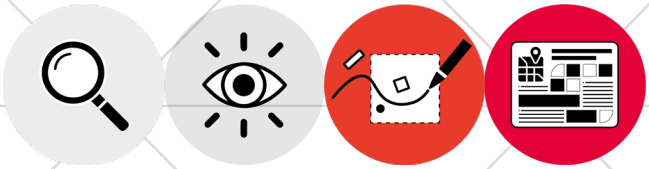
THE BARTLETT SCHOOL OF PLANNING

UCL

Graphic Skills Lab

Handout series

Autodesk AutoCAD



URBAN GRAPHICS SKILLS

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1. Introduction

AutoCAD can be defined as the use of computer systems to assist in the creation, modification, and optimisation of a design. It is most commonly used for creating and modifying 2D & 3D designs for professional drawing with detailed measurement information about the conceptual design and layout.

AutoCAD is developed and marketed by Autodesk, which offers the software for free to students as part of the Education Programme. Visit the following link and follow the instruction to install AutoCAD: https://www.autodesk.com/education/edu-software/overview?sorting=featured&filters=individual

Key skills:

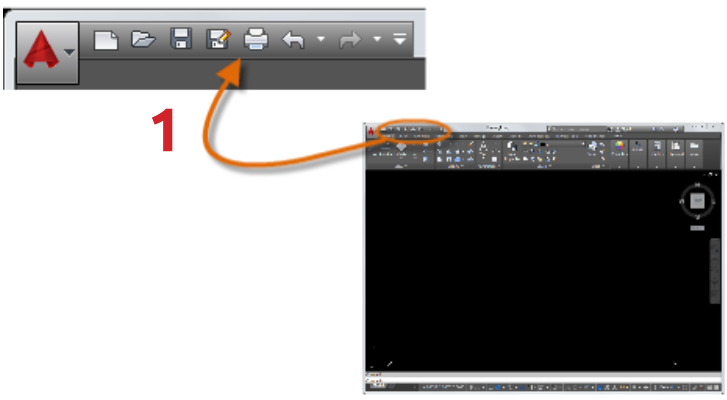
https://all3dp.com/1/autocad-tutorial-for-beginners/

AutoCAD is available for both the Windows and Mac operating systems.

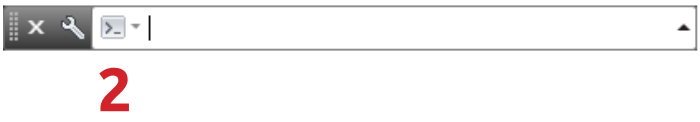
2. AutoCAD basics

After you launch AutoCAD, click the Start Drawing button to begin a new drawing.

AutoCAD includes a standard tabbed ribbon across the top of the drawing area. You can access nearly all the commands presented in this guide from the Home tab. In addition, the **Quick Access toolbar** (1) shown below includes familiar commands such as New, Open, Save, Print, Undo, and so on.

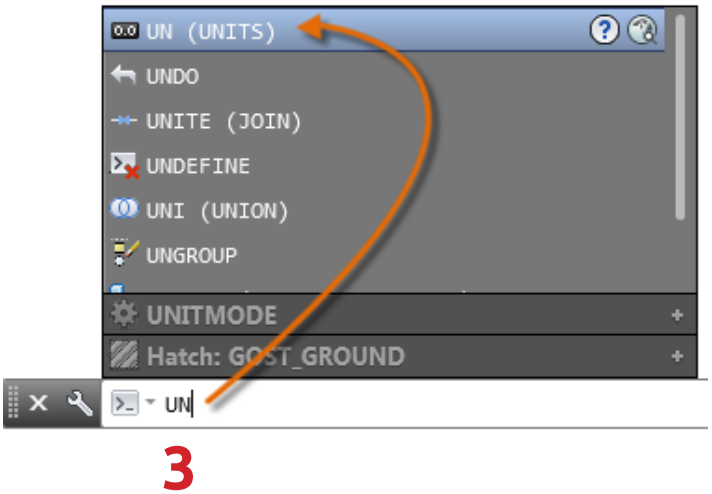


At the heart of AutoCAD is the **Command window** (2) which is normally docked at the bottom of the application window. The Command window displays prompts, options, and messages.



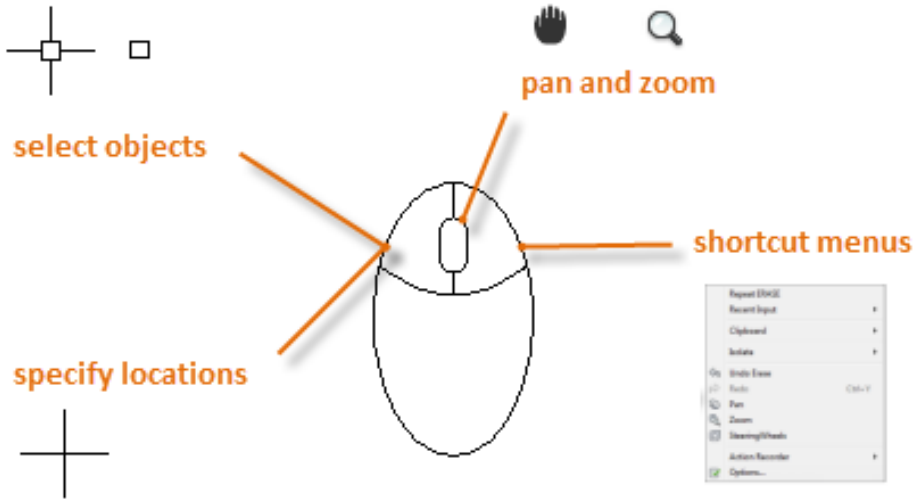
You can enter commands directly in the Command window instead of using the ribbon, toolbars, and menus. Many long-time AutoCAD users prefer this method.

Notice that as you start to type a command, an **auto-complete menu appears**. When several options are available, such as in the example below (3), make your choice by clicking the correct option or using the arrow keys and then pressing Enter or the Spacebar to confirm your selection.



The mouse

The use of the mouse is very important when you work with AutoCAD, as shown below. Most people use a mouse as their pointing device, but other devices have equivalent controls. When looking for a command or option, try right-clicking. Depending on where your cursor is located, different menus will display relevant commands and options.

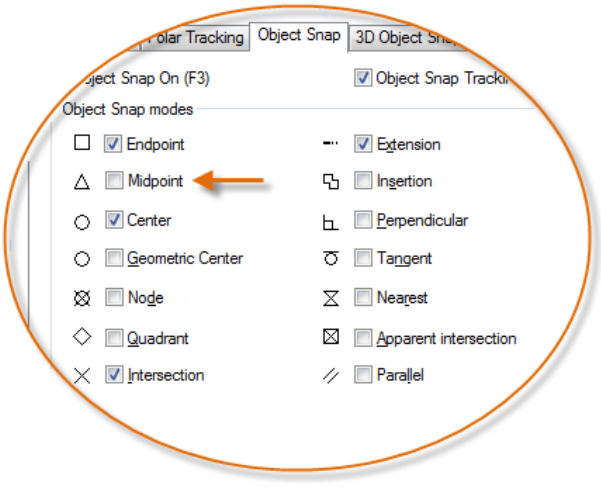


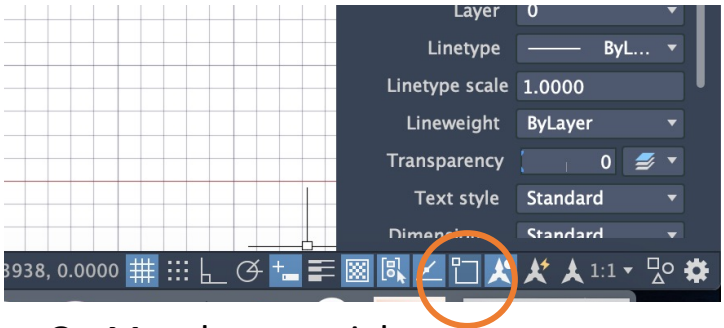
Set Default Object Snaps

Enter the OSNAP command to set the default object snaps, which are also called "running" object snaps. For example, you might find it useful to turn on the Midpoint object snap by default.

Recommendations

- At any prompt for a point, you can specify a single object snap that overrides all other object snap settings. Hold down Shift, right-click in the drawing area, and choose an object snap from the Object Snap menu. Then move the cursor to select a location on an object.
- Make sure that you zoom in close enough to avoid mistakes. In a densely populated model, snapping to the wrong object will result in an error that can propagate throughout your model.





On Mac: bottom right

Precision

Ensure the precision required for your models.

There are several precision features available, including:

- **Polar tracking:** Snap to the closest preset angle and specify a distance along that angle.
- **Locking angles:** Lock to a single, specified angle and specify a distance along that angle.
- **Object snaps:** Snap to precise locations on existing objects, such as an endpoint of a polyline, the midpoint of a line, or the centre point of a circle.
- **Grid snaps:** Snap to increments on a rectangular grid.
- **Coordinate entry:** Specify a location by its Cartesian or polar coordinates, either absolute or relative.

