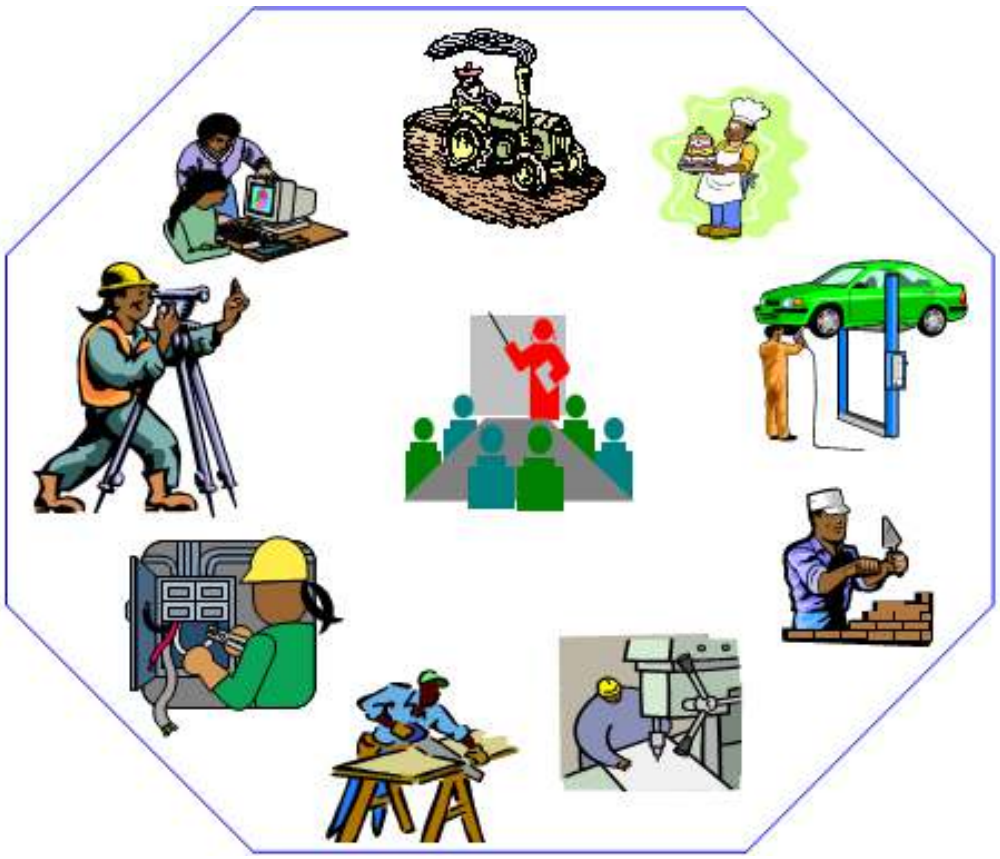
Bamboo Product Processing

Level-III

Based on November 2021, Version 1 OS and November 2021, V1 Curriculum



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LG #01	LO #1- Determine drawing requirements
Instruction sheet	

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Obtaining, confirming and applying work instructions
- Selecting tools and equipment
- Identifying preparing, materials
- Identifying and applying environmental protection requirements

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, you will be able to:

- Obtain, confirm and apply work instructions
- Select tools and equipment
- Identify and prepare materials
- Identify and apply environmental protection requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide

Information Sheet 1- Obtaining, confirming and applying work instructions

1.1. Work instruction

Work Instructions are detailed steps in a process an employee (designer and drafts man) can follow each time he or she performs a task. Work instructions provide

information relative to the assembly of components and/or the methodology for performing a process. Work Instructions organize steps in a logical format so an employee can follow independently. Procedures for a process can be very long with multiple steps, and Work Instructions enable removing unnecessary detail so an employee can better understand the overall process. Work instructions are **NOT** available to the public. They are strictly for internal use only. Never give a work instruction to an employee without explanation. To prepare work instruction consider the following points:

1. Record every step in the process. A bullet point should represent every stage of the task.
2. Use photographs as much as possible to support written instructions. If an employee can look at the work instruction photograph and hold the item or items the photographs shows, some questions can eliminate quickly.
3. Use language that is straightforward and devoid of slang and regional terminology. Do not use acronyms, abbreviations and confusing technical terms unless defined in the document.
4. Use native language.
5. Test the work instruction prior to issuing. Let individuals read the document, follow the instructions and perform the tasks as given by the text. More than one individual should allowed reading and following the instructions and providing comments. Allow enough time to make all necessary corrections.
6. Check the document for legalities, making sure it cannot used against you in court.
7. Revise the document as needed relative to modifications and revisions to product changes.
8. Use a consistent readable format.
9. Use a font type and size that allows for easy reading
10. To be effective, work instructions must be accessible. Generally, they placed in the work cell so all can read and refer.
11. The level of complexity is dependent upon the education and experience of the workforce.

1.1.2. Recommended Elements to Effective Work Instructions

Work instruction will be written or Digital. In both case we begin with a “header” that identifies the document. The following items recommended as minimum:

A. Document Identifiers: i.e. Header

- Company Name
- Document Control Number: Assigning a document control number makes it easier to apply a “filter” so quick access can be accomplished. In cases where many work instructions exists, this becomes a great aid to the document control specialists. You can filter in ascending order or descending order to find the document needed at a moment.
- Document Revision Number: the revision number defines the latest revision to the product or process. In cases where a new document number assigned when changes made, no revision number is necessary.
- Date of Implementation
- Document File Name
- Author of Document
- Approving Individuals
- If the work instruction is particular to a specific department, indicate that on the header.

NOTE: The header must appear on each page of the WI. If you wish to insert a blank page for expansion of the document later, indicate BLANK PAGE and number that page accordingly.

B. Purpose

This is where you define the work to be accomplish. It needs be specific and detailed.

Example: The purpose of this document is to provide guidance and instructions for assembly of GE Backsplash, model number WB27K10157, Revision 4. Drawing

number 164D3827G009 provides an exploded parts breakdown and a bill of materials indicating those components necessary for that assembly.

NOTE: You may list all drawing numbers and component part numbers in the Associated Documents section of the work instruction. I do recommend this reference given some place in the document, preferably in the very first part of the WI. This will give an opportunity for checking and identifying individual parts before continuing to read the instruction.

C. Scope

Indicates what needs to be accomplish. “These instructions cover component assembly, inspection, packaging and inventory of WB27K10157, Revision 4.” List every thing to be done in the work cell or the process.

D. Responsibilities

If you wish, you can include a flow chart that shows the chain of command; i.e. plant manager, quality supervisor, line supervisor, assembly operator, etc. Of course, I would indicate the function and not the name of the individual. Some companies add phone numbers and even e-mail addresses. It is nice for an employee to know who is in charge and more importantly, who to call for questions and decisions.

E. Definitions

This section is one of the most important sections in the work instruction**.** Its sole purpose is to eliminate ambiguity. Any abbreviations or acronyms used in the document should defined here; the purpose being to eliminate doubt and define what component or what process the text is referencing.

F. Supporting Documents

Any supporting documents that may be necessary to solve a problem or answer questions during operation relative to the work instruction should listed here.

Examples might be:

- The quality control document (manual) defining facility operating procedures.
- Hazardous material data sheets. (Mandated by OSHA when needed)
- Documents noting critical to quality dimensions for individual components.
- Any applicable third party test standards; i.e. National Electric Code, etc.
- Applicable ISO documents and any national codes.

We do not wish to burden an employee with unneeded supporting documents but availability, if needed, is important. As you know, in the life of an assembly or process, questions do arise, sometimes on a daily basis.

G. Specialized Equipment Needed

This is where you list items and equipment needed for the actual operation.

H. Safety Precautions and Safety Equipment Needed

List all personal protection equipment (PPE) required and safety precaution for the task.

I. Instructions

This is where you tell the workers or designers how to do the job. Again, a picture is worth a thousand words, so use photographs as much as possible to support the text and detail the progressive steps in the process. It may include the following:

- Types of materials needs to use based on the customer requirements.
- Supportive documents
- assembly sequences
- Work order
- Indicate in the work instruction the disposition of any off-quality components

- Highlight any inspection and / or test necessary during the design or after the design.

J. **Summary:** short summery about the design needs to require**.**

1.1.3. Benefits of Work Instruction:

There are several benefits to effective work instructions, as follows:

- Capture employee knowledge so that it becomes a corporate asset
- Enhanced productivity through reductions in “lost motion”
- Assurance that proper tools and safety equipment are being used in assembly process
- Maintenance and improvement of quality through standardization of methodology
- Reductions in waste
- Reductions in cost
- Reductions in variability due to change in operators over multiple shifts
- Easier training of new operators
- Reductions in injuries and strain
- Provision of a baseline for improvement activities
- Provide adherence to ISO and national code requirements
- Captures information for a task that is performed infrequently
- Maintains continuity for a job in which employee turnover is considerable.
- Work instructions are mandatory for ISO or national certification

1.2. Plans

Plan is an activity performing or accomplished before the actual manufacturing activity of the product. Planning is thinking through an activity before how to done, by what, when, how long it take to produce. Successful projects begin with diligent planning. The design process starts with an initial meeting to discuss the vision, logistics, and final project outcomes with the key decision makers and the creative experts on the commercial general contractor team. This should be a collaborative process that explores options and directions that ultimately lead to an amazing

finished product. Together, the team will walk through architectural, physical and economic requirements of the project as well as code requirements.

1.3. Specification

Apart from being a means of identifying the goods or services required, a specification will form part of any future contract that might result from offers received. In a procurement context, a specification defined as a statement of needs. It defines what the procurer wants to buy and, consequently, what the supplier is required to provide. Specifications can be simple or complex depending on the need. The success of the procurement activity relies on the specification being a true and accurate statement of the buyer's requirements.

A good specification should:

- state the requirement clearly, concisely and logically in functional and performance terms unless specific technical requirements are needed
- for goods, state what the item will be used for
- contain enough information for offers to decide and cost the goods or services they will offer and at what level of quality
- permit offered goods or services to be evaluated against defined criteria by examination, trial, test or documentation
- state the criteria for acceptance of goods or services by examination, trial, test or documentation
- provide equal opportunity for all potential suppliers to offer goods or services which satisfies the needs of the user, including goods or services incorporating alternative solutions
- form the fundamental basis of the contract between buyer and seller
- not over-specify requirements
- not contain features that directly or indirectly discriminate against people with disability, but allows optimal access and inclusion
- not contain features that directly or indirectly discriminate against suppliers
- For procurements covered under Free Trade Agreements, not contain features that directly or indirectly discriminate against suppliers.

1.3.1. Types of specifications

1. Functional specifications

Define the function, duty or role of the goods or services. It nominates what the goods or services are broadly required to do. Functional specifications define the task or desired result by focusing on what is to be achieve rather than how it done. They do not describe the method of achieving the intended result. This enables suppliers to provide solutions to defined problems. For example, a specification for “an accessible device capable of conveying children from their school to their homes” does not limit responses to bus operators alone.

2. Performance specifications

Define the purpose of the goods or services in terms of how effectively it will perform, that is, in capability or performance terms. Performance is a logical extension of function. Performance specifications define the task or desired result by focusing on what is to be achieve. They do not describe the method of achieving the desired result. This enables suppliers to provide solutions to defined problems.

3. Technical specifications

Define the technical and physical characteristics and/or measurements of a product, such as physical aspects (for example, dimensions, color, and surface finish), design details, material properties, energy requirements, processes, maintenance requirements and operational requirements. They used when functional and performance characteristics are insufficient to define the requirement.

Self-check 1	Written test

Directions: give **Short Answer for the following Questions**

1. What is work instructions ?(2pts)

2. List the elements of work instruction letter?(6pts)

3. Describe plans of product design. (3pts)

4. What are the basic types of specification? Discuss on each type.(9pts)

Note: **Satisfactory rating - 18 points** **Unsatisfactory - below 18 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- Selecting tools and equipment

1. Introduction

To produce drawings of bamboo products various drawing tools and equipment are used. Admittedly, in the computer era, technical drawing does not play the same role as in the past. However, to complete a CAD drawing the user must understand the basics of technical drawing and know how to set out a drawing. The rules for putting technical drawings on paper also apply to setting out a drawing on the computer screen. Below some of the equipment required to create a technical drawing on paper and produce drawing with CAD are described.

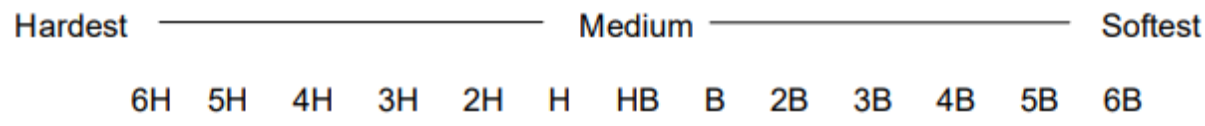
- **Drafting Table:** Drafting tables or art tables have a top that can lifted up or tilted to various angles. This allows the person eye level to be more directly in line with the working surface.
- **Portable drawing board**: which allows the fixing of paper in such a way that it does not slip.
- **T-squares**: A2 size, Tape Blade, best quality hardwood, with maple edges to blade and stock; blade screwed and dowelled to stock or equal. The T-square used to line the sheet up on the board and draw horizontal lines on the drawing.
- **Set square:** The size of the setsquares expressed in cm (mm) as the hypotenuse length for right-angled squares. 60°/30° Set Square transparent

heavy duty, non-brittle plastic, with beveled edge and open center. Size: 200 mm, 2 mm thick. 45° Set Square transparent heavy duty, non-brittle plastic, with beveled edge and open center. Size: 200 mm, 2 mm thick.

- **Protractor:** used for measuring or setting off angles other than those obtainable with the triangles, the protractor is used.
- **Compass**: Compasses are used to draw circles and arcs.
- **Divider:** A divider is a drawing instrument used for dividing distances into equal parts or for laying off a series of equal spaces.
- **Drawing template:** A template is a thin and flat piece of plastic containing various cutout shapes. It designed to increase the speed and accuracy of the drafter. Templates are available for drawing geometric shapes, furniture, plumbing fixtures, bolts, nuts, screw threads, electronic symbols, springs, gears and much more. A template should use whenever possible to increase the accuracy and the speed.
- **French curve:** When it is required to draw mechanical curves other than circles or circular arcs, a French curve generally employed.
- **Pencils:** Pencils are made of a graphite or plastic lead stick, surrounded by a wood casing used for making sketches and drawings on paper.

Soft pencils graded with the letter B and numbered from B to 6B. The larger the number before the B, the softer the pencil material. Soft leads often used for sketching and shading because they are generally darker and easier to manipulate.

Hard pencils graded with the letter H and numbered from H to 6H. The larger the number before the H, the harder the pencil material. The hardest leads are used to create sharp, clear lines; e.g., those in drafting or architectural drawings.



- **Pencil Crayons:** Colored pencils may use to draw fine, colored lines or to shade areas in color. A variety of colored pencils are available and the

craftsperson or artist can be creative in mixing and matching different colors, blending two or more colors or using colored pencils with other drawing or painting materials.

- **Pencil Sharpeners:** Pencil sharpeners are drawing instruments used for sharpening pencils
- **Scale:** A scale is an item of drawing instrument that has carefully graduated (marked) and calibrated (labeled) in convenient increments for the user. Scales enable a user to make size reductions or enlargements rapidly and accurately. Scales are graduated in such a way that they can be used to draw objects to scale by direct measurement without any calculation. Depending on its size, the drawing of an object may be the same size as the object, larger or smaller than the object. When one unit on the object equals one unit on the drawing, we say the object drawn to full size scale; written as 1:1. When one unit on the object is equal to two units on the drawing, we say the object drawn to a magnification scale of 2:1. Whereas when two units on the object is equal to one unit on the drawing, we say the object drawn to a reduction scale of 1:2.
- **Eraser and Erasing shield:** In the process of making a drawing, corrections and changes may be required. To do so, erasers used to clean unnecessary line works. An erasing shield restricts the erasing area so that the correctly drawn lines will not disturbed during the erasing procedure.
- **Dusting Brush:** During erasing, particles coming from the eraser will remain on the drawing paper. These particles removed or cleaned using a dusting brush. It is poor practice to use fingers or palm of the hand for cleaning the drawing paper.
- **Computers and Digital Equipment:** As technology continues to change and access improves, students and artists have more opportunities to use computers and digital equipment and software. Various equipment and technologies may incorporated when appropriate for capturing, creating, manipulating, displaying and plot images or drawings. Example computer, printer, digital camera.

- **Model making tools and materials:** Any material or combination of materials can used to create 3-D products. Example wood, wire, Model paper, plaster, paper cutter, steel rule, adhesive.

Self-Check – 2	Written test

Directions: Give short and direct answer for the Questions below.

1. List important drawing tools and equipment used for bamboo product designing then discuss on their functions?(10pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Identifying and preparing materials

1. Introduction

Drawings made on many different kinds of drawing sheets, known as drafting media. Paper is one kind of drafting medium.

1.1. Sketchbook and field note book

A sketchbook is one of the most important things designer can have to develop ideas and recording customer interest and the existing condition in the place design can made. Since a sketchbook is recommended for daily practice, it is important to choose one that is durable and has plenty of pages for all of your ideas. I suggest a sketchbook that has a hardcover so that it will stand up to repeated use and travel. A hardcover keeps the corners of the pages inside nice, clean, and will help keep the pages flat if you use mixed media applications.

1.2. Drawing paper

Drawing papers are the materials on which the drawings made. Depending on its application different size of drawing papers are available. A0, A1, A2, A3, A4, A5.

1.3. Drafting or Masking Tape

Before starting drawing, it is a common practice to attach the drawing paper to the drawing board in order to avoid unnecessary errors due to misalignment. Drafting tape used for attaching the paper to the drawing board. Thumbtacks can also use for fixing the paper to the drawing board.

3.4.**Uhu / Adhesive** : used for fixing models to make the required form and shapes of the project.

Self-Check – 3	**Written test**

Directions: Give short and direct answer for the Questions below.

1. List important drawing materials used for bamboo product designing then discuss on their functions?(10pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Identifying and applying environmental protection requirements

4.1. Environmental protection

Environment refers to a system of natural and artificial physical factors affecting the existence and development of human beings and creatures. Land, water, air, sound, light, organism and things are components of environment.

Environmental protection refers to the environmental conservation, and the prevention and control of harmful impacts on environment; the response to environmental emergencies; the mitigation of environmental pollution, degradation, improvement and remediation; proper extraction and consumption of natural resources for maintaining a pure environment. To protect environment with the progress of design designer should manage waste with the prevention, control, minimization, monitoring, classification, collection, transportation, reuse, recycling and disposition of wastes.

4.2. Environmental regulation

Environmental regulations attempt to protect public health and the environment from pollution by waste.

4.3. Environmental policy

Any measure by a government or corporation or other public or private organization regarding the effects of human activities on the environment, particularly those measures that designed to prevent or reduce harmful effects of human activities on ecosystems. Environmental policies needed because environmental values usually not considered in organizational decision-making. There are two main reasons for that omission. First, environmental effects are economic externalities. Polluters do not usually bear the consequences of their actions; the negative effects most often occur elsewhere or in the future. Second, natural resources usually underpriced because they often assumed to have infinite availability.

Therefore as a designer, we need to consider or work on the protection of our living environment by using environmentally friendly materials, methods of manufacturing product and waste management by respecting environmental police and environmental regulations.

Self-Check – 4	Written test

Directions: Give short and direct answer for the Questions below.

