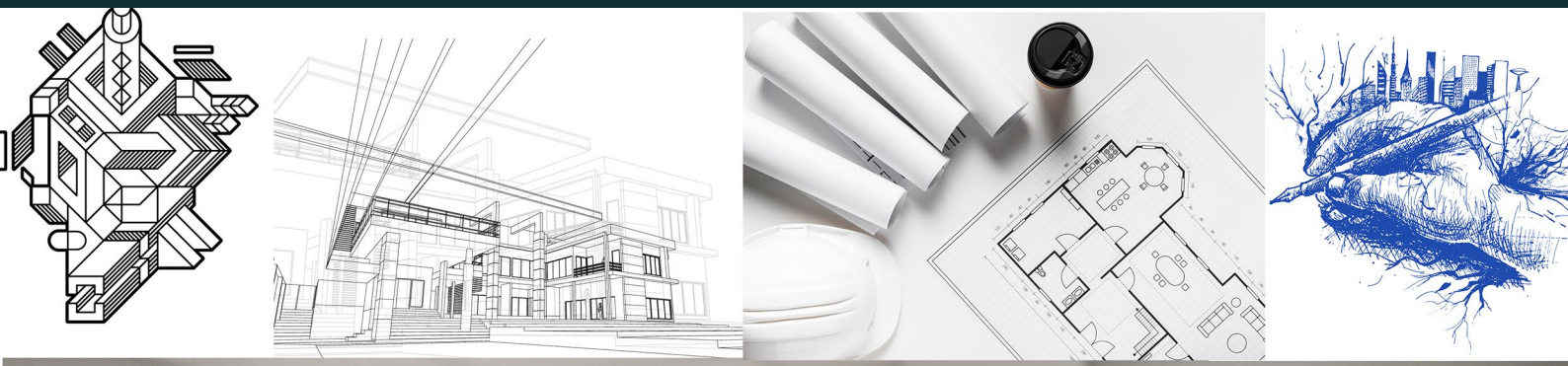
MINISTRY OF EDUCATION

DESIGN AND COMMUNICATION TECHNOLOGY

For Senior High Schools

TEACHER MANUAL





YEAR TWO

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 Two

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 a new Senior High School (SHS) curriculum which aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, competencies, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, further their education and enter the world of work.

This is the first time that Ghana has developed an SHS Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

This Teacher Manual for Design and Communication Technology is a single reference document which covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively teach Year Two of the new curriculum. It contains information for all 24 weeks of Year Two including the nine Key Assessments required for the Student Transcript Portal (STP).

Thank you for your continued efforts in teaching our children to become responsible citizens.

It is our belief that, if implemented effectively, this new curriculum will go a long way to transforming our Senior High Schools and developing Ghana so that we become a proud, prosperous and values-driven nation where our people are our greatest national asset.

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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SECTION 1: CONCEPTUAL DRAWING

UNIT 1 CONCEPT SKETCHES

STRAND: CONCEPTUAL DRAWING

Sub-Strands: Concept sketches

Learning Outcome: *Demonstrate basic knowledge in concept sketches by creating designs using basic shapes, rendering techniques, perspective and proportions*

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



HINT

- *Learners should be assigned a group project in week 3 and present their digital or manual album in week 7. Refer to Appendix B at the end of this section for more information on the project.*
- *Remind learners to create a portfolio in week 2 to show performance progress in the academic year and submit in week 22. Refer to appendix A for sample portfolio assessment. Include the designs in the portfolio.*

INTRODUCTION AND UNIT 1 SUMMARY

This unit draws on learners' confidence and ability built in year one to use the various rendering techniques, proportions and perspectives to create their own complex object forms in perspectives, using freehand drawing, individually and in groups. Learners will be allowed to explore and experiment with the various techniques and tools available to enhance their drawings, learners will be encouraged to create 21st century designs using concept sketches.

The weeks covered by sub-strand 1 (concept sketches) are:

Week 1: Examine various basic shapes and rendering techniques used to create complex object 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.

Week 3*:* Use the idea of concept sketches to create complex designs with graphite pencil and coloured pencil sketches in freehand drawing

SUMMARY OF PEDAGOGICAL EXEMPLARS

The pedagogical strategy to facilitate the learning process should be learner-centred, learners should be made to experience various examples of complex object forms through internet searching and any other appropriate medium. Learners should work in defined groups to share ideas on complex object forms and how to create different forms individually or in groups.

ASSESSMENT SUMMARY

The assessment for monitoring learning will be based on learners' ability to analyse and record various basic shapes and rendering techniques as well as generate a manual or digital album of complex forms created with simple shapes. Learners' ability to experiment with the various techniques and shapes to create complex forms should also be assessed, whilst encouraging learners to appreciate each other's work.

WEEK 1

Learning Indicator: Examine various basic shapes and rendering techniques used to create complex object forms in freehand drawing

Focal Area 1: BASIC SHAPES AND RENDERING TECHNIQUES

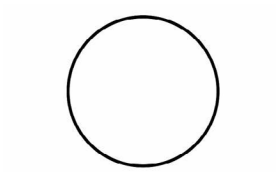
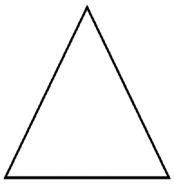
Sketching complex object forms can be an exciting and challenging aspect of drawing, which involves creating intricate and detailed shapes that go beyond basic geometric figures.

Complex object forms are often made up of simple shapes combined in various ways. By breaking down a complex form into its basic components, you can easily understand and sketch the overall shape.

Basic shapes are the foundation of all geometric forms and are essential with the use of various rendering techniques.

Basic Shapes

Table 1.1.1 basic shapes used for designing

CIRCLE A set of points equidistant from a centre point.	
SQUARE A quadrilateral with four equal sides and four right angles.	
TRIANGLE A polygon with three edges and three vertices.	

Rendering techniques

Rendering techniques in free-hand sketches involve using various methods to add depth, texture, and realism to drawings. Here are some techniques commonly used:

1. **Contour Shading:** By varying the thickness and darkness of lines along the contours of objects, you can create the illusion of depth and form.

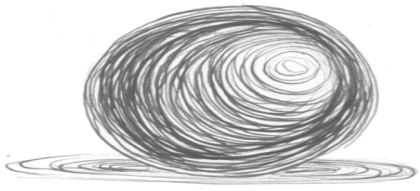


Figure 1.1.1: *contour shading*

2. **Smudging and Blending:** You can use your fingers, a tissue, or blending stumps to gently smudge and blend pencil or charcoal marks. This technique helps to soften transitions and create smoother gradients.

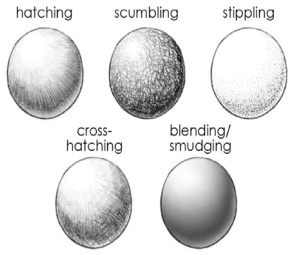


Figure 1.1.2: *smudging and blending*

3. **Highlighting:** Leaving areas of the paper blank or lightly shading them can create highlights and enhance the contrast in your sketches.

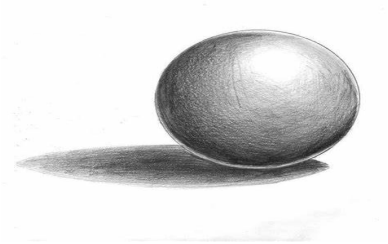


Figure 1.1.3: *highlighting*

4. **Negative Space Drawing:** Paying attention to the spaces around and between objects can help define shapes and improve overall composition.



Figure 1.1.4: *negative space drawing*

5. **Adding Texture:** Experiment with different marks and strokes to suggest textures like wood grain, fabric, or rough surfaces.
6. **Layering:** Building up layers of pencil or charcoal gradually to create depth and richness in your sketches. Start with light layers and gradually darken areas as needed
7. **Erase and Lift-off:** Using an eraser or kneaded eraser, you can lighten areas or create highlights by lifting off some of the graphite or charcoal.
8. **Using Different Pencils and Tools:** Different pencils (hardness and softness) and tools (charcoal, pastels) can create different effects. Experiment with them to find what works best for your style.

These techniques can be combined and adjusted to suit the subject matter and style of the sketches, whether drawing still life, landscapes, or portraits. Practice and experimentation will help develop unique rendering style.

Advancements in technology have introduced Artificial Intelligence (AI) and neural rendering, which can create more efficient and accurate rendering processes. These techniques are used in architecture, game design, and 3D animation, bringing virtual concepts to life with stunning clarity.

Common mistakes in rendering

Mistakes will happen, and possibly one of the most important things to remember when one approaches rendering to drawings is not to be afraid of making mistakes. The work needs to be as close to perfect as possible and will get the credit it deserves when shared with others.

Common mistakes in rendering can significantly affect the quality and realism of the final image. Here are some of the most frequently encountered mistakes:

Inaccurate Reflections: Rendering materials like glass and mirrored surfaces requires careful attention to detail. Overlooking the subtleties of reflections can lead to images that don't match the final structure.

Unrealistic Placement of Elements: For example, placing trees on top of skyscrapers without considering the practicalities of such design decisions can lead to misleading visualisations.

Overcrowding the Scene: Adding too many elements to a design can make a space feel chaotic and detract from the main focus of the rendering.

Excessive Use of Colour: While colour adds vibrancy, using too much can make a render look unrealistic and distract from the intended design elements.

Poor Lighting: Lighting should mimic real-world sources to highlight the focus of your render realistically. Incorrect lighting can make a scene appear too dark or too bright, obscuring details.

Ignoring the Impact of Scale: Using scale figures (people, vehicles, trees) repetitively or inaccurately can disrupt the sense of realism and proportion in a rendering.

Taking the Wrong Perspective: Choosing an inappropriate viewpoint can distort the perception of space and scale, leading to a less impactful rendering.

To improve rendering skills, it Is essential to learn from these common mistakes and apply best practices to create more compelling and realistic visualisations. Always strive for a balance between creativity and realism and remember that practice makes perfect. Practice, critique, and continuous learning are key to mastering the art of rendering.

Learning Task

1. List the characteristics of 3 basic shapes and 3 rendering techniques used to create complex object forms.
2. Generate manual/digital pictorial charts of basic shapes and rendering techniques that can be used to create complex forms.

Pedagogical Exemplars

1. **Group Work/Collaborative Learning**

   Learners in groups discuss the characteristics of basic shapes and rendering techniques used to create complex forms with the aid of relevant resources such as photographs, drawings, videos, charts and actual objects in the environment. Ensure the AP and P learners actively participate in the discussions. To ensure differentiation, the teacher can form groups considering the learners' readiness, interests, and learning styles. The complexity of the task can be varied based on the group's readiness level.

2. **Problem-based Learning/Experiential Learning**

   Learners in groups observe how basic shapes and rendering techniques have been used to create complex forms with the aid of relevant resources such as photographs, drawings, videos, charts and actual objects in the environment.

3. **Project-based Learning/Experiential Learning**

   Learners in groups generate manual/digital pictorial charts of basic shapes and rendering techniques that can be used to create complex forms.

Key Assessment

Level 1: List the characteristics of 3 basic shapes and 3 rendering techniques used to create complex forms.

Level 2: Describe the characteristics of basic shapes and rendering techniques used to create complex forms

Level 3: Explain how basic shapes and rendering techniques have been used to create complex forms.

Level 4

1. Generate manual/digital pictorial charts of basic shapes and rendering techniques that can be used to create complex forms.
2. Discuss and record
   a. Two characteristics each of two basic shapes used to create complex forms
   b. Two characteristics each of two rendering techniques, used to create complex forms



HINT

The recommended mode of assessment for week 1 is group discussion. Use the level 4 question 2 as a sample question.

WEEK 2

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

Focal Area 1: CREATING DESIGNS IN TWO-POINT PERSPECTIVE

Drawing is full of fundamental techniques which are used to improve artworks and drawing realistically, understanding these techniques is vital. Perspective is one of these approaches.

Perspective

It is a method of representing space in which the scale of an object diminishes as the distance from the viewer increases. Essentially, objects that are farther away from the observer appear smaller than those that are closer. The position at which they meet is the horizon line, while the intersection where the ground meets the sky is called the vanishing point**.**

Principles of two-point perspective

Just as one-point perspective focuses on one vanishing point, two-point perspective focuses on two vanishing points. Typically, these two points are at the opposite sides of the composition, such as one on the far left and another on the far right. Two-point perspective has vertical lines that are perpendicular to the ground plane. For example: think of the sides of a building as the vertical lines and the sidewalk as your ground plane.

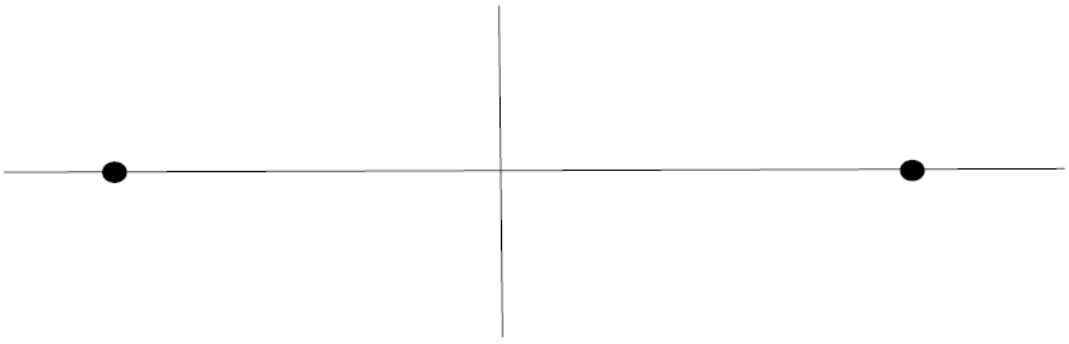
Procedures

1. Draw a horizontal line to represent the horizon or the eye level, this could be at eye level, above eye level or below eye level

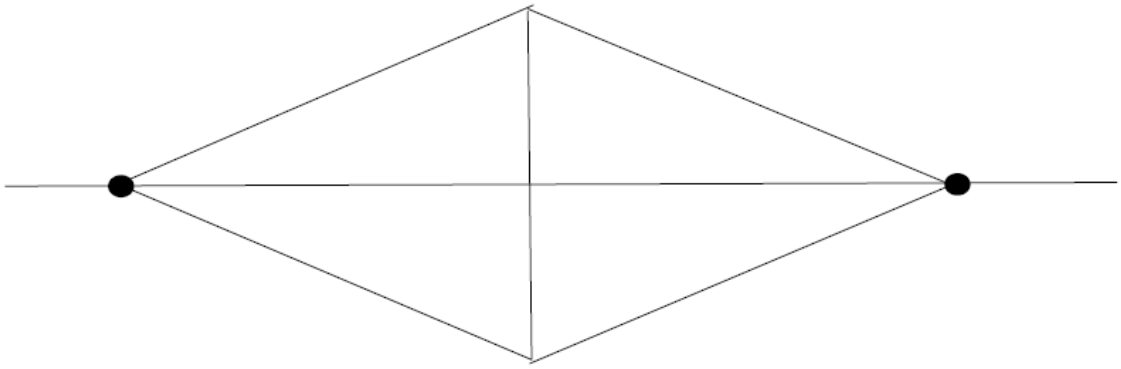
2. Mark two vanishing points on the horizon, one on the left and one on the right.



3. Draw a vertical line to represent the corner of the object you want to sketch.



4. Draw perspective lines from each vanishing point to create a grid.



5. Draw parallel vertical lines to indicate where the object ends.

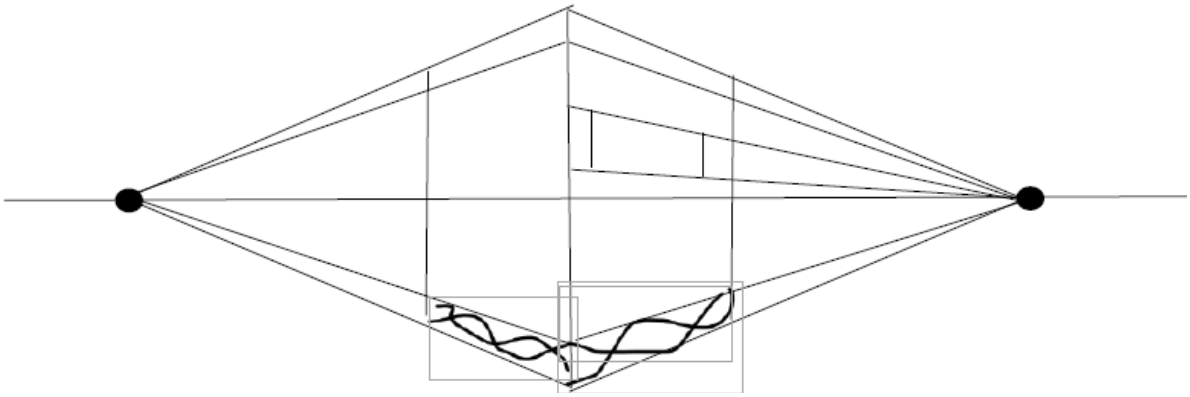


Figure 1.1.4: *Stages involved in creating two- point perspective*

Sketching in two-point perspective

Create a Grid: The technique for improving perspective in realism is creating a grid. This simple yet effective tool can help you maintain proportion in perspective, especially when drawing complex scenes or objects.

Measure Proportions: One critical aspect of achieving realism in your drawings is mastering the art of measuring with respect to proportions. Proper proportion can make your drawings more appealing and real.

Use Shading and Shadow: Another essential tool in the realism toolbox is the use of shading and shadow. These elements are key to adding depth and dimension to your drawings, which will make them appear more real.

Practice Regularly: Now that we have covered some essential techniques for improving perspective in realism, let's talk about an aspect that is just as important: regular practice. Just like any other skill, the more you draw, the better you become.

Examples of designs in two-point perspectives

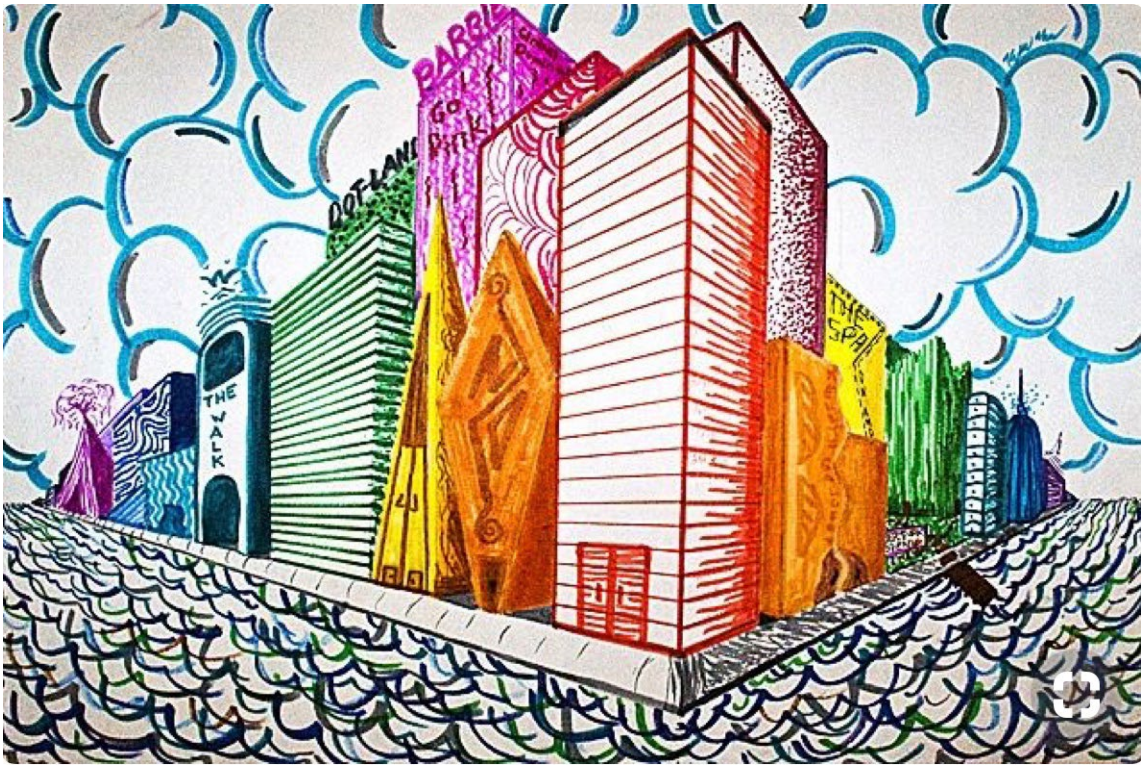


Figure 1.1.5: *two-point perspective design*

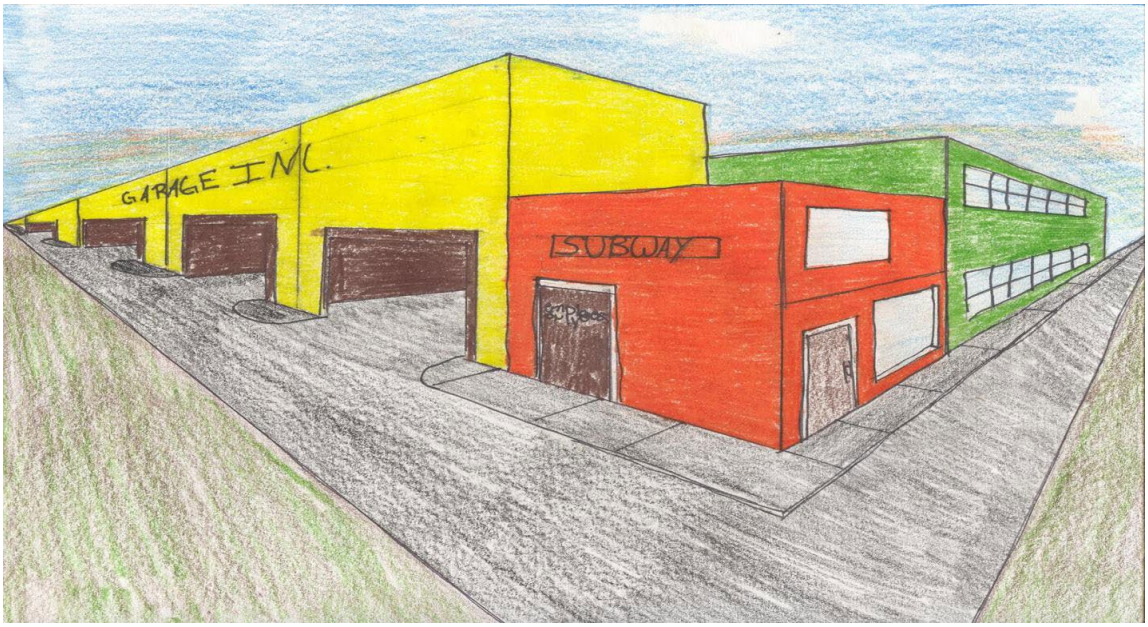


Figure 1.1.6: *two-point perspective design*

Learning Task

Create a complex object form using 2-point perspective with emphasis on proportions and freehand sketches

Pedagogical Exemplars

1. **Group Work/Collaborative Learning**

   Learners in groups discuss the characteristics of 2-point perspective with emphasis on proportions, and how they can be used to create complex forms with the aid of relevant resources such as photographs, drawings, videos, charts and actual objects in the environment. Encourage all learners to contribute to the discussion while ensuring that a few learners do not dominate the discussion session. Develop communication and discussion skills to facilitate learning.

2. **Project-based Learning/Experiential Learning**

   Learners in groups generate manual/digital pictorial charts of complex object forms created using 2-point perspective with emphasis on proportions.

3. **Project-based Learning**

   Learners in groups/individuals experiment with relevant tools and techniques to create complex object forms using 2-point perspective with emphasis on proportions and freehand sketches. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

Key Assessment

Level 1: List 3 (three) characteristics of 2-point perspectives.
Level 2

1. Describe the characteristics of 2-point perspectives and how they can be used to create complex forms.
2. Explain 3(three) characteristics of 2-point perspectives.

Level 3: Analyse and compare the characteristics of complex forms created using 2-point perspectives and create manual/digital pictorial charts that highlight the proportions and variations in these forms.
Level 4: Create complex forms using 2-point perspectives with emphasis on proportions and freehand sketches



HINT

The recommended mode of assessment for week 1 is **homework**. *Use the level 2 question 2 as a sample question.*

WEEK 3

Learning Indicator: Create complex designs with graphite pencil and coloured pencil sketches in freehand drawing using the idea of concept sketches

Focal Area 1: COMPLEX DESIGNS

Many complex designs use simple shapes to create more complex shapes. With some rendering, complex shapes transform into realistic compositions. Mastery of the fundamental use of simple shapes and rendering is the path to create beautiful designs.

Creating complex designs

Understanding Basic Forms: Before diving into complex forms, it is essential to have a good understanding of basic geometric shapes like cubes, spheres, cylinders, and cones. These simple forms are the building blocks of more complex structures.

Breaking Down Complex Shapes: Complex object forms are often made up of simple shapes combined in various ways. By breaking down a complex form into its basic components, it can easily be understood and sketched to the overall shape.

Perspective and Proportion: Understanding perspective is crucial when sketching complex forms. It helps in maintaining the correct proportion and depth, making the sketches look more realistic.

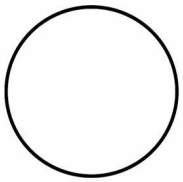
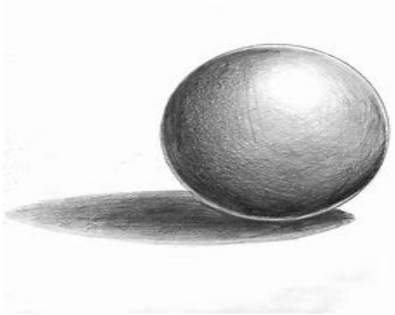
Light and Shadow: The interplay of light and shadow can turn a flat shape into a three-dimensional form. Learning how to effectively use shading can greatly enhance the perception of complexity in sketches.

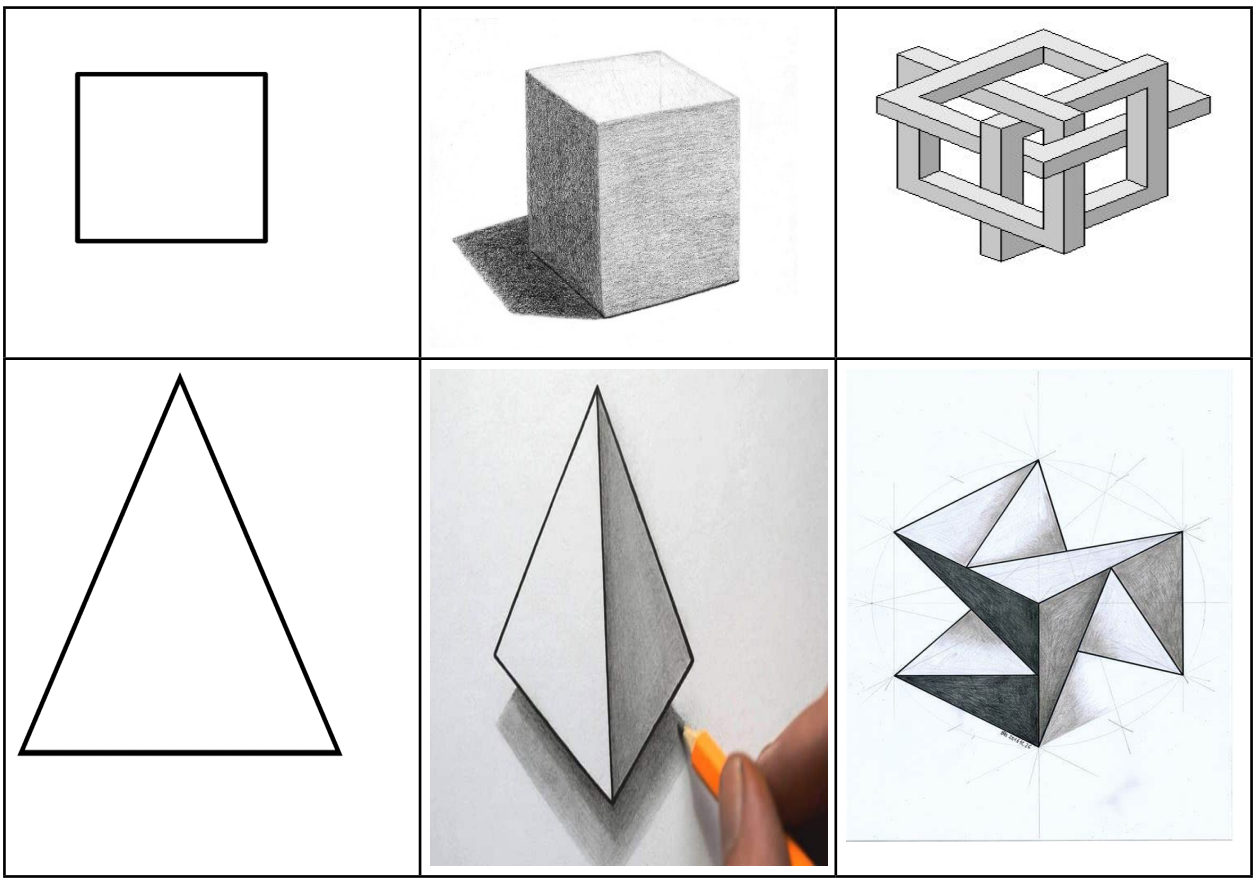
Practice: Mastering the art of sketching complex forms takes practice. Start with simple exercises and gradually move on to more complex designs for a more in-depth exploration

Remember, the key to sketching complex forms is to build a strong foundation with basic shapes and gradually adding layers of complexity.

Examples of complex designs

Table1.1.2 complex shapes

Basic shape	Simple form	Complex form
		



Learning Task

1. List four (4) relevant tools and four (4) materials that are used for creating and rendering complex forms.
2. Create complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil in freehand drawing.

Pedagogical Exemplars

1. **Collaborative Learning/Group work:** Learners in groups brainstorm to select the type of basic shapes, rendering techniques and complex forms they want to create and the relevant tools and materials they will be using. Tailor the discussion's depth based on learners' understanding. Use simpler explanations for beginners and delve deeper into concepts like hidden lines for advanced learners.
2. **Project-based Learning:** Guide learners in groups/individuals to create complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil in freehand drawing. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
3. **Project-based Learning:** Let learners in groups generate manual/digital pictorial reports on how they created the complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil sketches in freehand drawing. Create a peer-to-peer mentoring system to help learners having difficulties receive help from colleagues.

Key Assessment

Level 1: List four relevant tools and four materials that are used for creating and rendering complex forms.

Level 2: Explain how two relevant tools and two materials are used for creating and rendering complex forms.

Level 3: Evaluate different basic shapes and rendering techniques, then create a series of sketches that demonstrate how these elements can be combined to develop complex designs using graphite and coloured pencils in freehand drawing.

Level 4

1. Generate manual/digital pictorial reports on how the complex designs were created.
2. Create a digital or manual album of all complex designs with basic shapes and rendering techniques using graphite pencil and coloured pencil in freehand drawing.

HINT



The recommended mode of assessment for week 1 is group project. Use the level 4 question 2 as a sample question. Refer to Appendix B at the end of this section for rubrics.

UNIT 1 REVIEW

During the learning process under this unit, learners discussed and selected tools and materials as well as rendering techniques used in creating complex designs. Learners created complex designs by experimenting with the techniques and tools available. The principles of perspective and proportions were integrated to assist learners produce their drawings in perspectives.

Learners were given the liberty to choose whether to produce their designs manually or digitally.

Different pedagogical strategies were used to target the different learning proficiencies in the class. The assessment covered all the levels under the depth of knowledge DoK, to ensure all learners benefits. Teaching and learning resources such as videos, internet surfing, charts were used to enhance the learning process.

Marking scheme/Rubrics for the group discussion task

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Needs Improvement (1)*
Collaborative skills	*Exhibit four of these* *Contributing to the group.* *Respecting the views of others* *Tolerating others* *Resolving conflicts* *Taking responsibility*	*Exhibit three of these* *Contributing to the group.* *Respecting the views of others* *Tolerating others* *Resolving conflicts* *Taking responsibility*	*Exhibit two of these* *Contributing to the group.* *Respecting the views of others* *Tolerating others* *Resolving conflicts* *Taking responsibility*	*Exhibit one of these* *Contributing to the group.* *Respecting the views of others* *Tolerating others* *Resolving conflicts* *Taking responsibility*
Explanation of Basic Shapes	*Provides an explanation of four basic shapes, example triangle, has three angles, etc.*	*Provides an explanation of three basic shapes.*	*Provides an explanation of two basic shapes*	*Provides an explanation of one basic shape.*
Explanation of Rendering Techniques	*Offers an explanation of all rendering techniques, example, smudging, stippling, shading, cross hatching etc. demonstrating a deep understanding of their use in creating complex forms.* *Example, creates depth and illusion*	*Offers an explanation of three rendering techniques, example, smudging, stippling, shading, etc. demonstrating a deep understanding of their use in creating complex forms.* *Example, creates depth and illusion*	*Offers an explanation of two rendering techniques, example, smudging, stippling, etc. demonstrating a deep understanding of their use in creating complex forms.* *Example, creates depth and illusion*	*Offers an explanation of one rendering technique, example, stippling, etc. demonstrating a deep understanding of their use in creating complex forms.* *Example, creates depth and illusion*
Understanding of Rendering Characteristics	*identifies four relevant characteristics of each rendering technique and clearly explains how they enhance complex forms.* *Example: cross hatching enhances form representation by using intersecting lines to build up layers of shading*	*identifies three relevant characteristics of each rendering technique and clearly explains how they enhance complex forms.* *Example: cross hatching enhances form representation by using intersecting lines to build up layers of shading*	*identifies two relevant characteristics of each rendering technique and clearly explains how they enhance complex forms.* *Example: cross hatching enhances form representation by using intersecting lines to build up layers of shading.*	*identifies one rendering technique without stating any characteristics*

Use of Examples of real-life application	*Provides four excellent, relevant examples that illustrate the characteristics of shapes and rendering techniques in real-world applications.* *Example: architecture and interior design, clothing and textile, automobile designs, landscape designs, etc.*	*Provides three excellent, relevant examples that illustrate the characteristics of shapes and rendering techniques in real-world applications.* *Example: architecture and interior design, clothing and textile, landscape designs, etc.*	*Provides two excellent, relevant examples that illustrate the characteristics of shapes and rendering techniques in real-world applications.* *Example: architecture and interior design, clothing and textile, etc.*	*Provides one excellent, relevant example that illustrate the characteristics of shapes and rendering techniques in real-world applications.* *Example: architecture designs, etc.*
Writing skills	*Learner exhibits all of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*	*Learner exhibits three of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*	*Learner exhibits two of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*	*Learner exhibits one of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*

Total – 24 marks

Marking scheme/Rubrics for the homework task.

Characteristics of two-point perspective

1. Two-point perspective effectively conveys the three-dimensionality of objects, making them appear more realistic.
2. Lines that are parallel to the object being drawn recede towards the two vanishing points. These lines are called orthogonal lines, and they create the illusion of depth.
3. They have two vanishing points, etc.

Or any other appropriate response from learner

What to consider in scoring the explanation:

If a learner can give one characteristic, 1 mark

If a learner can give two characteristics, 2 marks

If a learner can give three characteristics, 3 marks

Total 3marks

APPENDIX A: INDIVIDUAL PORTFOLIO

Sample portfolio assessment

1. *Task:* Collect all your work from the academic year, starting from the beginning of the first semester, and compile it into a portfolio to be submitted at the end of the year for assessment.

   Your portfolio should include assignments, projects, quizzes, tests, and mid-term and end-of-semester papers. This portfolio will be assessed to evaluate your overall understanding and progress throughout the year.

2. Example of structure and organisation of the Portfolio Assessment

   As part of the structure of the portfolio assessment, make sure the following information has been provided:

   a. Cover Page which entails the learner's name, class, subject and period/date.

   b. Table of Contents which has the list of items included with page numbers.

3. Example of learners' works to be included in the Portfolio Assessment

   - Assignments
   - Projects
   - Quizzes and Tests
   - Designs
   - Mid semester and end of semester papers

4. **Sample mode of administration**

   - Explain the purpose and components of the portfolio to the learners and provide examples and templates for each section.
   - Schedule periodic reviews (e.g., every 3-4 weeks) to ensure learners are keeping up with their portfolios and provide feedback and guidance during these checkpoints.
   - Provide learners with the scoring rubrics and provide detailed explanation on the rubrics.
   - Final portfolios are due in week 22 of the academic calendar.

5. Sample mode of submission/presentation

a. Communicate the final deadline for portfolio submission to all learners to ensure timely and complete submissions.

b. Learners will submit their completed portfolios either as a physical or through the school's online submission system.

c. Ensure the portfolio includes all required elements: assignments, projects, quizzes, tests, designs, class participation records, and a final reflection.

d. Learners should organise their portfolios clearly and logically, with each component clearly labelled and easy to access.

e. For digital submissions, learners should upload their portfolios as a single file or in clearly marked folders within the online portal.

6. **Sample feedback strategy**

- Schedule periodic check-ins to discuss progress, set goals, and adjust strategies as needed.
- Utilise both formative and summative feedback to guide learners' development and ensure they understand how to enhance their work continuously.

7. **Sample Portfolio Assessment Marking scheme**

Learner's works	*Scores*
Assignments/Exercises	*10 marks*
Projects/Case studies	*10 marks*
Quizzes and Tests	*10 marks*
Reflective Pieces	*5 marks*
Mid-semester and End-of-semester papers	*5 marks*
Total marks	***40 marks***

APPENDIX B: GROUP PROJECT

Structure

1. **Project Objective:** Creating complex designs with graphite pencil and coloured pencil sketches using the idea of concept sketches.
2. **Project Title:** create a digital or manual album of all complex designs from basic shapes.
3. **Group Roles and Responsibilities:** define specific roles (e.g., leaders, researchers, designers, presenters) for each member and outline tasks associated with each role to ensure all learners participate fully.
4. **Timeline:** detailed timeline including start and end dates
5. Resources: list of required materials, tools, and resources (books, pictures of complex designs, websites, etc.)
6. **Deliverables:** Specify what the final output will be (e.g., picture portrait/landscape, etc.)

This structure above can help ensure that the group project is well-organized, collaborative, and successful**.**

Rubrics for assessing the group project

criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Needs Improvement (1)*
Creativity and Originality of Designs	*The designs exhibit the following.* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.* 3. *The designs are unique, well-thought-out,* 4. *visually striking.*	*The designs exhibit three of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.* 3. *The designs are unique, well-thought-out, and visually striking.* 4. *visually striking.*	*The designs exhibit two of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.* 3. *The designs are unique, well-thought-out, and visually striking.* 4. *visually striking.*	*The designs exhibit one of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.* 3. *The designs are unique, well-thought-out, and visually striking.* 4. *visually striking*
Complexity and Structure of Designs	*The designs exhibit all the following;* 1. *well-structured* 2. *display a deep understanding of how to transform basic shapes into intricate forms.* 3. *The design process is evident, showing careful thought and effort.* 4. *complexity*	*The designs exhibit three the following;* 1. *well-structured* 2. *display a deep understanding of how to transform basic shapes into intricate forms.* 3. *The design process is evident, showing careful thought and effort.* 4. *complexity*	*The designs exhibit two the following;* 1. *well-structured* 2. *display a deep understanding of how to transform basic shapes into intricate forms.* 3. *The design process is evident, showing careful thought and effort.* 4. *complexity*	*The designs exhibit one the following;* 1. *well-structured* 2. *display a deep understanding of how to transform basic shapes into intricate forms.* 3. *The design process is evident, showing careful thought and effort.* 4. *complexity*

Technical Execution (Digital or Manual)	*Learner exhibits all of the following* 1. *The album is exceptionally well-executed, whether digital or manual.* 2. *The designs are clean, professional, and polished* 3. *Digital designs have excellent resolution* 4. *manual designs are neat and well-organized.*	*Learner exhibits three of the following* 1. *The album is exceptionally well-executed, whether digital or manual.* 2. *The designs are clean, professional, and polished* 3. *Digital designs have excellent resolution* 4. *manual designs are neat and well-organized.*	*Learner exhibits two of the following* 1. *The album is exceptionally well-executed, whether digital or manual.* 2. *The designs are clean, professional, and polished* 3. *Digital designs have excellent resolution* 4. *manual designs are neat and well-organized.*	*Learner exhibits one of the following* 1. *The album is exceptionally well-executed, whether digital or manual.* 2. *The designs are clean, professional, and polished* 3. *Digital designs have excellent resolution* 4. *manual designs are neat and well-organized.*
Use of Colour and Visual Appeal	*Learner exhibits all of the following* 1. *designs are visually striking,* 2. *excellent use of colour and contrast that enhance the overall appeal.* 3. *Colours are thoughtfully chosen to complement the shapes and complexity of the designs.* 4. *The overall colouring is neat*	*Learner exhibits three of the following* 1. *designs are visually striking,* 2. *excellent use of colour and contrast that enhance the overall appeal.* 3. *Colours are thoughtfully chosen to complement the shapes and complexity of the designs.* 4. *The overall colouring is neat*	*Learner exhibits two of the following* 1. *designs are visually striking,* 2. *excellent use of colour and contrast that enhance the overall appeal.* 3. *Colours are thoughtfully chosen to complement the shapes and complexity of the designs.* 4. *The overall colouring is neat*	*Learner exhibits one of the following* 1. *designs are visually striking,* 2. *excellent use of colour and contrast that enhance the overall appeal.* 3. *Colours are thoughtfully chosen to complement the shapes and complexity of the designs.* 4. *The overall colouring is neat*
Presentation and Organisation	*The album exhibits all the following* 1. *excellently organized* 2. *easy to navigate,* 3. *each design clearly labelled and presented in a cohesive way.* 4. *The layout is aesthetically pleasing and enhances the viewer's experience.*	*The album exhibits three of the following* 1. *excellently organized* 2. *easy to navigate,* 3. *each design clearly labelled and presented in a cohesive way.* 4. *The layout is aesthetically pleasing and enhances the viewer's experience.*	*The album exhibits two of the following* 1. *excellently organized* 2. *easy to navigate,* 3. *each design clearly labelled and presented in a cohesive way.* 4. *The layout is aesthetically pleasing and enhances the viewer's experience.*	*The album exhibits one of the following* 1. *excellently organized* 2. *easy to navigate,* 3. *each design clearly labelled and presented in a cohesive way.* 4. *The layout is aesthetically pleasing and enhances the viewer's experience.*

Explanation and Documentation	*All the all designs are accompanied by a clear, well-written explanation of the* *design process and the relationship between the basic shapes used. The documentation is insightful and detailed.*	*three designs are accompanied by a clear, well-written explanation of the design process and the relationship between the basic shapes used. The documentation is insightful and detailed.*	*two designs are accompanied by a clear, well-written explanation of the design process and the relationship between the basic shapes used. The documentation is insightful and detailed.*	*One design is accompanied by a clear, well-written explanation of the design process and the relationship between the basic shapes used. The documentation is insightful and detailed.*

Total score 24 marks

UNIT 2: OBJECT MANIPULATION

STRAND: CONCEPTUAL DRAWING

SUB-STRAND: OBJECT MANIPULATION IN DRAWING

Content Standard: *Demonstrate understanding and skills in object manipulation with various tools and techniques.*

Learning Outcome: *Apply the understanding and skills in how simple and complex objects can be manipulated by drawing with concepts, symbols and narratives associated with objects.*

HINT



Remind learners of Mid semester examination in week 6. Refer to the Appendix C for more sample task and the Table of Specification.

INTRODUCTION AND UNIT 2 SUMMARY

This session analyses object manipulation using freehand drawing as a fundamental ability that is essential to all forms of artistic expression. The analysis takes into consideration how simple and complex objects can be modified through object manipulation techniques. The session aims to help learners skilfully bring out their ideas through the exploration of techniques such as composition, perspective, proportion, and rendering. The session further explores simple and complex objects that can be modified placing special emphasis on form comprehension, observational skills, and drawing tool proficiency.

Designers can generate solutions by modifying simple and complex objects into new forms. The key to honing this skill is practice, experimentation, and ongoing learning. Object manipulation skills as presented in this session are to help improve creative ability and encourage originality and creativity. This overview provides thorough guidance for designers of all skill levels, highlighting the significance of these principles in creating designs with depth, volume, and realism.

The weeks covered by sub strand 2 are:

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 lessons on Object Manipulation in Freehand drawing, teachers must adopt an approach to cater for the diverse learner needs. Firstly, there should be a clear learning objective that emphasises what learners need to know, understand, and do. Teachers should also employ varied pedagogies such as group/individual work, whole class discussion, think-pair-share, role-play etc while encouraging respect for each other's views among the learners.

Learning can be scaffolded by providing accessible resources, such as photographs, videos, relevant texts, and real objects as well as simplified language, to support understanding and participation for all learners. Assessments should align with the learning objectives by providing multiple variations of tasks that evaluate learners' abilities to analyse and manipulate objects using freehand drawing and rendering techniques and their significance in generating designs.

Additional content can be provided to help gifted and talented learners to challenge their critical thinking skills. This may involve exploring advanced concepts in object manipulation using freehand drawing and rendering techniques.

Through the differentiation strategies, teachers will ensure that all learners, regardless of their learning styles or abilities, can engage meaningfully with the subject matter and develop a deeper understanding and skills in object manipulation using freehand drawing and rendering techniques.

ASSESSMENT SUMMARY

Assessing learners' understanding and skills in object manipulation using freehand drawing and rendering techniques requires a multifaceted approach. First, consider the various learning abilities as well as the levels of competencies of the learners. The assessment should look at oral, and written components such as reports, multiple-choice questions and short answer questions that will assess learners' knowledge of object manipulation using freehand drawing and rendering techniques as well as the relevance in generating designs.

In addition to the written component. There can be the incorporation of a practical assessment where learners use varied techniques in freehand drawing and rendering to manipulate simple shapes and forms. Provide learners with photographs, videos or physical examples of these objects, shapes and forms as well as works done by some designers and ask them to identify the techniques employed and the significance of such manipulation to the development of designs.

During the assessment, encourage learners to express their understanding through both verbal written and pictorial means. Record their responses in a transcript, capturing their observations, interpretations, and insights regarding the materials, methods, drawing and rendering techniques. This transcript will serve as a valuable tool for evaluating individual comprehension and facilitating further discussion and learning in the classroom.

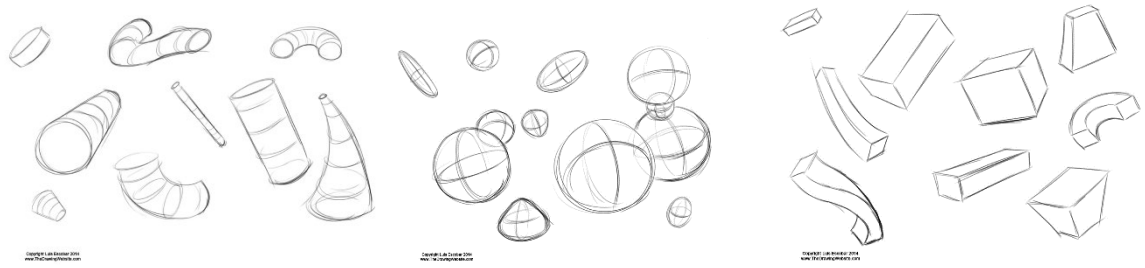
WEEK 4

Learning Indicator: Investigate how simple and complex objects can be modified through object manipulation techniques in free-hand drawing

Focal Area 1: MODIFYING TWO-DIMENSIONAL SHAPES USING FREEHAND DRAWING TECHNIQUES

In our communities, most objects are created by transforming simple shapes into complex designs, sometimes imitating other objects for artistic effect. Artists practice freehand drawing to refine shapes, add details, and transform basic forms, blending creativity, keen observation, and constant practice. They start with geometric shapes like circles and squares, gradually adding depth and texture to bring their creations to life. This process of modification and enhancement helps to improve their skills over time, breaking down complex transformations into manageable steps. Through these activities, artists balance technical proficiency with aesthetic understanding, striving to capture the essence and intricacies of their subjects. With dedication and practice, they enhance their ability to create dynamic and visually appealing artwork that resonates authentically. Each stroke and adjustment contributes to drawings that not only captivate viewers but also inspire through their creativity and artistic expression.

Shapes of objects that can be modified



spheres cylinder cubes

Figure 1.2.1: *shapes of objects that can be modified*

Here are some methods and tips to help you modify your drawings effectively:

Altering Shapes and Proportions: this can be done by stretching and shrinking the shape being modified. As you go about this activity, the original shape will be distorted, resulting in an entirely new form but having traces of the original shape and form

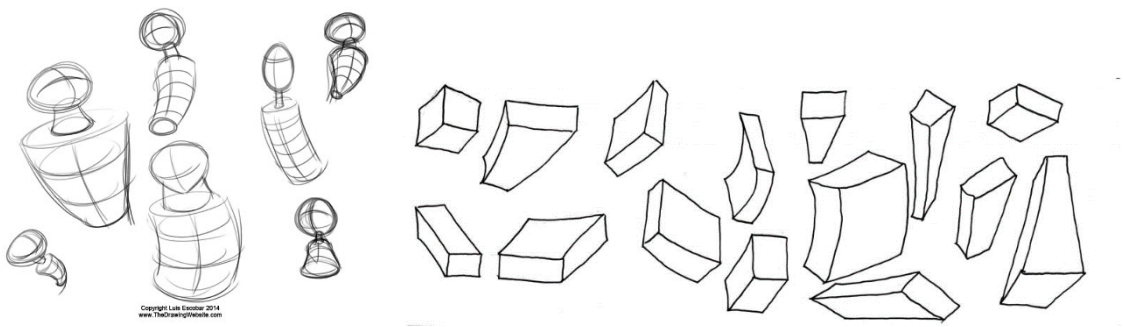


Figure 1.2.2: *Altered shapes*

Combining Shapes: a variety of shapes and forms can be put together to generate new shapes and forms in object manipulation using freehand. This can be achieved by Overlaying shapes and the use of the union and subtraction of forms.

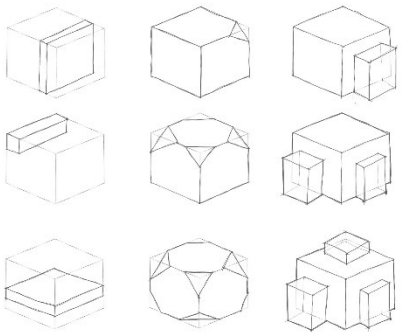


Figure 1.2.3: *Combined shapes*

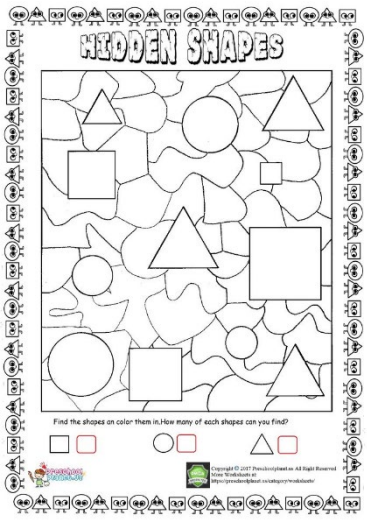


Figure 1.2.4: *Overlaying Shapes, union and subtraction of forms*

Changing Perspective: Perspective is another way of altering and modifying forms and shapes in free-hand drawing. to manipulate an object perspective plays a very important role. this can be achieved by rotating and using the concept of foreshortening

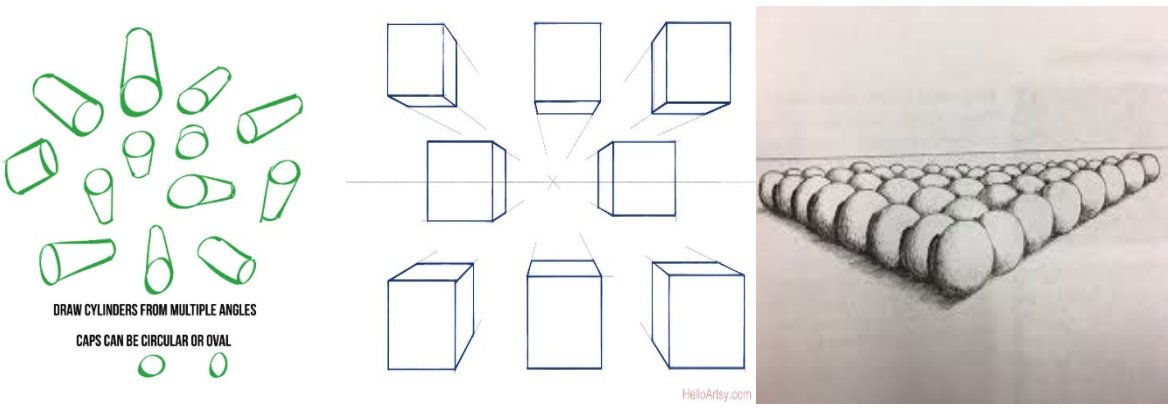


Figure 1.2.5: *Rotating and foreshortening*

Learning Tasks

1. Analyse how objects can be modified through object manipulation techniques.
2. Discuss the various techniques that can be used to modify shapes and forms using object manipulation techniques in free-hand drawing.

Pedagogical Exemplars

1. **Collaborative learning/Group work /Managing Talk for Learning:** Put learners in mixed groups to brainstorm how the shapes and forms in different objects seen in the environment can be manipulated through free-hand drawing. Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.
2. **Collaborative/Group learning:** In mixed groups, let learners examine the various techniques that can be used to manipulate. Provide them with resources such as photographs, drawings and videos of objects and let them identify the possible techniques used to modify the initial shape and form of the object. To ensure differentiation, the teacher can form groups considering the learners' readiness, interests, and learning styles. The complexity of the task can be varied based on the group's readiness level.
3. **Project-Based Learning:** Let learners work individually/in groups to generate an annotated manual or digital pictorial table/chart of designs that have been created through object manipulation. they should indicate the initial form/shape of the objects.

   Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

Key Assessments

Level 1: List three techniques that can be used to manipulate simple shapes and forms to achieve new forms.

Level 2: Create a pictorial table/chart that identifies and describes various techniques for manipulating simple shapes and forms, highlighting how these techniques can lead to the creation of new forms.

Level 3: Generate a manual or digital pictorial table/chart of the various tools and techniques that can be used in object manipulation in free-hand drawing.

HINT



The recommended mode of assessment for week 4 is **e-assessment**. *Use the level 1 question as a sample question.*

WEEK 5

Learning Indicator: Experiment with how shapes and forms can be manipulated using free drawing to achieve new forms

Focal Area 1: EXPERIMENTING WITH FREE-HAND DRAWING TO MODIFY 2-DIMENSIONAL SHAPES TO ACHIEVE NEW FORMS

Designs to achieve new forms

Introduction

In creating drawings using the free-hand method artists and designers can transform two-dimensional designs by modifying the various shapes and forms in the design. This method enables designers to explore unconventional shapes, sizes, and viewpoints that are often limited in traditional 2D design processes. By sketching without restrictions and with the freedom to modify forms, designers can explore unconventional shapes and sizes, experimenting with fluid and dynamic forms to create new forms. This creative flexibility helps uncover new and improved ideas from the original 2D drawings, leading to designs that go beyond their initial boundaries and open up new possibilities. Through free-hand drawing, designers can transform and develop shapes in ways that enhance and broaden the design possibilities.

Steps for using free-hand drawing to modify 2-dimensional designs can be simple or complex. We should remember that the same tools and materials used in drawing freehand designs and sketches are what are used in modifying simple 2-D objects in drawing.

Choosing a Design: This can be done by selecting a base design which is usually a simple but specific 2 or 3D regular or irregular shape and form you want to modify. It could be a sketch, blueprint, or any existing drawings. Think of the design selected in terms of a simple form first, and then expand by manipulating it using free-hand drawing.

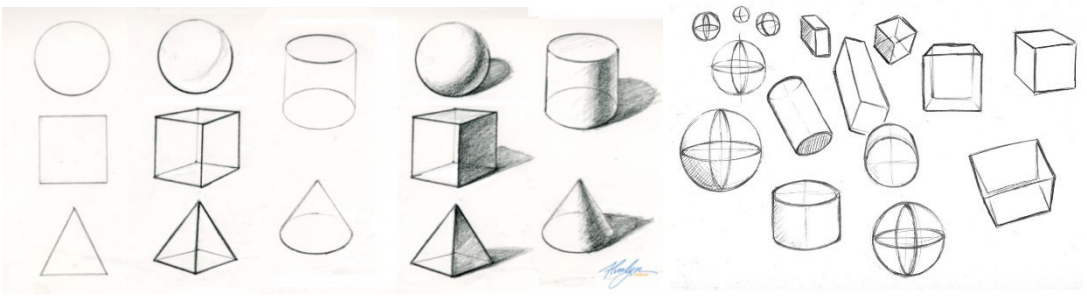


Figure 1.2.6: *Shapes to be manipulated*

The base design of simple but specific 2 or 3D shape

Understand the shape and form: Critically observe the details of the shapes and forms you have selected. This will help you to know the nature of th**e** key components and structure of the shape or form such as the type of line i.e. *straight, curved, diagonal or parallel*. Space i.e. *wide space, closed space, narrowing space* etc. Proportions and perspective,

Selecting the technique to use for the modification. There are many different ways to modify a shape or form to achieve a new form. Some of the techniques include pulling, squashing, twisting, coiling, bending subtracting or adding other shapes etc.

Create Modifications: in modifying a form or shape, you have to first look at it as a very flexible and elastic object that can be manipulated in any direction. This helps to use any of the techniques mentioned above to work on them. It is also important to approach the whole exercise in a very playful manner. Begin with a light sketch of the original form or shape to use as a reference and then experiment Freely by making modifications. Try altering proportions, adding or removing elements, and changing the shapes and form using one or multiple techniques.

Explore Variations: to have good experimentation on how to modify shapes and forms to create new forms, it is advisable to generate multiple variations: Draw several modified versions of the shape or form you selected, exploring different approaches and ideas.

Finalise your drawing: you can finish up the drawing by sharpening the lines and cleaning up any rough areas. Where necessary you can add colour or texture: If applicable, to enhance the visual appeal.



Figure 1.2.7: *Modified cylinders*

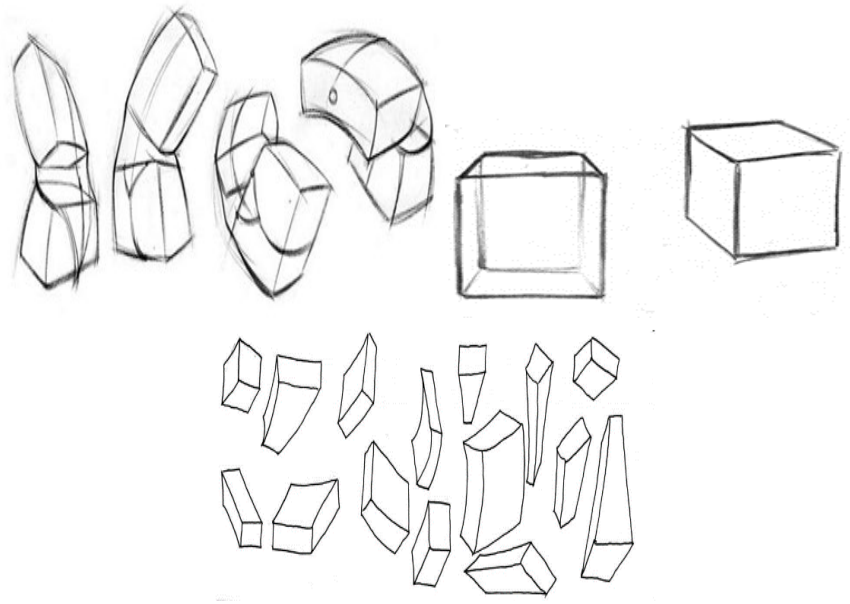


Figure 1.2.8: *Cubes and rectangles*

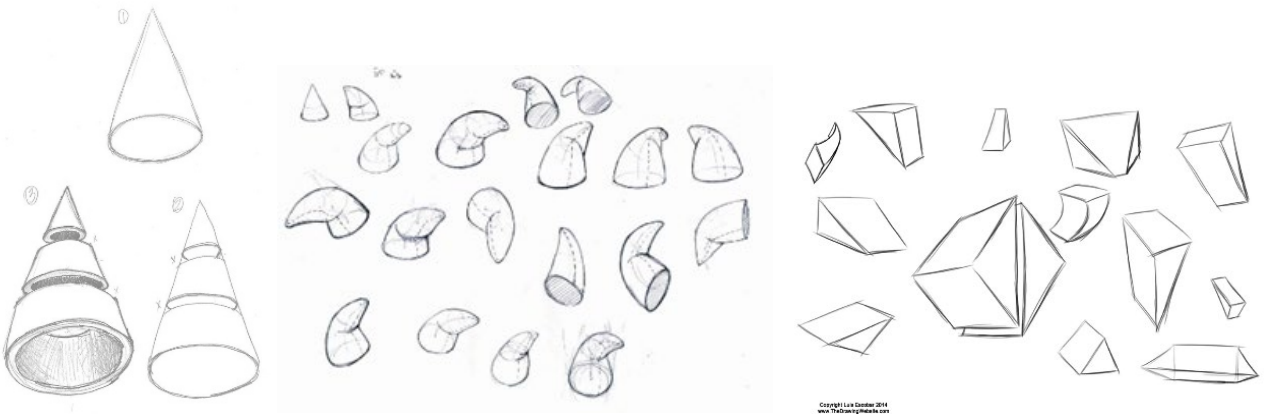


Figure 1.2.9: *Triangles and cones*

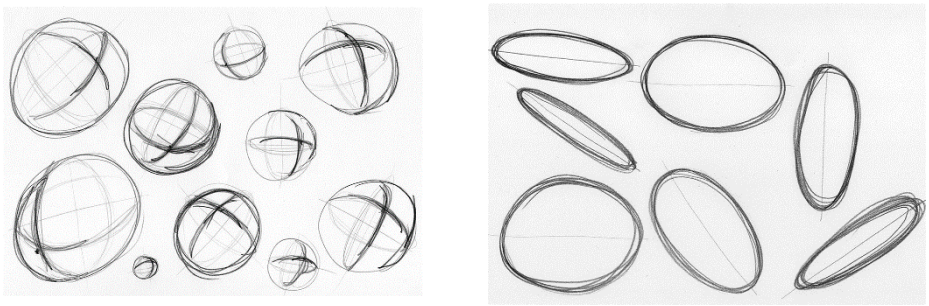


Figure 1.2.10: *Circles and spheres*

Learning Tasks

1. Identify and record various techniques that can be used to modify simple and complex shapes and forms using freehand drawing techniques to achieve new forms.
2. Experiment with how simple and complex shapes and forms can be modified into new forms using freehand drawing techniques.

Pedagogical Exemplars

1. **Group work/Collaborative Learning Problems-Based Learning:** In mixed-ability groups provide learners with different types of sketches, photographs, videos etc of objects in their environment and allow them to determine the possible basic shapes and forms in each of the objects. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. **Group work/Collaborative Learning/Project-based learning:** In small groups, let learners generate a pictorial chart of some of the techniques that can be used to modify shapes and forms to achieve new forms. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
3. **Project-Based Learning:** Learners work individually to use the available tools and techniques to manipulate selected shapes and forms to achieve new forms. Support an individual or group working at a slower pace whilst the rest of the class completes more activities

Key Assessments

Level 1: List some common tools used in free-hand drawing?

Level 2: Explain the concept of object manipulation and manipulation techniques in free-hand drawing.

Level 3: Develop a table/chart of tools and techniques that can be used in object manipulation in free-hand drawing.

Level 4

1. Generate a manual or digital pictorial table/chart of the various tools and techniques that can be used in object manipulation in free-hand drawing.
2. Experiment with the available tools and techniques to modify two simple and complex shapes into new forms using freehand drawing techniques.

HINT



The recommended mode of assessment for week 5 is **experiment**. *Use the level 4 question 2 as a sample question.*

WEEK 6

Learning Indicator: Generate simple objects in line with the concepts and narratives associated with objects and designs

Focal Area 1: GENERATING SIMPLE OBJECTS IN LINE WITH THE CONCEPTS AND NARRATIVES ASSOCIATED WITH OBJECTS AND DESIGNS

In our previous lessons, we have seen freehand drawing as a creative technique that encourages experimentation and intuition and also helps designers capture the essence of their designs through expressive lines and gestures. This hands-on approach allows for quick iterations, fostering a deeper understanding of spatial and visual dynamics. Overall, freehand drawing merges artistic expression with design thinking, resulting in visually compelling and thoughtfully crafted objects. In year one we talked about how forms and shapes have symbolism and meaning across cultures and contexts. Designers usually use such forms and shapes as well as their symbolism to create simple to complex objects that can be useful to society.

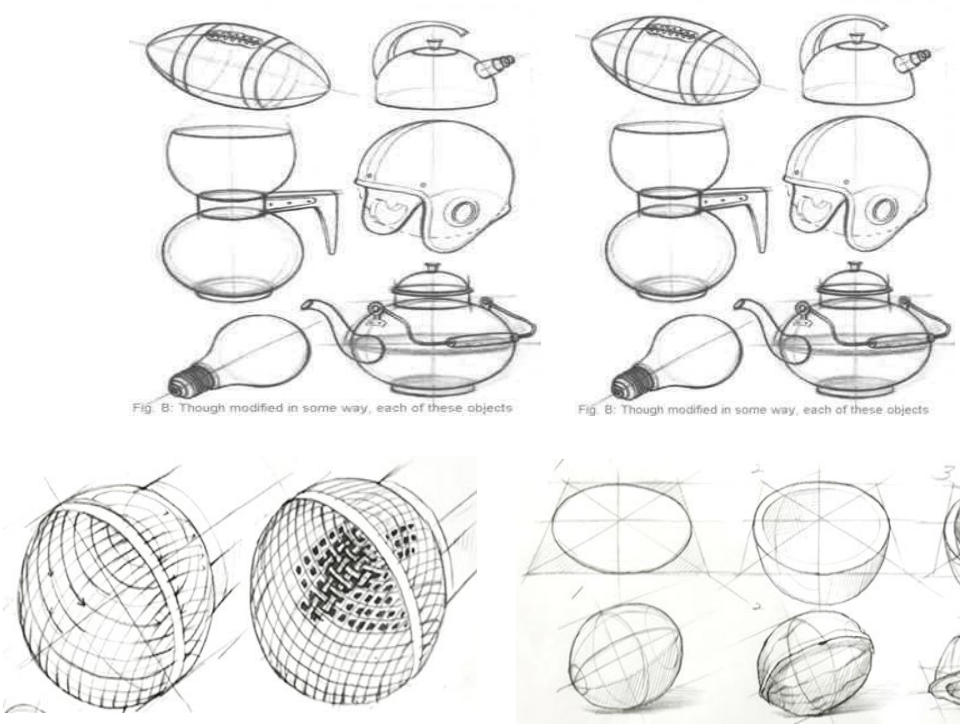
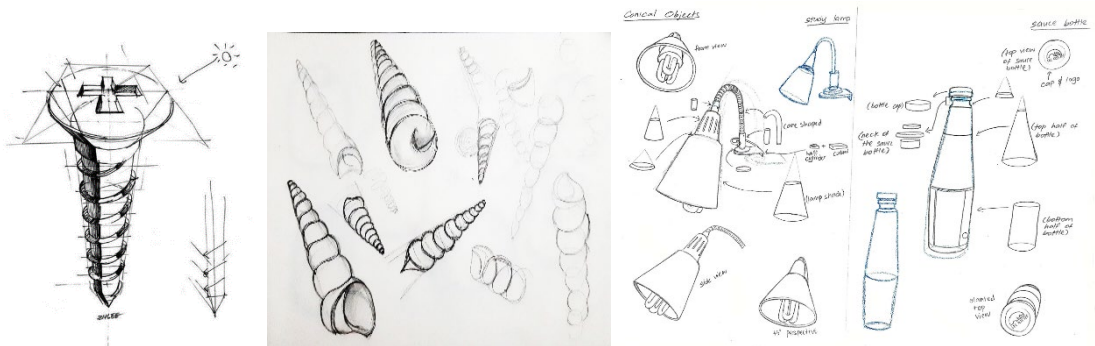


Figure 1.2.11: *Circles*



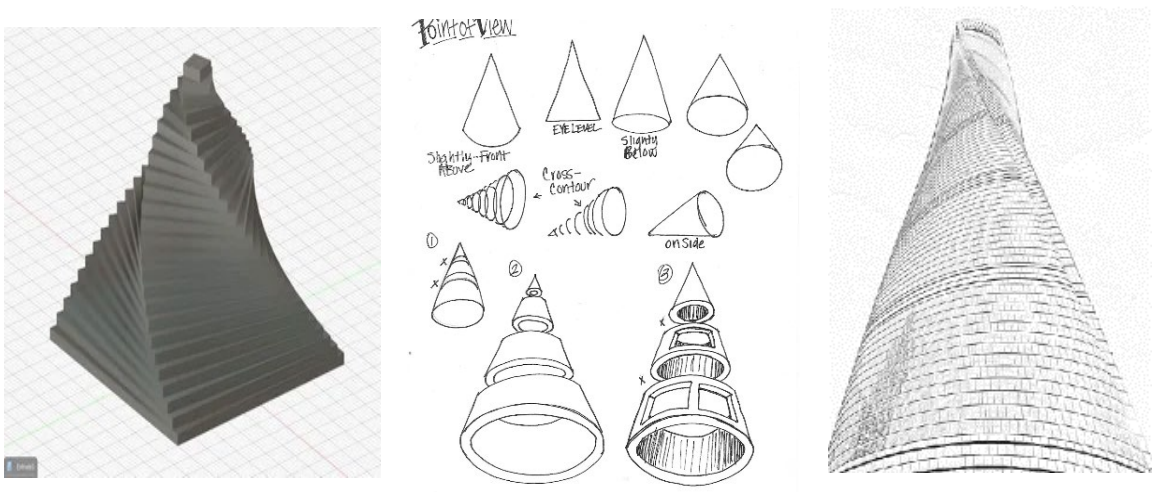


Figure 1.2.12: *Triangles*

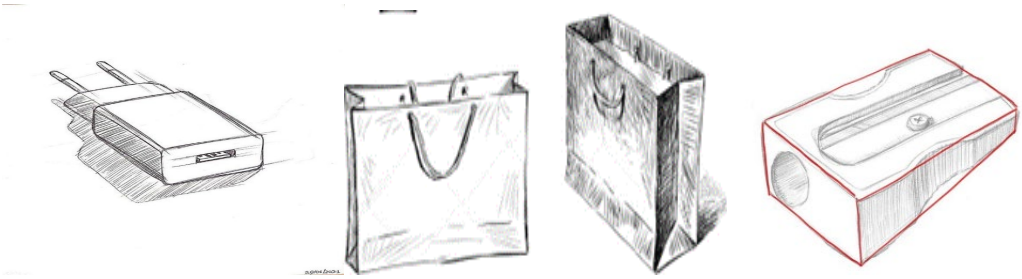
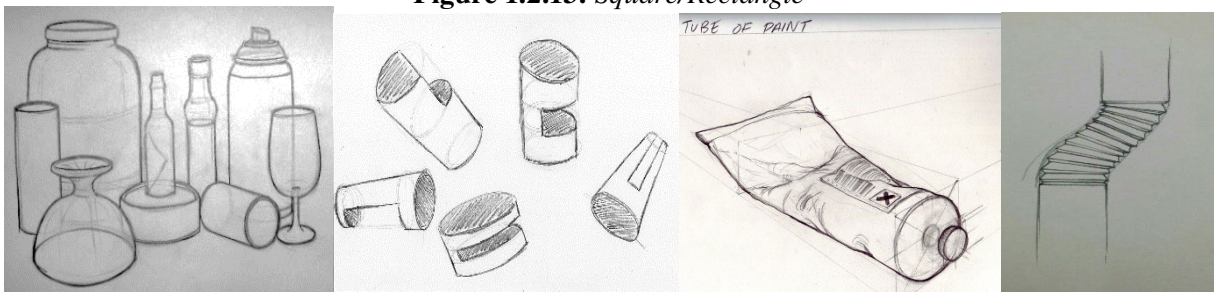


Figure 1.2.13: *Square/Rectangle*



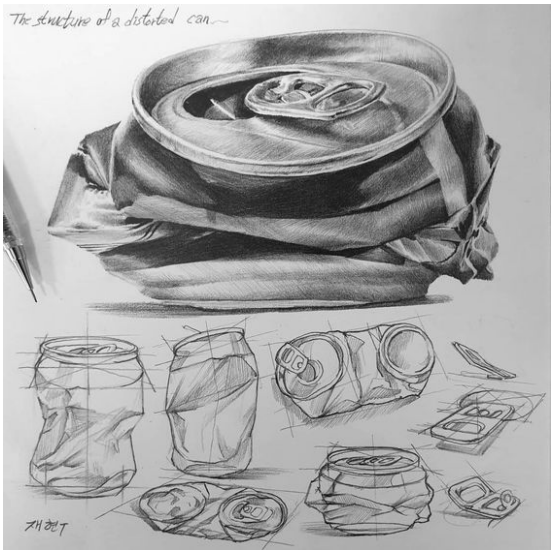


Figure 1.2.14: *Cylinders*

Activity 1

Use the following steps to generate simple objects using Free-Hand Drawing

Define the Concept or Narrative

- Identify the idea or story you want to convey through the object
- Write down keywords and phrases associated with the concept or narrative

Sketch Loose Shapes

- Quickly sketch basic shapes (circles, squares, triangles) to represent the object
- Use simple gestures to suggest the object's form and movement

Add gestural lines

- Use expressive lines to convey texture, emotion, or movement
- Emphasise key features that support the concept or narrative

Simplify and refine

- Streamline the drawing by removing unnecessary details
- Focus on essential features that communicate the concept or narrative

Add Minimal Details

- Include only essential details that support the concept or narrative
- Use simple lines and shapes to maintain a clean design

Refine lines and proportions

- Adjust lines, shapes, and proportions for a balanced composition
- Ensure the drawing effectively conveys the concept or narrative

Additional Tips

As a beginner, it is advisable to experiment with different styles and expressions to find the best fit.

