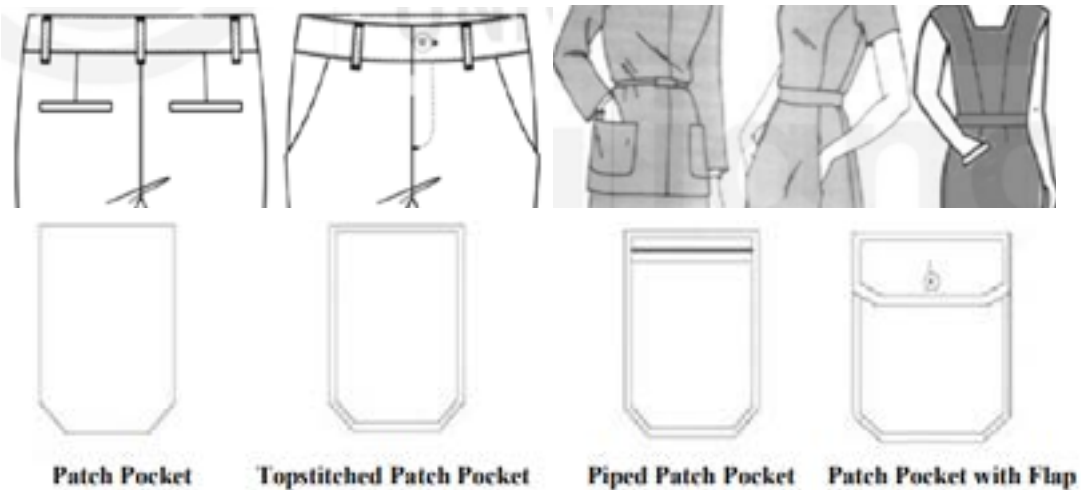


Figure 20.10: Types of pockets

Pattern breakdown in garment making

The process of carefully dissecting a completed garment or a design sketch to determine each component's composition and construction is known as “pattern breakdown” in the apparel industry. It entails determining the shapes, sizes, and fittings of each individual pattern piece needed to make the garment. In essence, pattern breakdown provides a roadmap for understanding and recreating a garment, serving as a vital link between design and production. It involves the following processes;

Identifying Individual Pieces

Identifying each unique component of the garment, including the collar, sleeves, cuffs, skirt panels, front and back bodices, facings, linings, pockets, and so on.

Analysing Seam Lines

Examining the stitching lines and seam allowances to ascertain where each piece is attached to the others.

Comprehending Construction Specifics: determining how the garment is put together, including the sequence of steps, the kind of seams used, and any unique methods like pleats, gathers, darts, or fasteners (buttons, zippers, etc.). **Identifying Style Lines:** Identifying the design lines, such as princess seams, yokes, or style elements on collars and cuffs, that give the garment its distinct shape and style.

Determining Measurements:

This entails getting exact measurements of every pattern component if you're working from an existing garment. Interpreting the desired measurements and proportions is necessary when working from a sketch.

Identification of Notches and Markings

Identifying and comprehending the function of grain-lines, which indicate the direction of the fabric, notches, which serve as alignment guides, and other markings on the pattern pieces.

Importance of pattern breakdown

- **Reverse Engineering:** It's crucial for recreating existing garments or adapting their designs.
- **Design Analysis:** It helps designers understand how different shapes and construction methods achieve specific looks and fits.
- **Pattern Making:** It's a foundational step in creating new patterns from existing garments or sketches. By breaking down a design, a pattern maker can then draft the individual pieces accurately.
- **Manufacturing:** In production, understanding the pattern breakdown ensures that the garment can be efficiently cut and assembled.
- **Alterations:** Tailors use pattern breakdown to understand how a garment is constructed, which is essential for making effective alterations.
- **Teaching and Learning:** It's a fundamental skill for fashion design and garment construction students to learn how garments are put together.

Common Female Dress Designs & Pattern Breakdowns

1. A-Line Dress



Figure 20.11: A-Line Dress

Design Features

Fitted bodice, flares out gently from waist Simple and versatile

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Front (with darts or princess seam)
- Bodice Back (with darts or zipper allowance)
- Dress Front (A-line flare)
- Dress Back (with flare and possibly a back zipper)
- Sleeve (front and back)
- Neckline facing or lining

2. Sheath Dress



Figure 20.12: Sheath dress

Design Features

- Slim-fit through the body
- Often knee-length
- Classic for formal or office wear

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Front (shaped with darts or princess seams)
- Bodice Back (often with back zip and darts)
- Dress Front (fitted or slightly tapered)
- Dress Back (can include walking slit)

- Lining or facing
- Sleeveless finish

3. Wrap Dress



Figure 20.13: Wrap dress

Design Features

- Bodice wraps across the front and ties at the side or back
- V-neckline
- Flattering for many body types

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Left Front (with wrap extension)
- Bodice Right Front (with wrap extension)
- Bodice Back
- Dress Front (left/right or one piece)
- Dress Back
- Waist tie/belt
- Sleeve (flutter, cap, or long)
- Facing for neckline

4. Empire Waist Dress



Figure 20.14: Empire dress

Design Features

- Waistline just below bust
- Flowing dress
- Great for maternity or romantic looks

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Front (shorter, cut under bust)
- Bodice Back
- Skirt Front (starts under bust, flared or gathered)
- Skirt Back
- Sleeves (optional)
- Facings or linings

5. Peplum Dress



Figure 20.15: Peplum dress

Design Features

- Fitted bodice with a short overskirt (peplum) at the waist
- Often bodycon

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Front
- Bodice Back
- Peplum (circular or flared strip attached at waist)
- Dress Front (pencil shape)
- Dress Back
- Sleeves (cap or short sleeves common)
- Facings

6. Maxi Dress



Figure 20.16: Maxi dress

Design Features

- Floor-length
- Flowy or fitted, depending on style
- Often features gathered or pleated skirts

Pattern Pieces: (adapt and draft manually or with CAD)

- Bodice Front
- Bodice Back
- Dress Front (gathered)
- Dress Back
- Waistband (optional)
- Sleeves (many variations)
- Neckline facing or lining

Learning Tasks

- List the key sub-topics under female garment designs and pattern breakdown
- Explain types of garment designs and their descriptions
- Describe pattern breakdown in pattern drafting

Pedagogical Exemplars

Group work/Collaborative Learning

Let learners in groups examine female garment designs and describe the various style lines or details in them. Assist learners to break down female garment designs into various components indicating the pattern symbols through the use of videos, photographs, drawings and charts. Let them present their findings in a whole class discussion.