1. What is environment ?(3pts)

2. As a bamboo product designer how you protect your environment. (7pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

LG #02	LO #2- Identify project design work

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identifying design principles and elements
- selecting design requirements
- confirming appropriate product design
- Identify production materials standard design, and methods
- Identifying need of customers with work/job order
- Confirming Type of project

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, **you will be able to**:

- Identify design principles and elements
- select design requirements
- confirm appropriate product design
- Identify production materials standard design, and methods
- Identify need of customers with work/job order
- Confirm type of project

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
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5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1- Identifying design principles and elements

1.1. Elements of design

Elements of design is the components you need for a formal design work. These basic components are essential both in art and in design. Each element is a crucial part of a visual message, and the combination of these has an impact on how the design perceived. Use these elements alone or in combination with each other, depending on what you are looking to achieve. The main elements are:

- Line
- Color
- Shape
- Form
- Value
- Space
- Texture

1.1.1. Line

Lines are the most basic elements of design. They come in all shapes, sizes, and colors. Once you start noticing them, you will see grids all around you. Lines have direction; they can be visible or invisible and can help direct the eye to a specific spot. The thickness of a line can also communicate certain cues.

Bold and thick lines can draw attention, while thin lines are the opposite. Most if not all layouts contain invisible lines. Grids are made of multiple lines and lend structure to a page. Lines can used to create demarcation on a specific section of a design. Depending on the form of the line, you can convey different moods. A simple line can carry so much for instance, a squiggly line perceived as young and fun compared to a straight line. Lines do not necessarily have to be solid. Dashed and dotted lines can also be used and have a friendlier feel than a solid line. Straight lines usually come across as a steady and static element. On the other hand, curved lines are dynamic and give energy to your design.

- **Vertical** – Represents dignity, formality, stability, and strength
- **Horizontal –** Represents calm, peace, and relaxation
- **Diagonal –** Represents action, activity, excitement, and movement

- **Curved** – Represents freedom, the natural, having the appearance of softness, and creates a soothing feeling or mood

1.1.2. Shape

A shape is the result of enclosed lines to form a boundary. Shapes are two-dimensional and can described as geometric, organic, and abstract.

- **Geometric shapes** have structure and are often mathematical and precise (squares, circles, triangles). Shapes can add emphasis to a layout.
- **Organic shapes** lack well-defined edges and often feel natural and smooth. Shapes add emphasis to a layout.
- **Abstract shapes** are a minimalist representation of reality. For instance, a stick figure of a person is an abstract shape. Logo are mostly represent by abstract figures to show the type of business. The icon pack below is a great example of abstract shapes conveying real-life objects and situations.

Depending on the color, form, and size of shapes, we can determine particular moods and send messages. For instance, triangles direct the eyes to a specific point and represent stability. Shapes that we may not think about much surround us; we usually think of shapes as the main geometric structures. For designers, shape is one of the most important elements when it comes to branding development. These figures are at the root of logos and illustrations.

1.1.3. Form (Positive Space)

On a page, form is the positive element over the space, the negative element. A dot, line, or shape is a form when placed on a page. Unfortunately, form and shape mostly used interchangeably. A form can be either two-dimensional or three-dimensional. Many also believe that form is a shape that acquires three-dimensional values, but the correct term is volume. Form and shape are mutually dependent because changing one would affect the other. The spatial relationship between form and space can create tension and add 3D qualities to your design. Form and space

will lend the design lots of visual activity that can help keep viewers engaged. To create a 3D effect in your design, you can add shadows, stack multiple elements, or play with color.

1.1.4. Space (Negative Space)

Space is the area that surrounds a shape; it creates a form within the space. Think of it as music: space is the silence between the notes of a song. If all the notes played together, that would turn into noise. If you look at a design piece, the negative space is the area that not occupied by any elements. In essence, it is the background color that you are able to see. For instance, abundant negative space in a layout results in an open, airy, and light background. The lack of negative space can result in a cluttered design. Visually speaking, a layout needs space to achieve a level of clarity within the design. Negative space is a very important element to consider as you are designing a piece.

1.1.5. Color

We can apply color to any of the elements we mentioned before this point. Colors create moods and can say something different depending on the connotations associated with it. Color can create an emphasis on specific areas of your design layout. This element contains multiple characteristics:

- ✓ **Hue** is the name of a color in its purest form. For instance, cyan, magenta, and green are pure colors.
- ✓ **Shade is the addition of black to a hue in order to make a darker version.**
- ✓ **Tint is the addition of white to a color to make a lighter version.**
- ✓ **Tone is the addition of grey to make a color muted.**
- ✓ **Saturation** refers to the purity of a color. A specific color is most intense when it not mixed with white or black. In design, there are two color systems, RGB and

CMYK. RGB is a system dedicated to digital design. This additive system stands for red, green, and blue. The colors produced by adding primary colors together to create various combinations. This mode should use for designs that will only be used on a screen. If you want to output your design as a printed piece, you need to use the CMYK system. This subtractive system stands for cyan, magenta, yellow, and black (key). CMYK reduces the light that would reflected on a white background to create color. It is extremely important to start a file using the right color system. Converting colors between the systems can result in muted and inaccurate colors.

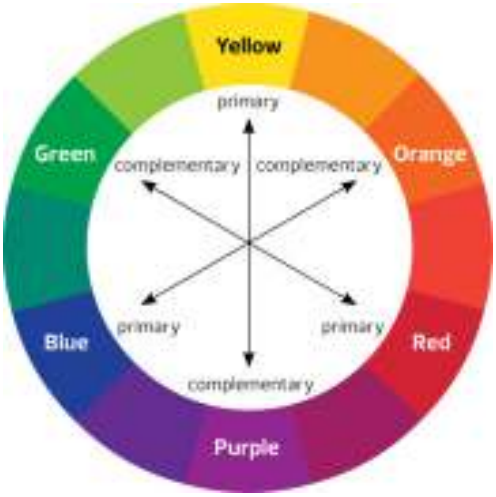


Figure 1. Color wheel

- Primary hues are yellow, red, and blue.
- Secondary hues are orange, violet and green.
- The intermittent colors are yellow-orange, red- violet, blue violet, blue-green, and yellow-green.

1.1.5.1. Color psychology

- 90% of an assessment for trying out a product is based on color alone
- Color is the first thing a customer notices about a company's logo
- Most popular logo colors:

  ✓ Blue (33%)

  ✓ Red (29%)

- ✓ Black/Gray (28%)
- ✓ Yellow (13%)

Figure 2. color psychology

1.1.6. Value

Value refers to the degree of lightness and darkness of a specific hue. Yellow has a higher value than purple because it is closer to white. Value changes create contrast

on a page. The reason you can read this text is that the black content contrasts with the white background. In design, use different tonal values to create emphasis in your design. Create the illusion of movement by overlapping multiple elements with different values. Value is also important in photography. You will notice that high-value images have a light and airy feel to them, while dark value images feel heavy and dramatic. Value also defines the spatial relationship between elements. If color values are close between the elements and space, then the design will look flat. If there is a strong contrast between the elements, then the form will be extremely noticeable. The example below features multiple colors with multiple values, which helps add a sense of depth to the design.

1.1.7. Texture

Texture adds a tactile appearance to a design layout. Imagine how a design piece would feel if you touched it. The goal of texture is to add depth to a 2D surface. Texture can applied graphically through either patterns, digitally created or an image mimicking the desired pattern. Below is an example of an abstract geometric pattern made up of basic geometric elements.

To achieve an authentic vintage feel, you may try a rough effect as a background or a natural pattern like the wood pattern below highly texturized patterns like this can translate the feel below. Highly texturized patterns like this can translate the feel of wood grains visually. Textures can also be physical for example, laser cutters give you the ability to stack multiple shapes and intensify a tactile response. Add real tactile texture to your design by embossing a texture to paper. This way, you have the chance to create a memorable piece that will certainly stand out from the crowd. Stylistically, it is not ideal to blend multiple textures in a design (unless necessary) as it can be overwhelming for the viewer.

In design, texture can also refer to the elements placed on a page. Multiple layers of text placed on top of each other can lend a unique texture that cannot mimicked by anything organic. Different textures give off a different vibration try thinking of different materials if you work with physical shapes. For instance, try using soft

surfaces like felt for children's books. Art book designs are the most forgiving for thinking outside the box.

1.2. Principle of design

Design made up of basic elements built into a structure that communicates a message. These elements are the building blocks you need to construct your design. These objects can arranged in any way as part of your composition; we call this the principles of design. These principles are important concepts that can help you organize the basic structural elements on a page. The main principle of design are:

- Balance
- Rhythm
- Movement
- Variety
- Scale
- Proportion
- Emphasis
- Unit

1.1.1. Balance

Balance refers to the weight of objects, and their placement in relation to each other. It is a sense of stability you might feel from elements in alignment. When establishing balance consider visual weight created by size, color, texture and number of objects.

Figure 3. Balance

1. **Symmetrical Balance**

This can take three forms: symmetrical, asymmetrical and radial. Symmetrical balance refers to the exact mirroring of objects across an axis (i.e. an invisible line on the page).

Achieved by placing identical objects on either side of a central point. Creates a quiet, restful feeling, Suggests restraint, orderliness, formality. Also called, FORMAL balance.

Figure 4. Symmetrical Balance

An artwork with symmetrical balance is well balanced, looks even and stable. When one side of an artwork mirrors the other, it has absolute symmetry. When the symmetrical balance is not exact called bilateral symmetry. In this example of symmetrical balance in art, each animal on the left has its equal counterpart on the right. The colors are not exact, but still considered symmetrical balance.

Figure 5. Symmetrical Balance

2. Asymmetrical Balance

An artwork with asymmetrical balance is “heavier” or “lighter” in some areas, looks unstable, and can make the viewer uncomfortable. Asymmetric balance adds a dynamic look to artworks and often draws attention to focal points in the composition. υ In this example of asymmetrical balance in art, the artist balances the heavy black figure on the right with the curtain on the left. If the curtain were a different size or a different color, the balance would throw off.

Figure 6. Asymmetrical Balance

Asymmetrical balance is the opposite of symmetrical – when objects do not mirror each other perfectly, shifting the balance to one side or the other of the axis. This often done to highlight an object in relation to another. Achieved by placing different objects of equal visual weight on either side of a central point. Creates arrangements

that are more interesting. Suggests informality and relaxed. Also referred to as INFORMAL balance.

Figure 7. Asymmetrical Balance

In this case:

- Mirror placed off center on the mantle.
- Tray and bottles on either side of the mirror help to balance it out.

Figure 8. Asymmetrical Balance

- Wall hangings of the same visual weight hung on each side of the plant stand.
- Chair balances out the fireplace on the other side of the room.

3. Radial Balance

Radial balance is when; objects distributed all around a central point. Involves having furnishings or patterns arranged in a **circular** manner. Radiation creates a sweeping, dramatic, circular motion in a room.

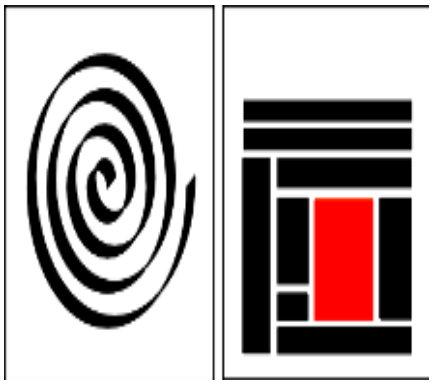
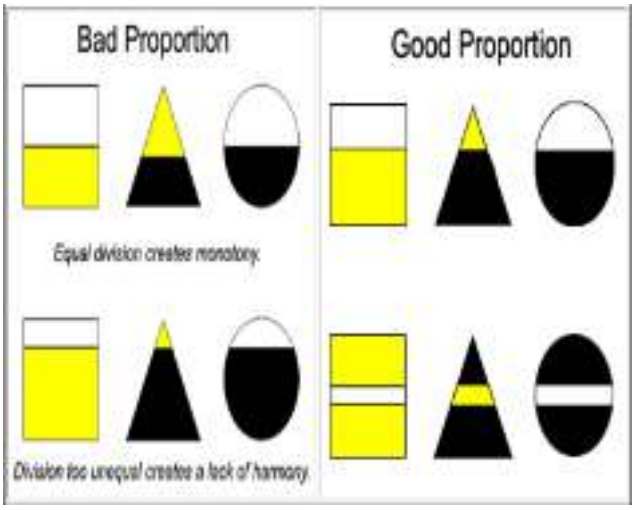


Figure 9. Radial Balance

3.1.2. Scale and Proportion

Scale relates to the size of a design in relation to the height and width of the area in which it placed. Proportion relates to the parts of the object. Proportion is also how one part relates to another. Scale relates to the actual and relative size and visual weight of the design and its components. Furniture and accessories must be in scale to the room. Proportion is the size of objects in relation to each other, or within a larger whole. The creative use of color, texture, pattern, and furniture arrangement can create illusions of properly proportioned space. This could be natural (e.g. a nose which fits onto a face the way you would expect it), exaggerated (e.g. a nose that is vastly over or undersized), and idealized, in which parts have the kind of perfect proportion that you just do not see occurring naturally. Proportion usually not even noticed until something is out of proportion. When the relative size of two elements being compared seems wrong or out of balance, it is said to be out of proportion. For example if a person has a head larger than their entire body, then we would say that they were out of proportion.



Scale and Proportion may be Too Big, Too Small, and Just Right

The chairs light palate emphasizes its skinny scale or too small scale.

This chairs massive scale or too big scale and diminishes everything around it.

This club chair matches the scale of the sofa or Just Right.

Figure 10. Scale proportion

3.1.3. Emphasis

The center or focus of attention and interest within a design. The feature that commands attention and makes a design visually interesting. Emphasis is an extension of these first two principles: it is when contrast, placement, size, color or other features used to highlight one object, area, or other elements of the artwork. This used to draw attention, a focal point – or accentuate a feature.

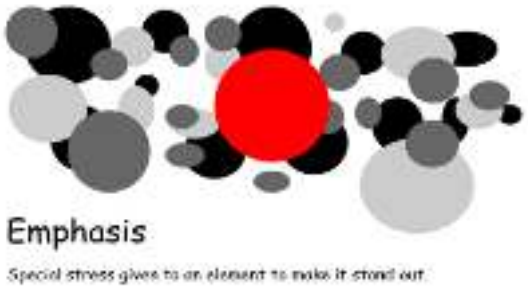


Figure 11. Emphasis

Architectural features such as fireplaces, decorative windows and Television often used as focal points. Works of art and decorative accessories often emphasized in a design.

Figure 12. Emphasis

The point of emphasis should command attention, but not dominate the overall design. Other features within the room should not compete for the emphasis.

Emphasis can create through the following ways:

- Arrangement of furniture around a focal point.
- Use of color, texture, or pattern.
- Placement of accessories.
- Use of lighting.

3.1.4. Harmony

In follow on from variety, harmony is the use of related elements. This might be similar colors, shapes, sizes of objects, etc. It is about repetition and a relationship between elements. This creates a sense of connection between the objects, creating a sense of flow. Harmony is one of the most important aspects when it comes to principles of art

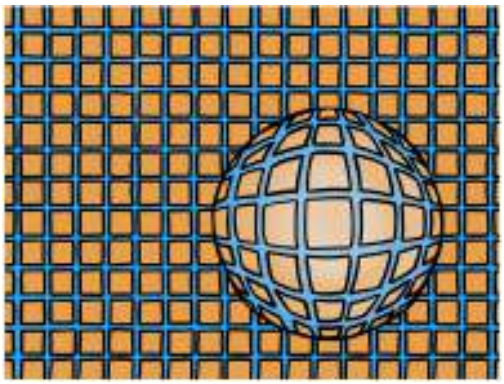


Figure 13. Harmony

There are two types of harmony: Unity and Variety

Unity occurs when all the parts of a home or room related by one idea. A unified design has consistency of style.

Figure 14. Unity in Harmony

Varity occurs when two or more different elements of design used to add interest to a design. Variety can achieved by combining different styles and materials, as long as they are compatible.

Figure 15. Varity in Harmony

Harmony achieved when unity and variety effectively combined. Carrying variety too far creates confusion. A lack of unity may make a small home seem even smaller.

Figure 16. Harmony

3.1.5. Movement

This indicates the direction your eye takes as you view the work – in what order does your eye travel? If emphasis is used, this often means you start with this element first and travel away from it. The movement inherent in the image is

important, as it tells you a story through use of lines (whether they are literal or implied).

Figure 17. Movement

3.1.6. Rhythm

Leads the eye from one point to another, creates motion. Rhythm is a kind of relationship between patterned objects. Rhythm is often the use of regular, evenly distributed elements – they could occur in slow, fast, smooth or jerky intervals, and this tells you something about the feelings invoked. Like listening to an upbeat pop song versus a slow ballad, the arrangement of notes creates a kind of pattern you naturally respond to. The important part is recognizing the relationship between the objects.

Figure 18. Rhythm

Types of Rhythm

- **Rhythm by Repetition**

Rhythm created by duplicating (repeating) shapes, colors, pattern, line, texture.

Figure 19. Rhythm by Repetition

Beams in the ceiling repeated. Windowpanes, repeat. Stripes on ottoman and chair repeated.

- **Rhythm by Gradation**

Rhythm created by a gradual change in size or color.

Figure 20. Rhythm by Gradation

Paint on wall changes gradually in value.

- **Rhythm by Radiation**

Rhythm created by identical objects coming from a central axis.

Figure 21. Rhythm by Radiation

Tall Grasses “radiate” from the center of the vase on this bathroom vanity.

- **Rhythm by Opposition**

Rhythm created by lines at right angles or contrasting colors.

Figure 22. Rhythm by Opposition

Contrasting black and white tiles and the lines intersecting at right angles.

- **Rhythm by Transition**

Rhythm created by curved lines that carry your eye across a straight surface.

Figure 23. Rhythm by Transition

Window treatments that gently swag down create a soft rhythm by transition.

Self-Check – 1	Written test

Name…… ID…… Date…

Direction I: choose the correct answer.

1. _____ is type of line catch attention more. (2pts)

A. Straight line B. Curved line C. Bold line D. Thin line E. Inclined line

2. _____ Type of line perceived as young and fun.(2pts)

A. Straight line B. Curved line C. Bold line D. Thin line E. Inclined line

3. _____ is the result of enclosed lines.(2pts)

A. Form B. Shape C. Space D. Volume

4. _____ refers to the purity of a color. (2pts)

A. Hue B. Tint C. Tone D. Saturation

5. One is note primary color in design.(2pts)

A. yellow B. Red C. Green D. Blue

6. What type of rhythm you see in the room below?(3pts) Why (5pts)

A. Reputation B. Gradation C. Radiation D. Opposite E. Transition

Direction II: Give short answer for the following Questions

1. What are the basic difference between unity and verity harmony? (4pts)

2. How Emphasis can create in design? Give at least three reason. (3pts)

3. Discus on symmetrical, asymmetrical and radial balance support with illustration. (15pts)

Note: Satisfactory rating - 35 points Unsatisfactory - below 35 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 2- selecting design requirements

2. Design requirements

The design requirements for a product are the basis for the design requirements of the product elements (components, joints, and in-process structures). Once the product elements' design requirements have defined, it is possible to identify, evaluate, and select the materials that can used for each product element. There will be design tradeoffs between the physical construction and the materials that can used for a product element. Using a specific physical construction can affect the range of materials that can used for a product element. Alternatively, trying to use a specific material for a product element may constrain its physical construction. Ideally, a product element's physical construction and materials optimized to provide the required performance and reliability at the lowest cost.

The design requirements for a product based on the wants and needs of the intended customer. Need and wants of customer identified by the company making the product, and they are often communicated by the target customer in nontechnical and sometimes vague terms. For example, a product should not be too heavy, should be easy to open, or should look "high-tech." Design teams must convert these wants and needs to technical design requirements. Once the customer's wants and needs identified, the design team converts them to engineering requirements for the product. These engineering requirements become parts of the design requirements for the product. Successfully converting the customer's wants and needs to meaningful engineering requirements necessitates good communication between the marketing and engineering groups within a company. An engineering technique that is useful for helping design teams convert customer wants and needs to engineering requirements is quality function deployment. In other case product can design based on a set of design requirements, which are already in technical terms. After the design requirements for a product defined, the design team develops, evaluates, and selects product design

concepts, which are descriptions of the product's physical form then design team develops design concepts and defines design requirements for the subassemblies within the product. Subassemblies designed so that they satisfy the design requirements of the product. Finally, the design team develops design concepts and defines design requirements for the product elements within the subassemblies. The product elements designed so that they satisfy the design requirements of the subassemblies.