Try to emphasise the essence of the object in terms of lines, shape, form, distortions etc rather than trying to draw it realistically

Use simple shapes and lines to maintain a clean and intuitive design

Remember that free-hand drawing is about capturing the essence not about immediate perfection. You will surely improve upon your skill of drawing with time and constant practice.

Activity 2

Generate these simple objects using Free-Hand Drawing

Note: your drawing should show the sequence of development

- A square shape for a TV or computer screen.
- A crumbled square-based box for a package or container.

Cylinders

- A cylindrical shape for a water bottle or vase. Notice how the curves connect to the base and top.
- A cylinder-based body for a simple robot or animal.
- A squashed cylinder-shaped pencil or pen holder. Capture the subtle tapering of the shape.

Triangles

- A distorted triangle kitchen knife holder
- A triangle-based shape cloth hanger
- distorted triangle-shaped doorknob

Circles

- A circle shaped item of outdoor furniture.
- A twisted elliptical-shaped milk container.
- A coiled circle-shaped flower holder.

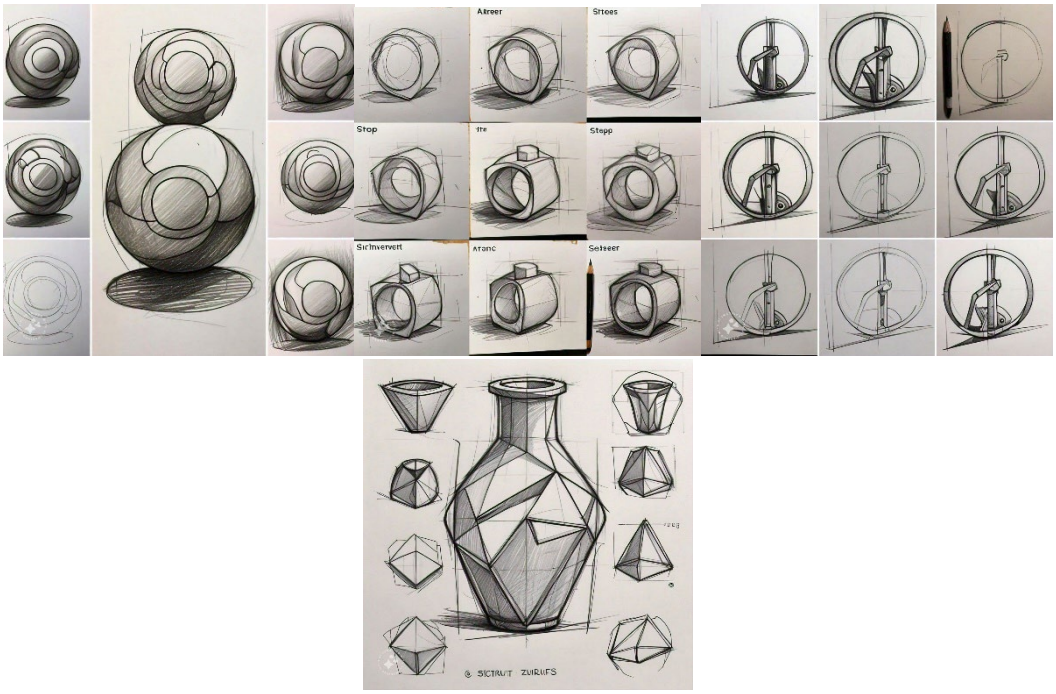


Figure 1.2.15: *Circle and sphere*

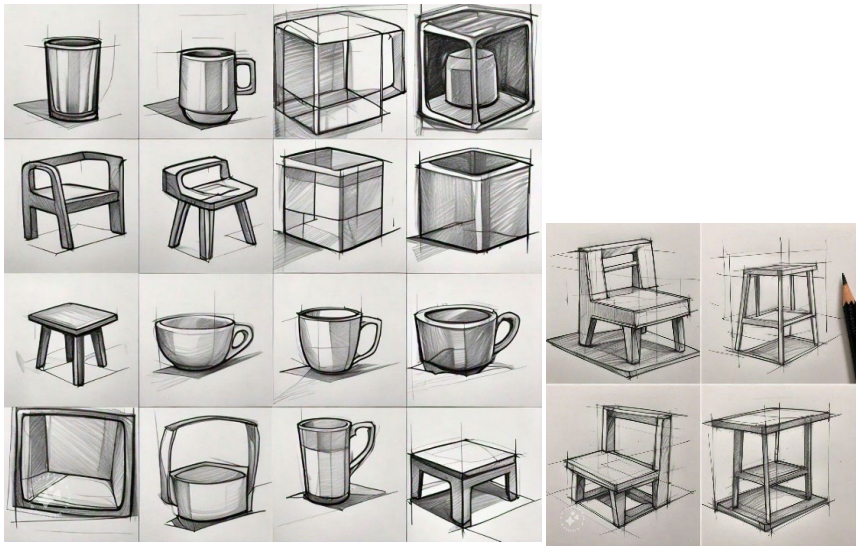


Figure 1.2.16: *designed objects*

Learning Task

1. Examine the steps used in generating simple objects in line with the concepts and narratives associated with objects and designs
2. Generate a simple object using free-hand drawing techniques and object-manipulating techniques such as twisting, coiling, stretching, squashing, bending etc

Pedagogical Exemplars

1. **Managing Talk for Learning:** Learners in mixed groups examine concepts, symbolisms, and narratives associated with specific designs and objects using resources like photographs, drawings, sketches, videos, real objects, etc. Develop a peer mentoring system in the mixed-ability groups to encourage more advanced learners to support their colleagues in understanding and effectively applying these concepts.
2. **Project-Based Learning/Experiential Learning:** In small groups, let learners select simple objects (from the various shapes) and use the available tools and free-hand drawing techniques to imitate the object they have selected by generating a sequence of simple line drawings into finished drawings of objects. Encourage them to use manipulating techniques such as twisting, coiling, stretching, squashing, bending etc. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
3. **Project-Based Learning:** Task learners to work individually/in groups to use the available tools and techniques to create a design in line with specific concepts, symbolisms and narratives. Their drawing should show a sequence of simple line drawings into finished drawings of objects. Encourage them to use manipulating techniques such as twisting, coiling, stretching, squashing, bending etc. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

level 1: List possible concepts, symbolism, and narratives associated with forms and objects.

Level 2: Describe how to use the available tools and free-hand drawing techniques to imitate the object they have selected by generating a sequence of simple line drawings into finished drawings of objects.

Level 3: Use available tools and techniques to imitate a selected object using the available tools and free-hand drawing techniques and object manipulating techniques such as twisting, coiling, stretching, squashing, bending etc

Level 4: Design and create a complex object that incorporates advanced techniques, including twisting, coiling, stretching, squashing, and bending, while justifying your choices of tools and methods. Reflect on how your design process and the manipulation of materials impact the final outcome.

HINT



The recommended mode of assessment for week 6 is Mid-semester examination. Refer to the Appendix C for more sample task and the Table of Specification

UNIT 2 REVIEW

The section emphasised freehand drawing for artistic expression, aiming to help learners explore composition, perspective, proportion, and rendering. It stressed form comprehension, observational skills, and the use of drawing tools, guiding designers of all skill levels in creating designs with depth, volume, and realism. Diverse pedagogies, including group and individual work, whole-class discussions, and think-pair-share activities, were employed to promote respect for differing views. Learning was supported with resources such as photographs, videos, texts, and real objects. Assessments aligned with learning objectives provided varied tasks to evaluate learners' ability to analyse and manipulate objects using freehand drawing. Gifted learners received advanced concepts, while differentiation strategies engaged all learners, regardless of learning styles or abilities. Practical assessments required the use of various techniques to manipulate shapes and forms, identifying their significance in design development. Learners expressed understanding through verbal, written, and pictorial means, with responses recorded in transcripts to evaluate comprehension and facilitate further learning.

Rubrics for assessing the e-assessment task

Ability to exhibit digital literacy -2 marks

Ability to list the techniques used to manipulate simple shapes.

Examples

- Shading
- Negative space
- Contour drawing, etc.

3 marks (1 mark each)

Total score 5 marks

Rubrics for assessing the experiment task

Learners' ability to use manipulation techniques to alter simple/complex shapes to create new forms, etc.

Criteria	*1*	*2*	*3*
Ability to apply manipulation technique to alter the shape to create new form. Example twisting, extruding, etc.	*Ability to apply only one manipulation technique to alter the shape to create new form. E.g. shading*	*Ability to apply two manipulation technique to alter the shape to create new form E.g. shading and contour drawing*	*Ability to apply three manipulation technique to alter the shape to create new form* *E.g. shading, contour drawing and negative space drawing*
Ability to use rendering techniques to enhance the new form, e.g. shading, cross hatching, etc.	*Ability to use only one rendering techniques to enhance the new form, e.g. stippling,*	*Ability to use two rendering techniques to enhance the new form* *e.g. shading, cross hatching*	*Ability to use three rendering techniques to enhance the new form e.g. shading, cross hatching and stippling*

Total score: 6 marks

APPENDIX C: MID-SEMESTER EXAMINATION TABLE OF SPECIFICATION

Nature of assessment

The assessment should span from week 1 to week 5 and should comprise of 20 multiple choice questions. The time allocation for the examination should be 30 minutes.

Resources

- Question papers
- Conducive environment
- Pen, pencil and erasers

Sample assessment

Mid semester one examination

Answer all questions; by **circling** *the most appropriate answer from the option lettered* **A-D**

1. What is a defining characteristic of a complex design?
   A. lack of detail
   B. multiple interconnected elements
   C. simplicity in form
   D. use of basic geometric shapes only
2. When sketching, what does "foreshortening" refer to?
   A. adding shadows to enhance realism
   B. drawing objects in flat, two-dimensional shapes
   C. the distortion of an object to create the illusion of depth
   D. using shorter lines to create texture

KEYS

1. B
2. C

1 mark each **=20 marks**

Table of specification for mid semester one examination

weeks	*Focal Area(s)*	*Type of Questions*	*DoK Levels*				*Total*
		1	*2*	*3*	*4*		
1	*Basic shapes and rendering techniques*	*Multiple choice*	*2*	*2*	*1*		*5*
2	*Complex designs*	*Multiple choice*	*1*	*1*	*2*		*5*
3	*Modifying two-dimensional shapes using freehand drawing techniques.*	*Multiple choice*	*1*	*2*	*1*		*4*
4	*Experimenting with free-hand drawing to modify 2-dimensional shapes to achieve new forms*	*Multiple choice*	*1*	*2*	*1*		*5*
5	*Experiment with how shapes and forms can be manipulated using free drawing to achieve new forms*	*Multiple choice*	*1*	*1*	*1*		*1*
Total			***6***	***8***	***6***		***20***

UNIT 3: PATTERN DESIGN

INTRODUCTION AND UNIT SUMMARY

STRAND: CONCEPTUAL DRAWING

SUB-STRAND: PATTERN DESIGN

Learning Outcome: *Apply the understanding and skills of creating templates and patterns to develop freehand-drawn 2-dimensional templates and patterns for new concepts and designs*

Content Standard: *Demonstrate knowledge and skill in using freehand drawing techniques to create 2-dimensional templates and patterns for concepts and designs*



HINT

Remind learners to submit their group project on digital or manual album in week 7.

Introduction and Section Summary

This section outlines a three-week curriculum for creating 2-dimensional free hand-drawn templates and patterns. The curriculum encourages learners to use collaborative and problem-based learning methods, allowing them to brainstorm, create, and refine their designs. Learners in mixed-ability groups work on complex geometric shapes and themes, creating detailed designs. In the next three weeks, learners will select materials and tools, develop a drawing framework, and complete complex designs. The section involves a structured hand-drawing process where learners brainstorm complex geometric shapes and thematic ideas, generate multiple sketches, determine dimensions and proportions, plan their drawing process, and create detailed templates and patterns. The section concludes with learners presenting their work for peer feedback, sharing templates, recording criticisms, and refining drawings. The assessment framework evaluates cognitive abilities, critical thinking, problem-solving, innovative solutions, communication, and collaborative skills in design, focusing on technical skills and creativity, preparing learners for future initiatives.

The weeks covered by the section are:

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

Pedagogical Summary

This section involves learners developing 2-dimensional free hand-drawn templates and patterns through collaborative and problem-based learning. They work in mixed-ability groups, brainstorming complex geometric shapes and themes like art, design, or textiles. They develop multiple sketches to determine the best ideas for templates and patterns and select materials like pencils, markers, cardboard, and foam for their projects.

The process involves learners determining dimensions, brainstorming in groups, and planning their drawing process using soft strokes. They create detailed templates and patterns, adding textures and ornamentations to enhance their designs. The final stage involves presenting their work for feedback, sharing templates and patterns, and recording peer feedback. This collaborative discussion helps identify areas for improvement. Learners refine their drawings and write a report explaining their creative process, demonstrating how their 2-dimensional templates can be useful to the community. This structured approach fosters critical thinking, problem-solving, and innovative solutions while developing critical skills like communication and resourcefulness.

Assessment Summary

The assessment framework evaluates learners' skills in creating 2-dimensional free hand-drawn templates and patterns through cognitive levels, from basic recall to extended critical thinking. At the foundational level, learners list ideas, dimensions, and feedback received from peers. Learners engage in critical thinking activities, describing plans and ideas and categorising peer feedback into commendations, suggestions, and criticisms. They create templates and patterns using materials and tools and use peer feedback to improve their work. They also create sketches, drawings, and a report explaining their creative process and their community utility, emphasising critical thinking, creativity, and real-world application. The assessment strategy guides learners from basic concepts to real-world scenarios, enhancing their understanding of the art and design process through recall, description, development, and creation. It also incorporates peer feedback and report generation, enhancing communication and critical thinking skills, and preparing them for future design challenges.

WEEK 7

Learning Indicator: Select appropriate drawing materials and tools that can be used to create 2-dimensional free hand-drawn templates and patterns

Focal Area 1: ADVANCED FREEHAND DRAWING TECHNIQUES FOR 2-DIMENSIONAL TEMPLATES AND PATTERNS

Complex Geometric Shapes and Forms

Complex geometric shapes and forms are intricate designs that combine multiple geometric elements such as polygons, curves, and solids. Geometric shapes, such as fractals, polyhedral, and tessellations, are used in fields like architecture, art, mathematics, engineering, and design to create aesthetically pleasing and structurally sound works.

Complex geometric shapes and forms, found in art, nature, and various fields of study, possess unique properties and characteristics. This means that Complex Geometric Shapes and Forms (CGSF) are

1. **Intricate:** they have many complexly arranged parts or details.
2. **Non-repeating:** they lack regular, repeating patterns.
3. **Self-similar:** they exhibit the same pattern or shape at different scales.
4. **Fractal:** they display self-similarity at different scales.
5. **Curved:** they have smooth, continuous curves rather than straight lines.
6. **Tessellated:** they are composed of repeating shapes that fit together without overlapping.
7. **Polyhedral:** they have multiple faces, edges, and vertices.
8. **Manifold:** they have a complex, connected surface.
9. **Helical**: they may have a spiral or helix-like shape.
10. **Organic:** they usually resemble natural, biological forms.
11. **Abstract:** they do not represent a recognisable object or form.
12. **Dynamic:** they appear to change or move when viewed from different angles.
13. **Symmetrical:** they have balanced, mirror-like reflections.
14. **Asymmetrical:** they lack symmetry, with unique, uneven arrangements.
15. **Dimensionally complex:** they exist in multiple dimensions or have complex spatial relationships.

Complex geometric shapes and forms are essential for creating structurally resilient, visually and complex works. The control of geometric shapes and forms allows for various fields to push the boundaries of creativity and functionality, resulting in works that are structurally sound and aesthetically pleasing. These principles are applied to design innovative structures like the Sydney Opera House, which uses complex geometric forms for aesthetic appeal and structural integrity.



Figure 1.3.1: *Sidney Opera House (1973), Sidney, Australia*

Engineering uses these principles to ensure the stability and efficiency of bridges, buildings, and other constructions, such as geodesic domes.



Figure 1.3.2: *Adomi bridge, The* Montreal Biosphère*,*

1. Adomi Bridge (1957), Ghana. https://en.wikipedia.org/wiki/Adomi_Bridge#/media/File:Adome_Bridge,_River_Volta,_Ghana.jpg
2. The Montreal Biosphère, formerly the American Pavilion of Expo 67, by R. Buckminster Fuller, on Île Sainte-Hélène, Montreal, Quebec, Canada. https://en.wikipedia.org/wiki/Geodesic_dome#/media/File:Mtl._Biosphere_in_Sept._2004.jpg

In art, geometric shapes balance complexity and harmony, with artists like M.C. Escher creating intricate patterns and impossible shapes.

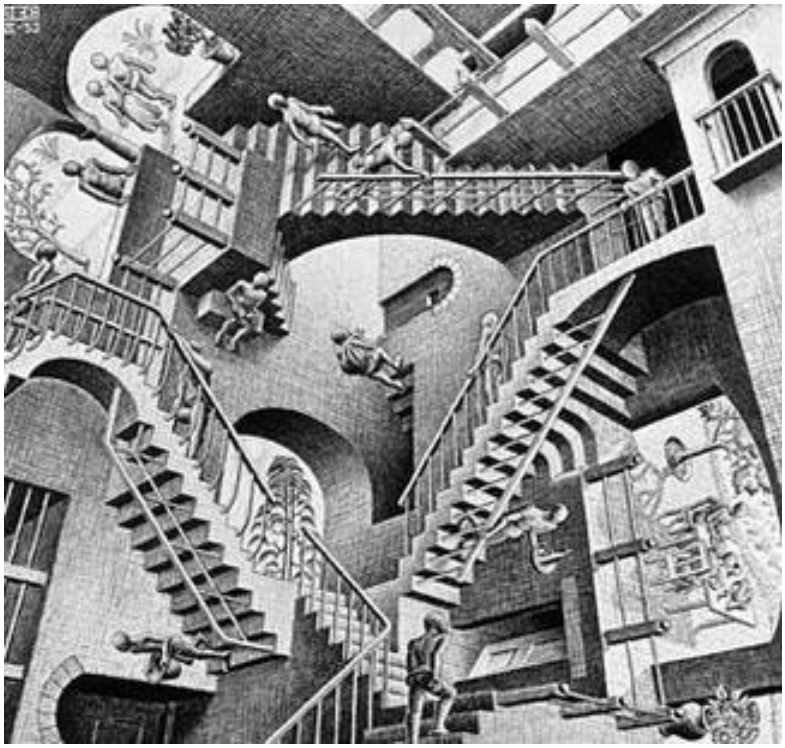


Figure 1.3.3: *Maurits C. Escher (1953). Relativity*

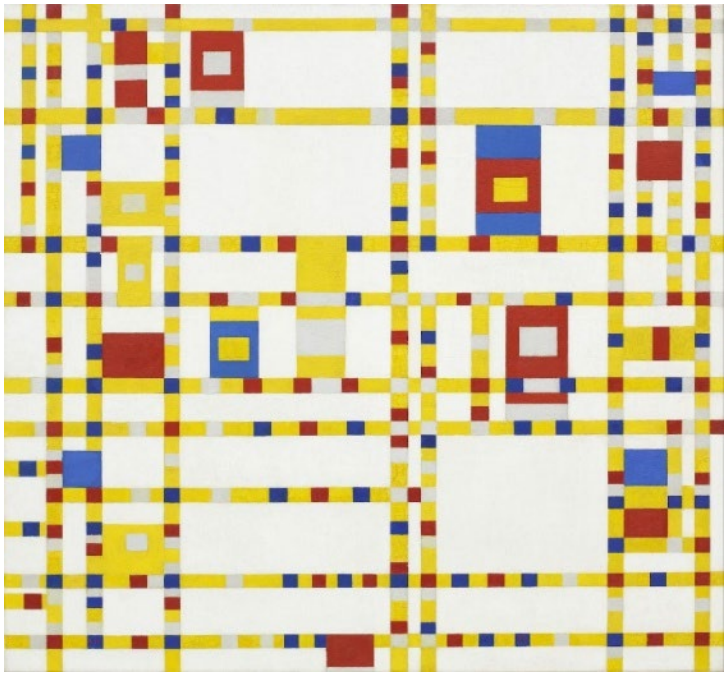


Figure 1.3.4: *Piet Mondrian's (1942-43)*

Piet Mondrian's (1942-43) *Broadway Boogie Woogie* uses the geometric shapes of squares and rectangles to represent the busy grid of streets in Manhattan, New York.

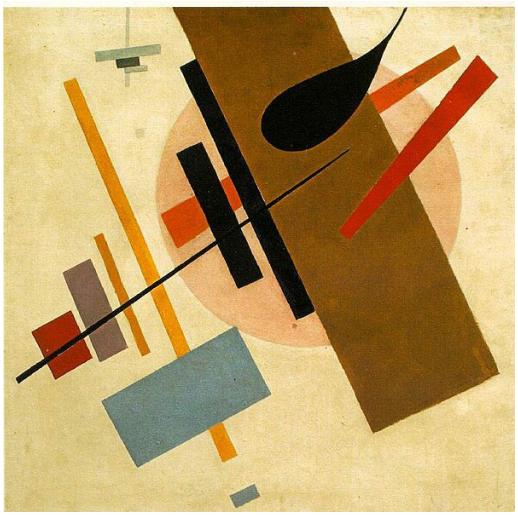


Figure 1.3.5: *Kazimir Malevich (1916). Suprematism / Supremus No.55*

In design, geometric principles are used to create functional yet visually engaging objects, as seen in Bauhaus's minimalistic designs.



Figure 1.3.6: *Bauhaus Design (1919-1933)*

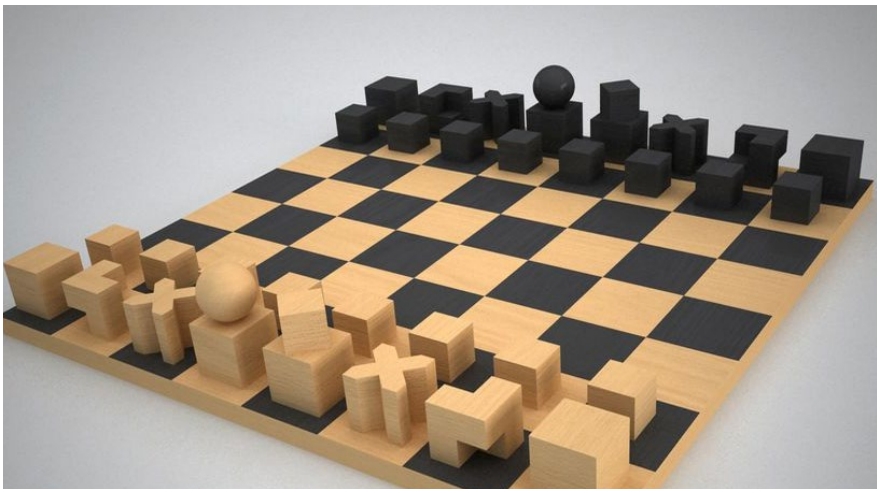


Figure 1.3.7: Josef Hartwig *(1922), The Chess Set is typical of timeless Bauhaus design.*

Designed in 1922 by Josef Hartwig, this beautiful *Chess Set* is typical of timeless Bauhaus design. With **characteristically reduced forms** featuring shapes such as cubes, cylinders and balls, the design of each piece indicates **the type of its manoeuvre**.

Freehand Drawing of Complex Geometric Shapes and Forms

Drawing complex geometric shapes and forms through freehand requires skill, practice, and an understanding of geometric principles. By consistently rehearsing relevant techniques and exploring different approaches, one can master the freehand drawing of complex geometric shapes and forms.

Here are a few thoughts to consider when working on complex geometric shapes and forms:

1. It is crucial to use high-quality materials and tools, like drawing paper, gridded paper, or a sketchbook, and various drawing tools (including rulers, pairs of compasses, and protractors, when necessary for beginners).
2. Understand basic geometric shapes like circles, triangles, squares, and polygons, and draw them repeatedly with freehand, focusing on symmetry and proportion.
   a. Draw regularly to improve hand-eye coordination, practising straight lines, curved lines, and simple shapes to build good memory.
   b. Begin by lightly drawing a grid on your paper to ensure alignment and proportion, using it as a guide to maintain symmetry and balance.

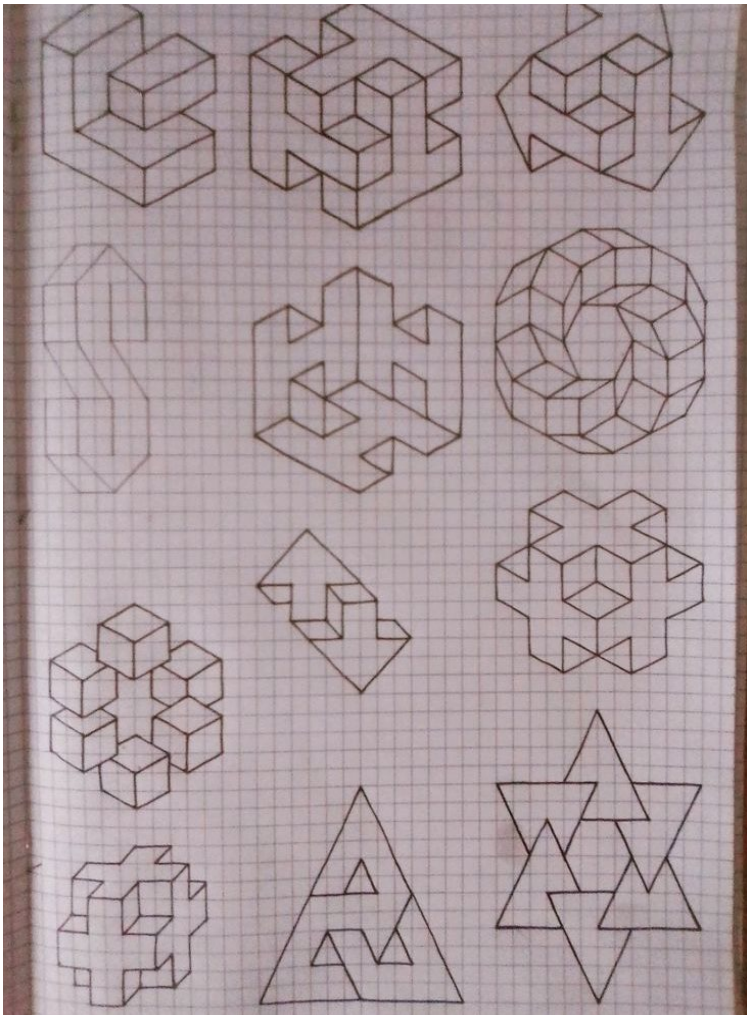


Figure 1.3.8: *Grid paper*

   c. Start drawing with light, rough sketches to map out basic structures, and gradually refine the lines to make them darker and more precise.

d. Review and refine your drawings, erasing and redrawing parts to improve accuracy and detail.
e. Maintain a sketchbook dedicated to geometric drawings to document your progress Deconstruct complex forms into simpler geometric components, drawing each individually before combining them.

3. Use isometric and one-point perspectives and techniques like vanishing points and horizon lines for depth and perspective, practising.

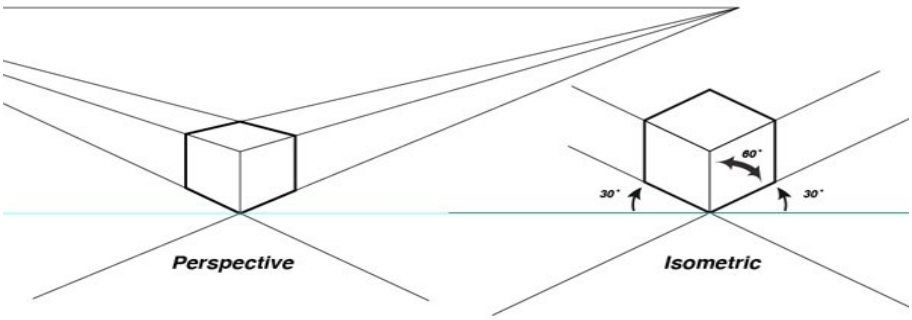


Figure 1.3.9: *perspective drawing*

4. Apply symmetry and repetition to create balanced designs and add complexity.
5. Experiment with shading techniques like hatching, cross-hatching, and stippling to add depth and dimension, and explore different textures to enhance visual interest.
6. Study real-life examples of geometric shapes and forms in the environment, drawing from observation to capture their essence.



Figure 1.3.10: *Honeycomb*

7. Combine different geometric elements to create complex designs, experimenting with overlapping shapes and new intersections.

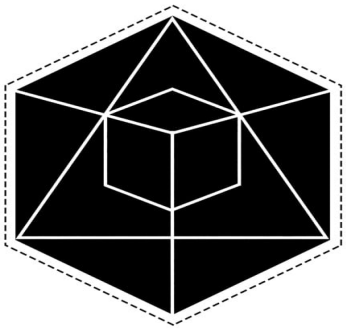


Figure 1.3.11: *combined geometric figures*

8. Discuss works with peers or mentors for constructive feedback, and collaborate with other learners to gain new insights and techniques.
9. Explore artistic styles by looking at works by artists, architects and designers known for geometric designs, like Maurits Cornelis Escher, Zaha Hadid, and David Adjaye to imitate their techniques to expand our skills.



Figure 1.3.12: *Zaha Hadid*

Zaha Hadid, Vitra Fire Station in Weil am Rhein, Germany (1991–1993). Hadid's first building complex

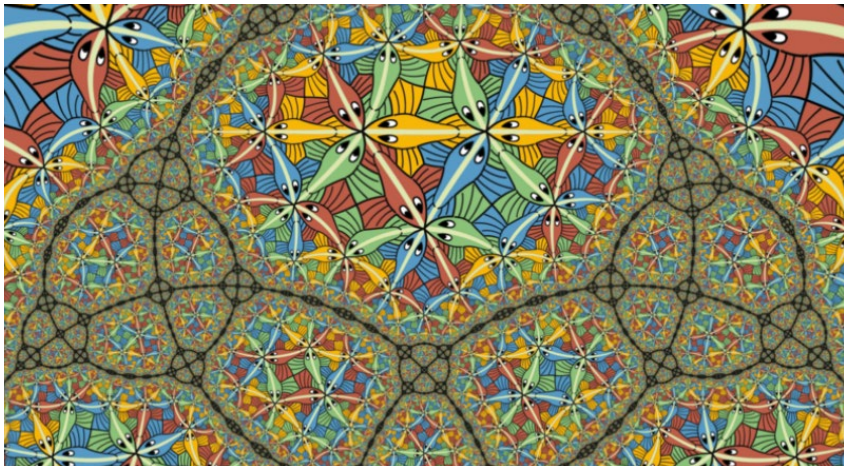


Figure 1.3.13: *Maurits Cornelis Escher Circle Limits III (1959)*

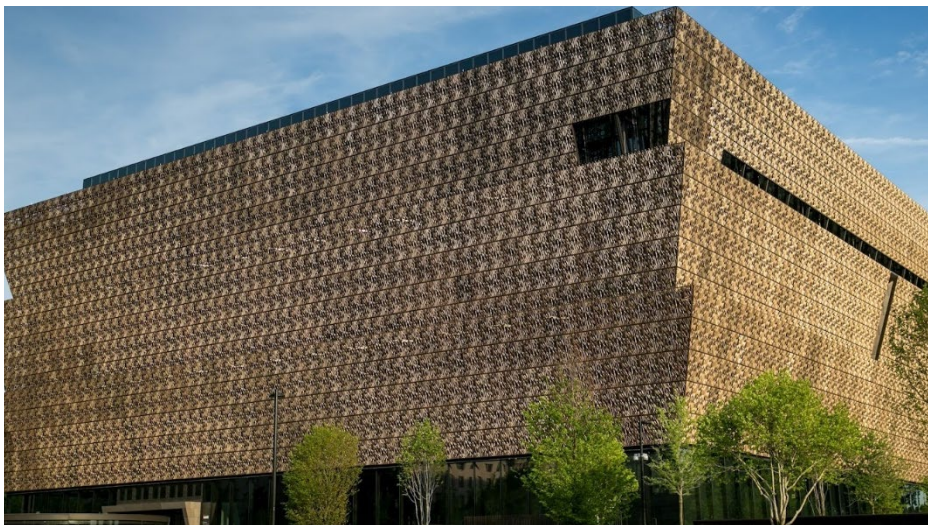


Figure 1.3.14: *the Smithsonian's National Museum of African American History and Culture (NMAAHC), Washington DC.*

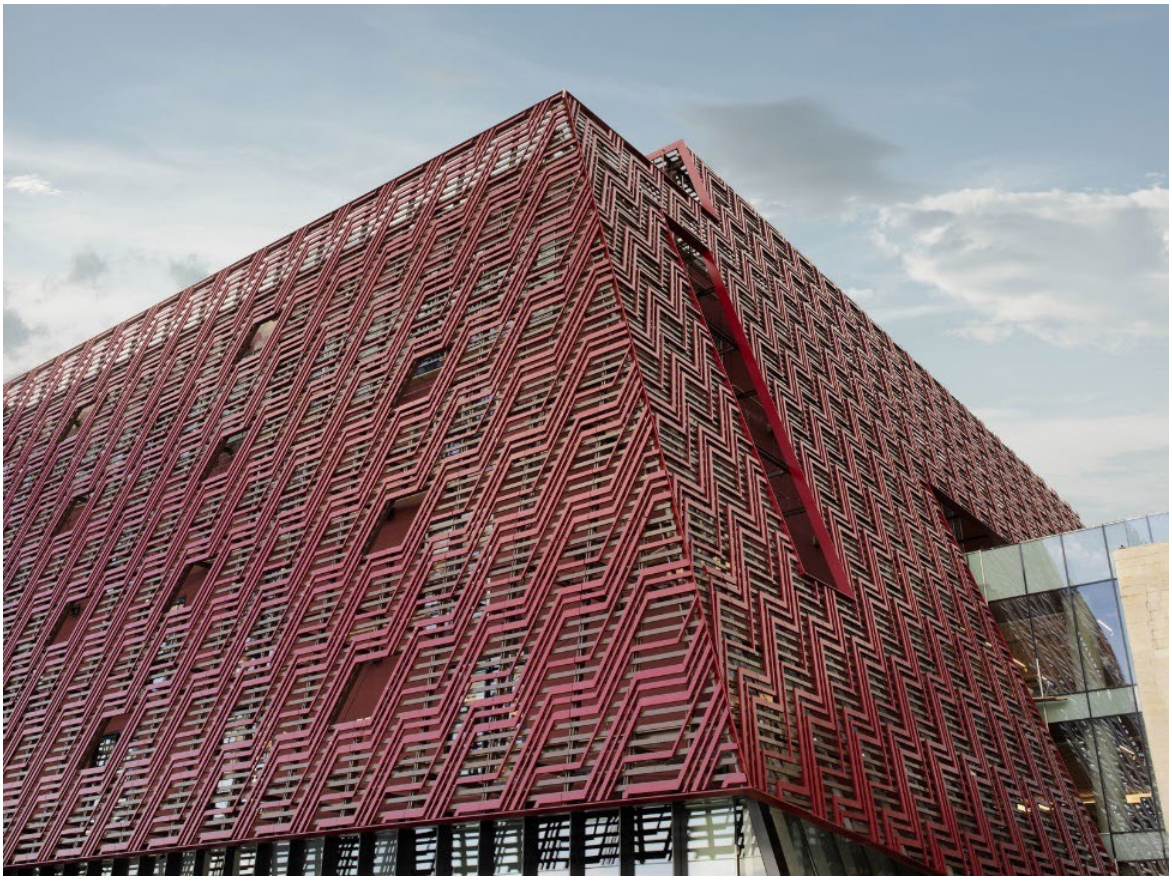


Figure 1.3.15: *Detail,*

10. Analyse works and objects that incorporate complex geometric shapes, using them as inspiration.



Figure 1.3.16: *African craft/prints*

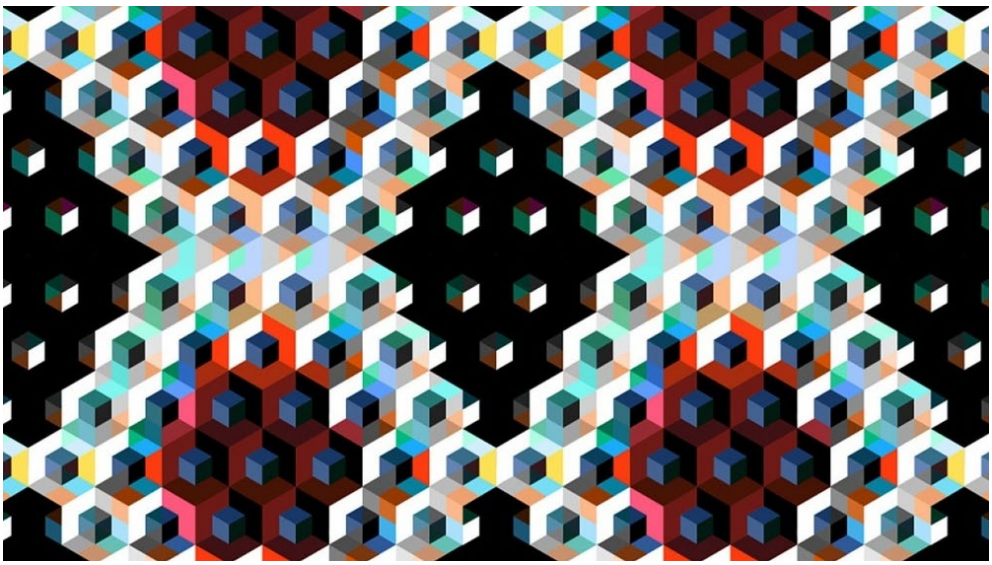
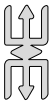


Figure 1.3.17: *Complex Isometric Cube Pattern*

Creating Templates and Patterns with Complex Geometric Shapes and Forms

Creating stencils and patterns with complex geometric shapes and forms involves exploring repetitions in tessellation and fractals, where shapes fit together without gaps. Applying the following steps combines precision with creativity, and allows the creation of aesthetically pleasing and complex designs using complex geometric shapes and forms in stencils and patterns. Here are some useful tips to consider:

1. Use grid systems to maintain proportions and alignment, drawing lightly on the grid for guidance.
2. When drawing complex shapes freehand, break down forms into simpler components and draw each part individually before combining them.
3. Refine the technique by focusing on accuracy and smoothness, using light strokes initially and darkening the lines once satisfied.
4. Create stencils by transferring designs to stencil material, and carefully cutting out the shapes with a sharp blade or scissors.
    a. Test the stencil on paper and adjust as necessary for accuracy.
5. Seek inspiration by studying examples of complex geometric patterns in art, textiles, and architecture, and analysing how shapes are combined to create intricate designs.
6. Challenge complex geometric freehand drawing skills with increasingly complex designs.
7. Apply complex geometric patterns to art, design, and crafts, such as painting, interior design, and DIY projects.



Note

Create a couple of step-by-step processes for creating hand-drawn templates and patterns with complex geometric shapes and forms as described above.

Freehand Drawing of Polyhedrons and Complex Geometric Patterns in Fractals and Tessellations

When experimenting with freehand drawing of polyhedrons, fractals, and tessellations, precise measurements and angles are used to create complex geometric patterns. This process enhances understanding of geometric principles and improves the ability to create intricately and visually appealing designs. The following steps illustrate how to approach similar work:

1. **Experiment with Polyhedrons**
   - **Study Basic Polyhedrons**: Understand basic polyhedrons like cubes, tetrahedrons, and dodecahedrons by analysing their faces, edges, and vertices.

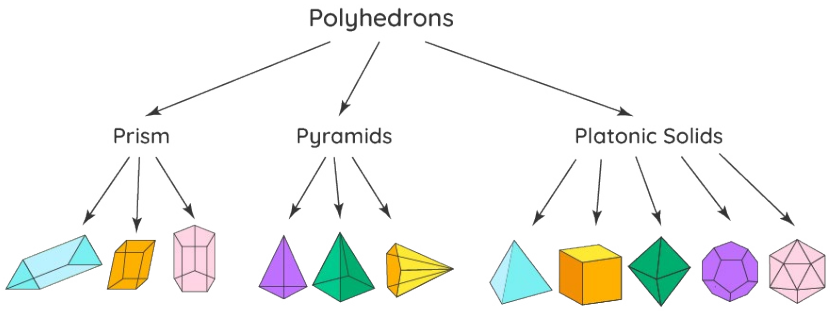


Figure 1.3.18: *Basic polyhedrons*

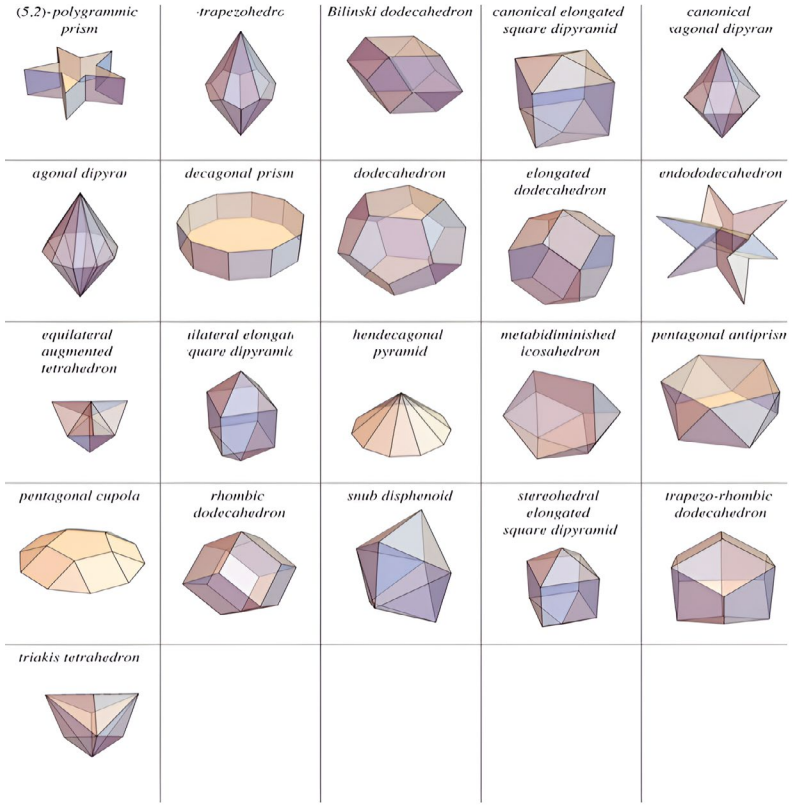


Figure 1.3.19: *Dodecahedrons*

- **Deconstruct Structures**: Break down complex polyhedrons into simpler shapes, and practice drawing these simpler shapes first.
- **Combine Shapes**: Combine simpler shapes and forms gradually to form the whole and complete polyhedron.

2. **Explore Fractals with Polyhedrons**
    - **Understand Fractal Patterns**: Learn about fractals, which repeat at smaller and smaller scales.
    - **Draw Simple Fractals**: Start with basic fractal patterns such as the Sierpinski triangle or the Koch snowflake.
    - **Increase Complexity**: Gradually add more iterations and details to make the fractals more complex.

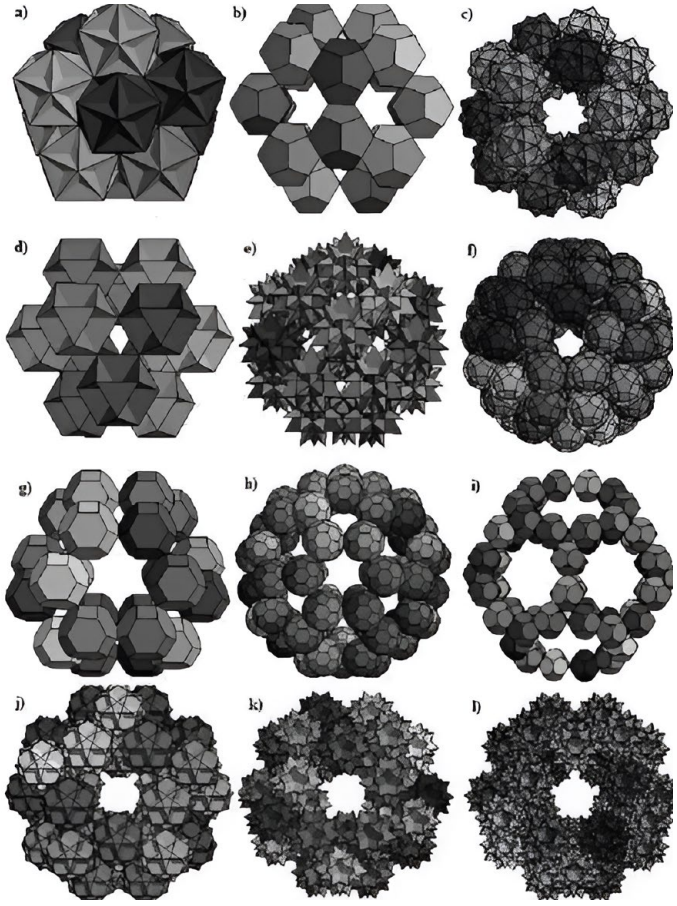


Figure 1.3.20: *Fractal construction from polyhedrons.*

3. **Create Polyhedron Tessellations**
    - **Learn Tessellation Basics**: Experiment with how to fit shapes together without gaps or overlaps.
    - **Experiment with Shapes**: Start with basic shapes like triangles, squares, and hexagons, and explore how they can tessellate.



Figure 1.3.21: *Roman geometric mosaic*

- **Combine Shapes and Forms**: Explore more complex tessellations by combining various shapes and forms.

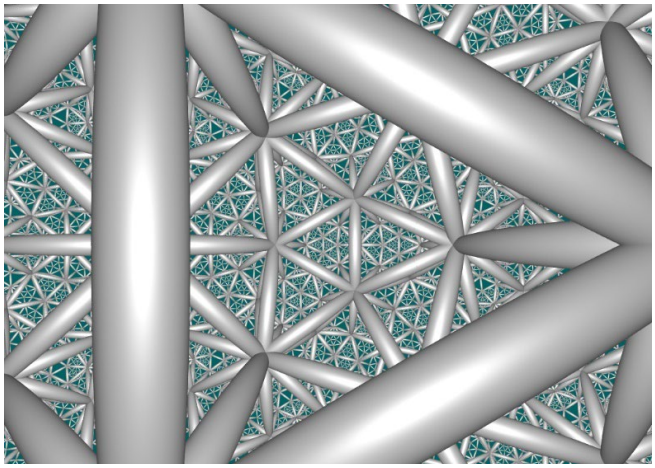


Figure 1.3.22: *The regular* icosahedral honeycomb*,*

one of four regular compact honeycombs in hyperbolic 3-space

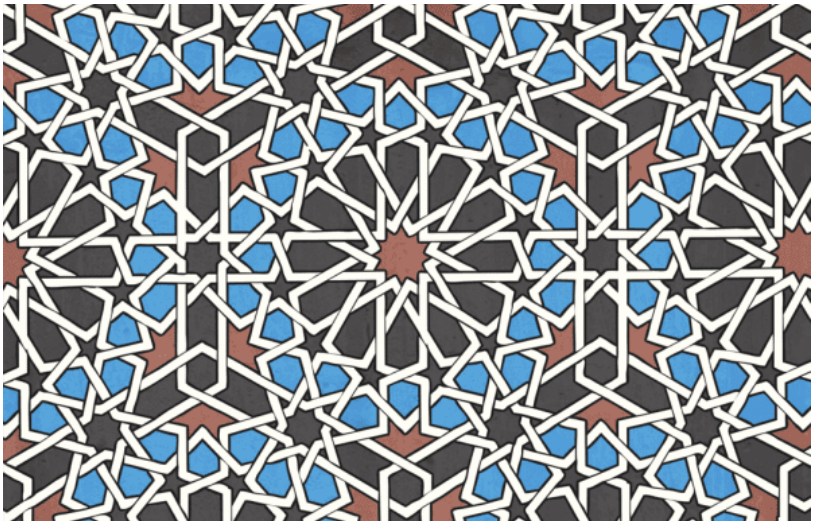
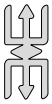


Figure 1.3.23: *Tessellation*

4. **Use Precise Measurements and Angles**

   Tools: Use a ruler and protractor to ensure precision in your drawings.

   Angles and Sides: Carefully measure angles and sides to maintain pattern accuracy.



Note

Tools are to be employed only when necessary

5. **Construct Complex Patterns with Freehand Drawing**

   Light Sketches: Always begin freehand drawing with light, rough sketches to outline patterns.

   Refine and Detail: Gradually refine and define lines and add details, darkening the lines once satisfied.

   Symmetry and Proportions: Ensure patterns are symmetrical and proportionate.

6. **Inspiration and Practice**

   Study Examples for Practice: Explore examples of polyhedrons, fractals, and tessellations in art, objects, and built and natural environments for inspiration, and challenge oneself with increasingly complex designs.



Figure 1.3.24: *Islamic mosaic ceramic tile* tessellations *in Marrakech, Morocco.*

Pattern Morphing and Transformation

Pattern morphing and transformation is a technique that involves altering and adapting geometric patterns to create dynamic, visually appealing designs, a concept widely used in architecture, design, fashion, and digital art. Understanding and applying these concepts and techniques creates innovative and visually stunning designs that push the boundaries of traditional patterns.

Basic Concepts in Pattern Morphing and Transformation

1. **Morphing**

   It is the gradual transformation of images, shapes or patterns used to create fluid, dynamic designs that change, evolve or become something else, e.g. tangle morphs by Eni Oken

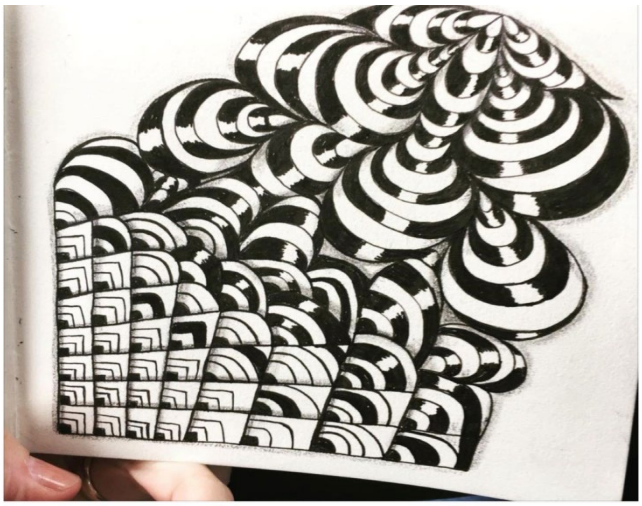


Figure 1.3.25: *Morphing art*

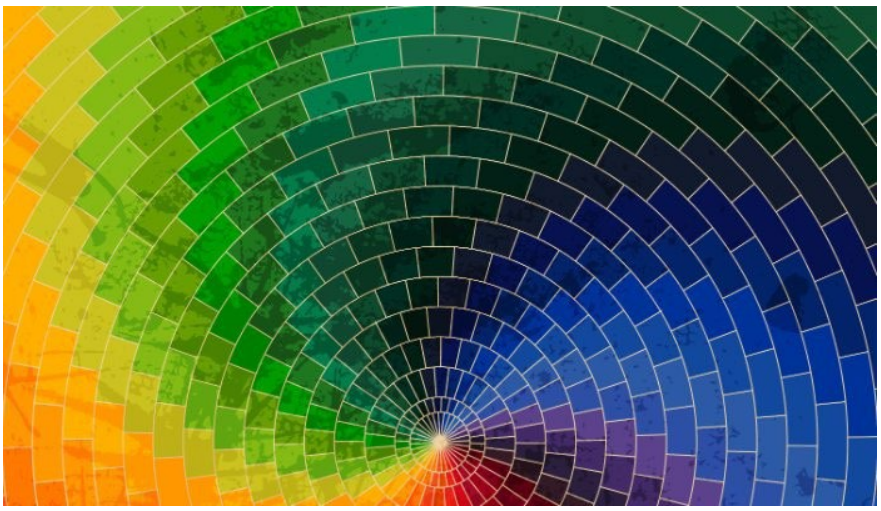


Figure 1.3.26: *Morphing art*

2. **Transformation**

It is the change in pattern position, size, orientation, or form achieved through translation, rotation, scaling, reflection, and distortion.

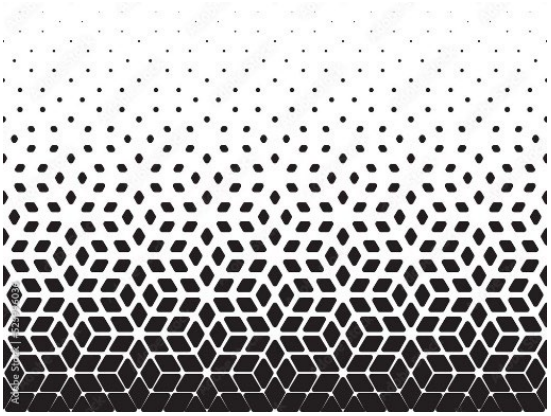


Figure 1.3.27: *Transformation artwork*

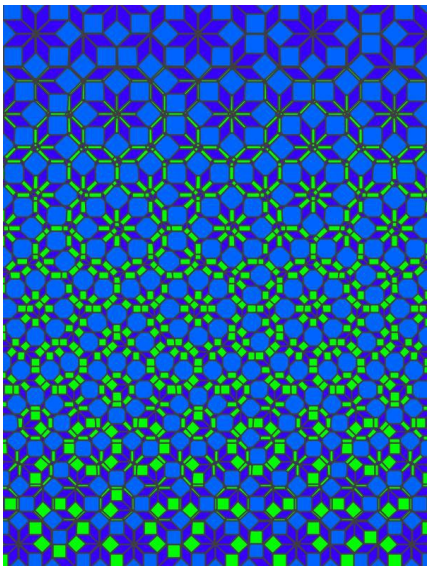


Figure 1.3.28: *Morphing the quasiperiodic tiling of octagons and squares. It has eight-fold rotational symmetry.*

Tools and Techniques

Manual techniques for pattern transformation include drawing and sketching, and pattern repetition using tiling and tessellation.

Digital techniques employ tools like Adobe Illustrator, Photoshop, or CorelDRAW for 2D transformations, while 3D modelling tools like Blender, Rhino, or Maya can be used for 3D patterns.

Practical techniques for gradual transformation include breaking down the process into smaller steps and using interpolation techniques to create intermediate steps between two patterns.

Algorithmic design involves creating procedural rules for transforming patterns and using mathematical functions and equations to control the transformation process.

Dynamic systems involve kinetic art and responsive design, which create patterns that change with movement or interaction and react to environmental factors like light, sound, or user input.

Applications and Examples

1. Architecture involves morphing patterns in facade design to create dynamic building facades, and in interior design, applying pattern transformations to wall coverings, flooring, and decorative elements.



Figure 1.3.29: *Dynamic D*Haus moves and morphs according to the seasons in eight different configurations.*



Figure 1.3.30: *Guggenheim Museum, Bilbao, Spain*

2. Fashion and textiles involve creating fabric designs with changing patterns across the surface and designing wearables with transforming patterns that change with movement or lighting.
3. Digital art and animation involve morphing techniques for gradual pattern transformation, while interactive art involves developing digital installations that change based on viewer interaction.
4. Islamic geometric patterns: Islamic art uses geometric transformations to create intricate designs.

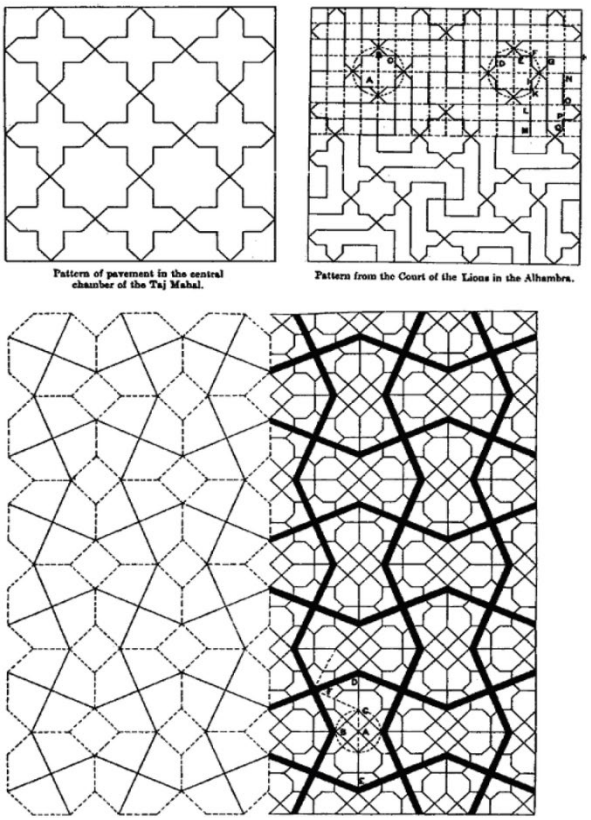


Figure 1.3.31: *Islamic geometric patterns*

Analysis of octagonal patterns in Mughal architecture by Ernest Hanbury Hankin, 1925. 8-pointed stars emerge (lower right) where heavy black lines cross.

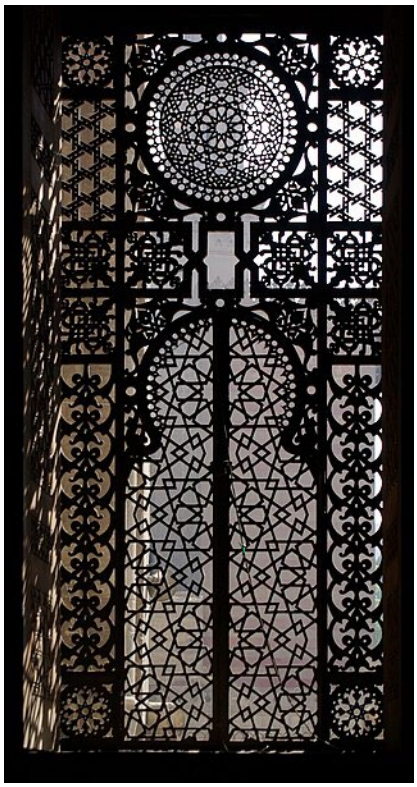


Figure 1.3.32: *Iron gate with 10-point stars and kites at Al-Rifa'i Mosque, Cairo (1869–1912)*

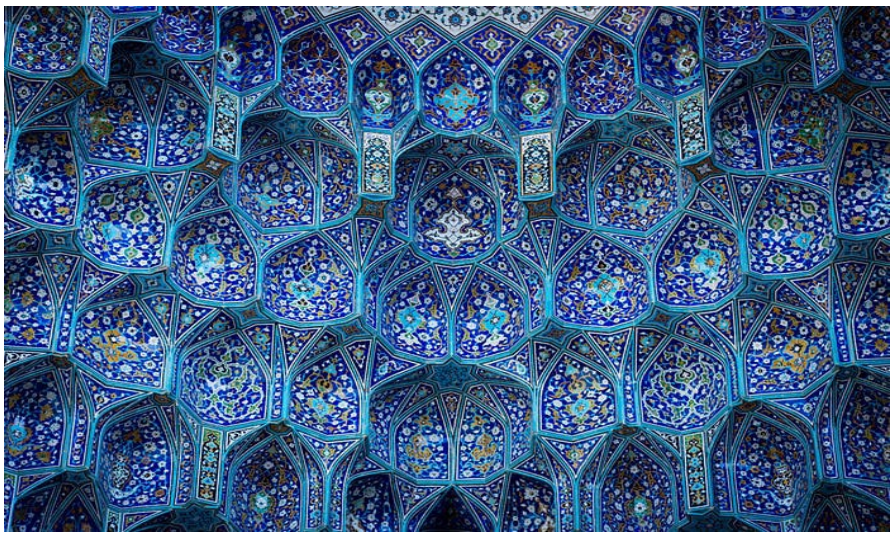


Figure 1.3.33: *Islamic-geometrical designs*

5. Contemporary architecture: Architects like Zaha Hadid and Frank Gehry incorporate complex geometric transformations in their designs.



Figure 1.3.34: *Nanjing International Youth Cultural Centre by Zaha Hadid.*



Figure 1.3.35: Beko Masterplan by Zaha Hadid, *Belgrade.*

6. Digital art installations employ morphing and transformation.

Learning Task

Experiment with different small free hand-drawing ideas to select appropriate materials and tools for 2-dimensional free hand-drawn templates and patterns.

Pedagogical Exemplars

1. **Group work/Collaborative Learning**: In mixed-ability groups, learners brainstorm to come up with ideas for drawing freehand templates and patterns with complex geometric shapes and forms.
2. This could be a theme or an idea, and what the 2-dimensional template and pattern drawing is for; e.g. art, design, textiles, etc. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
3. **Group work/Collaborative Learning; Project-based Learning**: Learners in mixed-ability groups develop many small sketches and drawings based on their ideas to see which ones could work as 2-dimensional templates and patterns. Create a peer-to-peer mentoring system to help learners having difficulties receive help from colleagues.
4. **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 board, foam, Styrofoam, etc. for their free hand-drawn 2-dimensional template and pattern projects. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

Level 1

1. List ideas that can be used for drawing freehand 2-dimensional templates and pattern designs.
2. Select five drawing materials and tools that can be used to create 2-dimensional free hand-drawn templates and patterns

Level 2: Describe plans or ideas required to create free hand-drawn 2-dimensional template and pattern designs.

Level 3: Develop a detailed chart that categorizes and justifies the selection of materials and tools needed for creating effective 2-dimensional hand-drawn templates and patterns, including potential applications for each item.

Level 4: Design a comprehensive portfolio of innovative 2-dimensional templates and patterns, including sketches, detailed descriptions, and explanations of the artistic choices made, and evaluate how these designs could be applied in various real-world contexts.

HINT



The recommended mode of assessment for week 7 is **gamification**. *Use the level 1 question 2 as a sample question.*

WEEK 8

Learning Indicator: Develop appropriate drawing framework and necessary elements to create 2-dimensional templates and patterns

Focal Area 1: APPROPRIATE DIMENSIONS FOR FREEHAND DRAWING TECHNIQUES FOR 2-DIMENSIONAL TEMPLATES AND PATTERNS

Negative Space in Complex Geometric Template and Pattern Design

Negative space is the empty or open space around an object, giving it meaning and purpose. It is the area around and between subjects in an image, defining the boundaries of the positive space. Examples of works that effectively use negative space include those by M.C. Escher, where it often forms an essential part of the design.

To effectively employ negative space in hand-drawn templates and patterns with complex geometric shapes and forms, effective planning, accurate measurement, and careful execution are very important for creating balanced designs and artworks. By carefully planning, measuring, and using negative space, you can create complex and balanced hand-drawn geometric designs that are compelling and aesthetically innovative.

Planning and conceptualising a design usually begins with rough ideas to explore negative space interactions with geometric shapes. The focus is usually on balancing positive and negative space for visual stability and identifying key areas, including balance and harmony, for successful design.

Activity

The following guide provides steps on how to employ negative spaces in template and pattern design effectively. It also explains the importance of negative space in successful design.

Planning

1. **Conceptualise Design**
   - **Brainstorm** about the theme and purpose of the design (to create templates and patterns with complex geometric shapes and forms) and how negative space can be used to harmonise the composition.
   - **Sketch rough design ideas** to explore various ways of incorporating negative spaces between and around the geometric shapes.
2. **Positive and Negative Spaces**
   - **Decide and define** which areas and parts of the design will be positive space (the complex geometric shapes) and which will be negative space (the background or empty areas between and around the shapes).
   - **Create a balance** between positive and negative space, knowing that the negative space (around and between) is as important as the positive space (shapes or objects).

3. **Measuring Tools**
   - **Use grid** paper, or create a grid to help measure and accurately align your geometric shapes.
   - **Tools needed** include rulers, pairs of compasses, protractors, and pencils for precise measurements and good registration.
4. **Determine Proportions**
   - **Scale, Size and Proportion:** Decide on the scale and size of the work and the proportions of the shapes with the overall design.
   - **Measure Distances:** Use a grid to measure the distances between shapes and consistency in spacing. Where plain paper is used, rulers and protractors could be used.

Using Negative Space

1. **Draw the Outline**
   - **Shapes:** Draw the outlines of your geometric shapes, considering the negative space.
   - **Adjustments:** Adjust the positions and sizes of the shapes to optimise negative spaces.
2. **Create Patterns**
   - **Pattern Integration:** Use negative space to create patterns that complement the shapes and design.
   - **Symmetry and Repetition:** Align the shapes and negative spaces to incorporate symmetry and repetition to create a cohesive design.

Execution

1. **Detailed Drawing**
   - **Add Details:** Ensure that details are added to both positive and negative spaces after assembling the basic shapes.
   - **Refine Edges:** Create clean and precise edges for the shapes.
2. **Balance and Contrast**
   - **Contrast:** Use different shading techniques, colours, or line weights to create contrast between positive and negative spaces.
   - **Balance Elements:** Ensure that negative spaces balance well with positive spaces, and also guide viewers through the design.

Final Steps

1. **Review and Refine**
   - **Review:** Take a step back and look at the design from a distance to see how the negative and positive spaces interact in real-time.

- **Make Adjustments:** Refine the design by making necessary changes where appropriate to improve balance and harmony.

2. **Finalise the Design**

- **Ink or Shade:** Use ink or selected shading techniques to complete the design by creating a distinction between positive and negative spaces.
- **Clean Up:** Erase all unnecessary pencil marks and smudges, and clean up the edges to ensure a clean final work.

Recommendations

1. **Symmetry and Asymmetry:** Experiment with both symmetrical and asymmetrical designs to see how negative space can create different visual effects in the same project.
2. **Layering:** Consider layering shapes and forms to create depth and complexity, using negative space to separate the layers.
3. **Textures:** Use different textures in the negative space to add contrast and dimension to the design.

Examples

1. **Traditional African Patterns:** Look at traditional African geometric patterns, which often use negative space to create rhythm and balance; e.g. Kente, and Ndebele Geometric wall designs.



Figure 1.3.36: *Asante kente cloth, 20th century, silk and cotton*



Figure 1.3.37: *Esther Mahlangu releases her second one-of-a-kind Ndebele-inspired design for BMW.*

2. **Sophie Taeuber-Arp:** A Dada artist known for her abstract and geometric designs, Taeuber-Arp skilfully used negative space to create balanced and harmonious compositions.



Figure 1.3.38: *Various elements in vertical-horizontal composition, 1918*

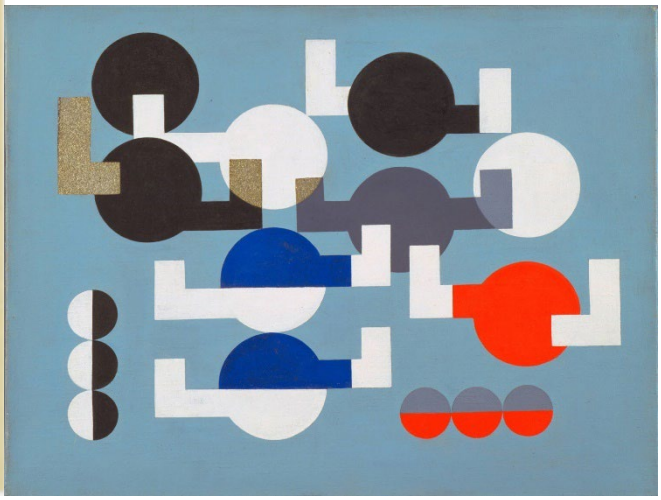


Figure 1.3.39: *Composition of Circles and Overlapping Angles, 1930.*

3. **Bridget Riley:** A key figure in Op Art, Riley used negative space in her black-and-white and colourful geometric patterns to create a sense of movement and depth.



Figure 1.3.40: *Uneasy Centre, 1963.*

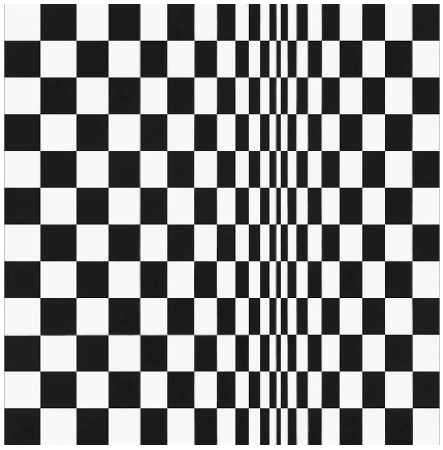


Figure 1.3.41: *Bridget Riley, Movement in Squares, 1961.*

4. **Josef Albers:** Known for his series "Homage to the Square," Albers explored the interaction of colours and geometric shapes, often using negative space to enhance the visual impact of his work.

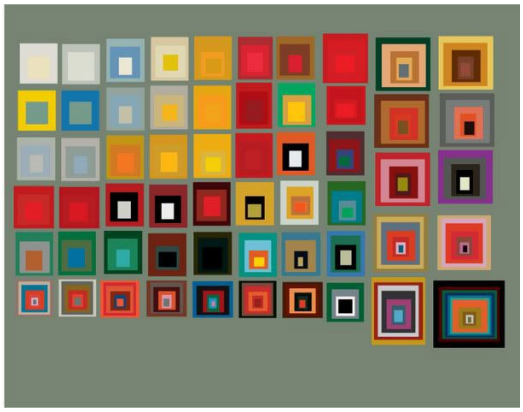


Figure 1.3.42: *Josef Albers, Homage to Squares*

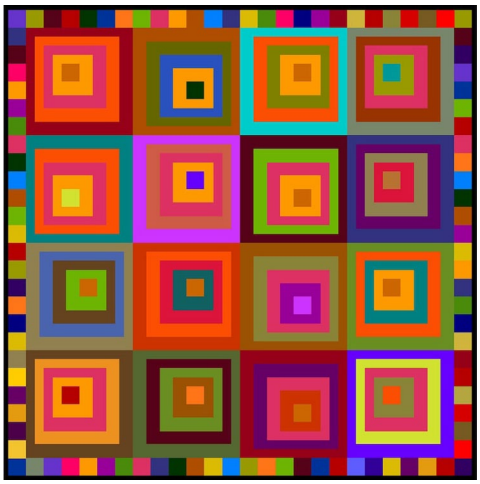


Figure 1.3.43: *Quilt-Addicts, Pre-cut Quilt Kit*

Learning Task

1. Investigate the processes involved in determining appropriate dimensions in free-hand drawn templates and patterns.
2. Create 2-dimensional free hand-drawn templates and patterns by Determining appropriate dimensions, proportions, and steps.

Pedagogical Exemplars

1. **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 also refer to the small sketches they did in LI 1. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.

2. **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. Support an individual or group working at a slower pace whilst the rest of the class completes more activities

3. **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. To ensure differentiation, the teacher can form groups considering the learners' readiness, interests, and learning styles. The complexity of the task can be varied based on the group's readiness level.

Key Assessments

Level 1: List the steps to determine appropriate dimensions and proportions for 2-dimensional free hand-drawn templates and patterns.

Level 2: Describe the steps used to create 2-dimensional free hand-drawn templates and patterns.

Level 3: Develop steps for creating 2-dimensional free hand-drawn templates and patterns.

Level 4

1. Create 2-dimensional free hand-drawn templates and patterns.
2. Investigate the processes involved in determining appropriate dimensions in free-hand drawn templates and patterns, and apply it to draw two-dimensional template and pattern

HINT



*The recommended mode of assessment for week 8 is **observation**. Use the level 4 question 2 as a sample question.*

WEEK 9

Learning Indicator: Finalise the 2-dimensional template and pattern design

Focal Area: APPROPRIATE FREEHAND DRAWN 2-DIMENSIONAL TEMPLATES AND PATTERNS

A. Pattern layering and interplay with complex geometric shapes and forms

Pattern Layering and Interplay

Pattern layering and interplay are techniques that combine multiple patterns and geometric shapes to create innovative designs with depth and complexity in art, design, and architecture. Elements usually used include well-drawn basic shapes like circles, triangles, squares, and hexagons and their combinations. Layering patterns can be simple or complex, with intricate designs like waves, spirals, and tessellations over basic shapes, while interplay of shapes can be achieved through overlapping, negative space, symmetry, proportional balance, contrast, texture, and texture variations. Pattern layering and interplay processes include planning and sketching, refining sketches, adding layers of patterns, and adjusting proportions as needed, with techniques like sequential layering and selective overlapping. Tools and methods include manual tools like rulers, compasses, protractors, and various digital tools, and improving composition and interplay patterns and forms through regular evaluation and repetition. Examples include Islamic art, mosaic tiles, interlocking shapes, Op Art, optical illusions, and pattern interaction.

