

ENG-A2001 Computer-aided Tools in Engineering
AUTOCAD: Useful tools in the Exercise

AutoCAD Instruction Material

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Leaders

A lot of leaders are needed in the assignment. Like text, leaders can be drawn with many different commands. The most useful might be the multileader (command **MLEADER (MLD)**), which has easily editable text and arrows. Its advantage is also that you can easily make multiple arrows to leave from the text (e.g. by selecting mleader with right click and selecting *Add Leader* from the opening menu). You can create your own styles for the arrowheads and make them scale according to the scale used (annotativeness), just like normal texts. Single line leaders can be used with the **LEADER** command.

Figure 1 shows example of leaders. Can you create similar leaders?

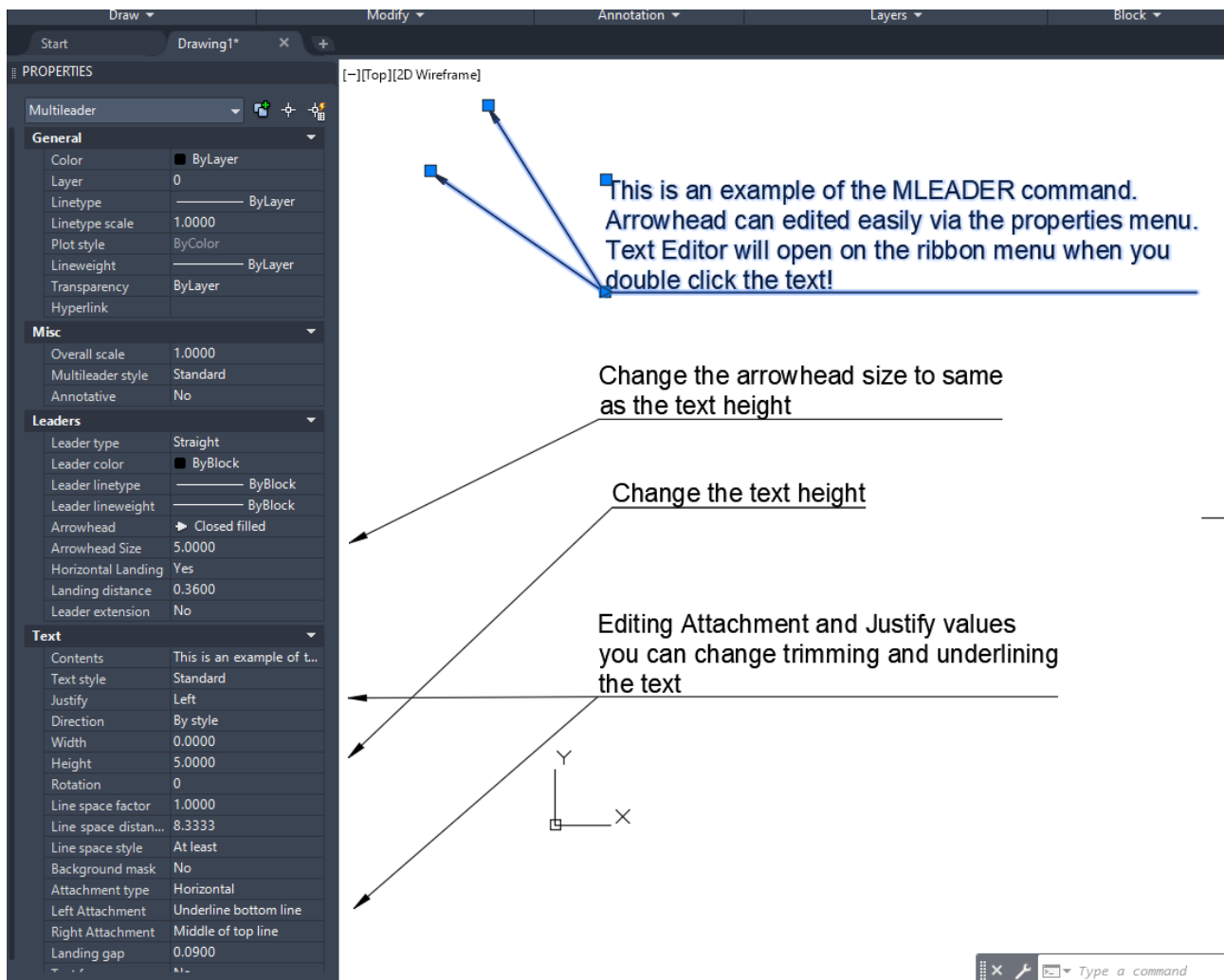


Figure 1. Different kinds of leaders

Rasterization and rectangle array

In this chapter, we will draw a rectangle and duplicate it. In the end we will fill the rectangles with color (rasterization). Specify a rectangle with width of 1500 and height of 600. You do not have to draw dimensioning.

