MGEO 2014

AutoCAD Civil 3D Manual

For Hydrography & Survey Use.

Tiffany Schnare
www.Geo-Tiff.com
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Brian Pyke
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Foreward

The following document was produced with the Marine Geomatics instructor, Brian Pyke in mind. From my experience observing the Marine Geomatics class of 2014 I would say AutoCAD is the number one most used software by hydrographers. This is because AutoCAD can be used for everything from creating plans of the data, to data analyses, and calculating traverses. This manual will give users the information they need to become familiar with basic survey processes in an AutoCAD environment which will lead to the user becoming more accustomed to using AutoCAD in everyday life.

Enjoy exploring AutoCAD Civil 3D 2013!

Table of Contents

1 Important to Remember

The following is a list of tips & tricks that I find helpful when working in an AutoCad environment.

- The Command Line in the most helpful tool in AutoCAD; if you are unsure of what to do next or why a certain tool is not working correctly see the Command Line for further information.

- Before Starting a Project open a BLANK AutoCAD Template then set the units (see Section 4 – Setting Units)

   > New > Drawing

  * Any Templates with 'ISO' in the name are metric files.

- Press the Esc key to exit a command or tool; may need to be pressed multiple times.

- When using AutoCAD it is widely suggested that a mouse with a Scroll wheel be used as the wheel can be pressed while the mouse is moving to pan (this can be done during any tool or command).

- As with any software AutoCAD has its share of quirks. At times the drawing will not appear correctly in the display area. To combat this problem type 'Regen' in the command line to refresh the drawing.

- When inputting Coordinates as **text** into AutoCAD '%%d' will input a degree symbol. If Coordinates are being entered into the **Command Line** 'd' represents a degree symbol.

- Never auto-launch AutoCAD! (i.e. do not double click on a .dwg to open AutoCAD; open the program first then open the project (.dwg) from the menu bar).

- Many times the Command Line will not automatically open with AutoCAD or it may be closed by accident. If so Ctrl+9 will reopen the command line.

2 Switching Workspaces and What They Mean

Workspaces dictate which tools are available to the user and how the interface is displayed. AutoCAD has four options; the two most commonly used workspaces in the Geomatics industry are:

- **Civil 3D**
  Fully loaded; includes all the 2D and 3D tools from the Basic, Civil Engineering, and Geospatial suites.
- **2D Drafting & Annotation**
  Plain AutoCAD; includes the Basic 2D tools to create simple survey plans and diagrams.

The '3D Modeling' and 'Planning and Analysis' workspaces are used mostly in the Construction and Engineering industries; Geomatics technicians will use them on an as needed basis.

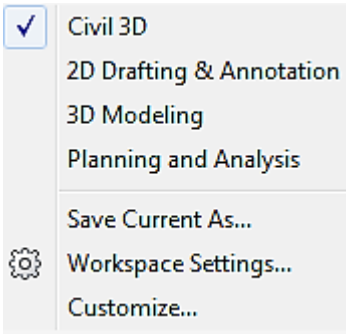


Figure 2.1 Workspace Options

Workspaces can be switched at any point during the project:

1. Left-click on the cog icon on the status bar in the bottom right hand corner.

Figure 2.2 Status Bar

2. Choose the workspace
3. Wait a few seconds for the changes to take place

3 Resetting AutoCAD

If AutoCAD is acting up (i.e. Closing for no reason, freezing, not saving any changes, etc.) then the Civil3D Fix should be performed.

This will restore AutoCAD to the default interface; meaning if the user has added any tools to the ribbon or changed the workspace is any way the changes will be deleted.

To avoid requiring to do this never open AutoCAD by double-clicking on a .dwg file; always open AutoCAD then open the project (.dwg) using the menu bar.

1. Close AutoCAD
2. Navigate to the Civil3D_Fix folder
   (A copy can be found on the MGEO drive – P:\CIVIL3D_FIX)
3. Double-click on the Civil3DFix.bat file
4. Restart the computer
5. Open AutoCAD

4 Setting Units

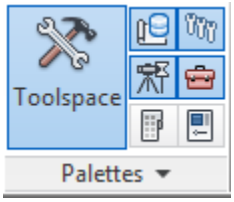
This process will dictate the type of values a user can utilize in the project.

The following should be the **first** step after opening a template file (> New > Drawing).

1. Type units in the Command Line
2. The unit settings will depend on the type and use of the project being created; think carefully before the units are set as changing the units halfway through the project can cause issues

If using Civil 3D then the scale needs to be set as well:

1. Ensure the following tools are turned on:



This tool can be found on the **Home ribbon**

2. In the Toolspace window > Settings tab > Right-click on 'Drawing1' (default name) or if the file has already been saved then on the name of the file
3. Edit Drawing Settings... > Units and Zone tab > Input a Custom Scale or choose a default
4. Apply and OK

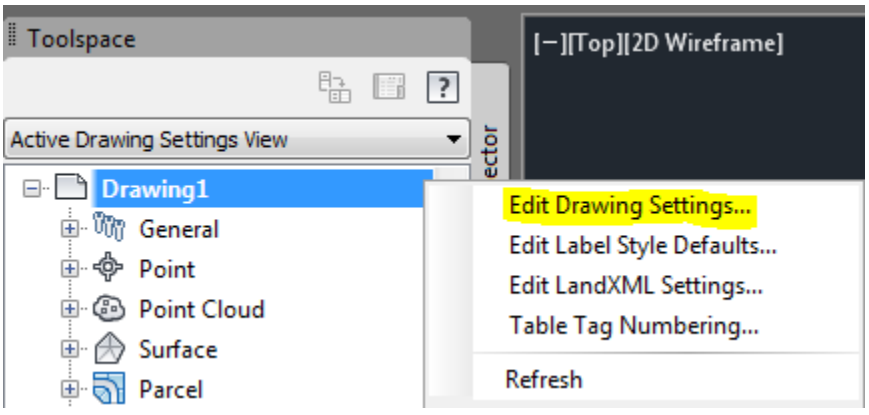


Figure 4.1 Open Edit Drawing Settings

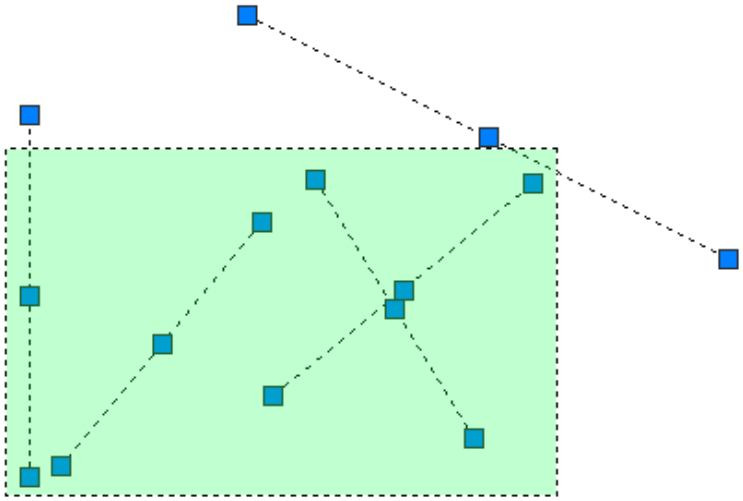
5 Selecting Items

Items are typically selected when the user wants to perform a number of commands on them such as; move, rotate, change attributes, or modify/analyze them in any way.