Research, group work

Help learners in their groups to find out the importance of female garment design examination with the use of internet surfing, videos, photographs, drawings, etc. Assist learners to break down examined style lines or details into different components. Generate a manual chart on

female garment design examination and pattern breakdown with their importance/uses. Present report in a whole class discussion

Collaborative Learning, research, experiential learning

In mixed groups, let learners identify various female garment design examinations and components of pattern breakdown during garment design. Prepare a manual report to be presented in a whole class discussion.

Project based learning, Group work

Pair learners and ask them to identify various female garment designs from different sources to examine the style lines or details and break them down into different components with the appropriate pattern drafting tools.

Key Assessment Level 3: Process Portfolio

You are working with a fashion house that needs to recreate a party dress for a special client. (Learners can be provided with similar party dress such as the one figure below)

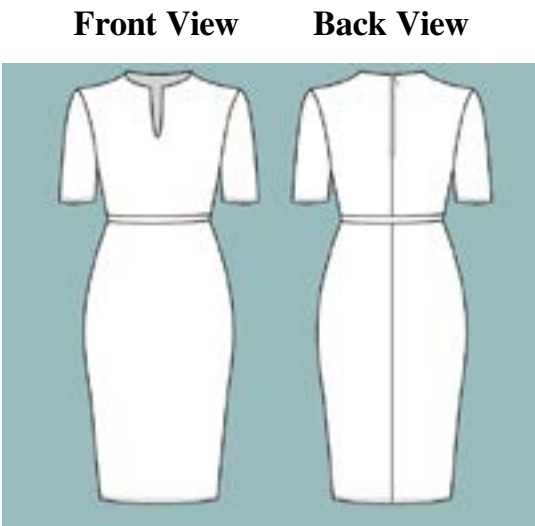


Figure 20.17: Sample party dress

1. Analyse the provided **party dress** photographs and identify all separate pattern components that would be required to create this garment (25 Marks).
2. Create a component map that shows: (30 marks)
 - All individual pattern pieces needed
 - How these components relate to each other
 - Order of assembly
 - Critical construction points
3. For complex components (e.g., draped bodice, pleated overlay, structured collar): (30 marks)
 - Sketch the pattern shape
 - Explain the drafting approach you would use to create each piece
 - Justify why your approach would achieve the design effect shown

4. Evaluate which components would require specialised drafting techniques beyond basic pattern manipulation, and explain your reasoning. (15 Marks)

PLC Session 20

45 minutes	Planning & Reviewing the Learning Plan
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- Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.
- Use your subject specific app to explore the content before planning. Ask the app to
 - explain the week’s concepts in a practical way that will make it easier for learners to understand
 - identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).
- Use your subject specific app to plan your lesson. Ask the app to
 - suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.
 - suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)
 - review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

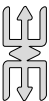
Note

- Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.
- Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app
- The key assessment for the week is *process portfolio*. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the portfolio presentation (NTS 3k-3q).

10 minutes	Content Exploration
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5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then
- use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)
 - all teachers in the group work through a similar problem individually for 3–4 minutes
 - the group then works through the problem together step by step
 - highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).

Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes	Enactment
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6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - After the enactment, ask for structured feedback from the group
 - was the concept explained in a way that a learner with no prior knowledge could follow?
 - were the examples grounded in contexts familiar to Ghanaian learners?
 - did any misconceptions surface and if so, how were they addressed?

5 minutes	Reflection
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7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- transfer your chats into your learning planner template.
 - read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

WEEK 21

Learning Indicator: *Examine garment designs to break patterns down into different components*

FOCAL AREA: FEMALE GARMENT DESIGNS AND PATTERN BREAKDOWN

Understanding Pattern Construction Through Technical Drawings and Design Translation

Technical drawings are essential for clear communication between designers and pattern makers. Translating a sketch into a pattern requires both artistic interpretation and technical skill. Problem-solving in pattern making involves understanding fabric behavior, design proportions, and fitting techniques.

At this level you are expected to compile the different female garment components to design, apply the basic blocks (bodice and sleeves) drafting techniques lent in year two (Week 18) and grading female garments techniques in Week 19 of Year 3 to suit clients specifications.

The steps below can serve as a guide;

General Objective

Learners will develop the ability to interpret technical garment drawings and accurately convert design features into working patterns using appropriate pattern-making techniques. They will also learn to identify and solve problems during the pattern construction process.

Technical Drawings and Specifications

Technical Drawing (Flat Sketch): A simplified, 2D illustration that shows the structure and components of a garment.

Specifications: Written or diagrammatic details that accompany the flat sketch, including seams, darts, grain lines, and finishes.

Symbols: Common notations like notches, fold lines, and stitch lines used in pattern making.

Translating Design Features into Pattern Techniques

Key Techniques

Dart Manipulation: Changing the position of a dart (e.g., from bust to waist or shoulder) to create new design lines.

Slash and Spread Method: Cutting and spreading a pattern piece to add fullness or volume (used in skirts, sleeves, etc.).

Adaptation: Changing a standard block to create features like pleats, gathers, different sleeves, or necklines.

Common Design Adaptations

Design Feature	Pattern Adaptation Method
Sweetheart neckline	Redraw neckline on bodice block

Puff sleeve	Add volume via slash and spread
Princess seam	Convert darts into seam lines

Problem Solving in Pattern Construction

Common Pattern Issues and Solutions:

Problem	Cause	Solution
Neckline gaping	Dart not properly placed or neckline cut too big	Adjust dart or neckline shape
Tight sleeve	Inadequate bicep width	Add ease using slash-and-spread
Uneven hemline after sewing	Incorrect grainline	Recheck grainline and fabric layout

Critical Thinking Practice

You drafted a dress with puff sleeves, but the sleeve feels too tight. What steps would you take to fix it?

Your neckline gaps open when worn. What might be causing this and how would you correct the pattern?

