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Seminar in General Education for Teachers

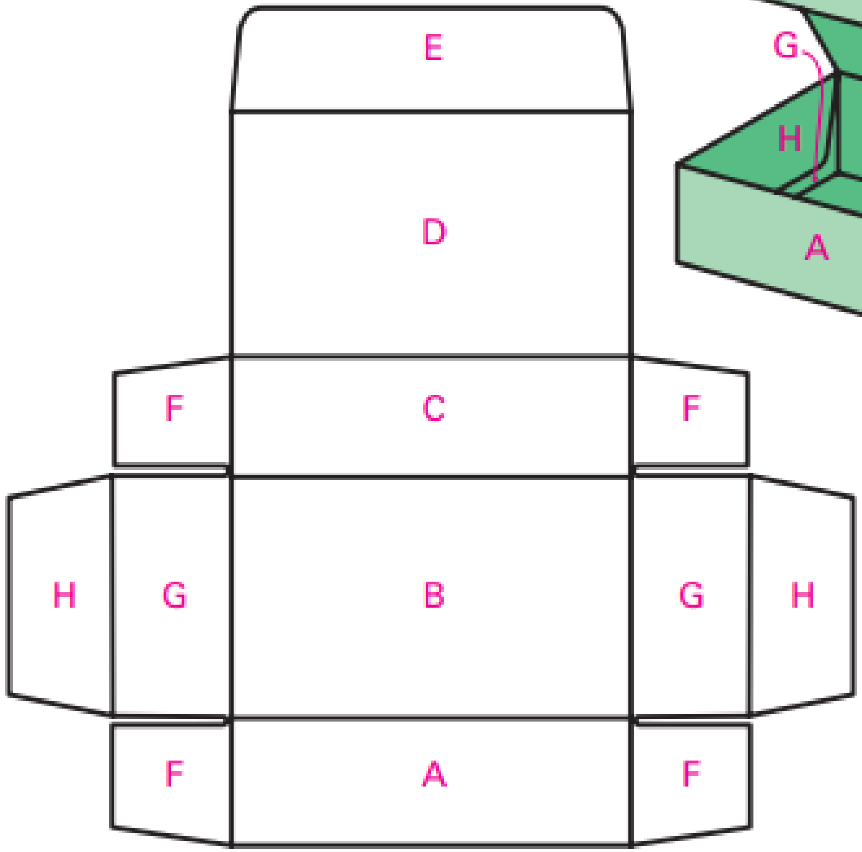
Pattern Development

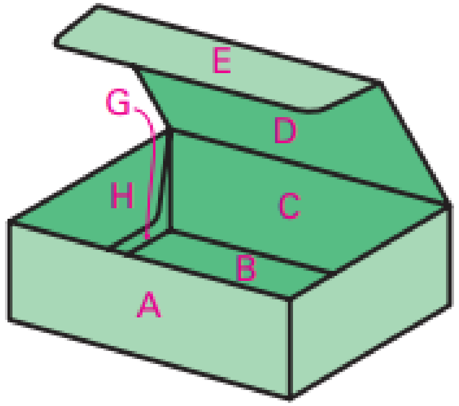
Prof. Isagani A. Maliksi

Pattern Development

- A **pattern development**, also called a **stretchout** or simply a **development**, is a full-size layout of an object made on a single flat plane.
- The **pattern** is the original part of the pattern development from which flat patterns can then be cut from flat sheets of material that are folded, rolled, or otherwise formed into the required shape

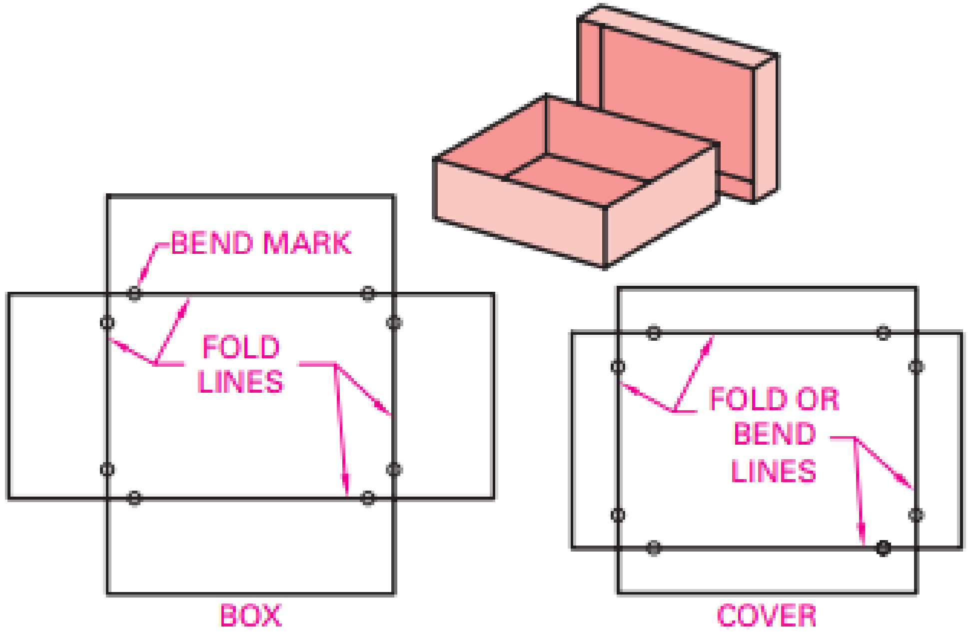
T U P C





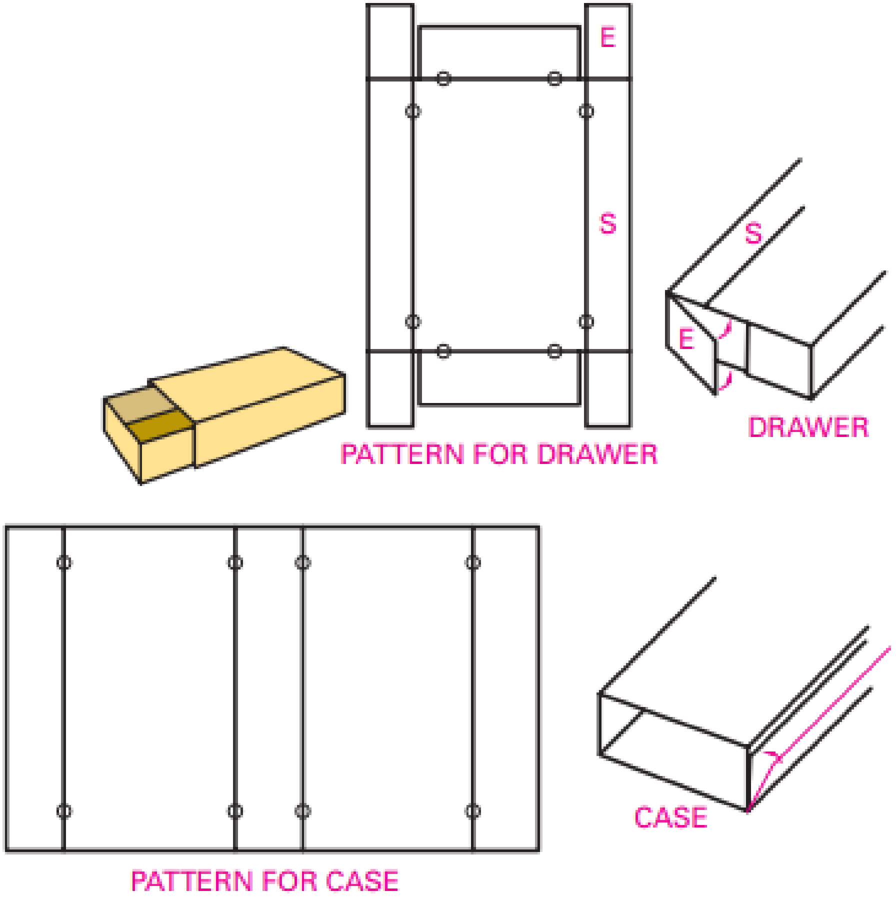
Pattern for A One-piece Package With Fold-down Tabs

T U P C



Pattern for a box and cover

Sheet-Metal Pattern Drafting



A two-part package with a slide-in box.

- The fold lines on the drawer are positioned so that the box will slide in correctly after assembly.

