ME 113
Computer Aided Engineering Drawing

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Pictorial Drawing

- In order to represent 3D view of an object pictorial drawings can be used.
- Drawing 3-D object on 2-D plane (paper/screen/board)
- Types of pictorial drawings that are commonly used:

  - Perspective
  - Isometric
  - Oblique
Pictorial Drawing

- **Perspective** pictorial sketches are based on perspective projection rules.
- In **isometric** sketches, three orthogonal axes are placed on the projection plane such that there is $120^\circ$ angle in between.
- In **oblique** sketches, three orthogonal axes are placed on the projection plane such that two of them are horizontally and vertically placed, while the third one is placed in between by $45^\circ$ offset.
Perspective is the only technique that does not use parallel lines of sight.
Pictorial Projection

A type of technical illustration that shows several faces of an object at once.

Axonometric Projection

An axonometric view is created by rotating the object about one or more axes.
Classification of Projections

Projections

Perspective Projections
- One-point perspective
- Two-point perspective
- Three-point perspective

Parallel Projections
- Orthographic Projections

Oblique Projections

Axonometric Projections
- Isometric Projections
- Dimetric Projections
- Trimetric Projections

Multiview Projections
Axonometric Projection

Axon – axis
Metric - measure

Angles that determine the type of axonometric drawing produced:

**TRIMETRIC**
No equal angles
No equal corners

**DIMETRIC**
Angles A and C are equal
Corners MY and MX are equal in length

**ISOMETRIC**
Angles A, B, and C are equal
Corners MZ, MY, and MX are equal in length
An axonograph of a part, showing some of the views that can be created by rotating about two of the axes.
Isometric Projection

The object is rotated 45 degrees about one axis and 35 degrees 16 minutes on another axis.
The different scales of an isometric projection and an isometric drawing.
The different scales of an isometric projection and an isometric drawing
Isometric Projection

Theory of Isometric Projection

(A) Regular isometric

(B) Reversed axis isometric

(C) Long axis isometric

(D) Long axis isometric

Positions of isometric axes and their effect on the view created
Isometric Drawing

- 3 axes
  - 1 vertical
  - 2 inclined 30° wrt to horizontal

- Lines parallel to axes are true length
  - Used to establish scale

Not true length
Isometric Drawing

- Isometric drawing is one of the most common pictorial drawing today. An isometric drawing is begun by drawing three axes 120° apart. Lines parallel to these axes are called isometric lines.
- To draw an isometric pictorial, select from drafting settings dialog box “isometric snap”.

![Isometric lines diagram](image-url)
Isometric Drawing

- In isometric drawing, true-length distances can ONLY be measured along isometric lines, that is, lines that run parallel to any of the isometric axes.

- Any line that does NOT run parallel to an isometric axis is called a non-isometric line.

- Non-isometric lines include inclined and oblique lines and cannot be measured directly. Instead they must be created by locating two endpoints.
Isometric Drawing

- The three faces of the isometric cube are isometric planes, because they are parallel to the isometric surfaces formed by any two adjacent isometric axes.
- Planes that are not parallel to any isometric plane are called non-isometric planes.
A cube, sphere, pyramid and cylinder in isometric projection. Black labels denote dimensions of the 3D object, while red labels denote dimensions of the 2D projection.

http://commons.wikimedia.org/wiki/File:3D_shapes_in_isometric_projection.png
Isometric View Illusions

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Isometric View Illusions
Isometric View Illusions

Thanks to www.utefans.net
Isometric drawing is basically pictorially sketching the object whose multi-views are projected on isometric planes.

In AutoCAD, before starting isometric sketching one has to set “isometric snap” on from “drafting setting” dialog box.
Isometric Grid
Constructing an Isometric View

Consider the figure below.

First, construct the front view on the front isometric plane according to given dimensions (You can toggle between isometric planes in AutoCAD by pressing F5 button at anytime.).
Then, copy the front view along the axis perpendicular to the front isometric plane at a given distance in order to define the depth.
Lastly, connect the corner points and delete / trim the invisible entities to construct the isometric view.