Command: REC

RECTANG

Specify first corner point or

[Chamfer/Elevation/Fillet/Thickness/Width]:

Specify other corner point or [Area/Dimensions/Rotation]:

@1500,600

Let us practice duplication with the **ARRAY** command, but this time we will be using Rectangular as array type (Figure 2).

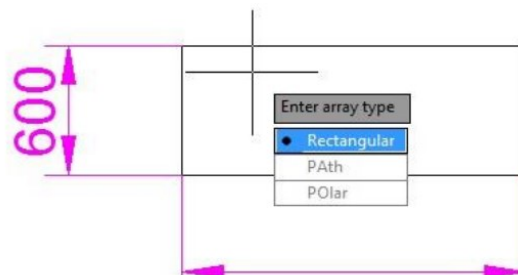


Figure 2. Selecting the array type

By default, AutoCAD draws multiple rectangles, but we only want two in this exercise. Select the set of rectangles you just drew and adjust its properties (**Properties, ch**), so that you get two adjacent rectangles spaced 4500 units apart (Figure 3).

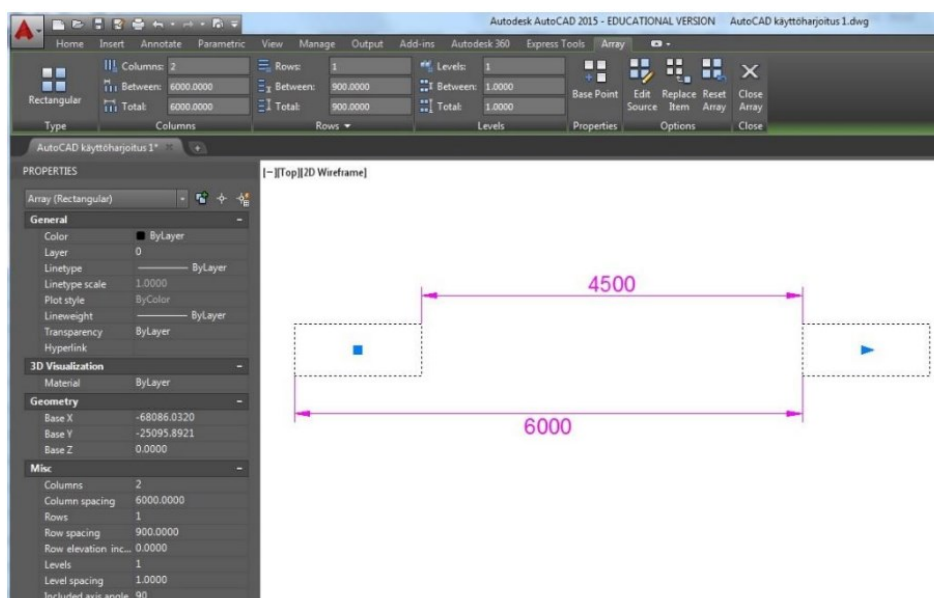


Figure 3. Adjacent rectangles

Next, fill the rectangles with the **HATCH (H)** command. Begin with the command, and immediately after, adjust the color and fill type (solid) from the ribbon menu (Figure 4). Next, select the area to be filled by clicking. Array duplication is a single object, so you can fill both rectangles at same time with the *Select objects* option. Alternatively, you can fill rectangles one by one by selecting *Internal Points*.

Command: H

HATCH

Select objects or [pickK internal point/Undo/seTtings]:1 found

Select objects or [pickK internal point/Undo/seTtings]:

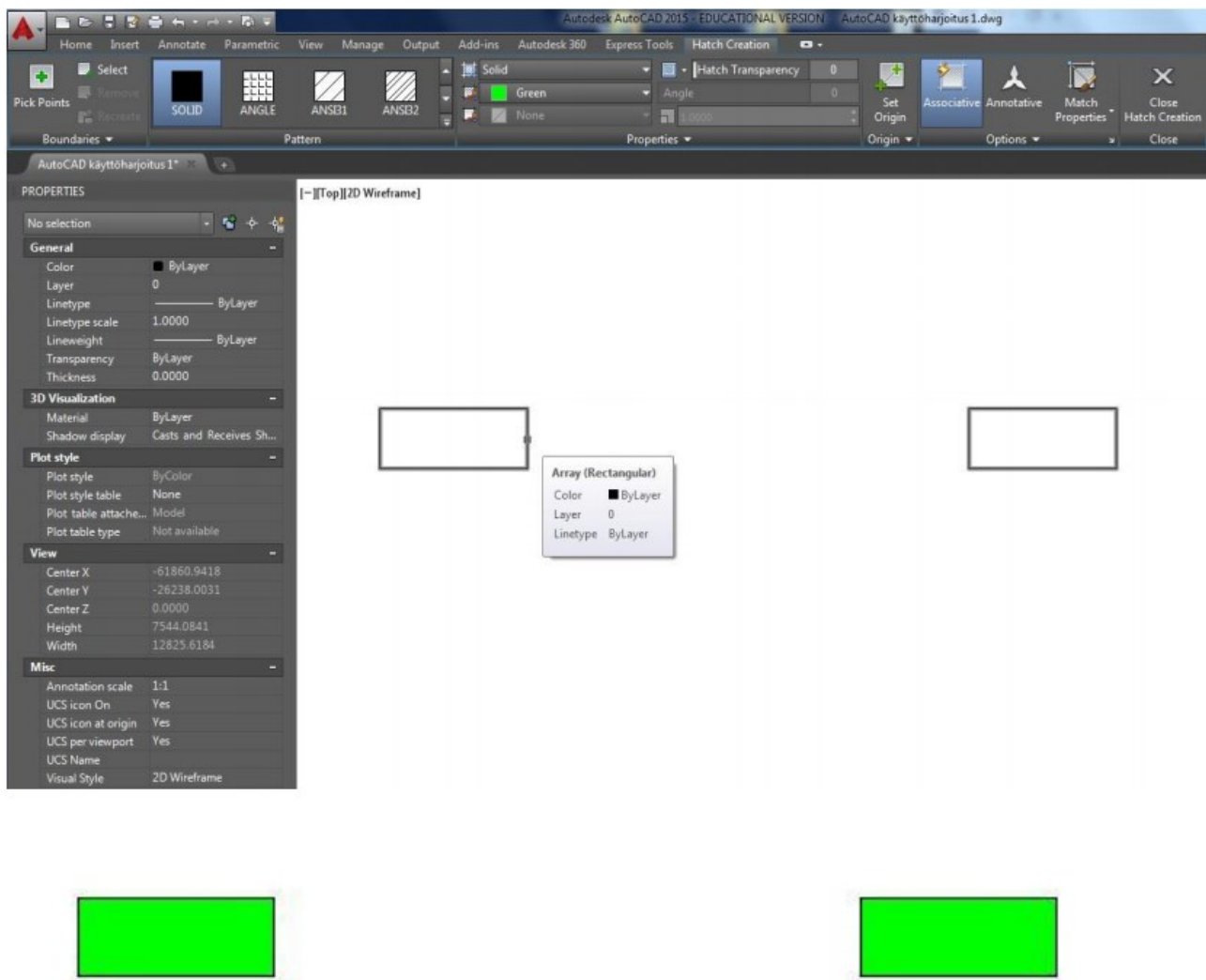


Figure 4. Using hatch and final result

Rasterization performed with *Select object* are a single object, so they are easy to edit through the Properties menu. In addition to colors, various patterns can be used to describe things, such as materials, in rasterization. Rasterizations can also be made partially transparent or, for example, the pattern can be skewed.

Plot Styles

AutoCAD has 255 indexed color, that you can use in Model Space. It often is advisable to use colors, that are easily distinguishable when plotted on white paper, while drawing to make the drawing easier to read. AutoCAD has separate option to change how the colors will be plotted. This is done using a plot style file. Plot style specifies which color is used to plot any single color. *Lineweight*, *Line Style*, *Fill Style*, and *Screening* (color intensity) can also be changed. When screening is set to 100, color will be plotted completely, and when the value is set to 0, the color is completely transparent. Plot style file can be used to specify colors to print in Grayscale or to utilize color mixing (Dither). If the plotter currently in use does not support dithering (pixels of different colors mixed together to get more colors), the dithering is automatically turned off.

Select desired plot style from the top right of the *Page Setup* window, that is opened by selecting *Modify* in the *Page Setup Manager* (Figure 5). If the selected plot style in the top right corner is *None*, colors will be plotted like the are drawn (like in exercise 1). Below the Plot Style selection, you can specify if plot style properties are applied also to paper space or just the finished plot. There will be a step by step guide about viewing, setting up, and editing the plot styles next.