Sheet-Metal Pattern Drafting

- Metal that has been formed into very thin, flat sheets is called sheet metal.
- It is available in many different thicknesses, or gauges.
- For steel, gauges are based on a weight of pounds per square foot per inch of thickness.
- Sheet metal is used to make patterns for many objects.
- The metal is shaped by bending, folding, or rolling and fastened by riveting, seaming, soldering, or welding.

T U P C

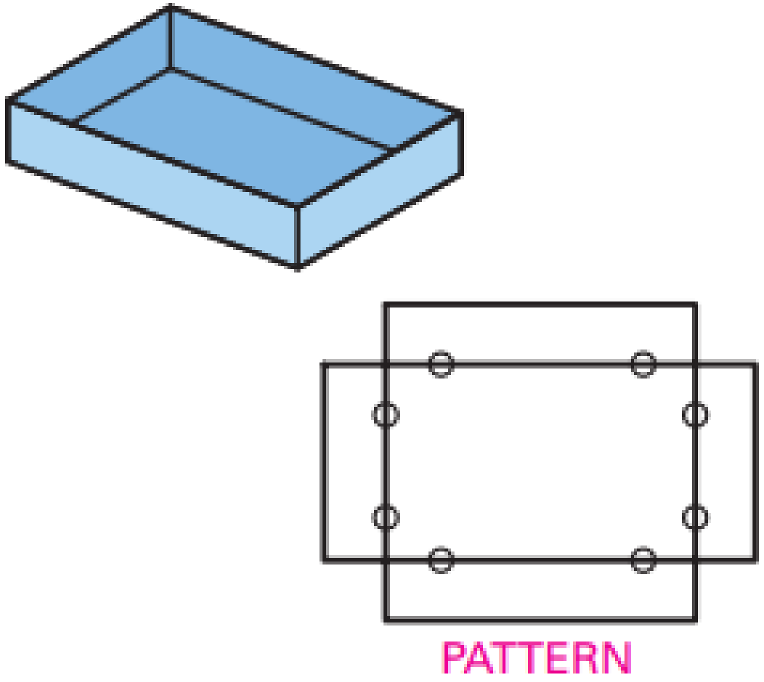
The bends in this metal spatula make it easier to use.

Sheet-Metal Pattern Drafting

For each sheet-metal object, two drawings are usually made.

1. One is a **pictorial drawing** of the finished product,
2. **Development**, or **pattern**, that shows the shape of the flat sheet that, when rolled or folded or fastened, will form the finished object

Sheet-Metal Pattern Drafting



Pictorial drawing and stretchout of a sheet-metal box

Sheet-Metal Pattern Drafting

- Some metal objects without seams are formed by *die* ***stamping or*** **pressing** a flat sheet into shape under heavy pressure.
- Others are made by spinning.
- Die stamping and spinning stretch the metal out of its original shape and into a new one.

Sheet-Metal Pattern Drafting

A

B

Examples of products created by (A) die stamping and (B) spinning sheet metal

Calculating Volume

- Familiar items such as pipes, storage tanks, cabinets, and boxes are designed and patterns are prepared using pattern development.
- When these items are meant to hold a specific quantity or amount of fluid, solid, or gaseous material, the designer must calculate the volume of the items to make sure they will hold the specified amount of material.

Calculating Volume

TUPC

- Familiar items such as pipes, storage tanks, cabinets, and boxes are designed and patterns are prepared using pattern development.
- When these items are meant to hold a specific quantity or amount of fluid, solid, or gaseous material, the designer must calculate the volume of the items to make sure they will hold the specified amount of material.

Calculating Volume

- For some shapes, calculating the volume is easy.
- For example, to find the volume of a cube, simply multiply the length times the width times the height.
- Calculating the volumes of other shapes requires the use of other mathematical formulas.

Calculating Volume

The volume of a right cylinder is determined using the formula:

- Volume = (area of base) (height)

For **example**, the calculations to find the volume of the cylinder:

Area of base = πr^2

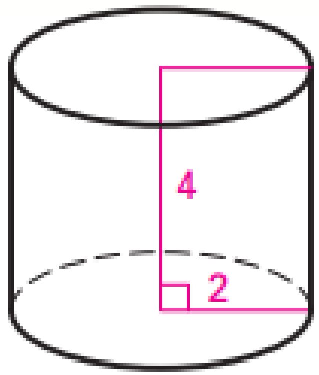
= (3.1416 (2^2)

= (3.1416) (4)

= 12.57 square inches

Volume = (12.57) (4)

= 50.28 cubic inches



RIGHT CIRCULAR CYLINDER

Calculating Volume

The volume of a right circular cone is determined using the formula:

Volume $= \dfrac{\text{(Area of base) (height)}}{3}$

Area of base $= \pi r^2$

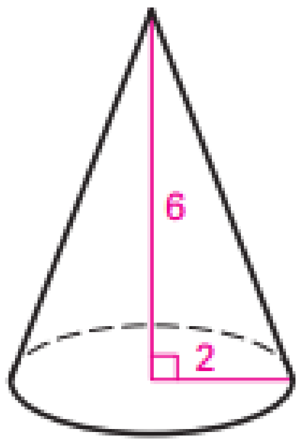
$= (3.1416)\ (2^2)$

$= (3.1416)\ (4)$

$= 12.57$ square inches

Volume $= \dfrac{(12.57)\ (6)}{3}$

$= 25.14$ cubic inches

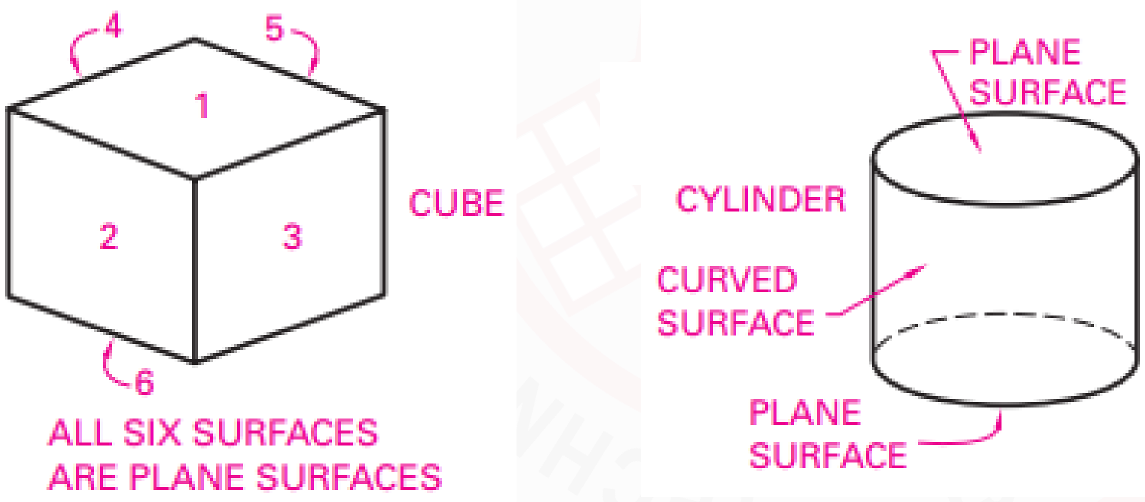


RIGHT CIRCULAR CONE

Surface Geometry

- Sheet-metal patterns, like all other patterns, are developed using principles of surface geometry.
- Two general classes of surfaces are plane (flat) and curved.
- The six faces of a cube are plane surfaces.
- The top and bottom of a cylinder are also plane surfaces.

