Unit 4: Geometric Construction
(Chapter 4: Geometry For Modeling and Design)

DFTG-1305 Technical Drafting
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OBJECTIVES

1. Identify and specify basic geometric elements and primitive shapes.
2. Select a 2D profile that best describes the shape of an object.
3. Identify mirrored shapes and sketch their lines of symmetry.
4. Identify shapes that can be formed by extrusion and sketch their cross sections.
5. Identify shapes that can be formed by revolution techniques and sketch their profiles.
6. The usage of Drafting tools
MANUALLY BISECTING A LINE OR CIRCULAR ARC

Bisecting a Line or a Circular Arc

(a) Given line or arc

(Step 1)

(Step 2)
DRAWING TANGENTS TO TWO CIRCLES

Drawing Tangents to Two Circles

A tangent point is perpendicular to a radius
DRAWING AN ARC TANGENT TO A LINE OR ARC AND THROUGH A POINT

Given AB, P, and radius R

Given AB, CQ, and P

Given radius G, R, Q, and P
**BISECTING AN ANGLE**

Below shows the given angle BAC to be bisected.

Step 1. Lightly draw large arc with center at A to intersect lines AC and AB.
Step 2. Lightly draw equal arcs r with radius slightly larger than half BC, to intersect at D.
Step 3. Draw line AD, which bisects the angle.
LAYING OUT AN ANGLE

Many angles can be laid out directly with the triangle or protractor

\[ Y = 10 \tan \theta \]
\[ R = 10 \sin \theta \]
\[ C = 2 \sin \left( \frac{\theta}{2} \right) \]

Tangent method
Sine method
Chord method

DRAWING A TRIANGLE WITH SIDES GIVEN

DRAWING A RIGHT TRIANGLE WITH HYPOTENUSE AND ONE SIDE GIVEN
DRAWING AN EQUILATERAL TRIANGLE

Side AB is given. With A and B as centers and AB as radius, lightly construct arcs to intersect at C (Figure 4.32a). Draw lines AC and BC to complete the triangle.

Alternative Method Draw lines through points A and B, making angles of 60° with the given line and intersecting C.
POLYGONS

A polygon is any plane figure bounded by straight lines. If the polygon has equal angles and equal sides, it can be inscribed in or circumscribed around a circle and is called a regular polygon.

Polygons can be defined by the number of sides and whether they are inscribed or circumscribed in a circle. (Autodesk screen shots reprinted courtesy of Autodesk, Inc.)
**DRAWING A REGULAR PENTAGON**

Dividers Method Divide the circumference of the circumscribed circle into five equal parts with the dividers, and join the points with straight lines.

**Step 1.** Bisect radius OD at C.

**Step 2.** Use C as the center and CA as the radius to lightly draw arc AE. With A as center and AE as radius, draw arc EB.

**Step 3.** Draw line AB, then measure off distances AB around the circumference of the circle. Draw the sides of the pentagon through these points.
DRAWING A HEXAGON

Each side of a hexagon is equal to the radius of the circumscribed circle. To use a compass or dividers, use the radius of the circle to mark the six points of the hexagon around the circle. Connect the points with straight lines. Check your accuracy by making sure the opposite sides of the hexagon are parallel.

Centerline Variation Draw vertical and horizontal centerlines. With A and B as centers and radius equal to that of the circle, draw arcs to intersect the circle at C, D, E, and F, and complete the hexagon.

Measurement Across Flats vs. Across Corners
**ELLIPSES**

An ellipse can be defined by its major and minor axis distances. The major axis is the longer axis of the ellipse; the minor axis is the shorter axis.

Major and Minor Axes of Some Ellipses
To use the Compass

Figure 1b-3
Using the Giant Bow Compass.
To use the Divider

Figure 1b-12

Using the Dividers.
To use the French Curves

Use the French Curves to trace irregular curves

Figure 1b-15
To use T-Square to draw Horizontal lines

Figure 3-11
Drawing a Horizontal Line.
To use T-Square to draw Vertical lines

Figure 3-12
Drawing a Vertical Line.
To Draw 30°, 60°, 45° Angles

Figure 3-13
Triangles.
To use Templates

Templates are available for a great variety of specialized needs. Templates may be found for drawing almost any ordinary drafting symbol or repetitive feature.

Circle templates and compasses are the most used drafting tools for drawing arcs and circles.
GEOMETRIC RELATIONSHIPS

Tangency. Lines that are tangent to an entity have one point in common but never intersect. 3D objects may be tangent at a single point or along a line.

An angle is defined by the space between two lines (such as those highlighted here) or planes that intersect.

The highlighted lines are parallel.

The highlighted lines are perpendicular.

The highlighted circle intersects the highlighted line at two different points.
SOLID PRIMITIVES

Many 3D objects can be visualized, sketched, and modeled in a CAD system by combining simple 3D shapes or primitives. They are the building blocks for many solid objects. You should become familiar with these common shapes and their geometry. The same primitives that are useful when sketching objects are also used to create 3D models of those objects.
RECOGNIZING SYMMETRY

3D Mirrored Shapes. Each of these symmetrical shapes has two mirror lines, indicated by the thin axis lines. To create one of these parts, you could model one quarter of it, mirror it across one of the mirror lines, then mirror the resulting half across the perpendicular mirror line.

Right- and Left-hand Brake Levers (Using symmetry when you model can be important when the design requires it)
**EXTRUDED FORMS**

*Extrusion* is the manufacturing process of forcing material through a shaped opening.

A *swept* form is a special case of an extruded form. Sweeping describes extruding a shape along a curved path.
REVOLVED FORMS

Revolution creates 3D forms from basic shapes by revolving a 2D profile around an axis to create a closed solid object. To create a revolved solid, create the 2D shape to be revolved, specify an axis about which to revolve it, then indicate the number of degrees of revolution.
COORDINATES FOR 3D CAD MODELING

Most CAD systems use the right-hand rule for coordinate systems; if you point the thumb of your right hand in the positive direction for the X-axis and your index finger in the positive direction for the Y-axis, your remaining fingers will curl in the positive direction for the Z-axis.

The Z-Axis. In systems that use the right-hand rule, the positive Z-axis points toward you when the face of the monitor is parallel to the X-Y plane.
COORDINATES FOR 3D CAD MODELING

Axis of Rotation. The curl of the fingers indicates the positive direction along the axis of rotation.