1.2. Ergonomics

Ergonomics is a science focused on the study of human fit, and decreased fatigue and discomfort through product design. Ergonomics applied to the products we design fit the people that are using them. At work, at school, or at home, when products fit the user, the result can be more comfort, higher productivity, and less stress. Ergonomics can be an integral part of design, manufacturing, and use. Knowing how the study of anthropometry, posture, repetitive motion, and workspace design affects the user is critical to a better understanding of ergonomics as they relate to end-user needs.

Ergonomics is designing a job to fit the worker so the work is safer and more efficient. Implementing ergonomic solutions can make employees more comfortable and increase productivity. Ergonomics is important because when you are doing a job and your body stressed by an awkward posture, extreme temperature, or repeated movement your musculoskeletal system is affected. Your body may begin to have symptoms such as fatigue, discomfort, and pain, which can be the first signs of a musculoskeletal disorder. Therefore, we required to design ergonomically feet products.

1.3. Anthropometric Measurements

Anthropometry is the science that measures the range of body sizes in a population. When designing products it is important to remember that people come in many sizes and shapes. Anthropometric data varies considerably between regional populations.

Anthropometric dimensions for each population ranked by size and described as percentiles called Percentile Humans. It is common practice to design for the 5th percentile (5th %) female to the 95th percentile (95th %) male. The 5th% female value for a particular dimension (e.g. sitting height) usually represents the smallest measurement for design in a population. Conversely, a 95th% male value may represent the largest dimension for which one is designing. The 5th% to 95th% range accommodates approximately 90% of the population. To design for a larger portion of the population, one might use the range from the 1st% female to the 99th% male.

Anthropometric datasets compare people of different ages and occupations. Data in anthropometric databases may represent static dimensions, such as “lower leg length” or functional dimensions such as “reach.”

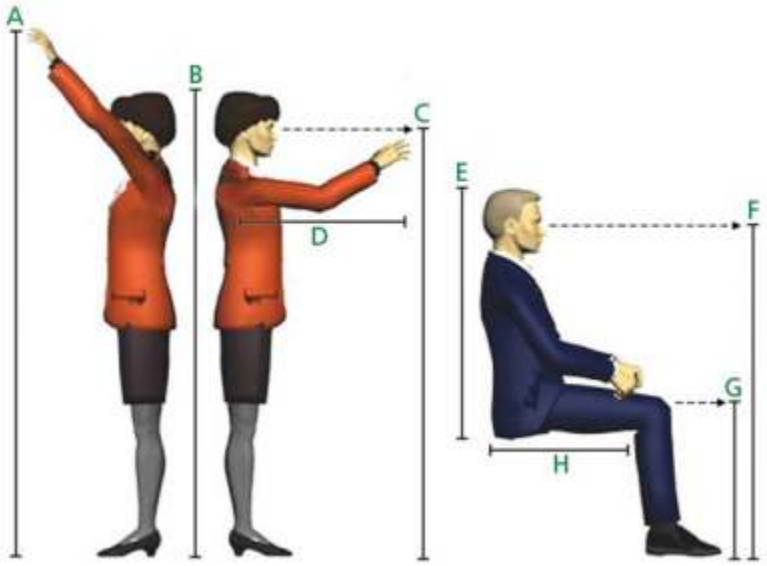


Figure 24. Common ranges of measurements

Table 1. Anthropometric measurements (including allowances for clothing) of small and large males and females.

Measurement	Letter	Female	Male
Standing Overhead Reach	A	74.9" – 86.8"	81.2" – 93.7"
Standing Height	B	60.2" – 68.4"	64.8" – 73.5"
Standing Eye Height	C	56.9" – 65.0"	61.4" – 69.8"
Standing Forward Reach	D	30.8" – 36.1"	33.8" – 39.5"
Sitting Height	E	31.3" – 35.8"	33.6" – 38.3"
Sitting Eye Height	F	42.6" – 48.8"	46.3" – 52.6"
Sitting Knee Height	G	19.8" – 23.2"	21.4" – 25.0"
Seat Depth	H	16.9" – 20.4"	17.7" – 21.1"

1.3.1. Common Workplace Postures

There are common postures found in the work environment that can consider when designing workplace products or space. Includes:

- Standing
- Sitting
- Reaching
- Moving

1.4. Function

Function can expressed as a number of properties related to the usage of a product. These properties include the relationship between a product and a consumer. Based on the purchasing motivations, the system of functions can divided into two:

- Functionality (e.g. utility and practical function) and
- Aesthetic functions (e.g. visual sensation, emotions, etc.).

These functions are inseparable; their relation has an important role in the product usage. Functionality and aesthetic functions, determinative forms and fashionable style play very important role in furniture design and production. The proportion of functionality and aesthetic functions in case of furniture design has to be determined to satisfy consumer demands. The customer needs are helpful to define the purpose (functions) of a product. To achieve it, the needs have transformed into functions. Functions are abstractions of what a product should “do”. A limited number of elementary or general functions on a high level of abstraction create a function structure.

1.5. Aesthetic

It is an adjective on the things that give in the self-pleasure and a sense of harmony. Aesthetics regularity through the achievement of unity between the formal relations that we perceive with our senses, and it is one of the characteristics that characterize the structural and structural aspects. Formation aesthetics directly affect the construction of the external composition of the product units. Aesthetics formulated appropriately for their function, which positively reflected on attracting the costumer. Develop aesthetic sense in order to achieve maximum sales, and build the exterior of the product units, which depends on the ability of the designer’s awareness. Continuous modern theories and renewable sciences that will help in the formation of renewable designs based on scientific studies embody the main idea of design to achieve a harmonization between the aesthetic and functional values of the product. Aesthetic is an important experimental entry and creative character in the field of visual and applied arts, through the conscious study of product designers who can create new designs with unconventional form relationships.

1.6. Economics

The economic success of most firms depends on their ability to identify the needs of customers and to quickly create products that meet these needs and can be produced at low cost. Achieving these goals is not solely a marketing problem, nor is it solely a

design problem or a manufacturing problem; it is a product development problem involving all of these functions.

Economics answers the following during product designing and production:

- How long will it take to produce the container?
- How much will it cost to produce it?
- How many will be sold?

1.7. Construction and technology

During designing and production of products methods of construction and the types of technology is the most crucial. Method of construction is the way to construct or model the product and it affect strength and functionality of the product. Whereas technology has impact on the quality of the final product, cost and product manufacturing time.

For product construction, consider the following points:

- Will construction require any special skill/ equipment?
- How it be made sufficiently stable?
- How the stand be fixed to the body?
- What method will used for fixing the handle?
- What shape should the handle be?
- How the cover be fixed on to the body?

Self-Check – 2	Written test

Name…… ID…… Date…

Directions: give Short Answer for the Questions below.

1. What are the elements required in product design? (3pts)

2. What are the difference between ergonomics and atrophy? (2pts)

3. What are the Common Workplace Postures? (3pts)

4. Discuss on function and aesthetics in product design. (7pts)

Note: Satisfactory rating - 13 points Unsatisfactory - below 13 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- confirming appropriate product design

1. Introduction

Product design takes a long time and a great deal of effort. It is important to target the design program to minimize time and costs and to plan successfully complete within allocated resources. Product design plan begins with the product design specifications. These include a profile of the product characteristics as defined by the consumer, the structure and composition, safety factors, convenience and aesthetics, and indicates the manufacturing, processing, storage variables, and their effects on the product qualities. Many of these product design specifications start as general descriptions; product design and process development focuses them into definite, quantitative descriptions. In the design process, the product and process development are integrate so that at the end of the design stage there is a product with the optimum qualities, and a process to produce it.

In the product design, both the input variables to the process and the output variables of the product qualities identified early in the developments. The input variables are:

- Raw materials: type, quality, quantity
- Processing variables: types of processing, processing conditions.

The output variables are:

- Product qualities;
- Product yields

In designing product, which fulfill needs of customer, confirm appropriate product design, which can produce with available input and the output, requires to quality, moderate cost, less development time and functional.

• **Product quality**: How good is the product resulting from the development effort? Does it satisfy customer needs? Is it robust and reliable? Product quality ultimately reflect in market share and the price that customers are willing to pay.

• **Product cost**: What is the manufacturing cost of the product? This cost includes spending on capital equipment and tooling as well as the incremental cost of producing each unit of the product. Product cost determines how much profit accrues to the firm for a particular sales volume and a particular sales price.

• **Development time**: How quickly did the team complete the product development effort? Development time determines how responsive the firm can be to competitive forces and to technological developments, as well as how quickly the firm receives the economic returns from the team's efforts.

• **Development cost:** How much did the firm have to spend to develop the product? Development cost is usually a significant fraction of the investment required to achieve the profits.

• Development capability: Are the team and the firm better able to develop future products as a result of their experience with a product development project? Development capability is an asset the firm can use to develop products more effectively and economically in the future

Self-Check – 3	Written test

Name…… ID…… Date…

Directions: give Short Answer for the following Questions

1. What are the input and output variables in bamboo product manufacturing? (3pts)

2. What are the difference between product cost and development cost? (2pts)

3. How designers confirm appropriate bamboo product design for his/her customer? (10pts)

Note: Satisfactory rating - 13 points Unsatisfactory - below 13 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Identify production materials standard design, and methods

4.1. Production materials

Use appropriate types of Martials for the production of products, which are easily valuable, less cost, strong enough, easily processed, beautiful, use last long and environmentally friendly.

4.2. Design Standards

Standards are an important part of our society, serving as rules to measure or judge capacity, quantity, content, extent, value and quality. Some standards take the form of an actual item such as the atomic clock, which serves as the reference for measuring time throughout the world. Others set criteria for use and practice in industry and for products used in everyday life

Designers made a design decision all the time; we can design better together by establishing design standards upfront. Design standards are expectations between the designer and others, whether the clients, colleagues or your bosses.

Surprisingly, the best design standards are your standards. It might not the one that others follow, but it will be the one that helps you achieve your design goals. You might notice that good design is hard to notice because it fits our needs so well, and does not draw attention to itself. **Use these three standards (in order) to noticing a great design**.

1. **Does the design feel right?**

Before we think, we feel. Does the typography feel right? How about Color? Spacing? The basic foundations can make a significant impact on how people think. Rationally, emotional always wins. We are human, and we have bias; we unconsciously judge the design by its looks all the time. People gut feeling significantly influences their

emotions, which affect their actions. The outstanding design will be worthless if people do not interact with it.

2. **Does the design solve the problems?**

Great design must have a purpose and help people solve their problems. Not just good looking, but the design should influence usage and help people perform the tasks intuitively as intended. A good design should always consider how people think and behave in a broader landscape. My professor once told me that a great design is never finish designing. As long as humans still have needs, things will keep changing. Designers should keep iterating the design to be relevant and serving them.

3. **Does design creative?**

Without creativity, we just create another mediocrity stuff. It is shallow innovation, and the world is full of that. Creativity is a crucial standard in my design standards as it ensures that the designer will push the boundary and keep raising the bar. It is easy to pull back if we go beyond expectation. However, it is hard to push beyond expected in the first place but that could make all the difference. Yesterday's great is today's mediocrity.

4.2.1. Reason for care about the design standards

Most people approach the designer not because they cannot see the solution but because they cannot see the problem. The design standards are a great tool to highlight the problem before you approach any project. In any project, use the design standards to identify:

- If your design does not feel right (Feeling),
- Did not solve the right problem (Thinking), or lacks creativity (Sensing)?

4.3. Product design process

Generally, product design involves four periods, namely, the research phase, the analysis and positioning phase, conceptual design phase, detailed design phase, and the design output phase. According to different design objects, the specific matters of each stage are slightly different and complicated.

4.3.1 The research phase

Research phase mainly focuses on people, machines, and environment. Among them, people include target users, potential users, producers, sellers, recyclers, etc., which are related to the product life cycle; gender, age, education background, income level, social status, family conditions, as well as other factors which reflects in status, lifestyle, and values all have a profound impact on the future direction of product design. The machine mainly refers to the various attributes involved in the design object and related products including the current status of the market products and various property expectations of the products involved such as function, form, structure, color, human-machine relationship, usage, carrying method, etc. The existing attributes of the product market have a certain reference and guiding role for future design. From the existing market survey, we can understand the distribution and gathering of market products, to find the opportunity of post-development positioning. At the same time, the investigation of the attributes of future products can further clarify the product characteristics, zero to thin, and gradually deepen the refinement of product concept until the entire product design process is completed. The environment mainly refers to the natural and human context in which the design object is located. Any product used in a certain time, space, and social environment and the product status should match the current environment, which can highlight the design intent and the characteristics of the times.

4.3.2 The analysis and positioning stage

The analysis and positioning stage mainly based on the abovementioned research information. Through the actual deep investigation of people, machines, and environment, we are firstly able to analyze the direct and potential needs of the users, to achieve design customization in a targeted manner. Secondly, the investigation of the

machine can be intuitive and effective in discovering market development opportunities. In general, we can explore products from two aspects. On the one hand, in the state of market agglomeration, it means that the product status is very suitable for the current trend and can meet the needs of most users. It can used as a follow-up product development, taking the advantages of popular goods and targeting the mainstream of the market. On the other hand, as to the market's unpopular performance, the challenge of the alternative way of solving problems with the mutant thinking and the use of unique strategies to creatively complete the development of brand-new products can be reversely considered. Ensuring the service life of the product and saving the human, material, and financial investment in the industrial chain. Based on design analysis, the related aspects of the products involved are positioned to create a benchmark for subsequent series development and visual design, which lays the design direction and basis for the whole design process.

4.3.3 Conceptual design stage

Conceptual design is a series of organized and targeted concepts of concise design based on analysis of the previous market demand and user needs. It manifests itself as an evolving process from coarse to fine, from fuzzy to clear, and from abstract to concrete, which is a preparation stage for the visualization of the design conceptions after the above design positioning is determined. Conceptual design determines the main purpose and developing direction of the future product, through which we can save our resource input as much as possible, help the following production and sales, extend the profit margin, and effectively estimate and guide the late recycling issues. Thus, conceptual design in the initial stage of product is undoubtedly a crucial part of product life cycle.

4.3.4 Detailed design

Detailed design is a visualization process based on the previous design concepts. It is extending and diverging based on design concepts, gradually forms a visual clear plan. Based on this, the process of design evaluation, program selection, and optimization, as well as the product expressions, carried out. With a same script, different interpretations

produce different works. The same is true of the design concept. Focusing on the abstract design concept, divergent thinking, and extension, starting from different angles, different characteristics, different ways, etc., the abstract concept is gradually associated with concrete objects, and the design process is gradually cleared and definitely expressed. In terms of design evaluation, program selection, and optimization, based on the advancement and popularization of modern technology, computer-aided design and manufacturing technology can fully utilized; digital models can be built with design sketches, and even 3D physical models can be obtained by using rapid prototyping technology. The model carries out product functional design, structural design, color design, human-machine interface design, etc. At the same time, according to the evaluation results, the digital model or physical model optimized and improved through computer aided design software and reverse engineering technology.

4.3.5 The design output stage

The design output stage mainly refers to the expression of design results and the preliminary preparation for the following production. At this stage, through the design renderings, dimensional drawings, parts drawings, construction drawings, detail display drawings, structural drawings, etc., the design results presented in a detailed and complete manner. Through this way, the above design work closed and integrated on one the hand. On the other hand, these outputs also provide the basis for production and construction after the design phase.

4.4. Product Design methods

In different design stages and target objects, the complexity of the steps is slightly different and so as the design methods involved. Generally spoken, blows are the common methods involved in the main four steps of product design.

4.4.1. Design survey

With the advent of the information age, the world has become smaller and smaller, and the acquisition of various information has become feasible and convenient. The individual and the mainstream increasingly influence the factors that people choose products. At

the same time, in the whole product design process, each step has a series of internal or external constraints. The design is just like “dancing with shackles.” Every involved part needs information intervention and guidance and gradually coordinates, optimizes, and iterates to initiate better ideas and works. This factor makes the investigation and research at the beginning of the design particularly important. Common survey methods include comprehensive surveys, typical surveys, and sample surveys. The main difference is the coverage of survey samples. When carrying out the survey, firstly, it is necessary to prepare for the whole investigation, determine its objectives, and clarify whether its form is inquiry, observation, experiment, or case, and based on preliminary analysis, formulate the basic ideas and problems of the investigation, and highlight the key points concisely as much as possible. The second one is to conduct an investigation. This stage is the way to obtain information. Incorporate the survey objectives to determine the respondents, select appropriate survey techniques to determine the query items and design questionnaires, and then conduct a field survey in an orderly manner. Finally, collate the survey results by analyses and research, draw into various forms, and then present analysis results of the survey. At different stages of design, surveys conducted around different surveys, with different design goals and processes to make sure the results armed with comprehensive information feedback, to develop and create new products in a targeted manner.

4.4.2. Creating Techniques

The creating technique is an important part to improve the design quality. It is a means to use the multi-directionality, the differentiation, the suddenness, the broadness, and the flexibility of creative thinking to propose new ideas. According to different classification criteria, creating techniques can divided into different types. Such as according to the personality characteristics of the creative team members, the creating techniques can divided into open speech and anonymous expression. The typical representative techniques are brainstorming and 635 method. The former is free expression of team members, not bound to each other, and open to freedom. By this free style, the creativities of the group are stimulating, while the latter is to be silence in the previous

period. Each one needs to avoid mutual interference and privately express their ideas in a recorded way. According to the nature of the creative proposal, it can divided into active stimulating and passive stimulating. The typical representatives are the comprehensive method and enumeration method. The former uses abstract expressions to let the team members of different professional backgrounds associate with each other freely; the latter is based on existing objects, enumerate expressions and deep cognition one by one, and then use these expressions as sources of creativity. Flexible selection of different creative techniques at different stages of design needed.

4.4.3. Product form design method

This stage of creating techniques designed to complete the visualization process from design concept to product modeling. After completing the functional positioning of the product, the product structure and the later modeling design become the final platform for design creativity. Therefore, the product design method mainly includes the following three steps. Firstly, decompose the product into individual parts according to the previous function and form positioning. Secondly, confirm the changeable parts of each shape. Thirdly, the changeable part is changed. Finally, recompose the relevant individual parts into a complete one, and select the best shape you evaluated. For example, a simple face will be a brand-new one if we change parts of it, including face skin color and facial features and any other aspects. In principle, the number of new schemes is the same exponential power of the changeable part.

4.4.4. Design evaluation method

Design evaluation is to compare and evaluate the solution to the problem in the design process, thereby determining the value of each program and judging its merits and demerits in order to screen out the best design. The meaning of “program” here is extensive and can be in various forms, such as principle program, structural program, modeling program, etc. From the perspective of its carrier, it can be a component or an overall drawing, or it can be a model, a prototype, a product, etc. In general, the “program” referred to in the evaluation is essentially the answer to the problems encountered in the design. The significance of design evaluation is consciously control

the design process, to target the direction of the design, and to assess the design plan with scientific analysis rather than subjective feeling, which provides designers with the basis for judging design ideas. Through design evaluation, the quality of design can effectively guaranteed, and the best solution in which all aspects of performance meet the target requirements can selected among many design programs. Secondly, proper design evaluation can reduce the blindness in the design and improve the efficiency of it. In addition, the applicative performance of evaluation can effectively verify the design plan, find out deficiencies during the process, and provide the basis for deeper design improvement. In the actual evaluation process, due to the complexity of the design factors, the main influencing factors generally selected. According to different design objects and different stages of the design, different evaluation objectives are determined, and the most appropriate content selected to establish the evaluation target system. After selecting the evaluation items, the weighing coefficients are, respectively, set according to the importance of each evaluation item, and the entire project evaluation process is finally completed.