Free hand-drawn pattern layering and interplay of complex geometric shapes and forms

Freehand drawing involves creating intricate designs by combining and overlapping various patterns and shapes without guiding tools. By applying the required concepts and techniques, one can create interesting designs that effectively create free hand-drawn patterns of complex geometric shapes and forms.

Concepts in pattern layering and interplay include

1. **Foundation Shapes**
   - **Base Geometry**: Begin with fundamental geometric shapes like circles, triangles, squares, and hexagons.
   - **Accuracy**: Ensure precision in drawing these shapes to maintain consistency and harmony.
2. **Layering Patterns**
   - **Basic Patterns**: Employ simple patterns like lines, dots, and grids.
   - **Complex Motifs**: Use complex patterns such as waves, spirals, and tessellations over the base shapes.

3. **Interplay of Shapes**
    - **Overlapping**: Play around with overlapping shapes to create new forms and intersections.
    - **Negative Space**: Use negative space to define and highlight the interplay between shapes and patterns.
4. **Symmetry and Balance**
    - **Symmetrical Designs**: Use radial, bilateral, or rotational symmetry to organise elements.
    - **Balanced Composition**: Ensure the distribution of shapes and patterns is balanced to create a cohesive design.
5. **Contrast and Texture**
    - **Contrasting Elements**: Use contrasting colours, patterns, and textures to create visual interest.
    - **Texture Variations**: Use different shading techniques and line weights to add depth and dimension.

Activity 1

1. **Planning and Sketching**
    - **Initial Sketches**: Begin with rough sketches to plan the overall design and placement of geometric shapes.
    - **Refinement**: Gradually refine the sketches, adding layers of patterns and adjusting proportions.
2. **Layering Techniques**
    - **Sequential Layering**: Add patterns in sequential layers, ensuring each layer complements the previous one.
    - **Selective Overlapping**: Overlap shapes and patterns selectively to create intricate designs without overcrowding the composition.
3. **Use of Tools**
    - **Manual Tools**: Use rulers, pairs of compasses, and protractors for precise measurements, as well as different pens and pencils for varied colours and textures.
    - **Digital Tools**: Use appropriate computer software for easy adjustments and precise pattern placement for complex design concepts, studies, and inspirations.
4. **Analyse and Iterate**
    - **Continuous Analysis**: Frequently analyse the design to ensure harmony and coherence.
    - **Iterative Process**: Repeat the design, making necessary adjustments to improve the composition and interplay.

Examples

1. **M.C. Escher**: M.C. Escher, renowned for his mathematically inspired artworks, employed complex geometric shapes and negative spaces to create interesting visual effects. His "*Metamorphosis*" series shows interlocking forms, demonstrating his mathematical precision and ability to create complex visual interplays.

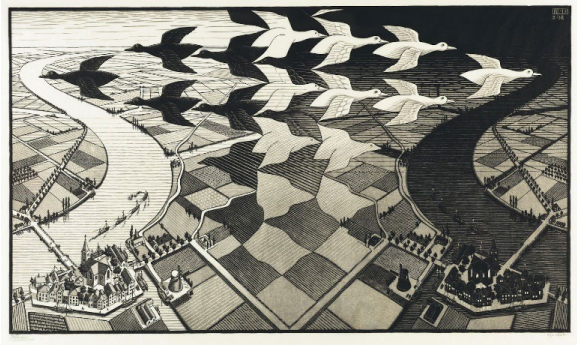


Figure 1.3.44: *Escher, 1/14 Day and Night, 1938,*

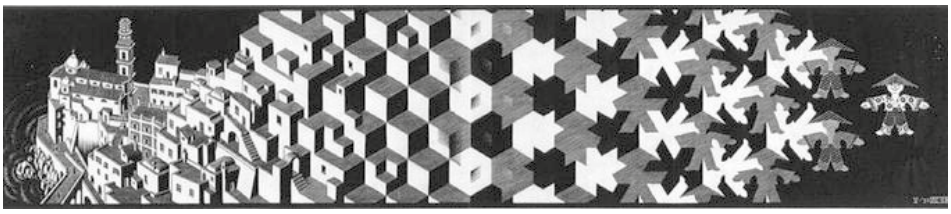


Figure 1.3.45: *Escher, Metamorphosis I*

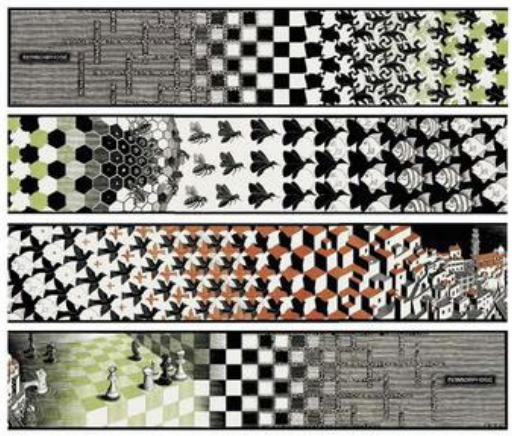


Figure 1.3.46: *Escher, Metamorphosis II,*

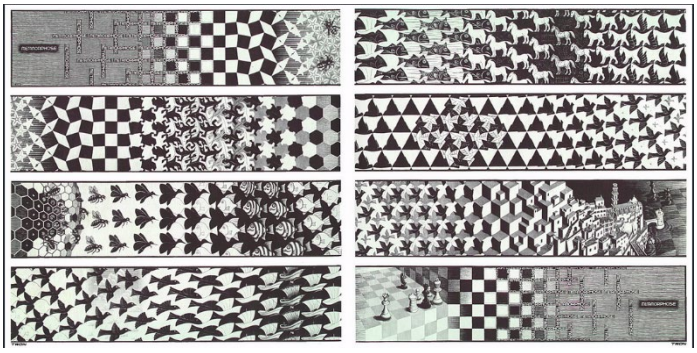


Figure 1.3.47: *Escher, Metamorphosis III (1967-1968),*

2. **Islamic Art:** Islamic art often features intricate geometric patterns, layered with intricate tilework and calligraphy. Examples include Alhambra's tilework, which features elaborate geometric designs layered with symmetrical patterns, showcasing the complex interplay of shapes and negative space in Islamic art.



Figure 1.3.48: *Alhambra-tilework,*



Figure 1.3.49: *Detail 1&2*

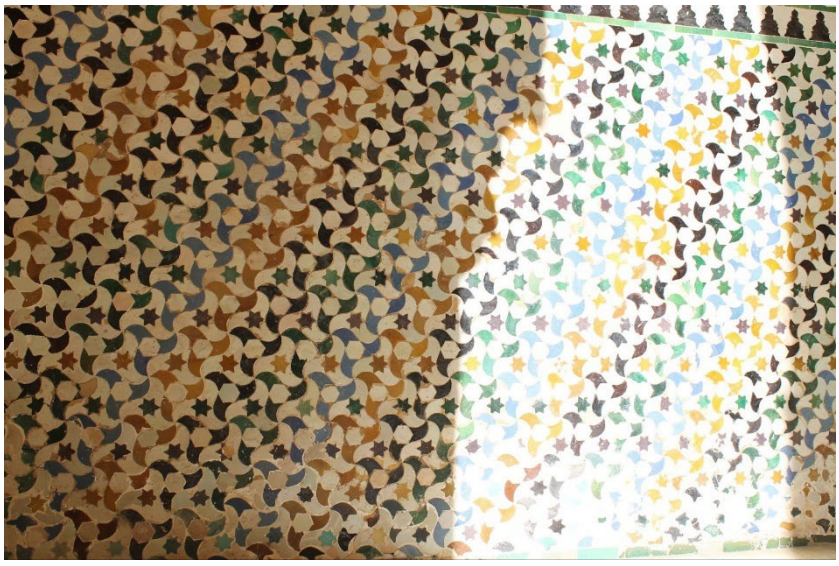


Figure 1.3.50: *Detail 3,*

3. **Op Art:** Artists like Bridget Riley and Victor Vasarely employ geometric shapes and patterns to create optical illusions, highlighting the interplay between foreground and background. Riley's work, like "*Movement in Squares*," demonstrates the use of repetitive patterns and geometric shapes to create dynamic visual effects.

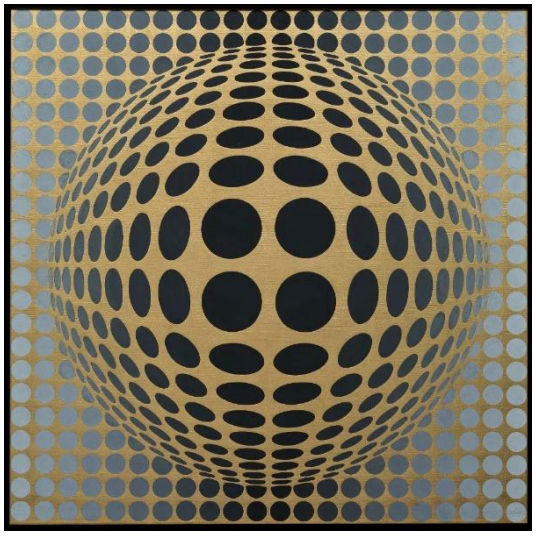


Figure 1.3.51: *Victor Vasarely. Vega-Or, 1969*

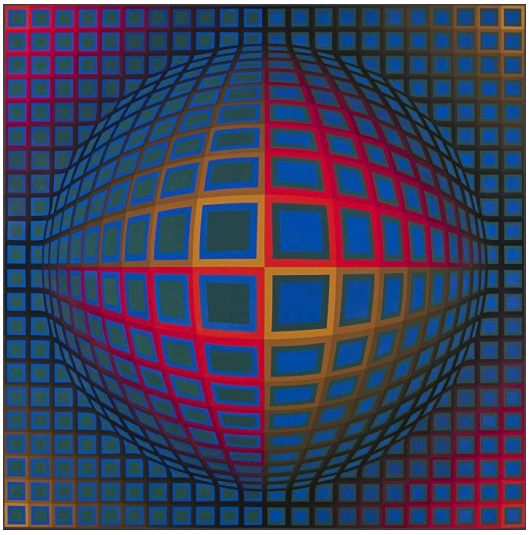


Figure 1.3.52: *Victor Vasarely. Vega-Or, 1969*

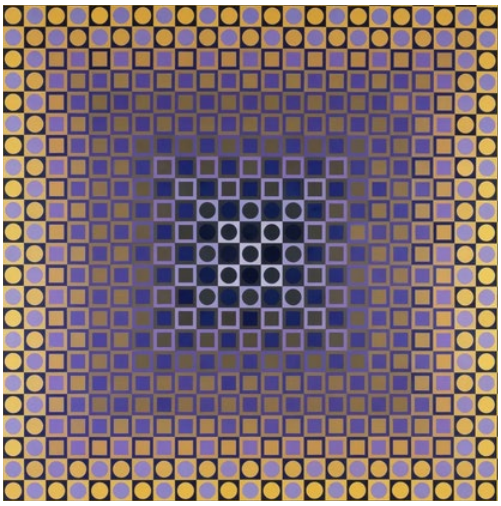


Figure 1.3.53: *Victor Vasarely, Dream, 1966*

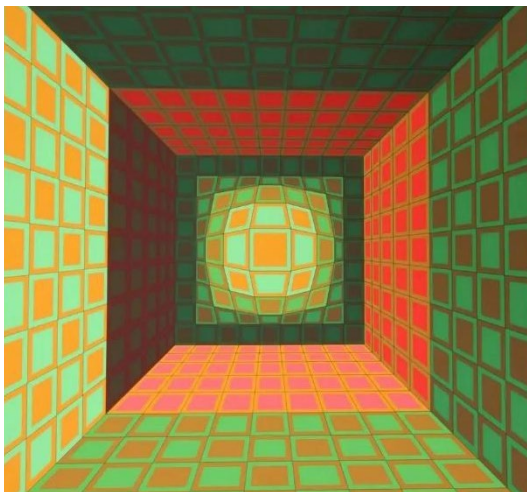


Figure 1.3.54: *Green and orange composition, 1980*



Figure 1.3.55: *Carlo Crus Dees, Physichromie 508, 1970*

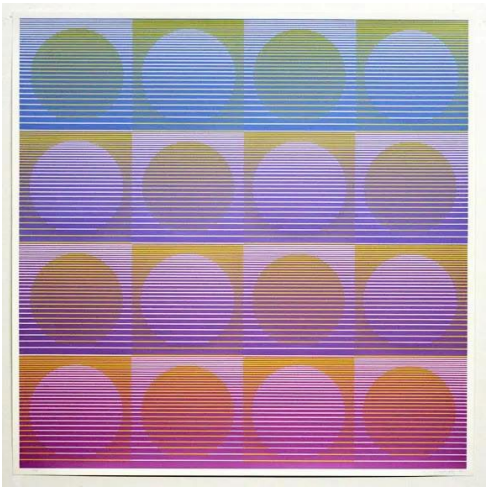


Figure 1.3.56: *Julian Stanchak, Antenna, 1971*

Note

Refer to LI 1& 2 to see the works of Bridget Riley.

Recommendations

1. **Use Grids**: Always start with a grid layout to ensure accuracy and alignment in your geometric shapes and patterns.
2. **Explore Different Tools**: Experiment with various drawing tools like pens, pencils, and markers to achieve different textures and line qualities.
3. **Digital Tools**: Utilise digital tools and software for more complex and precise pattern layering to create layers and interplays of complex geometric shapes and forms for study and inspiration.
4. **Study Existing Designs**: Analyse existing artworks that employ pattern layering and geometric forms to understand their structure and techniques.

B. Templates and Patterns Overlays, Transparencies and Opacities with Complex Geometric Shapes and Forms

Overlaying complex motifs with varying opacities and textures involves combining design elements in steps to create complex, visually engaging designs that use intricate motifs, varying opacities, and textures to produce dynamic and compelling visual interplay.

Activity 2

1. **Materials and Tools**: Tracing paper and different types of drawing or painting media.
2. **Create motifs:** Create designs or modify existing ones from libraries.
3. **Set Up Support:** Use a base paper or canvas for your initial design.
4. **Layering with Varying Opacities:** Use tracing paper to overlay your motifs, or apply lighter shades or dilute your paints or inks to achieve varying opacities.
5. **Applying Textures:** Use various materials like textured papers, sponges, or brushes for varied surface effects, or layer with media like pencil, ink, and paint for depth and texture.
6. **Experiment with transparent layers:** Use semi-transparent materials like tracing paper or sheer fabric to overlay your motifs, or apply washes of colour or use transparent inks to achieve layered transparency.
7. **Overlapping Elements:** Draw or paint motifs over one another, allowing some areas to remain partially visible, or use collage techniques to layer cut-out motifs on top of each other.
8. **Creating Moiré Effects:** Overlay mesh or finely patterned materials with slight misalignments to produce a moiré effect, and experiment with line patterns drawn at different angles and spacing.
9. **Fine-tuning:** Adjust opacity, texture, and overlapping elements to create a dynamic effect, then observe their interaction from different distances.

10. **Recommendations**

    a. **Experimentation**: Try different combinations of motifs, textures, transparency, and opacities.

    b. **Balance**: Maintain a balance between complexity and clarity to ensure acceptable design.

    c. **Consistency**: Ensure that the motifs and textures have a cohesive style or theme.

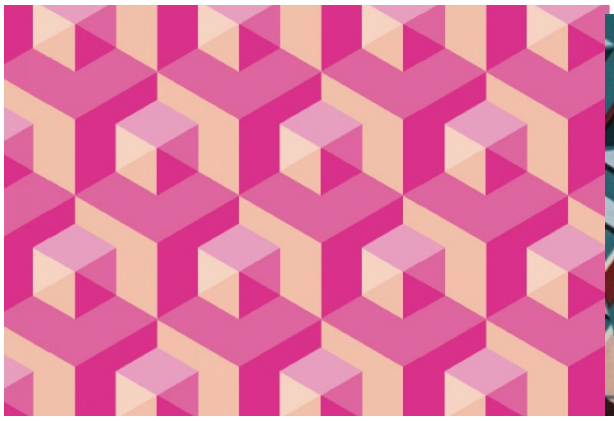


Figure 1.3.57: *Pattern*

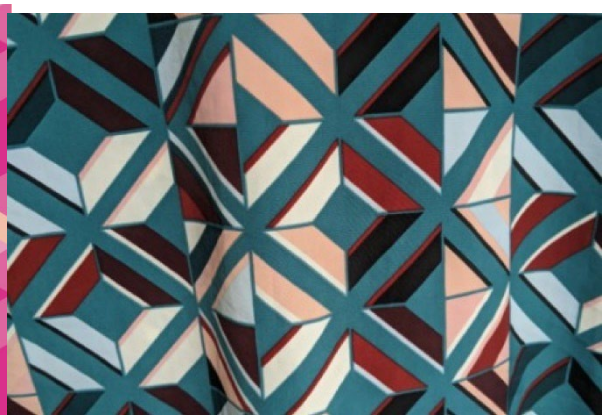


Figure 1.3.58: *Clothing Pattern,*

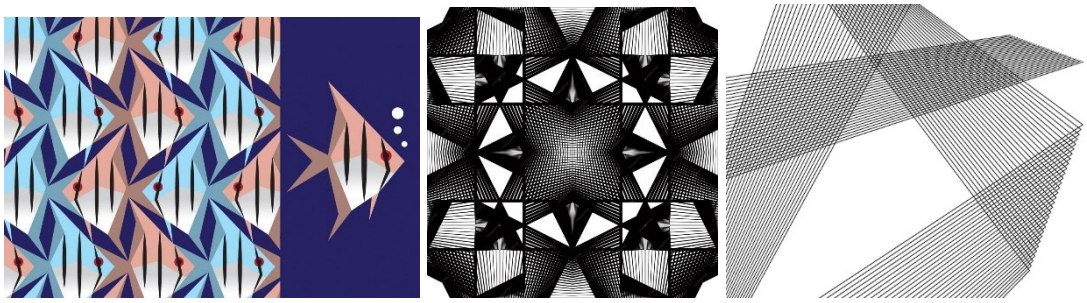


Figure 1.3.59: *Angelfish,*

Learning Task

Present group work in class discussion for feedback from peers to finalise the 2-dimensional template and pattern design.

Pedagogical Exemplars

1. **Managing Talk for Learning:** Learners in their groups present their developed 2-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. Other groups add to the content presented by each group in a respectful manner. Groups should be encouraged to tolerate others' views.

2. **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. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

3. **Group work/Collaborative Learning; Project-based Learning** Learners in small groups write a report explaining how they made their drawings and demonstrate how their 2-dimensional free hand-drawn templates and patterns can be useful for the community. Allow learners to demonstrate their understanding in different ways. For example, some learners could present their findings to the class, while others could create a report or a mind map.

Key Assessments

Level 1: List feedback given by peers on the 2-dimensional free hand-drawn templates and patterns presented in class.

Level 2: Categorise feedback into commendations, suggestions and criticism.

Level 3 Strategic reasoning

1. Describe how the feedback received from the class discussion was used to improve the 2-dimensional free hand-drawn templates and patterns.
2. Paste the developed 2-dimensional free hand-drawn templates and patterns from week 8 in class and record criticisms and suggestions from peers.

Level 4: Generate a report on how the 2-dimensional free hand-drawn templates and patterns were created and demonstrate how they can be useful to the community.



HINT

The recommended mode of assessment for week 9 is **peer assessment**. *Use the level 3 question 2 as a sample question.*

UNIT 3 REVIEW

The section in the last three weeks, engaged learners in creating 2-dimensional free hand-drawn templates and patterns using collaborative and problem-based learning methods. They brainstormed, created, and refined their designs in mixed-ability groups, working on complex geometric shapes and themes. Learners selected appropriate drawing materials and tools, developed a drawing framework, and finalised their designs. The structured process involved brainstorming ideas, generating sketches, determining dimensions, and creating detailed templates using various materials. In the final stage, learners presented their work for peer feedback, shared templates, recorded criticisms, and refined their drawings. They wrote reports explaining their creative process and demonstrated the community utility of their designs. This approach fostered critical thinking, problem-solving, communication, and resourcefulness. The assessment framework evaluated learners' skills through cognitive levels from basic recall to extended critical thinking. It guided learners from basic concepts to real-world scenarios, incorporating peer feedback and report generation, and preparing them for future design challenges.

Marking scheme for the Gamification Assessment task

Criteria	Points	Description	Feedback/Challenge
1. Selection of Drawing Materials/Tools	***20 Points***	*The learner selects five drawing materials/tools commonly used for 2D freehand drawing. Each selection should be relevant and diverse (e.g., pencils, markers, rulers, erasers, etc.).*	*"Can you find a material that adds texture or helps in creating perfect lines? Add it to your list!"*
2. Description of Each Tool/Material	***25 Points***	*Each selected tool/material is explained clearly, including how it's used in creating templates and patterns. The explanation should be precise and demonstrate an understanding of the tool's function. Example* *Pencil is ideal for sketching and creating initial lines and light outlines. It can be easily erased and adjusted, making it perfect for freehand templates.*	*"Describe the role of shading in drawing. Can you think of a material that helps with that?"*
3. Creativity and Justification	***20 Points***	*The learner justifies why each selected tool/material is important for creating freehand drawings. Emphasis should be placed on its unique contribution to the design process.*	*"Which tool would you use if you wanted to add intricate details to your design? Why?"*
4. Clarity and Organization	***15 Points***	*The list is presented in a well-organized manner, with each material/tool clearly listed and described. Explanations are easy to follow.*	*"Can you organize your materials in a logical sequence, from sketching to final details?"*
5. Bonus – Innovation	***10 points***	*If the learner includes a less common or innovative tool/material that is particularly useful in freehand drawing, they receive bonus points.*	*"Discover a new material that enhances creativity! What's something unusual you can add?"*

Total Possible Points: 100

Marking scheme for the observation Assessment task

Processes involved in determining appropriate dimensions in free-hand drawn templates and patterns.

1. Use Reference Objects
2. Apply Scaling Techniques
3. Double-Check Dimensions
4. Make adjustments, etc.

Observations

Observations	*Yes*	*No*
Were learners able to determine the processes involved in determining appropriate dimensioning?		
Were learners able to draw?		
Were the drawings appropriate?		
Did learners struggle?		

Marking scheme for the peer Assessment task

Expected responses

1. **Clarity in the Pasting Process**
   - How well the learner organized their templates and patterns.
   - The neatness of the pasting and overall presentation.
2. **Constructive Peer Criticism**
   - How well the learner records and reflects on their peers' feedback.
   - The ability to identify and articulate specific areas of improvement in their designs.
3. **Actionable Suggestions for Improvement**

   The specificity of the action steps the learner intends to take based on feedback.

   Whether the suggestions are thoughtful and demonstrate a clear path for improvement.
4. **Reflection on the Peer Feedback Process**
   - The depth of the learner's reflection on how feedback has influenced their approach to design.
   - Openness to criticism and a positive attitude towards improving the work.
5. **Future Planning and Next Steps**
   - How well the learner has planned for future improvements in their designs.
   - Whether the learner is proactive in applying feedback to enhance their drawing skills and creativity.

Sample Peer Assessment Response

Learners record their strength and weakness based on feedback from peers

Name of learner	
Strength	*Weakness*

UNIT 4: Design and Realisation

STRAND: CONCEPTUAL DRAWING

Sub-Strands: Design and Realisation

Learning Outcome: *With the idea of developed solution in mind, explain exploded view, draw the exploded view of the artefact and prepare a working drawing*

Content Standard: *Apply the concept of designing processes in solving problems.*

INTRODUCTION AND UNIT SUMMARY

This unit explores various aspects of designing with the idea of designed solutions in mind. Learners will discuss and draw exploded views of the final solution, its relevance to designing, and produce a neat working drawing for artefacts. Precision in terms of dimensioning and correct use of drawing instruments will be emphasised.

Since most machinery and objects are dismantled to aid in smooth transportation and assembly on delivery, exploded views play vital roles in illustrating how individual parts or components of the machinery are fitted together.

Working drawings on the other hand are precise and detailed drawings showing how the construction work of an artefact should be executed.

The weeks covered by unit are:

Week 10: Draw exploded views of final solutions

Week 11: Make a neat working drawing

SUMMARY OF PEDAGOGICAL EXEMPLARS

Real objects should be dismantled and assembled for learners to observe the various parts or components that fit together, as a starter activity. Thus, experiential learning should be emphasised. In this unit, learners should be allowed to dominate the discussions relating to exploded views and working drawings.

Varied support should be given to AP and P learners to enable them to draw expertly, while the HP learners should be given an extended task to do.

ASSESSMENT SUMMARY

Tracking the learning process should be backed by effective assessment strategies and prompt feedback. Room should be made for both verbal and written responses as well as drawing to cater for various learning abilities in the class.

WEEK 10

Learning Indicator: Draw exploded views of final solutions

Focal Area 1: EXPLODED VIEW

Drawing exploded views of the final solution is an important aspect of design technology and design documentation, particularly in fields such as engineering, architecture, product design, and manufacturing. An exploded view also known as an exploded display or exploded diagram, is a visual representation of an object or system that is presented in a disassembled or exploded state. It shows the individual components of the object or system positioned apart from one another, allowing viewers to better understand the construction in relationship with each part.

Purpose of exploded views

The purpose of an exploded view is to provide a clear and detailed illustration of how the various components of an object or system fit together. By presenting the parts separately but in a logical arrangement, viewers can see how each piece contributes to the whole and how they interact with one another. This can be particularly useful for understanding complex mechanisms, such as engines, machines, or electronics.

Documentation: Exploded views are typically included in technical drawings and design documentation packages to complement other views such as orthographic projections and detailed views, providing a comprehensive representation of the design.
Clarity and Understanding: By separating components and showing their relationships to other parts, an exploded view provides clarity on how each part contributes to the whole assembly. This helps designers, engineers, and manufacturers understand the assembly process and how different parts interact.
Assembly Instructions: Serve as a guide for assembly technicians or manufacturers by clearly indicating the order of assembly, disassembly, and the orientation of parts. This reduces the likelihood of errors during assembly and ensures that the final product is built correctly.
Communication Tool: Exploded views serve as effective communication tools between designers, engineers, clients, and stakeholders. They facilitate discussions about design choices, modifications, and improvements by visually depicting the assembly in a straightforward manner.

Benefits of exploded views

The use of exploded diagrams can bring several benefits to various industries and fields.

1. Exploded diagrams offer a clear and visual representation of the components and their arrangement within a complex system or product. This helps in understanding the structure and function of the system making it easier for engineers, technicians, and users to identify and locate specific parts.
2. Exploded diagrams aid in the assembly and disassembly processes by providing a step-by-step breakdown of the components. These diagrams serve as a guide for technicians and users, ensuring that they can assemble or disassemble the product accurately and efficiently.

3. Exploded diagrams improve communication and collaboration among different teams or departments. These diagrams serve as a common language that allows engineers, designers, and manufacturers to effectively communicate their ideas and requirements.
4. Exploded diagrams are useful in the field of education and training. They are employed as teaching tools to explain the inner workings of a system or product. They also aid learners in grasping complex concepts and enhance their practical skills.

In summary, exploded diagrams offer several advantages, including visual clarity, assistance in assembly and disassembly, improved communication, and enhanced education and training. By utilising these diagrams, industries and individuals can benefit from a better understanding of complex systems, increased efficiency, and improved overall performance.

Methodology

- **Initial Assembly Drawing:** Start with a detailed assembly drawing showing all components in their assembled state. This serves as the base for creating the exploded view.
- **Component Separation:** Identify each individual part within the assembly and determine how they are interconnected.
- **Exploded Representation:** Using standard drafting practices, create separate drawings or layers where each component is moved away from the others. Use dash lines or arrows to indicate the direction in which parts are moved and the order of assembly.
- **Annotation and Detailing:** Label each part clearly with its corresponding part number or description. Include any necessary annotations to explain assembly steps, fasteners, or other critical details.

Examples of exploded views

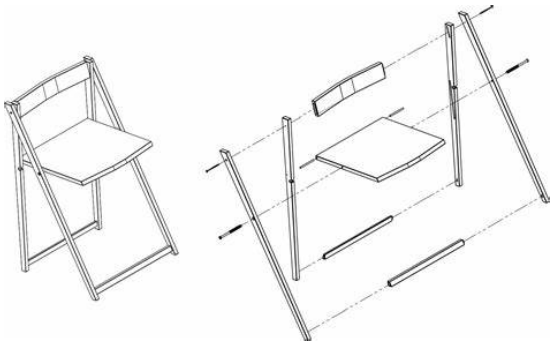


Figure 1.4.1: *Explode view of a folding chair*

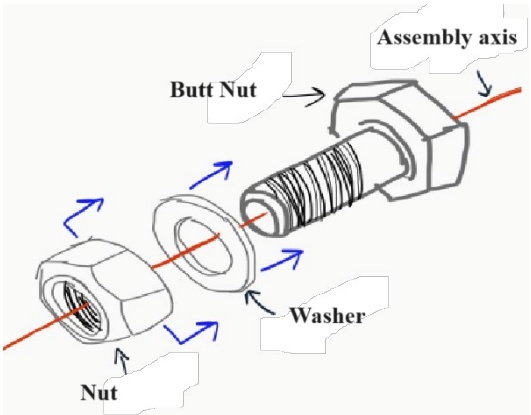


Figure 1.4.2: *Exploded view of bolt and nut with washer*

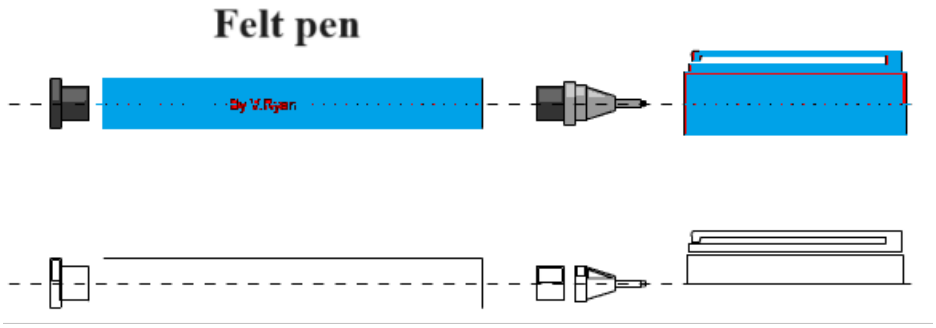


Figure 1.4.3: *Exploded view of a felt pen*



Figure 1.4.4: *Exploded view of a stool*

Learning Task

1. Describe what is meant by the exploded view of an object
2. Explain the principles used to draw the exploded view of an object
3. Draw the exploded view of a given three-dimensional final solution of an artefact

Pedagogical Exemplars

Managing talk for learning

1. Review learners' knowledge in the design process through whole class discussion to bring out the new topic. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. With the use of videos, simulations and board illustrations and in groups, learners explain exploded view. Learners come out with the principles underlying the drawing of exploded views and present their findings in a whole class discussion. Remember to consider socio-emotional learning by encouraging respectful and open communication among learners. Promote gender equality and social inclusion by ensuring that all learners, regardless of gender or social background, are given equal opportunities to participate in the discussion. Lastly, incorporate national core values in your teaching by relating the discussion to real-life scenarios or issues relevant to Ghana.
3. With the use of sketches, board illustrations, pictures and drawing, demonstrate the drawing of exploded views of objects and guide learners to draw exploded views of objects individually in freehand. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

4. Assist learners in groups to explain working drawing with the use of sketches, videos, internet surfing and charts. From the sketches, demonstrate the making of a working drawing of an artefact in freehand and using drawing instruments. Encourage learners to share their findings with each other to promote collaborative learning. Let advanced learners find more complex examples relating to each concept.

Activity based learning, Talk for learning: With the use of drawing instruments and the understanding of the exploded view concept, help learners to draw the exploded view of a given "final solution" individually. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

Key Assessment

Level 1: Describe an exploded view of an object

Level 2: List three principles used in drawing the exploded view of an object and explain any two of them

Level 3

1. Draw the exploded view of a given three-dimensional "final solution" of an artefact
2. How do exploded views contribute to the design process in engineering, particularly for complex systems like machinery or electronics?



HINT

The recommended mode of assessment for week 10 is **research**. *Use the level 3 question 2 as a sample question.*

WEEK 11

Learning Indicator: Make a neat working drawing

Focal Area 1: WORKING DRAWING

A working drawing is a precise and detailed technical drawing that provides essential information for the construction, assembly and manufacturing of a product or structure.

Working drawings include many parts and elements that work together to create an accurate view of the finished product and how technicians will construct/build it.

Types of working drawing

Elevations

An elevation is a view of the front, back, or side of an artefact. Typically, elevations are drawn to scale and they show the height, width, and depth of the artefact. In the case of buildings, they show the locations of doors, windows, and other features that need to be shown.



Figure 1.4.5: *Building elevations*

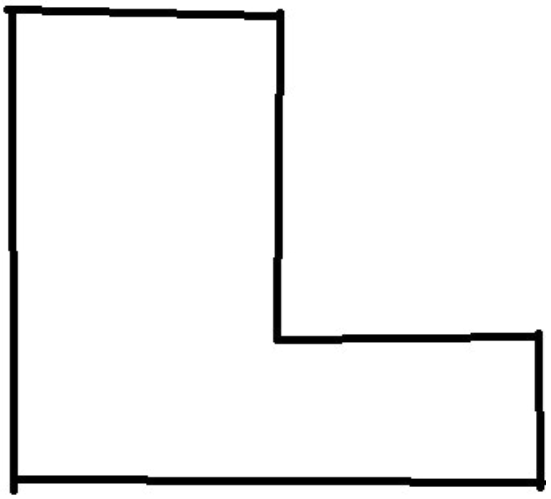


Figure 1.4.6: *Front elevation of a block*

Plans

A plan is a view of the inside of a building from above.
Plans are typically drawn to scale showing the location of walls, doors, windows, and other features in the building. With other engineering artefacts the plan is viewed from the top of the object

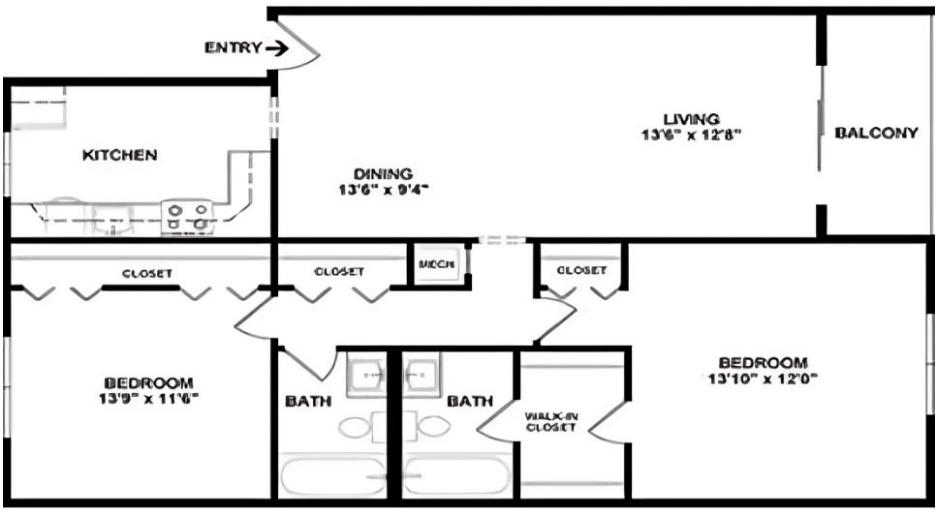


Figure 1.4.7: *Plan of a building*

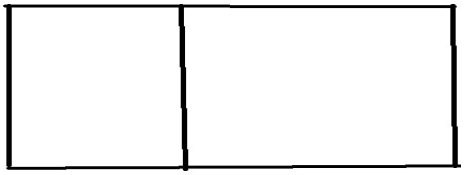


Figure 1.4.8: *Plan of a block*

Sections

A section is a view that shows how a building is divided into different floors or levels.
Sections are typically drawn to scale and can be used to see the height and width of different features and components in the building.

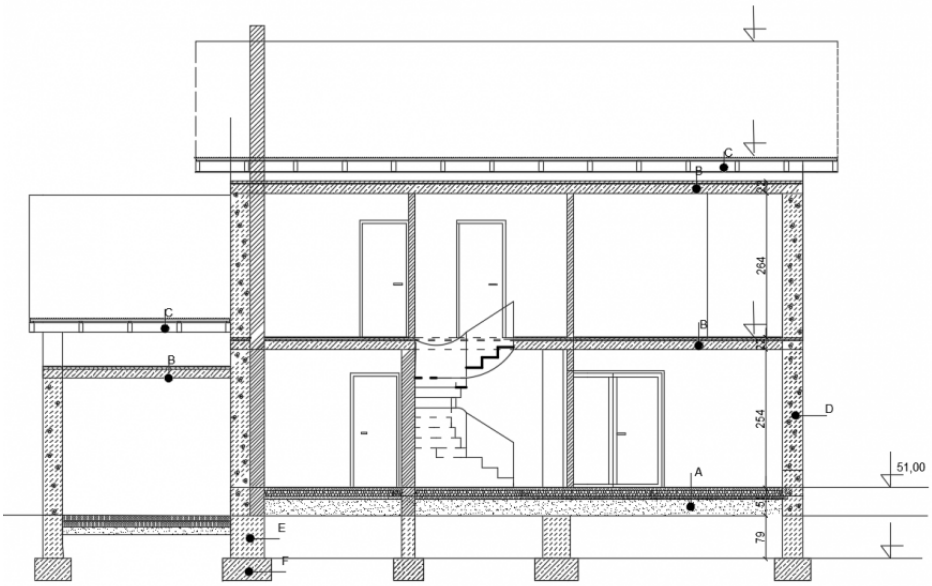


Figure 1.4.9: *Section through a building*

Structural Drawings

Structural drawings emphasise load-bearing components in construction.

The structural engineer is responsible for signing and stamping the drawings.

The contractor will use the structural drawings and designer's drawing set to build out the project.

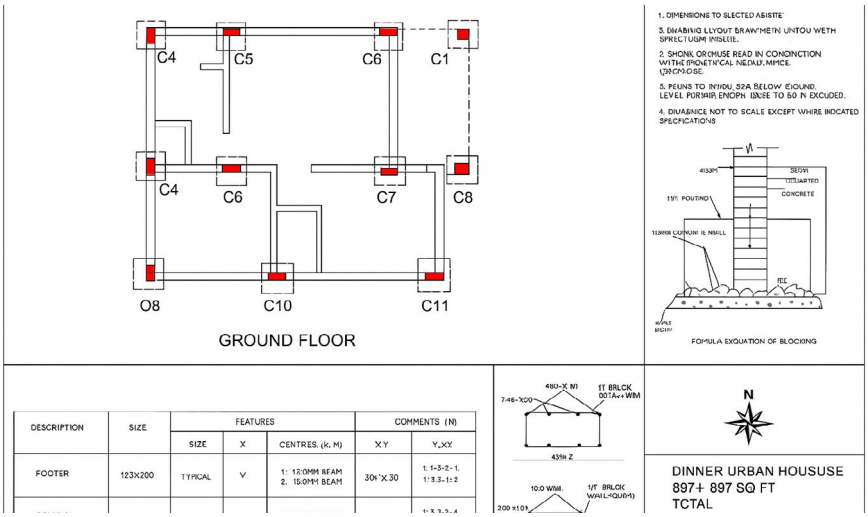


Figure 1.4.10: *Structural drawing of a building*

Electrical Drawings

The electrical drawings are technical drawings that illustrate information on lighting and communication in commercial construction projects.

The electrical construction drawing shows a schematic diagram of electrical wiring and other components connected to the electrical system and external grids inside a building.

Typical symbols on Electrical Drawings represent circuit breakers, transformers, capacitor buses, conductors, etc.

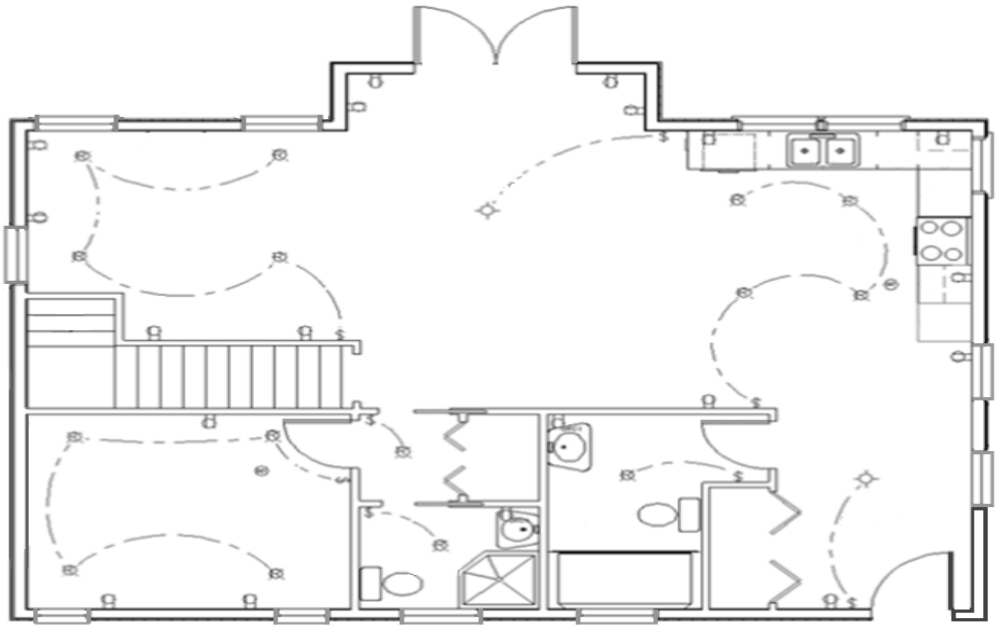


Figure 1.4.11: *Electrical drawing*

Plumbing and Sanitation Drawings

These technical drawings show the pumping of water around the house or building.

Equipment, pipes, pumps, and drainage are illustrated with drawings in detail.

Plumbing design drawings also outline the positions of sanitary pipes for water supplies and fixtures and the connection process for the various accessories. drawings also show the connection process for the various accessories.

Plumbing and sanitation drawings are often drawn by a plumbing designer and provide detailed information on water pumping around the house or building.

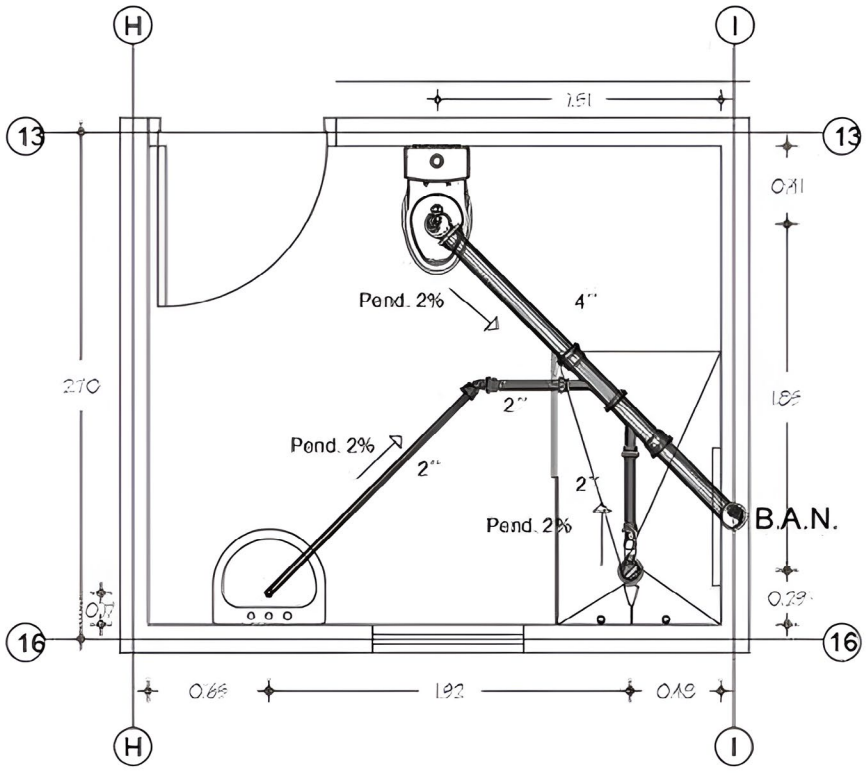


Figure 1.4.12: *Plumbing and Sanitation Drawings*

Mechanical Drawings

Mechanical drawings show the mechanical systems in the building.

A typical mechanical construction drawing shows pumps, compressors, and fans used in a commercial or residential project.

Mechanical drawings also show the piping systems for hot and cold water and other liquids required to operate those machines.

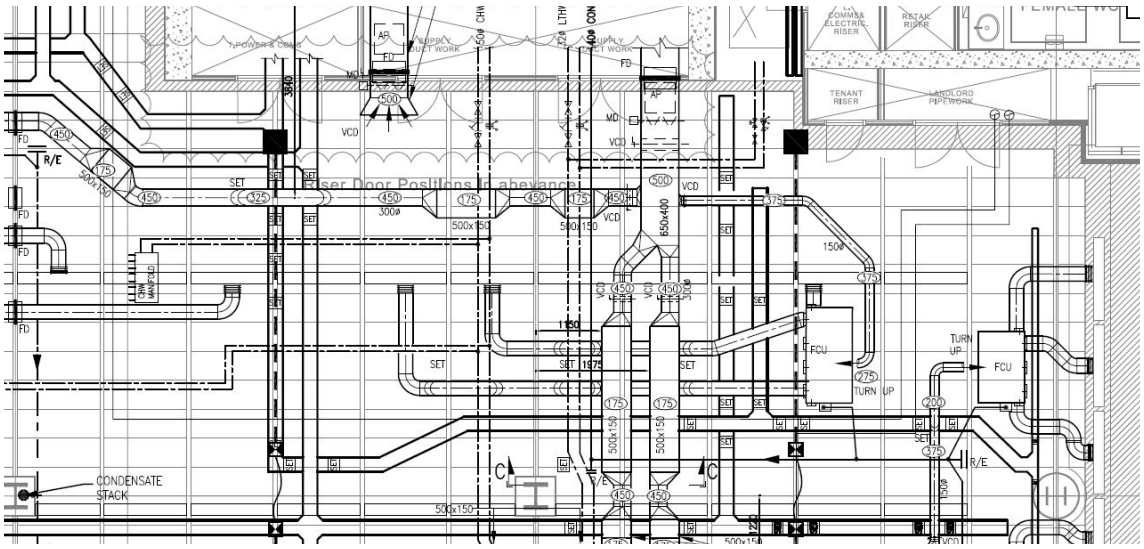


Figure 1.4.13: *Mechanical Drawings*

Roof Drawings

A roof is an integral part of any structure, it should be designed with utmost care and precision.

The roofs can be drawn by engineers trained on this who can quickly create blueprints, saving both time and money for the designer.

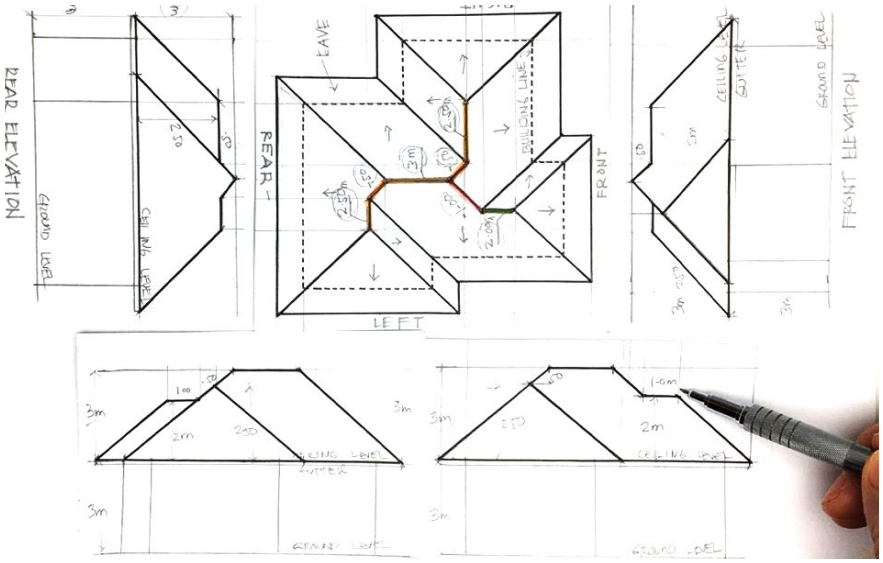


Figure 1.4.14: *Roof Drawings*

Key components and characteristics of a working drawing

1. **Orthographic Projections:** Typically, working drawings include multiple views of the object or structure in orthographic projection. These views commonly include front, plan, side, and sometimes rear views to fully describe the geometry and dimensions of the design.
2. **Dimensions and Tolerances:** Accurate dimensions are crucial in working drawings. They specify the size, shape, and location of features such as holes, slots, and edges. Tolerances indicate the allowable variations in dimensions to ensure proper fit and function.
3. **Annotations and Notes:** Annotations provide additional information and details that clarify the drawing. This may include material specifications, surface finishes, assembly instructions, part numbers, and any special considerations or notes for construction.

4. **Section Views and Detail Views:** Section views show internal details of complex parts or assemblies by cutting through the object. Detailed views zoom in on specific areas to provide a clearer representation of intricate features or critical dimensions.
5. **Symbols and Conventions:** Working drawings use standardised symbols and conventions to represent features such as welds, threads, fasteners, and surface textures. These symbols ensure consistency and clarity in interpretation across different disciplines and industries.
6. **Scale and Units:** Drawings are typically drawn to a specific scale (e.g., 1:10, 1:50) to ensure that dimensions are accurately represented relative to the actual size of the object or structure. Units of measurement (e.g., millimetres, inches) are specified clearly.

Working drawings play a crucial role in the manufacturing, construction, and fabrication processes by providing detailed guidelines and specifications. They serve as legal documents in contractual agreements and are essential for quality control, compliance with regulations, and ensuring the safety and functionality of the final product or structure.

Learning Task

Create a neat working drawing for a given artefact showing all necessary features.

Pedagogical Exemplars

1. **Managing talk for learning:** Learners explain working drawings with the use of videos, pictures, internet surfing, sketches and charts. Through demonstration, help learners to making working drawings of artefact using freehand sketches. Use your knowledge of your learners and your creativity to adapt the activity as needed. With more support for those learners who need it.
2. **Activity based learning, Talk for learning:** Guide learners to prepare neat working drawings based on the knowledge acquired from the demonstration and using drawing instruments. Learners paste their drawings on the classroom walls for critique and assessment. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessment

Level 3

1. Create a neat working drawing for a given artefact showing all necessary features.

2. Case

You have been assigned to create working drawings for a new product that will be used in an industry. The component includes several features such as plan and elevations. Your task is to produce detailed working drawings that include all necessary views and annotations to guide manufacturing and assembly.

Question:

a. Identify a design.
b. Create a neat working drawing for the design

HINT

The recommended mode of assessment for week 11 is **case study**. *Use the level 3 question 2 as a sample question.*

Marking scheme for the Research Assessment task

Criterial	Excellent (4)	Good (3)	Satisfactory (2)	Needs improvement (1)
Introduction and Research Question	*Learner exhibits all of the following;* 1. *The introduction clearly introduces the topic,* 2. *the research question is well-defined.* 3. *Provides a strong rationale for the research.* 4. *The introduction Follows the pattern above*	*Learner exhibits three of the following;* 1. *The introduction clearly introduces the topic,* 2. *the research question is well-defined.* 3. *Provides a strong rationale for the research.* 4. *Follows the pattern above*	*Learner exhibits two of the following;* 1. *The introduction clearly introduces the topic,* 2. *the research question is well-defined.* 3. *Provides a strong rationale for the research.* 4. *Follows the pattern above*	*Learner exhibits one of the following;* 1. *The introduction clearly introduces the topic,* 2. *the research question is well-defined.* 3. *Provides a strong rationale for the research.* 4. *Follows the pattern above*
Literature Review/ Background	*Learner provides these;* 1. *comprehensive review of existing literature,* 2. *showing a deep understanding of the role of exploded views in engineering design.* 3. *Integrates a range of relevant sources.*	*Learner provides two of these;* 1. *comprehensive review of existing literature,* 2. *showing a deep understanding of the role of exploded views in engineering design.* 3. *Integrates a range of relevant sources.*	*Learner provides one of these;* 1. *comprehensive review of existing literature,* 2. *showing a deep understanding of the role of exploded views in engineering design.* 3. *Integrates a range of relevant sources.*	*Learner provides none of these;* 1. *comprehensive review of existing literature,* 2. *showing a deep understanding of the role of exploded views in engineering design.* 3. *Integrates a range of relevant sources.*
Use of Visuals/ Examples	*Includes all these* 1. *clear visuals* 2. *well-annotated visuals (e.g., exploded views)* 3. *examples from real-world systems (machinery, electronics)* 4. *the visuals effectively support the argument.*	*Includes three of these* 1. *clear visuals* 2. *well-annotated visuals (e.g., exploded views)* 3. *examples from real-world systems (machinery, electronics)* 4. *the visuals effectively support the argument.*	*Includes two of these* *clear visuals* 1. *well-annotated visuals (e.g., exploded views)* 2. *examples from real-world systems (machinery, electronics)* 3. *the visuals effectively support the argument.*	*Include one of these* *clear visuals* 1. *well-annotated visuals (e.g., exploded views)* 2. *examples from real-world systems (machinery, electronics)* 3. *the visuals effectively support the argument.*

Clarity and Organization	*The learner exhibits all the following* 1. *The paper is exceptionally well-organized,* 2. *clear headings* 3. *logical flow.* 4. *Ideas are clearly presented and easy to follow.*	*The learner exhibits three of the following* 1. *The paper is exceptionally well-organized,* 2. *clear headings* 3. *logical flow.* 4. *Ideas are clearly presented and easy to follow.*	*The learner exhibits two of the following* 1. *The paper is exceptionally well-organized,* 2. *clear headings* 3. *logical flow.* 4. *Ideas are clearly presented and easy to follow.*	*The learner exhibits one of the following* 1. *The paper is exceptionally well-organized,* 2. *clear headings* 3. *logical flow.* 4. *Ideas are clearly presented and easy to follow.*
Conclusion and Implications	*The conclusion summarizes all the following* 1. *the findings in a comprehensive manner,* 2. *highlighting key insights and implications for engineering design.* 3. *Provides thoughtful suggestions for future research or practice.*	*The conclusion summarizes two of the following* 1. *the findings in a comprehensive manner,* 2. *highlighting key insights and implications for engineering design.* 3. *Provides thoughtful suggestions for future research or practice.*	*The conclusion summarizes one of the following* 1. *the findings in a comprehensive manner,* 2. *highlighting key insights and implications for engineering design.* 3. *Provides thoughtful suggestions for future research or practice.*	*The conclusion summarizes none of the following* 1. *the findings in a comprehensive manner,* 2. *highlighting key insights and implications for engineering design.* 3. *Provides thoughtful suggestions for future research or practice.*
Writing Quality	*Learner exhibits all of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*	*Learner exhibits three of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*	*Learner exhibits two of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Iv. Sentences are well punctuated*	*Learner exhibits one of the following* 1. *Writing is free of errors,* 2. *polished and professional language.* 3. *Sentences are varied and engaging.* 4. *Sentences are well punctuated*
Citation and Referencing	*Learner exhibits all the following;* 1. *Citations are correctly formatted* 2. *a wide variety of academic sources are referenced,* 3. *including books, journals,* 4. *reliable websites.*	*Learner exhibits three of the following* 1. *Citations are correctly formatted,* 2. *and a wide variety of academic sources are referenced,* 3. *including books, journals,* 4. *reliable websites.*	*Learner exhibits two of the following* 1. *Citations are correctly formatted,* 2. *and a wide variety of academic sources are referenced,* 3. *including books, journals,* 4. *reliable websites.*	*Learner exhibits one of the following* 1. *Citations are correctly formatted,* 2. *and a wide variety of academic sources are referenced,* 3. *including books, journals,* 4. *reliable websites.*

Marking scheme for the Case study Assessment task

Criteria	Marks
Identifying designs such as, consumer goods packaging, building or skyscraper, furniture, smart home devices, etc.	2
For drawing the plan *Considerations: well defined outlines, maintain proportionality, etc.*	2
For drawing elevations *Considerations: well defined outlines, maintain proportionality, etc.*	2
Ensuring the plan and elevation is proportional	2
Working drawings conforms with the identified design *Considerations: if the working drawing resembles the identified design.*	2

SECTION 2: GEOMETRY

UNIT 1 PLANE GEOMETRY

STRAND: GEOMETRY

Sub-Strands: 1. Plane geometry
2. Solid geometry

Learning Outcomes

1. *Use the knowledge of plane geometry to draw plane geometrical shapes and design different artefact based on plane geometrical figures.*
2. *Based on the understanding gained from the study of the concepts of solid geometry, construct complex solid geometrical objects*

Content Standards

1. *Apply the concept of plane geometry in designing*
2. *Apply the concept of solid geometry in designing*



HINT

- *Remind learners of the end of semester examination in week 12. Refer to Appendix D at the end of this section for Table of specification.*
- *Assign Individual project to learners in week 14 to be presented in week 21. Refer to Appendix E at the end of this section for Table of specification.*

INTRODUCTION AND UNIT 1 SUMMARY

This unit draws on learners understanding and application of plane geometrical figures in year one to explain orthographic projections, loci and construct the orthographic projections of objects and loci using appropriate drawing instruments.

Orthographic projection, also known as orthogonal projection, is a means of representing three-dimensional objects in two dimensions. their actual sizes, shapes and dimensions are emphasised during the construction process.

Loci is the plural form of locus. In Geometry, the locus is the set of points that follows certain properties or rules. Generally, the loci tell the construction of figures or shapes. For example, a circle is the loci of the points, which are at the same (fixed) distance from the fixed (same) point.

Learners will be encouraged to design artefacts based on the working principles of loci.

The weeks covered by section are:

Week 12 Draw orthographic projections of given objects

Week 13 Explain the principles underlying the working of Loci and construct loci

Week 14 Design artefact with loci

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teachers should encourage the correct use of drawing instruments and correct dimensions when drawing. Support systems should be used to assist the AP and P learners to be able to do better.

The use of board instruments should be an integral part of the demonstration process, since this enhances the learners understanding of concept and principles used to construct. Managing talk for learning, activity-based learning, experiential learning are a few of the pedagogies that can be used to facilitate the learning process.

ASSESSMENT SUMMARY

Learners' ability to explain the orthographic projections and loci using sketches, written or oral responses should be accepted. Learners should be encouraged to construct the orthographic projections and loci using drawing instruments and correct dimensions should be accepted and recorded, designing artefacts based on the working principles of loci; learners should be encouraged to create modern/ 21st century designs

WEEK 12

Learning Indicator: Draw orthographic projections of given objects

Focal Area 1: ORTHOGRAPHIC PROJECTIONS

Orthographic projection is a fundamental technique used in technical drawing and engineering to represent three-dimensional objects in two dimensions by projecting its views onto two or more perpendicular planes typically, front view, plan, and side views.

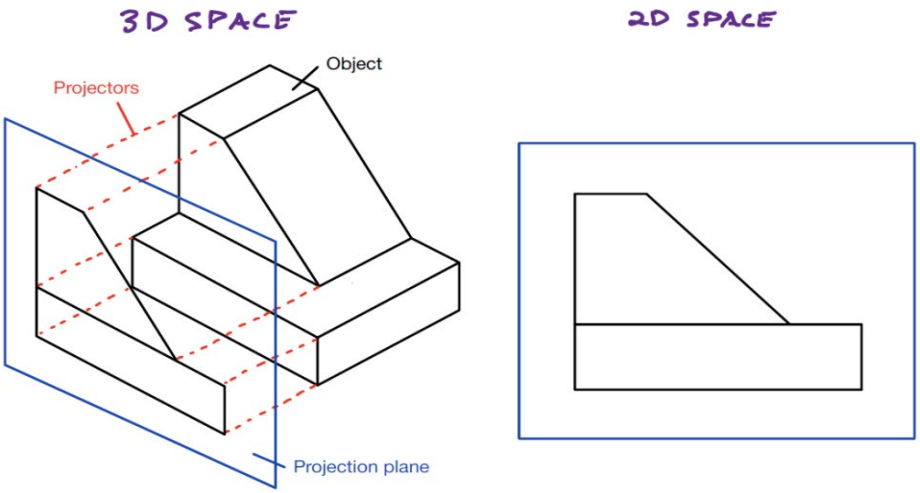


Figure 2.1.1: *Orthographic projection*

Orthographic planes

Principal Planes: In orthographic projection, the object is projected onto three principal planes:

- **Vertical Plane (VP)**: Represents the front view of the object.
- **Horizontal Plane (HP)**: Represents the top view of the object.
- **Side Vertical Plane (SVP)**: Represents the side view of the object.
- **Projection Lines**: Lines drawn from points on the object perpendicular to the projection planes determine the projected views.

The orthographic quadrants

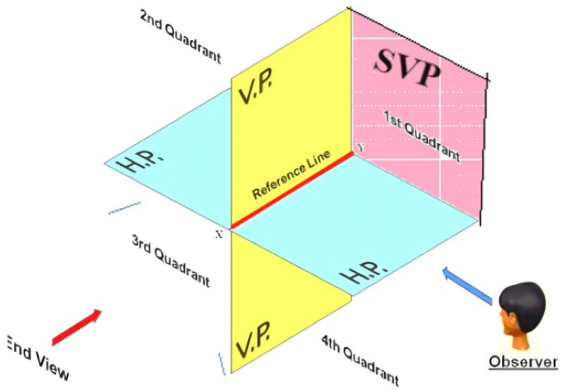


Figure 2.1.2: *The orthographic quadrants*

Table 2.1.1: Types of orthographic projections and their symbols

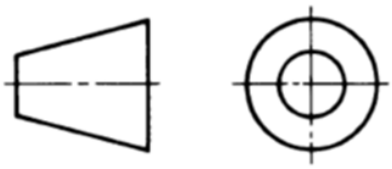
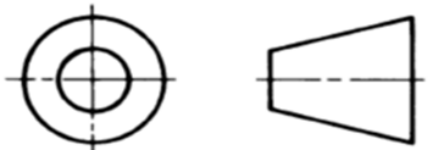
Projection	Symbols
First angle	
Third angle	

Table 2.1.2: Characteristics of first and third angle orthographic projections

First angle	Third angle
The object is imagined to be in the first quadrant	The object is imagined to be in the third quadrant
The front and top view are always in line vertically	The front and top view are always in line horizontally
The front and side view are in line vertically (the side views are directly next to the front view)	The front and side view are always in line horizontally
The object lies between the observer and plane of projection	The plane of projection is assumed to be transparent
When views are drawn in their relative positions top view comes below front view, right view side view is drawn to the left side of the elevation	When views are drawn in their relative positions top view comes above front view, right view side view is drawn to the right side of the elevation
Is usually used in Europeans countries	Is usually used in American countries

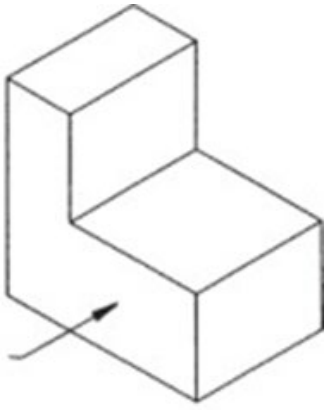


Figure 2.1.3: *Isometric block*

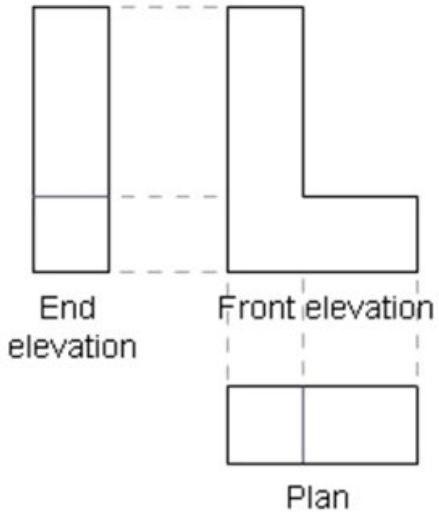


Figure 2.1.4: *First angle projection*

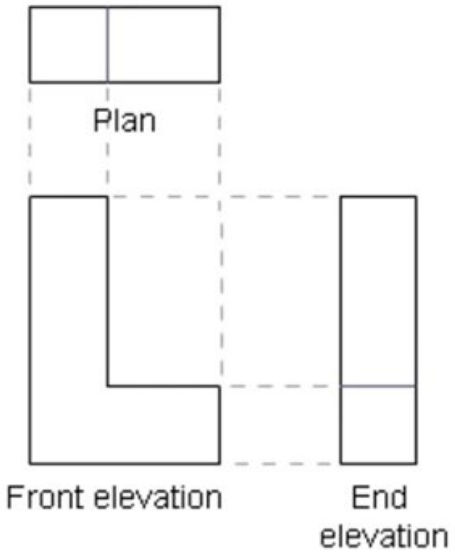


Figure 2.1.5: *Third angle projection*

Applications of orthographic projections

- **Engineering Drawings**: Essential for accurately representing objects in architecture, mechanical engineering, and other technical fields.
- **Manufacturing**: Guides production processes by providing detailed information on dimensions, shapes, and assembly instructions.
- **Design and Visualisation**: Helps designers and engineers visualise and communicate ideas effectively.

Learning Task

1. Explain the concept of orthographic projection
2. With the aid of a sketch differentiate between 1st and 3rd angle projection
3. Display an artefact (a box, table, kitchen stool) in the class for learners to draw it in either 1st or 3rd angle orthographic projection

Pedagogical Exemplars

1. **Managing talk for learning, Activity based learning**

   Through demonstration and the understanding gained from the concepts of plane geometry, assist learners to draw Orthographic Projections in first and third angles. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

2. **Project-based learning, Activity based learning**

   Use the knowledge gained from the principles of drawing orthographic views to find the true lengths, true angles of inclination and traces of lines in space. Monitor learner progress and adjust your approach as needed. For example, if a learner is struggling, you could provide additional support or modify the activity.

Key Assessment

Level 2: Explain the concept of orthographic projection

Level 3: With the aid of a sketch differentiate between 1st and 3rd angle projection

Level 3: Display an artefact (a box, table, kitchen stool, in the class for learner to draw it in either 1st or 3rd angle orthographic projection

HINT



Remind learners of the end of semester examination in week 12. Refer to Appendix D at the end of this section for Table of specification.

WEEK 13

Learning Indicator: Explain the principles underlying the working of Loci and construct loci

Focal Area 1: Loci

A locus is the path traced by a point moving in a plane in a specified direction.A shape created by a set of points whose positions satisfy a given set of rules. Many engineering curves are considered as loci (plural of locus)

Examples of loci include

- Ellipse
- Helix
- Involute
- Parabola
- Hyperbola
- Trochoid
- Cycloid
- Link mechanism etc.

The involute as a loci

An involute is a curve generated by a point at the end of a taut string unwinding from around a plane figure such as triangles, quadrilaterals, polygons or circles.

To draw the involute of a square

Procedure

1. Draw the given square ABCD
2. With centre A and radius AD draw an arc to intersect BA produced in 1
3. With centre B and radius B1draw an arc to intersect CB produced in 2
4. Repeat the process for C and D to complete the involute.

Note

Demonstrate the construction of involute with different plane geometrical figures.

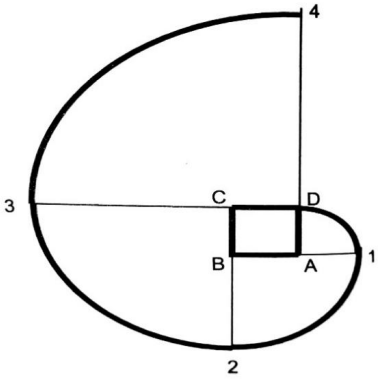


Figure 2.1.6: *Involute from a rectangle*

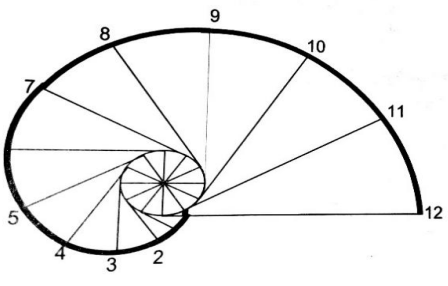


Figure 2.1.7: *Involute from a circle*

HELIX

An ant trying to reach sugar in a container, climbs the container in a serpentine move and at the same time climbs vertically upwards. The ant eventually gets to the sugar. The distance between two serpentine moves is referred to as the pitch. This is the principle for drawing

HELIX

Helix is the locus of a point moving around the circumference of a right cylinder with uniform velocity and at the same time moving axially along the cylinder with uniform velocity. The axial movement during one revolution is called the helix while the distance covered is the pitch.

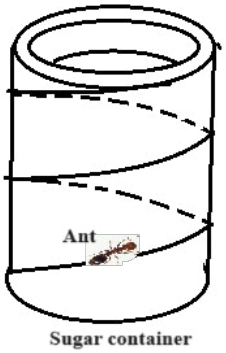


Figure 2.1.8: *Ant ascending a sugar container*

Construction of helix

1. Draw the elevation equal to the pitch and the plan of the cylinder
2. Divide the plan (circle) into several equal parts and the elevation into the same number of parts
3. Number the points on both the plan and elevation i.e. 1, 2…x
4. Construct vertical lines from the points on the plan through the elevation (pitch)
5. Project the points from the pitch to intersect with the vertical lines from the plan to create series of points at their intersection
6. These points of intersection are points on the helix. Join them with a smooth curve to obtain the helix

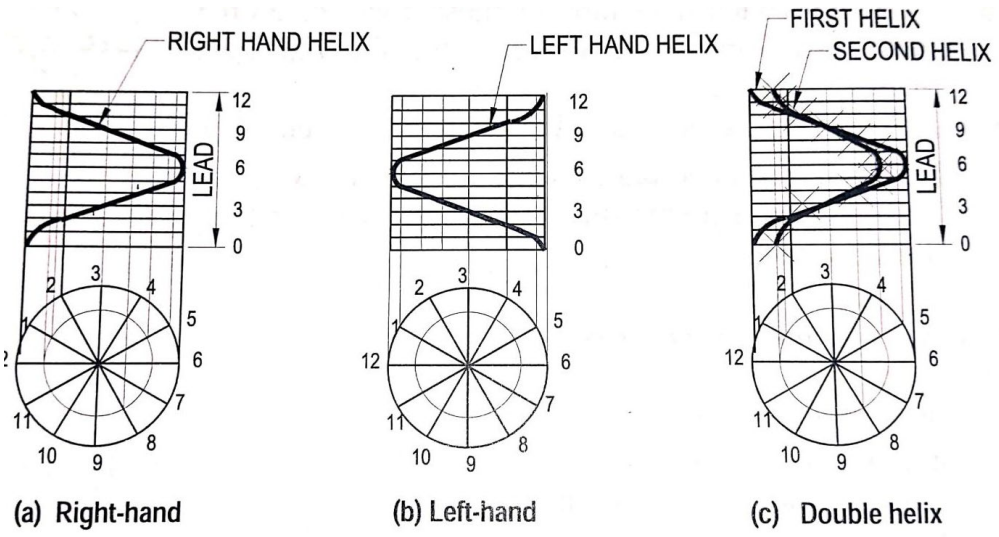


Figure 2.1.9: *Helix construction*

Practical application of helix

The principles of helix are used for the construction of objects which include

- Square springs
- Screw thread
- Coil spring
- Drill flutes
- Car jack

Learning Task

Use the principles of constructing helix and involute to construct a helix and an involute with given dimensions.

Pedagogical Exemplars

1. **Managing talk for learning:** With the use of pictures, videos and charts, help learners to explain the principles underlying the construction and operations of loci, for example helix, link mechanism and Involute as types of loci. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
2. **Activity based learning:** Guide learners to use the principles discussed to construct some of the loci discussed. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessment

Level 4

1. Design and execute a project where you construct a helix and an involute with specified dimensions. Analyse the implications of your design choices on the functionality of these shapes in a real-world application and evaluate the effectiveness of your construction process. Provide a detailed report that includes your methodology, challenges faced, and potential improvements for future constructions.
2. Construct the involute of a square with sides 25

HINT



The recommended mode of assessment for week 13 is **class exercise**. *Use the level 3 question 2 as a sample question*

WEEK 14

Learning Indicator: Design artefact with loci

Focal Area 1: DESIGNING BASED ON THE WORKING PRINCIPLES OF LOCI

The position of the automobile jack shown is controlled by a screw ABC that is single-threaded at each end (right-handed thread at A, left-handed thread at C), using this preamble and sketch, design a car jack to be used by the school driver.

