Intermediate Engineering Graphics
4th Week 1st Meeting Lecture Notes
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Topic: Types of pictorial drawings (isometric, oblique, and perspective), isometric sketching and drafting in AutoCAD

1st Subject: Types of Pictorial Drawings (Isometric, Oblique, and Perspective)

1. Types of pictorial drawings:

(2) Pictorial drawings: The word pictorial literally means "like a picture". Among the three types of pictorial drawings, the simplest and least realistic is oblique, the most realistic and complicated is perspective, isometric is in the middle, and is the most common method used in industry:

a. Isometric: One corner of the object appears closest. The lines slanting away from this corner are 120 degrees apart, and are drawn true length. Isometric axis lines are 120º apart, receding lines are parallel, the three planes of an isometric axis are defined as left, right and top planes, isometric sketches may be sketched in different orientations to show as many of the object's features as possible. To make an isometric drawing, sketch a "prism" first and "chop away" or add something to come up with the desired object. Other axonometric drawings include diametric and trimetric, they are difficult to draw and are not used as often as isometrics. Isometric drawings can be used for client presentation and product literature, in the forms of explosion and assembly drawings.

b. Oblique drawing: one side of the object appears closest. The top and one side slant away. Useful for circular objects. Oblique sketches are based on one perpendicular set of lines and one receding line, at any angle but with 30º or 45º as the most common. All receding lines are parallel. Oblique drawings include three types:

cavalier (true length for all sides);

cabinet (true length for front sides but half length for the sides on the top and the slanting side. Cabinet oblique looks more natural), and

general (3/4 scale for the receding axis, drawn at about 15º with horizontal).

c. Perspective drawing: the most realistic and natural type of pictorial drawing, but does not show the real dimensions of the object, therefore, can NOT be used as working drawings. All measurement in perspective drawings are "estimated", NOT measured with a rule as in isometrics or oblique drawings. Perspective drawings are good for showing large objects such as buildings and highway in a realistic way, before things are actually built. The perspective drawings are sometimes beautifully rendered, look like photographs and show the object the way it actually appears; and are used in architecture, aircraft and automotive industries.

In perspective drawings, receding lines converge to one or two vanishing points (VP, located on a theoretical HORIZON LINE, or EYE LEVEL, abbreviated as EL, always at eye level). Parts farther away from the view are drawn smaller than those close by, therefore, things seem to get smaller in the distance. **The one-point perspective** is called **"Parallel perspective"**, has similar appearance as oblique drawing, but has two sets of parallel lines; with the "receding" lines converge to one vanishing point. **Two-point perspective** is called

"Angular perspective", has similar appearance as isometric drawing, but has one set of parallel lines, and two sets of receding lines converge to two vanishing point. The drawing steps for one- and two-point perspectives are same as in isometric and oblique drawings. Sometime, **three-point perspective** can be used to draw tall buildings or objects rotated to a particular angle (the third vanishing point can be either above or below the horizon). The three-point perspective is more complicated and not used as often as one- and two-point perspectives.
To understand the construction of the grid system for perspectives, see handouts from **Perspective A Step-by-Step Guide for Mastering Perspective by using the Grid System, by Donald A. Gerds, 4th Edition, p5-7).** Ready-made grid system are available through the same author's publication.

2nd Subject: Isometric Sketching and Drafting in AutoCAD

1. Five Steps in Isometric and Oblique Drawings

(1) Draw the three axis (30º-90º-30º from horizontal for isometric; 0º-90º-30º or 45º for oblique);
(2) Mark the measurement on the axis (true length for isometric and cavalier oblique; true length on x- and y-axis but half length on z-axis for cabinet oblique);
(3) Complete the enclosing block;
(4) Remove or add parts;
(5) Make the desired lines heavy.

2. Basic rule to remember when drawing isometrics: lines parallel in orthogonal view must be parallel in an isometric view (AutoCAD ISOPLANE feature makes this task easy). Lines drawn in isometric drawings include:

(1) **Isometric lines:** parallel to the axis, drawn in full scale. Can be drawn directly along the isometric grids.
(2) **Non-isometric line:** not parallel to the axis, not drawn in full scale. Isometric construction lines are drawn first to help locating the endpoints of non-isometric lines.