Self-Check – 4	Written test

Name…… ID…… Date…

Directions I: say true if the statement is correct, false if the statement is false.

1. The best design standards are your standards. (2pts)
2. In designing a product, we need to think, then after we feel. (2pts)
3. Good design must have a purpose and help people solve their problems. (2pts)

Directions II: Give short answer.

1. What are the reason for care about the design standards? (5pts)

2. Discuss on the periods involves in the product design. (9pts)

Note: Satisfactory rating - 18 points Unsatisfactory - below 19 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 5- Identifying need of customers with work/job order

2.1. Customer need

A customer is the person/organization who buys goods & services. Customers are the most important asset of any organization. Customers will expect from supplier accurate and reliable information about products and services. Customer service is an organization's ability to identify and supply their customers' wants and needs. Customer needs are the problems that customers intend to solve with the purchase of a good or service. Customer needs are the things that customers require when purchasing a product or service. Businesses must find out about their customer's needs in order to be successful. Knowing the customer and his needs is most important for a successful business. The more you know about your customers, the more effective your sales and marketing efforts will be. Customer needs can assessed by analyzing the **factor** such as who they are, what they buy, and why they buy it. The major heads that a business firm has to be aware about its customers can briefly pointed as follows:

1. **Who they are**: A firm must be aware of the gender, age, marital status and occupation of the customers, if it is the firm should be aware of the selling its product directly to individuals. The firm should be aware of the size and kind of business, if it is selling to other businesses.
2. **What they do:** It is worth knowing the occupations and interests of the customers as well as the aim of the businesses, to which the product sold.
3. **Why they buy:** If you know why customers buy a product or service, it is easier to match their needs to the benefits your business can offer.
4. **When they buy**: A business can massively increase its chances of success if it approaches a customer just at the time they want to buy.
5. **How they buy**: For example, some people prefer to buy from a website, while others prefer a face-to-face meeting.

6. **How much money they have**: A business can be more successful if it can match its offering to what it know its customer can afford.
7. **What makes them feel good about buying**: If you know what makes them tick, you can serve them in the way they prefer.
8. **What they expect of you**: For example, if your customers expect reliable delivery and you do not disappoint them, you stand to gain repeat business.
9. **What they think about you:** If your customers enjoy dealing with you, they are likely to buy more. In addition, you can only tackle problems that customers have if you know what they are.
10. **What they think about your competitors**: If you know how your customers view your competition, you stand a much better chance of staying ahead of your rivals.

The requirements of a customer can further categorized in to three:

1. **Normal Requirements** – requirements typically what one gets by just asking customers what they want.
2. **Expected Requirements** – these are the obvious / compulsory requirements. For example, if meal served hot, customers barely notice it. If it is cold or too hot, dissatisfaction occurs. Expected requirements must fulfilled.
3. **Exciting Requirements**– These are beyond the customer's expectations. If provided, customer would be excited. If not ,they would hardly complain

Customer satisfaction are the measures how products or services supplied by a company meet or surpass a customer's expectation. ''Customer needs may vary, but their bias for quality never does''. Customer satisfaction can used as a metric to manage and improve the businesses and hence it is very important for the marketers and business.

2.2. work/job order

Work orders are an authorization of maintenance, repair or operations work to be completed. Work orders can manually generated through a work request submitted by a staff member, client, tenant, or automatically generated through a work order management software or Preventive Maintenance (PM) schedule. Work Orders can also generated via follow-ups to Inspections or Audits.

Work Orders includes:

- Who is requesting the work order
- Who is authorizing the work order
- Who will perform the labor
- What the task is
- When the work order needs to be completed
- Where the work order needs to be performed
- How to complete the task, including necessary parts and other notes

Work Order complete the following:

- Offer an explanation of the problem, repair, or installation
- Schedule resources and tools needed for maintenance
- Provide technicians with detailed instructions on the work to be performed
- Document the labor, materials, and resources used to complete the work
- Track all maintenance and repair work that has been performed on each asset

Steps in Making a Work Order

First thing is, to break down a work printable order into four main sections, which are:

- The contact information,
- The assignment,

- The issue, and
- The detail regarding a specific task or project.

At the top portion of your work order, write the following:

- The company name
- The complete address
- Essential contact information

Once you have written the company contact details, include beside it the following:

- Work order number
- Job number And
- the inclusive date

Do not forget to add the complete name and the address of the person who will be providing the service in the assignment section. You can just type in the complete location you want to visit in completing a certain task. In addition, part of the process is to describe the details of the issue in which the service professional has hired to resolve it. Do not forget to make a short sample list of the issue details. Include the date when the person in charge must help when it comes to completing the work given.

Self-Check – 5	Written test

Name…… ID…… Date…

Directions: Give short and direct answer.

1. who is customer.(2pts)

2. What are the basic requirements of customer? (4pts)

3. What solution you made when your customer need is out of standards and specification of design. (5pts)

4. What are the merits of work or job order? (4pts)

5. Develop work order for your friends used to collect the needs of customer who want to purchase bamboo furniture from your college. (10pts)

Note: Satisfactory rating - 22 points Unsatisfactory - below 22 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 6- Confirming type of project

6. Introduction

Every project needs to end and that is what project completion is all about in the last phase of the project life cycle. The whole point of the project is to deliver what you promised. By delivering everything, you said you would, you make sure that all stakeholders are satisfied and all acceptance criteria have met. Once that happens, your project can end.

Project completion is often the most neglected phase of the project life cycle. Once the project is over, it is easy to pack things up, throw some files in a drawer, and start moving right into the initiation phase of the next project. Hold on. You are not done yet.

The key activities in project completion are gathering project records; disseminating information to formalize acceptance of the product, service, or project; and performing project closure. As the project manager, you will need to review project documents to make certain they are up-to-date. For example, perhaps some scope change requests were implemented that changed some of the characteristics of the final product. The project information you are collecting during this phase should reflect the characteristics and specifications of the final product. Do not forget to update your resource assignments as well. Some team members will have come and gone over the course of the project. You need to double-check that all the resources and their roles and responsibilities are noted.

Once the project outcomes documented, you will request formal acceptance from the stakeholders or customer. They are interested in knowing if the product or service of the project meets the objectives the project set out to accomplish. If your documentation is up-to-date, you will have the project results at hand to share with them.

Self-Check – 6	Written test

Name…… ID…… Date…

Directions: give short and direct answer.

1. What are the key activities in project completion?(10pts)

2. Confirming your training on customer need in the previous content whether training meet the objective or not? (10pts)

Note: Satisfactory rating - 18 points Unsatisfactory - below 18 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

LG #03	LO #3- Establish designing criteria and limitations

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Obtaining samples
- Drawing and approving free hand sketch
- Establishing drawing requirements and documenting
- Identifying design conventions and specification

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, **you will be able to**:

- Obtain samples
- Draw and approve free hand sketch
- Establish drawing requirements and documenting
- Identify design conventions and specification

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Obtaining samples

2.1. Introduction

Product design is the process of identifying a market opportunity, clearly defining the problem, developing a proper solution for that problem and validating the solution with real users.

Product design is cross-functional, knowledge-intensive work that has become increasingly important in today's fast-paced, globally competitive environment. It is a key strategic activity in many firms because new products contribute significantly to sales revenue. When firms are able to develop distinctive products, they have opportunities to command premium pricing. Product design is a critical factor in organizational success because it sets the characteristics, features, and performance of the service or good that consumers demand. The objective of product design is to create a good or service with excellent functional utility and sales appeal at an acceptable cost and within a reasonable time. The product should produce using high quality, low-cost materials and methods. It should produce on equipment that is or will be available when production begins. The resulting product should be competitive with or better than similar products on the market in terms of quality, appearance, performance, service life, and price.

Therefore, to design a product that meet the needs of customer with high quality and low cost designer are requires to refer Samples on selected type of design that are done previously to obtained appropriate information on the specific area from appropriate source. On this practice designer check the types of materials and tools used, methods followed functionalities and aesthetics of the final product and check the feeling of the end users. Finally, the designer can get ideas from the previous one and a chance to practice the positive side and use alternative solution to negative side.

Self-Check – 1	Written test

Name…… ID…… Date…

Directions: give short and direct answer.

1. what is Product design?(3)

2. In current market what is the best source to Obtain product design samples.(5pts)

3. Why product designer obtain samples from other sources in designing new product. (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

2.3. Freehand sketching

Freehand sketching and drawing generally used during the early stages of design, to show ideas or concepts or to clarify basic questions about the form, construction or situation of an object. Sketches and drawings made at this phase can provide the basis for object models or technical drawings, which then make the design more concrete. They can also made with rulers and stencils, if they have a design character. The boundary to technical drawing is blurred. The sketch can also use in the later phases of a project, for example to show a detail for the detail design stage, or to provide instructions for skilled tradesmen working on the actual site.

Freehand sketching requires few tools: just a pencil and paper. It may be tempting to use straight-edged triangles or rulers for drawing straight lines and a compass to draw circles. However, these instruments often slow down the process and distract from the purpose of sketching, which is to create a quick, rough graphical representation of the image in the mind's eye. Generally sketching has three steps, although the steps are usually subconscious.

First, the sketch planned by visualizing it in the mind including the size of the sketch on the paper, the orientation of the object, and the amount of detail to be included in the sketch.

Second, the sketch outlined using very light lines to establish the orientation, proportion, and major features of the sketch.

Finally, sharpening and darkening object lines and adding details develops the sketch. All sketches made up of a series of arcs and lines, so the ability to draw circles and straight lines is necessary.

2.3.1. straight line free hand sketch

A straight line sketched in the following way.

First, sketch the endpoints of the line as dots or small crosses. Then place your pencil on the starting endpoint. Keeping your eyes on the terminal point, use a smooth continuous stroke to draw the line between the points as shown in Figure 25 below. Nearly horizontal or vertical lines are frequently easier to draw than inclined lines, so it may be helpful to shift the paper to draw the line horizontally or vertically. For long lines, it may be helpful to mark two or three points along the line and use the procedure between consecutive points or to make two or three shorter passes lightly with the pencil before a final darker line.

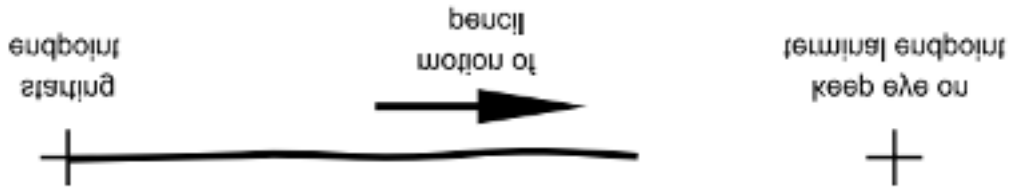


Figure 25. Free hand sketching of Line

2.3.2. Circle free hand sketch

A circle can sketched using the following steps, illustrated in Figure 26.

First, draw light horizontal and vertical lines crossing at the center of the circle.

Second, lightly mark the radius of the circle on each line.

Finally, connect the radius marks with a curved line to form a circle. Another technique is to lightly draw a square box the same size as the circle diameter. Then lightly draw diagonals of the box and centerlines between midpoints of the sides of the box. The diagonals and centerlines should intersect at the center of the circle. Mark the radius on these lines, and sketch the circle within the box. It is sometimes helpful to mark the radius on the edge of a scrap paper and mark the radius at as many points as desired in addition to the marks on the centerlines and diagonals. Arcs sketched in much the same

way as circles, except that only a portion of the circle sketched. It is generally easier to sketch an arc with your hand and pencil on the concave side of the arc.

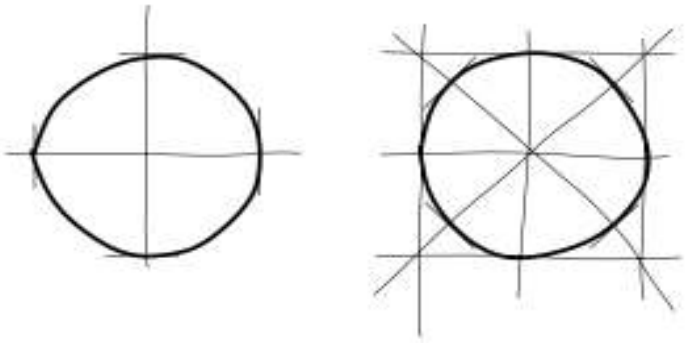


Figure 26. Free hand sketching of circle

2.3.3. Pictorial drawing free hand sketch

Pictorial sketches includes oblique and isometric.

1. **oblique projection**

The oblique projection places the principal face of the object parallel to the plane of the paper. The isometric projection tilts the part so that no surface of the part is in the plane of the paper. The advantage of the oblique projection is that details in the front face of the object retain their true shape. This often makes oblique freehand sketching easier than isometric sketching, where no plane is parallel to the paper. The disadvantage of the oblique projection is that it does not appear as “photorealistic” as an isometric projection. In other words, an isometric projection is similar to what a photograph of the object would look like.

Often freehand sketching begins with light thin lines called construction lines that define enclosing boxes for the shape that is sketch. Construction lines use in several ways. First, the construction lines become the path for the final straight lines of the sketch. Second, the intersection of construction lines specify the length of the final lines. Third, points marked by the intersection of construction lines guide the sketching of circles and arcs. Finally, construction lines guide the proportions of the sketch. This last

item is of crucial importance if the sketch is clearly represent the object. For example, if an object is twice as wide as it is high, the proportions in the sketch must reflect this. Proper proportions of the boxes defined by the construction lines will result in proper proportions of the sketch. An oblique freehand sketch is easy, since it begins with a two dimensional representation of the face of the object. Figure 27 shows the steps in quickly sketching a part with a circular hole.

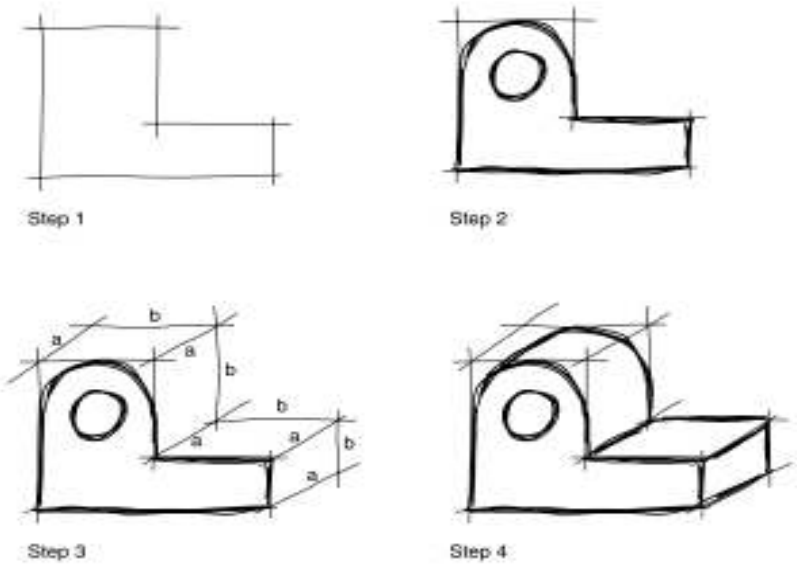


Figure 27. Free hand sketching of oblique view

Step 1: Horizontal and vertical construction lines are lightly drawn to outline the basic shape of the main face of the part. This known as blocking-in the sketch. If you are using a pencil or felt-tip marker, press lightly when drawing the construction lines to produce a thin or light line. If you are using a ballpoint pen, draw a single, light line. **Step 2:** Sketch in the face of the part using the construction lines as a guide. How you sketch the outline of the part depends on the type of pen or pencil that you are using. The idea is to thicken the lines of the part compared to the construction lines. If you are using a pencil or a felt-tip marker, pressing hard for the outline of the part will result in heavy or dark lines. If you are using a ballpoint pen, the line width does not depend much on how hard you press. In this case, the outline of the part sketched with a back and forth motion of the pen to thicken the lines of the part compared to the construction

lines. The straight lines usually sketched first, followed by the arcs. The circle for the hole in the part added last to complete the face of the part.

Step 3: Sketch receding construction lines (lines into the plane of the paper labeled a) at a convenient angle. All of the receding lines must be parallel to each other and are usually at an angle of 30° to 45°. The receding lines end at the appropriate depth for the object. Then vertical and horizontal lines at the back plane of the part are added (lines labeled b). These blocks in the three-dimensional box enclosing the object.

Step 4: Sketch in and darken the lines outlining the part. Again it is usually easiest to sketch in the straight lines first, then the arcs, and finally any details. Because construction lines are light compared to the outline of the part, they are not erased. The final sketch, while rough and lacking detail, clearly shows the design intent for the part.

2. Isometric freehand sketches

Isometric freehand sketches are somewhat more difficult to master than oblique sketches because no face is in the plane of the paper in an isometric view. The steps to construct a simple freehand isometric sketch shown in Figure 28 Below.

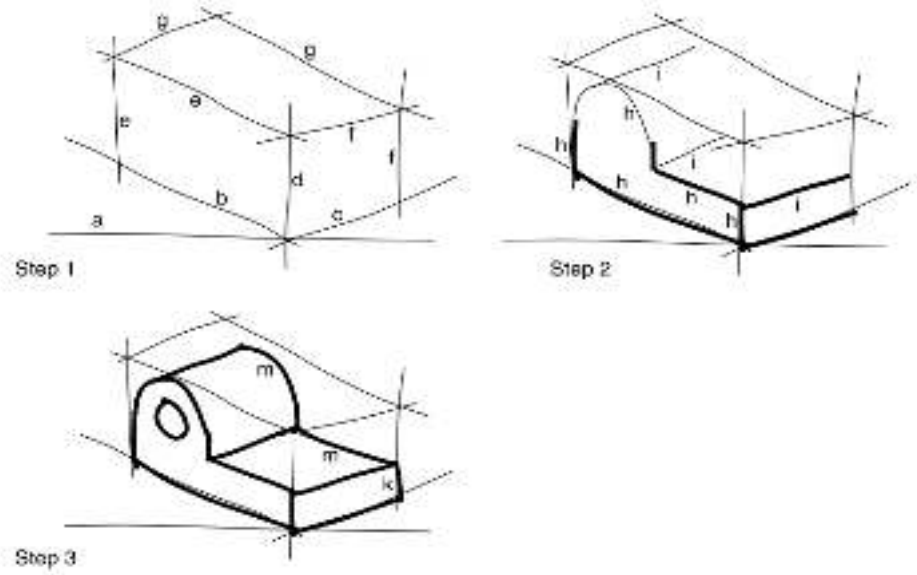


Figure 28. Free hand sketching of isometric view

Step 1: Sketch a light horizontal line (a). From this line, draw two intersecting lines at an angle of approximately 30° to the horizontal (b and c). Then draw a vertical line (d) through the intersection of the previous three lines. The three lines labeled b, c, and d form the isometric axes of the sketch. Next sketch the box to block in the front face of the part (e). These lines should be parallel to axes b and d. Similarly, sketch the lines to block in the right face (f) making sure that the lines are parallel to axes c and d. Finish this step by sketching lines parallel to the axes to complete the box that encloses the part (g).

Step 2: The outline for the front face added by sketching in lines and curves (h). Then outline the front face using heavy lines. In this case, a single heavy line such as might be produced from pressing hard on a pencil or felt-tip marker is used. Next, lines sketched to indicate the depth of the features of the front view (i). These lines should be parallel to axis c. They can darkened after they drawn lightly.

Step 3: Finally, a line added to complete the back corner of the part (k). Lines and arcs added to complete the back face of the part (m). Then the hole detail is added. Circular holes appear as ellipses in isometric views, as discussed in the next section.

The choice of whether to use an oblique projection or an isometric projection is often arbitrary. Because the oblique projection is easier to sketch, it is sometimes preferred. On the other hand, an isometric projection provides a more photorealistic image of the object.