Suggested solutions (to be discussed with learners)

Uses the knowledge gained in week 19 on female garment style analysis, pattern breakdown to draft and grade into different sizes, try the following female garments.

Guidelines

Study a flat sketch of the garment designs that is: Neckline style, Sleeve type, Dart placement, Hem shape, Closure position.

Learning Tasks

Make patterns for different female body sizes by grading

Pedagogical Exemplars

Group learning, Activity based learning, Experiential learning

Pair learners to prepare each other’s basic block to be used as base pattern.

Activity based learning

Guide learners to grade their basic block to lower or higher sizes using the standard grading rules.

Key Assessment level 3: Written Analysis and Oral Presentation

You are a designer specialising in inclusive fashion. A client with limited mobility due to arthritis needs professional ladies dress workwear that provides ease of dressing while maintaining a polished appearance.

1. Problem Analysis (1 day): (20 marks)
- a. Analyse the provided case study, identifying specific mobility challenges

b. Research existing adaptive clothing solutions and their limitations

c. Develop assessment criteria for successful pattern adaptations based on:

• Client needs

• Professional appearance requirements

• Practical dressing solutions

• Comfort and dignity considerations
2. Solution Development (3 days) (30 marks)
- a. Select appropriate base patterns for professional ladies’ dress workwear

b. Develop multiple pattern adaptation approaches that address:

• Ease of dressing (closures, openings)

• Comfort while seated

• Professional appearance

• Accommodation of mobility aids if applicable

c. Create detailed technical diagrams showing your pattern manipulations

d. Document your reasoning for each adaptation decision
3. Prototype Creation & Testing (2 days): (25 marks)
- a. Create a muslin (gray baft) prototype of your most promising design

b. Test the prototype against your assessment criteria

c. Document strengths and weaknesses

d. Develop and implement refinements

e. Create a second prototype incorporating improvements
4. Comprehensive Solution Presentation:(25 marks)
- a. Present your final adapted patterns with all markings and adjustments

b. Provide a comprehensive design report that:

• Analyses the effectiveness of your pattern adaptations

• Explains how your solution balances functional and aesthetic needs

• Compares your approach to existing adaptive solutions

• Proposes additional adaptations for a complete wardrobe

• Reflects on ethical considerations in adaptive fashion design

PLC Session 21

- | | |
|------------|--|
| 45 minutes | Planning & Reviewing the Learning Plan |
|------------|--|
1. Begin the session by recapping lessons from the previous year/session/week, focusing on how learning was applied.

2. Use your subject specific app to explore the content before planning. Ask the app to

a. explain the week’s concepts in a practical way that will make it easier for learners to understand

b. identify two or three common misconceptions learners may have on the week’s content and how to address them using contexts familiar to Ghanaian learners. (NTS 3a, 3g and 3m).

3. Use your subject specific app to plan your lesson. Ask the app to

a. suggest the most effective method for teaching the week’s concepts to learners with diverse backgrounds.

b. suggest learning activities, differentiation and essential questions based on the method of teaching (NTS 3a-3q)

c. review your prepared learning plan and address any challenging issues you may have identified in your subject area (NTS 3a-3c).

Note

• Take note of the recap topics linked to Years 1 and 2 while preparing for your lesson.

• Refer to the Values Learning Community Handbook and link the values for the week in your lesson to ensure that learners are applying what they learn.

4. Plan the week’s key assessment with your app

a. The key assessment for the week is **written analysis and oral presentation**. Chat with your app to plan this assessment, indicating what you and your learners will do before, during and after the presentation (NTS 3k-3q).
- | | |
|------------|---------------------|
| 10 minutes | Content Exploration |
|------------|---------------------|
5. As a subject group, select one problem or idea/term in the week’s content that is challenging (not a routine procedural question, but one that requires conceptual understanding) and then

a. use the app, ask it to solve the problem step by step and explain the reasoning behind each step (you may be assisted by a teacher who is strong in the content area)

b. all teachers in the group work through a similar problem individually for 3–4 minutes

c. the group then works through the problem together step by step

d. highlight the most common errors made at each step and discuss (NTS 1c, 1e, 2c, 2e, 3e-3j).



Note

- This part is not just about ‘How do I teach this?’ but how do I teach it for learners to understand?
- If the group still shares the same content gap, use the app: ask it to solve the problem step by step and explain the reasoning behind each step.
- Problems/ideas discussed should be sourced from the Teacher Manual content, not invented separately. This keeps the content exploration directly connected to what teachers will deliver.

30 minutes

Enactment

6. Enact a teaching activity based on your learning plan (NTS 1a-1b, 1e-1g, 2c, 2e, 2f, 3c-3j and 3o).
- Colleagues observe with specific attention to clarity of concept explanation, use of familiar Ghanaian examples and how misconceptions are handled if they arise.
 - After the enactment, ask for structured feedback from the group
 - was the concept explained in a way that a learner with no prior knowledge could follow?
 - were the examples grounded in contexts familiar to Ghanaian learners?
 - did any misconceptions surface and if so, how were they addressed?

5 minutes

Reflection

7. Reflect and share your views on the session. One thing that worked well, what did not work well and what you will do differently. (NTS 1a, 1b).
8. Identify a critical friend to observe and provide feedback on your lesson in relation to the PLC Session conducted (NTS 1f, 1g).
9. Remember to
- transfer your chats into your learning planner template.
 - read your Teacher Manual and related Learner Material in preparation for the next session. Take note of the recap weeks, which are linked to Years 1 and 2 (NTS 3a).
 - integrate National Values, GESI, SEL, and 21st century skills into your learning activities, assessment tasks, and rubrics/mark schemes.

Section Review

Under this section, learners examined garment designs to identify and break patterns down into their various components. Learners explored the structure and arrangement of garment parts, analysing how individual pattern pieces contribute to the construction and overall appearance of garments. Through guided activities, learners developed an understanding of pattern interpretation, layout and the relationship between garment design and pattern development.

Learners were also taken through the process of grading patterns into different sizes using appropriate pattern grading techniques. They practised enlarging and reducing patterns systematically while maintaining the proportions, style and fit of the original design. Learners applied both manual methods and relevant technological tools where available to achieve accurate grading results.

