

## 3D Modelling in AutoCAD - tutorial exercise

### The screen

#### The graphics area

This is the part of the screen in which the drawing will be created.

#### The command prompt area

This area at the bottom of the screen gives you clues about your next action:-

#### Command:

means that AutoCAD is expecting a new command e.g. line, arc, erase

#### The status line

Located at the very bottom of the screen, indicating current information about your drawing.

The function keys can toggle between the settings.

#### Screen Menu

This can be made to run down the right hand side of the screen, echoing the commands or options of commands chosen from the icons. It also provides the entire range of commands available. Highly recommended for beginners.

#### Object Snaps

An example of a parked toolbar. Snaps help you to find exact points on the drawing.

#### Properties Menu

All elements of the drawing have properties which may be edited at any time from this menu

#### The Keyboard

To Cancel Press **ESCAPE**

**Escape** will also remove the **GRIPS** (the blue squares which appear for simple editing)

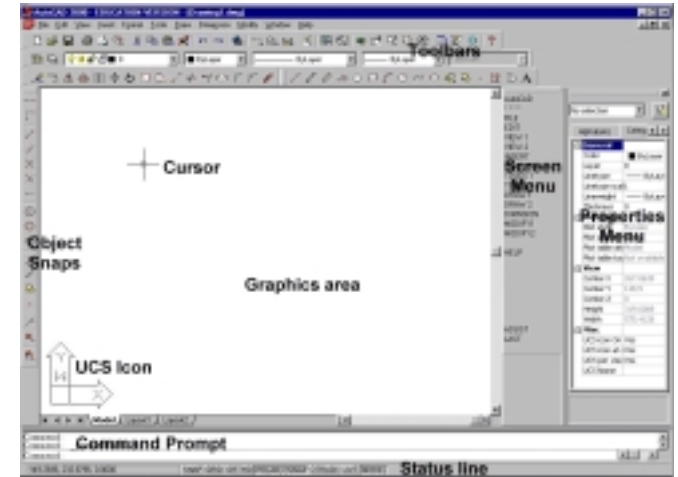
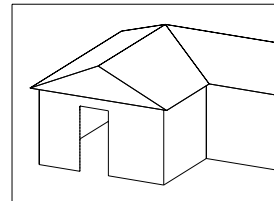
To Undo Press **U** followed by the **Return (or Enter ↵)** key or **Space**

The **Enter key ↵** is used to:

**finish** off commands (e.g. Line)

**accept** "selection sets" for Editing commands or <contents> in <>

**repeat** the last command



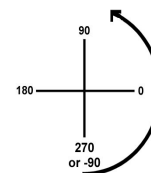
### Function keys

- F1 Help
- F2 Text screen
- F3 Object snap on and off
- F7 Grid on and off
- F8 Ortho on and off
- F9 Snap to grid on and off
- F10 Polar snaps on and off
- F11 Object Snap tracking on and off

### Measurement

Draw real sizes - scale will matter when putting your model onto paper. Think in metres or millimetres depending on what sort of object you are designing.

AutoCAD measures angles (and draws arcs) **anticlockwise**.



# Step by Step Exercise

## Setting up the drawing: Drawing Limits, Zoom All

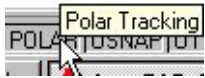
How big is your site or object? Always consider the **real** sizes in metres (or mm or whatever) of the overall site, in plan, measuring width then height. (x,y dimensions). This house is small, we will be thinking in metres, so it should fit into an area of 15mx12m

Pick: **Format, Drawing Limits**

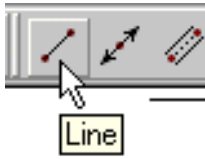
Accept the lower-left limit <0.0000, 0.0000> (Press Enter ↵) then type in 15,12↵ to define a new upper-right limit

Pick: **View, Zoom, All** to stretch to the new limits  
*this has provided you with a drawing area suitable to your project, but it will not stop you extending beyond this area later*

Check your status line. **POLAR** and **OSNAP** should be active



Pick: **Line** then a point near the lower left part of the screen



Move the mouse to the right direction

Type 6↵

6 is the distance in metres

4↵

4↵

From the **drop-down** menus

Pick: **Draw, Arc, Start-End-Angle**

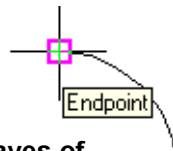
Pick: point to the **endpoint** of the line to begin the arc.