The three most commonly used features are polar tracking, locking angles, and object snaps.

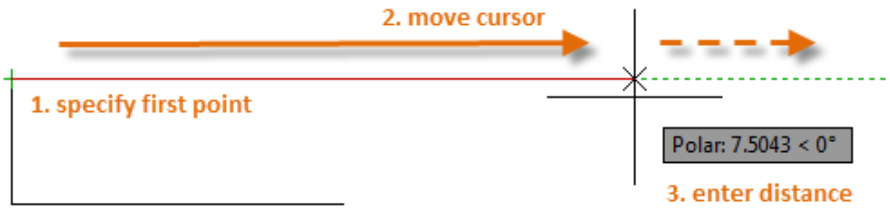
Polar Tracking

When you need to specify a point, such as when you create a line, you can use polar tracking to guide the movement of your cursor in certain directions.

For example, after you specify the first point of the line below, move your cursor to the right, and then enter a distance in the

Command window to specify a precise horizontal length for the line.

** **By default, polar tracking is turned on and guides your cursor in a horizontal or vertical direction (0 or 90 degrees).***



3. Properties

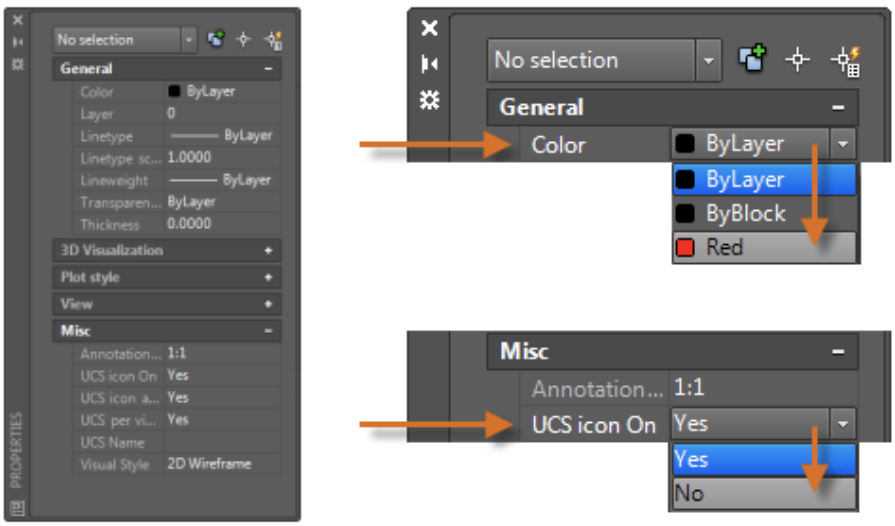
You can assign properties such as colour and linetype to individual objects, or as default properties assigned to layers.

Organize your drawing by assigning objects to layers.

When a drawing becomes visually complex, you can hide objects that you currently do not need to see.

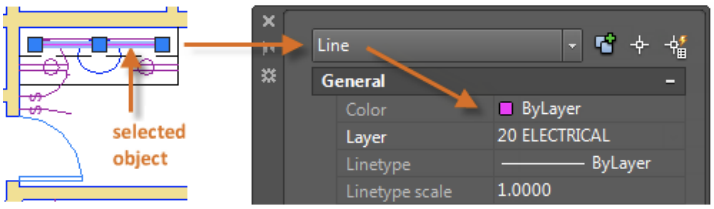
The Properties palette is an essential tool. You can open it with the PROPERTIES command (enter PR in the Command window), you can press Ctrl + 1, or you can click the tiny arrow in the Properties panel on the Home tab—whichever you prefer.

The Properties palette displays a list of all the important property settings. You can click any of the available fields to change the current settings. In the following example, if no objects are selected, the current colour will be changed from ByLayer to Red and the UCS icon will be turned off.



Verify and Change Object Properties

You can use the **Properties palette** to verify and change property settings for selected objects. If you click an object in your drawing to select it, here is what you might see in the **Properties palette.**



Notice that the current properties for the selected object are displayed in the palette. You can change any of these properties by clicking and changing the setting.

A property that is set to "**ByLayer**" inherits its setting from the layer. In the previous example, the objects that were created on the 20 ELECTRICAL layer are purple because that is the default color of the objects on that layer.

If you select several objects, only their common properties are listed in the Properties palette. If you change one of these properties, all the selected objects will change in one operation. Selecting objects is covered in more detail in the Modifying topic.

Quick Access to Property Settings

The Properties palette can take up a lot of space. For quick access to the most common properties, use the Properties panel.

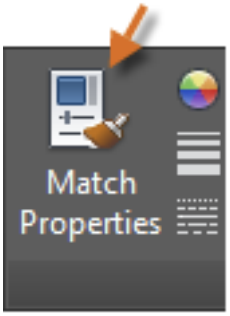
As you can see in this example, the listed properties will all be determined by the current layer.

The Properties panel works the same way as the Properties palette. When you select an object, the current property settings are replaced by the properties assigned to the selected object, and you can use this panel to easily change the properties of one or more selected objects.

Match the Properties of Objects

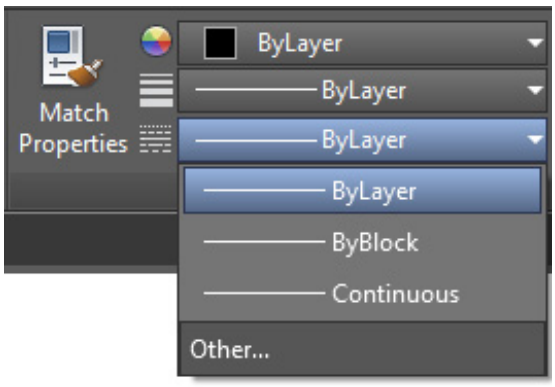
For a fast way to copy the properties of a selected object to other objects, use the Match Properties tool, or enter MATCHPROP or MA in the Command window.

Select the source object, and then select all of the objects that you want to modify.



Linetypes

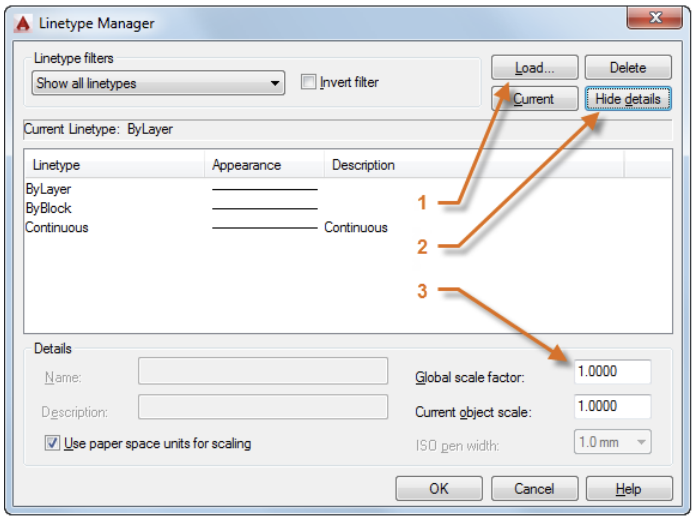
Dashed and other non-continuous linetypes are assigned from the Properties panel. You must first load a linetype before you can assign it. In the **Linetype drop-down list,** click Other.



This action displays the Linetype Manager dialog box.

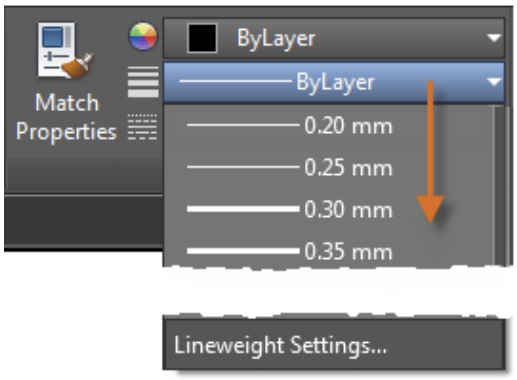
Perform the following steps in order:

1. Click Load. Choose one or more linetypes that you want to use. Notice that dashed (non-continuous) linetypes come in several preset sizes.
2. Click Show/Hide details to display additional settings.
3. Specify a different "global scale factor" for all linetypes—the larger the value, the longer the dashes and spaces. Click OK.
4. Once you've loaded the linetypes that you plan to use, you can select any object and specify a linetype from the Properties panel or the Properties palette. Alternatively, you can specify a default linetype for any layer in the Layer Properties Manager.