Note: There are two ways to unselect items; to unselect everything press Esc, to unselect a certain object hold shift then left-click on the object.

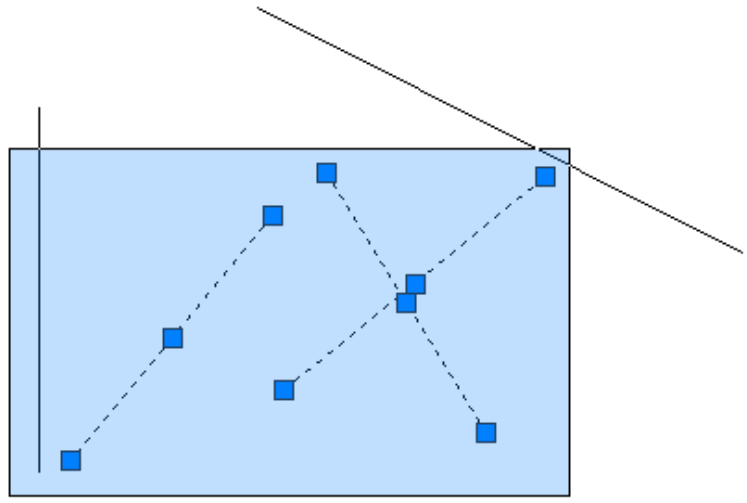
5.1 Crossing

Without any tools or commands active click on the screen then move the mouse from **right to left** over the objects you want to select. This will select any object that either falls within or touches the box.



5.2 Window

Without any tools or commands active click on the screen then move the mouse from **left to right** over the objects you want to select. This will select only the objects that fall fully in the box.



5.3 Quick Select (QSelect)

This command allows the user to specify a property (i.e. line weight, colour, etc.) then AutoCAD will automatically select all objects that match the specification.

1. There are four ways to open QSelect; choose the option that works best for you:
   a. Tools > Quick Select **(works in Classic interface only)**
   b. Utilities Panel > Quick Select **(works in 2D interface only)**
   c. Right-click anywhere in the display area > Quick Select
   d. Type qselect in the Command Line
2. Set the properties to match the objects you either want to select or the objects you want to remove from the current selection.

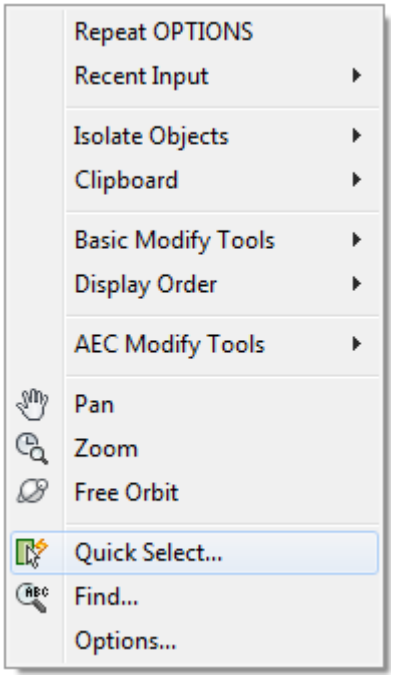


Figure 5.2 Right-click menu

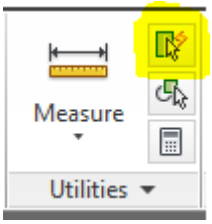


Figure 5.3 Utilities Panel in 2D mode

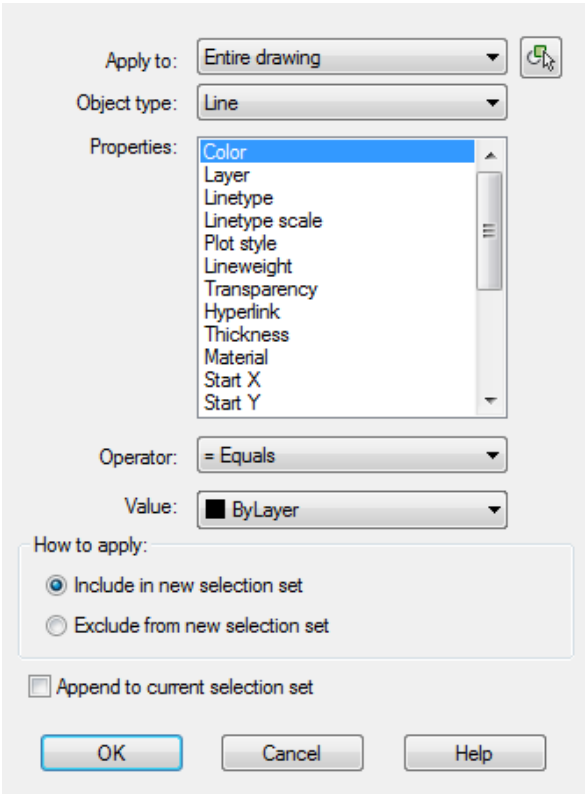


Figure 5.1 QSelect Tool Window

6 Drawing Limits

This will prevent anything from being created outside of the study area; so you won't end up with a point half way across the planet then lose your data when you try to 'zoom to extents' as the drawing will incorporate that one wrong point.

1. Type Limits in the Command Line
2. Choose a bottom left corner slightly outside of the study area (buffer zone)
3. Choose a top right corner slight outside of the study area

   These areas can either be chosen with a mouse click in the display area or by entering coordinates in the command line
4. Enter
5. Type Limits in the Command Line
6. Type on in the Command Line
7. To make sure the command worked properly
   a. Using the Line tool attempt to create a line outside of the limits; if the Command Line comes up with an error 'Outside Limits' then the limits are properly set

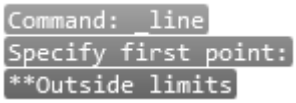


Figure 6.1 Error creating line outside of limits

7 Coordinate Entry Methods

Coordinates can be specified for any drawing tool, such as specifying the centre of a circle (point), a segment of a line, the four corners of a rectangle, etc.