Type @4<90↵ (4 units straight up)

Move the mouse until a full semicircle is displayed, then click again.

Pick: **Line** and snap to the **Endpoint** of the arc.

Complete the figure.



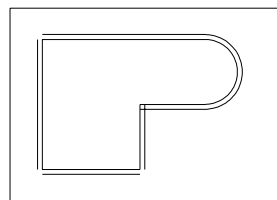
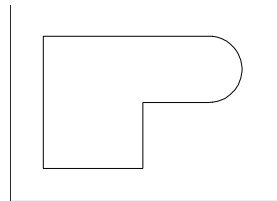
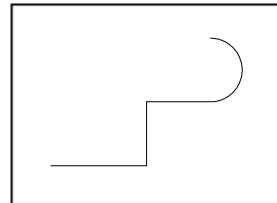
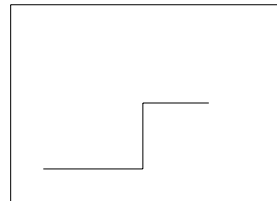
## Offset the eaves (also useful for the leaves of a cavity wall)



Pick: **Offset**

Type .3↵

Point at a line, then point **outside** the figure. Repeat for each line and arc round the figure.



## Fillet the corners

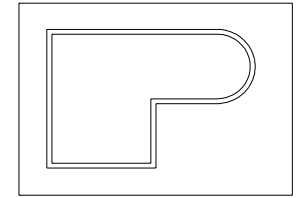
Pick: **Fillet**

Type: **R** ↵ **0** ↵ to set fillet to a sharp point (R=radius)

Pick: **Fillet** again

Point at two lines to make them meet neatly

Press Enter to repeat the Fillet command, and neaten the next pair. Repeat all round



## Offset the Roof ridge

Pick: **Offset**

Type: **3.3** ↵

Point at the left, vertical line, then towards the right

Pick: **Offset**

Type: **2.3** ↵

Point at top, horizontal line, then below it.

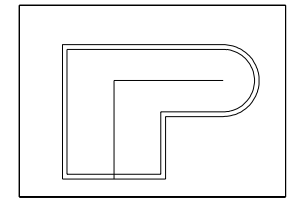
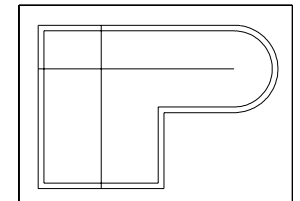
Pick: **Fillet**

Point at the two lines to make them meet at a point.

(Hint - point at the parts you want to **keep**)

Fillet and Offset are two of the most useful commands.

The offset distance can be any size - across a whole site, the depth of the wall cavity.

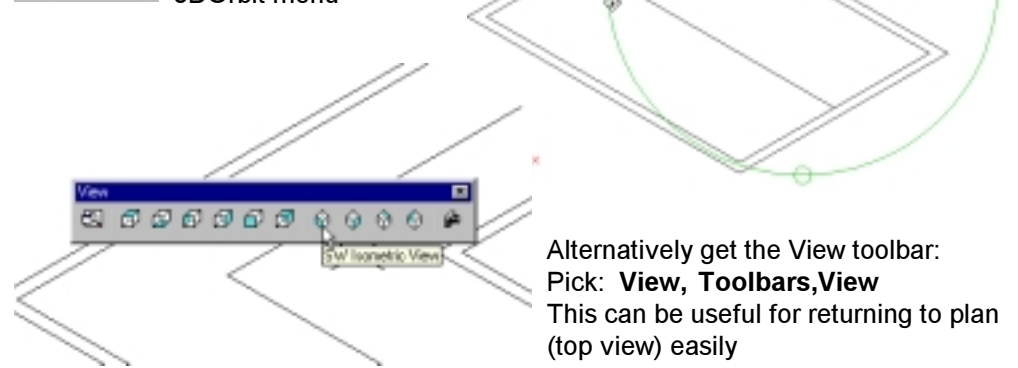


## View in 3D

Pick: **View, 3D Orbit**

Pull the model about using the orbit cursor

Right click with the mouse to see the 3D Orbit menu



Alternatively get the View toolbar:

Pick: **View, Toolbars, View**

This can be useful for returning to plan (top view) easily

## Extrude the plan



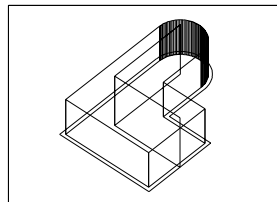
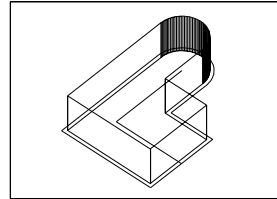
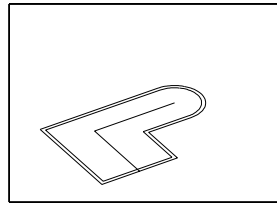
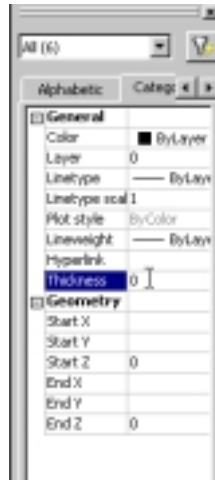
If the properties dialogue box is not yet available as illustrated on page 1, pick **Properties**

Push the box to the side to **park it**

Pick the inner, wall lines and arc so that all the blue GRIPS light up  
Point into the **Thickness** box and type 3.5 ↵

Press Escape twice to release the GRIPS

Pick the roof ridge lines  
Point into **Thickness** box and type 5



## To Erase mistakes (if or when you make some)

Pick: **Erase**



Point at the object(s) or window them (two clicks to frame them, right to left, picks up everything touched or framed)

Press **Enter** ↵ to accept the selection

## Move the eaves up

There are two good ways to use MOVE to do this:



Pick **Move**

Point at and pick all the lines outside the walls

Press Enter ↵

**Then either:**

Point at the **endpoint** of base of the wall (take care)

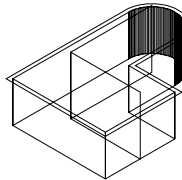
Point at the **endpoint** at the top of the wall

*This is using an object on the screen to reference the distance upwards*

**Or:** having picked the lines etc, pick any point on the model, then

Type: @0,0,3.5

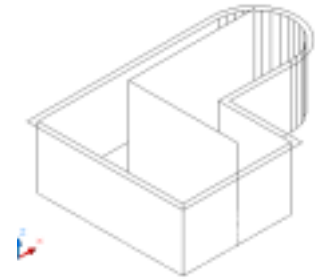
*This uses relative co-ordinates - the same X, the same Y, **new Z** (the distance upwards)*



## Hide the wire-frame

Type **hide** *Repeat this whenever needed*

Pick **View, Shade, 2DWireframe**  
*to return to the wire-frame*



## 3D Faces for the roof

Note that a 3D Face can only be either a quadrilateral or a triangle, nothing else. The command Region can be used for irregular shapes.

Pick: **Draw , Surfaces, 3D Face** from the drop down menu

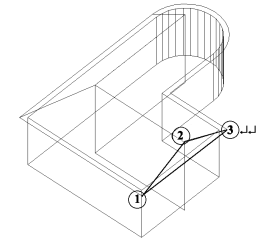
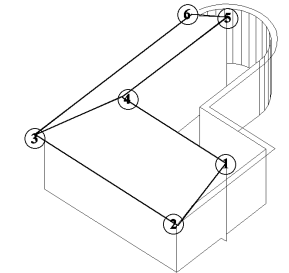


**OR: View, Toolbars, Surfaces, 3D Face**

Point at the four corners of one plane of the roof .

Note that you **do not** return to the first point in order to complete the face; the third and fourth points of one face can become the first and second point of its adjacent face.

Pick three points and then press Enter twice ↵↵ to form a triangle.