Surface Geometry

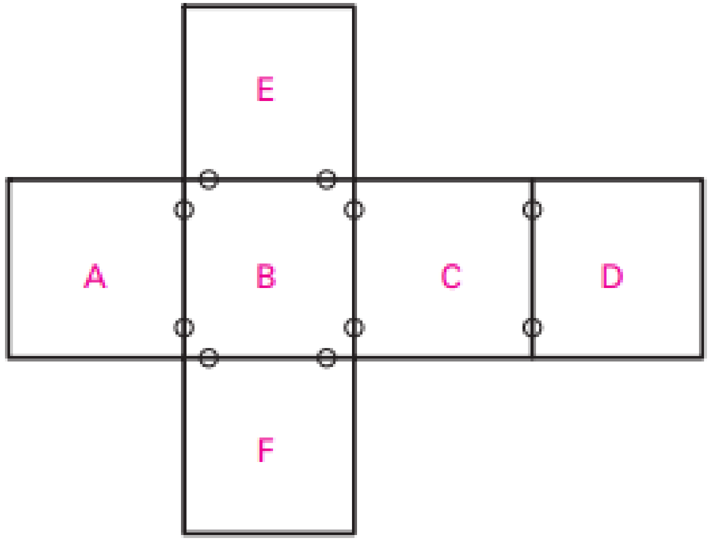


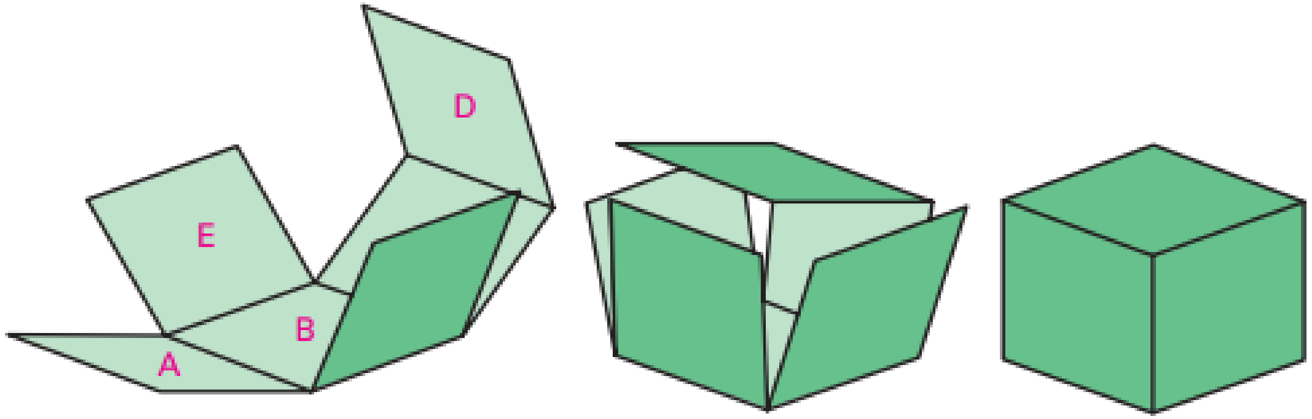
- The six faces of a cube are plane surfaces.
- The top and bottom of a cylinder are also plane surfaces.
- However, the side surface of the cylinder is curved

Surface Geometry

- Curved surfaces that can be rolled in contact with a plane surface, such as cylinders and cones, are called ***single-curved surfaces***.
- Exact pattern developments can be made for them.
- The other curved surface is called ***double curved*** and is found on spheres and spheroids.
- Because exact pattern developments cannot be made for objects with double-curved surfaces, drafters **approximate**.

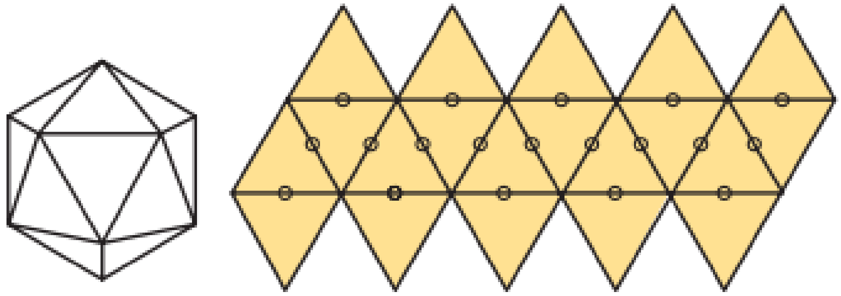
Surface Geometry



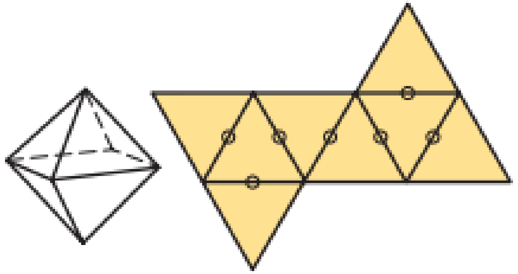


Pattern for a cube

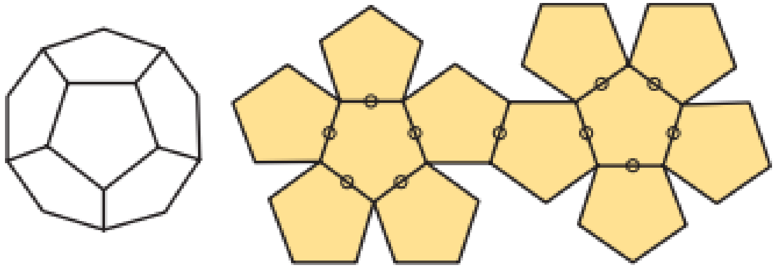
Surface Geometry



ICOSAHEDRON



OCTAHEDRON



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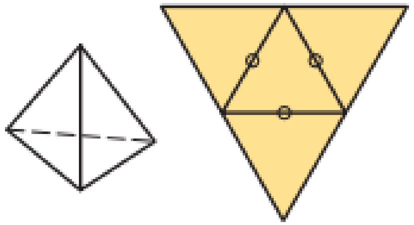


TETRAHEDRON

Patterns for four regular solids

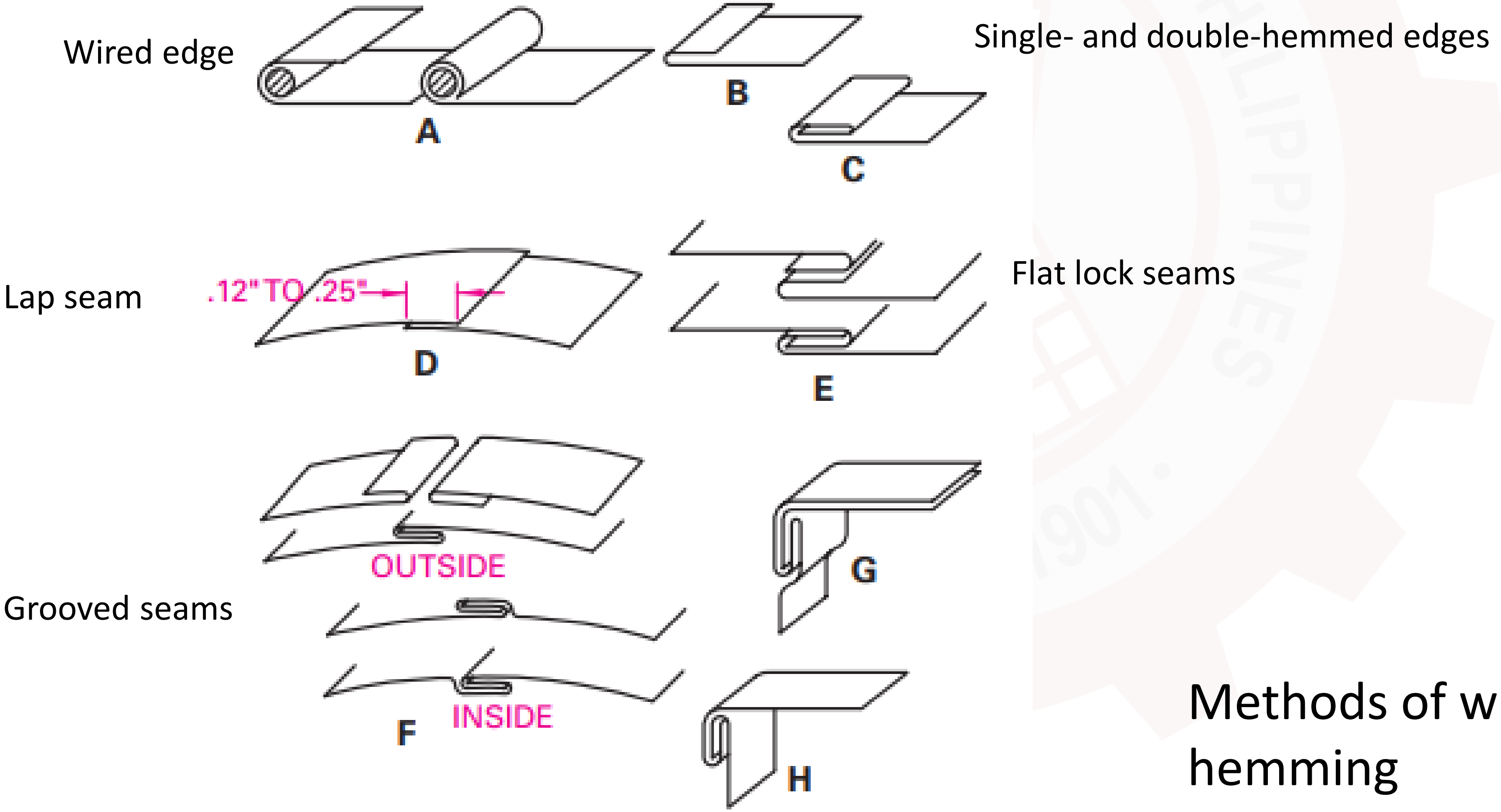
Surface Geometry

- To understand pattern development better, lay these patterns out on paper.
- Then cut them out and fold them to make the solids.
- Secure the joints with tape.
- Any solid that has plane surfaces can be made in the same way.