Note: The X coordinate is always entered first then Y then Z (optional).

The following can be used with most tools; including but not limited to point, line, and rectangle. For this demonstration line will be used.

1. Start the tool – Type line in the Command Line
2. Either manually select a location in the display area or type coordinates (i.e. 5,2,1)
3. There are three methods to establishing the next segment or end of the line
    a. Absolute Cartesian – (X,Y,Z)
       Enter the Coordinates same way as before (i.e. 7,3,1)
    b. Relative Cartesian – (@X,Y,Z)
       Enter the amount of units you want to move in each direction (i.e. @2,1,0)
    c. Polar – (@distance<angle)
       Enter the distance and angle from the first to second segment (i.e. @2.236<26d33'54")

   The examples from step 3 will all output the same location if the example from step 2 is used as the starting point.

4. Repeat step 3 until the end of the line
5. Press Enter

8 Point Styles

If the points you have been created are not able to be seen in the display window or if the current points are too small/big for the drawing then the style of the points can be changed.

1. Type ddptype in the Command Line
2. Check on Set Size in Absolute Units (this means the specified point size will be in metres, feet, etc.)
3. Select a point style other than the first two (they are impossible to read on a map/plan)

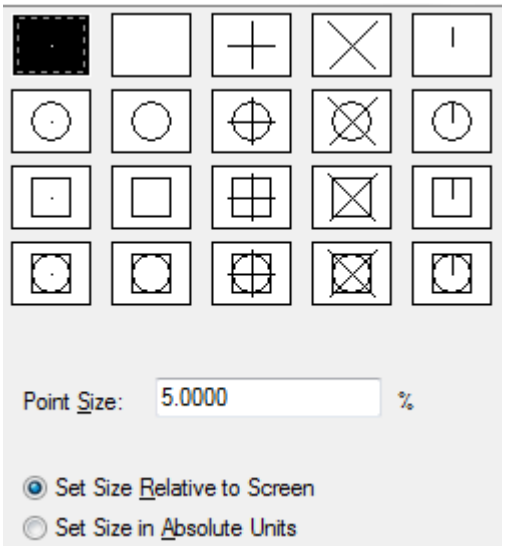


Figure 8.2 Default Point Settings

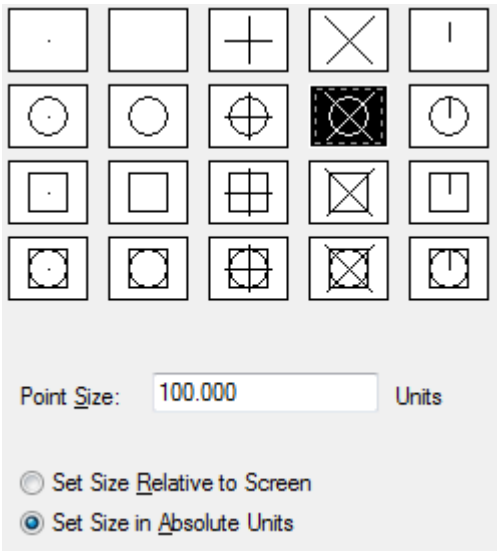


Figure 8.1 Point Style set to display a 100m circle and cross icon for each point

9 Offsets - Creating a Scale Bar

The offset command allows the user to create an identical copy of an existing object then move it a certain distance away from the original.

Note: This tool will be beyond helpful when creating a scale bar! The offset tool can be used for lines, circles, text, curves, etc.

1. Turn on Ortho Mode so the lines will be perfectly straight (F8)
2. Create the bottom horizontal line of the scale bar
    a. Type line in the Command Line
    b. Move the mouse so the line is drawing horizontally
    c. Input the distance you want the scale bar to be (i.e if you want a scale bar with three 10 metre intervals before zero and two 50 metre intervals after zero then the distance is 130 metres)
3. Create the left vertical line of the scale bar
    a. Type line in the Command Line
    b. **SNAP** (F3) to the start of the horizontal line
    c. Move the mouse so the line is drawing vertically upwards
    d. Input the height you want the scale bar to be

    Rules of Thumb: (a)Height of a scale bar should be 3 to 5% of its length or (b)1.5mm when printed.

4. Open the Offset tool one of two ways
    a. Click on the Icon found on the Home ribbon in the Modify panel
    b. Type offset in the Command Line
5. Select Through > Select the bottom horizontal line > Either input the height measurement of the scale bar or snap to the top of the vertical line
6. Open the Offset tool > Select Through > Select the bottom horizontal line > Either input HALF the height measure of the scale bar or snap to the MID-POINT of the vertical line
7. Open the Offset tool > Select Through > Select the vertical line > Move the mouse so the line is being drawn within the scale bar > Input the value of the intervals before zero (in this case 10m) > Enter > Click the newly created line > Input the same value > Move the mouse down the length of the scale bar > Enter
    a. Do this until the end of the scale bar, changing the interval value when needed.
8. Label the scale bar > Select all objects > Type group in the Command Line (This will make moving the scale bar easier)

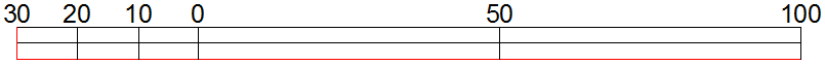


Figure 9.1 The final scale bar; red represents the first horizontal and vertical lines created.

10 Importing a Point File

Point files are used in a multitude of ways by hydrographers, such as from; total stations, RTK, SBES, MBES, etc. The following will outline how to bring the data into AutoCad for analyses and presentation.

Note: Point files can contain thousands of points resulting in AutoCAD slowing down and freezing; if this is the case then it is best to import the points directly into a surface or as a Point Cloud.

10.1 As a Point Cloud

The point cloud method creates a file outside of AutoCad that the software can reference to display the points rather than actually bringing them into the software thus slowing it down.