2.1.4. Approving free hand sketching

Discuss on the looks of sketches with responsible bodies (manager or customer), develop ideas (add or subtract) on sketch based on the discussions or the needs and wants of customers made modification and then approve sketches after approving activity develop or prepare the actual design and drawing of the product to be manufactured.

Self-Check – 2	Written test

Name…… ID…… Date…

Directions: Give short and direct answer.

1. What Free hand sketch?(2pts)

2. Why Free hand sketching is important product designing.(3pts)

3. Write the procedures for producing isometric sketches of product. (5pts)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1– sketch bamboo chair

Objectives: to know successful Sketching of product.

Tools and materials required:

Pencil, sketching pad, eraser, color pencil

The procedure to successful sketch of bamboo chair

Following the steps outlined below will help to ensure that sketching will be successful

Step 1: preparing tools materials for sketching

Step 2: seat the chair in front of you and observe the chair properly.

Step 3: sketch isometric or oblique box with the scale you need.

Step 4: sketch the chair inside the box you sketch in step 3.

Step 5: check for correctness by comparing the object or chair.

Step 6: if correct make bold the outline of chair on your sketch.

Step 7: apply painting and hatching for better look.

Information Sheet 3- Establishing drawing requirements and documenting

4.1. Drawing Requirement

Drawing need to communicate information that is legally binding by providing a specification. Drawing therefore need to meet the following requirements:

- Drawings should be unambiguous and clear. For any part of a component, there must be only one interpretation. If there is more than one interpretation or indeed, there is doubt or fluffiness within the one interpretation, the drawing is incomplete because it will not be a true specification.
- The drawing must be complete. The content of a drawing must provide all the information for that stage of its manufacture. There may be several drawings for several phases of manufacture, e.g. raw shape, bent shape and heat-treated. Although each drawing should be complete in its own right, it may rely on other drawings for complete specification, e.g. detailed drawings and assembly drawings.
- The drawing must be suitable for duplication. A drawing is a specification, which needs to communicate. The information may communicated electronically or in a hard copy format. The drawing needs to be of a suitable scale for duplicating and of a sufficient scale such that if is micro-copied it can be suitable magnified without loss of quality.
- Drawings must be language-independent. Drawings should not be dependent on any language. Words on a drawing should only use within the title block or where information of a non-graphical form needs to give. Thus, there is a trend within ISO to use symbol in place of words.
- Drawings need to conform to standards. The 'highest' standards are the ISO ones that are applicable worldwide. Alternatively, standards applicable within countries may be used. Company standards often produced for very specific industries.
- Drawing need to neat, made with proper line weight and type, with actual size means accurate to size, shape and angles.

4.1.1. Dimensioning

Dimensioning indicating on a drawing, the size of the object and other details essential for its construction and function, using lines, numerals, symbols, notes, etc.

Dimensions indicated on a drawing should be those that are essential for the production, inspection and functioning of the object and should not be mistaken as those that are required to make the drawing of an object.

Dimensioning of an object accomplished by dimensioning each element to indicate its size (size dimensions) and relative location (location dimensions) from a centerline, base line or finished surface.

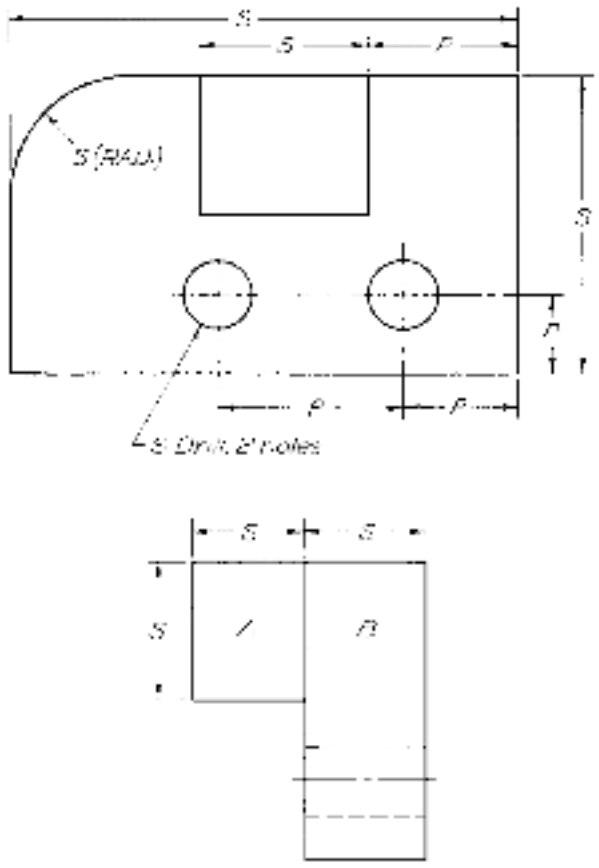


Figure 29. Dimension of size and Position. S indicates size, P position

- Each feature dimensioned and positioned only once, where its shape shows.
- Size dimensions – give the size of the component.
- Every solid has three dimensions, each of the geometric shapes making up the object must have its height, width, and depth indicated in the dimensioning.

Prism – most common shape requires three dimensions - give two dimensions on the principal view and one dimension on the other views.

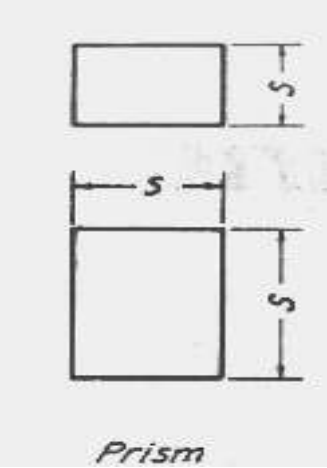


Figure 30. Dimension on two Views

- That is better to give dimension outside

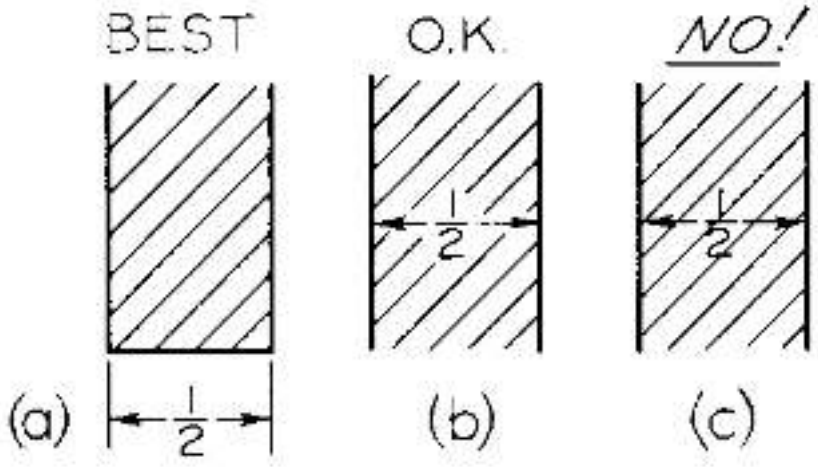


Figure 31. Dimension and Section Lines

- Dimension should be clear not be staggered.

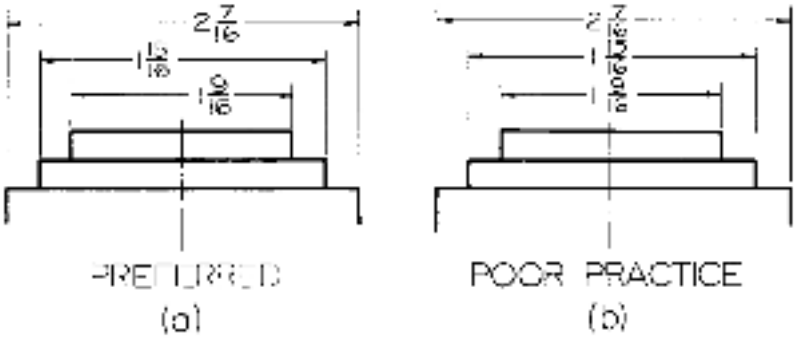


Figure 32. Staggered Numerals

- Give dimension of arc outside or inside.

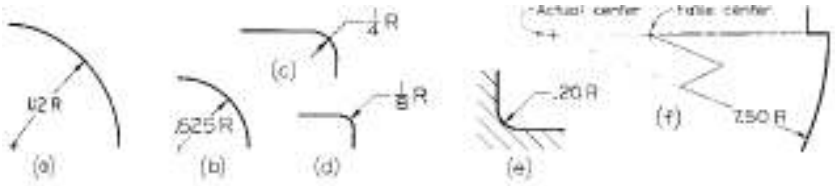
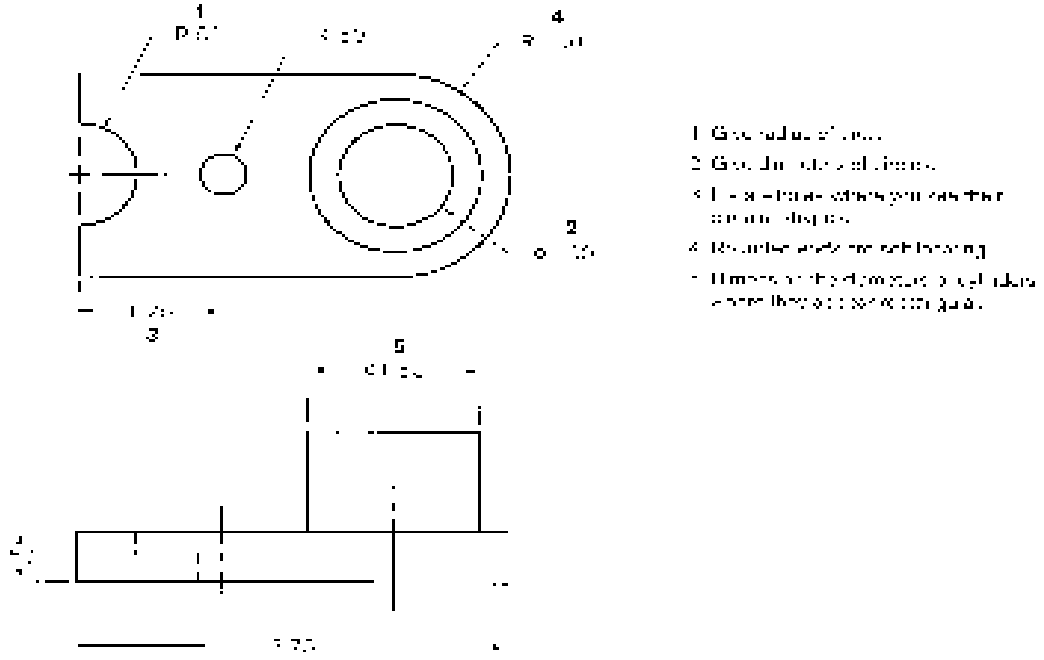


Figure 33. Arc dimensioning



- Dimension inside the view should be clear.

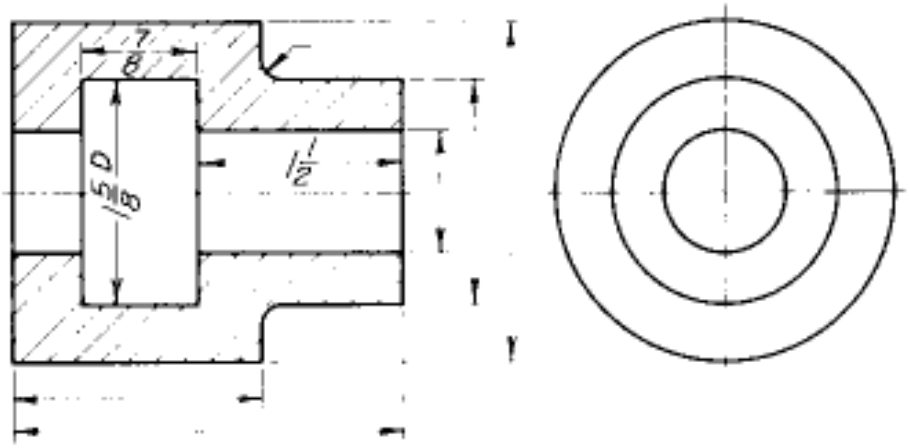


Figure 34. Dimensions inside the View

- **Location dimensioning**: After the basic geometric shapes have dimensioned for size, the location of each relative to the others must give. Locations must established in height, width and depth directions. Rectangular faces positioned with reference to their faces, cylinder and conic shapes with reference to their centerlines and their ends.
- Dimension: numerical value that defines the size or geometric characteristics of a feature – size 3.5 mm and space between lines of text 1.5 mm.

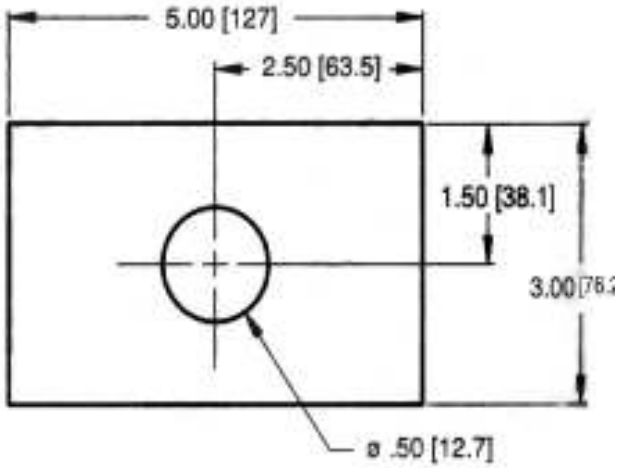


Figure 35. Dimension defines the size or geometric characteristics

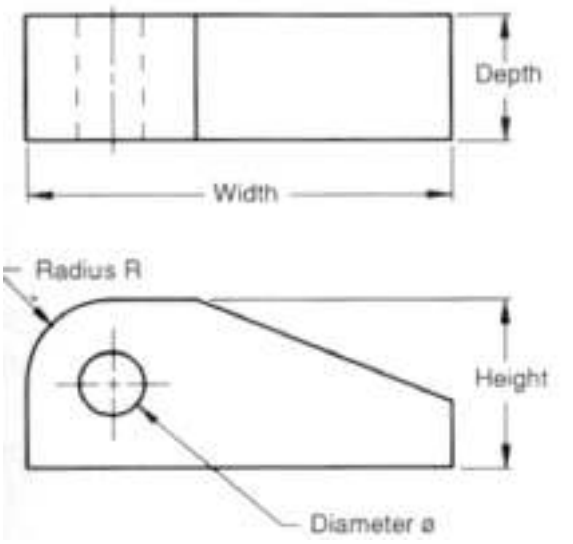


Figure 36. Dimensions showing the sizes of features, such as width, height and depths of the parts and the diameter of the hole.

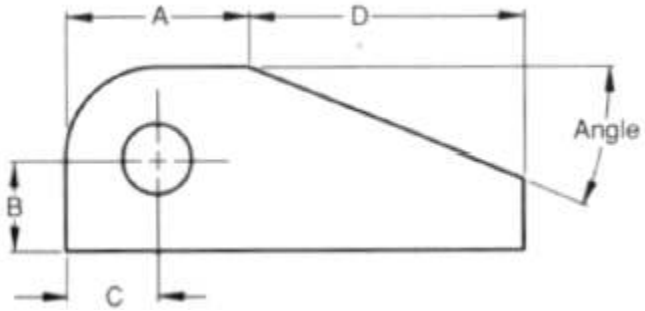


Figure 37. Dimensions showing the location and orientations of features, such as location of the center of the hole

- Basic dimension: a numerical value defining theoretically exact size of a feature.
- Reference dimension: a numerical value enclosed in parenthesis, provided for information only and not directly used in the fabrication of the part – is a calculated size used to show the intended design size of a part.
- **Dimension line**: A thin, solid line that shows the extent and direction of a dimension. Dimension lines are broken for insertion of the dimension numbers. Should be

placed at least 10 mm away from the outline and all other parallel dimensions should be at least 6 mm apart, or more if space permits.

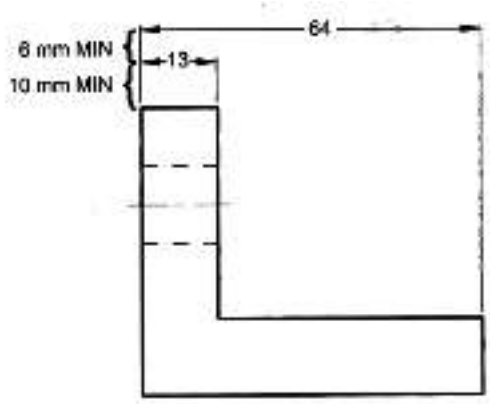


Figure 38. Dimension Placement

- **Arrows –** 3 mm wide and should be 1/3rd as wide as they are long - symbols placed at the end of dimension lines to show the limits of the dimension. Arrows are uniform in size and style, regardless of the size of the drawing.

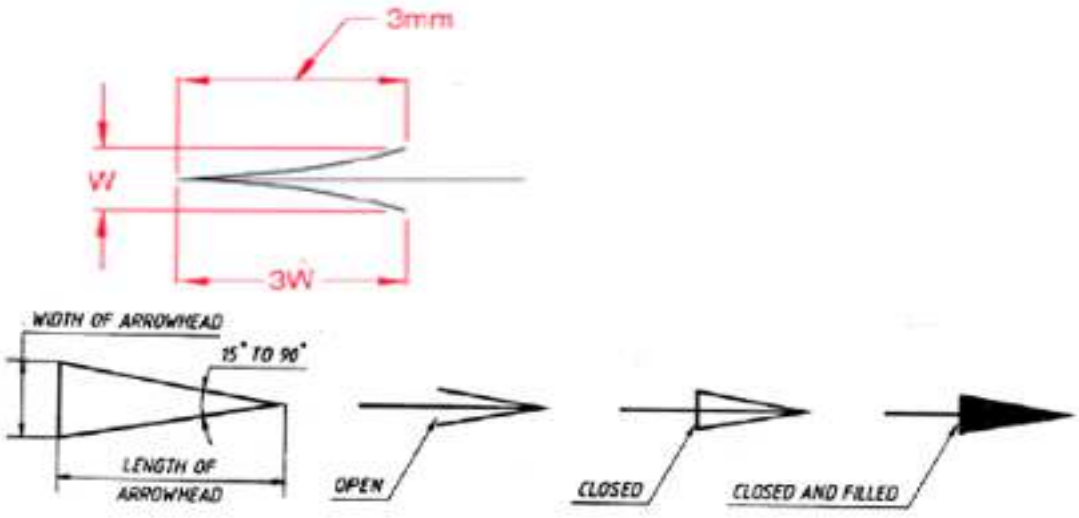


Figure 39. Dimension Arrow type and size

- **Extension line** – a thin, solid line perpendicular to a dimension line, indicating which feature is associated with the dimension.