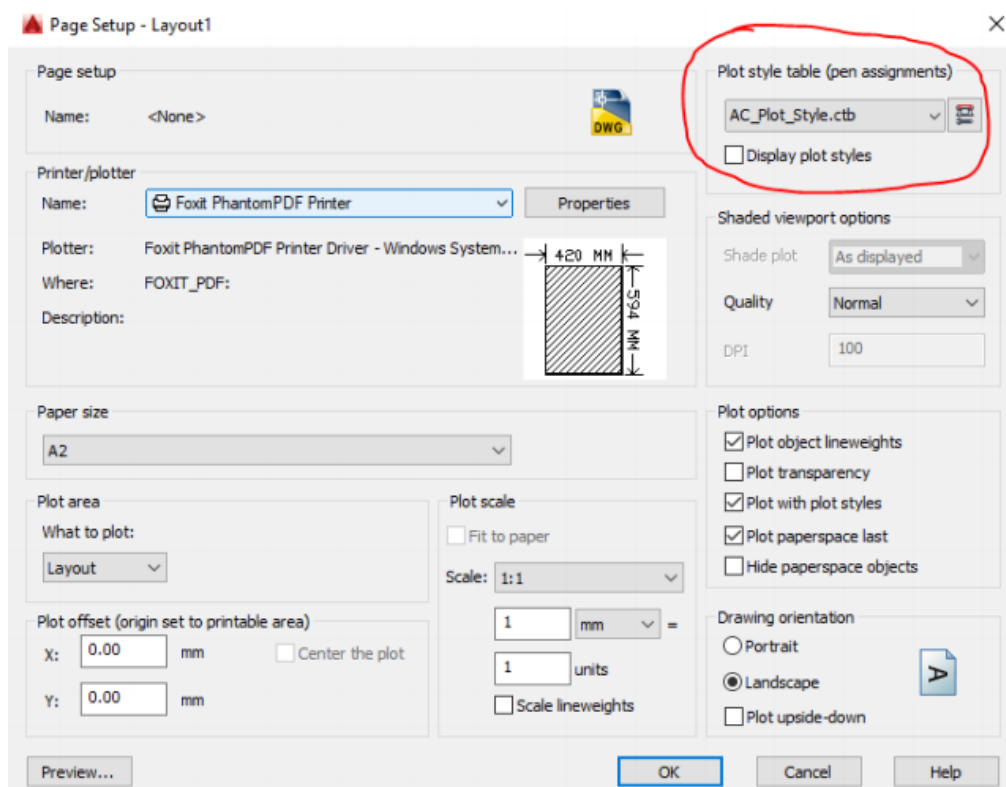


Figure 5. Selecting Plot Style file in Page Setup window

Exercise 2 uses a plot style in plotting the drawing. Before creating your own plot style, download AC_Plot_Style.ctb file from the course's MyCourses page. Plot styles are created by using either designated plot style table or a color linked print style table. Setting up a finished plot style:

1. Download the finished plot style from MyCourses (pen assignment, ctb file) and save it somewhere you can find it from.
2. Open Options menu in AutoCAD with **OP** command.
3. Select *Plot and Publish* tab
4. Select *Plot Style Table Settings* from the bottom right corner
5. Select *Add or Edit Plot Style Tables* on newly opened window
6. Drag the downloaded file to the folder window that opens
7. Close the folder window and other menus that are open
8. Enable the print style in the Layout's print settings (Page Setup Manager).