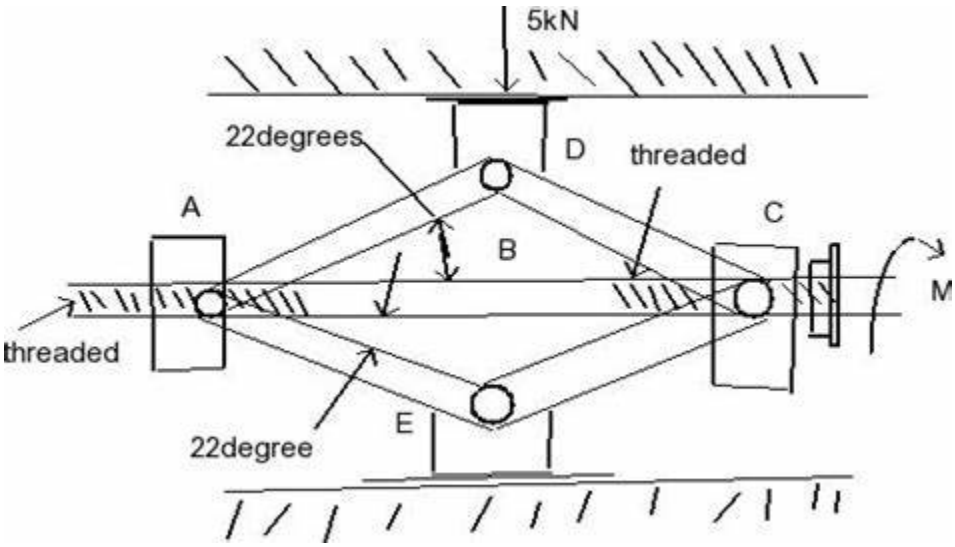


Figure 2.1.10: *Designing car jack*

Examples of automobile jacks that exist on the principles of helix



Figure 2.1.11: *Examples of car jack*

Learning Task

Apply the principles of helix in designing a car jack.

Pedagogical Exemplars

1. **Research, Managing talk for learning Group work** Through research, group work, pictures, videos and charts, help learners to identify the various types of car jacks working on the principles of helix. Learners should present their findings in whole class discussion. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. **Group work, Activity based learning** Assist learners to examine the various car jacks they have identified and come out with how they work. learners present their findings in a whole class discussion. Differentiation can be incorporated by allowing learners to express their understanding in various ways. For instance, some learners prefer to draw diagrams, while others prefer to write a paragraph or give a verbal explanation.
3. **Project based learning, Activity based learning and Problem based learning** Guide learners to design a car jack using the working principles of the helix. Monitor learner progress and adjust your approach as needed. For example, if a pair is struggling, you could provide additional support or modify the activity.

Key Assessment

Level 4

1. Design a car jack that incorporates the principles of the helix, ensuring it meets specific performance criteria such as load capacity, stability, and ease of use. Develop a comprehensive prototype, including detailed engineering drawings and calculations.
2.
    a. Identify all designed items that operates on the working principle of helix
    b. Based on the knowledge acquired from the principles of loci, design an artefact based on the working principles of HELIX

HINT



The recommended mode of assessment for week 14 is **Individual project**. *Use the level 4 question 2 a*

UNIT 1 PLANE GEOMETRY REVIEW

This unit discussed plane geometrical figures, examples, properties and their construction using drawing instruments.

Learners were expected to explain orthographic projections, its principles and expertly construct the orthographic views of objects in first and third angle orthographic projections.

Under loci, various examples of loci were mentioned while discussions were limited to involutes and helix

Learners understood involutes its principles and Construction of involutes from plane geometrical shapes

Discussions on helix as an example of loci exposed learners to its principles and construction as well as designing based on the working principles of helix

Resources

Models, Charts, drawing instruments, reference books, drawing studio, access to internet, LCD Projector.

APPENDIX D: END OF FIRST SEMESTER EXAMINATION

Structure of assessment

The assessment should span from week 1 to week 12 and should comprise of 40 multiple choice questions, 3 essay questions and 3 practical questions, learners are expected to answer all multiple-choice questions, two essay questions out of three and one practical question out of three.

The time allocation for the examination should be 2hrs 15mins. thus, 1hr for section A, 30 minutes for section B and 45mins for practical.

Resources

- Answer booklets
- Scannable sheets
- Conducive environment
- Pen, pencil and erasers

SECTION A

Answer all questions in this section; by circling the correct answer from the option lettered **A-D**

1. Which of the following best describes an exploded view?

A. only shows the external appearance of an object
B. uses shading and texture to enhance visual appeal
C. where all components are shown in their assembled state
D. where components are separated to show how they fit together

Essay Questions

SECTION B

Answer **two** *questions only from this section; all questions carry equal marks*

1. a. Explain two principles of two -point perspective
   b. Draw the two-point perspective axis and indicate the vanishing points.
   c. Name three techniques used to modify 2-dimensional shapes to achieve new forms
   Practical Questions

PRACTICALS

Answer **one** *question only from this section; all questions carry equal marks*

1. Create a complex form using triangle

Marking scheme/ rubrics

Multiple choice question - 40marks (1mark each x 40)

1. D - 1mark

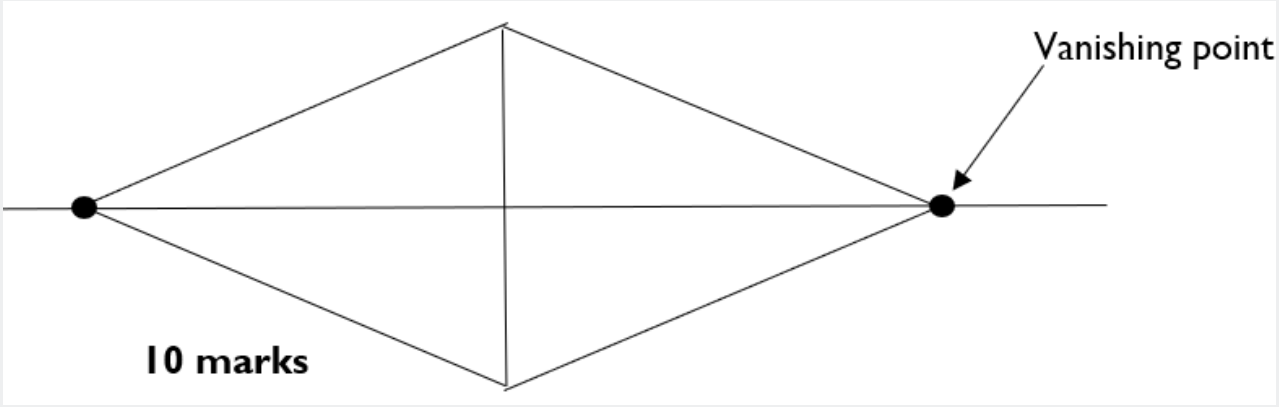
Essay- 40 marks (20 marks each x 2)

1 .a.

i. Two-point perspective focuses on two varnishing points, these two points are at the opposite sides of the composition, such as one on the far left and another on the far right. **2 marks**

ii. Two-point perspective has vertical lines that are parallel and perpendicular to the ground plane. **2 marks**

b.



c. Twisting, bending, compressing, etc.- 1 mark each.

1 b. Criteria for marking question 1b

Criteria	*Marks*
Drawing horizontal line	*2*
Indicating the vanishing points	*2*
Drawing a vertical line to indicate the height of the object	*2*
Joining the vanishing points to the tip of the vertical line	*2*
Maintaining proportionality *Considerations: the distance between the vertical line indicating the height of object is equidistance to the two vanishing points*	*2*

Total -20marks

Practical questions – 20 marks (20 marks each)

1. Create a complex form using triangle

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Needs improvements (1)*
Creativity	*uses four triangles to enhance design and the overall form such as logos, etc.*	*uses three triangles to enhance design and the overall form such as packaging designs,*	*uses two triangles to enhance design and the overall form such as furniture designs, etc.*	*use one triangle to enhance design and the overall form such as architecture, etc.*
Dimensional designs	*Designing in 3D*	*Designing in 2D*	*Designing in 1D*	*No appropriate dimension*

Using color/ rendering technique to enhance the ork	1. *demonstrates all the following* 2. *deep understanding of coloring* 3. *rendering techniques,* 4. *creating harmonious combination between colors* 5. *effective combinations between hatching.*	1. *demonstrates three of the following* 2. *deep understanding of coloring* 3. *rendering techniques,* 4. *creating harmonious combination between colors* 5. *effective combinations between hatching.*	1. *demonstrates two of the following* 2. *deep understanding of coloring* 3. *rendering techniques,* 4. *creating harmonious combination between colors* 5. *effective combinations between hatching.*	1. *demonstrates one of the following* 2. *deep understanding of coloring* 3. *rendering techniques,* 4. *creating harmonious combination between colors* 5. *effective combinations between hatching.*
General outlook of the work	*Learner exhibits all the following;* 1. *Neat work* 2. *well defined lines* 3. *clean hatching* 4. *neat coloring*	*Learner exhibits three of the following;* 1. *Neat work* 2. *well defined lines* 3. *clean hatching* 4. *neat coloring*	*Learner exhibits two of the following;* 1. *Neat work* 2. *well defined lines* 3. *clean hatching* 4. *neat coloring*	*Learner exhibits one of the following;* 1. *Neat work* 2. *well defined lines* 3. *clean hatching* 4. *neat coloring*

Total-16 marks

Table of specification for end of semester 1 examination

WEEK	FOCAL AREA	QUESTION TYPE	Dok LEVELS				TOTAL
			1	2	3	4	
1	Basic shapes and rendering techniques	Multiple choice	1	2	1		4
		Essay		1			1
2	Creating designs in two-point perspective	Multiple choice	2	2	1		4
		Essay			1		1
3	Complex designs	Multiple choice	1	2	1		4
		Practical			1		1
4	Modifying two-dimensional shapes using freehand drawing techniques.	Essay					1
5	Experimenting with free-hand drawing to modify 2-dimensional shapes to achieve new forms	Multiple choice	2	2	1		4
		Practical					
6	Generating simple objects in line with the concepts and narratives associated with objects and designs.	Multiple choice	1	3	1		5
		Practical				1	1

7	Advanced freehand drawing techniques for 2-dimensional templates and patterns	Multiple choice	1	2	1		4
		Essay					
8	Appropriate dimensions for freehand drawing techniques for 2-dimensional templates and patterns	Multiple choice	2	2	1		4
		Essay		1			1
9	Appropriate freehand drawn 2-dimensional templates and patterns	Multiple choice	2	1	2		4
		Practical				1	1
10	Exploded view	Multiple choice	1	1	2		4
11	Working drawing	Multiple choice	1	1			3
12	Orthographic projection	Essay			1		
	Total		14	20	14	2	46

Total: 40 multiple choice questions, 3 essay questions and 3 practical questions

Marking scheme for the Class exercise task

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs improvement (1)
Accuracy of Construction	The involute exhibits the following 1. constructed expertly 2. all points and curves clearly and accurately drawn. 3. The final result closely matches theoretical expectations	The involute exhibits two of the following 1. constructed expertly 2. all points and curves clearly and accurately drawn. 3. The final result closely matches theoretical expectations	The involute exhibits one of the following 1. constructed expertly 2. all points and curves clearly and accurately drawn. 3. The final result closely matches theoretical expectations	The involute exhibits none of the following 1. constructed expertly 2. all points and curves clearly and accurately drawn. 3. The final result closely matches theoretical expectations
Clarity and Neatness of Drawing	The construction exhibits 1. extremely neat, 2. clear lines and well-defined points. 3. All measurements and steps are presented in a clean and organized manner.	The construction exhibits two of these 1. extremely neat, 2. clear lines and well-defined points. 3. All measurements and steps are presented in a clean and organized manner.	The construction exhibits one of these 1. extremely neat, 2. clear lines and well-defined points. 3. All measurements and steps are presented in a clean and organized manner.	The construction exhibits none of these 1. extremely neat, 2. clear lines and well-defined points. 3. All measurements and steps are presented in a clean and organized manner.

Correct Use of Tools and Techniques	*Demonstrates these* 1. *excellent use of compasses,* 2. *rulers, and other tools.* 3. *The method used to construct the involute is flawless,* 4. *all technical requirements are met.*	*Demonstrates two of these* 1. *excellent use of compasses,* 2. *rulers, and other tools.* 3. *The method used to construct the involute is flawless,* 4. *all technical requirements are met.*	*Demonstrates one of these* 1. *excellent use of compasses,* 2. *rulers, and other tools.* 3. *The method used to construct the involute is flawless,* 4. *all technical requirements are met.*	*Demonstrates none of these* 1. *excellent use of compasses,* 2. *rulers, and other tools.* 3. *The method used to construct the involute is flawless,* 4. *all technical requirements are met.*
Presentation of the Final Product	*The final involute exhibits these* 1. *i. curve is perfectly formed,* 2. *smooth, and continuous.* 3. *iii. There is a clear distinction between the square and its involute.*	*The final involute exhibits two of these* 1. *curve is perfectly formed,* 2. *smooth, and continuous.* 3. *There is a clear distinction between the square and its involute.*	*The final involute exhibits one of these* 1. *curve is perfectly formed,* 2. *smooth, and continuous.* 3. *iii. There is a clear distinction between the square and its involute.*	*The final involute exhibits none of these* 1. *curve is perfectly formed,* 2. *smooth, and continuous.* 3. *There is a clear distinction between the square and its involute.*

APPENDIX E: INDIVIDUAL PROJECT

Structure

1. **Project Objective:** To design an innovative artifact that effectively demonstrates the principles of a helix, showcasing its structural integrity, efficiency, and applications in nature and technology.
2. **Project Title:** design an artefact based on the working principles of helix.
3. **Timeline:** detailed timeline including start and end dates
4. **Resources:** list of required materials, tools, and resources (books, pictures of various designs, websites, etc.)
5. **Deliverables:** Specify what the final output will be (e.g., pictures, conceptual drawings, CAD, files etc.)

This structured above can help ensure that individual project is well-organised, and successful**.**

Rubrics for assessing the artefact designed.

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Needs Improvement (1)*
Identification of helical designed items, example; helical springs, helical gears, helical stair, helical architecture, etc	*Learners' ability to identify all helical designed items, example; helical springs, helical gears, helical stair, helical architecture, etc.*	*Learners' ability to identify three helical designed items, example; helical springs, helical gears, helical stair, etc*	*Learners' ability to identify two helical designed items, example; helical stair, helical architecture, etc*	*Learners' ability to identify one helical designed item, example; helical architecture, etc*
Structural Integrity and Feasibility	*The design demonstrates these* 1. *excellent structural integrity,* 2. *with helical elements and other components carefully considered for durability and stability.* 3. *The design is highly feasible in terms of material selection and construction.*	*The design demonstrates two of these* 1. *excellent structural integrity,* 2. *with helical elements and other components carefully considered for durability and stability.* 3. *The design is highly feasible in terms of material selection and construction.*	*The design demonstrates one of these* 1. *excellent structural integrity,* 2. *with helical elements and other components carefully considered for durability and stability.* 3. *The design is highly feasible in terms of material selection and construction.*	*The design demonstrates none these* 1. *excellent structural integrity,* 2. *with helical elements and other components carefully considered for durability and stability.* 3. *The design is highly feasible in terms of material selection and construction.*

Documentation	*The documentation is comprehensive, well-organized, and clearly explains these* 1. *design process,* 2. *principles,* 3. *functionality* 4. *Adaptability*	*The documentation is comprehensive, well-organized, and clearly explains three of these* 1. *design process,* 2. *principles,* 3. *functionality* 4. *Adaptability*	*The documentation is comprehensive, well-organized, and clearly explains two of these* 1. *design process,* 2. *principles,* 3. *functionality* 4. *Adaptability*	*The documentation is comprehensive, well-organized, and clearly explains one of these* 1. *design process,* 2. *principles,* 3. *functionality* 4. *Adaptability*
Sustainability and Environmental Considerations	*The design thoughtfully incorporates* 1. *sustainability principles,* 2. *considering the environmental impact of materials, energy use,* 3. *end-of-life disposal.*	*The design thoughtfully incorporates two of the following* 1. *sustainability principles,* 2. *considering the environmental impact of materials, energy use,* 3. *end-of-life disposal.*	*The design thoughtfully incorporates one of the following* 1. *sustainability principles,* 2. *considering the environmental impact of materials, energy use,* 3. *end-of-life disposal.*	*The design incorporates none of the following* 1. *sustainability principles,* 2. *considering the environmental impact of materials, energy use,* 3. *end-of-life disposal.*

UNIT 2: SOLID GEOMETRY

HINT



Remind learners of the Mid-Semester Examination in week 18. Refer to Appendix F at the end of this section for the Table of Specification.

INTRODUCTION AND UNIT 2 SUMMARY

One of the best ways to communicate one's ideas is through the form of pictures or drawings; this is especially true for the engineer, architect, designer etc; hence the purpose of this unit which builds on learners' understanding and application of solid geometrical figures in year one as well;

1. Construct the development of pyramids
2. Draw the curve of intersections of objects meeting at right angles
3. Design artefact using the concept of solid geometry

Due to emerging technologies that make drawings faster, efficient, and more accurate, learners will be introduced to computer aided design (CAD) programmes that are used across a wide range of businesses such as architecture, engineering, construction, product design, graphic design and manufacturing.

Learners will

1. Demonstrate the use of basic concepts of computer aided design (CAD) in developing drawings
2. Manipulate drawings with computer aided design (CAD) tools through editing and plotting techniques

The weeks covered by sub-strand 2 (solid geometry) are:

Week 15 Construct the surface development of pyramids.

Week 16 Draw the curve of intersections of objects meeting at right angles

Week 17 Design artefact using the concept of solid geometry

Week 18 Demonstrate the use of basic concepts of CAD in developing drawings

Week 19 Manipulate drawing CAD tools through editing and plotting techniques (to draw 2D and 3D modelling of objects)

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teaching solid geometry effectively requires pedagogical approaches that engage learners in visualising and understanding three-dimensional shapes and their properties.

Teachers should provide learners with models of pyramids, cut and spread out to reveal the actual surface developments as well as pipes or models intersecting at angles.

The following pedagogies can be effective for teaching development of pyramids, curves of intersection and designing artefacts.

- Experiential learning
- Managing talk for learning
- Collaborative learning/Group work
- Activity-based learning
- Project-based learning

Again, teaching Computer-Aided Design (CAD) effectively involves utilising various pedagogical approaches to take care of the different learning proficiencies and digital literacies in the class.

Here are some pedagogies commonly used for teaching CAD:

Inquiry-Based Learning: Learners explore CAD concepts and tools through guided inquiry, asking questions and conducting research to deepen understanding and to promote curiosity, develop research skills, and encourage self-directed learning.

Collaborative Learning: Learners work in teams to solve CAD design challenges or complete simple projects which enhances teamwork skills, fosters peer learning, and encourages communication.

Problem-Based Learning: Learners are presented with open-ended CAD design problems that require critical thinking and application of CAD skills to find solutions. This approach develops analytical thinking, problem-solving skills, and deepens understanding of CAD principles.

Each of these pedagogical approaches can be adapted singularly or combined based on the learning styles, learners' backgrounds, and available resources to create well-rounded CAD lessons

ASSESSMENT SUMMARY

The assessments should be based on learners' ability to develop the surfaces of various pyramids with the right drawing tools and equipment, draw the curves of intersection of objects meeting at right angles and design artefacts based on the principles of solid geometry.

Learners' ability to manipulate CAD tools and produce drawings with AUTOCAD using accurate dimensions and lines should be assessed and recorded.

Levels of assessment should be varied to cater for the different learning proficiencies among learners.

WEEK 15

Learning Indicator: Construct the surface development of pyramids

Focal Area 1: Surface development of pyramids

Pyramids

In graphic communication, a pyramid refers to a geometric solid that has a flat polygonal base (i.e. triangle, square, pentagon, etc.) and triangular sides that meet at the apex.

Example in real life is the Great Pyramid of Giza in Egypt. This three-dimensional geometric shape is one of the largest and oldest pyramids existing today.

Pyramids are characterised by their base shape and the number of sides they have.

Examples of pyramids

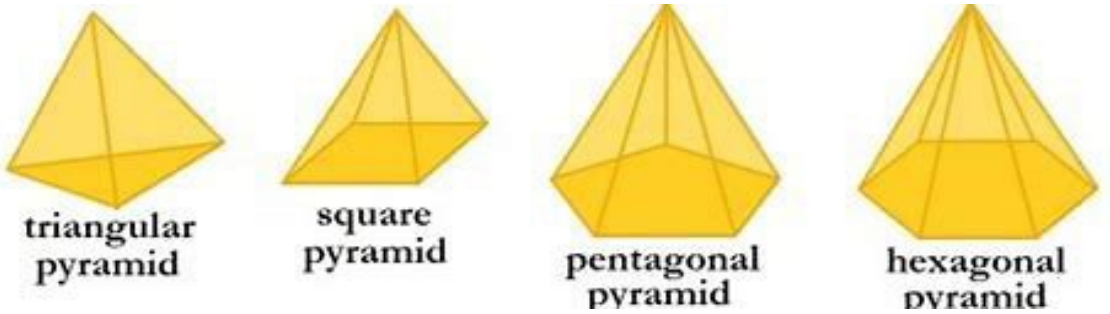


Figure 2.2.1: *Examples of pyramids*

Properties of pyramids

Base Shape: The base is flat and is typically drawn as a regular polygon in technical drawings. However, some pyramids can have irregular polygonal base

Sides: Pyramids have triangular sides that connect the edges of the base to the apex (top point).

Vertex (Apex): It is the highest point of the pyramid where all the triangular sides meet

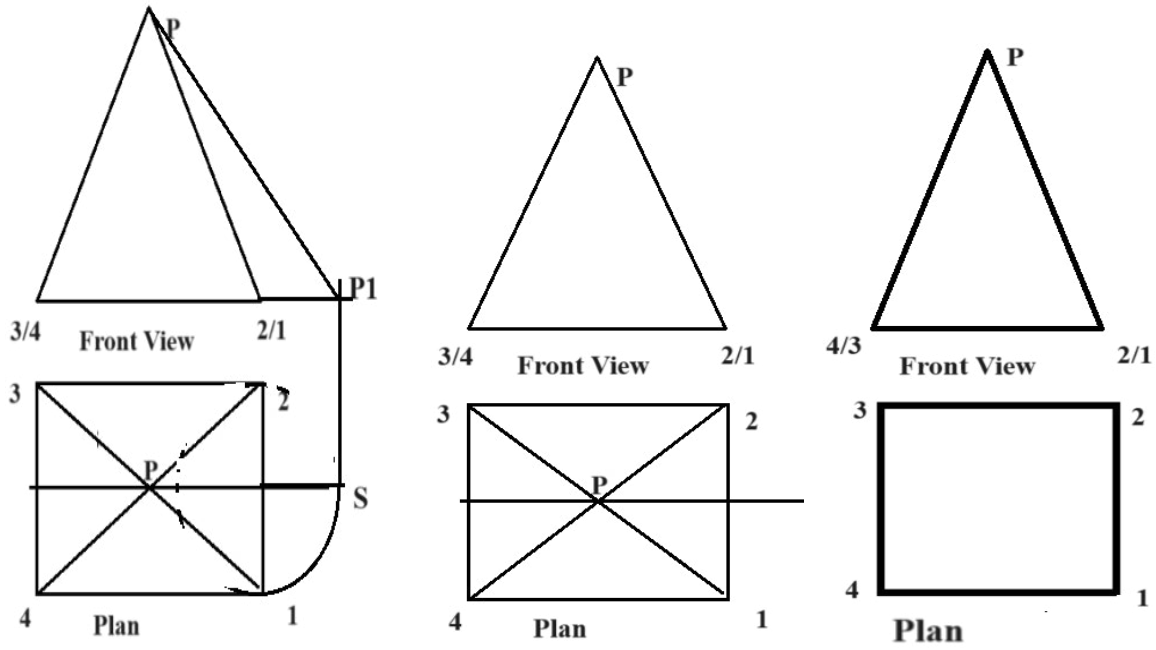
Height: In technical drawings, the height of a pyramid is the perpendicular distance from the base to the apex

Surface development of pyramids

When a pyramid is cut open along the vertex and spread out, the visible shape formed is known as the surface development of the pyramid.

Surface development of a square pyramid

Procedures/principles used to draw the surface development of a square pyramid



1. Draw the elevations I.e. the front view and plan (the front view and the plan can be drawn in two different ways) and number the sides of the plan to correspond with the front view.
2. Join the diagonals of the plan to intersect at point P and draw a horizontal line through P in the plan to touch the sides 1 2 and 3 4
3. With centre P and radius 1 draw an arc from 1 to meet the horizontal line extended at S
4. Draw a vertical line from point S to meet the baseline of the front view extended at P1
5. Join P in the front view to P1 to obtain the true shape of the slant height of the pyramid that is P1, P2, P3 and P4
6. With P as centre and radius P1 P draw a reasonable arc and use the length of the side of the square pyramid to mark off four times on the arc drawn. Label the points and join them to P to obtain the developed surface of the pyramid

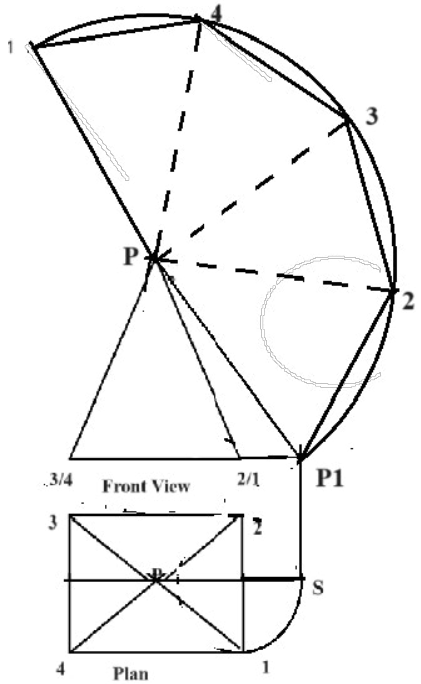


Figure 2.2.3: *Surface development of square pyramid*

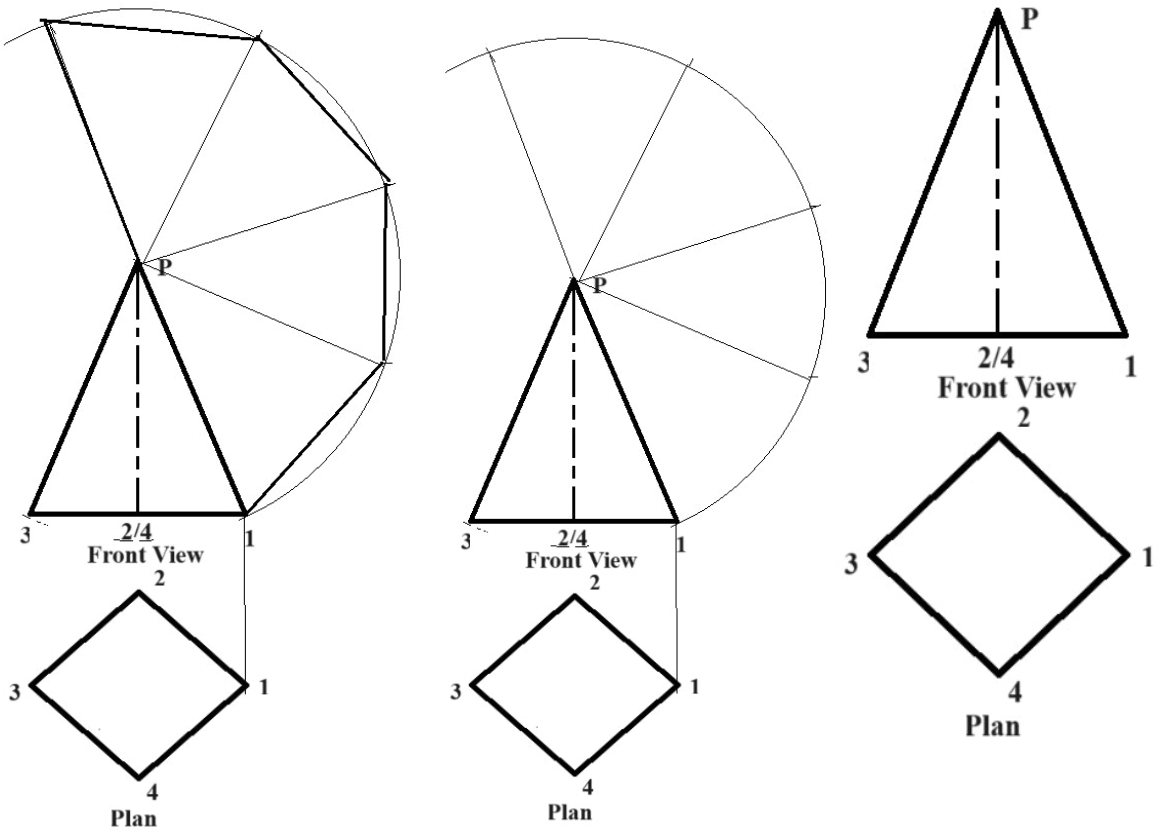


Figure 2.2.4: *Development of a square pyramid placed in a different way*

The figure above is showing the development of a square pyramid placed in a different way. In this case the true length of the slant height was not determined.

Note

Teachers should demonstrate the construction of the surface development of different examples of pyramids to learners.

Application of surface development of pyramids

- Packaging and Template Design
- Sheet Metal Fabrication
- Architectural Roofing and Cladding
- Fabric and Textile Design
- Metalworking and Welding
- Paper Crafts

Learning Task

1. Explain the principles used to draw the surface development of pyramids
2. Construct the surface development of a square pyramid of sides 30 and perpendicular height of 70

Pedagogical Exemplars

Managing talk for learning

1. Review learners' understanding of solid geometrical figures and the development of surfaces of prisms in year one through brainstorming board sketches and illustrations. Vary the questions to cater for all the learning proficiencies in the class. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. Demonstrate the development of the surfaces of types of pyramids with the use of drawing instruments. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

Managing talk for learning/ Experiential learning

With the aid of models, pictures, videos and charts, assist learners to explain the principles of developing pyramids. Ensure the HP, P, and AP learners take part in the discussion. Differentiation can be incorporated by allowing learners to express their understanding in various ways. For instance, some learners prefer to draw diagrams, while others prefer to write a paragraph or give a verbal explanation.

Project based learning; Activity based learning

Guide learners to develop the surfaces of some given pyramids such as rectangular, pentagonal and hexagonal pyramids.

Note

Make sure to provide varied support to the different learning proficiencies in the class (HP, P and AP)

Key Assessments

Level 2: Explain the principles used to draw the surface development of pyramids

Level 3

1. Construct the surface development of a square pyramid of sides 30 and perpendicular height of 70
2. Demonstrate how to develop the surfaces (net) of the model(s) displayed (e.g. square pyramid, triangular pyramid



HINT

The recommended mode of assessment for week 15 is **demonstration**. *Use the level 3 question 2 as a sample question.*

WEEK 16

Learning Indicator: Draw the curve of intersections of objects meeting at right angles

Focal Area 1: DRAWING CURVES OF INTERSECTION

When the surface of one solid meets that of another, the line(s) along which the two surfaces meet is known as the *curve(s) of intersection* of the surfaces of the two solids. Many components in engineering are formed by joining various geometrical shapes

Examples of objects that exist on the principles of curves of intersection:



Figure 2.2.5: *Interconnected pipes*

Principles used to construct curves of intersection of two square prisms meeting at 90° but are not of the same sizes

1. Draw the plan of the given prisms, the front and end views, in this case, the right end view
2. Number the plan and the front view of the smaller square prism as shown
3. Project like numbers from the plan to meet like numbers on the front view
4. Join these points by straight lines to obtain the curve of intersection.

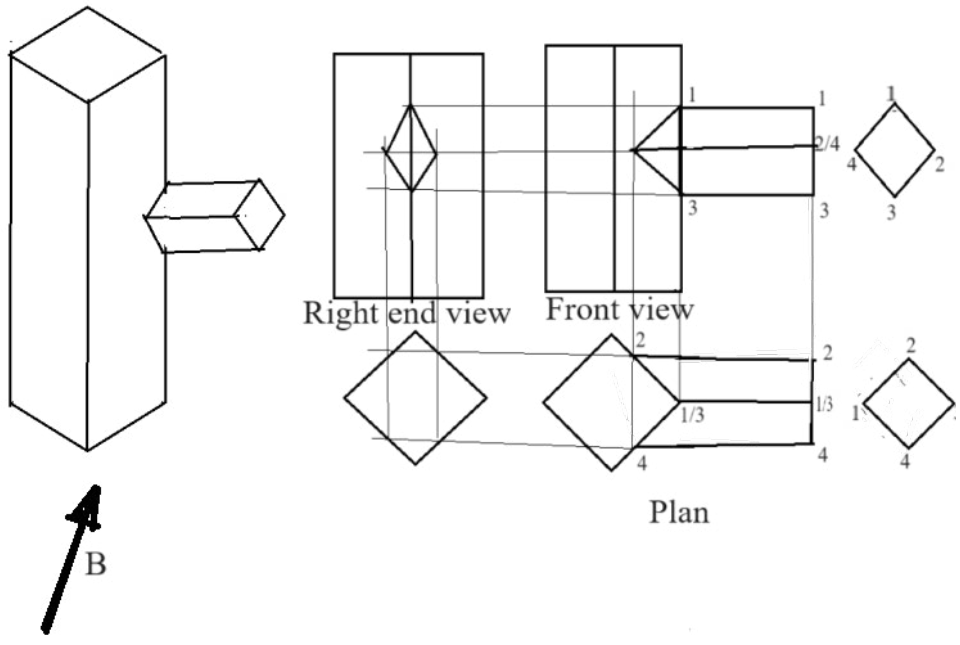


Figure 2.2.6: *Curves of intersection of two square prisms meeting at 90° but are not of the same sizes*

Principles used to construct curves of intersection of two square prisms meeting at 90° and are of the same sizes

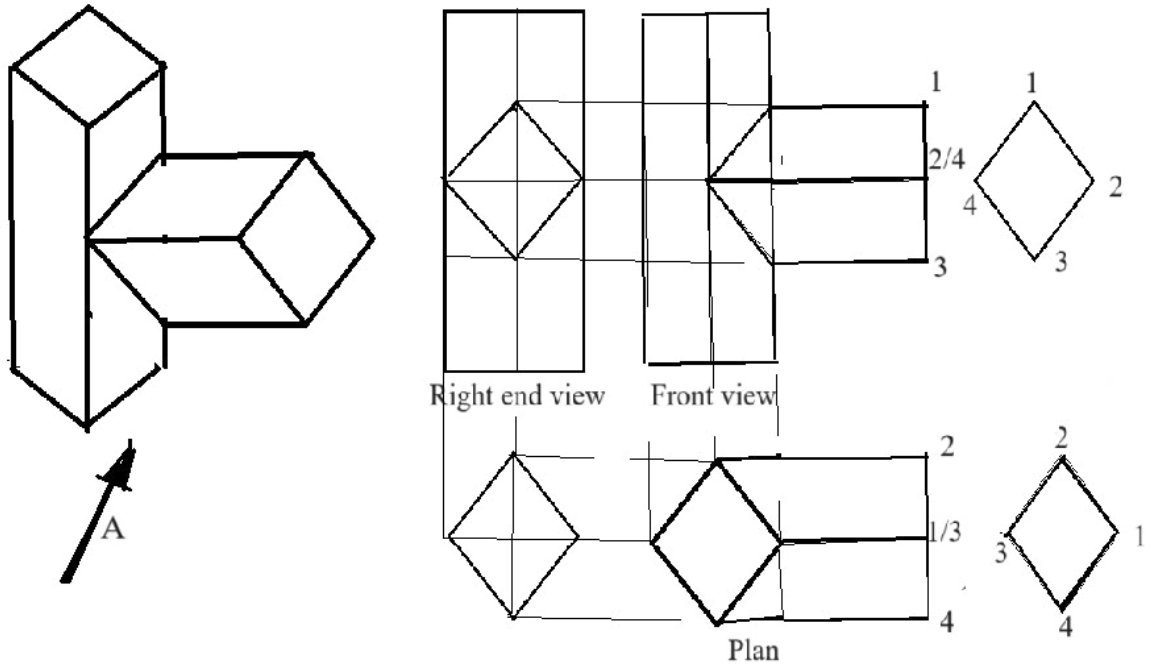


Figure 2.2.7: *Curves of intersection of two square prisms meeting at 90° and are of the same sizes*

1. Draw the plan of the given prisms, the front and end views, in this case, the right end view
2. Number the plan and the front view of the square prism as shown
3. Project like numbers from the plan to meet like numbers on the front view
4. Join these points by straight lines to obtain the curve of intersection.

Principles used to construct curves of intersection of two similar cylinders meeting at 90°

1. Draw the plan and the partial front view of the cylinders
2. Draw semi-circle on the joining cylinder in plan and in elevation
3. Divide the semi-circles into a number of equal parts i.e. 6
4. Project horizontal lines from the plan to meet the circle
5. Number them to correspond in both views
6. Project vertical lines from the points on the circle to meet like horizontal lines in the front view
7. Mark these points
8. Draw a smooth curve through these points to obtain the curve of intersection.

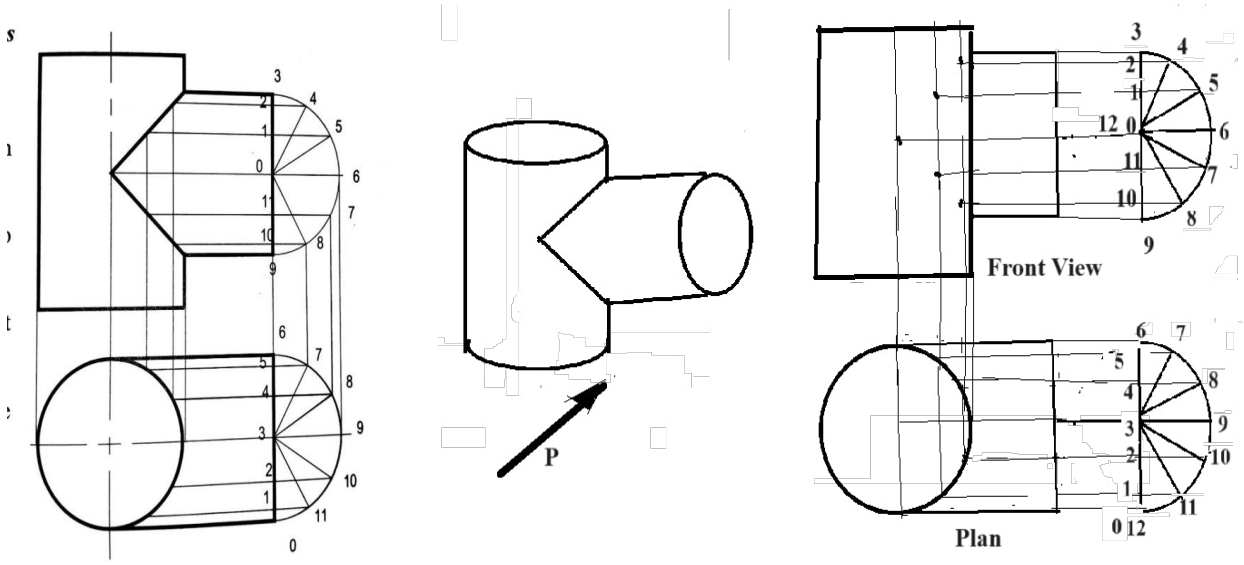


Figure 2.2.8: *Curves of intersection of two similar cylinders meeting at 90°*

Learning Task

1. Explain the concept of drawing the curve of intersections of two solid "geometrical objects meeting at right angles"
2. Mr. Mensah is connecting a pipe from the mains to his residence. The diameter of his pipe is the same as the mains =30. Construct the curve of intersection of the two pipes taking the length of the main pipe to be 80 and that of his to be 30 and intersecting at 90°.

Pedagogical Exemplars

1. **Managing talk for learning, Collaborative Learning/ Group work**
   In mixed ability grouping and with the use of models, pictures and charts, help learners to explain the principles of intersections and present their findings in a whole class discussion Ensure the groups consist of (HP, P and AP) learners. Anticipate that some learners may struggle with certain concepts, such as the applications of curves of intersection, and plan for additional support or resources to help these learners
2. **Managing talk for learning**
   Demonstrate the drawing of curves of intersection of square and cylindrical pipes meeting at right angles using board illustrations and drawing instruments. Use your knowledge of your learners and your creativity to adapt the activity as needed.
3. **Activity based learning**
   With the use of instruments and the application of the concept of intersection, task learners to draw the curves of intersection of two cylindrical pipes of different diameters meeting at right angles. Encourage the HP learners to assist the AP learners whilst the P learners are given extended tasks to do.

Key Assessments

Level 2: Explain the concept of drawing the curve of intersections of two solid "geometrical objects meeting at right angles"

Level 3: Mr. Mensah is connecting a pipe from the mains to his residence, if the diameter of his pipe is the same as the mains =30, construct the curve of intersection of the two pipes taking the length of the main pipe to be 80 and that of his to 30 and intersecting at 90°.

Task: Construct the curve of intersection of the pipes.



HINT

The recommended mode of assessment for week 16 is **self-assessment**. *Use the level 3 question as a sample question.*

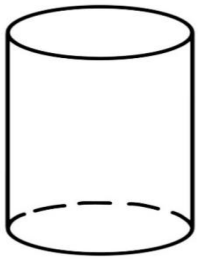
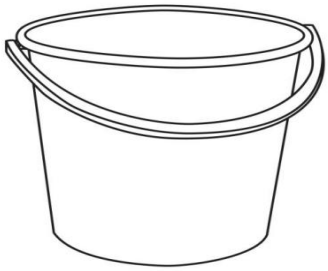
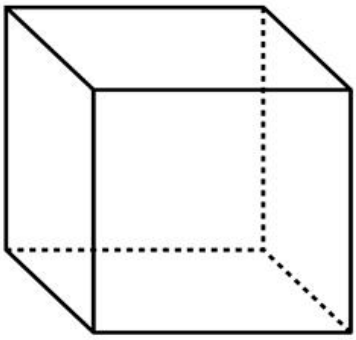
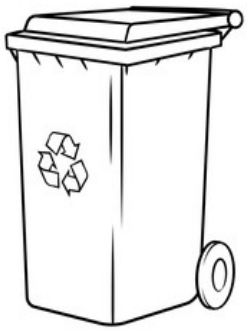
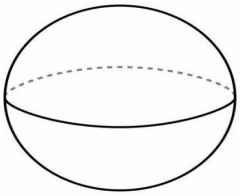
WEEK 17

Learning Indicator: Design artefact using the concept of solid geometry

Focal Area 1: DESIGNING WITH SOLID GEOMETRY

Solid geometry serves as a foundational tool for exploring form, structure, and designs, enabling innovative and creative solutions across various industries and applications. A lot of designed products or structures exist on the principles of solid geometry examples include water bottles, dustbins, packaging boxes, bowls etc.

Table 2.2.1: Design items based on solid geometry

Solid geometrical figures	Designed items
Cylinder 	Cylindrical bucket 
Cube 	Dustbin 
Sphere 	Basketball 

Principles used to design solid geometrical artefacts

Designing artefacts with solid geometry involves applying the principles of three-dimensional shapes and their properties to create functional and aesthetically pleasing objects. Here are some key principles and considerations in designing artefacts using solid geometry.

1. **Understanding solid geometry**: Familiarise with basic geometric shapes such as cubes, spheres, cylinders, cones, and pyramids. Understand their dimensions, proportions, and how they can be combined or modified to create complex forms.
2. **Sketching and Conceptualisation**: Begin the design process by sketching ideas and concepts that incorporate solid geometric shapes. Explore different arrangements, compositions, and variations to determine the form and structure of the artefact.
3. **Utilising Geometric Principles**: Apply geometric principles such as symmetry, balance, proportion, and spatial relationships in designs. Use these principles to create harmonious and visually appealing compositions.
4. **Structural Integrity and Functionality**: Ensure that the artefact's design considers structural integrity and functional requirements. Geometric shapes can influence the stability, strength, and usability of the artefact.
5. **Aesthetic Considerations**: Explore how solid geometry can enhance the artefact's aesthetics. Consider aspects such as texture, pattern, surface treatments, and colour schemes that complement the geometric forms and enhance the overall design.
6. **Computer Aided Design (CAD) Modelling**: Transition sketches into detailed three-dimensional models using Computer-Aided Design (CAD) software. CAD tools allow learners to precisely manipulate and visualise geometric shapes, explore variations, and refine designs.

By integrating solid geometry principles into the design process, learners can create artifacts that not only exhibit geometric elegance but also achieve practical functionality and aesthetic appeal.

Learning Task

Design artefacts using the concept of solid geometry.

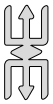
Pedagogical Exemplars

1. **Research, Experiential learning, Managing talk for learning, Collaborative learning**

   Using relevant resources, guide learners in mixed ability groups to research on various designs that exist on the principles of solid geometry and their uses in the community, task learners to present their findings in group presentations. Ensure the AP learners take part in the presentations. Allow learners to demonstrate their understanding in different ways. For example, some learners could present their findings to the class, while others could create a report or a mind map.

2. **Activity based learning, Individual learning**

   Assist learners to individually provide sketches of functional designs using solid geometrical figures and compare with their friends



Note

Encourage learners to be creative when designing. Create a peer-to-peer mentoring system to help learners having difficulties receive help from colleagues.

3. **Activity based learning/ Project based learning**
   Guide learners to use drawing instruments to construct the various designs they sketched earlier considering dimensions and proportionality. Provide support for the various learning proficiencies in the class. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

Level 4

1. Design artefacts using the concept of solid geometry
2. Design and defend an artefact using the concept of solid geometry



HINT

The recommended mode of assessment for week 17 is **presentation**. *Use the level 4 question 2 as a sample question.*

WEEK 18

Learning Indicator: Demonstrate the use of basic concepts of CAD in developing drawings

Focal Area 1: BASIC CONCEPTS IN COMPUTER AIDED DESIGNS (CAD)

Introduction to Auto CAD

CAD simply means Computer-Aided Design, Computer-Assisted Design, Computer-Aided Drafting, or Computer-Assisted Drafting. There are other related terms in the system because of their functions and these are Computer-Aided Design and Drafting (CADD) and Computer-Aided Mapping and Computer-Aided Cartography. By the end of these lessons, learners will be able to identify and manipulate tools in creating simple objects.

Why use Auto CAD?

Learning Auto CAD offers several advantages. CAD systems are available on many computer platforms, be it, laptops, personal computers (PC), Workstations and mainframes.

Auto CAD first became available to the public in late 1982, because CAD software was one of the first products to be used on the personal computer.

Since then, it has become the world's leading supplier of design software and multimedia tools. It is now clear why Auto CAD is one of the largest software producers in the world and has several millions of customers in more than 150 countries.

A fascinating highly efficient and accurate software programme that has a very high level of precision for either architecture, engineering, mechanical drawings, woodwork, fashion design, or electrical and electronic components.

There are different kinds of CAD systems in use today. Among them are

1. **Auto CAD:** This is a software generally used by Engineers for Mechanical, Furniture, Automobile or architectural drawings, etc.
2. **Auto CAD Architectural desktop**: particularly for Architectural drawings.
3. **Optitex PDF CAD/Patten design:** is for fashion design and drawing.

The following should be known before beginning actual drawing with CAD

1. Installation of Auto CAD software
2. Launching Auto CAD
3. Exploring the Auto CAD interface. These include:
    a. World coordinate system
    b. Crosshair cursor
    c. Start tap: Setting of sheets (e.g. acad, acadiso, architecture etc.)
    d. Draw/ Graphic area
    e. Ribbon: consisting of various command/tools for modelling artefact (e.g. layers, draw, modify, modelling, solid editing, mesh, views, etc.)

f. Command window/line
g. Status bar: numerous settings which consist of grid mode, snap mode, orthomode, polar tracking, object snaping, workspace switching, line weight etc.
h. Menu bar: consist of home, solid, surface, mesh, visualise, parametric, insect, view, manage, etc.

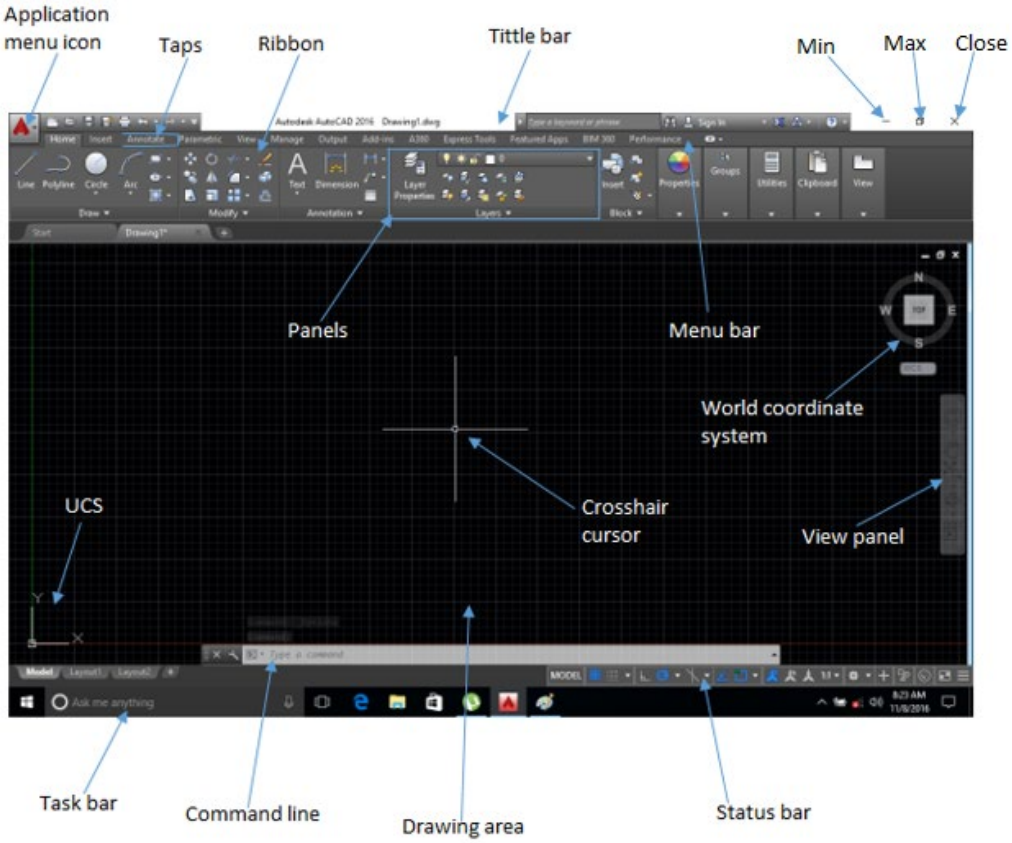


Figure 2.2.9: *CAD interface*

To begin AutoCAD drawing

For a professional drawing, you need to set up the interface. To set up means to create a new drawing/sheet that will meet your specification and convenience. By so doing you can start a new drawing from scratch. This can be undertaken according to the type of CAD software (AutoCAD, Architecture desktop or Patten design). E.g.

1. AutoCAD; acad for imperial sheet, acadiso for millimetres sheet etc.
2. This command establishes the appropriate **units** of measurement for drawing. This is an optional step in case you need a different unit measurement than the default unit measurement. For example;
   a. Do you want to measure in common fraction or decimal fractions?
   b. Will you measure angles in degrees or radians?

Cultivate the habit of saving

As you draw, you should develop the habit of saving the drawing periodically (about every 15 or 20 minutes) using the save icon or using the short cut keys Ctrl+C. Save stores the drawing in its most current state to disk or drive.

The World Coordinate System

Everything you draw in AutoCAD is created in an infinitely large drawing space and can be located by the x and y coordinates. The default coordinate system in AutoCAD is called the World Coordinate System, or WCS. Many AutoCAD users spend their whole careers drafting in the WCS. Unless you are working in 3D, there is little reason to change the WCS to a user-defined coordinate system (or UCS), but it can be done if necessary. For the last several releases, AutoCAD has displayed the UCS icon at the origin.



Figure 2.2.10: World Coordinate System (*WCS)*

To Control User-defined Coordinate Systems (UCS)

The following steps explain how to control the UCS icon's display

Step 1: Choose View ⇨UCS Icon.

Step 2: Select On to turn the display of the icon off and on.

Step 3: Select Origin to move the icon to 0, 0, 0 in the drawing, or to the lower left corner of the drawing area.

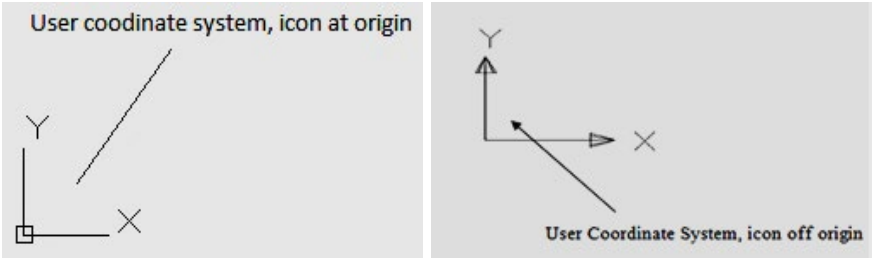


Figure 2.2.11: *User Coordinate Systems*

Coordinate System

Before you start drawing, you will need to employ a coordinate system to specify points in 2D space. AutoCAD 2016 makes available five different coordinate systems for specification of points. The five different coordinate systems are:

1. Interactive coordinate system
2. Relative coordinate system
3. Absolute coordinate system
4. Polar coordinate system

5. Direct distance entry method

For more easier drawing the direct distance entry method is more efficient in use compared with the other four.

Direct distance entry method

The direct distance entry method is a more realistic approach where dimensions are considered very important. To specify a live length quickly, without entering coordinate values, you can specify a point by moving the cursor to indicate a direction and then enter the distance from the first point.

Example

Step 1: Draw the lines below with the line command. Respond to the common prompts as follows:

Step 2: On the Command: - Type line. Or click on the line icon on the draw toolbar

Step 3: Specify first point: - Click anywhere within the drawing area to pick your first point.

Step 4: To Specify the next point, move the cursor towards the direction of the line and type in the length of the line (e.g. 100)

Step 5: Hit the enter key to accept the dimension.

Step 6: Specify next point by moving the cursor to the top of the draw and at an angle of 90 degrees and type the length of the second line. Example 80.

Step 7: Hit the enter key twice to break the rubber band.

Step 8: Note that the line band is not broken the first time you hit the enter key. To break it, press the Enter key a second time. Also you can press the escape key to end the command.

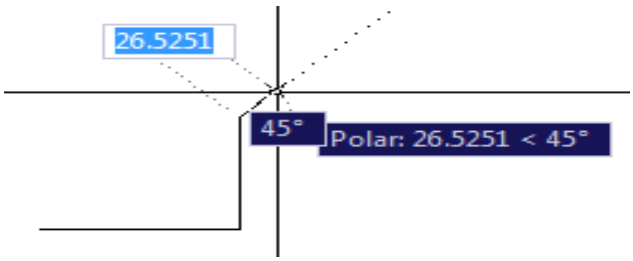


Figure 2.2.12: *Direct entry Line*

Object properties panel

The object property panel is a very useful feature that is used to separate different types of objects in the same space. It becomes more relevant when the objects are many and complex and need to be isolated for analyses, editing or identification.

You may choose layers from the following two ways.

Step 1: On the Home menu, choose layer properties

Or

Step 2: On the command line, type layer (or LA)

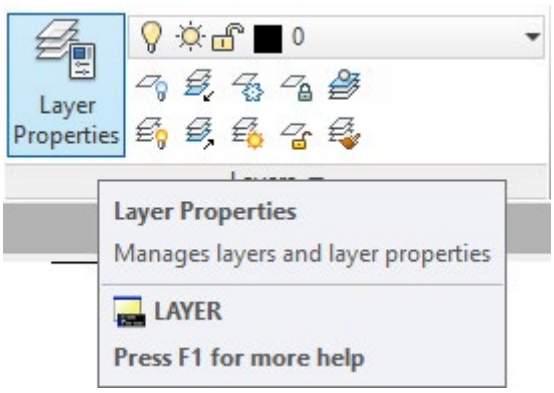


Figure 2.2.13: *Layer*

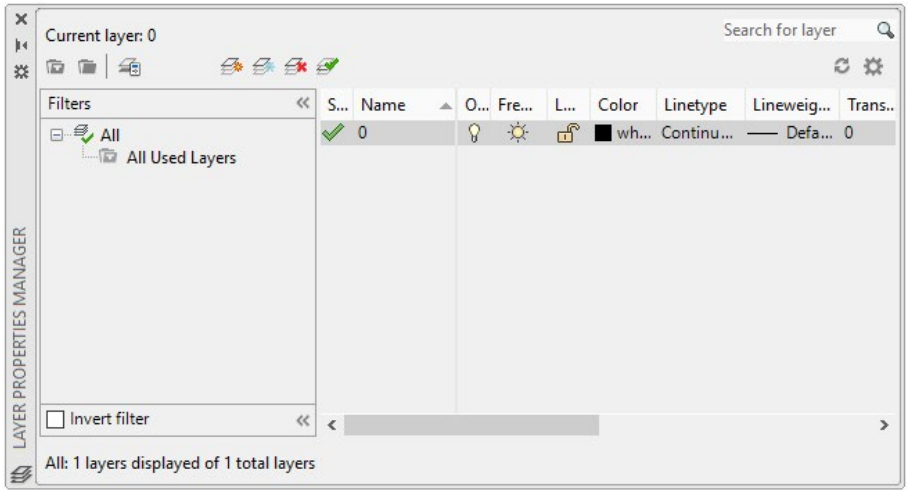


Figure 2.2.14: *Layer Property Manager*

Draw command

Draw commands are commands that create or add new entities to your drawing.

Locating the draw command

To involve commands any of these two-command entry methods can be used depending on your computer setup.

1. **Draw panel**: select the command or dialogue box by picking a tool (icon button) from a draw panel on the ribbon.
2. **Keyboard entry**: type the command name, command alias, or accelerator key at the key – board

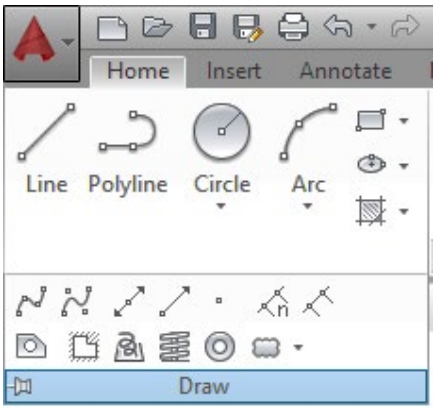


Figure 2.2.15: *Draw panel*

Line

The line symbol is used to draw lines. A line can be one segment or a series of connected segments, but each segment is a separate line object. Use lines if you want to edit individual segments. That is to say that if you want to edit a triangle, use lines to draw the three sides, each side representing a segment so you can edit each of the three sides.

To draw a line 80mm

Step 1: Click on the line icon on the draw panel or type Line at the command line.

Step 2: Specify the start point: click to pick the start point

Step 3: Specify the endpoint: type value (80)

Step 4: Press ENTER to complete the line.

To draw two perpendicular lines line AB 80mm, line BC 40

Step 1: Click on the line icon on the draw panel or type Line at the command line.

Step 2: Specify the start point: click to pick start point

Step 3: Specify the endpoint: type value (80)

Step 4: Specify the endpoints of the next segments directed upwards and at 90 degrees to the first line.

Step 5: Specify the endpoint: type value (40)

Step 6: Press ENTER to complete the line.

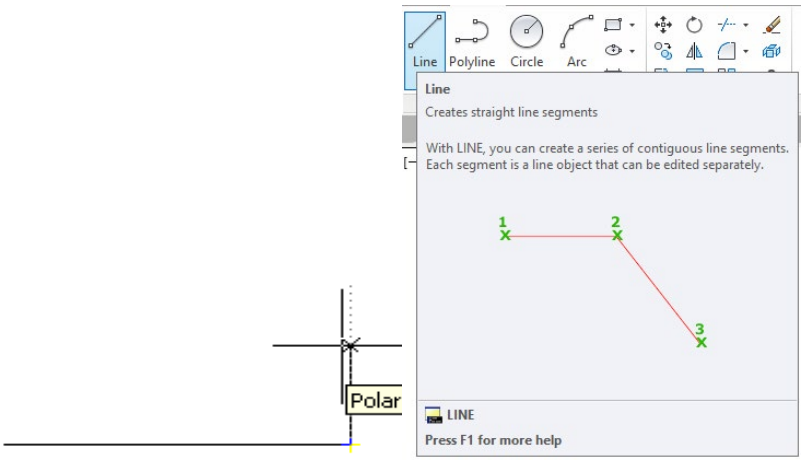


Figure 2.2.16: *line*

Arcs

You can create arcs in many ways. The default method is to specify three points. That is, a start point, a second point on the arc, and an endpoint. You can also specify the included angle, radius, direction, and chord length of arcs. The chord of an arc is a straight line between the endpoints.

To draw a continuous arc

Step 1: Click on the Arc icon from the draw panel or type Arc at the command line.

Step 2: Specify the first point of the arc: click to pick the first point.

Step 3: Specify the next point of the arc: click to pick the next point.

Step 4: Specify the next point of the arc: click to pick the next point.

Step 5: Continue until you get the required shape.

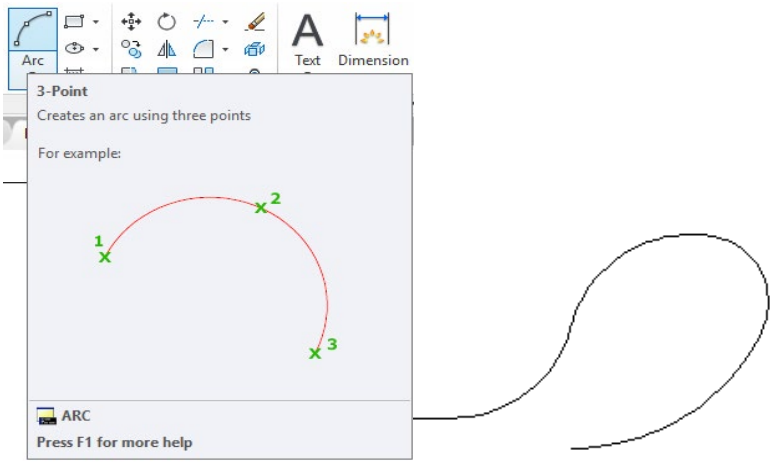


Figure 2.2.17: *Arc*

To draw an arc by specifying three points

Step 1: From the Draw panel, choose Arc

Step 2: From the flow-out box choose Start, Centre, End.

Step 3: Specify the start point: click to pick the start point

Step 4: Specify the second point: click to pick the second point

Step 5: Specify the endpoint of the arc: click to pick the endpoint

Circle

You can create circles in several ways. Most often the method you use depends on the specifications given.

To draw a circle by specifying a centre point and radius

Step 1: Click on the circle icon or from the Draw panel, choose Circle-Centre, Radius

Step 2: Specify the centre point: click to pickthe centre point

Step 4: Specify the radius of the circle: type the value (e.g. 80).

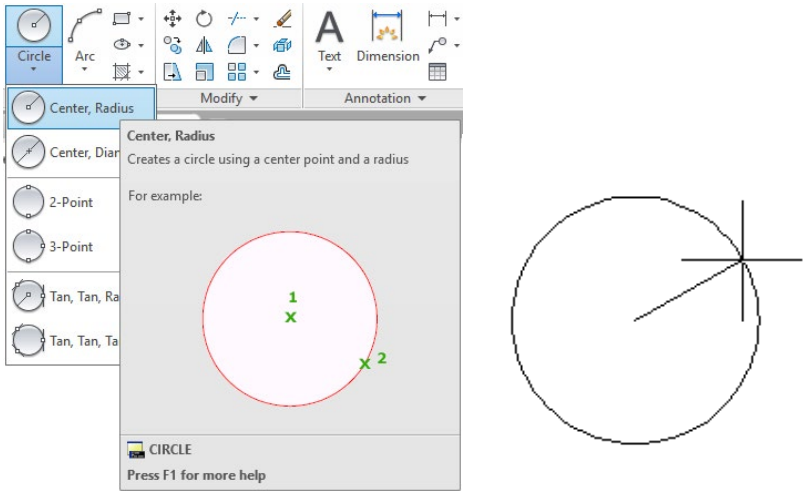


Figure 2.2.18: *Circle*

To create a circle tangent to existing objects:

Step 1: From the Draw panel, choose Circle Tan, Tan, Radius

Step 2: You are now in Tangent snap mode.

Step 3: Select the first object to draw the circle tangent to.

Step 4: Select the second object to draw the circle tangent to.

Step 5: Specify the radius of the circle: enter the value.

Step 6: Hit the enter key.

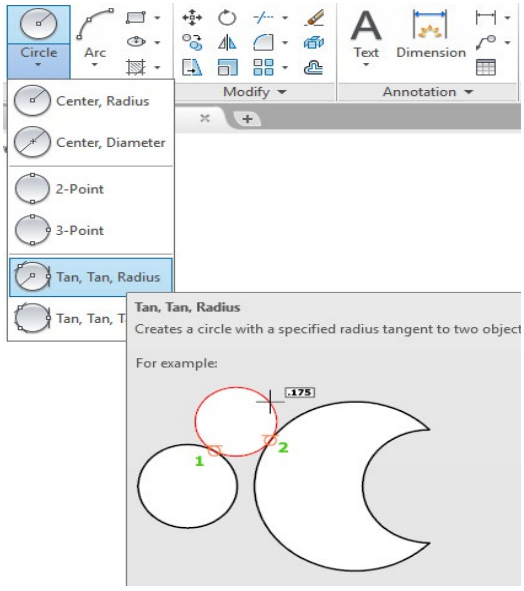


Figure 2.2.19: *Circle tangent*

Rectangle

To draw a rectangle the following procedure is required

Step 1: Click on the rectangle icon on the draw panel.

Step 2: Specify the first corner point: pick (move the cursor to any desired length and width).

Step 3: Specify the other corner point: pick

Example of using measurements, (180mm and 80mm), follow this procedure:

Step 1: From the draw panel, choose rectangle, **or** type rectangle at the command line.

Step 1: Specify the first point or (chamfer/fillet/thick width): click and drag

Step 2: Specify the other corner point or (Dimensions): type D

Note

type ‘D’ and press enter key to choose the dimension option.

Step 3: Specify the length for the rectangles. <0.000>: 180

Step 4: Specify the width for the rectangle. <0.000>: 80

Step 5: Click to end the command.

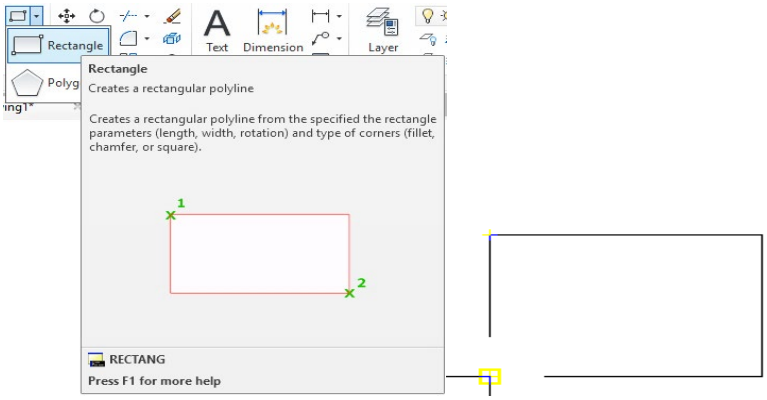


Figure 2.2.20: *Rectangle*

Polygon

The polygon command centres on regular polygons. It uses Line to create a polygon. You can specify the size of an imaginary circle for the polygon to inscribe or circumscribe.

The command sequence for this default method is as follows

Step 1: From the draw panel, choose polygon, **or** type polygon at the command line.

Step 2: Enter the number of sides <4>: 6

Step 3: Specify the centre of the polygon or (edge): click to pick the centre

Step 4: Enter an option (Inscribed in circle / Circumscribed about circle) <1>: I or C

Step 5: Specify the radius of the circle: enter value (60)

Step 6: Command: enter

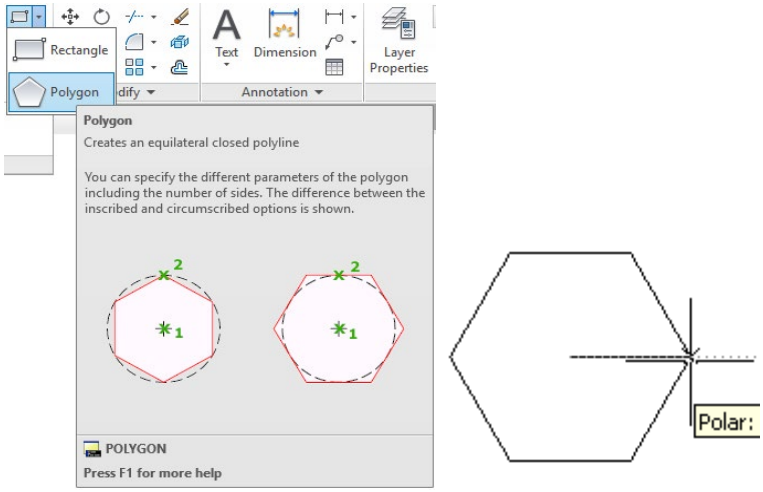


Figure 2.2.21: *Polygon*

Ellipse

You can create full ellipses and elliptical arcs. The default method of drawing an ellipse is to specify the endpoints of the first axis and the distance, which is half the length of the second axis.

To draw a true ellipse using endpoints and distance

Step 1: From the draw panel, choose ellipse, **or** type ellipse at the command line.

Step 2: Specify the first endpoint of the first axis: click

Step 3: Drag the pointing device away from the midpoint of the first axis
Step 4: Specify the other endpoint of the first axis: enter the minor axis value (330)
Step 5: Specify distance to the other axis or [rotation]: enter major axis value (600)

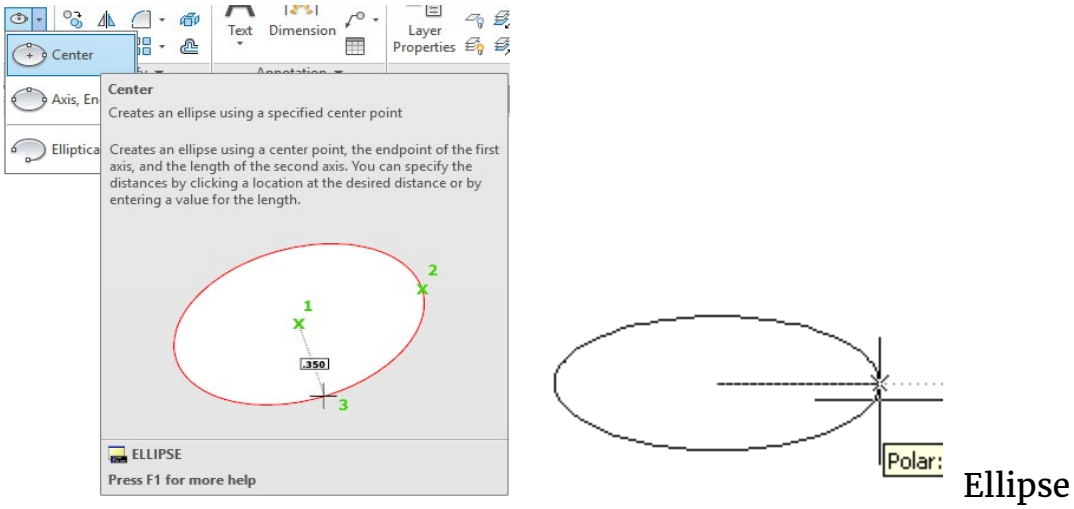


Figure 2.2.22: *Ellipse*

Hatch

A hatch is to create a pattern within a space provided either to enclose the space or provide some sort of beautification. The hatched space must be identified in the hatch dialogue box to take effect. Remember, it is useful to hatch boundaries and enclosed areas. Hatch is available on the command line, the draw toolbar and the screen menu.

To hatch an enclosed area

Step 1: Draw the object to be hatched
Step 2: From the draw panel, choose hatch, **or** Type hatch at the command line.
Step 3: From the ribbon, choose a different hatch from the default one.
Step 4: Within the Boundaries panel, click on the select button.
Step 5: Specify a point in your drawing inside each area you want to hatch. If you make a mistake, you can right-click and choose "Clear All" or "Undo Last". Select/Pick from the shortcut menu.

Step 6: Press Enter to apply the hatch.