## The curved roof

Find a 3D view which shows the curved end clearly

Pick: **Draw, Surfaces, 3DSurfaces, Cone**  
**or pick the icon**

Pick: **Snap to Centre**

Point at the arc raised for the eaves *to give the centre point of the cone's base.*

Pick: **Snap to Endpoint**

Point at the arc again  
*to give the radius of the base*

Press Enter ↵

Pick: **Snap to Endpoint**

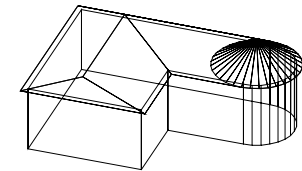
Snap to the apex of the roof

Type 32 ↵

*to accept 0 as the radius of the top*

*to show the height of the cone*

*to increase the number of segments*



## Return to plan to erase half of the cone

Pick: **View, 3D Views, Plan View, World**



Pick: **Explode**

Point at a line on the cone, press Enter  
*this turns the single cone into 32 faces*

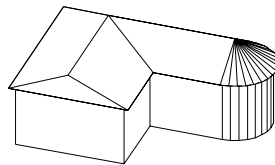
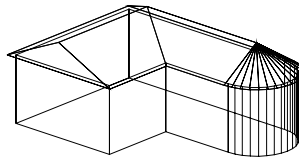
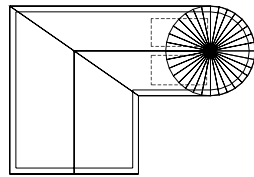
Pick: **Erase**

*this operation may erase extra objects, take care! See Diagram; the dotted line boxes show where to pick moving right to left.*

Point between segments just to the left of the vertical which should remain, but above the line of the roof ridge, and then across **to the left**

Point between segments just to the left of the vertical which should remain, below the roof ridge, and then across **to the left**

Press Enter ↵ Half of the cone should be gone.



## View in 3D again

Pick: **View, 3D Views, SE Isometric**

## Erase the ridge lines

Pick: **Erase**

Point at the two lines

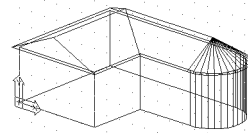
Press Enter ↵

## Define a User Co-ordinate System (UCS)

We want to draw onto a surface of the model, and so we must change the orientation of the drawing co-ordinates

Decide which face you wish to put a door on

Make sure you have Object Snaps active



2D wireframe

3D wireframe



Pick: **Tools, New UCS, 3Point**

Point at:-  
the lower-left point of the face, (the new Origin),  
the lower-right point of the face (new X-direction),  
and then the top-left corner of the face (new Y-direction)

If the UCS Icon is not attached to the face Check the properties box for **UCS icon at origin**

If the UCS Icon is still not attached to the face redefine it (UCS, 3point)

## Draw the Door



Put Ortho On (either press F8 or click the status line button)

Pick: **Line**

Pick: **Snap to Nearest**

Pick a point on the baseline to start the door

Draw up and across freehand but pick **Snap to Perpendicular** to return accurately to the bottom line

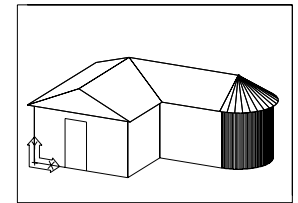
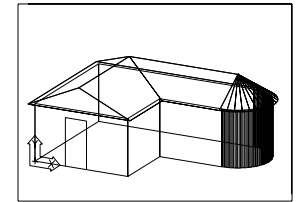
For fun, draw a circle on the face and Thicken it (Properties Box)

Type hide

*Note that you cannot see through the doorway*

Pick

**View, Shade, 2DWireframe** to return to the wireframe



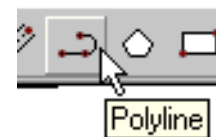
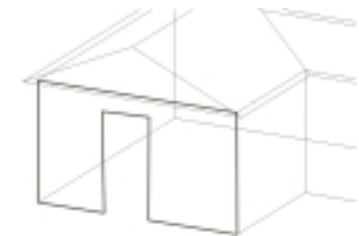
Find a view which shows the face with the door

Put Ortho off

Pick: **Erase**

Point at the face at its lower edge of the wall

Press Enter ↵



Pick: **Polyline**

**Draw round the shape shown**

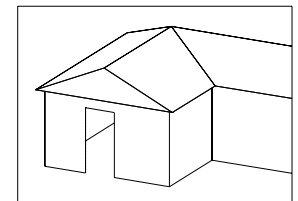
Type **C** ↵ to close



Pick: **Region**

Point at the polyline.

