

Applications in Technical Drawing

Objectives:

- To use drawing aids in orthographic projection.
- To recognise the use of construction line in orthographic projection.
- To locate points using OSNAP and OTRACK.
- To define isoplanes and isocircles.
- To present objects in the form of orthographic projection and isometric drawing.






Subject Matters:

Orthographic projection

Orthographic projection is the most common form of projection in engineering drawing. When drawing using orthographic projection, the aim should be to describe fully and completely the object being drawn in as few views as possible. It is also important to maintain accuracy and to ensure that a full understanding of the meaning of the drawing is not sacrificed.

With the use of AutoCAD, drawings with precise geometry can be created without performing tedious calculations. Precise points can often be specified without knowing the co-ordinates.

Drawing aids

1. **Snap mode**  and **Grid display**  – These aids are used to restrict the cursor movement and act as a visual guideline in drawing.
2. **Ortho mode**  – To restrict the cursor to the horizontal or vertical axis.
3. **Polar tracking**  – To help drawing objects at specific angles or in specific relationships to other objects.
4. **Object snaps**  – To locate an exact position of an object without having to know the co-ordinate or drawing construction lines.

Use of construction line

Construction lines are lines that extend to infinity in one or both directions. These lines can be used as references for creating other objects.

Calling the construction line command into action:



Draw menu: Construction Line

Command line: `xline`

Options: **Hor/Ver/Ang/Bisect/Offset**

Command sequence:

Command: **XLINE**

Specify a point or [Hor/Ver/Ang/Bisect/Offset]: (**enter H to specify the horizontal option**)

Specify through point: (**click a point on the drawing window**)

Specify through point: **↵(to end)**

Tips: The other options of the **xline** command are outlined as follows:

- **Ver (vertical)** creates a construction line that passes through a specified point and is parallel to the Y-axis of the current UCS.
- **Ang (Angle)** creates a construction line in one of two ways: either select a reference line and then specify the angle of the construction line from that line, or specify an angle to the horizontal axis and then a point through which the construction line should pass.
- **Bisect** creates a construction line that bisects a specified angle. The vertex and the lines that create the angle should be specified.
- **Offset** creates a construction line parallel to a specified baseline. Enter the offset distance, specify the baseline, and then indicate on which side of the baseline to locate the construction line.

A layer is usually created for construction lines and it is turned off when the drawing is completed.

Object snap tracking (OTRACK)

Object snap tracking is a tool which enables drawing objects relative to selected alignment points (osnaps) that acquired from other objects. By default, object snap tracking is set to orthogonal. This tool can be used to quickly draw orthographic views that are perfectly aligned in 2D drawing.

When **OTRACK** (**status bar** button) is turned on, the acquired points display a small plus sign (+), and up to seven tracking points at a time can be acquired. After a point is acquired, horizontal, vertical, or polar alignment paths relative to the point are displayed as the cursor moves over their drawing paths.

Procedure:

- (i) Turn on the **OTRACK** and **OSNAP** buttons (pushed in).
- (ii) Choose a draw tool.
- (iii) Hold crosshairs over an **osnap marker** without clicking on it to acquire the osnap point as an alignment point.
- (iv) Move crosshairs to the desired location and tracking vectors will constrain the next point relative to your alignment points.
- (v) To cancel the acquired alignment point, hold crosshairs over the point again.

Isometric drawing

Tips: The current **OTRACK** status can be toggled at any time (even when commands are running) by: left-click on the **OTRACK** button or press the **F11** function key.

Isometric drawing appears as 3D drawing, in fact, it is true 2D drawing. The drawing involves co-ordinates in only the x and y directions.


Using isometric snap mode

Isometric snap mode helps creating 2D drawings that represent 3D objects.

Setting the isometric snap for creating 2D isometric views by:

 **Tools menu:** Drafting Settings

Shortcut menu: Right-click Snap, Grid, Polar, Osnap, or Otrack on the status bar and choose Settings.

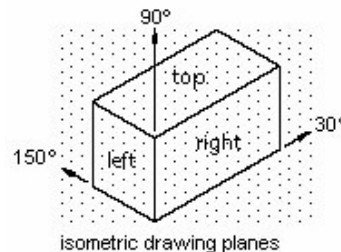
 **Command line:** `dsettings` (or `*dsettings` for transparent use)

Procedure (using shortcut menu):

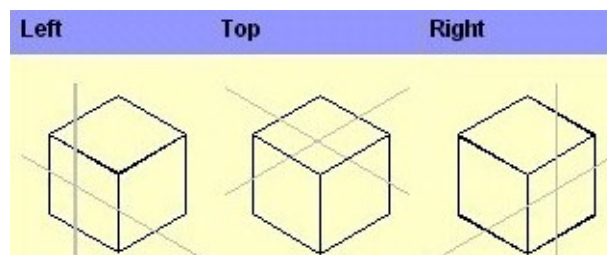
- (i) Right-click **SNAP** on the status bar and choose **Settings...**, the **Snap and Grid** tab of the **Drafting Settings** dialogue box is invoked.
- (ii) Under **Snap type & style**, select **Grip snap** and **Isometric snap** radio buttons.
- (iii) Click **OK** to close the dialogue box.

Isoplanes (Isometric planes)

Isoplanes are planes made up by the three isometric axes. There are three isoplanes: **Left**, **Top** and **Right**.




1. The **Left** isoplane is defined by the 90^0 and 150^0 axis pair.
2. The **Top** isoplane is defined by the 30^0 and 150^0 axis pair.
3. The **Right** isoplane is defined by the 90^0 and 30^0 axis pair.



