Tutorial 3: Constructive Editing (2D-CAD)

The editing done up to now is not much different from the normal drawing board techniques. This section deals with commands to copy items we have already drawn, to move them and to make multiple copies.

**Moving drawing items**

When an item is drawn correctly but in the wrong place the MOVE command can be used to erase it in its current position and redraw it at whatever location you desire. When the command is picked from the MODIFY pull down menu you are asked to select the object or objects to be moved, the easiest way is to define a window around the items. Then you define a base point, which can be any point on object and finally you define a 'displacement' i.e. the vector which tells AutoCAD how far to move the item. This vector can be entered by picking another location for the base point using the mouse or typing the co-ordinates for the new point.

Example: draw a rectangle on the screen.

From Modify toolbar click on the MOVE icon or type M at the command line.

Command: MOVE
Select objects: pick a point below and to the left of the rectangle
Specify opposite corner: pick a point to enclose all the rectangle
1 found
Select objects: press enter to end object selection
Specify base point or [Displacement] <Displacement>: Click anywhere on the screen
Specify second point or <use first point as displacement>: @0,30

AutoCAD then tells you how many drawing items it has found and proceeds to move them 30 units up from their current position.

If you are not quite sure where you want to move something to it is best to use the Base point option facility when specifying the displacement vector. To do this select the objects as before, then:

Specify base point or [Displacement] <Displacement>: pick an obvious point on the object, say the lower left corner of the rectangle
Specify second point or <use first point as displacement>: pick another point on the screen

The object will then follow the crosshair in the screen until you pick or enter the co-ordinates of the best location.

**Copying drawing elements**

If an item occurs more than once in a drawing you can use the COPY: command so you have to draw it only once. COPY: works exactly the same way as MOVE: except that it does not erase the original objects. The COPY command repeats for convenience. You can create multiple copies by defining displacements or coordinates for each. To exit the command, press ENTER. Try the previous example using COPY: instead of MOVE: and choose your own displacement.
Very often we require drawing elements copied repeatedly and arranged in same order. For example, a plan of the drawing office would consist of a number of rows of desks. The ARRAY: command allows you to make multiple copies of items and arranges them in a regular order, either in a rectangular or a circular array. The following example uses ARRAY to form the spokes of a wheel. In it one spoke is drawn and then a circular array is drawn centred on one end of the spoke. Note that the spokes are rotated as they are copied.

First refresh the screen

Click on the LINE icon

Specify first point: 100,100
Specify next point or [Undo]: 100,200
Specify next point or [Undo]:

Command: ARRAY or click on array icon from Modify toolbar

Select Polar Array

Click on the icon Select objects
Click on the line and press <ret>
Centre point of array: X:100, Y:100
Choose the method as “Total number of items & Angle to fill”
Total number of items is 24
Angle to fill is 360
Click on OK

![Array dialog box](image)
In a rectangular array you need to specify how many rows and columns are in the array and the spacings between them. By selecting objects with the window complex objects can be copied. The following commands copy the spokes drawn above.

Click on the **ARRAY** icon
Select **Rectangular Array**

Pick the icon Select objects
Pick two corners of a window to enclose the spokes
Number of rows: 2
Number of columns: 3
Unit cell or distance between rows: 120 (gives rows above)
Distance between columns: 120 (gives columns to right)
Finally, mirror imaging provides another convenient method of 'copying' items - especially those with axes of symmetry. With symmetrical objects one only needs to draw half and mirror it in its axis of symmetry. With the MIRROR command one specifies the objects to be mirrored and then you give the end co-ordinates of the mirror line. Before the item is mirrored you are asked if you want the old item deleted i.e. the original. The mirror line can only be horizontal or vertical.
To assist you choosing the mirror line the ORTHO mode is temporarily switched on when using MIRROR. First refresh the screen and draw a rectangle near the left side of the screen and turn the ORTHO on.

Click on the MIRROR icon or type MI at the command line.

Select objects: window the rectangle
AutoCAD should prompt as: I found
Select objects: Press ENTER to end the object selection.
Specify first point of mirror line: select point on the bottom right of the rectangle
Specify second point of mirror line: point on the top right of the rectangle
Erase source objects? [Yes/No] <N>: 

Snapping to object

To conclude this session on cursor control we will consider the OSNAP (object snap) facility. Click on Tools on the top of the screen, then Drafting Settings. Select Object snap settings, the Osnap Settings dialogue box appears. Check any one of the boxes that you wish to use eg Endpoint, Midpoint and Intersection. Click on the OK icon. Now draw a line of any length on the screen keeping ortho (F8) on. Click the line icon and move the crosshairs to any point along the line. When you are close to the ends of the line a box appears to show you are snapping to that endpoint. In the middle of the line a triangle appears showing you are snapping to the midpoint of the triangle. Clicking on any one of these points starts a line from the point. Similarly you can draw to the midpoint of a line, perpendicular to a line, to the centre of an arc or circle or tangential to one. The ‘quadrant’ allows you to draw the nearest quadrant point of a circle or arc – these occur at 0 deg, 90 deg, 180 deg, and 270 deg. You can also locate the intersection of two items. OSNAP nearest snaps to the point on a line, circle etc nearest to the last point picked.