Please note that the red lines are used just to represent the front isometric plane. It should be deleted obviously.
Constructing an Isometric View

- **Common standards:**
  - **Hidden lines:** Hidden lines are omitted unless they are absolutely necessary to completely describe the object. Most isometric drawing will not have hidden lines. An example of isometric drawing with hidden lines is shown in the figure.
Common standards:

- **Center lines**: They are drawn only for showing axisymmetry or for dimensioning. Dimension lines, extension lines, and lines being dimensioned shall lie in the same plane as shown in the Figure.
ANSI Standard unidirectional isometric dimensioning
Aligned isometric dimensioning used for illustrations
Isometric Pictorial Sketching

The basic steps used to create an isometric sketch of an object:

Step 1: Isometric axis

Step 2: Width and Depth

Step 3: Front face

Step 4: Top + side faces

Step 5: Intersections

Step 6: Additional structures

Step 7: Final sketch
A special case: Isocircle

- In an isometric drawing, circular features appear as ellipses. The orientation of the ellipse is set according to the face on which the circle lies as shown in the figure.
Sketching an Isocircle

- The steps used to create a sketch of an isometric ellipse begin with constructing an isometric box whose sides are equal to the diameter of the circle.
- The center of the box and the midpoints of the sides are found.
- Arcs are drawn to create the ellipse.
When the Isometric snap is on, the Ellipse command will display an Isocircle option. The Isocircle option is in the Axis, End selection. After selecting the Axis, End option, look down at the command line. The command line will list the options in brackets [Arc/Center/Isocircle]. Type I and press the Enter key to select Isocircle option.

Press F5 to change the ellipse alignment before you select diameter of the isocircle.
Sketching an Isometric Cylinder

Step 1
Sketch Bounding Box

Step 2
Sketch End of Cylinder

Step 3
Sketch Far End of Cylinder

Step 4
Sketch Sides of Cylinder

Step 5
Complete the Sketch
Sketching SemiEllipses

Step 1
Sketch Isometric Square

Step 2
Sketch Second Arc

Step 3
Complete the Sketch
Isometric Sketching of Common Objects

Trackball
Stapler
Screwdriver
Cassette Tape
Constructing an isometric sketch having an oblique surface

**Step 1** – Determine proper view and sketch isometric axes.

**Step 2** – Construct front isometric plane using W and H dimensions.

**Step 3** – Construct top isometric plane using W and D dimensions.

**Step 4** – Construct right side isometric plane using W and D dimensions.

**Step 5** – Locate slot across top plane by measuring distances E, F, and G along isometric axes.

**Step 6** – Locate endpoints of the oblique plane in top plane by locating distances A,B,C, and D along lines.
Constructing angles in isometric sketch

Step 1

Step 2

Step 3

Step 4
Isometric Drawing

3-D Model Isometric Assembly Drawing

(Courtesy of Alventive, Inc.)
Exploded Isometric Assembly Drawing and Parts List

(Courtesy of Alvenive, Inc.)
Oblique Projection

Typical Furniture Industry Oblique Drawing
Oblique Projection

Orthographic Projection

(A)

(B)
Types of Oblique Drawings

- Cavalier oblique
- Cabinet oblique
- General oblique

FULL SCALE
FULL SCALE
FULL SCALE

HALF SCALE
HALF SCALE
FULL SCALE

DRAW AT 45°
DRAW AT 45°
DRAW AT 45°
Receeding Axis Angles

An object can be drawn with a variety of angles, to emphasize different features.
Place holes and arcs parallel to the frontal plane whenever possible to avoid distortion and to minimize having to draw circles as ellipses.
Long Distance Orientation

Place longest dimension of the object parallel to the frontal plane to avoid distortion.
Oblique Drawings

Cylinder rule overrides the longest-dimension rule when creating an oblique drawing.
Oblique Drawings

Isometric versus Oblique Sketches

In oblique sketching, the front face of the object (showing the height and width dimensions) is squared with the paper, and the depth dimension is drawn at an angle to the horizontal. This is different from an isometric sketch, where no faces are squared with the paper.
Oblique Sketching

The construction of an oblique sketch is a multistep process that begins by boxing in the front view, adding details, and then boxing in the depth dimension.
Perspective Projection

Pictorial drawings used to represent 3-D forms on 2-D media.

Convergence as seen in a photograph

This photograph shows parallel railroad lines receding to a point on the horizon

(Courtesy of Anna Anderson.)
Perspective Projection

Da Vinci sketch drawn in perspective

(By permission of Art Resource, NY.)
Perspective and Orthographic Profile Views of a Scene

This photograph shows parallel railroad lines receding to a point on the horizon.
Changing the object’s position relative to the picture plane determines the size of the object drawn.
Perspective Projection

Vanishing Point Position

Changing the Vanishing Point changes the perspective view.
Trace the photograph onto tracing paper to determine the vanishing point.
Ground Line Position

Changing the ground line relative to the horizon line changes the perspective view created.
Classification of Perspective Drawings