Varied pedagogical strategies such as demonstrations, guided practice, collaborative learning and practical exercises were used to cater for the different learning proficiencies within the class. Assessment activities targeted higher levels of the Depth of Knowledge (DoK), requiring learners to analyse garment structures, apply grading principles and produce graded patterns accurately. Learners demonstrated understanding through the examination, development and presentation of garment pattern components and graded pattern pieces produced during the section.

MARKING SCHEMES FOR THE KEY ASSESSMENTS

WEEK 18

LI - Grade patterns to different sizes

Total Marks: 100

Question one marking scheme (40 marks)

1. Analyse the Size Chart Differences (Size 12 vs 14)

(Example based on a typical women’s size chart; adapt to your given chart)

Measurement	Size 12	Size 14	Difference
Bust	92 cm/ 36inches	96 cm/ 38	Inches +4cm/2inches
Waist	74 cm/ 29inches	78 cm/ 31	Inches +4cm/2inches
Hip	98 cm/ 39inches	102cm/ 40	Inches +4 cm/2inches

Conclusion: Grade the pattern (bodice) to add **4 cm/2inches** at bust, waist, and hip (total circumference). Since patterns are usually symmetrical (half or quarter), divide this increase accordingly:

For a **half bodice**, add 2 cm total (1 cm per side seam).

For a **quarter bodice**, add 1 cm total (0.5 cm per side).

(Use inches equivalent by choice)

Question one (40 marks)

Technical Accuracy

Check list Criteria	Excellent (Full Marks. 10)	Good (8, Marks)	Satisfactory (5, Marks)	Needs Improve- ment (3, marks)
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1.Measurement analysis from size chart (10 marks)	All measure-ments identi-fied with pre-cise values for bust, waist, hip, back width, and shoulder width differences	5 of the meas-urements cor-rectly identified with errors	4 of the meas-urements cor-rectly identified but with errors	3 of the meas-urements cor-rectly identified with errors
2. Grade rule application (10 marks)	Grade rules ap-plied with com-plete accuracy at all points	Grade rules applied with inaccuracies at 2 points	Grade rules applied with some significant inaccuracies at 4 points	Grade rules in-correctly applied at 6 points
3. Slash place-ment (10 marks)	Slashes placed at precise opti-mal locations for grading	Slashes placed at appropriate locations with 2 issues	Slashes placed with 4 signifi-cant positioning errors	Slashes incor-rectly positioned with 6 signifi-cant positioning errors
4. Spread meas-urement accura-cy (10 marks)	All spread meas-urements pre-cisely match required grade increments	Spread meas-urements match grade increments with 1 errors	Spread meas-urements have 4 errors	Spread meas-urements have 6 errors

2. Grade the Basic Bodice Pattern (Slash and Spread Method) (30 marks)

Question two marking scheme (30 marks)

Steps

Draw horizontal and vertical cut lines through key points:

Across the bust line

Across the waistline

Vertical lines through shoulder, armhole, and side seam

Slash (cut) along these lines without detaching completely.

Spread the pattern segments evenly:

Bust: Spread 1 cm at bust line (quarter bodice)

Waist: Spread 1 cm at waistline

Length (if needed): Add 0.5 cm to bodice length

Smooth curves along armhole, neckline, and hem.

Tape the adjusted pieces to a new sheet and retrace the full graded pattern.

Question two (30 marks)

Application of Principles

Criteria	Excellent (Full 10, Marks)	Good (8, Marks)	Satisfactory (5, Marks)	Needs Improve-ment (3, Marks)
Proportion-al grading (10 marks)	Style and propor-tions of original maintained	Style and propor-tions maintained with 2 distortions	4 distortions in style proportions	6 distortions in style proportions
Dart manipula-tion (10 marks)	Darts graded with correct po-sitioning and size	Darts graded with 2 issues in positioning or size	Darts graded with 4 issues in positioning or size	Darts incorrectly graded with 6 issues
Edge treatment (10 marks)	All edges (neck-line, armhole, etc.) smoothly graded with cor-rect curves	2 edges smoothly graded with mi-nor curve issues	4 edges improv-erly graded with noticeable curve issues	6 edges improv-erly graded with distorted curves

3. Mark All Necessary Pattern Markings (15 marks)

Question three (30 marks)

Ensure your graded pattern includes:

Grainline: Parallel to centre front/back

Notches: On armholes, sleeve caps, and side seams (single and double)

Darts: Redrawn and properly aligned

Seam Allowances: Typically, 1 cm or 1.5 cm or inches conversion; clearly marked

Size Label: “Size 14” on pattern piece

Question three (15 marks)

Pattern Markings

Criteria	Excellent (Full Marks, 3)	Good (2, Marks)	Satisfactory (1, Marks)	Needs Improve-ment (1, Marks)
Grainline place-ment (3 marks)	Grainline per-fectly positioned and clearly marked	Grainline ap-propriately positioned with minor clarity issues	Grainline po-sitioning has minor errors	Grainline incor-rectly positioned or missing
Notch placement and marking (3 marks)	All notches cor-rectly positioned and clearly marked	3 notches cor-rectly positioned and marked	2 notches posi-tioning or mark-ing	1 notch position-ing or missing notches
Dart marking (3 marks)	Darts precisely marked with all required infor-mation	Darts clear-ly marked with omissions like slightly turned	Darts marked with some signif-icant omissions like imbalance	Darts incorrectly marked or miss-ing information

Seam allowance indication (3 marks)	All seam allowances clearly indicated with correct widths	Seam allowances indicated with inconsistencies at just one side	Seam allowance indication at two sides	Seam allowance indication at all sides
Size labeling (3 marks)	Size label clearly marked and positioned correctly	Size label marked with positioning issues like one left unlabeled	Size label present but poorly positioned like two left unlabeled	Size label missing or incorrect like all left unlabeled

Question four (15 marks)

4. Written Explanation – Why Maintaining Original Style Proportions Is Important

Reason 1: Aesthetic Balance

Maintaining original proportions ensures that design features like darts and style lines appear in the correct places and retain their visual appeal. Without proportional accuracy, the garment can look distorted or unflattering.