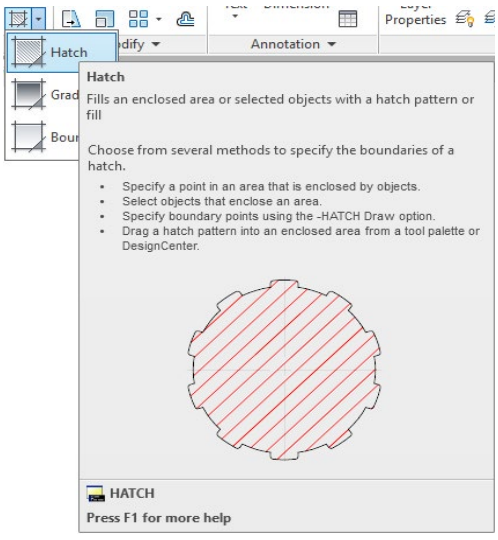


Figure 2.2.23: *Hatch and Gradient*

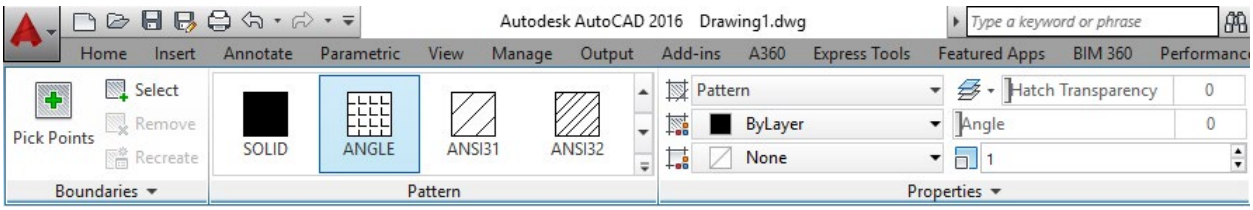


Figure 2.2.242: *Hatch creation ribbon*

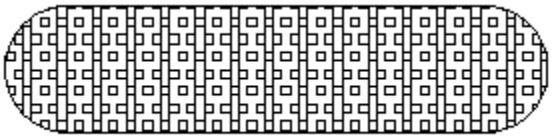


Figure 2.2.25: *Select Object Hatch*

Multiline Text

1. From the Annotation panel, Choose Multiline Text **or** Type MTEXT at the command line
2. Type one of the following options: Height/Justify/Rotation/Style/Width:

   Or
3. Pick 2 Points to define the text window.
4. Type the text and click to end the command

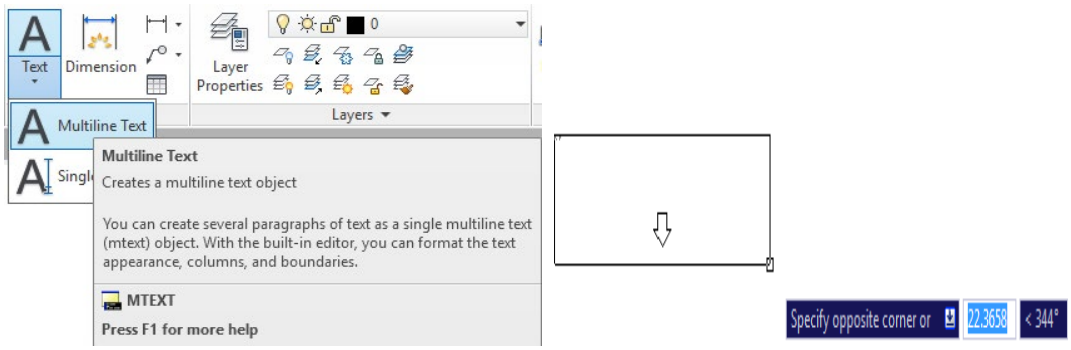


Figure 2.2.26: *Multiline Text Editor*

Note

The following modify commands can be explored: Spline, polyline, constructional line, divide, donut, ray, revcloud, point, etc.

The Modify command

Modifying commands are used to edit or change the properties of entities in your drawing.

These commands can be found in the Modify panel.

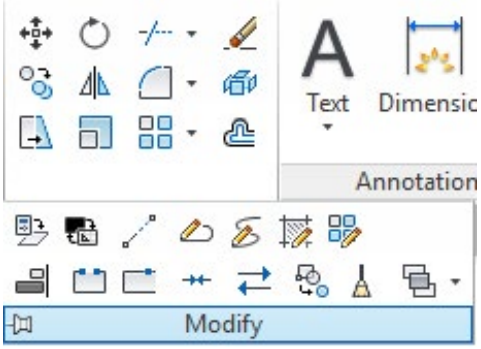


Figure 2.2.27: *Modify tool bar*

Erase

This command deletes objects you select from the drawing.

To erase a selection set

Step 1: click on the Erase icon.
Step 2: Using window selection, select the objects to erase.
Step 3: Press ENTER to close the command.

Mirror

This command allows you to mirror objects around a mirror line, which you define with two points, as shown in the following illustration. You can delete or retain the original objects.

To mirror objects

Step 1: From the modify panel, click on mirror, **or** type mirror at the command line.
Step 2: Select the objects to mirror with a window.
Step 3: Specify the first point of the mirror line - Pick.
Step 4: Specify the second point - Pick.
Step 5: Press ENTER to retain the original objects.

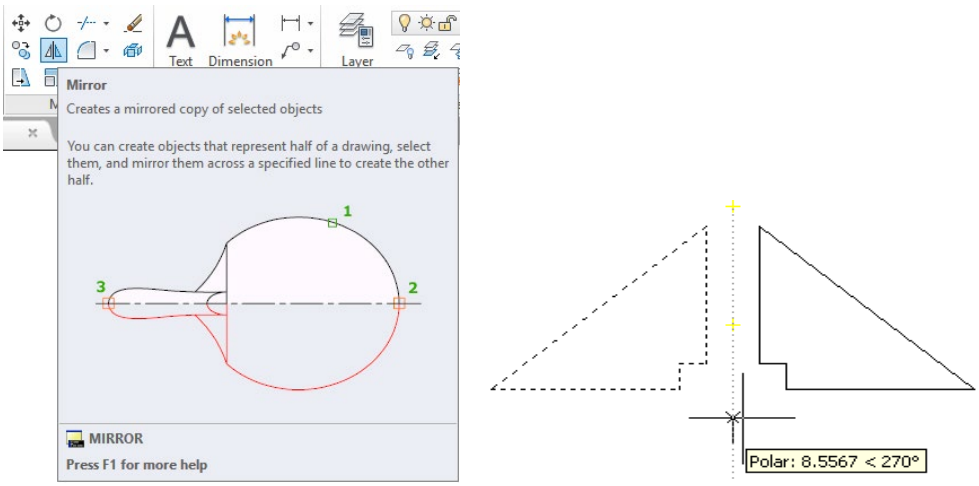


Figure 2.2.28: *Mirror*

Offset

Offsetting creates a new object that is similar to a selected object but at a specified distance. You can offset lines, arcs, and circles.

To offset an object by specifying a distance

Step 1: From the modify panel, click on offset, **or** type offset at the command line.
Step 2: Use the pointing device to specify the offset distance or enter a value.
Step 3: Select the object of offset.
Step 4: Specify which side to offset - Pick.
Step 5: Select another object to offset, or press ENTER to end the command.

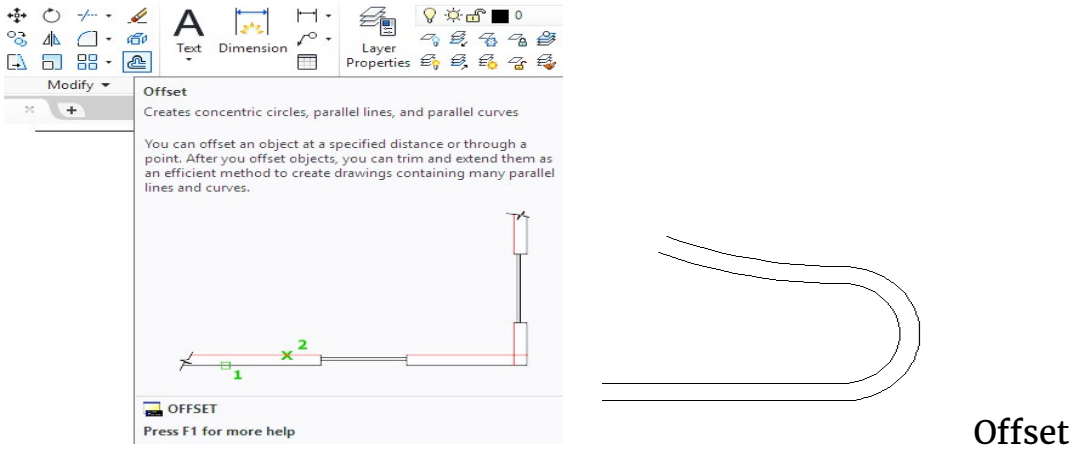


Figure 2.2.29: *Offset object*

Move

Move allows you to relocate one or more objects from the existing position in the drawing to any other position you specify. When you move objects, you can rotate or align them or move them without changing orientation or size.

To move an object

Step 1: From the modify panel, click on Move, **or** type Move at the command line
Step 2: Select the object to move.
Step 3: Specify the base point for the move: click
Step 4: Specify the second point of displacement: click **or** type the value

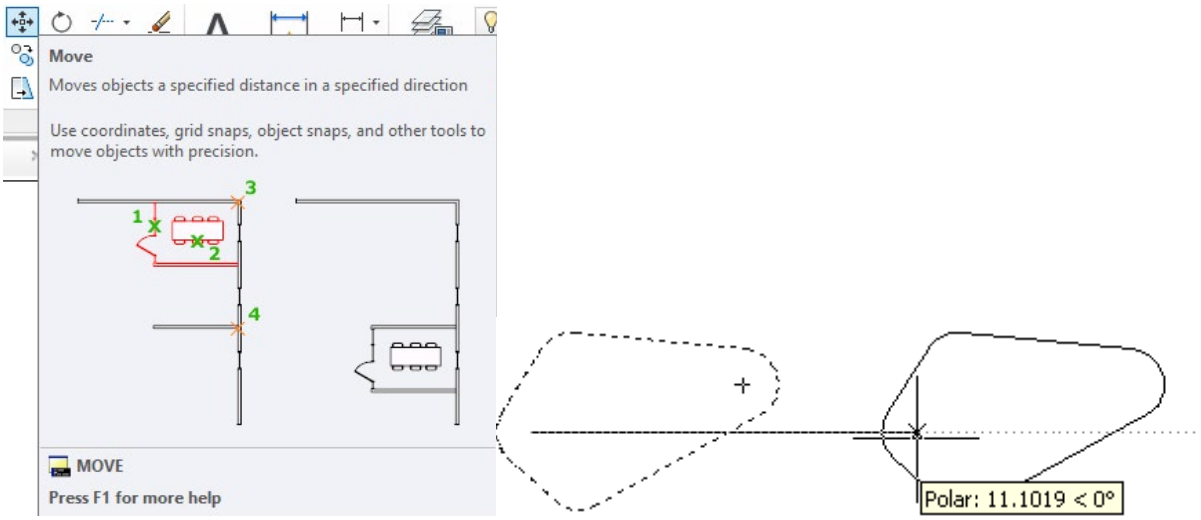


Figure 2.2.30: *Move object*

Copy

You can copy single or multiple objects within the current drawing, and you can copy between drawings or applications.

To Copy a selection set once

Step 1: From the modify panel, click on copy, **or** type copy at the command line
Step 2: Select the objects to copy and press ENTER.
Step 3: Specify the base point, (by picking a point).
Step 4: Specify the second point of displacement: click to copy.

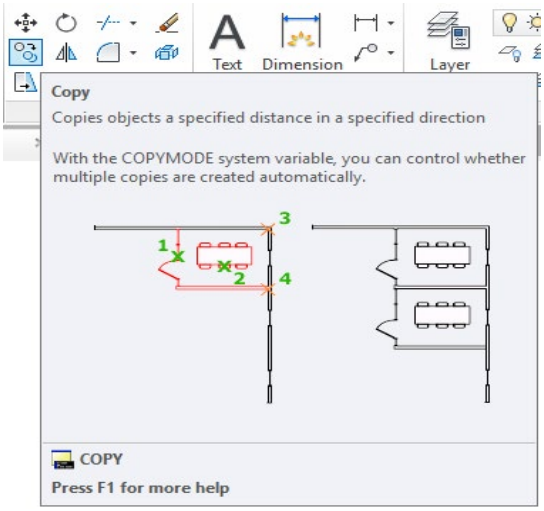


Figure 2.2.31 Copy

Trim

The trim command allows you to trim (shorten) the end of an object back to the intersection of another object. The middle section of an object can also be trimmed between two intersecting objects.

Step 1: From the modify panel, choose Trim, **or** type Trim at the command line.
Step 2: Select cutting edges: Enter
Step 3: Select object or <select all>: Enter
Step 4: Select object: Pick

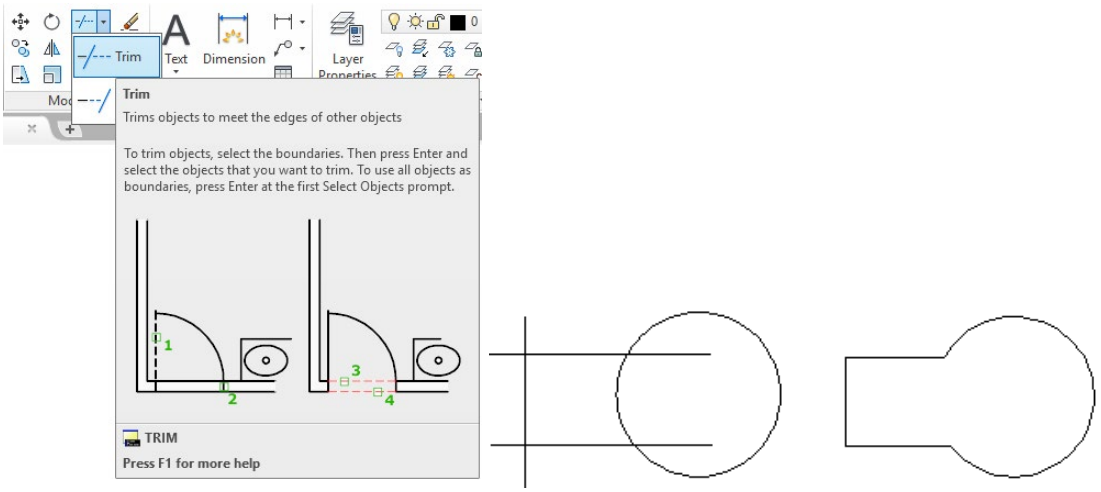


Figure 2.2.32: *Trim*

Note

the following modify command can be explored: Extend, stretch, Scale, Fillet, Chamfer, Explode, Break, Rotate, Array etc.

Advance creation techniques

AutoCAD provides you with some other drawing tools, which enable you to draw 3D objects.

Extrude

With EXTRUDE you can create solids by extruding (adding thickness to) selected objects. You can extrude an object along a path, or you specify a height value and a tapered angle. You can also extrude planer faces along a path, or you can specify a height value and a tapered angle.

Extruding 2D shapes

With the extrude command; you can create solids by adding thickness to 2D objects. If you create a profile using lines or arcs, use the join option of PEDIT to convert them to a single Polyline object or make them into a region before you use **extrude**.

Example: Draw a circle with radius 50mm and extrude to a height 70.

Step 1: From the modelling panel, select Extrude, **or** type Extrude at the command line.
Step 2: Select objects: click to select the object
Step 3: Specify height of extrusion or [path]: (e.g. 70)
Step 4: Specify angle of taper for extrusion <0>: Enter.

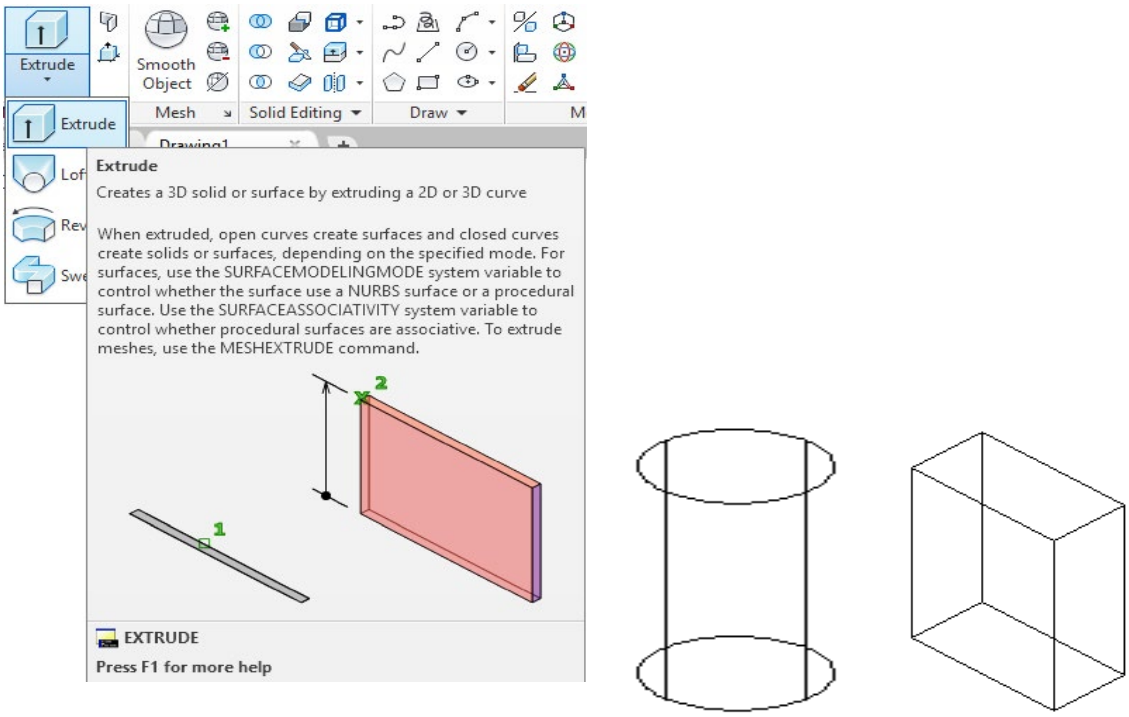


Figure 2.2.33: *Extrude*

Presspull

You can press or pull bounded areas by pressing and holding CTRL + ALT, or by clicking the Presspull button on the dashboard and then picking the bounded area. The area must be bounded by coplanar lines or edges.

1. From the modelling panel, select Presspull, **or** type Presspull at the command line.
2. Select the object or bounded area: Click and drag to a new location.
3. Presspull specify extrusion height or [multiple]: Enter the value (e.g. 90)
4. Select object or bounded area: Enter

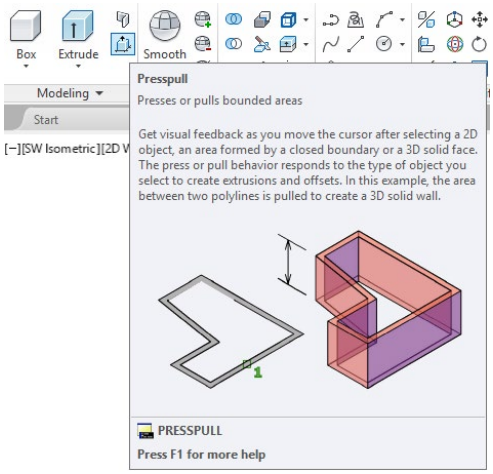


Figure 2.2.34: *3D Views*

3D view commands

The "view pull" commands shown in the view pull-down menu below are used to change the direction from which you view a 3D model. You can access view from the view panel.

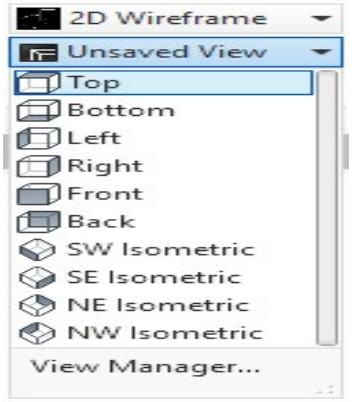


Figure 2.2.35: *3D Views*

Modelling with Solids

Building 3D solids is the most flexible way to create 3D models in AutoCAD due to the ease of creating and modifying them. 3D solids were improved (in AutoCAD 2008-2014 to be more flexible so they could be used to create both conceptual and dimensionally accurate models. The exercises in this chapter show you how to create primitive and complex 3D solids.

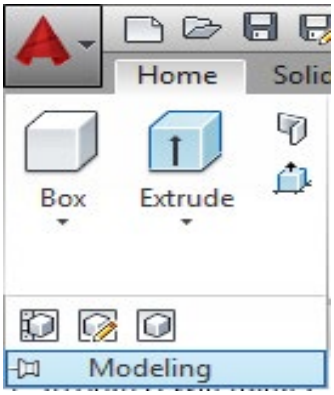


Figure 2.2.36: *modelling*

Primitive solids

Primitive solids (often called primitives) are basic geometric shapes that create 3D models. AutoCAD allows you to create eight different 3D solid primitives (see Figure 38). The primitives fall into two categories: those with straight edges and those with curves. Most of the primitives fall into two categories except for what is called a Polysolid. A Polysolid is the 3D solid version of a Polyline, which can be made up of both straight and curved segments.

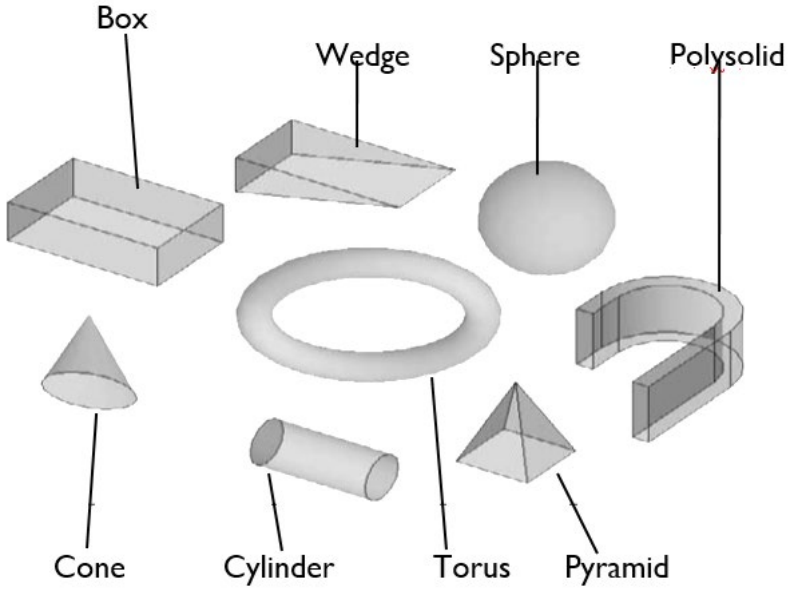


Figure 2.2.37: *Primitive solids*

Learning Task

1. Explain CAD and state its importance in drawing.
2. Identify the interface and pallets of CAD software and state the use of each

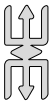
Pedagogical exemplars

Experiential learning, managing talk for learning, Research

1. Assist learners with relevant resources to conduct research on computer aided design (CAD) and why there is a need to use CAD. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
2. Assist learners to launch the CAD interface and identify the pallets.
3. Demonstrate the use of the basic drawing tools in CAD for learners to practise.

Activity based learning

1. Assist learners to state the uses of the various pallets identified.
2. Assist learners to set the drawing area i.e. the unit, the scale and the size of drawing area.



Note

Permit the HP learners to assist the AP and P learners where necessary creating a peer-to-peer mentoring system to help learners having difficulties receive help from colleagues.

Key Assessments

Level 2: Explain CAD and state its importance in drawing

Level 3: Identify the interface and pallets of CAD software and state/demonstrate the use of each

HINT



The recommended mode of assessment for week 18 is Mid-Semester Examination. Refer to Appendix F for the Table of Specification

WEEK 19

Learning Indicator: Manipulate drawings with CAD tools through editing and plotting techniques

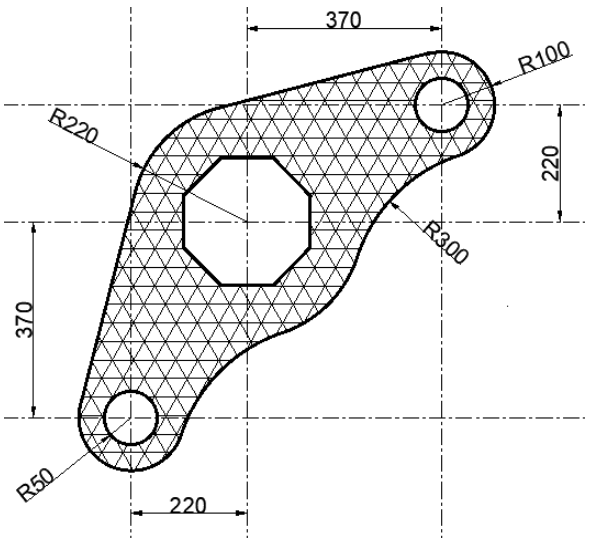
Focal Area 1: DRAWING WITH COMPUTER AIDED DESIGNS (CAD)

Application of AutoCAD (Mechanical drawings)

AutoCAD is used to design and document engineering drawings, (that is, creating orthographic projections, sections, detail and 3D modelling all within a coordinated set of drawings). This is used in Woodwork, Automotive technology, Metal technology etc.

Imperial and metric system: AutoCAD contains both imperial and metric values input. Learners must choose which version to use before starting to draw. All viewers using imperial measurements should use the imperial values/version only. All viewers using metric measurements should use the metric values/version only.

Table 2.2.1: Two-dimensional drawing application exercise



Draw the figure in AutoCAD by using the following command:

1. Use line to locate any point in 2D space. (See draw commands for the steps of line).
2. Use by layer properties to change line to centre lines.
3. Use offset command to offset lines (See modify command for the steps of offset).
4. Use circle command to draw circles at centres. (See draw commands for the steps of circles).
5. Use lines to form tangents to the circles.
6. Use fillet command to form arcs to the circles (See modify command for the steps of offset).
7. Use polygon (circumscribe) to obtain the octagon at the centre with radius 120mm (See draw commands for the steps of polygon).
8. Use hatch command to hatch the portions in the drawing.

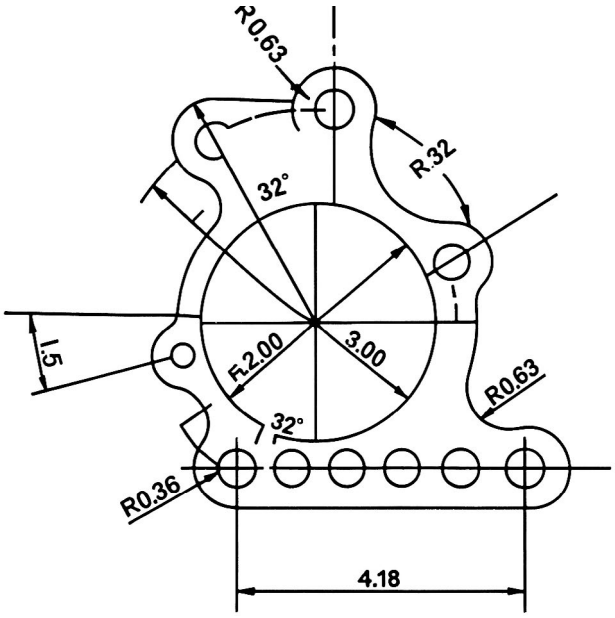


Figure 2.2.38: *Primitive solids*

Application AutoCAD Architecture Desktop (Building drawing)

AutoCAD Architecture desktop is used to design and document building drawings (that is, creating a presentation plan, a floor plan layout, door and window schedules, a section, and a detail, all within a coordinated set of drawings.

Imperial and metric system: AutoCAD Architecture contains both imperial and metric values input. Learners have to choose which version to use before starting to draw. All viewers using imperial measurements should use the imperial values/version only. All viewers using metric measurements should use the metric values only.

Exercise 1: Draw the following flow plan with architecture desktop.

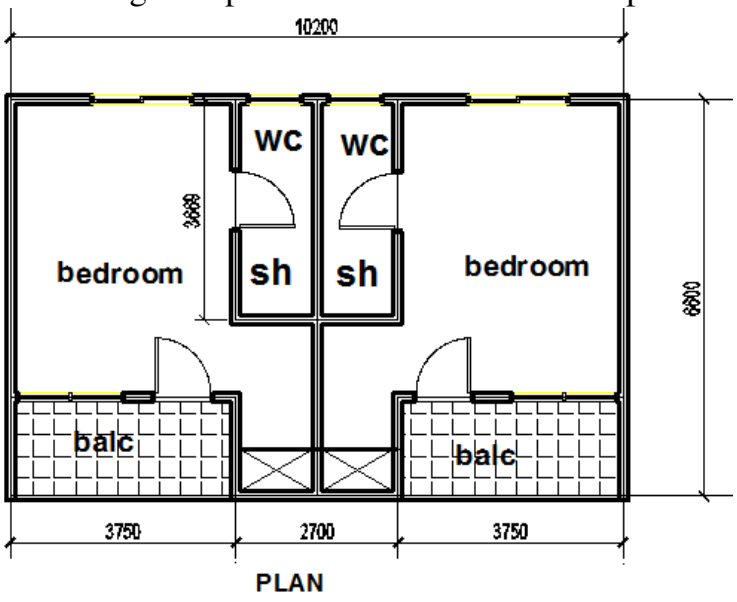
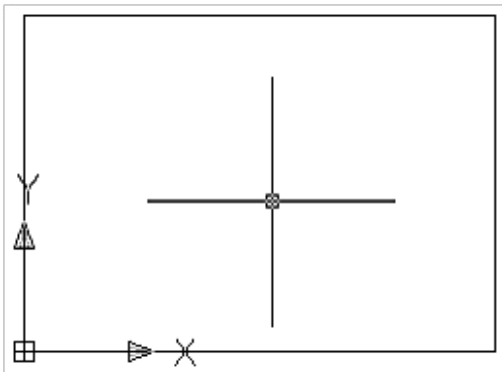
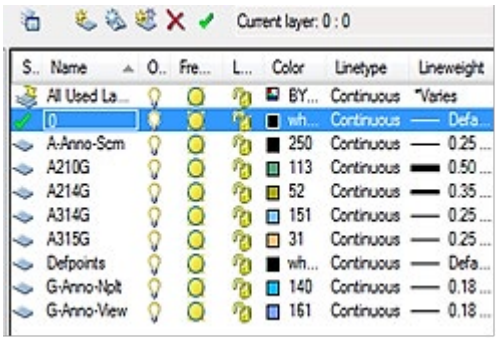
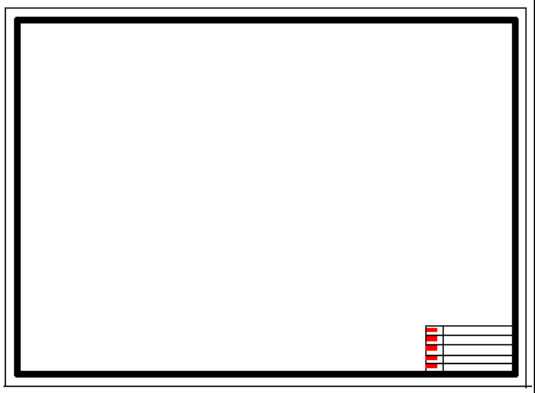
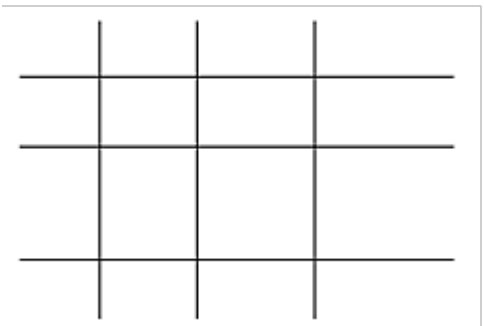
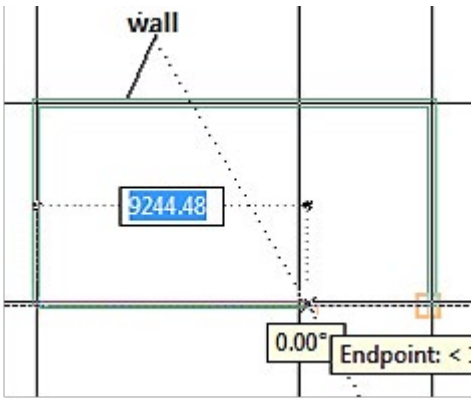
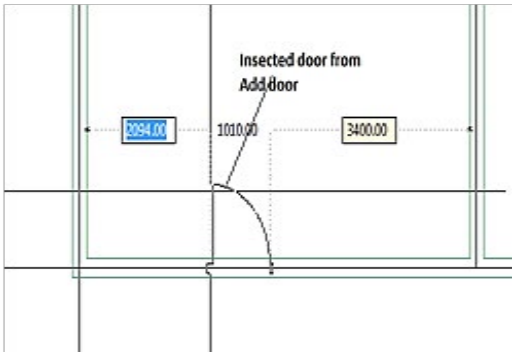
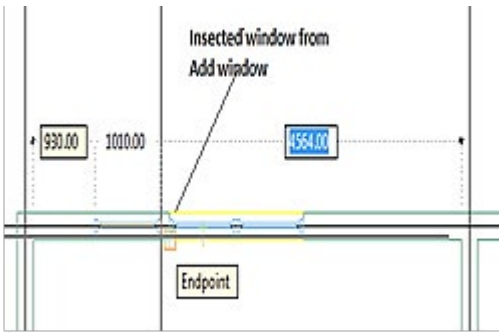
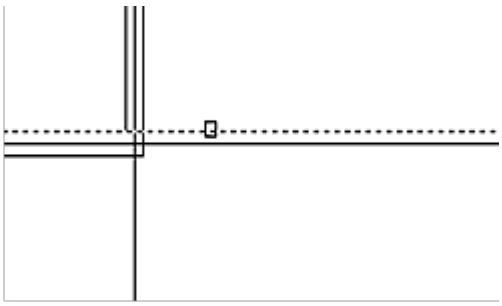
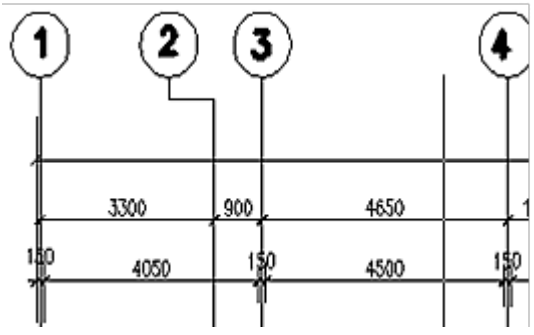
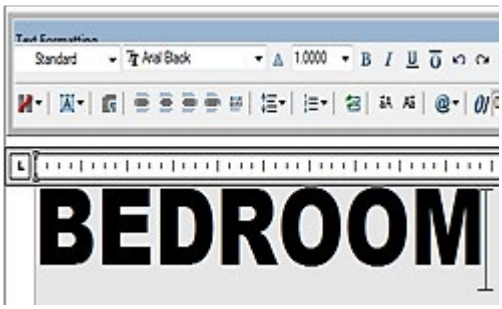


Figure 2.2.39: *Ground floor Plan*

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 different colours, line type and line weight before starting to draw the actual objects.
	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)
	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 Use the column grid command.

	Use the Add Wall command to offset the grid lines to obtain wall thickness .
	Insect door from design centre or tool palettes. Or use the command Add door.
	Insect windows from design centre or tool palettes. Or use the command Add window.
	Use the erase command to erase unwanted parts of object (see modify command for the steps of erase). Use the trim command to trim unwanted parts of object (see modify command for the steps of trim).
	Use the dimension commands (e.g. Linear) to dimension the object.

	Use multiline text to write text in AutoCAD. (See Draw command for the steps of multiline text).
Add Other Elements	

Samples of other building drawings

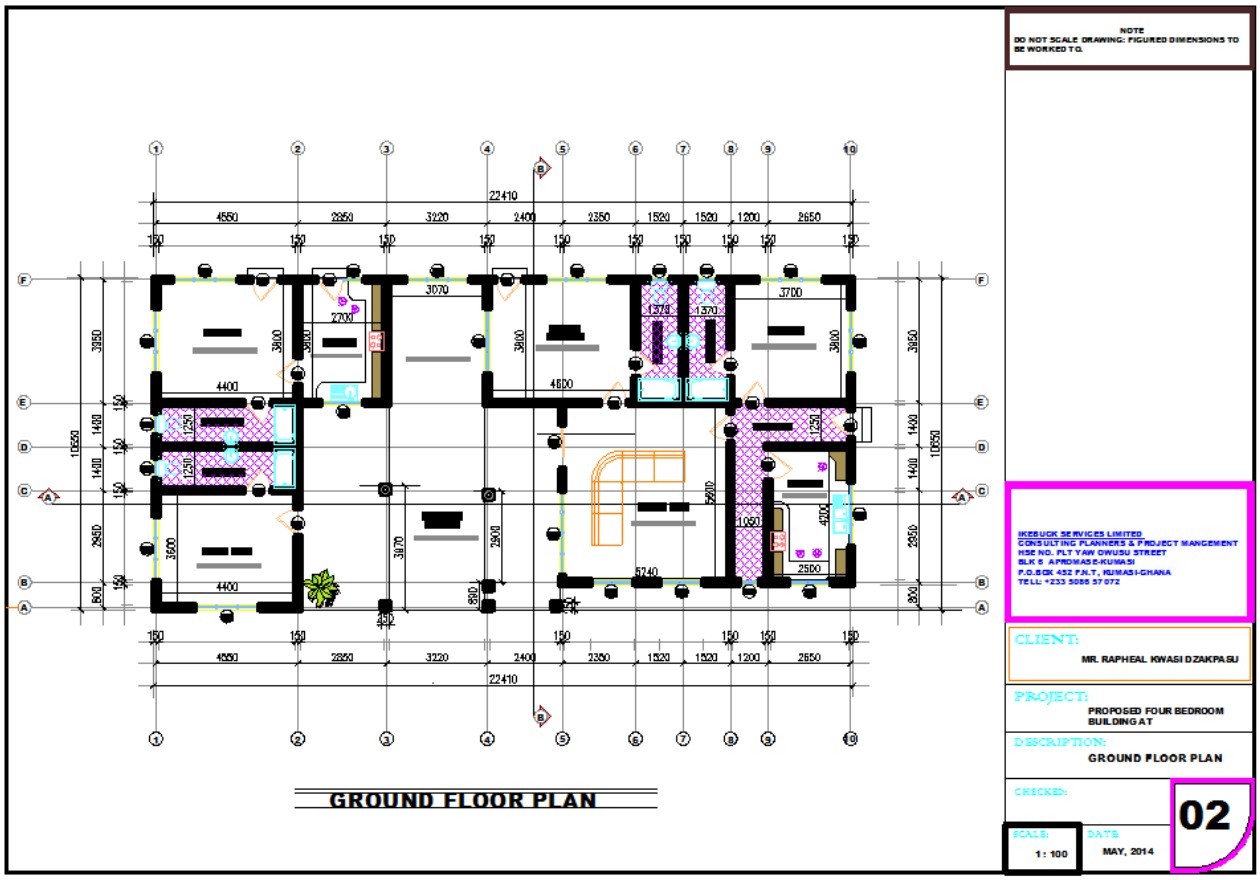


Fig. 2.2.40: *Ground floor Plan*

Note

Use the instruction or technics in the table in drawing this plan.

Elevations

Before you start the elevation drawing, you will need a floor plan. You will need to establish the overall size of the building and placement of windows, doors and other features. To draw the elevation, you must be familiar with Orthographic projection. The concepts are very similar. To create an elevation, you will project down from the plan to create a new view.

Front Elevation: Use the floor and roof plans as a guide to obtain all horizontal locations. If a roof plan has not been drawn, draw the outline of the roof shape on the print of the floor plan. For this drawing it will be assumed that (600mm) overhangs and a (300mm) gable end wall overhang will be used. Turn off any layers that you need from the drawn floor plan.

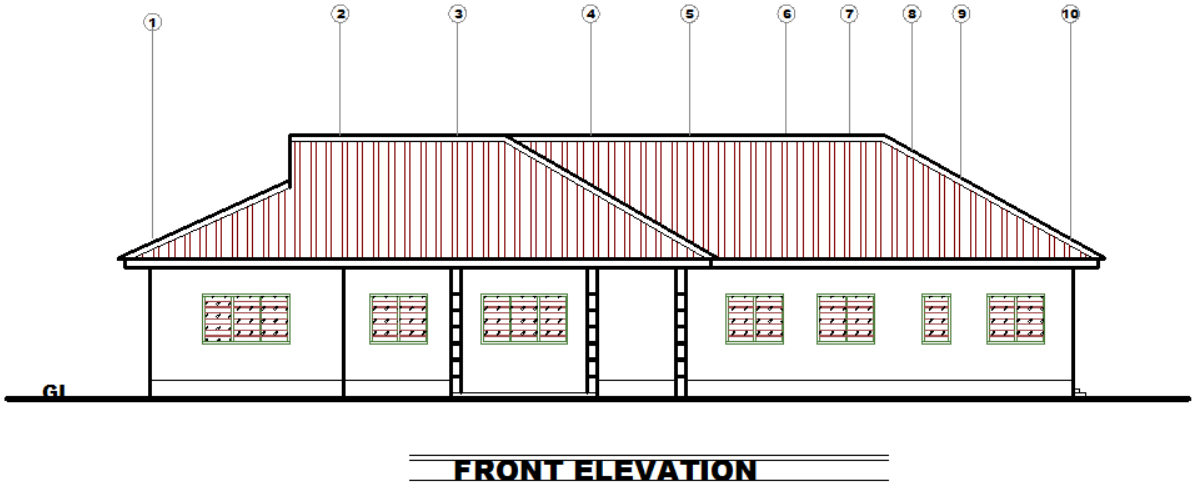


Figure 2.2.41: *Front Elevation*

Side Elevation: Use the floor and roof plans as a guide to obtain all horizontal locations. If a roof plan has not been drawn, see "front elevation" above.

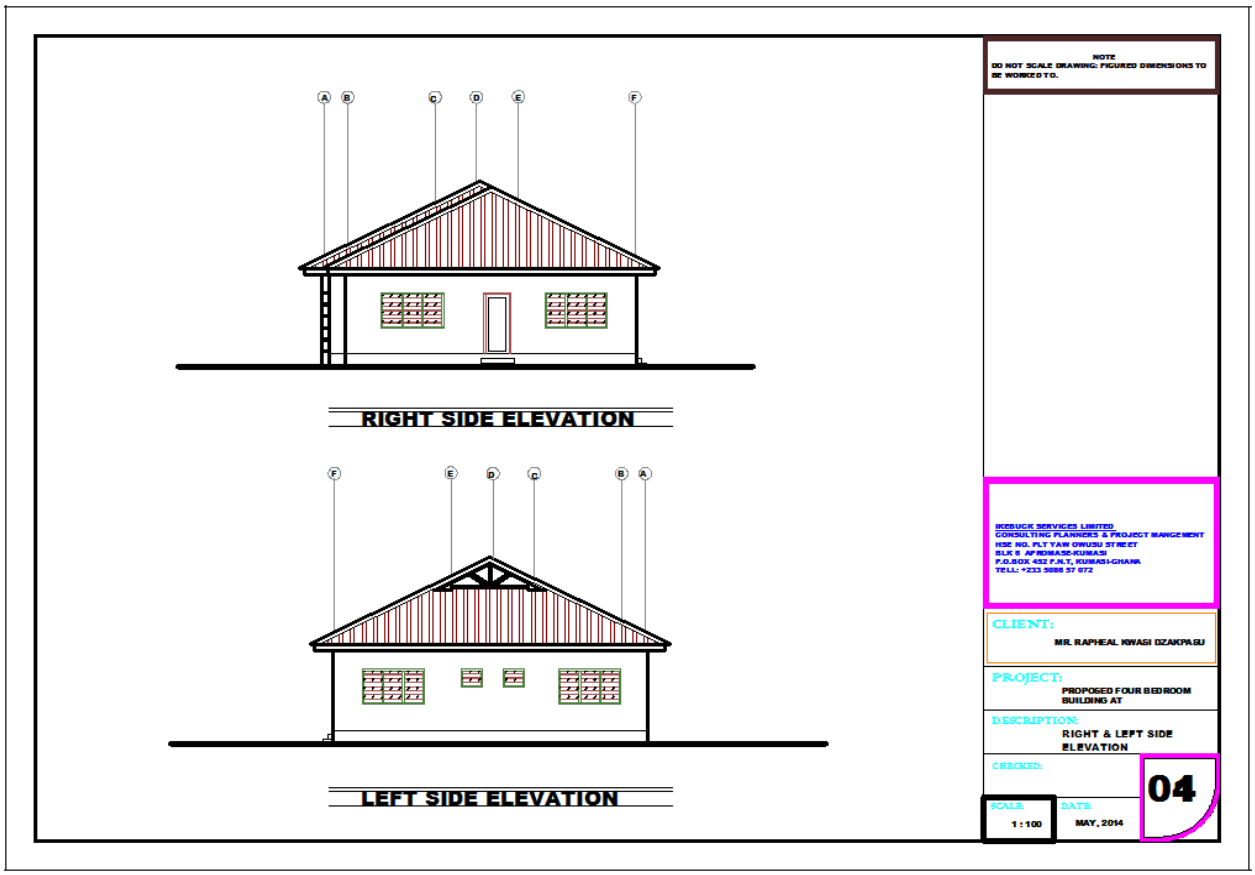


Figure 2.2.42: *Side Elevations*

Sectional Elevation: Architects frequently prepare drawings that show a building cut in half. Their purpose is to show how the building is constructed. These drawings are known as longitudinal or transverse sections. Longitudinal means lengthwise. A longitudinal section is one showing lengthwise cut through the house. Transverse means across. A transverse section is one showing a cut across the building. The cutting plane is an imaginary plane that passes through the building.

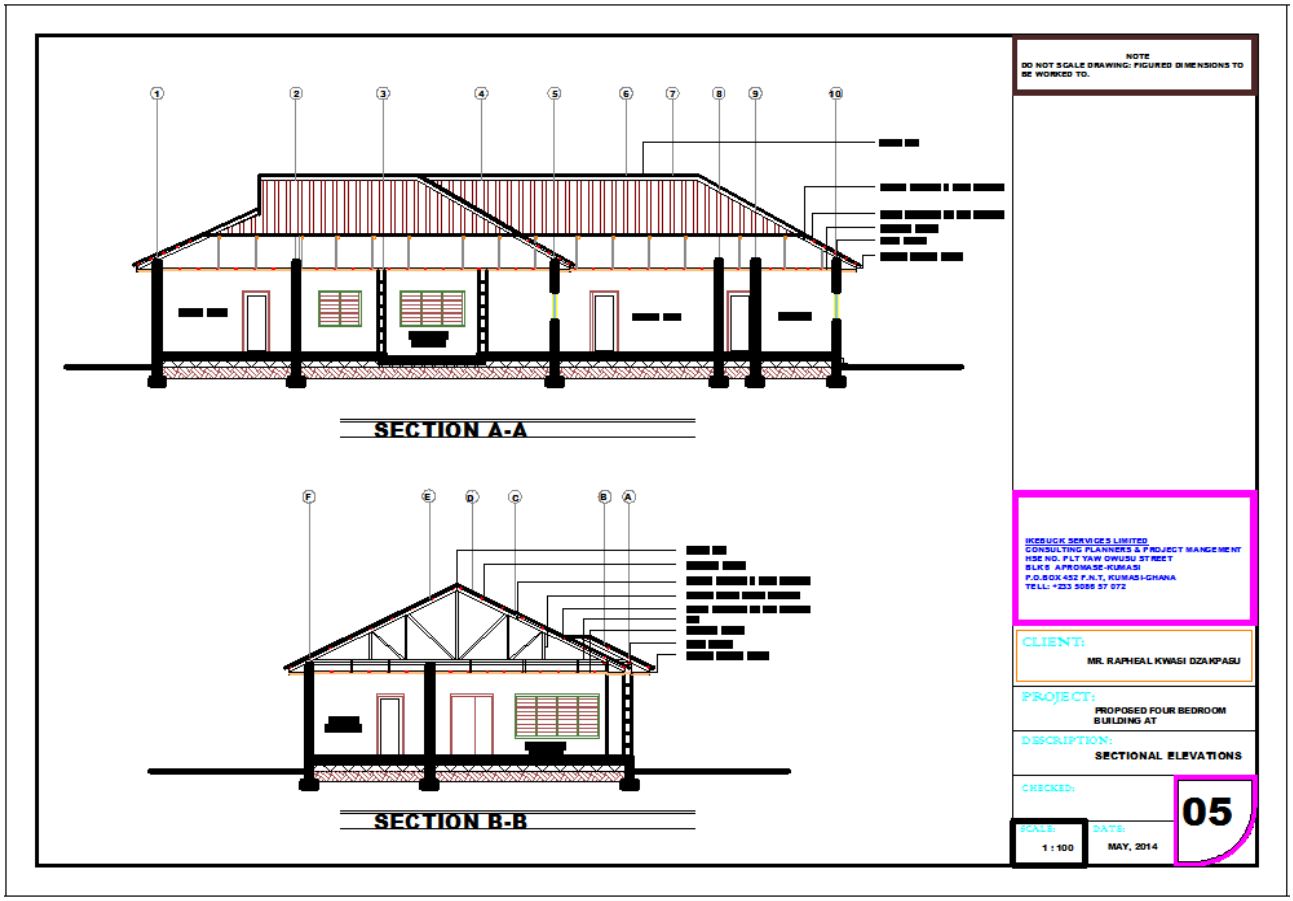


Figure 2.2.43: *Sectional Drawings*

Application of AutoCAD/Clo 3D Standalone (Garment design)

AutoCAD/Pattern design is used to design and document pattern design drawings, (that is, sketching, creating patterns, sowing and fitting of garment, adjustment 3D modelling all within a coordinated set of drawings). This is used by fashion designers.

Imperial and metric system: AutoCAD contains both imperial and metric values input. Learners have to choose which version to use before starting to draw. All viewers using imperial measurements should use the imperial values/version only. All viewers using metric measurements should use the metric values/version only.

Exercise

Draw the detail drawing in 2D to the correct dimension with AutoCAD.

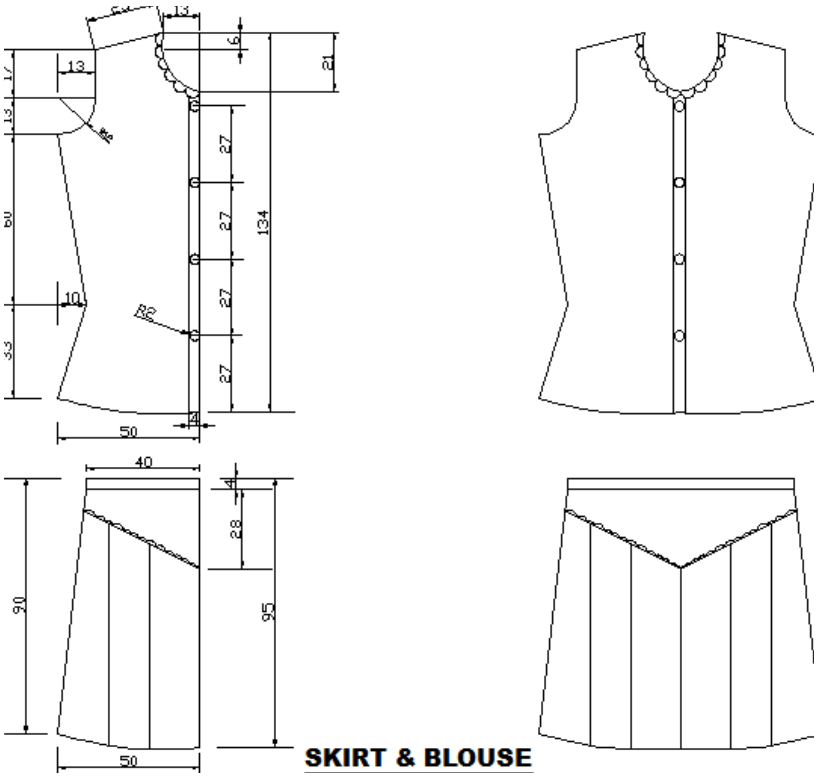


Figure 2.2.44: *Skirt and blouse*

Table 2.2.3 Guide

	**Step 1 => Line:** Click on the line **or** type line at the command prompt to draw a rectangular guide of 50mm by 134mm. **Step 2 => Offset:** Click on offset **or** type offset at the command prompt to offset the top line of a distance 6mm inward and the sides of a distance 13mm inside the rectangle. **Step 3 => Line:** Click on the line **or** type line at the command prompt to draw a diagonal line for the shoulder at the top of the object. **Step 4 => Offset:** Click on offset **or** type offset at the command prompt to offset the top line of a distance 19mm insides the rectangle to obtain the neck. **Step 5 => Arc:** Click on Arc **or** type Arc at the command prompt to draw an Arc inside the object for the neck, by using (Centre, Start, End). **Step 6 => Offset** the top line downward. **Step 7 => Arc:** Click on Arc **or** type Arc at the command prompt to draw an Arc inside the object for the arm, by using (Centre, Start, End).

	Step 9 => Line: Use line to draw a diagonal line from the tip of the arm through the intersect offset line to the bottom left corner of the object **Step 10 => Trim and erase:** unwanted lines. **Step 11 => Circle:** Click on circle icon **or** type circle at the command prompt to draw a small circle to represent button. **Step 12 => Mirror:** Click on Mirror **or** type Mirror at the command prompt to obtain the other side of the dress
	**Step 13 => Hatch** the object with a collar material (see draw panel above for steps of hatch)
	**Step 14 => Render** the object with a material

Introduction to Clo 3D Standalone

CLO3D system realises virtual fitting, including two-dimensional 2D, three-dimensional 3D body modelling, parametric punching, three-dimensional virtual sewing fitting, fabric texture attribute setting, and dynamic display, which realises the design and realisation of display.

The clothing deformation algorithm based on human input posture is used to deform the clothing model, which presents the physical characteristics of virtual clothing more truly.

At the same time, the image acquisition equipment is used to obtain the real-life image, and the clothing image transfer algorithm is used to superimpose the virtual clothes and the real-life image.

The position of human joints is obtained by feature extraction technology, and the scaling ratio of the virtual clothes is calculated so that the virtual clothes are closely combined with the real-life image.

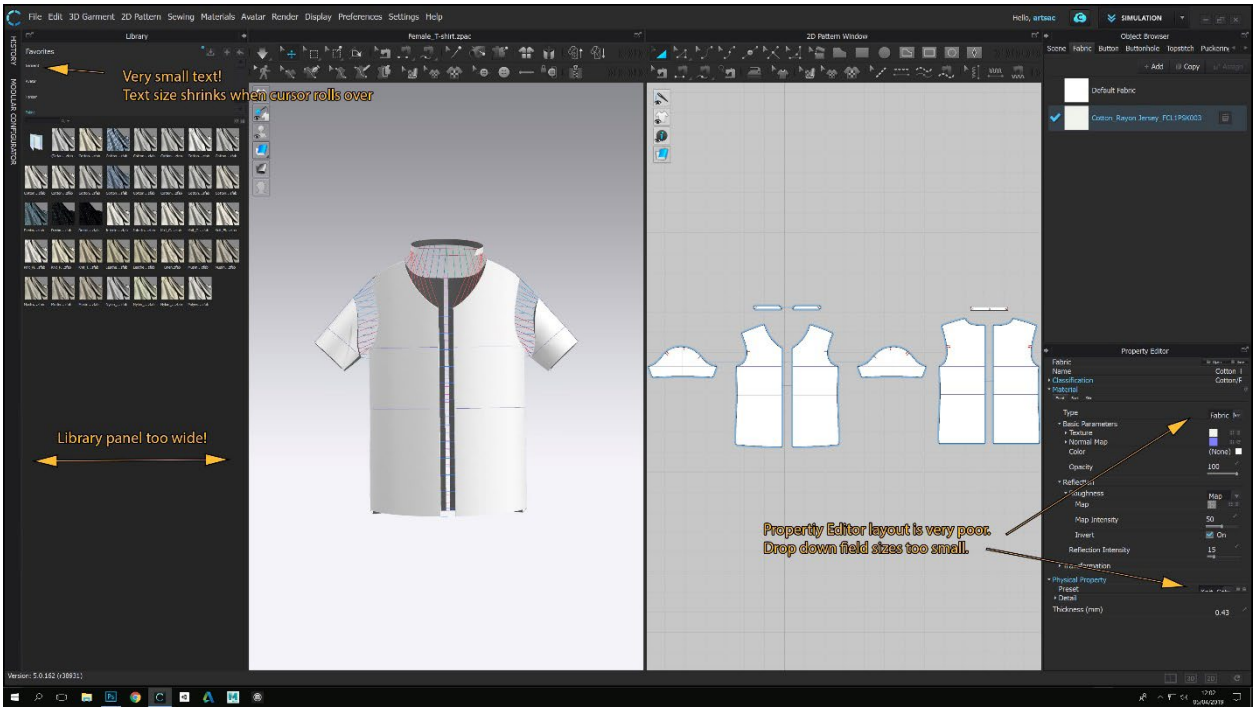


Figure 2.2.45: *Clo interface*

Learning Task

Use the drawing tools to produce simple building drawings/mechanical drawings/ garment designs.

Pedagogical exemplars

Activity based learning, Experiential learning, Managing talk for learning

1. Assist learners to identify the editing or modifying tools and apply them in building drawings/ mechanical drawings/ or garment design. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
2. Guide learners to edit or modify their drawings using the appropriate tools.

Note

permit the HP learners to assist the AP and P learners

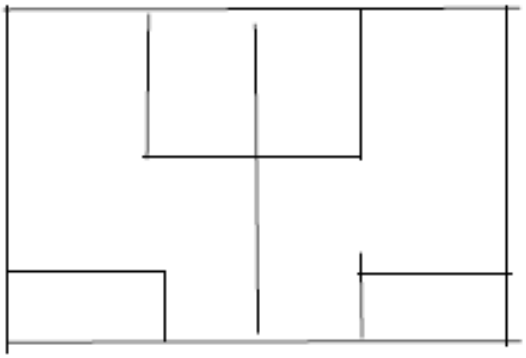
Key Assessments

Level 3: Use the drawing tools to produce simple building drawings/mechanical drawings/ garment designs.

Level 4

1. Integrate advanced drawing tools and techniques to create a comprehensive design proposal that includes detailed building drawings, or mechanical drawings, or garment designs. Justify your design choices and explain how they meet specific user needs and industry standards.
2. Role -play the duty of an architect designing a two-bedroom domestic building for a client with Auto CAD architecture using the client's specification below

    - 2 Bedrooms
    - 2 W/C
    - 2 Verandah



HINT

*The recommended mode of assessment for week 19 is **role play.** Use the level 4 question 2 as a sample question.*

UNIT 2 REVIEW

This unit discussed the principles and surface development of pyramids, construction of curves of intersection of objects, and an introduction to computer aided designs (CAD).

Learners are expected to exhibit correct use of drawing instruments and dimensions when developing the surface of pyramids and constructing the curve of objects intersecting at angles

The introduction of computer aided designs (CAD) will help learners to familiarise themselves by applying the concepts in manipulating drawings and using AutoCAD to produce drawings in building, mechanical and garment design.

Learners were assisted in different ways to be able to understand and apply concepts and principles effectively.

Additional Reading

Teachers should supplement their knowledge by conducting further reading on plane geometry.

Resources

Installed AutoCAD software, Models, Charts, drawing instruments, reference books, drawing studio, access to the internet, LCD Projector.

Marking scheme for the demonstration task

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Need improvement (1)*
Accuracy of the Net Development	*The net exhibits the following* 1. *constructed expertly* 2. *all points and curves clearly and accurately drawn.* 3. *The final result closely matches theoretical expectations*	*The net exhibits two of the following* 1. *constructed expertly* 2. *all points and curves clearly and accurately drawn.* 3. *The final result closely matches theoretical expectations*	*The net exhibits one of the following* 1. *constructed expertly* 2. *all points and curves clearly and accurately drawn.* 3. *The final result closely matches theoretical expectations*	*The net exhibits none of the following* 1. *constructed expertly* 2. *all points and curves clearly and accurately drawn.* 3. *The final result closely matches theoretical expectations*
Precision and Neatness	*The drawing is extremely neat.* *And exhibits four of the following* 1. *with clean lines* 2. *well-labelled faces* 3. *precise angles.* 4. *The net is easy to read and follow.* 5. *A clear distinction between constructional lines and outlines.*	*The drawing is neat and exhibits three of the following* *And exhibits four of the following* 1. *with clean lines* 2. *well-labelled faces* 3. *precise angles.* 4. *The net is easy to read and follow.* 5. *A clear distinction between constructional lines and outlines.*	*The drawing is neat and exhibits two of the following* *And exhibits four of the following* 1. *with clean lines* 2. *well-labelled faces* 3. *precise angles.* 4. *The net is easy to read and follow.* 5. *A clear distinction between constructional lines and outlines.*	*The drawing is neat and exhibits one of the following* *And exhibits four of the following* 1. *with clean lines* 2. *well-labelled faces* 3. *precise angles.* 4. *The net is easy to read and follow.* 5. *A clear distinction between constructional lines and outlines.*
Correct Dimensions	*All faces are dimensionally accurate based on the original pyramid. The correct scaling and proportions are used throughout.*	*Three faces are dimensionally accurate, with only small discrepancies in size or proportions.*	*Two faces are dimensionally inaccurate, with noticeable errors in scaling or proportions.*	*The dimensions are significantly incorrect, with major discrepancies in size and proportions across faces.*

Creativity and Layout	*The net is exhibiting all the following* 1. *creatively arranged* 2. *a focus on clarity and efficiency.* 3. *The faces are laid out in a way that minimizes material.*	*The net is exhibiting two of the following* 1. *creatively arranged* 2. *a focus on clarity and efficiency.* 3. *The faces are laid out in a way that minimizes material.*	*The net is exhibiting one of the following* 1. *creatively arranged* 2. *a focus on clarity and efficiency.* 3. *The faces are laid out in a way that minimizes material.*	*The net is exhibiting none of the following* 1. *creatively arranged* 2. *a focus on clarity and efficiency.* 3. *The faces are laid out in a way that minimizes material.*

Self-Assessment form for drawing the curve of intersection of objects

Criteria	*Self-Rating*	*Comments*	*What can you do to improve.*
Accuracy of Dimensions	*[ ] Excellent (5)* *[ ] Good (4)* *[ ] Satisfactory (3)* *[ ] Needs Improvement (2)* *[ ] Unsatisfactory (1)*		
Correct drawing of the curve of intersection	*[ ] Excellent (5)* *[ ] Good (4)* *[ ] Satisfactory (3)* *[ ] Needs Improvement (2)* *[ ] Unsatisfactory (1)*		
Correct use of drawing tools and techniques	*[ ] Excellent (5)* *[ ] Good (4)* *[ ] Satisfactory (3)* *[ ] Needs Improvement (2)* *[ ] Unsatisfactory (1)*		

RUBRICS FOR ASSESSING THE ARTEFACT DESIGNED

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Need improvement (1)*
Creativity and Innovation	*The artefact exhibit all of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.*	*The artefact exhibits three of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.*	*The designs exhibit two of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.*	*The designs exhibit one of the following* 1. *highly creative and original* 2. *demonstrate innovative thinking in the use of basic shapes.*

	3. The designs are unique, well-thought-out, and visually striking. 4. visually striking	3. The designs are unique, well-thought-out, and visually striking. 4. visually striking	3. The designs are unique, well-thought-out, and visually striking. 4. visually striking	3. The designs are unique, well-thought-out, and visually striking. 4. visually striking
Geometric Accuracy and Precision	The artefact exhibits these 1. geometrically precise, 2. accurate proportions and angles. 3. Dimensions are accurate 4. The solid geometry concepts (e.g., surface area, volume) are applied correctly and with attention to detail.	The artefact exhibits three of these 1. geometrically precise, 2. accurate proportions and angles. 3. Dimensions are accurate 4. The solid geometry concepts (e.g., surface area, volume) are applied correctly	The artefact exhibits two of these 1. geometrically precise, 2. accurate proportions and angles. 3. Dimensions are accurate 4. The solid geometry concepts (e.g., surface area, volume) are applied correctly	The artefact exhibits one of these 1. geometrically precise, 2. accurate proportions and angles. 3. Dimensions are accurate 4. The solid geometry concepts (e.g., surface area, volume) are applied correctly
Functionality and Purpose	The artefact exhibits these 1. functional 2. well-suited for its intended purpose. 3. The design makes practical use of solid geometry to solve a real-world problem.	The artefact exhibits two of these 1. functional 2. well-suited for its intended purpose. 3. The design makes practical use of solid geometry to solve a real-world problem.	The artefact exhibits one of these 1. functional 2. well-suited for its intended purpose. 3. The design makes practical use of solid geometry to solve a real-world problem.	The artefact exhibits none of these 1. functional 2. well-suited for its intended purpose. 3. The design makes practical use of solid geometry to solve a real-world problem.
Defence and Explanation of Design	The learner provides these 1. a clear, comprehensive defense of the design choices.	The learner provides three of these 1. a clear, comprehensive defense of the design choices.	The learner provides two of these 1. a clear, comprehensive defense of the design choices.	The learner provides one of these 1. a clear, comprehensive defense of the design choices.

	2. The rationale for using specific geometric shapes 3. principles is well-explained, and 4. the learner shows a deep understanding of how these concepts influence the design.	2. The rationale for using specific geometric shapes 3. principles is well-explained, and 4. the learner shows a deep understanding of how these concepts influence the design.	2. The rationale for using specific geometric shapes 3. principles is well-explained, and 4. the learner shows a deep understanding of how these concepts influence the design.	2. The rationale for using specific geometric shapes 3. principles is well-explained, and 4. the learner shows a deep understanding of how these concepts influence the design.
Aesthetics and Visual Appeal	*The artifact exhibits* 1. visually striking 2. elegant and harmonious design. 3. The use of solid geometry enhances the aesthetic value, and the 4. design is both functional and beautiful.	*The artifact exhibits three of these* 1. visually striking 2. elegant and harmonious design. 3. The use of solid geometry enhances the aesthetic value, and the 4. design is both functional and beautiful.	*The artifact exhibits two of these* 1. visually striking 2. elegant and harmonious design. 3. The use of solid geometry enhances the aesthetic value, and the 4. design is both functional and beautiful.	*The artifact exhibits one of these* 1. visually striking 2. elegant and harmonious design. 3. The use of solid geometry enhances the aesthetic value, and the 4. design is both functional and beautiful.
Structural Integrity and Feasibility	*The artifact exhibits these* 1. well-constructed, with solid structural integrity 2. feasible construction methods. 3. The geometric principles used contribute to its stability and durability.	*The artifact exhibits two of these* 1. well-constructed, with solid structural integrity 2. feasible construction methods. 3. The geometric principles used contribute to its stability and durability.	*The artifact exhibits one of these* 1. well-constructed, with solid structural integrity 2. feasible construction methods. 3. The geometric principles used contribute to its stability and durability.	*The artifact exhibits none of these* 1. well-constructed, with solid structural integrity 2. feasible construction methods. 3. The geometric principles used contribute to its stability and durability.

Use of Materials and Manufacturing Techniques	*The learner exhibits these* 1. *selects appropriate materials* 2. *applies suitable manufacturing techniques that complement the geometric design.* 3. *The material choices enhance both form and function.*	*The learner exhibits two of these* 1. *selects appropriate materials* 2. *applies suitable manufacturing techniques that complement the geometric design.* 3. *The material choices enhance both form and function.*	*The learner exhibits one of these* 1. *selects appropriate materials* 2. *applies suitable manufacturing techniques that complement the geometric design.* 3. *The material choices enhance both form and function.*	*The learner exhibits none of these* 1. *selects appropriate materials* 2. *applies suitable manufacturing techniques that complement the geometric design.* 3. *The material choices enhance both form and function.*
Documentation and Presentation	*The learner exhibits these* 1. *The documentation is comprehensive* 2. *clear, and well-organized.* 3. *It thoroughly explains the design process, including the use of solid geometry principles,* 4. *with detailed sketches or diagrams.*	*The learner exhibits three of these* 1. *The documentation is comprehensive* 2. *clear, and well-organized.* 3. *It thoroughly explains the design process, including the use of solid geometry principles,* 4. *with detailed sketches or diagrams.*	*The learner exhibits two of these* 1. *The documentation is comprehensive* 2. *clear, and well-organized.* 3. *It thoroughly explains the design process, including the use of solid geometry principles,* 4. *with detailed sketches or diagrams.*	*The learner exhibits one of these* 1. *The documentation is comprehensive* 2. *clear, and well-organized.* 3. *It thoroughly explains the design process, including the use of solid geometry principles,* 4. *with detailed sketches or diagrams.*

APPENDIX F: MID-SEMESTER EXAMINATION AND TABLE OF SPECIFICATION

Nature of assessment

The assessment should span from week 13 to week 17 and comprise of 15 multiple choice questions and two essay questions where learners will answer only one.

The time allocation for the examination should be one hour, thus 20 minutes for section A, 20 minutes for section B and 20 minutes for the practical

Resources

- Question papers
- Answer booklets
- Conducive/controlled environment
- Pen, pencil and erasers

Sample multiple choice questions

SECTION A

Answer all questions in this section; by circling the correct answer from the option lettered **A-D**

1. Rectangular prism is an example of objects having _____
   A. curved surfaces.
   B. isometric lines.
   C. non-isometric lines.
   D. straight lines.

Sample essay Question:

SECTION B

Answer ONE question only from this section; all questions carry equal marks

1. a. Identify three examples of loci

   b. Construct the helix of a cylinder with diameter 40 and height/pitch 35

MARKING SCHEME/RUBRICS

Multiple Choice Question – 15 marks (1mark each x 15)

1. B

– 1mark

Essay- 5 marks

Essay Question

1 a.

i. Ellipse,

Criteria	Score
Drawing the plan and elevation of the cylinder	½
Dividing the plan and the side of elevation into a number of equal parts	½
Numbering the points on both plan an elevation	½
Projecting the points from the plan vertically to the front elevation to intersect	½
Plotting the points of intersection	½
Drawing a smooth curve to obtain the helix	½
Correct use of constructional and outlines	½

ii. Helix
iii. Involute
iv. Parabola
v. Hyperbola
vi. Trochoid
vii. Cycloid

Any of the above is correct, 1/2 mark each **=1.5 marks**

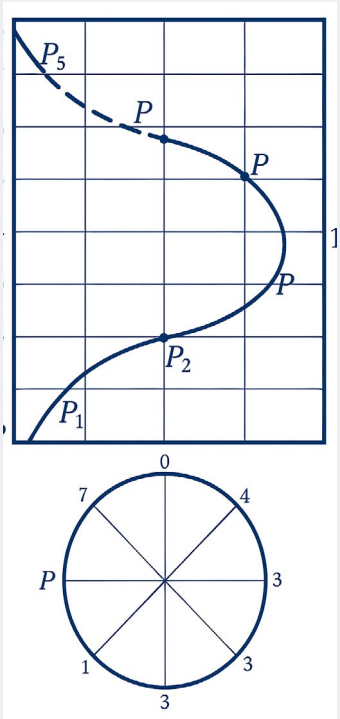


Table of specification for mid-semester 2 examination

weeks	Focal Area(s)	Type of Questions	DoK Levels				
			1	2	3	4	Total
13	loci	Essay	1				1
		Multiple choice	1	2	1		4
14	Design artefact with loci	Multiple choice	2	1	1		4
15	Surface development of pyramids	Essay		1			1
16	Drawing curve of intersection	Multiple choice	1	1	2		4
17	Designing with solid geometry	Essay					
		Multiple choice		2	1		3
		Total	5	7	5	-	17

RUBRICS FOR ASSESSING THE ROLE PLAY

Activity	Marks
Setting up the sheet by using MVSETUP or Using a customised sheet set.	1
Setting new layers and choosing different colours, line type and line weight before starting to draw the actual objects.	1
Using line command and offset command to draw title block lines in 2D space.	1
1. *Using line command and offset command to draw grid lines in 2D space.* ***OR*** 2. *Using the column grid command.*	1
Using the Add Wall command to offset the grid lines to obtain wall thickness	1
Inserting doors from design centre or tool palettes. Or using the command Add door.	1
Insect windows from design centre or tool palettes. Or use the command Add window.	1
Using the erase command to erase unwanted parts or object Use the trim command to trim unwanted parts or object	1
Using the dimension commands (e.g. Linear) to dimension the object.	1
Use multiline text to Wright text in AutoCAD. (See Draw command for the steps of multiline text).	1

Total score: 10 marks

UNIT 3: FRACTAL GEOMETRY



HINT

Remind learners to submit their individual project in week 21.

INTRODUCTION AND UNIT 3 SUMMARY

This unit builds on the foundation of fractals from year one to create complex fractal designs with free hand and drawing instruments. Learners will be allowed to explore and experiment with the various plane and solid geometrical figures and patterns of existing fractal designs.to genuinely create their own fractal designs and indicate where their designs will be applicable in the community.

Learners will be given the opportunity to use digital or manual means to create fractal designs.

The weeks covered by sub-strand 3 are:

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

Learners should be given the opportunity to observe and interact with various forms of complex fractal designs and the steps used to create them. The pedagogies should be learner-centred to allow the learners the freedom to creatively generate fractal designs manually or digitally. Targeted support should be given to learners when needed.

ASSESSMENT SUMMARY

Assessments should be based on learners' ability to identify various plane and solid geometrical figures used in creating complex fractal designs, create complex fractal designs individually, and use the various colouring/hatching techniques to enhance their designs.

The level of complexity of tasks should correspond to the level of learning proficiencies

(HP, P and AP). Prompt feedback should be given to learners**.** Oral, written or visual responses should also be accepted.

WEEK 20

Learning Indicator: Use various geometric shapes to create complex fractal designs

Focal Area 1: GEOMETRICAL SHAPES USED TO CREATE COMPLEX FRACTAL DESIGNS

The geometrical shapes can be either plane or solid depending on the choice of the learner, and understanding the principles and construction of basic shapes is required for the designing of complex fractals.

Examples of geometrical figures

1. Square/cube
2. Circle/sphere
3. Triangles
4. Other polygons

Characteristics of geometric shapes used to create complex fractal designs

Square

- It is a regular quadrilateral, which means it has four sides of equal length and four angles of equal measure.
- It is a two-dimensional figure, which means it has only width and height.
- It has four right angles, which means each angle measures 90 degrees.
- It has two diagonals that are equal in length and bisect each other at right angles.