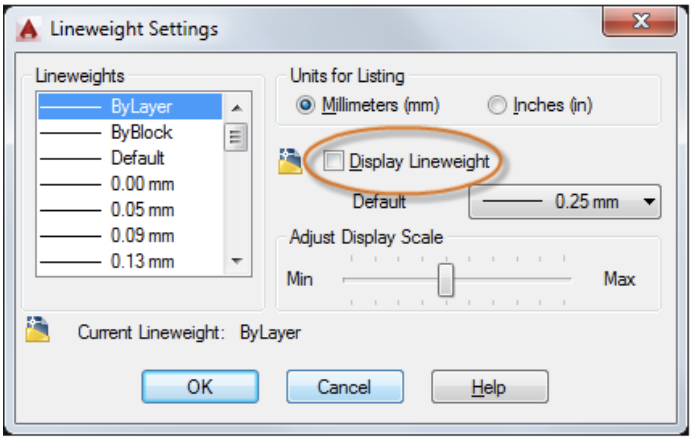
Lineweights

The Lineweight property provides a way to display different thicknesses for selected objects. The thickness of the lines remains constant regardless of the scale of the view. In a layout, lineweights are always displayed and printed in real-world units. Lineweights can also be assigned from the Properties panel.



You can leave the lineweight set to ByLayer, or you can specify a value that overrides the layer's lineweight. In some cases, the lineweight previews look the same because they are displayed in approximated pixel widths on a monitor. However, they will print at the correct thickness.

To control the display of lineweights, click the Lineweight Settings button at the bottom of the lineweight list. In the Lineweight Settings dialog box, you can choose whether you want to display or hide lineweights.



Regardless of the display setting, lineweights will always be printed at the correct scale.

Here's a Tip:

It's usually best to leave lineweights turned off while you work. Heavy lineweights can obscure nearby objects when you use object snaps.

You might want to turn them on for checking purposes just before you print.

4. Geometry

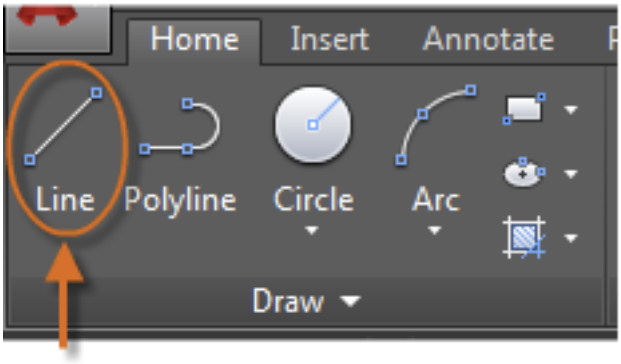
Create basic geometric objects such as lines, circles, and hatched areas.

You can create many different types of geometric objects in AutoCAD, but you only need to know a few of them for most 2D drawings.

NOTE: If you want to simplify the display while creating geometric objects, press F12 to turn off dynamic input.

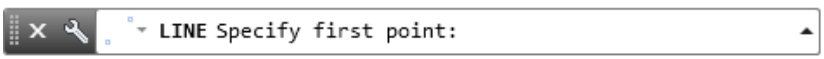
Lines

The line is the most basic and common object in AutoCAD drawings. To draw a line, click the **Line tool.**

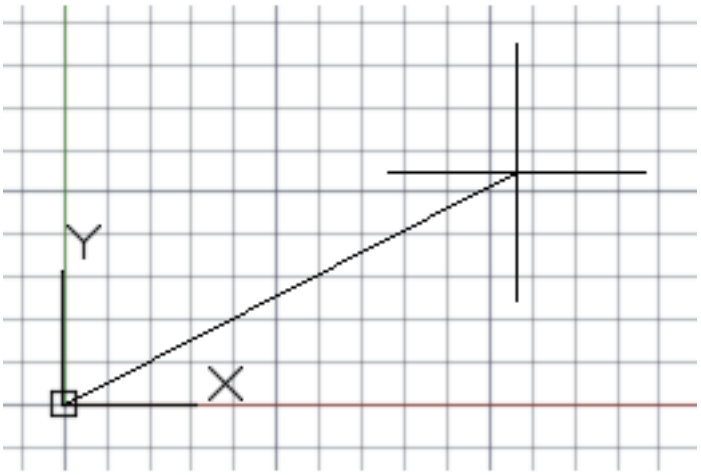


Alternatively, you can type **LINE** or just L in the Command window, and then press Enter or the Spacebar.

Notice the prompt in the Command window for a point location.



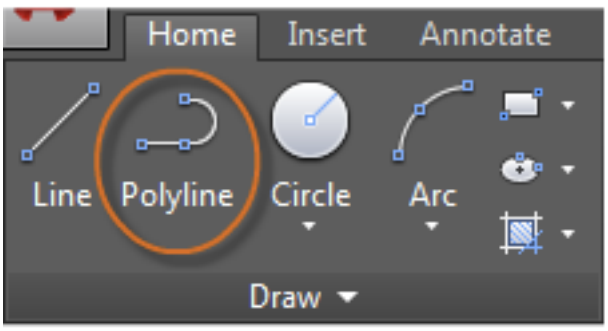
To specify the starting point for this line, you would type in the coordinates 0,0. It is a good idea to locate one corner of your model at 0,0, which is called the **origin point.** To locate additional points, you could specify additional X,Y coordinate locations in the drawing area, however more efficient methods for specifying points are available, and will be presented in the Precision topic.



After you specify the next point, the LINE command automatically repeats itself, and it keeps prompting you for additional points. Press **Enter** or the Spacebar to end the sequence.

Polylines and Rectangles

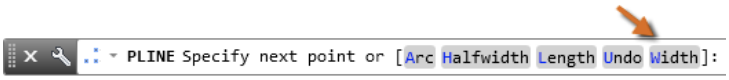
A polyline is a connected sequence of line or arc segments that is created as a single object.



Use the PLINE command to create open or closed polylines for:

- Geometry that requires fixed-width segments
- Continuous paths for which you need to know the total length
- Contour lines for topographic maps and isobaric data
- Wiring diagrams and traces on printed circuit boards
- Process and piping diagrams

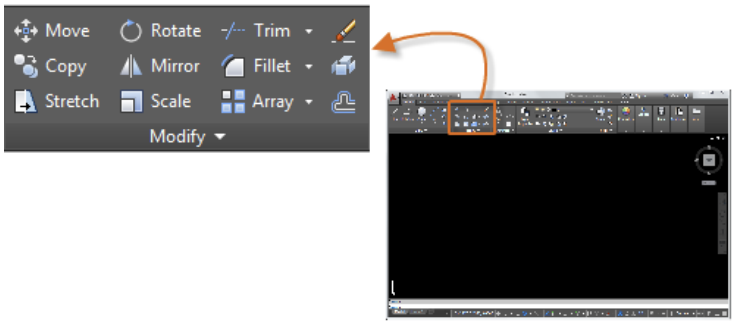
Polylines can have a constant width or they can have different starting and ending widths. After you specify the first point of the polyline, you can use the Width option to specify the width of all subsequently created segments. You can change the width value at any time, even as you create new segments.



5. Modifying

Perform editing operations such as erase, move, and trim on the objects in a drawing.

The most common modifying tools are located on the Modify panel of the Home tab. Take a minute to look through them.



Select Multiple Objects

Sometimes you may need to select a large number of objects. Instead of selecting each object individually, you can select the objects in an area by clicking an empty location (1), moving your cursor right or left, and then clicking a second time (2).

- With a crossing selection, any objects within or touching the green area are selected.
- With a window selection, only the objects completely contained within the blue area are selected.

The result is called the selection set, which is the set of objects that will be processed by a command.

Here's a Tip:

You can easily remove objects from the selection set. For example, if you select 42 objects, and two of them should not have been selected, hold down Shift and then select the two that you want to remove. Then, press

Enter or the Spacebar, or right click to end the selection process.

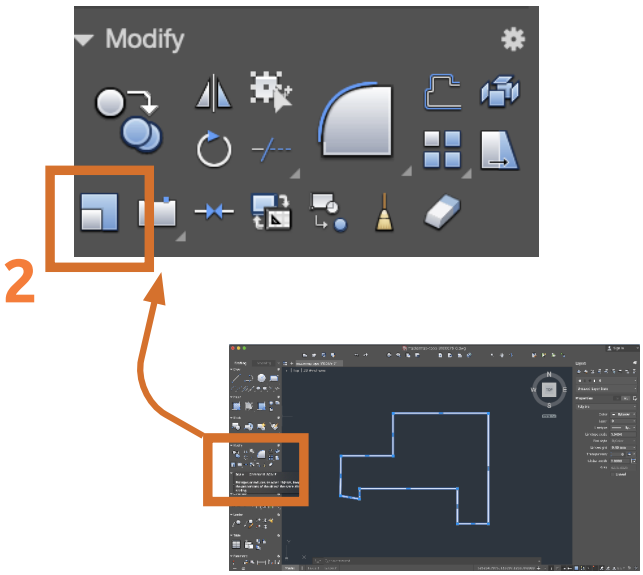
Erase

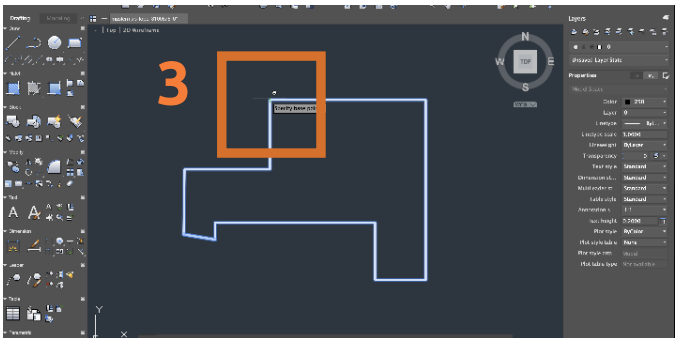
To erase an object, use the **ERASE** command. You can enter **E** in the Command window, or click the Erase tool. When you see the cursor change to a square pickbox, click each object that you want to erase, and then press Enter or the Spacebar.