1. Toolspace window > Prospector tab > Right-click on Point Clouds > Create Point Cloud…
2. Next > Select a point cloud file format – This is the **most important step**; make absolute sure that you have selected the proper format for **YOUR** file(s)
3. Add point file(s)  > Finish
4. A pop-up message will appear – Close
5. Type ZE in the Command Line to zoom to the extents of the data
6. The style of the points will need to be changed to make them easier to view
    a. Select the point cloud
    b. The Ribbon will change > Open Point Cloud Properties drop-down menu > Edit Point Cloud Style > Under the Points tab change the Size in Pixels to an appropriate size for your data > Apply > OK

To add these points to a surface:

1. Expand Point Clouds Layer
2. Right-click on Point Cloud – (1)
3. Add Points to Surface… > Either:
    a. Add points to a new surface > Next (x2) > Finish
    b. Add points to an existing surface > Choose surface > Next (x2) > Finish

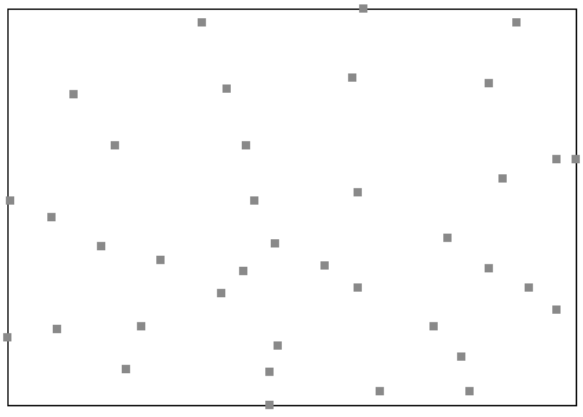


Figure 10.2 Point Cloud with enhanced pixel size

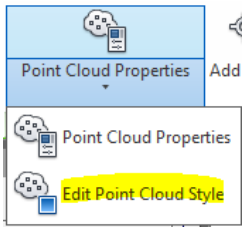


Figure 10.3 Edit Point Cloud Style

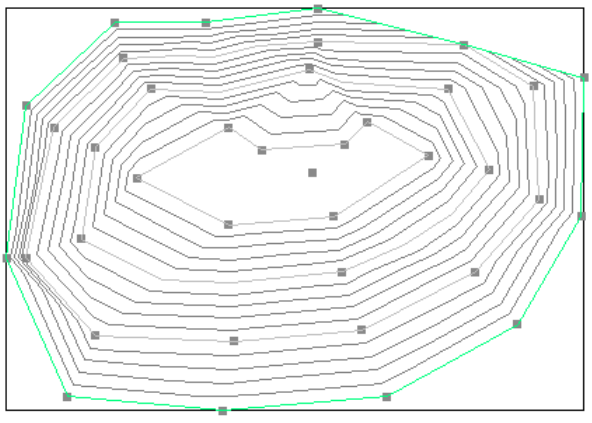


Figure 10.1 Point Cloud within a Surface

10.2 Directly into a Surface

This method will automatically create and display contours to view the actual points: Right-click on Surface1 > Edit Surface Style > Display tab > Click the light bulb next to points to turn it yellow (on) > Apply & OK

1. Toolspace window > Prospector tab > Right-click on Surfaces > Create Surfaces
2. Open the Object Layer window > Modifier: Suffix > Modifier value: name the surface > OK (x2)
   (The name set above will be the name of the layer the surface is displayed on)
3. in the Prospector tab expand the Surfaces layer > Expand Surface1 > Expand Definition
4. Right-click on Point Files > Add…
5. Select Files > Choose point file(s)
6. Specify point file format – This is the **most important step**; make absolute sure that you have selected the proper format for **YOUR** file(s) > OK
7. Type ZE in the Command Line to zoom to the extents of the data

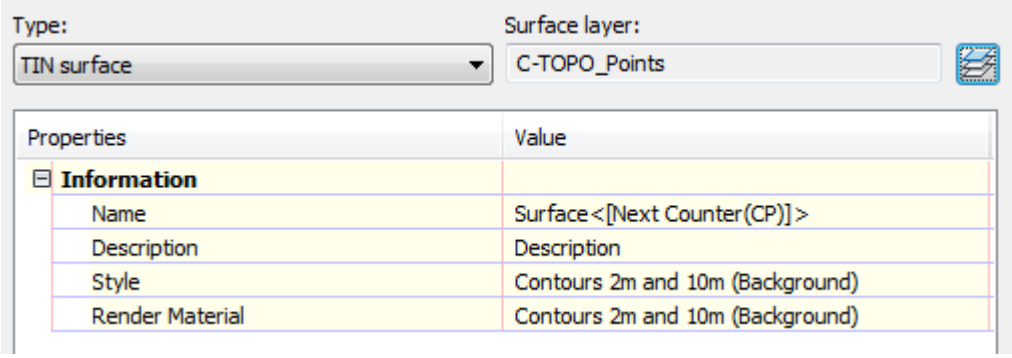


Figure 10.4 Create New Surface

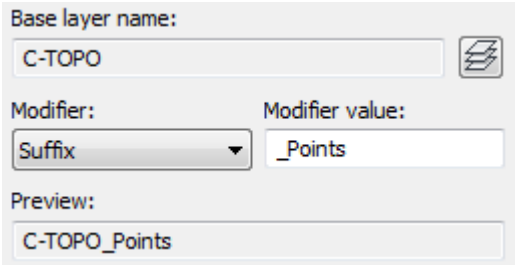


Figure 10.5 Name the Surface Layer

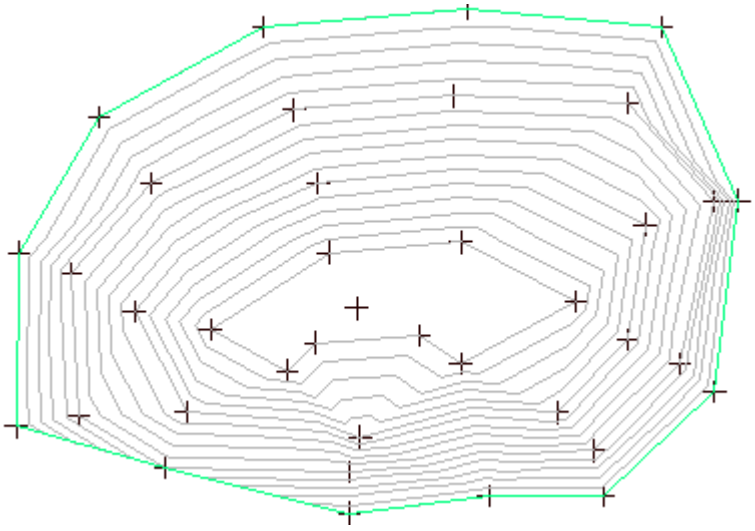


Figure 10.6 The Final Product with Points

11 Hatching Objects

Hatching is what AutoCAD calls a filled region of an object which expresses how the feature is composed or to distinguish it from surround features. (i.e. a gravel parking lot will be filled differently than a paved parking lot)

11.1 Simple Hatch

Simple hatch is when you're hatching an enclosed object. (i.e. circle)

1. Be Patient; Hatching can be a pain but once the desired results are attained it is worth it
2. Type Hatch in the Command Line
3. Choose a pattern and color
4. Move your mouse to the centre of the object (should display an example of what the hatch will look like)
5. Click in the object
6. Enter
7. Type Regen in the Command Line

11.2 Advanced Hatch

Advanced hatch is when you're hatching a non-enclosed object. (i.e. four single lines forming a box)

1. Type Hatch in the Command Line
2. Choose Pick Points from the Boundaries Ribbon
3. Choose a pattern and color
4. Move your mouse to the centre of the object (should display an example of what the hatch will look like)
5. Click in the object
6. Enter
7. Type Regen in the Command Line

12 Geo-Rectifying/Rubbersheeting

This process will take an image (i.e. air photo or map) and give it a place on the earth. Meaning the image can be brought in behind data for additional information.