Check with Hide to see the surface



*Note that the views from SE Isometric have been only projections, not true Isometric nor Perspective. 3DOrbit will produce a Perspective with Right Click mouse, Projection, Perspective.*

Return again to the usual (World) drawing plane

Pick: **Tools, New UCS, World**

**Setting up a Layout for 3D modelling**

It is often useful to see more than one view of your model while you are creating it. The minimum would be the views: Plan, Section and 3D view.

**Point to Layout1**



Choose a Plot Device and paper size.



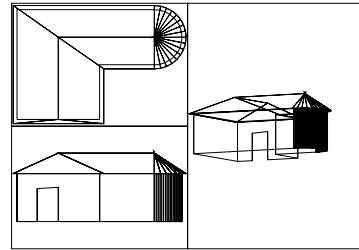
Viewport switching to: Model

**Erase** the frame containing your model. Yes, really! You are only erasing a **viewport**

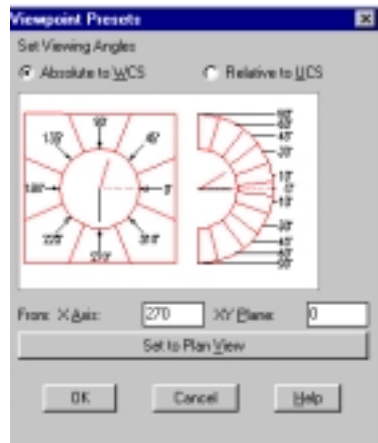
Create more useful viewports.

Pick View, Viewports, 3Viewports

Press Enter twice; the 3 views appear.



Double click on any viewport to activate it. This is called Modelspace. Any drawing or editing will appear in all three viewports. Indeed you can start a line in one, and finish it in another.



To show an Elevation/section:-

Pick View, 3DViews, Viewpoint Presets

Set the figure on the right to zero the pointer on the left should be set to the side you want to view.

**Layouts need not be regular. Single Viewports can be placed as required. Polygonal shaped Viewports can be created. Note the triangular Paperspace icon.**

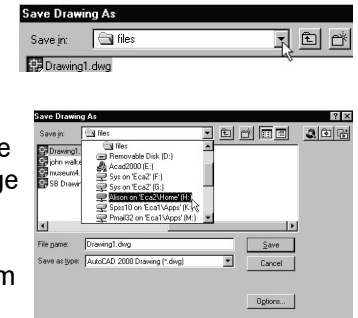


**Saving files**

Save regularly (every hour or so):

Pick: **File, Save (or Save As** if you wish to change the name or drive e.g. H: )

Point at the little arrow and scroll up or down to find the drive, then pick a folder to save you drawing in. Change the name in the File name box if you wish.



There is an automatic save which may rescue you from emergencies. Ask for help before panicking

**Leaving the programme**

Pick: **File, Exit** if you have not **SAVEd** recently it will ask if you wish to save the changes to the drawing

**Shut down the machine before leaving the room - it is vital that you shut down elegantly - the Network works better for us all if everyone logs out neatly.**

**In this exercise you have used the following commands:-**

**Drawing**

- Line
- Arc
- Circle
- 3dFace
- 3Dsurfaces - a cone
- Polyline

**Editing**

- Erase
- Explode
- Move
- Offset
- Fillet
- Region

**Viewing**

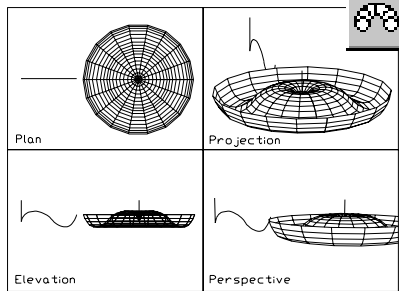
- Zoom
- Viewports
- 3Dviews
- 3dOrbit
- Hide
- Shade

You have also made **Viewports**, and switched between **Modelspace** and **Paperspace**. You have used the Properties box to edit the **Thickness** of lines, arcs and circles.