Scale

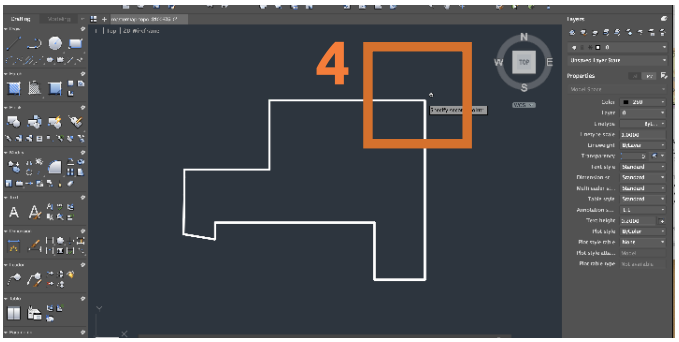
If we know one dimension of our object we can scale it based on that dimension:

1. Select the object you want to scale (you can also select more objects together)
2. Click on the '**scale tool**'
3. Click on the first corner and press R + ENTER





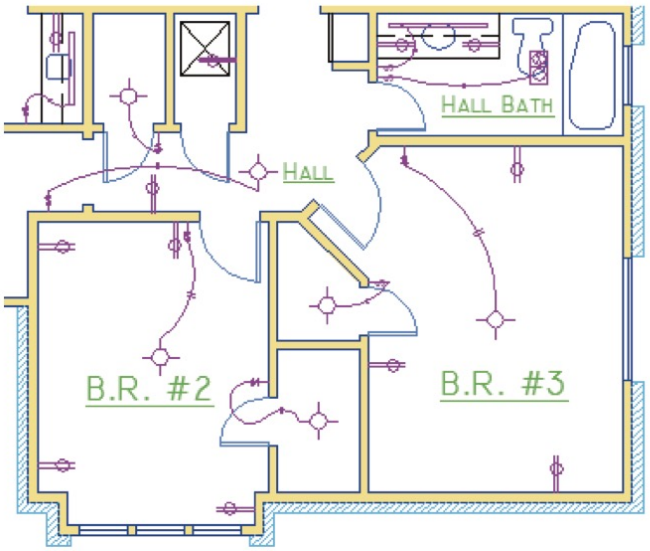
4. Click on the second corner
5. Type the dimension you want the length to be. e.g. 25m and click ENTER



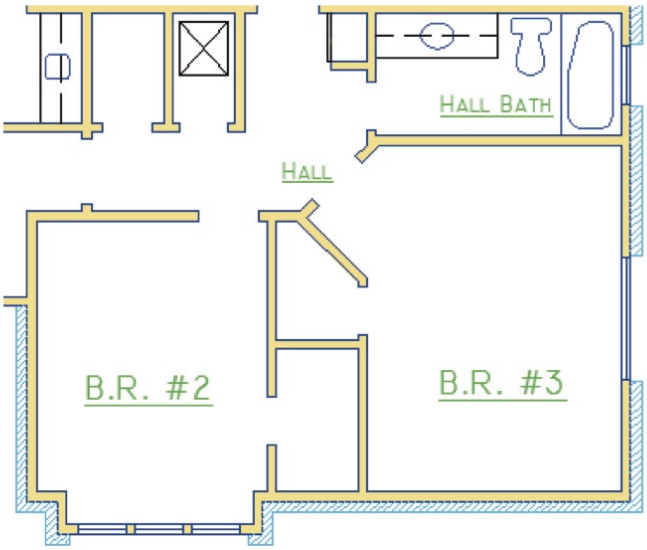
6. Layers

Organize your drawing by assigning objects to layers.

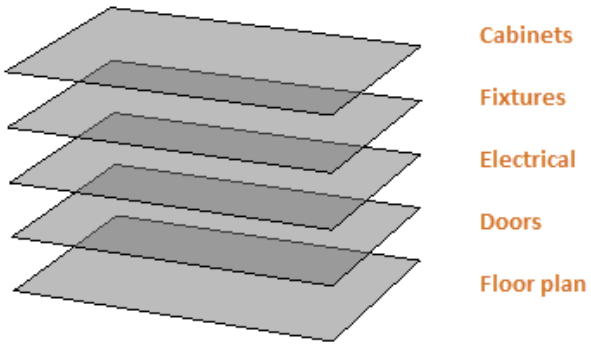
When a drawing becomes visually complex, you can hide objects that you currently do not need to see.



In the drawing below, the doors and electrical wiring were temporarily hidden by hiding their layers.



You gain this level of control by organizing the objects in your drawing on layers that are associated with a specific function or purpose. It might be helpful to think of layers as clear plastic sheets:

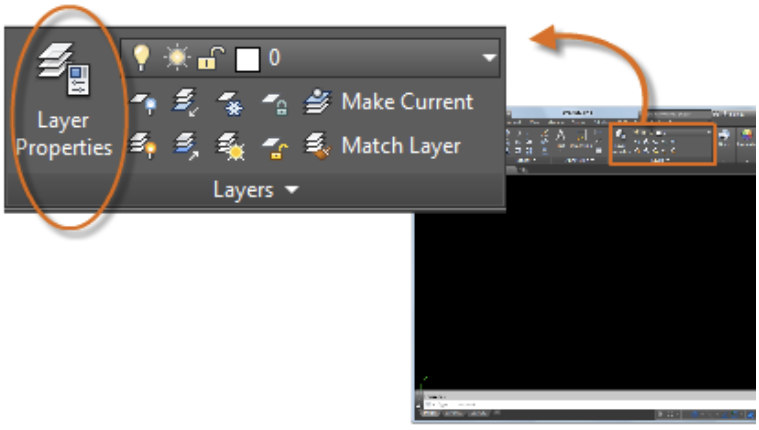


With layers, you can:

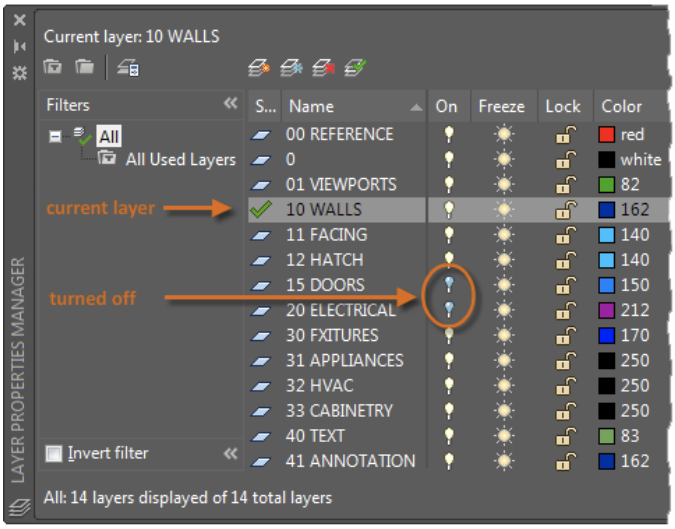
- Associate objects by their function or location.
- Display or hide all objects related to a single operation.
- Enforce linetype, color, and other property standards for each layer.

Layer controls

To see how a drawing is organized, use the LAYER command to open the **Layer Properties Manager.** You can either enter LAYER or LA in the Command window, or you can click the **Layer Properties tool on the ribbon**.



Here's what the Layer Properties Manager displays for this drawing.



As indicated, layer 10 WALLS is the current layer. All new objects are automatically placed on that layer. In the list of layers, the **green** check next to layer 10 WALLS indicates that it is the current layer.

In the column labelled On, notice that the light bulb icons for two layers are dark. This indicates that these layers were **turned off** to hide the doors and electrical wiring in the floor plan.

Notice that each layer name starts with a two-digit number.

This convention makes it easy to control the order of the layers because their order does not depend on the alphabet.

Here's a Tip:

For complex drawings, you might want to consider a more elaborate layer naming standard. For example, layer names could begin with 3 digits followed by a naming code that accommodates multiple floors in a building, project numbers, sets of survey and property data, and so on.

Practical recommendations

- Layer 0 is the default layer that exists in all drawings and has some esoteric properties. Instead of using this layer, it's best to create your own layers with meaningful names.
- Any drawing that contains at least one dimension object automatically includes a reserved layer named **Defpoints**.
- Create a layer for behind-the-scenes construction geometry, reference geometry, and notes that you usually do not need to see or print.
- Create a layer for layout **viewports**. Information about layout viewports is covered in the Layouts topic.
- Create a layer for all hatches and fills. This lets you to turn them all on or off in one action.