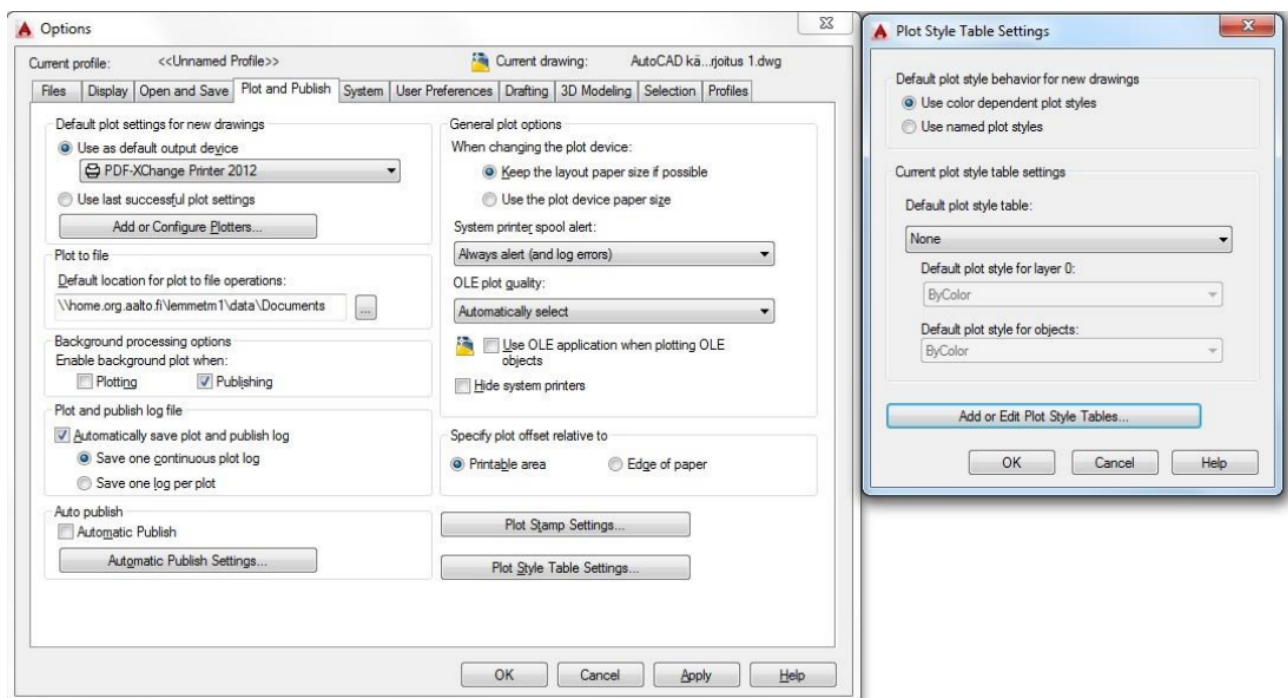


Figure 6. Adding a finished plot style

Editing a plot style file:

1. Open the folder, where plot styles are located on your computer (items 2.-6. on previous listing)
2. Open the plot style to be edited by double clicking on the file
3. Edit the desired options, notice different tabs
4. After editing, select *Save & Close*
5. Close folder window and other menus