Finishing a Pattern

- In dealing with sheet-metal patterns, drafters must also know about the processes of wiring, hemming, and seaming and the material quantity required for each process.
- ***Wiring*** is one method to reinforce open ends of an item by enclosing a wire in its edge.
- To allow for wiring, a drafter must add a band of material to the pattern equal to 2.5 times the wire's diameter.

Finishing a Pattern



Methods of wiring, seaming, and hemming

Finishing a Pattern

- ***Hemming*** is another way to stiffen edges of a sheet-metal product by folding the edges.
- Single- and double-hemmed edges are shown in **Figures 14-10B** and **C**.
- Edges can also be fastened by soldering on lap seams (**Figure 14-10D**), flat lock seams **Figure 14-10E**, or grooved seams **Figure 14-10F**.
- **Figure 14-10G** and **H** for other types of seams and laps. The material required for each process depends on the thickness, the fastening method, and the application. In most cases, the corners of the lap are notched to make a neater joint.

Types of Developments

- The type of development needed for an individual object depends on the object's shape.
- **The three basic types are:**
  a. Parallel-line Development
  b. Radial-line Development
  c. Triangulation.

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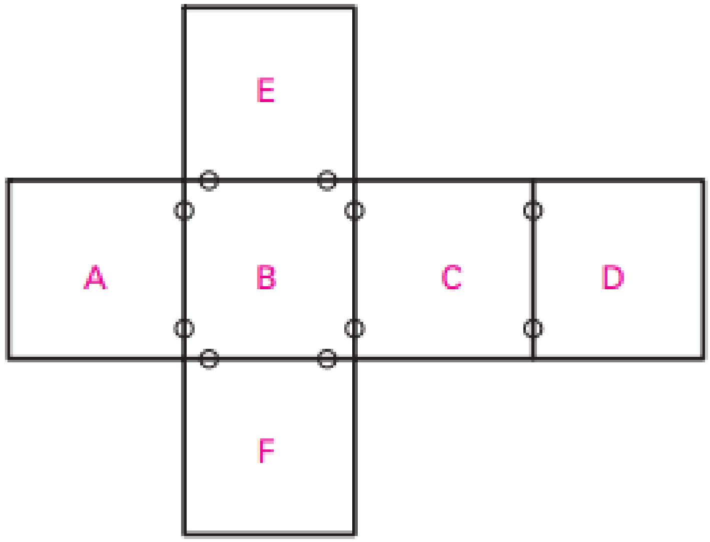
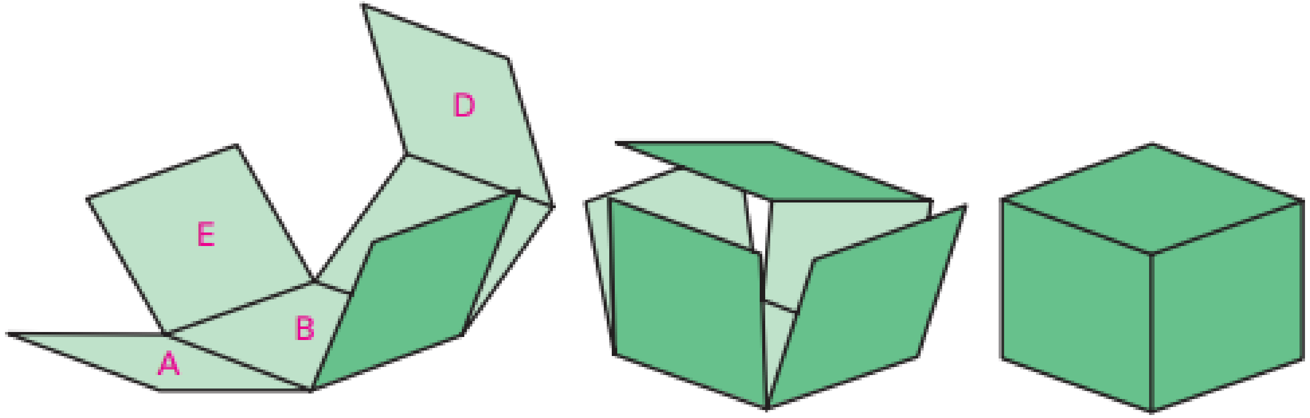
Types of Developments

a. Parallel-Line Development

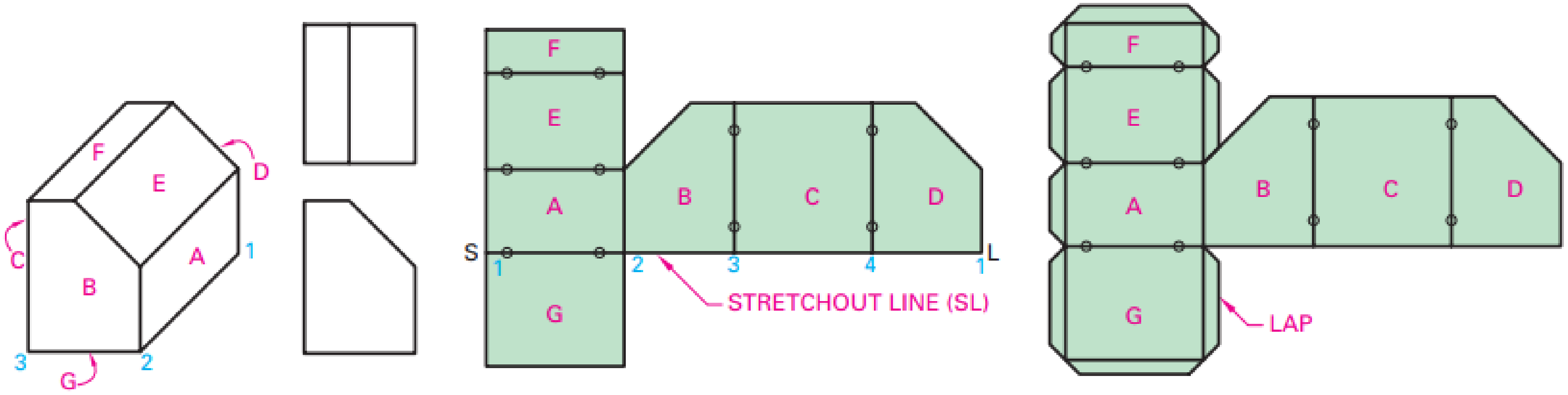
- Making a pattern by drawing the edges of an object as parallel lines is known as parallel-line development.





Parallel-line Development

Types of Developments



A pattern for a prism, showing stretchout line and lap

Types of Developments

- In the patterns for prisms and cylinders, the **stretchout line**, which shows the full length of the pattern when it is completely unfolded, is straight, and the **measuring lines**, or vertical construction lines, are perpendicular to it and parallel to each other.

Types of Developments

b. Radial-Line Development

- The edges on cones and pyramids are not parallel.
- Therefore, the stretchout line is not a continuous straight line.
- Also, instead of being parallel to each other, measuring lines radiate from a single point.
- This type of development is called **radial-line development**.

Types of Developments

- Imagine the curved surface of a cone as being made up of an infinite number of triangles, each running the height of the cone.
- To understand the development of the pattern, imagine rolling out each of these triangles, one after another, on a plane (flat surface).

Types of Developments

- The resulting pattern would look like a sector of a circle. Its radius would be equal to an element of the cone, that is, a line from the cone's tip to the rim of its base.
- Its arc would be the length of the rim of the cone's base.