3. The correct way to draw isometric ellipses: the minor axis of the ellipses must always align with one of the axis and be parallel to one of the isometric plane. The apparent direction of the major axis: left-to-right on the top plane, upper left-to-lower right on the left plane, upper right-to-lower left on the right plane, if connected, the three major axis of the three ellipses on the three planes will form an "Upside down Triangle" (or "Right side Up Triangle" if bottom view replaces the top view). Also, for any isometric plane, the major axis of the isometric elliptical circle will line up with the set of smaller opposite angles of the bounding box, and the minor axis will line up with the set of larger opposite angles of the bounding box (the Minor Axis-Larger Angles and Major Axis-Smaller Angles Appearance).

4. Isometric drafting in AutoCAD

(1) Settings: Type DS to open the Drafting Settings dialogue box, select Snap and Grid tab; check "Snap On (F9)" and enter a value in "Snap Y-spacing" line; check "Grid On (F7)"

and enter a value in “Grid Y-spacing” line; select “Isometric Snap” in the “Snap type and style” section, press OK button.

(2) Change isometric crosshairs orientation: press F5 or Ctrl+E, or type ISOPLANE and press Enter (keep pressing Enter or type L, R, T), to change the isoplane. ISOPLANE helps to draw isometric ellipses correctly in the three isometric planes.

(3) To draw isometric ellipses in the three isometric planes: press F5 to select the corresponding isoplane, then select the Ellipse command by typing el or clicking on the Ellipse icon button in the Draw toolbar:

Command: _ellipse

Specify axis endpoint of ellipse or [Arc/Center/Isocircle]: (Type I to select Isometric, press Enter)

Specify center of isocircle: (Pick a point on the drawing screen or type coordinate values, press Enter)

Specify radius of isocircle or [Diameter]: (Type a value for radius or to select Diameter, press Enter)

Caution: To maintain appropriate appearance of the ellipse in isometric planes when changing it from one isoplane to another, the rotation angle should be 120°.

(3) To draw Isometric arcs: isometric arcs are used to create filleted corners. Two ways to draw isometric arcs: A. draw complete object first, trim away excess after locating the fillets and move the object lines; or B. draw the isometric arcs first and then draw the connecting lines. **The edge lines should be tangent to the isometric arcs. Use snaps to achieve this. Rounded edges, when viewed straight on, or not seen in the outer edge of the object, cannot be shown as complete-edge lines that extend to the end of the object, and need to be broken off from the edge).** To create isometric arcs:

Type el for arc in the command line or go to Ellipse icon button on Draw toolbar (or go to Draw pull down menu to select Ellipse/Arc):

Command: el

ELLIPSE

Specify axis endpoint of ellipse or [Arc/Center/Isocircle]: (Type A to select Arc, press Enter)

Specify axis endpoint of elliptical arc or [Center/Isocircle]: (Type I to select Isometric, press Enter)

Specify center of isocircle: (Pick a point on the drawing screen or type coordinate values, press Enter)

Specify radius of isocircle or [Diameter]: (Type a value for radius or to select Diameter, press Enter)

Specify start angle or [Parameter]: (Type a value and press Enter)

Specify end angle or [Parameter/Included angle]: (Type a value and press Enter)

Professional Tips: to help locate the center of the iso arcs or ellipse, draw a point with an easily visible shape first.

5. Isometric Dimensioning (Using Oblique Dimensioning) in AutoCAD: draw the regular dimensions first and than rotate it:

A. 30 degree for extension lines forming 30 degrees ccw with horizontal and

B. –30 degrees for extension line forming 30 cw with the horizontal.

To rotate the dimensions, type DIMEDIT or DED:

Command: ded DIMEDIT

Enter type of dimension editing [Home/New/Rotate/Oblique] <Home>: (Type o, and press Enter)
Select objects: 1 found
Select objects: (Press Enter)
Enter obliquing angle (press ENTER for none): (Type 30 or –30 depending on the dimensions, and press Enter)

Study Questions

1. What is the most commonly used form of pictorial drawings in the presentation of consumer products?

2. What is the most realistic form of pictorial drawings?

3. Can perspective drawings be used as production drawings? Explain the reason for your answer.

4. What are the two most common types of perspective drawings? And what is their relationship with other types of pictorial drawings such as isometric and oblique drawings? Explain the way they are drawn.

5. What are three types of oblique drawings? Explain the way they are drawn.

6. Sketch a cube in isometric, cavalier oblique, and two-point perspective:

Isometric Cavalier oblique Two-point perspective

7. Are all lines in isometric drawings drawn at true length? Please explain in detail.

8. What is the magic key for drawing isometric ellipse in AutoCAD 2000? And how to use it? Practice drawing in isometric in AutoCAD 2000.

9. Practice drawing isometric arcs and dimensioning.