Reason 2: Functional Fit

Style proportions affect how a garment fits across various body shapes. If the neckline, armholes, or darts are not properly scaled, the garment may restrict movement or not align with key anatomical landmarks.

Question four (15 marks)

Written Explanation

Criteria	Excellent (Full Marks, 7)	Good (5, Marks)	Satisfactory (3, Marks)	Needs Improvement (1, Marks)
Reason 1 explanation (7 marks)	Comprehensive explanation with specific examples and technical justification	Clear explanation with 5 examples	Basic explanation with 3 examples	Minimal or incorrect explanation with no explanation
Reason 2 explanation (7 marks)	Comprehensive explanation with specific examples and technical justification	Clear explanation with 5 examples	Basic explanation with 3 examples	Minimal or incorrect explanation with no explanation
Technical terminology (1 mark for all attempt)	Correct use of technical pattern grading terminology throughout	Some correct use of technical terminology	Limited use of technical terminology	Incorrect use or absence of technical terminology

WEEK 19

Total Marks: 100

Question one (40 marks)

1. Grading the bodice Down (Pattern Shift Method)

Step-by-Step: Pattern Shift Method (Downsizing)

The pattern shift method moves the pattern by specific increments and retraces the outline to grade between sizes.

Example Size Chart Comparison

(Adjust based on actual size chart cm/inches)

Measurement	Size 14	Size 10	Difference
Bust	92 cm	96 cm	-4cm
Waist	78 cm	70 cm	-8 cm
Hip	102 cm	94 cm	-8 cm
Length	60 cm	58 cm	-2 cm

Shift Calculations (For Quarter Pattern)

Divide circumference changes by 4 (for front and back halves):

Bust: $8 \div 4 = 2 \text{ cm}$ reduction

Waist: $8 \div 4 = 2 \text{ cm}$ reduction

Hip: $8 \div 4 = 2 \text{ cm}$ reduction

Length: Reduce by **2 cm total**

Execution

Place the original size 14 pattern on new paper.

Shift the pattern inward by 2 cm at both waist and hip points horizontally.

Shift downward by 2 cm at the hemline.

Connect Bust, waist, hip, and hemline smoothly with curved rulers.

Redraw darts so they maintain proportion relative to the waist reduction.

Retrace the smaller outline to complete the size 10 version.

Question One (40 marks)

Pattern Grading Execution

Criteria	Excellent	Good	Satisfactory	Needs Improvement
Pattern shift technique application (15 marks)	15 marks Pattern shift method applied with perfect precision for all pieces	11marks Method applied correctly with imprecisions	7marks Method applied with some significant errors	4 marks Method incorrectly applied or partially completed

Measurement accuracy (10 marks)	10 marks All graded measurements precisely match size 10 requirements	7 marks measurements accurate with 1–2mm deviations	5 marks Measurements have 3–5mm deviations	3 marks Measurements have 5mm deviations
Silhouette preservation (10 marks)	10 marks Bodice silhouette perfectly maintained in proportion	7 marks Silhouette maintained with 1 distortion	5 marks Silhouette has 2 noticeable distortions	3 marks Silhouette significantly altered
Curve transitions (5 marks)	5 marks All curves smoothly transitioned with perfect blending	3 marks Curves well-blended with 1 imperfection	2 marks 2 transitions in curved areas	1 mark Poor curve transitions throughout

Question two (30 marks)

2. Necessary Pattern Markings on the New Pattern

Mark the following clearly on your size 10 graded pattern:

Seam Allowances: Usually 1 cm for side seams, 1.5 cm for waist/hem, or inches equivalent labelled on edges.

Dart Placements: Clearly marked with notches and fold lines.

Bustline, Waistline and Hemline: Drawn and labelled.

Zipper Placement: Indicated along centre back seam or side seam, with notch marks.

Size Label: Write “Size 10” near pattern title block.

Question two rubrics (30 marks)

Pattern Markings (30 marks)

Criteria	Excellent	Good	Satisfactory	Needs Improvement
Seam allowances (8 marks)	8 marks All seam allowances precisely marked with correct widths	6 marks Seam allowances correctly marked with one inconsistency	4 marks 2 errors in seam allowance marking	2 marks Significant errors or omissions in all seam allowances
Dart placements (8 marks)	8 marks Darts perfectly positioned with accurate apex and legs	6 marks Darts correctly positioned with one inaccuracy	4 marks Darts positioned with 2 significant errors	2 marks Darts incorrectly positioned or missing entirely
Waistline/hemline marking (6 marks)	6marks Bustlines, waistline and hemline perfectly marked and shaped	4 marks Bustline, waistline and hemline correctly marked with 1 issue	3 marks 2 issues with Bustline, waistline or hemline marking	1 mark Poor or missing Bustlines, waistline or hemline marking

Zipper placement (4 marks)	4 marks Zipper placement clearly and correctly indicated	3 marks Zipper placement marked with 1 positioning issues	2 marks Zipper placement marked with 2 significant issues	1 mark Zipper placement missing or incorrect
Size label (4 marks)	4 marks Size 10 label clearly and professionally marked	3 marks Size label correctly marked with 1 presentation issues	2 marks Size label present but 2 poorly executed	1 mark Size label missing or incorrect

Question 3 (15 marks)

3. Measurement Calculations Worksheet

Measurement	Size 14	Size 10	Reduction	Quarter Pattern Adjustment
Bust	92 cm	96cm	-8 cm	-2 cm
Waist	78 cm	70 cm	-8 cm	-2 cm
Hip	102 cm	94 cm	-8 cm	-2 cm
Length	60 cm	58 cm	-2 cm	-2 cm (entire pattern)

These measurements are used to shift the pattern inward and upward during grading.