Layer settings

The following are the most commonly used layer settings in the **Layer Properties Manager.**

COMMONLY USER LAYER SETTINGS

Turn Off Layers: This will help reduce the visual complexity of your drawing while you work.

Freeze Layers: Freeze layers that you do not need to access for a while. Freezing layers is similar to turning them off, but improves performance in very large drawings.

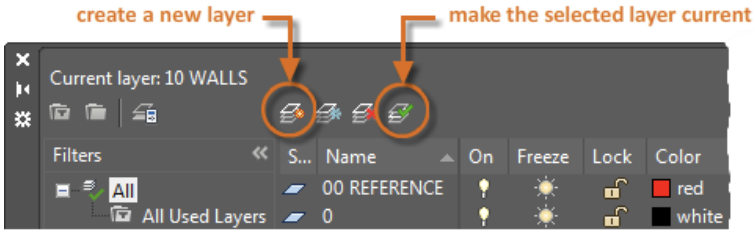
Lock Layers: Locking layers prevents accidental changes to the objects on those layers. Also, the objects on locked layers appear faded, which helps reduce the visual complexity of your drawing.

Set Default Properties: You can set the default properties for each layer, including color, linetype, line weight, and transparency. New objects that you create will use these properties unless you override them. Overriding layer properties is explained later in this topic.

7. Blocks

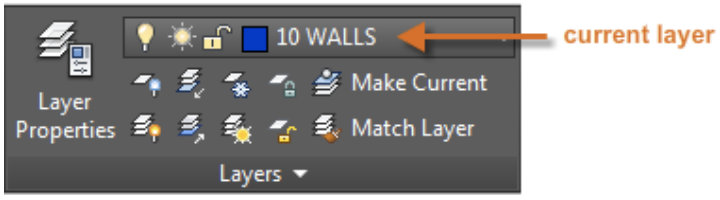
Controls in the Layer Properties Manager

To create a new layer, click the button shown and enter the name of the new layer. To make a different layer the current one, click the layer and then click the indicated button.

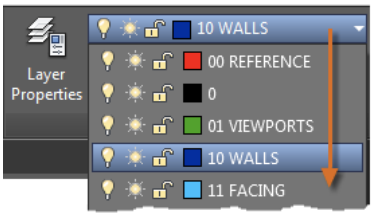


Quick Access to Layer Settings

The Layer Properties Manager takes up a lot of space, and you may not always need to access all the options. For **quick access** to the most common layer controls, use the controls on the ribbon. When no objects are selected, the **Layers panel** on the Home tab displays the name of the current layer as shown here.

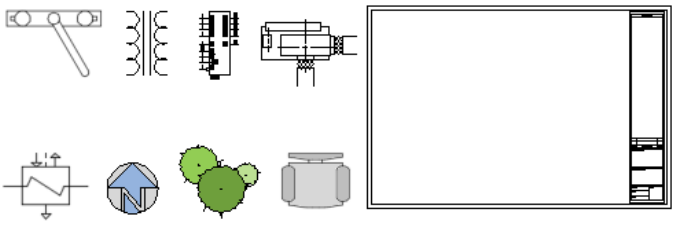


Occasionally, check to make sure that the objects you create will be on the correct layer. It's easy to forget to do this, but it's also easy to set. Click the **drop-down arrow** to display a list of layers. Then click a layer on the list to make it the current layer. You can also click on any **layer setting icon** to change its setting.



Insert symbols and details into your drawings from commercial online sources or from your own designs.

In AutoCAD, a block is a collection of objects that are combined into a single named object. The following are some sample blocks at various scales.



Some of these blocks are realistic representations of objects, some are symbols, and one of them is an architectural title block for a D-size drawing.

Insert a Block

Typically, each of these blocks is an individual drawing file, perhaps saved in a folder with similar drawing files. When you need to insert one into your current drawing file, use the **INSERT** command (or enter I in the Command window).

The first time you insert the drawing as a block, you must click **Browse** to locate the drawing file. Make sure you organize your blocks into easy-to-find folders.

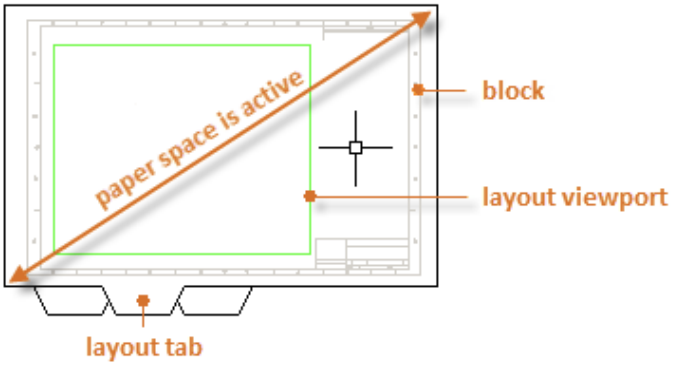
Once inserted, the **block definition** is stored in your current drawing. From then on, you can choose it from the Name dropdown list without needing to click the Browse button.

8. Layout and exporting

Display one or more scaled views of your design on a standard size drawing sheet called a layout.

After you finish creating a model at full size, you can switch to a paper space layout to create scaled views of the model, and to add notes, labels, and dimensions. You can also specify different linetypes and line widths for display in paper space.

Model Space and Paper Space



As you know, you create the geometry of your model in model space.

Originally, this was the only space available in AutoCAD. All notes, labels, dimensions, and the drawing border and title block were also created and scaled in the model space.

After **paper space** was introduced, you could click a layout tab to access a space designed specifically for layouts and scaling.

In the following illustration, paper space is active. There are currently only two objects in paper space: a drawing border block, and a single layout viewport, which displays a view of model space.

Four methods of scaling:

There are four different methods in AutoCAD that are used to scale views, notes, labels, and dimensions. Each method has its advantages depending on how the drawing will be used.

- **The Original Method:** You create geometry, annotate, and print from model space. Dimensions, notes, and labels must all be scaled in reverse. You set the dimension scale to the inverse of the plot scale. With this method, scaling requires a little math. For example, a common scale used in architecture is 1/4" = 1'-0" which is 1:48 scale. If a note is to be printed 1/4" high, then it must be created 48 times as large, or 12" high in model space. The same scale factor also applies to dimensions, and an ARCH D drawing border at that scale is 144 feet long. When the drawing is printed as a D-size sheet, everything scales down to the correct size.
- **The Layout Method:** You create geometry and annotate in model space, and print from the layout. Set the dimension scale to 0 and the dimensions will scale automatically.
- **The Annotative Method:** You create geometry in model space, create annotative dimensions, notes, and labels (using a special annotative style) in model space from the layout, and you print from the layout. Annotative objects display only in layout viewports that share the same scale. The dimension scale is automatically set to 0 and all annotative objects scale automatically.

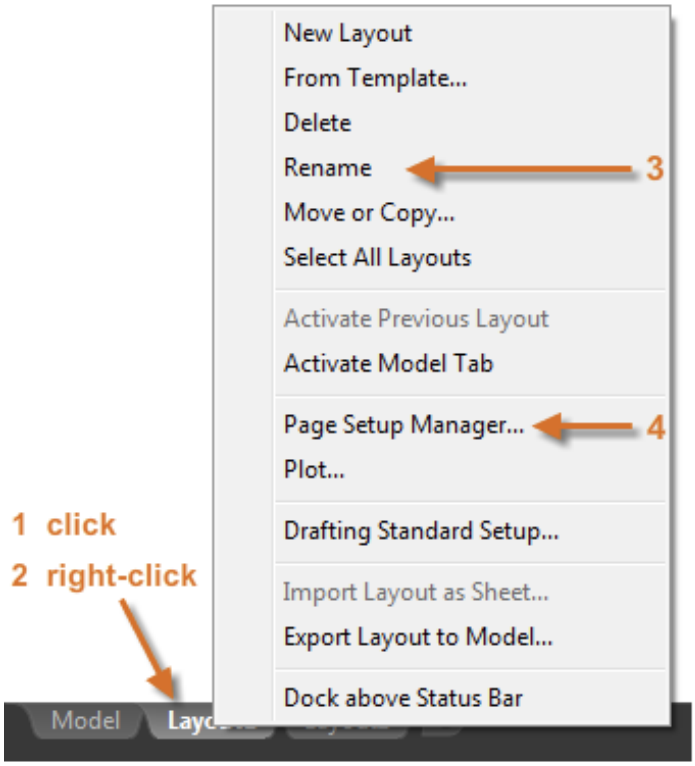
- **The Trans-Spatial Method:** You create geometry in model space, create annotations in paper space on a layout with dimension scale set to 1, and you print from the layout. This is arguably the easiest, most direct method, and it is the method of choice for this guide.

Talk to other AutoCAD users in your discipline about these four methods and why they chose the method that they use.