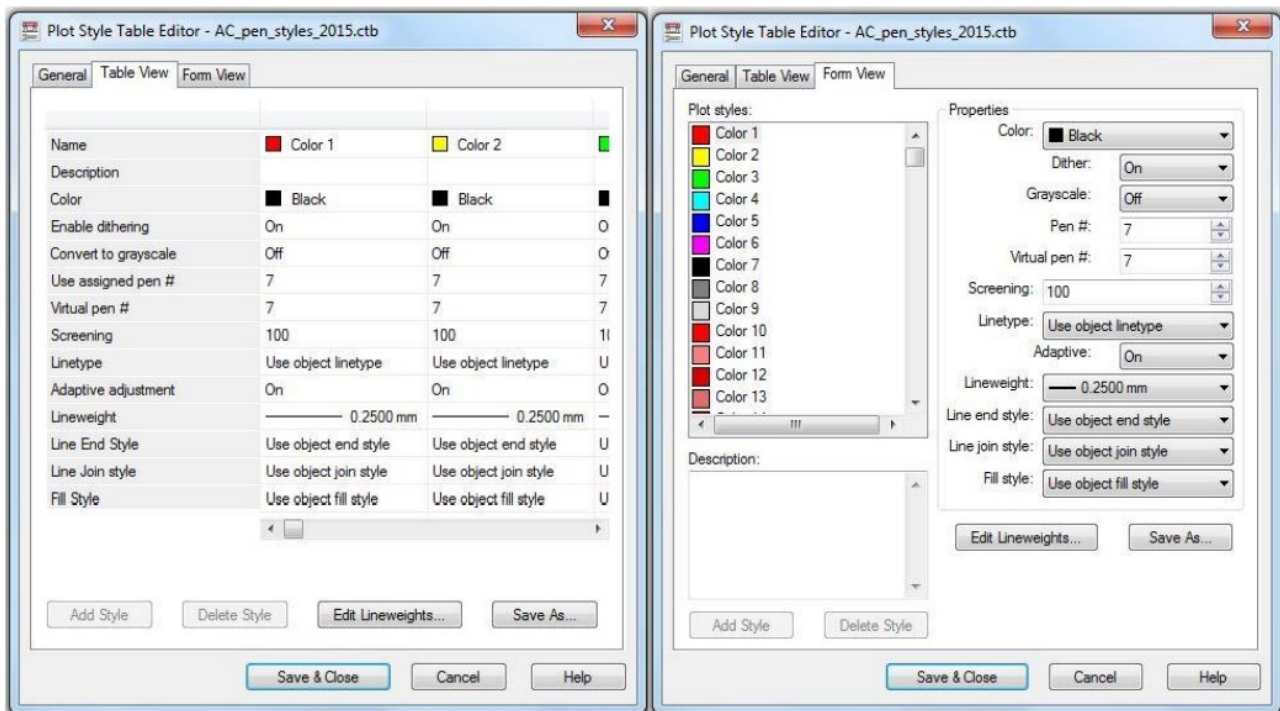


Figure 7. Different tabs of plot style table editor

Appendix 1. Drawing objects



Line

Command: **line, l** (*Draw – Line*)

Line is a vector which's start and end points are known. Create a series of contiguous line segments. Each segment is a line object that can be edited separately. Line polygon can be closed with command **c (close)**.



Construction Line

Command: **xline, xl** (*Draw – Construction Line*)

Construction line command is used to draw guidelines, that are infinite long. Objects do not affect the zoom in any way, but the zoom factor e.g. Zoom Extents command is determined by rest of the geometry. Construction line objects change to line objects if they are, for example, cut with the trim command. Guidelines can be especially useful if drawn vertical or horizontal.



Ray

Command: **ray** (*Draw – Ray*)

Ray is a special case of construction line. Line drawn with the Ray command begins from a specified point and continues infinitely long towards specified direction.



Polyline

Command: **pline, pl** (*Draw – Polyline*)

Creates a 2D polyline, a single object that is composed of line and arc segments. The following prompts are displayed:

- Arc – **a**: creating arc segments
- Close – **c**: Connects the first and last segments to create a closed polyline.
- Halfwidth – **h**: Specifies the width from the center of a wide segment to an edge.
- Length – **l**: Creates a segment of a specified length at the same angle as the previous segment.
- Undo – **u**: Removes the most recently added segment.
- Width – **w**: Specifies the width of the next segment.

Polyline object can be edited like any other objects or with command **pedit** that is purely meant for editing polylines. Pedit can be used to join multiple polyline objects as one or turn line and arc objects into polylines.



Polygon

Command: **polygon, pol** (*Draw – Polygon*)

Creates an equilateral closed polyline. You specify the number of sides of the polygon and whether it is inscribed or circumscribed. Number of sides can vary between 3 and 1024.



Rectangle

Command: **rectangle, rec** (*Draw – Rectangle*)

Creates a rectangular polyline. Creates a closed rectangular polyline from the specified parameters such as its diagonal corner points, dimensions, area, and type of corners. Inclined rectangles can be drawn using an inverted coordinate system.



Arc

Command: **arc, a** (*Draw – Arc*)

Creates an arc. To create an arc, you can specify combinations of center, endpoint, start point, radius, angle, chord length, and direction values. Arcs are drawn in a counterclockwise direction by default. Hold down the Ctrl key as you drag to draw in a clockwise direction.



Circle

Command: **circle, c** (*Draw – Circle*)

Creates a circle with selected options. Usually circles are drawn using middle point and radius or diameter. Circles can also be drawn by specifying two or three points on the circumference of the circle.



Ellipse

Command: **ellipse, el** (*Draw – Ellipse*)

Creates an ellipse or an elliptical arc. The first two points of the ellipse determine the location and length of the first axis. The third point determines the distance between the center of the ellipse and the end point of the second axis.

Spline



Command: **spline, spl** (*Draw – Spline*)

Creates a smooth curve that passes through or near a set of fit points, or that is defined by the vertices in a control frame. SPLINE creates curves called nonuniform rational B-splines (NURBS), referred to as splines for simplicity.

Point



Command: **point, po** (*Draw – Point – ...*)

Points objects can act as nodes to which you can snap objects. You can specify 2D and 3D locations for a point. Often used with Divide and Measure commands when it is desired to divide an object evenly or by entered distances.

Donut



Command: **donut, do** (*Draw – Donut*)

A donut consists of two arc polylines that are joined end-to-end to create a circular shape. The width of the polylines is determined by the specified inside and outside diameters. Objects can be edited with pedit just like any other polyline.