Cube

A cube is a three-dimensional geometric shape characterised by six equal square faces, twelve equal edges, and eight vertices (corners),

The following are the most important characteristics of cubes:

- All their faces have a square shape.
- All faces and sides have equal dimensions.
- Each of the faces meets four other faces.
- The interior angles of the cube are right angles.
- Each of the vertices meets three faces and three edges.
- The edges opposite each other are parallel.

Circle

A circle is a fundamental geometric shape that is defined as the set of all points in a plane that are at a given distance (called the radius) from a fixed point (called the centre). Here are some characteristics of a circle:

- Its circumference and radius are proportional, and the diameter is the longest chord
- All circles are similar, and two circles are congruent if they have the same radius
- Equal chords are equidistant from the centre and subtend equal angles at the centre.
- The perpendicular bisector of a chord passes through the centre, and the radius drawn perpendicular to the chord bisects the chord.
- A circle can circumscribe a rectangle, trapezium, triangle, square, or kite when creating fractal designs

Sphere

A sphere is a three-dimensional geometric shape defined as the set of all points in space that are equidistant from a fixed point called the centre. Here are some characteristics of a sphere:

- Similar to circles in two-dimensional drawings, spheres have a defined centre point (O) from which all measurements and constructions are referenced.
- The radius (r) of the sphere is critical and is typically dimensioned to specify the size of the sphere.
- The diameter (d) of the sphere is often dimensioned as well

Triangles

In technical drawing, triangles are fundamental geometric shapes that are often used to represent various elements, structures, and angles. characteristics of triangles in technical illustrations. Triangles can be classified based on their angles and sides:

Based on sides

- **Equilateral Triangle:** All three sides are equal in length.
- **Isosceles Triangle:** Two sides are equal in length.

Based on angles

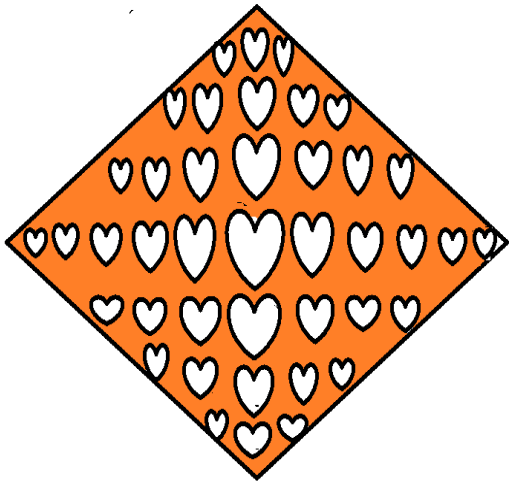
- **Acute Triangle:** All angles are less than 90 degrees.
- **Right Angle Triangle:** One angle is exactly 90 degrees.
- **Obtuse Triangle:** One angle is greater than 90 degrees.
- **Scalene Triangle:** All three sides have different lengths

Other polygons

- **Pentagon:** A polygon with five sides and five angles.
- **Hexagon:** A polygon with six sides and six angles.
- **Heptagon (Septagon):** A polygon with seven sides and seven angles.

- **Octagon:** A polygon with eight sides and eight angles.
- **Nonagon (Enneagon):** A polygon with nine sides and nine angles.
- **Decagon:** A polygon with ten sides and ten angles.

Examples of complex fractal designs



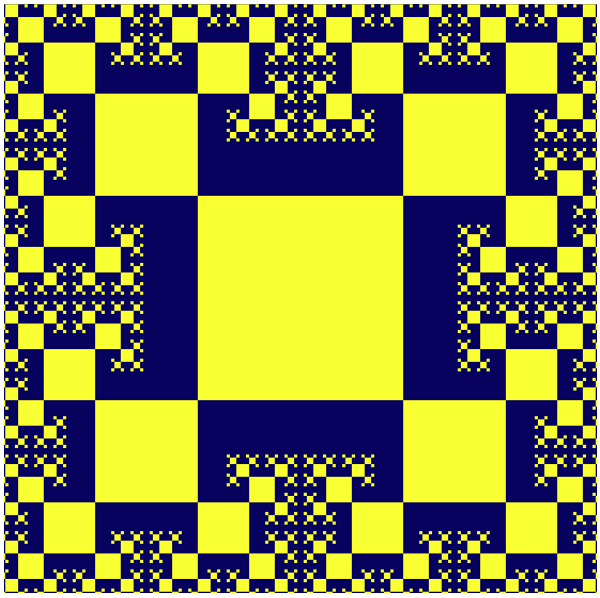


Figure 2.3.1: *Complex Square fractals Figure 2.3.2: Complex heart fractals*

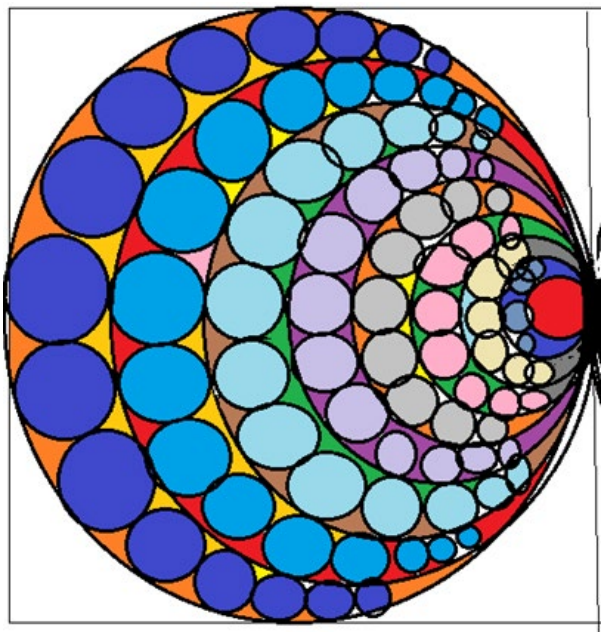




Figure 2.3.3: *Examples of complex circle fractals*

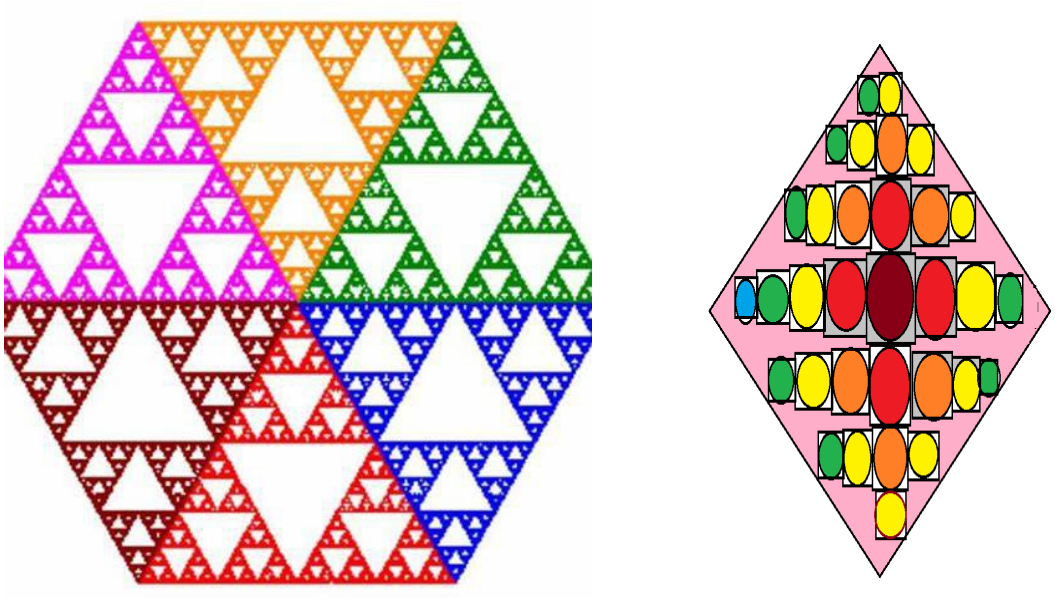


Figure 2.3.4: *Examples of complex triangle fractals. Figure 2.48: Complex circle fractals*

Learning Task

1. Select 4(four) geometric shapes that can be used for fractal designs and list 3 (three) characteristics of each
2. Explain why the selected geometric shapes can be used for fractal designs

Pedagogical exemplars

1. **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. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. **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. Differentiation can be incorporated by allowing learners to express their understanding in various ways. For instance, some learners prefer to draw diagrams, while others prefer to write a paragraph or give a verbal explanation.
3. **Project-based Learning/Experiential Learning**; Learners in groups generate manual/digital pictorial charts of geometric shapes that can be used to create fractal designs. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

Level 1: Select 4(four) geometric shapes that can be used for fractal designs and list 3 (three) characteristics of each

Level 2

1. Explain why the selected geometric shapes can be used for fractal designs.

2. Explain all geometrical figure and its property used to create fractal designs

Level 3: Generate manual/digital pictorial charts of geometric shapes that can be used to create fractal designs.



HINT

The recommended mode of assessment for week 20 is **Oral presentation**. *Use the level 3 question 2 as a sample question.*

WEEK 21

Learning Indicator: Experiment with the creation of various fractal designs using geometric shapes.

Focal Area 1: CREATING COMPLEX FRACTAL DESIGNS

Fractals are geometric shapes that exhibit similar patterns at increasingly smaller scales, designing complex fractals involves self-similar geometric patterns that exhibit complexity and beauty through repetition and scaling.

Generating complex fractal designs

Select various plane/ solid geometrical figures: Familiarise yourself with the various plane or solid geometrical figures

Choose a Fractal Type: Select a type of fractal you want to design. Common fractals include the Mandelbrot set, Julia set, Koch snowflake, Sierpiński triangle, and others. **(Refer to year one)**

Experiment with Parameters: Small changes in parameters can result in significant visual differences, adjusting parameters such as iteration counts, scaling factors, colour schemes, and transformation rules to explore different variations and complexities within the fractal design.

Explore Colour and Visual Aesthetics: Enhance the visual appearance of your fractal design by experimenting with colour palettes, shading techniques, and gradient effects. Colour can emphasise depth, highlight patterns, and create visual interest in the fractal structure.

Consider 3D and Animated Fractals: Explore 3D fractals (fractals beyond two dimensions) and animated fractals that evolve over time. These variations can add another layer of complexity and dynamic visual storytelling to your fractal designs.

Apply Fractals in Art and Design: Integrate fractal designs into digital art, visualisations, illustrations, prints, textiles, and architectural concepts. Fractals offer unique opportunities for creating abstract, organic, and intricate patterns that captivate the viewer and enhance the aesthetic complexity of artistic works.

Computer aided designs (CAD): Complex fractal designs can be generated using computer software such as Matplotlib and NumPy), Java (with libraries like Processing), or specialised fractal software (e.g., Fractint, Ultra Fractal) to create and visualise fractals.

Designing complex fractals is a creative and exploratory process that merges mathematics, art, and digital technology. By experimenting with fractal generation techniques and visual aesthetics, you can create mesmerising and intellectually stimulating designs that showcase the beauty and complexity of fractal geometry.

Examples

Drawing your own complex fractals

All you need to design and draw your own fractals is a simple rule which can be repeated. You can start with any regular polygon or symmetric shape, and you can remove (colour in) shapes, add a shape to a side, or add a shape to a vertex. Here are some examples:

Example 1

1. Draw a square.
2. Divide it into 9 equal parts
3. Shade/colour the centre square
4. With the exception of the centre square, divide the other squares into nine equal parts
5. Shade/colour all the centre squares to give the design

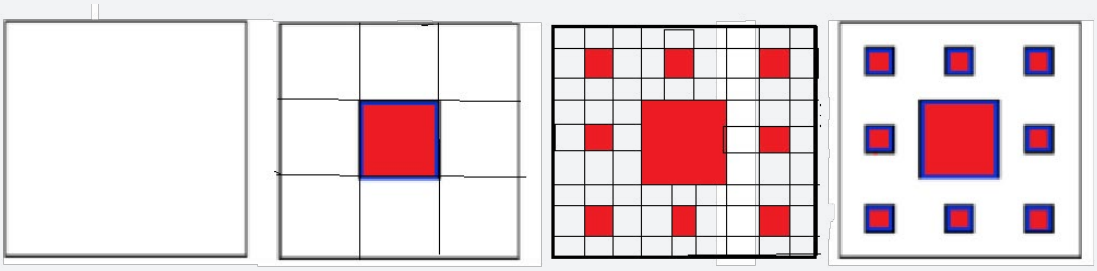


Figure 2.3.5: *Drawing complex square fractals*

Example 2

1. Draw a 'house' shape.
2. Add the 'house' shape to the sides of the'roof'.

What is the scale factor for the areas of the squares?

What is the scale factor for the lengths of the squares?

This appears more complex but still has a simple rule:

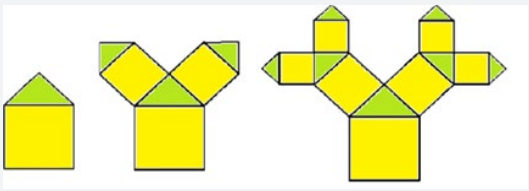


Figure 2.3.6: *Drawing complex square and triangle fractals*

Example 3

1. Draw a 6-pointed star.
2. Put a 6-pointed star on each vertex.

What is the scale factor for the lengths of the sides of the stars?

Design and investigate your own fractal, using the Sierpinski Gasket analysis as a guide.

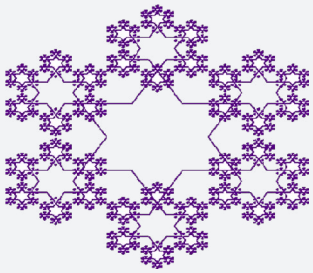


Figure 2.3.7: *Drawing a star fractal*

Note

- Start with a regular polygon, e.g. a square, equilateral triangle or regular hexagon, or another simple symmetric shape.
- Decide on a simple rule.
- Draw the stages of your fractal in separate diagrams – it will help you to keep track of what you are doing

Learning tasks

1. List 3 (three) characteristics of self- similar fractal designs.
2. Describe the main steps that are followed to create self-similar fractal designs geometric shapes
3. With relevant tools and techniques create self- similar geometric shaped complex fractal design

Pedagogical exemplars

1. **Group Work/Collaborative Learning**

   Learners in groups discuss the characteristics of self-similar fractal designs and how they can be created with the aid of relevant resources such as photographs, drawings, videos, charts and actual objects in the environment. Encourage all learners to contribute to the discussion while ensuring that a few learners do not dominate the discussion session. Develop communication and discussion skills to facilitate learning.

Project-based Learning/Experiential Learning

1. Let learners in groups generate manual/digital pictorial charts of self-similar fractal designs created using geometric shapes. Develop a peer mentoring system in the mixed-ability groups to encourage more advanced learners to support their colleagues in understanding and effectively applying these concepts.
2. Let learners in groups/individuals experiment with relevant tools and techniques to create self- similar fractal designs. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

Key Assessments

Level 1: List 3 (three) characteristics of self- similar fractal designs.

Level 2: Describe the main steps that are followed to create self-similar fractal designs

Level 3: Generate manual/digital pictorial charts of self-similar fractal designs created using geometric shapes

Level 4

1. With relevant tools and techniques create self- similar geometric shaped fractal design

2. Create a beautiful fractal design for a clothing company in Ghana.

HINT



*The recommended mode of assessment for week 21 is **Portfolio**. Use the level 4 question 2 as a sample question.*

UNIT 3 REVIEW

This unit stressed the creation of complex fractal designs by understanding geometrical shapes and forms and studying the procedure artists use to crate complex fractal designs.

Learners were encouraged to create their own complex fractal designs from geometric shapes and also enhance their designs by colouring or applying rendering.

RUBRICS FOR ASSESSING THE ORAL PRESENTATION

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Need improvement (1)*
Understanding of Fractals	*Learner exhibits all the following* i. *Explain fractals* ii. *Give examples of fractals* iii. *State uses of fractals* iv. *State application of fractals*	*Learner exhibits three of the following* i. *Explain fractals* ii. *Give examples of fractals* iii. *State uses of fractals* iv. *State application of fractals*	*Learner exhibits two of the following* i. *Explain fractals* ii. *Give examples of fractals* iii. *State uses of fractals* iv. *State application of fractals*	*Learner exhibits one of the following* i. *Explain fractals* ii. *Give examples of fractals* iii. *State uses of fractals* iv. *State application of fractals*
Selection of Geometric Figures	*Selects four geometric figures (e.g., triangle, square, circle and kite) that are highly relevant to fractals, such as the Sierpinski triangle and the Koch snowflake.*	*Selects three geometric figures (e.g., square, circle and kite) that are highly relevant to fractals, such as the Sierpinski triangle and the Koch snowflake.*	*Selects two geometric figures (e.g., circle and kite) that are highly relevant to fractals, such as the Sierpinski triangle and the Koch snowflake.*	*Selects one geometric figure (e.g., triangle) that are highly relevant to fractals, such as the Sierpinski triangle and the Koch snowflake.*
Explanation of Properties of Figures	*Provides a clear, detailed explanation of the properties of each of the four geometric figures,*	*Provides a clear, detailed explanation of the properties of each of the three geometric figures,*	*Provides a clear, detailed explanation of the properties of each of the two geometric figures,*	*Provides a clear, detailed explanation of the properties of the one geometric figure,*
Clarity and Organization of Presentation	*Learner exhibits all of these* i. *The presentation is highly organized,* ii. *easy to follow,* iii. *effectively communicates key points.* iv. *The learner speaks clearly, with logical flow and excellent use of visuals or examples.*	*Learner exhibits three of these* i. *The presentation is highly organized,* ii. *easy to follow,* iii. *effectively communicates key points.* iv. *The learner speaks clearly, with logical flow and excellent use of visuals or examples.*	*Learner exhibits two of these* i. *The presentation is highly organized,* ii. *easy to follow,* iii. *effectively communicates key points.* iv. *The learner speaks clearly, with logical flow and excellent use of visuals or examples.*	*Learner exhibits one of these* i. *The presentation is highly organized,* ii. *easy to follow,* iii. *effectively communicates key points.* iv. *The learner speaks clearly, with logical flow and excellent use of visuals or examples.*

Engagement and Audience Interaction	*Learner exhibits all of the following* i. *actively engages the audience through clear communication* ii. *appropriate eye contact,* iii. *inviting questions.* iv. *The presentation is engaging and maintains the audience's attention throughout.*	*Learner exhibits three of the following* i. *actively engages the audience through clear communication* ii. *appropriate eye contact,* iii. *inviting questions.* iv. *The presentation is engaging and maintains the audience's attention throughout.*	*Learner exhibits two of the following* i. *actively engages the audience through clear communication* ii. *appropriate eye contact,* iii. *inviting questions.* iv. *The presentation is engaging and maintains the audience's attention throughout.*	*Learner exhibits one of the following* i. *actively engages the audience through clear communication* ii. *appropriate eye contact,* iii. *inviting questions.* iv. *The presentation is engaging and maintains the audience's attention throughout.*
Use of Visuals or Examples	*Learner exhibits all of the following* i. *Uses highly effective visuals* ii. *Uses diagrams,* iii. *Uses examples to illustrate the fractal designs and the properties of the geometric figures.* iv. *Visual aids enhance the understanding of the topic.*	*Learner exhibits three of the following* i. *Uses highly effective visuals* ii. *Uses diagrams,* iii. *Uses examples to illustrate the fractal designs and the properties of the geometric figures.* iv. *Visual aids enhance the understanding of the topic.*	*Learner exhibits two of the following* i. *Uses highly effective visuals* ii. *Uses diagrams,* iii. *Uses examples to illustrate the fractal designs and the properties of the geometric figures.* iv. *Visual aids enhance the understanding of the topic.*	*Learner exhibits one of the following* i. *Uses highly effective visuals* ii. *Uses diagrams,* iii. *Uses examples to illustrate the fractal designs and the properties of the geometric figures.* iv. *Visual aids enhance the understanding of the topic.*
Time Management skills	*The presentation is well-paced, covering all key points in a timely manner without rushing or exceeding time limits.*	*The presentation is well-paced but may spend too much time on one aspect or rush through others.*	*The presentation lacks balance, with some parts too brief and others overly detailed or rushed.*	*The presentation is poorly timed, with key aspects either underexplained or skipped due to time constraints.*

Total score: 24 marks

RUBRICS FOR ASSESSING THE PORTFOLIO

Criteria	*mark*
A clear bag with name of learner boldly written on it	*1*
5 pictures of design samples	*1 each=5*
Documented process used to create the design	*1*
A reflective piece used to explain: *a. The choice* *b. Challenges encountered* *c. Lessons learned*	 *1* *1* *1*

SECTION 3: EXTENDED DRAWING

HINT



- *Remind learners to submit their Individual portfolio in week 22.*
- *Remind learners of the end of semester examination in week 24. Refer to Appendix J at the end of this section for Table of specification.*

INTRODUCTION AND SECTION 3 SUMMARY

This section introduces learners to the diverse working drawings for professionals in the technology/engineering industry. Learners at this point will be given the opportunity to select either, building drawing, mechanical drawing or garment design technology to aid in selecting academic pathways for further studies, learners who offer building drawing or mechanical drawing will be introduced to electrical and electronic drawings as well.

Teachers may guide learners to make informed decisions concerning which option to choose with regard to the subject combinations selected by the learner.

Learners should be encouraged to use computer aided design (CAD) to produce working drawings.

UNIT 1 BUILDING DRAWING

SUMMARY

Learners who select Unit 1 (Building Drawing) will be introduced to architectural draughtsmanship which will consider elevations at this point. Learners will be encouraged to exhibit professional draughtsmanship skills and will also be introduced to electrical and electronic drawings as well.

Building drawing is a crucial aspect of architectural and construction processes. which involves creating detailed representations of buildings and structures, which serve as blueprints for construction, renovation, and design whilst electrical and electronic drawing exposes learners to the layout of electrical and electronic components in circuits and electrical installations.

The weeks covered by Unit 1 (building drawing) are:

Week 22

1. Explain building elevations in relation to building plans.
2. Make freehand sketches of elevations of simple domestic buildings in relation to their plans

Week 23: Draw elevations of simple buildings in relation to their plans using appropriate drawing instruments.

Week 24

1. Distinguish between electrical circuits and electronic circuits.
2. Use electronic and electrical symbols to draw simple electronic and electrical circuit diagrams.

SUMMARY OF PEDAGOGICAL EXEMPLARS

Learners should be given the opportunity to move around the school environment to observe the various buildings and discuss their observations with their peers and also observe electrical or electronic components in a circuit displayed hence experiential learning should be an integral part of teaching building drawing. Learners should engage in activities that permit them to produce freehand sketches of the various elevations of the buildings and electrical/ electronic circuits they observed and proceed to produce those drawings with instruments hence activity-based learning and project-based learning.

Each of these pedagogical exemplars aims to build a comprehensive understanding of building drawing, from basic principles to advanced techniques, and encourages learners to apply their skills in a practical way.

ASSESSMENT SUMMARY

Assessing learners in building drawing involves evaluating their understanding of technical skills, creativity, accuracy, and application of architectural concepts

Understanding and Application of Architectural Concepts; learners' knowledge of different types of building elevations (front, back, left end and right end).

Understanding of architectural symbols, line types, and scale.

Technical Drawing Skills; Proficiency in drawing techniques, including line weight, accuracy, and adherence to scale and ability to use drawing tools and software effectively.

Practical Drawings; Learners produce technical drawings (elevations of buildings)

Software Proficiency; Evaluate the use of architectural drawing software through specific tasks or projects and effective application of drawing tools and software features.

Design and Creativity; learners' ability to create functional and aesthetically pleasing designs.

Varied assessment strategies should be used to differentiate among the different learning competencies in the class i.e. **AP**, **P** and **HP.**

WEEK 22

Learning Indicators

1. Explain building elevations in relation to building plans
2. Make freehand sketches of elevations of simple domestic buildings in relation to their plans

Focal Area 1: BUILDING ELEVATIONS

The stakeholders in the building industry i.e. the client, architect, etc. will want to visualise how the final building project will turn out, hence the various elevations of the building project need to be drawn.

Building elevations are crucial components of architectural drawings, they provide a view of a building's exterior/interior from one side, showing the vertical layout, and design details.

Building elevations are drawn in an orthographic view and typically drawn to scale, to show the exact size and proportions of the building's features.

Types of elevations

1. Front Elevation (Main Elevation)

Description: Typically, the front view shows the front of the building that faces the main approach or street.

Details Included

- Main entrance
- Roof designs
- Decorative elements
- Windows and doors
- Balustrades
- Overall front view design



Figure 3.1.1: *Front view of a domestic building*

Uses

- Provides a clear view of the building's primary appearance.
- Used for visualising the main entrance and key design elements.
- Essential for understanding the building's first impression and architectural style.

2. Rear/end Elevation

Description: Displays the side of the building opposite the front elevation.

Details Include

- Secondary entrances or exits
- Roof design
- Rear windows
- Any rear-facing architectural features or extensions



Figure 3.1.2: *Rear view of a domestic building*

Uses

- Useful for understanding the back view of the building, which may include emergency entries or exits.
- Important for evaluating how the building fits into its site, particularly in residential and commercial areas.

3. Side Elevations (Left and Right Elevations)

Description: The side elevation shows the sides of the building, typically the left and right views.

Details Included

- Side windows and doors
- Projecting or recessed elements
- Side design features
- Rooflines



Figure 3.1.3: *Right side view*



Figure 3.1.4: *Left side view*

Uses

- Provides a view of the building's depth and the side aspects of its design.
- Helps to visualise how the building extends beyond the main facade.
- Essential for understanding side details and architectural continuity.

Learning Task

Explain the concept of elevations in buildings

Pedagogical exemplars

1. **Managing talk for learning, Research**
   With the aid of a model, assist learners to explain the concept of elevations. Individuals add to what others have said respectfully. Learners should be encouraged to tolerate others' views.
2. **Activity based learning**
   Assist learners to identify the various components that can be seen in the elevations and how they are represented. Offer multiple ways to learn, such as hands-on practice, instructional videos, and step-by-step guides. Allow learners to demonstrate their understanding through different formats, such as written reports, oral presentations, or practical demonstrations.

Key Assessment

Level 2: Explain the concept of elevations in buildings

Focal Area 2: FREEHAND SKETCHES OF ELEVATIONS

Freehand sketches of building elevations are a great way to quickly capture the design and shape of a building.

Techniques to consider in sketching building elevations

1. Observe real buildings or photos to grasp the pictorial views of the various elevations
2. Begin by drawing simple shapes to outline the main structure of the building.
3. Identify and sketch key architectural elements such as windows, doors, and rooflines. These should be proportionate and placed according to your design.
4. Incorporate details like texture, patterns, and ornamentation.

Sketching techniques

- Sketch lightly first, then refine lines.
- Experiment with pencil grades for varying line weights.

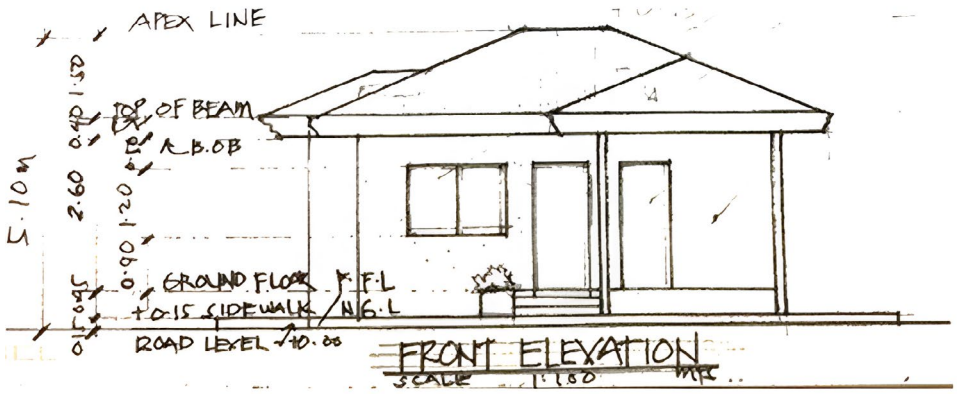


Figure 3.1.5: *Sketch of front elevation of a building*

Learning Task

Make a free hand sketch of the elevations of a given two-bedroom plan

Pedagogical exemplars

1. **Managing talk for learning, Experiential learning**

   Guide learners to observe the elevations of a simple building based on the floor plan using relevant resources such as videos, internet surfing, charts etc. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

2. **Activity-based learning**

   Task learners to sketch the south, north, east and west elevations from a given floor plan using freehand. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

Level 3

1. Provide response to the following questions orally
   a. What do you know about building elevations?
   b. Describe the architectural elements you would include in a residential building elevation,
2. Make a free hand sketch of the elevations of a given two-bedroom plan
3. Provide response to the following questions orally
   a. What do you know about building elevations?
   b. Describe the architectural elements you would include in a residential building elevation,



HINT

The recommended mode of assessment for week 22 is **Questioning**. *Use the level 3 question 1 as a sample question.*

WEEK 23

Learning Indicator: Draw elevations of simple buildings in relation to their plans using appropriate drawing instruments

Focal Area 1: DRAWING BUILDING ELEVATIONS WITH INSTRUMENTS

For precision and clarity, architects and draughtsmen employ the use of drawing instruments or computer aided designs (CAD) to enhance a detailed architectural presentation of drawings

1. Drawing instruments and materials needed

- **T-Square:** Ensures straight, horizontal lines.
- Drawing sheets.
- **Set Squares (45° and 30/60°):** Help in drawing vertical lines.
- **Scale Ruler:** For accurate measurements and scaling.
- **Protractor:** For precise angles.
- **Pair of dividers:** for transfer of measurements.
- **Drawing Board:** A stable surface to work on.
- **Pencils (various grades):** For different line thicknesses.
- **Eraser:** For corrections.

2. Setting up the workspace

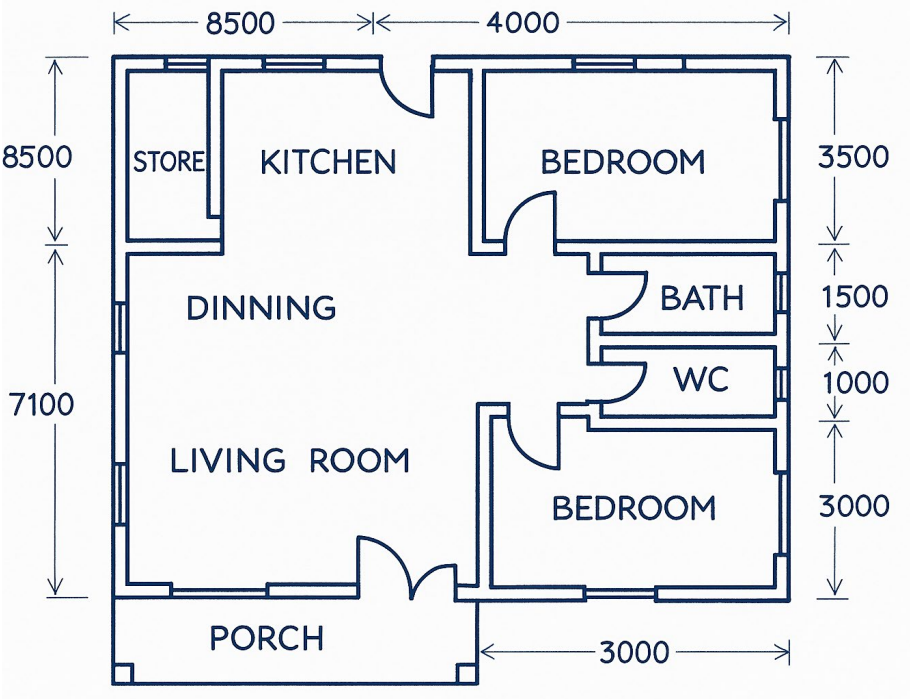
- **Set Up the Workspace:** Secure the drawing board at a comfortable space. Place the T-square on the edge of the board and make sure it's aligned properly with the drawing sheets.

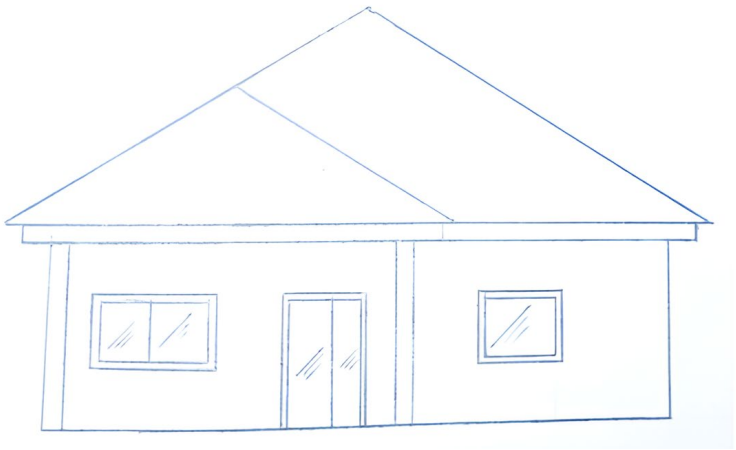
3. Drawing the elevations

- Transfer straight lines from the given floor plan (wall thickness, doors, windows, arches etc.) This will serve as the foundation for your elevation.
- **Add dimensions:** Draw dimension lines using the scale ruler to indicate the height, width, and depth of various elements. Add numeric values to show exact measurements in millimetres
- **Apply Textures and Patterns:** Use different pencil grades or fine liners to add texture to surfaces (like brickwork, etc.)

4. Presentation

- For presentation or submission, use high-quality paper and ensuring all lines are clean and well-defined, add a title block with details such as the name, date, and scale.





Front View

Figure 3.1.6: *Drawing elevations from a given floor plan*

Learning Task

Draw the south, north east and west elevations of a given floor plan to scale.

Pedagogical exemplars

1. **Managing talk for learning, Research**

   Using relevant resources guide learners to select the drawing tools and materials used to draw elevations and explain the techniques used to draw the elevations of a building. Encourage learners to share their findings with each other to promote collaborative learning.

2. **Activity based learning**

   Task learners to draw the south, north, east and west elevations from a given floor plan using drawing instrument and scale rule. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

Key Assessments

Level 3

1. Draw the south, north east and west elevations of a given floor plan to scale.
2. Sample assessment: answer the task to the scenario below

Miss Kuvena wants to construct a three-bedroom residential building and have consulted you as an architectural drafter for her new residential project.

The client has requested a set of building elevations for the three-bedroom house that she plan to construct on a corner plot. The architectural design should include modern aesthetics with large windows, a flat roof, and a combination of materials including brick, wood sidings and concrete.

Specifications

Building Dimensions

1. Length: 14500
2. Width: 8500
3. Height: 3200
4. Height of roof with coping: 850

Design Features

1. Large glass windows on the front facade
2. A central entrance
3. with a modern canopy
4. A brick facade on the lower level
5. Eaves 600

Tasks

Draw the Building Elevations

1. Front Elevation
2. Rear Elevation
3. Side Elevations (Left and Right)

Prepare a poster presentation on the task indicating

1. Instruments and techniques used
2. Challenges encountered

HINT



The recommended mode of assessment for week 23 is **Poster presentation**. *Use the level 3 question 2 as a sample question.*

WEEK 24

Learning Indicators

1. Distinguish between electrical circuit and electronic circuit
2. Use electronic and electrical symbols to draw simple electronic and electrical circuit diagrams

Focal Area 1: ELECTRICAL AND ELECTRONIC CIRCUIT

Electrical circuits

An **electrical circuit** is a path through which electric current flows. It includes components such as batteries that provide energy to charged particles, devices that use current (lamps or electric motors), and connecting wires or transmission lines.

Basic Components of an Electric Circuit

1. **Power Source: Battery:** A common source of direct current (DC) that provides the flow of electricity (electrical current).
2. **Conductors: wires:** typically, copper or aluminium, these provide a path for current to flow between components.
3. **Load: Resistor:** A component that limits current flow and can convert electrical energy into heat.
   - **Bulb:** A device that emits light when current passes through it.
   - **Motor:** Converts electrical energy into mechanical motion.
4. **Switch:** Opens or closes the circuit to control the flow of current.
5. **Other Components:**
   - **Capacitor:** Stores and releases electrical energy.
   - **Inductor:** Stores energy in a magnetic field when current passes through it.
   - **Diode:** Allows current to flow in one direction only.

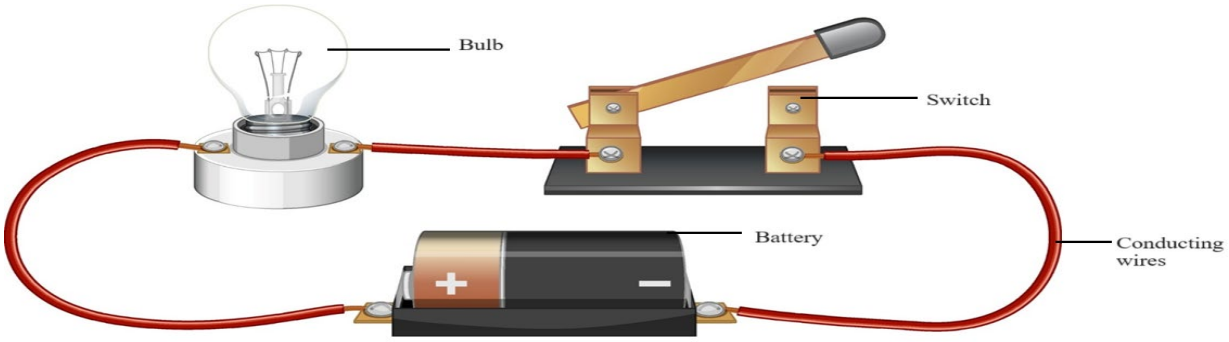


Figure 3.1.7: *Simple electrical circuit*

Electronic circuits

Electronic circuits are specialised types of electrical circuits that use electronic components to control the flow of electric current and perform specific functions. They are fundamental to modern technology and can be found in many modern items from everyday gadgets to complex systems.

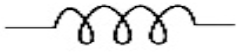
Basic Electronic Components

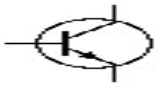
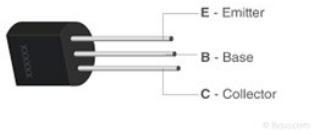
- Resistor
- Capacitor
- Inductor
- Diode
- Transistor
- Switch

Electrical/electronic symbols in circuits

Electrical and Electronic Symbols are graphical representations used to represent various components, devices, and connections in Electrical and Electronic Circuits. These symbols are standardised and universally recognised, allowing engineers, technicians, and electricians to communicate circuit designs and connections effectively.

Table 3.1.1: Electrical/ electronic symbols in circuits

Name/description	Symbol	Picture
Resistor It is a passive component that limits or controls the flow of electric current in a circuit.		
Capacitor It is often used for filtering, energy storage, and timing applications.		
Inductor It stores energy in a magnetic field and resists changes in current. Inductors are commonly used in applications such as filters, oscillators, and power supplies.		
Diode It allows current to flow in one direction while blocking it in the opposite direction. Diodes are widely used in rectifiers, switches, and voltage clamping circuits.		

Transistors It is a semiconductor device that amplifies or switches electronic signals and forms a fundamental building block in many electronic circuits.		
Battery It is a source of electrical energy that can supply power to a circuit.		
Switch It controls the flow of current in a circuit by either allowing or interrupting the path of electricity.		
Earth rod It represents the reference point in a circuit or the connection to Earth, providing a zero-voltage reference.		

Learning task

Distinguish between electrical circuit and electronic circuits

Pedagogical exemplars

1. **Managing talk for learning, Experiential learning**

   With the aid of real objects, models and board illustrations, brainstorm to come up with the difference between electrical circuits and electronic circuits. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

2. **Activity-based learning**

   Task learners to outline the components in an electronic circuit and explain their functions. Develop a peer mentoring system in the mixed-ability groups to encourage more advanced learners to support their colleagues in understanding and effectively applying these concepts.

Key Assessments

Level 2: Distinguish between electrical circuits and electronic circuits.

Level 3: Analyse the key differences between electrical circuits and electronic circuits, providing specific examples of applications for each type. Discuss how these differences affect their functionality and real-world use.

Focal Area 2: CIRCUIT DIAGRAMS

Circuit diagrams, also known as schematic diagrams, are graphical representations of electrical/electronic circuits which show the components and interconnections of the circuit using standardised symbolic representations. These diagrams are essential for designing, analysing, and troubleshooting circuits.

Drawing simple electrical/electronic circuit diagrams

Drawing circuit diagrams involves creating a visual representation of an electrical circuit using standardised symbols to represent components and their connections.

Steps to consider;

1. **Understand and Use Standard Symbols:** Familiarise yourself with the common symbols used in circuit diagrams (refer to focal area 1)
2. **Tools and Materials**
   - **Graph Paper:** Helps maintain alignment and proportion.
   - **Pencils and Erasers:** For sketching and making corrections.
   - Rulers For drawing straight lines and standard symbols.
3. **Sketch the Basic Layout:** List all the components required for your circuit. Identify their function and how they will be connected, lightly sketch the arrangement of components on graph paper. Place components logically to minimise crossing lines and ensure clarity.
4. **Connect the Components:** use a ruler to draw straight lines between component symbols, use dots to indicate junctions where wires meet.
5. **Label Each Component:** write the component value or part number next to each symbol
6. **Specify Values:** Include values for resistors, capacitors, and other components as part of the label (e.g., 10kΩ for a resistor).
7. **Finalise the Diagram:** ensure that all components are correctly represented and that connections match the intended design.

Example: Draw a Simple Circuit Diagram with the following components:

- A battery (power source)
- A resistor
- An LED (light-emitting diode)
- A switch

PROCEDURES

1. **Place the Battery:** Draw the battery symbol
2. **Add the Resistor:** Draw the resistor symbol.
3. **Place the LED:** Draw the LED symbol
4. **Connect Components:** Draw lines to connect the battery to the resistor, the resistor to the LED, and include a switch in the circuit to control the flow.
5. **Label Components:** Add labels for the battery (e.g., “9V”), resistor (e.g., “470Ω”), and LED.

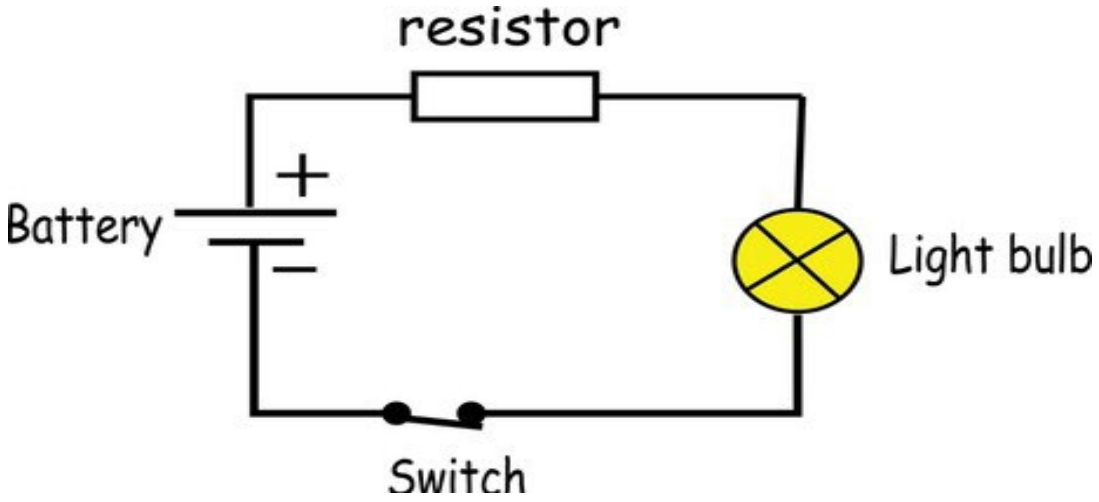


Figure 3.1.8: *Circuit diagram*

Learning Task

1. Design a simple electrical circuit with switch, fuse and circuit breakers and make a neat circuit diagram from the electrical circuit designed.
2. Design an electrical circuit with five different electrical/electronic components and make a neat circuit diagram from the electrical circuit designed with drawing instrument

Pedagogical exemplars

1. **Experiential learning, Managing talk for learning**

   Using a switch, fuse and circuit breakers assist learners to design a simple electrical circuit.

   Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.

2. **Activity- based learning, Project based learning**

   With the use of drawing instruments, make a neat circuit diagram from the electrical circuit designed. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

3. **Collaborative learning/ Group work, Project-based learning**

   Through brainstorming, charts, pictures and in mixed gender grouping, assist learners to design an electrical circuit using five different electrical components and use a drawing instrument to develop it into a circuit diagram and use it to explain "schematic diagram". Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.

Key Assessment

Level 3: Design a simple electrical circuit with switch, fuse and circuit breakers and make a neat circuit diagram from the electrical circuit designed.

Level 4: Design an electrical circuit with five different electrical/electronic components and make a neat circuit diagram from the electrical circuit designed with drawing instrument

HINT



The recommended mode of assessment for week 24 is End of second semester examination. Refer to Appendix J at the end of this section for Table of specification.

REVIEW

Under this option, learners were introduced to building elevations by discussing the meaning and applications of building elevations. The elevations of building drawings were emphasised during the lesson. Learners discussed the types of elevations and principles used to draw elevations both freehand and with drawing instruments.

The introduction to electrical circuits and the drawing of circuit diagrams exposed learners to the various components in electrical and electronic circuits and how to design circuits. The correct use of drawing instruments and principles was emphasised during the drawing stage. Learners were also encouraged to use computer aided design (CAD) to produce drawings

MARKING SCHEME FOR ASSESSING THE QUESTIONING

- Participation in discussion -1.5 marks
- Explaining building elevations

Building Elevations are two-dimensional drawings that show the vertical aspects of a building which illustrate how the building will look from each side, including the front, back, and sides, and help in visualizing the building's appearance and design features. **2 marks.**

Or any other appropriate response from learners.

MARKING SCHEME FOR ASSESSING THE POSTER PRESENTATION

Criteria	5 marks	4 marks	3 marks	2 marks	1 mark
Tools and materials used	List all tools and materials used	List all tools and materials used	List three tools and materials used	List two tools and materials used	List one tools and materials used
Challenges encountered and how you overcome it	Identifying all challenges and how you overcome the challenges	Identifies three challenges but with limited detail on how it was overcome	Identifies two challenges but with limited detail on how it was overcome	Identifies one challenge but with limited detail on how it was overcome	Struggles to identify challenges; explanations are vague or irrelevant.
Dimensions per elevation	All dimensions are accurate	Three elevations' dimensions are accurate	Two elevations' dimensions are accurate	One elevation dimension is accurate	None of the dimensions are accurate
Incorporating design features	Incorporating all five of the design features	Incorporating all of the design features	Incorporating three of the design features	Incorporating two of the design features	Incorporating one of the design features
Drawing elevations	Drawing four elevations	Drawing three elevations	Drawing two elevations	Drawing one elevation	Not drawing any elevations

Total marks 25

UNIT 2 MECHANICAL DRAWING

INTRODUCTION AND SUMMARY

This unit covers the principles of sectional drawing and sketches of machine parts.

Sectional drawing or a section drawing is a type of technical drawing used in architecture, engineering and construction to represent the interior of an object or structure as if it has been cut through, usually along a vertical plane. This type of drawing is essential for illustrating and understanding complex details that may not be visible in standard exterior views. The unit also discusses sketches of machine parts. Sketches of machine parts are preliminary drawings that represent the basic design and structure of mechanical components. These sketches are crucial in the initial stages of designing and manufacturing machinery, as they help communicate ideas, visualise concepts and plan the details of the parts.

Teaching the principles of sectional drawing and sketches of machine parts involve various pedagogical approaches to ensure effective learning. Pedagogical strategies have been suggested for teachers to employ in the delivery of lessons on the principles of sectional drawing and sketches of machine parts. By using these pedagogical approaches, learners will acquire a comprehensive and effective learning experience in studying the principles of sectional drawing and sketches of machine parts. By incorporating a mix of DoK levels, teachers should accommodate the different learning needs of learners and ensure that learners develop a deep understanding of the principles of sectional drawing and sketches of machine parts.

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this unit to be accomplished, learners must explain the principles of sectional drawing and sketches of machine parts. Teachers should employ pedagogies such as talk for learning and activity-based approaches with the use of models, internet surfing, pictures, videos, charts and in mixed ability groupings explain the principles and rules of sectional drawing and outline the various types of sectional drawing and present a comprehensive report in a whole class discussion. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individual learning.

ASSESSMENT SUMMARY

To demonstrate conceptual understanding of the principles of sectional drawing and sketches of machine parts, learners must demonstrate the drawing of the various types of sections with the use of board illustrations and in freehand and use drawing instruments to draw some parts of a machine using full, half, broken out, offset sections, etc

As a result, level 2, 3 and 4 of the DoK should be substantially covered in the assessment. To gather data regarding learners' progress and provide timely feedback, teachers should utilise a range of formative assessment tools, including pairs of tasks, reports and task learners to draw some parts of machines using the drawing instruments. Teachers should administer tests such as class exercises (including individual worksheets) after each lesson, homework, scores on group activities covering the principles of sectional drawing and sketches of machine parts. This ensures learners grasp the broader context and relevance design and technology across different domains.

The teacher can refer to the Teacher Assessment Manual and Toolkit (TAMTK) (NaCCA 2023) on how to use the assessment strategies effectively.

WEEK 22

Learning Indicator

1. Explain the principles of sectional drawing
2. Sketch the sectional views of machine parts and components in freehand

Focal Area 1: PRINCIPLES OF SECTIONING

Sectional drawings are multi-view technical drawings that contain special views of a part or parts, views that reveal interior features. Sectional drawings are used to improve clarity and reveal interior features of complicated assembled parts. Sectioning involves showing the interior of an object by imagining a cut through the object.

It is used as a drawing to show internal features or views of components that cannot be clearly seen from outside. An imaginary line known as a cutting plane is used to cut through the view to show the hidden details. The cutting plane shows where the object was cut to obtain the sectioned view.

The cutting planes are normally indicated as A – A, B – B, C – C, X – X, Y – Y, Z – Z etc.

The primary reason for creating a section view is the elimination of hidden lines, so that a drawing can be more easily understood or visualised.

Cutting plane

Cutting plane is an imaginary line that cuts the object to reveal the internal features.

The outside view is cut away by the cutting plane to show the internal view. The line has arrowheads Cutting plane lines are *thick* (0.7 mm) dashed lines, that extend past the edge of the object 6 mm and have line segments at each end drawn at 90 degrees and terminated with arrows.

The cutting plane is controlled by the designer and can

(a) go completely through the object (full section);

(b) go half-way through the object (half section);

(c) be bent to go through features that are not aligned (offset section); or

(d) go through part of the object (broken-out section).

A cutting plane is represented on a drawing by a cutting plane line. This is a heavy long-short-short-long kind of line terminated with arrows. The arrows show the direction of view.

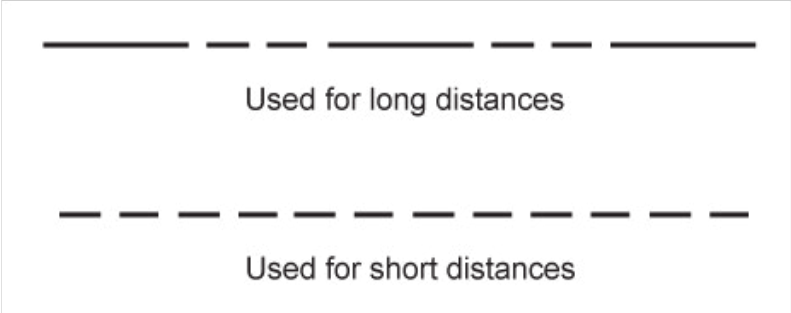


Figure 3.2.1: *Cutting plane lines*

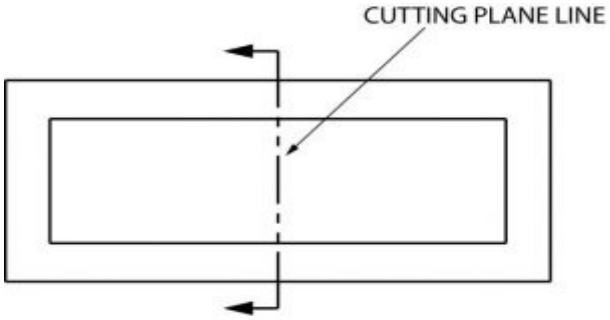


Figure 3.2.2: *Cutting plane through a rectangular block*

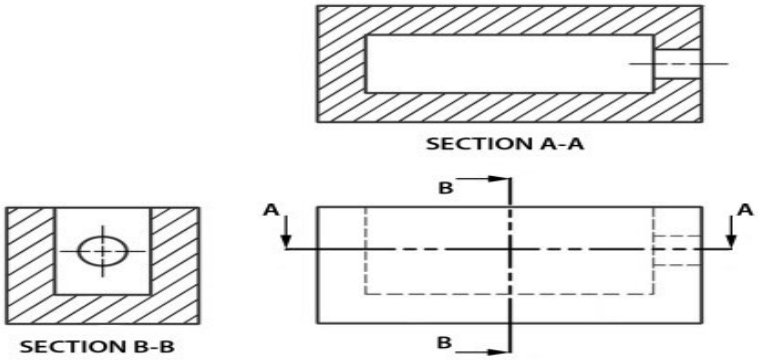


Figure 3.2.3: *Section of a rectangular object*

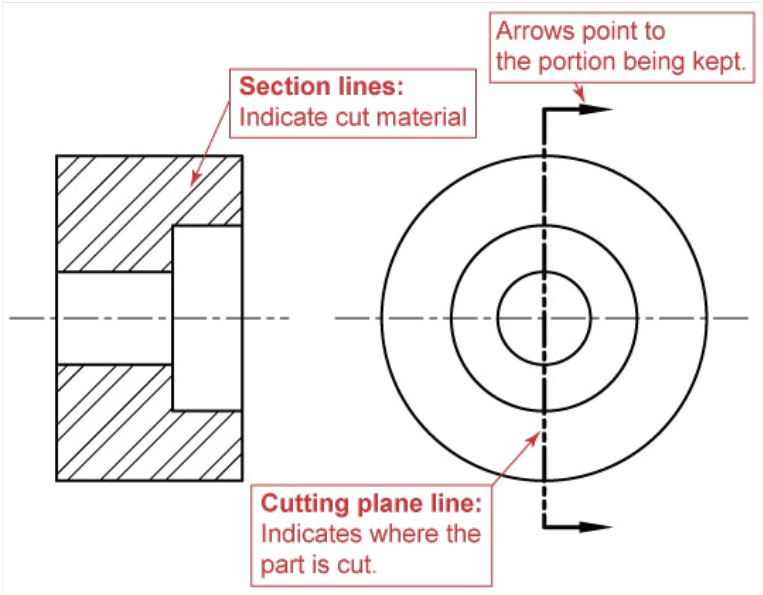


Figure 3.2.4: *Cutting plane through a block*

Section lining

Section lining are lines used to indicate the surface which has been exposed by the cutting plane. Different section line symbols can be used to represent various types of materials. When an object is made of a combination of materials, a variety of section lining symbols makes materials identification easier. Section lines or cross-hatch lines are added to a section view to indicate the surfaces that are cut by the imaginary cutting plane. The actual type of material required is noted in the title block or parts list or as a note on the drawing. The angle at which hatched lines are drawn is usually 45 degrees to the horizontal, but this can be changed for adjacent parts shown in the same section. The spacing between section lines must be uniform on a section view.

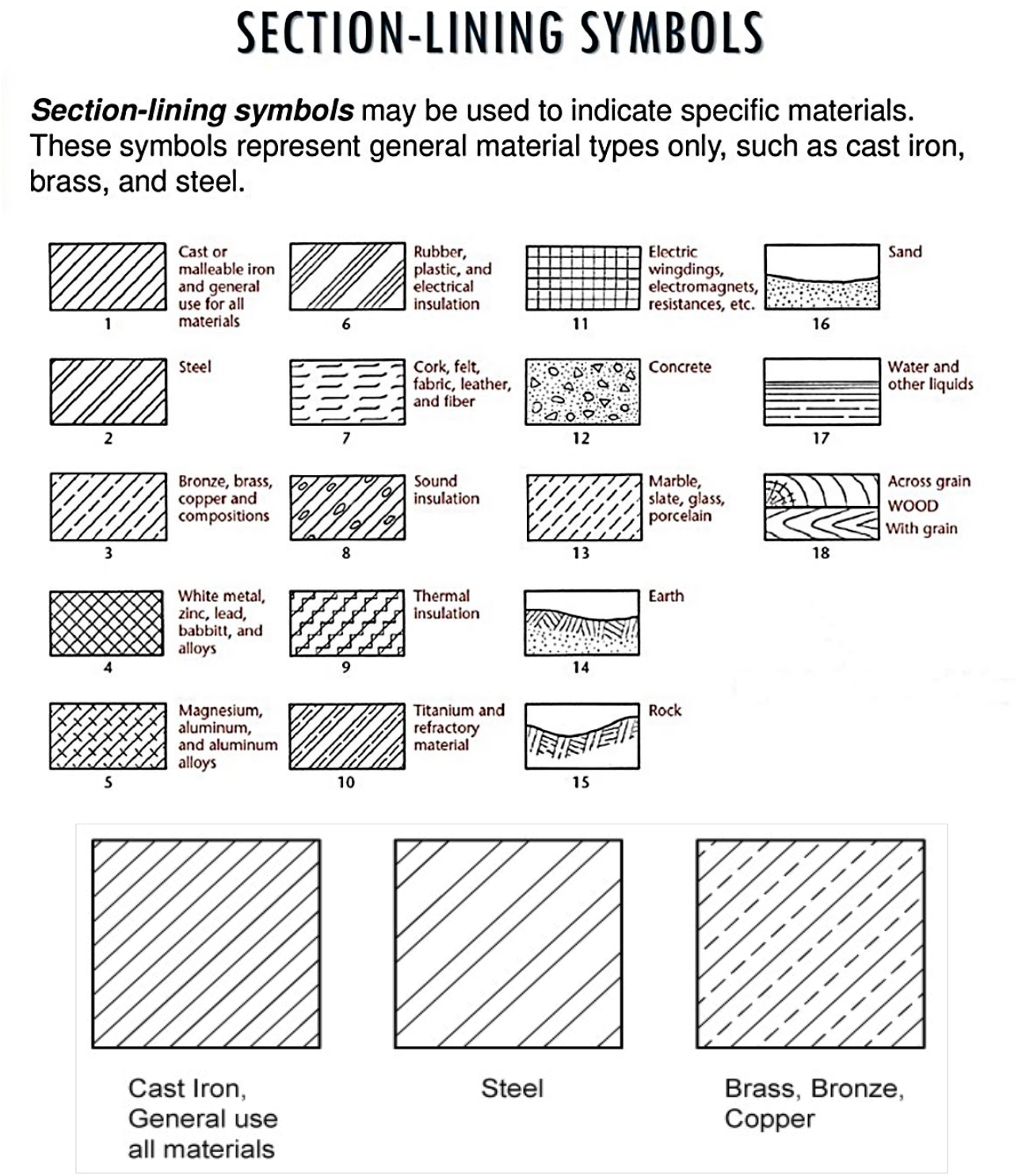


Figure 3.2.5: *Sectioning symbols*

Types of sectioning
Full section

In a full section view, the cutting plane cuts across the entire object. When a cutting plane line passes entirely through an object, the resulting section is called a full section The figure illustrates a full section. The cutting plane line passes through the object in a straight line. Full section is suitable for detail assembly drawings.

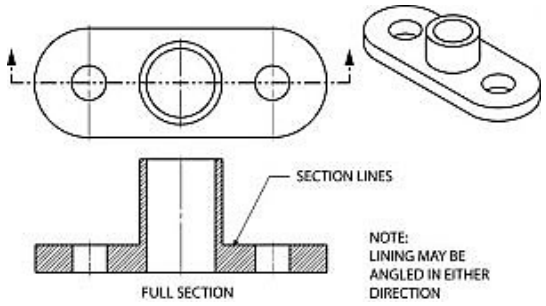
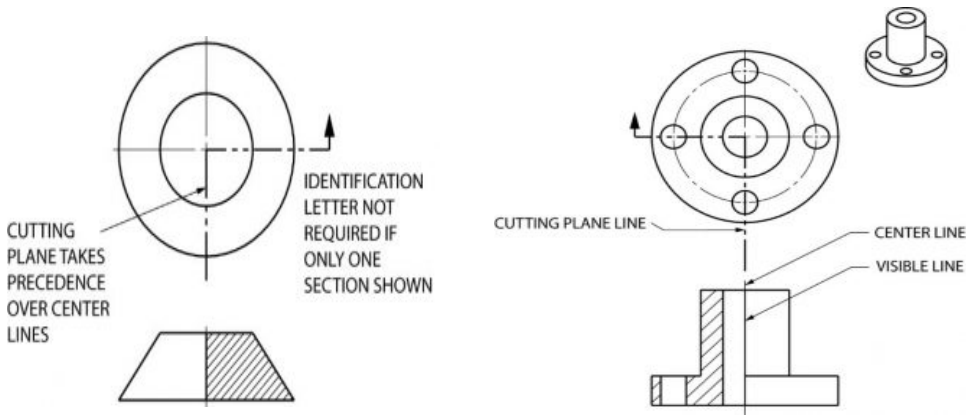


Figure 3.2.6: *full Sectioning*

Half sections cut halfway through an object, showing one half in section and the other half as a regular view.

Half Section

If the cutting plane passes halfway through an object and one-quarter of the object is removed, the resulting section is a half section. A half section has the advantage of showing both inside and outside configurations. It is frequently used for symmetrical objects. Hidden lines are usually not shown on the un-sectioned half unless they are needed for clearness or for dimensioning purposes. As in all sectional drawings, the cutting plane takes precedence over the centre line.



Half section

Figure 3.2.6: *Half sectioning*

Removed section

A section removed from its normal projected position in the standard arrangement of views is called a "removed" section. With a removed section, the cross-section is drawn outside the given view of the artefact. It is drawn to an open area of the drawing paper. Removed sections may be partial sections and are often drawn to a different scale.

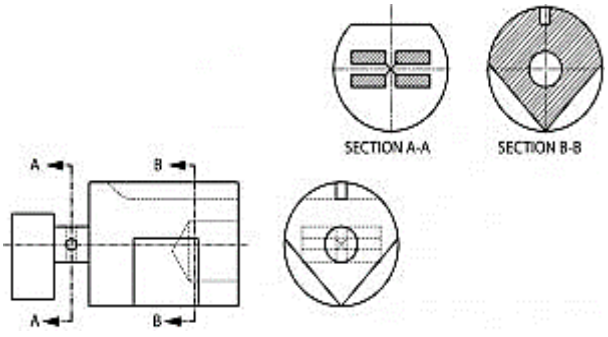


Figure 3.2.7: *Removed section*

A revolved section shows the shape of an object by rotating a section 90 degrees to face the viewer. The three revolved sections illustrated in the spear-like object of figure 3.2.8 show the changes that take place in its shape.

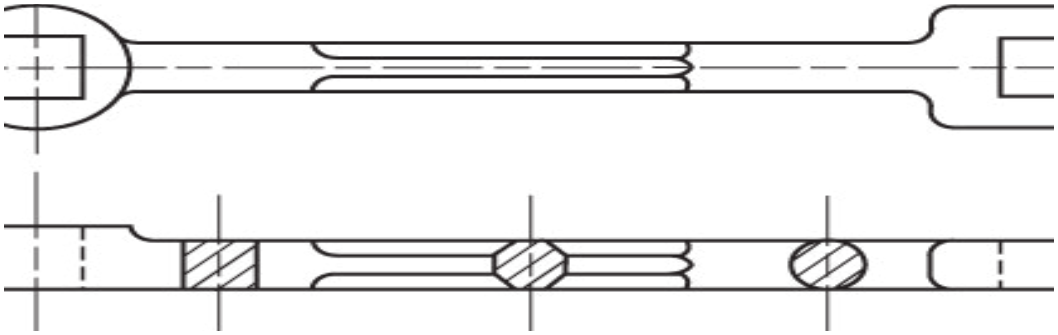


Figure 3.2.8: *Revolve section*

Rules of Sectioning

Rule 1: A section lined area is always completely bounded by a visible outline.

Rule 2: The section lines in all areas should be parallel. Section lines shown in opposite directions indicate a different part.

Rule 3: All the visible edges behind the cutting plane should be shown.

Rule 4: Hidden features should be omitted in all areas of a section view. Exceptions include threads and broken out sections.

Learning Task

1. Explain the principles of sectional drawing
2. Sketch the sectional views of given machine parts and components in freehand

Pedagogical exemplars

Managing talk for learning, Research

With the use of models, internet surfing, pictures, videos, charts and in mixed ability groupings assist learners to explain the principles and rules of sectional drawing, Other groups add to the content presented by each group in a respectful manner. Groups should be encouraged to tolerate others' views.

Activity- based learning

1. Task learners to outline various types of sectional drawing. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.
2. Guide learners to present a comprehensive report in a whole class discussion. Allow learners to demonstrate their understanding in different ways. For example, some learners could present their findings to the class, while others could create a written report or a mind map.

Key Assessment

Level 2: Explain the principles of sectional drawing

Focal Area 2: SKETCHING MACHINE PARTS

Sketching machine parts involves creating detailed drawings that represent the design and dimensions of various components used in machinery. These sketches can range from simple hand-drawn diagrams to more complex, precise CAD (Computer-Aided Design) drawings. Here are some tips and key elements to consider when sketching machine parts:

1. Understanding the function or purpose of the part within the machine and the material the part will be made from, as it can affect the design.
2. Tools and Equipment to use - Pencil and Paper for initial sketches, ruler and a pair of compasses for accurate measurements, CAD Software for precise and scalable designs (e.g., AutoCAD, SolidWorks).
3. Drawing Standards - Using standard views such as front, top, side, and isometric to provide a complete understanding of the part. Clearly indicating all necessary dimensions, including tolerances and including labels for important features, materials and finishes.

Lathe machine parts

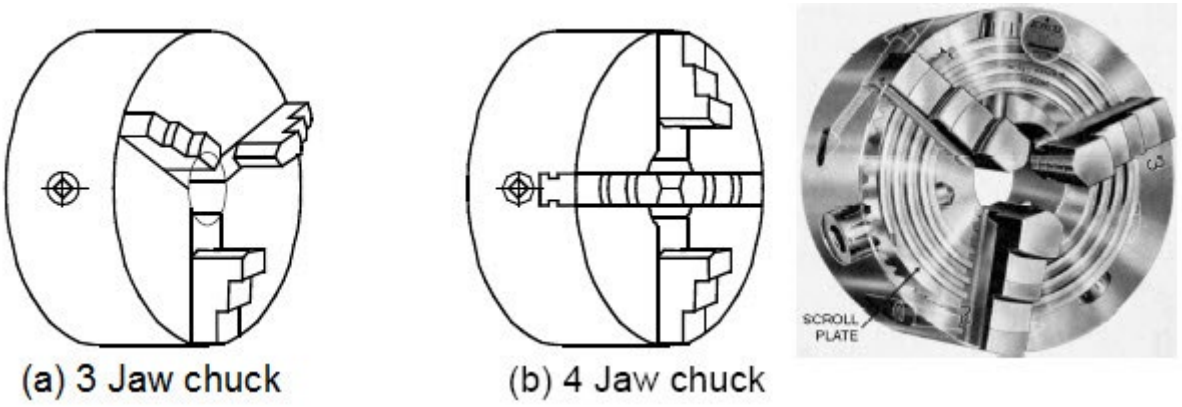


Figure 3.2.9: *Lathe machine parts*

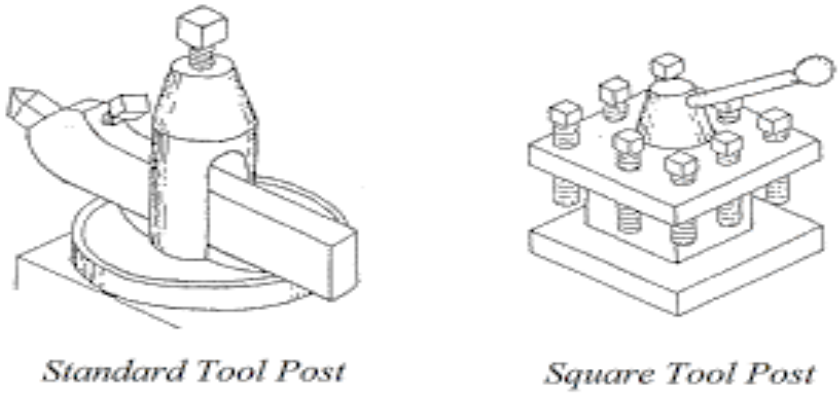


Figure 3.2.9: *Tool posts*

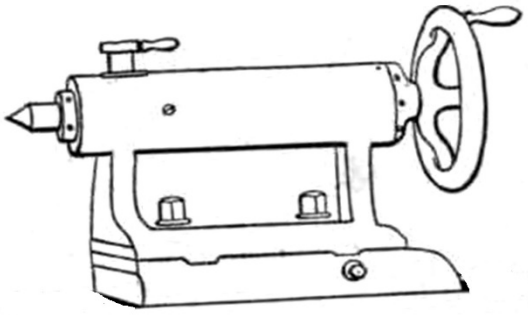


Figure 3.2.10: *Lathe operation*

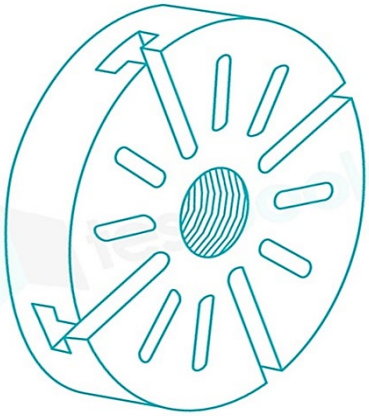
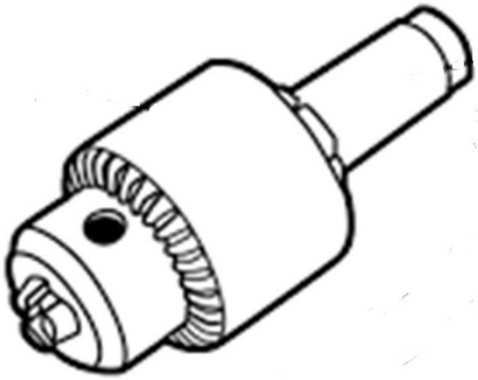
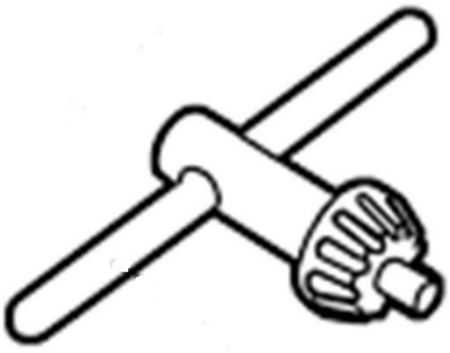


Figure 3.2.11: *face plate*

Drilling machine parts





Drill chuck **chuck key**

Figure 3.2.12: *Drilling machine parts*

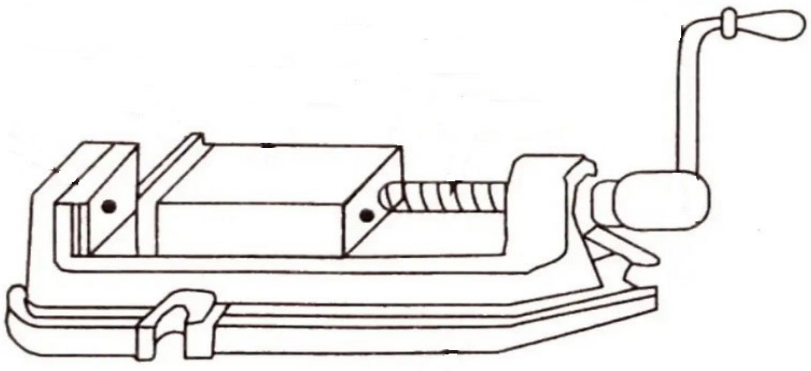


Figure 3.2.13: *Machine vice*

Learning Task

Sketch the sectional views of given machine parts and components in freehand

Pedagogical Exemplars

1. **Experiential learning, Managing talk for learning**

   Show learners a video or real machines parts and assist them to identify the parts by name. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

2. **Managing talk for learning**

   Demonstrate the drawing of the various types of sections with the use of board illustrations and in freehand. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

3. **Activity based learning, Experiential learning**

   Task learners to draw sections of given machine parts using free hand sketches. Monitor learner progress and adjust your approach as needed. For example, if an individual or group is struggling, you could provide additional support or modify the activity.

Key Assessment

Level 1: Sketch the following machine parts in free hand sketches

(a) Bolt
(b) Nut
(c) Cylindrical bushing

Level 2

1. Explain the purpose of sectional drawing in technical representation and identify two situations where sectional views are preferred over standard orthographic projections.
2. Sketch the sectioning line symbols of the following:
   a. Cast iron
   b. Steel
   c. Bronze
   d. Concrete
   e. Wood

Level 3

1. A machine part has a circular hole that contains an internal component. Compare and contrast how this would be represented in:
   a. A full section
   b. A half section
   c. A revolved section

2. Compare and contrast the design features and functional roles of a bolt and a nut by creating detailed freehand sketches. Include annotations to explain how each part contributes to their overall functionality in a mechanical assembly.