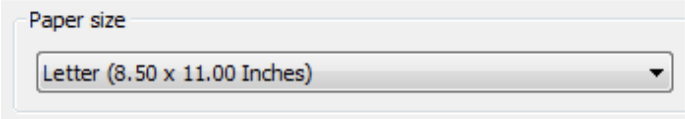
9. Creating a PDF file and exporting with the Window System

Specifying the Paper Size of a Layout:

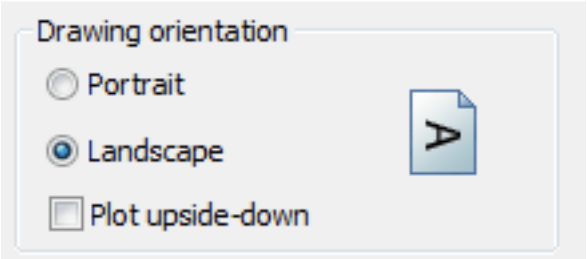
The first thing you should do when you access a layout tab (1) is right-click the tab (2) and rename it (3) to something more specific than Layout 1. For a D-size layout, ARCH D or ANSI D might be good choices.



Next, open the Page Setup Manager (4) to change the paper size displayed in the layout tab.



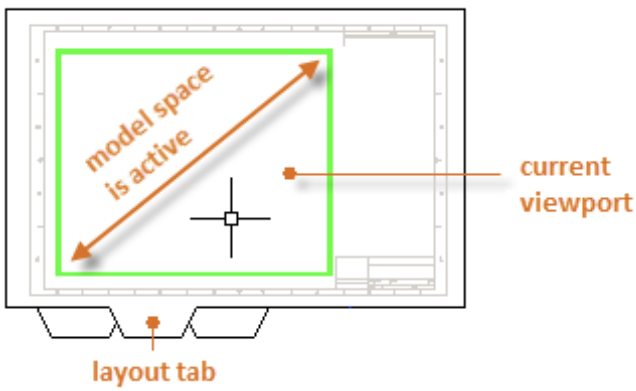
NOTE: You might be wondering why there are two entries in the list for every sheet size. This is because some printers and plotters do not recognize the drawing orientation setting.



Layout Viewports

In a layout, when model space is active, you can pan and zoom, and anything else that you could do on the Model tab. For example, let's say that you created a backyard deck design in model space, and now you want to lay out and print your design from a layout tab.

NOTE: You can switch between paper space and model space by double-clicking inside or outside the layout viewport.



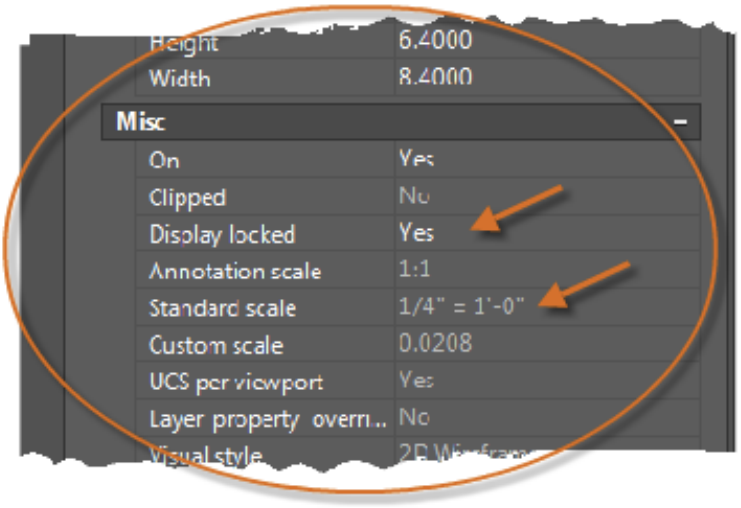
However, the view in the layout viewport is not yet set to the correct scale.

Scaling Views and Trans-Spatial Annotation

Here are the steps to follow if you use the trans-spatial method of annotating your drawing:

1. Click the layout tab. If you started the drawing with your own custom drawing template file, several tasks might already have been completed: the layout might already be set to D-size, and the title block might already have been inserted in the layout.
2. By default, paper space is active, so double-click within the layout viewport to make the model space active. Notice that the edge of the layout viewport becomes thicker as a result of switching to model space.
3. Zoom out and center the model space view by panning. Note that the displayed view will not yet be set to the correct scale.
4. Double-click outside the layout viewport to make paper space active again.
5. Open the Properties palette and then click to select the edge of the layout viewport.
6. In the Properties palette, specify a standard scale of 1/4" =1'-0" from the drop-down list. This action scales your view of model space precisely to the D-size drawing. You should also set the Display Locked property from No to Yes, which will prevent any unintentional display changes to the view.
7. Move the layout viewport as needed, and adjust its edges using grips.
8. Create notes, labels, and dimensions directly in paper space. They will automatically appear at the correct size.
9. Turn off the layer on which you created the layout viewport object. This hides the edges of the layout viewport as shown below.
10. Print the drawing to paper or as a DWF or PDF file.

NOTE: After you have finished dimensioning, you can use the EXPORTLAYOUT command to merge everything in model and paper space into the model space of a separate drawing file. This operation creates a drawing file that conforms to the original method of creating the model and all annotations in model space.



9.1 Printing

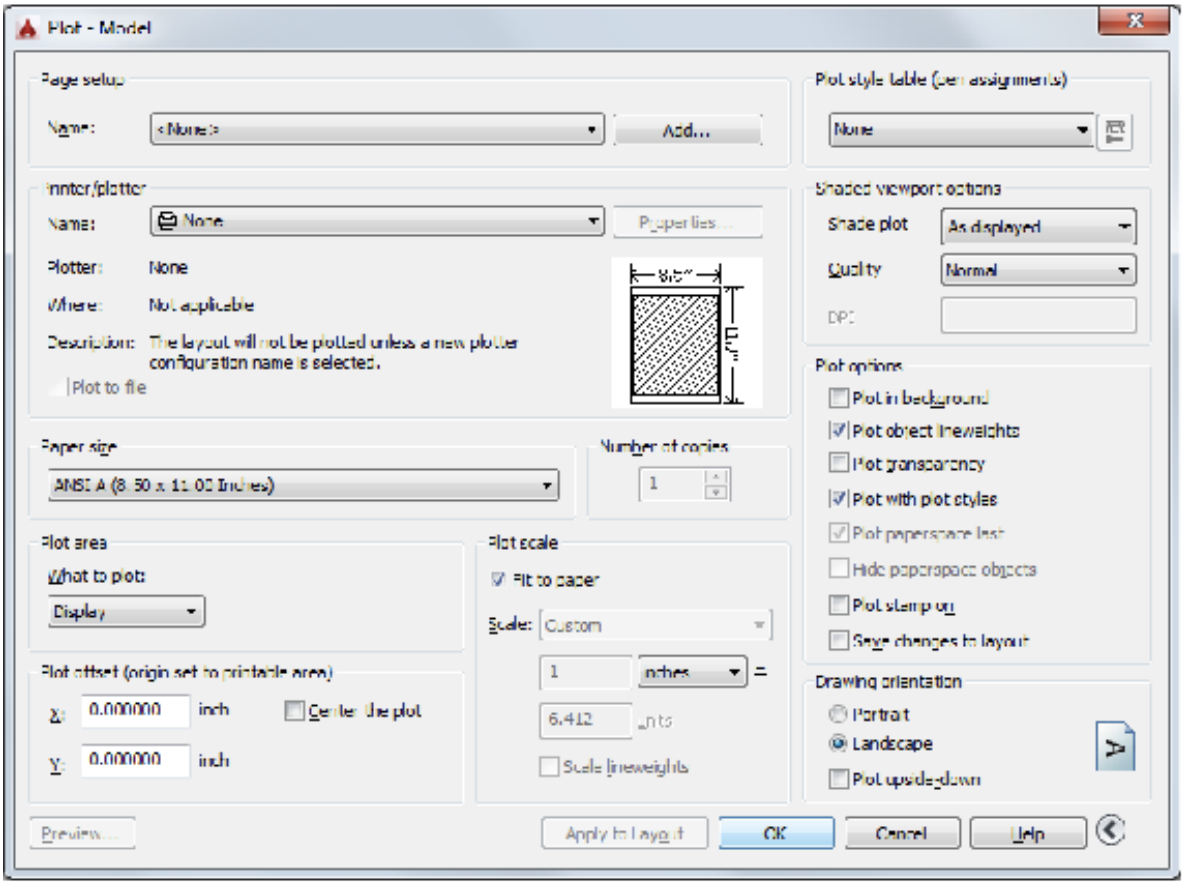
Output a drawing layout to a printer, a plotter, or a file. Save and restore the printer settings for each layout.

Originally, people printed text from printers and plotted drawings from plotters. Now, you can perform both with either device, so this guide will use the terms 'print' and 'plot' interchangeably.

The command to output a drawing is PLOT and you can access it from the Quick Access toolbar.

To display all of the options in the Plot dialog box, click the More Options button.