Appendix 2: Editing Functions and Commands

Let us learn more about editing finished objects.

Editing objects usually follows the following steps:

1. Enter editing command
2. Select the set of objects to be edited (if not selected before step 1)
3. Accept the selection with Enter
4. Follow the instructions on the command line to make command-specific selections or assignments

Selection Sets

Sets

Appendix 3: Additional Exercises and Useful Commands

First, create a rectangle that you can practice stretching on.

Command: **Rectangle** or **rec** alias

You can choose starting point freely (e.g. 0,0). Specify second point so that the size of the rectangle is (500,500).

Specify first corner point or

[Chamfer/Elevation/Fillet/Thickness/Width]: 0,0

Specify other corner point or [Area/Dimensions/Rotation]: 500,500

Now the practice component is ready.

Stretch command

Start stretching:

Command: **stretch** (or alias **s**)

Select objects to stretch by crossing-window or crossing-polygon...

Select the points that you want to move. Select a point from the right and below the created rectangle with the cursor (stretching is only possible if the selection is started from the right side and only part of the rectangle is selected. Figure 8 clarifies this, note that the red area is the rectangle to be stretched).



Figure 8. Selecting the rectangle

Press Enter to accept the selection. Now AutoCAD will ask for a point according to which the stretching is done, select the bottom right corner. By moving the cursor, you will notice how the stretch command works. Shape of the component starts to change as you move the cursor. Select a point that you want the lower right corner to move to, e.g. the top right corner. Another example is shown after this.

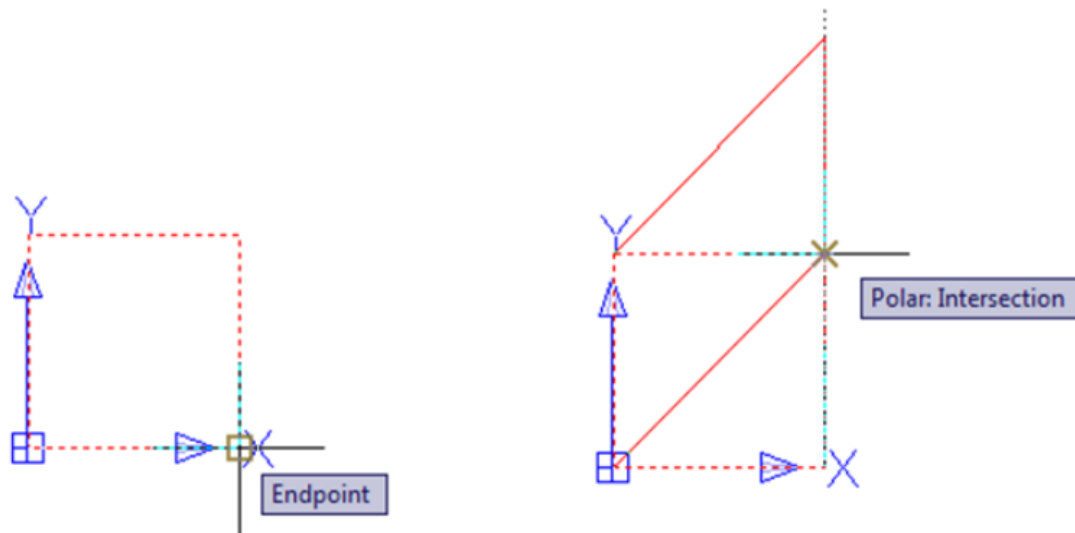


Figure 9. Changing the shape of rectangle with the stretch

Command: S

STRETCH

Select objects to stretch by crossing-window or crossing-polygon...

Select objects: Specify opposite corner: 1 found

Select objects:

Specify base point or [Displacement] <Displacement>:

Specify second point or <use first point as displacement>:

Changing the size of a T-section

First of all, draw a T-section with polyline

Command: pline tai alias Command: pl

Select the following points:

1000,1000

@380,0

@0,480

@500,0

@0,200

@-1380,0

@0,-200

@500,0

c (closes the polyline)

Ready T-section should look similar to Figure 10 without the dimensions.