Altering the way items are stored by AutoCAD

If you wish to alter the properties of items stored eg change the radius of a circle, height of text or change the layer of an item you do not have to erase it and redraw it. The PROPERTIES command provides this function. For example to change the radius of a circle draw a circle and then:

Click on Modify then Properties or select from Standard toolbar
Click on the icon Select Objects
Click on the circle on the screen.
The properties dialog box now lists the properties of the circle you selected.
Change the radius of the circle to 100. (In the Geometry list)
Move your cursor into the drawing area and press ESC to remove the grips
Close the Properties window

Repeat the same steps to change Colour, Layer, Linetype and Lineweight.
If you have many objects in your drawing and you want to change the characteristics of a specific group you might use the Quick Select option. For example if the circles in your drawing should have been drawn in the Circle layer but you drew them on the Line Layer, to select all the circles on the screen you might choose the Quick Select icon in the Properties Dialog Box and set the object type to Circle and change the layer from the properties dialog box. If you want you can define a smaller object set: i.e all the circles on the screen which have radii less than 50 units.

Lines are stored by AutoCAD as a pair of points i.e the endpoints. If you wish to delete part of the line you have to BREAK it up into two lines. Remember ERASE only deletes whole entities. Similarly BREAK can be used to delete parts of circles and arcs. Example: hatching the lower half of a rectangle:

First refresh the screen:

Draw a rectangle

Modify: Break or click on in the Modify Toolbar

Select object: pick any point on the rectangle

Specify second break point or [First point]: F

Specify first break point: pick top left corner of the rectangle

Specify second break point: pick top right corner of the rectangle
EXERCISE

(POLYLINE, SCALE, COPY, ZOOM, PAN, MOVE, ROTATE, STRETCH)

Start a new drawing
Click on the File menu and then New
Turn the grid on (F7)
Turn the snap on (F9)

From “DRAW” Toolbar, click (LH) on "POLYLINE" icon (This draws a continuous line through several points, rather than a series of lines between pairs of points as above).

Draw a square cross as shown in Figure 2 (If a point is put in the wrong place it can be removed by clicking (LH) on the "Undo" on top of the screen. Repeated clicking on "Undo" steps back through the points. Resume drawing the line by moving cursor to correct point and clicking (LH).

Go the Tools menu and click on Drafting Settings
Check the Endpoint and Intersection boxes
Click on the OK button

Click (LH) on the “MODIFY" menu
Click (LH) on "SCALE"
Move cursor to cross just drawn, and click (LH) on the polyline. (The cross should go dotted).
Click (RH).
Move cursor to centre of cross, and click (LH) to select base point.
Enter scale factor (eg 0.2) from keyboard; press "enter".

Click (LH) on "MODIFY" menu
Click (LH) on "COPY"
Click (LH) on object (cross just scaled). Click (RH).
Command line: Specify base point or [Displacement] <Displacement>: Click (LH) on base point (centre of cross)
Move cursor and note result. Click (LH). Move cursor and click (LH) again. Click (RH) to end operation.

Draw a rectangular grid of crosses (4 x 3), 5 grid squares spacing between base points, by clicking (LH) at each position
Finish by clicking (RH) when 12 crosses are in position
Click (LH) on "MODIFY"
Click (LH) on "ERASE"
Move cursor to original cross, and click (LH) to remove this cross (or any other crosses that are in the wrong place!)

Click (LH) on "VIEW" menu
Click (LH) on "REDRAW" to clean up drawing
Click (LH) on "DRAW"
Click (LH) on "POLYLINE"
Draw box around layout of crosses, 1 square clear of outer edges (draw 3 lines, then click (LH) on "CLOSE" on RH screen menu)
Click (RH) to start new line, and repeat previous process to draw another box one more square out.

Click (LH) on "VIEW" menu
Click (LH) on "ZOOM" and "Window"
Move cursor to one corner of window box; click (LH)
Move cursor to opposite corner of window box; click (LH)
Click (LH) on "VIEW"
Click (LH) on "ZOOM" and “All” to view whole drawing again

Zoom on one corner of layout (ie 4 crosses) using "Zoom window".
Click (LH) on "VIEW" menu
Click (LH) on "PAN"
Click (LH) on Point
Move cursor, and click (LH) near one corner of the screen.
Move cursor, and click (LH) near opposite (diagonal) corner of the screen. Note result.
Click (RH) to repeat “Pan”, and move cursor a short distance between LH clicks.
Zoom to whole drawing as above.

Click (LH) on “MODIFY” menu
Click (LH) on “MOVE”
Click (LH) on one of the crosses. Click (RH)
Move cursor to the middle of the cross selected; click (LH)
Moving the cursor now moves the cross; choose a new position and click (LH)

Click (LH) on "MODIFY" menu
Click (LH) on "ROTATE"
Click (LH) on one of the crosses. Click (RH)
Move cursor to the middle of the cross; click (LH)
Move cursor to rotate the cross round; choose a new orientation and click (LH).
An alternative is to enter the required angle via the keyboard; anti-clockwise angles are positive

Click (LH) on "MODIFY" menu
Click (LH) on "MOVE"
Position rotated cross back where it came from.

More than one object can be moved and rotated at the same time.
Click (LH) on "MODIFY" menu
Click (LH) on "MOVE".
Click (LH) on all objects to be moved. Click (RH)
Move objects as above.

Click (LH) on "MODIFY" menu
Click (LH) on "STRETCH"
Click (LH) box round right side of layout (2 clicks, right to left using the cross window)
Click (RH)
Move cursor to right-hand side of layout;
Click (LH)
Move cursor further right to right-hand side of drawing; click (LH)