- **Visible gap** – there should be a visible gap of **1.5 mm** between the feature's corners and the end of the extension line.
- **Leader line**: A thin, solid line used to indicate the feature with which a dimension, note, or symbol is associated. Generally, a straight line drawn at an angle that is neither horizontal nor vertical. Terminated with an arrow touching the part or detail. On the end opposite the arrow, the leader line will have a short, horizontal shoulder. Text extended from this shoulder such that the text height centered with the shoulder line.
- **Diameter symbol** – φ - a symbol that precedes a numerical value, to indicate that the dimension shows the diameter of a circle.
- **Radius symbol** – R 0.5
- **Use various types of dimension lines**

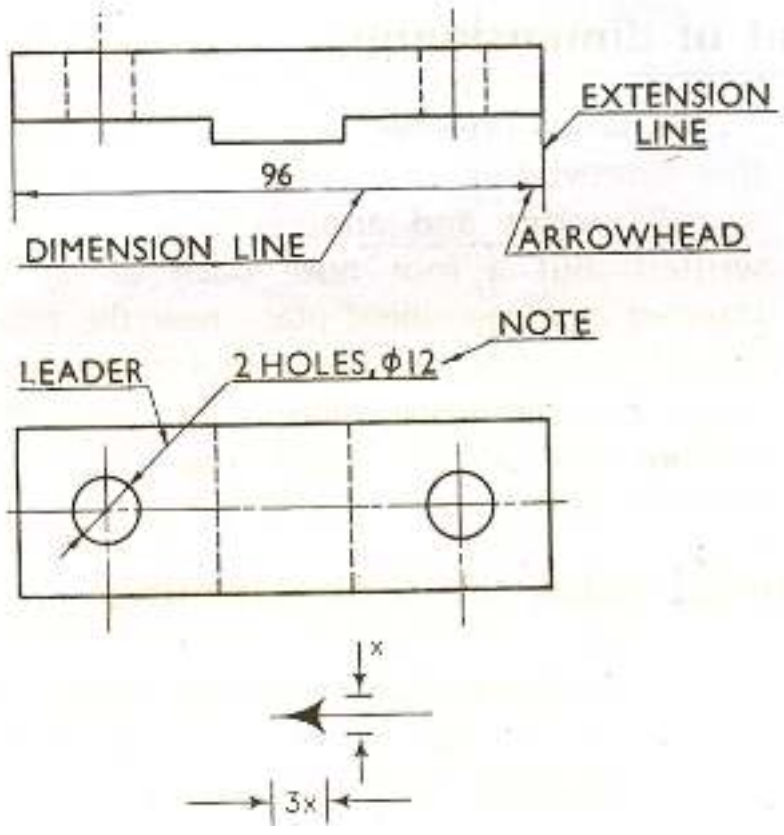
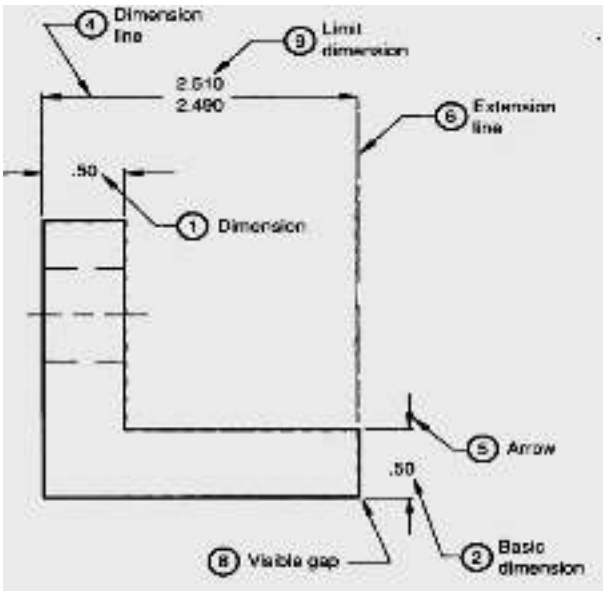


Figure 40. Different types of dimension line

- Use important elements of dimension



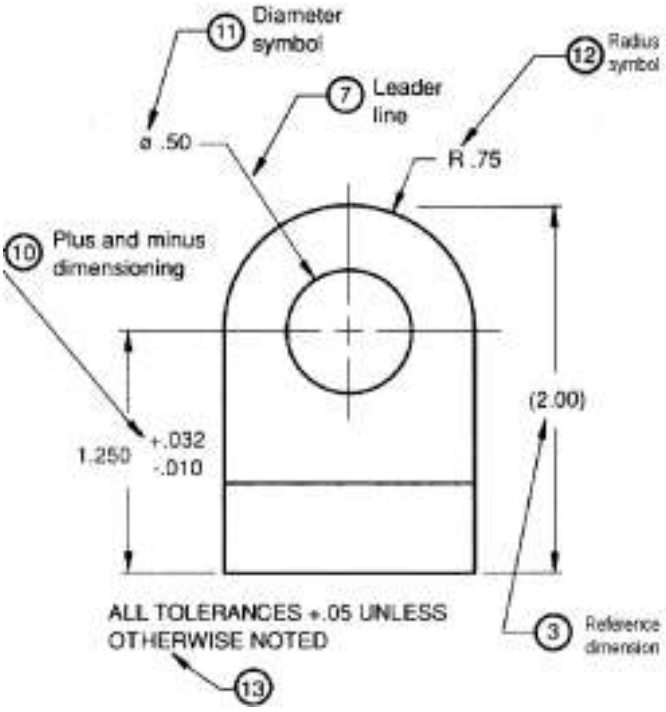


Figure 41. Important elements of a dimensioning

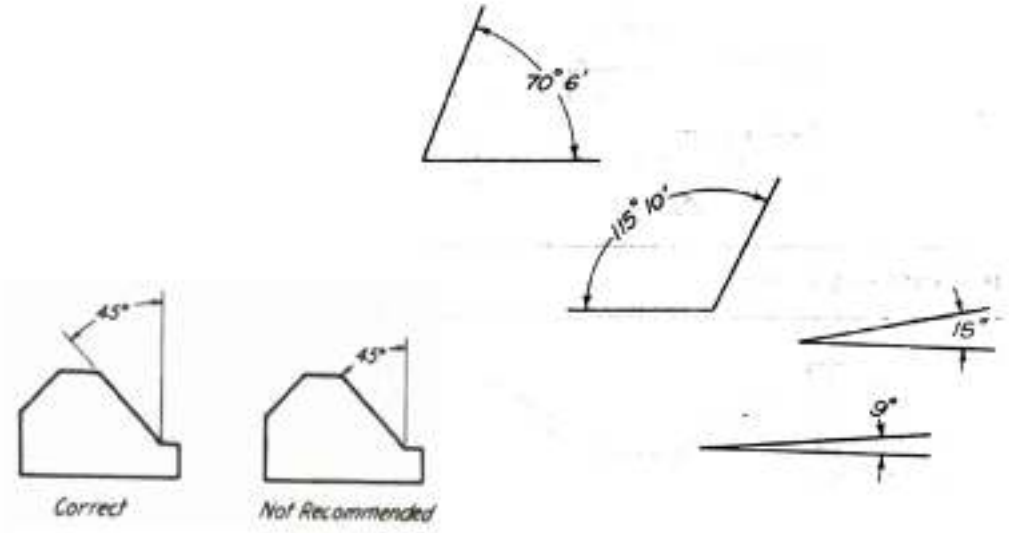


Figure 42. Dimensioning of angles

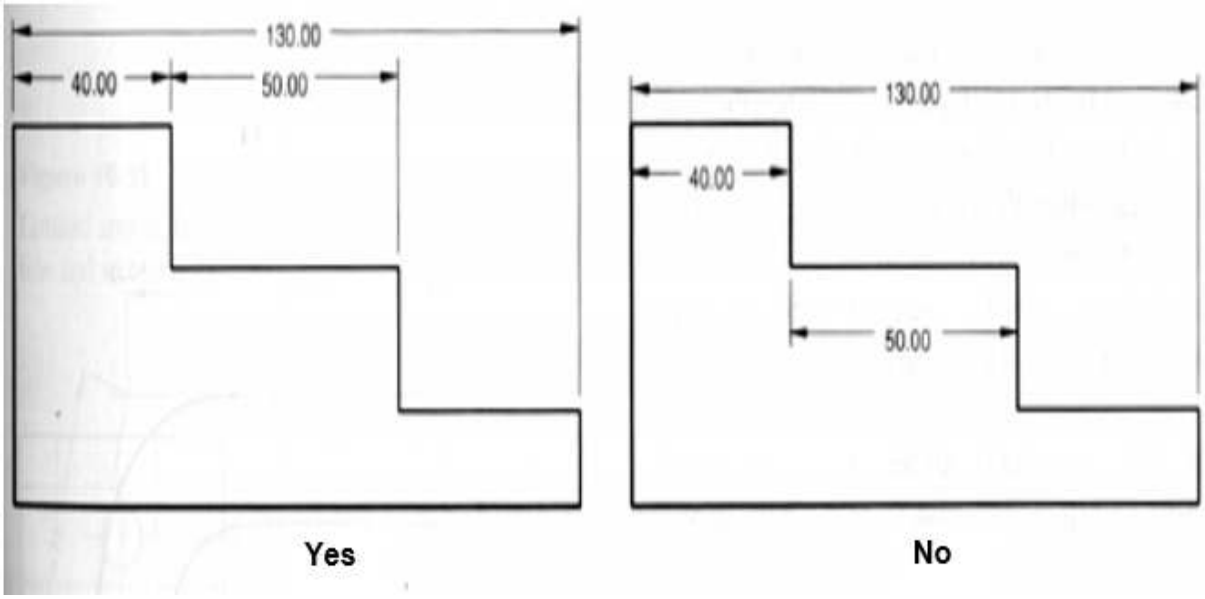


Figure 43. Correct way of dimensioning

Self-Check – 3	Written test

Name…… ID…… Date…

Direction I: choose the correct answer.

1. Used to indicate size of the object and other details essential for its construction and function, using lines, numerals, symbols, notes. (2pts)

A. Boarder line B. dimensioning C. Specification D. Note

2. Drawing always need to made _____. (2pts)

A. Neat C. made with proper line weight and type

B. With actual size object D. made with actual shape and angles of object

Direction II: Give short and direct answer for the following questions.

3. What are the basic requirements that drawing requires to fulfill. List at least four. (6 pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Identifying design conventions and specification

4.1. Design convention and standard

Design is creating a real product from an idea based on the collected need to solve problem. Drafting is the production of the drawings that used to document a design. No effective communication without an agreed upon standard of signs or symbols. Standards and conventions are the alphabet of technical drawing, and plane, solid, and descriptive geometry are the science (grammar) which underlies the graphics language. For effective communication of technical (graphics) information– set of standards and conventions is necessary and very important.

Drawings are dimensioned using an accepted set of standards such as placing the dimension text such that it is read from the bottom of the sheet.

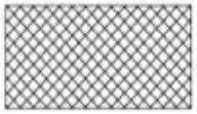
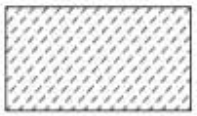
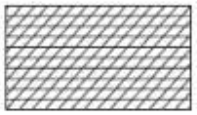
4.1.1. Units of Measurement

International systems of units (SI) – which based on the meter. Millimeter (mm) - The common SI unit of measure on engineering drawing. Individual identification of linear units is not required if all dimensions on a drawing are in the same unit (mm). The drawing shall however contain a note: ALL DIMENSIONS ARE IN MM. (Bottom left corner outside the title box)

4.1.2. Material conventions

Materials are represented with a common symbol on the design to indicate and describe for the types of materials used for the production of products without detail description for the involved body on the designing and manufacturing of a given product.

Table 2. Material conventions

Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc.
Liquids		Water, Oil, Petrol, Kerosene, etc.
Wood		Wood, Plywood, etc.
Concrete		A mixture of Cement, Sand and Gravel

4.1.3. Notes

Information other than pictorial views and dimensions necessary for completing a drawing can classified as “notes.” Notes are a useful means of communicating additional details about the intent of the designer and can help define some of the fit, form, and functional requirements of the part or assembly. Efficient use of notes can

help minimize errors and save time and money over the long run. The following are great example notes, which clearly communicate the intent of the designing engineer.

4.1.3.1. Note Location

Notes of general character that do not require leaders to indicate where they apply, and for which provision has not been made in the supplementary blocks of the drawing format, shall be located in the following order of preference:

- Adjacent to the upper left border and to the left of all views.
- Immediately to the left of the revision block.
- Adjacent to the lower left border or below the revision block, space being left for extending the revision block downward. This location should avoided whenever practical because the space required for revisions cannot anticipated.

4.1.3.2. Numbering of Notes

General notes numbered consecutively downward. Note numbers may be identified on the field of the drawing by placing the note number in a pennant-shaped flag at the general note location and in the field of the drawing, or in the List of Material (Material Specification column), whichever location is more appropriate.

4.2. Design specification

A design specification is a written document that explains your product and specifies what you want it to perform as well, as how the user should interact with it. While it may seem laborious to write everything down, it is the most crucial thing you can do in the early stages of product design and development. This is because the design specs direct the whole scope of your product development. As the term suggests, a design specification is a document that outlines a project's design needs. For the design team, this is a vital document since half of the success of a project depends on it. After extensive study, the document created by the client and contains extremely comprehensive, specific design requirements that must be consistently applied until the

project is completed. With such a list of requirements at hand, designers will be able to bring what the client sees to live.

The importance of design specifications in the design process well acknowledged. A set of requirements used to describe the desired solution in the specification document. A detailed description of the desired solution is critical since it increases the chances of a successful design. In order to have a clear description, there must be enough requirement statements to take design engineers from the abstract to the concrete solution in order to achieve the product's goal.

The criteria for selecting a feasible concept established in the form of a design specification, which is a collection of requirements that any solution to the problem must meet once it has found. As a result, the function of the specification is twofold: first, to create a solution space for design engineers to work in when creating a product, and second, to evaluate proposed solutions to ensure that they are within acceptable bounds.

4.2.1. Importance of design specification for product owner

As a product owner, you should have a clear understanding of what the product should be like, how it should look like, how users should interact with it, etc. You are the only person who describe clearly and in detail your future product's desired characteristics. By drawing up a design specification document at the initial stage of product development, you can save time and money, create the perfect product that meets your expectations; make the process easier for designers, and much more.

4.2.2. Role of design specification

The role of specification in the design process has an impact on its development. The specification is crucial in the product development process and it has discovered to play a number of roles, including:

- Designer guidance.

- Identify the intercommunication between requirements.
- Checklist, e.g., at meetings or workshops.
- An agreement within the design team and as a contract with the customer, e.g., a supplier agreement, to perform the design task.
- Trace the probability of propagation of change.
- Product overview.

4.2.3. Contents of design specification

Design specification document should include essential information about your product and all details you want your design and development team not to miss. Usually, the design requirements (specifications) document includes the following things:

- Full project overview.
- Main needs and goals.
- Target audience.
- Functional requirements and desired set of features.
- Aesthetic aspects.
- Non-functional details.
- Recommendation and prohibitions.
- Questions.

4.3. Factors affecting product design

There are several factors that affect the design of a product. A product designer must consider these factors before designing the product in order to create winning designs. These factors are as follows:

1. Customer requirements

The end users or customers are the ones that would leverage the product. So, due respect should be given to their requirements before designing a product. The

designers should make sure that the product is ergonomically designed so that the customers can use it conveniently in all conditions.

2. Facilities for the operators

It is the task of product designers to ensure that the operators can effortlessly perform the intended operations using the product. The product should integrated with all the essential features and facilities that make its operation simple and comfortable. If the product design is complicated, then the operator may become tired and be less productive. Therefore, the product should designed in such a way that it is easy to handle and operate.

3. Functionality

A product should designed in such a way that it yields 100% customer satisfaction. For this, the designer must ensure that the product is functioning optimally and is meeting the purpose for which it designed. There should be sync between the appearance of the product and its functionality to the customers.

4. Fitness for Purpose

Every product designed for a unique purpose. Before creating a product, the designer must know product's demand. and what customers require from the product. They should design the product with newer features that are essential and desirable. For example, mobile is essential for communications, but mobile phones with better camera quality are preferred.

5. Quality of product

The design of a product and its quality should go hand in hand. The quality of a product depends on its design as well as conformity. Therefore, the designer must ensure that he/she is producing a good quality product that embellishes an impressive design.

6. Materials and Finish

Before manufacturing a product, the designer must decide the material to use. The designer must ensure that their choices are compatible with each other. Since the materials used in their products also define its quality and guarantee, the designer must have perfect knowledge about the product's materials. The type, quality, and nature of a material used in the production of a product impact its design largely. Therefore, the designer must have adequate knowledge of the materials. He/she should have up to date information about the availability of new and better materials in order to create the desired product.

7. Maintenance

Most of the designers concentrate more on functions and aesthetics, and forget about maintenance. Proper maintenance can prolong the longevity of the product. Using durable materials for easy maintenance adds to the overall cost of the product. However, this cost can be justified.

8. Efficiency

The efficiency of a product depends directly on the quality of the product. Product designers must design their products to ensure complete customer satisfaction. Only then will the product be in greater demand.

9. Cost Ratio

A product designer must design high-quality product in a way that it is cost effective. The product should be of top-notch quality, functional and appealing in design, such that it attracts the customers. The designer must also ensure that he is creating a design, which is even cost effective, as that will attract the customers most.

10. Fashion

Designers must know how to design their products according to the ever-changing trending styles around them. The consumer usually makes purchasing decisions, according to the trend, and old styles are becoming obsolete faster.

11. Safety Measures

The designer must ensure that the products they design are safe to use. Quality products will have certificates such as ISO and others. Designers must create their products according to the regulations of these organizations. Gaining these certificates validates the product's quality and tempts the public to buy and use these products rather than your competitor's products.

12. Aesthetics

Aesthetics is the final and most crucial factor that needs to be considered in product design. Customers have their own aesthetics, and they purchase products guided by this sense. Even when the product quality is less than other products of the same cost, consumers will recommend buying a product because of its aesthetics.

13. Capability of process

A product designer must have the requisite knowledge of the machinery in order to take care of the quality of conformance. The quality of conformance depends on the capacity of equipment and machines (how much they can process). A designer should thus establish a tolerance limit of each machine and equipment.

14. Work methods

The work methods adopted and the equipment used to affect the viability of the design. Little changes in the work methods can considerably affect the production cost. Therefore, a designer must be inventive in order to find out the most efficient work methods. He/she should be accustomed to the innovations in the market so that he/she can improvise the work methods and equipment accordingly. A product should designed

in such a way that it should have the scope for improvisation in the type of equipment required and the work methods adopted.

15. Effect on existing designs

In case a new product design to replace an existing product, then a designer should ensure that, he/she uses the standards materials, parts, components, design strategies, techniques and manufacturing processes. It is the task of a product designer to blend the existing product with new manufacturing technology. In this way, the designer can keep the production cost minimum.

16. Packaging

Packaging is one of the core components associated with a product. The design of the package of a product is equally important as the product itself. This is because packaging ensures that the product delivered safely to the end users. Thus, the designer should ensure that the package is protective and even serves the promotional purpose. The package should be attractive, as that will appeal to the customers.

Self-Check – 4	Written test

Name…… ID…… Date…

Direction I: choose the correct answer.

1. One of the following is **not** included under drawing specification. (2pts)

B. Aesthetic aspects C. Non-functional details

C. Recommendation and prohibitions D. Questions E. None

2. Information other than pictorial views and dimensions necessary for completing a drawing. (2pts)

A. Section view B. drawing note C. Specification D. Standard unit

Direction II: Give short and direct answer for the following questions.

1. Discuss on the roles of design specification. (3pts)

2. Why material convention is important on drawing? (3pts)

3. What are the basic limitation on bamboo product design now in your area? (5)

Note: Satisfactory rating - 8 points Unsatisfactory - below 8 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

LAP TEST	Performance Test

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2** hour. The project expected from each student to do it.

Task 1.
Preform successful sketching of Student chair in your classroom.

LG #04	LO #4- Complete design work

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- working final design manually
- Checking and approving design
- Documenting Design
- Accomplishing reports

This guide will also assist you to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, **you will be able to**:

- work final design manually
- Check and approve design
- Document design
- Accomplish report

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- working final design manually

3.1. Pictorial drawing/ 3D

Pictorial drawings not often used for construction purposes. However, on some working drawings pictorial views are used to reveal information that orthographic views alone would be incapable of showing; other situations may require a pictorial drawing essentially to supplement a major view. Pictorial projection designed to allow the viewer to see all three primary dimensions of the object in the projection. Pictorial architectural drawings and renderings are very easy to understand and therefore used extensively to depict a three-dimensional view of an object and for explaining project designs to laypersons for sales-presentation purposes. They enable an inexperienced person to interpret drawings and quickly visualize the shape of individual parts or various components in complicated mechanisms.