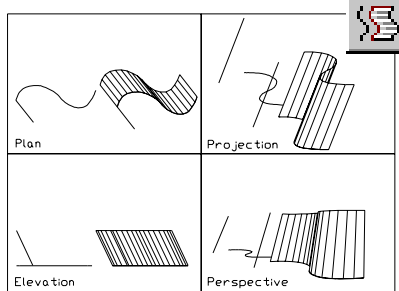
Most importantly, you have learned to change **UCS** so that you can draw in several planes.

**You should be able to model almost anything!**

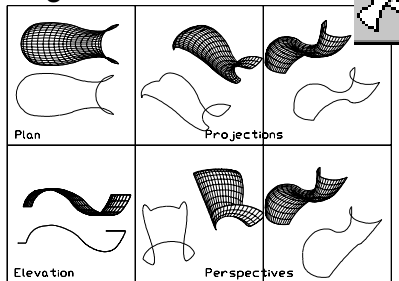
## Revsurf



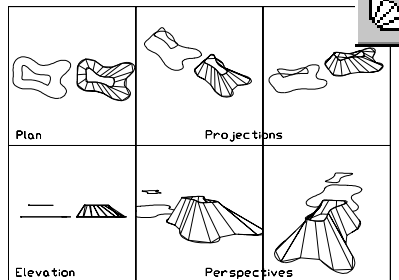
## Tabsurf



## Edgesurf



## Rulesurf



## AutoCAD provides some ways of making interesting surfaces.

They all require 2D or 3D Polylines. Draw the plines, then get the Surfaces Toolbar, or find them in the Draw, Surfaces drop down menu. They are limited by two variables; Surftab1, and Surftab2 which control the number of 3D Faces generated. If the surface you get is wrong, erase it, change the Surftabs and try again.

**Revsurf, or Surface of Revolution** requires one Polyline profile, and an axis round which to rotated the profile. Surftab1 and Surftab2 will affect the number of faces created.(Type Surftab1(or 2) at the Command prompt to give it a new number)

**Tabsurf or Tabulated Surface** extrudes a polyline along the path of a straight line. Surftab1 will be used.

**Edgesurf or Edge Surface** will construct a mesh between 4 3Dpolylines which must meet exactly. Surftab1 and Surftab2 can have a crucial effect Surftab1 affects the first polyline chosen.

**Rulesurf or Ruled Surface** draws a series of 3dfaces between two polylines. Take care in selecting two lines, the surfaces can get twisted. Surftab1 should be set suitably

In all cases a more flexible surface is constructed if the polylines have been smoothed first. Often it works best if the polylines and lines are on a different layer from the mesh.

## Keyboard Shortcuts

Command	Keyboard	Menu (drop-down unless otherwise indicated)
Arc	a	Draw, Arc, <i>various options</i>
Array	array	Modify, Array, <i>rectangular or polar</i>
Circle	c	Draw, Circle, <i>various options</i>
Copy	cp	Modify, Copy
Drawing limits	limits	Format, Drawing limits
Erase	e	Modify, Erase, Select
Exit		Files, Exit
Extend	extend	Modify, Extend
Fillet	fillet	Modify, Fillet
Grid	F7	Tools, Drafting settings, grid
Line	l	Draw, Line
Mirror	mirror	Modify, Mirror
Move	m	Modify, Move
Offset	offset	Modify, Offset
Open		Files, Open
Pan	p	View, Pan
Polyline	pl	Draw, Polyline
Redraw	r	View, Redraw
Save As		Files, Save As
Save	save	Files, Save
Snap	F9	Tools, Drafting settings, snap
Stretch	stretch	Modify, Stretch
Trim	trim	Modify, Trim
Viewpoint (3D view)	vpoint	View, 3Dview
Limits	limits	Format, Drawing limits
Zoom	z	View, Zoom
	d	Dynamic
	p	Previous
	e	Extents
	w	Window
	a	All