Choosing one of the three **isoplanes** causes **Ortho** and the crosshairs to be aligned along the corresponding isometric axes.

Specifying the current **isoplane** for drawing:

 **Command line:** **isoplane** (or **'isoplane** for transparent use)

then enter isometric plane setting [**Left/Top/Right**] or press **↵** for the default **<Top>**.

Alternatively, the three isoplanes can be swapped quickly by pressing **F5** or **CTRL+E**.

Isocircles

Isocircles are circles created on **isoplanes**. Before drawing isocircles, set the **Isometric Snap mode** on. The easiest way to draw circles with the correct shape is to use the **Isocircle** option of the **ELLIPSE** command.

Calling the **ELLIPSE** command into action:



Draw menu: Ellipse

 **Command line:** **ellipse**

Command sequence:

Command: **ELLIPSE**

Specify axis endpoint of ellipse or [Arc/Center/Isocircle]: (**enter I to specify the Isocircle option**)

Specify center of isocircle: (**pick a point for the center of the circle**)

Specify radius of isocircle or [Diameter]: (**enter a value for the radius**)

Tips: Select the correct isoplane before drawing the circle.

Drawing hints

Orthographic projection

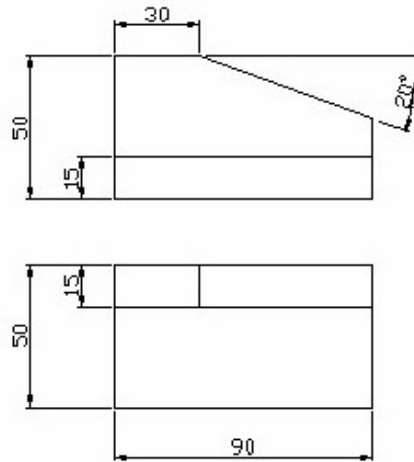
1. For simplicity, use **OTRACK** and **OSNAP** to draw objects of different views.
2. Use drawing aids: **Grid, Snap, Ortho, Polar**, etc. to create objects.
3. Use **Modify** tools to duplicate or resize objects avoiding drawing the same object twice.

Isometric drawing

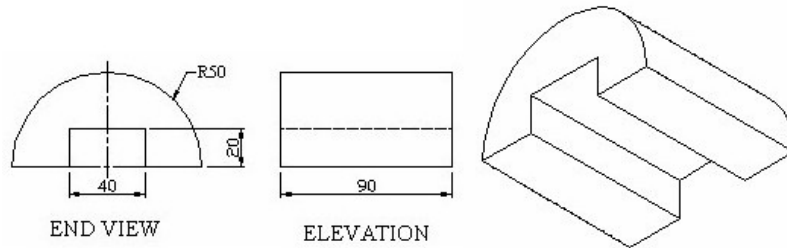
1. Use relative co-ordinates method to specify object co-ordinates.
2. Press **Ctrl+D** (press twice if it does not work) to display angular relative co-ordinates in the Status bar.
3. Press **Ctrl+E** (or **F5**) to swap between the **Left, Top** and **Right** isoplanes.
4. Try using **Break** to cut lines if the use of **Trim** does not work properly. It is because lines in isometric drawing appear to meet at a point are not, in fact, meeting.

Hands on practice

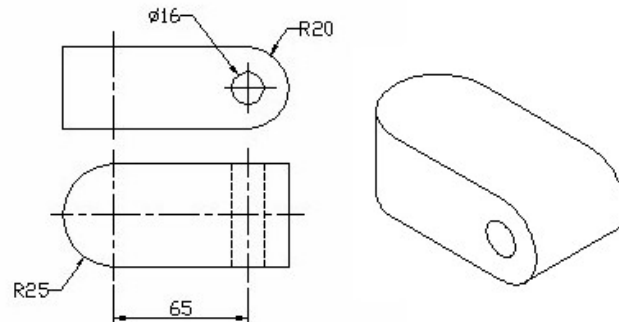
1. Draw the orthographic projection of the object shown below.



2. Draw the orthographic projection of the object and its isometric drawing as shown.

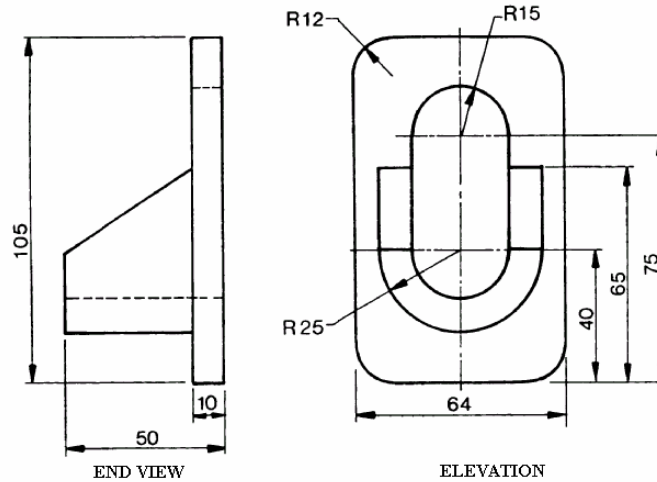


3. The elevation and plan of the object shown below is drawn in First Angle projection. At your discretion in positioning, make an isometric drawing of the object.



For your reference an isometric drawing is also shown viewing from the SW.

4. Draw the given elevation and end view, and project a plan.



Further exercises

Referring to your Engineering Drawing textbook, "Engineering Drawing with CAD Applications by O. Ostrowsky (Edward Arnold)", draw the figures for Questions 26 - 28 shown on Page 85. Do not include any of the dimensions.

(These drawings will be used for dimensioning practice.)