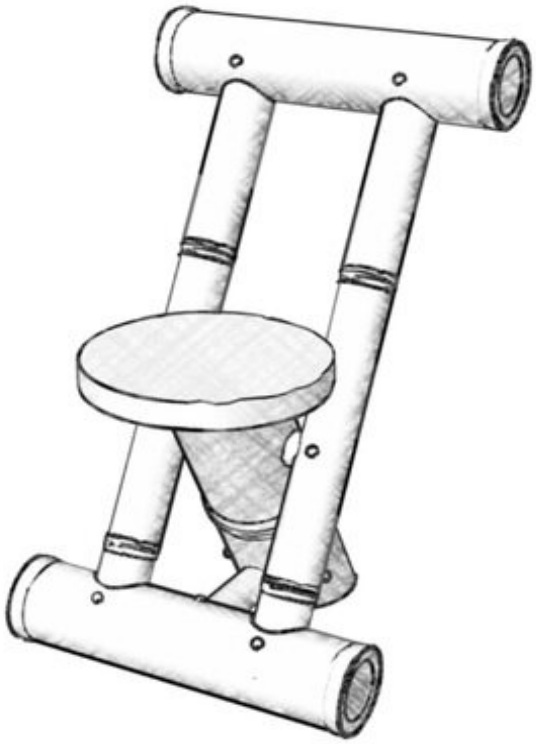


Figure 44. Pictorial Drawing

3.2. Orthographic view / 2D

Orthographic projection is a method of producing a number of separate two-dimensional inter-related views, which are mutually at right angles to each other. Using this projection, even the most complex shape can fully described. Orthographic/ multi view drawings typically dimensioned and usually drawn to a specific scale. Multi view drawing is designed to focus on only two of the three dimensions of the object and multi view drawing generally allows a less distorted view of the features in the two dimensions displayed while lacking a holistic view of the object (thus needing multiple views to fully describe the object).

Plot dimensions on orthographic view in a manner:

- Dimension and extension lines should draw parallel to the edge of view.
- When possible, dimensions placed on visible features.
- Arrowheads lie in the same plane as extension and dimension lines.
- Notes and dimensions should lettered parallel to the horizontal plane.
- Dimensional points are connected with construction line to match appropriate drawing views as shown below.

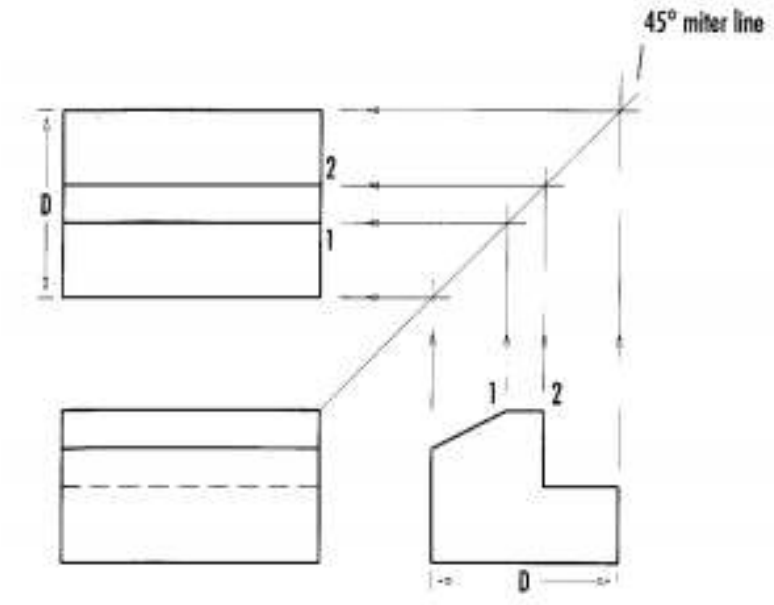


Figure 45. Dimensional point's connection and dimensioning

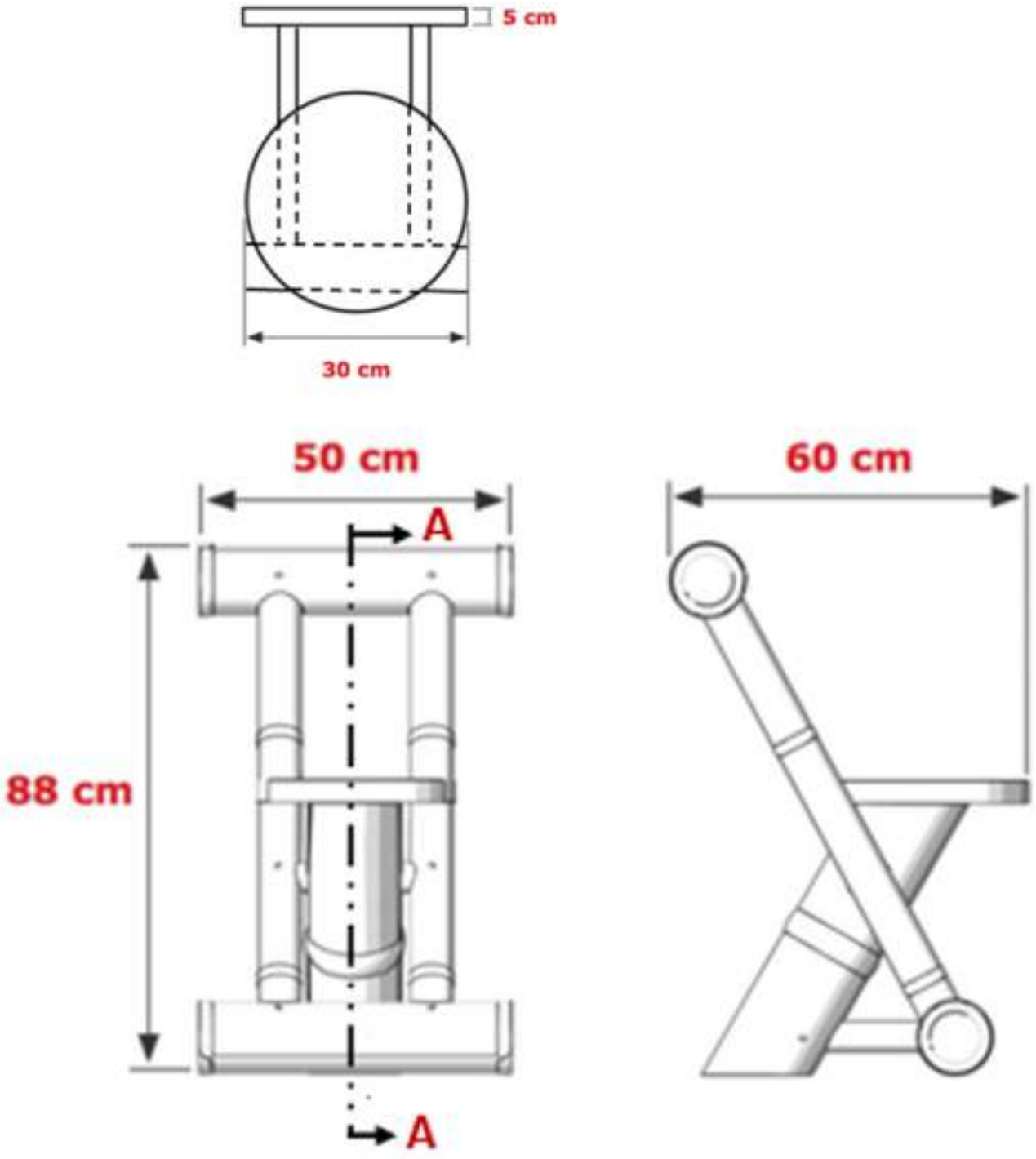


Figure 46. Orthographic View

3.3. Section View

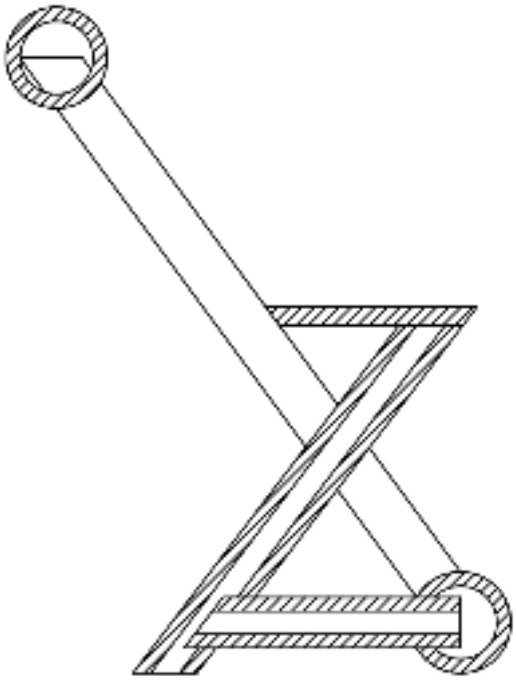
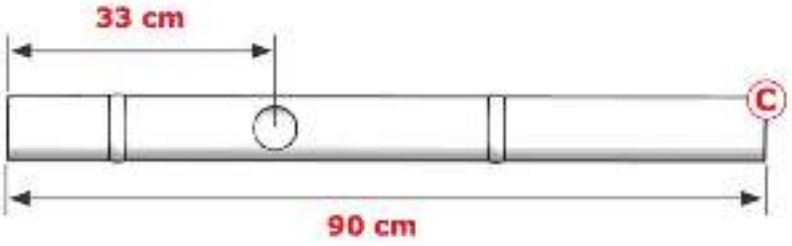
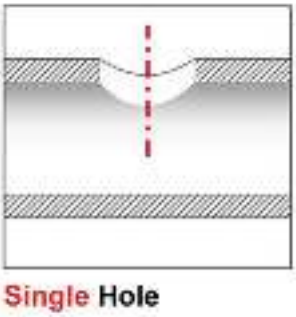
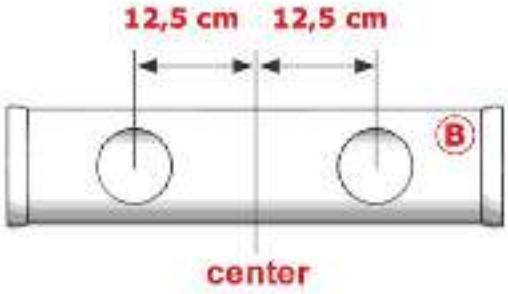


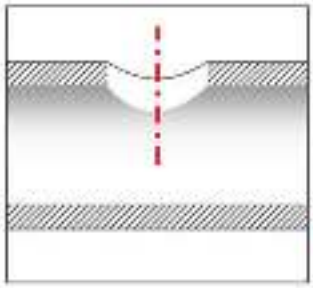
Figure 47. Section A-A

3.4. Part detail

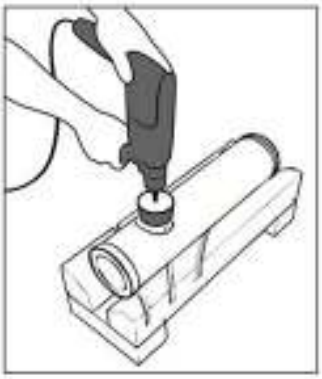


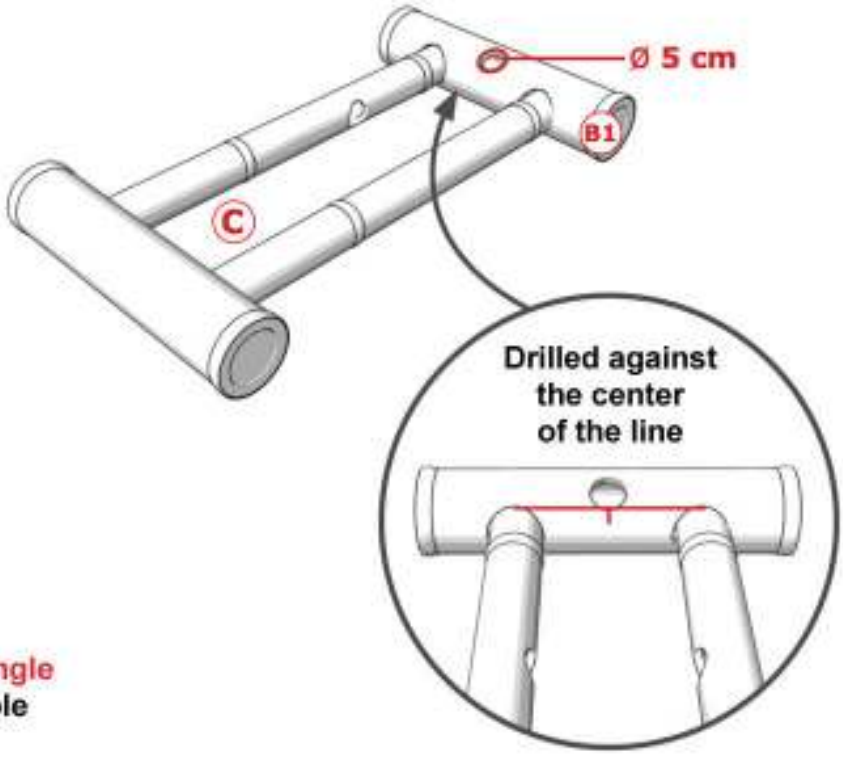


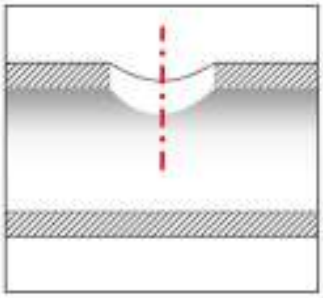




Single Hole







Single Hole

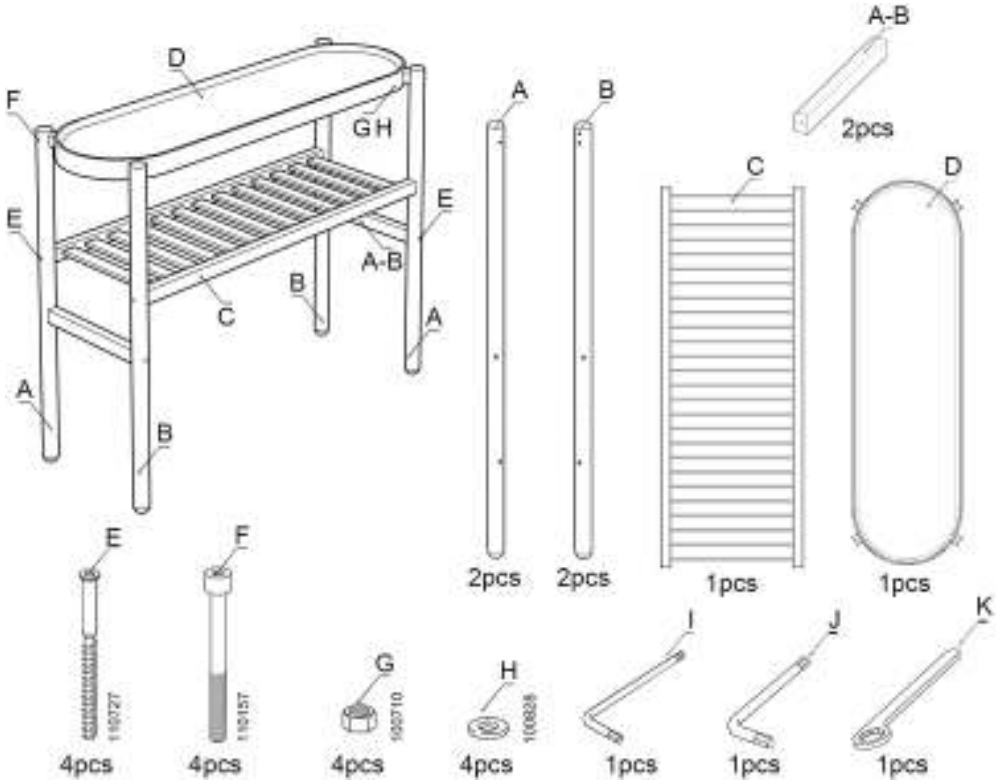


Figure 48. Part Detail

3.5. Joint detail

Joint detain describes the types of joint and the reinforcement type used for strengthening the joint.

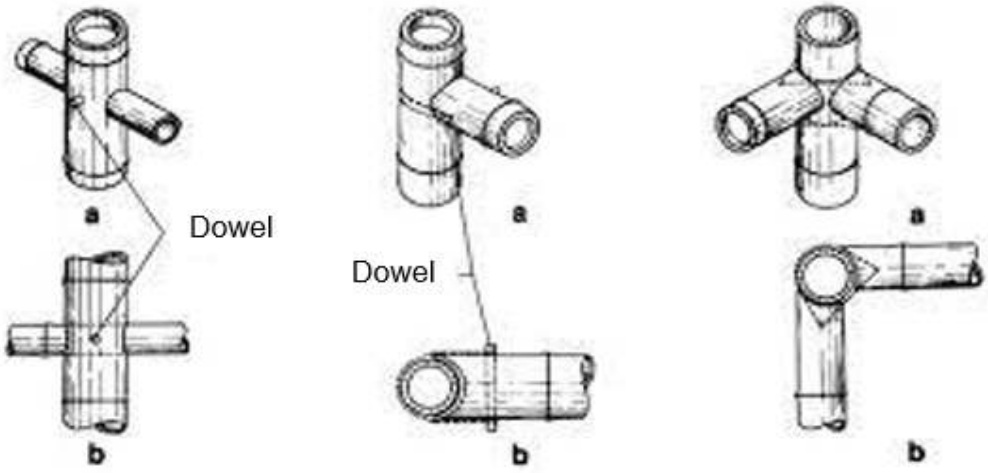


Figure 49. joint detail

3.6. Exploded or Assembly drawing

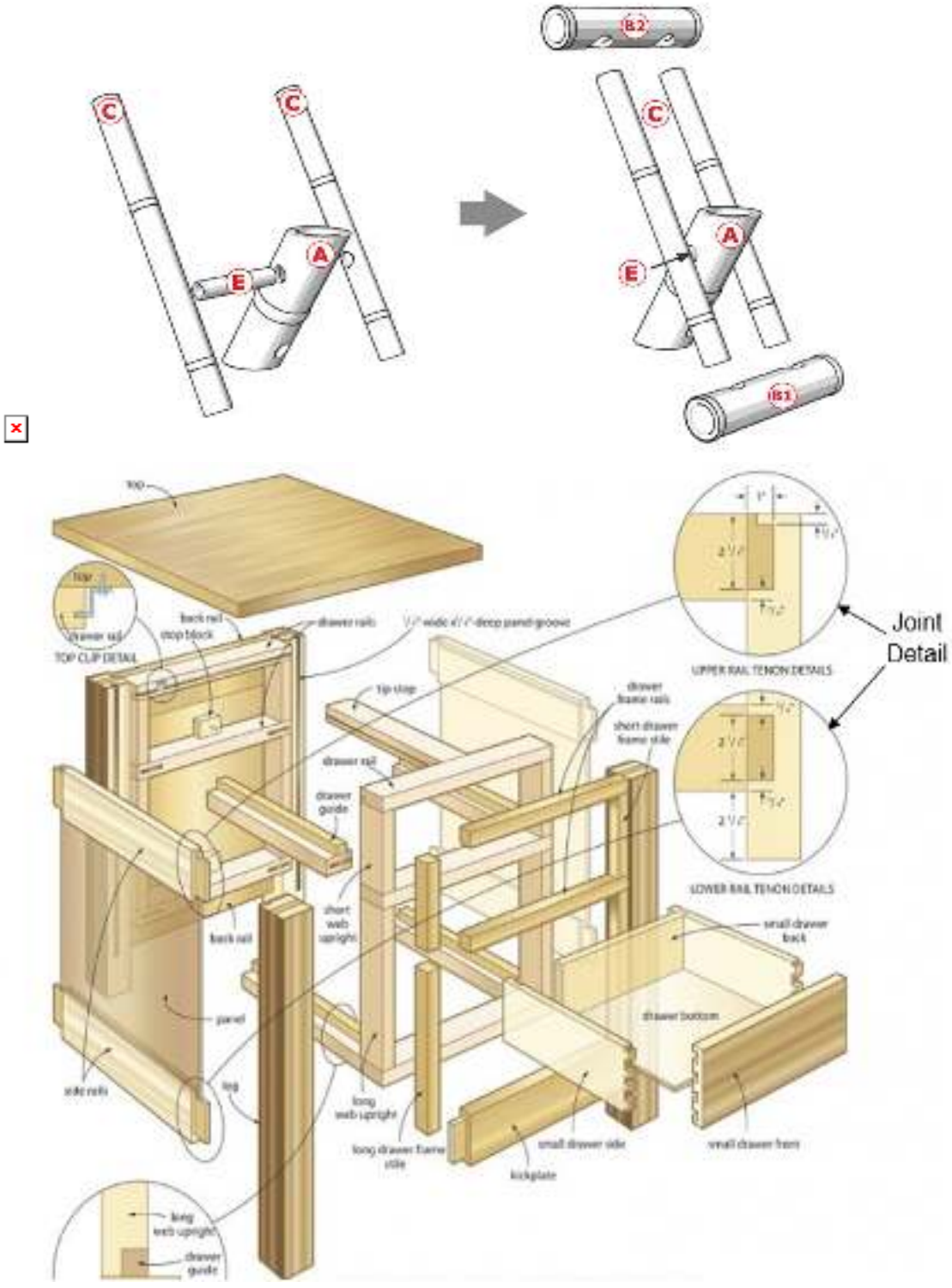


Figure 50. Assembly drawing and joint detail

Self-Check – 3	Written test

Name…… ID…… Date…

Directions: Give short and direct answer.