One-point perspective

Two-point perspective

Three-point perspective
Classification of Perspective Drawings

A CAD 3-D Model Displayed in Perspective View

Rendered Perspective Illustration of a CAD 3-D Model
Classification of Perspective Drawings

Creating a One-Point Perspective Sketch
Construct the isometric view of the object shown below.
Isometric Drawing Exercise 7_2
Isometric Drawing Exercise 7_3

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Isometric Drawing Exercise 7_4
Isometric Drawing Exercise 7_5

Figure 1

Figure 2

Figure 3

Figure 4
Isometric Drawing Exercise 7_6
Isometric Drawing Exercise 7_7
Isometric Drawing Exercise 7_9

(A)  
(B)  
(C)  
(D)  
(E)  

15  15  
10  10  
10  10  
2xØ10
Isometric Drawing Exercise 7_10
Isometric Drawing Exercise 7_11
Isometric Drawing Exercise 7_13
Isometric Drawing Exercise 7_14

Dimensions:
- 70 mm
- 50 mm
- 30 mm
- 30 mm
- 10 mm
- 100 mm
- 25 mm
- 60 mm
- 2XØ30

Notations:
- 2XØ30
- 30 mm
- 10 mm
- 10 mm
- 10 mm

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Isometric Drawing Exercise 7_15

[Diagram of an isometric drawing showing dimensions and features like 4XØ20, 4XR20, 2XØ20, and 2XR20.]
Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_17

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_18

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_19

Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_21

Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
Construct the isometric view from the...
Isometric Drawing Exercise 7_24

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_25

Construct the isometric view from the multiview.
Construct the isometric view of the object shown below.
Isometric Drawing Exercise 7_27

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_28

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_29

Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
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Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_34

Construct the isometric view from the multiview.
Isometric Drawing Exercise 7_35

Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
Construct the isometric view from the multiview.
Create isometric drawings of the objects directly or through solid drawing.
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Create isometric drawings of the objects directly or through solid drawing.
Problem 5.7 (Figure 5.130) Motor Plate

Create isometric drawings of the objects directly or through solid drawing.
Problem 5.7 (Figure 5.142) Bearing Block

Create isometric drawings of the objects directly or through solid drawing.
Problem 5.7 (Figure 5.154) Bearing Plate

Create isometric drawings of the objects directly or through solid drawing.
Problem 6.3 (Figure 6.23) Spindle Base

Create isometric drawings of the objects through solid drawing.
Problem 6.3 (Figure 6.28) Cylinder Stop

Create isometric drawings of the objects through solid drawing.
Practice Problem 7.3

Sketch a one-point perspective of the object on the grid.
Problem 7.1 (Figure 7.60 (6))

Construct the isometric view from the multiview.
Problem 7.1 (Figure 7.60 (6))

Construct the isometric view from the multiview.

(7) 

(8) 

(9) 

(10) 

(11) 

(12)
Construct the isometric view from the multiview.
Problem 7.8 (Figure 7.62)

Create one-point perspective drawing of the object.
Classic Problem 3 - Bracket

Create either isometric, oblique, or pictorial drawings of the object.
<table>
<thead>
<tr>
<th>English</th>
<th>Turkish</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>isometric</strong></td>
<td><strong>Eş ölçülü</strong></td>
</tr>
<tr>
<td><strong>projection</strong></td>
<td><strong>izdüşüm</strong></td>
</tr>
<tr>
<td><strong>Oblique projection</strong></td>
<td><strong>Eğik izdüşüm</strong></td>
</tr>
<tr>
<td><strong>axonometric</strong></td>
<td><strong>Eksen ölçülü</strong></td>
</tr>
<tr>
<td><strong>illusion</strong></td>
<td><strong>İllüzyon, görüntü yanılış</strong></td>
</tr>
<tr>
<td><strong>pictorial</strong></td>
<td><strong>resimli</strong></td>
</tr>
<tr>
<td><strong>Plane of projection</strong></td>
<td><strong>İzdüşüm düzlemi</strong></td>
</tr>
<tr>
<td><strong>Parallel projection</strong></td>
<td><strong>Paralel izdüşüm</strong></td>
</tr>
<tr>
<td><strong>snap</strong></td>
<td><strong>Şipşak yaslama</strong></td>
</tr>
<tr>
<td><strong>Multiview projection</strong></td>
<td><strong>Çok görünüşlü izdüşüm</strong></td>
</tr>
<tr>
<td><strong>Line of sight</strong></td>
<td><strong>Görüş hattı</strong></td>
</tr>
<tr>
<td><strong>orthographic projection</strong></td>
<td><strong>Ortografik (dik çizgisel) izdüşüm</strong></td>
</tr>
</tbody>
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