Note: This tool is only available in Civil 3D interface.

1. Insert Shapefile (see Section 13 – Inserting Objects)
2. Create a new layer for the Image > Make this layer active
3. Insert the image to be georeferenced
    a. Pick an arbitrary base point and guess an appropriate size
    b. Try to fit the image to the appropriate location using the move, scale, and rotate commands
4. Send the image behind the lines; Select Image > Right-click on outer edge > Display Order > Send to Back
5. Find a location on the raster that is also easy to find on the reference layer
    a. First select the location on the photo; then select the same location on the Shapefile
6. Repeat step 4 for a couple of locations
7. Press Enter > Select Select > Select the image > Enter
8. The image will move > Repeat step 4 if needed

Figure 12.1 Before Geo-rectification

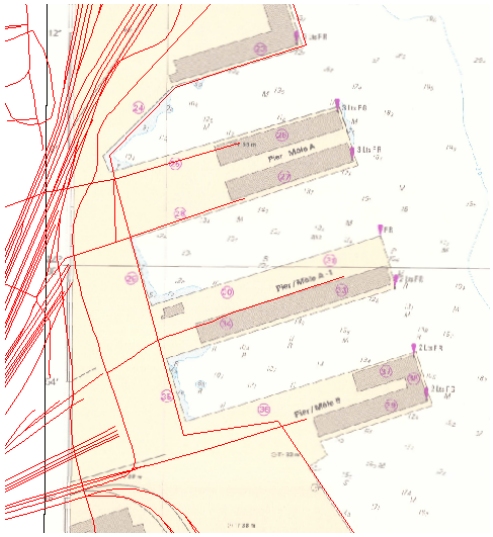


Figure 12.2 After Geo-rectification

13 Inserting Objects

Objects can be anything from images to vector data; the following outlines the processes taken to import the most common object types.

13.1 GeoTiff

*Note: When moving GeoTiff images always ensure that the .tfw and .tif files are moved together and if the .tif file is renamed then rename the .tfw file **EXACTLY** the same.*

1. Type mapiinsert in the Command Line
2. Select the .tif file
3. A window will pop-up; **DO NOT** change anything!
4. Apply & OK
5. Type ze in the Command Line to Zoom to Extents
6. Ensure the image came in properly

13.2 Images/Logos

1. Type image in the Command Line
2. In the upper left hand corner select the type of file that will be imported
3. Select the file > Open
4. Path type: Relative path ; Insertion point and scale: check on Specify on-screen
5. Ok
6. Choose a location in the display area; this will be the fixed point for the bottom left corner
7. Move the mouse and an outline of the file should appear; move the mouse until an appropriate size is obtained > Left-click
    a. The image can now be rotated, scaled, or moved by typing one of those commands into the Command Line and following the outlined steps
8. To remove the black outline surrounding the image type mapiframe in the Command Line

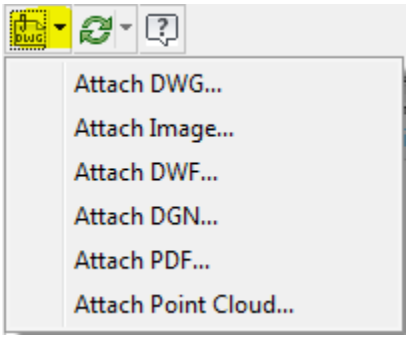


Figure 13.1 The available file formats to be imported into AutoCAD

13.3 Shapefiles

1. Type mapimport in the Command Line
2. Change Files of type to ESRI Shapefile
3. Select the file(s) > OK
4. Set the Coordinate system  > Select Coordinate System… > Use the Category filter to find the correct coordinate system > Select > OK
5. Check on Import polygons as closed polylines > OK
6. Type ze in the Command Line
7. Ensure the Shapefile came in properly

14 Digitizing

Digitizing is when the user turns a GeoTiff into vector data by manually outline and assign attributes to significant features.

14.1 From Side Scan Mosaics

1. Add the Mosaic GeoTiff (see Section 13 – Inserting Objects)
2. Choose one of the following tools to start:
    a. Line
    b. 3-Point Arc
    c. Polyline

    (The tool can be changed at any point during the digitizing)
3. Start digitizing feature
4. **DO NOT** stop digitizing a feature after you have started; otherwise the lines will not be connected and hatching will not be possible
5. Make sure to either slightly overlap the starting and ending lines or use object snap to snap the end to the start
6. Enter

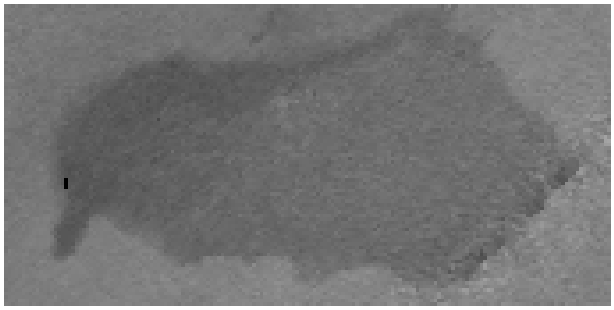


Figure 14.2 Feature to be digitized

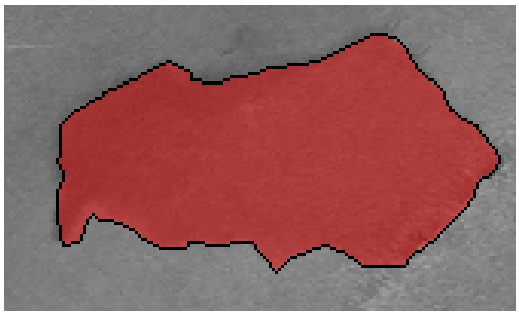


Figure 14.1 Digitized feature with red transparent hatch

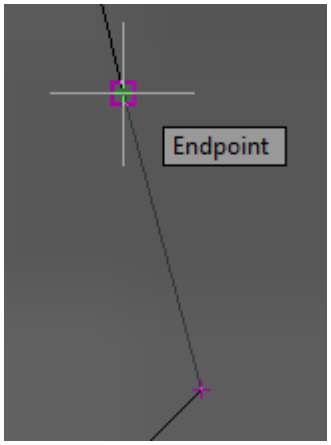


Figure 14.3 Snap the end point to the start point

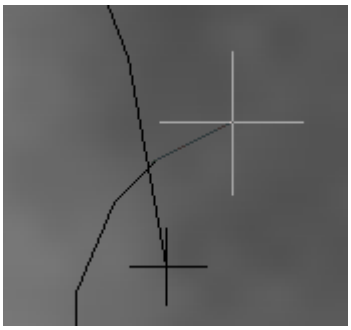


Figure 14.4 Slightly overlap the start and end points

15 Tips & Tricks for Navigating Surfaces

Surfaces are described as basic groups of data (i.e. TIN, DEM, point files, contours, etc). Having the data as a surface in AutoCAD opens of a new range of analyses and presentation tools.