Question 3 (15 marks)

Calculation Worksheet

Criteria	Excellent (Full Marks, 5)	Good (3, marks)	Satisfactory (2, marks)	Needs Improvement (1 Mark)
Bust and waist reduction calculations (5 marks)	Bust and waist reduction precisely calculated with clear method shown	Calculations correct with 1 error in presentation	Calculations with 2 errors but reasonable approach	Significant errors in waist reduction calculations
Hip reduction calculations (5 marks)	Hip reduction precisely calculated with clear method shown	Calculations correct with 1 error in presentation	Calculations with some errors but 2 reasonable approaches	Significant errors in hip reduction calculations
Length adjustment calculations (5 marks)	Length adjustment precisely calculated with clear method shown	Calculations correct with 1 error in presentation	Calculations with 2 errors but reasonable approach	Significant errors in length adjustment calculations

Question four (15 marks)

4. Brief Explanation: Grading Down vs. Grading Up

Grading Down

- Involves removing width and length from the pattern.
- Darts may need to be redrawn smaller and repositioned to maintain balance.
- Risk of losing important style or fit details (e.g., waistband could become too tight if not adjusted properly).
- Requires careful handling to avoid making the garment too tight or short.

Grading Up

- Adds width and/or length to the original pattern.
- Must ensure that design details scale correctly (e.g., increase dart intake and spacing proportionally).
- Can introduce distortion if not balanced across multiple points (e.g., waist, hips, hem).
- Both grading directions require maintaining design integrity and functional fit, but grading down typically focuses more on **compression without distortion**, while grading up emphasizes **expansion with balance**.

Question four (15 marks)

Written Explanation

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Technical accuracy (6 marks)	Explanation demonstrates complete understanding of grading differences	Good understanding with 1 technical omission	Basic understanding with 2 technical errors	Poor understanding of grading differences
Comprehensiveness (6 marks)	6 marks Comprehensive explanation covering multiple considerations (fit, proportion, balance, tension)	4, marks Good explanation covering 1 consideration	3 marks Explanation covers 2 considerations only	mark Limited or superficial explanation
Technical terminology (3 marks)	3 marks Excellent use of technical terminology throughout	2 marks Good use of technical terminology	1 mark Limited use of technical terminology	1 mark Poor or incorrect use of terminology

WEEK 20

Total Marks: 100

Question one marking scheme (25 marks)

1. Analyse them and Identify Pattern Components

From analysing the party dress photograph (typically a full-length formal dress with couture finishes), the pattern components would include:

Core Pattern Pieces

- Front bodice (draped or reached)
- Back bodice (possibly princess seamed)
- Bodice lining (front and back)
- Shoulder straps or sleeves (if applicable)
- Waistband or midriff panel (if applicable)
- Pleated overlay (skirt front and back)
- Dress lining
- Structured collar (if applicable)
- Zipper panel or back opening
- Hem facings or crinoline support
- Stay tape/support interfacing

Observation Tip: Use photos to identify seams, darts, pleats, grainline direction, and surface texture (e.g., matte, gathered, shiny).

Question one (25 marks)

Pattern Component Identification

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Completeness of identification (10 marks)	10 marks All pattern components identified, including hidden structural pieces	7, marks 1 pattern components identified with minor omissions	5 marks 2 components identified but several secondary pieces missed	2, marks Significant gaps in all component identification
Accuracy of component description (10 marks)	10 marks Precise technical description of each component with specific details	7, marks Accurate descriptions with 1 technical detail	5 marks Basic descriptions with 1 technical detail	2, marks Vague or incorrect descriptions in all
Recognition of construction methods (5 marks)	5 marks Thorough analysis of construction approaches evident in component identification	3. marks 1 analysis of most construction approaches	2. marks 2 analysis of obvious construction approaches	1 mark Limited or incorrect analysis of construction

Question 2 (30 marks)

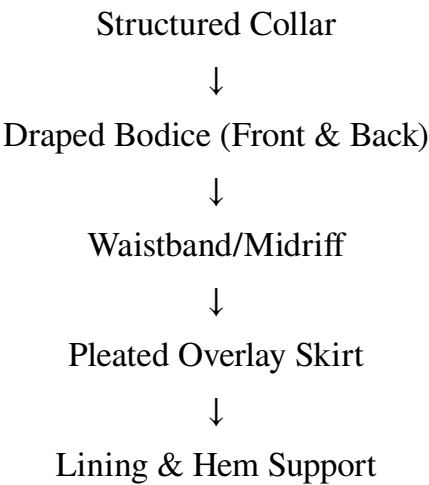
2. Component Map

Component Map Overview

Pattern Pieces & Relationships

mathematical

Copy-edit



Order of Assembly

- Construct bodice and insert bust/waist darts.
- Drape or pleat the bodice fabric as needed.
- Attach bodice front/back at shoulder seams.
- Insert structured collar and finish neckline.
- Sew side seams and add lining.
- Assemble waistband and attach it to bodice.
- Pleat lower dress /skirt overlay and attach to waistband.
- Add lower dress / skirt lining.
- Insert zipper at back seam.
- Finish hem with facing or horsehair braid.

Critical Construction Points

- Matching pleats precisely at the waist
- Aligning drape grainlines for proper fall
- Reinforcing structured collar with interfacing (if applicable)
- Inserting zipper cleanly at back closure
- Supporting bodice with stay tape for structure

Question two (30 marks)

2. Component Map Creation

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Comprehensive piece inventory (10 marks)	10 marks Complete, detailed inventory of all required pattern pieces with clear labels	marks Complete inventory with 2 omissions in detail	5 marks Basic inventory missing 4 secondary pieces	2, marks Incomplete inventory with significant omissions in all
Relationship mapping (7 marks)	7 marks Clear, precise illustration of all component relationships with technical notations	5 marks 1 illustration of most component relationships	4, marks 2 illustration of main component relationships	2, marks Poor or confusing relationship mapping in all
Assembly sequence (7 marks)	7 marks Logical, comprehensive assembly order with clear rationale	5, marks 1 assembly order with minor logical gaps	4, marks 2 assembly order with some logical issues	2, marks Confusing or technically incorrect assembly order
Critical construction points (6 marks)	6 marks All critical construction points identified with precise technical notes	5, mark 1 critical points identified with good technical notes	4, marks 2 critical points identified with limited notes	2, marks all critical points identified or incorrectly noted

Question three (30 marks)

3. Three Complex Components

A. Draft Bodice

Sketch: (Preferred image provided)

Drafting Approach

- Begin with a basic bodice block.
- Add 5–10 cm/ inches equivalent extra fabric along bust and waist areas for draping.
- Adjust folds, pin into shape, and transfer back to flat pattern.

Justification

This method preserves fit while giving natural, fabric-directed folds that mimic the original party dress.