Types of Developments

- The resulting pattern would look like a sector of a circle. Its radius would be equal to an element of the cone, that is, a line from the cone's tip to the rim of its base.
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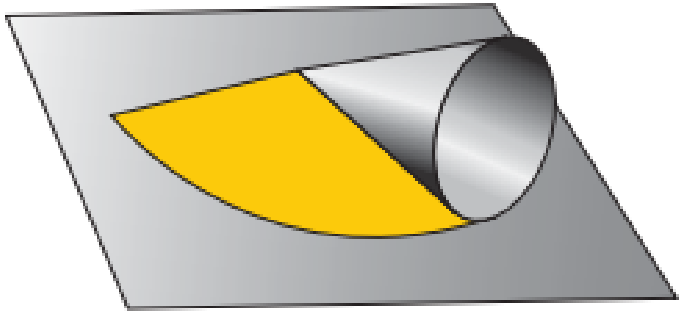

Developed Surface of A Cone

Types of Developments

c. Triangulation

- Some surfaces, such as double-curved surfaces, cannot be developed exactly.
- The method used to make approximate developments of these surfaces is known as **triangulation**.
- It involves dividing the surface into triangles, finding the true lengths of the sides, and then constructing the triangles in regular order on a plane.
- Because the triangles have one short side, on the plane they approximate the curved surface.

Transition Pieces

- A piece that is used to connect pipes, such as hot- and cold-air ducts, and openings of different shapes, sizes, or positions is known as a **transition piece**.
- Transition pieces have a surface that is a combination of different forms, including planes, curves, or both, and are usually developed by triangulation.

Transition Pieces

Examples of transition pieces

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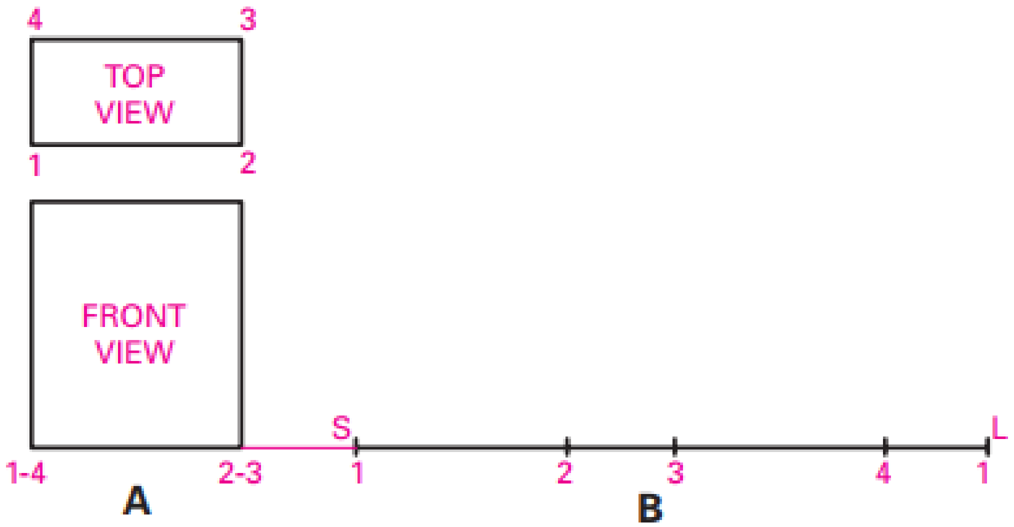
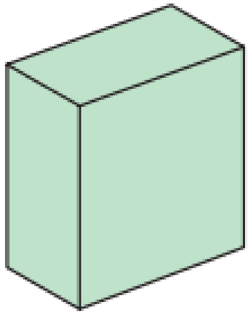
Examples: Prism

1. Draw the front and top views full size.

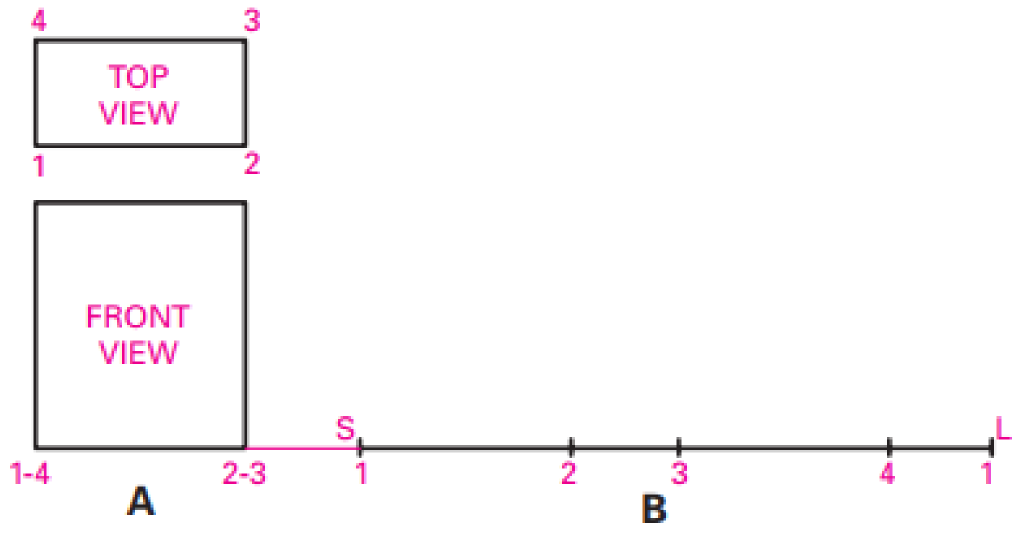


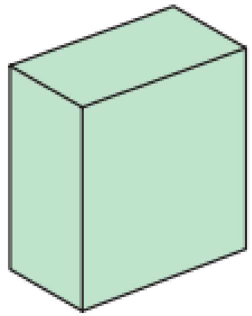


Examples: Prism

2. Draw the stretchout line (SL).

- Find the lengths of sides 1-2, 2-3, 3-4, and 4-1 in the top view.
- Mark off these lengths on the SL.

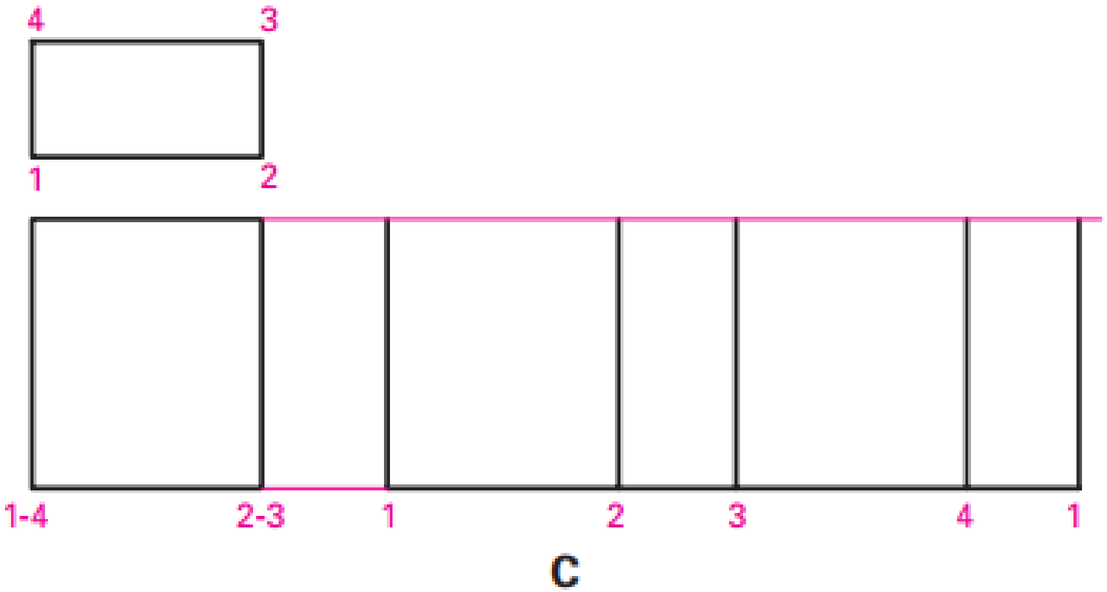


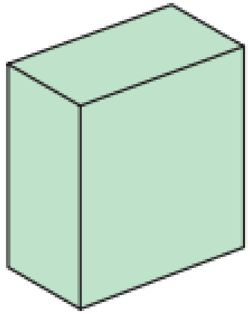


Examples: Prism

3. At points 1, 2, 3, 4, and 1 on the SL, draw vertical crease (fold or bend) lines.

- Make them equal in length to the height of the prism.