Note: Surfaces and the associated tools are only available in Civil 3D.

15.1 Display Tab

This is where the main colours, and line weights are changed; this tab is also where to go if you want to turn off/on any surface layers (i.e. triangles, contours, points, etc.).

1. Toolspace window > Prospector tab > Expand Surfaces > Right-click on surface1 > Edit Surface Style > Display tab

Compone...	Visible	Layer	Color	Linetype	LT Scale	Lineweight	Plot Style
Points		C-TINN	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Triangles		C-TINN-VIEW	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Border		C-TINN-BNDY	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Major Contour		C-TOPO-MAJR	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Minor Contour		C-TOPO-MINR	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
User Contours		C-TOPO-USER	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Gridded		C-TINN	BYLAYER	ByLayer	1.0000	ByLayer	ByBlock
Directions		0	BYLAYER	ByBlock	1.0000	ByLayer	ByBlock
Elevations		0	BYLAYER	ByBlock	1.0000	ByLayer	ByBlock
Slopes		0	BYLAYER	ByBlock	1.0000	ByLayer	ByBlock

Figure 15.1 Surface Display tab.

15.2 Displaying Point Elevations/ID/Description

1. Toolspace Window > Prospector tab > Point Groups > Information tab > Change Point Label Style; there are many options to chose from but for survey work Elevation Only is the most common

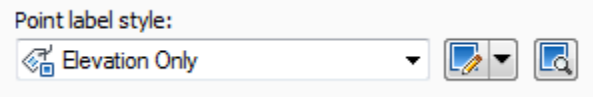


Figure 15.2 Point Label Style Menu.

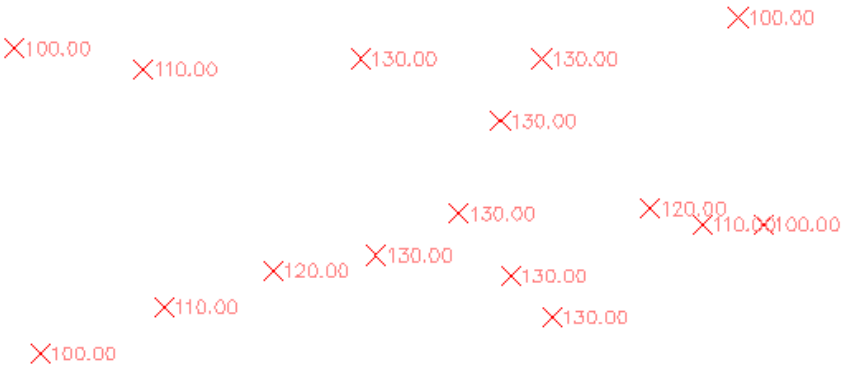


Figure 15.3 Points with Elevation Information.

15.3 Creating Surface Profiles

A surface profile is a graph which shows a particular area of the surface in a profile view; this allows the user to easily see the changes in elevation.

1. Create a Line, Arc, or Polyline intersecting the area of interest (the line should be created in the direction you want the profile to be displayed)
2. Home Ribbon > Create Design Panel > Open the Alignment drop-down menu > Create Alignment from Objects > Select the Line, Arc, or Polyline > Enter
3. Input the Alignment Name > Choose the appropriate Type > Alignment labe set is generally set to either Major and Minor only or None > OK
4. Home Ribbon > Profile & Section Views Panel > Open the Profile View drop-down menu > Create Profile View
5. There is nothing to change in the Create Profile View window > Create Profile View
6. Select an arbitrary point away from the surface > The profile will display automatically

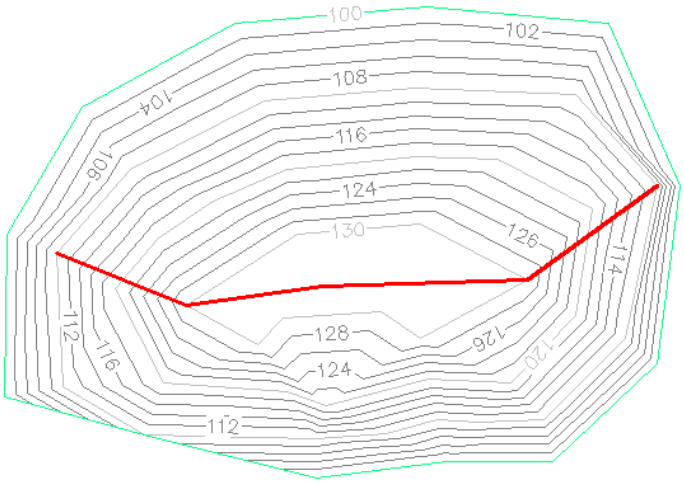


Figure 15.4 Surface with contours, labels, and alignment (red).

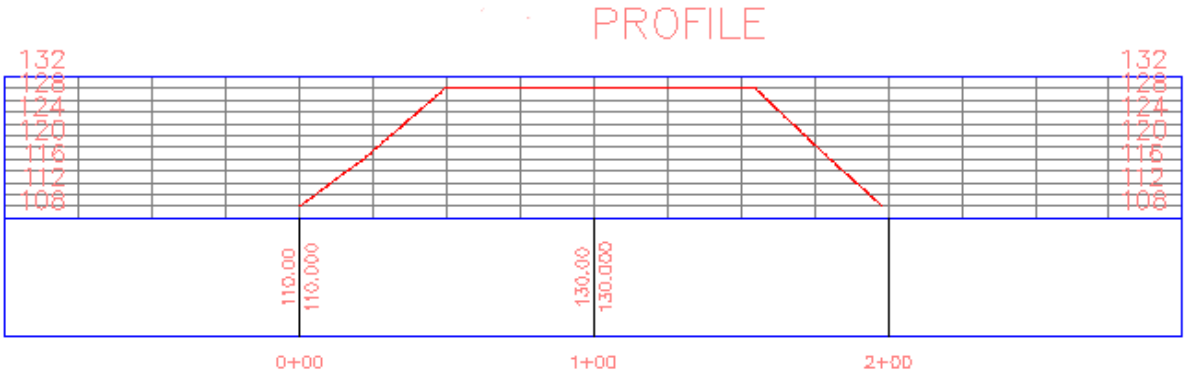


Figure 15.5 Alignment Profile.