Pleated Overlay lower dress/ Skirt

Sketch: (Preferred image provided)

Drafting Approach

- Start with a basic bodice block.

Determine number and width of pleats (e.g., 5 pleats at 4 cm each = 20 cm/ inches equivalent added to front width).

Mark fold lines and pleat depths.

Add seam allowances and notches to guide folding.

Justification

Flat pattern pleat drafting ensures consistent fold placement and volume control, mirroring the original structured fullness.

Structured Collar (If applicable)

Sketch: (Preferred image provided)

Drafting Approach

Use neckline measurements to create collar base.

Add flare or stand as needed.

Interface with horsehair braid, canvas, or fusible.

Add facing and match notches to neckline seam.

Justification

Tailored drafting allows for crisp shape and support without distortion, as seen in haute couture collar finishes.

Question thee (30 marks)

3. Complex Component Analysis

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Pattern shape sketching (9 marks per component)	9 marks Accurate, detailed technical sketches with precise proportions and notations	7, marks Good technical sketches with 1 proportion issues	5, marks 2 sketches with limited technical detail	2 marks Poor or incorrect sketches in all
Drafting approach explanation (12 marks per component)	12 marks Comprehensive, step-by-step explanation of drafting techniques with technical precision	9 marks Clear explanation with most technical detail	6 marks explanation with limited technical detail	3 marks Vague or incorrect drafting explanation in all
Design effect justification (9 marks per component)	9 marks Sophisticated justification connecting pattern shape directly to visual effect with fabric properties considered	7, marks justification with clear connections between pattern and effect	5, marks justification with limited connection to visual effect	2 marks Poor or illogical justification in all

Question four (15 marks)

4. Components Requiring Specialised Drafting Techniques

Components:

Drafted Bodice: Requires flat pattern.

Pleated lower dress/ skirt: Needs *advanced pleat engineering* to control volume.

Structured Collar: Involves *tailoring techniques* (horsehair, interfacing).

Explanation:

These parts go beyond basic pattern grading or manipulation because they rely on:

Fabric behavior (draping vs. stiffness)

Structural support (interfacing, lining)

Precision in decorative vs. functional seams

Question four (15 marks)

4. Specialised Technique Evaluation

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Identification of specialised components (5 marks)	5 marks Comprehensive identification of all components requiring specialised techniques	4, marks Identification of 3 specialised components	3, marks Identification of 2 specialised components only	1 mark 1 or incorrect identification
Technical reasoning (5 marks)	Sophisticated reasoning demonstrating deep understanding of pattern engineering principles	Good reasoning showing solid understanding of pattern engineering	Basic reasoning showing fundamental understanding	Limited or incorrect reasoning
Alternative approaches consideration (5 marks)	Thoughtful analysis of multiple possible approaches with comparative evaluation	Good consideration of alternative approaches	Basic mention of alternative approaches	No consideration of alternatives

WEEK 21

Question one (20 marks)

1. Problem Analysis (1 Day)

A. Mobility Challenges Identified (from Case Study)

- Difficulty with **fine motor skills** (buttons, zippers)
- Limited **shoulder and elbow mobility** (restricts reaching overhead and behind)
- Discomfort from **tight closures or stiff seams**
- Need for **seated comfort** for prolonged periods

B. Existing Adaptive Clothing Solutions & Limitations

Feature	Common Solutions	Limitations Identified
Magnetic closures	Used in adaptive shirts/ jackets	Often bulky or too casual in appearance
Velcro fastenings	Used in pants and blouses	Noisy, may lose adhesion with laundering
Elastic waistbands	Common in pants	Often too casual or unflattering for profes- sional wear
Back-closure gar- ments	Easier for caregivers to assist	Not always empowering for independent use

C. Assessment Criteria for Pattern Adaptation

- Client Needs:** Easy-on/easy-off design; minimal pressure on joints
- Professional Appearance:** Clean lines, structured fit, no visible adaptive features
- Practicality:** Front or side closures, soft linings, seated comfort
- Comfort & Dignity:** Soft seams, sensory-friendly fabrics, no infantilising design

Question one

Problem Analysis (20 marks)

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfacto- ry (50% of Marks)	Needs Improve- ment (25% of Marks)
Mobility challenge analysis (6 marks)	6 marks Comprehensive identifi- cation of specific mobility challenges with detailed understanding of their impact on dressing	5, marks Good identifica- tion of key (4) challenges with understanding of dressing impact	3 marks Basic iden- tification of obvious (3) challenges	2, marks Limited or superficial (1) analysis of chal- lenges
Adaptive solution research (6 marks)	6 marks Thorough research of ex- isting solutions with crit- ical analysis of strengths and limitations	5, marks Good research with solid analysis of limitations	3 marks Basic research with limited analysis	2, marks Minimal research with poor un- derstanding of limitations

Assess- ment criteria develop- ment (8 marks)	8 marks Sophisticated, client-cen- tred criteria framework addressing all key aspects with measurable indica- tors	6 marks Well-developed criteria framework addressing main aspects	4 marks Basic criteria covering es- sential ele- ments	2 marks Limited criteria lacking specifi- ty or client focus
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Question two (30 marks)

2. Solution Development (3 Days)

A. Sample Base Patterns Selected: (Suggestions)

- Princess-seam straight dress with shirt sleeve
- Straight dress with cap sleeve
- Professional blouse with raglan sleeves

B. Pattern Adaptation Approaches

Garment	Adaptation	Diagram Sum- mary	Reasoning
Prin- cess-seam straight	Side seam invisible zipper + mag- netic front overlap flap	[openings dia- gram]	Easy to don/doff without shoulder strain; main- tains a clean tailored front
Blouse	Extended batwing sleeve with opening (snap or Velcro closure)	Batwing with opening and clo- sure diagram]	Increases arm mobility; no need to raise arms; avoids back fastenings
Straight dress	Front openings and closers with overlapping panels and Velcro/ magnet combo inside waistband (where applicable)	front and back opening with magnetic waist- band diagram]	Mimics formal structure with adjustable entry point; easy for dressing seated or standing

C. Accommodation for Mobility Aids

- Slightly longer top back hems to prevent riding up in seated position
- Side-seam zippers angled to avoid interference with walking frames
- No back closures to preserve independence where applicable