HINT



The recommended mode of assessment for week 22 is **Questioning.** *Use the level 2 question 1 as a sample question.*

WEEK 23

Learning Indicator: Draw the sectional views of machine parts and components with drawing instruments

Focal Area: DRAWING SECTIONAL VIEWS

Sectional views of machine parts and components

Creating sectional views of machine parts and components requires a careful understanding of technical drawing conventions and the use of various drawing instruments. Sectional views can be drawn using traditional drawing instruments.

Sectional views are drawn in orthographic projections: first angle and third angle projections.

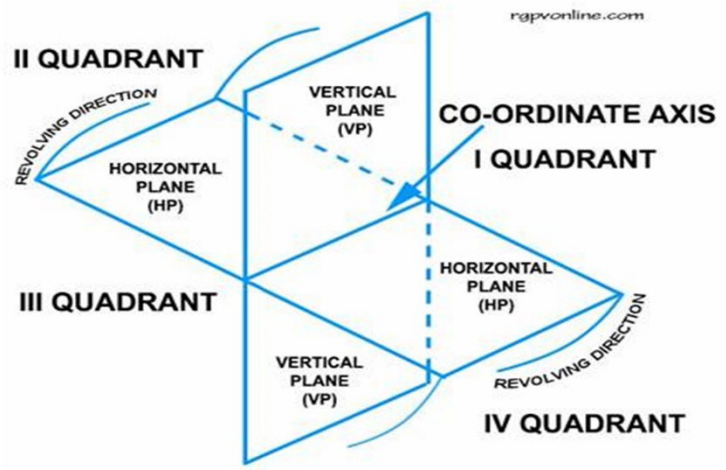


Figure 3.214: *Plane of projection*

The figure below shows part of a machine.

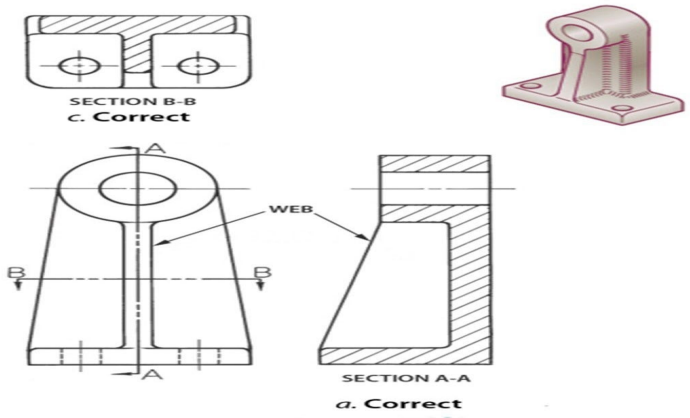


Figure 3.2.15: *Part of a machine*

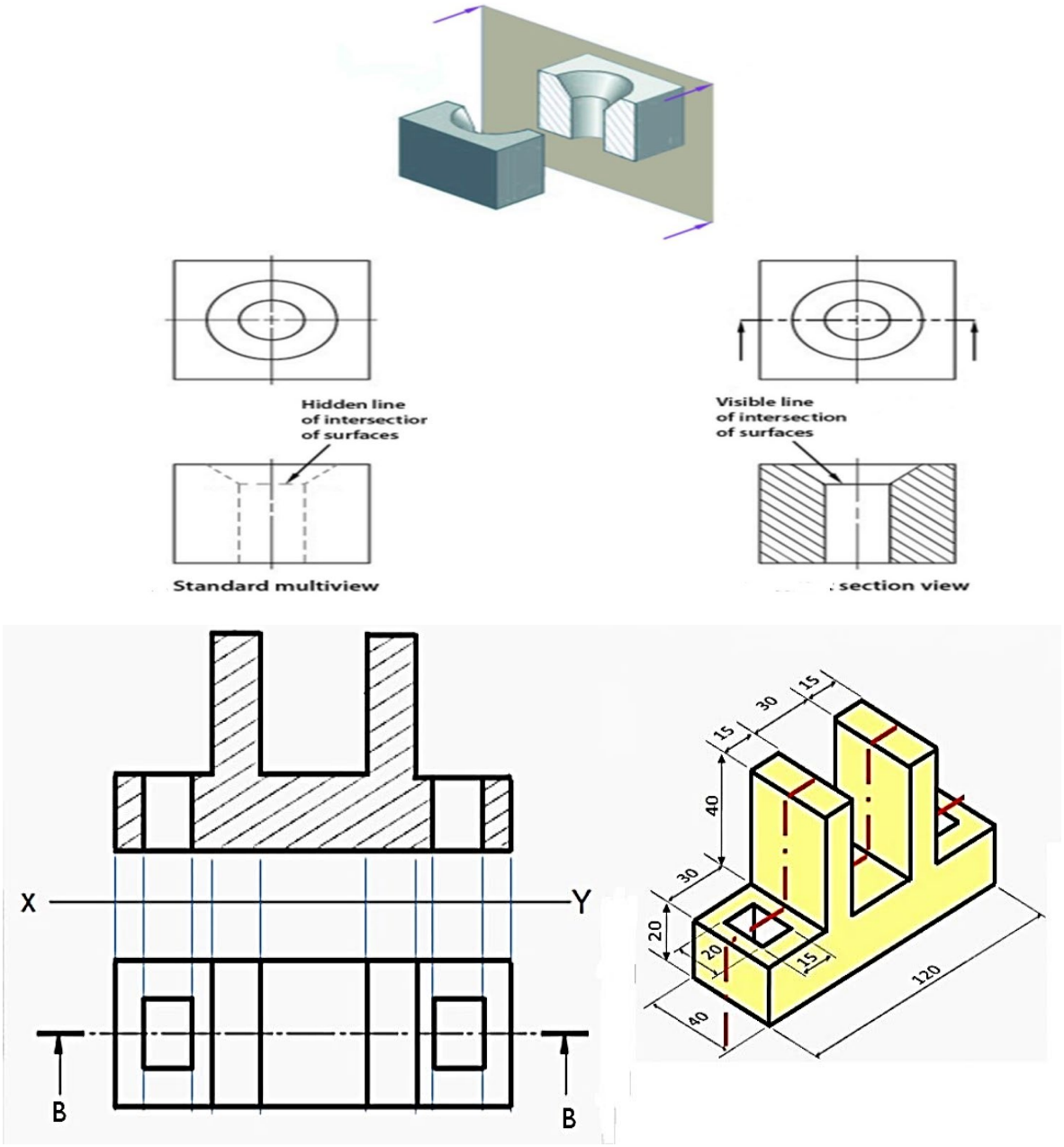


Figure 3.2.16: *Part of a machine*

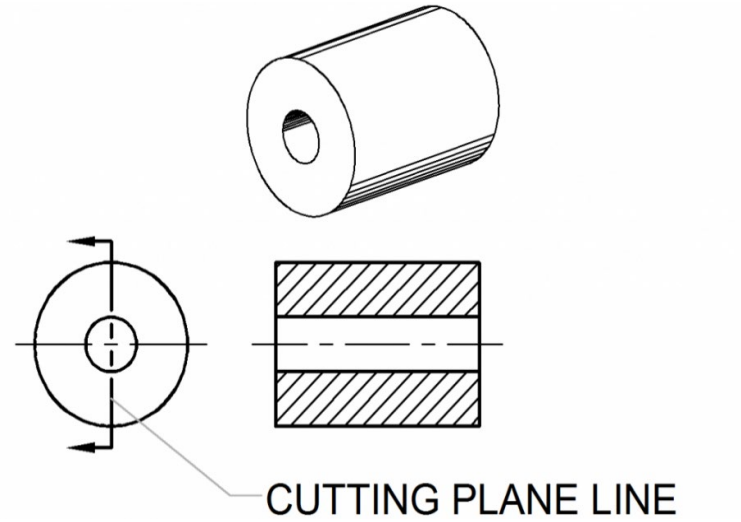


Figure 3.2.17: *Cutting plane line through a machine parts*

Cutting plane lines are seen as actually slicing the part into two. The exposed surface is shown in the section view.

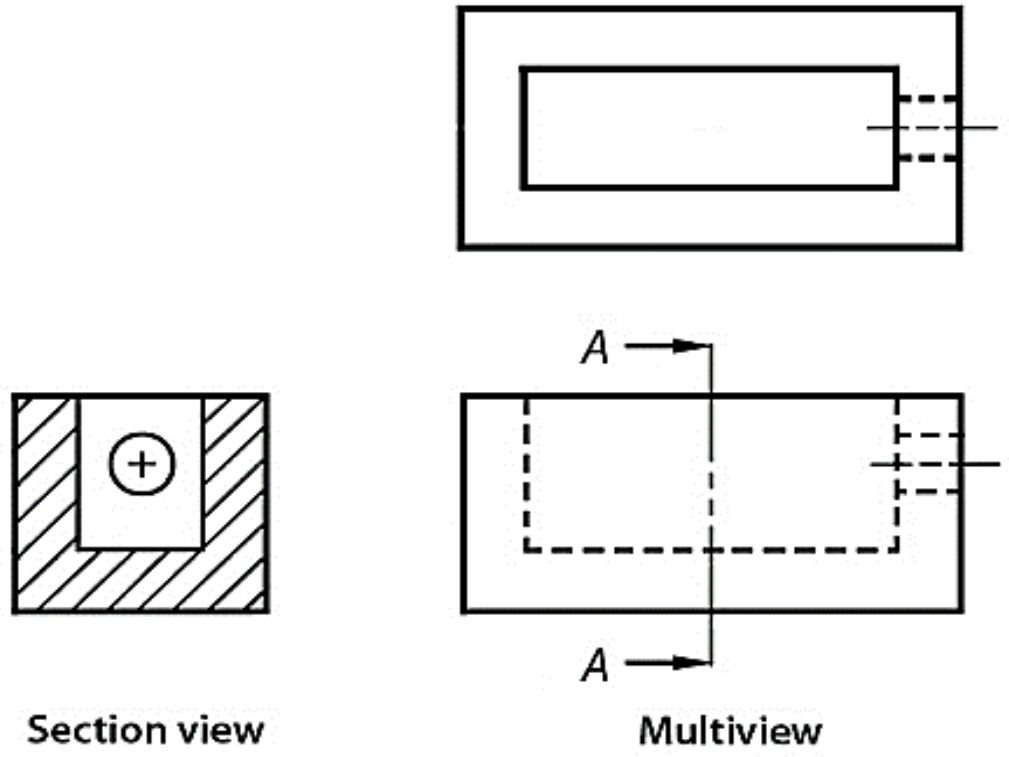


Figure 3.2.18: *sectioning*

Learning Task

Draw the sectional views of machine parts and components in first angle and third angle projections.

Pedagogical Exemplars

Activity based learning, Problem - based learning

With the use of real objects, models, board illustrations and with the understanding of the concept of sectioning, draw the sectional views of some complex machine parts and components with drawing instruments. Anticipate that some learners may struggle with certain concepts, such as planes of projection and sectional drawing, and plan for additional support or resources to help these learners.

Key Assessment

Level 2: Draw the sectional view of the figure below in first angle projection.

Level 3: Analyse the figure below and create a detailed sectional view in third angle projection. In your drawing, explain the significance of the chosen projection method and how it influences the interpretation of the object's dimensions and features

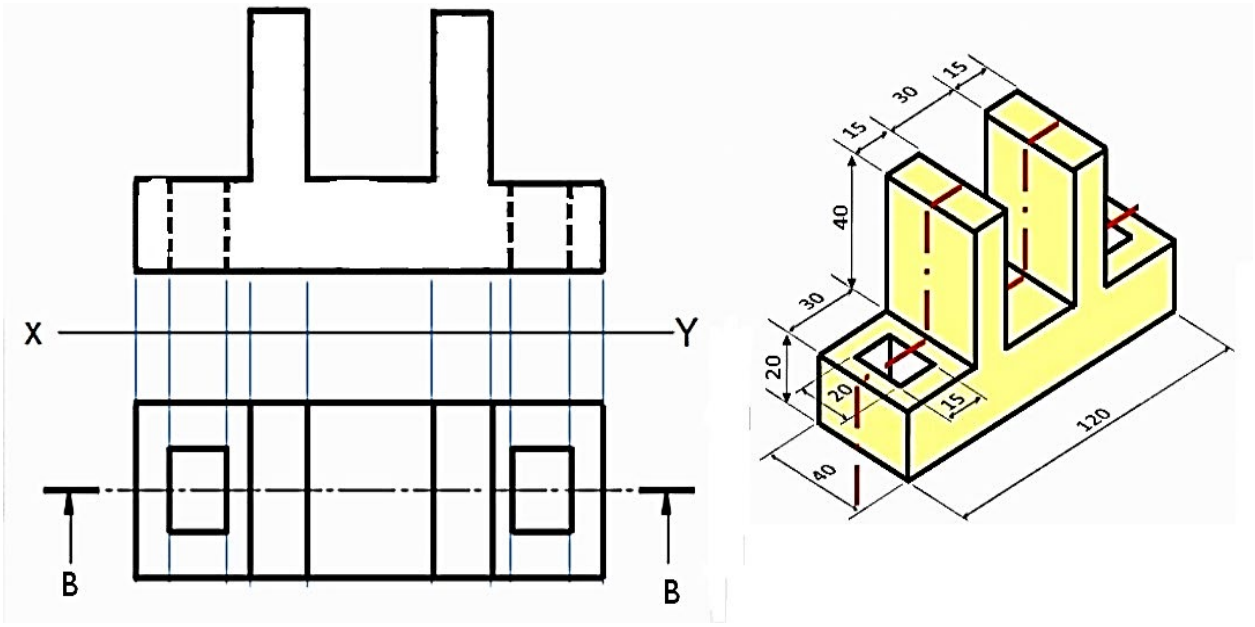


Figure 3.2.19: *Sectional view of a block*

Level 4

The sketch in Fig. 3 shows two views of a block in first-angle orthographic projection

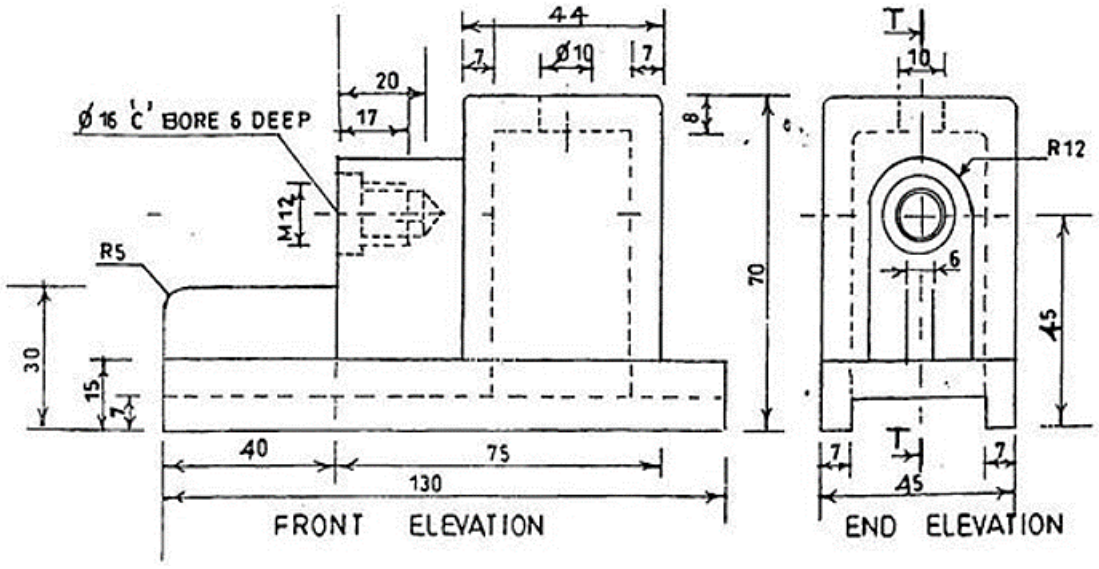


Fig 3

Draw full size and in first angle orthographic projection the:

a. End elevation

b. Sectional front elevation along plane T-T

c. Plan

(Assume suitable dimension(s) where unspecified)

HINT

The recommended mode of assessment for week 23 is **Poster presentation**. *Use the level 4 question as a sample question.*

WEEK 24

Learning Indicators

1. Distinguish between electrical circuit and electronic circuit
2. Use electronic and electrical symbols to draw simple electronic and electrical circuit diagrams

Focal Area 1: ELECTRICAL AND ELECTRONIC CIRCUIT

Electrical circuits

An **electrical circuit** is a path through which electric current flows. It includes components such as batteries that provide energy to charged particles, devices that use current (lamps or electric motors), and connecting wires or transmission lines.

Basic Components of an Electric Circuit

1. **Power Source: Battery:** A common source of direct current (DC) that provides the flow of electrical electricity (electrical current).
2. **Conductors: wires:** typically, copper or aluminium, these provide a path for current to flow between components.
3. **Load: Resistor:** A component that limits current flow and can convert electrical energy into heat.

   Bulb: A device that emits light when current passes through it.

   Motor: Converts electrical energy into mechanical motion.
4. **Switch:** Opens or closes the circuit to control the flow of current.
5. **Other Components:**
   - **Capacitor:** Stores and releases electrical energy.
   - **Inductor:** Stores energy in a magnetic field when current passes through it.
   - **Diode:** Allows current to flow in one direction only.

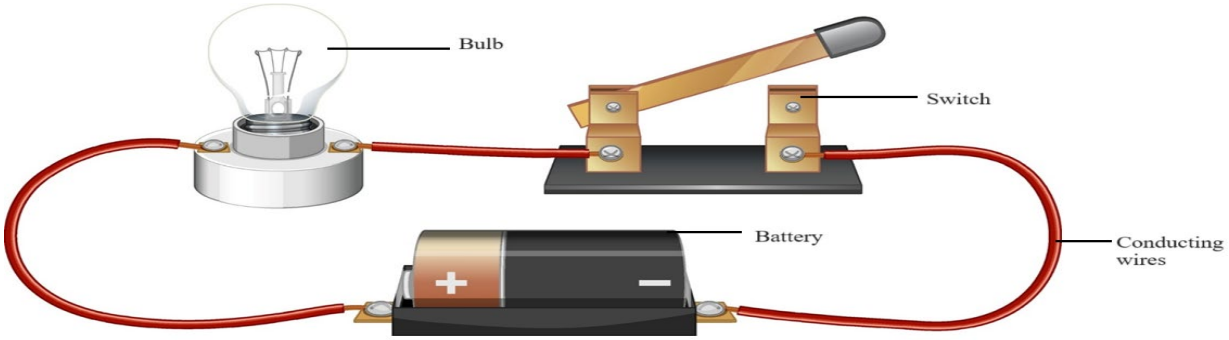


Figure 3.2.20: *Circuit diagram*

Electronic circuits

Electronic circuits are specialised types of electrical circuits that use electronic components to control the flow of electric current and perform specific functions. They are fundamental to modern technology and can be found in many modern items from everyday gadgets to complex systems.

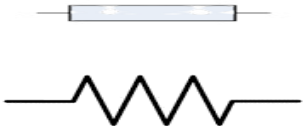
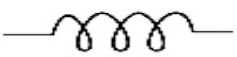
Basic Electronic Components

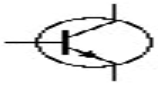
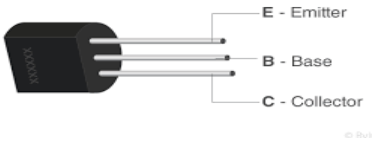
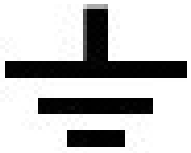
- Resistor
- Capacitor
- Inductor
- Diode
- Transistor
- Switch

Electrical/electronic symbols in circuits

Electrical and Electronic Symbols are graphical representations used to represent various components, devices, and connections in Electrical and Electronic Circuits. These symbols are standardised and universally recognised, allowing engineers, technicians, and electricians to communicate circuit designs and connections effectively.

Table 3.2.1: Electrical/ electronic symbols in circuits

Name/description	Symbol	Picture
Resistor It is a passive component that limits or controls the flow of electric current in a circuit.		
Capacitor It is often used for filtering, energy storage, and timing applications.		
Inductor It stores energy in a magnetic field and resists changes in current. Inductors are commonly used in applications such as filters, oscillators, and power supplies.		

Diode It allows current to flow in one direction while blocking it in the opposite direction. Diodes are widely used in rectifiers, switches, and voltage clamping circuits.		
Transistors It is a semiconductor device that amplifies or switches electronic signals and forms a fundamental building block in many electronic circuits.		
Battery It is a source of electrical energy that can supply power to a circuit.		
Switch It controls the flow of current in a circuit by either allowing or interrupting the path of electricity.		
Earth rod It represents the reference point in a circuit or the connection to Earth, providing a zero-voltage reference.		

Learning task

Distinguish between electrical circuit and electronic circuits

Pedagogical exemplars

1. **Managing talk for learning, Experiential learning**

   With the aid of real objects, models and board illustrations, brainstorm to come up with the difference between electrical circuits and electronic circuits. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

2. **Activity-based learning**

   Task learners to outline the components in an electronic circuit and explain their functions. Develop a peer mentoring system in the mixed-ability groups to encourage more advanced learners to support their colleagues in understanding and effectively applying these concepts.

Key Assessment

Level 2: Distinguish between electrical circuits and electronic circuits

Level 3: Analyse the key differences between electrical circuits and electronic circuits, providing specific examples of applications for each type. Discuss how these differences affect their functionality and real-world use.

Focal Area 2: CIRCUIT DIAGRAMS

Circuit diagrams, also known as schematic diagrams, are graphical representations of electrical/electronic circuits which shows the components and interconnections of the circuit using standardised symbolic representations. These diagrams are essential for designing, analysing, and troubleshooting circuits.

Drawing simple electrical/electronic circuit diagrams

Drawing circuit diagrams involves creating a visual representation of an electrical circuit using standardised symbols to represent components and their connections.

Steps to consider

1. **Understand and Use Standard Symbols:** Familiarise yourself with the common symbols used in circuit diagrams (refer to focal area 1)
2. **Tools and Materials:**
    - **Graph Paper:** Helps maintain alignment and proportion.
    - **Pencils and Erasers:** For sketching and making corrections.
    - Rulers For drawing straight lines and standard symbols.
3. **Sketch the Basic Layout:** List all the components required for your circuit. Identify their function and how they will be connected, lightly sketch the arrangement of components on graph paper. Place components logically to minimise crossing lines and ensure clarity.
4. **Connect the Components:** use a ruler to draw straight lines between component symbols, use dots to indicate junctions where wires meet.
5. **Label Each Component:** write the component value or part number next to each symbol
6. **Specify Values:** Include values for resistors, capacitors, and other components as part of the label (e.g., 10kΩ for a resistor).
7. **Finalise the Diagram:** ensure that all components are correctly represented and that connections match the intended design.

Example: Draw a Simple Circuit Diagram with the following components:

- A battery (power source)
- A resistor
- An LED (light-emitting diode)
- A switch

PROCEDURES

1. **Place the Battery:** Draw the battery symbol
2. **Add the Resistor:** Draw the resistor symbol
3. **Place the LED:** Draw the LED symbol
4. **Connect Components:** Draw lines to connect the battery to the resistor, the resistor to the LED, and include a switch in the circuit to control the flow
5. **Label Components:** Add labels for the battery (e.g., "9V"), resistor (e.g., "470Ω"), and LED

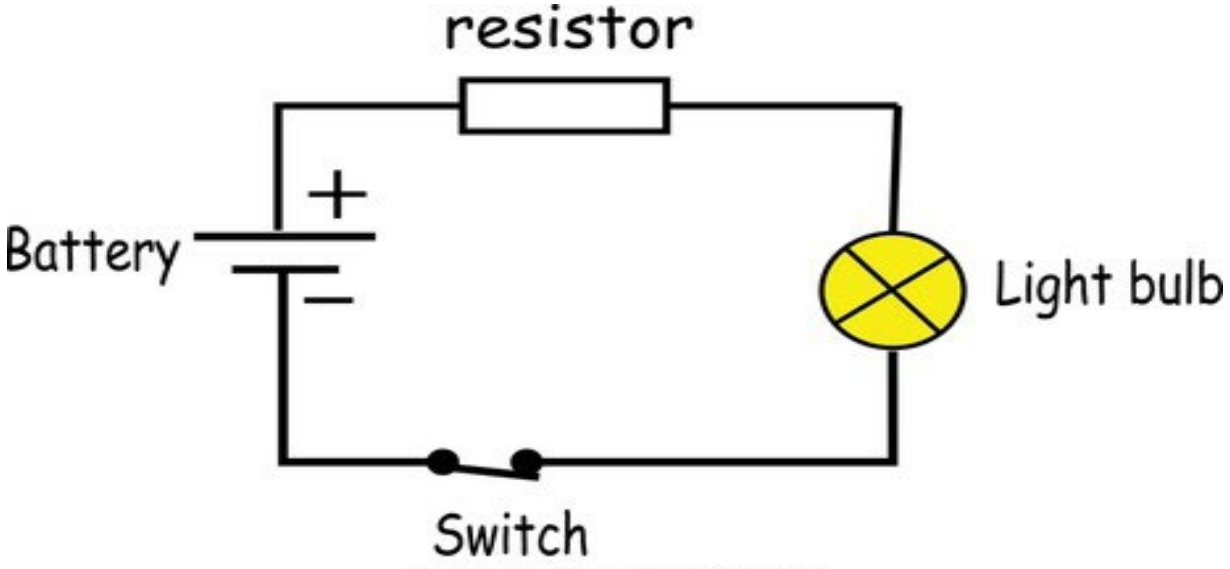


Figure 3.2.20: *Circuit diagram*

Learning Task

1. Design a simple electrical circuit with switch, fuse and circuit breakers and make a neat circuit diagram from the electrical circuit designed.
2. Design an electrical circuit with five different electrical/electronic components and make a neat circuit diagram from the electrical circuit designed with drawing instrument

Pedagogical exemplars

1. **Experiential learning, Managing talk for learning**

   Using a switch, fuse and circuit breakers assist learners to design a simple electrical circuit. Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.

2. **Activity- based learning, Project based learning**

   With the use of drawing instruments, make a neat circuit diagram from the electrical circuit designed. Support an individual or group working at a slower pace whilst the rest of the class completes more activities.

3. **Collaborative learning/ Group work, Project-based learning**

   Through brainstorming, charts, pictures and in mixed gender grouping, assist learners to design an electrical circuit using five different electrical components and use a drawing instrument to develop it into a circuit diagram and use it to explain "schematic diagram". Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.

Key Assessment

Level 3: Design a simple electrical circuit with switch, fuse and circuit breakers and make a neat circuit diagram from the electrical circuit designed.

Level 4: Design an electrical circuit with five different electrical/electronic components and make a neat circuit diagram from the electrical circuit designed with drawing instrument

HINT



The recommended mode of assessment for week 24 is End of second semester examination. Refer to Appendix J at the end of this section for Table of specification.

REVIEW

This unit covered the drawing of sectional views of machine parts and components. Instruments and materials needed as well as key points to consider in drawing the sectional views were discussed. Various machine parts were also given for teachers to present to learners and guide them to draw their sectional views in first and third angle projections.

The introduction to electrical circuits and the drawing of circuit diagrams exposed learners to the various components in electrical and electronic circuits and how to design circuits. The correct use of drawing instruments and principles were emphasised during the drawing stage. Learners were also encouraged to use computer aided design (CAD) to produce drawings.

Marking Scheme for the Questioning Assessment

Sectional drawings are used in technical representation to reveal the internal features of an object that are not visible in standard views. They provide a clearer understanding of complex internal components by cutting through the object along a chosen plane and removing one portion to show what lies within. This helps engineers, designers, and manufacturers interpret and analyse the internal structure accurately.

Situations where sectional views are preferred (2 marks each, total 4 marks)

1. **When internal components are hidden or complex:** For example, in mechanical parts like engines, valves, or gearboxes where the internal arrangements (such as bores, cavities, or passages) cannot be clearly shown using standard orthographic projections.
2. **When clarity is required for assembly or manufacturing:** For instance, in assemblies where multiple components fit together (e.g., bearings within housings), sectional views help show how parts align and fit, aiding in accurate manufacturing and assembly.

RUBRICS FOR THE POSTER PRESENTATION ASSESSMENT

Part 1: Purpose of Sectional Drawing **(3 marks)**

Criteria	*Sample Response*	*Marks*
Comprehensive explanation that clearly articulates the primary purpose of sectional drawing with specific reference to revealing internal features and improving clarity of representation	*"Sectional drawing serves the purpose of revealing internal features and construction details of an object that would otherwise be hidden or unclear in standard orthographic views. By conceptually cutting through the object with an imaginary cutting plane and removing a portion, sectional drawings allow for clear visualization of internal cavities, holes, and structures, thereby enhancing the understanding of complex parts and eliminating the confusion caused by hidden lines."*	*1*
Good explanation that identifies the main purpose with some elaboration on how sectional views improve technical representation	*"Sectional drawing is used to show the internal features of an object by cutting through it with an imaginary plane. This helps to make the drawing clearer by showing what's inside rather than using hidden lines."*	*0.5*
Basic explanation that mentions revealing internal features but lacks detail or complete understanding	*"Sectional drawing shows the inside of objects by cutting them open in the drawing."*	*0.5*
Limited explanation that vaguely relates to showing internal parts but demonstrates minimal understanding	*"Sectional drawing is for seeing inside things."*	*0.5*
No explanation or irrelevant/ incorrect information	*"Sectional drawing is used to make 3D drawings."*	*0.5*

Part 2: Situations Where Sectional Views are Preferred **(2 marks)**

Criteria	*Sample Responses*	*Marks per situation (1.5 each)*
Clear identification of a specific, relevant situation with detailed explanation of why sectional views are advantageous in this context	*Situation 1: "When representing objects with complex internal cavities or features, such as valve bodies or engine components, sectional views are preferred because the numerous hidden lines required in standard orthographic projections would create a cluttered and potentially confusing drawing. Sectional views eliminate this confusion by clearly showing the shape, size, and relationship of internal passages and chambers."*	*0.5*
Identification of a relevant situation with basic explanation of the advantage of sectional views	*"When drawing parts with many internal features, sectional views are better because they avoid having too many hidden lines which can be confusing to read."*	*0.5*
Identification of a situation with minimal or vague explanation	*"For complicated parts with holes inside."*	*0.5*
No identification or irrelevant/incorrect situation	*"When drawing the outside of a building."*	*0.5*

UNIT 3 GARMENT DESIGN TECHNOLOGY

INTRODUCTION AND SUMMARY

Garment Design Technology is a field that combines the principles of fashion design with technological advancements to create, develop, and produce clothing. It encompasses various aspects which include concept development, pattern making, fabric sourcing, production techniques and many others.

Pattern drafting is a key component of garment design. Accurate patterns ensure that the finished garment fits properly and is constructed correctly. It will be difficult to get the right fit and ideal silhouette without well-drafted patterns.

Learners in this unit will use the fundamental abilities acquired from year one in various design techniques to facilitate their garment design making. Learners will discuss the fundamental instruments of garment design technology and their applications; then get into the crucial process of getting precise body measurements. Again, there will be drafting of basic garment patterns, like skirt blocks, bodice blocks, pants blocks, and sleeve blocks, with these measurements in hand. Then finally learn how to cut out patterns and also be able to use them to make garments.

The weeks covered by sub-strand 3 are:

Week 22: Assess the tools used in garment design, and their applications

Week 23: Use basic principles to take accurate body measurements

Week 24: Draft basic pattern blocks for bodice and sleeve

SUMMARY OF PEDAGOGICAL EXAMPLARS

The pedagogical strategies to facilitate the learning process should be learner centred. Learners should be made to experience various examples of garment designs through internet surfing and any appropriate medium. Learners should be made to work in any defined groups to share ideas on various garment designs from the net and how they influence their creative skills. Pedagogies such as activity-based learning, individual learning and project-based learning should be emphasised

ASSESSMENT SUMMARY

The assessment should be varied to cater for the different learning proficiencies in the class, hence oral, written and graphic presentations should be accepted. The assessment for monitoring learning will be based on defined pattern drafting as it appears in garment design and its significance as well as drafting basic blocks for bodice and sleeves also learners' ability to show creativity in their design concepts and effectively incorporating trends and personal style into their work.

WEEK 22

Learning Indicator: Assess the tools used in garment design, and their applications

Focal Area 1: TOOLS USED IN GARMENT DESIGN, AND THEIR APPLICATIONS

The meaning of garments in the community

The word "garment" describes clothes or accessories that members of a certain social or cultural group wear. Beyond their practical use, clothes frequently have political, social, cultural, and economic significance within a community. The following show someof the importance of garments in relation to community:

Importance of garments in the community

The following show some of the importance of garments in relation to community:

1. **Cultural Identity and Expression:** Garments are essential for conveying cultural identity and legacy. They frequently showcase customary techniques, materials, hues, and designs that are exclusive to a certain neighbourhood or ethnic group.

   Communities transmit and retain cultural narratives, values, and beliefs through garments. For instance, wearing traditional garments can denote social standing, rites of passage, or adherence to particular cultural customs.

2. **Social Signifiers:** Garments act as a social identifier in a community, signifying a person's membership in particular groups or social classes. For example, leaders, elders, or people of special significance may be identified by their ceremonial or formal clothing.

   Membership of subcultures or communities of interest, such as sports teams, religious organisations, or fashion movements, can also be shown by one's clothing choices.

3. **Economic and Production Contexts:**Making garments is a major source of income for many communities. Local cooperatives, tailors, and artists frequently use traditional methods and locally produced materials to create garments.

   Community people may be able to support themselves through the manufacturing of garments, which boost local economies and preserves traditional methods of textile artistry.

4. **Adaptation and Evolution:** Garments are always changing in communities due to socio-economic considerations, worldwide fashion trends, and shifting fads. Classical designs can be updated to reflect modern preferences or functional requirements without sacrificing cultural authenticity.

   Over time, changes in community values, aesthetics, and lifestyles can be reflected in the way garments are worn.

5. **Symbolism and Ritual:** In many rituals, ceremonies, and celebrations, one's garment is an integral part. At weddings, religious celebrations, festivals, and other noteworthy occasions, special garments may be worn to represent spiritual beliefs or signify momentous life changes.

   Symbolic meanings, colours, or motifs that convey spiritual or cultural value are frequently seen in ritual garments.

Tools used in garment design, and their applications

The tools used in garment design and their applications guarantee that all ideas convert from concept to reality with the expected dimensions and fit, from the initial spark of an idea to the final, polished garment. The process of designing a garment is also sped up by using the right tools. These tools can be grouped into drawing and drafting (marking, measuring and cutting).

Drawing tools which include pencils, pens, erasers and drawing books or sheets are used to make sketches of garment designs. Drafting tools for marking consists of pencils, tailors chalk, pens, tracing wheel, dressmaker's carbon paper, etc. Drafting tools for measuring also includes tape measure, rulers, French curves, squares, etc. Then drafting tools for cutting are scissors, rotary cutter, etc.

Tools used in garment design, image and their applications

Table 3.3.1 Drawing tools for designing

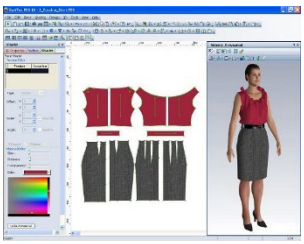
Tool	Image	Application
pencils		A pencil is a writing, sketching, or marking tool that is a thin rod of a solid marking material, such graphite, housed in a cylinder made of wood, metal, or plastic.
pens		Pens for drawing can be used to create marks that are powerful and substantial or delicate and subtle. Ballpoint pens are good for practicing mark-making techniques like cross-hatching and can be expressive.
erasers		The eraser is used to remove preliminary or unwanted lines. An erasing shield is used to remove a line that is close to other lines on the drawing that are not being removed.
drawing books		The garment designer commonly utilises sketchbooks, which are books or pads with blank pages for drawing, as a component of their creative process.
Computer Aided Design (CAD)		Using computer-aided design (CAD) software, garment designers can sketch concepts, create patterns, model clothes, and modify them to fit particular body shapes and uses. More inclusive and ecologically sensitive designs are possible with the use of CAD in fashion design in the future.

Table 3.3.2 Making tools for drafting

Tool	Image	Application
Drafting papers		It is a semi-transparent, lightweight paper that is frequently used in dressmaking and fashion design to create preliminary patterns. Additionally, businesses can use it as an underlayer for tracing heavier papers and for transferring or tracing patterns into cloth.
tracing wheel		It can be used to create slotted perforations and is used to transfer markings from sewing patterns onto cloth with or without the use of tracing paper.
dress makers carbon paper		Dress makers Carbon paper is Press the coloured side of the paper up against the fabric to be marked to make marks on the incorrect side. Often used for craft projects, but also frequently used in dressmaking to transfer darts, pleats, tucks, pocket placement lines, etc.

Table 3.3.3 Measuring tools for drafting

Tool	Image	Application
tape measure		A tape measure or measuring tape is a type of hand tool typically used to measure distance or size. It is like a much longer flexible ruler consisting of a case, thumb lock, blade/tape, hook, and sometimes a belt clip. A tape measure will have imperial readings, metric readings or both.
rulers,		The ruler is used to measure long, straight lines and is available in a variety of materials. The transparent tailoring ruler works particularly well for marking, precise measurement, and changing patterns.

French curves and squares		French curves are used in garment design and sewing alongside hip curves, straight edges and right-angle rulers. Commercial clothing patterns can be personalised for fit by using French curves to draw neckline, sleeve, bust and waist variations.

Table 3.3.4 Cutting tools for drafting

Tool	Image	Application
scissors		Scissors are used to cut through a variety of thin materials, including wire, cardboard, paper, fabric, and metal foil. There are many different types of shears and scissors, each with a specific use.
Rotary cutters		Several layers of fabric or paper and a design are cut through by a rotary cutter without moving the stack off the table.

Learning tasks

1. Explain garment as used in the community
2. State the importance of a garment as used in the community
3. List the various tools that are used in garment design and pattern making and explain how they are used

Pedagogical Exemplars

1. **Group work/Collaborative Learning,** let learners in groups explain garments through the use of videos, photographs, drawings, charts etc. Present their findings in a whole class discussion. Encourage all learners to contribute to the discussion while ensuring that a few learners do not dominate the discussion session. Develop communication and discussion skills to facilitate learning.
2. **Research, group work:** Help learners in their groups to find out the importance of garments in society with the use of internet surfing, videos, photographs, drawings, etc... Generate a manual chart of some garments and their importance/uses. Present report in a whole class discussion. Provide specific instructions to the groups to guide the discussions and to prevent the possibility of only one learner doing all the talking. Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.
3. **Collaborative Learning, research, communication, experiential learning** In mixed groups, let learners examine the various tools that are used for garment design and pattern making. Prepare a manual report to be presented in a whole class discussion. Tailor the

discussion's depth based on learners' understanding. Use simpler explanations for beginners and delve deeper into concepts like garment making for advanced learners.

Key Assessment

Level 1: Define the meaning of garment as used in the community

Level 2: Describe the various tools used in garment design and pattern making

Level 3

1. Generate manual/digital pictorial charts of how the various garment design and pattern making tools are used or applied in garment construction
2. For each garment design task below, select TWO most appropriate tools needed to complete the task effectively. Explain why each tool is necessary.
   a. Creating a dart on a fitted bodice

      Tools……..

      Explanation……..
   b. Transferring pattern markings to dark fabric

      Tools……..

      Explanation……
   c. Finishing a curved neckline on a blouse

      Tools……

      Explanation……..

Level 4: Evaluate the impact of garments on community identity and culture by identifying four key roles they play. Support your analysis with specific examples from different communities, discussing how these roles contribute to social, economic, and environmental aspects.

HINT



The recommended mode of assessment for week 22 is **Questioning.** *Use the level 3 question 2 as a sample question.*

WEEK 23

Learning Indicator: Take accurate body measurement to prepare a bodice block

Focal Area 1: TAKING BODY MEASUREMENTS ACCURATELY

The meaning of body measurement in garment design

Body measurements refer to measurements of a real person (or individuals) who will wear a garment.

Body measurements play a crucial role in the design of garments since they influence fit, comfort, and overall success of the piece. By taking accurate measurements, garment designers can make sure their creations fit well and satisfy the wearer's functional and aesthetic needs.

Body measurements are important in garment design since they guarantee that, the garment fits properly and accentuates the wearer's natural curves.

Key Body Measurements in Garment Design

the parts of the body to be measured are dependent on the kind or type of garment to be constructed. However, there are key measurements for garment design peculiar to all sex types (male or female garments). These include:

1. **Bust/Chest:** Measurement around the fullest part of the bust or chest.
2. **Waist:** Measurement around the natural waistline, typically above the belly button.
3. **Hips:** Measurement around the fullest part of the hips.
4. **Inseam:** Measurement from the crotch to the bottom of the ankle.
5. **Sleeve Length:** Measurement from the shoulder to the desired sleeve length.
6. **Shoulder Width:** Measurement from one shoulder seam to the other.

Importance of body measurements in garment design

The following are some importance of body measurements in garment design:

1. **promotes good fit and comfort:** Accurate measurements help create garments that fit the body properly, enhancing both comfort and appearance. It also helps in maintaining correct proportions, so the garment doesn't appear too loose or too tight.
2. **makes pattern drafting easy:** Body measurements are used by designers to create patterns that will result in clothes that fit properly. Every measurement helps to accurately shape the pattern. Once more, knowing body dimensions aids in creating custom or standard sizes that fit a variety of body shapes.
3. **ensures good style and aesthetical appeal:** Measurements guarantee that design features (such as hems, darts, and seams) suitably follow the natural contours of the body. Well-fitting clothing improves its visual attractiveness by giving the design a polished, deliberate appearance.
4. **aids alterations and customisation:** Precise measurements for bespoke clothing enable modifications to be made so that the finished item fits precisely in accordance with personal

preferences. It helps tailors to make the required post-production changes to ensure the garment fits the wearer well and is well-fitting.

5. **ensures consistency in production:** Precise body measurements facilitate the production of clothing in uniform sizes for various batches and clients. They provide the foundation for quality control, ensuring that clothing fits according to the necessary criteria.
6. **Guaranteed consumer Satisfaction:** For ready-to-wear clothing, providing accurate size guides based on body measurements helps consumers select the right size, leading to greater satisfaction. This also means proper sizing reduces the likelihood of returns due to fit issues, improving overall customer experience.

Principles of body measurement

The principles of body measurement in garment designing ensure that clothing fits well, complements the wearer's body shape, and aligns with the intended design.

Importance of principles for taking body measurements

Designers can make clothes that fit properly and improve the comfort and style of the wearer by following the principles or guidelines. Measurement must be precise and accurate in order to produce apparel that fits nicely.

1. **Accuracy:** To make sure the clothing fits properly, measurements must be taken precisely. The fit and general look might be impacted by even minor differences. To prevent measurement differences, always the same technique and appropriate measuring tools (tape measure).
2. **Proper Posture:** To guarantee that the garment fits comfortably, the wearer should stand in a relaxed, natural posture while having their measurements taken. The measuring tape should be snug without constricting the body, neither too tight nor too loose.
3. **Proper Measuring Tools:** For precise measures, use a flexible, non-stretchable measuring tape. Make sure the body is measured on a flat level surface for some measurements (such as the waist).
4. **Adjustments for Design:** Based on body measurements, include ease (more space for comfort and movement) and seam allowances (more fabric for sewing) in the design. Adjust the garment's pattern to suit individual body types and style preferences; for example, add pleats or darts where needed.
5. **Taking Body Shape into Account:** Recognise the various body types and how they impact clothes fit. It is necessary to modify measurements to account for different body shapes and sizes. Modify patterns to balance or accentuate body proportions based on personal measurements.
6. **Standardisation vs. Customisation:** Use size charts and standardised measurements for mass-produced clothing. Make sure a range of body shapes and sizes are represented in these criteria. Take precise measurements of each person when ordering bespoke or made-to-measure clothing to ensure a great fit that fits the wearer's unique body type.
7. **Measurement repetition and appropriate documentation or recording:** To guarantee precision and consistency, take several measurements. Measuring twice makes it easier to spot inconsistencies. Measurements should be meticulously recorded or documented,

particularly for custom designs, to guarantee that any future adjustments or clothing are made using correct measurements.

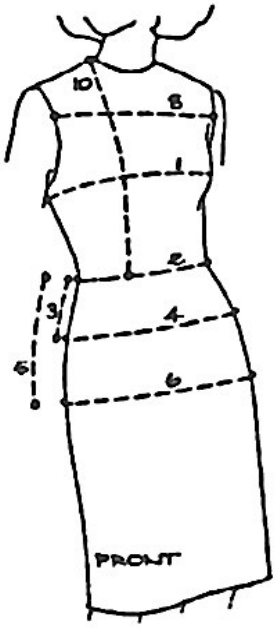
8. **Client Communication:** To make sure your clients' demands are satisfied, talk to them about their preferences, body issues, and fit requirements. Gather and evaluate fitter input to hone measurements and enhance subsequent designs.

BODY MEASUREMENTS

Measuring Techniques

1. Verify the accuracy of your tape measure with the rulers you plan to use.
2. Take measurements over unadorned, well-fitting, simple clothing. There should be regular shoes and undergarments. The subject of the measurement should stand up straight and naturally.
3. Tie a piece of string or thin tape around the natural waist to begin. Use this to get accurate direction for vertical measures, when every centimetre counts.
4. Measure every inch around the figure firmly but loosely. Always measure up to the nearest even centimetre or inch when measuring the breast or chest.
5. Marking the armhole and base of the neck with pins or chalk may be useful for cross measures (back, chest, shoulder).
6. If the measurement is based on standard charts, make sure it is current by measuring both summer and winter garments over suitable undergarments. Do not forget to annotate charts with names and dates.
7. Additional inspections may be necessary for a specific design, such as the depth of the neckline or the placement of the yoke. Record each of these specific design metrics in a notepad.

Table 3.3.5 Body Measurement for Women's Bodice and Skirts

1	Bust	Around the figure & over the fullest part of the bust	
2	Waist	Around the natural waist line	
3	Waist to hipbone	Length taken at side	
4	Hips	Around figure, over hip bones	
5	Waist to Seat	From side to the widest part	
6	Seat	Around widest part (Tape not to pull-in under abdomen)	
7	Back Width	Across the shoulder blades from armhole to armhole	

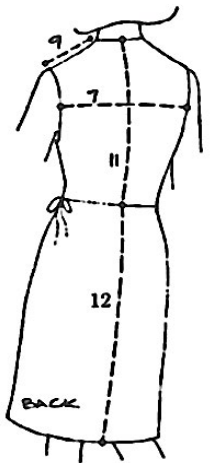
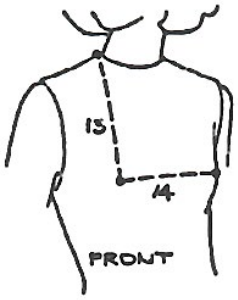
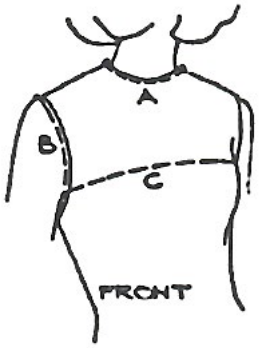
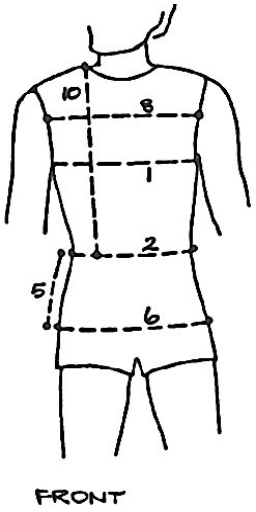
8	Front Chest	Across from armhole to armhole. Below the base of the throat	
9	Shoulder line	The length from base of neck to top of armhole position	
10	Neck to Waist front	Length, from shoulder at base of neck, over bust, to waist	
11	Neck to waist back	Length, from the bone at the top of the spine to the waist	
12	Full length of garment	At centre back from neck, in at waist & on to required length	
For Women's Patterns			
1	Shoulder to bust point	Length from the shoulder at base of neck to the bust point	
2	Distance between bust point		
Check measurements for bodice patterns			
A	Neck	Around the base of the neck	
B	Armhole	Around the armhole as for a set-in sleeve	
C	High Bust	Around the chest. Under arms and above bust	

Table 3.3.6 Body Measurement for men's Casual Wear

1	Chest	Around the figure and over the fullest part of the chest	
2	Waist	Around the natural waist line	
5	Waist to Hip/ Seat area	Taken from the side to the widest part	
6	Hip/ Seat	Around widest part	
7	Back width	Across the shoulder blades from armhole to armhole	
8	Front Chest	Across from armhole to armhole. Below the base of the throat	
9	Shoulder line	The length from base of neck to top of armhole position	

10	Neck to Waist front	Length, from shoulder at base of neck, to waist
11	Neck to Waist back	Length, from the bone at the top of the spine to the waist
12	Full length of garment	At centre back from neck, in at waist & on to required length
Check Measurements for Bodice patterns		
A	Neck	Around the base of the neck
B	Armhole	Around the armhole as for a set- in sleeve

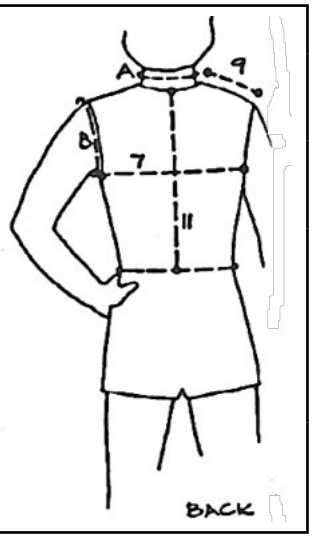
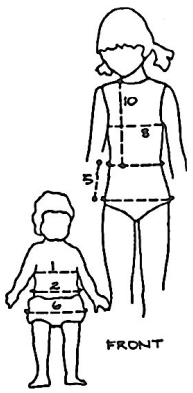
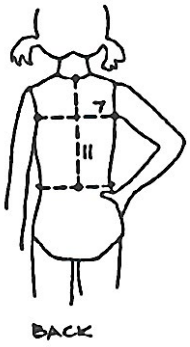


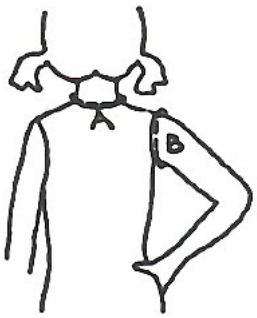
Table 3.3.7 Body Measurement for Children

1	Chest	Around the figure & over the fullest part of the chest
2	Waist	Around the natural waist line
5	Waist to hip/ Seat area	Length taken at side
6	Hip/ Seat	Around figure, over hip bones
7	Back width	From side to the widest part
8	Front Chest	A round widest part (Tape not to pull-in under abdomen)
9	Shoulder line	The length from base of neck to top of armhole position
10	Neck to Waist front	Length, from shoulder at base of neck, over bust, to waist
11	Neck to waist back	Length, from the bone at the top of the spine to the waist
12	Full length of garment	At centre back from neck, in at waist & on to required length
Check Measurement for Bodice patterns		
A	Neck	Around the base of the neck
B	Armhole	Around the armhole as for a set-in sleeve







Learning tasks

1. Explain body measurement and its importance in garment design
2. What are the principles of body measurement? List some of the principles for taking body measurement
3. Identify the parts of the body that need to be measured and measure them
4. Select specific measurements needed for bodice and sleeve blocks

Pedagogical Exemplars

1. **Collaborative Learning, research, experiential learning:** Let learners in groups explain body measurement and its importance with the use of relevant resources. Tabulate the importance of body measurement during the group discussion and present findings in a whole class discussion. Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.
2. **Research, group work:** Help learners in their groups to come out with the principles underling the process of body measurement using internet surf, videos, photographs, drawings, etc. Generate a manual chart of some principles underlying the process of body measurement. Present report in a whole class discussion. Provide specific instructions to the groups to guide the discussions and to prevent the possibility of only one learner doing all the talking. Encourage learners to simply and clearly articulate their points and listen to others during the discussions. Make room for non-vocal learners to contribute to the group discussions through writing.
3. **Collaborative Learning, research:** In groups let learners identify the parts of the body that need to be measured with the use of relevant resources. Make digital or manual charts of the parts to be measured when the client is a man, woman or child. Present findings in a whole class discussion. Encourage all learners to contribute to the discussion while ensuring that a few learners do not dominate the discussion session. Develop communication and discussion skills to facilitate learning.
4. **Project based learning, Group work:** Pair learners and ask them to take their body measurements taking into consideration the principles and concepts underpinning body measurement using the appropriate tools and materials. Learners use their measurements to identify the specific measurements that will be used for bodice, skirts, sleeve and pant blocks. Monitor learner progress and adjust your approach as needed. For example, if a pair is struggling, you could provide additional support or modify the activity.

Key Assessments

Level 1: Define body measurement in garment design

Level 2: Describe three principles of body measurements in garment design

Level 3: Generate manual/digital pictorial charts of different body measurements for different individuals and identify the specific ones to be used for bodice and sleeve blocks.

Level 4

1. Analyse and assess the significance of body measurement in garment design by identifying four critical principles for taking body measurements. Provide real-world examples or case studies that illustrate how accurate body measurements impact garment success in various fashion contexts.
2. Development and Analysis

Task

1. Draft a basic bodice block and a basic sleeve block using the provided measurement chart.
2. Analyse the relationship between these blocks and explain how they work together as a system.

Measurement Chart

Measurement	Value
Bust	92 cm/ 36.22″
Waist	74 cm/ 29.13″
Back Width	34 cm/ 13.39″
Chest Width	32 cm/ 12.60″
Shoulder Length	12 cm/ 4.72″
Bust Point to Bust Point	18 cm/ 7.09″
Nape to Waist	41 cm/ 16.14″
Armscye Depth	20 cm/ 7.87″
Upper Arm Circumference	28 cm/ 11.02″
Wrist Circumference	16 cm/ 6.30″
Sleeve Length	58 cm/ 22.83″

Requirements

1. Draft the blocks at 1/5 scale on the provided pattern paper
2. Include all necessary markings (grain lines, notches, balance marks, etc.)
3. Label all pattern pieces and indicate seam allowances
4. Document your drafting process with brief annotations explaining key decisions
5. Analyse how the sleeve and bodice blocks relate to each other at the armscye

HINT



The recommended mode of assessment for week 23 is Poster presentation. Use the level 4 question 2 as a sample question.

WEEK 24

Learning Indicator: Draft garment patterns using bodice block, skirt block and sleeve block

Focal Area 1: DRAFTING BASIC PATTERN BLOCKS FOR BODICE AND SLEEVE

In garment making, there are a number of ways to make patterns which will translate into final garment products. These include making patterns by drafting, draping or flat method. The focus for this unit will be on pattern making through drafting. Other methods of pattern making will be focused as we progress in garment manufacturing processes.

The ability to draw patterns is a fundamental activity in garment design that connects the idea to the final product. It entails making intricate templates that serve as a guide for cutting and assembling cloth into a wearable item. The fit, finish, and general success of the finished garment are directly impacted by the precision and calibre of pattern drafting. In addition to guaranteeing accuracy and consistency, pattern drafting gives designers the freedom to experiment with new ideas and expedite the manufacturing process.

Meaning of Pattern Drafting

Pattern Drafting is the process of making intricate garment patterns or templates. These patterns, which often include all the parts needed to make the garment—such as sleeves, bodices, skirt panels, and collars can be created either manually or digitally.

Importance of Pattern Drafting

1. **Consistency:** Patterns guarantee uniformity between several outfits in commercial production. Large-scale and high-quality manufacturing depend on the uniform fit and style of every piece made from the same pattern.
2. **Design Flexibility:** Designers can try out various fits, styles, and cuts by using drafting patterns. Designers have the creative flexibility to create new designs by altering pre-existing patterns.
3. **Cost Efficiency:** Accurate designs eliminate fabric waste and the necessity for trial-and-error fittings. Efficient pattern drawing leads to cost savings in fabric and labour.
4. **Precision and Fit:** Pattern drafting ensures that garments fit well and align with the designer's vision. Accurate patterns lead to better fitting garments and reduce the need for extensive alterations.
5. **Speed:** A pattern can be utilised again and again once it is established. This expedites the process of design and production, freeing up designers to concentrate on originality and creativity.
6. **Technical Communication:** Patterns give designers, pattern makers, and manufacturers a common language. They make sure that the design specifications are understood by all parties engaged in the garment production process.

Principles of drafting garment patterns

Drafting garment patterns involves applying a set of principles to create accurate and functional templates for garment construction. These principles ensure that patterns result in well-fitting, aesthetically pleasing garments. Here's an overview of the core principles involved in pattern drafting:

- **Ensure measurement accuracy**
  Having precise measurements is essential to designing patterns that fit nicely. They guarantee that the garment won't require a lot of alterations down the road to fit the specified body or dress shape.

  Measure important body parts such the bust, waist, hips, shoulder width, and inseam precisely. Make sure the individual being measured is standing in a relaxed, natural posture and use a flexible measuring tape.

- **Understanding Body Shapes**

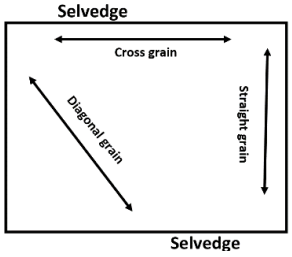
  Distinctive body forms and dimensions necessitate distinct adaptations. Drafting patterns that account for variances in body shape are made easier with an understanding of body kinds.
  Therefore, acquaint yourself with typical body types and dimensions. Adapt patterns to individual proportions, taking into account adjustments for ease of wear and stylistic choices.

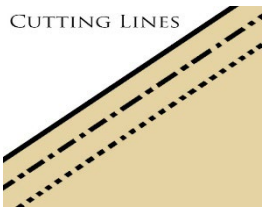
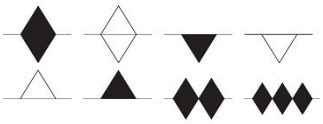
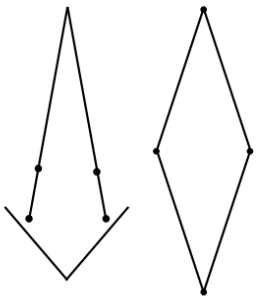
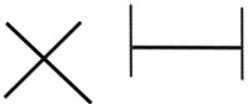
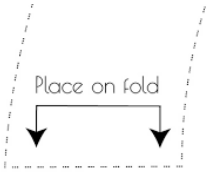
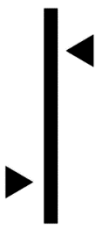
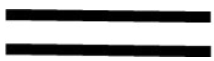
- **Comfort Allowance**
  The extra room that is added to a pattern to allow for comfort and movement is called ease. A well-fitting and wearable outfit is crucial.
  Include two different kinds of ease:
  a. For mobility and comfort on a daily basis. Usually included in every area of clothing.
  b. Extra room for aesthetic elements like gathers or pleats is known as design ease.

- **Allowances for seams**

  Extra fabric is added to pattern edges to allow for stitching, which is known as a seam allowance. They guarantee correct fit and assembly.
  Give all pattern piece edges seam allowances. Typical allowances vary from 1/4 inch (6.5mm) to 5/8 inch (16mm), contingent upon the article of clothing and the stitching methods employed.

Table 3.3.8 Pattern making symbols in pattern drafting

Symbol Name	Image	Purpose
Grainlines		Grain lines indicate the direction in which the pattern piece should be placed in relation to the fabric's grain. ensures that the apparel will hang and fit correctly.

Cutting Line		Cutting lines serves as the fabric's cutting line. Seam allowances are included in the cutting line if they are not shown separately.
Notches		Little triangles or diamonds pointing outward from the cutting line are used to align the pattern pieces correctly when sewing.
Darts		symbols in the shape of triangles or diamonds that show where the cloth should be stitched to form the garment to fit the wearer's body. Usually, they have a line that extends from the triangle's tip, either straight or curved.
Pleats		Symbols that indicate the proper placement for folding and stitching fabric to produce a pleated look. They frequently take the form of lines with numerous arrows or brackets.
Button and Buttonhole Marks		The locations of buttons and buttonholes are indicated by squares or circles. These symbols frequently have placement-related measurements.
Cut or place on Fold		On fold is a remark (often a line with a folded arrow) telling the seam-free cutter to cut the pattern piece as one continuous piece on the fold of the fabric.
Zip		It is positioned at the edge of a pattern piece—the centre back, side seam, or any other opening in the garment—where the zipper is going to be sewed.
Adjustment line		A guide or notation on a pattern piece that shows where modifications can be made to change the garment's fit, size, or shape is known as an adjustment line in clothing patterns.

Drafting basic blocks for bodice

Women's Basic Bodice Block Drafting

The shaping for the women's basic bodice block is based on two rectangles which represent half of the back and half of the front. The size of these rectangles or blocks is determined by the bust measurement and the shaping within these blocks by the figure measurements.

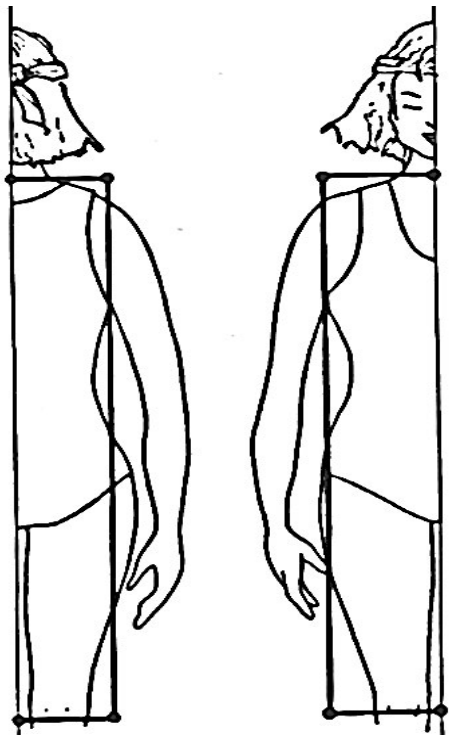


Figure 3.3.1: *The body foundation in rectangles*

The Body Foundation Pattern Method with the underarm dart drafting processes

Step 1 Rectangular Block

First draw two rectangles to represent half of the back and half of the front, spacing them 15cm/ 6inchs. Apart with the back to the left-hand side.

Table 3.1

Back Foundation Block	Width = ¼ of the bust measurement
	Length = as required
Front Foundation Block	Width = ¼ of the bust measurement + 3cm/ 6inchs for tolerance over the diaphragm
	Length = as required

The front pattern is wider than the back pattern for its full length. This places the side seam correctly. If the neck to waist front measurement is longer than the neck to waist back measurement then the extra is added on to the front block length at the hem.

Note

Name both blocks. The side seams face each other at the middle Centre Back to the far left. Centre Front to the far right.

Step 2 Horizontal Guide – lines

The next step is to rule lines across the block to give for the shaping of the pattern. Some are drawn according to the Guide Chart given and others are taken from the Personal Measurements Chart.

The shoulder guide line, bust guide line and waist line are all measured down from the top of the blocks. Hip and seat lines are measured down from the waist line. Name each line until they are well positioned.

Table 3.3.9

Shoulder Guide-line	Back & Front are the same
Bust Guide-line	
Waistline	Back taken from Measurement
	Front taken from Measurement
Hip line	Back and Front taken from Measurement
Seat Line	Back and Front taken from Measurement

Step 3

Draft on a large sheet of plain paper. Use metric rulers, a good set square, a 2B pencil and the required measurement needed for the pattern.

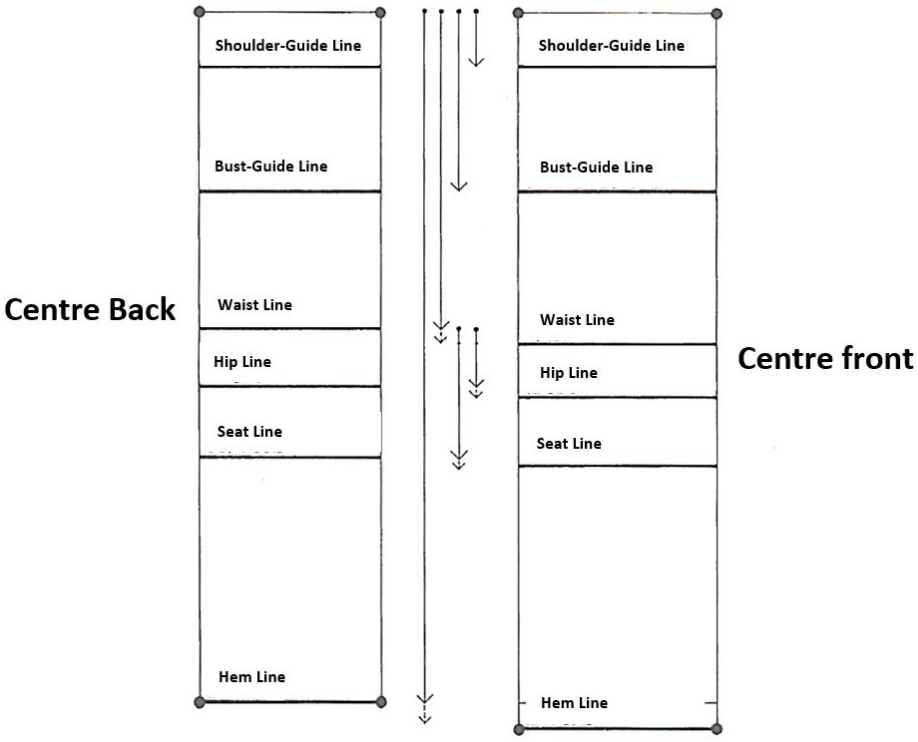


Figure 3.3.2: *body foundation block*

Step 4 Vertical Guide- lines

Now rule in the vertical guide- line for the armhole and neck shaping. These lines run from the top of each block at a distance in from the Centre back and Centre front.

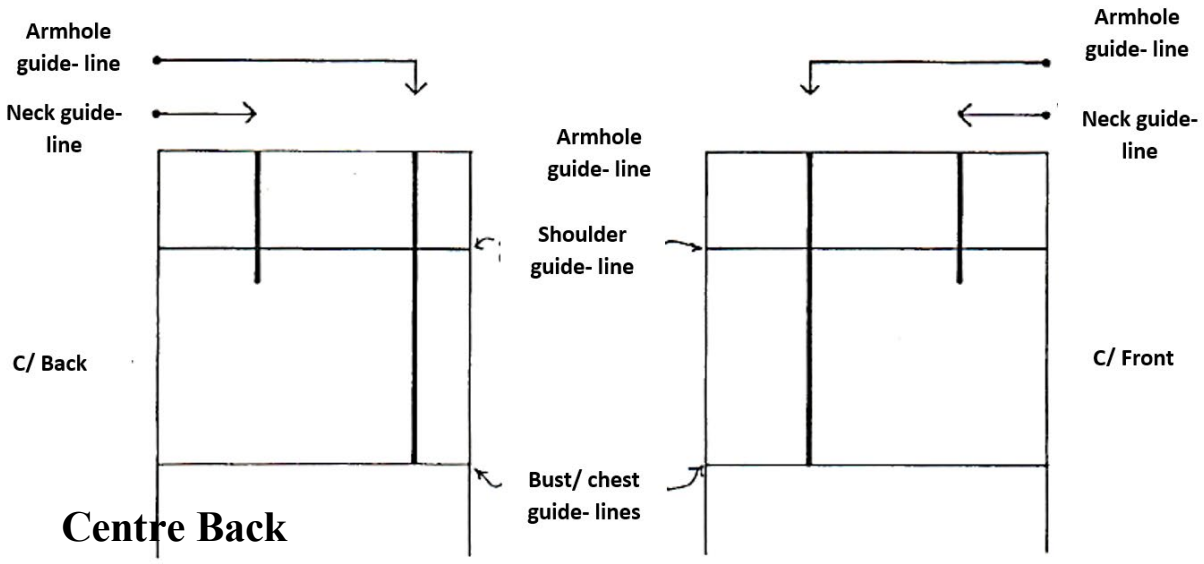
Table 3.3.10

Neck Guide- line	Back and Front taken from the Guide Chart. Rule down to just below the Shoulder Guide-line
Armhole Guide- line	Back = ½ back width in from centre back
	Front = ½ chest in from Centre front
	Rule both back and front down to the Bust Guide line

Step 5 Shaping the Bodice

The foundation is ready for shaping

1. **Back Neck:** Draw a curved line from the top of the neck guide- line to a point 1.5 cm / 5/8 inch, below the top of the block at the Centre back.
2. **Front Neck:** Draw a curved line from the top of the neck guide-line to a point 1.5 cm. below the shoulder guide line at the Centre front. As these two curves are to fit around the base of the neck column, shape them accordingly.
3. **Shoulder Lines:** The back and front are ruled from the top of the neck shaping to a point 1.5cm. up from the shoulder guide-lines for average positioning. Make these lines shoulder length.
4. **Armhole:** For back and front, rule the first part of the armhole from the outer point of the shoulder-line to touch the armhole guide-line about half-way down. From there, curve down and around until you reach the bust guide- line on the side seam edge. Keep the curve diagonally out from the corner by approximately 2.5cm on the front armhole and 1.5cm on the back armhole. (Less for very small sizes). The armhole may be reshaped later to curve out any sharp angles.



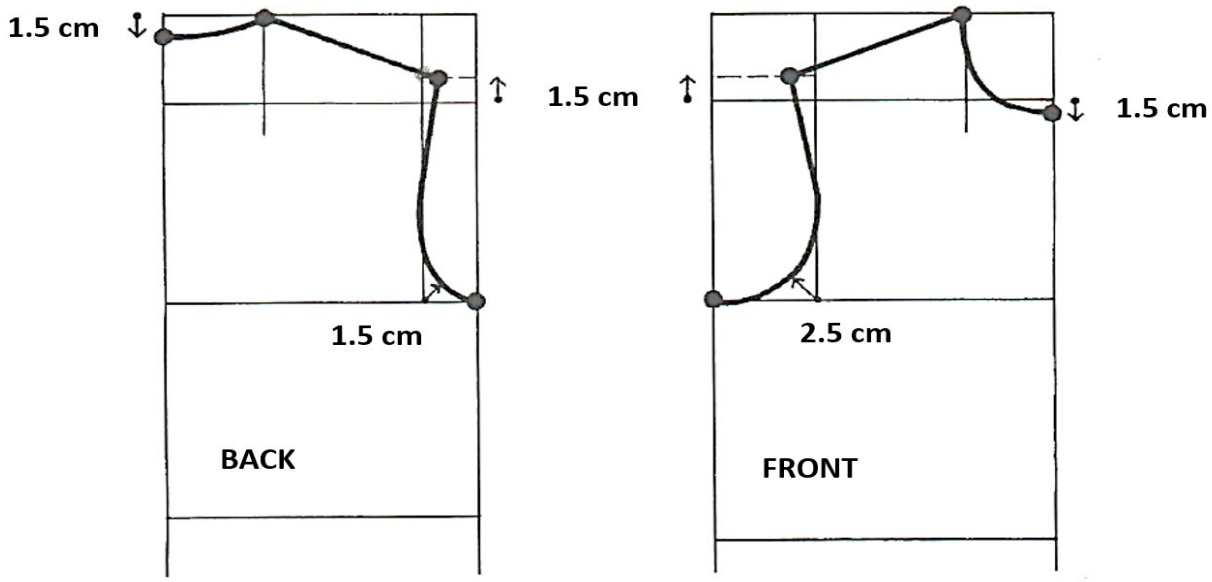


Figure 3.3.3: *Shaping the armhole*

Step 6 Shaping the Side seams

It will be easy to simply go along the waistlines for ¼ of the waist measurement, but as the blocks are of different widths this will make the side seams (which have to be joined together) run at different angles. By this method the sides seams match and the greater overall width of the front pattern is maintained.

1. **Waist shaping Back and Front**

   Halve the waist measurement (M/2) and subtract the answer from the sum of two block widths. This is for half the figure so divide by two and come in this amount from the side seam at the waist line on both blocks.

2. **Hip and Seat Shaping Back and Front**

   Work out these two measurements separately in the same way as for the waist shaping. However, if the ½ hip answer or the ½ seat answer is greater than the sum of the two blocks, the point for shaping will fall outside the blocks; If the answer to your sum is less, the point is inside. If it is the same you go exactly to the inside lines of the blocks.

3. **Hemline Back and Front**

   After joining up all the points on the side as far as the seat, go down to the hem, bringing the line out by a suitable amount. This could be from 3cm. For a short block to 7cm. For a floor length block. These side seams are ruled in the first instance. They will later be softly curved, but only after all shaping for a particular pattern is completed.