16 Managing Surface Contours

Note: A surface must be created in order to do the following procedures (see Section 10 – Importing a Point File)

16.1 Changing Intervals

1. Toolspace window > Prospector tab > Expand Surfaces > Right-click on Surface1 > Edit Surface Style > Contours tab > Expand Contour Intervals > Change the major and minor contour intervals to suit your data

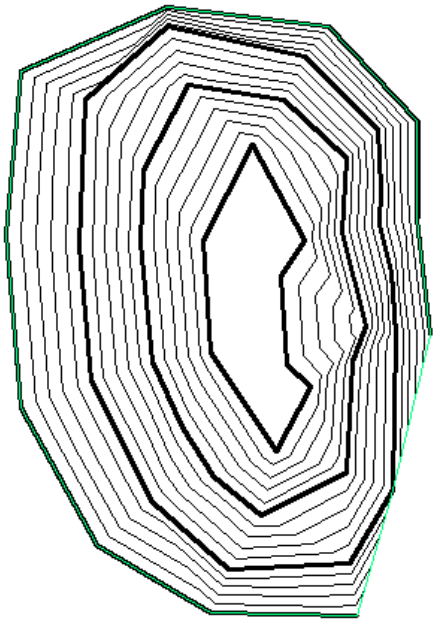


Figure 16.1 Contour Intervals: Major - 16m ; Minor 4m.

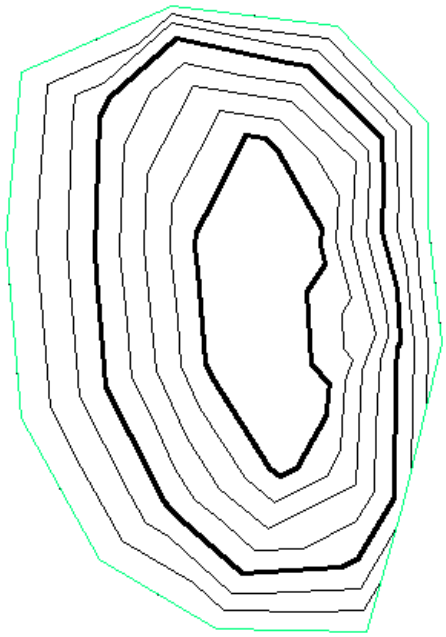


Figure 16.2 Contour Intervals: Major - 10m ; Minor 2m.

16.2 Smoothing Contours

1. Toolspace window > Prospector tab > Expand Surfaces > Right-click on Surface1 > Edit Surface Style > Contours tab > Expand Contour Smoothing > Change Smooth Contours to True > Use the Slider bar at the bottom of the window to increase or decrease the smoothness of the contours

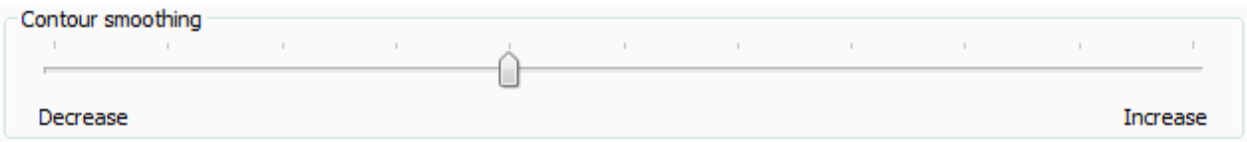


Figure 16.3 Contour Smoothing.

16.3 Labeling

Typically significant points (i.e. survey markers), areas (i.e. parks) and lines (i.e. contours) are labeled in this way.

1. Toolspace window > Prospector tab > Expand Surfaces > Right-click on Surface1 > Add Label
2. Change Label type to Contour – Single
3. Open the Label Style Composer for the Major Labels
   a. Layout tab > Click in the 'Text' – 'Contents' Value box > Click
   b. Highlight everything in the text box to the right > Delete/Backspace
   c. Change Precision to 1 > Click the arrow botton > OK
   d. Change the Text Height and Color (should match the color of the contour lines)
   e. Apply > OK
4. Repeat step 3 for Minor Contours (optional – only if minor contours are also being labeled)
5. Click Add
6. Select an area on a line; the contour label should display automatically

To delete a label:

1. Exit Add Label (Esc)
2. Select the label(s)
3. Delete

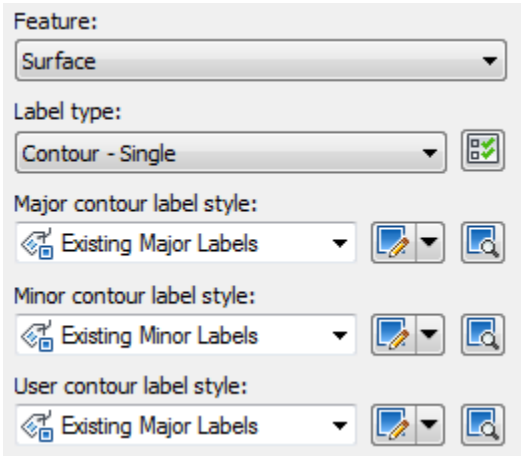


Figure 16.4 Add Label Dialogue Window.

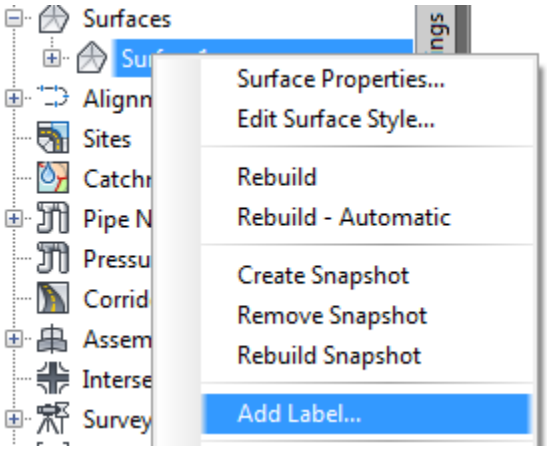


Figure 16.5 Open Add Label window.

Figure 16.6 Final Contour Labels.

17 Paper Space

Paper space is the area where the user can easily create a layout and surround information for a chart. This area allows the user to specify paper size, put multiple maps on one chart, and much more.