1. What is the basic importance of pictorial drawing than orthographic view? Why (5pts)

2. What are the basic considerations for Plot dimensions? (5 pts)

3. Why joint detail is important? (3pts)

4. Type of view, which tell the height of the product. (2pts)

5. Types of drawing direct bamboo furniture manufacturer to assemble bamboo products. (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Operation Sheet 1– Draw isometric views of the given Bed

Objectives: to know successful drawing operation.

Tools and materials required:

Set square, T-square, Pencil, drawing paper, eraser

The procedure to successful drawings of bed

Following the steps outlined below will help to ensure that drawing of isometric view will be successful

Step 1: preparing tools and materials for Drawing

Step 2: draw isometric box with construction line and with 1:50 scale.

Step 3: draw the object inside the box.

Step 4: check for correctness by comparing to the given drawing.

Step 5: if correct make bold the outline of the object.

Step 6: Write any necessary note and dimensioning.

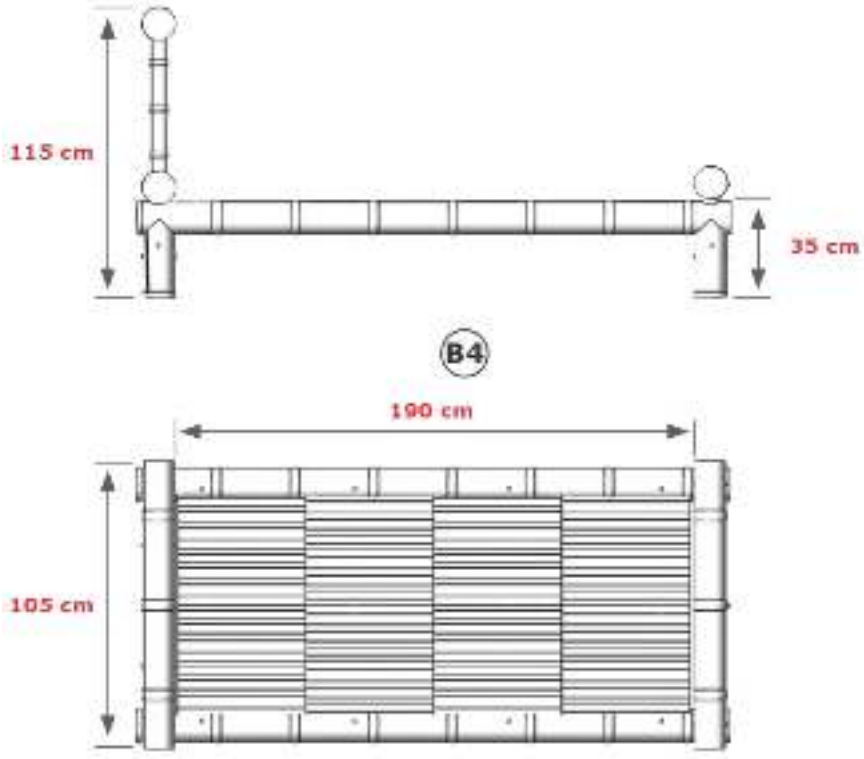


Figure 51. Multi views of Bed

Operation Sheet 2– Draw multi views of the given soap holder

Objectives: to know successful drawing operation.

Tools and materials required:

Set square, T-square, Pencil, drawing paper, eraser

The procedure to successful drawings of soap holder

Following the steps outlined below will help to ensure that drawing of orthographic view will be successful

Step 1: preparing tools and materials for Drawing.

Step 2: draw projection lines.

Step 3: draw top or front view first by using first or third angle projection.

Step 4. Connect dimensional points with construction line to complete views.

Step 5: check for correctness by comparing to the given drawing.

Step 6: if correct make bold the outline of the object.

Step 7: Write any necessary note and dimensioning.

Figure 52. soap holder

Operation Sheet 3– design kids school chair from bamboo

Objectives: to know successful designing of product.

Tools and materials required:

Set square, T-square, Pencil, sketching pad, drawing paper, eraser

The procedure to successful designing of product

Following the steps outlined below will help to ensure that bamboo product designing will be successful.

Step 1: preparing tools and materials for Drawing.

Step 2: use standards dimensions for kid's school chair manufacturing as customer need.

Step 3. Children use the chair are female, very trust full and like nature. Therefore, they need those feeling to transfer on chair.

Step 4. Prepare sketches of chair by isometric or oblique.

Step 5: draw isometric views of the kid's school chair.

Step 6: check for correctness.

Step 7: if correct make bold the outline of the object.

Step 8. Paint isometric view a combination of pink, blue and green colors.

Step 9. Draw multi views of the kid's school chair.

Step 10: check for correctness.

Step 11: if correct make bold the outline of the object.

Step 12. Connect dimensional points with construction line to complete views.

Step 13: Write any necessary note and dimensioning.

Step 14: draw section view, which cut seat and back once.

Step 15: check for correctness.

Step 16: if correct make bold the outline of the object.

Step 17: draw part details.

Step 18: Write any necessary note and dimensioning.

Step 19: check for correctness.

Step 20: if correct make bold the outline of the object.

Step 21: draw Joint details.

Step 22: Write any necessary note and dimensioning.

Step 23: check for correctness.

Step 24: if correct make bold the outline of the object.

Step 25: draw Exploded or assembly drawing.

Step 26: check for correctness

Step 27: if correct make bold the outline of the object.

Information Sheet 2- Checking and approving design

1.1. Design Check

Design Checking or checking of design is a process of validating a design and/or a design calculation to ensure that it is error-free and of good quality and is good for engineering and/or fabrication or whatever the end-use of it is. Checking is also a process of value addition in terms of applying good engineering practices, aesthetics, reduction in cost and thereby providing better value to the client.

A quality design check is required to:

- Ensure that the deliverable (drawing, calculation, etc.) is error-free.
- Ensure that it is in-line with the appropriate design standards and codes.
- Ensure that there is consistency in the design approach and aesthetics across units in the design.
- Ascertain optimization with respect to design and cost.
- Reduce field rework.

Design check on:

- Deliverable is error-free with respect to the inputs provided.
- Ease of fabrication, shipping, and erection.
- Reduction in material and fabrication costs.
- Value adding and functionality
- Build some flexibility into the design, especially for critical items
- Ensure a consistent design approach for similar pieces of equipment and/or unit area fitting
- Aesthetics

Design Checking Adds Value on:

- Owning responsibility and following good practices and procedures results in overall quality
- Use of checklists ensures important points needing check are not missing out
- Design reviews & inter-squad checks ensure interdisciplinary aspects are addressed in the design
- Safety and constructability reviews ensure good overall layout, approach, constructability, maintenance, and operability
- Incorporating fabrication/contractor specific details and/or preferences into the design helps in easier and faster fabrication and lesser errors
- Facilitates a once-through approach from start to finish thereby saving on time and schedule Minimizes rework in design and at the field

1.2. Design Approval

Design approval means a type of certificate (including amended and supplemental type certificates) on design for the correctness of design or for the fulfilment of all requirements based on the standard and codes.

Self-Check – 4	Written test

Name…… ID…… Date…

Directions: Give short and direct answer.

1. Why complete design checked at the end? (3pts)

2. What value should final design check have? (4pts)

3. What are the basic points require for bamboo product final design check? (5pts)

4. What is design approval? (3 pts)

Note: Satisfactory rating - 13 points Unsatisfactory - below 13 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 3- Documenting design

1.1. Design documentation

Design documentation is a collection of documents and resources that covers all aspects of your product design. Documentation should include information about users, product features, and project deadlines; all essential implementation details; and design decisions that your team and stakeholders have agreed on.

1.1.1. Importance of design documentation

- **Clarify project requirements**

Gaining stakeholder approval to begin implementing a design is one of the most important steps in the design process. You need to be on the same page with stakeholders to gain this approval. Proper documentation makes it easier to achieve this goal. How? Documentation helps you organize and deliver your thoughts to stakeholders, which in turn helps them understand how your design decisions will satisfy the user needs and their own business objectives.

- **Streamline design implementation**

By documenting a design, you also aid in the implementation of it. Product design is a collaborative process, and in many cases, multiple people work on the project. It is not always possible to share implementation details verbally (for example, when you work with remote teams). Thus, the design documents act as a single source of truth for everyone who is involved in product development and can rally your team around a specific goal.

- **Motivate your team**

Good documentation tells a high-level story about the product and gets team members excited about the vision. It answers the questions, “How do we want to build this?” and, importantly, “Why do we want to build this?”

1.1.2. Essential documents needs documentation

While documentation can vary from project to project, the following docs will be relevant to all. This information can be included in a single document or separated into multiple documents. Which approach you take will depend on the complexity of your project.

- **Project overview**: This document contains a high-level overview of the design and the goals the design team wants to accomplish. By reading this document, anyone should be able to understand the purpose of a project.
- **Product requirements**: This document covers the business and technical requirements of the design. It should shared with stakeholders before starting the design to ensure that both types of requirements are satisfied. It is also worth including in this doc information about constraints and assumptions because they will influence the design decisions.
- **Project deliverables**: This document provides information about the design artifacts established during the wire framing and prototyping phases (e.g., lo-fi wireframes, mock-ups, hi-fi prototypes) that will provided as deliverables once implementation has completed.
- **Target audience information**: This document lists relevant information about your audience, from user personas to data from user research. This information will help your team understand who your users are and what good design means to them (via their functional and aesthetic preferences). The doc serves as a reference for designers when sharing their rationale behind individual design decisions.
- **User journeys:** This document outlines the path a user may take to reach their goal when using a product.

- **Design guidelines**: This document describes the components and specifications required to build the solution.
- **Style guides**: This document lists a set of standards for the stylization of design. Styles, colors, and typefaces are essential pieces of this guide.
- **Project scope and implementation plan:** This document describes the roles and flow of cross-team collaboration. The implementation plan documents the requirements necessary to complete the implementation of the design. For simple projects, it might be a high-level overview of the steps required to complete the implementation. For complex projects, it can include a project timeline with information about the time required to complete each of the steps.
- **Design validation and user testing:** This document provides an overview of the practices to be executed during the product design cycle, as well as steps to be taken after product release to verify that the product satisfies user needs.
- **Operational instructions:** This document provides detailed instructions on how to perform common operational tasks after the design implementation. For example, it can provide step-by-step instructions on how to roll out a new version of an app in the production environment.

1.1.3. Properly documenting design

Though there is no single way to conduct design documentation, and it varies by product team, there are a few general recommendations that can benefit every project.

- **Make documentation usable for the target audience**

It is possible to identify three large groups of users for documentation: product team members, stakeholders, and end users. Every group has its own needs, and it is important to consider this fact when working on your docs. Both the content of and the format for documentation should be adapted to suit your target audience.

- **Provide up-to-date documentation**

Introduce a version control framework to keep your documentation up-to-date and therefore minimize the risk of incorrect design decisions. Managers should validate the documentation at least once a month.

- **Work on design documentation incrementally**

Documentation design is not a one-and-done activity. In many cases, it is impossible to create all the docs in one attempt. Thus, product teams should work on documentation as they go through the project. Documentation should be a “living” project that constantly updated as you work on the design. Product teams should invest time in creating a flexible, accessible structure—anyone from a team should be able to update documentation rather effortlessly.

- **Test documentation**

Documentation is a by-product of your product design, and like other products, it should tested with users. Ensure that users know how to use it and find the documentation valuable. You can also introduce a simple feedback loop, such as an online response form, so your users can record their reactions and help you continuously improve your documentation.

- **Avoid jargon**

Every field has its own special language. When used in an appropriate context, this special language helps you communicate precisely with specialists that have the required expertise. However, when you are uncertain about the expertise of your target audience, minimize the use of technical language in your documents.

The best documentation is the kind that your target audience can easily understand. It is important to learn what is appropriate for your audience and leave out jargon if it can replaced by terms that are more familiar. Try reading the text aloud and evaluating it from the perspective of your documentation readers. Note any terms that might cause confusion and replace them with clearer terms.

- **Create easy access**

Static paper-based documentation is quickly becoming a thing of the past. Modern documentation should provide as an online resource. This format not only makes it easier for users to access the documentation, but it also simplifies the procedure for updates. Prioritize sections with information, and make sure search works fine. The structure you choose should follow the pattern that users follow when browsing the documentation.

- **Provide visual or code samples in the document**

It is much easier to use information when you can match it with an actual design. To create contextual hierarchies and improve comprehension, documentation should include visual design and code snippets, not just plain words. Visual design or code samples make it easier for users to translate the information into design decisions.

- **Update documentation automatically**

If some part of the design goes undocumented, it does not exist. If elements of the design system go undocumented, you run the risk of duplicating elements. Try to keep documentation up-to-date with your product's code by automating documentation. Rules and systems should be in place for documentation to update as soon as developers introduce a change in the front-end design. This includes both visual references and code samples.

- **Find patterns in existing docs and turn them into templates**

Once you have created the documentation for a few projects review the docs and try to identify common aspects of all the projects. Define templates for the standard parts to aid in the creation of design documentation. Templates will also serve as a foundation for building out design documents for your future projects.

Self-Check – 1	Written test

Name…… ID…… Date…

Directions: **Give short and direct answer.**

1. What is design documentation? (3pts)

2. What are the basic importance of design documentation? (2pts)

3. Discuss on the elements of design documentation.(2pts)

4. What types of design document requires documentation. (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Accomplishing reports

5.1. Design Report

A design report is the written record of the project and generally is the only record that lives once the design team disbands at the end of the project. The report has three sections. The first section describes the problem that needs to solve and provides the background to the design. The second section describes the design and the third section evaluates how well the design worked by comparing its performance to the design requirements. The report starts with a short executive summary that contains a synopsis of the three sections. The body of the report is relatively short. Appendices to the report contain supporting information with the details needed by a reader who wishes fully understand the design. While this document describes the general content and organization of a design report, some of the specifics (section headings, length, and format) may be determined by your project client.

5.1.1 Design report content

- **Title Page:** The front page has the project title, the names of the design team, the name of the client, the date and one graphic that best illustrates the design solution. The project title should be descriptive and generally is not the internal project name used by the team.
- **Executive Summary:** The executive summary distills your entire report onto a single page and is for the busy reader who does not have the time to read the whole report. It contains a succinct synopsis of the problem definition, the design description and the evaluation. Executive summary recommended that you use those headings in the executive summary to make sure that the summary touches all three points. That is what separates a summary from an introduction. The executive summary placed right after the title page and before the table of contents, and should be limited to one page. Use passive voice in the executive summary.

("The objective of this project was to," rather than "our objective was," or "we developed a.")

- **Table of Contents:** If the report is more than 10 pages, include a table of contents. Do not include a table of figures.
- **References** The references section has the list of references cited in the report. Use ASME, IEEE or APA style. (If you do not know what that means, look it up.) Citations are easier if you use a citation manager such as Zotero, RefWorks or EndNote.
- **Appendices:** Appendices come at the back of the report and are not part of the main body. Appendices for a design report contain additional detail about the design that would not fit into the main body because of page limits or because including the detail would distract the reader from understanding the design. Content for the appendices could include patent search results, working drawings, schematics, computer code, rejected concepts, bill of materials, front pages of key data sheets, laboratory reports from the evaluation and so on. Your client will likely have specific requests for what to include in the appendices. While the appendices may be lengthy, do not go overboard. It makes no sense to include 100 pages of computer code. Instead, refer the reader to an electronic file.

Table 3. Sample design report

Section	Content
Title page	Key info and one illustration
Executive Summary	One-page summary of the project
Table of Contents	
Problem Definition Problem Scope Technical Review Design Requirements	Introduces and defines the problem
Design Description Overview Detailed Description Use	Describes the design
Evaluation Overview Prototype Testing and Results Subsection for each requirement Assessment Next Steps	Evaluates the design
References	List of references used and cited
Appendices	All of the backup information

Self-Check – 5	Written test

Name…… ID…… Date…

Directions: Give short and direct answer.

1. What is design report.(3pts)

2. What are the contents that design report needs to have? (5 pts)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

LAP TEST	Performance Test

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 16 hour. The project expected from each student to do it.

Task 1.

Preform successful designing of bamboo dining chair and dining table (for serving eight person). Chair made up of round bamboo and table made from bamboo board.

Reference Materials

Book:

1. Maria Reka, A., Péter György,H. and Danijela, D. (2017). Furniture design using function analysis.
2. Cheng, J. (2018). Product Design Process and Methods.
3. Camilleri, M. (2018). Understanding Customer Needs and Wants.
4. Taffesse, W. and Kassa, L. (2005). Engineering Drawing.
5. Gagnon, D., Machungwa, M., McKay,B. and Stewart,G.(2011). Final Design Report Design of an Automated Radiator Panel Rotating Machine.
6. Uysal, M. (2014). Furniture design and product development principles considering end-of-life options and design for environment strategies.
7. Williams, R. (2016). Basic Design Principles.
8. Openshaw,S. and Taylor,E. (2006). Ergonomics and Design. A Reference Guide.
9. Netto,U. and Kaminski, P. (2004). The Concept of Product Design.
10. T. Ulrich, K. and D. Eppinger, S. (2012). Product Design and Development. Fifth Edition.
11. P. Jackson, R. (2012). Writing Effective Work Instructions.

Web Addresses

1. https://www.kocha.com.au/blog/design-standards.
2. https://www.bbc.co.uk/bitesize/guides/zn3847h/revision/1.
3. https://www.business.qld.gov.au/starting-business/planning/market-customer-research/researching-customers/customer-needs.
4. https://opentextbc.ca/projectmanagement/chapter/chapter-18-project-completion-project-management/
5. https://qubstudio.com/blog/ten-steps-of-the-product-design-process/
6. https://northell.design/blog/how-to-write-the-design-specifications-quick-guide/
7. https://xd.adobe.com/ideas/principles/web-design/design-documentation/

8. https://www.linkedin.com/pulse/how-use-notes-engineering-drawings-mauricio-lastres/
9. https://www.northernarchitecture.us/building-codes/pictorial-drawings.html
10. https://www.avantikauniversity.edu.in/design-colleges/factors-affecting-product-design.php
11. https://mitaoe.ac.in/design-programs/Essential-Factors-of-Product-design.php

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MINISTRY OF LABOR
AND SKILLS