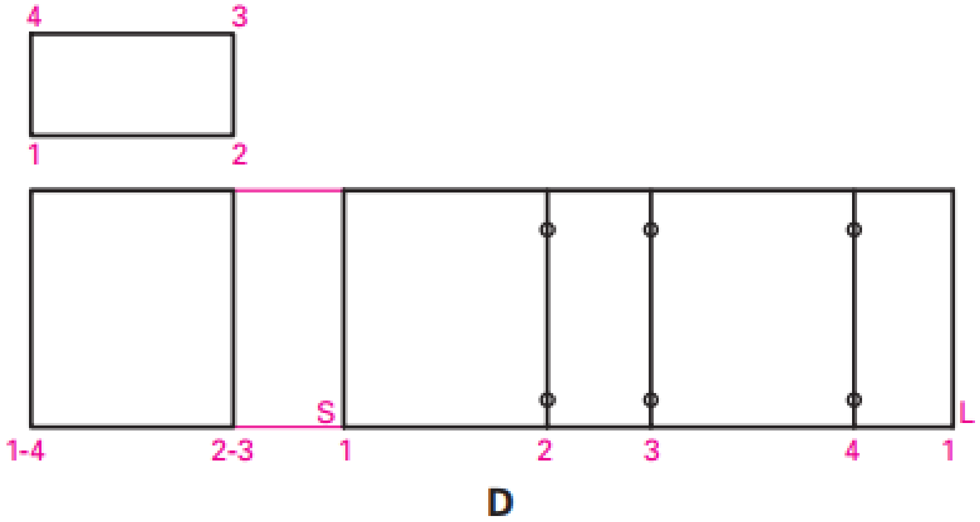


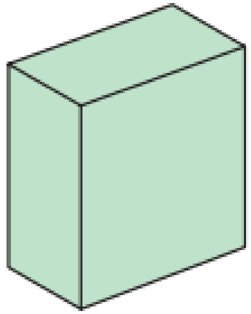


Examples: Prism

4. Project the top line of the pattern from the top of the front view. Make it parallel to the SL.

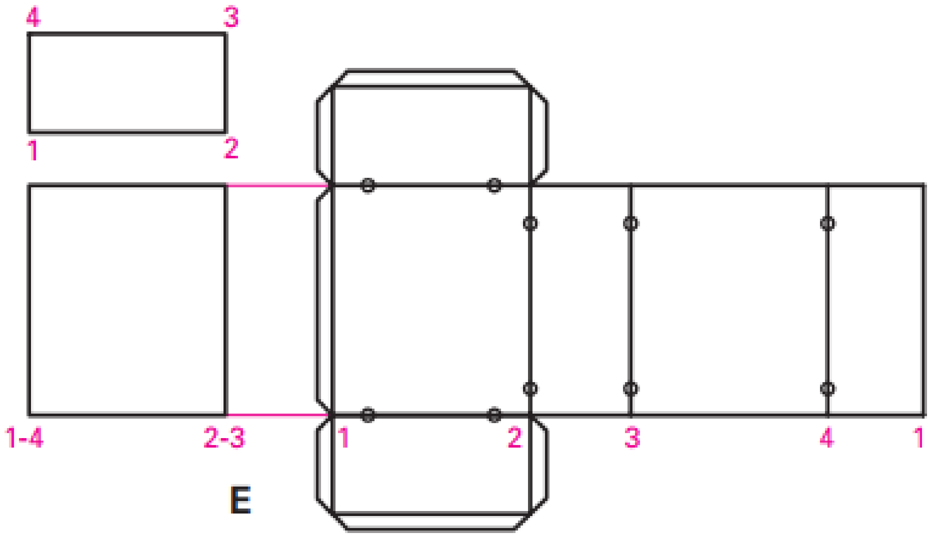
- Darken all outlines until they are sharp and black.
- Use a small circle or X to identify a fold line.

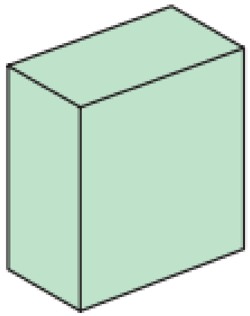




Examples: Prism

5. Add the top and bottom to the pattern by transferring distances 1-4 and 2-3 from the top view.

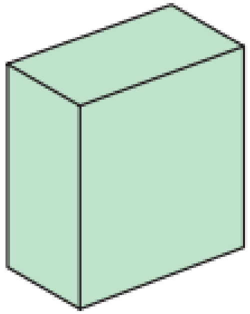


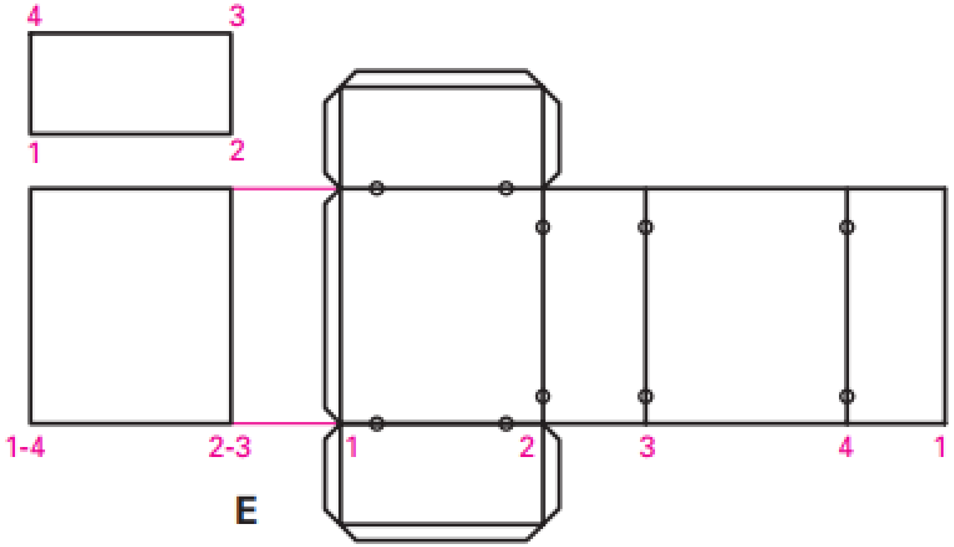


Examples: Prism

6. Add laps or tabs as necessary for the assembly of the prism.

- The size of the laps will vary depending on how they are to be fastened and the type of material used.



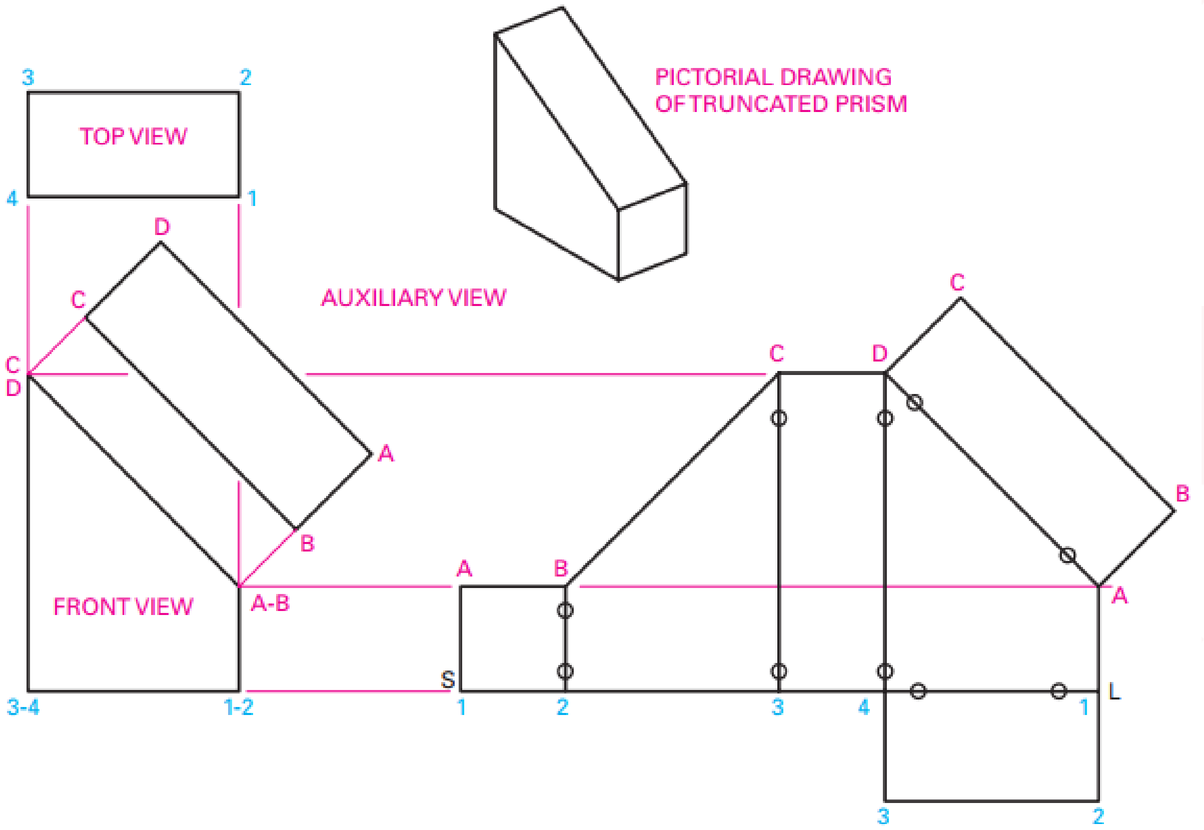


Parallel Line Development of a Prism

Examples: Truncated Prism

- A slight variation is the pattern for a truncated prism.
- To draw it, first make the front, top, and auxiliary views at full size. Label points as shown.
- The next two steps are the same as steps 2 and 3.
- Then project horizontal lines from points A-B and C-D on the front view to locate points on the pattern.
- Connect the points to complete the top line of the pattern.
- Add the top and bottom as shown. Tabs may be added.