Note: When creating the layout in Paper Space **DO NOT** create anything outside of the dotted line.

17.1 Blank Paper Space

1. Right-click on the Layout bar (bottom of screen) > New Layout
2. Open newly created layout (Layout3)
3. Right-click on Layout3 > Page Setup Manager > Modify
    a. Change Printer/plotter to Adobe PDF
    b. Choose the appropriate paper size and scale
4. OK & Close

17.2 Template Paper Space

1. Right-click on the Layout bar (bottom of screen) > From Template
2. Open the Template file:
    a. If using a specific template then navigate to template file
    b. If using an AutoCAD default template file open the SheetSets folder and choose a template
3. Open the template layout

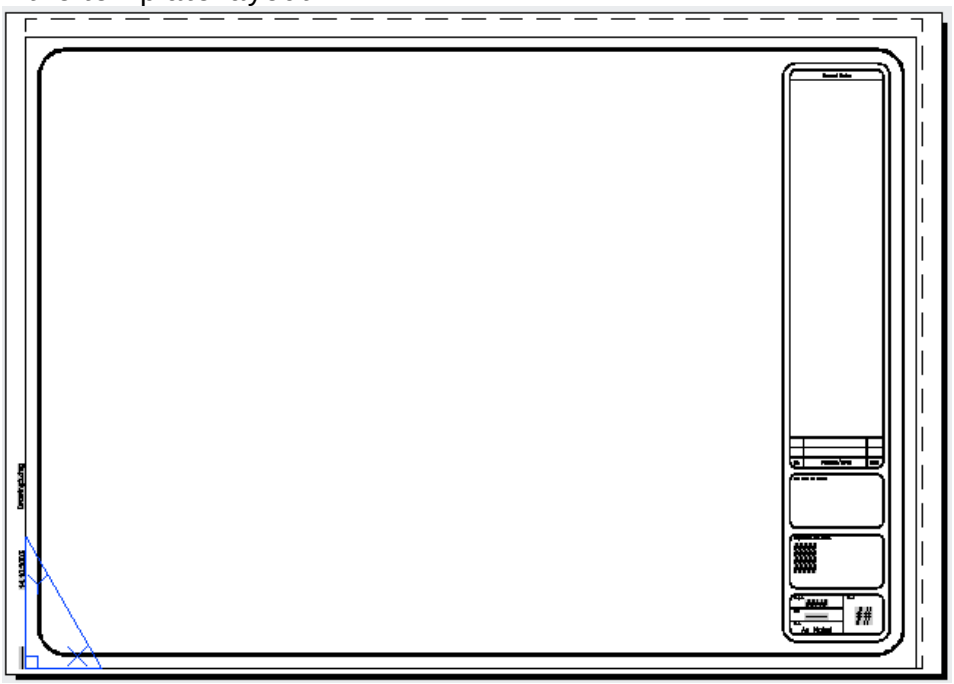


Figure 17.1 A1 size metric template (AutoCAD default).

18 Plotting

Plotting is the final step in map creation; it is when the chart goes from screen to paper.

ALWAYS PLOT TO ADOBE PDF BEFORE AN ACTUAL PLOTTER!

18.1 From Paper Space

1. Make sure Object Snap (F3) is turned on
2. Right-click on the layout in the Layout bar (bottom of screen)
3. Plot
4. Change Printer/Plotter to Adobe PDF
5. Choose Appropriate page size
6. Either:
    a. Input the associated scale
        Or
    b. Change What to Plot to Window then define the area to plot as the dotted rectangle or the user created neatline*(may not be to scale)*
7. Preview
8. If everything is correct then Plot 

18.2 From Model Space

1. Make sure Object Snap (F3) is turned on
2. Type plot in the Command Line
3. Change Printer/Plotter to Adobe PDF
4. Choose Appropriate page size
5. Change What to Plot to Window then using OSnap snap to the neatline
6. Check on Center the Plot
7. Uncheck Fit to Paper and Input Scale (Optional – If this step is skipped then the final product may not be to scale)
8. Expand the window 
9. Choose the Drawing Orientation (portrait or landscape)
10. Preview
11. If everything is correct then plot 

18.3 From PDF to Plotter

1. Once either Section 18.1 or 18.2 have been completed the PDF will automatically open
2. File > Print
3. Choose the correct printer
4. Check on Choose paper source by PDF size > PRINT

19 How to Get Rid of AutoDesk stamps on Final Plots

If an educational liscence was used at any point during the project then the final plot will have 'Produced by an AutoDesk Educational Product' stamped to the four sides; this is the easiest way to delete it.

1. When completing either Section 18.1 or 18.2 choose a paper size that is well larger then the size that it will be printed on and make sure to uncheck Fit to Paper
2. Open the PDF
3. File > Print
4. Choose Adobe PDF as the printer
5. Uncheck Choose paper source by PDF size
6. Open Page Setup
7. Change the size of the paper to the appropriate size for the final product > OK
8. Print
9. This will print it to a new PDF; Section 18.3 – From PDF to Plotter will need to be completed next

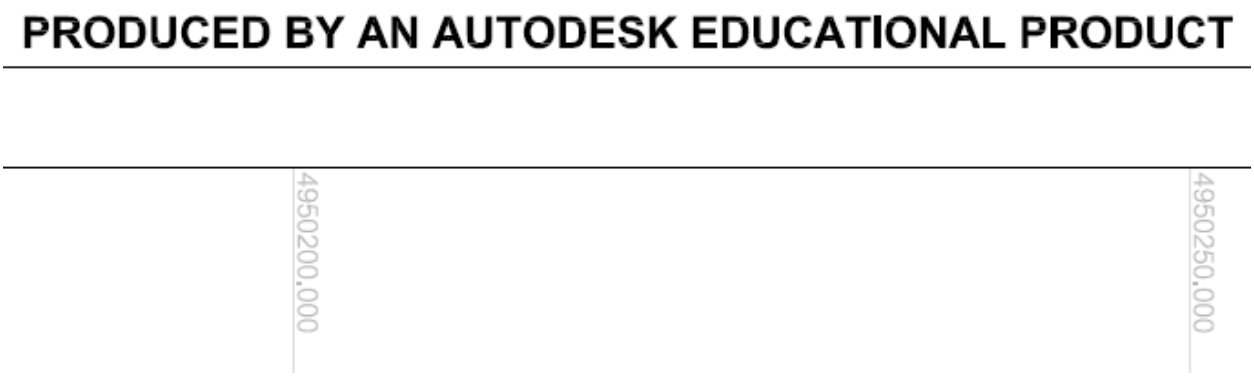


Figure 19.1 AutoDESK Stamp on Final Plot.