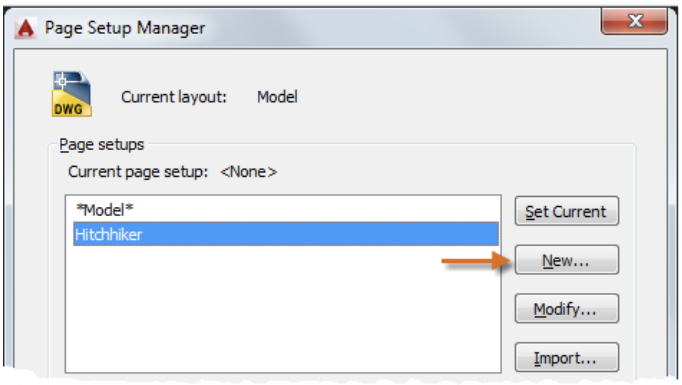
As you can see, there are many settings and options available. For the sake of convenience, you can save and restore collections of these settings by name. These are called page setups. With page setups you can store the settings that you need for different printers, printing in grayscale, creating a PDF file from your drawing, and so on.



Create a Page Setup

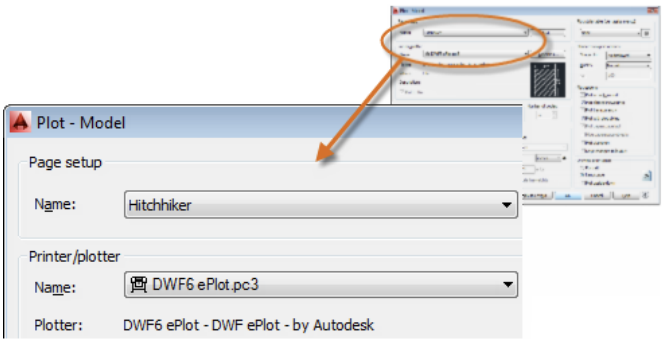
To open the Page Setup Manager, right-click on the Model tab or a layout tab and choose Page Setup Manager. The command is **PAGESETUP**.

Each layout tab in your drawing can have an associated page setup. This is convenient when you use more than one output device or format, or if you have several layouts with different sheet sizes in the same drawing.



To create a new page setup, click New and enter the name of the new page setup. The Page Setup dialog box that displays next looks like the Plot dialog box. Choose all the options and settings that you wish to save.

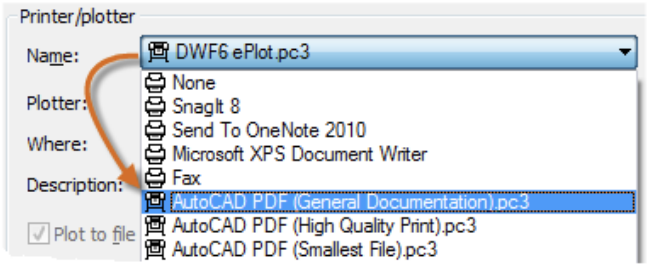
When you are ready to plot, simply specify the name of the page setup in the Plot dialog box, and all your plot settings will be restored. In the following illustration, the Plot dialog box is set to use the Hitchhiker page setup, which will output a DWF (Design Web Format) file rather than print to a plotter.



Output to a PDF File

The following example shows you how to create a page setup for creating PDF files.

From the Printer/plotter drop-down list, choose AutoCAD PDF (General Documentation).pc3:



Next, choose the size and scale options that you want to use:

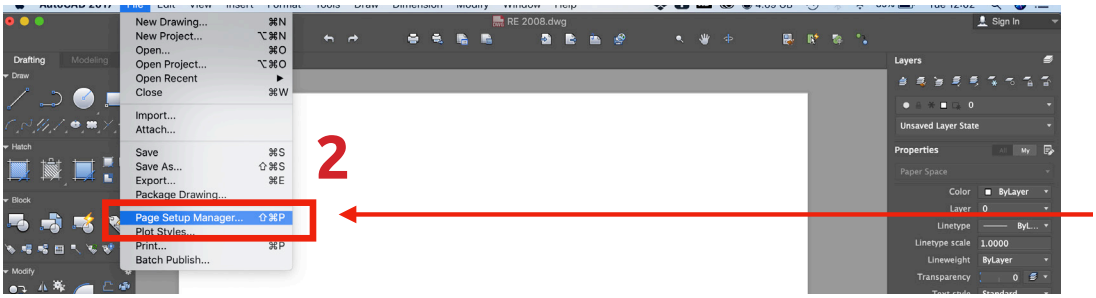
- Paper Size: The orientation (portrait or landscape) is built into the choices in the drop-down list.
- Plot Area: You can clip the area to be plotted with these options, but typically everything will be plotted.
- Plot Offset: This setting changes based on your printer, plotter, or other output. Try centering the plot or adjusting the origin, but remember that printers and plotters have a built-in margin around the edges.
- Plot Scale: Choose your plot scale from the drop-down list. A scale such as 1/4" = 1'-0" is meant for printing to scale from the Model tab. On a layout tab, you normally print at a 1:1 scale.

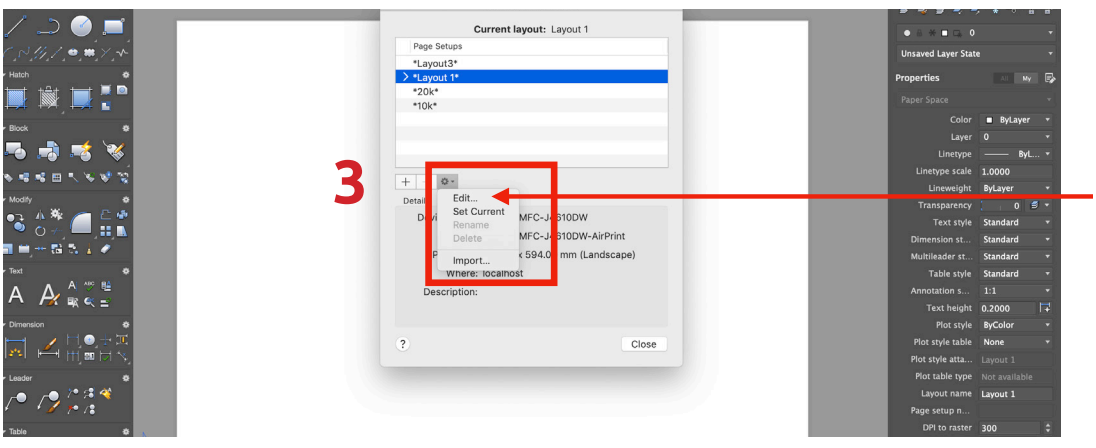
The plot style table provides information about processing colours. Colours that look good on your monitor might not be suitable for a PDF file or for printing. For example, you might want to create a drawing in colour, but create monochrome output.

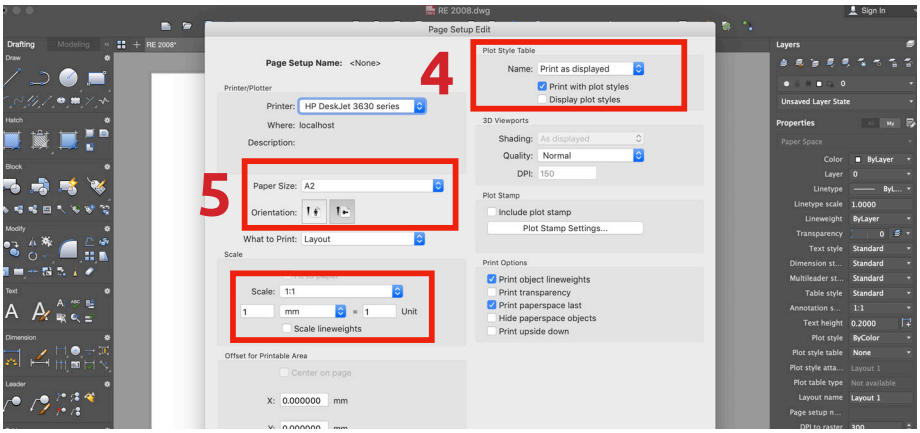
10. Creating a PDF file and exporting with the Macintosh System

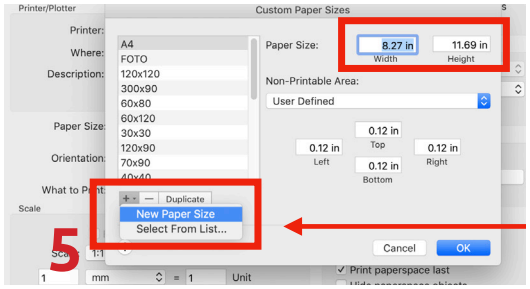
Windows and Macintosh are the same in terms of AutoCAD tools and settings. However, the interface may change slightly.
The next steps will show the standard process to set the paper size and export using a Macintosh System:

1. Use the existing layouts . e.g. Layout 1
2. Set the paper you want to use
3. Edit your paper size
4. Check the settings
5. Open ‘paper size’ if you want to change your paper size. Otherwise, you can also ass a ‘new paper size’.