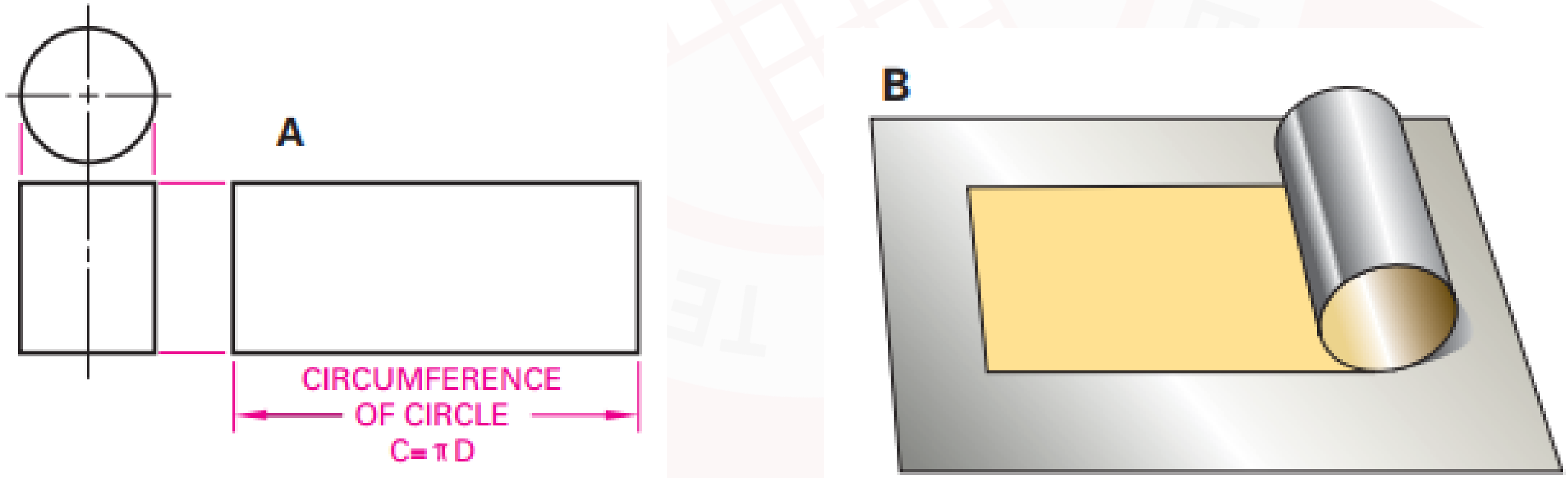
Examples: Truncated Prism



Development of a Truncated Prism

Examples: Cylinder

- A cylinder is made by rolling the cylinder out on a plane surface. In the pattern for cylinders, the stretchout line is straight and equal in length to the circumference of the cylinder.
- If the base of the cylinder is perpendicular to the axis, its rim will roll out to form the straight line



Developed Surface Of A Right Circular Cylinder

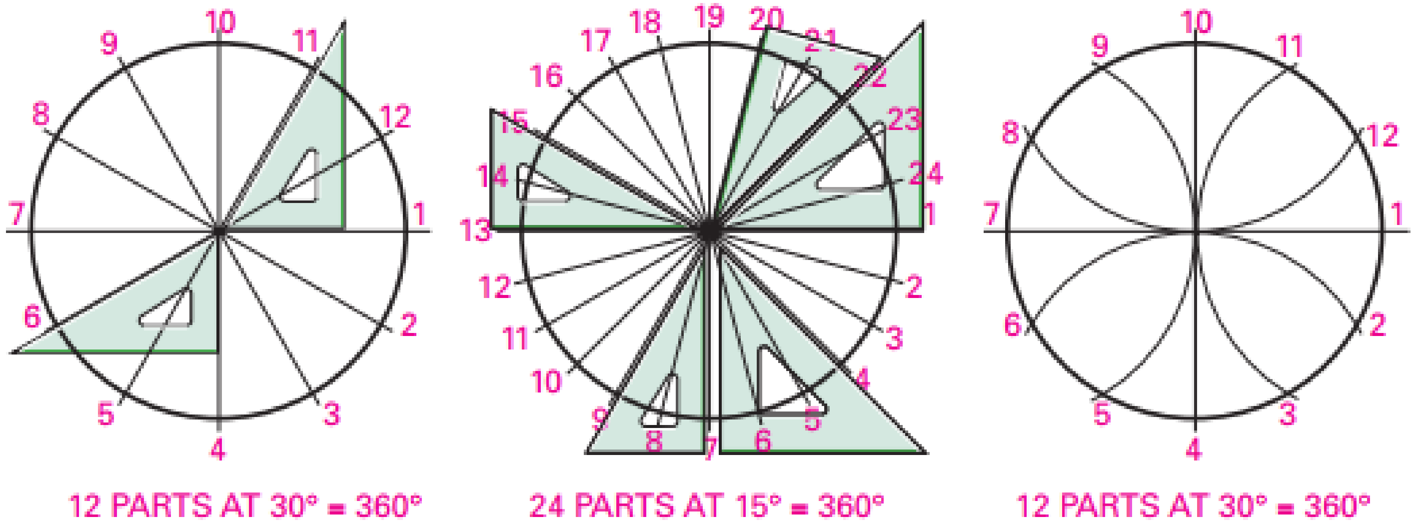
Examples: Cylinder

- In developing a cylinder, imagine that it is actually a many-sided prism.
- Each side forms an edge called an ***element***.
- Because there are so many elements, however, they seem to form a smooth curve on the surface of the cylinder.
- Imagining the cylinder in this way will help you find the length of the stretchout line.

Examples: Cylinder

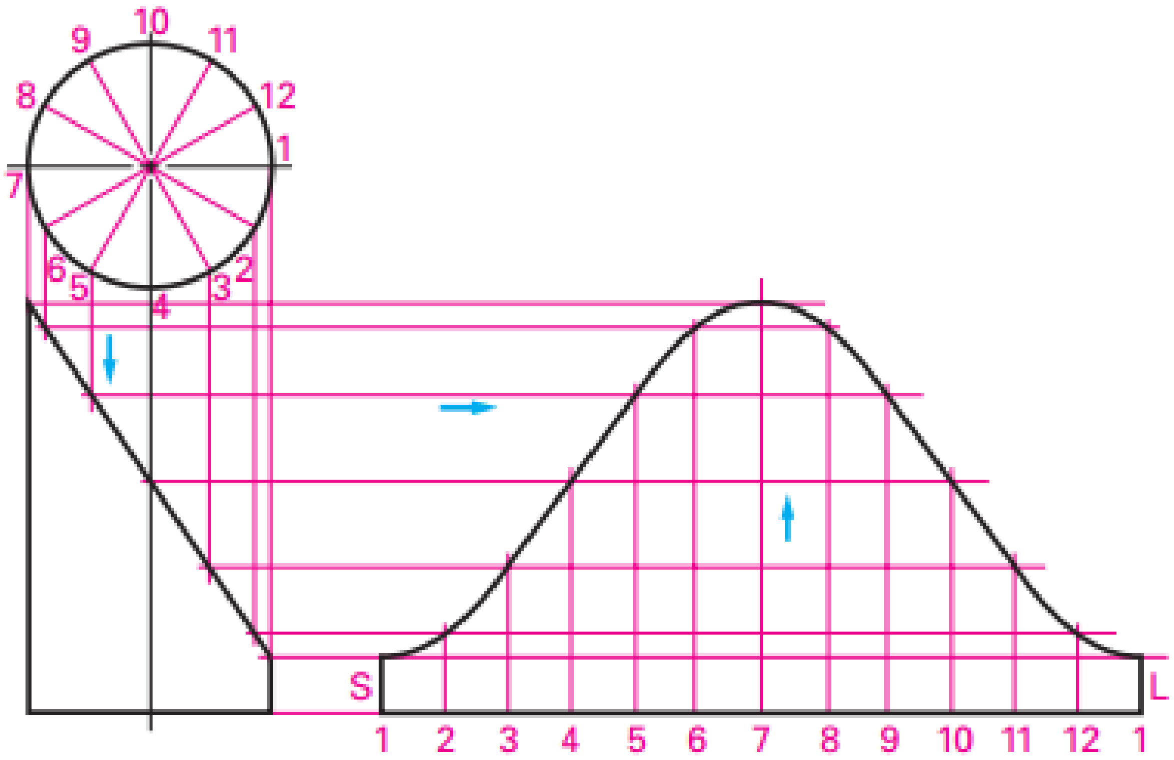
- This length will equal the total of the distances between all of the elements.
- Technically, of course, the elements are infinite in number.
- For your purposes, however, you need to mark off elements at convenient equal spaces only around the circumference of the cylinder.
- Then add up these spaces to make the stretchout line.
- This must equal the circumference of the cylinder.