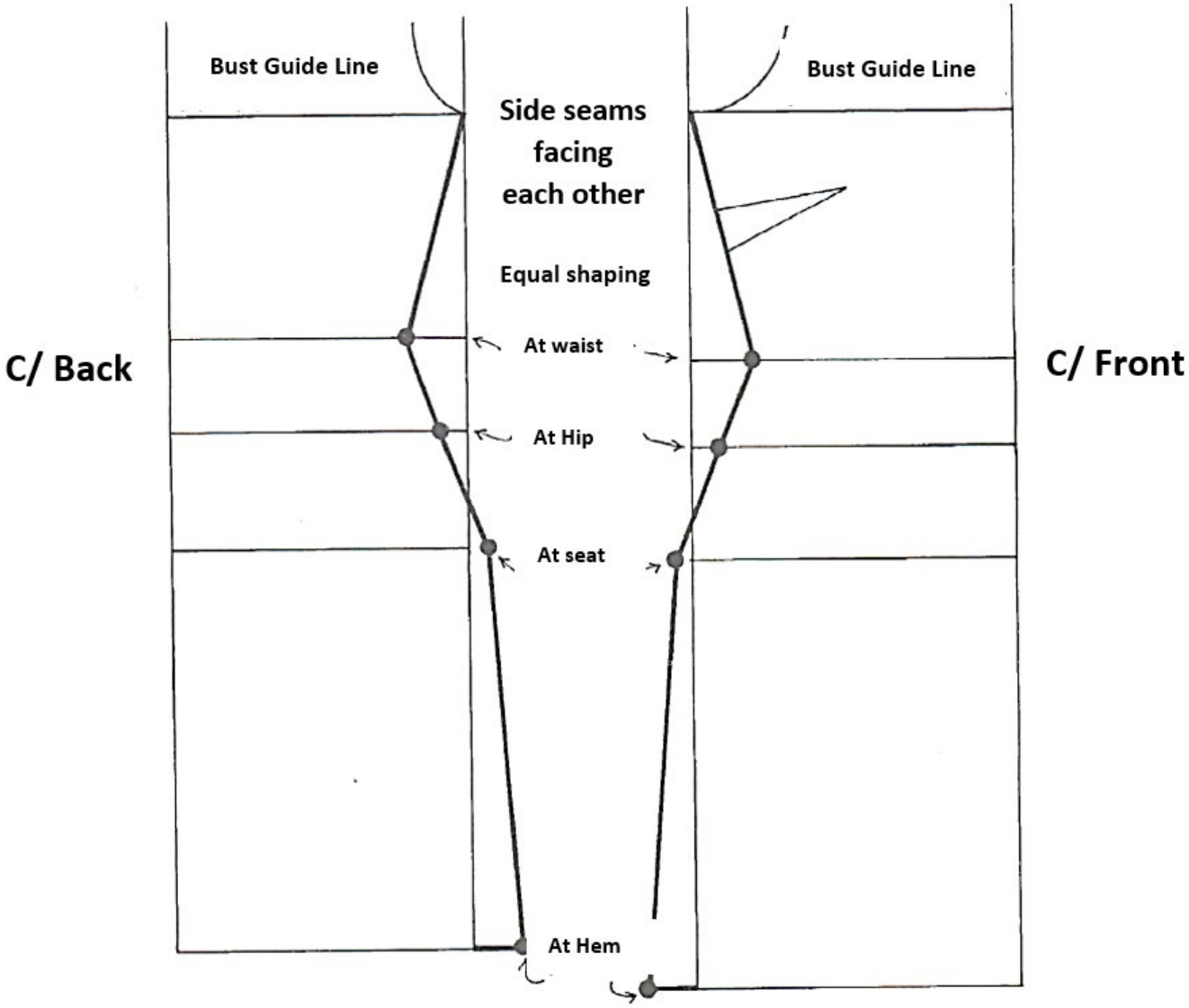


Figure 3.3.4: *Shaping the side seams*

Step 7 Dart

Darts give shape and form to an otherwise flat pattern. Some darts are essential while others are optional. In a later lesson we will learn how to shift darts to new positions, but for the initial foundation they should be placed as follows:

Front Underarm Dart: For bust shaping in women's pattern. This is the most important dart in a women's pattern as it gives the shaping for the bust and brings the side seam to the same length.

First establish the bust point as measured M/13 down from the neck / shoulder point and half of measurement M/14 in from the centre front. See table 3.3.5

Then from the bust guide line. Go down the side seam by approximately 9cm. Rule a line from there to the bust point. This is the centre line of your dart. The width of this dart is the difference between M/10 and M/11. The dart length should stop several cm short of the bust point. Adjust the side seams to allow for the stitching of the dart. This can be done by folding in.

Front Shoulder Dart (Optional): This dart is not necessary for all figures and designs but can be useful.

Go down the shoulder-line 6cm and rule to the bust point. This is the centre line of your dart. Rule in the dart 2.5cm. wide and the full length of the centre line. This width (2.5cm) must be added on to the shoulder line, being careful not to drop its end below the established point

Back Shoulder Dart (Only used when necessary): This is used to correct the length of the back shoulder-line and can be placed in the most suitable position for the figure and style involved

Its length should be from 6cm to 8cm. its direction should be towards a point 8cm. in from the centre back on the bust guide line. This will then line up with any vertical darts.

Vertical Waist- Shaping Darts: These can be placed in the foundation pattern, particularly those running from back waist to the hip/ seat area. As they vary so much from style to style they are best left to each individual pattern.

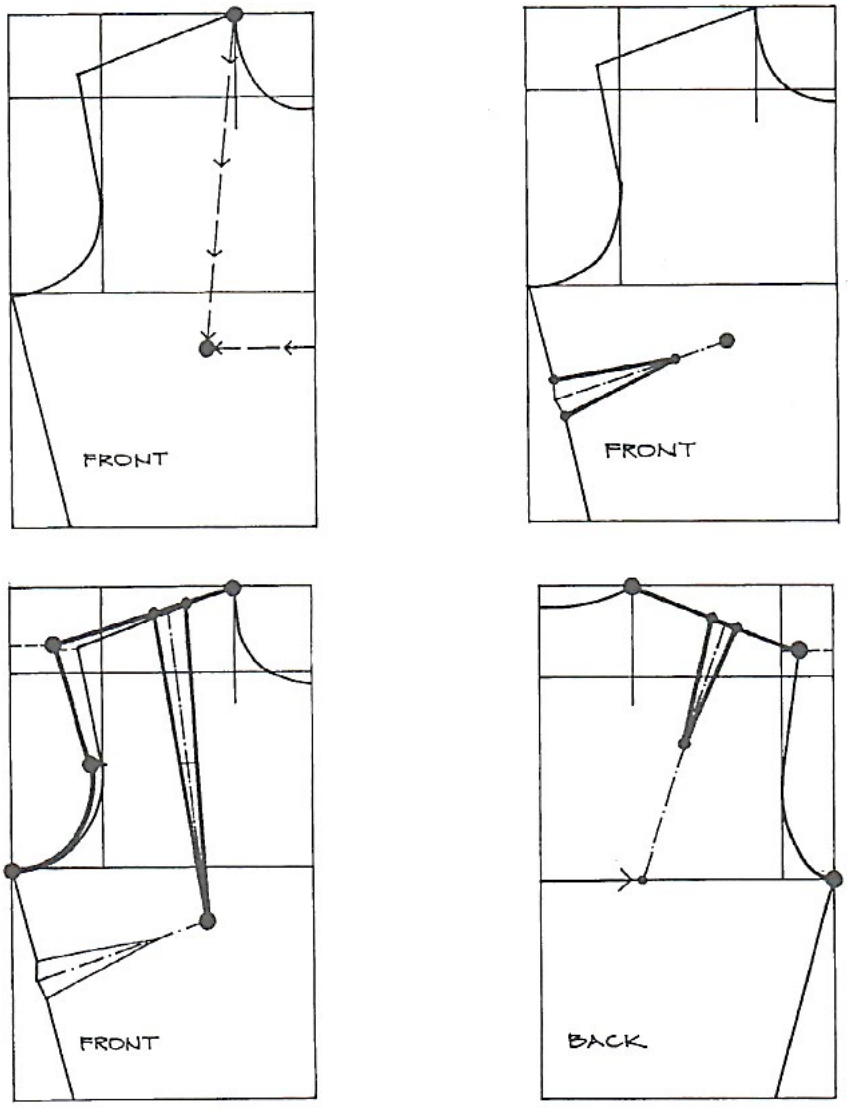


Figure 3.3.5: *Connecting and transferring darts*

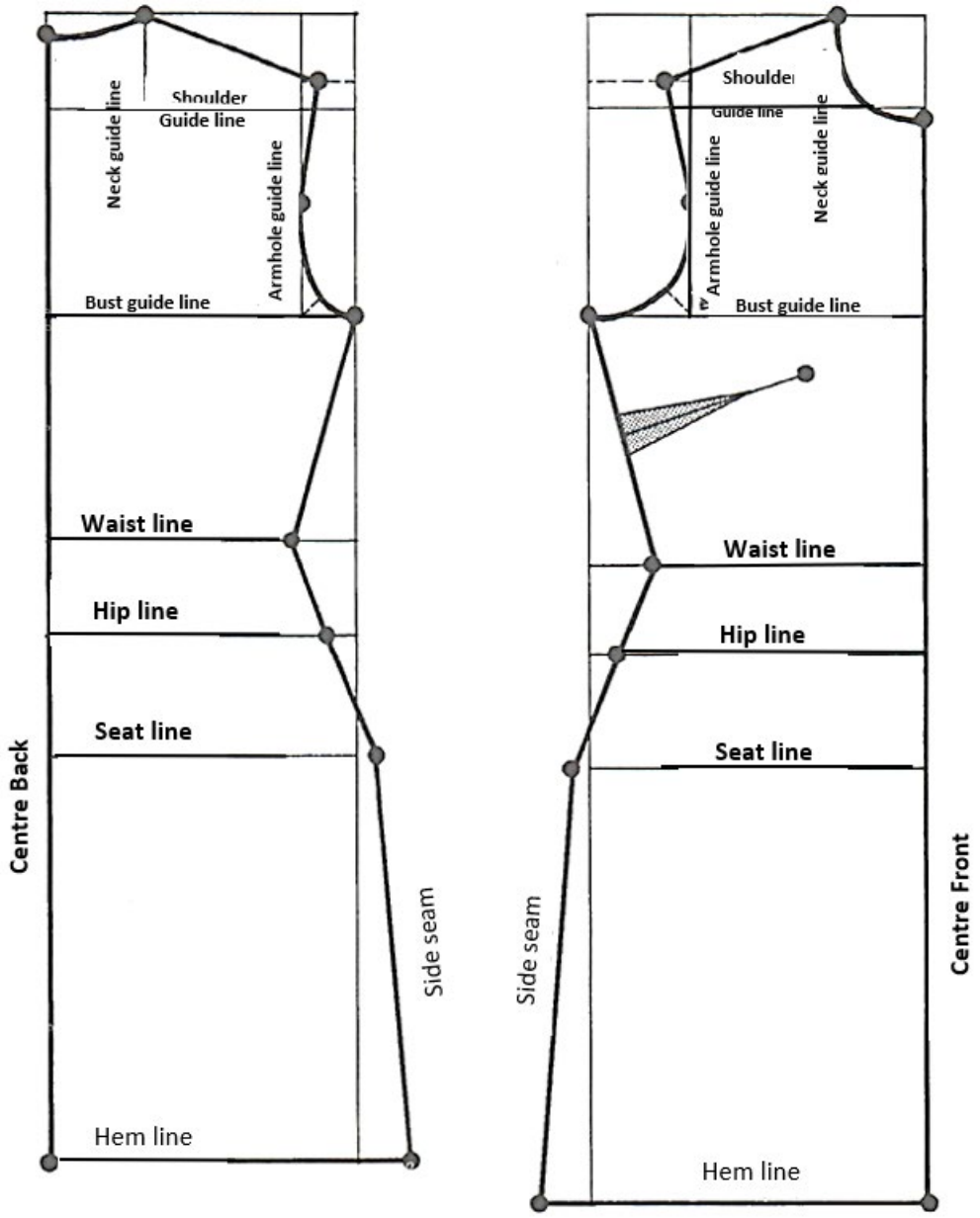


Figure 3.3.6: *Completed front and back bodice block*

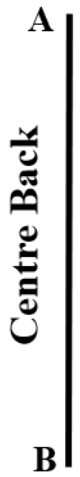
Note

Dart positioned to any referred section of the block depending on the individual style preference and adaptation. Then pattern marking symbols can now be added.

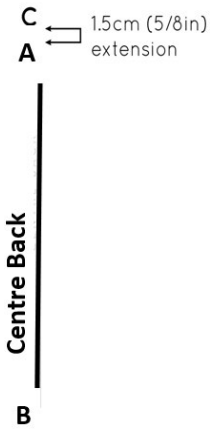
Body Foundation with waist dart drafting processes

Step one: CONSTRUCT THE CENTRE BACK

With a large piece of pattern paper mark a point **A** close to the top left corner (always leave some space around the starting point when drafting patterns). From this point, draw a vertical line down the left-hand side of the paper that is the length of the **nape of neck to waist measurement**. Mark the end point as **B**. This line will become the CENTRE BACK of the block and the grainline of the back pattern piece.

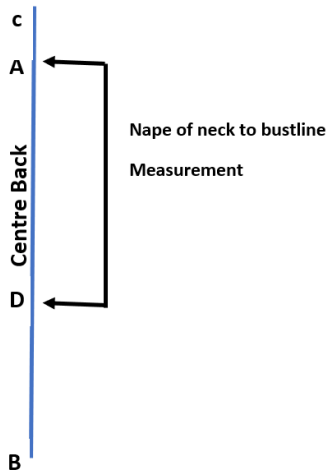


Extend line AB by 1.5cm (1/2”) from **A**, and label new endpoint as **C**. This extra 1.5cm (1/2”) allows for back neck shaping. Label AB as CENTRE BACK (CB).

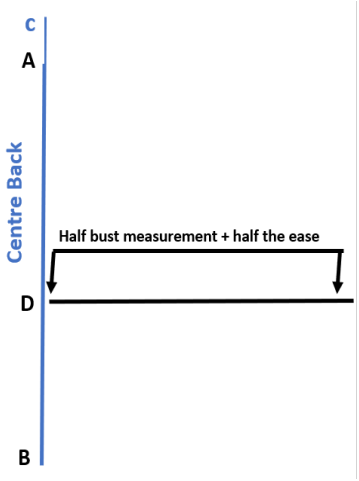


Step two: CONSTRUCT THE BUSTLINE

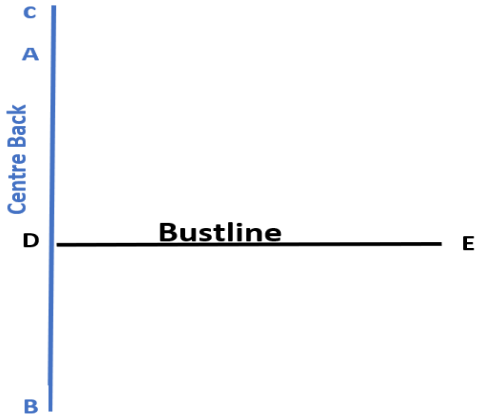
Next, indicate BUST LINE (the horizontal line that runs through both the front and back of the pattern at bust level). Take the nape of neck to bustline measurement. Then, measuring from point A, mark this length as point D on line AB.



Square out from point D with a line that is half of your bust measurement (only half bust is required as the pattern is on a half – i.e. the front will be cut on the fold, and a pair of the back will be cut) plus ease. For the example if you decide to add 5cm (2") ease to the bust. Remember to halve the amount of ease, before adding it to your half-bust measurement,

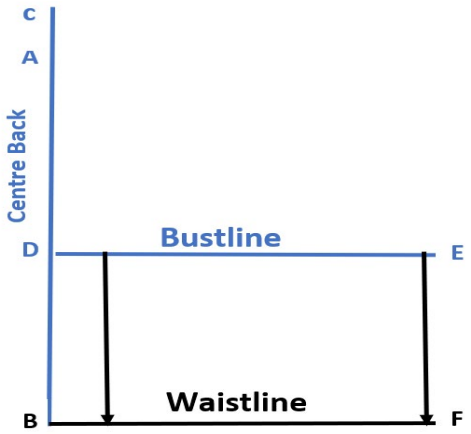


Label end point of this line as E. Mark this line as BUST LINE.



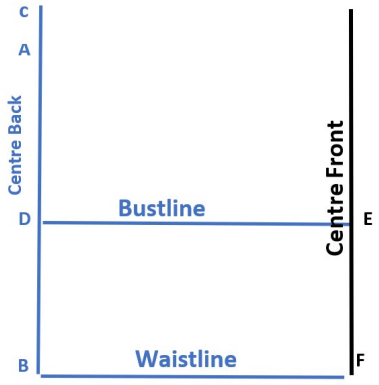
Step 3: CONSTRUCT THE WASITLINE

Square out from point B, drawing a line the same length as your bust line. Mark endpoint as F. Label this line WAIST LINE.

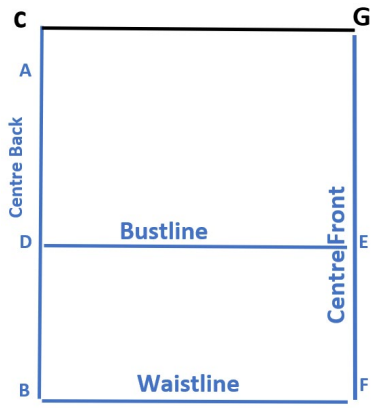


Step 5: CONSTRUCT THE CENTRE FRONT

Square up from F (passing through E), the length of the CENTRE BACK (including the extension), and mark the end point as G. Label FG as the CENTRE FRONT (CF). This will also be the grainline of your front pattern piece.

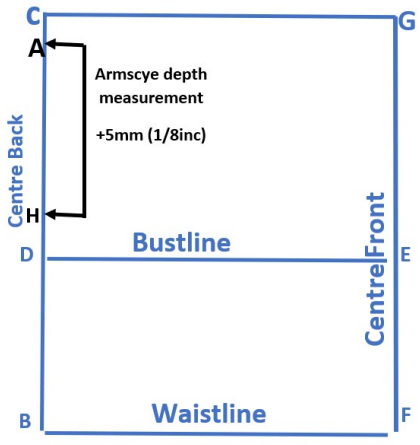


Join G to C with a straight line.

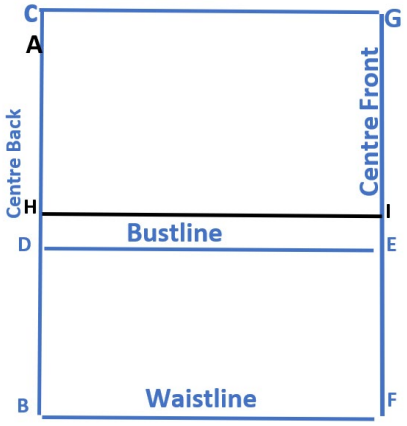


Step 6: MARK THE ARMSCYE

Take the armscye depth measurement and add 0.5cm (1/4”). Measuring from point A down towards point B, mark this distance on CENTRE BACK. Label this point as H.

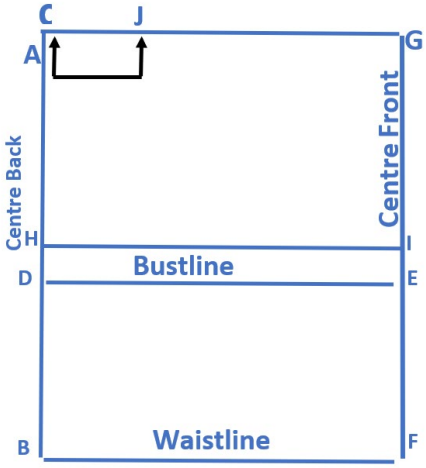


Square out from H and extend the line until it intersects the CENTRE FRONT line. Mark the intersection points as I.

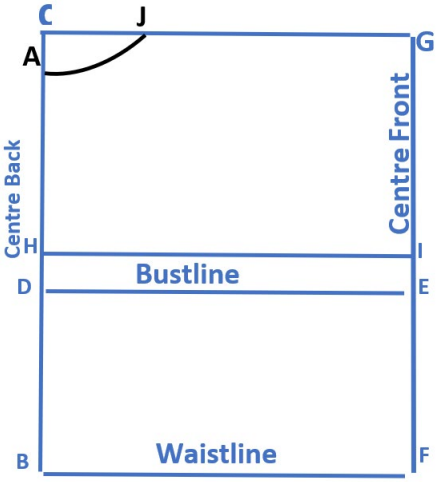


Step 7: CONSTRUCT THE BACK NECKLINE

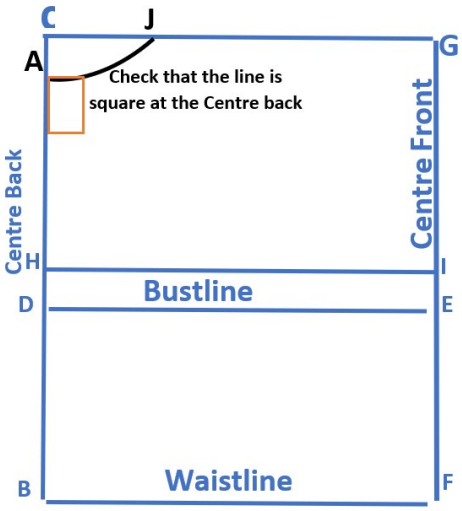
Take your neck measurement and divide it by 5. Measuring from point C, mark this measurement on line CJ. Label this point as point J.



Join points A and J with a shallow curve – this curve is the back neckline.

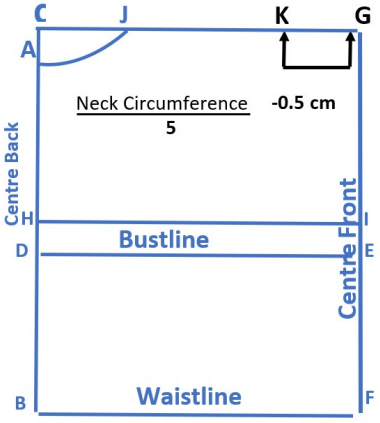


When working with curved lines, always check that they come to a right angle when they meet a straight seam (for example, the centre front, centre back or side seam). By doing this, you ensure that you will get a nice smooth curve when you cut a pair of a particular piece, or cut it on the fold.

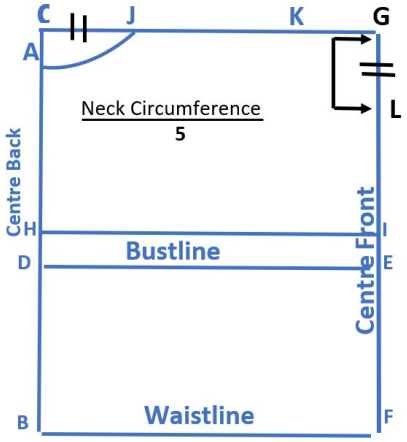


Step 8: CONSTRUCT THE FRONT NECKLINE

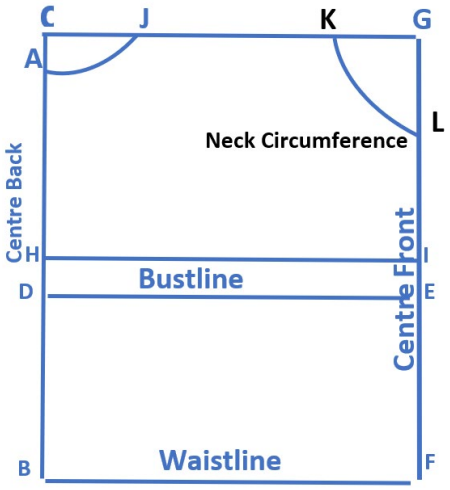
Take the neck measurement, divide it by 5 and then subtract 0.5cm (1/4"). Mark this measurement on line GC (measuring from point G) as point K.



On the CENTRE FRONT (GF) mark a point the same length as CJ down from point G (neck circumference divided by 5). Mark the point as L.

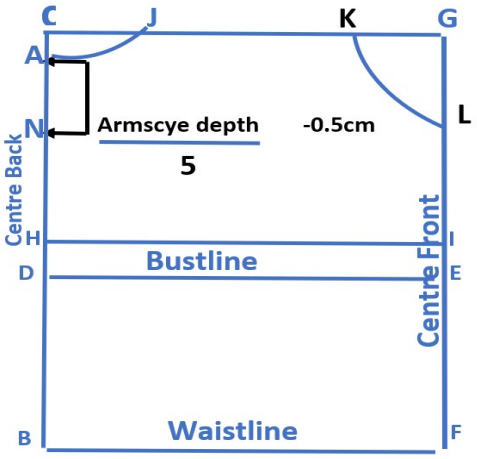


Join K to L with a deep curve – this is the front neckline. As we did with the back neckline, check that the curve of the neckline meets the centre front at a right angle (so that you will get a nice smooth neckline when you cut the piece on the fold).

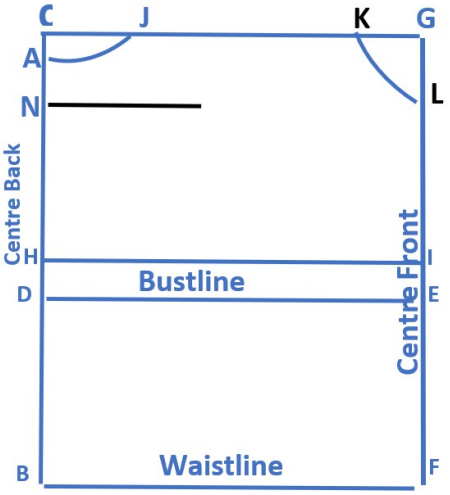


Step 9: DRAFTING THE BACK SHOULDER SEAM

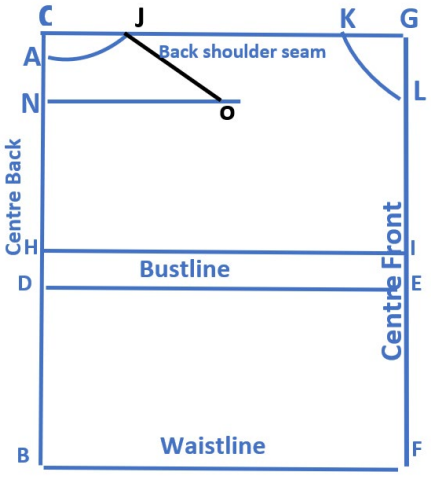
Take the armscye depth measurement and divide it by 5 and then subtract 0.5cm (1/4»). Mark this distance, measuring down from A on the CENTRE BACK as point N.



Square out from point N. This is just a guideline, so does not have to be a specific length.

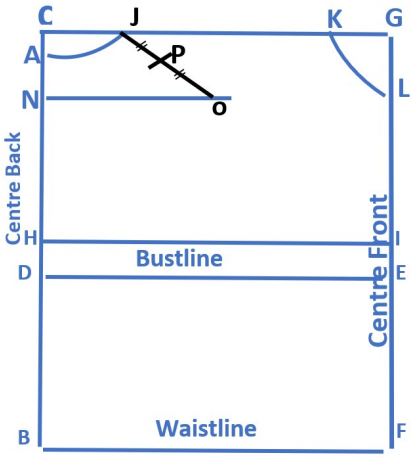


Take the shoulder length measurement and add 1.5cm (1/2”) (this is the allowance for the shoulder dart). With this length in mind (or written down if you have a bad memory like me), use a ruler to pivot from point J until your measurement passes through the perpendicular line drawn from N. Draw a straight line to create your shoulder line. Label the endpoint as O.

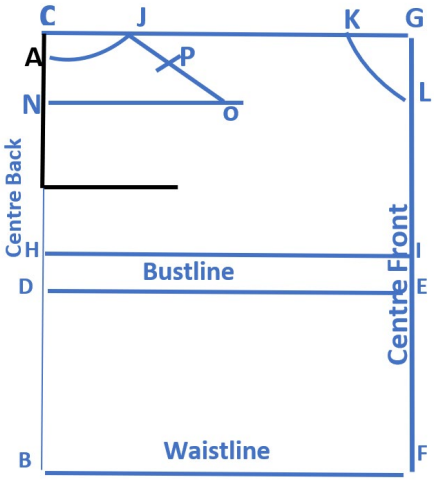


Step 10: DRAFTING THE BACK SHOULDER DART

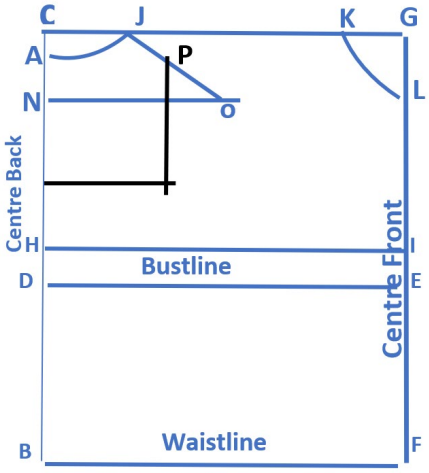
Mark the midpoint of the back shoulder seam (line JO) (i.e. the distance halfway between J and O) as point P.



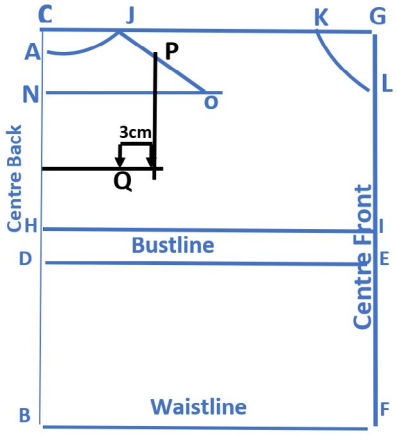
Mark a point 15cm (6”) down from point A, on the CENTRE BACK line, and square out from this point. Once again, this is only a guideline, so does not need to be a specific length.



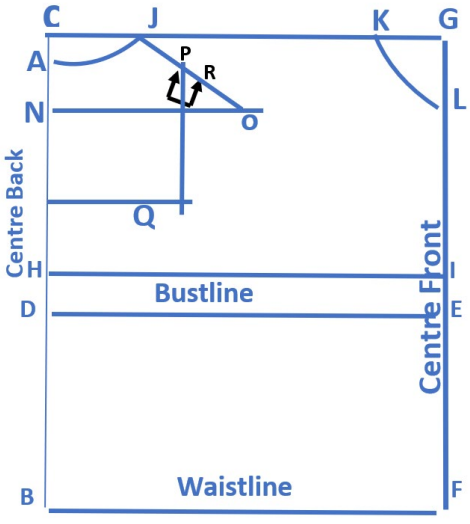
From point **P**, draw a guideline parallel to CENTRE BACK, extending down until it passes through the perpendicular line that you marked in the previous step.



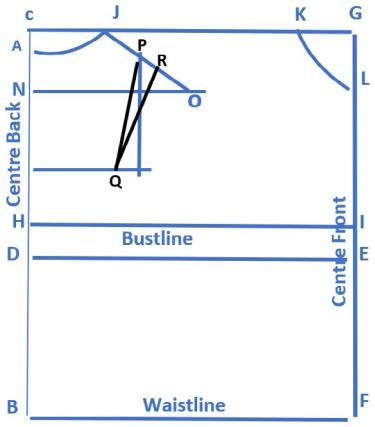
From where these lines intersect, mark a point 3cm (1 1/4") towards the CENTRE BACK and label as point **Q**. **Q** will become the point of the back shoulder dart.



Mark a point 1.5cm (1/2") from **P** on the back shoulder seam (line JO), towards **O**. Label this point as point **R**.

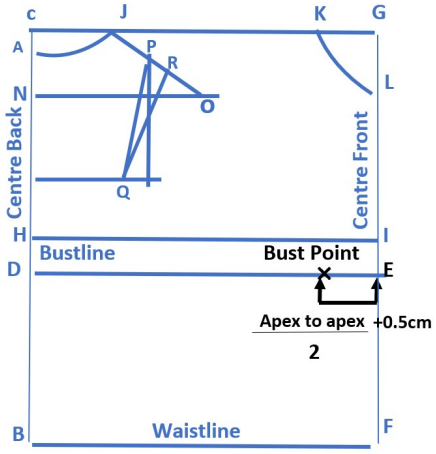


Join P to Q to create the first dart arm and point R to Q to create the second dart arm.

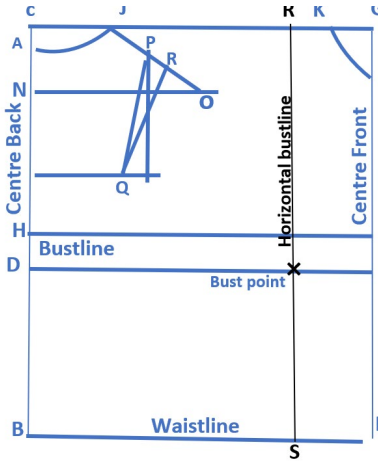


Step 11: MARK THE BUST POINT

Move your attention to you BUST LINE (line ED). Take the bust point to point measurement and divide it by 2 (as we are working on the half) and add 0.5cm (1/4") (allocated ease). Take note of this measurement. From point E, on the bustline, mark a point, the distance you just found from point E. Mark this point as your BUST POINT.

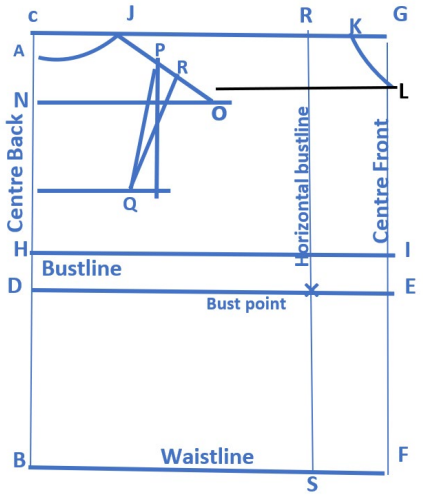


Draw a vertical line, parallel to the centre front and centre back, passing through the bust point, intersecting all your horizontal guidelines. This line is the VERTICAL BUST LINE. Where it intersects CG label as point R and point S where it intersects the WAISTLINE (BF).



Step 12: DRAFT THE FRONT SHOULDER DART

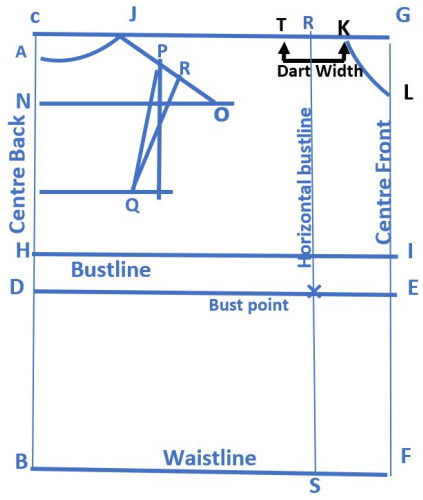
Mark a point 0.5cm (1/4") up from L on the CENTRE FRONT (line GF) and square out from this point. Again, this is just a guideline, so it doesn't have to be a specific length.



Add or subtract 0.6 cm (1/4") to 7cm (2 3/4") for each 4cm (1 1/2") bust increment above or below 88cm (34 1/2"). For bigger busts you will need a larger dart (add to 7cm), and for a smaller bust you will need a small dart (therefore subtract from 7cm).

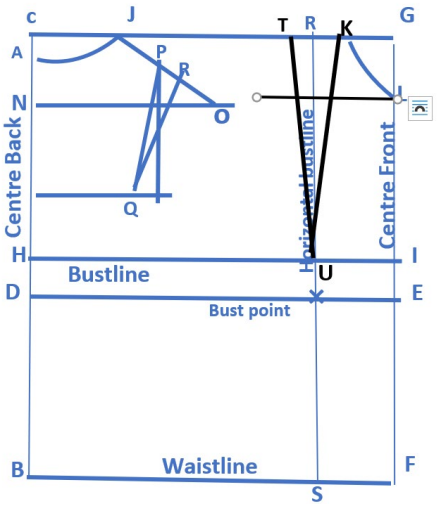
For example, a bust measurement of 84cm (33"), which is 4cm (1 1/2") below 88cm (34 1/2"), therefore I need to subtract 0.6cm (1/4") from 7cm (2 3/4"), leaving a dart width of 6.4cm (2 1/2").

Take dart width measurement and mark this distance from K as point T.



Move down to the BUST POINT and mark a point 1cm (3/8") above it on line RS (vertical bust line) as point U. This will be the point of your dart. The reason why we lift the dart point a little above the bust point is that if the dart point was right at bust point you will be left with Madonna style pointed breasts!

Join K and T to U with straight lines to create the front shoulder dart.

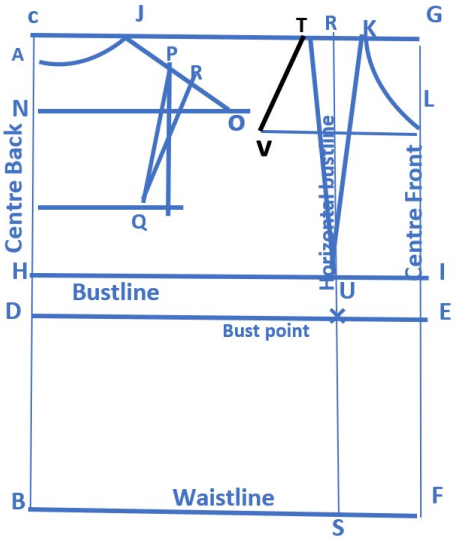


Step 13: DRAFTING FRONT SHOULDER SEAM

Take your shoulder length measurement and, with this length in mind, and using your ruler, pivot from point T until your measurement passes through the perpendicular line drawn from above point L. Draw a straight line - creating your front shoulder line. Mark the endpoint as point V.

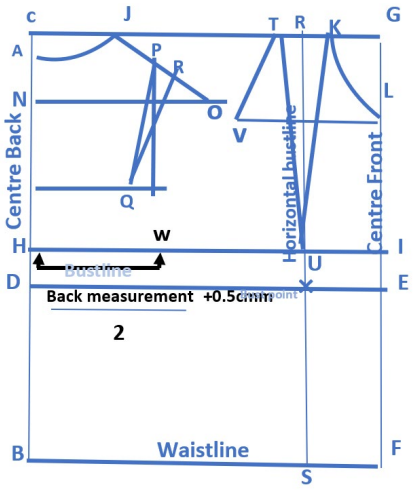
Note

it's not a problem if your shoulder lines overlap - just keep working through the tutorial. When you get to the end you will be tracing a copy so that you have separate front and back bodice pieces and can add seam allowance.

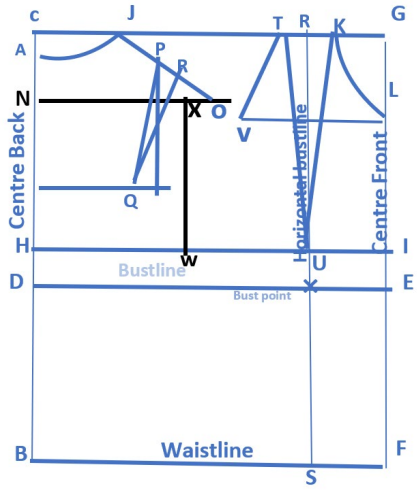


Step 14: DRAFTING THE ARMHOLE

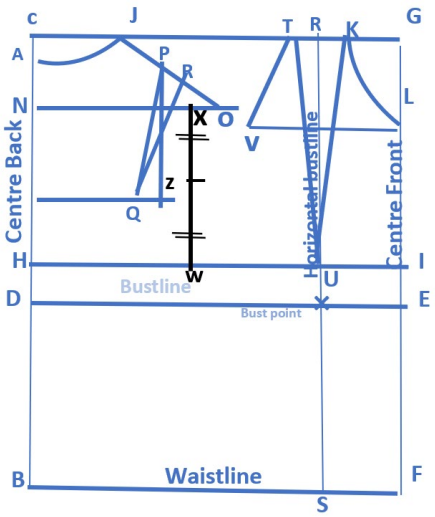
On line HI mark a point that is the length of half of your back measurement plus 0.5cm (1/4") (allocated ease), from H. Label point as W.



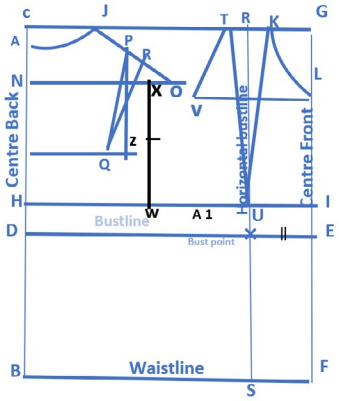
Square up from point W until the line intersects the perpendicular line drawn from **N**. Mark the intersection points as **X**.



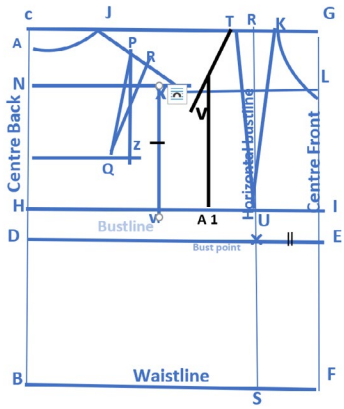
Find the midpoint of line XW. Mark as point **Z**.



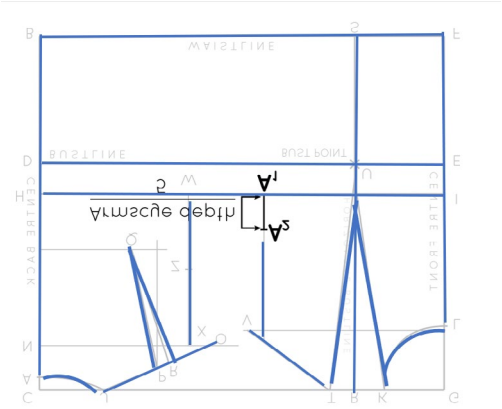
Take the distance from the CENTRE FRONT to BUST POINT (i.e length from E to BP or half bust apex to apex measurement plus 0.5cm) and mark this distance on line HI, measuring from the dart arm closest to CENTRE back. Mark point as A1.



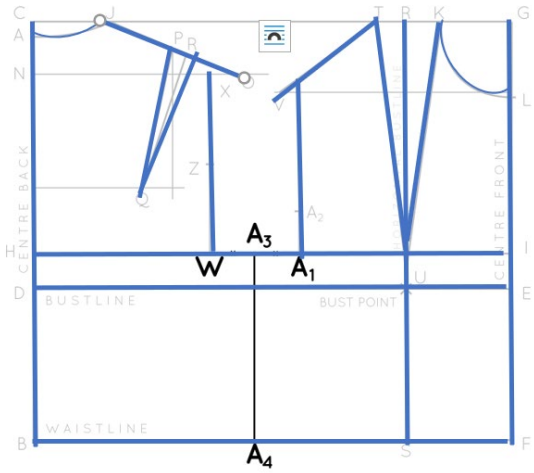
Square up from point A1 so that the line intersects the front shoulder seam (line VT).



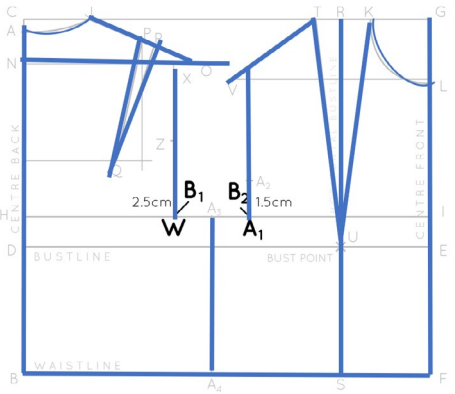
Take the **armscye depth measurement** and divide it by five. Mark this length on the line just drawn from **A1**, as point **A2**.



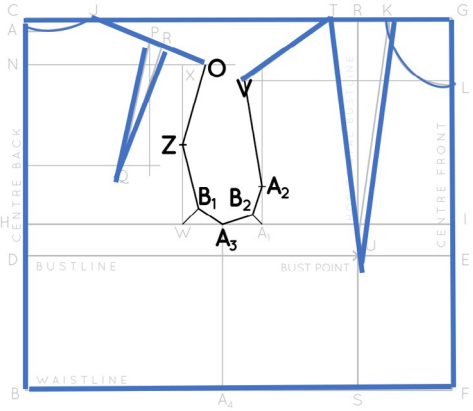
Find the midpoint of the line between **W** and **A1** and mark as **A3**. Square down from this point so that the line intersects waistline (line BF). Mark intersection point as **A4**.



Draw diagonal lines (lines drawn at a 45-degree angle) inwards from points **W** and **A1**. From **W** the line needs to be 2.5cm long (1") (mark endpoint as **B1**), and from **A1** 1.5cm long (1/2") (mark endpoint as **B2**). These diagonal lines will help in the next step, when we are at the stage of drawing in the curve of the armhole.



Join **O** to **Z** to **B1** to **A3** to **B2** to **A2** to **T** with straight lines.



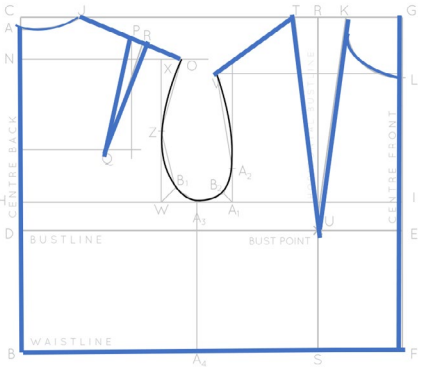
Step 15: CREATING DARTS

At this point, the waist measurement is the same as the bust measurement. For a lot of us, our bust measurement is larger than our waist measurement. To remove this excess width from the waist and to create a well-fitting block you will add waist darts (one in the back waist and one in the front waist – remember this is on the half so when you make your block there will be

two in the back, and two in the front. We will also slightly taper the side seam, which we will also treat as a dart at this stage).

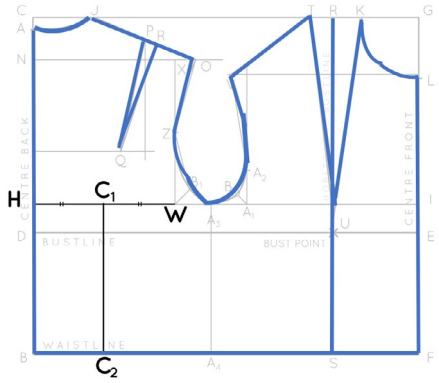
To work out how much width you will need to remove with your darts, take your waist measurement and add 2cm (7/8") ease. Subtract this measurement from your bust measurement and divide your answer by 2.

Divide this number by three, so that it can be distributed evenly throughout back dart, front dart and side seam.

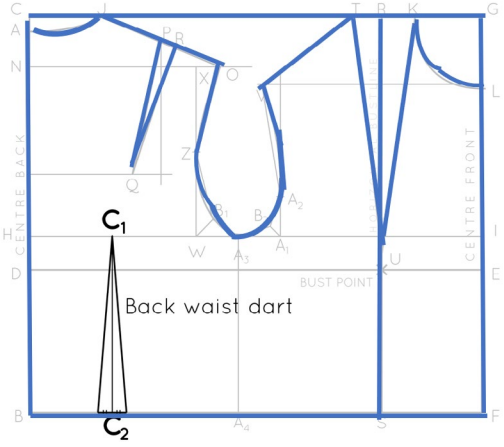


Step 16: DRAFT THE BACK WAIST DART

To mark the placement of the back waist dart, find the midpoint of line HV and label as C1. Square down from this point so that line intersects the WAIST LINE (BF). Mark the point of intersection as point C2. This will become the centre of your back dart.

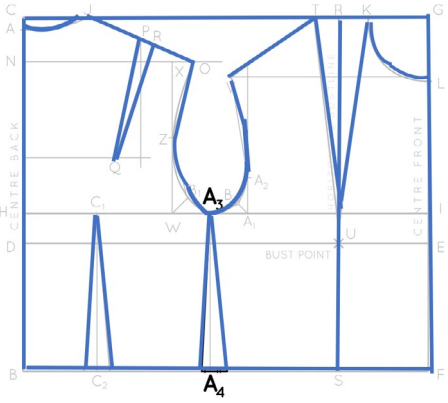


Distribute the dart width evenly either side of C2 and join endpoints to C1 to create dart arms.



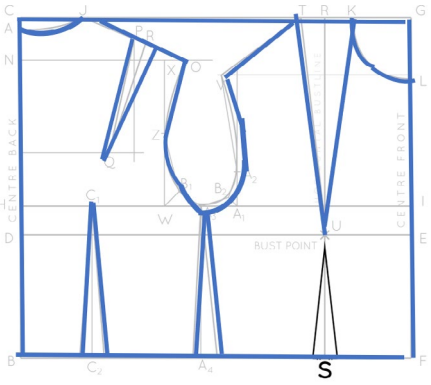
Step 17: DRAFT THE SIDE SEAM

For simplicity, at this stage, treat the side seam (line A3-A4) as a dart at this point. Distribute one third of the dart width to the back of the bodice and two-thirds to front of the bodice, either side of A2. Join the endpoints to A3 to create the front and back side seams.



Step 18: DRAFT THE FRONT WAIST DART

Distribute dart width evenly either side of S and join the endpoints to a point 1cm (3/8”) down from BP to create dart arms.



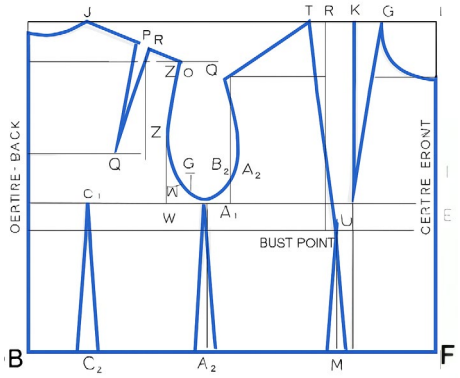
Step 19: BALANCE THE WAISTLINE

At this point the waistline of the pattern is straight. But as the front of our bodice must pass over the fullest part of our chest (our bust), we need to add a little extra length to our CENTRE FRONT, to prevent this part of the waistline from riding up when the bodice is made.

Mark a point 0.5cm (1/4”) to 1.5cm (1/2”) down from point F as point C1.

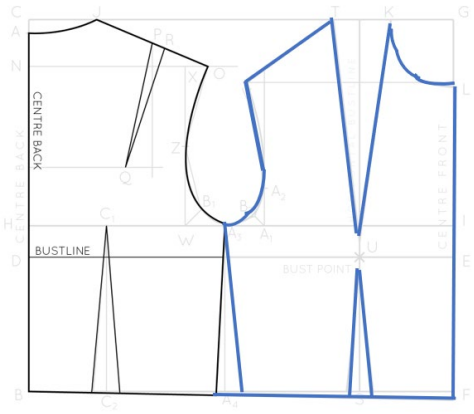
(0.5cm (1/4”) for small bust / 1cm (3/8”) for medium bust / 1.5cm (1/2”) for large bust)

Join point B to point C1.

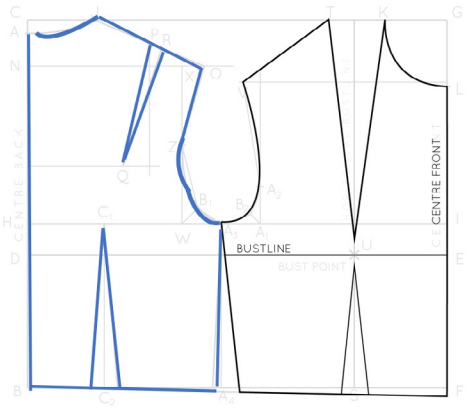


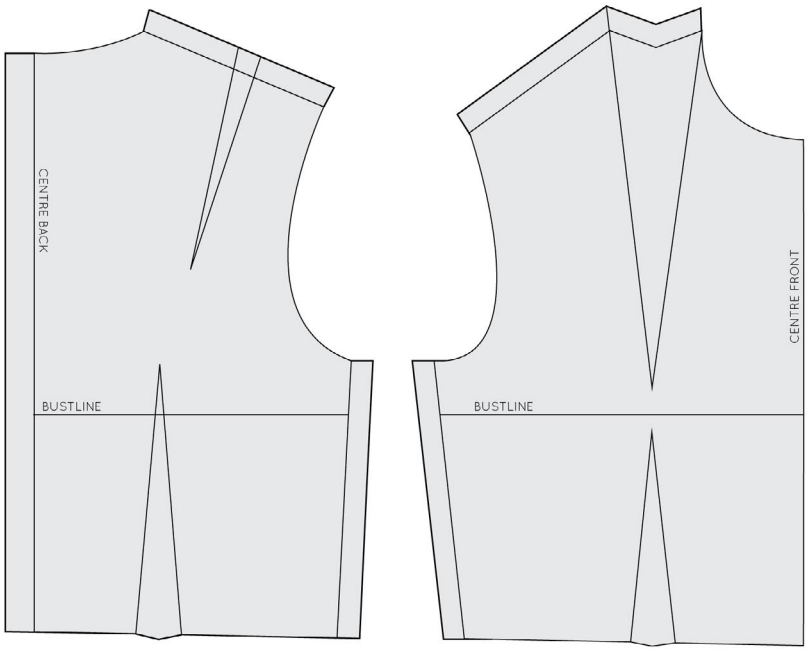
Step 20: TRACE THE PATTERN

With a second piece of pattern paper, trace off the back pattern piece – being sure to include all important details (i.e., bust line and darts).



Leaving a space between the pieces, trace the front pattern piece.



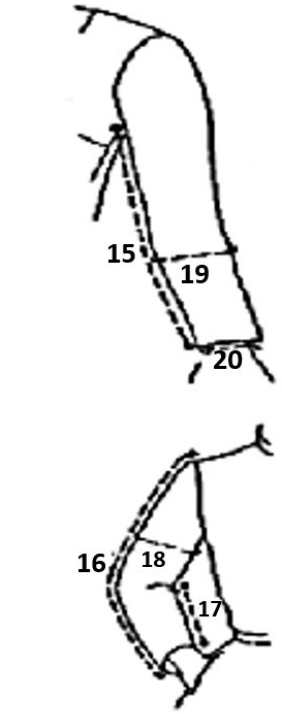


To finish, add shaping to the darts and then add seam allowance to the pattern. As it is a bodice block, it is handy to have it available without seam allowance (as when you are making alterations or adjusting a pattern it is far easier to do so without seam allowance), but as you will need to make a toile to see how it fits, add seam allowance to the seams that will be sewn - the side seams, centre back and shoulder seams. The other seams - the neckline, armholes and waistline - can be left without seam allowance so that you can get a true indication of what it will look like without having to finish these seams or add a facing etc.

ADD PATTERN MARKINGS AND CUTTING INSTRUCTIONS

Drafting of Sleeve block

Table 3.11 Arm Measurements for Sleeve Patterns

15. Front length	With the arm straight, take on the inside from armhole to wrist	
16. Outside Length	With the arm bent, from shoulder, over elbow to the wrist bone	
17. Elbow to wrist	Length taken on the inside of the arm	
18. Thickest part of the arm	With the arm bent measure around the muscle	
19. Forearm	Around the arm at the thickest part below elbow	
20. Wrist	Around the wrist over the wrist bone	
D. Sleeve head depth	Tie a piece of string around the arm as high up as possible. Measure from the shoulder point to the string	
E. Hand	Around the hand and over the knuckles with thumb in palm	

The Sleeve Foundation Pattern

One Piece, Set- in Sleeve Foundation

Rule up a rectangle on a plain sheet of paper. This will be known as the Sleeve Block. The back is to be on the left-hand side.

Sleeve Block Size	Width = Thickest part of arm (M/ 18) + 5cm
	Length = Outside arm length (M/ 16)

- Divide this block in half-length ways
- Now rule two guide lines across the block to help shape the sleeve head
- Line AB is one third of the block width down from the top. Around this up to the nearest centimetre. Line "CD" is half the depth of "AB" plus 1cm. down from the top. This makes the top section 2cm. deeper than the second section.
- Divide the two top sections into four equal parts length ways, making eight top sections in all.
- The elbow line is ruled across at measurement M/17, up from the base or wrist, "EF"
- Mark in the wrist (M/20) evenly each side of the centreline. Add a further 2cm to each side for easing and mark again.
- Mark in the forearm (M/19) evenly each side of the centre line and 1.5cm. below the elbow line.
- Now shape in the sleeve as shown in the diagram
- The top shaping or "sleeve cap" starts at point "A". This curved shaping rises at the back by 1.5cm. from where the guide lines cross at "G". touches the centre line at the top of the block, curves down through the right-hand crossed lines and on to point "B". You should take care to get a good smooth flowing line. It should look more like the rolling hills.
- Rule in the underarm seamlines from points A and B to the eased wrist marks.
- N.B. If the forearm marks are not inside these lines, rule in two stages. First to the forearm, then on to the wrist
- A short sleeve foundation is marked at 10cm. bellow the sleeve head and its seamline narrowed at the base by 1cm. on each side
- A Three-Quarter Sleeve foundation will have its base anywhere from 3cm. below the elbow line to bracelet length at 8cm above the wrist. It may need the elbow darts.
- All sleeves need a length check for each individual style.

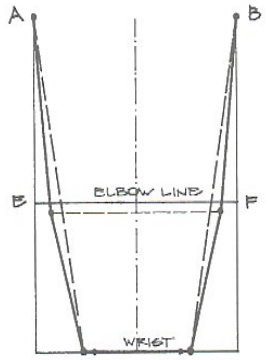


Figure3.16: *Sleeve foundation*

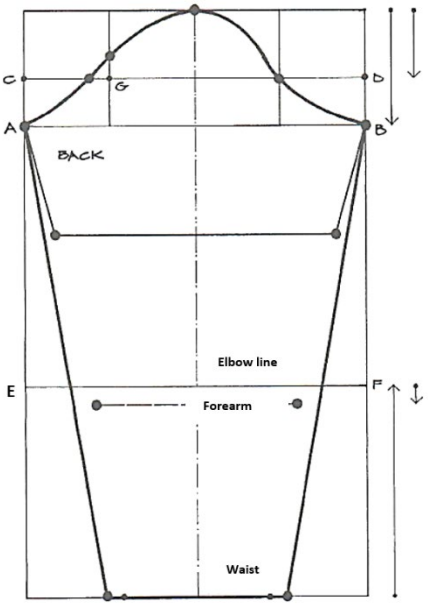


Figure 3. 17 *Adjustment for wide forearm*

Learning tasks

1. Explain pattern drafting as it applies in garment design and its importance
2. Explain the principles of drafting garment patterns and list some of the principles
3. Identify the various pattern making symbols in pattern drafting
4. Use the measurements taken for women, men and children to draft basic blocks for bodice, skirts and sleeve add the necessary pattern marking symbols
5. Draft basic blocks for bodice, skirts, sleeve and pants using your body measurement

Pedagogical Exemplars

1. **Collaborative Learning, research, experiential learning;** Let learners in mixed groups explain drafting in garment design and its importance and the tools used in drafting. Learners present their report in a whole class discussion. Other groups add to the content presented by each group in a respectful manner. Groups should be encouraged to tolerate others' views.
2. **Group work, research, experiential learning;** With the use of relevant resources, let learners brainstorm and come out with the principles guiding the drafting of patterns. Let the groups present their findings in a whole class discussion. Remember to consider socio-emotional learning by encouraging respectful and open communication among learners. Promote gender equality and social inclusion by ensuring that all learners, regardless of gender or social background, are given equal opportunities to participate in the discussion.
3. **Project based learning, experiential learning;** Based on the body blocks developed from the body measurement and the drafting principles, let learners individually draft body blocks for themselves taking into consideration all allowances and bearing in mind drafting principles and symbols. Let learners paste their body blocks on the walls of the classroom

for gallery walk and appraisal. Anticipate that some learners may struggle with certain concepts and plan for additional support or resources to help these learners.

4. **Group work, activity-based learning;** Let learners go back into their groups and discuss the suggestions and corrections made by their peers and the facilitator on the patterns. Help the learners to individually use the corrections and suggestions to make the necessary corrections that will make the patterns fit well on the body. Create a peer-to-peer mentoring system to help learners having difficulties receive help from colleagues.

Key Assessment

Level 1: Define pattern drafting as it appears in garment design

Level 2: State and explain three importance of pattern drafting

Level 3: Draft basic blocks bodice, skirts, sleeve and pants using your body measurement

Level 4: Critically assess the impact of pattern marking symbols on the overall effectiveness of pattern drafting in the fashion industry. Analyse how these symbols facilitate accuracy and efficiency in garment production, and provide a comprehensive list of five key symbols, including detailed explanations of their functions and implications for both designers and manufacturers.

HINT



The recommended mode of assessment for week 24 is End of second semester examination. Refer to Appendix J at the end of this section for Table of specification.

UNIT 3 REVIEW

The fundamental tools and their uses in garment design were discussed in this unit. Additionally, it covered the fundamentals of taking precise body measurements, which is necessary to develop the basic pattern blocks for bodice and sleeves.

MARKING SCHEME FOR THE QUESTIONING ASSESSMENT

Part 1: Categorise the Tools

Correct Categorisation

Category	Tool Numbers
Measuring and Marking Tools	*2 (Measuring tape), 8 (Awl), 9 (Grading ruler)*
Cutting Tools	*1 (Fabric scissors)*
Pattern Making Tools	*5 (Pattern paper), 8 (Awl), 9 (Grading ruler)*
Sewing Tools	*4 (Dressmaker's pins), 6 (Needle threader), 10 (Point turner)*
Pressing Tools	*3 (Sleeve board), 7 (Pressing cloth)*

Some tools like the awl and grading ruler can fall under multiple categories, which is acceptable in garment design communication if justified correctly.

Part 2: Task-Based Tool Selection & Explanation

1. **Creating a dart on a fitted bodice**
   a. **Tools**
      i. Dressmaker's pins
      ii. Grading ruler
   b. **Explanation**
      i. Dressmaker's pins help hold the fabric in place for accurate stitching along the dart line.
      ii. Grading ruler ensures the dart is drawn with precision and the angle is consistent, aiding in proper fit.
2. **Transferring pattern markings to dark fabric**
   a. **Tools**
      i. Awl
      ii. Tailor's chalk or tracing wheel with carbon paper (If not listed, accept Awl and an explanation for substitution)
   b. **Explanation**
      i. Awl allows precise marking through small holes in pattern paper, especially for dart points or button positions.
      ii. Tailor's chalk or tracing wheel with carbon (typically used for dark fabrics) ensures visibility of marks. If chalk isn't listed, a rationale should be accepted.
3. **Finishing a curved neckline on a blouse**
   a. **Tools**
      i. Point turner
      ii. Pressing cloth
   b. **Explanation**
      i. Point turner helps shape and smooth the curve at the neckline after turning it inside out.
      ii. Pressing cloth protects the fabric during pressing to achieve a clean, professional finish without scorching or shine.

MARKING SCHEME FOR THE POSTER PRESENTATION ASSESSMENT

Development and Analysis (10 Marks)

Answer Guide

1. Drafting the Basic Blocks (at 1/5 scale)

Bodice Block Includes

a. Front and back bodice pieces.

b. Key measurements applied: bust, waist, back width, chest width, shoulder length, nape to waist, bust point to bust point, armscye depth.

c. Markings: Grainlines, bust point, waist darts, notches on armholes and side seams.

d. Seam allowances (e.g., 1 cm) clearly indicated.

Sleeve Block Includes

a. Sleeve head drafted using armscye depth and upper arm circumference.

b. Tapered toward wrist circumference.

c. Sleeve length applied.

d. Markings: Notches (1 front, 2 back), grainline, bicep line, elbow line.

e. Seam allowance clearly labeled.

Brief Annotations

- Notations on placement of bust point, armscye shaping.
- Description of sleeve cap curve matching the armscye circumference.
- Adjustments made for balance and fit.

2. Relationship and Analysis (Key Points)

- **Armscye and Sleeve Head Fit**: The sleeve cap must match the bodice armscye for smooth insertion, ease considered for mobility.
- **Mobility**: The armscye depth affects sleeve range—too deep restricts movement, too shallow creates tightness.
- **Grainline Alignment**: Bodice and sleeve grainlines work together to maintain garment drape.
- **Balance**: Bodice shoulder line and sleeve cap must be balanced to avoid twisting or pulling.

Marking Scheme – (10 Marks)

Criteria	*Marks*	*Description*
Accuracy of Drafting	4	Measurements correctly applied, accurate 1/5 scale blocks.
Pattern Details & Markings	2	Includes grainlines, notches, bust point, dart lines, seam allowances.
Drafting Annotations	1	Clear notes on drafting decisions.
Armscye–Sleeve Analysis	2	Insightful explanation of how blocks interact.
Presentation	**1**	**Clear, clean, readable with proper labeling.**

APPENDIX J: END OF SEMESTER EXAMINATION

Nature of assessment

The assessment should span from week 13 to week 24 and should comprise 40 multiple choice questions, 3 essay questions and 3 practical questions, learners are expected to answer all multiple-choice questions, two essay questions out of three and one practical question out of three.

The time allocation for the examination should be 2hrs 15mins. thus, 1hr for section A, 30 minutes for section B and 45mins for practical.

Resources

- Answer booklets
- Scannable sheets
- Conducive environment
- Pen, pencil and erasers

Sample assessment

Multiple Choice

SECTION A

Answer all questions in this section; by circling the most appropriate answer from the option lettered **A-D**

1. One of the options below is not a loci

   A. Cycloid
   B. Helix
   C. Isometrics
   D. Trochoid

Sample essay question

SECTION B

Answer two questions only in this section; all questions carry equal marks

1. a. List and explain two principles of sectional drawing, etc.
   b. Sketch the sectioning symbol for
      - steel
      - cast iron
      - brass

PRACTICALS

Answer one question only in this part; all questions carry equal marks

1. Use the scenario below to complete the task.

   Scenario: You are tasked with preparing a basic bodice block for a client who requires a custom-fit blouse. The client has provided the following measurements, which you will use to create the bodice block:

i. Bust Circumference: 36 inches
ii. Waist Circumference: 30 inches
iii. Hip Circumference: 38 inches (for a fitted bodice)
iv. Shoulder Width: 16 inches
v. Back Width: 15 inches
vi. Front Neck Depth: 7 inches
vii. Back Neck Depth: 3 inches
viii. Armhole Depth: 8 inches
ix. Desired Sleeve Length: 22 inches (optional for future designs)

Task: Draft a bodice block for the client.

Marking scheme/rubrics

Multiple Choice:

1. C

1 mark for each correct answer =40 marks

Essay question:

1.a.

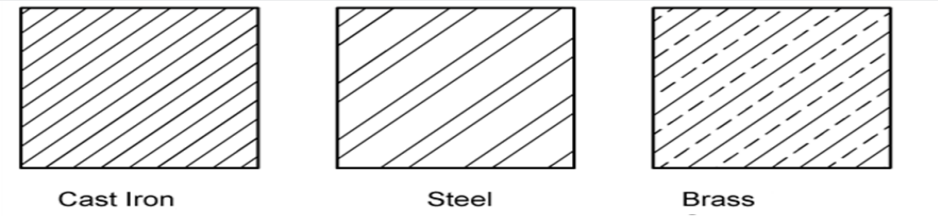
i. **Section lines:** They are lines used to indicate the surface which has been exposed by the cutting plane**.**

ii. **Cutting plane**: is an imaginary line that cuts the object to reveal the internal features.

The outside view is cut away by the cutting plane to show the internal view

[for listing 1mark, for explaining 1.5 Marks]

b.



[5 Marks each]

Total score 20 marks

Practical question

Rubrics

Criteria	*Excellent (4)*	*Good (3)*	*Satisfactory (2)*	*Need improvement (1)*
Accuracy of Measurements	*All provided measurements (bust, waist, hip, shoulder width, etc.) are accurately interpreted and applied in the draft, with no errors in size or proportions.*	*Measurements are mostly accurate with* *PLUS 1 or MINUS 1 margin of errors in interpretation or application.*	*Several measurements are misinterpreted* *With PLUS 2 or MINUS 2 margin of errors affecting the fit of the bodice block.*	*Significant errors in interpreting with PLUS 3 or MINUS 3 margin of errors leading to an inaccurate bodice block.*
Drafting Technique and Skills	*The bodice block is drafted with the following;* *precise lines* *precise curves, and angles.* *The proportions and shapes are balanced,* *ensuring the bodice fits as intended.*	*The bodice block is drafted with three of the following;* *precise lines* *precise curves, and angles.* *The proportions and shapes are balanced,* *ensuring the bodice fits as intended.*	*The bodice block is drafted with two of the following;* *precise lines* *precise curves, and angles.* *The proportions and shapes are balanced,* *ensuring the bodice fits as intended.*	*The bodice block is drafted with one the following;* *precise lines* *precise curves, and angles.* *The proportions and shapes are balanced,* *ensuring the bodice fits as intended.*
Understanding of Bodice Construction	*Demonstrates understanding of bodice construction including;* *using the measurements to correctly form* *the front* *the back* *armhole,* *necklines, and shoulder seams.*	*Demonstrates understanding of bodice construction including* *using the measurements to correctly form three of the following* *the front* *the back* *armhole,* *necklines, and shoulder seams.*	*Demonstrates understanding of bodice construction including* *using the measurements to correctly form two of the following* *the front* *the back* *armhole,* *necklines, and shoulder seams.*	*Demonstrates understanding of bodice construction including* *using the measurements to correctly form one of the following* *the front* *the back* *armhole,* *necklines, and shoulder seams.*
Fit Considerations	*The drafted bodice block appears to be well-designed to fit the client's measurements, with the correct ease allowances and overall proportions for a custom fit.*	*The bodice block is designed to fit well, but may need minor adjustments for ease or proportions. Some fit considerations may need refinement.*	*The fit of the bodice block is not ideal. Ease allowances or proportions may be incorrect, leading to a fit that may need significant adjustments.*	*The bodice block does not appear to fit the measurements accurately, with incorrect proportions and no clear allowance for ease.*

Neckline and Armhole Shape	*The neckline and armhole shapes are perfectly executed, reflecting professional drafting standards, with smooth curves that follow the body's natural shape.*	*The neckline and armhole shapes are well-drafted, but may require slight adjustments for better shape or smoothness.*	*The neckline and armhole shapes are acceptable but require considerable adjustments to achieve a more natural or comfortable fit.*	*The neckline and armhole shapes are poorly drafted, with sharp angles, irregular curves, or improper placement.*
Use of Drafting Tools and Materials	*Demonstrates expert use of drafting tools (e.g., ruler, French curve, measuring tape) to create clean, precise lines. The material used for the draft is appropriate, and the block is neat and professional.*	*Uses drafting tools well, though there may be slight imperfections in lines or measurements. The material used is adequate, and the draft is generally neat.*	*Some difficulty using drafting tools, resulting in less accurate or uneven lines. The material used may not be ideal for creating a precise bodice block.*	*Poor use of drafting tools, leading to imprecise lines and an untidy, unprofessional bodice block. The material is inadequate for a clear draft.*
Clarity and Presentation	*The bodice block presented exhibits these* *clearly with all lines and markings legible.* *The client's measurements are annotated clearly for easy reference.* *The bodice block is neat*	*The bodice block presented exhibits two of these* *clearly with all lines and markings legible.* *The client's measurements are annotated clearly for easy reference.* *The bodice block is neat*	*The bodice block presented exhibits one of these* *clearly with all lines and markings legible.* *The client's measurements are annotated clearly for easy reference.* *The bodice block is neat*	*The bodice block presented exhibits none of these* *clearly with all lines and markings legible.* *The client's measurements are annotated clearly for easy reference.* *The bodice block is neat*
Attention to Detail	*Every detail of the bodice block, from the neckline to armholes, waistline, and shoulder seams, is meticulously considered. The block demonstrates thorough attention to all aspects of the design.*	*Good attention to detail, though some aspects may require minor refinement. Overall, the design is thoughtful and coherent.*	*Some attention to detail is lacking in the design, and there are noticeable gaps in the draft that will need further refinement.*	*Lacks attention to detail, with significant omissions or mistakes that impact the overall integrity of the bodice block.*

Total score: **32 marks**

TABLE OF SPECIFICATION FOR END OF SEMESTER 2 EXAMINATION

			DoK LEVEL				
WEEK	FOCAL AREA	QUESTION TYPE	1	2	3	4	TOTAL
13	Loci	Multiple choice	1	1	1		3
14	Designing based on the working principles of loci	Multiple choice	1	1	1		3
		Essay		1			1
15	Surface development of pyramids	Multiple choice	1	2	1		4
16	Drawing curves of intersection	practical			1		1
17	Designing with solid geometry	Multiple choice	2	2			4
		Essay			1		1
18	Basic concept in computer aided designs (CAD)	Multiple choice	1	2	1		4
	Drawing with computer aided designs	Essay			1		1
19		Multiple choice	1	2	1		4
	Geometrical shapes used to create complex fractal designs	Essay			1		1
20		Multiple choice	2	2			4
	Creating complex fractal designs	Essay		1			1
21		Multiple choice	1	2	1		4
UNIT 1 BUILDING DRAWING							
22	Building elevations	practical			1		1
		Multiple choice	1	2	2		5
23	Drawing building elevations with instruments	Essay					
		practical			1		1
24	Electrical and electronic circuit	Multiple choice	2	2	1		5
		Practical				1	1
UNIT 2 MECHANICAL DRAWING							
22	Principles of sectioning	Essay			1		1
		Multiple choice	2	2	1		5
23	Drawing sectional views	Essay		1			1
		Practical		1			1

24	Electrical and electronic circuits	Multiple choice	2	2	1		5
		Practical			1		1
UNIT 3 GARMENT DESIGN TECHNOLOGY							
22	Tools used in garment design and their applications	Essay			1		1
		Multiple choice	2	1	2		5
23	Taking body measurement accurately	Easy					1
		practical			1		1
24	Drafting basic pattern blocks for bodice and sleeves	Multiple choice	1	2	2		5
		Practical			1		1
Total			14	18	13	1	40

Multiple choice	40
Essay	3
Practical	3

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