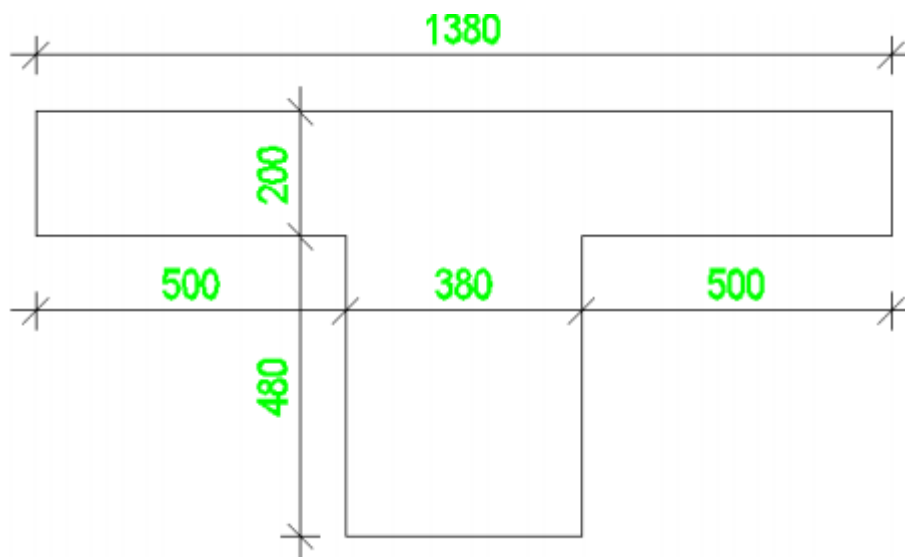


Figure 10. Original T-section

After the sketch, the structural engineer has dimensioned the structure and ask you to fix the dimensions of the cross section to correct.

Beam's width grows 100 mm (380 → 480)

Beam's height grows 100 mm (480 → 580)

Plate thins 20 mm (200 → 180)

Plate's flanges widen 50 mm (500 → 550)

Do these changes only using the stretch command. You can stretch the structure in the desired direction of a fixed value by typing it instead of pointing. For example, in case of increasing the height of the beam, select the bottom edge of the beam and point it straight down. After this write 100 and the beam will "stretch" downwards 100 units. Result should look similar to

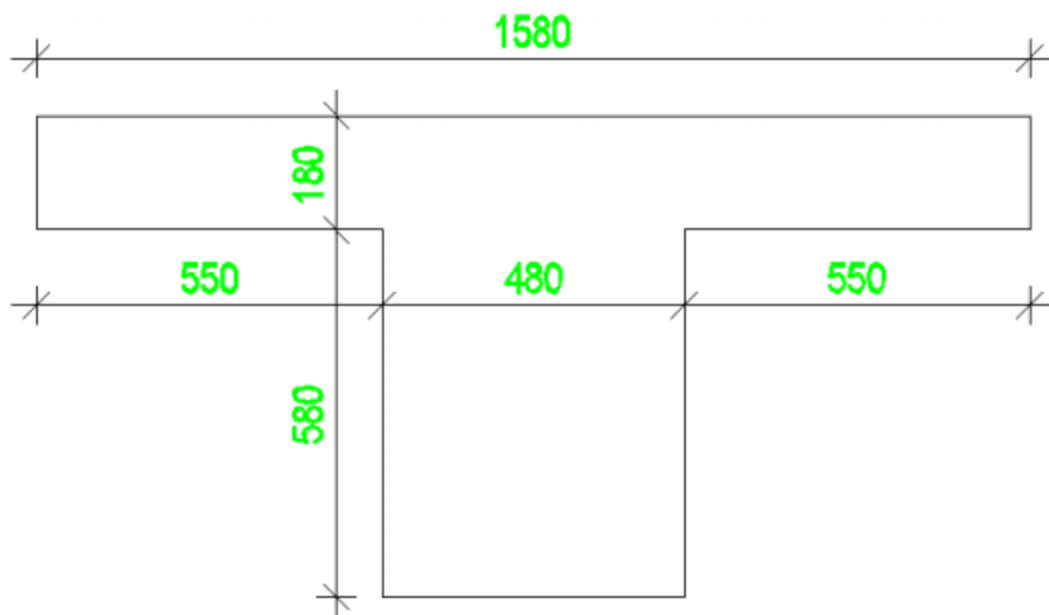


Figure 11. Finished T-section

Appendix 4: Literature, more information, and links

- AutoCAD Help (**Help** command or F1)
- - Mastering AutoCAD 2013 and AutoCAD LT 2013 / George Omura with Brian C.Benton (available as an e-book in from library)
- AutoCAD 2013 and AutoCAD LT 2013 Bible / Ellen Finkelstein (available as an e-book in from library)
- Googling “AutoCAD tutorials” will find several good websites and tutorial videos for self-studying