Examples: Various Ways of Dividing a Circle



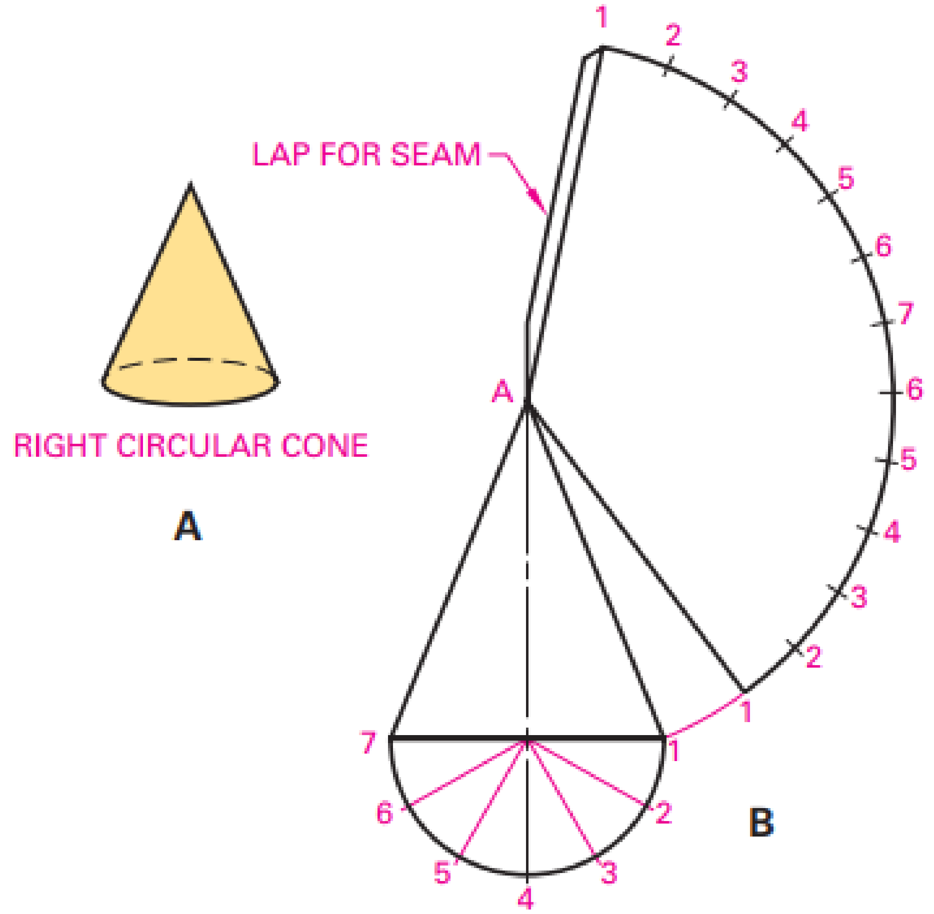
Dividing A Circle

Examples: Truncated Right Cylinder



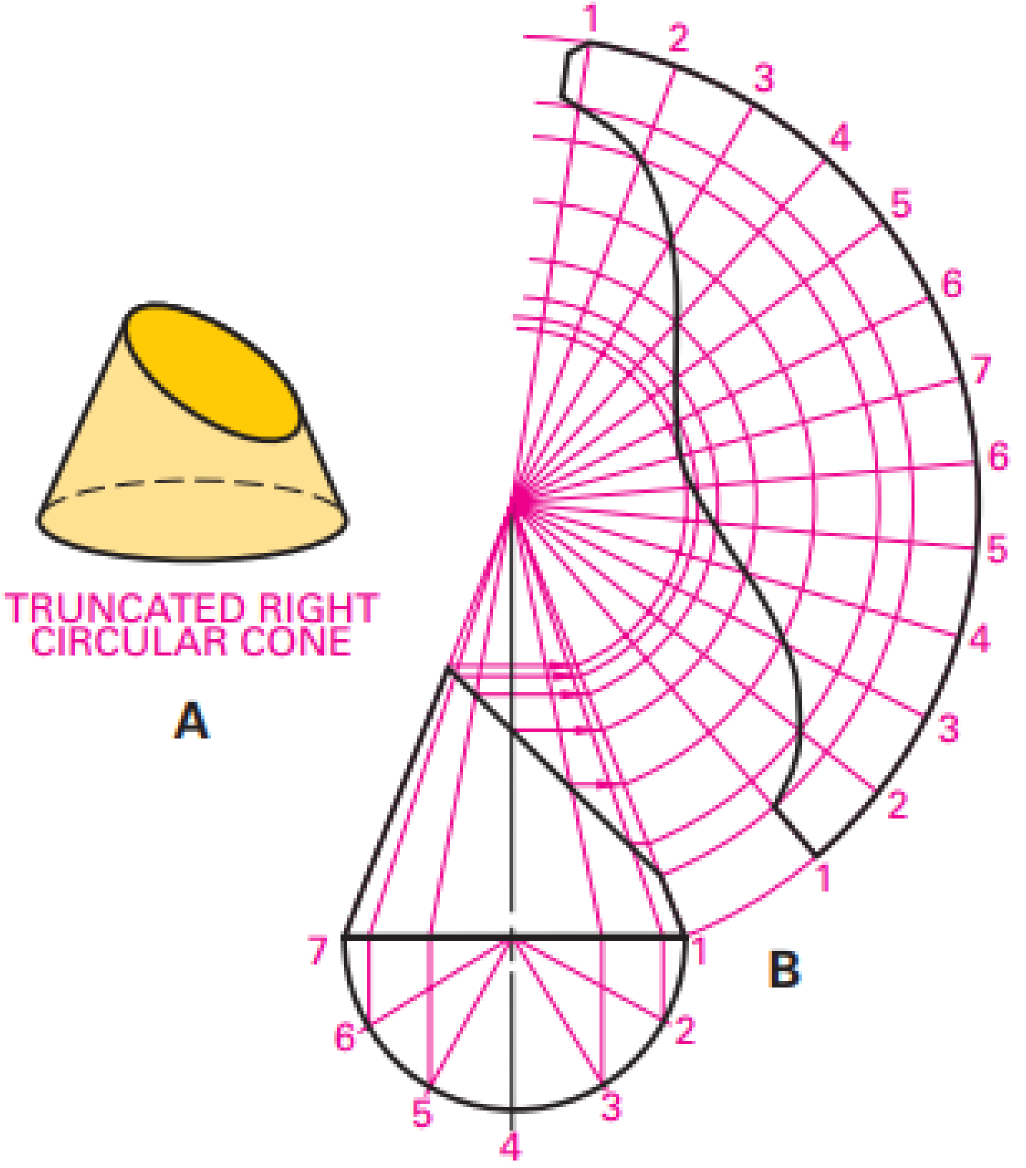
Development Of A Pattern For A Truncated Right Cylinder

Examples: Cone



Development of a Pattern For A Cone

Examples: Cone



Development of a Pattern For a Truncated Right Circular Cone