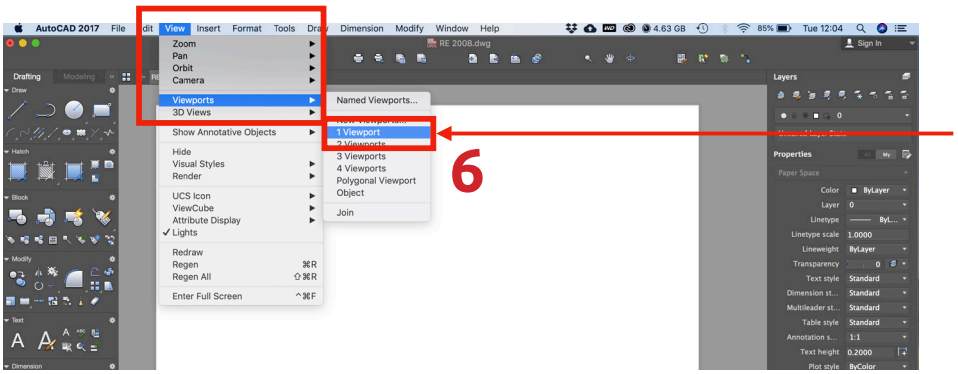


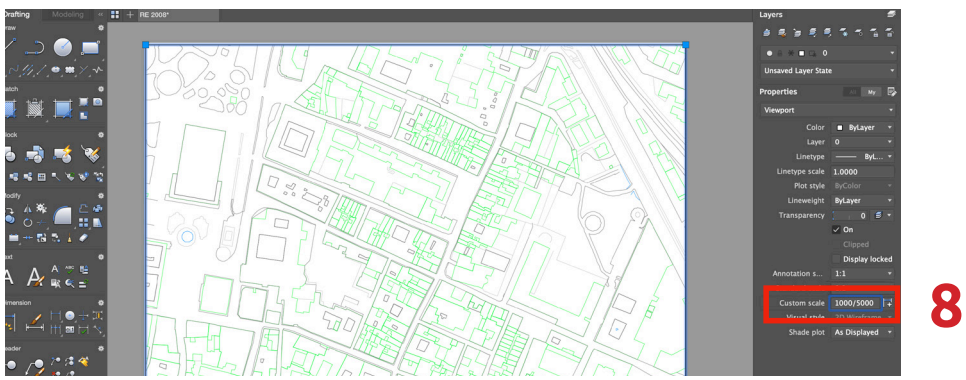




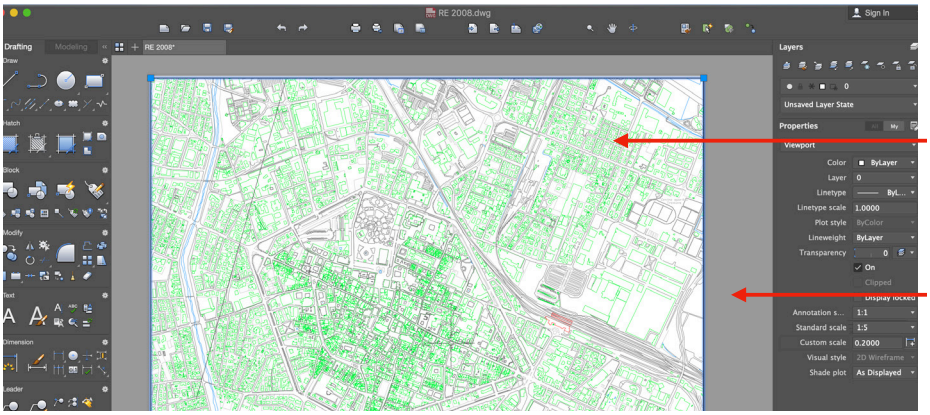
Now your paper is set, but you need to set the dimension / scale of the drawing inside your paper:

6. Setting the viewport > always chose "**1 viewport**"
7. Drag the selection to fit the layout
8. Keep your drawing selected and the chose "**scale**". You should always type **1000/SCALE YOU WANT,** e.g. 1000/5000 means scale 1:50000



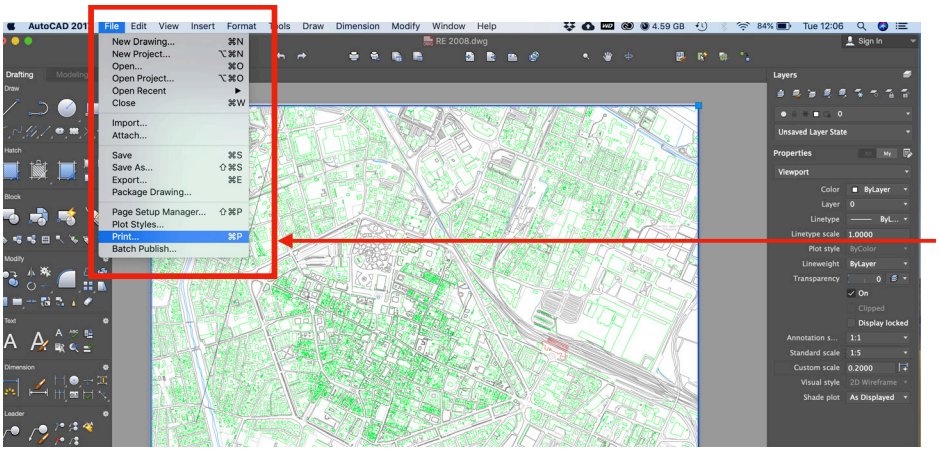


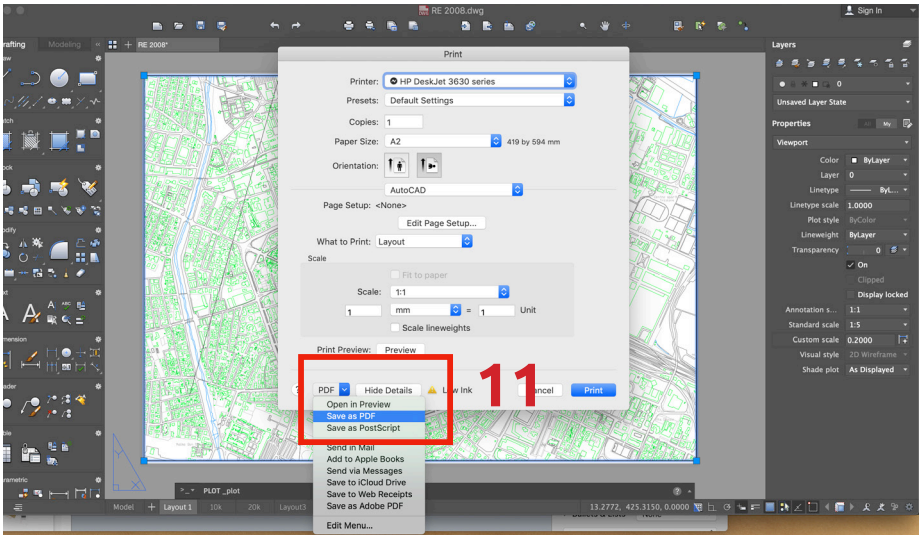
9. If you double click inside the selection, you can move your drawing.
10. To stop, double click in the grey space



Now everything is set and you just need to export it as a PDF file.

11. Select **Print> Export as a pdf**





11. AutoCAD shortcuts

Here, you'll find an abbreviated list of commands that can be used in AutoCAD: ***https://www.autodesk.com/shortcuts/autocad***

Below, you'll find the AutoCAD one-key shortcuts.

- Q QSAVE / Saves the current drawing.
- A ARC / Creates an arc.
- Z ZOOM / Increases or decreases the magnification of the view in the current viewport.
- W WBLOCK / Writes objects or a block to a new drawing file.
- S STRETCH / Stretches objects crossed by a selection window or polygon.
- X EXPLODE / Breaks a compound object into its component objects.
- E ERASE / Removes objects from a drawing.
- D DIMSTYLE / Creates and modifies dimension styles.
- C CIRCLE / Creates a circle.
- R REDRAW / Refreshes the display in the current viewport.
- F FILLET / Rounds and fillets the edges of objects.
- V VIEW / Saves and restores named views, camera views, layout views, and preset views.
- T MTEXT / Creates a multiline text object.
- G GROUP / Creates and manages saved sets of objects called groups.
- B BLOCK / Creates a block definition from selected objects.
- N NEW / Create a new drawing
- H HATCH / Fills an enclosed area or selected objects with a hatch pattern, solid fill, or gradient fill.
- J JOIN / Joins similar objects to form a single, unbroken object.
- M MOVE / Moves objects a specified distance in a specified direction.
- I INSERT / Inserts a block or drawing into the current drawing.
- O OFFSET / Creates concentric circles, parallel lines, and parallel curves.
- L LINE / Creates straight line segments.
- P PAN / Adds a parameter with grips to a dynamic block definition.

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