D. Documented Reasoning

- Every closure aims for **low-pressure, intuitive use**
- Stretch panels subtly integrated for comfort without compromising formality
- Professional look maintained via **faux flies, dart shaping**, and **structured facings**

Question two

Solution Development (30 marks)

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Base pattern selection (5 marks)	5 marks Strategic selection of professional patterns with detailed consideration of adaptation potential	4, marks Good selection with consideration of adaptation needs	3, marks Acceptable selection with basic consideration of needs	1 mark Poor selection with limited consideration of client needs
Pattern adaptation approaches (10 marks)	Multiple innovative adaptation approaches comprehensively 10 10 10 marks addressing all client needs	Multiple good approaches 8. marks addressing most client needs	5 marks Basic approaches addressing essential needs	Limited approaches 3, marks inadequately addressing needs
Technical diagrams (8 marks)	Precise, detailed technical diagrams clearly illustrating all pattern manipulations	Good diagrams illustrating main manipulations	Basic diagrams showing essential changes	Poor or unclear diagrams
Adaptation reasoning (7 marks)	7 marks Comprehensive documentation with evidence-based reasoning for all decisions	5 marks Good documentation with clear reasoning for most decisions	4, marks Basic documentation with simple reasoning	2, marks Limited documentation with poor reasoning

Question three (25 marks)

3. Prototype Creation & Testing (2 Days)

A. First Muslin Prototype

Fabrics used: cotton blend (blouse), poly-viscose (trousers), soft suiting (blazer)

Closure locations tested with client input

B. Prototype Evaluation

Feature samples	Strength	Weakness
Magnetic flap	Easy to close; looks like standard double-breasted	Slight bulk at seam—revised with thinner magnets
Wrap waistband	Fully adjustable and stylish	Needed softer interfacing
Raglan sleeve	Allowed greater range of motion	Side closure angle needed adjustment

C. Refinements Made

Switched to **flat magnetic closures** embedded in seam for less bulk

Recut sleeve placket with angled cut for easier reach

Added a small loop at inside dress closers and openings for one-handed pulling

D. Second Prototype Created

Fully refined, professionally finished version

Client successfully dressed without assistance

Passed wear-test for both **functionality** and **style**

Question 3 (25 marks)

Prototype Creation & Testing

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
First prototype construction (6 marks)	6 marks Expertly constructed with precise execution of adaptations	5, marks Well-constructed with good execution of adaptations	3 marks Adequately constructed with functional adaptations	1 mark Poorly constructed with significant flaws
Testing methodology (6 marks)	6 marks Rigorous, systematic testing against all assessment criteria with detailed documentation	5, marks Good testing against most criteria with documentation	3 marks Basic testing against main criteria	1 mark Limited testing with poor documentation
Strengths/weaknesses analysis (5 marks)	5, marks Insightful, balanced analysis with specific references to client needs	4, marks Good analysis with references to key client needs	3, marks Basic analysis identifying obvious issues	1, mark Limited analysis lacking client focus
Refinement implementation (8 marks)	8 marks Strategic refinements directly addressing identified weaknesses, with excellent second prototype	6, marks Good refinements addressing main weaknesses with improved prototype	4, marks Basic refinements with functional second prototype	2, marks Minimal refinements with limited improvement

Question four (25 marks)

4. Comprehensive Solution Presentation

A. Final Adapted Patterns Submitted

Digital and physical versions with:
All markings: darts, notches, seam allowances, fold lines, adaptive points
Colour-coded pattern instructions
Step-by-step assembly notes

B. Design Report Summary

- i. **Pattern Adaptation Effectiveness**
Clear improvement in **ease of dressing**
Style integrity maintained through **hidden adaptations**
Comfort and self-reliance prioritised
- ii. **Functional & Aesthetic Balance**
Adaptive features completely concealed when worn
Sleek, tailored silhouette with soft inner finishes
- iii. **Comparison with Existing Adaptive Solutions**

Your Design	Typical Adaptive Options
Tailored, office-ready look	Often casual or overly medical
Hidden magnetic/Velcro closures	Bulky or childlike adaptations
Soft seam engineering	Rarely prioritised in fast-adaptive wear

- iv. **Suggested Wardrobe Additions**
Matching skirt with **rear or side full-length invisible zip**
Soft suiting dress with **front panel lift system**
Cardigan blazer hybrid with **snap shoulder openings**

C. Ethical Considerations

Avoided designs that infantilise or stigmatise
Empowered independence and personal style
Aimed for **inclusion, not distinction**

Question 4 (25 marks)

Comprehensive Solution Presentation

Criteria	Excellent (Full Marks)	Good (75% of Marks)	Satisfactory (50% of Marks)	Needs Improvement (25% of Marks)
Final pattern presentation (5 marks)	5 marks Professional-quality patterns with precise markings, adaptations clearly indicated	4, marks Good quality patterns with clear markings and adaptations	3, marks Functional patterns with basic markings	1 mark Poor quality patterns with unclear markings
Adaptation effectiveness analysis (5 marks)	5 marks Comprehensive analysis with evidence-based evaluation of all adaptations	4, marks Good analysis with evaluation of most adaptations	3, marks Basic analysis with limited evaluation	1 mark Superficial analysis lacking depth
Functional/aesthetic balance (5 marks)	5 marks Sophisticated discussion of balance achievement with specific examples	4, marks Good discussion with relevant examples	3, marks Basic discussion with limited examples	1 mark Poor discussion with few examples
Comparative analysis (4 marks)	4 marks Insightful comparison with existing solutions highlighting unique advantages	3 marks Good comparison with clear advantages identified	2 marks Basic comparison with some advantages noted	1 mark Limited comparison with few insights
Wardrobe extension proposals (3 marks)	3 marks Creative, comprehensive proposals for cohesive wardrobe extension	2 marks Good proposals for wardrobe extension	1 mark Basic proposals with limited scope	1 mark Few or impractical proposals
Ethical reflection (3 marks)	3 marks Profound reflection on multiple ethical dimensions of adaptive design	2 marks Good reflection on main ethical considerations	1 mark Basic reflection on obvious ethical aspects	1 mark Limited reflection lacking depth

